EMERSON
Industrial Automation

Design Guide

E300 Advanced Elevator Drive

Model sizes 3 to 7

Dedicated Elevator Variable Speed AC drive for induction and permanent magnet motors

Part Number: 0479-0024-01
Issue: 1

Control Techniques

www.controltechniques.com

Original Instructions

For the purposes of compliance with the EU Machinery Directive 2006/42/EC

General information

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation or adjustment of the optional operating parameters of the equipment or from mismatching the variable speed drive with the motor.

The contents of this guide are believed to be correct at the time of printing. In the interests of a commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or its performance, or the contents of the guide, without notice.

All rights reserved. No parts of this guide may be reproduced or transmitted in any form or by any means, electrical or mechanical including photocopying, recording or by an information storage or retrieval system, without permission in writing from the publisher.

Drive firmware version

This product is supplied with the latest firmware version. If this drive is to be connected to an existing system or machine, all drive firmware versions should be verified to confirm the same functionality as drives of the same model already present. This may also apply to drives returned from a Control Techniques Service Centre or Repair Centre. If there is any doubt please contact the supplier of the product.

The firmware version of the drive can be checked by looking at Firmware Version (**J04**).

Environmental statement

Control Techniques is committed to minimising the environmental impacts of its manufacturing operations and of its products throughout their life cycle. To this end, we operate an Environmental Management System (EMS) which is certified to the International Standard ISO 14001. Further information on the EMS, our Environmental Policy and other relevant information is available on request, or can be found at www.greendrives.com.

The electronic variable-speed drives manufactured by Control Techniques have the potential to save energy and (through increased machine/process efficiency) reduce raw material consumption and scrap throughout their long working lifetime. In typical applications, these positive environmental effects far outweigh the negative impacts of product manufacture and end-of-life disposal.

Nevertheless, when the products eventually reach the end of their useful life, they must not be discarded but should instead be recycled by a specialist recycler of electronic equipment. Recyclers will find the products easy to dismantle into their major component parts for efficient recycling. Many parts snap together and can be separated without the use of tools, while other parts are secured with conventional fasteners. Virtually all parts of the product are suitable for recycling.

Product packaging is of good quality and can be re-used. Large products are packed in wooden crates, while smaller products come in strong cardboard cartons which themselves have a high recycled fibre content. If not re-used, these containers can be recycled. Polythene, used on the protective film and bags for wrapping product, can be recycled in the same way. Control Techniques' packaging strategy prefers easily-recyclable materials of low environmental impact, and regular reviews identify opportunities for improvement.

When preparing to recycle or dispose of any product or packaging, please observe local legislation and best practice.

REACH legislation

EC Regulation 1907/2006 on the Registration, Evaluation, Authorisation and restriction of Chemicals (REACH) requires the supplier of an article to inform the recipient if it contains more than a specified proportion of any substance which is considered by the European Chemicals Agency (ECHA) to be a Substance of Very High Concern (SVHC) and is therefore listed by them as a candidate for compulsory authorisation.

For current information on how this requirement applies in relation to specific Control Techniques products, please approach your usual contact in the first instance. Control Techniques position statement can be viewed at:

http://www.controltechniques.com/REACH

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Issue Number: 1

Drive Firmware: 03.10.01.00 onwards

For patent and intellectual property related information please go to: www.ctpatents.info

How to use this guide

This *Design Guide* provides complete information for installing and operating the drive from start to finish.

The information is in logical order, taking the reader from receiving the drive through to fine tuning the performance.

NOTE

There are specific safety warnings throughout this guide, located in the relevant sections. In addition, Chapter 1 *Safety information* on page 8 contains general safety information. It is essential that the warnings are observed and the information considered when working with or designing a system using the drive.

This map of the *Design Guide* helps to find the right sections for the task you wish to complete, but for specific information, refer to the table of contents.

	Quick start / bench testing	Familiarization	System design	Programming and commissioning	Troubleshooting
1 Safety information	●	●	●	●	●
2 Product information	●	●	●		
3 Mechanical installation			●		
4 Electrical installation			●		
5 Getting started	●	●	●		
6 User Menu A	●	●	●	●	
7 Commissioning	●	●	●	●	
8 Advanced parameters			●	●	
9 Diagnostics					●
10 Optimization			●	●	
11 Technical data		●	●	●	

Conventions used in this guide

The configuration of the drive and any option modules is done using menus and parameters. A menu is a logical collection of parameters that have similar functionality.

In the case of an option module, the option module set-up parameters in menu 0 will appear in drive menu P, Q and R depending on which slot the module is installed in.

The method used to determine the menu or parameter is as follows:

- Pr **S.mm.ppp** - Where S signifies the option module slot number and mm.ppp signifies the menu and parameter number respectively. If the option module slot number is not specified then the parameter reference will be a drive parameter.
- Pr **mmpp** - Where mm signifies the menu and pp signifies the parameter number within the menu.
- Pr **mm00** - Signifies parameter number 00 in any drive menu.
- Pr **S.mm.000** - Signifies parameter number 000 in any option module menu.

Contents

Declaration of Conformity

Control Techniques Ltd
The Gro
Newtown
Powys
UK
SY16 3BE

This declaration applies to Elevator E200 and E300 variable speed drive products, comprising models numbers as shown below:

E*aaa-bbbbbbbbb* Valid characters:	
aaa	200, 300
bbbbbbbbb	03200050A, 03200066A, 03200080A, 03200106A, 03400025A, 03400031A, 03400045A, 03400062A, 03400078A, 03400100A 04200137A, 04200185A, 04400150, 04400172A 05200250A, 05400270A, 05400300A, 05500030A, 05500040A, 05500069A 06200330A, 06200440A, 06400350A, 06400420A, 06400470A, 06500100A, 06500150A, 06500190A, 06500230A, 06500290A, 06500350A 07200610A, 07200750A, 07200830A, 07400660A, 07400770A, 07401000A, 07500440A, 07500550A, 07600190A, 07600240A, 07600290A, 07600380A, 07600440A, 07600540A

The AC variable speed drive products listed above have been designed and manufactured in accordance with the following European harmonized standards:

EN 61800-5-1:2007	Adjustable speed electrical power drive systems - safety requirements - electrical, thermal and energy
EN 61800-3:2004	Adjustable speed electrical power drive systems. EMC product standard including specific test methods
EN 61000-6-2:2005	Electromagnetic compatibility (EMC). Generic standards. Immunity standard for industrial environments
EN 61000-6-4:2007	Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments
EN 61000-3-2:2006	Electromagnetic compatibility (EMC), Limits, Limits for harmonic current emissions (equipment input current <16 A per phase)
EN 61000-3-3:2008	Electromagnetic compatibility (EMC), Limits, Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current <16 A

EN 61000-3-2:2006 Applicable where input current <16 A. No limits apply for professional equipment where input power >1 kW.

Moteurs Leroy-Somer
Usine des Agriers
Boulevard Marcellin Leroy
CS10015
16915 Angoulême Cedex 9
France

These products comply with the requirements of the Restriction of Hazardous Substances Directive 2011/65/EU, the Low Voltage Directive 2006/95/EC and the Electromagnetic Compatibility Directive 2004/108/EC.

T. Alexander
Control Techniques Vice President, Technology
Newtown
Date: 20th January 2015

These electronic drive products are intended to be used with appropriate motors, controllers, electrical protection components and other equipment to form complete end products or systems. Compliance with safety and EMC regulations depends upon installing and configuring drives correctly, including using the specified input filters. The drives must be installed only by professional assemblers who are familiar with requirements for safety and EMC. The assembler is responsible for ensuring that the end product or system complies with all the relevant laws in the country where it is to be used. Refer to the Design Guide. An EMC Data Sheet is also available giving detailed EMC information.

Declaration of Conformity (including 2006 Machinery Directive)

Control Techniques Ltd
The Gro
Newtown
Powys
UK
SY16 3BE

This declaration applies to Elevator E200 and E300 variable speed drive products, comprising models numbers as shown below:

E*aaa-bbbbbbbbb* Valid characters:	
aaa	200, 300
bbbbbbbbb	03200050A, 03200066A, 03200080A, 03200106A, 03400025A, 03400031A, 03400045A, 03400062A, 03400078A, 03400100A 04200137A, 04200185A, 04400150, 04400172A 05200250A, 05400270A, 05400300A, 05500030A, 05500040A, 05500069A 06200330A, 06200440A, 06400350A, 06400420A, 06400470A, 06500100A, 06500150A, 06500190A, 06500230A, 06500290A, 06500350A 07200610A, 07200750A, 07200830A, 07400660A, 07400770A, 07401000A, 07500440A, 07500550A, 07600190A, 07600240A, 07600290A, 07600380A, 07600440A, 07600540A

This declaration relates to these products when used as a safety component of a machine. Only the SAFE TORQUE OFF function may be used for a safety function of a machine. None of the other functions of the drive may be used to carry out a safety function.

These products fulfil all the relevant provisions of Directives 2006/42/EC (The Machinery Directive) and 2004/108/EC (The EMC Directive).

EC type-examination has been carried out by the following notified body:

TÜV Rheinland Industrie Service GmbH

Am Grauen Stein

D-51105 Köln

Notified Body identification number: 0035

EC type-examination certificate number: 01/205/5270/12

Moteurs Leroy-Somer
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Boulevard Marcellin Leroy
CS10015
16915 Angoulême Cedex 9
France

The harmonized standards used are shown below:

EN 61800-5-1:2007	Adjustable speed electrical power drive systems - safety requirements - electrical, thermal and energy
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EN 61000-3-3:2008	Electromagnetic compatibility (EMC), Limits, Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current <16 A

Person authorised to compile the technical file:

C Hargis

Chief Engineer

Newtown, Powys. UK

T. Alexander
VP Technology
Date: 19th January 2015
Place: Newtown, Powys. UK

IMPORTANT NOTICE

These drive products are intended to be used with appropriate motors, sensors, electrical protection components and other equipment to form complete systems. It is the responsibility of the installer to ensure that the design of the complete machine, including its safety-related control system, is carried out in accordance with the requirements of the Machinery Directive and any other relevant legislation. The use of a safety-related drive in itself does not ensure the safety of the machine.

Compliance with safety and EMC regulations depends upon installing and configuring inverters correctly.

1 Safety information

1.1 Warnings, Cautions and Notes

WARNING

A Warning contains information which is essential for avoiding a safety hazard.

CAUTION

A Caution contains information which is necessary for avoiding a risk of damage to the product or other equipment.

NOTE

A Note contains information which helps to ensure correct operation of the product.

1.2 Electrical safety - general warning

The voltages used in the drive can cause severe electrical shock and/or burns, and could be lethal. Extreme care is necessary at all times when working with or adjacent to the drive.

Specific warnings are given at the relevant places in this *Design Guide*.

1.3 System design and safety of personnel

The drive is intended as a component for professional incorporation into complete equipment or a system. If installed incorrectly, the drive may present a safety hazard.

The drive uses high voltages and currents, carries a high level of stored electrical energy, and is used to control equipment which can cause injury.

Close attention is required to the electrical installation and the system design to avoid hazards either in normal operation or in the event of equipment malfunction. System design, installation, commissioning/start-up and maintenance must be carried out by personnel who have the necessary training and experience. They must read this safety information and this *Design Guide* carefully.

The STOP and Safe Torque Off (STO) functions of the drive do not isolate dangerous voltages from the output of the drive or from any external option unit. The supply must be disconnected by an approved electrical isolation device before gaining access to the electrical connections.

With the sole exception of the Safe Torque Off (STO) function, none of the drive functions must be used to ensure safety of personnel, i.e. they must not be used for safety-related functions.

Careful consideration must be given to the functions of the drive which might result in a hazard, either through their intended behavior or through incorrect operation due to a fault. In any application where a malfunction of the drive or its control system could lead to or allow damage, loss or injury, a risk analysis must be carried out, and where necessary, further measures taken to reduce the risk - for example, an over-speed protection device in case of failure of the speed control, or a fail-safe mechanical brake in case of loss of motor braking.

The Safe Torque Off (STO) function may be used in a safety-related application. The system designer is responsible for ensuring that the complete system is safe and designed correctly according to the relevant safety standards.

1.4 Environmental limits

Instructions in this *Design Guide* regarding transport, storage, installation and use of the drive must be complied with, including the specified environmental limits. Drives must not be subjected to excessive physical force.

1.5 Access

Drive access must be restricted to authorized personnel only. Safety regulations which apply at the place of use must be complied with.

1.6 Fire protection

The drive enclosure is not classified as a fire enclosure. A separate fire enclosure must be provided. For further information, refer to section 3.2.5 *Fire protection* on page 29.

1.7 Compliance with regulations

The installer is responsible for complying with all relevant regulations, such as national wiring regulations, accident prevention regulations and electromagnetic compatibility (EMC) regulations. Particular attention must be given to the cross-sectional areas of conductors, the selection of fuses or other protection, and protective ground (earth) connections.

This guide contains instructions for achieving compliance with specific EMC standards.

Within the European Union, all machinery in which this product is used must comply with the following directives:

2006/42/EC: Safety of machinery.
2004/108/EC: Electromagnetic Compatibility.

1.8 Motor

Ensure the motor is installed in accordance with the manufacturer's recommendations. Ensure the motor shaft is not exposed.

Standard squirrel cage induction motors are designed for single speed operation. If it is intended to use the capability of the drive to run a motor at speeds above its designed maximum, it is strongly recommended that the manufacturer is consulted first.

Low speeds may cause the motor to overheat because the cooling fan becomes less effective. The motor should be installed with a protection thermistor. If necessary, an electric forced vent fan should be used.

The values of the motor parameters set in the drive affect the protection of the motor. The default values in the drive should not be relied upon.

It is essential that the correct value is entered into the *Motor Rated Current* (**B02**). This affects the thermal protection of the motor.

1.9 Mechanical brake control

The brake control functions are provided to allow well coordinated operation of an external brake with the drive. While both hardware and software are designed to high standards of quality and robustness, they are not intended for use as safety functions, i.e. where a fault or failure would result in a risk of injury. In any application where the incorrect operation of the brake release mechanism could result in injury, independent protection devices of proven integrity must also be incorporated.

1.10 Adjusting parameters

Some parameters have a profound effect on the operation of the drive. They must not be altered without careful consideration of the impact on the controlled system. Measures must be taken to prevent unwanted changes due to error or tampering.

1.11 Electrical installation

1.11.1 Electric shock risk

The voltages present in the following locations can cause severe electric shock and may be lethal:

- AC supply cables and connections
- Output cables and connections
- Many internal parts of the drive, and external option units
- Unless otherwise indicated, control terminals are single insulated and must not be touched.

1.11.2 Stored charge

The drive contains capacitors that remain charged to a potentially lethal voltage after the AC supply has been disconnected. If the drive has been energized, the AC supply must be isolated at least ten minutes before work may continue.

2 Product information

2.1 *E300 Advanced Elevator* drive

E300 Advanced Elevator drive features

- Universal high performance drive for asynchronous induction motors and synchronous permanent magnet motors.
- Flexibility with speed and position measurement, supporting multiple devices and all common interfaces
- Analog and digital I/O with single channel Safe Torque Off (STO) input
- Local and Remote keypad options
- NV Media Card for parameter copying and data storage

Configuration

The *E300 Advanced Elevator* drive can operate in either Open loop or RFC-A mode with asynchronous induction motors for geared Elevator applications or in RFC-S mode with synchronous permanent magnet motors for gearless Elevator applications. The default operating mode for the *E300 Advanced Elevator* drive is RFC-S mode with this targeted at gearless Elevator applications using PM synchronous motors.

Full support is provided for a both a rotating and static autotune. There is support for a wide range of position feedback devices from the incremental encoder to high resolution SinCos encoders along with a simulated encoder output as standard onboard the drive.

The *E300 Advanced Elevator* drive also has TuV Nord approval to EN81 for a zero output motor contactor solution using the drives Safe Torque Off (STO), Drive enable input.

Profile

The default operating profile for the *E300 Advanced Elevator* drive is Creep to floor mode. Optimization of the profile is possible through the separate acceleration and deceleration rates along with multiple jerks. Variable speed and current control loop gains are available for the start, travel and stop.

The *E300 Advanced Elevator* drive additionally offers enhanced profile control:

- Direct to floor mode - decelerates the elevator car directly to the floor following a signal to stop, with no creep speed.
- Peak curve operation - profile peak speed and stopping distance controlled regardless of when the signal to stop is given, optimizing travel time.
- Floor sensor correction - using a floor sensor / limit switch to compensate for rope slip, rope stretch and other mechanical offsets.
- Position controlled short floor operation.

An optional external load cell compensation input can be connected to the drive where required.

Parallel interface

The *E300 Advanced Elevator* drive and control software can support either digital only parallel interfaces (binary or priority speed selection) or digital parallel interfaces with an analog speed reference. The drive has brake control set-up configured as default with the option of selecting the additional output motor contactor control.

Programming, monitoring

The *E300 Advanced Elevator* drive has a standard Keypad which allows set-up and optimization of the drive along with monitoring of parameters.

An NV Media Card can be used which allows drive parameters to be uploaded and downloaded. The NV Media Card can also be used to back up the drive parameter set. The NV Media Card support is via a SMARTCARD or SD card Adaptor and SD card.

The Elevator Connect PC tool allows programming, uploading and downloading of drive parameter sets along with monitoring the *E300 Advanced Elevator* drive during operation and optimization. The Elevator Connect PC tool is free of charge and can be downloaded from www.controltechniques.com.

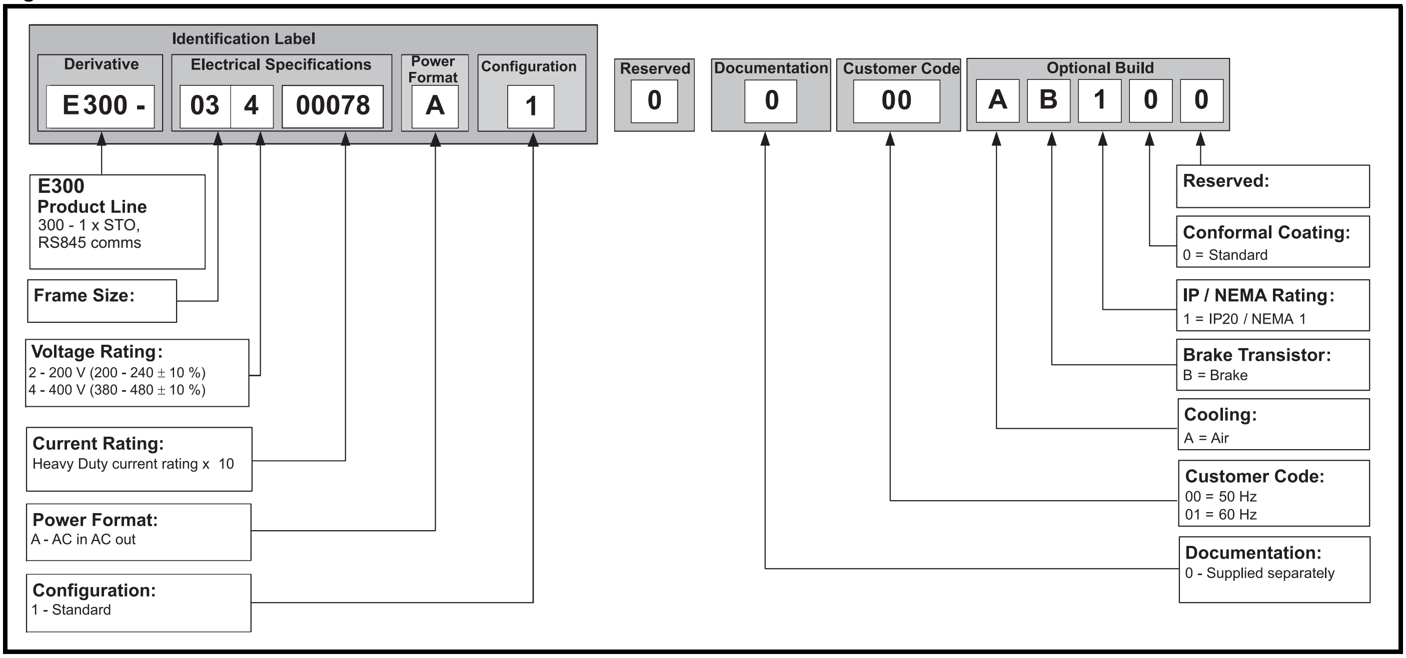
Communications

The *E300 Advanced Elevator* drive has RS485 serial communications by default. This supports communications to the Elevator controller, PC tools and Firmware programming. Additional communications protocols are supported via SI option modules.

2.2 Model number

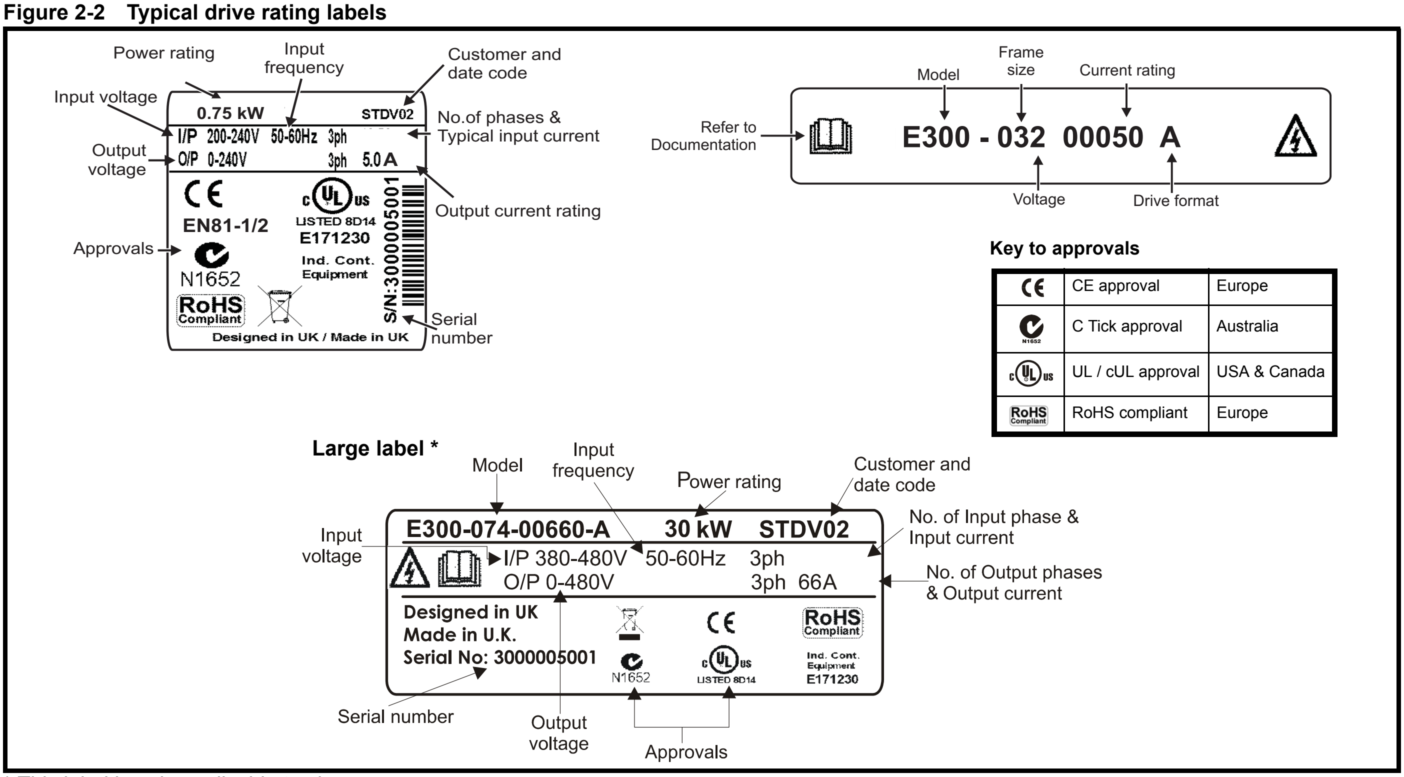
The way in which the model numbers for the *E300 Advanced Elevator* drive range is formed is illustrated below:

Figure 2-1 Model number



2.3 Nameplate description

Figure 2-2 Typical drive rating labels



* This label is only applicable to size 7

NOTE

Date code format

The date code is split into two sections: a letter followed by a number. The letter indicates the year, and the number indicates the week number within the year in which the option module was built.The letters go in alphabetical order, starting with A in 1990 (B in 1991, C in 1992 etc).

Example:

A date code of **W28** would correspond to week 28 of year 2013.

2.4 Ratings

The *E300 Advanced Elevator* drive is configured for Heavy Duty operation, For constant torque applications or applications which require a high overload capability, or full torque is required at low speeds (e.g. elevators, hoists). The thermal protection is set to protect force ventilated induction motors and permanent magnet servo motors by default.

Motor I^2t protection defaults to be compatible with:

NOTE

If the application uses a self ventilated (TENV/TEFC) induction motor and increased thermal protection is required for speeds below 50 % base speed, then this can be enabled by setting *Low Speed Thermal Protection Mode* (**B44**) = On (1).

The rating label details the available output current under the following conditions:

- 40 °C (104 °F) maximum ambient,
- 1000 m altitude,
- 8 kHz switching frequency,
- A typical elevator profile (50 % ED),
- IGBT lifetime optimization enabled (reduction of switching frequency based on drive inverter temperature).

Derating is required for higher switching frequencies, ambient temperatures >40 °C (104 °F) and higher altitude. For derating information, refer to *section 2.4.2 Power and current ratings (derating for switching frequency and temperature)* on page 14.

The input current is affected by the supply voltage and impedance. The input current given on the rating label is the typical input current and is stated for a balanced supply.

WARNING

Fuses
The AC supply to the drive must be installed with suitable protection against overload and short-circuits. The following section shows recommended fuse ratings. Failure to observe this requirement will cause risk of fire.

Table 2-1 200 V drive and AC fuse ratings

Model	Max. cont. input current	Heavy Duty			Fuse			
					IEC		UL	
	3 ph	Max. cont. output current	Nom power @ 230 V	Motor power @ 230 V	Nom	Class	Nom	Class
	A	A	kW	hp	A		A	
03200106	20	10.6	2.2	3	25	gG	25	CC, J or T*
04200137	20	13.7	3	3	25	gG	25	CC, J or T*
04200185	28	18.5	4	5	32		30	
05200250	31	25	5.5	7.5	40	gG	40	CC, J or T*
06200330	48	33	7.5	10	63	gG	60	CC, J or T*
06200440	56	44	11	15	63		70	
07200610	67	61	15	20	80	gG	80	CC, J or T*
07200750	84	75	18.5	25	100		100	
07200830	105	83	22	30	125		125	

Table 2-2 400 V drive and AC fuse ratings

Model	Max. cont. input current	Heavy Duty			Fuse			
					IEC		UL	
	3ph	Max. cont. output current	Nom power @ 400 V	Motor power @ 460 V	Nom	Class	Nom	Class
	A	A	kW	hp	A		A	
03400062	13	6.2	2.2	3.0	20	gG	20	CC, J or T*
03400078	13	7.8	3	5.0	20		20	
03400100	16	10	4	5.0	20		20	
04400150	19	15	5.5	10.0	25	gG	25	CC, J or T*
04400172	24	17.2	7.5	10.0	32		30	
05400270	29	27	11	20	40	gG	35	CC, J or T*
05400300	30	30	15		40		35	
06400350	36	35	15	25	63	gR	40	HSJ or DFJ
06400420	46	42	18.5	30	63		50	
06400470	60	47	22	30	63		70	
07400660	74	66	30	50	100	gG	80	CC, J or T*
07400770	88	77	37	60	100		100	
07401000	105	100	45	75	125		125	

* These fuses are fast acting.

2.4.1 Typical short term overload limits

The maximum overload limit changes depending on the selected motor. Variations in motor rated current, motor power factor and motor leakage inductance all result in changes in the maximum possible overload due to the thermal models estimation of the motor temperature as a percentage of its maximum allowed temperature. Typical values for overload are shown in the table below:

Table 2-3 Typical overload limits

Operating mode	Closed loop from cold	Closed loop from 100 %	Open loop from cold	Open loop from 100 %
Heavy Duty overload Motor rated current = drive rated current	175 % for 40 s	175 % for 5 s	150 % for 60 s	155 % for 8 s

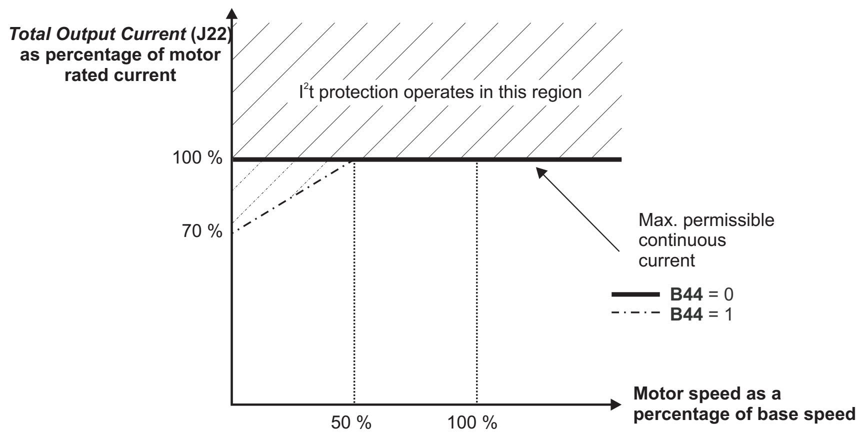
Heavy duty operating mode

The thermal protection is set to protect force ventilated induction motors and permanent magnet servo motors by default. If the application uses a self ventilated (TENV/TEFC) induction motor and increased thermal protection is required for speeds below 50 % base speed, then this can be enabled by setting *Low Speed Thermal Protection Mode* (**B44**) = On (1).

Operation of motor I^2t protection

Motor I^2t protection defaults to be compatible with:

- Forced ventilation induction motors
- Permanent magnet servo motors



2.4.2 Power and current ratings (derating for switching frequency and temperature)

Table 2-4 Maximum permissible continuous output current @ 40 °C (104 °F) ambient

<table>
<tr><th rowspan="3">Model</th><th colspan="9">Heavy Duty</th></tr>
<tr><th colspan="2">Nominal rating</th><th colspan="7">Maximum permissible continuous output current (A) for the following switching frequencies</th></tr>
<tr><th>kW</th><th>hp</th><th>2 kHz</th><th>3 kHz</th><th>4 kHz</th><th>6 kHz</th><th>8 kHz</th><th>12 kHz</th><th>16 kHz</th></tr>
<tr><td colspan="10">200 V</td></tr>
<tr><td>03200106</td><td>2.2</td><td>3.0</td><td colspan="5">10.6</td><td>TBC</td><td>TBC</td></tr>
<tr><td>04200137</td><td>3.0</td><td>3.0</td><td colspan="5">13.7</td><td>TBC</td><td>TBC</td></tr>
<tr><td>04200185</td><td>4.0</td><td>5.0</td><td colspan="5">18.5</td><td>TBC</td><td>TBC</td></tr>
<tr><td>05200250</td><td>5.5</td><td>7.5</td><td colspan="5">25</td><td>TBC</td><td>TBC</td></tr>
<tr><td>06200330</td><td>7.5</td><td>10</td><td colspan="5">33.0</td><td>TBC</td><td>TBC</td></tr>
<tr><td>06200440</td><td>11</td><td>15</td><td colspan="5">44.0</td><td>TBC</td><td>TBC</td></tr>
<tr><td>07200610</td><td>15</td><td>20</td><td colspan="5">61</td><td>TBC</td><td>TBC</td></tr>
<tr><td>07200750</td><td>18.5</td><td>25</td><td colspan="5">75</td><td>TBC</td><td>TBC</td></tr>
<tr><td>07200830</td><td>22</td><td>30</td><td colspan="5">83</td><td>TBC</td><td>TBC</td></tr>
<tr><td colspan="10">400 V</td></tr>
<tr><td>03400062</td><td>2.2</td><td>3.0</td><td colspan="4">6.2</td><td>5.8</td><td>TBC</td><td>TBC</td></tr>
<tr><td>03400078</td><td>3.0</td><td>5.0</td><td colspan="4">7.8</td><td>6.0</td><td>TBC</td><td>TBC</td></tr>
<tr><td>03400100</td><td>4.0</td><td>5.0</td><td colspan="4">10</td><td>6.0</td><td>TBC</td><td>TBC</td></tr>
<tr><td>04400150</td><td>5.5</td><td>10</td><td colspan="4">15.0</td><td rowspan="2">12.8</td><td>TBC</td><td>TBC</td></tr>
<tr><td>04400172</td><td>7.5</td><td>10</td><td colspan="4">17.2</td><td>TBC</td><td>TBC</td></tr>
<tr><td>05400270</td><td>11</td><td>20</td><td colspan="4">27</td><td>20.2</td><td>TBC</td><td>TBC</td></tr>
<tr><td>05400300</td><td>15</td><td>20</td><td colspan="4">30</td><td>26.5</td><td>TBC</td><td>TBC</td></tr>
<tr><td>06400350</td><td>15</td><td>25</td><td colspan="4">35</td><td rowspan="3">27.1</td><td>TBC</td><td>TBC</td></tr>
<tr><td>06400420</td><td>18.5</td><td>30</td><td colspan="4">42</td><td>TBC</td><td>TBC</td></tr>
<tr><td>06400470</td><td>22</td><td>30</td><td colspan="4">47</td><td>TBC</td><td>TBC</td></tr>
<tr><td>07400660</td><td>30</td><td>50</td><td colspan="4">66</td><td rowspan="3">66</td><td>TBC</td><td>TBC</td></tr>
<tr><td>07400770</td><td>37</td><td>60</td><td colspan="4">77</td><td>TBC</td><td>TBC</td></tr>
<tr><td>07401000</td><td>45</td><td>75</td><td colspan="4">100</td><td>TBC</td><td>TBC</td></tr>
</table>

Table 2-5 Maximum permissible continuous output current @40 C (104 F) ambient with high IP insert installed

Model	Heavy Duty						
	Maximum permissible continuous output current (A) for the following switching frequencies						
	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	12 kHz	16 kHz
200 V							
03200106	TBC						
04200137	TBC						
04200185	TBC						
05200250	TBC						
400 V							
03400062	TBC						
03400078	TBC						
03400100	TBC						
04400150	TBC						
04400172	TBC						
05400270	TBC						
05400300	TBC						

Table 2-6 Maximum permissible continuous output current @ 50 C (122 F)

Model	Heavy Duty						
	Maximum permissible continuous output current (A) for the following switching frequencies						
	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	12 kHz	16 kHz
200 V							
03200106	TBC						
04200137	TBC						
04200185	TBC						
05200250	TBC						
06200330	TBC						
06200440	TBC						
07200610	TBC						
07200750	TBC						
07200830	TBC						
400 V							
03400062	TBC						
03400078	TBC						
03400100	TBC						
04400150	TBC						
04400172	TBC						
05400270	TBC						
05400300	TBC						
06400350	TBC						
06400420	TBC						
06400470	TBC						
07400660	TBC						
07400770	TBC						
07401000	TBC						

2.5 Operating modes

The *E300 Advanced Elevator* drive is designed to operate in any of the following modes, with the default operating mode being RFC-S.

Open loop mode

Open loop vector mode
Fixed V/F mode (V/Hz)

RFC - A, Closed loop vector

With position feedback sensor
Sensorless mode without position feedback for rescue operation

RFC - S, Closed loop Servo

With position feedback sensor
Sensorless mode without position feedback for rescue operation

2.5.1 Open loop mode

The drive applies power to the motor at frequencies varied by the user. The motor speed is a result of the output frequency of the drive and slip due to the mechanical load. The drive can improve the speed control of the motor by applying slip compensation. The performance at low speed depends on whether Fixed V/F mode or Open loop vector mode is selected.

Vector mode
The voltage applied to the motor is directly proportional to the frequency except at low speed where the drive uses motor parameters to apply the correct voltage to keep the flux constant under varying load conditions. Typically 100 % torque is available down to 1 Hz for a 50 Hz motor.

Fixed V/F mode
The voltage applied to the motor is directly proportional to the frequency except at low speed where a voltage boost is provided which is set by the user. This mode can be used for multi-motor applications. Typically 100 % torque is available down to 4 Hz for a 50 Hz motor.

2.5.2 RFC-A

Rotor **F**lux **C**ontrol for **A**synchronous induction motors **RFC-A** encompasses closed loop vector control with a position feedback device

With position feedback
For use with induction motors with a feedback device installed. The drive directly controls the speed of the motor using the feedback device to ensure the rotor speed exactly as demanded. Motor flux is accurately controlled at all times to provide full torque all the way down to zero speed.

Sensorless mode without position feedback for rescue operation
Sensorless mode provides closed loop control without the need for position feedback by using current, voltages and key motor parameters to estimate the motor speed.

2.5.3 RFC- S

Rotor **F**lux **C**ontrol for **S**ynchronous permanent magnet brushless motors **RFC-S** provides closed loop control with position feedback device.

With position feedback
For use with permanent magnet brushless motors with a feedback device installed. The drive directly controls the speed of the motor using the feedback device to ensure the rotor speed is exactly as demanded. Flux control is not required because the motor is self excited by the permanent magnets which form part of the rotor. Absolute position information is required from the feedback device to ensure the output voltage is accurately matched to the back EMF of the motor. Full torque is available all the way down to zero speed.

Sensorless mode without position feedback for rescue operation
Sensorless mode provides closed loop control without the need for position feedback by using current, voltages and key motor parameters to estimate the motor speed.

2.6 Compatible position feedback devices

Table 2-7 Supported feedback devices

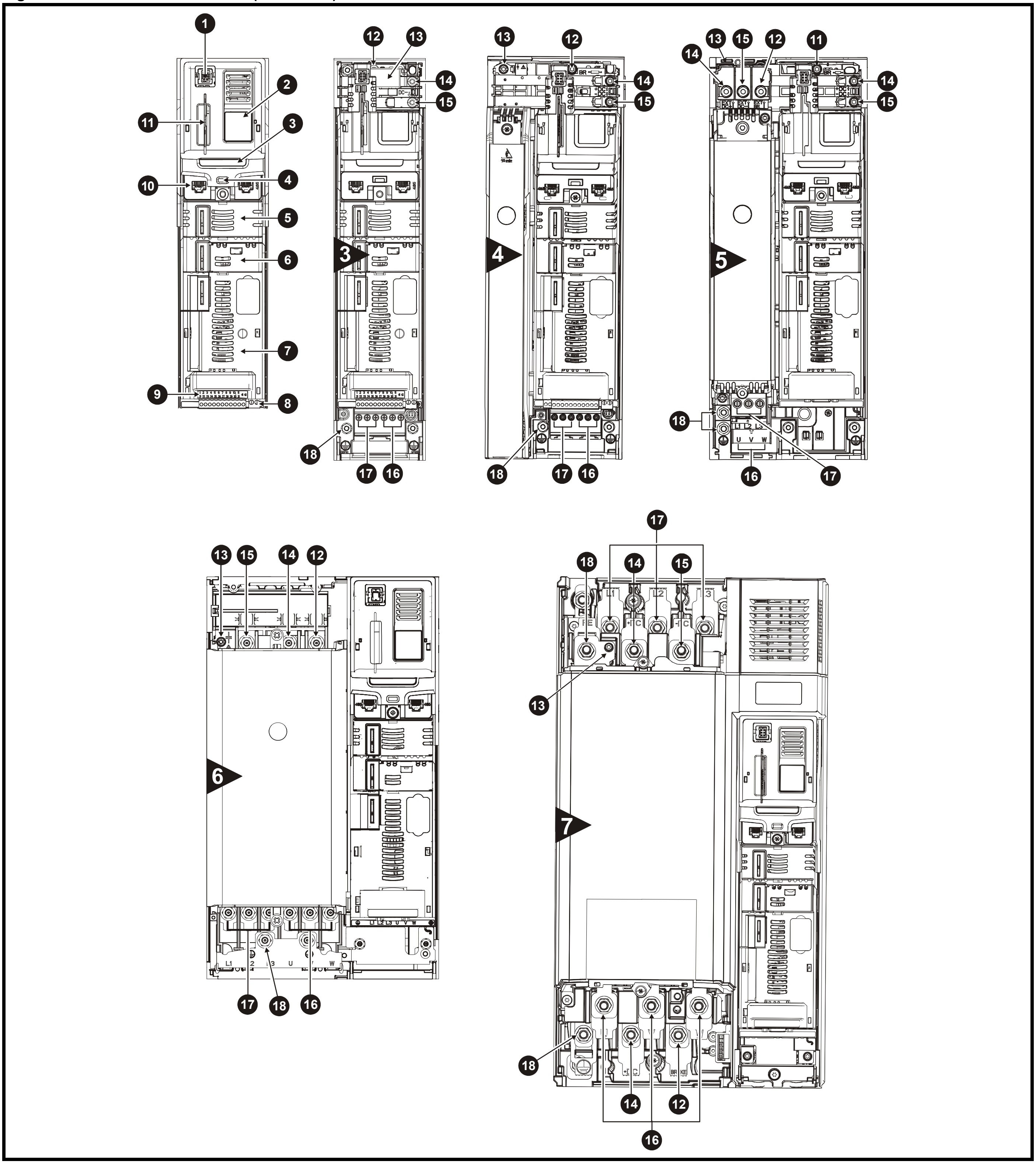
Encoder type	***Drive encoder type* (C01)**
Quadrature incremental encoders with or without marker pulse	AB (0)
Quadrature incremental encoders with UVW commutation signals for absolute position for permanent magnet motors with or without marker pulse	AB Servo (3)
Forward / reverse incremental encoders with or without marker pulse	FR (2)
Forward / reverse incremental encoders with UVW commutation signals for absolute position for permanent magnet motors with or without marker pulse	FR Servo (5)
Frequency and direction incremental encoders with or without marker pulse	FD (1)
Frequency and direction incremental encoders with UVW commutation signals for absolute position for permanent magnet motors with or without marker pulse	FD Servo (4)
Sincos incremental encoders	SC (6)
Sincos incremental with commutation signals	SC Servo (12)
Heidenhain sincos encoders with EnDat comms for absolute position	SC EnDat (9)
Stegmann sincos encoders with Hiperface comms for absolute position	SC Hiperface (7)
Sincos encoders with SSI comms for absolute position	SC SSI (11)
Sincos incremental with absolute position from single sin and cosine signals	SC SC (15)
SSI encoders (Gray code or binary)	SSI (10)
EnDat communication only encoders	EnDat (8)
BiSS communication only encoders* (not currently supported)	BiSS (13)
UVW commutation only encoders** (not currently supported)	Commutation only (16)

* Only BiSS type C encoders are supported.

** This feedback device provides very low resolution feedback and should not be used for applications requiring a high level of performance.

2.7 Drive features

Figure 2-3 Features of the drive (size 3 to 7)

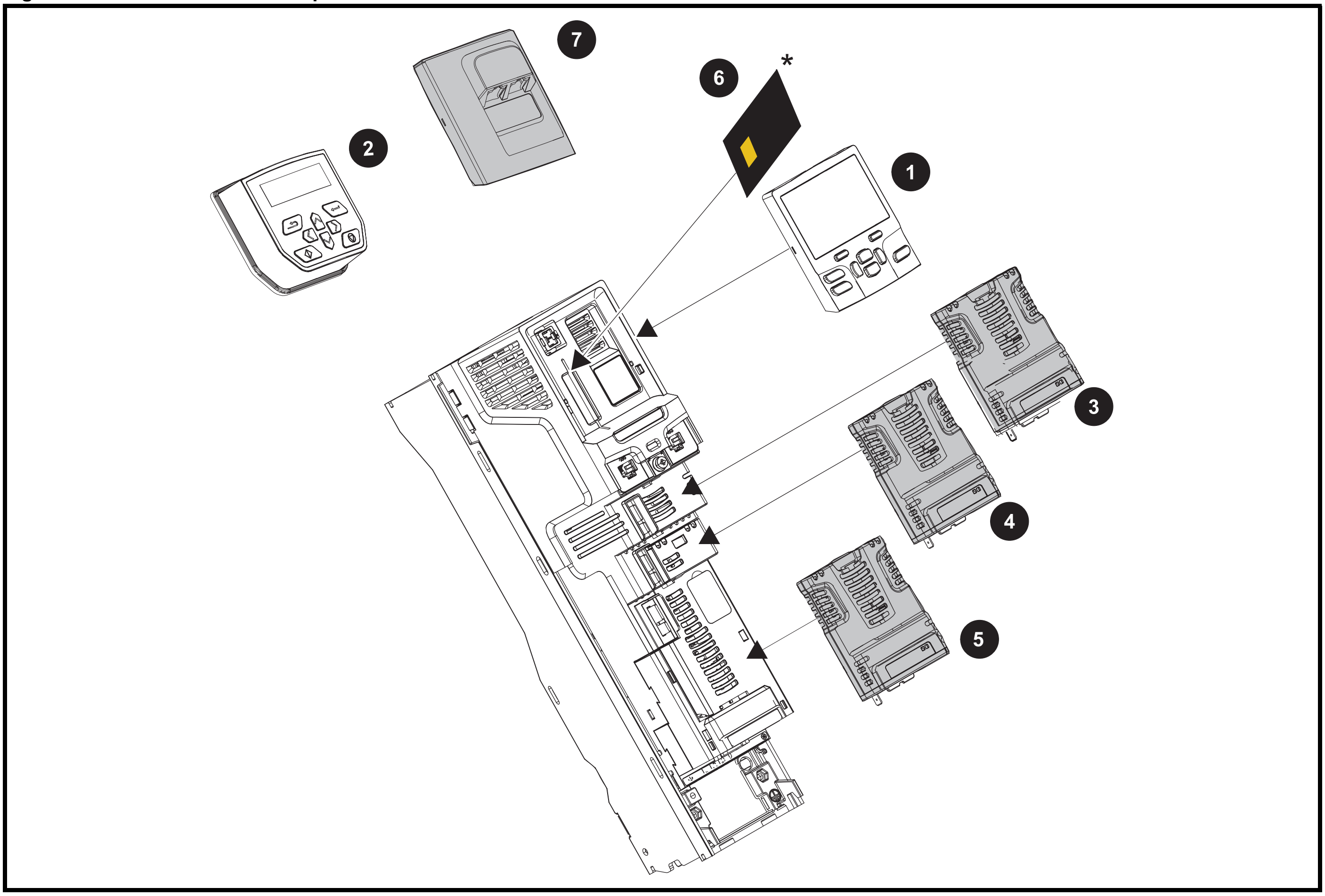


Key

1. Keypad connection
2. Rating label
3. Identification label
4. Status LED
5. Option module slot 1
6. Option module slot 2
7. Option module slot 3
8. Relay connections
9. Position feedback connections
10. Control connections
11. NV Media Cardslot
12. Braking terminal
13. Internal EMC filter
14. DC bus +
15. DC bus -
16. Motor connections
17. AC supply connections
18. Ground connections

2.8 Options

Figure 2-4 Drive features and options



Key

1. Keypad - Local
2. Keypad - Remote
3. Option module slot 1
4. Option module slot 2
5. Option module slot 3
6. NV Media Card
7. KI-485 Adaptor

Option modules come in two different formats, a standard option module and a large option module. All standard option modules are color-coded in order to make identification easy, whereas the larger option module is black. All modules have an identification label on top of the module. Standard option modules can be installed to any of the available option slots on the drive, whereas the large option modules can only be installed to option slot 3. The following tables shows the color-code key and gives further details on their function.

Table 2-8 Option module identification

Type	Color	Name	Further Details
Feedback	N/A	15 way D type converter	**Drive encoder input converter** Provides screw terminal interface for encoder wiring and spade terminal for shield
	N/A	Single ended encoder interface (15 V or 24 V)	**Single ended encoder interface** Provides an interface for single ended ABZ encoder signals such as those from hall effect sensors. 15 V and 24 V versions are available
	Dark Brown	SI-Universal Encoder	Additional combined encoder input and output interface supporting Incremental, SinCos, HIPERFACE, EnDAT and SSI encoders.
Fieldbus	Beige	SI-Ethernet	External Ethernet module that supports EtherNet/IP, Modbus TCP/IP and RTMoE. The module can be used to provide high speed drive access, global connectivity and integration with IT network technologies, such as wireless networking
Automation (I/O expansion)	Orange	SI-I/O	**Extended I/O** Increases the I/O capability by adding the following combinations: • Digital I/O • Digital Inputs • Analog Inputs (differential or single ended) • Analog Output • Relays

Type	Color	Name	Further Details
Automation (Applications)	Moss Green	MCi 200	**Machine Control Studio compatible applications processor** 2nd processor for running pre-defined and/or customer created application software.
	Moss Green	MCi 210	**Machine Control Studio compatible applications processor (with Ethernet communications)** 2nd processor for running pre-defined and/or customer created application software with Ethernet communications.
	Black	SI-Applications Plus	**SyPTPro compatible applications processor (with CTNet)** 2nd processor for running pre-defined and/or customer created application software with CTNet support (can only be used on Slot 3).

Table 2-9 Keypad identification

Type	Name	Further Details
Keypad	KI-Elv Keypad RTC	**LCD RTC keypad option** Keypad with LCD display and real time clock
	CI-Elv Remote Keypad	**LCD Remote keypad option** Keypad with LCD display which can be mounted remotely (KI-485 Adaptor and CT USB comms cable required)

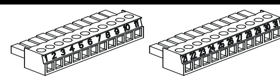
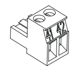
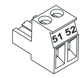
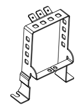
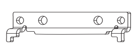
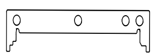
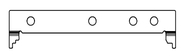
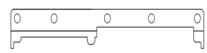
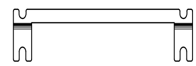
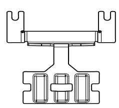
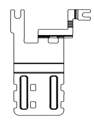
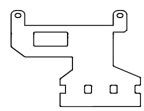
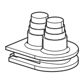
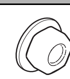
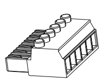
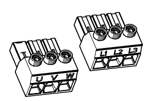
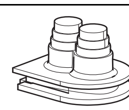
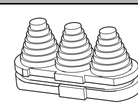
Table 2-10 Additional options

Type	Name	Further Details
Back-up	SD Card Adaptor	**SD card adaptor** Allows the drive to use an SD card for drive back-up
	SMARTCARD	**SMARTCARD** Used for parameter back-up with the drive
Communications	KI-485 Adaptor	**485 Comms adaptor** 485 Comms adaptor provides 485 communication interface and connection of the remote keypad. This adaptor supports 115 k Baud, node addresses between 1 to 16 and 8 1 NP M serial mode.
	CT USB comms cable	**Comms cable** CT USB to RJ485 comms cable for use with KI-485 Adaptor to provide communications interface

2.9 Items supplied with the drive

The drive is supplied with a copy of the safety information booklet, the Certificate of Quality and an accessory kit box including the items shown in Table 2-11 below.

Table 2-11 Parts supplied with the drive (size 3 to 7)

Description	Size 3	Size 4	Size 5	Size 6	Size 7
Control connectors	 x 1 x 1				
Relay connector	 x 1				
24 V power supply connector				 x 1	
Grounding bracket	 x 1				
Surface mounting brackets	 x 2	 x 2	 x 2	 x 2	 x 2
Grounding clamp	 x 1		 x 1	 x 1	
DC terminal cover grommets	 x 2				
Terminal nuts				 M6 x 11	
Supply and motor connector	 x 1		 x 1 x 1		
Finger guard grommets			 x 3	 x 2	

2.10 EMC filters

There are three EMC filter options available:

Table 2-12 EMC filter options

Filter option	Requirements of EN 61800-3:2004 met
Internal EMC filter	Second environment, with short motor cable
Standard external EMC filter	First and second environment with motor cable length up to 100 m
Compact external EMC filter	First and second environment with motor cable length up to 20 m

2.10.1 Internal EMC filter

It is recommended that the internal EMC filter be kept in place unless there is a specific reason for removing it, for example the drive is part of a Regen system or there is excessive ground leakage current in the system.
The internal EMC filter reduces radio-frequency emission into the line power supply. Where the motor cable is short, it permits the requirements of EN 61800-3:2004 to be met for the second environment. For longer motor cables the filter continues to provide a useful reduction in emission levels, and when used with any length of shielded motor cable up to the limit for the drive, it is unlikely that nearby industrial equipment will be disturbed. It is recommended that the filter be used in all applications unless the instructions given above require it to be removed, or where the ground leakage current is unacceptable.

WARNING

If the drive is used with ungrounded (IT) supplies, the internal EMC filter must be removed unless additional motor ground fault protection is installed.

WARNING

The power supply must be removed prior to removing the internal EMC filter.

2.10.2 Standard external EMC filter

The external EMC filter for all drive size can be either footprint or bookcase mounted, the details for each EMC filter is provided in the following.

Table 2-13 External EMC filter data

Model	CT part number	Weight	
		kg	lb
200 V			
03200050 to 03200106	4200-3230	1.9	4.20
04200137 to 04200185	4200-0272	4.0	8.82
05200250	4200-0312	5.5	12.13
06200330 to 06200440	4200-2300	6.5	14.3
07200610 to 07200830	4200-1132	6.9	15.2
400 V			
03400025 to 03400100	4200-3480	2.0	4.40
04400150 to 04400172	4200-0252	4.1	9.04
05400270 to 05400300	4200-0402	5.5	12.13
06400350 to 06400470	4200-4800	6.7	14.8
07400660 to 07401000	4200-1132	6.9	15.2
575 V			
05500030 to 05500069	4200-0122	7.0	15.4
06500100 to 06500350	4200-3690	7.0	15.4
07500440 to 07500550	4200-0672		
690 V			
07600190 to 07600540	4200-0672		

The external EMC filters for sizes 3 to 6 can be footprint mounted or bookcase mounted.

2.10.3 Compact external EMC filters

The external Compact EMC filter for size 3, 4 and 5, drives can be bookcase mounted, the details for each of the Compact EMC filters is provided following.

Table 2-14 External Compact EMC filter data

Model	CT part number	Weight	
		kg	lb
400 V			
03400025 to 03400100	4200-6126	0.4	0.88
	4200-6219	0.6	1.32
04400150 to 04400172	4200-6220	0.7	1.54
05400270 to 05400300	4200-6221-01	1.7	3.75

NOTE

When using the external Compact EMC filters an additional AC input line reactor is required which is selected to meet the requirements of EN 12015.

2.11 AC input line reactors

The AC power supply current harmonics for the complete Elevator system will be the vector sums of the harmonic currents for all of the individual electrical loads in the system. Usually the main drive will dominate the electrical load, and it will be sufficient to ensure that these meet the harmonic requirements detailed in IEC 61000-3-12 (EN 12015). Where drives are also used for ancillary functions such as door opening, ventilation etc., it may be necessary to ensure that their harmonic contributions are not excessive, although generally their power ratings will be too small to be significant.

AC input line reactors must be provided in order to maintain the harmonics below the required levels detailed in IEC 61000-3-12 (EN 12015), the following table provides details of suitable AC input line reactors to meet this standard whilst operating at rated power. Note the correct value reactor depends upon the maximum input power for the particular Elevator system, and not necessarily the drive model / rating. For a given application, it is important the actual maximum input power is measured / estimated and the correct reactor value calculated in inverse proportion to the power.

Table 2-15 AC input line reactors

Drive model	AC Input Line reactor		
	Inductance mH	Current rating A	Input power kW
03200050	6	3.8	0.75
03200066	5	5.0	1.1
03200080	3	6.2	1.5
03200106	3	8.1	2.2
04200137	2.0	10.4	3.0
04200185	1.5	14	4.0
05200250	0.75	19.7	5.5
06200330	0.40	26.5	7.5
06200440	0.40	34.5	11.0
07200610	0.19	47.76	15.0
07200750	0.178	57.97	18.5
07200830	0.089	64.68	22.0
03400025	18	1.8	0.75
03400031	15	2.2	1.1
03400045	11	3.2	1.5
03400062	8	5.1	2.2
03400078	5	6.7	3.0
03400100	4	8.8	4.0
04400150	2.0	12.6	5.5
04400172	2.0	14.4	7.5
05400270	1.5	22	11.0
05400300	1.5	24.4	15.0
06400350	0.80	29.0	15.0
06400420	0.80	34.5	18.5
06400470	0.80	38.4	22.0
07400660	0.315	55.79	30.0
07400770	0.190	65.23	37.0
07401000	0.190	83.33	45.0

Drive model	AC Input Line reactor		
	Inductance mH	Current rating A	Input power kW
05500030	19	2.2	1.5
05500040	13	3.0	2.2
05500069	7	5.1	4.0
06500100	4.0	8.4	5.5
06500150	4.0	12.3	7.5
06500190	2.0	15.8	11.0
06500230	2.0	19.1	15.0
06500290	1.5	22.6	22.0
06500350	1.0	29.5	30.0
07500440	1.0	33.8	37.0
07500550	1.0	38.6	45.0

NOTE

Where input line reactors are not required to meet IEC 61000-3-12 (EN 12015) line reactors may still be required due to power supply quality issues, poor phase balance, severe disturbances etc in this case refer to section 4.11 *Supplies requiring Input line reactors* on page 90.

2.12 EMC compliance (general standards)

This is a summary of the EMC performance of the drive. For full details, refer to the *EMC Data Sheet* which can be obtained from the supplier of the drive.

Table 2-16 Immunity compliance

Standard	Type of immunity	Test specification	Application	Level
IEC61000-4-2 EN61000-4-2	Electrostatic discharge	6 kV contact discharge 8 kV air discharge	Module enclosure	Level 3 (industrial)
IEC61000-4-3 EN61000-4-3	Radio frequency radiated field	10 V/m prior to modulation 80 - 1000 MHz 80 % AM (1 kHz) modulation	Module enclosure	Level 3 (industrial)
IEC61000-4-4 EN61000-4-4	Fast transient burst	5/50 ns 2 kV transient at 5 kHz repetition frequency via coupling clamp	Control lines	Level 4 (industrial harsh)
		5/50 ns 2 kV transient at 5 kHz repetition frequency by direct injection	Power lines	Level 3 (industrial)
IEC61000-4-5 EN61000-4-5	Surges	Common mode 4 kV 1.2/50 µs waveshape	AC supply lines: line to ground	Level 4
		Differential mode 2 kV 1.2/50 µs waveshape	AC supply lines: line to line	Level 3
		Lines to ground	Signal ports to ground [1]	Level 2
IEC61000-4-6 EN61000-4-6	Conducted radio frequency	10V prior to modulation 0.15 - 80 MHz 80 % AM (1 kHz) modulation	Control and power lines	Level 3 (industrial)
IEC61000-4-11 EN61000-4-11	Voltage dips and interruptions	-30 % 10 ms +60 % 100 ms -60 % 1 s <-95 % 5 s	AC power ports	
IEC61000-6-1 EN61000-6-1:2007	Generic immunity standard for the residential, commercial and light - industrial environment			Complies
IEC61000-6-2 EN61000-6-2:2005	Generic immunity standard for the industrial environment			Complies
IEC61800-3 EN61800-3:2004	Product standard for adjustable speed power drive systems (immunity requirements)		Meets immunity requirements for first and second environments	

[1] See section 4.17.8 *Surge immunity of control circuits* on page 103 for control ports for possible requirements regarding grounding and external surge protection

Emission

The drive contains an in-built filter for basic emission control. An additional optional external filter provides further reduction of emission. The requirements of the following standards are met, depending on the motor cable length and switching frequency.

Table 2-17 Size 3 emission compliance (200 V drives)

Motor cable length (m)	Switching Frequency (kHz)						
	2	3	4	6	8	12	16
Using internal filter:							
0 – 2	C3			C4			
Using internal filter and ferrite ring (2 turns):							
0 – 10	C3				C4		
10-20	C3			C4			
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Table 2-18 Size 3 emission compliance (400 V drives)

Motor cable length (m)	Switching Frequency (kHz)						
	2	3	4	6	8	12	16
Using internal filter:							
0 – 5	C3			C4			
Using internal filter and ferrite ring (2 turns):							
0 – 10	C3					C4	
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Table 2-19 Size 4 emission compliance (200 V drives)

Motor cable length (m)	Switching Frequency (kHz)						
	2	3	4	6	8	12	16
Using internal filter:							
0 – 2	C3				C4		
Using internal filter and ferrite ring (2 turns):							
0 – 4	C3		C4				
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Table 2-20 Size 4 emission compliance (400 V drives)

Motor cable length (m)	Switching Frequency (kHz)						
	2	3	4	6	8	12	16
Using internal filter:							
0 – 4	C3			C4			
Using internal filter and ferrite ring (2 turns):							
0 – 10	C3		C4				
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Table 2-21 Size 5 emission compliance (200 V drives)

Motor cable length (m)	Switching Frequency (kHz)						
	2	3	4	6	8	12	16
Using internal filter:							
0 – 2	C3		C4				
Using internal filter and ferrite ring (1 turn – no advantage to 2 turns):							
0 – 2	C3					C4	
0 – 5	C3			C4			
0 – 7	C3		C4				
0 – 10	C3	C4					
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Table 2-22 Size 5 emission compliance (400 V drives)

Motor cable length (m)	Switc0hing Frequency (kHz)						
	2	3	4	6	8	12	16
Using internal filter:							
0 – 4	C3			C4			
0 – 10	C3	C4					
No advantage to using ferrite ring							
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Table 2-23 Size 5 emission compliance (575 V drives)

Motor cable length (m)	Switching Frequency (kHz)						
	2	3	4	6	8	12	16
Using internal filter:							
-	C4						
Using internal filter and ferrite ring (2 turns):							
0 – 4	C3			C4			
0 – 2	C3					C4	
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Table 2-24 Size 6 emission compliance (200 V drives)

Motor cable length (m)	Switching Frequency (kHz)						
	2	3	4	6	8	12	16
Using internal filter:							
0 – 2	C3		C4				
Using internal filter and ferrite ring (1 turn – no advantage to 2 turns):							
0 – 2	C3					C4	
0 – 5	C3			C4			
0 – 7	C3		C4				
0 – 10	C3	C4					
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Table 2-25 Size 6 emission compliance (400 V drives)

Motor cable length (m)	Switching Frequency (kHz)						
	2	3	4	6	8	12	16
Using internal filter:							
0 – 4	C3			C4			
0 – 10	C3	C4					
No advantage to using ferrite ring							
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Table 2-26 Size 6 emission compliance (575 V drives)

Motor cable length (m)	Switching Frequency (kHz)						
	2	3	4	6	8	12	16
Using internal filter:							
-	C4						
Using internal filter and ferrite ring (2 turns):							
0 – 4	C3			C4			
0 – 2	C3					C4	
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Table 2-27 Size 7 emission compliance (200 V drives)

Motor cable length (m)	Switching frequency (kHz)					
	2	3	4	6	8	12
Using the internal filter						
2~10	C4					
Using the external filter (CT No. 4200-1132)						
0 – 20	R (C1)	R (C1)	R (C1)	R (C1)	R (C1)	R (C1)
20 – 40	R (C1)	R (C1)	R (C1)	R (C1)	R (C1)	R (C1)
40 – 100	R (C1)	R (C1)	R (C1)	R (C1)	I (C2)	I (C2)

Table 2-28 Size 7 emission compliance (400 V drives)

Motor cable length (m)	Switching frequency (kHz)						
	2	3	4	6	8	12	16
Using the internal filter							
2~10	C4						
Using the external filter (CT No. 4200-1132)							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 50	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
50 – 100	I (C2)	I (C2)	I (C2)	-	-	-	-

Table 2-29 Size 7 emission compliance (575 V and 690 V drives)

Motor cable length (m)	Switching frequency (kHz)						
	2	3	4	6	8	12	16
Using the internal filter							
2~10							
Using the external filter (CT No. 4200-0672)							
0 – 20	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 50	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
50 – 100	I (C2)	I (C2)	-	-	-	-	

Key (shown in decreasing order of permitted emission level):

E2R EN 61800-3:2004 second environment, restricted distribution (Additional measures may be required to prevent interference)

E2U EN 61800-3:2004 second environment, unrestricted distribution

I Industrial generic standard EN 61000-6-4:2007
EN 61800-3:2004 first environment restricted distribution (The following caution is required by EN 61800-3:2004)

CAUTION

This is a product of the restricted distribution class according to IEC 61800-3. In a residential environment this product may cause radio interference in which case the user may be required to take adequate measures.

R Residential generic standard EN 61000-6-3:2007
EN 61800-3:2004 first environment unrestricted distribution

EN 61800-3:2004 defines the following:

- The first environment is one that includes residential premises. It also includes establishments directly connected without intermediate transformers to a low-voltage power supply network which supplies buildings used for residential purposes.
- The second environment is one that includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for residential purposes.
- Restricted distribution is defined as a mode of sales distribution in which the manufacturer restricts the supply of equipment to suppliers, customers or users who separately or jointly have technical competence in the EMC requirements of the application of drives.

IEC 61800-3:2004 and EN 61800-3:2004

The 2004 revision of the standard uses different terminology to align the requirements of the standard better with the EC EMC Directive.

Power drive systems are categorized C1 to C4:

Category	Definition	Corresponding code used above
C1	Intended for use in the first or second environments	R
C2	Not a plug-in or movable device, and intended for use in the first environment only when installed by a professional, or in the second environment	I
C3	Intended for use in the second environment, not the first environment	E2U
C4	Rated at over 1000 V or over 400 A , intended for use in complex systems in the second environment	E2R

Note that category 4 is more restrictive than E2R, since the rated current of the PDS must exceed 400 A or the supply voltage exceed 1000 V, for the complete PDS.

2.13 EMC compliance (elevator standards)

This section provides specific information for the E300 drives when used in lifts, elevators and escalators which are required to comply with the harmonized European EMC standards EN 12015 (emission) and EN 12016 (immunity). These standards were revised in 2004, although in some EU countries the revised versions did not become available until 2006. The revised versions became mandatory in June 2006. They contain some important changes from the previous (1998) versions. The information given here includes the requirements of the revised versions. For full details refer to the EMC data sheet, which can be obtained from the supplier of the drive.

2.13.1 Emission - EN 12015

The standard sets limits in the following categories:

1. Radiated emission from the enclosure

This covers the frequency range 30 MHz to 1000 MHz.

The limits are the same as for the generic standard EN 61000-6-4 and are unchanged from the 1998 version.

2. Conducted emission from the AC mains port(s)

This covers the frequency range 0.15 MHz to 30 MHz.

The limits are the same as for the generic standard EN 61000-6-4 and are unchanged from the 1998 version.

3. Conducted emission from the power port(s) (motor port etc).

This covers the frequency range 0.15 MHz to 30 MHz.

These are new limits, which apply unless the motor cable length does not exceed 2 m or it is screened.

4. Impulse noise

This is a special requirement for impulsive conducted emission.

The limits are the same as for the 1998 version.

5. Voltage fluctuations

This covers fluctuations, which are variations in the supply voltage which result in lighting flicker.

These are new limits. They are based on the standard EN 61000-3-11.

6. Mains current harmonics

This covers harmonics up to order 40.

These are new limits. They are based on standard IEC 61000-3-4.

Conformity of the Control Techniques drive products with EN 12015

The drives conform to the standard for Power Drives Systems, EN 61800-3, and the generic standard for industrial environments EN 61000-6-4. In many respects this also covers the requirements of EN 12015.

Mains conducted emission

Generally the standard optional external filter must be used.

The motor cable length is set by the filter capability, on the assumption that the highest available switching frequency is in use. If longer lengths are required this can usually be achieved by reducing the switching frequency, see the appropriate EMC data sheet for further information.

Where the lift system has a rated input current exceeding 100 A, and a dedicated supply transformer, higher emission levels are permitted and then only the built-in filter is required.

Please note that the standard test method requires the use of a mains supply cable 1 m long, this being the cable which connects the system under test to the LISN (line impedance stabilization network). This requirement might be inconvenient and appear to be unrealistic in some cases. However it is important to adhere to this recommendation to ensure a valid and comparable test result.

Output conducted emission

The cable must be screened and the screen must be correctly bonded in accordance with the EMC (Electromagnetic compatibility) section of this *Design Guide* or the EMC data sheet for the product, unless the motor cable length is less than or equal to 2 m in length.

Impulse noise

The drive does not generate impulse noise. Care is required to ensure that associated power contactors do not generate impulse noise.

Voltage fluctuations

The drive does not in itself cause significant voltage fluctuations or flicker. The control system must be designed so as not to cause rapid changes in motor power which could result in flicker. Generally the requirements for passenger comfort ensure that this is the case.

Mains current harmonics

The mains current harmonics for the complete lift system will be the vector sums of the harmonic currents for all of the individual electrical loads in the system. Usually the main lift drive(s) will dominate the electrical load, and it will be sufficient to ensure that these meet the harmonic requirements. Where electronic drives are also used for ancillary functions such as door opening, ventilation etc., it may be necessary to ensure that their harmonic contributions are not excessive, although generally their power ratings will be too small to be significant. It is important that test conditions should be realistic and/or calculations done correctly, in order for harmonic emission from small drives to be correctly assessed. Please see the note below on test conditions for harmonic testing.

The information in section 2.11 *AC input line reactors* on page 23, shows the measures required for drives rated at 2.2 kW upwards, in order to meet the harmonics requirements. For harmonic data related to the smaller drives which might be used for auxiliary functions, please refer to the relevant EMC data sheet.

Input chokes must be provided in order to maintain the harmonics below the required levels. Table 2-15 gives the choke data. Note that the correct value of choke depends upon the maximum input power for which the particular lift controller is designed, and not necessarily on the drive model number or rating. The figure for input power in Table 2-15 is based on the efficiency of a typical standard Eff2 induction motor. For a given application, it is important that the actual maximum input power should be measured or estimated and the necessary choke value calculated in inverse proportion to the power.

Table 2-30 Emissions compliance

Item	Limit (%)	Typical (%)
Harmonic:		
5	30	27.6
7	18	7.9
11	13	6.4
13	8	3.7
THD	35	29.9
PWHD	39	16.5
$\cos\varphi$		0.9790
Distortion factor		0.9580
Power factor		0.9379

The limits in the table are based on the ratios of the specific harmonics to the rated fundamental current (In / I1 in clause 6.7.2 of EN 12015:2004).

2.13.2 Immunity - EN 12016

The standard gives immunity requirements over a range of standard immunity test methods. Generally these correspond to the tests required by the generic standards for the residential and industrial environments, EN 61000-6-1 and EN 61000-6-2. However there are more severe test levels prescribed for safety circuits. In the tests for safety circuits, the drive is permitted to trip but the safety function must continue to operate.

The following table shows the status of the whole range of drives covered by this data sheet.

Table 2-31 Immunity compliance

Test	Status – drive functions	Status – Safe Torque Off used in safety circuits
Electrostatic discharge	Conform	Electrostatic discharge Conform
Radio frequency electromagnetic field	Conform	Conform (the drive might trip but no loss of safety function)
Fast transients common mode – to signal and power ports	Conform	Conform
Surge: Signal and control lines	Conform	Conform (External suppression is required to prevent trip or damage)*
Power ports	Conform	Conform
Radio frequency common mode – to signal and power ports	Conform	Conform
Voltage dips	Conform	Conform
Voltage interruptions	Conform	Conform

* Suppression is not required to ensure safety, and is generally not required. Control Techniques recommends that the suppression be installed if the lines connected to the port exceed 30 m in length, based on the requirements of EN 61000-6-2. See section 4.17.8 *Surge immunity of control circuits* on page 103.

3 Mechanical installation

This chapter describes how to use all mechanical details to install the drive. The drive is intended to be installed in an enclosure. Key features of this chapter include:

- Installing the drive
- Option module installation
- Terminal location and torque settings

3.1 Safety information

WARNING

Follow the instructions
The mechanical and electrical installation instructions must be adhered to. Any questions or doubt should be referred to the supplier of the equipment. It is the responsibility of the owner or user to ensure that the installation of the drive and any external option unit, and the way in which they are operated and maintained, comply with the requirements of the Health and Safety at Work Act in the United Kingdom or applicable legislation and regulations and codes of practice in the country in which the equipment is used.

WARNING

Competence of the installer
The drive must be installed by professional assemblers who are familiar with the requirements for safety and EMC. The assembler is responsible for ensuring that the end product or system complies with all the relevant laws in the country where it is to be used.

WARNING

Enclosure
The drive is intended to be mounted in an enclosure which prevents access except by trained and authorized personnel, and which prevents the ingress of contamination. It is designed for use in an environment classified as pollution degree 2 in accordance with IEC 60664-1. This means that only dry, non-conducting contamination is acceptable.

3.2 Installation

The following considerations must be made for the installation:

3.2.1 Access

Access must be restricted to authorized personnel only. Safety regulations which apply at the place of use must be complied with.

The IP (Ingress Protection) rating of the drive is installation dependent. For further information refer to *section 3.8 Enclosing standard drive for high environmental protection* on page 43

3.2.2 Environmental protection

The drive must be protected from:

- Moisture, including dripping water or spraying water and condensation. An anti-condensation heater may be required, which must be switched Off when the drive is running.
- Contamination with electrically conductive material
- Contamination with any form of dust which may restrict the fan, or impair airflow over various components
- Temperature beyond the specified operating and storage ranges
- Corrosive gasses

NOTE

During installation it is recommended that the vents on the drive are covered to prevent debris (e.g. wire off-cuts) from entering the drive.

3.2.3 Cooling

The heat produced by the drive must be removed without its specified operating temperature being exceeded. Note that a sealed enclosure gives much reduced cooling compared with a ventilated one, and may need to be larger and/or use internal air circulating fans.

3.2.4 Electrical safety

The installation must be safe under normal and fault conditions.

3.2.5 Fire protection

The drive enclosure is not classified as a fire enclosure. A separate fire enclosure must be provided which can be metal and/or polymeric. Polymer must meet requirements which can be summarized for larger enclosures as using materials meeting at least UL 94 class 5VB at the point of minimum thickness. Air filter assemblies to be at least class V-2.

3.2.6 Electromagnetic compatibility

Variable speed drives are powerful electronic circuits which can cause electromagnetic interference if not installed correctly, with careful attention to the layout of the wiring. Some simple routine precautions can prevent disturbance to typical industrial control equipment.

If it is necessary to meet strict emission limits, or if it is known that electromagnetically sensitive equipment is located nearby, then full precautions must be observed. In-built into the drive, is an internal EMC filter, which reduces emissions under certain conditions. If these conditions are exceeded, then the use of an external EMC filter (located very close to the drives input) may be required.

3.2.7 Hazardous areas

The drive must not be located in a classified hazardous area unless it is installed in an approved enclosure and the installation is certified.

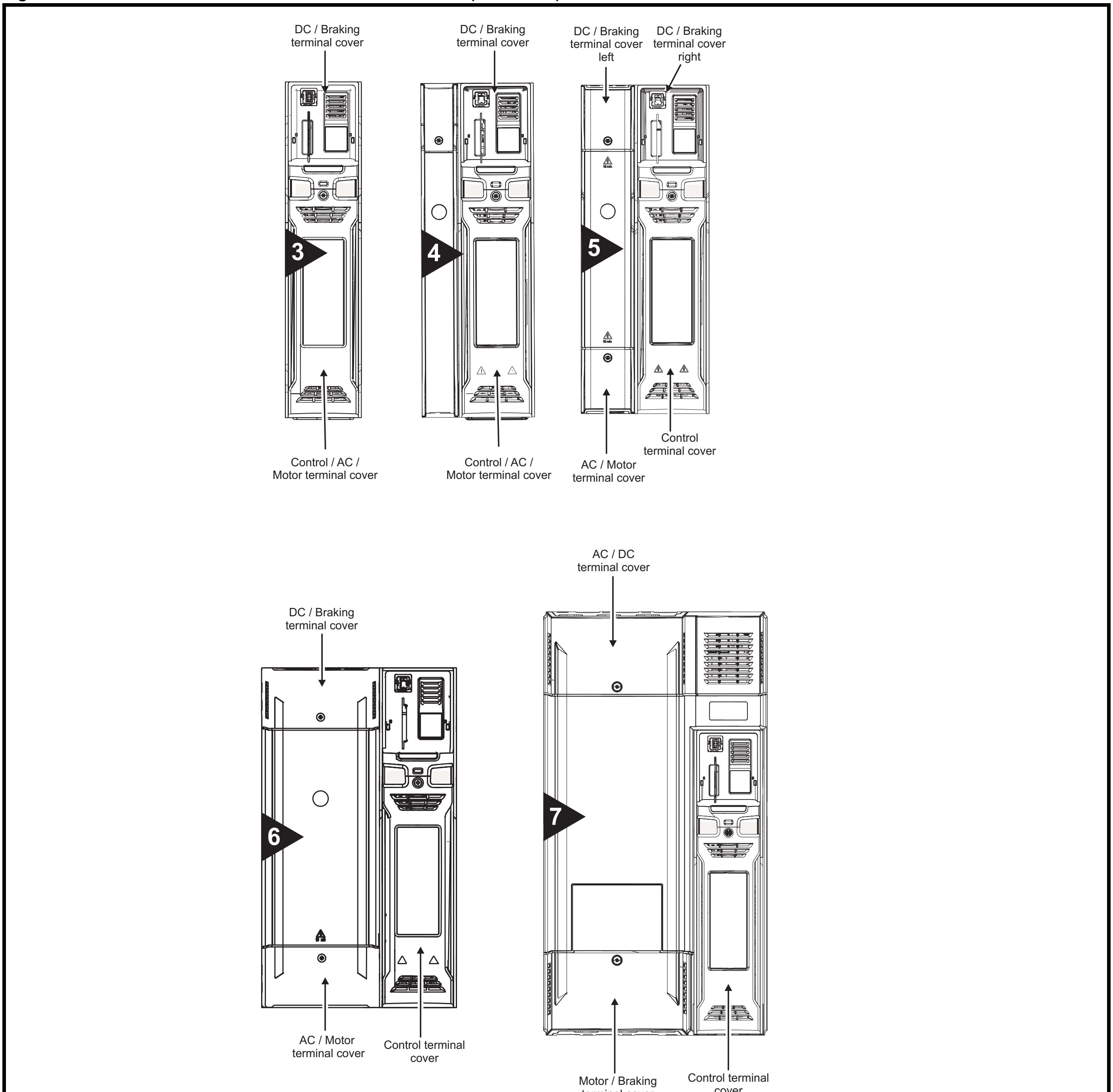
3.3 Terminal cover removal

WARNING	**Isolation device** The AC and / or DC power supply must be disconnected from the drive using an approved isolation device before any cover is removed from the drive or before any servicing work is performed.

WARNING	**Stored charge** The drive contains capacitors that remain charged to a potentially lethal voltage after the AC and / or DC power supply has been disconnected. If the drive has been energized, the power supply must be isolated for at least ten minutes before work may continue. Normally the capacitors are discharged by an internal resistor. Under certain unusual fault conditions, it is possible that the capacitors may fail to discharge, or be prevented from being discharged by a voltage applied to the output terminals. If the drive has failed in a manner that causes the display to go blank immediately, it is possible the capacitors will not be discharged. In this case consult Control Techniques or their authorized distributor.

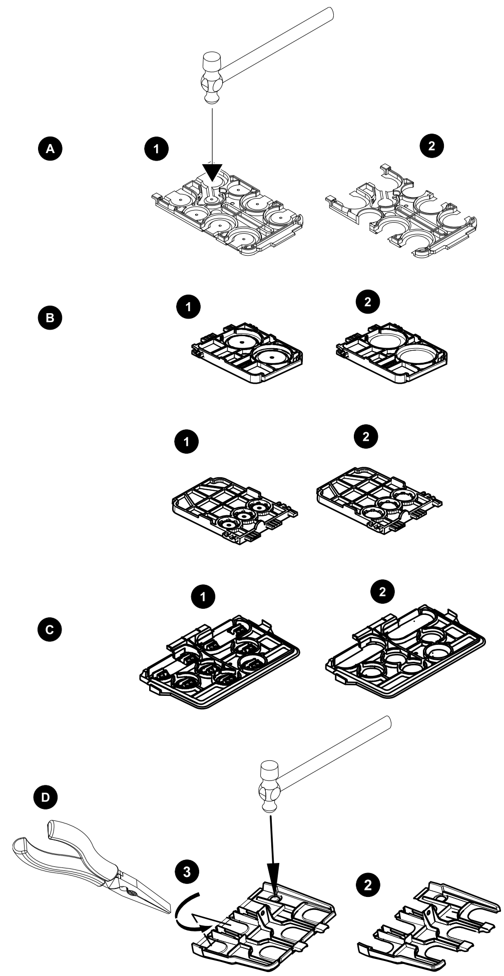
3.3.1 Removing the terminal covers

Figure 3-1 Location and identification of terminal covers (size 3 to 7)



3.3.2 Removing the finger-guard and DC terminal cover break-outs

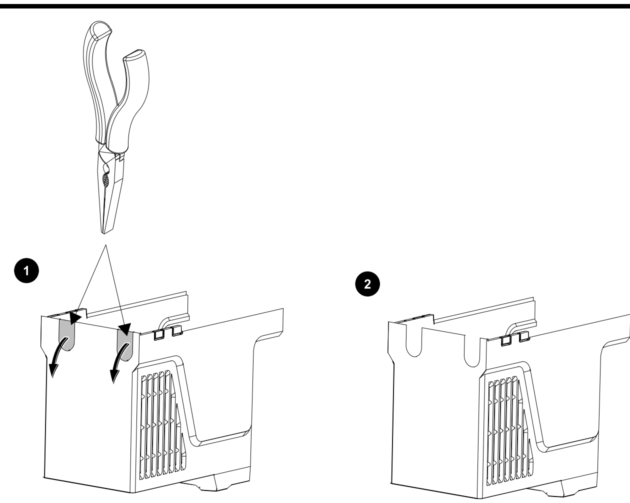
Figure 3-2 Removing the finger-guard break-outs



A: All sizes, **B**: Size 5, **C**: Size 6 **D**: Size 7

Place the finger-guard on a flat solid surface and remove the relevant break-outs with a hammer as shown (1). For size 7, pliers can be used to remove the break-outs, grasp the relevant break-out with the pliers and twist as shown (3). Continue until all required break-outs are removed (2). Remove any flash / sharp edges once the break-outs are removed.

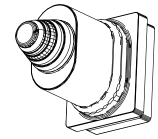
Figure 3-3 Removing the size 3 and 4 DC terminal cover break-outs



Grasp the DC terminal cover break-outs with pliers as shown (1) and pull down in the direction shown to remove. Continue until all required break-outs are removed (2). Remove any flash / sharp edges once the break-outs are removed. Use the DC terminal cover grommets supplied in the accessory box to maintain the seal at the top of the drive.

A grommet kit is available for size 7 finger guards.

Table 3-1 Grommet kit (size 7)

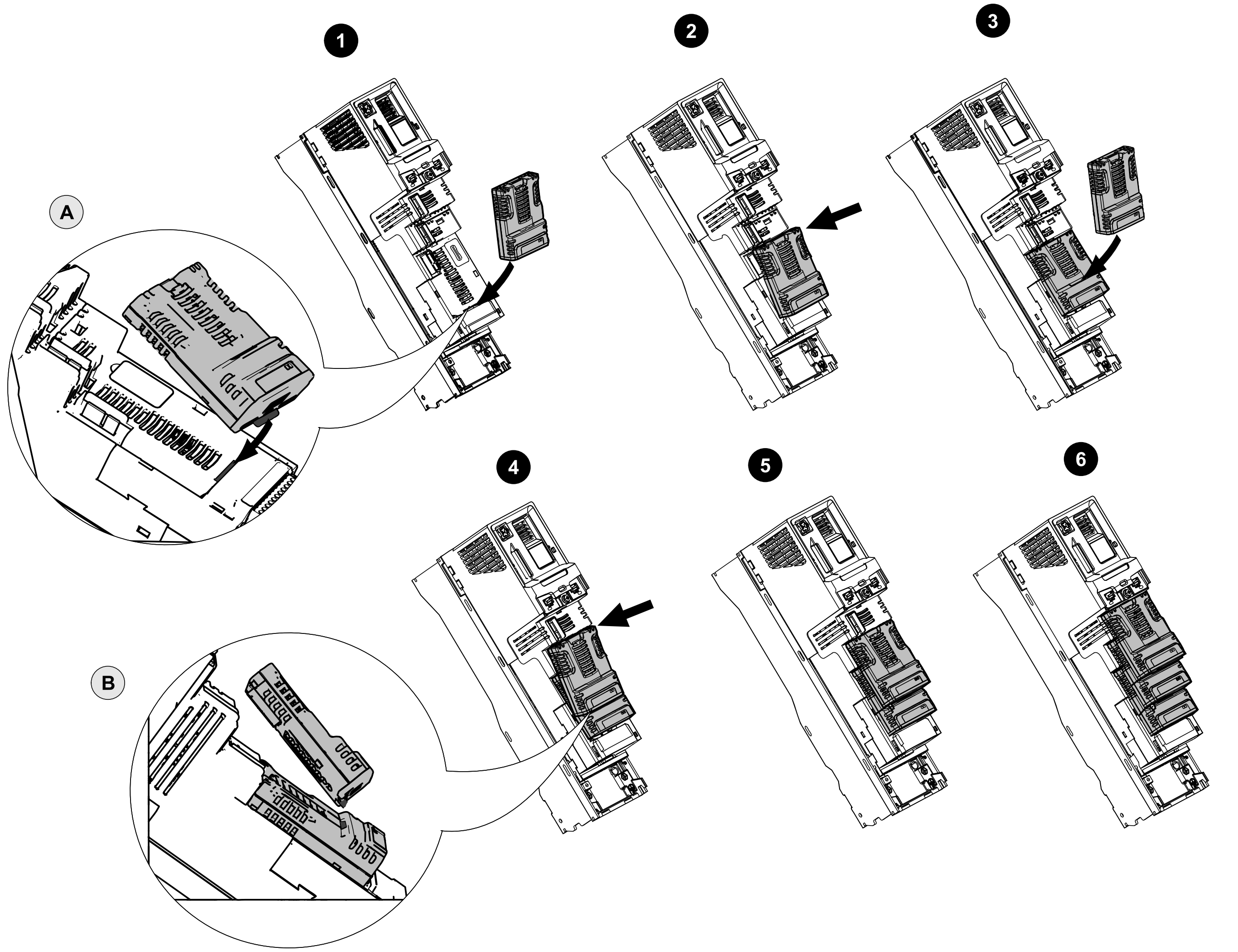
Drive size	Part number	Picture
Size 7 - Kit of 8 x single entry grommets	3470-0086-00	

3.4 Installing / removing option modules, keypad

CAUTION

Power down the drive before installing / removing the option module. Failure to do so may result in damage to the product.

Figure 3-4 Installation of a standard option module



NOTE

Option module slots must be used in the following order: slot 3, slot 2 and slot 1

Installing the first option module

- Move the option module in direction shown (1).
- Align and insert the option module tab in to the slot provided (2), this is highlighted in the detailed view (A).
- Press down on the option module until it clicks into place.

Installing the second option module

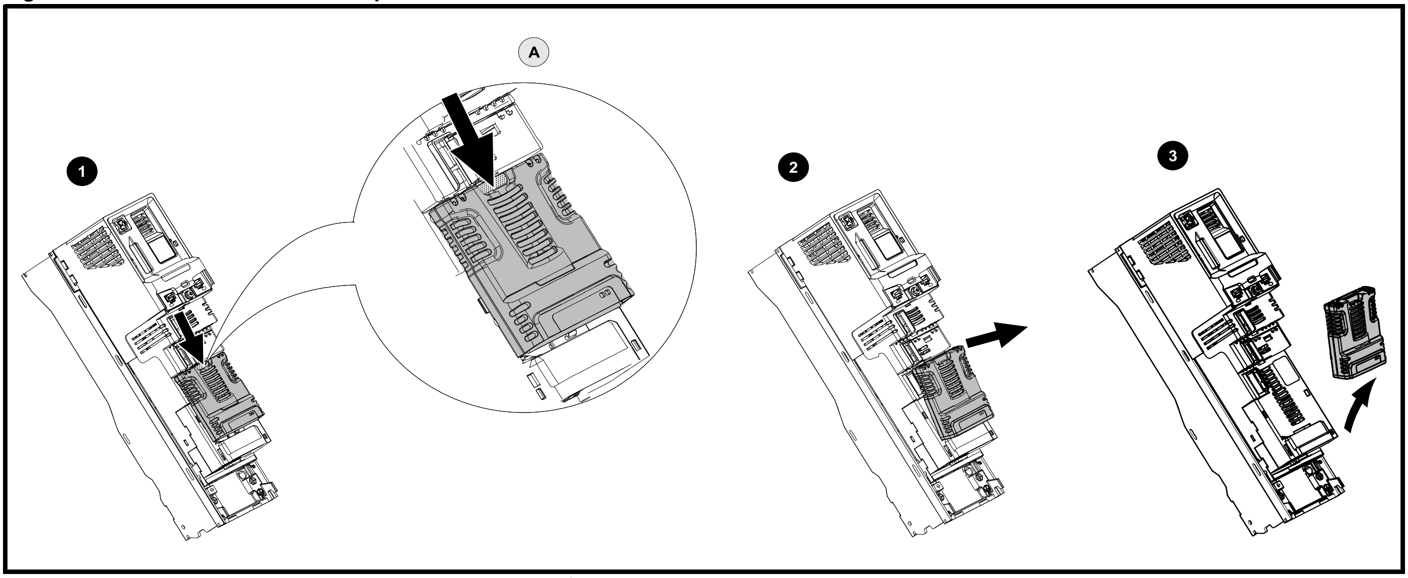
- Move the option module in direction shown (3).
- Align and insert the option module tab in to the slot provided on the already installed option module (4), this is highlighted in the detailed view (B).
- Press down on the option module until it clicks into place. Image (5) shows two option modules fully installed.

Installing the third option module

- Repeat the above process.

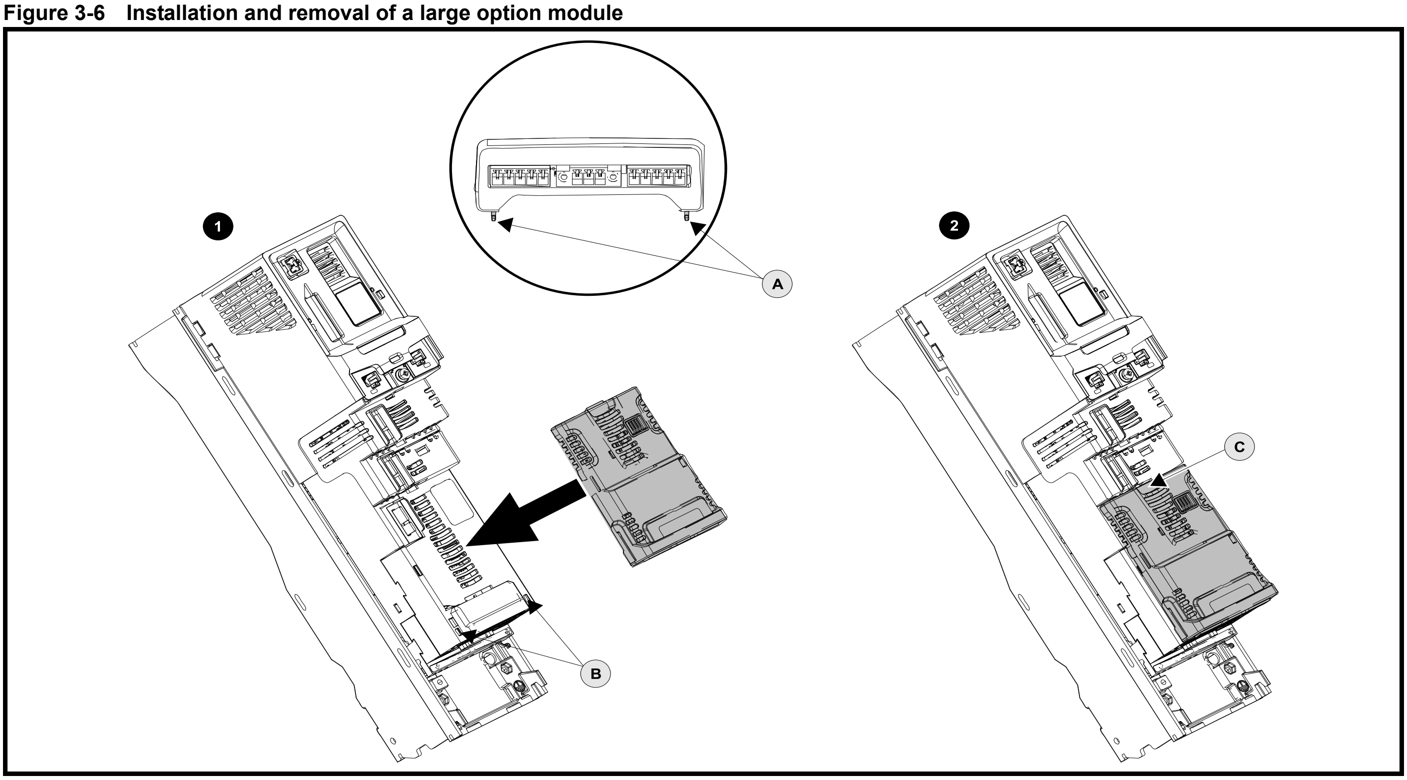
The drive has the facility for all three option module slots to be used at the same time, image (6) shows the three option modules installed.

Figure 3-5 Removal of a standard option module



- Press down on the tab (1) to release the option module from the drive housing, the tab is highlighted in the detailed view (A).
- Tilt the option module towards you as shown (2).
- Totally remove the option module in direction shown (3).

Figure 3-6 Installation and removal of a large option module



Installing a large option module

- Move the option module in direction shown (1).
- Align and insert the option module tabs A) into the slot provided (B).
- Press down on the option module until it clicks into place.

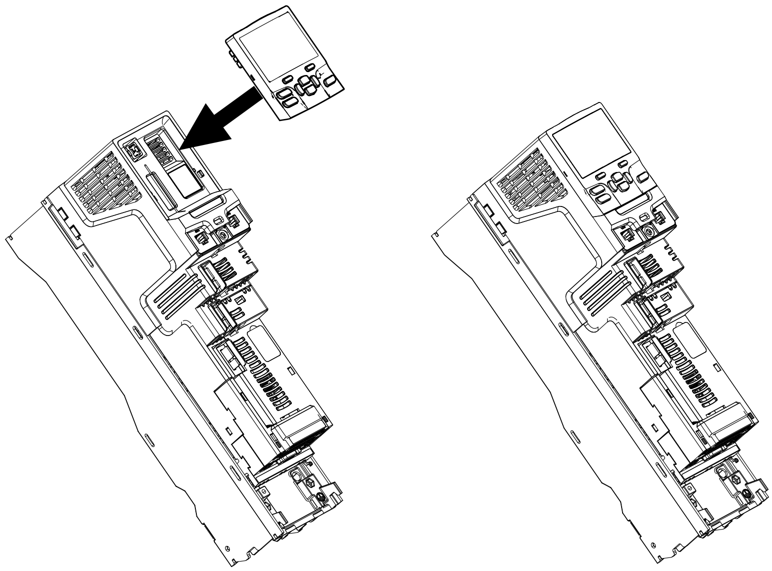
Removing a large option module

- Press down on the tab (2C), tilt the option module towards you and remove..

NOTE

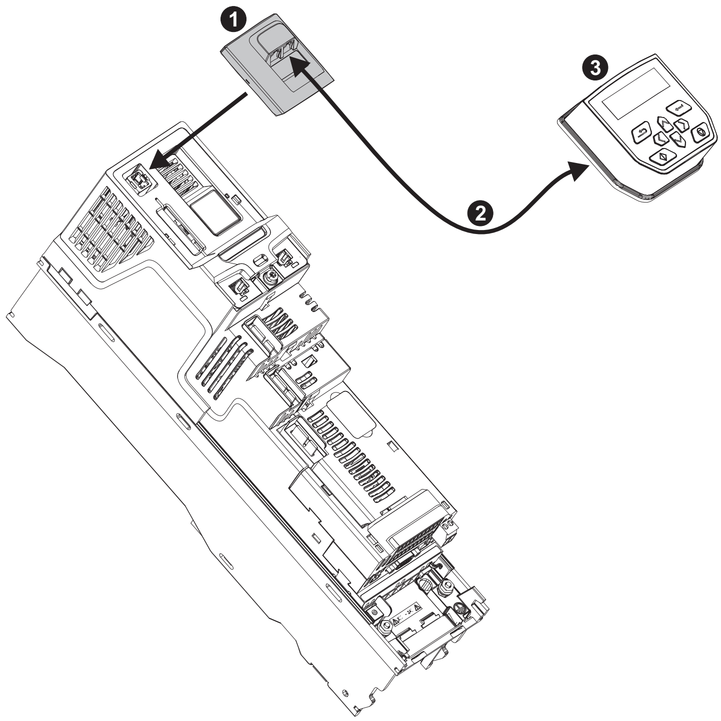
The large option module can only be inserted into slot 3. Additional standard option modules can still be installed and used in slot 2 and slot 1.

Figure 3-7 Installation and removal of the KI-Elv Keypad RTC



- To install, align the keypad and press gently in the direction shown until it clicks into position.
- To remove, reverse the installation instructions.

Figure 3-8 Connection of the CI-Elv Remote Keypad



1. KI-485 Adaptor
2. RJ-485 lead
3. Remote keypad (CI-Elv Remote Keypad)

NOTE

The keypad options can be installed / removed while the drive is powered up and running a motor, provided the drive is not operating in keypad mode.

Table 3-2 Communications option

Part number	Communications option
82400000016100	KI-485 Adaptor - A removable adaptor which provides 485 comms interface. This adaptor supports 115 k Baud
4500-0096	CT USB comms cable

3.5 Dimensions and mounting methods

The drive can be either surface or through-panel mounted using the appropriate brackets. The following drawings show the dimensions of the drive and mounting holes for each method to allow a back plate to be prepared. The Through-panel mounting kit is not supplied with the drive and can be purchased separately. The relevant part numbers are shown the table below.

Table 3-3 Through-panel mounting kit part number numbers for size 3 to 7

Size	CT part number
3	3470-0053
4	3470-0056
5	3470-0067
6	3470-0055
7	3470-0079

WARNING

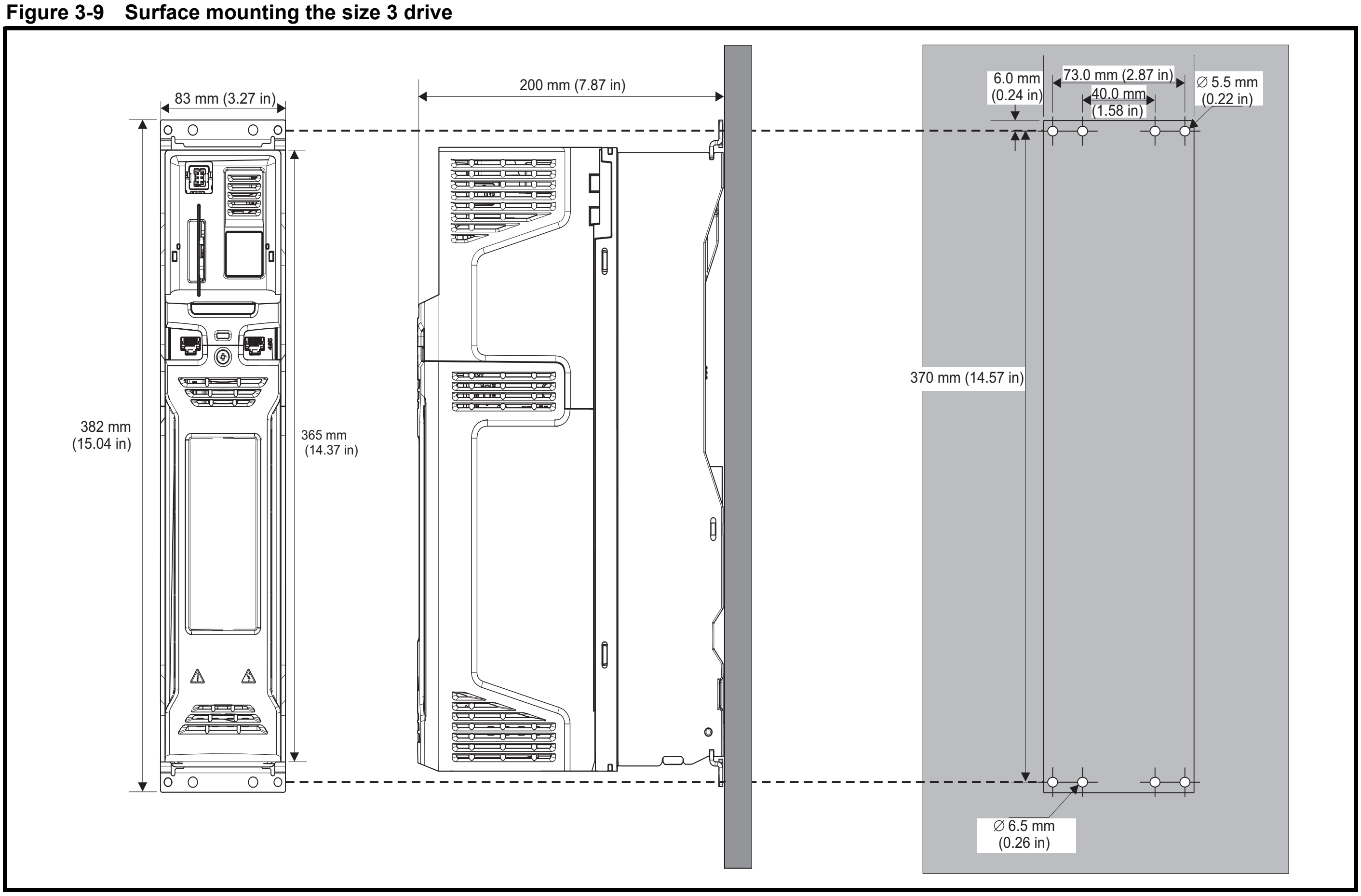
If the drive has been used at high load levels for a period of time, the heatsink can reach temperatures in excess of 70 °C (158 °F). Human contact with the heatsink should be prevented.

WARNING

Many of the drives in this product range weigh in excess of 15 kg (33 lb). Use appropriate safeguards when lifting these models.

3.5.1 Surface mounting

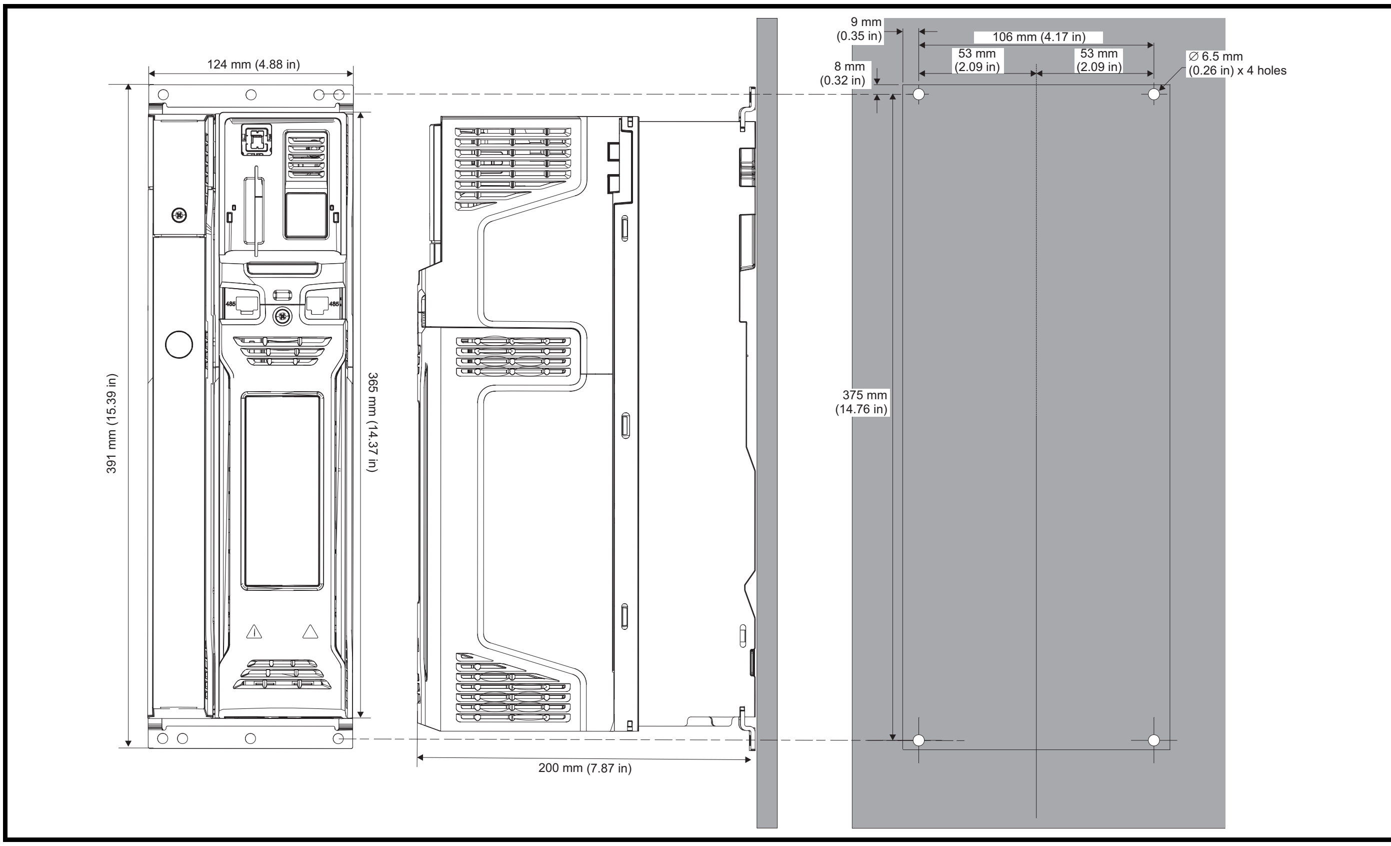
Figure 3-9 Surface mounting the size 3 drive



NOTE

Each mounting bracket contains 4 mounting holes, the outer holes (5.5 mm) x 2 should be used for mounting the drive to the backplate as this allows the heatsink fan to be replaced without removing the drive from the backplate. The inner holes (6.5 mm) x 2 are used for Unidrive SP size 1 retrofit applications. See Table 3-4 for further information.

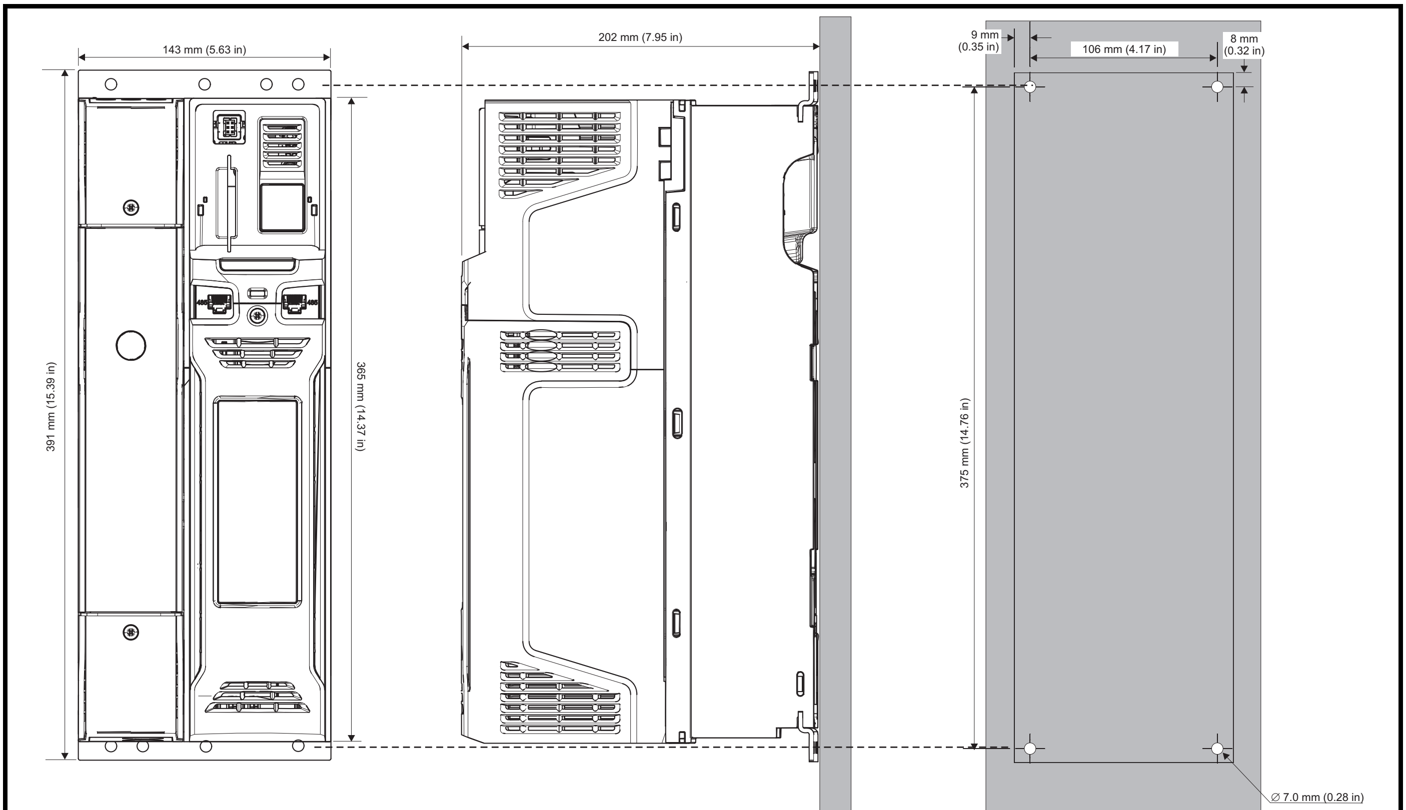
Figure 3-10 Surface mounting the size 4 drive



NOTE

The outer holes in the mounting bracket are to be used for surface mounting. See Table 3-4 for further information.

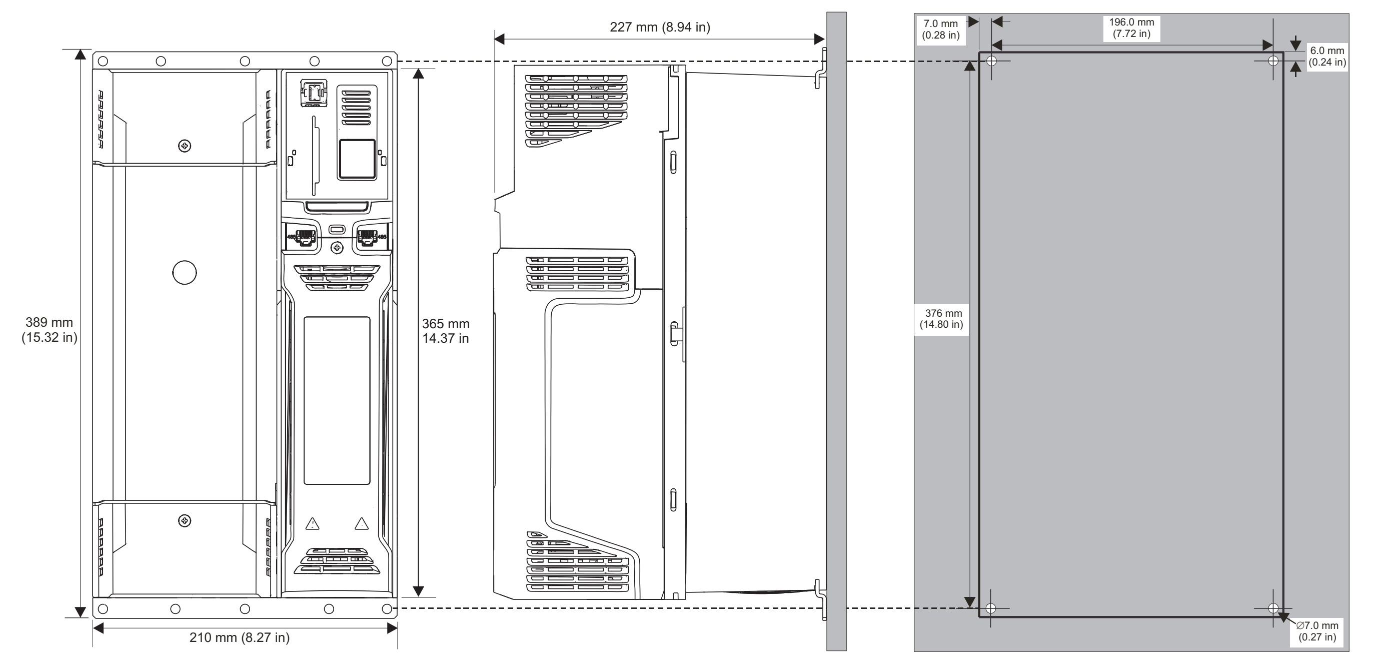
Figure 3-11 Surface mounting the size 5 drive



NOTE

The outer holes in the mounting bracket are to be used for surface mounting. See Table 3-4 for further information.

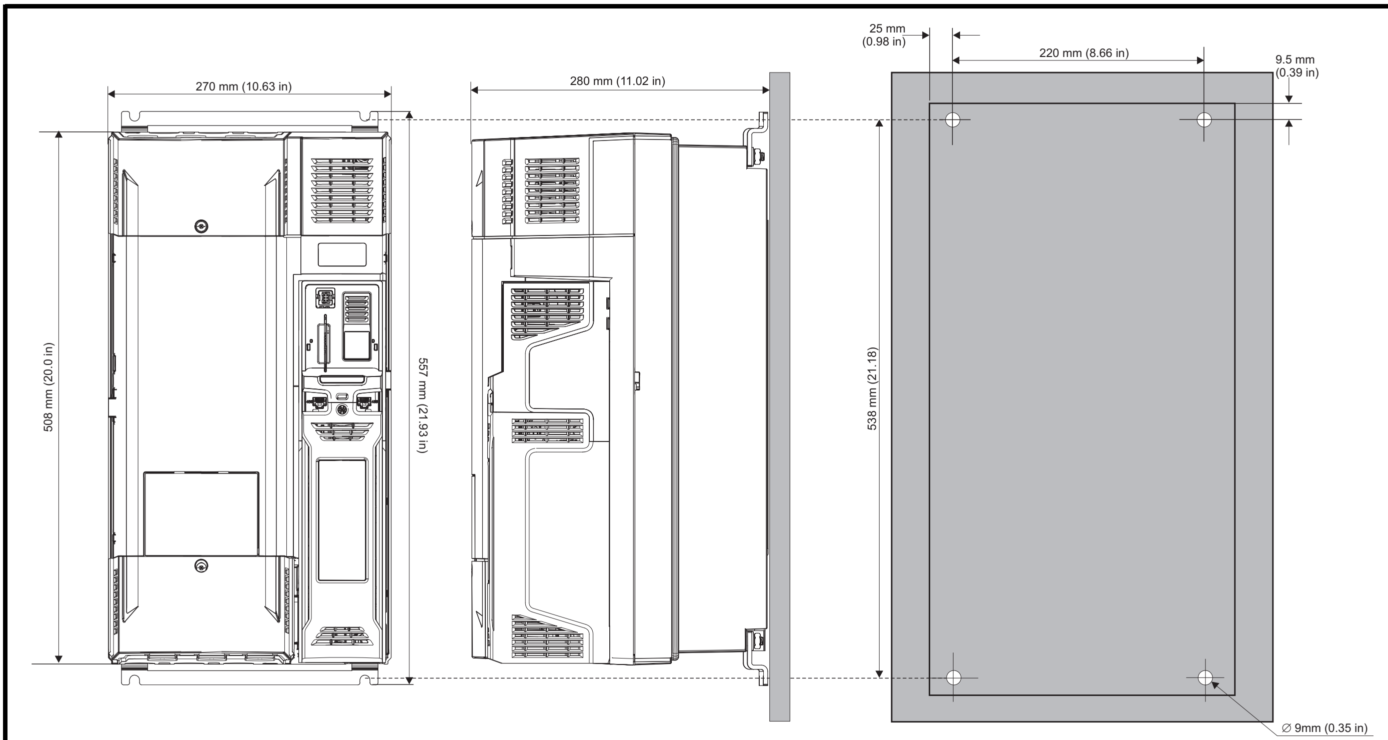
Figure 3-12 Surface mounting the size 6 drive



NOTE

The outer holes in the mounting bracket are to be used for surface mounting. See Table 3-4 for further information.

Figure 3-13 Surface mounting the size 7 drive



3.5.2 Through-panel mounting

Figure 3-14 Through-panel mounting the size 3 drive

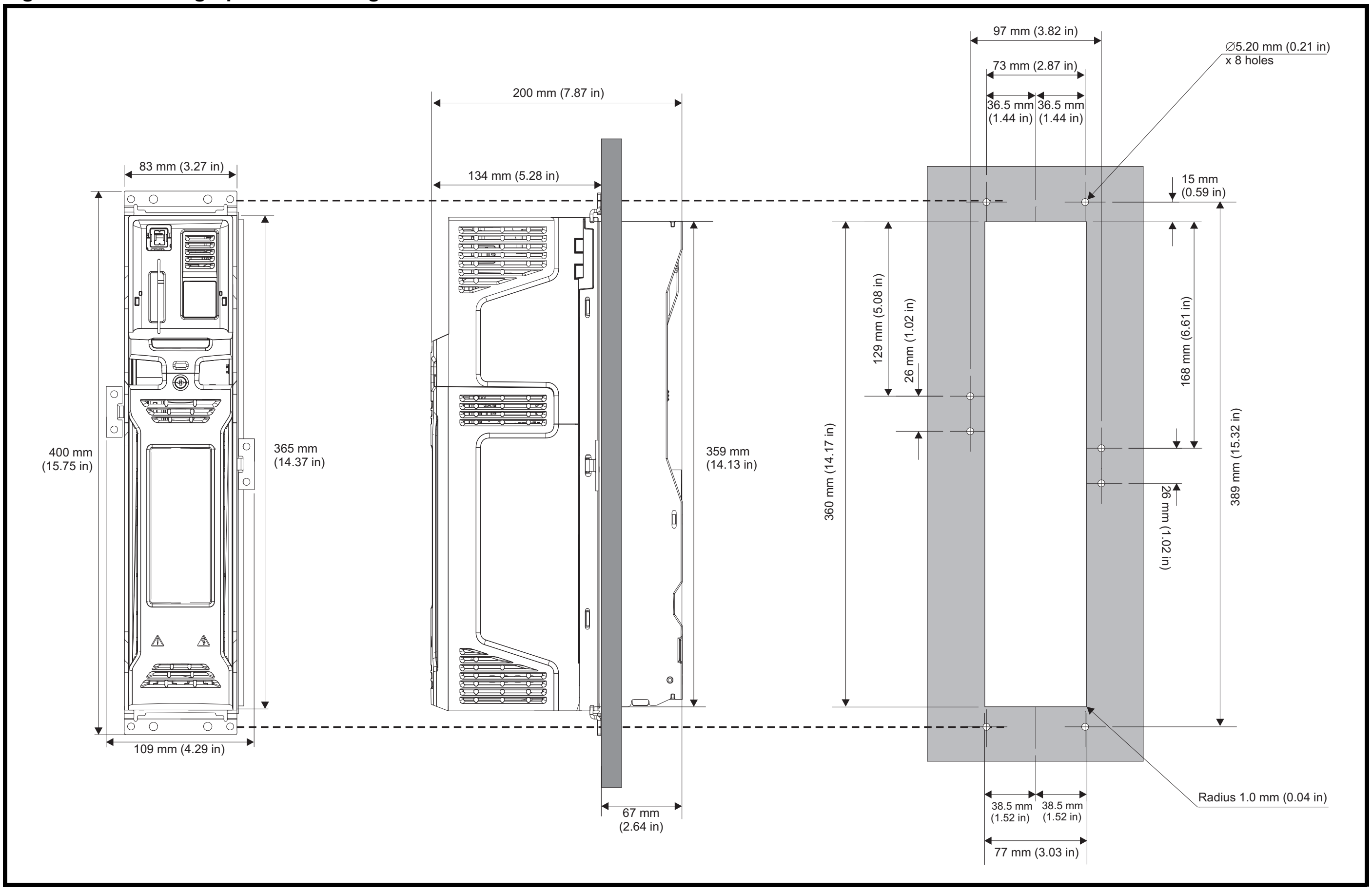


Figure 3-15 Through panel mounting the size 4 drive

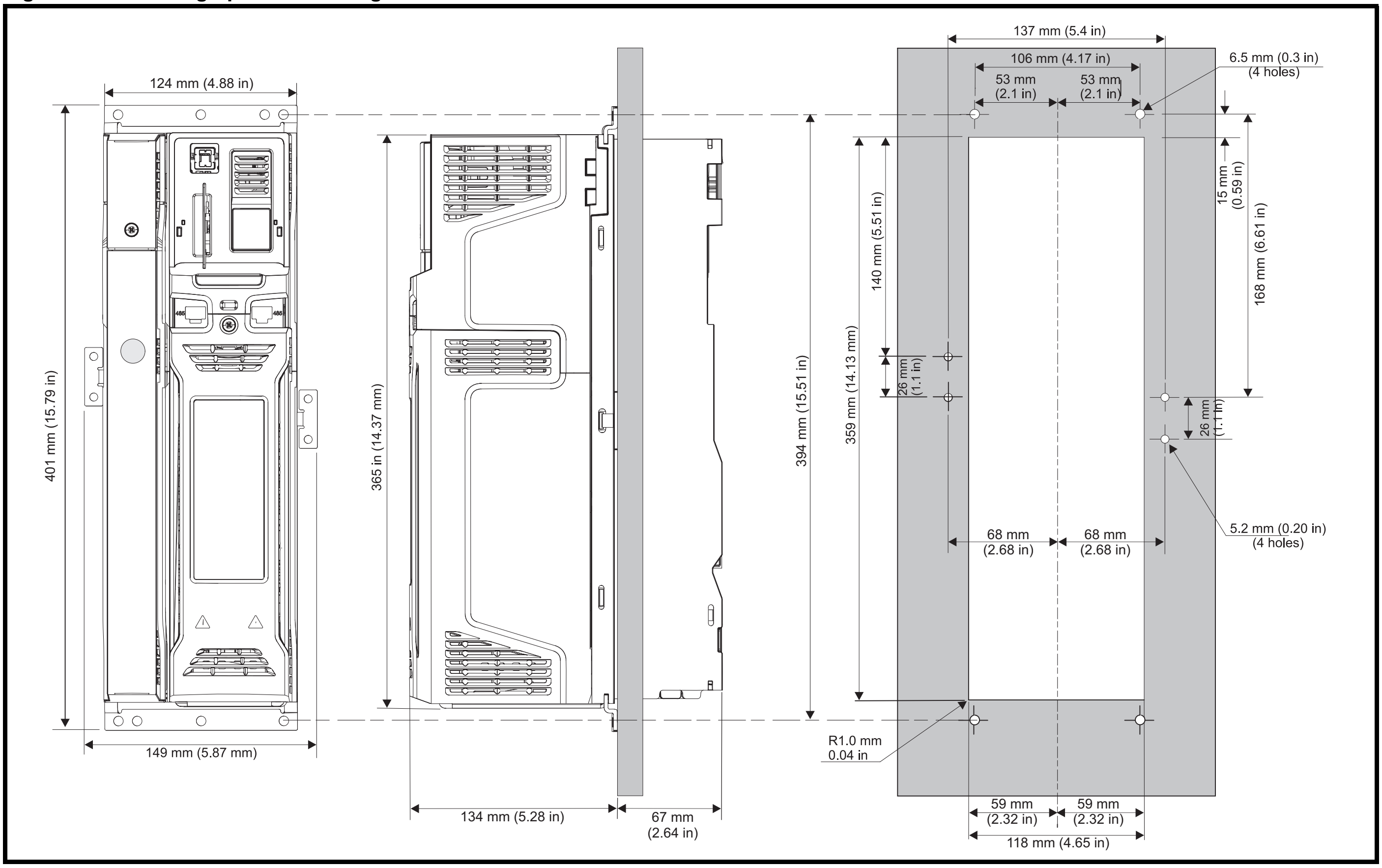


Figure 3-16 Through panel mounting the size 5 drive

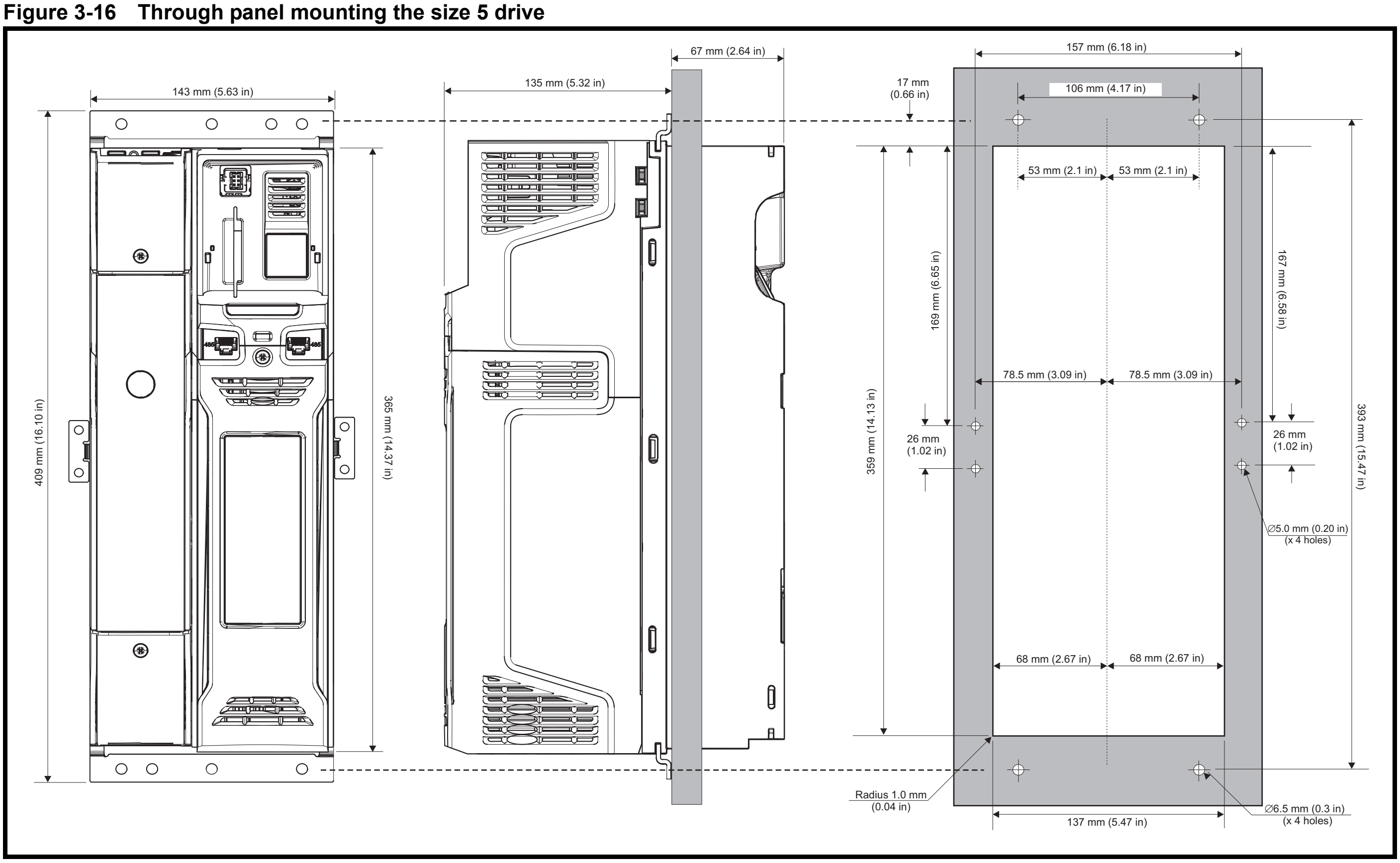
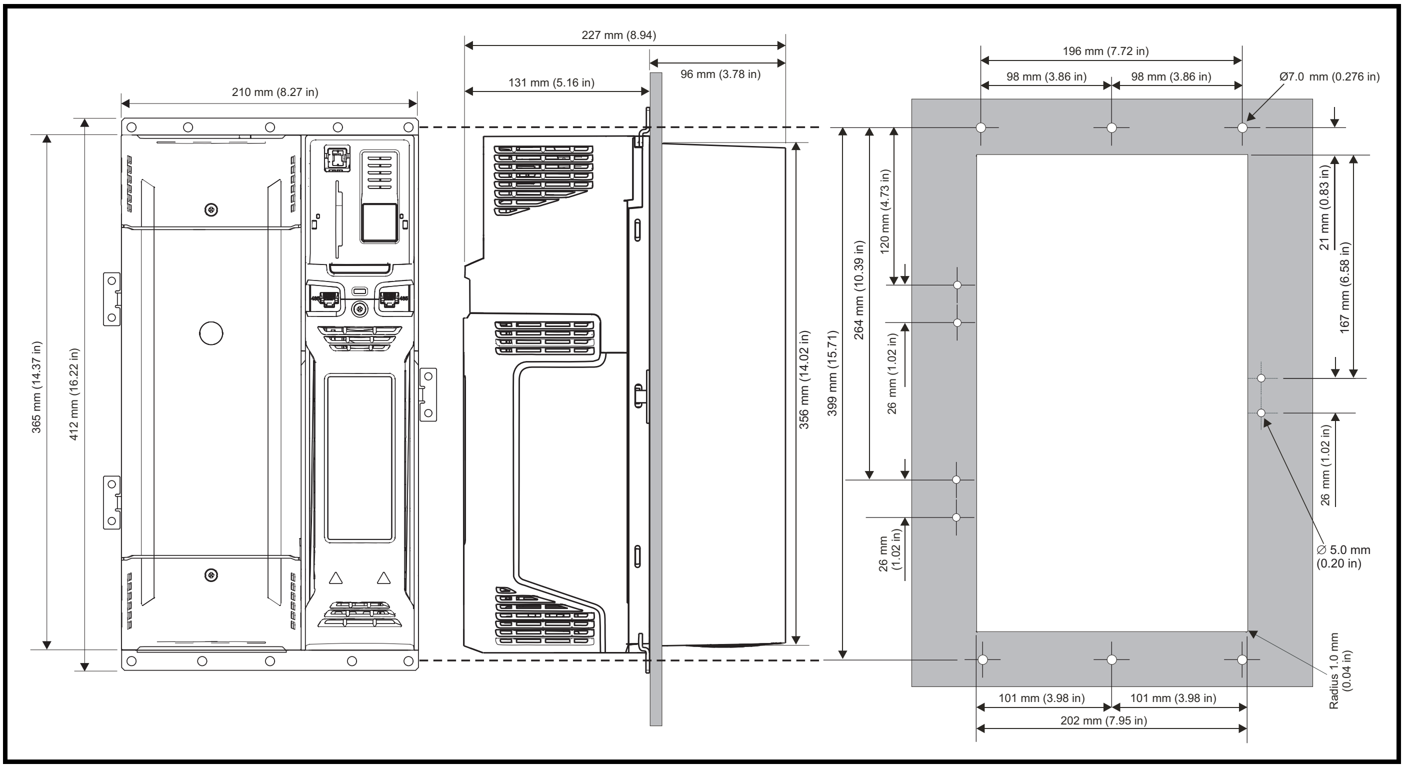


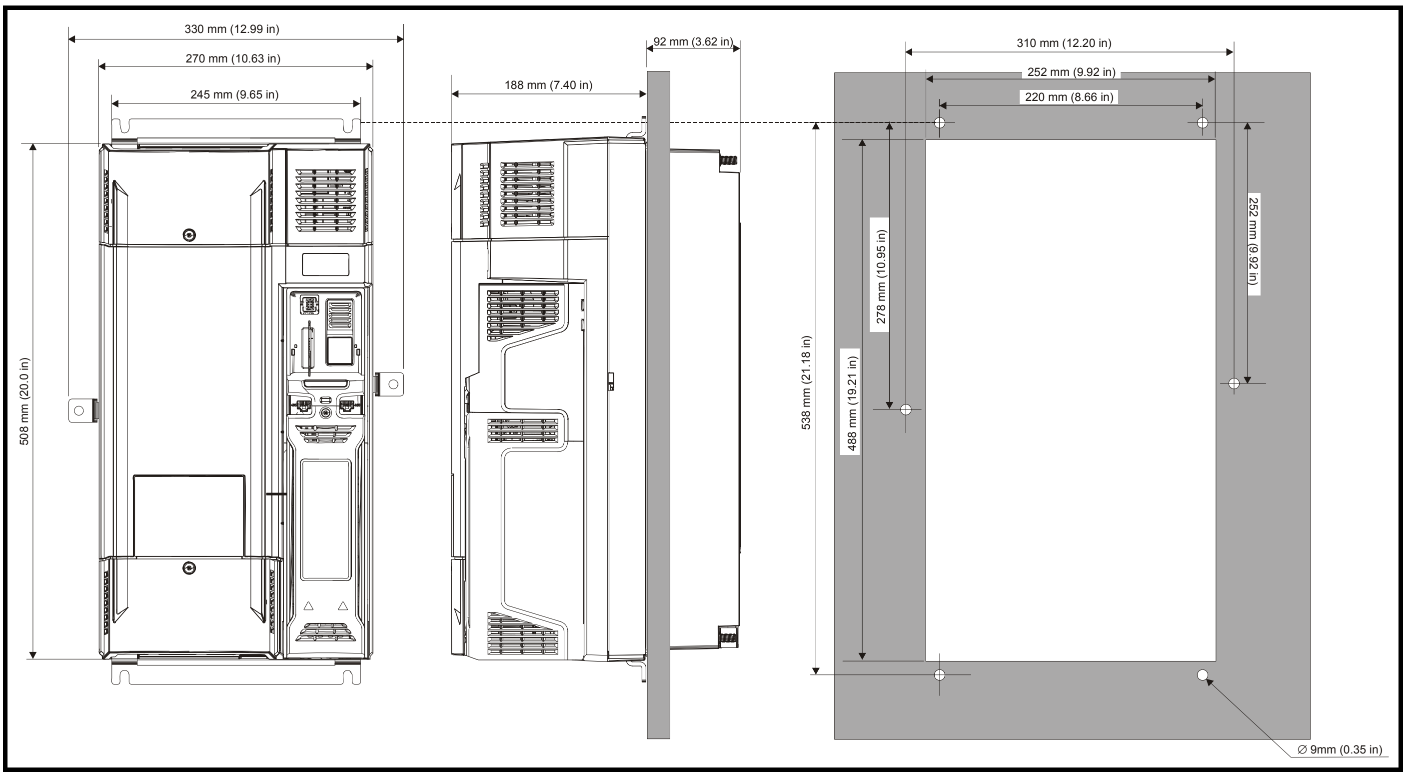
Figure 3-17 Through panel mounting the size 6 drive



NOTE

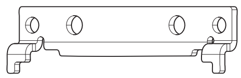
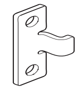
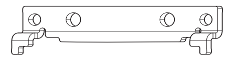
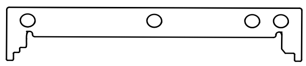
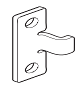
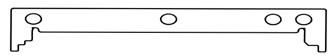
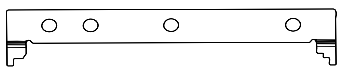
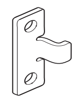
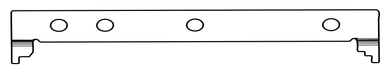
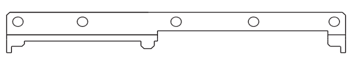
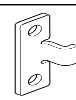
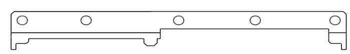
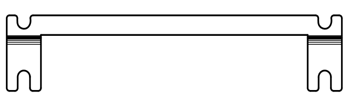
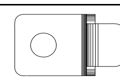
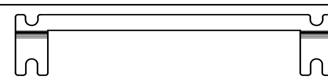
The outer holes plus the hole located in the center of the bracket are to be used for through panel mounting.

Figure 3-18 Through panel mounting the size 7 drive



3.5.3 Mounting brackets

Table 3-4 Mounting brackets size (3 to 7)

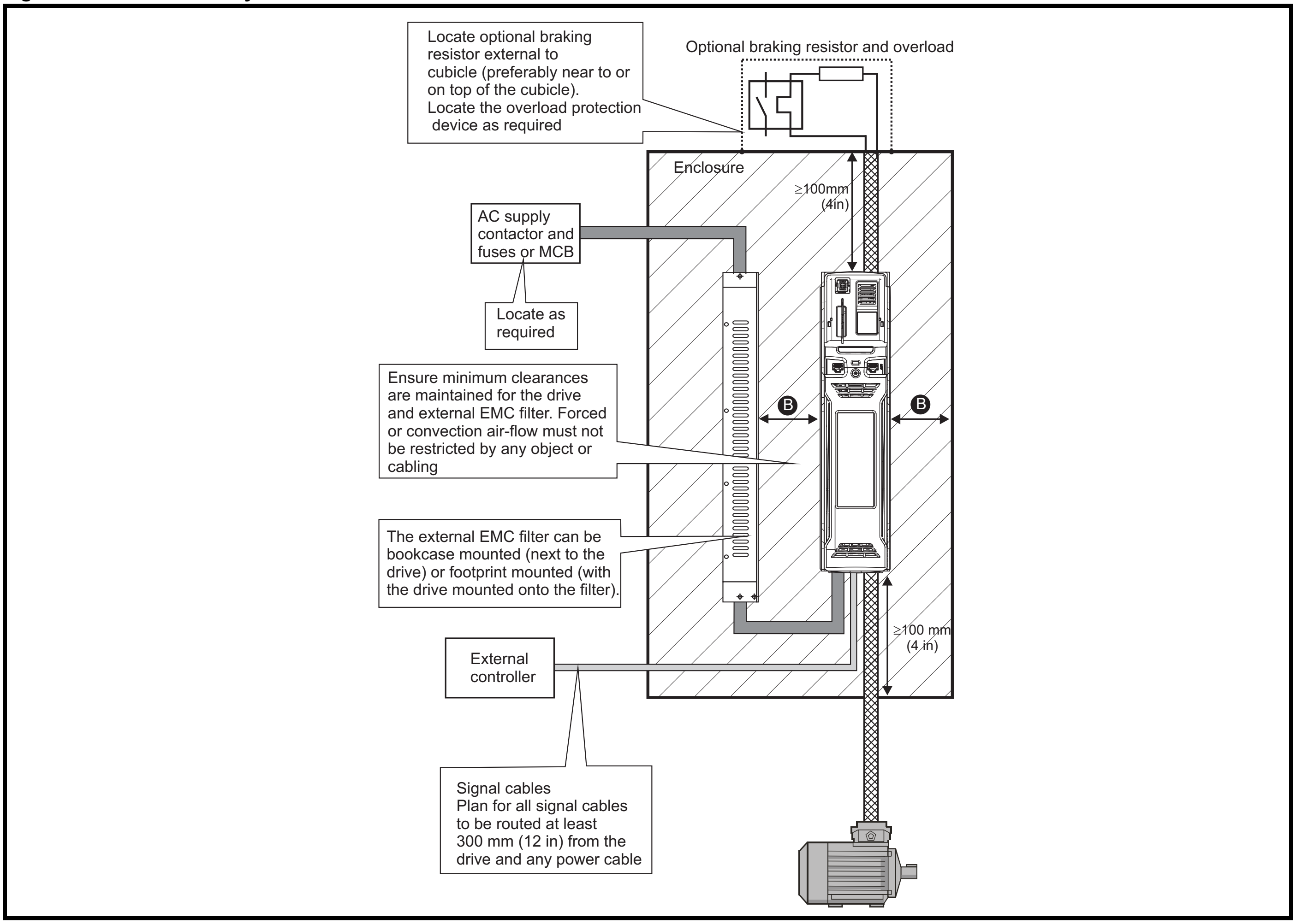
Size	Surface	Qty	Through-panel	Qty
3	 Inner hole size: 6.5 mm (0.26 in) Outer hole size: 5.5 mm (0.22 in)	**x 2**	 Hole size: 5.5 mm (0.22 in)	**x 2**
			 Inner hole size: 6.5 mm (0.26 in) Outer hole size: 5.5 mm (0.22 in)	**x 2**
4	 Hole size: 6.5 mm (0.26 in)	**x 2**	 Hole size: 5.2 mm (0.21 in)	**x 3**
			 Hole size: 6.5 mm (0.26 in)	**x 2**
5	 Hole size: 6.5 mm (0.26 in)	**x 2**	 Hole size: 5.2 mm (0.21 in)	**x 2**
			 Hole size: 6.5 mm (0.26 in)	**x 2**
6	 Hole size: 6.5 mm (0.26 in)	**x 2**	 Hole size: 5.2 mm 0.21 in)	**x 3**
			 Hole size: 6.5 mm (0.26 in)	**x 2**
7	 Hole size: 9 mm (0.35 in)	**x 2**	 Hole size: 9 mm (0.35 in)	**x 2**
			 Hole size: 9 mm (0.35 in)	**x 2**

3.6 Enclosure for Elevator drive

3.6.1 Enclosure layout

Please observe the clearances in the diagram below taking into account any appropriate notes for other devices / auxiliary equipment when planning the installation.

Figure 3-19 Enclosure layout



NOTE

For EMC compliance:

1. When using an external EMC filter, one filter is required for each drive.
2. Power cabling must be at least 100 mm (4 in) from the drive in all directions

Table 3-5 Spacing required between drive / enclosure and drive / EMC filter

Drive Size	Spacing (B)
3	0 mm (0.00 in)
4	30 mm (1.18 in)
5	
6	
7	

NOTE

Drive sizes 3 to 5 can be tile mounted where limited mounting space is available. The tile mounting kit is not supplied with the drive, it can be purchased separately.

3.7 Heatsink fan operation

The drive is ventilated by an internal heatsink mounted fan. The fan housing forms a baffle plate, channelling the air through the heatsink chamber. Thus, regardless of mounting method (surface mounting or through-panel mounting), the installing of additional baffle plates is not required.

Ensure the minimum clearances around the drive are maintained to allow air to flow freely. The heatsink fan on all sizes is a variable speed fan. The drive controls the speed at which the fan runs based on the temperature of the heatsink and the drive's thermal model system. The maximum speed at which the fan operates can be limited in *Fan maximum Speed* (**H18**). This could incur an output current derating. Refer to section 3.11.2 *Fan removal procedure* on page 57 for information on fan removal. The size 6 and 7 is also installed with a variable speed fan to ventilate the capacitor bank.

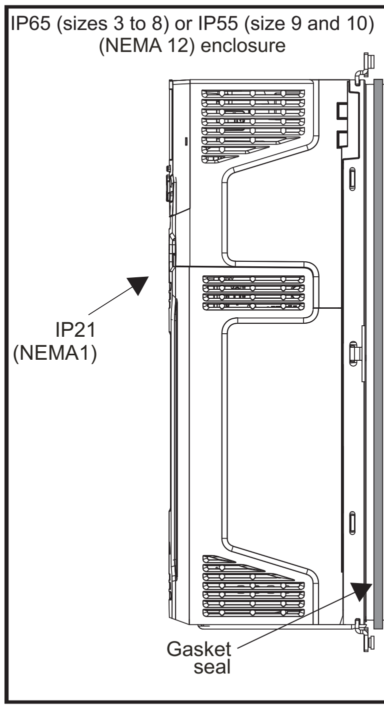
3.8 Enclosing standard drive for high environmental protection

An explanation of environmental protection rating is provided in section 12.1.9 *IP / UL Rating* .

The standard drive is rated to IP20 pollution degree 2 (dry, non-conductive contamination only) (NEMA 1). However, it is possible to configure the drive to achieve IP65 rating (sizes 3 to 7) (NEMA 12) at the rear of the heatsink for through-panel mounting (some current derating is required). Refer to Table 2-5 on page 15.

This allows the front of the drive, along with various switchgear, to be housed in a high IP enclosure with the heatsink protruding through the panel to the external environment. Thus, the majority of the heat generated by the drive is dissipated outside the enclosure maintaining a reduced temperature inside the enclosure. This also relies on a good seal being made between the heatsink and the rear of the enclosure using the gaskets provided.

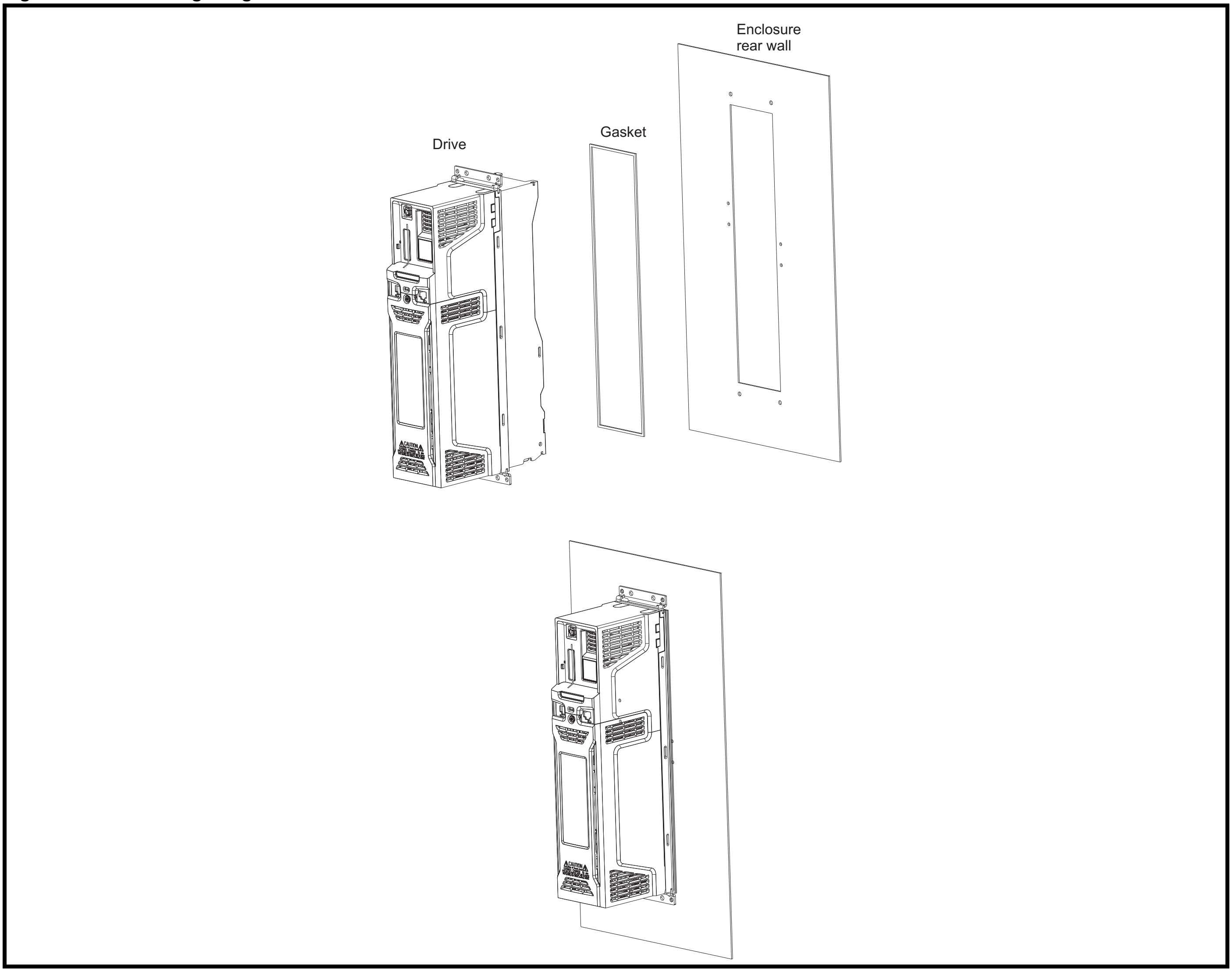
Figure 3-20 Example of IP65 (sizes 3 to 7) (NEMA 12) through-panel layout



The main gasket should be installed as shown in Figure 3-21.

On drive sizes 3, 4 and 5, in order to achieve the high IP rating at the rear of the heatsink it is necessary to seal a heatsink vent by installing the high IP insert as shown in Figure 3-23, Figure 3-24 and Figure 3-25.

Figure 3-21 Installing the gasket



To seal the space between the drive and the backplate, use two sealing brackets as shown in Figure 3-22.

Figure 3-22 Through panel mounting

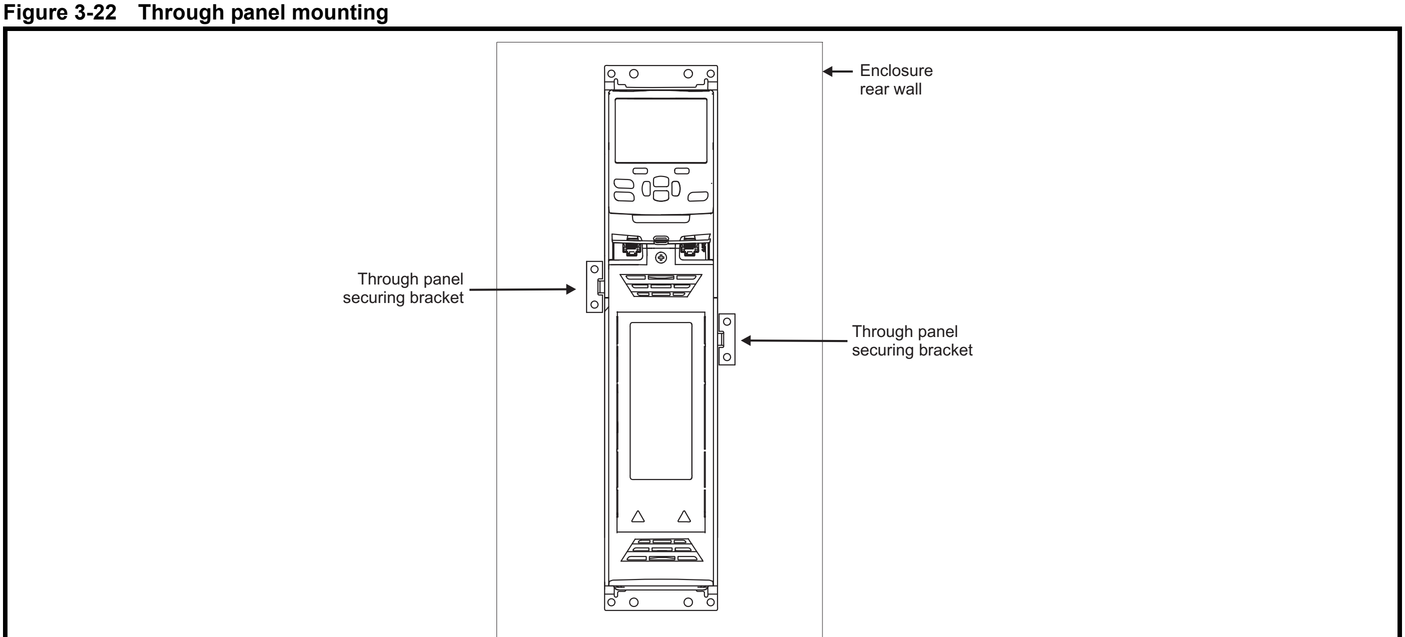
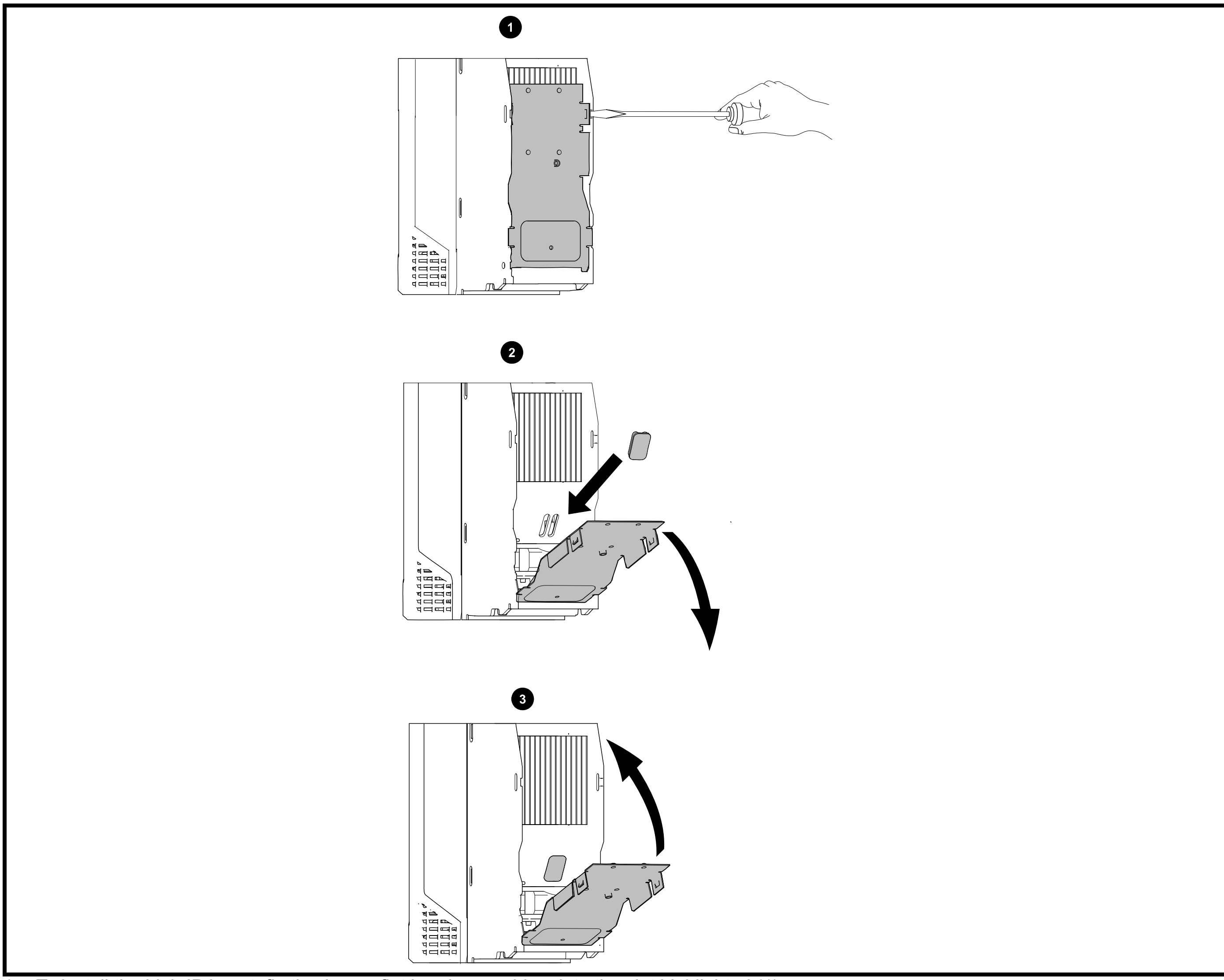


Figure 3-23 Installation of high IP insert for size 3

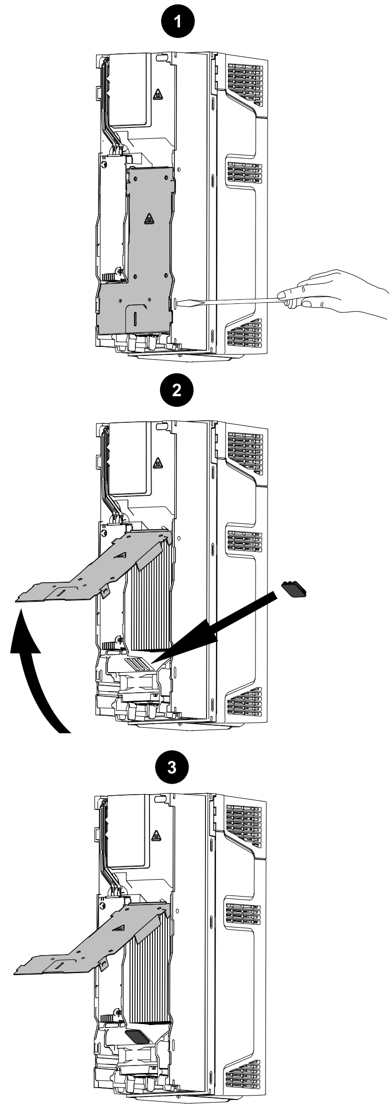


1. To install the high IP insert, firstly place a flat head screwdriver into the slot highlighted (1).
2. Pull the hinged baffle down to expose the ventilation hole, install the high IP insert into the ventilation hole in the heatsink (2). Ensure the high IP insert is securely installed by firmly pressing it into place (3).
3. Close the hinged baffle as shown (1).

To remove the high IP insert, reverse the above instructions.

The guidelines in Table 3-6 should be followed.

Figure 3-24 Installation of high IP insert for size 4

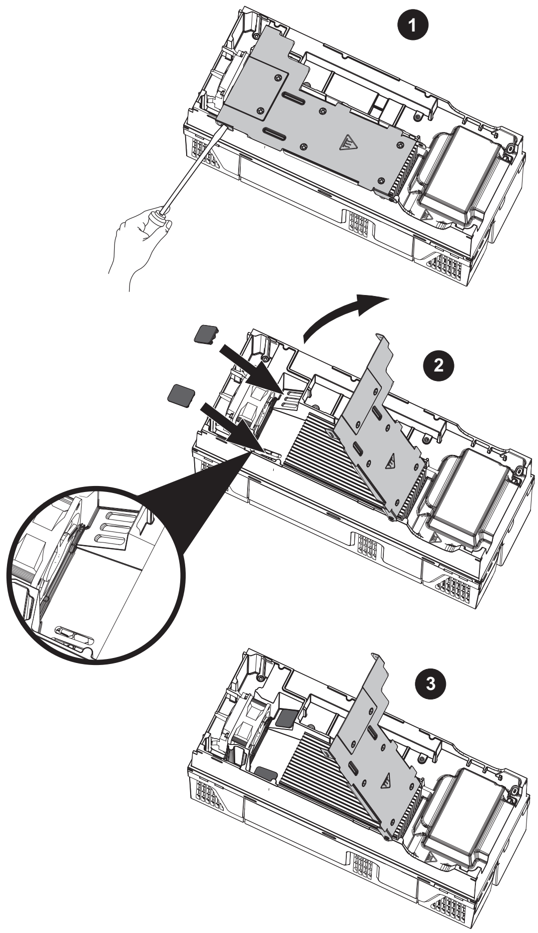


1. To install the high IP insert, firstly place a flat head screwdriver into the slot highlighted (1).
2. Pull the hinged baffle up to expose the ventilation hole, install the high IP insert into the ventilation hole in the heatsink (2).
3. Ensure the high IP insert is securely installed by firmly pressing it into place (3).
4. Close the hinged baffle as shown (1).

To remove the high IP insert, reverse the above instructions.

The guidelines in Table 3-6 should be followed.

Figure 3-25 Installation of high IP insert for size 5



1. To install the high IP insert, firstly place a flat head screwdriver into the slot highlighted (1).
2. Pull the hinged baffle up to expose the ventilation holes, install the high IP inserts into the ventilation holes in the heatsink (2).
3. Ensure the high IP inserts are securely installed by firmly pressing them into place (3).
4. Close the hinged baffle as shown (1).

To remove the high IP insert, reverse the above instructions.

The guidelines in Table 3-6 should be followed.

Table 3-6 Environment considerations

Environment	High IP insert	Comments
Clean	Not installed	
Dry, dusty (non-conductive)	Installed	Regular cleaning recommended
Dry, dusty (conductive)	Installed	
IP65 compliance	Installed	

NOTE

A current derating must be applied to the drive if the high IP insert is installed. Derating information is provided in section 2.4.2 *Power and current ratings (derating for switching frequency and temperature)* on page 14.

Failure to do so may result in nuisance tripping.

NOTE

When designing an IP65 (NEMA 12) enclosure (Figure 3-20 *Example of IP65 (sizes 3 to 7) (NEMA 12) through-panel layout* on page 43), consideration should be made to the dissipation from the front of the drive.

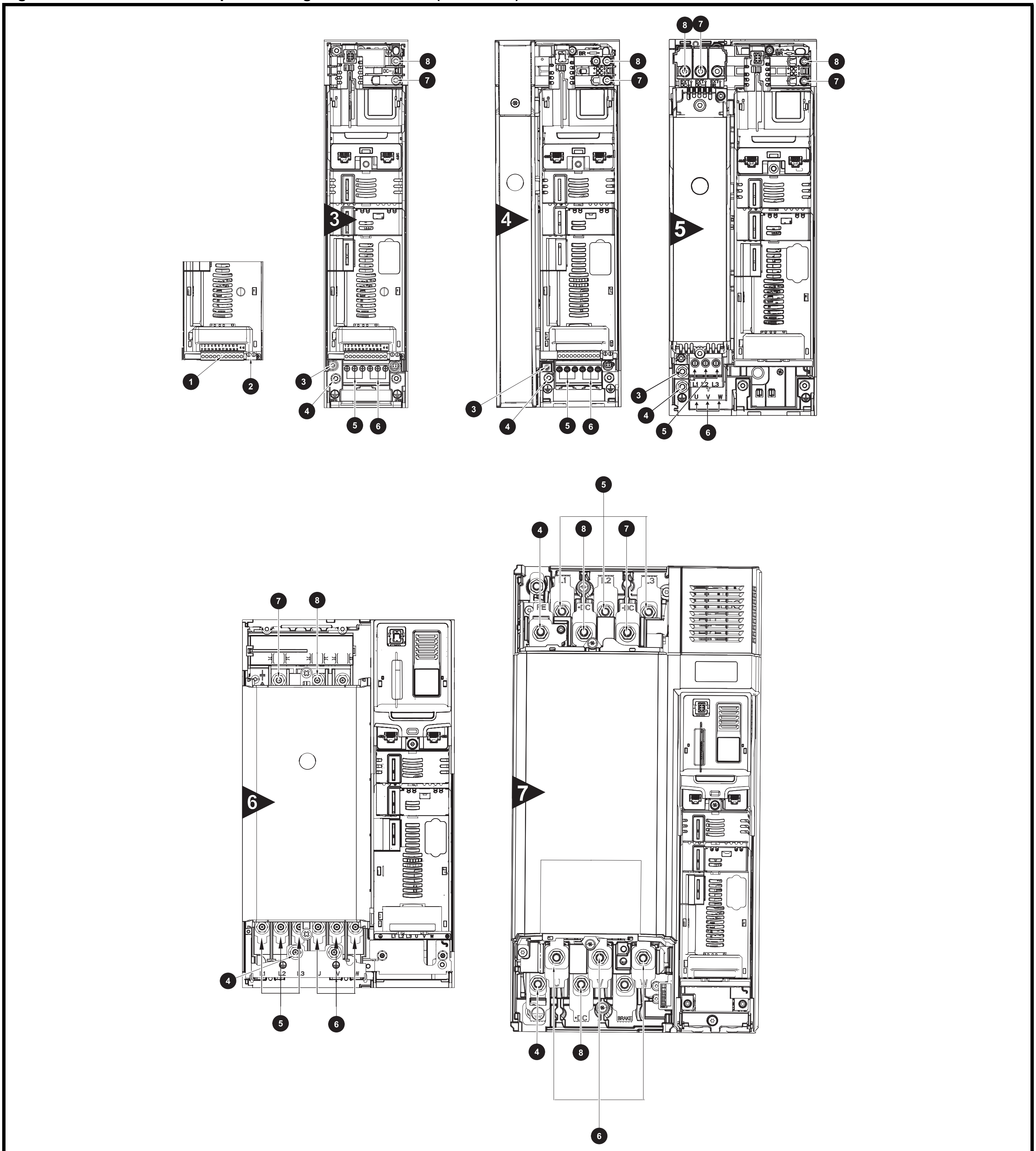
Table 3-7 Power losses from the front of the drive when through-panel mounted

Frame size	Power loss
3	≤ 50 W
4	≤ 75 W
5	≤ 100 W
6	≤ 100 W
7	≤ 204 W

3.9 Electrical terminals

3.9.1 Location of the power and ground terminals

Figure 3-26 Location of the power and ground terminals (size 3 to 7)



Key

1. Control terminals
2. Relay terminals
3. Additional ground connection
4. Ground connections
5. AC power terminals
6. Motor terminals
7. DC bus -
8. DC bus +
9. Brake terminal

3.9.2 Terminal sizes and torque settings

WARNING

To avoid a fire hazard and maintain validity of the UL listing, adhere to the specified tightening torques for the power and ground terminals. Refer to the following tables.

Table 3-8 Drive power terminal data

Model size	AC and motor terminals		DC and braking		Ground terminal	
	Recommended	Maximum	Recommended	Maximum	Recommended	Maximum
3 and 4	Plug-in terminal block		T20 Torx (M4)		T20 Torx (M4) / M4 Nut (7 mm AF)	
	0.7 N m (0.5 lb ft)	0.8 N m (0.6 lb ft)	2.0 N m (1.4 lb ft)	2.5 N m (1.8 lb ft)	2.0 N m (1.4 lb ft)	2.5 N m (1.8 lb ft)
5	Plug-in terminal block		T20 Torx (M4) / M4 Nut (7 mm AF)		M5 Nut (8 mm AF)	
	1.5 N m (1.1 lb ft)	1.8 N m (1.3 lb ft)	1.5 N m (1.1 lb ft)	2.5 N m (1.8 lb ft)	2.0 N m (1.4 lb ft)	5.0 N m (3.7 lb ft)
6	M6 Nut (10 mm AF)		M6 Nut (10 mm AF)		M6 Nut (10 mm AF)	
	6.0 N m (4.4 lb ft)	8.0 N m (6.0 lb ft)	6.0 N m (4.4 lb ft)	8.0 N m (6.0 lb ft)	6.0 N m (4.4 lb ft)	8.0 N m (6.0 lb ft)
7	M8 Nut (13 mm AF)		M8 Nut (13 mm AF)		M8 Nut (13 mm AF)	
	12 N m (8.8 lb ft)	14 N m (10.0 lb ft)	12 N m (8.8 lb ft)	14 N m (10.0 lb ft)	12 N m (8.8 lb ft)	14 N m (10.0 lb ft)

Table 3-9 Drive control and relay terminal data

Model	Connection type	Torque setting
All	Plug-in terminal block	0.5 N m (0.4 lb ft)

Table 3-10 Plug-in terminal block maximum cable sizes

Model size	Terminal block description	Max cable size
All	11 way control connectors	1.5 mm^2 (16 AWG)
	2 way relay connector	2.5 mm^2 (12 AWG)
3	6 way AC power connector	6 mm^2 (10 AWG)
4		
5	3 way AC power connector 3 way motor connector	8 mm^2 (8 AWG)
6	2 way low voltage power 24 V supply connector	1.5 mm^2 (16 AWG)
7		

3.10 EMC filters

WARNING

If the drive is used with ungrounded (IT) supplies, the internal EMC filter must be removed unless additional motor ground fault protection is installed.

WARNING

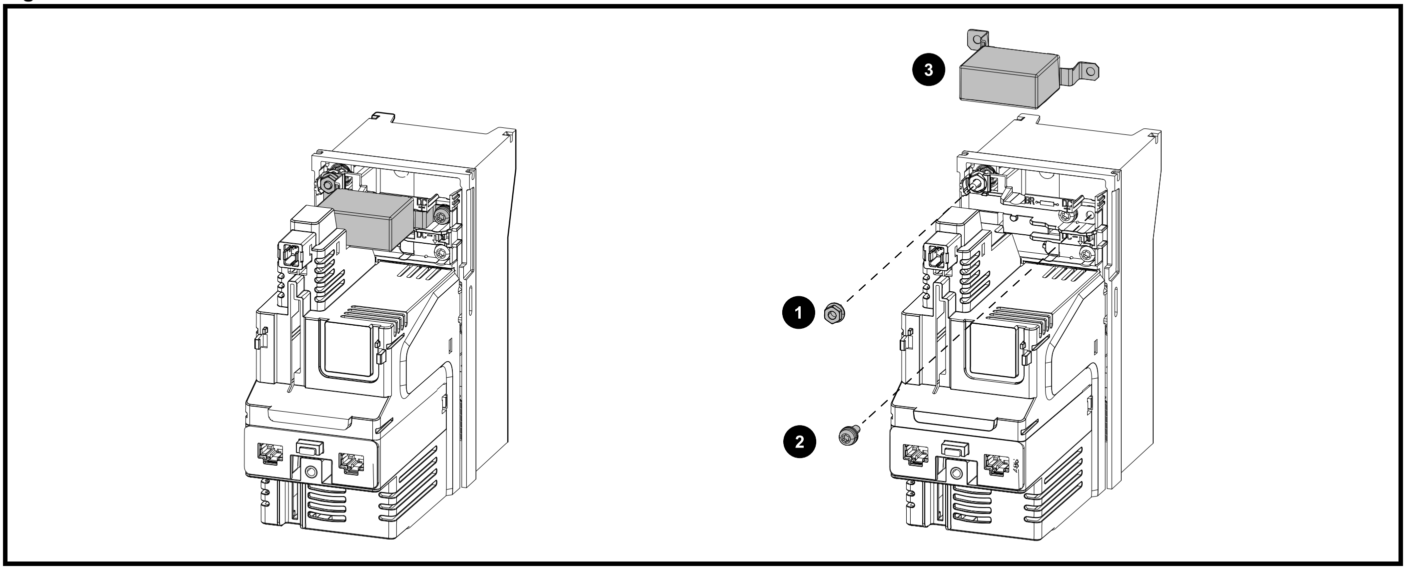
The power supply must be removed prior to removing the internal EMC filter.

3.10.1 Internal EMC filter

It is recommended that the internal EMC filter be kept in place unless there is a specific reason for removing it. If the drive is part of a Regenerative system or it is connected to an IT supply then the internal EMC filter must be removed.

The internal EMC filter reduces radio-frequency emission into the line power supply. Where the motor cable is short, it permits the requirements of EN 61800-3:2004 to be met for the second environment. With regard to motor cables, the filter provides useful reduction in emission levels with any length of shielded motor cable up to the limit for the drive. It is unlikely that nearby industrial equipment will be disturbed. It is recommended that the filter be useful used in all applications unless the instructions given above require it to be removed or the ground leakage current of the drive is unacceptable.

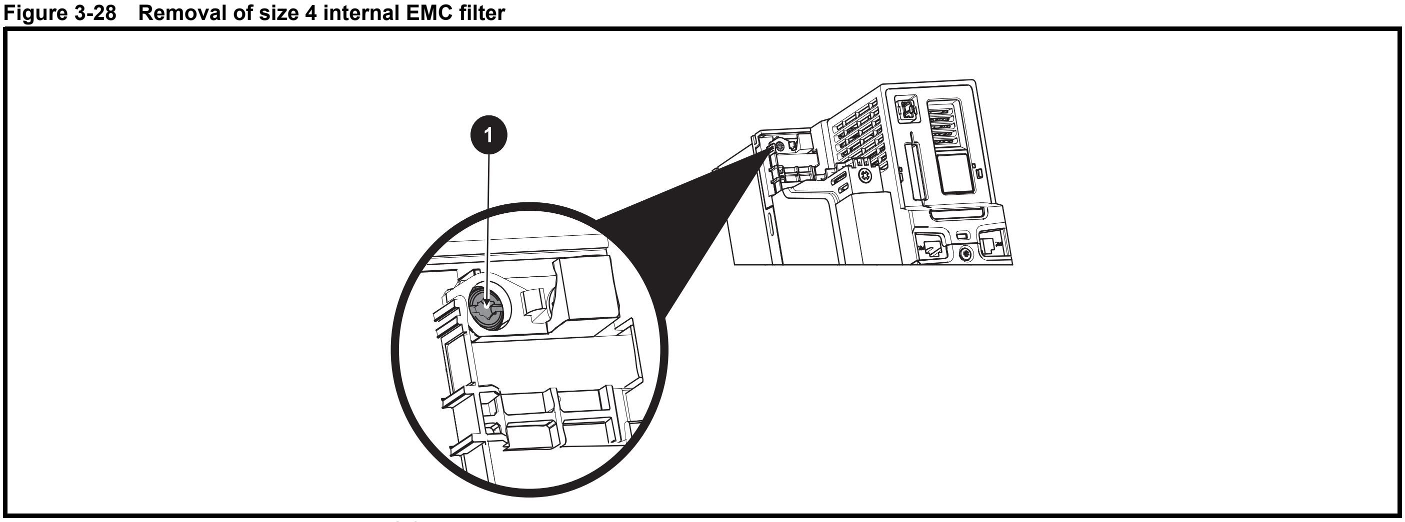
Figure 3-27 Removal of size 3 internal EMC filter



Loosen / remove the screw and nut as shown (1) and (2).

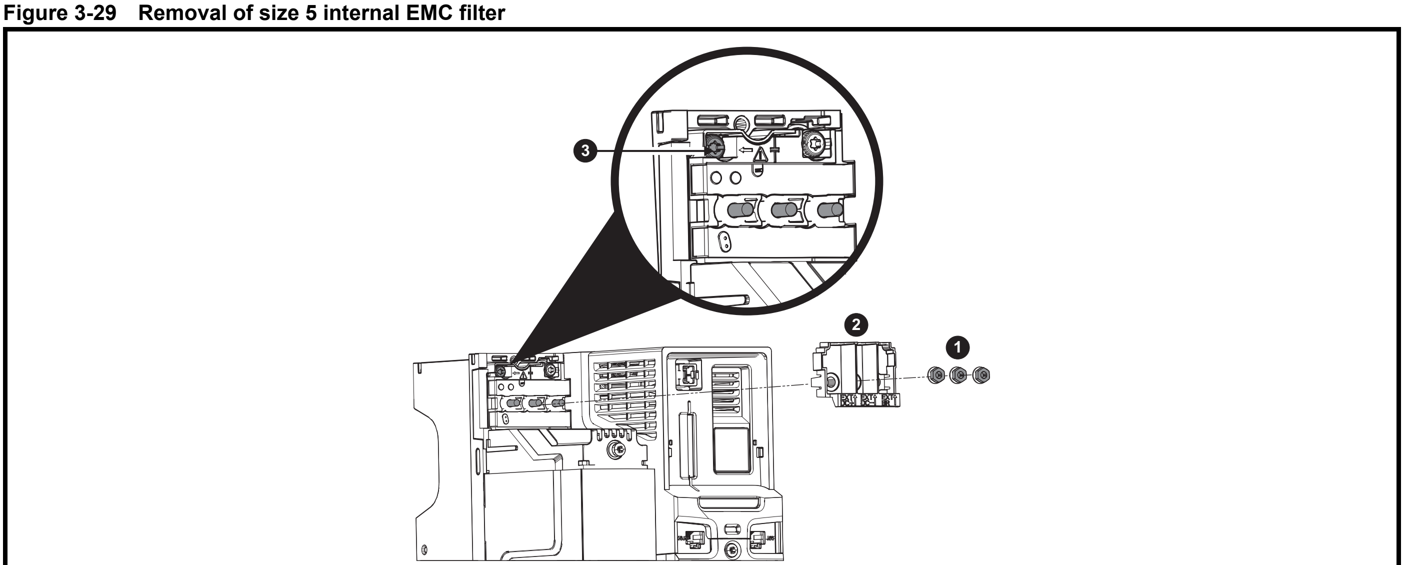
Lift away from securing points and then rotate away from the drive. Ensure the screw and nut are replaced and re-tightened with a maximum torque of 2 N m (1.47 lb ft).

Figure 3-28 Removal of size 4 internal EMC filter



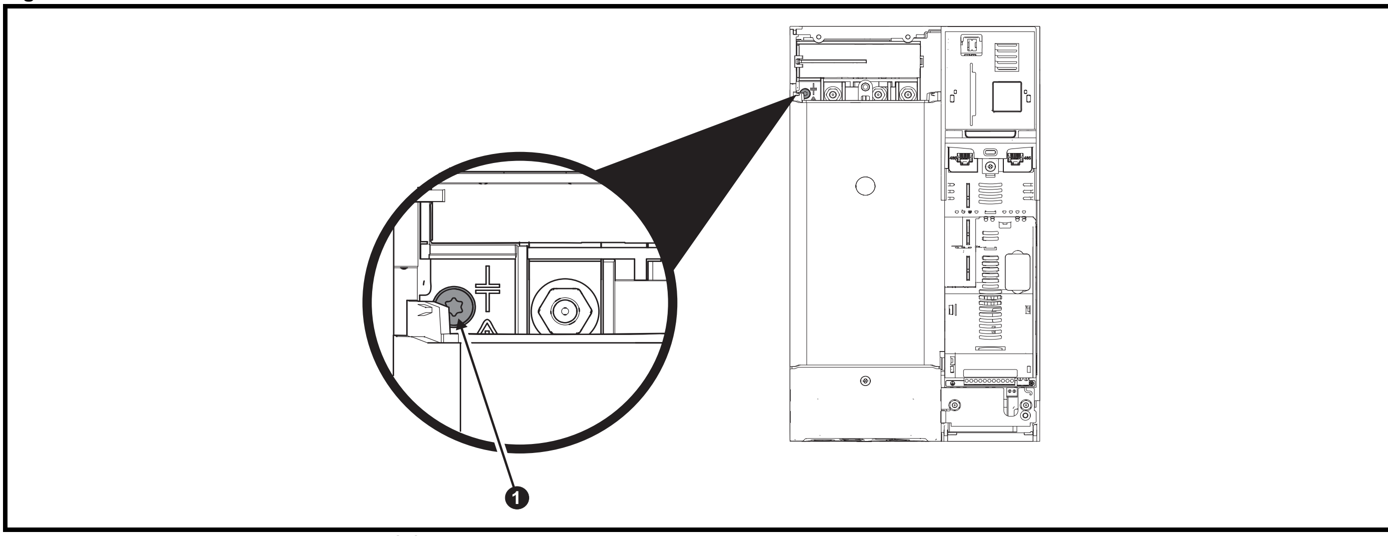
To electrically disconnect the Internal EMC filter, remove the screw (1) as highlighted above.

Figure 3-29 Removal of size 5 internal EMC filter



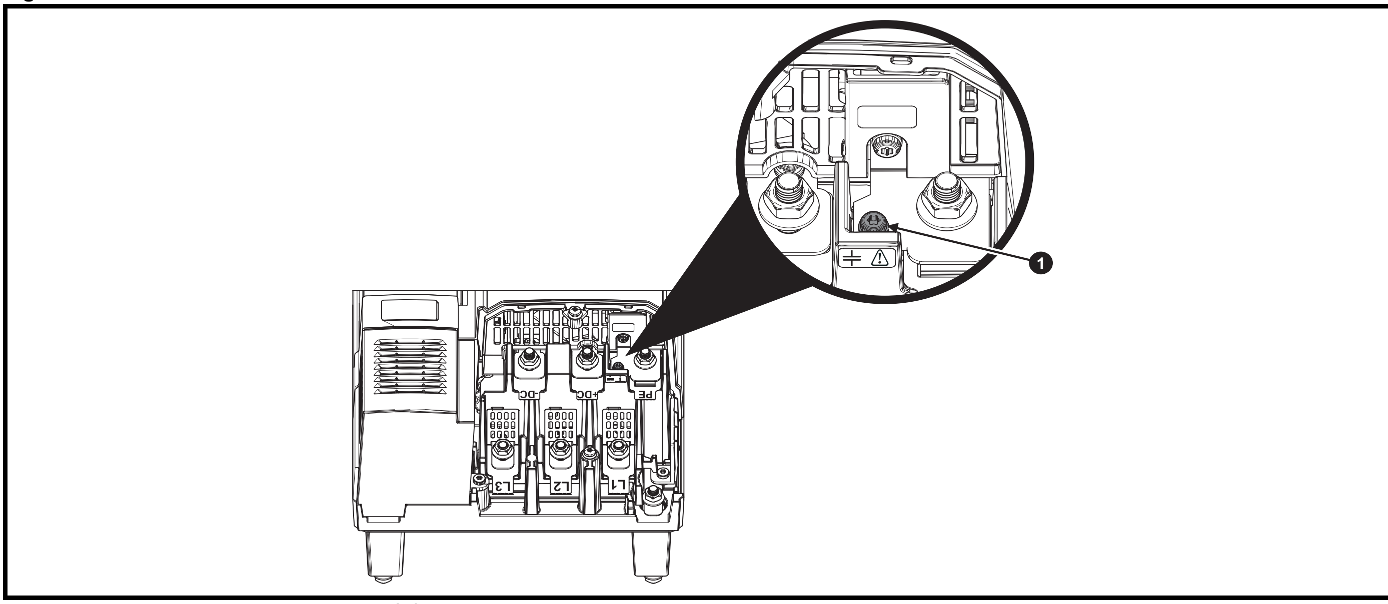
Remove the three M4 terminal nuts (1). Lift away the cover (2) to expose the M4 Torx internal EMC filter removal screw. Finally remove the M4 Torx internal EMC filter removal screw (3) to electrically disconnect the internal EMC filter.

Figure 3-30 Removal of size 6 internal EMC filter



To electrically disconnect the Internal EMC filter, remove the screw (1) as highlighted above.

Figure 3-31 Removal of the size 7 internal EMC filter



To electrically disconnect the Internal EMC filter, remove the screw (1) as highlighted above.

3.10.2 Standard external EMC filter details

The external EMC filter details for each drive rating are provided in the table below.

Table 3-11 Standard external EMC filter data

Model	CT part number	Weight	
		kg	lb
200 V			
03200050 to 03200106	4200-3230	1.9	4.20
04200137 to 04200185	4200-0272	4.0	8.82
05200250	4200-0312	5.5	12.13
06200330 to 06200440	4200-2300	6.5	14.3
07200610 to 07200830	4200-1132	6.9	15.2
400 V			
03400025 to 03400100	4200-3480	2.0	4.40
04400150 to 04400172	4200-0252	4.1	9.04
05400270 to 05400300	4200-0402	5.5	12.13
06400350 to 06400470	4200-4800	6.7	14.8
07400660 to 07401000	4200-1132	6.9	15.2
575 V			
05500030 to 05500069	4200-0122	7.0	15.4
06500100 to 06500350	4200-3690	7.0	15.4
07500440 to 07500550	4200-0672		
690 V			
07600190 to 07600540	4200-0672		

The external EMC filters for sizes 3 to 6 can be footprint mounted or bookcase mounted as shown below. The external EMC filters for size 7 is designed to be mounted above the drive as shown below.

Figure 3-32
Footprint mounting the EMC filter

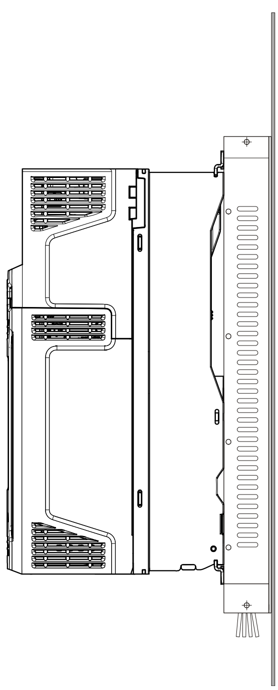


Figure 3-33
Bookcase mounting the EMC filter

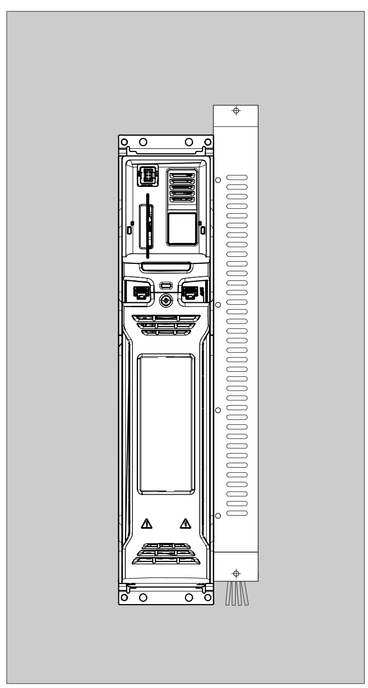


Figure 3-34
Size 7 to 10 mounting of the EMC filter

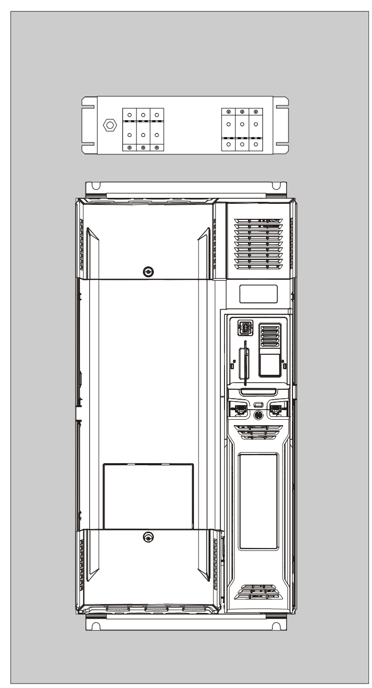
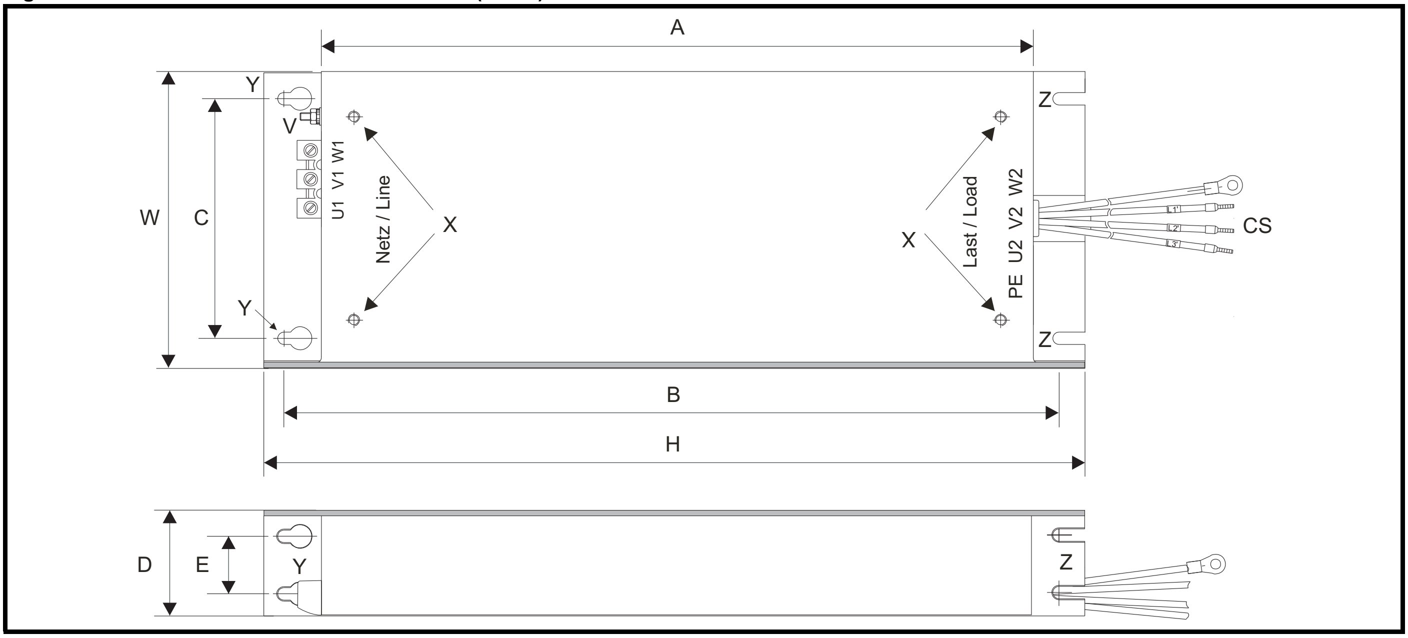


Figure 3-35 Standard external EMC filter size (3 to 6)



V: Ground stud
X: Threaded holes for footprint mounting of the drive
Y: Footprint mounting hole diameter
Z: Bookcase mounting slot diameter.
CS: Cable size

Table 3-12 Size 3 EMC filter dimensions

CT part number	A	B	C	D	E	H	W	V	X	Y	Z	CS
4200-3230	384 mm (15.12 in)	414 mm (16.30 in)	56 mm (2.21 in)	41 mm (1.61 in)		426 mm (16.77 in)	83 mm (3.27 in)	M5	M5	5.5 mm (0.22 in)	5.5 mm (0.22 in)	2.5 mm^2 (14 AWG)
4200-3480												

Table 3-13 Size 4 EMC filter dimensions

CT part number	A	B	C	D	E	H	W	V	X	Y	Z	CS
4200-0272	395 mm (15.55 in)	425 mm (16.73 in)	100 mm (3.94 in)	60 mm (2.36 in)	33 mm (1.30 in)	437 mm (17.2 in)	123 mm (4.84 in)	M6	M6	6.5 mm (0.26 in)	6.5 mm (0.26 in)	6 mm^2 (10 AWG)
4200-0252												

Table 3-14 Size 5 EMC filter dimensions

CT part number	A	B	C	D	E	H	W	V	X	Y	Z	CS
4200-0312	395 mm (15.55 in)	425 mm (16.73 in)	106 mm (4.17 in)	60 mm (2.36 in)	33 mm (1.30 in)	437 mm (17.2 in)	143 mm (5.63 in)	M6	M6	6.5 mm (0.26 in)	6.5 mm (0.26 in)	10 mm^2 (8 AWG)
4200-0402												
4200-0122												2.5 mm^2 (14 AWG)

Table 3-15 Size 6 EMC filter dimensions

CT part number	A	B	C	D	E	H	W	V	X	Y	Z	CS
4200-2300	392 mm (15.43 in)	420 mm (16.54 in)	180 mm (7.09 in)	60 mm (2.36 in)	33 mm (1.30 in)	434 mm (17.09 in)	210 mm (8.27 in)	M6	M6	6.5 mm (0.26 in)	6.5 mm (0.26 in)	16 mm^2 (6 AWG)
4200-4800												
4200-3690												

Figure 3-36 Standard external EMC filter (size 7)

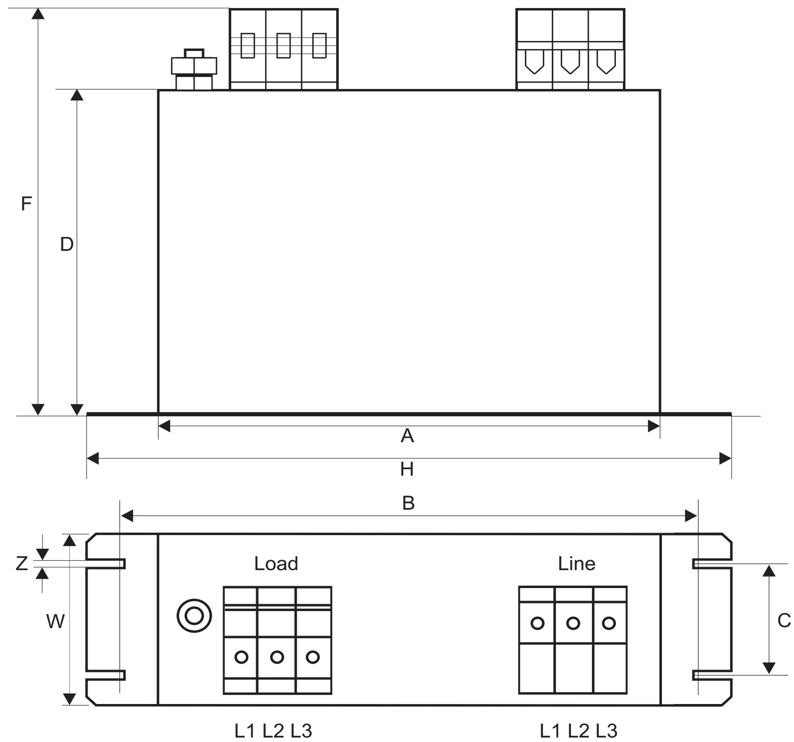


Table 3-16 Size 7 EMC filter dimensions

CT part number	A	B	C	D	E	F	H	W	V	X	Y	Z
4200-1132 4200-0672	240 mm (9.45 in)	255 mm (10.04 in)	55 mm (2.17 in)	150 mm (5.90 in)		205 mm (8.07 in)	270 mm (10.63 in)	90 mm (3.54 in)	M10			6.5 mm (0.26 in)

Table 3-17 Standard external EMC filter torque settings

CT part number	Power connections		Ground connections	
	Max cable size	Max torque	Ground stud size	Max torque
4200-0122	16 mm^2 (6 AWG)	2.3 N m (1.7 lb ft)	M6	4.8 N m (2.8 lb ft)
4200-0252		1.8 N m (1.3 lb ft)		
4200-0272				
4200-0312				
4200-0402				
4200-3230	4 mm^2 (12 AWG)	0.8 N m (0.59 lb ft)	M5	3.0 N m (2.2 lb ft)
4200-3480				
4200-2300	16 mm^2 (6 AWG)	2.3 N m (1.7 lb ft)	M6	4.8 N m (2.8 lb ft)
4200-4800				
4200-3690				
4200-0122				
4200-1072	50 mm^2 (1/0 AWG)	8.0 N m (5.9 lb ft)	M10	22 N m (16.2 lb ft)
4200-1132				
4200-0672				

3.10.3 Compact external EMC filter data

The external Compact EMC filter for size 3, 4 and 5, drives can be bookcase mounted. The details for each of the Compact EMC filters is provided below.

Table 3-18 Compact external EMC filter data

Model	CT part number	Weight	
		kg	lb
400 V			
03400025 to 03400100	4200-6126	0.4	0.88
	4200-6219	0.6	1.32
04400150 to 04400172	4200-6220	0.7	1.54
05400270 to 05400300	4200-6221-01	1.7	3.75

The external Compact EMC filters for sizes 3, 4 and 5 can be bookcase mounted as shown following to provide a compact solution.

Figure 3-37 Bookcase mounting the Compact external EMC filter (size 3 to 5)

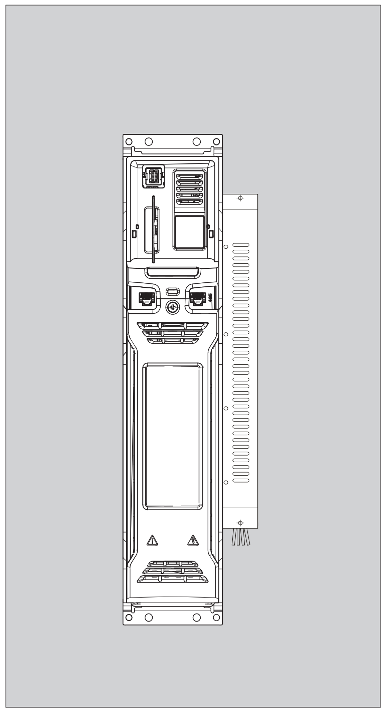


Figure 3-38 Compact external EMC filter (size 3, 4 and 5 400 V)

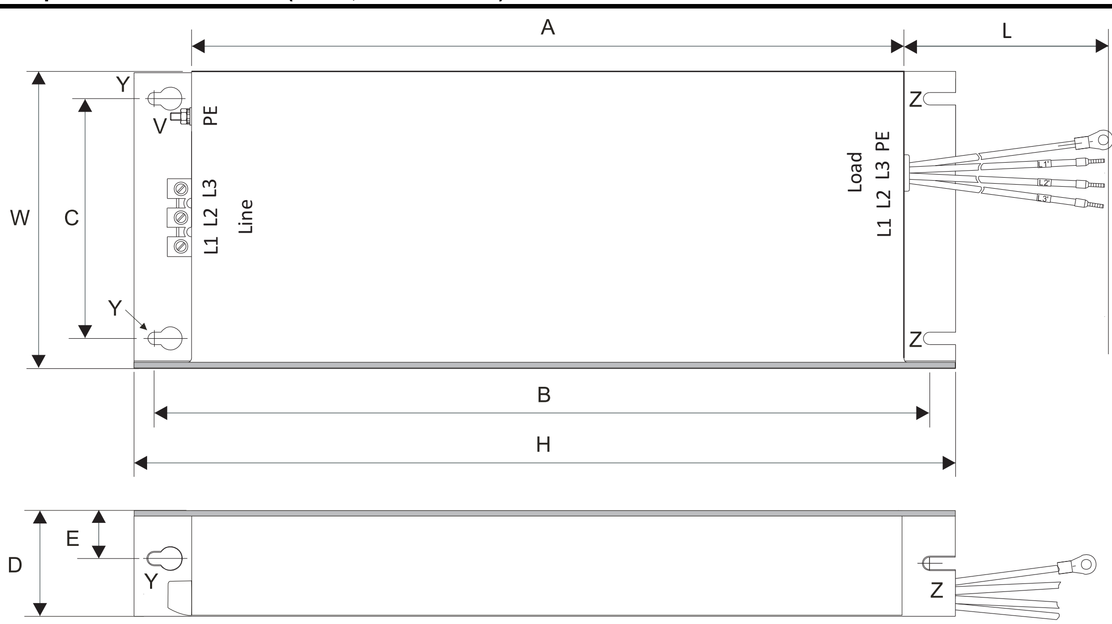


Table 3-19 Compact external EMC filter overall dimensions

CT part number	A	B	C	D	E	H	W	V	Y	Z	L
4200-6126	145 mm (5.07 in)	175 mm (6.89 in)	70 mm (2.75 in)	30 mm (1.81 in)	15 mm (0.59 in)	205 mm (8.07 in)	101 mm (3.98 in)	M5	5.5 mm (0.22 in)	5.5 mm (0.22 in)	350 mm ± 5 mm
4200-6219				41 mm (1.61 in)	20 mm (0.79 in)						
4200-6220											
4200-6221-01	180 mm (7.08 in)	210 mm (8.27 in)	130 mm (5.12 in)	60 mm (2.36 in)	30 mm (1.18 in)	240 mm (9.45 in)	161 mm (6.34 in)		6.5 mm (0.26 in)	6.5 mm (0.26 in)	

Table 3-20 Compact external EMC filter torque settings

CT part number	Power connections		Ground connections	
	Max cable size	Max torque	Ground stud size	Max torque
4200-6126	4 mm^2 (12 AWG)	0.8 N m (0.59 lb ft)	M5	3.0 N m (2.2 lb ft)
4200-6219				
4200-6220	10 mm^2 (8 AWG)	1.9 N m (1.4 lb ft)		
4200-6221-01				

3.11 Routine maintenance

The drive should be installed in a cool, clean, well ventilated location. Contact of moisture and dust with the drive should be prevented. Regular checks of the following should be carried out to ensure drive / installation reliability are maximized:

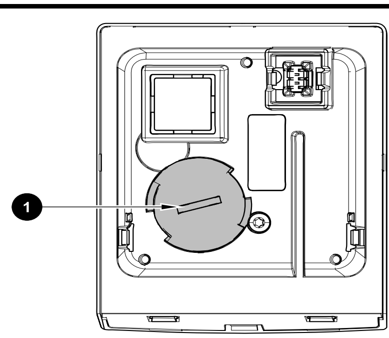
Environment	
Ambient temperature	Ensure the enclosure temperature remains at or below maximum specified.
Dust	Ensure the drive remains dust free – check that the heatsink and drive fan are not gathering dust. The lifetime of the fan is reduced in dusty environments.
Moisture	Ensure the drive enclosure shows no signs of condensation.
Enclosure	
Enclosure door filters	Ensure filters are not blocked and that air is free to flow.
Electrical	
Screw connections	Ensure all screw terminals remain tight.
Crimp terminals	Ensure all crimp terminals remains tight – check for any discoloration which could indicate overheating.
Cables	Check all cables for signs of damage.

3.11.1 Real time clock battery replacement

Those keypads which have the real time clock feature contain a battery to ensure the clock works when the drive is powered down. The battery has a long lifetime, but if the battery needs to be replaced or removed follow the instructions below.

Low battery voltage is indicated by low battery symbol on the keypad display.

Figure 3-39 KI-Elv Keypad RTC (rear view)



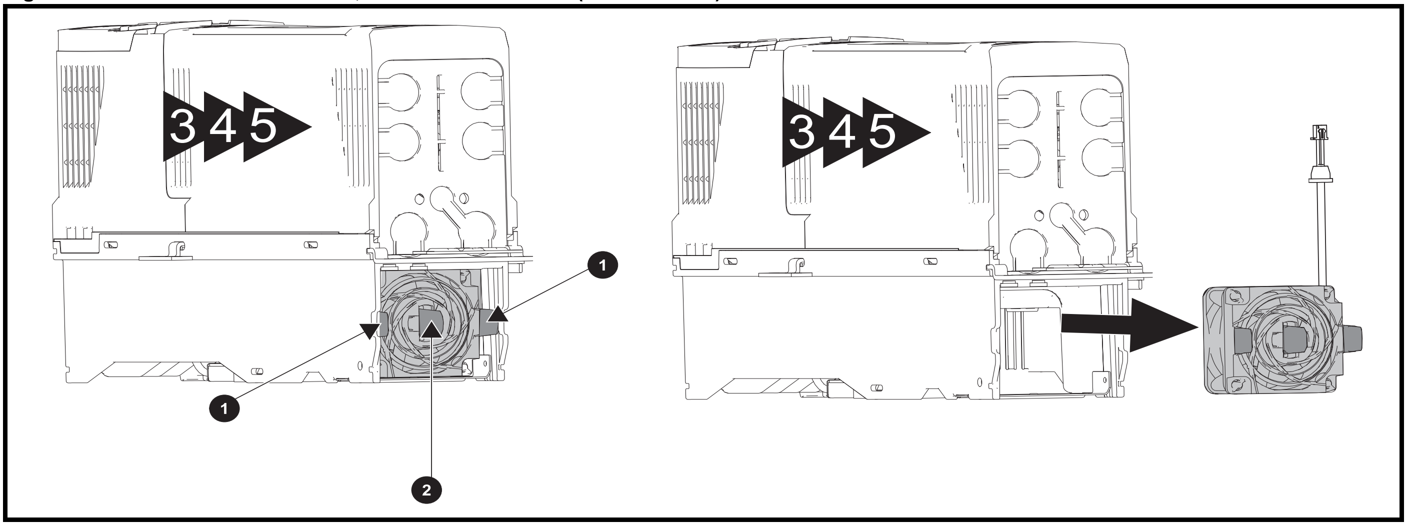
1. To remove the battery cover insert a flat head screwdriver into the slot as shown (1), push and turn anti-clockwise until the battery cover is released.
2. Replace the battery the battery type is: (CR2032).
3. Reverse point 1 above to replace battery cover.

NOTE

Ensure the battery is disposed of correctly.

3.11.2 Fan removal procedure

Figure 3-40 Removal of the size 3, 4 and 5 heatsink fan (size 3 shown)



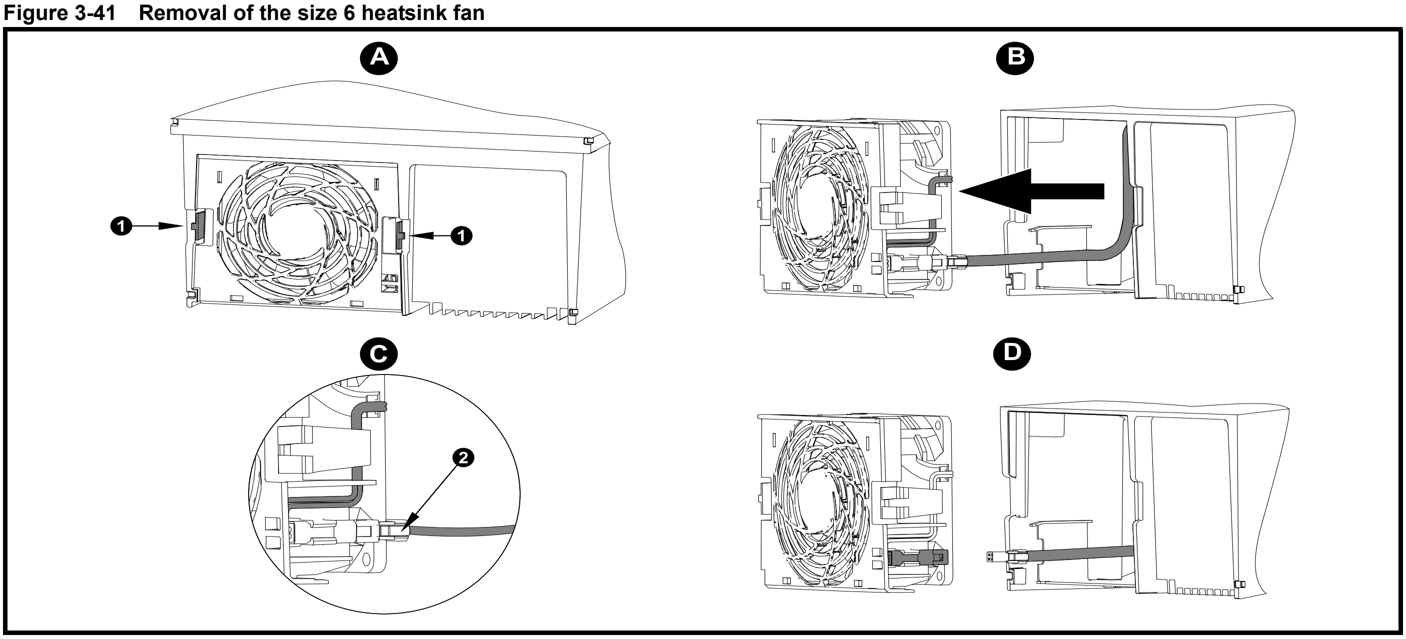
1. Ensure the fan cable is disconnected from the drive prior to attempting fan removal.
2. Press the two tabs (1) inwards to release the fan from the drive frame.
3. Using the central fan tab (2), withdraw the fan assembly from the drive housing.

Replace the fan by reversing the above instructions.

NOTE

If the drive is surface mounted using the outer holes on the mounting bracket, then the heatsink fan can be replaced without removing the drive from the backplate.

Figure 3-41 Removal of the size 6 heatsink fan



A: Press the tabs (1) inwards to release the fan assembly from the underside of the drive.

B: Use the tabs (1) to withdraw the fan by pulling it away from the drive.

C: Depress and hold the locking release on the fan cable lead as shown (2).

D: With the locking release depressed (2), take hold of the fan supply cable and carefully pull to separate the connectors.

4 Electrical installation

Many cable management features have been incorporated into the product and accessories, this chapter shows how to optimize them. Key features include:

- Safe Torque Off (STO) function
- Internal EMC filter
- EMC compliance with shielding / grounding accessories
- Product rating, fusing and cabling information
- Brake resistor details (ratings)

WARNING

Electric shock risk
The voltages present in the following locations can cause severe electric shock and may be lethal:
- AC supply cables and connections
- DC and brake cables, and connections
- Output cables and connections
- Many internal parts of the drive, and external option units
- Unless otherwise indicated, control terminals are single insulated and must not be touched

WARNING

Isolation device
The AC and / or DC power supply must be disconnected from the drive using an approved isolation device before any cover is removed from the drive or before any servicing work is performed.

WARNING

STOP function
The STOP function does not remove dangerous voltages from the drive, the motor or any external option units.

WARNING

Safe Torque Off (STO) function
The Safe Torque Off (STO) function does not remove dangerous voltages from the drive, the motor or any external option units.

WARNING

Stored charge
The drive contains capacitors that remain charged to a potentially lethal voltage after the AC and / or DC power supply has been disconnected. If the drive has been energized, the AC and / or DC power supply must be isolated at least ten minutes before work may continue. Normally the capacitors are discharged by an internal resistor, however under certain unusual fault conditions, it is possible that the capacitors may fail to discharge, or be prevented from being discharged by a voltage applied to the output terminals. If the drive has failed in a manner which causes the display to go blank immediately, it is possible that the capacitors will not be discharged.
In this case, consult Control Techniques or their authorized distributor.

WARNING

Equipment supplied by plug and socket
Special attention must be given if the drive is installed in equipment which is connected to the AC supply by a plug and socket. The AC supply terminals of the drive are connected to the internal capacitors through rectifier diodes which are not intended to give safety isolation. If the plug terminals can be touched when the plug is disconnected from the socket, a means of automatically isolating the plug from the drive must be used (e.g. a latching relay).

WARNING

Permanent magnet motors
Permanent magnet motors generate electrical power if they are rotated, even when the supply to the drive is disconnected. If that happens then the drive will become energized through its motor terminals. If the motor load is capable of rotating the motor when the supply is disconnected, then the motor must be isolated from the drive before gaining access to any live parts.

4.1 AC supply requirements

Voltage:

200 V drive: 200 V to 240 V ±10 %
400 V drive: 380 V to 480 V ±10 %
575 V drive: 500 V to 575 V ±10 %
690 V drive: 500 V to 690 V ±10 %

Number of phases: 3

Maximum supply imbalance: 2 % negative phase sequence (equivalent to 3 % voltage imbalance between phases).

Frequency range: 45 to 66 Hz

For UL compliance only, the maximum supply symmetrical fault current must be limited to 100 kA

Table 4-1 Supply fault current used to calculate maximum input currents

Model	Symmetrical fault level (kA)
All	100

4.1.1 Ground connections

The drive must be connected to the system ground of the AC supply. The ground wiring must conform to local regulations and codes of practice.

4.1.2 Main AC supply contactor

The recommended AC supply contactor type for size 3 to 7 is AC1.

4.1.3 Supply types

All drives are suitable for use on any supply type i.e TN-S, TN-C-S, TT and IT.

- Supplies with voltage up to 600 V may have grounding at any potential, i.e. neutral, centre or corner (“grounded delta”)
- Supplies with voltage above 600 V may not have corner grounding

WARNING

If an SI-Applications Plus option module is installed in the drive, then the drive must not be used on a corner-grounded or centre-grounded delta supply if the supply voltage is above 300 V. If this is required, please contact the supplier of the drive for more information.

Drives are suitable for use on supplies of installation category III and lower according to IEC60664-1 which allows permanent connection to the supply at its origin in a building. For outdoor installation however, additional over-voltage suppression (transient voltage surge suppression) must be provided to reduce category IV to category III.

WARNING

Operation with IT (ungrounded) supplies:
Special attention is required when using internal or external EMC filters with ungrounded supplies, because in the event of a ground (earth) fault in the motor circuit the drive may not trip and the filter could be over-stressed. In this case, either the EMC filter must not be used (removed) or additional independent motor ground fault protection must be provided.
For details of ground fault protection contact the supplier of the drive.

A ground fault in the supply has no effect in any case. If the motor must continue to run with a ground fault in its own circuit then an input isolating transformer must be provided and if an EMC filter is required it must be located in the primary circuit. Unusual hazards can occur on ungrounded supplies with more than one source, for example on ships. Contact the supplier of the drive for more information.

WARNING

Fuses
The AC supply to the drive must be installed with suitable protection against overload and short-circuits. Nominal fuse ratings are shown in section 2.4 *Ratings* on page 12. Failure to observe this requirement will cause risk of fire.

4.2 Fuse types

A fuse or other protection must be included in all live connections to the AC supply. An MCB (miniature circuit breaker) or MCCB (moulded-case circuit-breaker) with type C may be used in place of fuses for size 3 under the following condition:

- The fault-clearing capacity must be sufficient for the installation

The fuse voltage rating must be suitable for the drive supply voltage, refer to section 2.4 *Ratings* on page 12

WARNING

Fuses
The AC supply to the drive must be installed with suitable protection against overload and short-circuits. Nominal fuse ratings are shown in section 2.4 *Ratings* on page 12. Failure to observe this requirement will cause risk of fire.

The input current is affected by the supply voltage and impedance.

4.3 Power connections

Figure 4-1 Size 3 power and ground connections

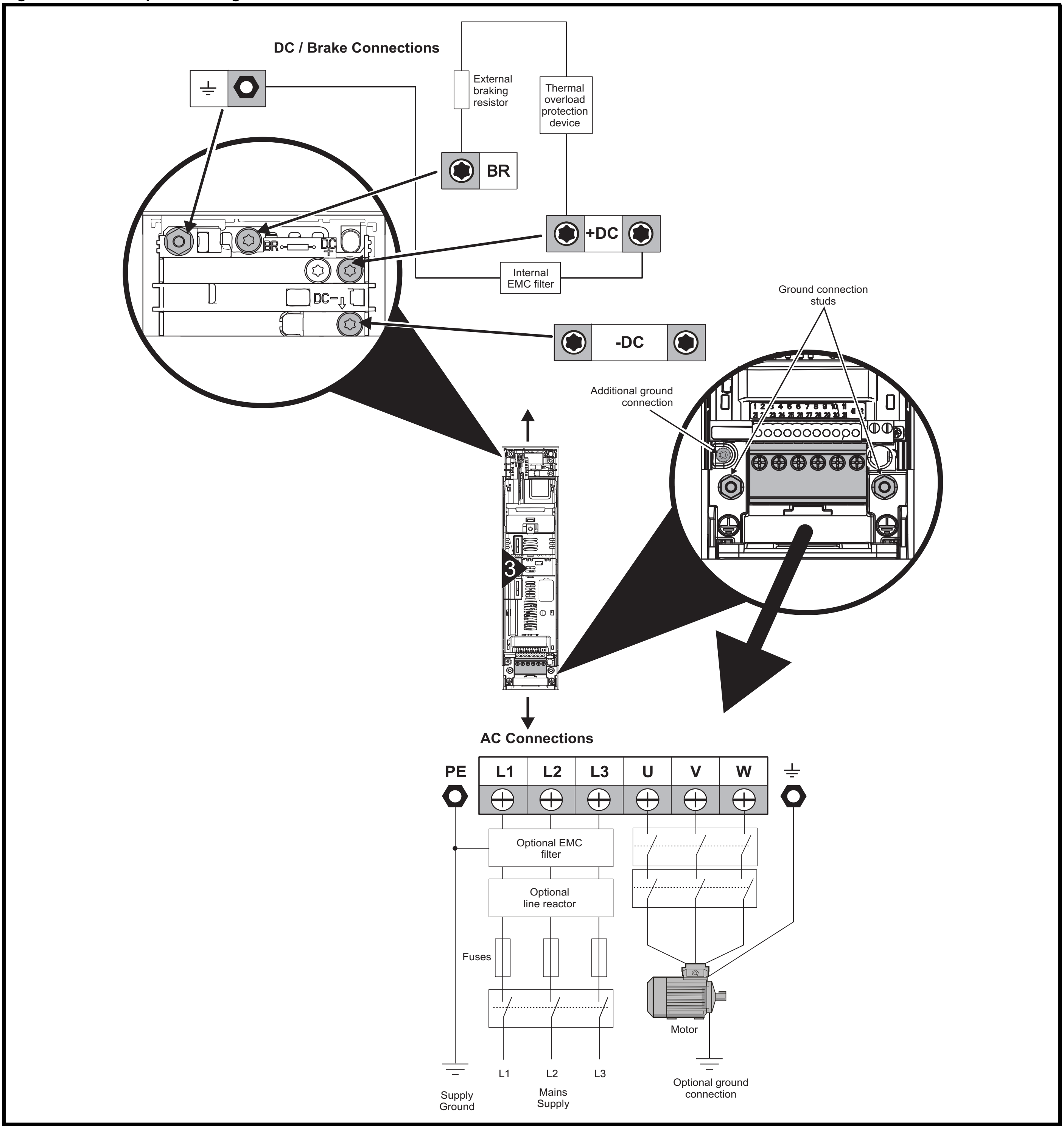


Figure 4-2 Size 4 power and ground connections

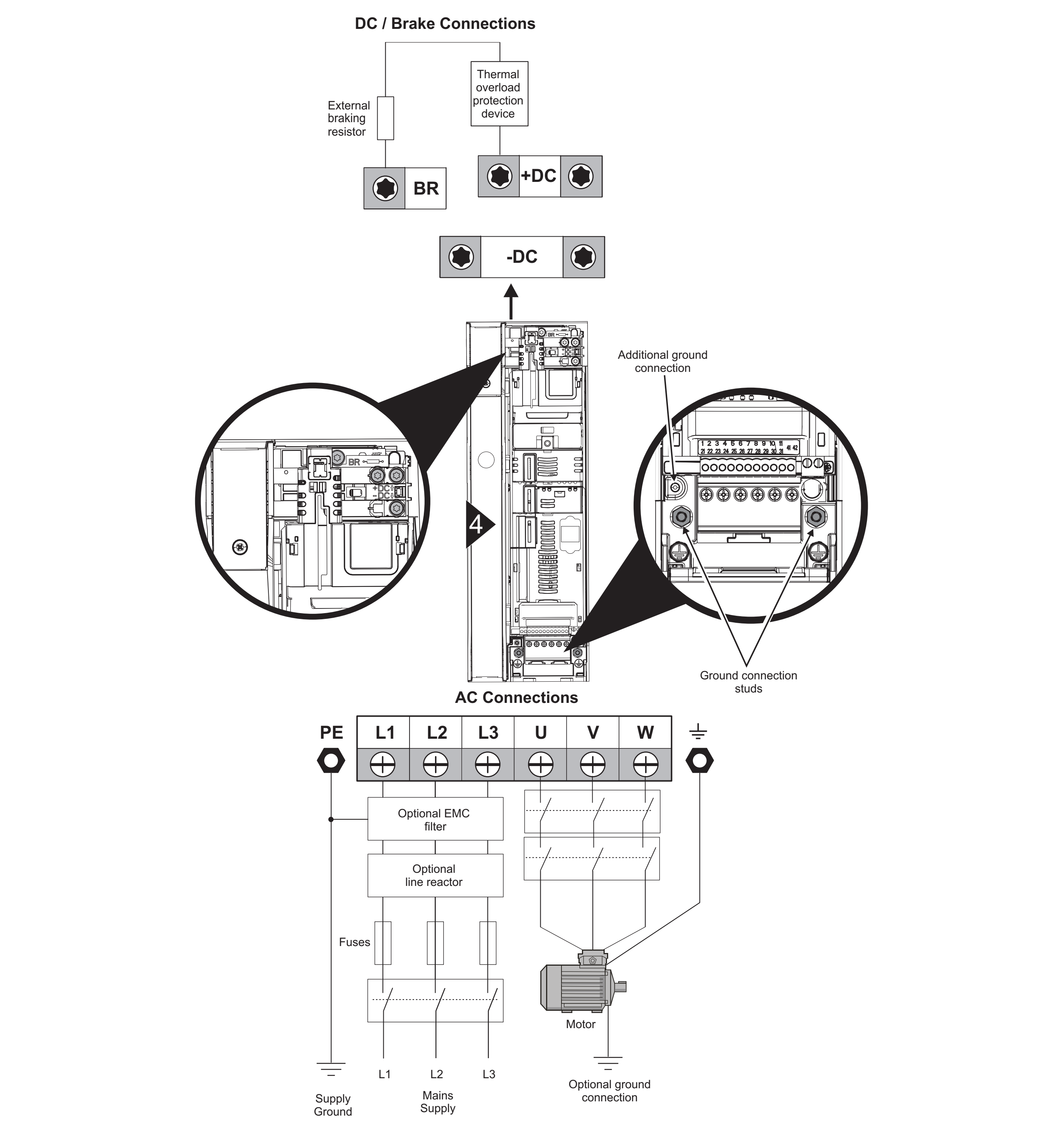


Figure 4-3 Size 5 power and ground connections

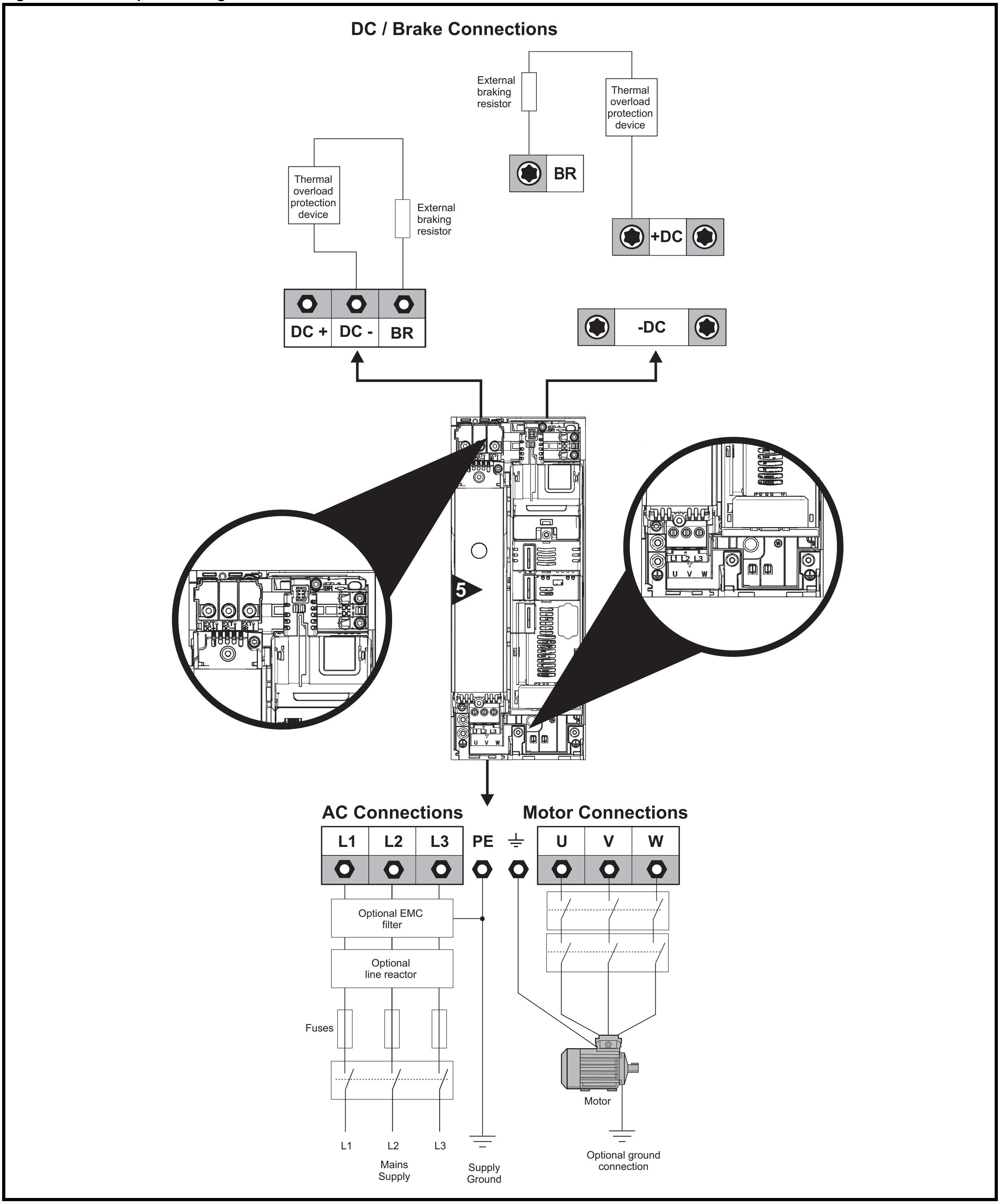


Figure 4-4 Size 6 power and ground connections

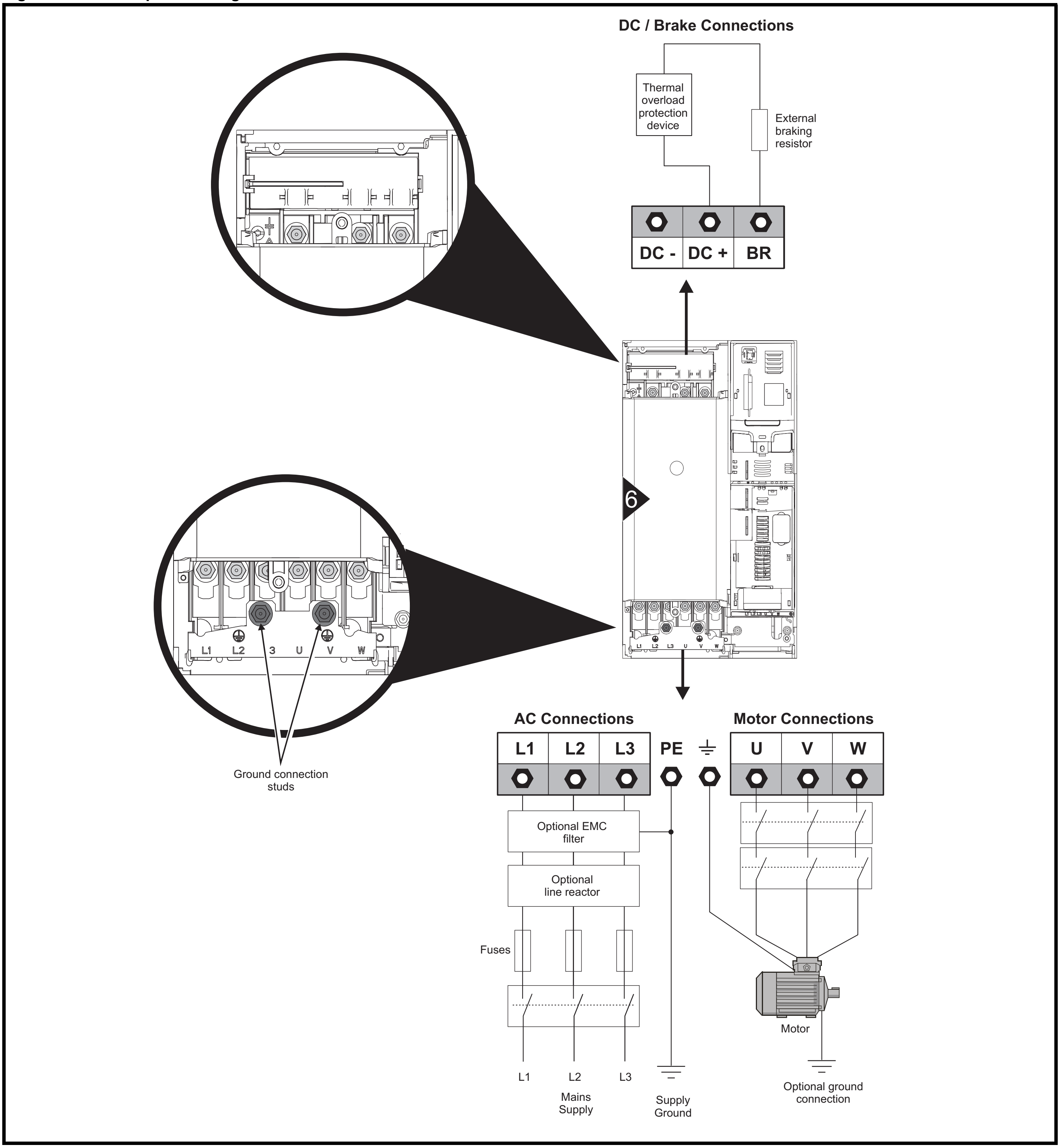
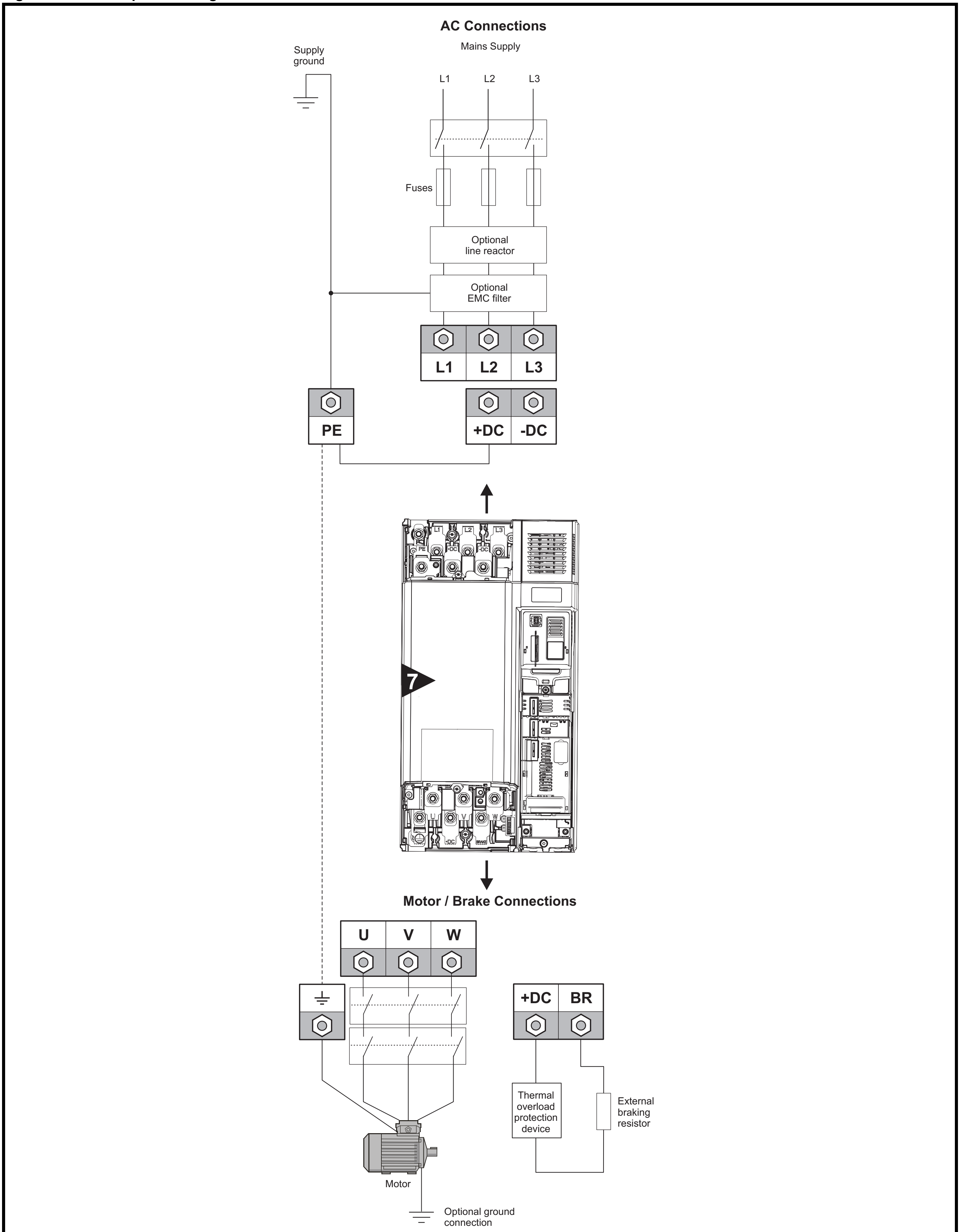


Figure 4-5 Size 7 power and ground connections



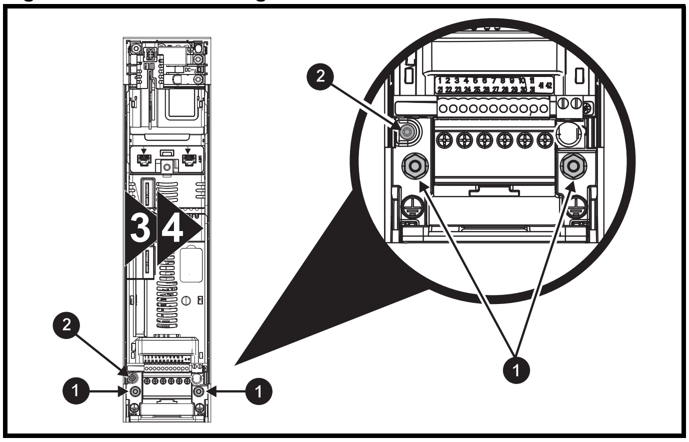
4.3.1 Ground connections

> **WARNING**
> **Electrochemical corrosion of grounding terminals**
> Ensure that grounding terminals are protected against corrosion i.e. as could be caused by condensation.

Size 3 and 4

On sizes 3 and 4, the supply and motor ground connections are made using the M4 studs located either side of the drive near the plug-in power connector. Refer to Figure 4-6 for additional ground connection.

Figure 4-6 Size 3 and 4 ground connections

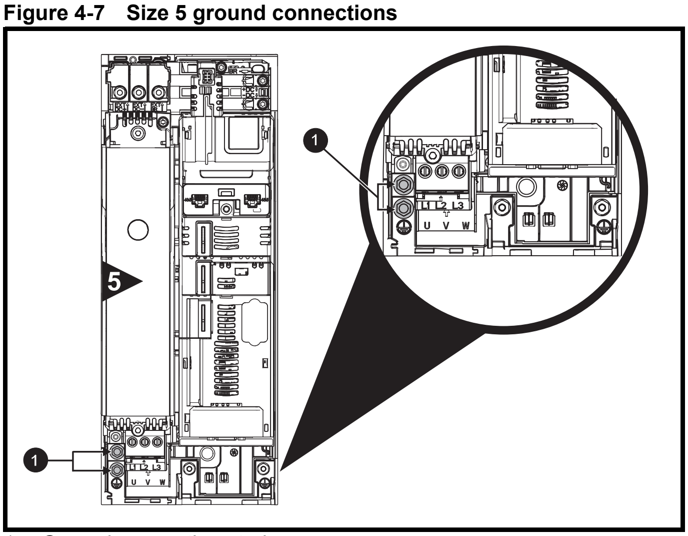


1. Ground connection studs.
2. Additional ground connection.

Size 5

On size 5, the supply and motor ground connections are made using the M5 studs located near the plug-in power connector. Refer to Figure 4-7 for additional ground connection.

Figure 4-7 Size 5 ground connections

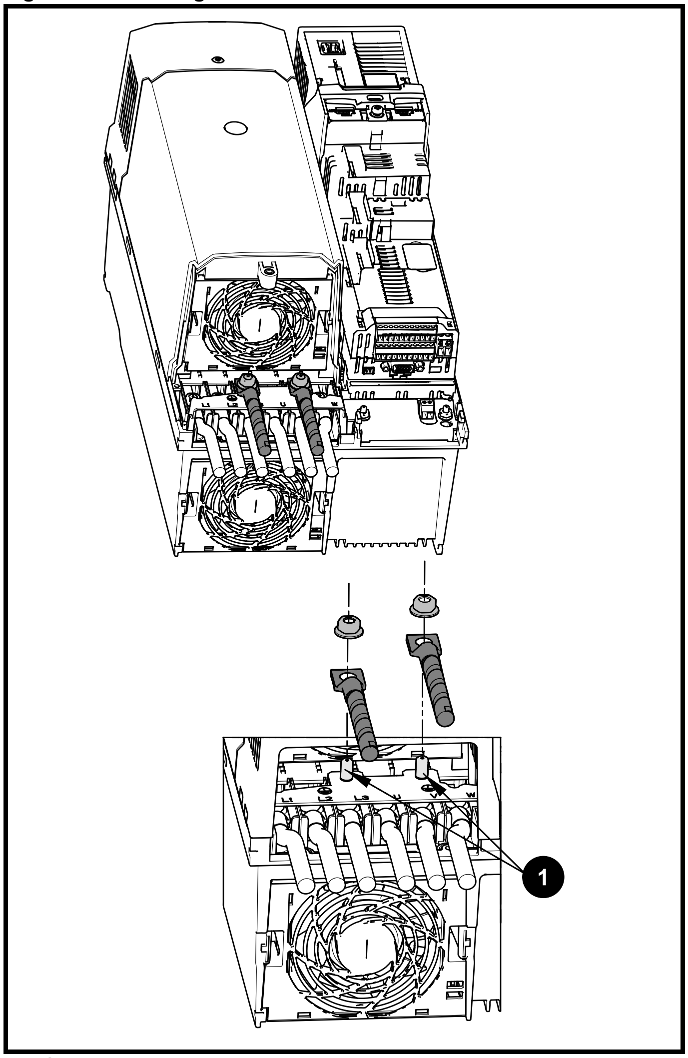


1. Ground connection studs.

Size 6

On a size 6, the supply and motor ground connections are made using the M6 studs located above the supply and motor terminals. Refer to Figure 4-8 below.

Figure 4-8 Size 6 ground connections



1. Ground connection studs

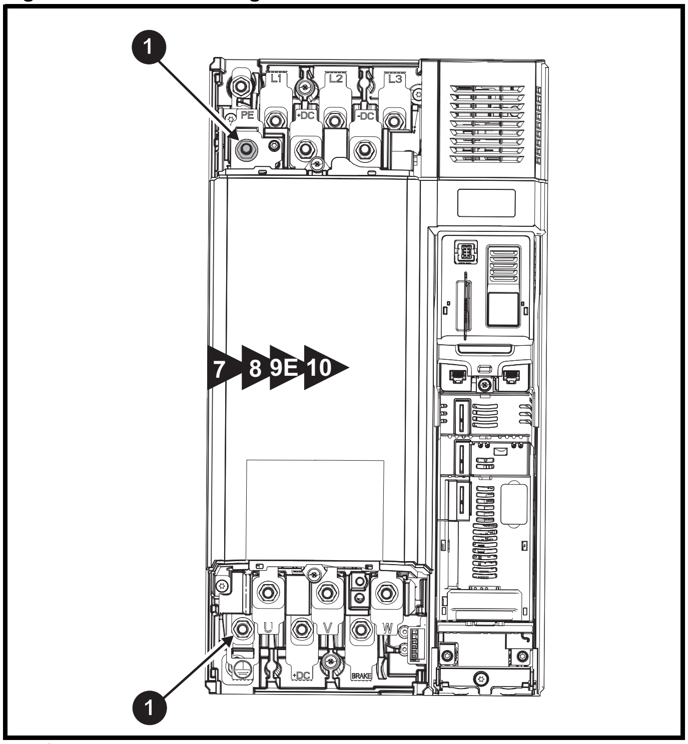
Size 7

On size 7, the supply and motor ground connections are made using the M8 studs located by the supply and motor connection terminals.

Size 8 to 10

On size 8 to 10, the supply and motor ground connections are made using the M10 studs located by the supply and motor connection terminals.

Figure 4-9 Size 7 to 10 ground connections



1. Ground connection studs.

WARNING

The ground loop impedance must conform to the requirements of local safety regulations.

The drive must be grounded by a connection capable of carrying the prospective fault current until the protective device (fuse, etc.) disconnects the AC supply.

The ground connections must be inspected and tested at appropriate intervals.

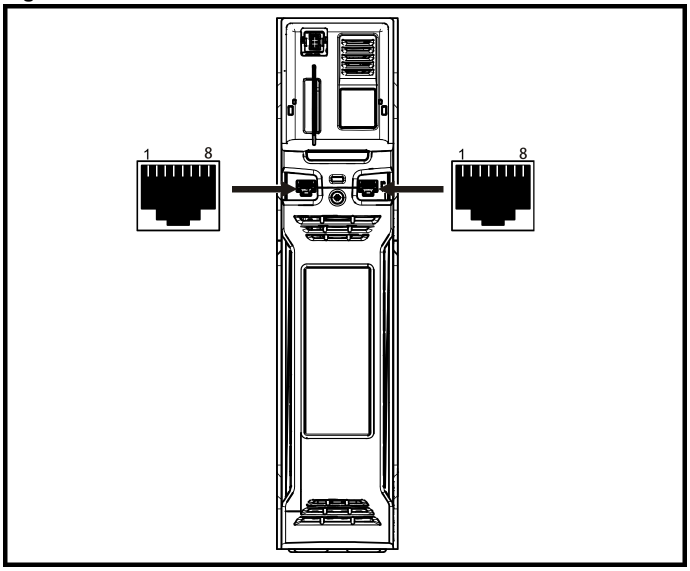
Table 4-2 Protective ground cable ratings

Input phase conductor size	Minimum ground conductor size
≤ 10 mm^2	Either 10 mm^2 or two conductors of the same cross-sectional area as the input phase conductor (an additional ground connection is provided on sizes 3, 4 and 5 for this purpose).
> 10 mm^2 and ≤ 16 mm^2	The same cross-sectional area as the input phase conductor
> 16 mm^2 and ≤ 35 mm^2	16 mm^2
> 35 mm^2	Half of the cross-sectional area of the input phase conductor

4.4 Communications connections

The drive offers a 2 wire 485 interface. This enables the drive set-up, operation and monitoring to be carried out with a PC or controller if required.

Figure 4-10 Location of the comms connectors



The 485 option provides two parallel RJ45 connectors are provided allowing easy daisy chaining. The drive only supports MODBUS RTU protocol. See Table 4-3 for the connection details.

NOTE

Standard Ethernet cables are not recommended for use when connecting drives on a 485 network as they do not have the correct twisted pairs for the pinout of the serial comms port.

Table 4-3 Serial communication port pin-outs

Pin	Function
1	120 Ω Termination resistor
2	RX TX (Receive / transmit line - positive)
3	Isolated 0 V
4	+24 V (100 mA)
5	Isolated 0 V
6	TX enable
7	RX\ TX\ (Receive / transmit line - negative)
8	RX\ TX\ (if termination resistors are required, link to pin 1)
Shell	Isolated 0 V

Minimum number of connections are 2, 3, 7 and shield.

NOTE

The TX Enable is a 0 to +5 V output signal from the drive, which can be used to control the buffers on an external serial communications device / converter.

4.4.1 Isolation of the 485 serial communications port

The serial PC communications port is double insulated and meets the requirements for SELV in EN 50178:1998.

WARNING

In order to meet the requirements for SELV in IEC60950 (IT equipment) it is necessary for the control computer to be grounded. Alternatively, when a lap-top or similar device is used which has no provision for grounding, an isolation device must be incorporated in the communications lead.

An isolated serial communications lead has been designed to connect the drive to IT equipment (such as laptop computers), and is available from the supplier of the drive. See below for details:

Table 4-4 Isolated serial comms lead details

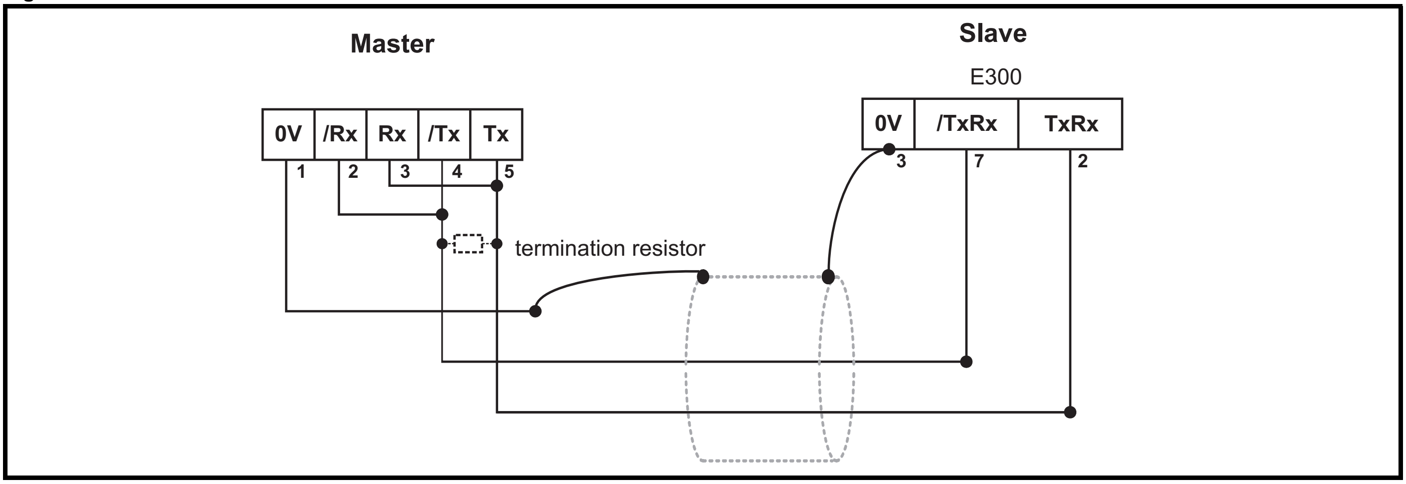
Part number	Description
4500-0096	CT USB Comms cable

The “isolated serial communications” lead has reinforced insulation as defined in IEC60950 for altitudes up to 3,000 m.

4.4.2 2 wire EIA-RS485 network

The diagram below shows the connections required for a 2 wire EIA-RS485 network, using a master controller with an EIA-RS485 port.

Figure 4-11 2 wire EIA-RS485 network connections



NOTE

If more than one drive is connected to a host computer / PLC etc, each drive must have a unique serial address see Section 10.2 *Slave address* and Section 5.10 *Communications*

Any number in the permitted range 1 to 247 may be used.

4.4.3 Routing of the cable

A data communications cable should not run parallel to any power cables, especially ones that connect drives to motors. If parallel runs are unavoidable, ensure a minimum spacing of 300 mm (1 ft) between the communications cable and the power cable.

Cables crossing one another at right-angles are unlikely to give trouble.

4.4.4 Termination

Termination resistors should not be required unless the baud rate is set at or higher than 38.4 kBaud. Linking pins 1 and 8 of the drive communications port connects an internal 120 Ω termination resistor between RXTX and RX\TX\. A resistor should also be connected at the controller end of the cable.

4.5 Control connections

4.5.1 *E300 Advanced Elevator* drive control connections

Table 4-5 The control connections consist of:

Function	Qty	Control parameters available	Terminal number
Differential analog input *	1	Mode, offset, invert, scaling	5, 6
Single ended analog input *	2	Mode, offset, invert, scaling, destination	7, 8
Analog output	2	Source, scaling	9, 10
Digital input	3	Destination, invert, logic select	27, 28, 29
Digital input / output	3	Input / output mode, destination / source, invert, logic	24, 25, 26
Relay	1	Source, invert	41, 42
Safe Torque Off (STO), Drive enable	1		31
+10 V User output	1		4
+24 V User output	1	Source, invert	22
0V common	6		1, 3, 11, 21, 23, 30
+24 V External input	1	Destination, invert	2

* Analog inputs can configured and used as digital inputs.

Key:

Destination parameter:	Indicates the parameter which is being controlled by the terminal / function
Source parameter:	Indicates the parameter being output by the terminal
Mode parameter:	Analog - indicates the mode of operation of the terminal, i.e. voltage 0 - 24 V, current 4 - 20 mA etc. Digital - indicates the mode of operation of the terminal, i.e. positive / negative logic

All analog and digital terminal functions (including the relay) can be programmed in Menu F, Hardware I/O.

WARNING

The control circuits are isolated from the power circuits in the drive by basic insulation (single insulation) only. The installer must ensure that the external control circuits are insulated from human contact by at least one layer of insulation (supplementary insulation) rated for use at the AC supply voltage.

WARNING

If the control circuits are to be connected to other circuits classified as Safety Extra Low Voltage (SELV) (e.g. to a personal computer), an additional isolating barrier must be included in order to maintain the SELV classification.

CAUTION

If any of the digital inputs (including the drive enable input) are connected in parallel with an inductive load i(.e. contactor or motor brake) then suitable suppression (i.e. diode or varistor) should be used on the coil of the load. If no suppression is used then over voltage spikes can cause damage to the digital inputs and outputs on the drive.

CAUTION

Ensure the logic sense is correct for the control circuit to be used. Incorrect logic sense could cause the motor to be started unexpectedly. Positive logic is the default state for the drive.

WARNING

When reading a parameter set from a SMARTCARD, SD card to the drive during setup this can result in the control I/O firstly defaulting and then changing to the configuration on the SMARTCARD,SD card. Ensure during this process all control terminals are removed from the drive and any SI-I/O module to prevent uncontrolled operation of external devices and the risk of damage to the system.

NOTE

Any signal cables which are carried inside the motor cable i.e. motor thermistor), will pick up large pulse currents via the cable capacitance. The shield of these signal cables must be connected to ground close to the point of exit of the motor cable to avoid noise current spreading through the control system.

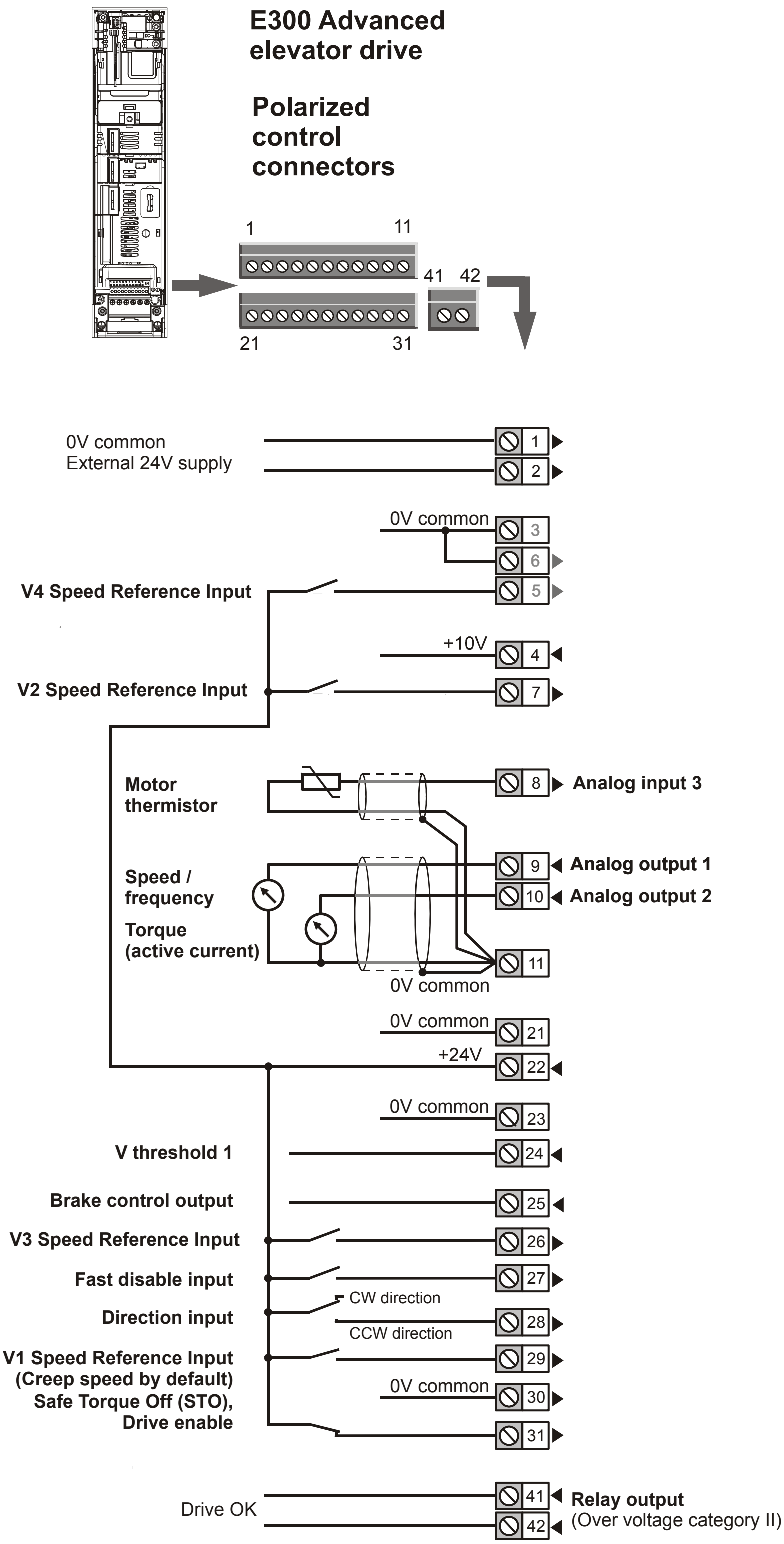
NOTE

The Safe Torque Off (STO) Drive enable terminal is a positive logic input only. It is not affected by the setting of *Input Logic Polarity* (**F02**)

NOTE

The common 0 V from analog signals should, wherever possible, not be connected to the same 0 V terminal as the common 0 V from digital signals. Terminals 3 and 11 should be used for connecting the 0V common of analog signals and terminals 21, 23 and 30 for digital signals. This is to prevent small voltage drops in the terminal connections causing inaccuracies in the analog signals.

Figure 4-12 Default terminal functions



NOTE

The Safe Torque Off (STO) Drive enable terminal is a positive logic input only.

4.5.2 *E300 Advanced Elevator* drive control terminal specification

1	0V common
Function	**Common connection control terminals 1 to 11**

2	+24V external input
Function	**To supply the control circuit without providing a supply to the power stage**
Programmability	Can be used as digital input when using an external 24 V supply
Nominal voltage	+ 24.0 Vdc
Minimum continuous operating voltage	+ 19.2 Vdc
Maximum continuous operating voltage	+ 28.0 Vdc
Recommended power supply	40 W 24 Vdc nominal
Recommended fuse	3 A, 50 Vdc

3	0V common
Function	**Common connection control terminals 1 to 11**

4	+10V User output
Function	**Supply for external analog devices**
Voltage	10.2 V nominal ±1 %
Nominal output current	10 mA
Protection	Current limit and trip @ 30 mA

5	Precision reference Analog input 1 (Non-inverting input)	Default configuration used as Digital input
6	**Precision reference Analog input 1 (Inverting input)**	**Default configuration connected to 0 V**
Default function	**V4 Speed Reference**	
Type of input	Bipolar differential analog voltage or current, thermistor input	
Mode controlled by:	Parameter **F38**	
Operating in Voltage mode		
Full scale voltage range	± 10 V ±2 %	
Absolute maximum voltage range	± 36 V relative to 0 V	
Working common mode voltage range	± 13 V relative to 0 V	
Operating in current mode		
Current ranges	0 to 20 mA ± 5 %, 20 to 0 mA ± 5 %, 4 to 20 mA ± 5 %, 20 to 4 mA ± 5 %	
Absolute maximum voltage (reverse biased)	± 36 V relative to 0 V	
Absolute maximum current	±3 0 mA	
Operating in thermistor input mode (in conjunction with analog input 3)		
Trip threshold resistance	User defined in parameter **F60**	
Short-circuit detection resistance	50 Ω ± 40 %	

7	Analog input 2	Default configuration used as Digital input
Default function	**V2 Speed Reference**	
Type of input	Bipolar single-ended analog voltage or unipolar current	
Mode controlled by...	Parameter **F45**	
Operating in voltage mode		
Full scale voltage range	± 10 V ±2 %	
Absolute maximum voltage range	± 36 V relative to 0 V	
Operating in current mode		
Current ranges	0 to 20 mA ± 5 %, 20 to 0 mA ± 5 %,, 4 to 20 mA ± 5 %, 20 to 4 mA ± 5 %	
Absolute maximum voltage (reverse bias)	± 36 V relative to 0V	
Absolute maximum current	± 30 mA	

8	**Analog input 3**
Default function	**Motor thermistor input**
Type of input	Bipolar single-ended analog voltage, or thermistor input
Mode controlled by...	Parameter **F52**
Operating in Voltage mode (default)	
Voltage range	± 10 V ± 2 %
Absolute maximum voltage range	± 36 V relative to 0 V
Operating in thermistor input mode	
Supported thermistor types	Din 4408, KTY 84, PT100, PT 1000, PT 2000
Trip threshold resistance	User defined in parameter **F60**
Reset resistance	User defined in parameter **F61**
Short-circuit detection resistance	50 Ω ± 40 %

9	**Analog output 1**
10	**Analog output 2**
Terminal 9 default function	**SPEED / FREQUENCY output signal**
Terminal 10 default function	**Motor torque producing current**
Type of output	Bipolar single-ended analog voltage output
Voltage range	±10 V ± 5 %
Maximum output current	± 20 mA
Protection	20 mA max. Short circuit protection

11	**0V common**
Function	**Common connection control terminals 1 to 11**
21	**0V common**
Function	**Common connection control terminals 21 to 31**

22	**+24 V User output (selectable)**
Terminal 22 default function	**+24 V User output**
Programmability	Can be switched Off (0) or On (1) to act as a fourth digital output (positive logic only) by setting the source **F29** and source invert **F32**
Nominal output current	100 mA combined with **DIO3**
Maximum output current	100 mA 200 mA total (including all Digital I/O)
Protection	Current limit and trip

23	**0V common**
Function	**Common connection control terminals 21 to 31**

24	**Digital I/O 1**
25	**Digital I/O 2**
26	**Digital I/O 3**

Terminal 24 default function	**V threshold 1 output**
Terminal 25 default function	**Brake control output**
Terminal 26 default function	**V3 Speed Reference**
Type	Positive or negative logic digital inputs, positive logic voltage source outputs
Input / output mode controlled by...	Parameters **F24**, **F25** and **F26**
Voltage range	0 V to + 24 V
Operating as an input	
Logic mode controlled by...	Parameter **F02**
Absolute maximum applied voltage range	- 3 V to + 30 V
Operating as an output	
Nominal maximum output current	100 mA (Digital I/O 1 & 2 combined), 100 mA (Digital I/O 3 & + 24 V User output combined)
Maximum output current	100 mA, 200 mA (total including all Digital I/O)

27	**Digital Input 4**
28	**Digital Input 5**

Terminal 27 default function	**FAST disable input**
Terminal 28 default function	**Direction input**
Type	Negative or positive logic digital inputs
Logic mode controlled by...	Parameter **F02**
Voltage range	0 V to + 24 V
Absolute maximum applied voltage range	- 3 V to + 30 V

29	**Digital Input 6**

Terminal 29 default function	**V1 Speed Reference**
Type	Negative or positive logic digital inputs
Logic mode controlled by...	Parameter **F02**
Voltage range	0 V to + 24 V
Absolute maximum applied voltage range	- 3 V to + 30 V

30	**0V common**
Function	**Common connection control terminals 21 to 31**

31	**Safe Torque Off (STO), Drive enable**
Type	Positive logic only digital input
Voltage range	0 V to + 24 V
Absolute maximum applied voltage	+ 30 V

The Safe Torque Off (STO) function may be used in a safety-related application in preventing the drive from generating torque in the motor to a high level of integrity. The system designer is responsible for ensuring that the complete system is safe and designed correctly according to the relevant safety standards. If the Safe Torque Off (STO) function is not required, this terminal is the Drive enable.

41 **42**	**Relay contacts**
Default function	**Drive OK indicator**
Contact voltage rating	240 Vac, Installation over-voltage category II
Contact maximum current rating	2 A AC 240 V, 4 A DC 30 V resistive load, 0.5 A DC 30 V inductive load (L/R = 40 ms)
Contact minimum recommended rating	12 V 100 mA
Contact type	Normally open
Default contact condition	Closed when power applied and drive OK
Update period	4 ms

51	**0 V**
52	**+24 Vdc**
Size 6	
Nominal operating voltage	+ 24.0 Vdc
Minimum continuous operating voltage	+ 18.6 Vdc
Maximum continuous operating voltage	+ 28.0 Vdc
Minimum startup voltage	+ 18.4 Vdc
Maximum power supply requirement	40 W
Recommended fuse	4 A @ 50 Vdc
Size 7	
Nominal operating voltage	+ 24.0 Vdc
Minimum continuous operating voltage	+ 19.2 Vdc
Maximum continuous operating voltage	+ 30 Vdc
Minimum startup voltage	+ 21.6 Vdc
Maximum power supply requirement	60 W
Recommended fuse	4 A @ 50 Vdc

WARNING

To prevent the risk of a fire hazard in the event of a fault, a fuse or other over-current protection must be installed in the relay circuit.

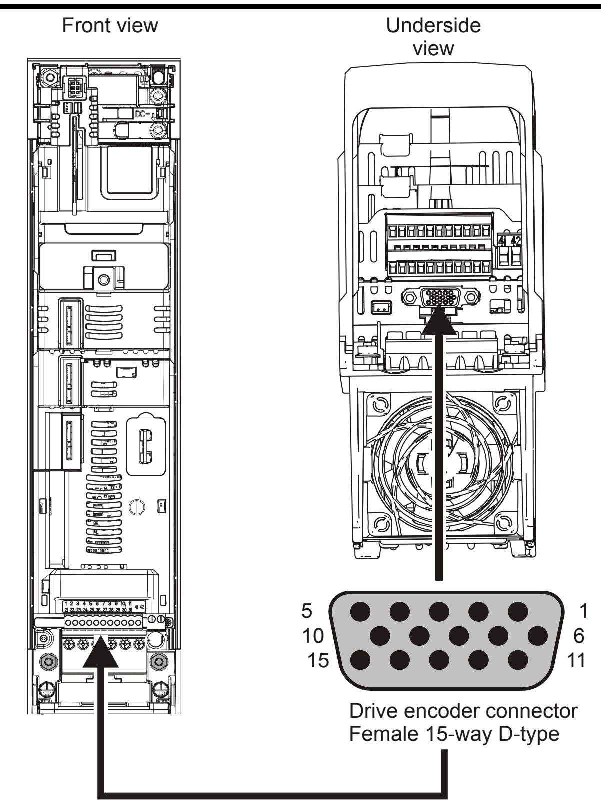
4.6 Position feedback interface

The following functions are supported on the 15-way high density D-type connector on the drive:

- Position feedback interface
- Encoder simulation output.
- Motor thermistor input.

The position feedback interface is always available however the encoder output simulation depends on the position feedback device selected

Figure 4-13 Location of position feedback interface



4.6.1 Compatible position feedback devices

Table 4-6 Supported feedback devices on the Drive Position Feedback Interface

Encoder type	(C01) setting
Quadrature incremental encoders with or without marker pulse	AB (0)
Quadrature incremental encoders with UVW commutation signals for absolute position for permanent magnet motors with or without marker pulse	AB Servo (3)
Forward / reverse incremental encoders with or without marker pulse	FR (2)
Forward / reverse incremental encoders with UVW commutation signals for absolute position for permanent magnet motors with or without marker pulse	FR Servo (5)
Frequency and direction incremental encoders with or without marker pulse	FD (1)
Frequency and direction incremental encoders with UVW commutation signals for absolute position for permanent magnet motors with or without marker pulse	FD Servo (4)
Sincos incremental encoders	SC (6)
Sincos incremental with commutation signals	SC Servo (12)
Heidenhain sincos encoders with EnDat comms for absolute position	SC EnDat (9)
Stegmann sincos encoders with Hiperface comms for absolute position	SC Hiperface (7)
Sincos encoders with SSI comms for absolute position	SC SSI (11)
Sincos incremental with absolute position from single sin and cosine signals	SC SC (15)
SSI encoders (Gray code or binary)	SSI (10)
EnDat communication only encoders	EnDat (8)
BiSS communication only encoders (not currently supported)	BiSS (13)
UVW commutation only encoders* (not currently supported)	Commutation only (16)

* This feedback device provides very low resolution feedback and should not be used for applications requiring a high level of performance.

Table 4-7 Availability of the encoder simulation output

Functions	
Drive position feedback interface	**Encoder Simulation Output**
AB Servo FD Servo FR Servo SC Servo SC SC Commutation only	None
AB FD FR SC SC Hiperface	Full
SC EnDat SC SSI	No Z marker pulse output
EnDat BiSS SSI	Full

The priority of the position feedback interfaces and the encoder simulation output on the 15-way D-type is assigned in the following order from the highest priority to the lowest.

- Drive position feedback interface (highest)
- Encoder simulation output (lowest)

For example, if an AB Servo type position feedback device is selected for use on the Drive position feedback interface, then the encoder simulation output will not be available as this device uses all connections of the 15-way D-type connector.

Depending on the device type used on the Drive position feedback interface, the encoder simulation output may not be able support a marker pulse output (e.g. SC EnDat or SC SSI device types). *Encoder Simulation Status* (**C29**) shows the status of the encoder simulation output indicating whether the output is disabled, no marker pulse is available or full encoder simulation is available.

4.6.2 Position feedback connection details

Table 4-8 Drive position feedback interface connection details

Drive Encoder Type (C01)	15 Way D Type Connections														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
AB (0)	A	A\	B	B\	Z	Z\									
FD (1)	F	F\	D	D\	Z	Z\									
FR (2)	F	F\	R	R\	Z	Z\									
AB Servo (3)	A	A\	B	B\	Z	Z\	U	U\	V	V\	W	W\			
FD Servo (4)	F	F\	D	D\	Z	Z\	U	U\	V	V\	W	W\			
FR Servo (5)	F	F\	R	R\	Z	Z\	U	U\	V	V\	W	W\			
SC (6)	A (Cos)	A\ (Cos\)	B (Sin)	B\ (Sin\)	Z	Z\									
SC Hiperface (7)	Cos	Cosref	Sin	Sinref	DATA	DATA\									
EnDat (8)	DATA	DATA\	CLK	CLK\									+V	0 V	Th
SC EnDat (9)	A	A\	B	B\	DATA	DATA\					CLK	CLK\			
SSI (10)	DATA	DATA\	CLK	CLK\											
SC SSI (11)	A (Cos)	A\ (Cos\)	B (Sin)	B\ (Sin\)	DATA	DATA\					CLK	CLK\			
SC Servo (12)	A (Cos)	A\ (Cos\)	B (Sin)	B\ (Sin\)	Z	Z\	U	U\	V	V\	W	W\			
BiSS (13)	DATA	DATA\	CLK	CLK\											
SC SC (15)	A (Cos)	A\ (Cos\)	B (Sin)	B\ (Sin\)	Z	Z\	C	C\	D	D\					
Commutation Only (16)							U	U\	V	V\	W	W\			

Greyed cells are for simulated encoder outputs.

Table 4-9 Encoder simulation output connection details

Drive Encoder Type (C01)	Encoder Simulation Output	Connections					
		7	8	9	10	11	12
AB (0) FD (1) FR (2) SC (6) SC Hiperface (7) EnDat (8) SSI (10) BiSS (13)	AB	Asim	Asim\	Bsim	Bsim\	Zsim	Zsim\
	FD	Fsim	Fsim\	Dsim	Dsim\	Zsim	Zsim\
	FR	Fsim	Fsim\	Rsim	Rsim\	Zsim	Zsim\
	SSI	DATAsim	DATAsim\	CLKsim	CLKsim\		
SC EnDat (9) SC SSI (11)	AB	Asim	Asim\	Bsim	Bsim\		
	FD	Fsim	Fsim\	Dsim	Dsim\		
	FR	Fsim	Fsim\	Rsim	Rsim\		
	SSI	DATAsim	DATAsim\	CLKsim	CLKsim\		

Sincos encoder resolution

The sine wave frequency can be up to 500 kHz but the resolution is reduced at the higher frequencies. Table 4-10 shows the number of bits of interpolated information at different frequencies and with different voltage levels at the drive encoder port. The total resolution in bits per revolution is the ELPR plus the number of bits of interpolated information. Although it is possible to obtain 11 bits of interpolation information, the nominal design value is 10 bits.

Table 4-10 Feedback resolution based on frequency and voltage level

Volt/Freq	1 kHz	5 kHz	50 kHz	100 kHz	200 kHz	500 kHz
1.2	11	11	10	10	9	8
1.0	11	11	10	9	9	7
0.8	10	10	10	9	8	7
0.6	10	10	9	9	8	7
0.4	9	9	9	8	7	6

4.6.3 Position feedback terminal specifications

1	**A,F, Cosref, Data, Cos H**
2	**A\,F\ Cosref\, Data\, Cos L**
AB (0), FD (1), FR (2), AB Servo (3), FD Servo (4), FR Servo (5)	
Type	EIA 485 differential receivers
Line termination components	120 Ω (selectable)
Working common mode range	– 7 V to + 12 V
SC Hiperface (7), SC EnDat (9), SC SSI (11), SC Servo (12), SC SC (15)	
Type	Differential voltage
Maximum Signal level	1.25 V peak to peak (sin with regard to sinref and cos with regard to cosref)
Maximum applied differential voltage and common mode voltage range	± 4 V
EnDat (8), SSI (10), BISS (13)	
Type	EIA 485 differential receivers
Line termination components	120 Ω (selectable)
Working common mode range	– 7 V to + 12 V
Common to All	
Absolute maximum applied voltage relative to 0V	- 9 V to + 14 V

3	**B, D, R Sinref, Clock, Sin H**
4	**B\, D\, R\, Sinref\, Clock\, Sin L**
AB (0), FD (1), FR 2), AB Servo (3), FD Servo (4), FR Servo (5)	
Type	EIA 485 differential receivers
Line termination components	120 Ω (selectable)
Working common mode range	– 7 V to + 12 V
SC Hiperface (7), SC EnDat (9), SC SSI (11), SC Servo (12), SC SC (15)	
Type	Differential voltage
Maximum Signal level	1.25 V peak to peak (sin with regard to sinref and cos with regard to cosref)
Maximum applied differential voltage and common mode voltage range	± 4 V
EnDat (8), SSI (10), BISS (13)	
Type	EIA 485 differential receivers
Line termination components	120 Ω (selectable)
Working common mode range	– 7 V to + 12 V
Common to All	
Absolute maximum applied voltage relative to 0V	- 9 V to + 14 V

5	**Z, Data, Freeze, Ref H**
6	**Z\, Data\, Freeze\, Ref L**
AB (0), FD (1), FR 2), AB Servo (3), FD Servo (4), FR Servo (5), SC SC (15)	
Type	EIA 485 differential receivers
Line termination components	120 Ω (selectable)
Working common mode range	– 7 V to + 12 V
SC Hiperface (7), SC EnDat (9), SC SSI (11), SC Servo (12)	
Type	EIA 485 differential receivers
Line termination components	120 Ω (selectable)
Working common mode range	– 7 V to + 12 V
EnDat (8), SSI (10), BiSS (13)	
Type	EIA 485 differential receivers
Line termination components	120 Ω (selectable)
Working common mode range	– 7 V to + 12 V
Common to All	
Absolute maximum applied voltage relative to 0V	- 9 V to + 14 V

7	**U, C, Not used, Not used**
8	**U\, C\, Not used, Not used**
AB Servo (3), FD Servo (4), FR Servo (5), SC Servo (12)	
Type	EIA 485 differential receivers
Line termination components	120 Ω (selectable)
Working common mode range	– 7 V to + 12 V
SC SC (15)	
Type	Differential voltage
Maximum Signal level	1.25 V peak to peak (sin with regard to sinref and cos with regard to cosref)
Maximum applied differential voltage and common mode voltage range	± 4 V
EnDat (8), SSI (10), BiSS (13)	
Not used	
Common to All	
Absolute maximum applied voltage relative to 0V	- 9 V to + 14 V

9	V, D, Not used, Not used
10	V\, D\, Not used, Not used

AB Servo (3), FD Servo (4), FR Servo (5), SC Servo (12)	
Type	EIA 485 differential receivers
Line termination components	120 Ω (selectable)
Working common mode range	– 7 V to + 12 V
SC SC (15)	
Type	Differential voltage
Maximum Signal level	1.25 V peak to peak (sin with regard to sinref and cos with regard to cosref)
Maximum applied differential voltage and common mode voltage range	± 4 V
EnDat (8), SSI (10), BiSS (13)	
Not used	
Common to All	
Absolute maximum applied voltage relative to 0V	- 9 V to + 14 V

11	W, Clock, Not used, Not used
12	W\, Clock\, Not used, Not used

AB Servo (3), FD Servo (4), FR Servo (5), SC Servo (12)	
Type	EIA 485 differential receivers
Line termination components	120 Ω (selectable)
Working common mode range	– 7 V to + 12 V
SC EnDat (9), SC SSI (11)	
Type	Differential voltage
Maximum Signal level	1.25 V peak to peak (sin with regard to sinref and cos with regard to cosref)
Maximum applied differential voltage and common mode voltage range	± 4 V
EnDat (8), SSI (10), BiSS (13)	
Not used	
Common to All	
Absolute maximum applied voltage relative to 0V	- 9 V to + 14 V

Common to all Feedback types

13	Feedback device supply
Supply voltage	5.15 V ± 2 %, 8 V ± 5 % or 15 V ± 5 %
Maximum output current	300 mA for 5 V and 8 V, 200 mA for 15 V
The voltage on control terminal 13 is controlled by *Drive Encoder Voltage Select* (**C04**). The default for this parameter is 5 V (0) but this can be set to 8 V (1) or 15 V (2). Setting the encoder voltage too high for the encoder could result in damage to the feedback device. The termination resistors should be disabled if the outputs from the encoder are higher than 5 V.	

14	0 V Common

15	Motor thermistor input
Thermistor type is selected in *Encoder Thermistor Input Type* (**F69**)	

4.7 Shield, Ground connections

Shielding considerations are important for PWM drive installations due to the high voltages and currents present in the output (motor) circuit with a very wide frequency spectrum, typically from 0 to 20 MHz.

Resolver connections:

- Use a cable with an overall shield and twisted pairs for the resolver signals
- Connect the cable shield to the drive 0 V connection by the shortest possible link ("pigtail")
- It is generally preferable not to connect the cable shield to the resolver. However in cases where there is an exceptional level of common-mode noise voltage present on the resolver body, it may be helpful to connect the shield there. In this case ensure absolute minimum lengths of "pigtails" are used at both shield connections. Also clamp the cable shield directly to the resolver body and the drive grounding bracket
- Preferably the cable should not be interrupted. Where interruption is unavoidable, ensure minimal length of "pigtail" shield connections at each interruption.

Encoder connections:

- Use a cable with the correct impedance
- Use a cable with individually shielded twisted pairs
- Connect the cable shields to 0V at both the drive and the encoder, using the shortest possible links ("pigtails")
- Preferably the cable should not be interrupted. If interrupted, ensure the absolute minimum length of "pigtail" in the shield connections at each interruption. Preferably, use a connection method which provides substantial metallic clamps for the cable shield terminations

The above applies where the encoder body is isolated from the motor and where the encoder circuit is isolated from the encoder body. Where there is no isolation between the encoder circuits and the motor body, and if in any doubt, the following additional requirement must be observed in the interests of best possible noise immunity.

- The shields must be directly clamped to the encoder body (no pigtail) and to the drive grounding bracket. This may be achieved by clamping of the individual shields or by providing an additional overall shield which is clamped

NOTE

The recommendations of the encoder manufacturer must also be adhered to for the encoder connections.

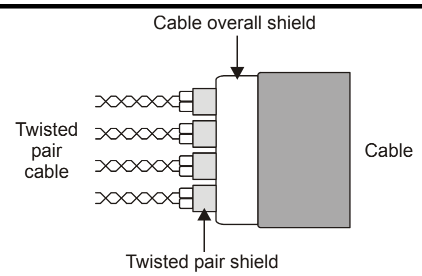
Motor cable: Use a motor cable with an overall shield. Connect the shield of the motor cable to the ground terminal of the motor frame using a link that is as short as possible and not exceeding 50 mm (2 in) long. A full 360 ° termination of the shield to the terminal housing of the motor is beneficial.

Brake resistor cable: The optional braking resistor should also be wired with shielded cable. If un-shielded wire is required refer to *section 4.17.5 Shielding requirements for the braking circuit* on page 102 for guidance.

Control cables (including encoder): If the control wiring is to leave the enclosure, it must be shielded and the shield(s) clamped to the drive using the grounding bracket. Remove the outer insulating cover of the cable to ensure the shield(s) make contact with the bracket but keep the shield(s) intact until as close as possible to the terminals. Refer to *Figure 4-36 Grounding of signal cable shields using the grounding bracket* **on page 102**.

Figure 4-14 *Feedback cable, twisted pair* and Figure 4-15 *Feedback cable connections* illustrate the preferred construction of cable and the method of clamping.

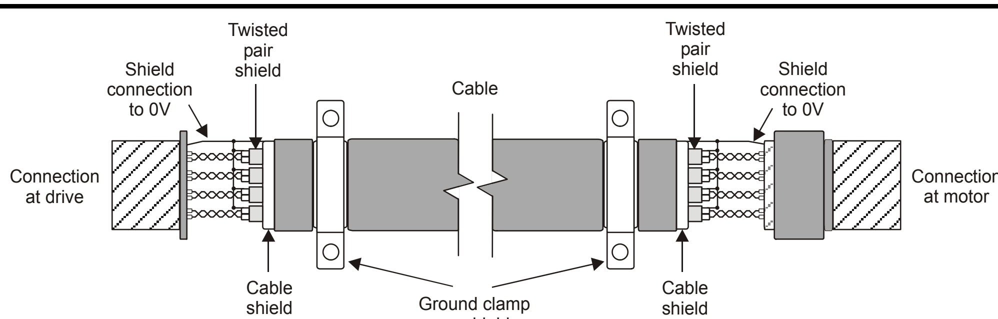
Figure 4-14 Feedback cable, twisted pair



NOTE

In order to guarantee maximum noise immunity for any application double shielded cable as shown should be used.

Figure 4-15 Feedback cable connections

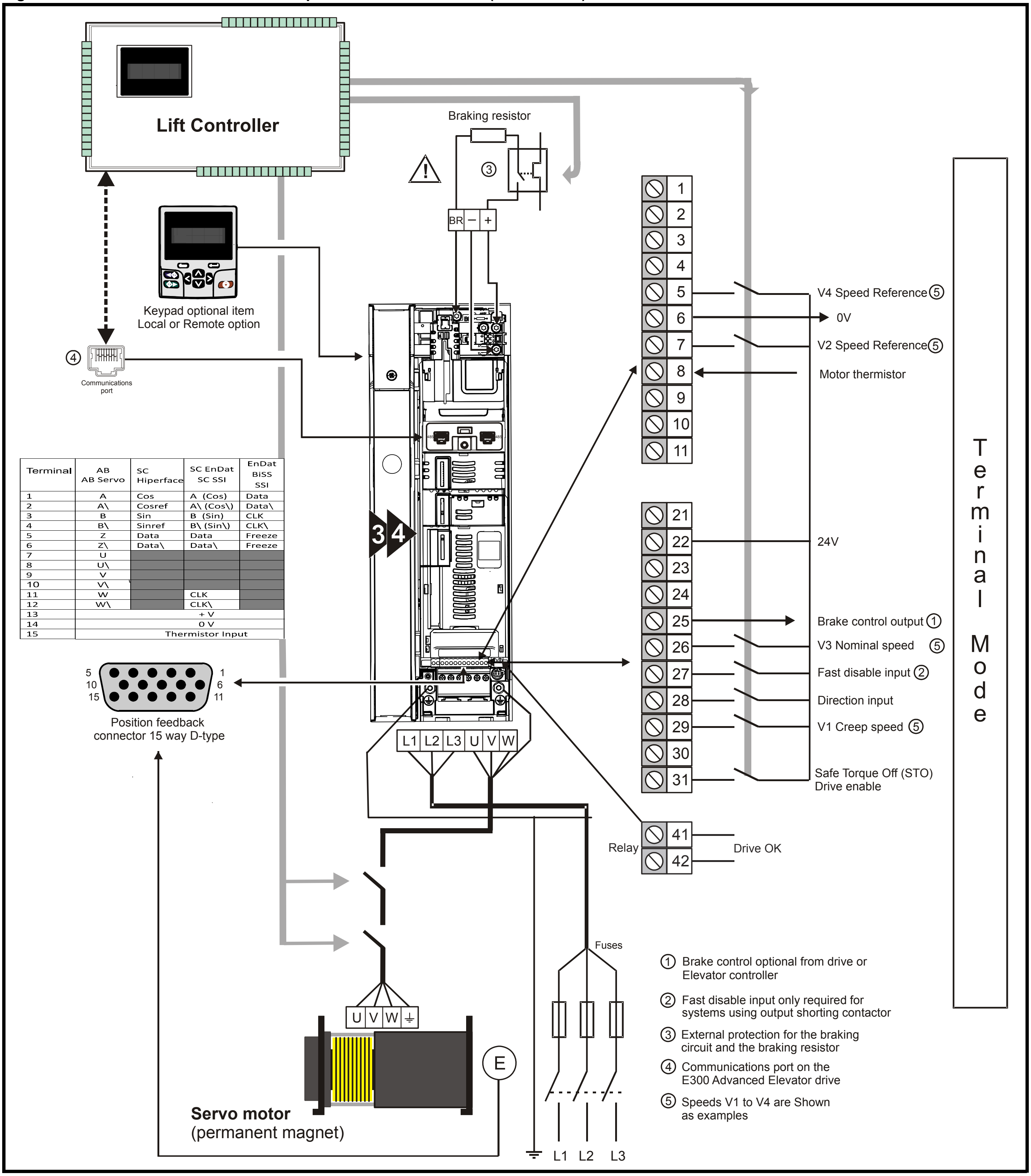


Use the grounding bracket and grounding clamp supplied with the drive to terminate all shielded cables at the drive.

4.8 Minimum connections

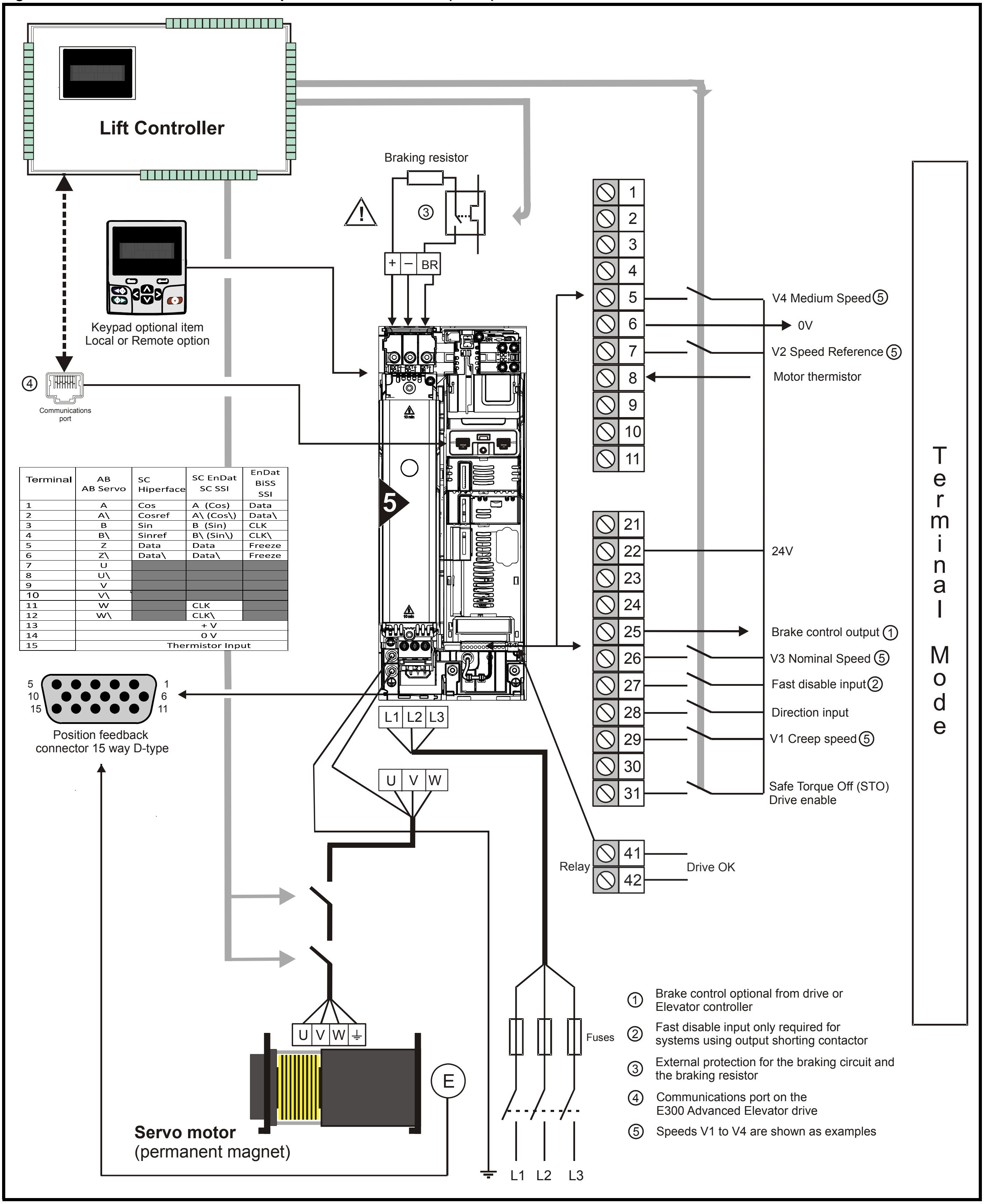
This following section shows the basic connections which are required for the drive to operate.

Figure 4-16 Minimum connections for operation in RFC-S mode (size 3 and 4)



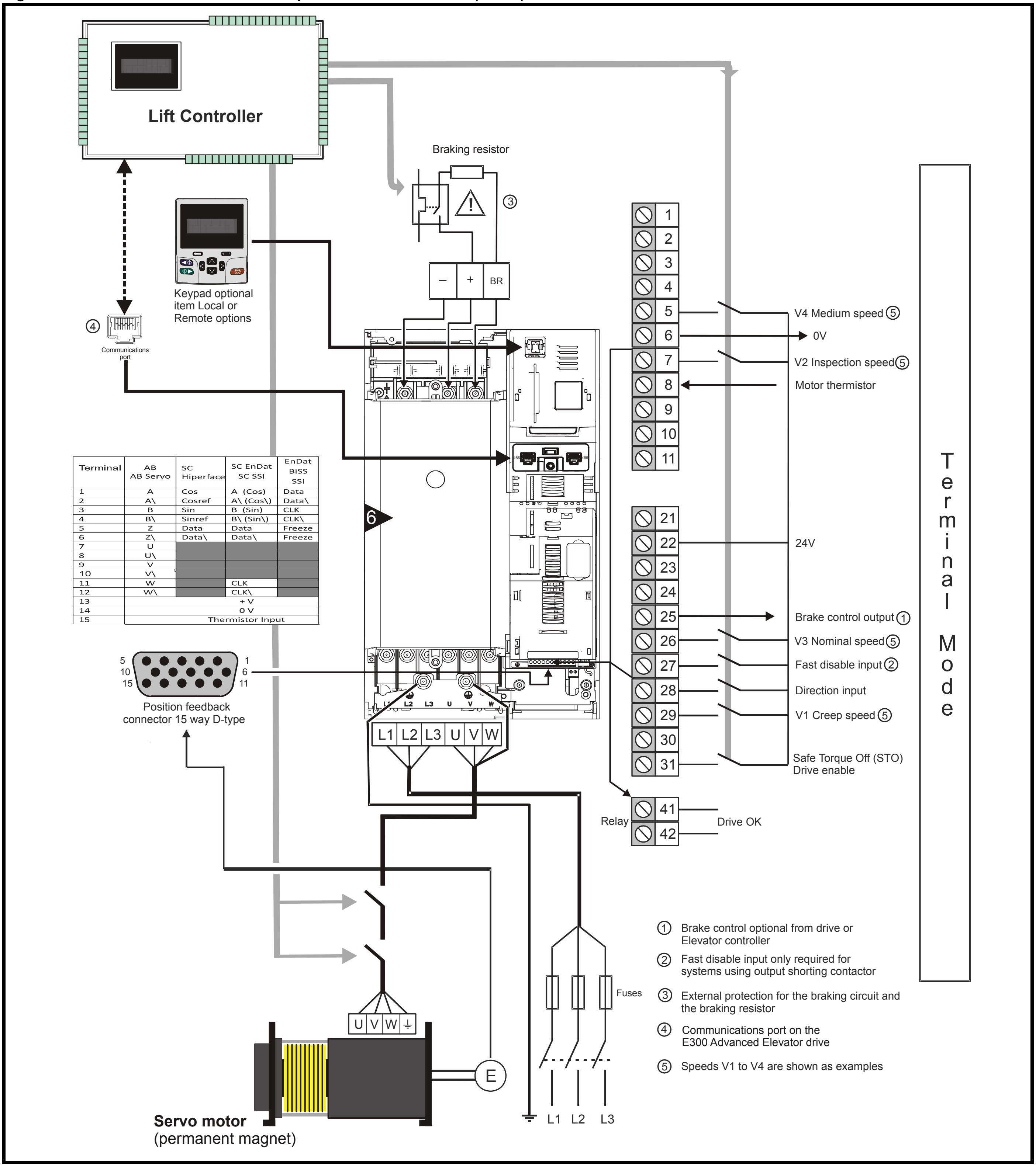
Terminal	AB AB Servo	SC Hiperface	SC EnDat SC SSI	EnDat BiSS SSI
1	A	Cos	A (Cos)	Data
2	A\	Cosref	A\ (Cos\)	Data\
3	B	Sin	B (Sin)	CLK
4	B\	Sinref	B\ (Sin\)	CLK\
5	Z	Data	Data	Freeze
6	Z\	Data\	Data\	Freeze
7	U			
8	U\			
9	V			
10	V\			
11	W		CLK	
12	W\		CLK\	
13	+ V			
14	0 V			
15	Thermistor Input			

Figure 4-17 Minimum connections for operation in RFC-S mode (size 5)



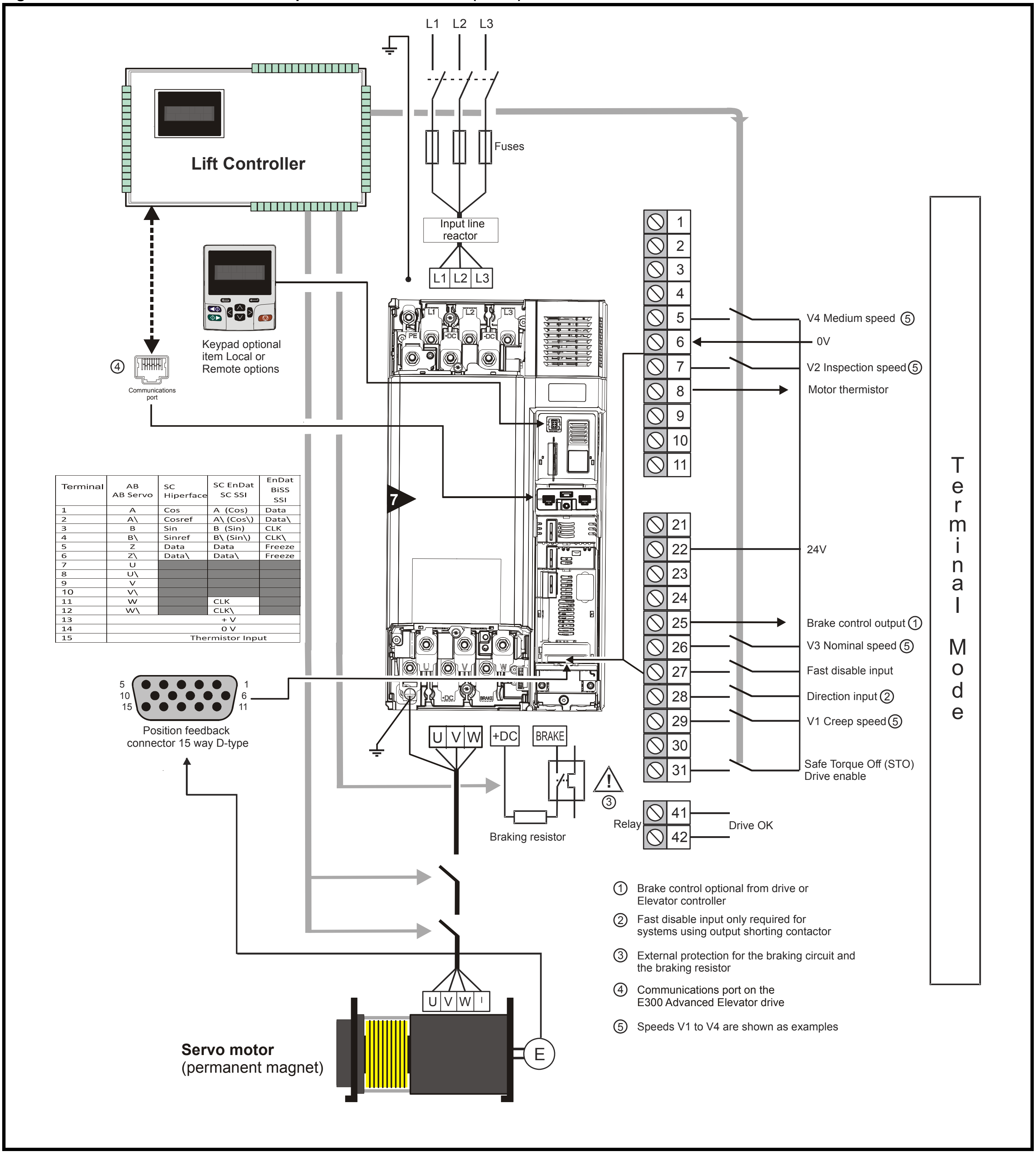
Terminal	AB AB Servo	SC Hiperface	SC EnDat SC SSI	EnDat BiSS SSI
1	A	Cos	A (Cos)	Data
2	A\	Cosref	A\ (Cos\)	Data\
3	B	Sin	B (Sin)	CLK
4	B\	Sinref	B\ (Sin\)	CLK\
5	Z	Data	Data	Freeze
6	Z\	Data\	Data\	Freeze
7	U			
8	U\			
9	V			
10	V\			
11	W		CLK	
12	W\		CLK\	
13	+ V			
14	0 V			
15	Thermistor Input			

Figure 4-18 Minimum connections for operation in RFC-S mode (size 6)



Terminal	AB AB Servo	SC Hiperface	SC EnDat SC SSI	EnDat BiSS SSI
1	A	Cos	A (Cos)	Data
2	A\	Cosref	A\ (Cos\)	Data\
3	B	Sin	B (Sin)	CLK
4	B\	Sinref	B\ (Sin\)	CLK\
5	Z	Data	Data	Freeze
6	Z\	Data\	Data\	Freeze
7	U			
8	U\			
9	V			
10	V\			
11	W		CLK	
12	W\		CLK\	
13	+ V			
14	0 V			
15	Thermistor Input			

Figure 4-19 Minimum connections for operation in RFC-S mode (size 7)



Terminal	AB AB Servo	SC Hiperface	SC EnDat SC SSI	EnDat BiSS SSI
1	A	Cos	A (Cos)	Data
2	A\	Cosref	A\ (Cos\)	Data\
3	B	Sin	B (Sin)	CLK
4	B\	Sinref	B\ (Sin\)	CLK\
5	Z	Data	Data	Freeze
6	Z\	Data\	Data\	Freeze
7	U			
8	U\			
9	V			
10	V\			
11	W		CLK	
12	W\		CLK\	
13	+ V			
14	0 V			
15	Thermistor Input			

4.9 24 Vdc supply

The 24 Vdc supply connected to control terminals 1 & 2 provides the following functions:

- Can be used to supplement the drive's own internal 24 V supply when multiple option modules are being used and the current drawn by these module is greater than the drive can supply.
- Can be used as a back-up power supply to keep the control circuits of the drive powered up when the line power supply is removed. This allows any fieldbus modules, application modules, encoders or serial communication options to continue to operate.
- Can be used to commission the drive when the line power supply is not available, as the display operates correctly. However, the drive will be in the under voltage (UU) trip state unless either line power supply or low voltage DC operation is enabled, therefore diagnostics may not be possible. (Power down save parameters are not saved when using the 24 V back-up power supply input).
- If the DC bus voltage is too low to run the main SMPS in the drive, then the 24 V supply can be used to supply all the low voltage power requirements of the drive. *Low Under Voltage Threshold Select* (**O13**) must also be enabled for this to happen.

NOTE

On size 6 and larger, if the power 24 Vdc supply is not connected none of the above mentioned functions can be used and “Waiting For Power Systems” will be displayed on the keypad. The location of the 24 Vdc power supply connection is shown following.

Table 4-11 24 Vdc Supply connections

Function	Size 3 to 5	Size 6 and 7
Supplement the drive’s internal supply	Control terminal 1, 2	Control terminal 1, 2
Back-up supply for the control circuit	Control terminal 1, 2	Control terminal 1, 2, 50, 51

The working voltage range of the control 24 V power supplies are as follows:

1	**0 V**
2	**+24 Vdc**
All drive sizes	
Nominal operating voltage	+ 24.0 Vdc
Minimum continuous operating voltage	+ 19.2 V
Maximum continuous operating voltage	+ 28.0 V
Minimum start up voltage	+ 21.6 V
Maximum power supply requirement at 24 V	40 W
Recommended fuse	3 A, 50 Vdc

51	**0 V**
52	**+24 Vdc**
Size 6	
Nominal operating voltage	+ 24.0 Vdc
Minimum continuous operating voltage	+ 18.6 Vdc
Maximum continuous operating voltage	+ 28.0 Vdc
Minimum startup voltage	+ 18.4 Vdc
Maximum power supply requirement	40 W
Recommended fuse	4 A @ 50 Vdc
Size 7	
Nominal operating voltage	+ 24.0 Vdc
Minimum continuous operating voltage	+ 19.2 Vdc
Maximum continuous operating voltage	+ 30 Vdc
Minimum startup voltage	+ 21.6 Vdc
Maximum power supply requirement	60 W
Recommended fuse	4 A @ 50 Vdc

Minimum and maximum voltage values include ripple and noise, ripple and noise values must not exceed 5 %.

Figure 4-20 Location of the 24 Vdc power supply connection on size 6

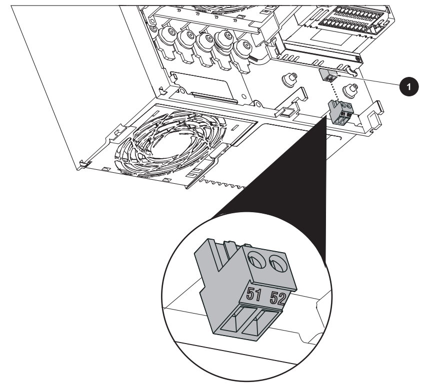
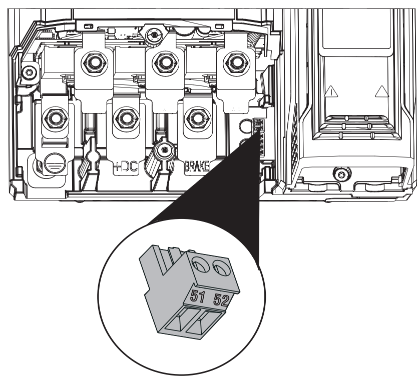


Figure 4-21 Location of the 24 Vdc power supply connection on size 7



4.10 Low voltage operation

With the addition of a 24 Vdc power supply to supply the control circuits, the drive is able to operate from a low voltage DC supply with a range of voltages from 24 Vdc to the maximum DC voltage for the given drive. The working voltage ranges for the low voltage DC power supply are as follows:

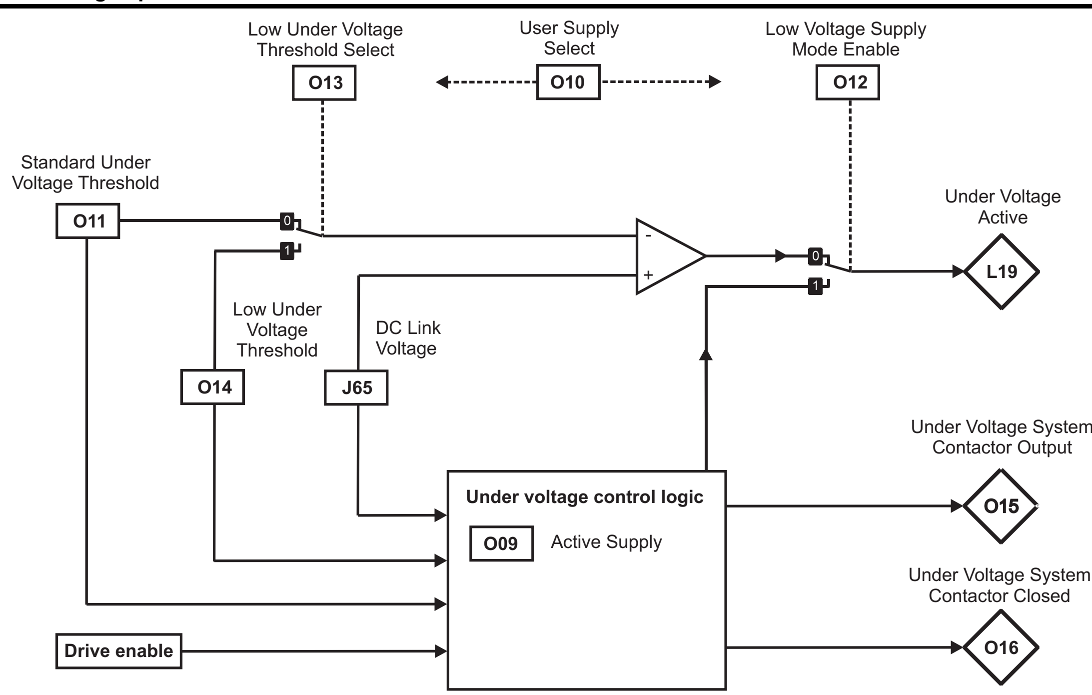
Size 3 to 7

Minimum continuous operating voltage: 26 V

Minimum start up voltage: 32 V

Maximum over voltage trip threshold: 200 V drives = 415 V, 400 V drives = 830 V, 575 V drives = 990 V, 690 V drives = 1190 V

Figure 4-22 Low voltage operation



Going from low voltage operation to normal mains operation requires the inrush current to be controlled. This may be provided externally. If not, the drive supply can be interrupted to utilize the normal soft starting method in the drive. To fully exploit the new low voltage mode of operation the under voltage trip level is now user programmable. Details of the drive set-up and operating parameters are given below.

Table 4-12 Low voltage operation parameters

Parameter	Description
O09	Active Supply
O10	User Supply Select
O11	Standard Under Voltage Threshold
O12	Low Voltage Supply Mode Enable
O13	Low Under Voltage Threshold Select
O14	Low Under Voltage Threshold
O15	Under Voltage System Contactor Output
O16	Under Voltage System Contactor Closed

Active Supply

Parameter *Active Supply* (**O09**). If *LV Supply Mode Enable* (**O12**) = Off (0) then *Active Supply* (**O09**) = Off (0). If *LV Supply Mode Enable* (**O12**) = On (1) then *Active Supply* (**O09**) = Off (0) when the DC link voltage is above the upper under-voltage threshold otherwise *Active Supply* (**O09**) = On (1).

User Supply Select

Parameter *User Supply Select* (**O10**). The power for the drive control system is either taken from the user 24 V power supply input or it is derived from the DC link. If *Low Under Voltage Threshold Select* (**O13**) = Off (0) and *LV Supply Mode Enable* (**O12**) = Off (0) and *User Supply Select* (**O10**) = Off (0) then the supply used is determined from the level of the *DC Bus Voltage* (**J65**). A hysteresis band is provided: if *DC Bus Voltage* (**J65**) is less than 85 % of the minimum value for *Standard Under Voltage Threshold* (**O11**), the 24 V user supply is selected, if *DC Bus Voltage* (**J65**) is more than 95 % of the minimum value for *Standard Under Voltage Threshold* (**O11**), the main supply is selected. If the user 24 V supply is not present and *DC Bus Voltage* (**J65**) is less than 85 % of the minimum value for *Standard Under Voltage Threshold* (**O11**) then the drive simply powers down.

Parameters can be saved by setting Pr **mm00** to 1 or 1000 (not in under-voltage state) or 1001 and initiating a drive reset. Power-down save parameters are saved when the under-voltage state becomes active.

If *Low Under Voltage Threshold Select* (**O13**) = On (1) or *LV Supply Mode Enable* (**O12**) = On (1) or *User Supply Select* (**O10**) = On (1) then the 24 V user supply is always selected if present. If the user 24 V supply is not present then it is not selected and a PSU 24V trip is initiated.

Parameters can only be saved by setting Pr **mm00** to 1001 and initiating a drive reset. Power down save parameters are not saved when the under-voltage state becomes active. It should be noted that for drive sizes 6 and below, if both the 24 V user supply and the main supply are present and the user 24 V supply is removed, the drive will power down and then power up again using the main supply.

Standard Under Voltage Threshold, Under Voltage System

The under-voltage system controls the state of *Under Voltage* (**L19**) active which is then used by the sequencer. Each under voltage threshold detection system includes an hysteresis of 5 % of the actual threshold level therefore:

DC link voltage	Under voltage detection
Vdc	Active
Threshold < Vdc	No change
Vdc > Threshold x 1.05 *	Not active

* Hysteresis is 5% subject to a minimum of 5 V

When *Under Voltage* (**L19**) = On (1) the sequencer will change and it is not possible to enable the drive. The under-voltage system operates in different ways depending on the setting of *LV Supply Mode Enable* (**O12**). If the *Low Under Voltage Threshold* (**O14**) is used or if back-up supply mode is selected the internal drive power supplies are normally powered from the 24 V supply input i.e. (Digital I/O 13). *User Supply Select* (**O10**) should be set to On (1) to select this supply and its monitoring system.

Low Voltage Supply Mode Enable = Off (0)

If *Low Under Voltage Threshold Select* (**O13**) = Off (0) then the under voltage threshold is defined by *Standard Under Voltage Threshold* (**O11**). If *Low Under Voltage Threshold Select* (**O13**) = On (1) then the under voltage threshold is defined by *Low Under Voltage Threshold* (**O14**)

Size 6 drives and smaller have a charging resistor that is in circuit for either the main AC or DC power supplies to the drive. The charge system is generally active when *Under Voltage* (**L19**) = On (1) and inactive when Off (0).

If the DC link voltage is above the under-voltage threshold and *Under Voltage* (**L19**) = Off (0) a large surge of current can occur if the AC supply is removed and then reapplied to the drive.

If the under voltage threshold needs to be lower than the minimum of *Standard Under Voltage Threshold* (**O11**), then the *Low Under Voltage Threshold* (**O14**) should be used. It is important that the difference between the under-voltage threshold level and the peak of the supply voltage is never larger than the difference between the minimum *Standard Under Voltage Threshold* (**O11**) and the peak of the maximum allowed AC supply voltage for the drive. For example:

The minimum *Standard Under Voltage Threshold* (**O11**) for a 400 V drive is 330 V see *Low Under Voltage Threshold* (**O14**))

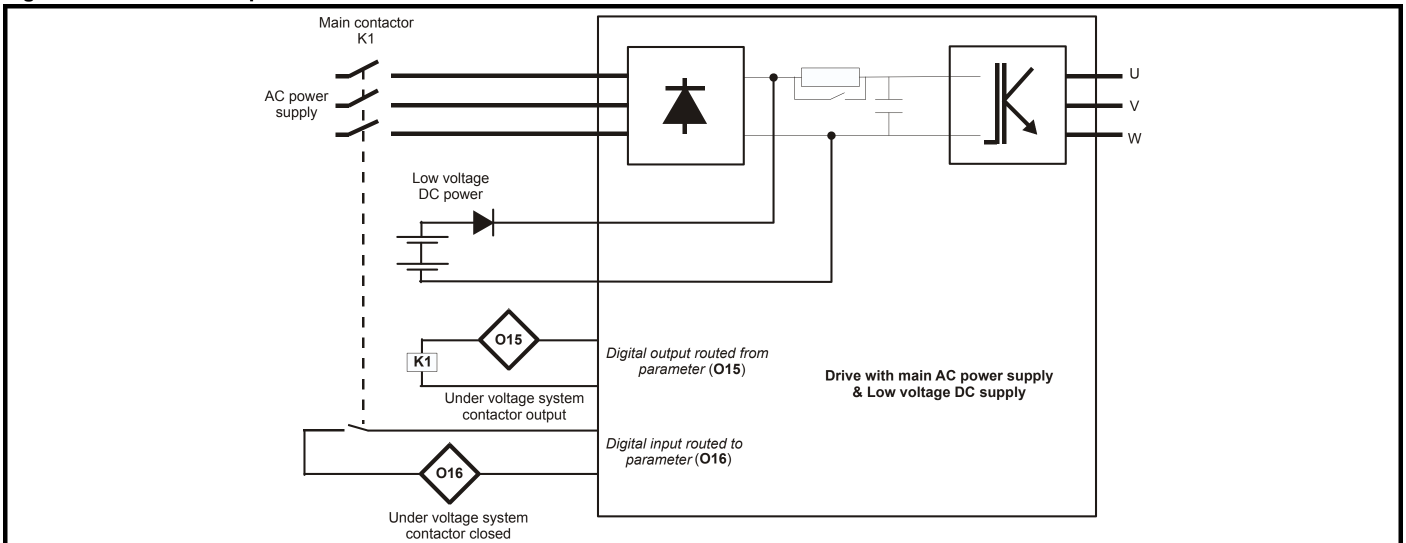
Maximum allowed AC supply voltage: 480 V + 10 %
Peak of maximum allowed AC supply voltage: $480 \times 1.1 \times \sqrt{2} = 747$ V
The difference between the under-voltage threshold and the peak supply voltage = 747 - 330 = 417 V
Therefore for this drive voltage rating the peak line to line voltage must never be higher than *Low Under Voltage Threshold* (**O14**) + 417 V.

If *Low Under Voltage Threshold Select* (**O13**) = On (1) and *Low Under Voltage Threshold* (**O14**) is reduced below the variable maximum level VM_STD_UNDER_VOLTAGE[MIN], or *LV Supply Mode Enable* (**O12**) = On (1), an indication is stored in *Potential Drive Damage Condition* (**L73**) that cannot be cleared by the user. This effectively “marks” the drive so that if it is damaged as a result of an input current surge, this can be detected by service personnel.

For size 7 drives and larger which use a DC link charge system based on a half controlled thyristor input stage, the charge system is activated based on the level of the voltage at the AC supply terminals of the drive. The threshold for the charge system is set so that the rectified supply will give the required under voltage threshold level. The under voltage system operates in exactly the same way as for size 6 drives and smaller.

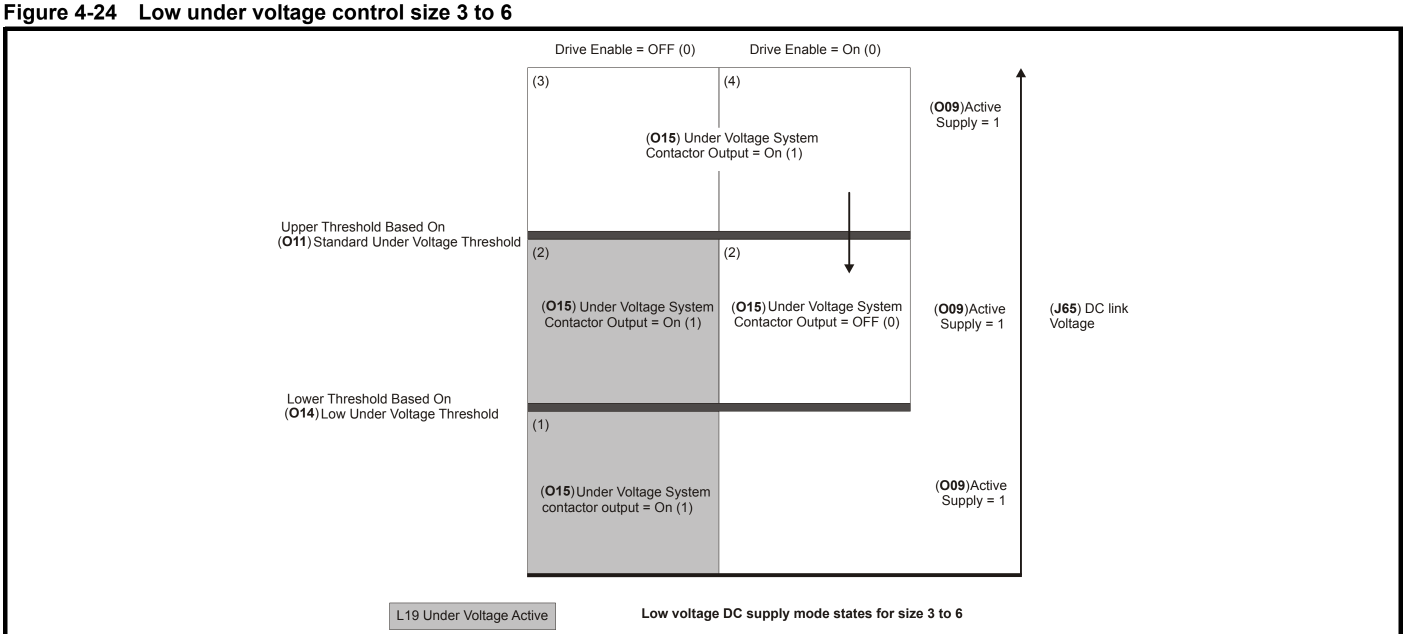
Low Voltage Supply Mode Enable = On (1) Size 3 to 6 drives
LV Supply Mode Enable (**O12**). Low voltage supply mode is intended to provide a smooth transition without disabling the drive, from a high voltage AC supply to a low voltage DC supply. It is necessary to disable the drive for the transition back to the high voltage AC supply from the low voltage DC supply. The following diagram is a simple representation of the power circuit required. This does not include the necessary circuit protection components or possible battery charger.

Figure 4-23 Size 3 to 6 power circuit



The diagram below shows the state of *Under Voltage* (**L19**). The control signal to the external contactor *Under Voltage Contactor Close Output* (**O15**) and *Active Supply* (**O09**). When *LV Supply Mode Enable* (**O12**) = On (1) the maximum applied to *Low Under Voltage Threshold* (**O14**) prevents this from being increased above *Standard Under Voltage Threshold* (**O11**) / 1.1 so that the 5 % hysteresis band on the low under voltage threshold does not overlap the standard under voltage threshold.

Figure 4-24 Low under voltage control size 3 to 6



1. If the *DC Bus Voltage* (**J65**) is below the lower threshold the drive is in the under-voltage state and the internal charge system is active to limit the charging current from either the low voltage DC supply or high voltage AC supply. *Under Voltage Contactor Close Output* (**O15**) = On (1), and so it is possible for the high voltage AC supply to charge the link.
2. If *DC Bus Voltage* (**J65**) is above the *Low Under Voltage Threshold* (**O14**), but below the *Standard Under Voltage Threshold* (**O11**), there are two possible states depending on the Drive enable = On (1) or Off (0). If the Drive enable = Off (0) then *Under Voltage* (**L19**) = On (1) the internal charge system is active and *Under Voltage System Contactor Closed* (**O16**) = On (1) so the DC link can be charged by the high voltage AC supply. If Drive enable = On (1) then *Under Voltage* (**L19**) = Off (0) and the internal charge system is inactive so the drive can run from the low voltage DC supply. *Under Voltage Contactor Close Output* (**O15**) = Off (0), so it is not possible for the high voltage AC supply to charge the DC link.

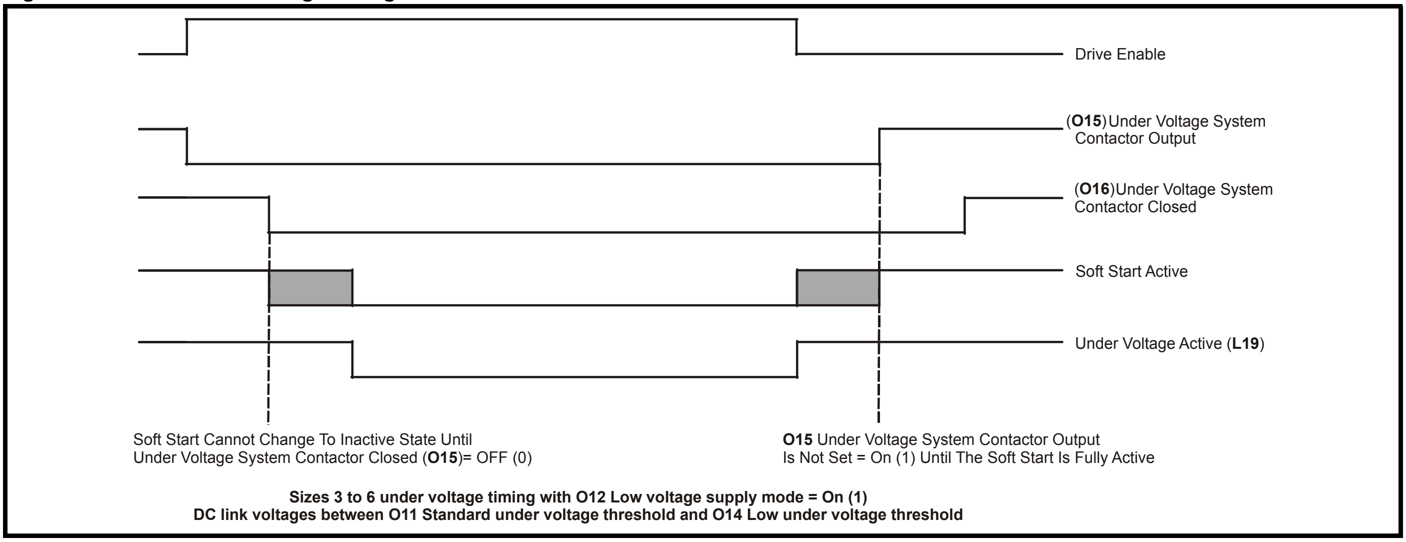
3. If *DC Bus Voltage* (**J65**) is above the *Standard Under Voltage Threshold* (**O11**) then *Under Voltage* (**L19**) = Off (0) and *Under Voltage System Contactor Closed* (**O16**) = On (1), so the drive can run from the high voltage AC supply.
4. If *DC Bus Voltage* (**J65**) subsequently falls below the *Standard Under Voltage Threshold* (**O11**) and the Drive enable = On (1), the drive can continue to run, but *Under Voltage System Contactor Closed* (**O16**)= Off (0) to open the high voltage AC supply contactor. The DC link voltage will fall until it reaches the low voltage DC supply level. This gives a smooth changeover to the backup supply without stopping the motor.

To ensure that the soft-start is in the correct state to protect the drive and to ensure that the under voltage condition is detected correctly the following additional restrictions are applied:

1. The soft start cannot change from the active state unless the DC link voltage is above the upper under voltage threshold or *Under Voltage System Contactor Closed* (**O16**) = On (1).
2. *Under Voltage Contactor Close Output* (**O15**)= On (1) if the DC link voltage is above the upper under voltage threshold or Drive enable = On (1). The *Under Voltage Contactor Close Output* (**O15**) is only set to 0 if the soft-start is fully active.

The following diagram shows how these restrictions apply to the system timing when Lower Threshold ≤ *DC Bus Voltage* (**J65**).

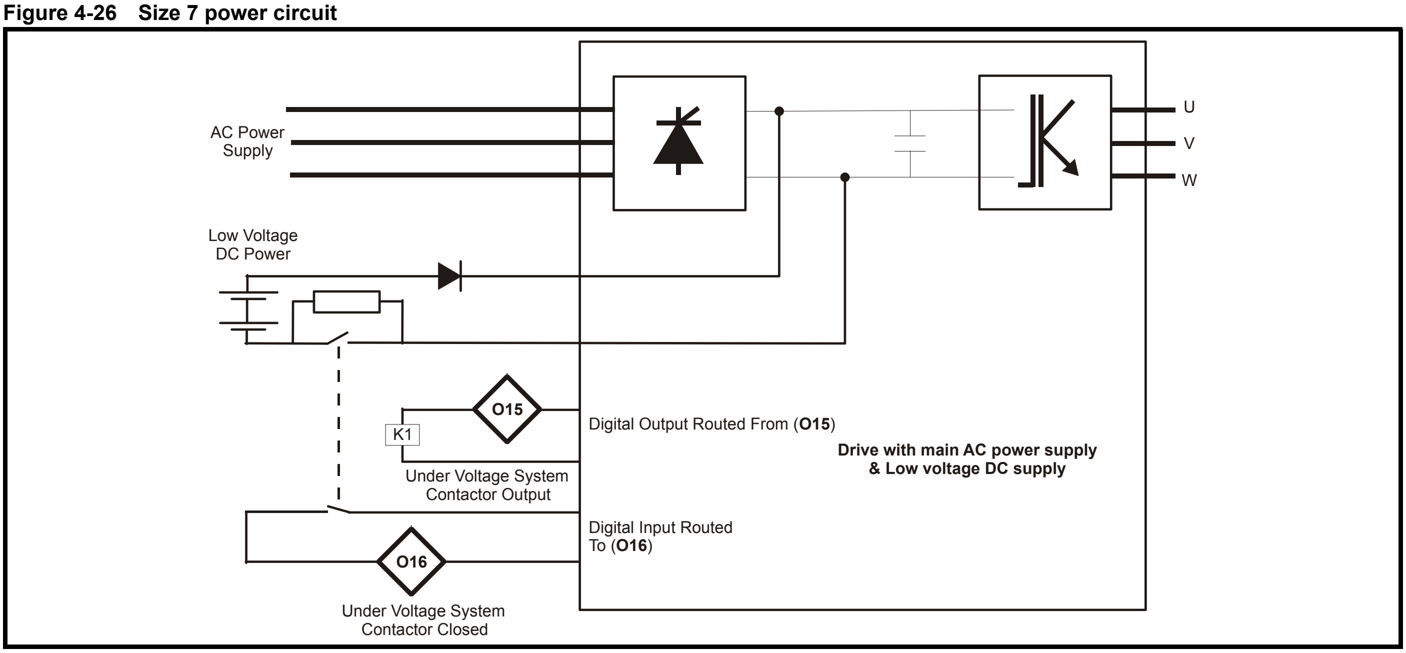
Figure 4-25 Low under voltage timing size 3 to 6



Low Voltage Supply Mode Enable = On (1) Size 7 Drives

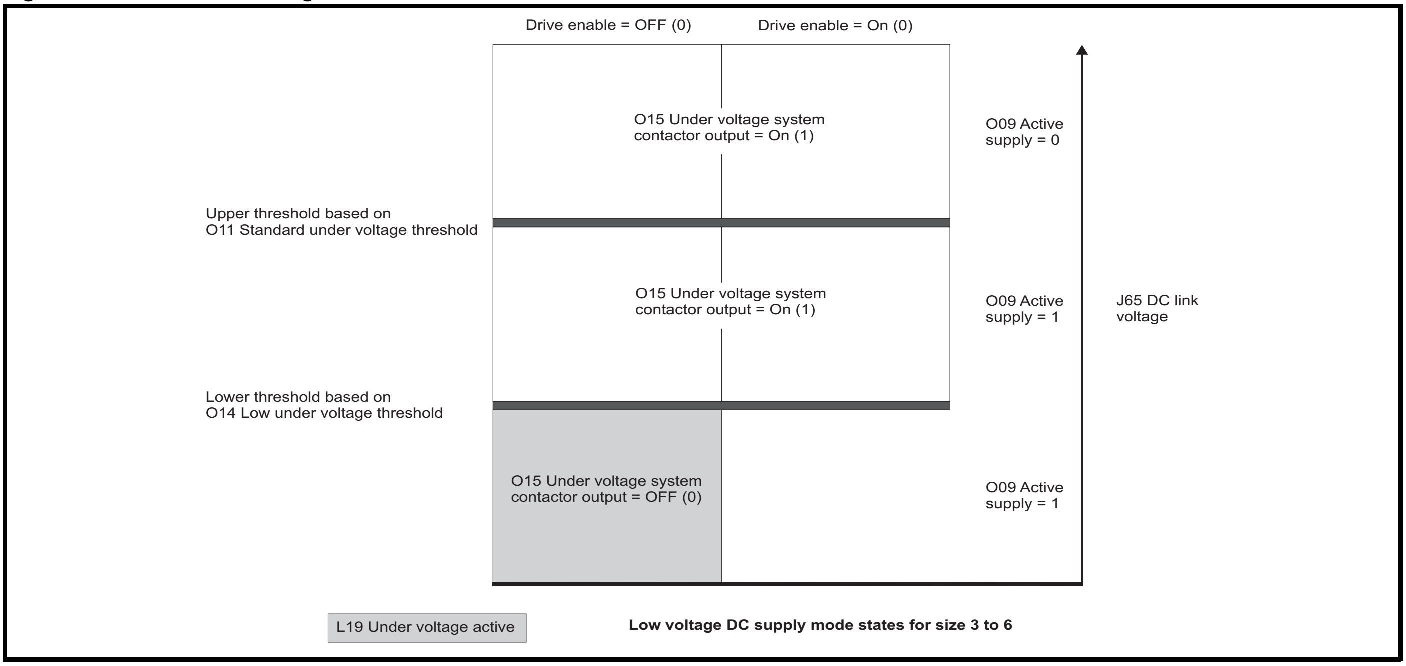
Low voltage mode is intended to provide a smooth transition, without disabling the drive, from a high voltage AC supply to a low voltage DC supply and vice versa. The following diagram is a simple representation of the power circuit required. This does not include the necessary circuit protection components or possible battery charger, etc.

Figure 4-26 Size 7 power circuit



The diagram below shows the state of *Under Voltage* (**L19**) and the control signal to the external contactor Under Voltage Contactor Close Output (**O15**)).

Figure 4-27 Low under voltage control size 7

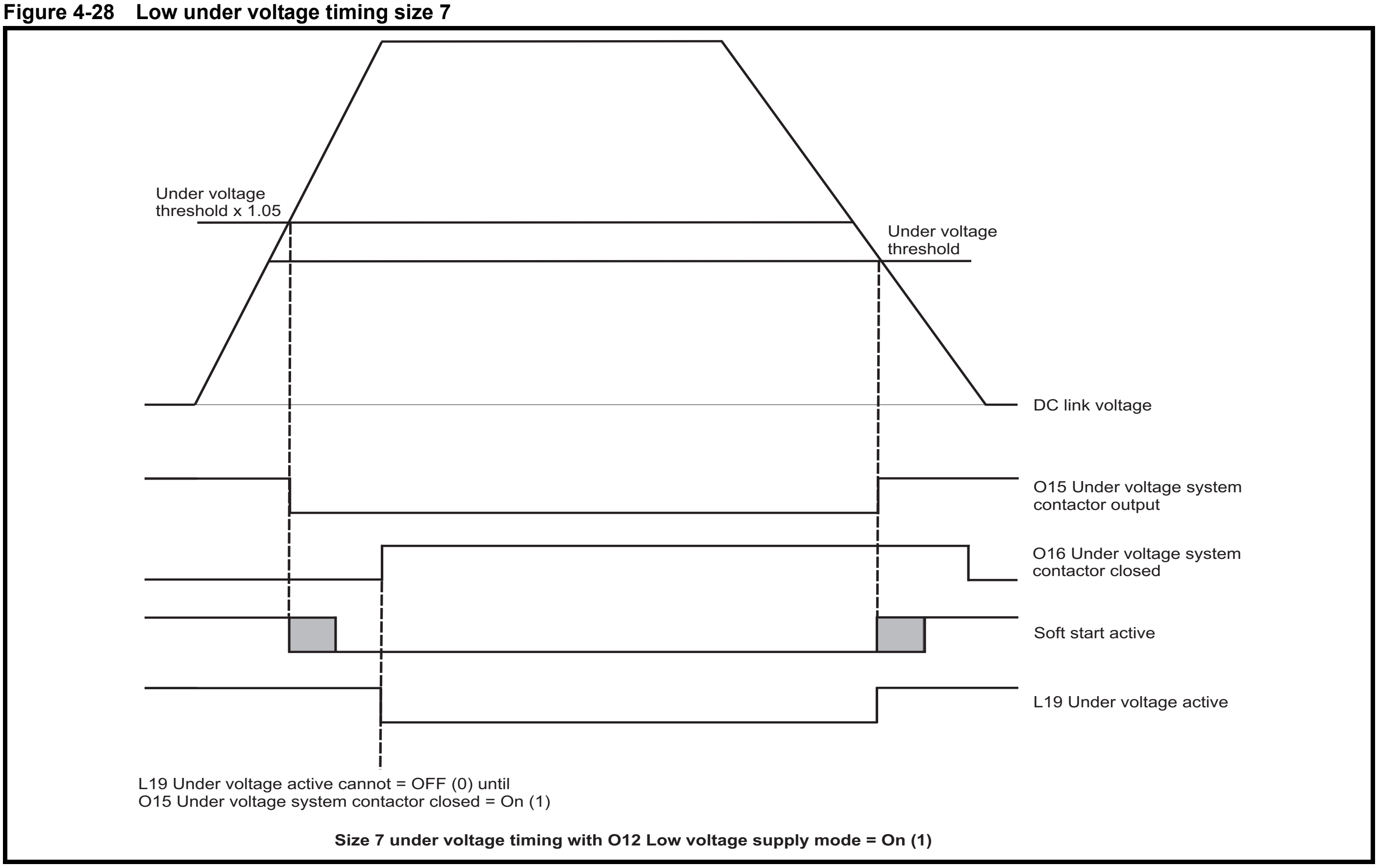


The backup supply system contactor is used to provide the charge system for the low voltage DC supply. The charge system for the high voltage AC. supply is provided by the half controlled thyristor input bridge within the drive. The system operates in a similar way to standard mode i.e. low voltage mode not enabled) with the following differences.

1. The thyristor charge system always uses a threshold voltage related to the upper under voltage threshold.
2. *Under Voltage Contactor Close Output* (**O15**) = On (1) when the DC link voltage is above the lower under voltage threshold.
3. *Under Voltage* (**L19**) cannot be Off (0) if *Under Voltage System Contactor Closed* (**O16**) = Off (0).

The following diagram shows how these differences apply to the system operation.

Figure 4-28 Low under voltage timing size 7



Low voltage supply mode enable

Parameter *LV Supply Mode Enable* (**O12**). See *Standard Under Voltage Threshold* (**O11**) and *User Supply Select* (**O10**) for details of when and how drive parameters can be saved, and when a a PSU 24 V trip can occur.

Low under voltage threshold select

Parameter *Low Under Voltage Threshold Select* (**O13**) See *Standard Under Voltage Threshold* (**O11**), also see *User Supply Select* (**O10**) for details of when and how drive parameters can be saved, and when a a PSU 24 V trip can occur.

Low under voltage threshold

Parameter *Low Under Voltage Threshold* (**O14**)

Voltage	Default value
200 V	175 V
400 V	330 V
575 V	435 V
690 V	435 V

Under voltage system contactor output

Parameter *Under Voltage Contactor Close Output* (**O15**) , see *Standard Under Voltage Threshold* (**O11**).

Under voltage system contactor closed

Parameter *Under Voltage System Contactor Closed* (**O16**), see *Standard Under Voltage Threshold* (**O11**).

4.11 Supplies requiring Input line reactors

Input line reactors reduce the risk of damage to the drive resulting from poor phase balance or severe disturbances on the supply network. Where line reactors are to be used, reactance values of approximately 2 % are recommended. Higher values may be used if necessary, but may result in a loss of drive output (reduced torque at high speed) because of the voltage drop. For all drive ratings, 2 % line reactors permit drives to be used with a supply unbalance of up to 3.5 % negative phase sequence (equivalent to 5 % voltage imbalance between phases). Severe disturbances may be caused by the following factors, for example:

- Power factor correction equipment connected close to the drive.
- Large DC drives having no or inadequate line reactors connected to the supply.
- Across the line (DOL) started motor(s) connected to the supply such that when any of these motors are started, the voltage dip exceeds 20 %.

Such disturbances may cause excessive peak currents to flow in the input power circuit of the drive. This may cause nuisance tripping, or in extreme cases, failure of the drive. Drives of low power rating may also be susceptible to disturbance when connected to supplies with a high rated capacity. Line reactors are particularly recommended for use with the following drive models when the above factors exist, or when the supply capacity exceeds 175 kVA:

Drive models: 03200050, 03200066, 03200080, 03200106, 03400025, 03400031, 03400045, 03400062

Drive models 03400078 to 07600540 have an internal DC reactor and do not require AC line reactors except in extreme supply conditions.

When required, each drive must have its own reactor(s). Three individual reactors or a single three-phase reactor should be used.

Input line reactor current ratings

The current rating of the line reactors should be as follows:

Continuous current rating = Not less than the continuous input current rating of the drive
Repetitive peak current rating = Not less than twice the continuous input current rating of the drive

Input line reactor calculation

To calculate the inductance required (at **Y**%), use the following equation:

$$\mathbf{L} = \frac{\mathbf{Y}}{\mathbf{100}} \times \frac{\mathbf{V}}{\sqrt{3}} \times \frac{\mathbf{1}}{\mathbf{2\pi fI}}$$

Where:

I = drive rated input current (A)
L = inductance (H)
f = supply frequency (Hz)
V = voltage between lines

NOTE

For details of the AC input line reactors required for compliance with IEC 61000-3-12 (EN 12015) refer to section 2.11 *AC input line reactors* on page 23

4.12 Cable selection

The values of maximum continuous input current are given to aid the selection of cables and fuses. These values are stated for the worst case condition with the unusual combination of stiff supply with high imbalance. The value stated for the maximum continuous input current would only be seen in one of the input phases. The current in the other two phases would be significantly lower.

The values of maximum input current are stated for a supply with a 2 % negative phase-sequence imbalance and rated at the maximum current given in section 2.4 *Ratings* on page 12. Refer to local wiring regulations for the correct size of cables. In some cases a larger cable is required to avoid excessive voltage drop.

NOTE

The nominal output cable size assumes the motor maximum current matches that of the drive. Where a motor of reduced rating is used the cable rating may be chosen to match that of the motor. To ensure that the motor and cable are protected against over-load, the drive must be programmed with the correct motor rated current.

NOTE

Ensure cables used suit local wiring regulations.

CAUTION

The nominal cable sizes below are only a guide. The mounting and grouping of cables affects their current-carrying capacity, in some cases smaller cables may be acceptable but in other cases a larger cable is required to avoid excessive temperature or voltage drop. Refer to local wiring regulations for the correct size of cables.

4.12.1 Cable type

Use 105 °C (221 °F) (UL 60/75 °C (temp rise) PVC-insulated cable with copper conductors having a suitable voltage rating, for the following power connections:

- AC supply to external EMC filter (when used)
- AC supply (or external EMC filter) to drive
- Drive to motor
- Drive to braking resistor

Most cables have an insulating jacket between the cores and the armor or shield; these cables have a low capacitance and are recommended.

Table 4-13 Cable ratings (200 V)

Model	Cable size (IEC) mm^2						Cable size (UL) AWG			
	Input			Output			Input		Output	
	Nominal	Maximum	Installation	Nominal	Maximum	Installation	Nominal	Maximum	Nominal	Maximum
03200050	1.5	4	B2	1.5	4	B2	14	10	14	10
03200066										
03200080	4			4			12		12	
03200106										
04200137	6	8	B2	6	8	B2	10	8	10	8
04200185	8			8			8		8	
05200250	10	10	B2	10	10	B2	8	8	8	8
06200330	16	25	B2	16	25	B2	4	3	4	3
06200440	25			25			3		3	
07200610	35	70	B2	35	70	B2	2	1/0	2	1/0
07200750							1		1	
07200830	70			70			1/0		1/0	

Table 4-14 Cable ratings (400 V)

Model	Cable size (IEC) mm^2						Cable size (UL) AWG			
	Input			Output			Input		Output	
	Nominal	Maximum	Installation	Nominal	Maximum	Installation	Nominal	Maximum	Nominal	Maximum
03400025	1.5	4	B2	1.5	4	B2	18	10	18	10
03400031							16		16	
03400045							14		14	
03400062	2.5			2.5						
03400078										
03400100							12		12	
04400150	4	6	B2	4	6	B2	10	8	10	8
04400172	6			6			8		8	
05400270	6	6	B2	6	6	B2	8	8	8	8
05400300										
06400350	10	25	B2	10	25	B2	6	3	6	3
06400420	16			16			4		4	
06400470	25			25			3		3	
07400660	35	70	B2	35	70	B2	1	1/0	1	1/0
07400770	50			50			2		2	
07401000	70			70			1/0		1/0	

Table 4-15 Cable ratings (575 V)

Model	Cable size (IEC) mm^2						Cable size (UL) AWG			
	Input			Output			Input		Output	
	Nominal	Maximum	Installation	Nominal	Maximum	Installation	Nominal	Maximum	Nominal	Maximum
05500030	0.75	1.5	B2	0.75	1.5	B2	16	16	16	16
05500040	1			1			14		14	
05500069	1.5			1.5			14		14	
06500100	2.5	25	B2	2.5	25	B2	14	3	14	3
06500150	4			4			10		10	
06500190	6			6			10		10	
06500230	10			10			8		8	
06500290							6		6	
06500350	16						6		6	
07500440	16	25	B2	16	25	B2	4	3	4	3
07500550	25			25			3		3	

Table 4-16 Cable ratings (690 V)

Model	Cable size (IEC) mm^2						Cable size (UL) AWG			
	Input			Output			Input		Output	
	Nominal	Maximum	Installation method	Nominal	Maximum	Installation method	Nominal	Maximum	Nominal	Maximum
07600190	10	25	B2	10	25	B2	8	3	8	3
07600240							6		6	
07600290							6		6	
07600380	16			16			4		4	
07600440	16			16			4		4	
07600540	25			25			3		3	

NOTE

PVC insulated cable should be used.

NOTE

Cable sizes are from IEC60364-5-52:2001 table A.52.C with correction factor for 40°C ambient of 0.87 (from table A52.14) for cable installation method as specified.

Installation class (ref: IEC60364-5-52:2001)
B1 - Separate cables in conduit.
B2 - Multicore cable in conduit.
C - Multicore cable in free air.

Cable size may be reduced if a different installation method is used, or if the ambient temperature is lower.

NOTE

The nominal output cable sizes assume that the motor maximum current matches that of the drive. Where a motor of reduced rating is used, the cable rating may be chosen to match that of the motor. To ensure that the motor and cable are protected against overload, the drive must be programmed with the correct motor rated current.

4.13 Output circuit and motor protection

The output circuit has fast-acting electronic short-circuit protection which limits the fault current to typically no more than five times the rated output current, and interrupts the current in approximately 20 µs. No additional short-circuit protection devices are required. The drive provides overload protection for the motor and its cable. For this to be effective, *Motor Rated Current* (**B02**) must be set to suit the motor.

WARNING

Motor Rated Current (**B02**) must be set correctly to avoid a risk of fire in the event of motor overload.

There is also provision for the use of a motor thermistor to prevent over-heating of the motor, e.g. due to loss of cooling.

4.13.1 Motor winding voltage

The PWM output voltage can adversely affect the inter-turn insulation in the motor. This is because of the high rate of change of voltage, in conjunction with the impedance of the motor cable and the distributed nature of the motor winding.

For normal operation with AC supplies up to 500 Vac and a standard motor with a good quality insulation system, there is no need for any special precautions. In case of doubt the motor supplier should be consulted. Special precautions are recommended under the following conditions, but only if the motor cable length exceeds 10 m:

- AC supply voltage exceeds 500 V
- DC supply voltage exceeds 670 V
- Operation of 400 V drive with continuous or very frequent sustained braking

For the other cases listed, it is recommended that an inverter-rated motor be used taking into account the voltage rating of the inverter. This has a reinforced insulation system intended by the manufacturer for repetitive fast-rising pulsed voltage operation.

Users of 575 V NEMA rated motors should note that the specification for inverter-rated motors given in NEMA MG1 section 31 is sufficient for motoring operation but not where the motor spends significant periods braking. In that case an insulation peak voltage rating of 2.2 kV is recommended.

If it is not practical to use an inverter-rated motor, an output inductor should be used. The recommended type is a simple iron-cored component with a reactance of about 2 %. The exact value is not critical. This operates in conjunction with the capacitance of the motor cable to increase the rise-time of the motor terminal voltage and prevent excessive electrical stress.

4.13.2 Star / Delta motor operation

The voltage rating for Star and Delta connections of the motor should always be checked before attempting to run the motor. The default setting of the motor rated voltage parameter is the same as the drive rated voltage, i.e:

400 V drive 400 V rated voltage
230 V drive 230 V rated voltage

A typical 3 phase motor would be connected in Star for 400 V operation or Dela for 230 V operation, however, variations on this are common e.g. Star 690 V Delta 400 V.

Incorrect connection of the windings will cause severe under or over fluxing of the motor, leading to a very poor output torque or motor saturation and overheating respectively.

4.13.3 Output contactor

WARNING

If the cable between the drive and the motor is to be interrupted by a contactor ensure that the drive is disabled before the contactor is opened or closed. Severe arcing may occur if this circuit is interrupted with the motor running at high current and low speed.

A contactor is sometimes required to be installed between the drive and motor for safety purposes. The recommended motor contactor is the AC3 type. Switching of an output contactor should only occur when the output of the drive is disabled. Opening or closing of the contactor with the drive enabled will lead to:

1. OI ac trips (which cannot be reset for 10 seconds)
2. High levels of radio frequency noise emission
3. Increased contactor wear and tear

The Drive enable on control (terminal 31) when opened provides a Safe Torque Off (STO) function. This can in many cases replace output contactors. For further information see section 4.18 *Safe Torque Off (STO)* on page 104.

4.14 Braking

Braking occurs when the drive is decelerating the motor, or is preventing the motor from gaining speed due to mechanical influences. During braking, energy is returned to the drive from the motor. When motor braking is applied by the drive, the maximum regenerated power that the drive can absorb is equal to the power dissipation (losses) of the drive.

When the regenerated power is likely to exceed these losses, the DC bus voltage of the drive increases. Under default conditions, the drive brakes the motor under PI control, which extends the deceleration time as necessary in order to prevent the DC bus voltage from rising above a user defined set-point. If the drive is expected to rapidly decelerate a load, or to hold back an overhauling load, a braking resistor must be installed.

Table 4-17 shows the default DC voltage level at which the drive turns on the braking transistor. However the braking resistor turn on and the turn Off voltages are programmable with *Braking IGBT Lower Threshold* (**D19**) and *Braking IGBT* (**D20**) upper threshold.

Table 4-17 Default braking transistor turn on voltage

Drive voltage rating	DC bus voltage level
200 V	390 V
400 V	780 V
575 V	930 V
690 V	1120 V

WARNING

High temperatures
Braking resistors can reach high temperatures. Locate braking resistors so that damage cannot result. Use cable having insulation capable of withstanding high temperatures.

CAUTION

Braking resistor overload protection parameter settings. Failure to observe the following information may damage the resistor.
The drive software contains an overload protection function for a braking resistor.

Parameter	Detail
Braking Resistor Rated Power (**D15**)	Power units in kW and if the rated power is set to zero this protection is disabled
Braking Resistor Thermal Time Constant (**D16**)	The thermal time constant of the resistor can be calculated from the single pulse energy rating (E) and continuous power rating (P) of the resistor. Thermal time constant = $\tau = E / P$
Braking Resistor Resistance (**D18**)	Braking resistor resistance in ohms

The drive software contains an overload protection function for a braking resistor. In order to enable and set-up this function, it is necessary to enter three values into the drive:

- *Braking Resistor Rated Power* (**D15**)
- Braking Resistor Thermal Time Constant (**D16**)
- *Braking Resistor Resistance* (**D18**)

This data should be obtained from the manufacturer of the braking resistors.

Braking Resistor Thermal Accumulator (**D17**) gives an indication of braking resistor temperature based on a simple thermal model. Zero indicates the resistor is close to ambient and 100 % is the maximum temperature the resistor can withstand. A 'Brake Resistor' alarm is given if this parameter is above 75 % and the braking IGBT is active. A Brake R Too Hot trip will occur if *Braking Resistor Thermal Accumulator* (**D17**) reaches 100 %, when *Action On Trip Detection* (**H45**) is set to 0 default value) or 1.

If *Action On Trip Detection* (**H45**) is equal to 2 or 3, a Brake R Too Hot trip will not occur when *Braking Resistor Thermal Accumulator* (**D17**) reaches 100 %, but instead the braking IGBT will be disabled until *Braking Resistor Thermal Accumulator* (**D17**) falls below 95 %. This option is intended for applications with parallel connected DC buses where there are several braking resistors, each of which cannot withstand full DC bus voltage continuously. With this type of application, it is unlikely the braking energy will be shared equally between the resistors because of voltage measurement tolerances within the individual drives. Therefore with *Action On Trip Detection* (**H45**) set to 2 or 3, then as soon as a resistor has reached its maximum temperature the drive will disable the braking IGBT, and another resistor on another drive will take up the braking energy. Once *Braking Resistor Thermal Accumulator* (**D17**) has fallen below 95 % the drive will allow the braking IGBT to operate again.

This software overload protection should be used in addition to an external overload protection device.

When a braking resistor is to be mounted outside the enclosure, ensure that it is mounted in a ventilated metal housing that will perform the following functions:

- Prevent inadvertent contact with the resistor
- Allow adequate ventilation for the resistor

When compliance with EMC emission standards is required, external connection requires the cable to be armored or shielded, since it is not fully contained in a metal enclosure. See section 4.17.3 *Sensitive control signal* on page 100 for further details. Internal connection does not require the cable to be armored or shielded.

4.14.1 Minimum resistances and power ratings for the braking resistor at 40 °C (104 °F)

WARNING

Overload protection
When an external braking resistor is used, it is essential that an overload protection device is incorporated in the braking resistor circuit; this is described in *Figure 4-29 Typical protection circuit for a braking resistor* on page 96.

Table 4-18 Braking resistor resistance and power rating (200 V)

Model	Minimum resistance * Ω	Instantaneous power rating kW	Continuous power rating kW
03200050	20	8.5	1.5
03200066			1.9
03200080			2.8
03200106			3.6
04200137	18	9.4	4.6
04200185			6.3
05200250	16.5	10.3	8.6
06200330	8.6	19.7	12.6
06200440			16.4
07200610	6.1	27.8	20.5
07200750			24.4
07200830	4.5	37.6	32.5

Table 4-19 Braking resistor resistance and power rating (400 V)

Model	Minimum resistance * Ω	Instantaneous power rating kW	Continuous power rating kW
03400025	74	9.2	1.5
03400031			2.0
03400045			2.8
03400062			4.6
03400078	50	13.6	5.0
03400100			6.6
04400150	34	19.9	9.0
04400172			12.6
05400270	31.5	21.5	16.2
05400300	18	37.5	19.6
06400350	17	39.8	21.6
06400420			25
06400470			32.7
07400660	9.0	75.2	41.6
07400770			50.6
07401000	7.0	96.6	60.1

Table 4-20 Braking resistor resistance and power rating (575 V)

Model	Minimum resistance * Ω	Instantaneous power rating kW	Continuous power rating kW
05500030	80	12.1	2.6
05500040			4.6
05500069			6.5
06500100	13	74	8.7
06500150			12.3
06500190			16.3
06500230			19.9
06500290			24.2
06500350			31.7
07500440	8.5	113.1	39.5
07500550			47.1

Table 4-21 Braking resistor resistance and power rating (690 V)

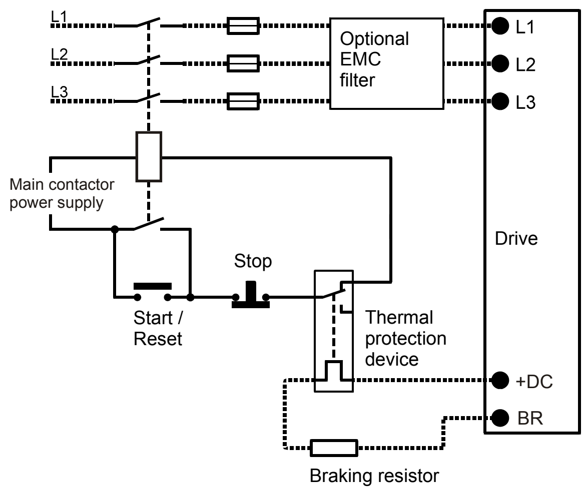
Model	Minimum resistance * Ω	Instantaneous power rating kW	Continuous power rating kW
07600190	11.5	121.2	20.6
07600240			23.9
07600290			32.5
07600380			41.5
07600440			47.8
07600540			60.5

* Resistor tolerance: ±10 %

Thermal protection circuit for the braking resistor

The thermal protection circuit must disconnect the AC supply from the drive if the resistor becomes overloaded due to a fault. Figure 4-29 shows a typical circuit arrangement.

Figure 4-29 Typical protection circuit for a braking resistor



See section 4.3 *Power connections* on page 60 for the location of the +DC and braking resistor connections.

4.15 Ground leakage

The ground leakage current depends upon whether the internal EMC filter is installed or not. The drive is supplied with the internal EMC filter installed. Instructions for removing the internal filter are given in section 3.10.1 *Internal EMC filter* on page 49.

With internal filter installed:

Size 3 to 5: 28 mA* AC at 400 V 50 Hz
30 μA DC with a 600 V DC bus (10 MΩ)

Size 7 to 10: 56 mA* AC at 400 V 50 Hz
18 μA DC with a 600 V DC bus (33 MΩ)

* Proportional to the supply voltage and frequency.

With internal filter removed: <1 mA

WARNING

When the internal filter is installed the leakage current is high. In this case a permanent fixed ground connection must be provided, or other suitable measures taken to prevent a safety hazard occurring if the connection is lost.

4.15.1 Use of residual current device (RCD)

There are three common types of ELCB / RCD:

1. AC - detects AC fault currents
2. A - detects AC and pulsating DC fault currents (provided the DC current reaches zero at least once every half cycle)
3. B - detects AC, pulsating DC and smooth DC fault currents
   - Type AC should never be used with drives
   - Type A can only be used with single phase drives
   - Type B must be used with three phase drives

WARNING

Only type B ELCB / RCD are suitable for use with 3 phase inverter drives.

If an external EMC filter is used, a delay of at least 50 ms should be incorporated to ensure spurious trips are not seen. The leakage current is likely to exceed the trip level if all of the phases are not energized simultaneously.

4.16 EMC (Electromagnetic compatibility)

The requirements for EMC are divided into three levels in the following three sections:

- **General requirements** for all applications, to ensure reliable operation of the drive and minimise the risk of disturbing nearby equipment.
- **Requirements for meeting the EMC standard for power drive systems**, **IEC61800-3 (EN 61800-3:2004).**
- **Requirements for meeting the generic emission standards for the industrial environment**, **IEC61000-6-4, EN 61000-6-4:2007.**

The recommendations will usually be sufficient to avoid causing disturbance to adjacent equipment of industrial quality. If particularly sensitive equipment is to be used nearby, or in a non-industrial environment, then the recommendations of **Requirements for meeting the EMC standard for power drive systems** or **Requirements for meeting the generic emission standards for the industrial environment** should be followed to give reduced radio-frequency emission. For full details refer to section 2.12 *EMC compliance (general standards)* on page 24.

In order to ensure the installation meets the various emission standards described in:

- The EMC data sheet available from the supplier of the drive

The correct external EMC filter must be used for further details refer to section 2.10 *EMC filters* on page 22.

WARNING

High ground leakage current
When an EMC filter is used, a permanent fixed ground connection must be provided which does not pass through a connector or flexible power cord. This includes the internal EMC filter.

NOTE

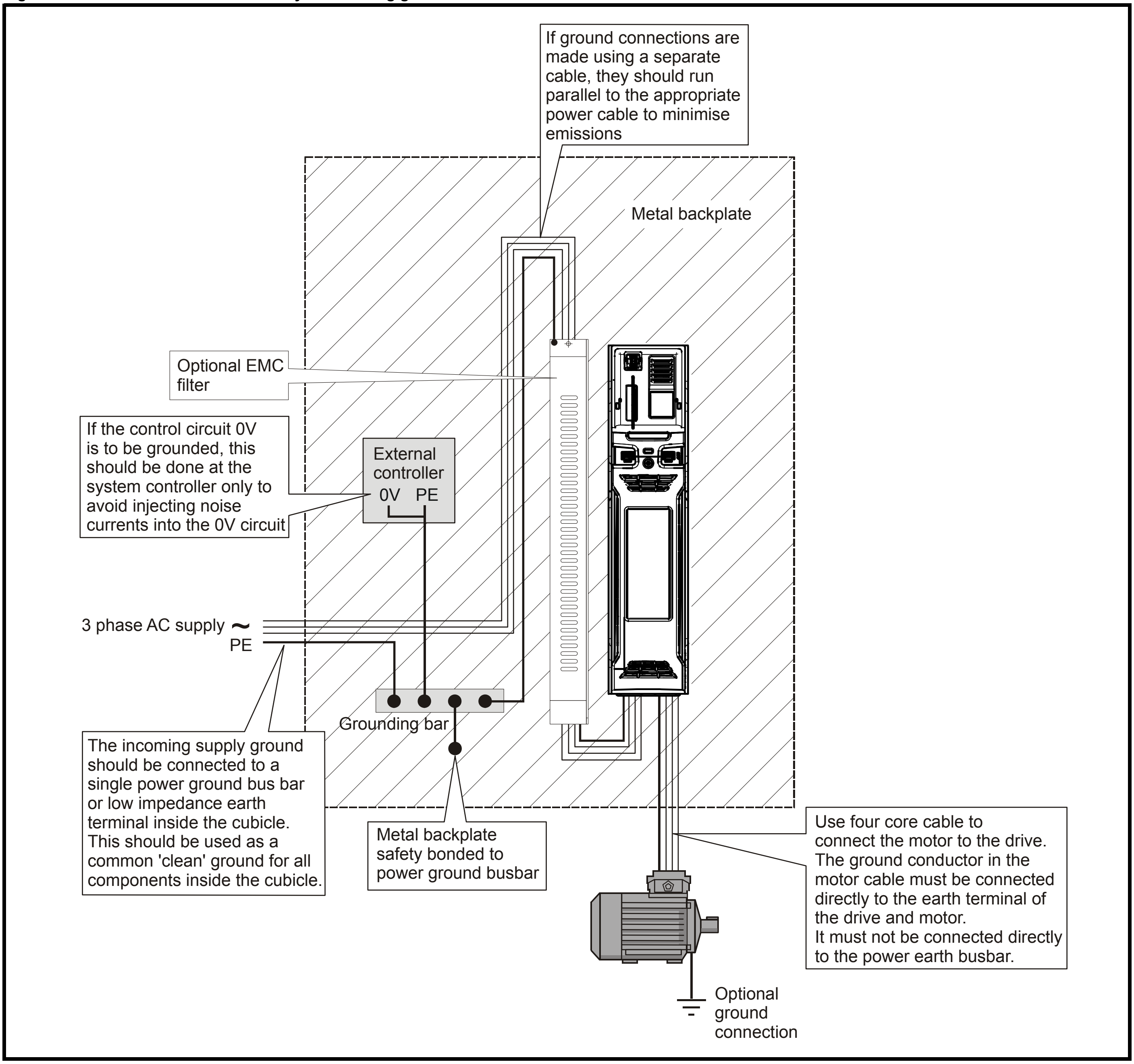
The installer of the drive is responsible for ensuring compliance with the EMC regulations that apply in the country in which the drive is to be used.

4.17 General requirements for EMC

Ground connections

The grounding arrangements should be in accordance with the following, which shows a single drive on a back-plate with or without an additional enclosure. Figure 4-30 *General EMC enclosure layout showing ground connections* following shows how to configure and minimise EMC when using un-shielded motor cable. However shielded cable is a better option, in which case it should be installed as shown in section 4.17.3 *Sensitive control signal* on page 100.

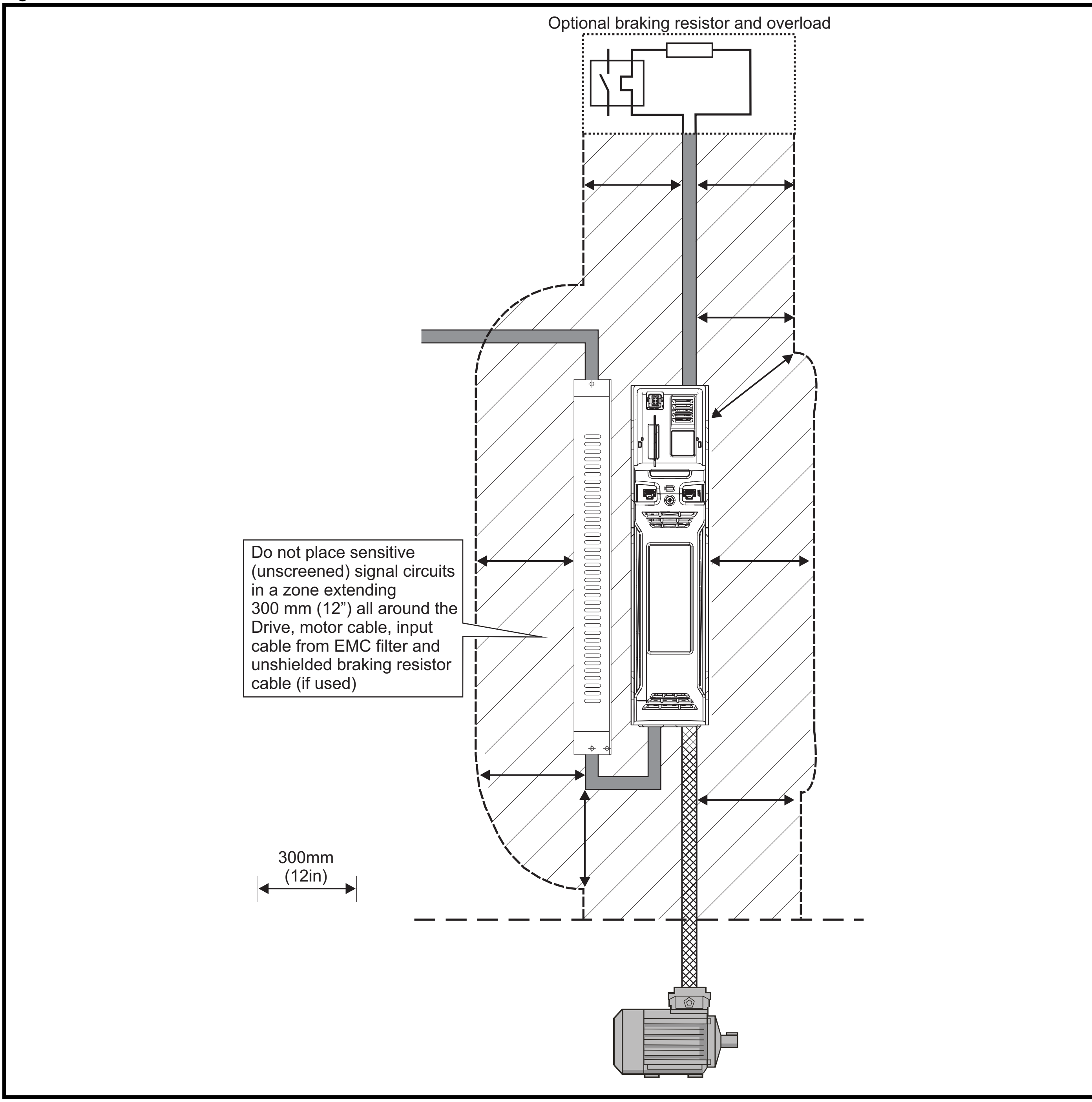
Figure 4-30 General EMC enclosure layout showing ground connections



4.17.1 Cable layout

Figure 4-31 shows the clearances which should be observed around the drive and related 'noisy' power cables by all sensitive control signals / equipment.

Figure 4-31 Drive cable clearances



4.17.2 EMC requirements (first and second environments)

Operation in the first environment

An external EMC filter will always be required.

> **CAUTION**
> This is a product of the restricted distribution class according to IEC 61800-3
> In a residential environment this product may cause radio interference in which case the user may be required to take adequate measures.

Operation in the second environment

In all cases a shielded motor cable must be used, and an EMC filter is required for all drives with a rated input current of less than 100 A. The drive contains an integral filter for basic emission control. In some cases feeding the motor cables (U, V and W) once through a ferrite ring can maintain compliance for longer cable lengths. For longer motor cables, an external filter is required. Where a filter is required refer to Figure 2.10 *EMC filters* .

Where a filter is not required, follow the guidelines given in section 4.17 *General requirements for EMC* on page 98.

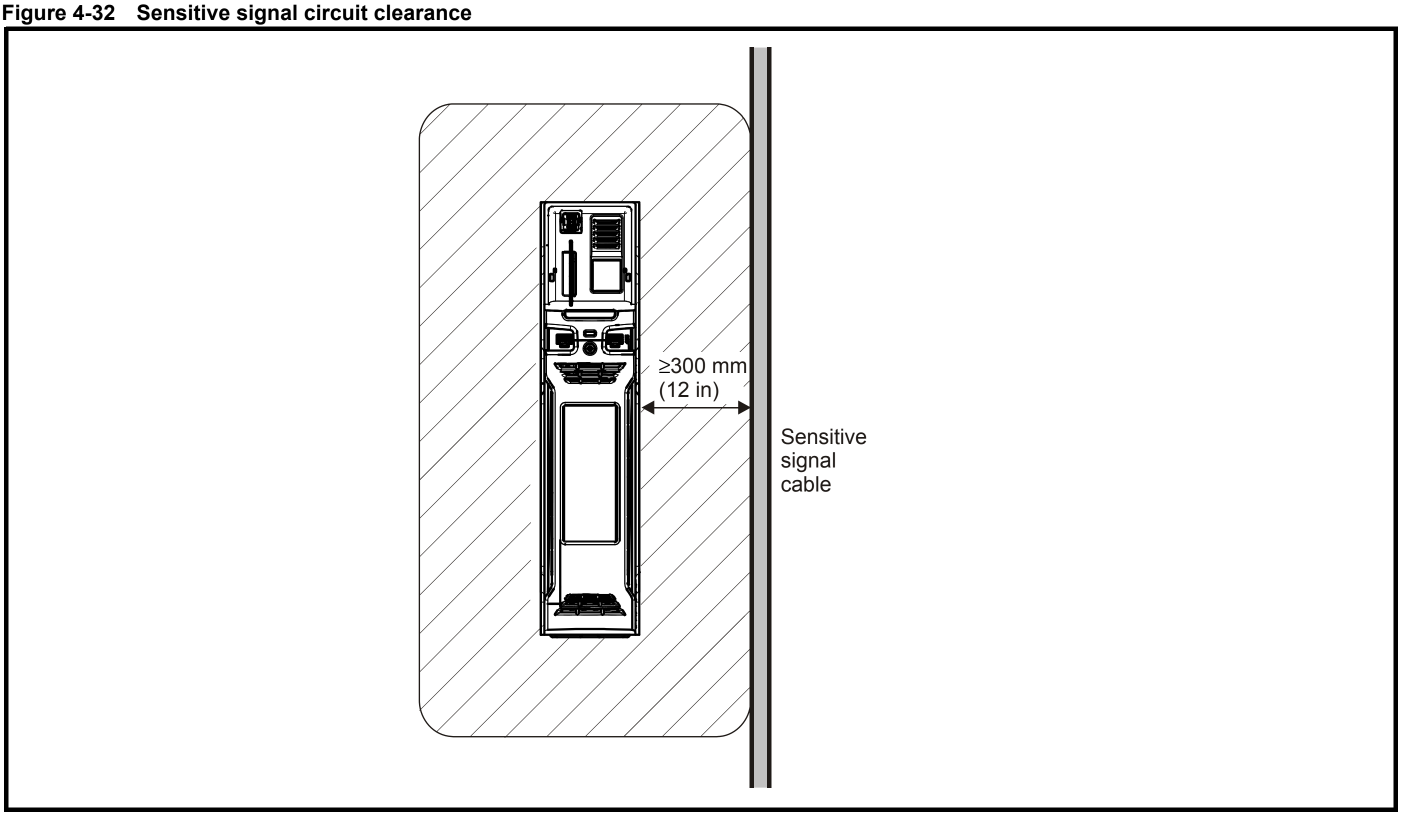
> **CAUTION**
> The second environment typically includes an industrial low-voltage power supply network which does not supply buildings used for residential purposes. Operating the drive in this environment without an external EMC filter may cause interference to nearby electronic equipment whose sensitivity has not been appreciated. The user must take remedial measures if this situation arises. If the consequences of unexpected disturbances are severe, it is recommended that the guidelines in section 4.17.3 *Sensitive control signal* on page 100 be adhered to.

Detailed instructions and EMC information are given in section 2.10 *EMC filters* on page 22.

4.17.3 Sensitive control signal

The following information applies to sizes 3 to 7. Avoid placing sensitive signal circuits in a zone 300 mm (12 in) in the area immediately surrounding the power module. Ensure good EMC grounding.

Figure 4-32 Sensitive signal circuit clearance



4.17.4 Grounding of the drive and EMC filter

Connect the shield of the motor cable to the ground terminal of the motor frame using a link that is as short as possible and not exceeding 50 mm (2 in) long. A complete 360° termination of the shield to the terminal housing of the motor is beneficial.

From an EMC consideration it is irrelevant whether the motor cable contains an internal (safety) ground core, or if there is a separate external ground conductor, or where grounding is through the shield alone. An internal ground core will carry a high noise current and therefore it must be terminated as close as possible to the shield termination.

Figure 4-33 Grounding the drive, motor cable shield and filter

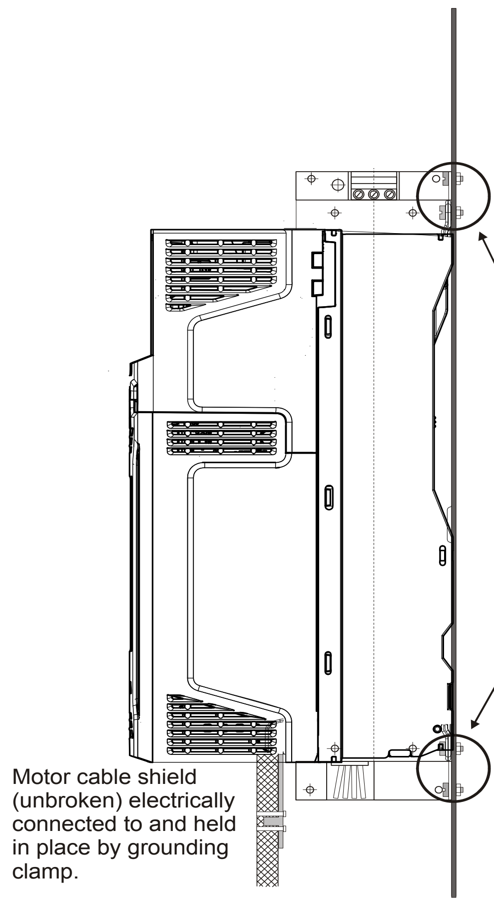
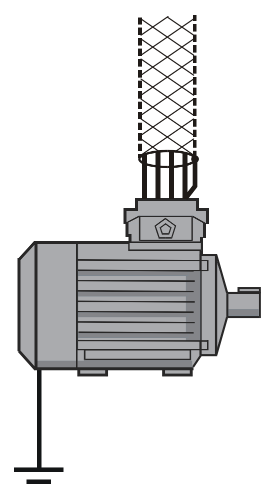


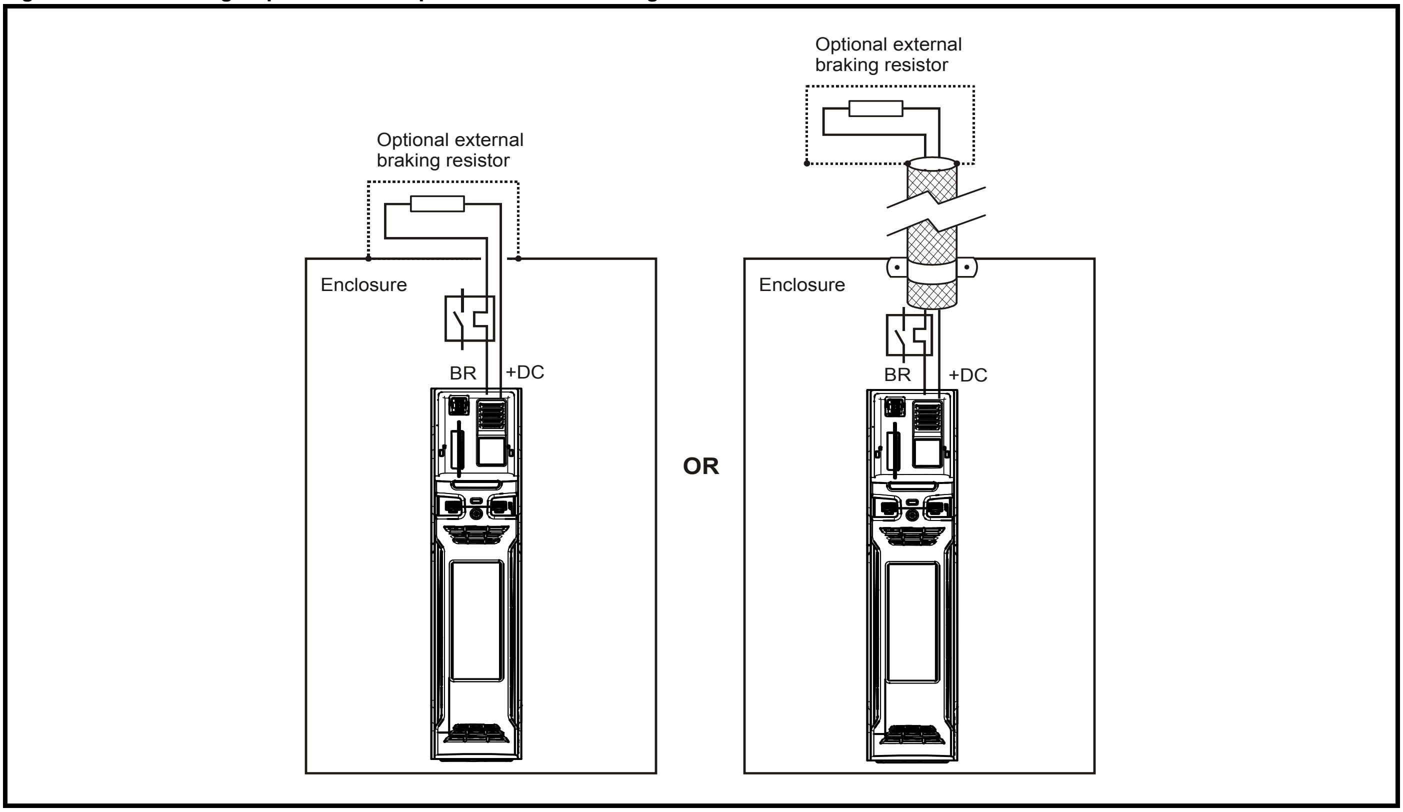
Figure 4-34 Grounding the motor cable shield



4.17.5 Shielding requirements for the braking circuit

Un-shielded wiring to the external braking resistor may be used provided the wiring runs internally to the enclosure. Ensure a minimum spacing of 300 mm (12 in) from the signal wiring and the AC supply wiring to the external EMC filter. If this condition cannot be met then the wiring must be shielded.

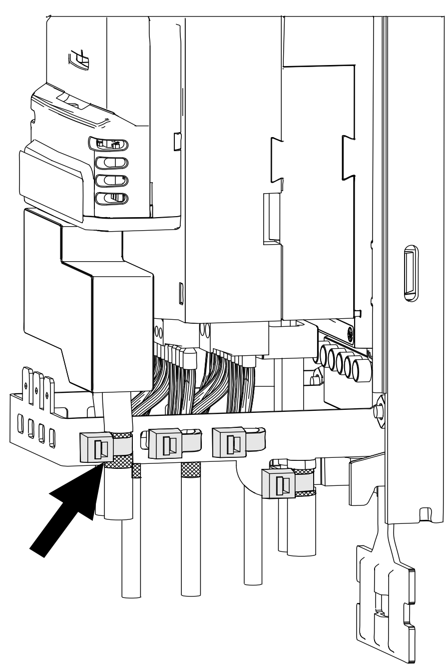
Figure 4-35 Shielding requirements of optional external braking resistor



4.17.6 Shielding requirements for the control circuit

If the control wiring is to leave the enclosure, it must be shielded and the shield clamped to the drive using the grounding bracket as shown in Figure 4-36 *Grounding of signal cable shields using the grounding bracket* . Remove the outer insulating cover of the cable to ensure the shield(s) make direct contact with the bracket (see arrow in Figure 4-36 below). Keep the shield(s) intact until as close as possible to the terminals. Alternatively, wiring may be passed through a ferrite ring.

Figure 4-36 Grounding of signal cable shields using the grounding bracket



4.17.7 Interruptions to the motor cable

The motor cable should ideally be a single length of shielded or armored cable having no interruptions. In some situations it may be necessary to interrupt the cable as shown in the following examples:

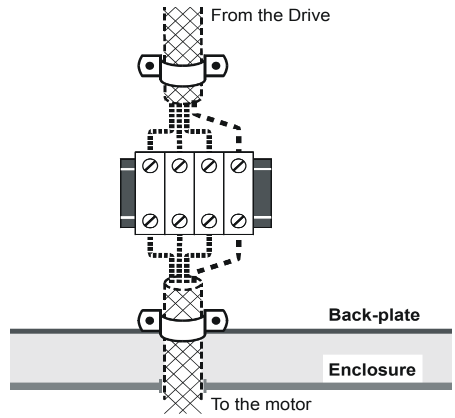
- Connecting the motor cable to a terminal block in the drive enclosure
- Installing a motor isolator / disconnect switch for safety when work is done on the motor

In these cases the following guidelines should be followed.

Terminal block in the enclosure

The motor cable shields should be bonded to the back-plate using un-insulated metal cable-clamps which should be positioned as close as possible to the terminal block. Keep the length of power conductors to a minimum and ensure that all sensitive equipment and circuits are at least 0.3 m (12 in) away from the terminal block.

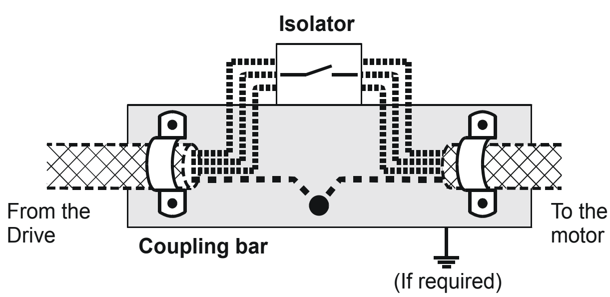
Figure 4-37 Connecting the motor cable to a terminal block in the enclosure



Using a motor isolator / disconnect-switch

The motor cable shields should be connected by a very short conductor having a low inductance. The use of a flat metal coupling-bar is recommended; conventional wire is not suitable. The shields should be bonded directly to the coupling-bar using un-insulated metal cable-clamps. Keep the length of the exposed power conductors to a minimum and ensure that all sensitive equipment and circuits are at least 0.3 m (12 in) away.

Figure 4-38 Connecting the motor cable to an isolator / disconnect switch



4.17.8 Surge immunity of control circuits

The input/output ports for the control circuits are designed for general use within machines and small systems without any special precautions. These circuits meet the requirements of EN 61000-6-2:2005 (1 kV surge) provided the 0 V connection is not grounded. In applications where they may be exposed to high-energy voltage surges, some special measures may be required to prevent malfunction or damage. Surges may be caused by lightning or severe power faults in association with grounding arrangements which permit high transient voltages between nominally grounded points. If a digital port experiences a severe surge its protective trip may operate (I/O Overload trip). For continued operation after such an event, the trip can be reset automatically by setting parameter *Number Of Auto-reset Attempts* (**H46**) > 0.

Figure 4-39 Surge suppression for digital and unipolar inputs and outputs

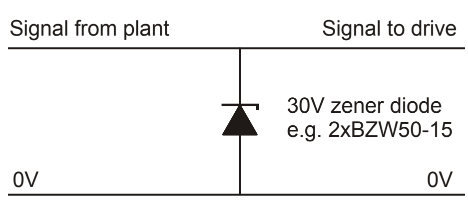
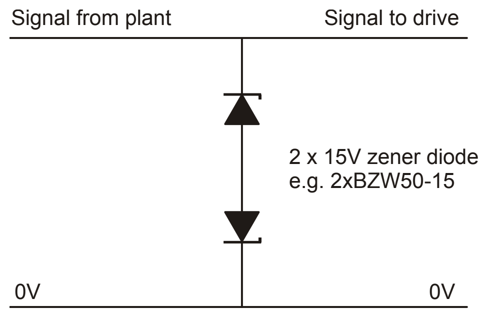


Figure 4-40 Surge suppression for analog and bipolar inputs and outputs



Surge suppression devices are available as rail-mounting modules, e.g. from Phoenix Contact:

Unipolar TT-UKK5-D/24 DC
Bipolar TT-UKK5-D/24 AC

These devices are not suitable for encoder signals or fast digital data networks because the capacitance of the diodes adversely affects the signal. Most encoders have galvanic isolation of the signal circuit from the motor frame, in which case no precautions are required. For data networks, follow the specific recommendations for the particular network.

4.18 Safe Torque Off (STO)

The *E300 Advanced Elevator* drive has a single channel Safe Torque Off (STO)

4.18.1 Single channel Safe Torque Off (STO)

The Safe Torque Off (STO) function provides a means for preventing the drive from generating torque in the motor, with a very high level of integrity. It is suitable for incorporation into a safety system for a machine. It is also suitable for use as a conventional drive enable input.

The safety function is active when the Safe Torque Off (STO) input is in the logic-low state as specified in the control terminal specification. The function is defined according to EN 61800-5-2 and IEC 61800-5-2 as follows. In these standards a drive offering safety-related functions is referred to as a PDSSR)):

'Power, that can cause rotation or motion in the case of a linear motor), is not applied to the motor. The PDS(SR) will not provide energy to the motor which can generate torque (or force in the case of a linear motor)'.

This safety function corresponds to an uncontrolled stop in accordance with stop category 0 of IEC 60204-1.

The Safe Torque Off (STO) function makes use of the special property of an inverter drive with an induction motor, which is that torque cannot be generated without the continuous correct active behavior of the inverter circuit. All credible faults in the inverter power circuit cause a loss of torque generation.

The Safe Torque Off (STO) function is fail-safe, so when the Safe Torque Off (STO) input is disconnected the drive will not operate the motor, even if a combination of components within the drive has failed. Most component failures are revealed by the drive failing to operate. Safe Torque Off (STO) is also independent of the drive firmware. This meets the requirements of the following standards, for the prevention of operation of the motor.

Data as verified by TÜV Rheinland:

According to EN ISO 13849-1:

PL = e

Category = 4

$MTTF_D$ = High

DC_{av} = High

Mission Time and Proof Test Interval = 20 years

The calculated $MTTF_D$ for the complete Safe Torque Off (STO) function is:

STO1 2574 yr

According to EN 61800-5-2:

SIL = 3

PFH = $4.21 \times 10^{-11}\ h^{-1}$

The Safe Torque Off (STO) input also meets the requirements of EN 81/2 as part of a system for preventing unwanted operation of the motor in an Elevator application.

Safe Torque Off (STO) can be used to eliminate electro-mechanical contactors, including special safety contactors, which would otherwise be required for safety applications.

The function can be used in safety-related machines or systems which have been designed according to IEC 62061 or IEC 61508, or other standards which are compatible with IEC 61508, since the analysis and the integrity metrics used in EN 61800-5-2 are the same.

Note on response time of Safe Torque Off (STO), and use with safety controllers with self-testing outputs.

Safe Torque Off (STO) has been designed to have a response time of greater than 1 ms, so that it is compatible with safety controllers whose outputs are subject to a dynamic test with a pulse width not exceeding 1 ms.

Note on the use of servo motors, other permanent-magnet motors, reluctance motors and salient-pole induction motors.

When the drive is disabled through Safe Torque Off (STO), a possible (although highly unlikely) failure mode is for two power devices in the inverter circuit to conduct incorrectly.

This fault cannot produce a steady rotating torque in any AC motor. It produces no torque in a conventional induction motor with a cage rotor. If the rotor has permanent magnets and/or saliency, then a transient alignment torque may occur. The motor may briefly try to rotate by up to 180° electrical, for a permanent magnet motor, or 90° electrical, for a salient pole induction motor or reluctance motor. This possible failure mode must be allowed for in the machine design.

> **WARNING**
> The design of safety-related control systems must only be done by personnel with the required training and experience.
> The Safe Torque Off (STO) function will only ensure the safety of a machine if it is correctly incorporated into a complete safety system. The system must be subject to a risk assessment to confirm that the residual risk of an unsafe event is at an acceptable level for the application.

> **WARNING**
> Safe Torque Off (STO) inhibits the operation of the drive, this includes inhibiting braking. If the drive is required to provide both braking and Safe Torque Off (STO) in the same operation (e.g. for emergency stop) then a safety timer relay or similar device must be used to ensure that the drive is disabled a suitable time after braking. The braking function in the drive is provided by an electronic circuit which is not fail-safe. If braking is a safety requirement, it must be supplemented by an independent fail-safe braking mechanism.

> **WARNING**
> Safe Torque Off (STO) does not provide electrical isolation.
> The supply to the drive must be disconnected by an approved isolation device before gaining access to power connections.

With Safe Torque Off (STO) there are no single faults in the drive which can permit the motor to be driven. Therefore it is not necessary to have a second channel to interrupt the power connection, nor a fault detection circuit.

It is important to note that a single short-circuit from the Safe Torque Off (STO) input to a DC supply of approximately +24 V would cause the drive to be enabled. This can be excluded under EN ISO 13849-2 by the use of protected wiring. The wiring can be protected by either of the following methods:

- By placing the wiring in a segregated cable duct or other enclosure.

or

- By providing the wiring with a grounded shield in a positive-logic grounded control circuit. The shield is provided to avoid a hazard from an electrical fault. It may be grounded by any convenient method; no special EMC precautions are required.

> **WARNING**
> It is essential to observe the maximum permitted voltage of 5 V for a safe low disabled) state of Safe Torque Off (STO) The connections to the drive must be arranged so that voltage drops in the 0 V wiring cannot exceed this value under any loading condition. It is strongly recommended that the Safe Torque Off (STO) circuit be provided with a dedicated 0 V conductor which should be connected to terminal 30 at the drive.

Safe Torque Off (STO) over-ride

The drive does not provide any facility to over-ride the Safe Torque Off (STO) function, for example for maintenance purposes.

NOTE

Emerson Control Techniques provide a zero output motor contactor solution which meets EN81-1 (clause 12.7.3) and EN81-2 (clause 12.4). For further details contact the supplier of the drive.

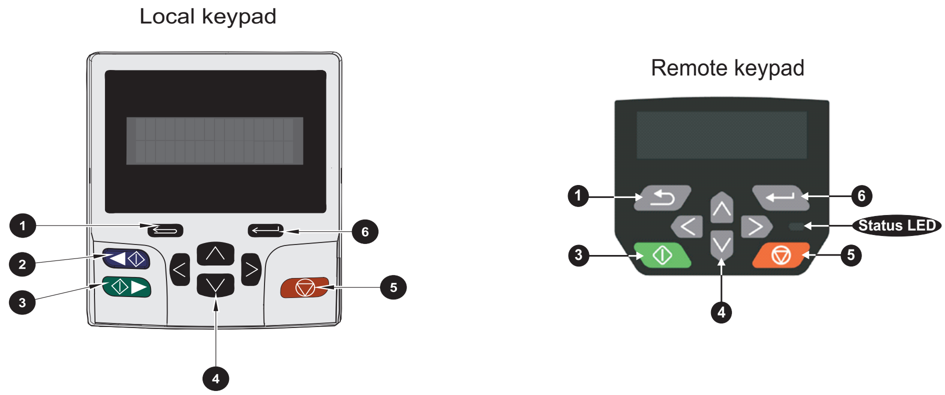
5 Getting started

WARNING

Incorrect operation
Adjustment of drive parameters could result in a risk of damage to the product or present a safety hazard. Careful consideration to the adjustment of drive parameters must be taken. The user should ensure they are familiar with parameter access, navigation and parameter operation by reading this guide before adjustment to avoid the risk of damage to the product or a potential safety hazard.

The *E300 Advanced Elevator* drive has both a mounted keypad (KI-Elv Keypad RTC) and an alternative remote mount keypad (CI-Elv Remote Keypad). Each keypad has the same LCD text display.

Figure 5-1 Keypad buttons



The keypad consists of a number of buttons, keys as detailed following which support navigation and editing.

1. **Escape button** - Used to exit from parameter edit or view mode. In parameter edit mode, if parameter values are edited and the exit button pressed, the parameter value will be restored to the value it had on entry to edit mode.
2. **Start reverse (Auxiliary) button** - Not used.
3. **Start forward button** - Not used.
4. **Navigation keys** (x4) - Used to navigate through the menu and parameter structure and edit parameter values.
5. **Reset button** - Used to reset the drive.
6. **Enter / Mode button** - Used to toggle between parameter edit and view mode.

NOTE

The remote keypad as shown above has an additional status LED present on the keypad which can be used as a status indication for when the drive status LED is no longer visible.

5.1 Keypad set-up menu

To enter the keypad set-up menu press and hold the escape button from status mode. All the keypad parameters are saved to non-volatile memory when exiting from the set-up menu. To exit from the set-up menu press the escape or or button.

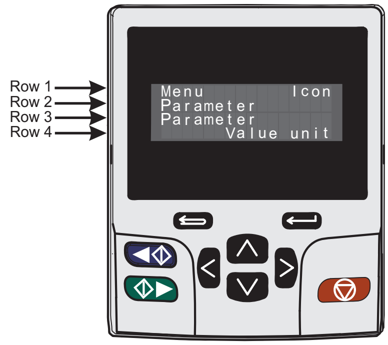
Table 5-1 Keypad set-up parameters

Parameter		Range	Type
Keypad.00	Language	Classic English (0), English (1)	RW
Keypad.01	Show units	Off (0), On (1)	RW
Keypad.02	Backlight level	0 to 100 %	RW
Keypad.03	Keypad date (RTC Keypad)	01.01.10 to 31.12.99	RO
Keypad.04	Keypad time (RTC Keypad)	00:00:00 to 23:59:59	RO
Keypad.05	Show numerated text values	Off (0), On (1)	RW
Keypad.06	Software version	00.00.00.00 to 99.99.99.99	RO

5.2 Keypad display

The keypad can display up to a maximum of 4 rows of data. During navigation all 4 rows can be displayed.
When the drive is powered up the lower display row will show the selected “power up parameter” defined by *Parameter Displayed At Power-up* (**H39**)

Figure 5-2 Keypad display



- The upper 3 rows display the menu and parameter currently being viewed or the drive status
- The bottom row of the display shows the selected parameter value or the specific trip type.
- The last two characters on the top row may display special indications. If more than one of these indications is active, then the indications have priority as shown in Table 5-2 below.

Table 5-2 Keypad special indication icon priority

Active action icon	Description	Row 1 = top	Priority in row
	Alarm active	1	2
	Real-time clock battery low	1	3
	Accessing NV Media Card	1	1
 or 	Drive security active and locked or unlocked	1	4

5.2.1 Keypad display modes

Four display modes can be seen during operation as shown in Figure 5-3 *Mode examples* on page 107 and detailed following.

1. Parameter view mode

Menu and parameter view mode, read write (RW) or read only (RO)

2. Status mode

If the drive is OK and the parameters are not being edited or viewed, the upper row of the display will show one of the following:

- **Inhibit**, **Ready** or **Run**.

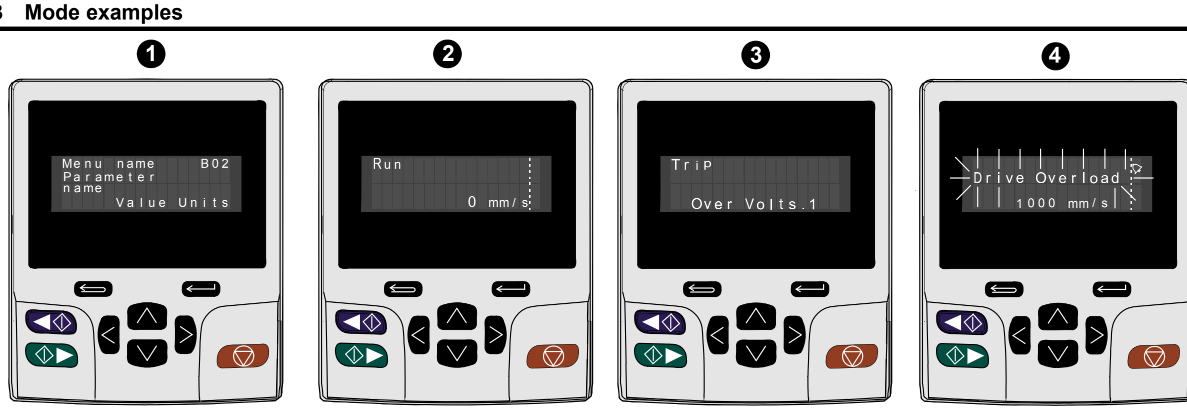
3. Trip status mode

When the drive is in a trip condition the upper row of the display will indicate that the drive has tripped and the lower row of the display will show the trip code.

4. Alarm status mode

During an ‘alarm’ condition the upper row of the display flashes between the drive status Inhibit, Ready or Run (drive not in parameter view or edit mode) and the alarm condition.

Figure 5-3 Mode examples



5.3 Display messages

The following tables indicate the various possible mnemonics which can be displayed by the drive and their meanings.

5.3.1 Alarm indications

An alarm is an indication given on the display. The alarm string alternates with the drive status string on the upper row, showing the alarm icon in the last character in the upper row. Alarm strings are not displayed when a parameter is being edited, but the user will still see the alarm icon.

Table 5-3 Alarm indications

Alarm string	Description
Brake Resistor	Brake resistor overload. Parameter D16 Resistor thermal accumulator has reached 75.0 % of the value at which the drive will trip.
Motor Overload	Parameter *Motor Protection Accumulator* (**J26**) has reached 75.0 % of the value at which the drive will trip and the load on the drive is >100 %.
Drive Overload	Drive over temperature. *Percentage Of Drive Thermal Trip Level* (**J79**) drive is greater than 90 %.
Autotune	An autotune has been initialized and is in progress.

5.3.2 Status indications

Table 5-4 Status indications

Upper row string	Description	Drive output
Inhibit	The drive is inhibited and cannot be run. The Safe Torque Off (STO), Drive enable signal is not applied to control terminal T31.	Disabled
Ready	The drive is ready to run. The Drive enable is On, the drive is not active due to the drive run signal not being present.	Disabled
Stop	The drive is stopped / holding zero speed.	Enabled
Run	The drive is active and running.	Enabled
Supply Loss	Supply loss condition has been detected.	Enabled
Deceleration	The motor is being decelerated to zero speed / frequency following removal of the drive run signal.	Enabled
dc injection	The drive is applying dc injection braking.	Enabled
Trip	The drive has tripped and is no longer controlling the motor. Trip code appears in the lower display.	Disabled
Under Voltage	The drive is in an under voltage state either in low voltage or high voltage mode.	Disabled
Phasing	The drive is performing a ‘phasing test on enable’	Enabled

Table 5-5 Option module and NV Media Card status indications

First row string	Second row string	Status
Booting	**Parameters**	Parameters are being loaded
Drive parameters are being loaded from a NV Media Card.		
Booting	**Option Program**	User program being loaded
User program loading from a NV Media Card to a option module.		
Writing To	**NV Card**	Writing data to NV Media Card
Data is being written to a NV Media Card to ensure that its copy of the drive parameters is correct because the drive is in Auto or Boot mode.		
Waiting For	**Power System**	Waiting for power stage
Waiting for processor in power stage to respond following power-up.		
Waiting For	**Options**	Waiting for an option module
Waiting for the options modules to respond after power-up.		
Uploading From	**Options**	Loading parameter database
A power-parameter database is being updated because an option module has changed or because an applications module has requested changes to the parameter structure.		

5.4 Security and parameter access

The navigation buttons can only be used to move between menus and parameters if the parameter access level *User Security Status* (**H02**) has been set to show 'All Menus'. The security and parameter access level determines whether the user has access to User Menu A only, or to all menus in addition to User Menu A. The security also determines whether the user has read only (RO) or read write (RW) access. The *E300 Advanced Elevator* drive provides a number of different levels of security that can be set by the user via *User Security Status* (**H02**) as shown in Table 5-6.

Table 5-6 Security and parameter access

User Security Status **(H02)**	**Description**
User Menu A (0)	All writable parameters are available to be edited but only parameters in User Menu A are visible
All menus (1)	All parameters are visible and all writable parameters are available to be edited
Read- only User Menu A (2)	Access is limited to User Menu A parameters only. All parameters are read-only
Read-only (3)	All parameters are read-only however all menus and parameters are visible
Status only (4)	The keypad remains in status mode and no parameters can be viewed or edited
No access (5)	The keypad remains in status mode and no parameters can be viewed or edited

The default security and parameter access levels for the drive are,

- Parameter access level = User Menu A
- Security = Open i.e. read / write access to User Menu A with the all menus not visible.

Both the security and parameter access level can operate independently of each other as shown in Table 5-7.

Table 5-7 Security, Parameter access level

Security status	Parameter access level	Security	User Menu A status	All Menus status
0	User Menu A	Open	RW	Not visible
		Closed	RO	Not visible
1	All Menus	Open	RW	RW
		Closed	RO	RO
2	Read-only User Menu A	Open	RO	Not visible
		Closed	RO	Not visible
3	Read-only	Open	RO	RO
		Closed	RO	RO
4	Status only	Open	Not visible	Not visible
		Closed	Not visible	Not visible
5	No access	Open	Not visible	Not visible
		Closed	Not visible	Not visible

5.5 Changing security and parameter access

The security level is determined by the setting of *User Security Status* (**H02**). The security level can be changed through the keypad even if a security code has been set. The security code, when set, prevents write access to any of the parameters in any menu.

5.5.1 Setting security code

Enter a security code value between 1 and 2147483647 in *User Security Code* (**H01**) and press the button; the security code has now been set to this value.

5.5.2 Setting parameter access level

To activate the security, the parameter access level must be set to the desired level in *User Security Status* (**H02**). When the drive is reset, the security code will have been activated and the drive returns to User Menu A and the symbol is displayed in the right hand corner of the keypad display. The value of *User Security Code* (**H01**) will return to 0 in order to hide the security code.

5.5.3 Unlocking security code

Select a parameter that needs to be edited and press the button, the upper display will now show 'Security Code'. Use the arrow buttons to set the security code and press the button. With the correct security code entered, the keypad display will revert to the parameter selected in edit mode. If an incorrect security code is entered, the following message 'Incorrect security code' is displayed, then the display will revert to parameter view mode.

5.5.4 Disabling security

WARNING	Disabling security can lead to parameter values being changed without careful consideration; ensure a security code is active to avoid incorrect or unintentional parameter adjustments which could lead to damage or a safety hazard.

To unlock the previously set security code as detailed above. Set *User Security Code* (**H01**) to 0 and press the button. The security has now been disabled, and will not have to be unlocked each time the drive is powered up to allow read / write access to the parameters.

5.6 Keypad menu and parameter navigation

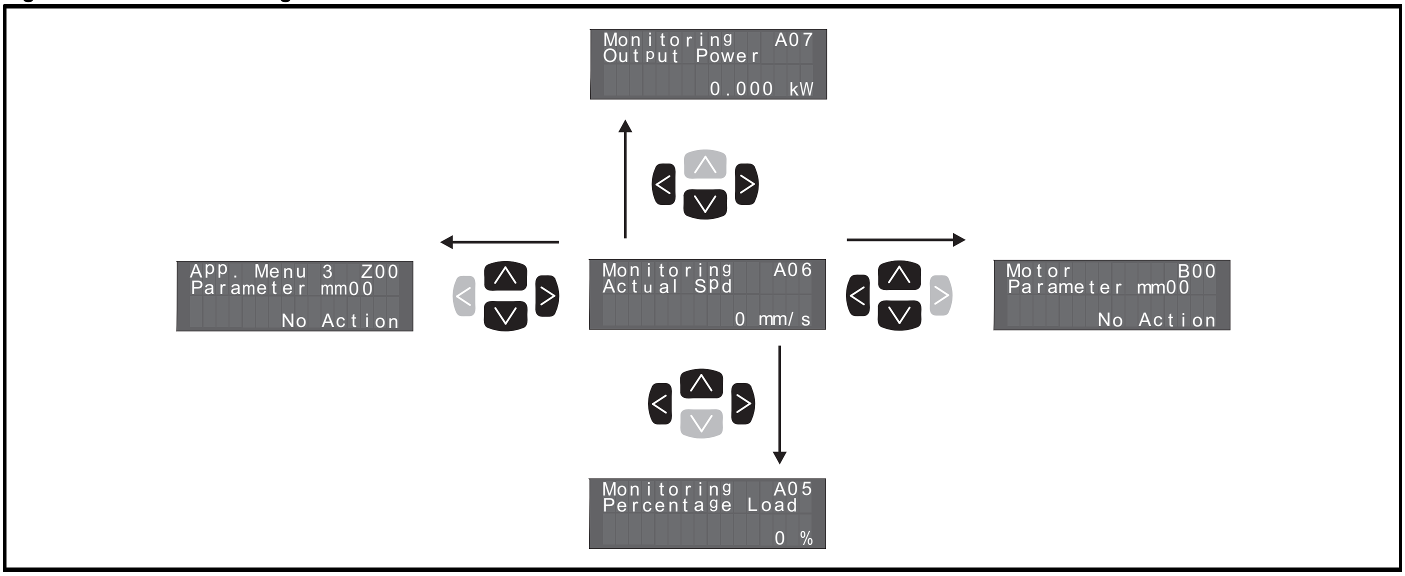
The drive parameter structure consists of menus and parameters, which at power up displays the User Menu A due to the default security, parameter access level in *User Security Status* (**H02**).

The keypad will display both the menu and the parameter list within the drive as described following. All menus are structured alphabetically **A**, **B**, **C** through to **Z**, these also covering any additional option modules installed. All parameters within each menu are numbered from **00**, **01**, **02**, **03**, up to the highest parameter in the menu, which will vary dependant upon the menu.

The left and right navigation keys can be used to navigate between “All Menus” and the up and down navigation keys are used to navigate between “All Parameters” within the menu.

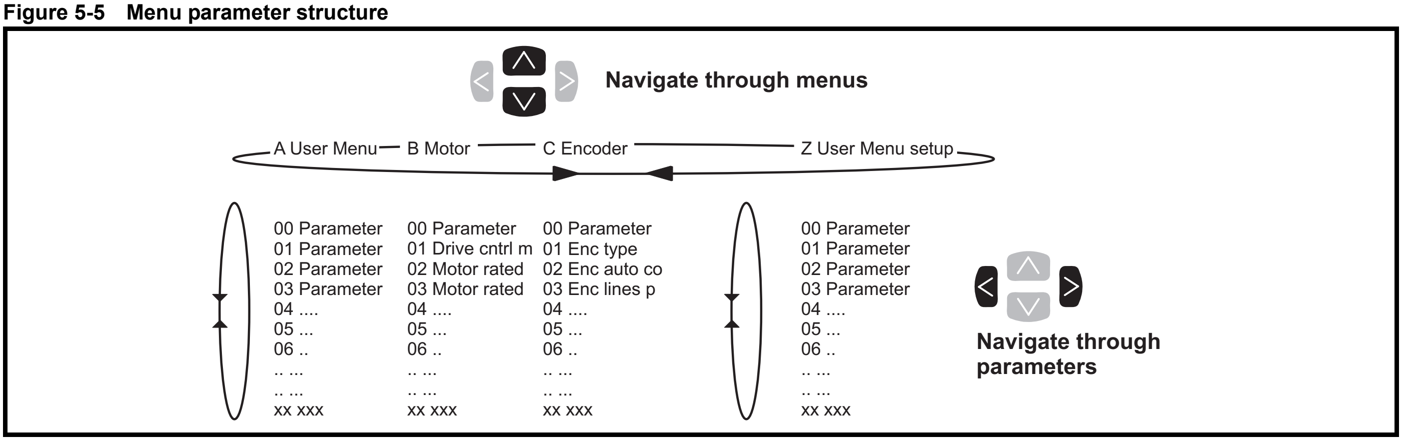
The security and parameter access in *User Security Status* (**H02**) should be set to 'All Menus'.

Figure 5-4 Parameter navigation



The navigation keys will only move between all menus if “All Menus” have been enabled *User Security Status* (**H02**). Refer to section 5.5 *Changing security and parameter access* on page 109. The menus and parameters will roll over in both directions. i.e. if the last parameter (highest number) is displayed, a further press will cause the display to rollover and show the first parameter mm00. Similarly if the last menu (highest letter) is displayed, a further press will cause the display to rollover and show the first menu (User Menu A).

Figure 5-5 Menu parameter structure



5.7 Keypad menu and parameter shortcuts

The keypad shortcuts in ‘parameter mode’ allow the user to move quickly within the menus and parameters using the navigation keys. The parameter value in edit mode can also be accessed much faster using the navigation keys also as detailed following.

- **Menu shortcut**

If the left and right navigation keys are pressed together, then the keypad display will jump to User Menu A from the current menu being viewed, i.e. menu G Profile is being viewed when the above keys are pressed together the display will jump directly to User Menu A.

- **Parameter shortcut**

If the up and down navigation keys are pressed together, then the keypad display will jump to the first parameter 00 in the menu being viewed, i.e. Menu B Motor and parameter 05 *Motor Number Of Poles* is being viewed, when the above keys are pressed together the display will jump to Menu B Motor and parameter 00.

- **Parameter editing**

If the up and down keys are pressed together in parameter edit mode, where the value is flashing, then the value of the parameter being edited will be set to 0 or the minimum value selectable for the given parameter.

If the left and right keys are pressed together in parameter edit mode, where the value is flashing, the least significant digit in the parameter value furthest right) will be selected for editing.

NOTE

The navigation keys can only be used to move between menus if *User Security Status* (**H02**) has been set to show 'All Menus'.

5.8 Saving parameters

When changing a parameter in User Menu A, the new value is saved when pressing the Enter button to return to parameter view mode from parameter edit mode.

If parameters have been changed in the advanced menus, then the change will not be saved automatically. A save function must be carried out.

Procedure

1. Select 'Save Parameters'* in Pr **mm00** (alternatively enter a value of 1000* in Pr **mm00**)
2. Either:

- Press the red reset button
- Toggle the reset digital input

* If the drive is in the under voltage state (i.e. when the control terminal 1 & 2 are being supplied from a low voltage DC supply) a value of 1001 must be entered into Pr **mm00** to perform a save function.

5.9 Restoring parameter defaults

Restoring parameter defaults by this method saves the default values in the drives memory. *User Security Status* (**H02**) and *User Security Code* (**H01**) are not affected by this procedure.

Procedure

1. Ensure the drive is not enabled, i.e. the Safe Torque Off (STO), Drive enable on terminal 31 is open or Off 0)
2. Select 'Reset 50 Hz Defs' or 'Reset 60 Hz Defs' in Pr **mm00** (alternatively, enter 1233 (50 Hz settings) or 1244 (60 Hz settings) in Pr **mm00**).
3. Either:

- Press the red reset button
- Toggle the reset digital input

5.10 Displaying destination parameters only

By selecting 'Destinations' in Pr **mm00** (Alternatively enter 12001 in Pr **mm00**), the only parameters that will be visible to the user will be destination parameters. This function does not require a drive reset to become active. In order to deactivate this function, return to Pr **mm00** and select 'No action' (alternatively enter a value of 0).

Please note that this function can be affected by the access level enabled, refer to section 5.4 *Security and parameter access* on page 109.

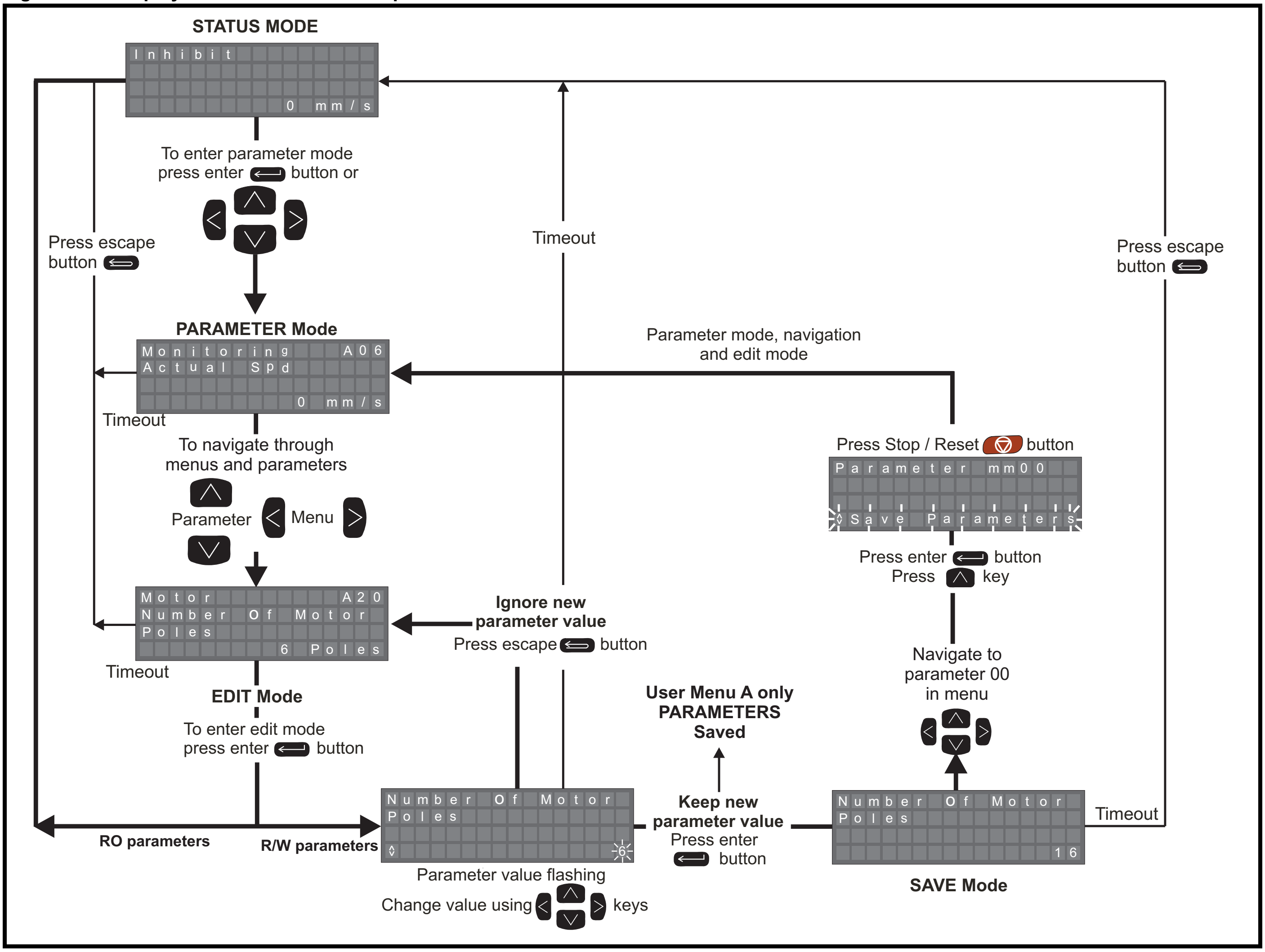
5.11 Displaying non default parameters

The keypad has an option to display all parameters which have been changed from their default values. By selecting 'Show non-default' in Pr **mm00** (or alternatively, enter 12000 in Pr **mm00**), the only parameters that will then be visible to the user will be those containing a non-default value. This function does not require a drive reset to become active. To deactivate this function, return to Pr **mm00** and select 'No action' or (alternatively enter a value of 0 in Pr **mm00**).

NOTE

This function can be affected by the parameter access level selected refer to section 5.4 *Security and parameter access* on page 109.

Figure 5-6 Display modes- RFC-A/S example



5.12 Menus, Parameters

5.12.1 Menu, parameter structure

The *E300 Advanced Elevator* drive has a full list of menus which range from **Menu A** through to **Menu Z** as detailed in Table 5-8 *Full menu descriptions* . Each menu consists of groups of parameters which are specific to the Elevator application. The menus are arranged in a sequential order to support simple set up of the drive, motor and feedback, to configuring the systems mechanical arrangement, setting up the control interface then auto tuning and running the system for the first time along with tuning the final ride comfort.

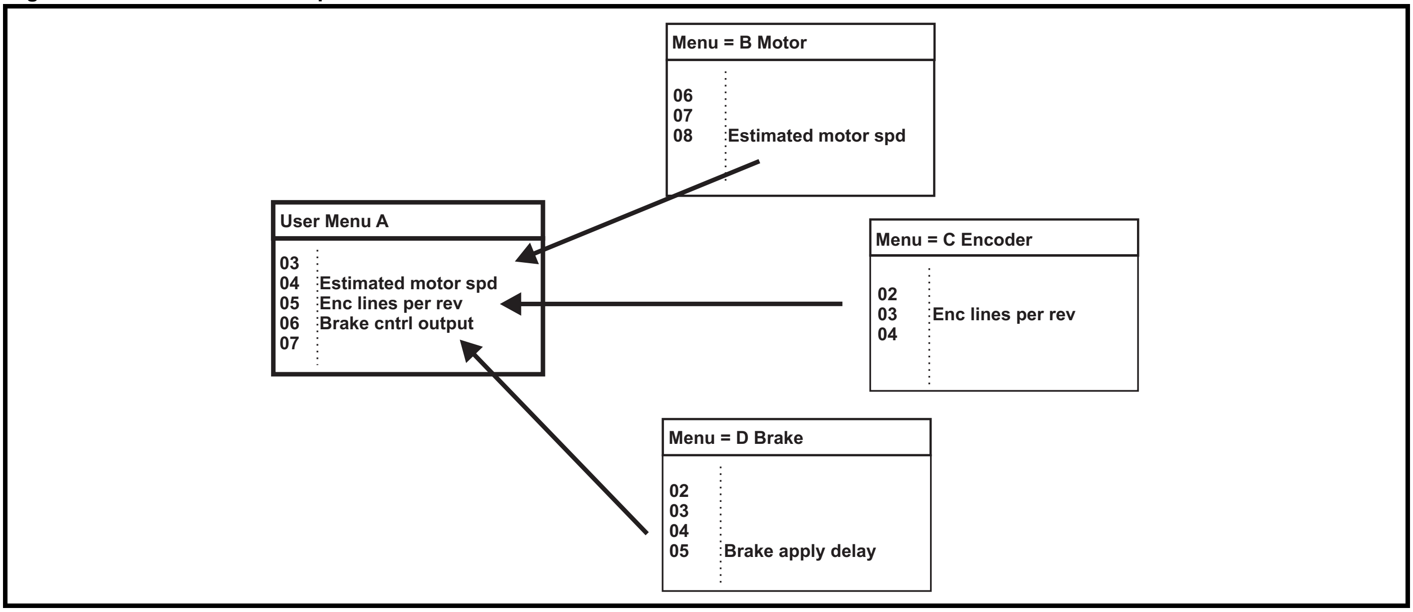
Table 5-8 Full menu descriptions

Menu	Description
A	User Menu
B	Motor
C	Encoder
D	Brake
E	Mechanical
F	IO Hardware
G	Profile
H	Configuration
I	Tuning
J	Monitoring
K	Logic
L	Diagnostics
M	Comms
N	Storage
O	Backup Power
P	Slot 1 set-up*
Q	Slot 2 set-up*
R	Slot 3 set-up*
S	Application Menu 1
T	Application Menu 2
U	Application Menu 3
V	Slot 1 Application*
W	Slot 2 Application*
X	Slot 3 Application*
Y	Data Logger
Z	User Menu A set-up

* Only displayed when option modules are installed

User Menu A is used to bring together various commonly used parameters for the given application allowing fast access to parameters for adjustment of the drive. The parameters displayed in the User Menu A are configured through to Z (User Menu A set-up). Once the parameters are configured, they will then exist in both the User Menu A and in the full menu parameter list. The default configuration of User Menu A has been created using specific parameters in an arranged sequence to allow quick sequential set-up and adjustment of the drive for standard Elevator applications. User Menu A can consist of up to a maximum of 80 parameters which are user selectable.

Figure 5-7 User Menu A set-up



5.13 Powering up the drive

When the drive is first powered up, the following operating modes can be selected. The default operating mode is RFC-S

Table 5-9 Drive operating mode

Parameter	Detail
Drive control mode (**B01**)	Open loop
	RFC-A (Closed loop vector)
	RFC-S (Closed loop Servo)

NOTE

When programming the drive and where the current parameter settings are unknown, a default is recommended prior to programming the drive as follows (a) Ensure the drive is disabled (b) Set Pr **mm00**= Reset 50 Hz defs or Pr **mm00** = 1233 (c) Reset the drive.

5.14 Programming the drive

The *E300 Advanced Elevator drive* can be programmed using any of the following:-

- A keypad programming the drive parameters manually
- An NV Media Card downloading a drive parameter set
- The Elevator Connect PC tool and either manually programming the drive parameters or downloading a parameter set.

WARNING

Changing parameter values without careful consideration can lead to the risk of damage or a safety hazard. The User must read this guide to avoid any risk of damage and a safety hazard which could lead to a death or serious injury.

WARNING

When reading a parameter set from a SMARTCARD, SD card to the drive during setup this can result in the control I/O firstly defaulting and then changing to the configuration on the SMARTCARD, SD card. Ensure during this process all control terminals are removed from the drive and any SI-IO module to prevent uncontrolled operation of external devices and the risk of damage to the system.

5.15 Keypad operation

Programming the drive manually using the keypad from its default configuration for operation in RFC-S can be carried out using the User Menu A detailed in Table 6-2 *User Menu A Open loop, RFC-A and RFC-S parameters* on page 123

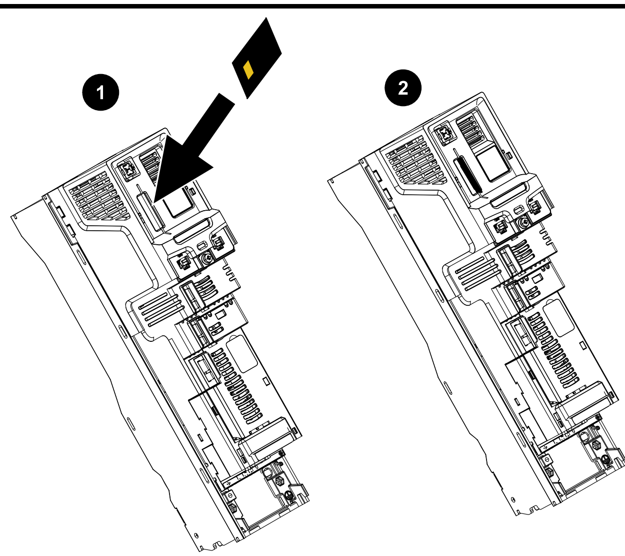
5.16 NV Media Card operation

WARNING

When installing and removing the NV Media Card beware of possible live power terminals which could result in a safety hazard and electric shock. All safety covers must be installed and power terminals shrouded to avoid the risk of death or serious injury.

An NV Media Card allows simple configuration of the drive parameters using an existing parameter file, along with parameter back-up, and cloning. The NV Media Card can be either a SMARTCARD or SD card Adaptor with SD card inserted. The locations available on the NV Media Card can range from data blocks 001 to data block 499.

Figure 5-8 Installation of the NV Media Card



1. Installing the NV Media Card
2. NV Media Card installed

Figure 5-9 NV Media Card operation, programming drive

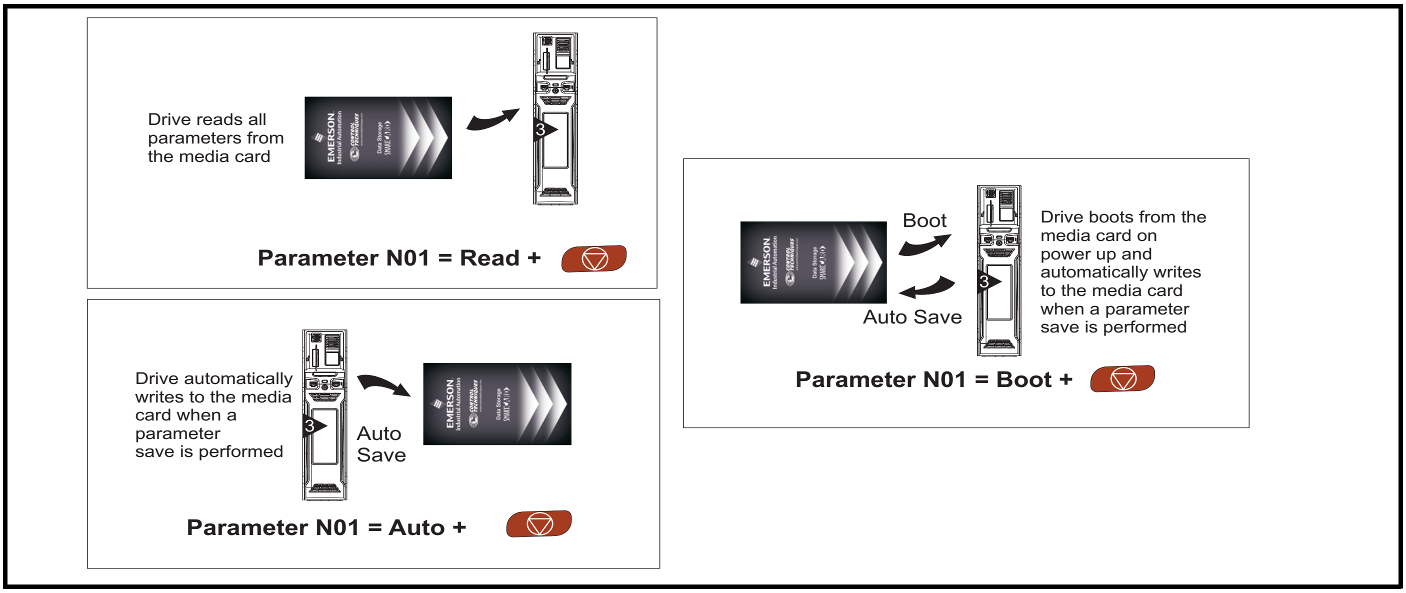


Table 5-10 NV Media Card part numbers

NV media card	Part number
SD card Adaptor (memory card not included)	3130-1212-03
8 kB SMARTCARD	2214-4246-03
64 kB SMARTCARD	2214-1006-03

Table 5-11 SMARTCARD and SD card codes

Code	Operation	SMARTCARD	SD card
2001	Transfers all drive parameters (including SI options) to parameter file 001 and sets the block as bootable.	✓	✓
4yyy	Transfers all drive parameters (including SI options) to parameter file yyy.	✓	✓
6yyy	Load the drive parameters from parameter file yyy	✓	✓
7yyy	Erase parameter file yyy.	✓	✓
8yyy	Compare drive parameters with parameter file yyy.	✓	✓
9555	Clear the warning suppression flag	✓	✓
9666	Set the warning suppression flag	✓	✓
9777	Clear the read-only flag	✓	✓
9888	Set the read-only flag	✓	✓
9999	Erase and format the NV Media Card	✓	
15yyy	Transfer a program from an option module in slot 1 to a option module applications file		✓
16yyy	As 15yyy, but for slot 2		✓
17yyy	As 15yyy, but for slot 3		✓
18yyy	Load a program to the option module in slot 1 from an option module applications file		✓
19yyy	As 18yyy, but for slot 2		✓
20yyy	As 18yyy, but for slot 3		✓
21yyy	As 15yyy, but for slot 4		✓
22yyy	As 18yyy, but for slot 4		✓
40yyy	Backup all drive data (parameter differences from defaults, applications programs and miscellaneous options module data), including the drive name; the store will occur to the </MCDF/driveyyy/> folder on the NV Media Card; if it does not exist, it will be created. Because the name is stored, this is a backup, rather than a copy. The command will clear when all drive and option module data is saved.		✓
60yyy	Load all drive data (parameter differences from defaults, applications programs and miscellaneous options module data); the load will come from the </MCDF/driveyyy/> folder on the NV Media Card. The command code will clear once all drive and option module data has been loaded.		✓

Where yyy indicates the block number 001 to 999.

NOTE

If the ***NV Media Card read only flag, 9888*** is set then only codes 6yyy or 9777 are effective.

5.16.1 NV Media Card trips

The NV Media Card should not be removed during data transfer as the drive will produce a trip. If this occurs, then either the transfer should be re-attempted or in the case of a NV Media Card to drive transfer, default parameters should be loaded.

After an attempt to read, write or erase data from a NV Media Card a trip is initiated if there has been a problem with the command. See the diagnostics section for more information on the NV Media Card trips.

5.16.2 Data block header information

Each data block stored on a NV Media Card has header information as detailed in the following parameters:

- *Media card file number* (**N03**)
- *Media card file type* (**N04**)
- *Media card file version* (**N05**)
- *Media card file checksum* (**N06**)

The header information for each data block used can be viewed in *Media card file type* (**N04**) to *Media card file checksum* (**N06**) by increasing or decreasing the data block number set in *Media card file number* (**N03**). If there is no data on the card *Media card file number* (**N03**) can only have a value of 0.

5.17 NV Media Card transferring data

Data transfer, erasing and protecting the information is performed by entering a code in Pr **mm00** and then resetting the drive as shown in Table 5-11 *SMARTCARD and SD card codes* .

The whole card may be protected from writing or erasing by setting the read-only flag as detailed in Table 5-11 *SMARTCARD and SD card codes* .

5.17.1 Reading from the NV Media Card

- **6yyy** - Reading from the NV Media Card

When data is transferred to the drive, using 6yyy in Pr **mm00**, it is transferred to the drive RAM and the EEPROM. A parameter save is not required to retain the data after power down. If the option modules installed are different between source and destination drives, the menus for the option module slots where the option module categories are different are not updated from the NV Media Card and will contain their default values. The drive will produce a 'Card Option' trip if the option module installed to the source and the destination drives are different or are in different slots.

If the data is being transferred to the drive with different voltage or current rating a 'Card Rating' trip will occur. The following drive rating dependant parameters RA coding bit set) will not be transferred to the destination drive from a NV Media Card when the voltage rating of the destination drive is different from the source drive and the file is a parameter file. However, drive rating dependent parameters will be transferred if only the current rating is different. If drive rating dependant parameters are not transferred to the destination drive they will contain their default values.

Parameter number	Description
B15	Symmetrical Current Limit
B02	Rated Current
B03	Rated Voltage
B04	Rated Power Factor
B35	Stator Resistance
B13	Maximum Switching Frequency
B34	Transient Inductance
B36	Stator Inductance
D18	Injection Braking Level
O18	Supply Loss Detection Level
O11	Standard Under Voltage Threshold
O14	Low Under Voltage Threshold

- *Parameter Cloning* (**N01**) **= Read (1)** - Reading from the NV Media Card

Setting *Parameter Cloning* (**N01**) modes to Read (1) and resetting the drive will transfer parameters from the NV Media Card to the drive parameters and the drive EEPROM, i.e. this is equivalent to writing 6001 to Pr **mm00**. Once the parameters are successfully copied this parameter is automatically reset to None (0). Parameters are saved to the drive EEPROM after this action is complete.

5.17.2 Auto saving drive parameter changes

- *Parameter Cloning* (**N01**) **= Auto (3)**

This setting causes the drive to automatically save any changes made to User Menu A parameters in the drive to the NV Media Card. If the NV Media Card data block already contains information it is automatically overwritten.

Changing *Parameter Cloning* (**N01**) to Auto (3) and resetting the drive will immediately save the complete parameter set from the drive to the NV Media Card. Once the whole parameter set is stored only the individual modified User Menu A parameter setting is updated. At power up, if *Parameter Cloning* (**N01**) is set to Auto (3), the drive will save the complete parameter set to the NV Media Card.

Advanced parameter changes are only saved to the NV Media Card when Pr **mm00** is set to 'Save Parameters' or 1000 and the drive reset.

If the NV Media Card is removed when *Parameter Cloning* (**N01**) is set to 3 *Parameter Cloning* (**N01**) is then automatically set to None (0).

When a new NV Media Card is installed *Parameter Cloning* (**N01**) must be set back to Auto (3) by the user and the drive reset so the complete parameter set is rewritten to the new NV Media Card if auto mode is still required.

When *Parameter Cloning* (**N01**) is set to Auto (3) the setting of *Parameter Cloning* (**N01**) itself is saved to the drive EEPROM but not the NV Media Card.

5.17.3 Boot from the NV Media Card on every power up

- *Parameter Cloning* (**N01**) **= Boot (4)** - Boot from NV Media Card on every power up

When *Parameter Cloning* (**N01**) is set to Boot (4) the drive operates the same as Auto mode, except when the drive is powered-up the parameters are automatically transferred to the drive at power up if the following are true:

- An NV Media Card is inserted in the drive
- Parameter data block 1 exists on the NV Media Card
- The data in block 1 is type 1 to 4 as defined in *Media Card File Type* (**N04**)
- *Parameter Cloning* (**N01**) on the NV Media Card set to Boot (4)

The drive will display 'Booting Parameters during this operation. If the drive mode is different from that on the NV Media Card the drive gives a 'Card Drive Mode' trip and the data is not transferred.

If 'Boot' mode is stored on the copying NV Media Card this makes the copying NV Media Card the master device. This provides a very fast and efficient way of re-programming a number of drives.

'Boot' mode is saved to the NV Media Card but when the NV Media Card is read, *Parameter Cloning* (**N01**) is not transferred to the drive.

- Pr **mm00 = 2001**

It is possible to create a bootable parameter data block by setting Pr **mm00** to 2001 and carrying out a drive reset. This data block is created in one operation and is not updated when further parameter changes are made. Setting Pr **mm00** to 2001 will overwrite the data block 1 on the NV Media Card if it already exists.

5.17.4 Comparing drive parameter set to NV Media Card

- **8yyy** - Comparing drive parameter set to NV Media Card

Setting 8yyy in Pr **mm00**, will compare the NV Media Card file with the data in the drive. If the compare is successful Pr **mm00** is simply set to 0. If the compare fails a 'Card Compare' trip is initiated.

5.17.5 Erasing data from the NV Media Card

- **7yyy / 9999** - Erasing data from the NV Media Card

Data can be erased from the NV Media Card either one block at a time or all blocks in one go.

- Setting 7yyy in Pr **mm00** will erase data block yyy
- Setting 9999 in Pr **mm00** will erase all data blocks on a SMARTCARD. Note: It is not possible to erase all data blocks on an SD card. This must be carried out using a PC and suitable adaptor.

5.17.6 NV Media Card warning suppression flag

- **9666 / 9555** - Setting, clearing NV Media Card warning suppression flag

If the option module installed in the source and destination drive are different or are in different slots the drive will produce a 'Card Option' trip. If data is being transferred to a drive of a different voltage or current rating a 'Card Rating' trip will occur. It is possible to suppress these trips by setting the warning suppression flag. Once the suppression flag is set the option module, rating dependent parameters are not transferred.

- Setting 9666 in Pr **mm00** will set the warning suppression flag
- Setting 9555 in Pr **mm00** will clear the warning suppression flag

5.17.7 NV Media Card read only flag

- **9888 / 9777** - Setting and clearing the NV Media Card read only flag

The NV Media Card may be protected from writing or erasing by setting the read only flag. If an attempt is made to write or erase a data block when the read only flag is set, a 'Card Read Only' trip is initiated. When the read only flag is set only codes 6yyy or 9777 are effective.

- Setting 9888 in Pr **mm00** will set the read only flag
- Setting 9777 in Pr **mm00** will clear the read only flag

5.18 Elevator Connect PC tool

The discovery protocol feature which is supported on the Elevator Connect PC tool will discover Elevator drives automatically which are connected to a PC.

To allow operation with the Elevator Connect PC tool on the *E300 Advanced Elevator* drive a comms cable is required. See section 5.20.1 *485 Serial communications* on page 119 for details.

5.19 Changing the operating mode

Changing the operating mode returns all parameters to their default value, including the motor parameters. *User Security Status* (**H02)** and *User Security Code* (**H01**) are not affected by this procedure.

Procedure

Use the following procedure only if a different operating mode is required:

1. Ensure the drive is not enabled, i.e. the Safe Torque Off (STO), Drive enable on Terminal 31 is On (1) or Off (0)
2. Enter either of the following values in Pr **mm00**, as appropriate:
   1253 (50 Hz AC supply frequency)
   1254 (60 Hz AC supply frequency)
3. Change the setting of *Drive Control Mode* (**B01**) as follows:

***Drive control mode* (B01)**		**Operating mode**
1	Open-loop	Open loop mode
2	RFC-A	RFC-A mode
3	RFC-S	RFC-S mode

The figures in the second column apply when serial communications are used.

4. Either:

- Press the red reset button
- Toggle the reset digital input

NOTE

Entering 1253 or 1254 in Pr **mm00** will only load defaults if the setting of *Drive Control Mode* (**B01**) has been changed.

5.20 Communications

The *E300 Advanced Elevator* drive offers a 2 wire EIA485 interface. This enables the drive set-up, operation and monitoring to be carried out with a PC or controller if required.

5.20.1 485 Serial communications

The EIA485 option provides two parallel RJ45 connectors allowing easy daisy chaining. The drive only supports MODBUS RTU protocol.

The serial communications port of the drive is a RJ45 socket, which is isolated from the power stage and the other control terminals (see section 4.4 *Communications connections* on page 66 for connection and isolation details).

The communications port applies a 2 unit load to the communications network.

USB/EIA232 to EIA485 Communications

An external USB/EIA232 hardware interface such as a PC cannot be used directly with the 2-wire EIA485 interface of the drive. Therefore a suitable converter is required.

Suitable USB to EIA485 and EIA232 to EIA485 isolated converters are available as follows:

- CT USB Comms cable (CT Part No. 4500-0096)
- CT EIA232 Comms cable (CT Part No. 4500-0087)

NOTE

When using the CT EIA232 Comms cable the available baud rate is limited to 19.2 k baud.

When using one of the above converters or any other suitable converter with the drive, it is recommended that no terminating resistors be connected on the network. It may be necessary to remove / deselect the terminating resistor within a non-CT converter, depending on which type is used. The information on how to link out the terminating resistor will normally be contained in the user information supplied with the converter.

Serial communications set-up parameters

The following parameters need to be set according to the system requirements.

***Serial Address* (M01)**

This parameter defines the serial address and an addresses between 1 and 247 are permitted.

Changing the parameters does not immediately change the serial communications settings. See note below for more details.

***Serial Mode* (M02)**

This parameter defines the data format used by the EIA485 comms port on the drive.

Value	Text
0 (Default)	8 2 NP
1	8 1 NP
2	8 1 EP
3	8 1 OP
4	8 2 NP M
5	8 1 NP M
6	8 1 EP M
7	8 1 OP M
8	7 2 NP
9	7 1 NP
10	7 1 EP
11	7 1 OP
12	7 2 NP M
13	7 1 NP M
14	7 1 EP M
15	7 1 OP M

The bits in the value of *Serial Mode* (**M02**) define the data format as follows.:

Bits	3	2	1 and 0
Format	Number of data bits 0 = 8 bits 1 = 7 bits	Register mode 0 = Standard 1 = Modified	Stop bits and Parity 0 = 2 stop bits, no parity 1 = 1 stop bit, no parity 2 = 1 stop bit, even parity 3 = 1 stop bit, odd parity

Bit 3 is always 0 in the core product as 8 data bits are required for MODBUS RTU.

Bit 2 selects either standard or modified register mode. The menu and parameter numbers are derived for each mode as given in the table below. Standard mode is the default setting and allows up to 99 parameters to be accessed within a menu. Modified mode is provided to allow register numbers up to 255 to be addressed.

Register mode	Register address
Standard	(M x 100) + pp -1 Where M is the effective menu number (A = 0, B = 1, C = 2 etc.) ≤ 162 and pp ≤ 99
Modified	(M x 100) + ppp -1 Where M is the effective menu number (A = 0, B = 1, C = 2 etc.) ≤ 63 and ppp ≤ 255

This parameter can be changed via the drive keypad, or via the comms interface itself. Changing the parameters does not immediately change the serial communications settings. See note below for more details.

***Serial Baud Rate* (M03)**

This parameter defines the baud rate used by the serial comms interface.

Value	Text
0	300
1	600
2	1200
3	2400
4	4800
5	9600
6 (Default)	19200
7	38400
8	57600
9	76800
10	115200

Changing the parameters does not immediately change the serial communications settings. See note below for more details.

***Minimum Comms Transmit Delay* (M04)**

There will always be a finite delay between the end of a message from the host (master) and the time at which the host is ready to receive the response from the drive (slave). The drive does not respond until at least 1ms after the message has been received from the host allowing 1ms for the host to change from transmit to receive mode. This initial delay can be extended using *Minimum Comms Transmit Delay* (**M04**) if required.

Value	Action
0	The transmitters are turned on and data transmission begins immediately after the initial delay (≥1 ms)
1	The transmitters are turned on after the initial delay (≥1 ms) and data transmission begins 1ms later
2 or more	The transmitters are turned on after a delay of at least the time specified by *Minimum Comms Transmit Delay* (**M04**) and data transmission begins 1ms later

The drive holds its own transmitters active for up to 1 ms after it has transmitted data before switching to the receive mode; the host should not send any data during this time.

Changing the parameters does not immediately change the serial communications settings See note below for more details.

***Silent Period* (M05)**

The silent period defines the idle time required to detect the end of a received data message. If *Silent Period* (**M05**) = 0 then the silent period is at least 3.5 characters at the selected baud rate. This is the standard silent period for MODBUS RTU. If *Silent Period* (**M05**) is non-zero it defines the minimum silent period in milliseconds.

Changing the parameters does not immediately change the serial communications settings. See note below for more details.

NOTE

When *Serial Address* (**M01**), *Serial Mode* (**M02**), *Serial Baud Rate* (**M03**), M*inimum Comms Transmit Delay* (**M04**) or *Silent Period* (**M05**) are modified the changes do not have an immediate effect on the serial communications system. The new values are used after the next power-up or if *Reset Serial Communications* (**M06**) is set to one. *Reset Serial Communications* (**M06**) is automatically cleared to zero after the communications system is updated.

This does not save any changes made and a separate parameter save is required.

6 User Menu A

6.1 Basic parameter descriptions Creep to floor operation

The *E300 Advanced Elevator* drive in its default configuration is for a gearless Elevator application using a synchronous PM motor in RFC-S operating mode with position feedback. The table following details the default parameter settings for the User Menu A parameters.

Table 6-1 Key to parameter table coding

Coding	Attribute
RW	Read / Write: can be written by the user
RO	Read only: can only be read by the user
Bit	1 bit parameter. On (1) or Off (0) on the display
Num	Number: can be uni-polar or bi-polar
Txt	Text: the parameter uses text strings instead of numbers.
Bin	Binary parameter
IP	IP Address parameter
Mac	Mac Address parameter
Date	Date parameter
Time	Time parameter
Chr	Character parameter
FI	Filtered: parameters which have rapidly changing values are filtered when displayed on the keypad for easy viewing
DE	Destination: This parameter selects the destination of an input or logic function
RA	Rating dependent: this parameter is likely to have different values and ranges with drives of different voltage and current ratings. Parameters with this attribute will be transferred to the destination drive by non volatile storage media when the rating of the destination drive is different from the source drive and the file is a parameter file. However, the values will be transferred if only the current rating is different and the file is different from the default file.
ND	No default: The parameter is not modified when defaults are loaded.
NC	Not copied: not transferred to or from non volatile media during copying.
PT	Protected: cannot be used as a destination.
US	User save: parameter saved in drive EEPROM when the user initiates a parameter save.
PS	Power-down save: parameter automatically saved in drive EEPROM when the under volts (UV) trip occurs.

WARNING

The parameters listed are for reference purposes only and do not include detailed information on the parameter or adjustment. Changing parameter values without careful consideration can lead to a safety hazard. The user must read this guide to avoid any risk of damage to the product or the risk of creating a safety hazard users.

Table 6-2 User Menu A Open loop, RFC-A and RFC-S parameters

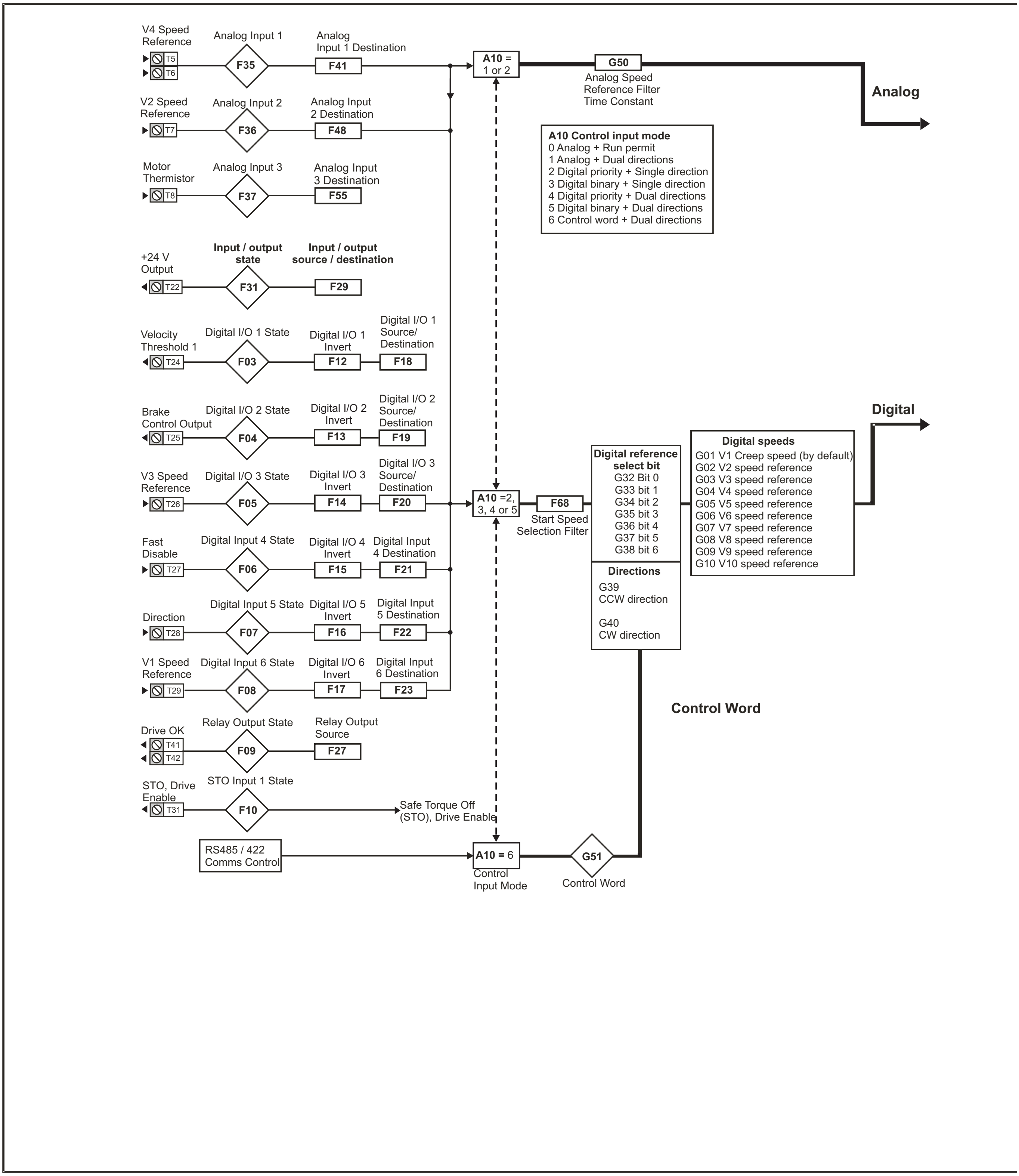
Parameter			Range(⇳)			Default(⇨)			Type					
			OL	RFC-A	RFC-S	OL	RFC-A	RFC-S						
A00	Parameter	{**A00**}	0 to 65535						RW	Num	ND	NC	PT	
A01	User Security Status	{**H02**}	User Menu A (0), All Menus (1), Read-only User Menu A (2), Read-only (3), Status Only (4), No Access (5)						RW	Txt	ND		PT	
A02	Drive Control Mode	{**B01**}	Open loop (1), RFC-A (2), RFC-S (3)			Open loop (1)	RFC-A (2)	RFC-S (3)	RW	Txt	ND	NC	PT	
A03	Parameter Cloning	{**N01**}	None (0), Read (1), Program (2), Auto (3), Boot (4)			None (0)			RW	Txt		NC		US
A04	Total Output Current	{**J22**}	± VM_DRIVE_CURRENT_UNIPOLAR A						RO	Num	ND	NC	PT	FI
A05	Percentage Load	{**J23**}	± VM_USER_CURRENT %						RO	Num	ND	NC	PT	FI
A06	Profile Speed	{**J39**}	0 to 10000 mm/s						RO	Num	ND	NC	PT	
	Actual Speed	{**J40**}		0 to 10000 mm/s					RO	Num	ND	NC	PT	
A07	Output Power	{**J59**}	± VM_POWER kW						RO	Num	ND	NC	PT	FI
A08	Output Frequency	{**J60**}	±VM_SPEED_FREQ_REF Hz	± 550.0 Hz					RO	Num	ND	NC	PT	FI
A09	Output Voltage	{**J61**}	± VM_AC_VOLTAGE V						RO	Num	ND	NC	PT	FI
A10	Control Input Mode	{**H11**}	Analog Run Prmit (0), Analog 2 Dir (1), Priority 1 Dir (2), Binary 1 Dir (3), Priority 2 Dir (4), Binary 2 Dir (5), Control Word (6)			Priority 1 Dir (2)			RW	Txt				US
A11	Direction Input Invert	{**H12**}	Off (0) or On (1)			0ff (0)			RW	Bit				US
A12	Drive Encoder Type	{**C01**}		AB (0), FD (1), FR (2), AB Servo (3), FD Servo (4), FR Servo (5), SC (6), SC Hiperface (7), EnDat (8), SC EnDat (9), SSI (10), SC SSI (11), SC Servo (12), BiSS (13), SC SC (15), Commutation Only (16)			AB (0)	AB Servo (3)	RW	Txt				US
A13	Drive Encoder Auto Configuration Select	{**C02**}		Disabled (0) or Enabled (1)			Enabled (1)		RW	Txt				US
A14	Drive Encoder Rotary Pulses Per Revolution	{**C03**}		1 to 100,000 ppr			1024 ppr	4096 ppr	RW	Num				US
A15	Drive Encoder Voltage Select	{**C04**}		5 V (0), 8 V (1), 15 V (2)			5V (0)		RW	Txt				US
A16	Position Feedback Phase Angle	{**C13**}			0.0 to 359.9 °			0.0 °	RW	Num	ND			US
	Slip Compensation Enable	{**B10**}	Off (0) or On (1)			On (1)			RW	Bit				US
A17	Drive Encoder Feedback Reverse	{**C12**}		Off (0) or On (1)			Off (0)		RW	Bit				US
	Low Frequency Voltage Boost	{**B12**}	0.0 to 25.0 %			3.0 %			RW	Num				US
A18	Motor Rated Current	{**B02**}	± VM_RATED_CURRENT A			Maximum Heavy Duty Rating (**J05**)			RW	Num		RA		US
A19	Motor Rated Voltage	{**B03**}	± VM_AC_VOLTAGE_SET V			200 V drive: 230 V 50 Hz - 400 V drive: 400 V 60 Hz - 400 V drive: 460 V 575 V drive: 575 V 690 V drive: 690 V			RW	Num		RA		US
A20	Number Of Motor Poles	{**B05**}	Automatic (0) to 480 Poles (240)			Automatic (0)		6 Poles (3)	RW	Txt				US

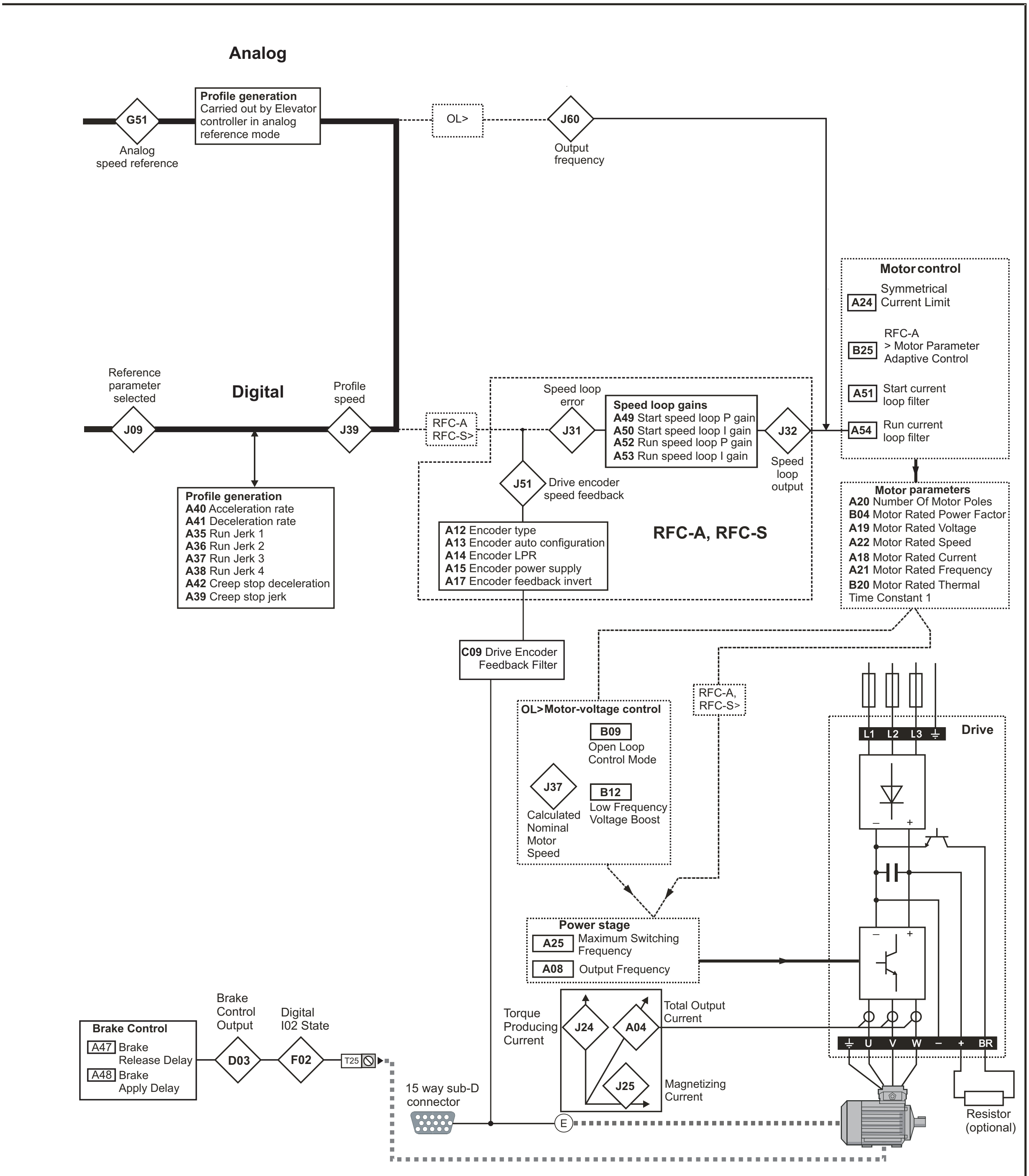
Parameter			Range(⇳)			Default(⇨)			Type					
			OL	RFC-A	RFC-S	OL	RFC-A	RFC-S						
A21	Motor Rated Frequency	{**B06**}	0.0 to 550.0 Hz			50 Hz: 50.0 60 Hz: 60.0			RW	Num				US
A22	Motor Rated Speed	{**B07**}	0 to 33000 rpm		0.00 to 33000.00 rpm	50 Hz: 1500.0 rpm, 60 Hz: 1800.0 rpm	50 Hz: 1450.00 rpm 60 Hz: 1750.00 rpm	3000.00 rpm	RW	Num				US
A23	Open Loop Control Mode	{**B09**}	Ur S (0), Ur (1), Fixed (2), Ur Auto (3), Ur I (4)			Ur I (4)			RW	Txt				US
	RFC: Action On Enable	{**B09**}			Disabled (0), Short (1), Short Once (2), Long (3), Long Once (4)			Disabled (0)	RW	Txt				US
A24	Symmetrical Current Limit	{**B16**}	± VM_MOTOR1_CURRENT_LIMIT %			165.0 %	175.0 %		RW	Num		RA		US
A25	Maximum Switching Frequency	{**B13**}	2 kHz (0), 3 kHz (1), 4 kHz (2), 6 kHz (3), 8 kHz (4) 12 kHz (5), 16 kHz (6)			8 kHz (4)			RW	Txt		RA		US
A26	Motor Autotune	{**B11**}	None (0), Static (1), Rotating (2)	None (0), Static (1), Rotating (2), Inertia (3)		None (0)			RW	Txt		NC		US
A27	Reverse Motor Phase Sequence	{**B26**}	Off (0) or On (1)			0ff (0)			RW	Bit				US
A28	Nominal Elevator Speed mm/s	{**E01**}	0 to 1800 mm/s	0 to 4000 mm/s		1000 mm/s			RW	Num				US
A29	Sheave Diameter	{**E02**}	1 to 32,767 mm			400 mm		480 mm	RW	Num				US
A30	Roping	{**E03**}	1:1 (1), 2:1 (2), 3:1 (3), 4:1 (4)			1:1 (1)			RW	Txt				US
A31	Gear Ratio Numerator	{**E04**}	1 to 32767			31		1	RW	Num				US
A32	Gear Ratio Denominator	{**E05**}	1 to 32767			1			RW	Num				US
A33	Nominal Elevator Speed Rpm	{**E07**}	1.00 to 4000.00 rpm			1480.14 rpm		39.48 rpm	RW	Num				US
A34	Motor Maximum Frequency Clamp	{**E08**}	-214748364.8 to 214748364.7			54.8 Hz			RO	Num				US
	Motor Maximum Speed Clamp	{**E08**}					1644.6 rpm	43.8 rpm	RO	Num				US
A35	Run Jerk 1	{**G13**}	1 to 65535 mm/s³ x10			50 mm/s³ x10			RW	Num				US
A36	Run Jerk 2	{**G14**}	1 to 65535 mm/s³ x10			100 mm/s³ x10			RW	Num				US
A37	Run Jerk 3	{**G15**}	1 to 65535 mm/s³ x10			100 mm/s³ x10			RW	Num				US
A38	Run Jerk 4	{**G16**}	1 to 65535 mm/s³ x10			50 mm/s³ x10			RW	Num				US
A39	Creep Stop Jerk	{**G18**}	1 to 65535 mm/s³ x10			100 mm/s³ x10			RW	Num				US
A40	Acceleration Rate	{**G11**}	0 to 10000 mm/s²			800 mm/s²			RW	Num				US
A41	Deceleration Rate	{**G12**}	0 to 10000 mm/s²			500 mm/s²			RW	Num				US
A42	Creep Stop Deceleration Rate	{**G17**}	0 to 10000 mm/s²			1000 mm/s²			RW	Num				US
A43	V1 Speed Reference	{**G01**}	0 to *Nominal Elevator Speed* (**A28**)			50 mm/s			RW	Num				US
A44	V2 Speed Reference	{**G02**}	0 to *Nominal Elevator Speed* (**A28**)			400 mm/s			RW	Num				US
A45	V3 Speed Reference	{**G03**}	0 to *Nominal Elevator Speed* (**A28**)			600 mm/s			RW	Num				US

Parameter			Range(⇳) OL	Range(⇳) RFC-A	Range(⇳) RFC-S	Default(⇨) OL	Default(⇨) RFC-A	Default(⇨) RFC-S	Type					
A46	V4 Speed Reference	{**G04**}	0 to *Nominal Elevator Speed* (**A28**)			10 mm/s			RW	Num				US
A47	Brake Control Release Delay	{**D04**}	0 to 10000 ms			500 ms			RW	Num				US
A48	Brake Control Apply Delay	{**D05**}	0 to 10000 ms			500 ms			RW	Num				US
A49	Start Speed Loop P Gain	{**I01**}		0.0000 to 200.0000 s/rad			0.0300 s/rad		RW	Num				US
A50	Start Speed Loop I Gain	{**I02**}		0.00 to 655.35 s^2/rad			0.10 s^2/rad		RW	Num				US
A51	Start Current Loop Filter	{**I05**}		0.0 to 25.0 ms			1.0 ms		RW	Num				US
A52	Run Speed Loop P Gain	{**I06**}		0.0000 to 200.0000 s/rad			0.0300 s/rad		RW	Num				US
A53	Run Speed Loop I Gain	{**I07**}		0.00 to 655.35 s^2/rad			0.10 s^2/rad		RW	Num				US
A54	Run Current Loop Filter	{**I10**}		0.0 to 25.0 ms			1.0 ms		RW	Num				US
A55	Start Lock Enable	{**I22**}		Off (0) or On (1)			Off (0)		RW	Bit				US
A56	Start Lock P Gain Speed Clamp	{**I21**}		0 to 10000 mm/s			100 mm/s		RW	Num				US
A57	Start Lock P Gain	{**I20**}		0.000 to 1000.000			50.000		RW	Num				US
A58	Start Optimizer Time	{**G48**}		0 to 10000 ms			1000 ms		RW	Num				US
A59	Start Optimizer Jerk	{**G47**}		±VM_EX00_RUN_JERK_1 mm/s^3 x 10			10 mm/s^3 x 10		RW	Num				US
A60	Start Optimizer Speed	{**G46**}	0 to 10000 mm/s			50 mm/s	10 mm/s		RW	Num				US
A61	Start Optimizer Enable	{**G45**}		Off (0) or On (1)			Off (0)		RW	Bit				US
A62 to A80	User Menu A Parameters Set-up Using Menu Z													

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination
IP	IP address	Mac	Mac address	Date	Date parameter	Time	Time parameter						

Figure 6-1 User Menu 0 logic diagram




Analog
Profile generation
Carried out by Elevator controller in analog reference mode
G51
Analog speed reference
OL>
J60
Output frequency
Motor control
A24 Symmetrical Current Limit
B25 RFC-A > Motor Parameter Adaptive Control
A51 Start current loop filter
A54 Run current loop filter
Reference parameter selected
Digital
Profile speed
J09
J39
RFC-A RFC-S>
Speed loop error
J31
Speed loop gains
A49 Start speed loop P gain
A50 Start speed loop I gain
A52 Run speed loop P gain
A53 Run speed loop I gain
J32
Speed loop output
J51
Drive encoder speed feedback
Profile generation
A40 Acceleration rate
A41 Deceleration rate
A35 Run Jerk 1
A36 Run Jerk 2
A37 Run Jerk 3
A38 Run Jerk 4
A42 Creep stop deceleration
A39 Creep stop jerk
A12 Encoder type
A13 Encoder auto configuration
A14 Encoder LPR
A15 Encoder power supply
A17 Encoder feedback invert
RFC-A, RFC-S
Motor parameters
A20 Number Of Motor Poles
B04 Motor Rated Power Factor
A19 Motor Rated Voltage
A22 Motor Rated Speed
A18 Motor Rated Current
A21 Motor Rated Frequency
B20 Motor Rated Thermal Time Constant 1
C09 Drive Encoder Feedback Filter
RFC-A, RFC-S>
OL>Motor-voltage control
B09 Open Loop Control Mode
J37 Calculated Nominal Motor Speed
B12 Low Frequency Voltage Boost
Drive
L1 L2 L3
Power stage
A25 Maximum Switching Frequency
A08 Output Frequency
Brake Control
A47 Brake Release Delay
A48 Brake Apply Delay
Brake Control Output
D03
Digital I02 State
F02
T25
Torque Producing Current
J24
A04
Total Output Current
J25
Magnetizing Current
15 way sub-D connector
E
U V W − + BR
Resistor (optional)

6.2 Parameter descriptions

Pr **mm00** is available in all menus and commonly used functions are provided and can be selected as either text strings or by selecting the appropriate numeric values as shown in the following table. For example, enter 4003 in Pr **mm00** to transfer drive parameters to parameter file 003.

Table 6-3 Commonly used functions in Pr mm00

Pr **mm00**	Equivalent value	Pr **mm00 String**	Action
0	0	[No Action]	
1000	1	[Save parameters]	Save parameters when under voltage is not active and low voltage threshold is not active
6001	2	[Load file 1]	Load the drive parameters or user program file from NV Media Card file 001
4001	3	[Save to file 1]	Transfer the drive parameters to parameter file 001
6002	4	[Load file 2]	Load the drive parameters or user program file from NV Media Card file 002
4002	5	[Save to file 2]	Transfer the drive parameters to parameter file 002
6003	6	[Load file 3]	Load the drive parameters or user program file from NV Media Card file 003
4003	7	[Save to file 3]	Transfer drive parameters to parameter file 003
12000	8	[Show non-default]	Displays parameters that are different from defaults
12001	9	[Destinations]	Displays parameters that are set
1233	10	[Reset 50 Hz Defs]	Load parameters with standard (50 Hz) defaults
1244	11	[Reset 60 Hz Defs]	Load parameters with US (60 Hz) defaults
1070	12	[Reset modules]	Reset all option modules

Table 6-4 Functions in Pr mm00

Pr **mm00**	Action
1000	Save parameters when *Under Voltage* is not active and *Low Under Voltage Threshold Select* mode is not active (Off (0)).
1001	Save parameter under all conditions
1070	Reset all option modules
1233	Load standard (50 Hz) defaults
1234	Load standard (50 Hz) defaults to all menus except option module menus (i.e menus P, Q and R)
1244	Load US (60 Hz) defaults
1245	Load US (60 Hz) defaults to all menus except option module menus (i.e menus P, Q and R)
1253	Change drive mode and load standard (50 Hz) defaults
1254	Change drive mode and load US (60 Hz) defaults
1255	Change drive mode and load standard (50 Hz) defaults except for menus P, Q and R
1256	Change drive mode and load US (60 Hz) defaults except for menus P, Q and R
1299	Reset {Stored HF} trip.
2001	Create a boot file on a NV Media Card based on the present drive parameters
4yyy	NV Media Card: Transfer the drive parameters to parameter file xxx
6yyy	NV Media Card: Load the drive parameters from parameter file xxx
7yyy	NV Media Card: Erase file xxx
8yyy	NV Media Card: Compare the data in the drive with file xxx
9555	NV Media Card: Clear the warning suppression flag
9666	NV Media Card: Set the warning suppression flag
9777	NV Media Card: Clear the read-only flag
9888	NV Media Card: Set the read-only flag
9999	NV Media Card: Erase and format the NV Media Card
12000	Only display parameters that are different from their default value. This action does not require a drive reset.
12001	Only display parameters that are used to set-up destinations (i.e. DE format bit is 1). This action does not require a drive reset.
15xxx	Transfer the user program in an option module installed in slot 1 to a NV Media Card file xxx
16xxx	Transfer the user program in an option module installed in slot 2 to a NV Media Card file xxx
17xxx	Transfer the user program in an option module installed in slot 3 to a NV Media Card file xxx
18xxx	Transfer the user program from file xxx in a NV Media Card to an option module installed in slot 1.
19xxx	Transfer the user program from file xxx in a NV Media Card to an option module installed in slot 2.
20xxx	Transfer the user program from file xxx in a NV Media Card to an option module installed in slot 3.
21xxx	Transfer the user program in an option module installed in slot 4 to a NV Media Card file xxx.
22xxx	Transfer the user program from file xxx in a NV Media Card to an option module installed in slot 4.

6.3 Full parameter descriptions

A00 {A00}	Parameter Zero							
RW	Num				ND	NC	PT	
⇳	0 to 65,535			⇨				

A00 (*Parameter Zero* **A00**)

A01 {H02}		User Security Status	
RW	Txt		ND PT
OL **RFC-A** **RFC-S**	⇳	User menu A (0), All Menus (1), Read-only User menu A (2), Read-only (3), Status Only (4), No Access (5)	⇨

A01 (*User Security Status* **H02**)
This parameter controls access via the drive keypad. The keypad can be used to adjust this parameter even when user security is set.

Security level	Description
0 (User menu A)	All writable parameters are available to be edited but only parameters in User menu A are visible.
1 (All Menus)	All writable parameters are visible and available to be edited.
2 (Read-only User menu A)	All parameters are read-only. Access is limited to User menu A parameters only.
3 (Read-only)	All parameters are read-only however all menus and parameters are visible.
4 (Status Only)	The keypad remains in status mode and no parameters can be viewed or edited.
5 (No Access)	The keypad remains in status mode and no parameters can be viewed or edited. Drive parameters cannot be accessed via a comms / fieldbus interface in the drive or any option module.

A02 {B01}		Drive Control Mode		
RW	Txt			ND NC PT US
OL	⇳	Open loop (1)	⇨	Open loop (1)
RFC-A		RFC-A (2)	⇨	RFC-A (2)
RFC-S		RFC-S (3)	⇨	RFC-S (3)

A02 (*Drive Control Mode* **B01**)

This parameter defines the drive operating mode. Pr **mm00** must be set to ‘1253’ (European defaults) or ‘1254’ (USA defaults) before this parameter can be changed. When the drive is reset to implement any change in this parameter, the default settings of all parameters will be set according to the drive operating mode selected and saved in memory.

The parameter settings for the drive mode are as follows:

Setting	Operating mode
1	Open loop
2	RFC-A
3	RFC-S

A03 {N01}		Parameter Cloning		
RW	Txt			NC US
OL **RFC-A** **RFC-S**	⇳	None (0), Read (1), Program (2), Auto (3), Boot (4)	⇨	None (0)

A03 (*Parameter Cloning Modes* **N01**) can be used to initiate data transfers to or from an NV Media Card as described below. Only a value of Auto (3) or Boot (4) can be saved in this parameter.

1: Read

Setting **A03** (**N01**) = Read (1) and initiating a drive reset will transfer the parameter data to the drive. When the action is complete this parameter is automatically reset to zero.

2: Program

Setting **A03** (**N01**) = Program (2) and initiating a drive reset will transfer the parameter data from the drive to a parameter file with file identification number 1 (any existing file will be overwritten). When the action is complete this parameter is automatically reset to zero.

3: Auto

Setting **A03** (**N01**) = Auto (3) and initiating a drive reset will transfer the parameter data from the drive to a parameter file with file identification number 1 (any existing file will be overwritten). When the action is complete this parameter remains at 3.

If the NV Media Card is removed when this parameter remains at 3, then parameter cloning is set to None (0), which forces the user to change parameter **A03** (**N01**) back to Auto (3) if auto is still required. The user needs to set parameter **A03** (**N01**) = Auto (3) and initiate a drive reset to write a complete parameter set to a new NV Media Card.

When a parameter in User menu A is changed via the keypad and **A03** (**N01**) = Auto (3), the parameter is saved both to the drive non volatile memory and to the parameter file with identification number 1 on the NV Media Card. Only the new value of the modified parameter, and not the value of all the other drive parameters, is stored each time. If **A03** (**N01**) is not cleared automatically when an NV Media Card is removed, then when a new card is inserted that contains a parameter file with identification number 1. The modified parameter would be written to the existing file on the new card and the rest of the parameters in this file may not be the same as those in the drive.

When **A03** (**N01**) = Auto (3) and the drive parameters are saved to non volatile memory, the file on the NV Media Card is updated, therefore this file becomes a copy of the drive parameters. At power up if **A03** (**N01**) = Auto (3) the drive will save the parameter set to the NV Media Card. This ensures that if an NV Media Card is inserted when the drive is powered Off, the new NV Media Card has the correct data when the drive is powered up again.

4: Boot

When **A03** (**N01**) = Boot (4), the drive operates in the same way as with **A03** (**N01**) = Auto (3) and automatically creates a copy of its parameters to the NV Media Card. The NC (not clonable) attribute for **A03** (**N01**) is 1, and so it does not have a value stored in the parameter file on the NV Media Card in the normal way. However the value of **A03** (**N01**) is held in the parameter file header. If **A03** (**N01**) = Boot (4) in the parameter file with a file identification value of 1 on an NV Media Card fitted to a drive at power-up, then the parameters from the parameter file with file identification number 1 are transferred to the drive and saved in non volatile memory. **A03** (**N01**) is then set to None (0) after the data transfer is complete.

It is possible to create a bootable parameter file by setting Pr **mm00** = 2001 and initiating a drive reset. This file is created in one operation and is not updated when further parameter changes are made.

When the drive is powered up, it detects which option modules are installed before loading parameters from an NV Media Card which has been set-up for boot mode. If a new option module has been installed since the last time the drive was powered up, a Slot1 Different ***trip*** is initiated and the parameters are then transferred from the NV Media Card. If the parameter file includes the parameters for the newly installed option module, then these are also transferred to the drive and the Slot1 Different ***trip*** is reset. If the parameter file does not include the parameters for the newly installed option module, then the drive does not reset the Slot1 Different ***trip***. Once the transfer is complete, the drive parameters are saved to non volatile memory and the Slot1 Different ***trip*** can be reset either by initiating a drive reset or by powering down and then powering up again.

A04 {J22}		**Total Output Current**						
RO	Num				ND	NC	PT	FI
OL	⇳	± VM_DRIVE_CURRENT_ UNIPOLAR A	⇨					
RFC-A			⇨					
RFC-S			⇨					

A04 (*Total Output Current* **J22**)

The total output current is the instantaneous drive output current scaled so that it represents the rms phase current in Amps under steady state conditions.

A05 {J23}		**Percentage Load**						
RO	Num				ND	NC	PT	FI
OL	⇳	± VM_USER_CURRENT %	⇨					
RFC-A			⇨					
RFC-S			⇨					

A05 (*Percentage Load* **J23**)

The percentage load displays *Torque Producing Current* (**J24**) as a percentage of the rated torque producing current for the motor. Positive values indicate motoring and negative values represent regenerating.

A06 {J39}	Profile Speed (OL)								
{J40}	Actual Speed (RFC)								
RO	Num				ND	NC	PT		
OL	⇳	0 to 10000 mm/s			⇨				
RFC-A					⇨				
RFC-S					⇨				

A06 (Profile Speed **J39**)
(Actual Speed **J40**)

Open loop mode Profile speed

This indicates the profile generator output speed in mm/s units. The profile generator output speed is based on the profile specified in menu G-Profile parameters.

RFC-A and RFC-S mode Actual speed

This parameter indicates the actual speed of the motor in mm/s units. In closed loop operation the actual speed is based upon the encoder feedback and motor rated speed mm/s and rpm scaling.

A07 {J59}	Output Power								
RO	Num				ND	NC	PT	FI	
OL	⇳	± VM_POWER kW			⇨				
RFC-A					⇨				
RFC-S					⇨				

A07 (*Output Power* **J59**)
The Output power is the power flowing via the AC terminals of the drive. The power is derived as the dot product of the output voltage and current vectors, and is therefore correct even if the motor parameters are incorrect and the motor model does not align the reference frame with the flux axis of a motor in RFC-A mode. For Open loop, RFC-A and RFC-S modes a positive value of power indicates power flowing from the drive to motor.

A08 {J60}	Output Frequency								
RW	Num				ND	NC	PT	FI	
OL	⇳	± VM_SPEED_FREQ _ REF Hz			⇨				
RFC-A		± 550.0 Hz			⇨				
RFC-S					⇨				

A08 (*Output Frequency* **J60**)
The Output frequency in Open loop mode is the sum of the post ramp reference and the motor slip compensation frequency. In Closed loop operation the output frequency is not controlled directly and the output frequency is a measurement of the frequency applied to the motor.

A09 {J61}	Output Voltage								
RO	Num				ND	NC	PT	FI	
OL	⇳	± VM_AC_VOLTAGE V			⇨				
RFC-A					⇨				
RFC-S					⇨				

A09 (*Output Voltage* **J61**)
The Output voltage is the rms line to line voltage at the AC output terminals (UVW) of the drive.

A10 {H11}	**Control Input Mode**								
RW	Txt							US	
OL **RFC-A** **RFC-S**	⇳	Analog Run Prmit (0), Analog 2 Dir (1), Priority 1 Dir (2), Binary 1 Dir (3), Priority 2 Dir (4), Binary 2 Dir (5), Control Word (6)	⇨	Priority 1 Dir (2)					

A10 (*Control Input Mode* **H11**)
This parameter allows the user to configure the input control mode. The following configurations are available:

Analog Run Prmit (0): Analog speed reference with run permit

Run permit and *Direction Input 1* CCW (**G39**) = On (1) to start the profile. The analog reference is bi-directional i.e. the direction of travel is taken from the sign of the analog reference where –ve references are *Counter Clockwise* (CCW) and +ve references are *Clockwise* (CW) direction. *Direction Input 2* CW (**G40**) has no effect in this mode.

- Sequencing may be started when the enable is received. It is assumed that the enable is made via an auxiliary contact on the output motor contactors. Motor contactor control output is not used when the enable starts the sequencing.
- Sequencing may be started when a run permit input is given. Motor contactor control is set to On (1) when the run permit (direction) signal is given. It is assumed that the enable is made via an auxiliary contact on the output motor contactors.
- When an analog speed reference mode is selected *Analog Input 1 Destination* (**F41**) is forced to *Analog Speed Reference* (**G49**). *T5 T6 Analog Input 1* (**F35**) must be used as the speed reference input.

Analog 2 Dir (1): Analog speed reference with dual direction inputs.
The analog reference is read from the analog speed reference input. If *Direction Input 1 CCW* (**G39**) = Off (0) and *Direction Input 2 CW* (**G40**) = On (1), clockwise direction is selected, and if *Direction Input 1* CCW (**G39**) = On (1) and *Direction Input 2* CW (**G40**) = Off (0) counter clockwise direction is selected. If *Direction Input 1* CCW (**G39**) and *Direction Input 2* CW (**G40**) = On (1) or Off (0) no direction is selected.

- Sequencing may be started when the enable is received. It is assumed that the enable is made via an auxiliary contact on the output motor contactors. Motor contactor control is not used when the enable starts the sequencing.
- Sequencing may be started when a direction input is given *Direction Input 1* CCW (**G39**) or *Direction Input 2* CW (**G40**) = On (1)). *Motor contactor control output* (**B29**) is set to On (1) when the direction signal is given. It is assumed that the enable is made via an auxiliary contact on the output motor contactors.

Priority 1 Dir (2): Single direction input and priority speed selection
Priority speed selection where for example V2 higher priority than V3. *Direction Input 1* CCW (**G39**) = Off (0) clockwise direction is selected, and *Direction Input 1* CCW (**G39**) = On (1) counter clockwise direction is selected.

Binary 1 Dir (3): Single direction input and binary speed selection
Binary speed selection and *Direction Input 1* CCW (**G39**) = Off (0) clockwise direction is selected, and *Direction Input 1* CCW (**G39**) = On (1) counter clockwise direction is selected.

Priority 2 Dir (4): Dual direction input with priority speed selection
Priority speed selection where for example V2 has higher priority than V3, *Direction Input 1* CCW (**G39**) = Off (0) and *Direction Input 2* CW (**G40**) = On (1) clockwise direction is selected, and if *Direction Input 1* CCW (**G39**) = On (1) and *Direction Input 2* CW (**G40**) = Off (0) counter clockwise direction is selected. If *Direction Input 1* CCW (**G39**) and *Direction Input 2* CW (**G40**) = On (1) or Off (0) then no direction is selected.

Binary 2 Dir (5): Dual direction input and binary speed selection
Direction Input 1 CCW (**G39**) = Off (0) and *Direction Input 2* CW (**G40**) = On (1) clockwise direction is selected, and if *Direction Input 1* CCW (**G39**) = On (1) and *Direction Input 2* CW (**G40**) = Off (0) counter clockwise direction is selected. If *Direction Input 1* CCW (**G39**) and *Direction Input 2* CW (**G40**) = On (1) or Off (0) then no direction is selected. Changing the direction during travel will cause the elevator to abort the present motion and come to a stop.

Control Word (6): Dual direction selection, and priority 10 bit selection using control word.
When Control input mode = 6 the control word is enabled. The control word replicates and extends the behaviour of the reference select bits, Reference select bit 0 to Reference select bit 6, and the direction bit inputs, *Direction Input 1* CCW (**G39**) and direction Input 2 (CW). A watchdog is provided to verify that the Elevator controller using the control word is still updating the speed and direction inputs. The user must write 1 to the watchdog bit every ≤ 500 ms to prevent the watchdog from stopping the Elevator and causing a *Trip 77* (**Ctrl Watchdog**).
When the system is powered on when *Control Input Mode* (**H11**) = Control Word (6) or when *Control Input Mode* (**H11**) is set to Control Word (6) for the first time after power up, a 10 s delay is implemented before calling a *Trip 77* (**Ctrl Watchdog**). This delay allows the lift controller time to start up after power on and begin writing to the watchdog bit in the control word. The delay reverts back to 1 s after this initial period.

The table below details the bits within the control word and their function:

Bit	Description	Priority
0	Selects V1 Speed Reference (Creep speed by default). If a higher priority speed is selected it will override this speed selection.	10 (lowest)
1	Selects V2 Speed Reference. If a higher priority speed is selected it will override this speed selection.	9
2	Selects V3 Speed Reference. If a higher priority speed is selected it will override this speed selection.	8
3	Selects V4 Speed Reference. If a higher priority speed is selected it will override this speed selection.	7
4	Selects V5 Speed Reference. If a higher priority speed is selected it will override this speed selection.	6
5	Selects V6 Speed Reference. If a higher priority speed is selected it will override this speed selection.	5
6	Selects V7 Speed Reference. If a higher priority speed is selected it will override this speed selection.	4
7	Selects V8 Speed Reference. If a higher priority speed is selected it will override this speed selection.	3
8	Selects V9 Speed Reference. If a higher priority speed is selected it will override this speed selection.	2
9	Selects V10 Speed Reference. If a higher priority speed is selected it will override this speed selection.	1 (highest)
10	Direction input 1 CCW	N/A
11	Direction input 2 CW	N/A
12	Watchdog bit. This must be set to 1 at least every 500 ms. Failure to do this will result in a *Trip 77* (**Ctrl Watchdog**). If a travel is in progress the elevator will perform a controlled stop and then trip.	N/A
13	Reserved	N/A
14	Reserved	N/A
15	Reserved	N/A

A11 {H12}	**Direction Input Invert**							
RW	Bit						US	
OL	⇳	Off (0) or On (1)	⇨	Off (0)				
RFC-A								
RFC-S								

A11 (*Direction Input Invert* **H12**)

When set to Off (0) the direction input operation is not inverted. For single direction input operation, if *Direction Input 1* (CCW **G39**) = Off (0) clockwise direction is selected, and if *Direction Input 1* (CCW **G39**) = On (1) then counter clockwise direction is selected. For dual direction input operation, if *Direction Input 1* (CCW **G39**) = On (1) then counter clockwise direction is selected, and if *Direction Input 2* CW (**G40**) = On (1) then clockwise direction is selected.

When set to On (1), the direction input operation is inverted. For single direction input operation, if *Direction Input 1* CCW (**G39**) = Off (0) counter clockwise direction is selected, and if *Direction Input 1* CCW (**G39**) = On (1) then clockwise direction is selected. For dual direction input operation, if *Direction Input 1* (CCW **G39**) = On (1) then clockwise direction is selected, and if *Direction Input 2* (CW **G40**) = On (1) then counter clockwise direction is selected. Parameter **A10** (*Control Input Mode* **H09**) selects either single or dual direction input mode.

A12 {C01}	**Drive Encoder Type**							
RW	Txt						US	
OL	⇳		⇨					
RFC-A		AB (0), FD (1), FR (2), AB Servo (3), FD Servo (4), FR Servo (5), SC (6), SC Hiperface (7), EnDat (8), SC EnDat (9), SSI (10), SC SSI (11), SC Servo (12), BiSS (13), SC SC (15), Commutation Only (16)		AB (0)				
RFC-S				AB Servo (3)				

A12 (*Drive Encoder Type* **C01**)

Encoder type should be set-up based on the position feedback device connected to the drive position feedback interface.

Table 6-5 overleaf details the position feedback types supported.

Table 6-5 Supported feedback types

Encoder type	Signals	Position feedback type	Communications
0: AB	Quadrature	Incremental	None
1: FD	Frequency and direction	Incremental	None
2: FR	Forward and reverse	Incremental	None
3: AB Servo	Quadrature + commutation	Incremental + Absolute commutation	None
4: FD Servo	Frequency and direction + commutation	Incremental + Absolute commutation	None
5: FR Servo	Forward and reverse + commutation	Incremental + Absolute commutation	None
6: SC	SINCOS	Incremental SINCOS	None
7: SC Hiperface	SINCOS + Hiperface comms	SINCOS incremental + Absolute comms	Hiperface
8: EnDat	EnDat comms	Absolute comms	EnDat 2.1, EnDat 2.2
9: SC EnDat	SINCOS + EnDat comms	SINCOS incremental + Absolute comm	EnDat 2.1
10: SSI	SSI comms	Absolute comms	SSI
11: SC SSI	SINCOS + SSI comms	SINCOS incremental + Absolute comm	SSI
12: SC Servo	SINCOS + commutation	Incremental + Absolute commutation	None
13: BiSS	BiSS comms	Absolute comms	BiSS
15: SC SC	SINCOS + single SINCOS per rev	SINCOS + absolute single SINCOS	None
16: Commutation	Commutation only	Absolute commutation only	None

Position Feedback Type:

Incremental Position feedback devices provide incremental feedback only and do not give absolute position feedback. The position is zero at power-up and accumulates the change of position from that point on. These devices are suitable for motor control in RFC-A mode. In RFC-S mode, a phasing autotune is required each time the drive is power cycled.

Incremental + Absolute Commutation Position feedback devices with commutations signals are intended to provide absolute position feedback for motor control in RFC-S mode. The commutation signals are not used in RFC-A mode.

The commutation signals are used in RFC-S mode to determine the motor position after position feedback initialization, and after drive power up. There must be one period of the commutation signals for each pole pair for a rotary motor (i.e. 3 commutation signal periods per revolution for a 6 pole motor). It should be noted that for a movement of up to $^1/_3$ of the commutation signal period after position feedback initialization drive power up, the maximum motor torque is limited to 0.866 of the maximum possible torque.

Absolute commutation signals only Position devices with commutations signals only are intended to provide absolute position feedback for motor control in RFC-S mode but can also be used to provide position feedback for motor control in RFC-A mode. The position is derived from the commutation signals alone. A phase locked loop is used to smooth the feedback, but this introduces a delay and there is significant ripple in the position and speed feedback at low speeds. If this method is used for motor control, then low speed loop gains should be used and the speed feedback filter should be set to its maximum value.

Incremental SINCOS An incremental SINCOS encoder can be used in the same way as an AB incremental encoder, except that the position resolution is increased with interpolation. These devices are suitable for motor control in RFC-A mode. They can also be used for RFC-S mode, but a phasing autotune is required each time the position feedback is initialized, the drive is power cycled.

Incremental SINCOS + Absolute comms The absolute position is obtained after position feedback initialization via the comms interface and then after that point by tracking the incremental change from the SINCOS signals. Interpolation is used to increase the position resolution. The comms interface can also be used for bi-directional transfer of data between the drive and encoder (except SSI comms).

These devices can be used for motor control in both RFC-A and RFC-S.

Absolute comms The absolute position is obtained at all times via the encoder comms. The comms interface can also be used for bi-directional transfer of data between the drive and the encoder (except SSI mode). These devices can be used for motor control in RFC-A or RFC-S mode.

SINCOS + absolute single SINCOS This type of device (which is not recommended for new applications), is intended to provide absolute position feedback for motor control in RFC-S mode. If one of these devices is used for RFC-A mode the additional sine wave signals and the Z1 marker signal do not affect the motor control position feedback.

Communications:

Hiperface Hiperface is an asynchronous bi-directional comms protocol that is only used with incremental sine waves. It can be used to check the position derived from the sine waves or for bi-direction data transfer between the drive and encoder. A checksum is provided for error checking.

EnDat 2.1 EnDat 2.1 is a synchronous bi-directional comms protocol that is intended to be used with incremental sine waves. It can be used to check the position derived from the sine waves or for bi-directional data transfer between the drive and encoder. It can also be used as an absolute comms only type position feedback interface, but the resolution of the position feedback may be limited. If it is used in this way, it is not possible to use the position feedback via comms at the same time as communication with the encoder for data transfer. A CRC is provided for error checking.

EnDat 2.2 and BiSS C Mode EnDat 2.2 and BiSS are synchronous bi-directional comms protocols that are intended to be used alone. It is possible to obtain position feedback at the same time as communicating with the encoder for data transfer. A CRC is provided for error checking.

SSI SSI is a uni-directional comms protocol which is intended to be used alone. The encoder provides position information only, with no possibility of data transfer between the drive and encoder. No error checking is provided by the SSI protocol.

A13 {C02}	Drive Encoder Auto Configuration Select							
RW	Txt						US	
OL	⇕							
RFC-A		Disabled (0) Enabled (1)	⇨	Enabled (1)				
RFC-S								

A13 (*Drive Encoder Auto Configuration Select* **C02**)

If auto configuration has not been disabled, **A13** (*Drive Encoder Auto Configuration Select* **C02**) = Enabled (1), then during position feedback initialization or power up. SC.Hiperface. SC.EnDat, EnDat, BiSS encoders are interrogated to determine the encoder type and parameters are then set-up correctly with information from the encoder as follows:-

Rotary
Drive Encoder Rotary Turns Bits (**C07**)
Drive Encoder Rotary Pulses Per Revolution (**C03**)
Drive Encoder Comms Bits (**C08**)

Once these parameters have been set-up it should be possible for the drive to operate correctly with the encoder. Auto configuration occurs as part of the position interface initialization or at power up if selected, and so if the auto configuration fails (i.e. comms cannot be established) then initialization will not be completed and an Encoder 7 trip occurs. For **SC Hiperface** and **BiSS** encoders the drive must identify the encoder model number to perform auto configuration. If communications are established but the drive cannot recognize the encoder model, an Encoder 12 trip is generated. If auto configuration is disabled **A13** (*Drive Encoder Auto Configuration Select* **C02**) = Disabled (0) then none of the above actions are carried out. For all other position feedback device types parameter auto configuration has no effect.

A14 {C03}	Drive Encoder Rotary Pulses Per Revolution							
RW	Num						US	
OL	⇕							
RFC-A		1 to 100,000 ppr	⇨	1024 ppr				
RFC-S				4096 ppr				

A14 (*Drive Encoder Rotary Pulses Per Revolution* **C03**)

This parameter only has any effect if the position feedback interface is being used with a rotary feedback device

Encoder type: AB, AB Servo

- The rotary pulses per revolution should be set to the number of rotary pulses per rev of the encoder connected to the position feedback interface.

Encoder type: FD, FR, FD Servo, FR Servo

- The rotary pulses per revolution should be set to the number of rotary pulses per rev for the encoder connected to the position feedback interface divided by 2.

Encoder type: SC, SC Servo, SC Hiperface, SC EnDat, SC SSI, SC SC

- The rotary pulses per revolution should be set to the number of sine waves per revolution for the encoder connected to the position feedback interface.

Encoder type: Any other device type

- **A14** (*Drive Encoder Rotary Pulses Per Revolution* **C03**) has no effect.

A15 {C04}	Drive Encoder Voltage Select							
RW	Txt						US	
OL	⇕							
RFC-A		5 V (0) 8 V (1) 15 V (2)	⇨	5 V (0)				
RFC-S								

A15 (*Drive Encoder Voltage Select* **C04**)

The encoder power supply voltage parameter sets the level for the supply voltage output to the position feedback device. To ensure that the maximum voltage for the position feedback device is not accidentally exceeded, the device should be disconnected from the drive when the level is being adjusted.

Value	Text
0	5 V
1	8 V
2	15 V

A16 {C13}	**Position Feedback Phase Angle**								
RW	Num				ND			US	
OL	⇳				⇨				
RFC-A									
RFC-S		0.0 to 359.9 °				0.0 °			

A16 (*Position Feedback Phase Angle* **C13**)

RFC-S mode Position feedback phase angle. The phase angle between the rotor flux and the encoder feedback position must be set-up correctly for the drive to control the motor correctly. If the phase angle is known it can be manually entered by the user. Alternatively the drive can automatically measure the phase angle by performing a phasing test (see **A26** *Motor Autotune* **B11**). When the phasing test is complete, the new position feedback phase angle value will be automatically updated in this parameter. Following the phasing test, the position feedback phase angle value and can be modified if required and will become effective immediately. The position feedback phase angle has a factory default value of 0.0, but this is not affected when defaults are loaded by the user.

A16 {B10}	**Slip Compensation Enable**								
RW	Bit							US	
OL	⇳	Off (0) On (1)			⇨	On (1)			
RFC-A									
RFC-S									

A16 (*Slip Compensation Enable* **B10**)

Open loop mode Slip compensation enable. **A21** (*Motor Rated Frequency* **B06**) and **A19** (*Motor Rated Voltage* **B03**) define the frequency to voltage characteristic applied to the motor. **A21** (*Motor Rated Frequency* **B06**), **A22** (*Motor Rated Speed* **B07**) and **A20** (*Motor Number Of Poles* **B05**) Motor number of poles are used to calculate the rated slip of the motor for slip compensation.

Rated slip (Hz) = Motor Rated Frequency - (Motor pole pairs x Motor rated speed / 60)

If slip compensation is required **A22** (*Motor Rated Speed* **B07**) should be set to the motor nameplate value, which should give the correct compensation for a hot motor provided the nameplate value is correct. Slip compensation can be used throughout the speed range of the motor, i.e. below base speed and in the flux weakening region, to correct / minimise a change of motor speed with load.

Slip compensation is disabled under the following conditions:

1. **A22** (*Motor Rated Speed* **B07**) = 0
2. **A22** (*Motor Rated Speed* **B07**) = **A21** (*Motor Rated Frequency* **B06**) x 60 / Pole pairs, i.e. synchronous speed.
3. **A16** (*Slip Compensation Enable* **B10**) = Off (0).

A17 {C12}	**Drive Encoder Feedback Reverse**								
RW	Bit							US	
OL									
RFC-A	⇳	Off (0) On (1)			⇨	Off (0)			
RFC-S									

A17 (*Drive Encoder Feedback Reverse* **C12**)

RFC-A and RFC-S mode: Drive Encoder Feedback Reverse. If encoder feedback invert parameter = On (1) the encoder feedback position from the motor is rotated within the drive, this can be used to reverse the direction of the encoder feedback where incorrect wiring connections have been made to either the drive or encoder.

A17 {B12}	**Low Frequency Voltage Boost**								
RW	Num							US	
OL	⇳	0.0 to 25.0 %			⇨	3.0 %			
RFC-A									
RFC-S									

(*Low Frequency Voltage Boost* **B12**)

Open loop mode: Low Frequency Voltage Boost. The default value for the low frequency voltage boost depends on the frame size of the drive being used as follows:

3.0 % up to frame size 6 drives
2.0 % for frame size 7 drives

Refer to **A23** (*Open Loop Control Mode* **B09**) for more details.

A18 {B02}	**Motor Rated Current**							
RW	Num				RA			US
OL	⇳	±VM_RATED_CURRENT A	⇨	Maximum Heavy Duty Rating (**J05**)				
RFC-A								
RFC-S								

A18 (*Motor Rated Current* **B02**)

Enter the motor name plate value for the motor rated current.

A19 {B03}	**Motor Rated Voltage**							
RW	Num				RA			US
OL	⇳	±VM_AC_VOLTAGE_SET V	⇨	200 V drive: 230 V 50 Hz default 400 V drive: 400 V 60 Hz default 400 V drive: 460 V 575 V drive: 575 V 690 V drive: 690 V				
RFC-A								
RFC-S								

A19 (*Motor Rated Voltage* **B03**)

Enter the motor name plate value for the motor rated voltage

A20 {B05}	**Number Of Motor Poles**							
RW	Txt							US
OL	⇳	Automatic (0) to 480 Poles (240)	⇨	Automatic (0)				
RFC-A								
RFC-S			⇨	6 Poles (3)				

A20 (*Motor Number Of Poles* **B05**)

The numeric value in number of motor poles should be set to the number of motor pole pairs (i.e. number of motor poles / 2). The text string associated with number of motor poles indicates the number of motor poles (i.e. the parameter value x 2).

Open-loop This parameter is used during the calculation of the motor speed and in then applying the correct slip compensation. When Automatic (0) is selected, the number of motor poles is automatically calculated from the motor rated frequency and motor rated speed. The number of poles = 120 x rated frequency / rpm rounded to the nearest even number.

RFC-A This parameter must be set correctly for the vector control algorithms to operate as expected. When Automatic (0) is selected the number of motor poles is automatically calculated from the motor rated frequency and motor rated speed rpm. The number of poles = 120 x rated frequency / rpm rounded to the nearest even number.

RFC-S This parameter must be set correctly for the vector control algorithms to operate as expected. If Automatic (0) is selected in RFC-S mode the number of poles are set = 3 pole pairs (6) and no calculation is carried out.

A21 {B06}	**Motor Rated Frequency**							
RW	Num							US
OL	⇳	0.0 to 550.0 Hz	⇨	50 Hz default: 50.0 Hz 60 Hz default: 60.0 Hz				
RFC-A								
RFC-S								

A21 (*Motor Rated Frequency* **B06**)

Enter the motor name plate value for the motor rated frequency

A22 {B07}	**Motor Rated Speed**							
RW	Num				ND			US
OL	⇳	0 to 33000 rpm	⇨	50 Hz default: 1500 rpm 60 Hz default: 1800 rpm				
RFC-A				50 Hz default: 1450 rpm 60 Hz default: 1750 rpm				
RFC-S		0.00 to 33000.00 rpm		3000.00 rpm				

A22 (*Motor Rated Speed* **B07**)

Open-loop This is the speed at which the motor will rotate when supplied with its base frequency at the rated voltage under rated load conditions (synchronous speed - slip speed). Entering the correct value into this parameter, allows the drive to increase the output frequency as a function of load in order to compensate for speed drop. If slip compensation is required, this parameter should be set to the value from the motor name plate which should give the correct rpm for a hot machine. Sometimes it will be necessary to adjust this during commissioning, as the nameplate value may be inaccurate. Slip compensation is disabled if the motor rated speed is set to 0 rpm or to the synchronous speed or if *Slip Compensation Enable* (**B10**) = Off (0).

RFC-A Rated load rpm is used with motor rated frequency to determine the full load slip of the motor which is used by the vector control algorithm. Incorrect setting of this parameter can result in the following:

- Reduced efficiency of motor operation
- Reduction of maximum torque available from the motor
- Failure to reach maximum speed
- Over-current trips
- Reduced transient performance
- Inaccurate control of absolute torque in torque control modes

The nameplate value is normally the value for a hot machine, however, some adjustment may be required when the drive is commissioned if the nameplate value is inaccurate. The rated full load rpm can be optimized by the drive (refer to *Motor Parameter Adaptive Control* (**B25**)).

RFC-S The motor rated speed is not used by the motor control algorithms, but it is used by the motor thermal protection system. The units for motor rated speed are always rpm The nameplate value is normally the value for a hot machine. Setting this parameter to 0 disables the motor thermal protection. For further details on the motor thermal protection system (refer to parameter *Thermal Protection Mode* (**B19**)).

A23 {B09}	**Open-Loop: Open Loop Control Mode**		
{B09}	**RFC-S: Action On Enable**		
RW	Txt		US
OL	UrS (0) Ur (1) Fixed (2) Ur Auto (3) Ur I (4)	⇨	Ur I (4)
RFC-A			
RFC-S	Disabled (0), Short (1), Short Once (2), Long (3), Long Once (4)		Disabled (0)

A23 (*Open Loop Control Mode* **B09**)

(*RFC-S Action On Enable* **B09**)

Open loop control mode

Value	Text
0	UrS
1	Ur
2	Fixed
3	Ur Auto
4	Ur I

The open loop control mode defines the drive output mode. It should be noted that the maximum output voltage of the drive is limited to a level just below DC bus voltage (**J65**) / √2 . Therefore if the drive is being supplied via its own rectifier input stage, the output voltage is limited to a level just below that of the supply voltage. If the drive is operating in voltage mode, the output voltage is limited to **A19** (*Motor Rated Voltage* **B03**) or the maximum possible output voltage whichever is the lowest. If (*Quasi Square Enable* **B45**) = On (1) the maximum possible output voltage can be increased.

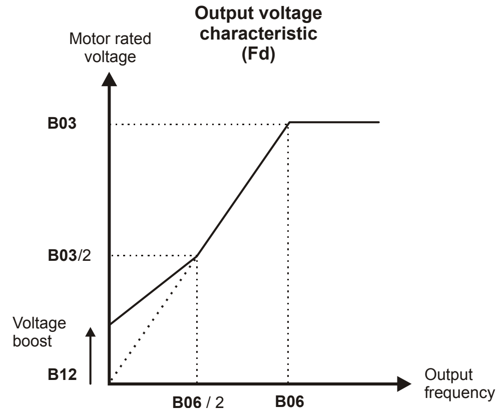
0: Ur S (Resistance compensation, stator resistance measured at each start) Resistance compensation is a form of stator flux oriented sensorless motor control. A linear frequency to voltage characteristic is used where the drive output voltage is increased from 0 V to **A19** (*Motor Rated Voltage* **B03**) as (*Output Frequency* **J60**) increases from 0 Hz to **A21** (*Motor Rated Frequency* **B06**).

When the output frequency is above the motor rated frequency, the output voltage is limited to **A19** (*Motor Rated Voltage* **B03**). Vector based stator resistance compensation is applied below **A21** *Motor Rated Frequency* (**B06**) / 4 and is then tapered out from (**A21** *Motor Rated Frequency* ***B06***) / 4 to (**A21** *Motor Rated Frequency* **B06**) / 2. This method controls the flux level correctly in the motor in the steady state, provided the correct value of Stator resistance (**B34**) is used. The stator resistance is measured each time the drive is started.

This test can only be done with a static motor where the flux has decayed to zero. To ensure that the measurement is not carried out before the flux has decayed, there is a period of one second after the inverter has been disabled during which the test is not carried out if the drive is re-started. B34 Stator resistance is not automatically saved in non volatile memory after each test.

1: Ur (Resistance compensation with no stator resistance measurement) Resistance compensation is used as in Ur S mode, but the stator resistance is not measured.

2: Fixed (Fixed boost with linear characteristic) A fixed frequency to voltage characteristic is used as shown below where the voltage at 0 Hz is defined by **A17** (*Low Frequency Voltage Boost* **B12**).



3: Ur Auto (Resistance compensation, stator resistance measured on first start) Resistance compensation is used as in Ur S mode, but the stator resistance is only measured once when the drive is first enabled. After the test has been completed successfully the mode is changed to Ur mode and the stator resistance is saved to non volatile memory. If **A03** (*Parameter Cloning* **N01**) is set to Auto (3) or Boot (4), the stator resistance is written to an NV Media Card installed in the drive. If the test fails the mode is changed to Ur mode and the stator resistance is not updated.

4: Ur I (Resistance compensation, stator resistance measured at power-up). Resistance compensation is used as in Ur S mode, but the stator resistance is only measured when the drive is enabled for the first time after each power-up.

RFC-S Action on enable

Parameter value	Text
0	Disabled
1	Short
2	Short Once
3	Long
4	Long Once

A23 (*Action On Enable* **B09**) can be used to get the drive to perform a phasing angle test when it is enabled. This test can be used when a non-absolute encoder is used for motor control feedback in RFC-S mode. The phasing test will measure and update *Position Feedback* (**C13**) phase angle, so that the correct offset is applied to run the motor with the non-absolute position feedback. The test can be selected to occur after power up and each time the position feedback is re-initialized.

It is not necessary to perform the test on every enable, but this can be selected as shown in Table 6-6 below. If the motor has significant cogging torque, and is not locked during the test, it is suggested that a long test is selected, otherwise a short test can be used. It should be noted that the motor inductances (*Transient Inductance* **B33** (Ld) and (*No Load* **B37** (Lq) are checked before the test is carried out, and if the difference is not sufficient then the drive will trip. Therefore, if the motor inductances have not been measured with an autotune or changed from their default value of zero the drive will trip when the drive is enabled.

Table 6-6 Action on enable

Action on enable	Detail
Disabled (0)	No phasing test is carried out on enable
Short (1)	A phasing test lasting approximately 0.4 s is carried out on every enable, the output motor contactors must be closed for this test
Short Once (2)	A phasing test lasting approximately 0.4 s is carried out when the drive is first enabled after power-up, and when the drive is enabled after the position feedback selected is initialized, the output motor contactors must be closed for this test
Long (3)	A phasing test lasting approximately 1.3 s is carried out on every enable, the output motor contactors must be closed for this test
Long Once (4)	A phasing test lasting approximately 1.3 s is carried out when the drive is first enabled after power-up, and when the drive is enabled after position feedback selected is initialized, the output motor contactors must be closed for this test

A24 {B16}		**Symmetrical current limit**							
RW	Num							US	
OL	⇳	± VM_MOTOR1_ CURRENT_LIMIT %	⇨	165.0 %					
RFC-A				175.0 %					
RFC-S									

A24 (*Symmetrical Current Limit* **B16**)

The symmetrical current limit controls the current when the motor is being accelerated away from standstill during constant speed with changing load levels and during deceleration towards standstill. The maximum possible symmetrical current limit (± VM_MOTOR1_CURRENT_LIMIT %) varies between drive sizes with default parameters loaded.

WARNING

Setting the *Symmetrical Current Limit* (**B16**) to a low value or zero can result in uncontrolled movement on brake release. Ensure the *Symmetrical Current Limit* (**B16**)is set to a suitable value taking into account both the motor rated current and overload requirement in the worst case load condition to avoid uncontrolled movement and the risk of damage to the system.

A25 {B13}		**Maximum Switching Frequency**							
RW	Txt				RA			US	
OL	⇳	2 kHz (0), 3 kHz (1), 4 kHz (2), 6 kHz (3), 8 kHz (4), 12 kHz (5), 16 kHz (6)	⇨	8 kHz (4)					
RFC-A									
RFC-S									

A25 (*Maximum Switching Frequency* **B13**)

Value	Text (kHz)
0	2
1	3
2	4
3	6
4	8
5	12
6	16

This parameter defines the PWM switching frequency. The drive may automatically reduce the switching frequency (without changing this parameter) if the power stage becomes too hot. A thermal model of the IGBT junction temperature is used based on the heatsink temperature and an instantaneous temperature drop using the drive output current and switching frequency. The full range of switching frequencies is not available on all ratings.

The estimated IGBT junction temperature is displayed in **J77**. If this temperature exceeds 145 °C, the switching frequency is reduced if possible, based on the current settings. Reducing the switching frequency, reduces the drive losses and the estimated IGBT junction temperature. If the load condition persists the estimated IGBT junction temperature may continue to rise again above 145 °C and if the drive cannot reduce the switching frequency any further the drive will initiate an 'OHt Inverter' trip.

Every second the drive will attempt to restore the switching frequency to the level set in **A25** (*Maximum Switching Frequency* **B13**).

The control over the drive switching frequency based upon the estimated IGBT junction temperature can be adjusted using the following parameters *Maximum Switching Frequency* (**B13**), *Minimum Switching Frequency* (**B14**) and *Switching Frequency Step Size* (**B15**).

A26 {B11}		**Motor Autotune**							
RW	Txt					NC		US	
OL	⇳	None (0), Static (1), Rotating (2)	⇨	None (0)					
RFC-A		None (0), Static (1), Rotating (2), Inertia (3)							
RFC-S									

A26 (*Motor Autotune* **B11**)

Autotune Open loop mode There are two autotunes available in open loop mode a static and rotating test. A rotating autotune should be used whenever possible so the measured value of power factor of the motor can be used by the drive.

Value	Autotune
0	No autotune being requested
1	Static autotune
2	Rotating autotune

- A static autotune can be used when the motor is loaded where it is not possible to remove the load from the motor shaft. The static test measures *Stator Resistance* (**B34**), *Transient Inductance* (**B33**), *Maximum Deadtime Compensation* (**B46**), *Current At Maximum Deadtime Compensation* (**B47**), all of which are required for good performance in vector control modes. The static autotune does not measure the power factor of the motor, so the value on the motor nameplate must be entered into the parameter *Motor Rated Power Factor* (**B04**). To perform the autotune enter 1 (Static) into the parameter followed by a Drive enable and run signal.
- A rotating autotune should only be used if the motor is unloaded and the lift de-roped. A rotating autotune first performs a static autotune as above, then a rotating autotune is performed where the motor is accelerated with the set ramps up to a frequency of **A21** *Motor Rated Frequency* (**B06**) x 2/3, and the frequency is maintained at that level for 4 seconds. *Stator Inductance* (**B35**) is measured and this value is used in conjunction with other motor parameters to calculate the *Motor Rated Power Factor* (**B04**). To perform the autotune, enter 2 (Rotating) into the parameter followed by a Drive enable and run signal.

WARNING

When a rotating auto tune is being carried out it is the responsibility of the authorized person to ensure they have read the auto tune instructions and are fully aware of its operation. Also ensure that it is safe to remove (lift) the motors brake with no risk of loss of control. Ensure during this process there is no load on the motor (or the system is balanced to avoid uncontrolled operation) and there is sufficient distance for the car to move within the lift shaft when the rotating auto tune is being carried out to avoid the risk of damage to the system.

Following the completion of an autotune test, the drive will go into the inhibit state. The drive must be disabled before the drive can be re-enabled and made to run. The drive can be disabled by removing the Drive enable signal from control terminal 31 by setting the Drive enable = Off (0).

Autotune RFC-A mode There are three autotunes available in RFC-A mode, a static test, a rotating test and a test to measure motor and load inertia. A static autotune will give good performance and a rotating autotune will give improved performance as it measures the actual values of the motor parameters required by the drive.

Value	Autotune
0	No autotune being requested
1	Static autotune
2	Rotating autotune
3	Inertia autotune

NOTE

It is highly recommended that a rotating autotune is performed which will provide good performance. Before this is done, the motor should be unloaded and the lift de-roped.

- A static autotune can be used when the motor is loaded and it is not possible to remove the load from the motor shaft. The static autotune measures the *Stator Resistance* (**B34**) and *Transient Inductance* (**B33**) of the motor, *Maximum Deadtime Compensation* (**B46**), *Current At Maximum Dead Time Compensation* (**B47**). The stator resistance and transient inductance are then used to calculate the current loop gains, and at the end of the test the current loop gains are updated. A static autotune does not measure the power factor of the motor, so the value on the motor nameplate must be entered into *Motor Rated Power Factor* (**B04**). To perform a static autotune enter 1 (Static) into the parameter followed by a Drive enable and run signal.
- A rotating autotune should only be used if the motor is unloaded and the lift de-roped. A rotating autotune first performs a static autotune, a rotating test is then performed where the motor is accelerated with the set ramps up to a frequency of **A21** *Motor Rated Frequency* (**B06**) x $^{2}/_{3}$, and the frequency is maintained at the level for up to 40 s. During the rotating autotune, the *Stator Inductance* (**B35**) and the motor saturation breakpoints are modified by the drive. The power factor is also modified for user information only, but this is not used after this point as the stator inductance is used in the vector control algorithm instead. To perform the autotune enter 2 (Rotating) into the parameter followed by a Drive enable and run signal.

WARNING

When a rotating auto tune is being carried out it is the responsibility of the authorized person to ensure they have read the auto tune instructions and are fully aware of its operation. Also ensure that it is safe to remove (lift) the motors brake with no risk of loss of control. Ensure during this process there is no load on the motor (or the system is balanced to avoid uncontrolled operation) and there is sufficient distance for the car to move within the lift shaft when the rotating auto tune is being carried out to avoid the risk of damage to the system.

- The inertia autotune measures the mechanical characteristic of the motor and load by rotating the motor at the speed defined by the present speed reference and injecting a series of speed test signals. This test should only be used provided all the basic control parameters have been set-up correctly and the speed controller parameters should be set to conservative levels, such as the default values, so that the motor is stable when it runs. The test measures the motor and load inertia, which can be used in producing a torque feed-forward term. If *Mechanical Load Test Level* (**B49**) is left at its default value of zero then the peak level of the injection signal will be 1% of the maximum speed reference subject to a maximum of 500 rpm. If a different test level is required then *Mechanical Load Test Level* (**B49**) should be set to a non-zero value to define the level as a percentage of the maximum speed reference, again subject to a maximum of 500 rpm. The user defined speed reference which defines the speed of the motor should be set to a level higher than the test level, but not high enough for flux weakening to become active. In some cases however, it is possible to perform the test at zero speed provided the motor is free to move, but it may be necessary to increase the test signal from the default value. The test will give the correct results when there is a static load applied to the motor and in the presence of mechanical damping. This test should be not be used, however for sensorless mode, or if the speed controller cannot be set-up for stable operation. A rotating test is performed in which the motor is accelerated with the currently selected ramps up to the currently selected speed reference, and this speed is maintained for the duration of the test. The resultant motor and load inertia is stored in *Inertia Compensation Total Inertia* (**E15**). To perform the autotune enter 3 (Inertia) into the parameter, followed by a Drive enable and run signal.

Following the completion of an autotune test, the drive will go into the inhibit state. The drive must be disabled before the drive can be re-enabled and made to run. The drive can be disabled by removing the Drive enable signal from control terminal 31, setting the Drive enable = Off (0).

Autotune RFC-S mode There are three autotune tests available in RFC-S mode a static test, a rotating test and a test to measure motor and load inertia. A static autotune will give good performance and a rotating autotune will give improved performance as it measures the actual values of the motor parameters required by the drive.

Value	Autotune
0	No autotune being requested
1	Static autotune
2	Rotating autotune
3	Inertia autotune

- The static autotune can be used when the motor is loaded and it is not possible to uncouple the load from the motor shaft. This test can be used to measure all the necessary parameters for basic control. During the static autotune, a test is performed to locate the flux axis of the motor. However this test may not be able to calculate such an accurate value for the **A16** (*Position Feedback Phase Angle* **C13**) as compared to the rotating autotune. The static test measures *Stator Resistance* (**B34**), *Transient Inductance* (**B33**), *Maximum Deadtime Compensation* (**B46**), *Current at Maximum Dead time Compensation* (**B47**) and *No Load Lq* (**B37**). The stator resistance and the transient inductance are then used to set-up the current loop gains. If sensorless mode is not selected then the position feedback phase angle is set-up for the position feedback device. To perform a static autotune enter 1 (Static) into the parameter followed by a Drive enable and run signal.
- A rotating autotune should only be used if the motor is unloaded and the lift de-roped. This test can be used to measure all the necessary parameters for the basic control. During the rotating autotune **A18** (*Motor Rated Current* **B02**) is applied and the motor is rotated by 2 electrical revolutions (i.e. up to 2 mechanical revolutions) in the required direction. If sensorless mode is not selected then the **A16** (*Position Feedback Phase Angle* **C13**) is set-up for the position feedback device. A static test is performed to measure *Stator Resistance* (**B34**), *Transient Inductance* (**B33**), *Maximum Deadtime Compensation* (**B46**), *Current at Maximum Dead time Compensation* (**B47**) and *No Load* Lq (**B37**). The stator resistance and transient inductance are used to set-up the current loop gains. This is only done once during the test so the user can make further adjustments to the current controller gains if required. To perform the autotune enter 2 (Rotating) into the parameter followed by a Drive enable and run signal.

WARNING

When a rotating auto tune is being carried out it is the responsibility of the authorized person to ensure they have read the auto tune instructions and are fully aware of its operation. Also ensure that it is safe to remove (lift) the motors brake with no risk of loss of control. Ensure during this process there is no load on the motor (or the system is balanced to avoid uncontrolled operation) and there is sufficient distance for the car to move within the lift shaft when the rotating auto tune is being carried out to avoid the risk of damage to the system.

- The inertia autotune measures the mechanical characteristic of the motor and load by rotating the motor at the speed defined by the present speed reference and injecting a series of speed test signals. This test should only be used provided all the basic control parameters have been set-up correctly and the speed controller parameters should be set to conservative levels, such as the default values, so that the motor is stable when it runs. The test measures the motor and load inertia, which can be used in producing a torque feed-forward term. If *Mechanical Load Test Level* (**B49**) is left at its default value of zero then the peak level of the injection signal will be 1% of the maximum speed reference subject to a maximum of 500 rpm. If a different test level is required then *Mechanical Load Test Level* (**B49**) should be set to a non-zero value to define the level as a percentage of the maximum speed reference, again subject to a maximum of 500 rpm. The user defined speed reference which defines the speed of the motor should be set to a level higher than the test level, but not high enough for flux weakening to become active. In some cases however, it is possible to perform the test at zero speed provided the motor is free to move, but it may be necessary to increase the test signal from the default value. The test will give the correct results when there is a static load applied to the motor and in the presence of mechanical damping. This test should be not be used, however for sensorless mode, or if the speed controller cannot be set-up for stable operation. A rotating test is performed in which the motor is accelerated with the currently selected ramps up to the currently selected speed reference, and this speed is maintained for the duration of the test. The resultant motor and load inertia is stored in *Inertia Compensation Total Inertia* (**E15**). To perform the autotune enter 3 (Inertia) into the parameter, followed by a Drive enable and run signal.

Following the completion of an autotune test the drive will go into the inhibit state. The drive must be disabled before it can be re-enabled and made to run. The drive can be disabled by removing the Drive enable signal from control terminal 31, setting the Drive enable = Off (0).

A27 {B26}		**Reverse Motor Phase Sequence**							
RW	Bit							US	
OL	⇳	Off (0) On (1)	⇨	Off (0)					
RFC-A									
RFC-S									

A27 (*Reverse Motor Phase Sequence* **B26**)
If reverse motor phase sequence = Off (0) the output motor phase sequence is U V W, when the output frequency is positive and W V U when the output frequency is negative. If Reverse motor phase sequence = On (1) the output motor phase sequence is reversed so that the phase sequence is W V U for positive output frequencies and U V W for negative output frequencies.

A28 {E01}		**Nominal Elevator Speed mm/s**							
RW	Num							US	
OL	⇳	0 to 1800 mm/s		⇨	1000 mm/s				
RFC-A		0 to 4000 mm/s							
RFC-S									

A28 (*Nominal Elevator Speed mm/s* **E01**)
This parameter sets the elevator linear shaft speed (contract speed) in mm/s. This is used to set the motion profile scaling such that distances calculated for the profile in mm will result in elevator car positioning in mm.

A29 {E02}		**Sheave Diameter**							
RW	Num							US	
OL	⇳	1 to 32767 mm		⇨	400 mm				
RFC-A									
RFC-S					480 mm				

A29 (*Sheave Diameter* **E02**)

This parameter defines the motor sheave diameter in mm units and is used to calculate the nominal elevator speed rpm. See **A33** (*Nominal Elevator Speed rpm* **E07**) for more details.

A30 {E03}		**Roping**							
RW	Txt							US	
OL	⇳	1:1 (1) 2:1 (2) 3:1 (3) 4:1 (4)		⇨	1:1 (1)				
RFC-A									
RFC-S									

A30 (*Roping* **E03**)
This parameter defines the roping ratio and is used to calculate the nominal elevator speed rpm. See **A33** (*Nominal Elevator Speed rpm* **E07**) for more details.

A31 {E04}		**Gear Ratio Numerator**							
RW	Num							US	
OL	⇳	1 to 32767		⇨	31				
RFC-A									
RFC-S					1				

A31 (*Gear Ratio Numerator* **E04**)
This parameter defines the gearbox ratio numerator for geared Elevator systems and used to calculate the nominal elevator speed rpm. See **A33** (*Nominal Elevator Speed rpm* **E07**) for more details. A gear box ratio of 7:3 is entered as 7 in gear ratio numerator. A default gearbox ratio of 1:1 is used for gearless PM motor applications.

A32 {E05}		**Gear Ratio Denominator**							
RW	Num							US	
OL	⇳	1 to 32767		⇨	1				
RFC-A									
RFC-S									

A32 (*Gear Ratio Denominator* **E05**)
This parameter defines the gearbox ratio denominator and is used to calculate the nominal elevator speed rpm. See **A33** *Nominal Elevator Speed rpm* (**E07**) for more details.
A gear box ratio of 7:3 is entered as 3 in gear ratio denominator. The default gearbox ratio of 1:1 is used for gearless PM motor applications.

A33 {E07}	Nominal Elevator Speed rpm								
RW	Num							US	
OL	⇳	1.00 to 4000.00 rpm			⇨	1480.14 rpm			
RFC-A									
RFC-S						39.48 rpm			

A33 (*Nominal Elevator Speed* **E07**)

This parameter displays the calculated nominal elevator motor speed in rpm. Alternatively this parameter can be used to manually set-up the nominal elevator speed in rpm. This nominal elevator speed rpm is used to set the motion profile scaling such that distances calculated for the profile in mm will result in the elevator car positioning correctly in the scaled mm units.

The nominal elevator speed rpm is derived using the following calculation:
A = (B x D x E x 60) / (Pi x C x F)

Where:
A = **A33** (*Nominal Elevator Speed rpm* **E07**)
B = **A28** (*Nominal Elevator Speed mm/s* **E01**)
C = **A29** (*Sheave Diameter* **E02**)
D = **A30** (Roping **E03**)
E = **A31** (*Gear Ratio Numerator* **E04**)
F = **A32** (*Gear Ratio Denominator* **E05**)

A34 (*Maximum Motor Speed* **E08**) must be set $\geq$ **A33** (*Elevator Speed rpm* **E07**)

A34 {E08}	Open Loop: Motor Maximum Frequency Clamp								
{E08}	RFC-A/S: Motor Maximum Speed Clamp								
RO	Num							US	
OL	⇳	-214748364.8 to 214748364.7			⇨	54.8 Hz			
RFC-A						1644.6 rpm			
RFC-S						43.8 rpm			

A34 (*Motor Maximum Frequency Clamp* **E08**)
(*Motor Maximum Speed Clamp* **E08**)

The maximum motor speed parameter allows the user to define a maximum frequency (Open loop) or speed (RFC-A, RFC-S) for the motor. For Open loop and RFC-A there are default settings configured for both European defaults at 50 Hz and USA defaults at 60 Hz. During operation where the motor maximum speed may be exceeded due to a loss of control the drive will generate an *Over Speed* trip.

A35 {G13} A36 {G14} A37 {G15} A38 {G16} A39 {G18}	Run Jerk 1 Run Jerk 2 Run Jerk 3 Run Jerk 4 Creep Stop Jerk								
RW	Num			ND				US	
OL	⇳	1 to 65535 mm/s^3 x10			⇨	50 mm/s^3 x10			
RFC-A						100 mm/s^3 x10			
						100 mm/s^3 x10			
RFC-S						50 mm/s^3 x10			
						100 mm/s^3 x10			

A35 (*Run Jerk 1* **G13**)
A36 (*Run Jerk 2* **G14**)
A37 (*Run Jerk 3* **G15**)
A38 (*Run Jerk 4* **G16**)
A39 (*Creep Stop Jerk* **G18**)

Run Jerk 1 is the start of acceleration jerk rate and is set in mm/s^3 x 10

Run Jerk 2 is the end of acceleration jerk rate, and is set in mm/s^3 x 10

Run Jerk 3 s the start of deceleration jerk rate, and is set in mm/s^3 x 10

Run Jerk 4 is the end of deceleration jerk rate, and is set in mm/s^3 x 10

Creep stop jerk is the final positioning jerk used for transition from Creep speed to stop, and is set in mm/s^3 x 10

If a value of 0 mm/s^3 is set in any of the jerk parameters, this section of the profile will be linear i.e. jerk = acceleration or deceleration rate.

A40 {G11} **A41 {G12}**		**Acceleration Rate** **Deceleration Rate**						
RW	Num						US	
OL **RFC-A** **RFC-S**	⇳	0 to 10000 mm/s²	⇨	800 mm/s² 500 mm/s²				

A40 (*Acceleration Rate* **G11**)
A41 (*Deceleration Rate* **G12**)

These are the acceleration and deceleration rates set in mm/s^2. The acceleration rate is also used during start optimization if constant acceleration is reached.

The acceleration rate defines the linear ramp rate and is applied when the frequency / speed is changing away from zero. Selecting a ramp rate that has been set to zero in Open-loop mode disables the ramp system in order that the post ramp reference follows the pre-ramp reference without any delay in acceleration or deceleration. This also disables the standard ramp DC link voltage controller and the frequency based current limits.

A42 {G17}		**Creep Stop Deceleration Rate**						
RW	Num						US	
OL **RFC-A** **RFC-S**	⇳	0 to 10000 mm/s²	⇨	1000 mm/s²				

A42 (*Creep Stop Deceleration* **G17**)

This is the final positioning deceleration rate from Creep speed to a stop and is set in mm/s^2. This deceleration rate can be set higher than the main deceleration rate to improve final positioning ride comfort and accuracy in creep to floor operation.

A43 {G01} **A44 {G02}** **A45 {G03}** **A46 {G04}**		**V1 Speed Reference** **V2 Speed Reference** **V3 Speed Reference** **V4 Speed Reference**						
RW	Num						US	
OL **RFC-A** **RFC-S**	⇳	0 to *Nominal Elevator Speed* (**A28**)	⇨	50 mm/s 400 mm/s 600 mm/s 10 mm/s				

A43 (*V1 Creep Speed* **G01**)
A44 (*V2 Speed Reference* **G02**)
A45 (*V3 Speed Reference* **G03**)
A46 (*V4 Speed Reference* **G04**)

Operating speed V1 has been defined as the creep speed which sets the operating speed during *creep fo*r and *creep to floor* operation set-up in mm/s. For *creep to floor* operation V1 is allocated as the creep speed by default. Other speed references may be selected to be creep speed via *Creep Speed Select* (**G52**). Operating speeds V2, V3 and V4 and above are open for allocation by the user and are set-up in mm/s. The naming strategy used can be changed to suit the system and required operating speeds, for example *V2 Low speed*, *V3 Contract speed* or *V4 High speed*.

A47 {D04} **A48 {D05}**		**Brake Control Release Delay** **Brake Control Apply Delay**						
RW	Num						US	
OL **RFC-A** **RFC-S**	⇳	0 to 10000 ms	⇨	500 ms				

A47 (*Brake Control Release Delay* **D04**)
A48 (*Brake Control Apply Delay* **D05**)
The brake release delay sets the time in ms for the brake to be fully released / opened on the motor. This is used during starting to determine when the brake is considered fully released / open prior to disabling any start optimization, and starting the travel profile. This time is also taken into consideration for the brake contact monitoring. For Open loop operation, the brake release delay must allow for the slip of the induction motor in order to ensure sufficient torque can be generated on brake release (Brake release delay ~ Motor output frequency > Motor slip).

The brake apply delay sets the time in ms for the brake to be fully applied / closed on the motor. This is used during stopping to determine when the brake is considered fully applied / closed, and the control sequence can be completed i.e. prior to ramping down the motor torque and disabling the drive. This time is also taken into consideration for the brake contact monitoring.

A49 {I01} A50 {I02}	Start Speed Loop P Gain Start Speed Loop I Gain		
RW	Num		US
OL			
RFC-A RFC-S	⇳ 0.0000 to 200.0000 s/rad 0.00 to 655.35 s^2/rad	⇨	P - 0.0300 s/rad I - 0.10 s^2/rad

A49 (*Start Speed Loop P Gain* **I01**)
A50 (*Start Speed Loop I Gain* **I02**)

Start speed loop P Gain sets the speed loop proportional gain, and Start speed loop I Gain sets the speed loop integral gain during the start of the profile. These gains can be optimized to overcome roll back and achieve a smooth transition from zero speed to acceleration. The Start P Gain and I Gain are active from zero speed during start, and are ramped to the variable gains transition speed threshold for a transition to the Run P Gain and I Gain when parameter *Variable Gains Mode* (**I19**) = 1 (Start, Run).
The default transition time for the acceleration (active when parameter *Variable Gains Mode* (**I19**) = 1 (Start, Run)), is 1000 ms which can be adjusted if required through parameter *Variable Gains Accel Transition Time* (**I17**). The transition time is used to ramp from the Start gains to the Run gains.

A51 {I05}	Start Current Loop Filter		
RW	Num		US
OL			
RFC-A RFC-S	⇳ 0.0 to 25.0 ms	⇨	1.0 ms

A51 (*Start Current Loop Filter* **I05**)
The Start current loop filter defines the time constant of a first order filter that can be applied to the final current reference. The filter is provided to reduce acoustic noise and vibration produced as a result of position feedback quantization, or induced noise on the position feedback. The filter introduces a lag in the speed control loop, and therefore the speed controller gains may need to be reduced to maintain stability as the filter time constant is increased.

A52 {I06} A53 {I07}	Run Speed Loop P Gain Run Speed Loop I Gain		
RW	Num		US
OL			
RFC-A RFC-S	⇳ 0.0000 to 200.0000 s/rad 0.00 to 655.35 s^2/rad	⇨	P - 0.0300 s/rad I - 0.10 s^2/rad

A52 (*Run Speed Loop P Gain* **I06**)
A53 (*Run Speed Loop I Gain* **I07**)

Run speed loop P Gain sets the speed loop proportional gain and Run speed loop I Gain sets the speed loop integral gain during the travel. The Run P Gain and I Gains are active from when the variable gains transition speed threshold is reached during acceleration for variable Start and Run gains, the default configuration.
The default transition time for acceleration (active when parameter *Variable Gains Mode* (**I19**) = 1 (Start, Run)) is 1000 ms which can be adjusted if required through parameter *Variable Gains Accel Transition Time* (**I17**). The transition times are used to ramp from the Start gains to the Run gains.

A54 {I10}	Run Current Loop Filter		
RW	Num	ND	US
OL			
RFC-A RFC-S	⇳ 0.0 to 25.0 ms	⇨	1.0 ms

A54 (*Run Current Loop Filter* **I10**)
The Run current loop filter defines the time constant of a first order filter that can be applied to the final current reference. The filter is provided to reduce acoustic noise and vibration produced as a result of position feedback quantization, or induced noise on the position feedback. The filter introduces a lag in the speed control loop, and therefore the speed controller gains may need to be reduced to maintain stability as the filter time constant is increased.

A55 {I22}	**Start Lock Enable**								
RW	Num							US	
OL	⇳				⇨				
RFC-A		Off (0) or On (1)				Off (0)			
RFC-S									

A55 (*Start Lock Enable* **I22**)

When set to Off (0), the Start lock enable control is disabled and in some configurations, i.e. low resolution position feedback devices resulting in low Start speed loop gains, some roll back could be encountered. When set to On (1), the Start lock enable control is enabled. The position loop is used to maintain the position of the motor during brake release. If a previous travel has been completed, the position of the motor after the brake has been applied, but before the drive is disabled is stored and used as the set point position to provide a smooth transition of load from the mechanical brake to the motor on the next travel. This feature can be useful to overcome roll back instability and acoustic noise, when a low resolution position feedback device is being used resulting in the Start speed loop gains being limited. In Open loop mode Start lock enable control is not available.

A56 {I21}	**Start Lock P Gain Speed Clamp**								
RW	Num							US	
OL	⇳				⇨				
RFC-A		0 to 10000 mm/s				100 mm/s			
RFC-S									

A56 (*Start Lock P Gain Speed Clamp* **I21**)
This sets the *Start Lock P Gain Speed Clamp* i.e. the maximum speed used to correct the motor position which is used to hold the position of the motor during brake release. This is used when **A55** (*Start Lock Enable* **I22**) = On (1)

A57 {I20}	**Start Lock P Gain**								
RW	Num							US	
OL	⇳				⇨				
RFC-A		0.000 to 1000.000				50.000			
RFC-S									

A57 (*Start Lock P Gain* (**I20**)
This sets the *Start Lock P Gain*, used to hold the position of the motor during brake release. This is active when **A55** (*Start Lock Enable* **I22**) = On (1).
The Start lock P Gain should be optimized in line with the Start speed loop gains to avoid any instability or acoustic noise during starting. Initial start optimization should be carried out with only the Start speed loop gains, if roll back or acoustic noise and instability occurs the Start speed loop gains may need to be reduced slightly and the Start lock position control enabled.

A58 {G48}	**Start Optimizer Time**								
RW	Num							US	
OL	⇳				⇨				
RFC-A		0 to 10000 ms				1000 ms			
RFC-S									

A58 (*Start Optimizer Time* **G48**)

The start optimization uses the time, speed and jerk, in order to define the start optimizer motion profile. The maximum acceleration during start optimization is defined by the Acceleration rate.
This feature can help overcome starting stiction for elevators installed with a motor gearbox, or for systems installed with guide rail pads rather than rollers, or in retro fit applications where imperfections in the guide rails result in reduced starting performance.
The start optimizer can be used in Open loop mode to provide a holding speed reference during brake release, and to overcome stiction within the gearbox. A request to release / open the brake in Open loop control mode using start optimization will not be carried out unless the start optimizer speed is reached.

A59 {G47}		**Start Optimizer Jerk**							
RW		Num						US	
OL	⇕				⇨				
RFC-A		±VM_EX00_RUN_JERK_1 mm/s³ x10				10 mm/s³ x10			
RFC-S									

A59 (*Start Optimizer Jerk* **G47**)

This parameter sets the start optimizer jerk in mm/s^3. This feature can help to overcome starting stiction for elevators installed with a motor gearbox, or for systems installed with guide rail pads rather than rollers, or in retro fit applications where imperfections in the guide rails result in reduced starting performance.

A60 {G46}		**Start Optimizer Speed**							
RW		Num						US	
OL	⇕	0 to 10000 mm/s			⇨	50 mm/s			
RFC-A						10 mm/s			
RFC-S									

A60 (*Start Optimizer Speed* **G46**)

This sets the start optimizer speed in mm/s^2. This feature can help to overcome starting stiction for elevators installed with a motor gearbox, or for systems installed with guide rail pads rather than rollers, or in retro fit applications where imperfections in the guide rails result in reduced starting performance. A request to release / open the brake in Open loop control mode using start optimization will not be carried out unless the start optimizer speed is reached, consider the rated slip for the motor when adjusting the speed level for the start optimizer. The start optimizer speed is also used on start up for the brake release delay.

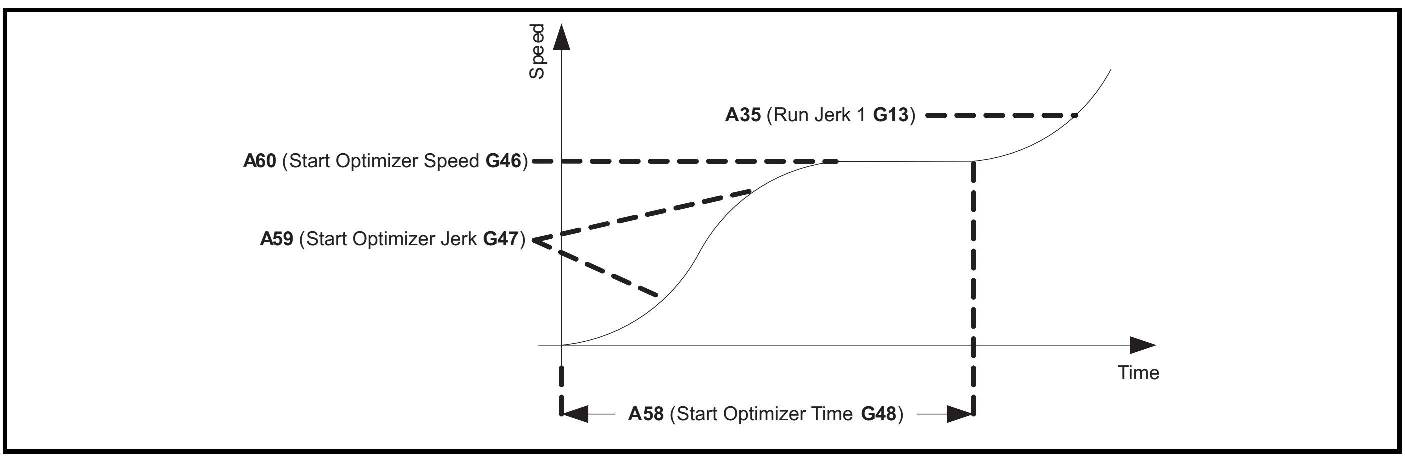
A61 {G45}		**Start Optimizer Enable**							
RW		Bit						US	
OL	⇕				⇨				
RFC-A		Off (0) or On (1)				Off (0)			
RFC-S									

A61 (*Start Optimizer Enable* **G45**)

When set to Off (0) the start optimizer is disabled.

When set to On (1) the start optimizer is enabled.

This feature can help to overcome starting stiction for elevators installed with a motor gearbox, or for systems installed with guide rail pads rather than rollers, or in retro fit applications where imperfections in the guide rails result in reduced starting performance. A request to release / open the brake in Open loop control mode using start optimization will not be carried out unless the start optimizer speed is reached, consider the rated slip for the motor when adjusting the speed level for the start optimizer. The start optimizer speed is also used on start up for the brake release delay.



A62 to A80	**User Defined Parameters For User Menu A**		
OL	⇳		⇨	
RFC-A				
RFC-S				

A62 to A80 (*User defined parameters for User menu A*)

Parameter **A62** through to **A80** are User menu A parameters which can be set-up by the user for quick access to parameters which are required for the specific application. Menu Z set-up configuration allows all parameters required to simply be routed from the advanced menu's to parameters **A29** through to **A80**.

Example:

Menu Z set-up configuration	**User menu A**
Parameter **Z01**	Parameter **A01**
Enter:	Configured to:
Z01 = *User Security Status* (**H02**)	**A01** = *User Security Status* (**H02**)

7 Commissioning

WARNING

The drive must be set-up by a responsible person who is familiar with the systems operation and safety requirements to avoid a safety hazard. Correct set-up must be carried out as detailed in this guide to avoid the risk of death, serious injury or product damage.

CAUTION

Ensure that no damage or safety hazard could arise due to any unexpected motor starting. Ensure the drive is operated in accordance with the systems safety requirements to avoid the risk of product damage and a safety hazard.

CAUTION

Where the maximum speed affects the safety of the machinery resulting in a safety hazard, additional independent over-speed protection must be used to avoid the risk of product damage or a safety hazard.

WARNING

The AC supply must be disconnected from the drive before any cover is removed from the drive to avoid an electric shock hazard. The disconnection should be carried out with an approved isolation device before any work is performed to avoid the risk of death or serious injury.

The following sections detail the set-up, programming and auto tuning in order to get the Elevator drive operational. Parameter settings can be made through the simplified User Menu A or through the standard drive menu's available Menu B through to Menu Z.

7.1 Operating mode

When the drive is first powered up, and prior to programming the parameters, the correct operating mode should be selected. The default operating mode is RFC-S, selecting an alternative operating mode can be done as follows (a) Ensure the drive is disabled (b) Set Pr **mm00** = 1253 (c) Select operating mode in *Drive Control Mode* (**B01**) (d) Press Reset button.

Table 7-1 Operating modes

Drive Control Mode **(B01)**	
Open loop	Open loop control for an induction motor
RFC-A	Closed loop vector control for an induction motor with position feedback
RFC-S.	Closed loop Servo control for a PM synchronous motor with position feedback

When setting up a drive and where the current parameters are unknown, a drive default is recommended before starting. A default can be carried out as follows:-

- Ensure the drive is disabled
- Set Pr **mm00** = Reset 50 Hz defaults or Pr **mm00** = 1233
- Reset the drive.

7.2 Motor and Encoder data

In order for the drive to control the motor with a high level of control, both the motor nameplate data and position feedback details RFC-A, RFC-S) need to be set-up in the following drive parameters and an autotune carried out. The default operating mode for the *E300 Advanced Elevator* drive is RFC-S for gearless Elevator applications using a PM synchronous motor.

CAUTION

The motor parameter settings affect the protection for the motor, and should they be set incorrectly, this can result in damage to the motor and encoder connected to the motor. It is essential that the correct value is entered for the *Motor Rated Current* with this affecting the thermal protection of the motor. The default values in the drive should not be relied upon.

WARNING

Setting the *Symmetrical Current Limit* (**B16**) to a low value or zero can result in uncontrolled movement on brake release. Ensure the *Symmetrical Current Limit* (**B16**) is set to a suitable value taking into account both the motor rated current and overload requirement in the worst case load condition to avoid uncontrolled movement and the risk of damage to the system.

Table 7-2 Motor parameters

Parameter	Mode	Detail
Motor Rated Current (**B02**)	Open loop, RFC-A, RFC-S	Motor nameplate data
Motor Rated Voltage (**B03**)		
Motor Rated Power Factor (**B04**)	Open loop	Can be derived from rotating autotune
Motor Number Of Poles (**B05**)	Open loop, RFC-A, RFC-S	Open loop and RFC-A mode select automatic if unknown
Motor Rated Frequency (**B06**)		Motor nameplate data
Motor Rated Speed (**B07**)		For Open loop, RFC-A control ensure correct slip speed refer to parameter **A16** (*Slip Compensation Enable* **B10**)
Symmetrical Current Limit (**B16**)		Maximum operating current limit to protect motor.
Reverse Motor Phase Sequence (**B26**)		Parameter to rotate motor output phase rotation.

Should the motor rotate in the incorrect direction due to the system wiring *Reverse Motor Phase Sequence* (**B26**), this can be used to invert the direction.

Table 7-3 Encoder parameters

Parameter	Mode	Detail
Drive Encoder Type (**C01**)	RFC-A, RFC-S	Encoder nameplate
Drive Encoder Auto Configuration Select (**C02**)		Can only be used with encoders with comms
Drive Encoder Rotary Pulses Per Revolution (**C03**)		Encoder nameplate data / auto configuration
Drive Encoder Voltage Select (**C04**)		Encoder nameplate data
Drive Encoder Feedback Reverse (**C12**)		Parameter to rotate encoder feedback position

CAUTION

Setting the encoder power supply voltage too high for the encoder connected to the drive could result in damage to the feedback device. Only increase the encoder power supply voltage setting for suitable encoders connected to the drive.

Should the encoder increment in the wrong direction, *Drive Encoder Feedback Reverse* (**C12**) can be used to invert the direction of rotation. If there is motor acoustic noise during operation following the autotune, refer to section 10.3 *Motor acoustic noise* on page 475.

7.3 Autotune

Prior to an autotune being carried out, the motor nameplate data must be set-up and for RFC-A, RFC-S operation with a position feedback device the position feedback parameters must be set-up. There are two possible autotunes available, these being a static autotune and a rotating autotune as described here.

Both the static and rotating autotunes are available for Open loop or RFC-A, RFC-S operating modes. The static autotune will measure motor parameters to provide good control, and the rotating autotune will measure motor parameters to provide a higher level of control. Only the rotating autotune will check the position feedback device connected to the drive. Refer to **A26** (*Motor Autotune* **B11**) used to select the required autotune, None (0) Static (1) Rotating (2).

7.3.1 Static Autotune

A26 (*Motor Autotune* **B11**) = Static autotune (1). The following describes how an autotune test can be initiated and normal operation resumed following successful completion of the test:

NOTE

The static autotune is carried out with the output motor contactors closed as the motor is energized, the motor brake remains fully closed during the complete autotune test. The control over the output motor contactors and the brake during the static autotune must be made manually.

1. The static autotune test cannot be initiated if the drive is tripped *Drive OK* (**L05**) = Off (0) or the drive is active *Drive Active* (**L06**) = On (1). The drive can be disabled by removing the drive enable signal from control terminal 31.
2. A static autotune test is initiated by setting **A26** (*Motor Autotune* **B11**) to Static autotune (1)
3. The output motor contactors should be manually closed by an authorised person who is familiar with the requirements for safety, this sequence also applies the drive enable signal on control terminal 31.
4. A drive run signal should be applied.
5. The static autotune will commence.
6. If the autotune sequence is completed successfully the drive enable is set to inactive (Inhibit) and **A26** (*Motor Autotune* **B11**) is set to zero.
7. The output motor contactors can be opened.
8. The drive enable will only be set active again by firstly opening the output motor contactors and removing the drive enable.
9. If a trip occurs during the autotune sequence, the drive will go into the trip state and **A26** (*Motor Autotune* **B11**) is set to zero. As above, the drive enable must be removed and re-applied before the drive can be restarted after the trip has been reset. ***Care should be taken if the autotune was not completed as the drive parameters that should have been measured and set-up will still have their original values.***

The following describes the effects of the autotune test on drive parameters:

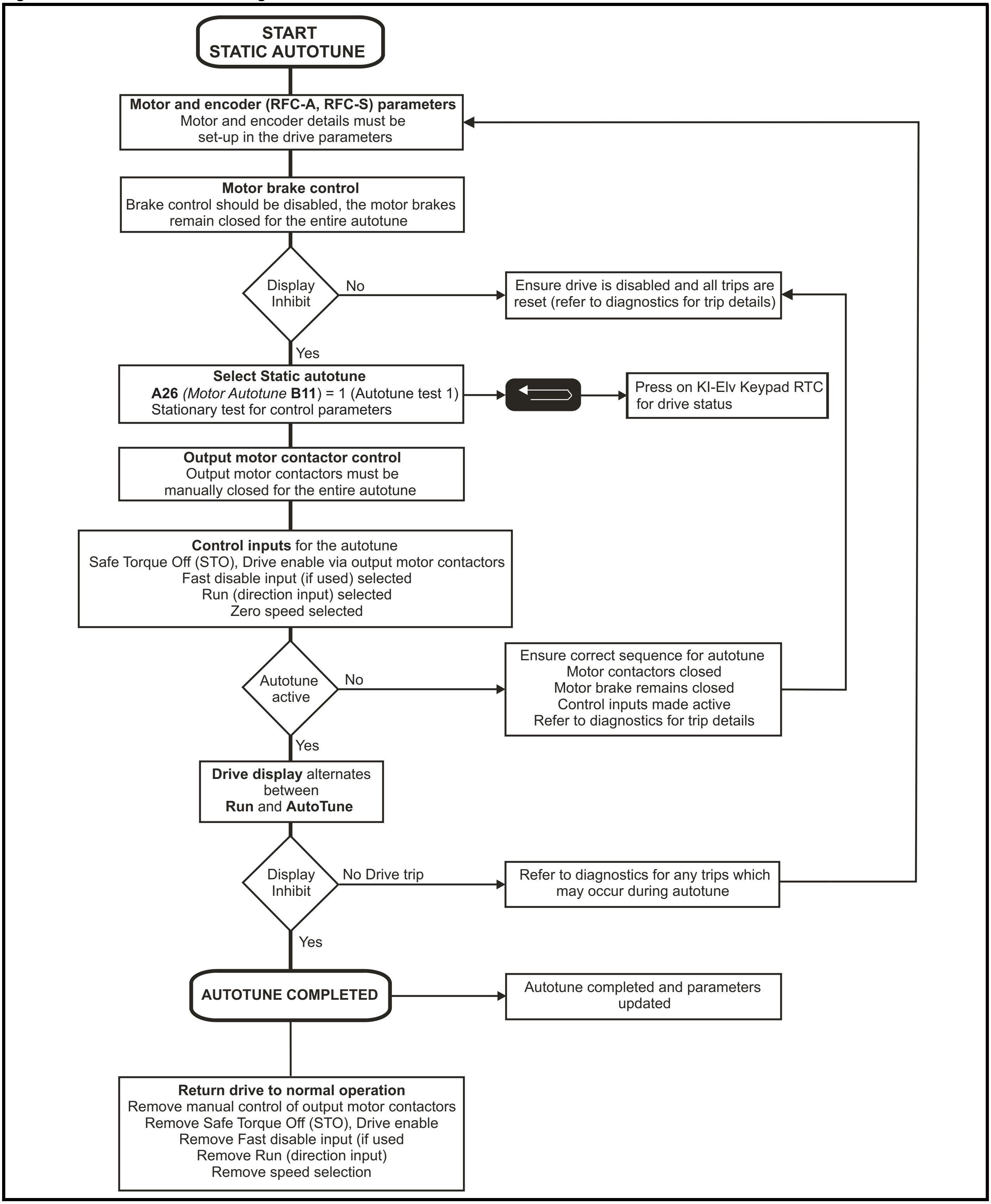
1. The static autotune relies on the motor being stationary when the test is initiated to give accurate results.
2. Parameters associated with the motor and feedback (position feedback phase angle), are updated following successful completion of the autotune test.

3. If the autotune test is not completed successfully, the parameters will retain their original values resulting in incorrect operation if the drive is enabled.
4. When each stage of the autotune test is complete, the results are written to the appropriate parameters, and these parameters are saved in the drive's non volatile memory.
5. If *Parameter Cloning* (**N01**) is set to Auto (3) or Boot (4) the parameters are also written to a NV Media Card installed in the drive.

NOTE

For diagnostic information following any drive trip which may occur during the autotune, refer to the diagnostics section.

Figure 7-1 Static autotune flow diagram



Open loop, Static autotune: Basic control parameters

This test measures the basic control parameters without moving the motor. A stationary test is performed to measure Stator resistance, Transient inductance, Maximum deadtime compensation and Current at maximum deadtime compensation as detailed in Table 7-4. Table 7-4 below shows the parameters required for basic Open loop motor control and indicates which can be set by the user from the motor nameplate and which can be measured with the static autotune.

Table 7-4 Open loop static autotune parameters

Parameter	Required for	Detail
A21 (*Motor Rated Frequency* **B06**)	Basic control	Motor nameplate
A18 (*Motor Rated Current* **B02**)		
A22 (*Motor Rated Speed* **B07**)	Slip compensation	
A19 (*Motor Rated Voltage* **B03**)	Basic control	
Motor Rated Power Factor (**B04**)	Not used	
A20 (Number Of Motor Poles **B05**)	Basic control	
Stator Resistance (**B34**)	Basic control Ur S (0) Ur (1), Ur Auto (3), Ur I (4) modes	Manually enter, Static or rotating autotune
Transient Inductance (**B33**)	Improved performance	Static or rotating autotune
Maximum Deadtime Compensation (**B46**)	Basic control	
Current At Maximum Deadtime Compensation (**B47**)		

RFC-A, Static autotune: Basic control parameters

This test measures the basic control parameters without moving the motor. A stationary test is performed to measure Stator resistance, Transient inductance, Maximum deadtime compensation and Current at maximum deadtime compensation as detailed in Table 7-5 *RFC-A static autotune parameters* . The Stator resistance and Transient inductance are used in RFC-A mode to set up the Current controller P and Current controller I gains. This is only performed once during the test, and the user can make manual adjustments to the current control loop gains if required for example where motor acoustic noise is present following an autotune and subsequent operation. Table 7-5 below shows the parameters required for basic RFC-A motor control and indicates which parameter can be set by the user from the motor nameplate, and which can be measured with the static autotune.

Table 7-5 RFC-A static autotune parameters

Parameter	Required for	Detail
A21 (*Motor Rated Frequency* **B06**)	Basic control	Motor nameplate
A18 (*Motor Rated Current* **B02**)		
A22 (*Motor Rated Speed* **B07**)	Slip compensation	
A19 (*Motor Rated Voltage* **B03**)	Basic control	
Motor Rated Power Factor (**B04**)	Not used	
A20 (Number Of Motor Poles **B05**)	Basic control	
Stator Resistance (**B34**)	Basic control	Manually enter, Static or rotating autotune
Transient Inductance (**B33**)	Improved performance	Static or rotating autotune
Maximum Deadtime Compensation (**B46**)	Basic control	
Current At Maximum Deadtime Compensation (**B47**)		
Start Current Loop P Gain (**I03**) *Run Current Loop P Gain* (**I08**) *Stop Current Loop P Gain* (**I13**)		
Start Current Loop I Gain (**I04**) *Run Current Loop I Gain* (**I09**) *Stop Current Loop I Gain* (**I14**)		

RFC-S Static autotune: Basic control parameters

This test measures the basic control parameters without moving the motor. This test can be used to measure all the necessary parameters for basic control, however higher performance can be achieved through carrying out a rotating autotune test.

1. A stationary test is performed to locate the flux axis of the motor.
2. The Position feedback phase angle is set-up for the position from the position feedback interface connected to the drives main interface.
3. A stationary test is performed to measure the*Transient Inductance Ld* (**B33**) and *No Load Lq* (**B37**)
4. A stationary test is performed to measure Stator resistance, Maximum deadtime compensation and Current at maximum deadtime compensation.
5. The Stator resistance and *Transient Inductance Ld* (**B33**) are used to set-up Current controller P and Current controller I Gains. This is only performed once during the test, the user can make manual adjustments to the current control loop gains if required, for example due to motor acoustic noise following an autotune and operation.

It should be noted that because this is a stationary test, it is not possible to check the direction of the position feedback. If the motor power connection phase sequence is incorrect, i.e. the position feedback counts in reverse when the drive applies a phase sequence U-V-W to operate in the forward direction, then the motor will jump through 90 degrees electrical, and stop with a current in the motor defined by the current limits. This can be corrected by changing the drive motor phase sequence with **A27** (*Reverse Motor Phase Sequence* **B26**), and then repeating the autotune test. This will ensure that the motor rotates correctly in the direction defined by the position feedback rotation.
If the position feedback direction is correct, the motor will rotate under control in the required direction, but if the position feedback direction is

incorrect, the motor will then rotate under control in the wrong direction. Table 7-6 below shows the parameters required for basic RFC-S motor control and indicates which can be set by the user from the motor nameplate and which can be measured with the static autotune.

Table 7-6 RFC-S static autotune parameters

Parameter	Required for	Detail
A18 (*Motor Rated Current* **B02**)	Basic control	Motor nameplate
A22 (*Motor Rated Speed* **B07**)	Slip compensation	
A19 (*Motor Rated Voltage* **B03**)	Basic control	
A20 (*Number Of Motor Poles* **B05**)	Basic control	
A16 (*Position Feedback Phase Angle* **C13**)	Basic control with position feedback	Static or rotating autotune
Stator Resistance (**B34**)	Basic control	Manually enter, Static or rotating autotune
Transient Inductance Ld (**B33**)	Improved performance	Static or rotating autotune
Maximum Deadtime Compensation (**B46**)	Basic control	Static or rotating autotune
Current At Maximum Deadtime Compensation (**B47**)		
Transient Inductance Ld (**B33**)		
Start Current Loop P Gain (**I03**) *Run Current Loop P Gain* (**I08**) *Stop Current Loop P Gain* (**I13**)		
Start Current Loop I Gain (**I04**) *Run Current Loop I Gain* (**I09**) *Stop Current Loop I Gain* (**I14**)		

7.3.2 Rotating Autotune

A26 *Motor Autotune* (**B11**) = Rotating autotune (2). The following describes how an autotune can be initiated and normal operation resumed following successful completion of the test. The autotune should be carried out with no load on the motor, i.e. the ropes should be lifted from the sheave with the motor free to rotate. Alternatively the Elevator car could be placed in a balanced condition with the counter weight, and with sufficient space to allow movement of the car during the rotating autotune. During the rotating autotune the motor will rotate, and if the ropes are still attached the car will also move as follows.

- Open loop and RFC-A: The motor is accelerated with the selected ramps to $^{2}/_{3}$ rated frequency and is maintained at that level for up to 40 seconds in the selected direction.
- RFC-S: The motor will rotate by 2 electrical rev's i.e. up to 2 mechanical rev's) in the selected direction.

CAUTION

The rotating autotune will rotate the motor in the direction selected, regardless of the reference. The drive can be stopped at any time during the autotune by removing the Safe Torque Off (STO), Drive enable or run signal. Following the autotune the Safe Torque Off (STO), Drive enable must be removed and re-applied before the drive can be made to run the motor.

WARNING

When a rotating auto tune is being carried out it is the responsibility of the authorized person to ensure they have read the auto tune instructions and are fully aware of its operation. Also ensure that it is safe to remove (lift) the motors brake with no risk of loss of control. Ensure during this process there is no load on the motor (or the system is balanced to avoid uncontrolled operation) and there is sufficient distance for the car to move within the lift shaft when the rotating auto tune is being carried out to avoid the risk of damage to the system.

For RFC-A and RFC-S the position feedback on the motor is also checked during the rotating autotune.

NOTE

The rotating autotune is carried out with the output motor contactors closed and the motors brake opened during the complete autotune test. The control over the output motor contactors and the brake during the autotune must be made manually.

The rotating autotune is carried out with the output motor contactors closed and the motors brake opened during the complete autotune test. The control over the output motor contactors and the brake during the autotune must be made manually.

1. The rotating autotune test cannot be initiated if the drive is tripped *Drive OK* (**L05**) = Off 0) or the drive is active *Drive Active* (**L06**) = On (1). The drive can be disabled by removing the drive enable signal from control terminal 31.
2. A rotating autotune test is initiated by setting **A26** (*Motor Autotune* **B11**) to Rotating autotune (2)
3. The output motor contactors should be manually closed by an authorised person who is familiar with the requirements for safety, this sequence also applies the drive enable signal on control terminal 31.
4. The motors brake should be manually opened by an authorised person who is familiar with the requirements for safety.
5. A drive run signal should be applied.
6. The rotating autotune will commence:

   Open loop, RFC-A the motor is accelerated to $^{2}/_{3}$ rated frequency and maintained at this level for up to 40 s in the selected direction

   RFC-S the motor will rotate by 2 electrical rev's (i.e. up to 2 mechanical rev's) in the selected direction.

   Ensure there is sufficient headroom for movement of the lift car if not de-roped as this could result in the car hitting the end stops.
7. If the autotune sequence is completed successfully the drive enable is set to inactive (Inhibit) and **A26** (*Motor Autotune* **B11**) is set to zero.
8. The motor brake can be applied.
9. The output motor contactors can be opened.
10. The drive enable will only be set active again by firstly opening the output motor contactors and removing drive enable.
11. If a trip occurs during the autotune sequence, the drive will go into the trip state and **A26** *Motor Autotune* **B11**) is set to zero, at this point the motor brake should be applied and the output motor contactors opened.

12. As before, the drive enable must be removed and re-applied before the drive can be restarted after the trip has been reset. ***Care should be taken if the autotune was not completed as the drive parameters that should have been measured and set-up will still have their original values.***

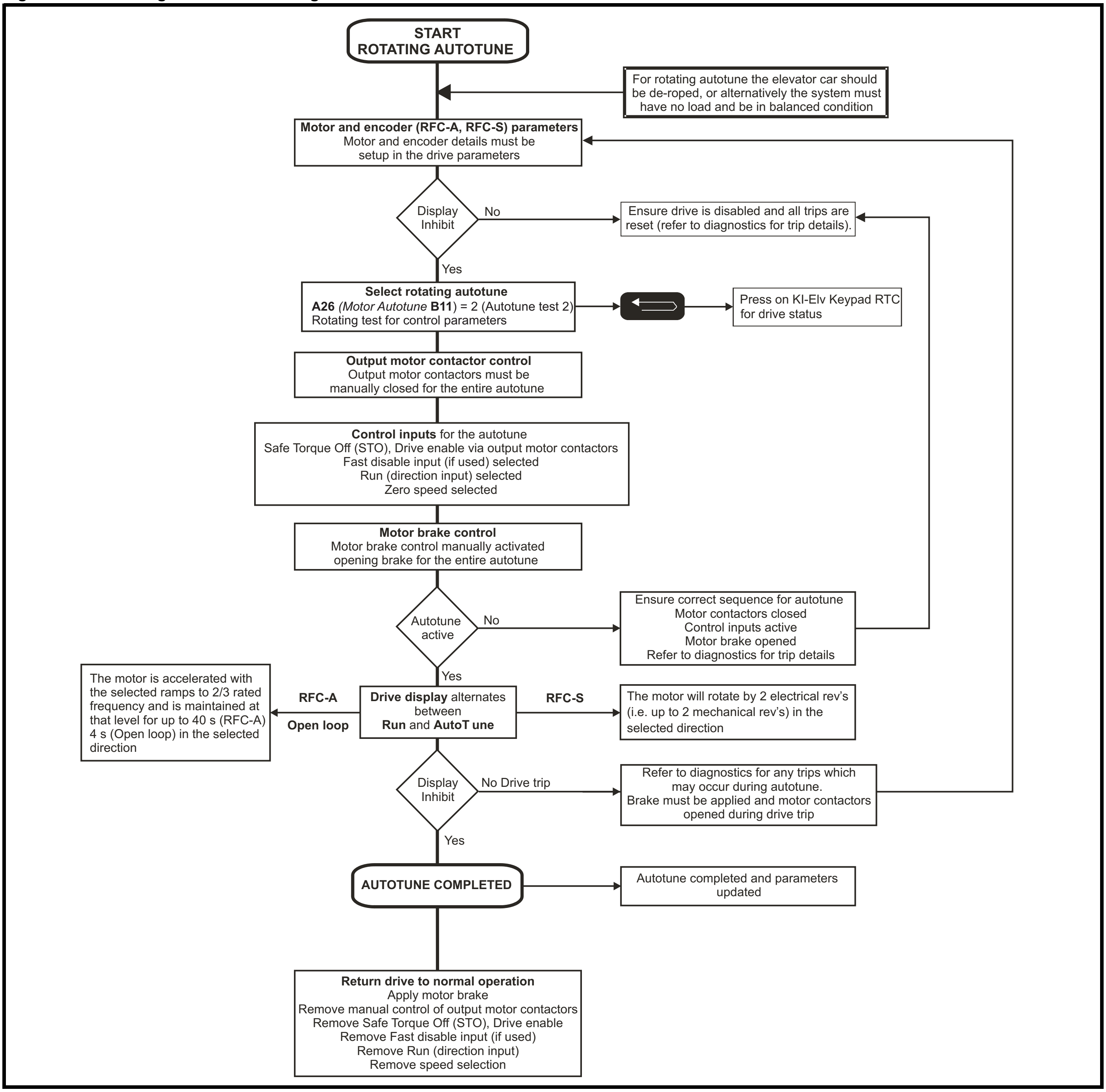
The following describes the effects of the autotune test on drive parameters:

1. The autotune relies on the motor being stationary when the test is initiated to give accurate results.
2. Parameters associated with the motor and feedback position feedback phase angle are updated following successful completion of the autotune test.
3. If the autotune test is not completed successfully parameters will retain their original values resulting in incorrect operation if the drive is enabled.
4. When each stage of the autotune test is complete the results are written to the appropriate parameters, and these parameters are saved in the drive non volatile memory.
5. If *Parameter Cloning* (**N01**) is set to Auto (3) or Boot (4) the parameters are also written to a NV Media Card installed in the drive.

NOTE

For diagnostic information following any drive trip which may occur during the autotune refer to the diagnostics section.

Figure 7-2 Rotating autotune flow diagram



Open loop Rotating autotune: Basic control and improved performance

Stage 1 of the Rotating autotune is to carry out the Static autotune in Open loop as described in section 7.3.1 *Static Autotune* .

Stage 2 a rotating autotune test is performed in which the motor is accelerated with the selected ramps up to a frequency of **A21** *Motor Rated Frequency* **B06**) x 2/3, and the frequency is maintained at that level for 4 seconds. *Stator Inductance* (**B35**) is measured and this value is used in conjunction with other motor parameters to calculate *Motor Rated Power Factor* (**B04**).

Table 7-7 lists the parameters required for Open loop motor control indicating which should be set by the user and which can be measured with an autotune.

Table 7-7 Open loop rotating autotune parameters

Parameter	Required for	Detail
A21 (*Motor Rated Frequency* **B06**)	Basic control	Motor nameplate
A18 (*Motor Rated Current* **B02**)		
A22 (*Motor Rated Speed* **B07**)	Slip compensation	
A19 (*Motor Rated Voltage* **B03**)	Basic control	
Motor Rated Power Factor (**B04**)	Not used	
A20 (Number Of Motor Poles **B05**)	Basic control	
Stator Resistance (**B34**)	Basic control Ur S (0) Ur (1), Ur Auto (3), Ur I (4) modes	Manually enter, Static or rotating autotune
Transient Inductance (**B33**)	Improved performance	Static or rotating autotune
Maximum Deadtime Compensation (**B46**)	Basic control	
Current At Maximum Deadtime Compensation (**B47**)		

RFC- A Rotating autotune: Basic control and improved performance

This test measures the parameters for improved performance by rotating the motor.

Stage 1 of the Rotating autotune is to carry out the Static autotune in RFC-A, refer to section 7.3.1 *Static Autotune on page 151*.

Stage 2 a rotating autotune test is performed in which the motor is accelerated with the selected ramps up to a frequency of **A21** (*Motor Rated Frequency* **B06**) x $^{2}/_{3}$, and the frequency is maintained at that level for 40 seconds. The *Stator Inductance* (**B35**) is measured, and this value is used in conjunction with other motor parameters to calculate the Motor rated power factor.

The motor should be unloaded for this test. Table 7-8 lists the parameters required for RFC-A motor control indicating which should be set by the user and which can be measured with an autotune.

Table 7-8 RFC-A rotating autotune parameters

Parameter	Required for	Measured in test
A21 (*Motor Rated Frequency* **B06**)	Basic control	Motor nameplate
A18 (*Motor Rated Current* **B02**)		
A22 (*Motor Rated Speed* **B07**)	Slip compensation	
A19 (*Motor Rated Voltage* **B03**)	Basic control	
Motor Rated Power Factor (**B04**)	Not used	Rotating autotune
A20 (Number Of Motor Poles **B05**)	Basic control	Motor nameplate
Stator Resistance (**B34**)	Ur S (0) Ur (1), Ur Auto (3), Ur I (4) modes	Static or rotating autotune
Stator Resistance (**B34**)	Improved performance	
Transient Inductance (**B33**)		Rotating autotune
Maximum Deadtime Compensation (**B46**)	Basic control	Static or rotating autotune
Current At Maximum Deadtime Compensation (**B47**)		
Start Current Loop P Gain (**I03**) *Run Current Loop P Gain* (**I08**) *Stop Current Loop P Gain* (**I13**)		Static or rotating autotune
Start Current Loop I Gain (**I04**) *Run Current Loop I Gain* (**I09**) *Stop Current Loop I Gain* (**I14**)		

RFC-S Rotating autotune: Basic control and improved performance

This test measures the parameters for improved performance by rotating the motor. The test can be used to measure all parameters for basic control and improved performance through cancelling cogging torque effects. The motor must be unloaded for this test. This test is likely to give a more accurate value for the **A16** (*Position Feedback Phase Angle* **C13**) than the static autotune.

Stage 1 of the Rotating autotune is to carry out the Static autotune in RFC-S refer to section 7.3.1 *Static Autotune* .

Stage 2 is a Rotating autotune which is performed to locate the flux axis of the motor, and from this the position feedback phase angle is set-up for the position from the position feedback device connected to the drive from the motor. This is done by rotating the motor by 2 electrical revolutions i.e. up to 2 mechanical revolutions) in the selected direction.

NOTE

If sensorless mode is selected a static autotune is performed.

Table 7-9 RFC-S rotating autotune parameter

Parameter	Required for	Detail
A21 (*Motor Rated Frequency* **B06**)	Basic control	Motor nameplate
A18 (*Motor Rated Current* **B02**)		
A22 (*Motor Rated Speed* **B07**)	Slip compensation	
A19 (*Motor Rated Voltage* **B03**)	Basic control	
Motor Rated Power Factor (**B04**)	Not used	
A20 (Number Of Motor Poles **B05**)	Basic control	
Stator Resistance (**B34**)	Ur S (0) Ur (1), Ur Auto (3), Ur I (4) modes	Manually enter, Static or rotating autotune
Transient Inductance Ld (**B33**)	Improved performance	Static or rotating autotune
A16 (*Position Feedback Phase Angle* **C13**)	Basic control	Manually enter, Static or rotating autotune
Start Current Loop P Gain (**I03**) *Run Current Loop P Gain* (**I08**) *Stop Current Loop P Gain* (**I13**)		Static or rotating autotune
Start Current Loop I Gain (**I04**) *Run Current Loop I Gain* (**I09**) *Stop Current Loop I Gain* (**I14**)		
Maximum Deadtime Compensation (**B46**)		
Current At Maximum Deadtime Compensation (**B47**)		

7.4 Elevator mechanical data

The Elevator system mechanical arrangement must be programmed into the drive to convert the linear speed of the Elevator to the rotational speed of the motor. In order to set-up the *Nominal Elevator Speed rpm* (**E07**) the elevator contact speed mm/s), roping, sheave diameter and gearbox ratio must be entered into the following parameters.

The nominal elevator speed in *Nominal Elevator Speed rpm* (**E07**). is the final speed of the motor which must be set-up correctly to ensure the nominal elevator speed in *Nominal Elevator Speed* **E01**) is achieved. *Calculated Nominal rpm* (**E06**) enable by default is set to On (1) to automatically calculate the *Nominal Elevator Speed rpm* (**E07**), this can however be disabled, set to Off (0) if required to manually enter, adjust the nominal elevator speed in *Nominal Elevator Speed rpm* (**E07**).

Table 7-10 Elevator mechanical parameters

Function	Parameter	Detail
A Nominal Elevator Speed rpm	**E07**	Final calculated motor operational rpm
B Nominal Elevator Speed	**E01**	Operating, contract speed of elevator in mm/s
C Sheave Diameter	**E02**	Sheave diameter in mm
D Roping	**E03**	Elevator roping 1:1, 2:1, 3:1, 4:1
E Gearbox Ratio Numerator	**E04**	Gearbox numerator
F Gear Ratio Denominator	**E05**	Gearbox denominator

The nominal elevator speed in *Nominal Elevator Speed rpm* (**E07**) is calculated based upon the Elevator mechanical data entered and using the following formula;

A = (**B** x **D** x **E** x 60) / (π x **C** x **F**)

example;

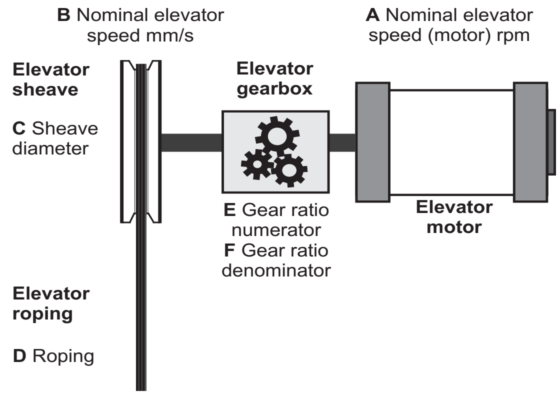
B - Nominal elevator speed = 1600 mm/s
C - Sheave diameter = 240 mm
D - Roping = 1 : 1
E - Gearbox ratio numerator = 1
F - Gearbox ratio denominator = 1

A = (**B** x **D** x **E** x 60) / (π x **C** x **F**)

(1600 x 1 x 1 x 60) / (3.1416 x 240 x 1) = 127.323 rpm.

Nominal Elevator Speed rpm (**E07**) = 127.323

Figure 7-3 Elevator mechanical data



7.5 Creep to floor profile

The default operating mode for the *E300 Advanced Elevator* drive is Closed loop Servo for permanent magnet synchronous servo motors in gearless Elevator systems with Creep to floor positioning. Positioning with Creep to floor is a commonly used operating mode.

For all sections of the profile shown below, there are independent parameters available for the Start optimization, Jerks, Acceleration, Deceleration and Creep to floor which allow the ride comfort of the Elevator to be optimized.

For Creep to floor operation, the operating speed is selected according to the Elevator landing distance. The *E300 Advanced Elevator* drive by default uses digital pre set speed selections set-up in *V1 Creep Speed Reference* (**G01**) to *V4 Speed Reference* (**G04**) as detailed below.

The Creep speed is configured to be *V1 Creep Speed Reference* (**G01**) the remaining speed selections **V2**, **V3** and **V4** can be configured for any speed e.g Nominal speed, High speed, Low speed.

In addition to controlling the profile, the deceleration distance is also calculated in mm dependent upon the speed selected speed selected shown in *Reference Parameter Selected* (**J09**)) and the profile settings. The calculated deceleration distance is displayed in *Deceleration Distance Calculated* (**J43**) for the activated speed.

The measured deceleration distance is displayed after every travel in *Deceleration Distance Measured* (**J44**) in mm. The measured Creep speed distance is also available and shown in *Creep Distance Measured* (**J45**).

The real-time demand on the Elevator control system is low with Creep to floor positioning with a typical cycle time of the Elevator controller of 5 to 20 ms and the *E300 Advanced Elevator* drive of 8 ms the minimal positioning distance with Creep to floor is calculated as follows:

The maximum Creep speed distance =

$$\textbf{Positioning distance [mm]} \geq V_{\textbf{Nominal}} \textbf{ [m/s] x 30 ms}$$

The stop accuracy =

$$\textbf{Accuracy [mm]} \leq V_{\textbf{Creep speed}} \textbf{ [m/s] x 30 ms}$$

The time required for the Creep speed =

$$\textbf{Time Creep speed [ms] = positioning distance [mm] / } V_{\textbf{Creep speed}} \textbf{ [m/s]}$$

Table 7-11 Elevator speeds and distances

Speed selected	Speed selected parameter
V1 *Speed Reference* (creep speed by default)	**G01**
V2 *Speed Reference*	**G02**
V3 *Speed Reference*	**G03**
V4 *Speed Reference*	**G04**

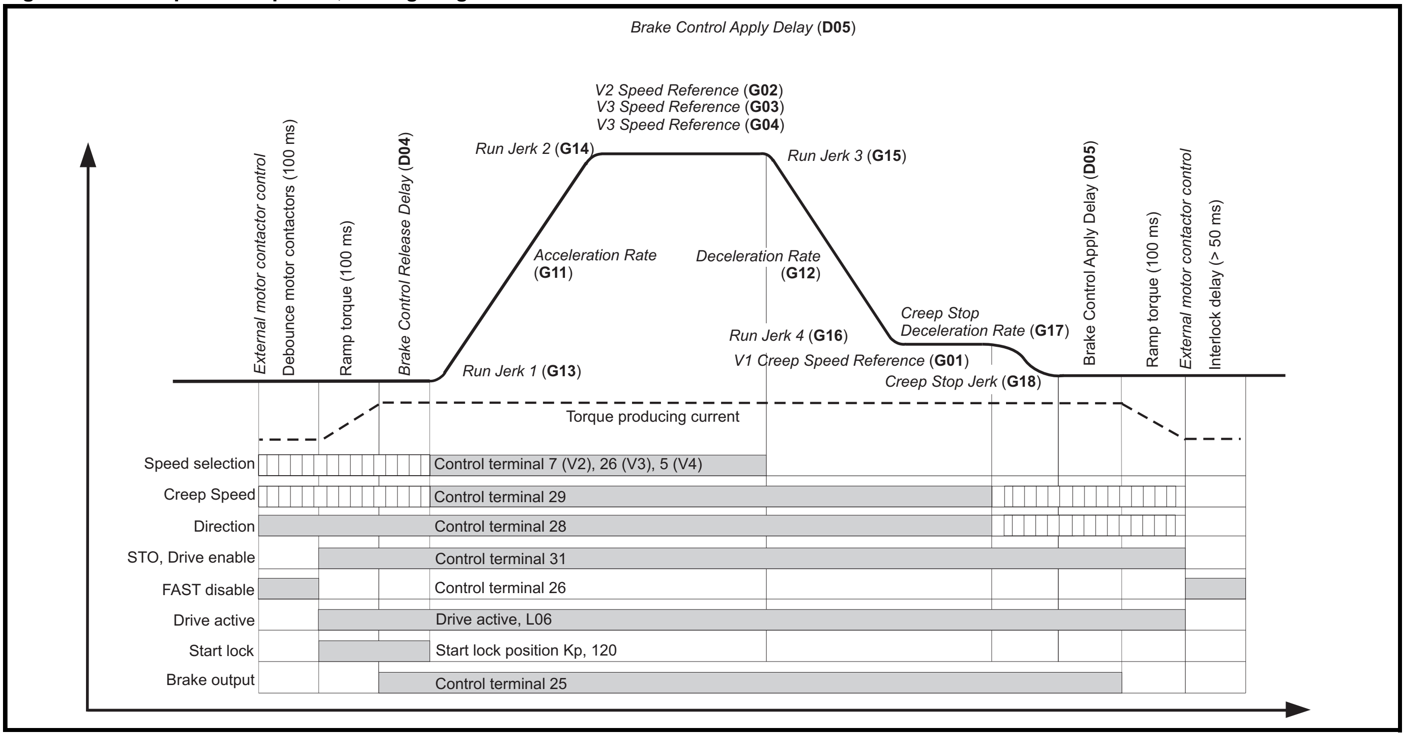
The timing diagram in Figure 7-4 *Creep to floor profile, Timing diagram* on page 160, shows the sequence of operation in the Creep to floor mode as is also detailed below:

- A start sequence is received at the drive from the Elevator controller by means of selecting both a speed and direction.
- Following selection of both the speed and direction inputs on the drive, the Elevator controller then closes the output motor contactors. On closing the output motor contactors, the Safe Torque Off (STO) Drive enable is applied to the drive, and if the Fast disable is used this is also removed and the drive's output becomes active.
- Once enabled, the symmetrical drive current limit is ramped up and torque is generated to hold the motor at zero speed, also using the Start lock position if active.
- With the drive holding the motor at zero speed the brake is opened and the profile started.

NOTE

Following any system fault where a drive trip may occur, and the brake control is carried out by the drive, the brake is automatically closed and the drive output disabled.

Figure 7-4 Creep to floor profile, Timing diagram



7.6 Direct to floor profile

For some applications, especially high-speed elevators and long travel distance elevators, direct-to-floor positioning control is often used to overcome inherent delays associated with creep-to-floor elevators.

Direct-to-floor positioning alone should only be used on elevators up to 1 m/s due to the accuracy and sampling of the *E300 Advanced Elevator* drive, above 1 m/s floor sensor correction should be enabled in addition.

The acceleration rate and all jerk rates of the velocity profile are independently adjustable, enabling the performance of Direct to floor operation to be optimized. The relevant parameters are as shown in Figure 7-5.

The deceleration profile in Direct to floor operation is applied according to the slowing distance to the selected floor level. The elevator controller instructs the drive to slow, either by applying a stop signal to digital input 4, or by deselecting the speed signals. This takes place at a distance from the selected floor level, which matches the slowing distance achievable with the required deceleration rate from the selected speed. On detecting the stop signal the drive decelerates directly under position control into the floor level. Creep speed positioning is not executed nor required.

The *E300 Advanced Elevator* drive calculates the deceleration distance for each of the speed references taking into account the profile settings. Alternatively the user may specify a distance for each speed. The relevant parameters are shown in Table 7-12. The actual distance is displayed in Deceleration Distance Measured (**J44**).

NOTE

If either the slowing signal is given too close to the selected floor level, or the user deceleration distance is too short for the selected speed, it is possible that the car will stop too late and hence overshoot the floor level.

Figure 7-5 Velocity profile with Direct to floor positioning

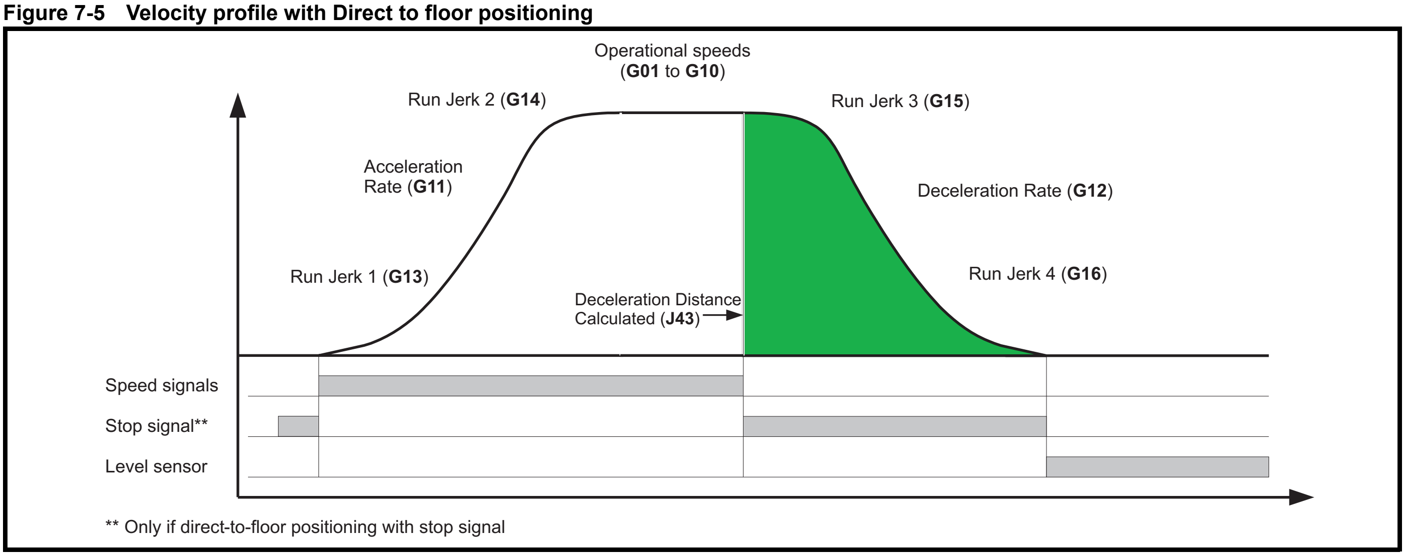


Table 7-12 Calculated and user deceleration distances

Speed	Calculated Deceleration Distance	User Deceleration Distance
V1 Speed Reference (**G01**)	*V1 Calculated Deceleration Distance* (**J10**)	*V1 Deceleration Distance Setpoint* (**G19**)
V2 Speed Reference (**G02**)	*V2 Calculated Deceleration Distance* (**J11**)	*V2 Deceleration Distance Setpoint* (**G20**)
V3 Speed Reference (**G03**)	*V3 Calculated Deceleration Distance* (**J12**)	*V3 Deceleration Distance Setpoint* (**G21**)
V4 Speed Reference (**G04**)	*V4 Calculated Deceleration Distance* (**J13**)	*V4 Deceleration Distance Setpoint* (**G22**)
V5 Speed Reference (**G05**)	*V5 Calculated Deceleration Distance* (**J14**)	*V5 Deceleration Distance Setpoint* (**G23**)
V6 Speed Reference (**G06**)	*V6 Calculated Deceleration Distance* (**J15**)	*V6 Deceleration Distance Setpoint* (**G24**)
V7 Speed Reference (**G07**)	*V7 Calculated Deceleration Distance* (**J16**)	*V7 Deceleration Distance Setpoint* (**G25**)
V8 Speed Reference (**G08**)	*V8 Calculated Deceleration Distance* (**J17**)	*V8 Deceleration Distance Setpoint* (**G26**)
V9 Speed Reference (**G09**)	*V9 Calculated Deceleration Distance* (**J18**)	*V9 Deceleration Distance Setpoint* (**G27**)
V10 Speed Reference (**G10**)	*V10 Calculated Deceleration Distance* (**J19**)	*V10 Deceleration Distance Setpoint* (**G28**)

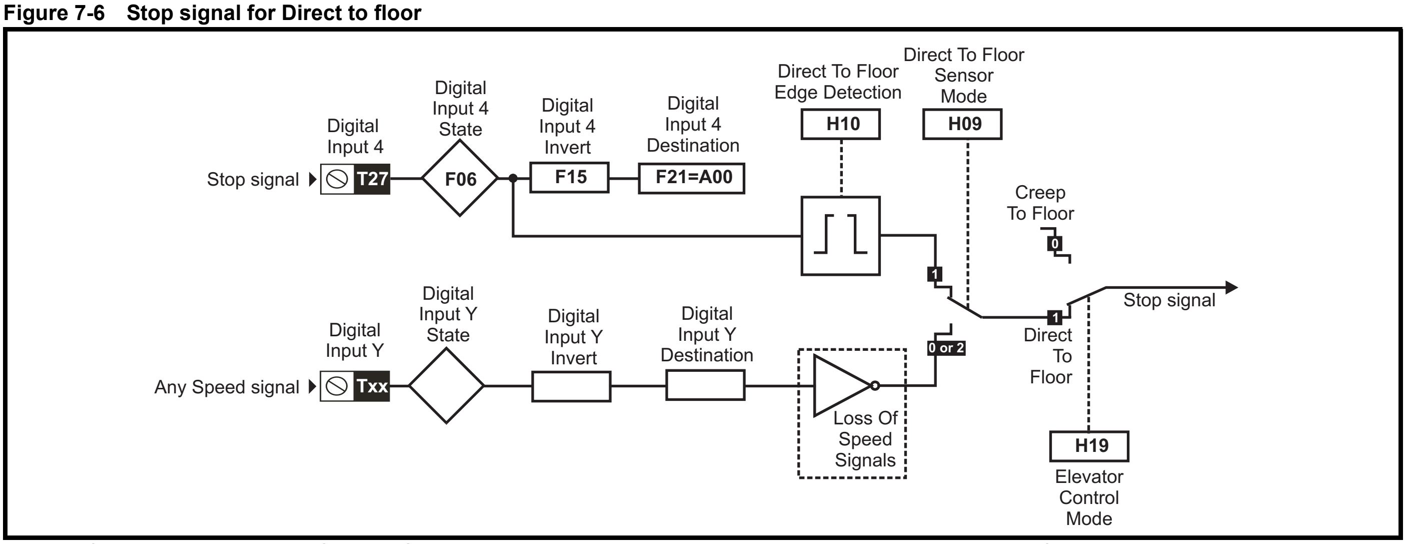
Table 7-13 Direct to floor parameters

Parameter	Details
Elevator Control Mode (**H19**)	Selects creep to floor or direct to floor positioning.
Direct To Floor Sensor Mode (**H09**)	Selects whether a stop signal digital input 4 or the removal of speed signals is used to trigger a direct to floor stop.
Direct To Floor Edge Detection (**H10**)	Selects whether a positive or negative edge of the stop signal is detected.

Table 7-14 Direct to floor sensor mode

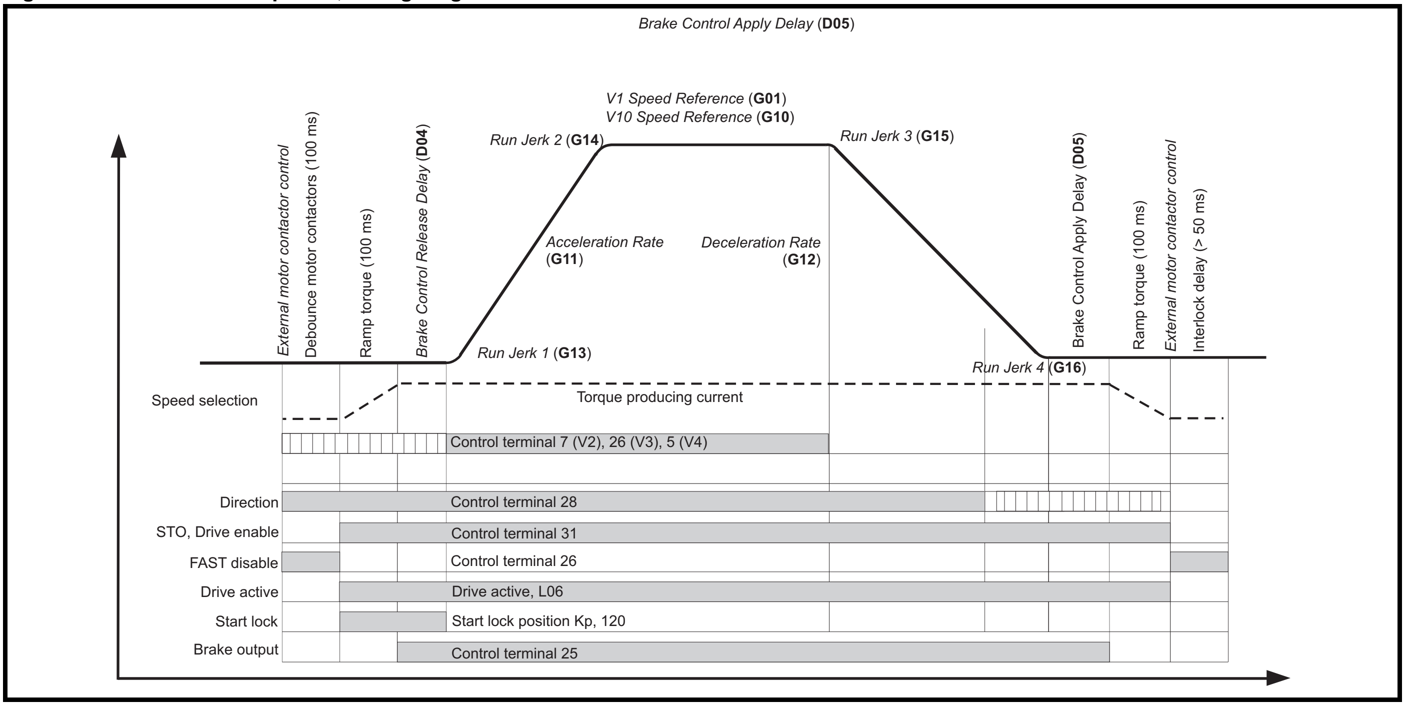
***Direct To Floor Sensor Mode* (H09)**	Details
Spd IP (0)	Stopping is activated by a removal of the speed signals. The deceleration distance is calculated from the profile parameters and is displayed in *V1 Calculated Deceleration Distance* (**J10**) **>** *V10 Calculated Deceleration Distance* (**J19**).
Stop IP (1)	Stopping is activated by a stop signal via digital input 4 (control terminal 27). The deceleration distance is calculated from the profile parameters and is displayed in *V1 Calculated Deceleration Distance* (J10) **>** *V10 Calculated Deceleration Distance* (**J19**). Edge detection is selected by *Direct To Floor Edge Detection* (**H10**) selects rising (0) or falling (1) edge detection.
Spd IP+User Dist (2)	Stopping is activated by a removal of the speed signals. The user can specify the deceleration distance used directly using *V1 Deceleration Distance Setpoint* (**G19**) to *V10 Deceleration Distance Setpoint* (**G28**).

Figure 7-6 Stop signal for Direct to floor



Direct to floor operation utilizes a feature of digital input 4, which bypasses the normal input logic resulting in a fast response to a change in the input signal, such that when the sensor is activated the signal is sampled in <1 µs. When digital input 4 is used for the Direct to floor slowing signal, it is recommended that the input is not used for any other purpose and *Digital Input 4 Destination* (**F21**) should be set to a value of 'A00'. It is possible to specify whether the positive or negative edge of the floor sensor correction signal is detected using *Direct To Floor Edge Detection* (**H10**).

Figure 7-7 Direct to floor profile, timing diagram



7.7 Creep to floor / Direct to floor - Start

For geared and gearless Elevator applications operating in Creep to floor mode / Direct to floor mode, the start performance can be optimized using the following procedure. For open loop operation only the start optimizer is available.

Table 7-15 Start set-up control

Feature	Details
Speed control loop gains	For Closed loop operation the Start Speed Loop P Gain (**I01**) and Start Speed Loop I Gain (**I02**) gains can be used for optimization
Start lock	A start lock position control is available for Closed loop operation and used in addition to the start speed loop gains. This control is mainly used in gearless applications where high start speed loop gains may not possible.
Start optimizer	The start optimizer is available for both Open and Closed loop operation with either geared or gearless Elevators. The start optimizer is mainly used to overcome mechanical imperfections in the system.

7.7.1 Start lock on brake release control

The start lock uses a position controller for the start and can be used to prevent roll back on brake release. The start lock holds the Elevator car in position following Drive enable and opening of the brake. Once the profile is started the start lock position control is disabled.

NOTE

The start lock position control is only available for Closed loop operation, and is by default disabled.

Closed loop operation

Start locking is independent of the start speed loop gains, and may be required where increased start speed loop gains are not possible due to instability associated with low resolution speed feedback devices or acoustic noise from the motor.

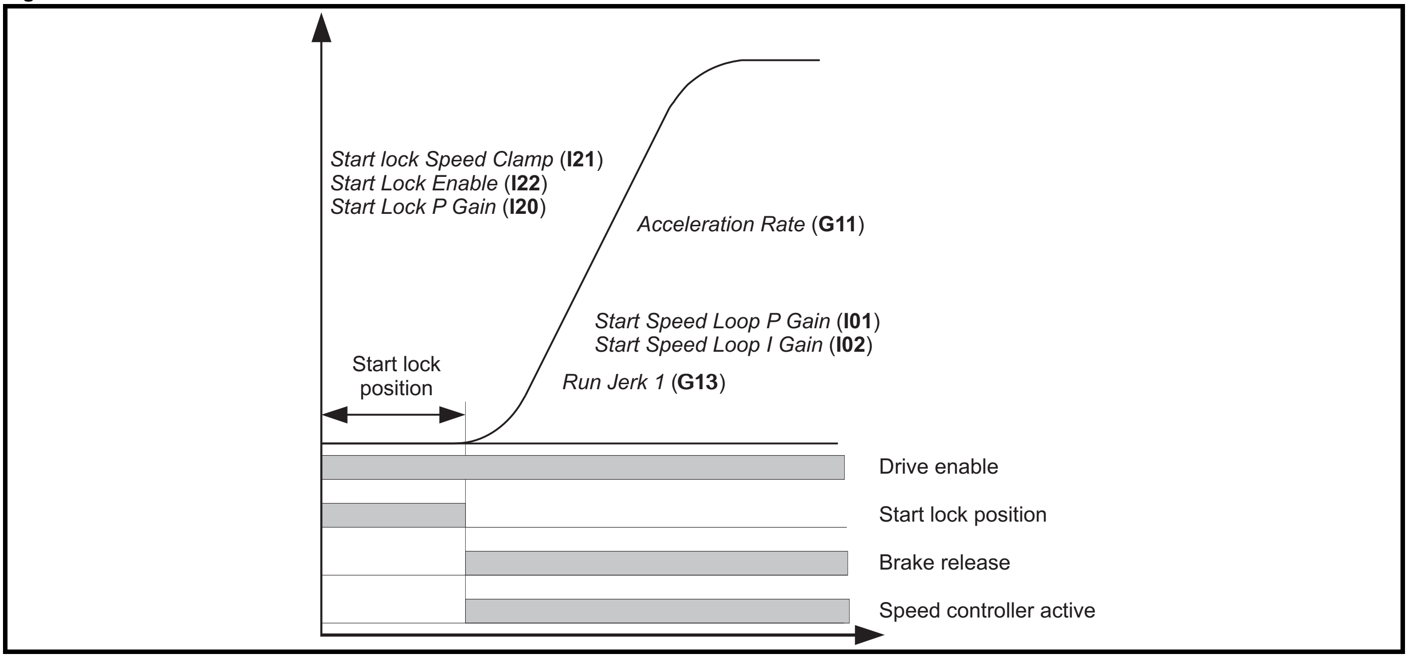
The maximum values for the start lock Kp gain will be limited by the settings of the active start speed loop gains. Under normal operation, the variable speed loop gains alone should be sufficient to hold the motor during brake release and prevent rollback. Therefore the start speed loop gains should be optimized before enabling the start lock position control.

If "STOP" is displayed on the keypad, the position controller does not operate as no speed has been selected and the motor's brake is closed.

Table 7-16 Start lock position control parameters

Parameter	Details
Start Lock P Gain (**I20**)	Setting to > 0 results in the Elevator car being held in position during brake release. The maximum detectable position error is determined by the level of proportional gain.
Start Lock P Gain Speed Clamp (**I21**)	Speed clamp, defines the rate of change of correction for the start locking. Default value is suitable for most applications.
Start Lock Enable (**I22**)	Enable, disable start lock position.

Figure 7-8 Start lock



7.7.2 Start optimizer, low speed control

The start optimizer can be enabled to overcome starting issues arising from static friction, or mechanical issues within the Elevator system. This would typically be enabled for geared applications or applications with mechanical imperfections resulting in reduced ride comfort.

NOTE

The start optimizer is available for both Closed loop and Open loop operation. By default the start optimizer is disabled.

Closed loop operation

For Closed loop gearless applications, the start optimizer is not normally required as correct optimization of the start speed loop gains will provide the required compensation and ride comfort.

The start optimizer has jerk, speed and time settings as illustrated in Figure 7-9 on page 164, which can be optimized to achieve the required ride comfort during the start sequence. To enable the start optimizer, the time in parameter *Start Optimizer Time* (**G48**) should be > 0. Once the start optimizer is enabled, *Start Optimizer Jerk* (**G47**) and speed *Start Optimizer Speed* (**G46**) are active.

On completion of the start optimization sequence, the Elevator will continue a transition to the acceleration using *Run Jerk 1* (**G13**). If the target speed for the start optimizer is not reached during the start optimizer time, there will be a continuous transition to the acceleration profile with *Run Jerk 1* (**G13**).

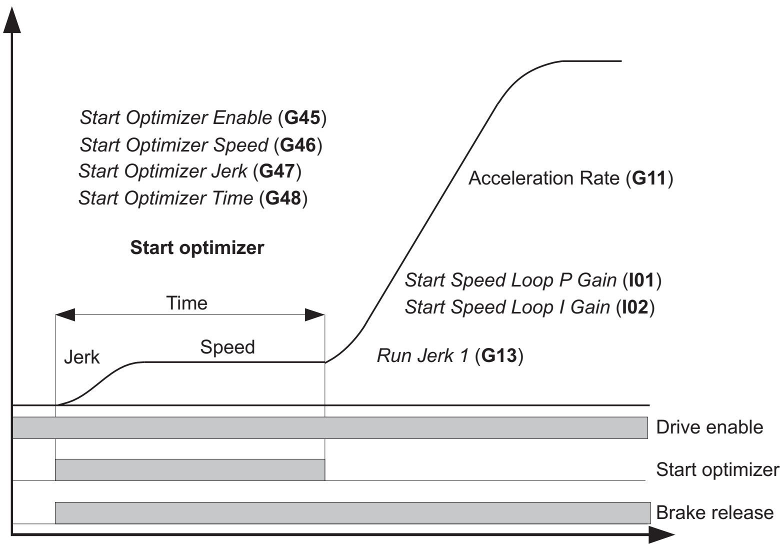
Open loop operation

In Open loop control, the start optimizer is always active during start. The start optimizer speed is used to set the minimum speed to hold the car still prior to releasing the brake. The start optimizer jerk is internally configured to achieve an acceleration maximum in 0.5 s, and the start optimizer time is set to 1000 ms + the brake release delay time. The brake in Open loop control will only be requested to release once the start optimizer speed has been reached.

Table 7-17 Start optimizer parameters

Parameter	Details
Start Optimizer Enable (**G45**)	Enables start optimizer function
Start Optimizer Speed (**G46**)	Start optimizer speed in mm/s, default setting = 10
Start Optimizer Jerk (**G47**)	Start optimizer jerk mm/s^3, default setting = 10. Value selected must be less than the start jerk in *Run Jerk 1* (**G13**)
Start Optimizer Time (**G48**)	Start optimizer time in ms, default setting = 0 start optimizer disabled. To enable start optimizer value should be > 0

Figure 7-9 Start optimization



7.7.3 Start profile and control loop gains

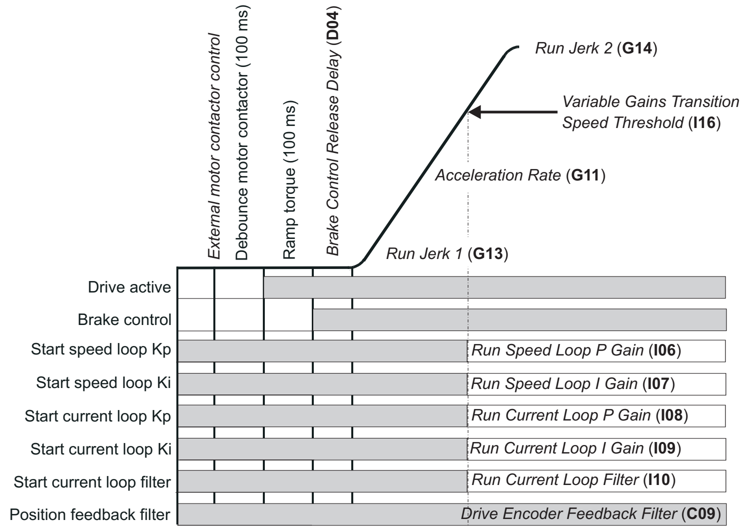
The start profile for the Elevator system can be configured and adjusted using the following profile parameters and control loop gains. For Closed loop operation, there are both speed loop and current control loop gains available. The following parameters are active from the Initial start, *Run Jerk 1* (**G13**), Acceleration and to the end of acceleration *Run Jerk 2* (**G14**).

Table 7-18 Start profile parameters

Parameter	Details
Run Jerk 1 (**G13**)	Start jerk, active during the start from zero speed or following the start optimizer.
Acceleration Rate (**G11**)	Acceleration rate
Run Jerk 2 (**G14**)	End of acceleration jerk
Start Lock Kp Speed Clamp (**I21**)	Kp position control gain used to prevent roll back during brake release.
Start Speed Loop Kp (**I01**) *Start Speed Loop Ki* (**I02**)	Start speed control loop gains active during the start to the speed threshold level where a change is made to the travel speed control loop gains.
Start Current Loop P Gain (**I03**) *Start Current Loop I Gain* (**I04**)	Start current control loop gains = autotune values
Variable Gains Transition Speed Threshold (**I16**)	Transition time from the start to travel speed and current control loop gains.
Start Current Loop Filter (**I05**)	Current loop filter for start
Drive Encoder Feedback Filter (**C09**)	Position feedback

The speed control loop gains can be limited dependant on the resolution of the position feedback device, low resolution, or due to induced noise on the encoder feedback due to cable, screen and ground terminations. *Drive Encoder Feedback Filter* (**C09**) can be used to overcome these issues and allow higher speed control loop gains.

Figure 7-10 Profile start and associated gains



7.7.4 Start profile brake control

The motor brake control for the Elevator can be controlled either from the *E300 Advanced Elevator* drive, or from the Elevator controller. By default, the drive is set-up to provide a brake control output on control terminal T25. If the Elevator controller manages the motor brake control, the drive can be configured using *T25 Digital I/O 02 Source/Destination* (**F19**) to provide a motor magnetized output. Only once the motor is fully magnetized, does the drive provide a motor magnetized output which can be used for the brake control in the Elevator controller. Table 7-19 and Table 7-20 describe the various brake control parameters and settings.

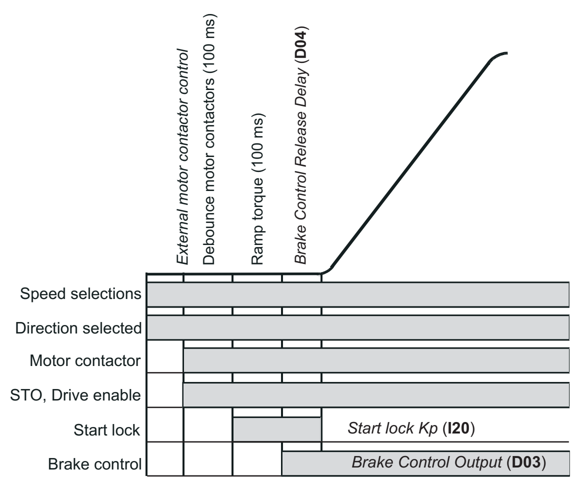
Table 7-19 Brake control digital output parameters

Parameter	Setting
T25 Digital I/O 02 Source/Destination (**F19**)	*Brake Control Output* (**D03**) for brake control output from drive
	Motor Magnetized Indication (**D01**) output for external brake control
T25 Digital I/O 02 State (**F04**)	Digital output state On (1) Off (0)
T25 Digital I/O 02 Invert (**F13**)	Invert digital output on T25

Table 7-20 Brake control parameters

Parameter	Detail
Brake Control Output (**D03**)	Brake control output state
Brake Control Release Delay (**D04**)	Brake release delay
Upper Current Threshold (**D06**)	Brake control release high current threshold (***Open loop***)
Brake Release Frequency (**D08**)	Brake release frequency (***Open loop***)

Figure 7-11 Brake control - Closed loop release



During any drive trip where brake control is being carried out on the drive, the brake output will become inactive forcing the brake to be closed and preventing further operation. If the brake control is being carried out by the Elevator controller and a drive trip occurs, the drive ok output will turn Off (0) and the Elevator controller will apply the motor brake to prevent further operation.

The operating speeds for the *E300 Advanced Elevator* drive are V1, V2, V3 and V4. V1 is selected by default as the Creep speed with V2, V3 and V4 being user defined speeds. The selected operating speed can be seen in *Reference Parameter Selected* (**J09**).

7.8 Travel

The travel profile for the Elevator system can be configured and adjusted using the following profile parameters and control loop gains. For Closed loop operation, there are both speed loop and current control loop gains available. The following parameters are active from the end of acceleration (Run jerk 2), and Travel and start of deceleration (Run jerk 3).

The operating speeds for the *E300 Advanced Elevator* drive are V1, V2, V3 and V4. V1 is selected by default as the Creep speed with V2, V3 and V4 being user defined speeds. The selected operating speed can be seen in *Reference Parameter Selected* (**J09**).

7.8.1 Travel profile and control loop gains

Table 7-21 Travel profile parameters

Parameter	Details
Run Jerk 2 (**G14**)	End of acceleration jerk
Run Jerk 3 (**G15**)	Start of deceleration jerk
Run Speed Loop P Gain (**I06**) *Run Speed Loop I Gain* (**I07**)	Run speed control loop gains active at the end of start speed control loop gains speed threshold level to the stop.
Run Current Loop P Gain (**I08**) *Run Speed Loop I Gain* (**I09**)	Run current control loop gains = autotune values
Run Current Loop Filter (**I10**)	Current loop filter from start threshold to run and stop from default.
Drive Encoder Feedback Filter (**C09**)	Position feedback

Figure 7-12 Creep to floor profile travel

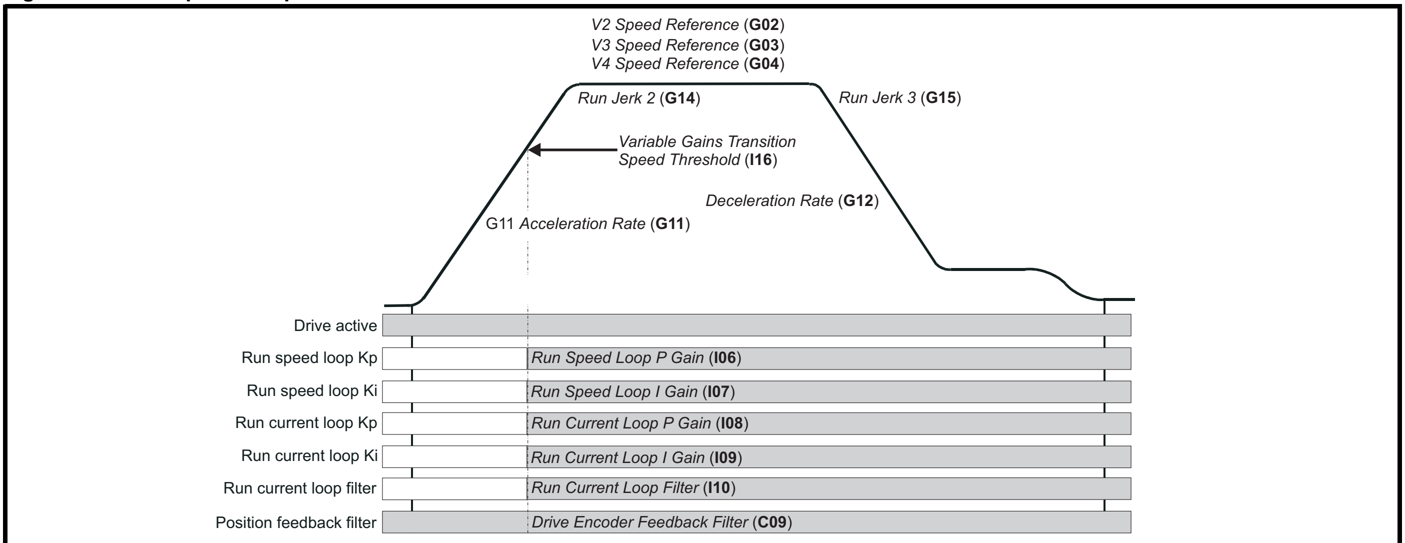
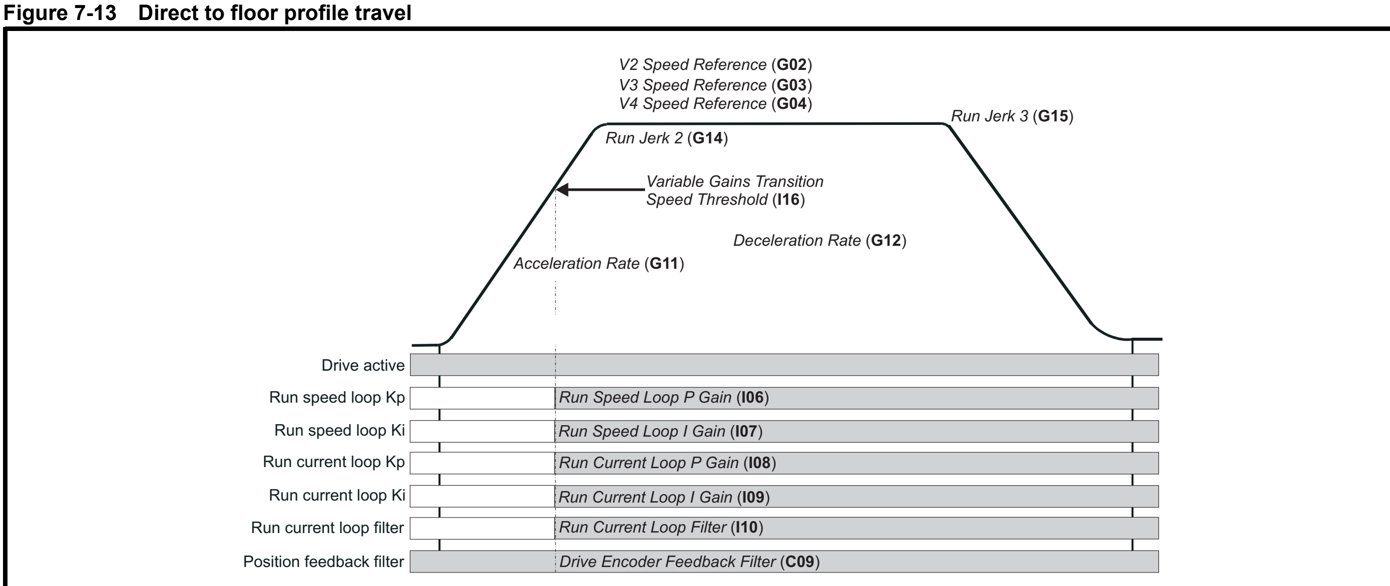


Figure 7-13 Direct to floor profile travel



7.9 Stop

The stop profile for the Elevator system can be configured and adjusted, using the following profile parameters and current control loop gains. For Closed loop operation there are additional speed control loop gains available. The following parameters are active from the Start of deceleration Run jerk 3), Deceleration, Run jerk 4, Creep deceleration and Creep stop jerk.

7.9.1 Stop profile and control loop gains

Table 7-22 Stop profile parameters

Parameter	Details
Run Jerk 3 (**G15**)	Start of deceleration jerk
Deceleration Rate (**G12**)	Deceleration rate
Run Jerk 4 (**G16**)	End of deceleration jerk
Creep Stop Deceleration Rate (**G17**)	Creep to floor deceleration rate
Creep Stop Jerk (**G18**)	Creep to floor stop jerk
Run Speed Loop P Gain (**I06**) *Run Speed Loop I Gain* (**I07**)	Run speed control loop gains are active during the travel and through to the stop
Run Current Loop P Gain (**I08**) *Run Speed Loop I Gain* (**I09**)	Run current control loop gains = autotune values
Run Current Loop Filter (**I10**)	Current loop filter from start threshold to run and stop from default

Figure 7-14 Creep to floor profile stop

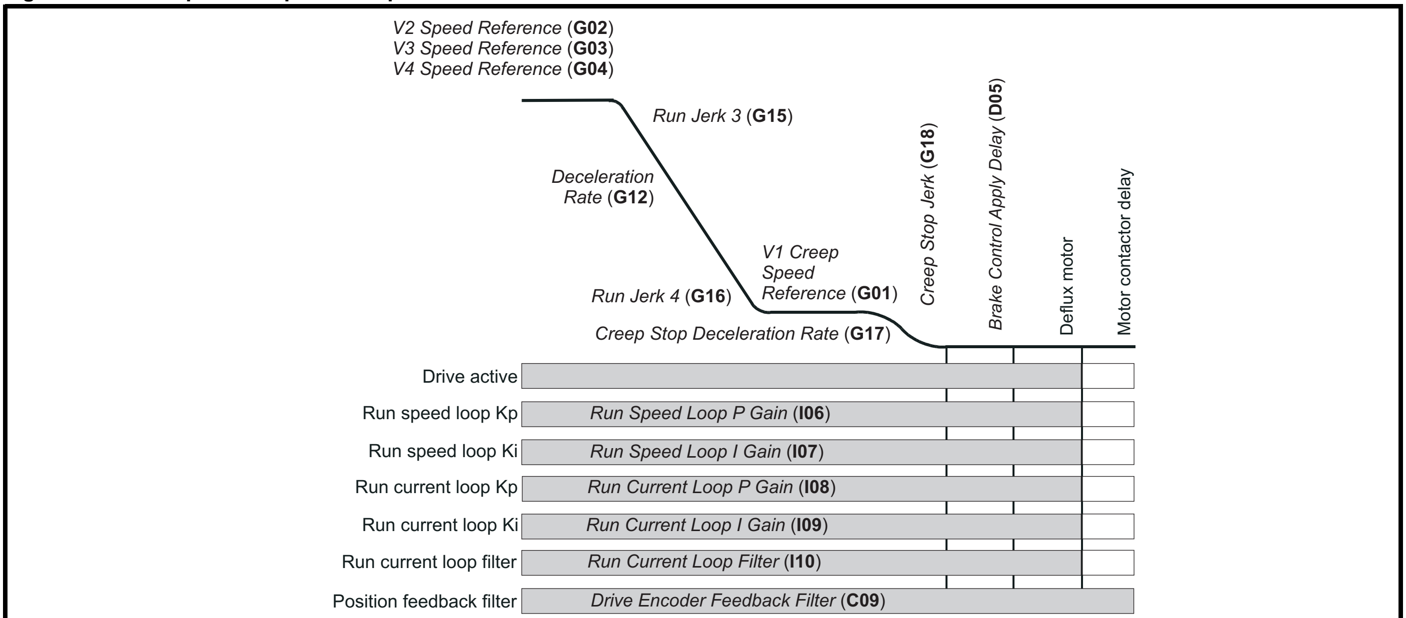
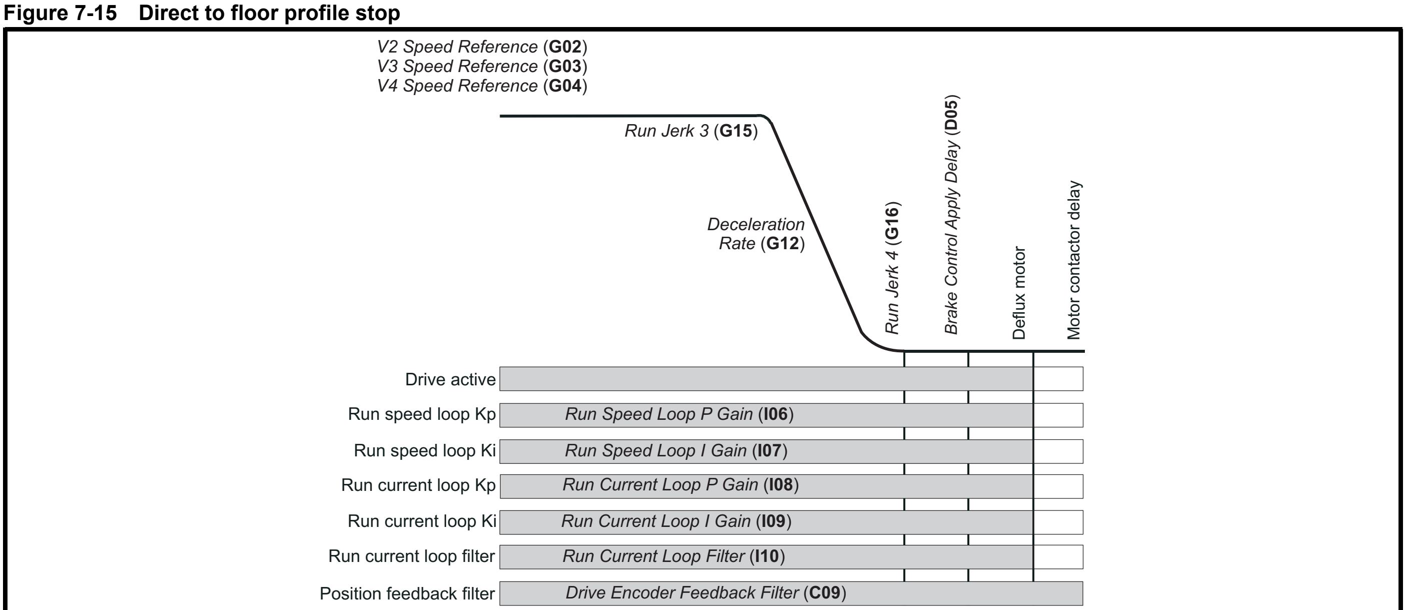


Figure 7-15 Direct to floor profile stop



7.9.2 Stop profile brake control

The motor brake control for the Elevator can be controlled either from the *E300 Advanced Elevator* drive or from the Elevator controller. By default the drive is set-up to provide a brake control output on control terminal T25. If the Elevator controller manages the motor brake control, the drive can be configured using *T25 Digital I/O 02 Source/Destination* (**F19**) to provide a motor magnetized output. Only once the motor is fully magnetized, does the drive provide a motor magnetized output which can be used for the brake control in the Elevator controller. Table 7-23 and Table 7-24 describe the various brake control parameters and settings.

Table 7-23 Brake control digital output parameters

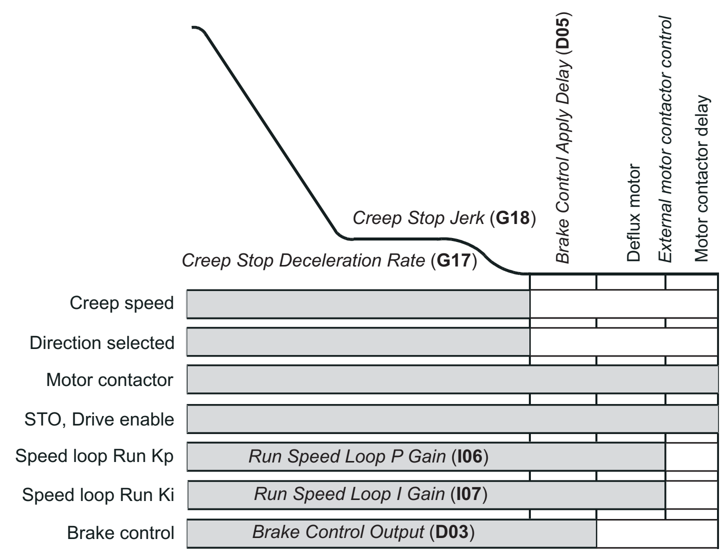
Parameter	Setting
T25 Digital I/O 02 Source/Destination (**F19**)	*Brake Control Output* (**D03**) for brake control output from drive
T25 Digital I/O 02 Source/Destination (**F19**)	*Motor Magnetized Indication* (**D01**) for external brake control
T25 Digital I/O 02 State (**F04**)	Digital output state On (1) Off (0)
T25 Digital I/O 2 Invert (**F13**)	Invert digital output on T25

Table 7-24 Brake control parameters

Parameter	Detail
Brake Control Output (**D03**)	Brake control output state
Brake Control Apply Delay (**D05**)	Brake apply delay
Brake Apply Low Threshold (**D07**)	Brake control apply low current threshold (***Open loop***)
Brake Apply Frequency (**D07**)	Brake apply frequency (***Open loop***)

During any drive trip where brake control is being performed, the brake output will become inactive forcing the brake to be closed and preventing further operation. If the brake control is being carried out by the Elevator controller and a drive trip occurs, the drive ok output will turn Off (0) and the Elevator controller must apply the motor brake to prevent further operation.

Figure 7-16 Brake control - Closed loop apply



7.9.3 Stop profile, motor contactor control

Following completion of the travel and during the stop sequence the motor brake is applied, after which the symmetrical current limit is ramped down and the output motor contactors are opened. During the opening of the output motor contactors, the drive's output should be inactive to avoid potential damage to both the output motor contactors and the drive as a result of arcing.

Where *Motor Contactor Measured Delay Time* (**B32**) is < 50 ms the brake control in *Brake Control Apply Delay* (**D05**) should be increased.

Table 7-25 Motor contactor control parameters

Parameter	Detail
Motor Contactor Measured Delay Time (**B32**)	Measured time between the end of the travel and the time taken to fully close the output motor contactors, and remove the Safe Torque Off (STO), Drive enable, value should be > 50 ms
Brake Control Apply Delay (**D05**)	Brake apply delay, increase where *Motor Contactor Measured Delay Time* (**B32**) is < 50 ms

7.10 Additional control functions

CAUTION

The brake control must be adjusted by a responsible person who is familiar with the system operation and safety requirements to avoid a safety hazard. Correct adjustment should be carried out as detailed in the *Installation and Commissioning Guide* to avoid the risk of product damage or a safety hazard.

Additional features can be configured for the *E300 Advanced Elevator* drive as described below where these features are not enabled by default. When selected, some additional features will require control inputs/outputs on the drive to be allocated. Where additional control inputs/outputs are not available, this will require an additional SI-I/O option module to be installed.

The following additional control functions available on the *E300 Advanced Elevator* drive are covered in this section

- Motor contactor control
- Load cell compensation
- Fast start
- Fast stop
- Load measurement
- Inertia compensation
- Simulated encoder output
- Advanced door opening
- Emergency backup operation
- Peak curve
- Floor sensor correction
- Short floor landing

7.11 Motor contactor control

The output motor contactor control can be implemented on either the Elevator controller or the drive. The *E300 Advanced Elevator* drive has output motor contactor control which can be enabled and routed to any digital output, by default this control is not enabled.

NOTE

The *E300 Advanced Elevator* drive can be used in Elevator applications with zero output motor contactors and has TUV Nord approval to EN81. For further details contact the supplier of the drive.

Table 7-26 Output motor contactor control parameters

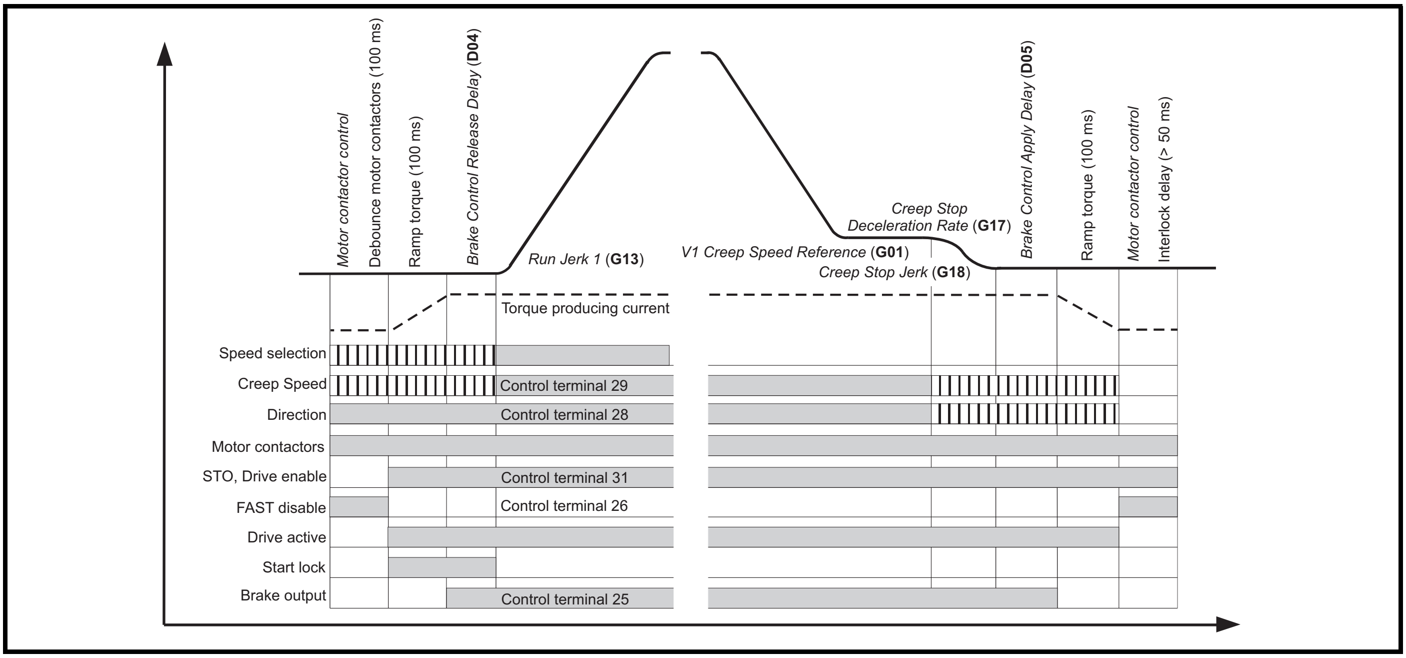
Parameter	Detail
Motor Contactor Control Output (**B31**)	Digital output source for motor contactor control.
Motor Contactor Measured Delay Time (**B32**)	Measured delay between the end of the travel and the time taken to fully close the output motor contactors, remove the Safe Torque Off (STO), Drive enable.
Brake Control Apply Delay (**D05**)	Programmable delay between brake being fully applied and when motor contactor can be opened.

To prevent over voltages at the drive's output and motor windings during output motor contactor control, the drive output should only be disabled after the brake apply delay. The time delay between the brake being applied and the opening of the output motor contactor is displayed in *Motor Contactor Measured Delay Time* (**B32**) in ms.

A negative value indicates that the motor contactor opened whilst current was flowing which must be prevented. In this case, the brake apply time in *Brake Control Apply Delay* (**D05**) must be increased to at least the value of *Motor Contactor Measured Delay Time* (**B32**).

The *E300 Advanced Elevator* drive has a Fast disable input that can be used to disable the drive in 600 µs, compared to the standard disable time of between 8 and 20 ms with the drives Safe Torque Off (STO), Drive enable input. The Fast disable is typically used to avoid OI.AC trips where either an output shorting contactor is being used, or to avoid OI.AC trips during operation in inspection mode. The Fast disable by default uses control terminal 27.

Table 7-27 Motor contactor control



7.12 Load cell compensation

Load cell compensation uses the elevator car load cell to apply a torque reference to overcome the mass of the people in the elevator car when running preventing roll back on brake release.

Any of the 3 analog inputs may be routed to *Load Cell Compensation Input* (**E11**). It is expected that the output from the load cell is a ±10 Vdc type suitable for connection to the Unidrive M analog inputs. Scaling and offsetting of the load cell signal is achieved using the standard features of the analog input used.

The final load cell compensation torque reference is sampled once (see description for Elevator Software State 2 in Table 9-13 *State machine and control state* on page 445) and used as a torque feed forward reference. Sampling once prevents noise generated during travel, electrical or mechanical, from being detected by the load cell and injected as a torque reference.

Figure 7-17 Load cell compensation

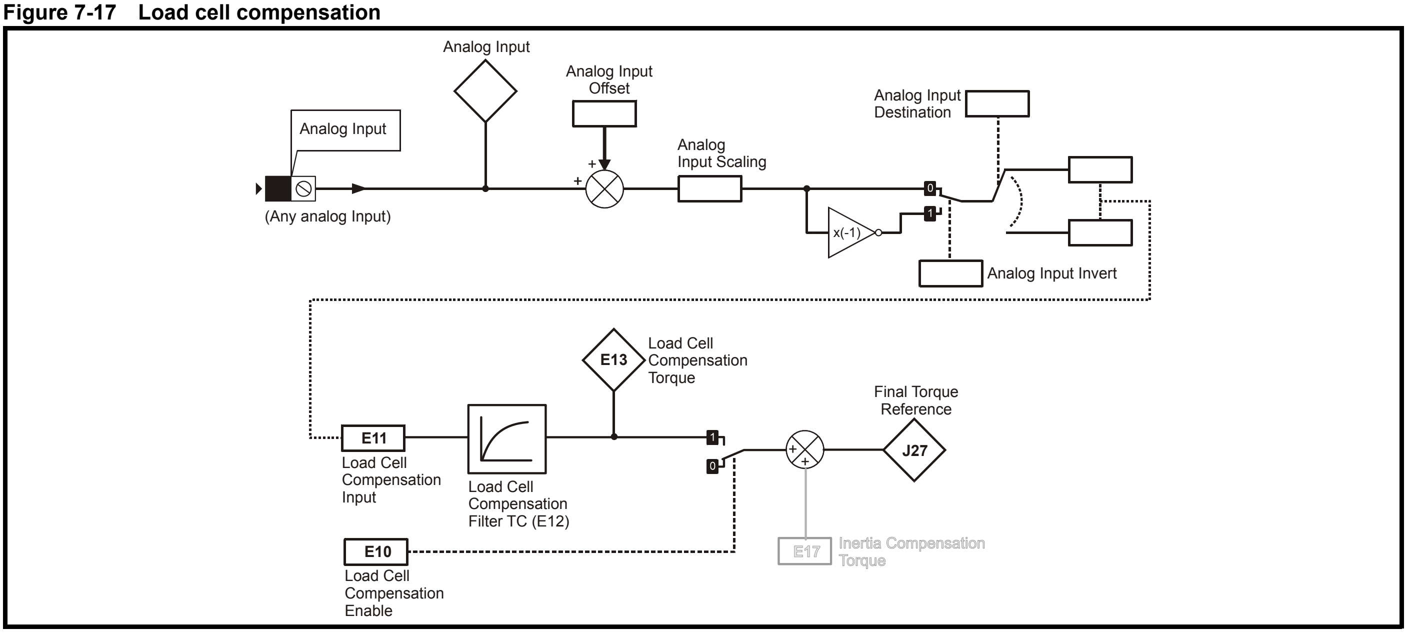


Table 7-28 Load cell compensation

Parameter	Detail
Load Cell Compensation Enable (**E10**)	Enables the load cell compensation torque offset to be applied
Load Cell Compensation Input (**E11**)	The input to the load cell compensations scheme. This is used as the destination for the analog input which receives the load cell signal
Load Cell Compensation Filter Time Constant (**E12**)	Filters the final load cell torque reference such that the effect of electrical noise in the load cell signal, or mechanical disturbances during travel affecting the load cell compensation are minimized
Load Cell Compensation Torque (**E13**)	Indicates the final torque reference in 0.1 % of system rated torque units

Load cell compensation uses the Elevator car external load cell to apply a torque reference to overcome the mass of the Elevator car preventing roll back on brake release. The external load cell compensation is sampled once during the start.

When this feature is active, any analog input may be routed to *Load Cell Compensation Input* (**E11**) to be used as the external load cell compensation input, where it is expected that the output from the external load cell will be a ±10 V.

Position locking Start Lock Enable (**I22**) must not be used at the same time as load cell compensation *Load Cell Compensation Enable* (**E10**). The load cell compensation is not applied during an autotune.

Correct operation of load cell compensation requires adjustment to be made under the following conditions:

- **Balanced elevator car:**

For a balanced elevator car, the torque shown in *Load Cell Compensation Torque* (**E13**) must be 0. If it is not 0 adjust the offset for the analog input used.

- **Empty elevator car**

After the balanced elevator car load cell offset has been made, the scaling for the analog input used must be modified with an empty elevator car. When the brake releases but before the elevator car accelerates, if the scaling for the analog input used is setup correctly then *Speed Error* (**J31**) = 0 (in RFC-A and RFC-S mode) and *Final Torque Reference* (**J27**) = *Load Cell Compensation Torque* (**E13**), indicating that the torque reference required to hold the car still is provided by the load cell compensation.

7.13 Fast stop

A fast stop is available for commissioning / start up and inspection of the Elevator system. The fast stop allows the user to define a fast stop deceleration rate that is greater than the standard stop deceleration rate. The fast stop function as default is disabled, to enable the fast stop set *Fast Stop Enable* (**H26**) = On.

The fast stop feature allows:

- User defined fast stop deceleration rate
- Faster stopping compared to the standard deceleration and jerk for commissioning / start up and inspection
- Can be used to overcome hard stops due to standard deceleration and jerk during commissioning / start up and installation

Table 7-29 Fast stop parameters

Parameter	Detail
Fast Stop Enable (**H26**)	Fast stop enable, default setting = Off 0), enabled using a control input routed to *Fast Stop Enable* (**H26**)
Fast Stop Deceleration Rate (**G29**)	Fast stop deceleration rate only active when fast stop is enabled.
Speed References **G02** to **G10** Speed References V2 to V10	A fast stop speed is selected as shown during the fast stop, this speed can be any speed selection from V1 through to V10 and must be set to 0 mm/s.

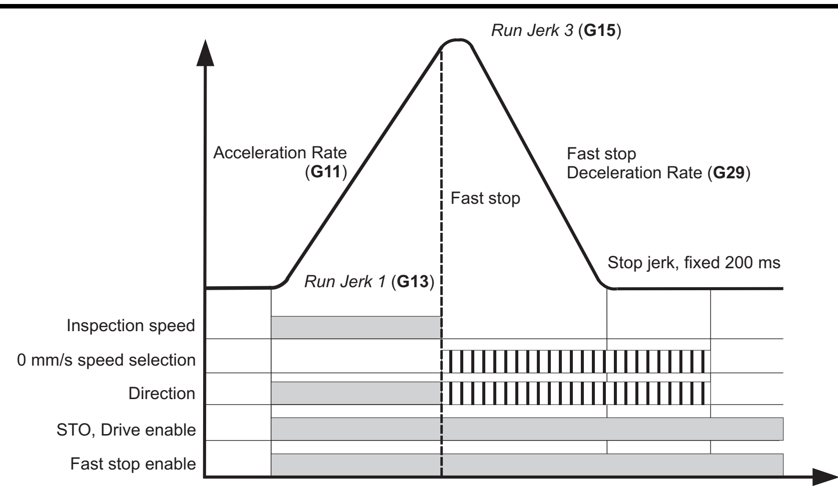
7.13.1 Fast stop using speed selection

When enabled, a fast stop can be initiated through a speed selection where the speed selection is 0 mm/s. The speed selection can be any of the available speeds from V2 through to V10, with these being selected using an additional control input routed to the required speed selection.
The deceleration rate in *Fast Stop Deceleration Rate* (**G29**) is used following the selection of the speed at 0 mm/s for the fast stop. The stop jerk for creep to floor operation in *Creep Stop Jerk* (**G18**) is no longer used, and a fixed time of 200 ms is used in order to provide smooth running from deceleration to the final stop.

7.13.2 Fast stop using direction control

When enabled, a fast stop can be initiated using the direction input, this being active for either a single direction input or dual direction inputs.
The deceleration rate in *Fast Stop Deceleration Rate* (**G29**) is used following the direction input control. The stop jerk for creep to floor operation in *Creep Stop Jerk (***G18**) is no longer used, and a fixed time of 200 ms is used in order to run as smoothly as possible from deceleration to the final stop.

Figure 7-18 Fast stop



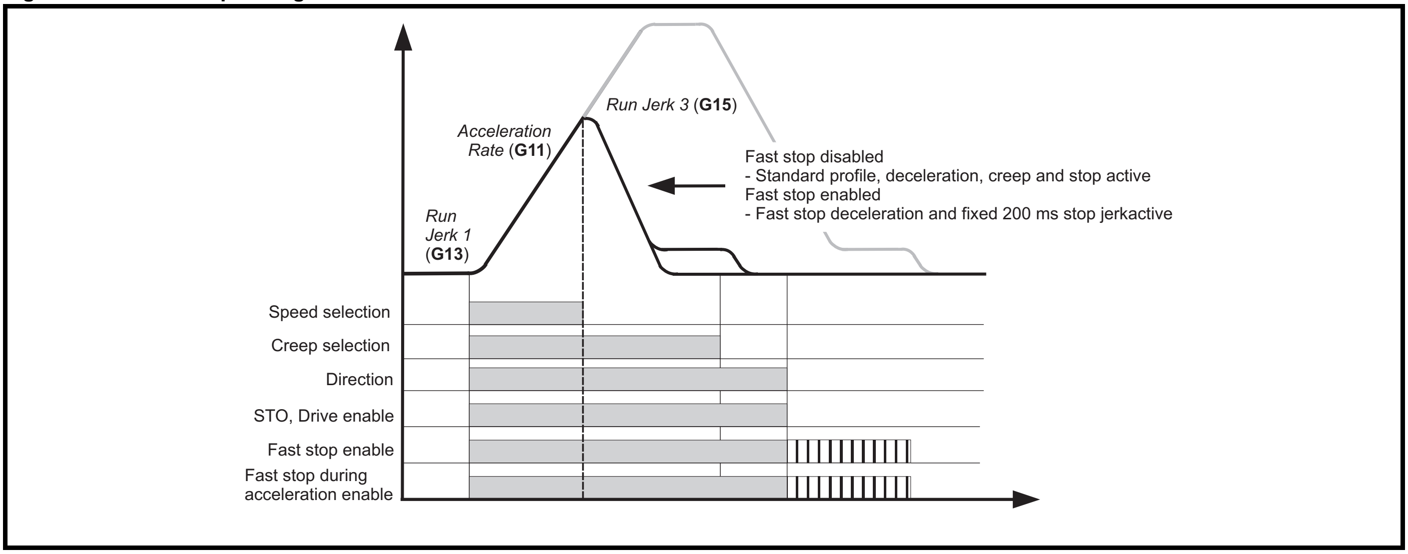
- Inspection speed removed and speed selection of 0 mm/s selected initiates a fast stop. If inspection speed only is removed a normal stop will be carried out.
- Direction input removed initiates a fast stop.

7.14 Rapid stop during acceleration

With fast stop using either speed selection or direction control, fast stop cannot be carried out during acceleration where the speed selection or direction are removed. Acceleration will continue to the speed selection made during the start.
With rapid stop, where speed selection or direction are removed during acceleration, the deceleration will start immediately. Rapid stop during acceleration is enabled with *Rapid Slow Down Enable* (**H27**)
The rapid stop during acceleration allows a stop to be initiated during the acceleration period, with the removal of the speed selections and with a fast stop being carried out immediately. The end of acceleration jerk is set to zero to prevent any further increase in speed, allowing the deceleration to start. The deceleration to stop for rapid stop during acceleration uses either:-

- The standard profile parameters where fast stop is not enabled, *Fast Stop Enable* (**H26**) = Off (0)
- The fast stop deceleration rate in *Fast Stop Deceleration Rate* (**G29**) and final fixed jerk of 200 ms where fast stop is enabled, *Fast Stop Enable* (**H26**) = On (1).

Figure 7-19 Fast stop during acceleration



7.15 Load measurement

During each travel operation, the *E300 Advanced Elevator* drive can measure the load in the Elevator car and provide an output to the Elevator controller to indicate the direction of least load. This output can be used during emergency back-up operation for example, where a low voltage back-up power supply becomes active to indicate the direction in which to travel with the least load.

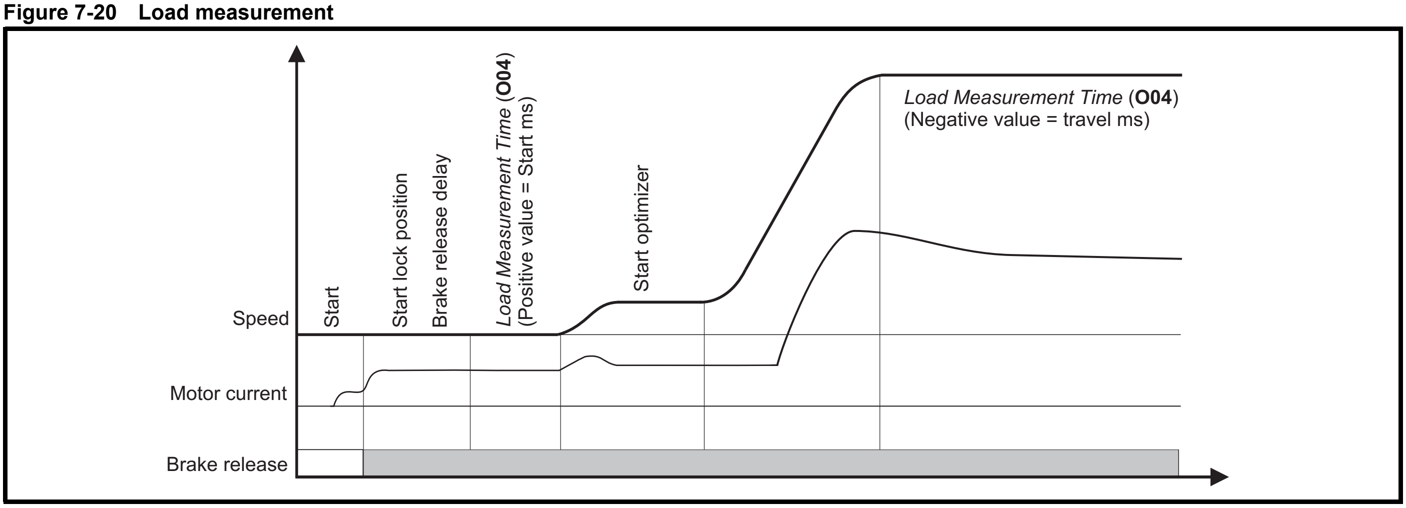
Table 7-30 Load measurement

Parameter	Detail
Load Measurement Direction Output (**O01**)	Final load measurement direction output
Load Measurement Direction Invert (**O02**)	Load measurement direction output invert
Load Measurement Value (**O03**)	Load measurement value
Load Measurement Time (**O04**)	Time period for load measurement. Positive value measurement during start, negative value measurement during travel.

NOTE

The load measurement and direction output for emergency backup operation is only available in RFC-A and RFC-S operating modes.

Figure 7-20 Load measurement



7.16 Inertia compensation

Inertia compensation compensates for the elevator inertia acceleration torque), and for the elevator car load holding torque). This information is then used to apply a torque reference to enable good ride comfort when starting the elevator. This is achieved by adding the torque reference to match the weight of passengers in the elevator and the accelerating torque for the inertia of the elevator car when opening the mechanical brake.

This data can then be used to overcome the mechanical inertia of the elevator system. Implementing inertia compensation gives a dynamic torque feed forward based upon the inertia of the system and the acceleration rate used, reducing the work done by the speed loop i.e. it reduces speed loop error.

Table 7-31 Inertia compensation parameters

Parameter	Description
Inertia Compensation Enable (**E10**)	Enables the inertia compensation torque offset to be applied.
Inertia Compensation Total Inertia (**E15**)	The total inertia is used in combination with Inertia compensation reference acceleration to derive the torque required for acceleration.
Torque Per Amp (**E16**)	This is used to scale the acceleration torque into percentage of system rated torque
Inertia Compensation Torque (**E17**)	Allows the load cell feedback to be zeroed for a balanced elevator car.
Inertia Compensation Acceleration (**E18**)	The profile generator acceleration output used in combination with Inertia compensation total inertia to derive the torque required for acceleration

The scaling to modify the acceleration feed forward to accommodate the system inertia may be calculated from

A = Inertia compensation scaling
B = Inertia of the system in kg m^2
C = Rated motor torque in Nm
D = Gear ratio numerator / Gear ratio denominator
E = Radius of the sheave

A = 1000 x B x D / (C x E)

NOTE

Inertia compensation is not active during an autotune.

7.17 Simulated encoder output

The *E300 Advanced Elevator* drive has a simulated encoder output available when operating in Closed loop operating modes which is generated from the drive's main position feedback at a default ratio of 1:1. The simulated encoder output (AB only) as default is derived through hardware from the main position feedback connected to the drive's encoder interface. Simulated encoder output is not available in Open-Loop.

Table 7-32 Encoder output options

Main position feedback	Simulated encoder output
AB.Servo, FD.Servo, FR.Servo, SC.Servo, SC.SC, Commutation only	No simulated encoder output available
AB, FD, FR, SC, Resolver, SC.Hiperface	Full simulated encoder output available
SC.EnDat, SC.SSI	Simulated encoder output available, no Z marker pulse available
EnDat, BiSS, SSI	Full simulated encoder output available

Encoder Simulation Status (**C29**) will display the hardware simulated encoder output which is available based upon the main position feedback device set-up on the drive.

The hardware simulated encoder output (AB only) from default is derived through hardware, *Encoder Simulation Mode* (**C31**) = 0 with an update rate of 250 µs. Additional modes of simulated encoder outputs are also available.

Table 7-33 Hardware simulated encoder output

Parameter	Detail
Encoder Simulation Status (**C29**)	Displays the simulated encoder output available based upon the position feedback connected to and configured in the drive.
Encoder Simulation Mode (**C31**)	**0**: Hardware **1**: Lines per rev **2**: Ratio **3**: SSI
Encoder Simulation Hardware Divider (**C32**)	Defines the ratio between the main position feedback device and the simulated encoder output in Hardware mode.
Encoder Simulation Hardware Marker Lock (**C33**)	Marker output is generated from the marker input. Alternatively the marker output can be locked where both AB, FD or FR are high.

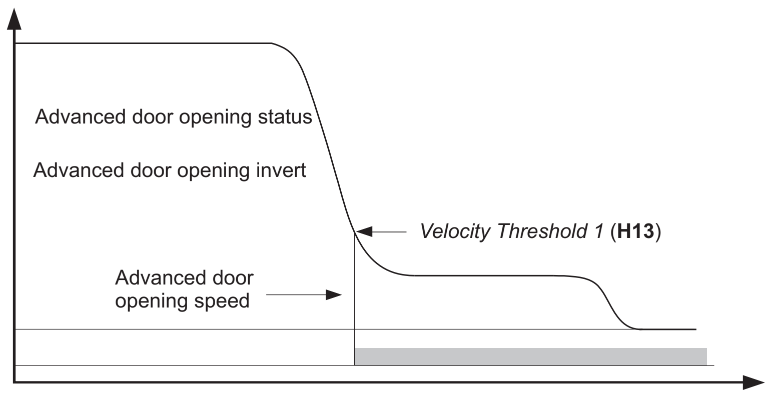
7.18 Advanced door opening

An advanced door opening output can be configured on the *E300 Advanced Elevator* drive. This feature provides an output to the Elevator controller to open the elevator car doors at a defined speed prior to the elevator car reaching the floor level. This allows the Elevator travel times to be reduced. The advanced door opening output is generated based upon a speed threshold and routed to a digital output to the Elevator controller.
The advanced door opening speed threshold is configured by the user in *Velocity Threshold 1* (**H13**). In addition there is also an invert for the output and status bit.

Table 7-34 Advanced door opening parameters

Parameter	Detail
Velocity Threshold 1 (**H13**)	Velocity threshold 1 used to define the speed at which advanced door opening starts, and the output is generated to the Elevator controller.
F18 (T24), F19 (T25) or F20 (T26)	Digital output for advanced door opening.
F12 (T24), F13 (T25) or F14 (T26)	Advanced door opening digital output invert
F03 (T24), F04 (T25) or F05 (T26)	Advanced door opening digital output status.

Figure 7-21 Advanced door opening



7.19 Emergency backup power supply control

IIn order to prevent a UPS system from being overloaded during emergency back up operation, there are two features within the software which will control both the current limit and speed to limit the output power demand from the UPS. The UPS protection requires the user to enter the UPS power rating into *UPS Maximum Power Set point* (**O06**). The protection then uses this value as the maximum power allowed and compares this with the actual drive output power.

When *UPS Control Enable* (**O05**) = On (1), UPS control is has been enabled using a digital input from the Elevator controller routed to the UPS control enable parameter. When the UPS control enable is active, the following functions are internally controlled to reduce the loading on the UPS and extending the operating time:-

- UPS maximum power setpoint
- Symmetrical current limit
- Start optimizer is disabled
- Start position lock is disabled
- Load measurement is disabled
- Maximum speed error threshold is disabled
- Maximum distance error threshold is disabled

To protect the UPS from overloading and switching into standby mode, the DC bus voltage control of *Symmetrical Current Limit* (**B16**) is carried out with the UPS control.

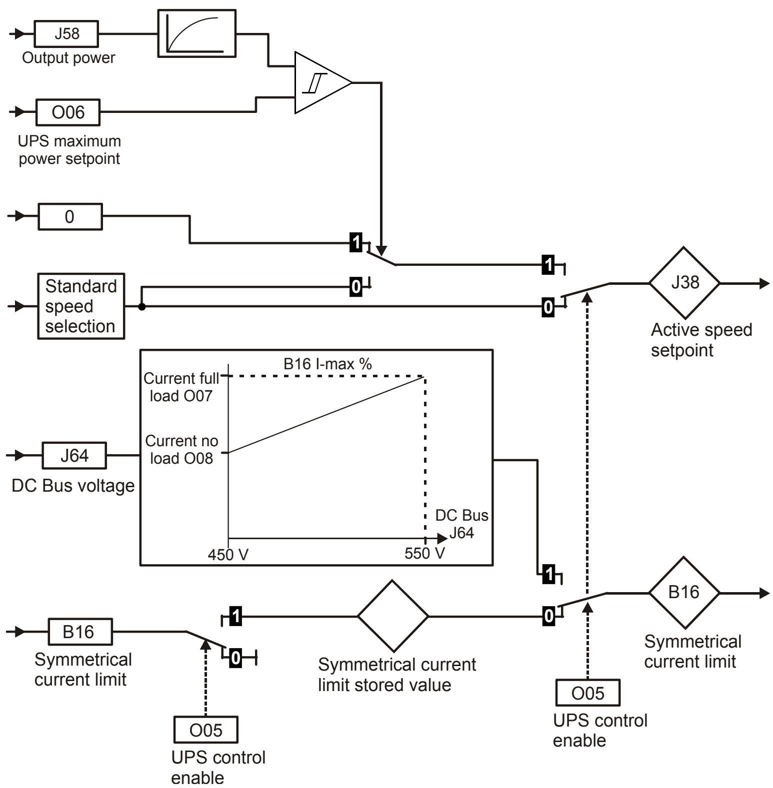
Where the DC bus voltage drops below the UU Reset voltage + 60 V (= 510 Vdc for 400 Vac drives), the current limit is decreased linearly from the nominal set value in *UPS evacuation current full load limit* (**O07**) to the reduced value in *UPS evacuation current no load limit* (**O08**) with the redcution in voltage to 450 Vdc.

The speed is also controlled to prevent exceeding the power set point in *UPS Maximum Power Set point* (**O06**) in kW. When the output power is > UPS maximum power set point, the speed reference will be internally set to 0.

Table 7-35 UPS power control parameter

Parameter	Detail
Ups Control Enable (**O05**)	Enable, disable for UPS control
UPS Maximum Power Set point (**O06**)	Maximum UPS power in kW. This setting prevents the UPS from being overloaded during emergency evacuation with UPS control enable = On (1).
UPS evacuation current full load limit (**O07**)	Defines the percentage full load current allowed during emergency evacuation with UPS control enable = On (1) to prevent overloading, and to extend the operating time of the UPS power supply.
UPS evacuation current no load limit (**O08**)	Defines the percentage no load current allowed during emergency evacuation with UPS control enable = On (1) to prevent overloading, and to extend the operating time of the UPS power supply.

Figure 7-22 Emergency power supply backup control



7.20 Peak curve operation

Peak curve operation optimizes the speed profile independent of the moment when the signal to stop occurs. Peak curve operation is especially suited to elevators, where the rated speed cannot be achieved on some floors, due to differing floor level distances, or where the rated speed cannot be achieved on a single floor travel, due to higher elevator speeds. Using Peak curve operation allows the use of a single speed reference, with the maximum profile speed automatically controlled. This avoids the use of an intermediate speed, or operating for extended periods at low speed and therefore reduces travel times for systems with different floor level distances.

Peak curve operation modifies the maximum profile speed based upon when the signal to stop occurs, ensuring that the required stopping distance is always achieved and the floor level is reached with the programmed jerks and deceleration rate. This method of motion profiling gives the additional benefit that the time taken to reach a given floor is the fastest possible. Peak curve operation can be enabled and used along with floor sensor correction control. Operation in Creep to floor mode may be enhanced by enabling Peak curve operation In Direct to floor mode, Peak curve operation is always enabled.

Parameter	Description
Peak Curve Enable (**G41**)	Enables Peak curve operation in Creep to floor mode. In Direct to floor mode, Peak curve operation is always active and this parameter has no effect
Peak Curve Setpoint Distance (**G42**)	**Creep to floor:** When any speed reference V1 to V10 other than Creep speed is selected and active, this indicates the distance to slow from the selected speed to Creep speed using the *Deceleration Rate* (**G12**), *Run Jerk 3* (**G15**) and *Run Jerk 4* (**G16**). When Creep speed is selected and active, this indicates the distance to slow from Creep speed to a stop using *Creep Stop Deceleration Rate* (**G17**) and *Creep Stop Jerk* (**G18**). **Direct to floor:** This indicates the distance from the selected speed to a stop using the *Deceleration Rate* (**G12**), *Run Jerk 3* (**G15**) and *Run Jerk 4* (**G16**).
Peak Curve Measured Distance (**G43**)	**Creep to floor:** When any speed reference V1 to V10 other than Creep speed is de-selected or a stop is requested, this shows the distance that is accumulated until Creep speed is reached. **Direct to floor:** When any speed reference V1 to V10 is de-selected or a stop is requested, this shows the distance that is accumulated until a complete stop.
Peak Curve Activated (**G44**)	Indicates when Peak curve operation has been activated during acceleration. Reset to Off (0) once a new travel has started.

The effect on the speed profile, with Peak curve operation enables, depends on the point during the profile when the stop signal is given. This results in the following three scenarios:

Table 7-36 Peak curve operating scenarios

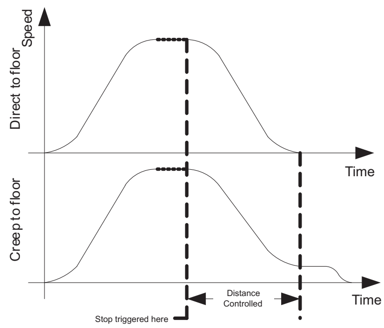
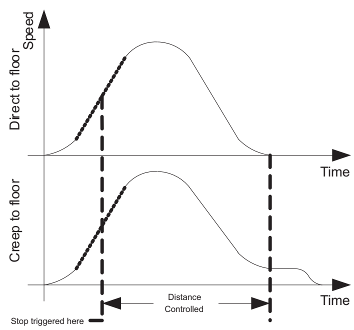
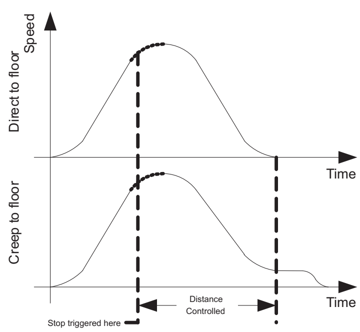
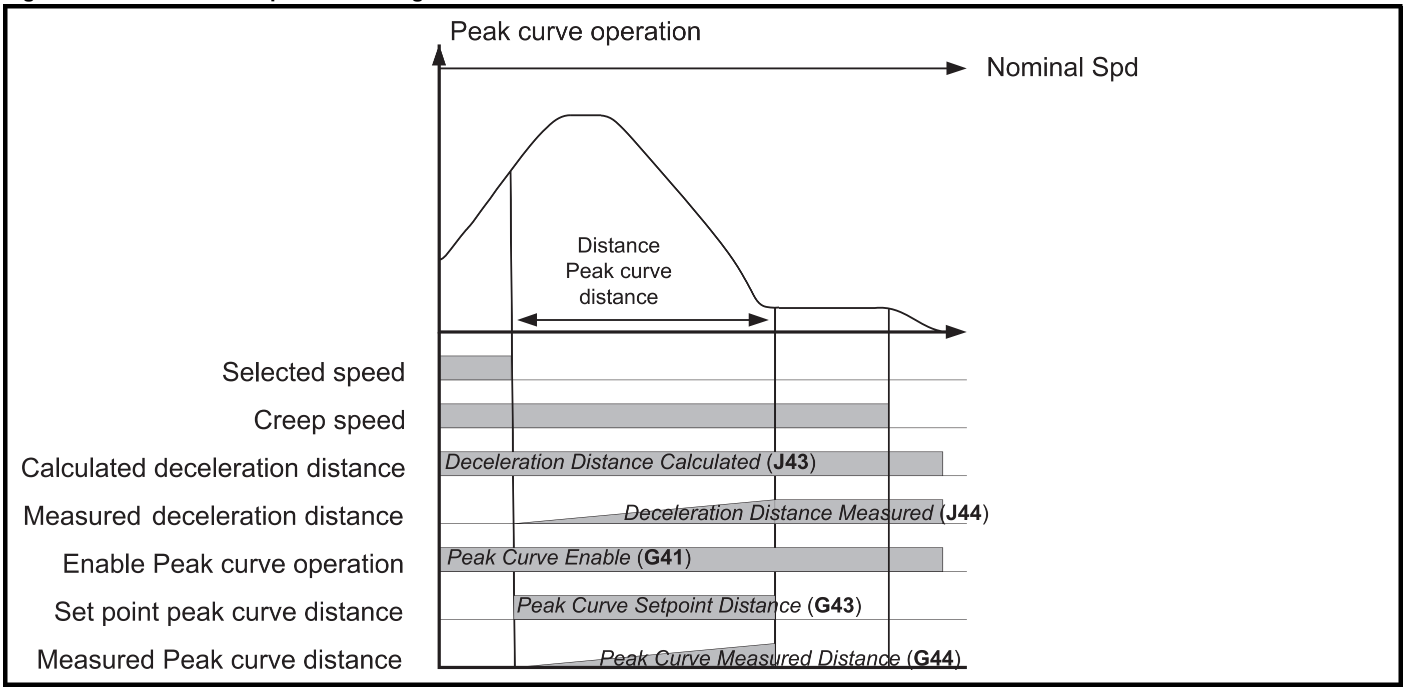
Condition	Diagram	Description
Stop activated while at constant speed		If a stop is activated while at constant speed, a normal stop occurs and the profile parameters are not modified.
Stop activated while at constant acceleration		If a stop is activated while at constant acceleration, a peak cure profile is generated where the profile jerk and acceleration are used as specified but the peak speed is optimized such that the target distance is reached without overshoot.
Stop activated while in Jerk 2 or Acceleration reduction		If a stop is activated while in Jerk 2 or acceleration reduction, a peak cure profile is generated where the profile jerk, acceleration and peak speed is optimized such that the target distance is reached without overshoot.

Figure 7-23 Peak curve operation timing



7.21 Floor sensor correction

Independent of the positioning profile selected (Direct to floor or Creep to floor), additional floor sensor correction can be implemented when operating in RFC-A or RFC-S mode. This feature provides improved accuracy for the final positioning at the floor target position.

Floor sensor correction allows:

- Compensation for rope creep and hardware scaling errors.
- High levels of floor target position accuracy with elevator speeds in excess of 1m/s, utilising Direct to floor positioning control.

Floor sensor correction requires the following:

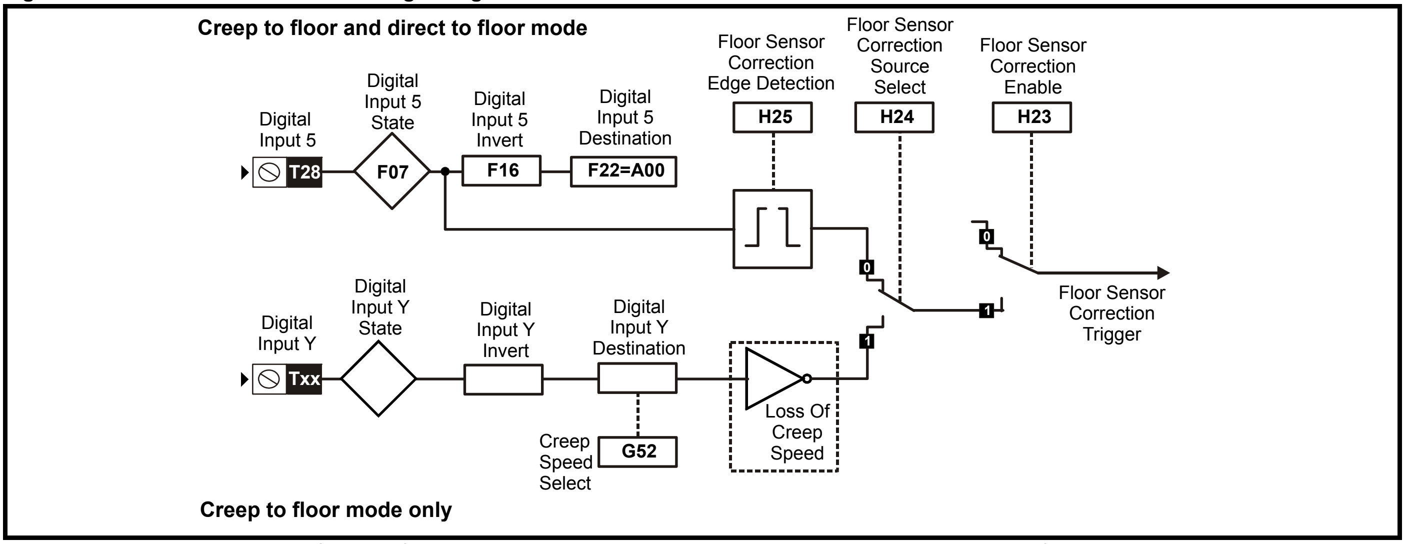
- A floor correction sensor e.g. door zone sensor, which is connected to the digital input 5 (control terminal 28) on the elevator drive. The sensor should be placed at a fixed distance (between 50 mm to 500 mm) before each floor level. Alternatively, in Creep to floor operation, the creep speed reference is deselected at a fixed distance (between 50 mm to 500 mm) before each floor level. Settings above 500 mm will reduce the accuracy at the floor level.

The distance from the floor correction sensor to the floor level must be set in *Floor Sensor Correction Target Distance* (**G31**). It is assumed that the distance to the floor level is symmetrical for travel upwards and downwards.

Table 7-37 Floor sensor correction distance parameters

Parameter	Details
Floor Sensor Correction Enable **(H23)**	Enables the floor sensor correction function
Floor Sensor Correction Source Select **(H24)**	Selects whether floor sensor correction is triggered by de-selection of creep speed or by the signal from the floor correction sensor.
Floor Sensor Correction Edge Detection **(H25)**	Selects whether a positive or negative edge of the signal from the floor correction sensor is detected.
Floor Sensor Correction Target Distance **(G31)**	Sets the floor sensor correction target distance in mm.
Speed At Floor Sensor Correction Active **(J46)**	Indicates the sampled elevator speed at the moment floor sensor correction was activated.
Remaining Floor Sensor Correction Distance **(J47)**	Indicates the remaining distance to floor level in mm when floor sensor correction is enabled.

Figure 7-24 Floor sensor correction logic diagram



Floor sensor correction utilizes a feature of digital input 5, which bypasses the normal input logic resulting in a fast response to a change in the input signal, such that when the sensor is activated the position is sampled in <1 μs. When digital input 5 is used for floor sensor correction, it is recommended that the input is not used for any other purpose and *Digital Input 5 Destination* (**F22**) should be set to a value of 'A00'. It is possible to specify whether the positive or negative edge of the floor sensor correction signal is detected using *Floor Sensor Correction Edge Detection* (**H25**).

Figure 7-25 Floor sensor correction modes

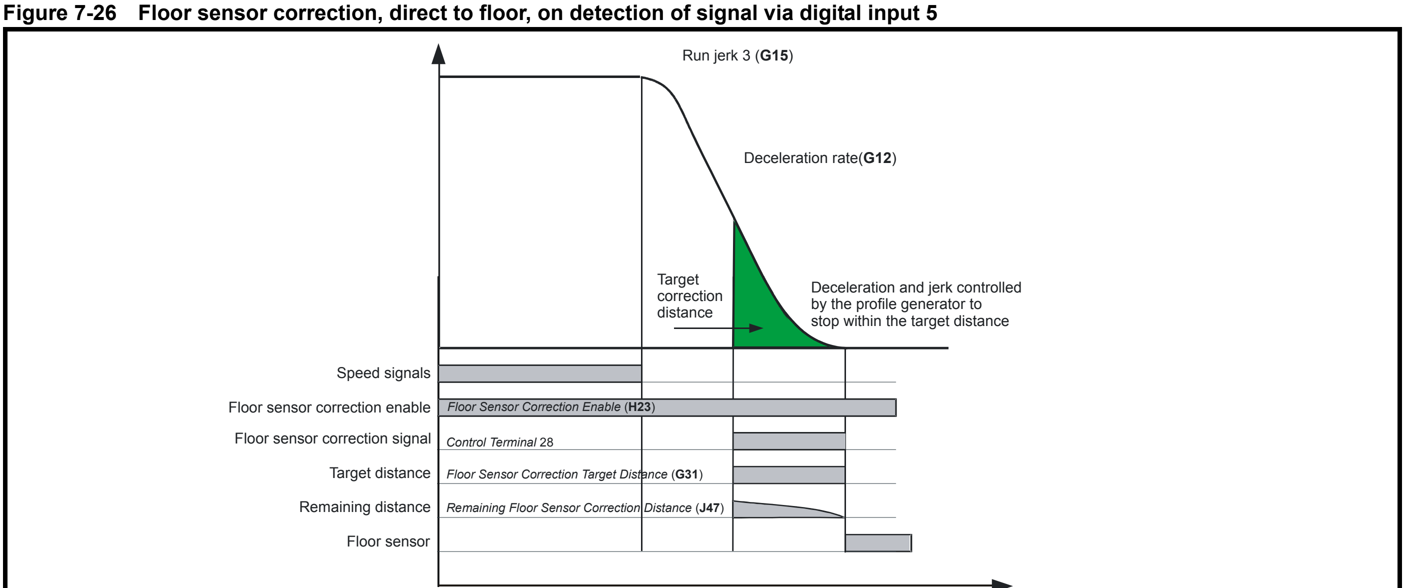
Profile	Floor Sensor Correction Mode
Direct to floor	Floor sensor correction is enabled via detection of the floor sensor correction signal connected to digital input 5. Travel within *Floor Sensor Correction Target Distance* **(G31)** is position controlled, modifying the profile as required.
Creep to floor	Floor sensor correction is enabled via detection of the floor sensor correction signal connected to digital input 5. Travel within *Floor Sensor Correction Target Distance* **(G31)** is position controlled, modifying the profile (deceleration and jerk rates) as required.
	Floor sensor correction is enabled via de-selection of the creep speed reference. Travel within *Floor Sensor Correction Target Distance* **(G31)** is position controlled, modifying the profile (deceleration and jerk rates) as required.

7.21.1 Floor sensor correction, direct to floor, on detection of signal via digital input 5

When the floor sensor correction signal is detected, travel within Floor Sensor Correction Target Distance (**G31**) is position controlled, modifying the profile (deceleration and jerk rates) as required.

Once the floor sensor correction signal becomes active, the remaining controlled distance to the floor level is displayed in *Remaining Floor Sensor Correction Distance* (**J47**). The speed at the point floor sensor became active is displayed in *Speed At Floor Sensor Correction Active* (**J46**).

Figure 7-26 Floor sensor correction, direct to floor, on detection of signal via digital input 5



NOTE

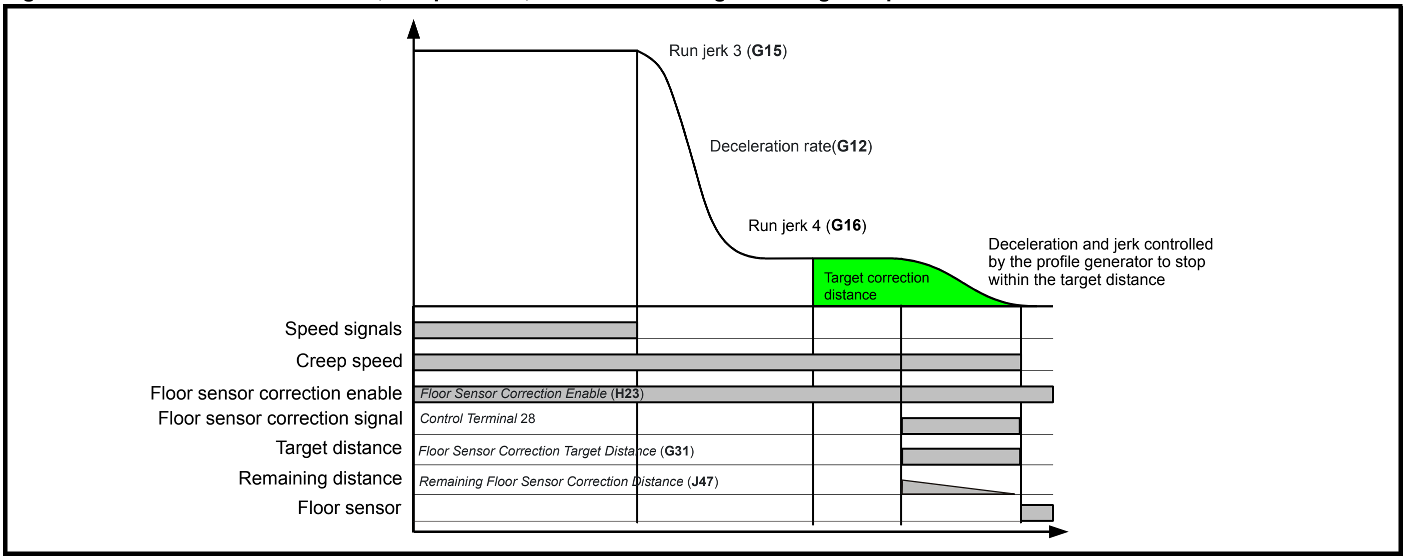
It should be noted that the floor sensor correction signal should be activated instantaneously at a position which is *Floor Sensor Correction Target Distance* (**G31**) away from the floor sensor in mm. If the stop distance is too low or the floor sensor signal was given at too high a speed (see *Speed At Floor Sensor Correction Active* (**J46**)) the elevator may not be able to stop smoothly and therefore a hard stop will be implemented.

7.21.2 Floor sensor correction, creep to floor, on detection of signal via digital input 5

When the floor sensor correction signal is detected, travel within *Floor Sensor Correction Target Distance* (**G31**) is position controlled, modifying the profile (deceleration and jerk rates) as required.

Once the floor sensor correction signal becomes active, the remaining controlled distance to the floor level is displayed in *Remaining Floor Sensor Correction Distance* (**J47**). The speed at the point floor sensor became active is displayed in *Speed At Floor Sensor Correction Active* (**J46**).

Figure 7-27 Floor sensor correction, creep to floor, on detection of signal via digital input 5



NOTE

It should be noted that the floor sensor correction signal should be activated instantaneously at a position which is *Floor Sensor Correction Target Distance* (**G31**) away from the floor sensor in mm. If the stop distance is too low or the floor sensor signal was given at too high a speed (see *Speed At Floor Sensor Correction Active* (**J46**)) the elevator may not be able to stop smoothly and therefore a hard stop will be implemented.

NOTE

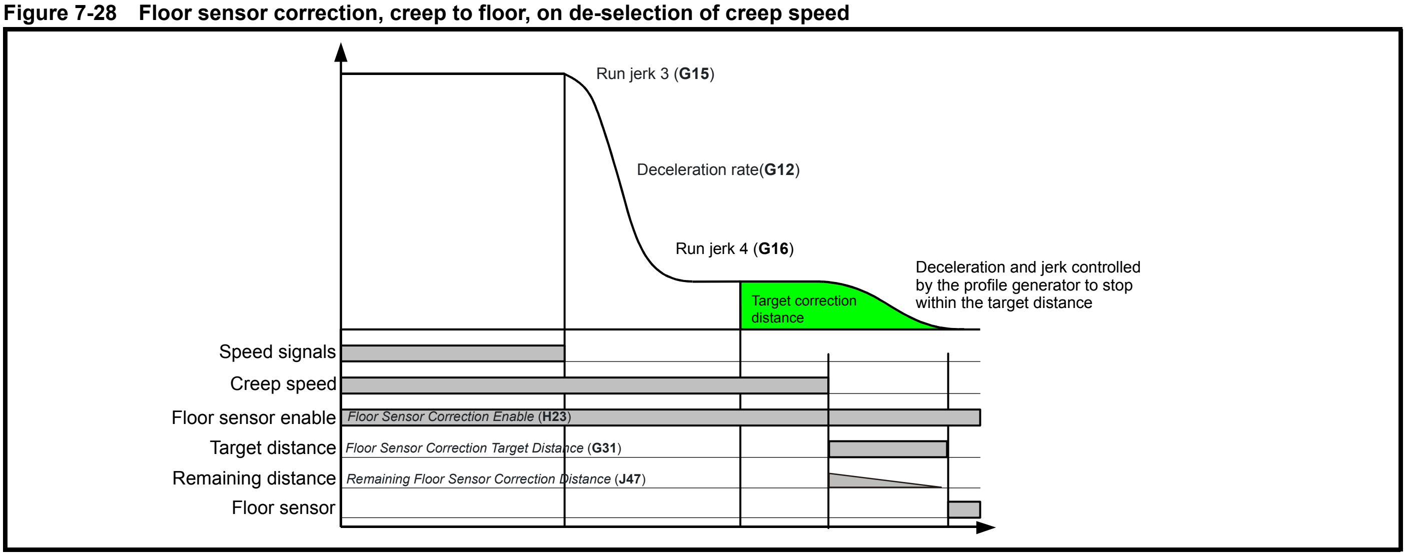
When the sensor input is triggered the elevator will come to a stop with Creep speed still selected. If Creep speed is deselected prior to the floor sensor correction trigger point the final relative position may not match the distance specified in *Floor Sensor Correction Target Distance* (**G31**).

7.21.3 Floor sensor correction, creep to floor, on de-selection of creep speed

The floor sensor correction system is only armed when the creep speed is reached. The elevator controller must de-select Creep speed at the correct position i.e. Floor Sensor Correction Target Distance (**G31**) mm from the target floor. Creep speed is maintained under position control during the remaining distance to the target floor with profile parameters (deceleration and jerk) controlled to stop the elevator accurately at the target floor.

Once the floor sensor correction signal becomes active, the remaining controlled distance to the floor level is displayed in *Remaining Floor Sensor Correction Distance* (**J47**). The speed at the point floor sensor became active is displayed in *Speed At Floor Sensor Correction Active* (**J46**).

Figure 7-28 Floor sensor correction, creep to floor, on de-selection of creep speed



NOTE

It should be noted that the Creep speed should be de-selected at a position which is *Floor Sensor Correction Target Distance* (**G31**) away from the floor sensor in mm. If the stop distance is too low or the floor sensor signal was given at too high a speed (see *Speed At Floor Sensor Correction Active* (**J46**)) the elevator may not be able to stop smoothly and therefore a hard stop will be implemented.

7.22 Short floor landing

The short floor landing function allows operation with 'short' floor heights, where the length of travel is less than the slowing distance from the rated elevator speed. In such a case, when operating in Creep to floor mode, peak curve operation may not be possible, using the existing profile settings. For these short floor distances, the short floor landing function provides position controlled travel to the point where the creep speed defined by *Creep Speed Select* (**G52**) would normally be reached.

The short floor landing distance is defined by *Short Floor Landing Distance* (**G30**) in mm, which is the distance from the current floor position to the floor / door zone.

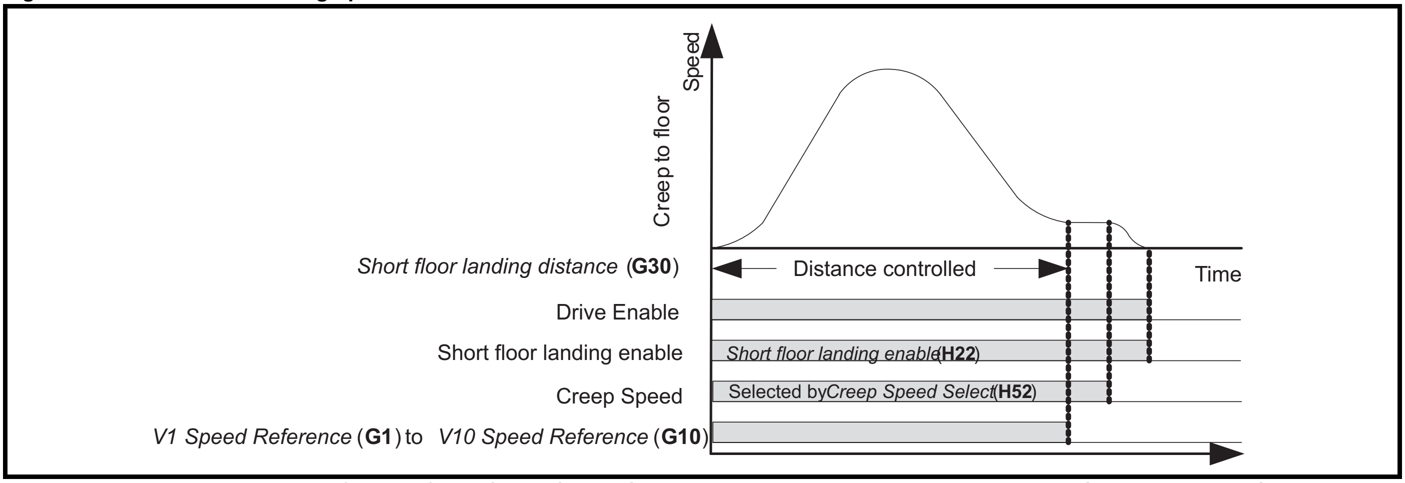
Short floor landing is selected using a digital input from the elevator controller routed to *Short Floor Landing Enable* (**H22**) for operation with short floor less then 0.7 m for example. The control signals for the creep speed defined by Creep Speed Select (**G52**) and short floor landing enable must be applied simultaneously.

Table 7-38 Floor sensor correction distance parameters

Parameter	Details
Short Floor Landing Enable **(H22)**	Enables the short floor landing function.
Short Floor Landing Distance **(H22)**	Short floor landing distance (to the floor (door) zone) used for position control during the short floor travel

The maximum operating speed is calculated from both the short floor distance and the current profile settings so that the creep speed defined by *Creep Speed Select* (**G52**) is reached after the distance set in *Short Floor Landing Distance* (**G30**), and when the floor (door) zone is reached. The elevator will then continue running at creep speed, stopping normally at the target floor.

Figure 7-29 Short floor landing operation



In the event that the creep speed defined by *Creep Speed Select* (**G52**) is deselected during operation *Run Jerk 2* (**G14**), *Run Jerk 3* (**G15**), *Run Jerk 4* (**G16**) and *Deceleration Rate* (**G12**) will be used to bring the elevator car to a stop. This is because *Creep Stop Deceleration Rate* (**G17**) and *Creep Stop Jerk* (**G18)** are often set to high values to improve accuracy which would result in an abrupt stop affecting ride comfort.

When *Short Floor Landing Enable* (**H22**) = On (1), Start optimization is not performed.

This mode of operation is not available in Direct to floor.

7.23 Fast start

The fast start function reduces the elevator start time by magnetizing the motor and releasing the brake while the elevator car doors are closing. For standard operation the magnetization of the motor and brake release are only carried out once the elevator car doors are closed.

This feature allows the elevator drive starting sequence to begin without a speed selection being applied such that the elevator will remain stationary until the speed signal is given. It is intended to be used with elevator controllers that support fast starting where the signal to close the elevator car door is routed to *Fast Start Enable* (**H20**) via a digital input, such that the following actions will happen during door closing:

- The motor contactors are closed
- The motor is magnetized (IM) / Fluxed (PM)
- The brake is released

The speed selection should only be applied when the door is closed.

Fast start in available only when operating in RFC-A and RFC-S modes.

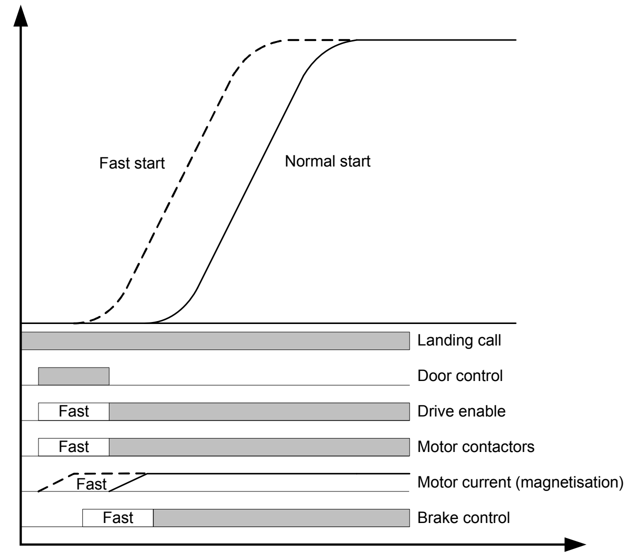
If the elevator controller handles the control of the motor contactors, *Fast Start Enable* (**H20**) must be set to On (1) before the motor contactors are closed. This is to ensure that the elevator drive enable signal via auxiliary contacts on the motor contactors is received after the Fast disable signal.

If the elevator drive handles the control of the motor contactors via *Motor Contactor Control Output* (**B31**) then setting *Fast Start Enable* (**H20**) = On (1) will begin the starting sequence, and request the motor contactors to close.

If the speed is not applied for 5 s after the load measurement state is reached, *Elevator Software State* (**J03**) = 5 then the fast enable will be aborted.

Additional protection is provided by monitoring any movement of the elevator while waiting for the speed selection to be applied. *Fast Start Monitoring Distance* (**H21**) determines the the maximum distance in mm which can be moved during a fast start. If the distance is exceeded then a Trip 69 (**Fast start err**) is generated, applying the brake and preventing further movement. This protection is disabled by setting *Fast Start Monitoring Distance* (**H21**) = 0.

Figure 7-30 Fast start



7.24 Backing up the drive parameter set

The *E300 Advanced Elevator* drive parameters can be backed up using either of the following two methods. Both the Elevator Connect PC tool and the NV Media Card allow the complete drive parameter set to be saved. Once the parameter set is saved, this can be re-programmed if required to the same drive or cloned to other drives.

7.25 NV Media Card

The NV Media Card used for backing up the drive parameters can be either a SMARTCARD or an SD card Adaptor with SD card.

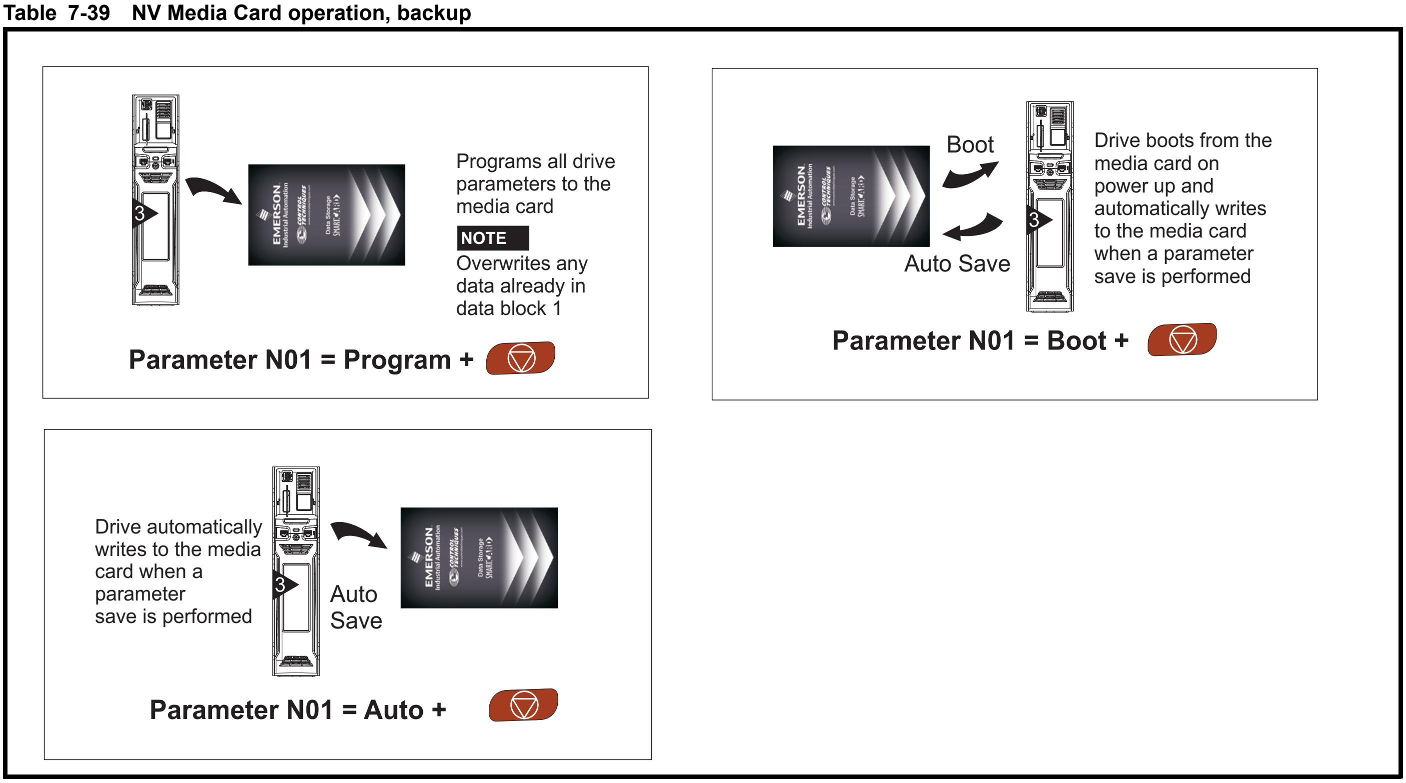
WARNING

When installing and removing the NV Media Card beware of possible live power terminals which could result in a safety hazard and electric shock. All safety cover must be installed and power terminals shrouded to avoid the risk of death or serious injury.

WARNING

When reading a parameter set from a SMARTCARD, SD card to the drive during setup this can result in the control I/O firstly defaulting and then changing to the configuration on the SMARTCARD,SD card. Ensure during this process all control terminals are removed from the drive and any SI-I/O module to prevent uncontrolled operation of external devices and the risk of damage to the system.

Table 7-39 NV Media Card operation, backup



7.25.1 Saving parameter set to NV Media Card

- **4yyy** - Saves all default differences to the NV Media Card

The data block only contains the parameter differences from the last time the default settings were loaded. All parameters except those with the NC Not copied) coding bit set are transferred to the NV Media Card.

- **N01 = Program (2)** - Saves parameter set to the NV Media Card

Setting *Parameter Cloning Modes* (**N01**) to Program (2) and resetting the drive will save the parameters to the NV Media Card this is the equivalent of writing 4001 to Pr **mm00**. If the data block already exists, it is automatically overwritten. When the action is complete this parameter is automatically reset to None 0).

7.25.2 Reading parameter set from NV Media Card

- **Parameter N01 = Read (1)**

Setting *Parameter Cloning Modes* (**N01**) to Read (1) and resetting the drive will transfer the parameters from the NV Media Card into the drive parameter set and the drive EEPROM, i.e. this is equivalent to writing 6001 to Pr **mm00**. Once the parameters are successfully copied this parameter is automatically reset to None (0). Parameters are saved to the drive EEPROM after this action is complete.

7.25.3 Auto saving parameters to NV Media Card

- **Parameter N01 = Auto (3)**

This setting automatically saves any changes made to User menu A parameter set to the NV Media Card. The latest User menu A parameter set in the drive is therefore always backed up on the NV Media Card.

If the NV Media Card is removed when *Parameter Cloning Modes* (**N01**) is set to Auto (3) *Parameter Cloning Modes* (**N01**) is then automatically set to None 0).

When a new NV Media Card is installed *Parameter Cloning Modes* (**N01**) must be set back to Auto (3) by the user and the drive reset so the complete parameter set is rewritten to the new NV Media Card if auto mode is still required.

When *Parameter Cloning Modes* (**N01**) is set to Auto (3) and the parameters in the drive are saved, the NV Media Card is also updated, and therefore the NV Media Card becomes a copy of the drives stored configuration.

At power up, if *Parameter Cloning Modes* (**N01**) is set to Auto (3), the drive will save the complete parameter set to the NV Media Card. The drive will display 'Card Write' during this operation. This is done to ensure that if a user puts a new NV Media Card in during power down the new NV Media Card will have the correct data.

NOTE

Refer to NV Media Card operation in the previous section on Programming the drive for diagnostic information when using the NV Media Card.

NOTE

When *Parameter Cloning Modes* (**N01**) is set to Auto (3) the setting of *Parameter Cloning Modes* (**N01**) itself is saved to the drive EEPROM but not the NV Media Card.

7.26 Elevator Connect PC tool

The discovery protocol feature which is supported on the Elevator Connect PC tool is able to discover drives automatically which are connected to a PC.

To allow operation with the Elevator Connect PC tool on the *E300 Advanced Elevator Drive* a communications option is required.

8 Advanced Parameters

This is a quick reference to all parameters in the drive showing units, ranges limits etc, with block diagrams to illustrate their function and full descriptions.

WARNING

These advanced parameters are listed for reference purposes only. The lists in this chapter do not include sufficient information for adjusting these parameters. Incorrect adjustment can affect the safety of the system, and damage the drive and or external equipment. Before attempting to adjust any of these parameters refer to the full descriptions and to section 7 *Commissioning* on page 150 and section 10 *Optimization* on page 474.

Table 8-1 Menu descriptions

Menu	Description
A	User menu
B	Motor
C	Encoder
D	Brake
E	Mechanical
F	Hardware IO
G	Profile
H	Configuration
I	Tuning
J	Monitoring
K	Logic
L	Diagnostics
N	Storage
O	Backup supply
P	Slot 1 Setup*
Q	Slot 2 Setup*
R	Slot 3 Setup*
S	Application Menu 1
T	Application Menu 2
U	Application Menu 3
V	Slot 1 Application*
W	Slot 2 Application*
X	Slot 3 Application*
Y	Data Logger
Z	User Menu Setup
AA	Slot 4 Setup*
AB	Slot 4 Applications*

* Only displayed when the option modules are installed.

Operation mode abbreviations:

Open-loop:

Sensorless control for induction motors

RFC-A

Asynchronous Rotor Flux Control for induction motors

RFC-S Sensorless: Synchronous Rotor Flux Control for synchronous motors including permanent magnet motors.

Default abbreviations:

Standard default value (50 Hz AC supply frequency)

USA default value (60 Hz AC supply frequency)

In some cases, the function or range of a parameter is affected by the setting of another parameter. The information in the lists relates to the default condition of any parameters affected in this way.

Table 8-2 Key to parameter table coding

Coding	Attribute
RW	Read/Write: can be written by the user
RO	Read only: can only be read by the user
Bit	1 bit parameter. 'On' or 'Off' on the display
Num	Number: can be uni-polar or bi-polar
Txt	Text: the parameter uses text strings instead of numbers.
Bin	Binary parameter
IP	IP Address parameter
Mac	Mac Address parameter
Date	Date parameter
Time	Time parameter
Chr	Character parameter
FI	Filtered: some parameters which can have rapidly changing values are filtered when displayed on the drive keypad for easy viewing.
DE	Destination: This parameter selects the destination of an input or logic function.
RA	Rating dependent: this parameter is likely to have different values and ranges with drives of different voltage and current ratings. Parameters with this attribute will be transferred to the destination drive by non-volatile storage media when the rating of the destination drive is different from the source drive and the file is a parameter file. However, the values will only be transferred if the current rating is different and the file is different from the default type file.
ND	No default: The parameter is not modified when defaults are loaded
NC	Not copied: not transferred to or from non-volatile media during copying.
PT	Protected: cannot be used as a destination.
US	User save: parameter saved in drive EEPROM when the user initiates a parameter save.
PS	Power-down save: parameter automatically saved in drive EEPROM when the under volts (UV) trip occurs.

Parameter ranges and Variable minimums/maximums:

Some parameters in the drive have a variable range with a variable minimum and a variable maximum values which is dependent on one of the following:

- The settings of other parameters
- The drive rating
- The drive mode
- Combination of any of the above

The tables below give the definition of variable minimum/maximum and the maximum range of these.

VM_AC_VOLTAGE	Range applied to parameters showing AC voltage
Units	V
Range of [MIN]	0
Range of [MAX]	0 to 930
Definition	VM_AC_VOLTAGE[MAX] is drive voltage rating dependent. See Table 8-3 *Voltage ratings dependant values* on page 190. VM_AC_VOLTAGE[MIN] = 0

VM_AC_VOLTAGE_SET	Range applied to AC voltage set-up parameters
Units	V
Range of [MIN]	0
Range of [MAX]	0 to 690
Definition	VM_AC_VOLTAGE_SET[MAX] is drive voltage rating dependent. See Table 8-3 *Voltage ratings dependant values* on page 190. VM_AC_VOLTAGE_SET[MIN] = 0

VM_DC_VOLTAGE	Range applied to DC voltage reference parameters
Units	V
Range of [MIN]	0
Range of [MAX]	0 to 1190
Definition	VM_DC_VOLTAGE[MAX] is the full scale DC bus voltage feedback (over voltage trip level) for the drive. This level is drive voltage rating dependent. VM_DC_VOLTAGE[MIN] = 0 See Table 8-3 *Voltage ratings dependant values* on page 190.

VM_DC_VOLTAGE_SET	Range applied to DC voltage reference parameters
Units	V
Range of [MIN]	0
Range of [MAX]	0.0 to 1000.0
Definition	VM_DC VOLTAGE_SET[MAX] is drive voltage rating dependant, See Table 8-3 *Voltage ratings dependant values* on page 190. VM_DC_VOLTAGE_SET[MIN] = 0

VM_DRIVE_CURRENT	Range applied to parameters showing current in A
Units	A
Range of [MIN]	-99999.999 to 0.000
Range of [MAX]	0.000 to 99999.999
Definition	VM_DRIVE_CURRENT[MAX] is equivalent to the full scale (over current trip level) for the drive and is given by *Drive Full Scale Current* (**J06**) VM_DRIVE_CURRENT[MIN] = - VM_DRIVE_CURRENT[MAX]

VM_DRIVE_CURRENT_UNIPOLAR	Unipolar version of VM_DRIVE_CURRENT
Units	A
Range of [MIN]	0.000
Range of [MAX]	0.000 to 99999.999
Definition	VM_DRIVE_CURRENT_UNIPOLAR[MAX] = VM_DRIVE_CURRENT[MAX] VM_DRIVE_CURRENT_UNIPOLAR[MIN] = 0.000

VM_LOW_UNDER_VOLTS	Range applied the low under voltage threshold
Units	V
Range of [MIN]	24
Range of [MAX]	24 to 1150
Definition	If *LV Supply Mode Enable* (**O12**) = 0 VM_LOW_UNDER_VOLTS[MAX] = VM_STD_UNDER_VOLTS[MIN] **Otherwise** VM_LOW_UNDER_VOLTS[MAX] = VM_STD_UNDER_VOLTS[MIN] / 1.1. VM_LOW_UNDER_VOLTS[MIN] = 24.

VM_MIN_SWITCHING_FREQUENCY	Range applied to the minimum switching frequency parameter
Units	User units
Range of [MIN]	0
Range of [MAX]	0 to 6
Definition	VM_MIN_SWITCHING_FREQUENCY[MAX] = *Maximum Switching Frequency* (**B13**) VM_MIN_SWITCHING_FREQUENCY[MIN] = 0.

VM_MOTOR1_CURRENT_LIMIT	Range applied to current limit parameters
Units	%
Range of [MIN]	0.0
Range of [MAX]	0.0 to 1000.0
Definition	VM_MOTOR1_CURRENT_LIMIT[MAX] is dependent on the drive rating and motor set-up parameters. VM_MOTOR1_CURRENT_LIMIT[MIN] = 0.00

VM_POSITIVE_REF_CLAMP1	Limits applied to the positive frequency or speed reference clamp
Units	Open-loop: Hz RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop: 0.0 RFC-A, RFC-S: 0.0
Range of [MAX]	Open-loop: 550.0 RFC-A, RFC-S: 0.0 to 33000.0
Definition	VM_POSITIVE_REF_CLAMP1[MAX] defines the range of the positive reference clamp, which in turn limit the references. VM_POSITIVE_REF_CLAMP1[MAX] = Calculated based on mechanical system data entered plus 10 %. VM_POSITIVE_REF_CLAMP[MIN] = 0.0

NOTE

An additional limit is applied to ensure that the drive output frequency cannot exceed 550 Hz. For Open-loop mode, an additional limit of 550 Hz is applied directly. For RFC modes the variable maximum is applied to the speed reference, and an additional limit of 550 x 60 / Motor pole pairs is applied.

VM_POWER	Range applied to parameters that either set or display power
Units	kW
Range of [MIN]	-99999.999 to 0.000
Range of [MAX]	0.000 to 99999.999
Definition	VM_POWER[MAX] is rating dependent and is chosen to allow for the maximum power that can be output by the drive with maximum a.c. output voltage, at maximum controlled current and unity power factor. VM_POWER[MAX] = √3 x VM_AC_VOLTAGE[MAX] x VM_DRIVE_CURRENT[MAX] / 1000 VM_POWER[MIN] = -VM_POWER[MAX]

VM_RATED_CURRENT	Range applied to rated current parameters
Units	A
Range of [MIN]	0.000
Range of [MAX]	0.000 to 99999.999
Definition	VM_RATED_CURRENT [MAX] is dependent on the drive rating. VM_RATED_CURRENT [MIN] = 0.000

VM_SPEED	Range applied to parameters showing speed
Units	Open-loop, RFC-A, RFC-S: RFC-S: rpm or mm/s
Range of [MIN]	Open-loop, RFC-A, RFC-S: -33000.0 to 0.0
Range of [MAX]	Open-loop, RFC-A, RFC-S: 0.0 to 33000.0
Definition	This variable minimum/maximum defines the range of speed monitoring parameters. To allow headroom for overshoot the range is set to twice the range of the speed references. VM_SPEED[MIN] = 2 x VM_SPEED_FREQ_REF[MIN] VM_SPEED[MAX] = 2 x VM_SPEED_FREQ_REF[MAX]

VM_SPEED_FREQ_REF	Range applied to the frequency or speed reference parameters
Units	Open-loop: Hz
Range of [MIN]	Open-loop: -550.0 to 0.0
Range of [MAX]	Open-loop: 0.0 to 550.0
Definition	This variable minimum/maximum is applied throughout the frequency and speed reference system so that the references can vary in the range from the minimum to maximum clamps. VM_SPEED_FREQ_REF[MAX] = Calculated based on mechanical system data entered, plus 10 %. VM_SPEED_FREQ_REF[MIN] = -VM_SPEED_FREQ_REF[MAX].

VM_STD_UNDER_VOLTS	Range applied to the standard under voltage threshold
Units	V
Range of [MIN]	0 to 1150
Range of [MAX]	0 to 1150
Definition	VM_STD_UNDER_VOLTS[MAX] = VM_DC_VOLTAGE_SET / 1.1 VM_STD_UNDER_VOLTS[MIN] is voltage rating dependent. See Table 8-3 *Voltage ratings dependant values* on page 190.

VM_SUPPLY_LOSS_LEVEL	Range applied to the supply loss threshold
Units	V
Range of [MIN]	0 to 1150
Range of [MAX]	0 to 1150
Definition	VM_SUPPLY_LOSS_LEVEL[MAX] = VM_DC_VOLTAGE_SET[MAX] VM_SUPPLY_LOSS_LEVEL[MIN] is drive voltage rating dependent. See Table 8-3 *Voltage ratings dependant values* on page 190.

VM_TORQUE_CURRENT	Range applied to torque and torque producing current parameters.
Units	%
Range of [MIN]	-1000.0 to 0.0
Range of [MAX]	0.0 to 1000.0
Definition	VM_TORQUE_CURRENT[MAX] = VM_MOTOR1_CURRENT_LIMIT[MAX] VM_TORQUE_CURRENT[MIN] = -VM_TORQUE_CURRENT[MAX]

VM_USER_CURRENT	Range applied to torque reference and percentage load parameters with one decimal place
Units	%
Range of [MIN]	-1000.0 to 0.0
Range of [MAX]	0.0 to 1000.0
Definition	VM_USER_CURRENT[MAX] = 165 % (Open-loop), 175 % (RFC-A / RFC-S) VM_USER_CURRENT[MIN] = -VM_USER_CURRENT[MAX]

Table 8-3 Voltage ratings dependant values

Variable min/max	Voltage level (V)			
	200 V	400 V	575 V	690 V
VM_DC_VOLTAGE_SET(MAX]	400	800	955	1150
VM_DC_VOLTAGE(MAX]	415	830	990	1190
VM_AC_VOLTAGE_SET(MAX]	240	480	575	690
VM_AC_VOLTAGE[MAX]	325	650	780	930
VM_STD_UNDER_VOLTS[MIN]	175	330	435	435
VM_SUPPLY_LOSS_LEVEL{MIN]	205	410	540	540

8.1 Menu B: Motor

Figure 8-1 Menu B Open loop logic diagram

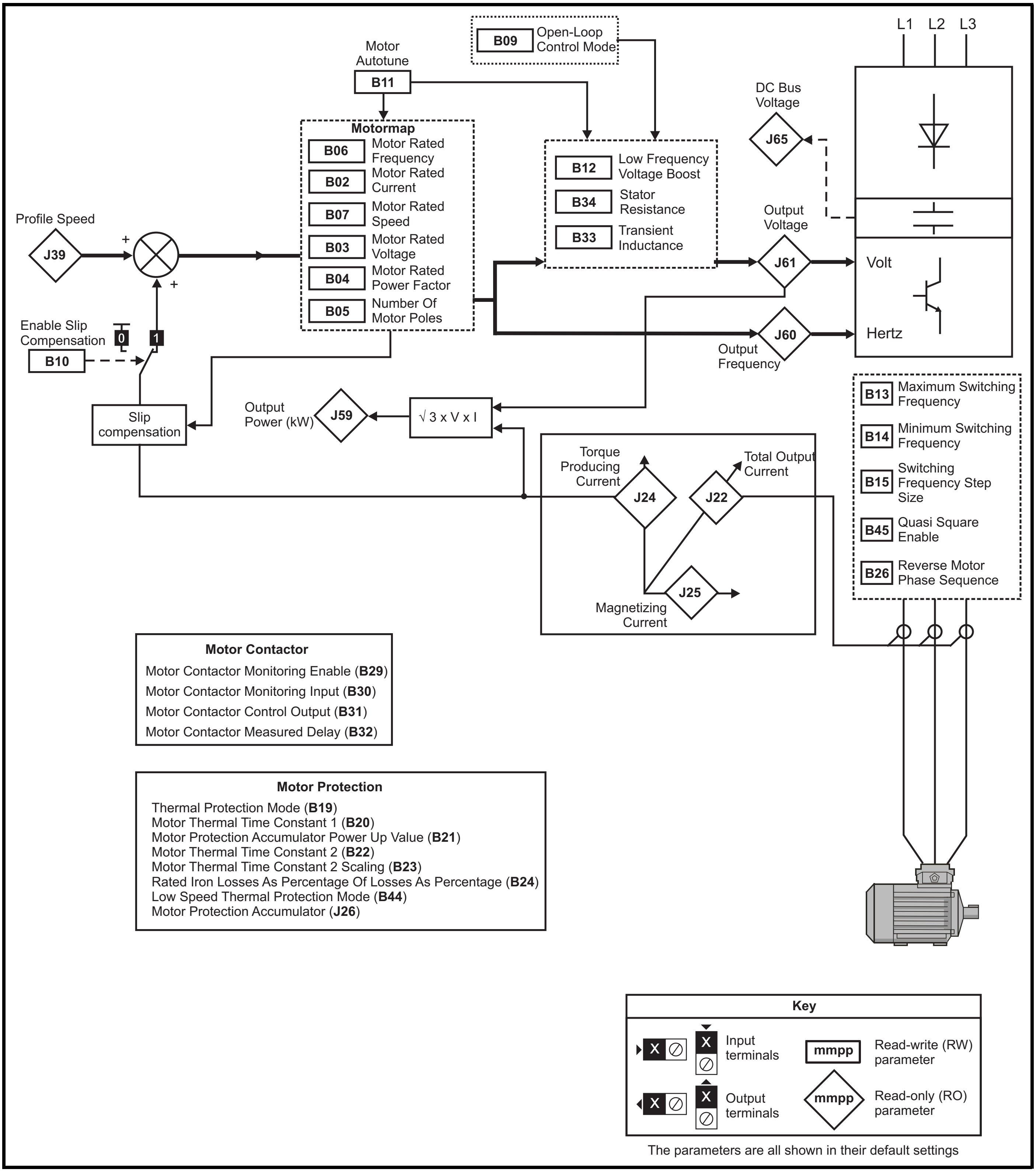
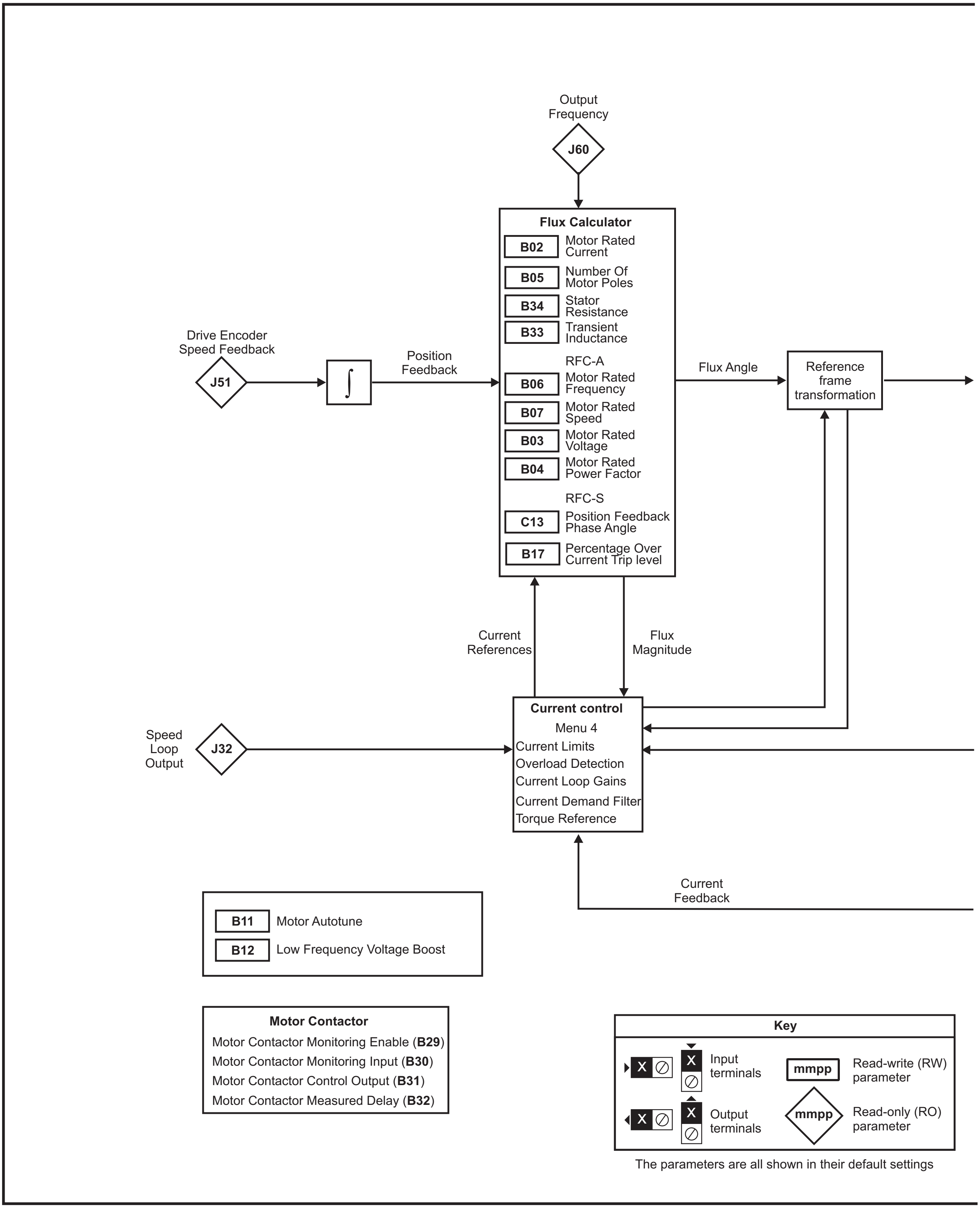
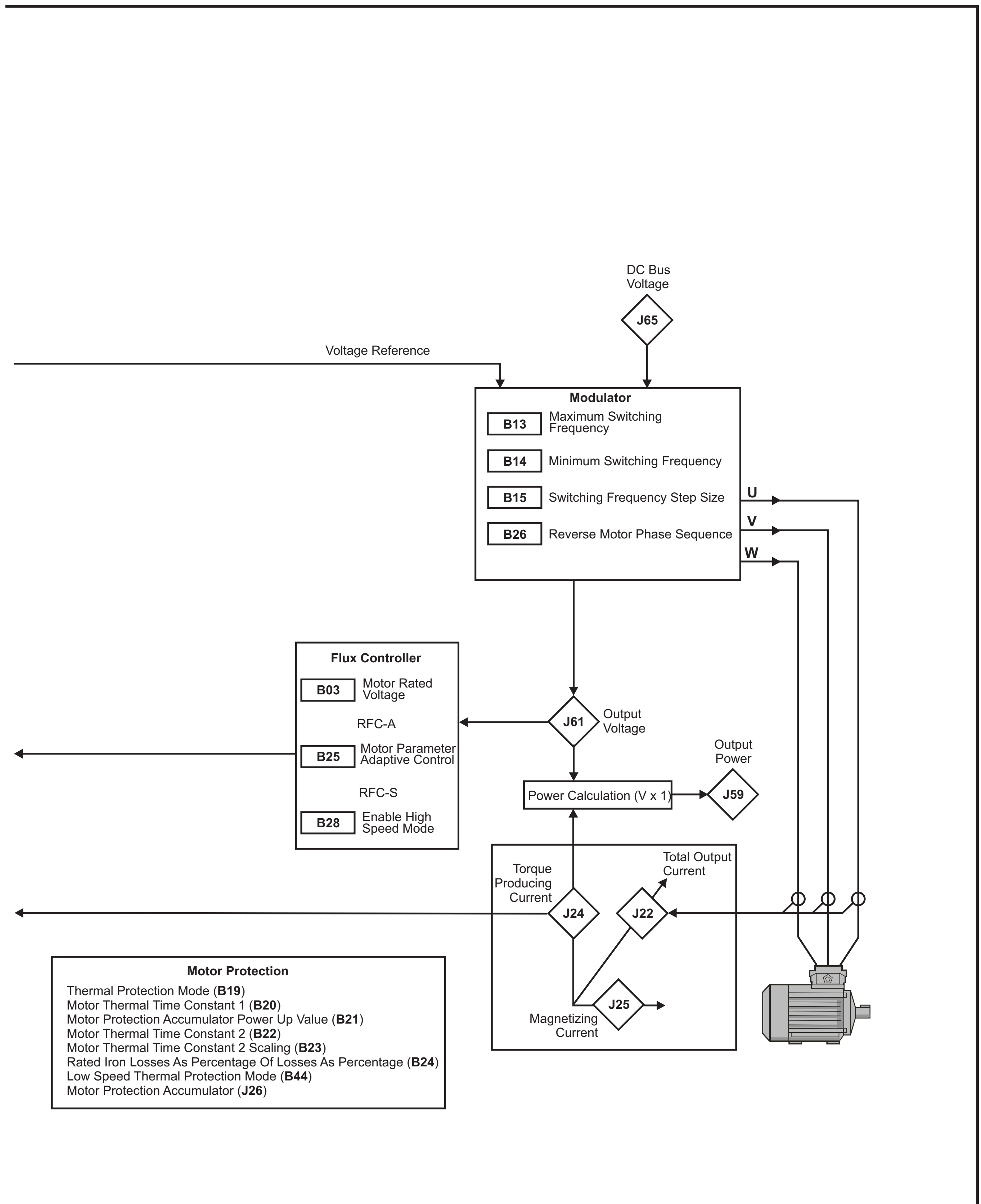


Figure 8-2 Menu B RFC-A, RFC-S logic diagram




DC Bus Voltage
J65
Voltage Reference
Modulator
B13 Maximum Switching Frequency
B14 Minimum Switching Frequency
B15 Switching Frequency Step Size
B26 Reverse Motor Phase Sequence
U
V
W
Flux Controller
B03 Motor Rated Voltage
RFC-A
B25 Motor Parameter Adaptive Control
RFC-S
B28 Enable High Speed Mode
J61
Output Voltage
Output Power
Power Calculation (V x 1)
J59
Torque Producing Current
Total Output Current
J24
J22
J25
Magnetizing Current
Motor Protection
Thermal Protection Mode (B19)
Motor Thermal Time Constant 1 (B20)
Motor Protection Accumulator Power Up Value (B21)
Motor Thermal Time Constant 2 (B22)
Motor Thermal Time Constant 2 Scaling (B23)
Rated Iron Losses As Percentage Of Losses As Percentage (B24)
Low Speed Thermal Protection Mode (B44)
Motor Protection Accumulator (J26)

Parameter		Range(⇳)			Default(⇨)			Type					
		Open-Loop	**RFC-A**	**RFC-S**	**Open-Loop**	**RFC-A**	**RFC-S**						
B01	Drive Control Mode	Open-loop (1), RFC-A (2), RFC-S (3)						RW	Txt	ND	NC	PT	
B02	Motor Rated Current	±VM_RATED_CURRENT A			Maximum Heavy Duty Rating			RW	Num		RA		US
B03	Motor Rated Voltage	±VM_AC_VOLTAGE_SET V			200V drive: 230 V 400V drive: 400 V 575V drive: 575 V 690V drive: 690 V			RW	Num		RA		US
B04	Motor Rated Power Factor	0.000 to 1.000			0.850			RW	Num		RA		US
B05	Open-Loop: Number Of Motor Poles	Automatic (0) to 480 (240) Poles			Automatic (0) Poles			RW	Txt				US
	RFC-A: Number Of Motor Poles		Automatic (0) to 480 (240) Poles			Automatic (0) Poles		RW	Txt				US
	RFC-S: Number Of Motor Poles			Automatic (0) to 480 (240) Poles			6 (3) Poles	RW	Txt				US
B06	Motor Rated Frequency	0.0 to 550.0 Hz			50 Hz : 50Hz 60 Hz : 60 Hz			RW	Num				US
B07	Motor Rated Speed	0 to 33000 rpm	0.00 to 33000.00 rpm		50 Hz : 1500 rpm 60 Hz : 1800 rpm	50 Hz : 1450 rpm 60 Hz : 1750 rpm	3000.00 rpm	RW	Num				US
B09	Open-Loop: Open Loop Control Mode	Ur S (0), Ur (1), Fixed (2), Ur Auto (3), Ur I (4),			Ur I (4)			RW	Txt				US
	RFC-S: Action On Enable			Disabled (0), Short (1), Short Once (2), Long (3), Long Once (4)			Disabled (0)	RW	Txt				US
B10	Slip Compensation Enable	Off (0) or On (1)			On (1)			RW	Bit				US
B11	Motor Autotune	None (0) Static (1) Rotating (2)	None (0) Static (1) Rotating (2) Inertia (3)		None (0)			RW	Num		NC		
B12	Low Frequency Voltage Boost	0.0 to 25.0 %			3.0 %			RW	Num				US
B13	Maximum Switching Frequency	0 to VM_SWITCHING_FREQUENCY kHz			8 (4) kHz			RW	Txt		RA		US
B14	Minimum Switching Frequency	0 to VM_MIN_SWITCHING_FREQUENCY kHz			3 (1) kHz			RW	Txt				US
B15	Switching Frequency Step Size	1 to 2			2			RW	Num				US
B16	Symmetrical Current Limit	±VM_MOTOR1_CURRENT_LIMIT %			165.0 %	175.0 %		RW	Num		RA		US
B17	Percentage Over Current Trip Level			10 (0), 20 (1), 30 (2), 40 (3), 50 (4), 60 (5), 70 (6), 80 (7), 90 (8), 100 (9) %			100 (9) %	RW	Txt				US
B18	Motor Percentage Flux		0.0 to 150.0 %					RO	Num	ND	NC	PT	
B19	Thermal Protection Mode	00 to 11			00			RW	Bin				US
B20	Motor Thermal Time Constant 1	1.0 to 3000.0 s			89.0 s			RW	Num				US
B21	Motor Protection Accumulator Power-up Value	Power down (0), Zero (1), Real time (2)			Power down (0)			RW	Txt				US
B22	Motor Thermal Time Constant 2	1.0 to 3000.0 s			89.0 s			RW	Num				US
B23	Motor Thermal Time Constant 2 Scaling	0 to 100 %			0 %			RW	Num				US
B24	Rated Iron Losses As Percentage Of Losses	0 to 100 %			0 %			RW	Num				US
B25	Motor Parameter Adaptive Control		0 to 2			0		RW	Num				US
B26	Reverse Motor Phase Sequence	Off (0) or On (1)			Off (0)			RW	Bit				US
B27	Fast Disable	Off (0) or On (1)						RO	Bit	ND	NC	PT	
B28	Enable High Speed Mode			Limit (-1), Disable (0), Enable (1)			Disable (0)	RW	Txt				US
B29	Motor Contactor Monitoring Enable	Off (0) or On (1)			Off (0)			RW	Bit				US
B30	Motor Contactor Monitoring Input	Off (0) or On (1)			Off (0)			RW	Bit				US
B31	Motor Contactor Control Output	Off (0) or On (1)				Off (0)		RO	Bit	ND	NC	PT	

Parameter		Range(⇕)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
B32	Motor Contactor Measured Delay Time	0 to 32767 ms			0 ms			RO	Num				
B33	Open-Loop: Transient Inductance	0.000 to 500.000 mH			0.000 mH			RW	Num		RA		US
	RFC-A: Transient Inductance		0.000 to 500.000 mH			0.000 mH		RW	Num		RA		US
	RFC-S: Transient Inductance Ld			0.000 to 500.000 mH			0.000 mH	RW	Num		RA		US
B34	Stator Resistance	0.000000 to 1000.000000 Ω			0.000000 Ω			RW	Num		RA		US
B35	Stator Inductance	0.00 to 5000.00 mH			0.00 mH			RW	Num		RA		US
B36	Saliency Torque control			Disabled (0), Low (1), High (2)			Disabled (0)	RW	Txt				US
B37	No Load Lq			0.000 to 500.000 mH			0.000 mH	RW	Num		RA		US
B38	Iq Test Current For Inductance Measurement			0 to 200 %			100 %	RW	Num				US
B39	Phase Offset At Iq Test Current			±90.0 °			0.0 °	RW	Num		RA		US
B40	Lq At The Defined Iq Test Current			0.000 to 500.000 mH			0.000 mH	RW	Num		RA		US
B41	Id Test Current for Inductance Measurement			-100 to 0 %			-50 %	RW	Num				US
B42	Lq At The Defined Id Test Current			0.000 to 500.000 mH			0.000 mH	RW	Num		RA		US
B43	Estimated Lq			0.000 to 500.000 mH				RO	Num	ND	NC	PT	FI
B44	Low Speed Thermal Protection Mode	0 to 1			0			RW	Num				US
B45	Quasi Square Enable	Off (0) or On (1)			Off (0)			RW	Bit				US
B46	Maximum Deadtime Compensation	0.000 to 10.000 µs			0.000 µs			RO	Num		NC	PT	US
B47	Current At Maximum Deadtime Compensation	0.00 to 100.00 %			0.00 %			RO	Num		NC	PT	US
B48	Disable Deadtime Compensation	Off (0) or On (1)			Off (0)			RW	Bit				US
B49	Mechanical load test level		0 - 100 %			0 %		RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

B01	Drive Control Mode		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	3
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, ND, NC, PT		

Value	Text
1	Open-loop
2	RFC-A
3	RFC-S

Drive Control Mode (**B01**) is set to the current drive mode at power-up. The user can change the drive mode as follows:

1. Set Pr **mm00** to 1253, 1254
2. Change
3. *Drive Control Mode* (**B01**) to the required mode
4. Initiate a drive reset

Provided *Drive Active* (**L06**) = 0 the drive will change to the new drive mode, and then load and save parameters to non-volatile memory. If Pr **mm00** is not set to one of the specified values then the drive mode does not change on drive reset. The value in Pr **mm00** determines which defaults are loaded as follows.

Parameter mm00	Defaults loaded
1253	50Hz defaults to all menus
1254	60Hz defaults to all menus

B02	Motor Rated Current		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	−VM_RATED_CURRENT	**Maximum**	VM_RATED_CURRENT
Default	*Maximum Heavy Duty Rating* (**J05**)	**Units**	A
Type	32 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	3
Coding	RW, VM, RA		

Motor Rated Current (**B02**) is used as follows:

1. To define the rated operating conditions for motor thermal protection. See *Motor Thermal Time Constant 1* (**B20**).
2. To define the range of the current limits.
3. In the motor control algorithm for Open-loop and RFC-A modes.

B03	Motor Rated Voltage		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	−VM_AC_VOLTAGE_SET	**Maximum**	VM_AC_VOLTAGE_SET
Default	See exceptions below	**Units**	V
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM, RA		

Voltage (V)	Region	Default Value (V)
200	All	230
400	50 Hz	400
	60 Hz	400
575	All	575
690	All	690

Open-loop

Motor Rated Frequency (**B06**) and *Motor Rated Voltage* (**B03**) define the frequency to voltage characteristic applied to the motor. See *Open Loop Control Mode* (**B09**) for more details.

RFC-A

The *Motor Rated Voltage* (**B03**) is the maximum continuous voltage that is applied to the motor. Normally this should be set to the motor nameplate value. If the drive is supplied through its own diode rectifier the maximum possible output voltage is just below the supply voltage level, and so the output voltage will not reach *Motor Rated Voltage* (**B03**) if this is equal to or above the supply voltage. If high transient performance is required at higher speeds then *Motor Rated Voltage* (**B03**) should be set to 95 % of the minimum DC Bus Voltage divided by √2 to allow some headroom for the drive to control the motor current. If the drive is fed through its own diode rectifier the minimum DC Bus Voltage is approximately supply voltage x √2.

In some cases it may be necessary to set the *Motor Rated Voltage* (**B03**) to a value other than the motor nameplate value. If this is the case the *Motor Rated Frequency* (**B06**) and *Motor Rated Speed* (**B07**) should be set up as follows:

K = *Motor Rated Voltage* (**B03**) / motor rated voltage

Motor Rated Frequency (**B06**) = motor rated frequency x K

Motor Rated Speed (**B07**) = motor rated speed + [(K - 1) x motor rated frequency x 60 / (number of motor poles / 2)]

The *Motor Rated Voltage* (**B03**), *Motor Rated Frequency* (**B06**) and *Number Of Motor Poles* (**B05**) are used during the auto-tuning process to determine the flux level required in the motor for normal operation. Therefore if the *Motor Rated Voltage* (**B03**) is set to a value other than the nameplate value and the above adjustment is not applied the motor may be under or over-fluxed

RFC-S

The *Motor Rated Voltage* (**B03**) is the maximum continuous voltage that is applied to the motor. As with RFC-A mode some headroom must be allowed if high performance is required at higher speeds. It should be noted that this limit is not applied unless *Enable High Speed Mode* (**B28**) is set to 1.

B04	**Motor Rated Power Factor**		
Mode	Open-Loop, RFC-A		
Minimum	0.000	**Maximum**	1.000
Default	0.850	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read/write
Display Format	Standard	**Decimal Places**	3
Coding	RW, RA		

Motor Rated Power Factor (**B04**) is the true power factor of the motor under rated conditions, i.e. the cosine of the angle between the motor voltage and current. If *Stator Inductance* (**B35**) is set to a non-zero value then the stator inductance is used to calculate the rated magnetising current for the motor and the rated power factor can be calculated by the drive. Therefore if *Stator Inductance* (**B35**) is non-zero *Motor Rated Power Factor* (**B04**) is continuously set to the calculated value of rated power factor by the drive. If *Stator Inductance* (**B35**) is set to zero then *Motor Rated Power Factor* (**B04**) is used to estimate the rated magnetizing current which is an approximation and not as accurate. *Stator Inductance* (**B35**) can be measured by the drive during auto-tuning and this is the preferred option, however, if it is not possible to obtain the value for *Stator Inductance* (**B35**) then *Motor Rated Power Factor* (**B04**) should be set to the motor nameplate value.

B05	**Number Of Motor Poles**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	240
Default	Open-Loop, RFC-A: 0 RFC-S: 3	**Units**	Pole Pairs
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

* The units relate to the text string of the parameter and not the numeric value.

The numeric value in *Number Of Motor Poles* (**B05**) should be set to the number of motor pole pairs (i.e. number of motor poles / 2). The text strings associated with *Number Of Motor Poles* (**B05**) show the number of motor poles (i.e. the parameter value x 2). If a linear position feedback device is used *Number Of Motor Poles* (**B05**) should be set to 1 (2 Pole).

If *Number Of Motor Poles* (**B05**) = 0 the number of motor poles are calculated automatically as given below.

Pole pairs = 60 x *Motor Rated Frequency* (**B06**) / *Motor Rated Speed* (**B07**) rounded down to the nearest integer.

Open-loop

RFCA:

RFCS: Pole pairs 8 (16 pole)

B06	Motor Rated Frequency		
Mode	Open-Loop, RFC-A		
Minimum	0.0	**Maximum**	550.0
Default	50.0	**Units**	Hz
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW		

Open-Loop

Motor Rated Frequency (**B06**) and *Motor Rated Voltage* (**B03**) define the frequency to voltage characteristic applied to the motor. See *Open Loop Control Mode* (**B09**) for more details. *Motor Rated Frequency* (**B06**), *Motor Rated Speed* (**B07**) and *Number Of Motor Poles* (**B05**) are used to calculate the rated slip of the motor for slip compensation.

Rated slip (Hz) = *Motor Rated Frequency* (**B06**) - (Pole pairs x *Motor Rated Speed* (**B07**) / 60)

where

Pole pairs = the numeric value of *Number Of Motor Poles* (**B05**) (i.e. 3 for a 6 pole motor)

If slip compensation is required *Motor Rated Speed* (**B07**) should be set to the motor nameplate value, which should give the correct compensation for a hot motor provide the nameplate value is correct. Slip compensation can be used throughout the speed range of the motor, i.e. below base speed and in the flux weakening region, to correct the motor speed to minimise the change of speed with load. Slip compensation is disabled under the following conditions:

1. *Motor Rated Speed* (**B07**) = 0
2. M*otor Rated Speed* (**B07**) = *Motor Rated Frequency* (**B06**) x 60 / Pole pairs, i.e. synchronous speed.
3. S*lip Compensation Enable* (**B10**) = 0

If slip compensation is not required it can be disabled by setting *Slip Compensation Enable* (**B10**) to 0.

RFC-A

Motor Rated Frequency (**B06**), *Motor Rated Speed* (**B07**) and *Number Of Motor Poles, Motor Number Of Motor Poles* (**B05**) are used to calculate the rated slip of the motor which is used by the motor control algorithm. An incorrect estimate of rated slip has the following effects:

1. Reduced efficiency
2. Reduction of maximum torque available from the motor
3. Reduced transient performance
4. Inaccurate control of absolute torque in torque control modes
5. The drive will produce rated flux in the motor in the shortest possible time when it is enabled. Incorrect parameter values will affect the flux build-up time.

The rated speed on the motor nameplate is normally the value for a hot motor, however, some adjustment may be required when the drive is commissioned if this is inaccurate. Either a fixed value can be entered for *Motor Rated Speed* (**B07**) or the optimization system within the drive may be used to automatically adjust the *Motor Rated Speed* (**B07**). See *Motor Parameter Adaptive Control* (**B25**). It should be noted that the optimization system does not operate when sensorless RFC-A mode is used.

B07	Motor Rated Speed		
Mode	Open-Loop		
Minimum	0	**Maximum**	33000
Default	1500	**Units**	rpm
Type	32 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Open-Loop

See *Motor Rated Frequency* (**B06**).

RFC-A

Motor Rated Frequency (**B06**), *Motor Rated Speed* (**B07**) and *Number Of Motor Poles, Motor Number Of Motor Poles* (**B05**) are used to calculate the rated slip of the motor which is used by the motor control algorithm. An incorrect estimate of rated slip has the following effects:

1. Reduced efficiency
2. Reduction of maximum torque available from the motor
3. Reduced transient performance
4. Inaccurate control of absolute torque in torque control modes
5. The drive will produce rated flux in the motor in the shortest possible time when it is enabled. Incorrect parameter values will affect the flux build-up time.

The rated speed on the motor nameplate is normally the value for a hot motor, however, some adjustment may be required when the drive is commissioned if this is inaccurate. Either a fixed value can be entered for *Motor Rated Speed* (**B07**) or the optimization system within the drive may be used to automatically adjust the *Motor Rated Speed* (**B07**). See *Motor Parameter Adaptive Control* (**B25**). It should be noted that the optimization system does not operate when sensorless RFC-A mode is used.

RFC-S

Motor Rated Speed (**B07**) is not used by the motor control algorithms, but it is used by the motor thermal protection system.

B09	Open Loop Control Mode		
Mode	Open-Loop		
Minimum	0	**Maximum**	4
Default	4	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Ur S
1	Ur
2	Fixed
3	Ur Auto
4	Ur I

Open Loop Control Mode (**B09**) defines the drive output mode, which can either be a voltage mode or a current mode as given below. It should be noted that the maximum output voltage of the drive is limited to a level just below *D.C. Bus Voltage* (**J65**) / √2. Therefore, if the drive is being supplied via its own rectifier input stage the output voltage is limited to a level just below that of the supply voltage. If the drive is operating in voltage mode the output voltage is limited to *Motor Rated Voltage* (**B03**) or the maximum possible output voltage whichever is the lowest. (If *Quasi Square Enable* (**B45**) = 1 the maximum possible output voltage can be increased. See *Quasi Square Enable* (**B45**) for details.)

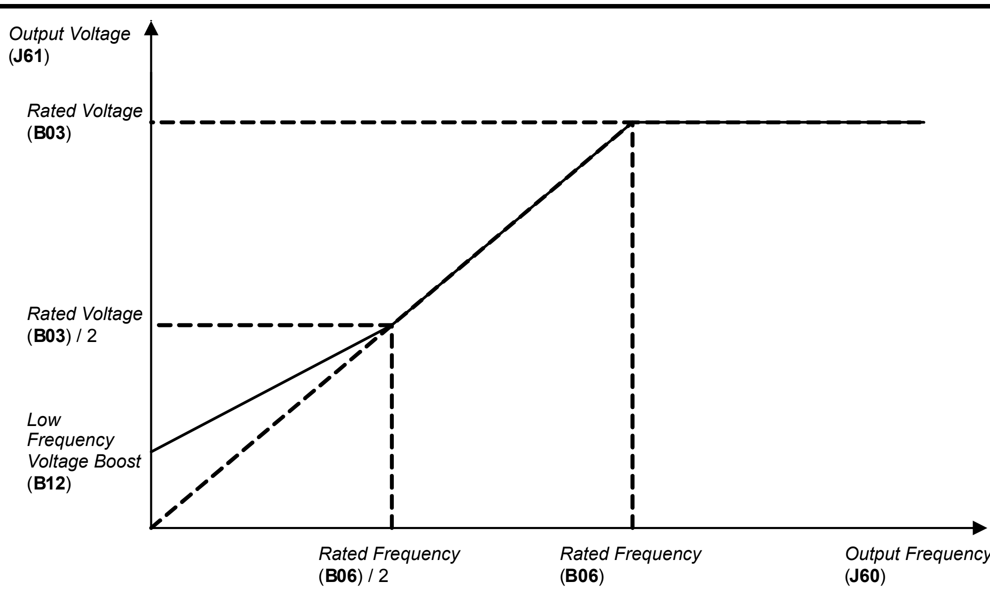
0: Ur S (Resistance compensation, stator resistance measured at each start)
Resistance compensation is a form of stator flux oriented sensorless motor control. A linear frequency to voltage characteristic is used where the drive output voltage is increased from 0V to *Motor Rated Voltage* (**B03**). as the |*Output Frequency* (**J60**)| increases from 0 Hz to *Motor Rated Frequency* (**B06**). When the |*Output Frequency* (**J60**)| is above *Motor Rated Frequency* (**B06**) the output voltage is limited to *Motor Rated Voltage* (**B03**). Vector based stator resistance compensation is applied below *Motor Rated Frequency* (**B06**)/4 and then this is tapered out from *Motor Rated Frequency* (**B06**)/4 to *Motor Rated Frequency* (**B06**)/2. This method controls the flux level correctly in the motor in the steady state provided the correct value of *Stator Resistance* (**B34**) is used.

The *Stator Resistance* (**B34**) is measured each time the drive is started. This test can only be done with a stationary motor where the flux has decayed to zero. Therefore this mode should only be used if the motor is guaranteed to be stationary each time the drive is enabled. To ensure that the measurement is not carried out before the flux has decayed, there is a period of one second after the inverter has been disabled during which the test is not carried out if the drive is re-started. The *Stator Resistance* (**B34**) is not automatically saved in non-volatile memory after each test.

1: Ur (Resistance compensation with no stator resistance measurement)
Resistance compensation is used as in Ur S mode, but the *Stator Resistance* (**B34**) is not measured.

2: Fixed (Fixed boost with linear characteristic)
A fixed frequency to voltage characteristic is used as shown below where the voltage at 0 Hz is defined by *Low Frequency Voltage Boost* (**B12**).

Figure 8-3 Fixed Boost Linear Characteristic



Fixed boost frequency to voltage characteristic

3: Ur Auto (Resistance compensation, stator resistance measured on first start)
Resistance compensation is used as in Ur S mode, but the *Stator Resistance* (**B34**) is only measured once when the drive is first enabled. After the

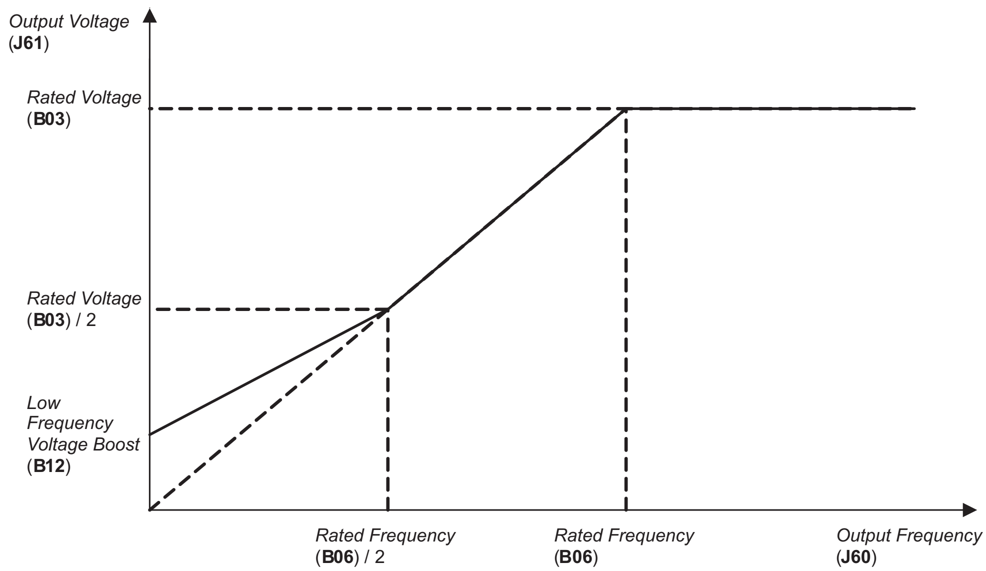
test has been completed successfully the mode is changed to Ur mode and *Stator Resistance* (**B34**) is saved to non-volatile memory. If *Parameter Cloning* (N01) is set to 3 or 4 the *Stator Resistance* (**B34**) is also written to a non-volatile media card fitted in the drive. If the test fails the mode is changed to Ur mode, but *Stator Resistance* (**B34**) is not updated.

4: Ur I (Resistance compensation, stator resistance measured at power-up)
Resistance compensation is used as in Ur S mode, but the *Stator Resistance* (**B34**) is only measured when the drive is enabled for the first time after each power-up.

5: Square (Fixed boost with square characteristic)
A fixed square frequency to voltage characteristic is used as shown below. When the *Output Frequency* (**J60**) is below *Motor Rated Frequency* (**B06**) the *Output Voltage* (**J61**) is given by:

Output Voltage (**J61**) = *Low Frequency Voltage Boost* (**B12**) + [*Motor Rated Voltage* (**B03**) - *Low Frequency Voltage Boost* (**B12**)] x (*Output Frequency* (**J60**) / *Motor Rated Frequency* (**B06**))^2]

Figure 8-4 Fixed Boost with Linear characteristic



Fixed boost frequency to voltage characteristic

B09	**Action On Enable**		
Mode	RFC-S		
Minimum	0	**Maximum**	4
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Disabled
1	Short
2	Short Once
3	Long
4	Long Once

Action On Enable (**B09**) can be used to get the drive to perform a phasing angle test when it is enabled. This test can be used when a non-absolute encoder is used for motor control feedback in RFC-S mode. The phasing test will measure and modify *Position Feedback Phase Angle* (**C13**), so that the correct offset is applied to run the motor with the non-absolute encoder. The test can be selected to occur after power-up and each time the position feedback is re-initialized. It is not necessary to perform the test on every enable, but this can be selected as shown in the table below. If the motor has significant cogging torque, and is not locked during the test, it is suggested that a long test is selected, otherwise a short test can be used. It should be noted that the motor inductances (*Transient Inductance Ld* (**B33**) and *No Load Lq* (**B37**) are checked before the test is carried out, and if the difference is not sufficient (see *Inductance*) then the drive will trip. Therefore, if the motor inductances have not been measured with auto-tuning or changed from their default values of zero the drive will trip when the drive is enabled.

***Action On Enable* (B09)**	**Action**
Disabled (0)	No phasing test is carried out on enable
Short (1)	A test lasting approximately 0.4 s is carried out on every enable
Short Once (2)	A test lasting approximately 0.4 s is carried out when the drive is first enabled after power-up, and when the drive is enabled after position is initialized
Long (3)	A test lasting approximately 1.3 s is carried out on every enable
Long Once (4)	A test lasting approximately 1.3 s is carried out when the drive is first enabled after power-up, and when the drive is enabled after position feedback is initialized

A test is only carried out when sensorless mode is not active. *Position Feedback Phase Angle* (**C13**) is updated by the test, but is not save in non-volatile memory in the drive.

Most motors have a positive saturation characteristic so that increasing the current in the flux axis increases motor saturation. It is possible with some motor designs for the characteristic to be reversed. If this is the case the phase angle measurement on enable will produce a value that is 180 deg from the real value.

B10	**Slip Compensation Enable**		
Mode	Open-Loop		
Minimum	0	**Maximum**	1
Default	1	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

See *Motor Rated Frequency* (**B06**).

B11	**Motor Autotune**		
Mode	Open-Loop		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit Volatile	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, NC		

Value	Text
0	None
1	Static
2	Rotating

The following describes how an auto-tune test can be initiated and normal operation can be resumed after the test for Open-loop mode:

1. An auto-tune test cannot be initiated if the drive is tripped or the drive inverter is active, i.e. *Drive OK* (**L05**) = 0 or *Drive Active* (**L06**) = 1. The inverter can be made inactive by ensuring that the Final drive enable is inactive, or the Final drive run is inactive.
2. An auto-tune test is initiated by setting *Motor Autotune* (**B11**) to a non-zero value and making the Final drive enable and the Final drive run active.
3. All tests that move the motor will move the motor in the forward direction if *Direction Input 2 CW* (**G40**) = 1 and *Direction Input Invert* (**H12**) = 0, or the reverse direction if *Direction Input 1 CCW* (**G39**) = 1 *Direction Input Invert* (**H12**) = 0.
4. If the auto-tune sequence is completed successfully the Final drive enable is set to the inactive state and *Motor Autotune* (**B11**) is set to zero. The Final drive enable can only be set to the active state again by removing the enable and re-applying it.
5. If a trip occurs during the auto-tune sequence the drive will go into the trip state and *Motor Autotune* (**B11**) is set to zero. As in 4. above the enable must be removed and re-applied before the drive can be restarted after the trip has been reset. However, care should be taken because if the auto-tune was not completed the drive parameters that should have been measured and set up will still have their original values.

The following describes the effects of the auto-tune test on the drive parameters for Open-loop mode:

1. All auto-tune tests rely on the motor being stationary when the test is initiated to give accurate results.
2. The parameters associated with the motor map are updated as a result of the test.
3. When each stage of the test is complete the results written to the appropriate parameters and these parameters saved in the drive non-volatile memory. If *Parameter Cloning* (**N01**) is set to 3 or 4 the parameters are also written to a non-volatile media card fitted in the drive.

The table below shows the parameters required for motor control indicating which should be set by the user and which can be measured with an auto-tune test.

Parameter	Required for	Measured in test
Motor Rated Frequency (**B06**)	Basic control	
Motor Rated Current (**B02**)	Basic control	
Motor Rated Speed (**B07**)	Slip compensation Spinning start	
Motor Rated Voltage (**B03**)	Basic control	
Motor Rated Power Factor (**B04**)	Basic control	2
Number Of Motor Poles, Motor Number Of Motor Poles (**B05**)	Not used	
Stator Resistance (**B34**)	Ur, Ur I, Ur S and Ur Auto modes Spinning start	1, 2
Transient Inductance (**B33**)	Improved performance	1, 2
Stator Inductance (**B35**)	Improved performance	2
Maximum Deadtime Compensation (**B46**)	Basic control	1, 2
Current At Maximum Deadtime Compensation (**B47**)	Basic control	1, 2

Auto-tune test 1: Basic control parameters

This test measures the basic control parameters without moving the motor.

1. A stationary test is performed to measure *Stator Resistance* (**B34**), *Transient Inductance* (**B33**), *Maximum Deadtime Compensation* (**B46**) and *Current At Maximum Deadtime Compensation* (**B47**).

Auto-tune test 2: Basic control and improved performance parameters

This test measures the parameters for improved performance by rotating the motor.

1. Auto-tune test 1 is performed.
2. A rotating test is performed in which the motor is accelerated with the currently selected ramps up to a frequency of *Motor Rated Frequency* (**B06**) x $^2/_3$, and the frequency is maintained at that level for 4 seconds. *Stator Inductance* (**B35**) is measured and this value is used in conjunction with other motor parameters to calculate *Motor Rated Power Factor* (**B04**). The motor should be unloaded for this test.

The table below shows the trips that can occur during an auto-tune test:

Trip	Reason	Trip can occur in test
Autotune Stopped	The final drive enable or the final drive run were removed before the test was completed.	All
Resistance.001	The measured value of *Stator Resistance* (**B34**) exceeded a value of (V_{FS} / √2) / *Drive Full Scale Current Kc* (**J06**), where V_{FS} is the full scale d.c. link voltage.	All
Resistance.002	It has not been possible to measure the drive inverter characteristic to define *Maximum Deadtime Compensation* (**B46**) and *Current At Maximum Deadtime Compensation* (**B47**).	

B11	Motor Autotune		
Mode	RFC-A		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit Volatile	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, NC		

Value	Text
0	None
1	Static
2	Rotating

The following describes how an auto-tune test can be initiated and normal operation can be resumed after the test for RFC-A mode:

1. An auto-tune test cannot be initiated if the drive is tripped or the drive inverter is active, i.e. *Drive OK* (**L05**) = 0 or *Drive Active* (**L06**) = 1. The inverter can be made inactive by ensuring that the Final drive enable is inactive, or the Final drive run is inactive.
2. An auto-tune test is initiated by setting *Motor Autotune* (**B11**) to a non-zero value and making the Final drive enable and the Final drive run active.
3. All tests that move the motor will move the motor in the forward direction if *Direction Input 2 CW* (**G40**) = 1 and *Direction Input Invert* (**H12**) = 0, or the reverse direction if *Direction Input 1 CCW* (**G39**) = 1 *Direction Input Invert* (**H12**) = 0.
4. If the auto-tune sequence is completed successfully the Final drive enable is set to the inactive state and *Motor Autotune* (**B11**) is set to zero. The Final drive enable can only be set to the active state again by removing the enable and reapplying it.
5. If a trip occurs during the auto-tune sequence the drive will go into the trip state and *Motor Autotune* (**B11**) is set to zero. As in 4. above the enable must be removed and re-applied before the drive can be restarted after the trip has been reset. However, care should be taken because if the auto-tune was not completed the drive parameters that should have been measured and set up will still have their original values.

The following describes the effects of the auto-tune test on the drive parameters for RFC-S mode:

1. All auto-tune tests rely on the motor being stationary when the test is initiated to give accurate results.
2. When each stage of the test is completed, the results written to the appropriate parameters and these parameters saved in the drive non-volatile memory. If
3. *Parameter Cloning* (**N01**) is set to 3 or 4 the parameters are also written to a non-volatile media card fitted in the drive.

The table below shows the parameters required for motor control indicating which should be set by the user and which can be measured with an auto-tune test.

Parameter	Required for	Measured in test
Motor Rated Frequency (**B06**)	Basic control	
Motor Rated Current (**B02**)	Basic control	
Motor Rated Speed (**B07**)	Basic control	
Motor Rated Voltage (**B03**)	Basic control	
Motor Rated Power Factor (**B04**)	Basic control	2
Number Of Motor Poles, Motor Number Of Motor Poles (**B05**)	Basic control	
Stator Resistance (**B34**)	Basic control	1, 2
Transient Inductance (**B33**)	Basic control	1, 2
Stator Inductance (**B35**)	Improved performance	2
Maximum Deadtime Compensation (**B46**)	Basic control	1, 2
Current At Maximum Deadtime Compensation (**B47**)	Basic control	1, 2
Current Controller Kp Gain, Final Current Loop Kp (**J29**)	Basic control	1, 2
Final Current Loop Ki (**J30**)	Basic control	1, 2

Auto-tune test 1: Basic control parameters

This test measures the basic control parameters without moving the motor.

1. A stationary test is performed to measure *Stator Resistance* (**B34**), *Transient Inductance* (**B33**), *Maximum Deadtime Compensation* (**B46**) and *Current At Maximum Deadtime Compensation* (**B47**). *Stator Resistance* (**B34**) and *Transient Inductance* (**B33**) are used to set up *Current Controller Kp Gain, Final Current Loop Kp* (**J29**) and *Final Current Loop Ki* (**J30**). This is only performed once during the test, and so the user can make further adjustments to the current controller gains if required.

Auto-tune test 2: Basic control and improved performance parameters

This test measures the parameters for improved performance by rotating the motor.

1. Auto-tune 1 test is performed.
2. A rotating test is performed in which the motor is accelerated with the currently selected ramps up to a frequency of *Motor Rated Frequency* (**B06**) x $^2/_3$, and the frequency is maintained at that level for up to 40 seconds. *Stator Inductance* (**B35**) is measured and this value is used in conjunction with other motor parameters to calculate *Motor Rated Power Factor* (**B04**). The motor should be unloaded for this test.

B11	**Motor Autotune**		
Mode	RFC-S		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit Volatile	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, NC		

Value	Text
0	None
1	Static
2	Rotating

The following describes how an auto-tune test can be initiated and normal operation can be resumed after the test for RFC-S mode:

1. An auto-tune test cannot be initiated if the drive is tripped or the drive inverter is active, i.e. *Drive OK* (**L05**) = 0 or *Drive Active* (**L06**) = 1. The inverter can be made inactive by ensuring that the Final drive enable is inactive, or the Final drive run is inactive.
2. An auto-tune test is initiated by setting *Motor Autotune* (**B11**) to a non-zero value and making the Final drive enable and the Final drive run active.
3. All tests that move the motor will move the motor in the forward direction if *Direction Input 2 CW* (**G40**) = 1 and *Direction Input Invert* (**H12**) = 0, or the reverse direction if *Direction Input 1 CCW* (**G39**) = 1 *Direction Input Invert* (**H12**) = 0.
4. If the auto-tune sequence is completed successfully the Final drive enable is set to the inactive state and *Motor Autotune* (**B11**) is set to zero. The Final drive enable can only be set to the active state again by removing the enable and reapplying it.
5. If a trip occurs during the auto-tune sequence the drive will go into the trip state and *Motor Autotune* (**B11**) is set to zero. As in 4. above the enable must be removed and re-applied before the drive can be restarted after the trip has been reset. However, care should be taken because if the auto-tune was not completed the drive parameters that should have been measured and set up will still have their original values.

The following describes the effects of the auto-tune test on the drive parameters for RFC-S mode:

1. All auto-tune tests rely on the motor being stationary when the test is initiated to give accurate results.
2. When each stage of the test is completed, the results written to the appropriate parameters and these parameters saved in the drive non-volatile memory. If *Parameter Cloning* (**N01**) is set to 3 or 4 the parameters are also written to a non-volatile media card fitted in the drive.

The table below shows the parameters required for motor control indicating which should be set by the user and which can be measured with an auto-tune test.

Parameter	Required for	Measured in test
Motor Rated Current (**B02**)	Basic control	
Motor Rated Speed (**B07**)	Basic control	
Motor Rated Voltage (**B03**)	Basic control	
Number Of Motor Poles, Motor Number Of Motor Poles (**B05**)	Basic control	
Stator Resistance (**B34**)	Basic control	1, 2
Transient Inductance Ld (**B33**)	Basic control	1, 2
Maximum Deadtime Compensation (**B46**)	Basic control	1, 2
Current At Maximum Deadtime Compensation (**B47**)	Basic control	1, 2
Position Feedback Phase Angle (**C13**)	Basic control with position feedback	1, 2
Current Controller Kp Gain, Final Current Loop Kp (**J29**)	Basic control	1, 2
Final Current Loop Ki (**J30**)	Basic control	1, 2

Auto-tune test 1: Stationary test for basic control parameters

This test can be used to measure all the necessary parameters for basic control. (This test is not likely to give such an accurate value for *Position Feedback Phase Angle* (**C13**) as auto-tune test 2.

1. A stationary test is performed to locate the flux axis of the motor.
2. If sensorless mode is not selected then *Position Feedback Phase Angle* (**C13**) is set up for the position from the position feedback interface.
3. A stationary test is performed to measure *Transient Inductance Ld* (**B33**) and *No Load Lq* (**B37**).
4. A stationary test is performed to measure *Stator Resistance* (**B34**), *Maximum Deadtime Compensation* (**B46**) and *Current At Maximum Deadtime Compensation* (**B47**).
5. *Stator Resistance* (**B34**) and *Transient Inductance Ld* (**B33**) are used to set up *Current Controller Kp Gain, Final Current Loop Kp* (**J29**) and *Final Current Loop Ki* (**J30**). This is only performed once during the test, and so the user can make further adjustments to the current controller gains if required.

It should be noted that because this is a stationary test, it is not possible to check the direction of the position feedback. If the motor power connection phase sequence is incorrect so that the position feedback counts in reverse when the drive applies a phase sequence U-V-W to operate in the forward direction then the motor will jump thought 90^{o} electrical and stop with a current in the motor defined by the current limits. This can be corrected by changing the drive output phase sequence with *Reverse Motor Phase Sequence* (**B26**) and then repeating the auto-tuning. This will make the motor rotate correctly in the direction defined by the position feedback rotation. If the position feedback direction is correct the motor will then rotate under control in the required direction, but if the position feedback direction is incorrect the motor will then rotate under control in the wrong direction.

Auto-tune test 2: Rotating test for basic control parameters

This test can be used to measure all the necessary parameters for basic control and parameters for cancelling the effects of cogging torque. The motor must be unloaded for this test. (This test is likely to give a more accurate value for Position Feedback Phase Angle than auto-tune test 1.) Note that if sensorless mode is selected Auto-tune 1 test is performed.

1. If sensorless mode is not selected then a rotating test is performed to locate the flux axis of the motor and *Position Feedback Phase Angle* (**C13**) is set up for the position from the position feedback interface. This is done by rotating the motor by 2 electrical revolutions (i.e. up to 2 mechanical revolutions) in the required direction.
2. Steps 3 to 6 of the stationary test above are carried out.

B12	Low Frequency Voltage Boost		
Mode	Open-Loop, RFC-A		
Minimum	0.0	**Maximum**	25.0
Default	3.0	**Units**	%
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

The default value for this parameter depends on the frame size of the drive as follows:

- 3.0 % up to frame size 6 drives
- 2.0 % for frame size 7

Open-Loop

See *Open Loop Control Mode* (**B09**).

RFC-A

During auto-tune test 2 the drive uses the Open-loop mode control strategy with fixed voltage boost. *Low Frequency Voltage Boost* (**B12**) is used to define the level of low voltage boost used during the test. See *Open Loop Control Mode* (**B09**) in Open-loop mode for more details.

B13	**Maximum Switching Frequency**		
Mode	Open-Loop, RFC-A, RFSC-S		
Minimum	0	**Maximum**	VM_SWITCHING_FREQUENCY
Default	4	**Units**	kHz
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, VM, RA		

Value	Text
0	2
1	3
2	4
3	6
4	8
5	12
6	16

Maximum Switching Frequency (**B13**) should be set to the required PWM switching frequency. The drive inverter will operate at this frequency unless the inverter temperature becomes too hot. Under these conditions the drive will reduce the switching frequency in an attempt to avoid tripping. The switching frequency has a direct effect on the sample rate for the current controllers (see *Current Controller Kp Gain, Final Current Loop Kp* (**J29**)). All other control tasks are at a fixed rate.

Task	
Speed controller (RFC-A, RFC-S)	250 µs
DC link voltage controller	1 ms
Flux controller (RFC-A, RFC-S)	1 ms

B14	**Minimum Switching Frequency**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	VM_MIN_SWITCHING_FREQUENCY
Default	1	**Units**	kHz
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, VM		

Value	Text
0	2
1	3
2	4
3	6
4	8
5	12
6	16

Minimum Switching Frequency (**B14**) defines the minimum switching frequency that the system will attempt to use. If the switching frequency needs to switch to a lower level, then the drive will trip. If *Minimum Switching Frequency* is changed the new value will only become active when *Switching Frequency* is at or above the minimum value

B15	Switching Frequency Step Size		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	2
Default	2	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

The switching frequency is changed in steps defined by *Switching Frequency Step Size* (**B15**). For example with a switching frequency of 16 kHz and a step size of two, the frequency will be reduced to 8 kHz, then 4 kHz, etc.

B16	Symmetrical Current Limit		
Mode	RFC-S		
Minimum	−VM_MOTOR1_CURRENT_LIMIT	**Maximum**	VM_MOTOR1_CURRENT_LIMIT
Default	Open loop: 165.0%, RFC-A, RFC-S 175.0%	**Units**	%
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	1
Coding	RW, VM, RA		

Symmetrical Current Limit (**B16**) limits the current when the motor is being accelerated away from standstill and when the motor is being decelerated towards standstill. The maximum possible current limit (VM_MOTOR1_CURRENT_LIMIT [MAX]) varies between drive sizes with default parameters loaded. For some drive sizes the default value may be reduced below the value given by the parameter range limiting.
The current limit can be further limited by motor overload protection and/or drive temperature monitoring to give final current limit (**J21**).

B17	Percentage Over Current Trip Level		
Mode	RFC-S		
Minimum	0	**Maximum**	9
Default	9	**Units**	%
Type	8 Bit User Save	**Update Rate**	Percentage Over-current Trip Level
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	10
1	20
2	30
3	40
4	50
5	60
6	70
7	80
8	90
9	100

If *Percentage Over Current Trip Level* (**B17**) is left at its default value of 100 % an over-current trip due to currents flowing between the output phases will occur at a level approximately equal to the current defined by *Drive Full Scale Current Kc* (**J06**). Note that this current is defined as an r.m.s. value, but the over-current trip activates if one of the phase currents exceeds the equivalent peak of a sine wave with the defined r.m.s. level. Permanent magnet motors are de-magnetized if the current in the motor exceeds a specified level. If this level is less than the peak of a sine wave with an r.m.s. value defined by *Drive Full Scale Current Kc* (**J06**) then *Percentage Over Current Trip Level* (**B17**) should be modified to reduce the over-current trip. *Percentage Over Current Trip Level* (**B17**) gives the percentage of *Drive Full Scale Current Kc* (**J06**) used to define the over-current trip level.

B18	Motor Percentage Flux		
Mode	RFC-A		
Minimum	0.0	**Maximum**	150.0
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	1
Coding	RO, ND, NC, PT		

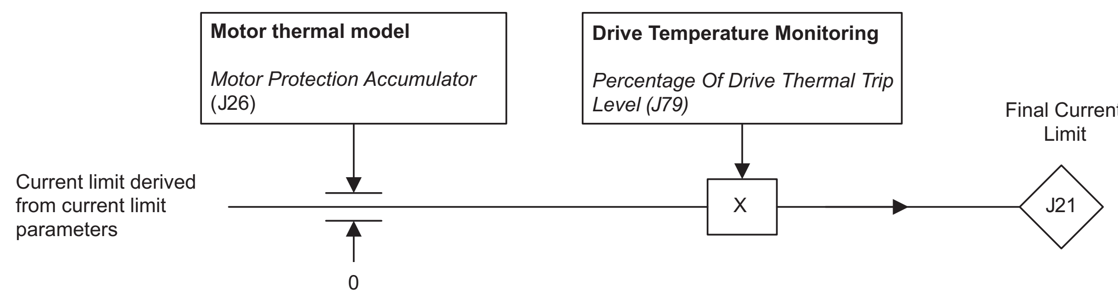
Motor Percentage Flux (**B18**) gives an indication of the flux level in the motor where a value of 100 % is equivalent to the rated flux level for the motor.

B19	Thermal Protection Mode		
Mode	RFC-S		
Minimum	0 (Display: 00)	**Maximum**	3 (Display: 11)
Default	0 (Display: 00)	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Binary	**Decimal Places**	0
Coding	RW		

Thermal Protection Mode (**B19**) defines the action taken by the drive when *Motor Protection Accumulator* (**J26**) reaches 100 % and/or *Percentage Of Drive Thermal Trip Level* (**J79**) exceeds 90 %. The bits in *Thermal Protection Mode* (**B19**) are defined as follows:

Bit	Function
0	0 = *Motor Too Hot* trip is initiated when *Motor Protection Accumulator* (**J26**) reaches 100 % 1 = *Motor Too Hot* trip is disabled and current limiting on motor overload is active as described below
1	0 = Drive thermal monitoring current limiting is disabled 1 = Drive thermal monitoring current limiting as described below is active

The required current limit is derived from *Symmetrical Current Limit* (**B16**). The current limit can be further limited by current limit on motor overload and/or drive temperature monitoring as shown below to give the *Final Current Limit* (**J21**).



Current limit modification

Current limiting on motor overload
When the *Motor Protection Accumulator* (**J26**) reaches 100.0 % the current limit is limited to (K_1 – 0.05) x 100.0 %. This limitation is removed when the *Motor Protection Accumulator* (**J26**) falls below 95.0 %. (K_1 is defined in the description of *Motor Thermal Time Constant 1* (**B20**).)

Drive thermal monitoring current limiting
If *Percentage Of Drive Thermal Trip Level* (**J79**) exceeds 90 % the current limit is modified as follows:

Final Current Limit (**J21**) = Current limit x (100 % - *Percentage Of Drive Thermal Trip Level* (**J79**)) / 10 %

If both of the above attempt to reduce the final current limit the lowest calculated value of current limit is used.

This system has the effect of reducing the current limit to zero at the point where the drive should be tripped because its thermal monitoring has reached a trip threshold. This is intended to limit the load on the drive to prevent it from tripping when supplying a load that increases with speed and does not include rapid transients.

B20	Motor Thermal Time Constant 1		
Mode	RFC-S		
Minimum	1.0	Maximum	3000.0
Default	89.0	Units	s
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

A dual time constant thermal model is provided that can be used to estimate the motor temperature as a percentage of its maximum allowed temperature. The input to the model is the *Current Magnitude, Total Output Current* (**J22**). Throughout the following discussion *Motor Rated Current* (**B02**) is used in the model. It should be noted that if the parameters that have been added in addition to those in Unidrive SP are left at their default values the model is a simple single time constant model as provided in Unidrive SP.

Percentage Losses
The losses in the motor are calculated as a percentage value, so that under these conditions the *Motor Protection Accumulator* (**J26**) would eventually reach 100 %.

Percentage Losses = 100 % x [Load Related Losses + Iron Losses]

where:

Load Related Losses = $(1 - K_{fe}) \times (I / (K_1 \times I_{Rated})^2$

Iron Losses = $K_{fe} \times (w / w_{Rated})^{1.6}$

where:
I = *Current Magnitude, Total Output Current* (**J22**)
I_{Rated} = *Motor Rated Current* (**B02**)
K_{fe} = *Rated Iron Losses As Percentage Of Losses* (**B24**) / 100 %

The iron losses are relatively low in motors that have a rated frequency of 60 Hz or less, and so the motor could be modelled based on load related losses alone. This can be done by setting K_{fe} to zero. In motors where iron losses are significant, K_{fe} defines the proportion of losses that are iron losses under rated conditions (i.e. rated current and rated frequency). For example if the iron losses are 30 % of losses and other losses are 70 % of losses under rated conditions *Rated Iron Losses As Percentage Of Losses* (**B24**) should be set to 30 %.

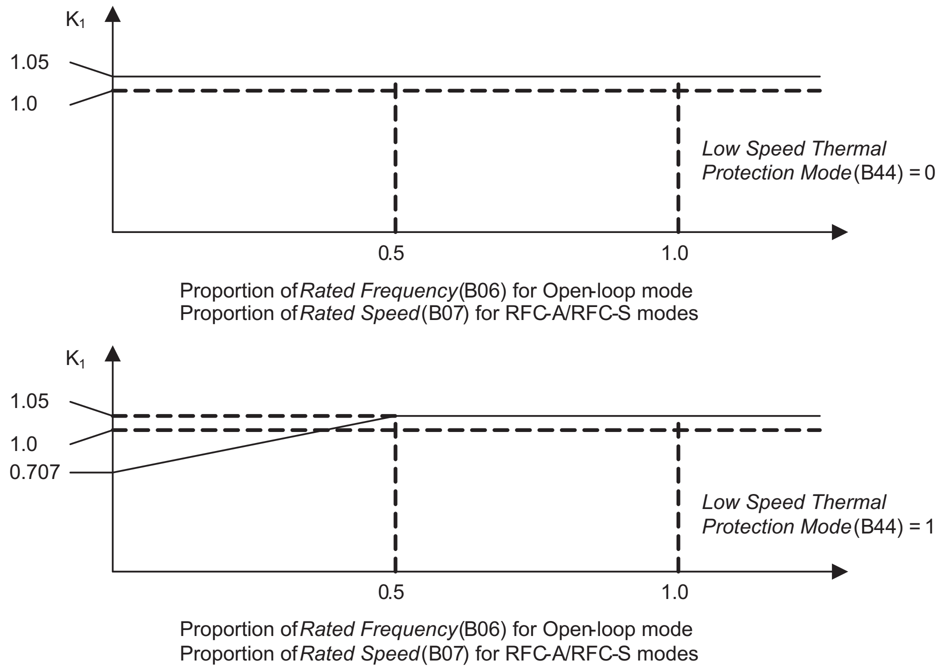
The value of K_1 defines the continuous allowable motor overload as a proportion of the *Motor Rated Current* (**B02**) before the *Motor Protection Accumulator* (**J26**) reaches 100 %. The value of K_1 can be used to model reduced cooling at low speeds and to allow the motor to operate under rated conditions with a small margin to prevent spurious trips. K_1 is defined in more detail later.

Motor Protection Accumulator
So far the steady state motor losses have been defined, but the motor model must estimate the temperature within the motor under dynamically changing conditions, and so the *Motor Protection Accumulator* (**J26**) is given by the following equation.

T = Percentage Losses x $[(1 - K_2)(1 - e^{-t/\tau1}) + K_2 (1 - e^{-t/\tau2})]$where:
T = *Motor Protection Accumulator* (**J26**)
K_2 = *Motor Thermal Time Constant 2 Scaling* (**B23**) / 100 %
τ1 = *Motor Thermal Time Constant 1* (**B20**)
τ2 = *Motor Thermal Time Constant 2* (**B22**)

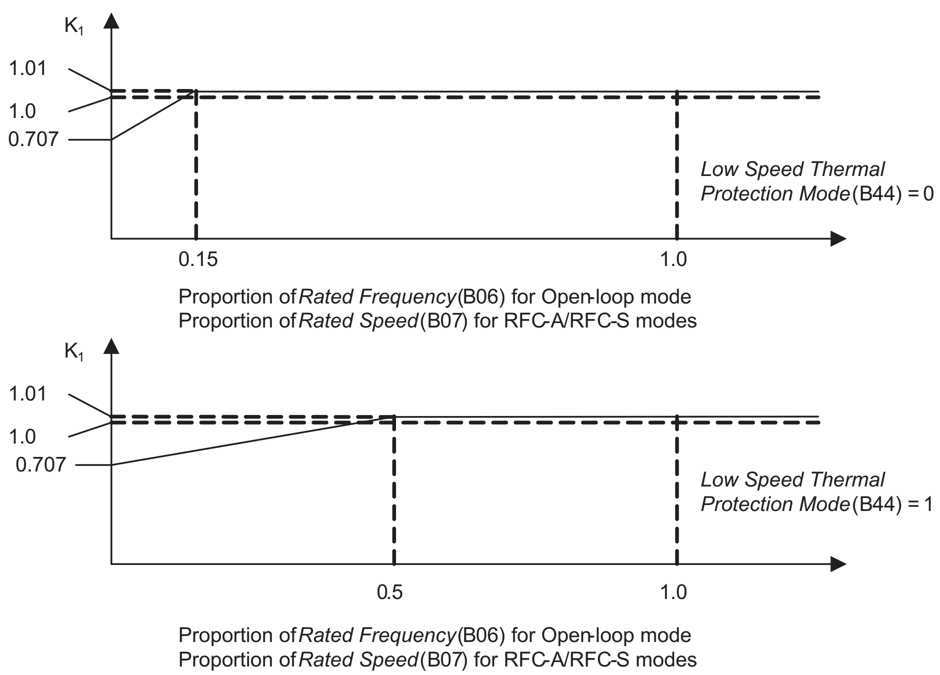
$[(1 - K_2)(1 - e^{-t/\tau1}) + K_2 (1 - e^{-t/\tau2})]$ gives the effects of the thermal time constants in the motor. K_2 defines the ratio of the contribution to the *Motor Protection Accumulator* (**J26**) value from each of the time constants. If K_2 is set to its default value of 0 then only *Motor Thermal Time Constant 1* (**B20**) is included and the model will give the temperature of the main mass of the motor body. To give better protection to the motor, the model can be used to model a particular point in the motor, for example the stator windings. This can be done by including an additional shorter time constant representing the thermal impedance between the windings and the main mass of the motor body which can be modelled with *Motor Thermal Time Constant 2* (**B22**).

Reduced cooling with lower speed
If *Motor Rated Current* (**B02**) ≤ *Maximum Heavy Duty Rating* (**J05**) then K_1 is defined as shown below. If *Low Speed Thermal Protection Mode* (**B44**) = 0 the characteristic is intended for a motor which can operate at rated current over the whole speed range. Induction motors with this type of characteristic normally have forced cooling. If *Low Speed Thermal Protection Mode* (**B44**) = 1 the characteristic is intended for motors where the cooling effect of motor fan reduces with reduced motor speed below half of rated speed. The maximum value for K_1 is 1.05, so that above the knee of the characteristics the motor can operate continuously up to 105 % of rated current.



K_1 when *Motor Rated Current* (B02) ≤ *Maximum Heavy Duty Rating* (J05)

If *Motor Rated Current* (**B02**) > *Maximum Heavy Duty Rating* (**J05**) then K_1 is defined as shown below. Two different characteristics are provided, but in both cases the motor performance is limited at lower speeds and the permissible overload is reduced from 105 % to 101 %.



K_1 when *Motor Rated Current* (B02) > *Maximum Heavy Duty Rating* (J05)

Time for Motor Protection Accumulator to reach 100 %

Assuming a single time constant model is being used (i.e. *Motor Thermal Time Constant 2 Scaling* (**B23**), the time for the *Motor Protection Accumulator* (**J26**) to change from its initial value to 100 % is given by the following equation:

Time to reach 100.0 % = $-\tau 1 \times \ln[(1 - C_1) / (C_0 - C_1)]$

C_0 represents the conditions that have persisted for long enough for the *Motor Protection Accumulator* (**J26**) to reach a steady state value. If the motor current and speed are I_0 and w_0 then,

$C_0 = [(1 - K_{fe}) \times (I_0 / (K_1 \times I_{Rated}))^2] + [K_{fe} \times (w_0 / w_{Rated})^{1.6}]$

C_1 represents the conditions that begin at the start of the time being calculated. If the motor current and speed are by I_1 and w_1 then,

$C_1 = [(1 - K_{fe}) \times (I_1 / (K_1 \times I_{Rated}))^2] + [K_{fe} \times (w_1 / w_{Rated})^{1.6}]$

Example 1:

The effect of iron losses are not modelled ($K_{fe} = 0$), *Motor Thermal Time Constant 1* (**B20**) = 89 s, the initial current is zero, *Motor Rated Current* (**B02**) ≤ *Maximum Heavy Duty Rating* (**J05**) and the new level of current is 1.5 x *Motor Rated Current* (**B02**).

$C_0 = 0$

$C_1 = [1.5 / (1.05 \times 1.0)]^2 = 2.041$

Time to reach 100.0 % = $-89 \times \ln(1 - 1/C_1) = -89 \times \ln(1 - 1/2.041) = 60$ s

This is the default setting for Open-loop and RFC-A modes allowing an induction motor to run at 150 % rated current for 60 s from cold.

Example 2:

The effect of iron losses are not modelled ($K_{fe} = 0$), *Motor Thermal Time Constant 1* (**B20**) = 89 s, the initial current is *Motor Rated Current* (**B02**), *Motor Rated Current* (**B02**) ≤ *Maximum Heavy Duty Rating* (**J05**) and the new level of current is 1.5 x *Motor Rated Current* (**B02**).

$C0 = [1.0 / (1.05 \times 1.0)]^2 = 0.907$

$C1 = [1.5 / (1.05 \times 1.0)]^2 = 2.041$

Time to reach 100.0 % = $-89 \times \ln((1 - C1) / (C0 - C1)) = -89 \times \ln[(1 - 2.041) / (0.907 - 2.041)] = 7.6$ s

This is the default setting for Open-loop and RFC-A modes allowing an induction motor to run at 150 % rated current for 7.6 s after running under rated conditions for a significant period of time.

Motor Protection Accumulator Reset

The initial value in the *Motor Protection Accumulator* (**J26**) at power-up is defined by *Motor Protection Accumulator Power-up Value* (**B21**) as given in the table below.

***Motor Protection Accumulator Power-up Value* (B21)**	***Motor Protection Accumulator* (J26) at power-up**
Power Down	The value is saved at power-down and is used as the initial value at power-up.
Zero	The value is set to zero
Real Time	If a real-time clock is present and if *Date/Time Selector* (**H32**) is set up to select the real-time clock then the value saved at power-down is modified to include the effect of the motor thermal protection time constants over the time between power-down and power-up. This modified value is then used as the initial value at power-up. If no real time clock is present then and this option is selected then the value saved at power-down is used as the initial value.

The *Motor Protection Accumulator* (**J26**) is reset when *Motor Thermal Time Constant 1* (**B20**) is set to 0.0. Note that this is not possible in the standard product as the minimum parameter value is 1.0.

Motor Protection Accumulator Warning

If Percentage Losses > 100 % then eventually the *Motor Protection Accumulator* (**J26**) will reach 100 % causing the drive to trip or the current limits to be reduced. If this is the case and *Motor Protection Accumulator* (**J26**) > 75.0 % then [Motor Overload] alarm indication is given and *Motor Overload Alarm* (**L21**) is set to one.

B21	**Motor Protection Accumulator Power-up Value**		
Mode	Open-loop: RFC-A, RFC-S		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Power down
1	Zero
2	Real time

See *Motor Thermal Time Constant 1* (**B20**).

B22	Motor Thermal Time Constant 2		
Mode	Open-loop: RFC-A, RFC-S		
Minimum	1.0	**Maximum**	3000.0
Default	89.0	**Units**	s
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW		

See *Motor Thermal Time Constant 1* (**B20**).

B23	Motor Thermal Time Constant 2 Scaling		
Mode	Open-loop: RFC-A, RFC-S		
Minimum	0	**Maximum**	100
Default	0	**Units**	%
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Motor Thermal Time Constant 1* (**B20**).

B24	Rated Iron Losses As Percentage Of Losses		
Mode	Open-loop: RFC-A, RFC-S		
Minimum	0	**Maximum**	100
Default	0	**Units**	%
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Motor Thermal Time Constant 1* (**B20**).

B26	Reverse Motor Phase Sequence		
Mode	Open-loop: RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

If *Reverse Motor Phase Sequence* (**B26**) = 0 the output phase sequence is U-V-W when *Output Frequency* (**J60**) is positive and W-V-U when *Output Frequency* (**J60**) is negative. If *Reverse Motor Phase Sequence* (**B26**) = 1 the output phase sequence is reversed so that the phase sequence in W-V-U for positive frequencies and U-V-W for negative frequencies.

B27	Fast Disable		
Mode	Open-loop: RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	2 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Fast Disable (**B27**) normally shows the hardware enable state based on the state of the safe torque off system. However, drive I/O can be routed to *Fast Disable* (**B27**) to reduce the disable time. See description of the enable logic for more details.

B28	Enable High Speed Mode		
Mode	RFC-S		
Minimum	-1	**Maximum**	1
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
-1	Limit
0	Disable
1	Enable

Care must be taken when high speed mode is not set to "disable" to avoid damaging the drive. The voltage produced by the magnet flux is proportional to speed. For high speed operation the drive must apply currents to the motor to counter-act the flux produced by the magnets. It is possible to operate the motor at very high speeds that would give a very high motor terminal voltage, but this voltage is prevented by the action of the drive. If however, the drive is disabled (or tripped) when the motor voltages would be higher than the rating of the drive without the currents to counter-act the flux from the magnets, it is possible to damage the drive. If high speed mode is not disabled the motor speed must be limited to the levels given in the table below unless an additional hardware protection system is used to limit the voltages applied to the drive output terminals to a safe level.

Drive voltage rating	Maximum motor speed (rpm)	Maximum safe line to line voltage at the motor terminals (V rms)
200	400 x 1000 / (Ke x √2)	400 / √2
400	800 x 1000 / (Ke x √2)	800 / √2
575	955 x 1000 / (Ke x √2)	955 / √2
690	1145x 1000 / (Ke x √2)	1145 / √2

Ke is the ratio between r.m.s. line to line voltage produced by the motor and the speed in V/1000rpm.

High speed mode is disabled as default (i.e. *Enable High Speed Mode* (**B28**) = 0 (Disable)). The motor flux is not modified to limit the motor voltage to the level defined by *Motor Rated Voltage* (**B03**). The motor voltage will increase as the speed is increased until the motor line voltage x √2 is equal to the d.c. link voltage (*D.c. Bus Voltage* (**J65**)). It will not be possible to further increase the speed significantly. This mode is safe because the motor voltage with no current flowing in the motor cannot exceed a level that can damage the drive provided *Position Feedback Phase Angle* (**C13**) is correct for the motor. Note that if *Position Feedback Phase Angle* (**C13**) is modified by the user to change the flux level in the motor then it is possible to damage the drive.

If *Enable High Speed Mode* (**B28**) = -1 (Limit) then the motor flux is modified to limit the motor voltage to the level defined by *Motor Rated Voltage* (**B03**). An *Over Speed*.1 trip is initiated if the measured motor speed exceeds the levels defined in the table to protect the drive.

If *Enable High Speed Mode* (**B28**) = 1 (Enable) then the motor flux is modified to limit the motor voltage to the level defined by *Motor Rated Voltage* (B03), but no trip is provided, and so it is possible to damage the drive without additional protection. An indication that cannot be cleared is stored in *Potential Drive Damage Conditions* (**L73**) and saved on power-down. The motor manufacturer should always be consulted before using this mode as care must be taken not to de-magnetize the motor.

B29	Motor Contactor Monitoring Enable		
Mode	Open-loop: RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When set to Off (0), monitoring of the motor contactors is disabled.

When set to On (1), monitoring of the motor contactors is enabled, where *Motor Contactor Monitoring Input* (**B30**) is monitored to determine the state of the contactor. It is assumed that if *Motor Contactor Monitoring Input* (**B30**) = Off (0) the contactor is open, and if *Motor Contactor Monitoring Input* (**B30**) = On (1) then it is closed. The contactor has 3s to operate before a *Trip 70 (**Mot con open**)* / *Trip 71 (**Mot con closd**)* is called.

B30	**Motor Contactor Monitoring Input**		
Mode	Open-loop: RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When *Motor Contactor Monitoring Enable* (**B29**) = On (1), then this parameter is used to monitor the state of the motor contactors. One of the elevator drive inputs or I/O option inputs must be routed to this parameter, where the signal to activate the input comes from the motor contactors auxiliary contacts.

When set to Off (0), the motor contactors are open, when set to On (1) the motor contactors are closed.

This input is used to generate *Trip 70 (**Mot con open**)* / *Trip 71 (**Mot con closd**)*.

B31	**Motor Contactor Control Output**		
Mode	Open-loop: RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit Volatile	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

If the motor contactors are to be connected to the elevator drive, route this parameter to a drive digital output, which will control the motor contactors.

When set to Off (0), the motor contactors will be opened.

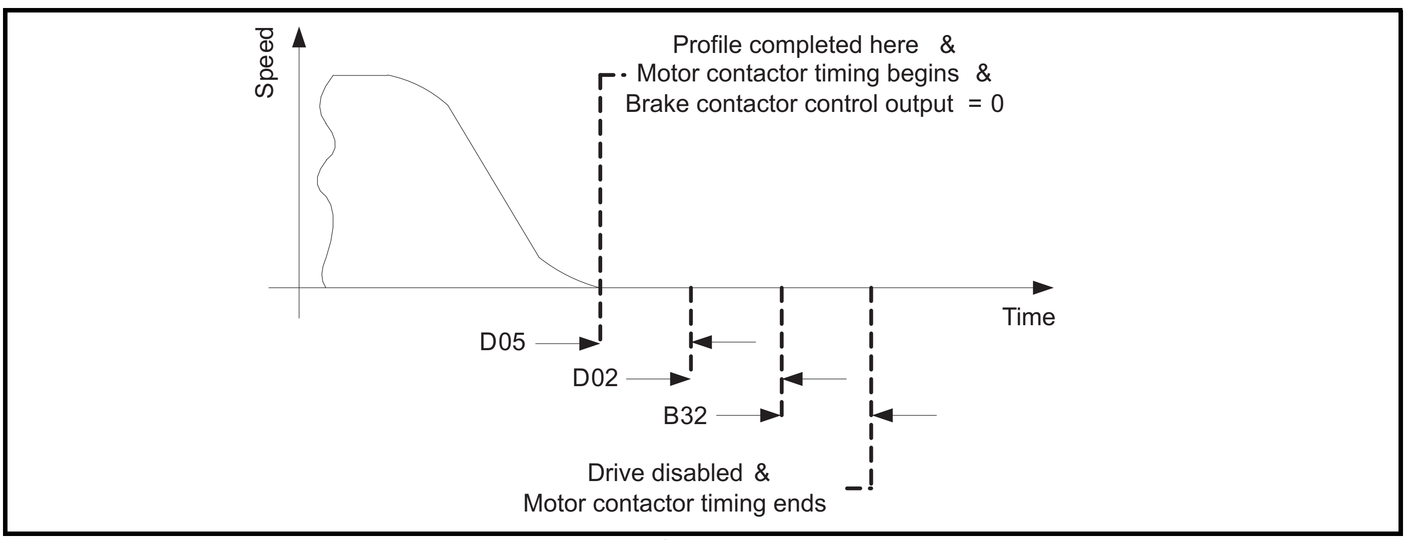
When set to On (1), the motor contactors will be closed.

A volatile source parameter must be used to prevent the user from saving to On (1).

B32	**Motor Contactor Measured Delay Time**		
Mode	Open-loop: RFC-A, RFC-S		
Minimum	0	**Maximum**	32767
Default	0	**Units**	ms
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO		

This indicates the measured contactor opening time delay in ms.

This is the time from when the brake apply delay starts to when the enable is removed – *Brake Control Apply Delay* (**D05**) – *Motor Torque Ramp Time* (**D02**). See the following diagram:



A negative time indicates that the contactor opened while current was flowing i.e. drive is disabled (via the motor contactors auxiliary contacts) during the *Brake Control Apply Delay* (**D05**) or the *Motor Torque Ramp Time* (**D02**). Negative values can only occur in situations where the Motor contactor is controlled by the elevator controller. This may be resolved by increasing the brake release time in the elevator controller, or reducing *Brake Control Apply Delay* (**D05**), or reducing *Motor Torque Ramp Time* (**D02**). The motor torque ramp modifies the symmetrical current limit using a linear ramp function over the time specified by *Motor Torque Ramp Time* (**D02**).

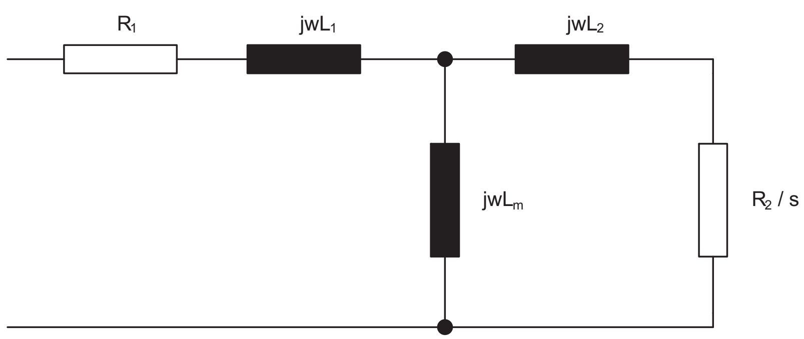
B33	**Transient Inductance Ld**		
Mode	Open-loop: RFC-A, RFC-S		
Minimum	0.000	**Maximum**	500.000
Default	0.000	**Units**	mH
Type	32 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	3
Coding	RW, RA		

See *Stator Resistance* (**B34**).

B34	**Stator Resistance**		
Mode	Open-loop: RFC-A, RFC-S		
Minimum	0.000000	**Maximum**	1000.000000
Default	0.000000	**Units**	Ω
Type	32 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	6
Coding	RW, RA		

Open-Loop, RFC-A

The *Stator Resistance* (**B34**), *Transient Inductance* (**B33**) and *Stator Inductance* (**B35**) are derived from the star connected per phase equivalent circuit of an induction motor shown below.



Steady state per phase star connected equivalent circuit of an induction motor

The steady state parameters are converted to equivalent transient model parameters:

$R_s = R_1$

$L_m = L_m$

$L_s = L_1 + L_m$

$L_r = L_2 + L_m$

$\sigma L_s = L_s - (L_m^2 / L_r)$

The equivalent drive parameters are:

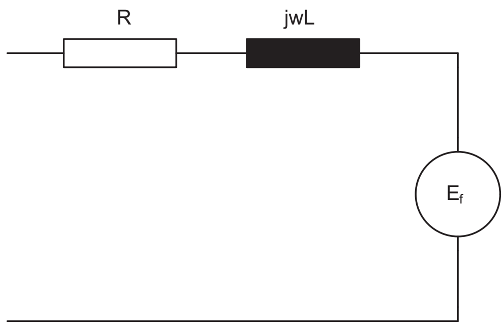
Stator Resistance (**B34**) = R_s

Transient Inductance (**B33**) = σL_s

Stator Inductance (**B35**) = L_s

RFC-S

The motor parameters used by the drive are derived from the star connected per phase equivalent circuit of a permanent magnet motor shown below.



Star connected equivalent circuit of a permanent magnet

Stator Resistance (**B34**) = R

Transient Inductance Ld (**B33**) = L in the d (flux) axis

No Load Lq (**B37**) = L in the q (torque) axis with no current in the motor

Lq At The Defined Iq Test Current (**B40**) = L in the q axis with Id = 0 and Iq = *Lq At The Defined Iq Test Current* (**B40**)

Lq At The Defined Id Test Current (**B42**) = L in the q axis with Id = *Lq At The Defined Id Test Current* (B42) and Iq = 0.

B35	Stator Inductance		
Mode	Open-loop: RFC-A		
Minimum	0.00	**Maximum**	500.00
Default	0.00	**Units**	mH
Type	32 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	2
Coding	RW, RA		

See *Stator Resistance* (**B34**).

B36	Saliency Torque Control		
Mode	RFC-S		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Disabled
1	Low
2	High

Most permanent magnet motors include some saliency due to saturation and physical construction. Torque is normally produced by interaction between the magnet flux and the stator current, but any saliency can be exploited to produce additional torque, which can increase the torque per Amp produced by the motor. If *Saliency Torque control* (**B36**) = 0 (disabled) torque is only produced from the magnet flux. If *Saliency Torque control* (**B36**) is set to a value of 1 or 2, and Rated Torque Angle is non-zero, the saliency of the motor will be used to produce additional torque. If the motor has low saliency, i.e. Lq < Lq x 1.5 then *Saliency Torque control* (**B36**) should be set to 1 otherwise it should be set to 2.

See *Rated Torque Angle* (**AS89**) for a list of parameters that should be set up correctly for the motor to derive this value and allow saliency torque to be exploited correctly.

Lq At The Defined Id Test Current (**B42**) = L in the q axis with Id = *Lq At The Defined Id Test Current* (**B42**) and Iq = 0.

B37	No Load Lq		
Mode	RFC-S		
Minimum	0.000	Maximum	500.000
Default	0.000	Units	mH
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, RA		

Motor q axis inductance with no current in the motor.

B38	Iq Test Current For Inductance Measurement		
Mode	RFC-S		
Minimum	0	Maximum	200
Default	100	Units	%
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Maximum test current level used for Iq during auto-tuning when measuring the motor inductance and phase offset as a percentage of *Motor Rated Current* (**B02**). This value is also used by the sensorless control algorithm to define the motor inductance and a reference frame phase offset at different levels of Iq. The values of *Lq At The Defined Iq Test Current* (**B40**) and *Phase Offset At Iq Test Current* (**B39**) should be the values which correspond to the test current level and will be set up during locked rotor auto tune tests (contact drive supplier for mor details). Alternatively these values can be set up by the user. For most motors *Phase Offset At Iq Test Current* (**B39**) will be zero and have little affect on the performance, however Lq is likely to vary significantly with Iq and should be set up correctly for good performance. If *Lq At The Defined Iq Test Current* (**B40**) or *Iq Test Current For Inductance Measurement* (**B38**) are zero then the estimate of Lq will not be affected by the level of Iq, and if *Phase Offset At Iq Test Current* (**B39**) or *Iq Test Current For Inductance Measurement* (**B38**) are zero the phase offset will not be affected by the level of Iq.

B39	Phase Offset At Iq Test Current		
Mode	RFC-S		
Minimum	-90.0	Maximum	90.0
Default	0.0	Units	°
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, RA		

Phase Offset At Iq Test Current (**B39**) defines the offset of the point of minimum inductance as an electrical angle from the point with no current in the motor to the point with a level of Iq equivalent to *Iq Test Current For Inductance Measurement* (**B38**). When the value is left at its default value of zero no compensation for phase offset with changes in Iq are made. *Phase Offset At Iq Test Current* (**B39**) is used for low speed RFC sensorless control using injection mode. A positive value advances the point of minimum inductance with positve Iq. See *Sensorless Low Speed Mode* (**C15**). For most motors a value of zero is acceptable.

B40	Lq At The Defined Iq Test Current		
Mode	RFC-S		
Minimum	0.000	Maximum	500.000
Default	0.000	Units	mH
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, RA		

Motor q axis inductance with no current in the d axis and the current defined by *Iq Test Current For Inductance Measurement* (**B38**) in the q axis of the motor. If this parameter is left at its default value of zero then no compensation is made to the value of Lq with changes in Iq.

B41	Id Test Current for Inductance Measurement		
Mode	RFC-S		
Minimum	-100	Maximum	0
Default	-50	Units	%
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Minimum test current level used for Id during auto-tuning when measuring the motor inductance as a percentage of *Motor Rated Current* (**B02**). This is then used in a similar way as *Iq Test Current For Inductance Measurement* (**B38**) to estimate the value of Lq used in the control algorithms as Id changes. If *Lq At The Defined Id Test Current* (**B42**) or *Id Test Current for Inductance Measurement* (**B41**) are set to zero then no compensation is made for changes in Lq with Id.

B42	**Iq At The Defined Id Test Current**		
Mode	RFC-S		
Minimum	0.000	**Maximum**	500.000
Default	0.000	**Units**	mH
Type	32 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	3
Coding	RW, RA		

Motor q axis inductance with no current in the q axis and the current defined by *Id Test Current for Inductance Measurement* (**B41**) in the d axis of the motor. If this parameter is left at its default value of zero then no compensation is made to the value of Lq with changes in Id.

B43	**Estimated Lq**		
Mode	RFC-S		
Minimum	0.000	**Maximum**	500.000
Default		**Units**	mH
Type	32 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	3
Coding	RO, FI, ND, NC, PT		

In sensorless mode the drive estimates a value for Lq to use in the control algorithm. *Estimated Lq* (**B43**) shows the calculated value.

B44	**Low Speed Thermal Protection Mode**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Motor Thermal Time Constant 1* (**B20**).

B45	**Quasi Square Enable**		
Mode	Open-Loop		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

If *Quasi-square Enable* (**B45**) = 0 then the output of the drive is limited to a modulation index of unity, which limits the output voltage to a level just below *D.c. Bus Voltage* (**J65**) / √2. Therefore, if the drive is being supplied via its own rectifier input stage the output voltage is limited to a level just below that of the supply voltage or *Motor Rated Voltage* (**B03**) whichever is lower.

If *Quasi-square Enable* (**B45**) = 1 then the limit imposed by *Quasi-square Enable* (**B45**) is ignored and the modulation index is allowed to increase beyond unity. As the output voltage increases the output voltage changes through trapezoidal waveforms to a quasi-square wave output. This mode is useful where the ratio between the switching frequency and the fundamental output frequency is less than 12, as it removes any sub-harmonic effects that occur. However, it does produce significant multiple odd harmonics of the output frequency in the output currents which cause acoustic noise, torque ripple and motor heating.

B46	Maximum Deadtime Compensation		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.000	**Maximum**	10.000
Default	0.000	**Units**	us
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	3
Coding	RO, NC, PT		

Maximum Deadtime Compensation (**B46**) is the deadtime compensation used to compensate for dead-time effects in the inverter. This level of compensation is used when the drive output current is above *Current At Maximum Deadtime Compensation* (**B47**). Both of these values related to dead-time compensation are measured during auto-tuning and cannot be set by the user. It should be noted that if the auto-tuning test is not performed and *Maximum Deadtime Compensation* (**B46**) = 0 then dead-time compensation is disabled. Although it is not recommended, it is possible to disable dead-time compensation by setting *Disable Deadtime Compensation* (**B48**) = 1.

B47	Current At Maximum Deadtime Compensation		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.00	**Maximum**	100.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	2
Coding	RO, NC, PT		

See *Maximum Deadtime Compensation* (**B46**).

B48	Disable Deadtime Compensation		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Maximum Deadtime Compensation* (**B46**).

B49	Disable Deadtime Compensation		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	100
Default	0	**Units**	%
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Motor Autotune* (**B11**)

8.2 Menu C: Encoder

Figure 8-5 Drive Encoder Interface

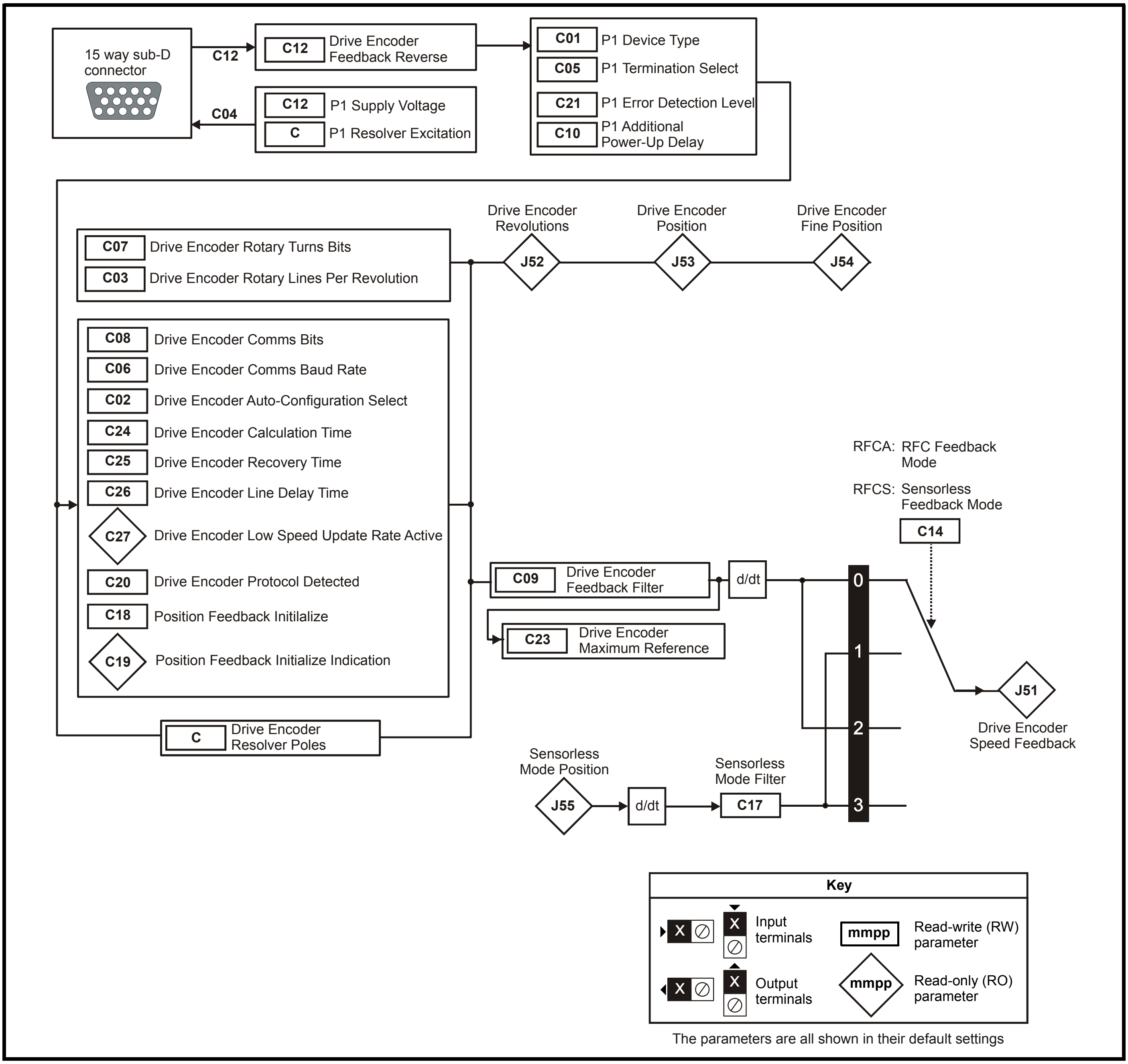
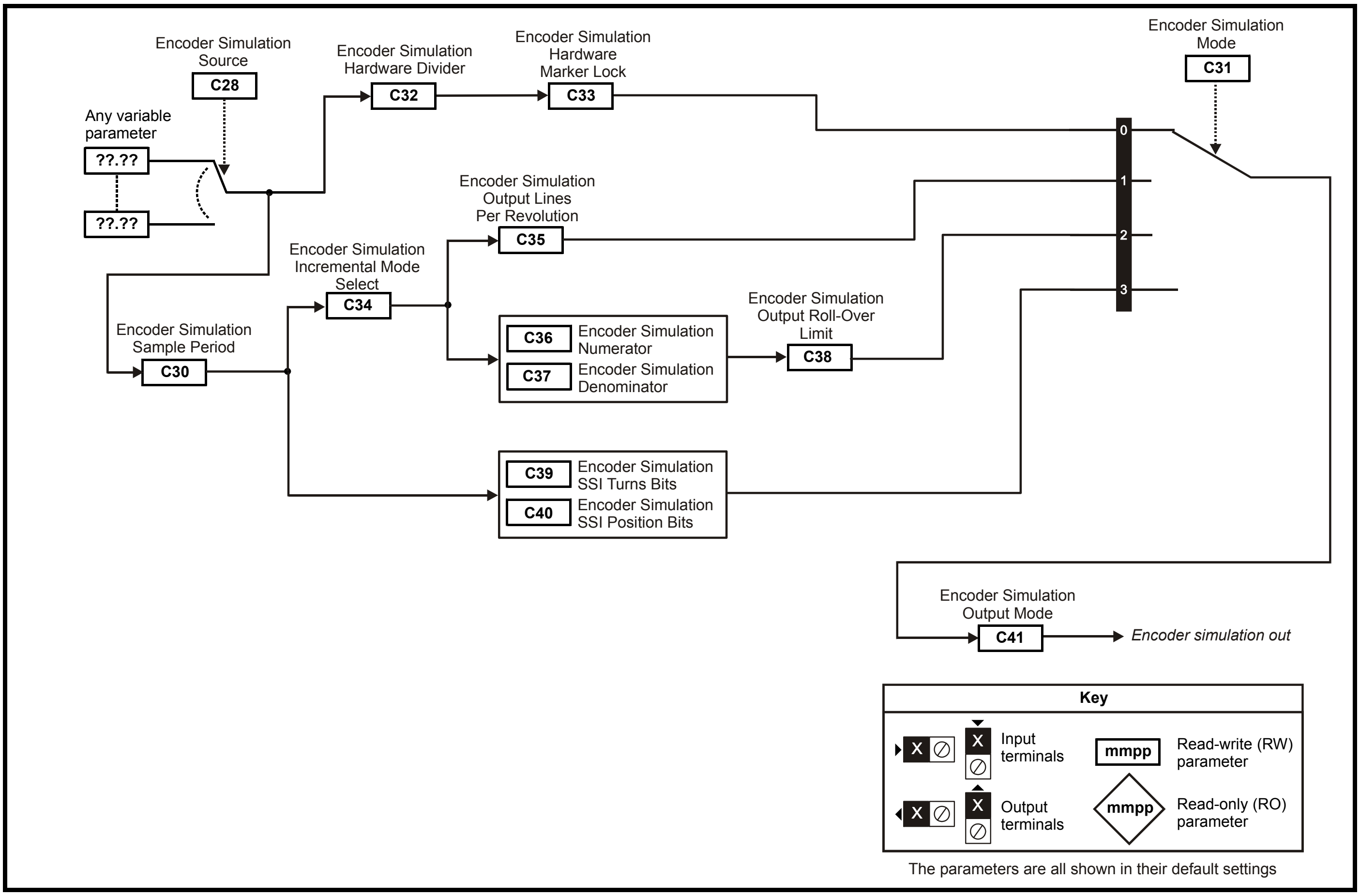


Figure 8-6 Encoder Simulation



Parameter		Range(⇕) RFC-A	Range(⇕) RFC-S	Default(⇨) RFC-A	Default(⇨) RFC-S	Type					
C01	Drive Encoder Type	AB (0), FD (1), FR (2), AB Servo (3), FD Servo (4), FR Servo (5), SC (6), SC Hiperface (7), EnDat (8), SC EnDat (9), SSI (10), SC SSI (11), SC Servo (12), BiSS (13), SC SC (15), Commutation Only (16)		AB (0)	SC EnDat (9)	RW	Txt				US
C02	Drive Encoder Auto Configuration Select	Disabled (0), Enabled (1)		Enabled (1)		RW	Txt				US
C03	Drive Encoder Rotary Pulses Per Revolution	1 to 100000		1024	2048	RW	Num				US
C04	Drive Encoder Voltage Select	5V (0), 8V (1), 15V (2)		5V (0)		RW	Txt				US
C05	Drive Encoder Termination Select	0 to 2		1		RW	Num				US
C06	Drive Encoder Comms Baud Rate	100k (0), 200k (1), 300k (2), 400k (3), 500k (4),1M (5), 1.5M (6), 2M (7), 4M (8) Baud		300k (2) Baud		RW	Txt				US
C07	Drive Encoder Rotary Turns Bits	0 to 16		16		RW	Num				US
C08	Drive Encoder Comms Bits	0 to 48		0		RW	Num				US
C09	Drive Encoder Feedback Filter	Disabled (0), 1 ms (1), 2 ms (2), 4 ms (3), 8 ms (4), 16 ms (5)		Disabled (0)		RW	Txt				US
C10	Drive Encoder Additional Power Up Delay	0.0 to 25.0 s		1.5 s		RW	Num				US
C11	Drive Encoder Position Feedback Signals	000000 to 111111				RO	Bin	ND	NC	PT	
C12	Drive Encoder Feedback Reverse	Off (0) or On (1)		Off (0)		RW	Bit				US
C14	RFC-A: RFC Feedback Mode RFC-S: Sensorless Feedback Mode	Feedback (0), Sensorless (1), Feedback NoMax (2), Sensorless NoMax (3)		Feedback (0)		RW	Txt				US
C17	Sensorless Mode Filter	4 (0), 8 (1), 16 (2), 32 (3), 64 (4) ms		4 (0) ms		RW	Txt				US
C18	Position Feedback Initialise	Off (0) or On (1)		Off (0)		RW	Bit		NC		
C19	Position Feedback Initialized Indication	0000000000 to 1111111111		0000000000		RO	Bin		NC	PT	
C20	Drive Encoder Protocol Detected	None (0), Hiperface (1), EnDat2.1 (2), EnDat2.2 (3), BiSS (4)				RO	Txt	ND	NC	PT	
C21	Drive Encoder Error Detection Level	0000 to 1111		0001		RW	Bin				US
C22	Drive Encoder Error Detected	Off (0) or On (1)				RO	Bit	ND	NC	PT	
C23	Drive Encoder Source Maximum Reference	0 to 33000		1500	3000	RW	Num				US
C24	Drive Encoder Calculation Time	0 to 20 μs		5 μs		RW	Num				US
C25	Drive Encoder Recovery Time	5 to 100 μs		30 μs		RW	Num				US
C26	Drive Encoder Line Delay Time	0 to 5000 ns				RO	Num	ND	NC	PT	US
C27	Drive Encoder Low Speed Update Rate Active	Off (0) or On (1)				RO	Bit	ND	NC	PT	
C28	Encoder Simulation Source	A00 to AB99		A00		RW	Num			PT	US
C29	Encoder Simulation Status	None (0), Full (1), No Marker Pulse (2)				RO	Txt	ND	NC	PT	
C30	Encoder Simulation Sample Period	0.25 (0), 1 (1), 4 (2), 16 (3) ms		0.25 (0) ms		RW	Txt				US
C31	Encoder Simulation Mode	Hardware (0), Lines Per Rev (1), Ratio (2), SSI (3)		Hardware (0)		RW	Txt				US
C32	Encoder Simulation Hardware Divider	0 to 7		0		RW	Num				US
C33	Encoder Simulation Hardware Marker Lock	Off (0) or On (1)		Off (0)		RW	Bit				US
C34	Encoder Simulation Incremental Mode Select	Off (0) or On (1)		Off (0)		RW	Bit				US
C35	Encoder Simulation Output Lines Per Revolution	1 to 16384		4096		RW	Num				US
C36	Encoder Simulation Numerator	1 to 65536		65536		RW	Num				US
C37	Encoder Simulation Denominator	1 to 65536		65536		RW	Num				US
C38	Encoder Simulation Output Roll-over Limit	1 to 65535		65535		RW	Num				US
C39	Encoder Simulation SSI Turns Bits	0 to 16		16		RW	Num				US
C40	Encoder Simulation SSI Comms Bits	2 to 48		33		RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Mode: RFC A, RFC-S

C01	Drive Encoder Type		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	16
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt		

Value	Text
0	AB
1	FD
2	FR
3	AB Servo
4	FD Servo
5	FR Servo
6	SC
7	SC Hiperface
8	EnDat
9	SC EnDat
10	SSI
11	SC SSI
12	SC Servo
13	BiSS
15	SC SC
16	Commutation Only

Drive Encoder Type (**C01**) should be set up to match the device connected to the Drive position feedback interface. The table below gives the position feedback types supported by the Drive position feedback interface.

Drive Encoder Type (C01)	Signals	Position feedback type	Communications
0: AB	Quadrature	Incremental	None
1: FD	Frequency and direction	Incremental	None
2: FR	Forward and reverse	Incremental	None
3: AB Servo	Quadrature and commutation	Absolute commutation signals with incremental	None
4: FD Servo	Frequency and direction, and commutation	Absolute commutation signals with incremental	None
5: FR Servo	Forward and reverse, and commutation	Absolute commutation signals with incremental	None
6: SC	SINCOS	Incremental SINCOS	None
7: SC Hiperface	SINCOS and Hiperface comms	Absolute comms with incremental SINCOS	Hiperface
8: EnDat	EnDat comms	Absolute comms	EnDat 2.1 EnDat 2.2
9: SC EnDat	SINCOS and EnDat comms	Absolute comms with incremental SINCOS	EnDat 2.1
10: SSI	SSI comms	Absolute comms	SSI
11: SC SSI	SINCOS and SSI comms	Absolute comms with incremental SINCOS	SSI
12: SC Servo	SINCOS and commutation	Absolute commutation signals with incremental	None
13: BiSS	BiSS comms	Absolute comms	BiSS
15: SC SC	SINCOS and single sine and cosine signals per revolution	SINCOS with absolute position from single sine and cosine signals	None
16: Commutation Only	Commutation only	Absolute commutation signals only	None

Position feedback type

Incremental

Position devices that provide incremental feedback do not give absolute position feedback. The position is zero at power-up and accumulates the change of position from that point on. These devices are suitable for motor control in RFC-A mode. They can also be used for RFC-S mode, but some form of phasing auto-tune is required each time the position feedback is initialized.

Absolute commutation signals with incremental

Position devices with commutations signals are intended to provide absolute position feedback for motor control in RFC-S mode. If one of these devices is used for RFC-A mode the commutation signals are ignored. The position information given in *Drive Encoder Revolutions* (**J52**), *Drive Encoder Position* (**J53**) and *Drive Encoder Fine Position* (**J54**) appears as though the position feedback device is an incremental type in that it is initialized to zero at power-up and then accumulates the change of position from that point on. The commutation signals are used directly by the motor control algorithms in RFC-S mode to determine the motor position after position feedback initialization. There must be one period of the commutation signals for each pole pair for a rotary motor (i.e. 3 commutation signal periods per revolution for a 6 pole motor), or one period of the commutation signals must be equal to the motor pole pitch for a linear motor. It should be noted that for a movement of up to 1/3 of the commutation signal period after position feedback initialization the maximum motor torque is limited to 0.866 of the maximum possible torque.

Absolute commutation signals only

Position devices with commutations signals are intended to provide absolute position feedback for motor control in RFC-S mode but can also be used to provide position feedback for motor control in RFC-A mode. The position is derived from the commutation signals alone. A phase locked loop is used to smooth the feedback, but this introduces a delay and there is significant ripple in the position and speed feedback at low speeds. If this method is used for motor control then low speed loop gains should be used and the *Drive Encoder Feedback Filter* (**C09**) should be set to its maximum value.

Incremental SINCOS

An incremental SINCOS encoder can be used in the same way as an AB incremental encoder, except that the position resolution is increased with interpolation. These devices are suitable for motor control in RFC-A mode. They can also be used for RFC-S mode, but some form of phasing auto-tune is required each time the position feedback is initialized.

Absolute comms with incremental SINCOS

The absolute position is obtained after position feedback initialization via the comms interface and then after that point by tracking the incremental change from the sine wave signals. Interpolation is used to increase the position resolution. The comms interface can be used to check the position derived from the sine waves. It can also be used for bi-direction transfer of data between the drive and encoder (except SSI comms). These devices can be used for motor control in RFC-A or RFC-S modes.

Absolute comms

The absolute position is obtained at all times via the encoder comms. The comms interface can also be used for bi-directional transfer of data between the drive and the encoder (except SSI mode). These devices can be used for motor control in RFC-A or RFC-S modes.

SINCOS with absolute position from sine and cosine signals

This type of device, which is not recommended for new applications, is intended to provide absolute position feedback for motor control in RFC-S mode. If one of these devices is used for RFC-A mode the additional sine wave signals and the Z1 marker signal do not affect the motor control position feedback. The position information given in *Drive Encoder Position* (**J53**) and *Drive Encoder Fine Position* (**J54**) is initialized to the position within one turn and *Drive Encoder Revolutions* (**J52**) is set to zero when the device is initialized based on the once per turn sine and cosine signals. This gives a moderately accurate absolute position. When a marker event occurs it is used to give a more accurate absolute position. Care should be taken to ensure that the position feedback device is connected correctly.

For example a Heidenhain ERN1387 device should be connected as follows: 1/2=A+/A-(Cosine), 3/4=B+/B-(Sine), 5/6=R+/R-(Marker), 7/8=C+/C-(Single turn cosine), 9/10=(Single turn sine). It is assumed that the marker occurs at the positive zero crossing of the single turn cosine signal when operating in the forwards direction (i.e. compatible with the ERN1387).

Communications

Hiperface

Hiperface is an asynchronous bi-direction communications protocol that is only used with incremental sine waves. Therefore it can be used to check the position derived from the sine waves or for bi-direction transfer of data between the drive and encoder. A checksum is provided for error checking.

EnDat 2.1

EnDat 2.1 is a synchronous bi-direction communications protocol that is intended to be used with incremental sine waves. Therefore it can be used to check the position derived from the sine waves or for bi-direction transfer of data between the drive and encoder. It can be used as an absolute comms only type position feedback interface, but the resolution of the position feedback using this method may be limited. If it is used in this way it is not possible to use the position feedback via comms at the same time as communicating with the encoder for data transfer. A CRC is provided for error checking.

EnDat 2.2 and BiSS C Mode

EnDat 2.2. and BiSS are synchronous bi-direction communications protocols that are intended to be used alone. It is possible to obtain position feedback at the same time as communicating with the encoder for data transfer. A CRC is provided for error checking.

SSI

SSI is a uni-directional communications protocol that is intended to be used alone. It is only possible to obtain the position information from the encoder and it is not possible to transfer data between the drive and the encoder. No error checking is provided by the SSI protocol, and so encoders based on this interface are not recommended for new applications.

C02	Drive Encoder Auto Configuration Select		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt		

Value	Text
0	Disabled
1	Enabled

Drive Encoder Type (C01): SC Hiperface, SC EnDat, EnDat, BiSS

If auto-configuration has not been disabled (i.e. *Drive Encoder Auto Configuration Select* (**C02**) is not 0) then during position feedback initialization the encoder is interrogated and the following parameters are set up based on information from the encoder:

Rotary
Drive Encoder Rotary Turns Bits (**C07**)
Drive Encoder Rotary Lines Per Revolution (**C03**)
Drive Encoder Comms Bits (**C08**)

The following actions are also taken to set up the timing for the encoder.

Comms Protocol	Actions taken
EnDat 2.1	*Drive Encoder Calculation Time* (**C24**) = From the encoder *Drive Encoder Recovery Time* (**C25**) = 30 µs Line delay measured and result written to *Drive Encoder Line Delay Time* (**C26**)
EnDat 2.2	*Drive Encoder Calculation Time* (**C24**) = From the encoder *Drive Encoder Recovery Time* (**C25**) = 4 µs and the recovery time within the encoder is set up to the shortest value of 3.75 µs if the *Drive Encoder Comms Baud Rate* (**C06**) is 1M or more.Line delay measured and result written to *Drive Encoder Line Delay Time* (**C26**)
BiSS	*Drive Encoder Recovery Time* (**C25**) = 12 µs Line delay measured and result written to *Drive Encoder Line Delay Time* (**C26**)

Once these parameters have been set up it should be possible for the drive to operate correctly with the encoder. Auto-configuration occurs as part of the position interface initialization if selected, and so if the auto-configuration fails (i.e. communications cannot be established) then initialization will not be completed. If initialization has not been completed successfully by the time the drive is enabled an Encoder 7 trip occurs. For SC Hiperface and BiSS encoders the drive must identify the encoder model number to perform auto-configuration. If communications is established, but the drive cannot recognise the encoder model, an Encoder 12 trip is produced immediately.

If auto-configuration is disabled ((i.e. Drive Encoder *Auto Configuration Select* (**C02**) = 0) then none of the above actions are carried out except for the line delay measurement.

Drive Encoder Type (C01): All other device types

Drive Encoder Auto Configuration Select (**C02**) has no effect.

C03	**Drive Encoder Rotary Lines Per Revolution**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	100000
Default	1024	**Units**	
Type	32 Bit User Save	**Update Rate**	Background read, auto-configuration write
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Drive Encoder Type (C01): AB, AB Servo

Drive Encoder Rotary Lines Per Revolution (**C03**) should be set to the number of lines per revolution for the encoder connected to the Drive position feedback interface.

Drive Encoder Type (C01): FD, FR, FD Servo, FR Servo

Drive Encoder Rotary Lines Per Revolution (**C03**) should be set to the number of lines per revolution for the encoder connected to the Drive position feedback interface divided by 2.

Drive Encoder Type (C01): SC, SC Servo, SC Hiperface, SC EnDat, SC SSI, SC SC

Drive Encoder Rotary Lines Per Revolution (**C03**) should be set to the number of sine waves per revolution for the encoder connected to the Drive position feedback interface.

Drive Encoder Type (C01): Any other device type

Drive Encoder Rotary Lines Per Revolution (**C03**) has no effect.

C04	**Drive Encoder Voltage Select**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt		

Value	Text
0	5 V
1	8 V
2	15 V

Drive Encoder Voltage Select (**C04**) sets the level for the supply voltage output. To ensure that the maximum voltage for the position feedback device is not accidentally exceeded, the device should be disconnected from the drive when the level is being adjusted.

C05	**Drive Encoder Termination Select**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	2
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Drive Encoder Termination Select (**C05**) is used to enable or disable the terminations on the position feedback interface inputs. The function of Drive *Encoder Termination Select* (**C05**) depends on the position feedback device type selected in *Drive Encoder Type* (**C01**) as shown below.

Terminals 5/6 have selectable pull-apart resistors which follow the same state as the termination resistors for terminals 1/2 and 3/4, unless described differently below.

Drive Encoder Type (C01): AB, FD, FR, AB Servo, FD Servo, FR Servo

Terminal	Input	C05 = 0	C05 = 1	C05 = 2
1/2 & 3/4	A1 & B1	Disabled	Enabled	Enabled
5/6	Z1	Disabled	Disabled	Enabled

U1, V1 & W1 terminations (terminals 7/8, 9/10 & 11/12) are always enabled for AB Servo, FD Servo and FR Servo encoders.

Drive Encoder Type (C01): SC, SC Servo, SC SC

Terminal	Input	C05 = 0	C05 = 1	C05 = 2
1/2 & 3/4	Cos1 & Sin1	Disabled	Enabled	Enabled
5/6	Z1	Disabled	Disabled	Enabled

U1, V1 & W1 (terminals 7/8, 9/10 & 11/12) terminations are always enabled for SC Servo encoders. SCs1 and SSn1 (terminals 7/8 & 9/10) terminations are always enabled for SC SC encoders.

Drive Encoder Type (C01): SC Hiperface, SC EnDat, SC SSI

Terminal	Input	C05 = 0	C05 = 1	C05 = 2
1/2 & 3/4	Cos1 & Sin1	Disabled	Enabled	Enabled
5/6	D1	Enabled	Enabled	Enabled

For SC EnDat and SC SSI encoder the pull-apart resistors on the D1 input/output (terminals 5/6) are always disabled, and for SC Hiperface encoders the pull-apart resistors on the D1 input/output (terminals 5/6) are always enabled.

Drive Encoder Type (C01): EnDat, BiSS, SSI

Terminal	Input	C05 = 0	C05 = 1	C05 = 2
1/2 & 3/4	D1/CLK1	Enabled	Enabled	Enabled
5/6	Z1	Disabled	Disabled	Enabled

Drive Encoder Type (C01): Commutation Only

Drive Encoder Termination Select (**C05**) has no effect as terminations are always enabled.

C06	Drive Encoder Comms Baud Rate		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	8
Default	2	**Units**	Baud
Type	8 Bit User Save	**Update Rate**	Background read, Auto-configuration write
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt		

Value	Text
0	100 k
1	200 k
2	300 k
3	400 k
4	500 k
5	1 M
6	1.5 M
7	2 M
8	4 M

Drive Encoder Comms Baud Rate (**C06**) defines the baud rate used for encoder communications. Restrictions are applied to the baud rate for different feedback devices, and so the baud rate may be different to the parameter value.

Drive Encoder Type (C01): SC.Hiperface

A fixed baud rate of 9600 baud is always used with this type of encoder so *Drive Encoder Comms Baud Rate* (**C06**) has no effect.

Drive Encoder Type (C01): SC.SSI, SC EnDat

Any baud rate that is within the range specified for the encoder may be used. The data from the encoder is not used for time critical functions, and so it is recommended that the default value of 300 K baud is used unless this needs to be reduced because of a limitation imposed by the encoder.

Drive Encoder Type (C01): EnDat, BiSS, SSI

Any baud rate that is within the range specified for the encoder may be used. The line delay is measured during initialization, and used to compensate this delay during communications with the encoder. Therefore there is no timing based restriction on the length of the cable between the position feedback interface and the encoder. However, care should be taken to ensure that the wiring arrangement and the type of cable used are suitable for the selected baud rate and the distance between the position interface and the encoder. See *Drive Encoder Low Speed Update Rate Active* (**C27**) for more details on timing restrictions related to the drive sample times.

Drive Encoder Type (C01): Any other device

Drive Encoder Comms Baud Rate (**C06**) has no effect.

C07	Drive Encoder Rotary Turns Bits		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	16
Default	16	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read, Auto-configuration write
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Drive Encoder Type (C01): SC Hiperface, SC EnDat, SC SSI, EnDat, BISS, SSI

Drive Encoder Rotary Turns Bits (**C07**) is used to determine the number of bits within the comms messages from the position feedback device that represent turns. For a single turn encoder *Drive Encoder Rotary Turns Bits* (**C07**) must be set to zero. It should be noted that some SSI encoders include leading zeros before the turns information and in this case the number of turns bits should include the leading zeros. The most significant bits in *Drive Encoder Revolutions* (**J52**) that are not included in the turns information provided by the encoder comms are held at zero. If *Drive Encoder Rotary Turns Bits* (**C07**) = 0 (single turn encoder) the whole of *Drive Encoder Revolutions* (**J52**) is held at zero. The number of bits of position information for a rotary device are calculated from *Drive Encoder Rotary Turns Bits* (**C07**) and *Drive Encoder Comms Bits* (**C08**). If the resulting value is greater than 32 it is limited to 32.

Drive Encoder Type (C01): Any other device type

It is sometimes desirable to mask off the most significant bits of *Drive Encoder Revolutions* (**J52**), but this does not have to be done for the drive to function correctly. If *Drive Encoder Rotary Turns Bits* (**C07**) = 0 the whole of *Drive Encoder Revolutions* (**J52**) is held at zero. If *Drive Encoder Rotary Turns Bits* (**C07**) has any other value it indicates the number of bits in *Drive Encoder Revolutions* (**J52**) that are not held at zero. For example, if *Drive Encoder Rotary Turns Bits* (**C07**) = 5, then *Drive Encoder Revolutions* (**J52**) counts up to 31 before being reset.

C08	**Drive Encoder Comms Bits**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	48
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read, Auto-configuration write
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Drive Encoder Type (C01): SC Hiperface, EnDat, SC EnDat, SSI, SC.SSI, BiSS

Drive Encoder Comms Bits (**C08**) should be set to the total number of bits of position information in the comms message from the encoder. If SSI communications is being used this should include any leading or trailing zeros and the power supply alarm bit if present.

Drive Encoder Type (C01): Any other device type

Drive Encoder Comms Bits (**C08**) has no effect.

C09	**Drive Encoder Feedback Filter**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	5
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt		

Value	Text
0	Disabled
1	1 ms
2	2 ms
3	4 ms
4	8 ms
5	16 ms

Drive Encoder Feedback Filter (**C09**) defines the time period for a sliding window filter that may be applied to the feedback taken from the Drive position feedback interface. This is particularly useful in applications where the drive encoder is used to give speed feedback for the speed controller and where the load includes a high inertia, and so the speed controller gains are very high. Under these conditions, without a filter on the feedback, it is possible for the speed loop output to change constantly from one current limit to the other and lock the integral term of the speed controller. In Unidrive SP this filter was applied to the output of the sensorless speed feedback, however, a separate filter is now provided (see *Sensorless Mode Filter* (**C17**)).

C10	**Drive Encoder Additional Power Up Delay**		
Mode	RFC-A, RFC-S		
Minimum	0.0	**Maximum**	25.0
Default	1.5	**Units**	s
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

When the position feedback is initialized, at power-up or at any other time, a delay is included before the information from the feedback device is used or any attempt is made to communicate with the device. The minimum delays are shown in the table below. *Drive Encoder Additional Power Up Delay* (**C10**) defines an additional delay that is added to the minimum delay.

Drive Encoder Type (C01)	Minimum delay
AB, FD, FR AB Servo, FD Servo, FR Servo SC, SC Serv, SC SC	100 ms
SC Hiperface	150 ms
EnDat, SC EnDat SSI, SC SSI BISS	1.3 s

C11	**Drive Encoder Position Feedback Signals**		
Mode	RFC-A, RFC-S		
Minimum	0 (Display: 000000)	**Maximum**	63 (Display: 111111)
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Binary	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Drive Encoder Position Feedback Signals (**C11**) shows the state of the signals from the position feedback device as given in the table below where the signals are relevant for the type of device. *Drive Encoder Position Feedback Signals* (**C11**) is only intended as a debugging aid.

***Drive Encoder Position Feedback Signals* (C11) bits**	**Signals**
0	A or F or Cos
1	B or D or R or Sin
2	Z
3	U
4	V
5	W

For Cos and Sin signals the relevant bits of *Drive Encoder Position Feedback Signals* (**C11**) will be set when the signals are positive and cleared when the signals are negative.

C12	**Drive Encoder Feedback Reverse**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

If *Drive Encoder Feedback Reverse* (**C12**) = 1 the position feedback is negated. This can be used to reverse the direction of the position feedback.

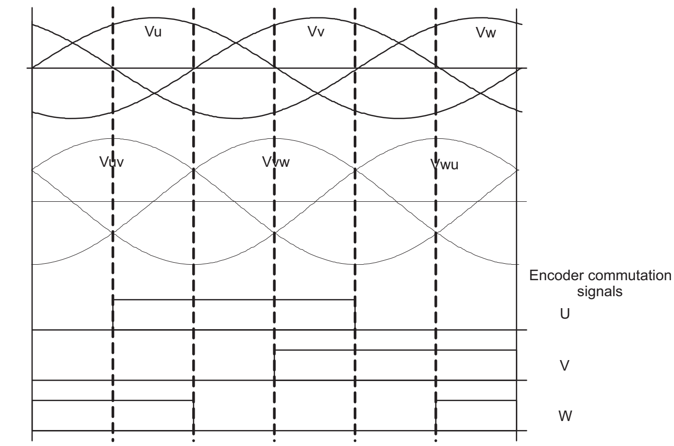
C13	**Position Feedback Phase Angle**		
Mode	RFC-S		
Minimum	0.0	**Maximum**	359.9
Default		**Units**	°
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	1
Coding	RW, ND		

The phase angle between the rotor flux and the feedback position must be set up correctly for the drive to control the motor correctly. If the phase angle is known it can be set in *Position Feedback Phase Angle* (**C13**) by the user. Alternatively the drive can automatically measure the phase angle by performing a phasing test (see *Motor Autotune* (**B11**)). When the test is complete the new value is automatically written to *Position Feedback Phase Angle* (**C13**). *Position Feedback Phase Angle* (**C13**) can be modified at any time and becomes effective immediately. *Position Feedback Phase Angle* (**C13**) has a factory default value of 0.0, but is not affected when defaults are loaded by the user.

The alignment required for zero position feedback phase angle (i.e. *Position Feedback Phase Angle* (**C13**) = 0.0) is given below for different feedback devices. Forward rotation of the motor is produced when Vu leads Vv leads Vw. Although it is not essential, forward rotation of a motor is normally defined as clockwise when looking at the motor shaft end. When the motor is rotating forwards the motor speed is shown as positive and the position increases.

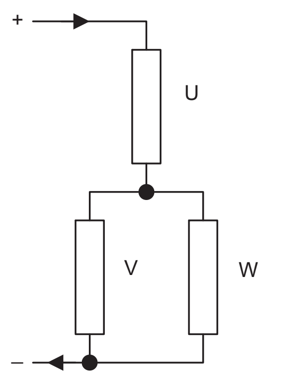
AB Servo, FD Servo, FR Servo

The alignment required between the no-load motor voltages and the commutation signals for *Position Feedback Phase Angle* (**C13**) = 0.0 is shown in the diagram below. It should be noted that if the encoder is advanced (i.e. the UVW signals are moved to the right with respect to the voltages) the angle in *Position Feedback Phase Angle* (**C13**) is increased from zero. If the encoder is retarded the angle changes to 359.9 and then reduces towards zero.



Position feedback phase angle alignment with commutation signals

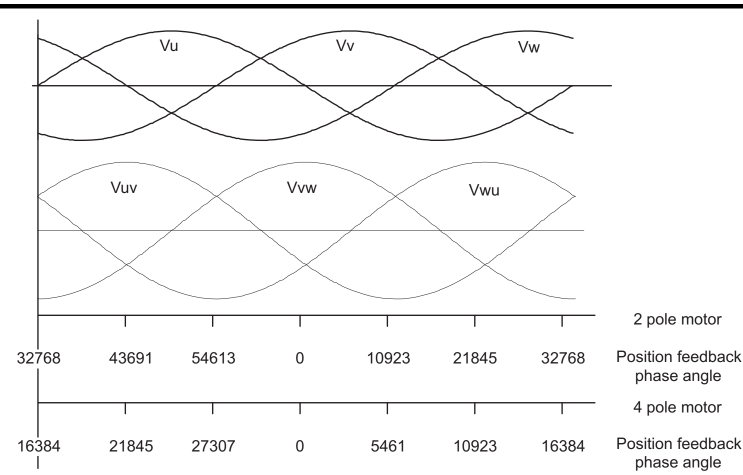
The encoder can be aligned statically by connecting the motor to a DC power supply as shown.



The motor will move to one of a number of positions defined by the number of motor pole pairs (i.e. 3 positions for a six pole motor, etc.). The encoder should be adjusted so that the U commutation signal is high, W is low and V is toggling in one of these positions.

Any other feedback device

The alignment required between the no-load motor voltages and the position feedback (i.e. Drive Encoder Position (J53) for the Drive position feedback interface) with *Position Feedback Phase Angle* (**C13**) = 0.0 is shown in the diagram below for a 2 or 4 pole motor. For higher numbers of poles the zero position should still be aligned as shown, but the one electrical cycle shown corresponds to 360° / (Number of poles / 2). It should be noted that if the position feedback device is advanced (i.e. the zero position is moved to the right with respect to the voltages) *Position Feedback Phase Angle* (**C13**) is increased from zero. If the position feedback is retarded *Position Feedback Phase Angle* (**C13**) changes to 359.9 and then reduces towards zero.



Position feedback phase angle alignment

The position feedback device can be aligned statically by connecting the motor to a d.c. power supply as already shown. The motor will move to one of a number of positions defined by the number of motor poles (i.e. 3 positions for a six pole motor, etc.). The position feedback device should be adjusted so that the position displayed by the drive is (n x 65536) / (Number of poles / 2), where n = 0, 1, etc.

C14	**RFC Feedback Mode**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	3
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	4ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt		

Value	Text
0	Feedback
1	Sensorless
2	Feedback NoMax
3	Sensorless NoMax

RFC Feedback Mode (**C14**), which can be changed even when the motor is running, selects the feedback method used to provide position feedback to control the motor. When sensorless mode is used, a filter with a 4 ms time constant is automatically included in the speed feedback as this is required for this system to operate correctly. The possible speed controller bandwidth will be reduced by a factor of approximately 10 compared with the bandwidth possible with a position feedback device. The maximum and minimum for the speed references are limited by the VM_POSITIVE_REF_CLAMP variable minimum/maximum which prevents the speed from exceeding the level where the position feedback cannot be interpreted correctly. This limit is disabled if *RFC Feedback Mode* (**C14**) is 2 or 3, so that it is possible to change between operation with or without position feedback if the speed range needs to be extended beyond the limit of the position feedback device. Care should be taken not to exceed a speed that would damage the position feedback device.

0: Position feedback

RFC mode is active using position feedback.

1: Sensorless

RFC mode using a sensorless algorithm to provide position feedback, is used to control the motor.

2: Position feedback with no maximum speed limit

RFC mode with position feedback. The maximum reference limit is disabled.

3: Sensorless with no maximum speed limit

RFC mode using a sensorless algorithm to provide position feedback, is used to control the motor. The maximum reference limit is disabled.

It should be noted that when sensorless mode is active the maximum torque that can be produced at low speeds (i.e. < 2 % or rated speed) is reduced.

C15	**Sensorless Low Speed Mode**		
Mode	RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt		

Value	Text
0	Injection
1	Non-salient

If sensorless mode is being used and is active and the motor speed is below *Motor Rated Speed* (**B07**) / 10 then a special low speed algorithm must be used to control the motor. *Sensorless Low Speed Mode* (**C15**) is used to select the algorithm to be used.

0: Injection

A high frequency signal is injected into the motor to detect the motor flux axis. This can be used in a similar way to operation with position feedback except that for the drive to remain stable the speed controller bandwidth may need to be limited to 10 Hz or less and the current limit may need to be limited (see *Sensorless Mode Low Speed Current* (**C16**)).

1: Non-salient

If the ratio Lq/Ld < 1.1 on no load then the injection mode cannot be used and this mode should be used instead. This mode does not provide the same level of control as injection mode and has the following restrictions:

1. Speed control is possible, but not torque control.
2. Spinning start is not possible and the motor must start from standstill.
3. Below *Motor Rated Speed* (**B07**) / 10 it will not be possible to produce more than approximately 60 % to 70 % of rated torque.
4. There may be some movement of the motor shaft in either direction as the motor starts.
5. It is not possible to measure the motor inertia using auto-tuning with *Motor Autotune* (**B11**) = 4.
6. Normally the ramp rate should not be slower than 5 s/1000 rpm when operating in the region below *Motor Rated Speed* (**B07**) / 10.
7. This mode is not intended to control the motor for prolonged periods below *Motor Rated Speed* (**B07**) / 10, but is intended to allow the motor to be started from standstill to run outside the low speed region.
8. This mode is not intended to allow motor reversals. If the direction does need to be reversed, the motor should be stopped and any oscillations must die away, before the motor is restarted in the other direction.

Sensorless Mode Low Speed Current (**C16**) defines a current applied in the motor d axis to aid starting. The default value is suitable for most motors with a load of up to 60% rated torque. However, in some applications this level may need to be adjusted.

C16	Sensorless Mode Low Speed Current		
Mode	RFC-S		
Minimum	0.0	**Maximum**	1000.0
Default	20.0	**Units**	%
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW, RA		

Injection mode

For low speed sensorless operation with signal injection (*Sensorless Low Speed Mode* (**C15**) = 0) it is necessary to have a ratio of Lq/Ld = 1.1. Even if a motor has a larger ratio on no load, this ratio normally reduces as the q axis current is increased from zero. *Sensorless Mode Low Speed Current* (**C16**) should be set at a level that is lower than the point where the inductance ratio falls to 1.1. The value of this parameter is used to define the drive current limits when signal injection is active and prevent loss of control of the motor.

Non-salient mode

For low speed sensorless operation for non-salient motors (*Sensorless Low Speed Mode* (**C15**) = 1) this defines a current applied in the d axis to aid starting. For most motors and application requiring up to 60 % torque on starting the default value is suitable. However the level of current may need to be increased to make the motor start.

C17	Sensorless Mode Filter		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	4
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt		

Value	Text
0	4
1	8
2	16
3	32
4	64

When sensorless mode is active, the measured speed can include some ripple which increases as the drive passes into field weakening. A filter is applied to the estimated speed and *Sensorless Mode Filter* (**C17**) defines the time constant. The default time constant is 4 ms, but this can be extended to improve the filtering. This is particularly useful when using standard ramp or spinning start with a low friction high inertia load, and can prevent over voltage trips when the drive has no braking resistor.

C18	**Position Feedback Initialize**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit Volatile	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, NC		

If *Position Feedback Initialize* (**C18**) is set to one any position feedback devices connected to the drive position feedback interfaces or any position feedback category option modules will be re-initialized.

C19	**Position Feedback Initialized Indication**		
Mode	RFC-A, RFC-S		
Minimum	0 (Display: 0000000000)	**Maximum**	1023 (Display: 1111111111)
Default	0 (Display: 0000000000)	**Units**	
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Binary	**Decimal Places**	0
Coding	RO, NC, PT		

Position Feedback Initialized Indication (**C19**) contains flags that represent the initialization state of position feedback devices connected to the drive position feedback interfaces or position feedback interfaces on position feedback category option modules. One indicates that the interface is initialized and zero indicates that the interface is not initialized.

The flags are assigned as shown below.

Bit	Position feedback interface
0	Drive
2	Option slot 1
4	Option slot 2
6	Option slot 3

If no option module, or an option module other than a position feedback category module, is installed in an option module slot then the relevant flag is always set to one. If an attempt is made to enable the drive when any of the flags are zero the drive initiates an Encoder 7 trip. If a drive reset is initiated, the bits in *Position Feedback Initialized Indication* (**C19**) are checked, and if any position feedback devices are not initialized an attempt is made to initialize them.

The table below shows the initialization process for different position feedback devices that can be connected to the drive.

Encoder types	Initialization process
AB, FD, FR	None. Initialization is immediate and is always successful. The position feedback is set to zero on initialization.
AB Servo FD Servo FR Servo SC Servo	The absolute position used to control a motor can only be defined accurately after two different changes of state of the UVW commutation signals. Initialization resets the system that ensures that the UVW signals alone will be used to define the motor position until the encoder has moved through two valid commutation signal state changes. Initialization is immediate and is always successful. The position feedback is set to zero on initialization.
SC	The SINCOS interpolation system must be initialised. Initialization is immediate and is always successful. The position feedback is set to zero on initialization.
SC Hiperface SC EnDat SC SSI	Auto-configuration if required except SC SSI. The absolute position must be obtained via comms. This may cause a large change in position feedback. The SINCOS interpolation system must be initialized. This may have a small effect on the position feedback.
EnDat BiSS SSI	Auto-configuration if required except SSI. The absolute position must be obtained via comms. This may cause a large change in position feedback.
SC SC	The absolute position used to control a motor is obtained from the sine and cosine signals provided for one revolution until the marker pulse occurs. The position obtained from the marker pulse is assumed to be a position of zero. Once a marker has occurred the incremental position is used and the single turn sine wave signals are ignored. When the position feedback device is initialised the single turn sine wave signals are used again until another marker event occurs. No part of the initialization process affects the position feedback seen in parameters, except that the SINCOS interpolation system must be initialized which may have a small effect on the position feedback. Initialization is immediate and is always successful.

C20	Drive Encoder Protocol Detected		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	4
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, Txt, ND, NC, PT		

Value	Text
0	None
1	Hiperface
2	EnDat2.1
3	EnDat2.2
4	BiSS

Drive Encoder Protocol Detected (**C20**) shows the encoder comms protocol detected during position feedback initialization. If *Drive Encoder Type* (**C01**) is set to SC Hiperface or BiSS then *Drive Encoder Protocol Detected* (**C20**) is set to the appropriate value after successful communication with the encoder during initialization. If *Drive Encoder Type* (**C01**) is set to EnDat or SC EnDat then *Drive Encoder Protocol Detected* (**C20**) is set to the appropriate EnDat protocol after successful communication with the encoder during initialization. If communications is not successful during initialization then *Drive Encoder Protocol Detected* (**C20**) is set to 0 (None).

C21	Drive Encoder Error Detection Level		
Mode	RFC-A, RFC-S		
Minimum	0 (Display: 0000)	**Maximum**	15 (Display: 1111)
Default	1 (Display: 0001)	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Binary	**Decimal Places**	0
Coding	RW		

This parameter can be used to enable or disable position feedback trip functions as follows:

Bit	Function
0	Enable wire break detection
1	Enable phase error detection
2	Enable SSI power supply alarm bit monitor
3	Disable trips Encoder 1 to Encoder 6

Encoder trips

The following table shows trips that can be initiated that are related to the position feedback interface. The sub-trip number is 1 for the Drive position feedback interface.

Drive trip	Encoders	Reason for error
*Encoder 1	All	Power supply short circuit
*Encoder 2	AB, FD, FR, AB Servo, FD Servo, FR Servo	+Hardware wire-break detect on A1, B1 and Z1 inputs[1]. There is no wire break detection on the U1, V1 and W1 commutation inputs
	SC, SC Servo, SC Hiperface, SC EnDat, SC SSI, SC SC	+Software wire break detection on sine wave signals. There is no wire break detection on the U1, V1 and W1 commutation inputs
*Encoder 3	AB Servo, FD Servo, FR Servo, SC Servo	+Phase error [2]
	SC Hiperface, SC EnDat, SC SSI	+Sine/cosine phase error [3]
*Encoder 4	SC Hiperface, SC EnDat, EnDat, BISS	Comms timeout
* Encoder 5	SC Hiperface, SC EnDat, EnDat, BISS	Checksum/CRC error
	SC SSI, SSI	Not ready at start of position transfer (i.e. data input not one)
* Encoder 6	SC Hiperface, SC EnDat, EnDat, BiSS	The encoder has indicated an error
	SSI, SC SSI	+Power supply alarm bit active
* Encoder 7	All	A set-up parameter for the device has been changed.
Encoder 8	EnDat, SSI, BiSS	*Drive Encoder Type* (**C01**), *Drive Encoder Comms Bits* (**C08**), *Drive Encoder Comms Baud Rate* (**C06**), *Drive Encoder Calculation Time* (**C24**), *Drive Encoder Recovery Time* (**C25**), *Drive Encoder Line Delay Time* (**C26**) are used to determine the time taken for the communications exchange with the encoder. If this time exceeds 250 μs an Encoder 8 trip is initiated.
Encoder 9	All	Speed feedback selected from an option slot that does not have a position feedback category option module installed
Phasing Error	All	Incorrect encoder phasing [4]
Encoder 12	SC Hiperface, BiSS	The encoder could not be identified during auto-configuration
Encoder 13	SC Hiperface, SC EnDat, EnDat, BiSS	Data read from the position feedback device during auto-configuration is out of range

+ These trips can be enabled or disabled with *Drive Encoder Error Detection Level* (**C21**) bits 0 to 2

* These trips can be enabled or disabled with *Drive Encoder Error Detection Level* (**C21**) bit 3

1. If the terminations are not enabled on the A1, B1 or Z1 inputs the wire break system will not operate. (Note that as default the Z1 input terminations are disabled to disable wire break detection on this input.)
2. Phase error detection for AB Servo, FD Servo, FR Servo or SC Servo encoders monitors the relationship between the position from the incremental signals and the commutation signals to ensure that the incremental pulses have been counted correctly. The error is detected if the incremental position moves outside the position range defined by the UVW commutation signals by 10°. The trip is initiated if the error is detected for 10 consecutive samples. This system should not be used unless 10° electrical is less than one encoder line (AB Servo), or two lines (FD Servo, FR Servo), or one sine wave (SC Servo) or else spurious Encoder 3 trips will occur.
3. Phase error detection for SINCOS encoders with comms monitors the relationship between the position derived from the sine waves with the position derived via comms. The encoder is interrogated via comms and the comparison is made once per second. If the error is greater than 10° electrical for 10 consecutive samples the trip is initiated. This system should not be used unless 10° electrical is less than one sine wave or else spurious Encoder 3 trips will occur.
4. Incorrect encoder phasing is detected if the motor reaches half of the speed defined by VM_SPEED_FREQ_REF[MAX] and the phasing error is large enough for the motor to accelerate uncontrollably.

Wire-break detection

It may be important to detect a break in the connections between the drive and the position feedback device. This feature is provided for most position feedback devices either directly or indirectly as listed below.

Device	Detection method	Trip produced
AB, FD, FR, AB Servo, FD Servo, FR Servo	Hardware detectors on the A1, B1 and Z1 signal detect a wire break.	Encoder 2
SC, SC Servo, SC Hiperface, SC EnDat, SC SSI, SC SC	The magnitudes of the sine wave signals are monitored and if $Sine^2 + Cosine^2$ is less than the value produced by two valid waveforms with a differential peak to peak magnitude of 0.25 V ($^1/_4$ of the nominal level) then a trip is initiated. This detects wire break in the sine and cosine connections.	Encoder 2
SC Hiperface, SC EnDat, EnDat, BiSS	Wire break in the comms link is detected by a CRC or timeout error.	Encoder 4, Encoder 5
SSI, SC SSI	Wire break detection in the comms is difficult with these devices. However, if power supply alarm bit monitoring is enabled the drive will be looking for a one at the start of the message and a zero to indicate that the power supply is okay. If the clock stops or the data line is disconnected the data input to the drive may stay in one state or the other and cause a trip.	Encoder 5, Encoder 6

Position feedback power supply trips

The position feedback power supply from the drive can be switched off by the drive either because the power supply is overloaded (Encoder 1 trip) or because the internal 24 V supply within the drive is overloaded (PSU 24 V trip). The internal 24 V supply provides power for the position feedback power supply, user 24 V output, digital I/O, option modules etc. To ensure that an Encoder 1 trip is not initiated when the internal 24 V is overloaded, and subsequently switched off by the drive, there is a delay of 40 ms in the detection of Encoder 1 trip. It is possible for other position feedback trips, such as wire break detection (i.e. Encoder 2), to occur when the power supply is removed from the position feedback device. Therefore overloading the internal 24 V supply or the position feedback supply could result in an immediate Encoder 2 trip. To ensure that the correct reason for the trip is given PSU 24V and Encoder 1 trips override an existing Encoder 2 to Encoder 6 trip. This means that both the original trip (Encoder 2 to Encoder 6) and then the new trip (PSU 24 V or Encoder 1) are stored in the trip log.

C22	Drive Encoder Error Detected		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Drive Encoder Error Detected (**C22**) is set if an error has been detected with the position feedback device connected to the Drive position feedback interface. This parameter is useful if encoder trips have been disabled by setting bit 3 of *Drive Encoder Error Detection Level* (**C21**). It should be noted that this bit is not set if specific trips are disabled with bits 0 to 2 of *Drive Encoder Error Detection Level* (**C21**).

C23	Drive Encoder Source Maximum Reference		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	33000
Default	1500	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

The speed feedback from the Drive position feedback interface can be used as a source to control a parameter. The speed feedback is scaled to give a value as a percentage of *Drive Encoder Source Maximum Reference* (**C23**) in 0.1 % units. Normally the destination is updated every 4 ms.

C24	Drive Encoder Calculation Time		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	20
Default	5	**Units**	μs
Type	8 Bit User Save	**Update Rate**	Background read, auto-configuration write
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Drive Encoder Type (C01): EnDat

Drive Encoder Calculation Time (**C24**) is the time from the first edge of the clock signal from the position feedback interface until the encoder has calculated the position and is ready to return this information. This is used to calculate the overall time for a message interchange with the encoder.

See *Drive Encoder Low Speed Update Rate Active* (**C27**) for more details.

Drive Encoder Type (C01): Any other type of device *Drive Encoder Calculation Time* (**C24**) has no effect.

C25	Drive Encoder Recovery Time		
Mode	RFC-A, RFC-S		
Minimum	5	**Maximum**	100
Default	30	**Units**	µs
Type	8 Bit User Save	**Update Rate**	Background read, auto-configuration write
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Drive Encoder Type (C01): EnDat, SSI, BiSS

Drive Encoder Recovery Time (**C25**) is the time that must be allowed after each message interchange before a new message begins.

Drive Encoder Type (C01): Any other type of device

Drive Encoder Recovery Time (**C25**) has no effect.

C26	Drive Encoder Line Delay Time		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	5000
Default	5	**Units**	ns
Type	16 Bit User Save	**Update Rate**	Background read, auto-configuration write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Drive Encoder Type (C.01): EnDat, SC EnDat, BiSS

During position feedback initialization the transmission delay between the position feedback interface and the encoder and back again is measured and stored in *Drive Encoder Line Delay Time* (**C26**). This value is then used to compensate for this delay so that the clock/data skew does not prevent the data from the encoder from being read. This means that longer line lengths can be used with these feedback devices provided the correct cable and connection arrangements are used.

Drive Encoder Type (C01): Any other type of device

Drive Encoder Line Delay Time (**C26**) is always zero.

C27	Drive Encoder Low Speed Update Rate Active		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Drive Encoder Type (C01): EnDat, SSI, BISS

There is a delay when the position information is obtained via a communications interface from an encoder. It is assumed that the position information is taken from all types of encoder at a fixed datum point during each sample period. The drive initiates the comms transfer at a suitable point in advance of the datum to ensure that the position information is available when required. A correction is then applied to the position information based on the change of position over the previous sample and the advance time so that the position appears to have been sampled at the datum. If the communications exchange, including allowing the encoder a recovery time (*Drive Encoder Recovery Time* (**C25**)), is completed in 60 µs and the time required to obtain the full position is completed in 40 µs then the position is sampled at each current controller task and Drive Encoder Low Speed *Update Rate Active* (**C27**) = 0. Otherwise if the communication exchange is completed in 230 µs the position is sampled every 250 µs and *Drive Encoder Low Speed Update Rate Active* (**C27**) = 1. If the complete exchange takes any longer a trip is initiated. The following table shows the calculations used by the drive to determine the necessary time to obtain the required data.

Protocol	Time for full position	Time for complete data exchange
Endat 2.1 encoder	$t_{ST} + t_D + 10T + 2T + NtT + 5T$ where tcal ≤ $t_{ST} + t_D/2 + 10T$ $t_D + t_{cal} + 2T + NtT + 5T$ where $t_{cal} > t_{ST} + t_D/2 + 10T$	Time for full position + t_m
EnDat 2.2 encoder	$t_{ST} + t_D + 10T + 3T + NtT + 5T$ where tcal ≤ $t_{ST} + t_D/2 + 10T$ $t_{ST} + t_D + t_{cal} + 3T + NtT + 5T$ where $t_{cal} > t_{ST} + t_D/2 + 10T$	Time for full position + t_{Add} + t_m
BISS	$t_D + 3T + NtT + 5T$	Time for full position + t_m
SSI	$t_D + T + NtT$ (t_D cannot be measured, and so a value of 1.25 µs is used)	Time for full position + t_m

where:

Value	Description	Source
t_{ST}	EnDat start time	For 100 K baud = 5 µs, 200 K baud = 2.5 µs, for all other baud rates = 2 µs
t_D	Transmission delay from the drive to the encoder and back	*Drive Encoder Line Delay Time* (**C26**)
T	1 / baud rate	*Drive Encoder Comms Baud Rate* (**C06**)
t_{cal}	Position calculation time	*Drive Encoder Calculation Time* (**C24**)
Ns	Single turn bits for a rotary encoder	*Drive Encoder Comms Bits* (**C08**) − *Drive Encoder Rotary Turns Bits* (**C07**)
Nt	Total number of position information bits	*Drive Encoder Comms Bits* (**C08**)
tm	Encoder recovery time	*Drive Encoder Recovery Time* (**C25**)
t_{Add}	Time for additional information	$t_{Add} = 31T + t_{ST} + 30T$

Drive Encoder Type (C01): Any other type of device

Drive Encoder Low Speed Update Rate Active (**C27**) is always zero.

C28	**Encoder Simulation Source**		
Mode	RFC-A, RFC-S		
Minimum	A.00	**Maximum**	BH.999
Default	A.00	**Units**	
Type	16 Bit User Save	**Update Rate**	Reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

Encoder Simulation Source (**C28**) is used to select a parameter as the input to the encoder simulation system. If *Encoder Simulation Source* (**C28**) is zero then no source is selected and the encoder simulation system is disabled. The encoder simulation output connections are shared with the Drive position feedback interface, and so encoder simulation may be disabled because the connections are not available. See *Encoder Simulation Status* (**C29**) for details.

Any parameter can be selected as the source, but it is assumed that the input is a 16 bit value with a range from 0 to 65535 or from -32768 to 32767.

The source parameter is treated differently depending on the value of *Encoder Simulation Mode* (**C31**) as given in the table below.

***Encoder Simulation Mode* (C31)**	**Description**
Hardware (0)	*Encoder Simulation Source* (**C28**) must be set to *Drive Encoder Position* (**J53**) for the output to be enabled and the position from the Drive position feedback interface is used and *Drive Encoder Position* (**J53**) is the source.
Lines Per Rev (1) or Ratio (2)	If *Encoder Simulation Source* (**C28**) = 3.029 (i.e. *Drive Encoder Position* (**J53**) is the source) then *Drive Encoder Position* (**J53**) and *Drive Encoder Fine Position* (**J54**) are combined as a 16 bit value with 16 bit fractional part as the input to the encoder simulation system, which gives additional output resolution if encoder simulation ratio is greater than unity. The encoder simulation system is intended to be used with a 16 bit source parameter. If the source of the encoder simulation system is not a 16 bit parameter then the drive uses the source parameter as follows. 1 bit parameter: Zero extended 8 bit parameter: Sign extended if BU attribute is zero (signed), otherwise zero extended (unsigned) 32 bit parameter: Only the least significant word is used.
SSI (3)	For SSI output mode the number of bits included in the output can be selected (see *Encoder Simulation Mode* (**C31**) for details).

Although *Encoder Simulation Source* (**C28**) is not a standard source parameter in common with other sources the actual source is only changed on drive reset.

C29	Encoder Simulation Status		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	2
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT		

Value	Text
0	None
1	Full
2	No Marker Pulse

The availability of the encoder simulation output on the 15 way connector on the drive is dependent on the type of feedback device selected with *Drive Encoder Type* (**C01**). Priority is as follows from highest to lowest priority:

1. Drive position feedback interface
2. Encoder simulation output

Encoder Simulation Status (**C29**) shows the status of the encoder simulation output.

0: None

The encoder simulation output is not enabled or is not available.

1: Full

Full encoder simulation with marker output is available.

2: No Marker

Encoder simulation without marker output is available.

C30	Encoder Simulation Sample Period		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	3
Default	0	**Units**	ms
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	0.25
1	1
2	4
3	16

The update rate of the encoder simulation system is nominally 250 μs, i.e. default value of *Encoder Simulation Sample Period* (**C30**), but if the update rate of the source parameter is different, the encoder simulation output will consist of bursts of pulses at the update rate of the parameter. To prevent this and to give a smooth output, the update rate can be adjusted with *Encoder Simulation Sample Period* (**C30**). *Encoder Simulation Sample Period* (**C30**) has no effect if hardware mode is selected, i.e. *Encoder Simulation Mode* (**C31**) = 0.

C31	Encoder Simulation Mode		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	3
Default	0	**Units**	ms
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Hardware
1	Lines Per Rev
2	Ratio
3	SSI

Encoder Simulation Mode (**C31**) defines the encoder simulation output as incremental signals (AB, FD or FR) derived directly via hardware, incremental signals generated via software or SSI data generate via software.

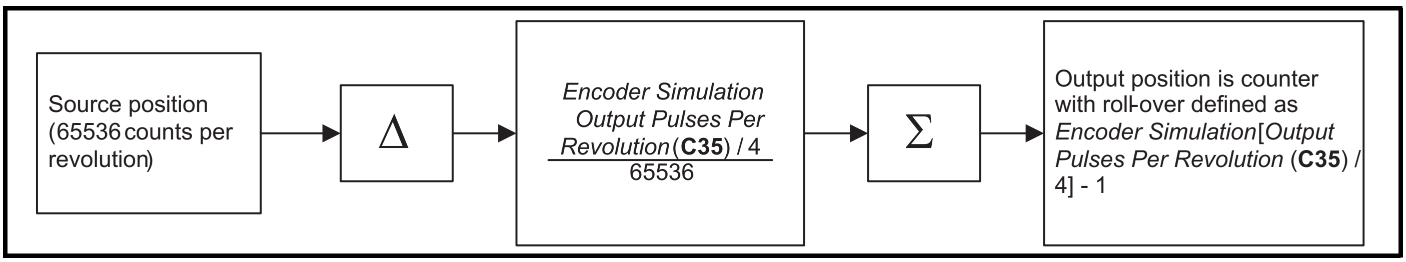
0: Hardware

The encoder simulation output is derived directly in hardware from the Drive position feedback interface in the drive and the output is derived from the input with negligible delay. The ratio between the input at the Drive position feedback interface and the output is either unity or a limited number of binary divider ratios (see *Encoder Simulation Hardware Divider* (**C32**)). Hardware mode only produces an output with AB, FD, FR, SC, SC Hiperface, SC EnDat or SC SSI type devices. It should be noted that with a SINCOS source device the output is based on the zero crossings of the sine wave inputs and does not include interpolation. If *Encoder Simulation Hardware Marker Lock* (**C33**) = 0 the marker output is derived directly from the marker input. If Encoder Simulation Hardware Marker Lock (**C33**) = 1 the incremental output signals are adjusted on each marker event so that the A and B are high with an AB type output. Marker locking is not recommended if the number of lines per revolution of the encoder simulation source combined with the ratio does not give an encoder simulation output with a multiple of 4 counts per revolution (i.e. between each output marker event) for AB signals, because this causes a count error in the system receiving these signals. The input marker pulse width is not adjusted to take account of the divider ratio, but is simply routed from the input to the output. Therefore the output marker pulse becomes shorter with respect to the output incremental signals as the divider ratio is increased.

1: Lines Per Rev

The encoder simulation output is derived via software from the selected source with a resolution defined by *Encoder Simulation Output Pulses Per Revolution* (**C35**) with a minimum delay of 250 µs which may be extended if *Encoder Simulation Sample Period* (**C30**) is set up for a longer sample period. Note that the number of output pulses per revolution apply to a quadrature (AB) type device. The output is derived by applying a ratio and output counter roll-over limit defined by *Encoder Simulation Output Pulses Per Revolution* (**C35**) as shown below. The output marker is produced when the output counter is zero.

Figure 8-7 Lines per rev mode



If *Drive Encoder Position* (**J53**) is selected as the source and *Encoder Simulation Incremental Mode Select* (**C34**) = 0 then the input and output counters are synchronised at power-up and when the P1 position feedback interface becomes initialized, so that the output marker is synchronised with zero position for the P1 position feedback interface. At power-up and on device initialization there will be a step change in position from zero to the actual position from the device and the pulses necessary to make this change are produced at the encoder simulation output. If a marker event occurs that causes a step change in position, again the necessary pulses will be produced for this change of position. Where large sudden changes occur the maximum output frequency is limited to 500 kHz, and so it may take some time for the output position to reach the input position. This mode of operation gives an initial position change from zero position and then follows all changes of position from that point onwards, and may be used to follow the absolute position of the device connected to the Drive position feedback interface.

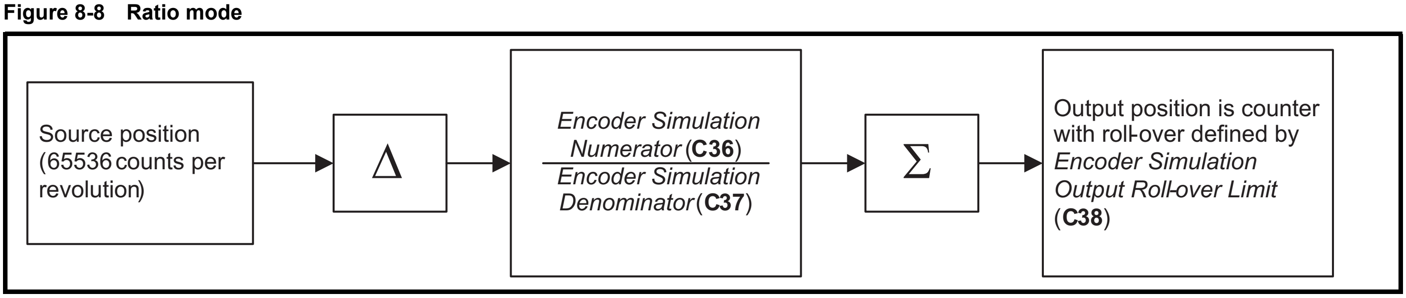
If *Drive Encoder Position* (**J53**) is selected as the source and *Encoder Simulation Incremental Mode Select* (**C34**) = 1 then the encoder simulation output only follows the changes of source position. At power-up, on device initialization and a marker event no additional pulses are produced to give the absolute position of the device related to zero position. The encoder simulation output markers is not synchronized to the source marker.

If a source other than *Drive Encoder Position* (**J53**) is selected *Encoder Simulation Incremental Mode Select* (**C34**) has no effect and the encoder simulation system always operates in absolute mode.

2: Ratio

The encoder simulation is derived in the same way as described previously for *Encoder Simulation Mode* (**C31**) = 1 (i.e. lines per rev mode), except that different parameters are used to set up the system giving more flexibility as shown below.

Figure 8-8 Ratio mode

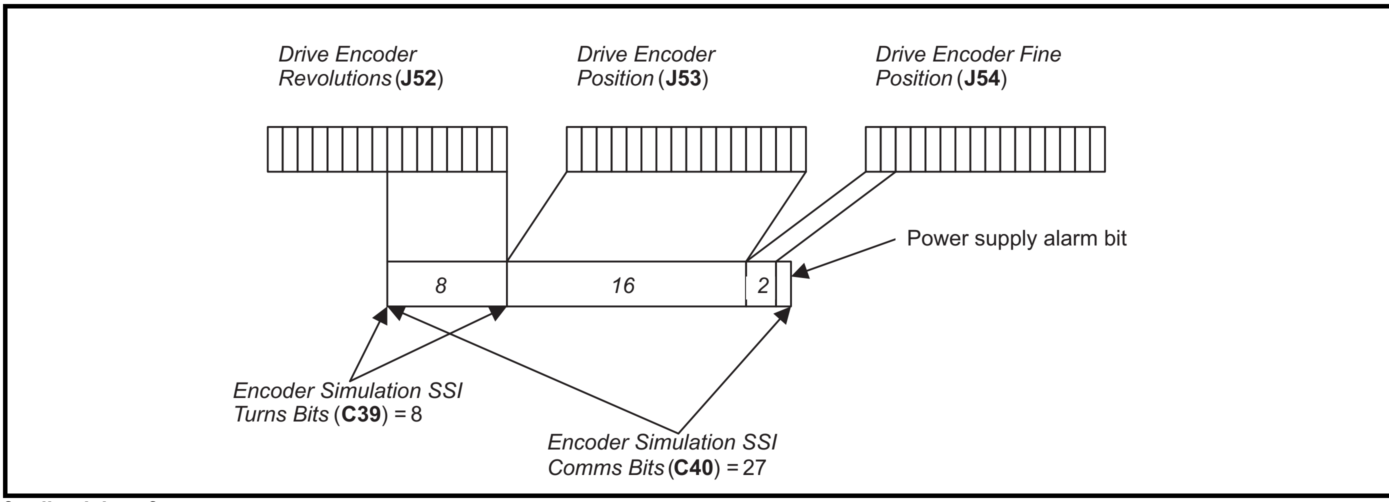


With the default settings (*Encoder Simulation Numerator* (**C36**) = 65536, *Encoder Simulation Denominator* (**C37**) = 65536 and *Encoder Simulation Output Roll-over Limit* (**C38**) = 65535) the output produces a state change each time the source parameter changes by one. The numerator and denominator can be changed to provide a different ratio between the source and the output. Output markers are produced each time the output counter is zero and the counters are synchronised in the same way as for lines per rev mode. It is possible to control the roll-over limit of the output counter and hence the rate at which output markers are produced using *Encoder Simulation Output Roll-over Limit* (**C38**). For example if the ratio is set to 1024/ 65536 and the roll-over limit is 1023 then one output marker is produced for every 1024 lines of output incremental signals. If the roll-over limit is changed to 512, then two output markers are produced for every 1024 lines of output incremental signals.

3: SSI

In this mode the B output becomes the clock input and the A output is the data output. If the source position is the Drive position feedback interface the data from the position feedback interface is transferred to the SSI output register once per sample period defined by *Encoder Simulation Sample Period* (**C30**). An example is given below which shows how the data is aligned.

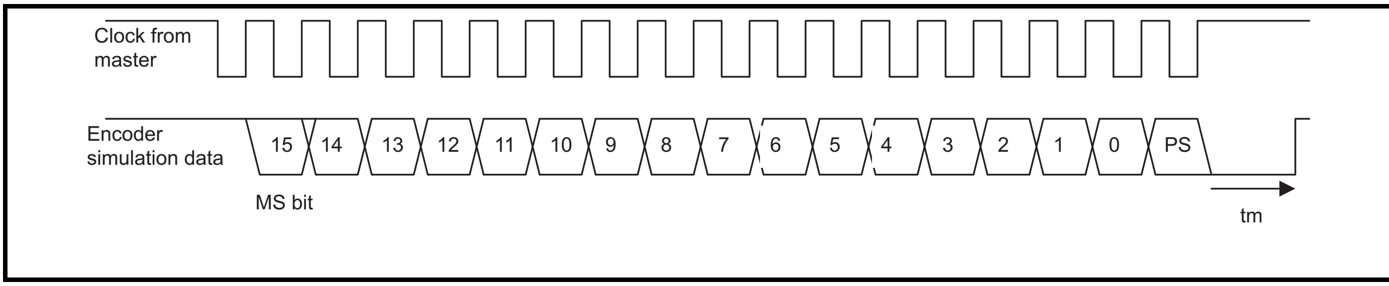
Figure 8-9 Example of SSI data set-up from Drive position



feedback interface

The SSI output is then clocked out from the register as shown in another example below which includes 15 bits of data.

Figure 8-10 SSI encoder simulation output



It should be noted that the data is shifted out by a clock that is produced by the SSI master connected to the encoder simulation interface as the interface is emulating an SSI encoder. However, unlike an SSI encoder the position data is not sampled on the first edge of the clock, but is updated by the drive at the rate defined by *Encoder Simulation Sample Period* (**C30**). If the Drive position feedback interface is being used as the source the power supply alarm bit (PS) is the inverse of the initialized flag in *Position Feedback Initialized Indication* (**C19**) related to this interface. The master can clock out as many bits of data as required, but once the power supply alarm bit has been produced the output will remain low. The SSI interface reset time (tm) of 20 µs is required so that the interface can detect the end of the transmission and reset itself so that the output data begins again at the most significant bit. During this period the master should hold the clock line high. The master should not use a clock frequency of less than 50 kHz or else spurious reset periods may be detected.

If any other parameter is used as the source the most significant M bits of the source parameter are used, where M = *Encoder Simulation SSI Comms Bits* (**C40**) - 1. If the source parameter has less than M bits then trailing zeros are added. The power supply alarm bit is always zero in this mode.

C32	**Encoder Simulation Hardware Divider**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	7
Default	0	**Units**	ms
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

If hardware mode is selected (i.e. *Encoder Simulation Mode* (**C31**) = 0) then *Encoder Simulation Hardware Divider* (**C32**) defines the divider ratio between the device connected to the Drive position feedback interface and the output as 1/2 *Encoder Simulation Hardware Divider* (**C32**). The maximum input frequency allowed is 500 kHz, and therefore the maximum output frequency with the highest ratio of unity is 500 kHz.

C33	Encoder Simulation Hardware Marker Lock		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Encoder Simulation Mode* (**C31**).

C34	Encoder Simulation Incremental Mode Select		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Encoder Simulation Mode* (**C31**).

C35	Encoder Simulation Output Lines Per Revolution		
Mode	RFC-A, RFC-S		
Minimum	1	**Maximum**	16384
Default	4096	**Units**	
Type	32 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Encoder Simulation Mode* (**C31**).

C36	Encoder Simulation Numerator		
Mode	RFC-A, RFC-S		
Minimum	1	**Maximum**	65536
Default	65536	**Units**	
Type	32 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Encoder Simulation Mode* (**C31**).

C37	Encoder Simulation Denominator		
Mode	RFC-A, RFC-S		
Minimum	1	**Maximum**	65536
Default	65536	**Units**	
Type	32 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Encoder Simulation Mode* (**C31**).

C38	**Encoder Simulation Output Roll-over Limit**		
Mode	RFC-A, RFC-S		
Minimum	1	**Maximum**	65535
Default	65535	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

See *Encoder Simulation Mode* (**C31**).

C39	**Encoder Simulation SSI Turns Bits**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	16
Default	16	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Encoder Simulation Mode* (**C31**).

C40	**Encoder Simulation SSI Comms Bits**		
Mode	RFC-A, RFC-S		
Minimum	2	**Maximum**	48
Default	33	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Encoder Simulation Mode* (**C31**).

8.3 Menu D: Brake

Figure 8-11 Menu D Open loop logic diagram

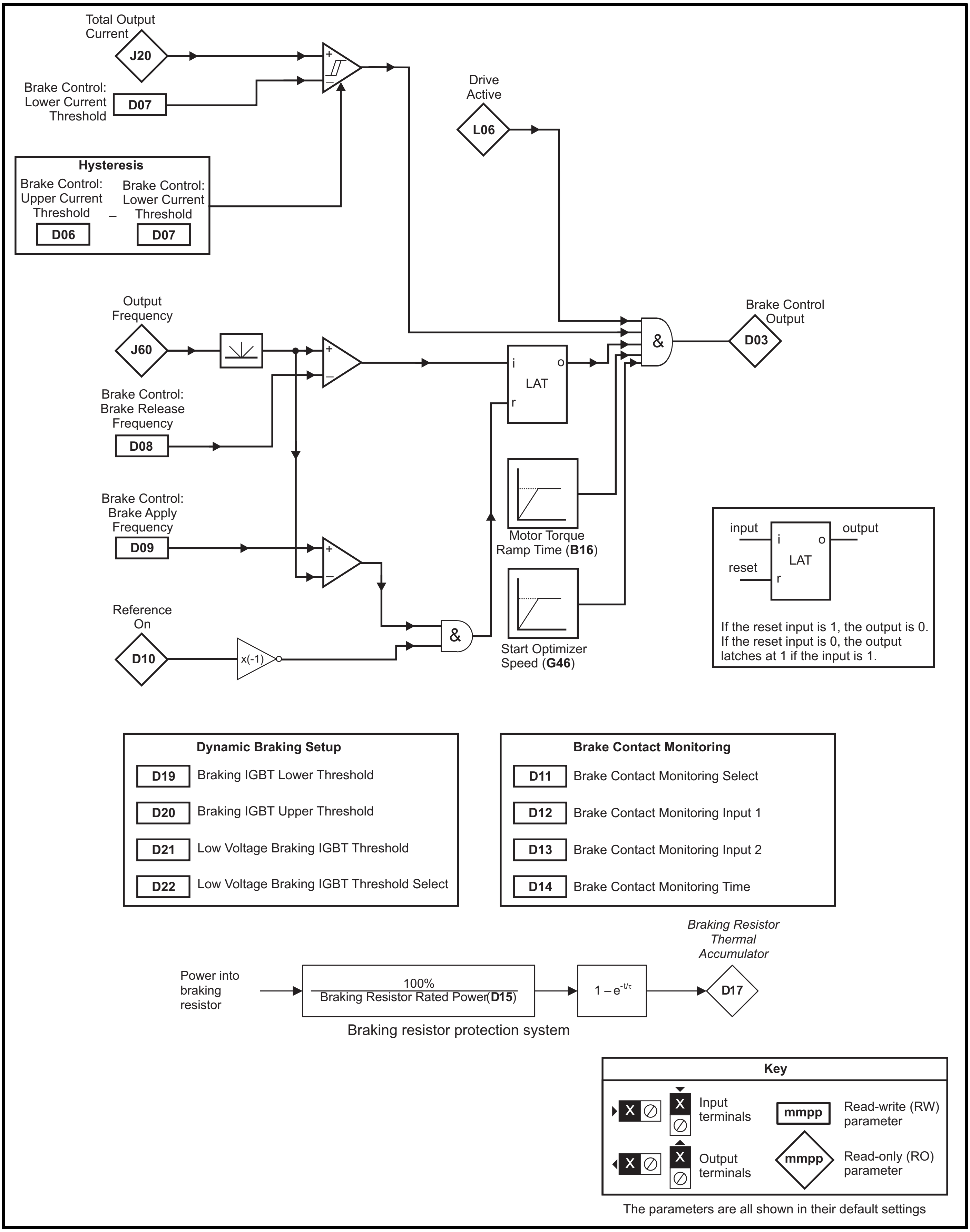
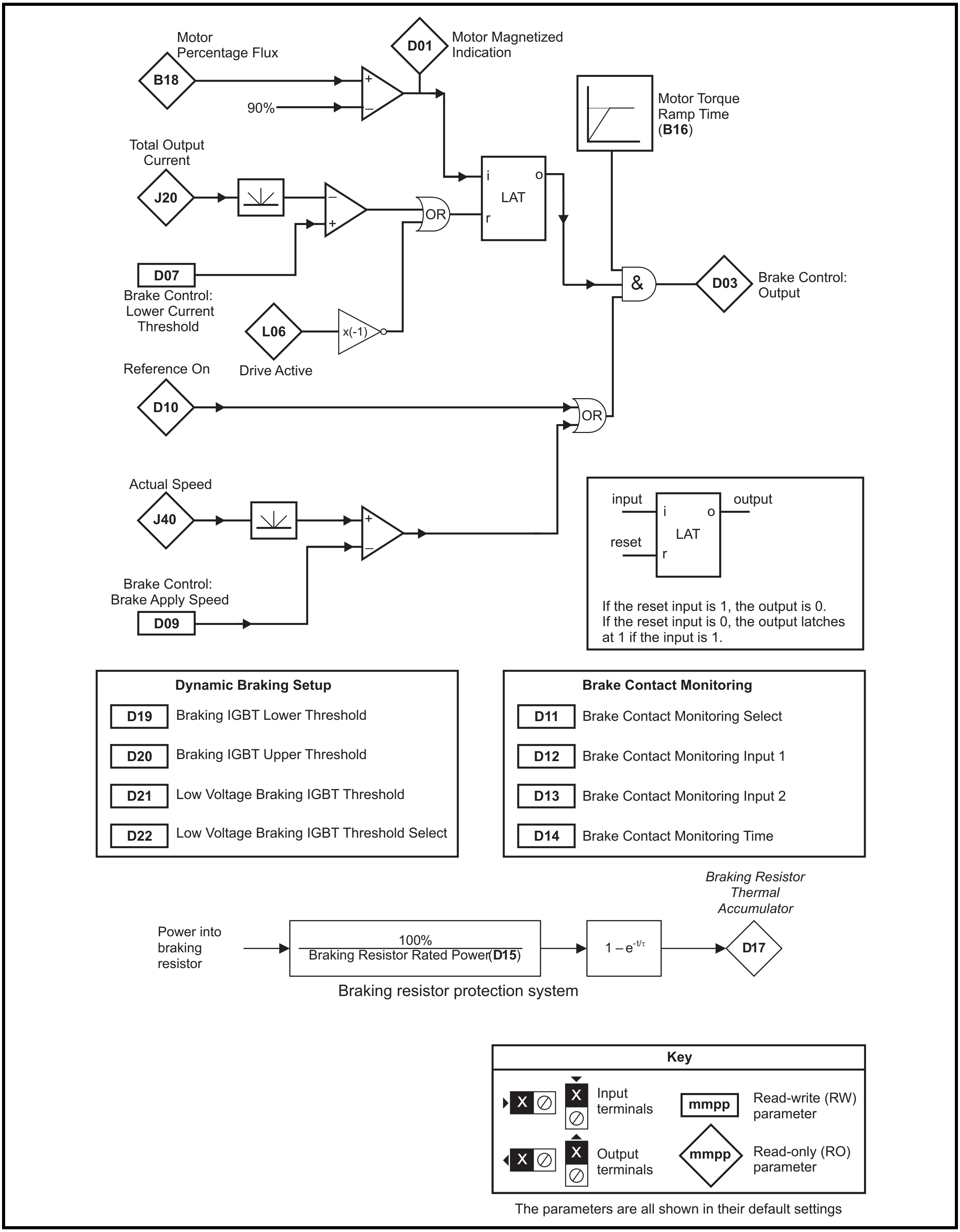


Figure 8-12 Menu D Brake RFC-A, RFC-S logic diagram



Parameter		Range(⇕)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
D01	Motor Magnetized Indication	Off (0) or On (1)			Off (0)			RW	Bit				US
D02	Motor Torque Ramp Time	-32768 to 32767 ms			100 ms			RW	Num				US
D03	Brake Control Output	Off (0) or On (1)						RO	Bit	ND	NC	PT	
D04	Brake Control Relase Delay	0 to 10000 ms			500 ms			RW	Num				US
D05	Brake Control Apply Delay	0 to 10000 ms			500 ms			RW	Num				US
D06	Brake Control: Upper Current Threshold	0 to 200 %			10 %			RW	Num				US
D07	Brake Control: Lower Current Threshold	0 to 200 %			10 %			RW	Num				US
D08	Open-Loop: Brake Control: Brake Release Frequency	0.0 to 20.0 Hz			1.0 Hz			RW	Num				US
D09	Open-Loop: Brake Control: Brake Apply Frequency	0.0 to 20.0 Hz			2.0 Hz			RW	Num				US
	RFC-A: Brake Control: Brake Apply Speed		0 to 200			5		RW	Num				US
	RFC-S: Brake Control: Brake Apply Speed			0 to 200			5	RW	Num				US
D10	Reference On	Off (0) or On (1)						RO	Bit	ND	NC	PT	
D11	Brake Contact Monitoring Select	None (0), IP 1 (1), IP 1 + IP2 (2)			None (0)			RW	Txt				US
D12	Brake Contact Monitoring Input 1	Off (0) or On (1)			Off (0)			RW	Bit				US
D13	Brake Contact Monitoring Input 2	Off (0) or On (1)			Off (0)			RW	Bit				US
D14	Brake Contact Monitoring Time	1.0 to 10.0			3.0			RW	Num				US
D15	Braking Resistor Rated Power	0.000 to 99999.999 kW			0.000 kW			RW	Num				US
D16	Braking Resistor Thermal Time Constant	0.000 to 1500.000 s			0.000 s			RW	Num				US
D17	Braking Resistor Thermal Accumulator	0.0 to 100.0 %						RO	Num	ND	NC	PT	
D18	Braking Resistor Resistance	0.00 to 10000.00 Ω			0.00 Ω			RW	Num				US
D19	Braking IGBT Lower Threshold	±VM_DC_VOLTAGE_SET V			200V drive: 390 V, 400V drive: 780 V 575V drive: 930 V, 690V drive: 1120 V			RW	Num				US
D20	Braking IGBT UpperThreshold	±VM_DC_VOLTAGE_SET V			200V drive: 390 V, 400V drive: 780 V 575V drive: 930 V, 690V drive: 1120 V			RW	Num				US
D21	Low Voltage Braking IGBT Threshold	±VM_DC_VOLTAGE_SET V			0 V			RW	Num				US
D22	Low Voltage Braking IGBT Threshold Select	Off (0) or On (1)			Off (0)			RW	Bit				
D23	Injection Braking Level	0.0 to 150.0 %			100.0 %			RW	Num		RA		US
D24	Injection Braking Time	0.0 to 100.0 s			1.0 s			RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Mode: Open-Loop, RFC-A, RFC-S

D01	Motor Magnetized Indication		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO,		

When set to Off (0), the motor is not magnetized, and when set to On (1), the motor is magnetized.

Internally this bit is set to On (1) when:

- In RFC-A only, *Motor Percentage Flux* (**B18**) >=90%
- The torque producing current limit has been ramped up to *Symmetrical Current Limit* (**B16**)) using *Motor Torque Ramp Time* (**D02**).
- *Reference On* (**D10**) = On (1), Reference must be enabled (Enabled, healthy, run signal present)
- The Elevator state machine must be > Idle (0)
- In open loop only, if Current Magnitude, *Total Output Current* (**J22**) >= Brake Control: *Upper Current Threshold* (**D06**) expressed as a percentage of *Motor Rated Current* (**B02**).
- In open loop only, *Start Optimizer Speed* (**G46**) has been reached

This bit is set to Off (0) when any of the above conditions is not met.

This indication can be routed to a digital output to send to an elevator controller to indicate when to release the brake if it is not controlled by the elevator drive.

D02	Motor Torque Ramp Time		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-32768	**Maximum**	32767
Default	100	**Units**	ms
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This sets the time in ms for the torque producing current limit to be ramped up to *Symmetrical Current Limit* (**B16**) when starting and ramped down to 0 when stopping. This gives a smooth transfer of load holding between the motor and the mechanical brake on start and stop.

This feature also acts to gently apply the torque feed forward from the load cell if one is used.

D03	Brake Control Output		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

The mechanical brake control function can be used to control an electro-mechanical brake via digital I/O. *Brake Control Output* (**D03**) = 0 when the brake should be applied and 1 when the brake should be released. Normally this should be routed to a digital output to control the mechanical brake.

D04	Brake Control Release Delay		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	500	**Units**	ms
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This sets the time delay in ms for the brake to be physically released. This is used during starting to determine if the brake can be considered fully opened i.e. prior to starting the travel profile and disabling the position lock position loop (if enabled via *Start Lock Enable* (**I22**) in RFC-A and RFC-S).

D05	**Brake Control Apply Delay**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	500	**Units**	ms
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This sets the time delay in ms for the brake to be physically applied. This is used during stopping to determine if the brake can be considered fully closed and the control sequence can be completed i.e. prior to ramping the motor torque down and disabling the drive.

D06	**Brake Control: Upper Current Threshold**		
Mode	Open-Loop		
Minimum	0	**Maximum**	200
Default	10	**Units**	%
Type	8 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

The Current Magnitude, *Total Output Current* (**J22**) is compared to an upper and lower threshold by a comparator with hysteresis to give torque present and drive output open detection functions respectively. Brake Control: *Lower Current Threshold* (**D07**) and Brake Control: *Upper Current Threshold* (**D06**) are given as a percentage of *Motor Rated Current* (**B02**). Brake Control: *Upper Current Threshold* (**D06**) should be set to the current level that indicates that there is magnetizing current and sufficient torque producing current in the motor to deliver the required amount of torque when the brake is released. The output of the comparator remains active after this level has been reached unless the current subsequently falls below Brake Control: *Lower Current Threshold* (**D07**) which should be set to the required level to detect the condition where the motor has been disconnected from the drive. If Brake Control: *Lower Current Threshold* (**D07**) ≥ Brake Control: *Upper Current Threshold* (**D06**) then the upper threshold applies with a hysteresis band of 0. If Brake Control: *Lower Current Threshold* (**D07**) = Brake Control: *Upper Current Threshold* (**D06**) = 0 then the output of the comparator is always one.

D07	**Brake Control: Lower Current Threshold**		
Mode	Open-Loop RFC-A, RFC-S		
Minimum	0	**Maximum**	200
Default	10	**Units**	%
Type	8 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

The Current Magnitude, *Total Output Current* (**J22**) is compared to an upper and lower threshold by a comparator with hysteresis to give torque present and drive output open detection functions respectively. Brake Control: *Lower Current Threshold* (**D07**) and Brake Control: *Upper Current Threshold* (**D06**) are given as a percentage of *Motor Rated Current* (**B02**). Brake Control: *Upper Current Threshold* (**D06**) should be set to the current level that indicates that there is magnetising current and sufficient torque producing current in the motor to deliver the required amount of torque when the brake is released. The output of the comparator remains active after this level has been reached unless the current subsequently falls below Brake Control: *Lower Current Threshold* (**D07**) which should be set to the required level to detect the condition where the motor has been disconnected from the drive. If Brake Control: *Lower Current Threshold* (**D07**) ≥ Brake Control: *Upper Current Threshold* (**D06**) then the upper threshold applies with a hysteresis band of 0. If Brake Control: *Lower Current Threshold* (**D07**) = Brake Control: *Upper Current Threshold* (**D06**) = 0 then the output of the comparator is always one.

D08	**Brake Control: Brake Release Frequency**		
Mode	Open-Loop RFC-A, RFC-S		
Minimum	0.0	**Maximum**	Open-Loop: 20.0
Default	Open-Loop: 1.0	**Units**	Hz
Type	8 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

Open-Loop

The frequency comparator is used on starting, to detect when the motor frequency has reached a level where the motor can produce the required amount of torque to ensure that the motor rotates in the demanded direction when the brake is released. Brake Control: *Brake Release Frequency* (**D08**) should be set to a level slightly above the motor slip frequency that is likely to occur under the highest expected load that is applied to the motor when the brake is released.

The brake apply frequency threshold is used to ensure that the brake is applied before the motor frequency reaches zero and to prevent the motor rotating (in the reverse direction due to an overhauling load for example) during the brake apply time. If the frequency falls below Brake Control: *Brake*

Apply Frequency (**D09**), but the motor is not required to stop (i.e. reversing direction without stopping) then *Reference On* (**D10**) will be one, and so the brake is not applied. This prevents the brake from activating and de-activating as the motor passes through zero speed. If the frequency falls below Brake Control: *Brake Apply Frequency* (**D09**) and *Reference On* (**D10**) = 0 then the brake will be applied.

D09 **D09**	**Brake Control: Brake Apply Frequency [Open-Loop]** **Brake Control: Brake Apply Frequency [RFC-A, RFC-S]**		
Mode	Open Loop, RFC-A, RFC-S		
Minimum	0.0	**Maximum**	Open-Loop: 20.0 RFC-A, RFC-S: 200
Default	Open-Loop: 2.0 RFC-A, RFC-S: 5	**Units**	Open-Loop: Hz RFC-A, RFC-S: rpm
Type	8 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

Open-Loop

The frequency comparator is used on starting, to detect when the motor frequency has reached a level where the motor can produce the required amount of torque to ensure that the motor rotates in the demanded direction when the brake is released. Brake Control: *Brake Release Frequency* (**D08**) should be set to a level slightly above the motor slip frequency that is likely to occur under the highest expected load that is applied to the motor when the brake is released.

The brake apply frequency threshold is used to ensure that the brake is applied before the motor frequency reaches zero and to prevent the motor rotating (in the reverse direction due to an overhauling load for example) during the brake apply time. If the frequency falls below Brake Control: *Brake Apply Frequency* (**D09**), but the motor is not required to stop (i.e. reversing direction without stopping) then *Reference On* (**D10**) will be one, and so the brake is not applied. This prevents the brake from activating and de-activating as the motor passes through zero speed. If the frequency falls below Brake Control: *Brake Apply Frequency* (**D09**) and *Reference On* (**D10**) = 0 then the brake will be applied.

RFC-A, RFC-S

The speed comparator is used on starting, to detect when the motor speed has reached a level where the motor can produce the required amount of torque to ensure that the motor rotates in the demanded direction when the brake is released. Brake Control: *Brake Release Speed* (**D08**) should be set to a level slightly above the motor slip frequency that is likely to occur under the highest expected load that is applied to the motor when the brake is released.

The brake apply speed threshold is used to ensure that the brake is applied before the motor speed reaches zero and to prevent the motor rotating (in the reverse direction due to an overhauling load for example) during the brake apply time. If the speed falls below Brake Control: *Brake Apply Speed* (**D09**), but the motor is not required to stop (i.e. reversing direction without stopping) then *Reference On* (**D10**) will be one, and so the brake is not applied. This prevents the brake from activating and de-activating as the motor passes through zero speed. If the speed falls below Brake Control: *Brake Apply Speed* (**D09**) and *Reference On* (**D10**) = 0 then the brake will be applied.

D10	**Reference On**		
Mode	Open Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	2 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Reference On (**D10**), which is controlled by the drive sequencer, indicates that the reference from the reference system is active.

D11	**Brake Contact Monitoring Select**		
Mode	Open Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	Text
0	None
1	IP 1
2	IP 1 + IP2

When set to Off (0), brake contact monitoring is disabled.

When set to On (1), brake contact 1 monitoring is enabled where *Brake Contact Monitoring Input 1* (**D12**) is monitored to determine the state of the contactor. It is assumed that if B*rake Contact Monitoring Input 1* (**D12**) = Off (0) the contact is open (brake applied), and if *Brake Contact Monitoring*

Input 1 (**D12**) = On (1) then it is closed (Brake released). The contact has 3 s to operate before a Trip 72 (**Brk con 1 open**) / Trip 73 (**Brk con 1 closd**) is called.

When set to 2, brake contact 1 and 2 monitoring is enabled, where *Brake Contact Monitoring Input 1* (**D12**) and *Brake Contact Monitoring Input 2* (**D13**) are monitored to determine the state of the contactor. It is assumed that if a brake contact monitoring parameter = Off (0) the contact is open (brake applied), and if it = On (1) then it is closed (brake released). The contact has *Brake Contact Monitoring Time* (**D14**) seconds to operate before a *Trip 72* (**Brk con 1 open**) / *Trip 73* (**Brk con 1 closd**) is called for brake contact 1 or for brake contact 2 *Trip 74* (**Brk con 2 open**) / *Trip 75* (**Brk con 2 closd**) is called.

A brake contact fault is determined by comparing *Brake Control Output* (**D03**) to *Brake Contact Monitoring Input 1* (**D12**) and *Brake Contact Monitoring Input 2* (**D13**). If *Brake Control Output* (**D03**) is not equal to *Brake Contact Monitoring Input 1* (**D12**) or *Brake Contact Monitoring Input 2* (**D13**) for more than *Brake Contact Monitoring Time* (**D14**) seconds then *Trip 72* (**Brk con 1 open**) / *Trip 73* (**Brk con 1 closd**) and *Trip 74* (**Brk con 2 open**) / *Trip 75* (**Brk con 2 closd**) will be called if Brake Contact Monitoring Select (**D11**) >0.

D12	**Brake Contact Monitoring Input 1**		
Mode	Open Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When *Brake Contact Monitoring Select* (**D11**) = 1 or 2, then this parameter is used to monitor the state of the brake contact 1. One of the elevator drive inputs or I/O option inputs must be routed to this parameter, where the signal to activate the input comes from a brake auxiliary contact.

When set to Off (0), the brake contact is open, when set to On (1) the brake contact is closed.

This input is used to generate *Trip 72* (**Brk con 1 open**) / *Trip 73* (**Brk con 1 closd**).

D13	**Brake Contact Monitoring Input 2**		
Mode	Open Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When *Brake Contact Monitoring Select* (**D11**) = 2, then this parameter is used to monitor the state of the brake contact 2. One of the elevator drive inputs or I/O option inputs must be routed to this parameter, where the signal to activate the input comes from a brake auxiliary contact.

When set to Off (0), the brake contact is open, when set to On (1) the brake contact is closed.

This input is used to generate *Trip 74* (**Brk con 2 open**) / *Trip 75* (**Brk con 2 closd**).

D14	**Brake Contact Monitoring Time**		
Mode	Open Loop		
Minimum	1.0	**Maximum**	10.0
Default	3.0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

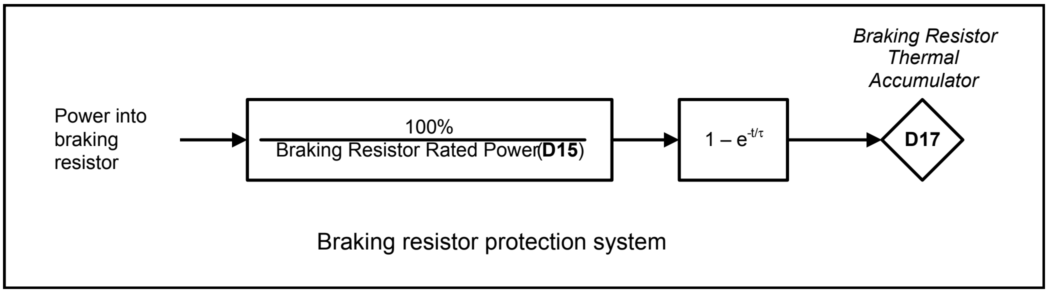
When *Brake Contact Monitoring Select* (**D11**) = 1 or 2, then this parameter is used to set the time delay before a brake contact monitoring trip is generated. This affects Trip 72 (Brk con 1 open) / Trip 73 (Brk con 1 closd) and Trip 74 (Brk con 2 open) / Trip 75 (Brk con 2 closd).

D15	**Braking Resistor Rated Power**		
Mode	Open Loop, RFC-A, RFC-S		
Minimum	0.000	**Maximum**	99999.999
Default	0.000	**Units**	kW
Type	32 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	3
Coding	RW		

A thermal protection system is provided for the braking resistor. If *Braking Resistor Rated Power* (**D15**) is set to zero this protection system is disabled and the *Braking Resistor Thermal Accumulator* (**D17**) is held at zero. If braking resistor thermal protection is required the *Braking Resistor Rated Power* (**D15**), *Braking Resistor Thermal Time Constant* (**D16**) and *Braking Resistor Resistance* (**D18**) should be set up with the braking resistor parameters. The thermal time constant of the resistor can be calculated from the single pulse energy rating (E) and continuous power rating (P) of the resistor.

Braking Resistor Thermal Time Constant (**D16**) = ≥ = E / P

The braking resistor is protected with a single time constant model as shown below:



The drive monitors the power flowing into the braking resistor and updates the *Braking Resistor Thermal Accumulator* (**D17**). If bit 1 of *Action On Trip Detection* (**H45**) = 0 and the accumulator reaches 100 % a Brake R Too Hot trip is initiated. If bit 1 of *Action On Trip Detection* (**H45**) = 1 and the accumulator reaches 100 % the braking IGBT is disabled until the accumulator falls below 95.0 %.

D16	Braking Resistor Thermal Time Constant		
Mode	Open Loop, RFC-A, RFC-S		
Minimum	0.000	**Maximum**	1500.000
Default	0.000	**Units**	%
Type	32 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	3
Coding	RW		

See *Braking Resistor Rated Power* (**D15**).

D17	Braking Resistor Thermal Accumulator		
Mode	Open Loop, RFC-A, RFC-S		
Minimum	0.0	**Maximum**	100.0
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	Background Write
Display Format	Standard	**Decimal Places**	1
Coding	RO, ND, NC, PT		

See *Braking Resistor Rated Power* (**D15**).

D18	Braking Resistor Resistance		
Mode	Open Loop, RFC-A, RFC-S		
Minimum	0.00	**Maximum**	10000.00
Default	0.00	**Units**	Ω
Type	32 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

See *Braking Resistor Rated Power* (**D15**).

D19	Braking IGBT Lower Threshold		
Mode	Open Loop, RFC-A, RFC-S		
Minimum	-VM_DC_VOLTAGE_SET	**Maximum**	VM_DC_VOLTAGE_SET
Default	See exceptions below	**Units**	V
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM		

Voltage	Default Value
200 V	390
400 V	780
575 V	930
690 V	1120

Braking IGBT Lower Threshold (**D19**) defines the lowest level of *DC Bus Voltage* (**J65**) where the braking IGBT will become active and *Braking IGBT Upper Threshold* (**D20**) defines the level of *DC Bus Voltage* (**J65**) where the braking IGBT will be on continuously. When the braking IGBT is turned on, it will remain on for at least 1 ms. The braking IGBT on-time is defined by the thresholds and the *DC Bus Voltage* (**J65**) as given in the table below where L = *Braking IGBT Lower Threshold* (**D19**) and U = *Braking IGBT Upper Threshold* (**D20**).

Braking IGBT Lower Threshold (**D19**) defines the lowest level of *D.C. Bus Voltage* (**J65**) where the braking IGBT will become active and *Braking IGBT Upper Threshold* (**D20**) defines the level of *DC Bus Voltage* (**J65**) where the braking IGBT will be on continuously. When the braking IGBT is turned on, it will remain on for at least 1 ms. The braking IGBT on-time is defined by the thresholds and the *DC Bus Voltage* (**J65**) as given in the table below where L = *Braking IGBT Lower Threshold* (**D19**) and U = *Braking IGBT Upper Threshold* (**D20**).

D.C. link voltage level	On-time
DC Bus Voltage (**J65**)	0%
L ≥ *DC Bus Voltage* (**J65**) (**J65**)	[(*DC Bus Voltage* (**J65**) - L) / (U - L)] x 100%
DC Bus Voltage (**J65**) ≥ U	100 %

As the *DC Bus Voltage* (**J65**) rises above the lower threshold, the braking IGBT is active with an on/off ratio of 1/100. As the voltage rises further, the on/off ratio increases until at the upper threshold the braking IGBT is on continuously. The upper and lower voltage threshold can be set up so that braking resistors in drives with parallel connected D.C. links will share the braking load.

If *Braking IGBT Lower Threshold* (**D19**) ≥ *Braking IGBT Upper Threshold* (**D20**) then the braking IGBT is off when *DC Bus Voltage* (**J65**) < *Braking IGBT Upper Threshold* (**D20**) and on if *DC Bus Voltage* (**J65**) ≥ *Braking IGBT Upper Threshold* (**D20**). This method of control is the same as that used in Unidrive SP and the default values for the braking thresholds are equal to the braking thresholds in Unidrive SP.

Unless sharing between braking resistors is required, the braking thresholds do not normally need to be adjusted. Care should be taken when reducing the thresholds, because if either threshold is below the maximum value of the peak rectified supply voltage the braking resistor could take power from the supply.

The list below gives conditions that will disable the braking IGBT:

1. *Braking IGBT Upper Threshold* (**D20**) = 0, or *Low Voltage Braking IGBT Threshold Select* (**D22**) = 1 and *Low Voltage Braking IGBT Threshold* (**D21**) = 0.
2. The drive is in the under-voltage state.
3. A priority 1, 2 or 3 trip is active (see *Trip 0* (**L29**)).
4. One of the following trips is active or would be active if another trip is not already active: OI Brake, PSU, Th Brake Res or OHt Inverter.
5. *Percentage Of Drive Thermal Trip Level* (**J79**) = 100%. This is an indication that some part of the drive is too hot and is used to indicate if an internally fitted braking resistor is too hot.
6. Brake R Too Hot is active or the system has been set up to disable the braking IGBT based on the braking resistor temperature and the resistor is too hot (i.e. bit 2 of *Action On Trip Detection* (**H45**) is set).

D20	Braking IGBT Upper Threshold		
Mode	Open Loop, RFC-A, RFC-S		
Minimum	-VM_DC_VOLTAGE_SET	**Maximum**	VM_DC_VOLTAGE_SET
Default	See exceptions below	**Units**	V
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM		

Voltage	Default Value
200 V	390
400 V	780
575 V	930
690 V	1120

See *Braking IGBT Lower Threshold* (**D19**).

D21	**Low Voltage Braking IGBT Threshold**		
Mode	Open Loop, RFC-A, RFC-S		
Minimum	-VM_DC_VOLTAGE_SET	**Maximum**	VM_DC_VOLTAGE_SET
Default	0	**Units**	V
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM		

If *Low Voltage Braking IGBT Threshold Select* (**D22**) = 0 the normal thresholds are used. If *Low Voltage Braking IGBT Threshold Select* (**D22**) = 1 then *Low Voltage Braking IGBT Threshold* (**D21**) is used, so that the braking IGBT is on with a minimum on time of 1 ms is the *DC Bus Voltage* (**J65**) is above this level, or off if the *DC Bus Voltage* (**J65**) is below this level.

D22	**Low Voltage Braking IGBT Threshold Select**		
Mode	Open Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit Volatile	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Low Voltage Braking IGBT Threshold* (**D21**).

D23	**Injection Braking Level**		
Mode	Open Loop		
Minimum	0.0	**Maximum**	150.0
Default	100.0	**Units**	%
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW, RA		

Injection Braking Level (**D23**) defines the level of current used for injection braking as a percentage of *Motor Rated Current* (**B02**). It should be noted that if detection of low speed is required, low speed detection may not be detected if *Injection Braking Level* (**D23**) is set to a low level. For detection of low speed it is recommended that *Injection Braking Level* (**D23**) is 50 % or more.

D24	**Injection Braking Time**		
Mode	Open Loop		
Minimum	0.0	**Maximum**	100.0
Default	1.0	**Units**	s
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW		

Injection Braking Time (**D24**) defines the time during which DC current is injected into the motor during stopping with injection stopping modes.

8.4 Menu E: Mechanical

Figure 8-13 Elevator Mechanical Data

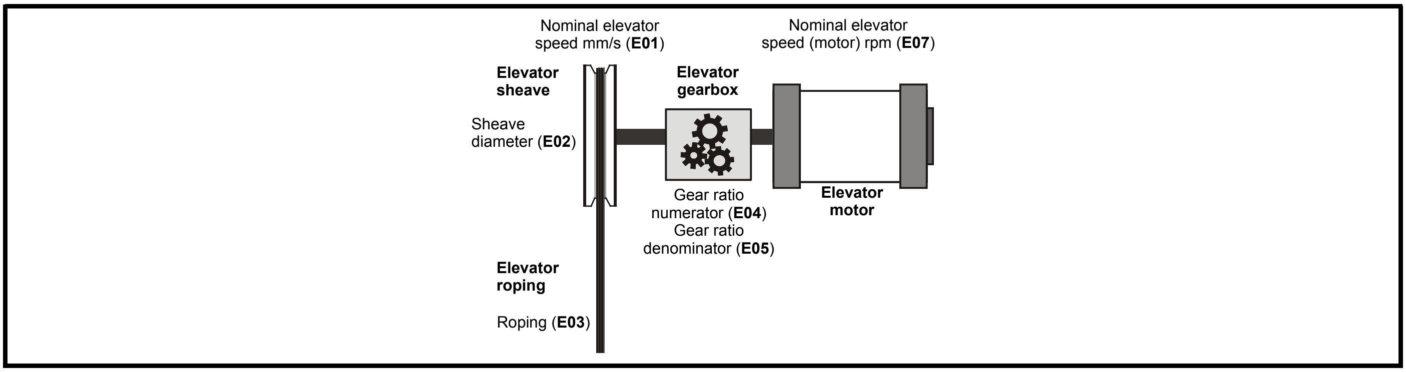


Figure 8-14 Load Cell Compensation

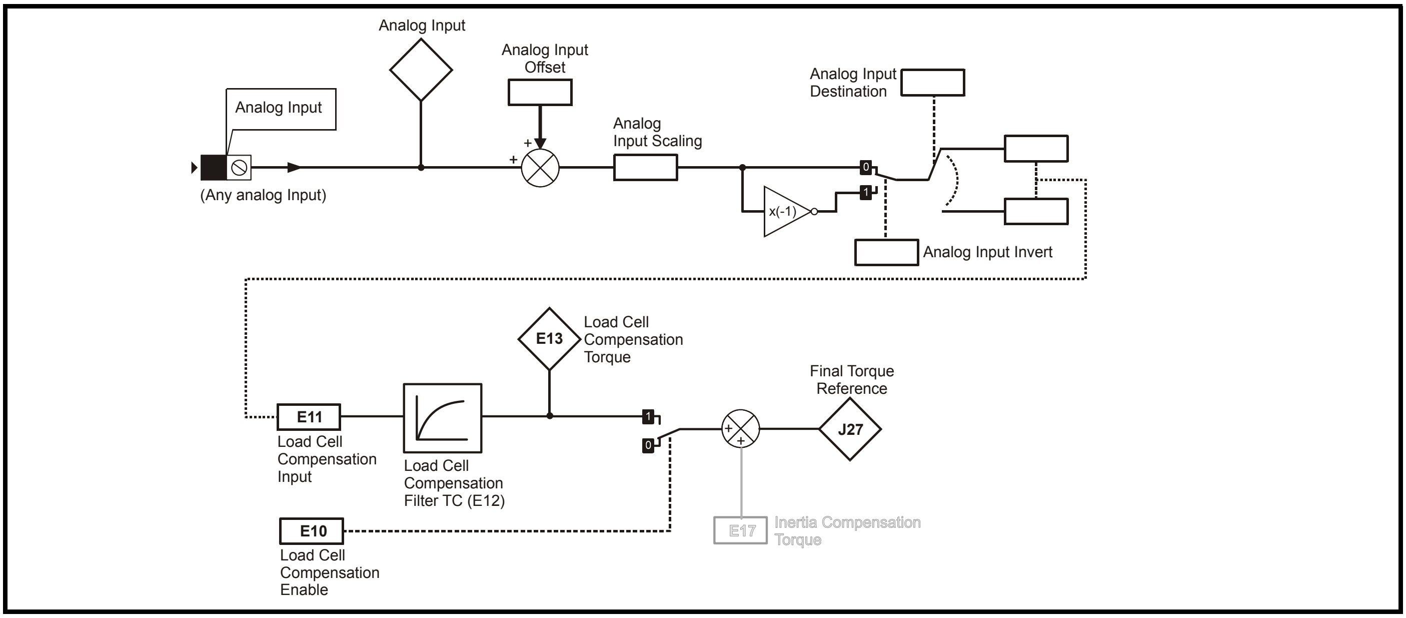
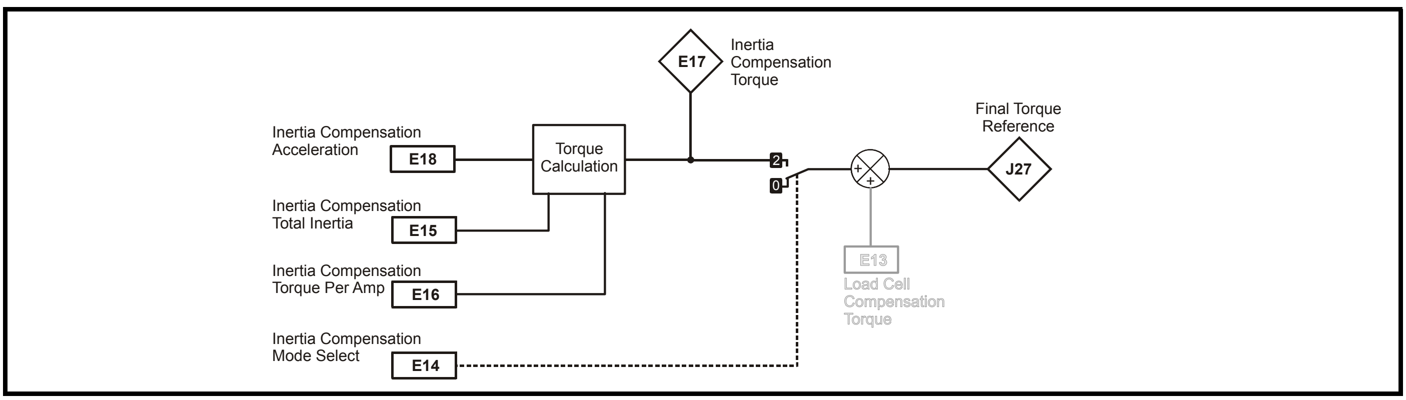


Figure 8-15 Inertia Compensation



Parameter		Range(⇳)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
E01	Nominal Elevator Speed	0 to 1800 mm/s	0 to 10000 mm/s		1000 mm/s			RW	Num				US
E02	Sheave Diameter	1 to 32767 mm			400 mm		480 mm	RW	Num				US
E03	Roping	1:1 (1), 2:1 (2), 3:1 (3), 4:1 (4)			1:1 (1)			RW	Txt				US
E04	Gearbox Ratio Numerator	1 to 32767			31		1	RW	Num				US
E05	Gear Ratio Denominator	1 to 32767			1			RW	Num				US
E07	Nominal Elevator Speed rpm	1.00 to 4000.00 rpm			1480.14 rpm		39.48 rpm	RW	Num				US
E08	Open-Loop: Motor maximum frequency	±VM_POSITIVE_REF_CLAMP1			54.8 Hz			RO	Num				US
	RFC-A: Motor maximum speed					1644.6 rpm		RO	Num				US
	RFC-S: Motor maximum speed						43.8 rpm	RO	Num				US
E09	Open-Loop: Over Speed Threshold	0.0 to 550.0 Hz			0.0 Hz			RW	Num			PT	US
	RFC-A: Over Speed Threshold		0 to 40000			0		RW	Num				US
	RFC-S: Motor Over Speed Threshold			0.0 to 550.0			0.0	RW	Num				US
E10	Load Cell Compensation Enable	Off (0) or On (1)			Off (0)			RW	Bit				US
E11	Load Cell Compensation Input	-32768 to 32767			0			RW	Num				US
E12	Load Cell Compensation Filter Time Constant	0 to 32767 ms			100 ms			RW	Num				US
E13	Load cell compensation torque	±VM_USER_CURRENT %			0.0 %			RW	Num				US
E14	Inertia Compensation Mode Select		None (0), Torque (2)			None (0)		RW	Txt				US
E15	Inertia Compensation Total Inertia		0.00000 to 1000.00000 kgm²			0.00000 kgm²		RW	Num				US
E16	Torque Per Amp		0.00 to 500.00 Nm/A				1.60 Nm/A	RO	Num	ND	NC	PT	
E17	Inertia Compensation Torque		±1000.0 %					RO	Num	ND	NC	PT	
E18	Inertia compensation acceleration		-1073741.824 to 1073741.823 mm/s² x100					RO	Num	ND	NC	PT	

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Mode: Open-Loop, RFC-A, RFC-S

E01	Nominal Elevator Speed		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	OL: 1800 RFC-A / RFC-S: 10000
Default	1000	**Units**	mm / s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This sets the nominal elevator linear shaft speed in mm/s. This is used to set the motion profile scaling such that distances calculated for the profile in mm will result in elevator car positioning in mm.

Nominal Elevator Speed rpm (**E07**) is calculated automatically when *Nominal Elevator Speed* (**E01**), or *Sheave Diameter* (**E02**), or *Roping* (**E03**), or *Gearbox Ratio Numerator* (**E04**), or *Gear Ratio Denominator* (**E05**) are modified.

See *Nominal Elevator Speed rpm* (**E07**) for more details.

E02	Sheave Diameter		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	32767
Default	Open-Loop, RFC-A: 400 RFC-S: 480	**Units**	mm
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This sets the sheave diameter in mm units and is used to calculate *Nominal Elevator Speed rpm* (**E07**).

Nominal Elevator Speed rpm (**E07**) is calculated automatically when *Nominal Elevator Speed* (**E01**), or *Sheave Diameter* (**E02**), or *Roping* (**E03**), or *Gearbox Ratio Numerator* (**E04**), or *Gear Ratio Denominator* (**E05**) are modified.

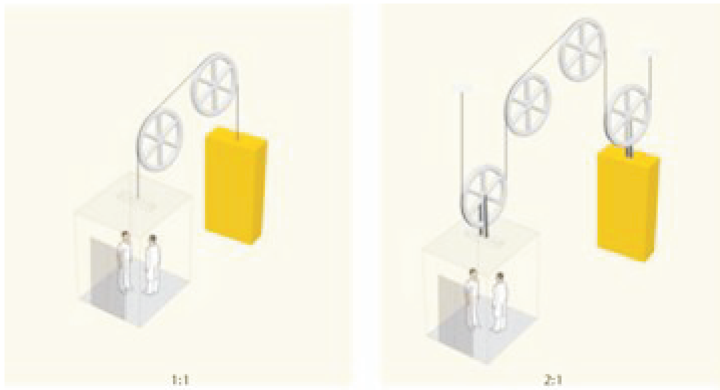
See *Nominal Elevator Speed rpm* (**E07**) for more details.

E03	Roping		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	4
Default	1:1 (1)	**Units**	
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This sets the roping ratio and is used to calculate *Nominal Elevator Speed rpm* (**E07**). A roping ratio of 2:1 is entered as 2.

Value	Text
1	1:1
2	2:1
3	3:1
4	4:1

Figure 8-16 Roping Ratio



Nominal Elevator Speed rpm (**E07**) is calculated automatically when *Nominal Elevator Speed* (**E01**), or *Sheave Diameter* (**E02**), or *Roping* (**E03**), or *Gearbox Ratio Numerator* (**E04**), or *Gear Ratio Denominator* (**E05**) are modified.

See *Nominal Elevator Speed rpm* (**E07**) for more details.

E04	**Gearbox Ratio Numerator**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	32767
Default	Open-Loop, RFC-A: 31 RFC-S: 1	**Units**	
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This sets the gearbox ratio numerator and is used to calculate *Nominal Elevator Speed rpm* (**E07**). A gear box ratio (In:Out) of 7:3 is entered as 7 in *Gearbox Ratio Numerator* (**E04**).

Nominal Elevator Speed rpm (**E07**) is calculated automatically when *Nominal Elevator Speed* (**E01**), or *Sheave Diameter* (**E02**), or *Roping* (**E03**), or *Gearbox Ratio Numerator* (**E04**), or *Gear Ratio Denominator* (**E05**) are modified.

The default gearbox ratio of 1:1 is used for gearless PM motor applications.

See *Nominal Elevator Speed rpm* (**E07**) for more details.

E05	**Gear Ratio Denominator**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	32767
Default	1	**Units**	
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This sets the gearbox ratio numerator and is used to calculate *Nominal Elevator Speed rpm* (**E07**). A gear box ratio (In:Out) of 7:3 is entered as 3 in *Gear Ratio Denominator* (**E05**).

Nominal Elevator Speed rpm (**E07**) is calculated automatically when *Nominal Elevator Speed* (**E01**), or *Sheave Diameter* (**E02**), or *Roping* (**E03**), or *Gearbox Ratio Numerator* (**E04**), or *Gear Ratio Denominator* (**E05**) are modified.

The default gearbox ratio of 1:1 is used for gearless PM motor applications.

See *Nominal Elevator Speed rpm* (**E07**) for more details.

E07	**Nominal Elevator Speed rpm**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1.00	**Maximum**	4000.00
Default	Open-Loop, RFC-A: 1480.14 RFC-S: 39.48	**Units**	rpm
Type	32 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This sets the nominal elevator motor speed in rpm units. This is used to set the motion profile scaling such that distances calculated for the profile in mm will result in elevator car positioning in mm.

This value may be set manually when or it will be calculated automatically when *Nominal Elevator Speed* (**E01**), or *Sheave Diameter* (**E02**), or *Roping* (**E03**), or *Gearbox Ratio Numerator* (**E04**), or *Gear Ratio Denominator* (**E05**).

Nominal Elevator Speed rpm (**E07**) is derived using the following calculation:

- A = *Nominal Elevator Speed rpm* (**E07**)
- B = *Nominal Elevator Speed* (**E01**)
- C = *Sheave Diameter* (**E02**)
- D = *Roping* (**E03**)
- E = *Gearbox Ratio Numerator* (**E04**)
- F = *Gear Ratio Denominator* (**E05**)

$A = (B * D * E * 60) / (\pi * C * F)$

Motor maximum frequency, Motor maximum speed (**E08**) must be set >= *Nominal Elevator Speed rpm* (**E07**).

This parameter also defines the maximum speed demand in rpm that the elevator drive will produce.

In Open loop mode the relationship between rpm and frequency is Nominal elevator frequency = Nominal elevator speed rpm x motor rated frequency / Motor synchronous speed.

If this value has been manually altered and the original calculated values must be restored, change *Nominal Elevator Speed* (**E01**) to *Gearbox Ratio Denominator* (**E05**) to a different value and then back again to recalculate the original value of *Nominal Elevator Speed rpm* (**E07**).

E08	**Motor Maximum Frequency [Open-Loop]** **Motor Maximum Speed [RFC-A, RFC-S]**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-214748364.8	**Maximum**	214748364.7
Default	Open-Loop: 54.8 RFC-A: 1644.6 RFC-S: 43.8	**Units**	Open-Loop: Hz RFC-A, RFC-S: rpm
Type	32 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	1
Coding	RO, PR		

Motor maximum frequency / Motor maximum speed (**E08**) provides a limit on the maximum frequency or speed.

This value is calculated internally to be the equivalent of 110 % of *Nominal Elevator Speed rpm* (**E07**).

E09	**Over Speed Threshold**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	40000
Default	Open-Loop: 0 RFC-A, RFC-S: 0	**Units**	Open-Loop: Hz RFC-A, RFC-S: rpm
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

If *Over Speed Threshold, Motor Over Speed Threshold* (**E09**) is set to a non-zero value it defines the over speed threshold. If the *Drive Encoder Speed Feedback* (**J51**) exceeds this threshold in either direction an *Over Speed* trip is produced. If *Over Speed Threshold* (**E09**) is set to 0.0 the threshold is based on the variable minimum/maximum for the references and is equal to 1.2 x VM_SPEED_FREQ_REF[MAX].

E10	**Load Cell Compensation Enable**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When set to Off (0), load cell compensation is disabled.

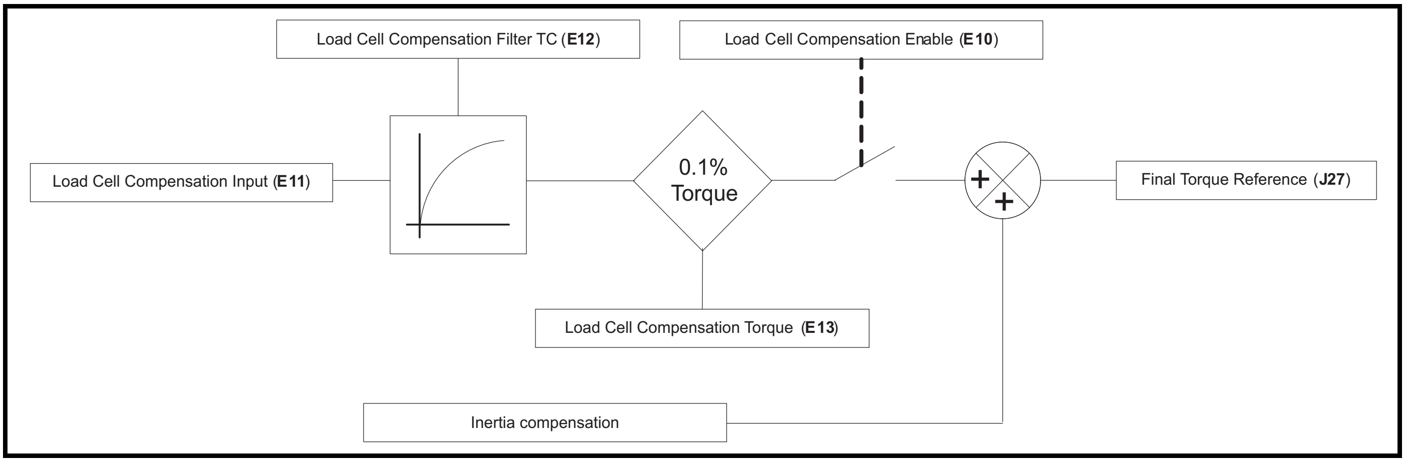
When set to On (1), load cell compensation is enabled.

Load cell compensation uses the elevator car load cell to generate a torque feed forward reference equivalent to the load torque preventing roll back on brake release when starting the elevator.

Any of the 3 analogue inputs may be routed to *Load Cell Compensation Input* (**E11**), where it is expected that the output from the load cell is a ±10VDC type. Scaling and offsetting the load cell signal is achieved using the standard analog input features.

The load cell compensation is not applied during an autotune.

Figure 8-17 Load Cell Compensation



Start Lock Enable (**I22**) must not be used at the same time as load cell compensation *Load Cell Compensation Enable* (**E10**).

Load cell compensation uses the elevator car load cell to apply a torque reference to overcome the mass of the people in the elevator car when running preventing roll back on brake release. The load cell compensation torque reference is sampled once.

Any analog input may be routed to *Load Cell Compensation Input* (**E11**). It is expected that the output from the load cell is a ±10 Vdc type suitable for connection to the Unidrive M analog inputs. Scaling and offsetting the load cell signal is done using the standard analog input features.

On exit from state 2, (*Elevator Software State* (**J03**) = 2), the final load cell compensation torque reference is sampled once and used as a torque feed forward reference. Sampling once prevents noise generated during travel, electrical or mechanical, from being detected by the load cell and injected as a torque reference.

The following parameters affect load cell compensation:

E11	**Load Cell Compensation Input**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-32768	**Maximum**	32767
Default	0	**Units**	
Type	16 Bit User Save	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, PR		

This is the input to the load cell compensation scheme. Any analogue input may be routed to *Load Cell Compensation Input* (**E11**). It is expected that the output from the load cell is a ±10 Vdc type and it is electrically connected to the analog input who's destination is *Load Cell Compensation Input* (**E11**). Scaling and offsetting the load cell signal is done using the standard analog input features.

Parameter	Description
Load Cell Compensation Torque (**E13**)	Enables the load cell compensation torque offset to be applied.
Load Cell Compensation Input (**E11**)	The input to the load cell compensations scheme. This is used as the destination for the analog input which receives the load cell signal.
Load Cell Compensation Filter Time Constant (**E12**)	Filters the final load cell torque reference such that the effect of electrical noise in the load cell signal, or mechanical disturbances during travel affecting the load cell compensation are minimized.
Load Cell Compensation Torque (**E13**)	Indicates the final torque reference in 0.1 % of system rated torque units.

Balanced elevator car:

For a balanced elevator car, the torque shown in *Load Cell Compensation Torque* (**E13**) must be 0. If it is not 0 adjust the offset for the analog input used.

Empty elevator car

After the balanced elevator car load cell offset has been made, the scaling for the analog input used must be modified with an empty elevator car. When the brake releases but before the elevator car accelerates, if the scaling for the analog input used is setup correctly then *Speed Error* (**J31**) = 0 (in RFC-A and RFC-S mode) and *Final Torque Reference* (**J27**) = *Load Cell Compensation Torque* (**E13**), indicating that the torque reference required to hold the car still is provided by the load cell compensation.

E12	Load Cell Compensation Filter Time Constant		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	32767
Default	100	**Units**	ms
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This sets the load cell compensation filter time constant in ms units. It may be increased to remove electrical noise from the load cell signal during travel, or to reduce the effect of mechanical disturbances on the load cell feedback.

E13	Load Cell Compensation Torque		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	−VM_USER_CURRENT	**Maximum**	VM_USER_CURRENT
Default	0.0	**Units**	%
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	1
Coding	RW, VM		

This indicates the final load cell measurement compensation torque in 0.01% of system rated torque units.

E14	Inertia Compensation Mode Select		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	None
1	Acceleration
2	Torque

Inertia Compensation Mode Select (**E14**) selects the inertia compensation mode as shown below.

0 (None)

No inertia compensation.

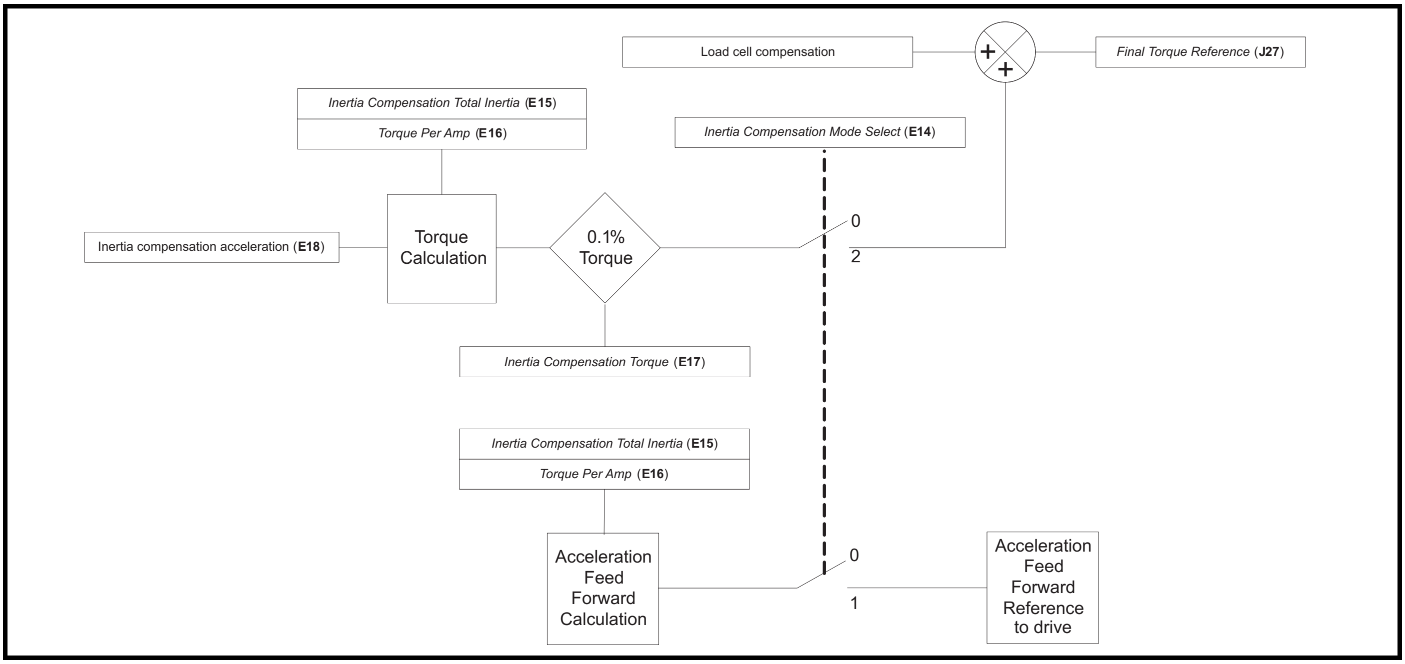
1 (Acceleration feed-forwards)

When acceleration feed-forwards is selected a gain term is automatically calculated based on the currently active drive speed controller gains, *Inertia Compensation Total Inertia* (**E15**) and *Torque Per Amp* (**E16**). The acceleration feed-forwards term is intended to cancel the effect of the speed controller time constant and give a faster position control loop response. *Current Controller Mode* (**H17**) must be set to On (1) to use this functionality.

2 (Torque feed-forwards)

When torque feed-forwards is selected the acceleration from the profile generator is used to define the torque feed-forwards. The *Inertia Compensation Total Inertia* (**E15**), *Torque Per Amp* (**E16**) and the output user units ratio are used to convert from acceleration to torque. It should be noted that the *Inertia Compensation Torque* (**E17**) is added to the output of the speed controller when *Inertia Compensation Mode Select* **(E14)** = 2.

Figure 8-18 Inertia Compensation



This can be used to overcome the mechanical inertia of the elevator system. Implementing inertia compensation gives a dynamic torque feed forward based upon the inertia of the system and the acceleration rate used, reducing the work done by the speed loop i.e. reduces speed loop error.

E15	Inertia Compensation Total Inertia		
Mode	RFC-A, RFC-S		
Minimum	0.00000	**Maximum**	1000.00000
Default	0.00000	**Units**	kg m^2
Type	32 Bit User Save	**Update Rate**	1 s read
Display Format	Standard	**Decimal Places**	5
Coding	RW		

The *Inertia Compensation Total Inertia* (**E15**) represents the total inertia driven by the motor. This is used to set the speed controller gains and to provide torque feed forwards during acceleration when required.

It is possible to measure the inertia as part of the auto-tune process (see *Motor Autotune* (**B11**).

E16	Torque Per Amp		
Mode	RFC-A, RFC-S		
Minimum	0.00	**Maximum**	500.00
Default		**Units**	Nm / A
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	2
Coding	RO, ND, NC, PT, BU		

RFC-A

Torque Per Amp (**E16**) is automatically calculated from the motor parameters assuming a motor efficiency of 90%.

Torque Per Amp (**E16**) = Estimated rated shaft power / [*Motor Rated Speed* (**B07**) x I_{TRated}]

where

I_{TRated} is the rated torque producing current

and

Estimated rated shaft power = √3 x *Motor Rated Voltage* (**B03**) x *Motor Rated Current* (**B02**) x *Motor Rated Power Factor* (**B04**) x 0.9

Torque Per Amp (**E16**) is used in the automatic calculation of the speed controller gains.

RFC-S

Torque Per Amp (**E16**) is used for automatic speed controller gain set up, and so the correct value for the motor should be entered if this feature is required.

E17	**Inertia Compensation Torque**		
Mode	RFC-A, RFC-S		
Minimum	-1000.0	**Maximum**	1000.0
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	1
Coding	RO, ND, NC, PT		

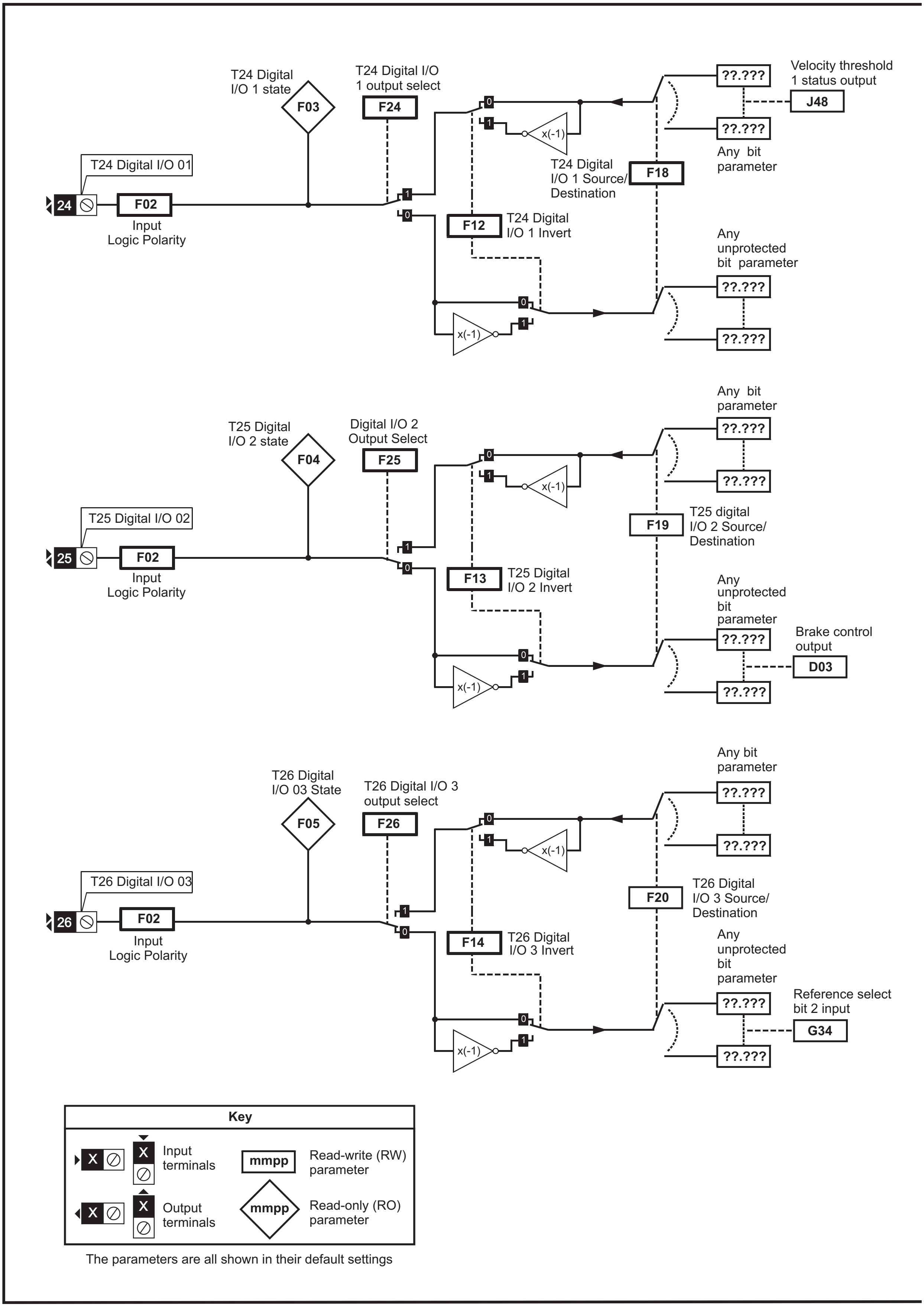
The *Inertia Compensation Total Inertia* (**E15**), *Torque Per Amp* (**E16**) and *Inertia compensation acceleration* (**E18**) are used to produce a torque feed-forwards value that should accelerate and decelerate the load at the required rate. This value can be used as a feed-forwards term that is added to the speed controller output. *Inertia Compensation Torque* (**E17**) gives the torque as a percentage of rated torque.

E18	**Inertia Compensation Acceleration**		
Mode	RFC-A, RFC-S		
Minimum	-1073741.824	**Maximum**	1073741.823
Default		**Units**	mm / s^2 x100
Type	32 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	3
Coding	RO, ND, NC, PT		

This is the profile generator output acceleration rate, and is set in 100mm/s^2 units with 3 decimal places where 0.001 = 0.1mm/s^2.

8.5 Menu F: - I/O Hardware

Figure 8-19 Menu F Digital input and output logic diagram



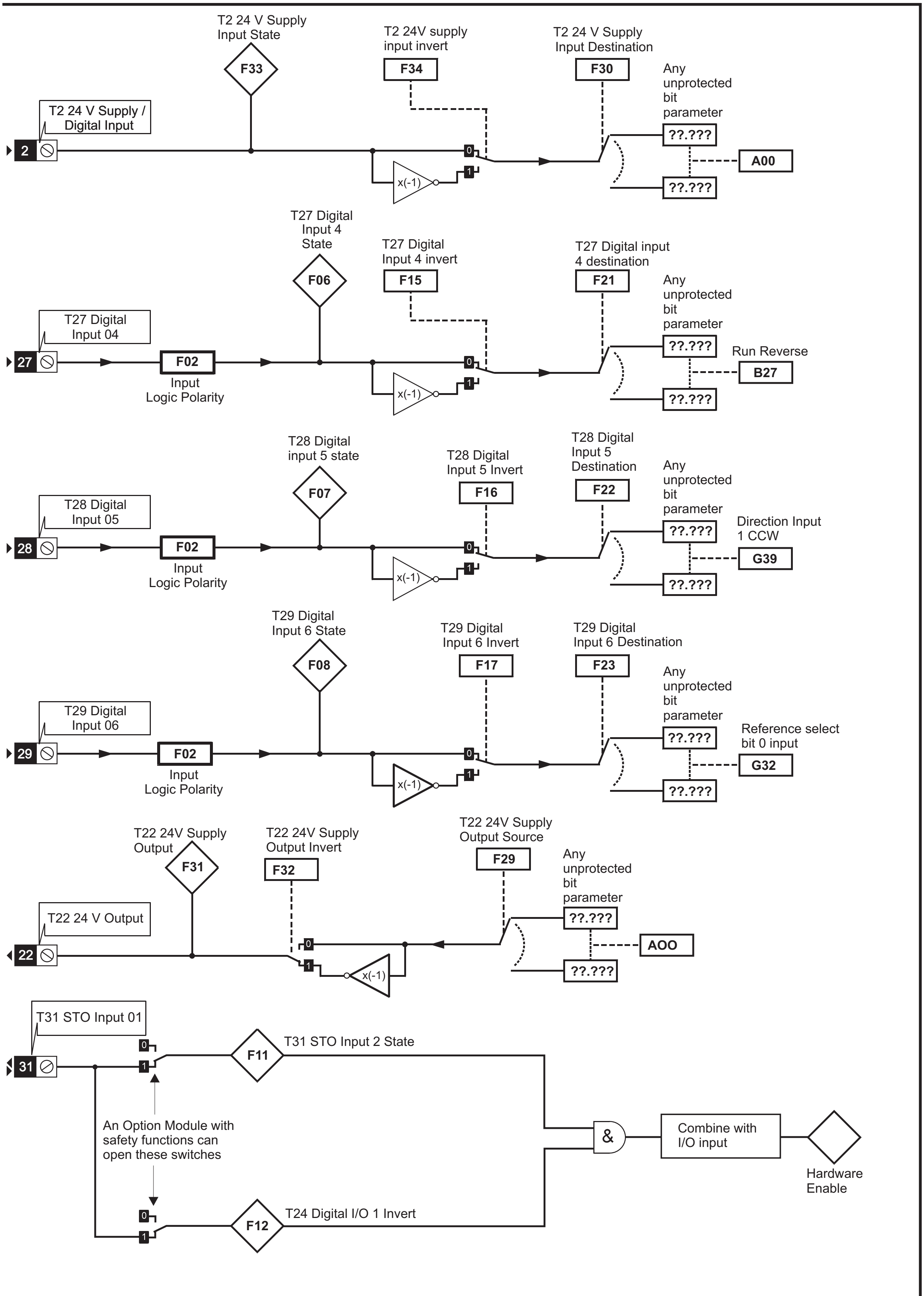

T2 24 V Supply Input State
F33
T2 24V supply input invert
F34
T2 24 V Supply Input Destination
F30
Any unprotected bit parameter
??.???
A00
??.???
T2 24 V Supply / Digital Input
2
x(-1)
T27 Digital Input 4 State
F06
T27 Digital Input 4 invert
F15
T27 Digital input 4 destination
F21
Any unprotected bit parameter
T27 Digital Input 04
27
F02
Input Logic Polarity
??.???
Run Reverse
B27
??.???
T28 Digital input 5 state
F07
T28 Digital Input 5 Invert
F16
T28 Digital Input 5 Destination
F22
Any unprotected bit parameter
T28 Digital Input 05
28
F02
Input Logic Polarity
??.???
Direction Input 1 CCW
G39
??.???
T29 Digital Input 6 State
F08
T29 Digital Input 6 Invert
F17
T29 Digital Input 6 Destination
F23
Any unprotected bit parameter
T29 Digital Input 06
29
F02
Input Logic Polarity
??.???
Reference select bit 0 input
G32
??.???
T22 24V Supply Output
F31
T22 24V Supply Output Invert
F32
T22 24V Supply Output Source
F29
Any unprotected bit parameter
??.???
AOO
??.???
T22 24 V Output
22
T31 STO Input 01
31
F11
T31 STO Input 2 State
An Option Module with safety functions can open these switches
&
Combine with I/O input
Hardware Enable
F12
T24 Digital I/O 1 Invert

Figure 8-20 Menu F Analog input and output logic diagram

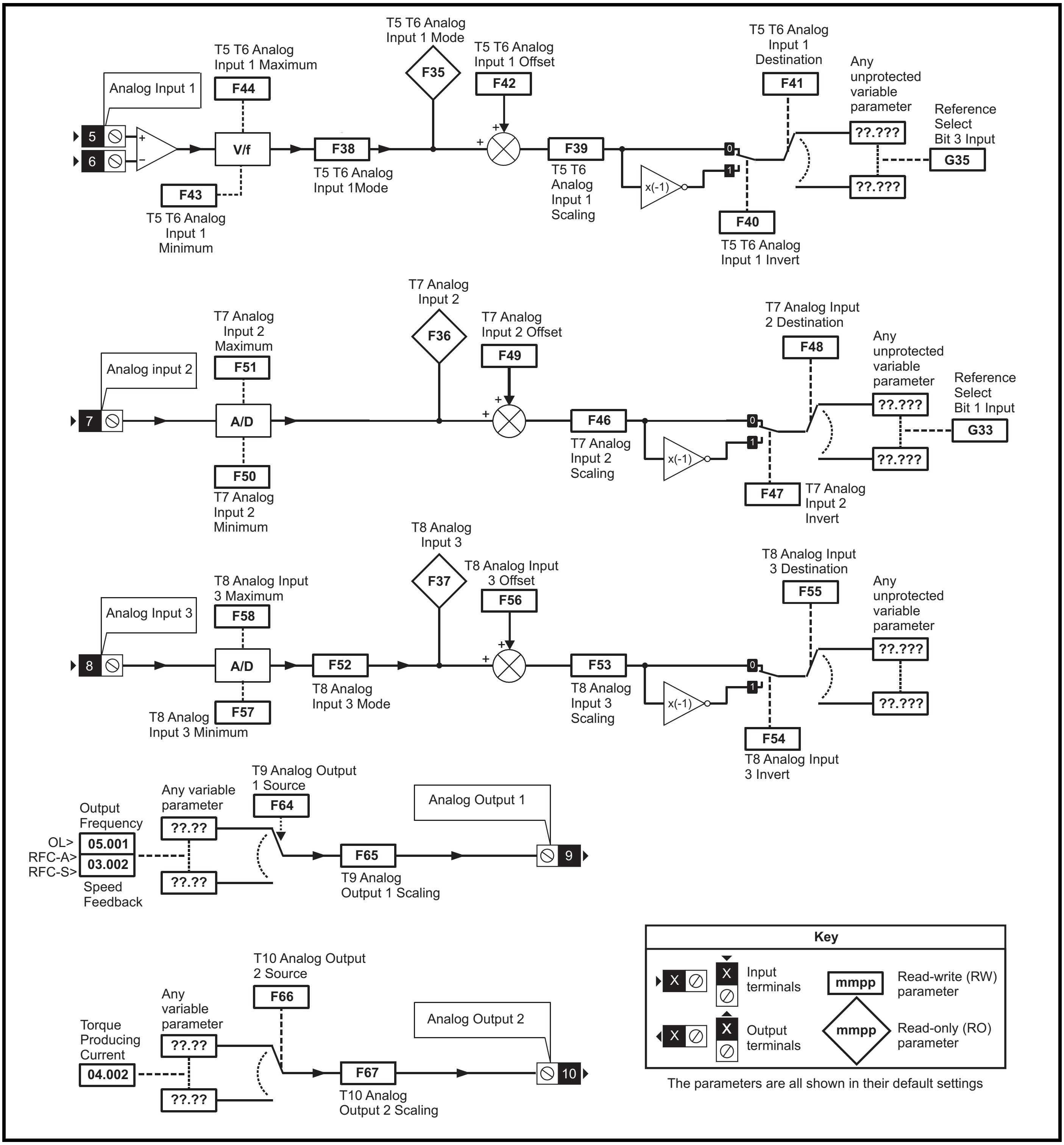
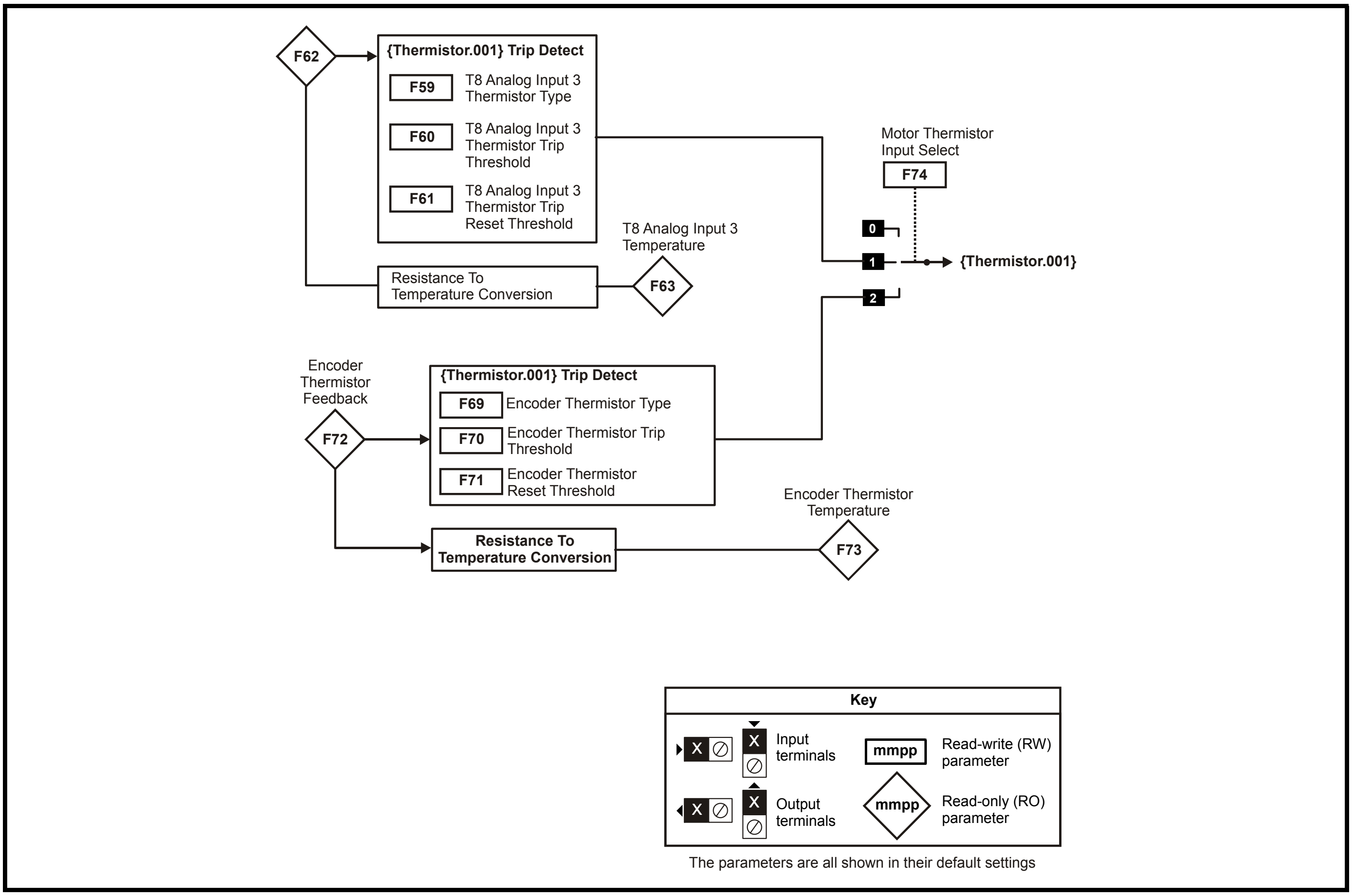


Figure 8-21 Thermistor monitoring logic diagram



Parameter		Range(⇕)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
F01	IO Status Word	0000000000000000 to 1111111111111111			0000000000000000			RO	Bin			PT	
F02	Input Logic Polarity	Negative Logic (0), Positive Logic (1)			Positive Logic (1)			RW	Txt				US
F03	T24 Digital I/O 01 State	Off (0) or On (1)						RO	Bit	ND	NC	PT	
F04	T25 Digital I/O 02 State	Off (0) or On (1)						RO	Bit	ND	NC	PT	
F05	T26 Digital I/O 03 State	Off (0) or On (1)						RO	Bit	ND	NC	PT	
F06	T27 Digital Input 04 State	Off (0) or On (1)						RO	Bit	ND	NC	PT	
F07	T28 Digital Input 05 State	Off (0) or On (1)						RO	Bit	ND	NC	PT	
F08	T29 Digital Input 06 State	Off (0) or On (1)						RO	Bit	ND	NC	PT	
F09	T41 T42 Relay Output State	Off (0) or On (1)						RO	Bit	ND	NC	PT	
F10	T31 STO Input 01 State	Off (0) or On (1)						RO	Bit	ND	NC	PT	
F12	T24 Digital I/O 01 Invert	Not Invert (0), Invert (1)			Not Invert (0)			RW	Txt				US
F13	T25 Digital I/O 02 Invert	Not Invert (0), Invert (1)			Not Invert (0)			RW	Txt				US
F14	T26 Digital I/O 03 Invert	Not Invert (0), Invert (1)			Not Invert (0)			RW	Txt				US
F15	T27 Digital Input 04 Invert	Not Invert (0), Invert (1)			Not Invert (0)			RW	Txt				US
F16	T28 Digital Input 05 Invert	Not Invert (0), Invert (1)			Not Invert (0)			RW	Txt				US
F17	T29 Digital Input 06 Invert	Not Invert (0), Invert (1)			Not Invert (0)			RW	Txt				US
F18	T24 Digital I/O 01 Source/ Destination	A00 to AB99			J48			RW	Num	DE		PT	US
F19	T25 Digital I/O 02 Source/ Destination	A00 to AB99			D03			RW	Num	DE		PT	US
F20	T26 Digital I/O 03 Source/ Destination	A00 to AB99			G34			RW	Num	DE		PT	US
F21	T27 Digital Input 04 Destination	A00 to AB99			B27			RW	Num	DE		PT	US
F22	T28 Digital Input 05 Destination	A00 to AB99			G39			RW	Num	DE		PT	US
F23	T29 Digital Input 06 Destination	A00 to AB99			G32			RW	Num	DE		PT	US
F24	T24 Digital I/O 01 Output Select	Off (0) or On (1)			On (1)			RW	Bit				US
F25	T25 Digital I/O 02 Output Select	Off (0) or On (1)			On (1)			RW	Bit				US
F26	T26 Digital I/O 03 Output Select	Off (0) or On (1)			Off (0)			RW	Bit				US
F27	T41 T42 Relay Output Source	A00 to AB99			L05			RW	Num			PT	US
F28	T41 T42 Relay Output Invert	Not Invert (0), Invert (1)			Not Invert (0)			RW	Txt				US
F29	T22 24V Supply Output Source	A00 to AB99			A00			RW	Num			PT	US
F30	T2 24V Supply Input Destination	A00 to AB99			A00			RW	Num	DE		PT	US
F31	T22 24V Supply Output State	Off (0) or On (1)						RO	Bit	ND	NC	PT	
F32	T22 24V Supply Output Invert	Not Invert (0), Invert (1)			Invert (1)			RW	Txt				US
F33	T2 24V Supply Input State	Off (0) or On (1)						RO	Bit	ND	NC	PT	
F34	T2 24V Supply Input Invert	Not Invert (0), Invert (1)			Not Invert (0)			RW	Txt				US
F35	T5 T6 Analog Input 1	±100.00 %						RO	Num	ND	NC	PT	FI
F36	T7 Analog Input 2	±100.00 %						RO	Num	ND	NC	PT	FI
F37	T8 Analog Input 3	±100.00 %						RO	Num	ND	NC	PT	FI
F38	T5 T6 Analog Input 1 Mode	4-20mA Low (-4), 20-4mA Low (-3), 4-20mA Hold (-2), 20-4mA Hold (-1), 0-20mA (0), 20-0mA (1), 4-20mA Trip (2), 20-4mA Trip (3), 4-20mA (4), 20-4mA (5), Volt (6), Therm Short Cct (7), Thermistor (8), Therm No Trip (9)			Volt (6)			RW	Txt				US
F39	T5 T6 Analog Input 1 Scaling	0.000 to 10.000			1.000			RW	Num				US
F40	T5 T6 Analog Input 1 Invert	Off (0) or On (1)			Off (0)			RW	Bit				US
F41	Analog Input 1 Destination	A00 to AB99			G35			RW	Num	DE		PT	US
F42	T5 T6 Analog Input 1 Offset	±100.00 %			0.00 %			RW	Num				US
F43	T5 T6 Analog Input 1 Minimum	±100.00 %			-100.00 %			RW	Num				US
F44	T5 T6 Analog Input 1 Maximum	±100.00 %			100.00 %			RW	Num				US
F45	T7 Analog Input 2 Mode	4-20mA Low (-4), 20-4mA Low (-3), 4-20mA Hold (-2), 20-4mA Hold (-1), 0-20mA (0), 20-0mA (1), 4-20mA Trip (2), 20-4mA Trip (3), 4-20mA (4), 20-4mA (5), Volt (6), Therm Short Cct (7), Thermistor (8), Therm No Trip (9)			Volt (6)			RW	Txt				US

Parameter		Range(⇳) Open-Loop / RFC-A / RFC-S	Default(⇨) Open-Loop / RFC-A / RFC-S	Type					
F46	T7 Analog Input 2 Scaling	0.000 to 10.000	1.000	RW	Num				US
F47	T7 Analog Input 2 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
F48	T7 Analog Input 2 Destination	A00 to AB99	G33	RW	Num	DE		PT	US
F50	T7 Analog Input 2 Minimum	±100.00 %	-100.00 %	RW	Num				US
F51	T7 Analog Input 2 Maximum	±100.00 %	100.00 %	RW	Num				US
F52	T8 Analog Input 3 Mode	Volt (6), Therm Short Cct (7), Thermistor (8), Therm No Trip (9)	Volt (6)	RW	Txt				US
F53	T8 Analog Input 3 Scaling	0.000 to 10.000	1.000	RW	Num				US
F54	T8 Analog Input 3 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
F55	T8 Analog Input 3 Destination	A00 to AB99	A00	RW	Num	DE		PT	US
F56	T8 Analog Input 3 Offset	±100.00 %	0.00 %	RW	Num				US
F57	T8 Analog Input 3 Minimum	±100.00 %	-100.00 %	RW	Num				US
F58	T8 Analog Input 3 Maximum	±100.00 %	100.00 %	RW	Num				US
F59	T8 Analog Input 3 Thermistor Type	DIN44082 (0), KTY84 (1), PT100 (4W) (2), PT1000 (4W) (3), PT2000 (4W) (4), 2.0mA (4W) (5), PT100 (2W) (6), PT1000 (2W) (7), PT2000 (2W) (8), 2.0mA (2W) (9)	DIN44082 (0)	RW	Txt				US
F60	T8 Analog Input 3 Thermistor Trip Threshold	0 to 5000 Ω	3300 Ω	RW	Num				US
F61	T8 Analog Input 3 Thermistor Reset Threshold	0 to 5000 Ω	1800 Ω	RW	Num				US
F62	T8 Analog Input 3 Thermistor Feedback	0 to 5000 Ω		RO	Num	ND	NC	PT	
F63	T8 Analog Input 3 Thermistor Temperature	-50 to 300 °C		RO	Num	ND	NC	PT	
F64	T9 Analog Output 1 Source	A00 to AB99	A00	RW	Num			PT	US
F65	T9 Analog Output 1 Scaling	0.000 to 10.000	1.000	RW	Num				US
F66	T9 Analog Output 2 Source	A00 to AB99	A00	RW	Num			PT	US
F67	Analog Output 2 Scaling	0.000 to 10.000	1.000	RW	Num				US
F68	Start Speed Selection Filter	±200 ms	20 ms	RW	Num				US
F69	Encoder Thermistor Type	DIN44082 (0), KTY84 (1), 0.8 mA (2)	DIN44082 (0)	RW	Txt				US
F70	Encoder Thermistor Trip Threshold	0 to 5000 Ω	3300 Ω	RW	Num				US
F71	Encoder Thermistor Reset Threshold	0 to 5000 Ω	1800 Ω	RW	Num				US
F72	Encoder Thermistor Feedback	0 to 5000 Ω		RO	Num	ND	NC	PT	
F73	Encoder Thermistor Temperature	-50 to 300 °C		RO	Num	ND	NC	PT	
F74	Motor Thermistor Input Select	0 to 2	1	RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Mode: Open-Loop, RFC-A, RFC-S

F01	IO Status Word		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 0000000000000000)	**Maximum**	65535 (Display: 1111111111111111)
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	250 µs write
Display Format	Binary	**Decimal Places**	0
Coding	RO, PT, BU		

The bits in the *IO Status Word* (**F01**) each correspond with one digital I/O as shown below. The update rate of the individual bits in these registers differs depending upon the I/O.

DI/O	Bit	Function	Bit update rate		
			Input Register	Output Register	Output Enable Register
1	0	Digital Input/Output	2 ms	250 µs	Background
2	1	Digital Input/Output	2 ms	250 µs	Background
3	2	Digital Input/Output	2 ms	2 ms	Background
4	3	Digital Input	250 µs	Not applicable	Not applicable
5	4	Digital Input	250 µs	Not applicable	Not applicable
6	5	Digital Input	2 ms	Not applicable	Not applicable
7	6	Relay Output	Bit always 0	2 ms	Background
8	7	24 V Supply Output	Bit always 0	2 ms	Background
9	8	Safe Torque Off 1	2 ms	Not applicable	Not applicable
10	9	Safe Torque Off 2	2 ms	Not applicable	Not applicable
11	10	Keypad Run Button	Background	Not applicable	Not applicable
12	11	Keypad Auxiliary Button	Background	Not applicable	Not applicable
13	12	24 V Supply Input	2 ms	Not applicable	Not applicable
14	13	Keypad Stop Button	Background	Not applicable	Not applicable
15	14	Relay 2 Output	Bit always 0	2 ms	Background

The *IO Status Word* (**F01**) is always active and shows the value in the Digital I/O State parameter for all digital I/O configured as inputs.

F02	Input Logic Polarity		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	Text
0	Negative Logic
1	Positive Logic

See *T24 Digital I/O 01 State* (**F03**).

F03	T24 Digital I/O 01 State		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	2 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

The Digital I/O State parameter shows the state of digital I/O on the drive. All I/O except Digital Input 11 (Keypad Run Button), Digital Input 12 (Keypad Auxiliary Button), Digital Input 13 (24 V Supply Input) and Digital Input 14 (Keypad Stop Button) use IEC61131-2 logic levels. As default the inputs use positive logic, and so the state parameter is 0 if the digital I/O is low or 1 if the digital I/O is high. *Input Logic Polarity* (**F02**) can be set to zero to change the logic for Digital I/O1-6 to negative logic, so that the state parameter is 0 if the digital I/O is high or 1 if the digital I/O is low. The state parameter represents the digital I/O state whether it is an input or an output.

Digital Input 11 (Keypad Run Button), Digital Input 12 (Keypad Auxiliary Button) and Digital Input 14 (Keypad Stop Button) represent the state of the Run, Auxiliary and Stop buttons on any keypad fitted to the drive; the input state is determined by ORing the state of the button on each keypad connected to the drive, if the button is pressed the state parameter is one otherwise it is zero. If a keypad is not fitted the state parameters are zero.

Digital Input 13 (24V Supply Input) is an external 24 V supply input that is monitored and can be used as a 24 V digital input if an external 24 V supply is not required. The state parameter is low for the voltage range from 0 V to 17 V and high for the voltage range above 18 V. As the input is a power supply it will consume significant current if the level is taken above 24 V when the drive is running from its internal power supply, or at any voltage level if this input is the only power supply to the drive.

F04	T25 Digital I/O 02 State		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	2 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *T24 Digital I/O 01 State* (**F03**).

F05	T26 Digital I/O 03 State		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	2 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *T24 Digital I/O 01 State* (**F03**).

F06	T27 Digital Input 04 State		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	2 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *T24 Digital I/O 01 State* (**F03**).

F07	T28 Digital Input 05 State		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	2 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *T24 Digital I/O 01 State* (**F03**).

F08	T29 Digital Input 06 State		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	2 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *T24 Digital I/O 01 State* (**F03**).

F09	T41 T42 Relay Output State		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2 ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *T24 Digital I/O 01 State* (**F03**).

F10	T31 STO Input 01 State		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2 ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *T24 Digital I/O 01 State* (**F03**).

F12	T24 Digital I/O 01 Invert		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Off
1	On

A value of 0 or 1 allows the digital I/O to be non-inverted or inverted respectively.

F13	T25 Digital I/O 02 Invert		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Off
1	On

See *T24 Digital I/O 01 Invert* (**F12**).

F14	T26 Digital I/O 03 Invert		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Off
1	On

See *T24 Digital I/O 01 Invert* (**F12**).

F15	**T27 Digital Input 04 Invert**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Off
1	On

See *T24 Digital I/O 01 Invert* (**F12**).

F16	**T28 Digital Input 05 Invert**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Off
1	On

See *T24 Digital I/O 01 Invert* (**F12**).

F17	**T29 Digital Input 06 Invert**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Off
1	On

See *T24 Digital I/O 01 Invert* (**F12**).

F18	T24 Digital I/O 01 Source/Destination		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**J48**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

Value	Text
0	Off
1	On

The Digital I/O Source/Destination parameters provide the routing for the source and/or destination for the digital I/O.

F19	T25 Digital I/O 02 Source/Destination		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**D03**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

See *T24 Digital I/O 01 Source/Destination* (**F18**).

F20	T26 Digital I/O 03 Source/Destination		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**G34**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

See *T24 Digital I/O 01 Source/Destination* (**F18**).

F21	T27 Digital Input 04 Destination		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**B27**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

See *T24 Digital I/O 01 Source/Destination* (**F18**).

F22	T28 Digital Input 05 Destination		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**G39**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

See *T24 Digital I/O 01 Source/Destination* (**F18**).

F23	T29 Digital Input 06 Destination		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**G32**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

See *T24 Digital I/O 01 Source/Destination* (**F18**).

F24	T24 Digital I/O 01 Output Select		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	1	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

The Digital I/O Output Select parameters allow the I/O to be selected as an input (0) or an output (1). These parameters are only present for digital I/O that can be used as an input or output.

F25	T25 Digital I/O 02 Output Select		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	1	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

See *T24 Digital I/O 01 Output Select* (**F24**).

F26	T26 Digital I/O 03 Output Select		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *T24 Digital I/O 01 Output Select* (**F24**).

F27	T41 T42 Relay Output Source		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**L05**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

See *T24 Digital I/O 01 Source/Destination* (**F18**).

F28	**T41 T42 Relay Output Invert**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Off
1	On

See *T24 Digital I/O 01 Invert* (**F12**).

F29	**T22 24V Supply Output Source**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

See *T24 Digital I/O 01 Source/Destination* (**F18**).

F30	**T2 24V Supply Input Destination**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

See *T24 Digital I/O 01 Source/Destination* (**F18**).

F31	**T22 24V Supply Output State**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	1	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

See *T24 Digital I/O 01 State* (**F03**).

F32	**T22 24V Supply Output Invert**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Off
1	On

See *T24 Digital I/O 01 Invert* (**F12**).

F33	T2 24V Supply Input State		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	2 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *T24 Digital I/O 01 State* (**F03**).

F34	T2 24V Supply Input Invert		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	Drive reset read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Off
1	On

See *T24 Digital I/O 01 Source/Destination* (**F18**).

F35	T5 T6 Analog Input 1		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-100.00	**Maximum**	100.00
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	2
Coding	RO, FI, ND, NC, PT		

Each analog input has a resolution of 11 bits plus sign. The inputs can operate in different modes (defined by *T5 T6 Analog Input 1 Mode* (**F38**) for analog input 1). These modes include voltage, current and thermistor modes. The available modes depend on the hardware configuration and are given in the table below.

Internal IO Identifier (J66)	Analog Input 1	Analog Input 2	Analog Input 3
0: Standard Analog and Digital I/O	Bipolar Voltage, Current	Bipolar Voltage, Current	Bipolar Voltage, Thermistor

The "Input Level" is defined for the different modes in the table below.

Mode	Input Level
Voltage	(Input Voltage / 10 V) x 100.00 %
0-20 mA	(Input Current / 20 mA) x 100.00 %
20-0 mA	((20mA - Input Current) / 20 mA) x 100.00 %
4-20 mA	((Input Current - 4 mA) / 16 mA) x 100.00 %
20-4 mA	((20 mA - Input Current) / 16 mA) x 100.00 %

T5 T6 Analog Input 1 (**F35**) is derived as follows:

Limits
A_1 is the value after the minimum and maximum limits are applied.

If *T5 T6 Analog Input 1 Minimum* (**F43**) ≥ *T5 T6 Analog Input 1 Maximum* (**F44**) then:
A_1 = 0.00% whatever the input level.

If *T5 T6 Analog Input 1 Minimum* (**F43**) < 0.00 % and *T5 T6 Analog Input 1 Maximum* (**F44**) > 0.00 % then:
A_1 = Input Level x (100.00 % / *T5 T6 Analog Input 1 Maximum* (**F44**))
A_1 is then limited between -100 % and +100 %.

Otherwise:
Input Level is limited between *T5 T6 Analog Input 1 Minimum* (**F43**) and *T5 T6 Analog Input 1 Maximum* (**F44**)
A_1 = [Input Level - *T5 T6 Analog Input 1 Minimum* (**F43**)] x 100.00 % / (*T5 T6 Analog Input 1 Maximum* (**F44**) - *T5 T6 Analog Input 1 Minimum* (**F43**))

F36	T7 Analog Input 2		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-100.00	**Maximum**	100.00
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	2
Coding	RO, FI, ND, NC, PT		

See *T5 T6 Analog Input 1* (**F35**).

F37	T5 T8 Analog Input 3		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-100.00	**Maximum**	100.00
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	2
Coding	RO, FI, ND, NC, PT		

Each analog input has a resolution of 11 bits plus sign. The inputs can operate in different modes (defined by *T8 Analog Input 3 Mode* (**F52**) for analog input 3). These modes include voltage and thermistor modes. The available modes depend on the hardware configuration and are given in the table below.

***Internal IO Identifier* (J66)**	**Analog Input 1**	**Analog Input 2**	**Analog Input 3**
0: Standard Analog and Digital I/O	Bipolar Voltage, Current	Bipolar Voltage, Current	Bipolar Voltage, Thermistor

The "Input Level" is defined for the different modes in the table below.

Mode	Input Level
Voltage	(Input Voltage / 10 V) x 100.00 %
Thermistor	(Input resistance / 10 K Ohm) x 100 %

T8 Analog Input 3 (**F37**) is derived as follows:

Limits

A_1 is the value after the minimum and maximum limits are applied.

If *T8 Analog Input 3 Minimum* (**F57**) ≥ *T8 Analog Input 3 Maximum* (**F58**) then:
A_1 = 0.00 % whatever the input level.

If *T8 Analog Input 3 Minimum* (**F57**) < 0.00 % and *T8 Analog Input 3 Maximum* (**F58**) > 0.00 % then:
A_1 = Input Level x (100.00 % / *T8 Analog Input 3 Maximum* (**F58**))
A_1 is then limited between -100 % and +100 %.

Otherwise:
Input Level is limited between *T8 Analog Input 3 Minimum* (**F57**) and *T8 Analog Input 3 Maximum* (**F58**) A_1 = [Input Level - *T8 Analog Input 3 Minimum* (**F57**)] x 100.00 % / (*T8 Analog Input 3 Maximum* (**F58**) - *T8 Analog Input 3 Minimum* (**F57**))

For thermistor modes it should be noted that *T8 Analog Input 3 Minimum* (**F57**) and *T8 Analog Input 3 Maximum* (**F58**) have no effect and that the input resistance is limited between 0 and 5 K Ohms.

F38	T5 T6 Analog Input 1 Mode		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-4	**Maximum**	6
Default	6	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
-4	4-20 mA Low
-3	20-4 mA Low
-2	4-20 mA Hold
-1	20-4 mA Hold
0	0-20 mA
1	20-0 mA
2	4-20 mA Trip
3	20-4 mA Trip
4	4-20 mA
5	20-4 mA
6	Volt

The table below gives all the possible analog input modes.

Mode	Function
4-20 mA Low	4-20 mA low value on current loss (1)
20-4 mA Low	20-4 mA low value on current loss (1)
4-20 mA Hold	4-20 mA hold at level before loss on current loss (2)
20-4 mA Hold	20-4 mA hold at level before loss on current loss (2)
0-20 mA	0-20 mA
20-0 mA	20-0 mA
4-20 mA Trip	4-20 mA trip on current loss (1), (3)
20-4 mA Trip	20-4 mA trip on current loss (1), (3)
4-20 mA	4-20 mA no action on loss (1)
20-4 mA	20-4 mA no action on loss (1)
Voltage	Voltage
Therm Short Cct	Temperature measurement input with short circuit detection
Thermistor	Temperature measurement without short circuit detection
Therm No Trip	Temperature measurement input with no trips

(1) Analog input level is 0.00 % if the current is below 3 mA.

(2) Analog input level remains at the value it had in the previous sample before the current fell below 3 mA.

(3) A *An Input 1 Loss* is initiated if the current falls below 3 mA.

F39	T5 T6 Analog Input 1 Scaling		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.000	**Maximum**	10.000
Default	1.000	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	3
Coding	RW		

T5 T6 Analog Input 1 (**F35**) is modified by *T5 T6 Analog Input 1 Scaling* (**F39**), *T5 T6 Analog Input 1 Offset* (**F42**) and *T5 T6 Analog Input 1 Invert* (**F40**) before it is routed to its destination as follows:

A_{1O} = *T5 T6 Analog Input 1* (**F35**) + *T5 T6 Analog Input 1 Offset* (F42)

A_{1O} is the value after the offset has been applied and is limited between -100.00 % and 100.00 %

A_{1S} = A_{1O} x *T5 T6 Analog Input 1 Scaling* (**F39**)

A_{1S} is the value after the scaling and the offset have been applied and is limited between -100.00 % and 100.00 %

If *T5 T6 Analog Input 1 Invert* (**F40**) = 0 then $A_{1I} = A_{1S}$ otherwise $A_{1I} = -A_{1S}$

A_{1I} is the value after the invert, scaling and offset have been applied and is the final value that is routed to the destination defined by *Analog Input 1 Destination* (**F41**).

F40	**T5 T6 Analog Input 1 Invert**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *T5 T6 Analog Input 1 Scaling* (**F39**).

F41	**Analog Input 1 Destination**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

See *T5 T6 Analog Input 1 Scaling* (**F39**).

F42	**T5 T6 Analog Input 1 Offset**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-100.00	**Maximum**	100.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

See *T5 T6 Analog Input 1 Scaling* (**F39**).

F43	**T5 T6 Analog Input 1 Minimum**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-100.00	**Maximum**	100.00
Default	-100.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

See *T5 T6 Analog Input 1* (**F35**).

F44	**T5 T6 Analog Input 1 Maximum**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-100.00	**Maximum**	100.00
Default	100.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

See *T5 T6 Analog Input 1* (**F35**).

F45	**T7 Analog Input 2 Mode**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-4	**Maximum**	6
Default	6	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
-4	4-20 mA Low
-3	20-4 mA Low
-2	4-20 mA Hold
-1	20-4 mA Hold
0	0-20 mA
1	20-0 mA
2	4-20 mA Trip
3	20-4 mA Trip
4	4-20 mA
5	20-4 mA
6	Volt

See *T5 T6 Analog Input 1 Mode* (**F38**).

F46	**T7 Analog Input 2 Scaling**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.000	**Maximum**	10.000
Default	1.000	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	3
Coding	RW		

The scaling, offset and invert functions for analog input 2 are defined in the same way as for analog input 1. See *T5 T6 Analog Input 1 Scaling* (**F39**).

F47	**T7 Analog Input 2 Invert**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

The scaling, offset and invert functions for analog input 2 are defined in the same way as for analog input 1. See *T5 T6 Analog Input 1 Scaling* (**F39**).

F48	**T7 Analog Input 2 Destination**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**G33**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

The scaling, offset and invert functions for analog input 2 are defined in the same way as for analog input 1. See *T5 T6 Analog Input 1 Scaling* (**F39**).

F50	**T7 Analog Input 2 Minimum**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-100.00	**Maximum**	100.00
Default	-100.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

See *T5 T6 Analog Input 1 Scaling* (**F35**).

F51	**T7 Analog Input 2 Maximum**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-100.00	**Maximum**	100.00
Default	100.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

See *T5 T6 Analog Input 1 Scaling* (**F35**).

F52	**T8 Analog Input 3 Mode**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	6	**Maximum**	9
Default	6	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
6	Volt Input
7	Therm Short Cct
8	Thermistor
9	Thermistor Input

See *T5 T6 Analog Input 1 Mode* (**F38**).

F53	**T8 Analog Input 3 Scaling**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.000	**Maximum**	10.000
Default	1.000	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

The scaling, offset and invert functions for analog input 3 are defined in the same way as for analog input 1. See *T5 T6 Analog Input 1 Scaling* (**F39**).

F54	**T8 Analog Input 3 Invert**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

The scaling, offset and invert functions for analog input 3 are defined in the same way as for analog input 1. See *T5 T6 Analog Input 1 Scaling* (**F39**).

F55	**T8 Analog Input 3 Destination**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

The scaling, offset and invert functions for analog input 3 are defined in the same way as for analog input 1. See *T5 T6 Analog Input 1 Scaling* (**F39**).

F56	**T8 Analog Input 3 Offset**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-100.00	**Maximum**	100.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

The scaling, offset and invert functions for analog input 3 are defined in the same way as for analog input 1. See *T5 T6 Analog Input 1 Scaling* (**F39**).

F57	**T8 Analog Input 3 Minimum**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-100.00	**Maximum**	100.00
Default	-100.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

See *T5 T6 Analog Input 1* (**F35**).

F58	**T8 Analog Input 3 Maximum**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-100.00	**Maximum**	100.00
Default	100.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

See *T5 T6 Analog Input 1* (**F35**).

F59	**T8 Analog Input 3 Thermistor Type**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	9
Default	0	**Units**	%
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

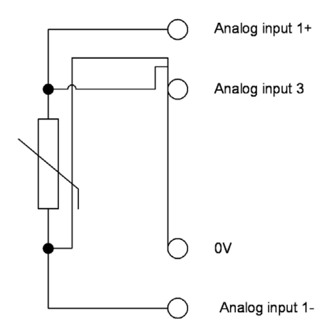
Value	Text
0	DIN44082
1	KTY84
2	PT100 (4 W)
3	PT1000 (4 W)
4	PT2000 (4 W)
5	2.0mA (4 W)
6	PT100 (2 W)
7	PT1000 (2 W)
8	PT2000 (2 W)
9	2.0mA (2 W)

T8 Analog Input 3 Thermistor Type (**F59**) defines the operation of the temperature feedback interface for analog input 3 when *T8 Analog Input 3 Mode* (**F52**) is set up for a temperature feedback mode. When a temperature feedback mode is selected a 2 mA current source is connected to analog input 3 to supply the temperature feedback device that is connected to the input.

***T8 Analog Input 3 Thermistor Type* (F59)**	**Compatible devices**
0: DIN44082	Three thermistors in series as specified in DIN44082 standard
1: KTY84	KTY84 PTC thermistor
2: PT100 (4 W)	PT100 PTC thermistor with 4 wire connection
3: PT1000 (4 W)	PT1000 PTC thermistor with 4 wire connection
4:PT2000 (4 W)	PT2000 PTC thermistor with 4 wire connection
5: 2.0 mA (4 W)	Any device. Full scale equivalent to a resistance of 2.5k Ohms with 4 wire connection
6: PT100 (2 W)	PT100 PTC thermistor with 2 wire connection
7: PT1000 (2 W)	PT1000 PTC thermistor with 2 wire connection
8: PT2000 (2 W)	PT2000 PTC thermistor with 2 wire connection
9: 2.0 mA (2 W)	Any device. Full scale equivalent to a resistance of 2.5k Ohms with 2 wire connection

DIN44082 and KTY84 devices should always be connected directly to analog input 3. The other devices can be connected directly to analog input 3 if the 2 wire connection option is selected. Alternatively these devices can be used with a 4 wire connection to remove the effect of voltage drops due to the 2 mA supply current as shown below. If a 4 wire connection is selected analog input 1 is disabled and *T5 T6 Analog Input 1* (**F35**) always reads as 0.0 %.

Figure 8-22 Connection for PT 100, PT1000 and PT2000 thermistors



F60	**T8 Analog Input 3 Thermistor Trip Threshold**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	5000
Default	3300	**Units**	Ω
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Over-temperature detection becomes active for input 3 if *T8 Analog Input 3 Thermistor Feedback* (**F62**) > *T8 Analog Input 3 Thermistor Trip Threshold* (**F60**). Over-temperature becomes inactive for input 3 if *T8 Analog Input 3 Thermistor Feedback* (**F62**) < *T8 Analog Input 3 Thermistor Reset Threshold* (**F61**). If *T8 Analog Input 3 Mode* (**F52**) is 7 or 8 (i.e. tripping is enabled) an *Thermistor*.003 trip is initiated. The default values for *T8 Analog Input 3 Thermistor Trip Threshold* (**F60**) and *T8 Analog Input 3 Thermistor Reset Threshold* (**F61**) are the levels specified in the DIN 44082 standard.

F61	**T8 Analog Input 3 Thermistor Reset Threshold**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	5000
Default	1800	**Units**	Ω
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *T8 Analog Input 3 Thermistor Trip Threshold* (**F60**).

F62	T8 Analog Input 3 Thermistor Feedback		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	5000
Default		**Units**	Ω
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

T8 Analog Input 3 Thermistor Feedback (**F62**) shows the measured resistance.

F63	T8 Analog Input 3 Thermistor Temperature		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-50	**Maximum**	300
Default		**Units**	°C
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

If a KTY84, PT100, PT1000 or PT2000 type device is selected for temperature feedback then *T8 Analog Input 3 Thermistor Temperature* (**F63**) shows the temperature of the device based on the resistance to temperature characteristic specified for this device. Otherwise *T8 Analog Input 3 Thermistor Temperature* (**F63**) = 0.0.

F64	T8 Analog Output 1 Source		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

T9 Analog Output 1 Source (**F64**) defines the source parameter for analog output 1. The value of the source parameter is scaled with *T9 Analog Output 1 Scaling* (**F65**) and if the scaling is greater than 1.000 the value is clamped between -100 % and +100 % or between 0 % and 100 % depending on whether the output is bipolar or unipolar. The resulting value is then used to control the output. It should be noted that the normal rules for parameter routing do not apply, but the scaling always makes -100 % to +100 % correspond to the range from minus source parameter maximum to plus source parameter maximum, and 0 % corresponds to the source parameter value of zero. This means for example that a parameter with a minimum of 1 and a maximum of 10 will produce an output that changes from 10 % to 100 % as the parameter is change from minimum to maximum.

The outputs provided with different hardware are given in the table below.

***Internal IO Identifier* (J66)**	**Analog Output 1**	**Analog Output 2**
0: Standard Analog and Digital I/O	Bipolar Voltage	Bipolar Voltage

The output mode is defined by *T9 Analog Output 1 Mode* (AU21) as shown in the table below.

***T9 Analog Output 1 Mode* (AU21)**	**Standard Analog and Digital I/O**
Volt	-10 V to + 10 V
0-20 mA	Not possible
20-0 mA	Not possible
4-20 mA	Not possible
20-4 mA	Not possible

F65	T9 Analog Output 1 Scaling		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.000	**Maximum**	10.000
Default	1.000	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	3
Coding	RW		

See *T9 Analog Output 1 Source* (**F64**).

F66	T9 Analog Output 2 Source		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

T9 Analog Output 2 Source (**F66**) defines the source parameter for analog output 2. The value of the source parameter is scaled with *Analog Output 2 Scaling* (**F67**) and if the scaling is greater than 1.000 the value is clamped between -100 % and +100 % or between 0 % and 100 % depending on whether the output is bipolar or unipolar. The resulting value is then used to control the output.

The outputs provided with different hardware are given in the table below.

Internal IO Identifier **(J66)**	**Analog Output 1**	**Analog Output 2**
0: Standard Analog and Digital I/O	Bipolar Voltage	Bipolar Voltage

The output mode is defined by *Analog Output 2 Mode* (**AU24**) as shown in the table below.

T9 Analog Output 2 Mode **(AU24)**	**Standard Analog and Digital I/O**
Volt	-10 V to + 10 V
0-20 mA	Not possible
20-0 mA	Not possible
4-20 mA	Not possible
20-4 mA	Not possible

F67	Analog Output 2 Scaling		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.000	**Maximum**	10.000
Default	1.000	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	3
Coding	RW		

See *T9 Analog Output 2 Source* (**F66**).

F68	Start Speed Selection Filter		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-200	**Maximum**	200
Default	20	**Units**	ms
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Many elevator controllers use relay derived outputs which have contact bounce. This contact bounce can generate spurious speed selection on start, particularly for binary selection type inputs. This filter time in ms allows the user to apply a digital speed selection / deselection filter time such that any intermediate speed selections caused by contactor bounce or by the processing of the elevator controller outputs will be filtered out from the elevator drive control.

When set >0 this filter is applied when selecting and deselecting V1 to V10. This operation is used for binary selection.

When set <0 this filter is applied only when selecting V1 to V10. This mode may be used for priority based selection only.

F69	Encoder Thermistor Type		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	DIN44082
1	KTY84
2	0.8mA

Encoder Thermistor Type (**F69**) defines the operating mode of the P1 thermistor input.

***Encoder Thermistor Type* (F69)**	**Compatible devices**
0: DIN44082	Three thermistors in series as specified in DIN44082 standard
1: KTY84	KTY84 PTC thermistor
2: 0.8mA	Any device

If a device is connected between the pin 15 of the encoder interface and 0 V a current source will pass 0.8 mA through the device with a maximum voltage of approximately 3.8 V (i.e. maximum resistance of approximately 4750 Ohms). The resistance of the device is calculated and displayed in *Encoder Thermistor Feedback* (**F72**). If *Encoder Thermistor Type* (**F69**) is set to select KTY84 the temperature is also calculated and written to *Encoder Thermistor Temperature* (**F73**). Note that DIN44082 mode and 0.8 mA mode operate in exactly the same way.

F70	**Encoder Thermistor Trip Threshold**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	5000
Default	3300	**Units**	Ω
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See **F74** *Motor Thermistor Input Select*.

F71	**Encoder Thermistor Reset Threshold**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	5000
Default	1800	**Units**	Ω
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See **F74** *Motor Thermistor Input Select*.

F72	**Encoder Thermistor Feedback**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	5000
Default		**Units**	Ω
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Encoder Thermistor Type* (**F69**).

F73	**Encoder Thermistor Temperature**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-50	**Maximum**	300
Default		**Units**	°C
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Encoder Thermistor Type* (**F69**).

F74	**Motor Thermistor Input Select**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	2
Default		**Units**	
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

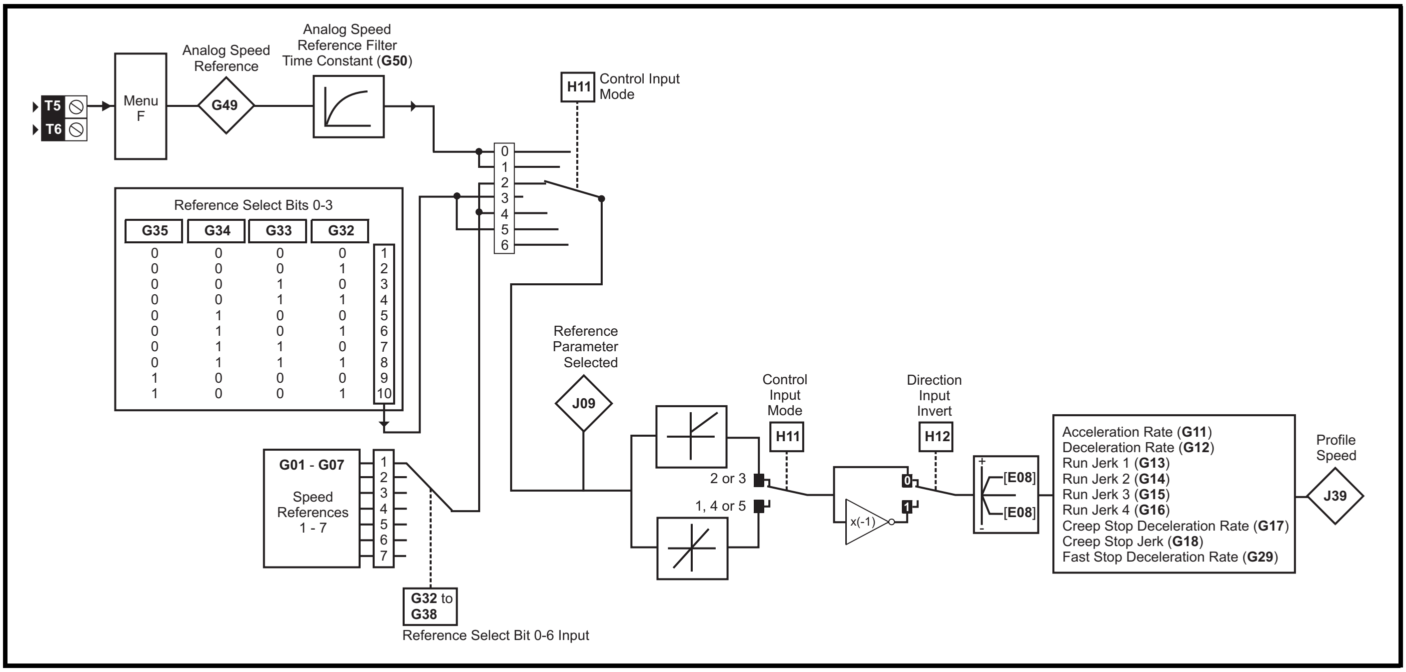
When set to 0, a thermistor input is not selected, and *T8 Analog Input 3 Mode* (**F52**) is set to Volt or 6.

When set to 1, analog input 3 thermistor input is selected, and *T8 Analog Input 3 Mode* (**F52**) is set to Therm No Trip or 9. *T8 Analog Input 3 Thermistor Type* (**F59**)**,** *T8 Analog Input 3 Thermistor Trip Threshold* (**F60**) and *T8 Analog Input 3 Thermistor Reset Threshold* (**F61**) are used to configure the thermistor input.

When set to 2, the drive encoder thermistor input is selected, and *T8 Analog Input 3 Mode* (**F52**) is set to Volt or 6. *Encoder Thermistor Type* (**F69**)**,** *Encoder Thermistor Trip Threshold* (**F70**) and *Encoder Thermistor Reset Threshold* (**F71**) are used to configure the thermistor input.

8.6 Menu G: Profile

Figure 8-23 Menu G Profile logic diagram



Parameter		Range(⇳)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
G01	V1 Speed Reference	0 to VM_EX00_NOMINAL_ELEVATOR_SPEED mm/s			50 mm/s			RW	Num				US
G02	V2 Speed Reference	0 to VM_EX00_NOMINAL_ELEVATOR_SPEED mm/s			400 mm/s			RW	Num				US
G03	V3 Speed Reference	0 to VM_EX00_NOMINAL_ELEVATOR_SPEED mm/s			600 mm/s			RW	Num				US
G04	V4 Speed Reference	0 to VM_EX00_NOMINAL_ELEVATOR_SPEED mm/s			10 mm/s			RW	Num				US
G05	V5 Speed Reference	0 to VM_EX00_NOMINAL_ELEVATOR_SPEED mm/s			100 mm/s			RW	Num				US
G06	V6 Speed Reference	0 to VM_EX00_NOMINAL_ELEVATOR_SPEED mm/s			100 mm/s			RW	Num				US
G07	V7 Speed Reference	0 to VM_EX00_NOMINAL_ELEVATOR_SPEED mm/s			100 mm/s			RW	Num				US
G08	V8 Speed Reference	0 to VM_EX00_NOMINAL_ELEVATOR_SPEED mm/s			100 mm/s			RW	Num				US
G09	V9 Speed Reference	0 to VM_EX00_NOMINAL_ELEVATOR_SPEED mm/s			100 mm/s			RW	Num				US
G10	V10 Speed Reference	0 to VM_EX00_NOMINAL_ELEVATOR_SPEED mm/s			100 mm/s			RW	Num				US
G11	Acceleration Rate	0 to 10000 mm/s²			800 mm/s²			RW	Num				US
G12	Deceleration Rate	0 to 10000 mm/s²			500 mm/s²			RW	Num				US
G13	Run Jerk 1	1 to 65535 10mm/s³			50 mm/s³ x 10			RW	Num				US
G14	Run Jerk 2	1 to 65535 10mm/s³			100 mm/s³ x 10			RW	Num				US
G15	Run Jerk 3	1 to 65535 10mm/s³			100 mm/s³ x 10			RW	Num				US
G16	Run Jerk 4	1 to 65535 10mm/s³			50 mm/s³ x 10			RW	Num				US
G17	Creep Stop Deceleration Rate	0 to 10000 mm/s²			1000 mm/s²			RW	Num				US
G18	Creep Stop Jerk	1 to 65535 10mm/s³			100 mm/s³ x10			RW	Num				US
G19	V1 Deceleration Distance Set point		0 to 10000 mm			0 mm		RW	Num				US
G20	V2 Deceleration Distance Set point		0 to 10000 mm			0 mm		RW	Num				US
G21	V3 Deceleration Distance Set point		0 to 10000 mm			0 mm		RW	Num				US
G22	V4 Deceleration Distance Set point		0 to 10000 mm			0 mm		RW	Num				US
G23	V5 Deceleration Distance Set point		0 to 10000 mm			0 mm		RW	Num				US
G24	V6 Deceleration Distance Set point		0 to 10000 mm			0 mm		RW	Num				US
G25	V7 Deceleration Distance Set point		0 to 10000 mm			0 mm		RW	Num				US
G26	V8 Deceleration Distance Set point		0 to 10000 mm			0 mm		RW	Num				US
G27	V9 Deceleration Distance Set point		0 to 10000 mm			0 mm		RW	Num				US
G28	V10 Deceleration Distance Set point		0 to 10000 mm			0 mm		RW	Num				US
G29	Fast Stop Deceleration Rate	0 to 10000 mm/s²			500 mm/s²			RW	Num				US
G30	Short Floor Landing Distance		0 to 10000 mm			0 mm		RW	Num				US
G31	Floor Sensor Correction Target Distance		0 to 10000 mm			0 mm		RW	Num				US
G32	Reference Select Bit 0 Input	Off (0) or On (1)			Off (0)			RW	Bit				US
G33	Reference Select Bit 1 Input	Off (0) or On (1)			Off (0)			RW	Bit				US
G34	Reference Select Bit 2 Input	Off (0) or On (1)			Off (0)			RW	Bit				US
G35	Reference Select Bit 3 Input	Off (0) or On (1)			Off (0)			RW	Bit				US
G36	Reference Select Bit 4 Input	Off (0) or On (1)			Off (0)			RW	Bit				US
G37	Reference Select Bit 5 Input	Off (0) or On (1)			Off (0)			RW	Bit				US
G38	Reference Select Bit 6 Input	Off (0) or On (1)			Off (0)			RW	Bit				US
G39	Direction Input 1 CCW	Off (0) or On (1)			Off (0)			RW	Bit				US
G40	Direction Input 2 CW	Off (0) or On (1)			Off (0)			RW	Bit				US
G41	Peak Curve Enable	Off (0) or On (1)			Off (0)			RW	Bit				US
G42	Peak Curve Set point Distance	0 to 32767 mm						RO	Num	ND	NC		
G43	Peak Curve Measured Distance	0 to 32767 mm						RO	Num	ND	NC		

Parameter		Range(⇳)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
G44	Peak Curve Activated	Off (0) or On (1)			Off (0)			RO	Bit				
G45	Start Optimizer Enable		Off (0) or On (1)			Off (0)		RW	Bit				US
G46	Start Optimizer Speed	0 to 10000 mm/s			50 mm/s	10 mm/s		RW	Num				US
G47	Start Optimizer Jerk		±VM_EX00_RUN_JERK_1 mm/s x10			1 mm/s³ x10		RW	Num				US
G48	Start Optimizer Time		0 to 10000 ms			500 ms		RW	Num				US
G49	Analog Speed Reference	-32768 to 32767			0			RW	Num				
G50	Analog Speed Reference Filter Time Constant	0 to 500 ms			16 ms			RW	Num				US
G51	Control Word	0000000000000000 to 1111111111111111			0000000000000000			RW	Bin				
G52	Creep Speed Select	V1 Is Creep Spd (1) V2 Is Creep Spd (2) V3 Is Creep Spd (3) V4 Is Creep Spd (4) V5 Is Creep Spd (5) V6 Is Creep Spd (6) V7 Is Creep Spd (7) V8 Is Creep Spd (8) V9 Is Creep Spd (9) V10 Is Creep Spd (10)			V1 Is Creep Spd (1)			RW	Txt			PT	US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Mode: Open-Loop, RFC-A, RFC-S

G01	V1 Speed Reference		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	VM_EX00_NOMINAL_ELEVATOR_SPEED
Default	50	**Units**	mm / s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM		

This is V1 speed reference and is set in mm / s.
Nominal Elevator Speed (**E01**) defines the maximum limit for this parameter.

G02	V2 Speed Reference		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	VM_EX00_NOMINAL_ELEVATOR_SPEED
Default	400	**Units**	mm / s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM		

This is V2 speed reference and is set in mm / s.
Nominal Elevator Speed (**E01**) defines the maximum limit for this parameter.

G03	V3 Speed Reference		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	VM_EX00_NOMINAL_ELEVATOR_SPEED
Default	600	**Units**	mm / s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM		

This is V3 speed reference and is set in mm / s.
Nominal Elevator Speed (**E01**) defines the maximum limit for this parameter.

G04	V4 Speed Reference		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	VM_EX00_NOMINAL_ELEVATOR_SPEED
Default	10	**Units**	mm / s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM, PT		

This is V4 speed reference and is set in mm / s.
Nominal Elevator Speed (**E01**) defines the maximum limit for this parameter.

G05	V5 Speed Reference		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	VM_EX00_NOMINAL_ELEVATOR_SPEED
Default	100	**Units**	mm / s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM		

This is V5 speed reference and is set in mm / s.
Nominal Elevator Speed (**E01**) defines the maximum limit for this parameter.

G06	V6 Speed Reference		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	VM_EX00_NOMINAL_ELEVATOR_SPEED
Default	100	**Units**	mm / s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM		

This is V6 speed reference and is set in mm / s.
Nominal Elevator Speed (**E01**) defines the maximum limit for this parameter.

G07	V7 Speed Reference		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	VM_EX00_NOMINAL_ELEVATOR_SPEED
Default	100	**Units**	mm / s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM		

This is V7 speed reference and is set in mm / s.
Nominal Elevator Speed (**E01**) defines the maximum limit for this parameter.

G08	V8 Speed Reference		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	VM_EX00_NOMINAL_ELEVATOR_SPEED
Default	100	**Units**	mm / s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM		

This is V8 speed reference and is set in mm / s.
Nominal Elevator Speed (**E01**) defines the maximum limit for this parameter.

G09	V9 Speed Reference		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	VM_EX00_NOMINAL_ELEVATOR_SPEED
Default	100	**Units**	mm / s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM		

This is V9 speed reference and is set in mm / s.
Nominal Elevator Speed (**E01**) defines the maximum limit for this parameter.

G10	V10 Speed Reference		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	VM_EX00_NOMINAL_ELEVATOR_SPEED
Default	100	**Units**	mm / s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM		

This is V10 speed reference and is set in mm / s.
Nominal Elevator Speed (**E01**) defines the maximum limit for this parameter.

G11	Acceleration Rate		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	800	**Units**	mm / s^2
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This is the acceleration rate, and is set in mm / s^2.
This rate is also used during start optimization if constant acceleration is reached. This rate is a maximum that will be used, and will only be reached if the other profile parameters like target speed, target distance and jerks require the maximum, i.e. constant acceleration may not be reached.

G12	Deceleration Rate		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	500	**Units**	mm / s^2
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This is the deceleration rate, and is set in mm / s^2. This rate is a maximum that will be used, and will only be reached if the other profile parameters like target speed, target distance and jerks require the maximum, i.e. constant acceleration may not be reached.

G13	Run Jerk 1		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	65535
Default	50	**Units**	mm / s^3 x 10
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This is the start of acceleration jerk rate, and is set in 10 mm / s^3 units where 1 = 10 mm / s^3.
If a value of 0 is set then this section of the profile will be linear i.e. jerk = acceleration.

G14	Run Jerk 2		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	65535
Default	100	**Units**	mm / s^3 x 10
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This is the end of acceleration jerk rate, and is set in 10 mm / s^3 units where 1 = 10 mm / s^3.
If a value of 0 is set then this section of the profile will be linear i.e. jerk = acceleration rate.

G15	Run Jerk 3		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	65535
Default	100	**Units**	mm / s^3 x 10
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This is the start of deceleration jerk rate, and is set in 10 mm / s^3 units where 1 = 10 mm / s^3.
If a value of 0 is set then this section of the profile will be linear i.e. jerk = deceleration.

G16	Run Jerk 4		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	65535
Default	50	**Units**	mm / s^3 x 10
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This is the end of deceleration jerk rate, and is set in 10 mm / s^3 units where 1 = 10 mm / s^3.
If a value of 0 is set then this section of the profile will be linear i.e. jerk = deceleration rate.

G17	Creep Stop Deceleration Rate		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	1000	**Units**	mm / s^2
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This is the final positioning deceleration rate used when transitioning from *V1 Speed Reference* (**G01**) to a stop, and is set in mm / s^2.
This can be set higher than the main deceleration rate to improve the accuracy of the final positioning when using Creep to floor elevator control mode.

G18	Creep Stop Jerk		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	65535
Default	100	**Units**	mm / s^3 x 10
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This is the final positioning jerk used when transitioning from *V1 Speed Reference* (**G01**) to a stop, and is set in 10 mm / s^3 units where 1 = 10 mm / s^3. If a value of 0 is set then this section of the profile will be linear i.e. jerk = creep stop deceleration rate.

G19	V1 Deceleration Distance Setpoint		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	0	**Units**	mm
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Num, US		

This sets the Direct to floor deceleration distance setpoint in mm for V1 when Direct to floor operation is active, *Elevator Control Mode* (**H19**) = Direct To Floor (1), and *Direct To Floor Sensor Mode* (**H09**) = Spd IP+User Dist (2).

G20	V2 Deceleration Distance Setpoint		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	0	**Units**	mm
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Num, US		

This sets the Direct to floor deceleration distance setpoint in mm for V2 when Direct to floor operation is active, *Elevator Control Mode* (**H19**) = Direct To Floor (1), and *Direct To Floor Sensor Mode* (**H09**) = Spd IP+User Dist (2).

G21	V3 Deceleration Distance Setpoint		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	0	**Units**	mm
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Num, US		

This sets the Direct to floor deceleration distance setpoint in mm for V3 when Direct to floor operation is active, *Elevator Control Mode* (**H19**) = Direct To Floor (1), and *Direct To Floor Sensor Mode* (**H09**) = Spd IP+User Dist (2).

G22	V4 Deceleration Distance Setpoint		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	0	**Units**	mm
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Num, US		

This sets the Direct to floor deceleration distance setpoint in mm for V4 when Direct to floor operation is active, *Elevator Control Mode* (**H19**) = Direct To Floor (1), and *Direct To Floor Sensor Mode* (**H09**) = Spd IP+User Dist (2).

G23	V5 Deceleration Distance Setpoint		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	0	**Units**	mm
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Num, US		

This sets the Direct to floor deceleration distance setpoint in mm for V5 when Direct to floor operation is active, *Elevator Control Mode* (**H19**) = Direct To Floor (1), and *Direct To Floor Sensor Mode* (**H09**) = Spd IP+User Dist (2).

G24	**V6 Deceleration Distance Setpoint**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	0	**Units**	mm
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Num, US		

This sets the Direct to floor deceleration distance setpoint in mm for V6 when Direct to floor operation is active, *Elevator Control Mode* (**H19**) = Direct To Floor (1), and *Direct To Floor Sensor Mode* (**H09**) = Spd IP+User Dist (2).

G25	**V7 Deceleration Distance Setpoint**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	0	**Units**	mm
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Num, US		

This sets the Direct to floor deceleration distance setpoint in mm for V7 when Direct to floor operation is active, *Elevator Control Mode* (**H19**) = Direct To Floor (1), and *Direct To Floor Sensor Mode* (**H09**) = Spd IP+User Dist (2).

G26	**V8 Deceleration Distance Setpoint**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	0	**Units**	mm
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Num, US		

This sets the Direct to floor deceleration distance setpoint in mm for V8 when Direct to floor operation is active, *Elevator Control Mode* (**H19**) = Direct To Floor (1), and *Direct To Floor Sensor Mode* (**H09**) = Spd IP+User Dist (2).

G27	**V9 Deceleration Distance Setpoint**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	0	**Units**	mm
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Num, US		

This sets the Direct to floor deceleration distance setpoint in mm for V9 when Direct to floor operation is active, *Elevator Control Mode* (**H19**) = Direct To Floor (1), and *Direct To Floor Sensor Mode* (**H09**) = Spd IP+User Dist (2).

G28	**V10 Deceleration Distance Setpoint**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	0	**Units**	mm
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Num, US		

This sets the Direct to floor deceleration distance setpoint in mm for V10 when Direct to floor operation is active, *Elevator Control Mode* (**H19**) = Direct To Floor (1), and *Direct To Floor Sensor Mode* (**H09**) = Spd IP+User Dist (2).

G29	Fast Stop Deceleration Rate		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	500	**Units**	mm / s²
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This is the fast stop deceleration rate, and is set in mm / s^2. This is activated when *Fast Stop Enable* (**H26**) or *Rapid Slow Down Enable* (**H27**) = On (1), and is activated via a digital input or comms from the elevator controller.

G30	Short Floor Landing Distance		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	0	**Units**	mm
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Num, US		

This sets the short floor landing distance in mm. This is the distance from the current floor to next the floor level. It is intended for situations where the distance to the next floor is shorter than normal e.g.0.7 m.

When this feature is used the entire profile will be completed as a position controlled profile. For this reason Start optimization is not available when using this mode.

This parameter is used when *Short Floor Landing Enable* (**H22**) = On (1).

G31	Floor Sensor Correction Target Distance		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	0	**Units**	mm
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Num, US		

This sets the floor sensor correction target distance in mm. This is the distance from the sensor / limit switch to the floor level. It is assumed that the distance is symmetrical above and below the floor level.

This parameter is used when *Floor Sensor Correction Enable* (**H23**) = On (1).

The remaining distance to floor is shown in *Remaining Floor Sensor Correction Distance* (**J47**).

G32	Reference Select Bit 0 Input		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This input bit is used to select the bit zero speed input when binary or priority speed selection is used, *Control Input mode* (**H11**) = Priority 1 Dir, Binary 1 Dir, Priority 2 Dir or Binary 2 Dir (2, 3, 4 or 5).
In priority input mode this selects *V1 Speed Reference* (**G01**), but in binary input mode it may be used to select a number of speeds from V1 to V10.

G33	Reference Select Bit 1 Input		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This input bit is used to select the bit 1 speed input when binary or priority speed selection is used, *Control Input mode* (**H11**) = Priority 1 Dir, Binary 1 Dir, Priority 2 Dir or Binary 2 Dir (2, 3, 4 or 5).
In priority input mode this selects *V2 Speed Reference* (**G02**), but in binary input mode it may be used to select a number of speeds from V2 to V10.

G34	Reference Select Bit 2 Input		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This input bit is used to select the bit 2 speed input when binary or priority speed selection is used, *Control Input mode* (**H11**) = Priority 1 Dir, Binary 1 Dir, Priority 2 Dir or Binary 2 Dir (2, 3, 4 or 5).
In priority input mode this selects *V3 Speed Reference* (**G03**), but in binary input mode it may be used to select a number of speeds from V4 to V10.

G35	Reference Select Bit 3 Input		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This input bit is used to select the bit 3 speed input when binary or priority speed selection is used, *Control Input mode* (**H11**) = Priority 1 Dir, Binary 1 Dir, Priority 2 Dir or Binary 2 Dir (2, 3, 4 or 5).
In priority input mode this selects *V4 Speed Reference* (**G04**), but in binary input mode it may be used to select a number of speeds from V8 to V10.

G36	Reference Select Bit 4 Input		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This input bit is used to select the bit 4 speed input when binary or priority speed selection is used, *Control Input mode* (**H11**) = Priority 1 Dir, Binary 1 Dir, Priority 2 Dir or Binary 2 Dir (2, 3, 4 or 5).
In priority input mode this selects *V5 Speed Reference* (**G05**), but in binary input mode it is not used.

G37	Reference Select Bit 5 Input		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This input bit is used to select the bit 5 speed input when binary or priority speed selection is used, *Control Input mode* (**H11**) = Priority 1 Dir, Binary 1 Dir, Priority 2 Dir or Binary 2 Dir (2, 3, 4 or 5).
In priority input mode this selects *V6 Speed Reference* (**G06**), but in binary input mode it is not used.

G38	Reference Select Bit 6 Input		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This input bit is used to select the bit 6 speed input when binary or priority speed selection is used, *Control Input mode* (**H11**) = Priority 1 Dir, Binary 1 Dir, Priority 2 Dir or Binary 2 Dir (2, 3, 4 or 5).
In priority input mode this selects *V7 Speed Reference* (**G07**), but in binary input mode it is not used.

G39	Direction Input 1 CCW		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When run permit direction input is selected, *Control Input mode* (**H11**) = Analog Run Prmit (0), this input allows the elevator sequencing to start but the direction is selected from the sign of the analog speed reference i.e. -10 V = CCW, +10 V = CW.

When single direction input is selected, *Control Input mode* (**H11**) = Priority 1 Dir or Binary 1 Dir (2 or 3), and *Direction Input 1 CCW* (**G39**) = Off (0) clockwise direction is selected, and when *Direction Input 1 CCW* (**G39**) = On (1) counter clockwise direction is selected.

When dual direction input is selected, *Control Input mode* (**H11**) = Analog 2 Dir, Binary 2 Dir or Binary 2 Dir (1,4 or 5), and *Direction Input 1 CCW* (G39) = Off (0) no direction is selected, and when and when *Direction Input 1 CCW* (**G39**) = On (1) counter clockwise direction is selected.

The physical direction of rotation depends on the orientation and wiring of the motor, and the setting of *Direction Input Invert* (**H12**).

If this bit is removed / changed during travel and a digital speed is still selected, a controlled stop will be performed, and the elevator drive will trip *Trip 76* ***(Dir change)*** indicating that the direction signal was changed / removed during travel.

G40	Direction Input 2 CW		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When single direction input is selected, *Control Input mode* (**H11**) = Analog Run Prmit, Priority 1 Dir or Binary 1Dir (0, 2 or 3), *Direction Input 2 CW* (**G40**) is not used and has no effect on the motion profile. Clockwise motion is caused by *Direction Input 1 CCW* (**G39**) = Off (0).

When dual direction input is selected, *Control Input mode* (**H11**) = Analog 2 Dir, Priority 2 Dir or Binary 2 Dir (1, 4 or 5), and *Direction Input 2 CW* (**G40**) = Off (0) no direction is selected, and when *Direction Input 2 CW* (**G40**) = On (1) clockwise direction is selected.

The physical direction of rotation depends on the orientation and wiring of the motor, and the setting of *Direction Input Invert* (**H12**).

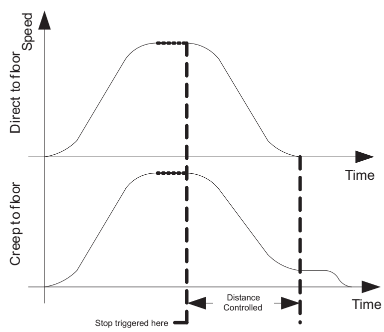
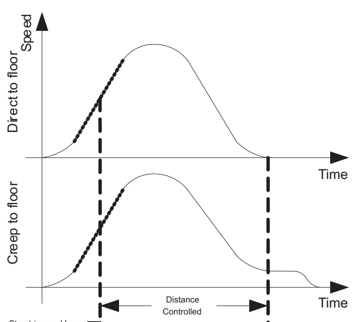
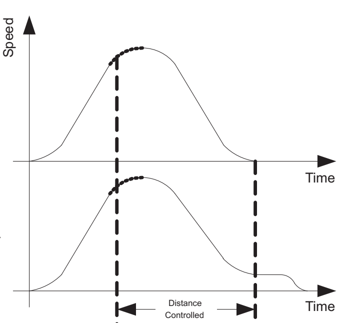
If this bit is removed during travel, and *Control Input mode* (**H11**) = Analog 2 Dir, Priority 2 Dir or Binary 2 Dir (1, 4 or 5), and a digital speed is still selected, a controlled stop will be performed, and the elevator drive will trip *Trip 76* ***(Dir change)*** indicating that the direction signal was changed / removed during travel.

G41	Peak Curve Enable		
Mode	Open loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Bit, US		

When set to Off (0) Peak curve operation is disabled in creep to floor mode, *Elevator Control Mode* (**H19**) = Creep To Floor (0). In Direct to floor, *Elevator Control Mode* (**H19**) = Direct To Floor (1), peak curve operation is always active.

When set to On (1) Peak curve operation is enabled in creep to floor mode, *Elevator Control Mode* (**H19**) = Creep To Floor (0). In peak curve mode the stopping distance is controlled regardless of when the signal to stop is given i.e. it is possible to signal a stop during acceleration and the profile peak speed be automatically adjusted to achieve the required distance to floor. This method of motion profiling gives the additional benefit that the time taken to reach a given floor is the fastest possible. The distance travelled during a peak curve operation in creep to floor to the creep speed will be a maximum of *Peak Curve Setpoint Distance* (**G42**).

The profile parameters are handled as follows during a stop:

Condition	Diagram	Description
Stop activated while at constant speed		If a stop is activated while at constant speed, a normal stop occurs and the profile parameters are not modified.
Stop activated while at constant acceleration		If a stop is activated while at constant acceleration, a peak cure profile is generated where the profile jerk and acceleration are used as specified but the peak speed is optimized such that the target distance is reached without overshoot.
Stop activated while in Jerk 2 or Acceleration reduction		If a stop is activated while in Jerk 2 or acceleration reduction, a peak cure profile is generated where the profile jerk, acceleration and peak speed is optimized such that the target distance is reached without overshoot.

G42	Peak Curve Setpoint Distance		
Mode	Open loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	32767
Default		**Units**	mm
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC		

Creep to floor:

When V2 to V10 is selected and active, this indicates the distance from the selected speed to *V1 Speed Reference* (**G01**) using the *Deceleration Rate* (**G12**), *Run Jerk 3* (**G15**) and *Run Jerk 4* (**G16**).

When *V1 Speed Reference* (**G01**) is selected and active, this indicates the distance from *V1 Speed Reference* (**G01**) to a stop using *Creep Stop Deceleration Rate* (**G17**) and *Creep Stop Jerk* (**G18**).

Direct to floor:

This indicates the distance from the selected speed to a stop using the *Deceleration Rate* (**G12**), *Run Jerk 3* (**G15**) and *Run Jerk 4* (**G16**).

G43	Peak Curve Measured Distance		
Mode	Open loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	32767
Default		**Units**	mm
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, Num, ND, NC		

Creep to floor:

When V2 to V10 is de-selected or a stop is requested, *Peak Curve Measured Distance* (**G43**) shows the distance that's accumulated until *V1 Speed Reference* (**G01**) is reached. This is based on sampling the motor encoder feedback.

Direct to floor:

When V1 to V10 is de-selected or a stop is requested, *Peak Curve Measured Distance* (**G43**) shows the distance that's accumulated until a complete stop. This is based on sampling the motor encoder feedback.

G44	Peak Curve Activated		
Mode	Open loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, Bit		

Indicates when peak curve operation has been activated during acceleration. This value is reset to Off (0) once a new travel has started.

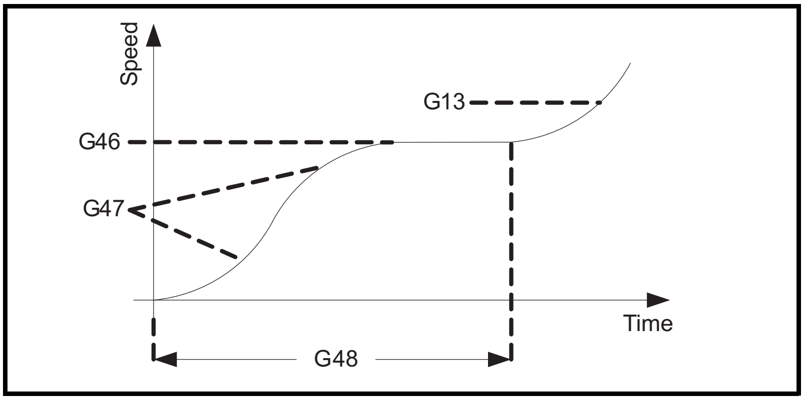
G45	Start Optimizer Enable		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When set to Off (0) the start optimizer is disabled.

When set to On (1) the start optimizer is enabled.

This feature is helps to overcome starting stiction for elevators fitted with a motor output gearbox, or for systems fitted with guide rail pads rather than rollers.

Figure 8-24 Start optimizer



NOTE The start optimizer is always used in Open-Loop mode to provide a holding speed reference for brake release. A request to release the brake in Open-Loop will not be made unless Start Optimizer Speed (**G46**) is reached.

In Open-Loop mode this parameter is not used.

G46	**Start Optimizer Speed**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	10	**Units**	mm / s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This is the start optimizer maximum speed and is set in mm / s. In Open loop start optimization applies a low speed to provide additional holding torque prior to brake opening.
Nominal Elevator Speed (**E01**) defines the maximum limit for this parameter.

G47	**Start Optimizer Jerk**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-VM_EX00_RUN_JERK_1	**Maximum**	VM_EX00_RUN_JERK_1
Default	1	**Units**	mm / s^3 x 10
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM, BU		

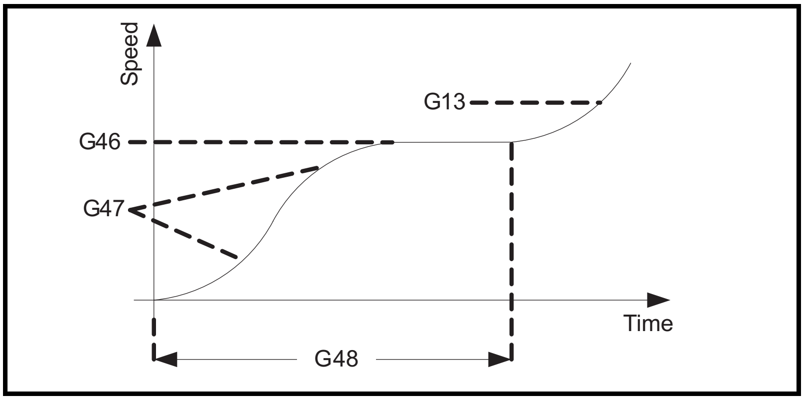
This sets the start optimiser jerk in 10 mm / s^3 units where 1 = 10 mm / s^3. The maximum for this parameter is limited by *Run Jerk 1* (**G13**).
This feature is helps to overcome starting stiction for elevators fitted with a motor output gearbox, or for systems fitted with guide rail pads rather than rollers. In Open loop mode this parameter is not used.

G48	**Start Optimizer Time**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	1000	**Units**	ms
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When *Start Optimizer Enable* (**G45**) = On (1), the start optimizer is time is used during starting state 6, to time the period where *Start Optimizer Speed* (**G46**) , and *Start Optimizer Jerk* (**G47**) are used to define the start optimiser motion profile. Acceleration maximum during start optimisation is defined by *Acceleration Rate* (**G11**).

This feature is helps to overcome starting stiction for elevators fitted with a motor output gearbox, or for systems fitted with guide rail pads rather than rollers.

Figure 8-25 Start optimizer



NOTE The start optimizer is always used in Open-Loop mode to provide a holding speed reference for brake release. A request to release the brake in Open-Loop will not be made unless Start Optimizer Speed (**G46**) is reached.

In Open-Loop mode this parameter is not used.

G49	**Analog Speed Reference**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-32768	**Maximum**	32767
Default	0	**Units**	
Type	16 Bit Volatile	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Nominal Elevator Speed (**E01**) defines the maximum linear speed in mm / s which is equivalent to an analog reference of 100 %.

If *Control Input mode* (**H11**) = Analog Run Prmit (0) then a reference from -10 V to 10 V is expected. If *Control Input mode* (**H11**) = Analog 2 Dir (1) then a reference from 0 V to 10 V is expected.

10 V = 100.00 % = 32767 = *Nominal Elevator Speed* (**E01**).

If the elevator controller outputs less than 10 V at full speed e.g. 9.8 V, then it is possible to compensate for this using the analog input's scaling factor.

On start up, the profile generator is used to ramp the speed from 0 to the analog reference level and is then bypassed once the speed is reached. This smoothes out the transition from 0 to the analog reference where the analog reference starts > 0 V e.g. in open loop the user may apply a small speed to improve holding torque prior to brake release.

G50	**Analog Speed Reference Filter Time Constant**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	500
Default	16	**Units**	ms
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When set to Off (0), the analog speed reference filter is bypassed.

When set > 0, the analog speed reference filter is active and the time constant of the filter is *Analog Speed Reference Filter Time Constant* (**G50**) ms. Due the internal sample rate the time constant for the filter responds in units of 4 e.g. 4, 8, 12, 16 etc, where a value that is not divisible by 4 will be rounded down to the nearest value divisible by 4 e.g. 9 will be rounded down to 8 ms time constant.

The filter will be implemented such that the filter accumulator will be held constant if the time constant changes allowing the filter to be modified on the fly.

G51	Control Word		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 0000000000000000)	**Maximum**	65535 (Display: 1111111111111111)
Default	0 (Display: 0000000000000000)	**Units**	
Type	16 Bit Volatile	**Update Rate**	4 ms
Display Format	Binary	**Decimal Places**	0
Coding	RW, BU		

When *Control Input mode* (**H11**) = Control Word (6), the control word is enabled. The control word replicates and extends the behaviour of the reference select bits, *Reference Select Bit 0 Input* (**G32**) to *Reference Select Bit 6 Input* (**G38**), and the direction bit inputs, *Direction Input 1 CCW* (**G39**) and *Direction Input 2 CW* (**G40**).

A watchdog is provided to verify that an elevator controller using the control word is still updating the speed and direction inputs. The user must write 1 to watchdog bit every <=500 ms to prevent the watch dog from stopping the elevator and causing a trip Trip 77 ***(Ctrl Watchdog)***.

The table below details the bits within the control word and their function:

Bit	Description	Priority
0	Selects V1 Creep speed. If a higher priority speed is selected it will override this speed selection.	10 (lowest)
1	Selects V2 Inspection speed. If a higher priority speed is selected it will override this speed selection.	9
2	Selects V3 Nominal speed. If a higher priority speed is selected it will override this speed selection.	8
3	Selects V4 Medium speed. If a higher priority speed is selected it will override this speed selection.	7
4	Selects V5 Releveling speed. If a higher priority speed is selected it will override this speed selection.	6
5	Selects V6 High speed. If a higher priority speed is selected it will override this speed selection.	5
6	Selects V7 Additional speed 1. If a higher priority speed is selected it will override this speed selection.	4
7	Selects V8 Additional speed 2. If a higher priority speed is selected it will override this speed selection.	3
8	Selects V9 Additional speed 3. If a higher priority speed is selected it will override this speed selection.	2
9	Selects V10 Additional speed 4. If a higher priority speed is selected it will override this speed selection.	1 (highest)
10	Direction input 1 CCW	N/A
11	Direction input 2 CW	N/A
12	Watchdog bit. This must be set to 1 at least every 500 ms or less. Failure to do this will result in a Trip 77 ***(Ctrl Watchdog)***. If a travel is in progress the elevator will perform a controlled stop and then trip.	N/A
13	Reserved	N/A
14	Reserved	N/A
15	Reserved	N/A

G52	Creep Speed Select		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	10
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, PT, BU		

Value	Text
1	V1 Is Creep Spd
2	V2 Is Creep Spd
3	V3 Is Creep Spd
4	V4 Is Creep Spd
5	V5 Is Creep Spd
6	V6 Is Creep Spd
7	V7 Is Creep Spd
8	V8 Is Creep Spd
9	V9 Is Creep Spd
10	V10 Is Creep Spd

This parameter allows the user to select which of the speeds, *V1 Speed Reference* (**G01**) to *V10 Speed Reference* (**G10**) is used as the Creep Speed in creep to floor mode *Elevator Control Mode* (**H19**) = Creep To Floor (0). From default V1 is the Creep Speed.

When modifying this parameter from V1 Is The Creep Speed (1) in a priority based control input mode (Control Input mode (**H11**) = Priority 1 Dir (2), Priority 2 Dir (4) or Control Word (6), it is important to note that the creep speed must be the lowest numbered speed that is to be selected. Failure to do this will result in the creep speed being selected with priority over a higher travel speed e.g. if V5 is the creep speed and V3 is the nominal speed when V5 and V3 are selected together V5 has priority so the system will run at the creep speed instead of V3 nominal speed, however, if V3 is the creep speed and V5 is the nominal speed and V3 and V5 are selected together the system will run at the nominal speed.

8.7 Menu H: Configuration

Parameter		Range(⇳)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
H01	User Security Code	0 to 2147483647						RW	Num	ND	NC	PT	US
H02	User Security Status	Menu 0 (0), All Menus (1), Read-only Menu 0 (2), Read-only (3), Status Only (4), No Access (5)						RW	Txt	ND		PT	
H03	Security Status	None (0), Read-only (1), Status-only (2), No Access (3)						RO	Txt	ND	NC	PT	PS
H04	Default Drive	None (0), Standard (1), US (2)			None (0)			RW	Txt		NC		
H06	Output Phase Loss Detection Enable	Disabled (0), Enabled (1)			Enabled (1)			RW	Txt				US
H07	Output Phase Loss Detection Time	0.5s (0), 1.0s (1), 2.0s (2), 4.0s (3)			0.5s (0)			RW	Txt				US
H08	Input Phase Loss Detection Mode Enable	Full (0), Ripple Only (1), Disabled (2)			Full (0)			RW	Txt				US
H09	Direct To Floor Sensor Mode		Spd IP (0), Stop IP (1), Spd IP+User Dist (2)			Spd IP (0)		RW	Txt				US
H10	Direct To Floor Edge Detection		Rising 1st (0), Falling 1st (1)			Rising 1st (0)		RW	Txt				US
H11	Control Input mode	Analog Run Prmit (0), Analog 2 Dir (1), Priority 1 Dir (2), Binary 1 Dir (3), Priority 2 Dir (4), Binary 2 Dir (5), Control Word (6)			Priority 1 Dir (2)			RW	Txt				US
H12	Direction Input Invert	Off (0) or On (1)			Off (0)			RW	Bit				US
H13	Velocity Threshold 1	0 to 10000 mm/s			300 mm/s			RW	Num				US
H14	Velocity Threshold 2	0 to 10000 mm/s			300 mm/s			RW	Num				US
H15	Maximum Speed Error Threshold		0 to 10000 mm/s			100 mm/s		RW	Num				US
H16	Maximum Distance Error Threshold		0 to 10000 mm			100 mm		RW	Num				US
H17	Current Controller Mode		Off (0) or On (1)			Off (0)		RW	Bit				US
H18	Fan Maximum Speed	±10			10			RW	Num				US
H19	Elevator Control Mode		Creep To Floor (0), Direct To Floor (1)			Creep To Floor (0)		RW	Txt				US
H20	Fast Start Enable		Off (0) or On (1)			Off (0)		RW	Bit				US
H21	Fast Start Monitoring Distance		0 to 10000 mm			200 mm		RW	Num				US
H22	Short Floor Landing Enable		Off (0) or On (1)			Off (0)		RW	Bit				US
H23	Floor Sensor Correction Enable		Off (0) or On (1)			Off (0)		RW	Bit				US
H24	Floor Sensor Correction Source Select		Floor Sensor IP (0), Creep Spd IP (1)			Floor Sensor IP (0)		RW	Txt				US
H25	Floor Sensor Correction Edge Detection		Rising 1st (0), Falling 1st (1)			Rising 1st (0)		RW	Txt				US
H26	Fast Stop Enable	Off (0) or On (1)			Off (0)			RW	Bit				US
H27	Rapid Slow Down Enable	Off (0) or On (1)			Off (0)			RW	Bit				US
H28	Freeze Protection Threshold	-10 to 0 °C			0 °C			RW	Num				US
H29	Normal Duty Enable	Off (0) or On (1)			Off (0)			RW	Bit				US
H30	Position Display Mode		Relative (0), Absolute (1)			Relative (0)		RW	Txt				US
H31	Elevator Trip Disable	Trips Enabled (0), Trips Disabled (1)			Trips Enabled (0)			RW	Txt				
H32	Date/Time Selector	Set (0), Powered (1), Running (2), Acc Powered (3), Local Keypad (4), Remote Keypad (5), Slot 1 (6), Slot 2 (7), Slot 3 (8), Slot 4 (9)			Powered (1)			RW	Txt				US
H33	Date Format	Std (0), US (1)			Std (0)			RW	Txt				US
H34	Turn On delay	200 to 65535 ms			200 ms			RW	Num				US
H35	Standby Mode Enable	Off (0) or On (1)			Off (0)			RW	Bit				US
H36	Standby Mode Mask	0000000 to 1111111			0000000			RW	Bin				US
H37	Reset Energy Meter	Off (0) or On (1)			Off (0)			RW	Bit				
H38	Blocked Elevator Release Enable Input		Off (0) or On (1)			Off (0)		RW	Bit				US
H39	Parameter Displayed At Power-up	A00 to A80			A06			RW	Num			PT	US
H40	Drive Name Characters 1-4	-2147483648 to 2147483647			0			RW	Num			PT	US
H41	Drive Name Characters 5-8	-2147483648 to 2147483647			0			RW	Num			PT	US
H42	Drive Name Characters 9-12	-2147483648 to 2147483647			0			RW	Num			PT	US
H43	Drive Name Characters 13-16	-2147483648 to 2147483647			0			RW	Num			PT	US
H45	Action On Trip Detection	00000 to 11111			00000			RW	Bin				US
H46	Number Of Auto reset Attempts	None (0), 1 (1), 2 (2), 3 (3), 4 (4), 5 (5), Infinite (6)			None (0)			RW	Txt				US
H47	Auto-reset Delay	1.0 to 600.0 s			1.0 s			RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Mode: Open-Loop, RFC-A, RFC-S

H01	**User Security Code**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	2147483647
Default		**Units**	
Type	32 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, ND, NC, PT		

See *User Security Status* (**H02**).

H02	**User Security Status**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	5
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, ND, PT		

Value	Text
0	Menu 0
1	All Menus
2	Read-only Menu 0
3	Read-only
4	Status Only
5	No Access

Security

The drive provides a number of different levels of security that can be set by the user via *User Security Status* (**H02**); these are shown in the table below.

Security Level	Description	*User Security Status* (H02)
Menu A	All writable parameters are available to be edited but only parameters in Menu A are visible.	0
All menus	All writable parameters are visible and available to be edited.	1
Read-only Menu A	All parameters are read-only. Access is limited to Menu A parameters only.	2
Read-only	All parameters are read-only however all menus and parameters are visible.	3
Status only	The keypad remains in status mode and no parameters can be viewed or edited	4
No access	The keypad remains in status mode and no parameters can be viewed or edited. Drive parameters cannot be accessed via a comms/fieldbus interface in the drive or any option module.	5

When security has been set up, the drive can either be in the locked or unlocked state. In the locked state the security level that has been set up applies. In the unlocked state the security is not active, but when the drive is powered down and powered up again the drive will be in the locked state. The drive may be relocked without powering down by selecting the required security level with the *User Security Status* (**H02**) and initiating a drive reset.

Security can be set up as follows:

The *User Security Code* (**H01**) should be set to the desired security unlock code (not zero). For security to remain set after power down then a parameter save should be performed to retain the set value.

If no further action is taken when the drive is powered down and then powered up read-only security will be set up and locked.

If at any time the *User Security Status* (**H02**) is set to a value corresponding the one of the security levels shown in the table above and a drive reset is performed the security level is changed to that level. The desired security level is automatically saved and retained after power down, the keypad state changes to status mode and security is locked. (The security level that is active, provided *User Security Code* (**H01**) has been saved as a non-zero value, if shown in *Security Status* (**H03**).

When security is set up and locked:

Parameter access is restricted as shown in the table above.

User Security Code (**H01**) reads as zero except in parameter edit mode. Therefore it is not possible to read the value of the security code when any level of security is active and locked.

Security can be unlocked as follows:

If read-only security is set and locked then any attempt to edit any read/write parameter causes “Security code” to be displayed on the first row of the display. When the Up or Down keys are pressed the second row shows the code being adjusted. On setting the code the user presses the Enter key. If the correct code has been entered then the drive switches to Parameter edit mode on the parameter the user selected to edit, but if the correct code has not been entered the notification “Incorrect security code” is displayed for 2 s and the drive returns to Parameter view mode.

If Status only or No access security is set and locked then any attempt to leave status mode causes the security code to be requested as per the process described above. If the security code entered must be correct for the keypad state machine to switch to the Parameter view mode. It is then possible to access all parameters normally.

Security can be cleared as follows:

Security must be unlocked.

The *User Security Code* (**H01**) should be set to zero. For security to remain cleared after power down then a parameter save should be performed.

At any time *Security Status* (**H03**) can be changed between 0 and 1 to restrict access to Menu A alone or to all menus. If the change is made by a keypad the new value becomes active on leaving parameter edit mode.

It should be that *Security Status* (H03) is a volatile parameter and that the actual state of the security system is stored in *Security Status* (H03) and *Menu Access Status* (J68), which are both power-down save parameters. Therefore the security status will be stored when the drive goes into the under-voltage state. If the drive is already in the under-voltage state the security state should be saved by writing 1001 to *Parameter mm.00* (mm.00) and initiating a reset.

H03	Security Status		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	3
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT		

Value	Text
0	None
1	Read-only
2	Status-only
3	No Access

Security Status (**H03**) shows the security that will apply when security is enabled by setting a non-zero value for *User Security Code* (**H01**).

H04	Default Drive		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit Volatile	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, NC		

Value	Text
0	None
1	Standard
2	US

If *Default Drive* (H04) is non-zero and a drive reset is initiated then the drive will load and save default parameters. If *Default Drive* (H04) = 1 then 50 Hz defaults are loaded and if *Default Drive* (**H04**) = 2 then 60 Hz defaults are loaded. This parameter has priority over actions defined by *Parameter **mm00*** (**mm00**) and *Parameter Cloning* (N01). If *Default Drive* (**H04**) is used to initiate loading defaults the it is cleared along with *Parameter **mm00*** (**mm00**) and *Parameter Cloning* (**N01**) when the action is completed.

H06	Output Phase Loss Detection Enable		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Disabled
1	Enabled

Output phase loss detection can be used to detect a disconnected motor phase if *Output Phase Loss Detection Enable* (**H06**) is set to a non-zero value.

0: Disabled
Output phase loss detection is not active.

1: Enabled
A test is carried out each time the drive is enabled to run to check if all three phases are connected. If the test fails a *Out Phase Loss*.X trip is initiated where X indicates which phase is not connected (1 = U, 2 = V, 3 = W). For Open-loop and RFC-A modes a test is also carried out while the drive is running. If the drive output frequency is above 4 Hz and a phase is disconnected for the time specified by *Output Phase Loss Detection Time* (H07) then a *Out Phase Loss*.4 trip is initiated. It should be noted that if the motor is operating at high speed and flux weakening is active so that the magnetizing current is below half the rated level then output phase loss will not be detected. If the motor is heavily loaded when a phase is disconnected it is likely that the motor will stall and the drive output frequency may fall below 4 Hz before output phase loss is detected.

H07	Output Phase Loss Detection Time		
Mode	Open-Loop, RFC-A		
Minimum	0	**Maximum**	3
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	0.5 s
1	1.0 s
2	2.0 s
3	4.0 s

See *Output Phase Loss Detection Enable* (**H06**). This parameter has no effect in RFC-S mode.

H08	Input Phase Loss Detection Mode Enable		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Full
1	Ripple Only
2	Disabled

Input phase loss is detected by monitoring the DC Bus voltage ripple which increases with load. When compared to normal operation, if an input phase is missing or there is excessive input phase imbalance the d.c. link the ripple level is higher. For frame sizes 7 and above additional input phase loss detection is provided by direct monitoring of the supply voltages. Unlike the DC Bus voltage ripple based detection which can only operate when the drive is enabled and on load, the additional input phase loss detection can operate whether the drive is enabled or not. *Input Phase Loss Detection Mode Enable* (**H08**) defines the methods used for input phase loss detection provided by the drive.

Input Phase Loss Detection Mode Enable **(H08)**	***Drive Active*** **(L06) = 0**	***Drive Active*** **(L06) = 1**
0	*Direct input phase loss detection	*Direct input phase loss detection D.c. link voltage ripple detection
1	No input phase loss detection	D.c. link voltage ripple detection
2	No input phase loss detection	No input phase loss detection

*Frame sizes 7 and above.

Input phase loss detection can be disabled when the drive is required to operate from a d.c. supply connected to the d.c. link or from a single phase supply. If the drive operates from a single phase supply or a supply with high levels of phase imbalanced under load the input stage and d.c. link thermal protection system may produce an *OHt dc bus* trip.

When frame sizes 10 and above are operated with parallel power modules a trip is initiated if the supply is completely removed from the input to any of the parallel modules. This additional detection is disabled if *Input Phase Loss Detection Mode Enable* (**H08**) > 0.

H09	**Direct To Floor Sensor Mode**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt, US		

Value	Text
0	Spd IP
1	Stop IP
2	Spd IP+User Dist

When set to 0, stopping is activated by a removal of the speed signals. The deceleration distance is calculated from the profile parameters and is displayed in *V1 Calculated Deceleration Distance* (**J10**) > *V10 Calculated Deceleration Distance* (**J19**).

When set to 1, stopping is activated by a stop signal via a digital input routed to the freeze input (Drive terminal 27). Upon receiving the freeze, the AMC switches to position mode using the stopping distance for the speed selected, and compensates for any distance from when the stop input is received to when the AMC is processed. The deceleration distance is calculated from the profile parameters and is displayed in *V1 Calculated Deceleration Distance* (**J10**) > *V10 Calculated Deceleration Distance* (**J19**). Edge detection is selected by *Direct To Floor Edge Detection* (**H10**) selects rising (0) or falling (1) edge detection.

When set to 2, stopping is activated by a removal of the speed signals. The user can specify the deceleration distance used directly using V1 *Deceleration Distance Setpoint* (**G19**) to *V10 Deceleration Distance Setpoint* (**G28**).

H10	**Direct To Floor Edge Detection**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt, US		

Value	Text
0	Rising 1st
1	Falling 1st

0: Rising 1st

Direct to floor stop input is triggered on a rising edge of Digital input 4. The first suitable edge produced by the trigger source causes the direct to floor stop to be actioned.

1: Falling 1st

Direct to floor stop input is triggered on a falling edge of Digital input 4. The first suitable edge produced by the trigger source causes the direct to floor stop to be actioned.

H11	Control Input Mode		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	6
Default	2	**Units**	
Type	8 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Analog Run Prmit
1	Analog 2 Dir
2	Priority 1 Dir
3	Binary 1 Dir
4	Priority 2 Dir
5	Binary 2 Dir
6	Control Word

This allows the user to configure the direction input mode. The following direction configurations are available:

Analog Run Prmit:

Analog speed reference with run permit, *Direction Input 1 CCW* (**G39**) = On (1) to start the profile. The analog reference is read from *Analog Speed Reference* (**G49**) and is bidirectional i.e. the direction of travel is taken from the sign of the analog reference where negative references are CCW and positive references are CW direction. *Direction Input 2 CW* (**G40**) has no effect in this mode.

Sequencing may be started when the enable is received. It is assumed that the enable is made via an auxiliary contactor on the Motor contactor. *Motor Contactor Control Output* (**B31**) is not used when enable starts the sequencing.

Sequencing may be started when a run permit input is given. *Motor Contactor Control Output* (**B31**) is set to On (1) when the run permit (direction) signal is given. It is assumed that the enable is made via an auxiliary contactor on the Motor contactor.

On start up, the profile generator is used to ramp the speed from 0 to the analog reference level and is then bypassed once the speed is reached. This smoothes out the transition from 0 to the analog reference where the analog reference starts > 0V e.g. in open loop the user may apply a small speed to improve holding torque prior to brake release.

Analog 2 Dir:

Analog speed reference with dual direction inputs. The analog reference is read from *Analog Speed Reference* (**G49**). *Direction Input 1 CCW* (**G39**) = Off (0) and *Direction Input 2 CW* (**G40**) = On (1) clockwise direction is selected, and if *Direction Input 1 CCW* (**G39**) = On (1) and *Direction Input 2 CW* (**G40**) = Off (0) counter clockwise direction is selected. If *Direction Input 1 CCW* (**G39**)and *Direction Input 2 CW* (**G40**) = On (1) or Off (0) then no direction is selected.

Sequencing may be started when the enable is received. It is assumed that the enable is made via an auxiliary contactor on the Motor contactor. *Motor Contactor Control Output* (**B31**) is not used when enable starts the sequencing.

Sequencing may be started when a direction input is given (*Direction Input 1 CCW* (**G39**) or *Direction Input 2 CW* (**G40**) = On (1)). *Motor Contactor Control Output* (**B31**) is set to On (1) when the direction signal is given. It is assumed that the enable is made via an auxiliary contactor on the Motor contactor.

On start up, the profile generator is used to ramp the speed from 0 to the analog reference level and is then bypassed once the speed is reached. This smoothes out the transition from 0 to the analog reference where the analog reference starts > 0V e.g. in open loop the user may apply a small speed to improve holding torque prior to brake release.

Priority 1 Dir:

Single direction input and speed selection with priority e.g. V3 higher priority than V2. *Direction Input 1 CCW* (**G39**) = Off (0) Clockwise direction is selected, and *Direction Input 1 CCW* (**G39**) = On (1) counter clockwise direction is selected.

Binary 1 Dir:

Single direction input and binary speed selection. *Direction Input 1 CCW* (**G39**) = Off (0) Clockwise direction is selected, and *Direction Input 1 CCW* (**G39**) = On (1) counter clockwise direction is selected.

Priority 2 Dir:

Dual direction input and speed selection with priority e.g. V3 higher priority than V2. *Direction Input 1 CCW* (**G39**) = Off (0) and *Direction Input 2 CW* (**G40**) = On (1) Clockwise direction is selected, and if *Direction Input 1 CCW* (**G39**) = On (1) and *Direction Input 2 CW* (**G40**) = Off (0) counter clockwise direction is selected. If *Direction Input 1 CCW* (**G39**) and *Direction Input 2 CW* (**G40**) = On (1) or Off (0) then no direction is selected.

Binary 2 Dir:

Dual direction input and binary speed selection. *Direction Input 1 CCW* (**G39**) = Off (0) and *Direction Input 2 CW* (**G40**) = On (1) Clockwise direction is selected, and if *Direction Input 1 CCW* (**G39**) = On (1) and *Direction Input 2 CW* (**G40**) = Off (0) counter clockwise direction is selected. If *Direction Input 1 CCW* (**G39**) and *Direction Input 2 CW* (**G40**) = On (1) or Off (0) then no direction is selected.

Changing the direction during travel will cause the elevator to abort the present motion and come to stop.

Control Word:

Dual direction selection, and 10bit priority selection by control word.

When *Control Input mode* (**H11**) = 6 the control word is enabled. The control word replicates and extends the behaviour of the reference select bits, *Reference Select Bit 0 Input* (**G32**) to *Reference Select Bit 6 Input* (**G38**), and the direction bit inputs, *Direction Input 1 CCW* (**G39**) and *Direction Input 2 CW* (**G40**).

A watchdog is provided to verify that an elevator controller using the control word is still updating the speed and direction inputs. The user must write 1 to watchdog bit every <=500 ms to prevent the watch dog from stopping the elevator and causing a trip Trip 77 ***(Ctrl Watchdog)***.

The table below details the bits within the control word and their function:

Bit	Speed reference (creep speed by default)	Priority
0	Selects V1. If a higher priority speed is selected it will override this speed selection.	10 (lowest)
1	Selects V2 speed reference. If a higher priority speed is selected it will override this speed selection.	9
2	Selects V3 speed reference. If a higher priority speed is selected it will override this speed selection.	8
3	Selects V4 speed reference. If a higher priority speed is selected it will override this speed selection.	7
4	Selects V5 speed reference. If a higher priority speed is selected it will override this speed selection.	6
5	Selects V6 speed reference. If a higher priority speed is selected it will override this speed selection.	5
6	Selects V7 speed reference. If a higher priority speed is selected it will override this speed selection.	4
7	Selects V8 speed reference. If a higher priority speed is selected it will override this speed selection.	3
8	Selects V9 speed reference. If a higher priority speed is selected it will override this speed selection.	2
9	Selects V10 speed reference. If a higher priority speed is selected it will override this speed selection.	1 (highest)
10	Direction input 1 CCW	N/A
11	Direction input 1 CCW	N/A
12	Watchdog bit. This must be set to 1 at least every 500 ms or less. Failure to do this will result in a Trip 77 ***(Ctrl Watchdog)***. If a travel is in progress the elevator will perform a controlled stop and then trip.	N/A
13	Reserved	N/A
14	Reserved	N/A
15	Reserved	N/A

H12	Direction Input Invert		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When set to Off (0), the direction input operation is not inverted. For single direction input operation, if *Direction Input 1 CCW* (**G39**) = Off (0) clockwise direction is selected, and if *Direction Input 1 CCW* (**G39**) = On (1) then counter clockwise direction is selected. For dual direction input operation, if *Direction Input 1 CCW* (**G39**) = On (1) then counter clockwise direction is selected, and if *Direction Input 2 CW* (**G40**) = On (1) then clockwise direction is selected.

When set to On (1), the direction input operation is inverted. For single direction input operation, if *Direction Input 1 CCW* (**G39**) = Off (0) counter clockwise direction is selected, and if *Direction Input 1 CCW* (**G39**) = On (1) then clockwise direction is selected. For dual direction input operation, if *Direction Input 1 CCW* (**G39**) = On (1) then clockwise direction is selected, and if *Direction Input 2 CW* (**G40**) = On (1) then counter clockwise direction is selected.

Control Input mode (**H11**) selects dual or single direction input mode.

H13	Velocity Threshold 1		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	300	**Units**	mm / s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This sets the velocity threshold 1 switch threshold where:

Open loop

- If Profile speed (**J39**) is <= *Velocity Threshold 1* (**H13**) then *Velocity Threshold 1 Status Output* (**J42***) On (1).*
- If Profile speed (**J39**) is >= *Velocity Threshold 1* (**H13**) then *Velocity Threshold 1 Status Output* (**J43***) Off (0).*
- If *Actual Speed* (**J40**) is <= *Velocity Threshold 1* (**H13**) then *Velocity Threshold 1 Status Output* (**J48**) = On (1).

- If *Actual Speed* (**J40**) is > *Velocity Threshold 1* (**H13**) then *Velocity Threshold 1 Status Output* (**J48**) = Off (0).

This threshold may be used as an at speed indication where *Velocity Threshold 1 Status Output* (**J48**) is routed to the elevator controller via a digital output, such that when the speed is below a certain level, the elevator controller can open the doors early.

In RFC-A and RFC-S the speed threshold is based on speed feedback, but in Open loop mode it is based upon the profile generator speed since there is no feedback device available.

H14	Velocity Threshold 2		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	500	**Units**	mm / s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This sets the velocity threshold 1 switch threshold where:

RFC-A, RFC-S

If *Actual Speed* (**J40**) is <= *Velocity Threshold 2* (**H14**) then *Velocity Threshold 2 Status Output* (**J49**) = On (1).

If *Actual Speed* (**J40**) is > *Velocity Threshold 2* (**H14**) then *Velocity Threshold 2 Status Output* (**J49**) = Off (0).

This threshold may be used for advanced door opening where *Velocity Threshold 2 Status Output* (**J49**) is routed to the elevator controller via a digital output, such that when the speed is below a certain level, the elevator controller can open the doors early.

In RFC-A and RFC-S the speed threshold is based on speed feedback, but in Open loop mode it is based upon the profile generator speed since there is no feedback device available.

H15	Maximum Speed Error Threshold		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	100	**Units**	mm / s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

In closed loop, this sets the maximum speed error threshold in mm / s. The error is calculated from *Profile Speed* (**J39**) - *Actual Speed* (**J40**). *Trip 62 (**Speed err**)* is generated when the calculated error is > *Maximum Speed Error Threshold* (**H15**) for 1 s continuously.

If *Maximum Speed Error Threshold* (**H15**) = 0 then *Trip 62 (**Speed err**)* is disabled.

Maximum Speed Error (**J57**) shows the maximum speed error for the current travel. It is reset when a new travel begins.

H16	Maximum Distance Error Threshold		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	100	**Units**	mm
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This sets the maximum distance error threshold in mm. The error is calculated from the integral of *Profile Speed* (**J39**) - *Actual Speed* (**J40**). *Trip 63 (**Distance err**)* is generated when the calculated error is > *Maximum Distance Error Threshold* (**H16**) for 1s continuously.

If *Maximum Distance Error Threshold* (**H16**) = Off (0) then *Trip 63 (**Distance err**)* is disabled.

Maximum Distance Error (**J56**) shows the maximum distance error for the current travel. It is reset when a new travel begins.

H17	Current Controller Mode		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Final Current Loop Kp (**J29**).

H18	**Fan Maximum Speed**		
Mode	RFC-A, RFC-S		
Minimum	-10	**Maximum**	10
Default	10	**Units**	
Type	8 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This sets the maximum operating speed for the fan during a travel, where:

- A value from 1 to 10 is the maximum speed that the fan will use where the fan speed is automatically optimized dependant on the actual heatsink temperature. When the travel completes the fan will be switched off. Lower values will decrease acoustic noise but will increase the chance of over-temperature trips.
- A value of 0 forces the fan to run at full speed during a travel, and is switched off when the travel ends. This setting gives the lowest possibility of drive thermal trips where the fan is switched off at the end of a travel.
- A value from -1 to -10 is the maximum speed that the fan will use where the fan speed is automatically optimized dependant on the actual heatsink temperature of the drive. When the travel completes the fan will remain active until the heatsink is fully cooled. Lower values will decrease acoustic noise but will increase the chance of over-temperature trips.

If *Drive Over Temperature Alarm* (**L22**) = On (1) then the fan will be forced to operate at full speed to bring the heatsink temperature down rapidly regardless of the operating state.

H19	**Elevator Control Mode**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt, US		

Value	Text
0	Creep To floor
1	Direct To floor

When set to Creep To Floor (0), the elevator drive operates in Creep to floor control mode. In this mode *Creep Speed Select* (**G52**) selects which of the speeds, *V1 Speed Reference* (**G01**) to *V10 Speed Reference* (**G10**) is the creep speed, and remaining speeds are the elevator operating speeds.

When set to Direct To Floor (1), the elevator drive operates in Direct to floor control mode. In this mode *V1 Speed Reference* (**G01**) > *V10 Speed Reference* (**G10**) sets the elevator operating speeds.

If analog speed reference is selected, *Control Input Mode* (**H11**) = Analog Run Prmit OR Analog 2 Dir (0 or 1), then this parameter has no effect.

H20	Fast Start Enable		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Bit, US		

When set to On (1) fast start is enabled. This feature allows the elevator drive starting sequence to begin without a speed selection being applied such that the elevator will remain stationary till the speed signal is given. It is intended to be used with elevator controllers that support fast starting where the signal to close the elevator car door is routed to *Fast Start Enable* (**H20**) via a digital input, such that the following actions will happen during door closing:

- The motor contactors are closed
- The motor is magnetized (IM) / Fluxed (PM)
- The brake is released

The speed selection should only be applied when the door is closed.

If the elevator controller handles the control of the motor contactors, *Fast Start Enable* (**H20**) must be set to On (1) before the motor contactors are closed. This is to ensure that the elevator drive enable signal via auxiliary contacts on the motor contactors is received after the Fast disable signal.

If the elevator drive handles the control of the motor contactors via Motor Contactor Control Output (**B31**) then setting *Fast Start Enable* (**H20**) = On (1) will begin the starting sequence, and request the motor contactors to close.

If the speed is not applied for 5 s after the load measurement state is reached, *Elevator Software State* (**J03**) = 5 then the fast enable will be aborted.

H21	Fast Start Monitoring Distance		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default	200	**Units**	mm
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Num, US		

When set >0 and *Fast Start Enable* (**H20**) = On (1), this determines the maximum distance in mm which can be moved during a fast start. If the distance is exceeded then a Trip 69 (***Fast start err***) is generated, applying the brake and preventing further movement.

When set = 0, or when fast *Fast Start Enable* (**H20**) = Off (0), Trip 69 (***Fast start err***) is disabled.

H22	Short Floor Landing Enable		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Bit, US		

When set to Off (0), short floor landing is disabled.

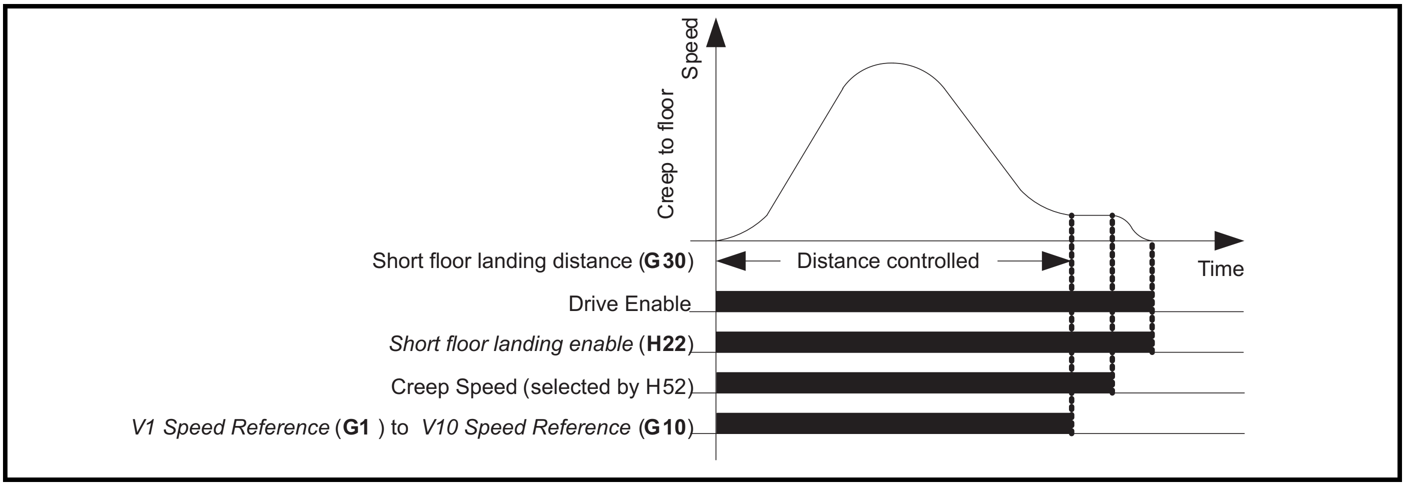
When set to On (1), short floor landing is enabled.

Short floor landing has been created to allow operation with a short floor distance which is lower than the braking distance from the normal floor selected speed. In this case peak curve operation cannot be used where the short floor distance is less than 0.7 m for example. For these short floor distances, the short floor landing mode is available with real distance control until the creep speed defined by *Creep Speed Select* (**G52**) is reached in Creep to floor mode.

The short floor landing distance is defined by *Short Floor Landing Distance* (**G30**) in mm, which is the distance from the current floor position to the floor / door zone.

The maximum operating speed is derived from both the short floor distance and the profile settings i.e. it is in position profile with speed target mode. Once the short floor landing distance has been reached the elevator will complete the travel operating at the creep speed defined by *Creep Speed Select* (**G52**) to a stop.

Short floor landing is selected using a digital input from the elevator controller routed to *Short Floor Landing Enable* (**H22**) for operation with short floor less then 0.7 m for example. The control signals for the creep speed defined by *Creep Speed Select* (**G52**) and short floor landing enable must be applied simultaneously. The maximum operating speed is internally calculated so that the creep speed defined by *Creep Speed Select* (**G52**) is reached after the short floor landing distance, *Short Floor Landing Distance* (**G30**), and when the floor (door) zone is reached.



In the event that the creep speed defined by *Creep Speed Select* (**G52**) is deselected during operation the *Run Jerk 2* (**G14**), *Run Jerk 3* (**G15**), *Run Jerk 4* (**G16**) and *Deceleration Rate* (**G12**) will be used to bring the elevator car to a stop. This is because Creep Stop Deceleration Rate (**G17**) and *Creep Stop Jerk* (**G18**) are often set to high values to improve accuracy which would result in an abrupt stop affecting ride comfort.

When *Short Floor Landing Enable* (**H22**) = On (1), Start optimization is not performed.

This mode of operation is not available in Direct to floor.

H23	**Floor Sensor Correction Enable**		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Bit, US		

When set to Off (0), floor sensor correction is disabled.

When set to On (1), floor sensor correction is enabled where a floor sensor / limit switch is used to compensate for rope slip, rope stretch and other mechanical offsets.

Floor Sensor Correction Target Distance (**G31**) sets the distance from the floor sensor to the floor level in mm.

Remaining Floor Sensor Correction Distance (**J47**) shows the remaining distance to the floor in mm.

In Creep to floor mode, *Elevator Control Mode* (**H19**) = Off (0) and *Floor Sensor Correction Source Select* (**H24**) = Off (1), floor sensor correction is performed on detection of a signal from an external sensor. When the sensor input is triggered the elevator will come to a stop with Creep speed still selected. If Creep speed is deselected prior to the floor sensor correction trigger point the final relative position may not match the *Floor Sensor Correction Target Distance* (**G31**). *T28 Digital Input 05 State* (**F07**) is used as the floor sensor correction activation input, and *Floor Sensor Correction Edge Detection* (**H25**) selects rising (0) or falling (1) edge detection.

In Creep to floor mode, *Elevator Control Mode* (**H19**) = Off (0) and *Floor Sensor Correction Source Select* (**H24**) = On (1), when Creep speed is deselected the distance specified by *Floor Sensor Correction Target Distance* (**G31**) is used as the distance control target, for the profile generator to modify the profile parameters in order to achieve the target distance. The elevator controller must deselect Creep speed at the correct position i.e. *Floor Sensor Correction Target Distance* (**G31**) mm from the target floor.

In Direct to floor mode, *Elevator Control Mode* (**H19**) = On (1), or Creep to floor mode, *Elevator Control Mode* (**H19**) = Off (0) and *Floor Sensor Correction Source Select* (**H24**) = Off (0), floor sensor correction on detection of a signal from an external sensor. When the sensor input is triggered, the distance specified by *Floor Sensor Correction Target Distance* (**G31**) is used as the distance control target, for the profile generator to modify the internal profile parameters in order to achieve the target distance. The floor sensor correction scheme will capture the floor position correction in <1 us in hardware and compensate for the distance travelled from when the input is activated to when the motion is calculated to give accurate positioning. *T28 Digital Input 05 State* (**F07**) is used as the floor sensor correction activation input, and *Floor Sensor Correction Edge Detection* (**H25**) selects rising (0) or falling (1) edge detection.

H24	Floor Sensor Correction Source Select		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt, US		

Value	Text
0	Floor Sensor IP
1	Creep Spd IP

This parameter selects which floor sensor correction input is used when performing a floor sensor correction in Creep to floor mode, *Control Input Mode* (**H11**) = Creep To Floor (0).

When set to Floor Sensor IP (0), the floor sensor correction is performed using freeze input 2 via T28 digital input 5. When set to Creep Spd IP (1), the floor sensor correction is performed when the creep speed is deselected.

H25	Floor Sensor Correction Edge Detection		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt, US		

Value	Text
0	Rising 1st
1	Falling 1st

0: Rising 1st

Floor sensor correction input is triggered on a rising edge of Digital input 5 and the first suitable edge produced by the trigger source causes the floor sensor correction to be actioned.

1: Falling 1st

Floor sensor correction input is triggered on a falling edge of Digital input 5 and the first suitable edge produced by the trigger source causes the floor sensor correction to be actioned.

H26	Fast Stop Enable		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When set to On (1), fast stop is enabled where the fast stop deceleration rate, *Fast Stop Deceleration Rate* (**G29**), is used to bring the elevator car to a stop. The jerk is fixed internally to reach constant acceleration / deceleration in 200 ms or *Fast Stop Deceleration Rate* (**G29**) * 5.

The fast stop may be actioned in one of 2 ways:

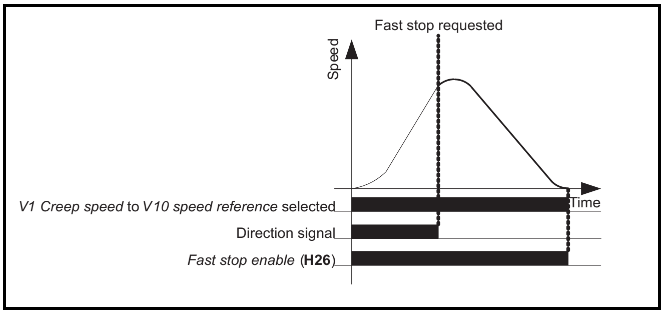
Speed control:

In this mode one of the user speeds, *V1 Creep Speed Reference* (**G01**) to *V10 Speed Reference* (**G10**), is set to 0 mm / s and is selected, and *Fast Stop Enable* (**H26**) = On (1), a fast stop is activated.

The user must reset the selected inspection speed such that a new inspection travel may begin.

Direction control:

In this mode if dual direction inputs are selected, *Control Input mode* (**H11**) = Priority 2 Dir or Binary 2 Dir (4 or 5), and the direction signal is removed, and *Fast Stop Enable* (**H26**) = On (1), a fast stop is activated.



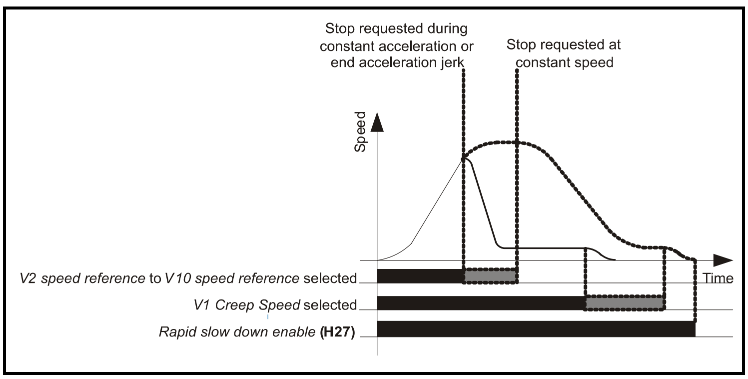
When this feature is enabled floor sensor correction and direct to floor using a stop input is disabled.

H27	Rapid Slow Down Enable		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When set to Off (0), rapid slow down is disabled.

When set to On (1), and *Elevator Control Mode* (**H19**) = Creep To Floor (0), *Peak Curve Enable* (**G41**) = Off (0) (peak curve is disabled), rapid slow down is enabled. This mode of operation is intended for Creep to floor elevator controllers that do not handle peak curve operation, where under normal circumstances the selected speed is reached prior to slowing to the creep speed defined by Creep Speed Select (**G52**).

Under emergency conditions the elevator controller may request the elevator drive to slow down before constant speed is reached i.e. during acceleration, and under these circumstances when Rapid Slow Down Enable (**H27**) = On (1), the profile is modified such that the speed will not increase further, and Fast Stop Deceleration Rate (**G29**) is used and a fixed 200ms jerk is applied, to bring the elevator car to the creep speed defined by Creep Speed Select (**G52**) as rapidly as possible. The creep speed defined by Creep Speed Select (**G52**) is used until the elevator controller deselects it.



H28	Freeze Protection Threshold		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-10	**Maximum**	0
Default	0	**Units**	° C
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This parameter is used to define the threshold level for a temperature monitoring trip to be generated. If either of the following drive temperature levels, *Monitored Temperature 1* (**J71**), *Monitored Temperature 2* (**J72**) or *Monitored Temperature 3* (**J73**) reaches or falls below the threshold value on completion of the travel a *Trip 60* (*Freeze protect*) will be generated notifying the user that the system is operating outside the recommended temperature. This trip can only occuur when *Elevator Software State* (**J03**) = 0 (Idle).

H29	Normal Duty Enable		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When set to Off (0), Normal Duty operation is prevented if *Motor Rated Current* (**B02**) **>** *Maximum Heavy Duty Rating* (**J05**) by *Trip 61 (**Drive rating**)*. *Trip 61 (**Drive rating**)* warns commissioning personnel that the drive and motor combination will result in normal duty operation where the maximum overload current is reduced which will result in reduced motor torque capability. It is possible that the drive has been sized incorrectly for the application. When the drive is used in Normal Duty operation *Symmetrical Current Limit* (**B16**) is reduced linearly to the minimum of 110 % of motor rated current.

When set to On (1), Normal Duty operation is allowed and *Trip 61 (**Drive rating**)* is disabled. The peak current capability is reduced to typically 110 % of motor rated current.

H30	Position Display Mode		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Relative
1	Absolute

When set to Off (0), *Elevator Position* (**J36**) displays the elevator position relative to the last stop. Selecting this mode resets the shaft position count. The reset behaviour can be used to datum the shaft position prior to selecting absolute mode.

When set to On (1), *Elevator Position* (**J36**) displays the absolute elevator position. The absolute position may be associated to the absolute shaft position by user manual entry when the elevator is in the idle state, *Elevator Software State* (**J03**) = 0. This may be achieved by stopping the elevator car at zero position in the elevator shaft, e.g. the lowest floor, and then reset *Elevator Position* (**J36**) to 0 by toggling *Position Display Mode* (**H30**) from Relative to Absolute (0 to 1).

It must be noted that this position can drift over time due to rope slip, therefore it is for indication only when commissioning.

H31	Elevator Trip Disable		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	8 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Trips Enabled
1	Trips Disabled

When set to On (1), the following trips are disabled to assist with commissioning and diagnostics for service personnel when setting up a new elevator system:

- *Trip 65 (**Fast disable err**),* Fast disable monitoring.
- *Trip 66 (**STO ctrl err**),* Safe Torque Off input monitoring.
- *Trip 70 (**Mot con open**) / Trip 71 (**Mot con closd**),* monitoring of the motor contactors.

It is recommended for normal operation to leave this parameter set to Off (0).

This parameter can't be saved to On (1) by the user.

NOTE

When *Elevator Trip Disable* (**H31**) = On (1) State 1 and state 14 will not time out in the event that the fast disable input, STO input or motor contactor monitoring inputs are not in the correct state.

H32	**Date/Time Selector**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	9
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Set
1	Powered
2	Running
3	Acc Powered
4	Local Keypad
5	Remote Keypad
6	Slot 1
7	Slot 2
8	Slot 3
9	Slot 4

Date/Time Selector (**H32**) is used to select the drive date and time as shown in the table below.

Date/Time Selector **(H32)**	**Date/Time Source**
0: Set	Date and time parameters can be written by the user.
1: Power	Time since the drive was powered up.
2: Running	Accumulated drive running time since the drive was manufactured.
3: Acc Power	Accumulated powered-up time since the drive was manufactured.
4: Local Keypad	If a keypad fitted to the front of the drive includes a real-time clock then the date/time from this clock is displayed, otherwise the date/time is set to zero.
5: Remote Keypad	If a keypad connected to the user comms port of a drive with a 485 includes a real-time clock then the date/time from this clock is displayed, otherwise the date/time is set to zero.
6: Slot 1	As 4 above, but for option slot 1
7: Slot 2	As 4 above, but for option slot 2
8: Slot 3	As 4 above, but for option slot 3
9: Slot 4	As 4 above, but for option slot 4

When *Date/Time Selector* (**H32**) = 0 the *Date* (**J80**) and *Time* (**J81**) can be written by the user and the values in these parameters are transferred to the real time clocks in the keypad or any option modules that support this feature that are fitted to the drive. When *Date/Time Selector* (**H32**) is changed to any other value, the real time clocks are allowed to run normally again. When *Date/Time Selector* (**H32**) is changed from any value to 0 the date and time from a real time clock, if present, is automatically loaded into *Date* (**J80**) and *Time* (**J81**), so that this date and time is used as the initial value for editing. If more than one real time clock is present the date/time from the keypad is used, if present, and if not then the date/time from the lowest number slot with a real time clock is used.

Date (**J80**) and *Time* (**J81**) are used for time stamping trips. These features will continue to use the originally selected clock even if *Date/Time Selector* (**H32**) is changed until a drive reset is initiated. If *Date/Time Selector* (**H32**) has been changed and a reset is initiated, the trip dates and times (L41 to L60) are reset to zero.

H33	**Date Format**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Standard
1	US

Date Format (**H33**) selects the display style for *Date* (**J80**), and for the trip time stamping date parameters (**L41, L43, L45, L47, L49, L51, L53, L55, L57** and **L59**) when displayed on a keypad connected to the drive. The format selection made in this parameter does not affect the value of these parameters if they are read using comms or by an applications program.

If *Date Format* (H33) is 0 then standard format is used and the date is displayed on the keypad as dd.mm.yy and if *Date Format* (H33) is 1 then US format is used and the date is displayed on the keypad as mm.dd.yy.

H34	**Turn On Delay**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	200	**Maximum**	65535
Default	200	**Units**	ms
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This sets a delay in ms at power up before the elevator drive will respond to elevator controller signals. This is provided to filter out spurious lift controller output signals during power up, and thereby prevent unintended elevator drive operation.

H35	**Standby Mode Enable**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

If *Standby Mode Enable* (**H35**) = 1 then the drive will go into the standby power state whenever *Drive Active* (**L06**) = 0. In this state the LED on the front of the drive flashes 0.5 s on and 5 s off, the drive cannot be enabled and the following actions are taken as defined by the *Standby Mode Mask* (**H36**). Actions are enabled by setting the appropriate bit to 1. Once standby mode has become active it will remain active, even if an attempt is made subsequently to enable the drive, until *Standby Mode Enable* (**H35**) is set to 0.

***Standby Mode Mask* (H36) bits**	**Action**
0	Turn off the drive position feedback power supply. On leaving standby mode the drive position feedback interfaces will be re-initialised.
1	Turn off the power supply to a keypad fitted to the drive.
2	Turn off the drive 24 V output.
3	Request that the option module in option slot 1 to go into the standby power mode
4	Request that the option module in option slot 2 to go into the standby power mode
5	Request that the option module in option slot 3 to go into the standby power mode
6	Request that the option module in option slot 4 to go into the standby power mode

H36	**Standby Mode Mask**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 0000000)	**Maximum**	127 (Display: 1111111)
Default	0 (Display: 0000000)	**Units**	
Type	8Bit User Save	**Update Rate**	Background read
Display Format	Binary	**Decimal Places**	0
Coding	RW		

See *Standby Mode Enable* (**H35**).

H37	**Reset Energy Meter**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit Volatile	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Energy Meter: MW h (**J84**) and *Energy Meter: kW h* (**J85**) accumulate the energy transferred through the drive. If *Reset Energy Meter* (**H37**) = 1 then *Energy Meter: MW h* (**J84**) and *Energy Meter: kW h* (J85) are held at zero. If *Reset Energy Meter* (**H37**) = 0 then the energy meter is enabled and will accumulate the energy flow. If the maximum or minimum of *Energy Meter: MW h* (**J84**) is reached the parameter does not rollover and is instead clamped at the maximum or minimum value. For Open-loop, RFC-A and RFC-S modes a positive energy flow indicates that power is flowing out of the a.c. motor terminals. For Regen mode a positive energy flow indicates that power is flowing from the supply to the AC drive terminals.

H38	**Blocked Elevator Release Enable Input**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When set to On (1) the blocked elevator release function is enabled.

The mechanical lock on an elevator car will operate independent of the drive during an over speed condition so the elevator car is safely stopped in a locked position. This elevator releasing feature will attempt to release the blocked elevator. The blocked elevator releasing function is enabled using a digital input to the drive routed to *Blocked Elevator Release Enable Input* (**H38**). Once enabled the elevator car locked condition is identified by using *Current Limit Reached* (**L15**) and *At Zero Speed* (**L08**) where if both = On (1) the elevator car is blocked, and if either = Off (0) the elevator car is released.

The blocked elevator releasing function can be used to release the elevator car when trapped after the elevator car mechanical brakes have been used.

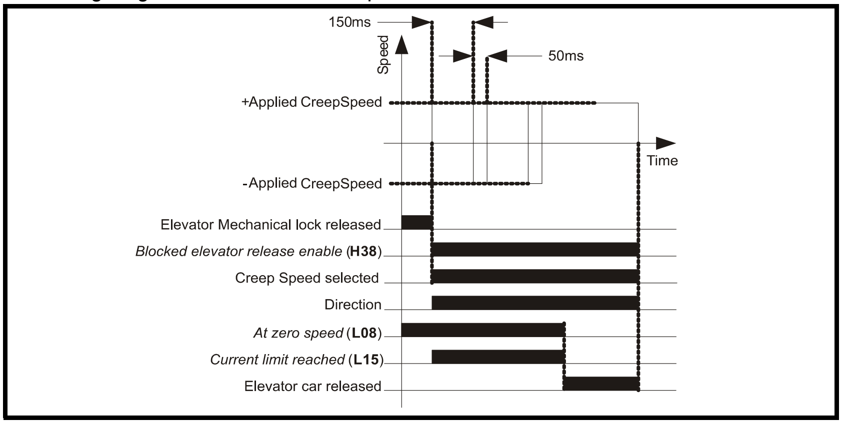
If the elevator car is not released immediately (within 150 ms) the drive will move the elevator car up and down by short distances (switch direction commands repeatedly) as long as a speed is selected (as part of the elevator controller inspection mode). A 150 ms commanded direction to 50 ms opposite direction ratio is applied to release the elevator car. When the elevator car is released it will travel at the creep speed defined by Creep Speed Select (**G52**). During elevator car release the drive will run the motor with regardless of the selected speed.

When the speed and direction signals have been removed, ending the elevator car release, *Blocked Elevator Release Enable Input* (**H38**) must be set to Off (0). If the blocked elevator releasing function is to be implemented again *Blocked Elevator Release Enable Input* (**H38**) must be set to On (1) again.

To allow maximum torque to be generated, and provide the best performance for the blocked elevator releasing, the following parameter settings are used:

Parameter	Description
At Zero Speed (L08)	Used to detect if the elevator car has been released
Current Limit Reached (L15)	Used to detect if the elevator car has been released
V1 Creep Speed Reference (G01)	Used to set the maximum speed
Maximum Speed Error Threshold (H15)	Set to 0 internally during blocked elevator release preventing a trip.
Maximum Distance Error Threshold (H16)	Set to 0 internally during blocked elevator release preventing a trip.

The timing diagram below shows the operation of the blocked elevator release feature:



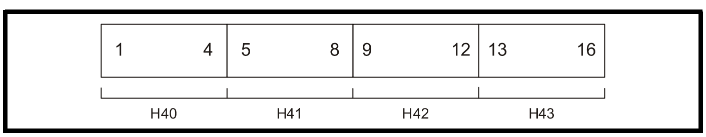
This feature is not available in Open-Loop mode.

H39	Parameter Displayed At Power-up		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	A00	**Maximum**	A80
Default	A06	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	3
Coding	RW, PT		

In status mode *Parameter Displayed At Power-up* (**H39**) defines which Menu 0 parameter is initially displayed at power-up.

H40	Drive Name Characters 1-4		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-2147483648	**Maximum**	2147483647
Default	0	**Units**	
Type	32 Bit User Save	**Update Rate**	N/A
Display Format	String	**Decimal Places**	0
Coding	RW, PT		

Drive Name Characters 1-4 (**H40**) to *Drive Name Characters 13-16* (**H43**) can be used to store a 16 character string which can be used to identify the drive. The string is arranged as shown below.



This uses the standard ASCII character set.

H41	Drive Name Characters 5-8		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-2147483648	**Maximum**	2147483647
Default	0	**Units**	
Type	32 Bit User Save	**Update Rate**	N/A
Display Format	String	**Decimal Places**	0
Coding	RW, PT		

See *Drive Name Characters 1-4* (**H40**).

H42	**Drive Name Characters 9-12**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-2147483648	**Maximum**	2147483647
Default	0	**Units**	
Type	32 Bit User Save	**Update Rate**	N/A
Display Format	String	**Decimal Places**	0
Coding	RW, PT		

See *Drive Name Characters 1-4* (**H40**).

H43	**Drive Name Characters 13-16**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-2147483648	**Maximum**	2147483647
Default	0	**Units**	
Type	32 Bit User Save	**Update Rate**	N/A
Display Format	String	**Decimal Places**	0
Coding	RW, PT		

See *Drive Name Characters 1-4* (**H40**).

H45	**Action On Trip Detection**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00000)	**Maximum**	31 (Display: 11111)
Default	0 (Display: 00000)	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Binary	**Decimal Places**	0
Coding	RW		

The bits in *Action On Trip Detection* (**H45**) are defined as follows:

Bit 0: Stop on defined non-important trips
If bit 0 is set to one the drive will attempt to stop before tripping if any of the following trip conditions are detected: *I/O Overload*, *An Input 1 Loss*, *An Input 2 Loss*.

Bit 1: Disable braking resistor overload detection
See *Braking Resistor Rated Power* (**D15**).

Bit 2: Disable phase loss stop
Normally the drive will stop when the input phase loss condition is detected. If this bit is set to 1 the drive will continue to run and will only trip when the drive is brought to a stop by the user.

Bit 3: Disable braking resistor temperature monitoring
If hardware based braking resistor thermal monitoring is provided this can be disabled by setting this bit to one.

Bit 4: Disable parameter freeze on trip
If this bit is 0 then the parameters listed below are frozen on trip until the trip is cleared. If this bit is 1 then this feature is disabled.

Open-loop mode	RFC-A or RFC-S modes
	Speed Error (**J31**)
	Speed Loop Output (**J32**)
Total Output Current (**J22**)	*Total Output Current* (**J22**)
Torque Producing Current (**J24**)	*Torque Producing Current* (**J24**)
Magnetizing Current (**J25**)	*Magnetizing Current* (**J25**)
Output Frequency (**J60**)	*Output Frequency* (**J60**)
Output Voltage (**J61**)	*Output Voltage* (**J61**)
Output Power (**J59**)	*Output Power* (**J59**)
D.c. Bus Voltage (**J65**)	*D.C. Bus Voltage* (**J65**)
T5 T6 Analog Input 1 (**F35**)	*T5 T6 Analog Input 1* (**F35**)
T7 Analog Input 2 (**F36**)	*T7 Analog Input 2* (**F36**)
T8 Analog Input 3 (**F37**)	*T8 Analog Input 3* (**F37**)

H46	**Number Of Autoreset Attempts**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	6
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	None
1	1
2	2
3	3
4	4
5	5
6	Infinite

If *Number Of Autoreset Attempts* (**H46**) = 0 then no auto-reset attempts are made. Any other value will cause the drive to automatically reset following a trip for the number of times programmed after a delay defined by *Auto-reset Delay* (**H47**) subject to the minimum reset time allowed for the type of trip. Note that for some trips the minimum is 10 s. The auto-reset count is only incremented when the trip is the same as the previous trip otherwise it is reset to 0. When the auto-reset count reaches the programmed value, any further trip of the same value will not cause an auto-reset. If the number of auto-reset attempts defined by *Number Of Autoreset Attempts* (**H46**) has not been reached and there has been no trip for 5 minutes then the auto-reset count is cleared. Auto reset will not occur after any trips with priority levels 1, 2 or 3 as defined in *Trip 0* (**L29**). When a manual reset occurs the auto-reset counter is reset to zero.

If *Number Of Autoreset Attempts* (**H46**) = 6 the auto-reset counter is held at zero, and so there is no limit on the number of auto-reset attempts.

H47	**Auto-reset Delay**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1.0	**Maximum**	600.0
Default	1.0	**Units**	s
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW		

See *Number Of Autoreset Attempts* (**H46**).

8.8 Menu I: Tuning

Figure 8-26 Variable Speed Loop Gains

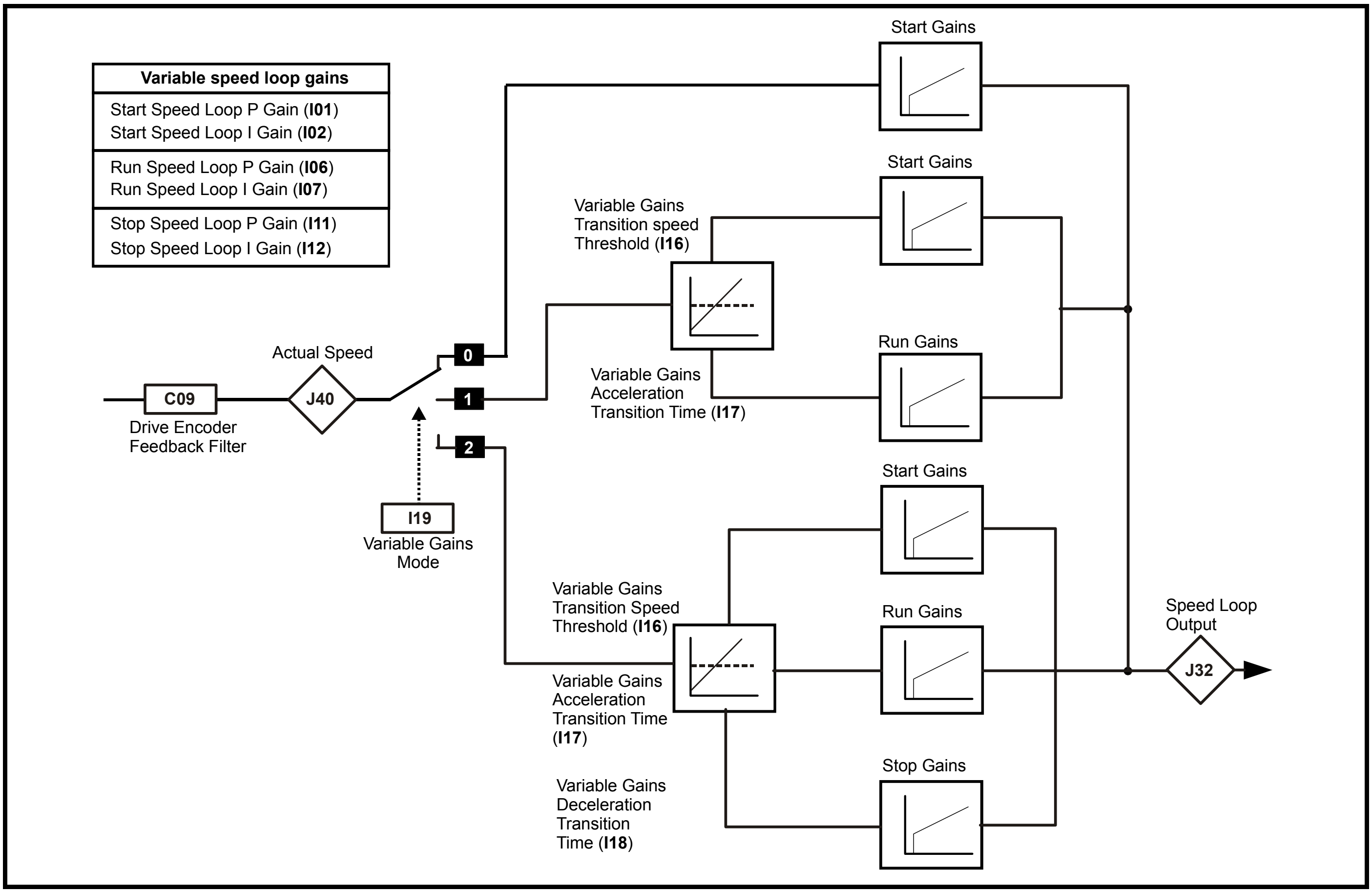
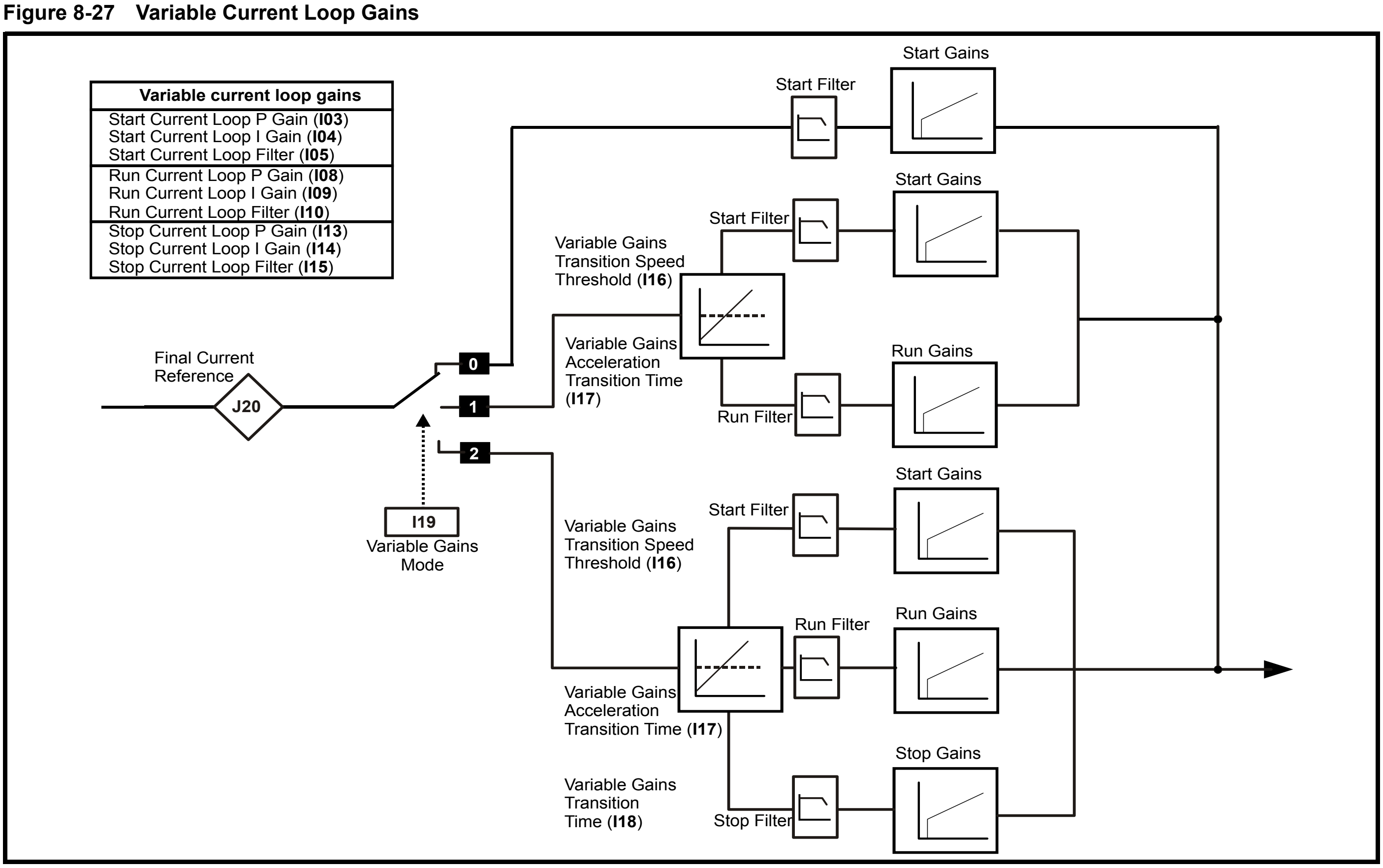


Figure 8-27 Variable Current Loop Gains



Parameter		Range(⇳)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
I01	Start Speed Loop Kp		0.0000 to 200.0000 s/rad			0.0300 s/rad		RW	Num				US
I02	Start Speed Loop Ki		0.00 to 655.35 s²/rad			0.10 s²/rad		RW	Num				US
I03	Start Current Loop Kp	0 to 30000			20	150		RW	Num				US
I04	Start Current Loop Ki	0 to 30000			40	2000		RW	Num				US
I05	Start Current Loop Filter		0.0 to 25.0 ms			1.0 ms		RW	Num			PT	US
I06	Run Speed Loop Kp		0.0000 to 200.0000			0.0300		RW	Num				US
I07	Run Speed Loop Ki		0.00 to 655.35			0.10		RW	Num				US
I08	Run Current Loop Kp	0 to 30000			20	150		RW	Num				US
I09	Run Current Loop Ki	0 to 30000			40	2000		RW	Num				US
I10	Run Current Loop Filter		0.0 to 25.0 ms			1.0 ms		RW	Num				US
I11	Stop Speed Loop Kp		0.0000 to 200.0000			0.0300		RW	Num				US
I12	Stop Speed Loop Ki		0.00 to 655.35			0.10		RW	Num				US
I13	Stop Current Loop Kp	0 to 30000			20	150		RW	Num				US
I14	Stop Current Loop Ki	0 to 30000			40	2000		RW	Num				US
I15	Stop current loop filter		0.0 to 25.0 ms			1.0 ms		RW	Num				US
I16	Variable Gains Transition Speed Threshold	0 to 10000 mm/s			100 mm/s			RW	Num				US
I17	Variable Gains Accel Transition Time	0 to 65535 ms			1000 ms			RW	Num				US
I18	Variable Gains Decel Transition Time	0 to 65535 ms			1000 ms			RW	Num				US
I19	Variable Gains Mode	Start only (0), Start+Run (1), Start+Run+Stop (2)			Start + run (0)			RW	Txt				US
I20	Start Lock Kp		0.000 to 1,000.000			50.000		RW	Num				US
I21	Start Lock Kp Speed Clamp		0.000 to 10000.000			100.000		RW	Num				US
I22	Start Lock Enable		Off (0) or On (1)			Off (0)		RW	Bit				US
I23	Start Lock Position Change Maximum		0.00 to 2.55 %			0.00 %		RW	Num				US
I24	Notch Filter Centre Frequency		50 to 1000 Hz			100 Hz		RW	Num				US
I25	Notch Filter Bandwidth		0 to 500 Hz			0 Hz		RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Mode: Open-Loop (where specified), RFC-A, RFC-S

I01	Start Speed Loop Kp		
Mode	RFC A, RFC-S		
Minimum	0.0000	**Maximum**	200.0000
Default	0.0300	**Units**	s/rad
Type	32 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	4
Coding	RW		

This sets the speed loop proportional gain during starting. This gain is active from when the travel starts to when the variable gains speed threshold, Variable Gains Transition Speed Threshold (**I16**), is reached where the running gain will be used.

I02	Start Speed Loop Ki		
Mode	RFC A, RFC-S		
Minimum	0.00	**Maximum**	655.35
Default	0.10	**Units**	s^2/rad
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	2
Coding	RW, BU		

This sets the speed loop integral gain during starting. This gain is active from when the travel starts to when the variable gains speed threshold, Variable Gains Transition Speed Threshold (**I16**), is reached is reached where the running gain will be used.

I03	Start Current Loop P Gain		
Mode	Open-Loop, RFC A, RFC-S		
Minimum	0	**Maximum**	30000
Default	Open-Loop: 20 RFC-A, RFC-S: 150	**Units**	
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This sets the current loop proportional gain during starting. This gain is active when a travel is started until the threshold set by *Variable Gains Transition Speed Threshold* (**I16**) is reached, where the running gain will be used.

I04	Start Current Loop I Gain		
Mode	Open-Loop, RFC A, RFC-S		
Minimum	0	**Maximum**	30000
Default	Open-Loop: 40 RFC-A, RFC-S: 2000	**Units**	
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This sets the current loop integral gain during starting. This gain is active when a travel is started until the threshold set by *Variable Gains Transition Speed Threshold* (**I16**) is reached, where the running gain will be used.

I05	Start Current Loop Filter		
Mode	RFC A, RFC-S		
Minimum	0.0	**Maximum**	25.0
Default	1.0	**Units**	ms
Type	8 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	1
Coding	RW, PT, BU		

This sets the starting current loop filter time constant in ms. This parameter filters the final current reference before the current loop, and can be used to reduce motor acoustic noise associated with low resolution encoders or high speed loop proportional gains. This gain is active when a travel is started until the threshold set by the *Variable Gains Transition Speed Threshold* (**I16**) is reached, where the running filter will be used.

I06	Run Speed Loop P Gain		
Mode	RFC A, RFC-S		
Minimum	0.0000	**Maximum**	200.0000
Default	0.0300	**Units**	s/rad
Type	32 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	4
Coding	RW		

This sets the speed loop proportional gain during running. This gain is active from when the variable gains speed threshold, *Variable Gains Transition Speed Threshold* (**I16**), is reached when accelerating and when decelerating.
This parameter is only used when *Variable Gains Mode* (**I19**) = 1 or 2.

I07	Run Speed Loop I Gain		
Mode	RFC A, RFC-S		
Minimum	0.00	**Maximum**	655.35
Default	Open-Loop: 40 RFC-A, RFC-S: 2000	**Units**	s^2 /rad
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	2
Coding	RW, BU		

This sets the speed loop integral gain during running. This gain is active from when the variable gains speed threshold, *Variable Gains Transition Speed Threshold* (**I16**), is reached when accelerating and decelerating.
This parameter is only used when *Variable Gains Mode* (**I19**) = 1 or 2.

I08	Run Current Loop P Gain		
Mode	Open-Loop, RFC A, RFC-S		
Minimum	0	**Maximum**	30000
Default	Open-Loop: 20 RFC-A, RFC-S: 150	**Units**	
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This sets the current loop proportional gain during running. This gain is active from when the variable gains speed threshold, *Variable Gains Transition Speed Threshold* (**I16**), is reached when accelerating and decelerating.
This parameter is only used when Variable Gains Mode (I19) = 1 or 2.

I09	Run Current Loop I Gain		
Mode	Open-Loop, RFC A, RFC-S		
Minimum	0	**Maximum**	30000
Default	2000	**Units**	
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This sets the current loop integral gain during running. This gain is active from when the variable gains speed threshold, *Variable Gains Transition Speed Threshold* (**I16**), is reached when accelerating and when decelerating.
This parameter is only used when *Variable Gains Mode* (**I19**) = 1 or 2.

I10	Run Current Loop Filter		
Mode	RFC A, RFC-S		
Minimum	0.0	**Maximum**	25.0
Default	1.0	**Units**	ms
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

This sets the running current loop filter time constant in ms. This parameter filters the final current reference before the current loop, and can be used to reduce motor acoustic noise associated with low resolution encoders or high speed loop proportional gains. This filter time constant is active from when the variable gains speed threshold, Variable Gains Transition Speed Threshold (**I16**), is reached when accelerating and when decelerating.
This parameter is only used when Variable Gains Mode (**I19**) = 2.

I11	Stop Speed Loop P Gain		
Mode	RFC A, RFC-S		
Minimum	0.0000	**Maximum**	200.0000
Default	0.0300	**Units**	s/rad
Type	32 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	4
Coding	RW		

This sets the speed loop proportional gain during stopping. This gain is active when decelerating and the variable gains speed threshold, *Variable Gains Transition Speed Threshold* (**I16**), is reached until standstill.
This parameter is only used when *Variable Gains Mode* (**I19**) = 2.

I12	Stop Speed Loop I Gain		
Mode	RFC A, RFC-S		
Minimum	0.00	**Maximum**	655.35
Default	0.10	**Units**	s^2/rad
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	2
Coding	RW, BU		

This sets the speed loop integral gain during stopping. This gain is active when decelerating and the variable gains speed threshold, *Variable Gains Transition Speed Threshold* (**I16**), is reached, until standstill.
This parameter is only used when *Variable Gains Mode* (**I19**) = 2.

I13	Stop Current Loop P Gain		
Mode	Open-Loop, RFC A, RFC-S		
Minimum	0	**Maximum**	30000
Default	Open-Loop: 20 RFC-A, RFC-S: 150	**Units**	
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This sets the current loop proportional gain during stopping. This gain is active when decelerating and the variable gains speed threshold, *Variable Gains Transition Speed Threshold* (**I16**), is reached, until standstill.
This parameter is only used when *Variable Gains Mode* (**I19**) = 2.

I14	Stop Current Loop I Gain		
Mode	Open-Loop, RFC A, RFC-S		
Minimum	0	**Maximum**	30000
Default	Open-Loop: 40 RFC-A, RFC-S: 2000	**Units**	
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This sets the current loop integral gain during stopping. This gain is active when decelerating and the variable gains speed threshold, *Variable Gains Transition Speed Threshold* (**I16**), is reached, until standstill.
This parameter is only used when *Variable Gains Mode* (**I19**) = 2.

I15	Stop current loop filter		
Mode	RFC A, RFC-S		
Minimum	0.0	**Maximum**	25.0
Default	1.0	**Units**	ms
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

This sets the stopping current loop filter time constant in ms. This parameter filters the final current reference before the current loop, and can be used to reduce motor acoustic noise associated with low resolution encoders or high speed loop proportional gains. This filter time constant is active when

decelerating and the variable gains speed threshold, *Variable Gains Transition Speed Threshold* (**I16**), is reached, until standstill.
This parameter is only used when *Variable Gains Mode* (**I19**) = 2.

I16	Variable Gains Transition Speed Threshold		
Mode	Open-Loop, RFC A, RFC-S		
Minimum	0	**Maximum**	10000
Default	100	**Units**	mm/s
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This sets the variable gains speed threshold used to select the starting, running and stopping gains in mm/s. When the motor speed is >= *Variable Gains Transition Speed Threshold* (**I16**), the transition from starting to running gains is made. When the motor speed is <= Travel speed - Variable Gains Transition Speed Threshold (**I16**) and decelerating, the transition from running to stopping gains is made.
This parameter is only used when *Variable Gains Mode* (**I19**) = 1 or 2.

I17	Variable Gains Accel Transition Time		
Mode	Open-Loop, RFC A, RFC-S		
Minimum	0	**Maximum**	65535
Default	1000	**Units**	ms
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This sets the variable gains accelleration transition time in ms, used to set the ramp time when transitioning from starting to running gains.
This parameter is only used when *Variable Gains Mode* (**I19**) = 1 or 2.

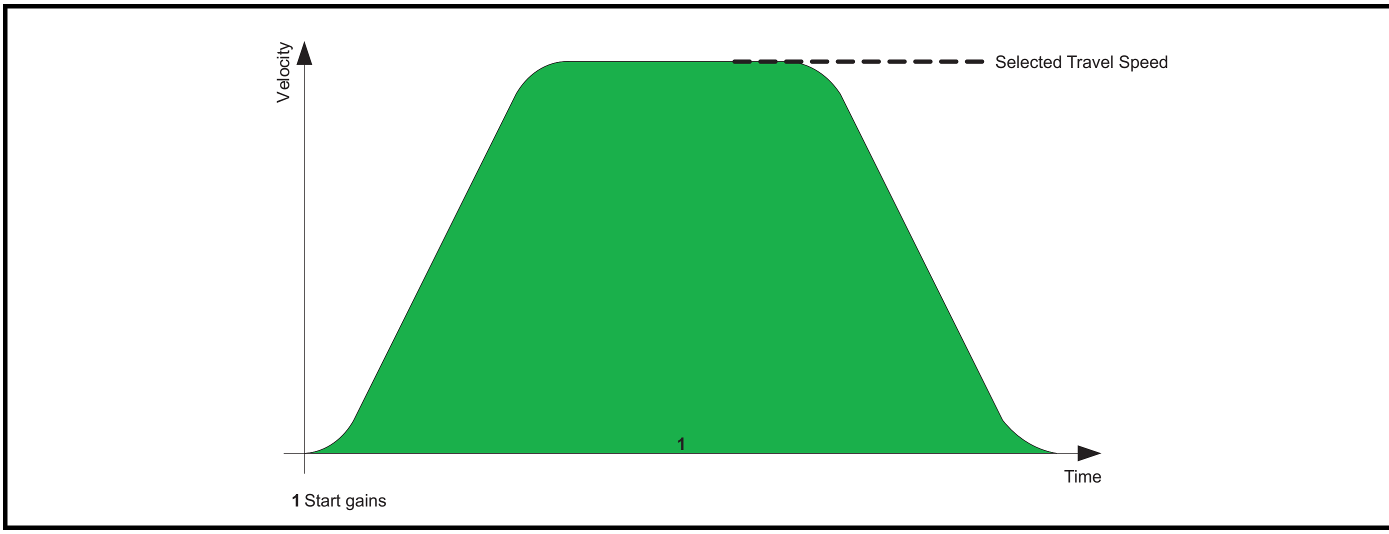
I18	Variable Gains Decel Transition Time		
Mode	Open-Loop, RFC A, RFC-S		
Minimum	0	**Maximum**	65535
Default	1000	**Units**	ms
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

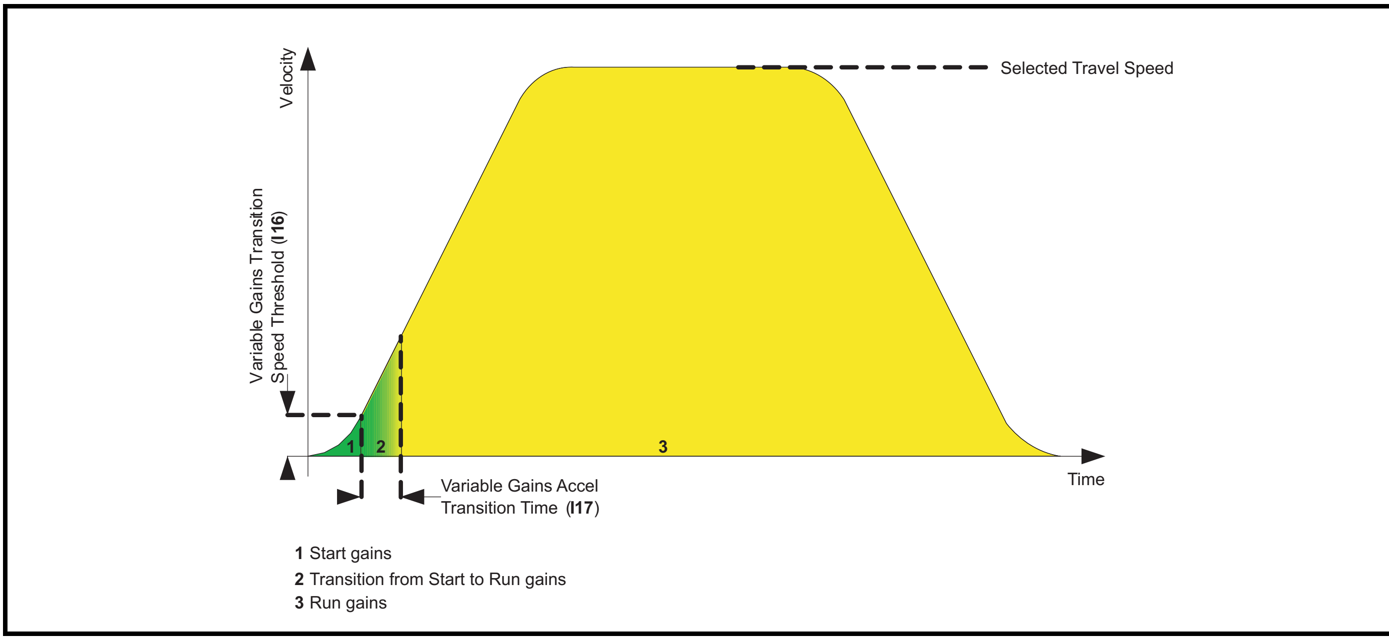
This sets the variable gains decel transition time in ms, used to set the ramp time when transitioning from running to stopping gains.
This parameter is only used when *Variable Gains Mode* (**I19**) = 2.

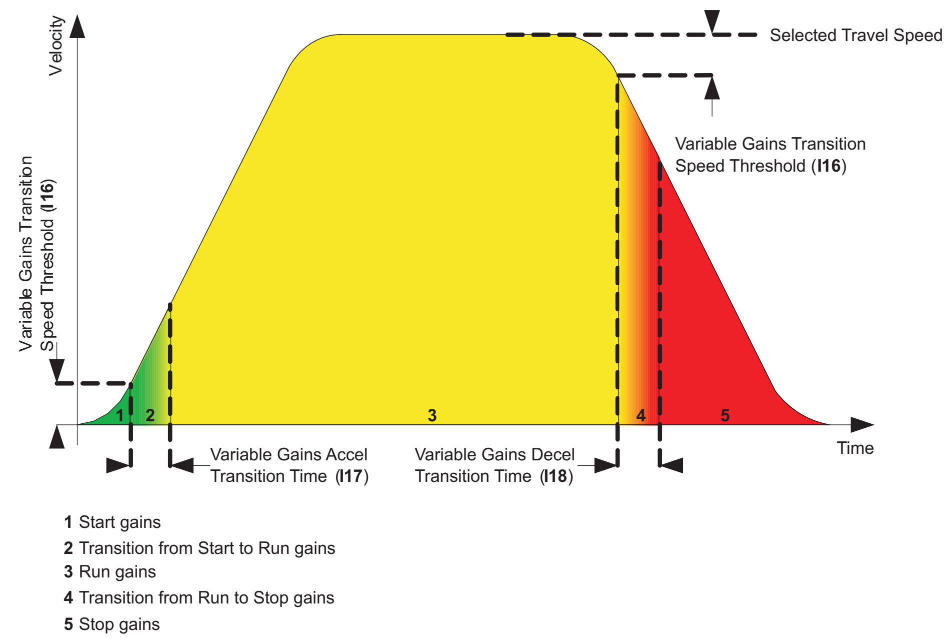
I19	Variable Gains Mode		
Mode	Open-Loop, RFC A, RFC-S		
Minimum	0	**Maximum**	2
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	Text
0	Start Only
1	Start+Run
2	Start+Run+Stop

This configures whether the Start, Stop or Run gains are used.
When set to 0, the start gains are used for the complete profile.


Velocity
Selected Travel Speed
1
Time
1 Start gains


Velocity
Selected Travel Speed
Variable Gains Transition Speed Threshold (**I16**)
1
2
3
Time
Variable Gains Accel Transition Time (**I17**)
1 Start gains
2 Transition from Start to Run gains
3 Run gains



I20	Start Lock Kp		
Mode	RFC A, RFC-S		
Minimum	0.000	**Maximum**	1000.000
Default	100.000	**Units**	
Type	32 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	3
Coding	RW		

Start Lock Kp (**I20**) is the proportional gain with units of (user units/s) / user unit. A *Start Lock Kp* (**I20**) of unity and a position error of one user unit will give a position control loop speed of 1 user unit/s.

I21	StartLock Kp Speed Clamp		
Mode	RFC A, RFC-S		
Minimum	0.000	**Maximum**	10000.000
Default	100.000	**Units**	mm/s
Type	32 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	3
Coding	RW		

This sets the position loop proportional gain speed clamp i.e. the maximum speed used to correct the motor position, used to hold the position of the motor when releasing the brake. This is used when *Start Lock Enable* (**I22**) = On (1).

I22	Start Lock Enable		
Mode	RFC A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When set to Off (0), position lock control is disabled.

When set to On (1), position lock control is enabled. The position loop is used to maintain the position of the motor on brake release. If a previous travel has been completed, the position of the motor after the brake has been applied but before the drive is disabled is stored and used as the set point position on the next start.

In Open loop mode this is not available.

Position locking *Start Lock Enable* (**I22**) must not be used at the same time as load cell compensation *Load Cell Compensation Enable* (**E10**).

I23	Start Lock Position Change Maximum		
Mode	RFC A, RFC-S		
Minimum	0.00	**Maximum**	2.55
Default	0.00	**Units**	%
Type	8 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	2
Coding	RW, BU		

This parameter is only used when *Start Lock Enable* (**I22**) = On (1).

When set to 0, this parameter disables movement compensation between when the mechanical brake is applied at the end of travel to when the torque is removed from the elevator motor.

When set > 1, this parameter enables compensation for the movement of the elevator motor shaft from when the mechanical brake is applied at the end of travel to when the torque is removed from the elevator motor. This gives a smooth transition of load from the mechanical brake to the motor on the next travel. The second function is to set a maximum limit for the position change that can be used in the compensation, which is expressed as a percentage of the diameter from 0.01 % to 2.55 %. This is to prevent a mechanical fault from introducing an excessive position change into the position controller. In the event that the position change for a travel was greater than *Start Lock Position Change Maximum* % (**I23**), the movement compensation is not used for the next travel but the position controller will still operate.

I24	Notch Filter Centre Frequency		
Mode	RFC A, RFC-S		
Minimum	50	**Maximum**	1000
Default	100	**Units**	Hz
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

A notch filter can be inserted be applied to the *Final Current Reference* (**J20**) to remove the effect of a mechanical resonance in the system. *Notch Filter Centre Frequency* (**I24**) defines the centre frequency (f_0) in Hertz and *Notch Filter Bandwidth* (**I25**) defines the bandwidth (f_{BW}) which is the frequency difference between the 3dB points of the notch filter in Hertz. The centre frequency should be set slightly below the resonant frequency of the mechanical load. The Q of the filter is given by $Q = f_0 / f_{BW}$. If *Notch Filter Bandwidth* (**I25**) is at its default value of zero, then the notch filter is disabled. It should be noted that although it is possible to set a bandwidth that is higher than half the centre frequency, the bandwidth of the filter is limited to half the centre frequency.

I25	Notch Filter Bandwidth		
Mode	RFC A, RFC-S		
Minimum	0	**Maximum**	500
Default	0	**Units**	Hz
Type	16 Bit User Save	**Update Rate**	Backround Read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Notch Filter Centre Frequency* (**I24**).

8.9 Menu J: Monitoring

Parameter		Range(⇕)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
J01	Drive Type	0 to 255						RO	Num	ND	NC	PT	
J03	Elevator Software State	0 to 14	0 to 3					RO	Num	ND	NC	PT	
J04	Firmware Version	0 to 99999999						RO	Num	ND	NC	PT	
J05	Maximum Heavy Duty Rating	0.000 to 99999.999 A						RO	Num	ND	NC	PT	
J06	Drive Full Scale Current Kc	0.000 to 99999.999 A						RO	Num	ND	NC	PT	
J07	Drive Rated Voltage	200V (0), 400V (1), 575V (2), 690V (3)						RO	Txt	ND	NC	PT	
J08	Drive Contol Mode Active	Open-loop (1), RFC-A (2), RFC-S (3), Regen (4)						RO	Txt	ND	NC	PT	US
J09	Reference Parameter Selected	0 to 10						RO	Num	ND	NC	PT	
J10	V1 Calculated Deceleration Distance	0 to 10000						RO	Num	ND	NC	PT	
J11	V2 Calculated Deceleration Distance	0 to 10000						RO	Num	ND	NC	PT	
J12	V3 Calculated Deceleration Distance	0 to 10000						RO	Num	ND	NC	PT	
J13	V4 Calculated Deceleration Distance	0 to 10000						RO	Num	ND	NC	PT	
J14	V5 Calculated Deceleration Distance	0 to 10000						RO	Num	ND	NC	PT	
J15	V6 Calculated Deceleration Distance	0 to 10000						RO	Num	ND	NC	PT	
J16	V7 Calculated Deceleration Distance	0 to 10000						RO	Num	ND	NC	PT	
J17	V8 Calculated Deceleration Distance	0 to 10000						RO	Num	ND	NC	PT	
J18	V9 Calculated Deceleration Distance	0 to 10000						RO	Num	ND	NC	PT	
J19	V10 Calculated Deceleration Distance	0 to 10000						RO	Num	ND	NC	PT	
J20	Final Current Reference	±VM_TORQUE_CURRENT %						RO	Num	ND	NC	PT	FI
J21	Final Current Limit	±VM_TORQUE_CURRENT %						RO	Num	ND	NC	PT	
J22	Total Output Current	±VM_DRIVE_CURRENT_UNIPOLAR A						RO	Num	ND	NC	PT	FI
J23	Percentage Load	±VM_USER_CURRENT %						RO	Num	ND	NC	PT	FI
J24	Torque Producing Current	±VM_DRIVE_CURRENT A						RO	Num	ND	NC	PT	FI
J25	Magnetizing Current	±VM_DRIVE_CURRENT A						RO	Num	ND	NC	PT	FI
J26	Motor Protection Accumulator	0.0 to 100.0 %						RO	Num	ND	NC	PT	PS
J27	Final Torque Reference	±VM_TORQUE_CURRENT %						RO	Num	ND	NC	PT	FI
J28	Final Current Filter Time Constant		0.0 to 25.0 ms			0.0 ms		RW	Num				US
J29	Open-Loop: Current Controller Kp Gain	0 to 30000			20			RW	Num				US
	RFC-A: Final Current Loop Kp		0 to 30000			150		RW	Num				US
	RFC-S: Final Current Loop Kp			0 to 30000			150	RW	Num				US
J30	Final Current Loop Ki	0 to 30000			40	2000		RW	Num				US
J31	Speed Error		±VM_SPEED					RO	Num	ND	NC	PT	FI
J32	Speed Loop Output		±VM_TORQUE_CURRENT %					RO	Num	ND	NC	PT	FI
J33	Final Speed Loop Kp		0.0000 to 200.0000 s/rad			0.0300 s/rad		RW	Num				US
J34	Final Speed Loop Ki		0.00 to 655.35 s²/rad			0.10 s²/rad		RW	Num				US
J35	Field Weakening Magnetizing Current	0 to 100 %						RO	Num	ND	NC	PT	
J36	Elevator Position		-2147483648 to 2147483647 mm					RO	Num	ND	NC	PT	
J37	Calculated Nominal Motor Speed rpm	0 to 32767 rpm						RO	Num	ND	NC	PT	
J38	Active Speed Setpoint	0 to 10000 mm/s						RO	Num	ND	NC	PT	
J39	Profile Speed	0 to 10000 mm/s						RO	Num	ND	NC	PT	
J40	Actual Speed		0 to 10000 mm/s					RO	Num	ND	NC	PT	
J41	Reference Acceleration	0 to 10000 mm/s²						RO	Num	ND	NC	PT	
J42	Deceleration Distance	0 to 32767 mm						RO	Num	ND	NC	PT	
J43	Deceleration Distance Calculated	0 to 10000 mm						RO	Num	ND	NC	PT	
J44	Deceleration Distance Measured	0 to 32767 mm						RO	Num	ND	NC	PT	
J45	Creep Distance Measured	0 to 32767 mm						RO	Num	ND	NC	PT	
J46	Speed At Floor Sensor Correction Active		0 to 32767 mm/s					RO	Num	ND	NC	PT	
J47	Remaining Floor Sensor Correction Distance		-32768 to 32767 mm					RO	Num	ND	NC	PT	
J48	Velocity Threshold 1 Status Output	Off (0) or On (1)						RO	Bit	ND	NC	PT	
J49	Velocity Threshold 2 Status Output	Off (0) or On (1)						RO	Bit	ND	NC	PT	
J50	Final Speed Reference		±VM_SPEED					RO	Num	ND	NC	PT	FI
J51	Speed Feedback		±VM_SPEED					RO	Num	ND	NC	PT	FI
J52	Drive Encoder Revolutions		0 to 65535					RO	Num	ND	NC	PT	PS

Parameter		Range(⇕)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
J53	Drive Encoder Position		0 to 65535					RO	Num	ND	NC	PT	PS
J54	Drive Encoder Fine Position		0 to 65535					RO	Num	ND	NC	PT	
J55	Sensorless Mode Position		-2147483648 to 2147483647					RO	Num	ND	NC	PT	
J56	Maximum Distance Error		0 to 10000 mm					RO	Num	ND	NC	PT	
J57	Maximum Speed Error		0 to 10000 mm/s					RO	Num	ND	NC	PT	
J58	Travel Counter	-2147483648 to 2147483647						RW	Num	ND	NC	PT	PS
J59	Output Power	±VM_POWER kW						RO	Num	ND	NC	PT	FI
J60	Output Frequency	±VM_SPEED_ FREQ_REF Hz	±2000.0 Hz					RO	Num	ND	NC	PT	FI
J61	Output Voltage	±VM_AC_VOLTAGE V						RO	Num	ND	NC	PT	FI
J62	Last Travel Maximum Power	0.000 to 32.767 kW						RO	Num	ND	NC	PT	
J63	Last Travel Maximum Motor Voltage	0 to 32767 V						RO	Num	ND	NC	PT	
J64	Last Travel Maximum Current	0.000 to 32.767 A						RO	Num	ND	NC	PT	
J65	D.c. Bus Voltage	±VM_DC_VOLTAGE V						RO	Num	ND	NC	PT	FI
J66	Internal IO Identifier	0 to 255						RO	Num	ND	NC	PT	
J67	Encoder Feedback Interface Identifier	0 to 255						RO	Num	ND	NC	PT	
J68	Menu Access Status	Menu 0 (0), All Menus (1)						RO	Txt	ND	NC	PT	PS
J69	Enable Conditions	000000000000 to 111111111111						RO	Bin	ND	NC	PT	
J70	Drive Event Flags	00 to 11			00			RW	Bin		NC		
J71	Monitored Temperature 1	±250 °C						RO	Num	ND	NC	PT	
J72	Monitored Temperature 2	±250 °C						RO	Num	ND	NC	PT	
J73	Monitored Temperature 3	±250 °C						RO	Num	ND	NC	PT	
J74	Monitor Temperature Select 1	0 to 1999			1001			RW	Num				US
J75	Monitor Temperature Select2	0 to 1999			1002			RW	Num				US
J76	Monitor Temperature Select 3	0 to 1999			1			RW	Num				US
J77	Inverter Temperature	±250 °C						RO	Num	ND	NC	PT	
J78	Percentage Of DC Link Thermal Trip Level	0 to 100 %						RO	Num	ND	NC	PT	
J79	Percentage Of Drive Thermal Trip Level	0 to 100 %						RO	Num	ND	NC	PT	
J80	Date	00-00-00 to 31-12-99						RW	Date	ND	NC	PT	
J81	Time	00:00:00 to 23:59:59						RW	Time	ND	NC	PT	
J82	Day Of Week	Sunday (0), Monday (1), Tuesday (2), Wednesday (3), Thursday (4), Friday (5), Saturday (6)						RO	Txt	ND	NC	PT	
J83	Date And Time Offset	±24.00 Hours			0.00 Hours			RW	Num				US
J84	Energy Meter: MWh	±999.9 MWh						RO	Num	ND	NC	PT	PS
J85	Energy Meter: kWh	±99.99 kWh						RO	Num	ND	NC	PT	PS
J86	Energy Cost Per kWh	0.0 to 600.0			0.0			RW	Num				US
J87	Running Cost kWh	±32000						RO	Num	ND	NC	PT	
J88	Drive Date Code	0 to 65535						RO	Num	ND	NC	PT	
J89	Serial Number LS	000000000 to 999999999						RO	Num	ND	NC	PT	
J90	Serial Number MS	0 to 999999999						RO	Num	ND	NC	PT	
J91	Drive Identifier Characters	1160982576 to 2147483647						RO	Num	ND	NC	PT	
J92	Drive Identifier Rating And Configuration	00000000 to 99999999						RO	Num	ND	NC	PT	
J93	Extra Identifier Characters 1	-2147483648 to 2147483647						RO	Num	ND	NC	PT	
J94	Extra Identifier Characters 2	-2147483648 to 2147483647						RO	Num	ND	NC	PT	
J95	Extra Identifier Character 3	-2147483648 to 2147483647						RO	Num	ND	NC	PT	
J96	Drive Derivative	0 to 255						RO	Num	ND	NC	PT	
J97	A3 Velocity Threshold Status Output		Off (0) or On (1)					RO	Bit	ND	NC	PT	

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Mode: Open-Loop (where specified), RFC A, RFC-S

J01	Drive Type		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Power-up write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

Drive Type (**J01**) shows the core product type as given in the table below. The drive could be the basic product or a derivative of the basic product defined by *Drive Derivative* (**J96**).

Drive Type (J01)	Core product range
2	Elevator drive

J03	Elevator Software State		
Mode	Open-Loop		
Minimum	0	**Maximum**	14
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This indicates the elevator software state number for the elevator state machine.

J03 Elevator software state	Description
0	**Idle (wait for travel request):**

To exit the idle state the following conditions need to be met:

- Drive OK parameter *Drive OK* (**L05**) = On (1)
- A speed reference has been selected and a direction input has been received (if dual direction inputs are used) **OR**
- A speed reference has been selected if single direction input is used. **OR**
- If the enable and Fast disable (if used) are received (speed and direction not required)

Provided brake contact and *Motor Contactor Monitoring Enable* (**B29**) = On (1), and none of the above conditions are true, check the state of *Motor Contactor Monitoring Input* (**B30**) and the brake contact and generate trips if they are in the incorrect state. The motor contactors should be open, but if it is closed generate Trip 71 (**Mot con Closd**) indicating an incorrect state. The brake contact should be open, but if it is closed and *Brake Contact Monitoring Select* (**D11**) > 0, generate Trip 73 (**Brk con 1 closd**) and Trip 75 (**Brk con 2 closd**) indicating an incorrect state.

Force all contactor and control outputs to Off (0) while a travel is not requested i.e. brake and motor contactor.

On exit from state 0:

- Sample the autotune selection parameter *Motor Autotune* (**B11**).

Exit to state 1:

- If the speed / direction signal starts the travel.

On exit to state 1:

- Sample the start time for the Safe Torque Off and Fast disable inputs (if used). Used to call *Trip 65* (**Fast disable err**) and *Trip 66* (**STO ctrl err**) (time from the command to close the motor contactors to close to receive the Safe Torque Off **OR** Safe Torque Off and Fast disable (if used).
- Close the motor contactors via *Motor Contactor Control Output* (**B31**).

Exit to state 2:

- If Safe Torque Off (STO) and Fast disable starts the travel.

1	Wait for Safe Torque Off (STO), Drive enable:

Wait for the Safe Torque Off and Fast disable inputs. When the Safe Torque Off and Fast disable inputs are received, sample the time and move to the next state. Time is used to de-bounce the motor contactors.
It is assumed that the Safe Torque Off and Fast disable are either directly electrically connected to the motor contactors auxiliary feedback (24V signal) or a buffered version of it. In systems with a "no contactor" solution the Safe Torque Off and Fast disable are derived from the system motor safety relays.

If the enable is not received within 6 s - generate *Trip 65* (**Fast disable err**) /*Trip 66* (**STO ctrl err**) as appropriate. Generate *Trip 65* (**Fast disable err**) if *Fast Disable* (**B27**) and Safe Torque Off are not received in time, or *Trip 66* (**STO ctrl err**) if Safe Torque Off is not received in time.

If *Motor Contactor Monitoring Enable* (**B29**) = On (1), and *Motor Contactor Monitoring Input* (**B30**) = Off (0) after 6 s, *Trip 70* (**Mot con open**) indicating the motor contactors should be closed.

Exit to state 2:

- When Safe Torque Off and Fast disable (if used) inputs are received.

Exit to state 14:

- If digital speed selection is removed
- If direction signal is removed (dual direction inputs)
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed
- If an autotune completes
- If the drive trips

2	De-bounce output motor contactors:

Wait until 100 ms has elapsed to de-bounce the motor contactors. This prevents the drive from being enabled while the motor contactors bounce when closing which could cause an ***OI ac*** trip.

Exit to state 3:
- When the motor contactors de-bounce delay is completed.

On exit to state 3:
- Sample the final load cell compensation torque value to provide as a torque feed forward reference if *Load Cell Compensation Enable* (**E10**) = On (1).

Exit to state 14:
- If digital speed selection is removed
- If direction signal is removed (dual direction inputs)
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed
- If an autotune completes
- If the drive trips

3	Ramp torque producing current limit and position lock:

Ramp Torque Producing Current (**J24**) to full limit over the *Motor Torque Ramp Time* (**D02**) in ms.

The brake controller is engaged once the torque ramp has completed. When *Brake Control Output* (**D03**) = On transition to state 4. This checks that the motor is magnetized, and for open loop that the minimum starting frequency has been reached.

If *Start Lock Enable* (**I22**) =1, enable the position loop, and if at least 1 travel has been completed, prime the position loop with the position of the motor when the brake was closed but before the drive is disabled and the *Torque Producing Current* (**J24**) ramped to 0, from the previous travel.
If the autotune value sampled on exit from state 0 is > 0 then apply the run signal in the direction specified by the CW / CCW terminals.
For open loop operation, the start optimizer parameters are applied and motion controller enabled before the brake is released to provide holding torque on start.

Exit to state 4:
- *Brake Control Output* (**D03**) = On (1) **AND**
- When the torque producing current limit has been ramped to *Symmetrical Current Limit* (**B16**).
- If an Autotune >=2 <=5 is in progress to release the brake.

On exit to state 4:
- Sample the start time for brake release.

Exit to state 13:
- If digital speed selection is removed
- If direction signal is removed (dual direction inputs)
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed
- If an autotune completes
- If the drive trips
- If the brake controller takes longer than 6 s to complete.

4 — Release the brake:

Release the brake, and after *Brake Control Release Delay* (**DO4**) ms, consider that the brake is released. If *Brake Contact Monitoring Select* (**D11**) > 0, then when the brake contact feedback is received exit to state 5 and bypass the *Brake Control Release Delay* (**DO4**).

Exit to state 5:
- If the drive is in a closed loop mode **AND**
- When the brake release time must has elapsed, **OR**
- If *Brake Contact Monitoring Select* (**D11**) > 0, the brake contact feedback via *Brake Contact Monitoring Input 1* (**D12**) and *Brake Contact Monitoring Input 2* (**D13**) must both be set to On (1), indicating that the brake contact is closed i.e. the brake is released.

On exit to state 5:
- If *Load Cell Compensation Enable* (**E10**) =1, disable the position loop by ramping the *Start Lock P Gain Speed Clamp* (**I21**) to 0, in order to smoothly pass the load to the speed loop.

Exit to state 6:
- If the drive is in open loop mode and digital speed references are selected **AND**
- When the brake release time has elapsed, **OR**
- If *Brake Contact Monitoring Select* (**D11**) > 0, the brake contact feedback via *Brake Contact Monitoring Input 1* (**D12**) and *Brake Contact Monitoring Input 2* (**D13**) must both be set to On (1), indicating that the brake contact is closed i.e. the brake is released.

Exit to state 8:
- If analog reference mode is selected, (*Control Input Mode* (**H11**) = 0 or 1) to indicate that we are travelling based on the analog speed reference. **AND**
- When the brake release time has elapsed, **OR**
- If *Brake Contact Monitoring Select* (**D11**) > 0, the brake contact feedback via *Brake Contact Monitoring Input 1* (**D12**) and *Brake Contact Monitoring Input 2* (**D13**) must both be set to On (1), indicating that the brake contact is closed i.e. the brake is released.

Exit to state 12:
- If digital speed selection is removed
- If direction signal is removed (dual direction inputs)
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed
- If an autotune completes
- If the drive trips

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load/direction accumulator for rescue operation

5 — Load measurement:

Accumulate *Torque Producing Current* (**J24**) and time for the rescue *Load Measurement Time* (**O04**) in ms. This is for determination of the load direction and magnitude for rescue operation.

This state is not used in open loop mode.

Exit to state 6:
- When *Load Measurement Time* (**O04**) has elapsed and *Start Optimizer Time* (**G48**) > 0

Exit to state 7:
- When *Load Measurement Time* (**O04**) has elapsed and *Start Optimizer Time* (**G48**) > 0

On exit to state 7:
- Apply the selected speed, accel start jerk, accel end jerk, decel start jerk and decel end jerk.
- Apply the main elevator profile accel and decel rate.
- If *Start Lock Enable* (**I22**) =1, disable the position loop by ramping the *Start Lock P Gain Speed Clamp* (**I21**) to 0, in order to smoothly pass the load to the speed loop.

Exit to state 12:
- If the digital speed selection is removed or the Safe Torque Off (STO), Drive enable and Fast disable input (if used) is removed or the drive trips, or the digital direction signal is removed in dual direction input mode), transition to state 12 to apply the brake.

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load / direction accumulator for rescue operation

6	Starting:

- Apply the start optimization speed and Jerk when *Start Optimizer Time* (**G48**) > 0).
- Apply the main elevator profile accel and decel rate.
- If Position lock enable = 1, disable the position loop by ramping the *Start Lock P Gain Speed Clamp* (**I21**) to 0, in order to smoothly pass the load to the speed loop.

This state is not used in open loop mode.

Exit to state 7:
- When the *Start Optimizer Time* (**G48**) has elapsed. The time may be set to 0 effectively bypassing this state.

On exit to state 7:
- Apply the selected speed, accel start jerk, accel end jerk, decel start jerk and decel end jerk.

Exit to state 9:
- If the digital speed selection is removed or the direction signal is removed (in dual direction input mode), transition to state 9 to decelerate the elevator car.

Exit to state 12:
- If the digital speed selection is removed or the Safe Torque Off (STO), Drive enable and Fast disable input (if used) is removed or the drive trips, or the digital direction signal is removed (in dual direction input mode), transition to state 12 to apply the brake.

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load / direction accumulator for rescue operation

7	Accelerating:

Remain in this state until constant speed is reached, or we begin to decelerate because a digital speed signal has been removed.

New target speeds that are ≥ *V2 Speed Reference* (**G02**), will be accepted and will become the new target speed. This type of speed selection is only recommended for commissioning where the elevator speeds must be tested.

Exit to state 8:
- When constant speed is reached

Exit to state 9:
- If the digital speed selection is removed or the direction signal is removed (in dual direction input mode), transition to state 9 to decelerate the elevator car. Where the direction signal is removed in dual direction mode profile will decelerate to a stop wherever it happens to be i.e. no use of Creep speed, in Creep to floor, no position control in Direct to floor OR
- If Creep to floor is selected (Elevator control mode = Off (0)) and creep speed is selected.

On exit to state 9:
- Apply Creep speed, if creep to floor is selected (Elevator control mode = Off (0)) and creep speed is selected, OR
- Switch to position control and profile to zero speed in Direct to Floor (Elevator control mode = On (1)).

Exit to state 12:
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed or the drive trips, go to state 12 to apply the brake.

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load / direction accumulator for rescue operation

8	Travelling:

Remain in this state until a speed signal is removed i.e. transition to Creep speed, in Creep to floor or zero speed in Direct to floor.

Exit to state 7:
- If a new target speed is selected.

Exit to state 9:
- If the digital speed selection is removed or the direction signal is removed in dual direction input mode), transition to state 9 to decelerate the elevator car. Where the direction signal is removed in dual direction mode profile will decelerate to a stop wherever it happens to be i.e. no Creep speed, in Creep to floor, no position control in Direct to floor

On exit to state 9:
- Creep speed, if Creep to floor is selected (Elevator control mode = Off (0)) and
- Switch to position control and profile to zero speed in Direct to Floor (Elevator control mode = On (1)).

Exit to state 12:

- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed or the drive trips, go to state 12 to apply the brake.
- If analog reference mode is selected, Control input mode = -0 or 1) and the direction input is removed.

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load / direction accumulator for rescue operation

9	Decelerating:

Exit to state 10:
- If Creep to floor is selected (Elevator control mode = Off (0)) and when Creep speed is reached.

For Creep to floor exit to state 10, for Direct to floor exit to state 12.

On exit to state 10:
- Apply the final positioning jerk

Exit to state 12:
- If Direct to Floor is selected (Elevator control mode = On (1)) when the positioning profile has completed i.e. zero speed.
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed or the drive trips, go to state 12 and apply the brake.
-

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load / direction accumulator for rescue operation.

10	Creep:

In this state the profile will run at Creep speed (*V1 Speed Reference* (**G01**)) by default, but can be any speed reference.

This state is not used if (Elevator control mode = On (1)) i.e. Direct to floor mode is selected.

Exit to state 11:
- When Creep speed is deselected OR
- When the floor sensor correction input is given

On exit to state 11:
- Apply *Creep Stop Deceleration Rate* (**G17**) and *Creep Stop Jerk* (**G18**)

Exit to state 12:
- If Direct to Floor is selected (Elevator control mode = On (1)) when the positioning profile has completed i.e. zero speed.
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed or the drive trips, go to state 12 to apply the brake.

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load / direction accumulator for rescue operation

11	Positioning.

Wait for zero speed if a normal creep stop is used i.e. no floor sensor correction. If floor sensor correction is used use the creep stop profile distance as the distance to floor and position correct to a stop.

Exit to state 12:
- When zero speed is reached i.e. motion profile is complete.
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed or the drive trips, go to state 12 to apply the brake.

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load / direction accumulator for rescue operation

12	Apply the brake:

Set *Brake Control Output* (**D03**) = Off (0) and wait *Motor Torque Ramp Time* (**D02**) ms for the brake to be applied. For systems where the brake control is implemented in the elevator controller *Brake Control Output* (**D03**) may be used to indicate when to apply / release the brake.

Exit to state 13:
- If *Brake Contact Monitoring Select* (**D11**) > 0, and this takes longer than *Brake Contact Monitoring Time* (**D14**), generate a *Trip 73* (**Brk con 1 closd)** / *Trip 75* (**Brk con 2 closd**).
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed or the drive trips

13	Ramp the torque down:

Sample the motor encoder position, and then ramp the Torque producing current to 0% in the time specified by Motor Torque Ramp Time (**D02**) in ms. When the ramp has completed move to the next state.

Don't sample the position if the previous state was < 6

Exit to state 14:
- When the torque producing current limit has been ramped to 0 using the Motor torque ramp time via *Symmetrical Current Limit* (**B16**) and *Motor Torque Ramp Time* (**D02**)
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed or the drive trips

On exit to state 14:
- Sample the time on exit for use to detect a feedback issue with the motor contactors, or a Safe Torque Off (STO), Drive enable and Fast disable input (if used) issue.
- Disable the drive via and remove the run signal.

14	Contactor control

Generate motor contactor control output.

Exit to state 0:

- *Fast Disable* (**B27**) = Off (0) AND
- T*otal Output Current* (**J22**) ≤ 25 % of rated current AND
- F10 *T31 STO Input 1 State* (**F10**)= Off (0) AND
- There is no digital speed signal present (if used) AND
- There is no direction signal present (in dual direction signal mode) AND
- The Fast disable input (if used) = Off (0) OR
- The drive trips

The following error detection is made in this state after 4 s. The list is in order of priority:

1. If *Motor Contactor Monitoring Enable* (**B29**)= On (1), and it takes > 4 s for the monitoring input to be set to 0, generate a *Trip 71* (**Mot con closd**).
2. If the *Fast Disable* (**B27**) input terminal = On (1), then generate *Trip 65* (**Fast disable err**).
3. If the F10 *T31 STO Input 1 State* (**F10**) = On 1, then generate *Trip 66* (**STO Ctrl err**).
4. If the total current is > 25 % of rated, then generate *Trip 67* (**Current on stop**).

J04	Firmware Version		
Mode	RFC-A		
Minimum	0	**Maximum**	99999999
Default		**Units**	A
Type	32 Bit Volatile	**Update Rate**	Power-up write
Display Format	Version	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Firmware Version (**J04**) displays the drive software version number as a decimal number wwxxyyzz. A keypad will display the value in this parameter as ww.xx.yy.zz.

J05	Maximum Heavy Duty Rating		
Mode	RFC-A		
Minimum	0.000	**Maximum**	99999.999
Default		**Units**	A
Type	32 Bit Volatile	**Update Rate**	Power-up write
Display Format	Standard	**Decimal Places**	3
Coding	RO, ND, NC, PT		

Maximum Heavy Duty Rating (**J05**) defines the maximum setting for *Motor Rated Current* (**B02**) that gives heavy duty operation. If *Maximum Heavy Duty Rating* (**J05**) = 0.000 then heavy duty operation is not possible. If *Maximum Heavy Duty Rating* (**J05**) = VM_RATED_CURRENT[MAX] then normal duty operation is not possible.

J06	Drive Full Scale Current Kc		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.000	**Maximum**	99999.999
Default		**Units**	A
Type	32 Bit Volatile	**Update Rate**	Power-up write
Display Format	Standard	**Decimal Places**	3
Coding	RO, ND, NC, PT		

Drive Full Scale Current Kc (**J06**) shows the full scale current in rms Amps. If the drive current exceeds this level it will cause an over current trip.

J07	Drive Rated Voltage		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	3
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Power-up write
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT		

Value	Text
0	200 V
1	400 V
2	575 V
3	690 V

Drive Rated Voltage (**J07**) shows the voltage rating of the drive.

J08	Drive Control Mode Active		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	4
Default		**Units**	
Type	8 Bit User Save	**Update Rate**	Background read/ write
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT		

Value	Text
1	Open-loop
2	RFC-A
3	RFC-S

Drive Control Mode Active (**J08**) is used to hold the currently active drive mode.

J09	Reference Parameter Selected		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This indicates the speed reference currently selected as the speed reference set point from V1 to V11 e.g. 1 = *V1 Speed Reference* (**G01**). If V11is selected this shows that an analog reference is selected, *Control Input mode* (**H11**) = Analog Run Prmit or Analog Dir (0 or 1). A value of 0 means no speed is currently selected.

J10	V1 Calculated Deceleration Distance		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

When V1 is the creep speed in creep to floor mode:

When *Creep Speed Select* (**G52**) = V1 (1) this shows the distance from *V1 Speed Reference* (**G01**) to a stop in mm. The distance is calculated from *V1 Speed Reference* (**G01**), *Creep Stop Deceleration Rate* (**G17**), and *Creep Stop Jerk* (**G18**).

When V1 is not the creep speed in creep to floor mode:

This indicates the distance from *V1 Speed Reference* (**G01**) to the creep speed defined by *Creep Speed Select* (**G52**) in mm. The distance is calculated from *V1 Speed Reference* (**G01**), the creep speed defined by *Creep Speed Select* (**G52**), *Deceleration Rate* (**G12**), *Run Jerk 3* (**G15**) and *Run Jerk 4* (**G16**).

Direct to floor:

In Direct to floor, *Elevator Control Mode* (**H19**) = Direct To Floor (1), this indicates the distance from V1 Speed Reference (**G01**) to a stop in mm. The distance is calculated from V1 Speed Reference (**G01**), Deceleration Rate (**G12**), Run Jerk 3 (**G15**) and Run Jerk 4 (**G16**).

J11	V2 Calculated Deceleration Distance		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

When V2 is the creep speed in creep to floor mode:

When *Creep Speed Select* (**G52**) = V2 (2) this shows the distance from *V2 Speed Reference* (**G02**) to a stop in mm. The distance is calculated from *V2 Speed Reference* (**G02**), *Creep Stop Deceleration Rate* (**G17**), and *Creep Stop Jerk* (**G18**).

When V2 is not the creep speed in creep to floor mode:

This indicates the distance from *V2 Speed Reference* (**G02**) to the creep speed defined by *Creep Speed Select* (**G52**) in mm. The distance is calculated from *V2 Speed Reference* (**G02**), the creep speed defined by *Creep Speed Select* (**G52**), *Deceleration Rate* (**G12**), *Run Jerk 3* (**G15**) and *Run Jerk 4* (**G16**).

Direct to floor:

In Direct to floor, *Elevator Control Mode* (**H19**) = Direct To Floor (1), this indicates the distance from V2 Speed Reference (**G02**) to a stop in mm. The distance is calculated from V2 Speed Reference (**G02**), Deceleration Rate (**G12**), Run Jerk 3 (**G15**) and Run Jerk 4 (**G16**).

J12	V3 Calculated Deceleration Distance		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

When V3 is the creep speed in creep to floor mode:

When *Creep Speed Select* (**G52**) = V3 (3) this shows the distance from *V3 Speed Reference* (**G03**) to a stop in mm. The distance is calculated from *V3 Speed Reference* (**G03**), *Creep Stop Deceleration Rate* (**G17**), and *Creep Stop Jerk* (**G18**).

When V3 is not the creep speed in creep to floor mode:

This indicates the distance from *V3 Speed Reference* (**G03**) to the creep speed defined by *Creep Speed Select* (**G52**) in mm. The distance is calculated from *V3 Speed Reference* (**G03**), the creep speed defined by *Creep Speed Select* (**G52**), *Deceleration Rate* (**G12**), *Run Jerk 3* (**G15**) and *Run Jerk 4* (**G16**).

Direct to floor:

In Direct to floor, *Elevator Control Mode* (**H19**) = Direct To Floor (1), this indicates the distance from V3 Speed Reference (**G03**) to a stop in mm. The distance is calculated from V3 Speed Reference (**G03**), Deceleration Rate (**G12**), Run Jerk 3 (**G15**) and Run Jerk 4 (**G16**).

J13	V4 Calculated Deceleration Distance		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

When V4 is the creep speed in creep to floor mode:

When *Creep Speed Select* (**G52**) = V4 (4) this shows the distance from *V4 Speed Reference* (**G04**) to a stop in mm. The distance is calculated from *V4 Speed Reference* (**G04**), *Creep Stop Deceleration Rate* (**G17**), and *Creep Stop Jerk* (**G18**).

When V4 is not the creep speed in creep to floor mode:

This indicates the distance from *V4 Speed Reference* (**G04**) to the creep speed defined by *Creep Speed Select* (**G52**) in mm. The distance is calculated from *V4 Speed Reference* (**G04**), the creep speed defined by *Creep Speed Select* (**G52**), *Deceleration Rate* (**G12**), *Run Jerk 3* (**G15**) and *Run Jerk 4* (**G16**).

Direct to floor:

In Direct to floor, *Elevator Control Mode* (**H19**) = Direct To Floor (1), this indicates the distance from V4 Speed Reference (**G04**) to a stop in mm. The distance is calculated from V4 Speed Reference (**G04**), Deceleration Rate (**G12**), Run Jerk 3 (**G15**) and Run Jerk 4 (**G16**).

J14	V5 Calculated Deceleration Distance		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

When V5 is the creep speed in creep to floor mode:

When *Creep Speed Select* (**G52**) = V5 (5) this shows the distance from *V5 Speed Reference* (**G05**) to a stop in mm. The distance is calculated from *V5 Speed Reference* (**G05**), Creep Stop Deceleration Rate (**G17**), and *Creep Stop Jerk* (**G18**).

When V5 is not the creep speed in creep to floor mode:

This indicates the distance from *V5 Speed Reference* (**G05**) to the creep speed defined by *Creep Speed Select* (**G52**) in mm. The distance is calculated from *V5 Speed Reference* (**G05**), the creep speed defined by *Creep Speed Select* (**G52**), *Deceleration Rate* (**G12)**, *Run Jerk 3* (**G15**) and *Run Jerk 4* (**G16**).

Direct to floor:

In Direct to floor, *Elevator Control Mode* (**H19**) = Direct To Floor (1), this indicates the distance from V5 Speed Reference (**G05**) to a stop in mm. The distance is calculated from V5 Speed Reference (**G05**), Deceleration Rate (**G12**), Run Jerk 3 (**G15**) and Run Jerk 4 (**G16**).

J15	V6 Calculated Deceleration Distance		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

When V6 is the creep speed in creep to floor mode:

When *Creep Speed Select* (**G52**) = V6 (6) this shows the distance from *V6 Speed Reference* (**G06**) to a stop in mm. The distance is calculated from *V6 Speed Reference* (**G06**), *Creep Stop Deceleration Rate* (**G17**), and *Creep Stop Jerk* (**G18**).

When V6 is not the creep speed in creep to floor mode:

This indicates the distance from *V6 Speed Reference* (**G06**) to the creep speed defined by *Creep Speed Select* (**G52**) in mm. The distance is calculated from *V6 Speed Reference* (**G06**), the creep speed defined by *Creep Speed Select* (**G52**), *Deceleration Rate* (**G12**), *Run Jerk 3* (**G15**) and *Run Jerk 4* (**G16**).

Direct to floor:

In Direct to floor, *Elevator Control Mode* (**H19**) = Direct To Floor (1), this indicates the distance from V6 Speed Reference (**G06**) to a stop in mm. The distance is calculated from V6 Speed Reference (**G06**), Deceleration Rate (**G12**), Run Jerk 3 (**G15**) and Run Jerk 4 (**G16**).

J16	V7 Calculated Deceleration Distance		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

When V7 is the creep speed in creep to floor mode:

When *Creep Speed Select* (**G52**) = V7 (7) this shows the distance from *V7 Speed Reference* (**G07**) to a stop in mm. The distance is calculated from *V7 Speed Reference* (**G07**), *Creep Stop Deceleration Rate* (**G17**), and *Creep Stop Jerk* (**G18**).

When V7 is not the creep speed in creep to floor mode:

This indicates the distance from *V7 Speed Reference* (**G07**) to the creep speed defined by *Creep Speed Select* (**G52**) in mm. The distance is calculated from *V7 Speed Reference* (**G07**), the creep speed defined by *Creep Speed Select* (**G52**), *Deceleration Rate* (**G12**), *Run Jerk 3* (**G15**) and *Run Jerk 4* (**G16**).

Direct to floor:

In Direct to floor, *Elevator Control Mode* (**H19**) = Direct To Floor (1), this indicates the distance from V7 Speed Reference (**G07**) to a stop in mm. The distance is calculated from V Speed Reference (**G07**), Deceleration Rate (**G12**), Run Jerk 3 (**G15**) and Run Jerk 4 (**G16**).

J17	**V8 Calculated Deceleration Distance**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

When V8 is the creep speed in creep to floor mode:

When *Creep Speed Select* (**G52**) = V8 (8) this shows the distance from *V8 Speed Reference* (**G08**) to a stop in mm. The distance is calculated from *V8 Speed Reference* (**G08**), *Creep Stop Deceleration Rate* (**G17**), and *Creep Stop Jerk* (**G18**)

When V8 is not the creep speed in creep to floor mode:

This indicates the distance from *V8 Speed Reference* (**G08**) to the creep speed defined by *Creep Speed Select* (**G52**) in mm. The distance is calculated from *V8 Speed Reference* (**G08**), the creep speed defined by *Creep Speed Select* (**G52**), *Deceleration Rate* (**G12**), *Run Jerk 3* (**G15**) and *Run Jerk 4* (**G16**).

Direct to floor:

In Direct to floor, *Elevator Control Mode* (**H19**) = Direct To Floor (1), this indicates the distance from V8 Speed Reference (**G08**) to a stop in mm. The distance is calculated from V8 Speed Reference (**G08**), Deceleration Rate (**G12**), Run Jerk 3 (**G15**) and Run Jerk 4 (**G16**).

J18	**V9 Calculated Deceleration Distance**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

When V9 is the creep speed in creep to floor mode:

When *Creep Speed Select* (**G52**) = V9 (9) this shows the distance from *V9 Speed Reference* (**G09**) to a stop in mm. The distance is calculated from *V9 Speed Reference* (**G09**), *Creep Stop Deceleration Rate* (**G17**), and *Creep Stop Jerk* (**G18**)

When V9 is not the creep speed in creep to floor mode:

This indicates the distance from *V9 Speed Reference* (**G09**) to the creep speed defined by *Creep Speed Select* (**G52**) in mm. The distance is calculated from *V9 Speed Reference* (**G09**), the creep speed defined by *Creep Speed Select* (**G52**), *Deceleration Rate* (**G12**), *Run Jerk 3* (**G15**) and *Run Jerk 4* (**G16**).

Direct to floor:

In Direct to floor, *Elevator Control Mode* (**H19**) = Direct To Floor (1), this indicates the distance from V9 Speed Reference (**G09**) to a stop in mm. The distance is calculated from V9 Speed Reference (**G09**), Deceleration Rate (**G12**), Run Jerk 3 (**G15**) and Run Jerk 4 (**G16**).

J19	**V10 Calculated Deceleration Distance**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

When V10 is the creep speed in creep to floor mode:

When *Creep Speed Select* (**G52**) = V10 (10) this shows the distance from *V10 Speed Reference* (**G10**) to a stop in mm. The distance is calculated from *V10 Speed Reference* (**G10**), *Creep Stop Deceleration Rate* (**G17**), and *Creep Stop Jerk* (**G18**)

When V10 is not the creep speed in creep to floor mode:

This indicates the distance from *V10 Speed Reference* (**G10**) to the creep speed defined by *Creep Speed Select* (**G52**) in mm. The distance is calculated from *V10 Speed Reference* (**G10**), the creep speed defined by *Creep Speed Select* (**G52**), *Deceleration Rate* (**G12**), *Run Jerk 3* (**G15**) and *Run Jerk 4* (**G16**).

In Direct to floor, *Elevator Control Mode* (**H19**) = Direct To Floor (1), this indicates the distance from V10 Speed Reference (**G10**) to a stop in mm. The distance is calculated from V10 Speed Reference (**G10**), Deceleration Rate (**G12**), Run Jerk 3 (**G15**) and Run Jerk 4 (**G16**).

J20	**Final Current Reference**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	−VM_TORQUE_CURRENT	**Maximum**	VM_TORQUE_CURRENT
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	1
Coding	RO, FI, VM, ND, NC, PT		

The *Final Torque Reference* (**J27**) is converted into the *Final Current Reference* (**J20**) by applying a torque to current conversion and by applying the *Final Current Limit* (**J21**). The torque to current conversion is applied as follows:

Current reference = *Final Torque Reference* (**J27**) x Motor Rated Flux / Motor Flux.

J21	**Final Current Limit**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	−VM_TORQUE_CURRENT	**Maximum**	VM_TORQUE_CURRENT
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	1
Coding	RO, VM, ND, NC, PT		

Final Current Limit (**J21**) is the current limit level that is applied to the torque producing current.

J22	**Total Output Current**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	−VM_DRIVE_CURRENT_UNIPOLAR	**Maximum**	VM_DRIVE_CURRENT_UNIPOLAR
Default		**Units**	A
Type	32 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	3
Coding	RO, FI, VM, ND, NC, PT		

Current Magnitude, Total Output Current (**J22**) is the instantaneous drive output current scaled so that it represents the r.m.s. phase current in Amps under steady state conditions.

J23	**Percentage Load**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	−VM_USER_CURRENT	**Maximum**	VM_DRIVE_CURRENT_UNIPOLAR
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	3
Coding	RO, FI, VM, ND, NC, PT		

Percentage Load (**J23**) gives the *Torque Producing Current* (**J24**) as a percentage of the rated torque producing current for the motor. Positive values indicate motoring and negative values represent regenerating.

J24	**Torque Producing Current**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	−VM_DRIVE_CURRENT	**Maximum**	VM_DRIVE_CURRENT
Default		**Units**	A
Type	32 Bit Volatile	**Update Rate**	250 μs write
Display Format	Standard	**Decimal Places**	3
Coding	RO, FI, VM, ND, NC, PT		

Torque Producing Current (**J24**) is the instantaneous level of torque producing current scaled so that it represents the r.m.s. level of torque producing current under steady state conditions. *Torque Producing Current* (**J24**) is proportional to the torque produced by the motor provided field weakening is not active. For field weakening operation the *Torque Producing Current* (**J24**) is boosted for a given level of torque to compensate for the reduction in the motor flux. The sign of *Torque Producing Current* (**J24**) is defined in the table overleaf.

Sign of *Torque Producing Current* (J24)	Sign of frequency or speed	Direction of motor torque
+	+	Accelerating
-	+	Decelerating
+	-	Decelerating
-	-	Accelerating

J25	Magnetizing Current		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	−VM_DRIVE_CURRENT	**Maximum**	VM_DRIVE_CURRENT
Default		**Units**	A
Type	32 Bit Volatile	**Update Rate**	250 μs write
Display Format	Standard	**Decimal Places**	3
Coding	RO, FI, VM, ND, NC, PT		

Magnetizing Current (**J25**) is the instantaneous level of magnetizing current scaled so that it represents the rms level of magnetizing current under steady state conditions.

J26	Motor Protection Accumulator		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.0	**Maximum**	100.0
Default		**Units**	%
Type	16 Bit Power Down Save	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	1
Coding	RO, ND, NC, PT		

See *Motor Thermal Time Constant 1* (**B20**).

J27	Final Torque Reference		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	−VM_TORQUE_CURRENT	**Maximum**	VM_TORQUE_CURRENT
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	250 μs write
Display Format	Standard	**Decimal Places**	1
Coding	RO, FI, VM, ND, NC, PT		

The *Speed Loop Output* (**J32**) can include a feed forward torque that will provide the torque necessary to accelerate the load inertia. This can be combined with the *Inertia Compensation Torque* (**E17**) and the *Load cell compensation torque* (**E13**) to give the *Final Torque Reference* (**J27**) as a percentage of the rated torque producing for the motor.

J28	Final Current Filter Time Constant		
Mode	RFC-A, RFC-S		
Minimum	0.0	**Maximum**	25.0
Default	0.0	**Units**	ms
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

Final Current Filter Time Constant (**J28**) defines the time constant of a first order filter that can be applied to the *Final Current Reference* (**J20**). The filter is provided to reduce acoustic noise and vibration produced as a result of position feedback quantisation. The filter introduces a lag in the speed controller loop, and so the speed controller gains may need to be reduced to maintain stability as the filter time constant is increased.

J29	Final Current Loop Kp		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	30000
Default	Open-Loop: 20 RFC-A, RFC-S: 150	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Final Current Loop Kp (**J29**) and *Final Current Loop Ki* (**J30**) are the proportional and integral gains of the current controllers. It is possible to use the current controller in standard mode (*Current Controller Mode* (**H17**) = 0) or high performance mode (*Current Controller Mode* (**H17**) = 1). The set up method for the current controller gains is described separately for each of these modes below. It should be noted that when an auto-tune is performed that measures the *Transient Inductance* (**B33**) and *Stator Resistance* (**B34**) the *Final Current Loop Kp* (**J29**) and *Final Current Loop Ki* (**J30**) are automatically set to the levels defined in the description for standard mode even if high performance mode is selected.

These gains will give good performance in standard mode and produce moderate acoustic noise due to position feedback quantisation with a standard incremental encoder. These represent the maximum levels that are likely to be used with this mode in most applications. For high performance mode it is recommended that a high resolution position feedback device is used or else the acoustic noise due to position feedback quantisation is likely to be excessive. In high performance mode the proportional gain can be increased to a higher level as given in the description of this mode.

Standard mode

Standard mode can be used to give good current control dynamic performance and is compatible with the performance of Unidrive SP. The current controller gains can either be set using auto-tuning (see *Motor Autotune* (**B11**)) or the values can be set up manually by the user. The calculations given below are those used by the auto-tuning system and should give good performance without excessive overshoot.

The proportional gain, *Final Current Loop Kp* (**J29**), is the most critical value in controlling the performance of the current controllers. The required value can be calculated as

Final Current Loop Kp (**J29**) = $(L / T) \times (I_{fs} / V_{fs}) \times (256 / 5)$

where:

T is the sample time of the current controllers. The drive compensates for any change of sample time, and so it should be assumed that the sample time is equivalent to the base value of 167µs.

L is the motor inductance. For a servo motor this is half the phase to phase inductance that is normally specified by the manufacturer. For an induction motor this is the per phase transient inductance (σLs). The inductance for either of these motors can be taken from the manufacturers data or it can be obtained from the value stored in the *Transient Inductance* (**B33**) after auto-tuning.

I_{fs} is the peak full scale current feedback, i.e. full scale current x √2. The r.m.s. full scale current is given by *Drive Full Scale Current Kc* (**J06**), and so I_{fs} = *Drive Full Scale Current Kc* (**J06**) x √2.

V_{fs} is the maximum d.c. bus voltage.

Therefore:

Final Current Loop Kp (**J29**) = $(L / 167\mu s) \times (Kc \times \sqrt{2} / V_{fs}) \times (256 / 5) = K \times L \times Kc$

Where $K = [\sqrt{2} / (V_{fs} \times 167\mu s)] \times (256 / 5)$

There is one value of the scaling factor K for each drive voltage rating as shown in the table below.

Drive Rated Voltage (J07)	Vfs	K
200 V	415 V	1045
400 V	830 V	522
575 V	990 V	438
690 V	1190 V	364

The integral gain, *Final Current Loop Ki* (**J30**), is less critical. A suggested value which matches the zero with the pole caused by the electrical time constant of the motor and ensures that the integral term does not contribute to current overshoot is given by

Final Current Loop Ki (**J30**) = *Final Current Loop Kp* (**J29**) x 256 x T / τ_m

Where τ_m is the motor time constant (L / R). R is the per phase stator resistance of the motor (i.e. half the resistance measured between two phases).

Therefore:

Final Current Loop Ki (**J30**) = $(K \times L \times Kc) \times 256 \times 167\mu s \times R / L = 0.0427 \times K \times R \times Kc$

The above equations give the gain values that should give a good response with minimal overshoot. If required the gains can be adjusted to modify the performance as follows:

1. *Final Current Loop Ki* (**J30**) can be increased to improve the performance of the current controllers by reducing the effects of inverter non-linearity. These effects become more significant with higher switching frequency. These effects will be more significant for drives with higher current ratings and higher voltage ratings. If *Final Current Loop Ki* (**J30**) is increased by a factor of 4 it is possible to get up to 10% overshoot in response to a step change of current reference. For high performance applications, it is recommended that *Final Current Loop Ki* (**J30**) is increased by a factor of 4 from the auto-tuned values. As the inverter non-linearity is worse with higher switching frequencies it is may be necessary to increase *Final Current Loop Ki* (**J30**) by a factor of 8 for operation with 16kHz switching frequency.

2. It is possible to increase *Final Current Loop Kp* (**J29**) to reduce the response time of the current controllers. If *Final Current Loop Kp* (**J29**) is increased by a factor of 1.5 then the response to a step change of reference will give 12.5% overshoot. It is recommended that *Final Current Loop Ki* (**J30**) is increased in preference to *Final Current Loop Kp* (**J29**).

As already stated, the drive compensates for changes of switching frequency and the sampling method used by the controller. The table below shows the adjustment applied to the proportional and integral gains.

***Switching Frequency* (L80)**	**Current controller sample time Current**	***Final Current Loop Kp* (J29) adjustment**	***Final Current Loop Ki* (J30) adjustment**
2 kHz	250 µs	x 167 / 250 = 0.7	x 1.0
3 kHz	167 µs	x 167 / 167 = 1.0	x 1.0
4 kHz	125 µs	x 167 / 125 = 1.3	x 1.0
6 kHz	83 µs	x 167 / 83 = 2.0	x 1.0
8 kHz	62.5 µs	x 167 / 62.5 = 2.7	x 1.0
12 kHz	83 µs	x (167 / 83) x (4 / 3) = 2.7	x 4 / 3 = 1.3
16 kHz	62.5 µs	x (167 / 62.5) x (4 / 3) = 3.6	x 4 / 3 = 1.3

The amount of acoustic noise produced in the motor from position feedback quantisation is related to the resolution of the position feedback and the product of the speed controller and current controller proportional gains. The values in this table can be used in conjunction with the speed controller loop proportional gain to assess the amount of acoustic noise that is likely to be produced.

High performance mode

High performance mode gives fast closed-loop dynamic performance as though the proportional gain has been set to the maximum value defined below. This is the maximum value that should be used to prevent excessive over-shoot or instability. It should be noted that this is 5 times the maximum value used for standard mode.

Final Current Loop Kp (**J29**) = $(L / T) \times (I_{fs} / V_{fs}) \times 256 = K \times L \times Kc \times 5$

The closed-loop dynamic performance defines the response of the current controllers to a change of current reference. This response cannot be changed by modifying, *Final Current Loop Kp* (**J29**), however the ability of the current controllers to reject voltage disturbances is affected by *Final Current Loop Kp* (**J29**). Normally the auto-tuned value (which is one fifth of the maximum recommended value) will give good rejection of voltage disturbances, but the proportional gain can be increased up to the maximum value to improve this. It should be noted that the higher closed-loop response of the controllers means that encoder position quantisation will cause significant acoustic noise in the motor unless a high resolution encoder is used. Increasing, *Final Current Loop Kp* (**J29**) also increases acoustic noise due to noise on the current feedback. High performance mode uses the measured motor resistance and inductance, and so it is recommended that these are obtained with auto-tuning using test 1 or 2.

The integral gain provides a trim on the currents, and generally the auto-tuned value should be sufficient, however, this may be increased if required.

The drive compensates for changes of switching frequency used by the controller. The table below shows the adjustment applied to the proportional and integral gains.

***Switching Frequency* (L80)**	**Current controller sample time Current**	***Final Current Loop Kp* (J29) adjustment**	***Final Current Loop Ki* (J30) adjustment**
2 kHz	500 µs	x 167 / 500 = 0.3	x 1.0
3 kHz	333 µs	x 167 / 333 = 0.5	x 1.0
4 kHz	250 µs	x 167 / 250 = 0.7	x 1.0
6 kHz	167 µs	x 167 / 167 = 1.0	x 1.0
8 kHz	125 µs	x 167 / 125 = 1.3	x 1.0
12 kHz	83 µs	x 167 / 83 = 2.0	x 1.0
16 kHz	62.5 µs	x 167 / 62.5 = 2.7	x 1.0

J30	**Final Current Loop Ki**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	30000
Default	2000	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Final Current Loop Kp* (**J29**).

J31	Speed Error		
Mode	RFC-A, RFC-S		
Minimum	−VM_SPEED	**Maximum**	VM_SPEED
Default		**Units**	
Type	32 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	1
Coding	RO, FI, VM, ND, NC, PT		

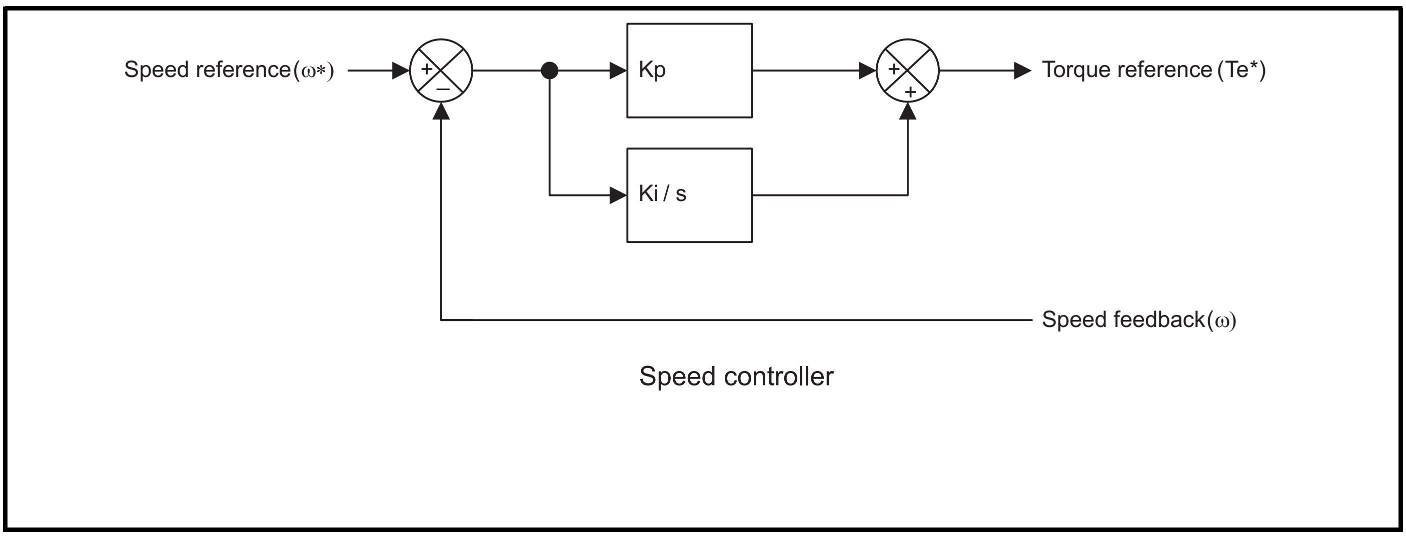
The speed error is the difference between the final *Final Speed Reference* (**J50**) and the *Drive Encoder Speed Feedback* (**J51**), and does not include the effect of the differential term in the speed controller feedback branch.

J32	Speed Loop Output		
Mode	RFC-A, RFC-S		
Minimum	−VM_TORQUE_CURRENT	**Maximum**	VM_TORQUE_CURRENT
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	1
Coding	RO, FI, VM, ND, NC, PT		

The output of the speed regulator is a torque demand given as a percentage of rated motor torque. It should be noted that this will be modified to take into account in the level of motor flux if field weakening is active before it is converted into the *Final Current Reference* (**J20**).

J33	Final Speed Loop Kp		
Mode	RFC-A, RFC-S		
Minimum	0.0000	**Maximum**	200.0000
Default	0.0300	**Units**	s/rad
Type	32 Bit User Save	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	4
Coding	RW		

The diagram below shows a generalized representation of the speed controller. The controller includes a feed forward proportional gain (Kp), a feed forward integral gain (Ki), and a differential feedback gain (Kd). The description here refers to the first set of gains for motor map 1 (*Final Speed Loop Kp* (**J33**) and *Final Speed Loop Ki* (**J34**).

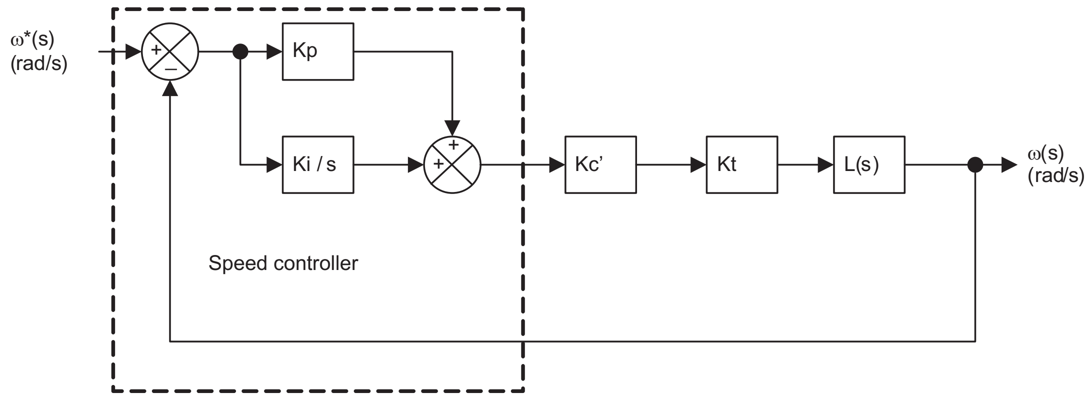


Proportional gain (Kp) - *Final Speed Loop Kp* (**J33**)
If Kp is non-zero and Ki is zero the controller will only have a proportional term, and there must be a speed error to produce a torque reference. Therefore, as the motor load increases there will be a difference between the reference and actual speeds. This effect, called regulation, depends on the level of the proportional gain, the higher the gain the smaller the speed error for a given load. If the proportional gain is too high either the acoustic noise produced due to speed feedback quantisation becomes unacceptable, or the closed-loop stability limit is reached.

Integral gain (Ki) - *Final Speed Loop Ki* (**J34**)
The integral gain is provided to prevent speed regulation. The error is accumulated over a period of time and used to produce the necessary torque reference without any speed error. Increasing the integral gain reduces the time taken for the speed to reach the correct level and increases the stiffness of the system, i.e. it reduces the positional displacement produced by applying a load torque to the motor. Unfortunately increasing the integral gain also reduces the system damping giving overshoot after a transient.

For a given integral gain the damping can be improved by increasing the proportional gain. A compromise must be reached where the system response, stiffness and damping are all adequate for the application. The integral term is implemented in the form of ∑(Ki x error), and so the integral gain can be changed when the controller is active without causing large transients on the torque reference.

To analyze the performance of the speed controller it may be represented as an s-domain model as shown below.



Speed controller (s domain)

Kc' is the conversion between the speed controller output and the torque producing current reference. A value of unity at the output of the speed controller gives a torque producing current equal to Kc'. The drive automatically compensates the torque producing current reference for flux variations in field weakening, and so Kc' can be assumed to have a constant value even in field weakening. Kc' = *Drive Full Scale Current Kc* (**J06**) x 0.45.

Kt is the torque constant of the motor (i.e. torque in Nm per amp of torque producing current). This value is normally available from the manufacturer for a permanent magnet motor, however, for induction motors the value must be calculated from the motor parameters. In RFC-A mode this calculation is performed by the drive and the result is stored in *Torque Per Amp* (**E16**)

L(s) is the transfer function of the load.

The speed controller calculations are provided for a rotary application. However, for a linear application it is possible to set *Torque Per Amp* (**E16**) to the force per amp and the *Inertia Compensation Total Inertia* (**E15**) to the mass, and all the rotary system equations still apply.

J34	Final Speed Loop Ki		
Mode	RFC-A, RFC-S		
Minimum	0.00	**Maximum**	655.35
Default	0.10	**Units**	s^2/rad
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	2
Coding	RW, BU		

See *Final Speed Loop Kp* (**J33**).

J35	Field Weakening Magnetizing Current		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	100
Default		**Units**	%
Type	8 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This parameter indicates the field weakening current while the elevator drive is running. The value is based upon the rated magnetizing current and the actual magnetizing current, *Magnetizing Current* (**J25**).

Open loop, RFC-A:

This parameter displays the minimum magnetizing current as a percentage of rated magnetizing current when travelling.

For induction motors with a correct motor setup, this parameter should be in the region of 95 % to 100 %. If it is below 90 % the motor map setting may be incorrect where the motor is operating in field weakening indicated by the reduced magnetizing current.

RFC-S:

For PM motors *Magnetizing Current* (**J25**) shows the maximum reactive current for field weakening if high speed mode is enabled with *Enable High Speed Mode* (**B28**) = On (1). The field weakening magnetizing current is calculated from:

100 - (MAX(*Magnetizing Current* (**J25**)) * 100 / *Motor Rated Current* (**B02**))

This provides a similar value to Open loop / RFC-A.

J36	Elevator Position		
Mode	RFC-A, RFC-S		
Minimum	-2147483648	**Maximum**	2147483647
Default		**Units**	mm
Type	32 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This indicates the elevator position in mm units.

There are two possible display modes:

· *Position Display Mode* (**H30**) = Relative (0), the position relative to the travel start position is shown.

· *Position Display Mode* (**H30**) = Absolute (1), the absolute shaft position is shown.

See *Position Display Mode* (**H30**) for more information.

J37	Calculated Nominal Motor Speed rpm		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	32767
Default		**Units**	rpm
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This indicates the elevator calculated motor speed in rpm units, before roping or gearbox ratios have been applied. This value is calculated when *Nominal Elevator Speed* (**E01**) to *Gear Ratio Denominator* (**E05**) are modified.

In Open loop mode the relationship between rpm and frequency is Nominal elevator frequency = Nominal elevator speed rpm * motor rated frequency / Motor synchronous speed.

J38	Active Speed Setpoint		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default		**Units**	mm / s
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This indicates the active elevator speed set point in mm / s. i.e. the presently selected profile speed from *V1 Speed Reference* (**G01**) to *Speed Reference* (**G10**) If no speed has been selected this will show 0 mm / s.

J39	Profile Speed		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default		**Units**	mm / s
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This indicates the profile generator output speed in mm / s units. The profile generator output speed is based upon the profile specified by the **Profile** category parameters.

J40	Actual Speed		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default		**Units**	mm / s
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This indicates the actual speed of the motor in mm / s units.

In **RFC-A and RFC-S**:
The actual speed is based upon the encoder feedback and motor rated speed mm/s and rpm scaling.

J41	Reference Acceleration		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	Maximum	10000
Default		Units	mm /s²
Type	16 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

This is the profile generator output acceleration rate, and is set in mm/s^2.

J42	Deceleration Distance		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	Maximum	32767
Default		Units	mm
Type	16 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

This indicates deceleration distance in mm, which is derived from the Profile generator output position and the target stopping position or the creep speed.

In Creep to floor, this indicates the distance used in the decelerating state, *Elevator Software State* (**J03**) = 9, which is the distance used to get from the speed at the time the deceleration state was entered to the creep speed. If floor sensor correction is triggered during the deceleration state then this shows the distance to a stop instead of the creep speed.

In Direct to floor, *Elevator Control Mode* (**H19**) = Direct To Floor (1), this indicates the distance used in the decelerating state, Elevator Software State (**J03**) = 9, which is the distance used to get from the speed at the time the deceleration state was entered to a stop.

This is not available when an analog reference is selected, *Control Input Mode* (**H11**) = Analog Run Prmit or Analog 2 Dir (0 or 1).

J43	Deceleration Distance Calculated		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	Maximum	10000
Default		Units	mm
Type	16 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

This indicates the sampled profile deceleration distance in mm, for the selected speed, *V1 Speed Reference* (**G01**) to *V10 Speed Reference* (**G10**), which is derived from the profile setup parameters in the **Profile** menu.

When only *V1 Speed Reference* (**G01**) is selected this shows the distance from the creep speed to zero speed. When *V2 Speed Reference* (**G02**) to *V10 Speed Reference* (**G10**) is selected this shows the distance from the selected speed to *V1 Speed Reference* (**G01).**

In Direct to floor, *Elevator Control Mode* (**H19**) = Direct To Floor (1), this shows the distance from the selected speed, *V1 Speed Reference* (**G01**) to *V10 Speed Reference* (**G10**) to zero speed.

This is not available when an analog reference is selected, *Control Input mode* (**H11**) = Analog Run Prmit or Analog 2 Dir (0 or 1).

J44	Deceleration Distance Measured		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	Maximum	32767
Default		Units	mm
Type	16 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

This indicates measured deceleration distance in mm, which is derived from the feedback position sampled when deceleration begins to when the elevator motor stops or reaches the creep speed.

In Creep to floor, this indicates the distance used in the decelerating state, *Elevator Software State* (**J03**) = 9, which is the distance used to get from the speed at the time the deceleration state was entered to the creep speed. If floor sensor correction is triggered during the deceleration state then this shows the distance to a stop instead of the creep speed.

In Direct to floor, *Elevator Control Mode* (**H19**) = Direct To Floor (1), this indicates the distance used in the decelerating state, *Elevator Software State* (**J03**) = 9, which is the distance used to get from the speed at the time the deceleration state was entered to a stop.

In RFC-A and RFC-S:

This is based on the actual encoder position feedback.

In Open loop:

This is based on the profile position.

This is not available when an analog reference is selected, *Control Input Mode* (**H11**) = Analog Run Prmit or Analog 2 Dir (0 or 1).

J45	Creep Distance Measured		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	32767
Default		**Units**	mm
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This indicates measured deceleration distance in mm, which is derived from the position sampled when the decelerating from *V1 Speed Reference* (**G01**) to when the elevator motor stops.

In **RFC-A and RFC-S**:

This is based on the actual encoder position feedback.

In **Open loop**:

This is based on the profile position.

This is not available when an analog reference is selected, *Control Input mode* (**H11**) = Analog Run Prmit or Analog 2 Dir (0 or 1).

J46	Speed At Floor Sensor Correction Active		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	32767
Default		**Units**	mm/s
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This indicates the sampled elevator speed at the moment floor sensor correction was activated. If the speed at the point when the floor sensor correction signal was received was too high or the floor sensor correction distance is too short a hard stop may be performed where the profile is internally modified to prevent position overshoot.

This is based on the profile generator speed.

J47	Remaining Floor Sensor Correction Distance		
Mode	RFC-A, RFC-S		
Minimum	-32768	**Maximum**	32767
Default		**Units**	mm
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This indicates the remaining distance to floor level in mm when floor sensor correction is enabled.

Negative values indicate a positional overshoot i.e. it was not possible with the motion profile parameters set and the floor sensor correction distance to stop without overshooting the required distance.

This is based on the actual encoder position feedback.

This is not available when an analog reference is selected, *Control Input Mode* (**H11**) = Analog Run Prmit or Analog 2 Dir (0 or 1).

J48	Velocity Threshold 1 Status Output		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

When set to On (1), this indicates when the elevator speed in mm/s, *Actual Speed* (**J40**) is <= *Velocity Threshold 1* (**H13**).

When set to Off (0), this indicates when the elevator speed in mm/s, *Actual Speed* (**J40**) is > *Velocity Threshold 1* (**H13**).

This threshold may be used for advanced door opening where *Velocity Threshold 1 Status Output* (**J48**) is routed to the lift controller via a digital output, such that when the speed is below a certain level, the elevator controller can open the doors early.

In RFC-A and RFC-S the speed threshold is based on speed feedback, but in Open loop mode it is based upon the profile generator speed since there is no feedback device available.

J49	Velocity Threshold 2 Status Output		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

When set to On (1), this indicates when the elevator speed in mm/s, *Actual Speed* (**J40**) is <= *Velocity Threshold 2* (**H14**).

When set to Off (0), this indicates when the elevator speed in mm/s, *Actual Speed* (**J40**) is > *Velocity Threshold 2* (**H14**).

This threshold may be used for advanced door opening where *Velocity Threshold 2 Status Output* (**J49**) is routed to the lift controller via a digital output, such that when the speed is below a certain level, the elevator controller can open the doors early.

In RFC-A and RFC-S the speed threshold is based on speed feedback, but in Open loop mode it is based upon the profile generator speed since there is no feedback device available.

J50	Final Speed Reference		
Mode	RFC-A, RFC-S		
Minimum	−VM_SPEED	**Maximum**	VM_SPEED
Default		**Units**	
Type	32 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	1
Coding	RO, FI, VM, ND, NC, PT		

Final Speed Reference (**J50**) shows the reference at the input to the speed controller.

J51	Drive Encoder Speed Feedback		
Mode	RFC-A, RFC-S		
Minimum	−VM_SPEED	**Maximum**	VM_SPEED
Default		**Units**	
Type	32 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	1
Coding	RO, FI, VM, ND, NC, PT		

The speed feedback is taken from the drive position feedback interfaces or from a position feedback interface. It is also possible to select sensorless speed feedback with *Sensorless Feedback Mode* (**C14**). *Drive Encoder Speed Feedback* (**J51**) shows the level of the speed feedback selected for the speed controller.

The FI attribute is set for this parameter, so display filtering is active when this parameter is viewed with one of the drive keypads. The value held in the drive parameter (accessible via comms or an option module) does not include this filter, but is a value that is obtained over a sliding 16ms period to limit the ripple. The speed feedback includes quantisation ripple given by the following equation in rpm:

Ripple in *Drive Encoder Speed Feedback* (**J51**) = 60 / 16 ms / Position resolution

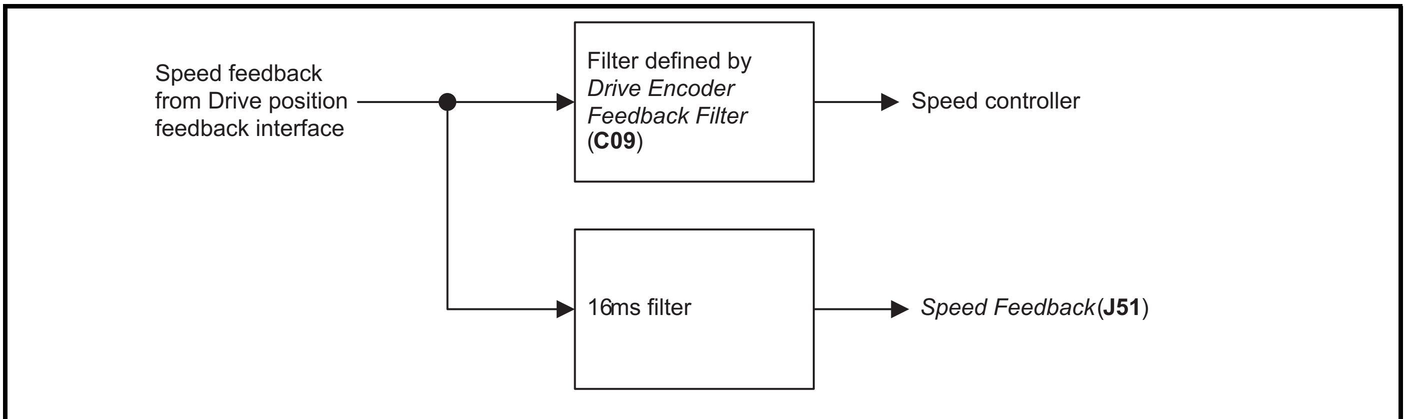
The ripple for a linear system is given by the following equation in mm/s:

Ripple in *Drive Encoder Speed Feedback* (**J51**) = Pole pitch in mm / 16 ms / Position resolution

The position resolution for each type of feedback device is defined in the table below.

Position feedback device	Position resolution
AB, AB Servo	4 x lines per revolution or pole pitch
FD, FR, FD Servo, FR Servo	2 x lines per revolution or pole pitch
SC, SC Hiperface, SC EnDat, SC SSI, SC Servo	1024 x sine waves per revolution or pole pitch
EnDat, SSI, BiSS	Comms bits per revolution or pole pitch

For example the ripple in *Drive Encoder Speed Feedback* (**J51**) when a 4096 line AB type encoder is used is 0.23 rpm. **It should be noted that no filtering is applied to the speed feedback used by the speed controller or for the position feedback reference system unless the feedback filter for that particular interface is activated by putting a non-zero value in the appropriate set up parameter (i.e. *Drive Encoder Feedback Filter* (C09) for the Drive position feedback interface).** The diagram below shows the filtering applied to the speed feedback when this is taken from the Drive position feedback interface.



Speed feedback filtering for Drive position feedback interface

The speed feedback ripple seen by the speed controller and the position feedback reference is given by the following equations when the filter set up value *Drive Encoder Feedback Filter* (**C09**) = 0.

Ripple for a rotary system in rpm = 60 / Speed controller sample time / Position resolution

Ripple for a linear system in mm/s = Pole pitch in mm / Speed controller sample time / Position resolution

The speed controller sample time is 250 µs. If the filter set up value is non-zero the ripple is given by:

Ripple for a rotary system in rpm = 60 / Filter time / Position resolution

Ripple for a linear system in mm/s = Pole pitch in mm / Filter time / Position resolution

The description so far covers the Drive position feedback interface.

It is not advisable to use the speed feedback filter unless it is specifically required for high inertia applications with high controller gains, or if commutation signals alone are used for feedback, because the filter has a non-linear transfer function. It is preferable to use the current demand filters (*Final Current Filter Time Constant* (**J28**) or *Run Current Loop Filter* (**I10**)) as these are linear first order filters that provide filtering on noise generated from both the speed reference and the speed feedback. It should be noted that any filtering included within the speed controller feedback loop, either on the speed feedback or the current demand, introduces a delay and limits the maximum bandwidth of the controller for stable operation.

The speed ripple seen by the speed controller can be quite high in some cases, for example with a 4096 line encoder the speed ripple is 14.6 rpm with a sample time of 250 µs. This causes high frequency torque ripple and acoustic motor noise. These effects increase with the level of speed feedback ripple and with the gains used in the speed controller. Therefore high speed feedback ripple usually limits the maximum possible gain settings for the speed controller, and so a position feedback device with high position resolution is usually required for a system with high dynamic performance or stiffness. **It should be noted that the ripple caused by feedback quantisation and does not define speed feedback resolution. The speed controller accumulates all pulses from the position feedback, and so the speed controller resolution is not limited by the feedback, but by the resolution of the speed reference.**

J52	Drive Encoder Revolutions		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	65535
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

Drive Encoder Revolutions (**J52**), *Drive Encoder Position* (**J53**) and *Drive Encoder Fine Position* (**J54**) combined give the encoder position with a resolution of $1/2^{32}$ of a revolution/pole pitch as a 48 bit number.

47 — 32	31 — 16	15 — 0
Revolutions/Pole Pitches	Position	Fine Position

Provided the position feedback interface set-up parameters are correct, the position is always converted to units of $1/2^{32}$ of a revolution/pole pitch, but some parts of the value may not be relevant depending on the resolution of the feedback device. For example a 1024 line digital encoder produces 4096 counts per revolution, and so the position is represented by the bits in the shaded area only.

47 — 32	31 — 20	19 — 16	15 — 0
Revolutions/Pole Pitches	Position (shaded)		Fine Position

When the position feedback moves by more than one revolution or pole pitch the *Drive Encoder Revolutions* (**J52**) increments or decrements in the form of a sixteen bit roll-over counter. If an absolute position feedback device (except AB Servo, FD Servo, FR Servo, SC Servo) is used the position is initialized at power-up and each time the encoder is subsequently initialized with the absolute position including the revolution count if a multi-turn absolute rotary encoder is used, or the pole pitch count if an absolute linear encoder is used.

The position interface parameter descriptions cover rotary and linear applications, but the revolutions or pole pitches are always referred to as turns.

J53	Drive Encoder Position		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	65535
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

See *Drive Encoder Revolutions* (**J52**).

J54	Drive Encoder Fine Position		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	65535
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

See *Drive Encoder Revolutions* (**J52**).

J55	Sensorless Mode Position		
Mode	RFC-A, RFC-S		
Minimum	-2147483648	**Maximum**	2147483647
Default		**Units**	
Type	32 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Whether the drive is operating with or without position feedback *Sensorless Mode Position* (**J55**) gives the motor position where the least significant 16 bits represent a movement equivalent to one pole of the motor. The most significant 16 bits represent turns where one turn is the movement associate with one pole. For example in a rotary application with a 4 pole motor, the movement associated with one pole is a mechanical movement of 180°. In RFC-A mode *Sensorless Mode Position* (**J55**) is aligned with the motor flux and voltages, but this has no fixed relationship to the mechanical position of the rotor.

J56	Maximum Distance Error		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This sets the maximum distance error threshold in mm. The error is calculated from the integral of *Profile Speed* (**J39**) – *Actual Speed* (**J40**). *Trip 63 (**Distance err**)* is generated when the calculated error is > *Maximum Distance Error Threshold* (**H16**) for 1 s continuously.
If *Maximum Distance Error Threshold* (**H16**) = 0 then *Trip 63 (**Distance err**)* is disabled. *Maximum Distance Error* (**J56**) shows the maximum distance error for the current travel. It is reset when a new travel begins.

J57	Maximum Speed Error		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	10000
Default		**Units**	mm / s
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO,ND, NC, PT		

In closed loop, this sets the maximum speed error threshold in mm/s. The error is calculated from *Profile Speed* (**J39**) – *Actual Speed* (**J40**). *Trip 62 (**Speed err**)* is generated when the calculated error is > *Maximum Speed Error Threshold* (**H15**) for 1 s continuously.

If *Maximum Speed Error Threshold* (**H15**) = 0 then *Trip 62 (**Speed err**)* is disabled.
Maximum Speed Error (**J57**) shows the maximum speed error for the current travel. It is reset when a new travel begins.

J58	Travel Counter		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-2147483648	**Maximum**	2147483647
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, ND, NC, PT		

This indicates the number of travels started for the system. It includes all complete and aborted travels i.e. every time *Elevator Software State* (**J03**) is >1 the travel count increments.

J59	Output Power		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	−VM_POWER	**Maximum**	VM_POWER
Default		**Units**	kW
Type	32 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	3
Coding	RO, FI, VM, ND, NC, PT		

The *Output Power* (**J59**) is the power flowing via the a.c. terminals of the drive. The power is derived as the dot product of the output voltage and current vectors, and so this is correct even if the motor parameters are incorrect and the motor model does not align the reference frame with the flux axis of a motor in RFC-A mode. For Open-loop, RFC-A and RFC-S modes a positive value of power indicates power flowing from the drive to motor. For Regen mode a positive value of power indicates power flowing from the supply to the regen drive.

J60	Output Frequency		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-2000.0	**Maximum**	2000.0
Default		**Units**	Hz
Type	32 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	1
Coding	RO, FI, ND, NC, PT		

The output frequency is not controlled directly, but the *Output Frequency* (**J60**) is a measurement of the frequency applied to the motor.

J61	Output Voltage		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	−VM_AC_VOLTAGE	**Maximum**	VM_AC_VOLTAGE
Default		**Units**	V
Type	16 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	
Coding	RO, FI, VM, ND, NC, PT		

The *Output Voltage* (**J61**) is the rms line to line voltage at the AC terminals of the drive.

J62	Last Travel Maximum Power		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.000	**Maximum**	32.767
Default		**Units**	kW
Type	32 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	3
Coding	RO,ND, NC, PT		

This indicates the maximum power sampled in the previous travel. The value is taken from *Output Power* (**J59**) and is filtered using a first order 50 ms time constant filter. This value is reset at the beginning of a new travel.

J63	**Last Travel Maximum Motor Voltage**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	32767
Default		**Units**	V
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO,ND, NC, PT		

This indicates the maximum motor voltage sampled in the previous travel. The value is taken from *Output Voltage* (**J61**). This value is reset at the beginning of a new travel.
This parameter may be used to indicate if the motor has gone into field weakening, and therefore a reduction in available motoring torque.

J64	**Last Travel Maximum Current**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.000	**Maximum**	32.767
Default		**Units**	A
Type	32 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	3
Coding	RO,ND, NC, PT		

This indicates the maximum motor current sampled in the previous travel. The value is taken from *Torque Producing Current* (**J24**).
This value is reset at the beginning of a new travel.

J65	**DC Bus Voltage**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	−VM_DC_VOLTAGE	**Maximum**	VM_DC_VOLTAGE
Default		**Units**	V
Type	16 Bit Volatile	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RO, FI, VM, ND, NC, PT		

DC. Bus Voltage (**J65**) gives the voltage across the DC Bus of the drive.

J66	**Internal IO Identifier**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Power-up write
Display Format	Standard	**Decimal Places**	0
Coding	RO,ND, NC, PT, BU		

Internal IO Identifier (**J66**) identifies the internally installed I/O option as given in the table over.

***Internal IO Identifier* (J66)**	**Internal I/O**
0	Analog and digital I/O

J67	**Encoder Feedback Interface Identifier**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Power-up write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

Encoder Feedback Interface Identifier (**J67**) identifies the type of interface fitted in the position feedback interface option location as given in the table overleaf.

***Encoder Feedback Interface Identifier* (J67)**	**Position feedback interface**
0	Standard Position Feedback
1	None
2	User Comms Module

J68	**Menu Access Status**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT		

Value	**Text**
0	Menu 0
1	All Menus

If *Menu Access Status* (**J68**) = 0 then only Menu 0 can be accessed with a keypad. If *Menu Access Status* (**J68**) = 1 then all menus can be accessed with a keypad.

J69	**Enable condition**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 000000000000)	**Maximum**	4095 (Display: 111111111111)
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	2 ms write
Display Format	Binary	**Decimal Places**	0
Coding	RO,ND, NC, PT		

The Final drive enable is a combination of the *Fast Disable* (**B27**), Safe Torque Off (STO) and other conditions that can prevent the drive from being enabled. All of these conditions are shown as bits in *Enable Conditions* (**J69**) as given in the table below.

***Enable Conditions* (J69) bits**	**Enable condition**
0	*Fast Disable* (**B27**)
1	Internal Enable
2	0 if auto-tune completed or trip during auto-tune, or if the drive stops when supply loss stop is active, but the drive needs to be disabled and re-enabled.
3	1 if fire mode is active.
4	Zero if *Position Feedback Initialized Indication* (**C19**) is present and all devices are not indicated as initialized, otherwise one. (Note that if *RFC Feedback Mode, Sensorless Feedback Mode* (**C14**) exists and is set to 4 for automatic changeover this bit is always one.)
5	Zero until the drive thermal model has obtained temperatures from all drive thermistors at least once.
6	Zero until all option modules that are present in the drive have indicated that they are ready to run or the system has timed out waiting for this.
7-10	Zero if an option module has forced the drive to be disabled if for example it is updating its user program. Bit 7 corresponds to slot 1, bit 8 to slot 2, etc.
11	Zero if the drive is in standby mode. See *Standby Mode Enable* (**H35**)

J70	Drive Event Flags		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00)	**Maximum**	4095 (Display: 11)
Default	0 (Display: 00)	**Units**	
Type	8 Bit Volatile	**Update Rate**	Background write
Display Format	Binary	**Decimal Places**	0
Coding	RW, NC		

Drive Event Flags (**J70**) indicates that certain actions have occurred within the drive as described below.

Bit	Corresponding event
0	Defaults loaded
1	Drive mode changed

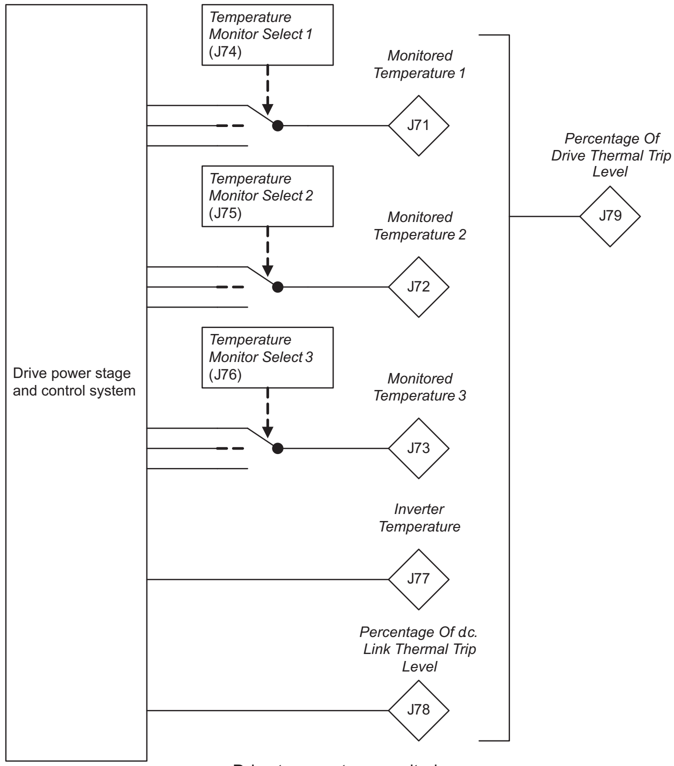
Bit 0: Defaults loaded
The drive sets bit 0 when defaults have been loaded and the associated parameter save has been completed. The drive does not reset this flag except at power-up.

Bit 1: Drive mode changed
The drive sets bit 1 when the drive mode has changed and the associated parameter save has been completed. The drive does not reset this flag except at power-up.

J71	Monitored Temperature 1		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-250	**Maximum**	250
Default		**Units**	°C
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Thermal monitoring is provided within the drive to protect the power stage and the control system from over temperature.

Monitored Temperature 1 (**J71**), *Monitored Temperature 2* (**J72**) and *Monitored Temperature 3* (**J73**) give an indication of the temperature of three selected monitoring points within the drive power system or control system. The required monitoring points can be selected using *Monitor Temperature Select 1* (**J74**), *Monitor Temperature Select2* (**J75**) and *Monitor Temperature Select 3* (**J76**) respectively. The default values give two monitoring points in the power system in *Monitored Temperature 1* (**J71**) and *Monitored Temperature 2* (**J72**), and control board temperature 1 in *Monitored Temperature 3* (**J73**).



Drive temperature monitoring

J72	Monitored Temperature 2		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-250	**Maximum**	250
Default		**Units**	°C
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Monitored Temperature 1* (**J71**) for details.

J73	Monitored Temperature 3		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-250	**Maximum**	250
Default		**Units**	°C
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Monitored Temperature 1* (**J71**) for details.

J74	Monitor Temperature Select 1		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1999
Default	1001	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Monitor Temperature Select 1 (**J74**) selects the temperature to be monitored in *Monitored Temperature 1* (**J71**) using the format given in the table below. If the monitoring point selected does not exist then the monitored temperature is always zero. The table below shows the monitoring points that can be selected.

Source	xx	y	zz
Control system	00	0	01: Control board thermistor 1
Control system	00	0	02: Control board thermistor 2
Control system	00	0	03: I/O board thermistor
Control system	00	1	00: Inverter thermal model
Control system	00	3	00: Braking IGBT thermal model
Power system	01	0	zz: Thermistor location defined by zz in the power system
Power system	01	Rectifier number	zz: Thermistor location defined by zz in the rectifier

J75	**Monitor Temperature Select 2**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1999
Default	1002	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Monitor Temperature Select 1* (**J74**).

J76	**Monitor Temperature Select 3**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1999
Default	1	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Monitor Temperature Select 1* (**J74**).

J77	**Inverter Temperature**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-250	**Maximum**	250
Default		**Units**	°C
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Inverter Temperature (**J77**) shows the estimated junction temperature of the hottest power device within the drive inverter. If this temperature exceeds the switch down threshold defined for the power stage the switching frequency is reduced.

J78	**Percentage Of DC Link Thermal Trip Level**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	100
Default		**Units**	%
Type	8 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Percentage Of DC Link Thermal Trip Level (**J78**) gives the percentage of the maximum allowed temperature as estimated by the thermal model of the d.c. link components.

J79	**Percentage Of Drive Thermal Trip Level**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	100
Default		**Units**	%
Type	8 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Percentage Of Drive Thermal Trip Level (**J79**) gives the percentage of the thermal trip level of the temperature monitoring point or thermal model in the drive that is highest. This includes all thermal monitoring points (not just those selected by *Monitored Temperature 1* (**J71**), *Monitored Temperature 2* (**J72**) and *Monitored Temperature 3* (**J73**)), *Inverter Temperature* (**J77**) and *Percentage Of DC Link Thermal Trip Level* (**J78**).

Percentage Of DC Link Thermal Trip Level (**J78**) is used directly to give *Percentage Of Drive Thermal Trip Level* (**J79**), but for all other monitored values which are temperatures this is given by Percentage of thermal trip level = (Temperature - 40 ^{o}C) / (Trip temperature - 40 ^{o}C) x 100 %

The location of the measurement or the thermal model that is related to this temperature is given in *Temperature Nearest To Trip Level* (**AU.37**). If *Percentage Of Drive Thermal Trip Level* (**J79**) exceeds 90 % *Drive Over Temperature Alarm* (**L22**) is set to one. If *Percentage Of Drive Thermal Trip Level* (**J79**) reaches 100 % one of the trips given in the table below is initiated. The trip can be reset when the percentage of thermal trip level fall below 95 %.

Temperature	Trip
Inverter Temperature (**J77**)	OHt Inverter
Power system temperature	OHt Power
Percentage Of DC Link Thermal Trip Level (**J78**)	OHt dc Link
Control system temperature	OHt Control

J80	**Date**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	311299 (Display: 31-12-99)
Default		**Units**	
Type	32 Bit Volatile	**Update Rate**	Background read/write
Display Format	Date	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Date (**J80**), *Time* (**J81**) and *Day Of Week* (**J82**) show the date and time as selected by *Date/Time Selector* (**H32**). *Date* (**J80**) stores the date in dd.mm.yy format regardless of the setting made in *Date Format* (**H33**) however if the parameter is viewed using a keypad the date will be displayed in the format selected in *Date Format* (**H33**). If a real time clock is selected from an option module then the days, months and years are from the real time clock and the day of the week is displayed in *Day Of Week* (**J82**). Otherwise the days have a minimum value of 0 and roll over after 30, the months have a minimum value of 0 and roll over after 11, and *Day Of Week* (**J82**) is always 0 (Sunday).

If when setting the date/time this parameter is being written via comms or from and applications module then the value should be written in standard dd/mm/yy format as described below.

The value of this parameter as seen over comms or to an applications module is as follows.

Value = (day[1..31] x 10000) + (month[1..12] x 100) + year[0..99]

J81	**Time**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00:00:00)	**Maximum**	235959 (Display: 23:59:59)
Default		**Units**	
Type	32 Bit Volatile	**Update Rate**	Background read/write
Display Format	Time	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Date* (**J80**).

The value of this parameter as seen over comms or to an applications module is as follows.

Value = (hour[0..23] x 10000) + (minute[0..59] x 100) + seconds[0..59]

J82	Day Of Week		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	6
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Background write
Display Format	Date	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT		

Value	Text
0	Sunday
1	Monday
2	Tuesday
3	Wednesday
4	Thursday
5	Friday
6	Saturday

See *Date* (**J80**).

J83	Date And Time Offset		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-24.00	**Maximum**	24.00
Default	0.00	**Units**	Hours
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

Date And Time Offset (**J83**) is an offset, specified in hours, that can be applied to the *Time* (**J81**). If the offset applied causes the time to roll-over midnight then the *Date* (**J80**) and *Day Of Week* (**J82**) are also modified. The offset is only applied when the clock source is a clock derived from a keypad or option module, i.e. *Date/Time Selector* (**H32**) > 3. The offset can be used for time zone offsets or daylight saving time etc. It should be noted that when the date and time is derived from an option module this may be in the form of UTC (Co-ordinated Universal Time) with an additional offset also provided by the option module. The data and time is derived by adding the additional offset and the time from the option module and then adding *Date And Time Offset* (**J83**).

J84	Energy Meter: MWh		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-999.9	**Maximum**	999.9
Default		**Units**	MWh
Type	16 Bit Power Down Save	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	1
Coding	RO, ND, NC, PT		

See *Reset Energy Meter* (**H37**).

J85	Energy Meter: kWh		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-99.99	**Maximum**	99.99
Default		**Units**	kWh
Type	16 Bit Power Down Save	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	2
Coding	RO, ND, NC, PT		

See *Reset Energy Meter* (**H37**).

J86	Energy Cost Per kWh		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.0	**Maximum**	600.0
Default	0.0	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW		

Running Cost kWh (**J87**) is derived from the *Output Power* (**J59**) and the *Energy Cost Per kWh* (**J86**) in cost per hour. The sign of *Running Cost kWh* (**J87**) is the same as the sign of *Output Power* (**J59**).

J87	Running Cost kWh		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-32000	**Maximum**	32000
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Energy Cost Per kWh* (**J86**).

J88	Drive Date Code		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	65535
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

Drive Date Code (**J88**) is a two-digit number in the form yyww where yy is the year and ww the week number.

J89	Serial Number LS		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 000000000)	**Maximum**	999999999 (Display: 999999999)
Default		**Units**	
Type	32 Bit Volatile	**Update Rate**	Power-up write
Display Format	Lead Zero Pad	**Decimal Places**	0
Coding	RO, ND, NC, PT		

The drive serial number is available as a pair of 32 bit values where *Serial Number LS* (**J89**) provides the least significant 9 decimal digits and *Serial Number MS* (**J90**) provides the most significant 9 decimal digits. The reconstructed serial number is ((**J90** * 1000000000) + J89).

Example 1
Serial number "1234567898765" would be stored as **J90** = 1234, J89 = 567898765.

Example 2
Serial number "1234000056789" would be stored as **J90** = 1234, J89 = 56789. *Serial Number LS* (**J89**) will be shown on the keypad as 000056789 (i.e. including the leading zeros).

J90	Serial Number MS		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	999999999
Default		**Units**	
Type	32 Bit Volatile	**Update Rate**	Power-up write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Serial Number LS* (**J89**).

J91	Drive Identifier Characters		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1160917040	**Maximum**	2147483647
Default		**Units**	
Type	32 Bit Volatile	**Update Rate**	Power-up write
Display Format	String	**Decimal Places**	0
Coding	RO, ND, NC, PT		

The drive model and rating can be identified as AAAA B nnnnnnnn CCCC DD EE FFF where each section of the model identifier is taken from a parameter. AAAA, B, CCCC, DDDD, EE and FFF are alpha-numeric characters. nnnnnnnn are decimal digits.

Section of Identifier	Parameter
AAAA	*Drive Identifier Characters* (**J91**)
nnnnnnnn	*Drive Identifier Rating And Configuration* (**J92**)
CCCC	*Extra Identifier Characters 1* (**J93**)
DDEE	*Extra Identifier Characters 2* (**J94**)
FFFB	*Extra Identifier Character 3* (**J95**)

Drive Identifier Rating And Configuration (**J92**) is split into a number of fields as defined in the table below.

Digits	Meaning
7 and 6	Frame size
5	Voltage code (2 = 200V, 4 = 400V, 5 = 575V, 6 = 690V)
4 and 0	Current rating multiplied by 10. The current rating is derived from *Maximum Heavy Duty Rating* (**J05**).

Example

The model number E300-03400078 A001 00 AB100 would be displayed in parameters as follows:

Parameter	Value
Drive Identifier Characters (**J91**)	E300
Drive Identifier Rating And Configuration (**J92**)	03400078
Extra Identifier Characters 1 (**J93**)	A001
Extra Identifier Characters 2 (**J94**)	00AB
Extra Identifier Character 3 (**J95**)	100-

J92	Drive Identifier Rating And Configuration		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00000000)	**Maximum**	99999999 (Display: 99999999)
Default		**Units**	
Type	32 Bit Volatile	**Update Rate**	Power-up write
Display Format	Lead Zero Pad	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Drive Identifier Characters* (**J91**).

J93	Extra Identifier Characters 1		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-2147483648	**Maximum**	2147483647
Default		**Units**	
Type	32 Bit Volatile	**Update Rate**	Power-up write
Display Format	String	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Drive Identifier Characters* (**J91**).

J94	**Extra Identifier Characters 2**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-2147483648	**Maximum**	2147483647
Default		**Units**	
Type	32 Bit Volatile	**Update Rate**	Power-up write
Display Format	String	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Drive Identifier Characters* (**J91**).

J95	**Extra Identifier Characters 3**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-2147483648	**Maximum**	2147483647
Default		**Units**	
Type	32 Bit Volatile	**Update Rate**	Power-up write
Display Format	String	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Drive Identifier Characters* (**J91**).

J96	**Drive Derivative**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Power-up write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

Drive Derivative (**J96**) shows the derivative identifier.

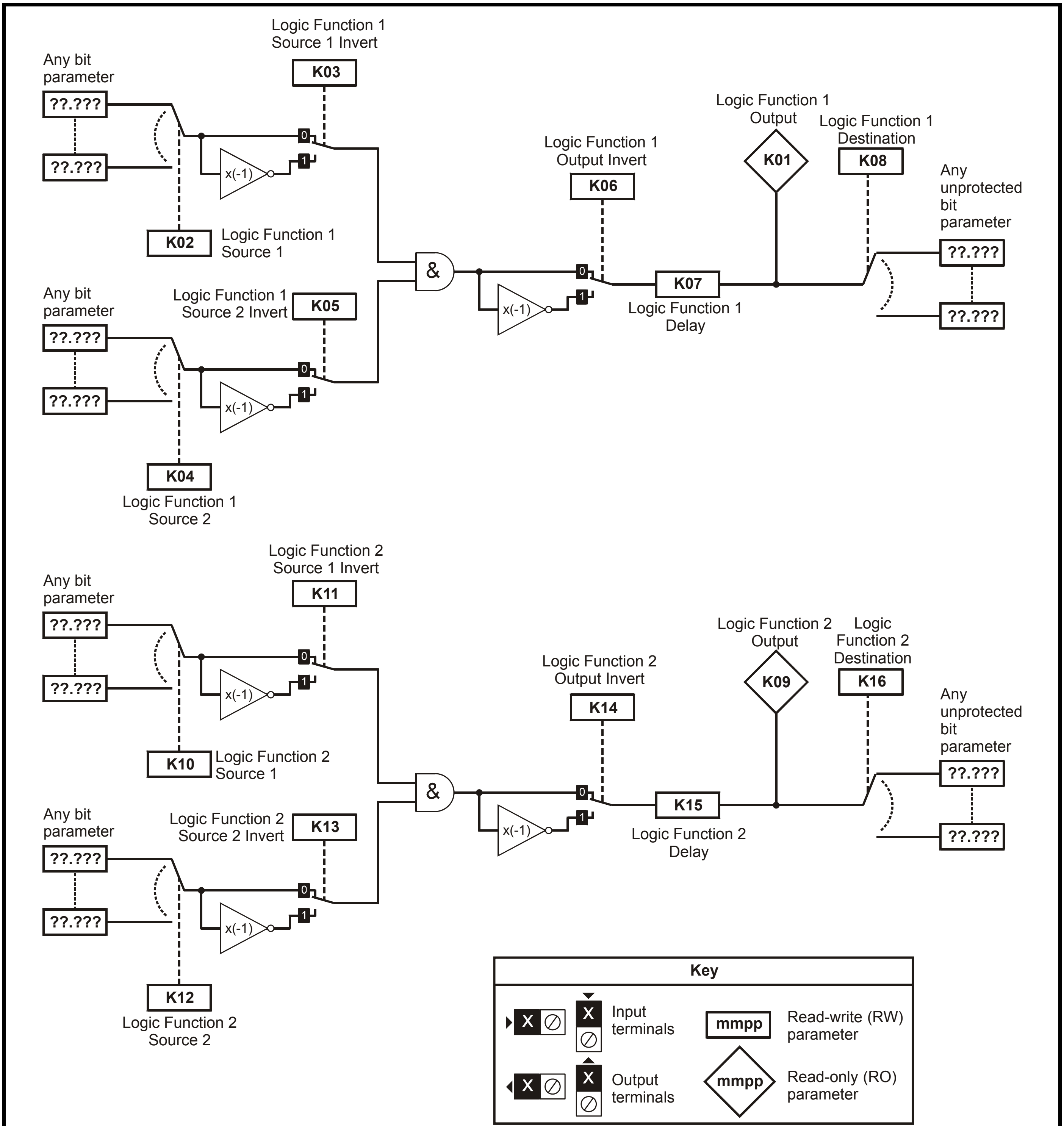
J97	**Velocity Threshold Status Output**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

When set to On (1), this indicates that the elevator speed is <= 200 mm/s.

When set to Off (0), this indicates that the elevator speed is > 200 mm/s

8.10 Menu K: Logic

Figure 8-28 Menu K logic diagram: Programmable logic



The parameters are all shown in their default settings

Figure 8-29 Menu K logic diagram: Binary sum

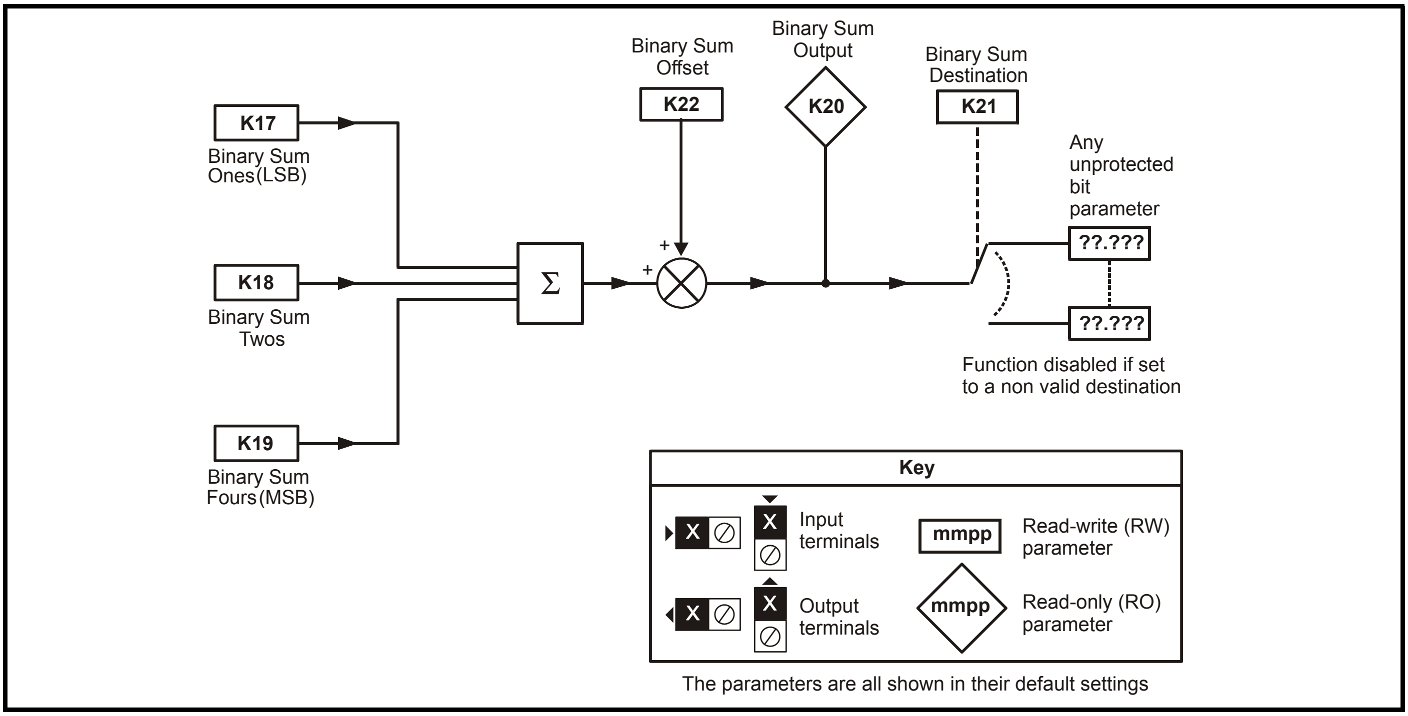


Figure 8-30 Menu K logic diagram: Threshold detectors

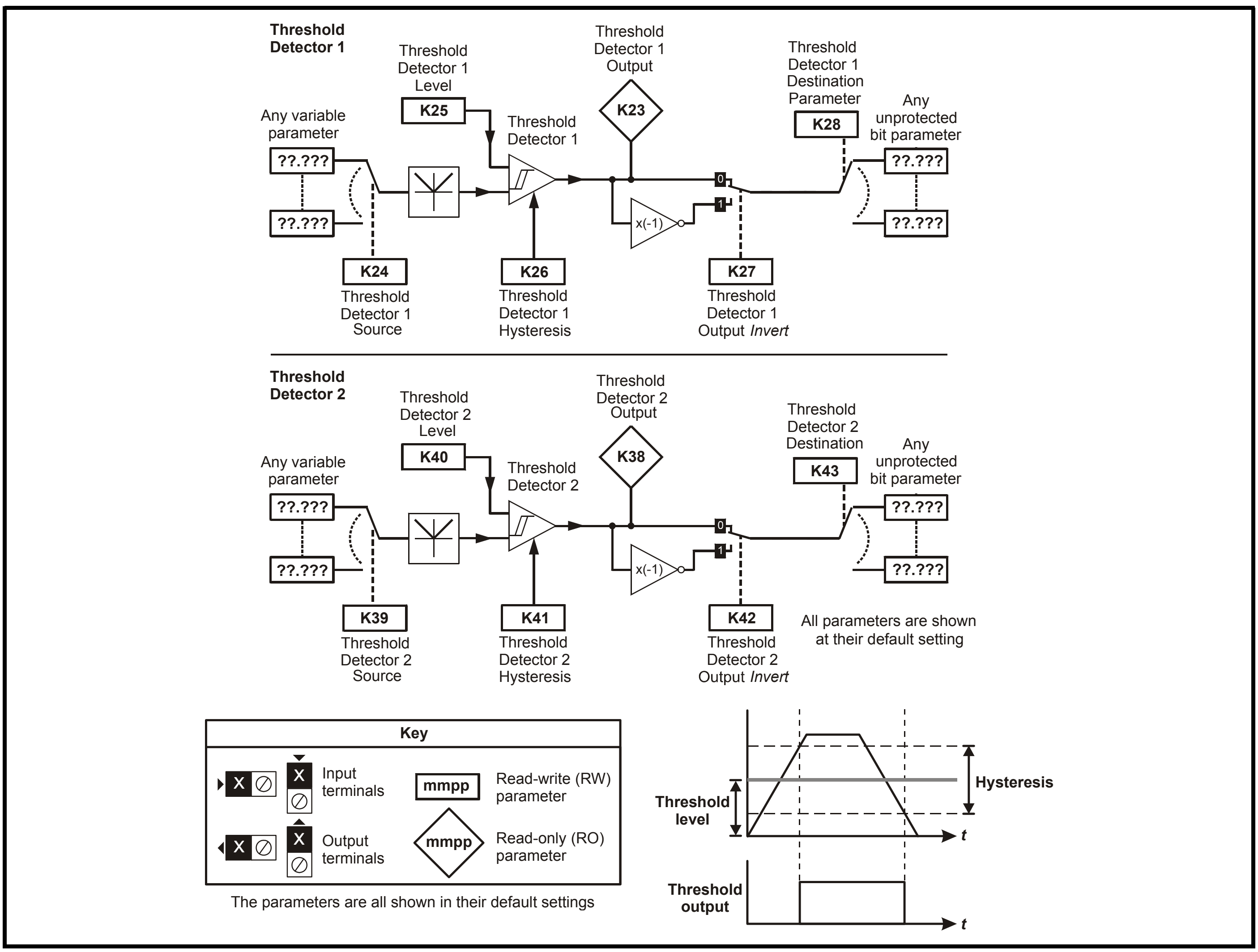
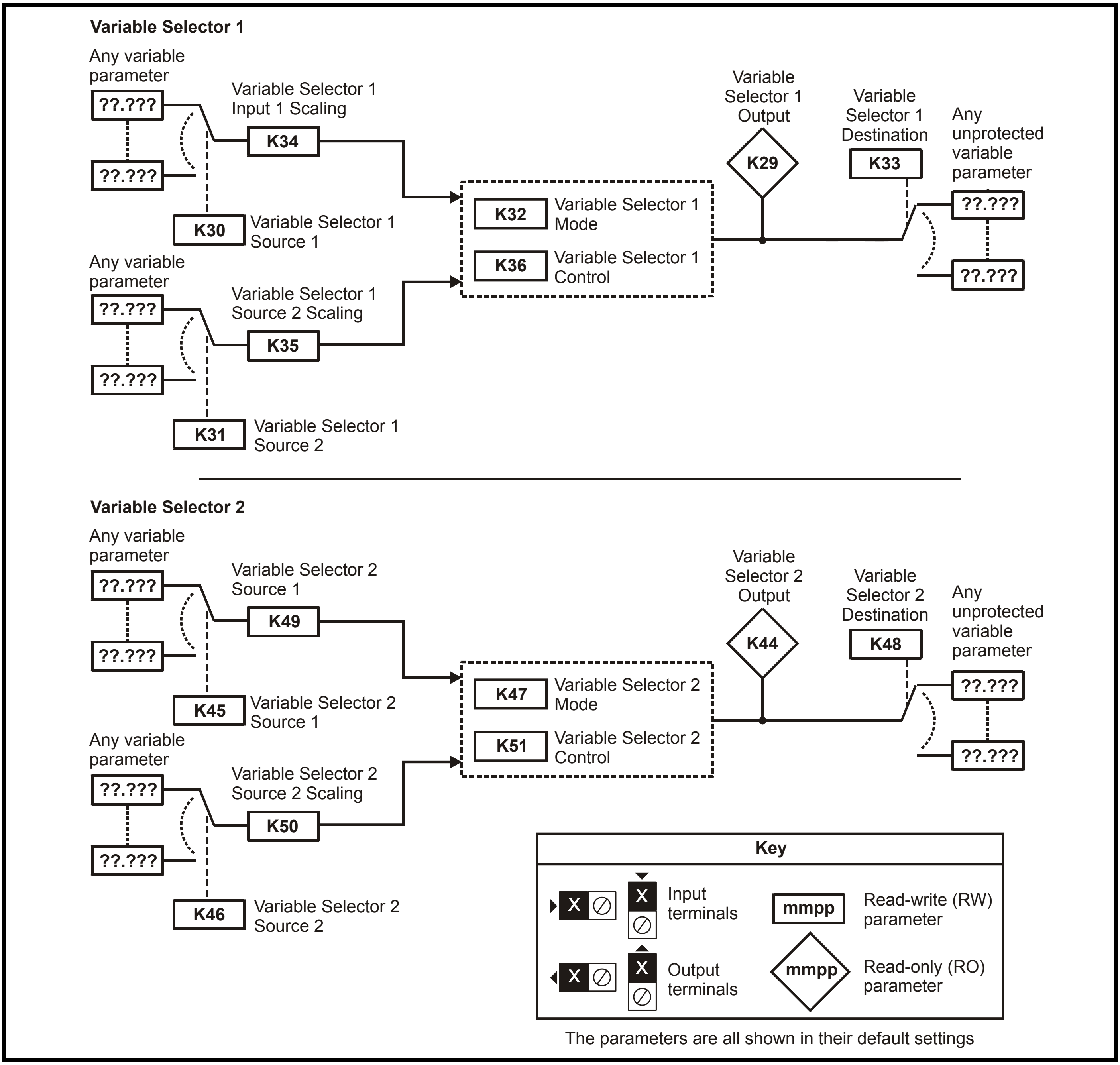


Figure 8-31 Menu K logic diagram: Variable selectors



Parameter		Range(⇕)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
K01	Logic Function 1 Output	Off (0) or On (1)						RO	Bit	ND	NC	PT	
K02	Logic Function 1 Source 1	A00 to AB99			A00			RW	Num			PT	US
K03	Logic Function 1 Source 1 Invert	Off (0) or On (1)			Off (0)			RW	Bit				US
K04	Logic Function 1 Source 2	A00 to AB99			A00			RW	Num			PT	US
K05	Logic Function 1 Source 2 Invert	Off (0) or On (1)			Off (0)			RW	Bit				US
K06	Logic Function 1 Output Invert	Off (0) or On (1)			Off (0)			RW	Bit				US
K07	Logic Function 1 Delay	±25.0 s			0.0 s			RW	Num				US
K08	Logic Function 1 Destination	A00 to AB99			A00			RW	Num	DE		PT	US
K09	Logic Function 2 Output	Off (0) or On (1)						RO	Bit	ND	NC	PT	
K10	Logic Function 2 Source 1	A00 to AB99			A00			RW	Num			PT	US
K11	Logic Function 2 Source 1 Invert	Off (0) or On (1)			Off (0)			RW	Bit				US
K12	Logic Function 2 Source 2	A00 to AB99			A00			RW	Num			PT	US
K13	Logic Function 2 Source 2 Invert	Off (0) or On (1)			Off (0)			RW	Bit				US
K14	Logic Function 2 Output Invert	Off (0) or On (1)			Off (0)			RW	Bit				US
K15	Logic Function 2 Delay	±25.0 s			0.0 s			RW	Num				US
K16	Logic Function 2 Destination	A00 to AB99			A00			RW	Num	DE		PT	US
K17	Binary Sum Ones	Off (0) or On (1)			Off (0)			RW	Bit		NC		
K18	Binary Sum Twos	Off (0) or On (1)			Off (0)			RW	Bit		NC		
K19	Binary Sum Fours	Off (0) or On (1)			Off (0)			RW	Bit		NC		
K20	Binary Sum Output	0 to 255						RO	Num	ND	NC	PT	
K21	Binary Sum Destination	A00 to AB99			A00			RW	Num	DE		PT	US
K22	Binary Sum Offset	0 to 248			0			RW	Num				US
K23	Threshold Detector 1 Output	Off (0) or On (1)						RO	Bit	ND	NC	PT	
K24	Threshold Detector 1 Source	A00 to AB99			A00			RW	Num			PT	US
K25	Threshold Detector 1 Level	0.00 to 100.00 %			0.00 %			RW	Num				US
K26	Threshold Detector 1 Hysteresis	0.00 to 25.00 %			0.00 %			RW	Num				US
K27	Threshold Detector 1 Output Invert	Off (0) or On (1)			Off (0)			RW	Bit				US
K28	Threshold Detector 1 Destination	A00 to AB99			A00			RW	Num	DE		PT	US
K29	Variable Selector 1 Output	±100.00 %						RO	Num	ND	NC	PT	
K30	Variable Selector 1 Source 1	A00 to AB99			A00			RW	Num			PT	US
K31	Variable Selector 1 Source 2	A00 to AB99			A00			RW	Num			PT	US
K32	Variable Selector 1 Mode	Input 1 (0), Input 2 (1), Add (2), Subtract (3), Multiply (4), Divide (5), Time Const (6), Ramp (7), Modulus (8), Powers (9), Sectional (10)			Input 1 (0)			RW	Txt				US
K33	Variable Selector 1 Destination	A00 to AB99			A00			RW	Num	DE		PT	US
K34	Variable Selector 1 Source 1 Scaling	±4.000			1.000			RW	Num				US
K35	Variable Selector 1 Source 2 Scaling	±4.000			1.000			RW	Num				US
K36	Variable Selector 1 Control	0.00 to 100.00			0.00			RW	Num				US
K37	Variable Selector 1 Enable	Off (0) or On (1)			On (1)			RW	Bit				US
K38	Threshold Detector 2 Output	Off (0) or On (1)						RO	Bit	ND	NC	PT	
K39	Threshold Detector 2 Source	A00 to AB99			A00			RW	Num			PT	US
K40	Threshold Detector 2 Level	0.00 to 100.00 %			0.00 %			RW	Num				US
K41	Threshold Detector 2 Hysteresis	0.00 to 25.00 %			0.00 %			RW	Num				US
K42	Threshold Detector 2 Output Invert	Off (0) or On (1)			Off (0)			RW	Bit				US
K43	Threshold Detector 2 Destination	A00 to AB99			A00			RW	Num	DE		PT	US
K44	Variable Selector 2 Output	±100.00 %						RO	Num	ND	NC	PT	
K45	Variable Selector 2 Source 1	A00 to AB99			A00			RW	Num			PT	US
K46	Variable Selector 2 Source 2	A00 to AB99			A00			RW	Num			PT	US
K47	Variable Selector 2 Mode	Input 1 (0), Input 2 (1), Add (2), Subtract (3), Multiply (4), Divide (5), Time Const (6), Ramp (7), Modulus (8), Powers (9), Sectional (10)			Input 1 (0)			RW	Txt				US
K48	Variable Selector 2 Destination	A00 to AB99			A00			RW	Num	DE		PT	US
K49	Variable Selector 2 Source 1 Scaling	±4.000			1.000			RW	Num				US
K50	Variable Selector 2 Source 2 Scaling	±4.000			1.000			RW	Num				US
K51	Variable Selector 2 Control	0.00 to 100.00			0.00			RW	Num				US
K52	Variable Selector 2 Enable	Off (0) or On (1)			On (1)			RW	Bit				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Mode: Open-Loop, RFC-A, RFC-S

K01	Logic Function 1 Output		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Logic Function 1 Output (**K01**) shows the output of logic function 1.

K02	Logic Function 1 Source 1		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

Logic Function 1 Source 1 (**K02**) defines input source 1 of logic function 1.

K03	Logic Function 1 Source 1		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Setting *Logic Function 1 Source 1 Invert* (**K03**) inverts input 1 of logic function 1.

K04	Logic Function 1 Source 2		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

Logic Function 1 Source 2 (**K04**) defines input source 2 of logic function 1.

K05	Logic Function 1 Source 2 Invert		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

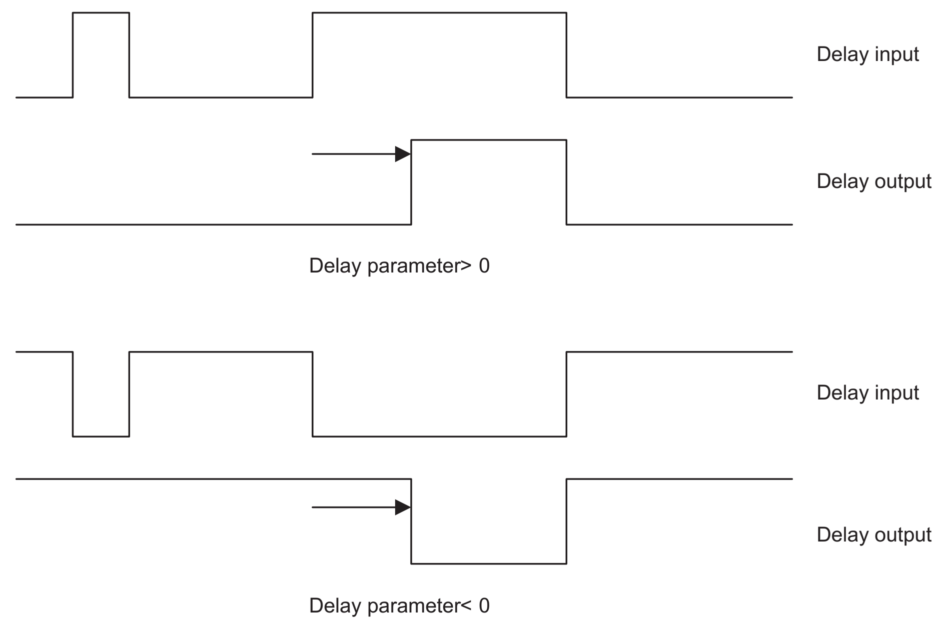
Setting *Logic Function 1 Source 2 Invert* (**K05**) inverts input 2 of logic function 1.

K06	Logic Function 1 Output Invert		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Setting *Logic Function 1 Output Invert* (**K06**) inverts the output of logic function 1.

K07	Logic Function 1 Delay		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-25.0	**Maximum**	25.0
Default	0.0	**Units**	s
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	1
Coding	RW		

Logic Function 1 Delay (**K07**) defines the delay at the output of logic function 1. If *Logic Function 1 Delay* (**K07**) is positive then the output does not become 1 until the input to the delay has been at 1 for the delay time. If *Logic Function 1 Delay* (**K07**) is negative then the output remains at 1 until the input to the delay has been 0 for the delay time.



Logic function delay

K08	Logic Function 1 Destination		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

Logic Function 1 Destination (**K08**) defines the output destination of logic function 1.

K09	Logic Function 2 Output		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Logic Function 2 Output (**K09**) shows the output of logic function 2.

K10	Logic Function 2 Source 1		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

Logic Function 2 Source 1 (**K10**) defines input source 1 of logic function 2.

K11	Logic Function 2 Source 1 Invert		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Setting *Logic Function 2 Source 1 Invert* (**K11**) inverts input 1 of logic function 2.

K12	Logic Function 2 Source 2		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

Logic Function 2 Source 2 (**K12**) defines input source 2 of logic function 2.

K13	Logic Function 2 Source 2 Invert		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

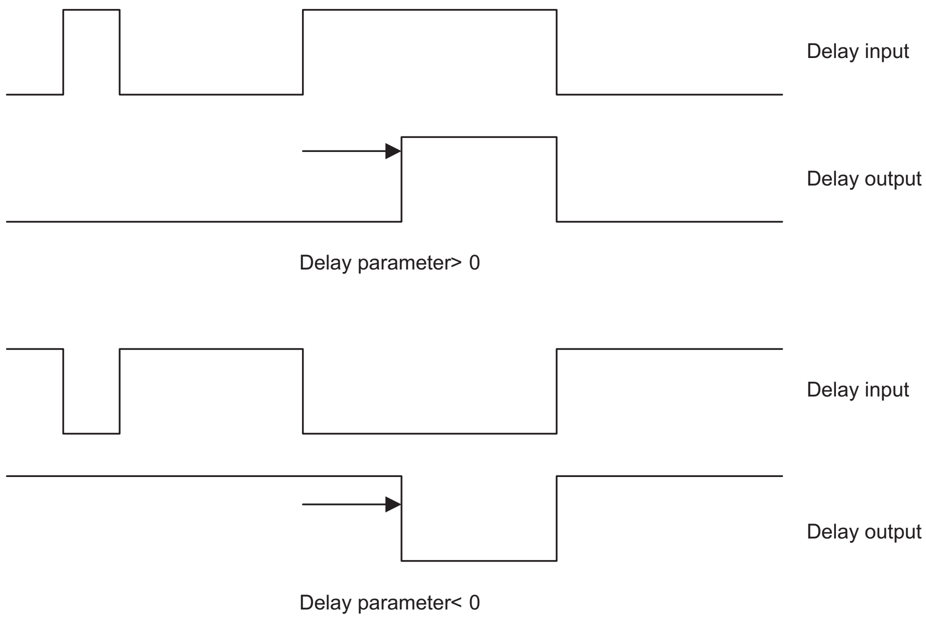
Setting *Logic Function 2 Source 2 Invert* (**K13**) inverts input 2 of logic function 2.

K14	Logic Function 2 Output Invert		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Setting *Logic Function 2 Output Invert* (**K14**) inverts the output of logic function 2.

K15	Logic Function 2 Delay		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-25.0	**Maximum**	25.0
Default	0.0	**Units**	s
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	1
Coding	RW		

Logic Function 2 Delay (**K15**) defines the delay at the output of logic function 1. If *Logic Function 2 Delay* (**K15**) is positive then the output does not become 1 until the input to the delay has been at 1 for the delay time. If *Logic Function 2 Delay* (**K15**) is negative then the output remains at 1 until the input to the delay has been 0 for the delay time.



Logic function delay

K16	Logic Function 2 Destination		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

Logic Function 2 Destination (**K16**) defines the output destination of logic function 2.

K17	Binary Sum Ones		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit Volatile	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW, NC		

See *Binary Sum Output* (**K20**).

K18	**Binary Sum Twos**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit Volatile	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW, NC		

See *Binary Sum Output* (**K20**).

K19	**Binary Sum Fours**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit Volatile	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW, NC		

See *Binary Sum Output* (**K20**).

K20	**Binary Sum Output**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

The output of the binary sum block is given by:

Binary Sum Output (**K20**) = *Binary Sum Offset* (**K22**) + (*Binary Sum Ones* (**K17**) x 1) + (*Binary Sum Twos* (**K18**) x 2) + (*Binary Sum Fours* (**K19**) x 4)

Binary Sum Destination (**K21**) defines the destination for the binary sum output. The routing for this destination is special if the maximum of the destination parameter ≤ 7 + *Binary Sum Offset* (**K22**) as follows:

Destination parameter = *Binary Sum Output* (**K20**), subject to the parameter minimum.

If the maximum of the destination parameter > 7, *Binary Sum Output* (**K20**) is routed in the same way as any other destination where the destination target is at its full scale value when the *Binary Sum Output* (**K20**) = 7 + *Binary Sum Offset* (**K22**).

K21	**Binary Sum Destination**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

Binary Sum Destination (**K21**) defines the destination for the binary sum output.

See *Binary Sum Output* (**K20**) for more information.

K22	**Binary Sum Offset**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	248
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

See *Binary Sum Output* (**K20**).

K23	Threshold Detector 1 Output		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

The threshold detector functions are always active even if the source and destination are not routed to valid parameters. If the source is not a valid parameter then the source value is taken as 0. The update rate for each of the threshold detector functions is always 4 ms.

The following description is for threshold detector 1, but threshold detector 2 operates in the same way. The level of the parameter defined by *Threshold Detector 1 Source* (**K24**) is converted to a percentage and compared to *Threshold Detector 1 Level* (**K25**) with hysteresis to give *Threshold Detector 1 Output* (**K23**) as follows:

Source	***Threshold Detector 1 Output*** (K23)
Source	0
Lower threshold ≤ Source	No change of state
Source ≥ Upper threshold	1

Lower threshold = *Threshold Detector 1 Level* (**K25**) - *Threshold Detector 1 Hysteresis* (**K26**)
Upper threshold = *Threshold Detector 1 Level* (**K25**) + *Threshold Detector 1 Hysteresis* (**K26**)

The output value can then be inverted with *Threshold Detector 1 Output Invert* (**K27**) before being routed to the destination defined by *Threshold Detector 1 Destination* (**K28**).

K24	Threshold Detector 1 Source		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

See *Threshold Detector 1 Output* (**K23**).

K25	Threshold Detector 1 Level		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.00	**Maximum**	100.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

See *Threshold Detector 1 Output* (**K23**).

K26	Threshold Detector 1 Hysteresis		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.00	**Maximum**	25.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

See *Threshold Detector 1 Output* (**K23**).

K27	Threshold Detector 1 Output Invert		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Threshold Detector 1 Output* (**K23**).

K28	Threshold Detector 1 Destination		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

See *Threshold Detector 1 Output* (**K23**).

K29	Variable Selector 1 Output		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-100.00	**Maximum**	100.00
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	2
Coding	RO, ND, NC, PT		

See *Variable Selector 1 Source 1* (**K30**).

K30	Variable Selector 1 Source 1		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

The variable selector functions are always active even if the source and destination are not routed to valid parameters. If a source is not a valid parameter then the source value is taken as 0. The update rate for each of the variable selector functions is always 4 ms.

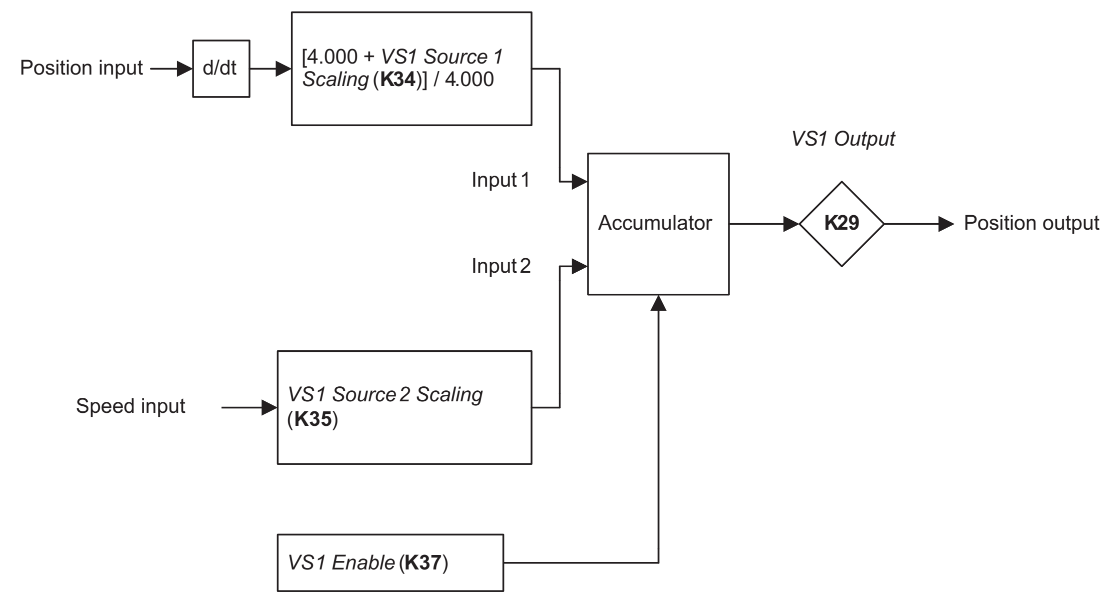
The following description is for variable selector 1, but variable selector 2 operates in the same way. The source parameters selected with *Variable Selector 1 Source 1* (**K30**) and *Variable Selector 1 Source 2* (**K31**) are converted to a percentage value, scaled with *Variable Selector 1 Source 1 Scaling* (**K34**) and *Variable Selector 1 Source 2 Scaling* (**K35**) respectively and then combined with a function defined by *Variable Selector 1 Mode* (**K32**) to give *Variable Selector 1 Output* (**K29**) as a percentage value. If *Variable Selector 1 Enable* (**K37**) = 1 then the function operates normally. If *Variable Selector 1 Enable* (**K37**) = 0 then *Variable Selector 1 Output* (**K29**) = 0.00% and any states within the function are reset (i.e. the time constant function accumulator is held at zero). If the value of *Variable Selector 1 Mode* (**K32**) is changed then all internal function state are also reset.

The table below shows the functions that can be selected with *Variable Selector 1 Mode* (**K32**).

***Variable Selector 1 Mode* (K32)**	***Variable Selector 1 Output* (K29)**
0: Input 1	Input 1
1: Input 2	Input 2
2: Add	Input 1 + Input 2
3: Subtract	Input 1 - Input 2
4: Multiply	(Input 1 x Input 2) / 100.00 %
5: Divide	(Input 1 x 100.00 %) / Input 2
6: Time Const	Input 1 / (1 + τs) where τ = *Variable Selector 1 Control* (K36) seconds
7: Ramp	Input 1 as an input to a linear ramp function where the time to ramp from 0.00 % to 100.00 % is defined by *Variable Selector 1 Control* (**K36**) seconds
8: Modulus	|Input1|
9: Powers	If *Variable Selector 1 Control* (**K36**) = 0.02 then $Input^2$ / 100.00 % Else if *Variable Selector 1 Control* (**K36**) = 0.03 then $Input^3$ / 100.00 % Else Input 1
10: Sectional	See description below

Sectional Controller

If *Variable Selector 1 Mode* (**K32**) = 10 then the variable selector can be used to provide a sectional control function. (Variable selector 2 operates in the same way.) The sectional control function is intended to apply scaling and a speed offset to a 16 bit position value to generate a new 16 bit position value. The output can be used as an input to the Standard motion controller (Menu 13) and to generate an encoder simulation output (Menu 3).



Sectional controller

The position input is selected with *Variable Selector 1 Source 1* (**K30**) and can be derived from any parameter. However, it is intended to be used with a position value that has a range from 0 to 65535 (e.g. *Drive Encoder Position* (**J53**)). The input is scaled so that as *Variable Selector 1 Source 1 Scaling* (**K34**) is changed between -4.000 and 4.000 so the proportion of the input position change added to the accumulator varies from 0.000 to 2.000 (i.e. the change of position input value is added without scaling if *Variable Selector 1 Source 1 Scaling* (**K34**) = 0.000). The remainder from the scaling division is stored and then added at the next sample to maintain an exact ratio between the position input and the position output, provided the speed from source 2 is zero. The controller only takes the change of position from the input source parameter, and not the absolute value, so that when the controller is first made active the output does not jump to the source position, but only moves with any changes of source position after that point in time.

The range of *Variable Selector 1 Output* (**K29**) is 0.00 % and 100.00 %. Unlike other functions the value is not simply limited, but rolls under or over respectively. Although the output destination can be any parameter it is intended to be used with a position value that has a range from 0 to 65535.

The speed input defines a speed offset with a resolution of 0.1 rpm. Full scale of the source parameter corresponds to 1000.0 rpm. Scaling may be applied using *Variable Selector 1 Source 2 Scaling* (**K35**) to give a full scale value up to 4000.0 rpm. The speed input is added to the accumulator to move the output position forwards or backwards with respect to the position input.

The sample time for the variable selector is 4 ms and the input or output position must not change by more than half a revolution over this time. Therefore the input or output speed must not exceed 7500 rpm.

K31	Variable Selector 1 Source 2		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	Maximum	**AB99**
Default	**A00**	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Menu Param Alpha Numeric	Decimal Places	3
Coding	RW, PT, BU		

See *Variable Selector 1 Source 1* (**K30**).

K32	Variable Selector 1 Mode		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	Maximum	10
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Input 1
1	Input 2
2	Add
3	Subtract
4	Multiply
5	Divide
6	Time Const
7	Ramp
8	Modulus
9	Powers
10	Sectional

See *Variable Selector 1 Source 1* (**K30**).

K33	Variable Selector 1 Destination		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	Maximum	**AB99**
Default	**A00**	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Menu Param Alpha Numeric	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Variable Selector 1 Source 1* (**K30**).

K34	Variable Selector 1 Source 1 Scaling		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-4.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	4 ms read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *Variable Selector 1 Source 1* (**K30**).

K35	Variable Selector 1 Source 2 Scaling		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-4.000	**Maximum**	4.000
Default	1.000	**Units**	
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	3
Coding	RW		

See *Variable Selector 1 Source 1* (**K30**).

K36	Variable Selector 1 Control		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.00	**Maximum**	100.00
Default	0.00	**Units**	
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

See *Variable Selector 1 Source 1* (**K30**).

K37	Variable Selector 1 Enable		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	1	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

See *Variable Selector 1 Source 1* (**K30**) for more details.
Variable Selector 1 Enable (**K37**) and *Variable Selector 2 Enable* (**K52**) have a default of 1 so that if these parameters are not used the variable selectors will still function.

K38	Threshold Detector 2 Output		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Threshold Detector 1 Output* (**K23**).

K39	Variable Selector 2 Source		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

See *Threshold Detector 1 Output* (**K23**).

K40	Threshold Detector 2 Level		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.00	**Maximum**	100.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

See *Threshold Detector 1 Output* (**K23**).

K41	Threshold Detector 2 Hysteresis		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.00	**Maximum**	25.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

See *Threshold Detector 1 Output* (**K23**).

K42	Threshold Detector 2 Output Invert		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Threshold Detector 1 Output* (**K23**).

K43	Threshold Detector 2 Destination		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

See *Threshold Detector 1 Output* (**K23**).

K44	Variable Selector 2 Output		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-100.00	**Maximum**	100.00
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	2
Coding	RO, ND, NC, PT		

See *Variable Selector 1 Source 1* (**K30**).

K45	Variable Selector 2 Source 1		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

See *Variable Selector 1 Source 1* (**K30**).

K46	Variable Selector 2 Source 2		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

See *Variable Selector 1 Source 1* (**K30**).

K47	Variable Selector 2 Mode		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	Text
0	Input 1
1	Input 2
2	Add
3	Subtract
4	Multiply
5	Divide
6	Time Const
7	Ramp
8	Modulus
9	Powers
10	Sectional

See *Variable Selector 1 Source 1* (**K30**).

K48	Variable Selector 2 Destination		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	**A00**	**Maximum**	**AB99**
Default	**A00**	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, DE, PT, BU		

See *Variable Selector 1 Source 1* (**K30**).

K49	Variable Selector 2 Source 1 Scaling		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-4.000	**Maximum**	4.000
Default	1.000	**Units**	
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	3
Coding	RW		

See *Variable Selector 1 Source 1* (**K30**).

K50	**Variable Selector 2 Source 2 Scaling**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-4.000	**Maximum**	4.000
Default	1.000	**Units**	
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	3
Coding	RW		

See *Variable Selector 1 Source 1* (**K30**).

K51	**Variable Selector 2 Control**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.00	**Maximum**	100.00
Default	0.00	**Units**	
Type	16 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	2
Coding	RW		

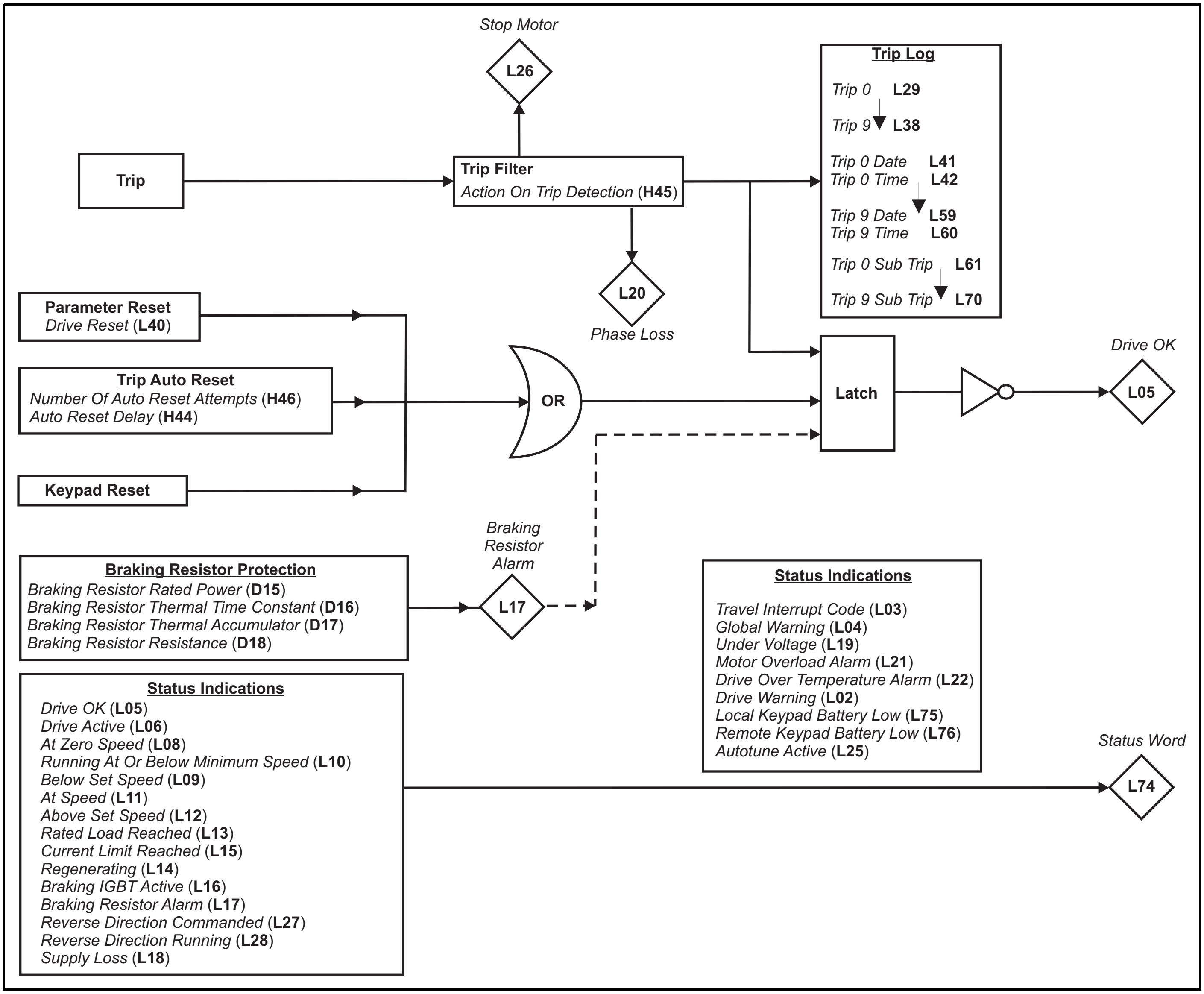
See *Variable Selector 1 Source 1* (**K30**).

K52	**Variable Selector 2 Enable**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	1	**Units**	
Type	1 Bit User Save	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

See *Variable Selector 1 Source 1* (**K30**).

8.11 Menu L: Diagnostics

Figure 8-32 Menu L Diagnostic logic diagram



Parameter		Range(⇳)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
L01	Drive Status	Inhibit (0), Ready (1), Stop (2), Scan (3), Run (4), Supply Loss (5), Deceleration (6), dc Injection (7), Position (8), Trip (9), Active (10), Off (11), Hand (12), Auto (13), Heat (14), Under Voltage (15), Phasing (16)						RO	Txt	ND	NC	PT	
L02	Drive Warning	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L03	Travel Interrupt Code	0 to 13						RO	Num	ND	NC	PT	
L04	Global Warning	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L05	Drive OK	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L06	Drive Active	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L07	Standstill Indication	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L08	At Zero Speed	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L13	Rated Load Reached	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L14	Regenerating	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L15	Current Limit Reached	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L16	Braking IGBT Active	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L17	Braking Resistor Alarm	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L18	Supply Loss	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L19	Under Voltage	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L20	Phase Loss	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L21	Motor Overload Alarm	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L22	Drive Over Temperature Alarm	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L23	Motor Thermistor Over Temperature Indication	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L24	Active Alarm	None (0), Brake Resistor (1), Motor Overload (2), Ind Overload (3), Drive Overload (4), Auto Tune (5), Limit Switch (6), Fire Mode (7), Low Load (8), Option Slot 1 (9), Option Slot 2 (10), Option Slot 3 (11), Option Slot 4 (12)						RO	Txt	ND	NC	PT	
L25	Autotune Active	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L26	Stop Motor	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L27	Reverse Direction Commanded	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L28	Reverse Direction Running	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L29	Trip 0	0 to 255						RO	Txt	ND	NC	PT	PS
L30	Trip 1	0 to 255						RO	Txt	ND	NC	PT	PS
L31	Trip 2	0 to 255						RO	Txt	ND	NC	PT	PS
L32	Trip 3	0 to 255						RO	Txt	ND	NC	PT	PS
L33	Trip 4	0 to 255						RO	Txt	ND	NC	PT	PS
L34	Trip 5	0 to 255						RO	Txt	ND	NC	PT	PS
L35	Trip 6	0 to 255						RO	Txt	ND	NC	PT	PS
L36	Trip 7	0 to 255						RO	Txt	ND	NC	PT	PS
L37	Trip 8	0 to 255						RO	Txt	ND	NC	PT	PS
L38	Trip 9	0 to 255						RO	Txt	ND	NC	PT	PS
L39	Reset Trip Log	Off (0) or On (1)						RW	Bit	ND	NC		
L40	Drive Reset	Off (0) or On (1)			Off (0)			RW	Bit		NC		
L41	Trip 0 Date	00-00-00 to 31-12-99						RO	Date	ND	NC	PT	PS
L42	Trip 0 Time	00:00:00 to 23:59:59						RO	Time	ND	NC	PT	PS
L43	Trip 1 Date	00-00-00 to 31-12-99						RO	Date	ND	NC	PT	PS
L44	Trip 1 Time	00:00:00 to 23:59:59						RO	Time	ND	NC	PT	PS
L45	Trip 2 Date	00-00-00 to 31-12-99						RO	Date	ND	NC	PT	PS
L46	Trip 2 Time	00:00:00 to 23:59:59						RO	Time	ND	NC	PT	PS
L47	Trip 3 Date	00-00-00 to 31-12-99						RO	Date	ND	NC	PT	PS
L48	Trip 3 Time	00:00:00 to 23:59:59						RO	Time	ND	NC	PT	PS
L49	Trip 4 Date	00-00-00 to 31-12-99						RO	Date	ND	NC	PT	PS
L50	Trip 4 Time	00:00:00 to 23:59:59						RO	Time	ND	NC	PT	PS
L51	Trip 5 Date	00-00-00 to 31-12-99						RO	Date	ND	NC	PT	PS
L52	Trip 5 Time	00:00:00 to 23:59:59						RO	Time	ND	NC	PT	PS
L53	Trip 6 Date	00-00-00 to 31-12-99						RO	Date	ND	NC	PT	PS
L54	Trip 6 Time	00:00:00 to 23:59:59						RO	Time	ND	NC	PT	PS
L55	Trip 7 Date	00-00-00 to 31-12-99						RO	Date	ND	NC	PT	PS
L56	Trip 7 Time	00:00:00 to 23:59:59						RO	Time	ND	NC	PT	PS
L57	Trip 8 Date	00-00-00 to 31-12-99						RO	Date	ND	NC	PT	PS

Parameter		Range(⇕)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
L58	Trip 8 Time	00:00:00 to 23:59:59						RO	Time	ND	NC	PT	PS
L59	Trip 9 Date	00-00-00 to 31-12-99						RO	Date	ND	NC	PT	PS
L60	Trip 9 Time	00:00:00 to 23:59:59						RO	Time	ND	NC	PT	PS
L61	Trip 0 Sub Trip Number	0 to 65535						RO	Num	ND	NC	PT	PS
L62	Trip 1 Sub Trip Number	0 to 65535						RO	Num	ND	NC	PT	PS
L63	Trip 2 Sub Trip Number	0 to 65535						RO	Num	ND	NC	PT	PS
L64	Trip 3 Sub Trip Number	0 to 65535						RO	Num	ND	NC	PT	PS
L65	Trip 4 Sub Trip Number	0 to 65535						RO	Num	ND	NC	PT	PS
L66	Trip 5 Sub Trip Number	0 to 65535						RO	Num	ND	NC	PT	PS
L67	Trip 6 Sub Trip Number	0 to 65535						RO	Num	ND	NC	PT	PS
L68	Trip 7 Sub Trip Number	0 to 65535						RO	Num	ND	NC	PT	PS
L69	Trip 8 Sub Trip Number	0 to 65535						RO	Num	ND	NC	PT	PS
L70	Trip 9 Sub Trip Number	0 to 65535						RO	Num	ND	NC	PT	PS
L71	Trip Reset Source	0 to 1023						RO	Num	ND	NC	PT	PS
L72	Trip Time Identifier	-2147483648 to 2147483647 ms						RO	Num	ND	NC	PT	
L73	Potential Drive Damage Conditions	0000 to 1111						RO	Bin	ND	NC	PT	PS
L74	Status Word	000000000000000 to 111111111111111						RO	Bin	ND	NC	PT	
L75	Local Keypad Battery Low	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L76	Remote Keypad Battery Low	Off (0) or On (1)						RO	Bit	ND	NC	PT	
L77	Deafaults Previously Loaded	0 to 2000						RO	Txt	ND	NC	PT	
L78	Power Stage Identifier	0 to 255						RO	Txt	ND	NC	PT	
L79	Control Board Identifier	0.000 to 65.535						RO	Txt	ND	NC	PT	
L80	Switching Frequency	2 (0), 3 (1), 4 (2), 6 (3), 8 (4), 12 (5), 16 (6) kHz						RO	Txt	ND	NC	PT	

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Mode: Open-Loop, RFC-A, RFC-S

L01	Drive Status		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	16
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, Txt, ND, NC, PT, BU		

Value	Text
0	Inhibit
1	Ready
2	Stop
3	Scan
4	Run
5	Supply Loss
6	Deceleration
7	DC Injection
8	Position
9	Trip
10	Active
11	Off
12	Hand
13	Auto
14	Heat
15	Under Voltage
16	Phasing

Drive Status (**L01**) shows the present status of the drive. The strings from this parameter are also used by the basic keypad to provide the status display text.

L02	Drive Warning		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Drive Warning (**L02**) is set to one if any of the drive warnings is active, and is defined as:

Drive Warning (**L02**) = *Braking Resistor Alarm* (**L17**) OR *Motor Overload Alarm* (**L21**) OR *Drive Over Temperature Alarm* (**L22**)

L03	Travel Interrupt Code		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	13
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This gives an indication of the elevator drive software activity at the point in time when a travel was last travel was interrupted. The value is reset when a new travel is started. A travel interrupt is actioned when the drive is disabled early or trips during the travel sequencing. See the table below:

Value	Description
0	No travel interrupt
1	Travel interrupt during while waiting for the enable input in state 1, *Elevator Software State* (**J03**) = 1.
2	Travel interrupt during the motor contactor de-bounce time in state 2, *Elevator Software State* (**J03**) = 2.
3	Travel interrupt during ramping the drive torque / brake release logic in state3 *Elevator Software State* (**J03**) = 3.
4	Travel interrupt during the brake release delay in state 4, *Elevator Software State* (**J03**) = 4.
5	Travel interrupt during the load measurement delay in state 5, *Elevator Software State* (**J03**) = 5.
6	Travel interrupt during start optimization in state 6, *Elevator Software State* (**J03**) = 6.
7	Travel interrupt during acceleration in state 7, *Elevator Software State* (**J03**) = 7.
8	Travel interrupt during travelling in state 8, *Elevator Software State* (**J03**) = 8.
9	Travel interrupt during deceleration in state 9, *Elevator Software State* (**J03**) = 9.
10	Travel interrupt during creep state 10, *Elevator Software State* (**J03**) = 10.
11	Travel interrupt during positioning in state 11, *Elevator Software State* (**J03**) = 11.
12	Travel interrupt during brake apply delay in state 12, *Elevator Software State* (**J03**) = 12.
13	Travel interrupt during torque ramp / brake apply in state 13, *Elevator Software State* (**J03**) = 13.

L04	Global Warning		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

When set to On (1), indicates that an error has been detected during travel. The trip for the given error will only happen when the elevator has finished the current travel.

The following trips are suppressed during a travel:

- Motor thermistor *Trip 24* (**Thermistor**)
- Brake monitoring *Trip 72* (**Brk con 1 open**), *Trip 73* (Brk con 1 closd), *Trip 74* (**Brk con 2 open**) and *Trip 75* (**Brk con 2 closd**)
- Motor contactor monitoring *Trip 70* (**Mot con open**) and *Trip 71* (**Mot con closd**)
- Heat sink over temperature *Trip 22* (**OHt Power**), the trip will happen when the next travel is initiated.
- The direction signal monitoring *Trip 76* (**Dir change**)
- Control word watchdog bit monitoring, *Trip 77* (**Ctrl Watchdog**).
- The freeze protection monitoring, trip 60 (Freeze protect).

L05	Drive OK		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Drive OK (**L05**) indicates that the drive is not in the trip or the under voltage state if it is set to one.

Drive State	LED
Normal power and *Drive OK* (**L05**) = 1	On continuously
Normal power and *Drive OK* (**L05**) = 0	Flashing: 0.5 s on and 0.5 s off
Standby power state	Flashing: 0.5 s on and 7.5 s off

L06	Drive Active		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	2 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

If the drive inverter is active *Drive Active* (**L06**) is set to one, otherwise it is zero.

L07	Standstill Indication		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This gives an indication of whether the elevator motor is at standstill or not.

It is set to Off (0) when the brake is released, and set to On (1) when the brake apply time has elapsed.

L08	At Zero Speed		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

At Zero Speed (**L08**) is set to one under the zero speed conditions, otherwise it is zero.

L13	Rated Load Reached		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Rated Load Reached (**L13**) is set to one when the torque producing current is at or above its rated level. This condition is detected when the modulus of *Percentage Load* (**J23**) is greater or equal to 100.0 %. It should be noted that this is an indication based on the level of current and not torque, which means that if field weakening is active a value of one in *Rated Load Reached* (**L13**) does not necessarily mean that the motor is producing rated torque.

L14	Regenerating		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Regenerating (**L14**) is set to one if power is being transferred from the motor to the drive.

L15	**Current Limit Reached**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Current Limit Reached (**L15**) is set to one if the current limit is active.

L16	**Braking IGBT Active**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Braking IGBT Active (**L16**) is set to one if the braking IGBT is active. As the braking IGBT active periods may be short, each time the braking IGBT is switched on *Braking IGBT Active* (**L16**) is set to one and remains at one for at least 0.5 s.

L17	**Braking Resistor Alarm**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Braking Resistor Alarm (**L17**) is set when the braking IGBT is active and *Braking Resistor Thermal Accumulator* (**D17**) is greater than 75.0 %. As the braking IGBT on periods may be short *Braking Resistor Alarm* (**L17**) is always held on for at least 0.5 s.

L18	**Supply Loss**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Supply Loss (**L18**) indicates that the drive is in the supply loss state. This condition can only occur if supply loss detection is enabled, In the supply loss state the drive will attempt to stop the motor.

L19	**Under Voltage**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Under Voltage (**L19**) indicates that the drive is in the under voltage state. See *Standard Under Voltage Threshold* (**O11**) for more details.

L20	Phase Loss		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

If phase loss or imbalance is detected that would initiate a phase loss trip with sub-trip 0, i.e. Phase Loss.000, then *Phase Loss* (**L20**) is set to one. Either the motor will be stopped and the drive tripped or the drive will continue to operate normally until the user stops the motor and the drive trips (see *Action On Trip Detection* (**H45**)). In either case *Phase Loss* (**L20**) is set to one when the phase loss condition is detected and remains set until the drive trips.

L21	Motor Overload Alarm		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Motor Overload Alarm (**L21**) is set if the drive output current is higher than the level that will eventually cause a Motor Too Hot trip and the *Motor Protection Accumulator* (**J26**) is higher than 75.0 %. See *Motor Thermal Time Constant 1* (**B20**) for more details.

L22	Drive Over Temperature Alarm		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Drive Over Temperature Alarm (**L22**) is set if *Percentage Of Drive Thermal Trip Level* (**J79**) is greater than 90 %.

L23	Motor Thermistor Over Temperature Indication		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This gives an indication of whether the elevator motor thermistor has reached the thermal trip threshold. When set to Off (0) the motor thermistor indicates that the temperature is healthy. When set to On (1) the temperature is not healthy.

L24	Active Alarm		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	12
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT, BU		

Value	Text
0	None
1	Brake Resistor
2	Motor Overload
3	Ind Overload
4	Drive Overload
5	Auto Tune
6	Limit Switch
7	Fire Mode
8	Low Load
9	Option Slot 1
10	Option Slot 2
11	Option Slot 3
12	Option Slot 4

If there is no alarm then *Active Alarm* (**L24**) = 0. If one alarm is active then *Active Alarm* (**L24**) shows the value of the alarm. If more than one alarm is active then *Active Alarm* (**L24**) shows the active alarm with the lowest value. The strings from this parameter are also used by the basic keypad to provide the status display text except for option slot warnings where the option module may supply the string.

L25	**Autotune Active**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Autotune Active (**L25**) is set to one while an auto-tune sequence is active.

L26	**Stop Motor**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

It is possible for some trips to cause the motor to stop before the trip is initiated (see *Action On Trip Detection* (**H45**)). During the period while the motor is being stopped before the trip is initiated *Stop Motor* (**L26**) is set to one. Once the motor stops *Stop Motor* (**L26**) is set back to zero.

L27	**Reverse Direction Commanded**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Reverse Direction Commanded (**L27**) indicates the reference direction at the input to the ramp system. If the *Profile Speed* (**J39**) is negative *Reverse Direction Commanded* (**L27**) is one otherwise *Reverse Direction Commanded* (**L27**) is zero.

L28	**Reverse Direction Running**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

In Open-loop mode, *Reverse Direction Running* (**L28**) is set to one if the *Profile Speed* (**J39**) is negative otherwise it is set to zero. In RFC-A and RFC-S modes, *Reverse Direction Running* (**L28**) is set to one if the *Drive Encoder Speed Feedback* (**J51**) is negative, otherwise it is set to zero.

L29	Trip 0		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT, BU		

Value	Text	Value	Text
0	None	16	Autotune 6
1	Reserved 001	17	Autotune 7
2	Over Volts	18	Autotune Stopped
3	OI ac	19	Brake R Too Hot
4	OI Brake	20	Motor Too Hot
5	PSU	21	OHt Inverter
6	External Trip	22	OHt Power
7	Over Speed	23	OHt Control
8	Inductance	24	Thermistor
9	PSU 24V	25	Th Short Circuit
10	Th Brake Res	26	I/O Overload
11	Autotune 1	27	OHt dc bus
12	Autotune 2	28	An Input 1 Loss
13	Autotune 3	29	An Input 2 Loss
14	Autotune 4	30	Watchdog
15	Autotune 5	31	EEPROM Fail

Trip 0 (**L29**) to *Trip 9* (**L38**) store the most recent 10 trips that have occurred where *Trip 0* (**L29**) is the most recent and *Trip 9* (**L38)** is the oldest. When a new trip occurs it is written to *Trip 0* (**L29**) and all the other trips move down the log, with oldest being lost. The date and time when each trip occurs are also stored in the date and time log, i.e. *Trip 0 Date* (**L41**) to *Trip 9 Time* (**L60**). The date and time are taken from *Date* (**J80**) and *Time* (**J81**). Some trips have sub-trip numbers which give more detail about the reason for the trip. If a trip has a sub-trip number its value is stored in the sub-trip log, i.e. *Trip 0 Sub Trip Number* (**L61**) to *Trip 9 Sub Trip Number* (**L70**). If the trip does not have a sub-trip number then zero is stored in the sub-trip log.

Trip categories and priorities

Trips are grouped into the categories given in the table below. A trip can only occur when the drive is not tripped, or if it is already tripped and the new trip has a higher priority than the active trip (i.e. lower priority number). Unless otherwise stated a trip cannot be reset until 1.0 s after it has been initiated.

Priority	Category	Trips	Comments
1	Internal faults	*HF01 – HF20*	These are fatal problems that cannot be reset. All drive features are inactive after any of these trips occur. If a basic keypad is installed it will show the trip, but the keypad will not function. These trips are not stored in the trip log.
1	Stored HF trip	Stored HF	This trip cannot be cleared unless 1299 is entered into *Pr **mm00*** and a reset is initiated.
2	Non-resettable trips	Trip numbers 218 to 247, *Slot1 HF*, *Slot2 HF*, Slot3 HF or Slot4 HF	These trips cannot be reset.
3	Volatile memory failure	EEPROM Fail	This can only be reset if *Pr **mm00*** is set to 1233 or 1244, or if *Default Drive* (**H04**) is set to a non-zero value.
4	Internal 24V power supply	PSU 24V	
5	Non-volatile media trips	Trip numbers 174, 175 and 177 to 188	These trips are priority 6 during power-up.
5	Position feedback interface power supply	Encoder 1	This trip can override *Encoder 2* to *Encoder 6* trips.
6	Trips with extended reset times	OI ac, *OI Brake*, and *OI dc*	These trips cannot be reset until 10s after the trip was initiated.
6	Phase loss and d.c. link power circuit protection	*Phase Loss* and *OHt dc bus*	The drive will attempt to stop the motor before tripping if a *Phase Loss*.000 trip occurs unless this feature has been disabled (see *Action On Trip Detection* (**H45**). The drive will always attempt to stop the motor before tripping if an *OHt dc bus* occurs.
6	Standard trips	All other trips	

Internal faults

Trips *{HF01}* to *{HF20}* are internal faults that do not have trip numbers. If one of these trips occurs, the main drive processor has detected an irrecoverable error. All drive functions are stopped and the trip message will be displayed on the drive keypad. The error can only be reset by powering the drive down and up again. The table below gives the reasons for internal faults and their corresponding trip.

Trip	Reason
{*HF01*}	CPU has detected an address error
{*HF02*}	CPU DMAC has detected an address error
{*HF03*}	CPU has detected an Illegal op code
{*HF04*}	CPU has detected an Illegal slot instruction
{*HF05*}	An interrupt has occurred that does not have a defined function (Undefined exception)
{*HF06*}	An interrupt has occurred which is reserved (Reserved exception)
{*HF07*}	Watchdog failure
{*HF08*}	CPU Interrupt crash
{*HF09*}	Free store overflow
{*HF10*}	Parameter routing system error
{*HF11*}	Non-volatile memory comms error
{*HF12*}	Stack overflow. Sub-trip is shown to indicate which stack: 1 – background tasks 2 – timed tasks 3 – main system interrupts
{*HF13*}	The control hardware is not compatible with the firmware. The sub-trip number gives the actual ID code of the control board hardware.
{*HF14*}	CPU register bank error
{*HF15*}	CPU divide error
{*HF16*}	RTOS error (the background task has returned)
{*HF17*}	The clock supplied to the control board logic is out of specification
{*HF18*}	The internal flash memory has failed when writing option module parameter data. Sub-trip is shown to indicate which failure: 1 - Programming error while writing menu in flash 2 - Erase flash block containing setup menus failed 3 - Erase flash block containing application menus failed
{*HF19*}	Invalid main application firmware CRC. Reprogramming required.
{*HF20*}	The ASIC is not compatible with the firmware. The sub-trip number displayed is the ASIC version.
{HF23}	If this trip occurs please consult the drive supplier.
{HF24}	If this trip occurs please consult the drive supplier.
{HF25}	If this trip occurs please consult the drive supplier.

When the drive is subsequently powered up a *Stored HF* trip is initiated where the sub-trip number is the number of the HF trip that last occurred. This trip will occur at every power-up until it is reset. The trip can only be reset by first entering 1299 into Pr *mm00*.

Similar trips that can be initiated by the control system or the power system

Trips shown in the table below can be generated either from the drive control system or from the power system. The sub-trip number which is in the form xxyzz is used to identify the source of the trip. The digits xx are 00 for a trip generated by the control system or the number of a power module if generated by the power system. If the drive is not a multi-power module drive then xx will always have a value of 1 the trip is related to the power system. The y digit is used to identify the location of a trip which is generated by a rectifier module connected to a power module. Where the y digit is relevant it will have a value of 1 or more, otherwise it will be 0. The zz digits give the reason for the trip and are defined in each trip description.

Over Volts	*OHt dc bus*
OI ac	*Phase Loss*
OI Brake	*Power Comms*
PSU	*OI Snubber*
OHt Inverter	*Reserved 102*
OHt Power	*Temp Feedback*
OHt Control	*Power Data*

Braking IGBT

The list below gives conditions that will disable the braking IGBT:

1. *Braking IGBT Upper Threshold* (**D20**) = 0, or *Low Voltage Braking IGBT Threshold Select* (**D22**) = 1 and *Low Voltage Braking IGBT Threshold* (**D21**) = 0.
2. The drive is in the under-voltage state.
3. A priority 1, 2 or 3 trip is active (see Trip 0 (**L29**)).
4. One of the following trips is active or would be active if another trip is not already active: OI Brake, PSU, Th Brake Res or OHt Inverter.

5. *Percentage Of Drive Thermal Trip Level* (**J79**) = 100 %. This is an indication that some part of the drive is too hot and is used to indicate if an internally installed braking resistor is too hot.
6. *Brake R Too Hot* is active or the system has been set up to disable the braking IGBT based on the braking resistor temperature and the resistor is too hot (i.e. bit 2 of *Action On Trip Detection* (**H45**) is set).

L30	**Trip 1**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L31	**Trip 2**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L32	**Trip 3**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L33	**Trip 4**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L34	**Trip 5**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L35	Trip 6		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L36	Trip 7		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L37	Trip 8		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L38	Trip 9		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L39	Reset Trip Log		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW, ND, NC		

When set to On (1), the drive trip log is reset. This parameter will automatically reset to Off (0) when the trip log reset has completed.
This parameter is intended for service personnel to reset the trip log manually as part of routine maintenance.

L40	Drive Reset		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit Volatile	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, NC		

A 0 to 1 transition in *Drive Reset* (**L40**) causes a drive reset. If a drive reset terminal is required a digital input should be routed to *Drive Reset* (**L40**).

L41	Trip 0 Date		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	311299 (Display: 31-12-99)
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Date	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L42	Trip 0 Time		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	235959 (Display: 23:59:59)
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Time	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L43	Trip 1 Date		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	311299 (Display: 31-12-99)
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Date	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L44	Trip 1 Time		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	235959 (Display: 23:59:59)
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Time	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L45	Trip 2 Date		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	311299 (Display: 31-12-99)
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Date	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L46	Trip 2 Time		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00:00:00)	**Maximum**	235959 (Display: 23:59:59)
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Time	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L47	Trip Trip 3 Date		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	311299 (Display: 31-12-99)
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Date	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L48	Trip 3 Time		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	235959 (Display: 23:59:59)
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Time	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L49	Trip Trip 4 Date		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	311299 (Display: 31-12-99)
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Date	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L50	**Trip 4 Time**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Time	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L51	**Trip 5 Date**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	311299 (Display: 31-12-99)
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Date	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L52	**Trip 5 Time**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Time	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L53	**Trip 6 Date**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	311299 (Display: 31-12-99)
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Date	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L54	**Trip 6 Time**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Time	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L55	**Trip 7 Date**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	311299 (Display: 31-12-99)
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Date	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L56	**Trip 7 Time**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Time	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L57	**Trip 8 Date**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	311299 (Display: 31-12-99)
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Date	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L58	**Trip 8 Time**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Time	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L59	**Trip 9 Date**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	311299 (Display: 31-12-99)
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Date	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L60	Trip 9 Time		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 00-00-00)	**Maximum**	
Default		**Units**	
Type	32 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Time	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Trip 0* (**L29**).

L61	Trip 0 Sub Trip Number		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	65535
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L62	Trip 1Sub Trip Number		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	65535
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L63	Trip 2 Sub Trip Number		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	65535
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L64	Trip 3 Sub Trip Number		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	65535
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L65	Trip 4 Sub Trip Number		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	65535
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L66	Trip 5 Sub Trip Number		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	65535
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L67	Trip 6 Sub Trip Number		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	65535
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L68	Trip 7 Sub Trip Number		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	65535
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L69	Trip 8 Sub Trip Number		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	65535
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L70	Trip 9 Sub Trip Number		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	65535
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (**L29**).

L71	**Trip Reset Source**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1023
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

The bits in *Trip Reset Source* (**L71**) correspond to each of the trips in the trip log (i.e. bit 0 corresponds to trip 0, bit 1 corresponds to trip 1, etc.). When a trip occurs, bit 0 is set to one and the other bits corresponding to the trips already in the trip log are shifted left one bit. If the trip is reset then bit 0 is set back to zero, otherwise if a higher priority trip occurs bit 0 is shifted left by one bit. The result is that each of the bits in *Trip Reset Source* (**L71**) show whether trips in the trip log were reset or moved up the trip log by a higher priority trip.

L72	**Trip Time Identifier**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-2147483648	**Maximum**	2147483647
Default		**Units**	ms
Type	32 Bit Volatile	**Update Rate**	Write on trip
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

When a trip occurs the time in milliseconds since the drive powered up is stored in *Trip Time Identifier* (**L72**). The time rolls-over when it reaches 231 - 1, but if the time is 0 a value of 1 is written. *Trip Time Identifier* (**L72**) can be used to determine when a new trip has occurred as the value will change (unless there were exactly 232 ms between trips) and will be non-zero.

L73	**Potential Drive Damage Conditions**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 0000)	**Maximum**	15 (Display: 1111)
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	background write
Display Format	Binary	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

The bits in *Potential Drive Damage Conditions* (**L73**) are set under the conditions shown in the table below to indicate that the user has put the drive in a condition that could potentially damage the drive. The bits in this parameter cannot be cleared by users.

Potential Drive Damage Conditions (L73) bit	**Condition**
1	*Low Under Voltage Threshold* (**O14**) has been reduced from its default value.
2	High speed RFC-S mode has been used. See *Enable High Speed Mode* (**B28**).
3	Not used.

The bits in *Status Word* (**L74**) mirror the status bit parameters as shown below. Where the parameters do not exist in any mode the bit remains at zero.

L74	**Status Word**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0 (Display: 000000000000000)	**Maximum**	32767 (Display: 111111111111111)
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background Write
Display Format	Binary	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Bit	Status parameter
0	*Drive OK* (L05)
1	*Drive Active* (L06)
2	*At Zero Speed* (L08)
3	*Running At Or Below Minimum Speed* (L10)
4	*Below Set Speed* (L09)
5	*At Speed* (L11)
6	*Above Set Speed* (L12)
7	*Rated Load Reached* (L13)
8	*Current Limit Reached* (L15)
9	*Regenerating* (L14)
10	*Braking IGBT Active* (L16)
11	*Braking Resistor Alarm* (L17)
12	*Reverse Direction Commanded* (L27)
13	*Reverse Direction Running* (L28)
14	*Supply Loss* (L18)

L75	Local Keypad Battery Low		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background Write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Local Keypad Battery Low (**L75**) is set to one when a keypad is installed to the front of the drive with an internal real-time clock and the battery is not installed or the voltage is below the minimum threshold.

L76	Remote Keypad Battery Low		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Remote Keypad Battery Low (**L76**) is set to one when a keypad is connected to the drive user comms port with an internal real-time clock and the battery is not installed or the voltage is below the minimum threshold.

L77	Defaults Previously Loaded		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	2000
Default		**Units**	
Type	16 Bit User Save	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Defaults Previously Loaded (**L77**) shows the value used to load the previously loaded defaults (i.e. 1233 for 50 Hz defaults, or 1244 for 60 Hz defaults).

L78	Power Stage Identifier		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Power-up write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT, BU		

Power Stage Identifier (**L78**) is used to show power stages which require changes to the drive user parameters (i.e. visibility, range of defaults). It should be noted that this parameter does not identify the rating of the power stage.

Power Stage Identifier (L78)	Power Stage
0	Standard Unidrive M
1	Unidrive M with no braking IGBT

L79	Control Board Identifier		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.000	**Maximum**	65.535
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Power-up write
Display Format	Standard	**Decimal Places**	3
Coding	RO, ND, NC, PT, BU		

Control Board Identifier (**L79**) identifies the main control board software and hardware in the form S.HHH, where S is the software as given in the table below, and HHH is the control board hardware identifier.

Control Board Identifier (L79)	Control board
0	Standard Unidrive M

L80	Switching Frequency		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	6
Default		**Units**	kHz
Type	8 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, TE, ND, NC, PT		

Value	Text
0	2
1	3
2	4
3	6
4	8
5	12

8.12 Menu M: Comms

Parameter		Range Open-Loop	Range RFC-A	Range RFC-S	Default Open-Loop	Default RFC-A	Default RFC-S	Type					
M01	Serial Address	1 to 247			1			RW	Num				US
M02	Serial Mode	8 2 NP (0), 8 1 NP (1), 8 1 EP (2), 8 1 OP (3), 8 2 NP M (4), 8 1 NP M (5), 8 1 EP M (6), 8 1 OP M (7), 7 2 NP (8), 7 1 NP (9), 7 1 EP (10), 7 1 OP (11), 7 2 NP M (12), 7 1 NP M (13), 7 1 EP M (14), 7 1 OP M (15)			8 2 NP (0)			RW	Txt				US
M03	Serial Baud Rate	300 (0), 600 (1), 1200 (2), 2400 (3), 4800 (4), 9600 (5), 19200 (6), 38400 (7), 57600 (8), 76800 (9), 115200 (10)			19200 (6)			RW	Txt				US
M04	Minimum Comms Transmit Delay	0 to 250 ms			2 ms			RW	Num				US
M05	Silent Period	0 to 250 ms			0 ms			RW	Num				US
M06	Reset Serial Communications	Off (0) or On (1)						RW	Bit	ND	NC		
M07	Keypad Port Serial Address	1 to 16			1			RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

M01	Serial Address		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	247
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	Read on serial communications reset
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

Serial Address (**M01**) defines the node address for the serial comms interface in the range from 1 to 247.

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (**M06**) for more details.

M02	Serial Mode		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	15
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Read on serial communications reset
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt		

Value	Text
0	8 2 NP
1	8 1 NP
2	8 1 EP
3	8 1 OP
4	8 2 NP M
5	8 1 NP M
6	8 1 EP M
7	8 1 OP M
8	7 2 NP
9	7 1 NP
10	7 1 EP
11	7 1 OP
12	7 2 NP M
13	7 1 NP M
14	7 1 EP M
15	7 1 OP M

The core drive always uses the Modbus rtu protocol and is always a slave. *Serial Mode* (**M02**) defines the data format used by the serial comms interface. The bits in the value of *Serial Mode* (**M02**) define the data format as follows. Bit 3 is always 0 in the core product as 8 data bits are required for Modbus rtu.

Bits	3	2	1 and 0
Format	Number of data bits 0 = 8 bits 1 = 7 bits	Register mode 0 = Standard 1 = Modified	Stop bits and Parity 0 = 2 stop bits, no parity 1 = 1 stop bit, no parity 2 = 1 stop bit, even parity 3 = 1 stop bit, odd parity

Bit 2 selects either standard or modified register mode. The menu and parameter numbers are derived for each mode as given in the table below. Standard mode is compatible with *Unidrive SP*. Modified mode is provided to allow register numbers up to 255 to be addressed. If any menus with numbers above 63 should contain more than 99 parameters, then these parameters cannot be accessed via Modbus rtu.

Register mode	Register address
Standard	(mm x 100) + ppp - 1 where mm ≤ 162 and ppp ≤ 99
Modified	(mm x 256) + ppp - 1 where mm ≤ 63 and ppp ≤ 255

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (**M06**) for more details.

M03	Serial Baud Rate		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	10
Default	6	**Units**	
Type	8 Bit User Save	**Update Rate**	Read on serial communications reset
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt		

Value	Text
0	300
1	600
2	1200
3	2400
4	4800
5	9600
6	19200
7	38400
8	57600
9	76800
10	115200

Serial Baud Rate (**M03**) defines the baud rate used by the serial comms interface.

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (**M06**) for more details.

M04	Minimum Comms Transmit Delay		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	250
Default	2	**Units**	ms
Type	8 Bit User Save	**Update Rate**	Read on serial communications reset
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

There will always be a finite delay between the end of a message from the host (master) and the time at which the host is ready to receive the response from the drive (slave). The drive does not respond until at least 1ms after the message has been received from the host allowing 1ms for the host to change from transmit to receive mode. This initial delay can be extended using *Minimum Comms Transmit Delay* (**M04**) if required.

Minimum Comms Transmit Delay **(M04)**	**Action**
0	The transmitters are turned on and data transmission begins immediately after the initial delay (≥1 ms)
1	The transmitters are turned on after the initial delay (≥1 ms) and data transmission begins 1ms later
2 or more	The transmitters are turned on after a delay of at least the time specified by *Minimum Comms Transmit Delay* (**M04**) and data transmission begins 1 ms later

The drive holds its own transmitters active for up to 1 ms after it has transmitted data before switching to the receive mode; the host should not send any data during this time.

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (**M06**) for more details.

M05	**Silent Period**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	250
Default	0	**Units**	ms
Type	8 Bit User Save	**Update Rate**	Read on serial communications reset
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

The silent period defines the idle time required to detect the end of a received data message. If *Silent Period* (**M05**) = 0 then the silent period is at least 3.5 characters at the selected baud rate. This is the standard silent period for Modbus rtu. If *Silent Period* (**M05**) is non-zero it defines the minimum silent period in milliseconds.

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (**M06**) for more details.

M06	**Reset Serial Communications**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	ms
Type	1 Bit Volatile	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, ND, NC		

When *Serial Address* (**M01**), *Serial Mode* (**M02**), *Serial Baud Rate* (**M03**), *Minimum Comms Transmit Delay* (**M04**) or *Silent Period* (**M05**) are modified the changes do not have an immediate effect on the serial communications system. The new values are used after the next power-up or if *Reset Serial Communications* (**M06**) is set to one. *Reset Serial Communications* (**M06**) is automatically cleared to zero after the communications system is updated.

M07	**Keypad Port Serial Address**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	16
Default	1	**Units**	ms
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Keypad Port Serial Address (**M07**) defines the node address for the keypad port serial comms interface. Normally the default value of 1 is used, but this can be changed if required. The keypad attached to the port will sense the address automatically.

8.13 Menu N: Storage

Parameter		Range(⇕)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
N01	Parameter Cloning	None (0), Read (1), Program (2), Auto (3), Boot (4)			None (0)			RW	Txt		NC		US
N02	Media Card File Previously Loaded	0 to 999			0			RO	Num		NC	PT	
N03	Media Card File Number	0 to 999			0			RW	Num				
N04	Media Card File Type	None (0), Open-loop (1), RFC-A (2), RFC-S (3), Regen (4), User Prog (5), Option App (6)						RO	Txt	ND	NC	PT	
N05	Media Card File Version	0 to 9999						RO	Num	ND	NC	PT	
N06	Media Card File Checksum	-2147483648 to 2147483647						RO	Num	ND	NC	PT	
N07	Media Card Create Special File	0 to 1			0			RW	Num		NC		
N08	Media Card Type	None (0), SMART Card (1), SD Card (2)						RO	Txt	ND	NC	PT	
N09	Media Card Read-only Flag	Off (0) or On (1)						RO	Bit	ND	NC	PT	
N10	Media Card Warning Suppression Flag	Off (0) or On (1)						RO	Bit	ND	NC	PT	
N11	Media Card File Required Version	0 to 9999						RW	Num	ND	NC	PT	

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Mode: Open-Loop, RFC-A, RFC-S

N01	Parameter Cloning		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	4
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt, NC		

Value*	Text
0	None
1	Read
2	Program
3	Auto
4	Boot

* Only a value of 3 or 4 in this parameter is saved.

Parameter Cloning (**N01**) can also be used to initiate data transfer to or from an NV media card as described below for each possible value of this parameter.

1: Read

Provided a parameter file with file identification number 1 exists on the NV media card then setting *Parameter Cloning* (**N01**) = 1 and initiating a drive reset will transfer the parameter data to the drive (i.e. the same action as writing 6001 to Pr mm00. When the action is complete *Parameter Cloning* (**N01**) is automatically reset to zero.

2: Program

Setting *Parameter Cloning* (**N01**) and initiating a drive reset will transfer the parameter data from the drive to a parameter file with file identification number 1. This is the same action as writing 4001 to Pr mm00 except that the file will be overwritten if it already exists. When the action is complete *Parameter Cloning* (**N01**) is automatically reset to zero.

3: Auto

Setting *Parameter Cloning* (**N01**) = 3 and initiating a drive reset will transfer the parameter data from the drive to a parameter file with file identification number 1. This is the same action as writing 4001 to Pr mm00 except that the file will be overwritten if it already exists. When the action is complete *Parameter Cloning* (**N01**) remains at 3.

If the card is removed when *Parameter Cloning* (**N01**) = 3, then *Parameter Cloning* (**N01**) is set to 0, which forces the user to change *Parameter Cloning* (**N01**) back to 3 if auto mode is still required. The user will need to set *Parameter Cloning* (**N01**) = 3 and initiate a drive reset to write the complete parameter set to the new card.

When a parameter in Menu zero is changed via the keypad and *Parameter Cloning* (**N01**) = 3 the parameter is saved both to the drive non-volatile memory and to the parameter file with identification number 1 on the card. Only the new value of the modified parameter, and not the value of all the other drive parameters, is stored each time. If *Parameter Cloning* (**N01**) is not cleared automatically when a card is removed, then when a new card is inserted that contains a parameter file with identification number 1 the modified parameter would be written to the existing file on the new card and the rest of the parameters in this file may not be the same as those in the drive.

When *Parameter Cloning* (**N01**) = 3 and the drive parameters are saved to non-volatile memory, the file on the card is also updated, therefore this file becomes a copy of the drive parameters. At power up, if *Parameter Cloning* (**N01**) = 3, the drive will save its complete parameter set to the card. This is done to ensure that if a card is inserted whilst the drive is powered down the new card will have the correct data after the drive is powered up again.

4: Boot

When *Parameter Cloning* (**N01**) = 4, the drive operates in the same way as with *Parameter Cloning* (**N01**) = 3 and automatically creates a copy of its parameters on the NV Media card. The NC (not clonable) attribute for *Parameter Cloning* (**N01**) is 1, and so it does not have a value stored in the parameter file on the card in the normal way. However, the value of *Parameter Cloning* (**N01**) is held in the parameter file header. If *Parameter Cloning* (**N01**) = 4 in the parameter file with a file identification value of 1 on an NV media card fitted to a drive at power-up then the parameters from the parameter file with file identification number 1 are transferred to the drive and then saved in non-volatile memory. *Parameter Cloning* (**N01**) is then set to 0 after the data transfer is complete.

It is possible to create a bootable parameter file by setting Pr **mm00** = 2001 and initiating a drive reset. This file is created in one operation and is not updated when further parameter changes are made.

When the drive is powered up it detects which option modules are installed before loading parameters from an NV media card which has been set up for boot mode. If a new option module has been installed since the last time the drive was powered up, a Slot1 Different trip is initiated and then the parameters are transferred from the card. If the parameter file includes the parameters for the newly installed option module then these are also transferred to the drive and the Slot1 Different trip is reset. If the parameter file does not include the parameters for the newly installed option module then the drive does not reset the Slot1 Different trip. Once the transfer is complete the drive parameters are saved to non-volatile memory. The trip can be reset either by initiating a drive reset or by powering down and then powering up again.

N02	**Media Card File Previously Loaded**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	999
Default	0	**Units**	
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, NC, PT		

Media Card File Previously Loaded (**N02**) shows the number of the last parameter file transferred from an NV Media Card to the drive. If defaults are subsequently reloaded *Media Card File Previously Loaded* (**N02**) is set to 0.

N03	**Media Card File Number**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	999
Default	0	**Units**	
Type	16 Bit Volatile	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Media Card File Number (**N03**) is used to select a file by its file identification number and can only be changed to values that correspond to files that are recognized by the drive on the NV media card or a value of 0. When *Media Card File Number* (**N03**) corresponds to the number of a file the following data about the file is shown.

Parameter
Media Card File Type (**N04**)
Media Card File Version (**N05**)
Media Card File Checksum (**N06**)

The actions of erasing a card, erasing a file, creating a new file, changing a Menu 0 parameter or removing a card resets *Media Card File Number* (**N03**) to 0.

N04	Media Card File Type		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	6
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, Txt, ND, NC, PT		

Value	Text
0	None
1	Open-Loop
2	RFC-A
3	RFC-S
4	Not used
5	User Prog
6	Option App

Media Card File Type (**N04**) shows the file type of the file selected with *Media Card File Number* (**N03**) as shown in the table below.

Media Card File Type (N04)	File
0	No file selected
1	Open-loop mode parameter file
2	RFC-A mode parameter file
3	RFC-S mode parameter file
4	Not used
5	Onboard user program file
6	Option module applications file

N05	Media Card File Version		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	999
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Media Card File Version (**N05**) shows the version number stored with the file selected with *Media Card File Number* (**N03**).

To set a file version number on a NV media card, the number required must be set in *Media Card File Required Version* (**N11**) and then the data must be written to the NV media card. Failure to do this will result in no version number being displayed when selecting the NV media card file number in *Media Card File Number* (**N03**).

N06	Media Card File Checksum		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-2147483648	**Maximum**	2147483647
Default		**Units**	
Type	32 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Media Card File Checksum (**N06**) shows the checksum from the file selected with *Media Card File Number* (**N03**). If the media file is a Unidrive SP SMARTCARD file, the checksum is ($\sum$ All bytes except the checksum) modulo 65536. If the file was generated by a Unidrive M, a value of zero will be displayed.

N07	Media Card Create Special File		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	8 Bit Volatile	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, NC		

If *Media Card Create Special File* (**N07**) = 1 when a parameter file is transferred to an NV media card the file is created as a macro file. *Media Card Create Special File* (**N07**) is reset to 0 after the file is created or the transfer fails.

N08	Media Card Type		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	2
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, Txt, ND, NC, PT		

Value	Text	Description
0	None	No media card has been inserted
1	SMARTCARD	A SMARTCARD has been inserted
2	SD Card	A FAT formatted SD card has been inserted

Media Card File Type (**N04**) shows the type of non-volatile media card inserted in the drive.

N09	Media Card Read-only Flag		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

Media Card Read-only Flag (**N09**) shows the state of the read-only flag for the currently installed card.

N10	Media Card Warning Suppression Flag		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

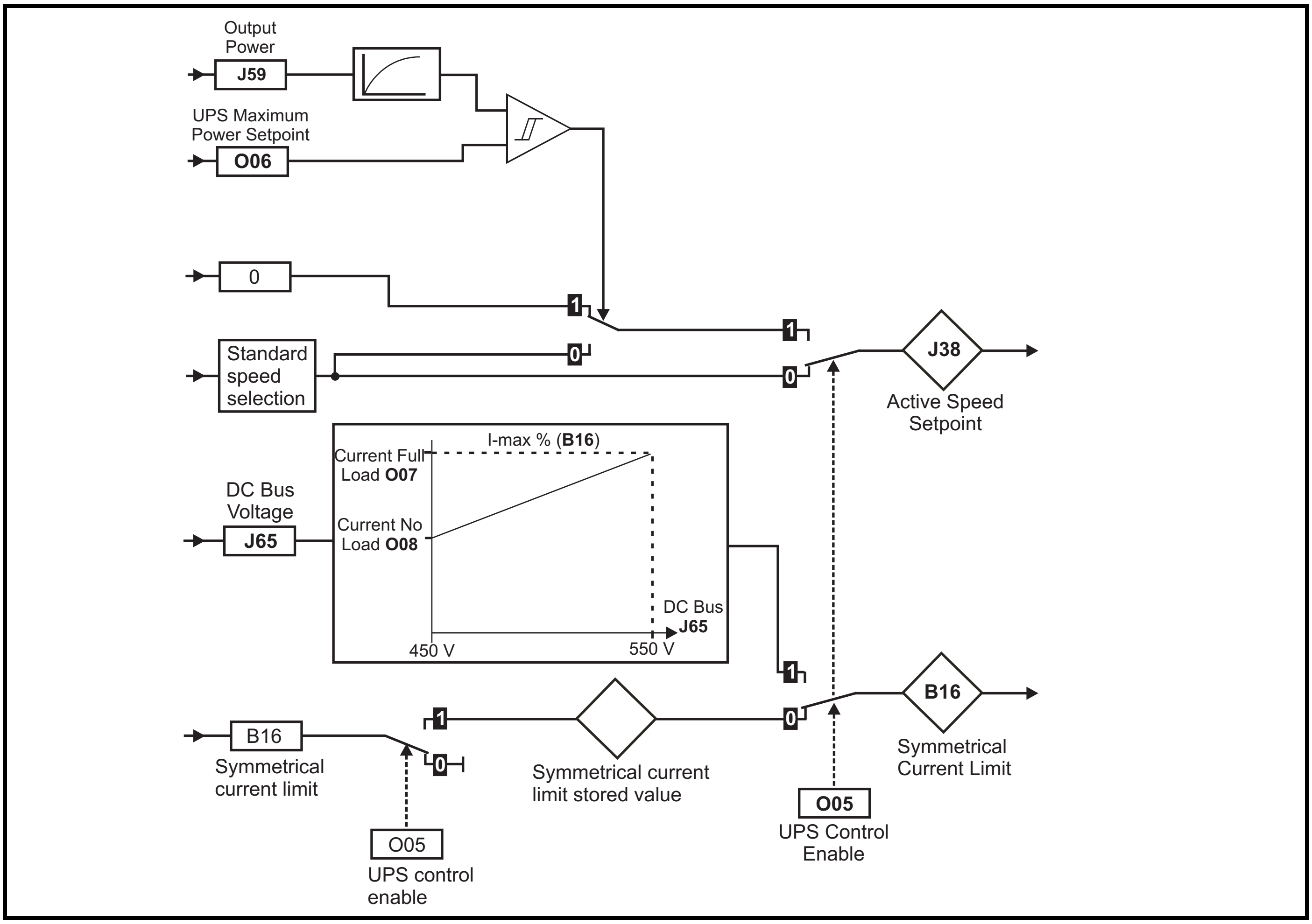
Media Card Warning Suppression Flag (**N10**) shows the state of the warning flag for the currently installed card.

N11	Media Card File Required Version		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	9999
Default		**Units**	
Type	16 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RW, ND, NC, PT		

The value of *Media Card File Required Version* (**N11**) is used as the version number for a file when it is created on an NV media card. *Media Card File Required Version* (**N11**) is reset to 0 when the file is created or the transfer fails.

8.14 Menu O: Back-up power

Figure 8-33 Menu O Back-up power logic diagram



Parameter		Range(⇕)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
O01	Load Measurement Direction Output		Off (0) or On (1)					RO	Bit	ND	NC	PT	
O02	Load Measurement Direction Invert		Off (0) or On (1)			Off (0)		RW	Bit				US
O03	Load Measurement Value		0 to 3276.7 %					RO	Num	ND	NC	PT	
O04	Load measurement time		±2000 ms			0 ms		RW	Num				US
O05	UPS Control Enable	Off (0) or On (1)			Off (0)			RW	Bit				US
O06	UPS Maximum Power Setpoint	0.00 to 655.35 kW			175.00 kW			RW	Num				US
O07	UPS evacuation current full load limit	0.0 to 6553.5 %			175.0 %			RW	Num		RA		US
O08	UPS evacuation current no load limit	0.0 to 6553.5 %			175.0 %			RW	Num		RA		US
O09	Active Supply	Off (0) or On (1)						RO	Bit	ND	NC	PT	
O10	User Supply Select	Off (0) or On (1)			Off (0)			RW	Bit				US
O11	Standard Under Voltage Threshold	±VM_STD_UNDER_VOLTS V			200V drive: 175 V 400V drive: 330 V 575V drive: 435 V 690V drive: 435 V			RW	Num		RA		US
O12	LV Supply Mode Enable	Off (0) or On (1)			Off (0)			RW	Bit				US
O13	Low Under Voltage Threshold Select	Off (0) or On (1)			Off (0)			RW	Bit				US
O14	Low Under Voltage Threshold	±VM_LOW_UNDER_VOLTS V			200V drive: 175 V 400V drive: 330 V 575V drive: 435 V 690V drive: 435 V			RW	Num		RA		US
O15	Under Voltage Contactor Close Output	Off (0) or On (1)						RO	Bit	ND	NC	PT	
O16	Under Voltage System Contactor Closed	Off (0) or On (1)			Off (0)			RW	Bit				
O17	Slow Rectifier Charge Rate Enable	Off (0) or On (1)			Off (0)			RW	Bit				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Mode: Open-Loop, RFC-A, RFC-S

O01	Load Measurement Direction Output		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

This displays the direction of the load from the current travel start. When set to On (1) the load direction is Positive or Motoring, and if it is set to Off (0) it is negative or regenerating.

O02	Load Measurement Direction Invert		
Mode	RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When set to On (1), *Load Measurement Direction Output* (**O01**) is inverted.

O03	Load Measurement Value		
Mode	RFC-A, RFC-S		
Minimum	0.0	**Maximum**	3276.7
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	1
Coding	RO, ND, NC, PT		

This is the calculated torque producing current percentage measured from *Torque Producing Current* (**J24**) after brake release, for *Load measurement time* (**O04**) ms.

O04	Load Measurement Time		
Mode	RFC-A, RFC-S		
Minimum	-2000	**Maximum**	2000
Default	0	**Units**	ms
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When set >0, this determines the time in ms taken to measure *Torque Producing Current* (**J24**) required for rescue operation at the start of a travel only.

When set <0, A load measurement is taken at the start of travel and when constant speed has been reached for *Load measurement time* (**O04**) ms. This determines the maximum time taken to measure *Torque Producing Current* (**J24**) required for rescue operation during travel at constant speed. If constant speed is reached, the constant speed value is used, however, if constant speed is not reached then the start of travel measurement is used instead. This mode compensates for changes in the load for tall buildings where the load value changes depending in the number of floors for a given travel.

When set = 0, load measurement is disabled.

This functionality is not available in Open loop mode, or if analog speed reference is selected i.e. *Control Input mode* (**H11**) = Analog Run Prmit or Analog 2 Dir (0 or 1).

O05	UPS Control Enable		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When set to Off (0), UPS control is disabled.

When set to On (1), UPS control is enabled, where an elevator drive digital input from the elevator controller routed to *UPS Control Enable* (**O05**).

When *UPS Control Enable* (**O05**) = On (1), the following functions are internally controlled to extend the operating time of the UPS:

- *Symmetrical Current Limit* (**B16**)
- *Start Lock Enable* (**I22**)
- *Maximum Speed Error Threshold* (**H15**)
- *Maximum Distance Error Threshold* (**H16**)
- *Start Optimizer Time* (**G48**)
- *Load measurement time* (**O04**)

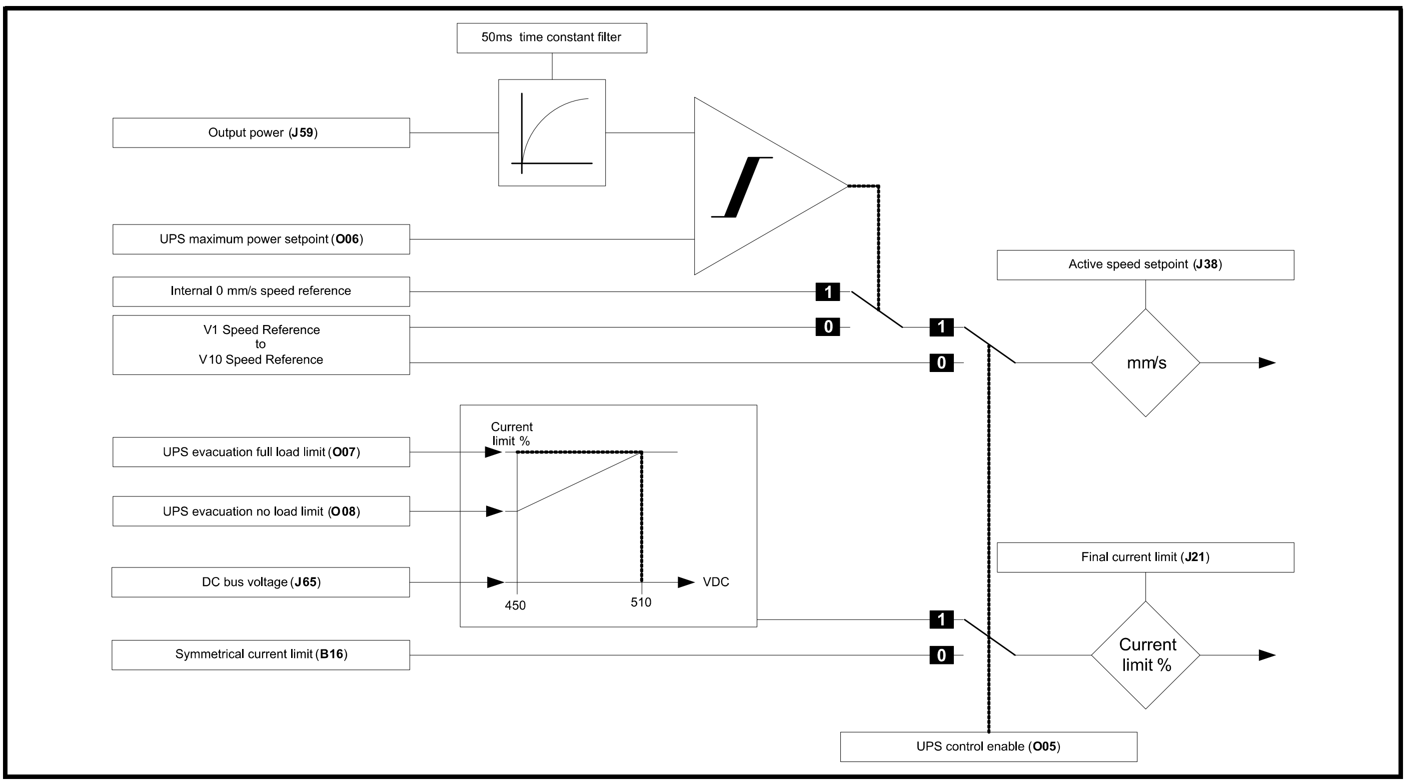
To protect the UPS from overloading and switching into standby, DC bus voltage control of the current limits is activated by setting *UPS Control Enable* (**O05**) = On (1).

If the DC bus voltage decreases below the UU Reset voltage + 60 V (= 510 V for 400 V drives), the current limit will be decreased linearly from the nominal set value to *UPS evacuation current full load limit* (**O07**) at low load and 510 Vdc linearly to the reduced value in *UPS evacuation current no load limit* (**O08**) at full load, 450 Vdc.

The speed is also controlled to prevent exceeding the power setpoint in *UPS Maximum Power Setpoint* (**O06**) in kW. When *Output Power* (**J59**) is > *UPS Maximum Power Setpoint* (**O06**), the speed reference will be internally set to 0.

The following logic diagram shows the UPS control features activated by setting *UPS Control Enable* (**O05**) = On (1):

Figure 8-34 UPS Control Enable



O06	UPS Maximum Power Setpoint		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.00	**Maximum**	655.35
Default	175.00	**Units**	kW
Type	16 Bit User Save	**Update Rate**	Background
Display Format	Standard	**Decimal Places**	2
Coding	RW, BU		

This parameter defines the maximum UPS power in kW. This helps prevent the UPS from being overloaded during emergency evacuation when *UPS Control Enable* (**O05**). = On (1).

O07	UPS Evacuation Current Full Load Limit		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.0	**Maximum**	6553.5
Default	175.0	**Units**	%
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW, RA, BU		

This parameter defines the full load current percentage allowed during evacuation control to prevent the UPS from being overloaded. During emergency evacuation the following functions are internally controlled to extend the operating time of the UPS:

Symmetrical Current Limit (**B16**)

Start Lock Enable (**I22**)

Maximum Speed Error Threshold (**H15**)

Maximum Distance Error Threshold (**H16**)

Start Optimizer Time (**G48**)

Load measurement time (**O04**)

UPS Maximum Power Setpoint (**O06**)

This parameter is used when *UPS Control Enable* (**O05**). = On (1).

O08	UPS Evacuation Current No Load Limit		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.0	**Maximum**	6553.5
Default	175.0	**Units**	%
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW, RA, BU		

This parameter defines the no load current percentage allowed during evacuation control to prevent the UPS from being overloaded. During emergency evacuation the following functions are internally controlled to extend the operating time of the UPS:

Symmetrical Current Limit (**B16**)

Start Lock Enable (**I22**)

Maximum Speed Error Threshold (**H15**)

Maximum Distance Error Threshold (**H16**)

Start Optimizer Time (**G48**)

Load measurement time (**O04**)

UPS Maximum Power Setpoint (**O06**)

This parameter is used when *UPS Control Enable* (**O05**). = On (1).

O09	Active Supply		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

If *LV Supply Mode Enable* (**O12**) = 0 then *Active Supply* (**O09**) = 0. If *LV Supply Mode Enable* (**O12**) = 1 then *Active Supply* (**O09**) = 0 when the d.c. link voltage is above the upper under-voltage threshold otherwise it is one.

O10	User Supply Select		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

The power for the drive control system is either taken from the user 24 V power supply or the main supply (i.e. derived from the power circuit d.c. link). If *Low Under Voltage Threshold Select* (**O13**) = 0 and *LV Supply Mode Enable* (**O12**) = 0 and *User Supply Select* (**O10**) = 0 then the supply used is determined as follows for drive sizes 5 and below. (For drive sizes 6 and above a diode OR system is used to select the required power supply, and so this is done automatically in hardware.)

1. When the drive first powers up it tries to use the main supply or the user 24 V supply in turn until the drive starts up, beginning with the main supply.
2. If the main supply is active and the d.c. link voltage (*D.C. Bus Voltage* (**J65**)) falls to a level where it is no longer possible to communicate with the power stage then the drive attempts to switch over to the user 24 V supply. If the user 24 V supply is not present then the drive will power down, otherwise it will continue to run off the user 24 V supply. The level at which the power stage powers down depends on whether the user 24 V supply is present or not. However this is usually below half the minimum for *Standard Under Voltage Threshold* (**O11**).
3. If the user 24 V supply is being used and the d.c. link voltage (*D.C. Bus Voltage* (**J65**)) rises above 95 % of the minimum for *Standard Under Voltage Threshold* (**O11**) then the drive attempts to switch to the main supply.

The following should be noted:

1. Parameters can be saved by setting *Parameter mm.000* (**mm.000**) to 1 or 1000 (not in under-voltage state) or 1001 and initiating a drive reset. Power-down save parameters are saved when the under-voltage state becomes active.
2. If the drive is powered from the user 24 V supply and then the main supply is activated but is not above 95 % of the minimum for *Standard Under Voltage Threshold* (**O11**) then the drive will continue to be powered from the user 24 V supply. If the user 24 V supply is subsequently removed the drive will power down, but then if the main supply is high enough will power up again on the main supply.

If *Low Under Voltage Threshold Select* (**O13**) = 1 or *LV Supply Mode Enable* (**O12**) = 1 or *User Supply Select* (**O10**) = 1 then the 24 V user supply is always selected. If the user 24 V supply is not present then a *PSU 24 V* is initiated. The following should be noted:

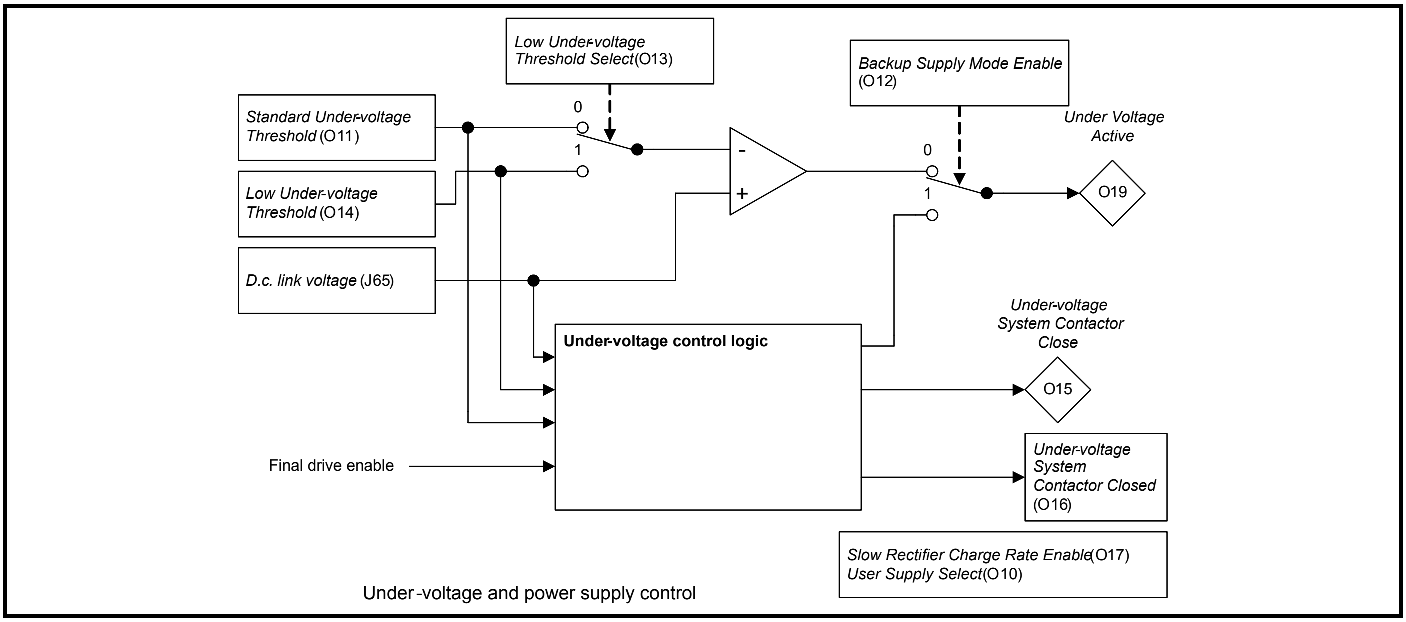
1. The drive will still power-up on the main supply even if the user 24 V supply is not present because the drive tries each supply in turn to power up, however the drive will remain in the tripped state until the user 24 V supply is activated.

Parameters can only be saved by setting *Parameter mm.000* (**mm.000**) to1001 and initiating a drive reset. Power-down save parameters are not saved when the under-voltage state becomes active.

O11	Standard Under Voltage Threshold		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-VM_STD_UNDER_VOLTS	**Maximum**	VM_STD_UNDER_VOLTS
Default	See exceptions below	**Units**	V
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM, RA		

Voltage	Default Value
200V	175
400V	330
575V	435
690V	435

Figure 8-35 Under-voltage and power supply control



Under-voltage system

The under-voltage system controls the state of *Under Voltage* (**L19**) which is then used by the sequencer state machine. Each under voltage threshold detection system includes hysteresis of 5 % of the actual threshold level therefore:

D.C. Bus Voltage **(J65)**	**Under voltage detection**
Vdc	Active
Threshold ≤ Vdc	No change
Vdc ≥ Threshold x 1.05*	Not active

* Hysteresis is 5 % subject to a minimum of 5 V

When *Under Voltage* (**L19**) = 1 the sequencer state machine will change to the UNDER_VOLTAGE state and when the UNDER_VOLTAGE state is active it is not possible to enable the drive inverter. The under-voltage system operates in different ways depending on the setting of *LV Supply Mode Enable* (**O12**).

If the low under-voltage threshold is used or if back-up supply mode is selected the internal drive power supplies are normally powered from the 24 V supply input (i.e. Digital I/O 13). *User Supply Select* (**O10**) should be set to one to select this supply and its monitoring system. (It should be noted that in Regen mode *LV Supply Mode Enable* (**O12**) is not present, and so back-up supply mode cannot be selected.)

It should be noted that the under-voltage threshold used with a thyristor based charge system and the charging rate (*Slow Rectifier Charge Rate Enable* (**O17**)) are automatically saved within the rectifier units each time the value is changed because these will be required at the next power-up before the drive control system is active. These values will be retained when they are changed 128 times. If any more changes are made between power-up and power-down the new values are not retained.

Standard mode: LV Supply Mode Enable (O12) = 0

If *Low Under Voltage Threshold Select* (**O13**) = 0 then the under voltage threshold is defined by *Standard Under Voltage Threshold* (**O11**). If *Low Under Voltage Threshold Select* (**O13**) = 1 then the under voltage threshold is defined by *Low Under Voltage Threshold* (**O14**).

Frame size 06 drives and smaller have a d.c. link charge system based on a charge resistor and shorting contactor that is in circuit for both the a.c. and d.c. inputs of the drive. The charge system is generally active (contactor open) when *Under Voltage* (**L19**) = 1 and inactive when *Under Voltage* (**L19**) = 0. The exception is that there is a delay of 50 ms while the contactor changes state and during these periods *Under Voltage* (**L19**) = 1.

If the d.c. link voltage is above the under-voltage threshold and *Under Voltage* (**L19**) = 0 a large surge of current can occur if the a.c. supply is removed and then reapplied to the drive. For a given level of supply voltage the worst case surge occurs when the supply is applied at the point where one of the line voltages is at its peak. The surge is proportional to the difference between the d.c. link voltage before the supply is reconnected and the magnitude of the supply voltage. The minimum setting and default for *Standard Under Voltage Threshold* (**O11**) corresponds to the lowest d.c. link voltage level where the maximum allowed a.c. supply voltage can be applied without damaging the drive or rupturing the recommended supply fuses. Therefore it is safe to adjust the under-voltage threshold using the *Standard Under Voltage Threshold* (**O11**).

If the under-voltage threshold needs to be lower than the minimum of *Standard Under Voltage Threshold* (**O11**), then the *Low Under Voltage Threshold* (**O14**) should be used. It is important that the difference between the under-voltage threshold level and the peak of the supply voltage is never larger than the difference between the minimum *Standard Under Voltage Threshold* (**O11**) and the peak of the maximum allowed a.c. supply voltage for the drive.

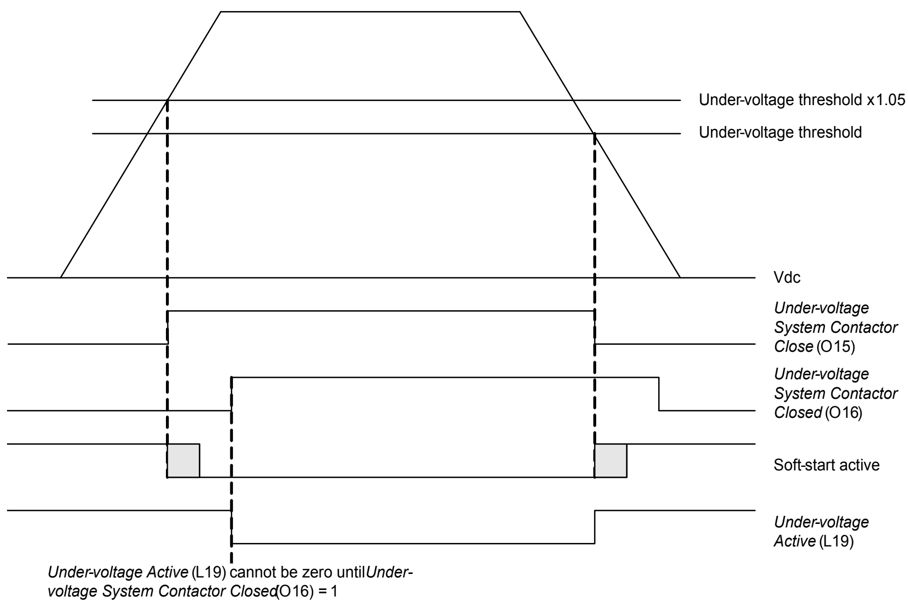
For example:

The minimum *Standard Under Voltage Threshold* (**O11**) for a 400 V drive is 330 V
The maximum allowed supply voltage for this drive is 480 V + 10 %
The peak of the maximum allowed supply voltage = 480 x 1.1 x √2 = 747 V
The difference between the under-voltage threshold and the peak supply voltage = 747 - 330 = 417 V
Therefore for this drive voltage rating the peak line to line voltage must never be higher than *Low Under Voltage Threshold* (**O14**) + 417 V.

If *Low Under Voltage Threshold Select* (**O13**) is set to one and *Low Under Voltage Threshold* (**O14**) is reduced below the variable maximum level VM_STD_UNDER_VOLTAGE[MIN], or if *LV Supply Mode Enable* (**O12**) is set to one, an indication is stored in *Potential Drive Damage Conditions* (**L73**) that cannot be cleared by the user. This marks the drive, so that if it is damaged as a result of an input current surge, this can be detected by service personnel.

For frame size 07 drives and larger, which use a d.c. link charge system based on a half controlled thyristor input bridge, the charge system is activated based on the level of the voltage at the a.c. supply terminals of the drive. The threshold for the charge system is set so that the rectified supply will give the required under-voltage threshold level. The under-voltage system operates in exactly the same way as for frame size 07 drives and smaller except that the delay during the transition out of the under-voltage state is extended. For single power module drive the delay is 1.0 s to allow the thyristor charge system to charge the d.c. link. For parallel power modules the delay is extended to 2.5 s to ensure that all modules power up correctly.

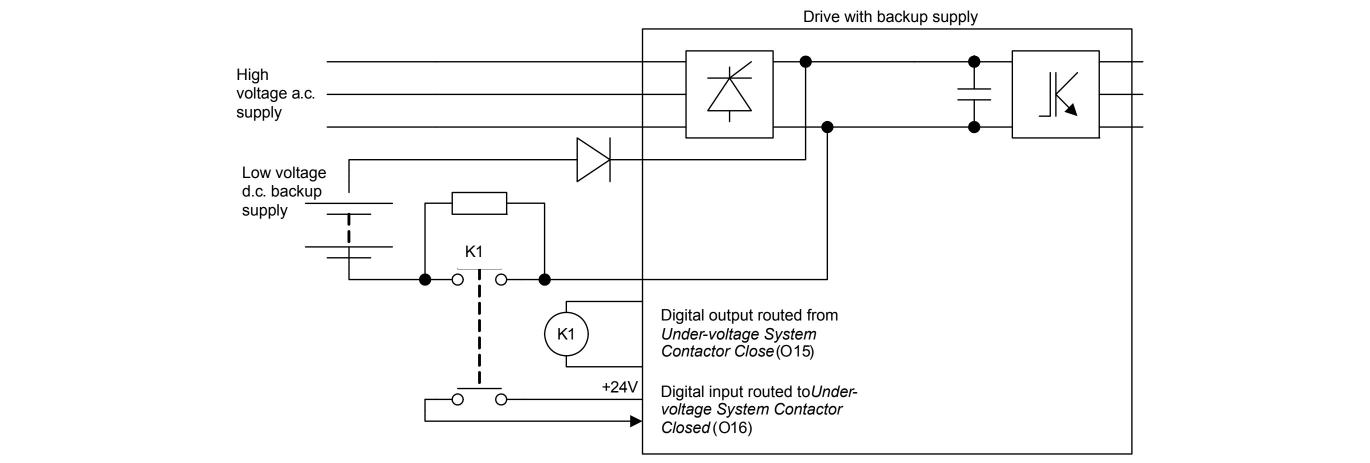
Figure 8-36 Backup Supply



Under-voltage timing with *Back-up Supply Mode Enable* (O12) = 1
(Frame sizes 08 and larger)

Backup Supply Mode for frame size 06 drives and smaller: LV Supply Mode Enable (O12) = 1

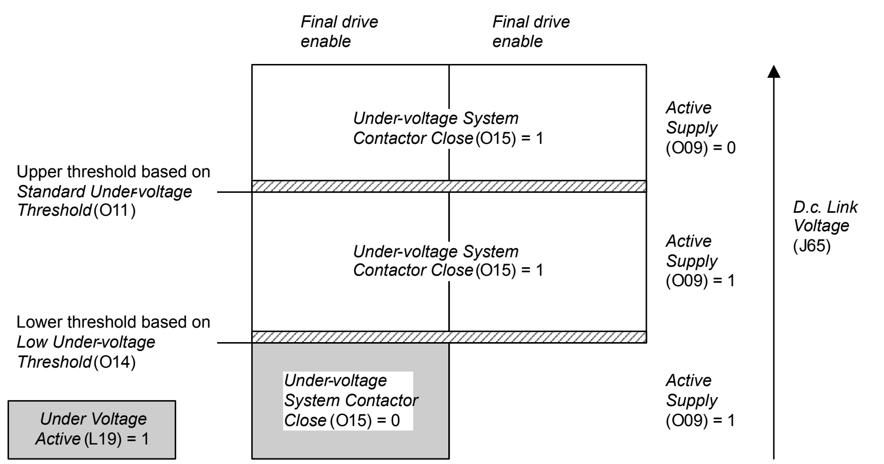
Backup supply mode is intended to provide a smooth transition, without disabling the drive, from a high voltage a.c. supply to a low voltage d.c. backup supply. It is necessary to disable the drive for the transition back to the high voltage a.c. supply. The following diagram is a simple representation of the power circuit required. This does not include the necessary circuit protection components or possible battery charger, etc.



Backup supply mode for frame size 08 drives and larger

The diagram below shows the state of *Under Voltage* (**L19**), the control signal to the external contactor (*Under Voltage Contactor Close Output* (**O15**)) and *Active Supply* (**O09**). When *LV Supply Mode Enable* (**O12**) is set to one the maximum applied to *Low Under Voltage Threshold* (**O14**) prevents this from being increased above *Standard Under Voltage Threshold* (**O11**) / 1.1 so that the 5 % hysteresis band on the low under-voltage threshold does not overlap the standard under-voltage threshold.

Figure 8-37 Backup Supply Mode



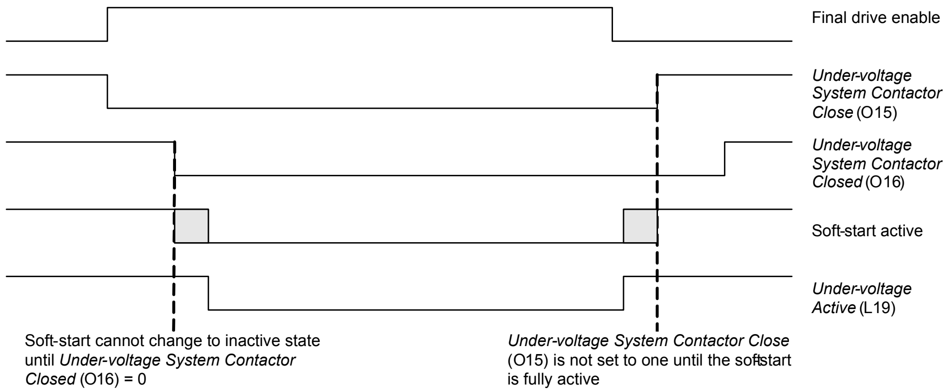
Backup supply mode states for frame size 08 drives and larger

1. If the *D.C. Bus Voltage* (**J65**) is below the Lower Threshold the drive is in the under-voltage state and the internal charge system is active to limit the charging current either from the low voltage d.c. backup supply or the high voltage a.c. supply. *Under Voltage Contactor Close Output* (**O15**) = 1, and so it is possible for the high voltage a.c. supply to charge the d.c. link.
2. If the *D.C. Bus Voltage* (**J65**) is above the Lower Threshold, but below the Upper Threshold, there are two possible states depending on whether the Final drive enable is 0 or 1. If Final drive enable = 0 then *Under Voltage* (**L19**) = 1, the internal charge system is active and *Under Voltage System Contactor Closed* (**O16**) = 1, so that the d.c. link can be charged by the high voltage a.c. supply. If Final drive enable = 1 then *Under Voltage* (**L19**) = 0 and the internal charge system is inactive so that the drive can run from the low voltage d.c. backup supply. *Under Voltage Contactor Close Output* (**O15**) = 0, so that it is not possible for the high voltage a.c. supply to charge the d.c. link.
3. If the *D.c. Bus Voltage* (**J65**) is above the Upper Threshold then *Under Voltage* (**L19**) = 0 and *Under Voltage System Contactor Closed* (**O16**) = 1, so the drive can run from the high voltage a.c. supply.
4. If the *D.c. Bus Voltage* (**J65**) subsequently falls below the Upper Threshold and the Final drive enable = 1, the drive can continue to run, but *Under Voltage System Contactor Closed* (**O16**) is set to 0 to open the high voltage a.c. supply contactor. The d.c. link voltage will fall until it reaches the low voltage d.c. backup supply level. This gives a smooth changeover to the backup supply without stopping the motor.

To ensure that the soft-start is in the correct state to protect the drive and to ensure that the under-voltage condition is detected correctly the following additional restrictions are applied:

1. The soft-start cannot change from the active state (i.e. internal soft-start contactor closed) unless the d.c. link voltage is above the upper under-voltage threshold or *Under Voltage System Contactor Closed* (**O16**) = 1.
2. The *Under Voltage Contactor Close Output* (**O15**) parameter is set to 1 if the d.c. link voltage is above the upper under-voltage threshold or the Final drive enable = 1. The *Under Voltage Contactor Close Output* (**O15**) is only set to 0 if the soft-start is fully active.

The following diagram shows how these restrictions apply to the system timing when Lower Threshold ≤ *D.c. Bus Voltage* (**J65**)



Under-voltage timing with *Back-up Supply Mode Enable* (O12) = 1
(Frame sizes 07 and smaller and d.c. link voltage between the upper and lower under-voltage threshold)

Backup Supply Mode for frame size 07 drives and larger: (LV Supply Mode Enable (O12) = 1)

Backup supply mode is intended to provide a smooth transition, without disabling the drive, from a high voltage a.c. supply to a low voltage d.c. backup supply and vice versa. The following diagram is a simple representation of the power circuit required. This does not include the necessary circuit protection components or possible battery charger, etc.

O12	**LV Supply Mode Enable**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Standard Under Voltage Threshold* (**O11**). Also see *User Supply Select* (**O10**) for details of when and how drive parameters can be saved, and when a *PSU 24 V* trip can occur.

O13	**Low Under Voltage Threshold Select**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Standard Under Voltage Threshold* (**O11**). Also see *User Supply Select* (**O10**) for details of when and how drive parameters can be saved, and when a *PSU 24 V* trip can occur.

O14	Low Under Voltage Threshold		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-VM_LOW_UNDER_VOLTS	**Maximum**	VM_LOW_UNDER_VOLTS
Default	See exceptions below	**Units**	V
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM, RA		

Voltage	Default Value
200V	175
400V	330
575V	435
690V	435

See *Standard Under Voltage Threshold* (**O11**).

O15	Under Voltage Contactor Close Output		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	4 ms write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Standard Under Voltage Threshold* (**O11**).

O16	Under Voltage System Contactor Closed		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit Volatile	**Update Rate**	4 ms read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

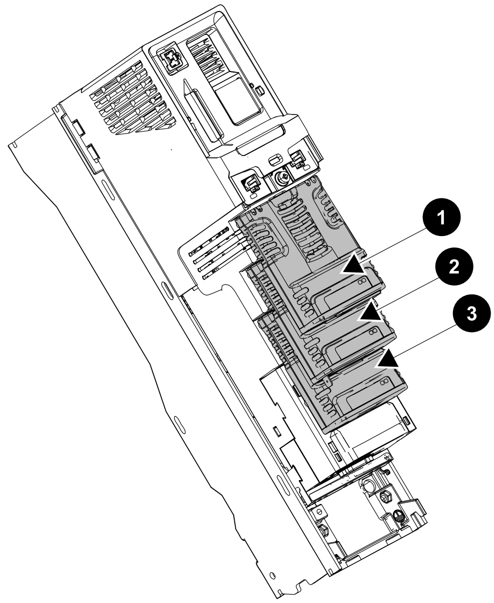
See *Standard Under Voltage Threshold* (**O11**).

O17	Slow Rectifier Charge Rate Enable		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

For frame size 07 drives and larger, which use a d.c. link charge system based on a half controlled thyristor input bridge, the rate at which the d.c. bus is charged can be reduced by setting *Slow Rectifier Charge Rate Enable* (**O17**) to one. This will reduce the charging current which may be required if significant additional capacitance is added to the d.c. link to prevent rupturing of input fuses.

8.15 Menus P, Q and R: Option module set-up

Figure 8-38 Location of option module slots and their corresponding menu numbers



1. Solutions Module Slot 1 - Menu P
2. Solutions Module Slot 2 - Menu Q
3. Solutions Module Slot 3 - Menu R

8.15.1 Parameters common to all categories

Parameter		Range(⇕)	Default(⇨)	Type					
mm01	Module ID	0 to 65535		RO	Num	ND	NC	PT	
mm02	Software Version	00.00.00 to 99.99.99		RO	Num	ND	NC	PT	
mm03	Hardware Version	0.00 to 99.99		RO	Num	ND	NC	PT	
mm04	Serial Number LS	0 to 99999999		RO	Num	ND	NC	PT	
mm05	Serial Number MS			RO	Num	ND	NC	PT	

The option module ID indicates the type of module that is installed in the corresponding slot. See the relevant option module user guide for more information regarding the module.

Option module ID	Module	Category
0	No module installed	
209	SI-I/O	Automation (I/O Expansion)
310	MCi 210	Automation (Applications)
311	MCi 200	
304	SI-Applications Plus	
443	SI-PROFIBUS	Fieldbus
447	SI-DeviceNet	
448	SI-CANopen	

8.16 Menu S: Application menu 1

Parameter		Range(⇕)		Default(⇨)			Type					
		OL	RFC-A / S	OL	RFC-A	RFC-S						
S01	Application Menu 1 Power-down Save Integer	-32768 to 32767		0			RW	Num				PS
S02 to S10	Application Menu 1 Read-only Integer	-32768 to 32767					RO	Num	ND	NC		US
S11 to S30	Application Menu 1 Read-write Integer	-32768 to 32767		0			RW	Num				US
S31 to S50	Application Menu 1 Read-write bit	Off (0) or On (1)		Off (0)			RW	Bit				US
S51 to S54	Application Menu 1 Power-down Save long Integer	-2147483648 to 2147483647		0			RW	Num				PS

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

8.17 Menu T: Application menu 2

Parameter		Range(⇕)		Default(⇨)			Type					
		OL	RFC-A / S	OL	RFC-A	RFC-S						
T01	Application Menu 2 Power-down Save Integer	-32768 to 32767		0			RW	Num				PS
T02 - T10	Application Menu 2 Read-only Integer	-32768 to 32767					RO	Num	ND	NC		US
T11-T30	Application Menu 2 Read-write Integer	-32768 to 32767		0			RW	Num				US
T31-T50	Application Menu 2 Read-write bit	Off (0) or On (1)		Off (0)			RW	Bit				US
T51-TT54	Application Menu 2 Power-down Save long Integer	-2147483648 to 2147483647		0			RW	Num				PS

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

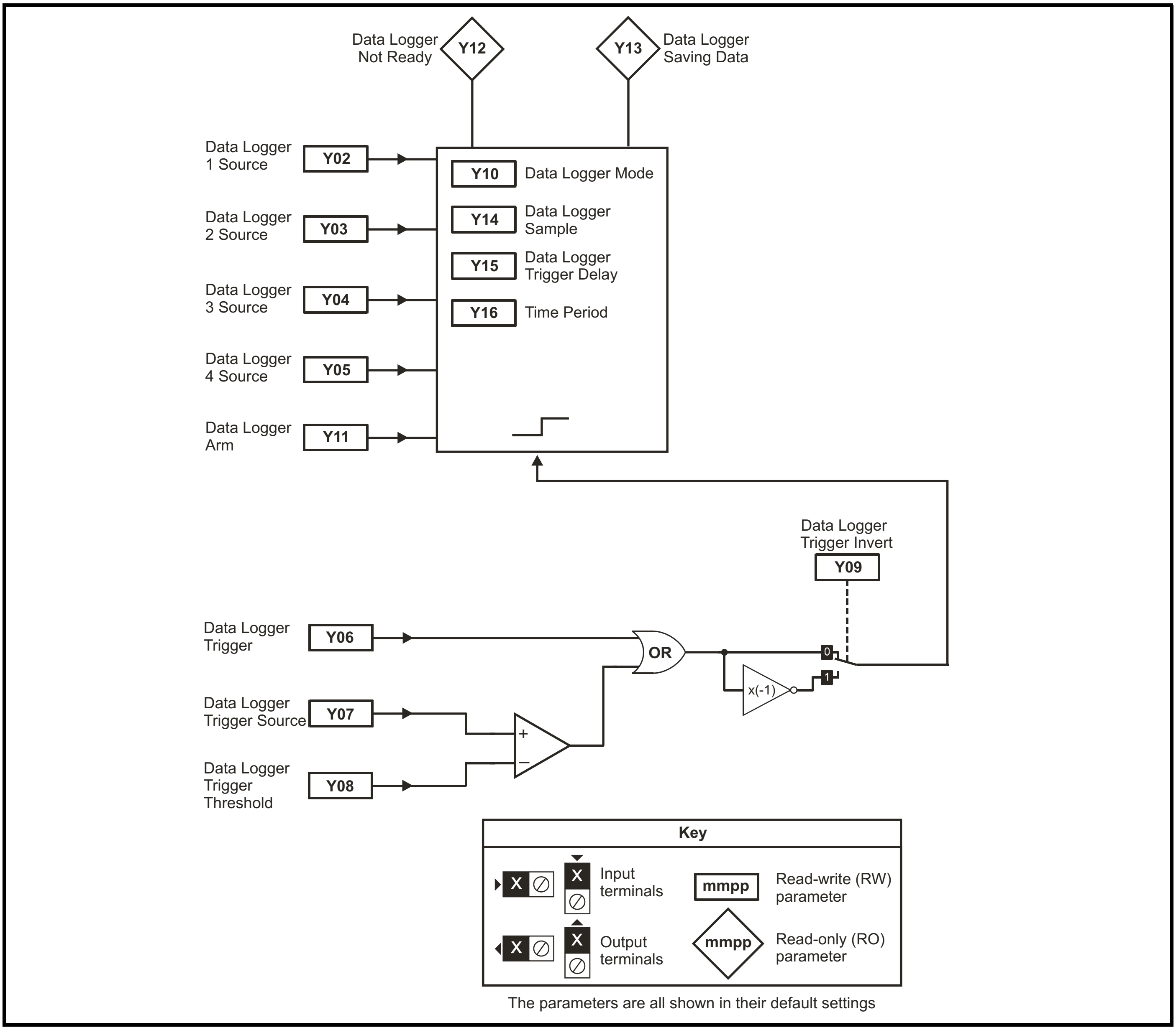
8.18 Menu U: Application menu 3

Parameter		Range(⇕)		Default(⇨)			Type					
		OL	RFC-A / S	OL	RFC-A	RFC-S						
UB01-UB20	Application Menu 3 Read-write Integer	-32768 to 32767		0			RW	Num				
UB21-UB40	Application Menu 3 Read-write Long Integer	-2147483648 to 2147483647		0			RW	Num				

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

8.19 Menu Y: Data Logger

Figure 8-39 Menu Y Data logger logic diagram



Parameter		Range(⇕)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
Y02	Data Logger Trace 1 Source	A00 to AB99			A00			RW	Num			PT	US
Y03	Data Logger Trace 2 Source	A00 to AB99			A00			RW	Num			PT	US
Y04	Data Logger Trace 3 Source	A00 to AB99			A00			RW	Num			PT	US
Y05	Data Logger Trace 4 Source	A00 to AB99			A00			RW	Num			PT	US
Y06	Data Logger Trigger	Off (0) or On (1)			Off (0)			RW	Bit				
Y07	Data Logger Trigger Source	A00 to AB99			A00			RW	Num			PT	US
Y08	Data Logger Trigger Threshold	-2147483648 to 2147483647			0			RW	Num				US
Y09	Data Logger Trigger Invert	Off (0) or On (1)			Off (0)			RW	Bit				US
Y10	Data Logging Mode	Single (0), Normal (1), Auto (2)			Single (0)			RW	Txt				US
Y11	Data Logger Arm	Off (0) or On (1)			Off (0)			RW	Bit		NC		
Y12	Data Logger Data Not Ready	Off (0) or On (1)						RO	Bit	ND	NC	PT	
Y13	Data Logger Saving Data	Off (0) or On (1)						RO	Bit	ND	NC	PT	
Y14	Data Logger Sample Time	1 to 200			1			RW	Num				US
Y15	Data Logger Trigger Delay	0 to 100 %			0 %			RW	Num				US
Y16	Data Logger Time Period	0.00 to 200000.00 ms						RO	Num	ND	NC	PT	
Y17	Autosave Mode	Disabled (0), Overwrite (1), Keep (2)			Disabled (0)			RW	Txt				US
Y18	Data Logger Autosave File Number	0 to 99			0			RO	Num				PS
Y19	Data Logger Autosave Reset	Off (0) or On (1)			Off (0)			RW	Bit				
Y20	Data Logger Autosave Status	Disabled (0), Active (1), Stopped (2), Failed (3)			Disabled (0)			RO	Txt				PS

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Mode: Open-Loop, RFC-A, RFC-S

Y02	**Data Logger Trace 1 Source**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	A00	**Maximum**	AB99
Default	A00	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	0
Coding	RW, PT, BU		

Up to four scope sources can be selected using *Data Logger Trace 1 Source* (**Y02**) to *Data Logger Trace 4 Source* (**Y05**). If the source value is set to 0.000, or the source parameter does not exist or is non-visible, then no source is selected. The sources do not operate in the same way as normal source parameters in that the input to the scope is the actual value of the parameter and not a value scaled to a percentage based on the range of the parameter. If a scope trace source parameter is modified the actual change is not effective until the drive is reset.

Y03	**Data Logger Trace 2 Source**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	A00	**Maximum**	AB99
Default	A00	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

See *Data Logger Trace 1 Source* (**Y02**).

Y04	**Data Logger Trace 3 Source**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	A00	**Maximum**	AB99
Default	A00	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

See *Data Logger Trace 1 Source* (**Y02**).

Y05	**Data Logger Trace 4 Source**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	A00	**Maximum**	AB99
Default	A00	**Units**	
Type	16 Bit User Save	**Update Rate**	Drive reset read
Display Format	Menu Param Alpha Numeric	**Decimal Places**	3
Coding	RW, PT, BU		

See *Data Logger Trace 1 Source* (**Y02**).

Y06	**Data Logger Trigger**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit Volatile	**Update Rate**	250 μs read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

The scope is triggered by a rising edge at the input to the main scope block. If *Data Logger Trigger Source* (**Y07**) is set at its default value of 0.000 then the output of the trigger threshold comparator is 0, and so the scope can be triggered with *Data Logger Trigger* (**Y06**). *Data Logger Trigger Invert* (**Y09**) can be used to invert the trigger signal.

Y07	**Data Logger Trigger Source**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	A00	**Maximum**	AB99
Default	A00	**Units**	
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, PT, BU		

If *Data Logger Trigger* (**Y06**) = 0, the scope can be triggered based on the level of a parameter defined by *Data Logger Trigger Source* (**Y07**) and the *Data Logger Trigger Threshold* (**Y08**). This source operates in the same way as the trace sources and a direct comparison is made between the actual parameter value and the threshold. Decimal places are ignored. The threshold detector output is 1 when the value from the scope trigger source is greater than *Data Logger Trigger Threshold* (**Y08**). If *Data Logger Trigger Source* (**Y07**) = 0.000, or it is used to select a parameter that does not exist or is non-visible, then the output of the threshold detector is 0.

Y08	**Data Logger Trigger Threshold**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	-2147483648	**Maximum**	2147483647
Default	0	**Units**	
Type	32 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Data Logger Trigger Source* (**Y07**).

Y09	**Data Logger Trigger Invert**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

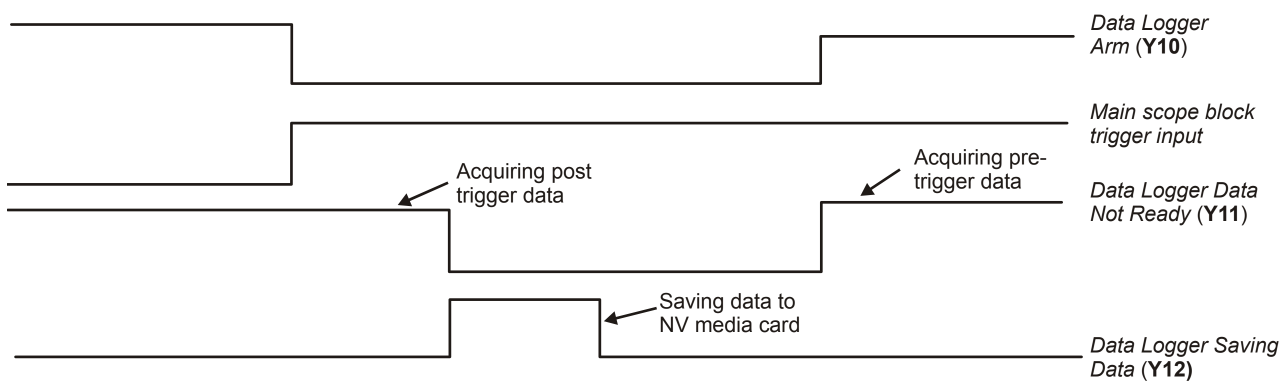
See *Data Logger Trigger* (**Y06**).

Y10	**Data Logging Mode**		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt		

Value	Text
0	Single
1	Normal
2	Auto

Single (0):

If *Data Logger Arm* (**Y11**) is set to 1 the scope starts to acquire pre-trigger data (i.e. enough data to provide information for the pre-trigger period) and *Data Logger Data Not Ready* (**Y12**) is set to 1. The scope can then be triggered on the next trigger event (i.e. a rising edge on the trigger input of the main scope block). Note that the scope can only be triggered once the required amount of pre-trigger data has been sampled. Failure to do this will result in the scope function not triggering correctly. When the trigger event occurs *Data Logger Arm* (**Y11**) is set to 0, and when the post-trigger data has been stored *Data Logger Data Not Ready* (**Y12**) is set to 0. If *Autosave Mode* (**Y17**) is non-zero, the data in the scope trace buffer is saved to a non-volatile media card fitted in the drive. When the save is complete (or data cannot be saved, i.e. no card installed or no space left) the scope is ready again to receive data. If *Data Logger Arm* (**Y11**) is set to 1 the scope will start to acquire data again.



Data Logging Mode (**Y09**) = Single (0) and *Auto-save Mode* (**Y16**) > 0

It is possible to read scope files via comms or into an option module. However, scope file transfer can only be initiated when *Data Logger Arm* (**Y10**) = 0, *Data Logger Data Not Ready* (**Y12**) = 0, *Data Logger Saving Data* (**Y13**) = 0 and at least one trace has been set up. While the file transfer is in progress *Data Logger Saving Data* (**Y13**) is set to 1.

The scope system is reset under any of the following conditions:

1. At power-up.
2. If the drive is reset when *Data Logger Trace 1 Source* (**Y02**) to *Data Logger Trace 4 Source* (**Y05**) have been modified.
3. The drive mode is changed.
4. If *Data Logging Mode* (**Y10**), *Data Logger Sample Time* (**Y14**) or *Data Logger Trigger Delay* (**Y15**) are modified.

When the scope is reset *Data Logger Arm* (**Y11**) is reset to 0 and the trace data is all cleared to 0.

Normal (1):

The scope operates in the same way as single mode except that *Data Logger Arm* (**Y11**) is automatically set back to 1 after a time delay of 1s once the post-trigger data has been acquired, and the scope data has been saved to a non-volatile media card if *Autosave Mode* (**Y17**) > 0.

Auto (2):

After the scope system is reset *Data Logger Data Not Ready* (**Y12**) is set to 1 and the scope begins to acquire data. Once the buffer is full Data *Logger Data Not Ready* (**Y12**) is set to 0 and the scope continues to acquire data. *Data Logger Arm* (**Y11**) has no effect on data acquisition. Provided *Data Logger Data Not Ready* (**Y12**) = 0 and *Data Logger Saving Data* (**Y13**) = 0 it is possible to read the data from the scope buffer as a scope file. Data acquisition is stopped when the file transfer begins. When the file transfer is complete, data acquisition begins again and *Data Logger Data Not Ready* (**Y12**) is set to 1 for a period that is long enough to fill the scope buffer with new data.

Y11	Data Logger Arm		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit Volatile	**Update Rate**	250 µs
Display Format	Standard	**Decimal Places**	0
Coding	RW, NC		

See *Data Logging Mode* (**Y10**).

Y12	Data Logger Data Not Ready		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	250 µs write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Data Logging Mode* (**Y10**).

Y13	Data Logger Saving Data		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default		**Units**	
Type	1 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, PT		

See *Data Logging Mode* (**Y10**).

Y14	Data Logger Sample Time		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	1	**Maximum**	200
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

Data Logger Sample Time (**Y14**) defines the sample rate of the scope function for all traces in 250 µs units (i.e. if *Data Logger Sample Time* (**Y14**) = 4, the sample time is 1 ms).

Y15	Data Logger Trigger Delay		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	100
Default	0	**Units**	%
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Data Logger Trigger Delay (**Y15**) defines how much data is stored before and after the scope is triggered. If *Data Logger Trigger Delay* (**Y15**) = 0 % then no data is stored before the trigger and all the data is after the trigger. If *Data Logger Trigger Delay* (**Y15**) = 100 % then no data is stored after the trigger, but all the data is before the trigger.

Y16	Data Logger Time Period		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0.00	**Maximum**	200000.00
Default	0	**Units**	ms
Type	32 Bit Volatile	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	2
Coding	RO, ND, NC, PT		

The scope function can capture up to 4000 bytes of parameter data. The *Data Logger Time Period* (**Y16**) gives the length of the time period covered by the scope buffer in milliseconds which depends on the number of traces stored, the sample time and the size of the parameters used as trace sources.

Sample time in milliseconds = (250 x 10^{-6} x *Data Logger Sample Time* (**Y14**)) x 1000

Size of trace data is the sum of the number of bytes in each of the trace sources selected by *Data Logger Trace 1 Source* (**Y02**) to *Data Logger Trace 4 Source* (**Y05**).

Data Logger Time Period (**Y16**) (ms) = 4000 x Sample time in milliseconds / Size of trace data

Y17	Autosave Mode		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW, Txt		

Value	Text
0	Disabled
1	Overwrite
2	Keep

Auto-save mode can be used to store a scope file on a non-volatile media card at each trigger event. The auto-save system is held in reset if *Data Logger Autosave Reset* (**Y19**) = 1. When the auto-save system is reset all the scope files in scope file folder on the NV media card are deleted, *Data Logger Autosave File Number* (**Y18**) is reset to 0 and the auto-save system is inactive. If any of the file operations fail during reset *Data Logger Autosave Status* (**Y20**) is 3 (Failed) when the reset is removed.

The following conditions must be met for auto-saving to be active:

1. *Autosave Mode* (**Y17**) is non-zero
2. Data Logger *Autosave Reset* (**Y19**) = 0
3. Data Logger *Autosave Status* (**Y20**) = 1 (Active)
4. *Data Logging Mode* (**Y10**) = 0 (Single) or 1 (Normal)

If auto-saving is active an attempt is made to copy the scope file to a non-volatile media card installed to the drive each time the post-trigger data has been acquired. The file name is SCY00XY.DAT, where XY is defined by *Data Logger Autosave File Number* (**Y18**). If *Autosave Mode* (**Y17**) = 1 (Overwrite) then a file is over-written if it already exists. If *Autosave Mode* (**Y17**) = 2 (Keep) then if the file already exists the auto-save process is aborted. *Data Logger Autosave File Number* (**Y18**) is incremented after a file is saved successfully and rolls over to 0 if it exceeds its maximum value.

If *Data Logger Autosave Status* (**Y20**) = 0 (Disabled) and all the other conditions listed above for auto-saving to be active are met, then *Data Logger Autosave Status* (**Y20**) changes to 1 (Active), so that auto-saving becomes active. If the scope file cannot be saved because the file exists and *Autosave Mode* (**Y17**) = 2 (Keep) then *Data Logger Autosave Status* (**Y20**) is set to 2 (Stopped). If the scope file cannot be saved for any other reason then *Data Logger Autosave Status* (**Y20**) is set to 3 (Failed). If *Data Logger Autosave Status* (**Y20**) is no longer 1 (Active), auto-saving is aborted. Auto-saving can be made active again by setting *Data Logger Autosave Reset* (**Y19**) to 1 and then to 0. If *Autosave Mode* (**Y17**) = 0 (Disabled) then *Data Logger Autosave Status* (**Y20**) is set to 0 (Disabled), or if *Autosave Mode* (**Y17**) is non-zero then *Data Logger Autosave Status* (**Y20**) is set to 1 (Active). It should be noted that *Data Logger Autosave Status* (**Y20**) is a power-down save parameter, and so auto-save will remain inactive if *Data Logger Autosave Status* (**Y20**) is 2 or 3 even if the drive is powered down and then powered up again.

Y18	Data Logger Autosave File Number		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	99
Default	0	**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Background read/write
Display Format	Standard	**Decimal Places**	0
Coding	RO		

See *Autosave Mode* (**Y17**).

Y19	Data Logger Autosave Reset		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit Volatile	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	0
Coding	RW		

See *Autosave Mode* (**Y17**).

Y20	Data Logger Autosave Status		
Mode	Open-Loop, RFC-A, RFC-S		
Minimum	0	**Maximum**	3
Default	0	**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Background write
Display Format	Standard	**Decimal Places**	0
Coding	RO, Txt		

Value	Text
0	Disabled
1	Active
2	Stopped
3	Failed

See *Autosave Mode* (**Y17**).

8.20 Menu Z: Menu A Setup

Parameter		Range(⇕)			Default(⇨)			Type					
		Open-Loop	RFC-A	RFC-S	Open-Loop	RFC-A	RFC-S						
Z01	Parameter A01 Set-up	A00 to AB99			H02			RW	Num			PT	US
Z02	Parameter A02 Set-up	A00 to AB99			B01			RW	Num			PT	US
Z03	Parameter A03 Set-up	A00 to AB99			N01			RW	Num			PT	US
Z04	Parameter A04 Set-up	A00 to AB99			J22			RW	Num			PT	US
Z05	Parameter A05 Set-up	A00 to AB99			J23			RW	Num			PT	US
Z06	Parameter A06 Set-up	A00 to AB99			J39	J40		RW	Num			PT	US
Z07	Parameter A07 Set-up	A00 to AB99			J59			RW	Num			PT	US
Z08	Parameter A08 Set-up	A00 to AB99			J60			RW	Num			PT	US
Z09	Parameter A09 Set-up	A00 to AB99			J61			RW	Num			PT	US
Z10	Parameter A10 Set-up	A00 to AB99			H11			RW	Num			PT	US
Z11	Parameter A11 Set-up	A00 to AB99			H12			RW	Num			PT	US
Z12	Parameter A12 Set-up	A00 to AB99			A00	C01		RW	Num			PT	US
Z13	Parameter A13 Set-up	A00 to AB99			A00	C02		RW	Num			PT	US
Z14	Parameter A14 Set-up	A00 to AB99			A00	C03		RW	Num			PT	US
Z15	Parameter A15 Set-up	A00 to AB99			A00	C04		RW	Num			PT	US
Z16	Parameter A16 Set-up	A00 to AB99			B10	A00	C13	RW	Num			PT	US
Z17	Parameter A17 Set-up	A00 to AB99			B12	C12		RW	Num			PT	US
Z18	Parameter A18 Set-up	A00 to AB99			B02			RW	Num			PT	US
Z19	Parameter A19 Set-up	A00 to AB99			B03			RW	Num			PT	US
Z20	Parameter A20 Set-up	A00 to AB99			B05			RW	Num			PT	US
Z21	Parameter A21 Set-up	A00 to AB99			B06		A00	RW	Num			PT	US
Z22	Parameter A22 Set-up	A00 to AB99			B07			RW	Num			PT	US
Z23	Parameter A23 Set-up	A00 to AB99			B09	A00	B09	RW	Num			PT	US
Z24	Parameter A24 Set-up	A00 to AB99			B16			RW	Num			PT	US
Z25	Parameter A25 Set-up	A00 to AB99			B13			RW	Num			PT	US
Z26	Parameter A26 Set-up	A00 to AB99			B11			RW	Num			PT	US
Z27	Parameter A27 Set-up	A00 to AB99			B26			RW	Num			PT	US
Z28	Parameter A28 Set-up	A00 to AB99			E01			RW	Num			PT	US
Z29	Parameter A29 Set-up	A00 to AB99			E02			RW	Num			PT	US
Z30	Parameter A30 Set-up	A00 to AB99			E03			RW	Num			PT	US
Z31	Parameter A31 Set-up	A00 to AB99			E04		A00	RW	Num			PT	US
Z32	Parameter A32 Set-up	A00 to AB99			E05		A00	RW	Num			PT	US
Z33	Parameter A33 Set-up	A00 to AB99			E07			RW	Num			PT	US
Z34	Parameter A34 Set-up	A00 to AB99			E08			RW	Num			PT	US
Z35	Parameter A35 Set-up	A00 to AB99			G13			RW	Num			PT	US
Z36	Parameter A36 Set-up	A00 to AB99			G14			RW	Num			PT	US
Z37	Parameter A37 Set-up	A00 to AB99			G15			RW	Num			PT	US
Z38	Parameter A38 Set-up	A00 to AB99			G16			RW	Num			PT	US
Z39	Parameter A39 Set-up	A00 to AB99			G18			RW	Num			PT	US
Z40	Parameter A40 Set-up	A00 to AB99			G11			RW	Num			PT	US
Z41	Parameter A41 Set-up	A00 to AB99			G12			RW	Num			PT	US
Z42	Parameter A42 Set-up	A00 to AB99			G17			RW	Num			PT	US
Z43	Parameter A43 Set-up	A00 to AB99			G01			RW	Num			PT	US
Z44	Parameter A44 Set-up	A00 to AB99			G02			RW	Num			PT	US
Z45	Parameter A45 Set-up	A00 to AB99			G03			RW	Num			PT	US
Z46	Parameter A46 Set-up	A00 to AB99			G04			RW	Num			PT	US
Z47	Parameter A47 Set-up	A00 to AB99			D04			RW	Num			PT	US
Z48	Parameter A48 Set-up	A00 to AB99			D05			RW	Num			PT	US
Z49	Parameter A49 Set-up	A00 to AB99			A00	I01		RW	Num			PT	US
Z50	Parameter A50 Set-up	A00 to AB99			A00	I02		RW	Num			PT	US
Z51	Parameter A51 Set-up	A00 to AB99			A00	I05		RW	Num			PT	US
Z52	Parameter A52 Set-up	A00 to AB99			A00	I06		RW	Num			PT	US
Z53	Parameter A53 Set-up	A00 to AB99			A00	I07		RW	Num			PT	US
Z54	Parameter A54 Set-up	A00 to AB99			A00	I10		RW	Num			PT	US
Z55	Parameter A55 Set-up	A00 to AB99			A00	I22		RW	Num			PT	US
Z56	Parameter A56 Set-up	A00 to AB99			A00	I21		RW	Num			PT	US
Z57	Parameter A57 Set-up	A00 to AB99			A00	I20		RW	Num			PT	US
Z58	Parameter A58 Set-up	A00 to AB99			A00	G48		RW	Num			PT	US
Z59	Parameter A59 Set-up	A00 to AB99			A00	G47		RW	Num			PT	US

Parameter		Range(⇕) Open-Loop	Range(⇕) RFC-A	Range(⇕) RFC-S	Default(⇨) Open-Loop	Default(⇨) RFC-A	Default(⇨) RFC-S	Type					
Z60	Parameter A60 Set-up	A00 to AB99			G46			RW	Num			PT	US
Z61	Parameter A61 Set-up	A00 to AB99			A00	G45		RW	Num			PT	US
Z62	Parameter A62 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z63	Parameter A63 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z64	Parameter A64 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z65	Parameter A65 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z66	Parameter A66 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z67	Parameter A67 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z68	Parameter A68 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z69	Parameter A69 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z70	Parameter A70 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z71	Parameter A71 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z72	Parameter A72 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z73	Parameter A73 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z74	Parameter A74 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z75	Parameter A75 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z76	Parameter A76 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z77	Parameter A77 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z78	Parameter A78 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z79	Parameter A79 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z80	Parameter A80 Set-up	A00 to AB99			A00			RW	Num			PT	US
Z81	Parameter A81 Set-up	A00 to AB99			A00			RW	Num			PT	US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

9 Diagnostics

The output of the *E300 Advanced Elevator* drive is disabled under a trip condition preventing further control of the motor. If the motor is running when the trip occurs a controlled stop is carried out applying the motors brake. The brake control could be carried out by either the *E300 Advanced Elevator* drive, Elevator controller or Safety chain preventing uncontrolled operation of the Elevator.

The drive status LED indicator will flash during a drive trip with a 0.5 s duty cycle.

WARNING	Users must not attempt to repair a drive if it is faulty, nor carry out fault diagnosis other than through the use of the diagnostic features described in this chapter. If a drive is faulty, it must be returned to an authorized Control Techniques distributor for repair.

9.1 Keypad

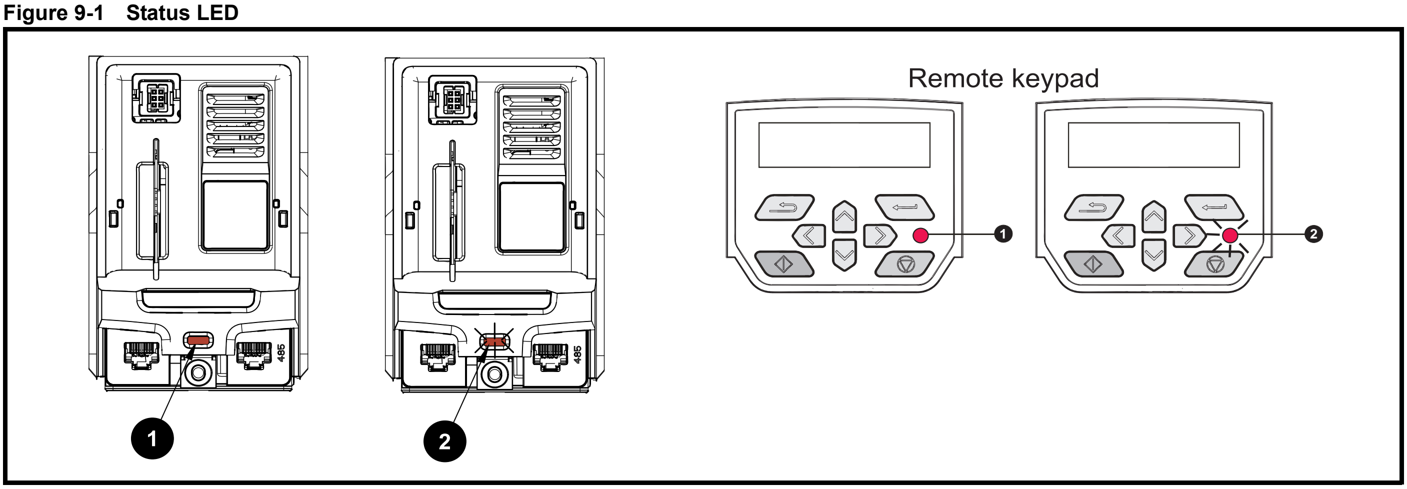
The keypad display provides information on Trip, Alarm and Status indications for further details refer to the keypad section

9.2 Status LED

The *E300 Advanced Elevator* drive has a status LED present on the front of the drive, as shown below, and one located on the remote keypad which provides a visual indication of the drive status. The status LED indicator will flash with a 0.5 s duty cycle if the drive has tripped.

1. Non flashing: Normal status
2. Flashing: Trip status

Figure 9-1 Status LED



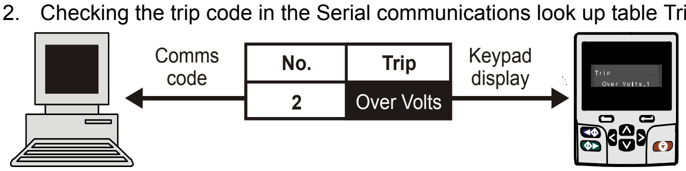
9.3 Communications protocols

The drive Status, Alarm and Trip codes can be read from the drive using communication protocols. The *E300 Advanced Elevator* drive has no communications support as standard, however where communications are required an option module can be installed refer to section 2.8 *Options* on page 19

Parameter *Drive OK* (**L05**) provides the drive Status and the drive Trips can be read in parameters *Trip 0* (**L29**) the most recent, through to parameter *Trip 9* (**L38**)

Example

1. Trip code 2 is read from *Trip 0* (**L29**) via serial communications.
2. Checking the trip code in the Serial communications look up table Trip 2 is an Over Volts trip.



3. Look up Over Volts in Table 9-15 *Serial communications look up table* on page 473
4. Perform checks detailed under Diagnosis.

NOTE

It should be noted that hardware trips (HF01 to HF20) do not have trip numbers, the HF trip will be displayed on the keypad only.

9.4 Trip indications

The drive status LED indicator will flash during a drive trip and the keypad will display the trip code.

During a trip condition where a keypad is being used, the upper row of the display indicates that a trip has occurred and the lower row displays the trip string. Some trips have a sub trip number to provide additional information about the trip. If a trip has a sub trip number, the sub trip number is flashed alternately with the trip string unless there is space on the second row of the keypad display for both the trip string and the sub trip number in which case both the trip string and sub trip information are displayed and separated by a decimal place.

9.5 Identifying a trip, trip source

Some trips only contain a trip string whereas some other trips have a trip string along with a sub trip number which provides the user with additional information on the trip. A trip can be generated from a control system or from a power system.

The sub trip number associated with the trips listed in Table 9-1 *Trips associated with xxyzz sub trip number* is in the form xxyzz and used to identify the source of the trip.

Table 9-1 Trips associated with xxyzz sub trip number

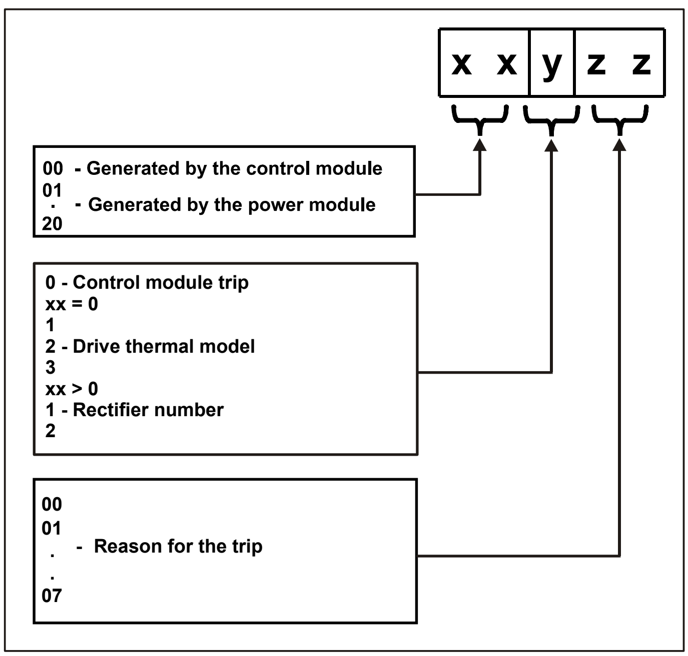
Over Volts	OHt dc bus
OI ac	Phase Loss
OI Brake	Power Comms
PSU	OI Snubber
OHt Inverter	OHt Rectifier
OHt Power	Temp Feedback
OHt Control	Power Data

The digits xx are 00 for a trip generated by the control system. For a single drive if the trip is related to the power system then xx will have a value of 01, when displayed the leading zeros are suppressed.

The y digit is used to identify the location of a trip which is generated by a rectifier module connected to a power module if xx is non zero). For a control system trip xx is zero), the y digit, where relevant is defined for each trip. If not relevant, the y digit will have a value of zero.

The zz digits give the reason for the trip and are defined in each trip description.

Figure 9-2 Key to sub-trip number



Example

If the drive has tripped and the lower line of the display shows 'OHt Control.2', with the help of the Trip indications table the trip can be interpreted as a "*Control stage over temperature*" and "*Control board thermistor 2 over temperature*" with the trip being generated by a fault in the control module. For further information on individual sub trips, refer to the diagnosis column in the Table 9-15 *Serial communications look up table* on page 473

Table 9-2 Sub-trip identification

Source	xx	y	zz	Description
Control system	00	0	01	Control board thermistor 1 over temperature
Control system	00	0	02	Control board thermistor 2 over temperature
Control system	00	0	03	Control board thermistor 3 over temperature

9.6 Displaying trip history

The *E300 Advanced Elevator* drive stores all drive trips for diagnostics along with date and time stamping information in Menu L Diagnostics.

9.6.1 Trip log parameters

Trip log

Parameter *Trip 0* **L29**) through to *Trip 9* **L38**) store the 10 most recent trips that have occurred where *Trip 0* **L29**) is the most recent and *Trip 9* **L38**) is the oldest trip captured. When a new trip occurs and is captured it is written to *Trip 0* **L29**) and all the other trips move down the log, with oldest being lost.

Sub trip numbers

Some trips have sub-trip numbers which provide more detail on the possible cause for the trip. If a trip has a sub trip number its value is stored in the sub trip log, i.e. *Trip 0, sub trip number* **L61**) to *Trip 9, sub trip number* **L70**). If the trip does not have a sub-trip number then zero will be stored in the sub-trip log.

Table 9-3 Trip history parameters

Trip	Sub trip	Date	Time
L29 Trip 0	L61 Trip 0, Sub Trip	L41 Trip 0 Date	L42 Trip 0 Time
L30 Trip 1	L62 Trip 1, Sub Trip	L43 Trip 1 Date	L44 Trip 1 Time
L31 Trip 2	L63 Trip 2, Sub Trip	L45 Trip 2 Date	L46 Trip 2 Time
L32 Trip 3	L64 Trip 3, Sub Trip	L47 Trip 3 Date	L47 Trip 3 Time
L33 Trip 4	L65 Trip 4, Sub Trip	L49 Trip 4 Date	L50 Trip 4 Time
L34 Trip 5	L66 Trip 5, Sub Trip	L51 Trip 5 Date	L52 Trip 5 Time
L35 Trip 6	L67 Trip 6, Sub Trip	L53 Trip 6 Date	L54 Trip 6 Time
L36 Trip 7	L68 Trip 7, Sub Trip	L55 Trip 7 Date	L56 Trip 7 Time
L37 Trip 8	L69 Trip 8, Sub Trip	L57 Trip 8 Date	L58 Trip 8 Time
L38 Trip 9	L70 Trip 9, Sub Trip	L59 Trip 9 Date	L60 Trip 9 Time

Date and time

The date and time when each of the trips occur is stored in the date and time log for all trips from Trip 0 through to Trip 9. The format of the date and time stamping is as follows. The date when each trip occurs is stored in *Trip 0 Date* (**L41**) and *Trip 0 Time* (**L42**) going through to *Trip 9 Date* (**L59**) and *Trip 9 Time* (**L60**). The date and time are taken from *Date* (**J80**) and *Time* (**J81**).

- Date: date - month - year 31 - 12 - 99
- Time: hours : minutes : seconds 23 : 59 : 59

The date and time for the trip log can be selected as detailed in the following table

Table 9-4 Date and Time selector

Date / Time Selector	Date / Time source
0: Set	Date and time parameters can be written by the user
1: Power	Time since the drive was powered up
2: Running	Accumulated drive running time since the drive was manufactured
3: Acc Power	Accumulated powered up time since the drive was manufactured
4: Local RTC keypad	If a keypad installed to the front of the drive includes a real time clock (RTC) then the date, time from this clock is displayed, otherwise the date, time is set to zero

When the Date, Time Selector = 0 the date and time can be written by the user, and the values are transferred to the real time clocks (RTC) in the keypad or any option module that support this feature installed to the drive. When Date, Time Selector is changed to any other value, the real time clocks are allowed to run normally again.

When Date, Time Selector is changed from any value to 0 the date and time from a real time clock, if present, is automatically loaded into the date and time so this is used as the initial value for editing. If more than one real time clock (RTC) is present the date and time from the keypad is used, if not then the date and time from the lowest number slot with a real time clock is used.

The Date and Time used for time stamping trips will continue to use the originally selected clock even if the Date, Time Selector is changed until a drive reset is initiated. If Date, Time Selector has been changed and a reset is initiated the trip dates and times are reset to zero.

Powered up time (ms)

When a trip occurs the time in milliseconds since the drive was powered up is also stored in *Trip Time Identifier* (**L72**) since powered up. The time will roll over when it reaches 2^{31} - 1, if the time is 0 a value of 1 is written.

9.7 Behavior of drive when tripped

If a drive trip occurs, the following read only parameters are frozen until the trip is reset. This is to assist in diagnosing the cause of the trip. If the parameter freeze is not required this can be disabled with *Action On Trip Detection* **H45**).

Parameter	Description
J31	Speed Error
J32	Speed Loop Output
J22	Total Output Current
J24	Torque Producing Current
J25	Magnetizing Current
J60	Output Frequency
J61	Output Voltage
J59	Output Power
J65	DC bus voltage
F35	T5 T6 Analog Input 1
F36	T7 Analog Input 2
F37	T8 Analog Input 3

9.8 Trip reset

9.8.1 Trip categories and priorities

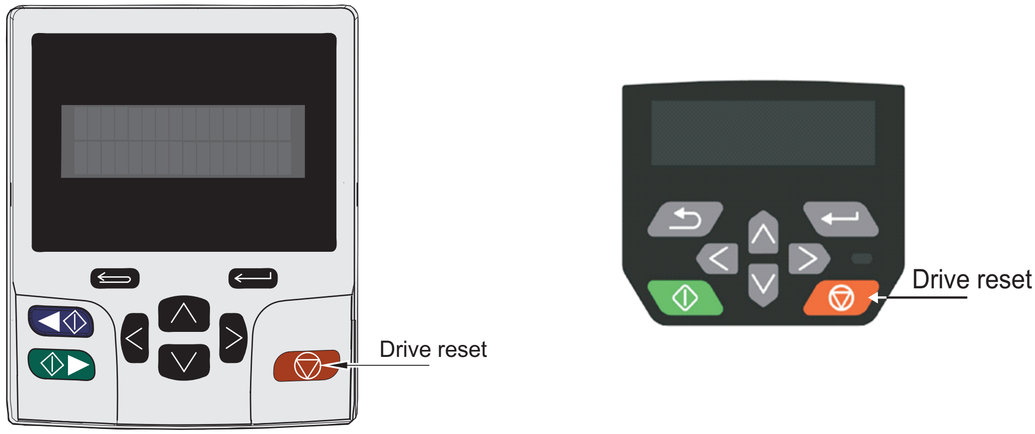
Trips are grouped into categories which are allocated priorities as detailed below, which can effect how and if a trip reset can be carried out. A trip can only occur when the drive is not already tripped, or if the drive is already tripped and the new trip occurs which has a higher priority than the current trip i.e. lower priority number). Unless otherwise stated, a trip cannot be reset until 1.0 s after it has been initiated.

Table 9-5 Trip categories and priorities

Priority	Category, Trips	Comments
1	Internal fault, HF01 - HF20	These are internal faults which cannot be reset, all drive features are rendered inactive. If a keypad is installed this will display the active HF trip. These trips are not stored in the trip log.
1	Stored HF trip	This trip can only be cleared by entering 1299 into Pr **mm00** followed by a reset.
2	Non re-settable trip, trip numbers 218 to 247	These trips cannot be reset.
3	Volatile memory fault, EEPROM Fail	This trip can only be cleared by entering to 1233 or 1244 into Pr **mm00**, or if Load Defaults is set to a non-zero value.
4	Internal 24 V power supply, PSU 24 V	
5	NV Media Card trips, trip numbers 174, 175 and 177 to 188	These trips are priority 6 during power up.
5	Position feedback power supply, Encoder 1	This trip can override Encoder 2 to Encoder 6 trips.
6	Trips with extended reset times, OI ac, OI Brake, and OI dc	These trips can only be reset 10 s after the trip was initiated.
6	Phase loss and DC Bus protection, Phase Loss and OHt dc bus	The drive will attempt to stop the motor before tripping phase loss unless disabled. The drive will attempt to stop the motor before tripping OHt dc bus.
6	Standard trips, All other trips	

Drive trips can be manually reset using the keypad using communication protocols or using the drives auto reset feature. The manual drive reset is carried out pressing the RED reset button as shown below in Figure 9-3 *Keypad drive reset* .

Figure 9-3 Keypad drive reset



To reset a drive trip using communication protocols, a value of On (1) should be written to *Drive Reset* (**L40**) followed by a Off (0). In addition it is also possible to clear the trip log within the drive. This is carried out by writing a value of On (1) to *Reset Trip Log* (**L39**).

Auto reset drive trip

An auto reset can be set-up in the *E300 Advanced Elevator* drive to reset a drive trip which would normally be reset through the keypad or using a communication protocol. The auto reset feature can be configured to carry out a number of auto reset attempts along with a time duration between each of the auto reset attempts.

- *Number Auto Reset Attempts* (**H46**) = 0 no auto reset attempts are made
- *Number Auto Reset Attempts* (**H46**) = 1 to 4, then 1 to 4 auto reset attempts are carried out
- *Number Auto Reset Attempts* (**H46**) = 6 the internal auto reset counter is held at zero and the number of auto reset attempts are infinite

The internal auto reset counter is only incremented when the trip being reset is the same as the previous trip otherwise the internal counter is reset to 0. When the internal auto reset counter reaches the programmed value any further trip of the same value will not cause another auto reset attempt.

Auto Reset Delay (**H47**) defines the time period in seconds between consecutive auto reset attempts. Note some trips may take longer to reset.

NOTE

If there has been no trip for 5 minutes then the internal auto reset counter is cleared.

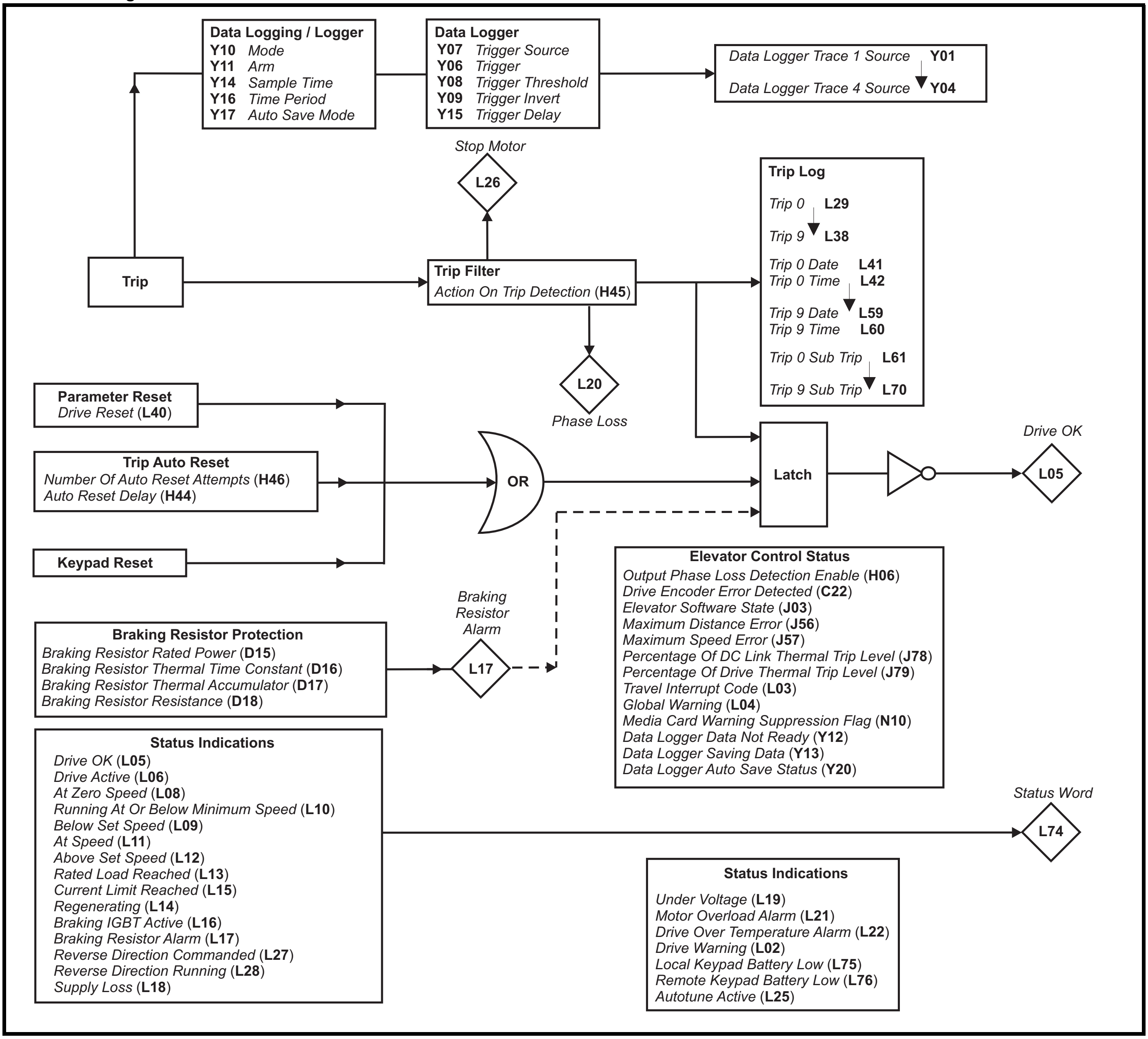
NOTE

Auto reset will not occur after any trips with priority levels 1, 2 or 3 as defined in Table 9-5 *Trip categories and priorities* on page 439

NOTE

When a manual reset occurs the auto-reset counter is reset to zero.

Table 9-6 Diagnostics



9.9 Status, Alarm, Trip indications

The *E300 Advanced Elevator* drive provides Status, Alarm and Trip information as detailed following.

9.9.1 Status indications

Table 9-7 Status indications

Upper row string	Description	Drive output stage
Inhibit	The drive is inhibited and cannot be run. The Safe Torque Off (STO), Drive enable signal is not applied to Control terminal 31	Disabled
Ready	The drive is ready to run, with the drive enable applied, but the drive is not active as the run signal has not been applied	Disabled
Stop	The drive is stopped / holding zero speed.	Enabled
Run	The drive is active and running	Enabled
Supply Loss	Supply loss condition has been detected	Enabled
Deceleration	The motor is being decelerated to zero speed / frequency following removal of the speed selection / direction / run signal.	Enabled
dc injection	The drive is applying dc injection braking	Enabled
Trip	The drive has tripped and the motor is stopped. The trip code appears in the lower display	Disabled
Under Voltage	The drive is in an under voltage state either in low voltage or high voltage mode	Disabled
Phasing	The drive is performing a ‘phasing test on enable’	Enabled

Table 9-8 Option module, NV Media Card and other status indications

First row string	Second row string	Status
Booting	**Parameters**	Parameters are being loaded
Drive parameters are being loaded from a NV Media Card		
Booting	**Option Program**	User program being loaded
User program is being loaded from a NV Media Card to the option module in slot X		
Writing To	**NV Card**	Data being written to NV Media Card
Data is being written to a NV Media Card to ensure that its copy of the drive parameters is correct because the drive is in Auto or Boot mode		
Waiting For	**Power System**	Waiting for power stage
The drive is waiting for the processor in the power stage to respond after power-up		
Waiting For	**Options**	Waiting for an option module
The drive is waiting for the options modules to respond after power-up		
Uploading From	**Options**	Loading parameter database
At power-up, it may be necessary to update the parameter database held by the drive because an option module has changed or because an applications module has requested changes to the parameter structure. This may involve data transfer between the drive and option modules.		

9.9.2 Alarm indications

In any mode, an alarm is an indication given on the display by alternating the alarm string with the drive status string on the first row and showing the alarm symbol in the last character in the first row. If an action is not taken to eliminate any alarm except "Autotune and Limit Switch" the drive may eventually trip. Alarms are not displayed when a parameter is being edited, but the user will still see the alarm character on the upper row.

Table 9-9 Alarm indications

Alarm string	Description
Brake Resistor	Brake resistor overload, *Braking Resistor Thermal Accumulator* (**D17**) in the drive has reached 75.0 % of the value at which the drive will trip.
Motor Overload	*Motor Protection Accumulator* (**J26**) in the drive has reached 75.0 % of the value at which the drive will trip and the load on the drive is >100 %.
Drive Overload	Drive over temperature. *Percentage Of Drive Thermal Trip Level* (**J79**) is greater than 90 %.
Autotune	The autotune procedure has been initialized and an autotune in progress.

9.10 Programming error indications

Following are error messages displayed on keypad when an error occurs during programming of drive firmware.

Table 9-10 Programming error indications

Error String	Reason	Solution
Error 1	There is not enough drive memory requested by all the option modules.	Power down drive and remove some of the option modules until the message disappears.
Error 2	At least one option module did not acknowledge the reset request.	Power cycle drive.
Error 3	The boot loader failed to erase the processor flash	Power cycle drive and try again. If problem persists, return drive.
Error 4	The boot loader failed to program the processor flash	Power cycle drive and try again. If problem persists, return drive.
Error 5	One option module did not initialize correctly. Option module did not set Ready to Run flag.	Remove faulty option module.

9.11 Trip indications

The trips can be grouped into the following categories. It should be noted that a trip can only occur when the drive is not tripped, or is already tripped but the new trip which occurs is of higher priority (lower trip number) than a current trip.

Table 9-11 Trip categories

Priority	Category, Trips	Comments
1	Internal fault, HF01 - HF20	These are internal faults which cannot be reset, all drive features are rendered inactive. If a keypad is installed this will display the active HF trip. These trips are not stored in the trip log.
1	Stored HF trip	This trip can only be cleared by entering 1299 into Pr **mm00** followed by a reset.
2	Non re-settable trip, trip numbers 218 to 247	These trips cannot be reset.
3	Volatile memory fault, EEPROM Fail	This trip can only be cleared by entering to 1233 or 1244 into Pr **mm00**, or if Load Defaults is set to a non-zero value.
4	Internal 24 V power supply, PSU 24 V	
5	NV Media Card trips, trip numbers 174, 175 and 177 to 188	These trips are priority 6 during power up.
5	Position feedback power supply, Encoder 1	This trip can override Encoder 2 to Encoder 6 trips.
6	Trips with extended reset times, OI ac, OI Brake, and OI dc	These trips can only be reset 10 s after the trip was initiated.
6	Phase loss and DC Bus protection, Phase Loss and OHt dc bus	The drive will attempt to stop the motor before tripping phase loss unless disabled. The drive will attempt to stop the motor before tripping OHt dc bus.
6	Standard trips, All other trips	

The following trips are suppressed during travel i.e. *Elevator Software State* (**J03**) >0:

- Motor thermistor, Trip 24 (**Thermistor**)
- Brake monitoring, Trip 72 (**Brk con 1 open**), Trip 73 (**Brk con 1 closd**), Trip 74 (**Brk con 2 open**) and Trip 75 (**Brk con 2 closd**).
- Motor contactor monitoring, Trip 70 (**Mot con open**) and Trip 71 (**Mot con closd**)
- Heat sink over temperature, Trip 22 (**OHt Power**), the trip will happen when the next travel is initiated.
- The direction signal monitoring, Trip 76 (**Dir change**)
- Control word watchdog bit monitoring, Trip 77 (**Ctrl Watchdog**)
- The freeze protection monitoring, Trip 60 (**Freeze Protect**)

If a delayed trip has been scheduled during travel (*Elevator Software State* (**J03**) > 0) then *Global Warning* (**L04**) = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.

9.12 Internal hardware trips

Internal hardware trips HF01 to HF20 do not have trip numbers. If one of these trips occurs, the main drive processor has detected an irrecoverable error.

All drive functions are stopped during internal hardware trips and the trip message is displayed on the keypad. If a non permanent trip occurs this may be reset by power cycling the drive.

On power up after the drive has been power cycled following an internal hardware trip, the drive will trip on Stored HF. Enter 1299 in Pr **mm00** to clear the Stored HF trip.

9.13 Trips and sub-trip numbers

The drive retains a log of the last ten trips that have occurred. Trip 0 to Trip 9 store the 10 most recent trips that have occurred where Trip 0 is the most recent and Trip 9 is the oldest.

When a new trip occurs it is written to Trip 0, all the other trips move down the log, with the oldest being lost.

Some trips have sub trip numbers which give more detail about the reason for the trip. If a trip has a sub trip number its value is stored in the sub trip log. If the trip does not have a sub-trip number then zero is stored in the sub trip log.

If any parameter between *Trip 0* (**L29**) through to *Trip 9* (**L38**) inclusive is read by communication protocols, the trip numbers in Table 9-15 *Serial communications look up table* on page 473 are read for the relevant drive trip.

9.14 Travel interrupt code

To assist in diagnosing a fault during operation, the sequence of the travel is continuously monitored within the Elevator control software. During a fault a travel interrupt code will be generated to indicate the point during operation where the fault occurred. The travel interrupt code is available in *Travel Interrupt Code* (**L03**).

Table 9-12 Travel interrupt codes

Travel Interrupt Code (L03)	Description
0	No travel interrupt
1	Travel interrupt while waiting for the enable input
2	Travel interrupt during the motor contactor de-bounce time
3	Travel interrupt during torque ramp-up torque / brake release
4	Travel interrupt during the brake release delay
5	Travel interrupt during the load measurement delay
6	Travel interrupt during start optimization
7	Travel interrupt during acceleration
8	Travel interrupt during normal travel
9	Travel interrupt during deceleration
10	Travel interrupt during creep
11	Travel interrupt during positioning
12	Travel interrupt during brake apply delay
13	Travel interrupt during torque ramp-down / brake apply

9.15 Control state

The state machine within the Elevator control software handles the general sequencing for the *E300 Advanced Elevator* drive in the Elevator system such that the drive will be in a known defined state during operation. The defined states will include for example the following;

- Idle
- Control sequencing
- Contactor control
- Motor control
- Brake control
- Profile control
- Start, travel, decelerate creep, stop

The state machine and its control states are sequenced based upon the Elevator controller signals to the drive, via the terminal interface and dependant upon the drive configuration. During operation the active states will be displayed as shown in the table following.

Table 9-13 State machine and control state

J03 Elevator software state	Description
0	**Idle (wait for travel request):**
	To exit the idle state the following conditions need to be met: • Drive OK parameter *Drive OK* (**L05**) = On (1) • A speed reference has been selected and a direction input has been received (if dual direction inputs are used) **OR** • A speed reference has been selected if single direction input is used. **OR** • If the enable and Fast disable (if used) are received (speed and direction not required) Provided brake contact and *Motor Contactor Monitoring Enable* (**B29**) = On (1), and none of the above conditions are true, check the state of *Motor Contactor Monitoring Input* (**B30**) and the brake contact and generate trips if they are in the incorrect state. The motor contactors should be open, but if it is closed generate Trip 71 (**Mot con Closd**) indicating an incorrect state. The brake contact should be open, but if it is closed and *Brake Contact Monitoring Select* (**D11**) > 0, generate Trip 73 (**Brk con 1 closd**) and Trip 75 (**Brk con 2 closd**) indicating an incorrect state. Force all contactor and control outputs to Off (0) while a travel is not requested i.e. brake and motor contactor. **On exit from state 0:** • Sample the autotune selection parameter *Motor Autotune* (**B11**). **Exit to state 1:** • If the speed / direction signal starts the travel. **On exit to state 1:** • Sample the start time for the Safe Torque Off and Fast disable inputs (if used). Used to call *Trip 65* (**Fast disable err**) and *Trip 66* (**STO ctrl err**) (time from the command to close the motor contactors to close to receive the Safe Torque Off **OR** Safe Torque Off and Fast disable (if used). • Close the motor contactors via *Motor Contactor Control Output* (**B31**). **Exit to state 2:** • If Safe Torque Off (STO) and Fast disable starts the travel.
1	**Wait for Safe Torque Off (STO), Drive enable:**
	Wait for the Safe Torque Off and Fast disable inputs. When the Safe Torque Off and Fast disable inputs are received, sample the time and move to the next state. Time is used to de-bounce the motor contactors. It is assumed that the Safe Torque Off and Fast disable are either directly electrically connected to the motor contactors auxiliary feedback (24V signal) or a buffered version of it. In systems with a "no contactor" solution the Safe Torque Off and Fast disable are derived from the system motor safety relays. If the enable is not received within 6 s - generate *Trip 65* (**Fast disable err**) /*Trip 66* (**STO ctrl err**) as appropriate. Generate *Trip 65* (**Fast disable err**) if *Fast Disable* (**B27**) and Safe Torque Off are not received in time, or *Trip 66* (**STO ctrl err**) if Safe Torque Off is not received in time. If *Motor Contactor Monitoring Enable* (**B29**) = On (1), and *Motor Contactor Monitoring Input* (**B30**) = Off (0) after 6 s, *Trip 70* (**Mot con open**) indicating the motor contactors should be closed. **Exit to state 2:** • When Safe Torque Off and Fast disable (if used) inputs are received. **Exit to state 14:** • If digital speed selection is removed • If direction signal is removed (dual direction inputs) • If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed • If an autotune completes • If the drive trips

2	De-bounce output motor contactors:

Wait until 100 ms has elapsed to de-bounce the motor contactors. This prevents the drive from being enabled while the motor contactors bounce when closing which could cause an ***OI ac*** trip.

Exit to state 3:
- When the motor contactors de-bounce delay is completed.

On exit to state 3:
- Sample the final load cell compensation torque value to provide as a torque feed forward reference if *Load Cell Compensation Enable* (**E10**) = On (1).

Exit to state 14:
- If digital speed selection is removed
- If direction signal is removed (dual direction inputs)
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed
- If an autotune completes
- If the drive trips

3	Ramp torque producing current limit and position lock:

Ramp Torque Producing Current (**J24**) to full limit over the *Motor Torque Ramp Time* (**D02**) in ms.

The brake controller is engaged once the torque ramp has completed. When *Brake Control Output* (**D03**) = On transition to state 4. This checks that the motor is magnetized, and for open loop that the minimum starting frequency has been reached.

If *Start Lock Enable* (**I22**) =1, enable the position loop, and if at least 1 travel has been completed, prime the position loop with the position of the motor when the brake was closed but before the drive is disabled and the *Torque Producing Current* (**J24**) ramped to 0, from the previous travel.
If the autotune value sampled on exit from state 0 is > 0 then apply the run signal in the direction specified by the CW / CCW terminals.
For open loop operation, the start optimizer parameters are applied and motion controller enabled before the brake is released to provide holding torque on start.

Exit to state 4:
- *Brake Control Output* (**D03**) = On (1) **AND**
- When the torque producing current limit has been ramped to *Symmetrical Current Limit* (**B16**).
- If an Autotune >=2 <=5 is in progress to release the brake.

On exit to state 4:
- Sample the start time for brake release.

Exit to state 13:
- If digital speed selection is removed
- If direction signal is removed (dual direction inputs)
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed
- If an autotune completes
- If the drive trips
- If the brake controller takes longer than 6 s to complete.

4	Release the brake:

Release the brake, and after *Brake Control Release Delay* (**DO4**) ms, consider that the brake is released. If *Brake Contact Monitoring Select* (**D11**) > 0, then when the brake contact feedback is received exit to state 5 and bypass the *Brake Control Release Delay* (**DO4**).

Exit to state 5:
- If the drive is in a closed loop mode **AND**
- When the brake release time must has elapsed, **OR**
- If *Brake Contact Monitoring Select* (**D11**) > 0, the brake contact feedback via *Brake Contact Monitoring Input 1* (**D12**) and *Brake Contact Monitoring Input 2* (**D13**) must both be set to On (1), indicating that the brake contact is closed i.e. the brake is released.

On exit to state 5:
- If *Load Cell Compensation Enable* (**E10**) =1, disable the position loop by ramping the *Start Lock P Gain Speed Clamp* (**I21**) to 0, in order to smoothly pass the load to the speed loop.

Exit to state 6:
- If the drive is in open loop mode and digital speed references are selected **AND**
- When the brake release time has elapsed, **OR**
- If *Brake Contact Monitoring Select* (**D11**) > 0, the brake contact feedback via *Brake Contact Monitoring Input 1* (**D12**) and *Brake Contact Monitoring Input 2* (**D13**) must both be set to On (1), indicating that the brake contact is closed i.e. the brake is released.

Exit to state 8:
- If analog reference mode is selected, (*Control Input Mode* (**H11**) = 0 or 1) to indicate that we are travelling based on the analog speed reference. **AND**
- When the brake release time has elapsed, **OR**
- If *Brake Contact Monitoring Select* (**D11**) > 0, the brake contact feedback via *Brake Contact Monitoring Input 1* (**D12**) and *Brake Contact Monitoring Input 2* (**D13**) must both be set to On (1), indicating that the brake contact is closed i.e. the brake is released.

Exit to state 12:
- If digital speed selection is removed
- If direction signal is removed (dual direction inputs)
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed
- If an autotune completes
- If the drive trips

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load/direction accumulator for rescue operation

5	Load measurement:

Accumulate *Torque Producing Current* (**J24**) and time for the rescue *Load Measurement Time* (**O04**) in ms. This is for determination of the load direction and magnitude for rescue operation.

This state is not used in open loop mode.

Exit to state 6:
- When *Load Measurement Time* (**O04**) has elapsed and *Start Optimizer Time* (**G48**) > 0

Exit to state 7:
- When *Load Measurement Time* (**O04**) has elapsed and *Start Optimizer Time* (**G48**) > 0

On exit to state 7:
- Apply the selected speed, accel start jerk, accel end jerk, decel start jerk and decel end jerk.
- Apply the main elevator profile accel and decel rate.
- If *Start Lock Enable* (**I22**) =1, disable the position loop by ramping the *Start Lock P Gain Speed Clamp* (**I21**) to 0, in order to smoothly pass the load to the speed loop.

Exit to state 12:
- If the digital speed selection is removed or the Safe Torque Off (STO), Drive enable and Fast disable input (if used) is removed or the drive trips, or the digital direction signal is removed in dual direction input mode), transition to state 12 to apply the brake.

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load / direction accumulator for rescue operation

6 Starting:

- Apply the start optimization speed and Jerk when *Start Optimizer Time* (**G48**) > 0).
- Apply the main elevator profile accel and decel rate.
- If Position lock enable = 1, disable the position loop by ramping the *Start Lock P Gain Speed Clamp* (**I21**) to 0, in order to smoothly pass the load to the speed loop.

This state is not used in open loop mode.

Exit to state 7:
- When the *Start Optimizer Time* (**G48**) has elapsed. The time may be set to 0 effectively bypassing this state.

On exit to state 7:
- Apply the selected speed, accel start jerk, accel end jerk, decel start jerk and decel end jerk.

Exit to state 9:
- If the digital speed selection is removed or the direction signal is removed (in dual direction input mode), transition to state 9 to decelerate the elevator car.

Exit to state 12:
- If the digital speed selection is removed or the Safe Torque Off (STO), Drive enable and Fast disable input (if used) is removed or the drive trips, or the digital direction signal is removed (in dual direction input mode), transition to state 12 to apply the brake.

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load / direction accumulator for rescue operation

7 Accelerating:

Remain in this state until constant speed is reached, or we begin to decelerate because a digital speed signal has been removed.

New target speeds that are ≥ *V2 Speed Reference* (**G02**), will be accepted and will become the new target speed. This type of speed selection is only recommended for commissioning where the elevator speeds must be tested.

Exit to state 8:
- When constant speed is reached

Exit to state 9:
- If the digital speed selection is removed or the direction signal is removed (in dual direction input mode), transition to state 9 to decelerate the elevator car. Where the direction signal is removed in dual direction mode profile will decelerate to a stop wherever it happens to be i.e. no use of Creep speed, in Creep to floor, no position control in Direct to floor OR
- If Creep to floor is selected (Elevator control mode = Off (0)) and creep speed is selected.

On exit to state 9:
- Apply Creep speed, if creep to floor is selected (Elevator control mode = Off (0)) and creep speed is selected, OR
- Switch to position control and profile to zero speed in Direct to Floor (Elevator control mode = On (1)).

Exit to state 12:
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed or the drive trips, go to state 12 to apply the brake.

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load / direction accumulator for rescue operation

8 Travelling:

Remain in this state until a speed signal is removed i.e. transition to Creep speed, in Creep to floor or zero speed in Direct to floor.

Exit to state 7:
- If a new target speed is selected.

Exit to state 9:
- If the digital speed selection is removed or the direction signal is removed in dual direction input mode), transition to state 9 to decelerate the elevator car. Where the direction signal is removed in dual direction mode profile will decelerate to a stop wherever it happens to be i.e. no Creep speed, in Creep to floor, no position control in Direct to floor

On exit to state 9:
- Creep speed, if Creep to floor is selected (Elevator control mode = Off (0)) and
- Switch to position control and profile to zero speed in Direct to Floor (Elevator control mode = On (1)).

Exit to state 12:

- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed or the drive trips, go to state 12 to apply the brake.
- If analog reference mode is selected, Control input mode = -0 or 1) and the direction input is removed.

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load / direction accumulator for rescue operation

9	Decelerating:

Exit to state 10:
- If Creep to floor is selected (Elevator control mode = Off (0)) and when Creep speed is reached.

For Creep to floor exit to state 10, for Direct to floor exit to state 12.

On exit to state 10:
- Apply the final positioning jerk

Exit to state 12:
- If Direct to Floor is selected (Elevator control mode = On (1)) when the positioning profile has completed i.e. zero speed.
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed or the drive trips, go to state 12 and apply the brake.
-

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load / direction accumulator for rescue operation.

10	Creep:

In this state the profile will run at Creep speed (*V1 Speed Reference* (**G01**)) by default, but can be any speed reference.

This state is not used if (Elevator control mode = On (1)) i.e. Direct to floor mode is selected.

Exit to state 11:
- When Creep speed is deselected OR
- When the floor sensor correction input is given

On exit to state 11:
- Apply *Creep Stop Deceleration Rate* (**G17**) and *Creep Stop Jerk* (**G18**)

Exit to state 12:
- If Direct to Floor is selected (Elevator control mode = On (1)) when the positioning profile has completed i.e. zero speed.
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed or the drive trips, go to state 12 to apply the brake.

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load / direction accumulator for rescue operation

11	Positioning.

Wait for zero speed if a normal creep stop is used i.e. no floor sensor correction. If floor sensor correction is used use the creep stop profile distance as the distance to floor and position correct to a stop.

Exit to state 12:
- When zero speed is reached i.e. motion profile is complete.
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed or the drive trips, go to state 12 to apply the brake.

On exit to state 12:
- Sample the time used to detect a brake contact fault.
- Reset the load / direction accumulator for rescue operation

12	Apply the brake:

Set *Brake Control Output* (**D03**) = Off (0) and wait *Motor Torque Ramp Time* (**D02**) ms for the brake to be applied. For systems where the brake control is implemented in the elevator controller *Brake Control Output* (**D03**) may be used to indicate when to apply / release the brake.

Exit to state 13:
- If *Brake Contact Monitoring Select* (**D11**) > 0, and this takes longer than *Brake Contact Monitoring Time* (**D14**), generate a *Trip 73* (**Brk con 1 closd)** / *Trip 75* (**Brk con 2 closd**).
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed or the drive trips

13	Ramp the torque down:

Sample the motor encoder position, and then ramp the Torque producing current to 0% in the time specified by Motor Torque Ramp Time (**D02**) in ms. When the ramp has completed move to the next state.

Don't sample the position if the previous state was < 6

Exit to state 14:
- When the torque producing current limit has been ramped to 0 using the Motor torque ramp time via *Symmetrical Current Limit* (**B16**) and *Motor Torque Ramp Time* (**D02**)
- If the Safe Torque Off (STO), Drive enable and Fast disable input (if used) are removed or the drive trips

On exit to state 14:
- Sample the time on exit for use to detect a feedback issue with the motor contactors, or a Safe Torque Off (STO), Drive enable and Fast disable input (if used) issue.
- Disable the drive via and remove the run signal.

14	Contactor control
Generate motor contactor control output. **Exit to state 0:** • *Fast Disable* (**B27**) = Off (0) AND • T*otal Output Current* (**J22**) ≤ 25 % of rated current AND • F10 *T31 STO Input 1 State* (**F10**)= Off (0) AND • There is no digital speed signal present (if used) AND • There is no direction signal present (in dual direction signal mode) AND • The Fast disable input (if used) = Off (0) OR • The drive trips The following error detection is made in this state after 4 s. The list is in order of priority: 1. If *Motor Contactor Monitoring Enable* (**B29**)= On (1), and it takes > 4 s for the monitoring input to be set to 0, generate a *Trip 71* (**Mot con closd**). 2. If the *Fast Disable* (**B27**) input terminal = On (1), then generate *Trip 65* (**Fast disable err**). 3. If the F10 *T31 STO Input 1 State* (**F10**) = On 1, then generate *Trip 66* (**STO Ctrl err**). 4. If the total current is > 25 % of rated, then generate *Trip 67* (**Current on stop**).	

9.16 Troubleshooting and identifying faults

Reported fault	Root cause	Recommended actions
Unable to carry out autotune, motor does not rotate	Output motor contactors are not closing during the static or rotating autotune.	Verify where the output motor contactor control is being carried out, on the drive or the Elevator controller. Select the autotune required and then ensure the output motor contactors are closed. • Refer to *Menu B Motor* for the motor contactor control and to select the autotune
	Motor brake is not releasing during rotating autotune	Verify where the brake control is being carried out, on the drive or the Elevator controller. Select the autotune required, close the output motor contactors and then release the motor brake. • Refer to *Menu D Brake* for the brake control and *Menu B Motor* to select the autotune.
	Motor data incorrect	Verify motor nameplate data and parameter settings in parameters **B01** through to **B10**. Ensure correct operating mode is also selected for motor type, *Induction motor or PM motor* • Refer to *Menu B Motor* for motor parameters
	Encoder data incorrect	Verify encoder data and parameter settings in parameters **C01** through to **C08** for Closed loop operation. Note that for encoders with an additional comms interface e.g. SC.EnDat an auto configuration option is available in parameter **C02**. • Refer to *Menu C Encoder* for encoder parameters For PM motors and operation in RFC-S an encoder phase angle test must be completed before operation. • Refer to *Motor Autotune* (**B11**)
	STO) Safe Torque Off, Drive enable not active	Check the enable signal is connected to control terminal 31 of the drive. The enable is typically connected via the auxiliary contacts on the output motor contactors therefore these must operate in order the drive to be enabled. • Check motor contactor control in *Menu F Hardware IO* and the connections to control terminal 31 of the drive.
	Rotating autotune not possible	A rotating autotune cannot be carried out where there is either insufficient space for the Elevator car to move in the Elevator shaft or load is present resulting in an unbalanced system. • In this condition a static autotune should be carried out refer to *Motor Autotune* (**B11**).

Reported fault	Root cause	Recommended actions
Motor acoustic noise on drive enable, motor operation	Incorrect drive switching frequency selected	Note the drive will modulate between a minimum (**B14**) and a maximum (**B13**) switching frequency. An increase in the drive maximum switching frequency may result in an output derating. • Adjust the drive switching frequency in parameter **B13** and **B14**.
	Current control loop	The current control loop gains calculated from the autotune may be high for the given motor and can therefore be manually adjusted or a current control loop filter implemented. Note there is separate current control adjustment for (1) Start and (2) Travel-Stop as default. • Refer to *Menu I Tuning* to adjust the current control loop under both full load and no load conditions.
	Speed control loop	The speed control loop gains may need to be tuned for the given system. If the acoustic noise is during standstill adjust Integral speed loop gain, if the noise is during operation reduce the Proportional speed loop gain. Note there is separate speed control loop gains for (1) Start, (2)Travel, Stop as default. • Refer to *Menu I Tuning* to adjust the speed control loop under both full load and no load conditions. • Ensure good EMC practices are followed for the position feedback, induced noise can limit the level of control loop gain which can be achieved
	Wiring issue, induced noise on position feedback	If there is induced noise on the position feedback from the motor to the drive due to the wiring arrangement, screening and terminations this will result in unstable operation and acoustic noise from the motor. • Ensure good EMC practices are followed, if issue persists a position feedback filter can be implemented with *Drive Encoder Feedback Filter* (**C09**)
	Elevator system mechanical issue	Check during operation that any acoustic noise present is not being generated as a result of a mechanical fault with the Elevator system or is a fault with motor, gearbox and/or couplings
Reported fault	**Root cause**	**Recommended actions**
Elevator incorrect operating speed or direction	Elevator mechanical data not entered correctly	In order for correct operation at the systems rated speed, the mechanical data for the Elevator system must be entered correctly, this includes the Nominal speed (m/s) Sheave diameter, Roping, Gear ratio and Maximum speed. • Refer to *Menu E Mechanical* to enter the mechanical data
	Elevator operating speeds not set-up	The *E300 Advanced Elevator* drive in default set-up has 4 speed selections V1 through to V4 which can be adjusted in parameters **G01** through to **G04.** Also ensure that the correct control connections are made to the drives control terminals to select the required speed. • Refer to *Menu G Profile* to set-up the operating speeds and *Menu F Hardware IO* for the control input configuration and monitoring
	Incorrect direction input configuration, selection	Where operation in an incorrect direction is identified, check that the correct direction input control single or dual directions) has been set-up in *Control Input Mode* (**H11**) and is being selected. Also check that the motor power and encoder connections are of the correct rotation • Refer to *Menu F Hardware IO* for input direction control
	Autotune has not been completed for RFC-S mode with a PM motor in a gearless Elevator system	For PM motors and operation in RFC-S an encoder phase angle test must be completed before operation. Failure to do an autotune will result in a loss of control and on brake release the motor could move in either direction dependant upon the direction of the load. • Refer to *Motor Autotune* (**B11**)
	Motor power, encoder control connections	Check both the motor power connections and the encoder control connections for the correct rotation. • Refer to *Reverse Motor Phase Sequence* (**B26**) for the motor or *Drive Encoder Feedback Reverse* (**C12**).

Reported fault	Root cause	Recommended actions
Elevator fails to reach contract speed	Drive operating in current limit	If the motor is unable to reach the demanded speed check if the drive is operating in current limit in *Current Limit Reached* (**L15**). • Check the motor parameters and symmetrical current limit are set-up correctly in *Menu B Motor* • Check motor load in *Total Output Current* (**J22**) • Check for system mechanical issue, brake, safety gear, incorrect balance weights • Check drive size correct • Reduce acceleration, deceleration rates in *Menu G Profile* if issue is during acceleration and/or deceleration
	Motor rated speed “slip” incorrect Open loop vector, RFC-A)	The motor is unable to reach the demanded speed due to a limitation in output torque as a result of the incorrect rated speed “slip” • Manually adjust the rated speed to achieve the maximum torque in *Torque Producing Current (***J24**) Open loop) • Tune the rated speed to achieve the maximum torque using *Motor Parameter Adaptive Control* (**B25**) RFC-A)
	Output motor voltage limited	If the motor is unable to reach the contract speed due to insufficient voltage available from the AC power supply, consider any voltage drops due to any additional AC power supply input choke or drive output choke to the motor. • Refer to *Output Voltage* and *Last Travel Maximum Output Voltage* (**J63**)
	PM motor operating in RFC-S reaching flux weakening region	The motor may be operating at its maximum speed / going into flux weakening. • Refer to *Enable High Speed Mode* (**B28**) and ensure *Motor Rated Voltage* (**B03**) is set to the maximum rated voltage for the motor
Overshoot during change in speed	Speed control loop	Overshoot can occur during operation where there is a change in speed due to the speed control loop proportional gain being to low. The speed control loop proportional gain should be increased for the section, Start, Travel, Stop to minimise overshoot under both full load and no load conditions • Refer to *Menu I Tuning* to adjust the speed loop P gain during the Start, Travel and Stop. • Ensure good EMC practices are followed for the position feedback, induced noise can limit the level of control loop gain which can be achieved.
Acoustic noise from motor/ brake arrangement during start / stop	Current limit ramp time	During the stop and following brake apply the drive ramps the current limit down releasing the load slowly onto the mechanical brake before disabling drive. If there is no ramp or the ramp time is not correct some acoustic noise can be heard with some motors and mechanical brakes. • Refer to *Motor Torque Ramp Time* (**D02**)

Reported fault	Root cause	Recommended actions
Vibration on brake release	Speed control loop	If the speed loop integral gain is to high this can result in vibration during start and on brake release, reduce the start speed loop I gain. The proportional gain can also be reduced to improve stability, however low values can result in roll back on brake release. • Refer to *Menu I Tuning* to adjust start speed loop gains under both full load and no load conditions. • Ensure good EMC practices are followed for the position feedback, induced noise can limit the level of control loop gain which can be achieved
	Start position lock	If the Start lock P gain is to high prior to and during brake release this will result in vibration during the start, to overcome vibration reduce the p gain, if this has little effective the speed loop start i gain should also be reduced. • Refer to *Menu I Tuning* to adjust start lock for start under both full load and no load conditions. • Ensure good EMC practices are followed for the position feedback, induced noise can limit the level of control loop gain which can be achieved
	Position feedback Closed loop operation)	Check the position feedback in Closed loop operation. Where induced noise is present on the position feedback cabling this can result in unstable control. • Ensure good EMC practices are followed with regards to cable routing, screen and terminations. Refer to *Drive Encoder Feedback Filter* (**C09**) which can also be used to limit induced noise.

Reported fault	Root cause	Recommended actions
Vibration during operation	Speed control loop	If the speed loop I, P gains are set-up incorrectly vibration can occur during any part of the travel. The speed loop gains are split into 2 sections with the default set-up being (1) Start speed loop gains and (2) Travel, Stop speed loop gains. • Refer to *Menu I Tuning* to adjust the Start, Travel, Stop speed loop gains for both full load and no load conditions. • Ensure good EMC practices are followed for the position feedback, induced noise can limit the level of control loop gain which can be achieved
	Position feedback Closed loop operation)	Check the position feedback in Closed loop operation. Where induced noise is present on the position feedback cabling this can result in unstable control. • Ensure good EMC practices are followed with regards to cable routing, screen and terminations. Refer to *Drive Encoder Feedback Filter* (**C09**) which can also be used to limit induced noise.
	Current control loop	The current control loop gains calculated from the autotune may be high for the given motor and can be manually adjusted or a current control loop filter implemented where vibration is present. Note there is separate current control adjustment for (1) Start and (2) Travel-Stop as default. • Refer to *Menu I Tuning* to adjust the current control loop under both full load and no load conditions.
Roll back during start	Speed control loop	During the start on brake release if roll back occurs the start speed loop I gain should be increased. Excessive values can result in motor acoustic noise and therefore may require the position lock at start to be enabled. If a low resolution encoder is being used, or there is induced noise on the position feedback these can limit the maximum speed loop gain due to acoustic noise and instability. • Refer to *Menu I Tuning* to adjust the start speed loop I gain for both full load and no load conditions. • Ensure good EMC practices are followed for the position feedback, induced noise can limit the level of control loop gain which can be achieved
	Start position lock	During the start on brake release if the start speed loop I gain is limited due to a low resolution encoder or there is induced noise on the position feedback the position lock for start can be enabled. • Refer to *Start Lock P Gain* (**I20**). The start speed loop gains I, P may need to be reduced to achieve a high P gain setting for the start lock. The start lock should be set-up for both full load and no load conditions
	Load cell compensation	If the Elevator system has a load cell available this can be connected to the drive using analog input 2 and provide a torque feed forward during the start to overcome roll back. • Refer to *Menu E Mechanical* for the Load cell compensation parameters to set-up compensation. Where the load cell compensation signal is unstable /noisy, a filter can be implemented with *Load Cell Compensation Filter Time Constant* (**E12**)
Reported fault	**Root cause**	**Recommended actions**
Motor goes into current limit following drive enable	Motor data, symmetrical current limit	Ensure the motor data has been set-up correctly in the drive and the symmetrical current limit has also been set-up for the system. • Refer to *Menu B Motor* and *Symmetrical Current Limit* (**B16**)
	Autotune	For a PM motor and operation in RFC-S if the motor goes into current limit on enable ensure an autotune has been carried out to derive the correct encoder phase angle, or this has been entered if known. • Refer to *Motor Autotune* (**B11**)
	Position feedback	Check the position feedback if this has failed or connected incorrectly the drive will no longer operate correctly in either RFC-A or RFC-S. • Refer to *Drive Encoder Position* (**J53**) and check connections to drive encoder port. • Refer to *Drive Encoder Feedback Reverse* (**C12**) to change rotation of encoder feedback where this is connected incorrectly.
	Motor rated speed "slip" incorrect (Open loop vector, RFC-A)	The motor is unable to reach the demanded speed due to a limitation in output torque, current limit operation as a result of the incorrect rated speed "slip" • Manually adjust the rated speed to achieve the maximum torque in *Torque Producing Current* (**J24**) (Open loop) • Tune the rated speed to achieve the maximum torque using *Motor Parameter Adaptive Control* (**B25**) (RFC-A)
	Motor, motor connection fault	Check the connections from the drive output to the motor including the output motor contactors and any shorting contactor which may be used.

9.17 Trip codes

The following section details the trip codes for the *E300 Advanced Elevator* drive

Table 9-14 Trip indications

<table>
<tr><th>Trip</th><th>Diagnosis</th></tr>
<tr><td>550 Hz Limit</td><td>Mechanical setup results in potential output frequency exceeding maximum threshold</td></tr>
<tr><td>83</td><td>The values used to configure the drive in the mechanical menu parameters E01 to E05 have resulted in a required output frequency of > 550 Hz which is not allowed.
Recommended actions:
• Alter E01 to E05 to reduce the required output frequency.</td></tr>
<tr><td>An Input 1 Loss</td><td>Analog input 1 current loss</td></tr>
<tr><td>28</td><td>An Input 1 Loss trip indicates that a current loss was detected in current mode on Analog input 1 Control terminals 5, 6). In 4-20 mA and 20-4 mA modes, the loss is detected where the current falls below 3 mA.
Recommended actions:
• Check control wiring is correct
• Check control wiring is undamaged
• Check the Analog Input 1 Mode (T5 T6 Analog Input 1 Mode (F40))
• Check current signal is present and > 3 mA</td></tr>
<tr><td>An Input 2 Loss</td><td>Analog input 2 current loss</td></tr>
<tr><td>29</td><td>An Input 2 Loss trip indicates that a current loss was detected in current mode on Analog input 2 (Control terminal 7). In 4-20 mA and 20-4 mA modes, the loss is detected if the current falls below 3 mA.
Recommended actions:
• Check control wiring is correct
• Check control wiring is undamaged
• Check the Analog Input 2 Mode (T5 T6 Analog Input 2 Mode (F45))
• Current signal is present and greater than 3 mA</td></tr>
<tr><td>An Output Calib</td><td>Analog output calibration failed</td></tr>
<tr><td>219</td><td>The zero offset calibration of one or both of the analogue outputs has failed. This indicates that the drive hardware has failed or a voltage has been applied to the output via a low impedance.
<table>
<tr><th>Sub-trip</th><th>Reason</th></tr>
<tr><td>1</td><td>Output 1 failed</td></tr>
<tr><td>2</td><td>Output 2 failed</td></tr>
</table>
Recommended actions:
• Check the wiring associated with analog outputs.
• Remove all the wiring that is connected to analog outputs and perform the calibration.
• If trip persists, replace the drive.</td></tr>
<tr><td>App Menu Changed</td><td>Customization table for an application module has changed</td></tr>
<tr><td>217</td><td>The App Menu Changed trip indicates that the customization table for an application menu has changed. The menu that has been changed can be identified by the sub-trip number.
<table>
<tr><th>Sub-trip</th><th>Reason</th></tr>
<tr><td>1</td><td>Menu S</td></tr>
<tr><td>2</td><td>Menu T</td></tr>
<tr><td>3</td><td>Menu U</td></tr>
</table>
Recommended actions:
• Reset the trip and perform a parameter save to accept the new settings</td></tr>
<tr><td>Analog No Dir</td><td>Run signal not received when starting in an analog control input mode</td></tr>
<tr><td>79</td><td>A direction signal or run permit was not provided within 1s of the brake release time elapsing in an analog control input mode, Control Input Mode (H11) = Analog Run Prmit or Analog 2 Dir (0 or 1).
Recommended actions:
• Check Direction Input 1 CCW (G39) and Direction Input 2 CW (G40) to ensure that a direction signal is received.
• Check control wiring is correct.
• Check control wiring is undamaged.</td></tr>
<tr><td>Autotune No Dir</td><td>Direction signal not received when starting an autotune</td></tr>
<tr><td>79</td><td>A direction signal was not given while attempting to perform an autotune. A direction signal must be given within 6s of enabling the drive to prevent this trip while attempting to autotune i.e Motor Autotune (B11) >=1.
Recommended actions:
• Check Direction Input 1 CCW (G39) and Direction Input 2 CW (G40) to ensure that a direction signal is received.
• Check control wiring is correct.
• Check control wiring is undamaged.</td></tr>
</table>

Trip	Diagnosis
Autotune 1	**Position feedback did not change or required speed could not be reached**
11	The drive has tripped during an autotune. The cause of the trip can be identified from the sub-trip number.

Sub-trip	Reason
1	The position feedback did not change where the position feedback is used during a rotating autotune.
2	Motor did not reach the required speed during a rotating autotune or mechanical load measurement.

Recommended actions:

- Check motor is free to turn i.e. mechanical brake and safety gear are released
- Check output motor contactor control
- Check *Drive Encoder Type* (**C01**) is set-up correctly
- Check *Drive Encoder Rotary Pulses Per Revolution* (**C03**) and *Drive Encoder Voltage Select* (**C04**) are set-up correctly
- Where a auto configuration compatible encoder is being used select *Drive Encoder Auto Configuration Select* (**C02**)
- Check the position feedback device wiring is correct
- Check position feedback mechanical coupling to the motor
- Check the position feedback in parameter
- Replace the position feedback device

Trip	Diagnosis
Autotune 2	**Position feedback direction incorrect**
12	The drive has tripped during a rotating autotune. The cause of the trip can be identified from the associated sub-trip number.

Sub-trip	Reason
1	The position feedback direction is incorrect when the position feedback is used during a rotating autotune
2	Motor did not reach the required speed during the rotating autotune or mechanical load measurement.

Recommended actions:

- Check position feedback device wiring is correct
- Check motor power cable wiring is correct rotation
- Rotate the direction of the encoder feedback with *Drive Encoder Feedback Reverse* (**C12**)
- Rotate any two motor phases or use *Reverse Motor Phase Sequence* (**B26**)

Trip	Diagnosis
Autotune 3	**Measured inertia has exceeded the parameter range or commutation signals changed in wrong direction**
13	The drive has tripped during a rotating autotune or mechanical load measurement test. The cause of the trip can be identified from the associated sub-trip number.

Sub-trip	Reason
1	Measured inertia has exceeded the parameter range during a mechanical load measurement
2	The commutation signals changed in the wrong direction during a rotating autotune
3	The mechanical load test has been unable to identify the motor inertia.

Recommended actions:

- Check position feedback device wiring is correct
- Check motor power cable wiring is correct rotation
- Check motor inertia load
- Rotate the direction of the encoder feedback with *Drive Encoder Feedback Reverse* (**C12**)
- Rotate any two motor phases or use *Reverse Motor Phase Sequence* (**B26**)

Trip	Diagnosis
Autotune 4	**Drive encoder U commutation signal fail**
14	A position feedback device with commutation signals is being used i.e. AB Servo, FD Servo, FR Servo, SC Servo, or a Commutation only encoder) and the U commutation signal did not change during a rotating autotune.

Recommended actions:

- Check position feedback device U commutation signal wiring is connected correctly Encoder terminals 7, 8)
- Check position feedback device U commutation signal wiring is not damaged
- Replace position feedback device

Trip	Diagnosis
Autotune 5	**Drive encoder V commutation signal fail**
15	A position feedback device with commutation signals is being used i.e. AB Servo, FD Servo, FR Servo, SC Servo, or a Commutation only encoder) and the V commutation signal did not change during a rotating autotune.

Recommended actions:

- Check position feedback device V commutation signal wiring is connected correctly Encoder terminals 9, 10)
- Check position feedback device V commutation signal wiring is not damaged
- Replace position feedback device

Trip	Diagnosis
Autotune 6	**Drive encoder W commutation signal fail**
16	A position feedback device with commutation signals is being used i.e. AB Servo, FD Servo, FR Servo, SC Servo, or a Commutation only encoder) and the W commutation signal did not change during a rotating autotune.

Recommended actions:

- Check position feedback device W commutation signal wiring is connected correctly Encoder terminals 11, 12)
- Check position feedback device W commutation signal wiring is not damaged
- Replace position feedback device

Trip	Diagnosis
Autotune 7	**Motor number of poles / position feedback resolution set incorrectly**
17	An Autotune 7 trip is initiated during a rotating autotune, if the number of motor poles, or the position feedback resolution has been set-up incorrectly, where position feedback is being used. **Recommended actions:** • Check the number of motor poles set-up in *Number Of Motor Poles* (**B05**) • Check the number of lines per revolution for feedback device in *Drive Encoder Rotary Pulses Per Revolution* (**C03**)
Autotune Stopped	**Autotune test stopped before completion**
18	The drive was prevented from completing an autotune test, because either the Safe Torque Off (STO), Drive enable, Fast disable input (if used) or run signal were removed. **Recommended actions:** • Check the Safe Torque Off (STO), Drive enable signal on Control terminal 31 *T31 STO Input 01 State* (**F10**) and the Fast disable input if used) are active during the autotune. • Check the run signal is active in *T28 Digital Input 05 State* (**F07**) during the autotune
Brk con 1 open	**Brake contact 1 open fault**
72	Brake 1 contact feedback to the drive has been detected closed when it should be open, incorrect sequence, using the brake contactor monitoring feature where enabled. **Recommended actions:** • Check control wiring connections from brake contact 1 to drive control terminal • Check correct sequence and operation of brake contact 1 during brake operation (Default configuration, Brake Off, Contact 1 closed = +24 V feedback, Brake ON, Contact 1 open = 0 V feedback) • Disable brake contact monitoring with *Brake Contact Monitoring Select* (**D11**) This is a delayed trip, where travel will complete (*Elevator Software State* (**J03**) = 0) and then the drive will trip. If a delayed trip has been scheduled during travel (*Elevator Software State* (**J03**) > 0) then *Global Warning* (**L04**) = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.
Brk con 1 closd	**Brake contact 1 closed fault**
73	Brake 1 contact feedback to the drive has been detected open when it should be closed, incorrect sequence, using the brake contactor monitoring feature where enabled. **Recommended actions:** • Check control wiring connections from brake contact 1 to drive control terminal • Check correct sequence and operation of brake contact 1 during brake operation Default configuration, Brake Off, Contact 1 closed = +24 V feedback, Brake ON, Contact 1 open = 0 V feedback) • Disable brake contact monitoring with *Brake Contact Monitoring Select* **D11**) This is a delayed trip, where travel will complete (*Elevator Software State* (**J03**) = 0) and then the drive will trip. If a delayed trip has been scheduled during travel (*Elevator Software State* (**J03**) > 0) then *Global Warning* (**L04**) = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.
Brk con 2 open	**Brake contact 2 open fault**
74	Brake 2 contact feedback to the drive has been detected closed when it should be open, incorrect sequence, using the brake contactor monitoring feature where enabled. **Recommended actions:** • Check control wiring connections from brake contact 2 to drive control terminal • Check correct sequence and operation of brake contact 2 during brake operation Default configuration, Brake Off, Contact 2 closed = +24 V feedback, Brake ON, Contact 2 open = 0 V feedback) • Disable brake contact monitoring with *Brake Contact Monitoring Select* **D11**) This is a delayed trip, where travel will complete (*Elevator Software State* (**J03**) = 0) and then the drive will trip. If a delayed trip has been scheduled during travel (*Elevator Software State* (**J03**) > 0) then *Global Warning* (**L04**) = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.
Brk con 2 closd	**Brake contact 2 closed fault**
75	Brake 2 contact feedback to the drive has been detected open when it should be closed, incorrect sequence, using the brake contactor monitoring feature where enabled. **Recommended actions:** • Check control wiring connections from brake contact 2 to drive control terminal • Check correct sequence and operation of brake contact 2 during brake operation Default configuration, Brake Off, Contact 2 closed = +24 V feedback, Brake ON, Contact 2 open = 0 V feedback) • Disable brake contact monitoring with *Brake Contact Monitoring Select* **D11**) This is a delayed trip, where travel will complete (*Elevator Software State* (**J03**) = 0) and then the drive will trip. If a delayed trip has been scheduled during travel (*Elevator Software State* (**J03**) > 0) then *Global Warning* (**L04**) = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.
Brk Ctrl Release	**Incorrect brake control sequence**
68	The brake release control conditions following, (a) ramping torque producing current and (b) magnetization of the motor were not completed within 6 s to allow the correct transition to start. **Recommended actions:** • Check motor torque ramp time in *Motor Torque Ramp Time* (**D02**) • Check correct motor map settings • Check *Motor Magnetized Indication* (**D01**) • Check motor contactor control • Check motor electrical connections

Trip	Diagnosis
Brake R Too Hot	**Braking resistor overload timed out (I^2t)**
19	The Brake R Too Hot indicates that braking resistor overload has timed out. The value in *Braking Resistor Thermal Accumulator* (**D17**) is calculated using *Braking Resistor Rated Power* (**D15**) rating, *Braking Resistor Thermal Time Constant* (**D16**) and *Braking Resistor Resistance* (**D18**) value. The *Brake R Too Hot* trip is initiated when *Braking Resistor Thermal Accumulator* (**D17**) reaches 100 %. **Recommended actions:** • Ensure the values entered into the braking resistor overload protection parameters **D14**, **D15** and **D17** are correct • Check the correct braking resistor is being used for the drive model and system • Check the motor regenerative loading • Check the Elevator is balanced correctly • If external thermal protection is being used for the braking resistor, and the internal software brake resistor overload protection is not required, set parameter **D14**, **D15** and **D17** = 0 to disable the protection and trip.
Card Access	**NV Media Card Write fail**
185	The Card Access trip indicates that the drive was unable to access the NV Media Card. • If the trip occurs during the data transfer to the NV Media Card then the file being written may be corrupted. • If the trip occurs when the data is being transferred to the drive then the data transfer may be incomplete. If a parameter file is transferred to the drive and this trip occurs during the transfer, the parameters are not saved to non-volatile memory, and so the original parameters can be restored by powering the drive down and up again. **Recommended actions:** • Check NV Media Card is installed / located correctly • Replace the NV Media Card
Card Boot	**The User Menu A parameter modification cannot be saved to the NV Media Card**
177	User Menu A changes are automatically saved on exiting edit mode. The *Card Boot* trip will occur if a write to a User Menu A parameter has been initiated via the keypad by exiting edit mode and *Parameter Cloning* (**N01**) modes is set for auto or boot mode, but the necessary boot file has not been created on the NV Media Card to take the new parameter value. This occurs when *Parameter Cloning* (**N01**) modes is changed to Auto (3) or Boot (4) mode, but the drive is not subsequently reset. **Recommended actions:** • Ensure that *Parameter Cloning* (**N01**) is correctly set, and then reset the drive to create the necessary file on the NV Media Card. • Re-attempt the parameter write to the User Menu A
Card Busy	**NV Media Card cannot be accessed as it is being accessed by an option module**
178	The Card Busy trip indicates that an attempt has been made to access a file on NV Media Card, but the NV Media Card is already being accessed by an option module, such as one of the Applications modules. No data is transferred. **Recommended actions:** • Wait for the option module to finish accessing the NV Media Card and re-attempt the required function
Card Data Exists	**NV Media Card data location already contains data**
179	The Card Data Exists trip indicates that an attempt has been made to store data on a NV Media Card in a data block which already contains data. **Recommended actions:** • Erase the data in the data block to allow save • Write data to an alternative data block
Card Compare	**NV Media Card file/data is different to the one in the drive**
188	A compare has been carried out between the drive and a file on the NV Media Card, a Card Compare trip is initiated if the parameters on the NV Media Card are different to the drive. **Recommended actions:** • Set Pr **mm00** to 0 and reset the trip • Check to ensure the correct data block on the NV Media Card has been used for the compare
Card Drive Mode	**NV Media Card parameter set not compatible with current drive mode**
187	The Card Drive Mode trip is produced during a compare if the drive mode in the data block on the NV Media Card is different from the current drive mode. This trip is also produced if an attempt is made to transfer parameters from a NV Media Card to the drive if the operating mode in the data block is outside the allowed range of operating modes. **Recommended actions:** • Ensure the destination drive supports the drive operating mode in the parameter file. • Clear the value in Pr **mm00** and reset the drive • Ensure the destination drive operating mode is the same as the source parameter file

<table>
<tr><th>Trip</th><th>Diagnosis</th></tr>
<tr><td>Card Error</td><td>NV Media Card data structure error</td></tr>
<tr><td>182</td><td>The Card Error trip indicates that an attempt has been made to access a NV Media Card but an error has been detected in the data structure on the card. Resetting the trip will cause the drive to erase and create the correct folder structure. The cause of the trip can be identified by the sub-trip.
<table>
<tr><th>Sub-trip</th><th>Reason</th></tr>
<tr><td>1</td><td>The required folder and file structure is not present</td></tr>
<tr><td>2</td><td>The HEADER.DAT file is corrupted</td></tr>
<tr><td>3</td><td>Two or more files in the GT8DATA\DRIVE folder have the same file identification number</td></tr>
</table>
Recommended actions:
• Ensure the NV Media Card is located correctly and is secure
• Erase all the data blocks and re-attempt the process
• Replace the NV Media Card</td></tr>
<tr><td>Card Full</td><td>NV Media Card full</td></tr>
<tr><td>184</td><td>The Card Full trip indicates that an attempt has been made to create a data block on a NV Media Card, but there is not enough space left on the card.
Recommended actions:
• Delete a data block or the entire NV Media Card to create sufficient space
• Use an alternative NV Media Card</td></tr>
<tr><td>Card No Data</td><td>NV Media Card data not found</td></tr>
<tr><td>183</td><td>The Card No Data trip indicates that an attempt has been made to access a non-existent file or data block on a NV Media Card
Recommended actions:
• Ensure NV Media Card data block number is correct</td></tr>
<tr><td>Card Option</td><td>NV Media Card trip; option modules installed are different between source drive and destination drive</td></tr>
<tr><td>180</td><td>The Card Option trip indicates that parameter data or default difference data is being transferred from a NV Media Card to the drive, but the option module categories are different between source and destination drives. This trip does not stop the data transfer, but is a warning that the data for the option modules that are different will be set to the default values and not the values from the NV Media Card. This trip also applies if a compare is attempted between the data block and the drive.
Recommended actions:
• Ensure the correct option modules are installed.
• Ensure the option modules are in the same option module slot as the parameter set stored.
• Press the red reset button to acknowledge that the parameters for one or more of the option modules installed will be at their default values
• This trip can be suppressed by setting Pr mm00 to 9666 and resetting the drive.</td></tr>
<tr><td>Card Product</td><td>NV Media Card data blocks are not compatible with the drive derivative</td></tr>
<tr><td>175</td><td>The Card Product trip is initiated either at power-up or when the NV Media Card is accessed, If Drive Derivative (J96) is different between the source and target drives.
This trip can be reset and data can be transferred in either direction between the drive and NV Media Card.
Recommended actions:
• Use a different NV Media Card
• This trip can be suppressed by setting Pr mm00 to 9666 and resetting the drive</td></tr>
<tr><td>Card Rating</td><td>NV Media Card Trip; The voltage and / or current rating of the source and destination drives are different</td></tr>
<tr><td>186</td><td>The Card Rating trip indicates that parameter data is being transferred from a NV Media Card to the drive, but the current and / or voltage ratings are different between source and destination drives. This trip also applies if a compare (using Pr mm00 set to 8yyy) is attempted between the data block on a NV Media Card and the drive. The Card Rating trip does not stop the data transfer but is a warning that rating specific parameters with the RA attribute may not be transferred to the destination drive.
Recommended actions:
• Reset the drive to clear the trip
• Ensure that the drive rating dependent parameters have transferred correctly</td></tr>
<tr><td>Card Read Only</td><td>NV Media Card has the Read Only bit set</td></tr>
<tr><td>181</td><td>The Card Read Only trip indicates that an attempt has been made to modify a read-only NV Media Card or a read-only data block. A NV Media Card is read-only if the read-only flag has been set (Pr mm00 was set to 9888)
Recommended actions:
• Clear the read only flag by setting Pr mm00 to 9777 and resetting the drive. This will clear the read-only flag for all data blocks in the NV Media Card</td></tr>
<tr><td>Card Slot</td><td>NV Media Card Trip; Option module application program transfer has failed</td></tr>
<tr><td>174</td><td>The Card Slot trip is initiated if the transfer of an option module application program to or from an application module failed because the option module does not respond correctly. If this happens this trip is produced with the sub-trip indicating the option module slot number.
Recommended actions:
• Ensure the source / destination option module is installed in the correct slot</td></tr>
</table>

Trip	Diagnosis
Current Offset	**Current feedback offset error**
225	The Current Offset trip indicates that the current offset is too large to be trimmed. **Recommended actions:** • Ensure that there is no possibility of current flowing at the output of the drive when the drive is not enabled • Hardware fault – Contact the supplier of the drive
Current on stop	**Current at stop has not decayed**
67	The current decay level detected after stop was ≥ 25 % of the motor rated current resulting in possible acoustic noise on removal of the Safe Torque Off (STO), Drive enable, or Fast disable input (if used) due to the load transfer onto the motors mechanical brake. **Recommended actions:** • *Reduce Motor Torque Ramp Time* (**D02**) to achieve < 25 % current following at stop
Ctrl Watchdog	**Control word watchdog**
77	*Control Input Mode* (**H11**) = 6 (Control word mode), and Control word bit 15 (Watchdog bit) Control word watchdog bit has not been set to 1 for 1 s. It is assumed that the elevator controller or the comms interface between the elevator controller and the drive have stopped working. This is a delayed trip, where travel will complete (*Elevator Software State* (**J03**) = 0) and then the drive will trip. If a delayed trip has been scheduled during travel (*Elevator Software State* (**J03**) > 0) then *Global Warning* (**L04**) = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.
Data Changing	**Drive parameters are being changed**
97	A user action or a file system write is active that is changing the drive parameters and the drive has been commanded to enable, i.e.*Drive Active* (**L06**) = On 1). **Recommended actions:** • Ensure the drive is not enabled when one of he following is being carried out •Loading defaults •Changing drive mode •Transferring data from NV Media Card •Transferring user programs
Derivative Image	**Derivative Image error**
248	The Derivative Image trip indicates that an error has been detected in the derivative image. **Recommended action:** • Contact the supplier of the drive
Destination	**Two or more parameters are writing to the same destination parameter**
199	The Destination trip indicates that output destination parameters of two or more logic functions within the drive are writing to the same parameter. **Recommended actions:** • Set Pr **mm00** to 'Destinations' or 12001 and check all visible parameters in all menus for parameter write conflicts
Dir change	**Direction change occurred during operation**
76	The direction selected during the start sequence has changed, this is applicable for both single and dual direction inputs. In this state a controlled stop will occur followed by the trip. **Recommended actions:** • Check the direction input is being selected during the complete travel • Check the control connection on terminal T28 • Check *T28 Digital Input 05 State* (**F07**) = On (1) during operation default configuration) This is a delayed trip, where travel will complete (*Elevator Software State* (**J03**) = 0 and then the drive will trip. If a delayed trip has been scheduled during travel (*Elevator Software State* (**J03**) > 0 then *Global Warning* (**L04**) = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.

Trip	Diagnosis
Distance err	**Excessive distance error**
63	**RFC-A** and **RFC-S** This trip indicates distance error is greater than the level defined in *Maximum Distance Error Threshold* (**H16**) resulting in reduced control. The distance error detection is the integral of the difference between *Profile Speed* (**J39**) and *Actual Speed* (**J40**) and active for closed loop operation only. The calculated distance error is compared to the user defined distance error threshold in *Maximum Distance Error Threshold* (**H16**) and where this is exceeded a trip is generated. The distance error during a travel is displayed in *Maximum Distance Error* (**J56**) independent of the activation of the distance error detection. The distance error in *Maximum Distance Error* (**J56**) is reset to zero at the start of each travel. **Recommended actions:** • Possible causes for the distance error trip can be due to the following **Motor** Check motor power connections Check motor phase rotation Check motor brake control Check Elevator safety gear **Position feedback** Check position feedback mechanical mounting Check position feedback phase rotation Check position feedback wiring arrangement, risk of induced noise Position feedback device failure, replace feedback device **Drive set-up** Check motor details and parameter set-up, including current limit Check position feedback device parameter set-up Check position feedback device phase offset, static autotune has been completed Check speed control loop gain settings where motor instability exists • Increase the maximum distance error threshold in *Maximum Distance Error Threshold* (**H16**) • The distance error detection can be disabled by setting *Maximum Distance Error Threshold* (**H16**) = 0
Drive rating	**Motor rated current exceeds allowable HD rating**
61	The motor rated current set-up in *Motor Rated Current* (**B02**) exceeds the limit for heavy duty operation resulting in reduced / limited overload capability when operating in the normal duty region. **Recommended actions:** • Motor rated current should be reduced to ≤ heavy duty rating • A larger drive should be used
Encoder 1	**Drive position feedback interface power supply overload**
189	The Encoder 1 trip indicates that the drive encoder power supply has been overloaded. Terminals 13, 14 of the 15 way D type connector can supply a maximum current of 200 mA @ 15 V and 300 mA @ 8 V and 5 V. **Recommended actions:** • Check encoder power supply connections to the drive • Check encoder specification, confirm it is compatible with the encoder power supply on the drive • Disable the termination resistors *Drive Encoder Termination Select* (**C05**) = Off 0)) to reduce current consumption • Use an external power supply with higher current capability to supply the encoder • For 5 V encoders with long cables, select 8 V (*Drive Encoder Voltage Select* (**C04**)) and install a 5 V voltage regulator close to the encoder • Internal encoder fault, replace encoder
Encoder 2	**Drive encoder feedback wire break detection**
190	The Encoder 2 trip indicates that the drive has detected a wire break on the 15 way D type connector of the drive. The exact cause of the trip can be identified from the sub-trip number. **Sub-trip** — **Reason** 10 — Drive position feedback interface on any input 11 — Drive position feedback interface on the A channel 12 — Drive position feedback interface on the B channel 13 — Drive position feedback interface on the Z channel **Recommended actions:** • Check correct encoder connections • Check the encoder cable shield connections, terminations, minimise length of any shield pigtails to connectors • Check encoder power supply is set-up correctly *Drive Encoder Voltage Select* (**C04**) • If wire break detection is not required, set *Drive Encoder Error Detection Level* (**C21**) = 0 to disable the Encoder 2 trip • Internal encoder fault, replace encoder

Trip	Diagnosis
Encoder 3	**Phase offset incorrect while running**
191	The Encoder 3 trip indicates that the drive has detected an incorrect U, V, W phase angle whilst running (RFC-S mode only) or a SinCos phase error. The feedback device can be identified by the sub-trip number. **Sub-trip** / **Reason** 1 — Drive position feedback interface 1 2 — Drive position feedback interface 2 **Recommended actions:** • Check the integrity of the encoder mechanical mounting • Check encoder shield connections, terminations, minimise length of any shield pigtails to connectors • For a U, V, W servo encoder, ensure that the phase rotation of the U, V, W commutation signals is the same as the phase rotation of the motor • For a SinCos encoder, ensure that motor and incremental SinCos connections are the correct rotation i.e. for forward rotation of the motor, the encoder rotates clockwise (when looking at the shaft of the encoder) • Repeat the phase offset measurement test • Check the encoder signal for noise with an oscilloscope
Encoder 4	**Feedback device comms failure**
192	The Encoder 4 trip indicates that the encoder communications has timed out or the communications position message transfer time is too long. This trip can also be caused due to wire break in the communication channel between the drive and the encoder. The feedback device can be identified by the sub-trip number. **Sub-trip** / **Reason** 1 — Drive position feedback interface **Recommended actions:** • Check correct encoder connections • Check the encoder cable shield connections, terminations, minimise length of any shield pigtails to connectors • Check the encoder power supply setting *Drive Encoder Voltage Select* (**C04**) is correct • Check *Drive Encoder Additional Power Up Delay* (**C10**) and adjust where required to support encoder feedback • Carry out encoder auto-configuration *Drive Encoder Auto Configuration Select (***C02**) • Faulty encoder, replace
Encoder 5	**Checksum or CRC error**
193	The Encoder 5 trip indicates that there is a checksum or CRC error, or the SSI encoder is not ready. The Encoder 5 trip can also indicate a wire break to a communications based encoder. **Sub-trip** / **Reason** 1 — Drive position feedback interface **Recommended actions:** • Check correct encoder connections • Check the encoder cable shield connections, terminations, minimise length of any shield pigtails to connectors • Check the comms resolution setting *Drive Encoder Comms Bits* (**C08**) • If using Hiperface, EnDat or BiSS encoders carry out auto-configuration *Drive Encoder Auto Configuration Select* (**C02**) • Check *Drive Encoder Additional Power Up Delay* (**C10**) power up delay and adjust where required to support encoder feedback • Check the encoder signal for noise with an oscilloscope • Faulty encoder, replace
Encoder 6	**Encoder has indicated an error**
194	The Encoder 6 trip indicates that the encoder has indicated an error or that the power supply to an SSI encoder has failed, this trip can also indicate a wire break to an SSI encoder. **Sub-trip** / **Reason** 1 — Drive position feedback interface **Recommended actions:** • Check correct encoder connections • Check the encoder cable shield connections, terminations, minimise length of any shield pigtails to connectors • Check the encoder power supply setting *Drive Encoder Voltage Select* (**C04**) • Replace the encoder / contact the supplier of the encoder

Trip	Diagnosis

Encoder 7 — **Initialization failed**

Trip number: **195**

The Encoder 7 trip indicates that the set-up parameters for the position feedback device are incorrect. The feedback device which has caused the trip can be identified by the sub-trip number.

Sub-trip	Reason
1	Drive position feedback interface

Recommended actions:
- Reset the trip and perform a save
- Check the encoder is connected correctly
- Check the correct encoder type is selected *Drive Encoder Type* (**C01**)
- Check the encoder power supply setting *Drive Encoder Voltage Select* (**C04**)
- Check the correct encoder comms baud rate is selected in *Drive Encoder Comms Baud Rate* (**C06**)
- Carry out an encoder auto-configuration *Drive Encoder Auto Configuration Select* (**C02**) = Enabled
- Carry out re-initialize with *Position Feedback Initialize* (**C18**)
- Check *Position Feedback Initialized Indication (***C19**)
- Faulty encoder, replace

Encoder 8 — **Position feedback interface has timed out**

Trip number: **196**

The Encoder 8 trip indicates that position feedback interface communications time exceeds 250 µs. The feedback device which has caused the trip can be identified by the sub-trip number.

Sub-trip	Reason
1	Drive position feedback interface

Recommended actions:
- Ensure the encoder is connected correctly
- Check the correct encoder type is selected *Drive Encoder Type* (**C01**)
- Ensure that the encoder is compatible with the drive encoder specification
- Increase the encoder baud rate in *Drive Encoder Comms Baud Rate* (**C06**)

Encoder 12 — **Encoder could not be identified during auto-configuration**

Trip number: **162**

The Encoder 12 trip indicates that the drive is communicating with the encoder but the encoder type is not recognized.

Sub-trip	Reason
1	Drive position feedback interface

Recommended actions:
- Check to see if auto-configuration is supported for the encoder type
- Disable *Drive Encoder Auto Configuration Select* (**C02**) and enter the encoder set-up parameters manually

Encoder 13 — **Data read from the encoder is out of range during auto-configuration**

Trip number: **163**

The Encoder 13 trip indicates that the data read from the encoder was out of the range during auto-configuration. No parameters will be modified with the data read from the encoder as a result of auto configuration.

Sub-trip	Reason	Parameter
11	P1 Rotary lines per revolution error	**C03**
14	P1 Rotary turns bits error	**C07**
15	P1 Communications bits error	**C08**
16	P1 Calculation time is too long	**C24**
17	P1 Line delay measured is longer than 5 µs	**C26**

Recommended actions:
- Check to see if auto-configuration is supported for the encoder type being used
- Disable *Drive Encoder Auto Configuration Select* (**C02**) and enter the encoder set-up parameters manually

Encoder Not Init — **Encoder initialization failure**

Trip number: **162**

The drive's encoder interface has not initialized prior to travel.

This may be because the encoder has an older / slower comms interface. *Drive Encoder Additional Power Up Delay* (**C10**) may be increased to allow extra time for the encoder comms to initialize *Position Feedback Initialize* (**C18**) may be used to manually initialize the feedback, and *Position Feedback Initialized Indication* (**C19**) indicates the initialization status.

Recommended actions:
- Ensure the encoder is connected correctly.
- Ensure that the encoder is compatible

Fast disable err — **Fast disable control sequence error**

Trip number: **65**

The Fast disable input sequence is incorrect i.e. the Fast disable input is not applied during the stop following brake apply, or removed during the start. The Fast disable input does not become active, On (1) following brake apply and after 4 s, or the Fast disable input failed to turn Off (0) after 6 s during the start whilst waiting for the Safe Torque Off (STO), Drive enable input to become active.

Recommended actions:
- Check the control wiring arrangement (default, Control terminal 27) Fast disable input
- Check *T27 Digital Input 04 State* (**F06**) during operation for the correct sequence Off (0) or On (1)
- Disable the Fast disable input by setting the control input destination from *Fast Disable* (**B27**) to 00.000

<table>
<tr><th>Trip</th><th>Diagnosis</th></tr>
<tr><td>Feedback rev</td><td>Encoder feedback is reversed</td></tr>
<tr><td>64</td><td>The encoder feedback is reversed with regards to the motor power connections and rotation
Recommended actions:
• Check power connections to the motor and rotation
• Motor rotation can be reversed with Reverse motor phase sequence (B26)
• Check correct connections of the encoder feedback to the drive
• Encoder feedback can be rotated with Drive Encoder Feedback Reverse (C12)</td></tr>
<tr><td>Freeze protect</td><td>Freeze protection limit exceeded</td></tr>
<tr><td>60</td><td>Freeze protection threshold in Freeze Protection Threshold (H28) has been exceeded,
Recommended actions:
• Check the temperature setting in Freeze Protection Threshold (H28)
• Check the actual temperature in Monitored Temperature 3 (J73)
• Provide heating, air conditioning, ventilation to support allowable temperature in Freeze Protection Threshold (H28)
This is a delayed trip, where travel will complete (Elevator Software State (J03) = 0) and then the drive will trip. If a delayed trip has been scheduled during travel (Elevator Software State (J03) > 0) then Global Warning (L04) = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.</td></tr>
<tr><td>I Limit Timeout</td><td>Drive has been in current limit (in open-loop mode) for an excessive time</td></tr>
<tr><td>82</td><td>In Open loop mode the drive has been in current limit for Maximum Time In Current Limit (H50) ms. This could be the result of a mechanical fault.
Recommended actions:
• Check that the elevator car is free to move.</td></tr>
<tr><td>Inductance</td><td>Inductance measurement out of range or motor saturation not detected</td></tr>
<tr><td>8</td><td>The drive has been enabled in RFC-S mode and sensorless control selected, or for auto-change over on position feedback loss, and the motor inductance will prevent the control algorithm from operating correctly. The reason for the trip can be identified from the sub-trip number.
<table>
<tr><th>Sub-trip</th><th>Reason</th></tr>
<tr><td>1</td><td>The difference between Transient Inductance Ld (B33) and No Load Lq (B37) is too small. B37 - B33 / B33 and must be greater than 0.2. Also B37 - B33 must be greater than K / Drive Full Scale Current Kc (J06), K is related to the drive rated voltage as given in the table below.
It is recommended that the differences are larger than the minimum limits above if possible.
<table>
<tr><th>Drive rated voltage</th><th>K</th></tr>
<tr><td>200 V</td><td>0.037</td></tr>
<tr><td>400 V</td><td>0.073</td></tr>
<tr><td>575 V</td><td>0.087</td></tr>
<tr><td>690 V</td><td>0.105</td></tr>
</table></td></tr>
<tr><td>2</td><td>A test is carried out to determine the direction of the flux in the motor which relies on detecting motor saturation. If a change in motor saturation cannot be detected during this test then this trip is initiated. This type of failure is unlikely in most normal motors.</td></tr>
<tr><td>3</td><td>During the stationary auto-tuning in RFC-S mode it is necessary to determine the location of the flux axis. If a change in motor saturation cannot be detected during this test then this trip is initiated. This type of failure is unlikely in most normal motors.</td></tr>
</table></td></tr>
<tr><td>I/O Overload</td><td>Digital output overload</td></tr>
<tr><td>26</td><td>The I/O Overload trip indicates that the current drawn from the + 24 V user supply or from the digital output has exceeded the limit. The trip is initiated for the following conditions:
• Maximum output current from one digital output is > 100 mA.
• The combined maximum output current from outputs 1 and 2 is > 100 mA
• The combined maximum output current from output 3 and +24 V output is > 100 mA
Recommended actions:
• Check for correct control wiring
• Check control wiring is undamaged
• Check for system fault resulting in user power supply becoming overloaded
• Check total loading on digital outputs
• Reduce loading</td></tr>
</table>

<table>
<tr><th>Trip</th><th>Diagnosis</th></tr>
<tr><td>Mot con open</td><td>Motor contactor open fault</td></tr>
<tr><td>70</td><td>The motor contactors have been detected closed when they should be open using the motor contactor monitoring when enabled, and the feedback is connected to the drive from the motor contactors.
Recommended actions:
• Check control wiring connections from motor contactors to drive control terminal
• Check correct signal from motor feedback during operation (Default configuration, Motor contactors open, feedback = +24 V, Motor contactors closed feedback = 0 V)
• Disable motor contactor monitoring with Motor Contactor Monitoring Enable (B29)
This is a delayed trip, where travel will complete (Elevator Software State (J03) = 0) and then the drive will trip. If a delayed trip has been scheduled during travel (Elevator Software State (J03) > 0) then Global Warning (L04) = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.</td></tr>
<tr><td>Mot con closd</td><td>Motor contactor closed fault</td></tr>
<tr><td>71</td><td>The motor contactors have been detected open when they should be closed using the motor contactor monitoring feature when enabled, and the feedback is connected to the drive from the motor contactors.
Recommended actions:
• Check control wiring connections from motor contactors to drive control terminal
• Check correct signal from motor feedback during operation (Default configuration, Motor contactors open, feedback = +24 V, Motor contactors closed feedback = 0 V)
• Disable motor contactor monitoring with Motor Contactor Monitoring Enable (B29)
This is a delayed trip, where travel will complete (Elevator Software State (J03) = 0) and then the drive will trip. If a delayed trip has been scheduled during travel (Elevator Software State (J03) > 0) then Global Warning (L04) = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.</td></tr>
<tr><td>Motor Too Hot</td><td>Output current overload timed out I^2t)</td></tr>
<tr><td>20</td><td>Motor Too Hot trip indicates a motor thermal overload based on the Motor Rated Current (B02) and Motor Thermal Time Constant 1 (B20). Motor Protection Accumulator (J26) displays the motor temperature as a percentage of the maximum value. The drive will trip on Motor Too Hot when Motor Protection Accumulator (J26) reaches 100 %.
Recommended actions:
• Check correct set-up of motor details in drive
• Check the load on the motor has not changed due to a fault
• Check for any system mechanical faults, brake applied, safety gear locked in
• Check Elevator balanced correctly
• Check for correctly sized drive
• If during autotune in RFC-S mode, ensure Motor Rated Current (B02) is ≤ Heavy duty current rating
• Tune the rated speed parameter Open loop and RFC-A mode)
• Check position feedback signals for induced noise
• Ensure the Motor Rated Current (B02) is not zero</td></tr>
<tr><td>OHt Brake</td><td>Braking IGBT over-temperature</td></tr>
<tr><td>101</td><td>OHt Brake trip indicates that a braking IGBT over-temperature has been detected based on the software thermal model for the braking IGBT
Recommended actions:
• Check the braking resistor value is ≥ minimum resistance value for drive model</td></tr>
<tr><td>OHt Control</td><td>Control stage over temperature</td></tr>
<tr><td>23</td><td>OHt Control trip indicates that a control stage over-temperature has been detected. From the sub-trip number ‘xxyzz’, the thermistor location is identified with ‘zz’.
<table>
<tr><th>Source</th><th>xx</th><th>y</th><th>zz</th><th>Description</th></tr>
<tr><td>Control system</td><td>00</td><td>0</td><td>01</td><td>Control board thermistor 1 over temperature</td></tr>
<tr><td>Control system</td><td>00</td><td>0</td><td>02</td><td>Control board thermistor 2 over temperature</td></tr>
<tr><td>Control system</td><td>00</td><td>0</td><td>03</td><td>I/O board thermistor over temperature</td></tr>
</table>
Recommended actions:
• Check ambient temperature
• Check enclosure cooling / drive cooling fans are functioning correctly
• Check enclosure ventilation paths and/or door filters
• Increase system ventilation
• Reduce the drive switching frequency</td></tr>
</table>

Trip	Diagnosis
OHt dc bus	**DC bus over temperature**
27	OHt DC bus trip indicates a DC bus component over temperature based on the software thermal model. The drive includes a thermal protection system to protect the DC bus components within the drive, this includes the effects of the output current and DC bus ripple. The estimated temperature is displayed as a percentage of the trip level in parameter *Percentage Of DC Link Thermal Trip Level* (**J78**). If this parameter reaches 100 % then an *OHt DC bus* trip is initiated. The drive will attempt to stop the motor before tripping. If the motor does not stop in 10 seconds the drive trips immediately. Source: Control system; xx: 00; y: 2; zz: 00; Description: DC bus thermal model gives trip with sub-trip 0 **Recommended actions:** • Check the AC power supply voltage level • Check the AC power supply voltage balance • Check the DC bus voltage ripple level • Reduce motor loading • Check the output current stability and if unstable; • Check the motor map settings within the drive (parameters **B06**, **B02**, **B07**, **B03**, **B04**, **B05**), all modes • *Slip Compensation Enable* (**B10**), (Open loop) • Select fixed boost mode, parameter **B09** (Open loop) • Disconnect load and complete a rotating autotune, *Motor Autotune* (**B11**) • Autotune the rated speed, parameter **B07** (Open loop) parameter **B25** (RFC-A) • Reduce the speed loop gains, parameters **I01**, **I02**, **I06** and **I07** run and stop (Closed loop operation) • Add a speed feedback filter parameter **C09** (Closed loop operation) • Add a current demand filter, parameters **I05**, **I10** run and stop • Check position feedback signals for noise with an oscilloscope (Closed loop operation) • Check encoder mechanical coupling (Closed loop operation) • Reduce duty cycle
OHt Inverter	**Inverter over temperature based on thermal model**
21	OHt Inverter trip indicates an IGBT junction over-temperature has been detected based on the software thermal model. Source: Control system; xx: 00; y: 1; zz: 00; Description: Inverter thermal model gives (OHt Inverter) trip with sub-trip 0 **Recommended actions:** • Check AC power supply input phases present and balanced • Check DC bus ripple • Check for motor instability • Reduce acceleration / deceleration rates • Reduce the maximum operating switching frequency • Reduce motor load • Reduce duty cycle
OHt Power	**Power stage over temperature**
22	OHt Power trip indicates that a power stage over-temperature has been detected. From the sub-trip 'xxyzz', the thermistor location is identified by 'zz'. OHt Power is detected at >= 90 % of the maximum threshold on starting a new travel i.e. exiting from *Elevator Software State* (**J03**) = 0 to 1. If during travel 100 % is reached the drive will trip immediately, where the location of the out of range temperature is indicated by the sub-trip number as detailed in the table below: Source: Power system; xx: 01; y: 0; zz: zz; Description: Thermistor location in the drive defined by zz **Recommended actions:** • Check enclosure / drive fans are still functioning correctly • Check enclosure ventilation paths, door filters • Check correct drive size for the application, load correct • Force heatsink cooling fans to run at maximum speed • Increase enclosure ventilation • Decrease acceleration / deceleration rates • Reduce motor load • Reduce duty cycle • Reduce the drive switching frequency • Use a drive with larger current / power rating If the temperature is >= 90 % of the maximum then *Global Warning* (**L04**) = On (1) indicating that there is a thermal issue and on the next start the elevator will trip OHt Power.

Trip	Diagnosis
OHt Rectifier	**Rectifier over temperature**
102	OHt Rectifier trip indicates that a rectifier over-temperature has been detected. The thermistor location can be identified from the sub-trip number.

Source	xx	y	zz	Description
Power system	01	Rectifier number	zz	Thermistor location defined by zz

Recommend actions:
- Check enclosure / drive fans are still functioning correctly
- Check enclosure ventilation paths, door filters
- Check the motor and motor cable insulation with an insulation tester
- Force the heatsink cooling fans to run at maximum speed
- Increase ventilation
- Decrease acceleration / deceleration rates
- Reduce motor load
- Reduce duty cycle
- Install an output line reactor or sinusoidal filter

Trip	Diagnosis
OI ac	**Instantaneous output over current detected**
3	The OI ac trip indicates the instantaneous drive output current has exceeded VM_DRIVE_CURRENT_MAX.

Source	xx	y	zz	Description
Control system	00	Rectifier number	00	Instantaneous over-current trip when the measured a.c. current exceeds VM_DRIVE_CURRENT[MAX].
Power system	01	0		

Recommended actions:
- Check correct motor set-up
- Check correct motor connections
- Check for short circuit on the output cabling
- Check for control sequence of output motor contactors
- Check for control sequence of any output shorting contactor
- Check integrity of the motor insulation using an insulation tester
- Check correct operation of motor mechanical brake
- Check feedback device mechanical coupling
- Check feedback device wiring
- Check feedback signals are free from noise
- Has the phase angle autotune been completed (RFC-S)
- If seen during autotune reduce the voltage boost (Open loop, RFC-A)
- Reduce speed loop gains (**I01**, **I02**, **I06** and **I07** run and stop) – (Closed loop operation)
- Reduce current loop gains (**I03**, **I04**, **I08** and **I09** run and stop)
- Acceleration/deceleration rate is too short

Trip	Diagnosis
OI Brake	**Braking IGBT over current detected: short circuit protection for the braking IGBT activated**
4	OI Brake trip indicates an over current has been detected in the brake IGBT or the brake IGBT protection has activated.

Source	xx	y	zz	Description
Power system	01	0	00	Braking IGBT instantaneous over-current trip

Recommended actions:
- Check the brake resistor installation, wiring
- Check any external brake resistor protection
- Check brake resistor value is ≥ the minimum brake resistance value for the drive model

Trip	Diagnosis
OI dc	**Power module over current detected from IGBT "ON" state voltage monitoring**
109	OI dc trip indicates that the short circuit protection for the drive output stage has been activated.

Recommended actions:
- Disconnect the motor cable at the drive output and check both motor and motor cable with an insulation tester
- Replace the drive

Trip	Diagnosis
OI Snubber	**Snubber over-current detected**
92	OI Snubber trip indicates an over-current condition has been detected in the rectifier snubber circuit. The reason for the trip can be identified by the sub-trip number. Source: Power system; xx: 01; y: Rectifier number; zz: 00; Description: Rectifier snubber over-current trip detected. **Recommended actions:** • Check for AC power supply voltage imbalance • Check for AC power supply disturbance such as notching from a DC drive • Check the motor and motor cable with an insulation tester • Check the motor cable length does not exceed the maximum for the selected switching frequency • Fit the internal EMC filter where not already installed • Fit an output line reactor or sinusoidal filter where long motor cables are used
Option Disable	**Option module does not acknowledge during drive mode changeover**
215	During drive mode changeover, option modules must acknowledge that they have stopped accessing the communications system between the option slots and the drive. If an option module does not do this in the allowed time then this trip is produced. **Recommended actions:** • Reset the trip. • If the trip persists, replace the option module.
Out Phase Loss	**Output phase loss detected**
98	Out Phase Loss trip indicates that phase loss has been detected at the drive output. Sub-trip 1: U phase detected as disconnected when drive enabled to run. Sub-trip 2: V phase detected as disconnected when drive enabled to run. Sub-trip 3: W phase detected as disconnected when drive enabled to run. Sub-trip 4: Output phase loss detected when the drive is running. NOTE If *Reverse Motor Phase Sequence* (**B26**)= 1 the physical output phases are reversed, and so sub-trip 3 refers to physical output phase V and sub-trip 2 refers to physical output phase W. **Recommended actions:** • Check motor power connections at drive, output motor contactors and motor • Check integrity of motor and motor cables using an insulation tester • Disable the trip in *Output Phase Loss Detection Enable* (**H06**) = 0
Over Speed	**Motor speed has exceeded the over speed threshold**
7	In open loop mode, if *Output Frequency* (**J60**) exceeds the threshold set in *Motor Over Speed Threshold* (**E09**) in either direction an Over speed trip is produced. In RFC-A and RFC-S mode, if the speed feedback *Drive Encoder Speed Feedback* (**J51**) exceeds *Motor Over Speed Threshold* (**E09**) in either direction an Over speed trip is produced. If *Motor Over Speed Threshold* (**E09**) is set to 0.0 the threshold is then equal to 1.2 x the value set in *Motor Maximum Speed Clamp* (**E08**) **Recommended actions:** • Adjust the speed loop proportional gain to reduce overshoot (RFC-A, RFC-S) The above description relates to a standard Over speed trip, however in RFC-S mode it is possible to produce an Over Speedy trip. This is caused if the speed is allowed to exceed the safe level in RFC-S mode with flux weakening, when *Enable High Speed Mode* (**B28**) is set.

Trip	Diagnosis
Over Volts	**DC bus voltage has exceeded the peak level or maximum continuous level for 15 seconds**
2	(see below)

The Over Volts trip indicates that the DC bus voltage has exceeded the VM_DC_VOLTAGE[MAX] or VM_DC_VOLTAGE_SET[MAX] for 15 s. The trip threshold varies depending on the voltage rating of the drive as detailed.

Voltage rating	VM_DC_VOLTAGE[MAX]	VM_DC_VOLTAGE_SET[MAX]
200	415	410
400	830	815
575	990	970
690	1190	1175

Sub-trip Identification

Source	xx	y	zz
Control system	00	0	01: Instantaneous trip when the DC bus voltage exceeds VM_DC_VOLTAGE[MAX].
Control system	00	0	02: Time delayed trip indicating that the DC bus voltage is above VM_DC_VOLTAGE_SET[MAX].

Recommended actions:

- Check the nominal AC power supply level
- Check the nominal AC power supply for disturbances which could cause the DC bus to rise
- Check external braking resistor circuit is connected
- Check operation of external braking resistor protection
- Check Elevator balanced correctly
- Decrease the braking resistor value staying above the minimum value for drive model)
- Increase the deceleration rate
- Check motor insulation using a insulation tester

Trip	Diagnosis
Phase Loss	**AC power supply phase loss**
32	(see below)

The Phase Loss trip indicates that the drive has detected an input phase loss or large AC power supply imbalance. The drive will attempt to stop the motor before this trip is initiated. If the motor cannot be stopped in 10 seconds the trip occurs immediately. The Phase Loss trip works by monitoring the ripple voltage on the DC bus of the drive, if the DC bus ripple exceeds the threshold, the drive will trip on Phase Loss. Potential causes of the DC bus ripple are input phase loss, Large AC power supply impedance and severe output current instability.

Source	xx	y	zz
Control system	00	0	00: Phase loss detected based on control system feedback. The drive attempts to stop the drive before tripping unless bit 2 of *Action On Trip Detection* (**H45**) is set to one.
Power system	01	Rectifier number	00: Phase loss has been detected by the rectifier module

Input phase loss detection can be disabled where the drive is required to operate from either a DC power supply or from a single phase AC power supply using *Input Phase Loss Detection Mode Enable* (**H08**)

Recommended actions:

- Check AC power supply connections
- Check AC power supply fusing
- Check AC power supply voltage balance and level at full load
- Check DC bus ripple with an isolated oscilloscope
- Check the output motor current stability
- Reduce the motor load
- Reduce the duty cycle
- Disable the phase loss detection, set *Input Phase Loss Detection Mode Enable* (**H08**) = 2.

Trip	Diagnosis
Phasing Error	**RFC-S mode phasing failure due to incorrect phase angle**
198	(see below)

The Phasing Error trip indicates that the phase angle in *Position Feedback Phase Angle* (**C13**) is incorrect and the drive is unable to control the motor correctly.

Recommended actions:

- Check the encoder wiring
- Check the encoder mechanical coupling
- Check the encoder signals for noise with an oscilloscope
- Carry out a autotune OR manually set-up the encoder phase angle in *Position Feedback Phase Angle* (**C13**)
- Spurious Phasing Error trips can be seen in very dynamic applications and can be disabled by setting the over-speed threshold in *Motor Over Speed Threshold* (**E09**) to a value > 0.

If sensorless control is being used this indicates that significant instability has occurred and the motor has accelerated without control.

Recommended actions:

- Ensure motor parameters are set-up correctly.
- Carry out an autotune OR manually set-up the encoder phase angle in *Position Feedback Phase Angle* (**C13**)
- Adjust the speed loop gains to reduce the systems dynamic response

Trip	Diagnosis
Power Comms	**Communication has been lost / errors detected between power, control and rectifier modules**
90	A Power Comms trip indicates a communications problem within the power system of the drive. The reason for the trip can be identified by the sub-trip number. **Type of drive** / **xx** / **y** / **zz**: Single power module system / 01 / Rectifier number / 00: Excessive communications errors detected by the rectifier module **Recommended actions:** • Hardware fault - contact the supplier of the drive.
Power Down Save	**Power down save error**
37	The Power Down Save trip indicates that an error has been detected in the power down save parameters saved in non-volatile memory. **Recommended actions:** • Perform a 1001 save in Pr **mm00** to ensure that the trip doesn't occur the next time the drive is powered up.
PSU	**Internal power supply fault**
5	The PSU trip indicates that one or more internal power supply rails are outside their limits or overloaded. **Source** / **xx** / **y** / **zz** / **Description**: Control system / 00 / 0 / 00 / Internal power supply overload. Power system / 01 / Rectifier number / 00 / Internal power supply overload. **Recommended actions:** • Remove keypad from the drive and perform a reset • Remove any option modules and perform a reset • Remove encoder connection and perform a reset • Hardware fault within the drive – return the drive to the supplier
PSU 24V	**24V internal power supply overload**
9	The total user load of the drive and option modules has exceeded the internal + 24 V power supply limit. The user load consists of the drive digital outputs and main encoder supply. **Recommended actions:** • Reduce the load and reset the drive • Remove control connections from the drive and perform a reset • Remove any option modules and perform a reset • Remove encoder connection and perform a reset • Provide an external + 24 V power supply on Control Terminal 2 of the drive • Permanent trip, hardware fault within the drive – return the drive to the supplier
Resistance	**Measured resistance has exceeded the parameter range**
33	The Resistance trip indicates that the measured motor stator resistance during an autotune test has exceeded the maximum possible value allowable for the drive in *Stator Resistance* (**B34**) **Recommended actions:** • Check the motor phase to phase resistance at the drive terminals • Check the motor phase to phase resistance at the motor terminals • Ensure the drives output stator resistance measurement for the motor falls within the range of the drive model • Check the motor power cable connections • Check the integrity of the motor stator winding using a insulation tester • Select a suitable drive model for the motor • Replace the motor
Slot App Menu	**Application menu Customization conflict error**
216	The Slot App Menu trip indicates that more than one option slot has requested to customize the application menus S, T and U. The sub-trip number indicates which option slot has been allowed to customize the menus. **Recommended actions:** • Ensure that only one of the Application modules is configured to customize the application menus S, T and U.

<table>
<tr><th>Trip</th><th>Diagnosis</th></tr>
<tr><td>SlotX Different</td><td>Option module in option slot X has changed</td></tr>
<tr><td>204
209
214</td><td>The SlotX Different trip indicates that the option module in option slot X on the drive is a different type to that installed when parameters were last saved on the drive. The reason for the trip can be identified by the sub-trip number.
<table><tr><th>Sub-trip</th><th>Reason</th></tr><tr><td>1</td><td>No module was installed previously</td></tr><tr><td>2</td><td>A module with the same identifier is installed, but the set-up menu for this option slot has been changed, and so default parameters have been loaded for this menu.</td></tr><tr><td>3</td><td>A module with the same identifier is installed, but the applications menu for this option slot has been changed, and so default parameters have been loaded for this menu.</td></tr><tr><td>4</td><td>A module with the same identifier is installed, but the set-up and applications menu for this option slot have been changed, and so default parameters have been loaded for these menus.</td></tr><tr><td>>99</td><td>Shows the identifier of the module previously installed.</td></tr></table>
Recommended actions:
• Check the currently installed option module is correct
• Check the option module parameters are set correctly and perform a user save in Pr mm00.
To inspect / change option module turn Off the AC power supply, ensure the correct option modules are installed in the correct option module slots and then re-apply the AC power supply</td></tr>
<tr><td>SlotX Error</td><td>Option module in option slot X has detected a fault</td></tr>
<tr><td>202
207
212</td><td>The SlotX Error trip indicates that the option module in option slot X on the drive has detected an error. The reason for the error can be identified by the sub-trip number.
Recommended actions:
• See the relevant Option module User guide for details of the trip and sub-trip number</td></tr>
<tr><td>SlotX HF</td><td>Option module X hardware fault</td></tr>
<tr><td>200
205
210</td><td>The SlotX HF trip indicates that the option module in option slot X on the drive has indicated a hardware fault. The possible causes of the trip can be identified by the sub-trip number.
<table><tr><th>Sub-trip</th><th>Reason</th></tr><tr><td>1</td><td>The module category cannot be identified</td></tr><tr><td>2</td><td>All the required customized menu table information has not been supplied or the tables supplied are corrupt</td></tr><tr><td>3</td><td>There is insufficient memory available to allocate the comms buffers for this module</td></tr><tr><td>4</td><td>The module has not indicated that it is running correctly during drive power-up</td></tr><tr><td>5</td><td>Module has been removed after power-up or it has stopped working</td></tr><tr><td>6</td><td>The module has not indicated that it has stopped accessing drive parameters during a drive mode change</td></tr><tr><td>7</td><td>The module has failed to acknowledge that a request has been made to reset the drive processor</td></tr><tr><td>8</td><td>The drive failed to correctly read the menu table from the module during drive power up</td></tr><tr><td>9</td><td>The drive failed to upload menu tables from the module and timed out (5 s)</td></tr></table>
Recommended actions:
• Ensure the option module is installed correctly
• Replace the option module
• Replace the drive</td></tr>
<tr><td>SlotX Not Fitted</td><td>Option module in option slot X has been removed</td></tr>
<tr><td>203
208
213</td><td>The SlotX Not Fitted trip indicates that the option module in option slot X has been removed since the last power up.
Recommended actions:
• Ensure the option module is installed correctly.
• Re-install the option module.
• To confirm that any removed option module is no longer required perform a save function in Pr mm00.</td></tr>
<tr><td>Soft Start</td><td>Soft start relay failed to close, soft start monitor failed</td></tr>
<tr><td>226</td><td>The Soft Start trip indicates that the soft start relay in the drive failed to close or the soft start monitoring circuit has failed.
Recommended actions:
• Hardware fault – Contact the supplier of the drive</td></tr>
</table>

Trip	Diagnosis
Spd / Dir Select	**Speed / direction sequencing problem**
81	The Spd / Dir Select trip indicates a sequencing problem caused by one of the following scenarios: • The direction and speed are still selected at the end of travel in state 14 after 4s. Remove the speed or direction signals to reset the trip. • When *Control Input Mode* (**H11**) = Analog Run Prmit (0), the Run Permit signal using *Direction Input 1 CCW* (**G39**) must be removed at the end of travel. • When *Control Input Mode* (**H11**) = Analog 2 Dir (0), Priority 2 Dir (4) or Binary 2 Dir (5) the direction signals (*Direction Input 1 CCW* (**G39**) or *Direction Input 2 CW* (**G40**)) OR the speed selection (*Reference Select Bit 0 Input* (**G32**) to *Reference Select Bit 6 Input* (**G38**)) must be removed at the end of travel. • When *Control Input Mode* (**H11**) = Priority 1 Dir (2) or Binary 1 Dir (3) the speed selection (*Reference Select Bit 0 Input* (**G32**) to *Reference Select Bit 6 Input* (**G38**)) must be removed at the end of travel. • When *Control Input Mode* (**H11**) = Control Word (6), the direction signals (*Control Word* (**G51**) Bit 10 or Bit 11) OR the speed selection (*Control Word* (**G51**) Bit 0 to Bit 9) must be removed at the end of travel.
Speed err	**Excessive following speed error**
62	**Open loop mode** For Open loop mode excessive following speed error is detected, and a trip generated, when the drive enters and operates in current limit for the time defined in *Maximum Speed Error Threshold* (**H15**). *Maximum Speed Error Threshold* (**H15**) defines the allowable time to operate in current limit prior to the trip being generated, selecting very high values will result in the Speed err trip being disabled. **RFC-A** and **RFC-S** The speed error is calculated from the difference between *Profile Speed* (**J39**) and *Actual Speed* (**J40**). The calculated speed error is then compared with the speed error threshold in *Maximum Speed Error Threshold* (**H15**) and where the threshold is exceeded for more than 100 ms a trip is generated. The speed error during a travel is displayed in *Maximum Speed Error* (**J57**) independent of the activation of the speed error detection and this is reset to 0 at each start. **Recommended actions:** • Possible causes for the speed error trip can be due to the following **Motor** Check motor power connections and phase rotation Check motor brake control Check Elevator safety gear **Position feedback** Check position feedback mechanical mounting Check position feedback phase rotation Check position feedback wiring arrangement, risk of induced noise Position feedback device failure, replace feedback device **Drive set-up** Check motor details and parameter set-up, including current limit Check position feedback device parameter set-up Check position feedback device phase offset, static autotune has been completed Check speed control loop gain settings where motor instability exists • Increase the *Maximum Speed Error Threshold* (**H15**) • The following speed error detection can be disabled by setting *Maximum Speed Error Threshold* (**H15**) = 0
STO Ctrl err	**Safe Torque Off (STO), Drive enable control sequence error**
66	The Safe Torque Off (STO), Drive enable input sequence is incorrect i.e. the Safe Torque Off (STO), Drive enable was not removed a the end of the travel following motor contactor control and after 4 s, or applied during the start of a travel following motor contactor control and after 6 s. **Recommended actions:** • Check for correct control connection of Safe Torque Off (STO), Drive enable to T31 on the drive • Check parameter F10 *T31 STO Input 1 State* (**F10**) Safe Torque Off (STO), Drive enable input sequence during start / stop • Check correct operation of output motor contactors and auxiliary contacts • Check OPEN / CLOSE delay time of output motor contactors • Check motor contactor delay in *Motor Contactor Measured Delay Time* (**B32**)

<table>
<tr><th>Trip</th><th>Diagnosis</th></tr>
<tr><td>Temp Feedback</td><td>Internal thermistor has failed</td></tr>
<tr><td>218</td><td>This trip indicates a fault with a thermistor in the drive (i.e. open circuit or short circuit). The thermistor location can be identified by the sub-trip number:
<table>
<tr><th>Source</th><th>xx</th><th>y</th><th>zz</th></tr>
<tr><td>Control board</td><td>00</td><td>00</td><td>01: Control board thermistor 1
02: Control board thermistor 2
03: I/O board thermistor</td></tr>
<tr><td>Power system</td><td>01</td><td>0</td><td>Zero for temperature feedback provided via power system comms.
21, 22 and 23 for direct ELV temperature feedback.</td></tr>
<tr><td>Power system</td><td>01</td><td>Rectifier number</td><td>Always zero</td></tr>
</table>
Recommended actions:
• Hardware fault - contact the supplier of the drive.</td></tr>
<tr><td>Th Brake Res</td><td>Brake resistor over temperature</td></tr>
<tr><td>10</td><td>The Th Brake Res is initiated, If hardware based braking resistor thermal monitoring is connected and the resistor overheats. If the braking resistor is not used then this trip must be disabled with bit 3 of Action On Trip Detection to prevent this trip.
Recommended actions:
• Check braking resistor value is greater than or equal to the minimum resistance value for the drive
• Check brake resistor wiring
• Check braking resistor insulation</td></tr>
<tr><td>Th Short Circuit</td><td>Motor thermistor short circuit</td></tr>
<tr><td>25</td><td>The Th Short Circuit trip indicates that the motor thermistor connected to the drive is short circuit or low impedance. The location of the trip can be identified by the sub-trip number.
<table>
<tr><th>Sub-trip</th><th>Reason</th></tr>
<tr><td>1</td><td>The resistance of the thermistor connected to the drive P1 position feedback interface is less than 50 Ω.</td></tr>
<tr><td>2</td><td>The resistance of the thermistor connected to analog input 3 is less than 50 Ω.</td></tr>
</table>
Recommended actions:
• Check thermistor control connection at drive
• Check thermistor wiring, continuity and signs of damage
• Replace motor / motor thermistor</td></tr>
<tr><td>Thermistor</td><td>Motor thermistor over-temperature</td></tr>
<tr><td>24</td><td>The Thermistor trip indicates that the motor thermistor connected to the drive has indicated a motor over temperature. The location of the trip can be identified by the sub-trip number
<table>
<tr><th>Sub-trip</th><th>Reason</th></tr>
<tr><td>1</td><td>Trip initiated from thermistor connected to P1 position feedback interface</td></tr>
<tr><td>2</td><td>Trip initiated from thermistor connected to analog input 3</td></tr>
</table>
Recommended actions:
• Check motor thermistor wiring connections and continuity
• Check motor temperature
• Check motor ventilation
• Provide additional forced cooling
• Replace motor / motor thermistor
This is a delayed trip, where travel will complete (Elevator Software State (J03) = 0) and then the drive will trip. If a delayed trip has been scheduled during travel (Elevator Software State (J03) > 0) then Global Warning (L04) = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.</td></tr>
<tr><td>User 24V</td><td>User 24 V supply is not present on control terminals 1 (0 V) and 2 (24 V)</td></tr>
<tr><td>91</td><td>A User 24 V trip is initiated, if User Supply Select (O10) is set to 1 Low Under Voltage Threshold Select (O13) = 1 and no user 24 V supply is present on Control Terminals 1 and 2 of the drive.
Recommended actions:
• Ensure user + 24 V supply is present and connected to Control Terminals 1 (0 V) and 2 (24 V) of the drive.
• Ensure user + 24 V supply meets the specification of the + 24 V user input on the drive</td></tr>
<tr><td>User Save</td><td>User Save error / not completed</td></tr>
<tr><td>36</td><td>The User Save trip indicates that an error has been detected in the user save parameters saved in non-volatile memory.
For example
... following a user save command, the power to the drive was removed as the user parameters were being saved.
Recommended actions:
• Perform a user save in Pr mm00 to ensure that the trip doesn’t occur the next time the drive is powered up.
• Ensure that the drive has enough time to complete the save before removing the power to the drive.</td></tr>
</table>

Table 9-15 Serial communications look up table

No	Trip	No	Trip	No	Trip
1	Reserved 001	76	Dir change	195	Encoder 7
2	Over Volts	77	Ctrl Watchdog	196	Encoder 8
3	OI ac	78	Autotune No Dir	198	Phasing Error
4	OI Brake	79	Analog No Dir	199	Destination
5	PSU	81	SPD / Dir Select	202	Slot1 Error
7	Over Speed	82	I Limit Timeout	203	Slot1 Not installed
8	Inductance	83	550 Hz Limit	204	Slot1 Different
9	PSU 24	84	Encoder Not Init	214	Slot3 Different
10	Th Brake Res	90	Power Comms	215	Option Disable
11	Autotune 1	91	User 24 V	216	Slot App Menu
12	Autotune 2	92	OI Snubber	217	App Menu Changed
13	Autotune 3	97	Data Changing	218	Temp Feedback
14	Autotune 4	98	Out Phase Loss	219	An Output Calib
15	Autotune 5	101	OHt Brake	225	Current Offset
16	Autotune 6	102	OHt Rectifier	226	Soft Start
17	Autotune 7	109	OI dc	248	Derivative Image
18	Autotune Stopped	162	Encoder 12		
19	Brake R Too Hot	163	Encoder 13		
20	Motor Too Hot	174	Card Slot		
21	OHt Inverter	175	Card Product		
22	OHt Power	177	Card Boot		
23	OHt Control	178	Card Busy		
24	Thermistor	179	Card Data Exists		
25	Th Short Circuit	180	Card Option		
26	I/O Overload	181	Card Read Only		
27	OHt dc bus	182	Card Error		
28	An Input Loss 1	183	Card No Data		
29	An Input Loss 2	184	Card Full		
32	Phase Loss	185	Card Access		
33	Resistance	186	Card Rating		
36	User Save	187	Card Drive Mode		
37	Power Down Save	188	Card Compare		
60	Freeze protect	189	Encoder 1		
61	Drive rating	190	Encoder 2		
62	Speed err	191	Encoder 3		
63	Distance err	192	Encoder 4		
64	Feedback rev	193	Encoder 5		
65	Fast disable err	194	Encoder 6		
66	STO Ctrl err	207	Slot2 Error		
67	Current on stop	208	Slot2 Not installed		
68	Brk Ctrl Release	209	Slot2 Different		
74	Brk con 2 open	212	Slot3 Error		
75	Brk con 2 closd	213	Slot3 Not installed		

10 Optimization

10.1 Optimization

NOTE

The *E300 Advanced Elevator Drive* has variable speed and current control loop gains available for the start, travel and stop functions. By default the drive is set-up to use 2 sets of control loop gains for start, travel and stop.

NOTE

Open loop operation has variable current control loop gains with no speed control loop gains.

NOTE

By default, the start lock position control loop gain is disabled. Prior to setting up the start lock position gain, the speed and current control loop gains should be optimized. During start and following brake release, if there is any roll back movement of the sheave, the start lock position control loop gain can be enabled.

NOTE

By default start optimization is disabled. In most cases correct adjustment of the speed and current control loop gains will provide good performance. The start optimization feature can be enabled should mechanical imperfections exist.

CAUTION

The drive must be optimized by a responsible person who is familiar with the systems operation and safety requirements to avoid a safety hazard. Correct adjustment should be carried out as detailed in the Installation and Commissioning guide to avoid the risk of product damage a safety hazard.

10.2 Control loop gain adjustment

10.2.1 Current control loop

Current control loop gains
P Gain parameters I03 (Start), I08 (Run), I13 (Stop)
I Gain parameters I04 (Start), I09 (Run), I14 (Stop)

Current control loop filter
Current loop filter, parameters I05 (Start), I10 (Run), I15 (Stop)

The current control loop gains proportional (P) and integral (I) control the response of the current loop to a change in current (torque) demand during start stop (brake control) and operation. The default values give satisfactory operation with most motors, however for best performance an autotune should be carried out to achieve optimum values, this being either a static or rotating autotune.

The proportional current control loop gain parameter **I03** (Start), **I08** (Run) are the most critical in controlling the performance.

Manual adjustment of the current control loop gains are not recommended from the autotune values;

- During a static or rotating autotune the drive measures both the resistance and inductance of the motor and sets up *Stator Resistance* (**B35**) and *Transient Inductance* (**B34**) from these values the current loop gains are calculated.
- Once the autotune has been completed and the current loop gains set-up these can be manually adjusted if required where for example motor acoustic noise may be an issue.

The current loop filter defines the time constant of a first order filter that can be applied to the final current reference. The filter is provided to reduce acoustic noise and vibration produced as a result of position feedback quantisation. The filter introduces a lag in the speed control loop, and so the speed controller gains may need to be reduced to maintain stability as the filter time constant is increased. The current control loop filter is not available in Open loop mode.

10.2.2 Speed control loop gains

Speed control loop gains
P Gain parameters I01 (Start), I06 (Run), I11 (Stop)
I Gain parameters I02 (Start), I07 (Run), I12 (Stop)

Speed control loop filter, C09

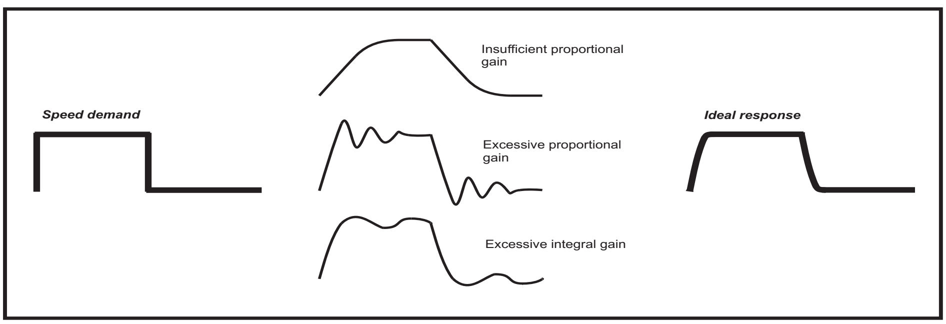
The speed control loop gains control the response of the speed controller to a change in speed demand. The speed controller includes both a proportional (P) and integral (I) feed forward term. The drive has three sets of P and I gains from default one for the Start and one for the Travel and Stop.

Proportional gain (P) *Start Speed Loop P Gain* (**I01**) and *Run Speed Loop P Gain* (**I06**) and *Stop Speed Loop P Gain* (**I11**)
If the proportional gain has a value and the integral gain is set to zero, there must be a speed error to produce a torque reference. Therefore as the motor load increases there will be a difference between the speed reference and actual speed. This effect, called regulation, depends on the level of proportional gain, the higher the gain the smaller the speed error under a given load. If the proportional gain is too high either the acoustic noise produced by speed feedback quantization becomes unacceptable, or the stability limit is reached.

Integral gain (I), *Start Speed Loop I Gain* (**I02**) and *Run Speed Loop I Gain* (**I07**) and *Stop Speed Loop I Gain* (**I12**)
The integral gain is provided to prevent speed regulation. The error is accumulated over a period of time and used to produce the necessary torque demand without any speed error. Increasing the integral gain reduces the time taken for the speed to reach the correct level and increases the stiffness of the system by applying a load torque to the motor. Increasing the integral gain to very high values can reduce the system damping giving overshoot after a transient. For a given integral gain the damping can be improved by increasing the proportional gain.

- Tuning the speed loop gains involves monitoring the speed feedback from the drive using an oscilloscope connected to one of the Analog outputs, or using the PC oscilloscope connected over comms, or monitoring the vibration level within the elevator car using an accelerometer.
- The drive is operated over a travel monitoring the response on the oscilloscope or the accelerometer and identifying any reduced ride quality.
- The proportional gain (P) should be set-up initially. The value should be increased up to the point where the speed overshoots or vibration is excessive and then reduced to achieve the required ride comfort level.
- The integral gain (I) should then be increased up to the point where the speed becomes unstable or vibration occurs and then reduced slightly.
- It may now be possible to increase the proportional gain slightly further, and the process should be repeated for both the proportional and integral gains until the system response matches the required ride comfort.
- The travel during tuning of the speed loop gains should be carried out for both a No-load and Full-load condition

The figure below shows the effect of P proportional and I integral gain adjustments as seen on an oscilloscope as well as the ideal response.



In some systems where low resolution feedback devices are used resulting in quantization, or where there is induced noise present on the position feedback due to the system wiring and termination, the maximum speed control loop gain settings can be limited. To improve the position feedback quality a feedback filter is available in *Encoder Feedback Filter* (**C09**) which can in some instances allow for higher speed control loop gains to be achieved.

10.3 Motor acoustic noise

Following set-up of the drive with the correct motor data and auto tuning section 7.3 *Autotune* on page 151, the drive settings can be further optimized to overcome motor acoustic noise. This motor instability which results in acoustic noise will also result in limited speed control loop gains.

Table 10-1 Motor parameters, acoustic noise

Parameter	Setting
Maximum Switching Frequency (**B13**)	Low switching frequencies < 6 kHz can result in high motor acoustic noise. High switching frequencies > 12 kHz can result in drive derating. Recommended = 8 to 12 kHz.
Start Current Loop P Gain (**I03**) *Run Current Loop P Gain* (**I08**)	High values of current loop P gain (> 150 % of autotune value) can result in motor acoustic noise. Low values of current control loop gains (< 50 % of autotune value) will result in oscillations and poor ride quality. Recommended = Autotune values
Start Current Loop Filter (**I05**) *Run Current Loop Filter* (**I10**)	Used to over come motor acoustic noise and instability due to system induced noise as a result of un-shielded cables or poor shield and ground terminations. Recommended = 1.0 to 4.0 ms
Encoder Feedback Filter (**C09**)	Used to over come motor acoustic noise and instability due to system induced noise as a result of un-shielded cables or poor shield and ground terminations. Recommended = 1 to 2 ms

10.4 Creep to floor - Start optimization

The start ride comfort of the Elevator can be optimized through either the profile settings or by adjustment of the drives control loop gains. The start profile should firstly be set-up, optimized (Run jerk 1, and Acceleration rate) prior to adjustment of the drives control loop gains which include the Start lock position gain plus speed and current control loop gains.

10.4.1 Profile settings

Optimization of the start profile is carried out adjusting the start S ramp (Run jerk 1) and the acceleration rate.

Table 10-2 Start profile optimization parameters

Parameter	Setting
Run Jerk 1 (**G13**)	The start S ramp can be increased if the Elevator starts with a jerk resulting in a slower more controlled start. If the Elevator starts slowly and swings the start S ramp should be decreased resulting in an increased acceleration at start. Recommended = application specific
Acceleration Rate (**G11**)	The acceleration rate is set-up for the profile to reach a given acceleration for the rated speed with good ride quality. This can be optimized to achieve higher levels of ride quality. Recommended = application specific

10.4.2 Control loop gains

During the start there is a start lock position control loop gain active during the brake control for optimization. Also during start there are both start speed and current control loop gains and a start current loop filter. The position feedback filter available is active during the complete travel and if required this should be adjusted to suit the start, travel and stop.

Table 10-3 Start control loop gains

Parameter	Setting
Motor Torque Ramp Time (**D02**)	Time to ramp torque up on the motor against the mechanical brake, increase to overcome any acoustic noise.
Start Lock P Gain Speed Clamp (**I21**)	The start lock position control loop P gain can be optimized if used following set-up of the speed and current loop gains. Higher values of P gain will correct for any position error during brake release. Excessive values will result in both instability while holding zero speed and acoustic noise. Recommended = 10 to 100
Start Speed Loop P Gain (**I01**) *Start Speed Loop I Gain* (**I02**)	Start speed loop gains are optimized to hold zero speed during brake release (I gain) and to provide smooth control during the start P gain). Both gains can be limited where noise is present on the position feedback, in this case the encoder feedback or current loop filter may be required. Recommended P) = 800 to 2500 Recommended I) = 1000 to 3000
Start Current Loop P Gain (**I03**) *Start Current Loop I Gain* (**I04**)	High values of current loop P gain (> 150 % of autotune value) can result in motor acoustic noise. Low values of current control loop gains (< 50 % of autotune value) will result in oscillations and poor ride quality. Recommended = Autotune values
Start Current Loop Filter (**I05**)	Used to over come motor acoustic noise and instability due to system induced noise as a result of un-shielded cables or poor shield and ground terminations. Recommended = 1.0 to 4.0 ms
Drive Encoder Feedback Filter (**C09**)	Used to over come motor acoustic noise and instability due to system induced noise as a result of un-shielded cables or poor shield and ground terminations. Recommended = 1 to 2 ms

10.5 Creep to floor - Travel optimization

The ride comfort of the Elevator can be optimized through either the profile settings or by adjustment of the drives control loop gains. The travel profile should firstly be set-up, optimized (Run jerk 2, Operating speed V2 to V4) prior to adjustment of the drives speed and current control loop gains.

10.5.1 Profile settings

Optimization of the travel is carried out adjusting the end of acceleration S ramp (Run jerk 2) and the operating speeds V2 through to V4.

Table 10-4 Travel profile optimization parameters

Parameter	Setting
Run Jerk 2 (**G14**)	If the ride comfort is hard at the end of acceleration when reaching constant speed increase the S ramp which will result in a softer transition to the operating speed. If the ride comfort is soft decrease the S ramp which will provide a stiffer transition through to the operating speed. Recommended = application specific
V2 Speed Reference (**G02**) *V3 Speed Reference* (**G03**) *V4 Speed Reference* (**G04**)	The operating speeds can be adjusted where the Elevator system is not reaching its required contract speed. The selected operating speed can be seen in *Reference Parameter Selected* (**J09**). Recommended = application specific

10.5.2 Control loop gains

During the travel, there are both Run speed and current control loop gains available along with a current loop filter. The position feedback filter available is active during the complete travel and if required this should be adjusted to suit the start, travel and stop.

Table 10-5 Travel optimization parameters

Parameter	Setting
Run Speed Loop P (**I06**) *Run Speed Loop I Gain* (**I07**)	Run speed loop gains are optimized to overcome any overshoot during a transition in speed and vibration during travel. The P gain should be increased to overcome overshoot and reduced to soften the transition between speeds. The I gain can be increased at constant speed to ensure maximum torque, or reduced to overcome or reduce vibration and acoustic noise. Recommended (P) = 500 to 1800 (I) = 1000 to 3000
Run Current Loop P Gain (**I08**) *Run Current Loop I Gain* (**I09**)	High values of current loop P gain (> 150 % of autotune value) can result in motor acoustic noise. Low values of current control loop gains (< 50 % of autotune value) will result in oscillations and poor ride quality. Recommended = Autotune values
Run Current Loop Filter (**I10**)	Used to over come motor acoustic noise and instability due to system induced noise as a result of un-shielded cables or poor shield and ground terminations. Recommended = 1.0 to 4.0 ms
Drive Encoder Feedback Filter (**C09**)	Used to over come motor acoustic noise and instability due to system induced noise as a result of un-shielded cables or poor shield and ground terminations. Recommended = 1 to 2 ms

10.6 Creep to floor - Stop optimization

The stop ride comfort of the Elevator can be optimized through either the profile settings or by adjustment of the drive's control loop gains. The stop profile should firstly be optimized (Run jerk 3, Deceleration rate, Run jerk 4, Creep speed*, Creep stop deceleration rate and Creep stop jerk) prior to adjustment of the drive's speed and current control loop gains.

10.6.1 Profile settings

Optimization of the Elevator stopping can be carried out by adjusting the stop S ramp (Run jerk 3), Deceleration rate, end of deceleration S ramp (Run jerk 4), Creep speed*, Creep stop deceleration rate and Creep stop jerk.

Table 10-6 Stop profile optimization parameters

Parameter	Setting
Run Jerk 3 (**G15**)	If the ride comfort is hard at the start of deceleration increase the S ramp which will result in a softer transition. If the ride comfort is soft decrease the S ramp which will provide a stiffer transition through to deceleration. Recommended = application specific
Deceleration Rate (**G12**)	The deceleration is set-up to stop from the operating speed with a good ride quality and to limit the time required at the Creep speed*. This can be optimized to achieve a higher ride quality. Recommended = application specific
Run Jerk 4 (**G16**)	If the ride comfort is hard at the end of deceleration and when reaching the Creep speed* increase the S ramp which will result in a softer transition. If the ride comfort is soft decrease the S ramp which will provide a stiffer transition through to Creep speed*. Recommended = application specific
Creep Speed (V1 Speed Reference (***G01****) by default, any speed can be selected)*	Can be reduced to improve floor positioning accuracy or increased to reduce the time operating at Creep speed* and to reach the floor. Recommended = application specific
Creep Stop Deceleration Rate (**G17**)	The Creep stop deceleration is set-up to give a good final stop ride quality. Recommended = application specific
Creep Stop Jerk (**G18**)	If the final stop at floor is hard increase the S ramp which will result in a softer transition. If the ride comfort is too soft decrease the S ramp which will provide a stiffer transition to stop. Recommended = application specific
Motor Torque Ramp Time (**D02**)	Time to ramp torque down on the motor against the mechanical brake, increase to overcome any acoustic noise.

* *V1 Speed Reference* (**G01**) by default, any speed can be selected.

10.6.2 Control loop gains

During the deceleration and stopping of the Elevator there are both Run speed and current control loop gains available along with a current loop filter. The position feedback filter available is active during the complete travel and if required this should be adjusted to suit the start, travel and stop.

Table 10-7 Stop optimization parameters

Parameter	Setting
Run Speed Loop P Gain (**I06**) Run Speed Loop I Gain (**I07**)	Run speed loop gains are optimized to overcome any overshoot during a transition in speed any vibration during travel. The P gain should be increased to overcome overshoot and reduced to soften the transition between speeds. The I gain can be reduced to overcome, reduce vibration and acoustic noise. Recommended (P) = 500 to 1800 (I) = 1000 to 3000
Run Current Loop P Gain (**I08**) *Run Current Loop I Gain* (**I09**)	High values of current loop P gain (> 150 % of autotune value) can result in motor acoustic noise. Low values of current control loop gains (< 50 % of autotune value) will result in oscillations and poor ride quality. Recommended = Autotune values
Run Current Loop Filter (**I10**)	Used to over come motor acoustic noise and instability due to system induced noise as a result of un-shielded cables or poor shield and ground terminations. Recommended = 1.0 to 4.0 ms
Drive Encoder Feedback Filter (**C09**)	Used to over come motor acoustic noise and instability due to system induced noise as a result of un-shielded cables or poor shield and ground terminations. Recommended = 1 to 2 ms

10.7 Brake control optimization

Optimization of the brake control can be carried out adjusting the brake release apply times along with the current and frequency thresholds. The brake release and apply times will vary dependant upon the time taken for the motor energise and dependant upon the brakes mechanical arrangement and operating times.

Table 10-8 Brake control optimization parameters

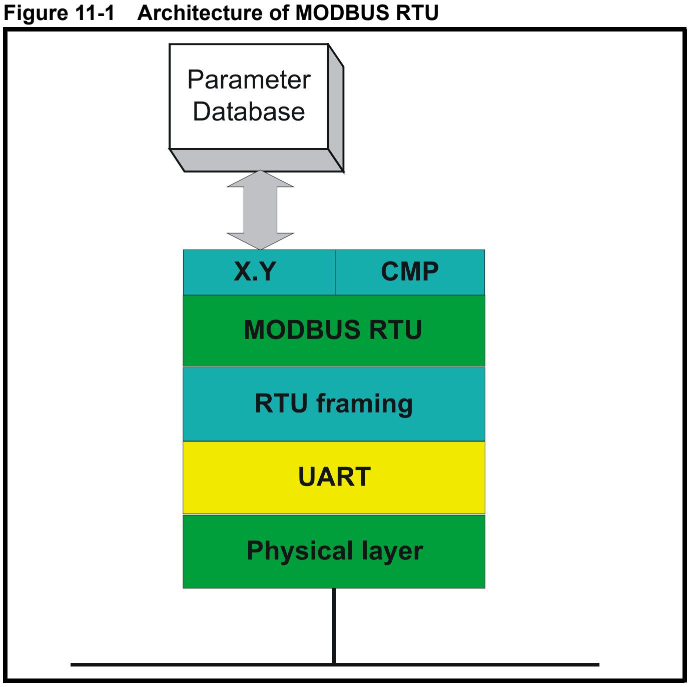
Parameter	Setting
Brake Control Release Delay (**D04**)	This is the time taken for the brake to fully open during the start prior to starting the travel. Recommended = 400 to 500 ms
Brake Control: Upper Current Threshold (**D06**)	Brake release high current threshold for open loop operation.
Brake Control: Brake Release Frequency (**D08**)	Brake release frequency for open loop operation.
Brake Control Apply Delay (**D05**)	This is the time required for the brake to fully close during the stop prior to disabling the drive. Recommended = 400 to 500 ms
Brake Control: Lower Current Threshold (**D07**)	Brake apply low current threshold for open loop operation
Brake Apply Frequency (**D09**)	Brake apply frequency for open loop operation

11 CT MODBUS RTU

This section describes the adaptation of the MODBUS RTU protocol offered on Control Techniques' products. The portable software class which implements this protocol is also defined.

MODBUS RTU is a master slave system with half-duplex message exchange. The Control Techniques (CT) implementation supports the core function codes to read and write registers. A scheme to map between MODBUS registers and CT parameters is defined. The CT implementation also defines a 32 bit extension to the standard 16 bit register data format.

Figure 11-1 Architecture of MODBUS RTU



11.1 MODBUS RTU

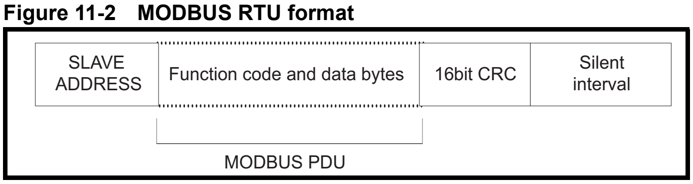
Physical layer

Attribute	Description
Normal physical layer for multi-drop operation	RS285 2-wire
Bit stream	Standard UART asynchronous symbols with Non Return to Zero (NRZ)
Symbol	Each symbol consists of:- 1 start bit 8 data bits (transmitted least significant bit first) 2 stop bits
Baudrates	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800, 115200

RTU framing

The frame has the following basic format:

Figure 11-2 MODBUS RTU format



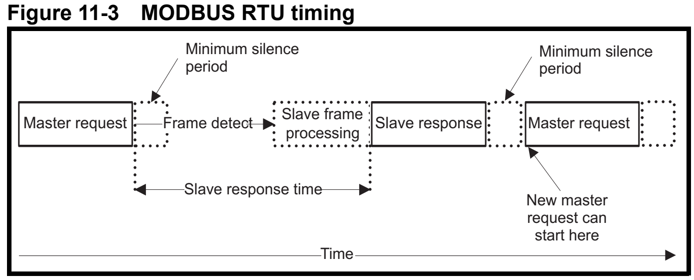
The frame is terminated with a minimum silent period of 3.5 character times (for example, at 19200 baud the minimum silent period is 2 ms). Nodes use the terminating silence period to detect the end of frame and begin frame processing. All frames must therefore be transmitted as a continuous stream without any gaps greater or equal to the silence period. If an erroneous gap is inserted then receiving nodes may start frame processing early in which case the CRC will fail and the frame will be discarded. See description of *Silent Period* (**M05**) in section 5.20.1 *485 Serial communications* on page 119.

MODBUS RTU is a master slave system. All master requests, except broadcast requests, will lead to a response from an individual slave. The slave will respond (i.e. start transmitting the response) within the quoted maximum slave response time (this time is quoted in the data sheet for all drive products). The minimum slave response time is also quoted but will never be less than the minimum silent period defined by 3.5 character times.

If the master request was a broadcast request then the master may transmit a new request once the maximum slave response time has expired.

The master must implement a message time out to handle transmission errors. This time out period must be set to the maximum slave response time + transmission time for the response.

Figure 11-3 MODBUS RTU timing



11.2 Slave address

The first byte of the frame is the slave node address. Valid slave node addresses are 1 through 247 decimal. In the master request this byte indicates the target slave node; in the slave response this byte indicates the address of the slave sending the response.

Global addressing

Address zero addresses all slave nodes on the network. Slave nodes suppress the response messages for broadcast requests.

11.3 MODBUS registers

The MODBUS register address range is 16 bit (65536 registers) which at the protocol level is represented by indexes 0 through 65535.

PLC registers

Modicon PLCs typically define 4 register 'files' each containing 65536 registers. Traditionally, the registers are referenced 1 through 65536 rather than 0 through 65535. The register address is therefore decremented on the master device before passing to the protocol.

File type	Description
1	Read only bits
2	Read / write bits
3	Read only 16 bit register
4	Read / write 16 bit register

The register file type code is NOT transmitted by MODBUS and all register files can be considered to map onto a single register address space. All parameters in the drive are holding registers.

CT parameter mapping

The drive is parameterized using the **mmpp** notation. Indexes '**mm**' and '**pp**' are in the range 0 through 99. Parameters are mapped into the MODBUS register space in standard addressing mode as:

Protocol register = (M x 100) + pp - 1

Where:

M is the effective menu number (A = 0, B = 1, C = 2 etc).

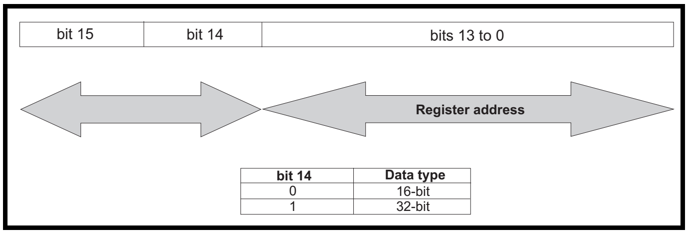
To correctly map the parameters at the application layer, the slave device increments the received register address. The consequence of this behavior is that **A00** cannot be accessed.

Data types

The MODBUS protocol specification defines registers as 16 bit signed integers. Each drive parameter is internally mapped to a single 16 bit MODBUS register, all MODBUS function codes access 16 bit registers only so to access a 32 bit parameter, two contiguous MODBUS registers must be specified in the request and the 32 bit data access scheme must be used.

32 bit data access

Standard MODBUS registers are 16 bits in size and reference a single drive parameter. To access a 32 bit data value the multiple read/write services must be used to transfer a contiguous array of 16 bit registers. Selection between either 16 bit or 32 bit access is specified using bit 14 of the register address. Note: Bit 15 of the register address is reserved for future use.



If 32 bit data type is selected then this effectively adds 16384 (0x4000) to the start register address.

e.g. For drive parameter Pr **01.021** in standard addressing mode, the start register value is 16384 + 120 = 16504 (0x4078)

If a 32 bit data type is selected then the drive uses two consecutive 16 bit MODBUS registers (in 'big endian'). The master must also set the correct 'number of 16 bit registers' in the request.

Example: read Pr **00.001** (Pr **01.021**) as a 32 bit parameter, using FC03 from node 1:

Master request

Byte	Value	Description
0	0x01	Slave destination node address
1	0x03	Function code 0x03
2	0x40	Start register Pr **00.001** (16384 + (100 x 0) + 1 – 1) = 16384 = 0x4000
3	0x00	
4	0x00	Number of 16 bit registers to read Pr **00.001** is 1 x 32 bit register = 2 x 16 bit registers
5	0x02	
6	0xD1	CRC LSB
7	0xCB	CRC MSB

Slave response

Byte	Value	Description
0	0x01	Slave destination node address
1	0x03	Function code 0x03
2	0x04	Length of data (bytes) = 1 x 32 bit register = 4 bytes
3		Pr **00.001** data
4		
5		
6		
7		CRC LSB
8		CRC MSB

Reads when actual parameter type is different from selected

The slave will send the least significant word of a 32 bit parameter if that parameter is read as part of a 16 bit access.

The slave will sign extend the least significant word if a 16 bit parameter is accessed as a 32 bit parameter. The number of 16 bit registers must be even during a 32 bit access.

Writes when actual parameter type is different from selected

The slave will allow writing a 32 bit value to a 16 bit parameter as long as the 32 bit value is within the normal range of the 16 bit parameter.

The slave will allow a 16 bit write to a 32 bit parameter. The slave will sign extend the written value, therefore, the effective range of this type of write will be ±32767.

11.4 Data encoding

MODBUS RTU uses a 'big-endian' representation for addresses and data items (except the CRC, which is 'little-endian'). This means that when a numerical quantity larger than a single byte is transmitted, the MOST significant byte is sent first. So for example:

16 bits 0x1234 would be 0 x12 0 x34

32 bits 0x12345678 would be 0 x12 0 x34 0 x56 0 x78

There is no facility to encode a decimal point, therefore values must be written and read raw (e.g. a value of 2.000 is written or read as 2000).

11.5 Function codes

The function code determines the context and format of the message data. Bit 7 of the function code is used in the slave response to indicate an exception.

The following function codes are supported:

Code	Description
03	Read multiple 16 bit registers
06	Write single register
16	Write multiple 16 bit registers
23	Read and write multiple 16 bit registers

FC03 Read multiple registers

Read a contiguous array of registers. The drive imposes an upper limit on the number of registers (16 in the case of the *E300 Advanced Elevator* drive), which can be read. If this is exceeded the drive will issue an exception code 2.

The normal response includes the function code, number of data bytes in the read block followed by the register data (unless an exception occurs).

If 32 bit parameter addressing is used, then for each parameter read:

- Two 16 bit registers must be used in the request
- The register data in the response will contain 4 bytes of data

Master request

Byte	Description
0	Slave destination node address (1 – 247, 0 is global)
1	Function code 0x03
2	Start register address MSB
3	Start register address LSB
4	Number of 16 bit registers to read MSB
5	Number of 16 bit registers to read LSB
6	CRC LSB
7	CRC MSB

Slave response

Byte	Description
0	Slave destination node address
1	Function code 0x03
2	Length of data in read block (bytes)
3	Register data 0 MSB
4	Register data 0 LSB
3+byte count	CRC LSB
4+byte count	CRC MSB

Example

Read Pr **00.011** to Pr **00.014** with 32 bit data access

Master request

Byte	Value	Description
0	0x01	Slave destination node address
1	0x03	Function code 0x03
2	0x40	Start register Pr **00.011**
3	0x0A	(16384 + (100 x 0) + 11 – 1) = 16394 = 0x400A
4	0x00	Number of 16 bit registers to read
5	0x08	4 x 32 bit register = 8 x 16 bit registers
6	0x71	CRC LSB
7	0xCE	CRC MSB

Slave response

Byte	Value	Description
0	0x01	Slave destination node address
1	0x03	Function code 0x03
2	0x10	Length of data (bytes) = 4 x 32 bit registers = 16 bytes
3-6		Pr **00.011** data
7-10		Pr **00.012** data
11-14		Pr **00.013** data
15-18		Pr **00.014** data
19		CRC LSB
20		CRC MSB

FC06 Write single register

Writes a single 16 bit value to a register. The normal response is an echo of the request (unless an exception occurs) returned after the parameter has been written.

The register address can correspond to a 32 bit parameter, but only the lower 16 bits of the value will be written.

Master request

Byte	Description
0	Slave destination node address (1 – 247, 0 is global)
1	Function code 0x06
2	Start register address MSB
3	Start register address LSB
4	Register data MSB
5	Register data LSB
6	CRC LSB
7	CRC MSB

Slave response

Byte	Description
0	Slave destination node address
1	Function code 0x06
2	Start register address MSB
3	Start register address LSB
4	Register data MSB
5	Register data LSB
6	CRC LSB
7	CRC MSB

Example

Write the value 0x0000 to Pr **00.020** (Pr **18.012**)

Master request

Byte	Value	Description
0	0x01	Slave destination node address
1	0x06	Function code 0x06
2	0x00	Start register Pr **00.020**
3	0x13	(100 x 0) + 20 – 1) = 19 = 0x0013
4	0x00	Register data MSB
5	0x00	Register data LSB
6	0x78	CRC LSB
7	0x0F	CRC MSB

Slave response

Byte	Value	Description
0	0x01	Slave destination node address
1	0x06	Function code 0x06
2	0x00	Start register MSB
3	0x13	Start register LSB
4	0x00	Register data MSB
5	0x00	Register data LSB
6	0x78	CRC LSB
7	0x0F	CRC MSB

FC16 - Write multiple registers

This function code allows a contiguous series of registers to be written. The drive imposes an upper limit on the number of registers to be written (16 in the case of CSD100), and if this is exceeded the drive will issue an exception response code 2.

The normal response includes the function code, start register address and number of 16 bit registers written (unless an exception occurs), returned after the parameters have been written.

If 32 bit parameter addressing is used, then for each parameter written:

- Two 16 bit registers must be used in the request
- Four bytes must be specified in the request
- The number of registers written in the response will be twice the number of parameters written

Master request

Byte	Description
0	Slave destination node address (1 – 247, 0 is global)
1	Function code 0x10
2	Start register address MSB
3	Start register address LSB
4	Number of 16 bit registers to write MSB
5	Number of 16 bit registers to write LSB
6	Length of register data to write (bytes)
7	Register data 0 MSB
8	Register data 0 LSB
7+byte count	CRC LSB
8+byte count	CRC MSB

Slave response

Byte	Description
0	Slave destination node address
1	Function code 0x10
2	Start register address MSB
3	Start register address LSB
4	Number of 16 bit registers written MSB
5	Number of 16 bit registers written LSB
6	CRC LSB
7	CRC MSB

Example

Write the value 2000 to Pr **00.011** and 3000 to Pr **00.012** with 32 bit data access

Master request

Byte	Value	Description
0	0x01	Slave destination node address
1	0x10	Function code 0x10
2	0x40	Start register Pr **00.011** 16384 + (100 x 0) + 11 – 1) = 16394 = 0x400A
3	0x0A	
4	0x00	Number of 16 bit registers MSB
5	0x04	Number of 16 bit registers LSB
6	0x08	Length of register data to write (bytes)
7-10	0x00 0x00 0x07 0xD0	Register data 0
11-14	0x00 0x00 0x0B 0xB8	Register data 1
15	0x97	CRC LSB
16	0x85	CRC MSB

Slave response

Byte	Value	Description
0	0x01	Slave destination node address
1	0x10	Function code 0x10
2	0x40	Start register address MSB
3	0x0A	Start register address LSB
4	0x00	Number of 16 bit registers written MSB
5	0x04	Number of 16 bit registers written LSB
6		CRC LSB
7		CRC MSB

FC23 - Read/Write multiple registers

This function code allows a contiguous series of registers to be written and another contiguous series of registers to be read. The drive imposes an upper limit on the number of registers to be written (16 in the case of CSD100), and if this is exceeded the drive will issue an exception response code 2.

The normal response includes the function code, number of data bytes in the read block followed by the register data (unless an exception occurs).

If 32 bit parameter addressing is used:

- For each parameter read or written, two 16 bit registers must be used in the request
- For each parameter written, four bytes must be specified in the request
- For each parameter read, four bytes of data will be used in the response

It should be noted that the FC23 request is effectively an FC03 (read multiple) request followed by an FC16 (write multiple) request. The write is performed first and continues until any of the errors given for FC16 occur. Some parameters may have been written when an error is detected, but no indication is given about how many parameters have been written successfully. The read is always performed even if an error is detected during writing. Any of the errors given for FC03 can occur and the exception response is the same as for FC03.

Master request

Byte	Description
0	Slave destination node address (1 – 247, 0 is global)
1	Function code 0x17
2	Start register address to read MSB
3	Start register address to read LSB
4	Number of 16 bit registers to read MSB
5	Number of 16 bit registers to read LSB
6	Start register address to write MSB
7	Start register address o write LSB
8	Number of 16 bit registers to write MSB
9	Number of 16 bit registers to write LSB
10	Length of register data to write (bytes)
11	Register data 0 MSB
12	Register data 0 LSB
11+byte count	CRC LSB
12+byte count	CRC MSB

Slave response

Byte	Description
0	Slave destination node address
1	Function code 0x10
2	Length of register data in read block (bytes)
3	Register data 0 MSB
4	Register data 0 LSB
3+byte count	CRC LSB
4+byte count	CRC MSB

Example

Write the value 200 to Pr **00.054** and read Pr **00.057** with 32 bit data access

Master request

Byte	Value	Description
0	0x01	Slave destination node address
1	0x17	Function code 0x17
2	0x40	Start register Pr **00.057** 16384 + (100 x 0) + 57 – 1) = 16440 = 0x4038
3	0x38	
4	0x00	Number of 16 bit registers MSB
5	0x02	Number of 16 bit registers LSB
6	0x40	Start register Pr **00.054** 16384 + (100 x 0) + 54 – 1) = 16437 = 0x4035
7	0x35	
	0x00	Number of 16 bit registers to write MSB
	0x02	Number of 16 bit registers to write LSB
	0x04	Length of register data to write (bytes)
8-11	0x00 0x00 0x00 0xC8	Register data 0
16	0x6B	CRC LSB
17	0x61	CRC MSB

Slave response

Byte	Value	Description
0	0x01	Slave destination node address
1	0x17	Function code 0x10
2	0x04	Length of register data in read block (bytes)
3-6	0x00 0x00 0x00 0x00	Register data 0
7		CRC MSB
8		CRC MSB

11.6 Exceptions

The slave will respond with an exception response if an error is detected in the master request. If a message is corrupted and the frame is not received or the CRC fails then the slave will not issue an exception. In this case, the master device will time out. If a write multiple (FC16 or FC23) request exceeds the slave maximum buffer size then the slave will discard the message. No exception will be transmitted in this case and the master will time out.

Exception message format

The slave exception message has the following format:

Byte	Description
0	Slave source node address
1	Original function code with bit7 set (e.g. FC 0x03 will be returned as 0x83)
2	Exception code
3	CRC LSB
4	CRC MSB

Exception codes

The following exception codes are supported:

Byte	Description
1	Function code not supported
2	Register address out of range, or request to read too many registers

11.7 CRC

The CRC is a 16 bit cyclic redundancy check using the standard CRC-16 polynomial x16 + x15 + x2 + 1. The 16 bit CRC is appended to the message and transmitted LSB first.

The CRC is calculated on ALL the bytes in the frame.

12 Technical Data

12.1 Motor requirements

No. of phases: 3

Maximum voltage:
- 200 V drive: 240 V
- 400 V drive: 480 V
- 575 V drive: 575 V
- 690 V drive: 690 V

12.2 Temperature, humidity and cooling method

Ambient temperature operating range:

- 20 °C to 50 °C (- 4 °F to 122 °F).

Output current derating must be applied at ambient temperatures >40 °C (104 °F).

Cooling method: Forced convection

Maximum humidity: 95 % non-condensing at 40 °C (104 °F)

12.3 Storage

-40 °C (-40 °F) to +50 °C (122 °F) for long term storage, or to +70 °C (158 °F) for short term storage.

Storage time is 2 years.

Electrolytic capacitors in any electronic product have a storage period after which they require reforming or replacing.

The DC bus capacitors have a storage period of 10 years.

The low voltage capacitors on the control supplies typically have a storage period of 2 years and are thus the limiting factor.

Low voltage capacitors cannot be reformed due to their location in the circuit and thus may require replacing if the drive is stored for a period of 2 years or greater without power being applied.

It is therefore recommended that drives are powered up for a minimum of 1 hour after every 2 years of storage.

This process allows the drive to be stored for a further 2 years.

12.4 Altitude

Altitude range: 0 to 3,000 m (9,900 ft), subject to the following conditions:

1,000 m to 3,000 m (3,300 ft to 9,900 ft) above sea level: de-rate the maximum output current from the specified figure by 1% per 100 m (330 ft) above 1,000 m (3,300 ft)

For example at 3,000 m (9,900 ft) the output current of the drive would have to be de-rated by 20 %.

12.5 IP / UL Rating

The drive is rated to IP20 pollution degree 2 (dry, non-conductive contamination only) (NEMA 1). However, it is possible to configure the drive to achieve IP65 rating (sizes 3 to 7) (NEMA 12) at the rear of the heatsink for through-panel mounting (some current derating is required).

In order to achieve the high IP rating at the rear of the heatsink with drive sizes 3,4 and 5 it is necessary to seal a heatsink vent by installing the high IP insert.

The IP rating of a product is a measure of protection against ingress and contact to foreign bodies and water. It is stated as IP XX, where the two digits (XX) indicate the degree of protection provided as shown in Table 12-1.

Table 12-1 IP Rating degrees of protection

First digit		Second digit	
Protection against contact and ingress of foreign bodies		Protection against ingress of water	
0	No protection	0	No protection
1	Protection against large foreign bodies ϕ > 50 mm (large area contact with the hand)	1	Protection against vertically falling drops of water
2	Protection against medium size foreign bodies ϕ > 12 mm (finger)	2	Protection against spraywater (up to 15 ° from the vertical)
3	Protection against small foreign bodies ϕ > 2.5 mm (tools, wires)	3	Protection against spraywater (up to 60 ° from the vertical)
4	Protection against granular foreign bodies ϕ > 1mm (tools, wires)	4	Protection against splashwater (from all directions)
5	Protection against dust deposit, complete protection against accidental contact.	5	Protection against heavy splash water (from all directions, at high pressure)
6	Protection against dust ingress, complete protection against accidental contact.	6	Protection against deckwater (e.g. in heavy seas)
7		7	Protection against immersion
8		8	Protection against submersion

Table 12-2 UL enclosure ratings

UL rating	Description
Type 1	Enclosures are intended for indoor use, primarily to provide a degree of protection against limited amounts of falling dirt.
Type 12	Enclosures are intended for indoor use, primarily to provide a degree of protection against dust, falling dirt and dripping non-corrosive liquids.

12.6 Corrosive gasses

Concentrations of corrosive gases must not exceed the levels given in:

- Table A2 of EN 50178:1998
- Class 3C2 of IEC 60721-3-3

This corresponds to the levels typical of urban areas with industrial activities and/or heavy traffic, but not in the immediate neighborhood of industrial sources with chemical emissions.

12.7 RoHS compliance

The drive meets EU directive 2002-95-EC for RoHS compliance.

12.8 Vibration

Maximum recommended continuous vibration level 0.14 g r.m.s. broad-band 5 to 200 Hz.

NOTE

This is the limit for broad-band (random) vibration. Narrow-band vibration at this level which coincides with a structural resonance could result in premature failure.

Bump Test

Testing in each of three mutually perpendicular axes in turn.
Referenced standard:IEC 60068-2-29: Test Eb:
Severity: 18 g, 6 ms, half sine
No. of Bumps: 600 (100 in each direction of each axis)

Random Vibration Test

Testing in each of three mutually perpendicular axes in turn.
Referenced standard:IEC 60068-2-64: Test Fh:
Severity: 1.0 m^2/s^3 (0.01 g^2/Hz) ASD from 5 to 20 Hz
-3 dB/octave from 20 to 200 Hz
Duration: 30 minutes in each of 3 mutually perpendicular axes.

Sinusoidal Vibration Test

Testing in each of three mutually perpendicular axes in turn.
Referenced standard: IEC 60068-2-6: Test Fc:
Frequency range: 5 to 500 Hz
Severity: 3.5 mm peak displacement from 5 to 9 Hz
10 m/s^2 peak acceleration from 9 to 200 Hz
15 m/s^2 peak acceleration from 200 to 500 Hz
Sweep rate: 1 octave/minute
Duration: 15 minutes in each of 3 mutually perpendicular axes.

EN 61800-5-1:2007, Section 5.2.6.4. referring to IEC 60068-2-6

Frequency range: 10 to 150 Hz
Amplitude: 10 to 57 Hz at 0.075 mm pk
57 to 150 Hz at 1g p
Sweep rate: 1 octave/minute
Duration: 10 sweep cycles per axis in each of 3 mutually perpendicular axes

12.9 Starts per hour

By electronic control: unlimited
By interrupting the AC supply: ≤20 (equally spaced)

12.10 Start up time

This is the time taken from the moment of applying power to the drive, to the drive being ready to run the motor:

Sizes 3:

12.11 Output frequency / speed range

In all operating modes (Open loop, RFC-A, RFC-S) the maximum output frequency is limited to 550 Hz.

12.12 Accuracy and resolution

Speed:

The absolute frequency and speed accuracy depends on the accuracy of the crystal used with the drive microprocessor. The accuracy of the crystal is 100 ppm, and so the absolute frequency/speed accuracy is 100 ppm (0.01 %) of the reference, when a preset speed is used. If an analog input is used the absolute accuracy is further limited by the absolute accuracy of the analog input.

The following data applies to the drive only; it does not include the performance of the source of the control signals.

Open loop resolution:
- Preset frequency reference: 0.1 Hz
- Precision frequency reference: 0.001 Hz

Closed loop resolution
- Preset speed reference: 0.1 rpm
- Precision speed reference: 0.001 rpm
- Analog input 1: 11 bit plus sign
- Analog input 2: 11 bit plus sign

Current:

The resolution of the current feedback is 10 bit plus sign.

Accuracy: typical 2 %
worst case 5 %

12.13 Acoustic noise

The heatsink fan generates the majority of the sound pressure level at 1 m produced by the drive. The heatsink fan on size 3 is a variable speed fan. The drive controls the speed at which the fan runs based on the temperature of the heatsink and the drive's thermal model system.

Table 12-3 gives the sound pressure level at 1 m produced by the drive for the heatsink fan running at the maximum and minimum speeds.

Table 12-3 Acoustic noise data

Size	Max speed dBA	Min speed dBA
3	35	30
4	40	35
5		
6	48	40
7		

12.14 Overall dimensions

- H Height including surface mounting brackets
- W Width
- D Projection forward of panel when surface mounted
- F Projection forward of panel when through-panel mounted
- R Projection rear of panel when through-panel mounted

Table 12-4 Overall drive dimensions

Size	Dimension				
	H	W	D	F	R
3	382 mm (15.04 in)	83 mm (3.27 in)	200 mm (7.87 in)	134 mm (5.28 in)	67 mm (2.64 in)
4	391 mm (15.39 in)	124 mm (4.88 in)			66 mm (2.59 in)
5	391 mm (15.39 in)	143 mm (5.63 in)	202 mm (7.95 in)	135 mm (5.32 in)	67 mm (2.64 in)
6	391 mm (15.39 in)	210 mm (8.27 in)	227 mm (8.94 in)	131 mm (5.16 in)	96 mm (3.78 in)
7	557 mm (21.93 in)	270 mm (10.63 in)	279 mm (10.98 in)	187 mm (7.36 in)	92 mm (3.62 in)

12.15 Weights

Table 12-5 Overall drive weights

Size	Model	kg	lb
3	034300078, 034300100	4.5	9.9
	All other variants	4.0	8.8
4	All variants	6.5	14.30
5	All variants	7.4	16.30
6	All variants	14	30.90
7	All variants	28	61.70

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