



Installation and Commissioning Guide

E300 Advanced Elevator drive

Model sizes 3 to 7

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

Part Number: 0479-0005-01

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.

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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.

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<http://www.controltechniques.com/REACH>

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Issue Number: 1

Drive Firmware: **03.10.00.00** onwards

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

How to use this guide

This Installation and Commissioning 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 6 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 Installation and Commissioning guide helps to find the right sections for the task you wish to complete, but for specific information, refer to the table of contents.

	Familiarization	Quick start	Commissioning	Optimization	Troubleshooting
1 Safety information	●	●			●
2 Product information	●				
3 Mechanical installation					
4 Electrical installation			●		
5 Getting started	●	●	●		
6 User Menu A	●		●	●	
7 Commissioning	●		●		
8 Optimization				●	●
9 Diagnostics			●		●

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

1	Safety information	6	5	Getting started	88
1.1	Warnings, Cautions and Notes	6	5.1	Keypad set-up menu	88
1.2	Electrical safety - general warning	6	5.2	Keypad display	89
1.3	System design and safety of personnel	6	5.3	Display messages	90
1.4	Environmental limits	6	5.4	Security and parameter access	91
1.5	Access	6	5.5	Changing security and parameter access	91
1.6	Fire protection	6	5.6	Keypad menu and parameter navigation	92
1.7	Compliance with regulations	6	5.7	Keypad menu and parameter shortcuts	92
1.8	Motor	7	5.8	Saving parameters	93
1.9	Mechanical brake control	7	5.9	Restoring parameter defaults	93
1.10	Adjusting parameters	7	5.10	Displaying destination parameters only	93
1.11	Electrical installation	7	5.11	Displaying non default parameters	93
2	Product information	8	5.12	Menus and parameters	95
2.1	E300 Advanced Elevator drive	8	5.13	Powering up the drive	96
2.2	Model number	9	5.14	Programming the drive	96
2.3	Nameplate description	9	5.15	Keypad operation	96
2.4	Ratings	10	5.16	NV Media Card operation	96
2.5	Operating modes	11	5.17	NV Media Card transferring data	98
2.6	Compatible position feedback devices	12	5.18	Elevator Connect PC tool	100
2.7	Drive features	13	5.19	Changing the operating mode	100
2.8	Options	14	5.20	Communications	101
2.9	Items supplied with the drive	16	6	User Menu A	103
2.10	EMC filters	17	6.1	Basic parameter descriptions Creep to floor operation	103
2.11	AC input line reactors	18	6.2	Parameter descriptions	110
3	Mechanical installation	19	6.3	Full parameter descriptions	111
3.1	Safety information	19	7	Commissioning	132
3.2	Installation	19	7.1	Operating mode	132
3.3	Terminal cover removal	20	7.2	Motor and Encoder data	132
3.4	Installing / removing option modules, keypad	22	7.3	Autotune	133
3.5	Dimensions and mounting methods	25	7.4	Elevator mechanical data	139
3.6	Electrical terminals	30	7.5	Creep to floor profile	140
3.7	EMC filters	31	7.6	Direct to floor profile	141
3.8	Routine maintenance	38	7.7	Creep to floor / Direct to floor - Start	143
4	Electrical installation	40	7.8	Travel	147
4.1	AC supply requirements	41	7.9	Stop	148
4.2	Fuse types	41	7.10	Additional control functions	150
4.3	Power connections	42	7.11	Motor contactor control	150
4.4	Communications connections	48	7.12	Load cell compensation	151
4.5	Control connections	49	7.13	Fast stop	152
4.6	Position feedback interface	55	7.14	Rapid stop during acceleration	153
4.7	Shield, Ground connections	60	7.15	Load measurement	154
4.8	Minimum connections	62	7.16	Inertia compensation	154
4.9	24 Vdc supply	66	7.17	Simulated encoder output	155
4.10	Low voltage operation	67	7.18	Advanced door opening	155
4.11	Supplies requiring Input line reactors	72	7.19	Emergency backup power supply control	156
4.12	Cable selection	73	7.20	Peak curve operation	157
4.13	Output circuit and motor protection	75	7.21	Floor sensor correction	159
4.14	Braking	76	7.22	Short floor landing	162
4.15	Ground leakage	78	7.23	Fast start	162
4.16	EMC (Electromagnetic compatibility)	79	7.24	Backing up the drive parameter set	163
4.17	General requirements for EMC	80	7.25	NV Media Card	163
4.18	Safe Torque Off (STO)	86	7.26	Elevator Connect PC tool	165

8	Optimization	166
8.1	Optimization	166
8.2	Control loop gain adjustment	166
8.3	Motor acoustic noise	167
8.4	Creep to floor - Start optimization	168
8.5	Creep to floor - Travel optimization	168
8.6	Creep to floor - Stop optimization	169
8.7	Brake control optimization	170
9	Diagnostics	171
9.1	Keypad	171
9.2	Status LED	171
9.3	Communications protocols	171
9.4	Trip indications	172
9.5	Identifying a trip, trip source	172
9.6	Displaying trip history	173
9.7	Behavior of drive when tripped	174
9.8	Trip reset	174
9.9	Status, Alarm, Trip indications	177
9.10	Programming error indications	178
9.11	Trip indications	178
9.12	Internal hardware trips	178
9.13	Trips and sub-trip numbers	179
9.14	Travel interrupt code	179
9.15	Control state	180
9.16	Troubleshooting and identifying faults	185
9.17	Trip codes	189
	Index	209

1 Safety information

1.1 Warnings, Cautions and Notes



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



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 Installation and Commissioning 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 Installation and Commissioning 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 Installation and Commissioning 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 the *E200 Design Guide*.

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.

The *E200 Design 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.

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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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.

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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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 Standard Elevator* drive is RFC-S mode with this targeted at gearless Elevator applications using PM synchronous motors.

Full support is provided for 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 Standard 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 Standard 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 Standard 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 Standard Elevator* drive during operation and optimization. The Elevator Connect PC tool is free of charge and can be downloaded from www.controltechniques.com.

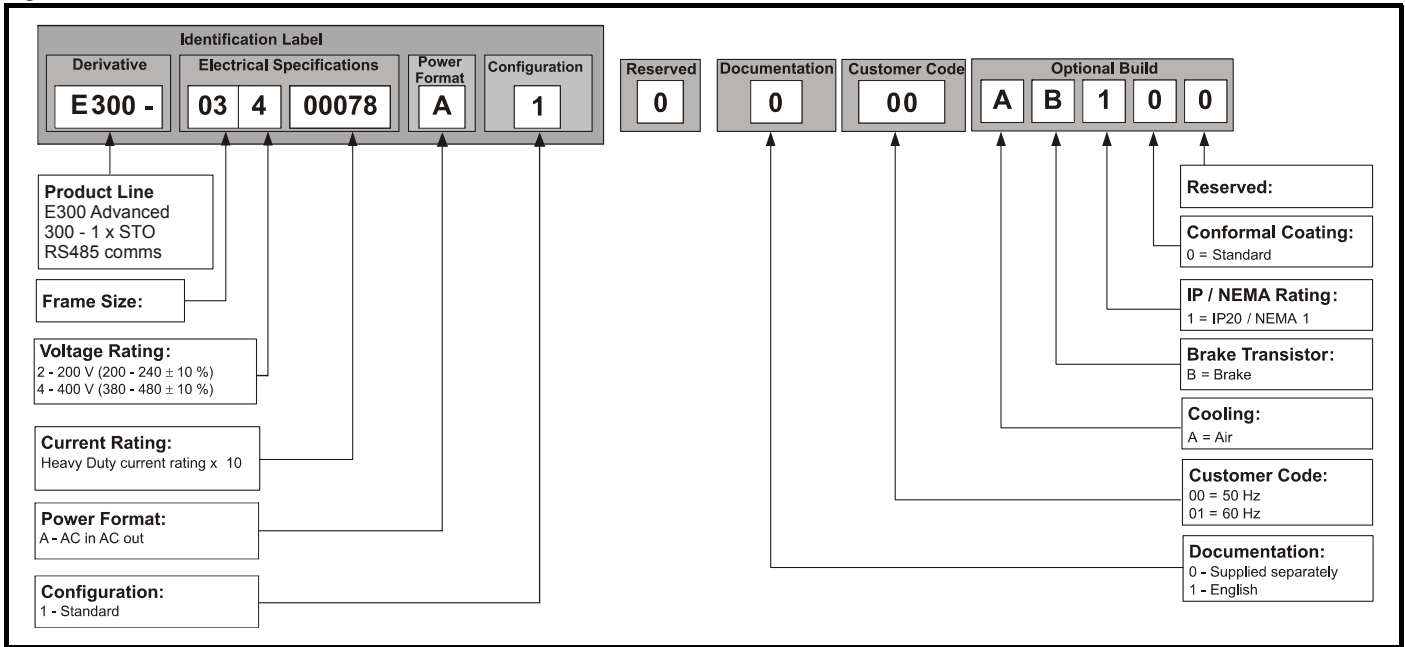
Communications

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

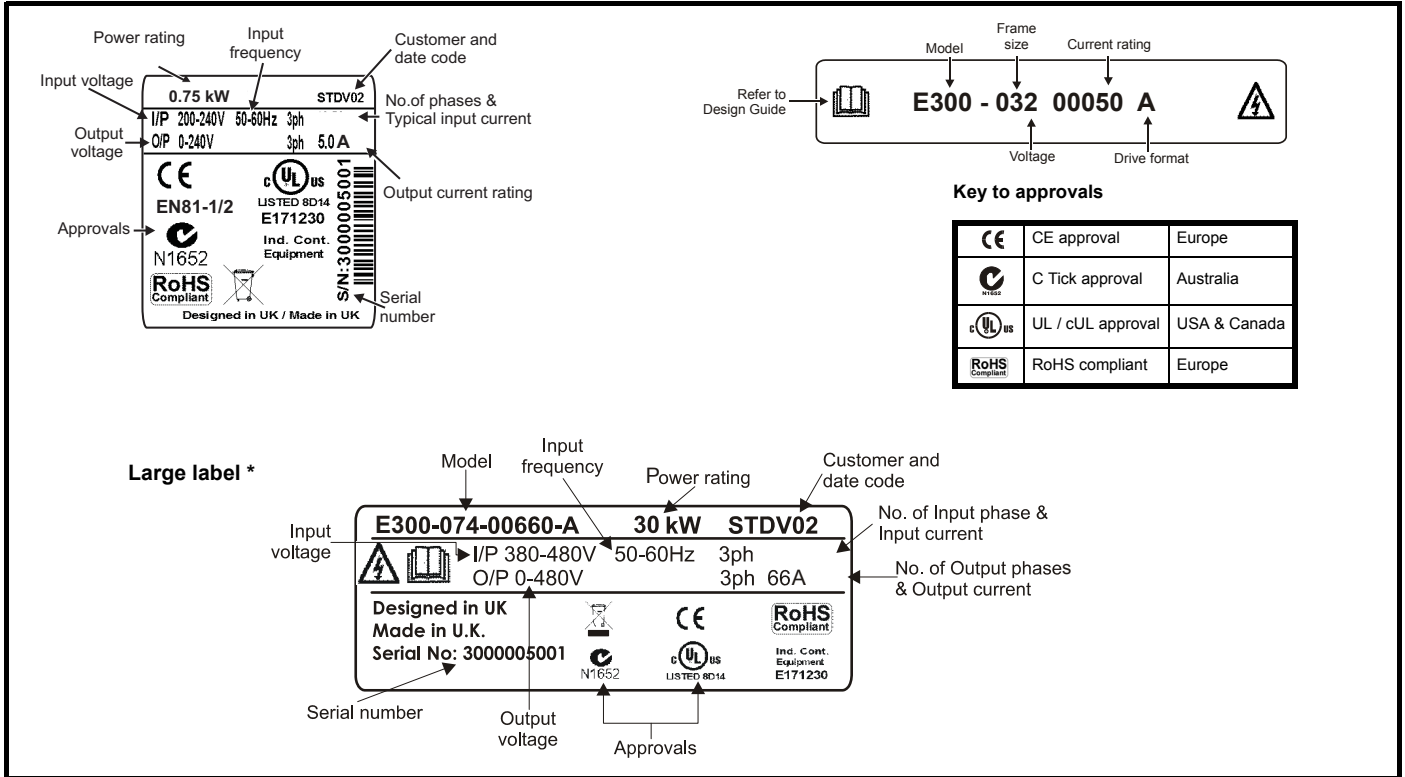
The way in which the model numbers for the *E300 Advanced Elevator* drive range is formed is illustrated below:

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 Solutions 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.

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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2.4 Ratings

The *E300 Standard 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
- Typical elevator profile (50% ED)
- IGBT lifetime optimization enabled (reduction of switching frequency based on the drive inverter temperature).

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.



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			
	3 ph	Max. cont. output current	Nom power @ 230 V	Motor power @ 230 V	IEC		UL	
					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			
	3ph	Max. cont. output current	Nom power @ 400 V	Motor power @ 460 V	IEC		UL	
					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	

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

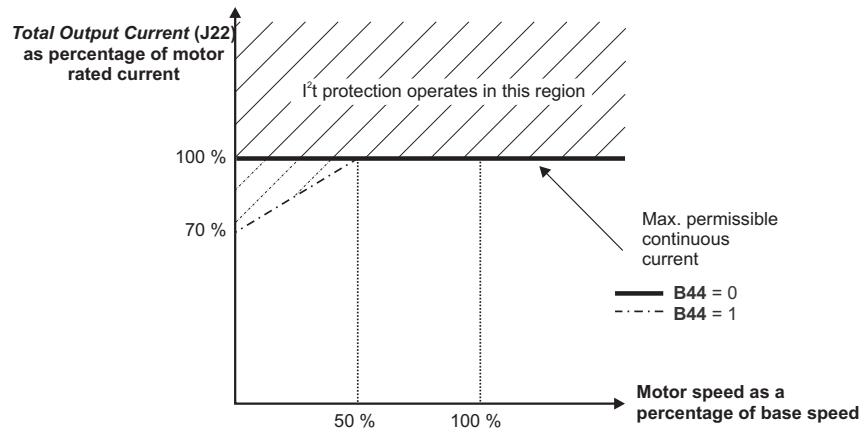
Heavy duty operating mode

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



2.5 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 Flux Control for Asynchronous 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.

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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2.5.3 RFC- S

Rotor Flux Control for Synchronous 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 2-4 Supported feedback devices

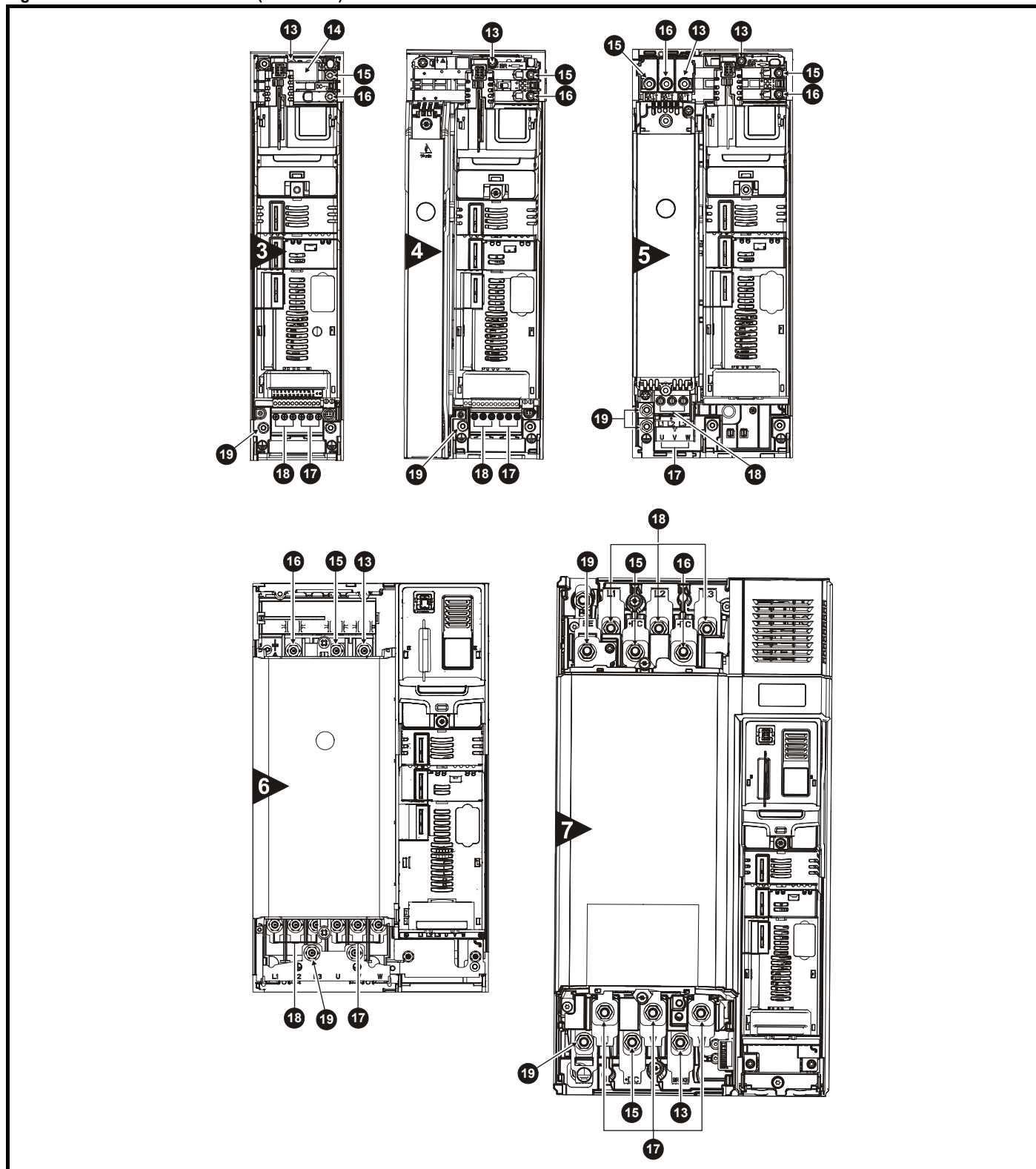
Encoder type	Drive encoder type (C01)
Quadrature incremental encoders with or without marker pulse	AB (0)
Quadrature incremental encoders with UVW commutation signals for absolute position for permanent magnet motors with or without marker pulse	AB Servo (3)
Forward / reverse incremental encoders with 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)

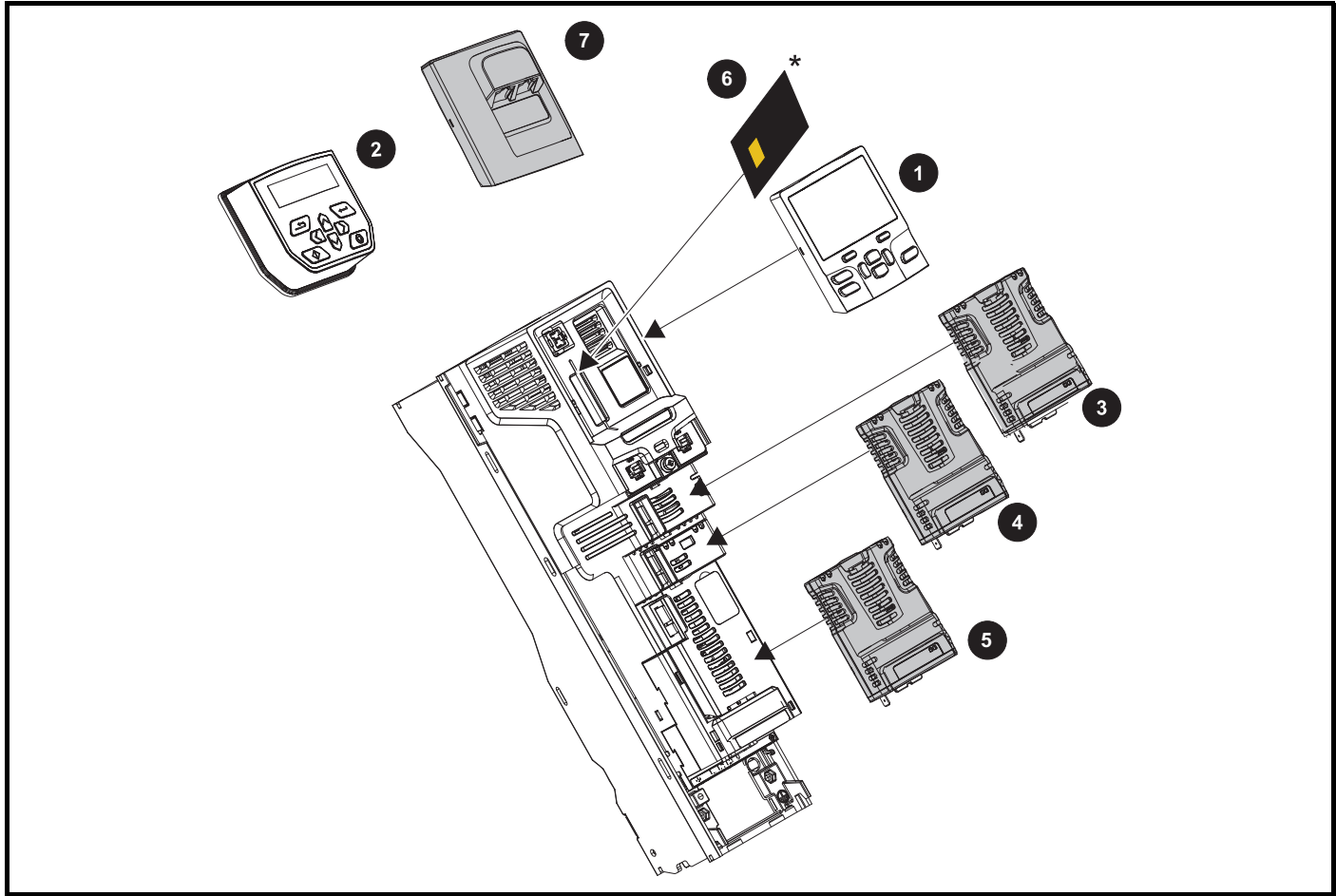


Key

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

2.8 Options

Figure 2-4 Drive features and options



Key

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

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.

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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Table 2-5 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
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 2-6 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)

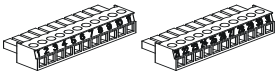
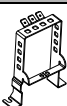
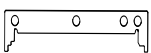
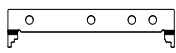
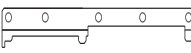
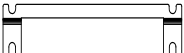
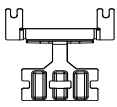
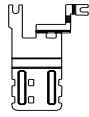
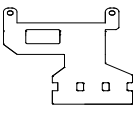
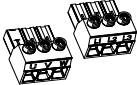
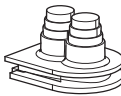
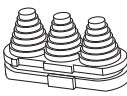
Table 2-7 Additional options

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 2-8 below.

Table 2-8 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

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.



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



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 2-9 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 2-10 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

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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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 while 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.

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
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 72.

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



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.



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.



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 the *E200 Design Guide*.

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



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.

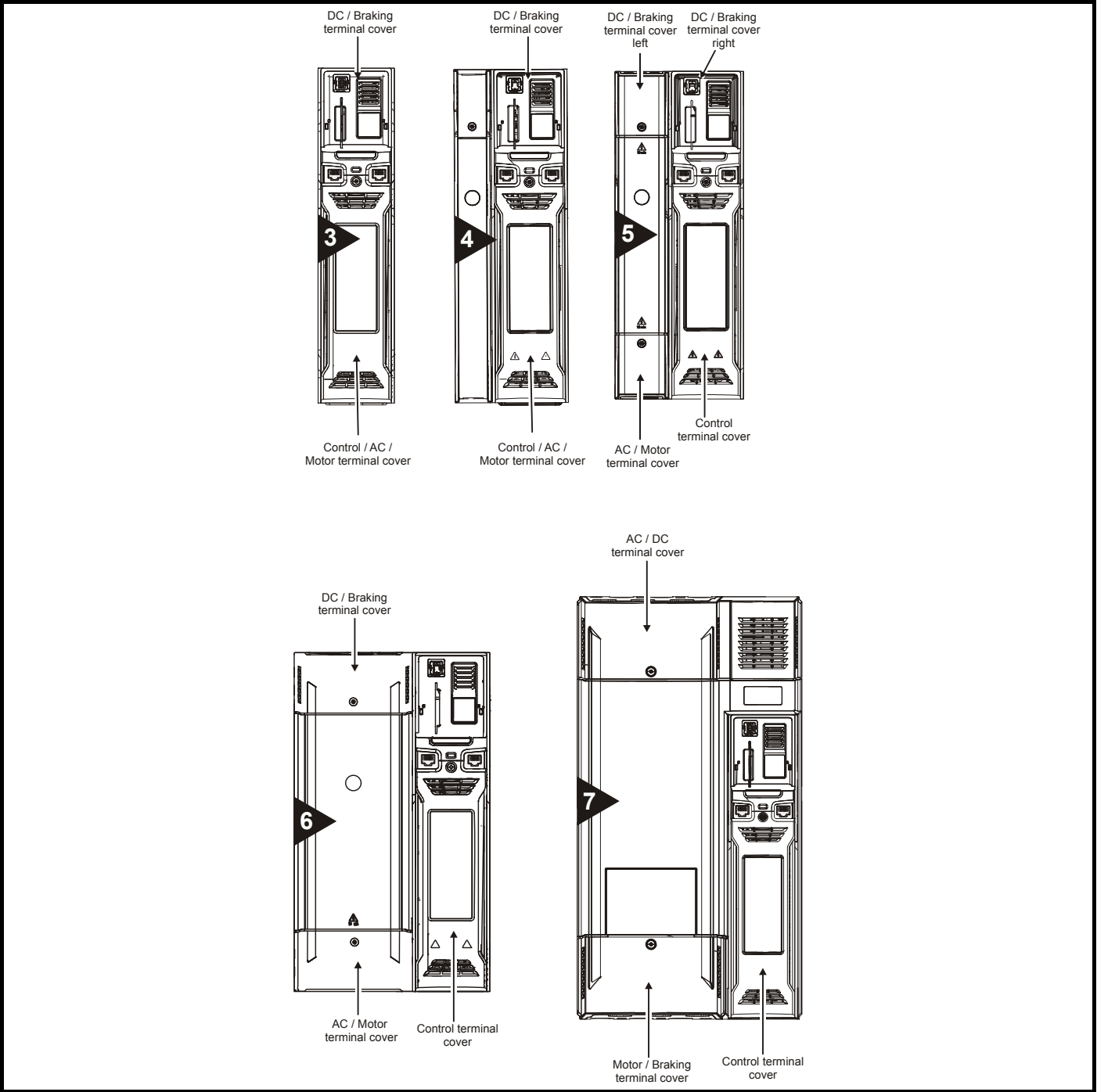


Stored charge

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.

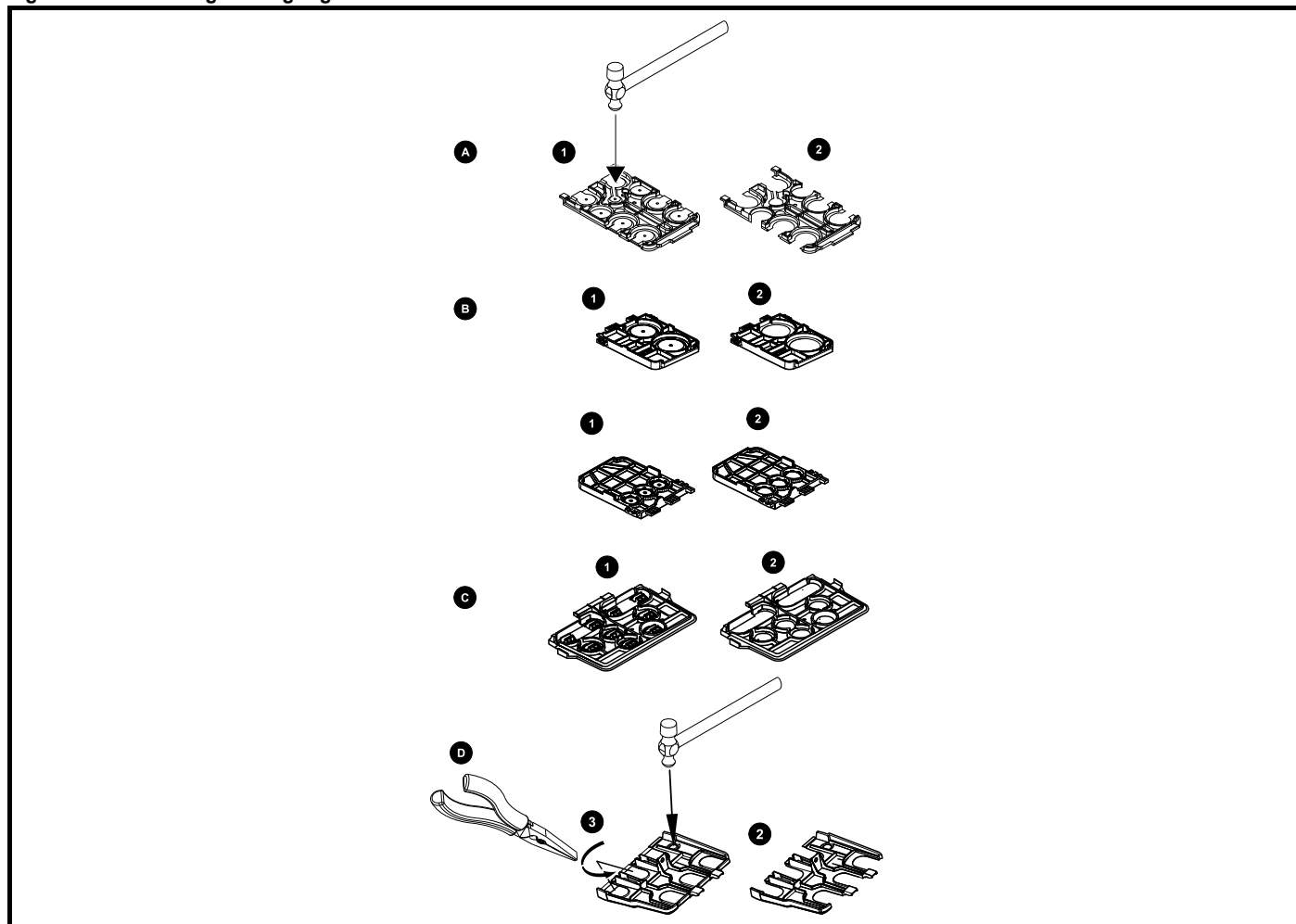
3.3.1 Removing the terminal covers

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

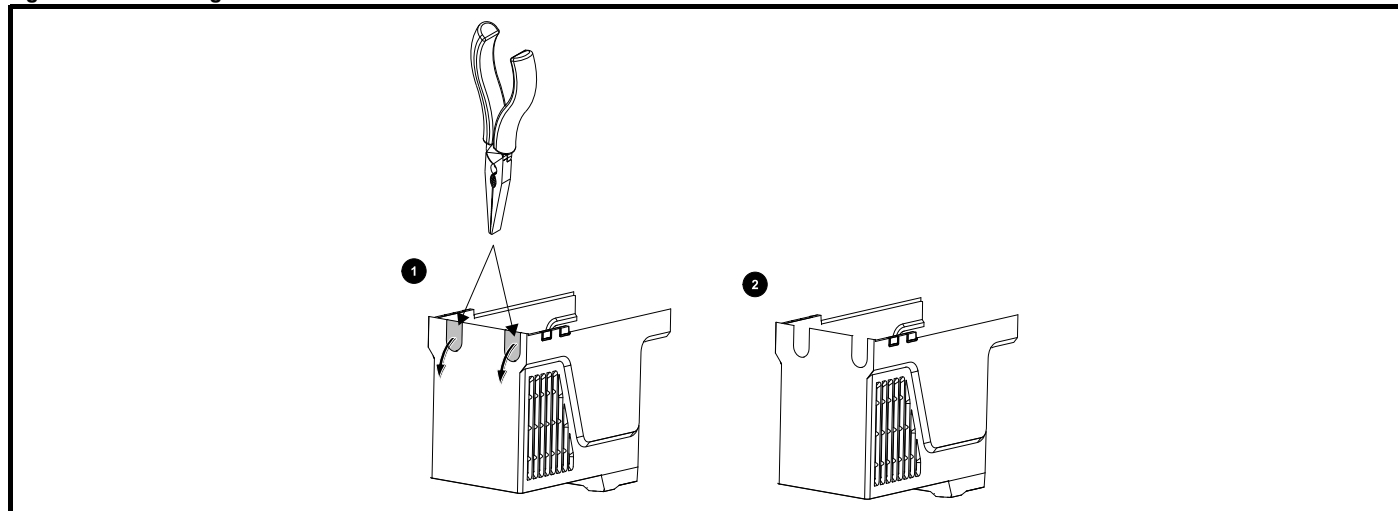
Figure 3-2 Removing the finger-guard break-outs



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.

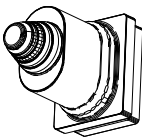
Figure 3-3 Removing the size 3 and 4 DC terminal cover break-outs



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	

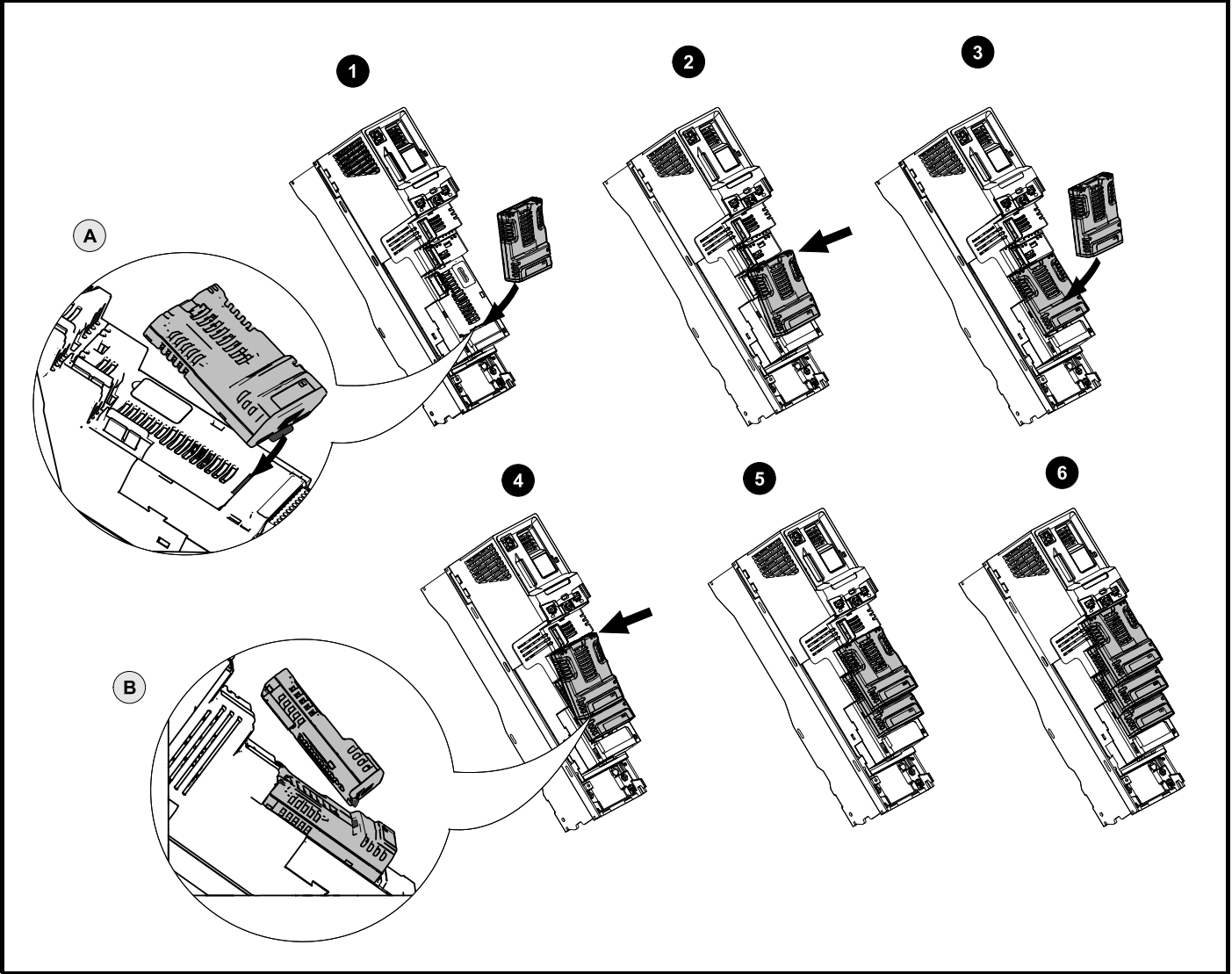
3.4 Installing / removing option modules, keypad



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

CAUTION

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

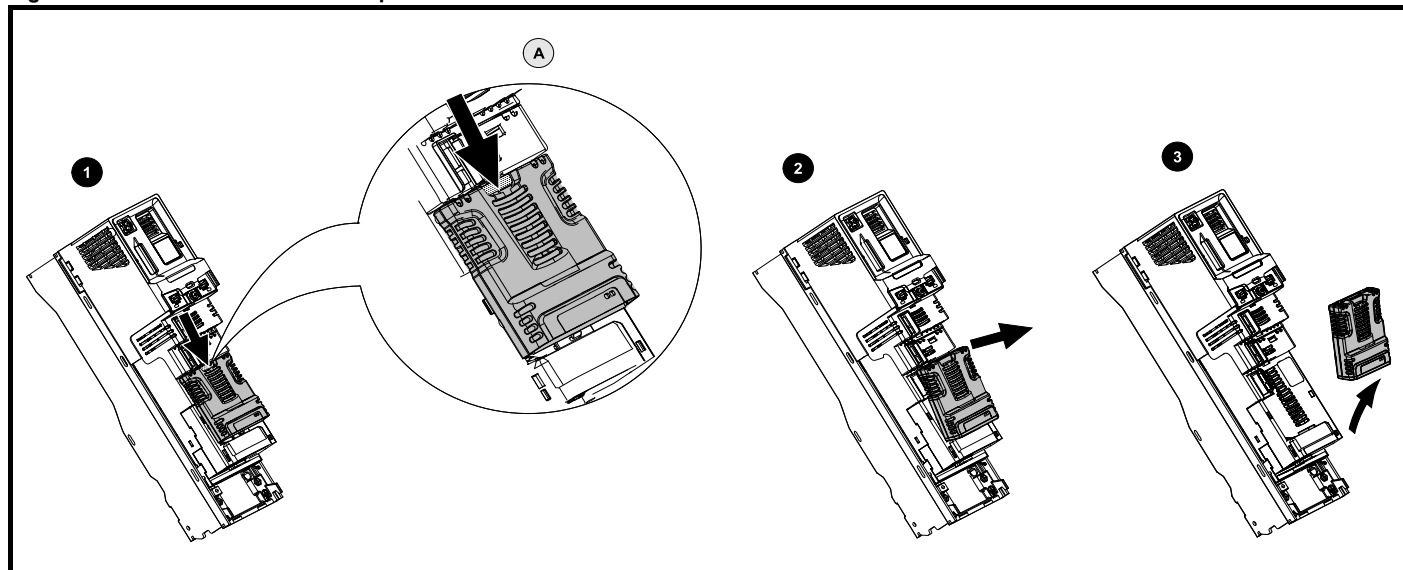
- Move the option module in direction shown (3).
- Align and insert the option module tab in to the slot provided on the already installed option module (4), this is highlighted in the detailed view (B).
- Press down on the option module until it clicks into place. Image (5) shows two option modules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

Installing the third option module

- Repeat the above process.

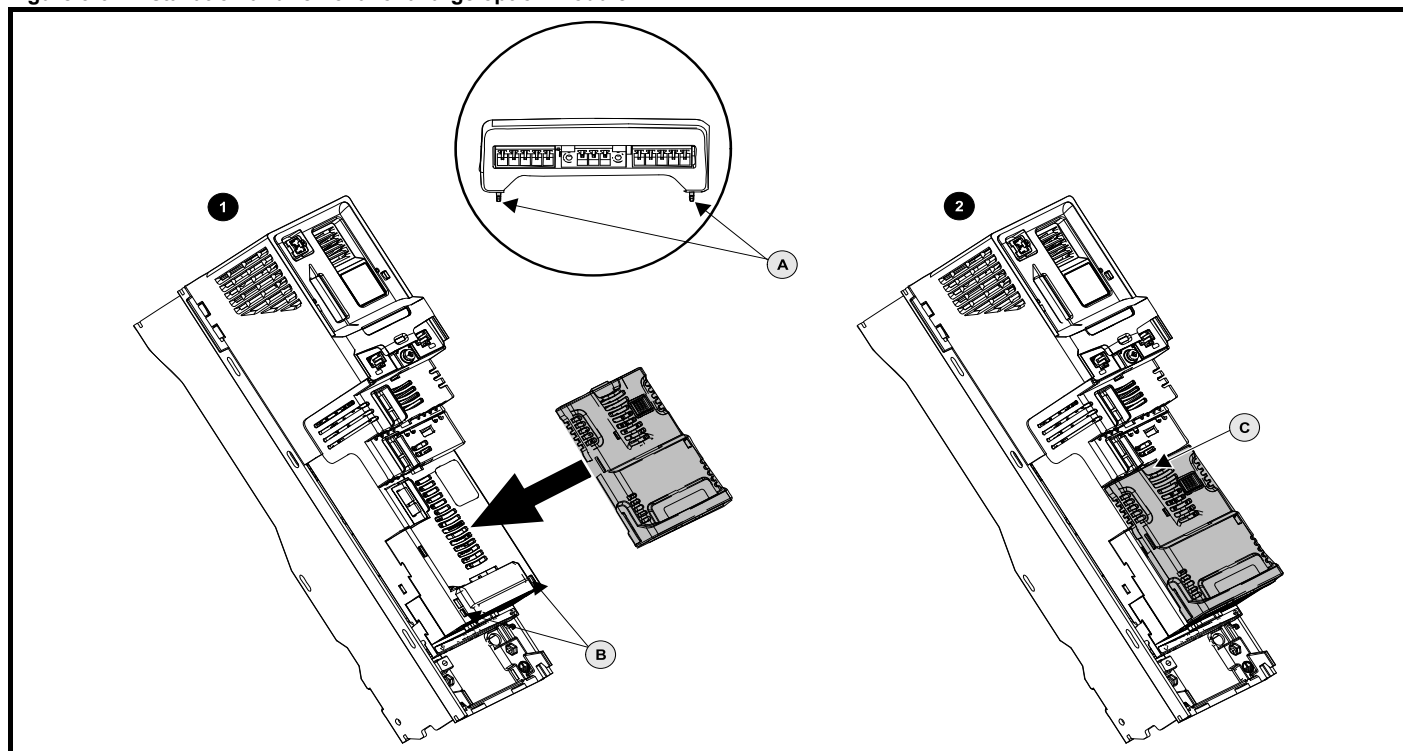
The drive has the facility for all three option module slots to be used at the same time, image (6) shows the three option modules installed.

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.

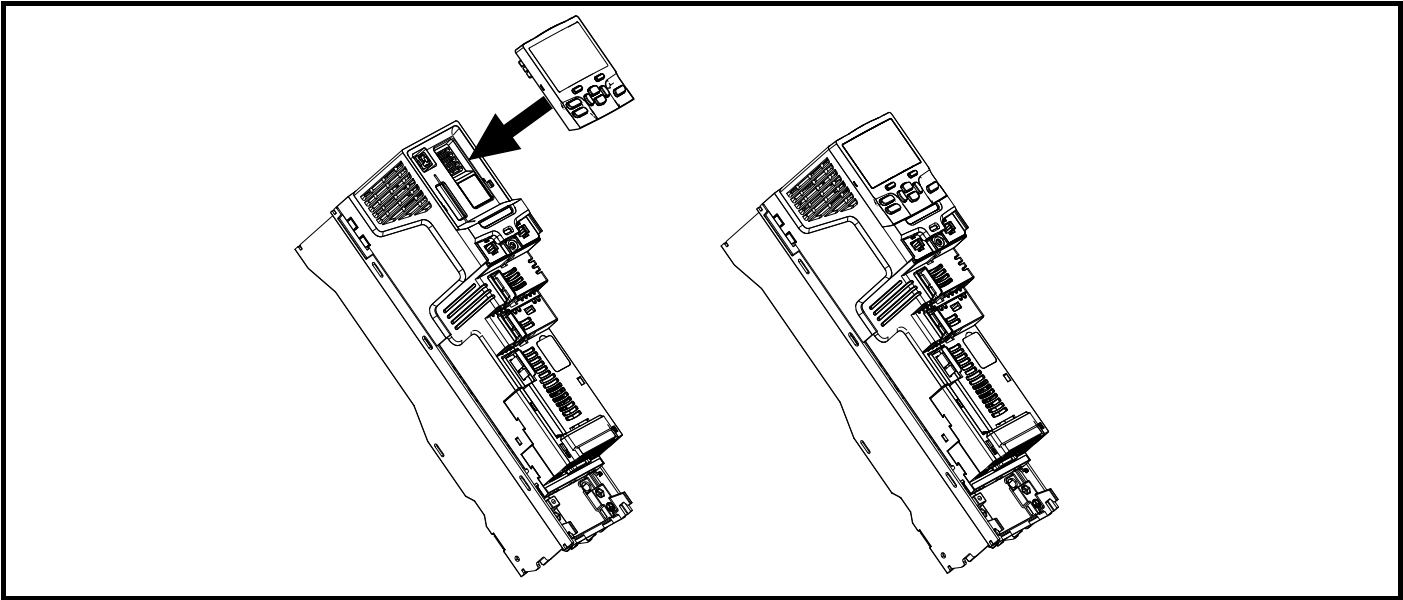
Removing a large option module

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

NOTE

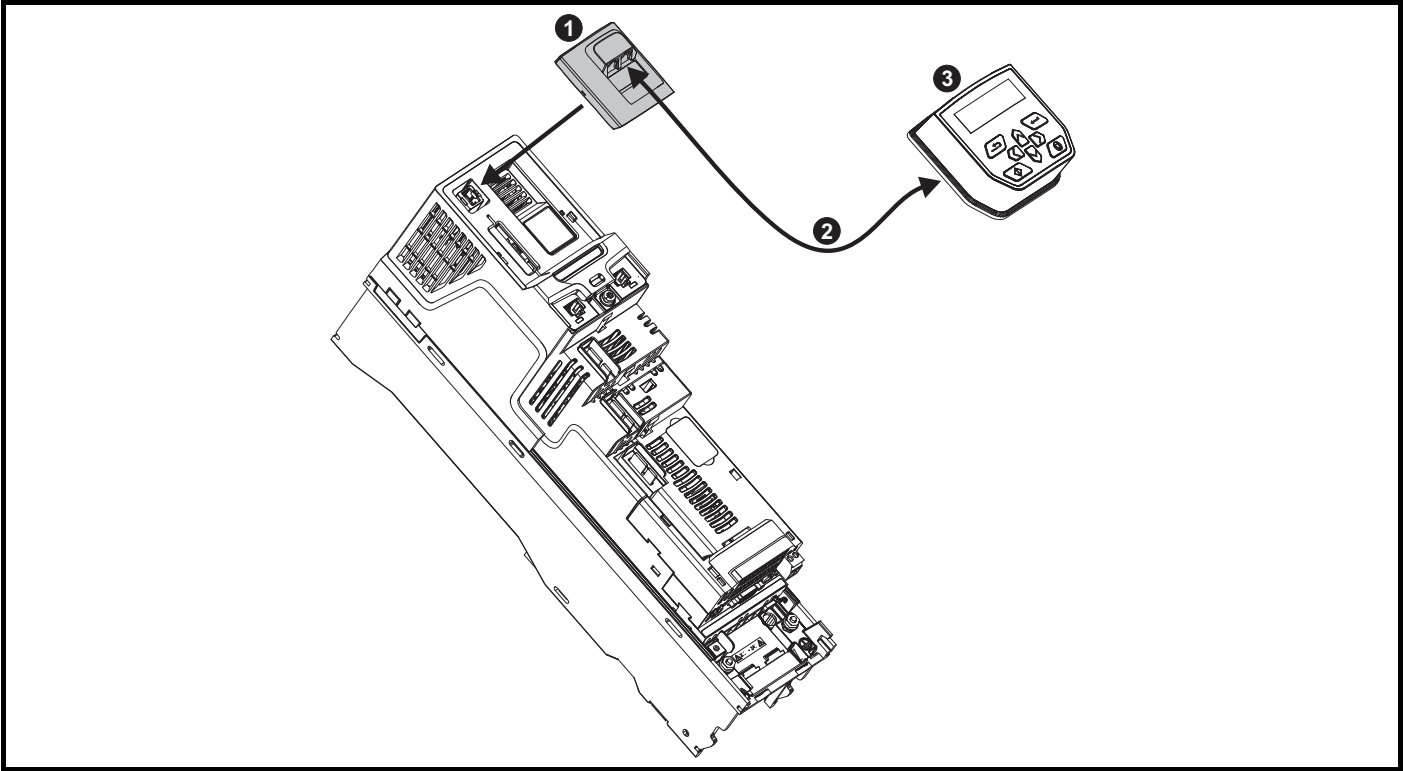
The large option module can only be inserted into slot 3. Additional standard option modules can still be installed and used in slot 2 and slot 1.

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.

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 in the table below.

Table 3-2 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



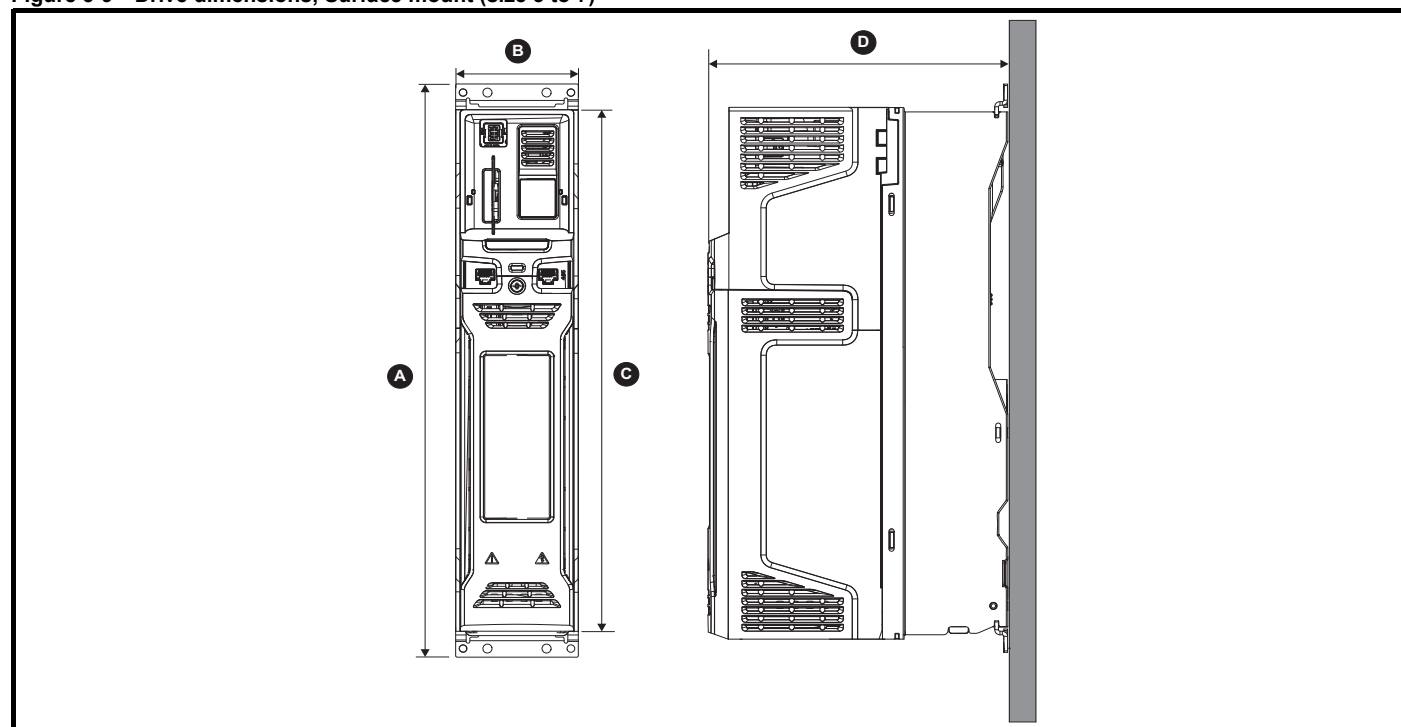
If the drive has been used at high load levels for a period of time, the heatsink can reach temperatures in excess of 70 °C (158 °F). Human contact with the heatsink should be prevented.



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 Drive dimensions, Surface mount (size 3 to 7)

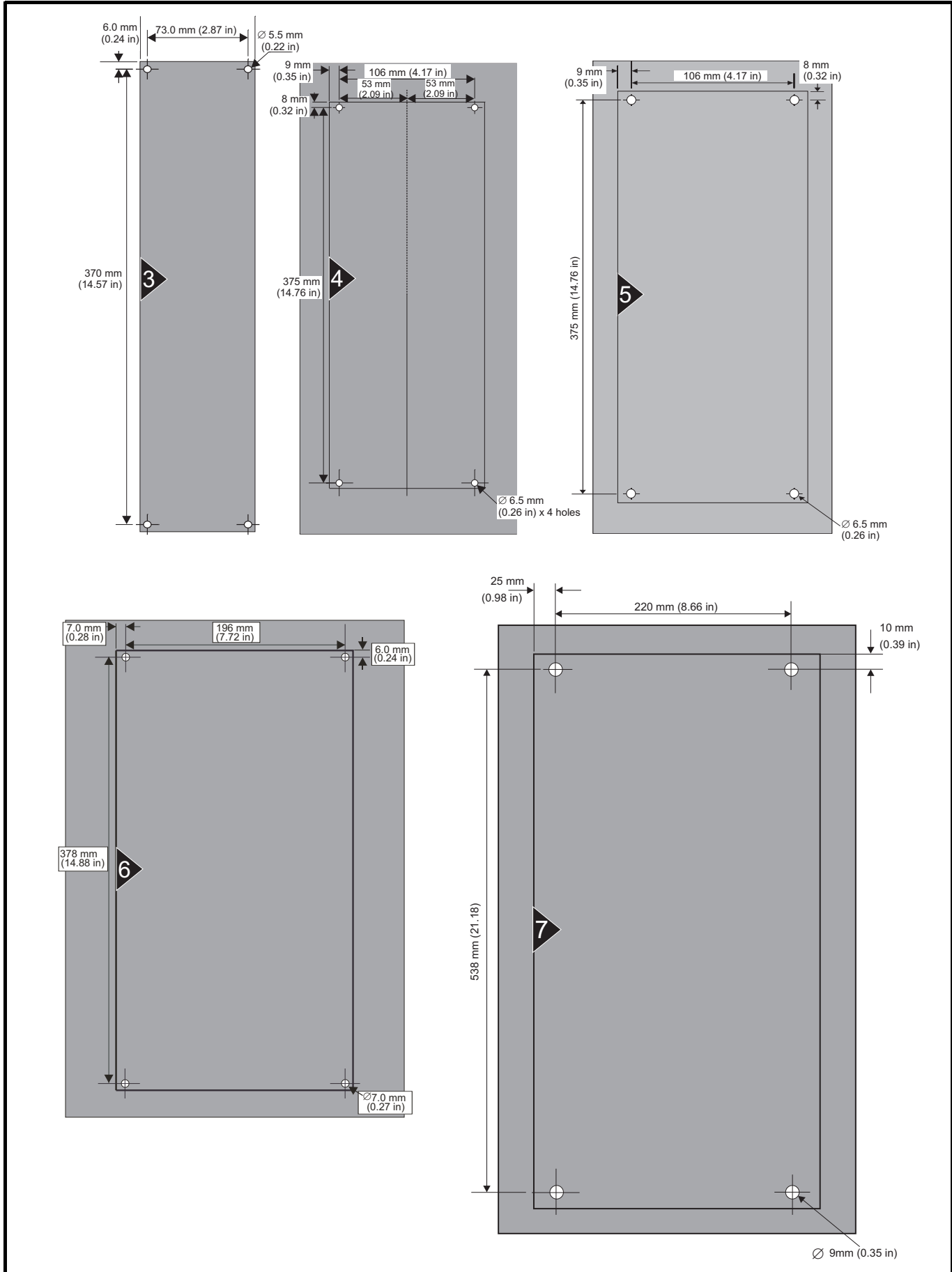


Size	A		B		C		D	
	mm	in	mm	in	mm	in	mm	in
3	382	15.04	365	14.37	83	3.27	200	7.87
4	391	15.39			124	4.88		
5					143	5.63	202	7.95
6					389	15.32	210	8.27
7	508	20.0	508	20	270	10.63	279	11

NOTE

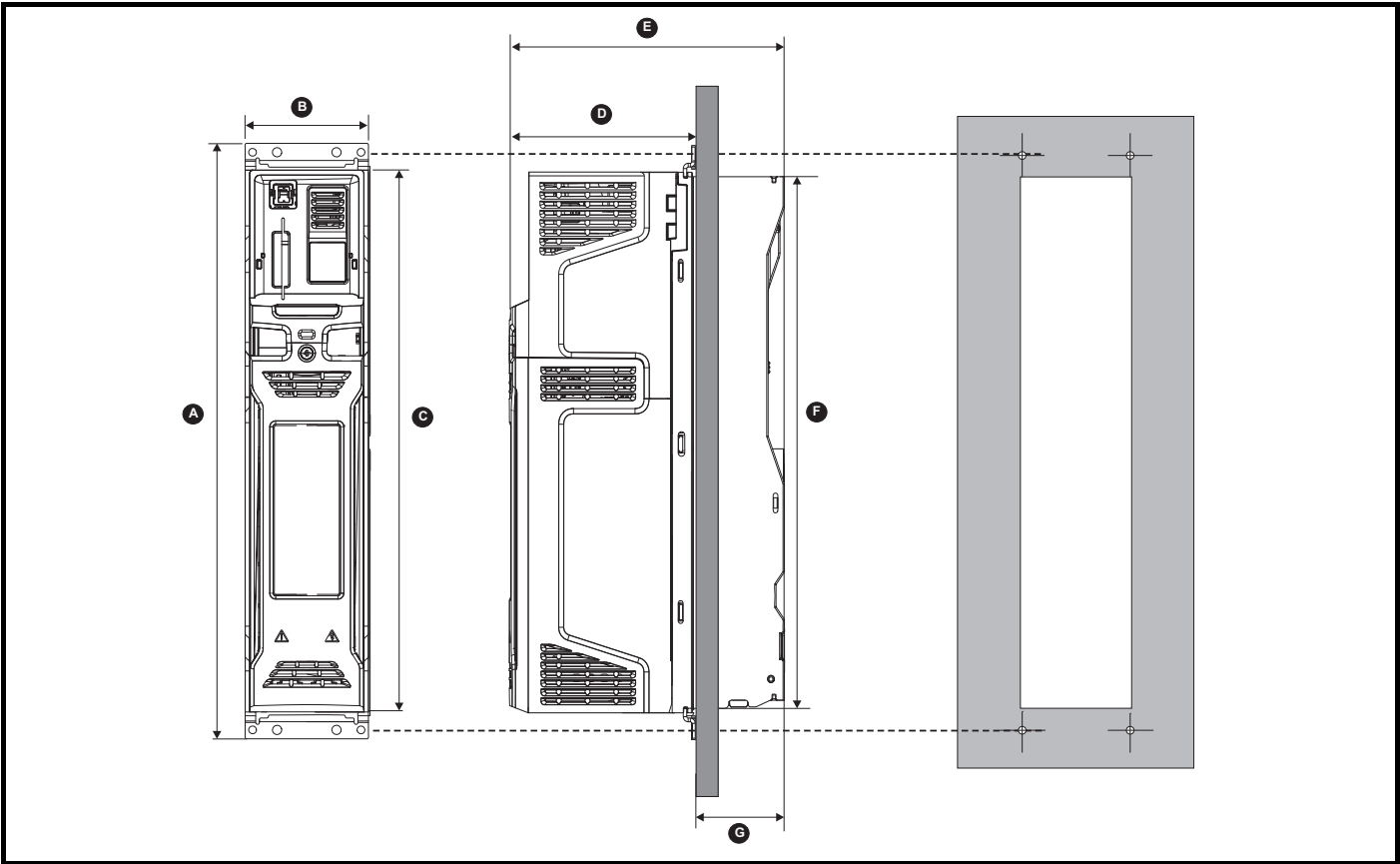
Each mounting bracket contains 4 mounting holes. The outer holes (5.5 mm) x 2 should be used for mounting the drive to the backplate, as this allows the heatsink fan to be replaced without removing the drive from the backplate. The inner holes (6.5 mm) x 2 are used for Unidrive SP size 1 retro fit applications.

Figure 3-10 Surface mounting dimensions (size 3 to 7)



3.5.2 Through panel mounting

Figure 3-11 Drive dimensions, Through panel mount (size 3 to 7)



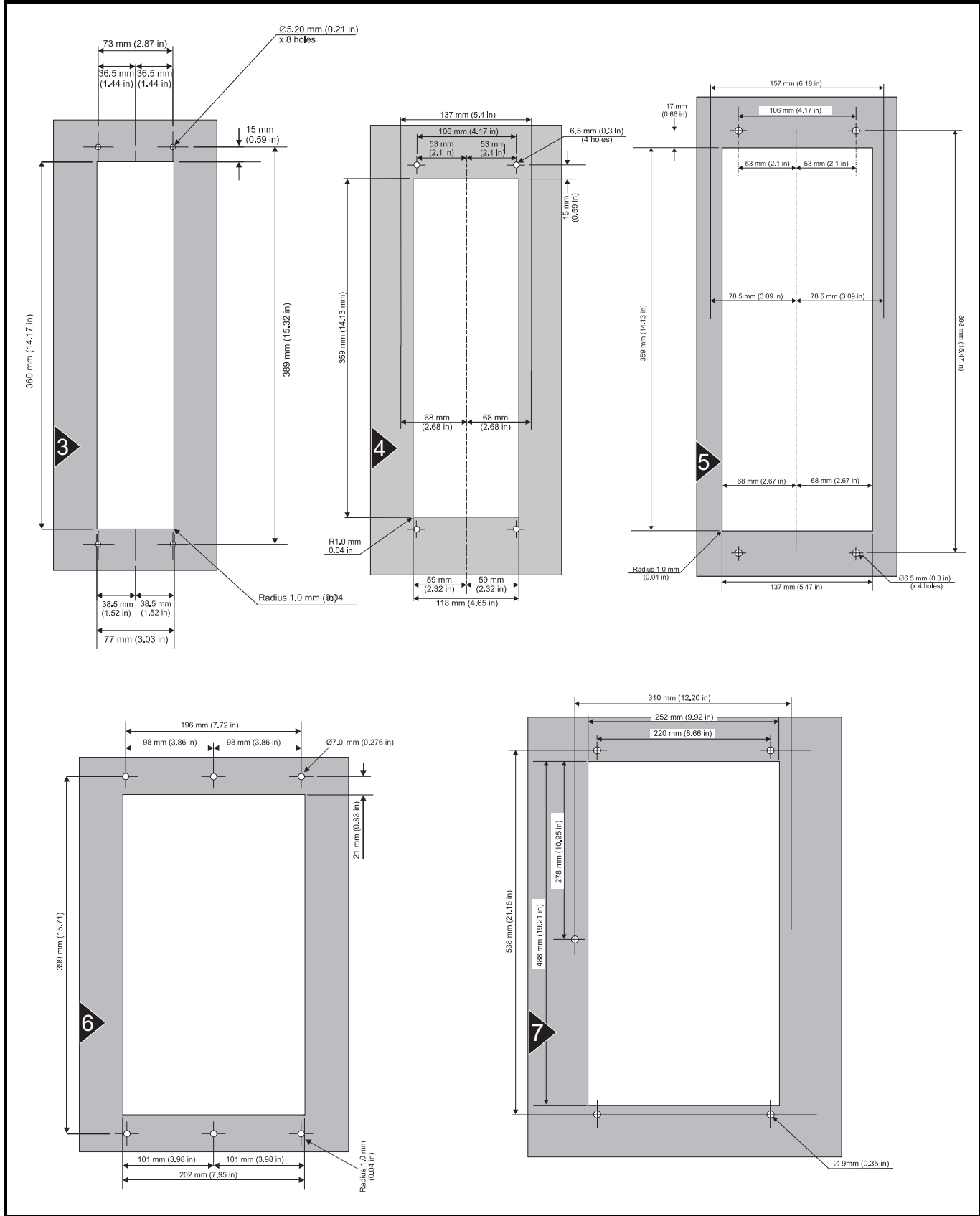
Size	A		B		C		D		E		F		G	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
3	400	15.75	83	3.27	365	14.37	134	5.28	201	7.92	359	14.13	67	2.64
4	401	15.79	124	4.88			135	5.32	202	7.96				
5	409	16.10	143	5.63			131	5.16	227	8.94				
6	412	16.22	210	8.27	508	20.0	188	7.40	280	11.02	488	19.21	96	3.78
7	559	22.0	270	10.63										

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. The inner holes (6.5 mm) x 2 are used for Unidrive SP size 1 retrofit applications.

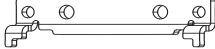
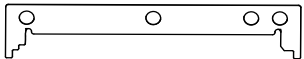
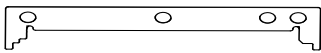
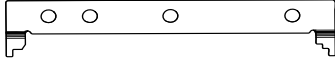
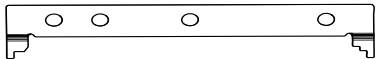
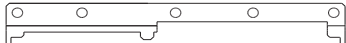
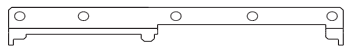
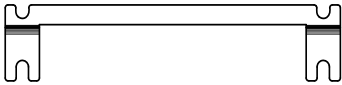
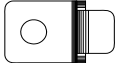
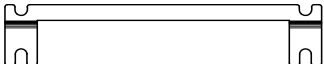
3.5.3 Through-panel mounting

Figure 3-12 Through-panel mounting dimensions (size 3 to 7)



3.5.4 Mounting brackets

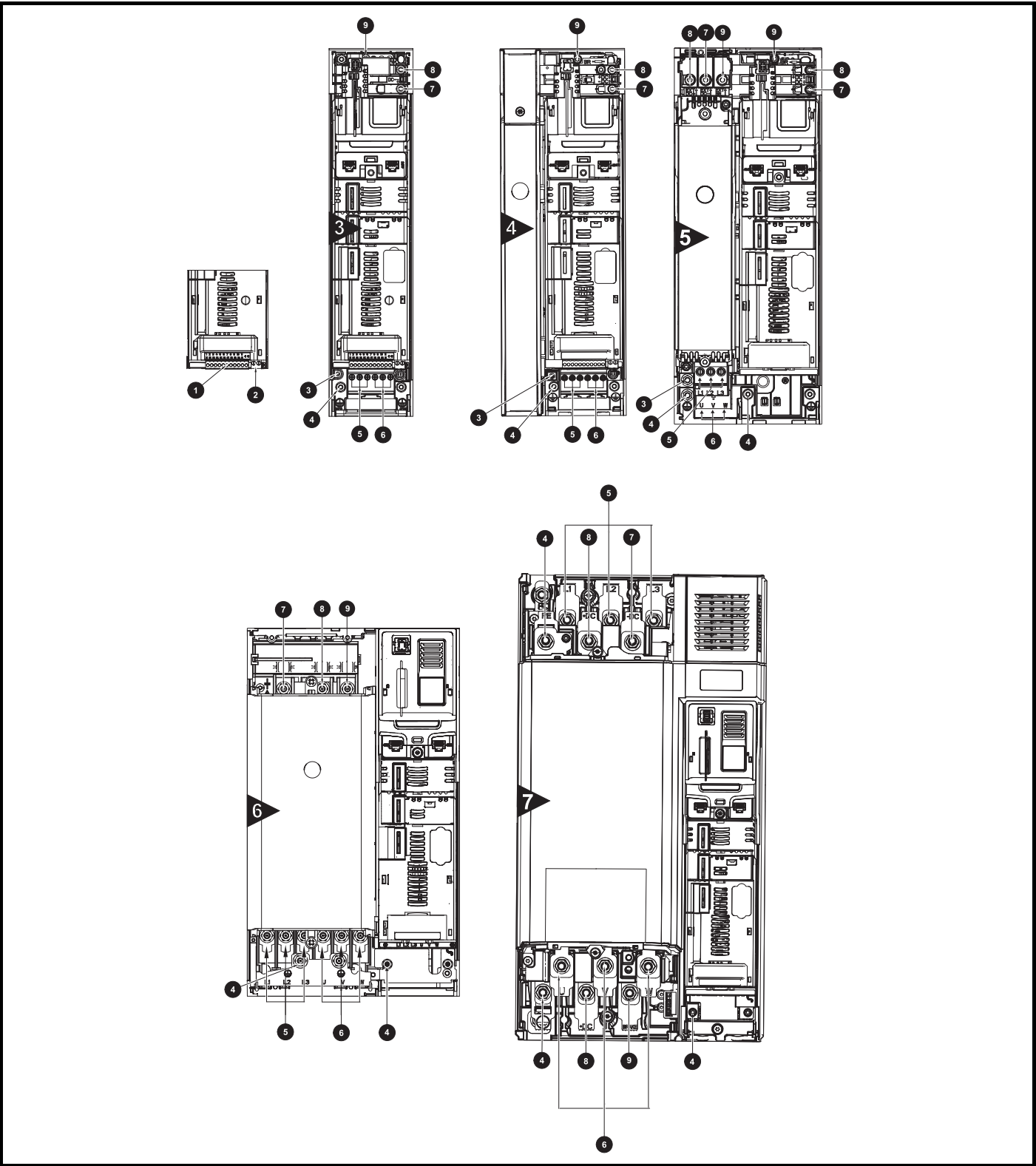
Table 3-3 Mounting brackets (size 3 to 7)

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 Electrical terminals

3.6.1 Location of the power and ground terminals

Figure 3-13 Location of the power and ground terminals (size 3 to 7)



3.6.2 Terminal sizes and torque settings



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.

WARNING

Table 3-4 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 3-5 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 3-6 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	1.5 mm ² (16 AWG)
7	24 V supply connector	

3.7 EMC filters



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.

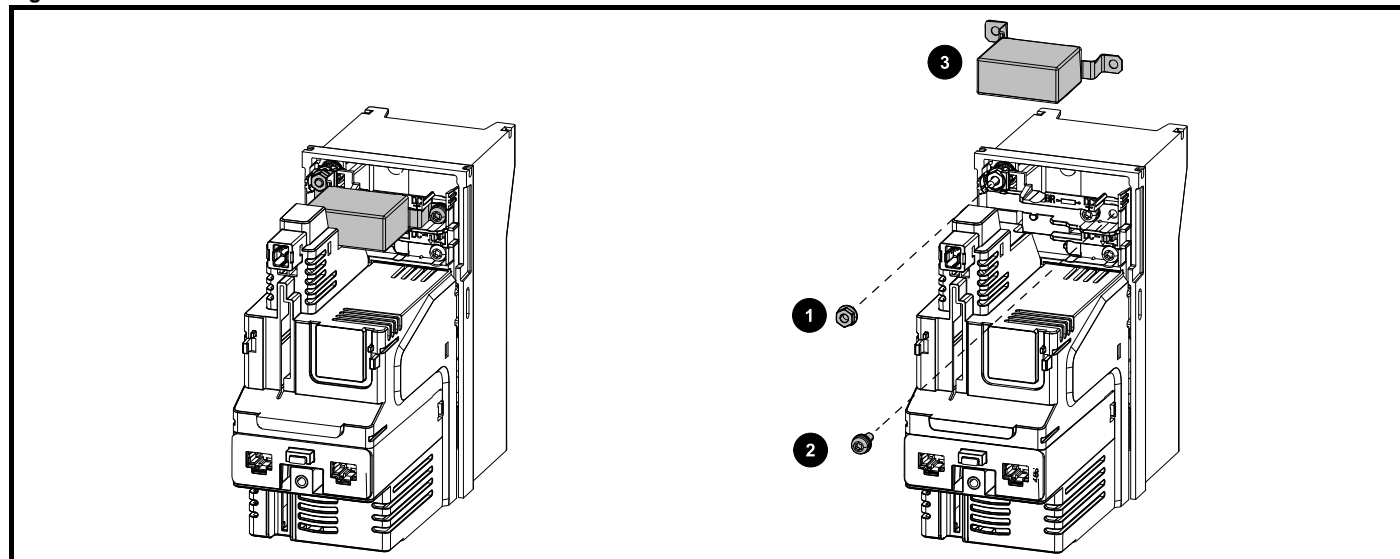
WARNING

3.7.1 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. For further information see the *E200 Design Guide*. 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.

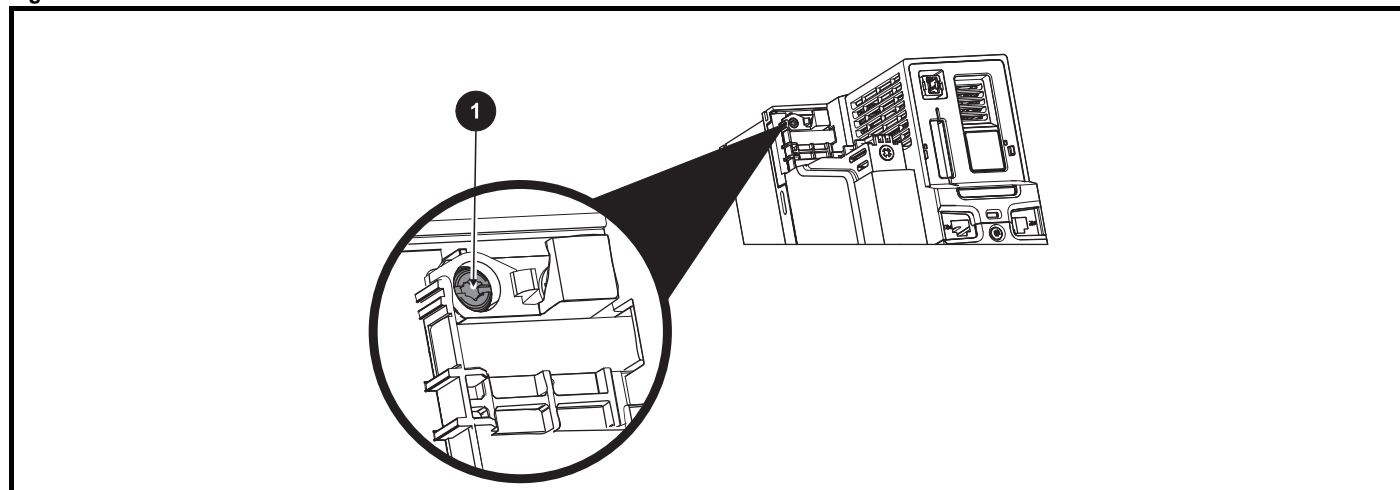
Figure 3-14 Removal of size 3 internal EMC filter



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

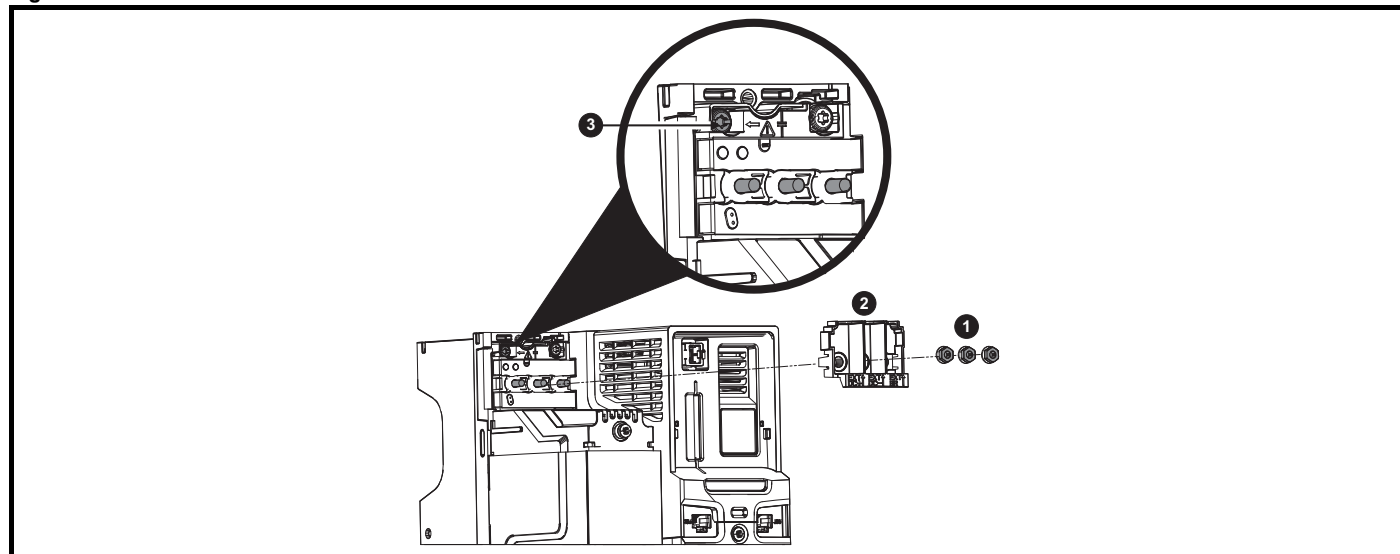
Lift away from securing points and then rotate away from the drive. Ensure the screw and nut are replaced and re-tightened with a maximum torque of 2 N m (1.47 lb ft).

Figure 3-15 Removal of size 4 internal EMC filter



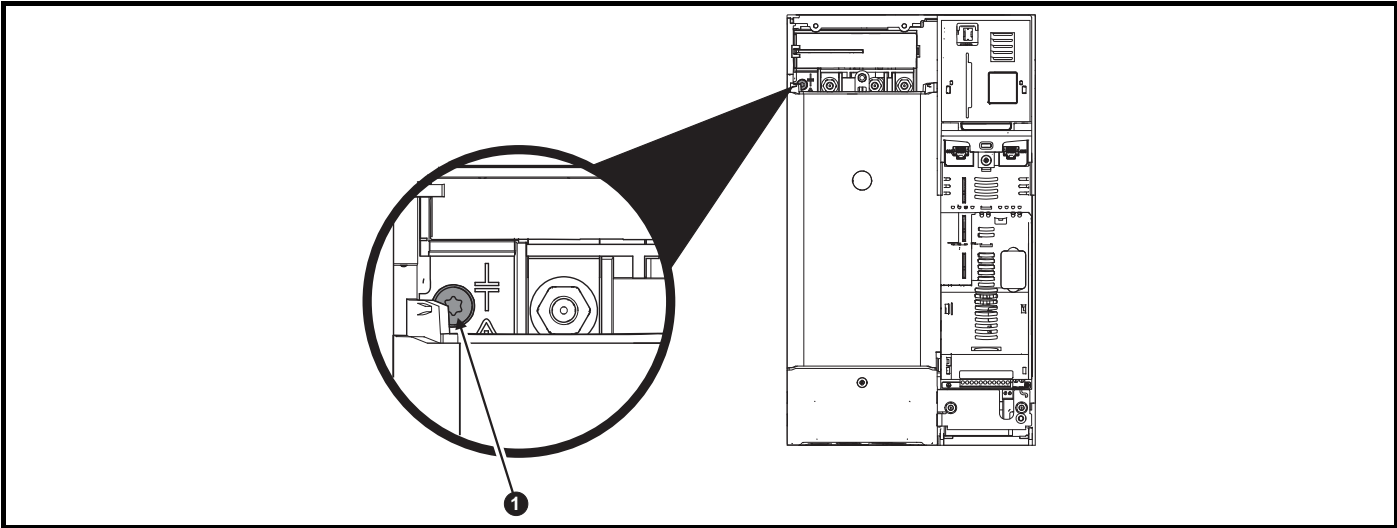
To electrically disconnect the Internal EMC filter, remove the screw (1) as highlighted above.

Figure 3-16 Removal of size 5 internal EMC filter



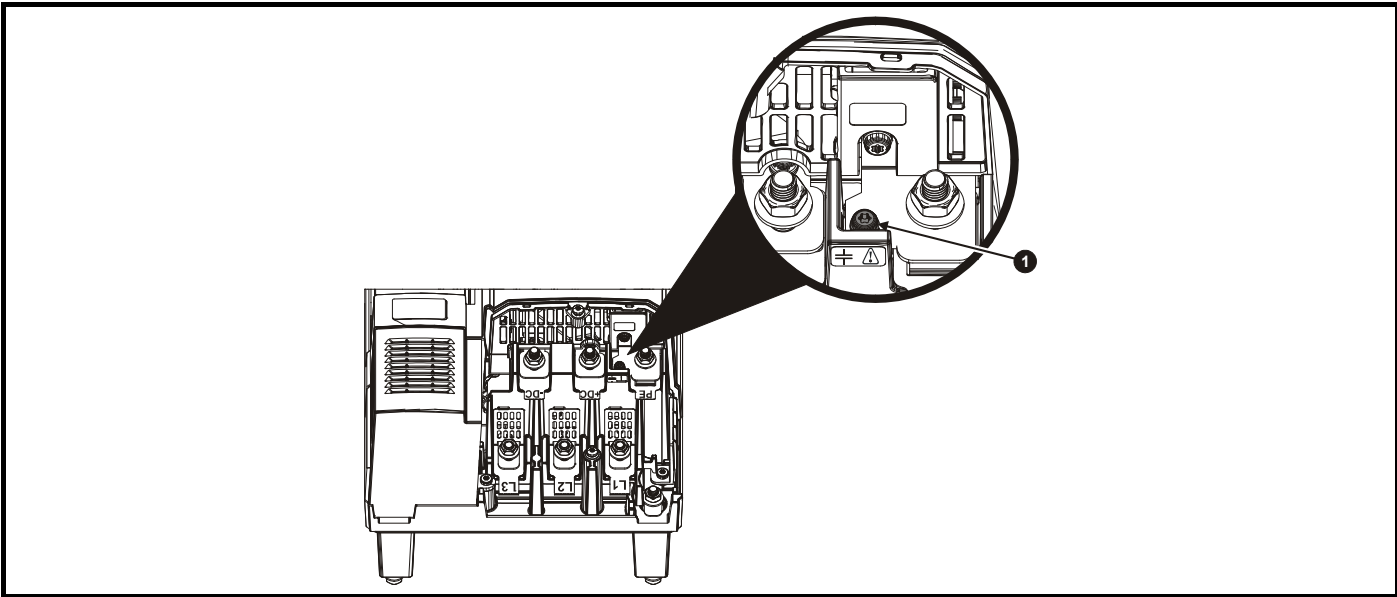
Remove the three M4 terminal nuts (1). Lift away the cover (2) to expose the M4 Torx internal EMC filter removal screw. Finally remove the M4 Torx internal EMC filter removal screw (3) to electrically disconnect the internal EMC filter.

Figure 3-17 Removal of size 6 internal EMC filter



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

Figure 3-18 Removal of the size 7 internal EMC filter



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

3.7.2 Standard external EMC filter details

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

Table 3-7 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.

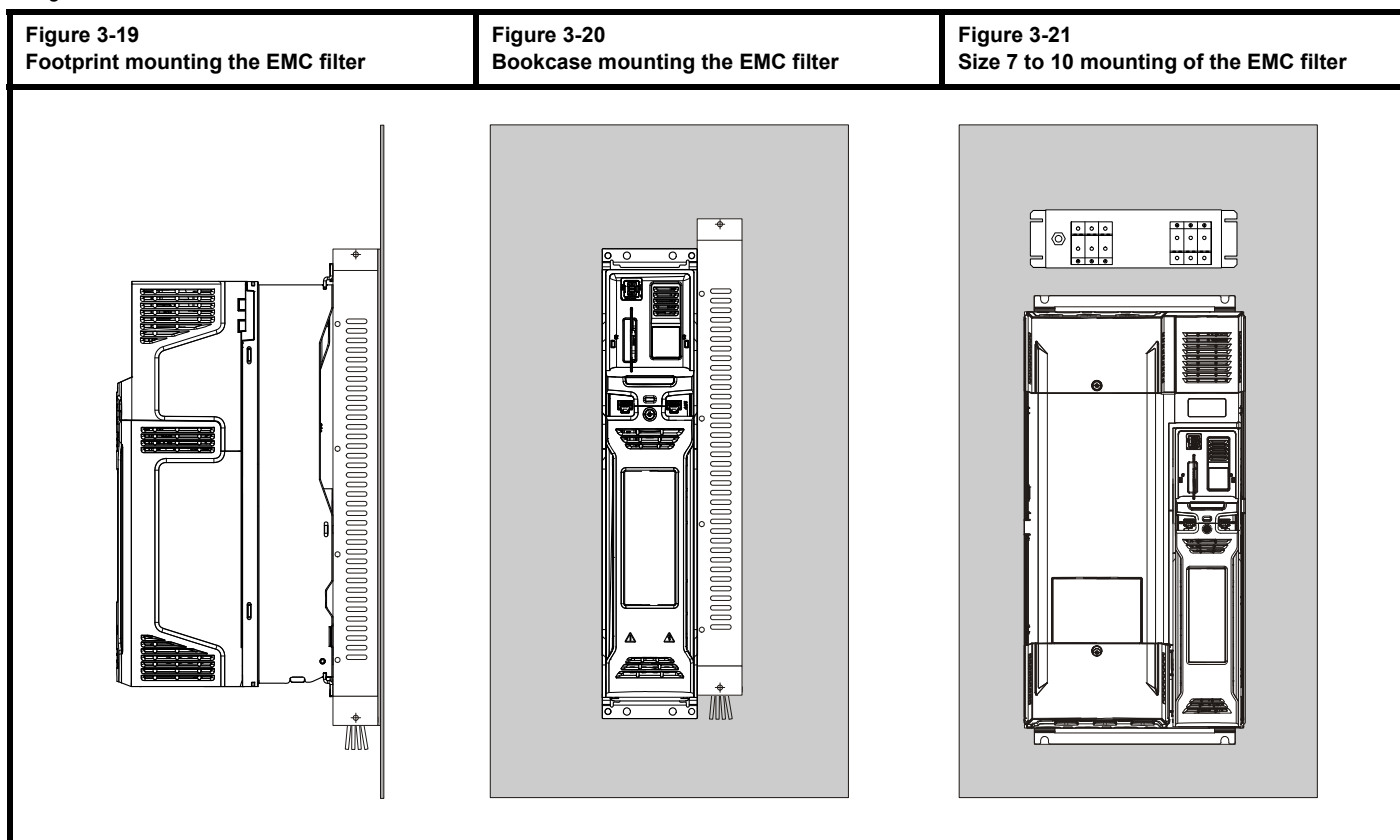
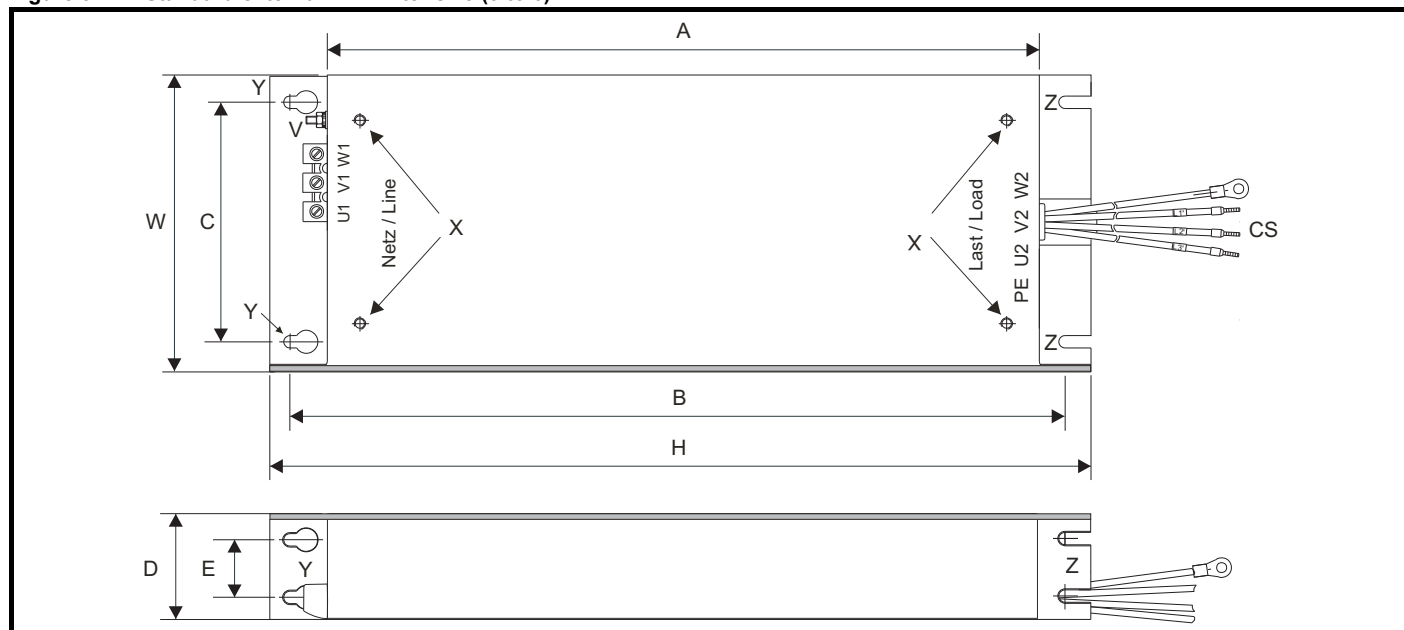


Figure 3-22 Standard external EMC filter size (3 to 6)



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 3-8 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 3-9 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 3-10 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												2.5 mm ² (14 AWG)
4200-0122												

Table 3-11 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 3-23 Standard external EMC filter (size 7)

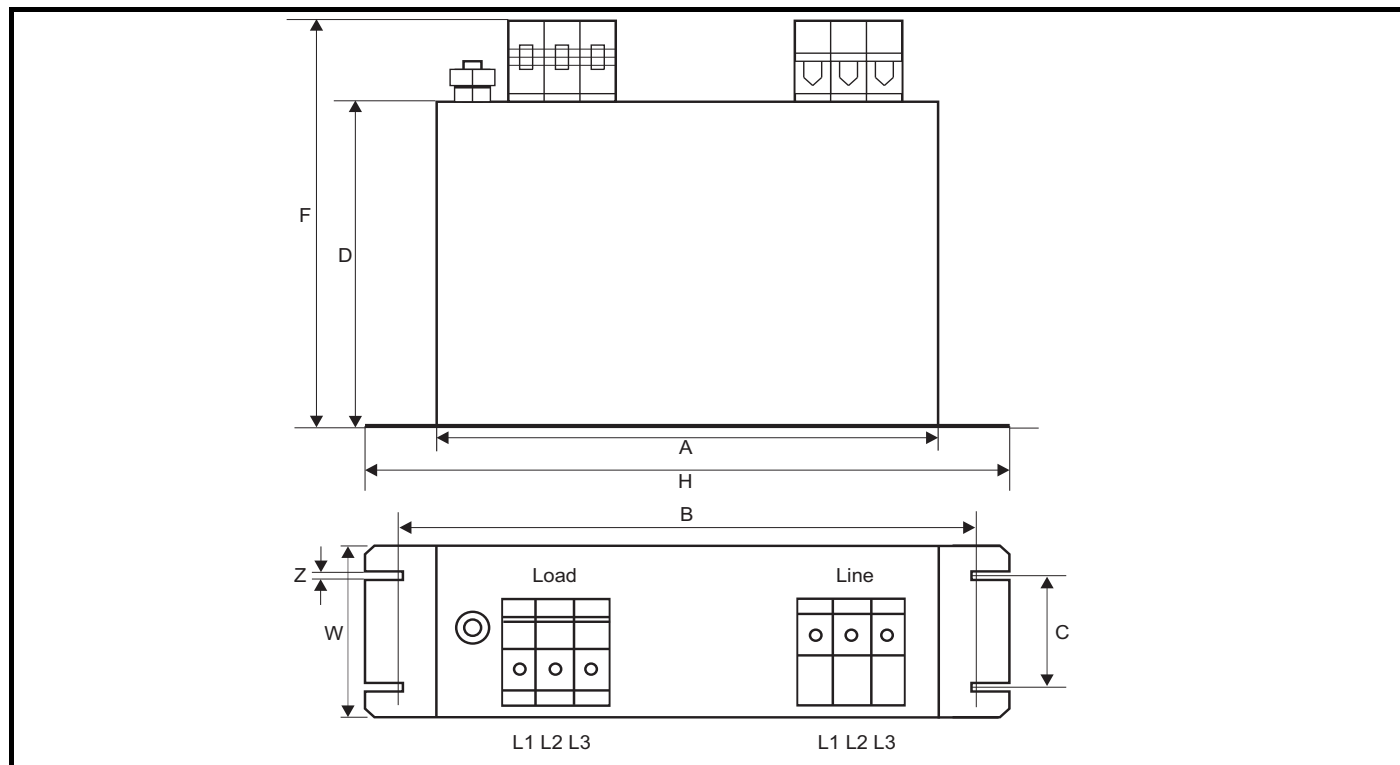


Table 3-12 Size 7 EMC filter dimensions

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

Table 3-13 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				

3.7.3 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 3-14 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 3-24 Bookcase mounting the Compact external EMC filter (size 3 to 5)

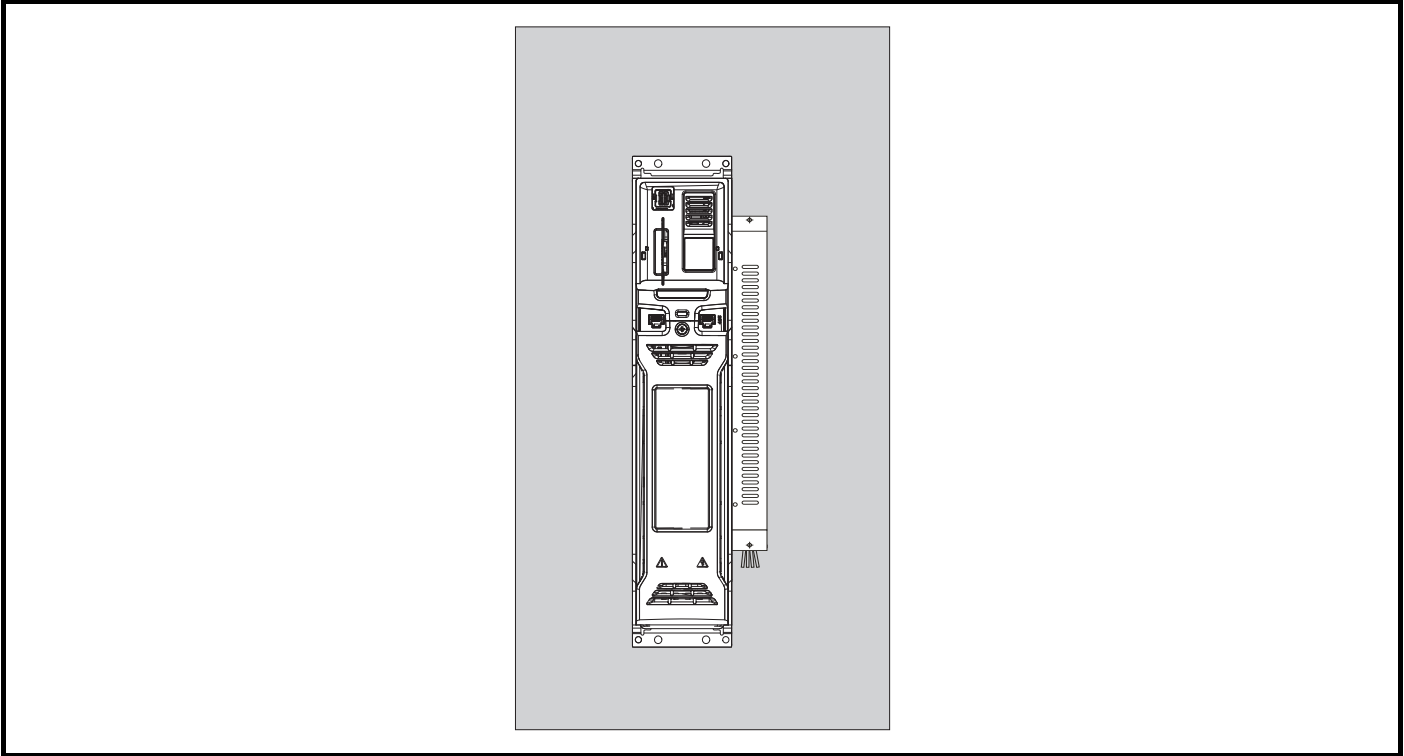
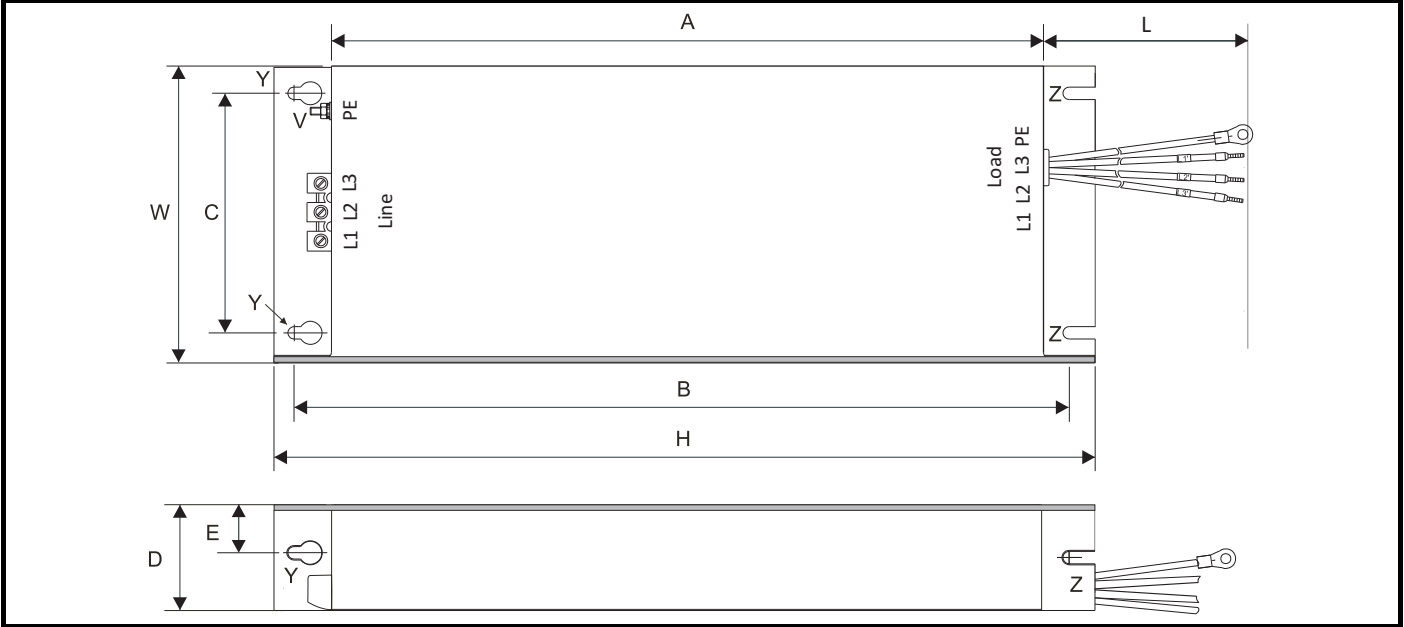


Figure 3-25 Compact external EMC filter (size 3, 4 and 5 400 V)



Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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Table 3-15 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 $\pm$ 5 mm
4200-6219				41 mm (1.61 in)	20 mm (0.79 in)						
4200-6220				60 mm (2.36 in)	30 mm (1.18 in)						
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 3-16 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				

3.8 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:

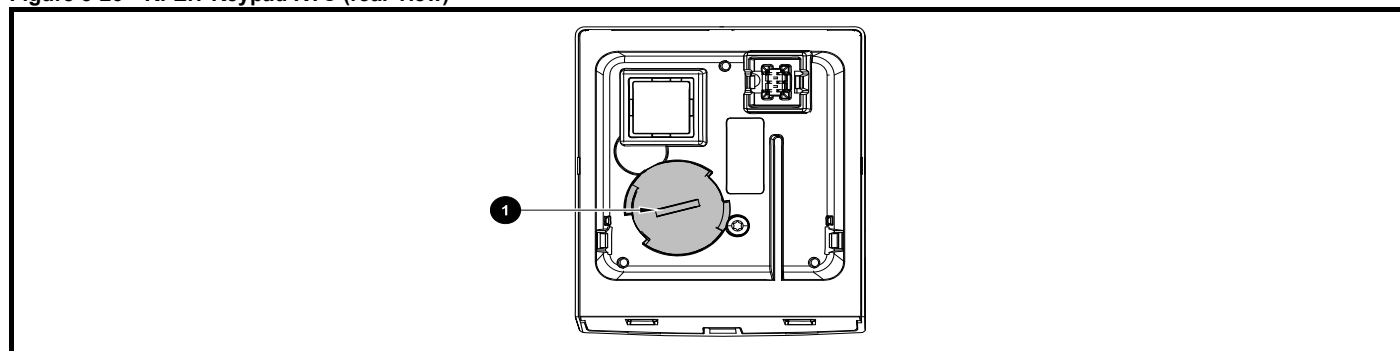
Environment	
Ambient temperature	Ensure the enclosure temperature remains at or below maximum specified.
Dust	Ensure the drive remains dust free – check that the heatsink and drive fan are not gathering dust. The lifetime of the fan is reduced in dusty environments.
Moisture	Ensure the drive enclosure 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.

3.8.1 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 3-26 KI-Elv Keypad RTC (rear view)



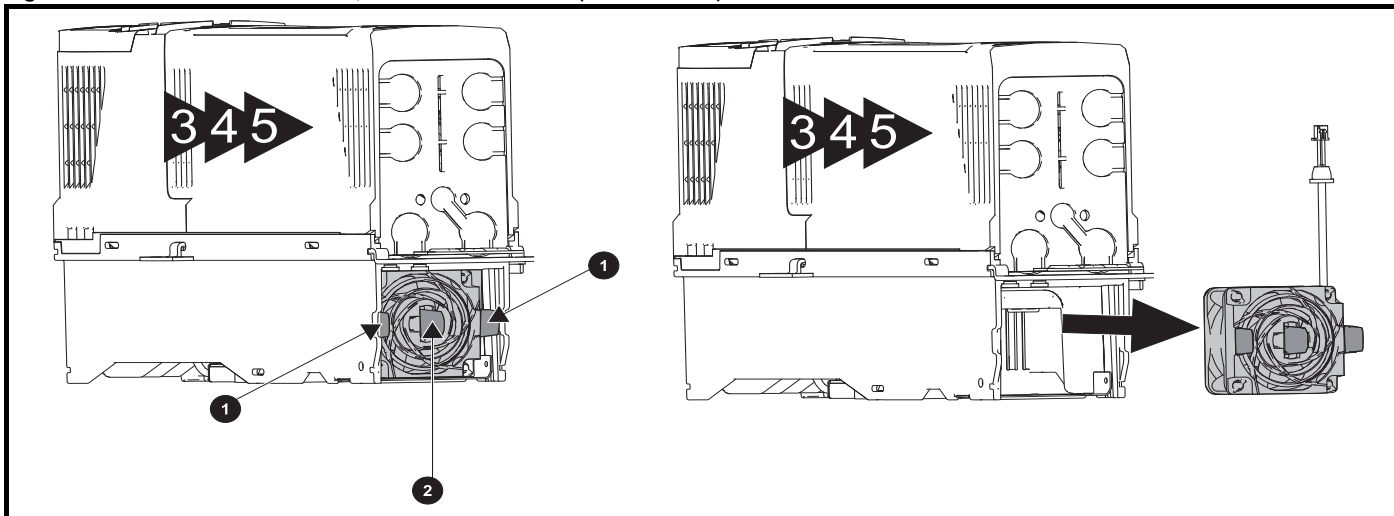
1. To remove the battery cover insert a flat head screwdriver into the slot as shown (1), push and turn anti-clockwise until the battery cover is released.
2. Replace the battery (the battery type is: (CR2032).
3. Reverse point 1 above to replace battery cover.

NOTE

Ensure the battery is disposed of correctly.

3.8.2 Fan removal procedure

Figure 3-27 Removal of the size 3, 4 and 5 heatsink fan (size 3 shown)



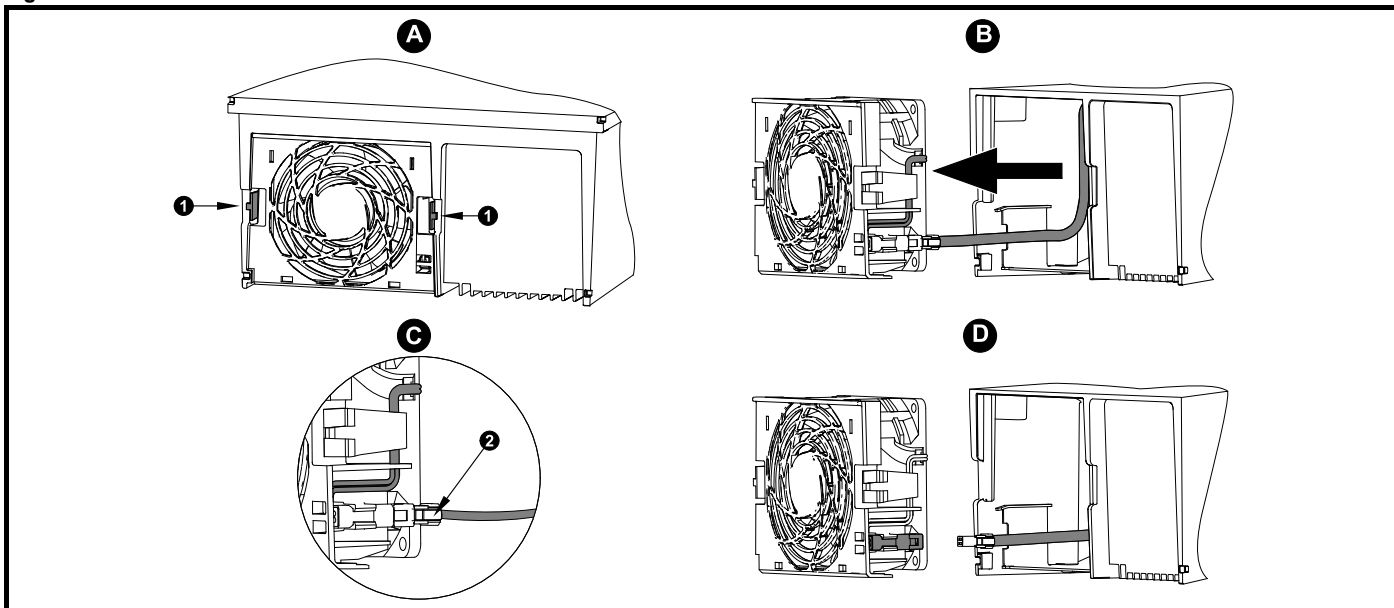
1. Ensure the fan cable is disconnected from the drive prior to attempting fan removal.
2. Press the two tabs (1) inwards to release the fan from the drive frame.
3. Using the central fan tab (2), withdraw the fan assembly from the drive housing.

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 3-28 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 $\pm 10\%$
- 400 V drive: 380 V to 480 V $\pm 10\%$
- 575 V drive: 500 V to 575 V $\pm 10\%$
- 690 V drive: 500 V to 690 V $\pm 10\%$

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



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.



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.



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 10. 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 10



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 10. 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

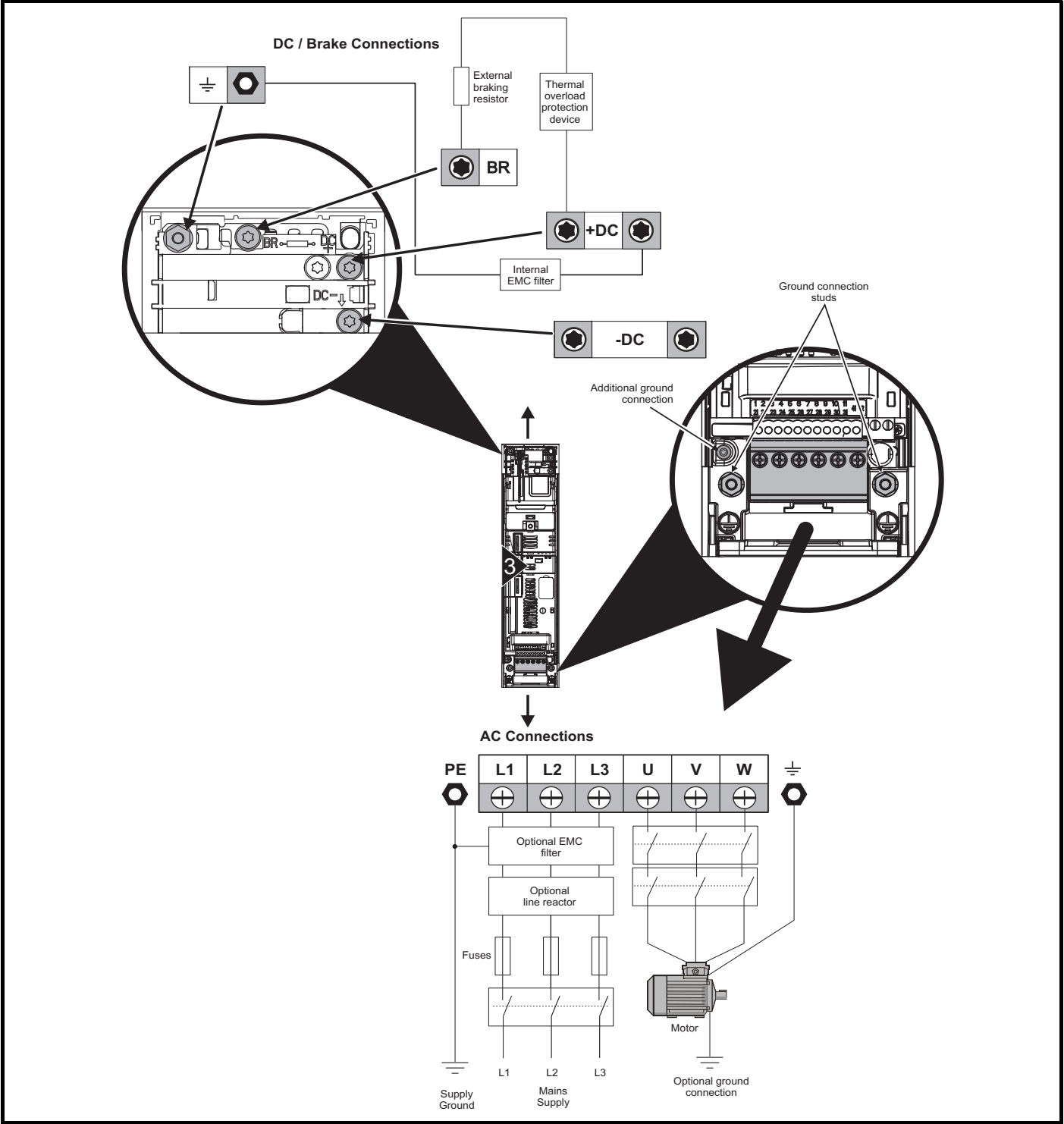


Figure 4-2 Size 4 power and ground connections

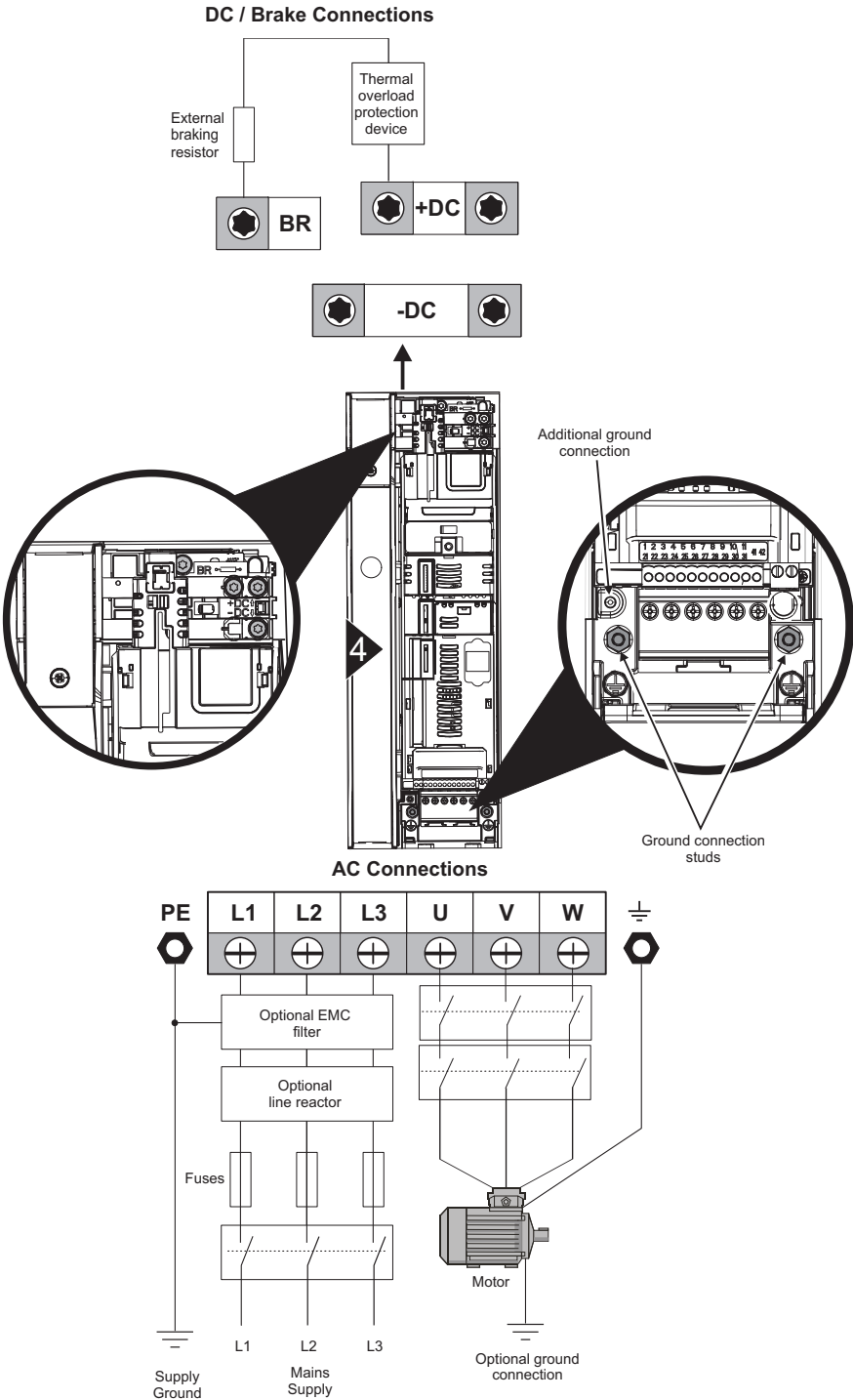


Figure 4-3 Size 5 power and ground connections

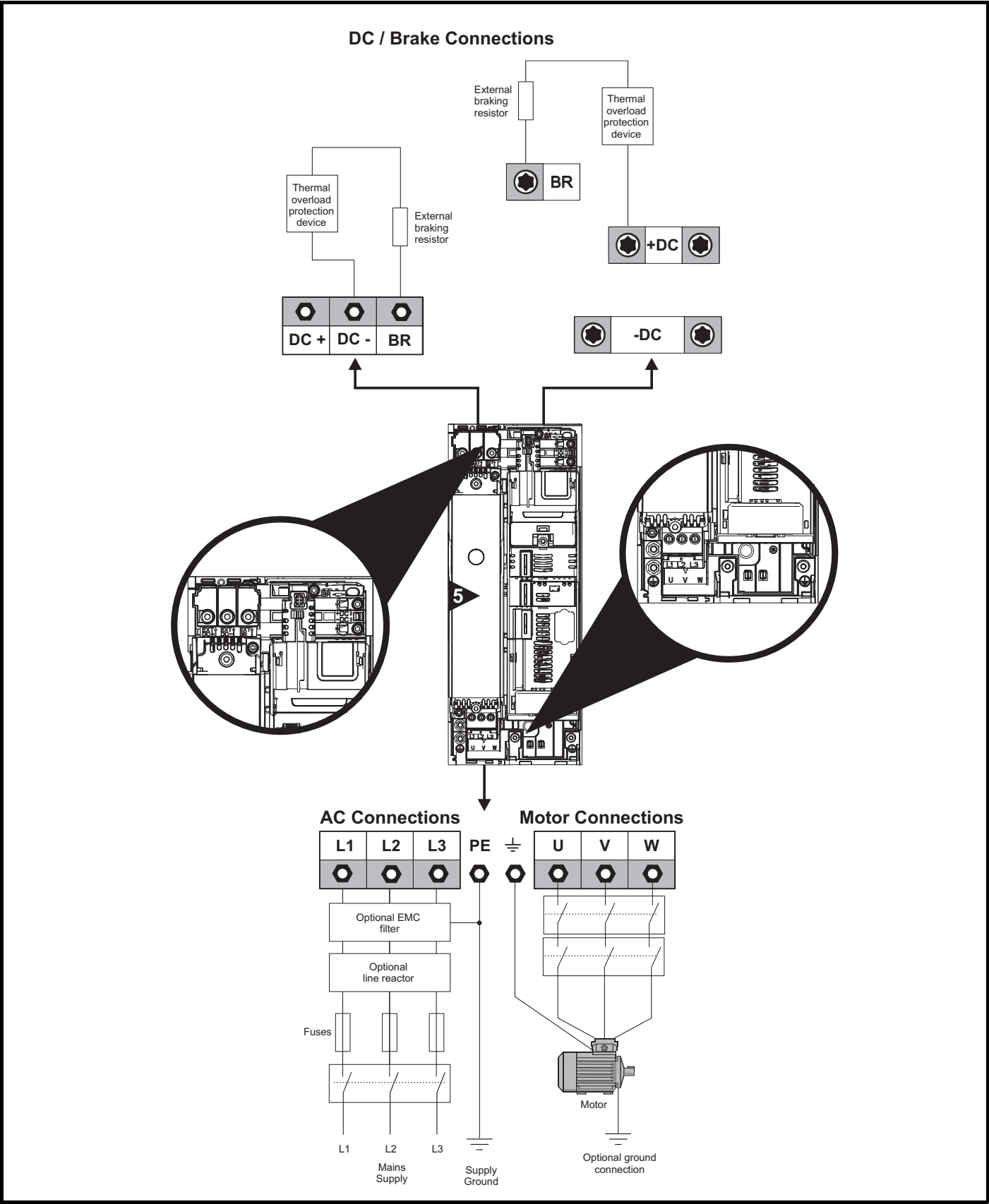


Figure 4-4 Size 6 power and ground connections

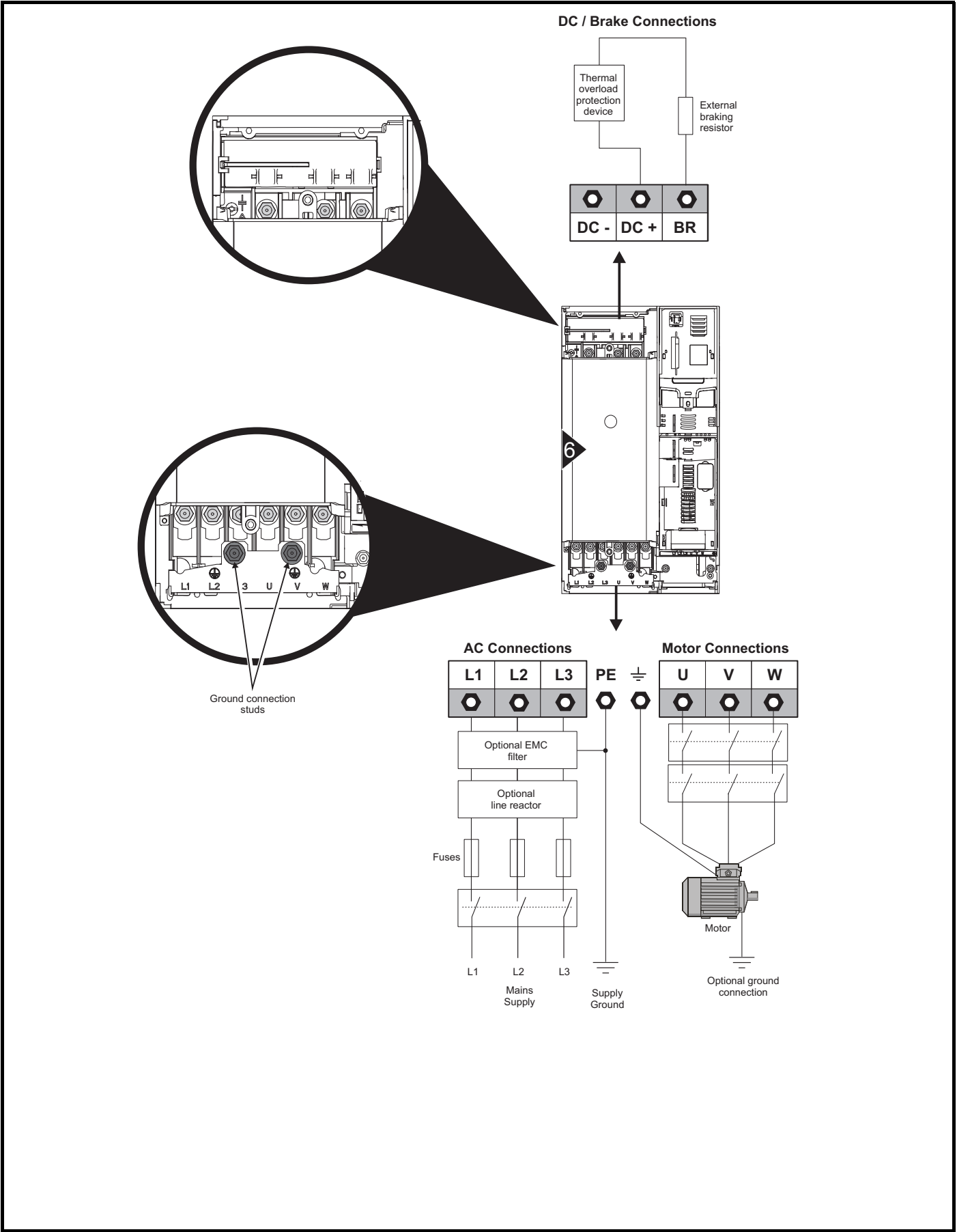
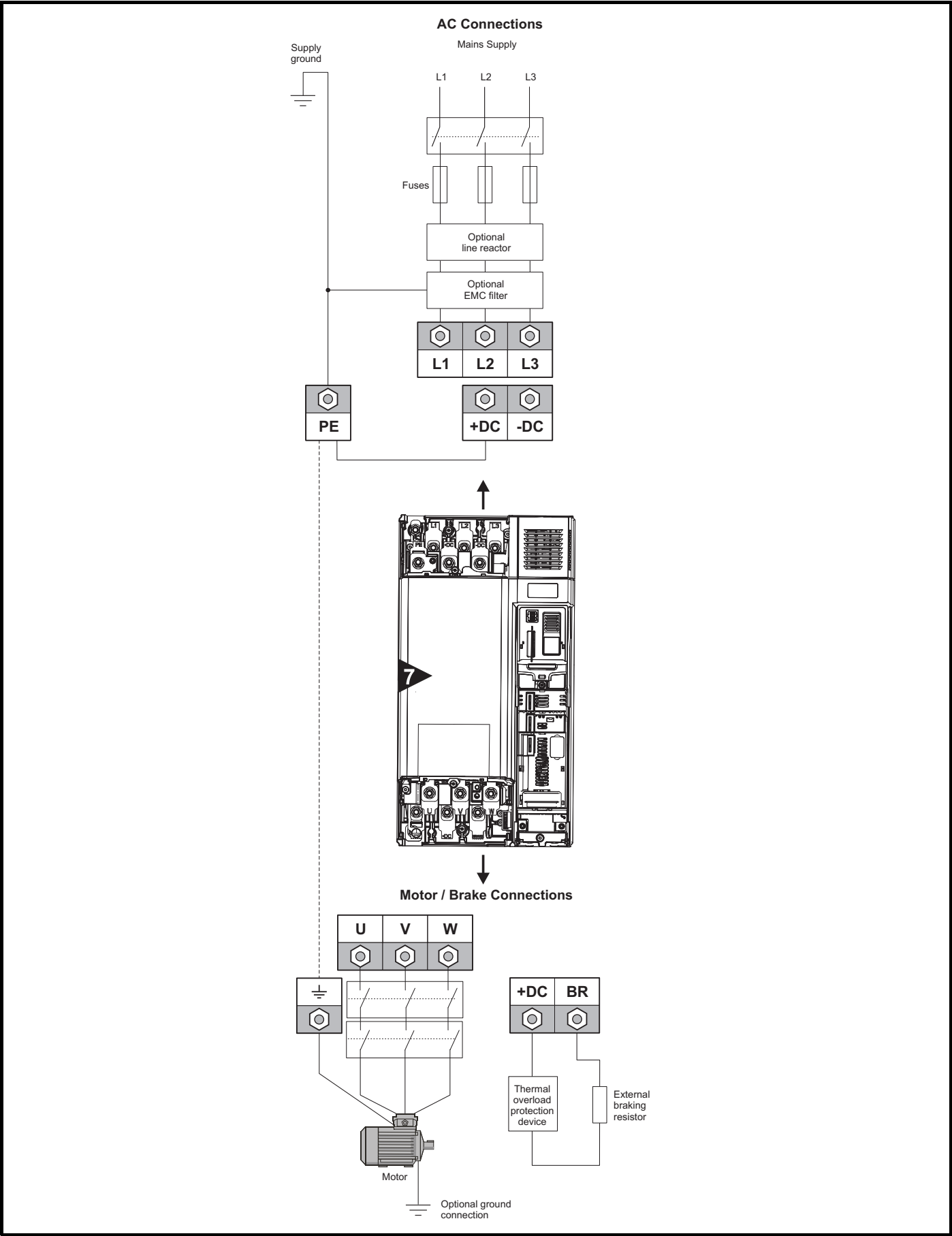


Figure 4-5 Size 7 power and ground connections



4.3.1 Ground connections



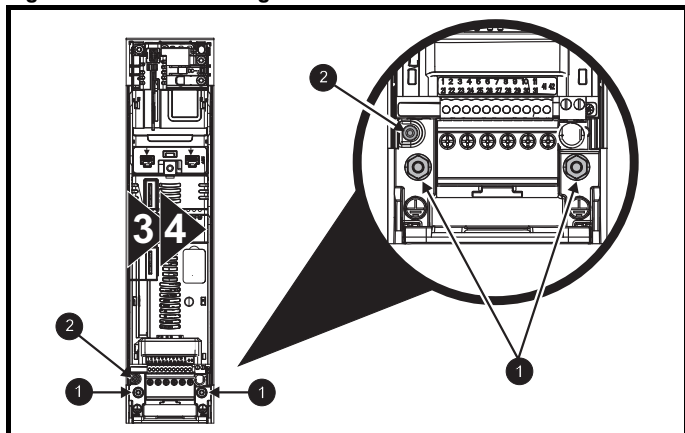
Electrochemical corrosion of grounding terminals
Ensure that grounding terminals are protected against corrosion i.e. as could be caused by condensation.

WARNING

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

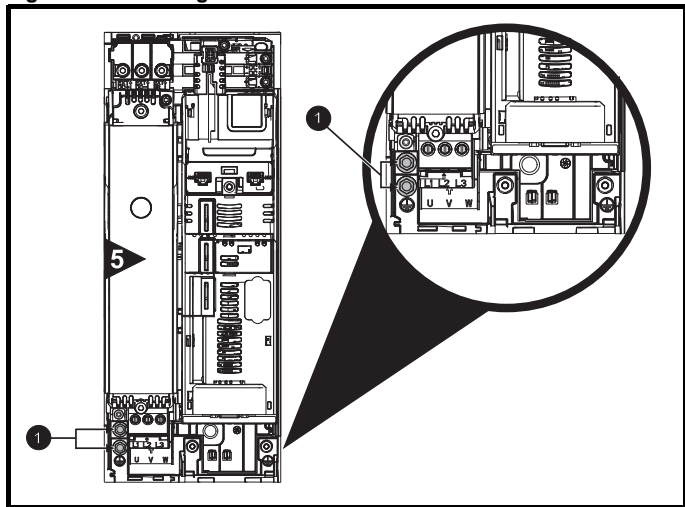


1. Ground connection studs.
2. Additional ground connection.

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

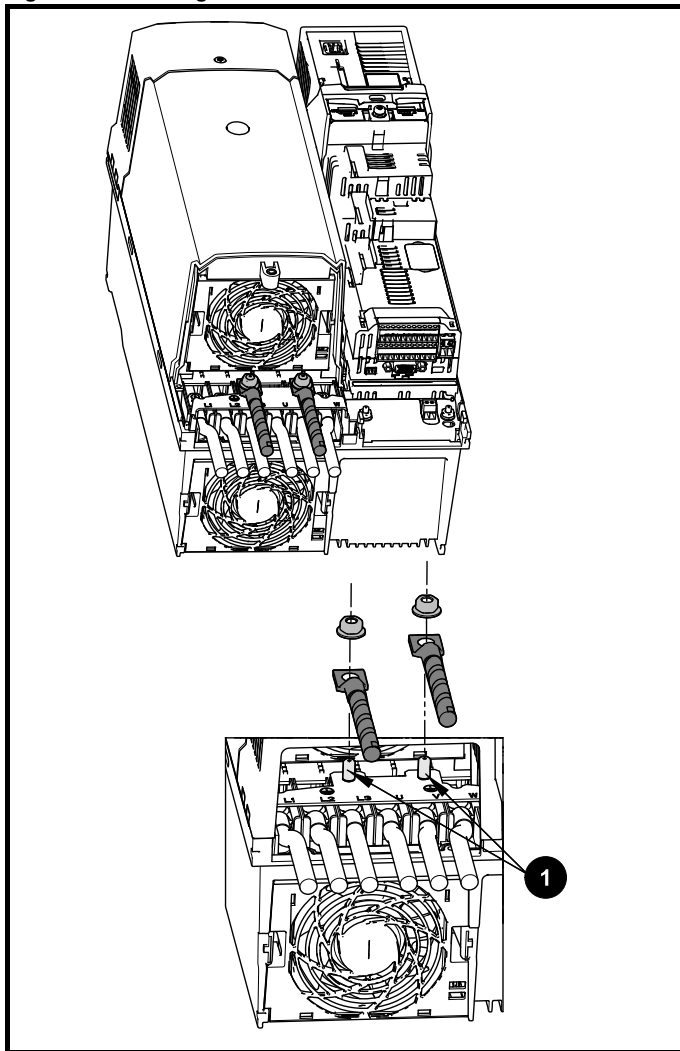


1. Ground connection studs.

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

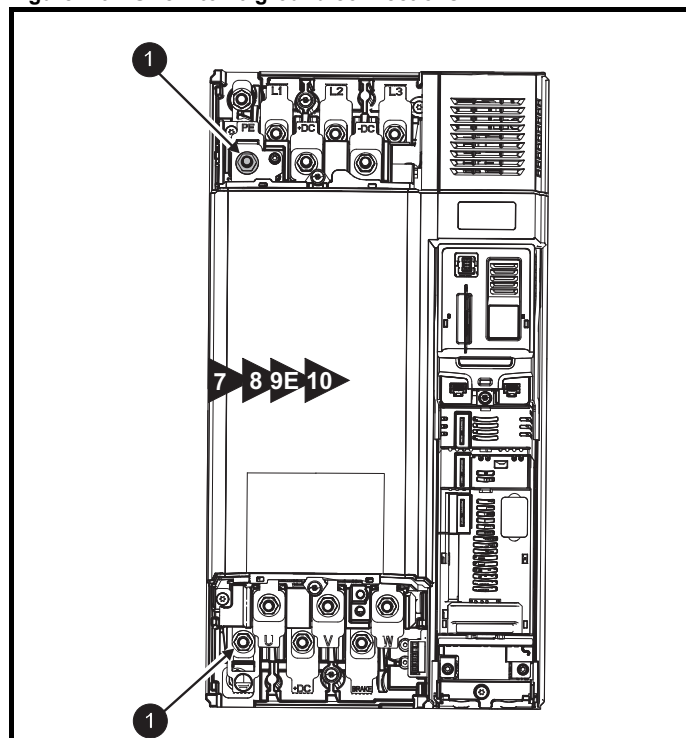
Size 7

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.

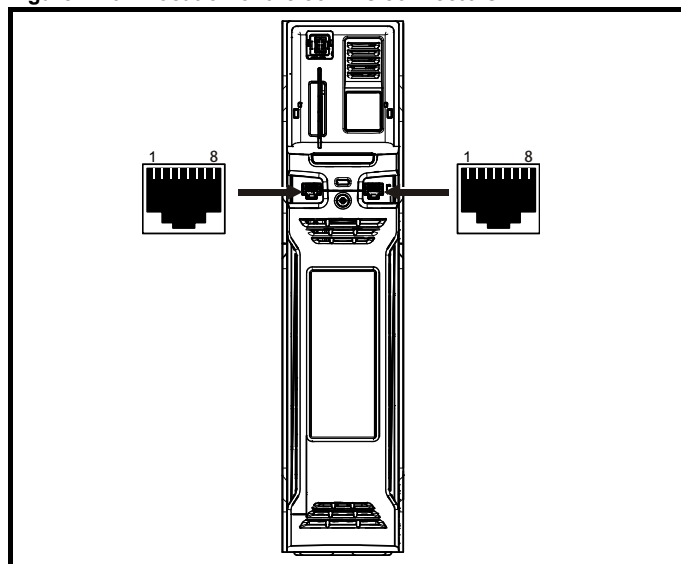
Table 4-2 Protective ground cable ratings

Input phase conductor size	Minimum ground conductor size
$\leq 10 \text{ mm}^2$	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).
$> 10 \text{ mm}^2$ and $\leq 16 \text{ mm}^2$	The same cross-sectional area as the input phase conductor
$> 16 \text{ mm}^2$ and $\leq 35 \text{ mm}^2$	16 mm^2
$> 35 \text{ mm}^2$	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	120Ω 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

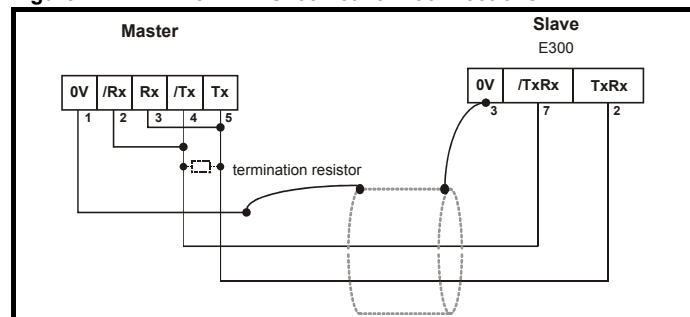
Part number	Description
4500-0096	CT USB Comms cable

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 k Baud. 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.



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.



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.



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.



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.

CAUTION

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.

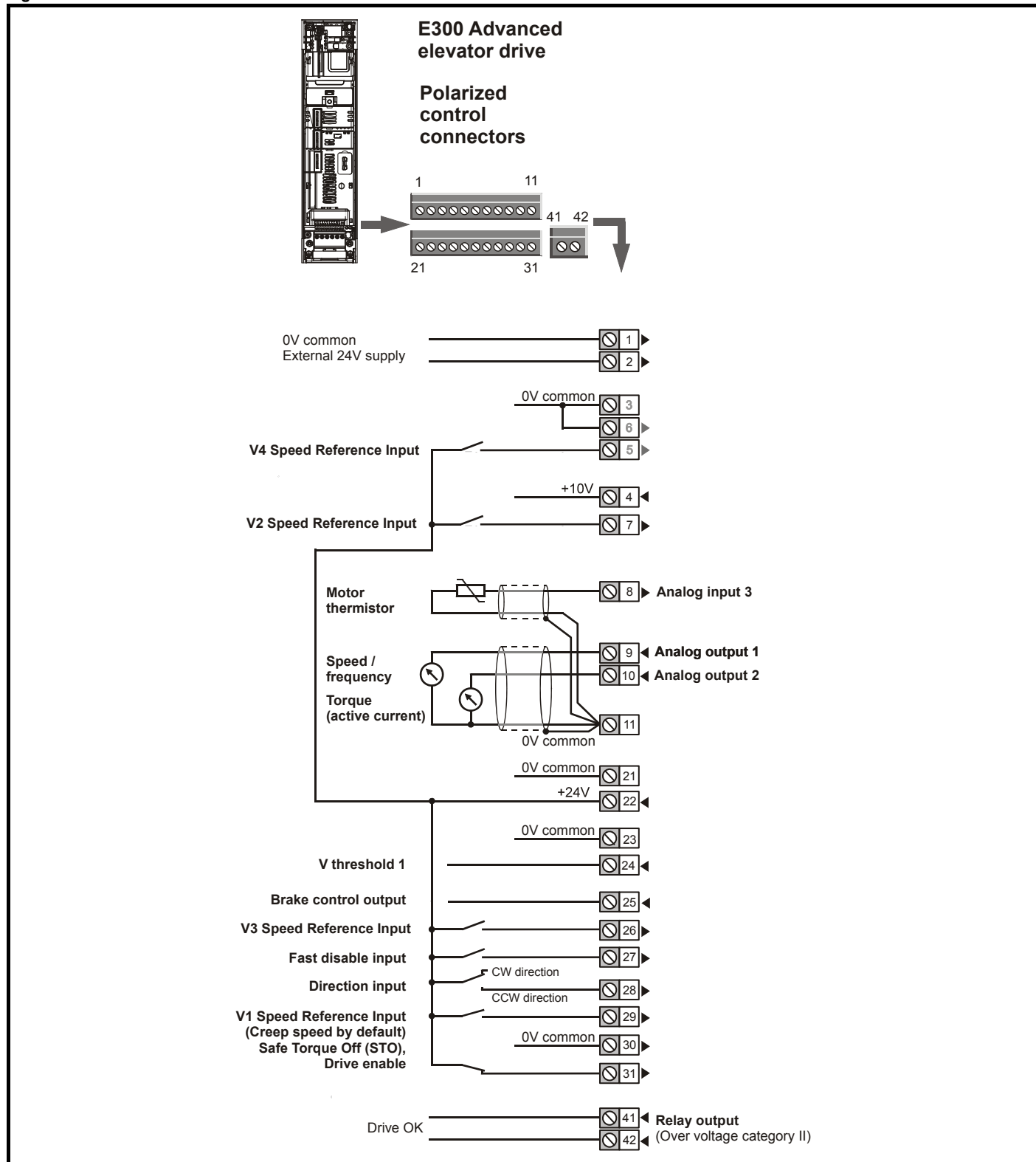
NOTE

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.

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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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 $\pm 1\%$
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 % (Analog input) 0V to 24 V (Digital input)
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 % (Analog input) 0V to 24 V (Digital input)
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	$\pm 10 \text{ V} \pm 5 \%$	
Maximum output current	$\pm 20 \text{ mA}$	
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

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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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	Relay contacts
42	
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 only	
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 only	
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



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:

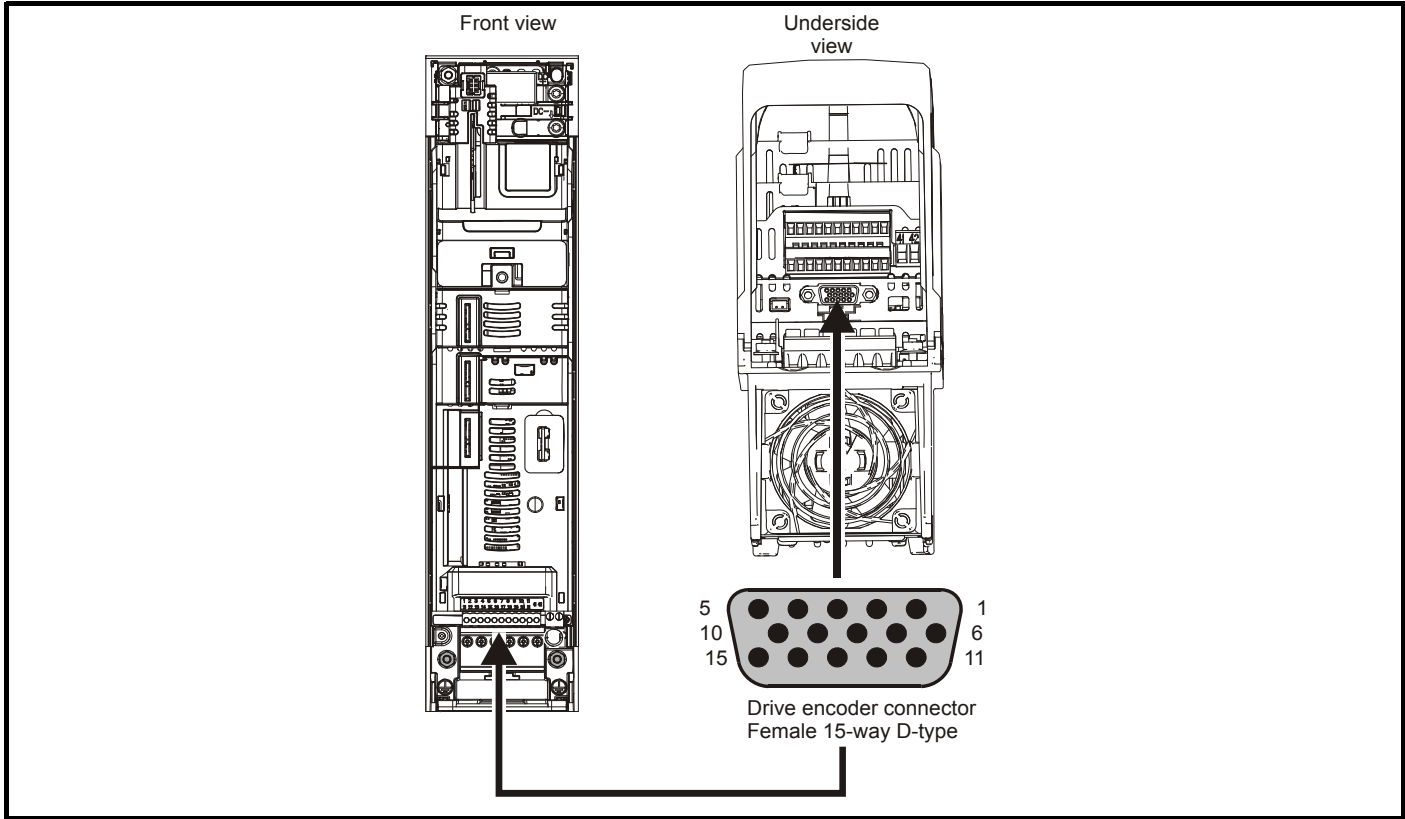
- Position feedback interface
- Encoder simulation output.
- Motor thermistor input.

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

NOTE

Refer to the *E200 Design Guide* for detailed information on the supported feedback devices and encoder output simulation.

Figure 4-13 Location of position feedback interface



Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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4.6.1 Position feedback connection details

Table 4-6 P1 position feedback connection details

C01 Drive Encoder type	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\							+V	0 V	Th
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\											
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. Refer to the *E200 Design Guide* for further information.

Sincos encoder resolution

The sine wave frequency can be up to 500 kHz but the resolution is reduced at the higher frequencies. Table 4-7 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 4-7 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

4.6.2 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	$\pm$ 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	$\pm$ 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

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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5	Z, Data, Freeze, Ref H
6	Z\, Data\, Freezel, 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), SC SC (15)	
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	$\pm$ 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_L, D_L, 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_L, Clock_L, 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 <i>Drive Encoder Voltage Select (C04)</i> . 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
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15	Motor thermistor input
Thermistor type is selected in <i>Encoder Thermistor Type (F69)</i>	

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.

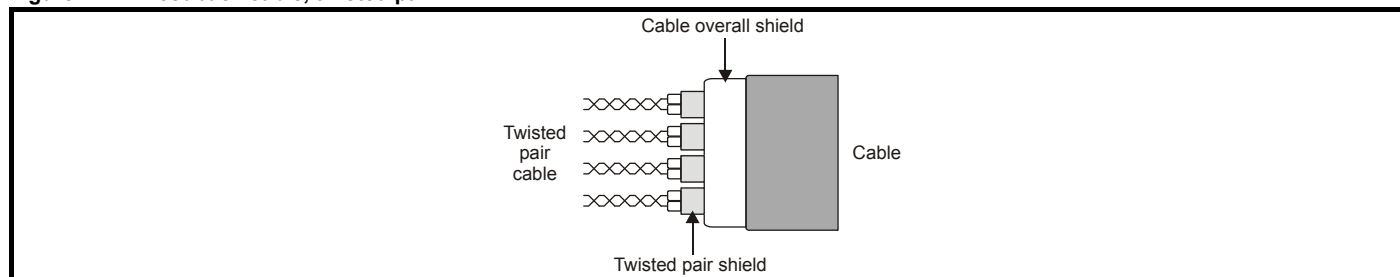
Motor cable: Use a motor cable with an overall shield. Connect the shield of the motor cable to the ground terminal of the motor frame using a link that is as short as possible and not exceeding 50 mm (2 in) long. A full 360 ° termination of the shield to the terminal housing of the motor is beneficial.

Brake resistor cable: The optional braking resistor should also be wired with shielded cable. If un-shielded wire is required, refer to the *E200 Design Guide* for guidance.

Control cables: 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.

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

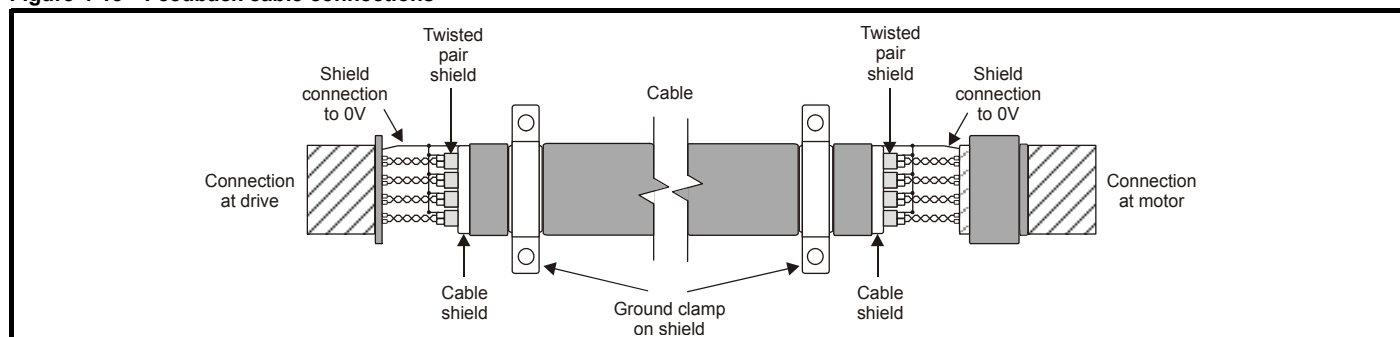
Figure 4-14 Feedback cable, twisted pair



NOTE

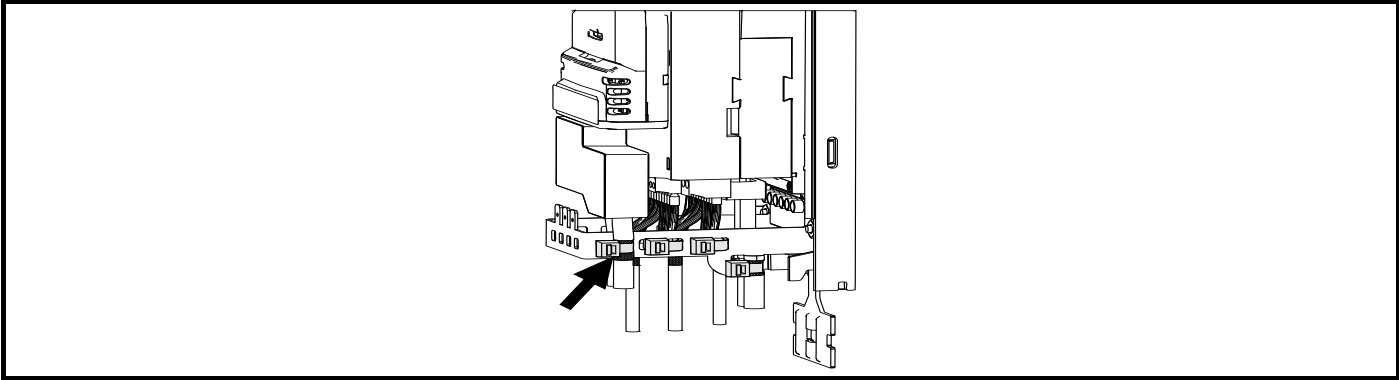
In order to guarantee maximum noise immunity for any application double shielded cable as shown should be used.

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.

Figure 4-16 Grounding of signal cable shields using the grounding bracket



4.8 Minimum connections

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

Figure 4-17 Minimum connections for operation in RFC-S mode (size 3 and 4)

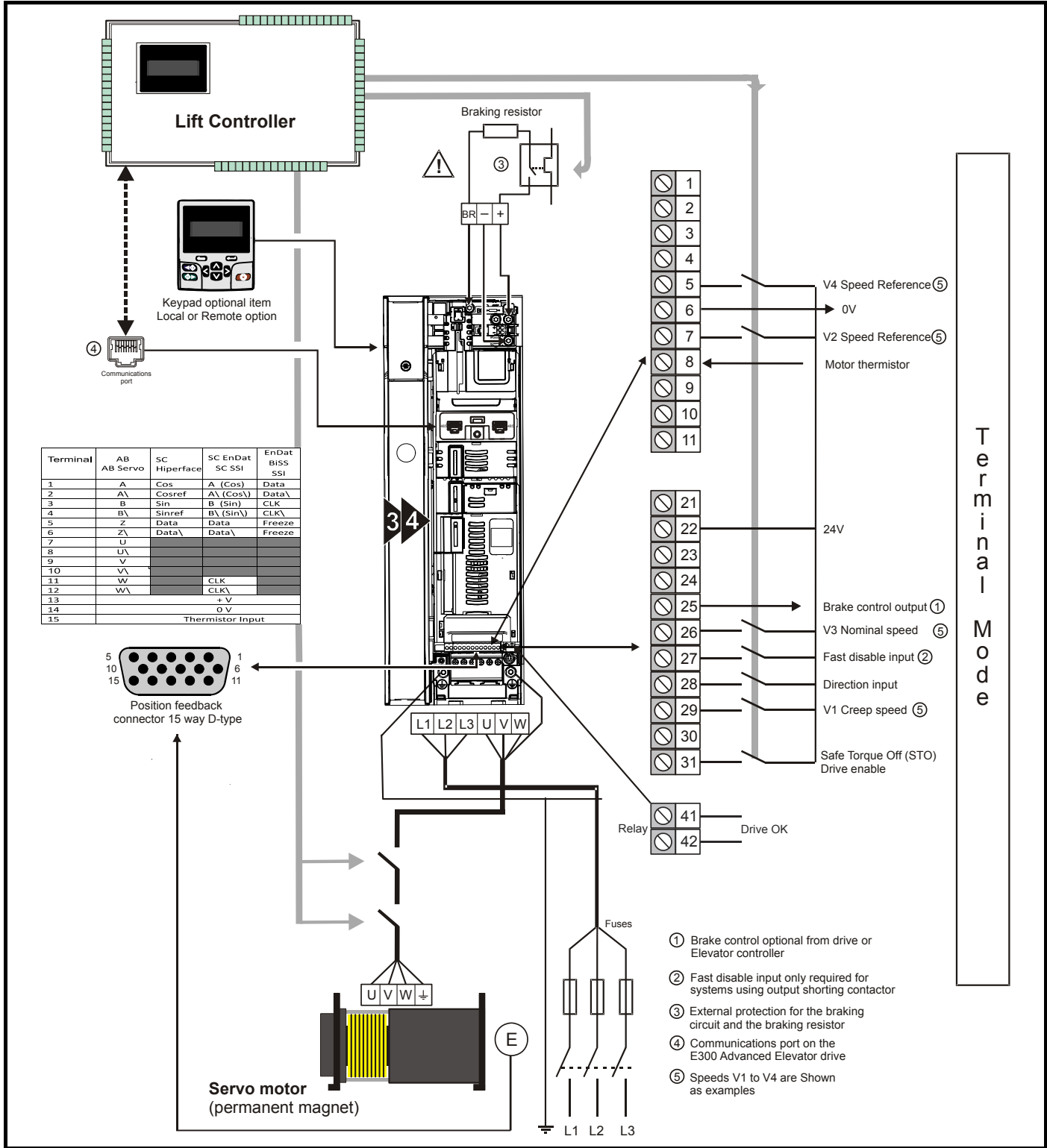


Figure 4-18 Minimum connections for operation in RFC-S mode (size 5)

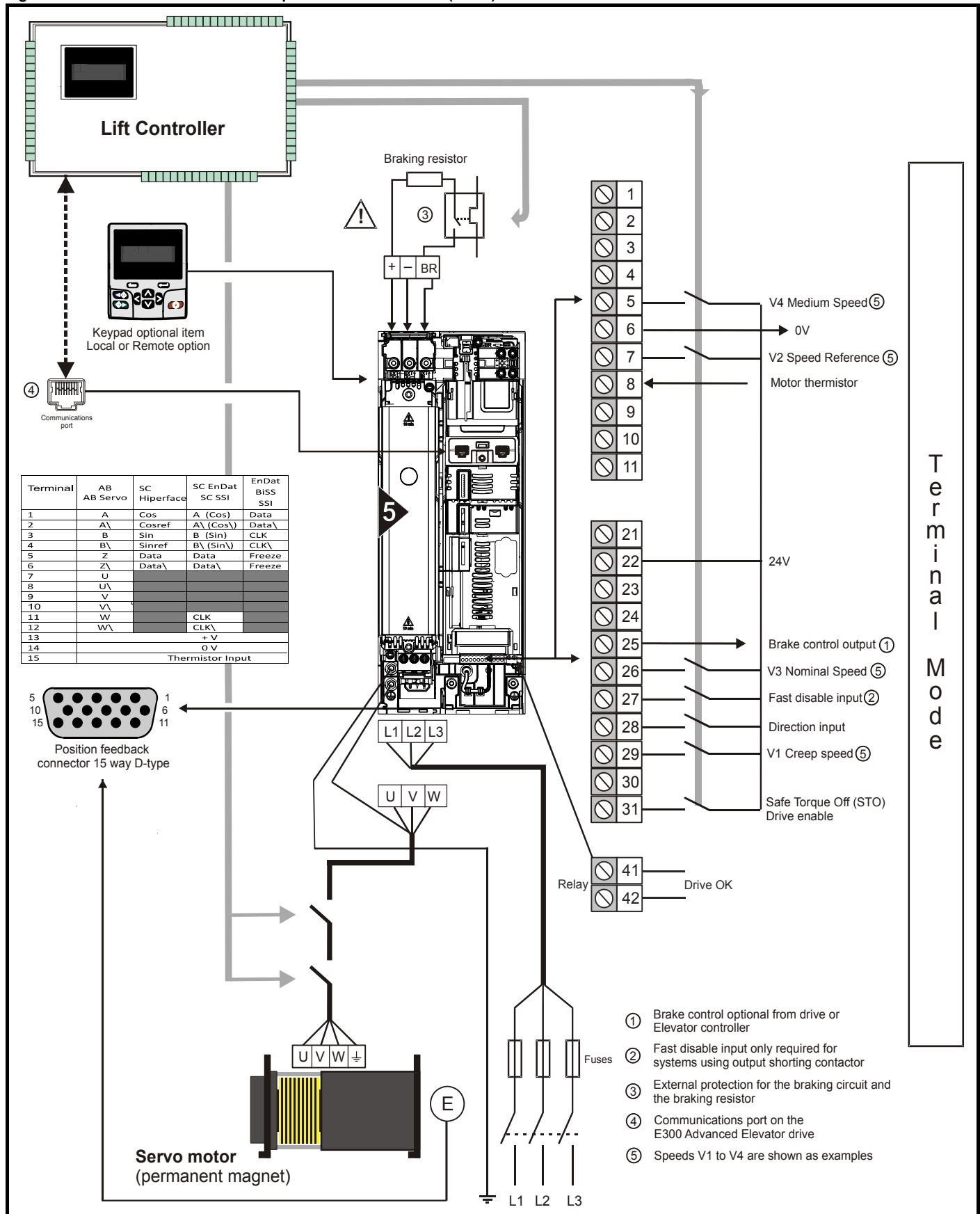


Figure 4-19 Minimum connections for operation in RFC-S mode (size 6)

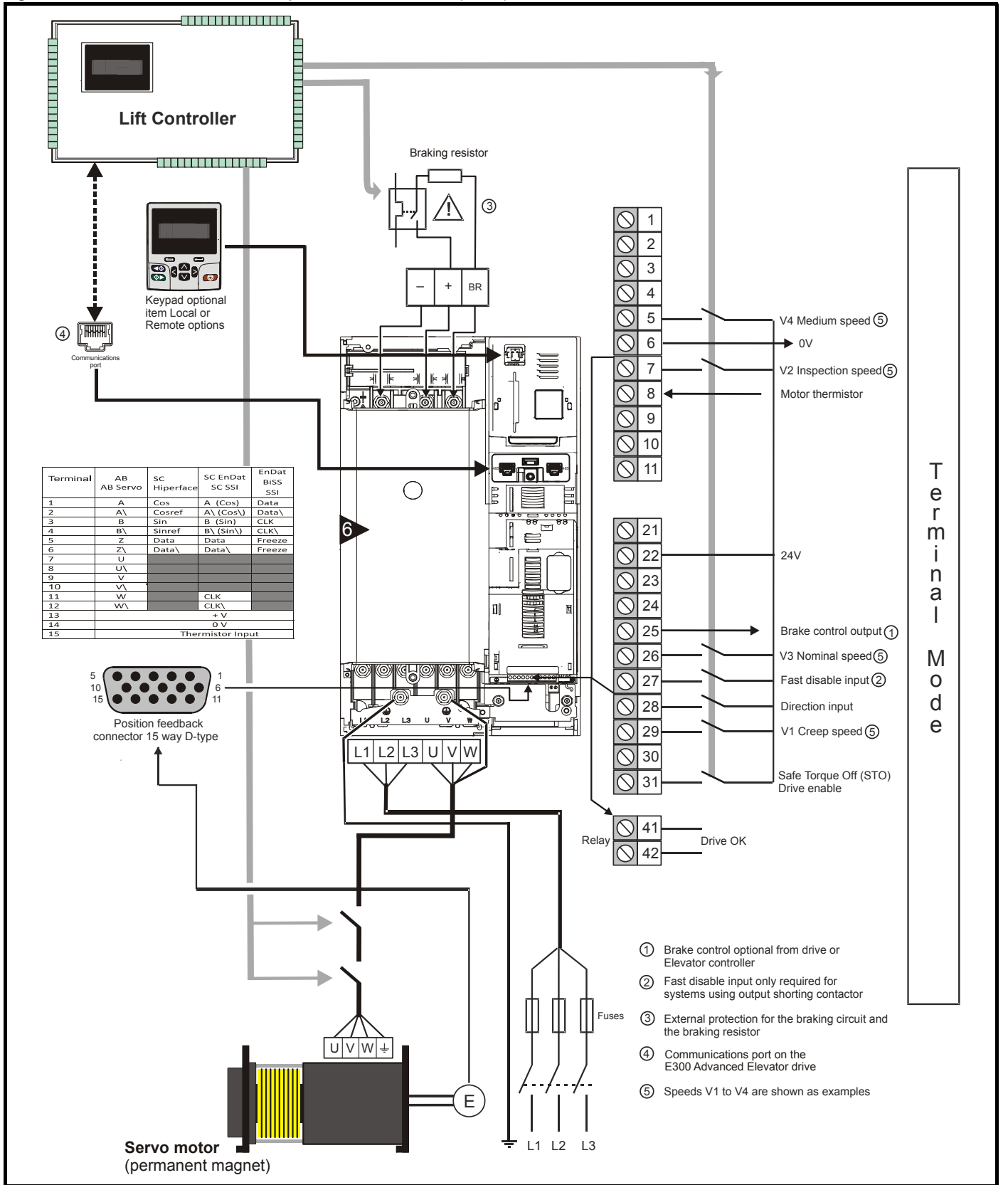
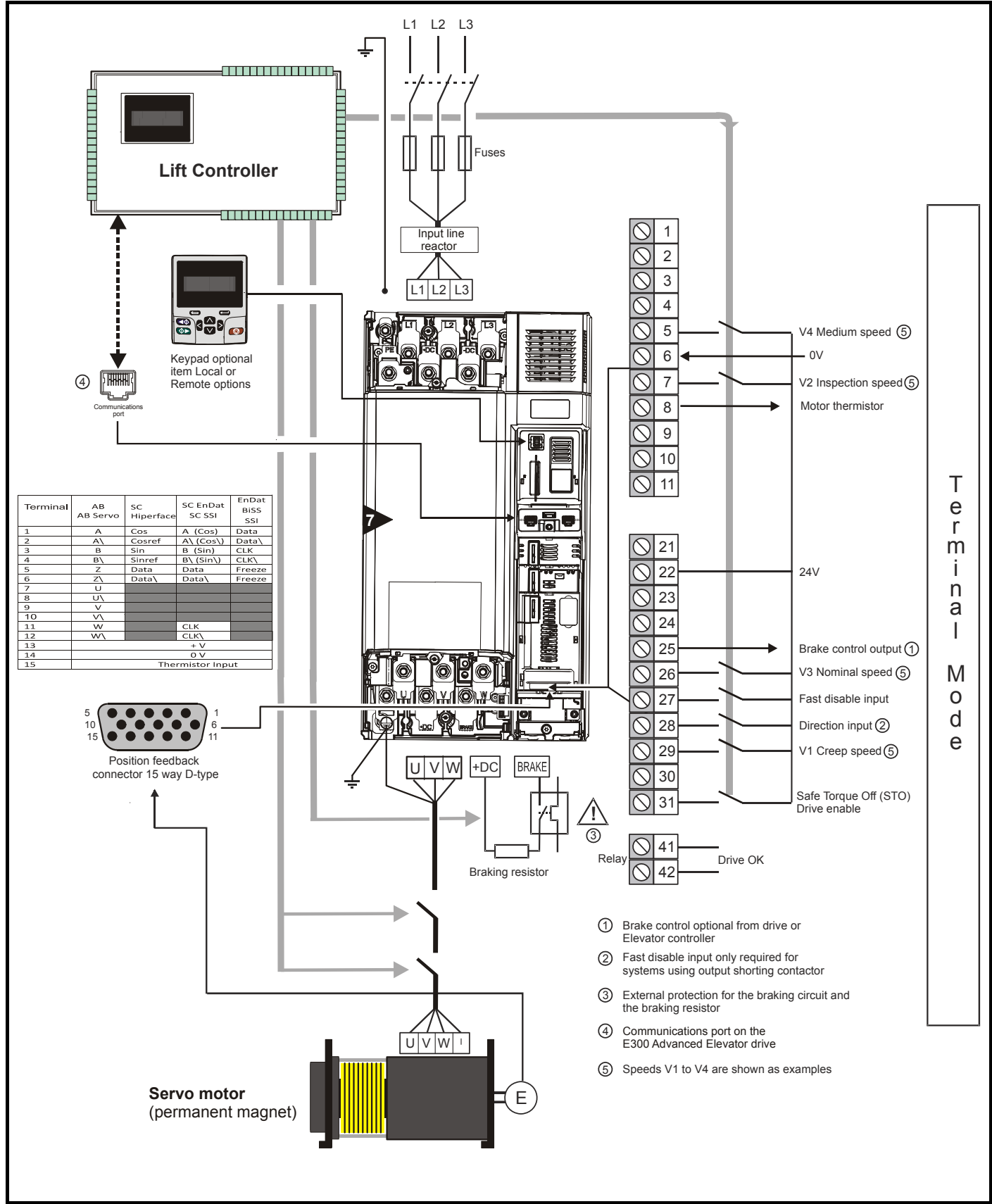


Figure 4-20 Minimum connections for operation in RFC-S mode (size 7)



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 4-8 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 4-21 Location of the 24 Vdc power supply connection on size 6

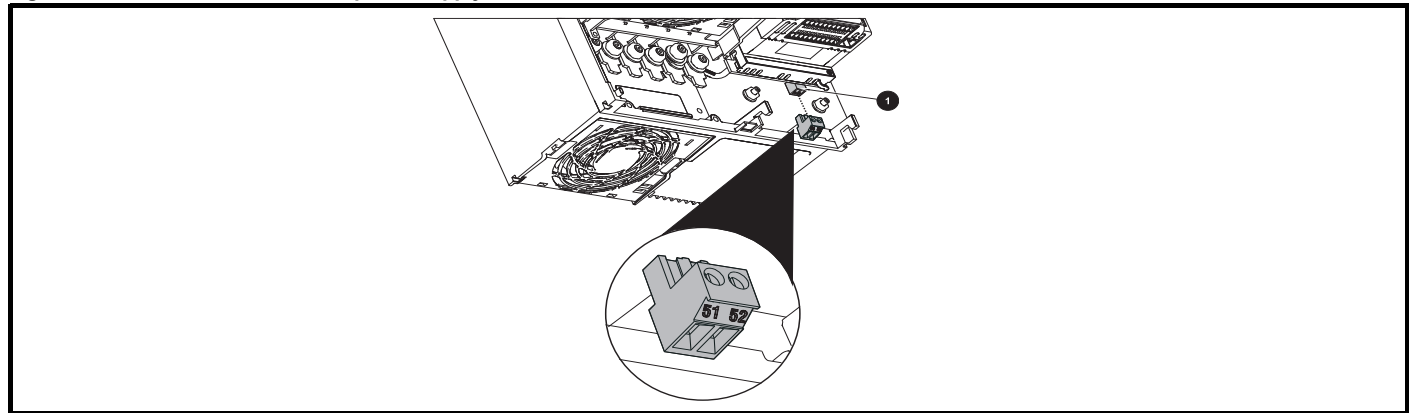
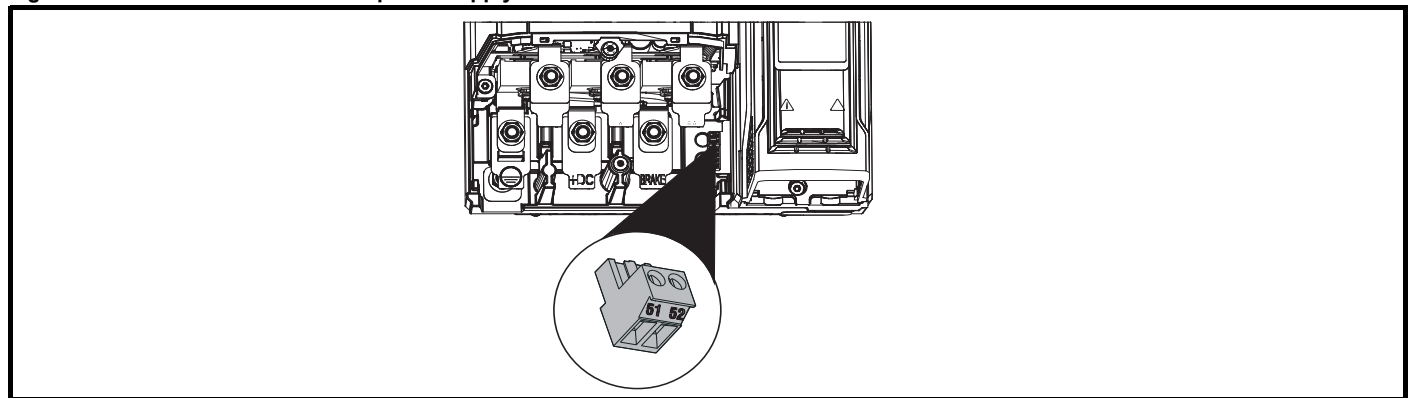


Figure 4-22 Location of the 24 Vdc power supply connection on size 7



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:

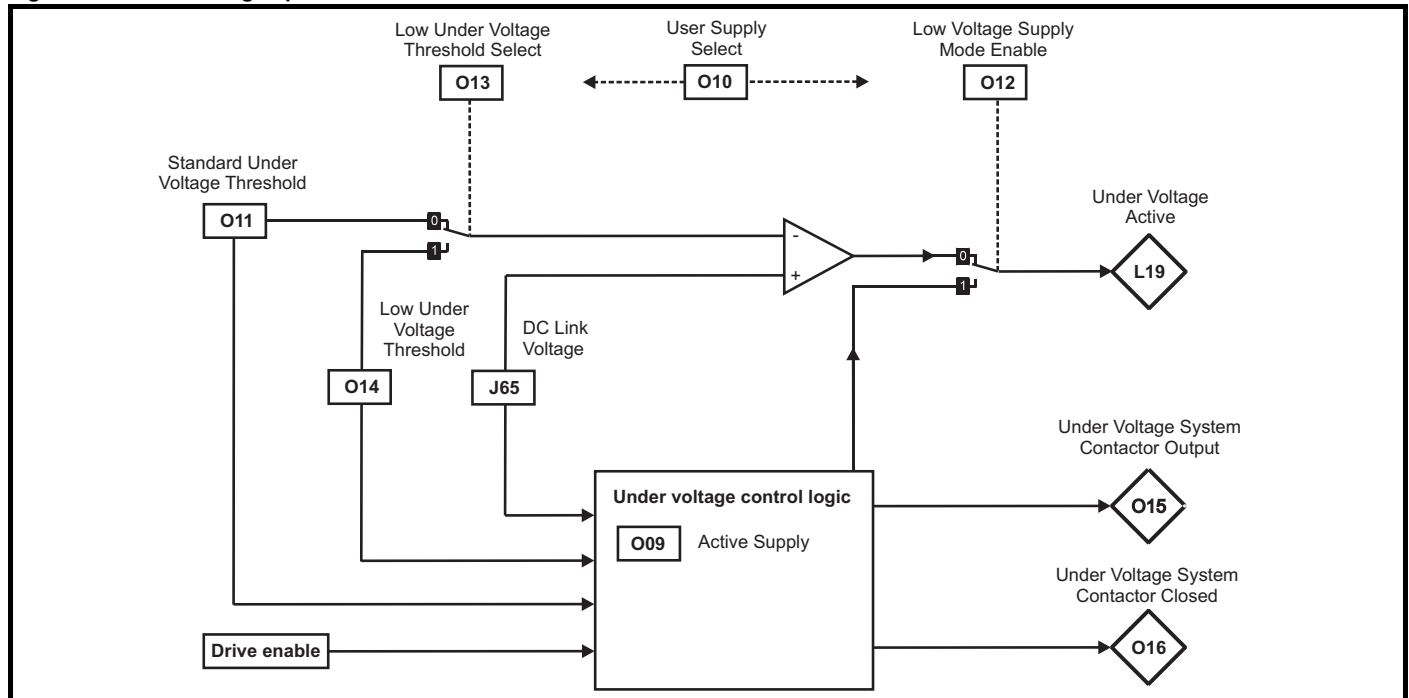
Size 3 to 7

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 4-23 Low voltage operation



Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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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 4-9 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: $480 \times 1.1 \times \sqrt{2} = 747 \text{ V}$

The difference between the under-voltage threshold and the peak supply voltage = $747 - 330 = 417 \text{ V}$

Therefore for this drive voltage rating the peak line to line voltage must never be higher than *Low Under Voltage Threshold (O14)* + 417 V.

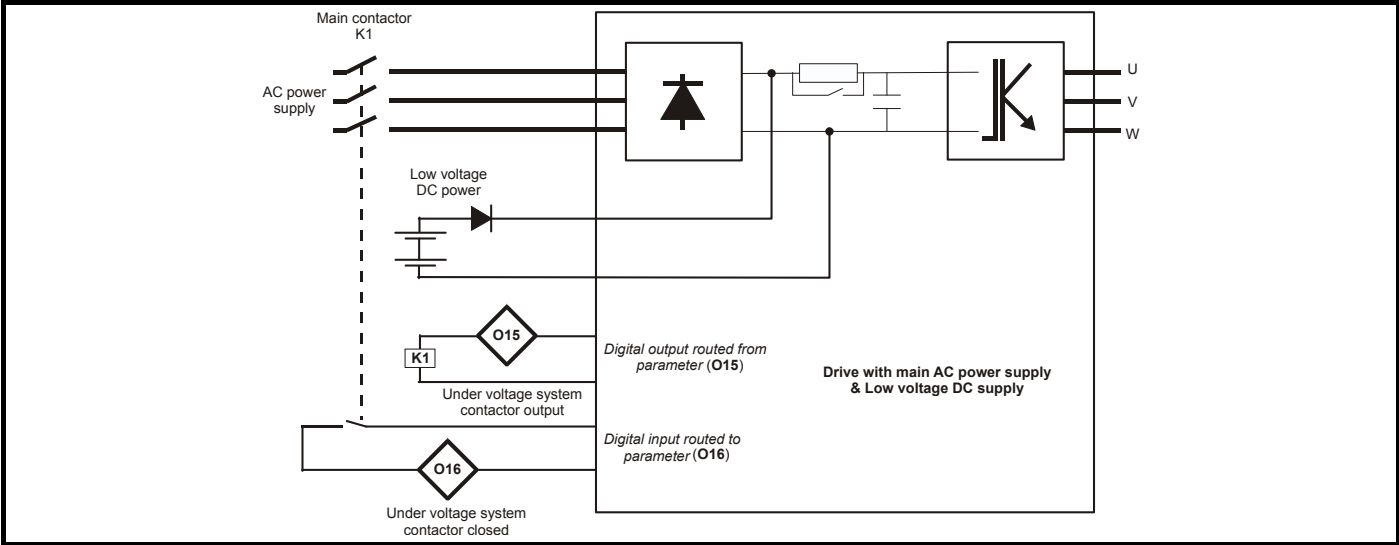
If *Low Under Voltage Threshold Select* (O13) = On (1) and *Low Under Voltage Threshold* (O14) is reduced below the variable maximum level VM_STD_UNDER_VOLTAGE[MIN], or *LV Supply Mode Enable* (O12) = On (1), an indication is stored in *Potential Drive Damage Condition* (L73) that cannot be cleared by 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

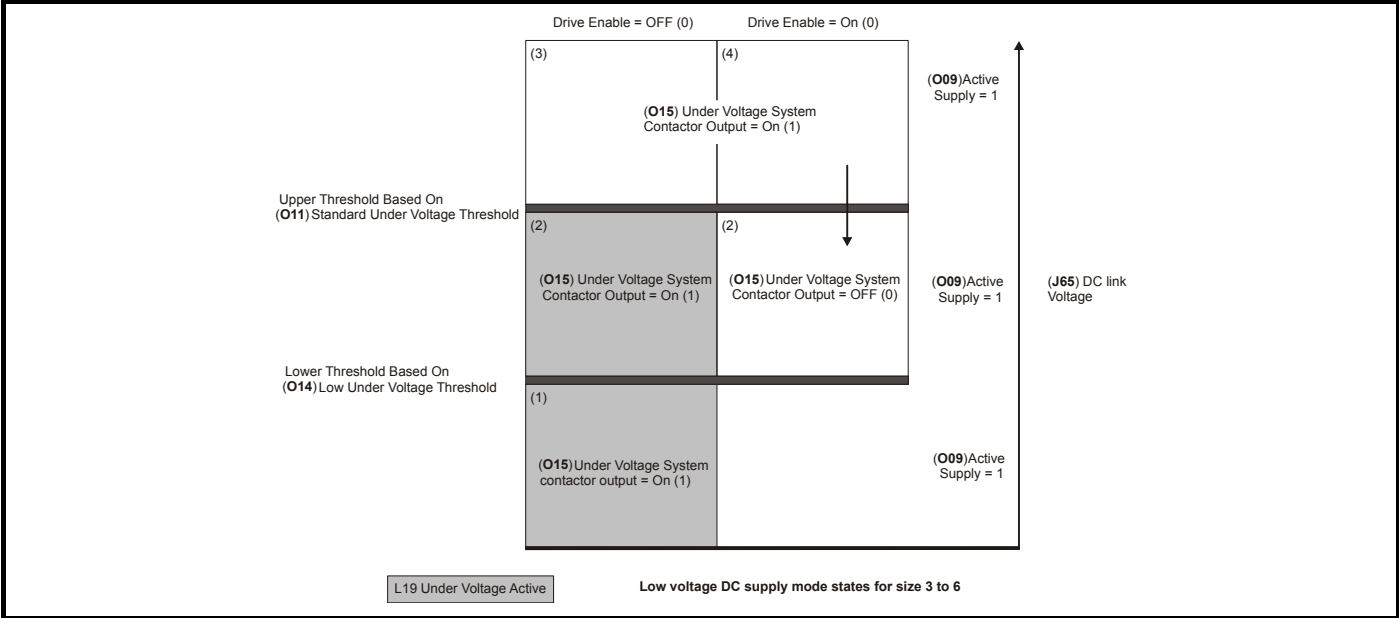
LV Supply Mode Enable (O12). Low voltage supply mode is intended to provide a smooth transition without disabling the drive, from a high voltage AC supply to a low voltage DC supply. It is necessary to disable the drive for the transition back to the high voltage AC supply from the low voltage DC supply. 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 4-24 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 4-25 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.

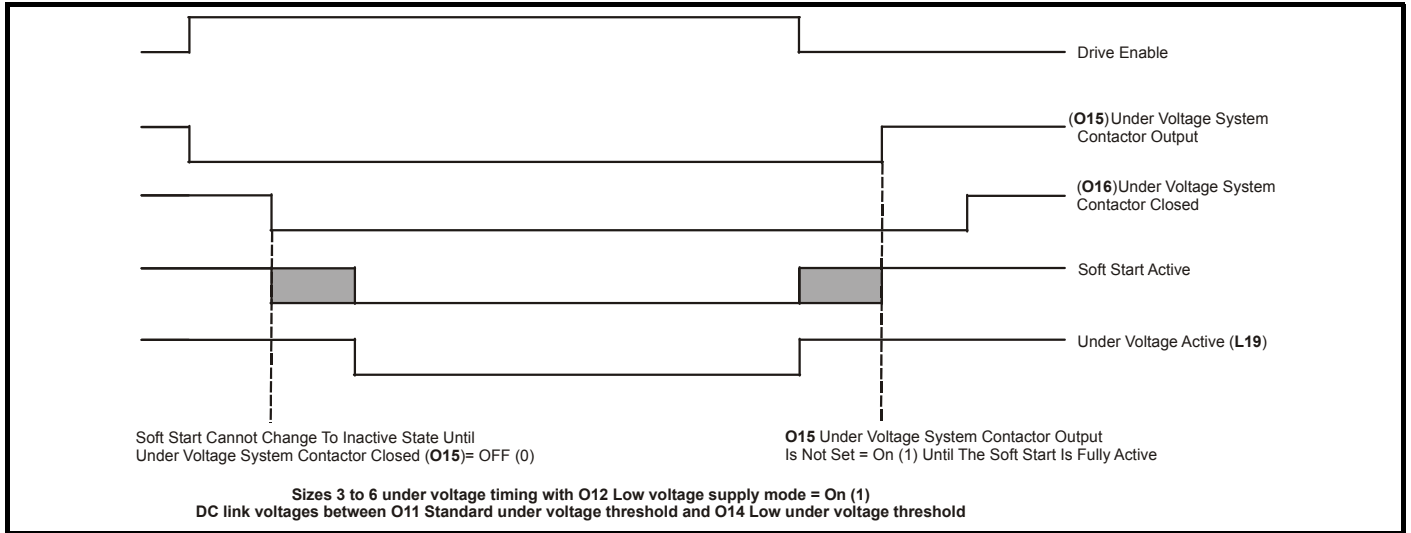
- If **DC Bus Voltage (J65)** is above the **Low Under Voltage Threshold (O14)**, but below the **Standard Under Voltage Threshold (O11)**, there are two possible states depending on the Drive enable = On (1) or Off (0). If the Drive enable = Off (0) then **Under Voltage (L19)** = On (1) the internal 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.
- 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.
- 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:

- 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).
- 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 $\text{Lower Threshold} \leq \text{DC Bus Voltage (J65)}$.

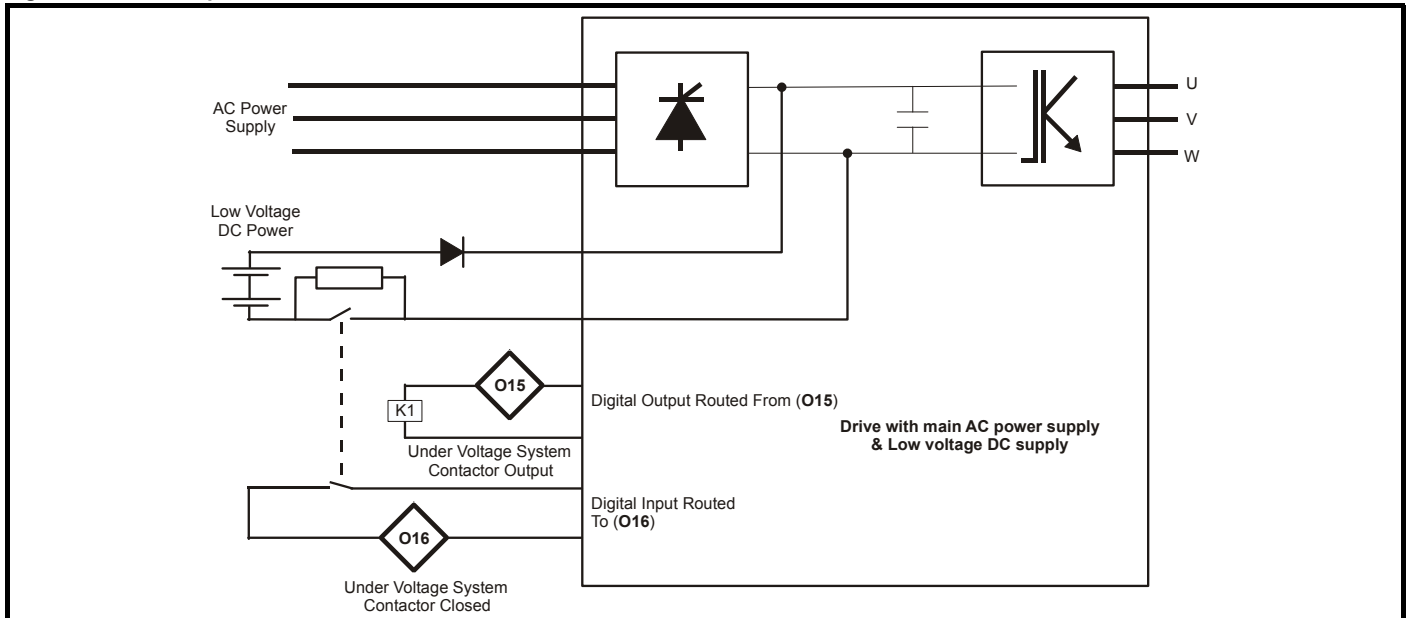
Figure 4-26 Low under voltage timing size 3 to 6



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

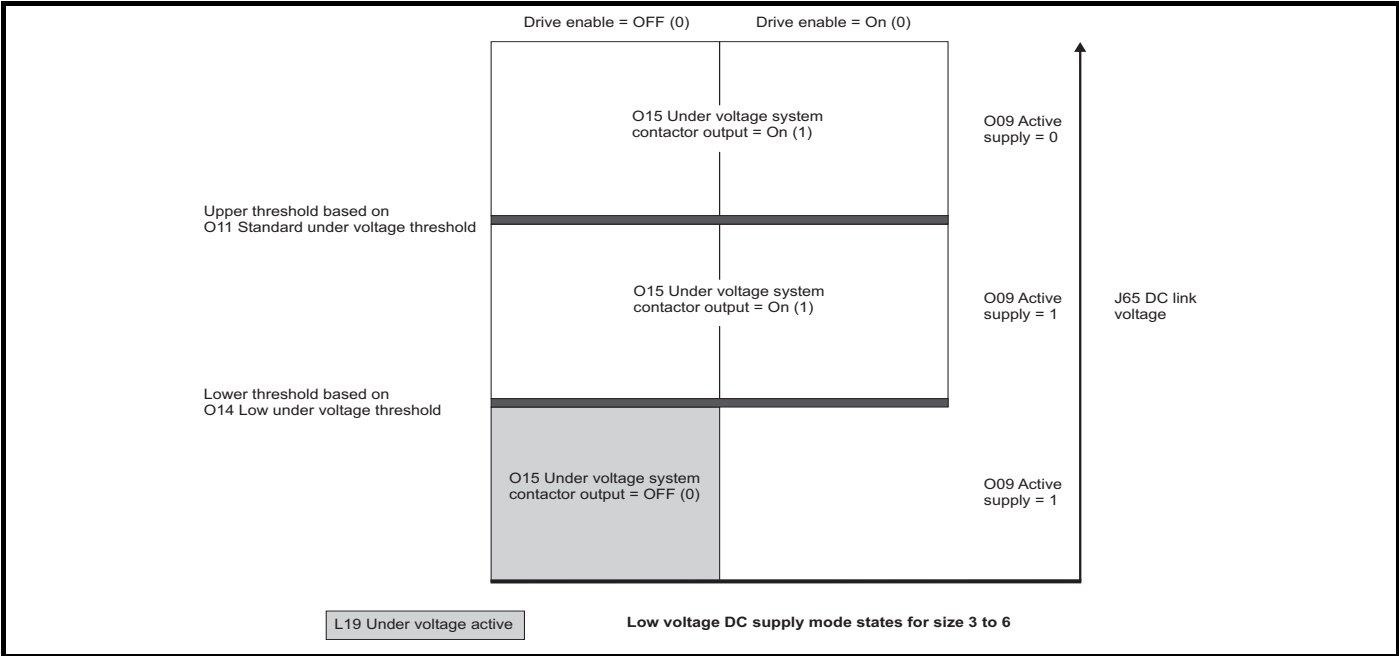
Low voltage mode is intended to provide a smooth transition, without disabling the drive, from a high voltage AC supply to a low voltage DC supply and vice versa. The following diagram is a simple representation of the power circuit required. This does not include the necessary circuit protection components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

Figure 4-27 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 4-28 Low under voltage control size 7

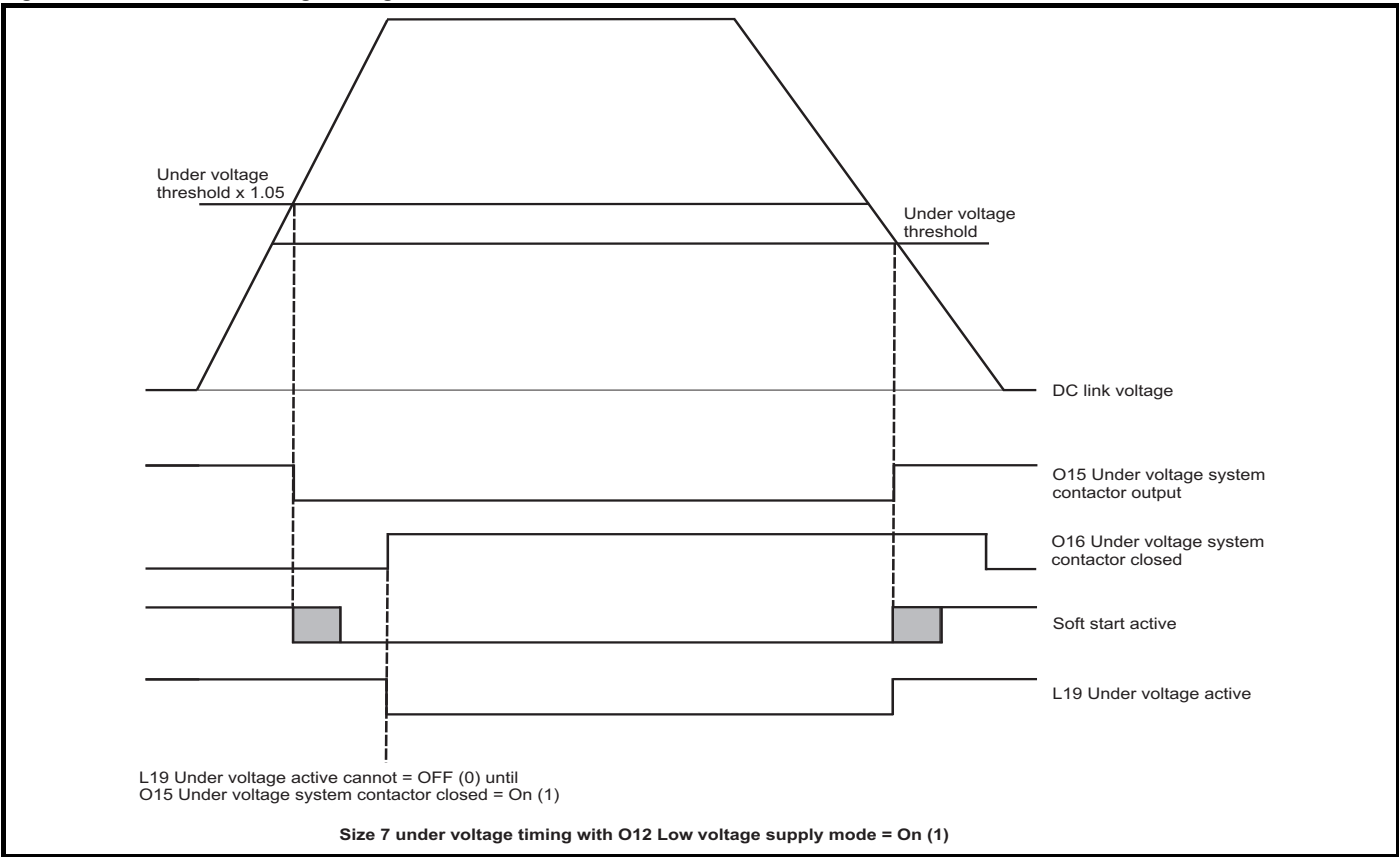


The backup supply system contactor is used to provide the charge system for the low voltage DC supply. The charge system for the high voltage AC supply is provided by the half controlled thyristor input bridge within the drive. The system operates in a similar way to standard mode i.e. low voltage mode 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 4-29 Low under voltage timing size 7



Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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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: 032000050, 032000066, 032000080, 03200106, 034000025, 034000031, 034000045, 034000062

Drive models 034000078 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:

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

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 18

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 10. 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.



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 4-10 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									
03200106										
04200137	6	8	B2	6	8	B2	10	8	10	8
04200185	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										
07200830	70									

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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Table 4-11 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	4	B2	2.5	4	B2	12	10	12	10
03400078							10		10	
03400100							8		8	
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							6		6	
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 4-12 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							6		6	
07500440	16	25	B2	16	25	B2	4	3	4	3
07500550	25			25			3		3	

Table 4-13 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							4		4	
07600440							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.

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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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 μ s. 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.



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 Delta 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



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 86.

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 4-14 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 4-14 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



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.



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
<i>Braking Resistor Rated Power (D15)</i>	Power units in kW and if the rated power is set to zero this protection is disabled
<i>Braking Resistor Thermal Time Constant (D16)</i>	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 = $\tau = E / P$
<i>Braking Resistor Resistance (D18)</i>	Braking resistor resistance in ohms

For more information on the braking resistor software overload protection, see full parameter descriptions in the *E200 Design Guide*.

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 82 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)



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 4-30 Typical protection circuit for a braking resistor* on page 78.

Table 4-15 Braking resistor resistance and power rating (200 V)

Model	Minimum resistance *	Instantaneous power rating	Continuous power rating
	Ω	kW	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 4-16 Braking resistor resistance and power rating (400 V)

Model	Minimum resistance *	Instantaneous power rating	Continuous power rating
	Ω	kW	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 4-17 Braking resistor resistance and power rating (575 V)

Model	Minimum resistance *	Instantaneous power rating	Continuous power rating
	Ω	kW	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 4-18 Braking resistor resistance and power rating (690 V)

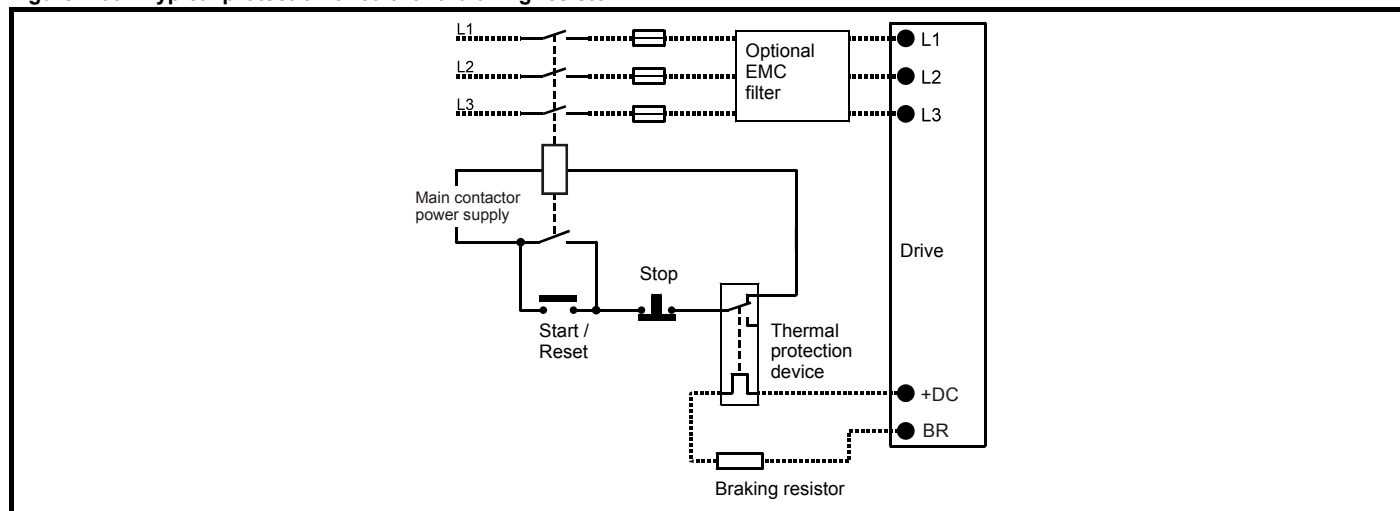
Model	Minimum resistance *	Instantaneous power rating	Continuous power rating
	Ω	kW	kW
07600190	11.5	121.2	20.6
07600240			23.9
07600290			32.5
07600380			41.5
07600440			47.8
07600540			60.5

* Resistor tolerance: $\pm 10\%$

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 4-30 shows a typical circuit arrangement.

Figure 4-30 Typical protection circuit for a braking resistor



See section 4.3 *Power connections* on page 42 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 3.7.1 *Internal EMC filter* on page 31.

With internal filter installed:

- Size 3 to 5:** 28 mA* AC at 400 V 50 Hz
30 μ A DC with a 600 V DC bus (10 M Ω)
- Size 7 to 10:** 56 mA* AC at 400 V 50 Hz
18 μ A DC with a 600 V DC bus (33 M Ω)

* 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



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 the *E200 Design Guide*.

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 Declaration of Conformity in the *E200 Design Guide*

The correct external EMC filter must be used for further details refer to section 2.10 *EMC filters* on page 17.



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

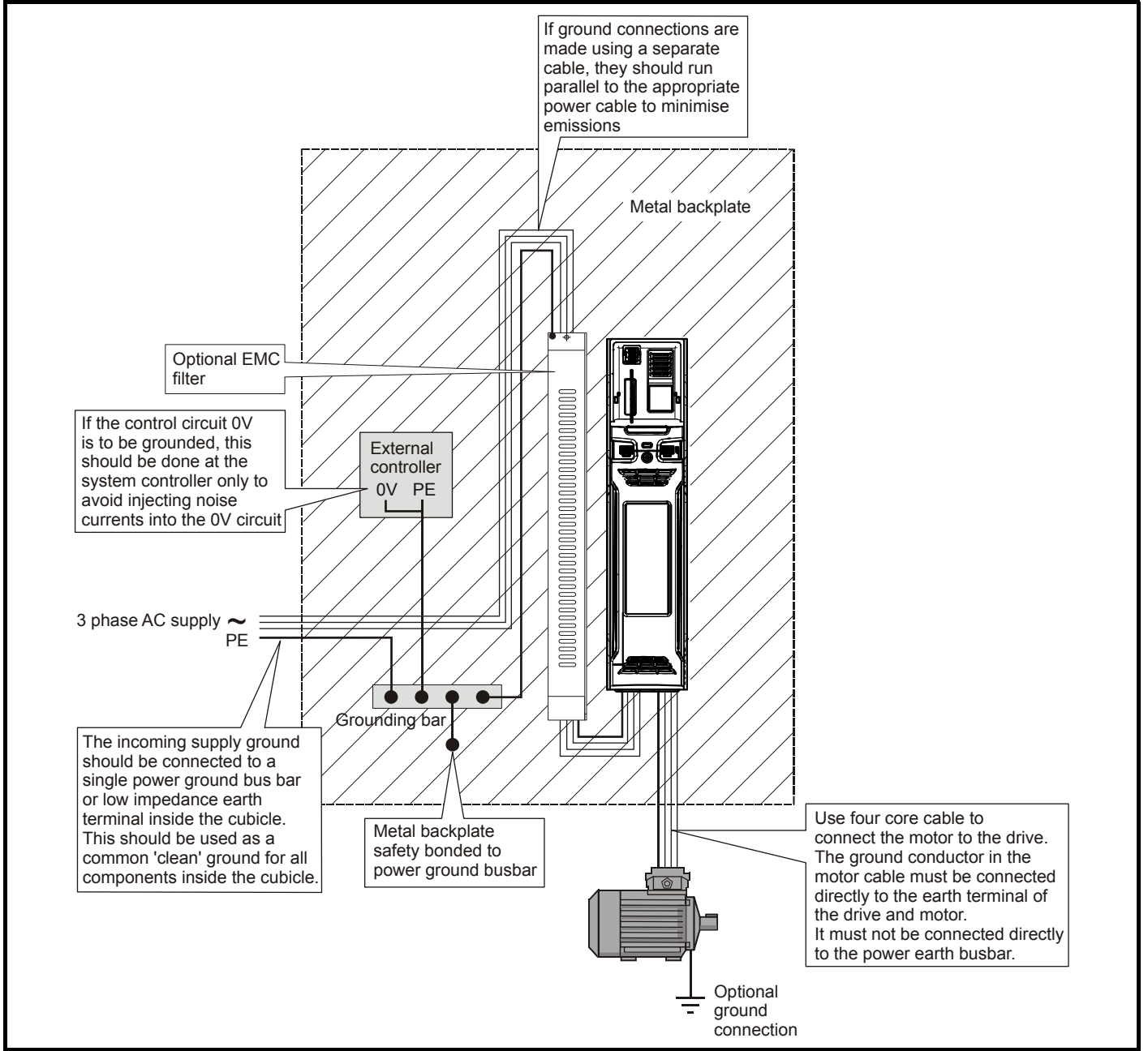
The installer of the drive is responsible for ensuring compliance with the EMC regulations that apply in the country in which the drive is to be used.

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 4-31 *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 82.

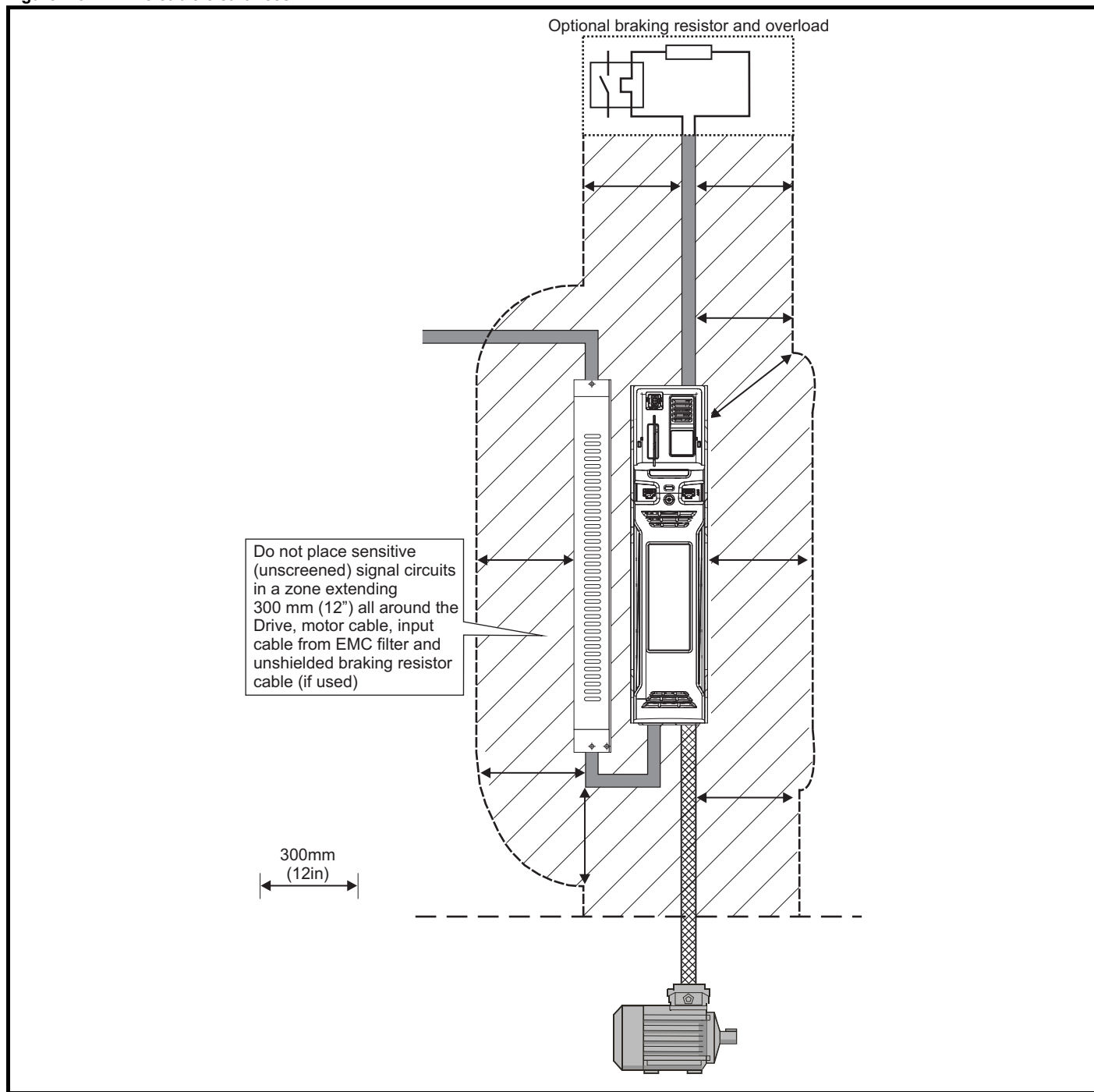
Figure 4-31 General EMC enclosure layout showing ground connections



4.17.1 Cable layout

Figure 4-32 *Drive cable clearances* shows the clearances which should be observed around the drive and related 'noisy' power cables by all sensitive control signals / equipment.

Figure 4-32 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.



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.

CAUTION

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 80.



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 82 be adhered to.

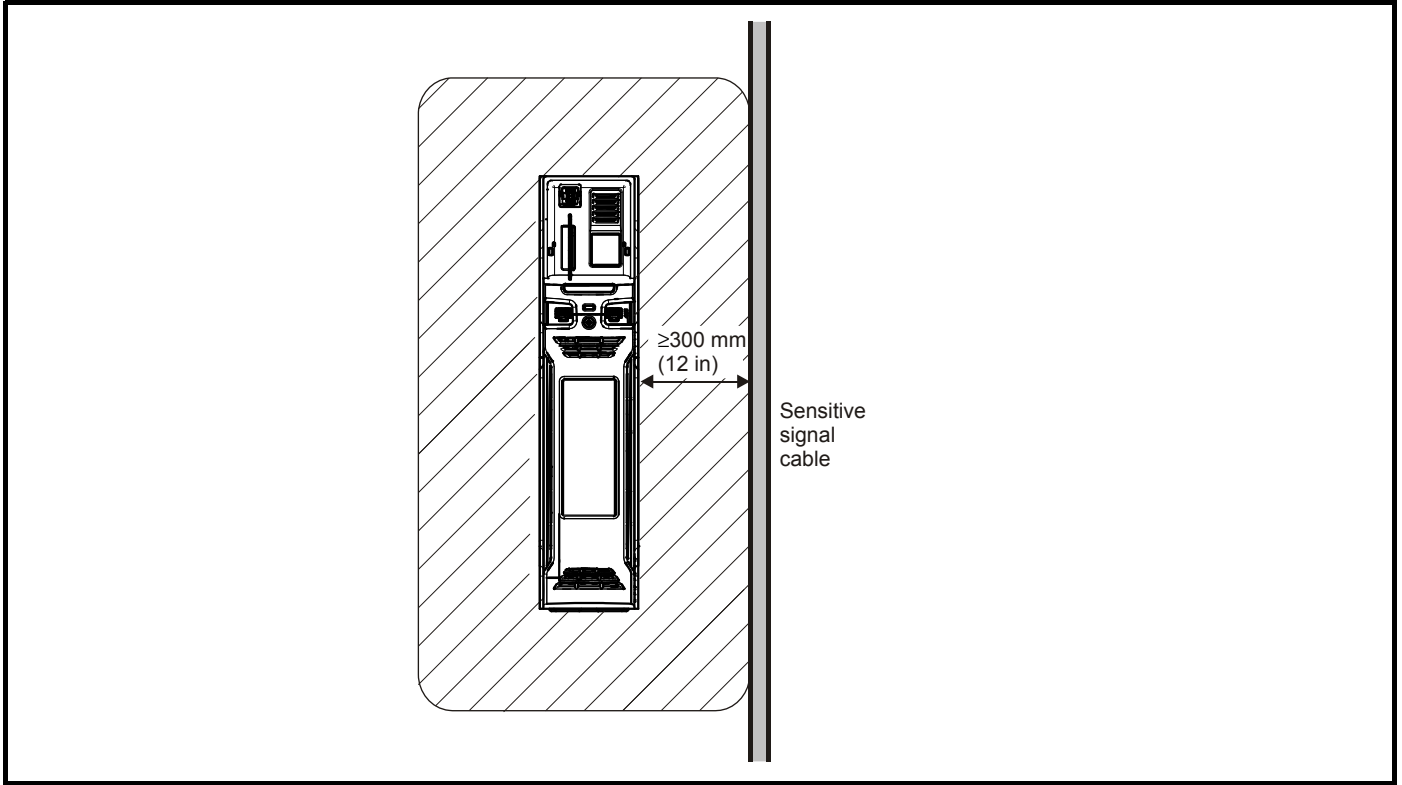
CAUTION

Detailed instructions and EMC information are given in the *E200 Design Guide* which is available from the supplier of the drive.

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 4-33 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 4-34 Grounding the drive, motor cable shield and filter

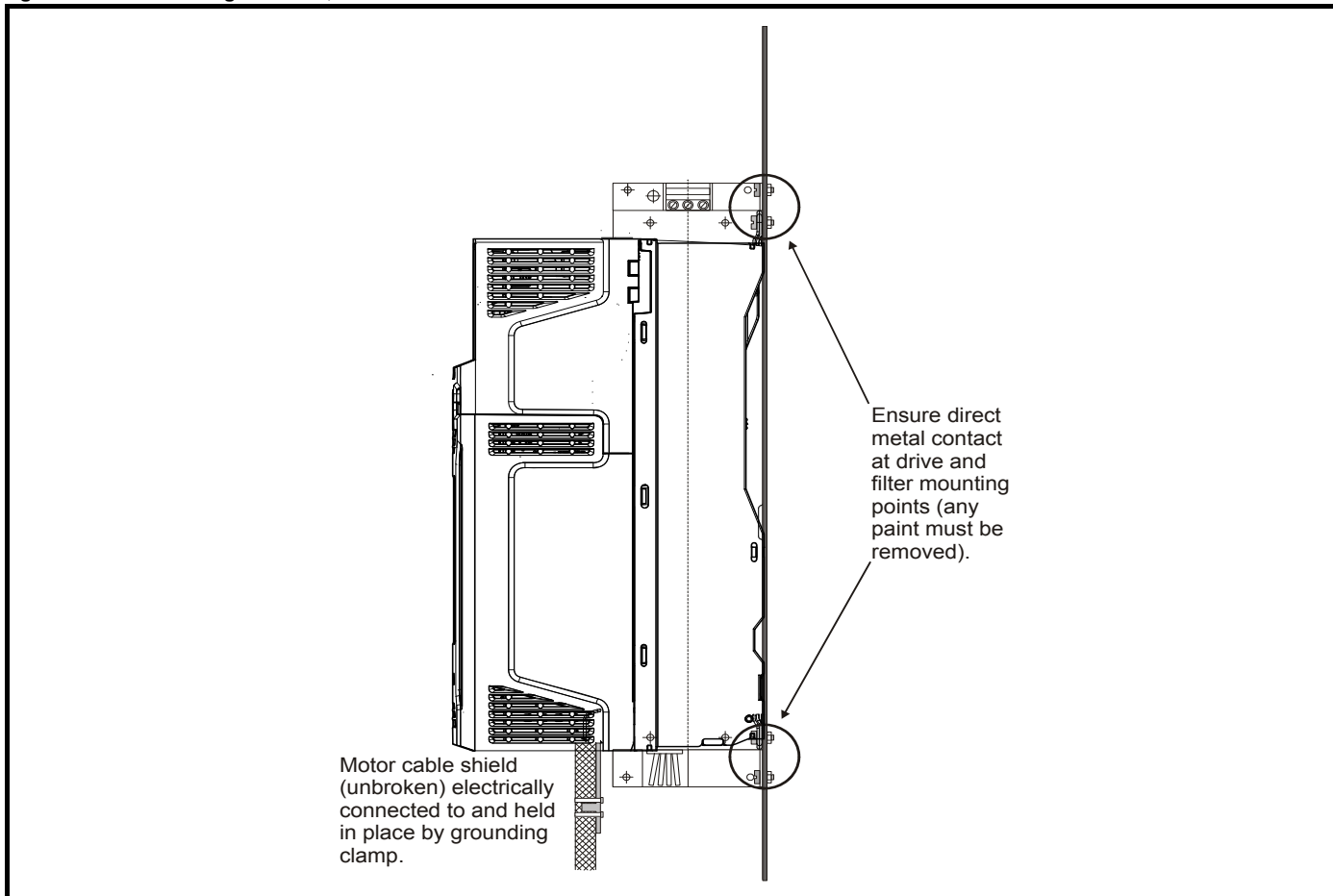
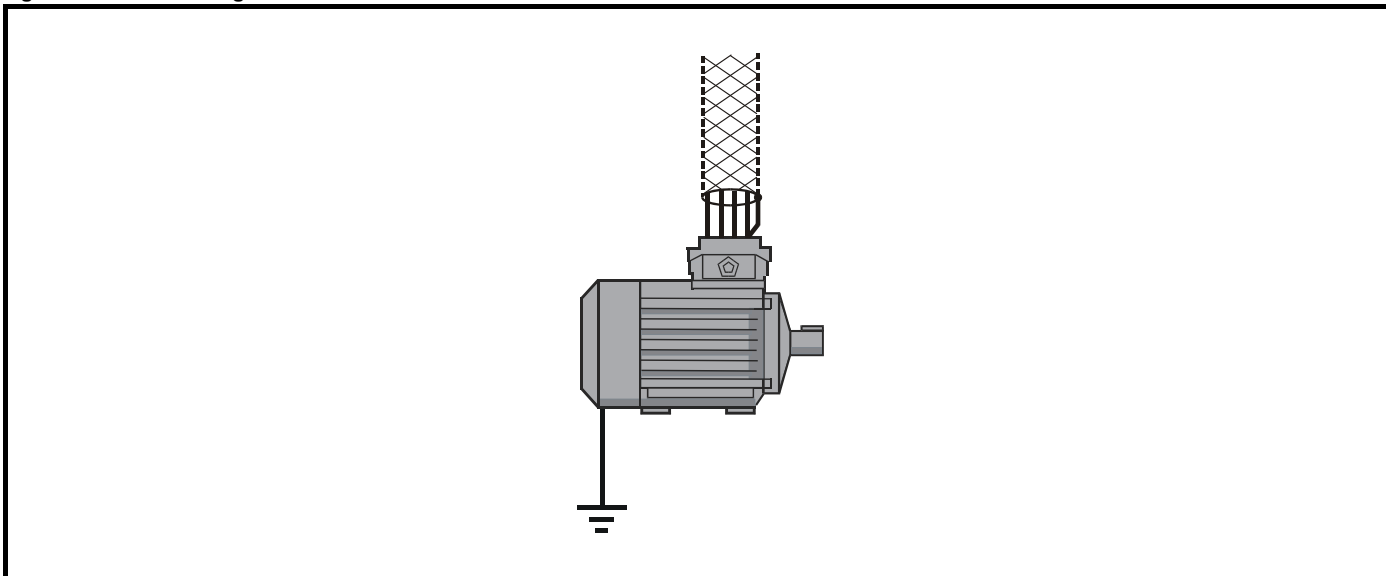


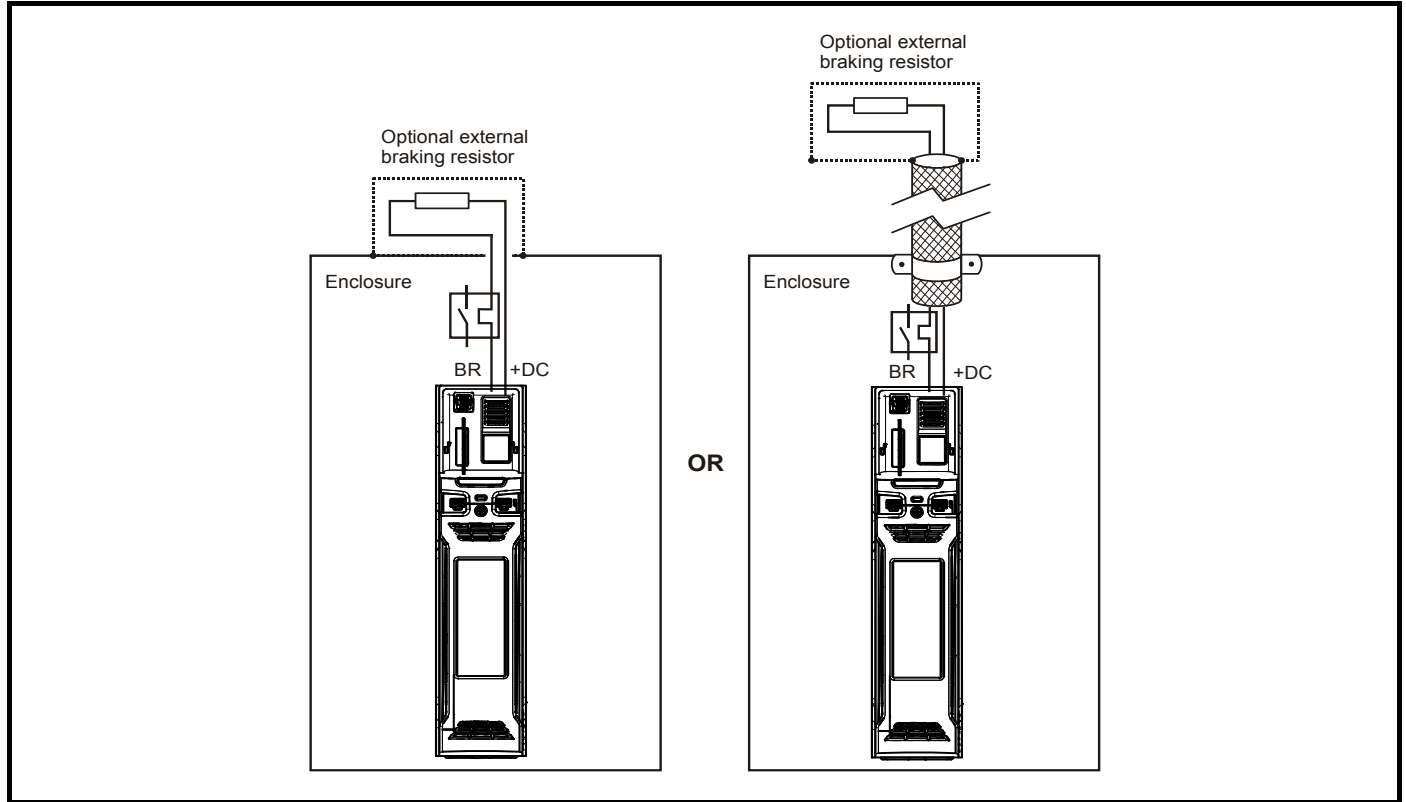
Figure 4-35 Grounding the motor cable shield



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.

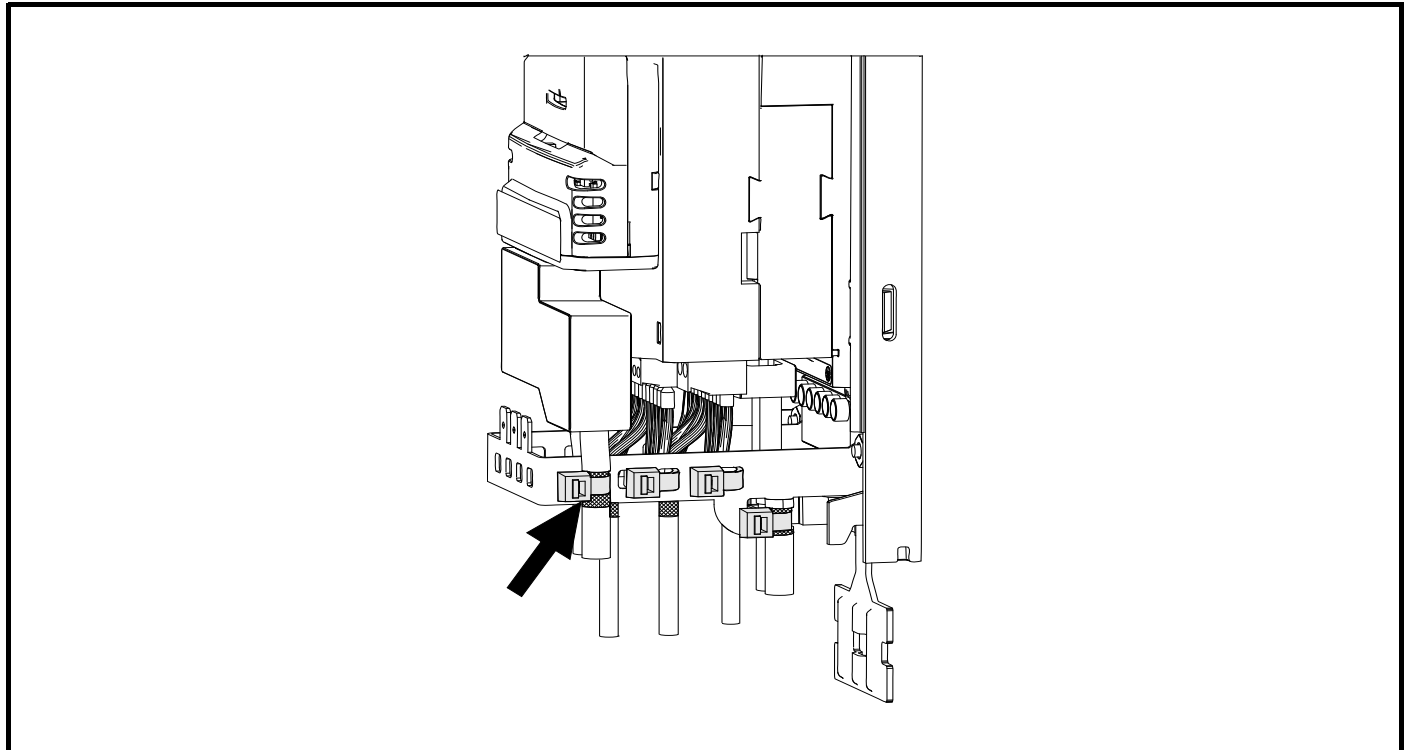
Figure 4-36 Shielding requirements of optional external braking resistor



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 4-37 *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. Keep the shield(s) intact until as close as possible to the terminals. Alternatively, wiring may be passed through a ferrite ring.

Figure 4-37 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:

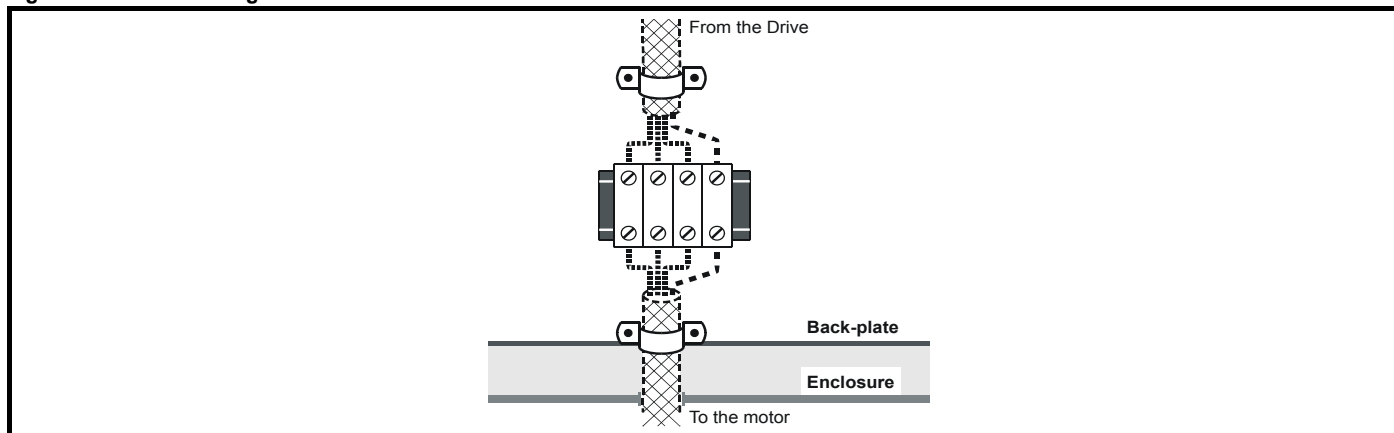
- Connecting the motor cable to a terminal block in the drive enclosure
- Installing a motor isolator / disconnect switch for safety when work is done on the motor

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.

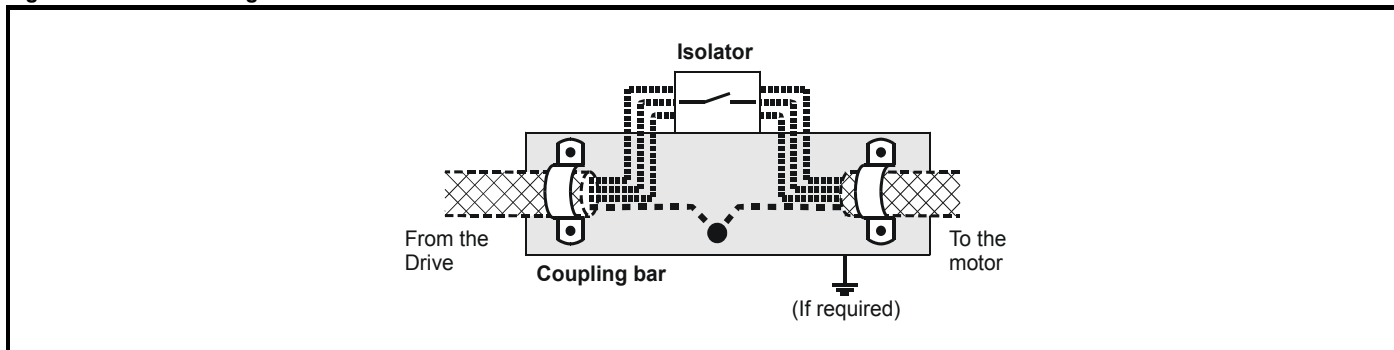
Figure 4-38 Connecting the motor cable to a terminal block in the enclosure



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 4-39 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 *Number Of Auto-reset Attempts (H46)* > 0.

Figure 4-40 Surge suppression for digital and unipolar inputs and outputs

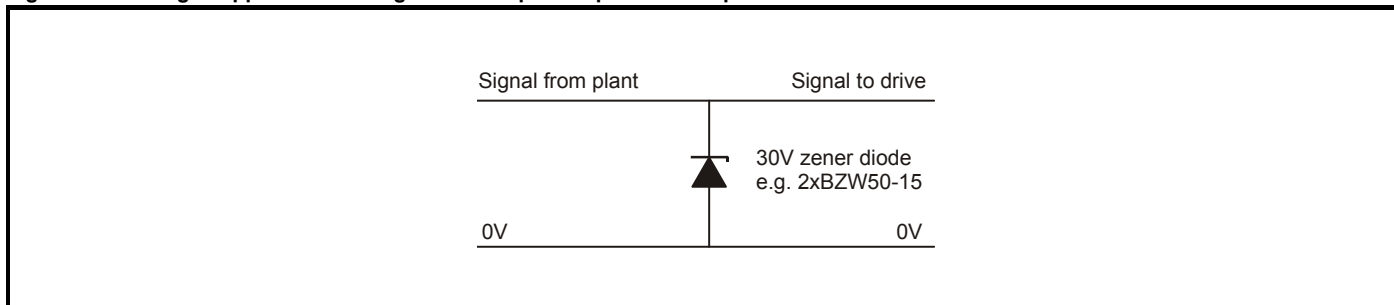
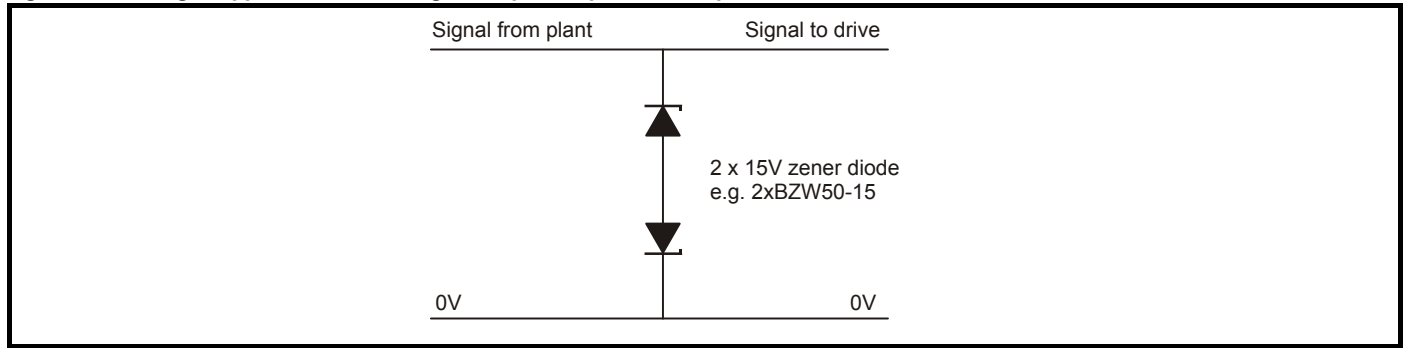


Figure 4-41 Surge suppression for analog and bipolar inputs and outputs



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 PDS(SR):

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

The Safe Torque Off (STO) input also meets the requirements of EN 81-1 (clause 12.7.3 b) as part of a system for preventing unwanted operation of the motor in a 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.

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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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.



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.



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.



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.



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

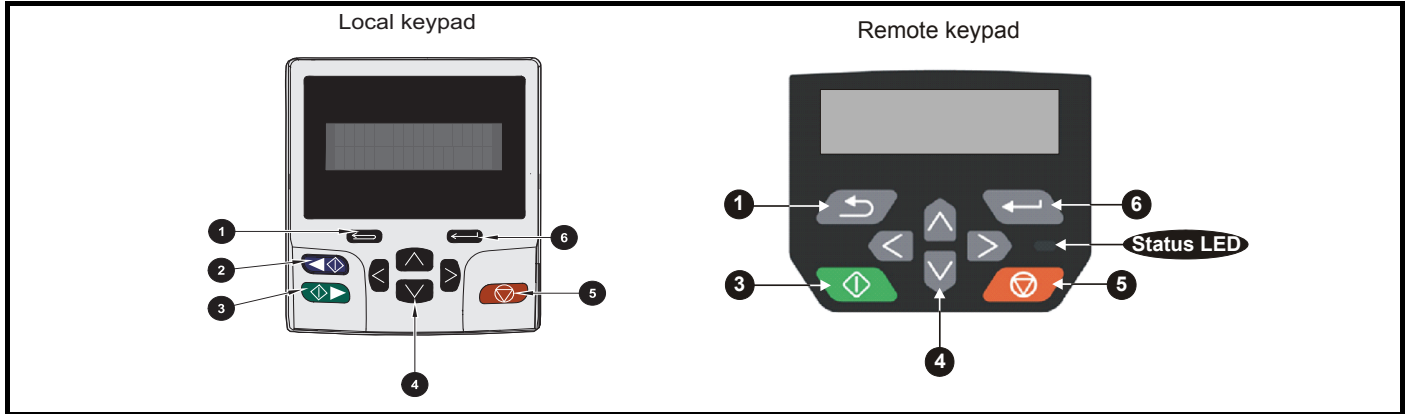


Incorrect operation

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 the *Installation And Commissioning 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.

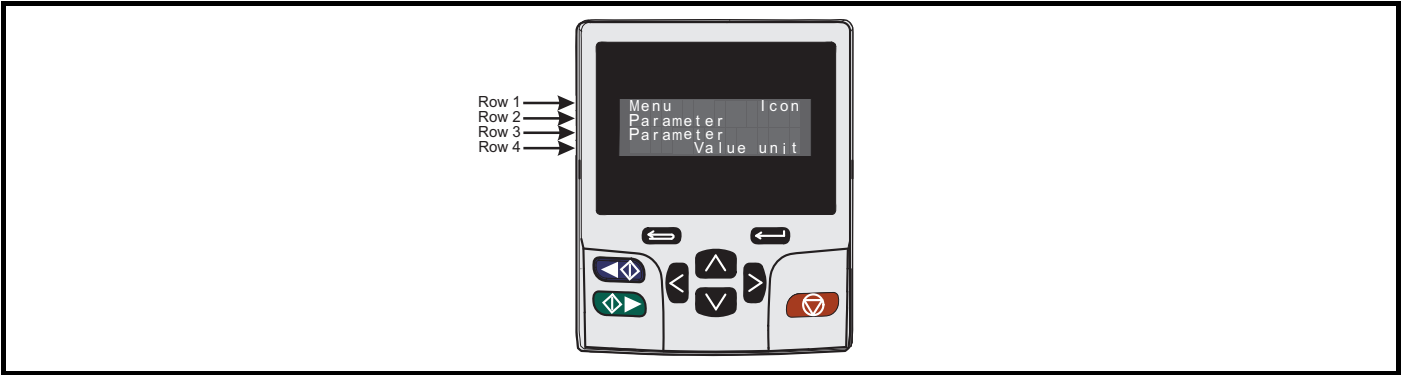
Table 5-1 Keypad set-up parameters

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 *Keypad special indication icon priority* .

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 89 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.

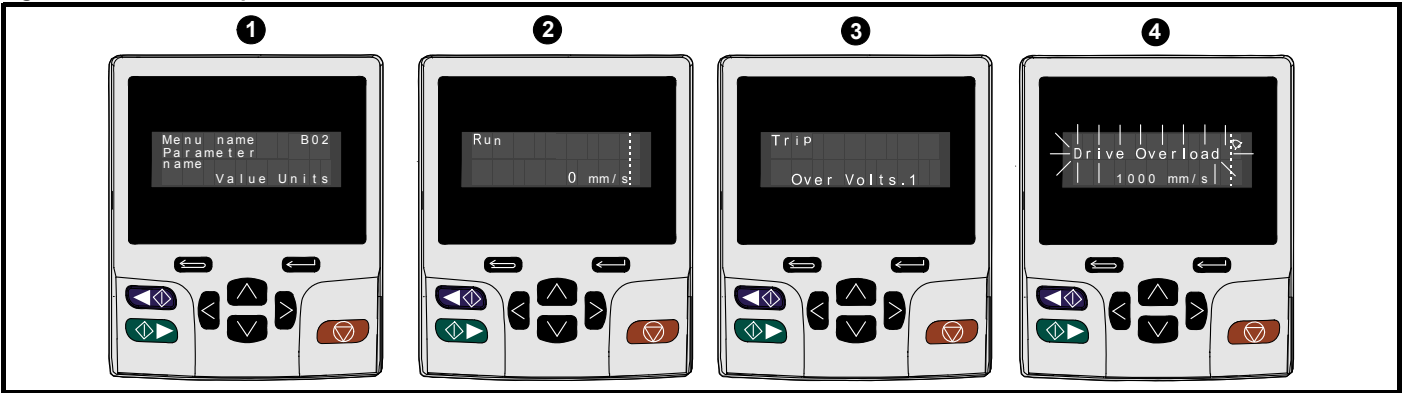
3. Trip status mode

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



Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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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. <i>Braking Resistor Thermal Accumulator (D17)</i> has reached 75.0 % of the value at which the drive will trip.
Motor Overload	<i>Motor Protection Accumulator (J26)</i> 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. <i>Percentage Of Drive Thermal Trip Level (J79)</i> 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 *Security, Parameter access level*

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



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

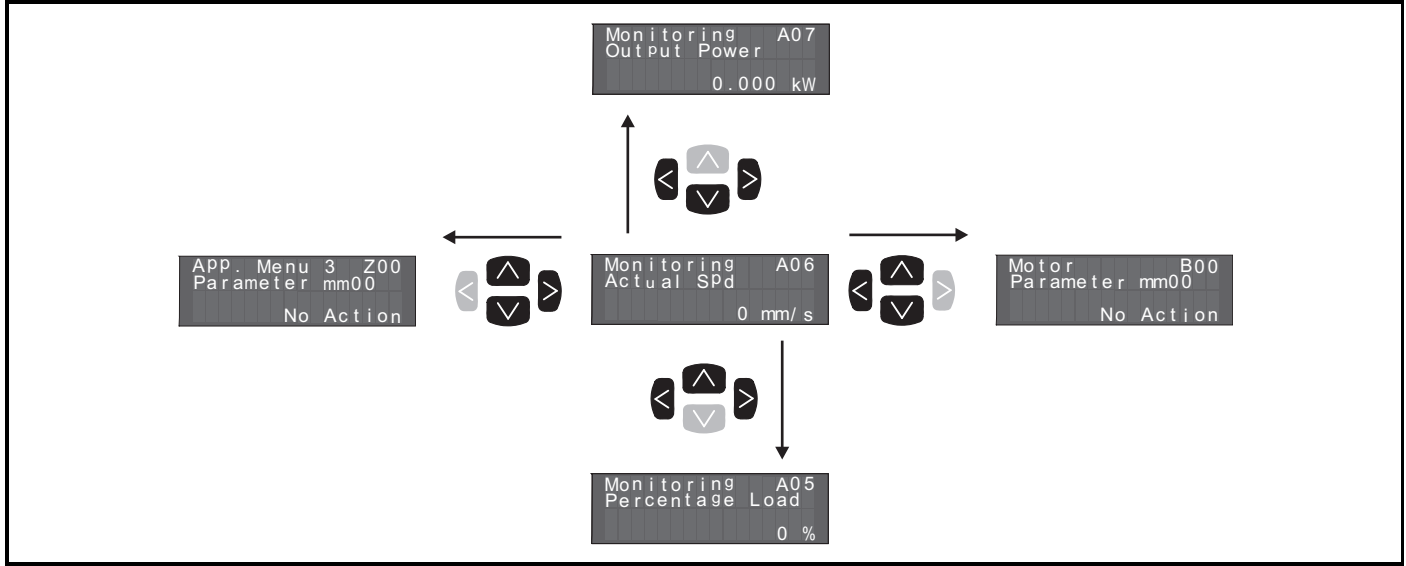
The drive parameter structure consists of menus and parameters, which at power up displays the User Menu A due to the default security, parameter access level in *User Security Status (H02)*.

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.

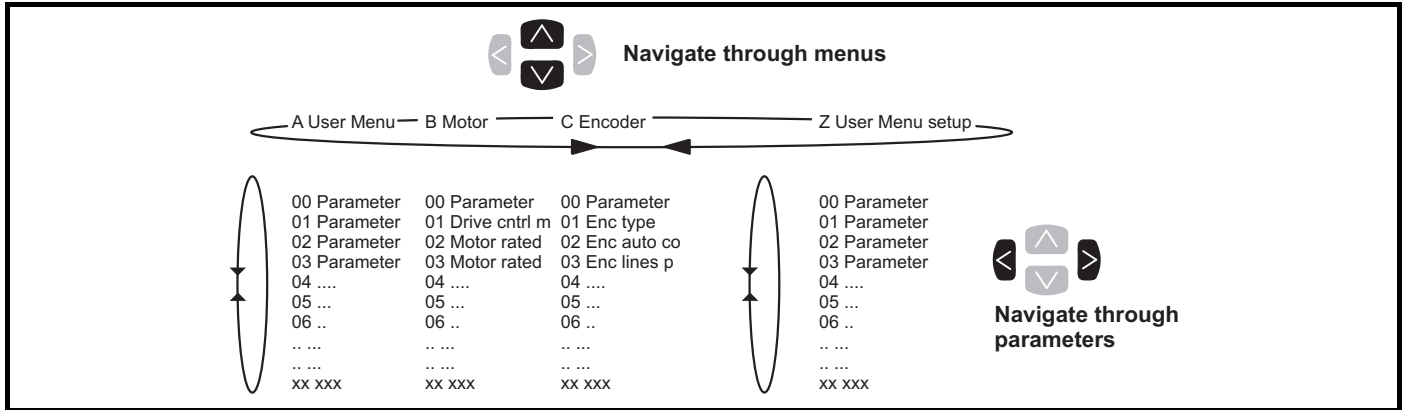
The security and parameter access in *User Security Status (H02)* should be set to 'All Menus'.

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 91. 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 91.

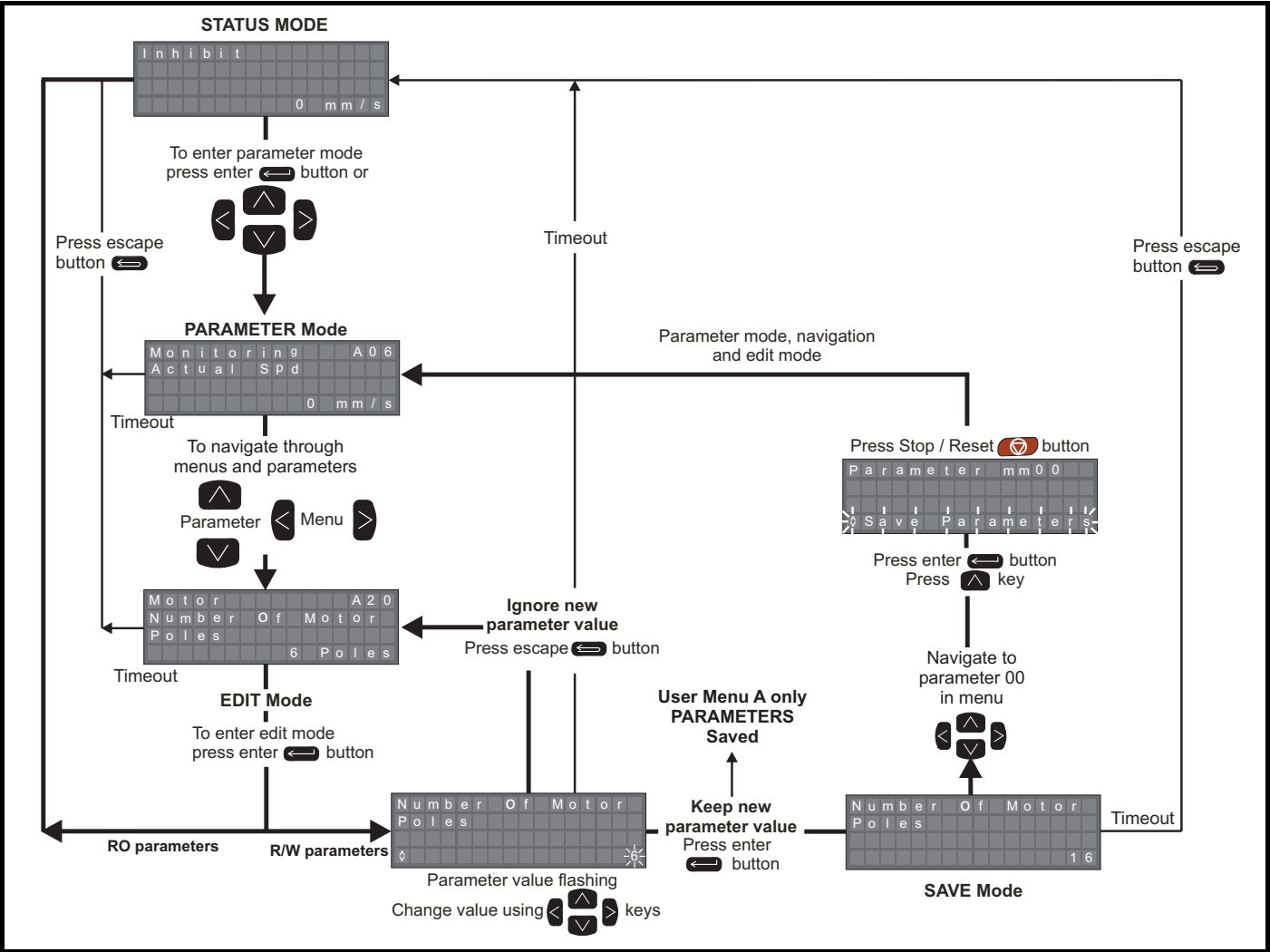
5.11 Displaying non default parameters

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 91.

Figure 5-6 Display modes



5.12 Menus and parameters

5.12.1 Menu and 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.

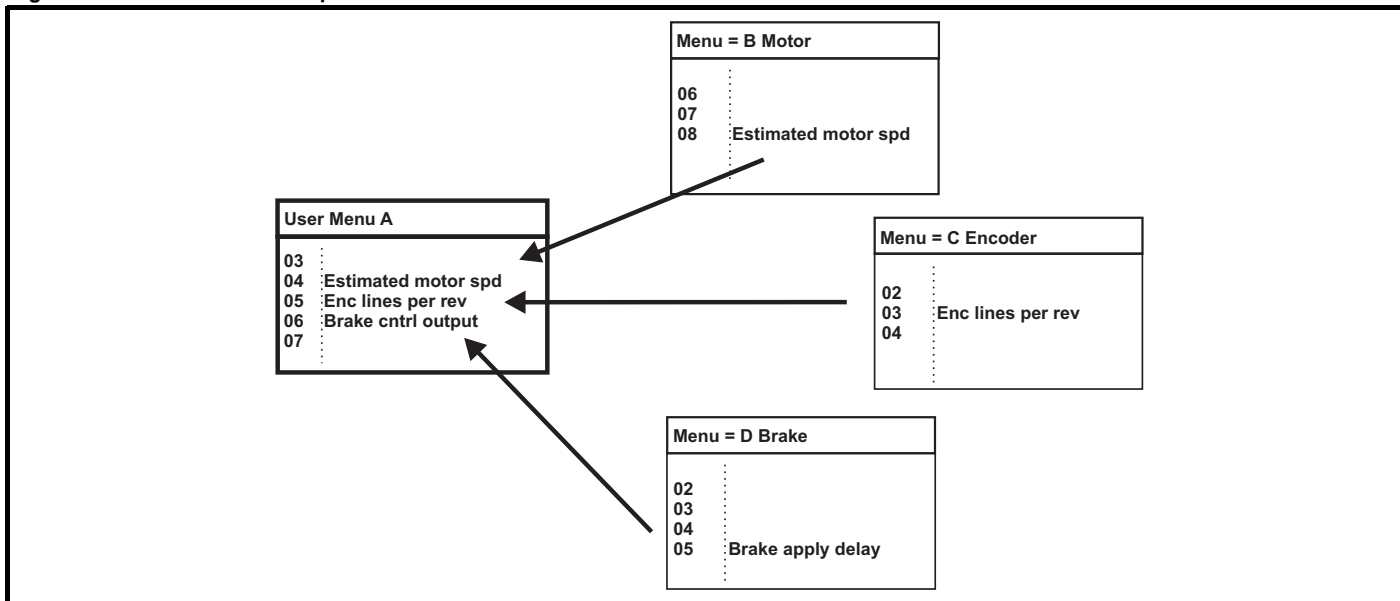
Table 5-8 Full menu descriptions

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 the 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 104

5.16 NV Media Card operation

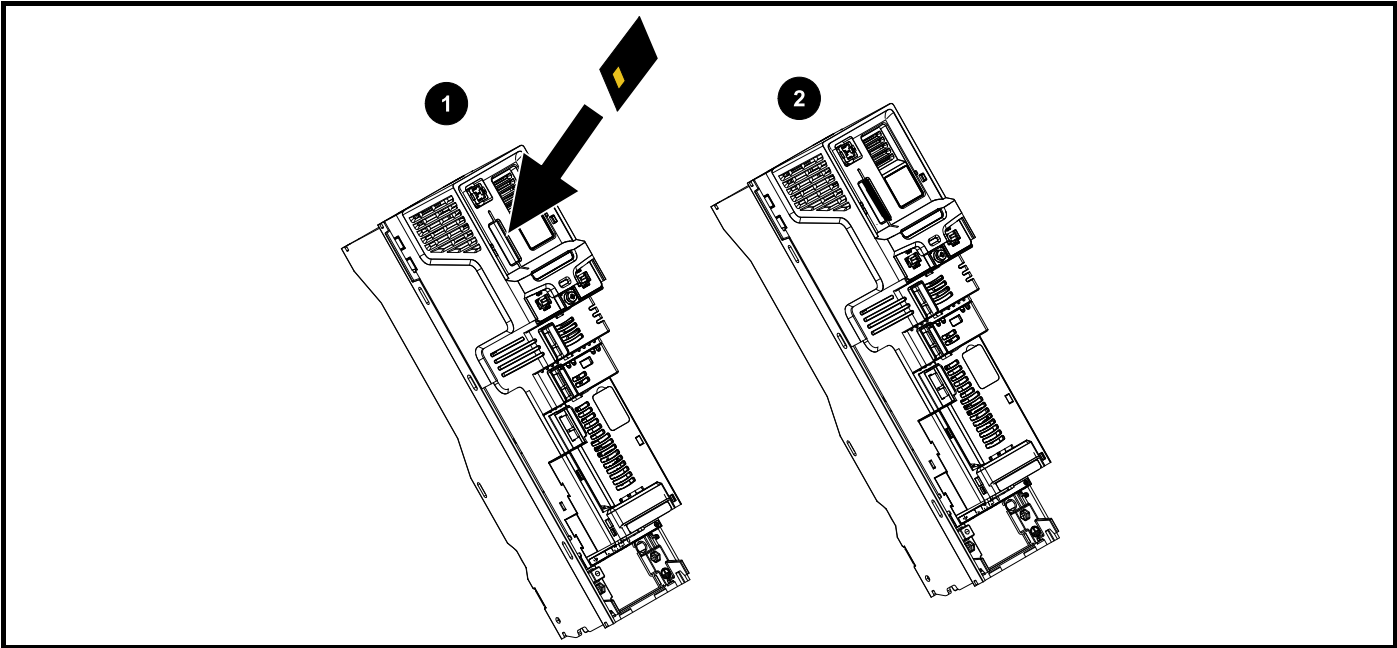


WARNING

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 copying. 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

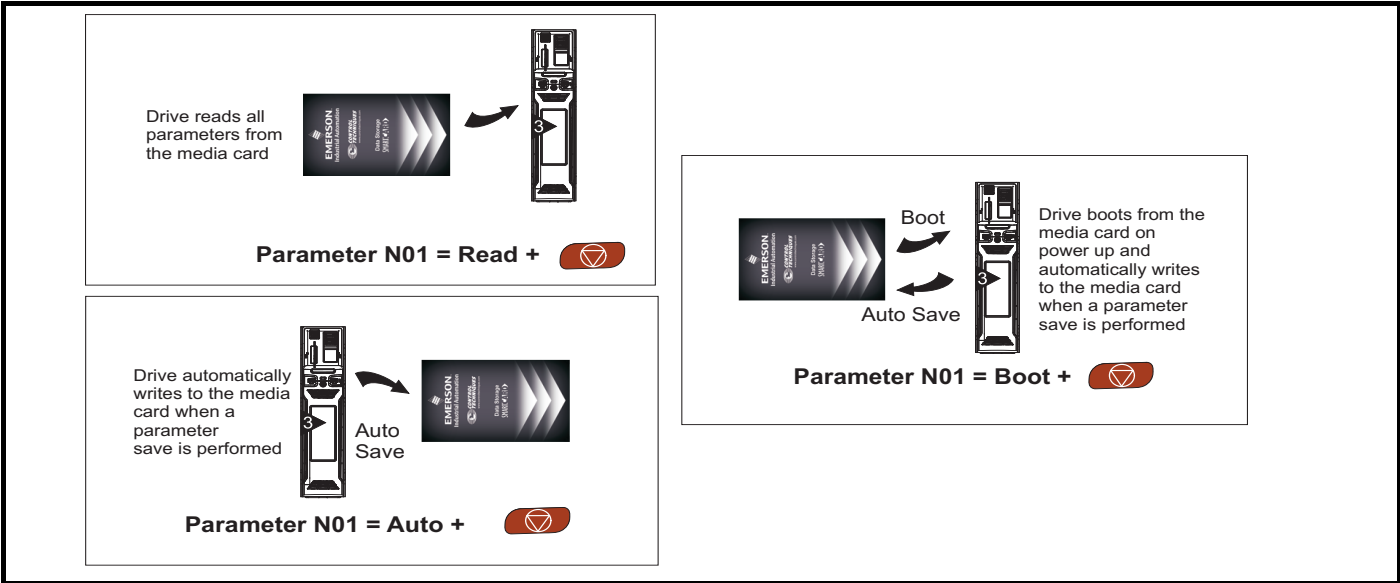


Table 5-10 NV Media Card part numbers

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 499.

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.

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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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
B34	Stator Resistance
B13	Maximum Switching Frequency
B34	Transient Inductance
B36	Stator Inductance
D18	Injection Braking 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 communications option and comms cable are required.

See section 5.20.1 *485 Serial communications* on page 101 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 48 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/deslect the terminating resistor within a non-CT converter, depending on which type is used.

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 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.

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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Register mode	Register address
Standard	$(M \times 100) + ppp - 1$ Where M is the effective menu number (A = 0, B = 1, C = 2 etc.) ≤ 162 and $pp \leq 99$
Modified	$(M \times 100) + ppp - 1$ Where M is the effective menu number (A = 0, B = 1, C = 2 etc.) ≤ 63 and $ppp \leq 255$

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 <i>Minimum Comms Transmit Delay (M04)</i> 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)*, *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.

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 Standard 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.



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 the *E300 Design 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

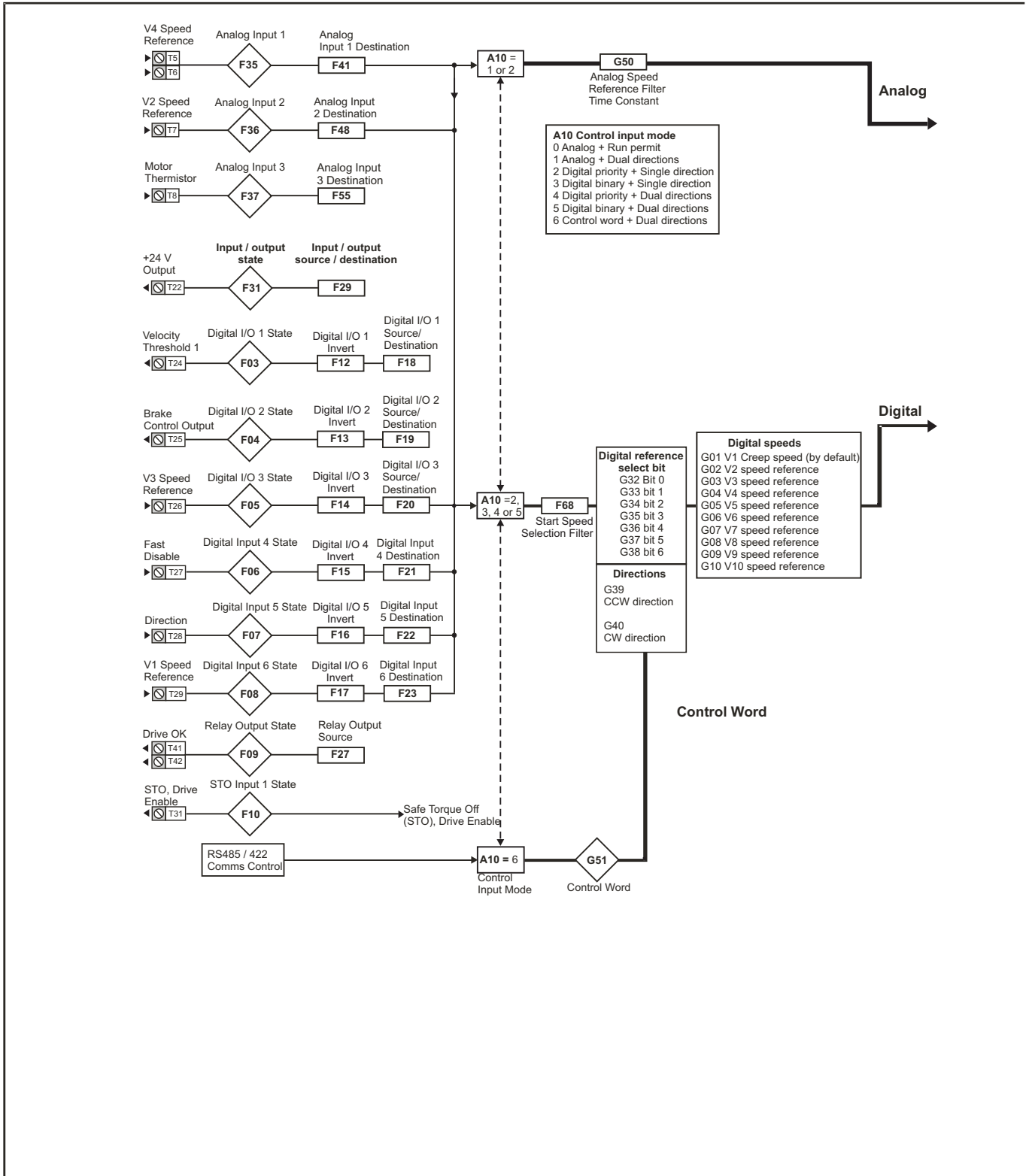
Parameter			Range(⇅)			Default(⇔)			Type					
			OL	RFC-A	RFC-S	OL	RFC-A	RFC-S						
A00	Parameter	{A00}	0 to 65535						RW	Num	ND	NC	PT	
A01	User Security Status	{H02}	User Menu A (0), All Menus (1), Read-only User Menu A (2), Read-only (3), Status Only (4), No Access (5)						RW	Txt	ND		PT	
A02	Drive 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)			Off (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

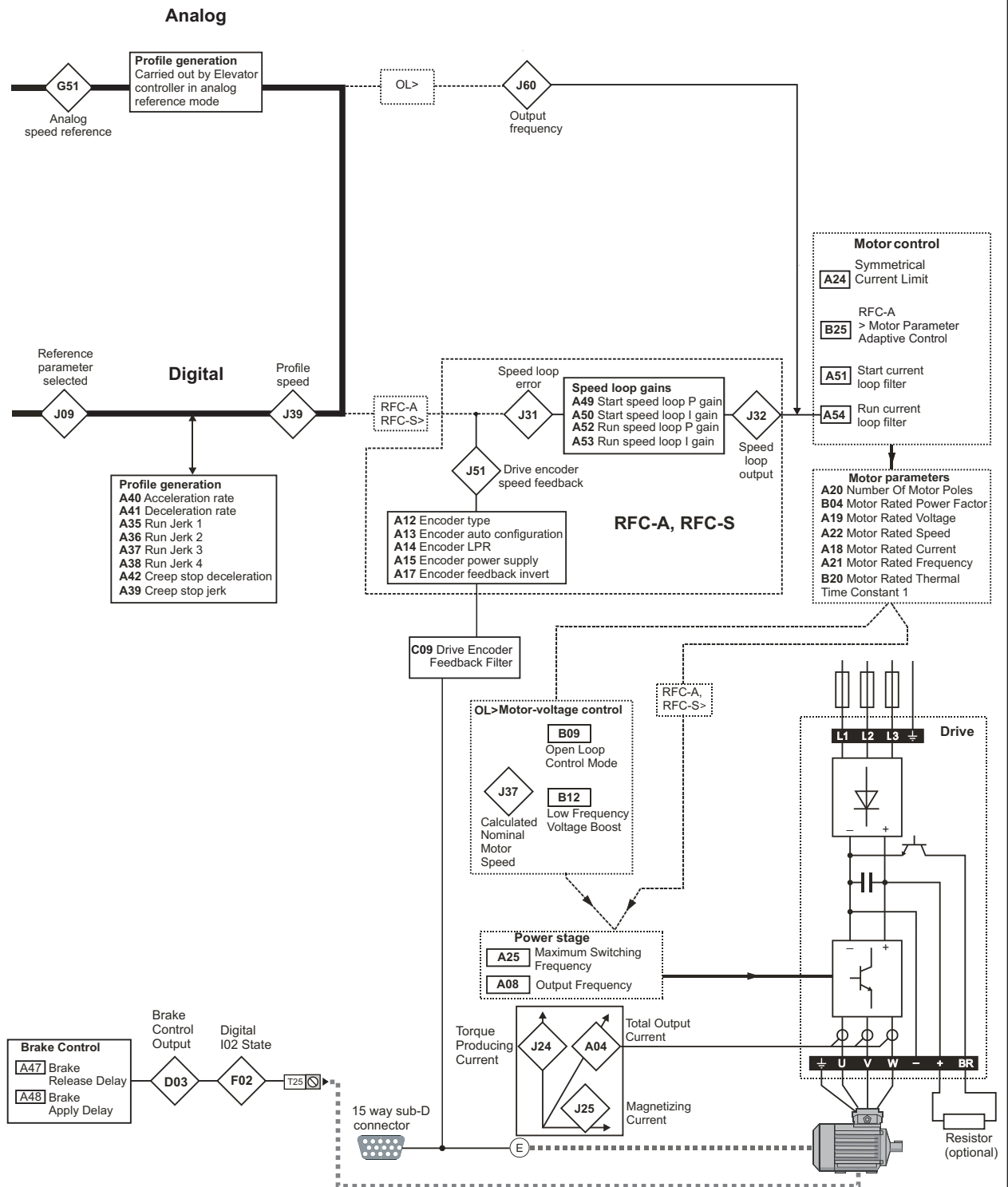
Safety information		Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning		Optimization		Diagnostics			
Parameter			Range(⇅)			Default(⇒)			Type					
			OL	RFC-A	RFC-S	OL	RFC-A	RFC-S						
A21	Motor Rated Frequency	{B06}	0.0 to 550.0 Hz			50 Hz: 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)			Off (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

Safety information		Product information		Mechanical installation		Electrical installation		Getting started		User Menu A		Commissioning		Optimization		Diagnostics	
Parameter			Range(⇅)			Default(⇆)			Type								
			OL	RFC-A	RFC-S	OL	RFC-A	RFC-S									
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





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 <i>Under Voltage</i> is not active and <i>Low Under Voltage Threshold Select</i> 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	↕	User Menu A (0), All Menus (1), Read-only User Menu A (2), Read-only (3), Status Only (4), No Access (5)			⇒				
RFC-A									
RFC-S									

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	↕	None (0), Read (1), Program (2), Auto (3), Boot (4)			⇒	None (0)			
RFC-A									
RFC-S									

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 installed 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	⇕				⇒			
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		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)							
RFC-A									
RFC-S	⇕								
				⇒		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							
RFC-A	⇕	Off (0) or On (1)				⇒	Off (0)
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 $\frac{1}{3}$ 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.

$$\text{Rated slip (Hz)} = \text{Motor Rated Frequency} - (\text{Motor pole pairs} \times \text{Motor rated speed} / 60)$$

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		
RFC-A							60 Hz default: 1800 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) in the *E200 Design Guide*).

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) in the *E200 Design Guide*.

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) / $\sqrt{2}$. 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. For further details refer to the *E200 Design Guide*.

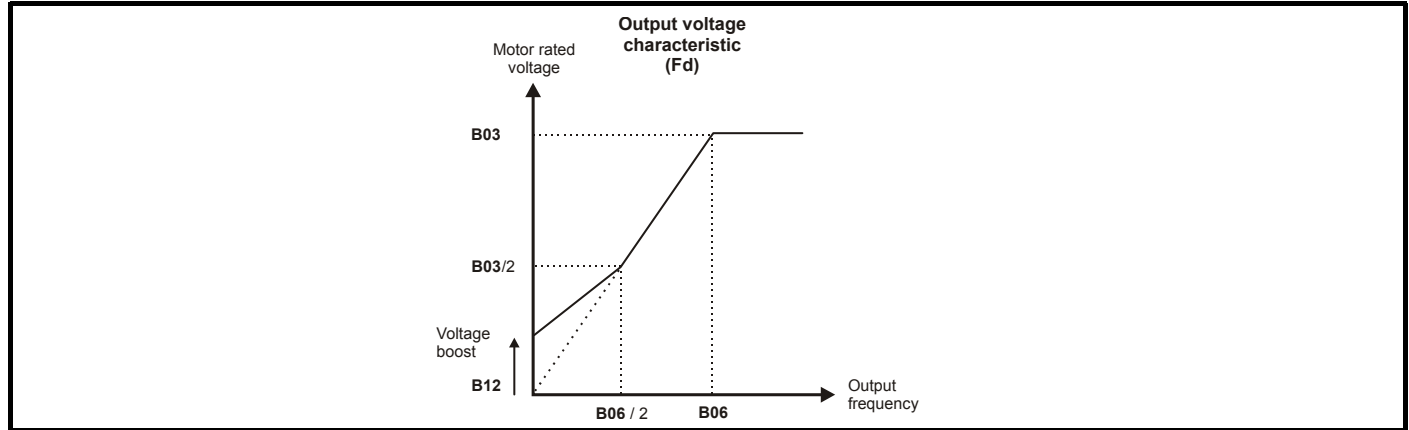
0: Ur S (Resistance compensation, stator resistance measured at each start) Resistance compensation is a form of stator flux oriented sensorless motor control. A linear frequency to voltage characteristic is used where the drive output voltage is increased from 0 V to **A19 (Motor Rated Voltage B03)** 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 ($\pm$ VM_MOTOR1_CURRENT_LIMIT %) varies between drive sizes with default parameters loaded.



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, refer to the *E200 Design Guide* for the maximum available switching frequencies for each drive rating.

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								
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.



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.



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 not be used, however for sensorless mode, or if the speed controller cannot be set-up for stable operation.

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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- 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							
RFC-A	⇕	Off (0) On (1)				⇒ Off (0)	
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:

$$A = (B \times D \times E \times 60) / (\pi \times C \times F)$$

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}		Run Jerk 1									
A36 {G14}		Run Jerk 2									
A37 {G15}		Run Jerk 3									
A38 {G16}		Run Jerk 4									
A39 {G18}		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				
RFC-S							100 mm/s ³ x10				
							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/s³ x 10

Run Jerk 2 is the end of acceleration jerk rate, and is set in mm/s³ x 10

Run Jerk 3 is the start of deceleration jerk rate, and is set in mm/s³ x 10

Run Jerk 4 is the end of deceleration jerk rate, and is set in mm/s³ x 10

Creep stop jerk is the final positioning jerk used for transition from Creep speed to stop, and is set in mm/s³ x 10

If a value of 0 mm/s³ 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}		Acceleration Rate						
A41 {G12}		Deceleration Rate						
RW	Num							US
OL	⇕	0 to 10000 mm/s ²			⇒	800 mm/s ² 500 mm/s ²		
RFC-A								
RFC-S								

A40 (Acceleration Rate G11)

A41 (Deceleration Rate G12)

These are the acceleration and deceleration rates set in mm/s². 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	⇕	0 to 10000 mm/s ²			⇒	1000 mm/s ²		
RFC-A								
RFC-S								

A42 (Creep Stop Deceleration G17)

This is the final positioning deceleration rate from Creep speed to a stop and is set in mm/s². 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}		V1 Speed Reference						
A44 {G02}		V2 Speed Reference						
A45 {G03}		V3 Speed Reference						
A46 {G04}		V4 Speed Reference						
RW	Num							US
OL	⇕	0 to Nominal Elevator Speed (A28)			⇒	50 mm/s 400 mm/s 600 mm/s 10 mm/s		
RFC-A								
RFC-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 for* 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}		Brake Control Release Delay						
A48 {D05}		Brake Control Apply Delay						
RW	Num							US
OL	⇕	0 to 10000 ms			⇒	500 ms		
RFC-A								
RFC-S								

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).

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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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	⇅	0.0000 to 200.0000 s/rad			⇒	P - 0.0300 s/rad		
RFC-S		0.00 to 655.35 s ² /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	⇅	0.0 to 25.0 ms			⇒	1.0 ms		
RFC-S								

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	⇅	0.0000 to 200.0000 s/rad			⇒	P - 0.0300 s/rad		
RFC-S		0.00 to 655.35 s ² /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	⇅	0.0 to 25.0 ms			⇒	1.0 ms		
RFC-S								

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_				⇒	10 mm/s³ x10		
RFC-S		1 mm/s³ x10							

A59 (Start Optimizer Jerk G47)

This parameter sets the start optimizer jerk in mm/s³. 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									
RFC-A	⇅	0 to 10000 mm/s				⇒	50 mm/s		
RFC-S							10 mm/s		

A60 (Start Optimizer Speed G46)

This sets the start optimizer speed in mm/s². 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.

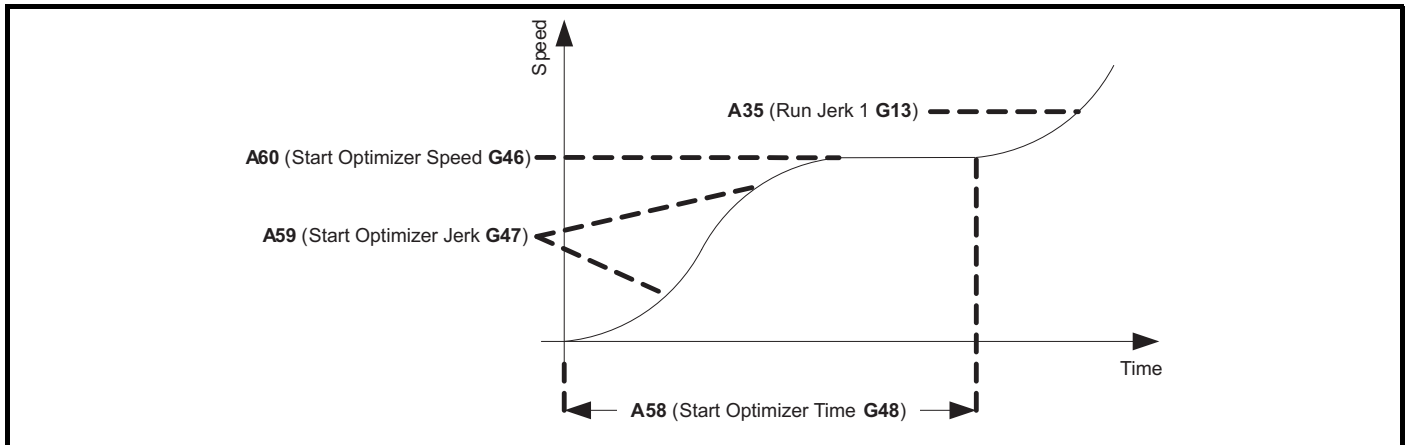
A61 {G45}		Start Optimizer Enable							
RW	Bit							US	
OL									
RFC-A	⇅	Off (0) or On (1)				⇒	Off (0)		
RFC-S									

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 = <i>User Security Status (H02)</i>	A01 = <i>User Security Status (H02)</i>

7 Commissioning



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.

WARNING



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.

CAUTION



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.

WARNING

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.



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.

CAUTION



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.

WARNING

Table 7-2 Motor parameters

Parameter	Mode	Detail
<i>Motor Rated Current (B02)</i>	Open loop, RFC-A, RFC-S	Motor nameplate data
<i>Motor Rated Voltage (B03)</i>		
<i>Motor Rated Power Factor (B04)</i>	Open loop	Can be derived from rotating autotune
<i>Motor Number Of Poles (B05)</i>	Open loop, RFC-A, RFC-S	Open loop and RFC-A mode select automatic if unknown
<i>Motor Rated Frequency (B06)</i>		Motor nameplate data
<i>Motor Rated Speed (B07)</i>		For Open loop, RFC-A control ensure correct slip speed refer to parameter A16 (Slip Compensation Enable B10)
<i>Symmetrical Current Limit (B16)</i>		Maximum operating current limit to protect motor.
<i>Reverse Motor Phase Sequence (B26)</i>		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 parameter

Parameter	Mode	Detail
<i>Drive Encoder Type (C01)</i>	RFC-A, RFC-S	Encoder nameplate
<i>Drive Encoder Auto Configuration Select (C02)</i>		Can only be used with encoders with comms
<i>Drive Encoder Rotary Pulses Per Revolution (C03)</i>		Encoder nameplate data / auto configuration
<i>Drive Encoder Voltage Select (C04)</i>		Encoder nameplate data
<i>Drive Encoder Feedback Reverse (C12)</i>		Parameter to rotate encoder feedback position

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 8.3 *Motor acoustic noise* on page 167.



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.

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 authorized 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:

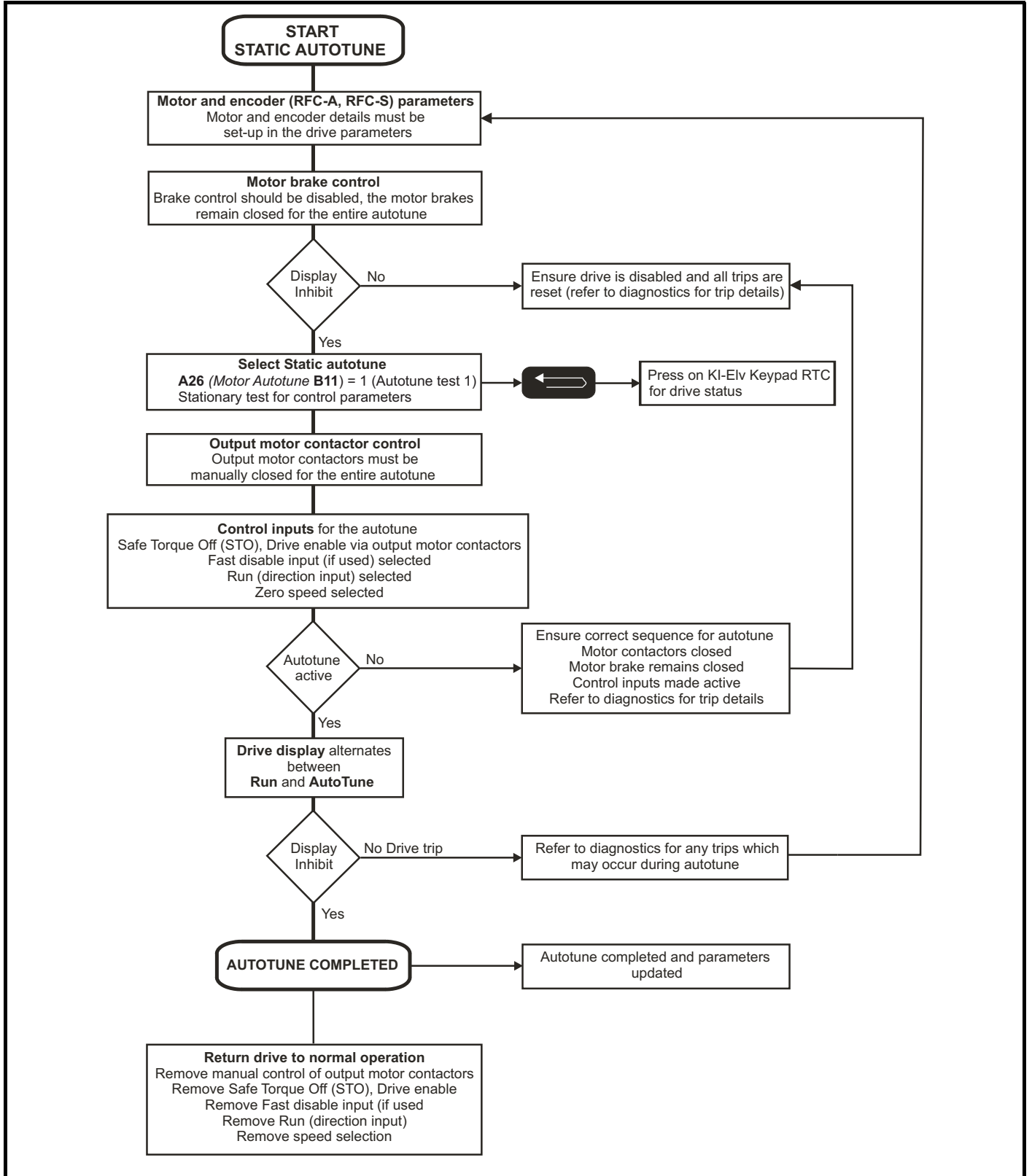
1. The static autotune relies on the motor being stationary when the test is initiated to give accurate results.
2. Parameters associated with the motor and feedback (position feedback phase angle), are updated following successful completion of the autotune test.

- If the autotune test is not completed successfully, the parameters will retain their original values resulting in incorrect operation if the drive is enabled.
- 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.
- 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 Kp and Current controller Ki 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.

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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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 $\frac{2}{3}$ 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 revolutions (i.e. up to 2 mechanical revolutions) in the selected direction.



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.

CAUTION



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.

WARNING

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.

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 authorized 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 authorized 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 $\frac{2}{3}$ 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 revolutions (i.e. up to 2 mechanical revolutions) in the selected direction.
7. **Ensure there is sufficient headroom for movement of the lift car if not de-rope as this could result in the car hitting the end stops.** 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.

13. 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.

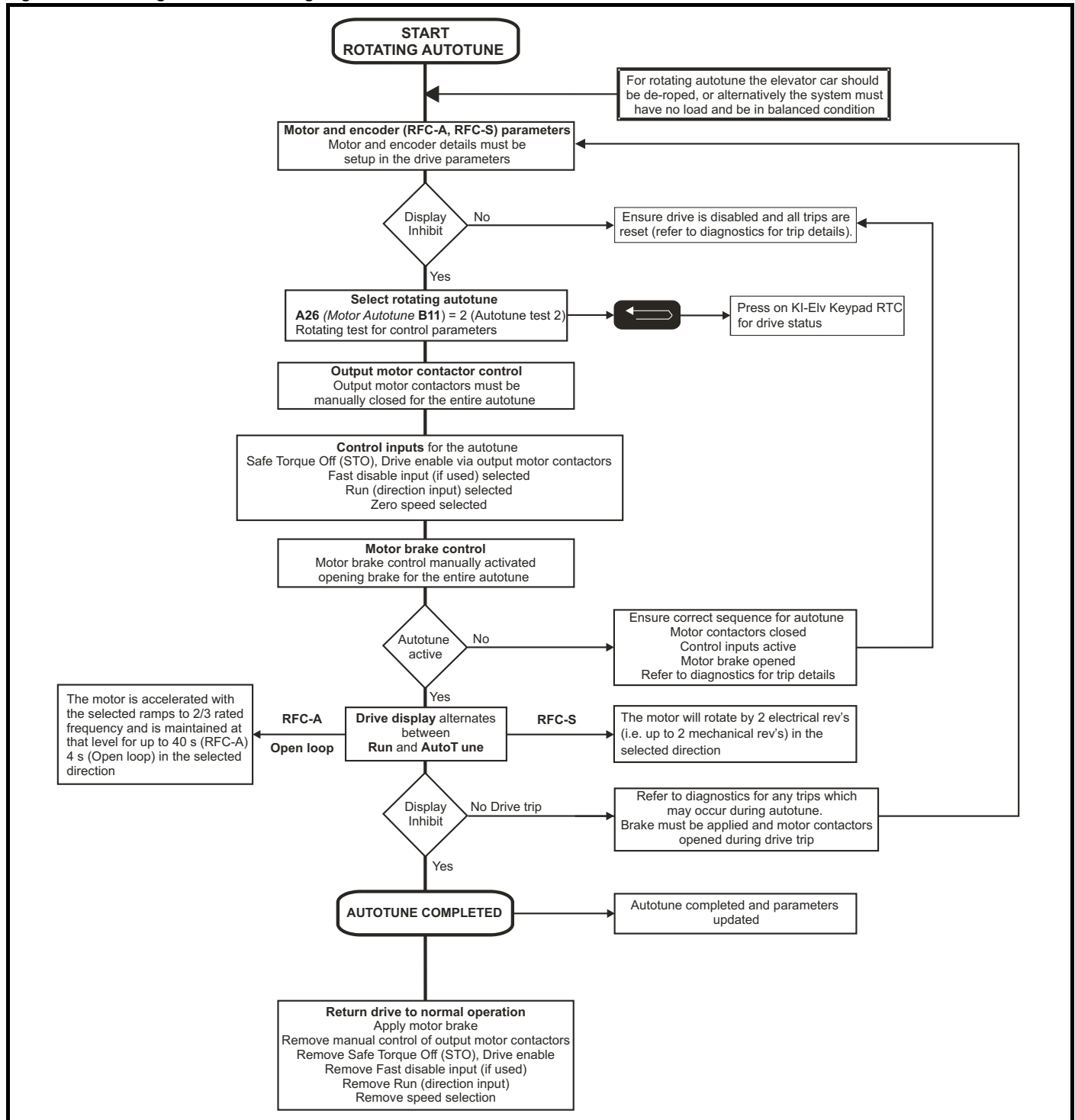
The following describes the effects of the autotune test on drive parameters:

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 non volatile drive 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 section 9 *Diagnostics* on page 171.

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)** $\times \frac{2}{3}$, 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 133.

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)** $\times \frac{2}{3}$, 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)		
A19 (Motor Rated Voltage B03)	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)		Static or rotating autotune
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 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)		Static or rotating autotune
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)		
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;

$$A = (B \times D \times E \times 60) / (\pi \times C \times F)$$

Example:

B - Nominal Elevator Speed = 1600 mm/s

C - Sheave Diameter = 240 mm

D - Roping = 1 : 1

E - Gearbox Ratio Numerator = 1

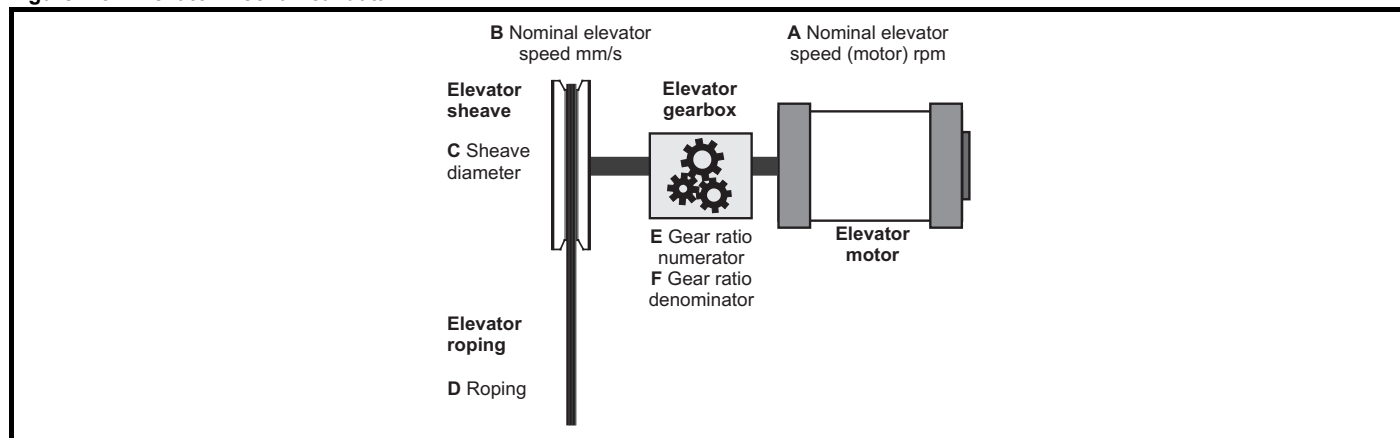
F - Gearbox Ratio Denominator = 1

$$A = (B \times D \times E \times 60) / (\pi \times C \times F)$$

$$(1600 \times 1 \times 1 \times 60) / (3.1416 \times 240 \times 1) = 127.323 \text{ rpm.}$$

$$\text{Nominal Elevator Speed rpm (E07)} = 127.323$$

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 =

$$\text{Positioning distance [mm]} \geq V_{\text{Nominal}} [\text{m/s}] \times 30 \text{ ms}$$

The stop accuracy =

$$\text{Accuracy [mm]} \leq V_{\text{Creep speed}} [\text{m/s}] \times 30 \text{ ms}$$

The time required for the Creep speed =

$$\text{Time Creep speed [ms]} = \text{positioning distance [mm]} / V_{\text{Creep speed}} [\text{m/s}]$$

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

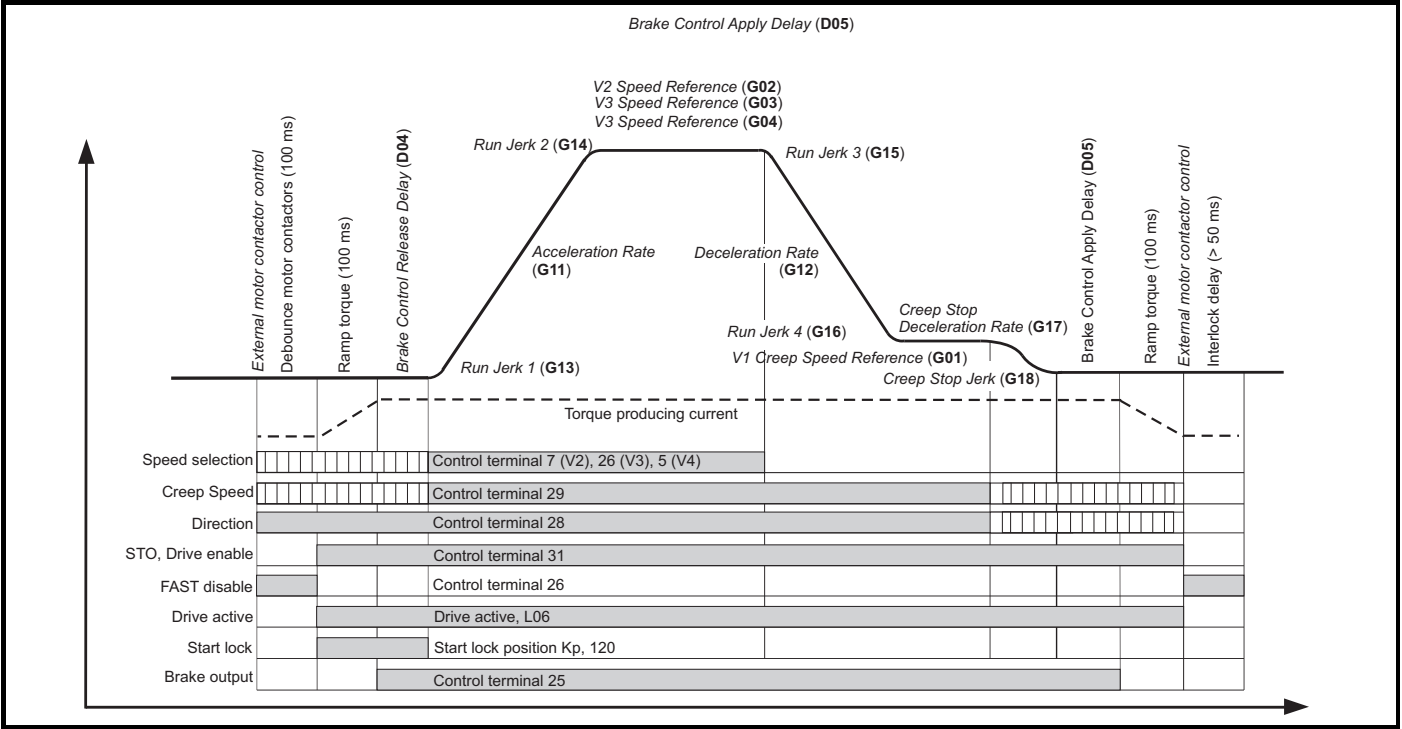
The timing diagram in Figure 7-4 *Creep to floor profile, Timing diagram* on page 141, shows the sequence of operation in the Creep to floor mode as is also detailed below:

- 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 . 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

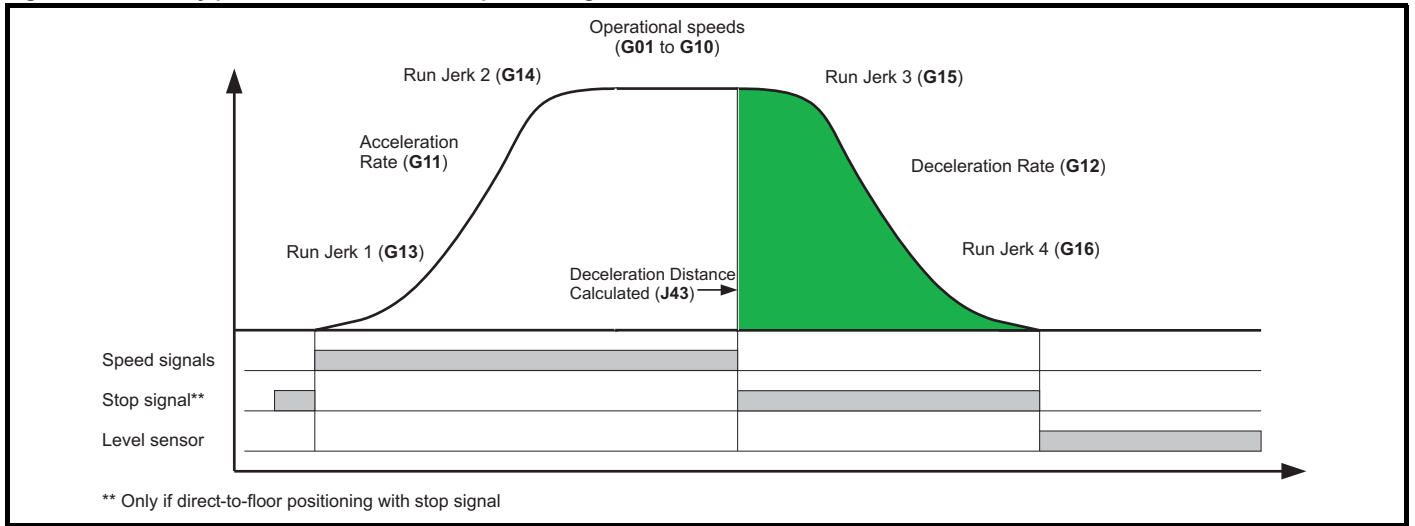


Table 7-12 Calculated and user deceleration distances

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)

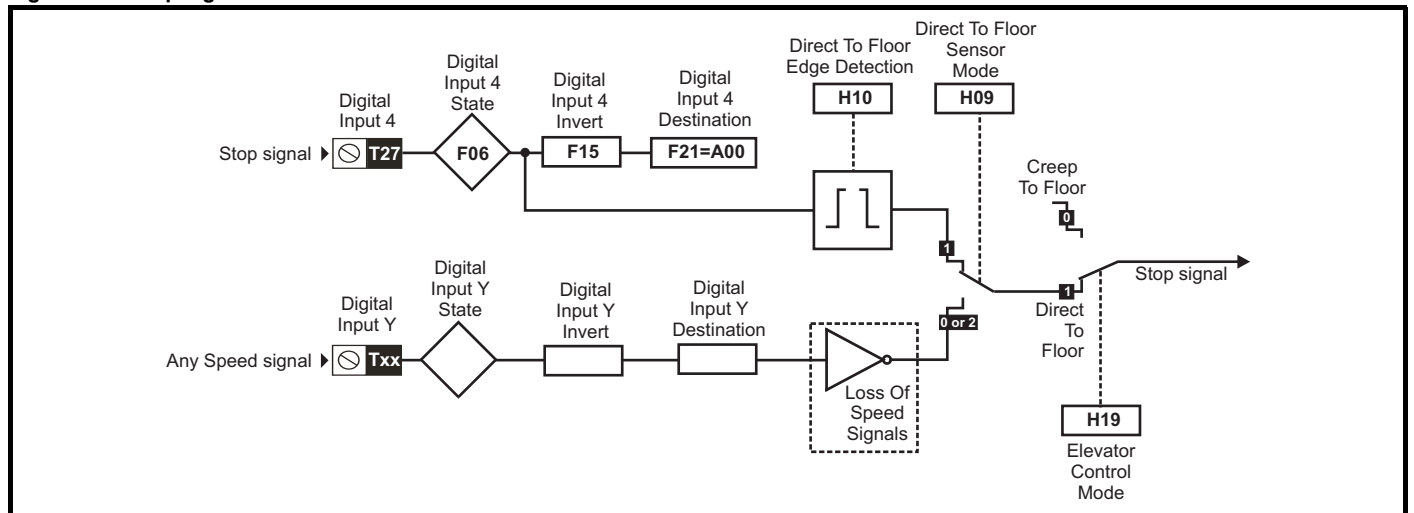
Table 7-13 Direct to floor parameters

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

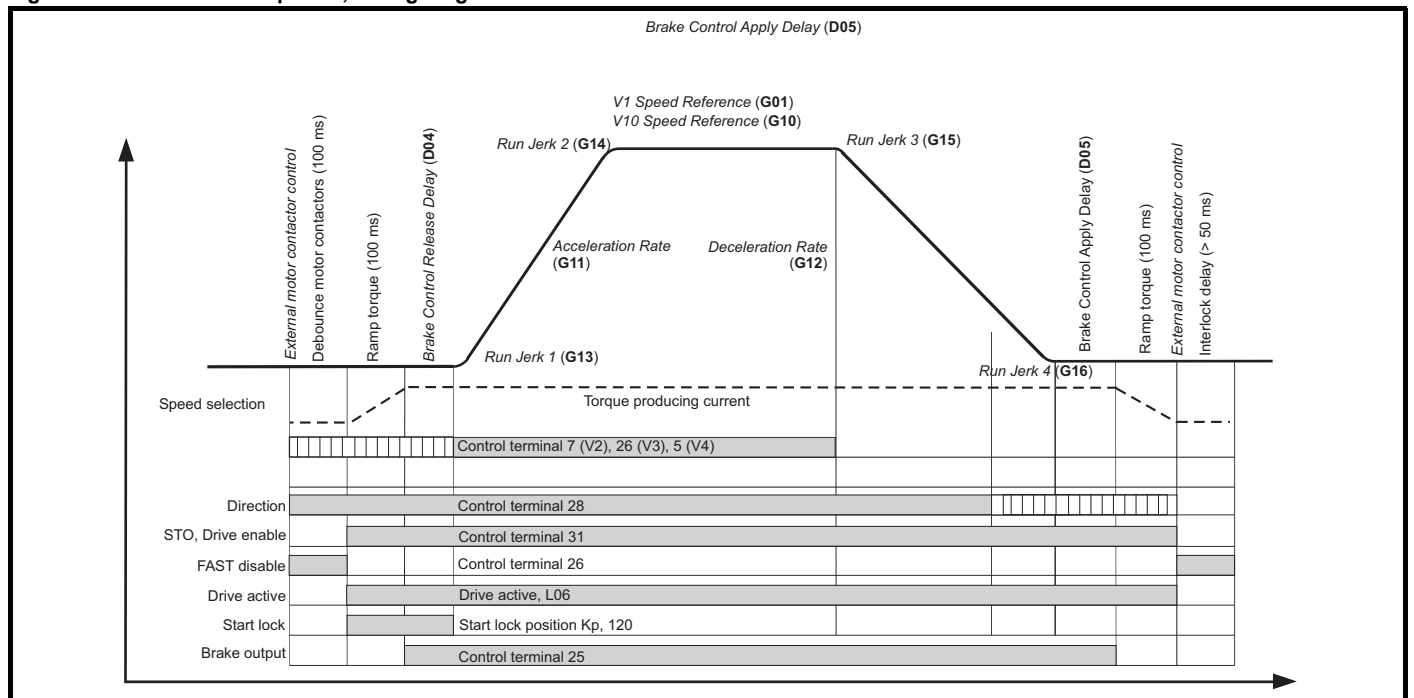
Direct To Floor Sensor Mode (H09)	Details
Spd IP (0)	Stopping is activated by a removal of the speed signals. The deceleration distance is calculated from the profile parameters and is displayed in V1 Calculated Deceleration Distance (J10) > V10 Calculated Deceleration Distance (J19).
Stop IP (1)	Stopping 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 $<1 \mu s$. 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 be 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.

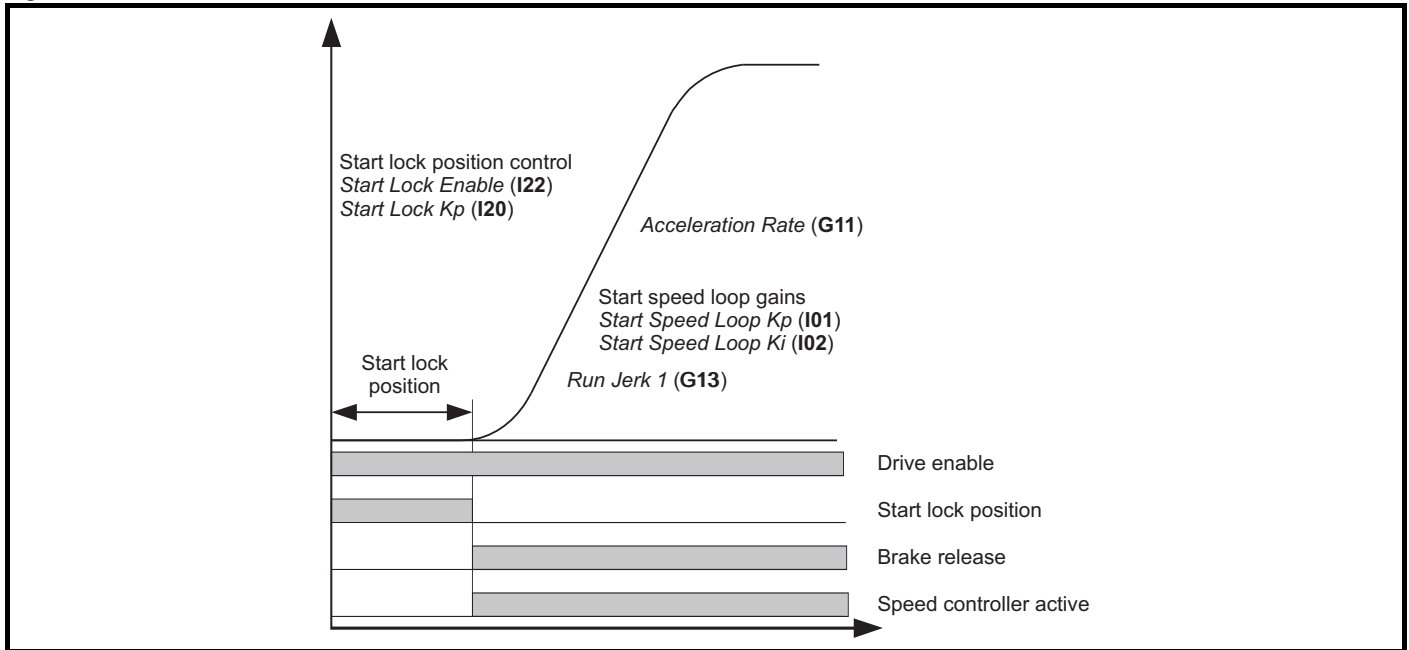
The maximum values for the start lock Kp gain will be limited by the settings of the active start speed loop gains. Under normal operation, the variable speed loop gains alone should be sufficient to hold the motor during brake release and prevent rollback. Therefore the start speed loop gains should 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
<i>Start Lock P Gain (I20)</i>	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.
<i>Start Lock P Gain Speed Clamp (I21)</i>	Speed clamp, defines the rate of change of correction for the start locking. Default value is suitable for most applications.
<i>Start Lock Enable (I22)</i>	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 145, 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)*.

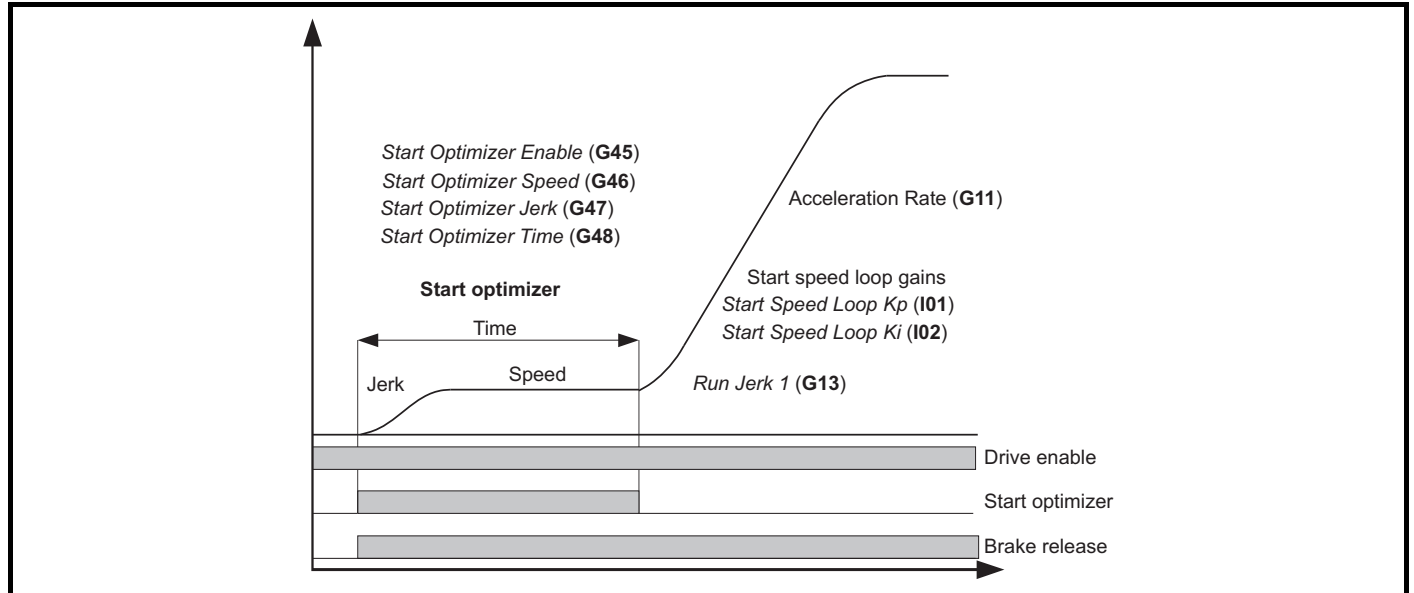
Open loop operation

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
<i>Start Optimizer Enable (G45)</i>	Enables start optimizer function
<i>Start Optimizer Speed (G46)</i>	Start optimizer speed in mm/s, default setting = 10
<i>Start Optimizer Jerk (G47)</i>	Start optimizer jerk mm/s ³ , default setting = 10. Value selected must be less than the start jerk in <i>Run Jerk 1 (G13)</i>
<i>Start Optimizer Time (G48)</i>	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

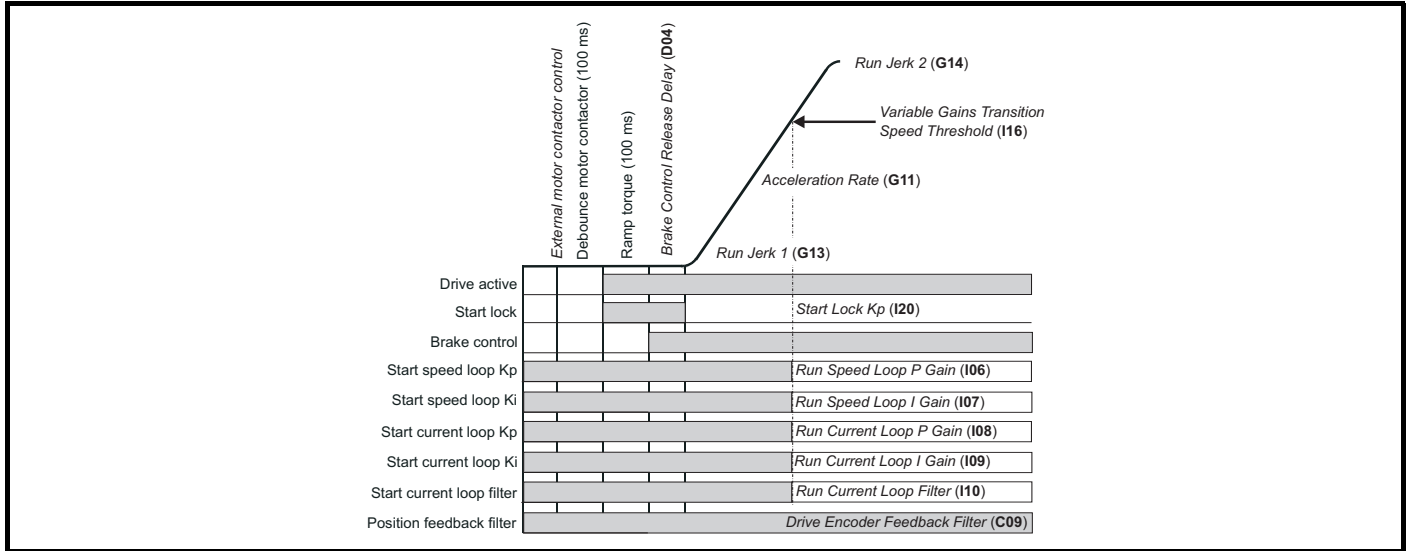
The start profile for the Elevator system can be configured and adjusted using the following profile parameters and control loop gains. For Closed loop operation, there are both speed loop and current control loop gains available. The following parameters are active from the Initial start, *Run Jerk 1 (G13)*, Acceleration and to the end of acceleration *Run Jerk 2 (G14)*.

Table 7-18 Start profile parameters

Parameter	Details
<i>Run Jerk 1 (G13)</i>	Start jerk, active during the start from zero speed or following the start optimizer.
<i>Acceleration Rate (G11)</i>	Acceleration rate
<i>Run Jerk 2 (G14)</i>	End of acceleration jerk
<i>Start Lock Kp Speed Clamp (I21)</i>	Kp position control gain used to prevent roll back during brake release.
<i>Start Speed Loop Kp (I01)</i> <i>Start Speed Loop Ki (I02)</i>	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.
<i>Start Current Loop P Gain (I03)</i> <i>Start Current Loop I Gain (I04)</i>	Start current control loop gains = autotune values
<i>Variable Gains Transition Speed Threshold (I16)</i>	Transition time from the start to travel speed and current control loop gains.
<i>Start Current Loop Filter (I05)</i>	Current loop filter for start
<i>Drive Encoder Feedback Filter (C09)</i>	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.

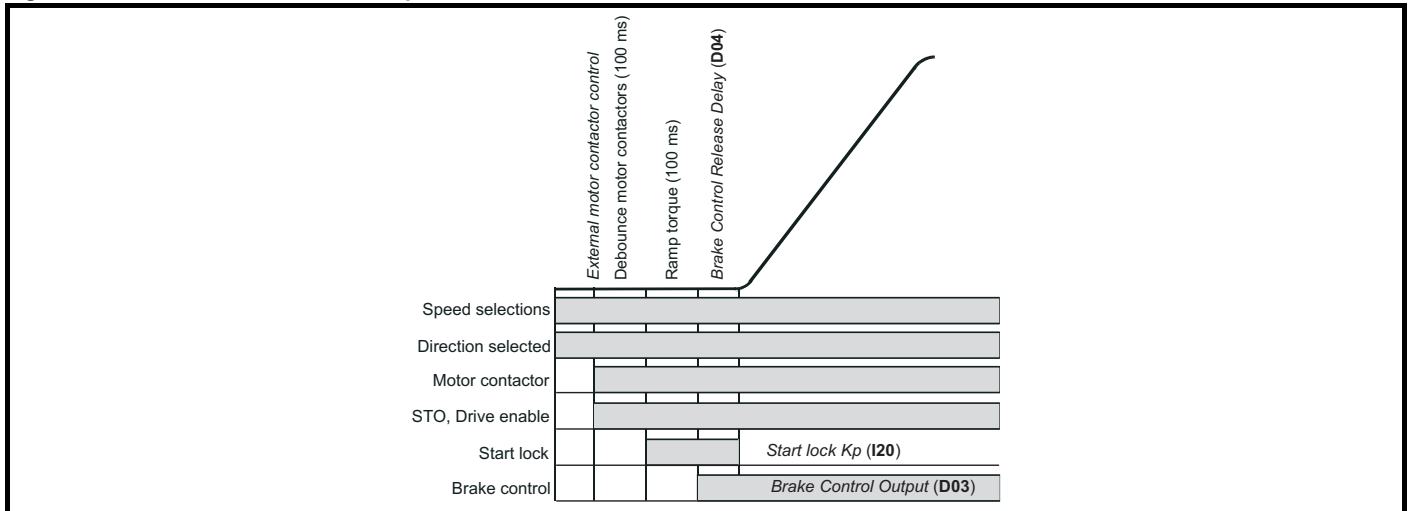
Table 7-19 Brake control digital output parameters

Parameter	Setting
<i>T25 Digital I/O 02 Source/Destination (F19)</i>	<i>Brake Control Output (D03)</i> for brake control output from drive <i>Motor Magnetized Indication (D01)</i> output for external brake control
<i>T25 Digital I/O 02 State (F04)</i>	Digital output state On (1) Off (0)
<i>T25 Digital I/O 02 Invert (F13)</i>	Invert digital output on T25

Table 7-20 Brake control parameters

Parameter	Detail
<i>Brake Control Output (D03)</i>	Brake control output state
<i>Brake Control Release Delay (D04)</i>	Brake release delay
<i>Upper Current Threshold (D06)</i>	Brake control release high current threshold (<i>Open loop</i>)
<i>Brake Release Frequency (D08)</i>	Brake release frequency (<i>Open loop</i>)

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
<i>Run Jerk 2 (G14)</i>	End of acceleration jerk
<i>Run Jerk 3 (G15)</i>	Start of deceleration jerk
<i>Run Speed Loop P Gain (I06)</i> <i>Run Speed Loop I Gain (I07)</i>	Run speed control loop gains active at the end of start speed control loop gains speed threshold level to the stop.
<i>Run Current Loop P Gain (I08)</i> <i>Run Speed Loop I Gain (I09)</i>	Run current control loop gains = autotune values
<i>Run Current Loop Filter (I10)</i>	Current loop filter from start threshold to run and stop from default.
<i>Drive Encoder Feedback Filter (C09)</i>	Position feedback

Figure 7-12 Creep to floor profile travel

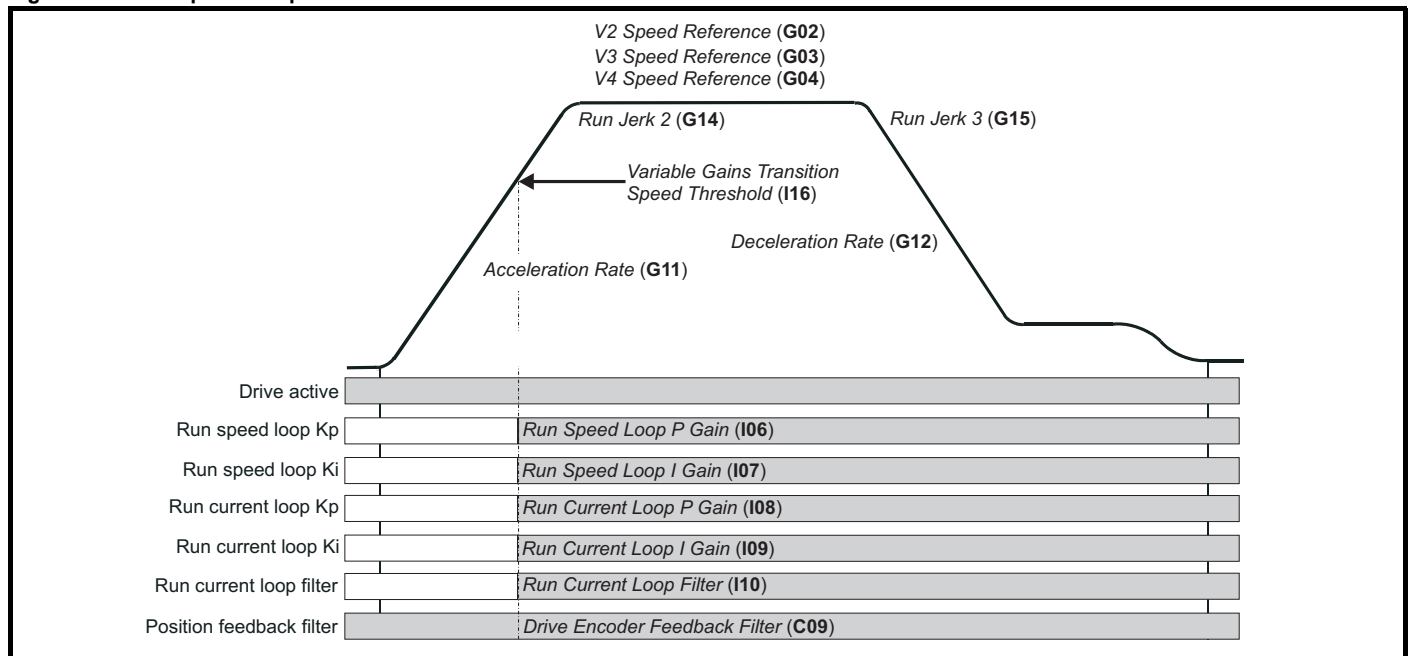
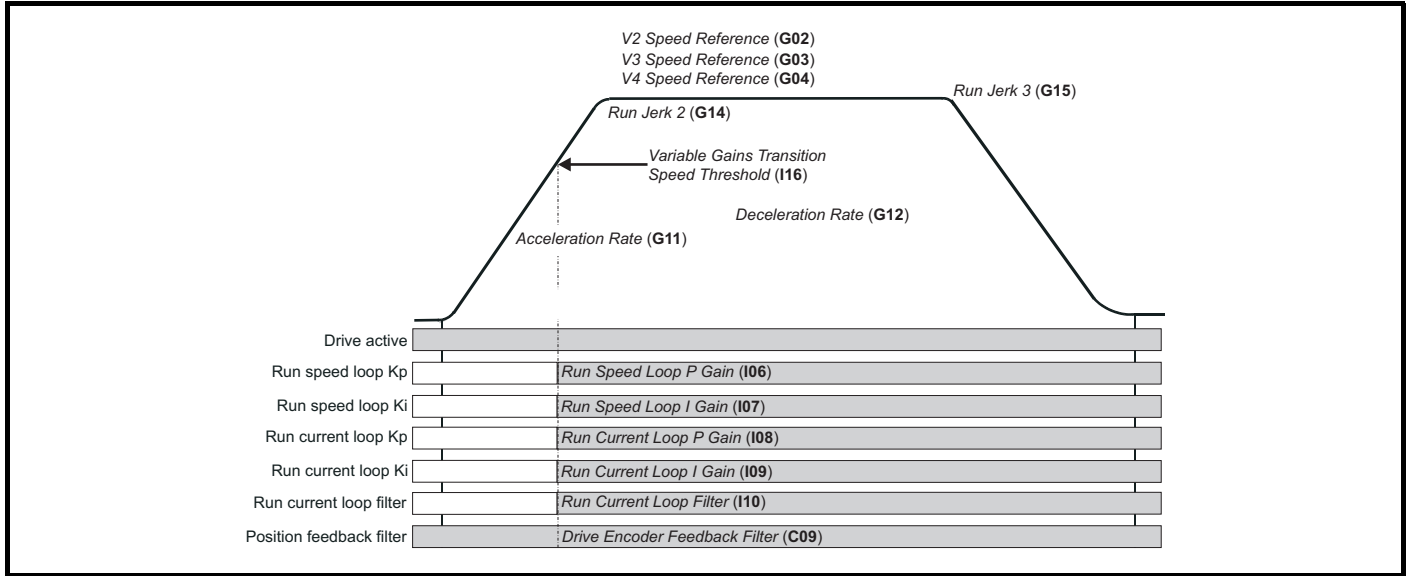


Figure 7-13 Direct to floor profile travel



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 control loop gains are active during the travel and through to the stop
Run Speed Loop I Gain (I07)	
Run Current Loop P Gain (I08)	
Run Speed Loop I Gain (I09)	Run current control loop gains = autotune values
Run Current Loop Filter (I10)	
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

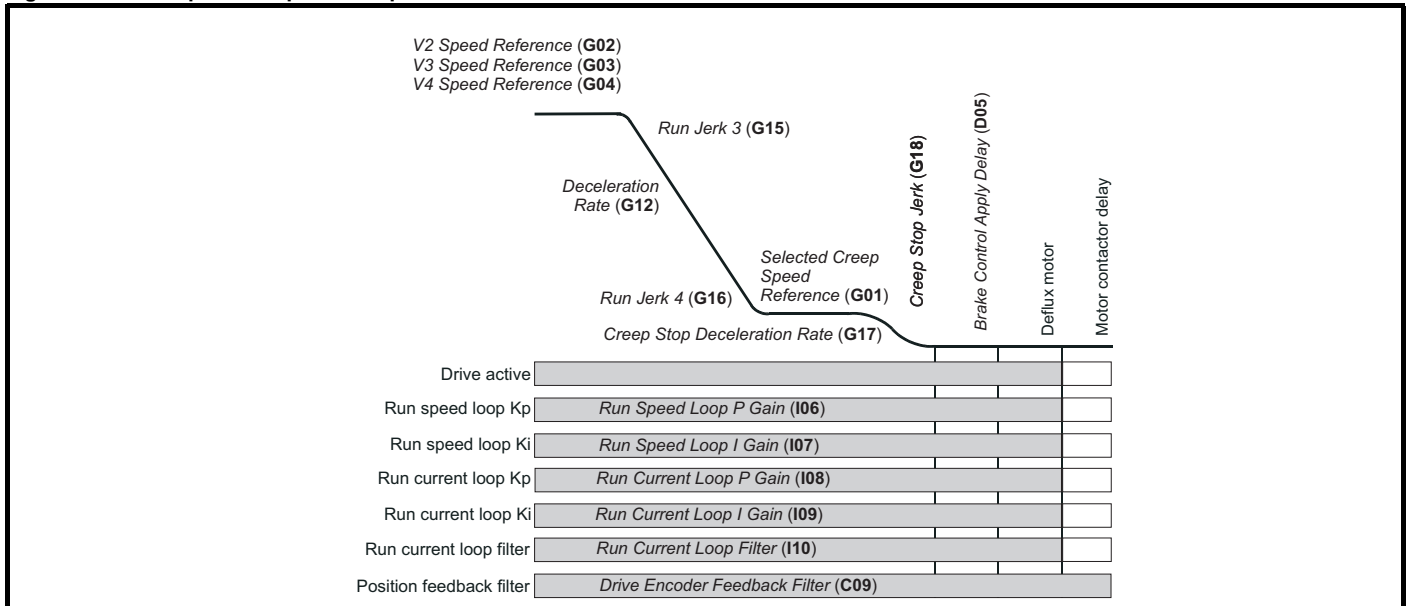
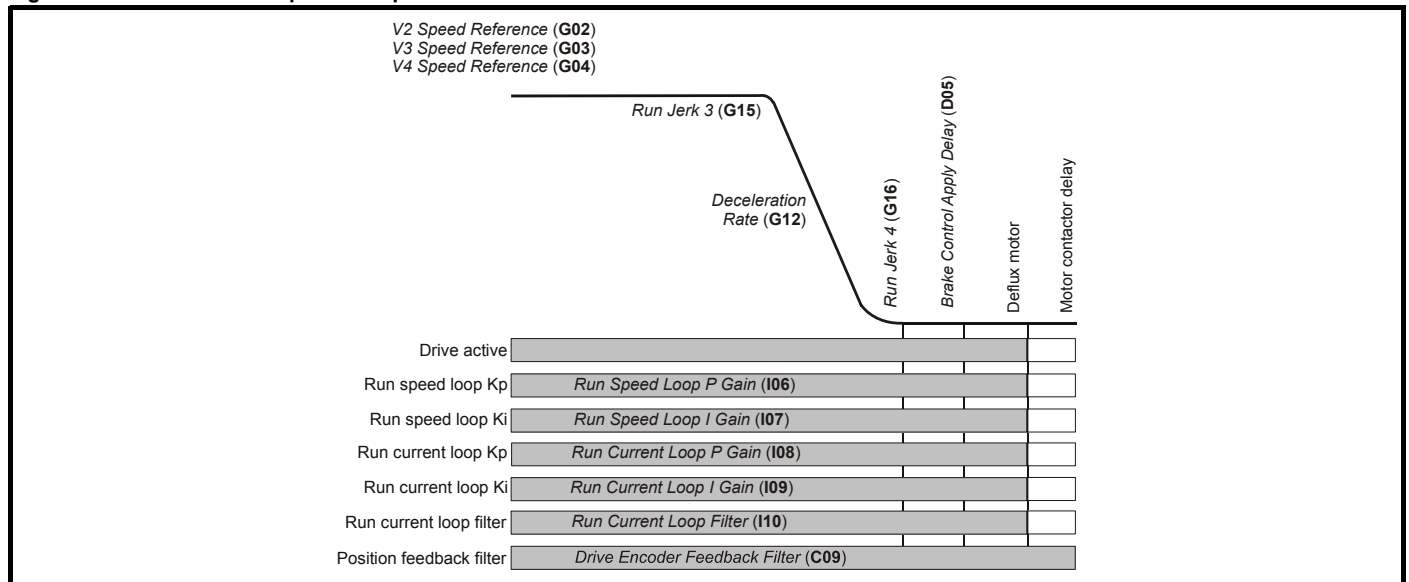


Figure 7-15 Direct to floor profile stop



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

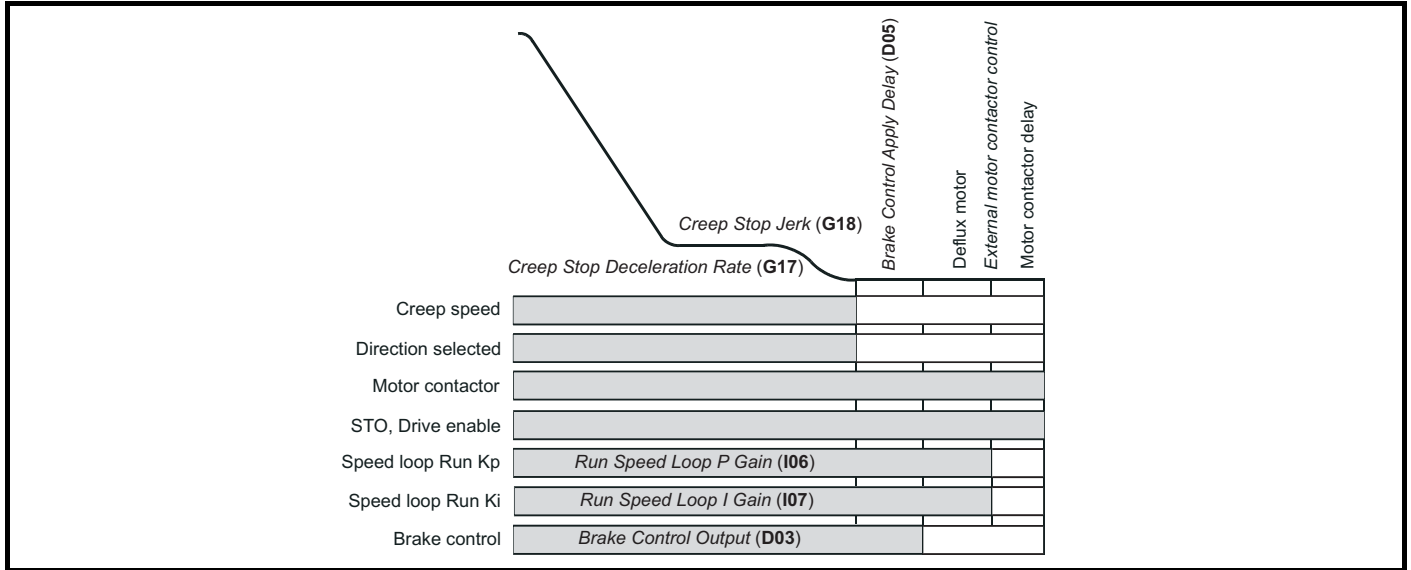
Parameter	Setting
<i>T25 Digital I/O 02 Source/Destination (F19)</i>	<i>Brake Control Output (D03)</i> for brake control output from drive
<i>T25 Digital I/O 02 Source/Destination (F19)</i>	<i>Motor Magnetized Indication (D01)</i> for external brake control
<i>T25 Digital I/O 02 State (F04)</i>	Digital output state On (1) Off (0)
<i>T25 Digital I/O 2 Invert (F13)</i>	Invert digital output on T25

Table 7-24 Brake control parameters

Parameter	Detail
<i>Brake Control Output (D03)</i>	Brake control output state
<i>Brake Control Apply Delay (D05)</i>	Brake apply delay
<i>Brake Apply Low Threshold (D07)</i>	Brake control apply low current threshold (<i>Open loop</i>)
<i>Brake Apply Frequency (D07)</i>	Brake apply frequency (<i>Open loop</i>)

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
<i>Motor Contactor Measured Delay Time (B32)</i>	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
<i>Brake Control Apply Delay (D05)</i>	Brake apply delay, increase where <i>Motor Contactor Measured Delay Time (B32)</i> is < 50 ms

7.10 Additional control functions

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 this *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 stop
- Load measurement
- Inertia compensation
- Simulated encoder output
- Advanced door opening
- Emergency backup operation
- Peak curve
- Floor sensor correction
- Short floor landing
- Fast start

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

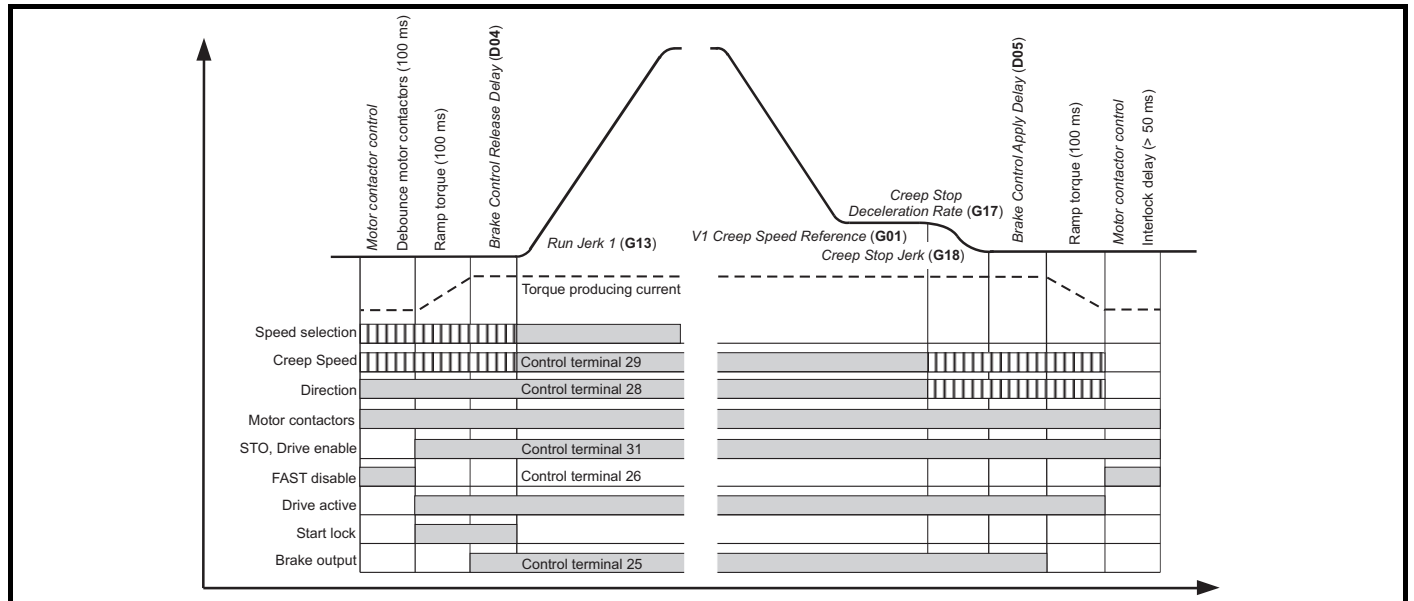
Parameter	Detail
<i>Motor Contactor Control Output (B31)</i>	Digital output source for motor contactor control.
<i>Motor Contactor Measured Delay Time (B32)</i>	Measured delay between the end of the travel and the time taken to fully close the output motor contactors, remove the Safe Torque Off (STO), Drive enable.
<i>Brake Control Apply Delay (D05)</i>	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 while 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 *E200 Standard Elevator* drive has a Fast disable input that can be used to disable the drive in 600 μ s, 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 180) 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

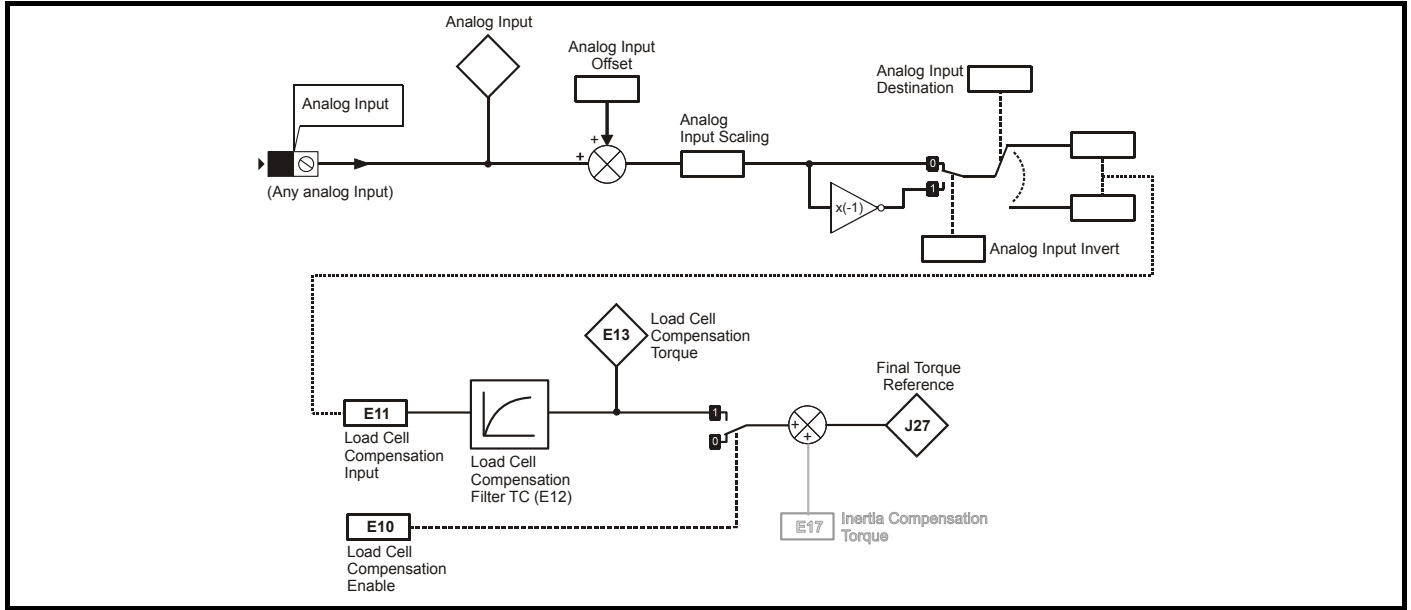


Table 7-28 Load cell compensation

Parameter	Detail
<i>Load Cell Compensation Enable (E10)</i>	Enables the load cell compensation torque offset to be applied
<i>Load Cell Compensation Input (E11)</i>	The input to the load cell compensations scheme. This is used as the destination for the analog input which receives the load cell signal
<i>Load Cell Compensation Filter Time Constant (E12)</i>	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
<i>Load Cell Compensation Torque (E13)</i>	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
<i>Fast Stop Enable (H26)</i>	Fast stop enable, default setting = Off 0, enabled using a control input routed to <i>Fast Stop Enable (H26)</i>
<i>Fast Stop Deceleration Rate (G29)</i>	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.

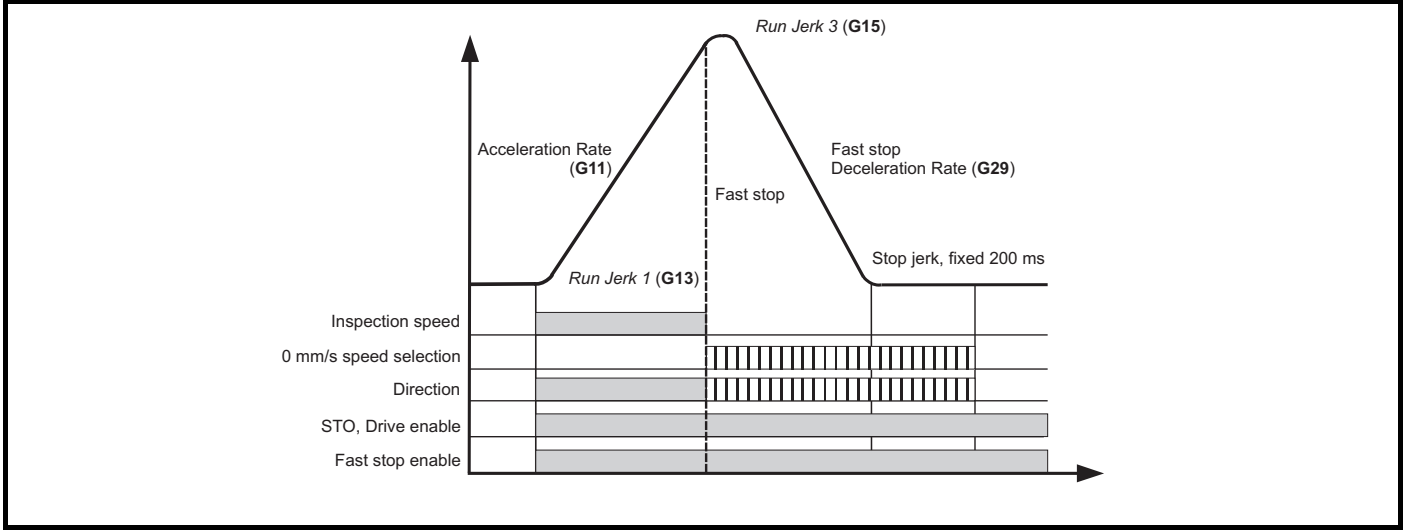
7.13.1 Fast stop using speed selection

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

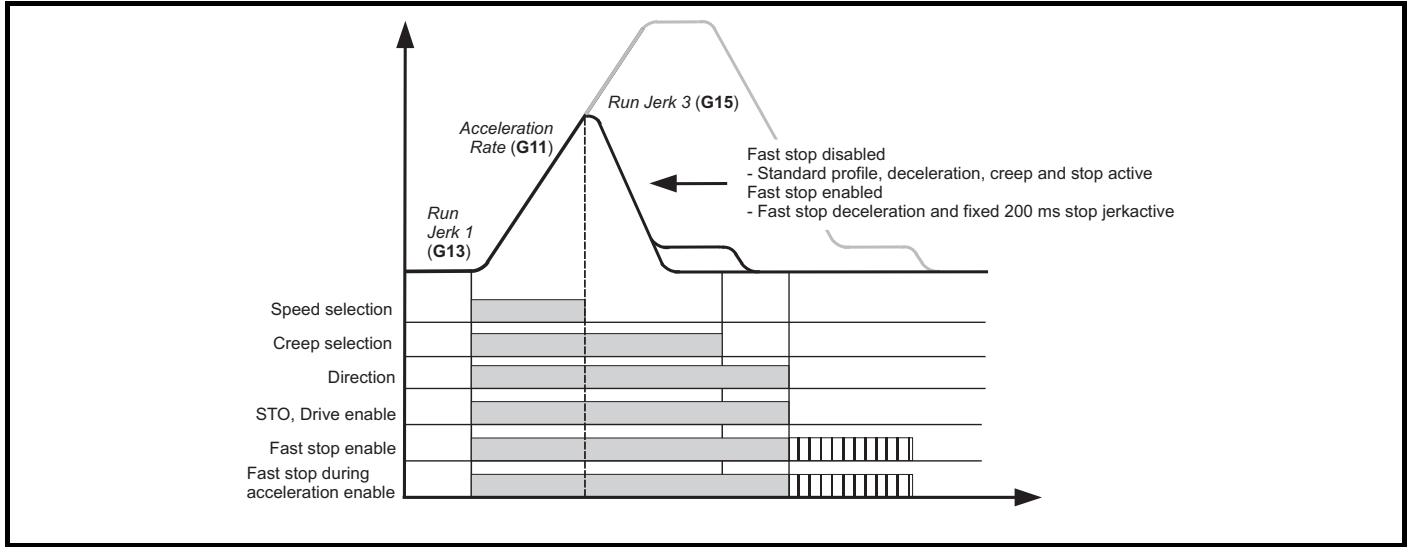
With fast stop using either speed selection or direction control, fast stop cannot be carried out during acceleration where the speed selection or direction are removed. Acceleration will continue to the speed selection made during the start.

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.

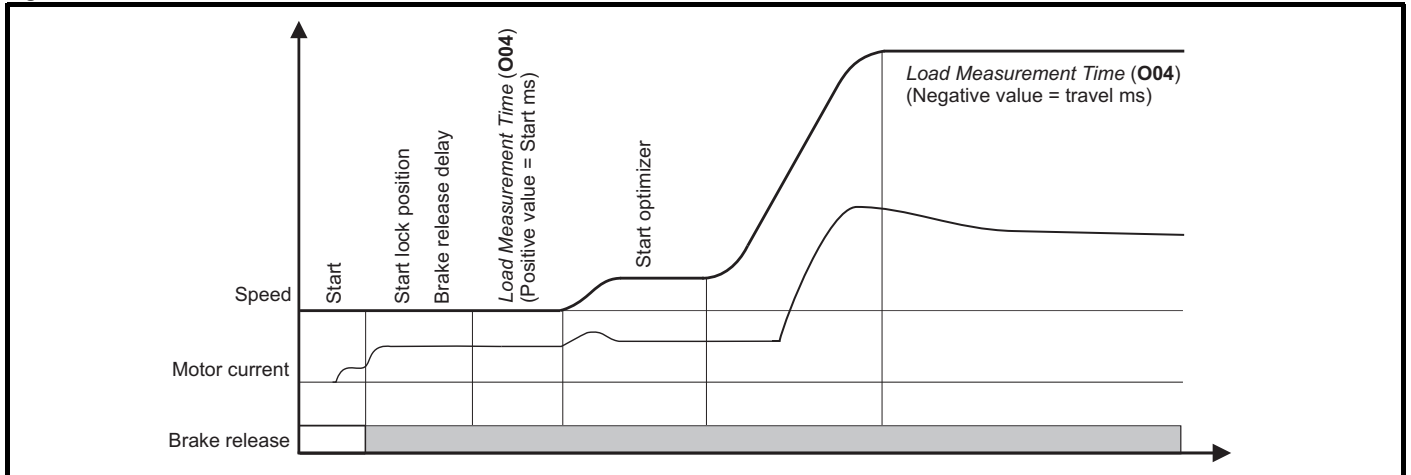
Table 7-30 Load measurement

Parameter	Detail
<i>Load Measurement Direction Output (O01)</i>	Final load measurement direction output
<i>Load Measurement Direction Invert (O02)</i>	Load measurement direction output invert
<i>Load Measurement Value (O03)</i>	Load measurement value
<i>Load Measurement Time (O04)</i>	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
<i>Inertia Compensation Enable (E10)</i>	Enables the inertia compensation torque offset to be applied.
<i>Inertia Compensation Total Inertia (E15)</i>	The total inertia is used in combination with Inertia compensation reference acceleration to derive the torque required for acceleration.
<i>Torque Per Amp (E16)</i>	This is used to scale the acceleration torque into percentage of system rated torque
<i>Inertia Compensation Torque (E17)</i>	Allows the load cell feedback to be zeroed for a balanced elevator car.
<i>Inertia Compensation Acceleration (E18)</i>	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 m²
- C** = Rated motor torque in Nm
- D** = Gear ratio numerator / Gear ratio denominator
- E** = Radius of the sheave

$$A = 1000 \times B \times D / (C \times E)$$

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, for further details refer to the *E200 Design Guide*.

Table 7-33 Hardware simulated encoder output

Parameter	Detail
<i>Encoder Simulation Status (C29)</i>	Displays the simulated encoder output available based upon the position feedback connected to and configured in the drive.
<i>Encoder Simulation Mode (C31)</i>	0: Hardware 1: Lines per rev 2: Ratio 3: SSI
<i>Encoder Simulation Hardware Divider (C32)</i>	Defines the ratio between the main position feedback device and the simulated encoder output in Hardware mode.
<i>Encoder Simulation Hardware Marker Lock (C33)</i>	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

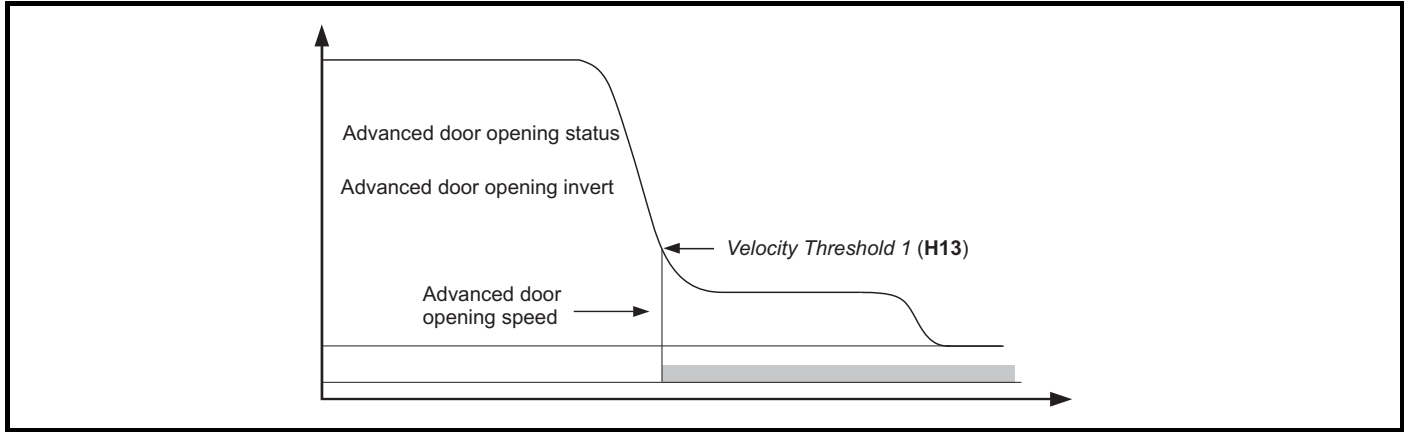
An advanced door opening output can be configured on the *E300 Advanced Elevator* drive. This feature provides an output to the Elevator controller to open the elevator car doors at a defined speed prior to the elevator car reaching the floor level. This allows the Elevator travel times to be reduced. 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
<i>Velocity Threshold 1 (H13)</i>	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

In 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.

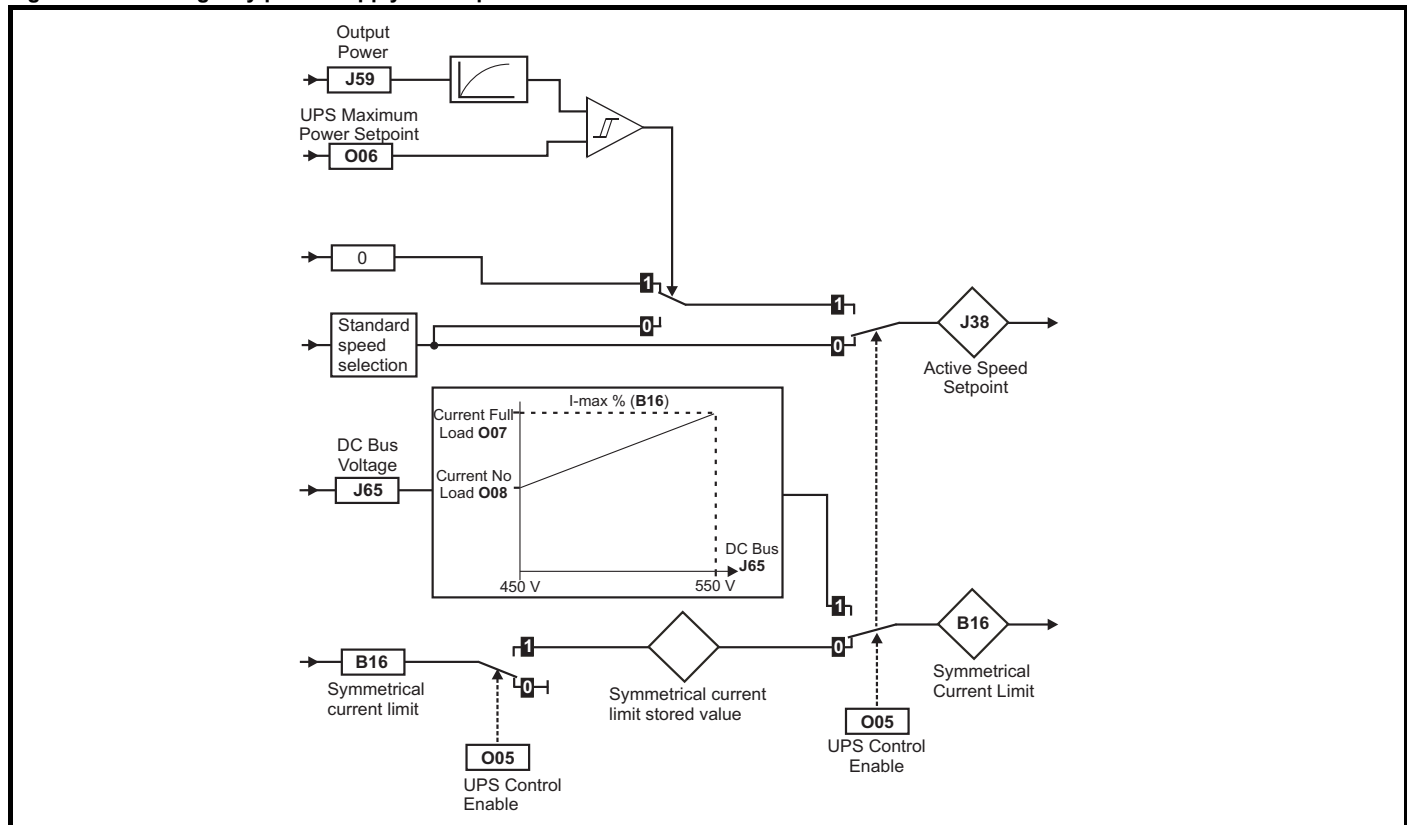
Where the DC bus voltage drops below the UU Reset voltage + 60 V (= 510 Vdc for 400 Vac drives), the current limit is decreased linearly from the nominal set value in *UPS evacuation current full load limit (O07)* to the reduced value in *UPS evacuation current no load limit (O08)* with the reduction 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
<i>Ups Control Enable (O05)</i>	Enable, disable for UPS control
<i>UPS Maximum Power Set point (O06)</i>	Maximum UPS power in kW. This setting prevents the UPS from being overloaded during emergency evacuation with UPS control enable = On (1).
<i>UPS evacuation current full load limit (O07)</i>	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.
<i>UPS evacuation current no load limit (O08)</i>	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 back-up 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.

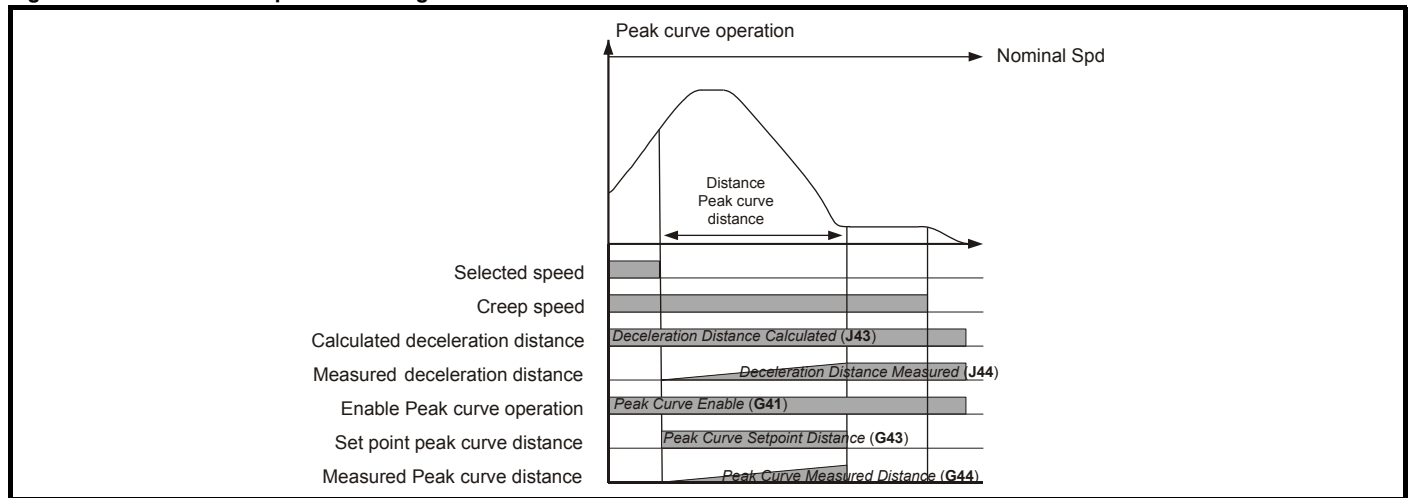
Parameter	Description
Peak Curve Enable (G41)	Enables Peak curve operation in Creep to floor mode. In Direct to floor mode, Peak curve operation is always active and this parameter has no effect
Peak Curve Setpoint Distance (G42)	Creep to floor: When any speed reference V1 to V10 other than Creep speed is selected and active, this indicates the distance to slow from the selected speed to Creep speed using the <i>Deceleration Rate (G12)</i>, <i>Run Jerk 3 (G15)</i> and <i>Run Jerk 4 (G16)</i>. When Creep speed is selected and active, this indicates the distance to slow from Creep speed to a stop using <i>Creep Stop Deceleration Rate (G17)</i> and <i>Creep Stop Jerk (G18)</i>. Direct to floor: This indicates the distance from the selected speed to a stop using the <i>Deceleration Rate (G12)</i>, <i>Run Jerk 3 (G15)</i> and <i>Run Jerk 4 (G16)</i>.
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 enabled, depends on the point during the profile when the stop signal is given. This results in the following three scenarios:

Figure 7-23 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 curve 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 curve profile is generated where the profile jerk, acceleration and peak speed is optimized such that the target distance is reached without overshoot.

Figure 7-24 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:

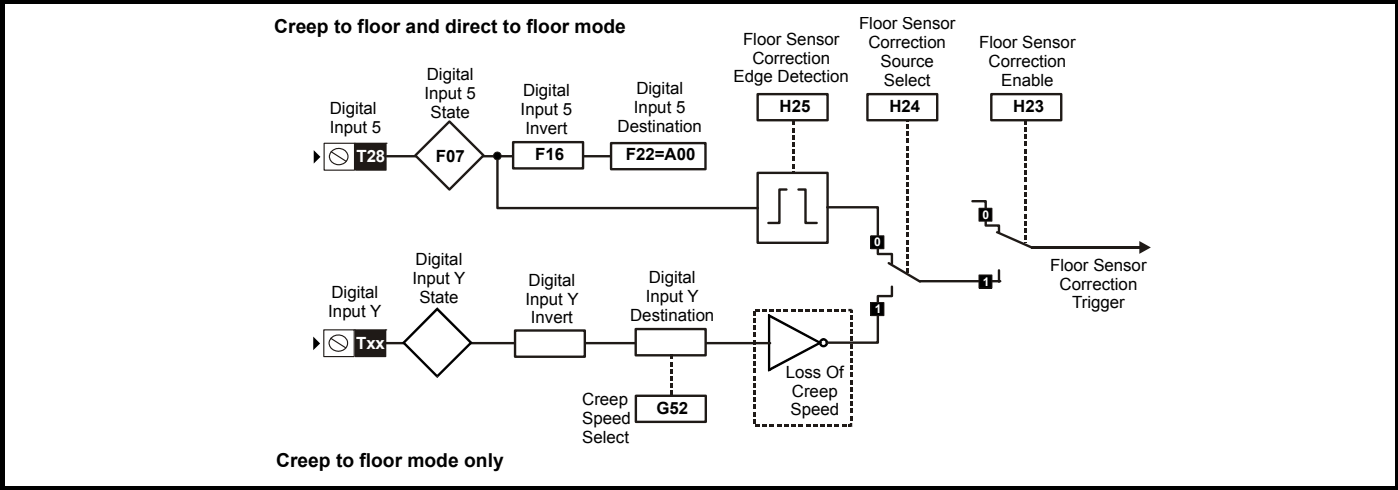
- Compensation for rope creep and hardware scaling errors.
- High levels of floor target position accuracy with elevator speeds in excess of 1m/s, utilising Direct to floor positioning control.

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.

Parameter	Details
<i>H23</i> Floor Sensor Correction Enable (H23)	Enables the floor sensor correction function
<i>Floor Sensor Correction Source Select</i> (H24)	Selects whether floor sensor correction is triggered by deselection of creep speed or by the signal from the floor correction sensor.
<i>Floor Sensor Correction Edge Detection</i> (H25)	Selects whether a positive or negative edge of the signal from the floor correction sensor is detected.
<i>Floor Sensor Correction Target Distance</i> (G31)	Sets the floor sensor correction target distance in mm.
<i>Speed At Floor Sensor Correction Active</i> (J46)	Indicates the sampled elevator speed at the moment floor sensor correction was activated.
<i>Remaining Floor Sensor Correction Distance</i> (J47)	Indicates the remaining distance to floor level in mm when floor sensor correction is enabled.

Figure 7-25 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 that 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).

Table 7-36 Floor Sensor Correction Modes

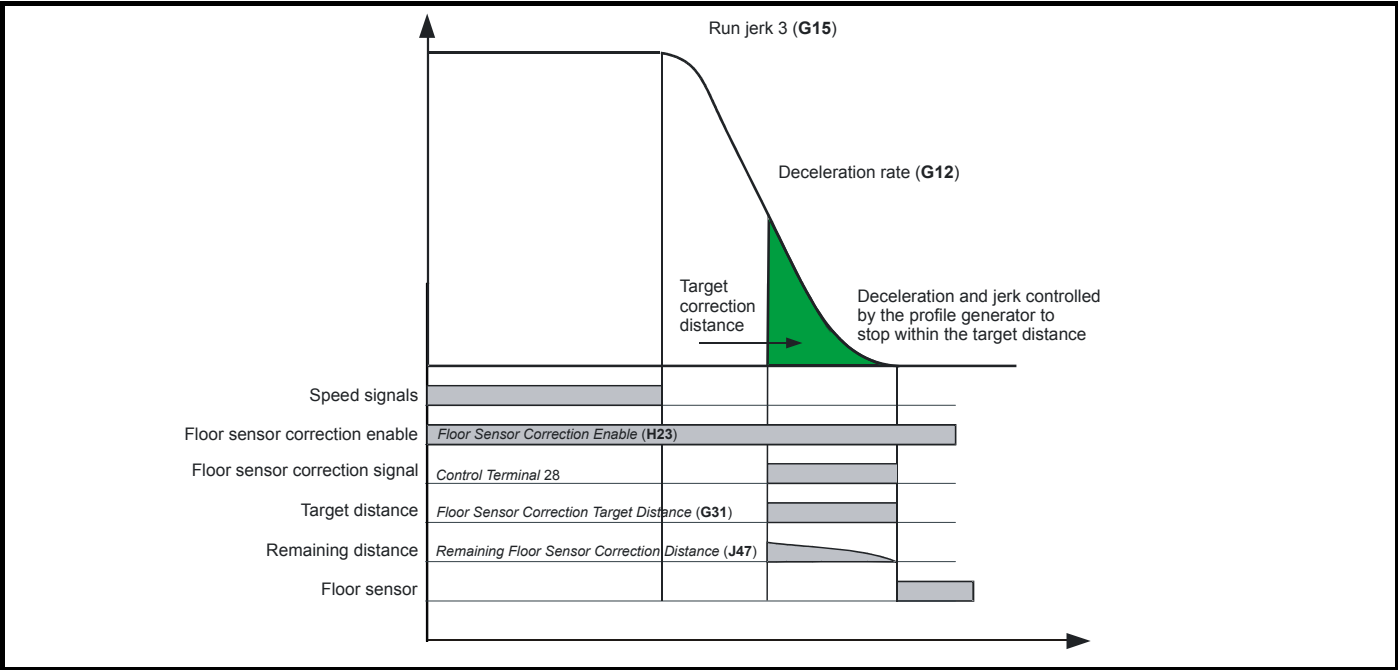
Profile	Floor Sensor Correction Mode
Direct to floor	Floor sensor correction is enabled via detection of the floor sensor correction signal connected to digital input 5. Travel within <i>Floor Sensor Correction Target Distance</i> (G31) is position controlled, modifying the profile as required.
Creep to floor	Floor sensor correction is enabled via detection of the floor sensor correction signal connected to digital input 5. Travel within <i>Floor Sensor Correction Target Distance</i> (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 <i>Floor Sensor Correction Target Distance</i> (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



NOTE

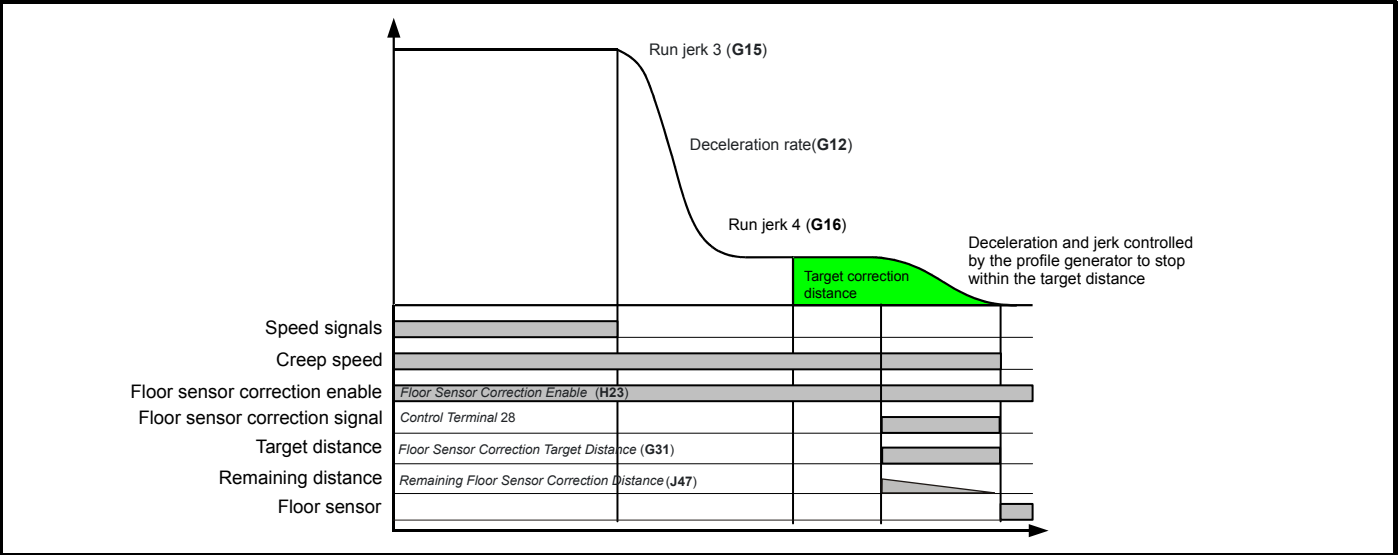
It should be noted that the floor sensor correction signal should be activated instantaneously at a position which is *Floor Sensor Correction Target Distance (G31)* away from the floor sensor in mm. If the stop distance is too low, or if the floor sensor signal was given at too high a speed (see *Speed 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 activated via Digital IP 5



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

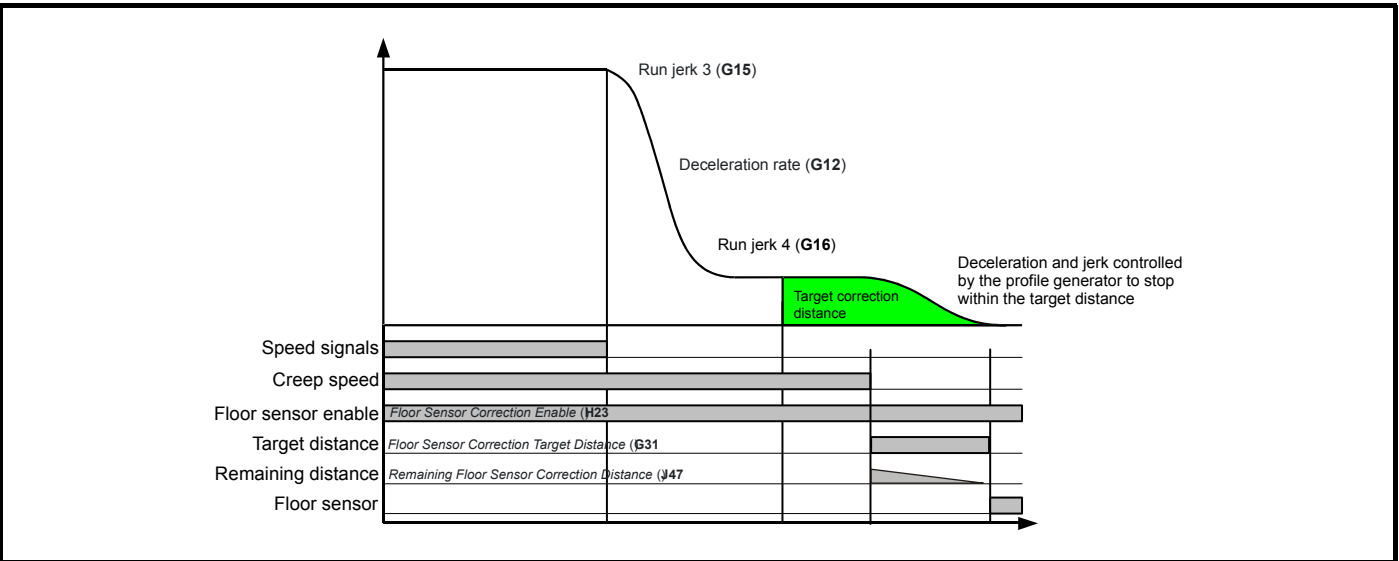
When the sensor input is triggered the elevator will come to a stop with Creep speed still selected. If Creep speed is deselected prior to the floor sensor correction trigger point, the final relative position may not match the distance specified in *Floor Sensor Correction Target Distance (G31)*.

7.21.3 Floor sensor correction, creep to floor, on deselect ion 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 distance controlled creep speed



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.

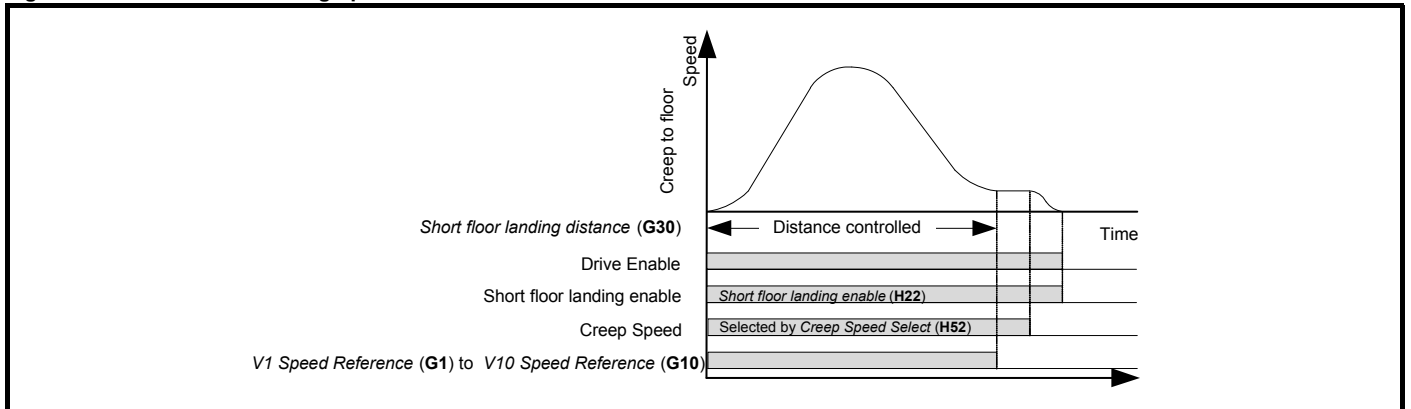
Short floor landing is selected using a digital input from the elevator controller routed to *Short Floor Landing Enable (H22)* for operation with short floor less than 0.7 m for example. The control signals for the creep speed defined by *Creep Speed Select (G52)* and short floor landing enable must be applied simultaneously.

Table 7-37 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 is available only when operating in RFC-A and RFC-S modes.

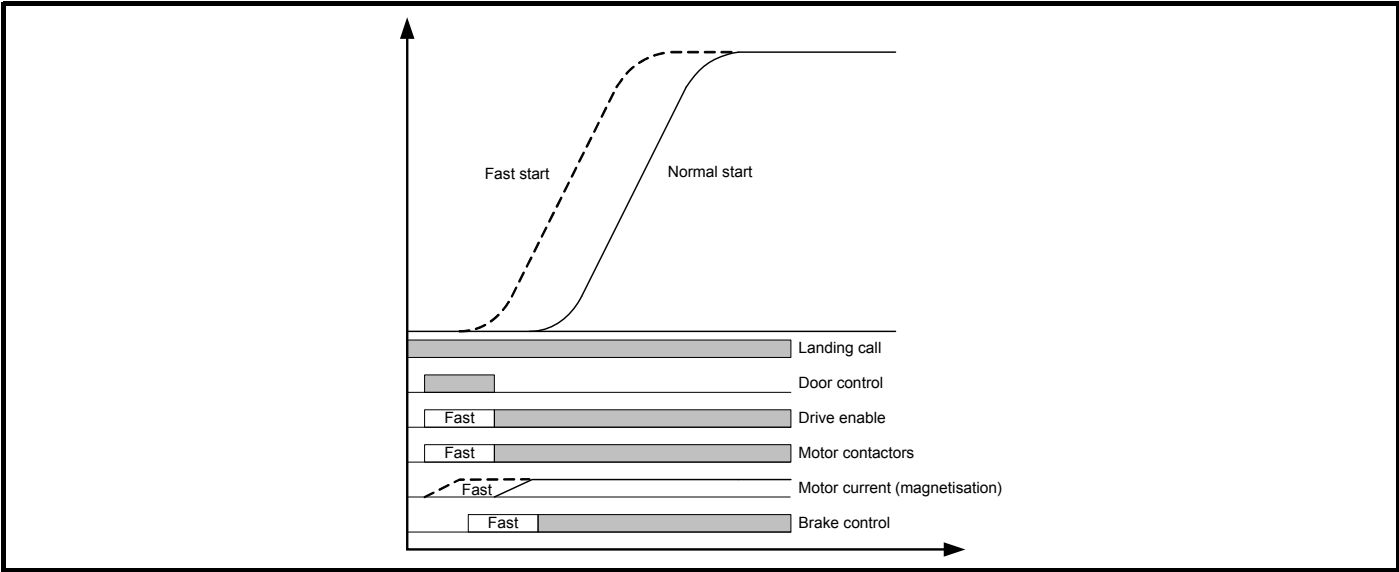
If the elevator controller handles the control of the motor contactors, *Fast Start Enable (H20)* must be set to On (1) before the motor contactors are closed. This is to ensure that the elevator drive enable signal via auxiliary contacts on the motor contactors is received after the Fast disable signal.

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 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 copied 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.

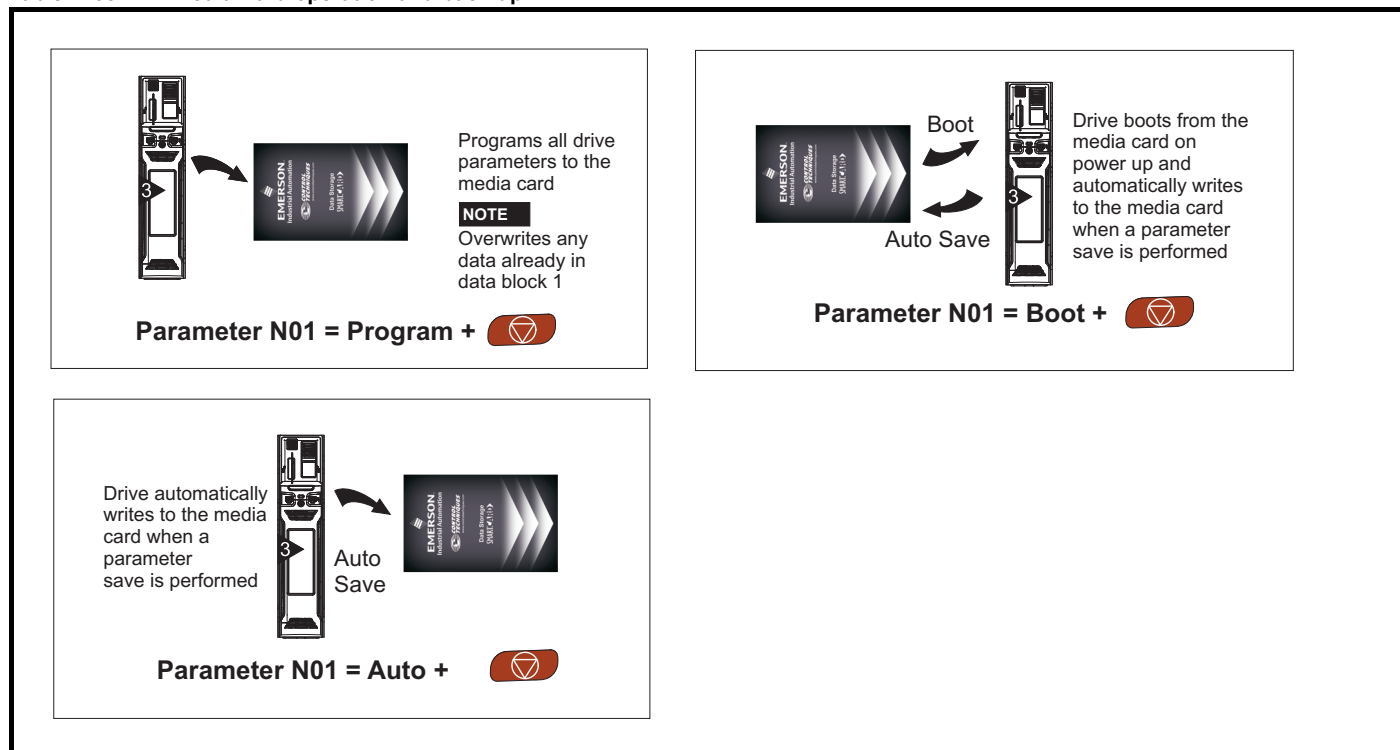
When installing and removing the NV Media Card beware of possible live power terminals which could result in a safety hazard and electric shock. All safety cover must be installed and power terminals shrouded to avoid the risk of death or serious injury.

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.

WARNING

Table 7-38 NV Media Card operation and back-up



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.

Parameter Cloning Modes (N01) should be set = Auto (3) and the drive reset which will immediately save the complete parameter set from the drive to the NV Media Card, except parameters with the NC coding bit set. Once the whole parameter set is stored, only the individual modified User Menu A parameter settings are updated.

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

If the data block already contains information it is automatically overwritten.

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 Optimization

8.1 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.



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.

8.2 Control loop gain adjustment

8.2.1 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.

8.2.2 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)*

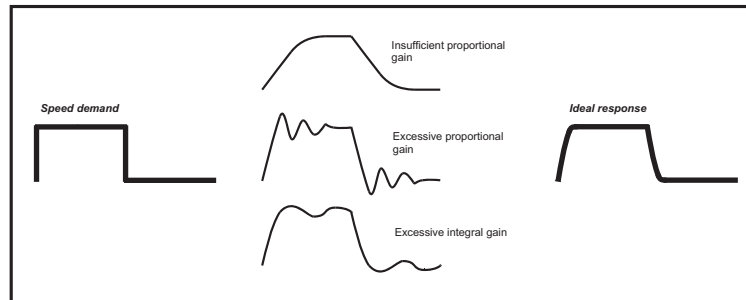
If the proportional gain has a value and the integral gain is set to zero, there must be a speed error to produce a torque reference. Therefore as the motor load increases there will be a difference between the speed reference and actual speed. This effect, called regulation, depends on the level of 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.

8.3 Motor acoustic noise

Following set-up of the drive with the correct motor data and auto tuning section 7.3 *Autotune* on page 133, 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 8-1 Motor parameters, acoustic noise

Parameter	Setting
<i>Maximum Switching Frequency (B13)</i>	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.
<i>Start Current Loop P Gain (I03)</i> <i>Run Current Loop P Gain (I08)</i>	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
<i>Start Current Loop Filter (I05)</i> <i>Run Current Loop Filter (I10)</i>	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
<i>Encoder Feedback Filter (C09)</i>	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

8.4 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.

8.4.1 Profile settings

Optimization of the start profile is carried out adjusting the start S ramp (Run jerk 1) and the acceleration rate.

Table 8-2 Start profile optimization parameters

Parameter	Setting
<i>Run Jerk 1 (G13)</i>	
<i>Acceleration Rate (G11)</i>	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

8.4.2 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 8-3 Start control loop gains

Parameter	Setting
<i>Motor Torque Ramp Time (D02)</i>	Time to ramp torque up on the motor against the mechanical brake, increase to overcome any acoustic noise.
<i>Start Lock P Gain Speed Clamp (I21)</i>	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
<i>Start Speed Loop P Gain (I01)</i> <i>Start Speed Loop I Gain (I02)</i>	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
<i>Start Current Loop P Gain (I03)</i> <i>Start Current Loop I Gain (I04)</i>	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
<i>Start Current Loop Filter (I05)</i>	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
<i>Drive Encoder Feedback Filter (C09)</i>	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

8.5 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.

8.5.1 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 8-4 Travel profile optimization parameters

Parameter	Setting
<i>Run Jerk 2 (G14)</i>	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
<i>V2 Speed Reference (G02)</i> <i>V3 Speed Reference (G03)</i> <i>V4 Speed Reference (G04)</i>	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 <i>Reference Parameter Selected (J09)</i> . Recommended = application specific

8.5.2 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 8-5 Travel optimization parameters

Parameter	Setting
<i>Run Speed Loop P (I06) Run Speed Loop I Gain (I07)</i>	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
<i>Run Current Loop P Gain (I08) Run Current Loop I Gain (I09)</i>	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
<i>Run Current Loop Filter (I10)</i>	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
<i>Drive Encoder Feedback Filter (C09)</i>	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

8.6 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.

8.6.1 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 8-6 Stop profile optimization parameters

Parameter	Setting
<i>Run Jerk 3 (G15)</i>	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
<i>Deceleration Rate (G12)</i>	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
<i>Run Jerk 4 (G16)</i>	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
<i>Creep Speed (V1 Speed Reference (G01) by default, any speed can be selected)</i>	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
<i>Creep Stop Deceleration Rate (G17)</i>	The Creep stop deceleration is set-up to give a good final stop ride quality. Recommended = application specific
<i>Creep Stop Jerk (G18)</i>	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
<i>Motor Torque Ramp Time (D02)</i>	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.

8.6.2 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 8-7 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

8.7 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 8-8 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

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.



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

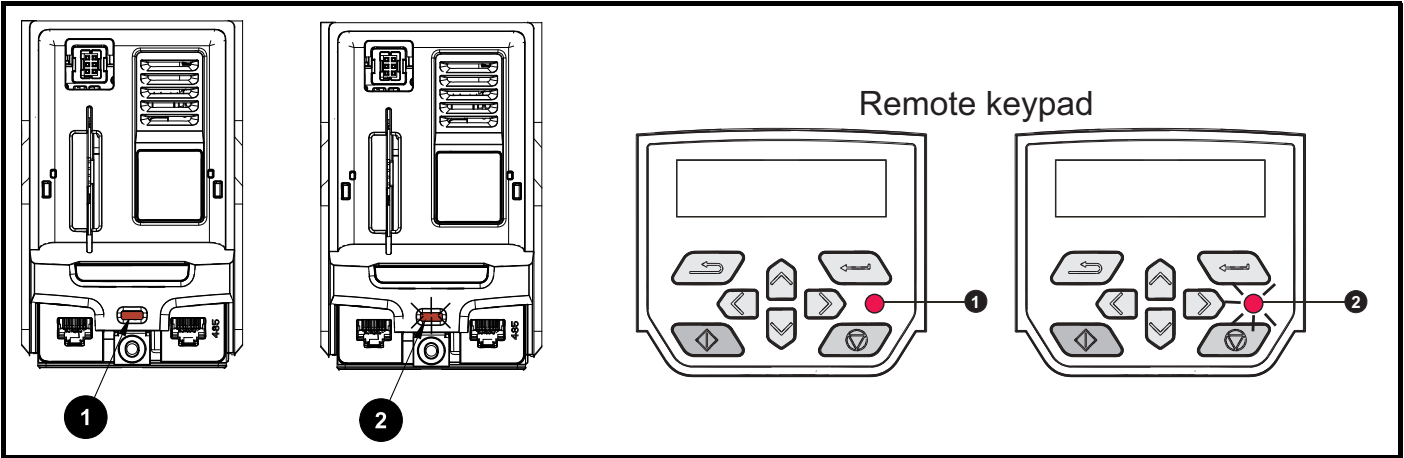
The keypad display provides information on Trip, Alarm and Status indications for further details refer to the keypad section

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



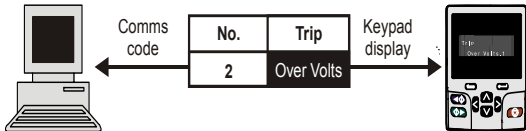
9.3 Communications protocols

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 14

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 208
- 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

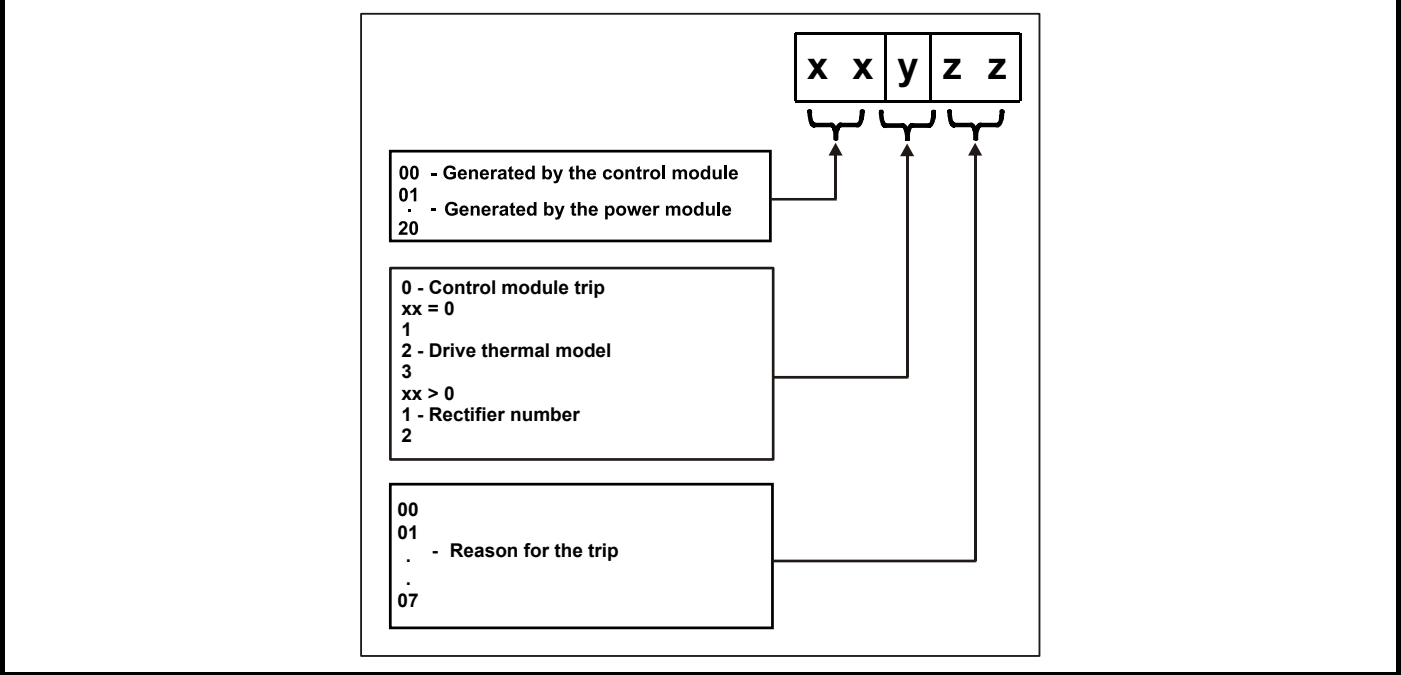
Over Volts	OHT dc bus
OI ac	Phase Loss
OI Brake	Power Comms
PSU	OI Snubber
OHT Inverter	OHT Rectifier
OHT Power	Temp Feedback
OHT Control	Power Data

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 208.

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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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

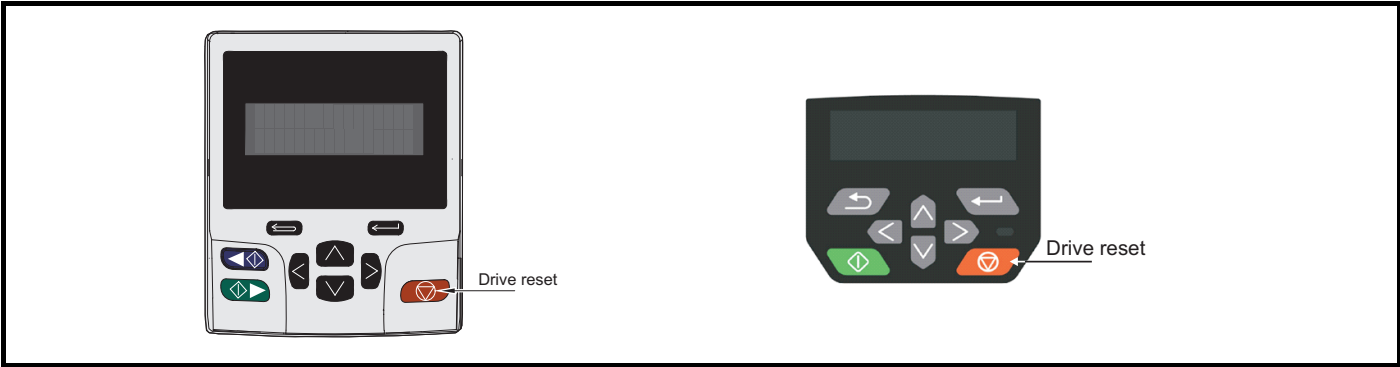
Trips are grouped into categories which are allocated priorities as detailed below, which can effect how and if a trip reset can be carried out. A trip can only occur when the drive is not already tripped, or if the drive is already tripped and the new trip occurs which has a higher priority than the 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.

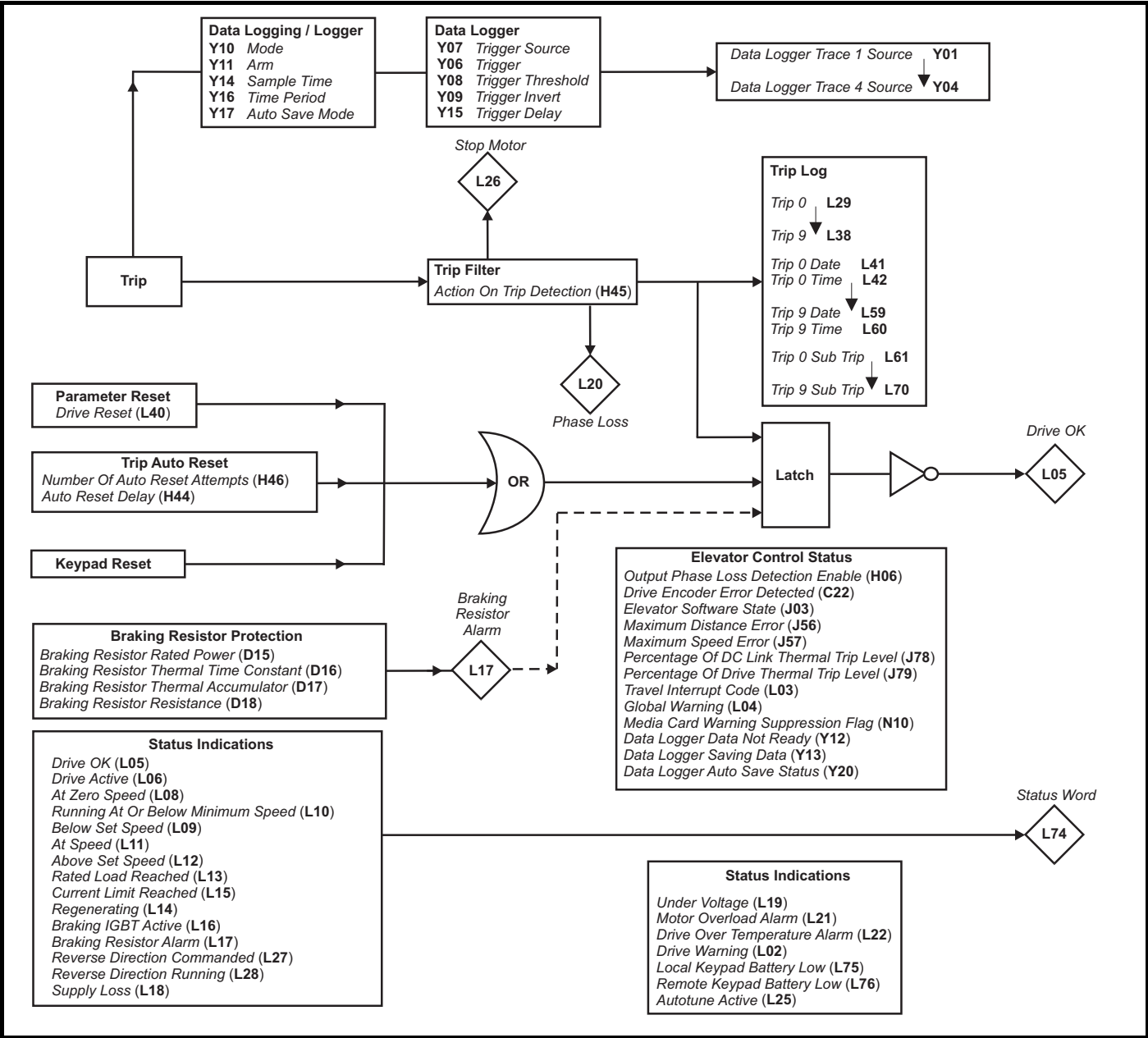
NOTE

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 174.

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, <i>Braking Resistor Thermal Accumulator (D17)</i> in the drive has reached 75.0 % of the value at which the drive will trip.
Motor Overload	<i>Motor Protection Accumulator (J26)</i> 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. <i>Percentage Of Drive Thermal Trip Level (J79)</i> 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 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 208 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 <i>Drive OK (L05)</i> = 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 <i>Motor Contactor Monitoring Enable (B29)</i> = On (1), and none of the above conditions are true, check the state of <i>Motor Contactor Monitoring Input (B30)</i> 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 Cload) indicating an incorrect state. The brake contact should be open, but if it is closed and <i>Brake Contact Monitoring Select (D11)</i> > 0, generate Trip 73 (Brk con 1 cload) and Trip 75 (Brk con 2 cload) 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 <i>Motor Autotune (B11)</i>. 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 <i>Motor Contactor Control Output (B31)</i>. 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 (24 V 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 <i>Fast Disable (B27)</i> 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 <i>Motor Contactor Monitoring Enable (B29)</i> = On (1), and <i>Motor Contactor Monitoring Input (B30)</i> = 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	

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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 OL 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 <i>Load Cell Compensation Enable (E10)</i> = 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:								
<i>Ramp Torque Producing Current (J24)</i> to full limit over the <i>Motor Torque Ramp Time (D02)</i> in ms. The brake controller is engaged once the torque ramp has completed. When <i>Brake Control Output (D03)</i> = 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 <i>Start Lock Enable (I22)</i> =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 <i>Torque Producing Current (J24)</i> 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: <i>Brake Control Output (D03)</i> = On (1) AND - When the torque producing current limit has been ramped to <i>Symmetrical Current Limit (B16)</i>. - 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

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
6 Starting: - Apply the start optimization speed and Jerk when <i>Start Optimizer Time (G48)</i> > 0). - Apply the main elevator profile accel and decel rate. - If Position lock enable = 1, disable the position loop by ramping the <i>Start Lock P Gain Speed Clamp (I21)</i> 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 <i>Start Optimizer Time (G48)</i> 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 $\geq V2$ <i>Speed Reference (G02)</i>, 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. On exit to state 9: - Apply Creep speed 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. 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. On exit to state 9: - Creep speed, if Creep speed is selected. OR 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: - When Creep speed is reached. On exit to state 10: - Apply the final positioning jerk								

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
10		Creep:						
In this state the profile will run at Creep speed (<i>V1 Speed Reference (G01)</i>) by default, but can be any speed reference.								
Exit to state 11:								
- When Creep speed is deselected OR - When the floor sensor correction input is given								
On exit to state 11:								
Apply <i>Creep Stop Deceleration Rate (G17)</i> and <i>Creep Stop Jerk (G18)</i>								
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								
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 <i>Brake Control Output (D03)</i> = Off (0) and wait <i>Motor Torque Ramp Time (D02)</i> ms for the brake to be applied. For systems where the brake control is implemented in the elevator controller <i>Brake Control Output (D03)</i> may be used to indicate when to apply / release the brake.								
Exit to state 13:								
- If <i>Brake Contact Monitoring Select (D11)</i> > 0, and this takes longer than <i>Brake Contact Monitoring Time (D14)</i>, generate a <i>Trip 73 (Brk con 1 cload) / Trip 75 (Brk con 2 cload)</i>. - 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 <i>Motor Torque Ramp Time (D02)</i> 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 <i>Symmetrical Current Limit (B16)</i> and <i>Motor Torque Ramp Time (D02)</i> - 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:								
<i>Fast Disable (B27)</i> = Off (0) AND <i>Total Output Current (J22)</i> ≤ 25 % of rated current AND <i>F10 T31 STO Input 1 State (F10)</i>= 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:								
- If <i>Motor Contactor Monitoring Enable (B29)</i>= On (1), and it takes > 4 s for the monitoring input to be set to 0, generate a <i>Trip 71 (Mot con cload)</i>. - If the <i>Fast Disable (B27)</i> input terminal = On (1), then generate <i>Trip 65 (Fast disable err)</i>. - If the <i>F10 T31 STO Input 1 State (F10)</i> = On 1, then generate <i>Trip 66 (STO Ctrl err)</i>. - If the total current is > 25 % of rated, then generate <i>Trip 67 (Current on stop)</i>.								

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 <i>Menu B Motor</i> 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 <i>Menu D Brake</i> for the brake control and <i>Menu B Motor</i> 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, <i>Induction motor or PM motor</i> Refer to <i>Menu B Motor</i> 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 <i>Menu C Encoder</i> for encoder parameters For PM motors and operation in RFC-S an encoder phase angle test must be completed before operation. - Refer to <i>Motor Autotune (B11)</i>
	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 <i>Menu F Hardware IO</i> 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 <i>Motor Autotune (B11)</i>.
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 <i>Menu I Tuning</i> 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 <i>Menu I Tuning</i> 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, shielding 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 <i>Drive Encoder Feedback Filter (C09)</i>
	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

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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 <i>Menu E Mechanical</i> to enter the mechanical data						
	Elevator operating speeds not set-up	The <i>E300 Advanced Elevator</i> 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 <i>Menu G Profile</i> to set-up the operating speeds and <i>Menu F Hardware IO</i> 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 <i>Control Input Mode (H11)</i> and is being selected. Also check that the motor power and encoder connections are of the correct rotation Refer to <i>Menu F Hardware IO</i> 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 <i>Motor Autotune (B11)</i>						
	Motor power, encoder control connections	Check both the motor power connections and the encoder control connections for the correct rotation. Refer to <i>Reverse Motor Phase Sequence (B26)</i> for the motor or <i>Drive Encoder Feedback Reverse (C12)</i>.						
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 <i>Current Limit Reached (L15)</i>. - Check the motor parameters and symmetrical current limit are set-up correctly in <i>Menu B Motor</i> - Check motor load in <i>Total Output Current (J22)</i> - Check for system mechanical issue, brake, safety gear, incorrect balance weights - Check drive size correct - Reduce acceleration, deceleration rates in <i>Menu G Profile</i> 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 <i>Torque Producing Current (J24)</i> Open loop) - Tune the rated speed to achieve the maximum torque using <i>Motor Parameter Adaptive Control (B25)</i> 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 <i>Output Voltage</i> and <i>Last Travel Maximum Output Voltage (J63)</i>						
	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 <i>Enable High Speed Mode (B28)</i> and ensure <i>Motor Rated Voltage (B03)</i> 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 too 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 <i>Menu I Tuning</i> 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 <i>Motor Torque Ramp Time (D02)</i>						

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
Reported fault		Root cause		Recommended actions				
Vibration on brake release		Speed control loop	If the speed loop integral gain is too 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 <i>Menu I Tuning</i> 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 too 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 <i>Menu I Tuning</i> 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, shield and terminations. Refer to <i>Drive Encoder Feedback Filter (C09)</i> which can also be used to limit induced noise.					
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 <i>Menu I Tuning</i> 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, shield and terminations. Refer to <i>Drive Encoder Feedback Filter (C09)</i> 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 <i>Menu I Tuning</i> 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 <i>Menu I Tuning</i> 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 <i>Start Lock P Gain (I20)</i>. 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 <i>Menu E Mechanical</i> 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 <i>Load Cell Compensation Filter Time Constant (E12)</i>					

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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 <i>Menu B Motor and Symmetrical Current Limit (B16)</i>					
		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 <i>Motor Autotune (B11)</i>					
		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 <i>Drive Encoder Position (J53)</i> and check connections to drive encoder port. - Refer to <i>Drive Encoder Feedback Reverse (C12)</i> 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 <i>Torque Producing Current (J24)</i> (Open loop) - Tune the rated speed to achieve the maximum torque using <i>Motor Parameter Adaptive Control (B25)</i> (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

Trip	Diagnosis								
550 Hz Limit	Mechanical setup results in potential output frequency exceeding maximum threshold								
83	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.								
An Input 1 Loss	Analog input 1 current loss								
28	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								
An Input 2 Loss	Analog input 2 current loss								
29	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								
An Output Calib	Analog output calibration failed								
219	The zero offset calibration of one or both of the analog 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 border="1"> <thead> <tr> <th>Sub-trip</th><th>Reason</th></tr> </thead> <tbody> <tr> <td>1</td><td>Output 1 failed</td></tr> <tr> <td>2</td><td>Output 2 failed</td></tr> </tbody> </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.	Sub-trip	Reason	1	Output 1 failed	2	Output 2 failed		
Sub-trip	Reason								
1	Output 1 failed								
2	Output 2 failed								
App Menu Changed	Customization table for an application module has changed								
217	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 border="1"> <thead> <tr> <th>Sub-trip</th><th>Reason</th></tr> </thead> <tbody> <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> </tbody> </table> Recommended actions: Reset the trip and perform a parameter save to accept the new settings	Sub-trip	Reason	1	Menu S	2	Menu T	3	Menu U
Sub-trip	Reason								
1	Menu S								
2	Menu T								
3	Menu U								
Analog No Dir	Run signal not received when starting in an analog control input mode								
79	A direction signal or run permit was not provided within 1s of the brake release time elapsing in an analog control input mode, <i>Control Input Mode (H11)</i> = Analog Run Prmit or Analog 2 Dir (0 or 1). Recommended actions: - Check <i>Direction Input 1 CCW (G39)</i> and <i>Direction Input 2 CW (G40)</i> to ensure that a direction signal is received. - Check control wiring is correct. - Check control wiring is undamaged.								
Autotune No Dir	Direction signal not received when starting an autotune								
79	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 <i>Motor Autotune (B11)</i> >=1. Recommended actions: - Check <i>Direction Input 1 CCW (G39)</i> and <i>Direction Input 2 CW (G40)</i> to ensure that a direction signal is received. - Check control wiring is correct. - Check control wiring is undamaged.								

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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 <i>Drive Encoder Type (C01)</i> is set-up correctly • Check <i>Drive Encoder Rotary Pulses Per Revolution (C03)</i> and <i>Drive Encoder Voltage Select (C04)</i> are set-up correctly • Where a auto configuration compatible encoder is being used select <i>Drive Encoder Auto Configuration Select (C02)</i> • 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								
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 <i>Drive Encoder Feedback Reverse (C12)</i> • Rotate any two motor phases or use <i>Reverse Motor Phase Sequence (B26)</i>								
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 <i>Drive Encoder Feedback Reverse (C12)</i> • Rotate any two motor phases or use <i>Reverse Motor Phase Sequence (B26)</i>								
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							
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							
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							

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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 <i>Number Of Motor Poles (B05)</i> - Check the number of lines per revolution for feedback device in <i>Drive Encoder Rotary Pulses Per Revolution (C03)</i>						
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 <i>T31 STO Input 01 State (F10)</i> and the Fast disable input if used) are active during the autotune. - Check the run signal is active in <i>T28 Digital Input 05 State (F07)</i> 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 <i>Brake Contact Monitoring Select (D11)</i> This is a delayed trip, where travel will complete (<i>Elevator Software State (J03) = 0</i>) and then the drive will trip. If a delayed trip has been scheduled during travel (<i>Elevator Software State (J03) > 0</i>) then <i>Global Warning (L04) = On (1)</i> indicating that there is a delayed trip scheduled to occur when travel completes.						
Brk con 1 closed		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 <i>Brake Contact Monitoring Select D11)</i> This is a delayed trip, where travel will complete (<i>Elevator Software State (J03) = 0</i>) and then the drive will trip. If a delayed trip has been scheduled during travel (<i>Elevator Software State (J03) > 0</i>) then <i>Global Warning (L04) = On (1)</i> 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 <i>Brake Contact Monitoring Select D11)</i> This is a delayed trip, where travel will complete (<i>Elevator Software State (J03) = 0</i>) and then the drive will trip. If a delayed trip has been scheduled during travel (<i>Elevator Software State (J03) > 0</i>) then <i>Global Warning (L04) = On (1)</i> indicating that there is a delayed trip scheduled to occur when travel completes.						
Brk con 2 closed		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 <i>Brake Contact Monitoring Select D11)</i> This is a delayed trip, where travel will complete (<i>Elevator Software State (J03) = 0</i>) and then the drive will trip. If a delayed trip has been scheduled during travel (<i>Elevator Software State (J03) > 0</i>) then <i>Global Warning (L04) = On (1)</i> 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 <i>Motor Torque Ramp Time (D02)</i> - Check correct motor map settings - Check <i>Motor Magnetized Indication (D01)</i> - Check motor contactor control - Check motor electrical connections						

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
Trip		Diagnosis						
Brake R Too Hot		Braking resistor overload timed out (I²t)						
19		The Brake R Too Hot indicates that braking resistor overload has timed out. The value in <i>Braking Resistor Thermal Accumulator (D17)</i> is calculated using <i>Braking Resistor Rated Power (D15)</i> rating, <i>Braking Resistor Thermal Time Constant (D16)</i> and <i>Braking Resistor Resistance (D18)</i> value. The <i>Brake R Too Hot</i> trip is initiated when <i>Braking Resistor Thermal Accumulator (D17)</i> 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 <i>Card Boot</i> trip will occur if a write to a User Menu A parameter has been initiated via the keypad by exiting edit mode and <i>Parameter Cloning (N01)</i> 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 <i>Parameter Cloning (N01)</i> modes is changed to Auto (3) or Boot (4) mode, but the drive is not subsequently reset. Recommended actions: • Ensure that <i>Parameter Cloning (N01)</i> 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						

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics	
Trip		Diagnosis							
Card Error		NV Media Card data structure error							
182	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.								
	Sub-trip		Reason						
	1		The required folder and file structure is not present						
	2		The HEADER.DAT file is corrupted						
	3		Two or more files in the GT8DATA\DRIVE folder have the same file identification number						
		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							
Card Full		NV Media Card full							
184	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							
Card No Data		NV Media Card data not found							
183	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							
Card Option		NV Media Card trip; option modules installed are different between source drive and destination drive							
180	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.								
	Card Product		NV Media Card data blocks are not compatible with the drive derivative						
	175	The Card Product trip is initiated either at power-up or when the NV Media Card is accessed, If <i>Drive Derivative (J96)</i> 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							
Card Rating		NV Media Card Trip; The voltage and / or current rating of the source and destination drives are different							
186	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								
Card Read Only		NV Media Card has the Read Only bit set							
181	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							
Card Slot		NV Media Card Trip; Option module application program transfer has failed							
174	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							

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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 $\geq 25\%$ 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 (<i>Elevator Software State</i> (J03) = 0) and then the drive will trip. If a delayed trip has been scheduled during travel (<i>Elevator Software State</i> (J03) > 0) then <i>Global Warning</i> (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. <i>Drive Active</i> (L06) = On (1). Recommended actions: • Ensure the drive is not enabled when one of the 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 <i>T28 Digital Input 05 State</i> (F07) = On (1) during operation default configuration) This is a delayed trip, where travel will complete (<i>Elevator Software State</i> (J03) = 0) and then the drive will trip. If a delayed trip has been scheduled during travel (<i>Elevator Software State</i> (J03) > 0) then <i>Global Warning</i> (L04) = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.							

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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 <i>Maximum Distance Error Threshold (H16)</i> resulting in reduced control. The distance error detection is the integral of the difference between <i>Profile Speed (J39)</i> and <i>Actual Speed (J40)</i> and active for closed loop operation only. The calculated distance error is compared to the user defined distance error threshold in <i>Maximum Distance Error Threshold (H16)</i> and where this is exceeded a trip is generated. The distance error during a travel is displayed in <i>Maximum Distance Error (J56)</i> independent of the activation of the distance error detection. The distance error in <i>Maximum Distance Error (J56)</i> 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 <i>Maximum Distance Error Threshold (H16)</i> - The distance error detection can be disabled by setting <i>Maximum Distance Error Threshold (H16)</i> = 0							
	Drive rating Motor rated current exceeds allowable HD rating The motor rated current set-up in <i>Motor Rated Current (B02)</i> 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 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 <i>Drive Encoder Termination Select (C05)</i> = 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 (<i>Drive Encoder Voltage Select (C04)</i>) and install a 5 V voltage regulator close to the encoder - Internal encoder fault, replace encoder							
Encoder 2	Drive encoder feedback wire break detection 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.							
190	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 <i>Drive Encoder Voltage Select (C04)</i> - If wire break detection is not required, set <i>Drive Encoder Error Detection Level (C21)</i> = 0 to disable the Encoder 2 trip - Internal encoder fault, replace encoder								

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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 while 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 <i>Drive Encoder Voltage Select (C04)</i> is correct • Check <i>Drive Encoder Additional Power Up Delay (C10)</i> and adjust where required to support encoder feedback • Carry out encoder auto-configuration <i>Drive Encoder Auto Configuration Select (C02)</i> • 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 <i>Drive Encoder Comms Bits (C08)</i> • If using Hiperface, EnDat or BiSS encoders carry out auto-configuration <i>Drive Encoder Auto Configuration Select (C02)</i> • Check <i>Drive Encoder Additional Power Up Delay (C10)</i> 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 <i>Drive Encoder Voltage Select (C04)</i> • Replace the encoder / contact the supplier of the encoder							

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
Trip		Diagnosis						
Encoder 7		Initialization failed						
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 <i>Drive Encoder Type (C01)</i> - Check the encoder power supply setting <i>Drive Encoder Voltage Select (C04)</i> - Check the correct encoder comms baud rate is selected in <i>Drive Encoder Comms Baud Rate (C06)</i> - Carry out an encoder auto-configuration <i>Drive Encoder Auto Configuration Select (C02)</i> = Enabled - Carry out re-initialize with <i>Position Feedback Initialize (C18)</i> - Check <i>Position Feedback Initialized Indication (C19)</i> - Faulty encoder, replace								
Encoder 8		Position feedback interface has timed out						
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 <i>Drive Encoder Type (C01)</i> - Ensure that the encoder is compatible with the drive encoder specification - Increase the encoder baud rate in <i>Drive Encoder Comms Baud Rate (C06)</i>								
Encoder 12		Encoder could not be identified during auto-configuration						
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 <i>Drive Encoder Auto Configuration Select (C02)</i> and enter the encoder set-up parameters manually								
Encoder 13		Data read from the encoder is out of range during auto-configuration						
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 <i>Drive Encoder Auto Configuration Select (C02)</i> and enter the encoder set-up parameters manually								
Encoder Not Init		Encoder initialization failure						
162	The drive's encoder interface has not initialized prior to travel.							
	This may be because the encoder has an older / slower comms interface. <i>Drive Encoder Additional Power Up Delay (C10)</i> may be increased to allow extra time for the encoder comms to initialize <i>Position Feedback Initialize (C18)</i> may be used to manually initialize the feedback, and <i>Position Feedback Initialized Indication (C19)</i> 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						
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 while 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 <i>T27 Digital Input 04 State (F06)</i> during operation for the correct sequence Off (0) or On (1) - Disable the Fast disable input by setting the control input destination from <i>Fast Disable (B27)</i> to 00.000								

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
Trip		Diagnosis						
Feedback rev		Encoder feedback is reversed						
64	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 <i>Reverse motor phase sequence (B26)</i> • Check correct connections of the encoder feedback to the drive • Encoder feedback can be rotated with <i>Drive Encoder Feedback Reverse (C12)</i>							
Freeze protect		Freeze protection limit exceeded						
60	Freeze protection threshold in <i>Freeze Protection Threshold (H28)</i> has been exceeded, Recommended actions: • Check the temperature setting in <i>Freeze Protection Threshold (H28)</i> • Check the actual temperature in <i>Monitored Temperature 3 (J73)</i> • Provide heating, air conditioning, ventilation to support allowable temperature in <i>Freeze Protection Threshold (H28)</i> This is a delayed trip, where travel will complete (<i>Elevator Software State (J03)</i> = 0) and then the drive will trip. If a delayed trip has been scheduled during travel (<i>Elevator Software State (J03)</i> > 0) then <i>Global Warning (L04)</i> = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.							
I Limit Timeout		Drive has been in current limit (in open-loop mode) for an excessive time						
82	In Open loop mode the drive has been in current limit for <i>Maximum Time In Current Limit (H50)</i> ms. This could be the result of a mechanical fault. Recommended actions: • Check that the elevator car is free to move.							
Inductance		Inductance measurement out of range or motor saturation not detected						
8	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.							
	Sub-trip		Reason					
	1	The difference between <i>Transient Inductance Ld (B33)</i> and <i>No Load Lq (B37)</i> is too small. $B37 - B33 / B33$ and must be greater than 0.2. Also $B37 - B33$ must be greater than $K / \text{Drive Full Scale Current } Kc (J06)$, 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.						
		Drive rated voltage		K				
		200 V		0.037				
400 V		0.073						
575 V		0.087						
690 V		0.105						
2	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.							
3	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.							
I/O Overload		Digital output overload						
26	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							

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics																				
Trip		Diagnosis																										
Mot con open		Motor contactor open fault																										
70		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 <i>Motor Contactor Monitoring Enable (B29)</i> This is a delayed trip, where travel will complete (<i>Elevator Software State (J03)</i> = 0) and then the drive will trip. If a delayed trip has been scheduled during travel (<i>Elevator Software State (J03)</i> > 0) then <i>Global Warning (L04)</i> = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.																										
Mot con closed		Motor contactor closed fault																										
71		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 <i>Motor Contactor Monitoring Enable (B29)</i> This is a delayed trip, where travel will complete (<i>Elevator Software State (J03)</i> = 0) and then the drive will trip. If a delayed trip has been scheduled during travel (<i>Elevator Software State (J03)</i> > 0) then <i>Global Warning (L04)</i> = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.																										
Motor Too Hot		Output current overload timed out I ² t)																										
20		Motor Too Hot trip indicates a motor thermal overload based on the <i>Motor Rated Current (B02)</i> and <i>Motor Thermal Time Constant 1 (B20)</i>. <i>Motor Protection Accumulator (J26)</i> displays the motor temperature as a percentage of the maximum value. The drive will trip on <i>Motor Too Hot</i> when <i>Motor Protection Accumulator (J26)</i> 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 <i>Motor Rated Current (B02)</i> 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 <i>Motor Rated Current (B02)</i> is not zero																										
OHt Brake		Braking IGBT over-temperature																										
101		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																										
OHt Control		Control stage over temperature																										
23		OHt Control trip indicates that a control stage over-temperature has been detected. From the sub-trip number 'xyzz', 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							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	I/O board thermistor over temperature
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	I/O board thermistor over temperature																								

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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 <i>Percentage Of DC Link Thermal Trip Level (J78)</i> . If this parameter reaches 100 % then an <i>OHT DC bus</i> 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	xx	y	zz	Description			
	Control system	00	2	00	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 • <i>Slip Compensation Enable (B10)</i>, (Open loop) • Select fixed boost mode, parameter B09 (Open loop) • Disconnect load and complete a rotating autotune, <i>Motor Autotune (B11)</i> • 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	xx	y	zz	Description			
	Control system	00	1	00	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 'xxyz', the thermistor location is identified by 'zz'.							
	Source	xx	y	zz	Description			
	Power system	01	0	zz	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							
This is a delayed trip, where travel will complete (<i>Elevator Software State (J03)</i> = 0) and then the drive will trip. If a delayed trip has been scheduled during travel (<i>Elevator Software State (J03)</i> > 0) then <i>Global Warning (L04)</i> = On (1) indicating that there is a delayed trip scheduled to occur when travel completes.								

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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							
Ol ac		Instantaneous output over current detected						
3	The Ol 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								
Ol Brake		Braking IGBT over current detected: short circuit protection for the braking IGBT activated						
4	Ol 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							
Ol dc		Power module over current detected from IGBT “ON” state voltage monitoring						
109	Ol 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							

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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	xx	y	zz	Description			
	Power system	01	Rectifier number	00	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	Reason						
	1	U phase detected as disconnected when drive enabled to run.						
	2	V phase detected as disconnected when drive enabled to run.						
	3	W phase detected as disconnected when drive enabled to run.						
	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	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.																	
	<table><tr><th>Voltage rating</th><th>VM_DC_VOLTAGE[MAX]</th><th>VM_DC_VOLTAGE_SET[MAX]</th></tr><tr><td>200</td><td>415</td><td>410</td></tr><tr><td>400</td><td>830</td><td>815</td></tr><tr><td>575</td><td>990</td><td>970</td></tr><tr><td>690</td><td>1190</td><td>1175</td></tr></table>			Voltage rating	VM_DC_VOLTAGE[MAX]	VM_DC_VOLTAGE_SET[MAX]	200	415	410	400	830	815	575	990	970	690	1190	1175
	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																	
	<table><tr><th>Source</th><th>xx</th><th>y</th><th>zz</th></tr><tr><td>Control system</td><td>00</td><td>0</td><td>01: Instantaneous trip when the DC bus voltage exceeds VM_DC_VOLTAGE[MAX].</td></tr><tr><td>Control system</td><td>00</td><td>0</td><td>02: Time delayed trip indicating that the DC bus voltage is above VM_DC_VOLTAGE_SET[MAX].</td></tr></table>			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].			
	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																		
Phase Loss		AC power supply phase loss																
32	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.																	
	<table><tr><th>Source</th><th>xx</th><th>y</th><th>zz</th></tr><tr><td>Control system</td><td>00</td><td>0</td><td>00: Phase loss detected based on control system feedback. The drive attempts to stop the drive before tripping unless bit 2 of <i>Action On Trip Detection (H45)</i> is set to one.</td></tr><tr><td>Power system</td><td>01</td><td>Rectifier number</td><td>00: Phase loss has been detected by the rectifier module</td></tr></table>			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 <i>Action On Trip Detection (H45)</i> is set to one.	Power system	01	Rectifier number	00: Phase loss has been detected by the rectifier module			
	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 <i>Action On Trip Detection (H45)</i> 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 <i>Input Phase Loss Detection Mode Enable (H08)</i>																	
	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 <i>Input Phase Loss Detection Mode Enable (H08) = 2.</i>																	
	Phasing Error		RFC-S mode phasing failure due to incorrect phase angle															
	198	The Phasing Error trip indicates that the phase angle in <i>Position Feedback Phase Angle (C13)</i> 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 <i>Position Feedback Phase Angle (C13)</i> • Spurious Phasing Error trips can be seen in very dynamic applications and can be disabled by setting the over-speed threshold in <i>Motor Over Speed Threshold (E09)</i> 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 <i>Position Feedback Phase Angle (C13)</i> • Adjust the speed loop gains to reduce the systems dynamic response																		

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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					
	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 <i>Stator Resistance (B34)</i> 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.							

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
Trip		Diagnosis						
SlotX Different	Option module in option slot X has changed							
204 209 214	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.							
	Sub-trip	Reason						
	1	No module was installed previously						
	2	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.						
	3	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.						
	4	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.						
	>99	Shows the identifier of the module previously installed.						
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								
SlotX Error	Option module in option slot X has detected a fault							
202 207 212	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 <i>Option module User guide</i> for details of the trip and sub-trip number							
SlotX HF	Option module X hardware fault							
200 205 210	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.							
	Sub-trip	Reason						
	1	The module category cannot be identified						
	2	All the required customized menu table information has not been supplied or the tables supplied are corrupt						
	3	There is insufficient memory available to allocate the comms buffers for this module						
	4	The module has not indicated that it is running correctly during drive power-up						
	5	Module has been removed after power-up or it has stopped working						
	6	The module has not indicated that it has stopped accessing drive parameters during a drive mode change						
	7	The module has failed to acknowledge that a request has been made to reset the drive processor						
	8	The drive failed to correctly read the menu table from the module during drive power up						
9	The drive failed to upload menu tables from the module and timed out (5 s)							
Recommended actions:								
• Ensure the option module is installed correctly • Replace the option module • Replace the drive								
SlotX Not Fitted	Option module in option slot X has been removed							
203 208 213	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.							
	Soft Start	Soft start relay failed to close, soft start monitor failed						
226	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								

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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 4 s. Remove the speed or direction signals to reset the trip. - When <i>Control Input Mode (H11)</i> = Analog Run Prmit (0), the Run Permit signal using <i>Direction Input 1 CCW (G39)</i> must be removed at the end of travel. - When <i>Control Input Mode (H11)</i> = Analog 2 Dir (0), Priority 2 Dir (4) or Binary 2 Dir (5) the direction signals (<i>Direction Input 1 CCW (G39)</i> or <i>Direction Input 2 CW (G40)</i>) OR the speed selection (<i>Reference Select Bit 0 Input (G32)</i> to <i>Reference Select Bit 6 Input (G38)</i>) must be removed at the end of travel. - When <i>Control Input Mode (H11)</i> = Priority 1 Dir (2) or Binary 1 Dir (3) the speed selection (<i>Reference Select Bit 0 Input (G32)</i> to <i>Reference Select Bit 6 Input (G38)</i>) must be removed at the end of travel. - When <i>Control Input Mode (H11)</i> = Control Word (6), the direction signals (<i>Control Word (G51)</i> Bit 10 or Bit 11) OR the speed selection (<i>Control Word (G51)</i> 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 <i>Maximum Speed Error Threshold (H15)</i>. <i>Maximum Speed Error Threshold (H15)</i> 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 <i>Profile Speed (J39)</i> and <i>Actual Speed (J40)</i>. The calculated speed error is then compared with the speed error threshold in <i>Maximum Speed Error Threshold (H15)</i> and where the threshold is exceeded for more than 100 ms a trip is generated. The speed error during a travel is displayed in <i>Maximum Speed Error (J57)</i> 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 <i>Maximum Speed Error Threshold (H15)</i> - The following speed error detection can be disabled by setting <i>Maximum Speed Error Threshold (H15)</i> = 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 at 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 <i>T31 STO Input 1 State (F10)</i> 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 <i>Motor Contactor Measured Delay Time (B32)</i>						

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
Trip		Diagnosis						
Temp Feedback	Internal thermistor has failed							
218	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:							
	Source	xx	y	zz				
	Control board	00	00	01: Control board thermistor 1 02: Control board thermistor 2 03: I/O board thermistor				
	Power system	01	0	Zero for temperature feedback provided via power system comms. 21, 22 and 23 for direct ELV temperature feedback.				
	Power system	01	Rectifier number	Always zero				
Recommended actions:								
• Hardware fault - contact the supplier of the drive.								
Th Brake Res	Brake resistor over temperature							
10	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								
Th Short Circuit	Motor thermistor short circuit							
25	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.							
	Sub-trip	Reason						
	1	The resistance of the thermistor connected to the drive P1 position feedback interface is less than 50 Ω.						
	2	The resistance of the thermistor connected to analog input 3 is less than 50 Ω.						
Recommended actions:								
• Check thermistor control connection at drive								
• Check thermistor wiring, continuity and signs of damage								
• Replace motor / motor thermistor								
Thermistor	Motor thermistor over-temperature							
24	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							
	Sub-trip	Reason						
	1	Trip initiated from thermistor connected to P1 position feedback interface						
	2	Trip initiated from thermistor connected to analog input 3						
	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 (<i>Elevator Software State (J03) = 0</i>) and then the drive will trip. If a delayed trip has been scheduled during travel (<i>Elevator Software State (J03) > 0</i>) then <i>Global Warning (L04) = On (1)</i> indicating that there is a delayed trip scheduled to occur when travel completes.								
User 24V	User 24 V supply is not present on control terminals 1 (0 V) and 2 (24 V)							
91	A User 24 V trip is initiated, if <i>User Supply Select (O10)</i> is set to 1 <i>Low Under Voltage Threshold Select (O13) = 1</i> 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								
User Save	User Save error / not completed							
36	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.								

Safety information	Product information	Mechanical installation	Electrical installation	Getting started	User Menu A	Commissioning	Optimization	Diagnostics
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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 closed	213	Slot3 Not installed		

Index

Symbols

+10V user output	52
+24V external input	52, 55, 66
+24V user output	53

Numerics

0V common	52
-----------------	----

A

AC supply contactor	41
AC supply requirements	62
Access	19
Alarm	178
Alarm Indications	178
Analog input 2	52
Analog input 3	53
Analog output 1	53
Analog output 2	53

B

Braking	76
---------------	----

C

Cable clearances	81
Cable types and lengths	73
Cautions	6
Control connections	49
Control terminal specification	52, 55
Cooling	19
Creep-to-floor positioning	140
Cycle time	140

D

DC bus voltage	76
Deceleration	76
Defaults (restoring parameter)	93
Destination parameter	49
Diagnostics	171
Digital I/O 1	54
Digital I/O 2	54
Digital I/O 3	54
Digital Input 1	54
Digital Input 2	54
Digital Input 3	54
Display messages	95
Drive enable	54
Drive features	12, 14

E

Electrical safety	19
Electrical terminals	30
Electromagnetic compatibility (EMC)	19, 79
EMC - Compliance with generic emission standards	82, 83
EMC - Variations in the wiring	84
Enclosure	29
Encoder connections	60
Environmental protection	19

F

Feedback device cable shielding	81
Fire protection	19
Fixed V/F mode	11
Fuse types	41

G

Getting Started	88
Ground connections	41, 47, 80
Ground leakage	78
Ground terminals	30

H

Hazardous areas	19
Heatsink mounted braking resistor	76

I

Isolator switch	85
Items supplied with the drive	16

K

Keypad and display - Installing / removing	23, 24
Keypad operation	89

L

Line reactors	72
---------------------	----

M

Mechanical Installation	19
Menu 0	95
Menu structure	92, 94
Minimum connections to get the motor running in any operating mode	62
Mode parameter	49
Monitoring	124
Motor (running the motor)	132
Motor isolator / disconnect-switch	85
Motor operation	75
Motor winding voltage	75
Multiple motors	75

N

Nominal elevator speed	139
Notes	6

O

Open loop mode	11
Operating mode (changing)	100
Operating modes	11
Operating-mode selection	111
Optimization	166
Options	14
Output contactor	75

P

Parameter security	91
Parameter x.00	111
Planning the installation	19
Power ratings	77
Power terminals	30
Precision reference Analog input 1	52
Product information	8

Q

Quadratic V/F mode	11
--------------------------	----

R

Reactor current ratings	72
Relay contacts	54
Residual current device (RCD)	79
Resistances (minimum)	77
RFC-A mode	11
RFC-S mode	12
Routine maintenance	38

S

SAFE TORQUE OFF	86
SAFE TORQUE OFF/drive enable	54
Safety Information	6, 8, 19, 174
Saving parameters	101
Serial comms lead	49
Serial communications connections	86
Serial communications look-up table	189
Serial communications port isolation	48
Solutions Module - Installing / removing	22
Speed limits	110
Speed loop gains	167
Status	178
Status Indications	178
Supply types	41
Surface mounting the drive	25, 27
Surge immunity of control circuits - long cables and connections outside a building	85
Surge suppression for analog and bipolar inputs and outputs	86
Surge suppression for digital and unipolar inputs and outputs	85

T

Terminal block in the enclosure	85
Terminal cover removal	20
Terminal sizes	30
Thermal protection circuit for the braking resistor	78
Through-panel mounting the drive	28
Torque settings	31
Trip	171
Trip Indications	171

U

User Security	91
---------------------	----

V

Ventilation	29
Voltage boost	117

W

Warnings	6
----------------	---



0479-0005-01