EMERSON™
Industrial Automation

Short Form Guide

Mentor MP

High performance DC drive
25A to 7400A, 480V to 690V
Two or four quadrant
operation

Part Number: 0476-0003-05
Issue: 5

CONTROL TECHNIQUES

www.controltechniques.com

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 software versions. If this drive is to be connected to an existing system or machine, all drive software 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.

This drive contains two software versions which can be checked by looking at Pr **11.29** (**di14/0.49**) and Pr **11.34**. This takes the form of xx.yy.zz where Pr **11.29** (**di14/0.49**) displays xx.yy and Pr **11.34** displays zz for the user software. Power software is displayed at Pr **11.56** and takes the form of xx.yy. (e.g. for software version 01.06.00, Pr **11.29** (**di14/0.49**) = 1.06 and Pr **11.34** displays 0 which is compatible with power software version 01.09, Pr **11.56** = 1.09).

Environmental statement

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

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

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

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

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

REACH legislation

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

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

http://www.controltechniques.com/REACH

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Issue Number: 5

Firmware versions:

> User: 01.06.00 onwards
> Power: 01.09.00 onwards

Contents

Declaration of Conformity

Control Techniques Ltd, The Gro, Newtown. Powys. UK. SY16 3BE

Size 1		Size 2		
MP25A4(R)	MP25A5(R)	MP350A4(R)	MP350A5(R)	MP350A6(R)
MP45A4(R)	MP45A5(R)	MP420A4(R)		
MP75A4(R)	MP75A5(R)		MP470A5(R)	MP470A6(R)
MP105A4(R)	MP105A5(R)	MP550A4(R)		
MP155A4(R)	MP155A5(R)	MP700A4(R)	MP700A5(R)	MP700A6(R)
MP210A4(R)	MP210A5(R)	MP825A4(R)	MP825A5(R)	MP825A6(R)
		MP900A4(R)		
		MP1200A4(R)	MP1200A5(R)	MP1200A6(R)
		MP1850A4(R)	MP1850A5(R)	MP1850A6(R)

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

EN 61800-5-1:2007	Adjustable speed electrical power drive systems - safety requirements - electrical, thermal and energy
EN 61800-3:2004	Adjustable speed electrical power drive systems. EMC product standard including specific test methods
EN 61000-6-2:2005	Electromagnetic compatibility (EMC). Generic standards. Immunity standard for industrial environments
EN 61000-6-4:2007	Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments

The corresponding international standards are:

IEC 61800-5-1:2007

IEC 61800-3:2004

IEC 61000-6-2:2005

IEC 61000-6-4:2006

These products comply with the Low Voltage Directive 2006/95/EC and the Electromagnetic Compatibility Directive 2004/108/EC.

T. Alexander

VP Technology

Date: 23rd December 2009

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

1 Safety Information

1.1 Warnings, Cautions and Notes

> ⚠️ **WARNING**
>
> A **Warning** contains information, which is essential for avoiding a safety hazard.

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

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

1.2 Electrical safety - general warning

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

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

1.3 System design and safety of personnel

The drive is intended as a component for professional incorporation into complete equipment or 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.

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 guide carefully.

The STOP and START controls or electrical inputs of the drive must not be relied upon to ensure safety of personnel. They 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.

The drive is not intended to be used for safety-related functions.

Careful consideration must be given to the function of the drive which might result in a hazard, either through its 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.

1.4 Environmental limits

Instructions within the supplied data and information within the *Mentor MP User Guide* regarding transport, storage, installation and the 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

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

1.6 Fire protection

The drive enclosure is not classified as a fire enclosure. A separate fire enclosure must be provided. For further information, refer to section 3.2 *Fire protection* on page 19.

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 and other protection, and protective ground (earth) connections.

The *Mentor MP User Guide* contains instructions for achieving compliance with specific EMC standards.

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

2006/42/EC: Safety of machinery

2004/108/EC: Electromagnetic compatibility

1.8 Motor

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

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 ventilation 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 Pr **5.07** (**SE07, 0.28**), *Motor rated current.* This affects the thermal protection of the motor.

1.9 Mechanical brake control

The brake control functions are provided to allow well co-ordinated 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.

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1.11   Electrical installation

1.11.1 Electric shock risk

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

- •   AC supply cables and connections
- •   Output cables and connections
- •   Many internal parts of the drive, and external option units

Unless otherwise indicated, control terminals are single insulated and must not be touched.

1.11.2 Stored charge

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

2 Product information

2.1 Introduction

The *Mentor MP Short Form Guide* is designed as a concise aid to drive installation and operation. More information, including the *Mentor MP User Guide* and *Mentor MP Advanced User Guide*, can be found on the CD supplied with the drive.

Table 2-1 Model to frame size cross reference

Model			Frame
480V EN/IEC cULus	575V EN/IEC cULus to 600V	690V EN/IEC	
MP25A4(R)	MP25A5(R)		1A
MP45A4(R)	MP45A5(R)		
MP75A4(R)	MP75A5(R)		
MP105A4(R)	MP105A5(R)		1B
MP155A4(R)	MP155A5(R)		
MP210A4(R)	MP210A5(R)		
MP350A4(R)	MP350A5(R)	MP350A6(R)	2A
MP420A4(R)			
	MP470A5(R)	MP470A6(R)	
MP550A4(R)			
MP700A4(R)	MP700A5(R)	MP700A6(R)	2B
MP825A4(R)	MP825A5(R)	MP825A6(R)	
MP900A4(R)			
MP1200A4	MP1200A5	MP1200A6	2C
MP1850A4	MP1850A5	MP1850A6	
MP1200A4R	MP1200A5R	MP1200A6R	2D
MP1850A4R	MP1850A5R	MP1850A6R	

2.2 Current ratings

The power ratings for the 480V, 575V and 690V configurations are shown in Table 2-2, Table 2-3 and Table 2-4.

The continuous current ratings given are for a maximum ambient temperature of 40 °C (104 °F) and an altitude of 1000 m. For operation at higher temperatures and altitudes de-rating is required. Overload of 150 % for 30 s is available with ambient temperature of 40 °C (104 °F) up to a maximum of 10 repetitions per hour. For further information refer to the *Mentor MP User Guide*.

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Table 2-2 480 V current ratings

Model	AC input current	DC output current		Typical motor power	
	Continuous	Continuous	150 % overload	@ 400 Vdc	@ 500 Vdc
	A	A	A	kW	hp
MP25A4(R)	22	25	37.5	9	15
MP45A4(R)	40	45	67.5	15	27
MP75A4(R)	67	75	112.5	27	45
MP105A4(R)	94	105	157.5	37.5	60
MP155A4(R)	139	155	232.5	56	90
MP210A4(R)	188	210	315	75	125
MP350A4(R)	295	350	525	125	200
MP420A4(R)	350	420	630	150	250
MP550A4(R)	450	550	825	200	300
MP700A4(R)	585	700	1050	250	400
MP825A4(R)	665	825	1237.5	300	500
MP900A4(R)	725	900	1350	340	550
MP1200A4(R)	1050	1200	1800	450	750
MP1850A4(R)	1570	1850	2775	700	1150

Table 2-3 575 V current ratings

Model	AC input current	DC output current		Typical motor power (With Vdc = 630 V)	
	Continuous	Continuous	150 % overload		
	A	A	A	kW	hp
MP25A5(R)	22	25	37.5	14	18
MP45A5(R)	40	45	67.5	25	33
MP75A5(R)	67	75	112.5	42	56
MP105A5(R)	94	105	157.5	58	78
MP155A5(R)	139	155	232.5	88	115
MP210A5(R)	188	210	315	120	160
MP350A5(R)	295	350	525	195	260
MP470A5(R)	395	470*	705	265	355
MP700A5(R)	585	700	1050	395	530
MP825A5(R)	665	825*	1237.5	465	620
MP1200A5(R)	1050	1200	1800	680	910
MP1850A5(R)	1570	1850	2775	1045	1400

*For this rating at 575 V, 150 % overload time is 20 s at 40 °C and 30 s at 35 °C.

Table 2-4 690 V current ratings

Model	AC input current	DC output Current		Typical motor power (With Vdc = 760 V)	
	Continuous	Continuous	150 % Overload		
	A	A	A	kW	hp
MP350A6(R)	295	350	525	240	320
MP470A6(R)	395	470*	705	320	425
MP700A6(R)	585	700	1050	480	640
MP825A6(R)	665	825*	1237.5	650	850
MP1200A6(R)	1050	1200	1800	850	1150
MP1850A6(R)	1570	1850	2775	1300	1750

* For this rating at 690 V, 150 % overload time is 20 s at 40 °C and 30 s at 35 °C.

Maximum continuous input current

The values of maximum continuous input current are given to aid the selection of cables and fuses. These values are stated for worst-case condition.

NOTE   For current ratings above 1850A then parallel connection of the drives is required. However, this function is not implemented on firmware versions V01.05.02 and earlier.

2.3   Model number

The way in which the model numbers for the Mentor MP range are formed is described in Figure 2-1.

Figure 2-1 Model number

MP 1 2 0 0 A 4 R

Mentor product line
MP :   Mentor Platform

Continuous armature current rating (A)

Voltage rating
4 = 480V 24V to 480V -20% +10%
5 = 575V 500V to 575V -10% +10%
6 = 690V 500V to 690V -10% +10%

R - 4 quadrant operation
Blank - 2 quadrant operation
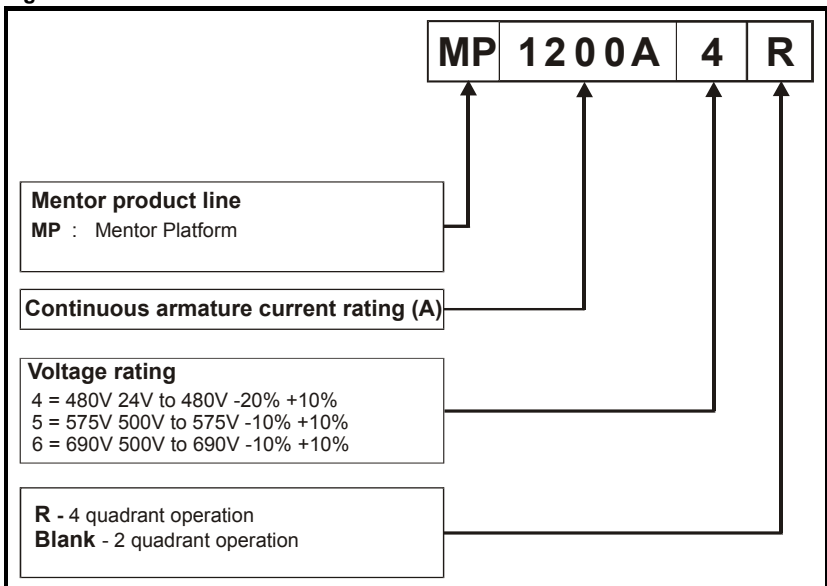
2.4 Nameplate description

Figure 2-2 Typical drive rating label
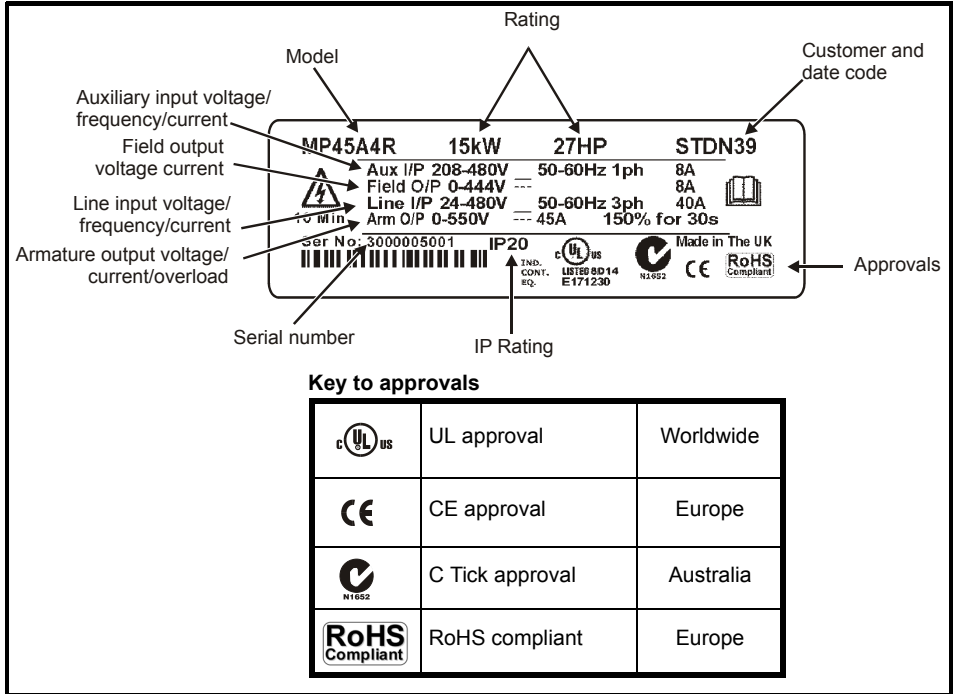
2.4.1 Output current

The continuous output current ratings given on the rating label are for maximum 40°C (104 °F) and 1000 m altitude. Derating is required for higher ambient temperatures >40°C (104 °F) and higher altitude. For derating information, refer to the *Mentor MP User Guide* on the CD supplied with the drive.

2.4.2 Input current

The input current is affected by the supply voltage, frequency and load inductance. The input current given on the rating label is the typical input current.

2.5 Drive features and options

Figure 2-3 Drive features and options on size 1
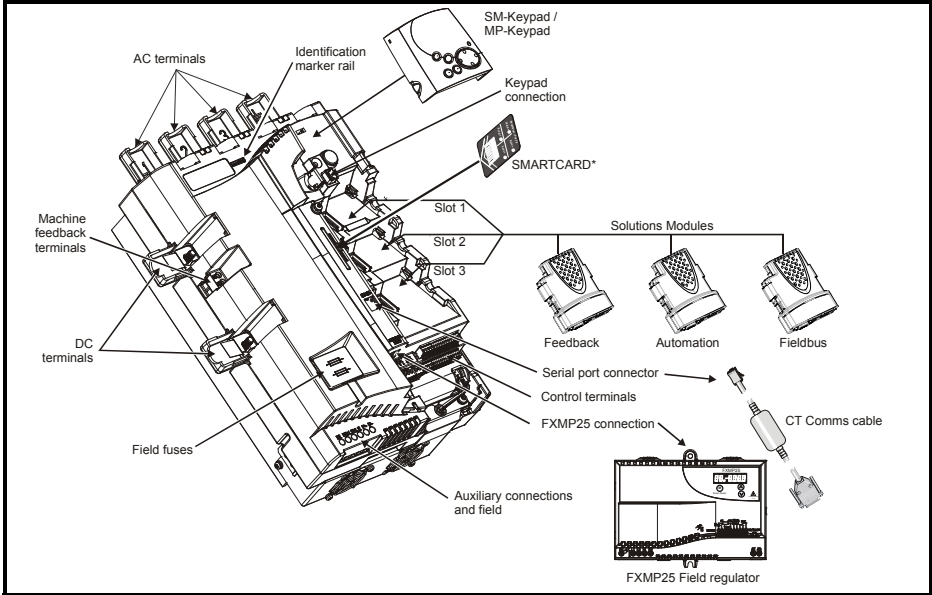
Figure 2-4 Drive features and options on size 2
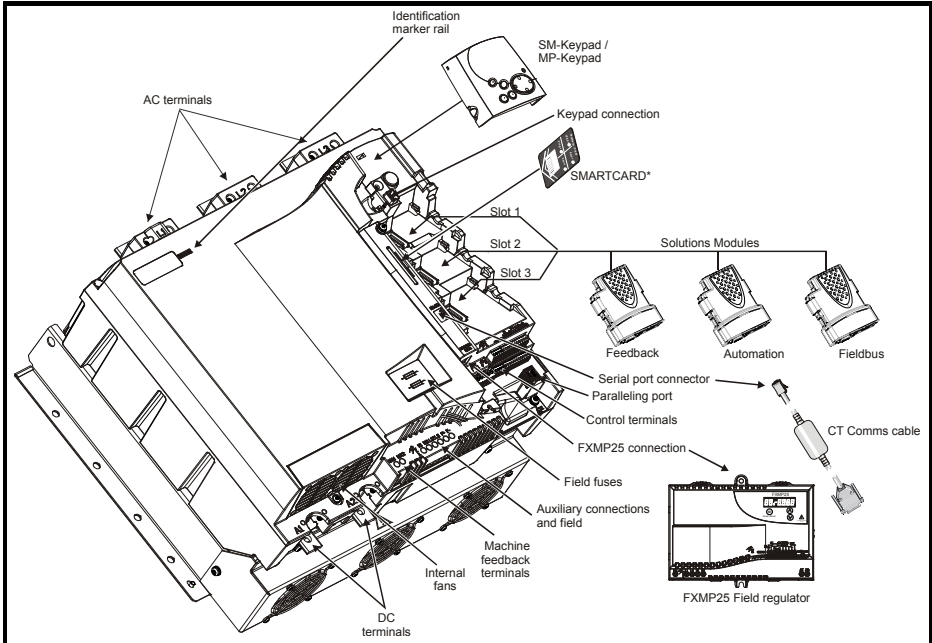
* A SMARTCARD is provided as standard. For further information, refer to Chapter 7 *SMARTCARD operation* on page 84.

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2.5.1 Options available for Mentor MP

All Solutions Modules are color-coded in order to make identification easy. The following table shows the color-code key and gives further details on their function.

Table 2-5 Solutions Module identification

Type	Solutions Module	Color	Name	Further Details
Feedback		Light Green	SM-Universal Encoder Plus	**Universal Feedback interface** Feedback interface for the following devices: **Inputs** / **Outputs** • Incremental encoders • Quadrature • SinCos encoders • Frequency and direction • SSI encoders • SSI simulated outputs • EnDat encoders
		Brown	SM-Encoder Plus	**Incremental encoder interface** Feedback interface for incremental encoders without commutation signals. No simulated encoder outputs available
		Dark Brown	SM-Encoder Output Plus	**Incremental encoder interface** Feedback interface for incremental encoders without commutation signals. Simulated encoder output for quadrature, frequency and direction signals
		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 (15V or 24V)	**Single ended encoder interface** Provides an interface for single ended ABZ encoder signals, such as those from hall effect sensors. 15V and 24V versions are available.

Table 2-5 Solutions Module identification

Type	Solutions Module	Color	Name	Further Details
Automation (I/O Expansion)		Yellow	SM-I/O Plus	**Extended I/O interface** Increases the I/O capability by adding the following to the existing I/O in the drive: • Digital inputs x 3 • Analog output (voltage) x 1 • Digital I/O x 3 • Relay x 2 • Analog inputs (voltage) x 2
		Yellow	SM-I/O 32	**Extended I/O interface** Increase the I/O capability by adding the following to the existing I/O in the drive: • High speed digital I/O x 32 • +24V output
		Dark Yellow	SM-I/O Lite	**Additional I/O** 1 x Analog input (± 10V bi-polar or current modes) 1 x Analog output (0 to 10V or current modes) 3 x Digital input and 1 x Relay
		Dark Red	SM-I/O Timer	**Additional I/O with real time clock** As per SM-I/O Lite but with the addition of a Real Time Clock for scheduling drive running
		Turquoise	SM-I/O PELV	**Isolated I/O to NAMUR NE37 specifications** For chemical industry applications 1 x Analog input (current modes) 2 x Analog outputs (current modes) 4 x Digital input / outputs, 1 x Digital input, 2 x Relay outputs
		Olive	SM-I/O 120V	**Additional I/O conforming to IEC 61131-2 120Vac** 6 digital inputs and 2 relay outputs rated for 120Vac operation
		Cobalt Blue	SM-I/O 24V Protected	**Additional I/O with overvoltage protection up to 48V** 2 x Analog outputs (current modes) 4 x Digital input / outputs, 3 x Digital inputs, 2 x Relay outputs
Automation (Applications)		Moss Green	SM-Applications Plus	**Applications Processor (with CTNet)** 2nd processor for running pre-defined and /or customer created application software with CTNet support. Enhanced performance over SM-Applications
		White	SM-Applications Lite V2	**Applications Processor** 2nd processor for running pre-defined and /or customer created application software. Enhanced performance over SM-Applications Lite
		Golden brown	SM-Register	**Applications Processor** 2nd processor for running position capture functionality with CTNet support.

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Table 2-5 Solutions Module identification

Type	Solutions Module	Color	Name	Further Details
Fieldbus		Purple	SM-PROFIBUS DP-V1	**Profibus option** PROFIBUS DP adapter for communications with the drive
		Medium Grey	SM-DeviceNet	**DeviceNet option** Devicenet adapter for communications with the drive
		Dark Grey	SM-INTERBUS	**Interbus option** Interbus adapter for communications with the drive
		Light Grey	SM-CANopen	**CANopen option** CANopen adapter for communications with the drive
		Beige	SM-Ethernet	**Ethernet option** 10 base-T / 100 base-T; Supports web pages, SMTP mail and multiple protocols: DHCP IP addressing; Standard RJ45 connection
		Brown Red	SM-EtherCAT	**EtherCAT option** EtherCAT adapter for communications with the drive

Table 2-6 Keypad identification

Keypad	Name	Further Details
	SM-Keypad	**LED keypad option** Keypad with a LED display
	MP-Keypad	**LCD keypad option** Keypad with an alpha-numeric LCD display with Help function

Table 2-7 Serial comms lead
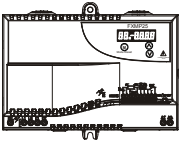
Serial comms lead	Name	Further Details
	CT Comms cable	CT EIA (RS) -232 (4500-0087) CT USB (4500-0096)
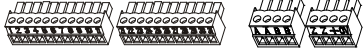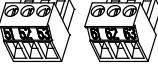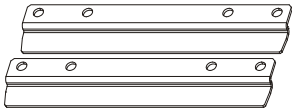
Table 2-8 External field control

External field controller	Name	Further Details
	FXMP25	For external control of field windings up to 25A, with field reversal capability. For further information, please see the *FXMP25 User Guide*.

2.6 Items supplied with the drive

The drive is supplied with a printed manual, a SMARTCARD, a safety information booklet, an accessory kit box including the items shown in Table 2-9, and a CD ROM containing all related product documentation and software tools.

Table 2-9 Parts supplied with the drive

Description	Size 1	Size 2A / 2B	Size 2C / 2D
Control connectors			
Tacho connector			
Relay connectors			
UL warning label	CAUTION Risk of Electric Shock Power down unit 10minutes before removing cover		
UL warning label for heatsink temperature			
Grounding bracket			
Terminal cover grommets			
Terminal shrouds			
Terminal shroud base covers			
M4 Screws			
Mounting feet brackets			

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3   Mechanical installation

3.1   Safety

⚠ **WARNING**

Follow the instructions

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

⚠ **WARNING**

Competence of the installer

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

⚠ **WARNING**

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

⚠ **WARNING**

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.

⚠ **WARNING**

The drive enclosure is not classified as a fire enclosure. A separate fire enclosure must be provided. For further information, refer to section 3.2 *Fire protection* on page 19.

⚠ **WARNING**

Many of the drives in this product range weigh in excess of 15 kg (33 lb). Use appropriate safeguards when lifting these models.
A full list of drive weights can be found in the *Mentor MP User Guide*.

⚠ **WARNING**

IP rating

It is the installer's responsibility to ensure that any enclosure which allows access to drives from model sizes 2A to 2D while the product is energized, provides protection against contact and ingress to the requirements of IP20.

Refer to section 12 of the *Mentor MP User Guide* for further details.

3.2 Fire protection

The drive enclosure is not classified as a fire enclosure. A separate fire enclosure must be provided.

For installation in the USA, a NEMA 12 enclosure is suitable.

For installation outside the USA, the following (based on IEC 62109-1, standard for PV inverters) is recommended.

Enclosure 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.

The location and size of the bottom shall cover the area shown in Figure 3-1. Any part of the side which is within the area traced out by the 5° angle is also considered to be part of the bottom of the fire enclosure.

Figure 3-1 Fire enclosure bottom layout
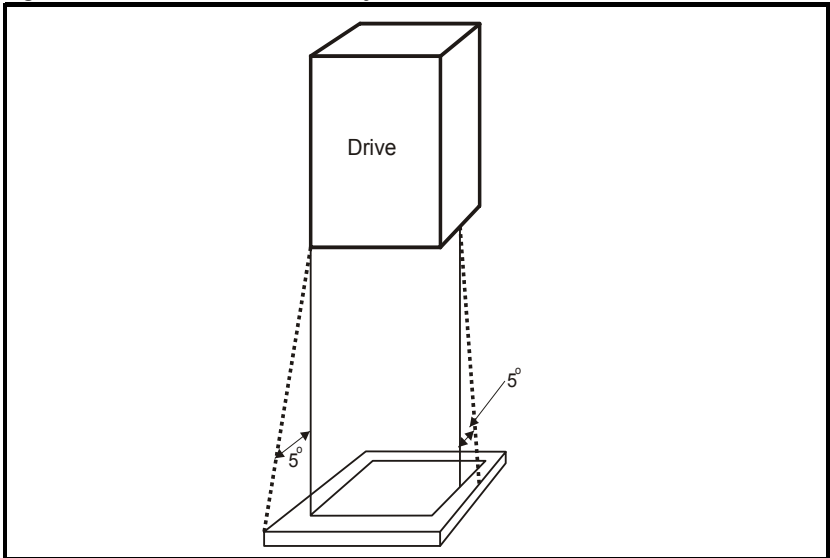
The bottom, including the part of the side considered to be part of the bottom, must be designed to prevent escape of burning material - either by having no openings or by having a baffle construction. This means that openings for cables etc. must be sealed with materials meeting the 5VB requirement, or else have a baffle above.

See Figure 3-2 for acceptable baffle construction. This does not apply for mounting in an enclosed electrical operating area (restricted access) with concrete floor.

Figure 3-2 Fire enclosure baffle construction

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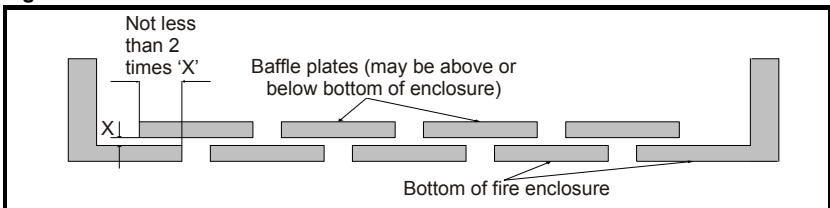
3.3 Terminal cover removal

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

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

3.3.1 Removing the terminal covers

The drive is installed with one control terminal cover.

Figure 3-3 Removing the control terminal cover (size 1 shown)
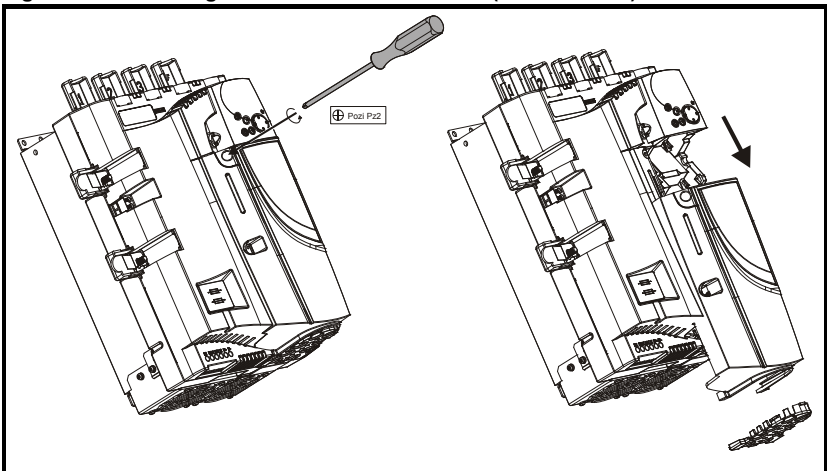
To remove the terminal cover, undo the screw and slide the terminal cover downwards. When replacing the terminal covers the screw should be tightened with a maximum torque of 1 N m (0.7 lb ft).

3.3.2 Removing the finger-guard and break-outs

Figure 3-4 Removing the finger-guard break-outs

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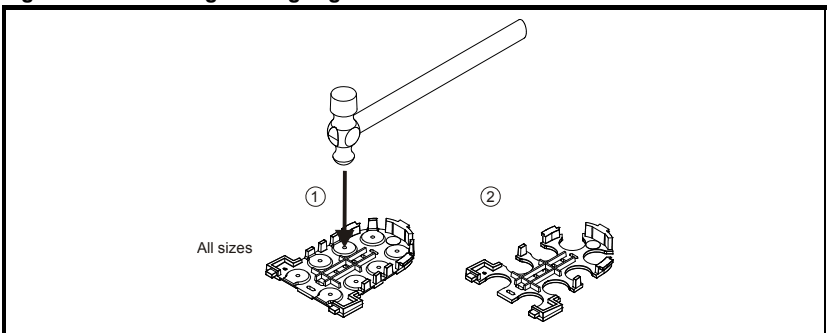
Place finger-guard on a flat solid surface and hit relevant break-outs with hammer as shown (1). Continue until all required break-outs are removed (2). Remove any flash / sharp edges once the break-outs are removed.

3.4 Mounting method

The Mentor MP can only be surface mounted.

Figure 3-5 Overall size 1A dimensions
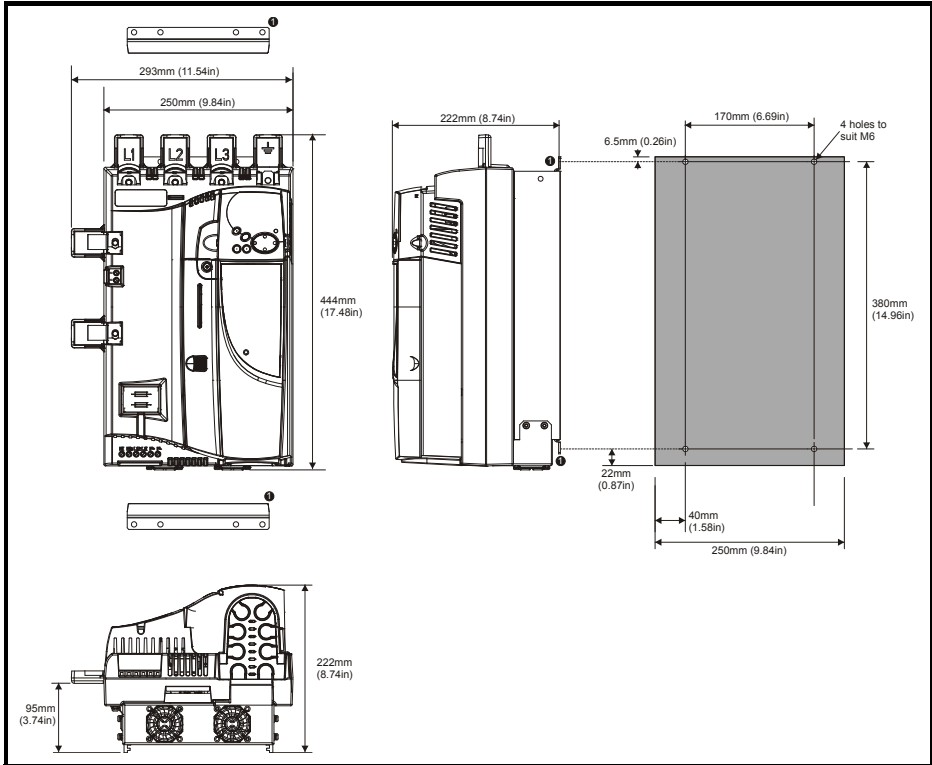
1. The two outer holes must be used for mounting the Mentor MP.

NOTE With the SMARTCARD installed to the drive, the depth measurement increases by 7.6 mm (0.30 in).

NOTE Fans are only installed to the MP75A4(R) and MP75A5(R)

.

Figure 3-6 Overall size 1B dimensions
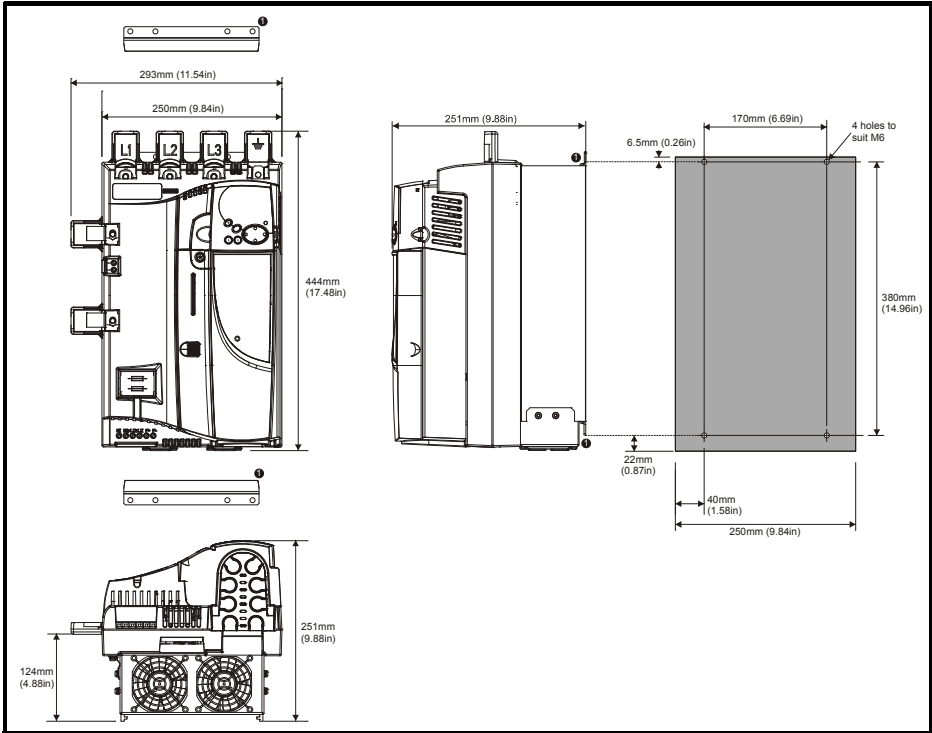
1.   The two outer holes must be used for mounting the Mentor MP.

NOTE   With the SMARTCARD installed to the drive, the depth measurement increases by 7.6 mm (0.30 in).

Figure 3-7 Installing the mounting feet bracket on size 1 drives
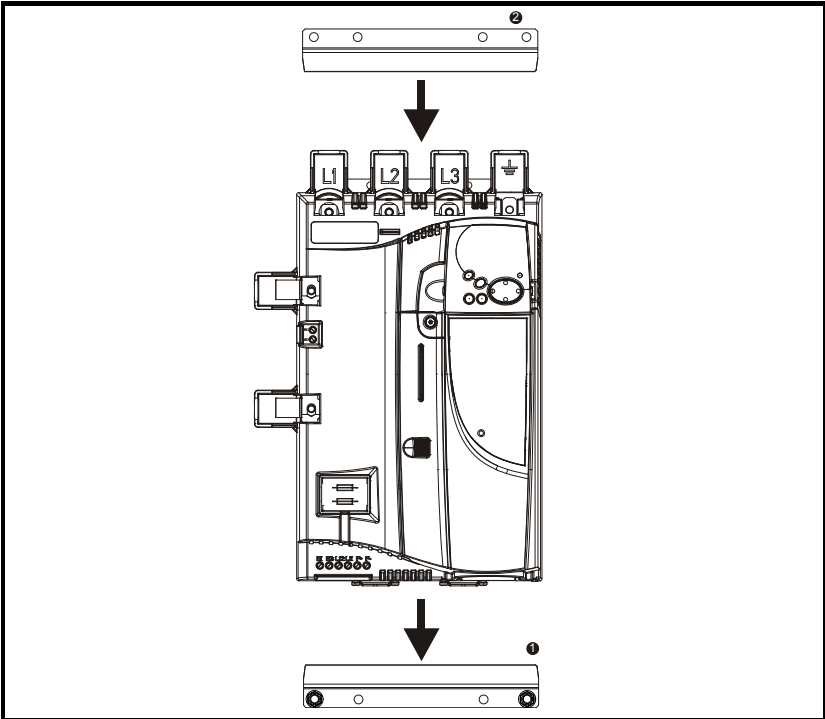
The bottom mounting bracket (1) should be installed to the back plate first with the screws fully tightened. The drive should then be lowered onto the bracket and slotted in. The top mounting bracket (2) should then be slotted into the drive and the top holes marked for mounting (380 mm [14.96 in] from the centre of the holes on the bottom mounting bracket). Once the holes have been drilled, fix the top mounting bracket accordingly and tighten the screws.

It is not necessary to tighten the bottom mounting brackets with the drive in place. The brackets are designed to clamp the drive heatsink against the back plate

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Figure 3-8 Overall size 2A / 2B dimensions with terminal shrouds attached
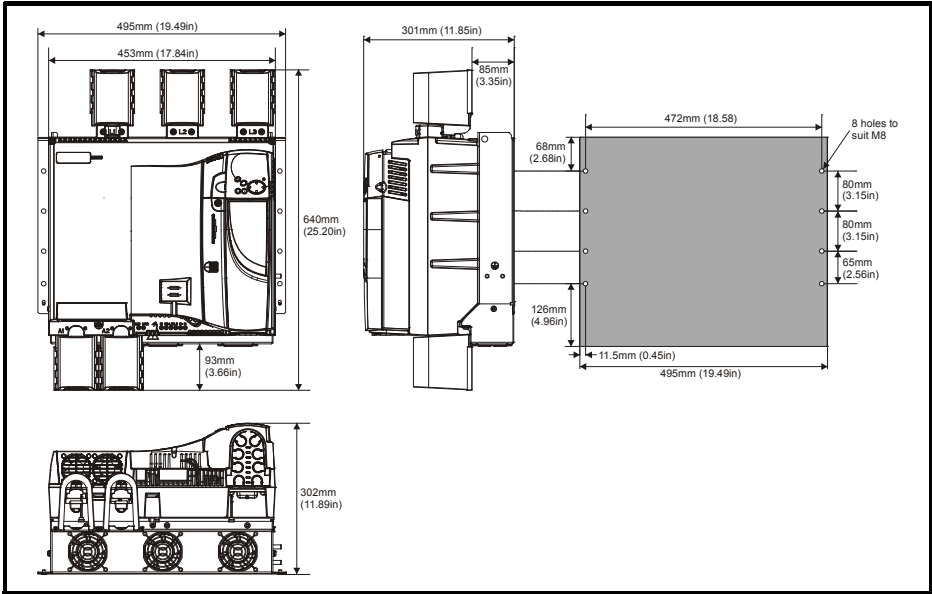
Figure 3-9 Overall size 2A dimensions without terminal shrouds attached
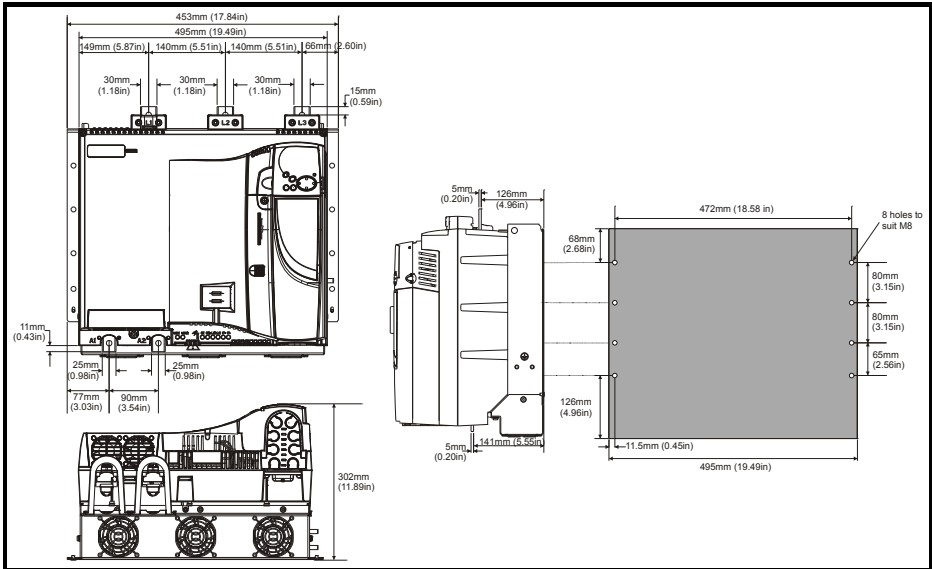
| NOTE | With the SMARTCARD installed to the drive, the depth measurement increases by 7.6 mm (0.30 in). |

Figure 3-10 Overall size 2B dimensions without terminal shrouds attached
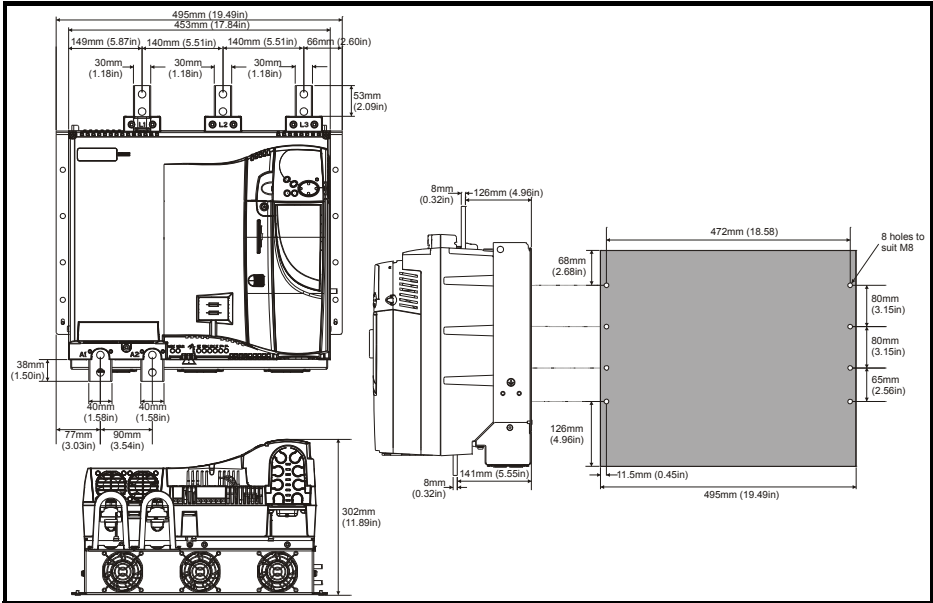
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| NOTE | With the SMARTCARD installed to the drive, the depth measurement increases by 7.6 mm (0.30 in). |

Figure 3-11 Size 2C front view and mounting dimensions
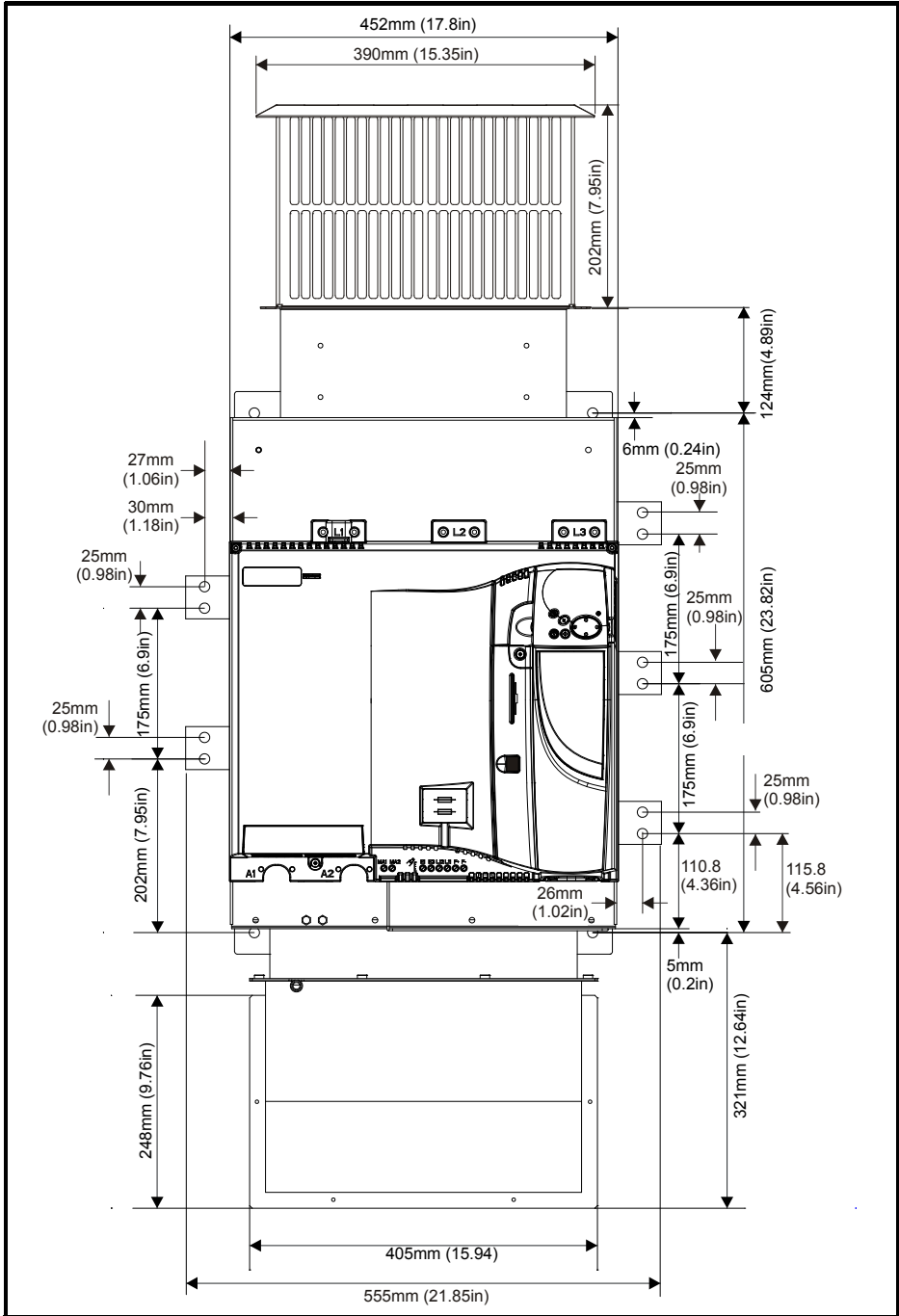
Figure 3-12 Size 2C back-plate and mounting detail
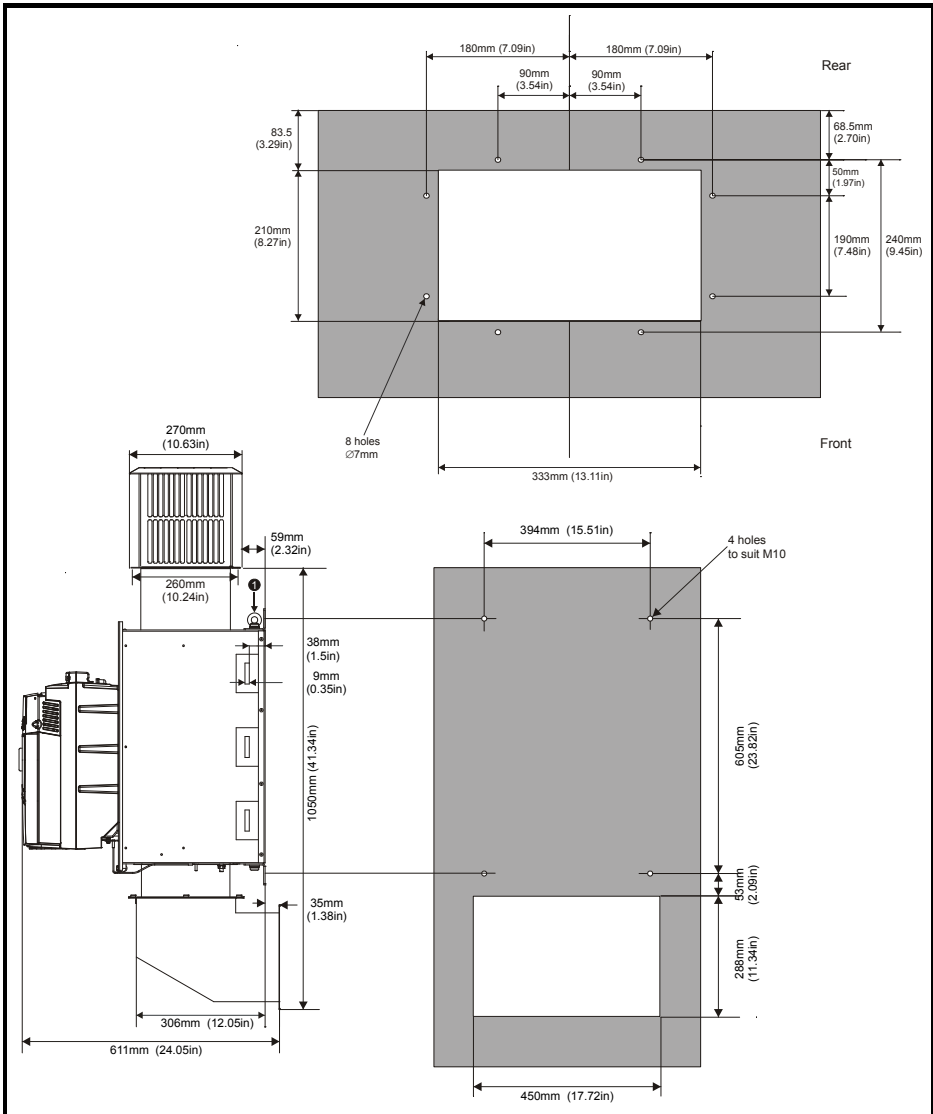
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NOTE 1. M10 eye-bolts can be inserted in the location shown for lifting the drive. These are not supplied with the drive.

NOTE With the SMARTCARD installed to the drive, the depth measurement increases by 7.6 mm (0.30 in).

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Figure 3-13 Size 2D front view and mounting dimensions
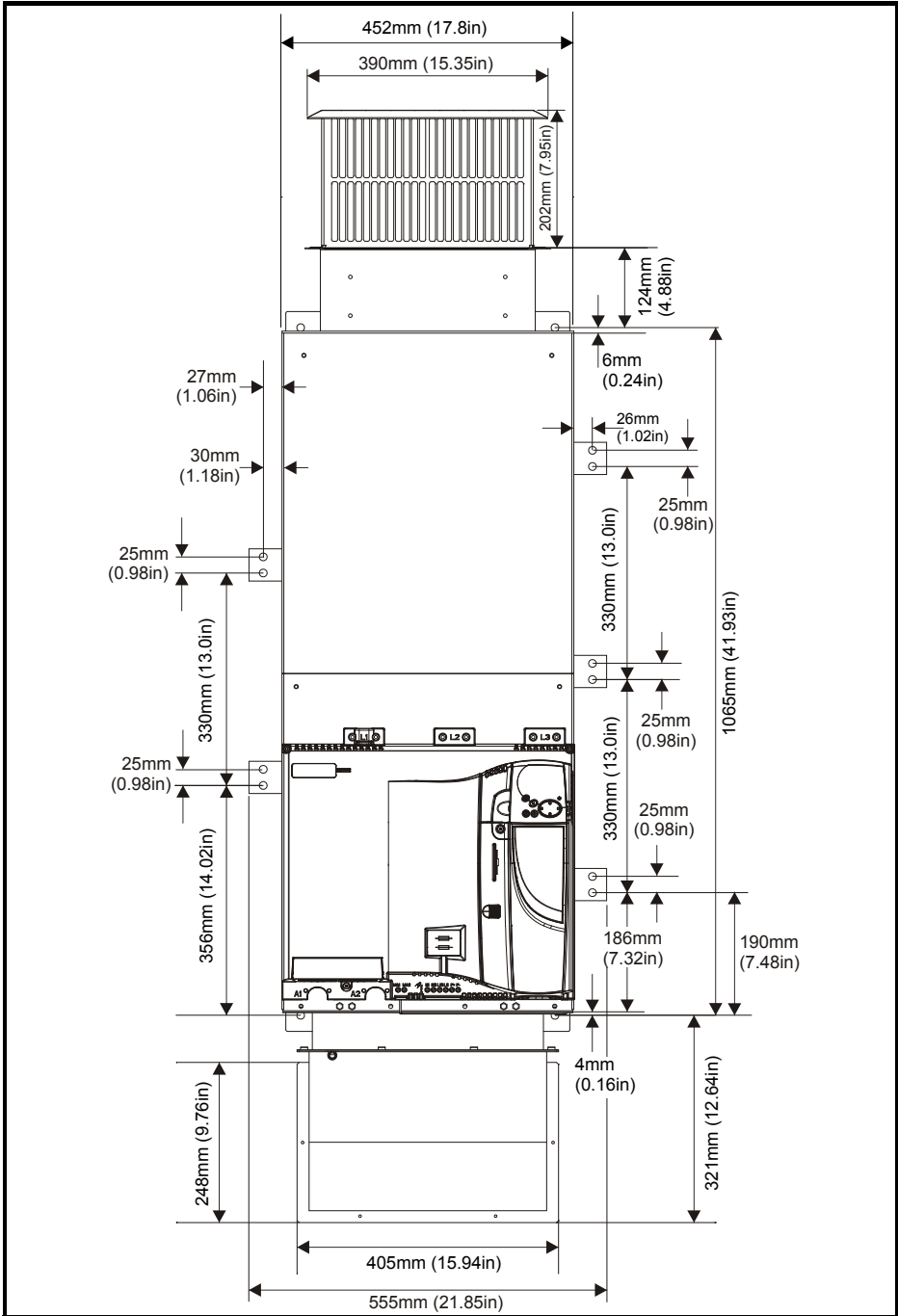
Figure 3-14 Size 2D back-plate and mounting detail
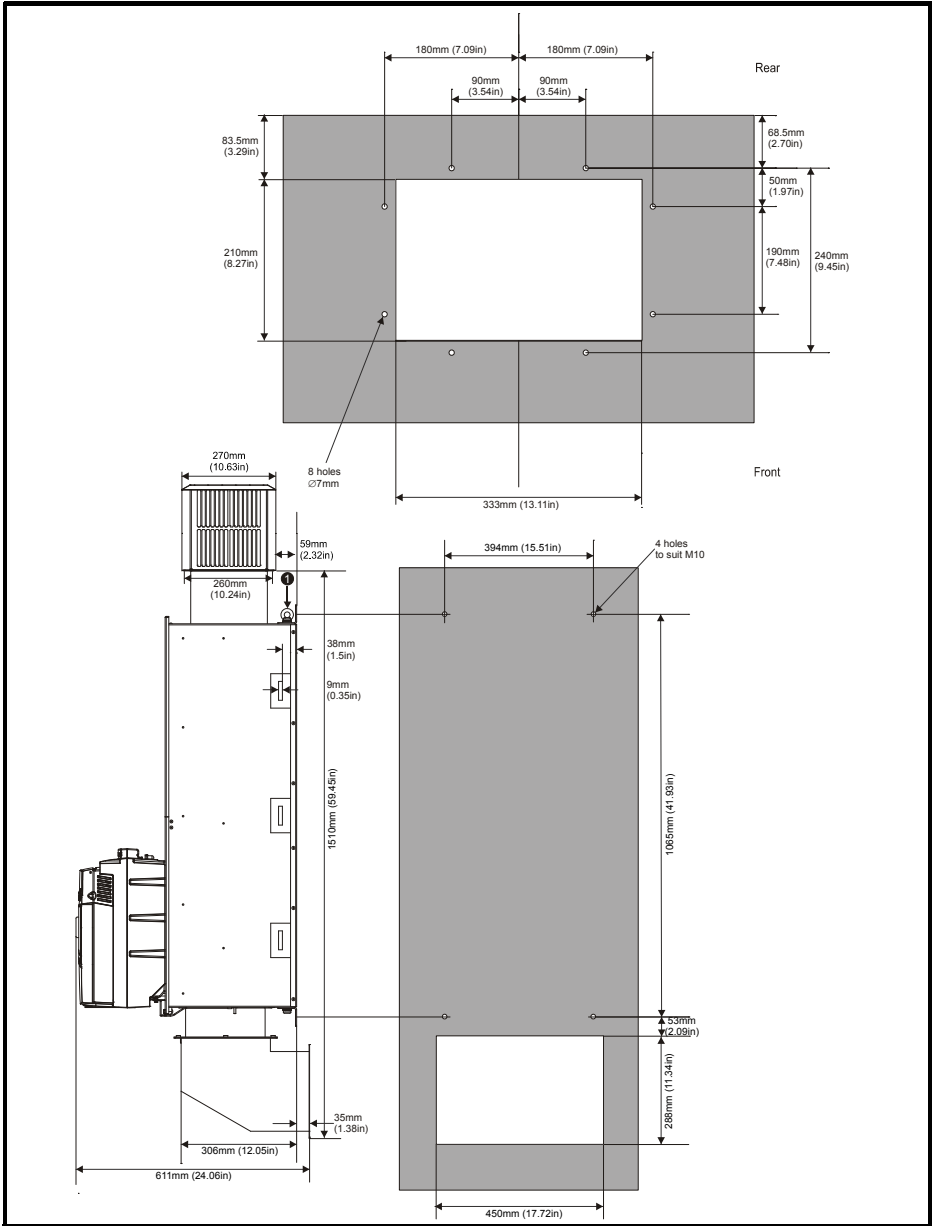
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| NOTE | 1. M10 eye-bolts can be inserted in the location shown for lifting the drive. These are not supplied with the drive. |

| NOTE | With the SMARTCARD installed to the drive, the depth measurement increases by 7.6 mm (0.30 in). |

Figure 3-15 Mounting methods of size 2C / 2D air duct
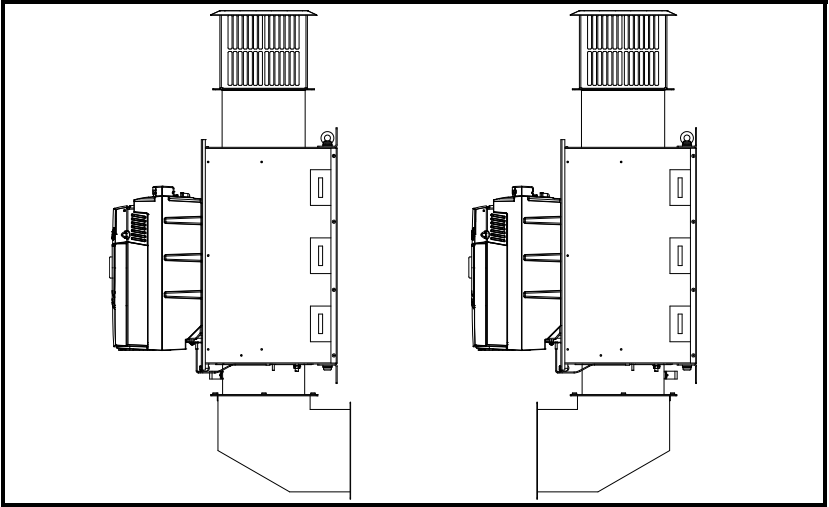
The Mentor MP size 2C and 2D air duct can be turned 180° to suit the customers infrastructure.

NOTE There is no seal provided with this product for sealing off the gap around the air duct when mounted.

3.5 Installing and removing the terminal shrouds

Figure 3-16 Installing the terminal shrouds on size 1 drives
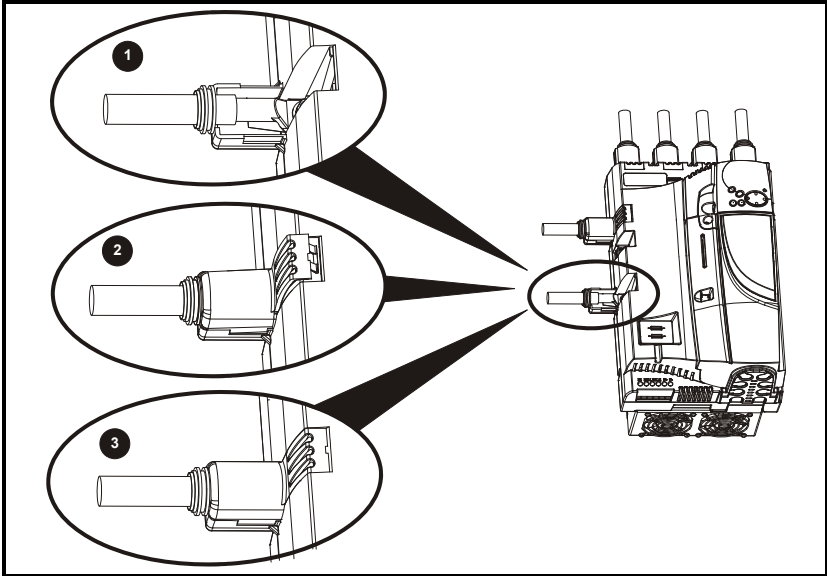
1. Thread the AC supply and DC output connectors through the grommets provided and connect them to the drive.
2. Place the terminal shroud over the top of the connectors and click into place (3).

Figure 3-17 Removing the terminal shrouds on size 1 drives
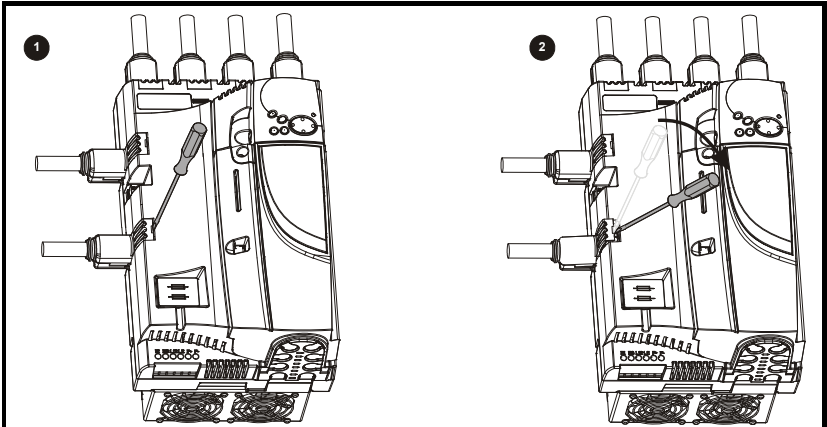
1. Insert the screwdriver as shown.
2. Lever in the direction shown to unclip the terminal shroud and remove.

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Figure 3-18 Installing the terminal shrouds on size 2 drives
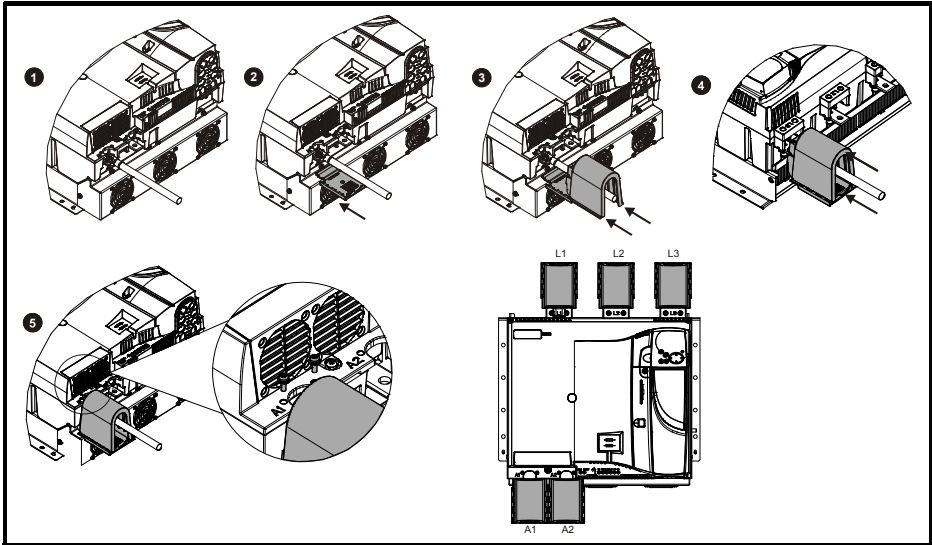
1. Assemble the cable to the busbar.
2. Place the terminal shroud base cover underneath the cable in the orientation shown.
3. Place the terminal shroud over the cable in the orientation shown, slide the terminal shroud on to the base cover in the direction shown until it clicks in to place.
4. For all power connections slide in the terminal shroud sub-assembly in the direction as shown.
5. Insert the 2 x M4 x 16 screws using a pozi drive screwdriver.

NOTE   To remove the terminal shrouds, please reverse the process above.

3.6 Enclosure

Enclosure layout

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

Figure 3-19 Enclosure layout
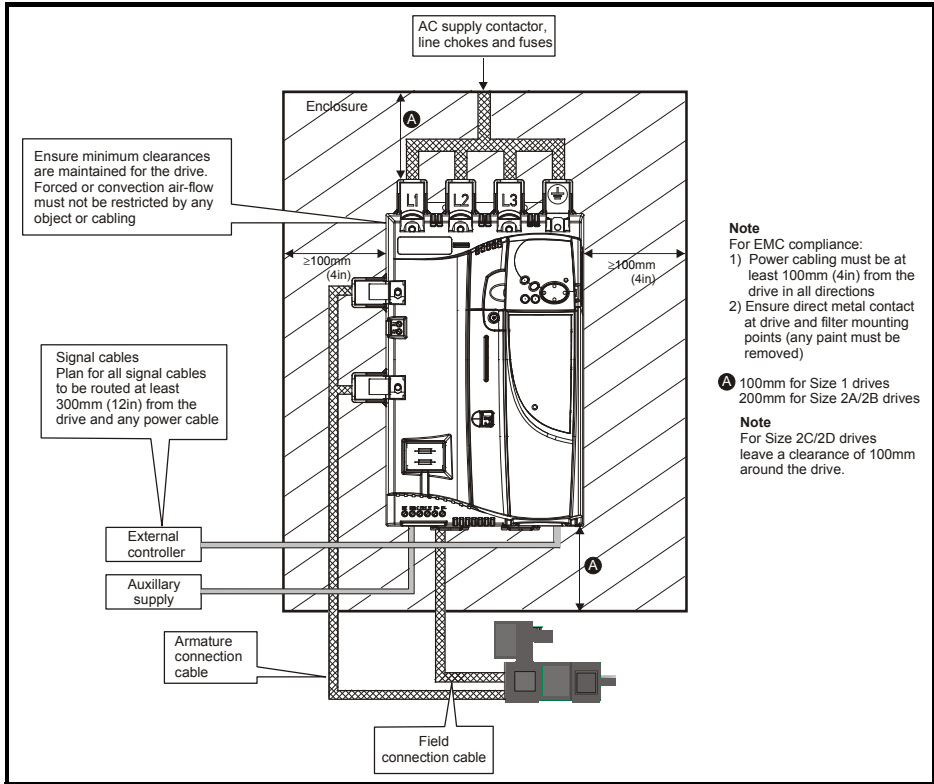
3.7 Fan air flow data

Refer to section 3.7 in the *Mentor MP User Guide*.

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4   Electrical installation

⚠️ **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 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 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**

Drives are suitable for use on supplies of installation category III and lower, according to IEC 60664-1. This means they may be connected permanently to the supply at its origin in a building, but for outdoor installation additional over-voltage suppression (transient voltage surge suppression) must be provided to reduce category IV to category III.

⚠️ **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.

NOTE   For details on the MOV ground (earth) disconnect, refer to the *Mentor MP User Guide.*

NOTE   For details on the external suppressor resistor connections, refer to the *Mentor MP User Guide.*

4.1 Electrical connections

Refer to Figure 4-1 to understand the function of the different power connections.

Figure 4-1 Power connections for 480V drive
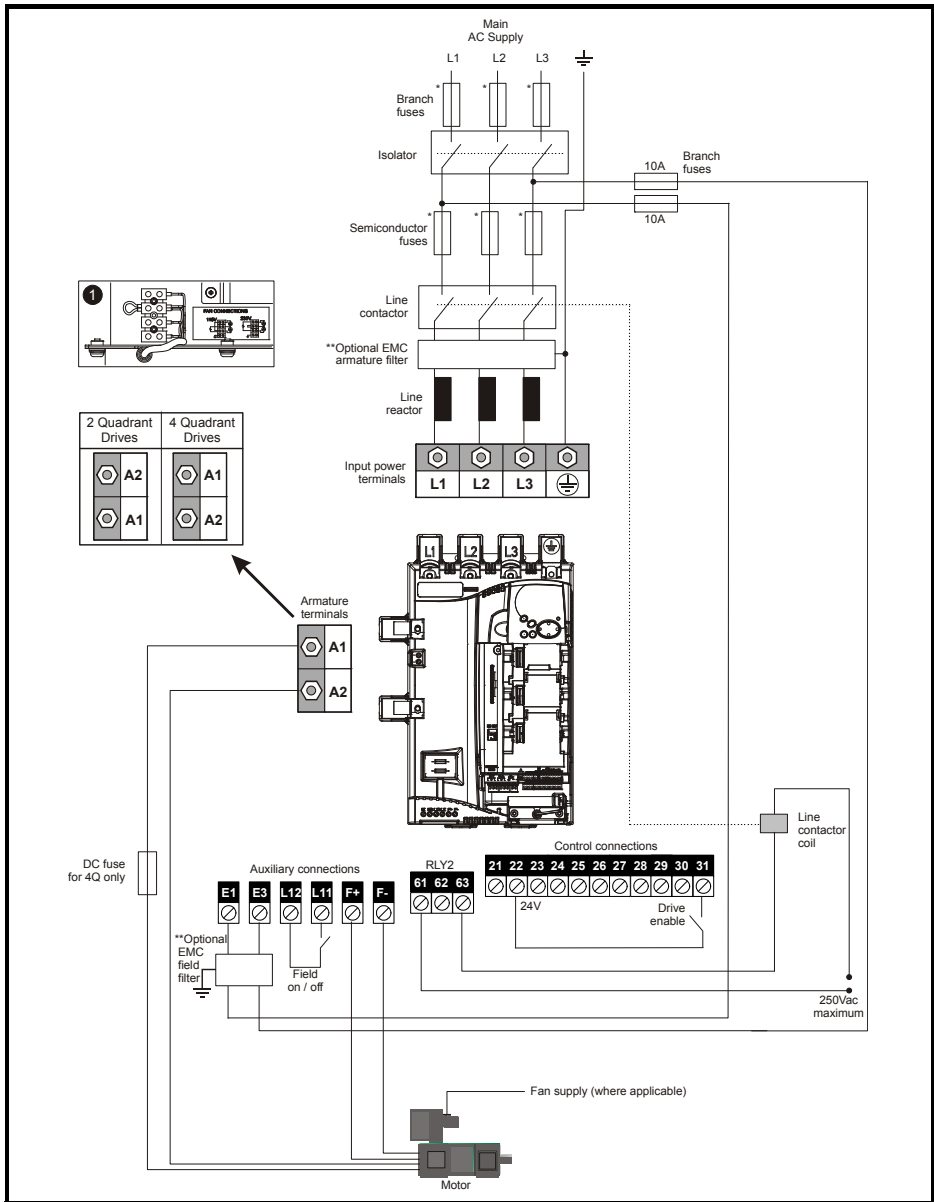
1. End user must provide 230 / 115 Vac supply for the internal fans on frame sizes C and D, see section 4.8 on page 58.

* For fuse ratings refer to section 4.6 *Cable and fuse size ratings* on page 41.

**For further information on EMC filters, please refer to the *Mentor MP User Guide*.

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4.1.1 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
   - Types A and AC should never be used with Mentor MP drives.
   - Type B must be used with all Mentor MP drives.

> **⚠ WARNING**
>
> Only type B ELCB / RCD are suitable for use with Mentor MP 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.

4.2 Ground connection

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.

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

> **⚠ WARNING**
>
> Ground loop impedance
>
> 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.

Figure 4-2 Location of ground connection on size 1 drives
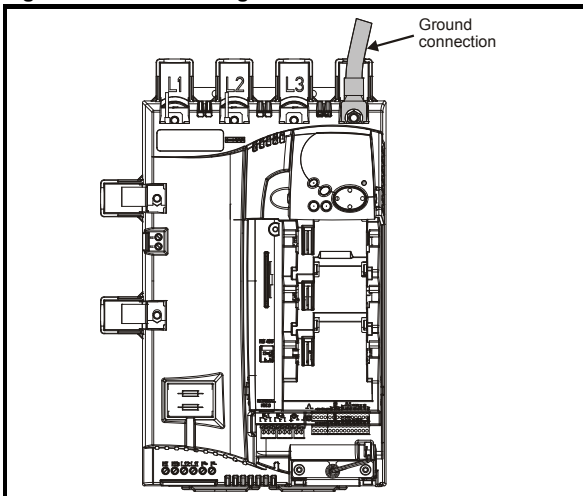
Figure 4-3 Location of ground connections on size 2A / 2B drives

Ground
connections
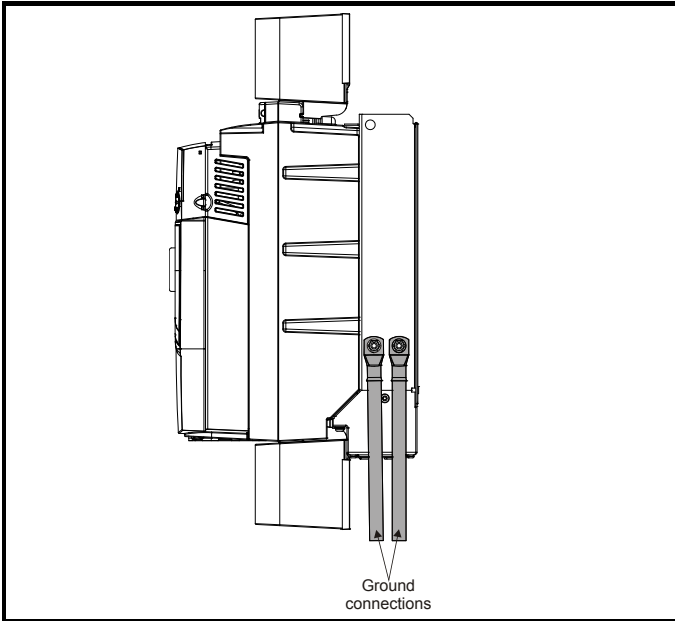
Figure 4-4 Location of ground connection on size 2C / 2D drives

Ground connection
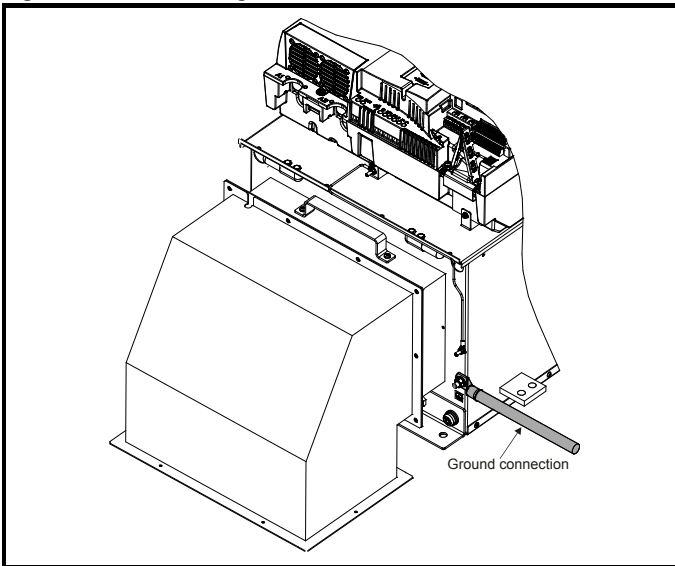
4.3 AC supply requirements

The standard drive is rated for a nominal supply voltage up to 480 Vrms.

An optional rating of 575 Vrms is available for size 1 drives.

An optional rating of 575 Vrms and 690 Vrms is available for size 2 drives.

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Grounded delta supplies exceeding 575 V are not permitted for drives rated up to and including 210 A. Grounded delta supplies exceeding 600 V are not permitted for drives rated 350 A and above.

4.3.1 Supply types

Drives rated for supply voltages up to 575 V (rated up to 210 A) and 600 V (350 A and above) are suitable for use with any supply type, i.e. TN-S, TN-C-S, TT, IT, with grounding at any potential, i.e. neutral, centre or corner ("Grounded-delta").

Grounded delta supplies >575 V are not permitted for drives rated up to and including 210A. Grounded delta supplies >600 V are not permitted for drives rated 350 A and above.

4.3.2 Supply fault current

The maximum fault current level of the supply to all circuits is 100 kA subject to the capability of the semiconductor fuse fitted.

4.3.3 Main AC supply (L1, L2, L3)

Table 4-1 Three phase AC supply

Specification	Product voltage variant		
	480V	**575V**	**690V**
Maximum nominal supply	480V	575V	690V
Tolerance	+10%		
Minimum nominal supply	24V	500V	
Tolerance	-20%	-10%	

4.4 Line reactors

The Mentor MP, in common with all naturally commutated thyristor drives, causes voltage notches at the input supply terminals. In order to avoid disturbance to other equipment using the same supply, the addition of external line inductance is strongly recommended in order to restrict the depth of the notches imposed on the shared supply. This is generally not necessary where a dedicated transformer is used to supply the drive.

The following recommendations for added line inductance, have been calculated based on the power drive systems standard: EN 61800-3:2004 "Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods".

NOTE The current ratings specified in Table 4-2 are for typical motor currents where the motor current ripple is no more than 50% of drive rating.

Table 4-2 Minimum required line inductance for a typical application (50% ripple content)

Drive rated current	System voltage				Typical current rating	Maximum current rating
	400V	480V	575V	690V		
A	μH	μH	μH	μH	A	A
25	220	260	320		21	22
45	220	260	320		38	40
75	220	260	320		63	67
105	220	260	320		88	94
155	160	190	230		130	139
210	120	140	170		176	188
350	71	85	110	120	293	295
420	59	71			351	350
470			80	91	393	395
550	45	54			460	450
700	36	43	53	61	586	585
825			45	52	690	665
900	28	33			753	725
1200	21	25	31	36	1004	1050
1850	18	23	29	32	1570	1655

| NOTE |

1. The above assumes the supply has 1.5% impedance.
2. Assumes a minimum supply rating of 5 kA and a maximum rating of 60 kA.

4.4.1 Auxiliary AC supply and connections

Table 4-3 Terminal functions

Terminals	Function
E1, E3	Supply for control electronics and field controller.
L11, L12	Field on / off. When L11 and L12 are open the supply is disconnected to the field regulator so there will be no field current.
F+, F-	Field supply to the motor.
MA1, MA2	Refer to the *Mentor MP User Guide*

Table 4-4 Line to line supply

Specification	Value
Maximum nominal supply	480 V
Tolerance	+10 %
Minimum nominal supply	208 V
Tolerance	-10 %

Each drive has an onboard field controller with the following current ratings.

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Table 4-5 Field controller current ratings

Model			Maximum auxiliary supply input current A	Maximum continuous field current rating A
MP25A4(R)	MP25A5(R)			
MP45A4(R)	MP45A5(R)			
MP75A4(R)	MP75A5(R)		13	8
MP105A4(R)	MP105A5(R)			
MP155A4(R)	MP155A5(R)			
MP210A4(R)	MP210A5(R)			
MP350A4(R)	MP350A5(R)	MP350A6(R)		
MP420A4(R)				
	MP470A5(R)	MP470A6(R)		
MP550A4(R)				
MP700A4(R)	MP700A5(R)	MP700A6(R)		
MP825A4(R)	MP825A5(R)	MP825A6(R)	23	20
MP900A4(R)				
MP1200A4	MP1200A5	MP1200A6		
MP1850A4	MP1850A5	MP1850A6		
MP1200A4R	MP1200A5R	MP1200A6R		
MP1850A4R	MP1850A5R	MP1850A6R		

4.4.2 Supply requirements

Maximum supply in-balance: 2% negative phase sequence (equivalent to 3% voltage in-balance between phases)

Frequency range: 45 to 65 Hz (maximum rate of frequency change is 7Hz/s)

4.5 Control 24 Vdc supply

The 24Vdc input has three main functions.

- It can be used to supplement the drive's own internal 24V when multiple SM-Universal Encoder Plus, SM-Encoder Output Plus, SM-I/O Plus, or SM-I/O 32 modules are being used and the current drawn by these modules is greater than the drive can supply. (If too much current is drawn from the drive, the drive will initiate a 'PS.24V' trip)
- It 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 communications to continue to operate.
- It 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 UV trip state unless the line power supply is enabled, therefore diagnostics may not be possible (Power down save parameters are not saved when using the 24V back-up power supply input).

The working voltage range of the 24V power supply is as follows:

Maximum continuous operating voltage:	30.0 V
Minimum continuous operating voltage:	19.2 V
Nominal operating voltage:	24.0 V
Minimum start up voltage:	21.6 V
Maximum power supply requirement at 24V:	60 W
Recommended fuse:	3 A, 50 Vdc

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

4.6   Cable and fuse size ratings

WARNING   The selection of the correct fuse is essential to ensure the safety of the installation

Maximum continuous input currents are given in section 2.2 *Current ratings* on page 9 to aid the selection of fuses and cabling. The maximum input current is dependent on the ripple content of the output current. A value of 100% ripple has been assumed for the given ratings.

The cable sizing selected when installing a Mentor MP must comply with the local wiring regulations. The information provided in this section is provided for guidance purposes only.

The power terminals on Mentor MP frame size 1 drives have been designed to accommodate a maximum cable size of 150 mm^2 (350 kcmil) with a temperature of 90 °C (194 °F).

The power terminals on Mentor MP frame size 2A drives have been designed to accommodate a maximum cable size of 2 x 150 mm^2 (2 x 350 kcmil) with a temperature of 75 °C (167 °F).

The power terminals on Mentor MP frame size 2B drives have been designed to accommodate 2 x 240 mm^2 with a temperature of 90 °C (194 °F). The use of cables sized using the US national electrical code as shown in Table 4-8 requires the use of a terminal adaptor.

The power terminals on Mentor MP frame size 2C and 2D drives have been designed for use with busbars. The drive can be used with cables as shown in Table 4-8 with the use of a terminal adaptor.

The actual cable size depends on a number of factors including:

• Actual maximum continuous current
• Ambient temperature
• Cable support, method and grouping
• Cable voltage drop

In applications where the motor used is of a reduced rating, the cable sizing selected can be appropriate for that motor. To protect the motor and the output cabling the drive must be programmed with the correct motor rated current.

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When using reduced cable sizes, the branch circuit protection fuse rating needs to be reduced in line with the cable size selected.

The following table shows typical cable sizes based on USA and International standards, assuming 3 conductors per raceway/conduit, an ambient temperature of 40°C (104°F) and applications with high output current ripple content.

Table 4-6 Typical cable sizes for size 1 drives

Model		IEC 60364-5-52[1]		UL508C/NEC[2]	
		Input	Output	Input	Output
MP25A4(R)	MP25A5(R)	2.5 mm^2	4 mm^2	8 AWG	8 AWG
MP45A4(R)	MP45A5(R)	10 mm^2	10 mm^2	4 AWG	4 AWG
MP75A4(R)	MP75A5(R)	16 mm^2	25 mm^2	1 AWG	1/0 AWG
MP105A4(R)	MP105A5(R)	25 mm^2	35 mm^2	1/0 AWG	1/0 AWG
MP155A4(R)	MP155A5(R)	50 mm^2	70 mm^2	3/0 AWG	4/0 AWG
MP210A4(R)	MP210A5(R)	95 mm^2	95 mm^2	300 kcmil	350 kcmil

1. The maximum cable size is defined by the power terminal housing using 90°C (194°F) rated cables as per Table A.52-5 of the standard.
2. Assumes the use of 75 °C (167 °F) rated cables, as per Table 310.16 of the National Electrical Code.

The use of higher temperature rated cable would allow a reduction on the minimum recommended cable size for Mentor MP shown above. For high temperature cable sizing, please refer to the data supplied by the manufacturer of the high temperature cable.

Table 4-7 Auxiliary wiring for size 1 drives

Frame size	Maximum input current	Continuous output current	IEC 60364-5-52 Table A52-4 Column B2		UL 508C	
			Column B2 derated by 0,87 of PVC at 40			
			E1, E3 size	F+, F- , L11 & L12 size	E1, E3 size	F+, F- , L11 & L12 size
	A	A	mm²	mm²	mm²	mm²
1	13	8	2.5	1.5	14 AWG	14 AWG

Notes for IEC 60364:
IEC 60364-5-52 use installation method B2, table A.52-4 for three loaded conductors, PVC insulation 30 °C and apply derating factor for 40 °C from table A.52-14 (0.87 for PVC).

Notes for UL508C:
Either 60 °C or 75 °C cable can be used. Ampacities as per table 40.3 as described in the UL508C standard.

Table 4-8 Typical cable sizes for size 2 drives

Model			Maximum input current	Continuous output current	IEC 60364-5-52 Table A52-12 Column 5 derated by 0.91 for 40°C XLPE cables (IEC 60364-5-52 table A52-14) and 0.77 for cables bunching (IEC 60364-5-52 table A52-17 item 4)		US National Electrical Code	
					90°C cables at 40°C ambient		75°C cable at 40°C ambient	
			A	A	Input size mm²	Output size mm²	Input cables Kcmil	Output cables Kcmil
MP350A4(R)	MP350A5(R)	MP350A6(R)	295	350	120	150	350	400
MP420A4(R)			350	420	150	185	400	500
	MP470A5(R)	MP470A6(R)	395	470	185	240	500	600
MP550A4(R)			450	550	300	2 x 185	2 x 300	2 x 350
MP700A4(R)	MP700A5(R)	MP700A6(R)	585	700	2 x 150	2 x 150	2 x 500	2 x 600
MP825A4(R)	MP825A5(R)	MP825A6(R)	665	825	2 x 185	2 x 240	2 x 600	3 x 350
MP900A4(R)			725	900	2 x 185	2 x 240	3 x 350	3 x 400
MP1200A4(R)	MP1200A5(R)	MP1200A6(R)	1050	1200	2 x 300	3 x 240	3 x 600	4 x 400
MP1850A4(R)	MP1850A5(R)	MP1850A6(R)	1450	1850	4 x 240	4 x 300	*	*

* Values are beyond the mechanical design of the drive. At this power level it may be prudent to consider busbars.

Notes for IEC 60364:

NOTE

1. IEC 60364-5-52 table A 52-12 F method column 5 = Single core cable in free air.
2. IEC 60364-5-52 table A52-14 correction factor for ambient air temperature others than 30°C.
3. IEC 60364-5-52 table A52-17 item 4 correction factor for groups of more than one circuit or more than one multi-core cable placed on a single layer on a perforated tray.

Notes for US National Electrical Code:

NOTE

1. Table 310.17 allowable ampacities of single-insulated conducted rated 0 through 2000V in free air, based on ambient air temperature of 30 °C (87 °F).
2. Derating factor of 0.88 is applied for 40 °C to the 75 °C cable column. Table 310.17 is based on 30 °C (86 °F) ambient air temperature.
3. NEC 2005 edition table 310.15(B)(2)(a) shows the adjustment factors for more than three current-carrying conductors in a race way or cable, for 4-6 current-carrying conductors 0.80 derating factor is applied.

Table 4-9 Auxiliary wiring for size 2 drives

Frame size	Maximum input current	Continuous output current	IEC 60364-5-52 Table A52-4 Column B2		UL 508C	
			Column B2 derated by 0,87 of PVC at 40			
			E1, E3 size	F+, F- , L11 & L12 size	E1, E3 size	F+, F- , L11 & L12 size
	A	**A**	**mm²**	**mm²**	**mm²**	**mm²**
2	23	20	6	4	10 AWG	10 AWG

Notes for IEC 60364:

IEC 60364-5-52 use installation method B2, table A.52-4 for three loaded conductors, PVC insulation 30 °C and apply derating factor for 40 °C from table A.52-14 (0.87 for PVC).

Notes for UL508C: Either 60 °C or 75 °C cable can be used. Ampacities as per table 40.3 as described in the UL508C standard.

4.6.1 Ferraz Shawmut fuses

> ⚠ **WARNING**
>
> **Fuses**
>
> The AC supply to the drive must be installed with suitable protection against overload and short-circuits. The following tables show the recommended fuses. Failure to observe this requirement will cause risk of fire.

Ferraz Shawmut fuses are recommended for the Mentor MP.

The applications, descriptions and ratings for the Ferraz Shawmut fuses with respect to drives are shown in Table 4-10, Table 4-11, Table 4-12, Table 4-13 and Table 4-14.

Table 4-10 Ferraz Shawmut semiconductor fusing for International size 1 drives

Model	International			
	Description	Catalog No.	Reference No.	UL approved
Field fuses	10 x 38 mm Ferrule	FR10GB69V12.5	H330011	√
MP25A4	22 x 58 mm Ferrule	FR22GC69V32	A220915	√
MP25A5				
MP45A4		FR22GC69V63	X220912	√
MP45A5				
MP75A4		FR22GC69V100	W220911	√
MP75A5				
MP25A4R		FR22GC69V32	A220915	√
MP25A5R				
MP45A4R		FR22GC69V63	X220912	√
MP45A5R				
MP75A4R		FR22GC69V100	W220911	√
MP75A5R				
MP105A4	Size 30 Square body fuse	PC30UD69V160EF	M300092	√
MP105A5				
MP155A4		PC30UD69V200EF	N300093	√
MP155A5				
MP210A4		PC30UD69V315EF	Q300095	√
MP210A5				
MP105A4R	Size 70 Square body fuse	PC70UD13C160EF	T300604	√
MP105A5R				
MP155A4R		PC70UD13C200EF	V300605	√
MP155A5R				
MP210A4R		PC70UD12C280EF	L300712	√
MP210A5R				

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Table 4-11 Ferraz Shawmut semiconductor fusing for USA size 1 drives

Model	USA			
	Description	Catalog No.	Reference No.	UL approved
Field fuses	10 x 38 mm Ferrule	FR10GB69V12.5	H330011	√
MP25A4	A50QS Series round fuse	A50QS40-4	Y215583	√
MP25A5				
MP45A4	A50QS Series round fuse	A50QS70-4	B222664	√
MP45A5				
MP75A4	A50QS Series round fuse	A50QS125-4	K218417	√
MP75A5				
MP25A4R	A70QS Series round fuse	A70QS60-4	H219473	
MP25A5R				
MP45A4R	A70QS Series round fuse	A70QS80-4	X212816	
MP45A5R				
MP75A4R	A70QS Series round fuse	A70QS125-4	Q216375	
MP75A5R				
MP105A4	A50QS Series round fuse	A50QS175-4	A222663	√
MP105A5				
MP155A4	A50QS Series round fuse	A50QS250-4	W211251	√
MP155A5				
MP210A4	A50QS Series round fuse	A50QS350-4	T215343	√
MP210A5				
MP105A4R	A70QS Series round fuse	A70QS175-4	A223192	
MP105A5R				
MP155A4R	A70QS Series round fuse	A70QS250-4	L217406	
MP155A5R				
MP210A4R	A70QS Series round fuse	A70QS350-4	M211266	
MP210A5R				

NOTE   A50QS series are only rated up to 500 Vac.

Table 4-12 Ferraz Shawmut branch circuit protection fusing for size 1 drives

Model		International				USA	
		Description	Catalog No.	Ref No.	UL app	Catalog No.	UL app
Auxiliary		21 x 57 mm Cylindrical	HSJ15	D235868		AJT10	√
MP25A4	MP25A5		FR22GG69V25	N212072		AJT30	√
MP45A4	MP45A5		FR22GG69V50	P214626		AJT45	√
MP75A4	MP75A5	22 x 58 mm Ferrule	FR22GG69V80	Q217180		AJT70	√
MP25A4R	MP25A5R		FR22GG69V25	N212072		AJT30	√
MP45A4R	MP45A5R		FR22GG69V50	P214626		AJT45	√
MP75A4R	MP75A5R		FR22GG69V80	Q217180		AJT70	√
MP105A4	MP105A5	NH 00 Knife blade	NH00GG69V100	B228460		AJT125	√
MP155A4	MP155A5	NH 1 Knife blade	NH1GG69V160	F228487		AJT175	√
MP210A4	MP210A5		NH1GG69V200	G228488		AJT225	√
MP105A4R	MP105A5R	NH 00 Knife blade	NH00GG69V100	B228460		AJT125	√
MP155A4R	MP155A5R	NH 1 Knife blade	NH1GG69V160	F228487		AJT175	√
MP210A4R	MP210A5R		NH1GG69V200	G228488		AJT225	√

Table 4-13 Ferraz Shawmut DC Semiconductor protection fusing for International size 1 drives

Model	International			
	Description	Catalog No.	Reference No.	UL approved
MP25A4R	20 x 127 mm Cylindrical	FD20GB100V32T	F089498	
MP25A5R				
MP45A4R	36 x 127 mm Cylindrical	FD36GC100V80T	A083651	
MP45A5R				
MP75A4R	20 x 127 mm Cylindrical	FD20GC100V63T x 2 connected in parallel	F083656	
MP75A5R				
MP105A4R	Size 120 Square body	D120GC75V160TF	R085253	
MP105A5R				
MP155A4R	Size 121 Square body	D121GC75V250TF	Q085252	
MP155A5R				
MP210A4R	Size 122 Square body	D122GC75V315TF	M085249	
MP210A5R				

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Table 4-14 Ferraz Shawmut DC Semiconductor protection fusing for USA size 1 drives

Model	USA			
	Description	Catalog No.	Reference No.	UL approved
MP25A4R	A70QS Series round fuse	A70QS60-4	H219473	√
MP25A5R				
MP45A4R	A70QS Series round fuse	A70QS80-4	X212816	√
MP45A5R				
MP75A4R	A70QS Series round fuse	A70QS125-4	Q216375	√
MP75A5R				
MP105A4R	A70QS Series round fuse	A70QS175-4	A223192	√
MP105A5R				
MP155A4R	A70QS Series round fuse	A70QS250-4	L217406	√
MP155A5R				
MP210A4R	A70QS Series round fuse	A70QS350-4	M211266	√
MP210A5R				

NOTE   The above DC fuse recommendations are not required for UL conformity of the Mentor MP drive. Any installations required to meet NEC and/or UL508a panel requirements, must use recognized fuses that meet the requirements of the standard being applied. The UL columns above indicate whether the recommended fuse is a UL recognized component and not its conformance to either NEC or UL508a.
DC fusing is required on four quadrant (R) drives only.

Table 4-15 Ferraz Shawmut semiconductor fusing for International size 2 drives

Model	International			
	Description	Catalog No.	Reference No.	UL approved
Field fuses (all size 2)	10 x 38 mm Ferrule	FR10GR69V25	F1014581	√
		FR10GB69V25	L330014	
MP350A4	Square body fuses	PC30UD69V500TF	W300399	√
MP350A4R		PC71UD11V500TF	F300523	√
MP350A5		PC31UD69V500TF	T300006	√
MP350A6		PC31UD69V500TF	T300006	
MP350A5R		PC72UD13C500TF	D300498	√
MP350A6R		PC72UD13C500TF	D300498	
MP420A4		PC32UD69V630TF	M300069	√
MP420A4R		PC272UD13C630TF	W300721	√
MP470A5		PC272UD13C700TF	X300722	√
MP470A6		PC272UD13C700TF	X300722	
MP470A5R		PC272UD13C700TF	X300722	√
MP470A6R		PC272UD13C700TF	X300722	
MP550A4		PC33UD69V700TF	Y300079	√
MP550A4R		PC272UD13C700TF	X300722	√
MP700A4		PC32UD69V1000TF	S300074	√
MP700A4R		PC72UD10C900TF	G300869	√
MP700A5		PC32UD69V1000TF	S300074	√
MP700A6		PC32UD69V1000TF	S300074	
MP700A5R		PC73UD12C900TF	T300512	√
MP700A6R		PC73UD12C900TF	T300512	
MP825A4		PC32UD69V1100TF	M300759	√
MP825A5		PC33UD69V1100TF	C300083	√
MP825A6		PC33UD69V1100TF	C300083	

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Model	International			
	Description	Catalog No.	Reference No.	UL approved
MP825A4R	Square body fuses	PC73UD95V800TFB	W300514	√
MP825A5R		PC73UD95V800TFB	W300514	√
MP825A6R		PC73UD95V800TFB	W300514	
MP900A4		PC33UD69V1250TF	D300084	√
MP900A4R		PC73UD95V800TFB	W300514	√
MP1200A4		PC33UD60V1600TF	Z300586	
		A075URD 44 PPASF	D1020007A	√
MP1200A4R		PC273UD11C16CTF	J302228	
		A075URD 44 PPASF	D1020007A	√
MP1200A5		PC232UD69V16CTD	W300215	
		A075URD 44 PPASF	D1020007A	√
MP1200A6		PC232UD69V16CTD	W300215	
MP1200A5R		PC273UD11C16CTF	J302228	
		A075URD 44 PPASF	D1020007A	√
MP1200A6R		PC273UD11C16CTF	J302228	
MP1850A4		** A075URD 44 PPASF	D1020007A	√
MP1850A4R				
MP1850A5				
MP1850A6				
MP1850A5R				
MP1850A6R				

Table 4-16 Ferraz Shawmut semiconductor fusing for USA size 2 drives

Model	USA			
	Description	Catalog No.	Reference No.	UL approved
Field fuses (all size 2)	10 x 38 mm Ferrule	FR10GR69V25	F1014581	√
		FR10GB69V25	L330014	
MP350A4	American round fuses	A50QS450-4	E216871	√
		A7OQS450-4	F214848	√
MP350A4R		A7OQS450-4	F214848	√
MP350A5		A70QS450-4	F214848	√
MP350A6		A70QS450-4	F214848	
MP350A5R		A70QS450-4	F214848	√
MP350A6R		A70QS450-4	F214848	
MP420A4		A50QS600-4	Q219457	√
		A70QS600-4	Y219993	√
MP420A4R		A70QS600-4	Y219993	√
MP470A5		2 x A70QS400 in parallel	J214345 (x2)	
MP470A6				
MP470A5R				
MP470A6R				
MP550A4		A50QS700-4	N223181	√
		A70QS700-4	E202772	√
MP550A4R		A70QS700-4	E202772	√
MP700A4		A50QS900-4	R212282	√
		2 x A70QS500-4 in parallel	A218431 (x2)	
MP700A4R		2 x A70QS500 in parallel	A218431 (x2)	
MP700A5				
MP700A6				
MP700A5R				
MP700A6R				
MP825A4		A50QS1200-4	C217904	√
		2 x A70QS600-4 in parallel	Y219993 (x2)	

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Model	USA			
	Description	Catalog No.	Reference No.	UL approved
MP825A5	American round fuses	2 x A7OQS600-4 in parallel	Y219993 (x2)	
MP825A6				
MP825A4R				
MP825A5R				
MP825A6R		2 x A7OQS600-4 in parallel	Y219993 (x2)	
MP900A4		A50QS1200-4	C217904	√
		2 x A7OQS600-4 in parallel	Y219993 (x2)	
MP900A4R		2 x A7OQS600-4 in parallel	Y219993 (x2)	
MP1200A4		2 x A5OQS800-4 in parallel	C202287 (x2)	
		2 x A70QS800-4 in parallel	Z213830 (x2)	
MP1200A4R		2 x A70QS800-4 in parallel	Z213830 (x2)	
MP1200A5				
MP1200A6				
MP1200A5R				
MP1200A6R				
MP1850A4		2 x A5OQS1000-4 in parallel	B217391 (x2)	
		*3 x A70QS700-4 in parallel	*E202772 (x3)	
MP1850A4R		*3 x A7OQS700-4 in parallel	*E202772 (x3)	
MP1850A5				
MP1850A6				
MP1850A5R				
MP1850A6R				

NOTE   A5OQS series are only rated up to 500 Vac.

*Application overload limited to infrequent overloads to avoid fuse wear out

**Fuse limits applications to those operating at rated current. No cyclic overloads permitted.

Table 4-17 Ferraz Shawmut branch circuit protection fusing for International size 2 drives

Model		International			
		Description	Catalog No.	Reference No.	UL approved
Auxiliary		25A 600 Vac High Speed Class J	HSJ205	G235871J	√
MP350A4(R)	MP350A5(R)	General purpose IEC (Square body)	NH2GG69V355	Y228503	
	MP350A6(R)				
MP420A4(R)			NH3GG69V400	D228508	
MP470A5(R)			NH4GG69V630-8 NH4AGG69V630-8	E215537 W222107	
MP470A6(R)					
MP550A4 (R)			NH4GG69V630-8	E215537	
			NH4AGG69V630-8	W222107	
MP700A4(R)	MP700A5(R)		NH4GG69V800-8	K216554	
	MP700A6(R)		NH4AGG69V800-8	M222858	
MP825A4(R)			NH4GG69V800-8 NH4AGG69V800-8	K216554 M222858	
MP825A5(R)					
MP825A6(R)					
MP900A4(R)		General Purpose IEC (Round body)	MF76GG69V1250	E302753	
MP1200A4(R)	MP1200A5(R)				
	MP1200A6(R)				
MP1850A4(R)	MP1850A5(R)		MF114GG69V2000	G302755	
	MP1850A6(R)				

Table 4-18 Ferraz Shawmut branch circuit protection fusing for USA size 2 drives

Model		Description	Catalog No.	Reference No.	UL approved
		USA			
Auxiliary		25A 600 Vac High Speed Class J	AJT25R	X21160J	√
MP350A4(R)	MP350A5(R)	General purpose US (Round body)	A6D400R	B216776	√
	MP350A6(R)				
MP420A4(R)			A6D500R	P217294	√
MP470A5(R)			A6D600R	T217804	√
MP470A6(R)					
MP550A4 (R)					
MP700A4(R)	MP700A5(R)		A4BQ800	Z219373	√
	MP700A6(R)				
MP825A4(R)					
MP825A5(R)					
MP825A6(R)					
MP900A4(R)			A4BQ1000	P216282	√
MP1200A4(R)	MP1200A5(R)		A4BQ1200	R216790	√
	MP1200A6(R)				
MP1850A4(R)	MP1850A5(R)		A4BQ2000	B223101	√
	MP1850A6(R)				

NOTE   USA fuses are only rated up to 600 Vac.

Table 4-19 Ferraz Shawmut DC protection fusing for International size 2 drives

Model	International			
	Description	Catalog No.	Reference No.	UL recognized
MP350A4R	Square body fuse	D123GB75V630TF	C098557	
MP350A5R				
MP350A6R				
MP420A4R		D123GB75V800TF	J220946	
MP470A5R		D2122GD75V900TF	T220955	
MP470A6R				
MP550A4R				
MP700A4R		D2123GB75V12CTF	D098558	
MP700A5R				
MP700A6R				
MP825A4R				
MP825A5R				
MP825A6R				
MP900A4R		D2123GB75V14CTF	B090483	
MP1200A4R	Square body fuses 3 in parallel	PC73UD13C630TF (x3)	Q300509 (x3)	
MP1200A5R				
MP1200A6R				
MP1850A4R	Square body fuses 4 in parallel	PC73UD13C700TF (x4)	R300510 (x4)	
MP1850A5R				
MP1850A6R				

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Table 4-20 Ferraz Shawmut DC protection fusing for USA size 2 drives

Model	USA			
	Description	Catalog No.	Reference No.	UL recognized
MP350A4R	American round fuse	A70QS600-4	Y219993	√
MP350A5R		A100P600-4	A217373	√
MP350A6R				
MP420A4R		A70QS800-4	Z213830	√
MP470A5R	American round fuses 2 in parallel	A100P1000-4 (x2)	Y217371 (x2)	
MP470A6R				
MP550A4R		A70QS450-4 (x2)	F214848 (x2)	√
MP700A4R		A70QS600-4 (x2)	Y219993 (x2)	√
MP700A5R	American round fuse	A100P1200-4	N218397	
MP700A6R				
MP825A4R	American round fuses 2 in parallel	A70QS800-4 (x2)	Z213830 (x2)	
MP825A5R	American round fuse	A100P1200-4	N218397	
MP825A6R				
MP900A4R	American round fuses 3 in parallel	A70QS600-4 (x3)	Y219993 (x3)	
MP1200A4R	American round fuses 3 in parallel	A70QS700-4 (x3)	E202772 (x3)	
MP1200A5R		A100P700-4 (x3)	T223163 (x3)	
MP1200A6R				
MP1850A4R	American round fuses 5 in parallel	A70QS600-4 (x5)	Y219993 (x5)	
MP1850A5R		A100P600-4 (x5)	A217373 (x5)	
MP1850A6R				

NOTE
The above DC fuse recommendations are not required for UL conformity of the Mentor MP drive. Any installations required to meet NEC and/or UL508a panel requirements, must use recognized fuses that meet the requirements of the standard being applied. The UL columns above indicate whether the recommended fuse is a UL recognized component and not its conformance to either NEC or UL508a.
The use of the A100P series fuses is limited to applications with L/R time constants of 30 ms or less. DC fusing is only required on four quadrant (R) drives.

4.6.2 Alternative fusing

Cooper Bussmann or Siba fuses are an acceptable alternative (refer to the *Mentor MP User Guide* for more details).

4.6.3   Internal field fuses

The internal field fuses provide protection to the field controller. The fuses can rupture if there is a fault in the field circuit. The user should check the internal field fuses if the drive is tripping field loss (FdL) and the field controller is enabled.

⚠ **WARNING**

Isolate the power before removing the internal field fuses.

Figure 4-5 Removing the internal field fuses
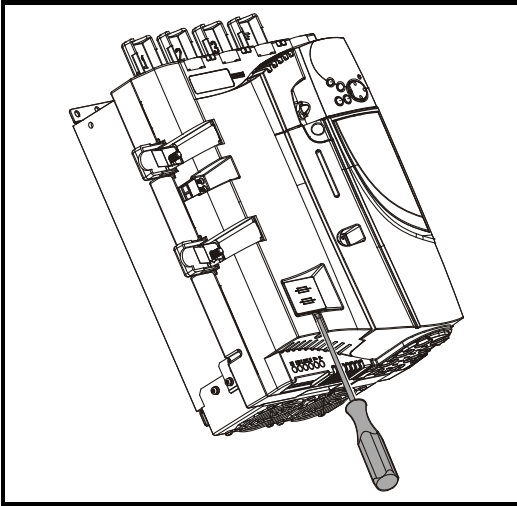
Insert a flat-head screwdriver into the groove as shown above and lever downwards to remove the fuse cover. Refer to section 4.6.1 *Ferraz Shawmut fuses* on page 44 for fuse types.

4.7   Shield connections

These instructions must be followed to ensure suppression of radio-frequency emission and good noise immunity in the encoder circuit. It is recommended that the instructions for the connection of the encoder cable be followed closely and, to use the grounding bracket and grounding clamp supplied with the drive, to terminate the shields at the drive.

4.7.1   Motor cables

Use of a motor cable with an overall shield for the armature and field circuits may be needed if there is a critical EMC emissions requirement. 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.

4.7.2   Encoder cable

To get the best results from shielding use cable with an overall shield and separate shields on individual twisted pairs. Connect the cable as illustrated in Figure 4-6. Assemble and clamp the overall shield to the grounded metallic surfaces at the encoder and at the drive ends of the cable.

Figure 4-6 Shielded cable assembly
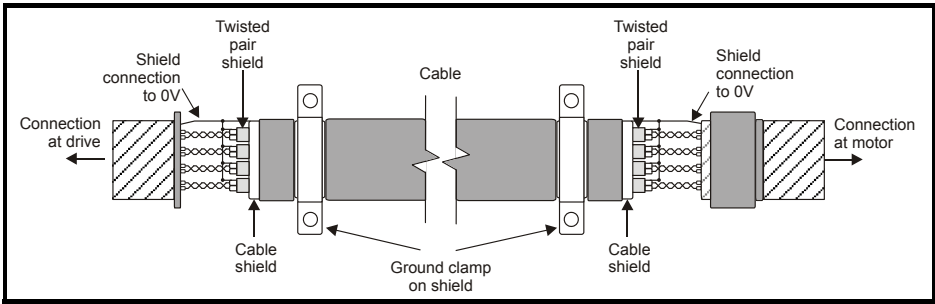
4.7.3 Control cables

It is recommended that signal cables should be shielded. This is essential for encoder cables, and strongly recommended for analog signal cables. For digital signals it is not necessary to use shielded cables within a panel, but this is recommended for external circuits, especially for inputs where a momentary signal causes a change of state (i.e. latching inputs).

4.8 Connecting the fan on size 2C and 2D drives

A supply needs to be connected to the dual fan unit enclosed within the lower duct on Mentor MP size 2C and 2D. The fans can be configured for a 230 Vac (factory setting) or 115 Vac supply as shown below on the label next to the fan connections. When connecting the fan supply, the screws should be tightened with a maximum torque of 1.2 N m (0.88 lb ft) to 2 N m (1.47 lb ft).

Figure 4-7 Fan connection
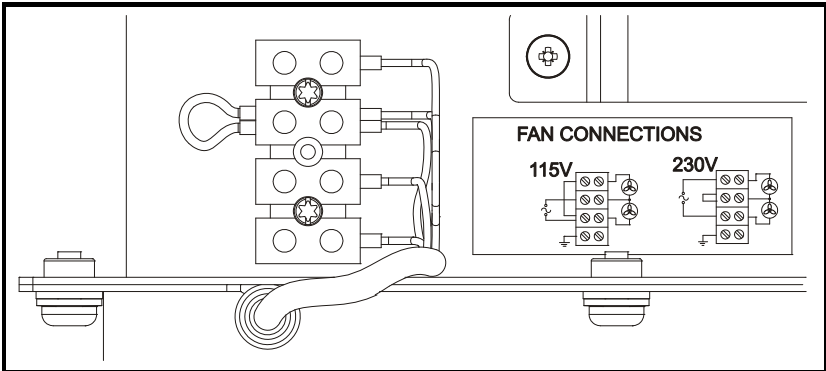
Table 4-21 Fan supply specification

Fan configuration	Supply specification
230 V	230 V ±10 %
115 V	115 V ±10 %

Cabling should be 300 V rated. Rated for at least 3 A continuous in line with local wiring regulations. Cabling should be protected by 3 A non time delay fuses i.e. gG, Class CC or Class J and rated for at least 300 V, in accordance with local wiring regulations.

4.9 Control connections

Refer to Figure 4-8 to understand the connection of the different control connections.

<table>
<tr><td>

⚠️ **WARNING**

</td><td>

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.

</td></tr>
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<table>
<tr><td>

⚠️ **CAUTION**

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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 on the drive.

</td></tr>
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<table>
<tr><td>

⚠️ **WARNING**

</td><td>

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

</td></tr>
</table>

<table>
<tr><td>

⚠️ **WARNING**

</td><td>

Status relay contacts are over-voltage category II.

</td></tr>
</table>

<table>
<tr><td>

⚠️ **WARNING**

</td><td>

A fuse or other over-current protection should be installed to the relay circuit.

</td></tr>
</table>

For the full terminal descriptions, refer to the *Mentor MP User Guide.*

Figure 4-8 Default terminal functions
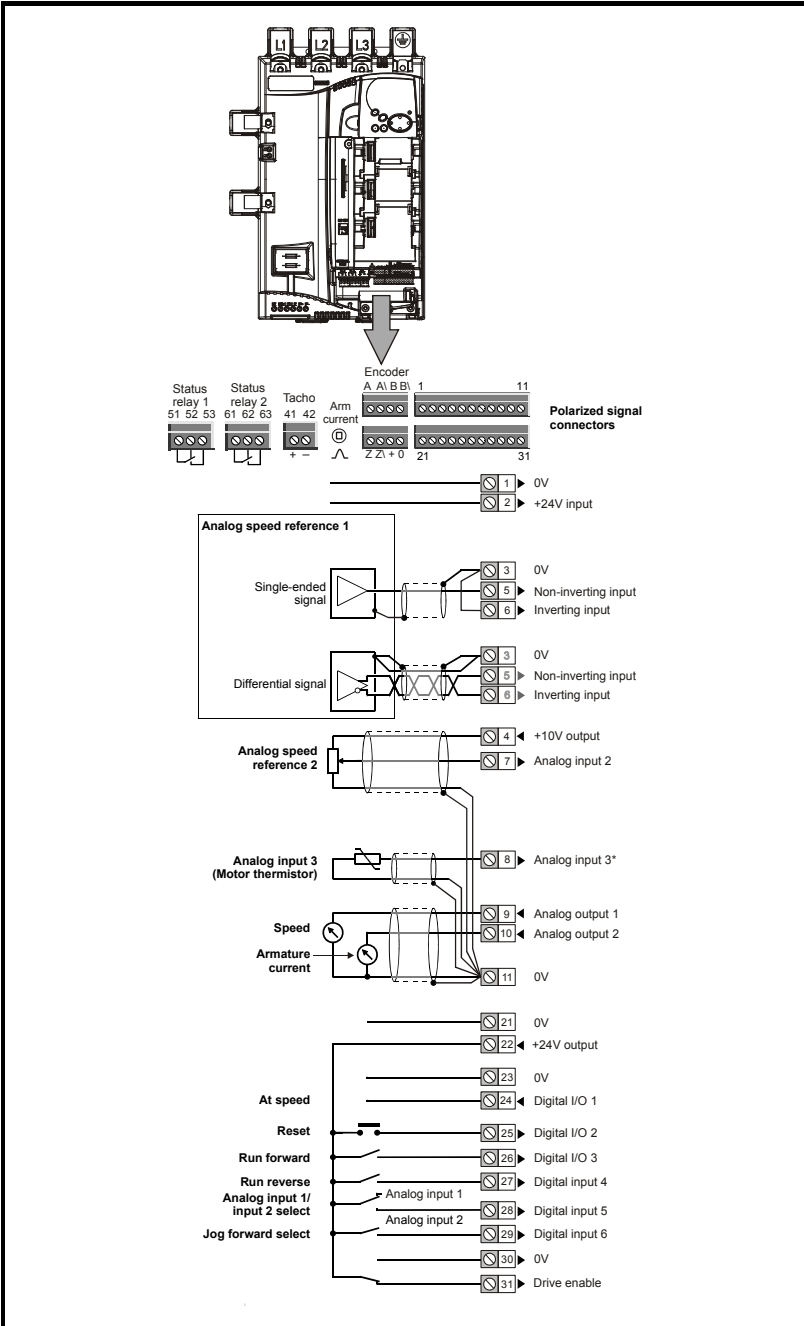
* Thermistor disabled by USA defaults.

4.9.1 Serial communications connections

The Mentor MP has a serial communications port (serial port) as standard supporting two wire EIA(RS)-485 communications.

Figure 4-9 Serial communications port
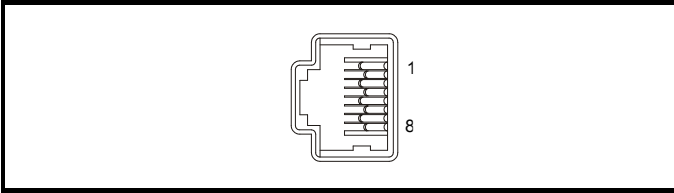
Table 4-22 RJ45 connections

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

The communications port applies a two-unit load to the communications network. Connectors 2, 3, 7 and shield must always be made to the serial communications port. Shielded cable must be used at all times.

⚠ **WARNING**
In order to meet the requirements for SELV in IEC 60950 (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.

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5   Getting started

This chapter introduces the user interfaces, menu structure and security level of the drive.

5.1   Understanding the display

There are two types of keypad available for the Mentor MP. The SM-Keypad has an LED display, and the MP-Keypad has an LCD display.

5.1.1   SM-Keypad (LED)

The display consists of two horizontal rows of 7 segment LED displays.
The upper display shows the drive status or the current menu and parameter number being viewed.
The lower display shows the parameter value or the specific trip type.

Figure 5-1 SM-Keypad
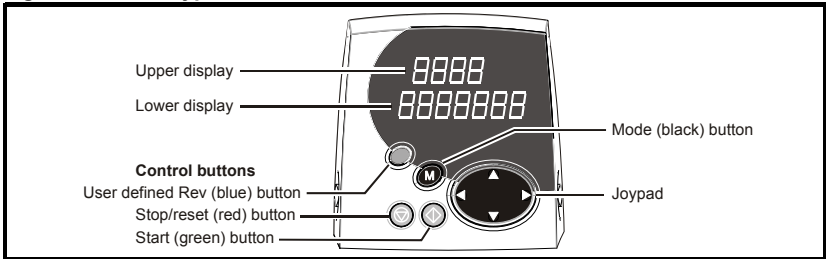
5.1.2   MP-Keypad (LCD)

The display consists of three lines of text.
The top line shows the drive status or the current menu and parameter number being viewed on the left, and the parameter value or the specific trip type on the right.
The lower two lines show the parameter name or the help text.

Figure 5-2 MP-Keypad
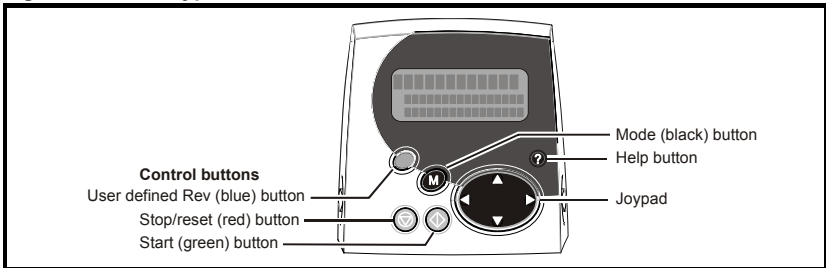
NOTE   The red stop button is also used to reset the drive.

The SM-Keypad and the MP-Keypad can indicate when a SMARTCARD access is taking place or when the second motor map is active (menu 21). These are indicated on the displays as follows.

	SM-Keypad	MP-Keypad
SMARTCARD access taking place	The decimal point after the fourth digit in the upper display will flash.	The symbol 'CC' will appear in the lower left hand corner of the display
Second motor map active	The decimal point after the third digit in the upper display will flash.	The symbol 'Mot2' will appear in the lower left hand corner of the display
Solutions Module parameters displayed		The symbol 'Opx' will appear in the left hand corner of the display

5.2 Keypad operation

Control buttons

The keypad consists of:

1. Joypad - used to navigate the parameter structure and change parameter values.
2. Mode button - used to change between the display modes – parameter view, parameter edit, status.
3. Three control buttons - used to control the drive if keypad mode is selected. Refer to the *Mentor MP User Guide* for further information.
4. Help button (MP-Keypad only) - displays text briefly describing the selected parameter.

The Help button toggles between other display modes and parameter help mode. The up and down functions on the joypad scroll the help text to allow the whole string to be viewed. The right and left functions on the joypad have no function when help text is being viewed.

The display examples in this section show the SM-Keypad, seven segment, LED display. The examples are the same for the MP-Keypad, The exceptions is that the information displayed on the lower row on the SM-Keypad is displayed on the right hand side of the top row on the MP-Keypad.

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The display examples in this section show the SM-Keypad 7 segment LED display. The examples are the same for the MP-Keypad except that the information displayed on the lower row on the SM-Keypad is displayed on the right hand side of the top row on the MP-Keypad.

Figure 5-3 Display modes
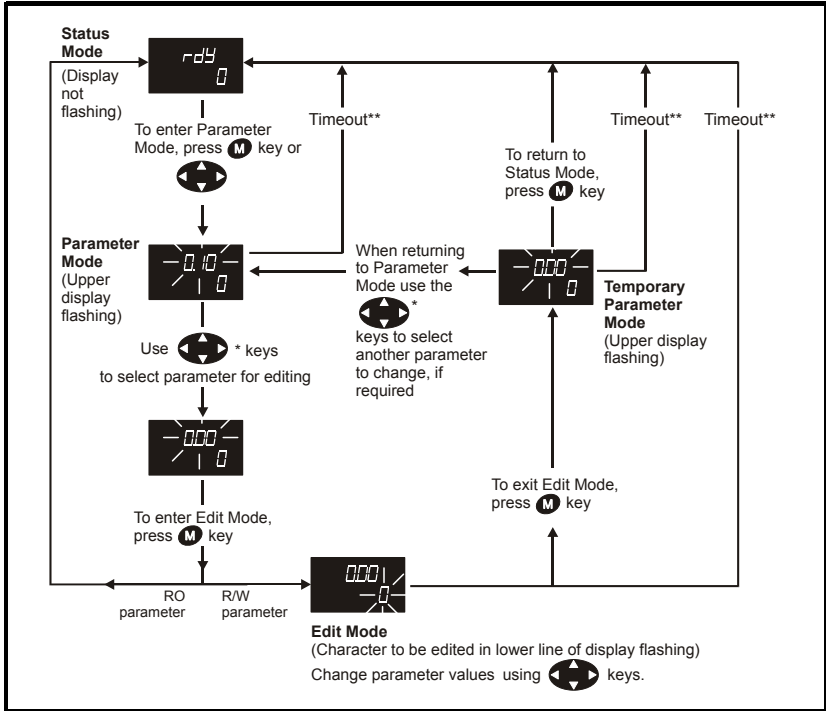
* Can only be used to move between menus if L2 access has been enabled Pr **11.44** (**SE14, 0.35**)
Time-out defined by Pr **11.41 (default value = 240s).

Figure 5-4 Mode examples

⚠ **WARNING**
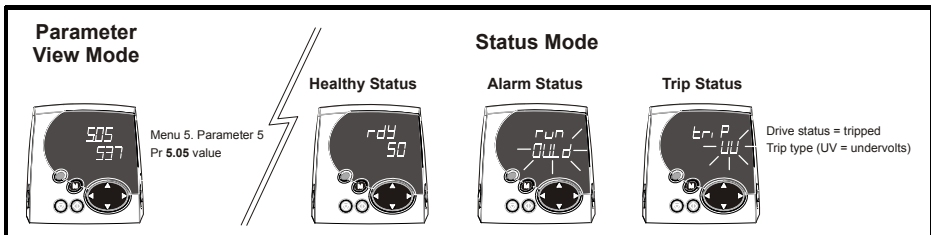
Do not change parameter values without careful consideration; incorrect values may cause damage or a safety hazard.

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NOTE When changing the values of parameters, make a note of the new values in case they need to be entered again.

NOTE For new parameter-values to apply after the AC supply to the drive is interrupted, new values must be saved (section 5.8 *Saving parameters* on page 74).

5.3 Menu 0 (sub block)

Menu 0 can be accessed by 2 methods:

1. Pr **11.44** (**SE14, 0.35**) = 0. Sub block mode.
2. Pr **11.44** (**SE14, 0.35**) <>0. Linear mode.

Menu 23 contains the parameters to allow menu 0 to be customized in sub block mode. The first sub block is a user defined area (USEr) which is configured by the parameters in menu 22. As default there are no parameters configured to the user sub block and so it is empty. The next 7 sub blocks are pre-defined. Access to the pre-defined blocks is enabled or disabled by Pr **23.03** to Pr **23.09**.

Movement between sub blocks is achieved with the left and right keys.

Pr **23.01** contains all the sub block headers.

Table 5-1 and Figure 5-5 show the result of the direction keys when Pr **11.44** (**SE14, 0.35**) is set to L1 (0). When Pr **11.44** (**SE14, 0.35**) is not 0 the left and right keys will allow access to the advance parameter set and menu 0 will become a linear menu.

Table 5-1 Keypad navigation

Starting location	Action	Finishing location
Header	Right	Next header
	Left	Previous header
	Up	First parameter in header block
	Down	Last parameter in header block
Parameter	Right	Next header
	Left	Previous header
	Up	Next parameter in header block
	Down	Previous parameter in header block

When moving to the user block header, the user block header is only displayed if there are some valid parameters in the block. When moving between pre-defined header blocks the pre-defined header block is only displayed if the pre-defined block is enabled.

When moving between parameters within a block, only valid parameters are displayed.

Figure 5-5 Sub block navigation
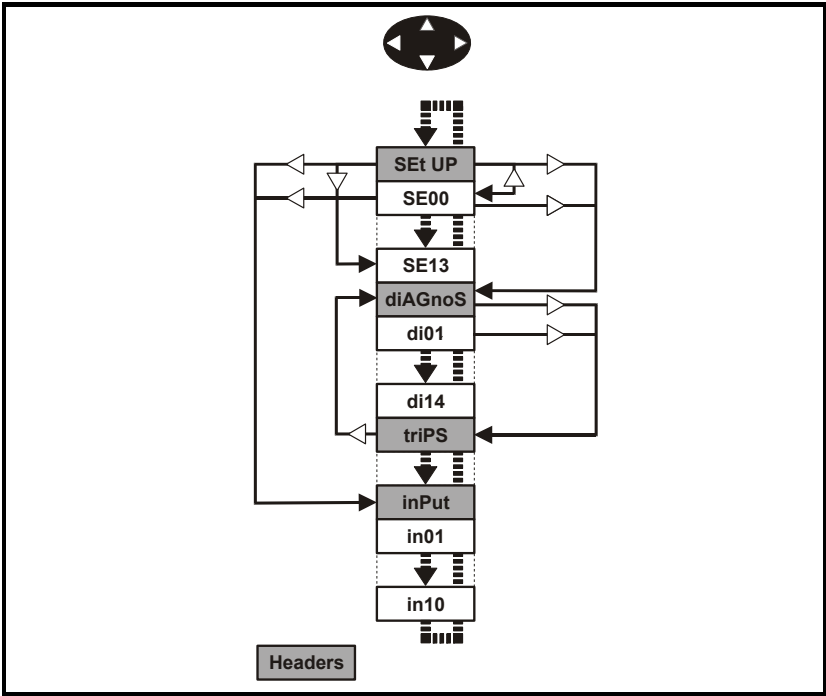
Coding

The coding defines the attributes of the parameter as follows.

Coding	Attribute
{X.XX}	Copied Menu 0 or advanced parameter.
Bit	1 bit parameter: 'On' or 'OFF' on the display.
Bi	Bipolar parameter.
Uni	Unipolar parameter.
Txt	Text: the parameter uses text strings instead of numbers.
SP	Spare: not used.
FI	Filtered: some parameters which can have rapidly changing values are filtered when displayed on the drive keypad for easy viewing.
DE	Destination pointer parameter: This parameter can be used to set up the location (i.e. menu/parameter number) where the destination data is to be routed.
VM	Variable maximum: the maximum of this parameter can vary.
DP	Decimal place: indicates the number of decimal places used by this parameter.
ND	No default: when defaults are loaded (except when the drive is manufactured or on EEPROM failure) this parameter is not modified.
RA	Rating dependant: this parameter is likely to have different values and ranges with drives of different voltage and current ratings. Parameters with this attribute will not be transferred to the destination drive by a SMARTCARD when the rating of the destination drive is different from the source drive if the drive voltage ratings are different or the file is a parameter file. However, the value will be transferred if only the current rating is different and the file is a differences from default type file.
NC	Not copied: not transferred to or from SMARTCARD during copying.
NV	Not visible: not visible on the keypad.
PT	Protected: cannot be used as a destination.
US	User save: saved in drive EEPROM when the user initiates a parameter save.
RW	Read/write: can be written by the user.
RO	Read only: can only be read by the user
BU	Bit default one/unsigned: Bit parameters with this flag set to one have a default of one (all other bit parameters have a default of zero. Non-bit parameters are unipolar if this flag is one.
PS	Power-down save: parameter automatically saved in drive EEPROM when the under volts (UV) trip occurs. Power-down save parameters are also saved in the drive when the user initiates a parameter save.

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23.01			Sub block headers							
RO	Txt	NC						PT		BU
⇳	USEr (0), SEt UP (1), diAGnoS (2), triPS (3), SP LOOP (4), SintEr (5), Fb SP (6), inPut (7)			⇨		USEr (0)				

Defines the sub block headers. Can be used by the MP-Keypad to display the same strings as the SM-Keypad.

23.02			Binary sum of pre-defined sub block enables							
RO		NC						PT		BU
⇳		0 to 127			⇨		0			

The OR of Pr **23.03** to Pr **23.09**. To be used by the MP-Keypad.

Parameter	Value
23.03	1
23.04	2
23.05	4
23.06	8
23.07	16
23.08	32
23.09	64

23.03 - 23.09			Pre-defined sub block enable							
RW	Bit								US	BU
⇳		0 to 1			⇨		1			

When this parameter is set to 1 the associated pre-defined sub block is accessible. When this parameter is 0 the associated pre-defined block is bypassed.

Parameter	Description	Display
23.03	Set up	SEt UP
23.04	Diagnostic	diAGnoS
23.05	Trips	triPS
23.06	Speed loop	SP LOOP
23.07	Serial interface	SintEr
23.08	Speed feedback	Fb SP
23.09	IO	InPut

5.4 Pre-defined sub blocks

Menu 0	Parameter	Description	Display
00.01 to **00.20**		Configured by Pr **22.01** to Pr **22.20**	

Set-up

Menu 0	Parameter	Description	Display
00.21	**1.00**	Parameter 0	**SE00**
00.22	**1.07**	Minimum reference clamp	**SE01**
00.23	**1.06**	Maximum reference clamp	**SE02**
00.24	**2.11**	Acceleration rate	**SE03**
00.25	**2.21**	Deceleration rate	**SE04**
00.26	**1.14**	Reference selector	**SE05**
00.27	**5.09**	Armature rated voltage	**SE06**
00.28	**5.07**	Motor rated current	**SE07**
00.29	**5.08**	Base speed	**SE08**
00.30	**11.42**	Parameter copying	**SE09**
00.31	**5.70**	Rated field current	**SE10**
00.32	**5.73**	Rated field voltage	**SE11**
00.33	**5.77**	Enable field control	**SE12**
00.34	**5.12**	Autotune	**SE13**
00.35	**11.44**	Security status	**SE14**

Diagnostic

Menu 0	Parameter	Description	Display
00.36	**1.01**	Speed reference selected	**di01**
00.37	**1.03**	Pre-ramp reference	**di02**
00.38	**2.01**	Post ramp reference	**di03**
00.39	**3.01**	Final speed reference	**di04**
00.40	**3.02**	Speed feedback	**di05**
00.41	**3.04**	Speed controller output	**di06**
00.42	**4.03**	Torque demand	**di07**
00.43	**4.01**	Current magnitude	**di08**
00.44	**5.56**	Field current feedback	**di09**
00.45	**5.02**	Armature voltage	**di10**
00.46	**1.11**	Reference enabled indicator	**di11**
00.47	**1.12**	Reverse selected indicator	**di12**
00.48	**1.13**	Jog selected indicator	**di13**
00.49	**11.29**	Software version	**di14**
00.50	**0.00**	Spare	

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Trips

Menu 0	Parameter	Description	Display
00.51	10.20	Trip 0	tr01
00.52	10.21	Trip 1	tr02
00.53	10.22	Trip 2	tr03
00.54	10.23	Trip 3	tr04
00.55	10.24	Trip 4	tr05
00.56	10.25	Trip 5	tr06
00.57	10.26	Trip 6	tr07
00.58	10.27	Trip 7	tr08
00.59	10.28	Trip 8	tr09
00.60	10.29	Trip 9	tr10

Speed loop

Menu 0	Parameter	Description	Display
00.61	3.10	Speed controller proportional gain	SP01
00.62	3.11	Speed controller integral gain	SP02
00.63	3.12	Speed controller differential feedback gain	SP03
00.64	0.00	Spare	
00.65	0.00	Spare	

Serial interface

Menu 0	Parameter	Description	Display
00.66	11.25	Baud rate	Si01
00.67	11.23	Serial address	Si02
00.68	0.00	Spare	
00.69	0.00	Spare	
00.70	0.00	Spare	

Speed feedback

Menu 0	Parameter	Description	Display
00.71	3.26	Speed feedback selector	Fb01
00.72	3.51	Tachometer rating (V/1000rpm)	Fb02
00.73	3.53	Tachometer input mode	Fb03
00.74	3.52	Tachometer speed feedback	Fb04
00.75	3.34	Drive encoder lines per revolution	Fb05
00.76	3.36	Encoder supply	Fb06
00.77	3.38	Encoder type	Fb07
00.78	3.39	Encoder termination select	Fb08
00.79	3.27	Encoder speed feedback	Fb09
00.80	0.00	Spare	

IO

Menu 0	Parameter	Description	Display
00.81	7.15	Analog input 3 mode	in01
00.82	7.01	Analog input 1	in02
00.83	7.02	Analog input 2	in03
00.84	7.03	Analog input 3	in04
00.85	8.01	I/O state 1	in05
00.86	8.02	I/O state 2	in06
00.87	8.03	I/O state 3	in07
00.88	8.04	I state 4	in08
00.89	8.05	I state 5	in09
00.90	8.06	I state 6	in10

For more information on the sub block function please refer to the *Mentor MP Advanced User Guide*.

5.5   Menu 0 (linear)

Menu 0 is used to bring together various commonly used parameters for basic easy set up of the drive.

Appropriate parameters are copied from the advanced menus into menu 0 and thus exist in both locations.

For further information, refer to section 5.3 *Menu 0 (sub block)* on page 65.

Figure 5-6 Menu 0 copying

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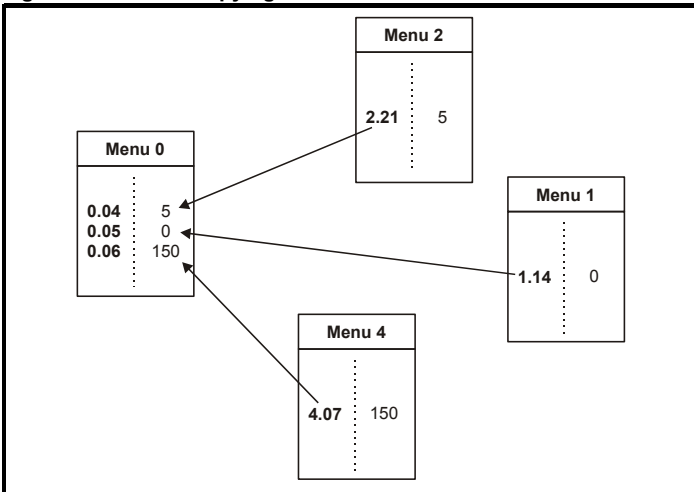
5.6 Menu structure

The drive parameter structure consists of menus and parameters.

The drive initially powers up in sub menu mode. Once Level 2 access (L2) has been enabled (refer to Pr **11.44** (**SE14, 0.35**)) the left and right buttons are used to navigate between numbered menus.

For further information, refer to section 5.13 *Parameter access level and security* on page 76.

Figure 5-7 Menu structure
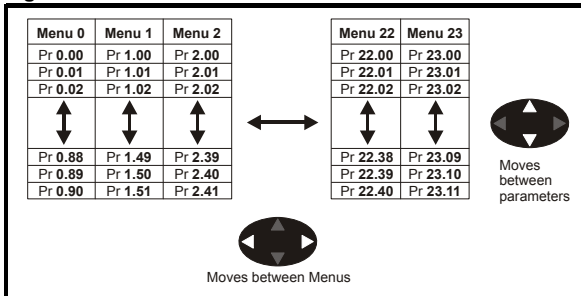
The menus and parameters roll over in both directions.

For example:

- If the last parameter is displayed, a further press will cause the display to rollover and show the first parameter.
- When changing between menus the drive remembers which parameter was last viewed in a particular menu and will display that parameter. The menus and parameters roll over in both directions.

5.7 Advanced menus

The advanced menus consist of groups of parameters appropriate to a specific function or feature of the drive. Menus 0 to 23 can be viewed on both keypads. Menus 40 and 41 are specific to the MP-Keypad (LCD). Menus 70 to 91 can be viewed with an MP-Keypad (LCD) only when an SM-Applications module is installed.

Table 5-2 Advanced menu descriptions

Menu	Description	LED	LCD
0	Commonly used basic set up parameters for quick / easy programming	✓	✓
1	Speed reference	✓	✓
2	Ramps	✓	✓
3	Speed feedback and speed control	✓	✓
4	Torque and current control	✓	✓
5	Motor control including field regulator	✓	✓
6	Sequencer and clock	✓	✓
7	Analog I/O	✓	✓
8	Digital I/O	✓	✓
9	Programmable logic, motorized pot and binary sum	✓	✓
10	Status and trips	✓	✓
11	General drive set-up	✓	✓
12	Threshold detectors and variable selectors	✓	✓
13	Position control	✓	✓
14	User PID controller	✓	✓
15	Solutions Module set-up	✓	✓
16	Solutions Module set-up	✓	✓
17	Solutions Module set-up	✓	✓
18	Application menu 1	✓	✓
19	Application menu 2	✓	✓
20	Application menu 3	✓	✓
21	Second motor parameters	✓	✓
22	Menu 0 set-up - user area	✓	✓
23	Menu 0 sub block control	✓	✓
40	Keypad configuration menu	X	✓
41	User filter menu	X	✓
70	PLC registers	X	✓
71	PLC registers	X	✓
72	PLC registers	X	✓
73	PLC registers	X	✓
74	PLC registers	X	✓
75	PLC registers	X	✓
85	Timer function parameters	X	✓
86	Digital I/O parameters	X	✓
88	Status parameters	X	✓
90	General parameters	X	✓
91	Fast access parameters	X	✓

Key: ✓ = Available

X = Not available

Table 5-3 Menu 40 parameter descriptions

Parameter		Range(⇕)
40.00	Parameter 0	0 to 32767
40.01	Language selection	English (0), Custom (1), French (2), German (3), Spanish (4), Italian (5)
40.02	Software version	999999
40.03	Save to flash	Idle (0), Save (1), Restore (2), Default (3)
40.04	LCD contrast	0 to 31
40.05	Drive and attribute database upload was bypassed	Updated (0), Bypass (1)
40.06	Browsing favourites control	Normal (0), Filter (1)
40.07	Keypad security code	0 to 999
40.08	Communication channel selection	Disable (0), Slot1 (1), Slot2 (2), Slot3 (3), Slave (4), Direct (5)
40.09	Hardware key code	0 to 999
40.10	Drive node ID (Address)	0 to 255
40.11	Flash ROM memory size	4Mbit (0), 8Mbit (1)
40.19	String database version number	0 to 999999
40.20	Screen saver strings and enable	None (0), Default (1), User (2)
40.21	Screen saver interval	0 to 600
40.22	Turbo browse time interval	0 to 200ms
40.23	Connected drive type	Unidrive SP (0), Commander SK (1), Mentor MP (2), Affinity (4), Digitax ST (5)

Table 5-4 Menu 41 parameter descriptions

Parameter		Range(⇕)
41.00	Parameter 0	0 to 32767
41.01 to 41.50	Browsing filter source F01 to F50	Pr **0.00** to Pr **22.99**
41.51	Browsing favourites control	Normal (0), Filter (1)

5.8   Saving parameters

When changing a parameter in Menu 0, the new value is saved when pressing the Ⓜ Mode 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. Enter SAVE in Pr **xx.00**
2. Either:

    •   Press the red ⊘ reset button

    •   Toggle the reset digital input, or

    •   Carry out a drive reset through serial communications by setting Pr **10.38** to 100 (ensure that Pr **xx.00** returns to 0).

5.9 Restoring parameter defaults

Restoring parameter defaults by this method saves the default values in the drive's memory (Pr **11.44** (**SE14, 0.35**) and Pr **11.30** are not affected by this procedure).

Procedure

1. Ensure the drive is not enabled, i.e. terminal 31 is open or Pr **6.15** is OFF (0)
2. Select Eur or USA in Pr **xx.00**.
3. Either:

    • Press the red ⊘ reset button

    • Toggle the reset digital input, or

    • Carry out a drive reset through serial communications by setting Pr **10.38** to 100 (ensure that Pr. **xx.00** returns to 0).

5.10 Differences between European and USA defaults

Pr	Description	Default
2.06	S ramp enable	Eur: OFF (0), USA: On (1)
3.51	Tachometer voltage rating **(Fb02, 0.72)**	Eur: 60.00, USA: 50.00
5.09, **21.09**	Armature rated voltage **(SE06, 0.27)**	480V drive Eur: 440, USA:500
5.28	Field weakening compensation disable	Eur: OFF (0), USA On (1)
5.59, **21.08**	Back emf set point	480V drive Eur: 440, USA:500
5.65	Economy timeout	Eur: OFF (0), USA: On (1)
5.70, **21.24**	Rated field current **(SE10, 0.31)**	Size 1: Eur: 2.00, USA: 8.00 Size 2A & B Eur: 3.00, USA: 20.00 Size 2C & D Eur: 5.00, USA 20.00
5.73, **21.23**	Rated field voltage **(SE11, 0.32)**	Eur: 360, USA: 300
5.75	Field voltage mode	Eur: OFF (0), USA: On (1)
7.15	Analog input 3 mode **(in01, 0.81)**	Eur: th (8), USA: VOLt (6)

5.11 Displaying parameters with non-default values only

Select dIS.dEf in Pr **xx.00**, the only parameters that will 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 **xx.00** and enter a value of 0.

Please note that this function can be affected by the access level enabled. You must refer to section 5.13 *Parameter access level and security* for more information regarding access level.

5.12 Displaying destination parameters only

Select dIS.dESt in Pr **xx.00**, 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. To deactivate this function, return to Pr **xx.00** and enter a value of 0.

Please note that this function can be affected by the access level enabled You must refer to section 5.13 *Parameter access level and security* for further information regarding access levels.

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5.13 Parameter access level and security

The parameter access levels determine whether the user has access to Menu 0 (in sub block mode) only or to all of the advanced menus (Menus 1 to 23), in addition to Menu 0 (in linear mode).

The user security determines whether the access to the user is read only or read write. The user security and the parameter access level can operate independently of each other as shown in Table 5-5 .

Table 5-5 User security and parameter access levels

Parameter access level	User security	Menu 0 status	Advanced menus status
L1	Open	Sub block RW	Not visible
L1	Closed	Sub block RO	Not visible
L2	Open	Linear RW	RW
L2	Closed	Linear RO	RO

RW = Read / write access   RO = Read only access

The default settings of the drive are parameter access level L1 and User Security Open, i.e. read / write access to Menu 0 with the advanced menus, not visible

5.13.1 User security

The user security, when set, prevents write access to any of the parameters (other than Pr **11.44** (**SE14, 0.35**) Access Level) in any menu.

Figure 5-8 User security open
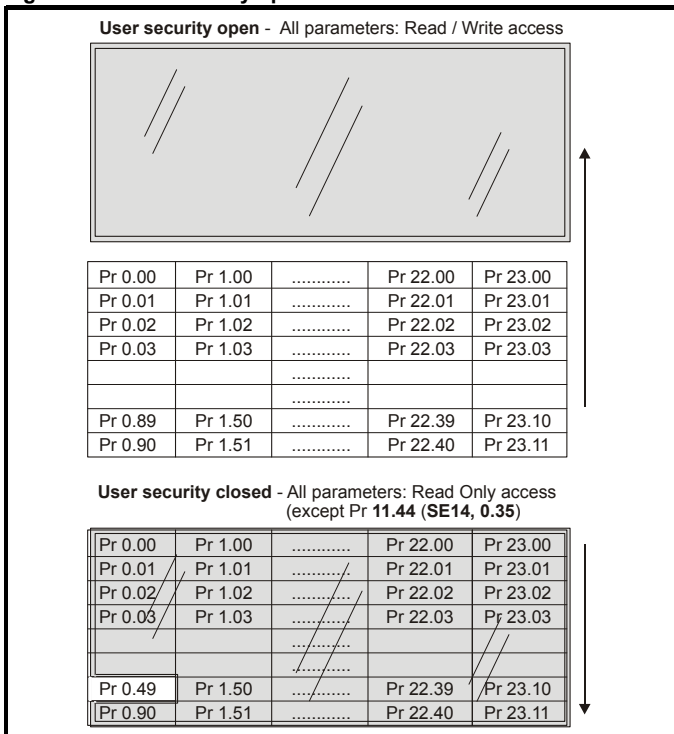
5.13.2 Setting user security

Enter a value between 1 and 999 in Pr **11.30** and press the (M) button; the security code has now been set to this value. To activate the security, the access level must be set to Loc in Pr **11.44** (**SE14, 0.35**). When the drive is reset, the security code will have been activated and the drive returns to access level L1. The value of Pr **11.30** will return to 0 in order to hide the security code. At this point, the only parameter that can be changed by the user is the access level Pr **11.44** (**SE14, 0.35**).

5.13.3 Unlocking user security

Select a read write parameter to be edited and press the (M) button; the upper display will now show CodE.

Use the arrow buttons to set the security code and press the (M) button. With the correct security code entered, the display will revert to the parameter selected in edit mode. If an incorrect security code is entered the display will revert to parameter view mode.

To lock the user security again, set Pr **11.44** (**SE14, 0.35**) to Loc and press the (M) reset button.

5.13.4 Disabling user security

Unlock the previously set security code as detailed above. Set Pr **11.30** to 0 and press the (M) button. The user 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.

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6   Running the motor

This chapter takes the new user through all the essential steps to running a motor for the first time, in each of the possible operating modes.

⚠ WARNING	Ensure that no damage or safety hazard could arise from the motor starting unexpectedly.

⚠ CAUTION	The values of the motor parameters 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 in Pr **5.07** (**SE07**, **0.28**) *Motor rated current*. This affects the thermal protection of the motor.

⚠ CAUTION	If the keypad mode has been used previously, ensure that the keypad reference has been set to 0 using the ▲▼ buttons as if the drive is started using the keypad it will run to the speed defined by the keypad reference (Pr **1.17**).

⚠ WARNING	If the intended maximum speed affects the safety of the machinery, additional independent over-speed protection must be used.

Table 6-1 Minimum control connection requirements for each control mode
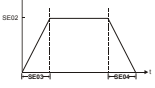
Drive control method	Requirements
Terminal mode	Drive enable Speed reference Run forward or run reverse command
Keypad mode	Drive enable
Serial communications	Drive enable Serial communications link

Refer to Figure 4-1 *Power connections for 480V drive* on page 35 for minimum connections to get a motor running.

6.1 Quick start commissioning / start-up (from European defaults)

Action	Detail	
Before power-up	Ensure: • Drive Enable signal is not given (terminal 31) • Run signal is not given • Motor connected • Tacho connected if one is being used • Encoder connected if one is being used	
Power-up the drive	Ensure: • Drive displays 'inh' **NOTE** The drive will trip 'th' (Motor thermistor trip) if no motor thermistor is connected to analog input 3 (terminal 8). If the motor protection is not connected to the drive, the 'th' trip can be disabled by setting Pr **7.15** (**in01**, **0.81**) (analog input 3 mode) to VOLt. For drive trips, see Chapter 9 *Diagnostics* on page 122.	
Enter motor nameplate details	Enter: • Armature rated voltage in Pr **5.09** (**SE06, 0.27**) (V) • Motor rated current in Pr **5.07** (**SE07, 0.28**) (A) • Motor rated speed (base speed) in Pr **5.08** (**SE08, 0.29**) (rpm) • Field rated current in Pr **5.70** (**SE10, 0.31**) (A) • Field rated voltage in Pr **5.73** (**SE11, 0.32**) (V)	

Set motor feedback parameters	**Incremental encoder basic set-up**
	Enter:
	• Drive encoder type in Pr **3.38** (**Fb07, 0.77**) = Ab (0): Quadrature encoder
	
	⚠ **CAUTION** Setting the encoder voltage supply too high for the encoder could result in damage to the feedback device
	
	• Encoder power supply in Pr **3.36** (**Fb06, 0.76**) = 5V (0), 8V (1), 15V (2) or 24V (3)
	NOTE
	If output voltage from the encoder is >5V, then the termination resistors must be disabled Pr **3.39** (**Fb08, 0.78**) to 0.
	
	• Drive encoder lines per revolution (ELPR) in Pr **3.34** (**Fb05, 0.75**) (set according to encoder)
	• Drive encoder termination resistor setting in Pr **3.39** (**Fb08, 0.78**)
	  0 = A-A\, B-B\, Z-Z\ termination resistors disabled
	  1 = A-A\, B-B\, termination resistors enabled, Z-Z\ termination resistors disabled
	  2 = A-A\, B-B\, Z-Z\ termination resistors enabled
	
	Tachometer set-up
	Enter:
	• Tachometer voltage rating Pr **3.51** (**Fb02, 0.72**) (V/1000 rpm)
	• Tachometer input mode Pr **3.53** (**Fb03, 0.73**)	

Set maximum speed	Enter: • Maximum speed in Pr **1.06** (**SE02, 0.23**) (rpm) • Set Pr **5.64** = On If field weakening is required **NOTE** For field weakening in Estimated Speed Mode please refer to the *Mentor MP User Guide - Chapter 8 Optimization - Field current*.	

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Action	Detail	
Set acceleration / deceleration rates	Enter: • Acceleration rate in Pr **2.11** (**SE03, 0.24**) (time to accelerate to maximum speed) • Deceleration rate in Pr **2.21** (**SE04, 0.25**) (time to decelerate from maximum speed)	
Enable the field controller	**Field controller set-up** • Select field mode by setting Pr **5.78** = IntrnL (Internal field controller is used), Etrnl (External half control), E FULL (External in full control). • Set Pr **5.77** (**SE12**, **0.33**) = On to enable the field.	
Static autotune	Mentor MP is able to perform either a static, rotating or continuous autotune. The motor must be at a standstill before an autotune is enabled. **Static autotune for current loop gains** When this operation is performed the drive will perform an estimation of *Motor constant* (Pr **5.15**), *Continuous proportional gain* (Pr **4.13**), *Continuous integral gain* (Pr **4.14**), *Discontinuous integral gain* (Pr **4.34**), *Back EMF set point* (Pr **5.59**), *Armature resistance* (Pr **5.61**) and *Flux loop I gain* (Pr **5.72**) with respect to the selected motor map and store the values. To perform a static autotune: • Set Pr **5.12** (**SE13, 0.34**)= 1 • Close the Drive Enable signal (terminal 31). The drive will display 'rdY' • Close the run signal (terminal 26 or 27). The lower display will flash 'Auto' and 'tunE' alternatively, while the drive is performing the autotune • Remove the enable signal when the autotune has finished • Remove the run signal	

Checking speed feedback	• Close the enable signal. Close the run signal (terminal 26 or 27). Provide speed reference to run the drive up to a low speed, the drive will regulate its own estimated speed.
	
	• Check that the feedback device is functioning correctly:
	    For encoder speed feedback - Check encoder speed feedback Pr **3.27** (**Fb09, 0.79**).
	    For tachometer speed feedback - Check tachometer speed feedback Pr **3.52** (**Fb04, 0.74**).
	
	• When the feedback device being used is seen to be functioning correctly, stop the drive and select the correct feedback device using Pr **3.26** (**Fb01,** Pr **0.71**)
	NOTE
	For improved estimated speed accuracy and torque control in the field weakening range a rotating autotune is recommended to determine the motor flux characteristics Pr **5.12** (**SE13**, **0.34**) = 2	

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Action	Detail	
Rotating autotune	Mentor MP is able to perform either a static, rotating or continuous autotune. The motor must be at a standstill and unloaded before a rotating autotune is enabled.	
	NOTE	
	A rotating autotune cannot be carried out in Estimated speed mode.	
	⚠ **WARNING** A rotating autotune will cause the motor to accelerate up to $^1/_4$ base speed in the direction selected regardless of the reference provided. Once complete the motor will coast to a stop. The enable signal must be removed before the drive can be made to run at the required reference. The drive can be stopped at any time by removing the run signal or removing the drive enable.	
	Rotating autotune for motor field flux set-up	
	When selected the drive will determine the *Rated field compensation facto*r (Pr **5.74**) for rated flux and the motor field winding saturation break-points (Pr **5.29** and Pr **5.30**), by spinning the motor at 25% of its Base speed Pr **5.08** (**SE08, 0.29**) with respect to the selected motor map and store the values.	
	To perform an autotune:	
	• Set Pr **5.12** (**SE13, 0.34**) = 2 for a rotating autotune	
	• Close the Drive Enable signal (terminal 31). The drive will display 'rdY'	
	• Close the run signal (terminal 26 or 27). The lower display will flash 'Auto' and 'tunE' alternatively, while the drive is performing the autotune	
	• Wait for the drive to display 'inh' and for the motor to come to a standstill	
	If the drive trips, see Chapter 9 *Diagnostics* on page 122.	
	• Remove the drive enable and run signal from the drive.	
Save parameters	Select SAVE in Pr **xx.00** (**SE00, 0.21**)	
	Press the red 🔴 reset button or toggle the reset digital input (ensure Pr **xx.00** (**SE00, 0.21**) returns to 'no Act').	
Run	Drive is now ready to run	⟲
	• Close enable signal	
	• Close run signal	
	• Provide speed reference	

6.2 Quick start commissioning / start-up (from USA defaults)

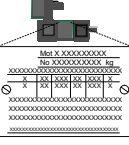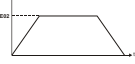| Action	Detail	
Before power-up	Ensure: • Drive Enable signal is not given (terminal 31) • Run signal is not given • Motor connected • Tacho connected if one is being used • Encoder connected if one is being used	
Power-up the drive	Ensure: • Drive displays 'inh' **NOTE** Motor thermistor input is disabled by default. If motor thermistor is available the thermistor should be used. The protection is enabled with Pr **7.15** (**in01**, **0.81**). For drive trips, see Chapter 9 *Diagnostics* on page 122.	
Enter motor nameplate details	Enter: • Armature rated voltage in Pr **5.09** (**SE06, 0.27**) (V) • Motor rated current in Pr **5.07** (**SE07, 0.28**) (A) • Motor rated speed (base speed) in Pr **5.08** (**SE08, 0.29**) (rpm) • Field rated voltage in Pr **5.73** (**SE11, 0.32**) (V)	

Set motor feedback parameters	**Incremental encoder basic set-up**
	Enter:
	• Drive encoder type in Pr **3.38** (**Fb07, 0.77**) = Ab (0): Quadrature encoder
	
	⚠ **CAUTION** Setting the encoder voltage supply too high for the encoder could result in damage to the feedback device.
	
	• Encoder power supply in Pr **3.36** (**Fb06, 0.76**) = 5V (0), 8V (1), 15V (2) or 24V (3)
	NOTE If output voltage from the encoder is >5V, then the termination resistors must be disabled Pr **3.39** (**Fb08, 0.78**) to 0.
	
	• Drive encoder lines per revolution (ELPR) in Pr **3.34** (**Fb05, 0.75**) (set according to encoder)
	• Drive encoder termination resistor setting in Pr **3.39** (**Fb08, 0.78**)
	    0 = A-A\, B-B\, Z-Z\ termination resistors disabled
	    1 = A-A\, B-B\, termination resistors enabled, Z-Z\ termination resistors disabled
	    2 = A-A\, B-B\, Z-Z\ termination resistors enabled
	Tachometer set-up
	Enter:
	• Tachometer voltage rating Pr **3.51** (**Fb02, 0.72**) (V/1000 rpm)
	• Tachometer input mode Pr **3.53** (**Fb03, 0.73**)	

Set maximum speed	Enter: • Maximum speed in Pr **1.06** (**SE02, 0.23**) (rpm) **NOTE** For field weakening the field controller needs to be setup in current control by setting Pr **5.75** = OFF, setting the rated field current into **5.70** (**SE10, 0.31**) and setting Pr **5.64** to On. For field weakening in Estimated Speed Mode please refer to the *Mentor MP User Guide - Chapter 8 Optimization - Field current*.	

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Action	Detail	
Set acceleration / deceleration rates	Enter: • Acceleration rate in Pr **2.11** (**SE03, 0.24**) (time to accelerate to maximum speed) • Deceleration rate in Pr **2.21** (**SE04, 0.25**) (time to decelerate from maximum speed)	
Enable the field controller	**Field controller set-up** • Select field mode by setting Pr **5.78** = IntrnL (Internal field controller is used), Etrnl (External half control), E FULL (External in full control). • Set Pr **5.77** (**SE12**, **0.33**) = On to enable the field.	
Static autotune	Mentor MP is able to perform either a static, rotating or continuous autotune. The motor must be at a standstill before an autotune is enabled. **Static autotune for current loop gains** When this operation is performed the drive will perform an estimation of *Motor constant* (Pr **5.15**), *Continuous proportional gain* (Pr **4.13**), *Continuous integral gain* (Pr **4.14**), *Discontinuous integral gain* (Pr **4.34**), *Back EMF set point* (Pr **5.59**), *Armature resistance* (Pr **5.61**) and *Flux loop I gain* (Pr **5.72**) with respect to the selected motor map and store the values. To perform a static autotune: • Set Pr **5.12** (**SE13, 0.34**)= 1 • Close the Drive Enable signal (terminal 31). The drive will display 'rdY' • Close the run signal (terminal 26 or 27). The lower display will flash 'Auto' and 'tunE' alternatively, while the drive is performing the autotune • Remove the enable signal when the autotune has finished • Remove the run signal **NOTE** A rotating autotune Pr **5.12** (**SE13**, **0.34**) = 2 should not be carried out when the field controller is in voltage mode, Pr **5.75** = On (USA default).	

Checking speed feedback	• Close the enable signal. Close the run signal (terminal 26 or 27). Provide speed reference to run the drive up to a low speed, the drive will regulate its own estimated speed.
	
	• Check that the feedback device is functioning correctly:
	   For encoder speed feedback - Check encoder speed feedback Pr **3.27** (**Fb09, 0.79**).
	   For tachometer speed feedback - Check tachometer speed feedback Pr **3.52** (**Fb04, 0.74**).
	
	• When the feedback device being used is seen to be functioning correctly, stop the drive and select the correct feedback device using Pr **3.26** (**Fb01,** Pr **0.71**).	

Save parameters	Select SAVE in Pr **xx.00** (**SE00, 0.21**) Press the red ⊘ reset button or toggle the reset digital input (ensure Pr **xx.00** (**SE00, 0.21**) returns to 'no Act').	
Run	Drive is now ready to run • Close enable signal • Close run signal • Provide speed reference	

7 SMARTCARD operation

7.1 Introduction

This is a standard feature that enables simple configuration of parameters in a variety of ways. The SMARTCARD can be used for:

• Parameter copying between drives
• Saving whole drive parameter sets
• Saving 'differences from default' parameter sets
• Storing Onboard PLC programs
• Automatically saving all user parameter changes for maintenance purposes
• Loading complete motor map parameters.

Refer to Figure 7-1 for installing the SMARTCARD. Ensure the SMARTCARD is inserted with the MP arrow pointing upwards.

The drive only communicates with the SMARTCARD when commanded to read or write, this means that the card may be 'hot swapped'.

⚠️ **WARNING**   Be aware of possible live terminals when inserting or removing the SMARTCARD.

Figure 7-1 Installation of the SMARTCARD
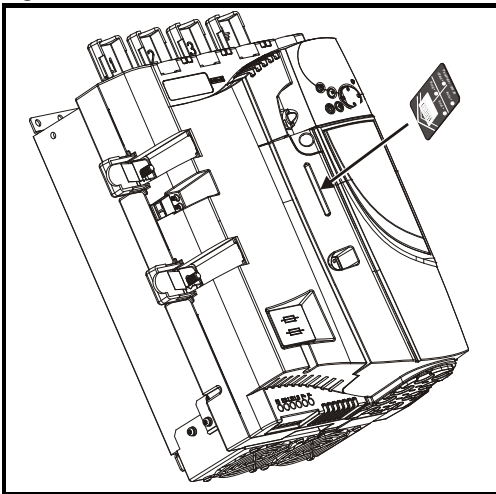
7.2 Easy saving and reading

The SMARTCARD has 999 individual data block locations. Each individual location from 1 to 499 can be used to store data.

The drive can support SMARTCARDS that have a capacity of between 4kB and 512kB.

The usage of the data block locations in the SMARTCARD are shown in Table 7-1.

Table 7-1 SMARTCARD data blocks

Data block	Type	Example of usage
1 to 499	Read / Write	Application set-up
500 to 999	Read Only	Macros

Parameter sets labelled as 'Differences from default' will be much smaller than whole parameter sets. Therefore they use a lot less memory because most applications only require a few parameters to be changed from the default setting.

Either of these indications will tell the user that data is being transferred to or from the SMARTCARD:

• SM-Keypad: The decimal point after the fourth digit in the upper display will flash.

• MP-Keypad: The symbol 'CC' will appear in the lower left hand corner of the display.

The card should not be removed during data transfer because the drive will trip. If a trip occurs you must either try to transfer the data again or, in the case of a card-to-drive transfer, the default parameters should be loaded.

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7.3 Transferring data

When a code is entered into Pr **xx.00** and the drive is subsequently reset, the drive will carry out the actions listed in Table 7-2.

Table 7-2 Transferring data

Codes	Actions
Pr **x.00** = rEAd 1	Transfer SMARTCARD data block 1 to the drive.
Pr **x.00** = rEAd 2	Transfer SMARTCARD data block 2 to the drive.
Pr **x.00** = rEAd 3	Transfer SMARTCARD data block 3 to the drive.
Pr **x.00** = PrOg 1	Transfer drive parameters as difference from default to SMARTCARD data block number 1.
Pr **x.00** = PrOg 2	Transfer drive parameters as difference from default to SMARTCARD data block number 2.
Pr **x.00** = PrOg 3	Transfer drive parameters as difference from default to SMARTCARD data block number 3.
Pr **x.00** = 2001	Transfer drive parameters as difference from defaults to a bootable SMARTCARD data block with block number 1. This will clear data block 1 on the card if it already exists.
Pr **x.00**= 3yyy	Transfer drive parameters to a SMARTCARD data block number yyy.
Pr **x.00** = 4yyy	Transfer drive data as difference from defaults to SMARTCARD data block number yyy.
Pr **x.00**= 5yyy	Transfer drive user program to SMARTCARD data block number yyy.
Pr **x.00** = 6yyy	Transfer SMARTCARD data block yyy to the drive.
Pr **x.00** = 7yyy	Erase SMARTCARD data block yyy.
Pr **x.00** = 8yyy	Compare drive parameters with data block yyy.
Pr **x.00** = 9555	Clear SMARTCARD warning suppression flag.
Pr **x.00** = 9666	Set SMARTCARD warning suppression flag.
Pr **x.00**= 9777	Clear SMARTCARD read-only flag.
Pr **x.00** = 9888	Set SMARTCARD read-only flag.
Pr **x.00** = 9999	Erase SMARTCARD.
Pr **11.42** (**SE09, 0.30**) = Read	Transfer SMARTCARD data block 1 to the drive provided it is a parameter file.
Pr **11.42** (**SE09, 0.30**) = Prog	Transfer drive parameters to a SMARTCARD data block number 1.
Pr **11.42** (**SE09, 0.30**) = Auto	Transfer drive parameters to a SMARTCARD data block with data block number 1 provided.
Pr **11.42** (**SE09, 0.30**) = boot	Pr **11.42** (**SE09, 0.30**) has been changed since power-up.

Where yyy indicates the data block number 001 to 999, refer to Table 7-1 for restrictions on data block numbers.

NOTE

If the read only flag is set then only codes 6yyy or 9777 are effective.

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8.1 Menu 1: Speed reference

Menu 1 controls the main reference selection.

Figure 8-1 Menu 1 logic diagram

*Refer to Pr **1.14** (**SE05**, **0.26**).

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JOG

RUN FORWARD

RUN REVERSE

29

28

27

Menu 8

Sequencer (Menu 6)

Menu 6
Sequencer

Jog selected
indicator

1.13

Bipolar
reference
select

1.10

OR

Menu 13
Position control

Reference
enabled
indicator

1.11

Reference in skip
speed band
indicator

1.35

Feed-forward
selected
indicator

1.06
Maximum
speed "clamp"

1.02

Pre-filter
reference

Pre-ramp
reference

1.03

Reverse
selected
indicator

1.12

1.40

1.07
Minimum
speed "clamp"
(Maximum
reverse speed)

Menu 2

Negative
minimum
speed
select

1.08

+ **[1.06]**
  [1.07]
  [1.07]
− **[1.06]**

×(-1)

1.39

Velocity
feed-forward
reference

+ **[1.06]**

− **[1.06]**

1.05
Jog
reference

1.29
Skip
speed 1

1.31
Skip
speed 2

1.33
Skip
speed 3

1.30
Skip
speed band
1

1.32
Skip
speed band
2

1.34
Skip
speed band
3

+ **[1.06]**

− **[1.07]**

8.2　Menu 2: Ramps

The pre-ramp speed reference passes through the ramp block controlled by menu 2 before being used by the drive to produce input to the speed controller. The ramp block includes: linear ramps, and an S ramp function for ramped acceleration and deceleration.

Figure 8-2　Menu 2 logic diagram
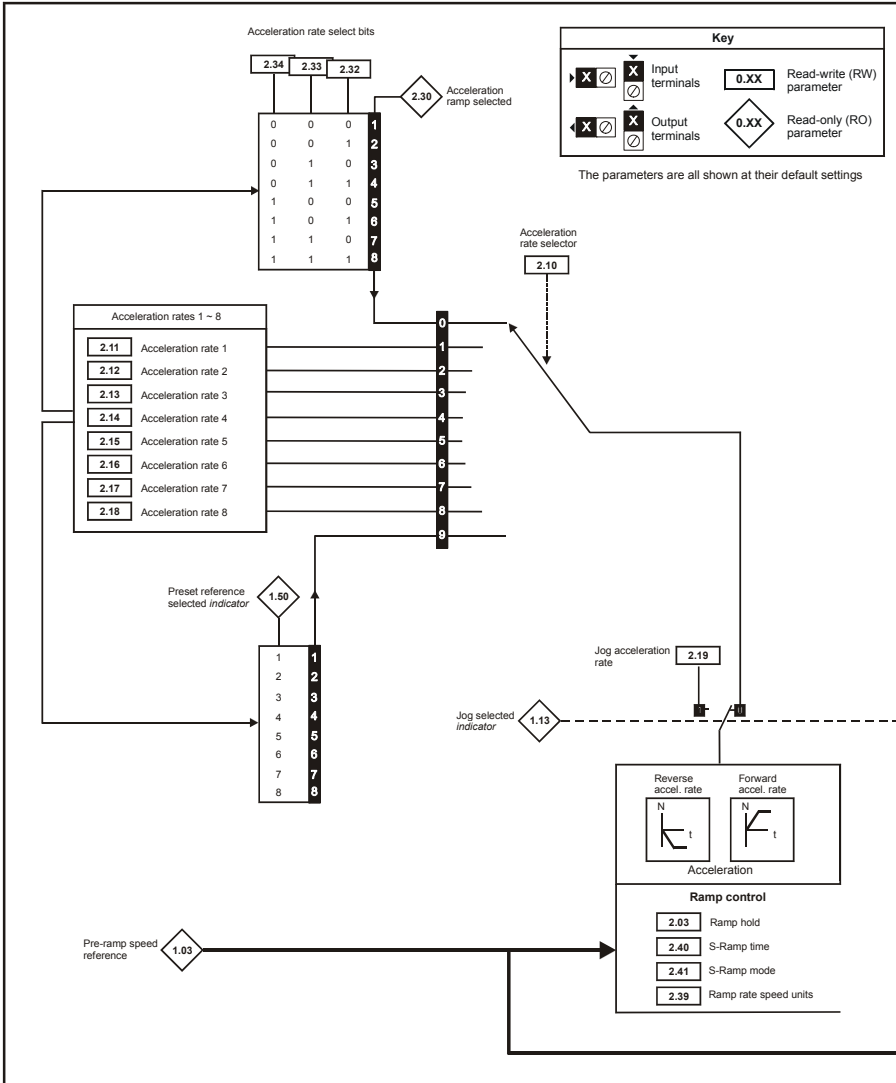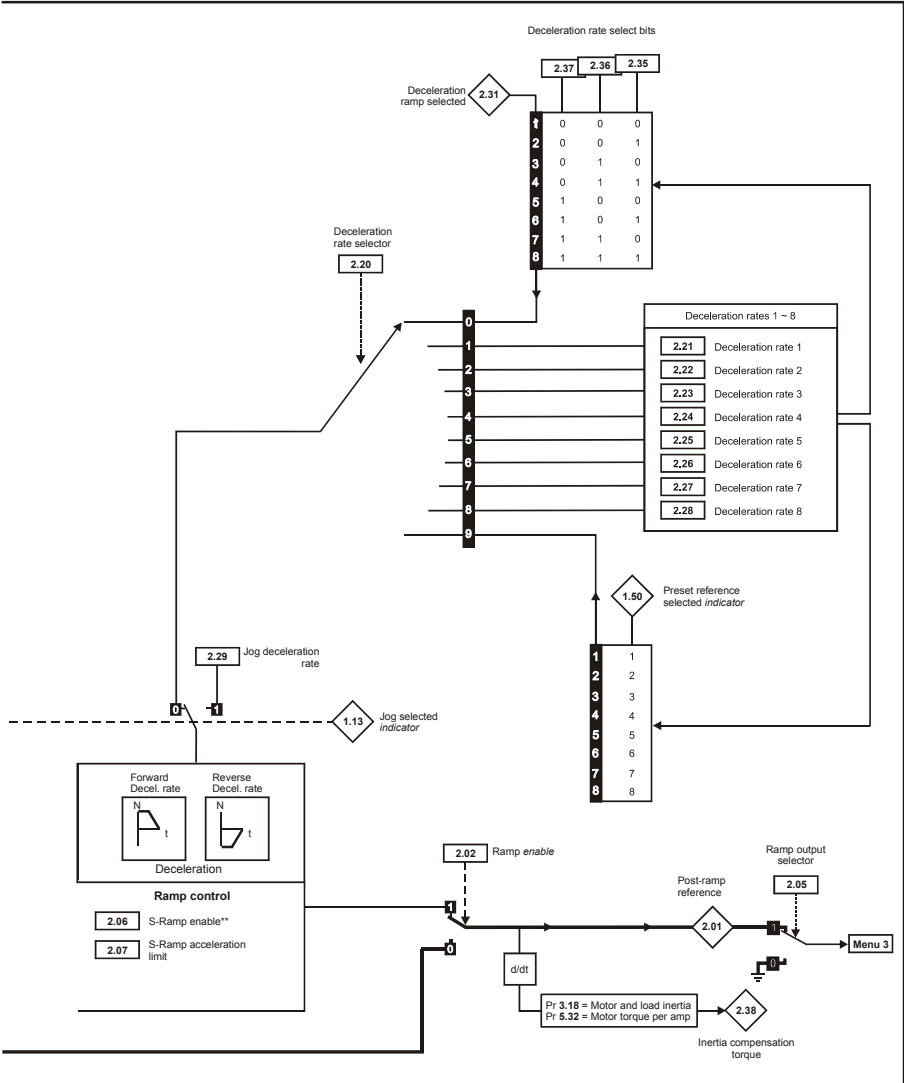
** For more information refer to the 'Advanced parameters' section in the *Mentor MP User Guide.*

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8.3   Menu 3: Speed feedback and speed control
Speed accuracy and resolution

Digital reference resolution

When a preset speed is used the reference resolution is 0.1rpm. Improved resolution can be obtained by using the precision reference (0.001rpm).

Analog reference resolution

The analog input has a maximum resolution of 14bits plus sign. The resolution of the reference from analog inputs 2 or 3 is 10bits plus sign.

Analog feedback resolution

The resolution for both Armature voltage and tachogenerator feedback is 10bit plus sign.

Accuracy

With encoder feedback the absolute speed accuracy depends on the accuracy of the crystal used with the drive microprocessor. The accuracy of the crystal is 100ppm, and so the absolute speed accuracy is 100ppm (0.01%) of the reference, when a preset speed is used. If an analog input is used the absolute accuracy is further limited by the absolute accuracy and non-linearity of the analog input. If analog feedback is used the accuracy is even further limited.

Figure 8-3 Menu 3 logic diagram
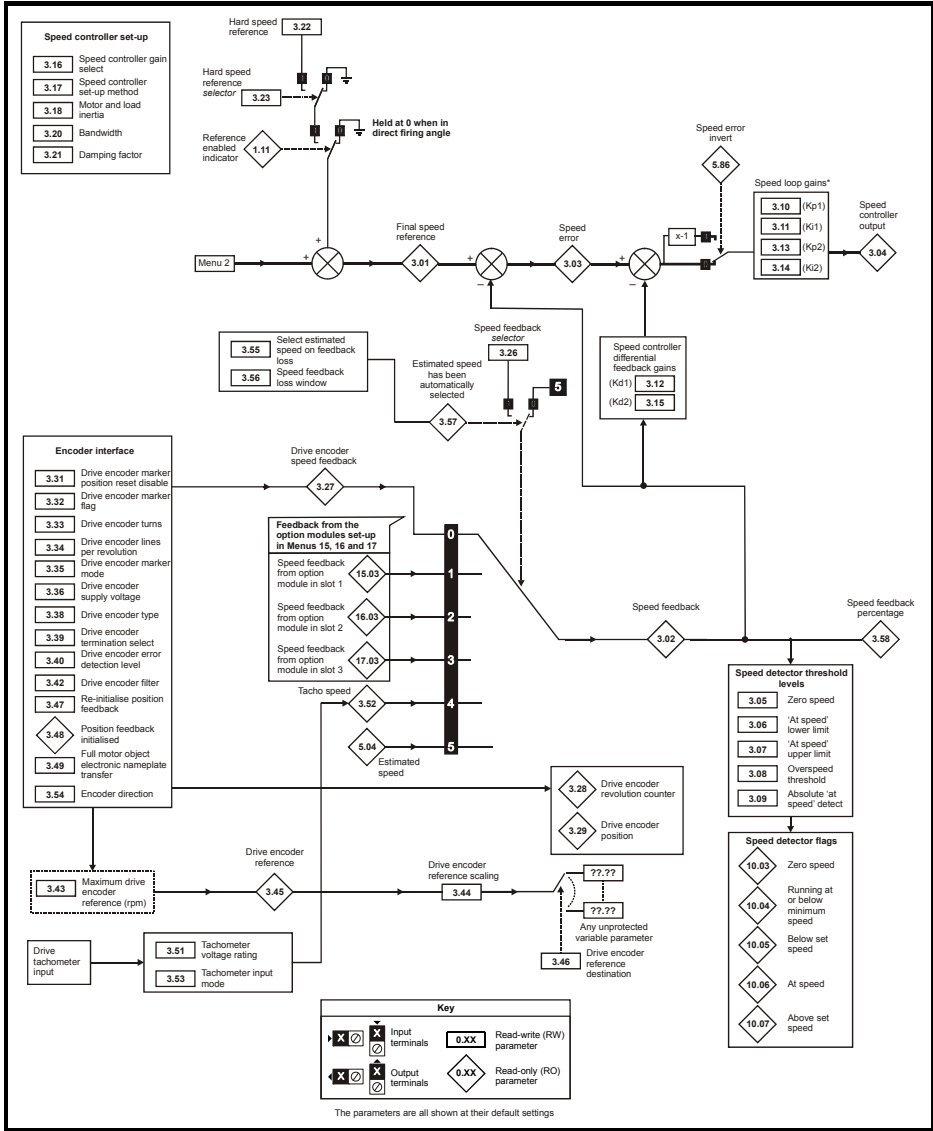
* If Pr **5.28** (Field weakening compensation disable) is set to 'OFF (0)' a multiplication factor is applied to the speed loop gains when the flux is below 100%.

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8.4 Menu 4: Torque and current control

MOTOR1_CURRENT_LIMIT_MAX is used as the maximum for some parameters such as the user current limits. The current maximum current limit is defined as follows (with a maximum of 1000%):

$$\text{CURRENT\_LIMIT\_MAX} = \left[\frac{\text{Maximum current}}{\text{Motor rated current}}\right] \times 100\%$$

Where:

Motor rated current is given by Pr **5.07** (**SE07**, **0.28**).

(MOTOR2_CURRENT_LIMIT_MAX is calculated from the motor map 2 parameters). The maximum current is 1.5 x drive rating.

Figure 8-4 Menu 4 logic diagram

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Current limit active indicator **10.09**

Menu 5

Torque to current conversion

4.04 Current demand

Current controller

4.12	Current demand filter 1
4.23	Current demand filter 2
4.33	Slew rate limit
11.32	Drive rating

Current controller

4.13	Continuous Kp gain
4.14	Continuous Ki gain
4.34	Discontinuous Ki gain

Menu 5

| 5.15 | Motor constant |
| 5.05 | Line voltage |

Menu 5

Overriding current limit

4.18

10.17 Motor current overload alarm indicator

4.19 Motor overload accumulator

Key

| X ⊘ / X ⊘ | Input terminals | **0.XX** | Read-write (RW) parameter |
| X ⊘ / X ⊘ | Output terminals | ◇ 0.XX | Read-only (RO) parameter |

The parameters are all shown at their default settings

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8.5   Menu 5: Motor and field control

Figure 8-5 Menu 5 armature control logic diagram

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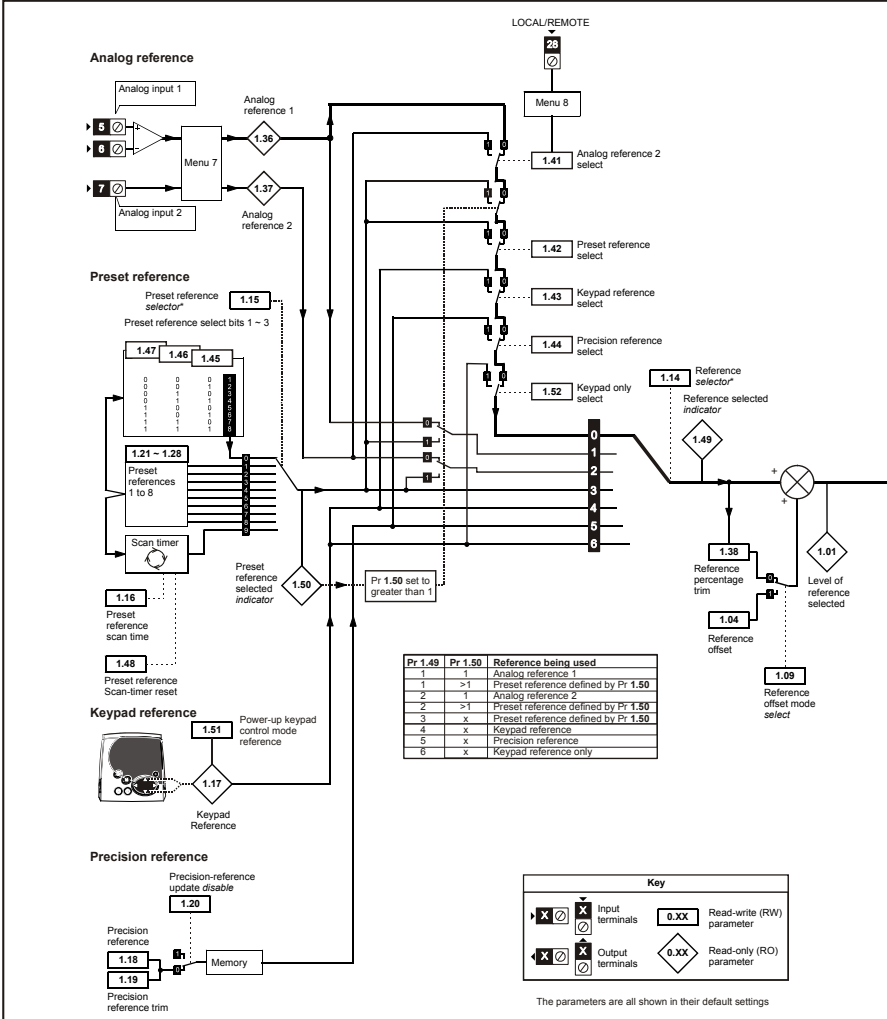**Figure 8-6 Menu 5 field control logic diagram**

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Enable field economy timeout

5.65

Field economy active

5.79

&

Sequencer run

Drive active

10.02

Field controller supply

5.76

Field economy level

5.67

5.80

Field economy level select

Power-up

OR

Drive reset

Field firing angle

5.58

Menu 6

Field economy timeout time

5.66

Field voltage mode select

5.75

Voltage to firing angle conversion

5.73

Rated field voltage

Flux / Voltage demand

5.55

-1

Flux loop

P gain

5.71

I gain

5.72

+

−

5.57

Percentage voltage demand

5.78

Field voltage mode

Field output voltage

5.60

100

5.54 Flux feedback

5.54 Flux feedback

5.48 External flux feedback select

5.89

External flux feedback

Flux calculator

5.29 Motor saturation breakpoint 1

5.30 Motor saturation breakpoint 2

5.70 Field rated current

5.74 Rated field compensation factor

Field overload calculation

5.81 Field thermal time constant

5.82 Field overload accumulator

5.56 Field current feedback

8.6 Menu 6: Sequencer and clock

Figure 8-7 Menu 6 logic diagram

8.7 Menu 7: Analog I/O

Figure 8-8 Menu 7 logic diagram

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8.8   Menu 8: Digital I/O

Figure 8-9 Menu 8 logic diagram
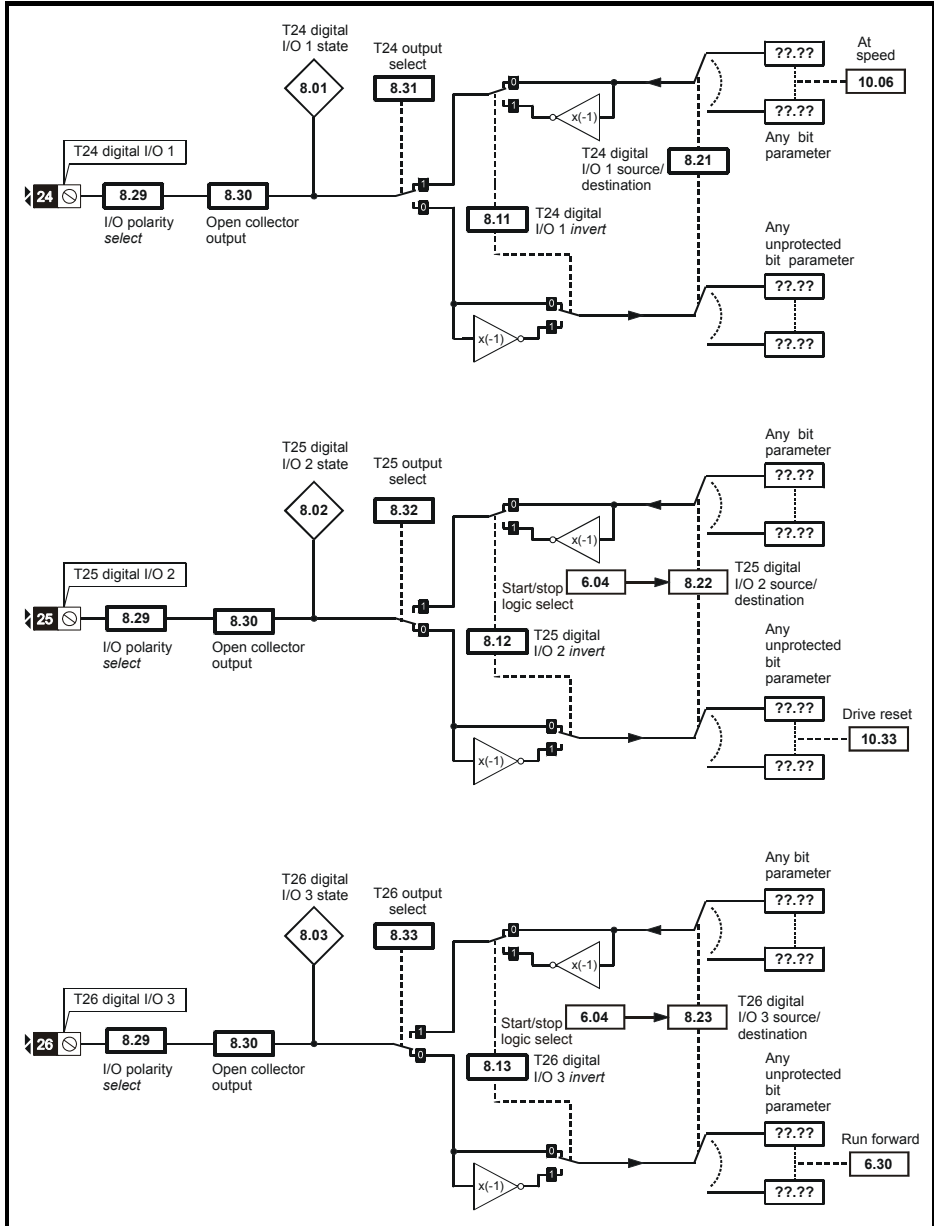
Figure 8-10 Menu 8 logic diagram (cont)
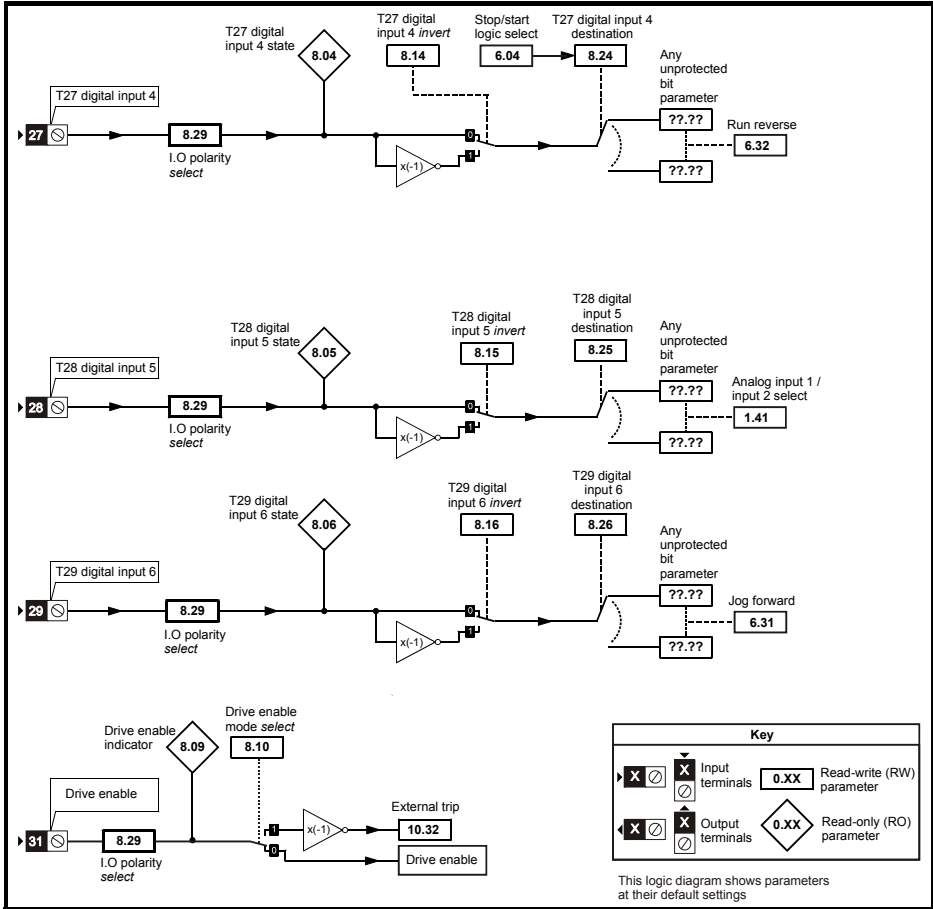
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Figure 8-11 Menu 8 logic diagram (cont)
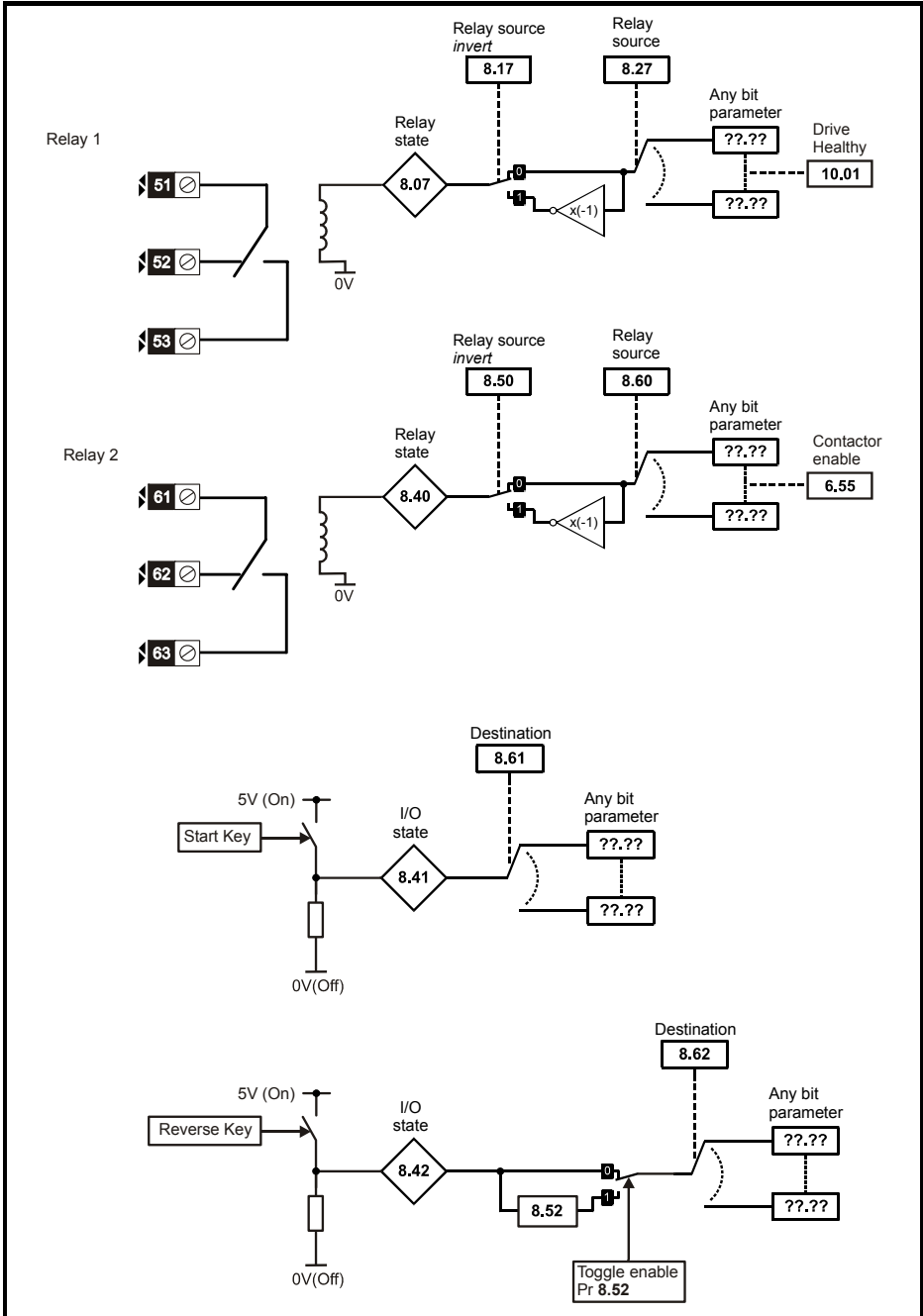
8.9 Menu 9: Programmable logic, motorized pot and binary sum

Figure 8-12 Menu 9 logic diagram: Programmable logic

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Figure 8-13 Menu 9 logic diagram: Motorized potentiometer and binary sum

Motorized pot. rate
9.23

Motorized pot. up
9.26

Motorized pot. down
9.27

Motorized pot. reset to zero
9.28

Motorized pot. mode
9.21

Motorized pot. bipolar *select*
9.22

Motorized pot. output *indicator*
9.03

Motorized pot. output scale
9.24

Motorized pot. destination parameter
9.25

Any unprotected variable parameter
??.??
??.??

Function disabled if set to a non valid destination

M

Binary-sum logic ones (LSB)
9.29

Binary-sum logic twos
9.30

Binary-sum logic fours (MSB)
9.31

Binary-sum offset
9.34

Binary-sum logic output value
9.32

Binary-sum logic destination parameter
9.33

Any unprotected bit parameter
??.??
??.??

Function disabled if set to a non valid destination

Σ

+
+

Key		
Input terminals	**0.XX**	Read-write (RW) parameter
Output terminals	**0.XX**	Read-only (RO) parameter

The parameters are all shown at their default settings

8.10 Menu 10: Status and trips

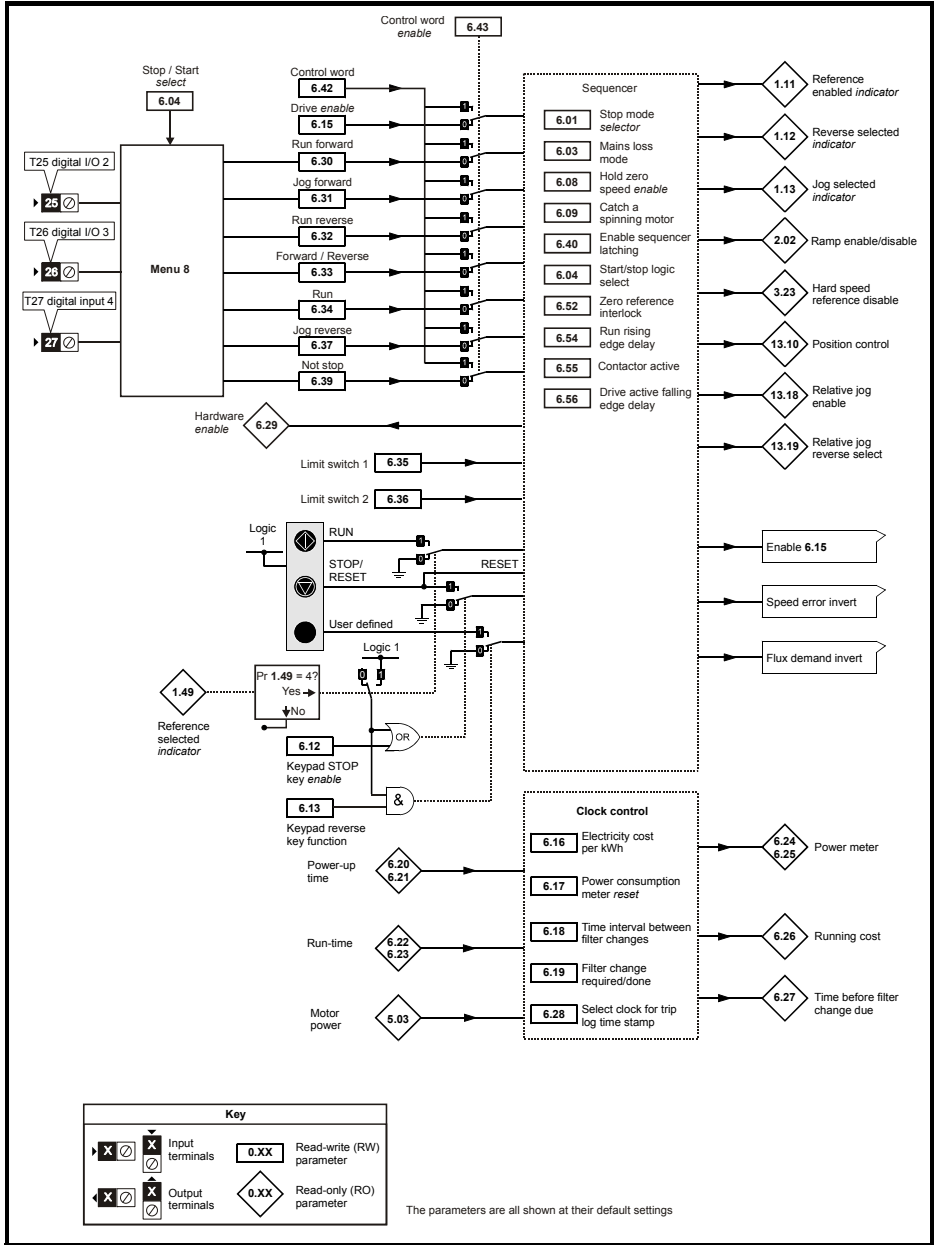| Parameter		
10.01	Drive ok	
10.02	Drive active	
10.03	Zero speed	
10.04	Running at or below minimum speed	
10.05	Below set speed	
10.06	At speed	
10.07	Above set speed	
10.08	Load reached	
10.09	Drive output is at current limit	
10.10	Regenerating	
10.13	Direction commanded	
10.14	Direction running	
10.17	Overload alarm	
10.18	Drive over temperature alarm	
10.19	Drive warning	
10.20	Trip 0	**tr01**
10.21	Trip 1	**tr02**
10.22	Trip 2	**tr03**
10.23	Trip 3	**tr04**
10.24	Trip 4	**tr05**
10.25	Trip 5	**tr06**
10.26	Trip 6	**tr07**
10.27	Trip 7	**tr08**
10.28	Trip 8	**tr09**
10.29	Trip 9	**tr10**
10.32	External trip	
10.33	Drive reset	
10.34	Number of auto-reset attempts	
10.35	Auto-reset delay	
10.36	Hold drive ok until last attempt	
10.38	User trip	
10.40	Status word	
10.41	Trip 0 time: years.days	
10.42	Trip 0 time: hours.minutes	
10.43	Trip 1 time	
10.44	Trip 2 time	
10.45	Trip 3 time	
10.46	Trip 4 time	
10.47	Trip 5 time	
10.48	Trip 6 time	
10.49	Trip 7 time	
10.50	Trip 8 time	
10.51	Trip 9 time	
10.52 to 10.61	Trip masks	
10.62 to 10.71	Stop on time masks	
10.72	Trip mask active	
10.73	Bridge active	
10.74	Electrical phase back	
10.75	Armature voltage clamp active	
10.76	Phase rotation	
10.77	Input frequency	

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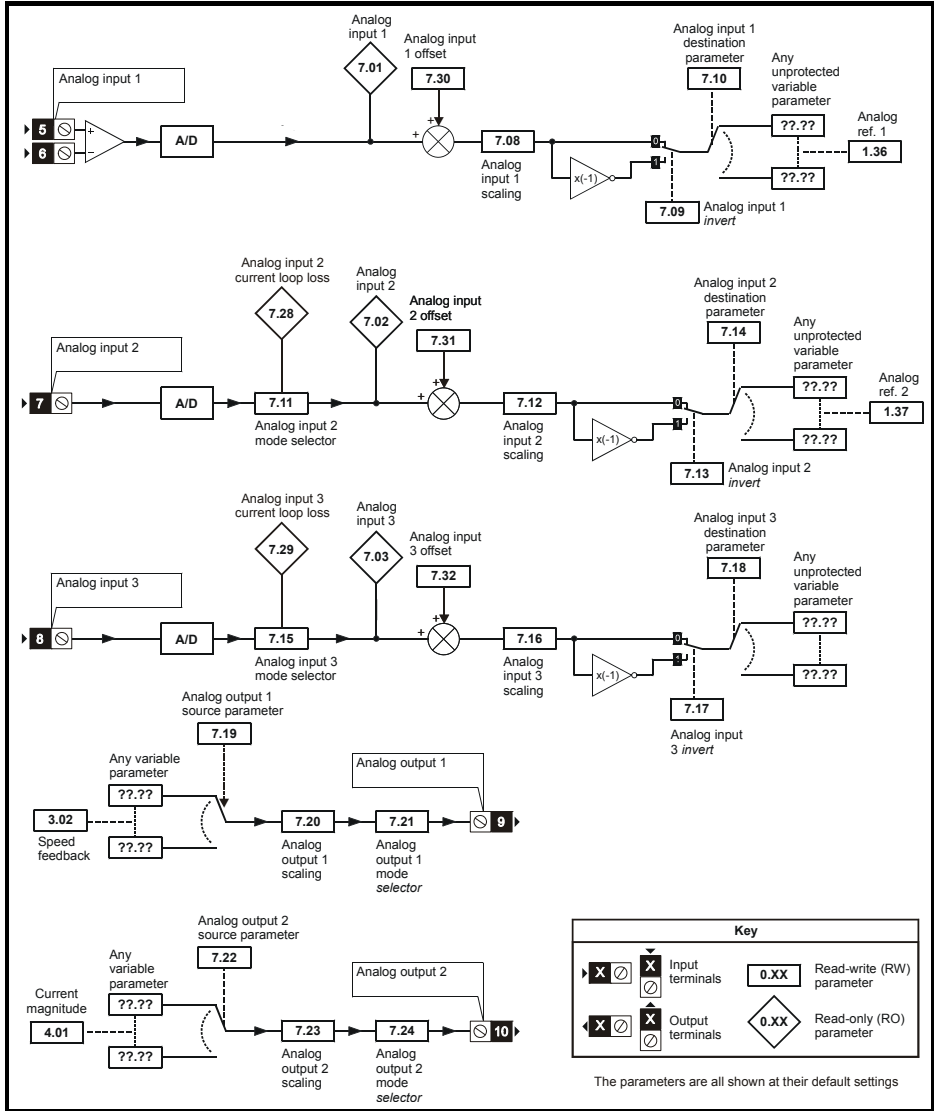**Advanced parameters**

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8.11 Menu 11: General drive set-up

	Parameter	
11.21	Parameter scaling	
11.22	Parameter displayed at power-up	
11.23	Serial address	**Si02**
11.24	Serial mode	
11.25	Baud rate	**Si01**
11.26	Minimum comms transmit delay	
11.29	Software version	**di14**
11.30	User security code	
11.32	Current rating	
11.33	Drive voltage rating	
11.34	Software sub-version	
11.35	Number of modules	
11.36	SMARTCARD parameter data previously loaded	
11.37	SMARTCARD data number	
11.38	SMARTCARD data type / mode	
11.39	SMARTCARD data version	
11.40	SMARTCARD data checksum	
11.41	Status mode timeout	
11.42	Parameter copying	**SE09**
11.44	Security status	**SE14**
11.45	Select motor 2 parameters	
11.46	Defaults previously loaded	
11.47	Drive Onboard Application Lite Ladder Program Enable	
11.48	Drive Onboard Application Lite Ladder Program Status	
11.49	Drive Onboard Application Lite Ladder Program Events	
11.50	Drive Onboard Application Lite Ladder Program Maximum Scan Time	
11.51	Drive Onboard Application Lite Ladder Program First Run	
11.52	Drive serial number	
11.53	Build location	
11.55	Drive rating number	
11.56	Power PCB software version	
11.57	Serial programmable source	
11.58	Serial scaling	
11.59	Mentor II parameter emulator module control	
11.60	Application parameters	
11.61	Application parameters	
11.62	Full power discharge time	
11.63	Full power discharge period	
11.64	External discharge resistance	
11.65	External resistor temperature	
11.66	Suppressor voltage	

## 8.12 Menu 12: Threshold detectors, variable selectors and brake control function
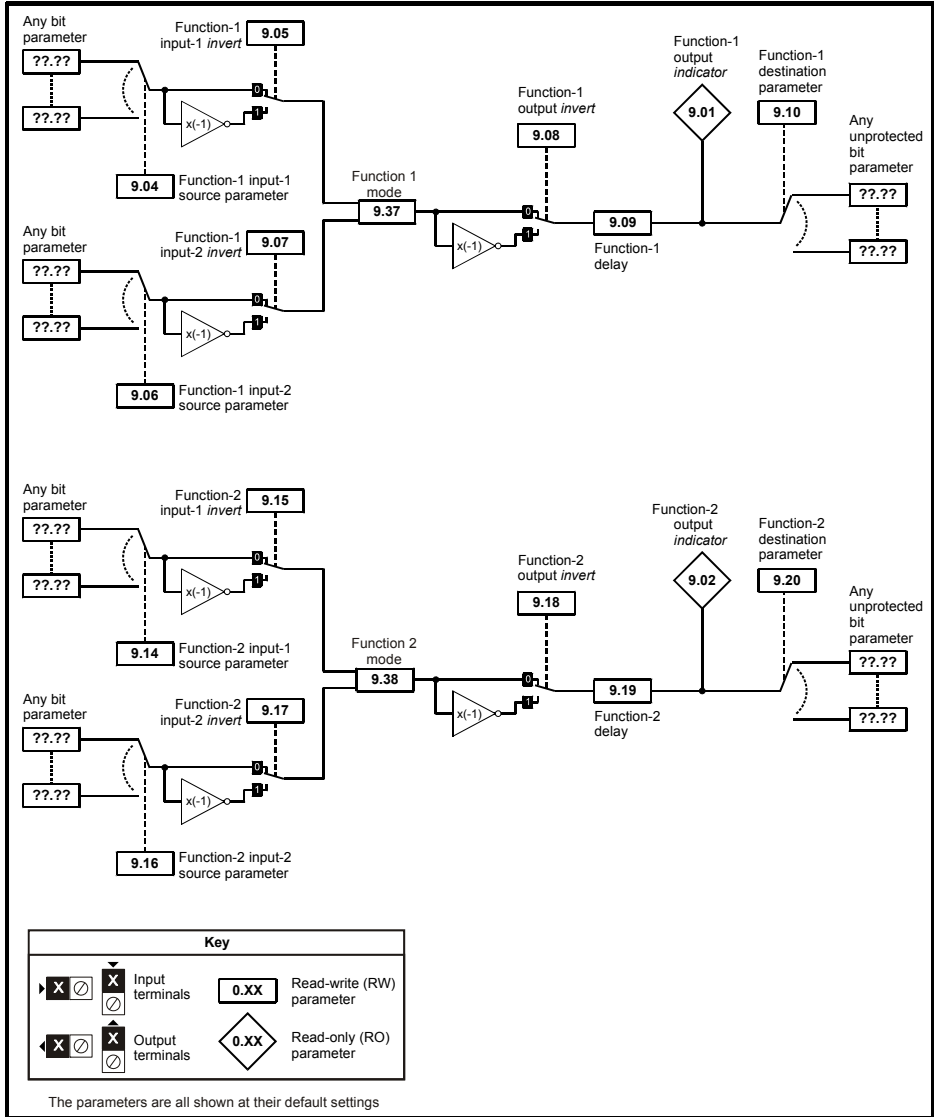
Figure 8-14 Menu 12 logic diagram
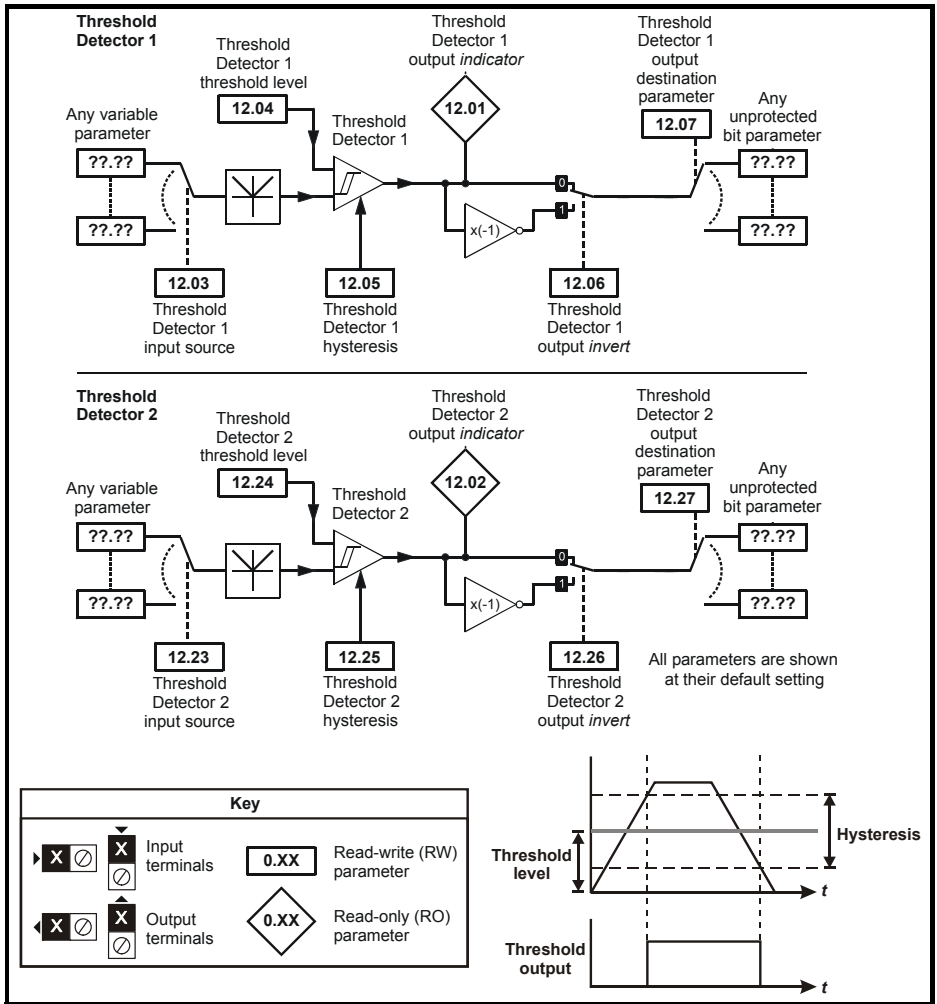
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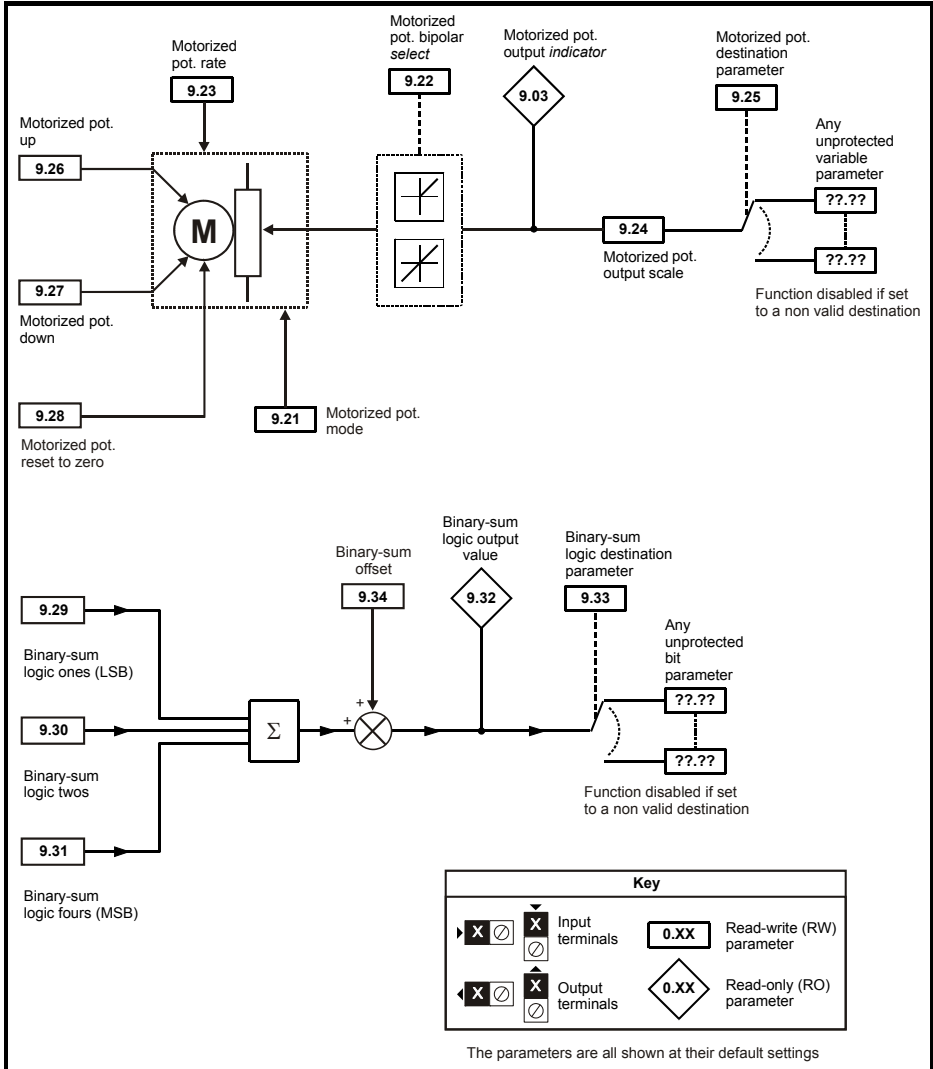
Figure 8-15 Menu 12 logic diagram (continued)

Variable Selector 1

Any variable parameter

??.??

??.??

Variable selector 1 input 1 scaling

12.13

12.08 Variable selector 1 input 1 source

Any variable parameter

??.??

??.??

Variable selector 1 input 2 scaling

12.14

12.09 Variable selector 1 input 2 source

12.10 Variable selector 1 mode

12.15 Variable selector 1 control

Variable selector 1 output indicator

12.12

Variable selector 1 output destination

12.11

Any unprotected variable parameter

??.??

??.??

Variable Selector 2

Any variable parameter

??.??

??.??

Variable selector 2 input 1 scaling

12.33

12.28 Variable selector 2 input 1 source

Any variable parameter

??.??

??.??

Variable selector 2 input 2 scaling

12.34

12.29 Variable selector 2 input 2 source

12.30 Variable selector 2 mode

12.35 Variable selector 2 control

Variable selector 2 output indicator

12.32

Variable selector 2 output destination

12.31

Any unprotected variable parameter

??.??

??.??

| Key			
X ⊘ ▼X ⊘	Input terminals	**0.XX**	Read-write (RW) parameter
X ⊘ ▲X ⊘	Output terminals	◇0.XX◇	Read-only (RO) parameter

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⚠ **WARNING**

The brake control functions are provided to allow well co-ordinated 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.

⚠ **WARNING**

The control terminal relay can be selected as an output to release a brake. If a drive is set up in this manner and a drive replacement takes place, prior to programming the drive on initial power up, the brake may be released. When drive terminals are programmed to non default settings the result of incorrect or delayed programming must be considered. The use of a SMARTCARD in boot mode or an SM-Applications module can ensure drive parameters are immediately programmed to avoid this situation.

Figure 8-16 Menu 12 Brake control function

Mentor MP Short Form Guide
Issue Number: 5   www.controltechniques.com

111
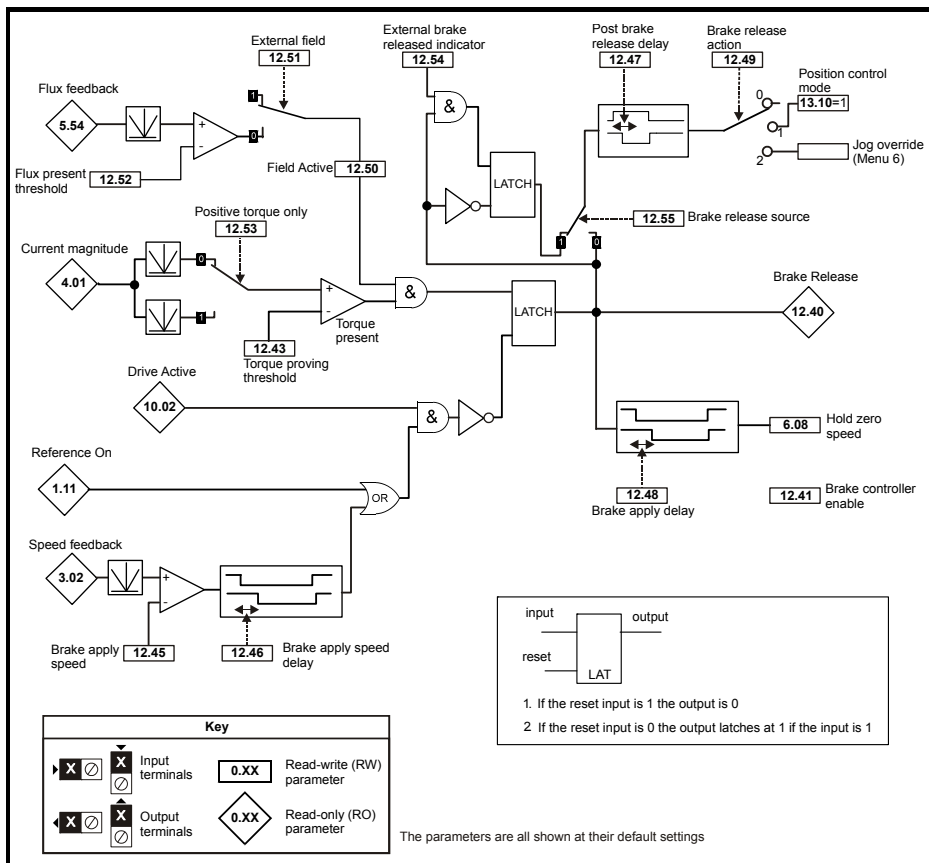
Figure 8-17 Brake sequence

1. Wait for armature current and fully fluxed machine
2. Post-brake release delay
3. Wait for speed threshold
4. Wait for brake apply speed delay
5. Brake apply delay

8.13   Menu 13: Position control

Figure 8-18 Menu 13 logic diagram

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Speed reference selected **1.01**

Pre-ramp reference **1.03**

Menu 2 Ramp Control

Post-ramp reference **2.01**

Final speed reference **3.01**

Velocity feed-forward **1.39**

Velocity feed-forward select **1.40**

Position controller mode **13.10**

13.10 = 5 or 6

13.10 = 1 or 3

13.10 = 1 to 6

Hard speed reference selector **3.23**

Position loop disabled

0
1
2
3
4
5
6

Hold zero speed **6.08**

Hard speed reference **3.22**

Position loop error **13.01 13.02 13.03**

Revolution   Position   Fine Position

Position controller P gain **13.09**

13.12
Position controller speed clamp

Position loop enabled

Orientation acceptance window **13.14**

Orientation

Orientation position complete **13.15**

Key	
Input terminals	**0.XX** Read-write (RW) parameter
Output terminals	**0.XX** Read-only (RO) parameter

This logic diagram applies only when all parameters are at their default settings

8.14   Menu 14: User PID controller

Figure 8-19 Menu 14 logic diagram

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Key	
X ⊘ / X ⊘ Input terminals	0.XX Read-write (RW) parameter
X ⊘ / X ⊘ Output terminals	0.XX Read-only (RO) parameter

The parameters are all shown at their default settings
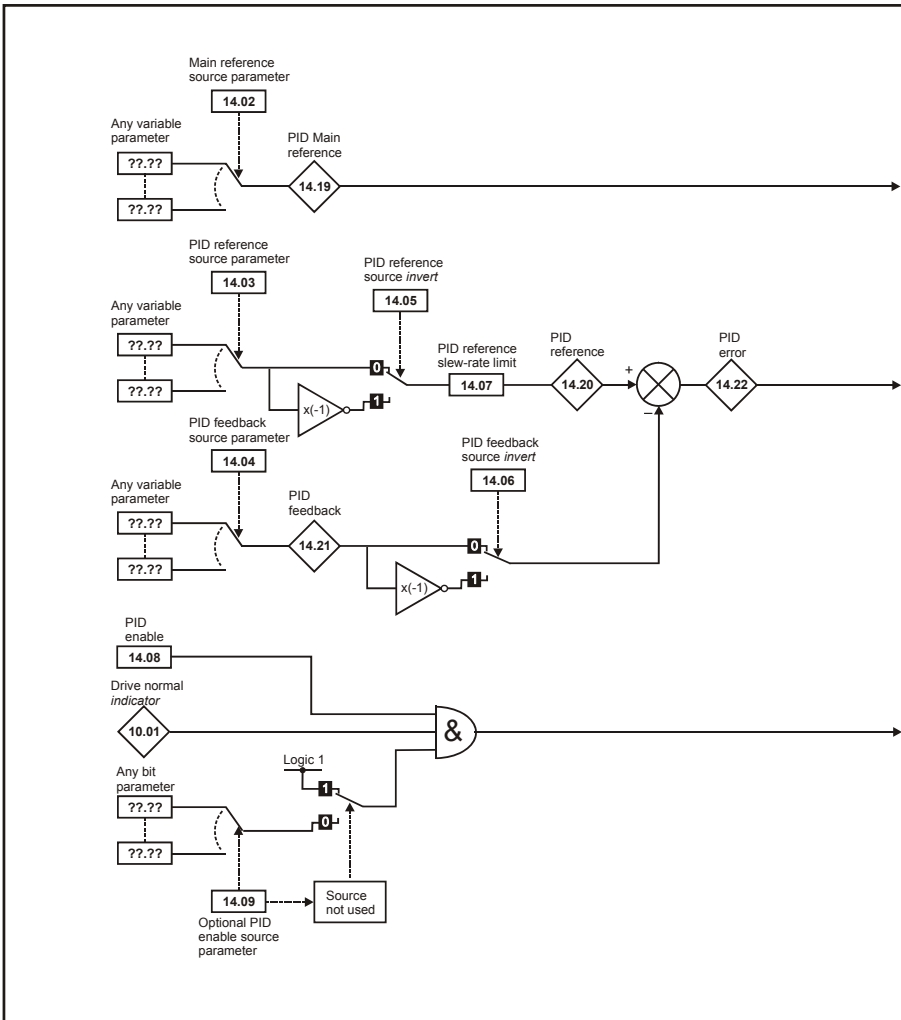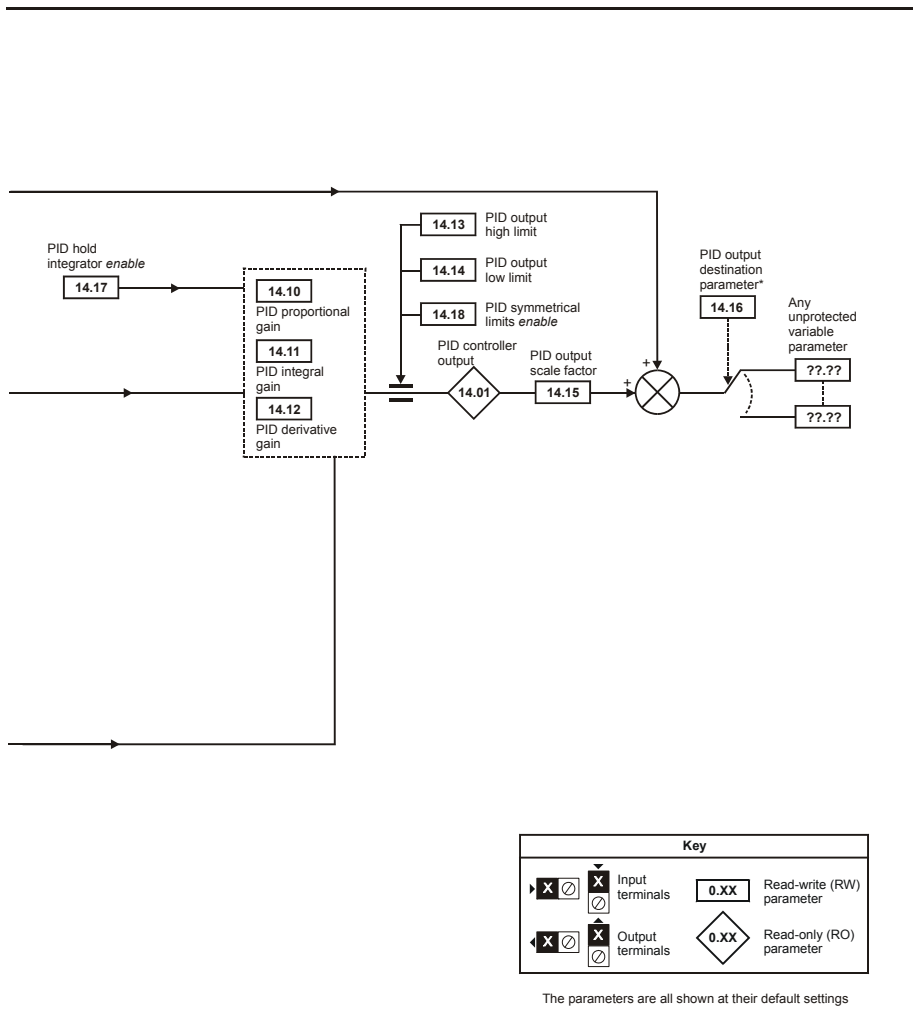
*The PID controller is only enabled if Pr **14.16** is set to a non Pr **xx.00** and unprotected destination parameter.

8.15   Menus 15, 16 and 17: Solutions Module slots

Figure 8-20 Location of Solution Module slots and their corresponding menu numbers

Solutions Module in slot 1 (Menu 15)

Solutions Module in slot 2 (Menu 16)

Solutions Module in slot 3 (Menu 17)
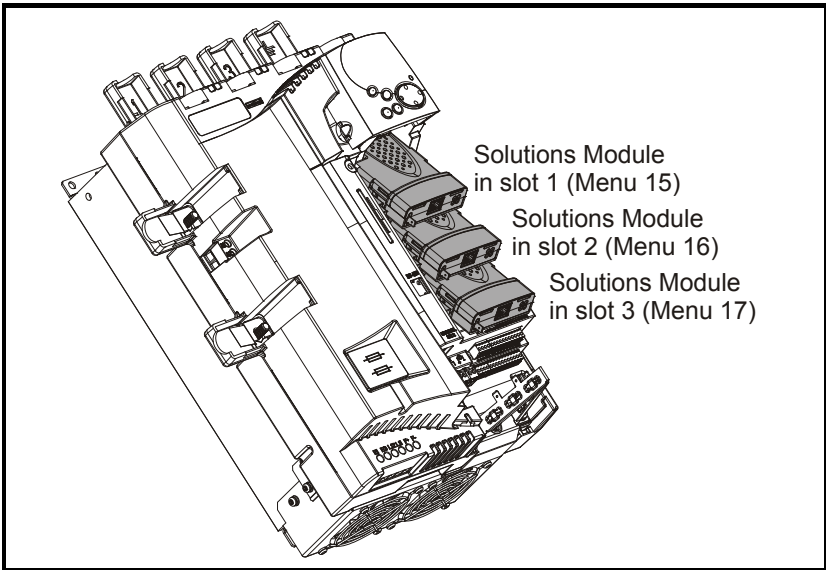
Pr **x.00** and Pr **x.01** are always present in menus 15, 16 and 17. Pr **x.01** indicates which type of module is present (0 = no module installed). When a module is installed the drive provides the relevant menu (menu 15 for slot 1, 16 for slot 2 and 17 for slot 3) depending on the Solutions Module installed.

The possible categories are shown below.
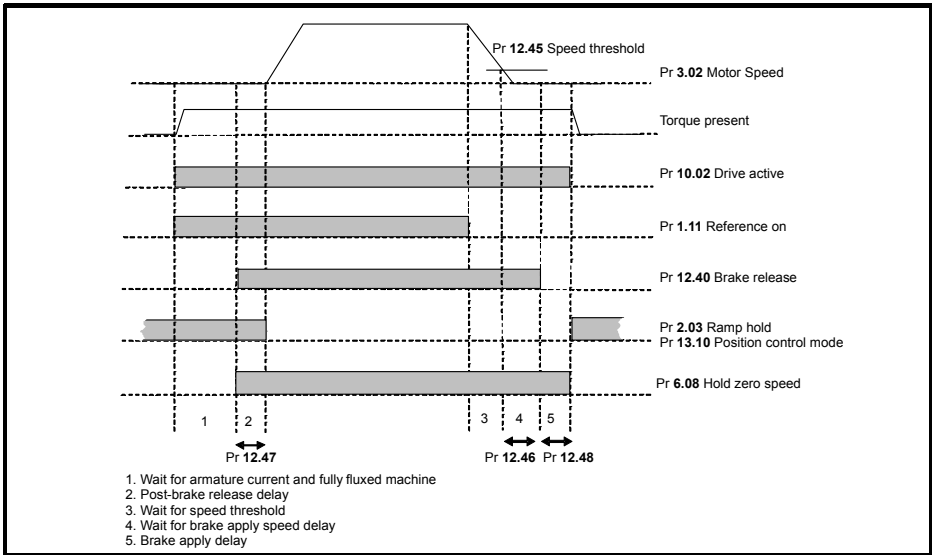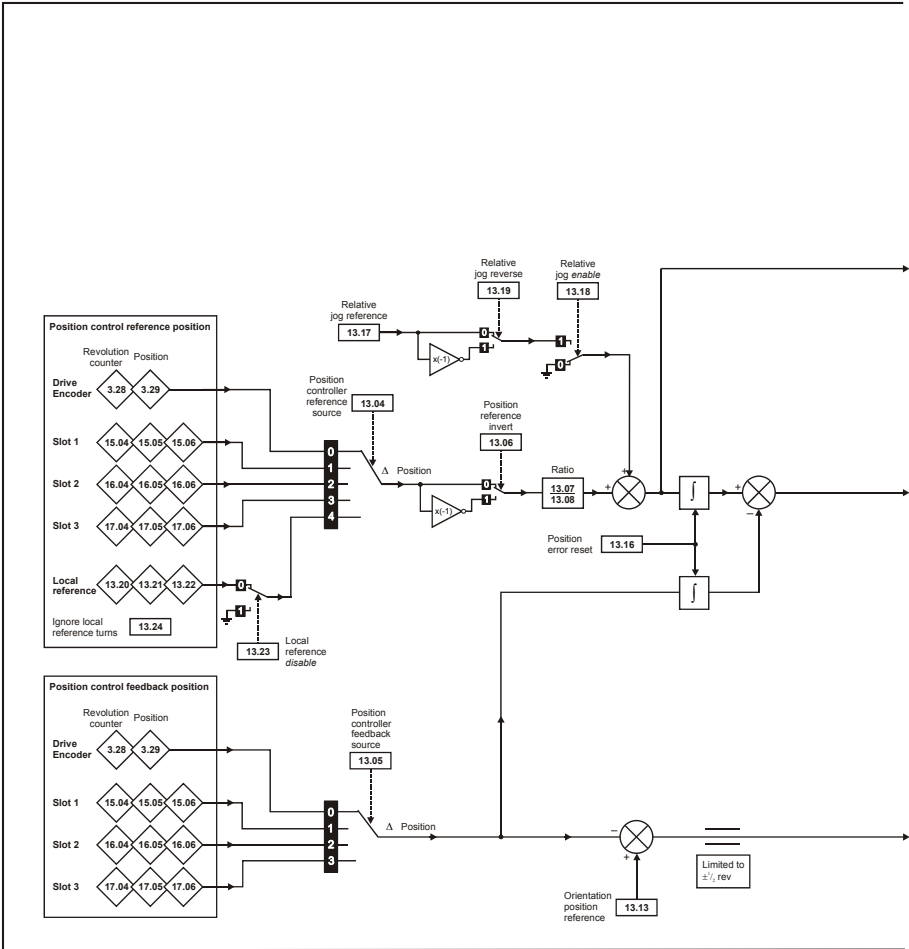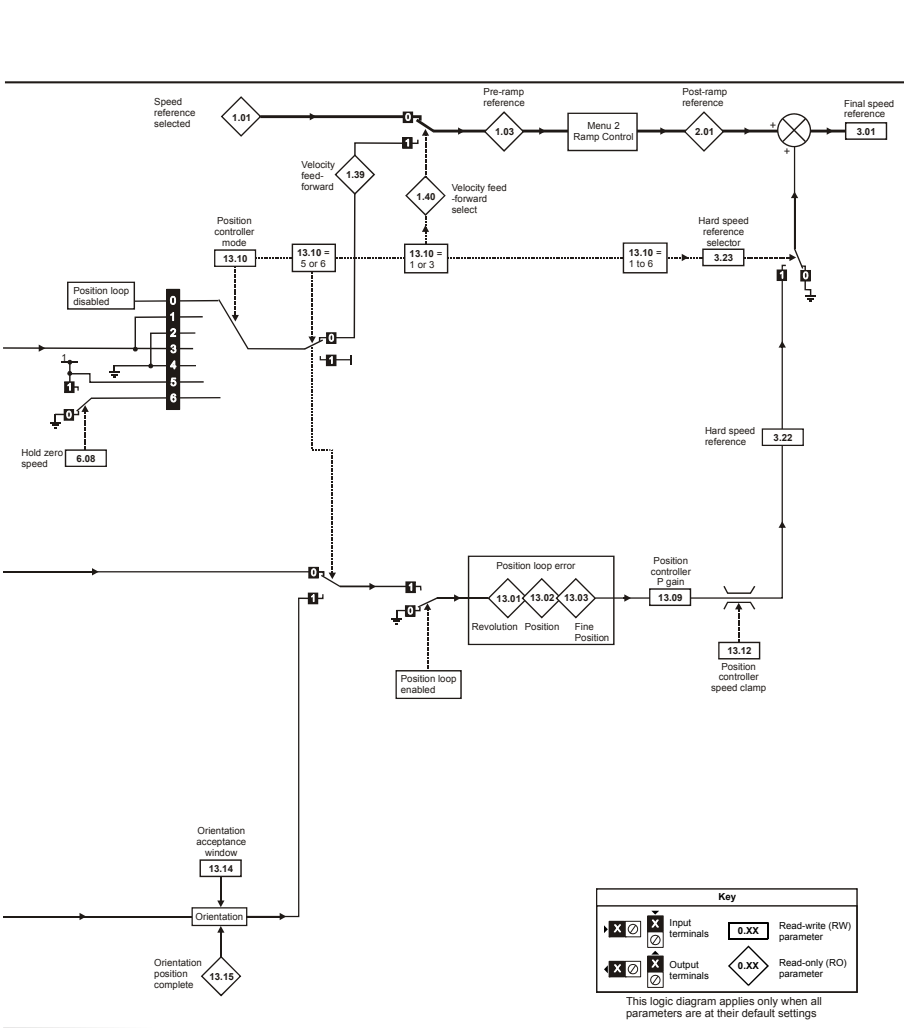
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Solutions Module ID	Module	Category
0	No module installed	
102	SM-Universal Encoder Plus	Feedback
104	SM-Encoder Plus and SM-Encoder Output Plus	
201	SM-I/O Plus	Automation (I/O Expansion)
203	SM-I/O Timer	
204	SM-I/O PELV	
205	SM-I/O 24V Protected	
206	SM-I/O120V	
207	SM-I/O Lite	
208	SM-I/O 32	
304	SM-Applications Plus	Automation (Applications)
305	SM-Applications Lite V2	
306	SM-Register	
403	SM-PROFIBUS-DP-V1	Fieldbus
404	SM-INTERBUS	
407	SM-DeviceNet	
408	SM-CANopen	
410	SM-Ethernet	
421	SM-EtherCAT	

Refer to the specific *Solutions Module User Guide* for more information.

Solutions Module software

Most Solutions Modules contain software. The software version of the module can be checked by looking at Pr **x.02** and Pr **x.51**.

The software version takes the form of xx.yy.zz, where Pr **x.02** displays xx.yy and Pr **x.51** displays zz. I.e. for software version 01.01.00, Pr **x.02** would display 1.01 and Pr **x.51** would display 0

The SM-Encoder Plus, SM-Encoder Output Plus and SM-I/O Plus modules do not contain any software, so Pr **x.02** and Pr **x.51** either show 0 or the parameters do not appear.

Parameters common to all categories

Parameter	
x.**01**	Solutions Module ID
x.02	Solutions Module software version
x.**50**	Solutions Module error status
x.51	Solutions Module software sub-version

8.16 Menu 18, 19 & 20: Application menu 1, 2 & 3

Parameter	
18.01 (1) 19.01 (2)	Power-down saved integer
18.02 to 18.10 (1) 19.02 to 19.10 (2)	Read-only integer
18.11 to 18.30 (1) 19.11 to 19.30 (2) 20.01 to 20.20 (3)	Read-write integer
18.31 to 18.50 (1) 19.31 to 19.50 (2)	Read-write bit
20.21 to 20.40 (3)	Read-write long integer

8.17 Menu 21: Second motor parameters

Parameter		Equivalent motor map 1 parameter
21.01	Maximum reference clamp	1.06
21.02	Minimum reference clamp	1.07
21.03	Reference selector	1.14
21.04	Acceleration rate	2.11
21.05	Deceleration rate	2.21
21.06	Base speed	5.08
21.07	Rated current	5.07
21.08	Back emf set point	5.59
21.09	Rated voltage	5.09
21.10	Armature resistance	5.61
21.11	Motor constant	5.15
21.12	Discontinuous current controller Ki gain	4.34
21.13	Continuous current controller Kp gain	4.13
21.14	Continuous current controller Ki gain	4.14
21.15	Motor 2 active	11.45
21.16	Thermal time constant	4.15
21.17	Speed controller Kp gain	3.10
21.18	Speed controller Ki gain	3.11
21.19	Speed controller Kd gain	3.12
21.21	Speed feedback selector	3.26
21.23	Rated field voltage	5.73
21.24	Rated field current	5.70
21.25	Motor saturation breakpoint 1	5.29
21.26	Motor saturation breakpoint 2	5.30
21.27	Motoring current limit	4.05
21.28	Regen current limit	4.06
21.29	Symmetrical current limit	4.07
21.30	Field thermal time constant	5.81
21.31	Flux loop P gain	5.71
21.32	Flux loop I gain	5.72
21.33	field weakening P gain	5.62
21.34	field weakening I gain	5.63
21.35	Rated field compensation factor	5.74
21.36	Field IR Compensation	5.87
21.37	Armature IR Compensation	5.88
21.38	External Flux feedback select	5.48

8.18 Menu 22: Additional Menu 0 set-up

Parameter	
22.01	Pr **0.01** set-up
22.02	Pr **0.02** set-up
22.03	Pr **0.03** set-up
22.04	Pr **0.04** set-up
22.05	Pr **0.05** set-up
22.06	Pr **0.06** set-up
22.07	Pr **0.07** set-up
22.08	Pr **0.08** set-up
22.09	Pr **0.09** set-up
22.10	Pr **0.10** set-up
22.11	Pr **0.11** set-up
22.12	Pr **0.12** set-up
22.13	Pr **0.13** set-up
22.14	Pr **0.14** set-up
22.15	Pr **0.15** set-up
22.16	Pr **0.16** set-up
22.17	Pr **0.17** set-up
22.18	Pr **0.18** set-up
22.19	Pr **0.19** set-up
22.20	Pr **0.20** set-up

8.19 Menu 23: Header selections

Parameter	
23.01	Sub block headers
23.02	Binary sum of pre-defined sub block enables
23.03	SEt UP
23.04	diAGnoS
23.05	triPS
23.06	SP LOOP
23.07	SintEr
23.08	Fb SP
23.09	InPut

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9 Diagnostics

The display on the drive gives various information about the status of the drive. These fall into three categories:

- Trip indications
- Alarm indications
- Status indications

For further information regarding trips, refer to the *Mentor MP User Guide*.

9.1 Trip indications

⚠️ **WARNING** Users must not attempt to repair a drive if it is faulty, nor carry out fault diagnosis other than through the use of the diagnostic features described in this chapter.
If a drive is faulty, it must be returned to an authorized Control Techniques distributor for repair.

Table 9-1 Trip indications

Trip	Number	Description
AOC	3	Instantaneous output over current detected: peak output current greater than 225%
AOP	158	Voltage has been applied to the armature but no current feedback has been detected
AtL.Err	161	Power processor armature timing loop cannot operate with the current PLL synchronization and the firing angle demand
C.Acc	185	SMARTCARD trip: SMARTCARD read/write fail
C.Boot	177	SMARTCARD trip: Menu 0 parameter modification cannot be saved to the SMARTCARD because the necessary file has not been created on the SMARTCARD
C.BUSy	178	SMARTCARD trip: SMARTCARD can not perform the required function as it is being accessed by a Solutions Module
C.Chg	179	SMARTCARD trip: Data location already contains data
C.cpr	188	SMARTCARD trip: values stored in the drive and the values in the data block on the SMARTCARD are different
C.dat	183	SMARTCARD trip: data location specified does not contain any data
C.Err	182	SMARTCARD trip: SMARTCARD data is corrupted
C.FULL	184	SMARTCARD trip: SMARTCARD full
cL2	28	Analog input 2 current loss (current mode)
cL3	29	Analog input 3 current loss (current mode)
CL.bit	35	Trip initiated from the control word (Pr **6.42**)
C.Optn	180	SMARTCARD trip: Solutions Modules installed are different between source drive and destination drive
C.Prod	175	SMARTCARD is not compatible with this drive
C.RdO	181	SMARTCARD trip: SMARTCARD has the read-only bit set
C.rtg	186	SMARTCARD trip: the voltage and/or the current rating of the source and the destination drives are different
C.Typ	187	SMARTCARD trip: SMARTCARD parameter set not compatible with drive
dESt	199	Two or more parameters are writing to the same destination parameter
EEF	31	EEPROM data corrupted: drive mode becomes open loop and serial comms will timeout with remote keypad on the drive RS485 comms port.
EnC1	189	Drive encoder trip: encoder power supply overload

Trip	Number	Description
EnC2	**190**	Drive encoder trip: wire break
EnC3	**191**	Drive encoder trip: overload
EnC9	**197**	Drive encoder trip: position feedback is selected from a Solutions Module slot which does not have a speed/position feedback Solutions Module installed
EnC10	**198**	Drive encoder trip: termination overload
Et	**6**	External trip from input on terminal 31
FbL	**159**	No signal from the tachogenerator or encoder
Fbr	**160**	The polarity of the feedback tachogenerator or encoder is incorrect
FdL	**168**	No current in the field supply circuit.
FOC	**169**	Excess current detected in field current feedback. If maximum current feedback is present when the firing angle is fully phased back then trip
F.OVL	**157**	Field I^2t overload
HF01*	**-**	Data processing error: CPU address error
HF02*	**-**	Data processing error: DMAC address error
HF03*	**-**	Data processing error: Illegal instruction
HF04*	**-**	Data processing error: Illegal slot instruction
HF05*	**-**	Data processing error: Undefined exception
HF06*	**-**	Data processing error: Reserved exception
HF07*	**-**	Data processing error: Watchdog failure
HF08*	**-**	Data processing error: Level 4 crash
HF09*	**-**	Data processing error: Heap overflow
HF10*	**-**	Data processing error: Router error
HF11*	**-**	Data processing error: Access to EEPROM failed
HF12*	**-**	Data processing error: Main program stack overflow
HF17*	**-**	Data processing error: No Comms from power processor
HF18*	**-**	Bucket suppressor capacitor failure
HF19*	**-**	Overheat on bucket suppressor or snubber circuits
HF20*	**-**	Power stage recognition: identification code error
HF21*	**-**	Power processor: Watchdog failure
HF22*	**-**	Power processor: Undefined exception
HF23*	**-**	Power processor: Level overrun
HF27*	**-**	Power circuit: Thermistor 1 fault
HF28*	**-**	Power software not compatible with user software
HF29*	**-**	User processor: Armature timing error
It.AC	**20**	I^2t on drive output current (refer to Pr **4.16**)
O.Ld1	**26**	Digital output overload: total current drawn from digital outputs exceeds 200 mA
O.ht1	**21**	Drive overheat (thyristor junction) based on thermal model
O.ht2	**22**	Heatsink over-temperature
O.ht3	**27**	External discharge resistor over-temperature
O.SPd	**7**	Motor speed has exceeded the over speed threshold
Pad	**34**	Keypad has been removed when the drive is receiving the speed reference from the keypad
PLL Err	**174**	Phase Lock Loop cannot lock to the auxiliary supply
PS	**5**	Internal power supply fault
PS.10V	**8**	10V user power supply current greater than 10 mA
PS.24V	**9**	24V user power supply current greater than 200 mA

Trip	Number	Description
PSAVE.Er	37	Power down save parameters in the EEPROM are corrupt
SAVE.Er	36	User save parameters in the EEPROM are corrupt
SCL	30	Drive RS485 serial comms loss to remote keypad
SL	170	One or more of the power supply phases is open circuit
S.Old	171	The maximum power the over voltage suppressor can handle has been exceeded
S.OV	172	Excessive suppressor voltage
SL.rtd	215	Solutions Module trip: drive mode has changed and Solutions Module parameter routing is now incorrect
SL1.dF	204	Solutions Module slot 1 trip: Solutions Module type installed in slot 1 changed
SL1.Er	202	Solutions Module slot 1 trip: Solutions Module in slot 1 has detected a fault
SL1.HF	200	Solutions Module in slot 1: error. The module has detected an error and tripped the drive. The reason for the error is stored in Pr **xx.50**.
SL1.nF	203	Solutions Module slot 1 trip: Solutions Module has been removed
SL1.tO	201	Solutions Module slot 1 trip: Solutions Module watchdog timeout
SL2.dF	209	Solutions Module slot 2 trip: Solutions Module type installed in slot 2 changed
SL2.Er	207	Solutions Module slot 2 trip: Solutions Module in slot 2 has detected a fault
SL2.HF	205	Solutions Module slot 2 trip: hardware fault
SL2.nF	208	Solutions Module slot 2 trip: Solutions Module has been removed
SL2.tO	206	Solutions Module slot 2 trip: Solutions Module watchdog timeout
SL3.dF	214	Solutions Module slot 3 trip: Solutions Module type installed in slot 3 changed
SL3.Er	212	Solutions Module slot 3 trip: Solutions Module in slot 3 has detected a fault
SL3.HF	210	Solutions Module in slot 3: hardware fault
SL3.nF	213	Solutions Module slot 3 trip: Solutions Module has been removed
SL3.tO	211	Solutions Module slot 3 trip: Solutions Module watchdog timeout
t002	2	Reserved
t004	4	Reserved
t010	10	Reserved
t019	19	Reserved
t023	23	User trip
t032	32	Reserved
t033	33	Reserved
t038 to t039	38 to 39	Reserved
t040 to t089	40 to 89	User trips
t099	99	User trip defined in 2nd processor Solutions Module code
t101	101	User trip
t102 to t111	102 to 111	Reserved
t112 to t156	112 to 156	User trip
t162 to t167	162 to 167	Reserved
t176	176	Reserved
t192	192	Reserved
t193	193	Reserved
t194	194	Reserved
t195	195	Reserved
t196	196	Reserved
t216	216	User trip
th	24	Motor thermistor trip

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Trip	Number	Description
th.Err	**173**	Thyristor missing
thS	**25**	Motor thermistor short circuit
tunE	**18**	Autotune stopped before completion
tunE1	**11**	The position feedback did not change or required speed could not be reached during the inertia test (refer to Pr **5.12 (SE13, 0.34)**)
tunE2	**12**	Position feedback direction incorrect or motor could not be stopped during the inertia test (refer to Pr **5.12 (SE13, 0.34)**)
tunE3	**13**	Field flux has not decayed to zero during autotune
tunE4	**14**	Back emf detected during autotune
tunE5	**15**	No field current detected during autotune
tunE6	**16**	Cannot achieve ¼ rated back emf during autotune. Reset Pr **5.70 (SE10, 0.31)** to name plate value and re- autotune motor
tunE7	**17**	Rotating autotune requested when using estimated speed feedback
UP ACC	**98**	Onboard PLC program: cannot access Onboard PLC program file on drive
UP div0	**90**	Onboard PLC program attempted divide by zero
UP OFL	**95**	Onboard PLC program variables and function block calls using more than the allowed RAM space (stack overflow)
UP ovr	**94**	Onboard PLC program attempted out of range parameter write
UP Par	**91**	Onboard PLC program attempted access to a non-existent parameter
UP ro	**92**	Onboard PLC program attempted write to a read-only parameter
UP So	**93**	Onboard PLC program attempted read of a write-only parameter
UP udF	**97**	Onboard PLC program undefined trip
UP uSEr	**96**	Onboard PLC program requested a trip
UV	**1**	Running from external +24V

* HF (Hardware fault) trip - Return drive to supplier.

9.2 Alarm indications

In any mode an alarm flashes alternately with the data displayed on the 2nd row when one of the following conditions occur. If action is not taken to eliminate any alarm except "Autotune", and "PLC" the drive may eventually trip. Alarms flash once every 640ms except "PLC" which flashes once every 10s. Alarms are not displayed when a parameter is being edited.

Table 9-2 Alarm indications

Lower display	Description
Hot	Heatsink alarm is active
The temperature displayed in Pr **7.04** has exceeded the alarm level (see Pr **7.04**).	
OVLd	Motor overload
The motor I^2t accumulator (Pr **4.19**) in the drive has reached 75% of the value at which the drive will be tripped and the load on the drive is > motor rated current Pr **5.07** (**SE07, 0.28**)	
Autotune	Autotune in progress
The autotune procedure has been initialised. 'Auto' and 'tunE' will flash alternatively on the display.	
CLt	Current limit is active
Indicates that current limits are active.	
PLC	Onboard PLC program is running
An Onboard PLC program is installed and running. The lower display will flash 'PLC' once every 10s.	
S.OV	Indicated suppressor over voltage
Indicates that the over voltage suppressor voltage is within 30V of the trip level	
S.rS	Suppressor resistor overload
Indicates that the external voltage suppressor resistor is in an overload condition	
ESt SPd	Estimated speed selected
The drive has lost speed feedback and automatically selected Estimated speed mode. See Pr **3.55** (Select estimated speed on feedback loss).	

9.3 Status indications

Table 9-3 Status indications

Upper display	Description	Drive output stage
dEC	Decelerating	Enabled
Speed is ramping to zero after a stop		
inh	Inhibited	Disabled
Enable input is inactive		
POS	Position	Enabled
Position control active during orientation stop		
rdY	Ready	Disabled
Enable closed, but drive not active		
run	Running	Enabled
Drive active and motor running		
StoP	Stopped	Enabled
Drive active, but holding zero speed.		
triP	Tripped	Disabled
Drive is tripped.		

9.4 Trip masking

Drive trips can be masked by setting the appropriate trip code in Pr **10.52** to Pr **10.61**. Refer to Pr **10.52** to Pr **10.72** (Advanced parameter descriptions chapter - Menu 10) in the *Mentor MP Advanced User Guide* for further information.

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10   UL listing

Mentor MP drives up to 575V have been assessed to comply with both ULus and cUL requirements.

Control Techniques UL file number is E171230. Confirmation of UL listing can be found at website: www.ul.com

10.1   Common UL Information

Conformity: The drive conforms to UL listing requirements only when the following are observed:

1. The drive is installed in a type 1 enclosure, or better as defined in UL 50.
2. The surrounding air temperature does not exceed 40°C when the drive is operating.
3. The terminal torques specified in the *Mentor MP User Guide* are to be used.
4. The power terminal lug used to crimp the, I/P & O/P cables are to be UL listed.
5. The drive is to be installed in to a pollution degree 2 environment.
6. If the drive control stage is supplied by an external power supply, (+24V), the external power supply must be a UL class 2 power supply.
7. Fuses sized as specified in the various tables in section 4.6 *Cable and fuse size ratings* on page 41 are to be used.
8. Field wiring is to be class 1 75°C (167°F) copper wire only.

Motor overload protection

All models incorporate an internal overload protection model for the motor load that does not require the use of an external or remote overload protection device.

The protection level is adjustable, and the method of adjustment is provided with the instructions for the product.

Maximum current overload is dependant on the values entered into the current limit parameters (motoring current limit, regen current limit and symmetrical current limit entered as percentage) and the motor rated current parameter (entered in amperes).

The duration of the overload is dependant on motor thermal time constant (variable up to a maximum of 3000 seconds). The default overload protection is set such that the product is capable of 150% of the current value entered into the motor rated current parameter (Pr **5.07** (**SE07**, **0.28**)) for 30 seconds (20 seconds for MP470A4(R), MP470A5(R), MP825A5(R) and MP825A6(R). The product also provides user terminal default functionality such that the product can be connected to a motor thermistor to protect the motor in terms of temperature, in the event of a motor cooling fan failure.

Over speed protection

The drive provides overspeed protection. However it does not provide the level of protection afforded by an independent high integrity overspeed protection device.

10.2   AC supply specification

The maximum UL supply voltage is 600Vac.

The drive is suitable for use in a circuit capable of delivering not more than 100,000rms symmetrical Amperes at 575V (size 1A and 1B).

10.3   Maximum ratings

The drive models are listed as having the maximum rating current (FLC) shown in Table 2-2 and Table 2-3 in section 2.2 *Current ratings* on page 9.

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10.4 Parallel operation

The drives are not currently UL listed for parallel operation.

10.5 Safety label

The safety label supplied with connectors and mounting brackets must be placed on a fixed part of the drive enclosure where it can be seen clearly by maintenance personnel for UL compliance.

The label clearly states "CAUTION risk of electric shock power down at least 10 minutes before removing cover".

10.6 UL Listed accessories

- SM-Keypad
- SM-DeviceNet
- SM-INTERBUS
- SM-Ethernet
- SM-Applications Plus
- SM-Encoder Plus
- SM-I/O Plus
- SM-I/O Lite
- SM-I/O PELV
- SM-I/O 24V Protected
- Single ended encoder interface

- MP-Keypad
- SM-PROFIBUS-DP-V1
- SM-CANopen
- SM-EtherCAT
- SM-Applications Lite-V2
- SM-Universal Encoder Plus
- SM-Encoder Output Plus
- SM-I/O 32
- SM-I/O Timer
- SM-I/O 120V
- 15-way D-type converter

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