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**CONTROL
TECHNIQUES**



艾默生CT一级代理商及全国联保维修中心，联系电话：021-51093390



User Guide ***Unidrive***

Model sizes 1 to 5

Universal Variable Speed AC Drive
for induction and servo motors

Part Number: 0460-0083-09
Issue Number: 9

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 software version

This product is supplied with the latest version of user-interface and machine control software. If this product is to be used in a new or existing system with other drives, there may be some differences between their software and the software in this product. These differences may cause this product to function differently. This may also apply to drives returned from a Control Techniques Service Centre.

If there is any doubt, contact a Control Techniques Drive Centre.

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 can very easily be dismantled into their major component parts for efficient recycling. Many parts snap together and can be separated without the use of tools, whilst other parts are secured with conventional screws. 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, whilst smaller products come in strong cardboard cartons which themselves have a high recycled fibre content. If not re-used, these containers can be recycled. Polyethylene, used on the protective film and bags for wrapping product, can be recycled in the same way. Control Techniques' packaging strategy favours 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.

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Issue Number: 9

Software: V03.02.12 onwards

How to use this User Guide

This User Guide provides complete information for installing and operating a Unidrive from start to finish.

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

NOTE

There are specific safety warnings throughout this guide, located in the relevant sections. In addition, Chapter 1 *Safety Information* on page 7 contains general safety information. It is essential that the warnings are observed and the information considered when working with or designing a system using the drive.

This map of the user guide helps to find the right sections for the task you wish to complete:

	Quick Start / bench testing	Familiarisation	System design	Programming and commissioning	Troubleshooting
1 Safety information	●	●	●	●	●
2 Product information		●	●		
3 Mechanical installation			●		
4 Electrical installation			●		
5 Getting started		●	●		
6 Menu 0		●	●	●	
7 Running the motor	●	●	●	●	
8 Optimisation			●	●	
9 Macros			●	●	
10 Advanced parameters			●	●	
11 Technical data		●	●	●	
12 Diagnostics					●
13 UL listing information			●	●	

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Declaration of Conformity

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These products comply with the Low Voltage Directive 73/23/EEC, the Electromagnetic Compatibility (EMC) Directive 89/336/EEC and the CE Marking Directive 93/68/EEC.

UNI1201	UNI1202	UNI1203	UNI1204	UNI1205
UNI2201	UNI2202	UNI2203		
UNI3201	UNI3202	UNI3203	UNI3204	

UNI1401	UNI1402	UNI1403	UNI1404	UNI1405
UNI2401	UNI2402	UNI2403		
UNI3401	UNI3402	UNI3403	UNI3404	UNI3405
UNI4401	UNI4402	UNI4403	UNI4404	UNI4405
UNI5401				

The AC variable speed drive products listed above, including the VTC, LFT (all sizes) and REGEN (UNI3401 to UNI4405 only) variants, have been designed and manufactured in accordance with the following European harmonised, national and international standards:

EN 60249	Base materials for printed circuits
IEC326-1	Printed boards: general information for the specification writer
IEC326-5	Printed boards: specification for single- and double-sided printed boards with plated-through holes
IEC326-6	Printed boards: specification for multilayer printed boards
IEC664-1	Insulation co-ordination for equipment within low-voltage systems: principles, requirements and tests
EN 60529	Degrees of protection provided by enclosures (IP code)
UL94	Flammability rating of plastic materials
UL508C	Standard for power conversion equipment
EN 50081-1 ¹	Generic emission standard for the residential, commercial and light industrial environment
EN 50081-2	Generic emission standard for the industrial environment
EN 50082-2	Generic immunity standard for the industrial environment
EN 61800-3	Adjustable speed electrical power drive systems - Part 3: EMC product standard including specific test methods

¹ Conducted emission sizes 1 to 3, not size 4 or 5. See the relevant EMC Data Sheet.



W. Drury
Executive Vice President, Technology
Newtown

Date: 26 September 2001

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. A *Unidrive EMC Data Sheet* is also available giving detailed EMC information.

1 Safety Information

1.1 Warnings, Cautions and Notes



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



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

NOTE

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

1.2 Electrical safety - general warning

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

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

1.3 System design and safety of personnel

The drive is intended as a component for professional incorporation into complete equipment or a system. If installed incorrectly, the drive may present a safety hazard. The drive uses high voltage and currents, carries a high level of stored electrical energy, and is used to control equipment which can cause injury.

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

The STOP function of the drive does not remove dangerous voltages from the output of the drive or from any external option unit.

Careful consideration must be given to the functions of the drive which might result in a hazard, either through their intended functions or through incorrect operation due to a fault.

In any application where a malfunction of the drive could lead to damage, loss or injury, a risk analysis must be carried out, and where necessary, further measures taken to reduce the risk.

The STOP and START controls or electrical inputs of the drive must not be relied upon to ensure safety of personnel. If a safety hazard could exist from unexpected starting of the drive, an interlock that electrically isolates the drive from the AC supply must be installed to prevent the motor being inadvertently started.

To ensure mechanical safety, additional safety devices such as electro-mechanical interlocks and overspeed protection devices may be required. The drive must not be used in a safety critical application without additional high integrity protection against hazards arising from a malfunction.

Under certain conditions, the drive can suddenly discontinue control of the motor. If the load on the motor could cause the motor speed to be increased (e.g. in hoists and cranes), a separate method of braking and stopping must be used (e.g. a mechanical brake).

1.4 Environmental limits

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

1.5 Compliance with regulations

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

98/37/EC: Safety of machinery.

89/336/EEC: Electromagnetic Compatibility.

1.6 Motor

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

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

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

1.7 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.

2 Product Information

2.1 Ratings

Table 2-1 200V drive ratings (200V to 240V $\pm 10\%$)







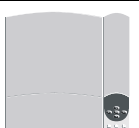
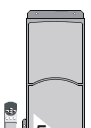
Model		Nominal rating		Output current* (A)	Typical Input current (A)
		kW	hp		
	1201	0.37	0.5	2.1	2.4
	1202	0.55	0.75	2.8	3.5
	1203	0.75	1	3.8	4.6
	1204	1.1	1.5	5.6	6.5
	1205	2.2	3	9.5	8.6
	2201	3	4	12	10.8
	2202	4	5	16	14.3
	2203	5.5	10	25	19.8
	3201	7.5	15	34	26
	3202	11	20	46	39
	3203	15	25	60	53
	3204	22	30	74	78

Table 2-2 400V drive ratings (380V to 480V $\pm 10\%$)

Model		Nominal rating		Output current* (A)	Typical Input current (A)
		@380V kW	@460V hp		
	1401	0.75	1	2.1	3.0
	1402	1.1	1.5	2.8	4.3
	1403	1.5	2	3.8	5.8
	1404	2.2	3	5.6	8.2
	1405	4	5	9.5	10.0
	2401	5.5	7.5	12	13.0
	2402	7.5	10	16	17.0
	2403	11	15	25	21.0
	3401	15	25	34	27
	3402	18.5	30	40	32
	3403	22	30	46	40
	3404	30	40	60	52
	3405	37	50	70	66
	4401	45	75	96	76
	4402	55	100	124	91
	4403	75	125	156	123
	4404	90	150	180	145
	4405	110	150	202	181
	5401	160	200	300**	280
	5402	320	400	600**	560
	5403	480	600	900**	840
	5404	640	800	1200**	1120
	5405	800	1000	1500**	1400
	5406	960	1200	1800**	1680
	5407	1120	1400	2100**	1960
	5408	1280	1600	2400**	2240

* The output currents are given for maximum 40°C (104°F) ambient, 1,000m altitude and 3kHz switching. Derating is required for higher switching frequencies, ambient temperatures >40°C (104°F) and high altitudes. For further information, refer to section 11.1.1 *Power and current ratings* on page 190.

** Multiples of 300A output current with 120% overload or multiples of 240A with 150% overload

NOTE

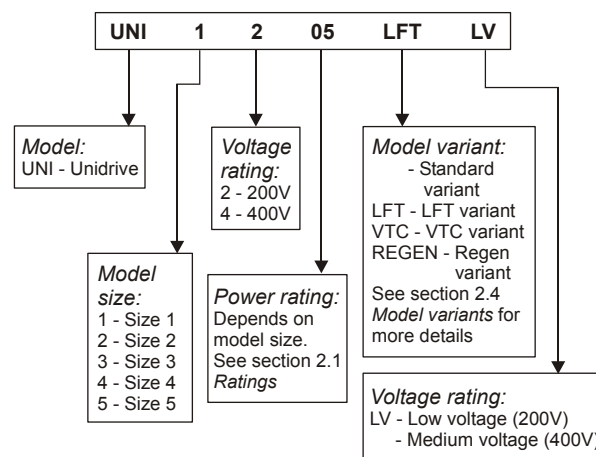
A Unidrive size 5 consists of a control module with one or more power modules connected in parallel.

i.e. UNI5401 = 1 x control module and 1 x power module

UNI5402 = 1 x control module and 2 x power modules etc.

2.2 Model number

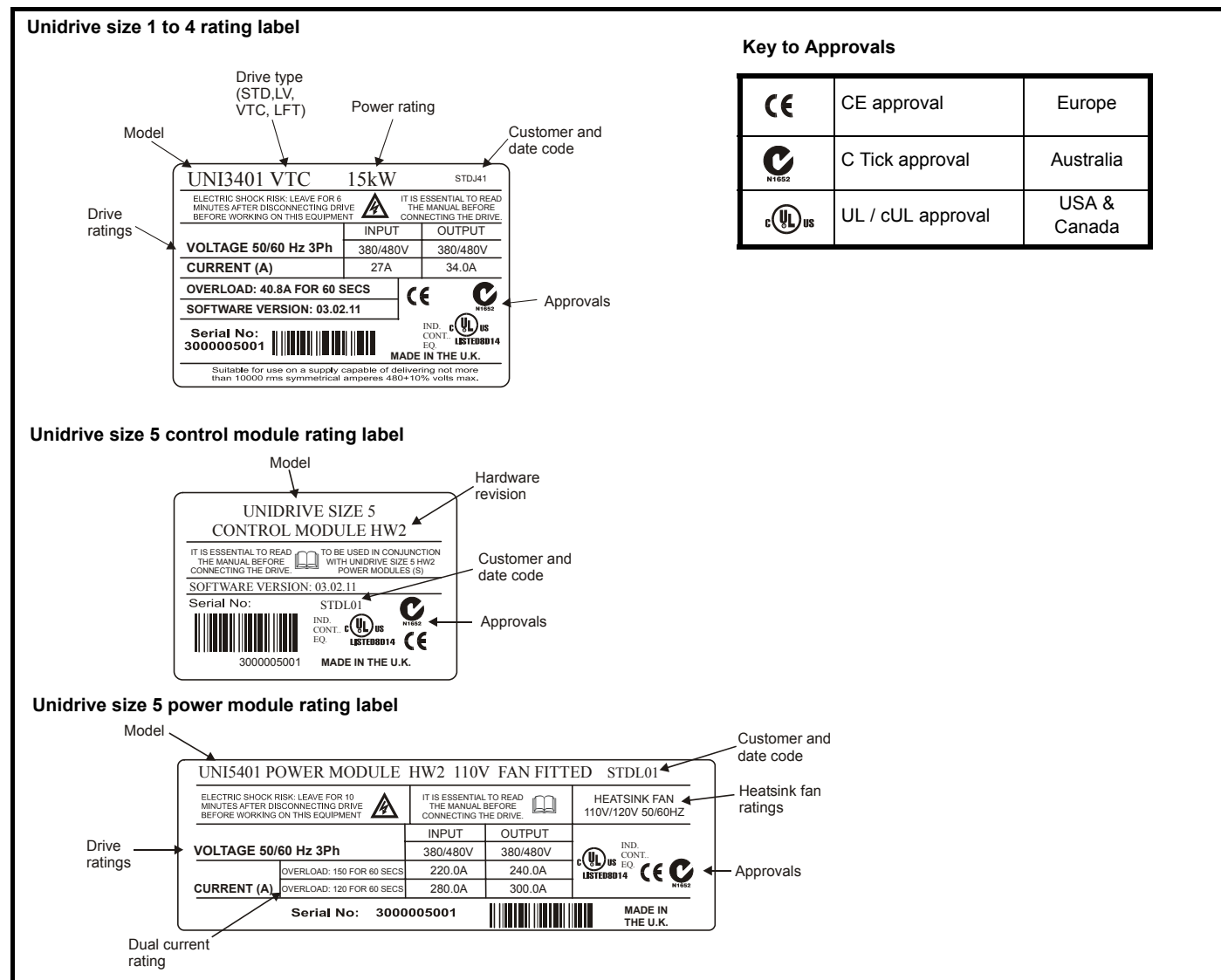
The way in which the model numbers for the Unidrive range are formed is illustrated below.



2.3 Nameplate description - drive identification

The drive label is found on the top surface of the control pod (right angles to the display) on Unidrive sizes 1 to 3 and size 5 control module, and on the side of the Unidrive size 4 and size 5 power module.

Figure 2-1 Typical drive rating labels



2.4 Model variants

2.4.1 Unidrive standard industrial (STD)

...for constant torque loads (All frame sizes)

Operating modes:

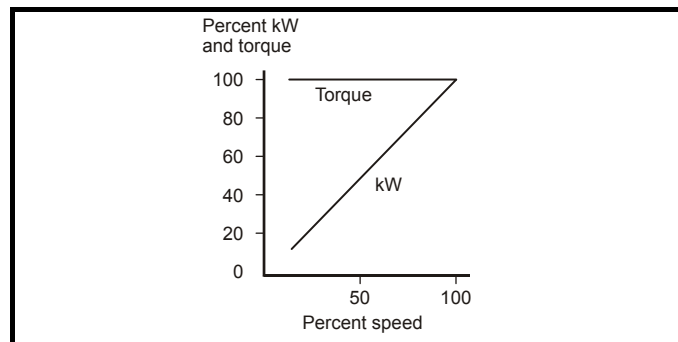
- Open Loop
- Closed Loop vector
- Servo
- Regen

Overload:

- Open loop 150% for 60s
- Closed loop vector 175% for 60s (sizes 1 to 4), 150%* for 60s (size 5)
- Servo 175% for 4s (sizes 1 to 4), 150%* for 4s (size 5)
- Regen 150% for 60s

* Multiples of 300A output current with 120% overload or multiples of 240A with 150% overload

Figure 2-2 Constant torque load



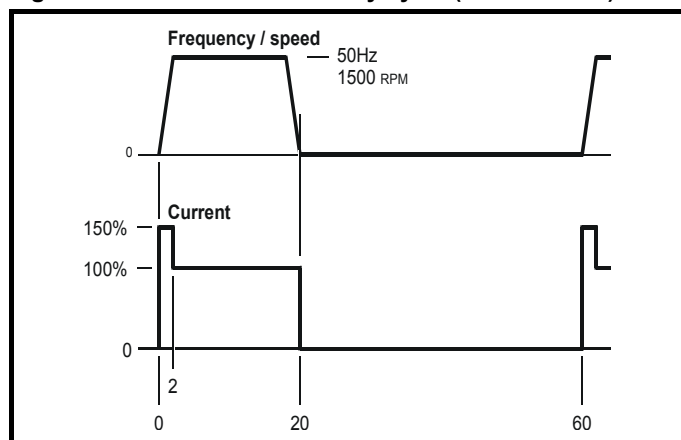
2.4.2 Unidrive LFT

...for lift applications

Overloads and operating modes as Unidrive standard industrial, in addition:

- low acoustic noise
- 9kHz default switching frequency
- S4/S5 duty cycle only

Figure 2-3 Standard S4/S5 duty cycle (Unidrive LFT)



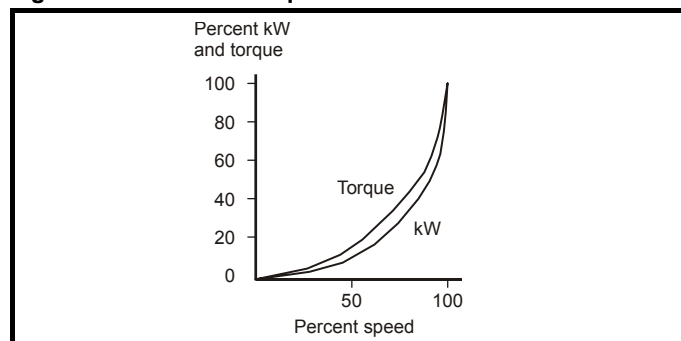
2.4.3 Unidrive VTC

...for quadratic load (variable torque) applications (fans and pumps)

Open loop fixed boost mode only

120% overload for 60s

Figure 2-4 Variable torque mode



2.4.4 Unidrive REGEN

All sizes of Unidrive can be used in regen mode. However, Unidrive sizes 3 and 4 require an internal modification before being used in a regen system.

This modification is already completed if the drive has been ordered as a Unidrive REGEN.

2.5 Operating modes

All variants of Unidrive (except VTC) are designed to operate in any of the following modes:

1. Open loop mode
 - V/f mode (V/ Hz)
 - Open loop vector
2. Closed loop vector
3. Servo
4. Regen

Unidrive VTC can only operate in open loop quadratic V/f mode.

2.5.1 Open Loop mode (OL)

For use with standard AC induction motors.

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

V/f mode

The voltage applied to the motor is directly proportional to the frequency except at low speed where a voltage boost is provided which is set by the user. This mode should be used for multi-motor applications.

Typically 100% torque at 4Hz.

Open loop vector mode

The voltage applied to the motor is directly proportional to the frequency except at low speed where the drive uses motor parameters to apply the correct voltage to keep the flux constant under varying load conditions.

Typically 100% torque at 1Hz.

2.5.2 Closed loop vector mode (VT)

For use with induction motors with a speed feedback device fitted.

The drive directly controls the speed of the motor using the feedback device to ensure the rotor speed is exactly as demanded. Motor flux is accurately controlled at all times to provide full torque all the way down to zero speed.

Typically 175% torque at 0rpm.

2.5.3 Servo (SV)

For use with permanent magnet brushless motors with a speed and position feedback device fitted.

The drive directly controls the speed of the motor using the feedback device to ensure the rotor speed is exactly as demanded. Flux control is not required because the motor is self excited by the permanent magnets which form part of the rotor.

Absolute position information is required from the feedback device to ensure the output voltage is accurately matched to the back EMF of the motor.

Typically 175% torque at 0rpm

2.5.4 Regen

For use as a regenerative front end for four quadrant operation.

Regen operation allows bi-directional power flow to and from the AC supply. This provides far greater efficiency levels in applications which would otherwise dissipate large amounts of energy in the form of heat in a braking resistor.

The harmonic content of the input current is negligible due to the sinusoidal nature of the waveform when compared to a conventional bridge rectifier or thyristor front end.

See the *Regen Installation Guide* for more information on this operating mode.

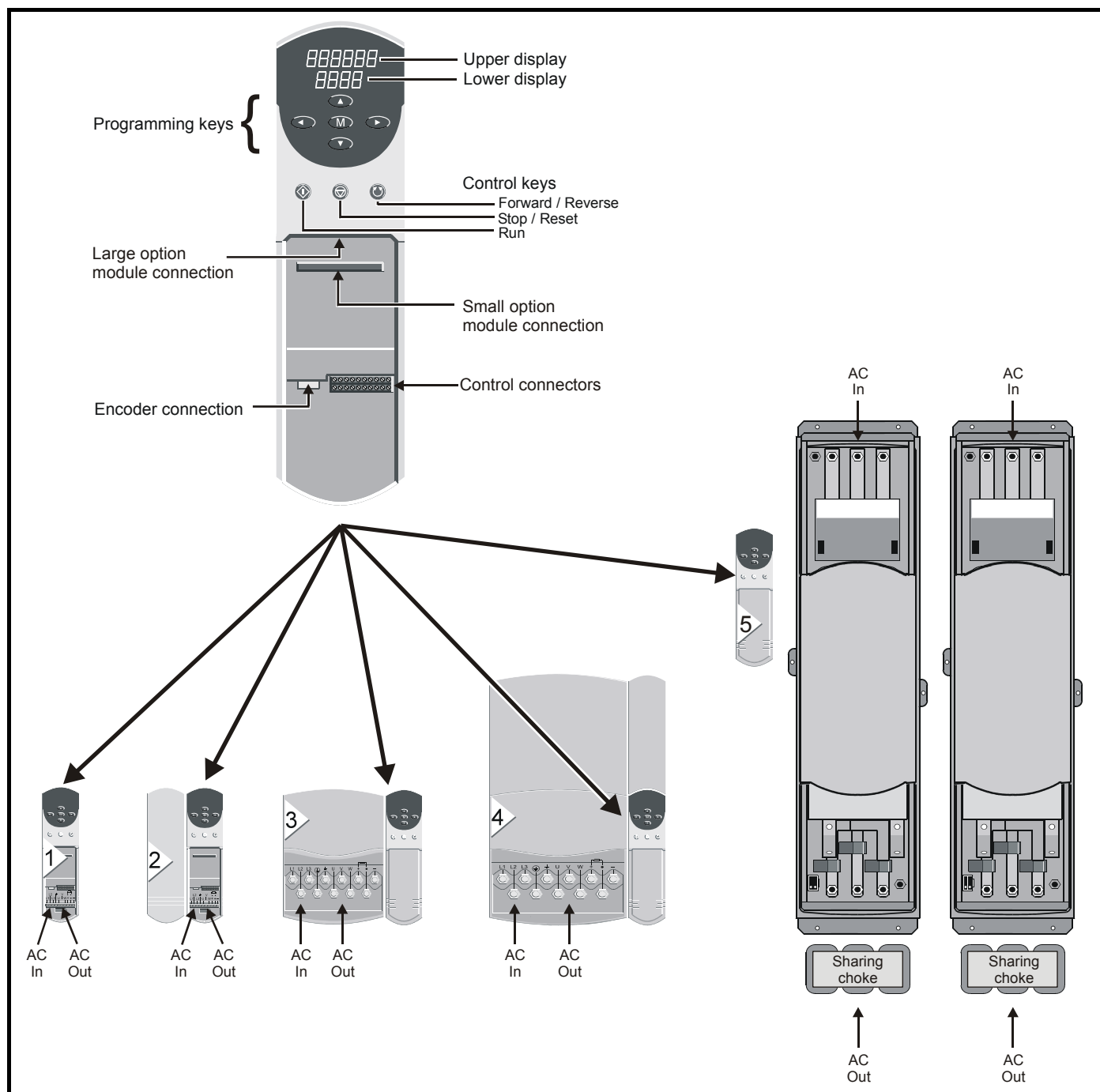
2.5.5 Key to operating mode abbreviations

Abbreviations are throughout this User Guide to define the operating mode for which the information applies as follows:

- OL> Open loop
- CL> Closed loop (which incorporates closed loop vector and servo mode)
- VT> Closed loop vector mode
- SV> Servo

2.6 Drive features

Figure 2-5 Features of the drive (Size 1 to 5)



NOTE

Unidrive size 5 consists of a control module and one or more power modules.

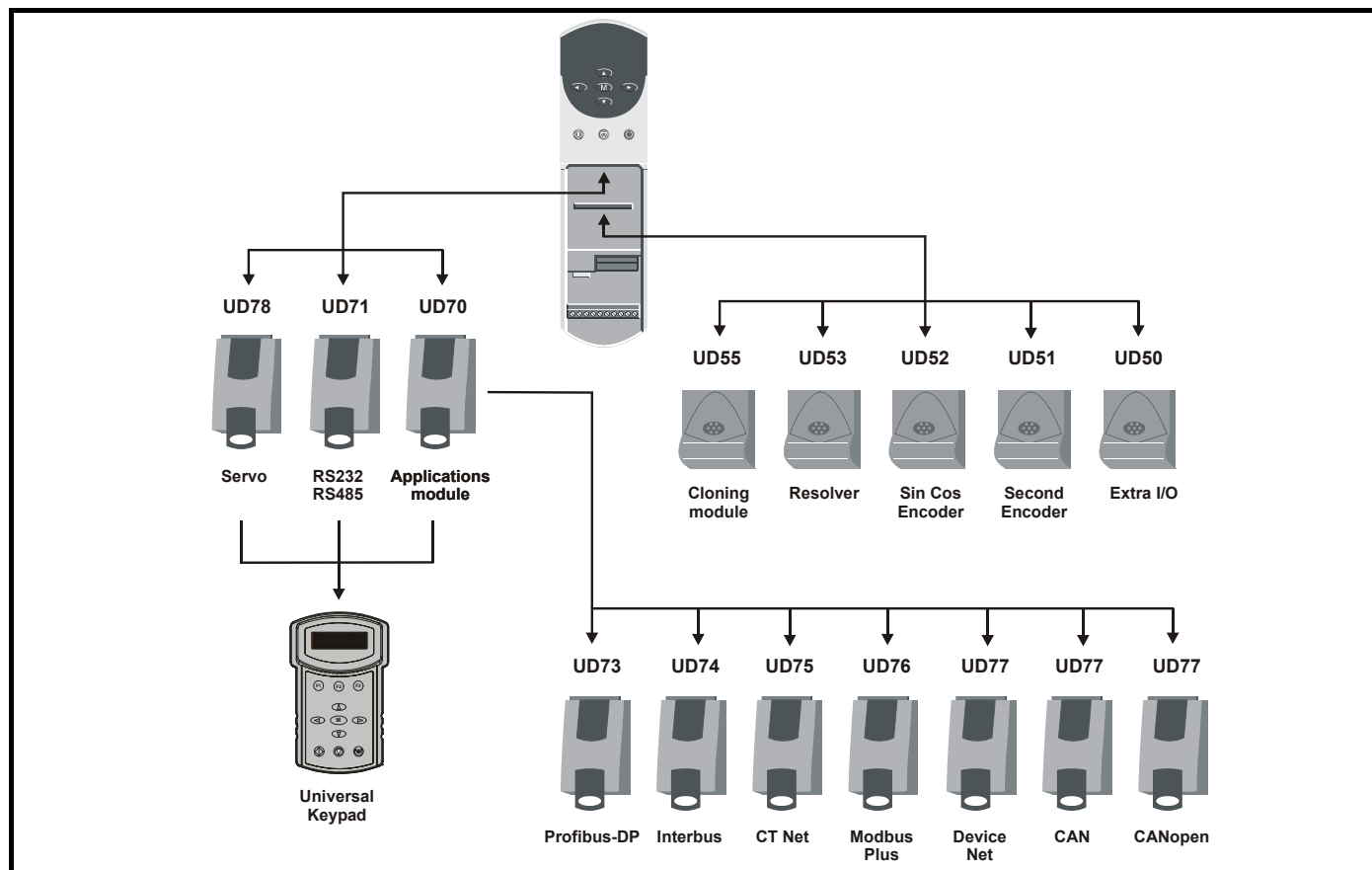
For power ratings greater than 160kW / 200hp, multiple power modules (up to a maximum of 8) can be connected in parallel.

When multiple power modules are used, an output sharing choke is required before the drive outputs are connected together.

2.7 Option Modules

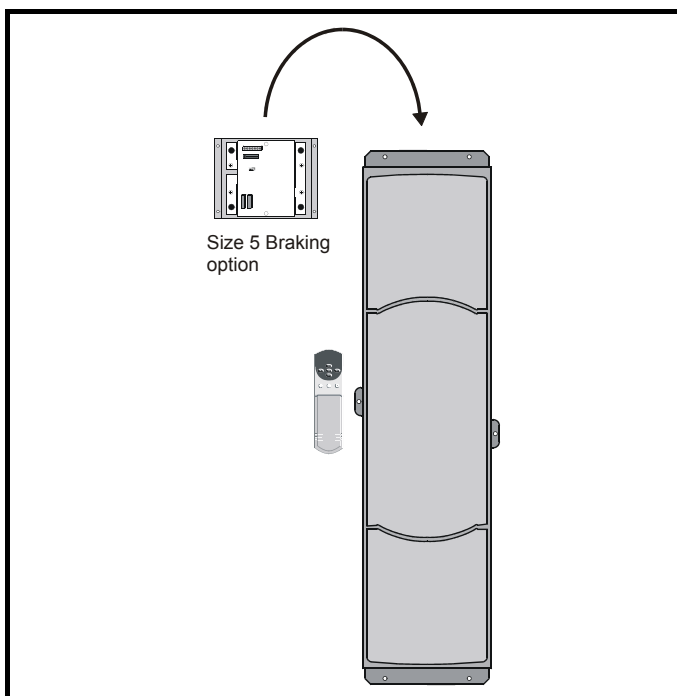
The following option modules are available for use with Unidrive.

Figure 2-6 Unidrive options available for all sizes



Unidrive sizes 1 to 4 have built in braking transistors; for Unidrive size 5 a braking option can be fitted if required as shown below:

Figure 2-7 Braking option available for Size 5



The drive must be powered down for a minimum duration of 10 minutes before an option module is fitted or removed.

WARNING

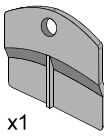
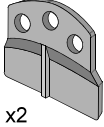
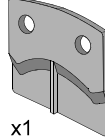
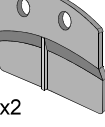
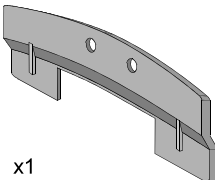
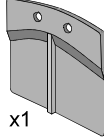
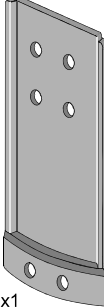
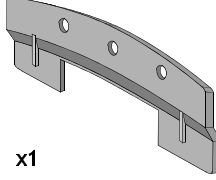
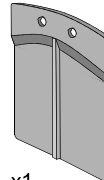
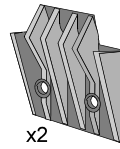
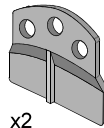
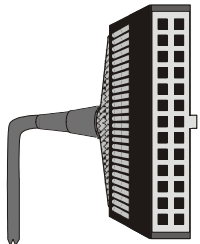
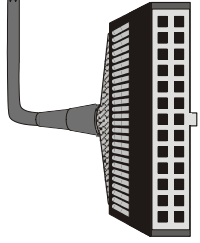
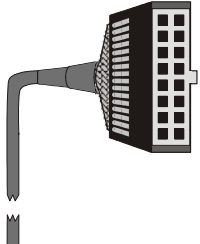
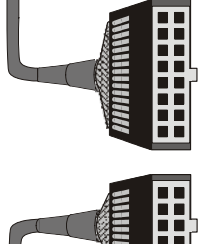
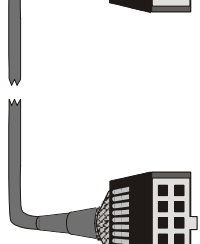
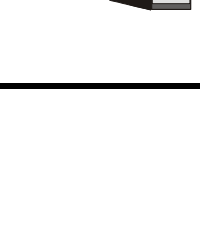
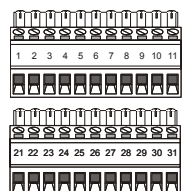
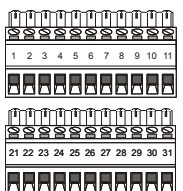
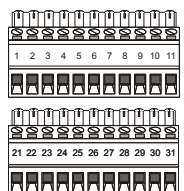
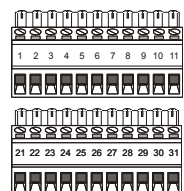
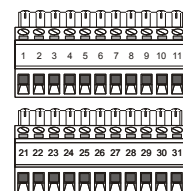
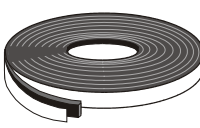
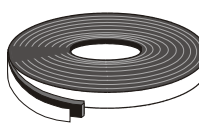
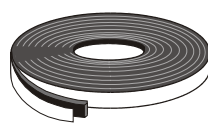
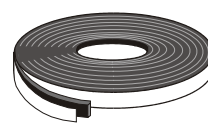

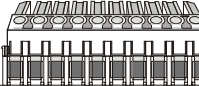
2.8 More information

The following manuals are also available providing full information on the various option modules, regen mode and advanced product use:

- *Unidrive Advanced User Guide*
- *Regen Installation Guide*
- *UD50 User Guide* (Additional I/O small option module)
- *UD51 User Guide* (Second encoder small option module)
- *UD52 User Guide* (SINCOS encoder interface small option module)
- *UD53 User Guide* (Resolver interface small option module)
- *UD55 User Guide* (Cloning interface small option module)
- *UD70 User Guide* (Large option module and software)
- *UD71 User Guide* (Serial communications large option module)
- *UD73 User Guide* (Profibus-DP large option module)
- *UD74 User Guide* (Interbus large option module)
- *UD75 CT Net User Guide* (Large option module)
- *UD76 User Guide* (Modbus Plus large option module)
- *UD77 User Guide* (Device Net large option module)
- *UD78 User Guide* (Servo large option module)
- *CAN User Guide* (Large option module)
- *CANopen User Guide* (Large option module)
- *Universal Keypad User Guide*
- *Universal Keypad Advanced User Guide*

Please also see the Unisoft drive commissioning software which contains a help file detailing full advanced parameter descriptions and other useful information.

2.9 Items supplied with the drive


Size 1	Size 2	Size 3	Size 4	Size 5 control	Size 5 power
Certificate of quality	Certificate of quality	Certificate of quality	Certificate of quality	Certificate of quality	Certificate of quality
Safety Booklet	Safety Booklet	Safety Booklet	Safety Booklet	Safety Booklet	Interface leads
Mounting brackets  x1  x2	Mounting brackets  x1  x2	Mounting brackets  x1  x1  x1	Mounting brackets  x1  x1  x2	Mounting brackets  x2	     
Control connectors	Control connectors	Control connectors	Control connectors	Control connectors	
					
Gasket foam	Gasket foam	Gasket foam	Gasket foam	UL Warning label	
				CAUTION Risk of Electric Shock Power down unit 10minutes before removing cover	
Power connector	Power connector	UL Warning label	UL Warning label		
		CAUTION Risk of Electric Shock Power down unit 10minutes before removing cover	CAUTION Risk of Electric Shock Power down unit 10minutes before removing cover		
UL Warning label	UL Warning label				
CAUTION Risk of Electric Shock Power down unit 10minutes before removing cover	CAUTION Risk of Electric Shock Power down unit 10minutes before removing cover				

3 Mechanical Installation


This chapter describes how to use all mechanical features to install the drive. Key features of this chapter include:

- Option module fitting
- Mounting methods
- Enclosure sizing and layout
- Terminal location and torque settings

3.1 Safety information



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



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

3.2 Planning the installation

The following considerations must be made when planning the installation:

3.2.1 Access

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

3.2.2 Environmental protection

The drive must be protected from:

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

3.2.3 Cooling

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

For further information, please refer to section 3.7.2 *Enclosure sizing* on page 24.

3.2.4 Electrical safety

The installation must be safe under normal and fault conditions. Electrical installation instructions are given in Chapter 4 *Electrical Installation* on page 37.

3.2.5 Fire protection

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

3.2.6 Electromagnetic compatibility

Variable speed drives are powerful electronic circuits which can cause electromagnetic interference if not installed correctly with careful attention to the layout of the wiring.


Some simple routine precautions can prevent disturbance to typical industrial control equipment.

If it is necessary to meet strict emission limits, or if it is known that electromagnetically sensitive equipment is located nearby, then full precautions must be observed. These will include the use of RFI filters at the drive inputs, which must be located very close to the drives. Space must be made available for the filters and allowance made for carefully segregated wiring. Both levels of precautions are covered in section 4.8 *EMC (Electromagnetic compatibility)* on page 44.


3.2.7 Hazardous areas

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

3.3 Terminal cover removal



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.



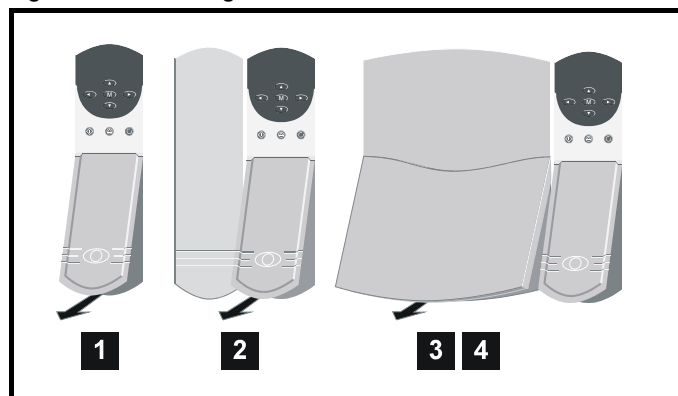
Stored charge
The drive contains capacitors that remain charged to a potentially lethal voltage after the AC supply has been disconnected. If the drive has been energised, the AC supply must be isolated at least ten minutes before work may continue.

Normally, the capacitors are discharged by an internal resistor. Under certain, unusual fault conditions, it is possible that the capacitors may fail to discharge, or be prevented from being discharged by a voltage applied to the output terminals. If the drive has failed in a manner that causes the display to go blank immediately, it is possible the capacitors will not be discharged. In this case, consult Control Techniques or their authorised distributor.

3.3.1 Removing the terminal covers

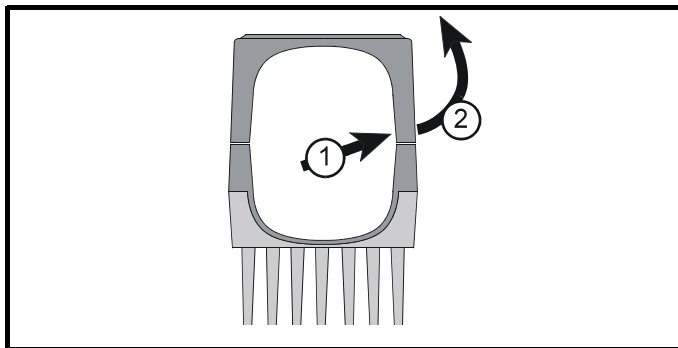
Unidrive sizes 1 to 4 and the size 5 control module are fitted with one or two terminal covers depending on the model size. When model sizes 1, 3 and 4 are through-panel mounted, the terminal cover(s) must first be removed in order for access to be gained to the lower mounting holes.

Figure 3-1 Removing the terminal covers



The terminal cover(s) of all models must be removed for access to the electrical connectors.

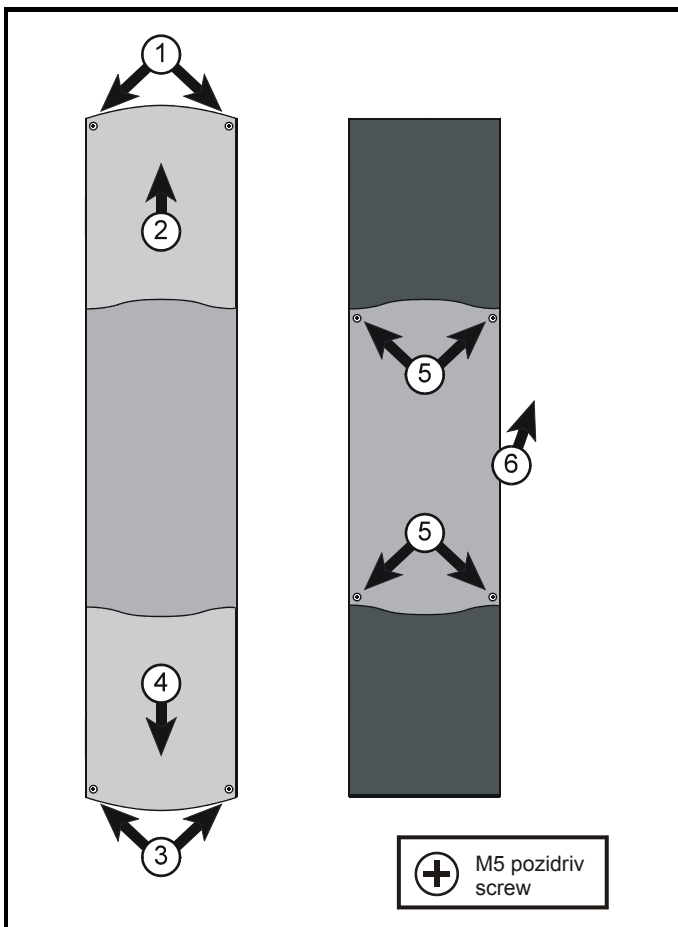
Figure 3-2 View from the underside showing how a terminal cover is removed from the drive



Remove terminal covers, as follows:

1. Working on either side of the terminal cover, push the inner edge of the cover firmly outward until it becomes unclipped.
2. Swing the side of the cover outward and upward until the remaining clips become released.
3. Remove the gland plate

Figure 3-3 Removing the three terminal covers on the Size 5 power module



Remove the three terminal covers on the power module, as follows:

1. Remove the two pozidriv screws.
 2. Remove the upper cover.
 3. Remove the two pozidriv screws.
 4. Remove the lower cover until it is released from the middle cover.
 5. Remove the four screws that are now revealed.
 6. Remove the middle cover.
- All the power terminals and ribbon-cable connectors are now accessible.

3.4 Ingress protection

Size 1 to 4:

Gland plate(s) not fitted: IP00

Gland plate(s) fitted; cable glands not fitted: IP10

Gland plate(s) fitted; cable-glands fitted: IP40, NEMA 1

Size 5 power and control modules: IP00

3.5 Option module fitting / removal

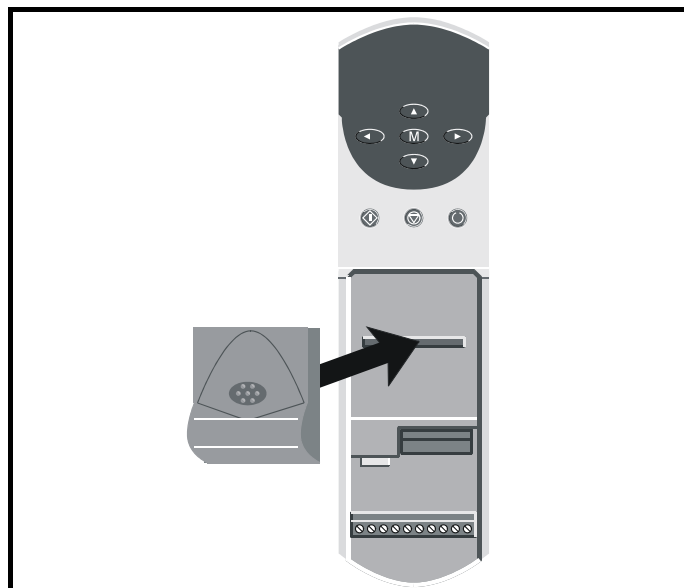


Power down the drive before fitting / removing an option module. Failure to do so may result in damage to the product.

CAUTION

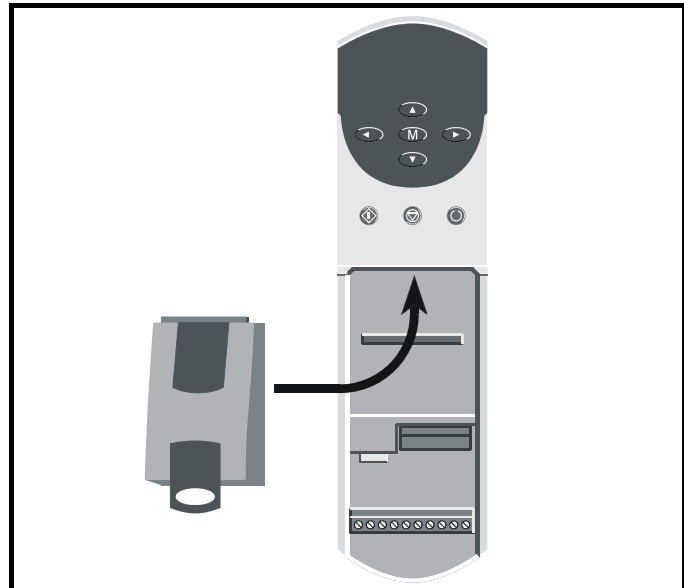
The small option module should be placed under the two green securing clips in the main housing beneath the drive display and pushed firmly into place. Ensure the two connectors mate securely.

Figure 3-4 Fitting of a Unidrive small option module



The large option module slides into the space directly beneath the drive display so that only the front face of the module can be seen. Ensure the module clicks into place indicating that the two connectors have mated successfully.

Figure 3-5 Fitting of a Unidrive large option module




3.6 Mounting methods

Unidrive sizes 1 to 4 can be either through hole or surface mounted using the appropriate brackets.

The Unidrive size 5 consists of two modules:


- the control module should be surface mounted
- the power module must be through hole mounted.

The following drawings show the dimensions of the drive and mounting holes for each method to allow a back plate to be prepared.



WARNING

Lifting the drive
The weights of model sizes 3 and 4 are 22kg (49lbs) and 70kg (154lbs) respectively; the size 5 power module exceeds 100kg (220lbs). Use appropriate safeguards when lifting these models.



WARNING

If the drive has been used at high load levels for a period of time, the heatsink may be hot. Human contact with the heatsink should be restricted.

Figure 3-6 Surface mounting of model sizes 1 and 2

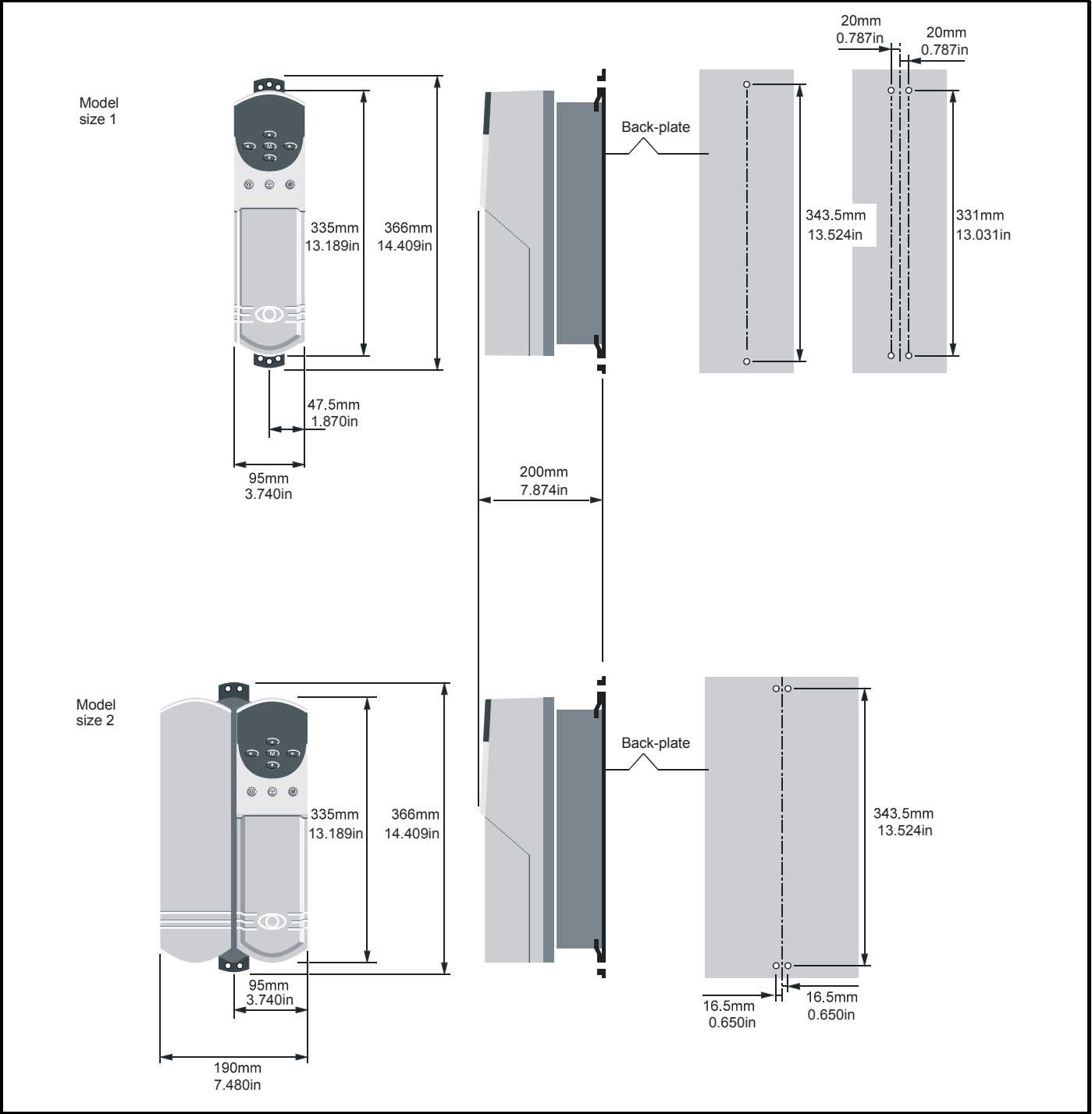


Figure 3-7 Surface mounting of model sizes 3 and 4

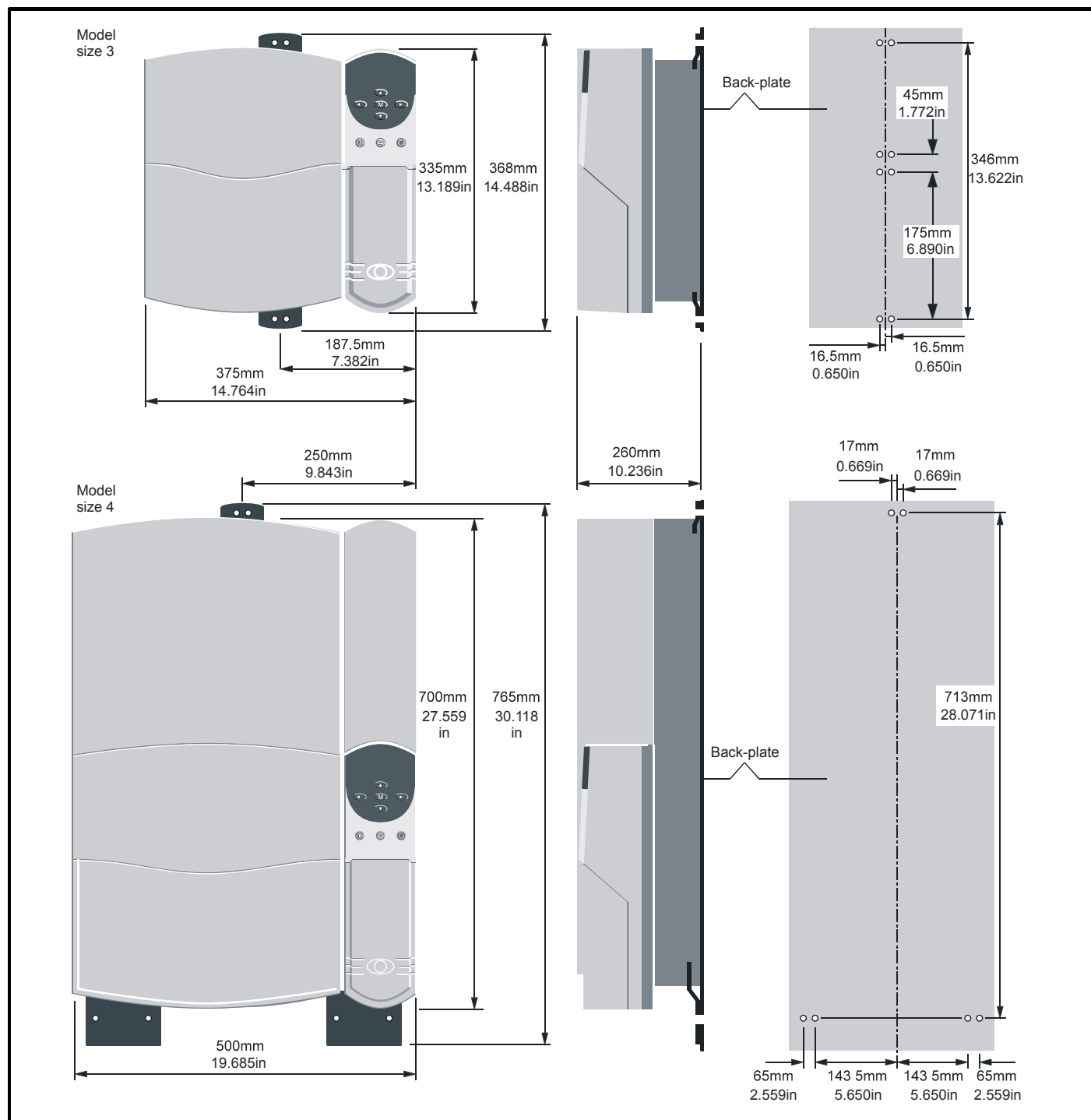
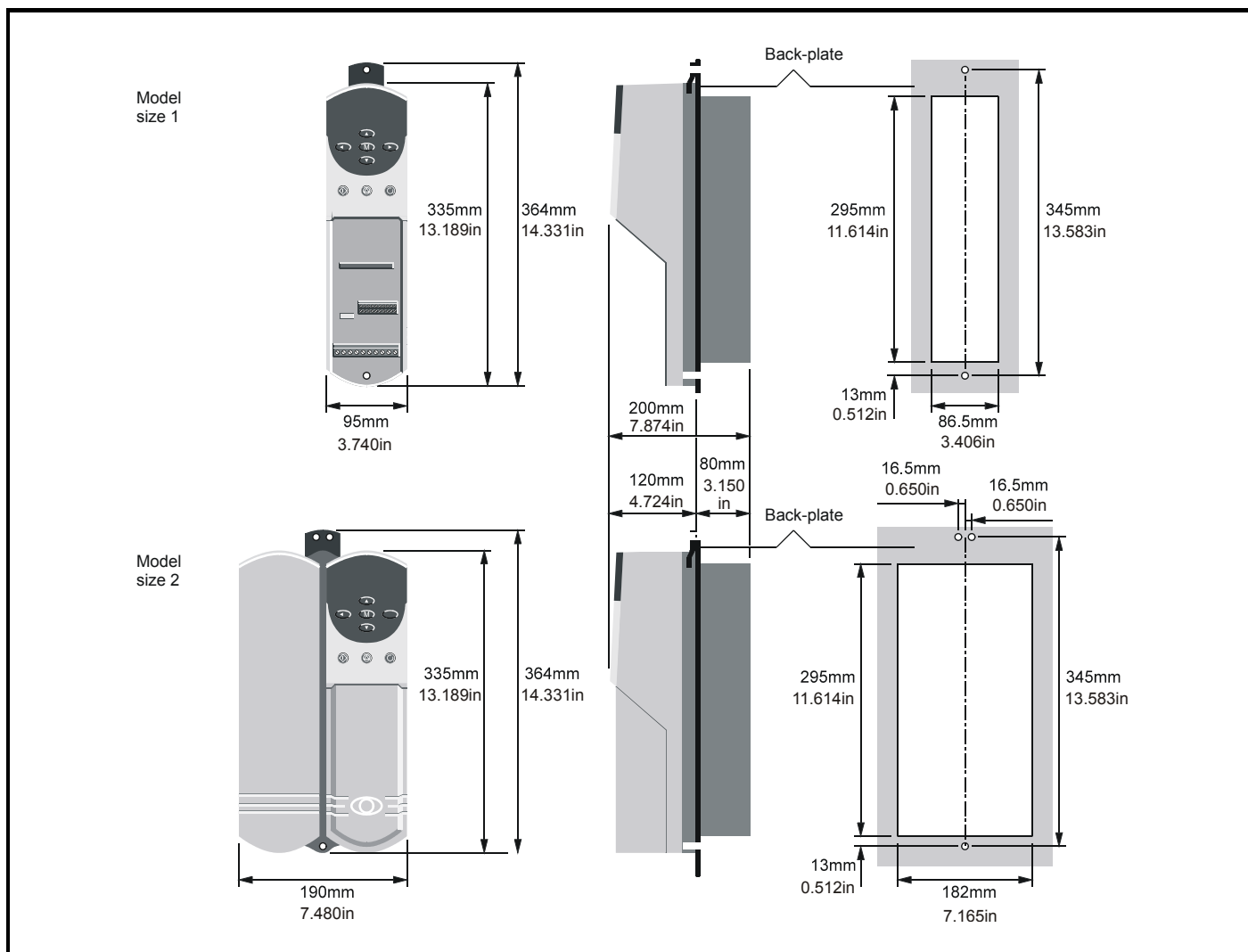


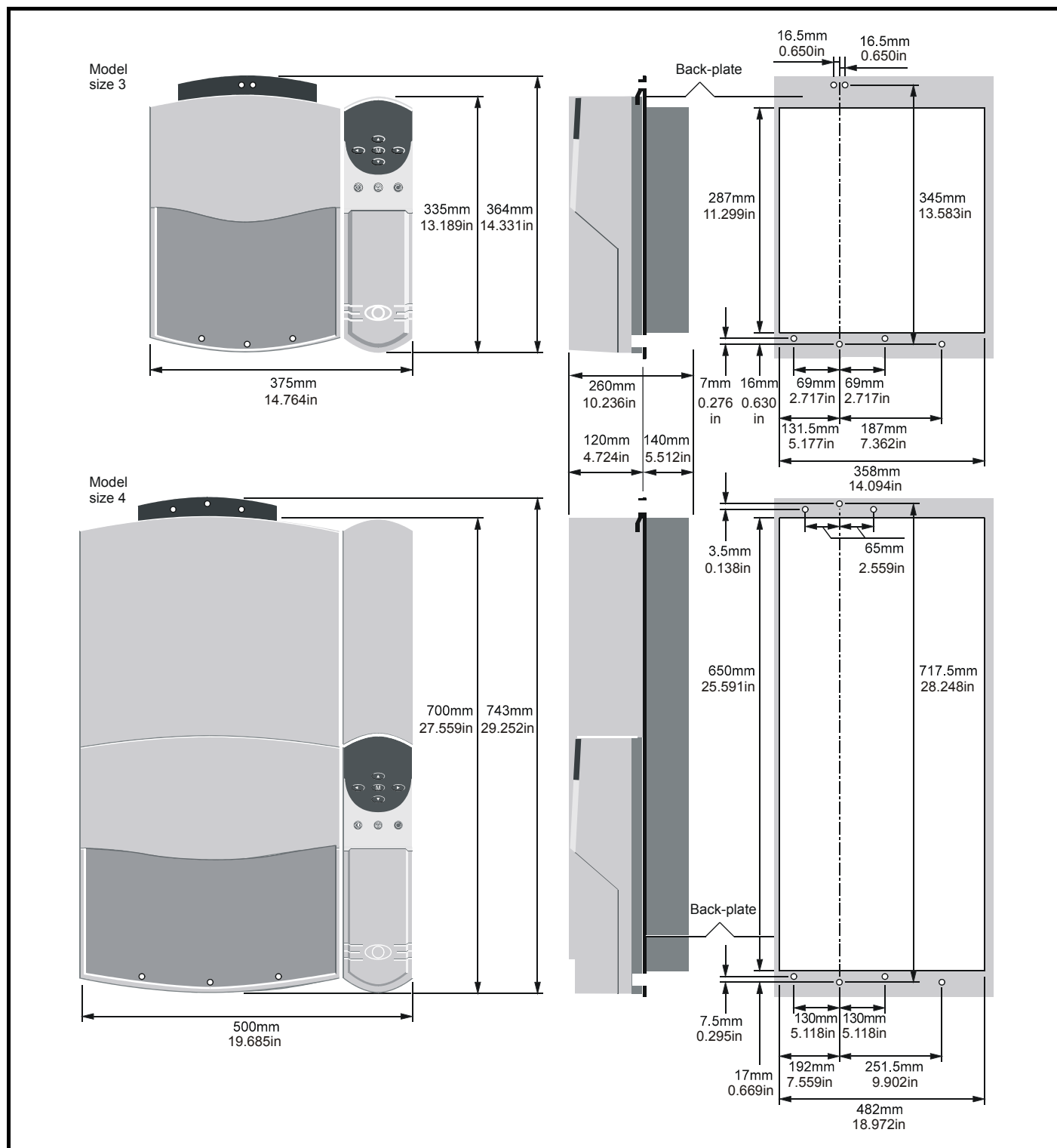
Figure 3-8 Through-panel mounting of model sizes 1 and 2



NOTE

When drives are through-panel mounted, a baffle plate is required to ensure the correct level of air-flow is maintained through the heatsink. For further information, please refer to section 3.9 *Baffle plates* on page 28.

Figure 3-9 Through-panel mounting of model sizes 3 and 4



NOTE

When drives are through-panel mounted, a baffle plate is required to ensure the correct level of air-flow is maintained through the heatsink. For further information, please refer to section 3.9 *Baffle plates* on page 28.

Figure 3-10 Unidrive Size 5 overall dimensions

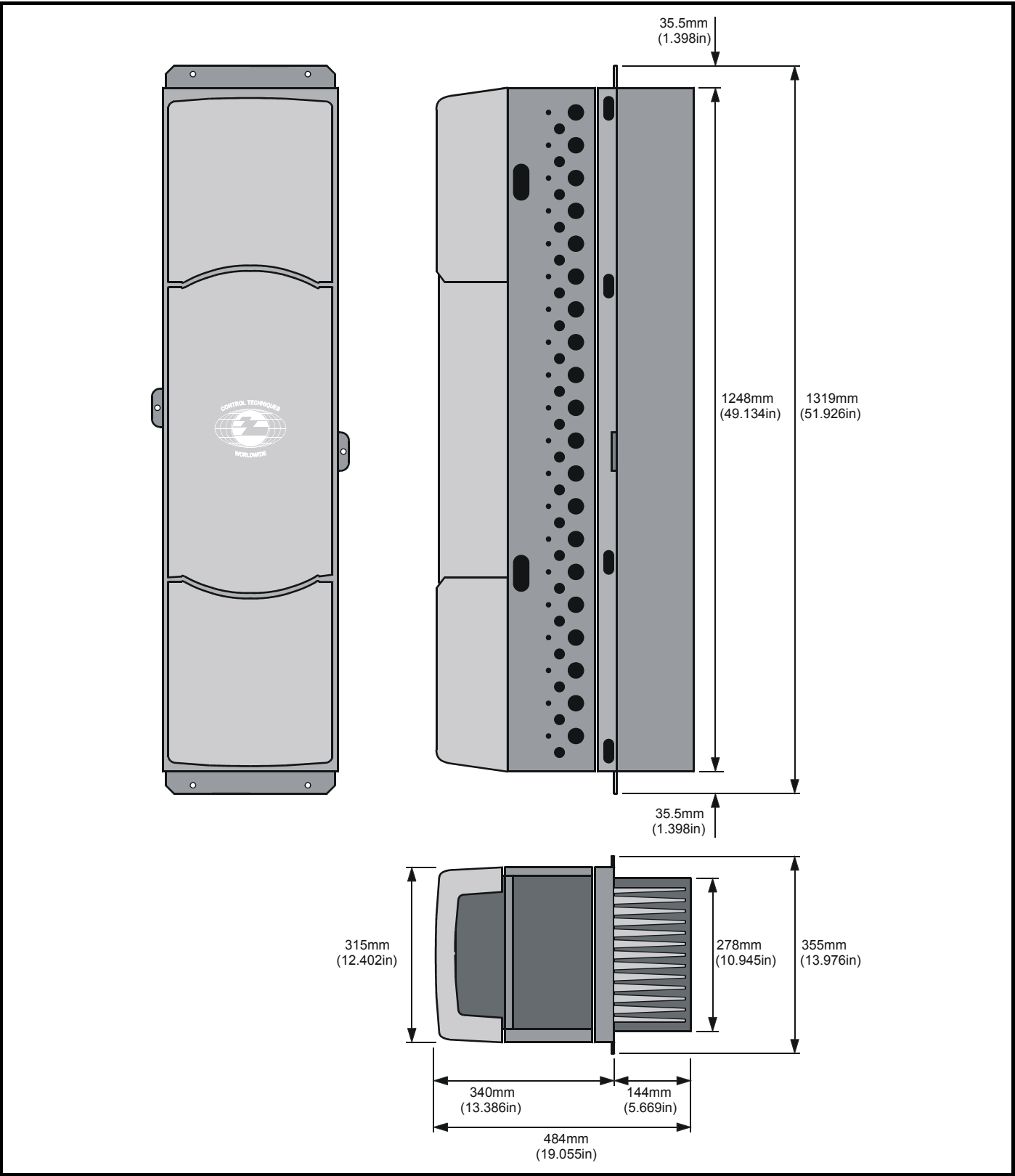


Figure 3-11 Unidrive Size 5 mounting dimensions

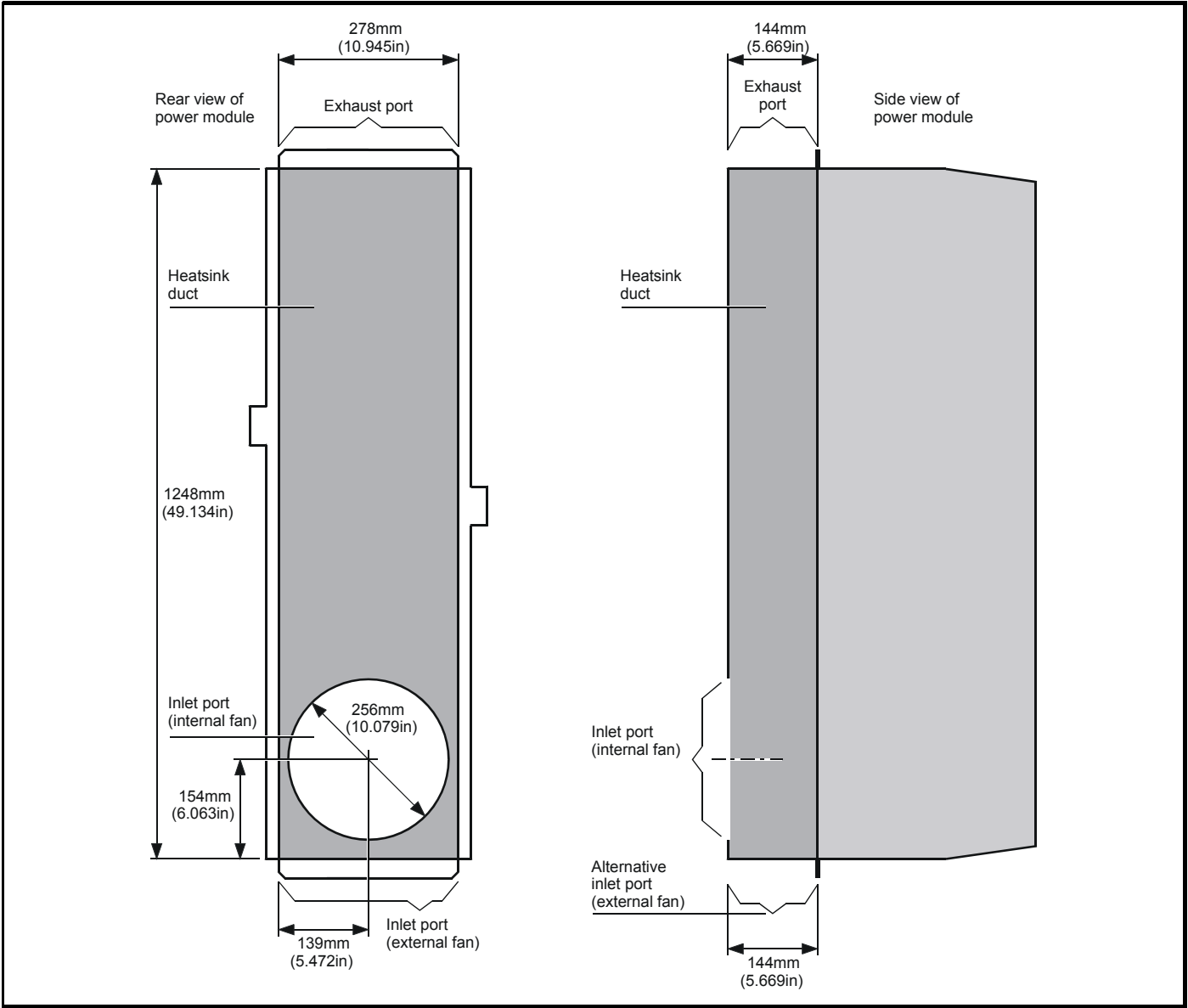


Figure 3-12 Unidrive size 5 backplate mounting holes and aperture

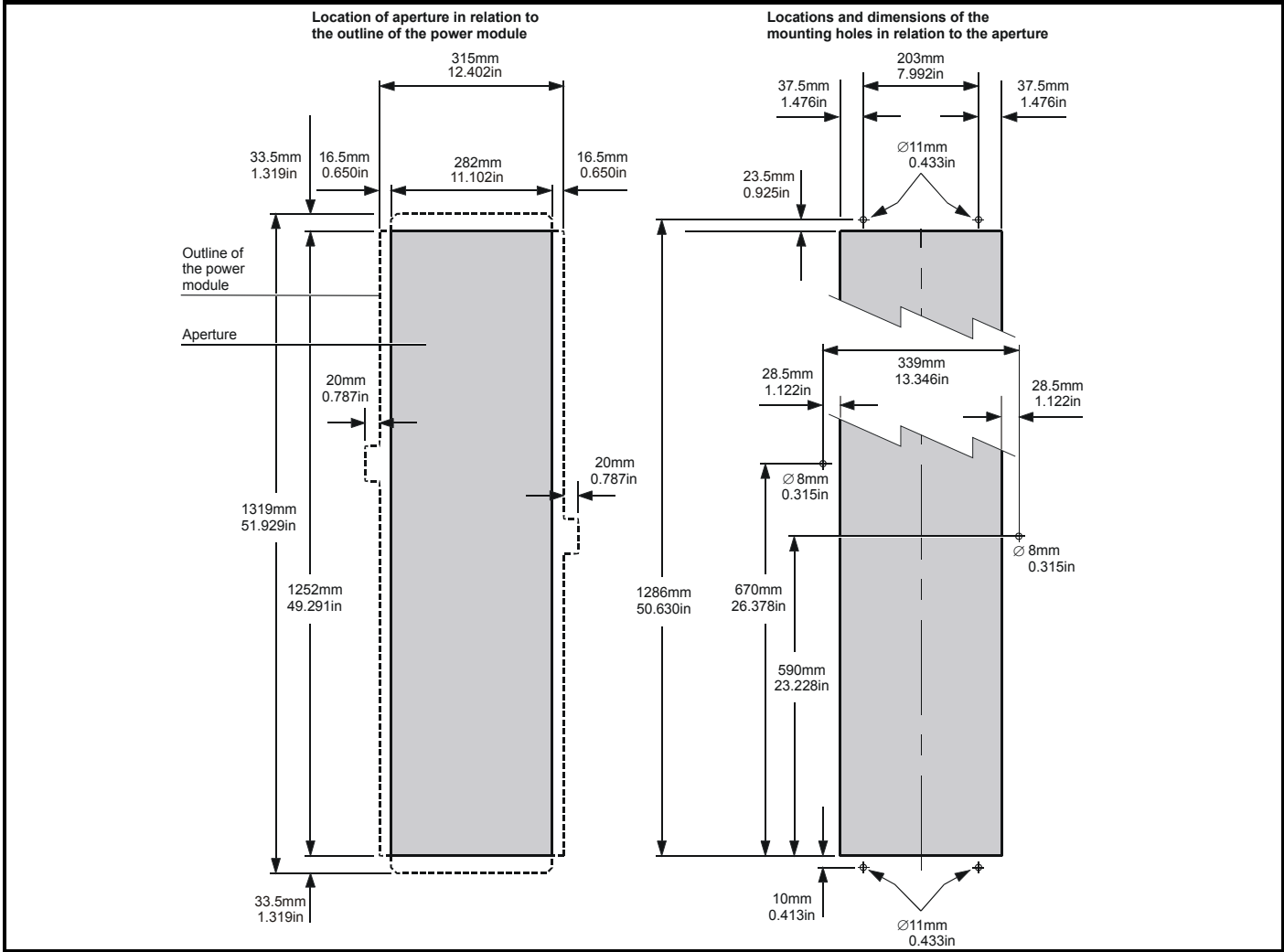
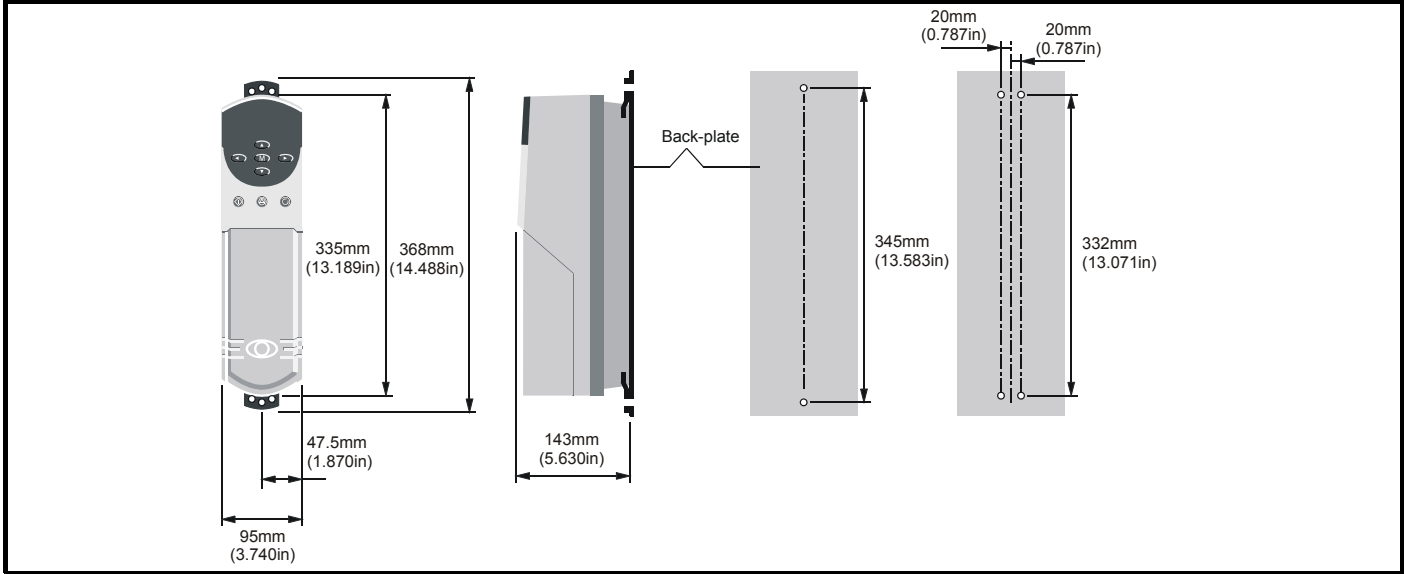


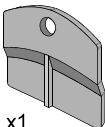
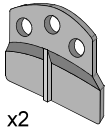
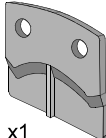
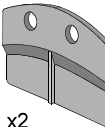
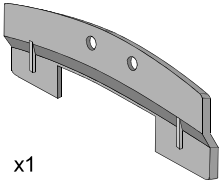
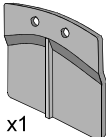
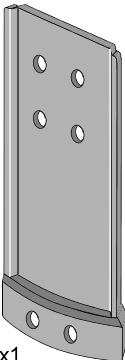
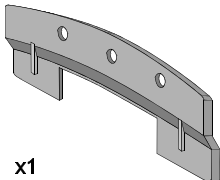
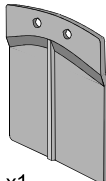
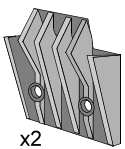
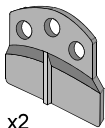
Figure 3-13 Unidrive Size 5 control module surface mounting



NOTE

The Unidrive size 5 control module should be located within 2m of the power module to allow the interconnections to be made using the ribbon cables supplied with the power module.

Table 3-1 General views of the mounting brackets

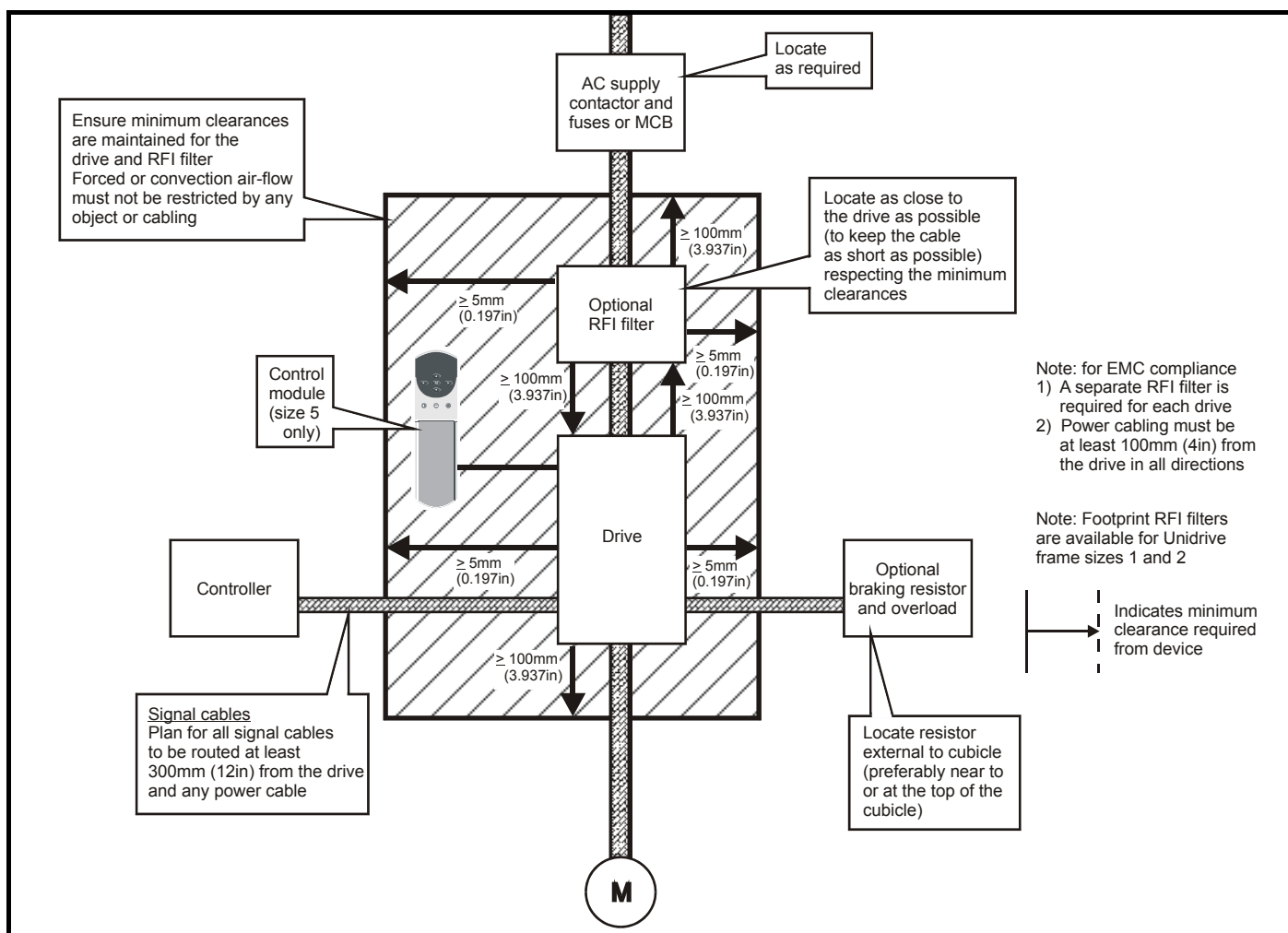
Model size	Through-panel	Surface	Hole size
1	 x1	 x2 Upper and lower	M6
2	 x1	 x2 Upper and lower	M6
3	 x1	 x1 Upper  x1 Lower	M6
4	 x1	 x1 Upper  x2 Lower	M6 (through-panel) M8 (surface)
5		 x2 Upper and lower	M6

3.7 Enclosure

3.7.1 Enclosure Layout

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

Figure 3-14 Enclosure layout



3.7.2 Enclosure sizing

1. Add the dissipation figures from section 11.1.2 *Power dissipation (all versions)* on page 191 for each drive that is to be installed in the enclosure.
2. If an RFI filter is to be used with each drive, add the dissipation figures from section 11.2.1 *Ratings* on page 197 for each RFI filter that is to be installed in the enclosure.
3. If the braking resistor is to be mounted inside the enclosure, add the average power figures for each braking resistor that is to be installed in the enclosure.
4. Calculate the total heat dissipation (in Watts) of any other equipment to be installed in the enclosure.
5. Add the heat dissipation figures obtained above. This gives a figure in Watts for the total heat that will be dissipated inside the enclosure.

Calculating the size of a sealed enclosure

The enclosure transfers internally generated heat into the surrounding air by natural convection (or external forced air flow); the greater the surface area of the enclosure walls, the better is the dissipation capability. Only the surfaces of the enclosure that are unobstructed (not in contact with a wall or floor) can dissipate heat.

Calculate the minimum required unobstructed surface area A_e for the enclosure from:

$$A_e = \frac{P}{k(T_{int} - T_{ext})}$$

Where:

- A_e Unobstructed surface area in m^2 ($1m^2 = 10.8 ft^2$)
- T_{ext} Maximum expected ambient temperature in $^{\circ}C$ *outside* the enclosure
- T_{int} Maximum permissible ambient temperature in $^{\circ}C$ *inside* the enclosure
- P Power in Watts dissipated by *all* heat sources in the enclosure
- k Heat transmission coefficient of the enclosure material in $Wm^2/^{\circ}C$

Example

To calculate the size of an enclosure for the following:

- Two UNI1405 models
- Each drive to operate at 4.5kHz PWM switching frequency
- RFI filter for each drive
- Braking resistors are to be mounted outside the enclosure
- Maximum ambient temperature inside the enclosure: 40°C
- Maximum ambient temperature outside the enclosure: 30°C

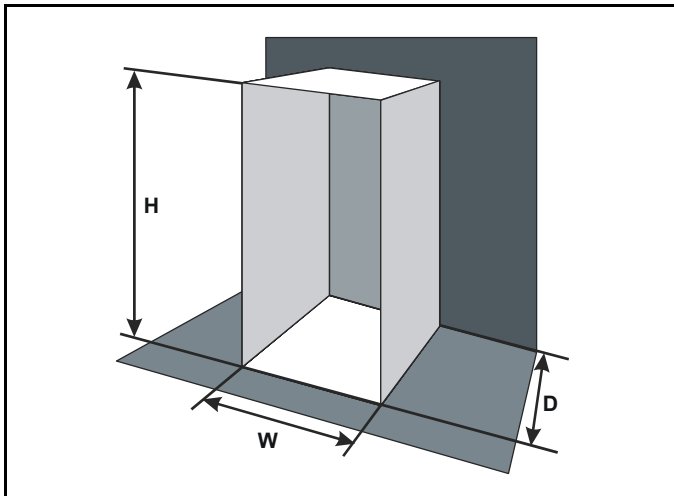
Dissipation of each drive: 190W

Dissipation of each RFI filter: 7.7W (max)

Total dissipation: $2 \times (190 + 7.7) = 395.4\text{W}$

The enclosure is to be made from painted 2mm (0.079 in) sheet steel having a heat transmission coefficient of $5.5\text{W/m}^2/^{\circ}\text{C}$. Only the top, front, and two sides of the enclosure are to be free to dissipate heat.

Figure 3-15 Enclosure having front, sides and top panels free to dissipate heat



Insert the following values:

T_{int}	40°C
T_{ext}	30°C
k	5.5
P	395.4W

The minimum required heat conducting area is then:

$$A_e = \frac{395.4}{5.5(40 - 30)}$$

$$= 7.2\text{m}^2 (78\text{ft}^2) \quad (1\text{m} = 3.3\text{ft})$$

Estimate two of the enclosure dimensions - the height (H) and depth (D), for instance. Calculate the width (W) from:

$$W = \frac{A_e - 2HD}{H + D}$$

Inserting $H = 2\text{m}$ and $D = 0.6\text{m}$, obtain the minimum width:

$$W = \frac{7.2 - (2 \times 2 \times 0.6)}{2 + 0.6}$$

$$= 1.8\text{m} (6\text{ft})$$

If the enclosure is too large for the space available, it can be made smaller only by attending to one or all of the following:

- Using a lower PWM switching frequency to reduce the dissipation in the drives
- Reducing the ambient temperature outside the enclosure, and/or applying forced-air cooling to the outside of the enclosure
- Reducing the number of drives in the enclosure
- Removing other heat-generating equipment

Calculating the air-flow in a ventilated enclosure

The dimensions of the enclosure are required only for accommodating the equipment. The equipment is cooled by the forced air flow.

Calculate the minimum required volume of ventilating air from:

$$V = \frac{3kP}{T_{\text{int}} - T_{\text{ext}}}$$

Where:

V	Air-flow in m^3 per hour
T_{ext}	Maximum expected ambient temperature in $^{\circ}\text{C}$ <i>outside</i> the enclosure
T_{int}	Maximum permissible ambient temperature in $^{\circ}\text{C}$ <i>inside</i> the enclosure
P	Power in Watts dissipated by <i>all</i> heat sources in the enclosure
k	Ratio of $\frac{P_o}{P_i}$

Where:

P_o is the air pressure at sea level

P_i is the air pressure at the installation

Typically use a factor of 1.2 to 1.3, to allow also for pressure-drops in dirty air-filters.

Example

To calculate the size of an enclosure for the following:

- Three UNI3401 models
- Each drive to operate at 6kHz PWM switching frequency
- RFI filter for each drive
- Braking resistors are to be mounted outside the enclosure
- Maximum ambient temperature inside the enclosure: 40°C
- Maximum ambient temperature outside the enclosure: 30°C

Dissipation of each drive: 670W

Dissipation of each RFI filter: 12.8W (max)

Total dissipation: $3 \times (670 + 60) = 2048.4\text{W}$

Insert the following values:

T_{int}	40°C
T_{ext}	30°C
k	1.3
P	2048.4W

Then:

$$V = \frac{3 \times 1.3 \times 2048.4}{40 - 30}$$

$$= 799\text{m}^3 / \text{hr} \quad (471\text{ft}^3 / \text{min})$$

$$(1\text{m}^3 / \text{hr} = 0.59\text{ft}^3 / \text{min})$$

3.8 Ventilation

Unidrive sizes 1-4 are ventilated by internally supplied heatsink fans. Ensure the minimum clearances around the drive are maintained to allow air to flow freely.

The Unidrive size 5 requires ventilation at the front (control) and rear (heatsink) of the module.

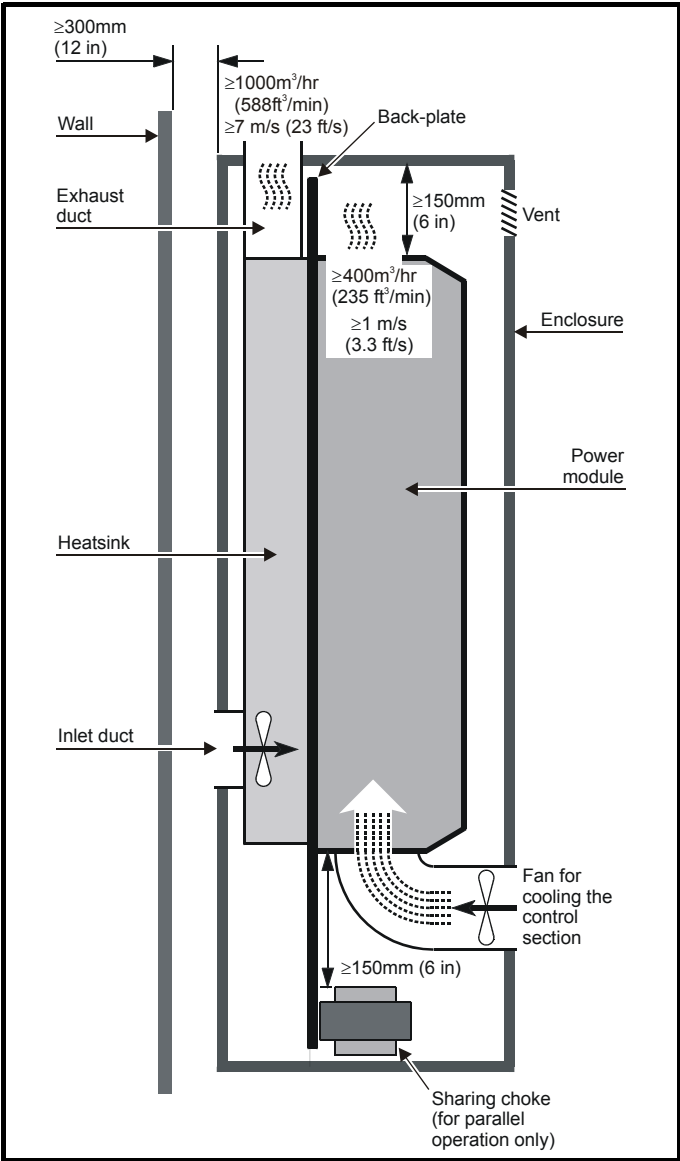
Two parallel independent paths must be provided as shown to ensure the heat produced is dispersed.

A heatsink fan is fitted as standard on request however this requires either a 110Vac or 240Vac external single phase power supply to be connected at the bottom left hand corner of the power module.

The choice of fan power supply must be made when ordering the power module.

3.8.1 Ventilation requirements for the Size 5 power module

Figure 3-16 Typical ventilation arrangement using the internal heatsink fan



Cooling the heatsink

When designing the cooling system, allow for the rear of the power module to produce 4kW of heat. This heat is dissipated in a heatsink that is inside a vertical duct at the rear of the power module. Forced air-flow is required through the duct in order to cool the heatsink.

If a fan is not fitted internally, the air flow must be obtained by an external fan and ducting. The blanking plate at the lower end of the duct must be removed in order to expose the inlet port (see Figure 3-17).

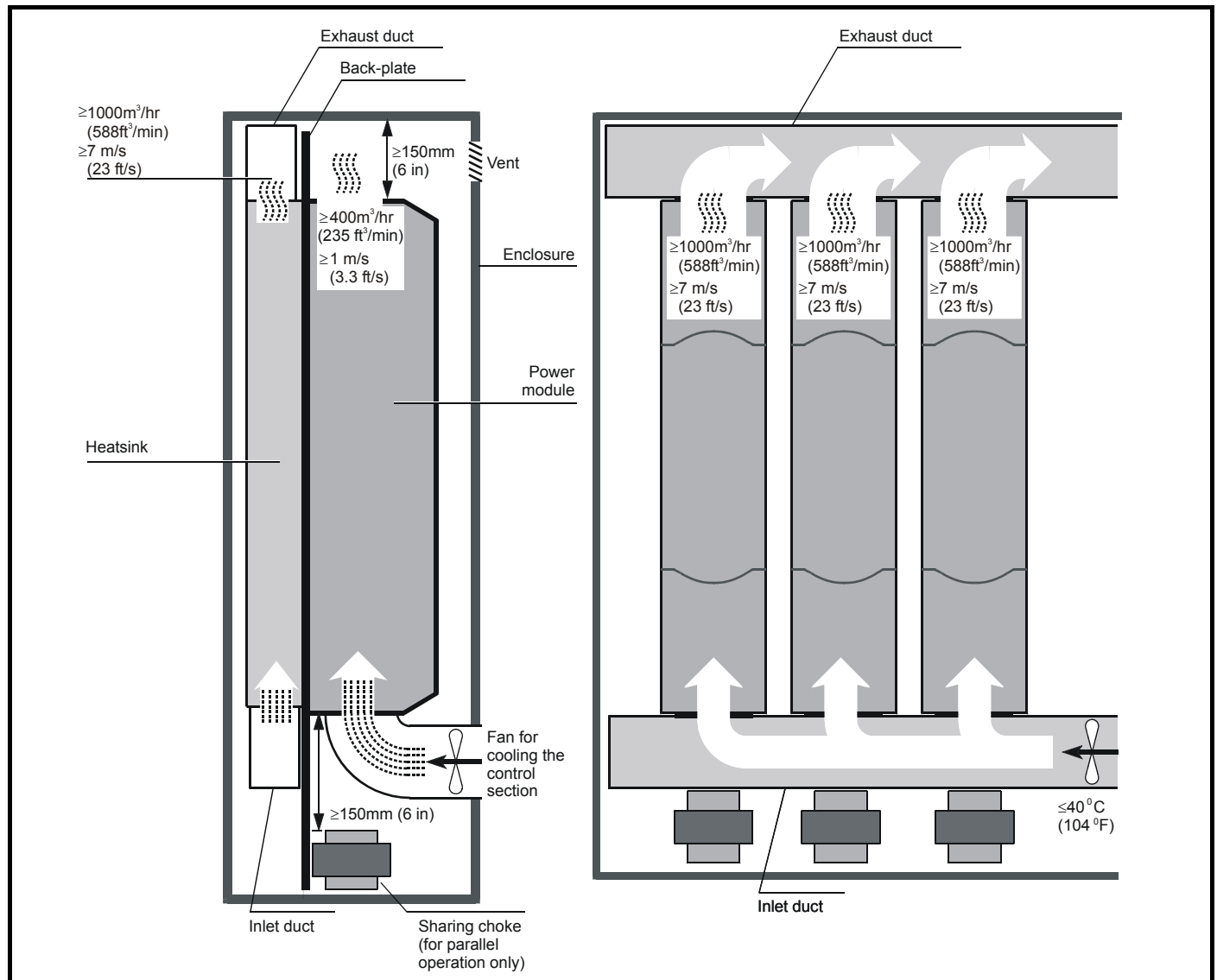
The air supply must be obtained from outside the enclosure and the exhaust air must exit the enclosure. The maximum permissible heatsink temperature is 95°C (203°F). Take the following precautions to help ensure this is not exceeded:

1. Ensure the temperature of the air at the inlet port of the heatsink does not exceed 40°C (104°F).
2. Ensure that the upward flow of the exhaust air from the top of the heatsink will be unobstructed. Fit additional ducting having the same cross-sectional area as the heatsink to extract all the exhaust air from the enclosure.
3. Ensure the volume of the exhaust air is not less than 1,000m³/hr (588ft³/min), equivalent airspeed 7m/s (23 ft/s). Measure the air-flow to ensure it is adequate.
4. If the power module has a ventilation fan fitted in the heatsink, to ensure that a sufficient amount of air is available to supply the fan, locate the enclosure at least 300mm (12 in) from a wall or large object that will be behind the enclosure. Fit a duct between the rear panel of the enclosure and the inlet port at the rear of the heatsink. If the power module does not have an internal fan, a forced air-flow must be ducted into the inlet port at the bottom of the heatsink.
5. Ensure that the exhaust air is not recycled into the inlet port of the heatsink or into the enclosure.

NOTE

The solutions shown for Unidrive size 5 ventilation are to illustrate the important points which must be considered. Many variations of this are possible to suit the specific site conditions.

Figure 3-17 Typical ventilation arrangement using an external heatsink fan



Cooling the control components in the Size 5 power module

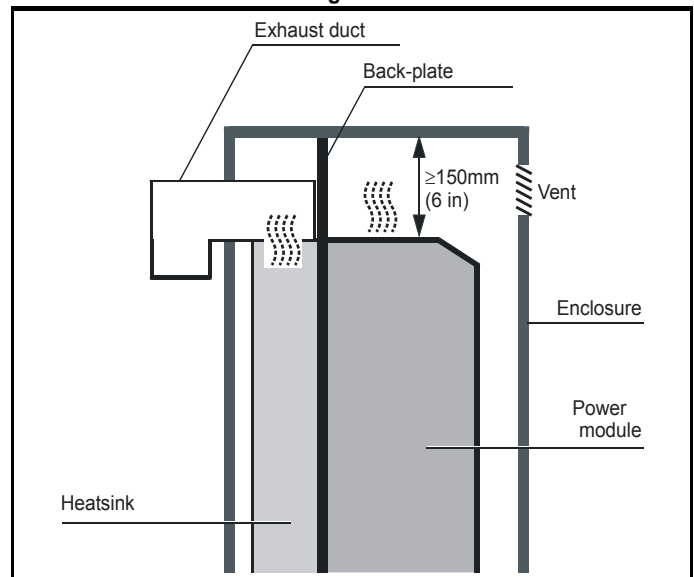
The circuit boards, DC-bus capacitors, etc., in the front part of the power module generate about 700W of heat when the power module is operating at full load. Since the heatsink fan does not ventilate these components, a separate air-flow must be used to remove the heat. The following precautions must be taken:

1. It is recommended that a fan is installed in the lower part of the enclosure door to drive air into the enclosure. An air vent should be added to the upper part of the door to remove the exhaust air.
2. It is recommended that the airflow is ducted into the front of the drive. This airflow must be at least 400m³/hr (235ft³/min), equivalent air speed of 1m/s (3.3ft/s) through the front control section of the size 5 power module.

If the airflow is not ducted into the front of the drive, the airflow into the enclosure must be at least 1000m³/hr (588ft³/min), equivalent air speed of 7m/s (23ft/s) for a enclosure of 800mm x 800mm x 2200mm.

3. The maximum temperature of the air in the enclosure must not exceed 40°C (104°F).

Figure 3-18 Alternative location of the exhaust duct in order to minimize overall height



3.11 RFI filters

RFI filters are available for all sizes of Unidrive as follows:

Table 3-3 RFI filters

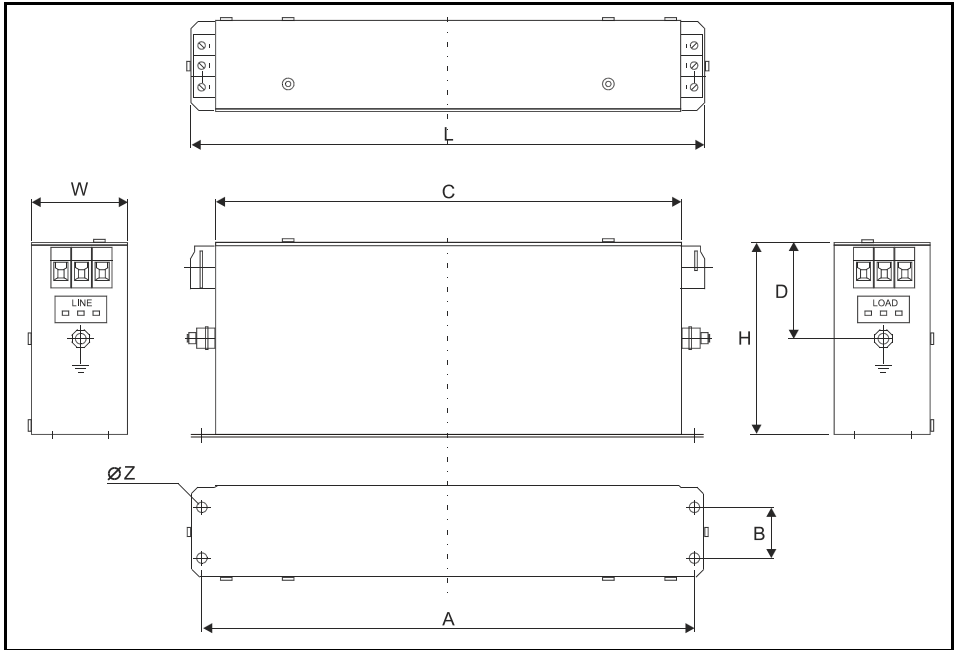
Drive	Filter type	Schaffner part no.	CT part no.	Max cable size	Weight
UNI1201 to 1205	Bookcase	FS5111-10-29	4200-6105	4 mm ² 10 AWG	1.4kg (3lb)
UNI1201 to 1205	Footprint or Bookcase	FS5101-10-07	4200-6104	4 mm ² 10 AWG	2.1kg (5lb)
UNI2201 to 2202	Bookcase	FS5112-16-07	4200-6109	4 mm ² 10 AWG	2.7kg (6lb)
UNI2201 to 2202	Footprint or Bookcase	FS5106-16-07	4200-6108	4 mm ² 10 AWG	2.1kg (5lb)
UNI2203	Bookcase	FS5113-25-29	4200-6114	4 mm ² 10 AWG	2.7kg (6lb)
UNI2203	Footprint or Bookcase	FS5106-25-07	4200-6113	4 mm ² 10 AWG	2.1kg (5lb)
UNI3201 to 3202	Bookcase	FS5113-50-53	4200-6116	10 mm ² 6 AWG	3.8kg (9lb)
UNI3203	Bookcase	FS5113-63-34	4200-6117	10 mm ² 6 AWG	3.8kg (9lb)
UNI3204	Bookcase	FS5113-100-35	4200-6106	50 mm ² 1/0 AWG	7.8kg (17lb)
UNI1401 to 1405	Bookcase	FS5111-10-29	4200-6105	4 mm ² 10 AWG	1.4kg (3lb)
UNI1401 - 1405	Footprint or Bookcase	FS5101-10-07	4200-6104	4 mm ² 10 AWG	2.1kg (5lb)
UNI2401	Bookcase	FS5112-16-07	4200-6109	4 mm ² 10 AWG	2.7kg (6lb)
UNI2401	Footprint or Bookcase	FS5106-16-07	4200-6108	4 mm ² 10 AWG	2.1kg (5lb)
UNI2402 to 2403	Bookcase	FS5113-25-29	4200-6114	4 mm ² 10 AWG	2.7kg (6lb)
UNI2402 to 2403	Footprint or Bookcase	FS5106-25-07	4200-6113	4 mm ² 10 AWG	2.1kg (5lb)
UNI3401 to 3403	Bookcase	FS5113-50-53	4200-6116	10 mm ² 6 AWG	3.8kg (9lb)
UNI3404	Bookcase	FS5113-63-34	4200-6117	10 mm ² 6 AWG	3.8kg (9lb)
UNI3405	Bookcase	FS5113-100-35	4200-6106	50 mm ² 1/0 AWG	7.8kg (17lb)
UNI4401 to 4402	Bookcase	FS5113-150-40	4200-6107	95 mm ² 4/0 AWG	7.8kg (17lb)
UNI4403 to 4404	Bookcase	FS5113-180-40	4200-6111	95 mm ² 4/0 AWG	15kg (33lb)
UNI4405	Bookcase	FS5113-220-37	4200-6112	150 mm ² 6/0 AWG	15kg (33lb)
UNI5401	Bookcase	FS113-300-99	4200-6115	M12 stud	16kg (35lb)

The RFI filters can be surface-mounted only.

Mount the RFI filter following the guidelines in Figure 4-12 *EMC compliance* on page 48.

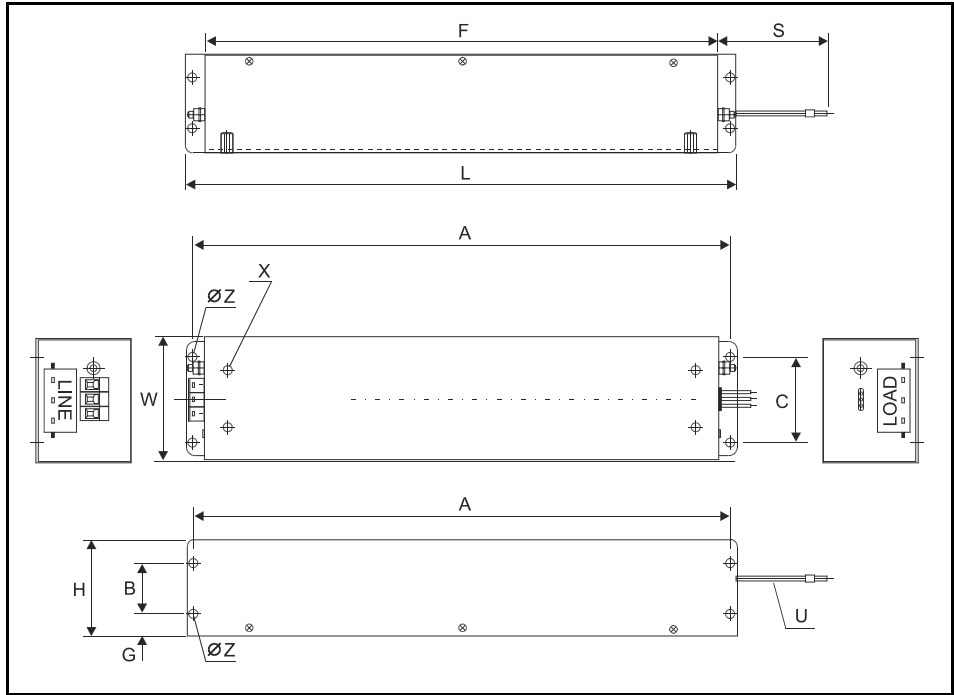
3.11.1 Unidrive size 1 filters

Figure 3-21 Unidrive size 1 bookcase mounted filter



Dimension	RFI Filter
	4200-6105 FS5111-10-29
Model	UNI1201 to UNI1205 UNI1401 to UNI1405
A	230mm (9.055in)
B	25mm (0.984in)
C	218mm (8.583in)
D	47.5mm (1.870in)
H	95mm (3.740in)
L	240mm (9.449in)
W	45mm (1.772in)
Z	4.5mm (0.177in)
Ground Terminal	M5

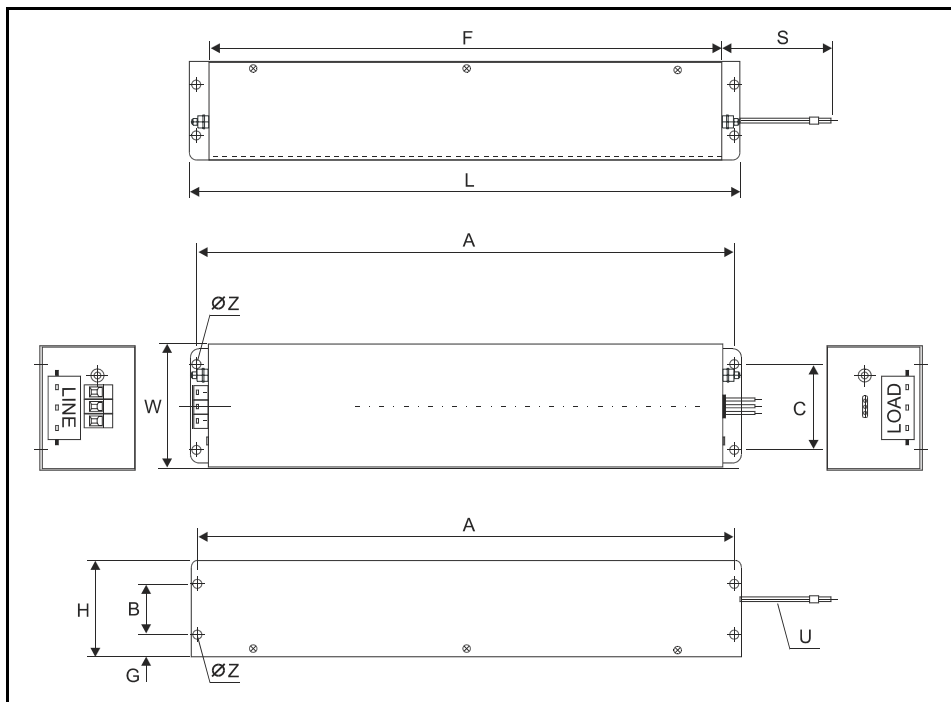
Figure 3-22 Unidrive size 1 footprint or bookcase mounted filter



Dimension	RFI Filter
	4200-6104 FS5101-10-07
Model	UNI1201 to UNI1205 UNI1401 to UNI1405
A	380mm (14.961in)
B	35mm (1.378in)
C	60mm (2.362in)
F	364mm (14.331in)
G	16.5mm (0.650in)
H	68mm (2.677in)
L	390mm (15.354in)
S	300mm ±5mm (11.811in ±0.197in)
U	3x 2.5mm ² (AWG14)
W	85mm (3.346in)
X	M6 (4x)
Z	5.5mm (0.217in)
Ground Terminal	M5

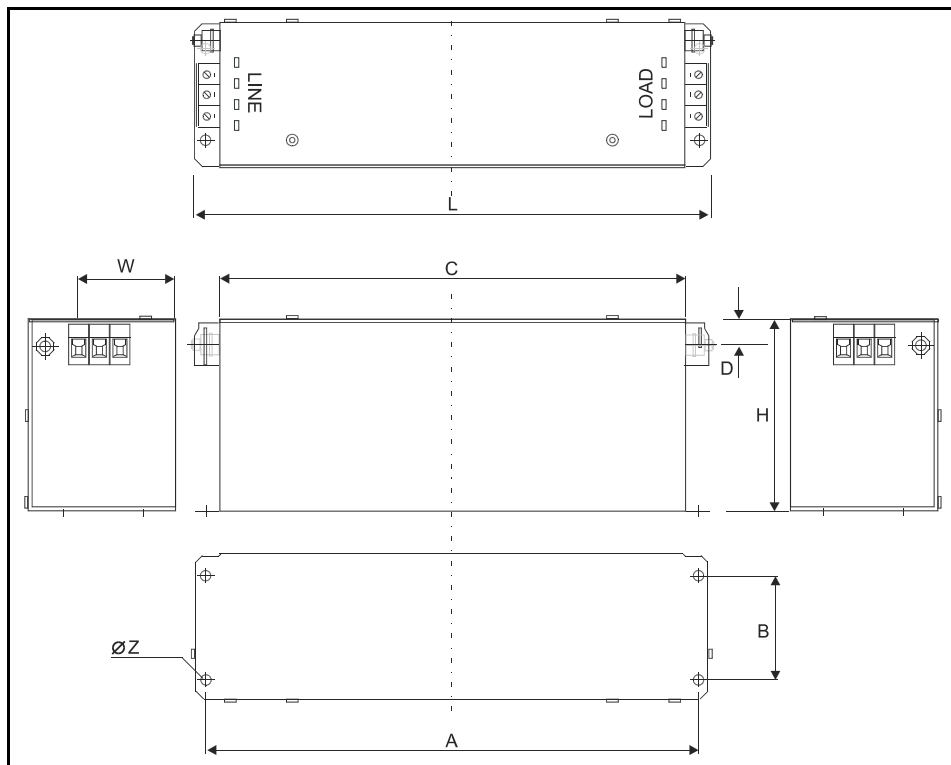
3.11.2 Unidrive size 2 filters

Figure 3-23 Unidrive size 2 (UNI2201 to UNI2202 and UNI2401) bookcase mounted filter



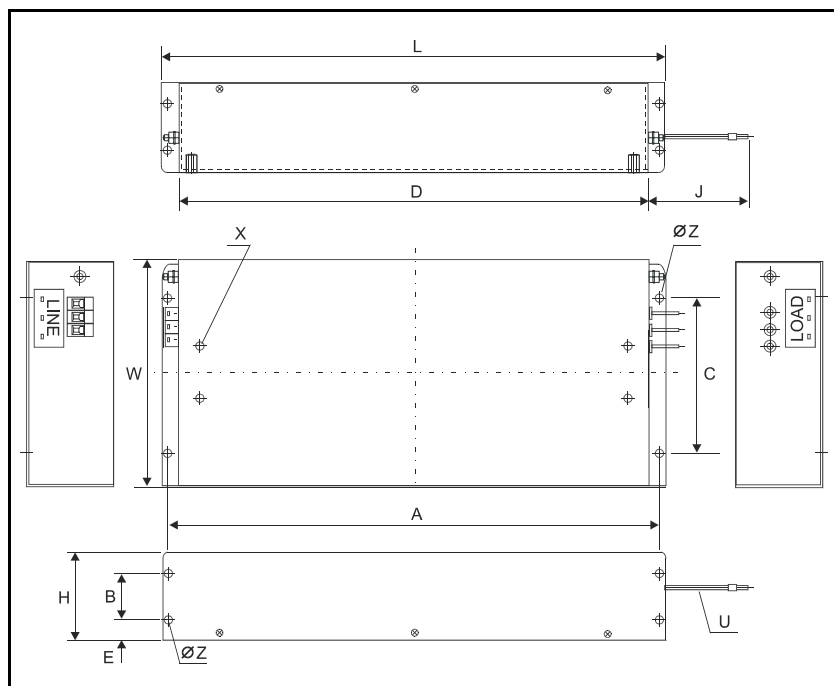
Dimension	RFI Filter
	4200-6109 FS5112-16-07
Model	UNI2201 to UNI2202 UNI2401
A	380mm (14.961in)
B	35mm (1.378in)
C	60mm (2.362in)
F	364mm (14.331in)
G	16.5mm (0.650in)
H	68mm (2.677in)
L	390mm (15.354in)
S	300mm ±5mm (11.811in ±0.197in)
U	3x 2.5mm ² (AWG14)
W	85mm (3.346in)
Z	5.5mm (0.217in)
Ground Terminal	M5

Figure 3-24 Unidrive size 2 (UNI2203, and UNI2402 to UNI2403) bookcase mounted filter



Dimension	RFI Filter
	4200-6114 FS5113-25-29
Model	UNI2203 UNI2402 to UNI2403
A	245mm (9.646in)
B	45mm (1.772in)
C	230mm (9.055in)
D	13mm (0.512in)
H	95mm (3.740in)
L	255mm (10.039in)
W	73mm (2.874in)
Z	4.5mm (0.177in)
Ground Terminal	M5

Figure 3-25 Unidrive size 2 footprint or bookcase mounted filters

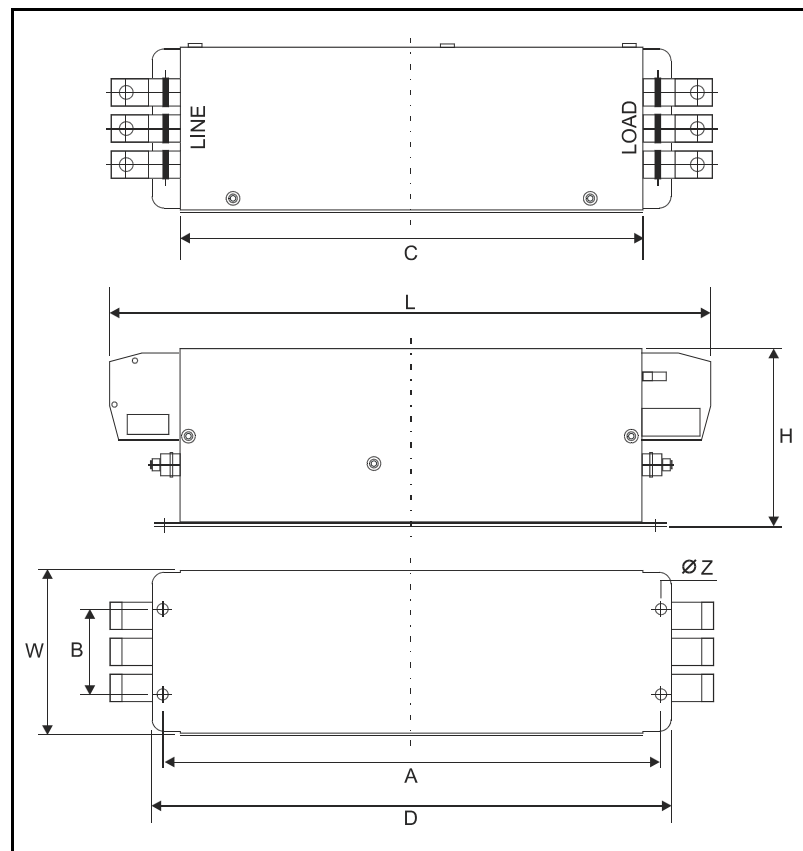


Dimension	RFI Filters	
	4200-6108 FS5106-16-07	4200-6113 FS5106-25-07
Model	UNI2201 to UNI2202 UNI2401	UNI2203 UNI2402 to UNI2403
A	385mm (15.157in)	385mm (15.157in)
B	35mm (1.378in)	35mm (1.378in)
C	120mm (4.724in)	120mm (4.724in)
D	364mm (14.331in)	364mm (14.331in)
E	16.5mm (0.650in)	16.5mm (0.650in)
H	68mm (2.677in)	68mm (2.677in)
J	300mm ±5mm (11.811in ±0.197in)	300mm ±5mm (11.811in ±0.197in)
U	3x 4mm ² (AWG12)	3x 4mm ² (AWG12)
W	180mm (7.087in)	180mm (7.087in)
X	M6 (4x)	M6 (4x)
Z	5.5mm (0.217in)	5.5mm (0.217in)
Ground Terminal	M5	M5

3.11.3 Unidrive size 3 and 4 filters

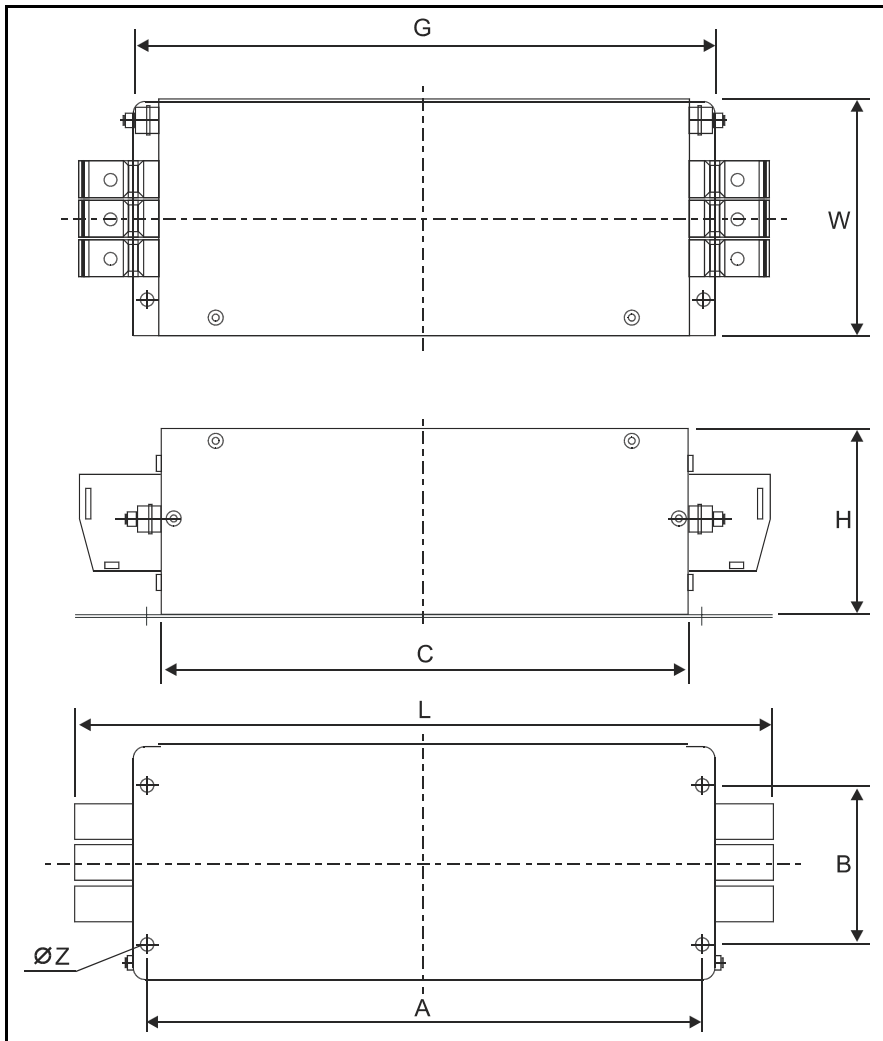
Ensure the LOAD terminals face the drive.

Figure 3-26 Unidrive size 3 (UNI3201 to UNI3202, UNI3401 to UNI3403) bookcase mounted filter



Dimension	RFI Filter
	4200-6116 FS5113-50-53
Model	UNI3201 to UNI3202, UNI3401 to UNI3403
A	275mm (10.827in)
B	50mm (1.969in)
C	259.5mm (10.217in)
D	290mm (11.417in)
H	100mm (3.937in)
L	337mm (13.268in)
W	90mm (3.543in)
Z	7mm (0.276in)
Ground Terminal	M5

Figure 3-27 Unidrive size 3 (UNI3203 to UNI3204, UNI3404 to UNI3405) & size 4 bookcase mounted filter

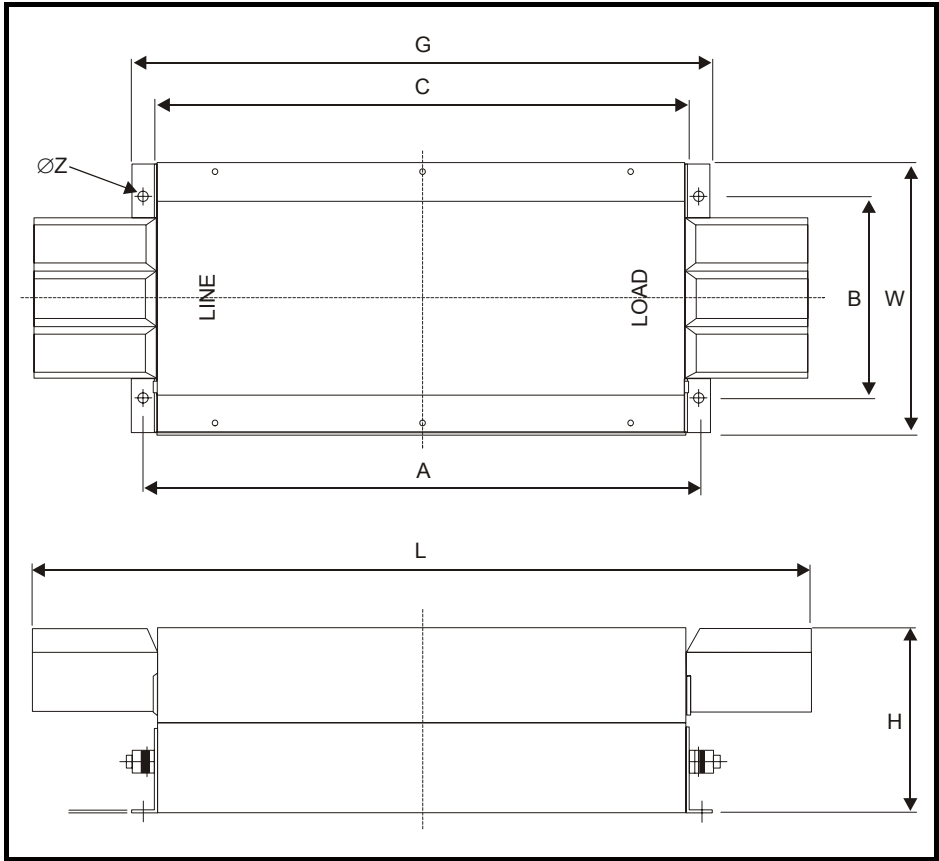


Dimension	RFI Filters				
	4200-6117 FS5113-63-34	4200-6106 FS5113-100-35	4200-6107 FS5113-150-40	4200-6111 FS5113-180-40	4200-6112 FS5113-220-37
Model	UNI3203 UNI3404	UNI3204 UNI3405	UNI4401 to UNI4402	UNI4403 to UNI4404	UNI4405
A	315mm (12.402in)	310mm (12.205in)	330mm (12.992in)	420mm (16.535in)	420mm (16.535in)
B	105mm (4.134in)	105mm (4.134in)	120mm (4.724in)	110mm (4.331in)	110mm (4.331in)
C	300mm (11.811in)	294mm (11.575in)	314mm (12.362in)	400mm (15.748in)	375mm (14.764in)
G	330mm (12.992in)	325mm (12.795in)	345mm (13.583in)	440mm (17.323in)	440mm (17.323in)
H	103mm (4.055in)	107mm (4.213in)	135mm (5.315in)	157mm (6.181in)	157mm (6.181in)
L	377mm (14.843in)	380mm (14.961in)	414mm (16.299in)	502mm (19.764in)	523mm (20.591in)
W	150mm (5.906in)	150mm (5.906in)	150mm (5.906in)	170mm (6.693in)	170mm (6.693in)
Z	7mm (0.276in)	7mm (0.276in)	7mm (0.276in)	8.5mm (0.335in)	8.5mm (0.335in)
Ground Terminal	M6	M8	M10	M12	M12

Unidrive Size 5 bookcase mounted filter

Ensure the LOAD terminals face the drive.

Figure 3-28 Unidrive size 5 bookcase mounted filter



Dimension	RFI Filters
	4200-6115 FS5113-300-99
Model	UNI3203 UNI3404
A	470mm (18.504in)
B	170mm (6.693in)
C	450mm (17.717in)
G	490mm (19.291in)
H	156mm (6.142in)
L	655mm (25.787in)
W	230mm (9.055in)
Z	8.5mm (0.335in)
Ground Terminal	M12

3.12 Power terminals

3.12.1 Location of power and ground terminals

Figure 3-29 Locations of the power and ground terminals on Unidrive Size 1 to 4

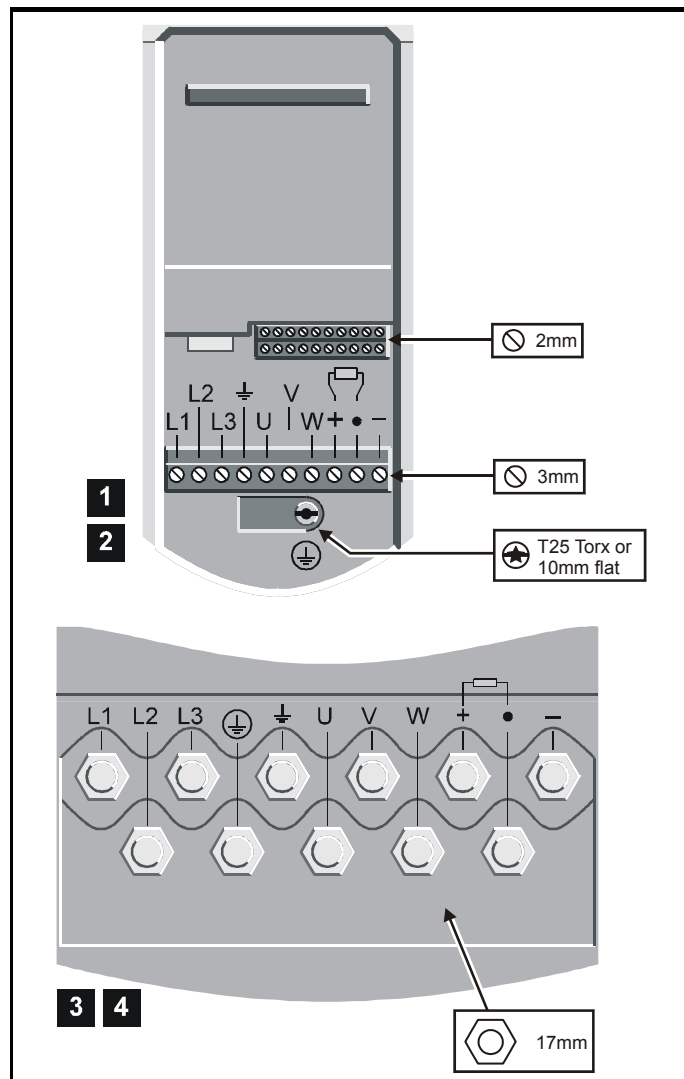
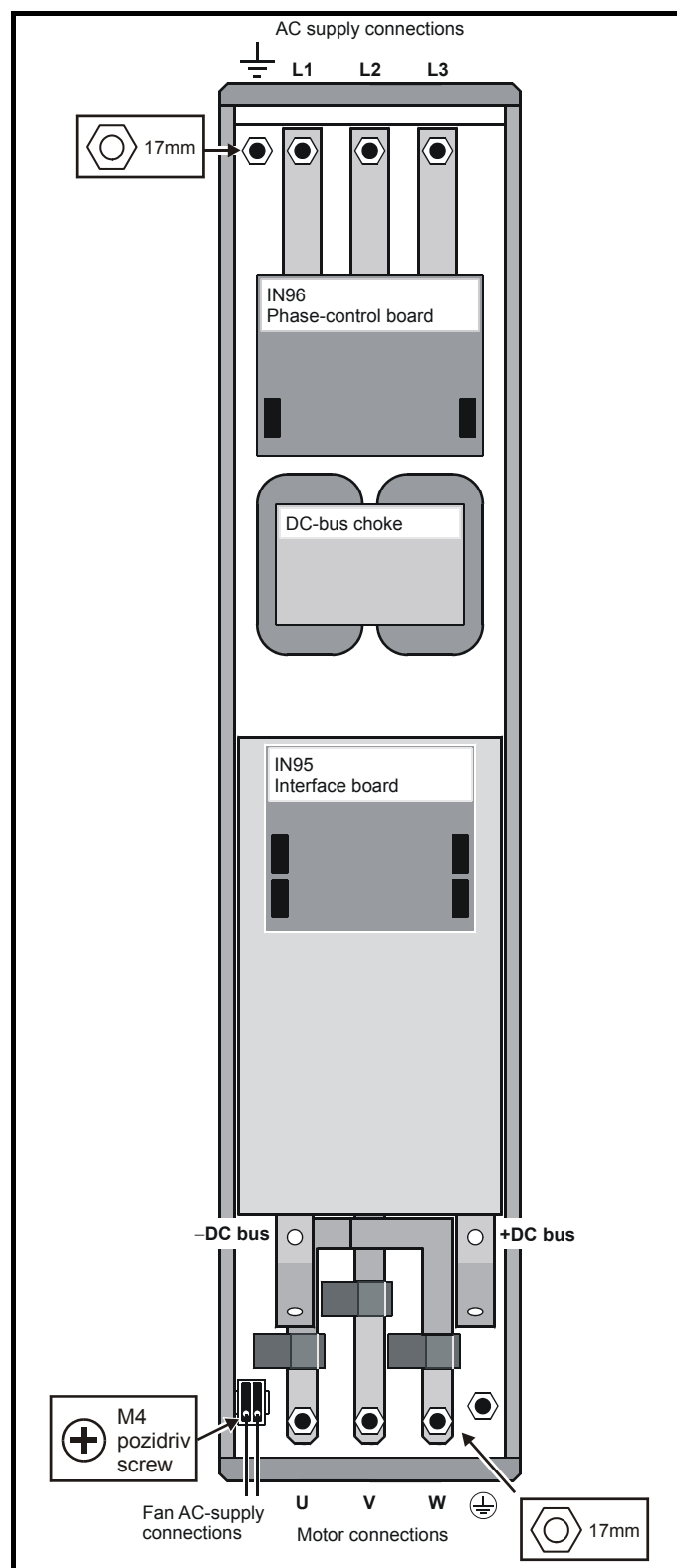


Figure 3-30 Locations of the power and ground terminals on the Size 5 power module



3.12.2 Terminal sizes and torque settings

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

WARNING

Table 3-4 Drive control terminal data

Model	Connection type	Torque setting
All	Plug-in terminal block	0.5 N m 4.4 lb in

Table 3-5 Drive power terminal data

Model size	AC terminals	DC terminals	Ground terminal
1	Plug-in terminal block 0.5 N m / 4.4 lb in		M4 (Torx/slot-head screw) 3 N m / 2.2 lb ft
2	Plug-in terminal block 0.5 N m / 4.4 lb in		M4 (Torx/slot-head screw) 3 N m / 2.2 lb ft
3	M10 stud 15 N m / 11 lb ft		M10 stud 15 N m / 11 lb ft
4	M10 stud 15 N m / 11 lb ft		M10 stud 15 N m / 11 lb ft
5	M10 bolt & nut 25 N m / 22.1 lb ft	M10 hole 25 N m / 22.1 lb ft	M10 stud 25 N m / 22.1 lb ft
Torque tolerance			±10%

Table 3-6 Size 5 fan supply connection

Type	Torque setting
Terminal block M4 Pozidriv screw	0.5 N m 4.4 lb in

Table 3-7 RFI Filter terminal data

CT part number	Schaffner part number	Power connections		Ground connections	
		Max cable size	Torque	Size	Torque
4200-6104	FS5101-10-07	4 mm ² 10 AWG	0.8 N m 7.1 lb in	M5	2.2 N m 19.5 lb in
4200-6105	FS5111-10-29	4 mm ² 10 AWG	0.8 N m 7.1 lb in	M5	2.2 N m 19.5 lb in
4200-6108	FS5106-16-07	4 mm ² 10 AWG	0.8 N m 7.1 lb in	M5	2.2 N m 19.5 lb in
4200-6109	FS5112-16-07	4 mm ² 10 AWG	0.8 N m 7.1 lb in	M5	2.2 N m 19.5 lb in
4200-6113	FS5106-25-07	4 mm ² 10 AWG	0.8 N m 7.1 lb in	M5	2.2 N m 19.5 lb in
4200-6114	FS5113-25-29	4 mm ² 10 AWG	0.8 N m 7.1 lb in	M5	2.2 N m 19.5 lb in
4200-6116	FS5113-50-53	10 mm ² 6 AWG	4.5 N m 3.3 lb ft	M5	2.2 N m 19.5 lb in
4200-6117	FS5113-63-34	10 mm ² 6 AWG	4.5 N m 3.3 lb ft	M6	4.0 N m 2.9 lb ft
4200-6106	FS5113-100-35	50 mm ² 1/0 AWG	8.0 N m 5.9 lb ft	M8	9.0 N m 6.6 lb ft
4200-6107	FS5113-150-40	95 mm ² 4/0 AWG	20.0 N m 14.7 lb ft	M10	18.0 N m 13.3 lb ft
4200-6111	FS5113-180-40	95 mm ² 4/0 AWG	20.0 N m 14.7 lb ft	M12	20.0 N m 14.7 lb ft
4200-6112	FS5113-220-37	150 mm ² 6/0 AWG	30.0 N m 22.1 lb ft	M12	20.0 N m 14.7 lb ft
4200-6115	FS5113-300-99	M12 stud	30.0 N m 22.1 lb ft	M12 stud	20.0 N m 14.7 lb ft

For all the RFI filters, except the size 5 (4200-6115), the power connections are screw terminals and the ground connections are stud terminals.

3.13 Routine maintenance

The drive should be installed in a cool, clean, well ventilated location. Contact of moisture and dust with the drive should be prevented.

Regular checks of the following should be carried out to ensure drive / installation reliability is maximised:

Environment	
Ambient temperature	Ensure the enclosure temperature remains at or below 40°C (50°C when derating applied)
Dust	Ensure the drive remains dust free – check that the drive fan is not gathering dust. The lifetime of the fan is reduced in dusty environments.
Moisture	Ensure the drive enclosure shows no signs of condensation
Enclosure	
Enclosure door filters	Ensure filters are not blocked and that air is free to flow
Electrical	
Screw connections	Ensure all screw terminals remain tight
Crimp terminals	Ensure all crimp terminals remains tight – check for any discolouration which could indicate overheating
Cables	Check all cables for signs of damage

4 Electrical Installation

This chapter describes the how to electrically install the drive. Key features include:

- EMC compliance with shielding / grounding accessories
- Product rating, fusing and cabling information
- Brake resistor details (selection / ratings)



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



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.



STOP function

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



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 energised, the AC supply must be isolated at least ten minutes before work may continue.

Normally, the capacitors are discharged by an internal resistor. Under certain, unusual fault conditions, it is possible that the capacitors may fail to discharge, or be prevented from being discharged by a voltage applied to the output terminals. If the drive has failed in a manner that causes the display to go blank immediately, it is possible the capacitors will not be discharged. In this case, consult Control Techniques or their authorised distributor.



Equipment supplied by plug and socket

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



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 energised 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

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 overvoltage suppression (transient voltage surge suppression) must be provided to reduce category IV to category III.

4.1 Power connections

Figure 4-1 Unidrive Size 1 to 2 power connections

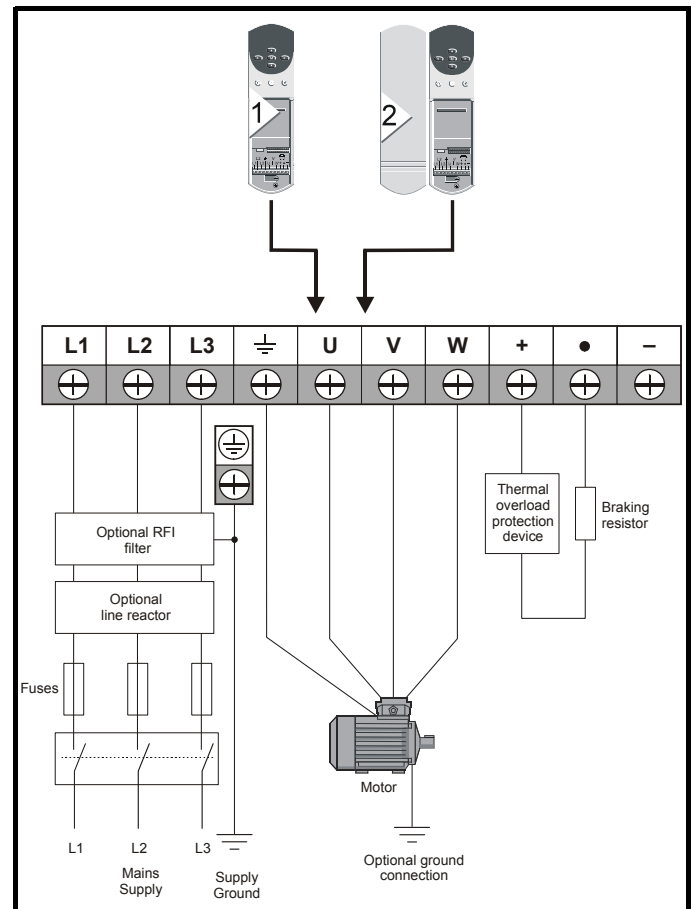
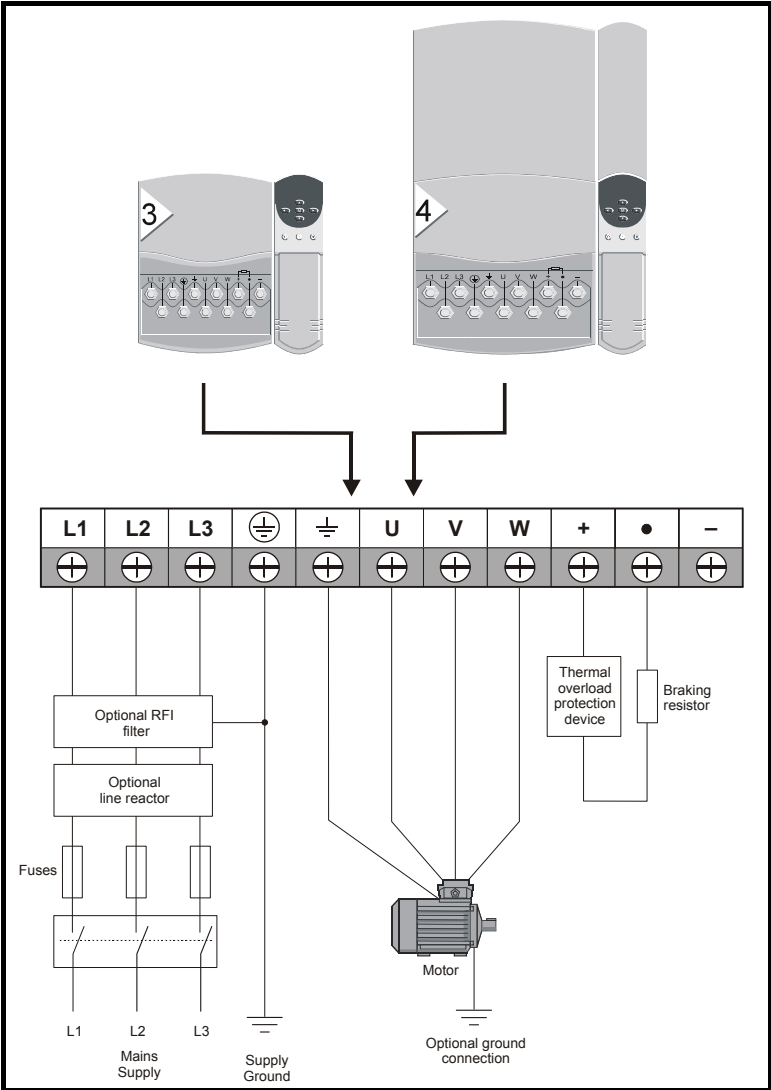


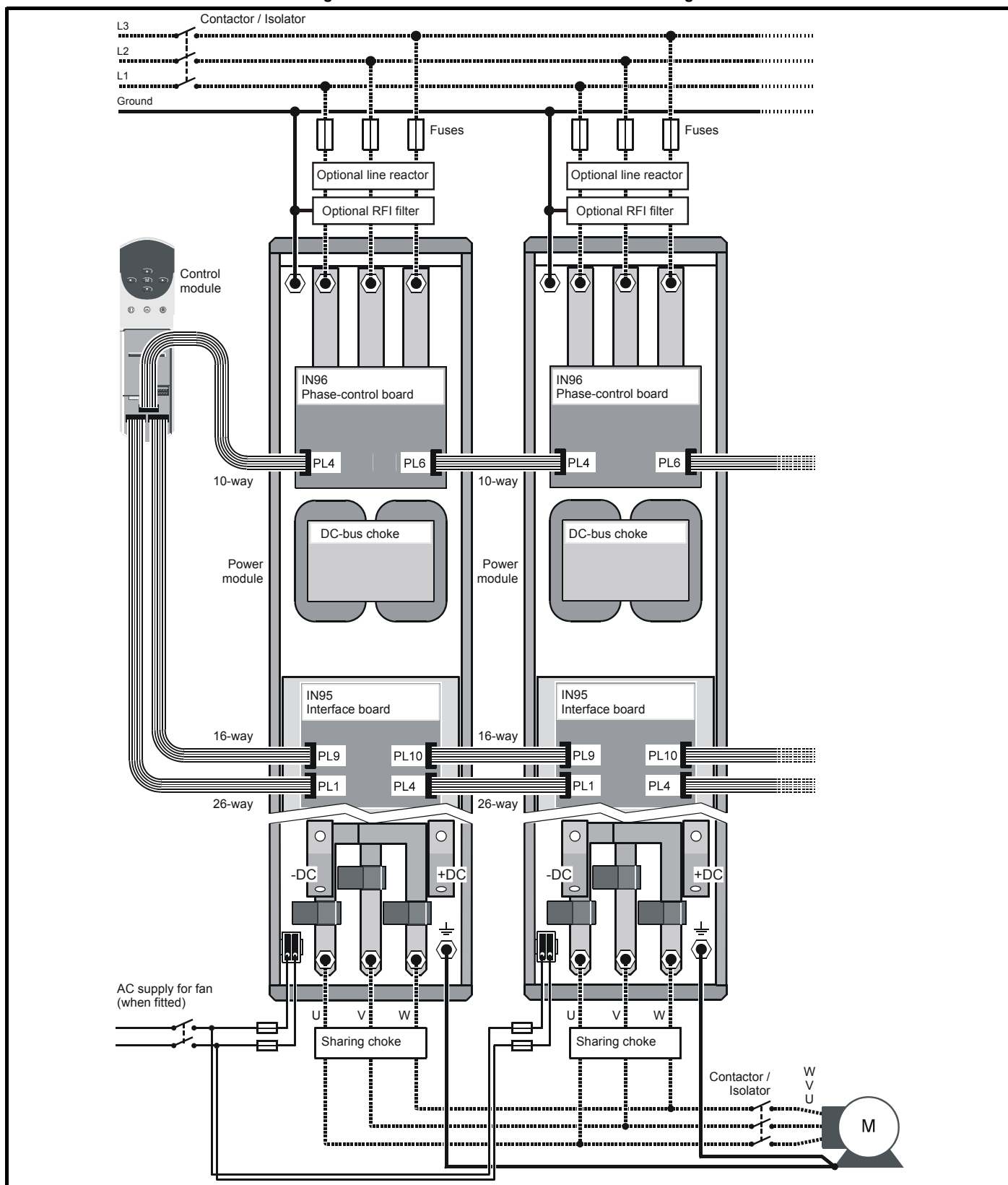
Figure 4-2 Unidrive Size 3 to 4 power connections



A thermal overload protection device should be connected as shown in Figure 4-7 on page 44 and must interrupt the AC supply on tripping. This applies to all sizes of Unidrive where a braking resistor is used.

4.1.1 Unidrive size 5 control / power module connections

Figure 4-3 Unidrive size 5 ribbon cable and sharing choke inter-



NOTE

When using Unidrive size 5 with multiple power modules, a sharing choke must be fitted on the output of each drive as shown. The specification for the choke is given in Chapter 11 *Technical Data* on page 190 and it should be sourced locally.



Ensure that the fan and power module can be isolated from the AC supplies. Isolation from the supplies must be interlocked, or a warning must be displayed indicating that two separate supplies are present.

4.2 AC supply requirements

Voltage:

UNIX20XLV	200V to 240V ±10%
UNIX40X	380V to 480V ±10%

Number of phases: 3

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

Frequency range: 48Hz to 65Hz

Maximum supply fault current:

Frame size	Symmetrical fault level (kA)
1, 2, 3	5
4	10
5	18

4.2.1 IT supplies

Special considerations are required when the neutral point of the distribution winding of the supply transformer is not directly grounded.

Before using the drive on such a supply, please contact the supplier of the drive.

4.2.2 Installation category

Drives are suitable for use on supplies of installation category III and lower, according to IEC60664-1. 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.

4.2.3 Supplies requiring line reactors

Input line reactors reduce the risk of damage to the drive resulting from poor phase balance or severe disturbances on the supply network.

Where line reactors are to be used, reactance values of approximately 2% are recommended. Higher values may be used if necessary, but may result in a loss of drive output (reduced torque at high speed) because of the voltage drop.

For all drive ratings, 2% line reactors permit drives to be used with a supply unbalance of up to 3.5% negative phase sequence (equivalent to 5% voltage imbalance between phases).

Severe disturbances may be caused by the following factors, for example:

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

Such disturbances may cause excessive peak currents to flow in the input power circuit of the drive. This may cause nuisance tripping, or in extreme cases, failure of the drive.

Drives of low power rating may also be susceptible to disturbance when connected to supplies with a high rated capacity.

Line reactors are particularly recommended for use with the following drive models when one of the above factors exists, or when the supply capacity exceeds 175kVA:

UNI1201 UNI1202 UNI1203 UNI1204

UNI1401 UNI1402 UNI1403 UNI1404

Model sizes 1205, 1405 and larger have an internal DC choke so they do not require AC line reactors except for cases of excessive phase unbalance or extreme supply conditions.

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

Reactor current ratings

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

Continuous current rating:

Not less than the continuous input current rating of the drive

Repetitive peak current rating:

Not less than twice the continuous input current rating of the drive

4.2.4 Input inductor calculation.

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

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

Where:

I = drive rated input current (A)

L = inductance (H)

f = supply frequency (Hz)

V = voltage between lines

4.3 Supplying the drive with DC / DC bus paralleling

The drive may be supplied with DC instead of 3 phase AC. For further information please refer to the supplier of your drive.

Connecting of the DC bus between several drives is typically used to:

1. Return energy from a drive which is being overhauled by the load to a second motoring drive.
2. Allow the use of one braking resistor to dissipate regenerative energy from several drives.

There are limitations to the combinations of drives which can be used in this configuration.

For application data, contact the supplier of the drive.

4.4 Ratings

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

4.4.1 Typical input current

The values of typical input current are given to aid calculations for power flow and power loss.

The values of typical input current are stated for a balanced supply.

4.4.2 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 the worst case condition with the unusual combination of stiff supply with bad balance. The value stated for the maximum continuous input current would only be seen in one of the input phases. The current in the other two phases would be significantly lower.

The values of maximum input current are stated for a supply with a 2% negative phase-sequence imbalance and rated at the maximum supply fault current given in Table 4-1.

Table 4-1 Input current, fuse and cable size ratings

Model	Typical input current	Maximum continuous input current	Fuse rating	Cable size	
	A	A	A	mm ²	AWG
UNI1201	2.4	4.0	6.0	1.5	16
UNI1202	3.5	6.0	10	2.5	14
UNI1203	4.6	8.0	10	2.5	14
UNI1204	6.5	10	10	2.5	14
UNI1205	8.6	12.5	16	2.5	14
UNI2201	10.8	13.9	16	2.5	14
UNI2202	14.3	16.9	20	4	10
UNI2203	19.8	27	35	4	10
UNI3201	26	28	40	6	8
UNI3202	39	43	60	10	6
UNI3203	53	56	70	16	4
UNI3204	78	84	80	25	4
UNI1401	3.0	4.5	6.0	1.5	16
UNI1402	4.3	5.5	10	2.5	14
UNI1403	5.8	6.8	10	2.5	14
UNI1404	8.2	8.6	10	2.5	14
UNI1405	10	12	16	2.5	14
UNI2401	13	16	16	2.5	14
UNI2402	17	20	20	4	10
UNI2403	21	25	35	4	10
UNI3401	27	34	40	6	8
UNI3402	32	39	50	10	6
UNI3403	40	53	60	10	6
UNI3404	52	66	70	16	4
UNI3405	66	82	80	25	4
UNI4401	76	98	100	35	2
UNI4402	91	114	125	35	2
UNI4403	123	152	160	50	0
UNI4404	145	205	200	70	2/0
UNI4405	181	224	250	95	3/0
UNI5401	280	321	450	120	4/0

The recommended cable sizes above are only a guide. Refer to local wiring regulations for the correct size of cables. In some cases a larger cable is required to avoid excessive voltage drop.

NOTE

UL listing is dependent on the use of the correct type of UL-listed fuse, and applies when symmetrical short-circuit current does not exceed 5kA for sizes 1 to 3, 10 kA for size 4 or 18kA for size 5.



Fuses

The AC supply to the drive must be fitted with suitable protection against overload and short-circuits. Table 4-1 shows recommended fuse ratings. Failure to observe this requirement will cause risk of fire.

A fuse or other protection must be included in all live connections to the AC supply.

An MCB (miniature circuit breaker) or MCCB (moulded case circuit breaker) with type C tripping characteristics and the same rating as the fuse(s), may be used in place of the fuse(s), on condition that the fault current clearing capacity is sufficient for the installation.

4.4.3 Fuse Types

The fuse voltage rating must be suitable for the drive supply voltage.

- Europe: Type gG HRC industrial fuses to IEC60269 (BS88)
- USA: Class CC fuses up to 30A, Class J above 30A

4.4.4 Ground connections

The drive must be connected to the system ground of the AC supply.

The ground wiring must conform to local regulations and codes of practice.



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.

4.4.5 Main AC supply contactor

The recommended AC supply contactor type for all sizes is AC1.

4.5 Output circuit and motor protection

The output circuit has fast-acting electronic short-circuit protection which limits the fault current to typically no more than five times the rated output current, and interrupts the current in approximately 20µs. No additional short-circuit protection devices are required.

The drive provides overload protection for the motor and its cable. For this to be effective, Pr 0.46 *Motor rated current* must be set to suit the motor.



Pr 0.46 *Motor rated current* must be set correctly to avoid a risk of fire in the event of motor overload.

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

4.5.1 Cable types and lengths

Since capacitance in the motor cable causes loading on the output of the drive, ensure the cable length does not exceed the values given in Table 4-2 and Table 4-3.

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

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

Table 4-2 Maximum motor cable lengths (200V drives)

200V Nominal AC supply voltage		
Model	Maximum permissible motor cable length (PWM switching frequency of 3kHz)	
	m	ft
UNI1201	65	210
UNI1202	100	330
UNI1203	130	430
UNI1204	200	660
UNI1205	300	990
UNI2201	300	990
UNI2202		
UNI2203		
UNI3201	200	660
UNI3202		
UNI3203		
UNI3204		

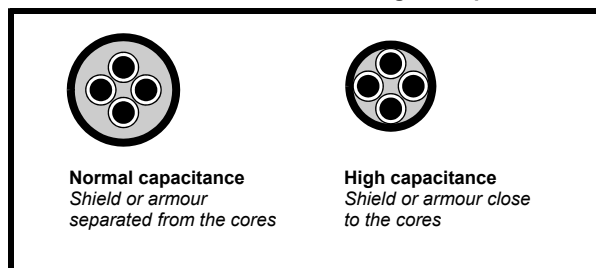
Table 4-3 Maximum motor cable lengths (400V drives)

Model	400V Nominal AC supply voltage		480V Nominal AC supply voltage	
	Maximum permissible motor cable length (PWM switching frequency of 3kHz)			
	m	ft	m	ft
UNI1401	65	210	50	160
UNI1402	100	330	75	250
UNI1403	130	430	100	330
UNI1404	200	660	150	490
UNI1405	300	990	250	820
UNI2401	300	990	300	990
UNI2402				
UNI2403				
UNI3401	200	660	124	410
UNI3402				
UNI3403				
UNI3404				
UNI3405				
UNI4401				
UNI4402				
UNI4403				
UNI4404				
UNI4405				
UNI5401	300	990	300	990
UNI5402	600	1980	600	1980
UNI5403	900	2970	900	2970
UNI5404	1200	3960	1200	3960
UNI5405	1500	4950	1500	4950
UNI5406	1800	5940	1800	5940
UNI5407	2100	6930	2100	6930
UNI5408	2400	7920	2400	7920

- Cable lengths in excess of the specified values may be used only when special techniques are adopted; refer to the supplier of the drive.
- The default switching frequency for all versions of Unidrive is 3kHz, except Unidrive LFT, which is 9kHz.

The maximum cable length is reduced from that shown in the table under the following conditions:

- **PWM switching frequency exceeding 3kHz in model sizes 3 and 4**
The maximum cable length is reduced in proportion to the increase in PWM switching frequency, e.g. at 9kHz, the maximum length is $\frac{1}{3}$ of that shown.
- **High-capacitance cables**
Most cables have an insulating jacket between the cores and the armour or shield; these cables have a low capacitance and are recommended. Cables that do not have an insulating jacket tend to have high capacitance; if a cable of this type is used, the maximum cable length is half that quoted in the table. (Figure 4-4 shows how to identify the two types.)

Figure 4-4 Cable construction influencing the capacitance


The capacitance measured above is from one line to all others and is obtainable from the cable manufacturer. This means the capacitance from one core to all the other cores and the screen shorted together.

4.5.2 Multiple motors

Open-loop only

If the drive is to control more than one motor, make connections as shown in Figure 4-5 and Figure 4-6. The maximum cable lengths given in Table 4-2 and Table 4-3 apply to the total length of cable from the drive to the farthest motor.

It is recommended that each motor is connected through a protection relay since the drive cannot protect each motor individually. For star connection, a sinusoidal filter or an output inductor must be connected as shown in Figure 4-5 and Figure 4-6, even when the cable lengths are less than the maximum permissible. For details, of inductor sizes refer to the supplier of the drive.

Figure 4-5 Preferred chain connection for multiple motors

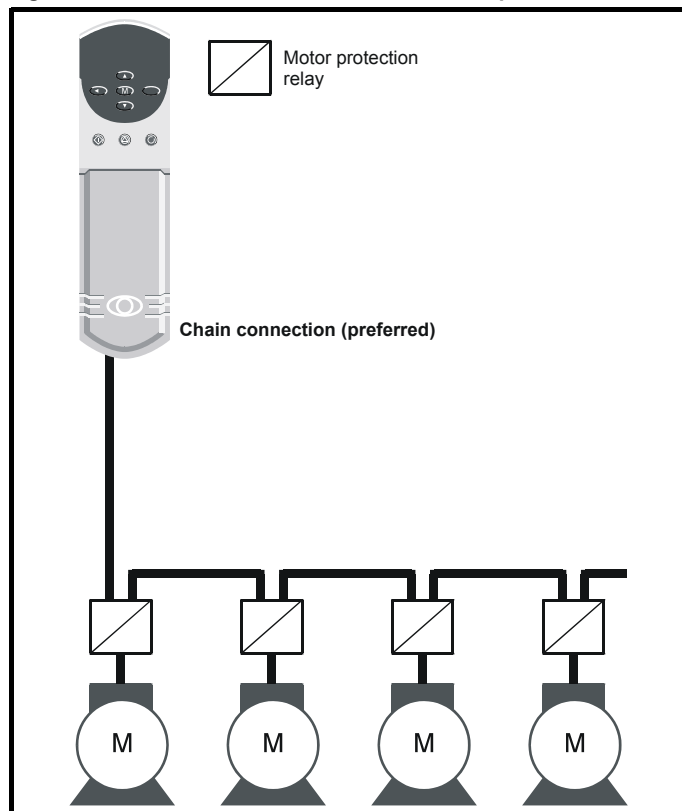
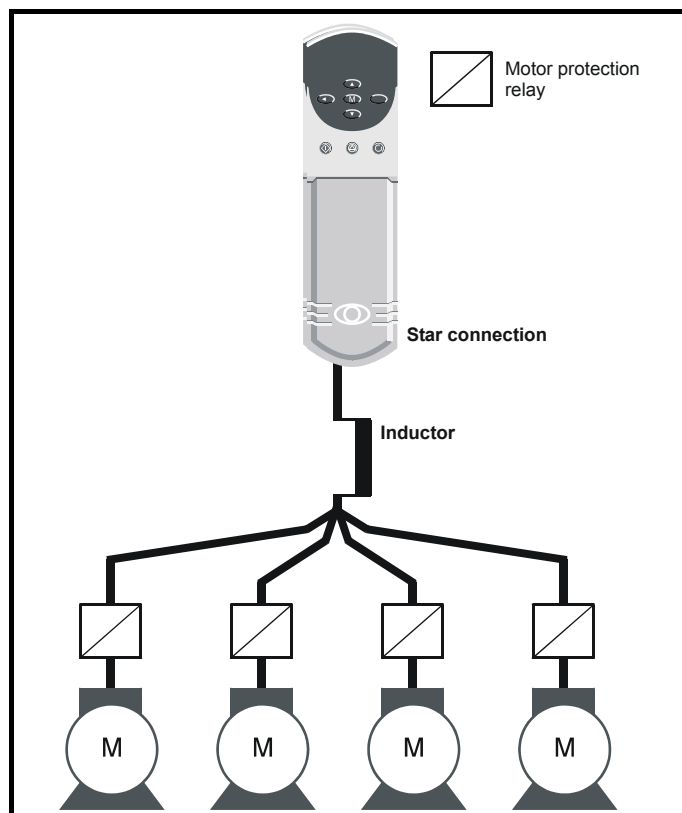


Figure 4-6 Alternative connection for multiple motors



4.5.3 Star / delta motor operation

The voltage rating for star and delta connections of the motor should always be checked before attempting to run the motor.

The default setting of the motor rated voltage parameter is the same as the drive rated voltage

i.e. 400V drive 400V rated voltage

200V drive 200V rated voltage

A typical 3 phase motor would be connected in star for 400V operation or delta for 200V operation however variations on this are common

i.e. star 690V delta 400V

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

4.5.4 Output contactor



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

A contactor is sometimes required to be fitted between the drive and motor for safety isolation purposes.

The recommended motor contactor is the AC3 type.

Switching of an output contactor should only occur when the output of the drive is disabled.

Opening or closing of the contactor with the drive enabled will lead to:

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

For more information please contact the supplier of the drive.

4.6 Braking

Internal connection does not require the cable to be armoured or shielded.

In-built in the Unidrive software is overload protection for the brake resistor. In order to enable and set-up this function, it is necessary to enter two values into the drive:

- Resistor short-time overload time (Pr 10.30)
- Resistor minimum time between repeated short-time overloads (Pr 10.31)

This data is available from the manufacturer of the braking resistors.

4.6.1 Minimum resistances and power ratings

Table 4-4 Minimum resistance values and peak power rating for the braking resistor at 40°C (104°F)

Model	Minimum resistance Ω	Instantaneous power rating kW
UNI1201 to UNI1205	20	15
UNI2201	20	15
UNI2202 to UNI2203	15	20
UNI3201 to UNI3205	5	60
UNI1401 to UNI1405	40	15
UNI2401	40	15
UNI2402 to UNI2403	30	20
UNI3401 to UNI3405	10	60
UNI4401 to UNI4405	5	120

The minimum resistance allows the braking resistor to dissipate up to approximately 150% of the power rating of the drive for up to 60 seconds.

For high-inertia loads or under continuous braking, the *continuous power* dissipated in the braking resistor may be as high as the power rating of the drive. The total *energy* dissipated in the braking resistor is dependent on the amount of energy to be extracted from the load.

The instantaneous power rating refers to the short-term maximum power dissipated during the *on* intervals of the pulse width modulated braking control cycle. The braking resistor must be able to withstand this dissipation for short intervals (milliseconds). Higher resistance values require proportionately lower instantaneous power ratings.

In most applications, braking occurs only occasionally. This allows the continuous power rating of the braking resistor to be much lower than the power rating of the drive. It is essential, though, that the instantaneous power rating and energy rating of the braking resistor are sufficient for the most extreme braking duty that is likely to be encountered.

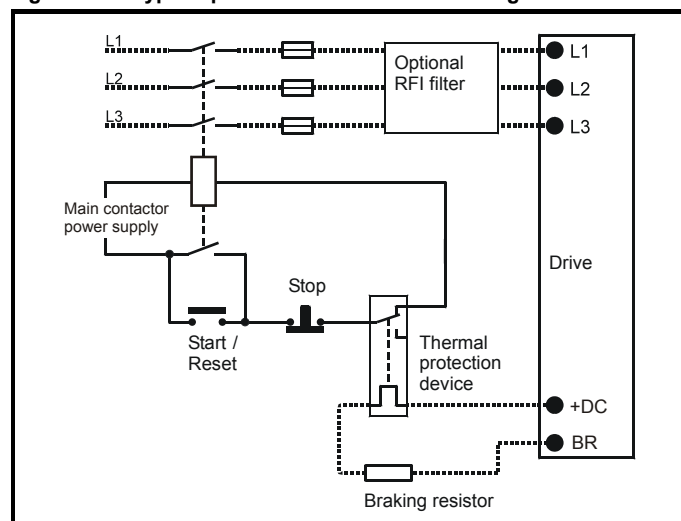
Optimisation of the braking resistor requires a careful consideration of the braking duty.

Select a value of resistance for the braking resistor that is not less than the specified minimum resistance. Larger resistance values may give a cost saving, as well as a safety benefit in the event of a fault in the braking system, however peak braking power is reduced. If the resistance is too high this could cause the drive to trip during braking.

Thermal protection circuit for the braking resistor

The thermal protection circuit must disconnect the AC supply from the drive if the resistor becomes overloaded. The thermal protection device can be either an external thermal overload device or an integrated temperature switch which is available from most braking resistor suppliers. A suitable thermal overload device is the LR2D from Telemecanique. Figure 4-7 shows a typical circuit arrangement.

Figure 4-7 Typical protection circuit for a braking resistor



4.7 Ground leakage

Unidrive sizes 1, 2 and 5 (including Unidrive REGEN size 3 and 4)

There is no direct connection with ground apart from the surge protection on the input of the drive. Ground leakage is therefore negligible.

Unidrive sizes 3 and 4 (400V product) except Unidrive REGEN

Ground leakage current is typically 9mA* (27mA with a Unidrive LFT with date code K08 onwards).

*9mA at 380V to 415V 50Hz AC supply; up to 14mA at 480V 60Hz AC supply. Measured by the method described in IEC950 Annex D.

Unidrive size 3 (200V product)

Ground leakage current is typically 5mA at 220V 50Hz.

WARNING When Unidrive sizes 3 and 4 are used the leakage current is high. In this case a permanent fixed ground connection must be provided, or other suitable measures taken to prevent a safety hazard occurring if the connection is lost.

4.7.1 Use of residual current device (RCD)

There are three common types of ELCB / RCD:

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



Only type B ELCB / RCD are suitable for use with Unidrive.

If an external RFI filter is used, a delay of at least 50ms 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 energised simultaneously.

4.8 EMC (Electromagnetic compatibility)

Compliance with EN61800-3 (standard for Power Drive Systems)

Meeting the requirements of this standard depends on the environment that the drive is intended to operate in, as follows:

Operation in the first environment

Observe the guidelines given in section 4.8.2 *EMC - Compliance* on page 48. An RFI filter will always be required. Some model sizes may require additional filtering techniques to be applied.

Operation in the second environment

An RFI filter is required for all Unidrives with a rated current of less than 100A. Where a filter is required follow the guidelines in section 4.8.2 *EMC - Compliance* on page 48. Where an RFI filter is not required follow the guidelines given in section 4.8.1 *EMC - General requirements*.



This is a product of the restricted distribution class according to IEC61800-3

In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.



The second environment typically includes an industrial low-voltage power supply network which does not supply buildings used for domestic purposes. Operating the drive in this environment without an RFI filter may cause interference to nearby electronic equipment whose sensitivity has not been appreciated. The user must take remedial measures if this situation arises. If the consequences of unexpected disturbances are severe, it is recommended that the emission limits of EN50081-2 be adhered to.

Refer to Chapter 11 *Technical Data* on page 190 for further information on compliance with EMC standards and definitions of environments.

Detailed instructions and EMC information are given in the *Unidrive EMC Data Sheet* which is available from the supplier of the drive.

NOTE

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

The drive will comply with the standards for emission, such as EN50081-2, only when the instructions given in this chapter are followed closely.

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

- The EMC data sheet
- The Declaration of Conformity at the front of this manual
- Chapter 11 *Technical Data* on page 190

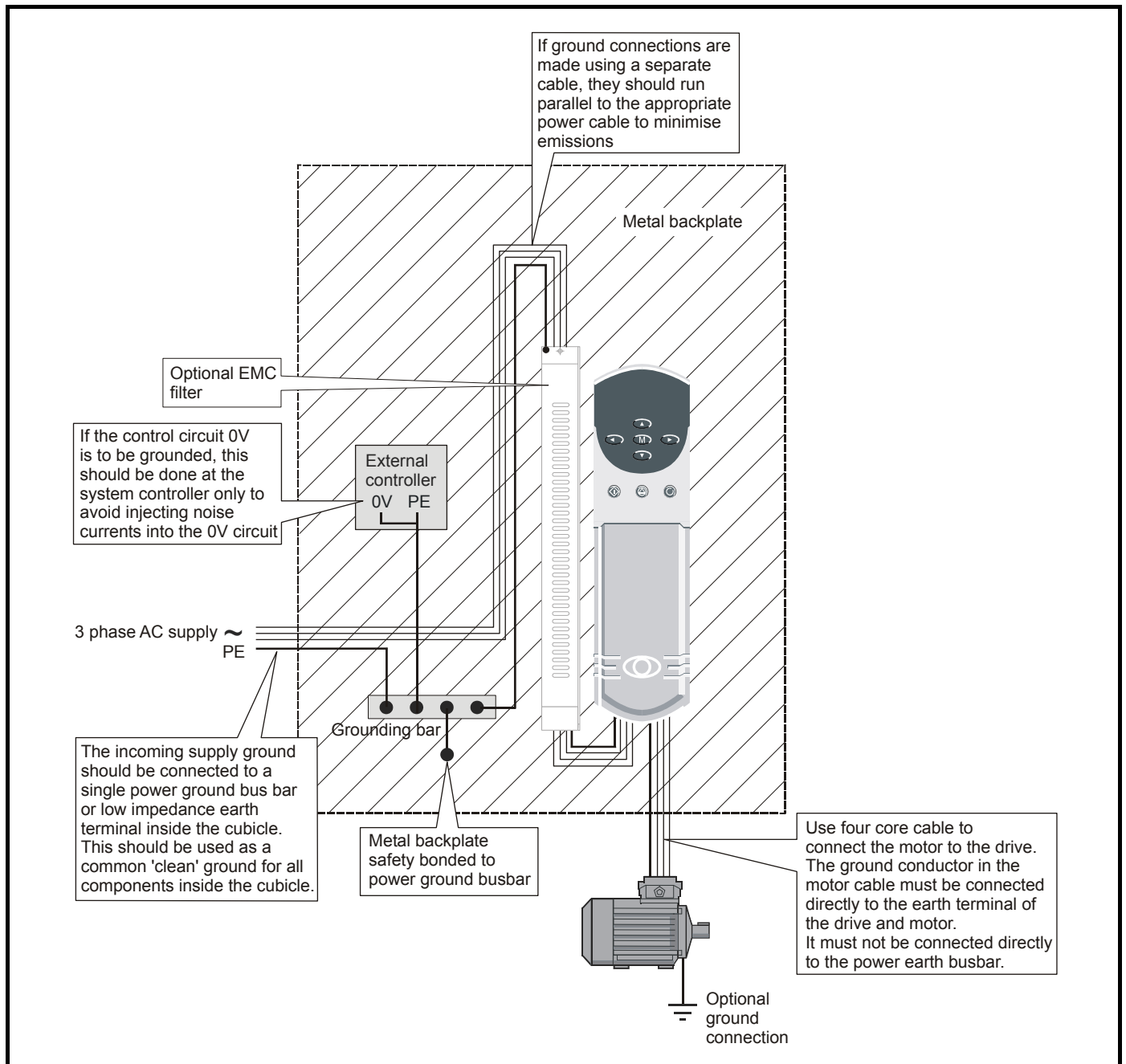
The correct RFI filter must be used and all of the guidelines in section 4.8.1 *EMC - General requirements* and section 4.8.2 *EMC - Compliance* must be followed.



When a RFI filter is used, a permanent fixed ground connection must be provided which does not pass through a connector or flexible power cord.

4.8.1 EMC - General requirements

Figure 4-8 General EMC enclosure layout showing earth / ground connections



The following guidelines should be followed for all installations to minimise the risk of disturbing any other equipment in the vicinity of the drive.

The earthing / grounding and clearance sections should be followed for all installations as good practice.

Earth / Ground connections

The diagram below indicates the grounding method which should be used in all standard installations using an grounded secondary AC supply.

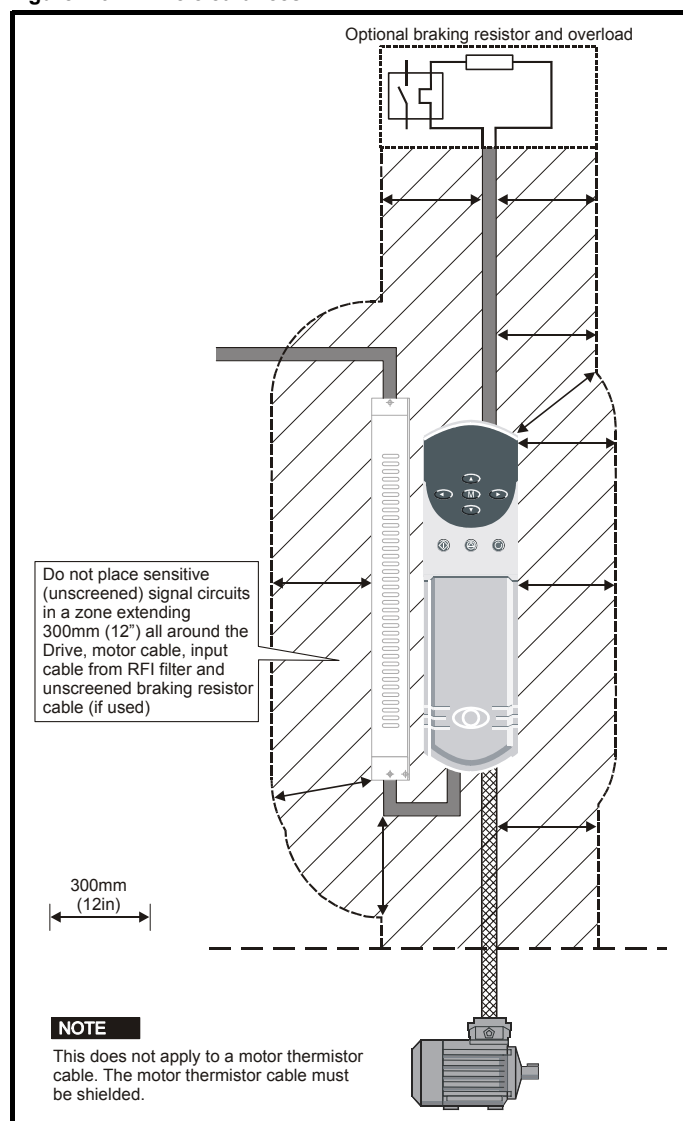


The ground loop impedance must conform to the requirements of local safety regulations.
The drive must be grounded by a connection capable of carrying the prospective fault current until the protective device (fuse, etc.) disconnects the AC supply.
The ground connections must be inspected and tested at appropriate intervals.

Clearances

The diagram below indicates the clearances which should be observed around the drive and related 'noisy' power cables by all sensitive control signals / equipment.

Figure 4-9 Drive clearances



Feedback device cable shielding

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

The following guidance is divided into two parts:

1. Ensuring correct transfer of data without disturbance from electrical noise originating either within the drive or from outside.
2. Additional measures to prevent unwanted emission of radio frequency noise. These are optional and only required where the installation is subject to specific requirements for radio frequency emission control.

To ensure correct transfer of data, observe the following: Resolver connections:

- Use a cable with an overall shield and twisted pairs for the resolver signals
- Connect the cable shield to the drive 0V connection by the shortest possible link ("pigtail")
- It is generally preferable not to connect the cable shield to the resolver. However in cases where there is an exceptional level of common-mode noise voltage present on the resolver body, it may be helpful to connect the shield there. If this is done then it becomes essential to ensure the absolute minimum length of "pigtails" at both shield connections, and possibly to clamp the cable shield directly to the resolver body and to the back plate, located as close as possible to the drive.
- The cable should preferably not be interrupted. If interruptions are unavoidable, ensure the absolute minimum length of "pigtail" in the shield connections at each interruption.

Encoder connections:

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

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

- The shields must be directly clamped to the encoder body (no pigtail) and to the back plate, located as close as possible to the drive. This may be achieved by clamping of the individual shields or by providing an additional overall shield which is clamped.

NOTE

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

NOTE

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

In some cases single shielding of each pair of differential signals cables or a single overall shield with an individual shield on the thermistor connections is sufficient. In these cases all the shields should be connected to ground and 0V at both ends.

If the 0V is required to be left floating a cable with individual shields and an overall shield must be used.

Figure 4-10 and Figure 4-11 illustrate the preferred construction of cable and the method of clamping. The outer sheath of the cable should be stripped back enough to allow the clamp to be fitted. The shield must not be broken or opened at this point. The clamps should be fitted close to the drive or feedback device, with the ground connections made to a ground plate or similar metallic ground surface.

Figure 4-10 Feedback cable, twisted pair

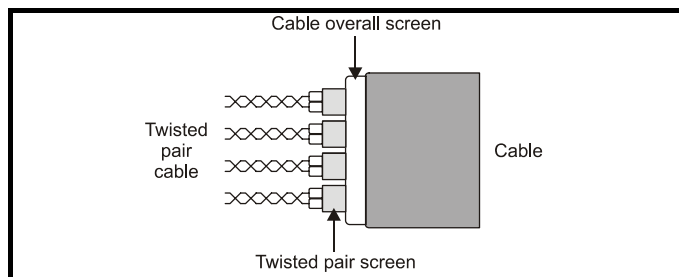
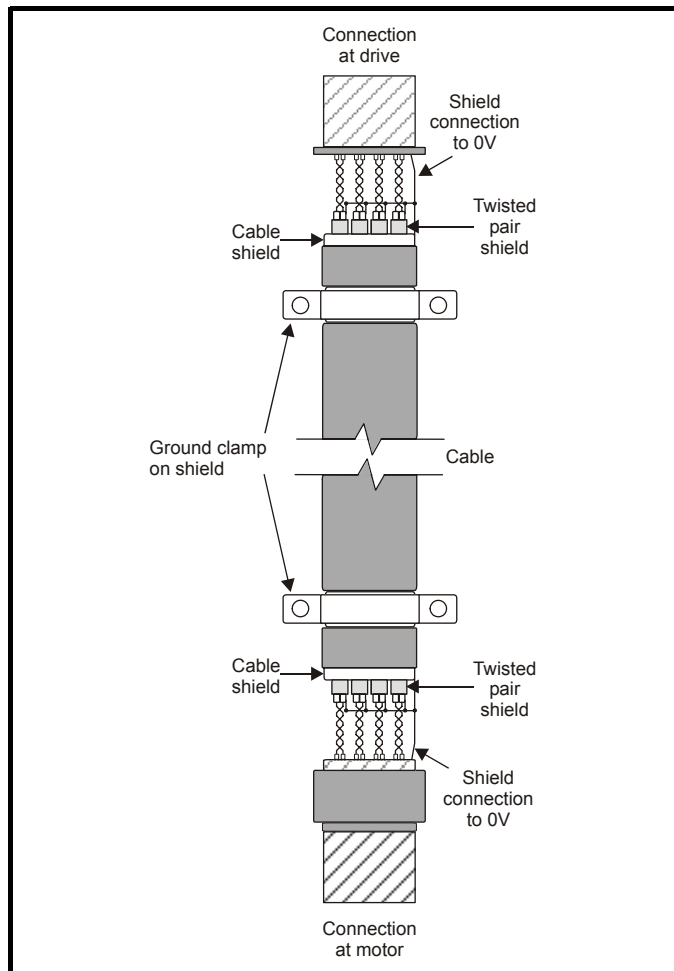


Figure 4-11 Feedback cable connections



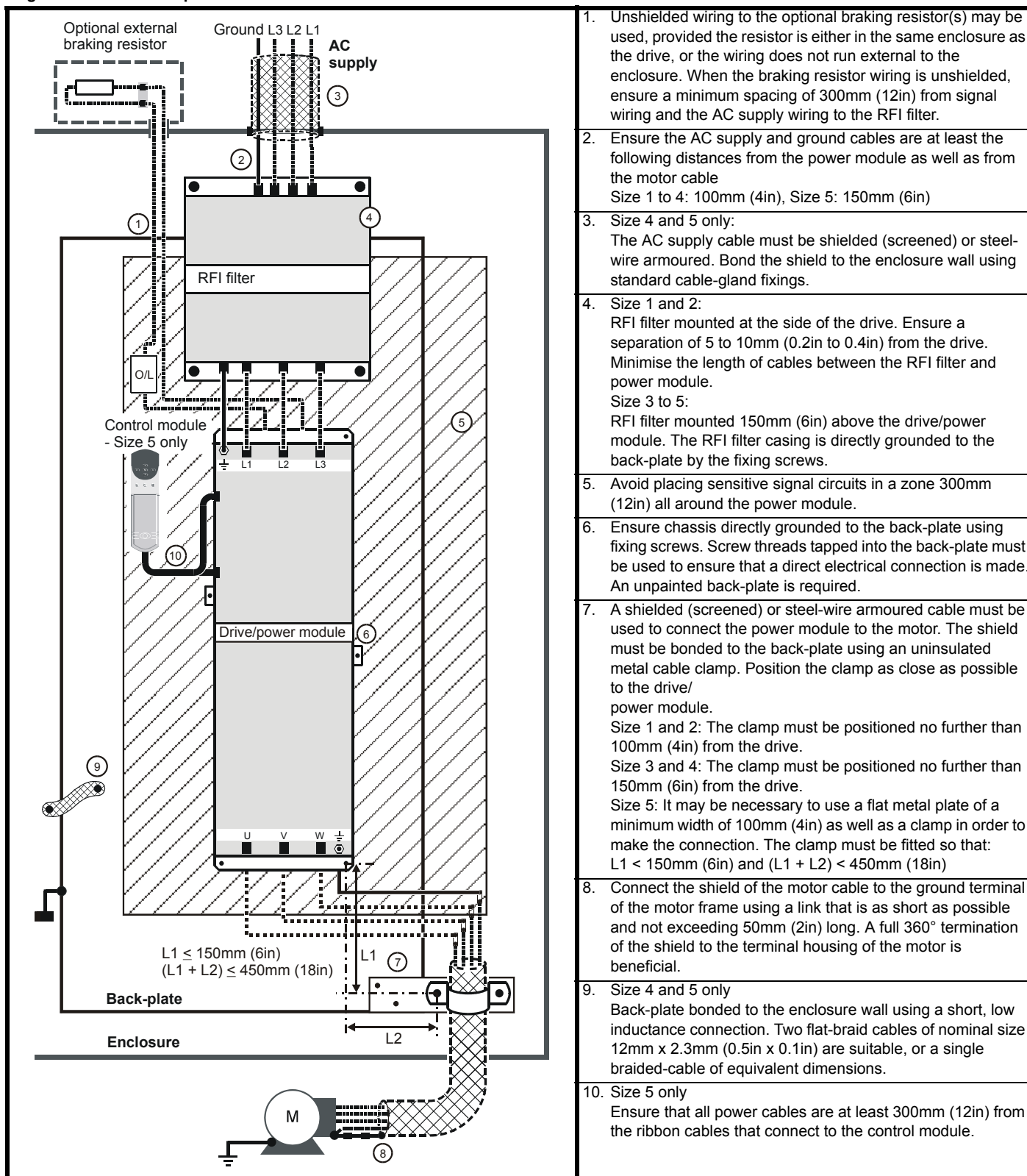
To ensure suppression of radio frequency emission, observe the following:

- Use a cable with an overall shield
- Clamp the overall shield to grounded metallic surfaces at both the encoder and the drive, as illustrated in Figure 4-11.

4.8.2 EMC - Compliance

Figure 4-12 details specific points which must be observed as well as the sections on grounding and clearances in order to ensure compliance with the standards detailed in the EMC data sheet.

Figure 4-12 EMC compliance



4.8.3 Variations in the EMC wiring

Control wiring

Control wiring which is connected to the drive and leaves the enclosure must have one of the following additional treatments:

- Pass the control cable(s) through a ferrite ring (part number 3225-1004). More than one cable can pass through a ferrite ring. Ensure the length of cable between the ferrite ring and the drive is not greater than 125mm (5 in).
- Use one or more cables having a separate overall shield. Bond this shield(s) to the back-plate using an uninsulated metal clamp. Position the clamp not further than 100mm (4 in) from the drive. Do not make any other connections to either end of the overall shield.

Interruptions to the motor cable

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

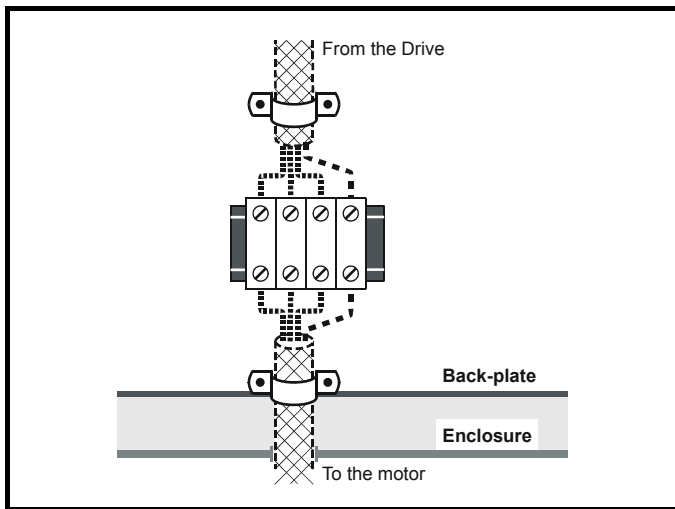
- Connecting the motor cable to a terminal block in the drive enclosure
- Fitting a motor isolator switch for safety when work is done on the motor

In these cases the following guidelines should be followed.

Terminal block in the enclosure

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

Figure 4-13 Connecting the motor cable to a terminal block in the enclosure



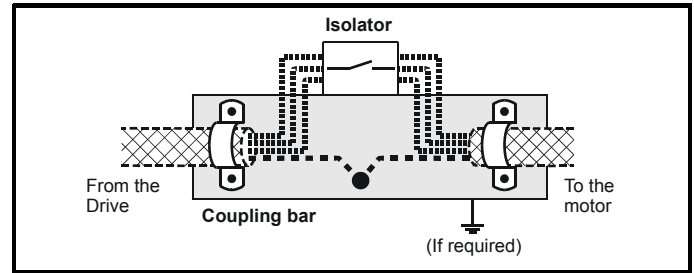
Using a motor isolator-switch

The motor cable shields should be connected by a very short conductor having a low inductance. The use of a flat metal coupling-bar is recommended; conventional wire is not suitable.

The shields should be bonded directly to the coupling-bar using uninsulated metal cable-clamps. Keep the length of the exposed power conductors to a minimum and ensure that all sensitive equipment and circuits are at least 0.3m (12 in) away.

The coupling-bar may be grounded to a known low-impedance ground nearby, for example a large metallic structure which is connected closely to the drive ground.

Figure 4-14 Connecting the motor cable to an isolator switch



Interruptions to the encoder cable

The screened cable should ideally not be interrupted throughout its run. If intermediate terminal arrangements are included with 'pigtailed' for the screen connections, every pigtail will contribute additional injection of electrical noise into the signal circuit. They should therefore be kept as short as possible. If interruptions are unavoidable, either a suitable connector with surrounding screen shell should be used, or a low-inductance bar or plate should be used for the screen connection, similar to that shown in Figure 4-14.

4.9 Control connections

4.9.1 General

Table 4-5 The Unidrive control connections consist of:

Function	Qty	Programmability	Terminals
Differential analog input	1	Destination, mode, scaling,	5,6
Single ended analog input	2	Destination, mode, scaling,	7,8
Analog output	2	Source, mode, scaling,	9,10
Digital input	3	Destination, mode,	27,28,29
Digital input / outputs	3	Destination / source, mode	24,25,26
Relay	1	Source	1,2
Drive enable	1	External trip (latching) or inhibit (non latching)	30
10V supply	1		4
24V supply	1		22
0V analog	2		3,11
0V digital	2		21,23,31

Key:

Destination parameter - indicates the parameter which is being controlled by the terminal

Source parameter - indicates the parameter being output by the terminal

Mode parameter

analog - indicates the mode of operation of the terminal, i.e. voltage 0-10V, current 4-20mA etc.

digital - indicates the mode of operation of the terminal, i.e. positive / negative logic, open collector.

All analog terminal functions can be programmed in menu 7. See section 10.7 *Menu 7: Analog I/O* on page 145 for more information on control terminal set-up.

All digital terminal functions can be programmed in menu 8. See section 10.8 *Menu 8: Digital I/O* on page 148 for more information on control terminal set-up.



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

Figure 4-15 Unidrive default terminal functions (except Unidrive VTC)

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

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

NOTE The common 0V from analog signals, wherever possible, should not be connected to the same 0V terminal as the common 0V from digital signals. Terminals 3 and 11 should be used for connecting the 0V common of analog signals and terminals 21, 23 and 31 for digital signals. This is to prevent small voltage drops in the terminal connections causing inaccuracies in the analog signals.

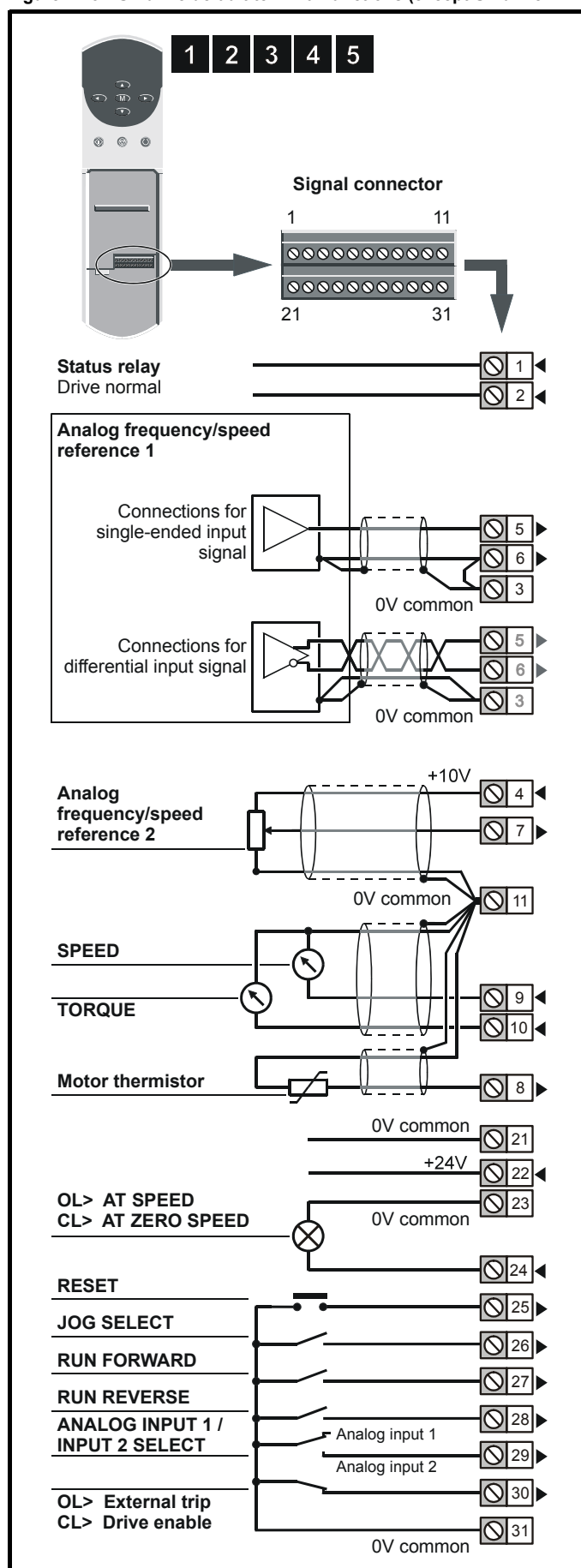
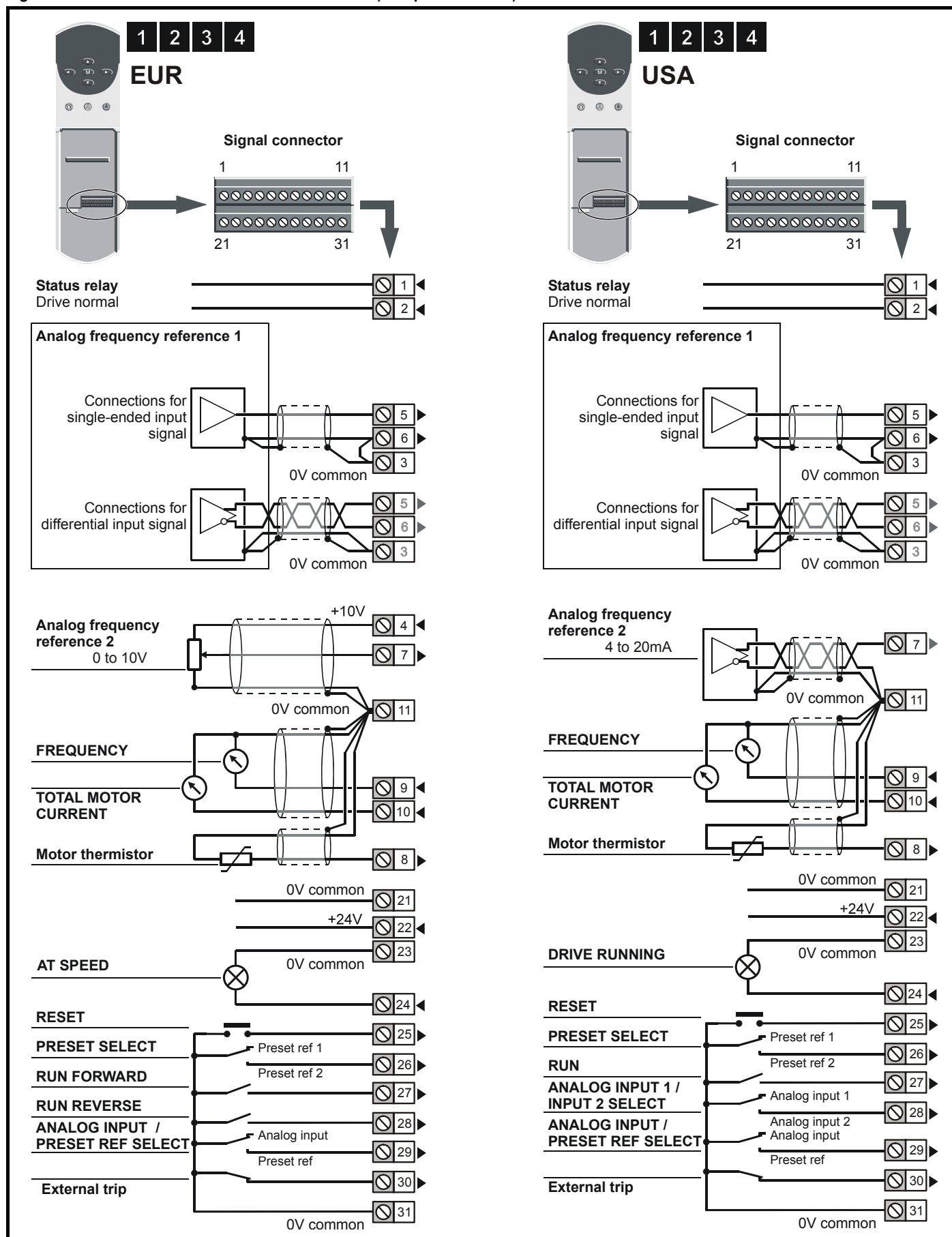


Figure 4-16 Unidrive VTC default terminal functions (European and USA)



4.9.2 Specification

These descriptions apply to the default functions of the terminals. Some macros can change terminal-functions.

1 2	Status relay contact
Default function	Drive healthy
Contact voltage rating	240Vac Installation category 1
Contact maximum current rating	5A resistive
Contact minimum current rating	10mA
Contact condition	Normally open
Isolation	1.5kV
Update period	8ms

3	0V common (analog)
Function	Common connection for external analog devices.

4	+10V reference voltage
Function	Supply for external analog signal devices
Voltage tolerance	±1%
Maximum output current	10mA
Protection	Current limit and thermal trip

5 6	Analog input 1
5	Non-inverting input
6	Inverting input
Default function	Frequency/speed reference
Type of input	Bipolar differential analog voltage or unipolar current (For single-ended use, connect terminal 6 to terminal 3)
Mode controlled by...	Parameter 0.24 { 7.06 }
Operating in Voltage mode	
Voltage range	±10V
Absolute maximum voltage range	±24V relative to 0V ±24V differential
Input resistance	100kΩ
Operating in current mode	
Current ranges	0 to 20mA 20mA to 0 4 to 20mA 20 to 4mA
Voltage range	±12V
Absolute maximum current	50mA
Equivalent input resistance	≤200Ω at 20mA
Common to all modes	
Resolution	12-bit plus sign
Sampling period default setting	PWM switching frequency dependent OL> 1.4ms for 3, 6, & 12kHz 1.9ms for 4.5 & 9kHz CL> 345μs for 3, 6 & 12kHz 460μs for 4.5 & 9kHz

7	Analog input 2
Default function	Frequency/speed reference
Type of input	Bipolar single-ended analog voltage or unipolar current
Mode controlled by...	Parameter 0.25 { 7.11 }
Operating in Voltage mode	
Voltage range	±10V
Absolute maximum voltage range	±24V relative to 0V
Input resistance	100kΩ
Operating in current mode	
Current ranges	0 to 20mA 20mA to 0 4 to 20mA 20 to 4mA
Voltage range	±12V
Absolute maximum current	50mA
Equivalent input resistance	≤200Ω at 20mA
Common to all modes	
Resolution	10-bit plus sign
Sampling period default setting	PWM switching frequency dependent OL> 1.4ms for 3, 6, & 12kHz 1.9ms for 4.5 & 9kHz CL> 345μs for 3, 6 & 12kHz 460μs for 4.5 & 9kHz

8	Analog input 3
Default function	Motor thermistor input (PTC)
Type of input	Bipolar single-ended analog voltage, unipolar current or thermistor input
Mode controlled by...	Parameter 7.15
Operating in Voltage mode	
Voltage range	±10V
Absolute maximum voltage range	±24V relative to 0V
Input resistance	100kΩ
Operating in current mode	
Current ranges	0 to 20mA 20mA to 0 4 to 20mA 20 to 4mA
Voltage range	±12V
Absolute maximum current	50mA
Equivalent input resistance	≤200Ω at 20mA
Operating in thermistor mode	
Internal pull-up voltage	<5V
Trip threshold resistance	3 kΩ ±15%
Reset resistance	1.9 kΩ ±15%
Short-circuit detection resistance	51Ω ±12%
Common to all modes	
Resolution	10-bit plus sign
Sampling period default setting	PWM switching frequency dependent 5.5ms for 3, 6, & 12kHz 7.4ms for 4.5 & 9kHz

9	Analog output 1	OL> FREQUENCY output signal CL> SPEED output signal
	10	Analog output 2 TORQUE output signal
Type of output		Bipolar single-ended analog voltage or unipolar current output
Mode controlled by...		7.19 & 7.22
Operating in Voltage mode		
Output voltage range		±10V
Maximum output current		10mA peak
Load resistance		1kΩ minimum
Protection		Short-circuit proof
Operating in current mode		
Current ranges		0 to 20mA 4 to 20mA
Maximum output voltage		±12V
Maximum load resistance		600Ω
Equivalent input resistance		≤200Ω at 20mA
Common to all modes		
Resolution		10-bit plus sign
Update period		PWM switching frequency dependent 5.5ms for 3, 6, & 12kHz 7.4ms for 4.5 & 9kHz

11	0V common (analog)
Function	Common connection for external analog devices.

21	0V common (digital)
-----------	----------------------------

22	+24V digital supply
Function	Supply for external digital signal devices
Voltage tolerance	±10%
Nominal output current	200mA (total including any digital outputs)
Overload output current	240mA (total including any digital outputs)
Protection	Current foldback above 240mA

23	0V common (digital)
Function	Common connection for external digital devices.

24	Digital input / output F1	OL> AT-SPEED output CL> AT ZERO SPEED output
25	Digital input / output F2	RESET input
26	Digital input / output F3	JOG SELECT input
Type of output		Negative or positive logic digital inputs, or negative-logic push-pull or open collector digital outputs
Input / output mode controlled by...		Parameters 8.12 , 8.15 & 8.18
Operating as an input		
Logic mode controlled by...		Parameter 8.27
Absolute maximum voltage range		-3V to +30V
Input current when 0V applied		≥3.2mA
Negative-logic levels		Inactive state (input open-circuit): >+15V Active state: <+5V
Positive-logic levels		Inactive state (input open-circuit): >+5V Active state: <+15V
Operating as an output		
Open collector outputs selected by...		Parameter 8.28
Maximum output current		200mA (total including terminal 22)
Overload output current		240mA (total including terminal 22)
Common to both modes		
Voltage range		0V to +24V
Sample / Update period		PWM switching frequency dependent 5.5ms for 3, 6, & 12kHz 7.4ms for 4.5 & 9kHz

27	Digital input F4	RUN FORWARD input
28	Digital input F5	RUN REVERSE input
29	Digital input F6	ANALOG INPUT 1 / INPUT 2 SELECT INPUT
Type		Negative or positive logic digital inputs
Logic mode controlled by...		Parameter 8.27
Voltage range		0V to +24V
Absolute maximum voltage range		-3V to +30V
Input current when 0V applied		≥3.2mA
Negative-logic levels		Inactive state (input open-circuit): >+15V Active state: <+5V
Positive-logic levels		Inactive state (input open-circuit): <+5V Active state: >+15V
Sample period		PWM switching frequency dependent 5.5ms for 3, 6, & 12kHz 7.4ms for 4.5 & 9kHz

The default configuration of the above digital inputs and outputs are different for Unidrive VTC. See Figure 4-16 *Unidrive VTC default terminal functions (European and USA)* on page 51 and section 4.9.3 *Unidrive VTC control terminal default configuration* on page 54 for details.

30	Drive enable input F7	OL> EXTERNAL TRIP INPUT CL> DRIVE ENABLE input
Type	Negative or positive logic digital inputs	
Logic mode controlled by...	Parameter 8.27	
Voltage range	0V to +24V	
Absolute maximum voltage range	-3V to +30V	
Input current when 0V applied	≥3.2mA	
Negative-logic levels	Inactive state (input open-circuit): >+15V Active state: <+5V	
Positive-logic levels	Inactive state (input open-circuit): <+5V Active state: >+15V	
Sample period	Enable function PWM switching frequency dependent 5.5ms for 3, 6, & 12kHz 7.4ms for 4.5 & 9kHz Disable or trip function 1ms	

31	0V common (digital)
Function	Common connection for external digital devices.

4.9.3 Unidrive VTC control terminal default configuration

The following is a list of the terminal default functions for Unidrive VTC. Any terminal not listed has the same default function as Unidrive.

5	Analog input 1	±10V frequency reference input
6	(differential input)	
7	Analog input 2	EUR> ±10V frequency reference input USA> 4 to 20 mA frequency reference input
8	Analog input 3	Motor thermistor input (PTC)

9	Analog output 1	Frequency output
10	Analog output 2	Total motor current output

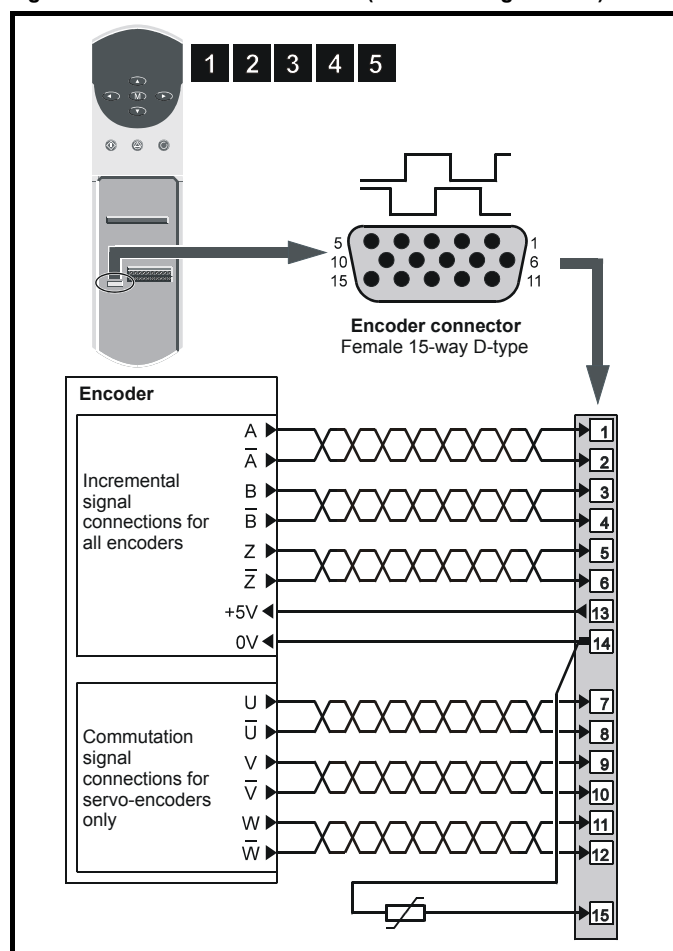
24	Digital input / Output F1	EUR> AT SPEED output USA> DRIVE RUNNING output
25	Digital input / Output F2	RESET input
26	Digital input / Output F3	PRESET SELECT

27	Digital input F4	EUR> RUN FORWARD input USA> RUN input
28	Digital input F5	EUR> RUN FORWARD input USA> ANALOG INPUT 1 / INPUT 2 SELECT input
29	Digital input F6	ANALOG INPUT / PRESET REF SELECT input

4.10 Encoder connections

4.10.1 Quadrature encoder connections

Figure 4-17 Encoder connections (default configurations)



For encoder cable screening, see section 4-10 *Feedback cable, twisted pair* on page 47.

Descriptions of the encoder connections

1	Quadrature channel A
2	Quadrature channel A\
3	Quadrature channel B
4	Quadrature channel B\
5	Marker pulse channel Z
6	Marker pulse channel Z\
Type	EIA422 differential receivers
Maximum data rate	250kHz (equivalent of 3,000rpm with a 5,000 lines per revolution encoder)
Line termination components	120Ω (switchable using Pr 3.24)
Line loading	1 unit load
Absolute maximum applied voltage relative to 0V	±15V
Absolute maximum applied differential voltage	±25V

7	Phase channel U
8	Phase channel U\
9	Phase channel V
10	Phase channel V\
11	Phase channel W
12	Phase channel W\
Type	EIA422 differential receivers
Maximum data rate	250kHz
Line termination components	120Ω
Line loading	1 unit load
Absolute maximum applied voltage relative to 0V	+15V to -10V
Absolute maximum applied differential voltage	±25V

13	Encoder supply
Supply voltage	+5.15V or +15V (selected by Pr 3.23)
Voltage tolerance	±2%
Nominal output current	300mA

The output voltage at terminal 13 is 5V when Pr 3.23 is set at 0 (default). When Pr 3.23 is set at 1, the output voltage will become 15V. This could damage encoders that require a 5V supply.

Termination resistors should be disabled by setting Pr 3.24 to 1 if the encoder output is 15V.

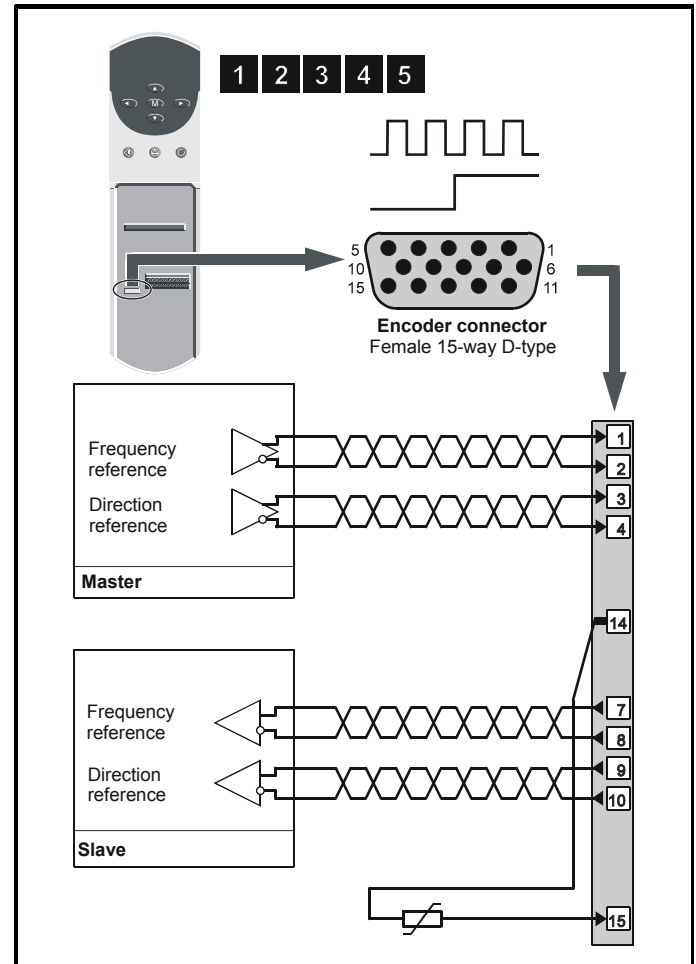
14	0V common
----	------------------

15	Motor thermistor input
----	-------------------------------

This terminal is connected internally to terminal 8 of the signal connector. Connect only one of these terminals to a motor thermistor. Analog input 3 must be in thermistor mode, Pr 7.15 = th.Sc (9) or th (10).

4.10.2 Frequency and direction connections

Figure 4-18 Frequency and direction connections and alternative motor-thermistor connections



For encoder cable screening, see section 4-10 *Feedback cable, twisted pair* on page 47.

Description of the frequency and direction connections

1	Frequency input F_{IN}
2	Frequency input $F_{IN\backslash}$
3	Direction input D_{IN}
4	Direction input $D_{IN\backslash}$
Type	EIA422 differential receivers
Maximum data rate	250kHz
Line termination components	120Ω (switchable using Pr 3.24)
Line loading	1 unit load
Absolute maximum applied voltage relative to 0V	±15V
Absolute maximum applied differential voltage	±25V

Figure 4-19 Location of the power module address switch

7	Frequency output Four
8	Frequency output Four\
9	Direction output Dout
10	Direction output Dout\
Type	EIA422 differential receivers
Maximum data rate	250kHz
Line termination components	120Ω
Absolute maximum applied voltage relative to 0V	+15V to -10V
Absolute maximum applied differential voltage	±25V

13	Encoder supply
Supply voltage	+5.15V or +15V (selected by Pr 3.23)
Voltage tolerance	±2%
Nominal output current	300mA

The output voltage at terminal 13 is 5V when Pr 3.23 is set at 0 (default). When Pr 3.23 is set at 1, the output voltage will become 15V. This could damage encoders that require a 5V supply.

Termination resistors should be disabled by setting Pr 3.24 to 1 if the encoder output is 15V.

14	0V common
----	-----------

15	Motor thermistor input
----	------------------------

This terminal is connected internally to terminal 8 of the signal connector. Connect only one of these terminals to a motor thermistor. Analog input 3 must be in thermistor mode, Pr 7.15 = th.Sc (9) or th (10).

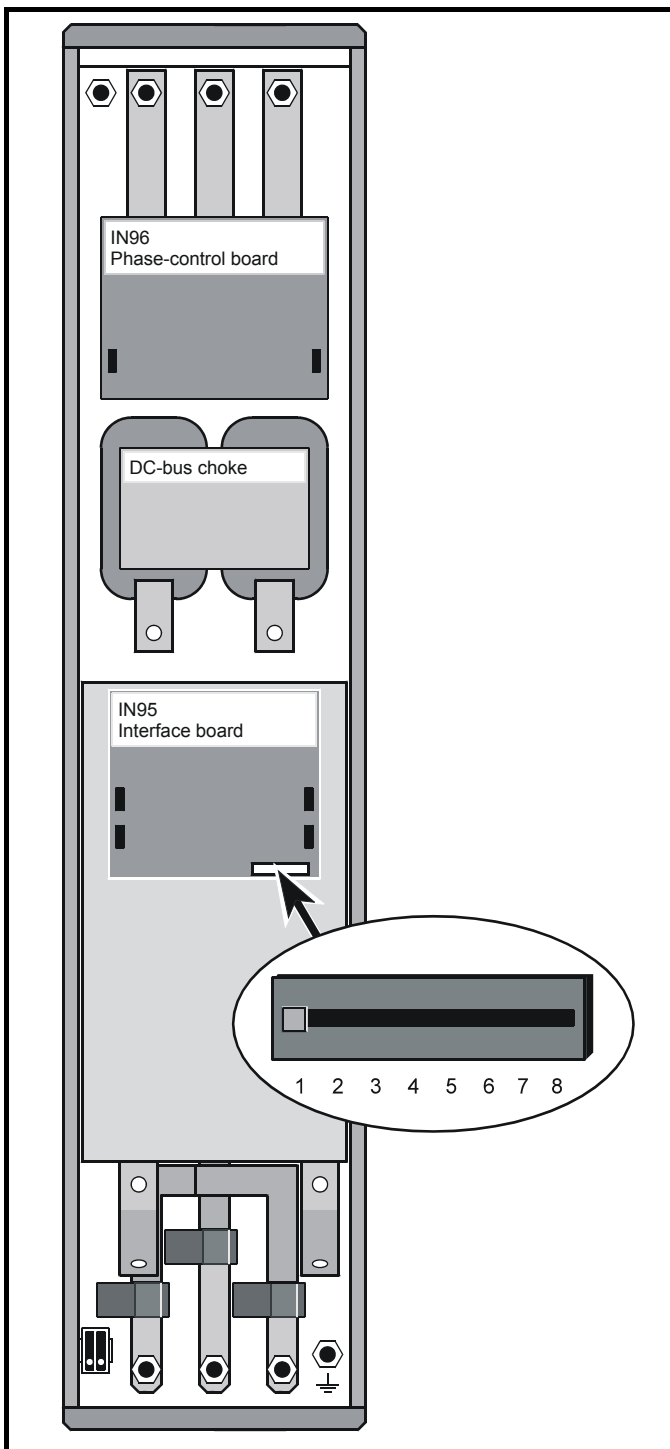
4.11 Configuring a Unidrive size 5 system

The following must be performed in order to configure a Unidrive size 5 system:

- Each power module must be given a unique address.
- The control module must be notified of the number of power modules it is to control.
- The new settings must be saved in the control module software.

4.11.1 Configuring the power modules

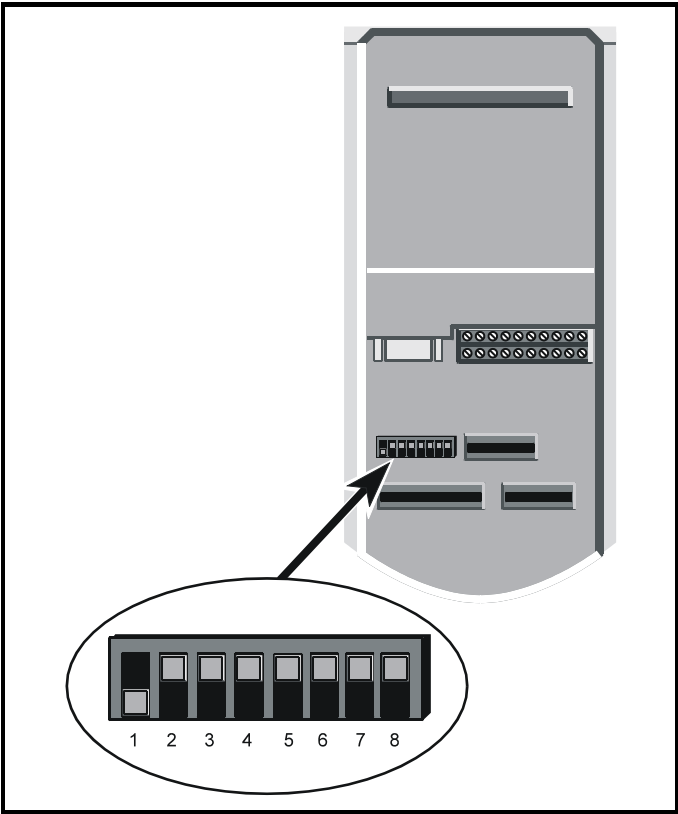
To set the address on a power module, set the slide switch to the required address number, see Figure 4-19 for the position of the switch. Ensure that each power module in a multiple module system has its own unique address number. See Table 4-6 for example configuration settings.



4.11.2 **Configuring the control module**

On the control module, set the configuration switches to correspond with the addresses given to the power modules in the system. Move the switch to the off position to set the switch. Ensure all remaining switches are in the on position. See Table 4-6 for example configuration setting.

Figure 4-20 Setting the configuration switches in the control module



4.11.3 **Saving the configuration**

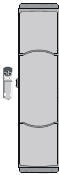
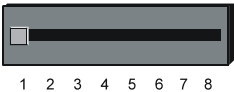
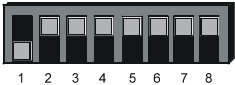
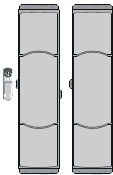
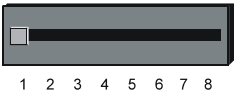
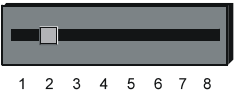

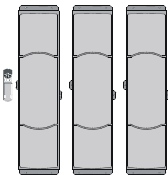
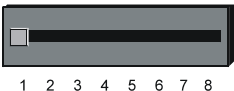
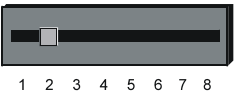
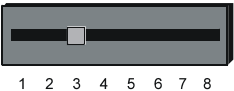

When the drive is first powered-up, and the system contains more than one power module (or the number of power modules has been changed), the control module display will indicate as shown in Figure 4-21.

Figure 4-21 Control module display



(The number displayed corresponds to the number power modules.)
A parameter save must be performed so that the drive will not trip next time the drive is powered up. To perform a save refer to section 5.8 *Saving parameters* on page 61.

Table 4-6 Example configuration settings

System	Configuration switches			
	1 st Power module	2 nd Power module	3 rd Power module	Control module
				
				
				

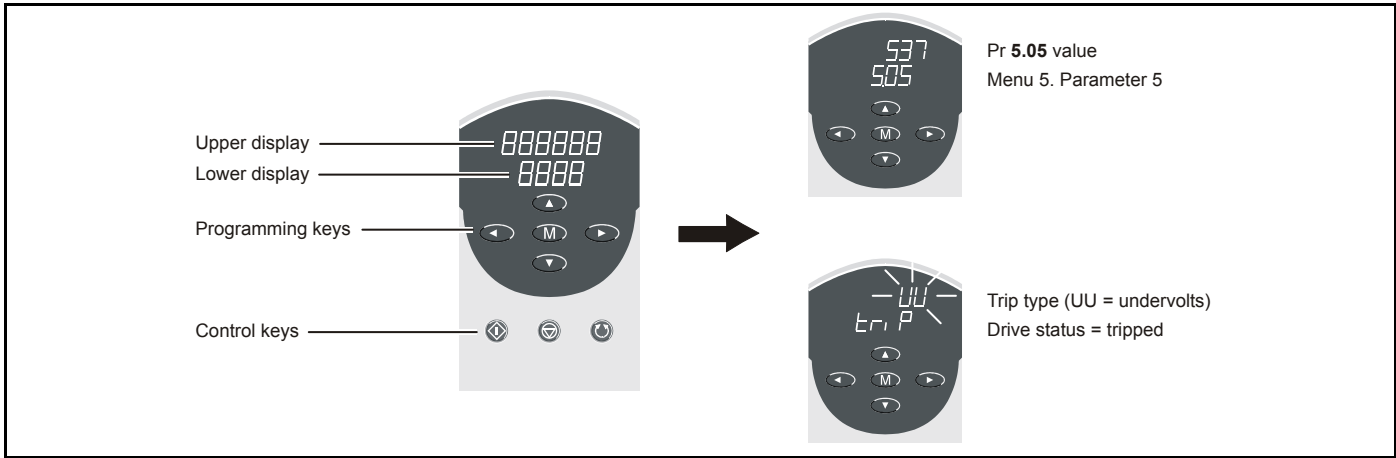
One control module can be used to control up to eight power modules.

5 Getting Started

5.1 Understanding the display

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

Figure 5-1 Keypad



5.2 Keypad operation

5.2.1 Control buttons




The keypad consists of:

1. Four arrow buttons
2. One mode button
3. Three control buttons

The arrow buttons are used to navigate the parameter structure and change parameter values.

The mode button is used to change between the display modes – parameter view, parameter edit, status.

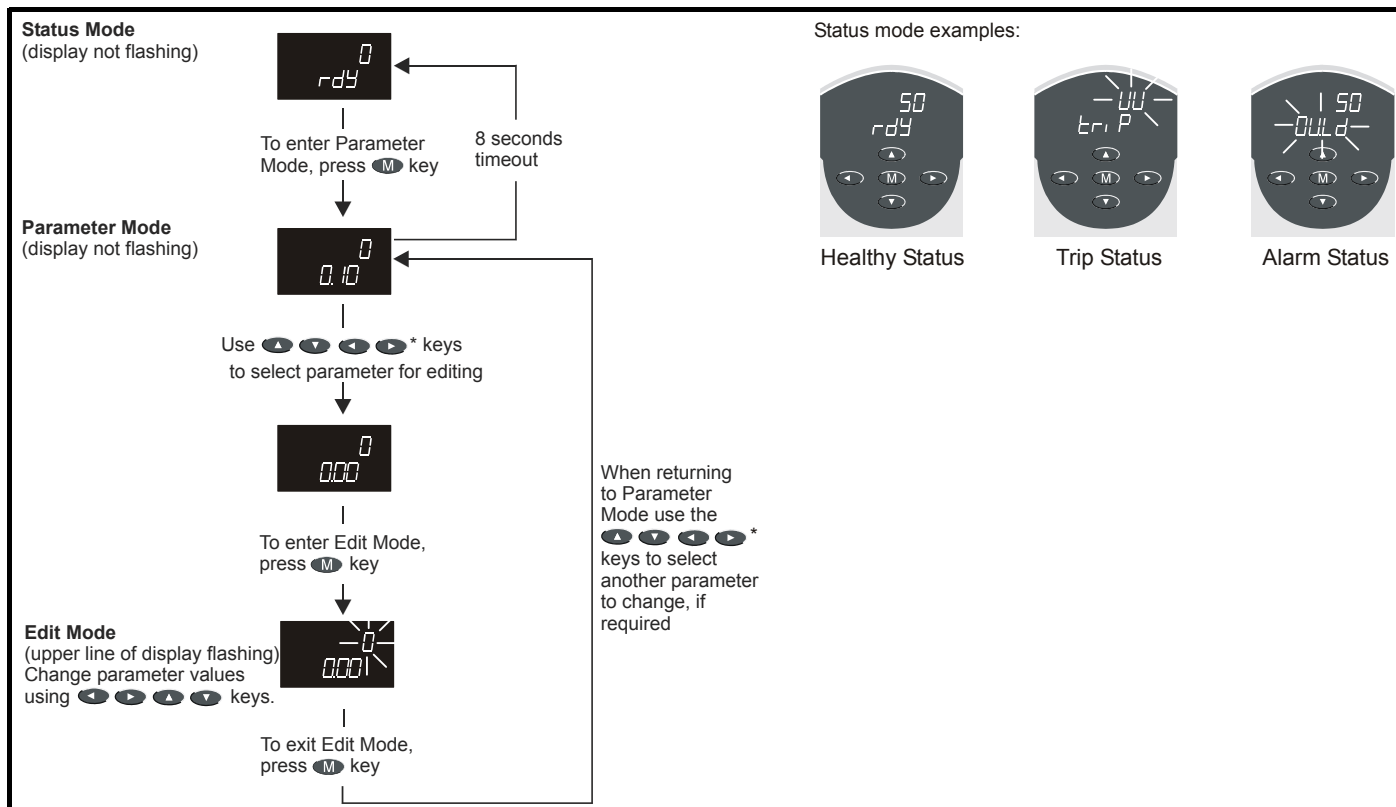
The three control buttons are used to control the drive if keypad mode is selected:

-  start (green)
-  stop (red)
-  forward / reverse (blue)

NOTE

The red 'stop' button is also used to reset the drive.

Figure 5-2 Display modes



* \leftarrow \rightarrow can only be used to move between menus if standard security has been opened. For further information, refer to section 5.10 *Parameter security* on page 62.



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

NOTE

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

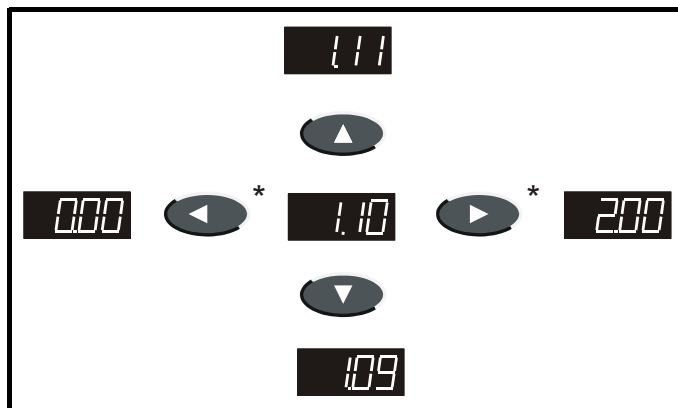
NOTE

For new parameter-values to apply after the AC supply to the drive is interrupted, new values must be saved. Refer to section 5.8 *Saving parameters* on page 61.

5.3 Menu structure

The drive parameter structure consists of menus of parameters.

The drive initially powers up so that only menu 0 can be viewed. The up and down arrow buttons are used to navigate between parameters and once standard security has been cleared, the left and right buttons are used to navigate between menus.



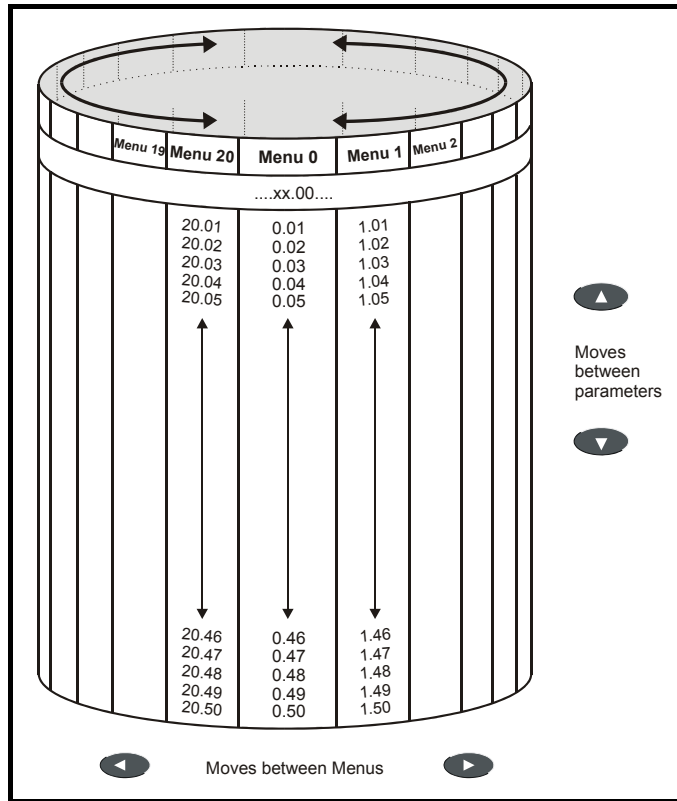
* \leftarrow \rightarrow can only be used to move between menus if standard security has been opened. For further information, refer to section 5.10 *Parameter security* on page 62.

The menus and parameters roll over in both directions.

i.e. 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 thus displays that parameter.





Figure 5-3 Menu Structure



NOTE
Menu 20 is only present when a large option module is present.

5.4 Advanced keypad functions

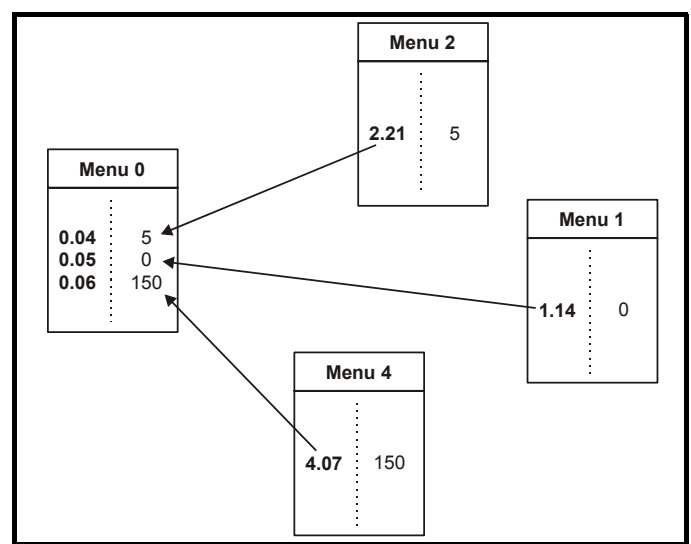
The following short-cuts can be used to speed up navigation of the drive parameters and editing of parameters.

Key Press	Parameter View Mode	Parameter Edit Mode
 + 	jumps to xx.00	Sets value to 0
 + 	jumps to 00.yy	Jumps to LSB

5.5 Menu 0

Menu 0 is used to bring together various commonly used parameters for basic easy set up of the drive. Appropriate parameters are cloned from the advanced menus into menu 0 and thus exist in both locations.

Figure 5-4 Menu 0 Cloning



5.6 Advanced menus

The advanced menus consist of groups or parameters appropriate to a specific function or feature of the drive as follows:

Menu number	Description
0	Commonly used basic set up parameters for quick / easy programming
1	Speed references and limits
2	Ramps (accel / decel)
3	Speed feedback / frequency slaving
4	Current control
5	Machine control
6	Sequencing logic
7	Analog I/O
8	Digital I/O
9	Programmable logic
10	Status flags / trip log
11	Menu 0 customisation / drive specific ratings
12	Programmable thresholds
13	Digital lock / orientation
14	Programmable PID function
15	Regen
16	Small option module set up
17	Large option module set up
18	Application menu 1
19	Application menu 2
20	Large option module set up

5.6.1 Display messages

Status indications

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

Trip types are not listed here but can be found in Chapter 12 *Diagnostics* if required.

Lower display	Conditions	Drive output stage
Act	Regeneration mode active	Enabled
Regen mode>	The Regen drive is enabled and synchronised to the supply.	
ACUU	AC Supply loss	Enabled
	The drive has detected that the AC supply has been lost and is attempting to maintain the DC bus voltage by decelerating the motor.	
dc	DC applied to the motor	Enabled
	The drive is applying DC injection braking.	
dEC	Decelerating	Enabled
	The drive is decelerating the motor.	
inh	Inhibit	Disabled
	The drive is inhibited and cannot be run. Drive enable signal not applied to terminal 30 or Pr 6.15 is set to 0.	
POS	Positioning	Enabled
	The drive is positioning/orientating the motor shaft.	
rdY	Ready	Disabled
	The drive is ready to be run.	
run	Running	Enabled
	The drive is running.	
SCAn	Scanning	Enabled
	OL> The drive is searching for the motor frequency when synchronising to a spinning motor. Regen> The drive is enabled and is synchronising to the line.	
StoP	Stop or holding zero speed	Enabled
	The drive is holding the motor at zero speed. Regen> The drive is enabled but the AC voltage is too low, or DC Bus voltage still rising or falling.	
triP	Trip condition	Disabled
	The drive has tripped and is no longer controlling the motor. The trip code appears on the upper display.	

Alarm indications

Lower display	Conditions
Air	Control PCB ambient temperature near maximum limit
	The ambient temperature around the control PCB has reached 90°C (194°F) and the drive will trip OA if the temperature continues to rise (see the OA trip).
br.rS	Braking resistor overload
	The braking-resistor [I x t] accumulator in the drive has reached 75% of the value at which the drive will be tripped.
hot	Heatsink temperature near maximum limit
	The drive heatsink has reached 90°C (194°F) and the drive will trip Oh2 if the temperature continues to rise (see the Oh2 trip).
OVLd	Motor overload
	The motor [I x t] accumulator in the drive has reached 75% of the value at which the drive will be tripped.





5.7 Changing the operating mode

Changing the operating mode returns all parameters to their default value, including the motor parameters.


Procedure

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

- Enter either of the following values in Pr 0.00, as appropriate:
1253 (Europe, 50Hz AC supply frequency)
1254 (USA, 60Hz AC supply frequency)
- Change the setting of Pr 0.48 as follows:

Pr 0.48 setting	Operating mode
 0	Open-loop
 1	Closed-loop Vector
 2	Closed-loop Servo
 3	For operation in this mode, refer to the <i>Unidrive Regen Installation Guide</i>

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

- Press  or momentarily close the RESET contact.
The new setting takes effect and all the parameters revert to the appropriate default values for the new mode.

5.8 Saving parameters

Procedure

Enter 1000 in Pr xx.00

Press the red reset button or toggle the reset digital input (ensure Pr xx.00 returns to 0)

5.9 Defaulting the drive

Procedure

Enter 1233 (EUR 50 Hz settings) or 1244 (USA 60 Hz settings) in Pr xx.00

Press the red reset button or toggle the reset digital input (ensure Pr xx.00 returns to 0)

5.10 Parameter security

There are two independent levels of security that can be enabled / disabled in the Unidrive. This gives four possible combinations of security settings as shown in the table below:

Standard security	User security	Menu 0 status	Advanced menus status (i.e menus 1 to 20)
Open	Open	RW	RW
Open	Closed	RO	RO
Closed	Open	RW	Not visible
Closed	Closed	RO	Not visible

RW = Read / write access

RO = Read only access

The default settings of the drive are standard security closed and user security open, i.e. read / write access to Menu 0 with the advanced menus (i.e. menus 1 to 20) not visible.

5.10.1 Standard security

Standard security prevents read and write access to the advanced menu parameters.

Standard security closed - Menu 0 only visible

Pr 0.00			
Pr 0.01			
Pr 0.02			
Pr 0.03			
Pr 0.49			
Pr 0.50			

Standard security open - All parameters visible

Pr 0.00	Pr 1.00	.....	Pr 19.00	Pr 20.00
Pr 0.01	Pr 1.01	.....	Pr 19.01	Pr 20.01
Pr 0.02	Pr 1.02	.....	Pr 19.02	Pr 20.02
Pr 0.03	Pr 1.03	.....	Pr 19.03	Pr 20.03
			
			
Pr 0.49	Pr 1.49	.....	Pr 19.49	Pr 20.49
Pr 0.50	Pr 1.50	.....	Pr 19.50	Pr 20.50

Opening standard security

Set parameter **xx.00** to 149 and press the **M** button.

Closing security

Set parameter **xx.00** to 2000 and press the **M** button or cycle the power to the drive.

NOTE

This action also closes user security if it has been enabled.

Disabling standard security

Set parameter **0.34** to 0 and press the **M** button.

NOTE

This action also disables user security if it has been enabled.

Enabling standard security

Set parameter **0.34** to 149 and press the **M** button.

5.10.2 User security

User security prevents write access to all parameters except **xx.00**.

User security open - All parameters: Read / Write access

Pr 0.00	Pr 1.00	.....	Pr 19.00	Pr 20.00
Pr 0.01	Pr 1.01	.....	Pr 19.01	Pr 20.01
Pr 0.02	Pr 1.02	.....	Pr 19.02	Pr 20.02
Pr 0.03	Pr 1.03	.....	Pr 19.03	Pr 20.03
			
			
Pr 0.49	Pr 1.49	.....	Pr 19.49	Pr 20.49
Pr 0.50	Pr 1.50	.....	Pr 19.50	Pr 20.50

User security closed - All parameters: Read Only access, except **Pr xx.00**

Pr 0.00	Pr 1.00	.....	Pr 19.00	Pr 20.00
Pr 0.01	Pr 1.01	.....	Pr 19.01	Pr 20.01
Pr 0.02	Pr 1.02	.....	Pr 19.02	Pr 20.02
Pr 0.03	Pr 1.03	.....	Pr 19.03	Pr 20.03
			
			
Pr 0.49	Pr 1.49	.....	Pr 19.49	Pr 20.49
Pr 0.50	Pr 1.50	.....	Pr 19.50	Pr 20.50

Setting user security

Enter a value between 1 and 256 (except 149) in parameter **0.34**. Once the **M** button has been pressed the value reverts to 149 to hide the security code which has been set.

Save parameters by setting parameter **xx.00** to 1000 and press the **↩** button.

Opening user security

Enter the security code into parameter **xx.00**.

Closing user security

Set parameter **xx.00** to 2000 and press the mode button or cycle the power to the drive.

NOTE

This action also closes standard security if it has been enabled.

Disabling user security

Set parameter **0.34** to 0 and press the **M** button to disable both user and standard security

Set parameter **0.34** to 149 and press the **M** button to disable user, but set standard, security.

5.11 Serial Communications

5.11.1 Introduction

The Unidrive has an optional serial communications interface in the form of the UD71 serial communications module. This module has a fully optically isolated 4 wire or 2 wire EIA485 interface and an EIA232 interface. (The EIA232 interface should be used for commissioning purposes only.)

5.11.2 Serial communications module hardware connections

See Figure 3-5 on page 15 for information regarding installing the UD71 serial communications large option module in the drive.

Figure 5-5 Location of communication interfaces

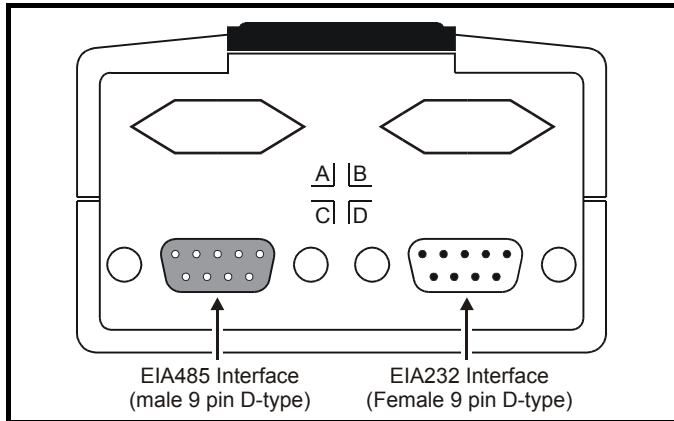


Table 5-1 Serial communications connections

Pin	EIA485 Interface		EIA232 Interface	
	4 wire mode	2 wire mode	UD71	Host PC
1	0V	0V	CD	CD
2	TX\	TX\ RX*	TXD**	RXD**
3	RX\	TX\ RX*	RXD**	TXD**
4	Not connected	Not connected	DTR	DTR
5	Not connected	Not connected	0V**	0V**
6	TX	TX RX*	DSR	DSR
7	RX	TX RX*	RTS	RTS
8	Not connected	Not connected	CTS	CTS
9	Not connected	Not connected	NC	RI

* Pins 2 and 3, and pins 6 and 7 must be connected together in 2 wire EIA485 mode.

** Depending on the host software being used, it may only be necessary to connect pins 2, 3 and 5 when using the EIA232 interface.

When connecting EIA232 interface on the UD71 serial communications module to the 9 pin serial port on a PC, a 9 pin male D-type to 9 pin female D-type serial extension cable can be used.

5.11.3 Serial communications set-up parameters

The following parameters need to be set according to the system requirements.

11.23 Serial comms. address	
RW	Uni
↕	0.0 to 9.9
	1.1

Defines the unique address for the drive. Any number in the permitted range 0.0 to 9.9 which has a zero in it, should not be used as these are used to address groups of drives.

11.24 Serial comms. mode	
RW	Txt
↕	ANSI 2 (0), ANSI 4 (1), OUTPUT (2), INPUT (4)
	ANSI 4 (1)

This is the mode of operation of the serial port.

ANSI 2 (0)	Standard 2 wire EIA485 using ANSI protocol
ANSI 4 (1)	Standard 4 wire EIA485 using ANSI protocol
OUTPUT (2)	Output variable defined by Pr 11.27
INPUT (3)	Input variable defined by Pr 11.27

OUTPUT (2) and INPUT (3) are used to transfer a variable parameter from one drive to another. See the *Unidrive Advanced User Guide* for more information.

11.25 Serial comms. baud rate	
RW	Txt
↕	4800 (0), 9600 (1), 19200 (2), 2400 (3)
	4800 (0)

Used in 2 or 4 wire ANSI modes to select the communications port baud rate.

4800 (0)	4800 baud
9600 (1)	9600 baud
19200 (2)	19200 baud
2400 (3)	2400 baud

11.26 Serial comms. two-wire mode delay	
RW	Uni
↕	0 to 255 ms
	0

If 2 wire EIA485 communications is being used then a delay is required between the drive receiving data and then responding to allow the device that sent the request to changes its buffers from transmit to receive.

6 Menu 0

6.1 Single line descriptions

6.1.1 Unidrive (All variants excluding Unidrive VTC)

Parameter			Range(⇅)		Default(⇨)			Type			
			OL	CL	OL	VT	SV				
0.00	Operating mode, Macro selection, Configuration, Saving		0 to 9,999		0			RW	Uni	R	
0.01	OL> Minimum frequency	{1.07}	0 to [Pr 0.02]Hz		0			RW	Uni		
	CL> Minimum speed	{1.07}		0 to [Pr 0.02]rpm		0		RW	Uni		
0.02	OL> Maximum frequency	{1.06}	0 to 1,000.0Hz		EUR> 50 USA> 60			RW	Uni		
	CL> Maximum speed	{1.06}		0 to 30,000rpm		EUR> 1,500 USA> 1,800	3000	RW	Uni		
0.03	Acceleration rate	{2.11}	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 s/1000rpm SV> 0 to 32,000 s/1000rpm	5	2	0.2	RW	Uni		
0.04	Deceleration rate	{2.21}	0 to 3,200.0 s/100Hz	VT> 0 to 32,000 s/1000rpm SV> 0 to 32,000 s/1000rpm	10	2	0.2	RW	Uni		
0.05	Reference selector	{1.14}	0 to 5		EUR> 0 USA> 4	0		RW	Uni		
0.06	Current limit	{4.07}	0 to I _{max} %		150		175	RW	Uni		
0.07	OL> Voltage mode selector	{5.14}	Ur_S (0), Ur_I (1), Ur (2), Fd (3)		Ur_I (1)			RW	Uni		P
	CL> Speed control P gain	{3.10}		0 to 32,000 %		200		RW	Uni		
0.08	OL> Voltage boost	{5.15}	0.0 to 25.0 %		3.0			RW	Uni		
	CL> Speed control I gain	{3.11}		0 to 32,000		100		RW	Uni		
0.09	OL> Dynamic V/f select	{5.13}	0 or 1		0			RW	Bit		
	CL> Speed control D gain	{3.12}		0 to 32,000		0		RW	Uni		
0.10	OL> Estimated motor speed	{5.04}	±6,000 rpm					RO	Bi		
	CL> Motor speed	{3.02}		±30,000 rpm				RO	Bi		
0.11	Pre-ramp reference	{1.03}	±1,000.0 Hz	±30,000 rpm				RO	Bi		
0.12	Post-ramp reference	{2.01}	±1,000.0 Hz	±30,000 rpm				RO	Bi		
0.13	Motor active-current	{4.02}	±I _{max} A					RO	Bi		
0.14	Jog reference	{1.05}	0 to 400.0 Hz	0 to 4,000.0 rpm	1.5	50		RW	Uni		
0.15	Ramp mode selector	{2.04}	Std.Hd (0), FAST (1), Std.Ct (2)		Std.Ct (2)			RW	Txt		
0.16	Stop mode selector	{6.01}	COAST (0), rP (1), rP-dcl (2), dcl (3), td.dcl (4)	COAST (0), rP (1), no.rP (2), rP-POS (3)	rP (1)		no.rP (2)	RW	Txt		
0.17	Torque mode select	{4.11}	0 to 1	0 to 4	0			RW	Uni		
0.18	S-Ramp enable	{2.06}	0 or 1		0			RW	Bit		
0.19	S-Ramp da / dt limit	{2.07}	0 to 3,000.0 s ² /100 Hz	0 to 30,000 s ² /1000 rpm	3.1	1.5	0.03	RW	Uni		
0.20	Skip frequency/speed 1	{1.29}	0.0 to 1,000.0 Hz	0 to 30,000 rpm	0			RW	Uni		
0.21	Skip band 1	{1.30}	0.0 to 5.0 Hz	0 to 50 rpm	0.5	5		RW	Uni		
0.22	Skip frequency/speed 2	{1.31}	0.0 to 1,000.0 Hz	0 to 30,000 rpm	0			RW	Uni		
0.23	Skip band 2	{1.32}	0.0 to 5.0 Hz	0 to 50 rpm	0.5	5		RW	Uni		
0.24	Analog input 1 mode selector	{7.06}	VOLT (0), 0 - 20 (1), 20 - 0 (2), 4 - 20.tr (3), 20 - 4.tr (4), 4 - 20.Lo (5), 20 - 4.Lo (6), 4 - 20.Pr (7), 20 - 4.Pr (8)		VOLT (0)			RW	Txt	R	
0.25	Analog input 2 mode selector	{7.11}	(as Pr 0.24)		VOLT (0)			RW	Txt	R	
0.26	Analog input 2 destination	{7.14}	Pr 0.00 to Pr 20.50		Pr 1.37			RW	Uni	R	P
0.27	EUR> Positive logic select	{8.27}	0 or 1		0			RW	Bit	R	P
	USA> Sequencing mode selector	{6.04}	0 to 4		4			RO	Uni		P
0.28	EUR> Current control P gain	{4.13}	0 to 30,000		20	150	30	RW	Uni		
	USA> Frequency/speed demand	{1.01}	±1,000Hz	±30,000 rpm				RO	Bi		
0.29	EUR> Current control I gain	{4.14}	0 to 30,000		40	2,000	1,200	RW	Uni		
	USA> Terminal-29 destination parameter	{8.23}	Pr 0.00 to Pr 20.50		Pr 1.41			RW	Uni	R	P
0.30	Forward / reverse key enable	{6.13}	0 or 1		0			RW	Bit		
0.31	Macro number	{11.37}	0 to 8					RO	Uni		
0.32	Serial comms mode	{11.24}	ANSI 2 (0), ANSI 4 (1), OutPUt (2), INPUt (3)		ANSI 4 (1)			RW	Txt	R	P
0.33	Drive rated current (FLC)	{11.32}	2.10 to 1920 A					RO	Uni		P
0.34	User security code	{11.30}	0 to 255		149			RW	Uni	S	P
0.35	Keypad reference	{1.17}	± [Pr 0.02] Hz	± [Pr 0.02] rpm				RO	Bi	S	P
0.36	Serial comms. baud rate	{11.25}	4,800 (0), 9,600 (1), 19,200 (2) baud		4,800 (0)			RW	Txt		P
0.37	Serial comms. address	{11.23}	0.0 to 9.9 Group.Unit		1.1			RW	Uni		P
0.38	Initial parameter displayed	{11.22}	Pr 0.00 to Pr 0.50		Pr 0.10			RW	Uni		P

Parameter			Range(↕)		Default(⇒)			Type			
			OL	CL	OL	VT	SV				
0.39	Synchronise to a spinning motor	{6.09}	0 or 1		0	1		RW	Bit		
0.40	Autotune	{5.12} (3.25)	0 or 1		0			RW	Bit		P
0.41	PWM switching frequency	{5.18}	3 kHz (0), 4.5 kHz (1), 6 kHz (2), 9 kHz (3), 12 kHz (4)		3 (0)*			RW	Txt		
0.42	Motor - no. of poles	{5.11}	2 POLE (0) to 32 POLE (15)		4 POLE (1)		6 POLE (3)	RW	Txt		P
0.43	Motor - rated power factor	{5.10}	0.000 to 1.000	VT> 0.000 to 1.000 SV> 1	0.92		1	RW	Uni	S	P
0.44	Motor - rated voltage	{5.09}	200V drive: 0 to 240 V 400V drive: 0 to 480 V		200V drive: 220 400V drive: EUR> 400 USA> 460		0	RW	Uni		
0.45	Motor - rated speed	{5.08}	0 to 6,000 rpm	0 to 30,000 rpm	0	EUR> 1450 USA> 1770		RW	Uni		
0.46	Motor - rated current	{5.07}	0 to FLC A		FLC			RW	Uni		
0.47	Motor - rated frequency	{5.06}	0 to 1,000.0 Hz	VT> 0 to 1,000.0 Hz SV> 0	EUR> 50 USA> 60		0	RW	Uni		
0.48	Drive operating mode <i>selector</i>	{11.31}	OPENLP (0), CL.VECT (1), SERVO (2), rEGEN (3)		OPENLP (0)	CL.VECT (1)	SERVO (2)	RW	Txt	R	P
0.49	Security status		0 to 1,000		1			RO	Uni		P
0.50	Software version number	{11.29}	1.00 to 99.99					RO	Uni		P

* Pr **0.41** PWM switching frequency has a default setting of 9kHz in Unidrive LFT

Key:

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous)

Types of current range

FLC Full load current of the drive (maximum continuous output current up to 40°C ambient temperature). Displayed in Pr **11.32** {0.33}.

I_{MAX} A Maximum overload output current of the drive up to 40°C ambient temperature, derived as follows:

Size 1 to 4: OL> 150% x FLC

CL> 175% x FLC

Size 5: 150% x FLC

I_{MAX} % See section 8.2 *Current limits* on page 98 for the definition of I_{MAX}%.

NOTE

Where a parameter is represented by a text value, the value in brackets in the range column is the setting used for serial communications.

Operation mode abbreviations:

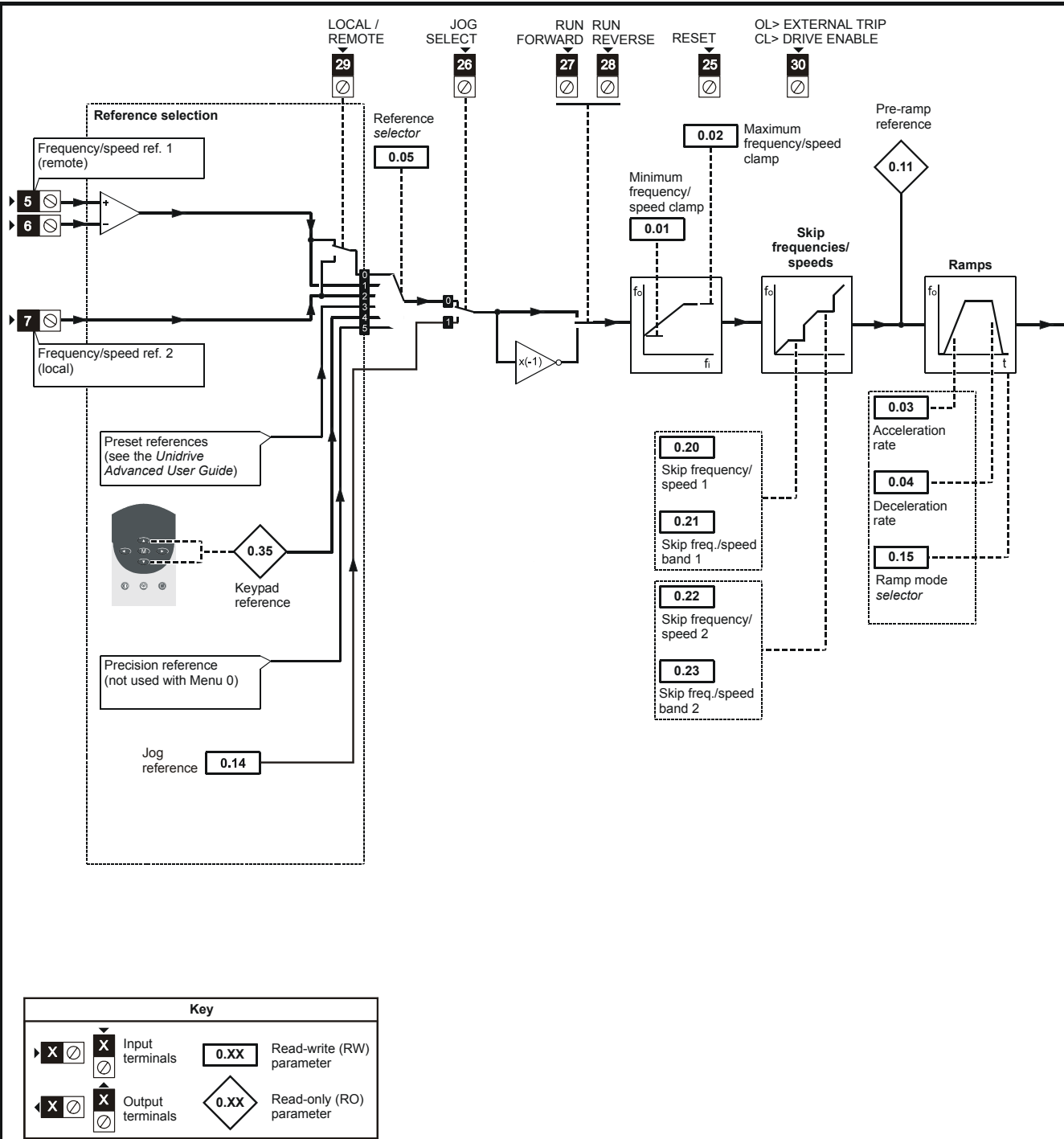
OL> Open loop

CL> Closed loop (which incorporates closed loop vector and servo mode)

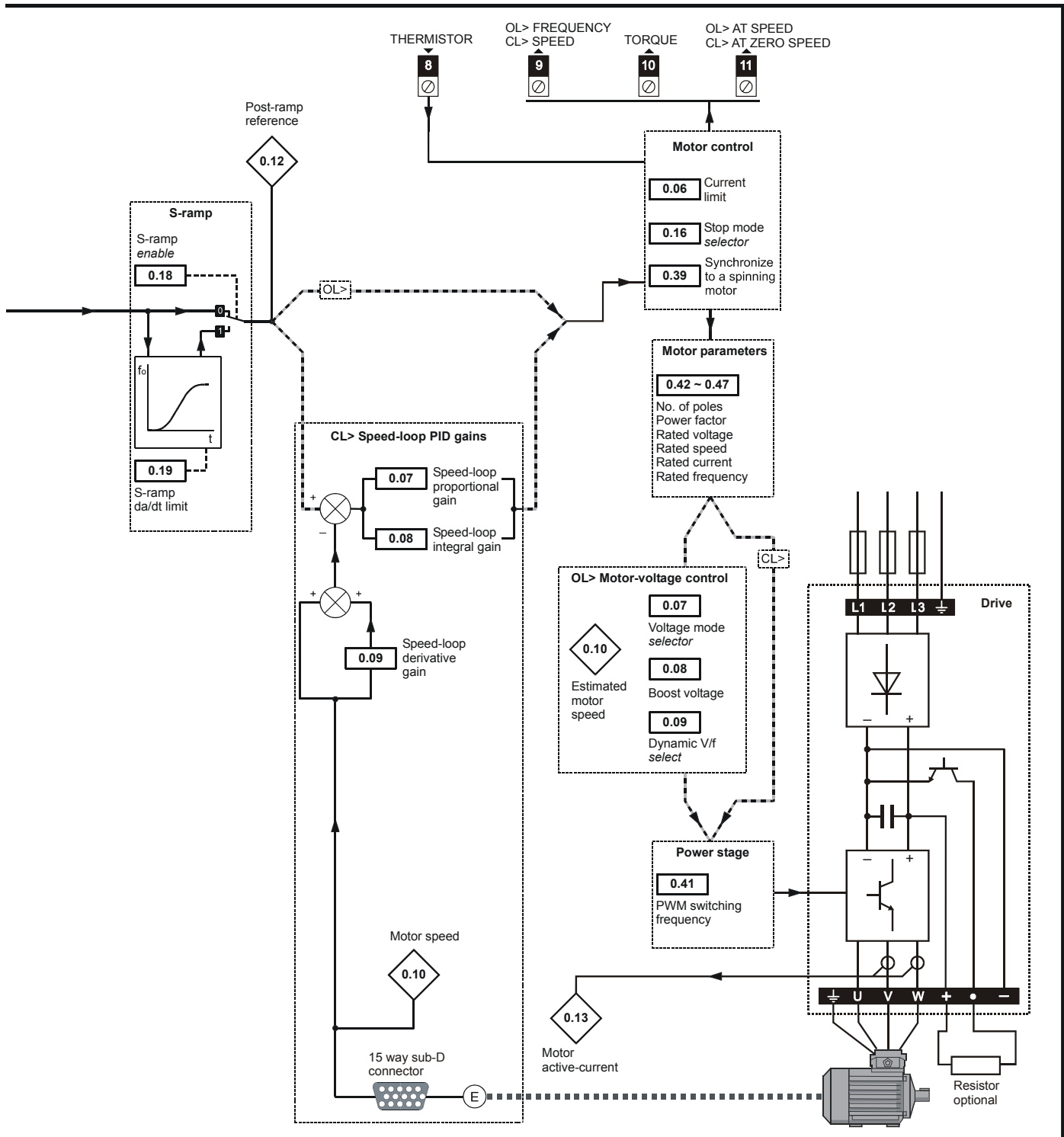
VT> Closed loop vector mode

SV> Servo

Figure 6-1 Unidrive menu 0 logic diagram (excluding VTC)



The parameters are all shown in their default settings



6.1.2 Unidrive VTC

Parameter		Range(⇅)	Default(⇨)		Type			
0.00	Operating mode, Macro selection, Configuration, Saving	0 to 9,999	0		RW	Uni	R	
0.01	Minimum frequency {1.07}	0 to [Pr 0.02]Hz	0		RW	Uni		
0.02	Maximum frequency {1.06}	0 to 250.0Hz	EUR> 50, USA> 60		RW	Uni		
0.03	Acceleration rate {2.11}	0 to 3,200.0 s/100Hz	60		RW	Uni		
0.04	Deceleration rate {2.21}	0 to 3,200.0 s/100Hz	60		RW	Uni		
0.05	Reference selector {1.14}	0 to 5	0		RW	Uni		
0.06	Current limit {4.07}	0 to I _{max} %	120		RW	Uni		
0.07	Voltage mode selector {5.14}	Ur_S (0), Ur_I (1), Ur (2), Fd (3)	Fd (3)		RW	Txt		P
0.08	Voltage boost {5.15}	0.0 to 15.0 %	3.0		RW	Uni		
0.09	Dynamic V/f select {5.13}	0 or 1	0		RW	Bit		
0.10	Estimated motor speed {5.04}	±6,000 rpm			RO	Bi		P
0.11	Pre-ramp reference {1.03}	±1,000.0 Hz			RO	Bi		P
0.12	Post-ramp reference {2.01}	±1,000.0 Hz			RO	Bi		P
0.13	Motor active-current {4.02}	±I _{max} A			RO	Bi		P
0.14	Total motor current {4.01}	0 to 400.0 Hz			RO	Uni		P
0.15	Ramp mode selector {2.04}	Std.Hd (0), FdSt (1), Std.Ct (2)	Std.Ct (2)		RW	Txt		
0.16	Stop mode selector {6.01}	COAST (0), rP (1), rP-dcl (2), dcl (3), td.dcl (4)	rP (1)		RW	Txt		
0.17	Total motor power {5.03}	±P _{MAX}			RO	Bi		P
0.18	S-Ramp enable {2.06}	0 or 1	0		RW	Bit		
0.19	S-Ramp da / dt limit {2.07}	0 to 3,000.0 s ² /100 Hz	450.0		RW	Uni		
0.20	Skip frequency 1 {1.29}	0.0 to 1,000.0 Hz	0		RW	Uni		
0.21	Skip band 1 {1.30}	0.0 to 5.0 Hz	0.5		RW	Uni		
0.22	Drive rated current (FLC) {11.32}	2.10 to 202 A			RO	Uni		P
0.23	Analog input 1 mode selector {7.06}	VOLt (0), 0 - 20 (1), 20 - 0 (2), 4 - 20.tr (3), 20 - 4.tr (4), 4 - 20.Lo (5), 20 - 4.Lo (6), 4 - 20.Pr (7), 20 - 4.Pr (8)	VOLt (0)		RW	Txt	R	
0.24	Preset frequency 1 {1.21}	±1,000.0 Hz	0		RW	Bi		
0.25	Preset frequency 2 {1.22}	±1,000.0 Hz	0		RW	Bi		
0.26	Standard ramp voltage {2.08}	200V drive: 0 to 400 V 400V drive: 0 to 800 V	200V drive: 375 400V drive: EUR> 750, USA> 775		RW	Uni		
0.27	Current control P gain {4.13}	0 to 30,000	20		RW	Uni		
0.28	Current control I gain {4.14}	0 to 30,000	20		RW	Uni		
0.29	DC bus voltage {5.05}	200V drive: 0 to 415 V 400V drive: 0 to 830 V			RO	Uni		P
0.30	Last trip {10.20}	0 to 200			RO	Txt	S	P
0.31	Macro number {11.37}	0, 1, 2, 3, 5	0		RO	Uni		
0.32	Number of auto-reset attempts {10.34}	0 to 5	0		RW	Uni		
0.33	Auto-reset time delay {10.35}	0.0 to 25.0 s	1.0		RW	Uni		
0.34	User security code {11.30}	0 to 255	149		RW	Uni	S	P
0.35	Serial comms. mode {11.24}	ANSI 2 (0), ANSI 4 (1), OutPut (2), INPut (3)	ANSI 4 (1)		RW	Txt	R	P
0.36	Serial comms. baud rate {11.25}	4,800 (0), 9,600 (1), 19,200 (2) baud	EUR> 4,800, USA> 9,600		RW	Txt		P
0.37	Serial comms. address {11.23}	0.0 to 9.9 Group.Unit	1.1		RW	Uni		P
0.38	Initial parameter displayed {11.22}	Pr 0.00 to Pr 0.50	EUR> Pr 0.10, USA> Pr 0.12		RW	Uni		P
0.39	Synchronise to a spinning motor {6.09}	0 or 1	0		RW	Bit		
0.40	Autotune {5.12}	0 or 1	0		RW	Bit		P
0.41	PWM switching frequency {5.18}	3 (0), 4.5 (1), 6 (2), 9 (3), 12 (4) kHz	3 (0)		RW	Txt		
0.42	Motor - no. of poles {5.11}	2 POLE (0) to 32 POLE (15)	4 POLE (1)		RW	Txt		P
0.43	Motor - rated power factor {5.10}	0.000 to 1.000	0.92		RW	Uni	S	P
0.44	Motor - rated voltage {5.09}	200V drive: 0 to 240 V 400V drive: 0 to 480 V	200V drive: 220 400V drive: EUR> 400, USA> 460	0	RW	Uni		
0.45	Motor - rated speed {5.08}	0 to 6,000 rpm	0		RW	Uni		
0.46	Motor - rated current {5.07}	0 to FLC A	FLC		RW	Uni		
0.47	Motor - rated frequency {5.06}	0 to 1,000.0 Hz	EUR> 50, USA> 60		RW	Uni		
0.48	Overload accumulator {4.19}	0 to 100 %			RO	Uni		P
0.49	Security status	0 or 1	1		RO	Bit		
0.50	Software version number {11.29}	1.00 to 99.99			RO	Uni		P

Key:

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous)

Types of current range

FLC Full load current of the drive (maximum continuous output current up to 40°C ambient temperature). Displayed in Pr **11.32** {0.22}.

I_{MAX} A Maximum overload output current of the drive up to 40°C ambient temperature, derived as follows:
120% x FLC

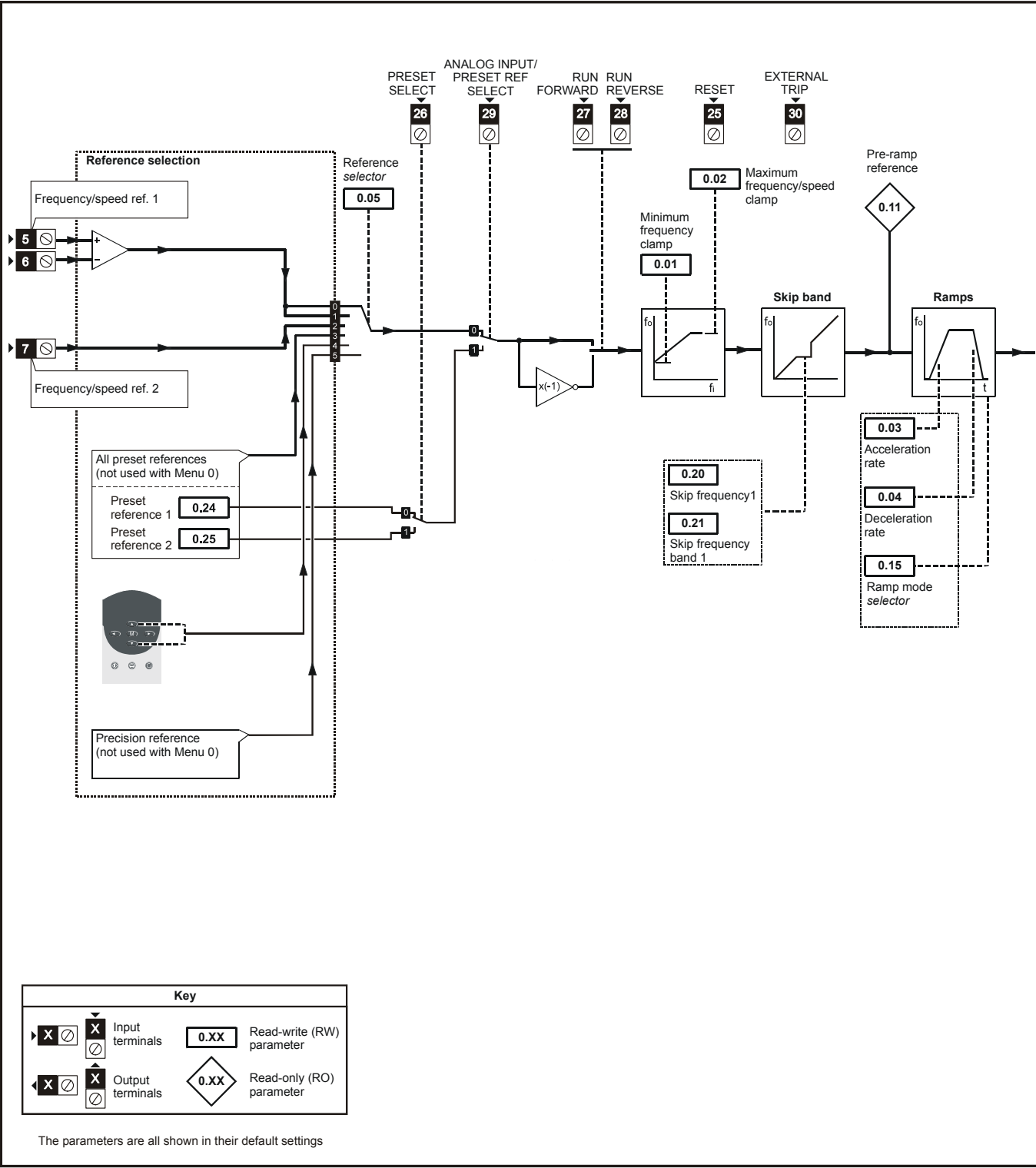
I_{MAX} % See section 8.2 *Current limits* on page 98 for the definition of I_{MAX}%.

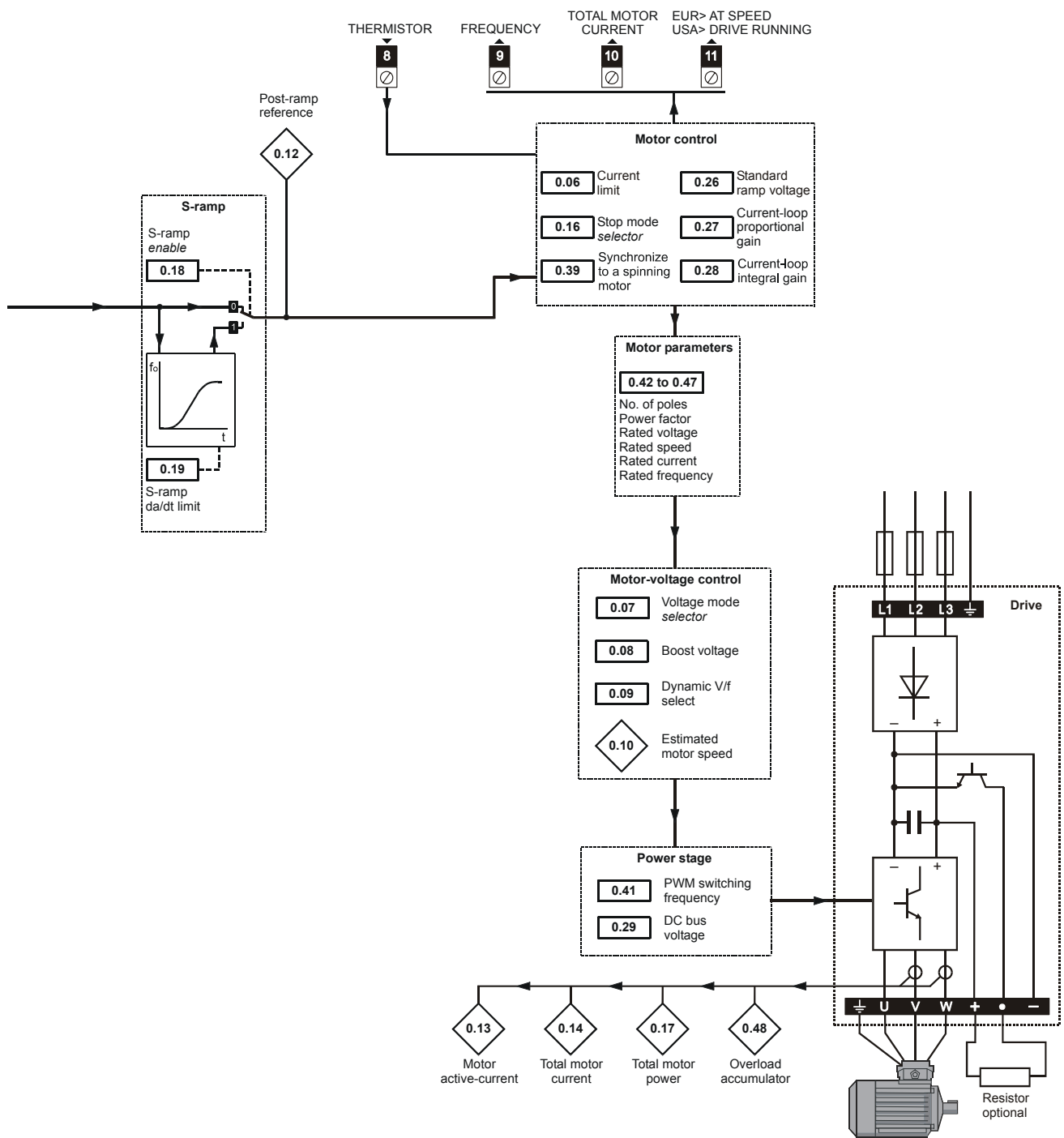
$$P_{MAX} = \sqrt{3} \times I_{MAX} \times \frac{Pr5.09}{1000}$$

NOTE

Where a parameter is represented by a text value, the value in brackets in the range column is the setting used for serial communications.

Figure 6-2 Unidrive VTC menu 0 logic diagram






6.2 Menu 0 full descriptions

6.2.1 Menu 0 configuration

0.00	Operating mode, Macro selection, Configuration, Saving			
RW	Uni		R	
↕	0 to 9,999	⇒	0	

Value	Function
1000	Save new parameter-values
1233	Restore parameters to their default values for 50Hz AC supply frequency (Europe)
1244	Restore parameters to their default values for 60Hz AC supply frequency (USA)
1253	Enable the operating mode of the drive to be changed and restore parameters to their default values for 50Hz AC supply frequency (Europe)
1254	Enable the operating mode of the drive to be changed and restore parameters to their default values for 60Hz AC supply frequency (USA)
2001	Macro 1 Easy mode
2002	Macro 2 Motorized potentiometer
2003	Macro 3 Preset speeds
2004	Macro 4 Torque control
2005	Macro 5 PID control
2006	Macro 6 Axis-limit control
2007	Macro 7 Brake control
2008	Macro 8 Digital lock / shaft orientation

Press  after setting Pr 0.00 at the required value.

6.2.2 Speed limits

0.01 {1.07}	OL> Minimum frequency CL> Minimum speed			
RW	Uni			
OL	↕	0 to [Pr 0.02]Hz	⇒	0
CL	↕	0 to [Pr 0.02]rpm	⇒	0

(When the drive is jogging, [Pr 0.01] has no effect.)

Open-loop

Set Pr 0.01 at the required minimum output frequency of the drive for both directions of rotation. The drive runs at the minimum frequency when the frequency reference is zero.

[Pr 0.01] is a nominal value; slip compensation may cause the actual frequency to be higher.

Closed-loop

Set Pr 0.01 at the required minimum motor speed for both directions of rotation. The motor runs at the minimum speed when the speed reference is zero.

0.02 {1.06}	OL> Maximum frequency CL> Maximum speed			
RW	Uni			
OL	↕	0 to 1,000Hz*	⇒	EUR> 50 USA> 60
CL	↕	VT> 0 to 30,000rpm SV> 0 to 30,000rpm	⇒	EUR> 1,500 USA> 1,800 3,000

* This parameter has a maximum range of 250Hz in Unidrive VTC.

(The drive has additional over-speed protection.)

Open-loop

Set Pr 0.02 at the required maximum output frequency for both directions of rotation. The frequency reference cannot cause the drive to run at a frequency higher than [Pr 0.02].

[Pr 0.02] is a nominal value; slip compensation may cause the actual frequency to be higher.

Closed-loop

Set Pr 0.02 at the required maximum motor speed for both directions of rotation. The speed reference cannot cause the drive to run the motor at a speed higher than [Pr 0.02].



For closed loop vector operation at motor frequencies greater than 400Hz (24,000rpm for 2-pole motors) may result in instability. For further advice, contact the supplier of the drive.

6.2.3 Ramps, Speed reference selection, Current limit

0.03 {2.11}	Acceleration rate			
RW	Uni			
OL	↕	0.0 to 3,200.0s/100Hz	⇒	5*
CL	↕	VT> 0 to 3,200.0 s/1,000rpm SV> 0 to 32.000 s/1,000rpm	⇒	2 0.2

*This parameter has a default setting of 60s in Unidrive VTC.

Set Pr 0.03 at the required rate of acceleration.

Note that larger values produce lower acceleration. The rate applies in both directions of rotation.

0.04 {2.21}	Deceleration rate			
RW	Uni			
OL	↕	0.0 to 3,200.0s/100Hz	⇒	10*
CL	↕	VT> 0 to 3,200.0 s/1,000rpm SV> 0 to 32.000 s/1,000rpm	⇒	2 0.2

*This parameter has a default setting of 60s in Unidrive VTC.

Set Pr 0.04 at the required rate of deceleration.

Note that larger values produce lower deceleration. The rate applies in both directions of rotation.

0.05 {1.14}	Reference selector			
RW	Uni			
OL	↕	0 to 5	⇒	EUR> 0* USA> 4*
CL	↕	0 to 5	⇒	EUR> 0 USA> 0

*This parameter has a European and USA default setting of 0 in Unidrive VTC.

The default setting of Pr 0.05 depends on the default configuration of the drive and the operating mode, as follows:

EUR	All operating modes	0	Terminal mode
USA	Closed-loop modes	0	Terminal mode
USA	Open-loop mode	4	Keypad mode

The default settings apply also when a macro is enabled.

Use Pr **0.05** to select the required frequency/speed reference, as follows:

Setting	Control mode	Function
0	Terminal	Analog frequency / speed reference selected by ANALOG INPUT 1 / INPUT 2 contact
1	Terminal	Analog frequency / speed reference 1 selected
2	Terminal	Analog frequency / speed reference 2 selected
3	Terminal	Preset frequency / speed references selected (not used with Menu 0)
4	Keypad	Frequency / speed controlled by the keypad
5	Terminal	Precision reference selected (not used with Menu 0)

0.06 {4.07} Current Limit	
RW	Uni
OL	150*
VT	150
SV	175

*This parameter has a default setting of 120% in Unidrive VTC.

For the definition of I_{MAX} %, see section 8.2 *Current limits* on page 98.

Pr **0.06** limits the maximum output current of the drive (and hence maximum motor torque) to protect the drive and motor from overload.

Set Pr **0.06** at the required maximum torque as a percentage of the rated torque of the motor, as follows:

$$\text{Pr } 0.06 = \frac{T_R}{T_{RATED}} \times 100 (\%)$$

Where:

T_R Required maximum torque
 T_{RATED} Motor rated torque

Alternatively, set 0.06 at the required maximum active (torque-producing) current as a percentage of the rated active current of the motor, as follows:

$$\text{Pr } 0.06 = \frac{I_R}{I_{RATED}} \times 100 (\%)$$

Where:

I_R Required maximum active current
 I_{RATED} Motor rated active current

6.2.4 Voltage boost (open-loop), Speed-loop PID gains (closed-loop)

0.07 {5.14} OL> Voltage mode selector	
0.07 {3.10} CL> Speed controller proportional gain	
RW	Uni
OL	Ur_S (0), Ur_I (1), Ur (2), Fd (3)
CL	0 to 32,000 %

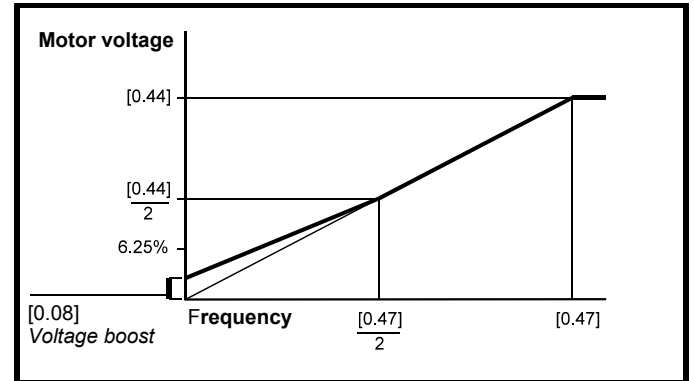
*This parameter has a default setting of Fd (3) in Unidrive VTC.

Open-loop

Setting	Function
Vector modes	
Ur_S	0 Motor stator resistance is measured each time the drive is started.
Ur_I	1 Motor stator resistance is measured at power-up if the EXTERNAL TRIP contact is closed and no other trip condition exists.
Ur	2 Motor stator resistance is not measured (use this mode only after having used Ur_S or Ur_I to measure the stator resistance).
Fixed boost mode	
Fd	3 Fixed voltage boost that can be manually adjusted by parameter 0.08 Boost voltage .

Use Pr **0.07** (Pr **5.14**) to select fixed voltage boost, or Vector control of voltage boost. Fixed boost requires a value to be set in Pr **0.08 Boost voltage** by the user. See Figure 6-3. Fixed boost should be used when Pr **0.39 Synchronize to a spinning motor** is set at 1.

Figure 6-3 Effect of fixed voltage boost on the voltage-to-frequency characteristic



Vector control causes the voltage boost to be automatically regulated according to the load on the motor.

Vector control requires the value of stator winding resistance to be stored in a parameter in the drive. The three Vector modes allow the resistance to be measured under different circumstances.

Closed-loop

Pr **0.07** (Pr **3.10**) operates in the feed-forward path of the speed-control loop in the drive. See Chapter 8 *Optimisation*.

0.08 {5.15} OL> Voltage boost	
0.08 {3.11} CL> Speed controller integral gain	
RW	Uni
OL	0 to 25.0 % of motor rated voltage*
CL	0 to 32,000

*This parameter has a maximum range of 15% in Unidrive VTC.

Open-loop

When Pr **0.07 Voltage mode selector** is set at **Fd**, set Pr **0.08** (Pr **5.15**) at the required value for the motor to run reliably at low speeds.

See Figure 6-3.

Excessive values of Pr **0.08** can cause the motor to be overheated.

Closed-loop

Pr **0.08** (Pr **3.11**) operates in the feed-forward path of the speed-control loop in the drive. See Chapter 8 *Optimisation*.

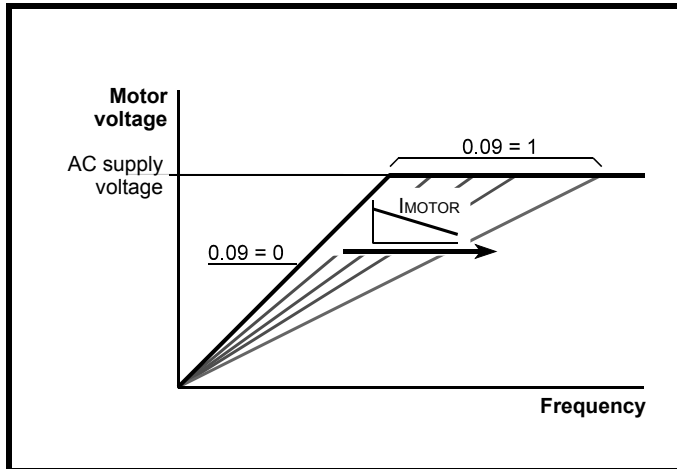
0.09 {5.13} Dynamic V/f select			
RW	Bit		
OL	↕	0 or 1	⇒ 0

Open-loop

Set Pr **0.09** (Pr **5.13**) at 0 when the V/f characteristic applied to the motor is to be fixed. It is then based on the rated voltage and frequency of the motor.

Set Pr **0.09** at 1 when reduced power dissipation is required in the motor when it is lightly loaded. The V/f characteristic is then variable resulting in the motor voltage being proportionally reduced for lower motor currents. Figure 6-4 shows the change in V/f slope when the motor current is reduced.

Figure 6-4 Fixed and variable V/f characteristics



0.09 {3.12} Speed control D gain			
RW	Uni		
CL	↕	0 to 32,000	⇒ 0

Closed-loop

Pr **0.09** (Pr **3.12**) operates in the feedback path of the speed-control loop in the drive. See Chapter 8 *Optimisation*.

6.2.5 Monitoring

0.10 {5.04} OL> Estimated motor speed			
0.10 {3.02} CL> Motor speed			
RO	Bi		
OL	↕	±60,00rpm	⇒
CL	↕	±30,000rpm	⇒

Open-loop

Pr **0.10** (Pr **5.04**) indicates the value of motor speed that is estimated from the following:

Pr **0.12** Post-ramp frequency reference

Pr **0.42** Motor - no. of poles

The value of Pr **0.10** is applied to the analog output on terminal 9 to indicate estimated speed.

Closed-loop

Pr **0.10** (Pr **3.02**) indicates the value of motor speed that is obtained from the speed feedback.

The value of Pr **0.10** is applied to the analog output on terminal 9 to indicate speed.

0.11 {1.03} Pre-ramp reference			
RO	Bi		
OL	↕	±1,000Hz	⇒
CL	↕	±30,000rpm	⇒

0.12 {2.01} Post-ramp reference			
RO	Bi		
OL	↕	±1,000Hz	⇒
CL	↕	±30,000rpm	⇒

When the frequency/speed is constant, [Pr **0.12**] = [Pr **0.11**]. During acceleration and deceleration, the two values may differ.

OL> [Pr **0.12**] differs from [Pr **0.11**] also under either of the following conditions:

- When the drive is in current limit
- During braking in a standard ramp mode (Pr **0.15** Ramp mode selector set at **Std.Hd** or **Std.Ct**).

0.13 {4.02} Motor active-current			
RO	Bi		
↕		±Imax A	⇒

When the motor is being driven below its rated speed, the torque is proportional to [Pr **0.13**].

6.2.6 Jog reference, Ramp mode selector, Stop and torque mode selectors

0.14 {1.05} Jog reference			
RW	Uni		
OL	↕	0 to 400.0Hz	⇒ 1.5
CL	↕	0 to 4,000.0rpm	⇒ 50

Enter the required value of jog frequency/speed.

The frequency/speed limits affect the drive when jogging as follows:

Frequency-limit parameter	Limit applies
0.01 Minimum frequency/speed	No
0.02 Maximum frequency/speed	Yes

0.15 {2.04} Ramp mode selector			
RW	Txt		
↕		(See below)	⇒ Std.Ct (2)

Select the required ramp mode as follows:

Std.Hd	(0)	Standard ramp with ramp hold
FASt	(1)	Fast ramp
Std.Ct	(2)	Standard ramp with proportional control (refer to the <i>Unidrive Advanced User Guide</i>)

For more information, see Pr **2.04** in section 10.22 *Advanced Features* on page 182.

0.16 {6.01} Stop mode selector			
RW	Uni	Bit	Bit
OL	↕	0 to 4 (see below)	⇒ rP (1)
CL	↕	0 to 3 (see below)	⇒ VT rP (1) SV no.rP (1)

Select the required stop mode as follows:

Open loop		
COASt	(0)	The motor is allowed to coast
rP	(1)	Ramp to a stop
rP-dcl	(2)	Ramp followed by 1 second DC injection
dcl	(3)	AC injection braking followed by 1 second DC injection braking
td-dcl	(4)	DC injection braking for an adjustable time (see the <i>Unidrive Advanced User Guide</i>).
Closed loop		
COASt	(0)	The motor is allowed to coast
rP	(1)	Ramp to a stop
no.rP	(2)	Stop under current limiting (no ramp)
rP-POS	(3)	Ramp, orientate and stop

For more information, see Pr 6.01 in section 10.22 *Advanced Features* on page 182.

0.17 {4.11} Torque mode select			
RW	Uni	Bit	Bit
OL	↕	0 to 1	⇒ 0
CL	↕	0 to 4	⇒ 0

Set Pr 0.17 as follows:

Setting	Open-loop	Closed-loop
0	Frequency control	Speed control
1	Torque control	Torque control
2		Torque control with speed over-ride
3		Coiler/uncoiler mode
4		Speed control with torque feed-forward

For more information, see Pr 4.11 in section 10.22 *Advanced Features* on page 182.

6.2.7 S-ramp

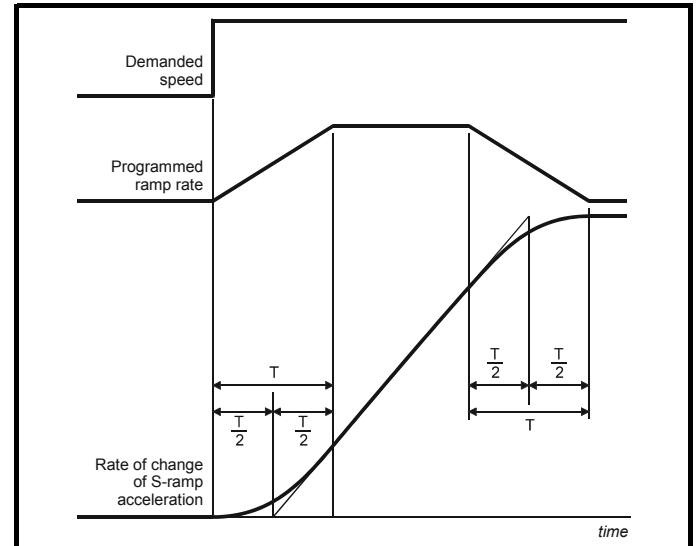
0.18 {2.06} S-Ramp enable			
RW	Bit	Bit	Bit
↕	0 or 1	⇒	0

Setting this parameter enables the S ramp function. S ramp is disabled during deceleration using Standard ramp with P control (Pr 2.04 = 2). When the motor is accelerated again after decelerating in standard ramp with P control the acceleration ramp used by the S ramp function is reset to zero.

0.19 {2.07} S-ramp da/dt limit			
RW	Uni	Bit	Bit
OL	↕	0.0 to 3,000.0s ² /100Hz	⇒ 3.1
CL	↕	0.000 to 30,000 s ² /1,000rpm	⇒ VT 1.5 SV 0.03

This parameter defines the maximum rate of change of acceleration/ deceleration that the drive will operate with. The default values have been chosen such that for the default ramps and maximum speed, the

curved parts of the S will be 25% of the original ramp if S ramp is enabled.



Since the ramp rate is defined in s/100Hz or s/1000rpm and the S ramp parameter is defined in s²/100Hz or s²/1,000rpm, the time T for the 'curved' part of the S can be determined from:

$$T = \frac{\text{S ramp rate of change}}{\text{Ramp rate}}$$

Enabling S ramp increases the total ramp time by the period T since an additional T/2 is added to each end of the ramp in producing the S.

6.2.8 Skip bands

0.20 {1.29} Skip frequency/speed 1			
0.22 {1.31} Skip frequency/speed 2			
RW	Uni	Bit	Bit
OL	↕	0.0 to 1,000.0Hz	⇒ 0.0
CL	↕	0 to 30,000rpm	⇒ 0

See Pr 0.21 and Pr 0.23 *Skip bands*.

0.21 {1.30} Skip band 1			
0.23 {1.32} Skip band 2			
RW	Uni	Bit	Bit
OL	↕	0 to 5.0Hz	⇒ 0.5
CL	↕	0 to 50rpm	⇒ 5

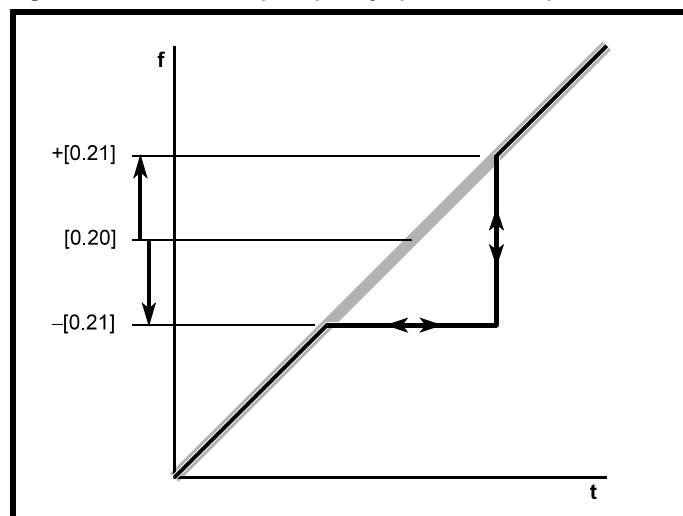
Use skip frequencies/speeds and skip bands to prevent the motor from running at speeds that cause mechanical resonances in the machine. During acceleration and deceleration, the drive passes through the skip bands, but it does not stabilize in a skip band.

Up to two skip frequencies/speeds can be programmed.

Enter the centre frequency/speed of the band in Pr 0.20 (or Pr 0.22) *Skip frequency/speed*, then enter the width of each sideband in Pr 0.21 (or Pr 0.23) *Skip band*.

When the value of a skip frequency is zero, the related skip band is disabled.

Figure 6-5 Action of skip frequency/speed 1 and skip band 1



When the frequency/speed (input) reference ascends into a skip band, the resulting (output) reference remains at the lower edge of the band until the input reference has reached the upper edge of the band. The output reference then jumps to the value of the input reference.

When the frequency/speed (input) reference descends into a skip band, the resulting (output) reference jumps immediately to the lower edge of the band.

Example

Skip speed 1 = 250rpm
Enter 250 in Pr **0.20**
Required skip band = 60rpm
Enter 30 in Pr **0.21**

(Skip band = 2 x Value of skip-band parameter.)

6.2.9 Analog input modes

0.24 {7.06} Analog input 1 mode selector	
0.25 {7.11} Analog input 2 mode selector	
RW	Txt
↕	0 to 8 ⇒ VOLT (0)

Set the required mode as follows:

Setting	Input signal	When current signal ≤3mA...
VOLT	(0)	±10V
0-20	(1)	0 to 20mA Signal treated as zero
20-0	(2)	20mA to 0 Signal treated as zero
4-20.tr	(3)	4mA to 20mA Drive trips
20-4.tr	(4)	20mA to 4mA Drive trips
4-20.Lo	(5)	4mA to 20mA Drive runs at minimum or low speed
20-4.Lo	(6)	20mA to 4mA Drive runs at minimum or low speed
4-20.Pr	(7)	4mA to 20mA Drive runs at previous speed
20-4.Pr	(8)	20mA to 4mA Drive runs at previous speed

0.26 {7.14} Analog input 2 destination parameter	
RW	Txt
↕	Pr 0.00 to Pr 21.50 (Menu param.) ⇒ Pr 1.37

A signal applied to an input terminal is converted into a value which is applied to a parameter. The function of this parameter determines the function of the terminal.

By default, terminal 7 (Analog input 2) is assigned to Pr **1.37** *Analog reference 2*. Use Pr **0.26** to change the function of terminal 7.

6.2.10 Miscellaneous

0.27 {8.27} EUR> Positive logic select	
RW	Bit
↕	0 or 1 ⇒ 0

European configuration

Use Pr **0.27** (Pr **8.27**) to select the logic polarity of the digital inputs, as follows:

0	Negative logic
1	Positive logic

0.27 {6.04} USA> Sequencing mode selector	
RW	Uni
↕	0 to 4 ⇒ 4

Refer to Pr **6.04** in the *Unidrive Advanced User Guide*.

0.28 {4.13} EUR> Current-loop proportional gain	
RW	Uni
OL	↕ 0 to 30000 ⇒ 20
CL	↕ VT> 0 to 30,000 SV> 0 to 30,000 ⇒ 150 130

0.29 {4.14} EUR> Current-loop integral gain	
RW	Uni
OL	↕ 0 to 30,000 ⇒ 40
CL	↕ VT> 0 to 30,000 SV> 0 to 30,000 ⇒ 2000 1200

European configuration

The values of Pr **0.28** and Pr **0.29** affect the dynamic performance of the drive in the following conditions:

- Current-limit in frequency/speed control
- Torque control
- Braking when Pr **0.15** *Ramp mode selector* is set at **Std.Ct** (default)
- Synchronizing the drive to a spinning motor (Pr **0.39** set at 1)
- Loss of AC supply when Pr **6.03** *AC supply loss mode selector* is set at **ridE.th**.

For information on adjusting these parameters, refer to Pr **4.13** and Pr **4.14** in the *Unidrive Advanced User Guide*.

0.28 {1.01} USA> Frequency/speed demand	
RO	Bi
OL	↕ ±1,000Hz ⇒
CL	↕ ±30,000rpm ⇒

USA configuration

Pr **0.28** differs from Pr **0.11** *Pre-ramp reference* in that it indicates the demanded reference before frequency/speed limiting and skip bands.

0.29 {8.23} USA> Terminal-29 destination parameter	
RW	Uni
↕	Pr 0.00 to Pr 20.50 (Menu param.) ⇒ Pr 1.41

USA configuration

Use Pr **0.29** to change the function of the digital input on terminal 29. The default setting (Pr **1.41**) gives **LOCAL/REMOTE** switching.

0.30 {6.13} Forward / reverse key enable				
RW	Bit			
↕	0 or 1	⇒	0	

The drive is supplied with the  button disabled. To enable this button, set Pr 0.30 FWD/REV enable at 1.

0.31 {11.37} Macro number				
RO	Uni			
↕	0 to 9	⇒		

Pr 0.31 indicates the number of the macro that is currently in operation.

0.32 {11.24} Serial comms. mode				
RW	Uni		R	P
↕	ANSI 2 (0) ANSI 4 (1) OUTPut (2) INPUt (3)	⇒	ANSI 4 (1)	

Use Pr 0.32 to select the required serial communications mode as follows:

ANSI 2 (0)	ANSI protocol, two-wire
ANSI 4 (1)	ANSI protocol, four-wire
Use the following modes to transfer the value of a parameter in one drive to a parameter in another drive:	
OUTPut (2)	Transmit the value of the parameter specified by the setting of Pr 11.27 Serial comms. source / destination parameter (CT protocol)
INPUt (3)	Apply the received value to the parameter specified by the setting of Pr 11.27 Serial comms. source / destination parameter (CT protocol)

0.33 {11.32} Drive rated current (FLC)				
RO	Uni			P
↕	2.10 to 1,920 A	⇒		

0.34 {11.30} User security code				
RW	Uni	S		P
↕	0 to 255	⇒	149	

Use Pr 0.34 to set up a User Security code. Irrespective of the code number entered in Pr 0.34, it always indicates the default value 149. When Pr 0.34 is actually set at 149, no User Security is applied.

See section 5.10 *Parameter security* on page 62.

6.2.11 Keypad-reference monitoring

0.35 {1.17} Keypad control mode reference				
RO	Bi	S		P
OL	↕	±[Pr 0.02]Hz	⇒	
CL	↕	±[Pr 0.02]rpm	⇒	

0.35 indicates the value of the frequency/speed reference when the drive is operating in Keypad mode. The reference is then controlled by the following control buttons (when the display is in Status mode):



The value is automatically saved when the drive is powered-down. At the next power-up, the drive ramps up to the frequency/speed that applied before the power-down.

6.2.12 Serial communications, Parameter displayed after power-up

0.36 {11.25} Serial comms. baud rate				
RW	Txt			P
↕	4,800 (0) 9,600 (1) 19,200 (2) 2,400 (3)	⇒	4800 (0)*	

*This parameter has a default setting of 9,600 (1) in the VTC variant when USA defaults are loaded.

Use Pr 0.36 to select the required baud rate for serial communications when a UD71 *Basic serial communications* large option module is fitted in the drive.

0.37 {11.23} Serial comms. address				
RW	Uni			P
↕	0.0 to 9.9 (Group.Unit)	⇒	1.1	

Use Pr 0.37 to select the required address for serial communications when a UD71 *Serial communications* large option module is fitted in the drive.

Do not enter an address that contains a zero, since this is used when addressing a group of drives.

0.38 {11.22} Initial parameter displayed				
RW	Uni			P
↕	Pr 0.00 to Pr 0.50	⇒	Pr 0.10*	

*This parameter has a default setting of Pr 0.11 in the VTC variant when USA defaults are loaded.

At the time the AC supply is connected to the drive, Pr 0.10 *Motor frequency/speed* is automatically pre-selected as the initial parameter to be displayed. This results in the following:

- After the AC supply is connected to the drive, and before any other parameter is selected, the value of Pr 0.10 is shown on the upper display. This allows the motor frequency/speed to be monitored without the need to select the parameter.
- If the keypad is subsequently used to select another parameter, the value of the newly selected parameter is displayed in place of the initial parameter.

To select a different Menu 0 parameter to be displayed initially, enter the required parameter number in Pr 0.38 (e.g. to display Pr 0.12 *Post-ramp frequency/speed reference*, enter 0.12).

6.2.13 Spinning motor, Autotune, PWM switching frequency

0.39 {6.09} Synchronise to a spinning motor				
RW	Bit			
OL	↕	0 or 1	⇒	0
CL	↕	0 or 1	⇒	1

Open-loop

Set Pr 0.39 at 1 for the drive to always automatically synchronise itself to the motor if the motor is already rotating when the drive is started.

If the drive is started when the motor is already spinning and Pr 0.39 is set at 0, the drive cannot detect the speed of the motor; the normal operation of the drive will cause the motor to be braked to a stand-still in the same way as DC injection braking. The drive will then accelerate the motor to the value of the frequency reference.

NOTE

The drive can be synchronised to a single motor only. If more than one motor is connected to the drive, this function should not be used.

NOTE

For the drive to operate correctly during and after synchronisation, Pr **0.07** Voltage mode selector must be set at Fd.

The drive starts a sequence of operations at one quarter of the rated motor voltage in order to detect the frequency associated with the speed of the motor. The sequence is stopped when the motor frequency is detected. The stages in the sequence are as follows:

1. The frequency of the drive is set at maximum (the value of Pr **0.02**) in the direction that the motor was last driven. (If the AC supply to the drive was interrupted before an attempt is made to synchronise to a spinning motor, the drive always starts in the forward direction.)
2. The frequency is reduced to zero. If the motor frequency is detected during the reduction in drive frequency, the test is stopped. The drive frequency is set at the detected motor frequency and the drive takes control of the motor.
3. If the motor frequency is not detected, the drive is set at maximum frequency in the opposite direction, and the test is repeated.
4. If the motor frequency is still not detected, the drive frequency is set at 0Hz, and the drive takes control of the motor.

Closed-loop

Pr **0.39** is set at 1 by default. The value of Pr **0.12** *Post-ramp reference* is automatically set at the value of speed feedback. The drive then takes control of the motor.

When Pr **0.39** is set at 0, the motor will be decelerated under current limit until the motor speed meets the value of Pr **0.12** *Post-ramp reference*.

For more information, see section 10.22 *Advanced Features* on page 182.

0.40 {5.12} Autotune	
RW	Bit
↕	0 or 1
⇒	0

Set Pr **0.40** at 1 to start the Autotune sequence. See Chapter 8 *Optimisation*.

Pr **0.40** is related to the advanced parameters as follows:

OL + VT> Pr **5.12** *Magnetizing current test enable*
SV> Pr **3.25** *Encoder phasing test enable*

0.41 {5.18} PWM switching frequency	
RW	Txt
↕	3 (0), 4.5 (1), 6 (2), 9 (3), 12 (4) kHz
⇒	3 (0)

If the switching frequency is increased from the default value, the power loss inside the drive is increased. The drive ensures the losses remain within acceptable levels by the use of an intelligent thermal model.

Intelligent thermal modelling in the drive effectively monitors the junction temperature of the IGBTs in the power stage. When the junction temperature is calculated to reach the maximum permissible value, two levels of protection occur, as follows:

1. When a PWM switching frequency of 6kHz, 9kHz or 12kHz is selected, the PWM switching frequency is automatically halved. This reduces switching losses in the IGBTs. (The value of parameter Pr **0.41** *PWM switching frequency* remains at the value set by the user.) Then at one-second intervals, the drive will attempt to return the PWM switching frequency to the original value. This will be successful when the thermal modelling has calculated that the temperature has reduced sufficiently.
2. If the junction temperature continues to rise (due to the output current) after the PWM switching frequency has been halved, and the temperature reaches the maximum permissible value, the drive will trip. The display will indicate trip code **Oh1**.

If the drive is required to run at a high load continuously with an elevated switching frequency, derating must be applied. Please see Table 11-1 *Unidrive and Unidrive VTC drive current ratings* on page 190.

NOTE

The Unidrive LFT default switching frequency is 9kHz, however, a limited duty cycle applies. See Figure 2-3 *Standard S4/S5 duty cycle (Unidrive LFT)* on page 10.

6.2.14 Motor parameters

0.42 {5.11} Motor - number of poles	
RW	Txt
OL	↕ 2 to 32 poles
CL	↕ VT> 2 to 32 poles SV> 2 to 32 poles
⇒	4 (1) 4 (1) 6 (2)

Enter the number of motor poles (not pole pairs).

0.43 {5.10} Motor - power factor	
RW	Uni
OL	↕ 0 to 1.000
CL	↕ VT> 0 to 1.000 SV> 1
⇒	0.92 0.92 1.0

Open-loop

Closed-loop Vector

When Autotune is used, the power factor of the motor is measured by the drive and stored in Pr **0.43**. The value can be seen when Pr **0.43** is accessed. The value may be slightly higher than the value stated on the motor rating plate.

If Autotune is not used, enter the value in Pr **0.43**.

0.44 {5.09} Motor - rated voltage	
RW	Uni
OL	↕ 0 to 480
CL	↕ VT> 0 to 480 SV> 0
⇒	400 460 0

Open-loop and Closed-loop Vector

Enter the value from the rating plate of the motor.

0.45 {5.08} Motor - rated speed	
RW	Uni
OL	↕ 0 to 6,000rpm
CL	↕ VT> 0 to 30,000rpm SV> 0 to 30,000rpm
⇒	0 EUR> 1,450 USA> 1,770 0

Open-loop

This parameter should be set to the synchronous speed minus the slip speed if slip compensation is required.

Closed-loop Vector

This parameter should be set to the synchronous speed minus the slip speed.

Closed-loop Servo

Leave Pr **0.45** set at 0. This parameter is not used in this operating mode.

0.46 {5.07} Motor - rated current	
RW	Uni
↕	0 to FLC A
⇒	FLC

FLC is the maximum permissible continuous output current of the drive up to 40°C ambient temperature and 3kHz PWM switching frequency.

Enter the value from the rating plate of the motor.

0.47 {5.06} Motor - rated frequency			
RW	Bit		
OL	↕	0 to 1,000.0Hz*	⇒ EUR> 50 USA> 60
CL	↕	VT> 0 to 1,000.0Hz SV> 0Hz	⇒ EUR> 50 USA> 60 0

*This parameter has a maximum range of 250Hz in Unidrive VTC.


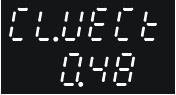


Open-loop and Closed-loop Vector

Enter the value from the rating plate of the motor.

6.2.15 Operating-mode selection

0.48 {11.31} Drive operating mode selector			
RW	Txt	R	P
↕	(See below)	⇒	OPEN.LP (0)

The settings for 0.48 are as follows:

Pr 0.48 setting	Operating mode
 0	Open-loop
 1	Closed-loop Vector
 2	Closed-loop Servo
 3	For operation in this mode, refer to the <i>Unidrive Regen Installation Guide</i>

See Chapter 8 *Optimisation* on page 92.

The operating mode cannot be changed while the drive is running.

6.2.16 Status information

0.49 Security status			
RO	Uni		P
↕	0 to 1,000	⇒	1

This parameter indicates the current status of the drive parameter security system. Each digit indicates a particular aspect of security as follows:

Units digit: 0 = Standard security has been unlocked
1 = Standard security is still set

Tens digit: 0 = User security has been unlocked or is not active
1 = User security is active preventing RW access

Hundreds digit: 1 = Pr 11.30 not equal to 149*

Thousands digit: 1 = Pr 11.30 equal to zero*

* The value of Pr 11.30 is the last value written by the user. Pr 11.30 always appears as 149 when first accessed by the key pad to hide the real value last written by the user. If Pr 11.30 = 149 then user security is cleared. If Pr 11.30 = 0 then user security and security preventing access outside menu 0 is cleared.

NOTE

In contrast to all the other parameters in menu 0, this parameter does not exist in any other menu.

0.50 {11.29} Software version number			
RO	Uni		P
↕	1.00 to 99.99	⇒	

Displays the first two sections of the software version of the drive.

6.2.17 Unidrive VTC Menu 0 differences

Menu 0 in Unidrive VTC contains some different parameters to menu 0 in Unidrive. The following menu 0 parameters are found in Unidrive VTC. Any parameter not listed below is the same as open loop Unidrive.

0.14 {4.01} Total motor current			
RO	Uni		P
↕	0 to I _{MAX} A	⇒	

Pr 0.14 indicates the total motor current (the vector sum of Pr 0.13 *Motor active-current* and Pr 4.17 *Motor magnetising current*).

0.17 {5.03} Total motor power			
RO	Bi		P
↕	±P _{MAX}	⇒	

Total output power of the drive (positive for power flow out of the drive output terminals).

0.22 Drive rated current			
RO	Uni		P
↕	2.10 to 202 A	⇒	

0.23 Analog input 1 mode selector			
RW	Txt	R	
↕	VOLt (0), 0 - 20 (1), 20 - 0 (2), 4 - 20.tr (3), 20 - 4.tr (4), 4 - 20.Lo (5), 20 - 4.Lo (6), 4 - 20.Pr (7), 20 - 4.Pr (8)	⇒	VOLt (0)

Setting	Input signal	When current signal ≤30mA
VOLt	(0) ±10V	
0-20	(1) 0 to 20mA	Signal treated as zero
20-0	(2) 20mA to 0	Signal treated as zero
4-20.tr	(3) 4mA to 20mA	Drive trips
20-4.tr	(4) 20mA to 4mA	Drive trips
4-20.Lo	(5) 4mA to 20mA	Drive runs at minimum or low speed
20-4.Lo	(6) 20mA to 4mA	Drive runs at minimum or low speed
4-20.Pr	(7) 4mA to 20mA	Drive runs at previous speed
20-4.Pr	(8) 20mA to 4mA	Drive runs at previous speed

0.24 {1.21} Preset frequency 1			
0.25 {1.22} Preset frequency 2			
RW	Bi		P
↕	±1000.0 Hz	⇒	0.0

Enter the value of frequency as required. When Pr 1.10 *Bipolar reference select* is set at 0, negative values are treated as zero. When Pr 1.10 is set at 1, negative values will cause the drive to run in the reverse direction.

0.26 {2.08} Standard ramp voltage			
RW	Uni		
↕	200V drive: 0 to 400 V 400V drive: 0 to 800 V	⇒	200V drive: 375 400V drive: EUR> 750, USA> 775

This voltage is used as the level for both standard ramp modes. If hold mode is used and this is set too low the drive will never stop, and if it is too high and no braking resistor is used the drive may trip on OV (DC bus over voltage). If Standard ramp with P control (Pr 2.04 = Stnd.Ct (2)) is used and Pr 2.08 is set too low the machine will coast to rest, and if it is set too high and no braking resistor is used it may trip on OV. The minimum level should be greater than the voltage produced on the DC bus by the highest supply voltage.

Normally the DC bus voltage will be approximately the rms supply voltage $\times \sqrt{2}$.

Care should be taken in the setting of Pr 2.08. It is recommended that the setting should be at least 50V higher than the maximum expected level of the DC bus voltage. If this is not done, the motor may fail to decelerate on a STOP command.

0.27 {4.13} Current-loop proportional gain			
RW	Uni		
↕	0 to 30,000	⇒	20

0.28 {4.14} Current-loop integral gain			
RW	Uni		
↕	0 to 30,000	⇒	40

The values of Pr 0.27 and Pr 0.28 affect the dynamic performance of the drive in the following conditions:

- Operation in current limit
- Braking when Pr 0.15 *Ramp mode selector* is set at Stnd.Ct (default)
- Loss of AC supply when Pr 6.03 *AC supply loss mode selector* is set at ridE.th.

See section 10.22.5 *Mains loss modes* on page 185 for more information.

0.29 {5.05} DC bus voltage			
RW	Uni		P
↕	200V drive: 0 to 415 V 400V drive: 0 to 830 V	⇒	

0.30 {10.20} Last trip			
RW	Txt	S	P
↕	0 to 200 V	⇒	

See section 12.1 *Trip indications* on page 198 for details of the trip codes.

If the drive trips, the trip code representing the cause of the trip is logged in Pr 0.30. Pr 0.30 continues to display this trip until the drive trips with a different trip code.

0.32 {10.34} Number of auto-reset attempts			
RW	Uni		
↕	0 to 5	⇒	0

If this parameter is set to zero then no auto-reset attempts are made. Any other value will cause the drive to automatically reset following a trip for the number of times programmed. Pr 10.35 defines the time between the trip and the auto reset. The reset count is only incremented when the trip is the same as the previous trip, otherwise it is reset to 0. When the

reset count reaches the programmed value, any further trip of the same value will not cause an auto-reset.

If there has been no trip for 5 minutes then the reset count is cleared. Auto reset will not occur on an External trip (Et).

0.33 {10.35} Auto-reset time delay			
RW	Uni		
↕	0.0 to 25.0 s	⇒	1.0

This parameter defines the time between a trip and an auto reset subject to the 10s minimum trip time for IGBT over-current trips (OI.AC and OI.br trips).

0.35 {11.24} Serial comms. mode			
RW	Txt	R	P
↕	ANSI 2 (0), ANSI 4 (1), OUTPUT (2), INPUT (3)	⇒	ANSI 4 (1)

Use Pr 0.32 to select the required serial communications mode as follows:

ANSI 2 (0)	ANSI protocol, two-wire
ANSI 4 (1)	ANSI protocol, four-wire
Use the following modes to transfer the value of a parameter in one drive to a parameter in another drive:	
OUTPUT (2)	Transmit the value of the parameter specified by the setting of Pr 11.27 <i>Serial comms. source / destination parameter</i> (CT protocol)
INPUT (3)	Apply the received value to the parameter specified by the setting of Pr 11.27 <i>Serial comms. source / destination parameter</i> (CT protocol)

0.48 {4.19} Overload accumulator			
RO	Uni		P
↕	0 to 100 %	⇒	

When the total current level is above 105% motor rated current (Pr 5.07 \times 1.05) the overload accumulator increases, until it reaches 100% when the drive will give an Ixt trip or apply a restriction on the current limit. The level of the accumulator is given by:

$$\text{Accumulator} = (I^2 / (\text{Pr } 5.07 \times 1.05)^2) \times (1 - e^{-t/\tau}) \times 100\%$$

NOTE

If the motor rated current parameter (Pr 5.07) is modified the overload accumulator is reset to zero. This allows the drive to be used with more than one motor of different ratings without producing overload trips when the drive has been running with a large motor and then a smaller motor is connected.

7 Running the motor



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



Motor overload protection

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 **0.46 Motor rated current**. The overload protection level is 150% (SV: 175%) of motor rated current. The protection level maybe adjusted below 150% if required. Refer to Chapter 8 *Optimisation* on page 92 for further information. These settings affect the thermal protection of the motor.



If the keypad mode has been used previously, ensure that the keypad reference has been set to 0 using the ▲ and ▼ buttons as if the drive is started using the keypad it will run to the speed defined by the keypad reference (Pr **0.35**).



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

7.1 Quick start set-up

7.1.1 Basic connections

This section shows the basic connections which must be made for the drive to run in the required mode. For minimal parameter settings to run in each mode please see the relevant part of section 7.2 *Quick Start commissioning*.

Table 7-1

Drive control method	Requirements
Terminal mode (Default configuration)	Drive enable Speed reference Run forward or run reverse command Connect thermistor or link to 0V
Keypad mode (Set Pr 0.05 = 4)	Drive enable Connect thermistor or link to 0V

Table 7-2

Operating mode	Requirements
Open loop mode	Induction motor
Closed loop vector mode	Induction motor with speed feedback
Servo	Permanent magnet motor with speed and position feedback

Speed feedback

Suitable devices are:

- Incremental encoder (A, B),
- Resolver with 0.33 or 0.5 transformation ratio
- SINCOS encoder

Speed and position feedback

Suitable devices are:

- Incremental encoder with commutation signals (A, B, U, V, W)
- Resolver with 0.33 or 0.5 transformation ratio
- Stegmann SINCOS encoder with Hiperface serial communications

For operation with a resolver or SINCOS encoder an option module is required. For option module terminal information see section 10.16 *Menu 16 Small option module set-up* on page 171 or the manual which is supplied with the option module.

7.1.2 Selecting the operating mode

Changing the operating mode returns all parameters to their default value, including the motor parameters.

Procedure

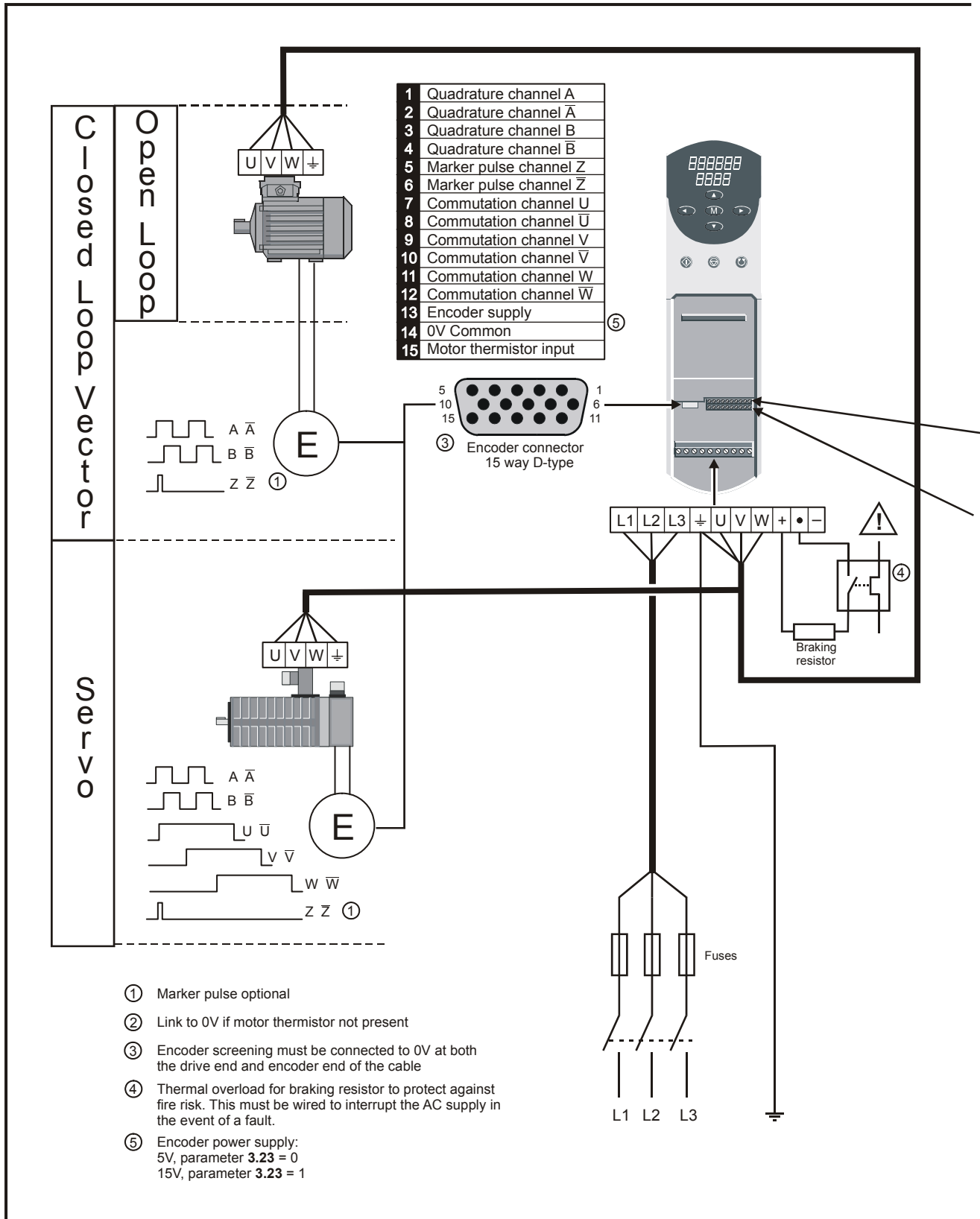
1. Enter either of the following values in parameter **0.00**, as appropriate:
1253 (Europe, 50Hz AC supply frequency)
1254 (USA, 60Hz AC supply frequency)
2. Change the setting of parameter **0.48** as follows:

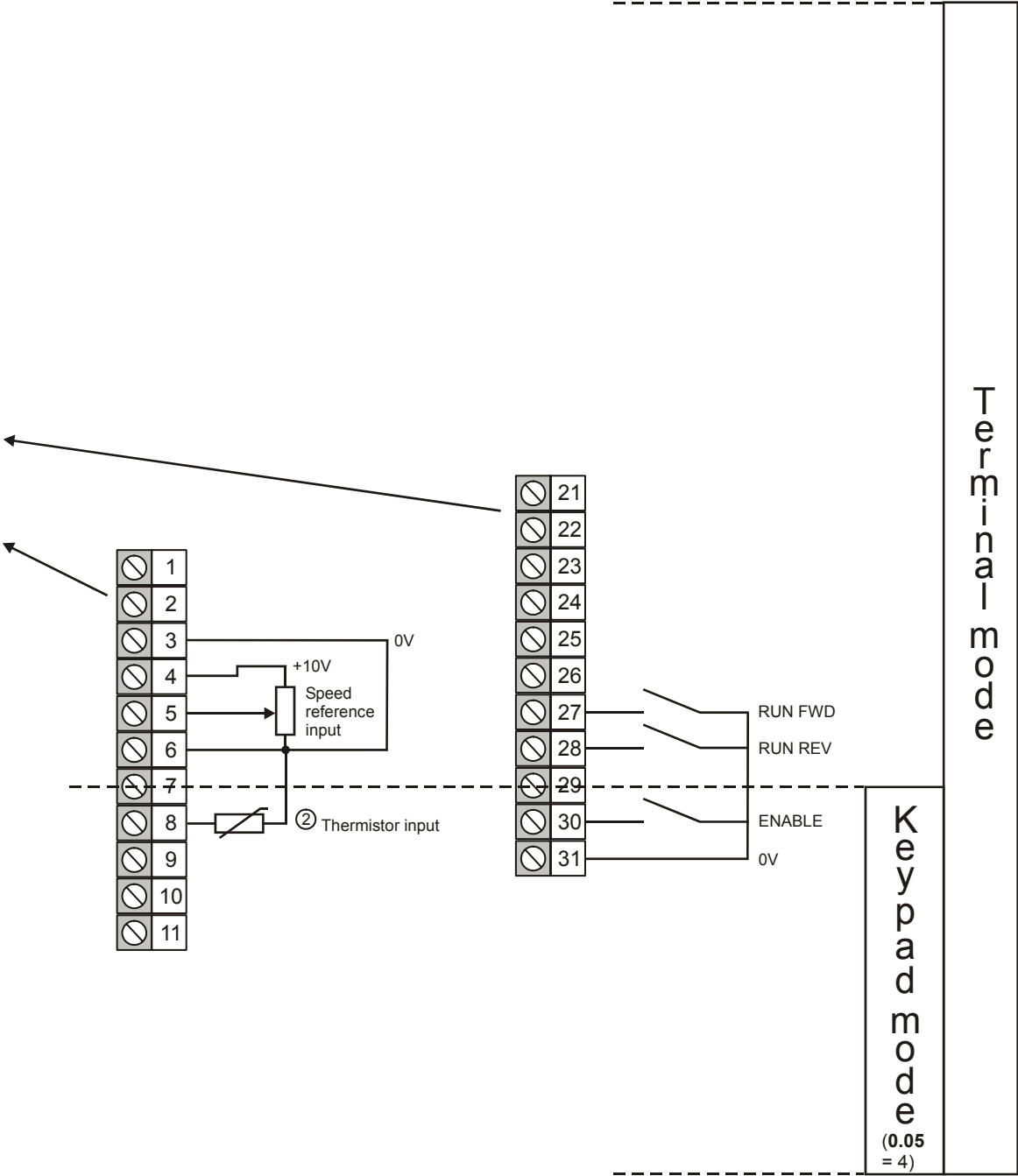
Pr 0.48 setting	Operating mode
	Open-loop
	Closed-loop Vector
	Closed-loop Servo
	For operation in this mode, refer to the <i>Unidrive Regen Installation Guide</i>

The figures apply when serial communications are used.

3. Press or momentarily close the RESET contact. The new setting takes effect and all the parameters revert to the appropriate default values for the new mode.

Figure 7-1 Minimum connections to get the motor running in any operating mode





7.2 Quick Start commissioning




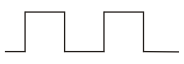

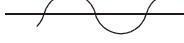
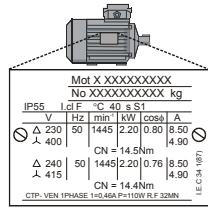
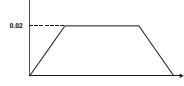
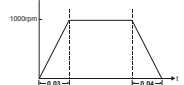


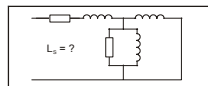
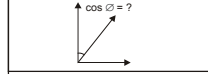
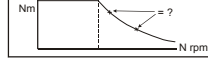


7.2.1 Open loop mode (including VTC variant)

Induction motor without feedback device

Action	Detail																																																																			
Before power-up	<div>Ensure:</div> <ul style="list-style-type: none">• Enable is closed (terminal 30)• Motor thermistor is connected or terminal 8 is linked to 0V• Run signal is not given• Motor is connected <div>NOTE</div> <p>The motor must be uncoupled from any gearbox or load before an autotune is carried out, as detailed below.</p>																																																																			
Power-up the drive	<div>Ensure:</div> <ul style="list-style-type: none">• Drive displays 'rdy' <p>If the drive trips, see Chapter 12 <i>Diagnostics</i> on page 198.</p>																																																																			
Enter motor nameplate details	<div>Enter:</div> <ul style="list-style-type: none">• Motor rated current in Pr 0.46 (A)• Motor rated frequency in Pr 0.47 (Hz)• Motor rated voltage in Pr 0.44 (V) - check if Δ or Δ connection• Number of poles in Pr 0.42 <div>$P = \frac{f \times 120}{N_s}$<div>Where:</div><div>P = Number of poles</div><div>f = Rated frequency (Hz)</div><div>N_s = Synchronous speed (rpm)</div></div>	<table><tr><td colspan="6">Mot X XXXXXXXXXX</td></tr><tr><td colspan="6">No XXXXXXXXXX kg</td></tr><tr><td>IP55</td><td>I_{cl}</td><td>F</td><td>°C</td><td>40</td><td>s S1</td></tr><tr><td>V</td><td>Hz</td><td>min</td><td>kW</td><td>cosφ</td><td>A</td></tr><tr><td>Δ 230</td><td>50</td><td>1445</td><td>2.20</td><td>0.80</td><td>8.50</td></tr><tr><td>Δ 400</td><td></td><td></td><td></td><td></td><td>4.90</td></tr><tr><td colspan="6">CN = 14.5Nm</td></tr><tr><td>Δ 240</td><td>50</td><td>1445</td><td>2.20</td><td>0.76</td><td>8.50</td></tr><tr><td>Δ 415</td><td></td><td></td><td></td><td></td><td>4.90</td></tr><tr><td colspan="6">CN = 14.4Nm</td></tr><tr><td colspan="6">CTP- VEN 1PHASE 1=0.46A P=110W R.F 32MIN</td></tr></table>	Mot X XXXXXXXXXX						No XXXXXXXXXX kg						IP55	I _{cl}	F	°C	40	s S1	V	Hz	min	kW	cosφ	A	Δ 230	50	1445	2.20	0.80	8.50	Δ 400					4.90	CN = 14.5Nm						Δ 240	50	1445	2.20	0.76	8.50	Δ 415					4.90	CN = 14.4Nm						CTP- VEN 1PHASE 1=0.46A P=110W R.F 32MIN					
Mot X XXXXXXXXXX																																																																				
No XXXXXXXXXX kg																																																																				
IP55	I _{cl}	F	°C	40	s S1																																																															
V	Hz	min	kW	cosφ	A																																																															
Δ 230	50	1445	2.20	0.80	8.50																																																															
Δ 400					4.90																																																															
CN = 14.5Nm																																																																				
Δ 240	50	1445	2.20	0.76	8.50																																																															
Δ 415					4.90																																																															
CN = 14.4Nm																																																																				
CTP- VEN 1PHASE 1=0.46A P=110W R.F 32MIN																																																																				
Set maximum frequency	<div>Enter:</div> <ul style="list-style-type: none">• Maximum frequency in Pr 0.02 (Hz)																																																																			
Set acceleration / deceleration rates	<div>Enter:</div> <ul style="list-style-type: none">• Acceleration rate in Pr 0.03 (s/100Hz)• Deceleration rate in Pr 0.04 (s/100Hz)																																																																			
Autotune	<div><div></div><div>Once this parameter is set, the motor will accelerate up to 2/3 base frequency without a run command being given. Once the measurement is complete, the motor will coast to a stop. The drive can be disabled at any time by pressing the red button.</div></div> <div>WARNING</div> <ul style="list-style-type: none">• Set Pr 0.40 = 1 and wait for the drive display to return to 'rdy' <p>If the drive trips, see Chapter 12 <i>Diagnostics</i> on page 198.</p> <div>NOTE</div> <p>The motor must be uncoupled from any gearbox or load before an autotune is carried out.</p>																																																																			
Save parameters	<p>Enter 1000 in Pr xx.00</p> <p>Press the red reset button or toggle the reset digital input (ensure Pr xx.00 returns to 0)</p>																																																																			
Run	Drive is now ready to run																																																																			




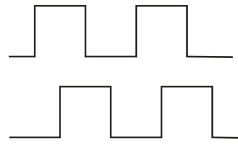
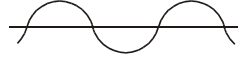

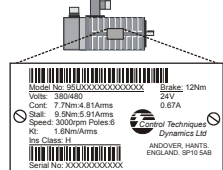
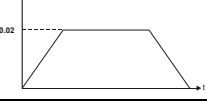
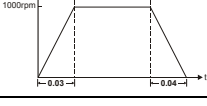

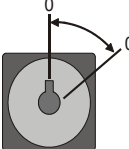


7.2.2 Closed loop vector mode

Induction motor with speed feedback

Action	Detail	
Before power-up	<p>Ensure:</p> <ul style="list-style-type: none"> • Enable signal is not given (terminal 30) • Motor thermistor is connected or terminal 8 is linked to 0V • Run signal is not given • Motor is connected • Feedback device is connected <p>NOTE The motor must be uncoupled from any gearbox or load before an autotune is carried out.</p>	
Power-up the drive	<ul style="list-style-type: none"> • Change drive operating mode to closed loop vector Set Pr xx.00 to 1253 / 1254 (USA). Change Pr 0.48 to 'CL.UEC' • Press the  reset button • Ensure the drive displays 'inh' ('SEP.EC' trip if 8V SINCOS encoder feedback is being used) <p>If the drive trips, see Chapter 12 <i>Diagnostics</i> on page 198.</p>	
Set feedback device parameters	<p>Encoder</p> <ul style="list-style-type: none"> • Encoder power supply Pr 3.23 = 0, 5V Pr 3.23 = 1, 15V. (If Pr 3.23 = 1 then termination resistors should be disabled - Pr 3.24 = 1) • Encoder PPR (pulses per revolution) Enter PPR in Pr 3.21 <p>Resolver</p> <ul style="list-style-type: none"> • The default setting is for a transformation ratio of 0.33 (3:1), if the resolver has a transformation ratio of 0.5 (2:1), set Pr 16.10 = 1 <p>SINCOS</p> <ul style="list-style-type: none"> • Encoder power supply Pr 16.15 = 0, 5V Pr 16.15 = 1, 8V. (Save parameters and cycle power to clear 'SEP.EC' trip) • Encoder PPR (pulses per revolution) Enter PPR in Pr 16.12 	  
Enter motor nameplate details	<p>Enter:</p> <ul style="list-style-type: none"> • Motor rated power factor Pr 0.43 • Motor rated voltage in Pr 0.44 (V) - check if Δ or \triangle connection • Motor rated speed (synchronous speed - slip speed) in Pr 0.45 (rpm) • Motor rated current in Pr 0.46 (A) • Motor rated frequency in Pr 0.47 (Hz) • Number of poles in Pr 0.42 <p>$P = \frac{f \times 120}{N_s}$</p> <p>Where: P = Number of poles, f = Rated frequency (Hz), N_s = Synchronous speed (rpm)</p>	
Set maximum speed	<p>Enter:</p> <ul style="list-style-type: none"> • Maximum speed in Pr 0.02 (rpm) 	
Set acceleration / deceleration rates	<p>Enter:</p> <ul style="list-style-type: none"> • Acceleration rate in Pr 0.03 (s/1,000rpm) • Deceleration rate in Pr 0.04 (s/1,000rpm) (If braking resistor fitted, set Pr 0.15 = FAST) 	
Autotune	<ul style="list-style-type: none"> • Close enable signal <div style="border: 1px solid black; padding: 5px;">  <p>Once this parameter is set and the enable signal is given, the motor will accelerate up to $\frac{2}{3}$ base frequency without a run command being given. Once the measurement is complete, the motor will coast to a stop. The drive can be disabled at any time by pressing the red  button.</p> </div> <ul style="list-style-type: none"> • Set Pr 0.40 = 1 and wait for the drive display to return to 'rdy' <p>If the drive trips, see Chapter 12 <i>Diagnostics</i> on page 198.</p> <p>NOTE The motor must be uncoupled from any gearbox or load before an autotune is carried out.</p>	  
Save parameters	<p>Enter 1000 in Pr xx.00</p> <p>Press the red  reset button or toggle the reset digital input (ensure Pr xx.00 returns to 0)</p>	
Run	Drive is now ready to run	

7.2.3 Servo

Permanent magnet motor with speed and position feedback

Action	Detail	
Before power-up	<p>Ensure:</p> <ul style="list-style-type: none"> • Enable signal is not given (terminal 30) • Motor thermistor is connected or terminal 8 is linked to 0V • Run signal is not given • Motor is connected • Feedback device is connected (U, V, W required for incremental encoders) <p>NOTE</p> <p>The motor must be uncoupled from any gearbox or load before an autotune is carried out.</p>	
Power-up the drive	<ul style="list-style-type: none"> • Change drive operating mode to servo Set Pr xx.00 to 1253 / 1254 (USA). Change Pr 0.48 to 'SErUO' • Press the  reset button • Ensure the drive displays 'inh' ('SEP.EC' trip if 8V SINCOS encoder feedback is being used) If the drive trips, see Chapter 12 <i>Diagnostics</i> on page 198. 	
Set feedback device parameters	<p>Encoder</p> <ul style="list-style-type: none"> • Encoder power supply Pr 3.23 = 0, 5V Pr 3.23 = 1, 15V. (If Pr 3.23 = 1 then termination resistors should be disabled - Pr 3.24 = 1) • Encoder PPR (pulses per revolution) Enter PPR in Pr 3.21 <p>Resolver</p> <ul style="list-style-type: none"> • The default setting is for a transformation ratio of 0.33 (3:1), if the resolver has a transformation ratio of 0.5 (2:1), set Pr 16.10 = 1 <p>SINCOS</p> <ul style="list-style-type: none"> • Encoder power supply Pr 16.15 = 0, 5V Pr 16.15 = 1, 8V. (Save parameter and cycle power to clear 'SEP.EC' trip) • Encoder PPR (pulses per revolution) Enter PPR in Pr 16.12 	  
Enter motor nameplate details	<p>Enter:</p> <ul style="list-style-type: none"> • Motor rated current in Pr 0.46 (A) • Number of poles in Pr 0.42 	
Set maximum speed	<p>Enter:</p> <ul style="list-style-type: none"> • Maximum speed in Pr 0.02 (rpm) 	
Set acceleration / deceleration rates	<p>Enter:</p> <ul style="list-style-type: none"> • Acceleration rate in Pr 0.03 (s/1,000rpm) • Deceleration rate in Pr 0.04 (s/1,000rpm) (If braking resistor fitted, set Pr 0.15 = FAST) 	
Autotune	<p> Once this parameter is set and the enable signal is given, the motor will rotate by part of 1 revolution without a run command being given.</p> <p>WARNING</p> <ul style="list-style-type: none"> • Set Pr 0.40 = 1, close the enable signal (terminal 30) and wait for the drive display to show 'STOP' <p>If the drive trips, see Chapter 12 <i>Diagnostics</i> on page 198.</p> <p>NOTE</p> <p>The motor must be uncoupled from any gearbox or load before an autotune is carried out.</p>	
Save parameters	<p>Enter 1000 in Pr xx.00</p> <p>Press the red  reset button or toggle the reset digital input (ensure Pr xx.00 returns to 0)</p>	
Run	Drive is now ready to run	

7.3 Quick start P.C. commissioning (UniSoft / VTCSoft)

This section details how to get the motor running using Unisoft or VTCsoft pc commissioning software in each operating mode and with the various feedback devices.

Unisoft or VTCsoft is available free of charge and can be downloaded from www.controltechniques.com.

7.3.1 Open Loop

Induction motor without feedback device

Please refer to the documentation that came with UniSoft or VTCSoft for instructions on how to install the drive commissioning software.

Select OPEN LOOP mode of operation

Enter motor nameplate details.

Set maximum / minimum speed.

Set acceleration / deceleration rates.

When entering the motor nameplate details, max/min speeds and acceleration/deceleration rates, click on the relevant field, enter the value here and click 'Change'

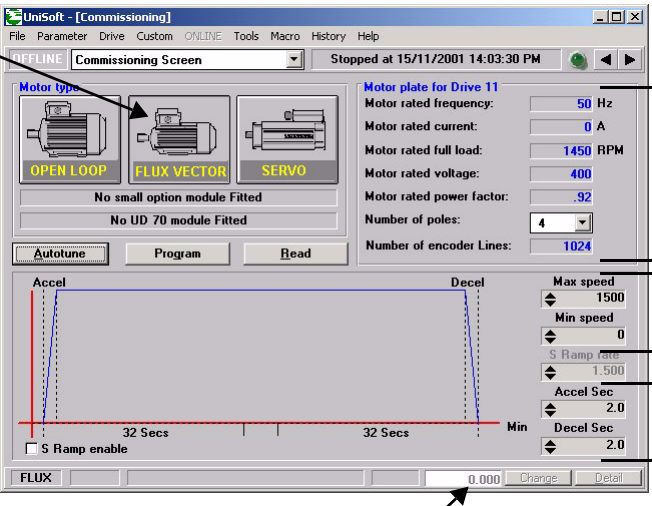
Action	Detail	
Before power-up	Ensure: <ul style="list-style-type: none"> • Enable is closed (terminal 30) • Motor thermistor is connected or terminal 8 is linked to 0V • Run signal is not given • Motor is connected • A UD71 serial communications module is fitted and is connected to the PC running UniSoft with the above screen displayed <p>NOTE</p> <p>The motor must be uncoupled from any gearbox or load before an autotune is carried out.</p>	
Power-up the drive	Ensure: <ul style="list-style-type: none"> • Drive displays 'inh'. If the drive trips, refer to Chapter 12 <i>Diagnostics</i> on page 198. 	
Program the drive	Click 'Program' to upload the values to the drive.	
Autotune	<p>WARNING</p> <p>Once this parameter is set, the motor will accelerate up to $\frac{2}{3}$ base frequency without a run command being given. Once the measurement is complete, the motor will coast to a stop. The drive can be disabled at any time by pressing the red button.</p> <ul style="list-style-type: none"> • Click 'Autotune' to enable the drive to perform the autotune If the drive trips, see Chapter 12 <i>Diagnostics</i> on page 198. <p>NOTE</p> <p>The motor must be uncoupled from any gearbox or load before an autotune is carried out.</p>	
Saving parameters	In the 'Tools' menu select 'Save parameters in drive'. UniSoft will ask whether you want to save parameters in the drive when UniSoft is closed.	
Run	Drive is now ready to run	

7.3.2 Closed Loop Vector

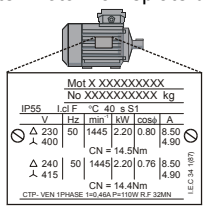
Induction motor with speed feedback

Please refer to the documentation that came with UniSoft for instructions on how to install the drive commissioning software

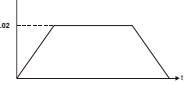
Select Flux Vector mode of operation



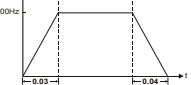
Enter motor nameplate details





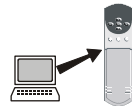
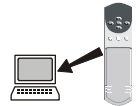
Set max / min speed

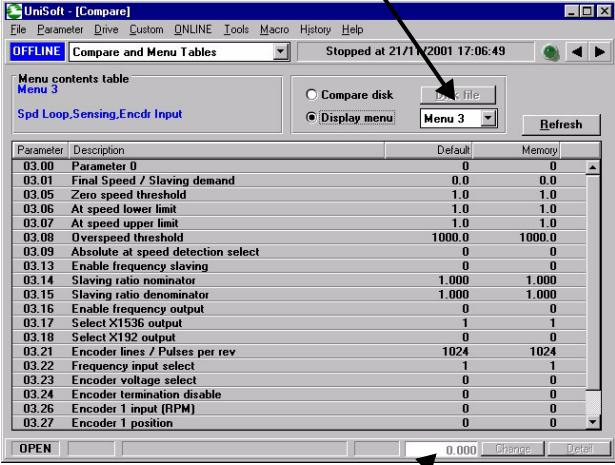
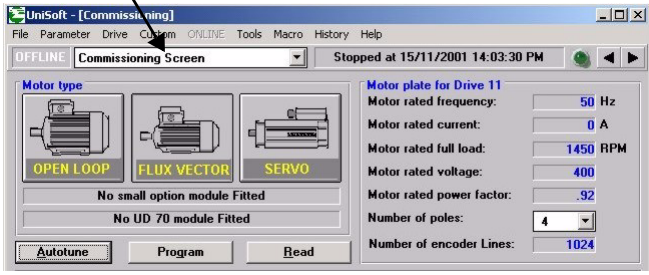




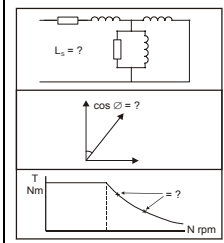
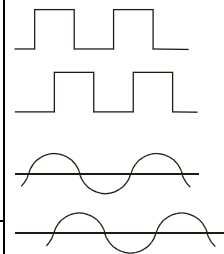
Set acceleration / deceleration rates



When entering the motor nameplate details, max/min speeds and acceleration/deceleration rates, click on the relevant field, enter the value here and click **Change**

Action	Detail	
Before power-up	<p>Ensure:</p> <ul style="list-style-type: none"> • Enable is closed (terminal 30) • Motor thermistor is connected or terminal 8 is linked to 0V • Run signal is not given • Motor is connected • Feedback is connected and relevant small option module fitted (SINCOS or resolver feedback) • A UD71 serial communications module is fitted and is connected to the PC running UniSoft with the above screen displayed <p>NOTE</p> <p>The motor must be uncoupled from any gearbox or load before an autotune is carried out.</p>	
Power-up the drive	<p>Ensure:</p> <ul style="list-style-type: none"> • Drive displays 'inh' ('SEP.EC' if 8V SINCOS encoder feedback is being used). If the drive trips, refer to Chapter 12 <i>Diagnostics</i> on page 198. 	
Program the drive	Click 'Program' to upload the values to the drive.	
Recognising the option module	If either a UD52 SINCOS or UD53 Resolver option module has been fitted, click 'Read' to allow UniSoft to recognise which small option module has been fitted.	

Action	Detail
Set encoder parameters	<p>• In the Parameter menu, select 'Display by menu'. For incremental encoder feedback, select 'Menu 3'. For SINCOS or Resolver feedback, select 'Menu16'.</p>  <p>Select the parameter to change in the list above. Enter the required value in the field and click 'Change'.</p> <p>Encoder</p> <ul style="list-style-type: none"> Encoder power supply Pr 3.23 = 0, 5V Pr 3.23 = 1, 15V. (If Pr 3.23 = 1 then termination resistors should be disabled - Pr 3.24 = 1) Encoder PPR (pulses per revolution) Enter PPR in Pr 3.21 <p>Resolver</p> <ul style="list-style-type: none"> The default setting is for a transformation ratio of 0.33 (3:1), if the resolver has a transformation ratio of 0.5 (2:1), set Pr 16.10 = 1 <p>SINCOS</p> <ul style="list-style-type: none"> Encoder power supply Pr 16.15 = 0, 5V Pr 16.15 = 1, 8V. (Save parameter and cycle power to clear 'SEP.EC' trip) Encoder PPR (pulses per revolution) Enter PPR in Pr 16.12
Programming the drive	<p>In the 'Drive' menu select 'Program all parameters' to upload the parameters to the drive.</p> <p>Select 'Commissioning Screen' to return to the front page of UniSoft</p>  <p>Autotune</p> <div>  <p>Once this parameter is set, the motor will accelerate up to $\frac{2}{3}$ base frequency without a run command being given. Once the measurement is complete, the motor will coast to a stop. The drive can be disabled at any time by pressing the red button.</p> </div> <ul style="list-style-type: none"> Close the enable signal (terminal 30) Click 'Autotune' to enable the drive to perform the autotune <p>If the drive trips, see Chapter 12 <i>Diagnostics</i> on page 198.</p> <p>NOTE</p> <p>The motor must be uncoupled from any gearbox or load before an autotune is carried out.</p>
Saving parameters	<p>In the 'Tools' menu select 'Save parameters in drive'. UniSoft will ask whether you want to save parameters in the drive when UniSoft is closed.</p>
Run	<p>Drive is now ready to run</p> 



7.3.3 Servo

Permanent magnet motor with speed and position feedback

Please refer to the documentation that came with UniSoft for instructions to install the drive commissioning software.

Select Servo mode of operation

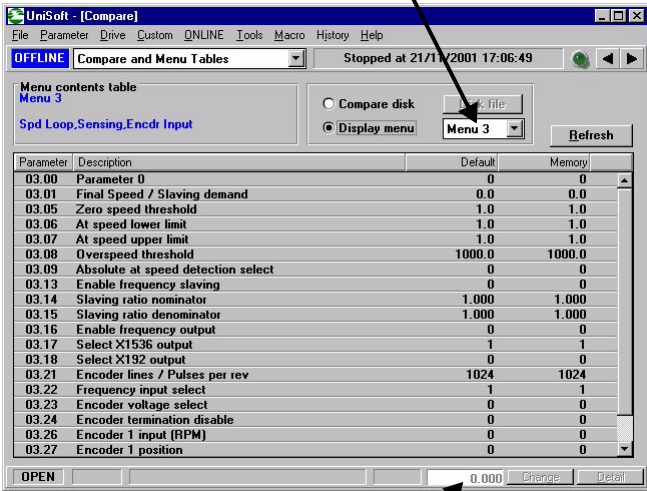
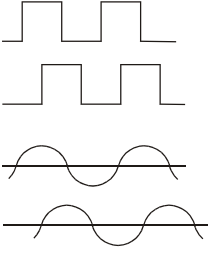
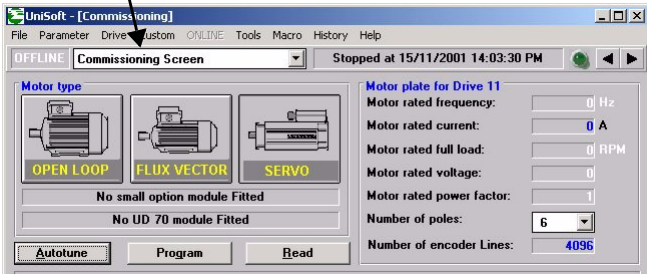


Enter motor nameplate details

Set max / min speed

Set acceleration / deceleration rates

When entering the motor nameplate details, max/min speeds and acceleration/deceleration rates, click on the relevant field, enter the value here and click '**Change**'

Action	Detail	
Before power-up	<p>Ensure:</p> <ul style="list-style-type: none"> • Enable is closed (terminal 30) • Motor thermistor is connected or terminal 8 is linked to 0V • Run signal is not given • Motor is connected • Feedback is connected and relevant small option module fitted (SINCOS or resolver feedback) • A UD71 serial communications module is fitted and is connected to the PC running UniSoft with the above screen displayed <p>NOTE</p> <p>The motor must be uncoupled from any gearbox or load before an autotune is carried out.</p>	
Power-up the drive	<p>Ensure:</p> <ul style="list-style-type: none"> • Drive displays 'inh' ('SEP.EC' if 8V SINCOS encoder feedback is being used). If the drive trips, refer to Chapter 12 <i>Diagnostics</i> on page 198. 	
Program the drive	Click ' Program ' to upload the values to the drive.	
Recognising the option module	If either a UD52 SINCOS or UD53 Resolver option module has been fitted, click ' Read ' to allow UniSoft to recognise which module has been fitted.	

Action	Detail	
Set encoder parameters	<ul style="list-style-type: none"> In the Parameter menu, select 'Display by menu'. For incremental encoder feedback, select 'Menu 3'. For SINCOS or Resolver feedback, select 'Menu16'.  <p>Select the parameter to change in the list above. Enter the required value in the field and click 'Change'.</p> <p>Encoder</p> <ul style="list-style-type: none"> Encoder power supply Pr 3.23 = 0, 5V Pr 3.23 = 1, 15V. (If Pr 3.23 = 1 then termination resistors should be disabled - Pr 3.24 = 1) Encoder PPR (pulses per revolution) Enter PPR in Pr 3.21 <p>Resolver</p> <ul style="list-style-type: none"> The default setting is for a transformation ratio of 0.33 (3:1), if the resolver has a transformation ratio of 0.5 (2:1), set Pr 16.10 = 1 <p>SINCOS</p> <ul style="list-style-type: none"> Encoder power supply Pr 16.15 = 0, 5V Pr 16.15 = 1, 8V. (Save parameter and cycle power to clear 'SEP.EC' trip) Encoder PPR (pulses per revolution) Enter PPR in Pr 16.12 	
Programming the drive	<p>In the 'Drive' menu select 'Program all parameters' to upload the parameters to the drive.</p> <p>Select 'Commissioning Screen' to return to the front page of UniSoft</p>  <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">  <p>If an encoder phasing test is selected and the enable signal given, the motor will rotate by part of 1 revolution without a run command being given.</p> </div> <p>WARNING</p> <ul style="list-style-type: none"> Close the enable signal (terminal 30) Click 'Autotune' to enable the drive to perform the encoder phasing test <p>If the drive trips, see Chapter 12 <i>Diagnostics</i> on page 198.</p> <p>NOTE</p> <p>The motor must be uncoupled from any gearbox or load before an autotune is carried out.</p>	
Saving parameters	In the ' Tools ' menu select ' Save parameters in drive '. UniSoft will ask whether you want to save parameters in the drive when UniSoft is closed.	
Run	Drive is now ready to run	

8 Optimisation

8.1 Motor map parameters

8.1.1 Open loop motor control

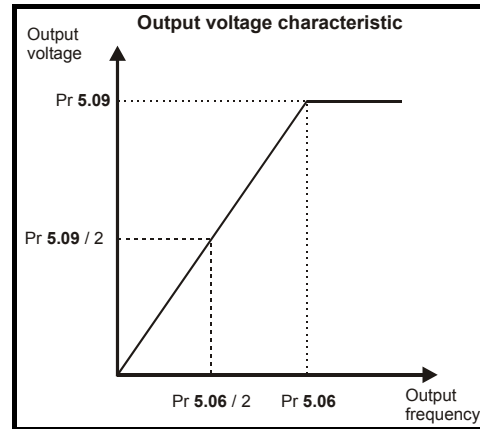
This section provides information on how to get the most from the Unidrive once an autotune and basic set up has been completed.

A separate section is provided for each operating mode at the beginning and then common parameters / features are detailed towards the end of the section.

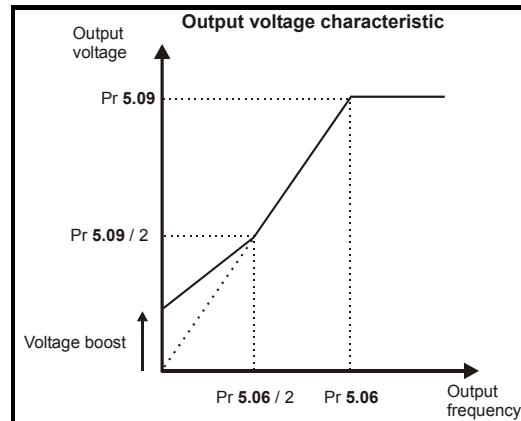
Information such as tuning the speed and current loop gains and also explanations of the effects of motor map parameters are included.

Pr 0.46 {5.07} Motor rated current	Defines the maximum motor continuous current
The motor rated current parameter must be set to the maximum continuous current of the motor to ensure the current limits in the drive function at the correct levels so that the motor is protected should an overload situation occur.	
Pr 0.42 {5.11} Motor number of poles	Defines the number of motor poles
The motor number of poles parameter defines the speed displayed by the drive for a given output frequency. i.e. 4 pole motor 50 Hz = 1,500 rpm 2 pole motor 50 Hz = 3,000 rpm	
Pr 0.44 {5.09} Motor rated voltage	Defines the voltage applied to the motor at rated frequency
Pr 0.47 {5.06} Motor rated frequency	Defines the frequency at which rated voltage is applied

The voltage and frequency parameters define the relationship between the voltage and frequency applied to the motor as shown aside:

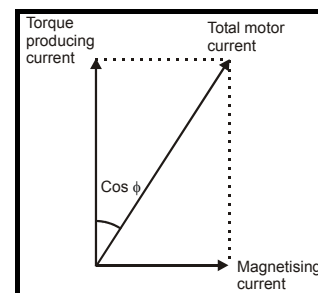


The volts / frequency ratio must be kept constant to ensure rated torque is available from the motor over the frequency range.
At low frequencies (from 0 Hz to $\frac{1}{2} \times \text{Pr } 5.06$) the voltage is increased from this characteristic by a level governed by either the voltage boost parameter or the motor parameters (found during the stator resistance test) depending on whether the drive is in fixed boost or open loop vector mode as shown aside:



Pr 0.43 {5.10} Motor rated power factor	Defines the angle between the motor rated current and the torque producing current
--	---

The power factor is found by the drive during the autotune procedure. It is used in the open loop vector algorithm and to set the current limit levels for the torque producing (active) current.



Pr 0.07 {5.14} Voltage mode

The voltage mode selects whether the drive is in open loop vector mode or fixed boost.

Fixed boost (**Fd**) should be used for fans and pumps and multiple motor applications.

Open loop vector is the default setting and should be used to tune the drive to the motor characteristic to get good performance at low output frequencies.

Open loop vector mode requires the stator resistance and voltage offset parameters for ideal operation.

These can be measured by the drive depending on the voltage mode selected as follows:

Ur_I = Stator resistance and voltage offset are measured on power up providing no trip condition is present and the drive enable (terminal 30) signal is active.

Ur_S = Stator resistance and voltage offset are measured every time the run command is activated. This mode ensures the drive compensates for any change in the motor parameters due to temperature changes.

Ur = No test is performed - a test should be carried out using one of the other modes or the stator resistance entered manually. (The voltage offset cannot be entered manually as this is also a function of the drive.) This mode should be used where it is not desirable for the drive to test the motor on power up or before a run.

The stator resistance and voltage offset values can be viewed in Pr 5.17 and Pr 5.23 respectively.

Pr 0.40 {5.12} Autotune

The motor must be disconnected from any load including the gearbox before commencing an autotune.

Once the test is enabled the drive runs the motor to two thirds base speed and measures the no load current which equals the magnetising current. From the no load current and the motor rated current the drive then calculates the power factor.

Pr 5.27 Slip compensation and Pr 0.45 {5.08} Motor rated speed

When a motor being controlled in open loop mode has load applied a characteristic of the motor is that the output speed droops in proportion to the load applied as shown aside:

In order to prevent the speed droop shown above slip compensation should be enabled.

Pr 5.27 must be set to a 1 (this is the default setting) and the motor rated speed must be entered in Pr 0.45 {5.08}. to enable slip compensation. The motor rated speed parameter should be set to the synchronous speed of the motor minus the slip speed. This is often displayed on the motor nameplate.

i.e. For a typical 18.5 kW, 50 Hz, 4 pole motor the motor rated speed is 1465 rpm

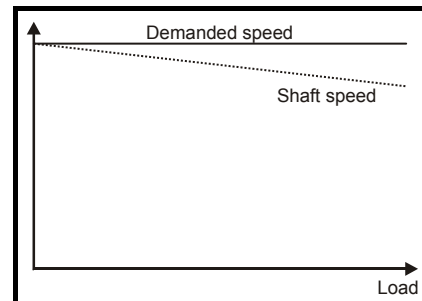
The synchronous speed for a 4 pole motor is 1500 rpm therefore the slip speed is 35 rpm

If the synchronous speed is entered slip compensation will have no effect.

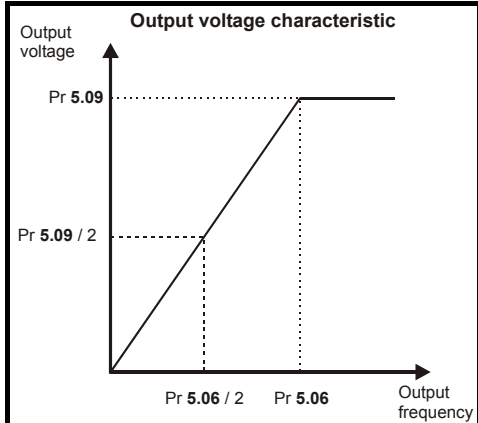
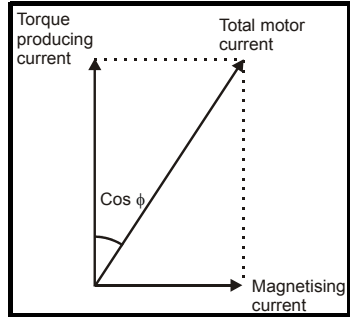
If too small a value is entered the motor will run faster than the demanded frequency.

Synchronous speeds for different numbers of poles are as follows:

- 2 pole = 3,000 rpm
- 4 pole = 1,500 rpm
- 6 pole = 1,000 rpm
- 8 pole = 750 rpm



8.1.2 Closed loop vector motor control

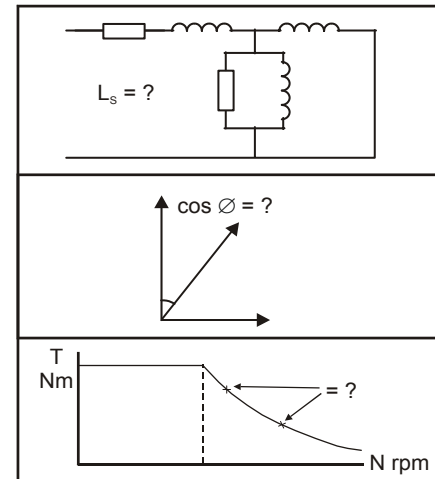
Pr 0.46 {5.07} Motor rated current	Defines the maximum motor continuous current
The motor rated current parameter must be set to the maximum continuous current of the motor to ensure the current limits in the drive function at the correct levels so that the motor is protected should an overload situation occur.	
Pr 0.42 {5.11} Motor number of poles	Defines the number of motor poles
The motor number of poles parameter defines the synchronous speed of the motor, which in conjunction with the motor rated speed parameter defines the slip speed.	
Pr 0.44 {5.09} Motor rated voltage	Defines the voltage applied to the motor at rated frequency
Pr 0.47 {5.06} Motor rated frequency	Defines the frequency at which rated voltage is applied
<p>The voltage and frequency parameters define the relationship between the voltage and frequency applied to the motor as shown aside:</p> <p>The volts / frequency ratio must be kept constant to ensure rated torque is available from the motor over the frequency range.</p>	
	
Pr 0.43 {5.10} Motor rated power factor	Defines the angle between the motor rated current and the torque producing current
<p>The power factor is found by the drive during the autotune procedure. It is used to set the level at which the magnetising current is controlled.</p>	
	
Pr 0.45 {5.08} Motor rated speed	Defines the motor rated speed
<p>The motor rated speed parameter should be set to the synchronous speed of the motor minus the slip speed.</p> <p>This is often displayed on the motor nameplate. I.e. For a typical 18.5 kW, 50 Hz, 4 pole motor the motor rated speed is 1465 rpm</p> <p>The synchronous speed for a 4 pole motor is 1500 rpm therefore the slip speed is 35 rpm</p> <p>Synchronous speeds for different numbers of poles are as follows:</p> <ul style="list-style-type: none"> 2 pole = 3,000 rpm 4 pole = 1,500 rpm 6 pole = 1,000 rpm 8 pole = 750 rpm <p>The accuracy of this parameter is very important as it directly affects the torque produced at the shaft.</p> <p>Often the value given on the motor nameplate is not 100% accurate which can lead to a loss of torque.</p> <p>The parameter can be tuned by the drive using the slip optimiser - please see the description which follows.</p>	

Pr 0.40 {5.12} Autotune

The motor must be stationary and disconnected from any load (including the gearbox) before commencing an autotune.

The test is completed in three stages as follows:

1. Motor leakage inductance (Pr 5.24)
Before the motor rotates the leakage inductance is measured. This is required for the slip optimiser to work correctly.
2. Power factor (Pr 0.43 / 5.10)
The motor runs up to two thirds base speed and the no load current is measured. This equals the magnetising current which in conjunction with the motor rated current value allows the power factor to be calculated.
3. Saturation characteristic (Pr 5.29 / 5.30)
The drive continues to turn the motor and while doing so gradually reduces the magnetising current to determine the relationship between magnetising current and motor flux for the specific motor being controlled.
The saturation characteristic sets the levels at which the magnetising current is controlled during operation above base speed (field weakening).



Pr 5.27 Slip optimisation

Slip optimisation is used as follows:

1. To optimise the motor rated speed parameter from the motor nameplate value to the best value for the individual motor on a one off basis during commissioning.
2. To constantly monitor and optimise the motor rated speed during normal operation to compensate for changes in motor temperature which can have a significant effect on rotor resistance and thus rated speed.

The following conditions must apply for the slip optimiser to function correctly:

- As detailed above in the autotune section the motor leakage inductance (Pr 5.24) is required for this feature to function correctly. An autotune should be carried out before enabling the slip optimiser.
- The drive must run at a speed greater than $\frac{1}{8}$ x rated speed.
- At least $\frac{1}{8}$ x rated load must be applied.
- Slip optimisation can only be used at or below base speed. If field weakening operation is required the optimiser should be enabled during commissioning only then disabled for high speed operation.

Pr 4.13 / 4.14 Current loop gains

The current loop gains control the response of the current loop to a change in current (torque) demand.

Inappropriate values entered in these parameters can cause the control system to become unstable.

The default values give satisfactory performance for most applications however for optimal performance in dynamic applications the values may require tuning for the specific motor.

The current loop gains can be calculated from the motor resistance and inductance values by either:

1. Using the formula detailed below
2. The gain calculator wizard in Unisoft version 3.43 in the 'Tools' menu

The proportional gain (Pr 4.13) should be set to $1800 \times \text{Pr 5.24} \times 10^{-3} \times \text{Pr 11.32}$

where:

Pr 5.24 = per phase motor leakage inductance (mH)
Pr 11.32 = Drive rated current

The integral gain (Pr 4.14) should be set to $0.044 \times \text{Pr 4.13} \times \frac{R}{\text{Pr 5.24} \times 10^{-3}}$

where:

Pr 4.13 = current loop proportional gain calculated above
R = per phase stator resistance (from the motor data sheet)
Pr 5.24 = per phase motor leakage inductance (mH)

NOTE

The numerical value in Pr 5.24 should be input directly into the above formula in mH

The $\times 10^{-3}$ term converts this to H.

Pr 3.10 / 3.11 / 3.12 Speed loop gains

The speed loop gains control the response of the speed loop to a change in speed demand.

The default values give satisfactory performance for most applications however for optimal performance in dynamic applications the values may require tuning for the specific motor.

Inappropriate values entered in these parameters can cause the control system to become unstable.

The proportional gain (Pr 3.10) responds proportionally to the difference between the demanded value and the actual value (the error).

The integral gain (Pr 3.11) responds proportionally to the accumulation of the error. It is used to eliminate steady state error and under dynamic conditions provide stiffness to the system.

The derivative gain (Pr 3.12) is proportional to the rate of change of the error. It improves the stability of the system under transient conditions.

The speed loop gains can be tuned by either:

1. Using an oscilloscope and the method described below
or
2. The gain calculator wizard in Unisoft version 3.43, which requires the following:
 - motor inertia
 - load inertia (reflected through the gear box if used)
 - stiffness / compliance angle (user defined deflection of the motor shaft when full torque is applied)
 - drive rated current
 - motor nameplate details

Tuning the speed loop gains using an oscilloscope

Connect the oscilloscope to analog output 1 to monitor the speed feedback.

Give the drive a step change in speed reference and monitor the response of the drive on the oscilloscope.

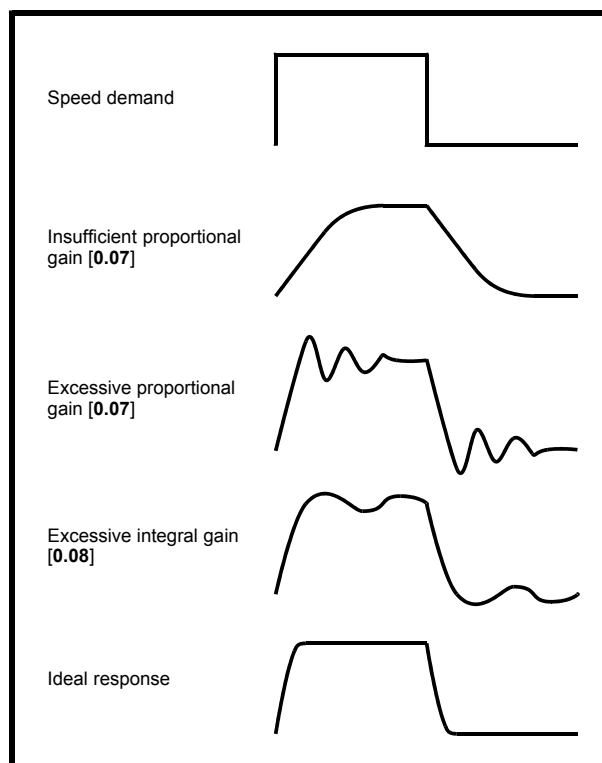
The proportional gain should be set up initially - the value should be increased up to the point where the speed overshoots and then reduced slightly.

The integral term should then be increased up to the point where the speed becomes unstable and then reduced slightly.

If a derivative gain is required the value should be increased up to the point where the system response becomes unstable and then reduced slightly.

It may now be possible to increase the proportional gain to a higher value and the process should be repeated until the system response matches the ideal response shown below.

The diagram below shows the effect of incorrect P and I gain settings as well as the ideal response.



WARNING

If the speed loop I gain (Pr 3.11) is set to zero and later increased, a large output transient will result causing the drive to accelerate under full current.

The over speed trip threshold (Pr 3.08) must be set to a suitable level to prevent the output from reaching a level where mechanical damage could result.

8.1.3 Servo motor control

Pr 0.46 {5.07} Motor rated current

Defines the maximum motor continuous current

The motor rated current parameter must be set to the maximum continuous current of the motor to ensure the current limits in the drive function at the correct levels so that the motor is protected should an overload situation occur.

Pr 0.42 {5.11} Motor number of poles

Defines the number of motor poles

The motor number of poles parameter defines the number of electrical revolutions in one whole mechanical revolution of the motor.

Pr 0.40 {3.25} Autotune

The motor should be stationary and disconnected from any load (including the gearbox) before commencing an autotune.

The test rotates the motor by less than a revolution. The exact distance depends on the number of motor poles.

The autotune measures the offset between the feedback device zero and the rotor zero. This is required so that the voltage applied is in phase with the back EMF from the motor.

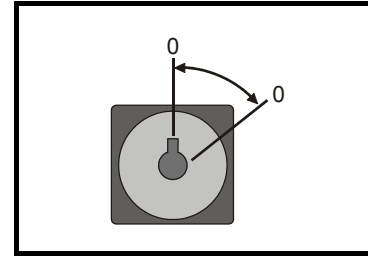
If the value entered is incorrect the drive will not control the motor correctly.

The result can be:

1. loss of torque
2. excessive heating of the motor
3. in extreme cases the motor can run out of control to maximum speed

If the load cannot be removed and it is solely an inertia a high current autotune can be enabled.

Set Pr 5.27 = 1 prior to enabling the autotune.



Pr 4.13 / 4.14 Current loop gains

The current loop gains control the response of the current loop to a change in current (torque) demand.

The default values give satisfactory performance for most applications however for optimal performance in dynamic applications the values may require tuning for the specific motor.

Inappropriate values entered in these parameters can cause the control system to become unstable.

The current loop gains can be calculated from the motor resistance and inductance values by either:

1. Using the formula detailed below
2. The gain calculator wizard in Unisoft version 3.43 in the 'Tools' menu

The proportional gain (Pr 4.13) should be set to $1800 \times L \times 10^{-3} \times \text{Pr 11.32}$

where:

L = per phase motor leakage inductance (mH) (from the motor data sheet)
Pr 11.32 = Drive rated current

The integral gain (Pr 4.14) should be set to $0.044 \times \text{Pr 4.13} \times \frac{R}{L \times 10^{-3}}$

where:

Pr 4.13 = current loop proportional gain calculated above
R = per phase stator resistance (from the motor data sheet)
L = per phase motor leakage inductance (mH) (from the motor data sheet)

NOTE

For very small servo motors with high inductance the values calculated from the above formulae can be too high resulting excessive motor noise. The values should be calculated and then reduced to a suitable level manually.

Pr 3.10 / 3.11 / 3.12 Speed loop gains

The speed loop gains control the response of the speed loop to a change in speed demand.

The default values give satisfactory performance for most applications however for optimal performance in dynamic applications the values may require tuning for the specific motor.

Inappropriate values entered in these parameters can cause the control system to become unstable.

The proportional gain (Pr 3.10) responds proportionally to the difference between the demanded value and the actual value (the error).

The integral gain (Pr 3.11) responds proportionally to the accumulation of the error. It is used to eliminate steady state error and under dynamic conditions provide stiffness to the system.

The derivative gain (Pr 3.12) is proportional to the rate of change of the error. It improves the stability of the system under transient conditions.

The speed loop gains can be tuned by either:

1. Using an oscilloscope and the method described below
2. The gain calculator wizard in Unisoft version 3.43, which requires the following:
 - motor inertia
 - load inertia (reflected through the gear box if used)
 - stiffness / compliance angle (user defined deflection of the motor shaft when full torque is applied)
 - drive rated current
 - motor nameplate details

Tuning the speed loop gains using an oscilloscope

Connect the oscilloscope to analog output 1 to monitor the speed feedback.

Give the drive a step change in speed reference and monitor the response of the drive on the oscilloscope.

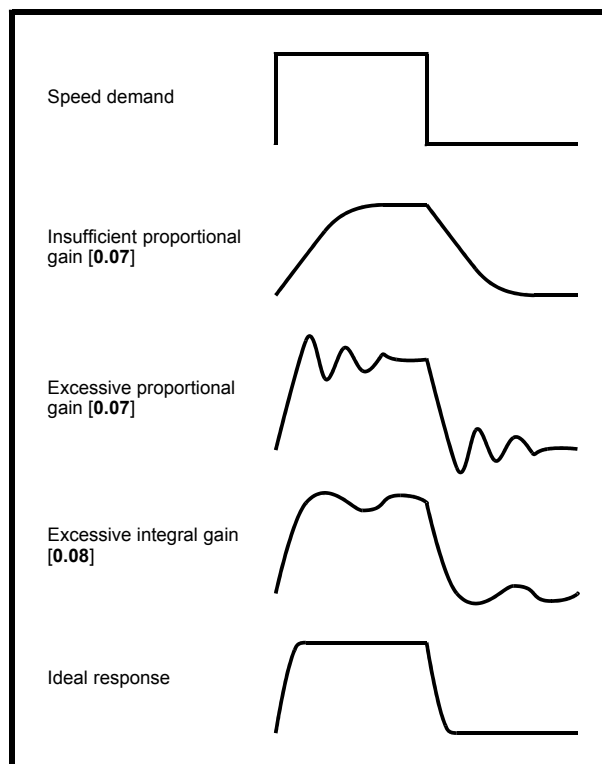
The proportional gain should be set up initially - the value should be increased up to the point where the speed overshoots and then reduced slightly.

The integral term should then be increased up to the point where the speed becomes unstable and then reduced slightly.

If a derivative gain is required the value should be increased up to the point where the system response becomes unstable and then reduced slightly.

It may now be possible to increase the proportional gain to a higher value and the process should be repeated until the system response matches the ideal response shown aside.

The diagram below shows the effect of incorrect P and I gain settings as well as the ideal response.



WARNING

If the speed loop I gain (Pr 3.11) is set to zero and later increased, a large output transient will result causing the drive to accelerate under full current.

The over speed trip threshold (Pr 3.08) must be set to a suitable level to prevent the output from reaching a level where mechanical damage could result.

8.2 Current limits

The default setting for the current limit parameters are 150% x motor rated current for open loop and closed loop vector modes and 175%* x motor rated current for servo mode. *150% for Unidrive size 5.

There are three parameters which control the current limits:

- Pr 4.05 *Motoring current limit*: power flowing from the drive to the motor
- Pr 4.06 *Regen current limit*: power flowing from the motor to the drive
- Pr 4.07 *Symmetrical current limit*: current limit for both motoring and regen operation

The lowest of either the motoring and regen current limit or the symmetrical current limit applies.

The maximum setting of these parameters depends on the ratio of motor rated current to drive rated current and the power factor.

The drive can be oversized to permit a higher current limit setting to provide higher accelerating torque as required up to a maximum of 400%.

Please note that too high a setting of these parameters can cause permanent damage to a servo motor by demagnetising the rotor.

The maximum current limits ($I_{MAX}\%$) available for each mode of operation, are calculated from the following equations.

Open loop

$$I_{MAX}\% = \left(\sqrt{\left(\frac{1.597^2 \times \left(\frac{Pr\ 11.32}{Pr\ 5.07} \right)^2 - 1}{Pr\ 5.10^2} \right) + 1} - \left(\frac{0.156 \times Pr\ 11.32}{Pr\ 5.10 \times Pr\ 5.07} \right) \right) \times 100$$

The above equation gives a value less than 150% if Pr 5.10 > 0.93. The maximum current limit value used by the drive is 150% if the calculated value is less than 150%.

Closed loop vector

$$I_{MAX}\% = \left(\sqrt{\left(\frac{1.597^2 \times \left(\frac{Pr\ 11.32}{Pr\ 5.07} \right)^2 - 1}{Pr\ 5.10^2} \right) + 1} \right) \times 100$$

Servo

$$I_{MAX}\% = \left(1.767 \times \left(\frac{Pr\ 11.32}{Pr\ 5.07} \right) \right) \times 100$$

Unidrive VTC

$$I_{MAX}\% = \left(\sqrt{\left(\frac{1.203^2 \times \left(\frac{Pr\ 11.32}{Pr\ 5.07} \right)^2 - 1}{Pr\ 5.10^2} \right) + 1} \right) \times 100$$

8.3 Motor thermal protection

The Unidrive models the temperature of the motor using the motor rated current parameter, the thermal time constant parameter and the actual current flowing at any point in time.

An accumulator (Pr 4.19) increments or decrements based on the current flowing in the motor.

If the motor runs for a given time at a level below the rated current of the motor the accumulator will settle at a value equivalent to the motor temperature.

An it.ac trip instantaneously occurs if the accumulator reaches 100%. This can only occur if the rms current flowing is greater than 105%. or if a current peak lasts for enough time to cause the accumulator to peak at or above this level.

The default setting of the thermal time constant (Pr 4.15) is 89s for an induction motor (open loop and closed loop vector) which is equivalent to an overload of 150% for 60s from cold.

The default value for a servo motor is 7s which is equivalent to an overload of 175% for 4s from cold.

The maximum value for the thermal time constant can be increased up to a maximum value of 400s to allow an increased overload if the motor thermal characteristics permit.

For applications using CT Dynamics Unimotors the thermal time constants can be found in the Unimotor manual.

8.4 Switching frequency

The default switching frequency for the drive is 3kHz however this can be increased up to a maximum value of 12kHz.

If the switching frequency is increased the following apply:

1. Increased heat loss in the drive which means that derating to the output current must be applied.
See the derating table for switching frequency and ambient temperature in the Chapter 11 *Technical Data* on page 190.
2. Reduced heating of the motor - due to improved output waveform quality
3. Increased sample rate on the speed and current controllers

A trade off must be made between motor heating and drive heating and the demands of the application with respect to the sample time required.

Switching frequency	Sample time (μs) OL > Current control CL > Speed control	Sample time (μs) OL > Peak limit CL > Current control
3	333	333
4.5	444	222
6	333	166
9	444	222
12	333	166

8.5 High speed operation

8.5.1 Encoder feedback limits

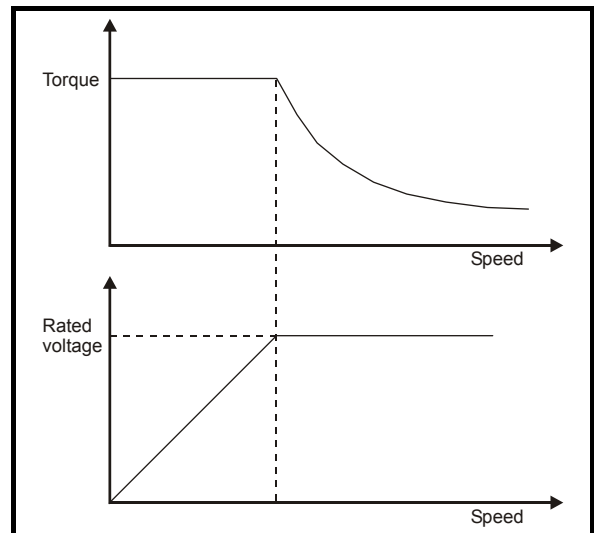
In the closed loop modes when using encoder feedback the maximum speed of the drive is limited by the maximum frequency limit of the encoder input as follows:

Encoder PPR	Maximum Speed (rpm)
up to 5,000	3,000
up to 2,500	6,000
up to 1,250	12,000
up to 625	24,000
up to 312	30,000

8.5.2 Field weakening (constant power) operation (Open loop and closed loop vector mode only)

The Unidrive can be used to run an induction machine above synchronous speed into the constant power region. The speed continues to increase and the available shaft torque reduces.

The characteristics below show the torque and output voltage characteristics as the speed is increased above the rated value.



Care must be taken to ensure the torque available above base speed is sufficient for the application to run satisfactorily.

8.5.3 Saturation breakpoints

The saturation breakpoint parameters (Pr 5.29 and Pr 5.30) found during the autotune in closed loop vector mode ensure the magnetising current is reduced in the correct proportion for the specific motor.

(In open loop mode the magnetising current is not actively controlled)

8.5.4 Switching frequency

With a default switching frequency of 3 kHz the maximum output frequency should be limited to 250 Hz. Ideally a minimum ratio of 12 : 1 should be maintained between the output frequency and the switching frequency. This ensures the number of switchings per cycle is sufficient to ensure the output waveform quality is maintained at a minimum level.

If this is not possible, quasi square switching should be enabled (Pr 5.20 =1). The output waveform will be quasi square above base speed however this also ensures a symmetrical output waveform which results in a better quality output than would otherwise result.

8.5.5 Output frequency doubling

(Open loop only)

If this bit is set the motor output frequency is twice the displayed value. The maximum open loop output frequency increases from 1,000Hz to 2,000Hz.

The following parameters need to be re-scaled when this mode of operation is used.

For example:-

The real machine is 4 pole, 2,000Hz, 400V, 60,000 rpm, full load speed 58,000 rpm, and the desired maximum speed is 40,000 rpm with a trip at 50,000 rpm. Acceleration is to be 500Hz / sec.

Menu 1:

maximum frequency (Pr 1.06) should be set to:

$$0.5 \times 2,000 \times 40,000 / 60,000 = 667\text{Hz}$$

Menu 2:

the ramp times (Pr 2.11 to 2.29) need to be set at:

$$0.5 \times 0.2 \text{ sec per } 100\text{Hz} = 0.1$$

Menu 3:

the over-speed trip threshold (Pr 3.08) should be set at

$$0.5 \times 2,000 \times 50,000 / 60,000 = 833\text{Hz}$$

Menu 5:

the rated motor voltage (Pr 5.09) = 400V

the rated frequency (Pr 5.06) = $0.5 \times 2,000 = 1,000\text{Hz}$

the full load speed is (Pr 5.08) = $0.5 \times 58,000 = 29,000\text{rpm}$

the motor poles (Pr 5.11) = 4 POLE

Extreme caution should be exercised when setting this bit as the actual machine speed will be double that indicated.

8.5.6 Maximum speed / frequency

In open loop mode the maximum frequency is 2,000 Hz when output frequency doubling is used (500 Hz for Unidrive VTC).

In closed loop vector mode the maximum output frequency should be limited to 400 Hz.

In servo mode field weakening is not possible so the maximum speed is limited by the voltage constant (K_e) of the motor. K_e is a specific constant for the servo motor being used. It can normally be found on the motor data sheet in V/krpm (volts per 1,000rpm).

9 Macros

9.1 Introduction

Application macros are pre-programmed parameter sets. They minimise the number of different parameters to be set during start-up. The control terminals are configured for specific applications and commonly used parameters are cloned into Menu 0.

The following parameters are common to each macro:

Pr	Function
0.00	Configuration and saving
0.01	Minimum frequency/speed clamp
0.02	Maximum frequency/speed clamp
0.03	Acceleration rate
0.04	Deceleration rate
0.05	Reference <i>selector</i>
0.06	Current limit
0.07	OL> Voltage mode <i>selector</i>
	CL> Speed-loop proportional gain
0.08	OL> Boost voltage
	CL> Speed-loop integral gain
0.09	OL> Dynamic V/f <i>select</i>
	CL> Speed-loop derivative gain
0.10	OL> Estimated motor speed
	CL> Motor speed
0.31	Macro number
0.32	Serial comms. mode
0.33	Drive rated current (FLC)
0.34	User security code
0.35	Keypad reference
0.36	Serial comms. baud rate
0.37	Serial comms. address
0.38	Power up parameter display <i>select</i>
0.39	Synchronise to a spinning motor
0.40	Autotune
0.41	PWM switching frequency <i>selector</i>
0.42	Motor – number of poles
0.43	Motor – power factor
0.44	Motor – rated voltage
0.45	Motor – rated full load rpm
0.46	Motor – rated current
0.47	Motor – rated frequency
0.48	Drive operating mode <i>selector</i>
0.49	Security status
0.50	Drive software version

The following macros are available.:

Macro	Description	Code
1	Easy mode	2001
2	Motorised potentiometer	2002
3	Preset frequencies / speeds	2003
4	Torque control	2004
5	PID (set-point control)	2005
6	Axis-limit control	2006
7	Brake control	2007
8 *	Digital lock / shaft orientation	2008

* Macro 8 is only available in closed loop vector or servo operating modes.

When using Unidrive VTC, only macros 1, 2, 3 and 5 are available. For macro differences when using Unidrive VTC, see section 9.5 *Unidrive VTC macro differences on page 122*.

Macro 1 – Easy Mode

The Easy mode macro gives the simplest operation of the drive for basic applications. It is identical to the default condition except that menu 0 has less parameters.

Macro 2 – Motorised potentiometer

The Motorised potentiometer macro enables the drive's own internal motorised potentiometer to control the speed of the drive via digital inputs. A digital input selects between an analog speed reference and the motorised potentiometer reference.

Macro 3 – Preset frequencies / speeds

The Preset reference macro enables the use of preset references to control the speed of the motor via digital inputs. A digital input selects between an analog speed reference and the preset references.

Macro 4 – Torque control

The Torque control macro configures the drive for use in Torque control mode, selectable via a digital input. Analog input 1 is configured for the torque reference. When in speed control analog 2 is the speed reference. When in torque control with the drive in closed loop mode analog input 2 is the speed override reference. Enabling torque mode with the drive in open loop mode will put the drive in to pure torque control. In closed loop mode the drive will be put in to torque control with speed override.

Macro 5 – PID (set-point control)

The PID control macro enables the drive's own internal PID controller to control the speed of the motor. Analog input 1 is configured for the main speed reference, analog input 2 is the PID reference and analog input 3 is the PID feedback. A digital input selects between an analog speed reference and the PID control.

Macro 6 – Axis-limit control

The Axis limit control macro configures the drive for use with limit switches so that the drive is stopped when a position limit has been reached. The speed reference can be either unipolar or bipolar.

Macro 7 – Brake control

The brake control macro configures the drive to apply or release a mechanical brake on a motor in a crane or hoist application. The drive issues a brake release signal via a digital output when the relevant conditions are met.



Where a safety hazard may exist the drive alone must not be permitted to release the brake. An independent safety interlock must be provided to ensure safe operation in the event of drive failure or incorrect operation.

Macro 8 – Digital lock / shaft orientation

Only available in closed loop vector or servo operating modes.

Digital lock:

The drive operates as a slave in a closed loop master-slave system. The slave motor is digitally locked to the master motor.

Shaft orientation:

The motor speed is controlled in the same way as for default operation, but the motor shaft can be orientated to a specified angular position before and/or after running the motor.

9.2 How to load a macro

The motor map can be entered and the drive autotuned before or after loading a macro.

Procedure

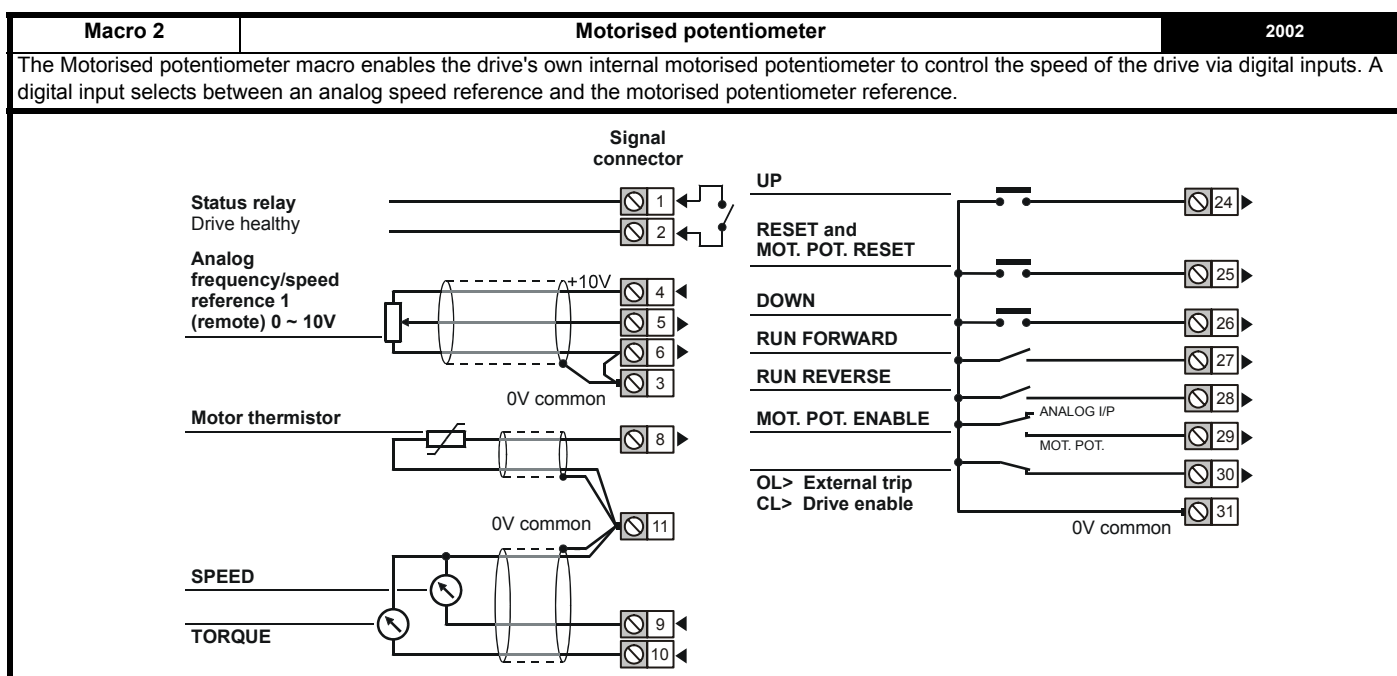
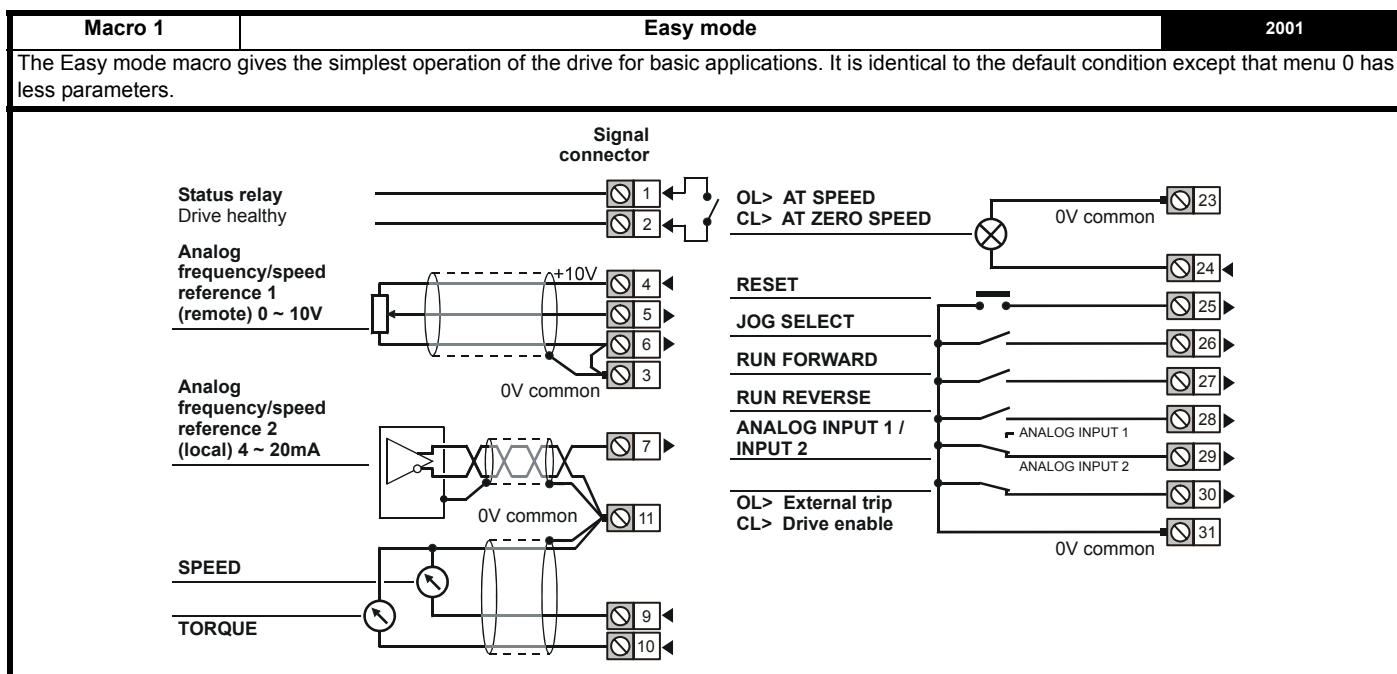
Enter code for the required macro in Pr **xx.00**

Press the red reset button or toggle the reset digital input (ensure Pr **xx.00** returns to 0)

Perform a parameter save.

When changing between macros ensure that the drive is defaulted before the new macro is loaded.

9.3 Macro terminal connection changes



Macro 3	Preset frequencies / speeds	2003
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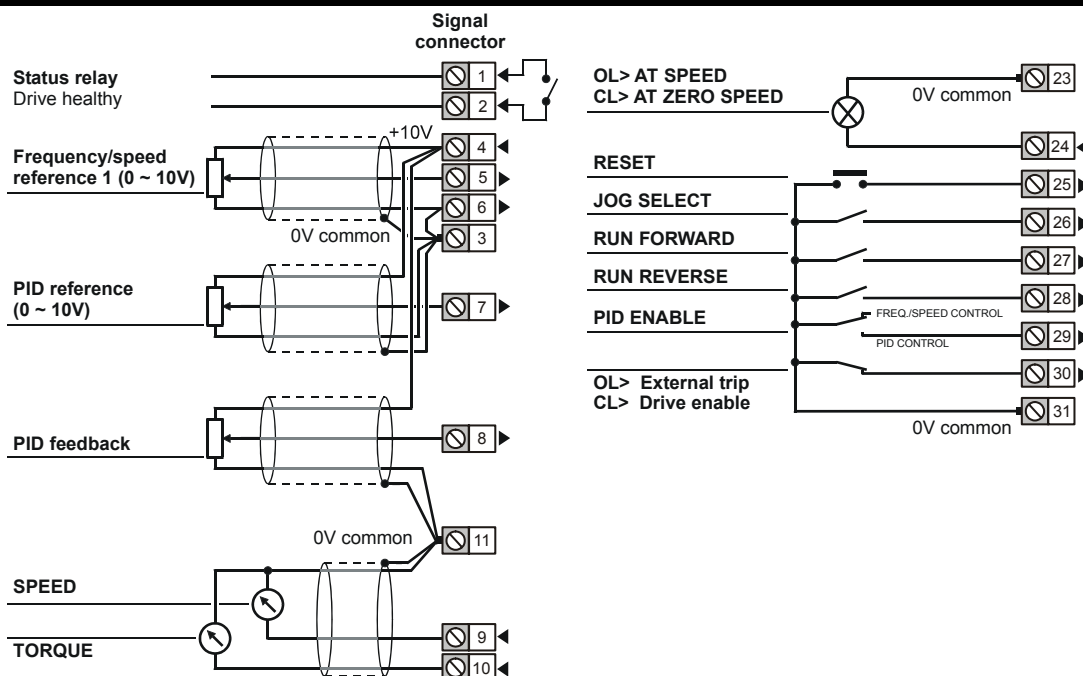
The Preset reference macro enables the use of preset references to control the speed of the motor via digital inputs. A digital input selects between an analog speed reference and the preset references.

Macro 4	Torque control	2004
---------	----------------	------

The Torque control macro configures the drive for use in Torque control mode, selectable via a digital input. Analog input 1 is configured for the torque reference. When in speed control analog 2 is the speed reference. When in torque control with the drive in closed loop mode analog input 2 is the speed override reference. Enabling torque mode with the drive in open loop mode will put the drive in to pure torque control. In closed loop mode the drive will be put in to torque control with speed override.

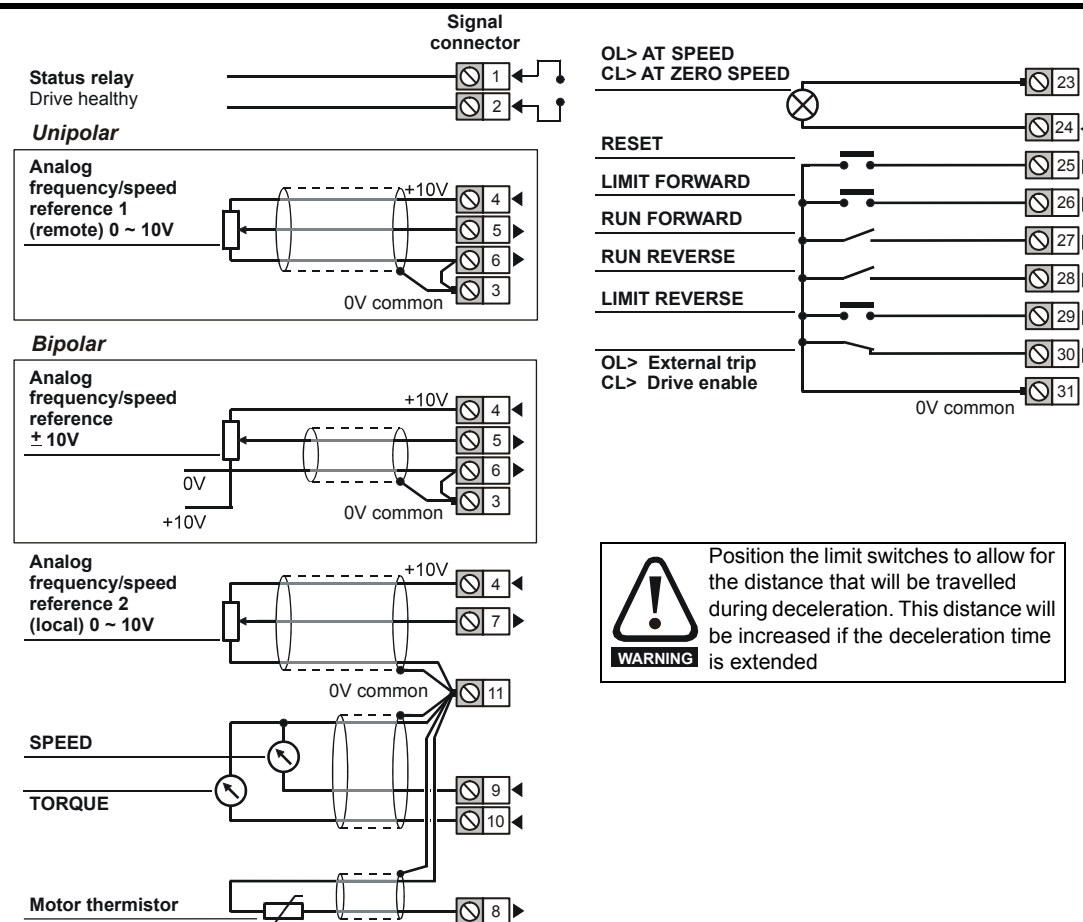
Macro 5	PID (set-point control)	2005
----------------	--------------------------------	-------------

The PID control macro enables the drive's own internal PID controller to control the speed of the motor. Analog input 1 is configured for the main speed reference, analog input 2 is the PID reference and analog input 3 is the PID feedback. A digital input selects between an analog speed reference and the PID control.



Macro 6	Axis-limit control	2006
----------------	---------------------------	-------------

The Axis limit control macro configures the drive for use with limit switches so that the drive is stopped when a position limit has been reached. The speed reference can be either unipolar or bipolar.



Macro 7	Brake control	2007
----------------	----------------------	-------------

The brake control macro configures the drive to apply or release a mechanical brake on a motor in a crane or hoist application. The drive issues a brake release signal via a digital output when the relevant conditions are met

Macro 8	Digital lock / shaft orientation	2008
----------------	---	-------------

This macro has two completely independent functions, digital lock and shaft orientation, selectable via Pr 0.15 {13.08}

Digital lock
The drive operates as a slave in a closed loop master-slave system. The slave motor is digitally locked to the master motor.

Shaft orientation
The motor speed is controlled in the same way as for default operation, but the motor shaft can be orientated to a specified angular position before and/or after running the motor.

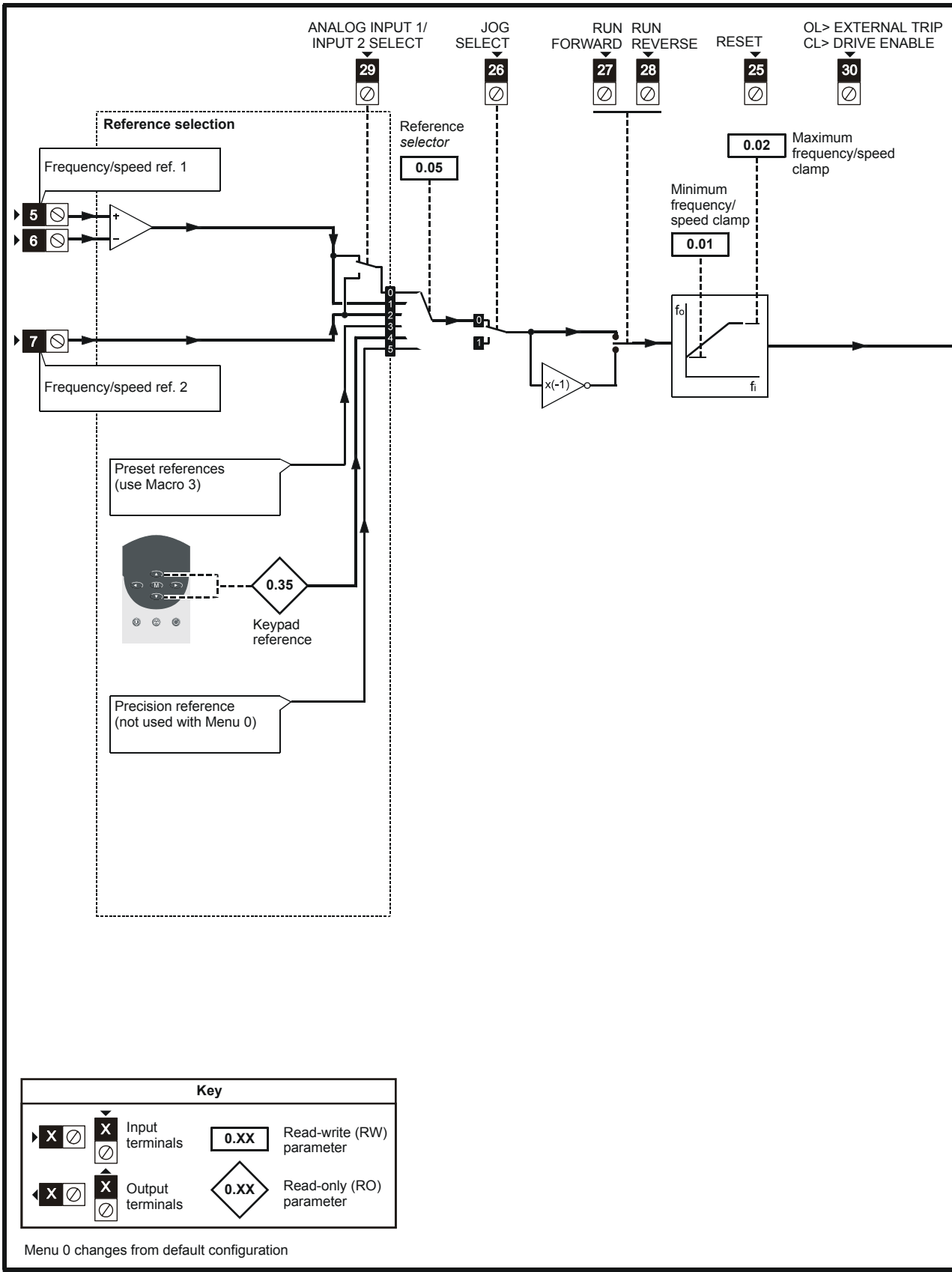
See Pr 13.08 in Chapter 10 *Advanced Parameters* for further information.

* Shaft orientation only
** Relative Jog when in Digital Lock mode

Pr 0.15	
0	Speed control
1	Rigid digital lock with feed forward
2	Rigid digital lock without feed forward
3	Non rigid digital lock with feed forward
4	Non rigid digital lock without feed forward
5	Orientate when stopping the drive
6	Orientate when enabling and stopping the drive

9.4 Macro logic diagrams and Menu 0 parameter changes

Figure 9-1 Macro 1 Easy mode logic diagram



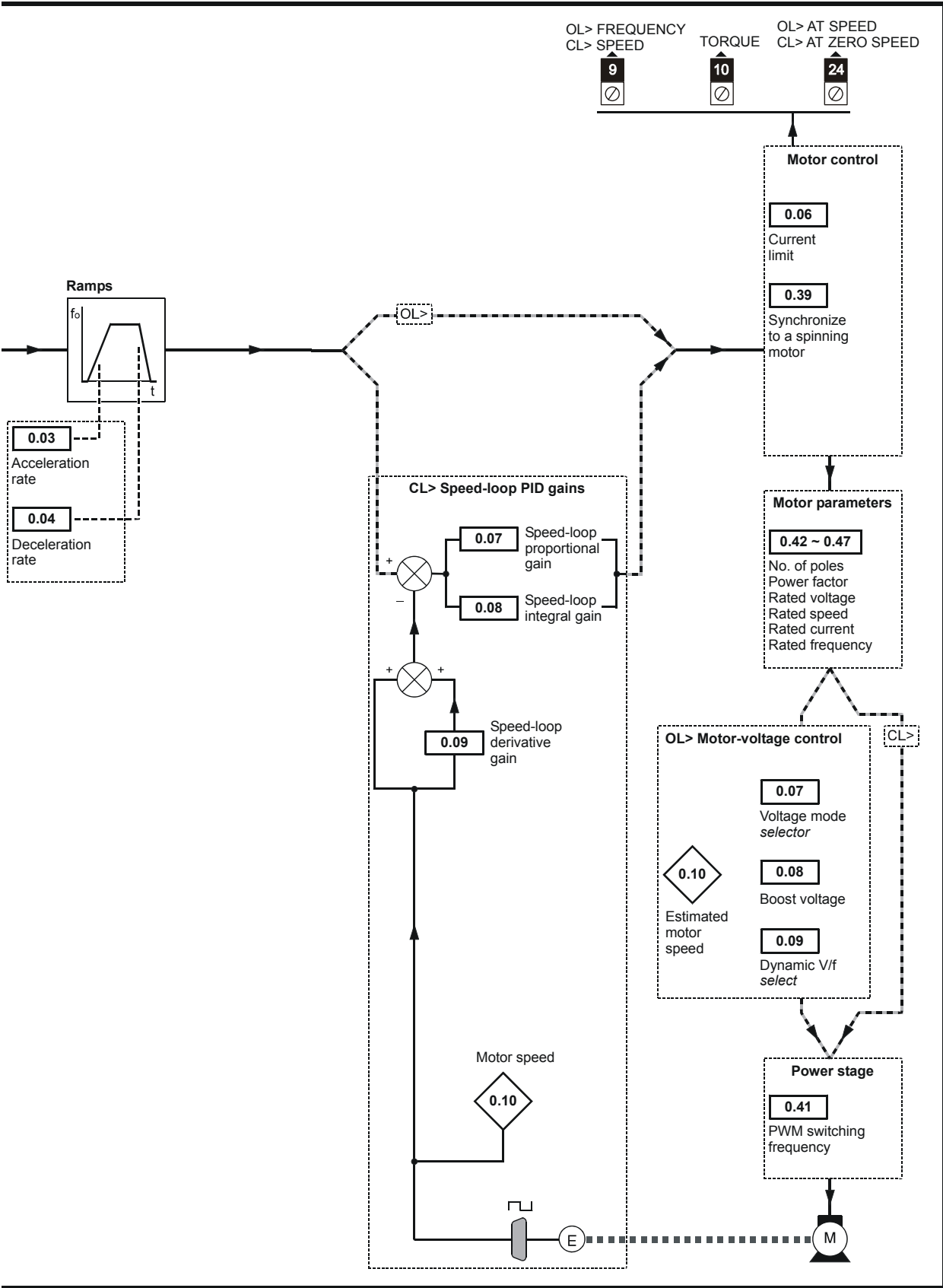
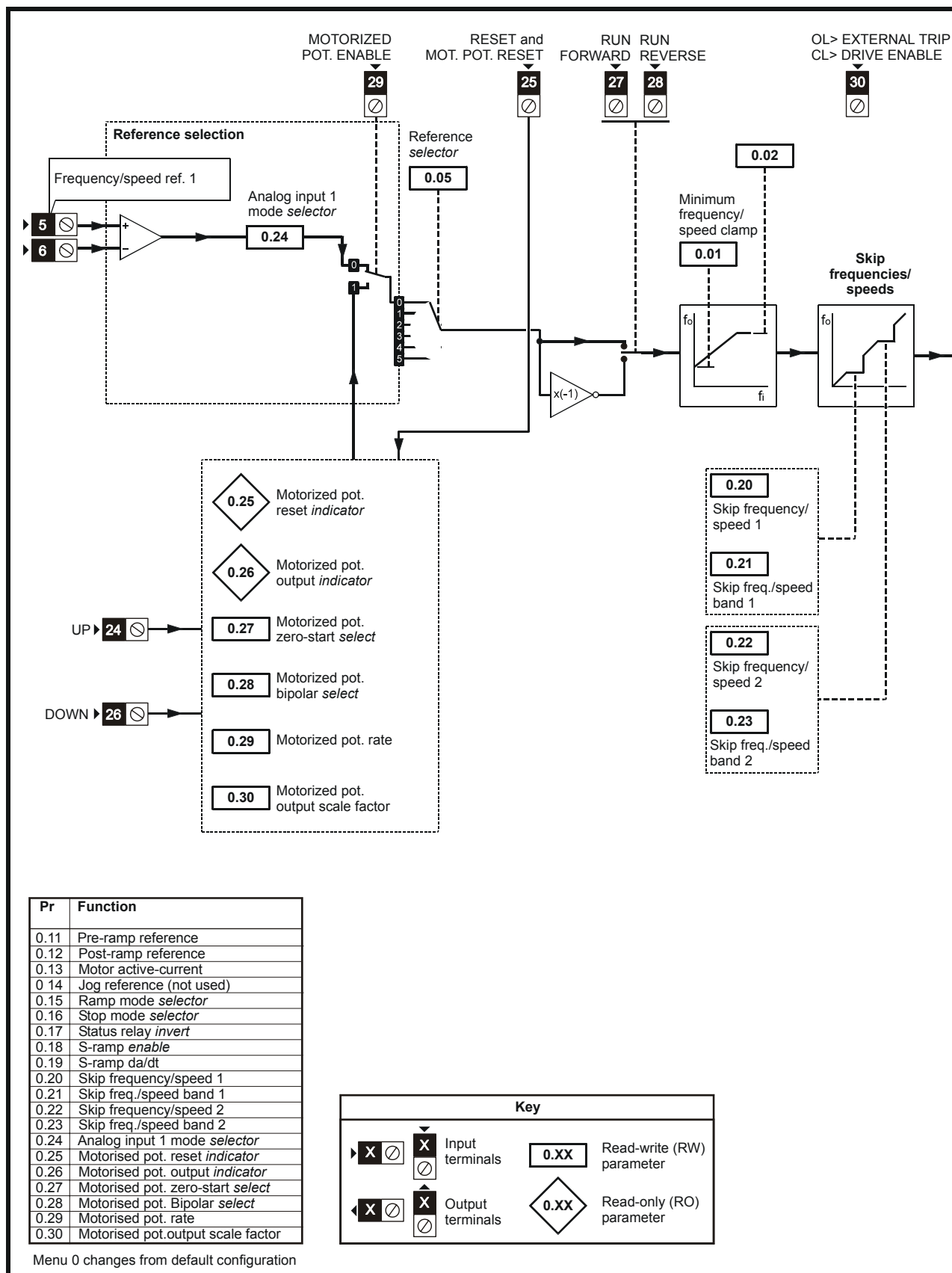


Figure 9-2 Macro 2 Motorised potentiometer logic diagram



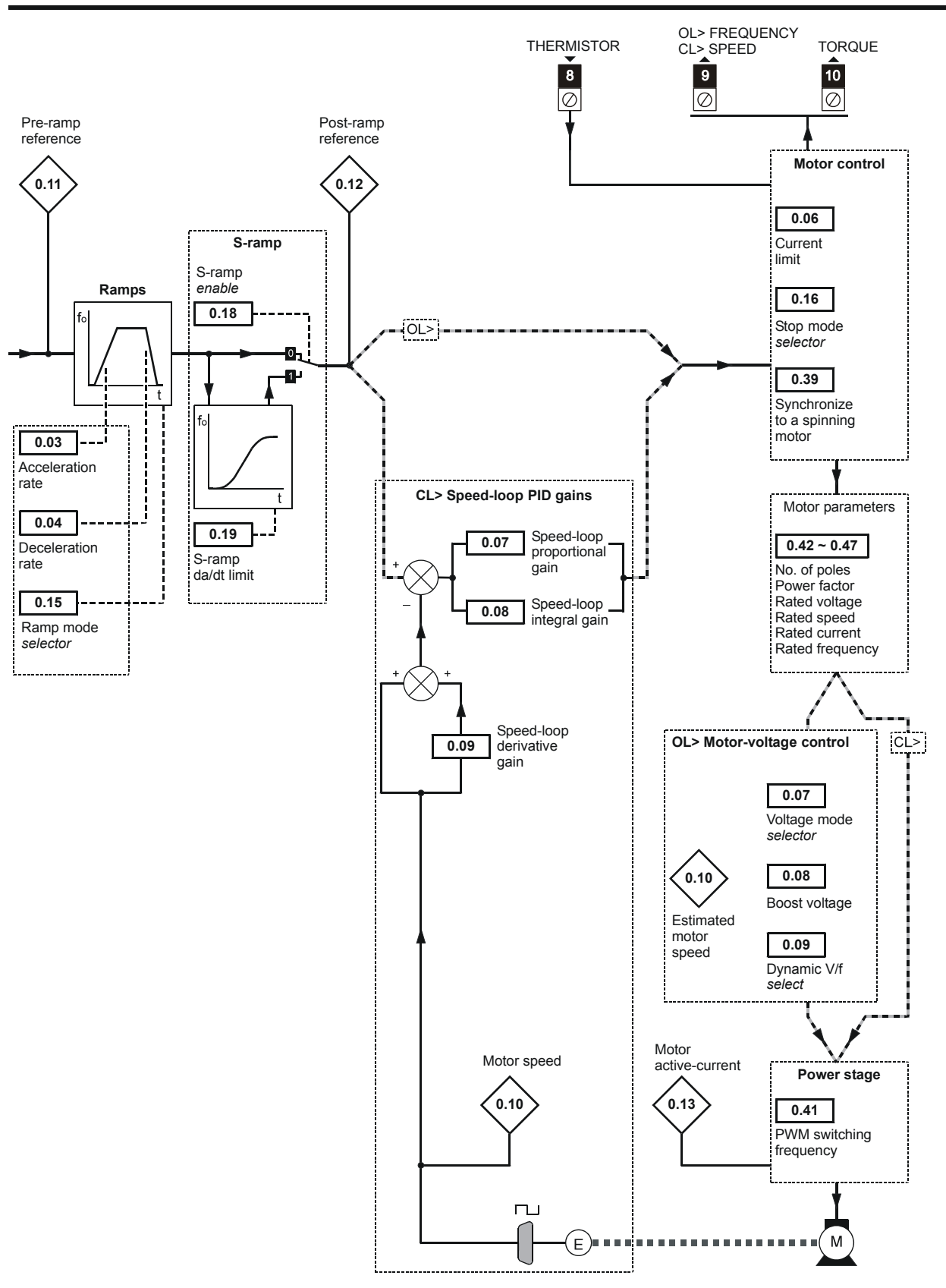
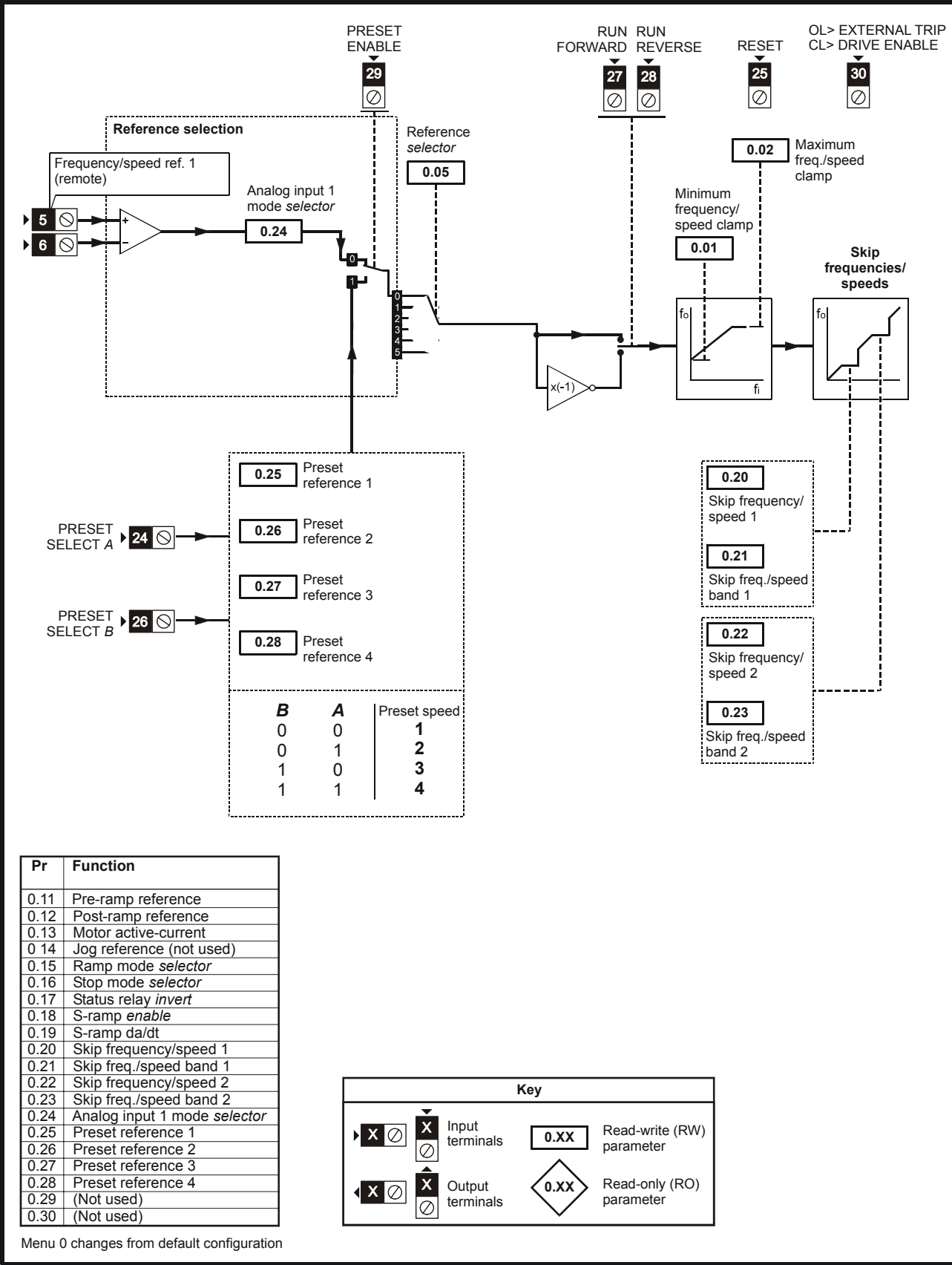


Figure 9-3 Macro 3 Preset speeds logic diagram



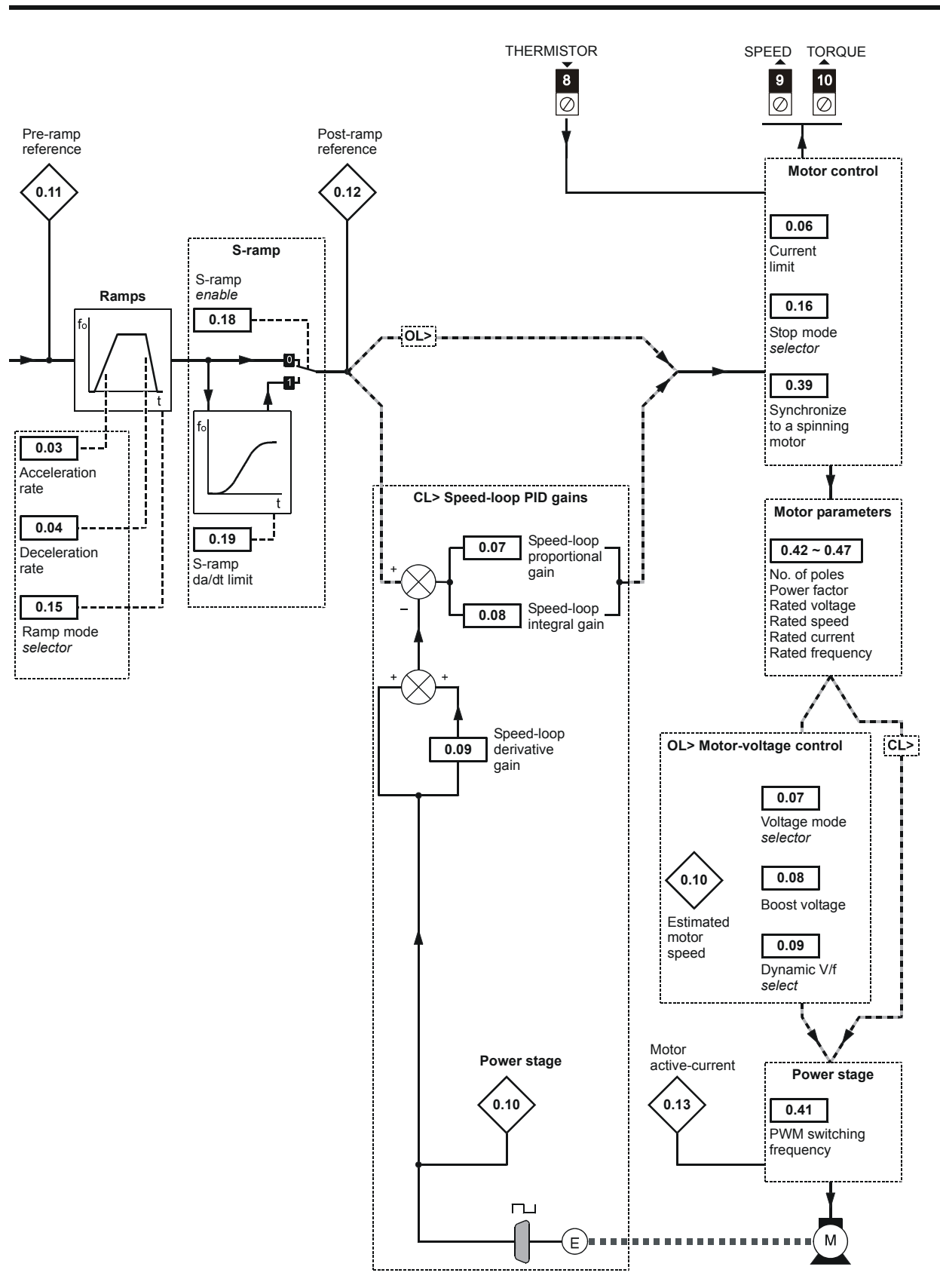
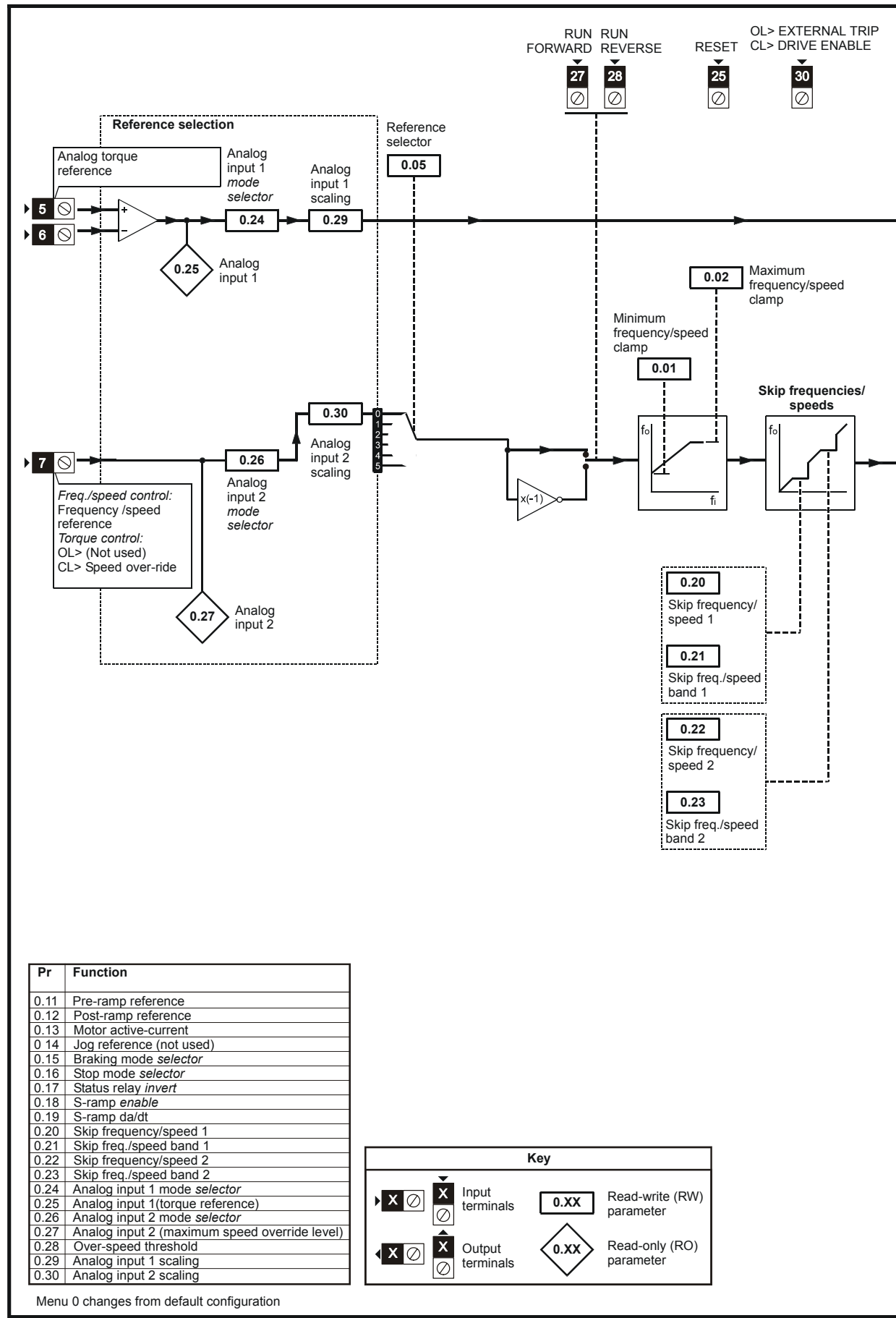


Figure 9-4 Macro 4 Torque control logic diagram



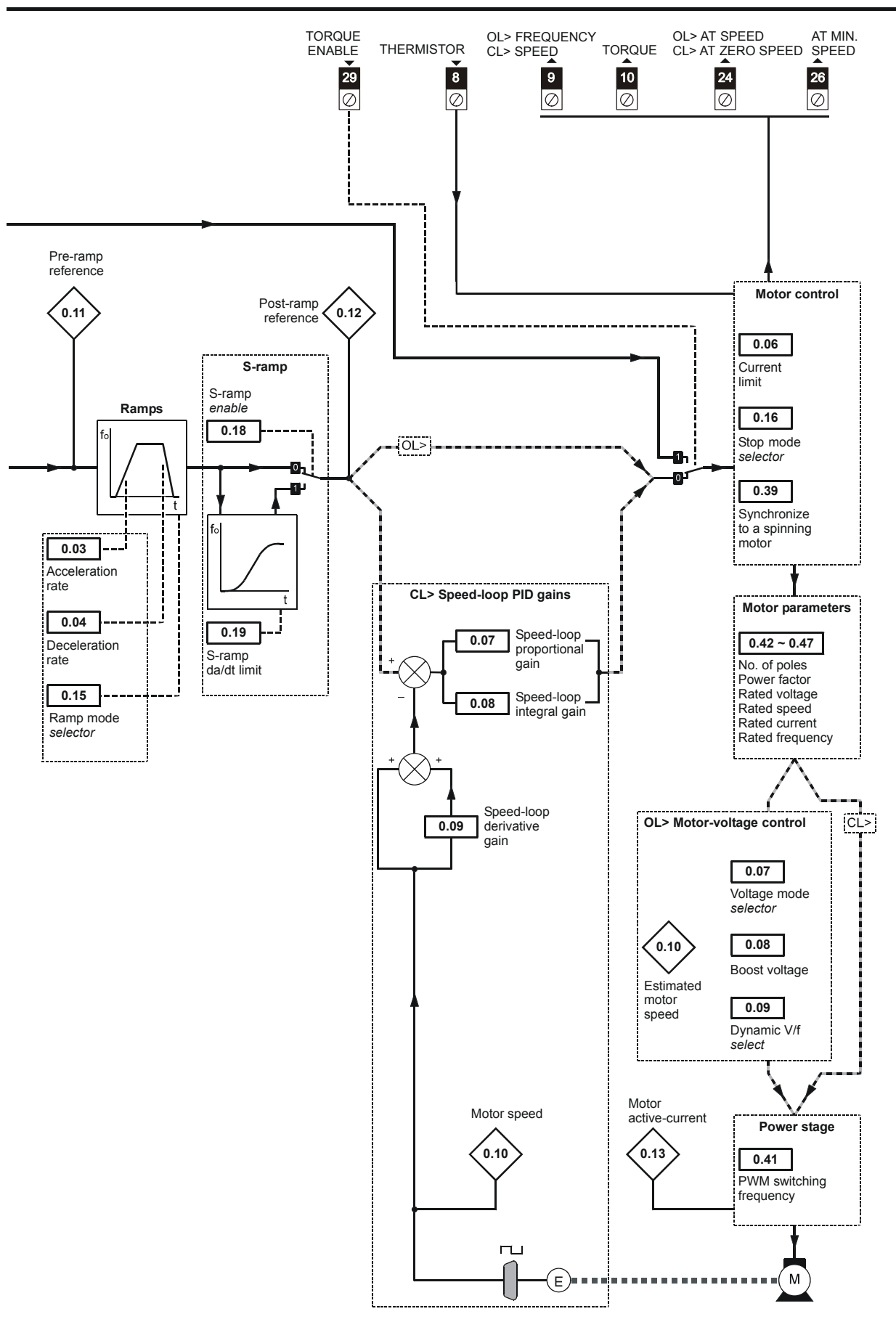
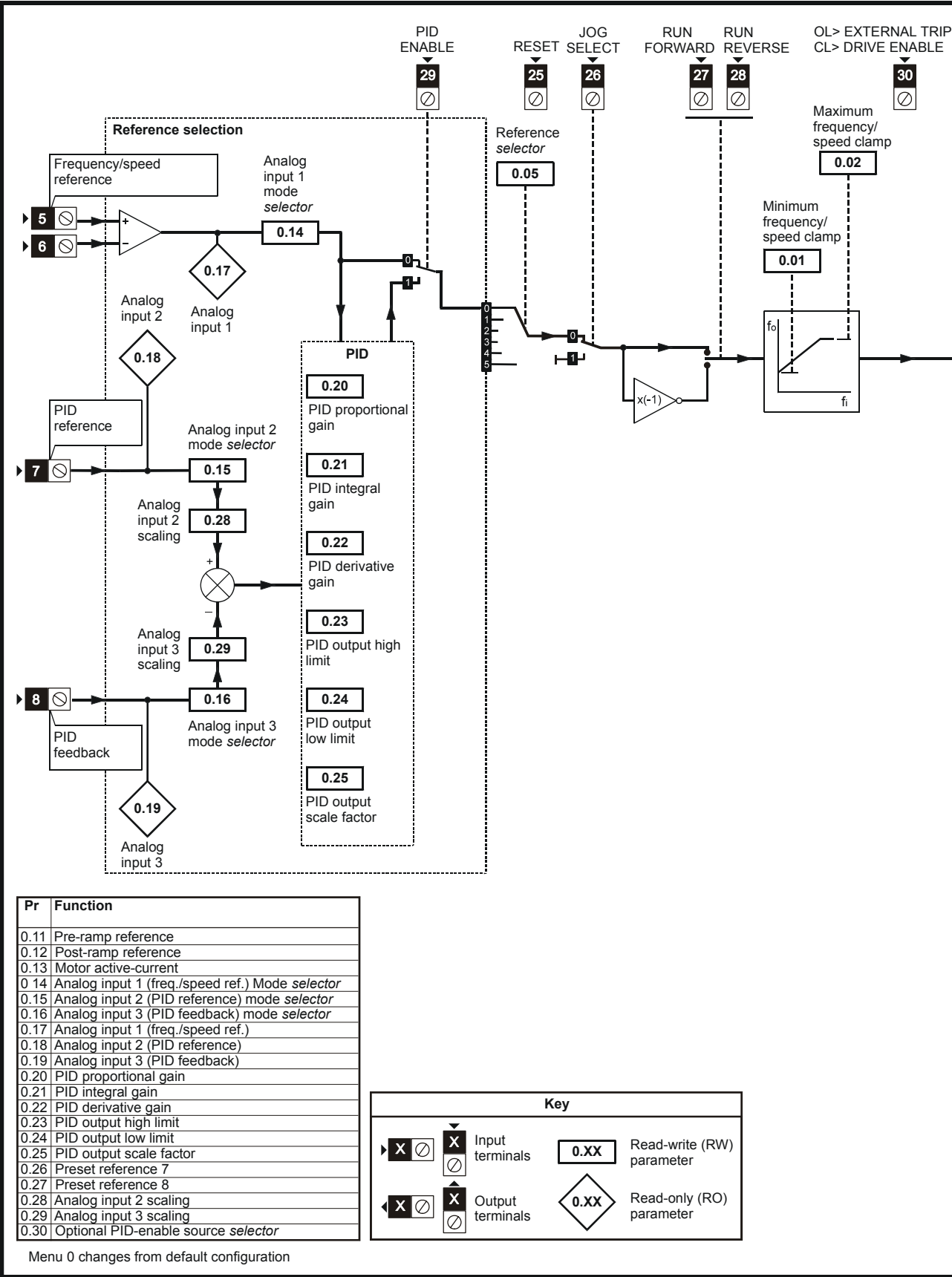


Figure 9-5 Macro 5 PID (set-point control) logic diagram



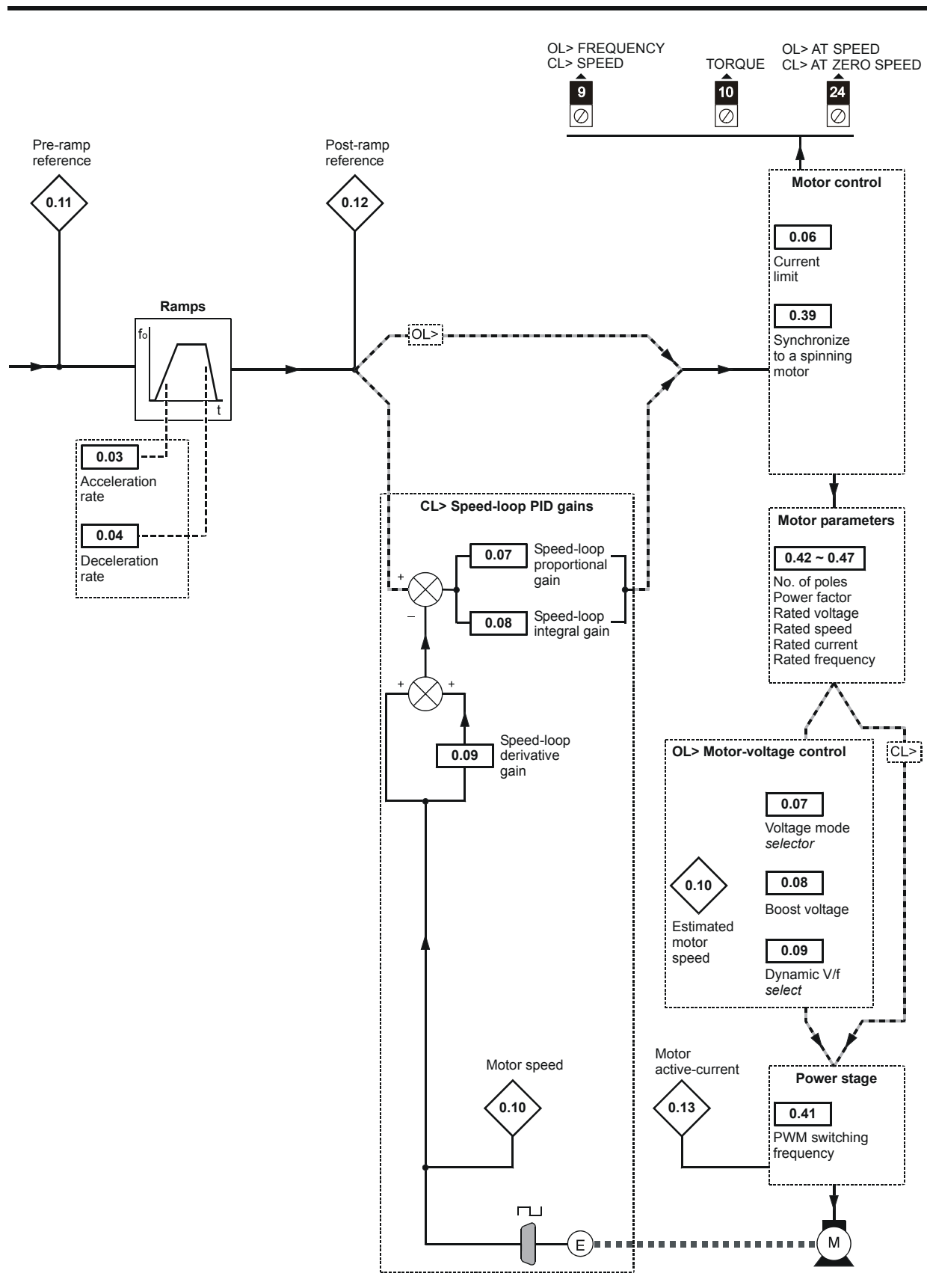
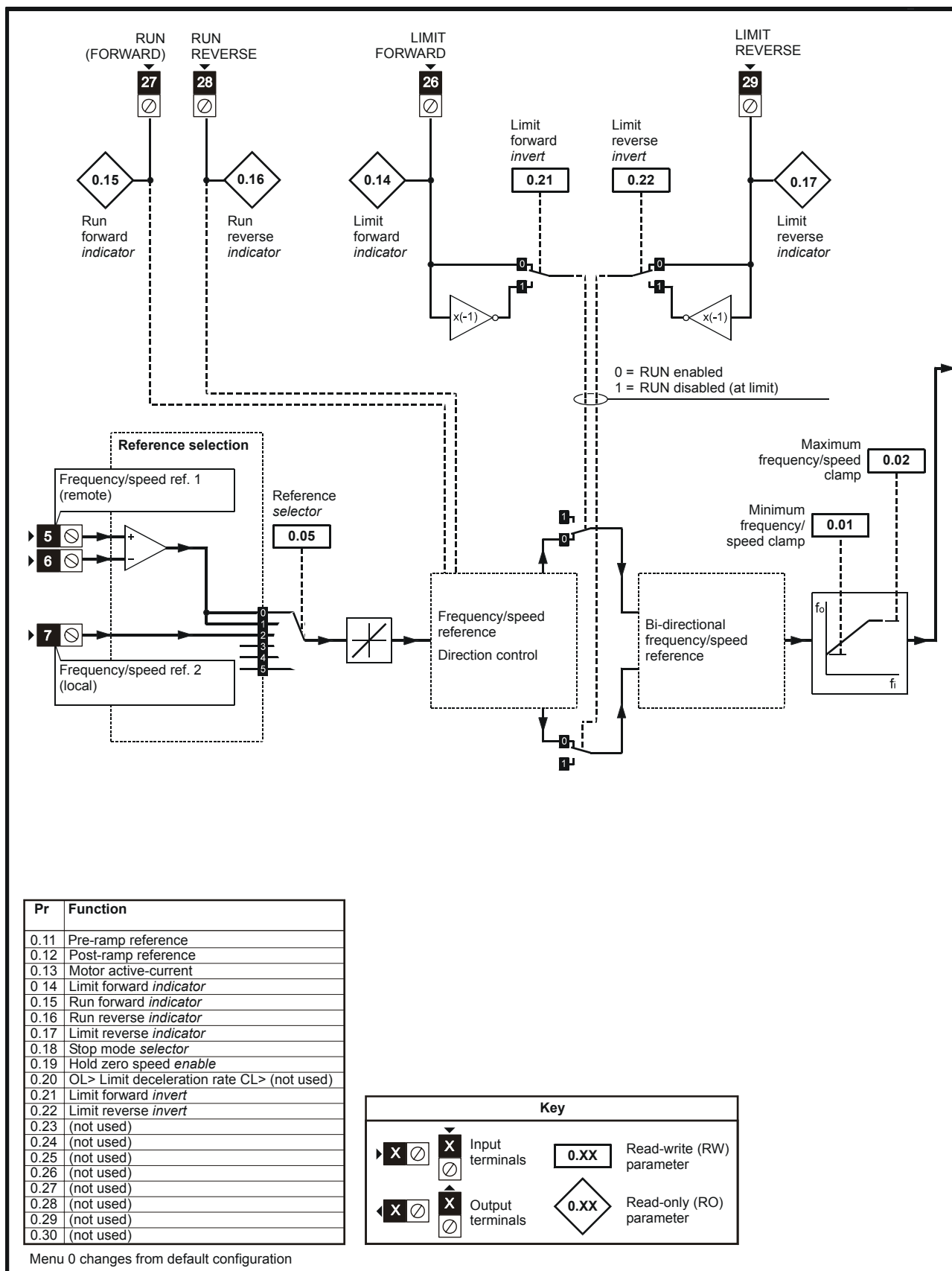


Figure 9-6 Macro 6 Axis-limit control logic diagram



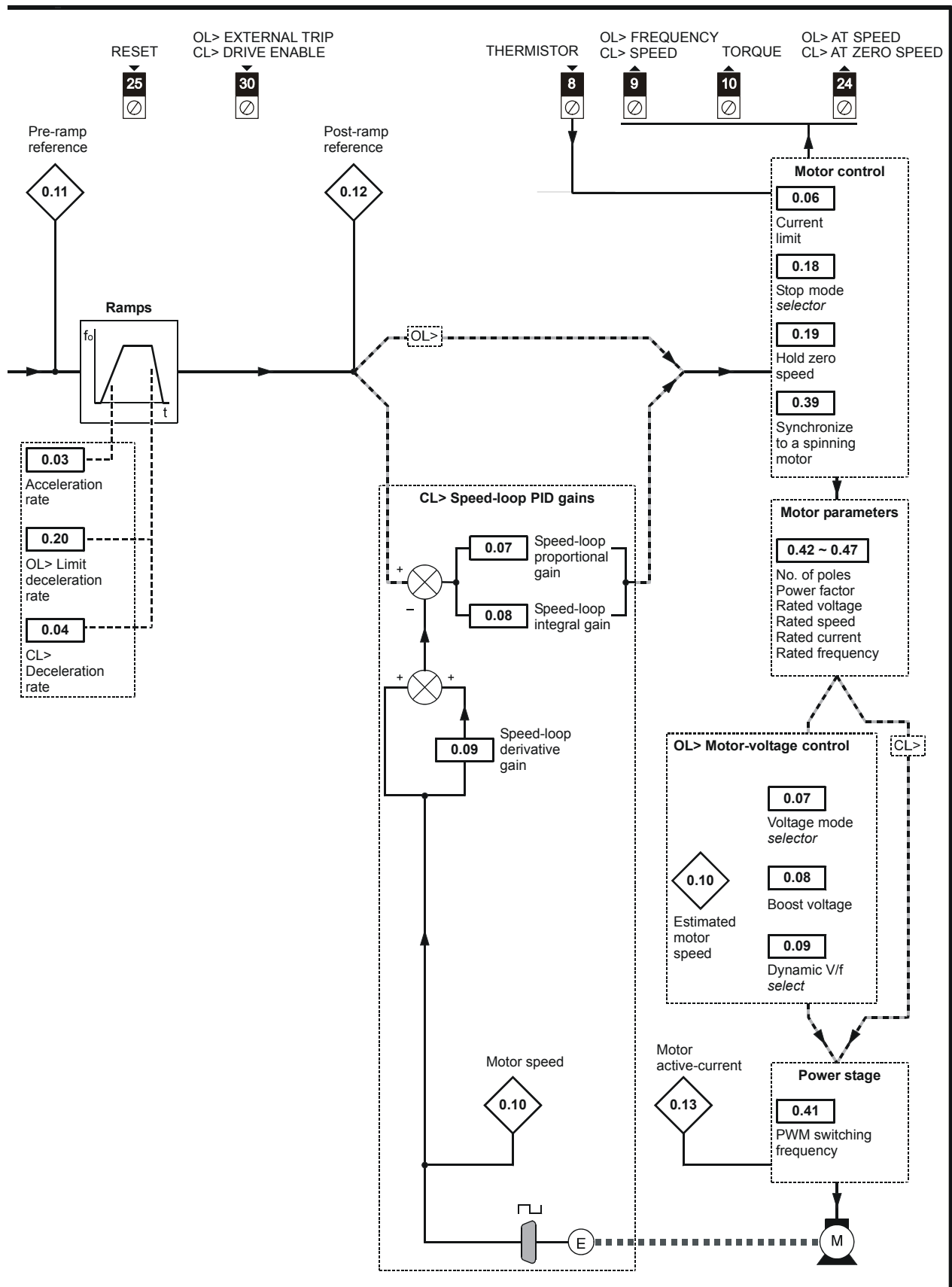
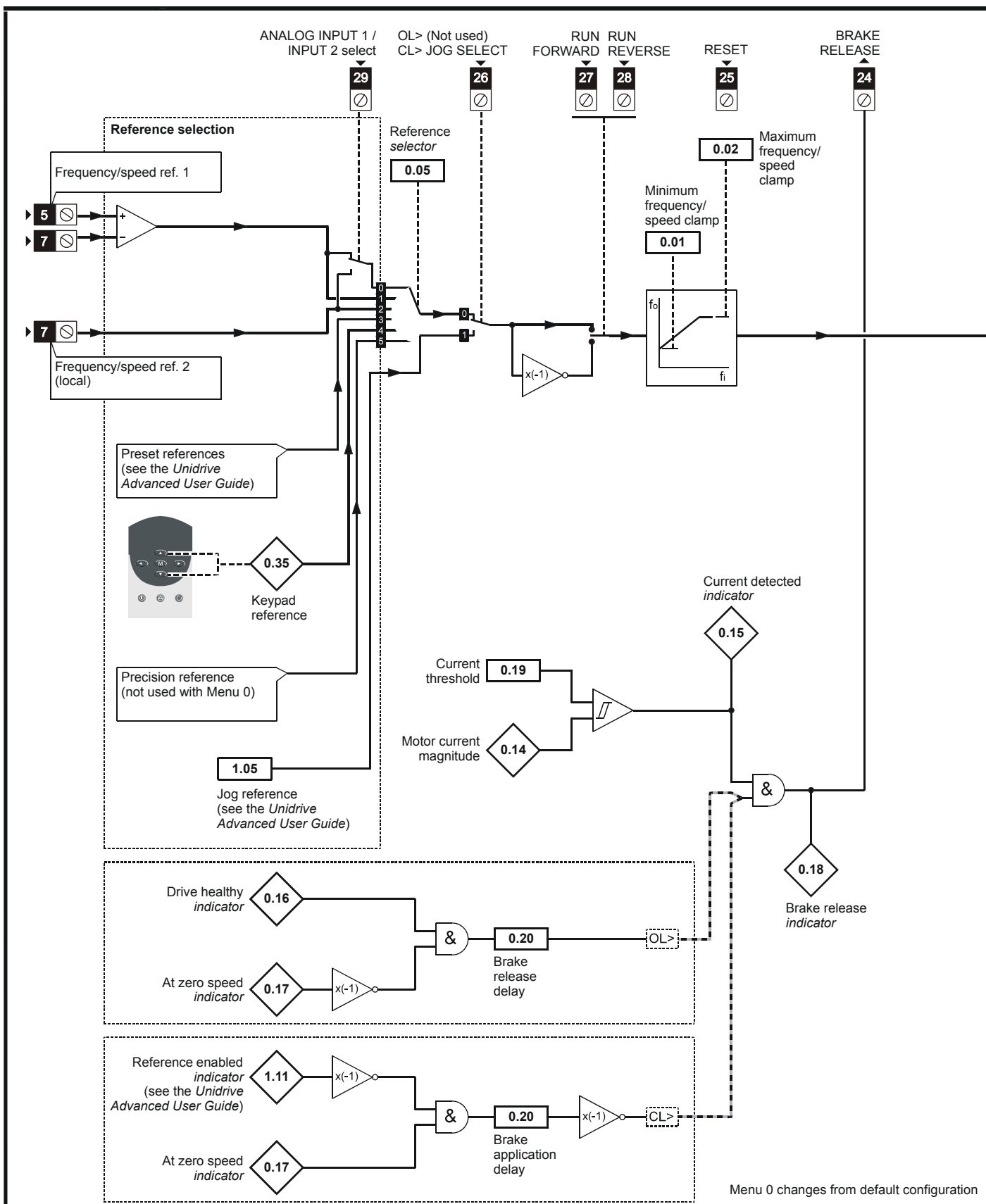
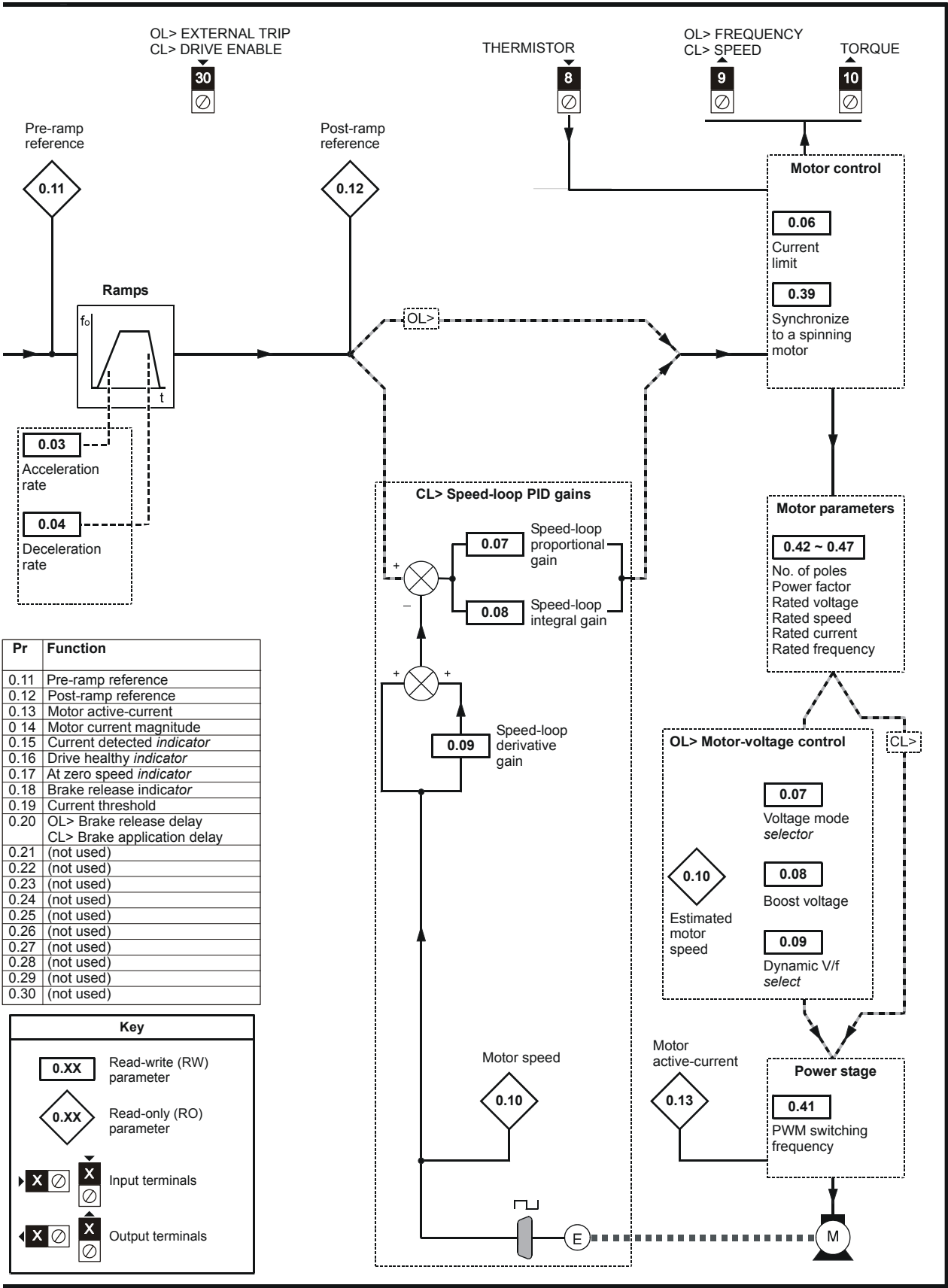
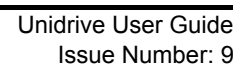
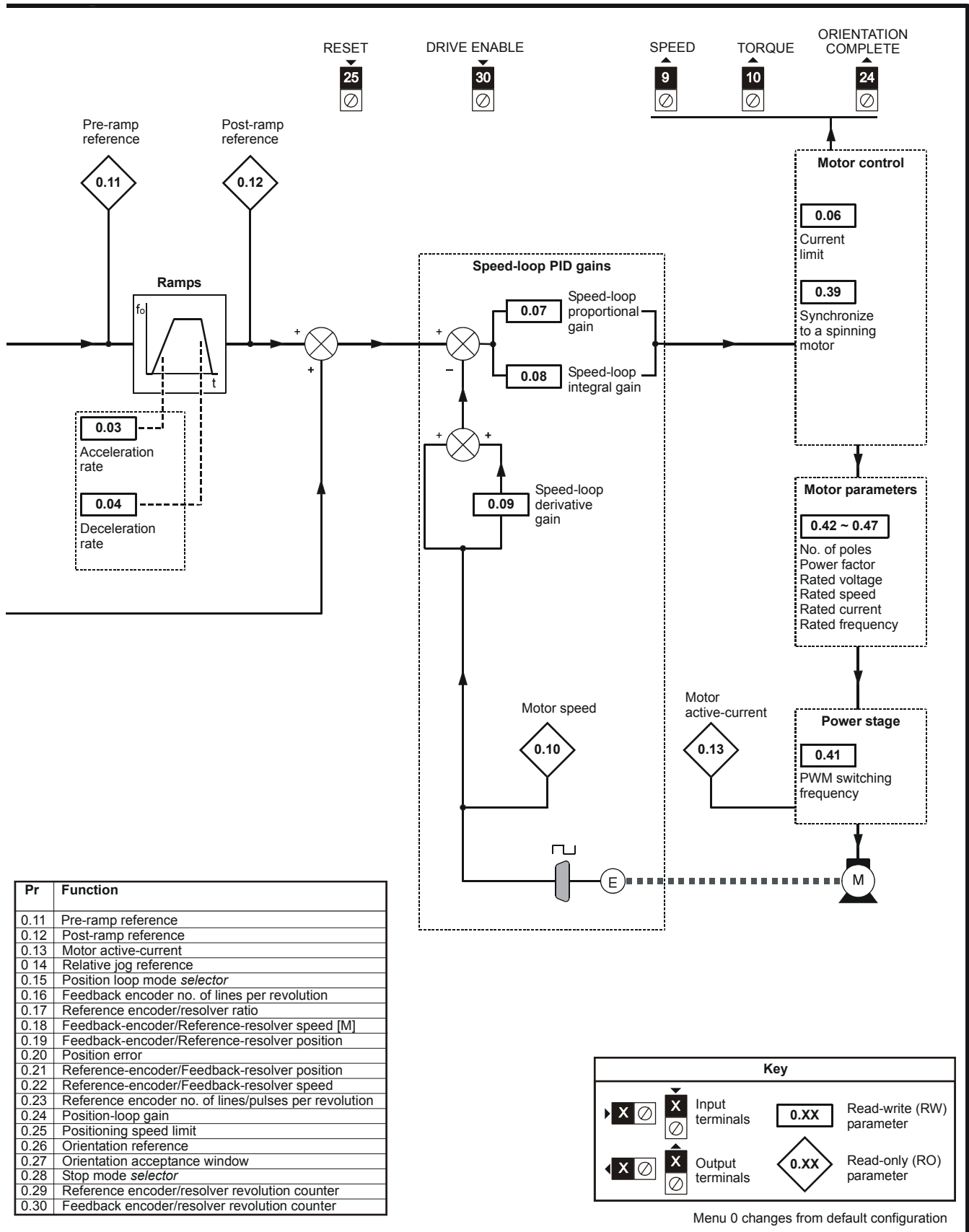


Figure 9-7 Macro 7 Brake Control logic diagram









9.5 Unidrive VTC macro differences

Only macros 1, 2, 3 and 5 can be used with Unidrive VTC.

The following highlights the macro terminal differences for Unidrive VTC.

Any terminal not listed below have the same function as open-loop Unidrive.

Macros 1 and 5

- Analog outputs 1 and 2 (terminals 9 and 10) are post ramp frequency and total current outputs rather than speed and torque outputs.
- USA> Digital output F1 (terminal 24) is drive running indicator rather than At speed.

Macros 2 and 3

- Analog outputs 1 and 2 (terminals 9 and 10) are post ramp frequency and total current outputs rather than speed and torque outputs.
- USA> Analog input 2 is configured as a 4-20mA input rather than a voltage input.

10 Advanced Parameters



These advanced parameters are listed for reference purposes only. The lists in this chapter do not include sufficient information for adjusting these parameters. Incorrect adjustment can affect the safety of the system, and damage the drive and or external equipment. Before attempting to adjust any of these parameters, refer to the *Unidrive Advanced User Guide*.

Menu number	Description
0	Commonly used basic set up parameters for quick / easy programming
1	Speed references and limits
2	Ramps (accel / decel)
3	Speed feedback / frequency slaving
4	Current control
5	Machine control
6	Sequencing logic
7	Analog I/O
8	Digital I/O
9	Programmable logic
10	Status flags / trip log
11	Menu 0 customisation / drive specific ratings
12	Programmable thresholds
13	Digital lock / orientation
14	Programmable PID function
15	Regen
16	Small option module set up
17	Large option module set up
18	Application menu 1
19	Application menu 2
20	Large option module set up

Operation mode abbreviations:

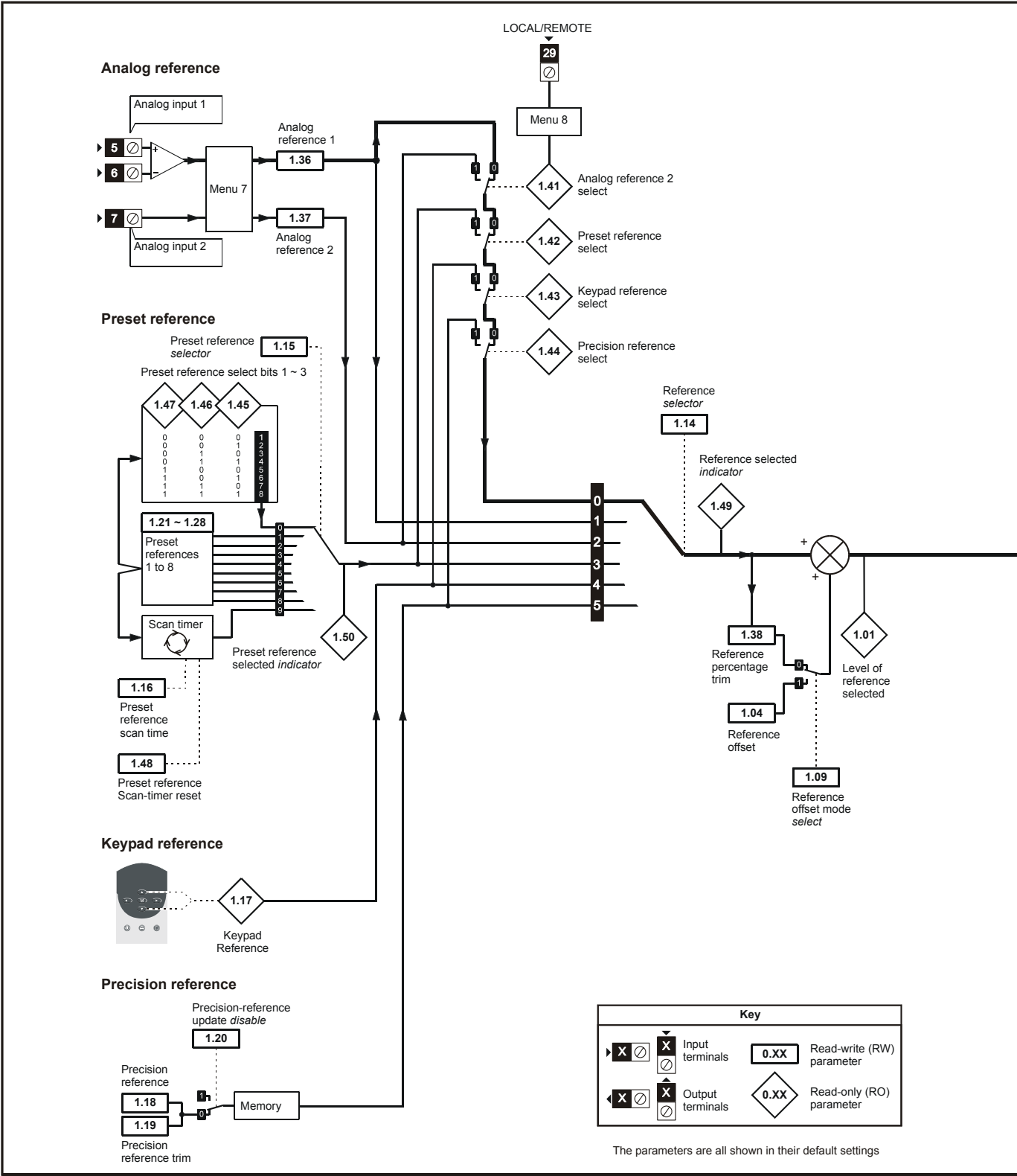
- OL> Open loop
- CL> Closed loop (which incorporates closed loop vector and servo mode)
- VT> Closed loop vector mode
- SV> Servo

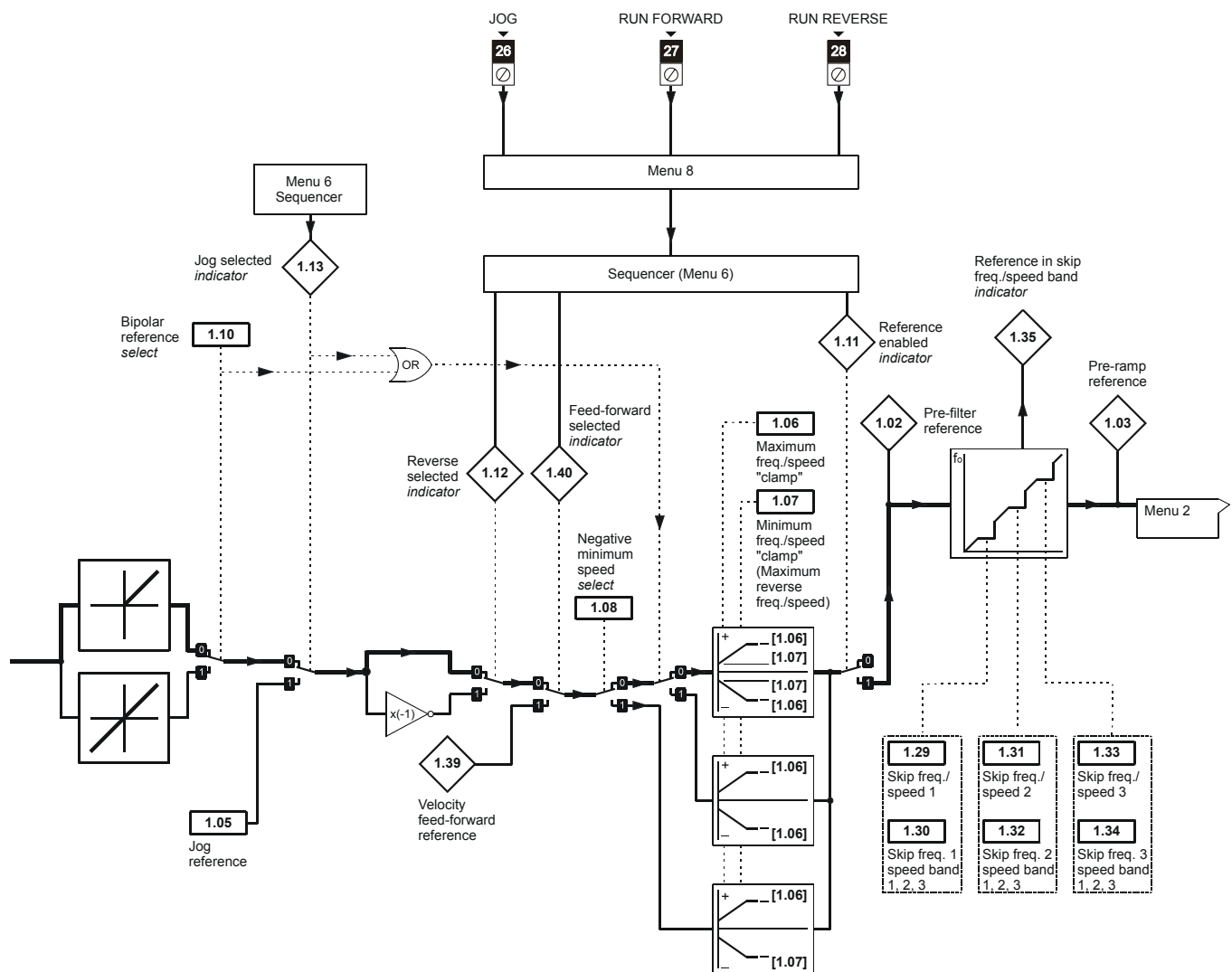
NOTE

- Parameter numbers shown in brackets {...} are the equivalent Menu 0 parameters. Some Menu 0 parameters appear twice since their function depends on the operating mode.
- The Range - CL column applies to both Closed-loop Vector and Closed-loop Servo. For some parameters, this column applies only to one of these modes; this is indicated accordingly in the Default columns.
- In some cases, the function or range of a parameter is affected by the setting of another parameter; the information in the lists relates to the default condition of such parameters.
- Some parameters have different ranges and/or default values between Unidrive VTC and open loop Unidrive. These differences are listed in section 10.21 *Unidrive VTC parameter range and default differences* on page 181.

10.1 Menu 1: Speed references and limits

Figure 10-1 Menu 1 logic diagram





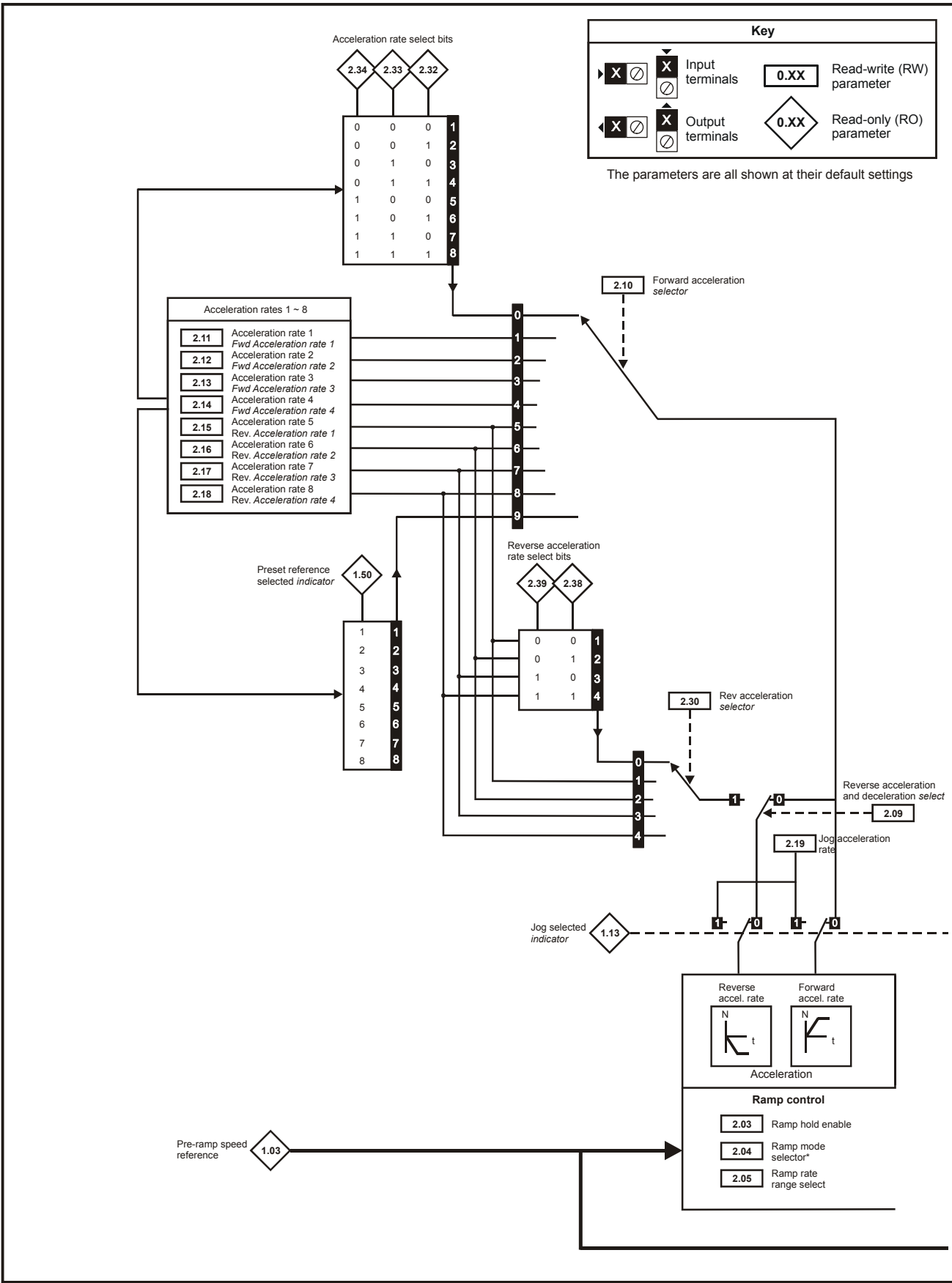
Parameter		Range(↕)		Default(⇒)			Type			
		OL	CL	OL	VT	SV				
1.01	Final reference	±1,000.0 Hz *	±30,000 rpm *				RO	Bi		P
1.02	Pre-filter reference	±1,000.0 Hz *	±30,000 rpm *				RO	Bi		P
1.03	Pre-ramp reference {0.11}	±1,000.0 Hz *	±30,000 rpm *				RO	Bi		P
1.04	Reference offset	±1,000.0 Hz	±30,000 rpm	0			RW	Bi		
1.05	Jog reference {0.14}	0 to 400.0 Hz	0 to 4,000 rpm	1.5	50		RW	Uni		
1.06	Maximum frequency/speed {0.02}	0 to 1,000.0 Hz	0 to 30,000 rpm	EUR> 50 USA> 60	EUR> 1,500 USA> 1,800	3,000	RW	Uni		
1.07	Minimum frequency/speed {0.01}	0 to [Pr 1.06], if Pr 1.08 = 0 -1,000 to 0 Hz, if Pr 1.08 = 1		0			RW	Bi		
1.08	Negative minimum speed select	0 or 1		0			RW	Bit		
1.09	Reference offset select	0 or 1		0			RW	Bit		
1.10	Bipolar reference select	0 or 1		0			RW	Bit		
1.11	Reference enabled indicator	0 or 1					RO	Bit		P
1.12	Reverse selected indicator	0 or 1					RO	Bit		P
1.13	Jog selected indicator	0 or 1					RO	Bit		P
1.14	Reference selector {0.05}	0 to 5		EUR> 0 USA> 4	0		RW	Uni		
1.15	Preset reference selector	0 to 9		0			RW	Uni		
1.16	Preset reference scan time	0 to 400.0 s		10			RW	Uni		
1.17	Keypad reference {0.35}	±1,000.0 Hz	±30,000 rpm	0			RO	Bi	S	P
1.18	Precision reference	±1,000.0 Hz	±30,000 rpm	0			RW	Bi		
1.19	Precision reference trim	0 to 0.099 Hz	0 to 0.99 rpm	0			RW	Uni		
1.20	Precision-reference update disable	0 or 1		0			RW	Bit		
1.21	Preset reference 1	±1,000.0 Hz	±30,000 rpm	0			RW	Bi		
1.22	Preset reference 2	±1,000.0 Hz	±30,000 rpm	0			RW	Bi		
1.23	Preset reference 3	±1,000.0 Hz	±30,000 rpm	0			RW	Bi		
1.24	Preset reference 4	±1,000.0 Hz	±30,000 rpm	0			RW	Bi		
1.25	Preset reference 5	±1,000.0 Hz	±30,000 rpm	0			RW	Bi		
1.26	Preset reference 6	±1,000.0 Hz	±30,000 rpm	0			RW	Bi		
1.27	Preset reference 7	±1,000.0 Hz	±30,000 rpm	0			RW	Bi		
1.28	Preset reference 8	±1,000.0 Hz	±30,000 rpm	0			RW	Bi		
1.29	Skip freq./speed 1 {0.20}	0 to 1,000.0 Hz	0 to 30,000 rpm	0			RW	Uni		
1.30	Skip band 1 {0.21}	0 to 5.0 Hz	0 to 50 rpm	0.5	5		RW	Uni		
1.31	Skip freq./speed 2 {0.22}	0 to 1,000.0 Hz	0 to 30,000 rpm	0			RW	Uni		
1.32	Skip band 2 {0.23}	0 to 5.0 Hz	0 to 50 rpm	0.5	5		RW	Uni		
1.33	Skip freq./speed 3	0 to 1,000.0 Hz	0 to 30,000 rpm	0			RW	Uni		
1.34	Skip band 3	0 to 5.0 Hz	0 to 50 rpm	0.5	5		RW	Uni		
1.35	Reference in skip-band indicator	0 or 1					RO	Bit		P
1.36	Analog reference 1	±1,000 Hz *	±30,000 rpm *				RO	Bi		
1.37	Analog reference 2	±1,000 Hz *	±30,000 rpm *				RO	Bi		
1.38	Reference percentage-trim	±100.0 %					RO	Bi		
1.39	Velocity feed-forward reference	±1,000.0 Hz	±30,000 rpm				RO	Bi		P
1.40	Feed-forward selected indicator	0 or 1					RO	Bit		P
1.41	Analog reference 2 selected indicator	0 or 1					RO	Bit		
1.42	Preset reference selected indicator	0 or 1					RO	Bit		
1.43	Keypad reference selected indicator	0 or 1					RO	Bit		
1.44	Precision reference selected indicator	0 or 1					RO	Bit		
1.45	Preset reference select bit 0 (LSB)	0 or 1					RO	Bit		
1.46	Preset reference select bit 1	0 or 1					RO	Bit		
1.47	Preset reference select bit 2 (MSB)	0 or 1					RO	Bit		
1.48	Scan-timer reset	0 or 1		0			RW	Bit		
1.49	Reference selected indicator	1 to 5					RO	Uni		P
1.50	Preset reference selected indicator	1 to 8					RO	Uni		P

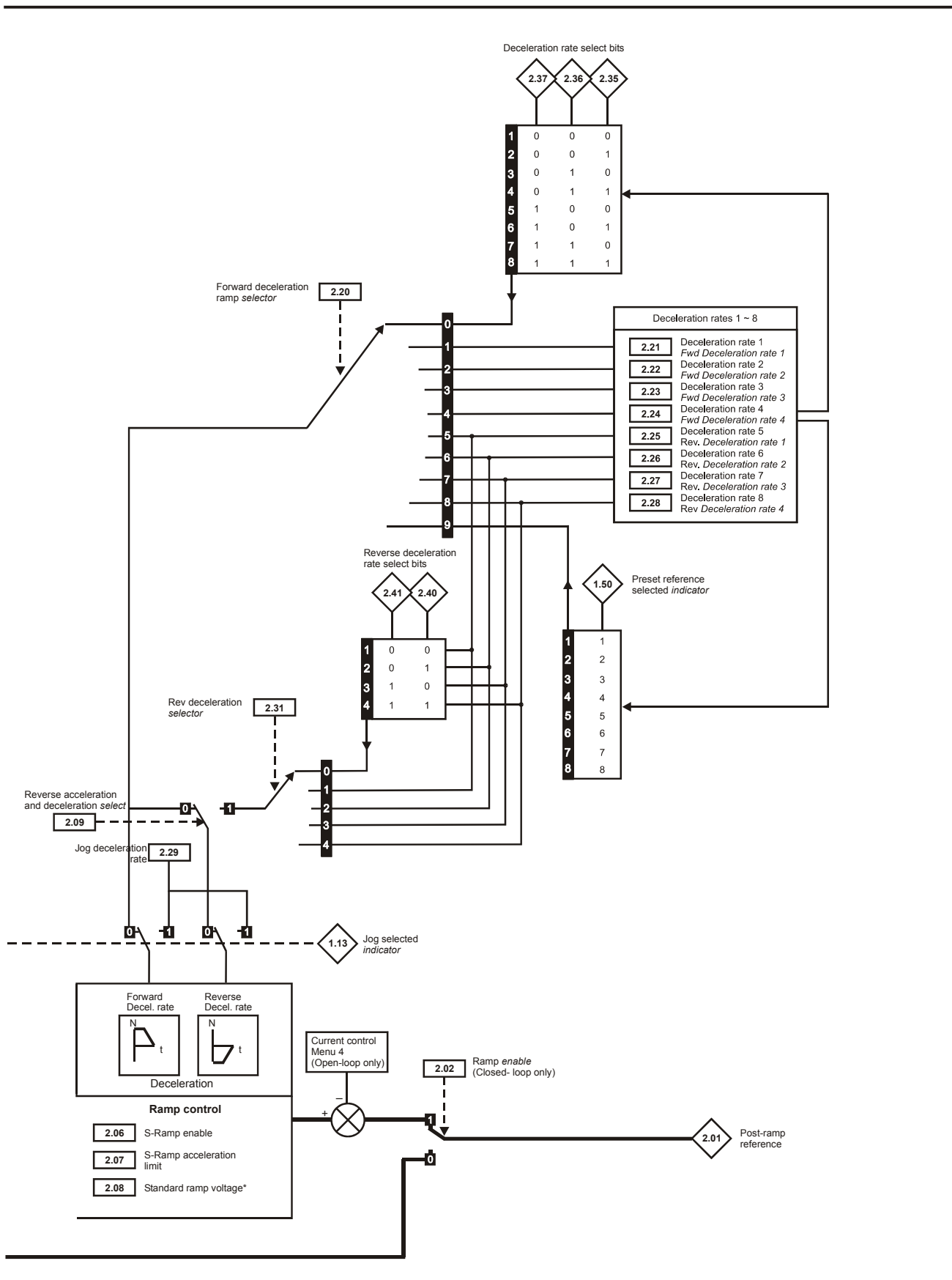
* The maximum value that can be used is limited to the larger value of Pr 1.06 and Pr 1.07.

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

10.2 Menu 2: Ramps (accel. / decel.)

Figure 10-2 Menu 2 logic diagram





Parameter		Range(⇅)		Default(⇨)			Type		
		OL	CL	OL	VT	SV			
2.01	Post-ramp reference {0.12}	±1,000 Hz *	±30,000 rpm *				RO	Bi	P
2.02	Ramp enable		0 or 1		1	0	RW	Bit	
2.03	Ramp hold enable		0 or 1		0		RW	Bit	
2.04	Ramp mode selector*** {0.15}		Std.Hd (0), FAST (1), Std.Ct (2)			Std.Ct (2)	RW	Txt	
2.05	Ramp-rate range select		0 or 1		0	1	RW	Bit	
2.06	S-ramp enable {0.18}		0 or 1		0		RW	Bit	
2.07	S-ramp da/dt {0.19}	0 to 3,000.0 s ² /100 Hz	0 to 30,000 s ² /1,000 rpm	3.1	1.5	0.03	RW	Uni	
2.08	Standard ramp voltage***		200V drive: 0 to 400 V 400V drive: 0 to 800 V			200V drive: 375 400V drive: EUR> 750, USA> 775	RW	Uni	
2.09	Reverse acceleration and deceleration select		0 or 1		0		RW	Bit	
2.10	Forward acceleration ramp selector		0 to 9		0		RW	Uni	
2.11	Acceleration rate 1 / Forward acceleration rate 1 {0.03}	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	5**	2	0.2	RW	Uni	
2.12	Acceleration rate 2 / Forward acceleration rate 2	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	5**	2	0.2	RW	Uni	
2.13	Acceleration rate 3 / Forward acceleration rate 3	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	5**	2	0.2	RW	Uni	
2.14	Acceleration rate 4 / Forward acceleration rate 4	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	5**	2	0.2	RW	Uni	
2.15	Acceleration rate 5 / Reverse acceleration rate 1	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	5**	2	0.2	RW	Uni	
2.16	Acceleration rate 6 / Reverse acceleration rate 2	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	5**	2	0.2	RW	Uni	
2.17	Acceleration rate 7 / Reverse acceleration rate 3	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	5**	2	0.2	RW	Uni	
2.18	Acceleration rate 8 / Reverse acceleration rate 4	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	5**	2	0.2	RW	Uni	
2.19	Jog acceleration rate	0 to 3,200.0 s/100Hz	VT>0 to 32.0 s/1,000rpm SV>0 to 32,000 s/1,000rpm	0.2		0	RW	Uni	
2.20	Forward deceleration ramp selector		0 to 9		0		RW	Uni	
2.21	Deceleration rate 1 / Forward deceleration rate 1 {0.04}	0 to 3,200.0 s/100Hz	VT> 0 to 32,000 s/1000rpm SV> 0 to 32,000 s/1000rpm	10**	2	0.2	RW	Uni	
2.22	Deceleration rate 2 / Forward deceleration rate 2	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	10**	2	0.2	RW	Uni	
2.23	Deceleration rate 3 / Forward deceleration rate 3	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	10**	2	0.2	RW	Uni	
2.24	Deceleration rate 4 / Forward deceleration rate 4	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	10**	2	0.2	RW	Uni	
2.25	Deceleration rate 5 / Reverse deceleration rate 1	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	10**	2	0.2	RW	Uni	
2.26	Deceleration rate 6 / Reverse deceleration rate 2	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	10**	2	0.2	RW	Uni	
2.27	Deceleration rate 7 / Reverse deceleration rate 3	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	10**	2	0.2	RW	Uni	
2.28	Deceleration rate 8 / Reverse deceleration rate 4	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	10**	2	0.2	RW	Uni	
2.29	Jog deceleration rate	0 to 3,200.0 s/100Hz	VT> 0 to 3,200 SV> 0 to 32,000 s/1,000rpm	0.2		0	RW	Uni	
2.30	Rev acceleration selector		0 to 4		0		RW	Uni	P
2.31	Rev deceleration selector		0 to 4		0		RW	Uni	P
2.32	Forward acceleration select bit 0 (LSB)		0 or 1		0		RO	Bit	
2.33	Forward acceleration select bit 1		0 or 1		0		RO	Bit	
2.34	Forward acceleration select bit 2 (MSB)		0 or 1		0		RO	Bit	
2.35	Forward deceleration select bit 0 (LSB)		0 or 1		0		RO	Bit	
2.36	Forward deceleration select bit 1		0 or 1		0		RO	Bit	
2.37	Forward deceleration select bit 2 (MSB)		0 or 1		0		RO	Bit	
2.38	Reverse acceleration select bit 0 (LSB)		0 or 1		0		RO	Bit	
2.39	Reverse acceleration select bit 1 (MSB)		0 or 1		0		RO	Bit	
2.40	Reverse deceleration select bit 0 (LSB)		0 or 1		0		RO	Bit	
2.41	Reverse deceleration select bit 1 (MSB)		0 or 1		0		RO	Bit	

* The maximum value that can be used is limited to the larger value of Pr 1.06 and Pr 1.07.

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

** These parameters have a default setting of 60s in the VTC variant.

*** For more info, see section 10.22.1 *Braking modes* on page 182.

NOTE

Where a parameter is represented by a text value, the value in brackets in the range column is the setting used for serial communications.

10.3 Menu 3: Speed feedback / frequency slaving

Figure 10-3 Menu 3 Open-loop logic diagram

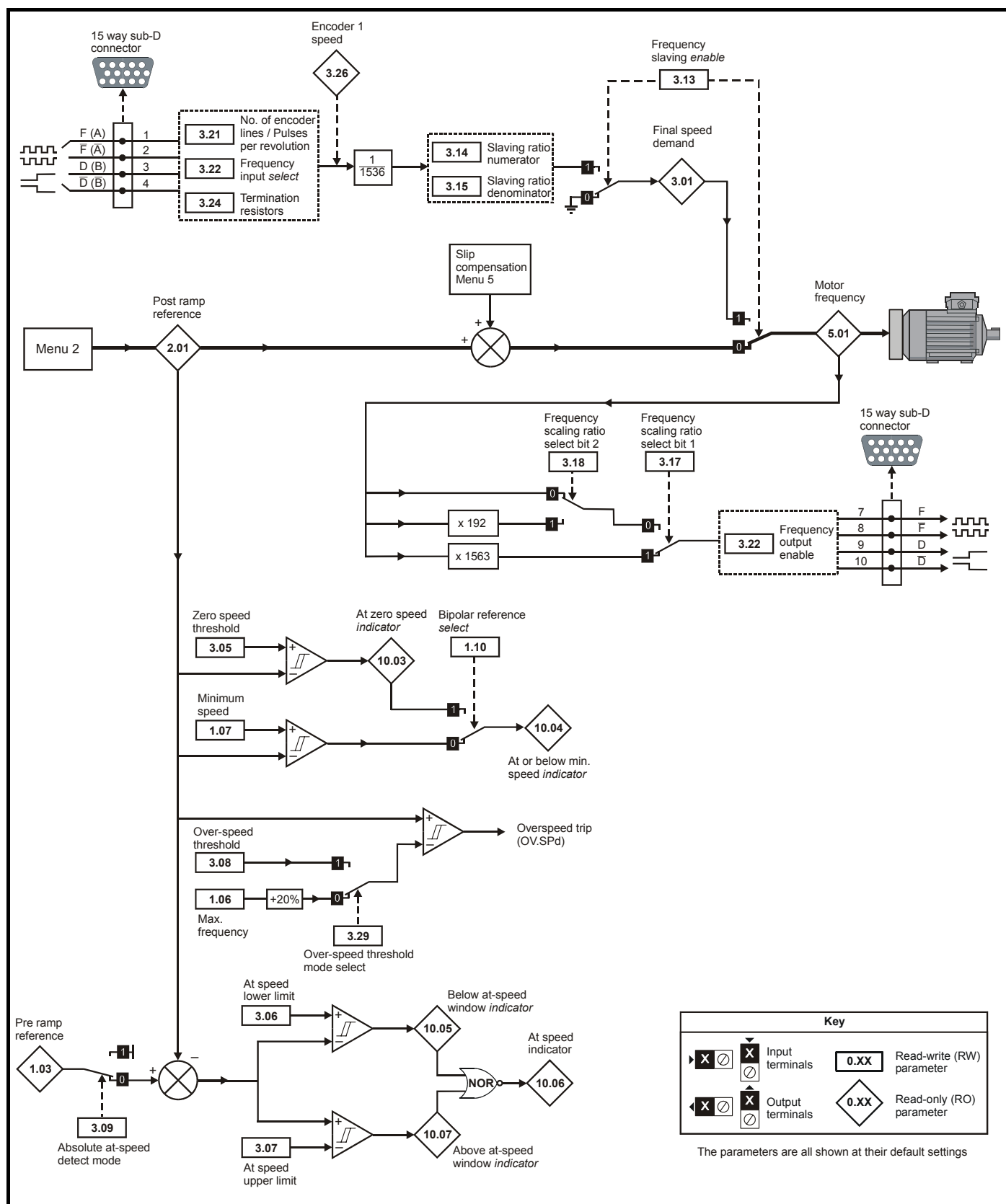
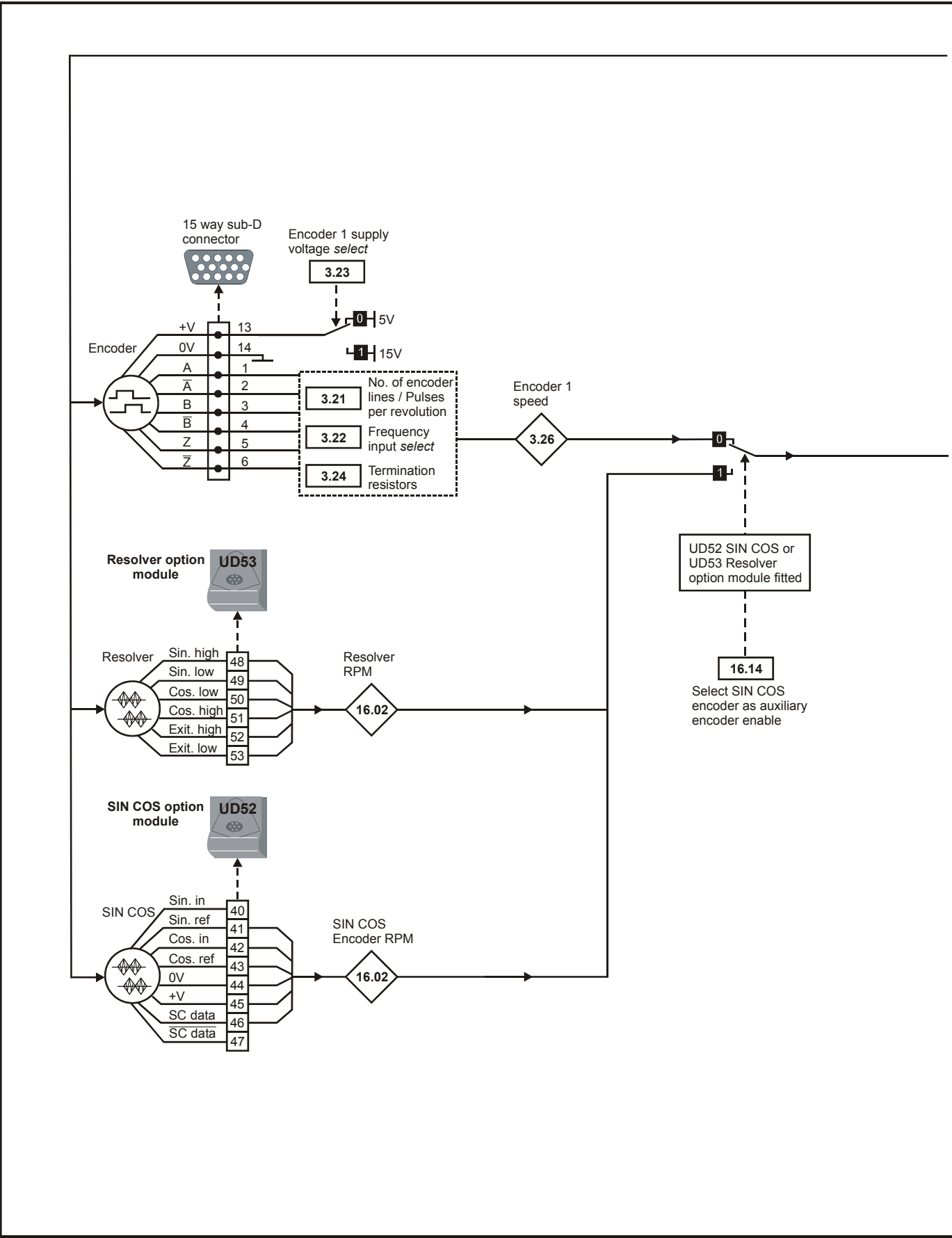
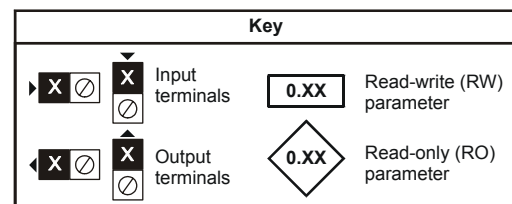
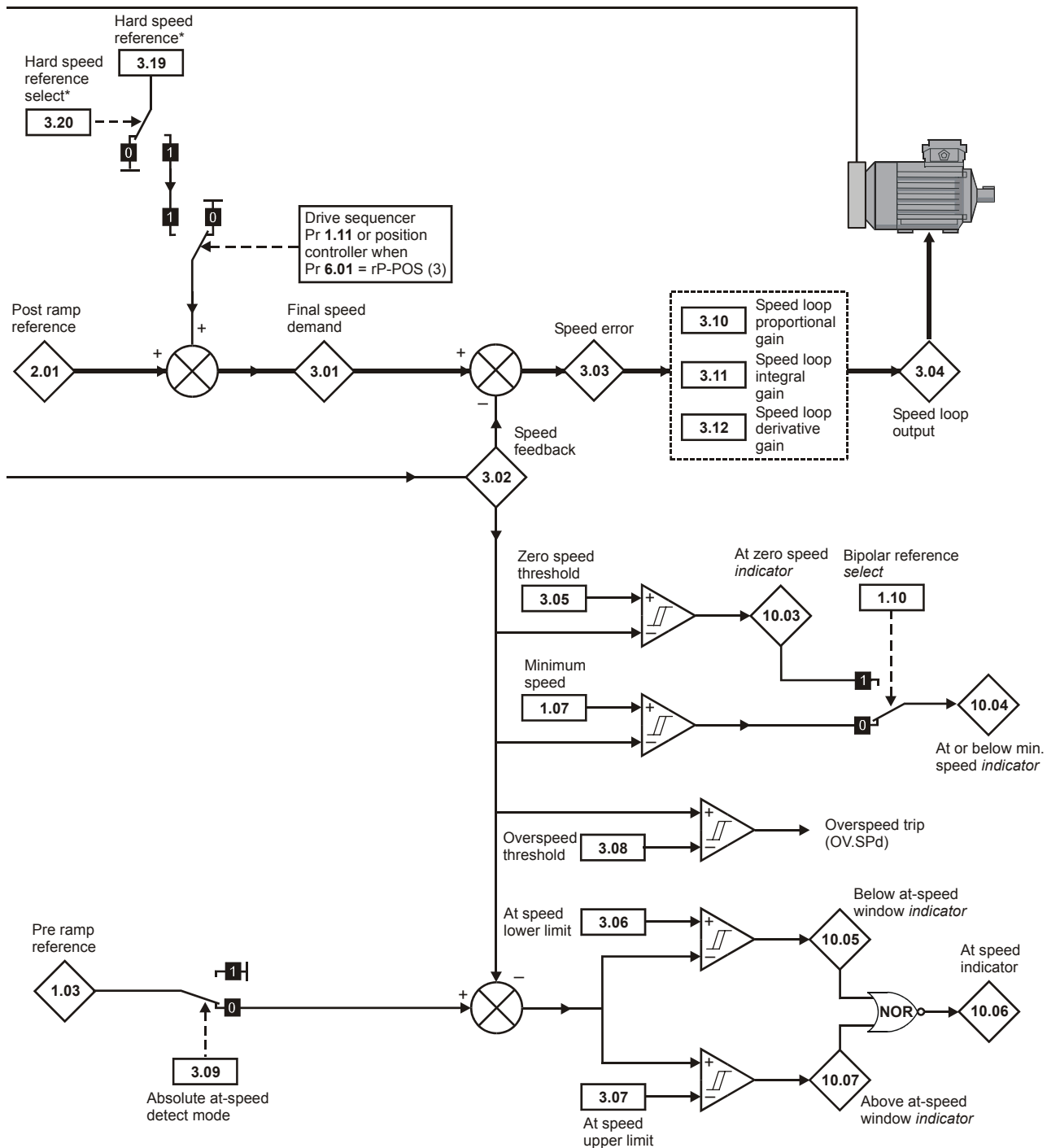


Figure 10-4 Menu 3 Closed-loop logic diagram





The parameters are all shown at their default settings

* For more information, refer to section 10.22.8 *Position loop modes* on page 188.

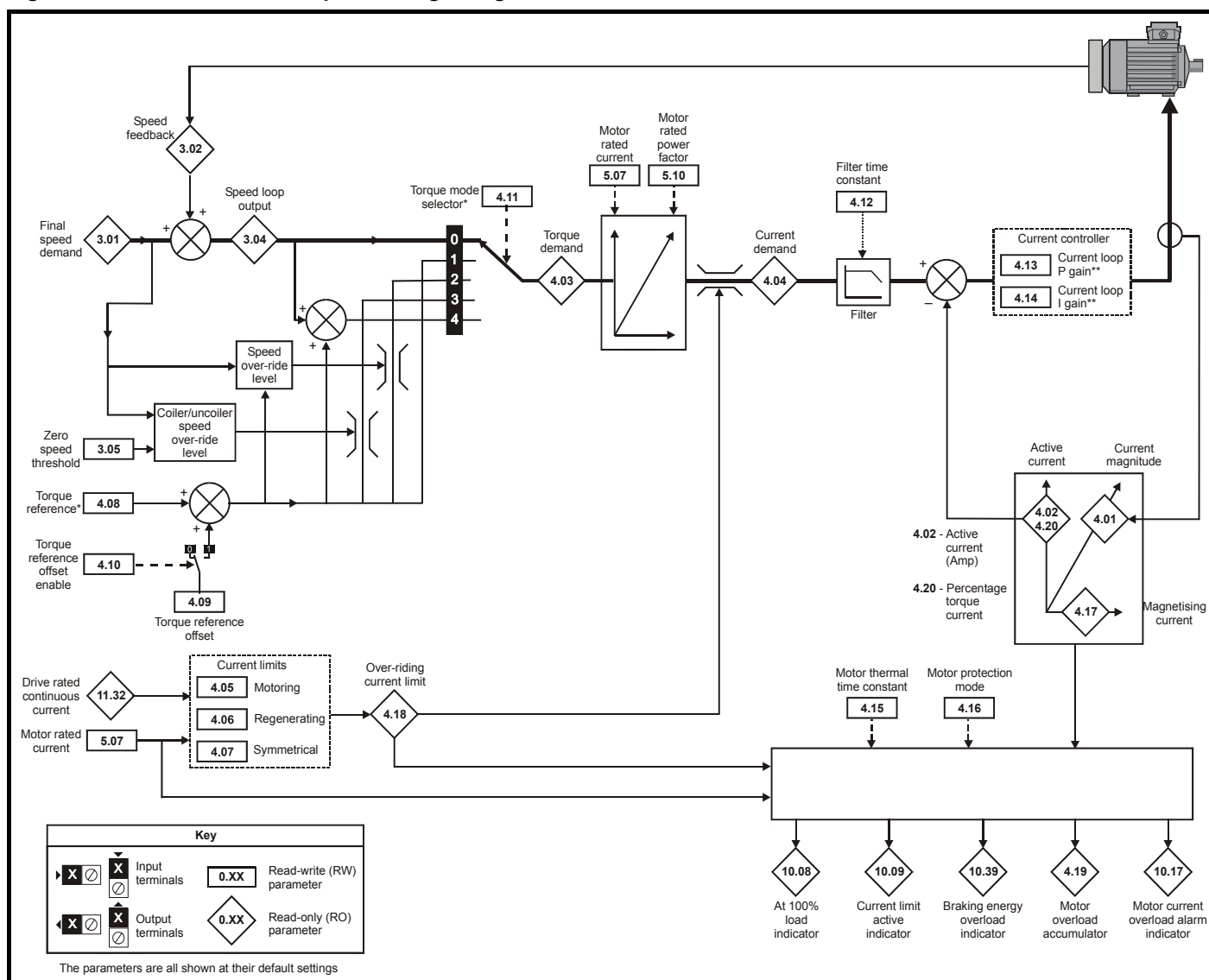
Parameter		Range($\hat{\cdot}$)		Default(\Rightarrow)			Type			
		OL	CL	OL	VT	SV				
3.01	OL> Slave frequency-demand	$\pm 1,000.0$ Hz	$\pm 30,000$ rpm				RO	Bi		P
	CL> Final speed demand									
3.02	Speed feedback {0.10}		Pr 1.06				RO	Bi		P
3.03	Speed error		$\pm 30,000$ rpm				RO	Bi		P
3.04	Speed loop output		$\pm I_{MAX} \% *$				RO	Bi		P
3.05	Zero-speed threshold	0 to 20.0 Hz	0 to 200 rpm	1	5		RW	Uni		
3.06	At-speed lower limit	0 to 1,000.0 Hz	0 to 30,000 rpm	1	5		RW	Uni		
3.07	At-speed upper limit	0 to 1,000.0 Hz	0 to 30,000 rpm	1	5		RW	Uni		
3.08	Over-speed threshold	0 to 1,000.0 Hz	0 to 30,000 rpm	1,000	2,000	4,000	RW	Uni		
3.09	Absolute at-speed detect mode	0 or 1		0			RW	Bit		
3.10	Speed-loop proportional gain {0.07}		0 to 32,000		200		RW	Uni		
3.11	Speed-loop integral gain {0.08}		0 to 32,000		100		RW	Uni		
3.12	Speed-loop derivative gain {0.09}		0 to 32,000		0		RW	Uni		
3.13	Frequency slaving <i>enable</i>	0 or 1		0			RW	Bit		
3.14	Slaving ratio numerator	0 to 1.000		1			RW	Uni		
3.15	Slaving ratio denominator	0.001 to 1.000		1			RW	Uni		
3.16	Frequency output <i>enable</i>	0 or 1		0			RW	Bit		
3.17	Frequency scaling ratio <i>select bit 1</i>	0 or 1		1			RW	Bit		
3.18	Frequency scaling ratio <i>select bit 2</i>	0 or 1		0			RW	Bit		
3.19	Hard speed reference**		$\pm [Pr 1.06]$		0		RW	Bi		
3.20	Hard speed reference <i>select**</i>		0 or 1		0		RW	Bit		
3.21	No. of encoder lines / Pulses per revolution	256 to 10,000 Encoder lines / Pulses per rev	256 to 5,000 Encoder lines / Pulses per rev	1,024		4,096	RW	Uni		
3.22	Frequency input <i>select</i>	0 or 1		1	0		RW	Bit		
3.23	Encoder supply voltage <i>select</i>	0 or 1		0			RW	Bit		
3.24	Encoder termination <i>disable</i>	0 or 1		0			RW	Bit		
3.25	Encoder phasing test <i>enable</i> {0.40}		0 or 1			0	RW	Bit		
3.26	Encoder 1 speed	$\pm 30,000$ rpm	$\pm 30,000$ rpm				RO	Bi		P
3.27	Encoder 1 position	0 to 16,383 revs / 16,384	0 to 16,383 revs / 16,384				RO	Uni		P
3.28	Phase position		0 to 6,143 rev / 6143				RW	Uni	S	P
3.29	Over-speed threshold mode <i>select</i>	0 or 1		0			RW	Bit		
3.30	Speed feedback filter		0 to 10.0 ms		0		RW	Uni		
3.31	Servo phasing fail (ENCPH9) detection disable		0 or 1			0	RW	Bit		

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

* For definition of $\pm I_{MAX} \%$, see section 8.2 *Current limits* on page 98.

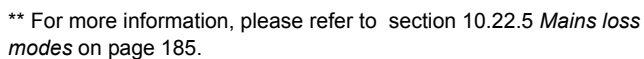
** For more information, refer to section 10.22.8 *Position loop modes* on page 188.

Figure 10-6 Menu 4 Closed-loop vector logic diagram



* For more information, please refer to section 10.22.3 *Torque Modes* on page 183.

** For more information, please refer to section 10.22.5 *Mains loss modes* on page 185.



Parameter		Range(↕)		Default(⇔)			Type		
		OL	CL	OL	VT	SV			
4.01	Motor current magnitude	0 to I_{MAX} A					RO	Uni	P
4.02	Motor active-current {0.13}	$\pm I_{MAX}$ A					RO	Bi	P
4.03	Torque demand	$\pm I_{MAX}$ %					RO	Bi	P
4.04	Current demand	$\pm I_{MAX}$ %					RO	Bi	P
4.05	Motoring current limit	0 to I_{MAX} %		150*		175	RW	Uni	
4.06	Regenerating current limit	0 to I_{MAX} %		150*		175	RW	Uni	
4.07	Symmetrical current limit {0.06}	0 to I_{MAX} %		150*		175	RW	Uni	
4.08	Torque reference**	$\pm I_{MAX}$ %		0			RW	Bi	
4.09	Torque reference offset	$\pm I_{MAX}$ %		0			RW	Bi	
4.10	Torque reference offset <i>enable</i>	0 or 1		0			RW	Bit	
4.11	Torque mode <i>selector</i> ** {0.17}	0 to 1	0 to 4	0			RW	Uni	P
4.12	Current-demand filter time-constant	0 to 250 ms		0			RW	Uni	
4.13	Current-loop proportional gain***	0 to 30,000		20	150	130	RW	Uni	
4.14	Current-loop integral gain***	0 to 30,000		40	2,000	1,200	RW	Uni	
4.15	Motor thermal time-constant	0 to 400.0 s		89.0		7.0	RW	Uni	
4.16	Motor protection mode <i>select</i>	0 or 1		0			RW	Bit	
4.17	Motor magnetizing current	$\pm I_{MAX}$ A					RO	Bi	P
4.18	Over-riding current limit	0 to I_{MAX} %					RO	Uni	P
4.19	Overload accumulator	0 to 100 %					RO	Uni	P
4.20	Percentage torque current	$\pm I_{MAX}$ %					RO	Bi	P

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

* These parameters have a default setting of 120% in Unidrive VTC.

** For more information, please refer to section 10.22.3 *Torque Modes* on page 183.

*** For more information, please refer to section 10.22.5 *Mains loss modes* on page 185.

Types of current range

FLC Full load current of the drive (maximum continuous output current up to 40°C ambient temperature). Displayed in Pr 11.32 {0.33}.

I_{MAX} A Maximum overload output current of the drive up to 40°C ambient temperature, derived as follows:

Size 1 to 4: $OL > 150\% \times FLC$

$CL > 175\% \times FLC$

Size 5: $150\% \times FLC$

I_{MAX} % See section 8.2 *Current limits* on page 98 for the definition of $I_{MAX}\%$.

10.5 Menu 5: Machine control

Figure 10-8 Menu 5 Open-loop logic diagram

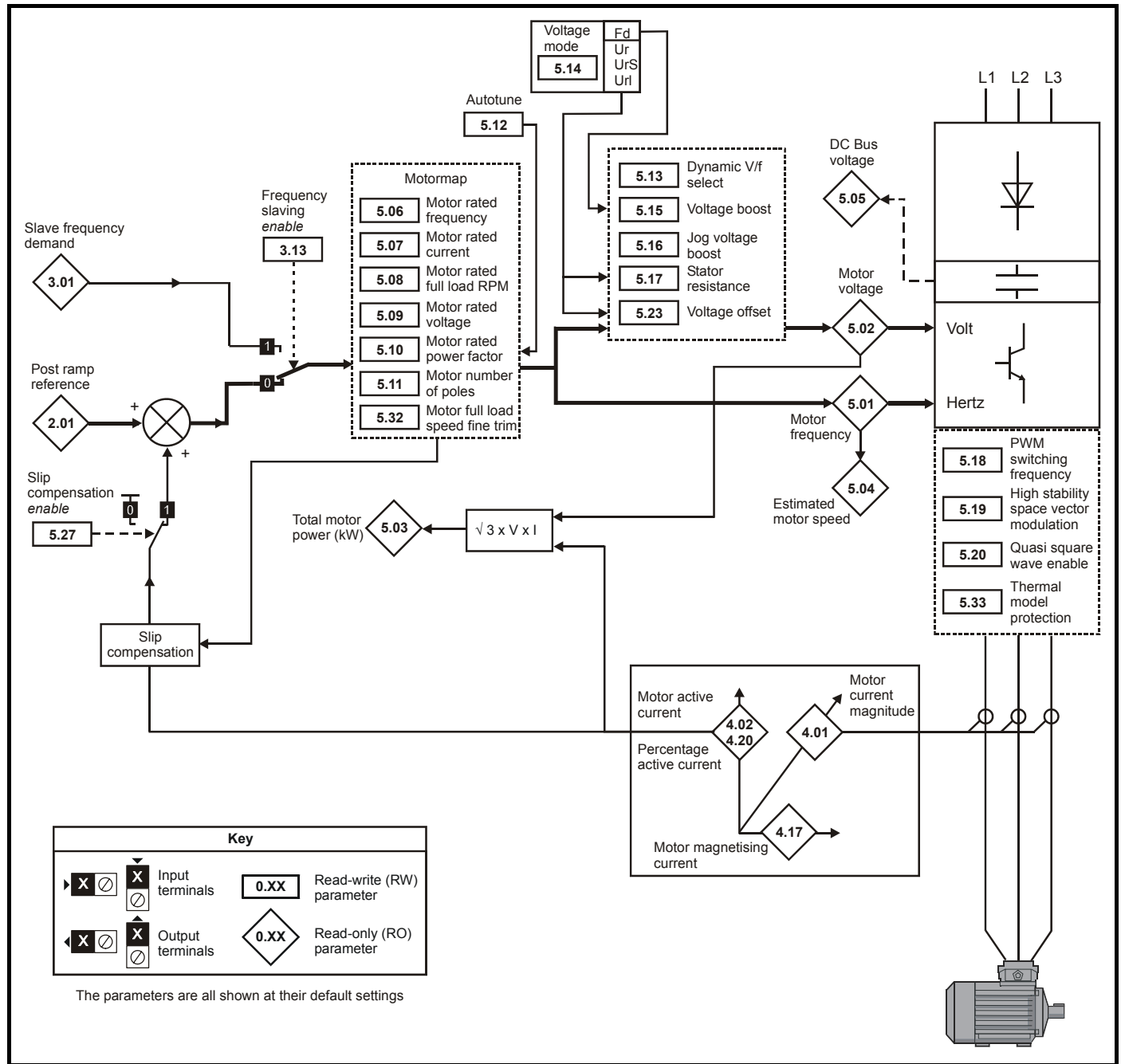
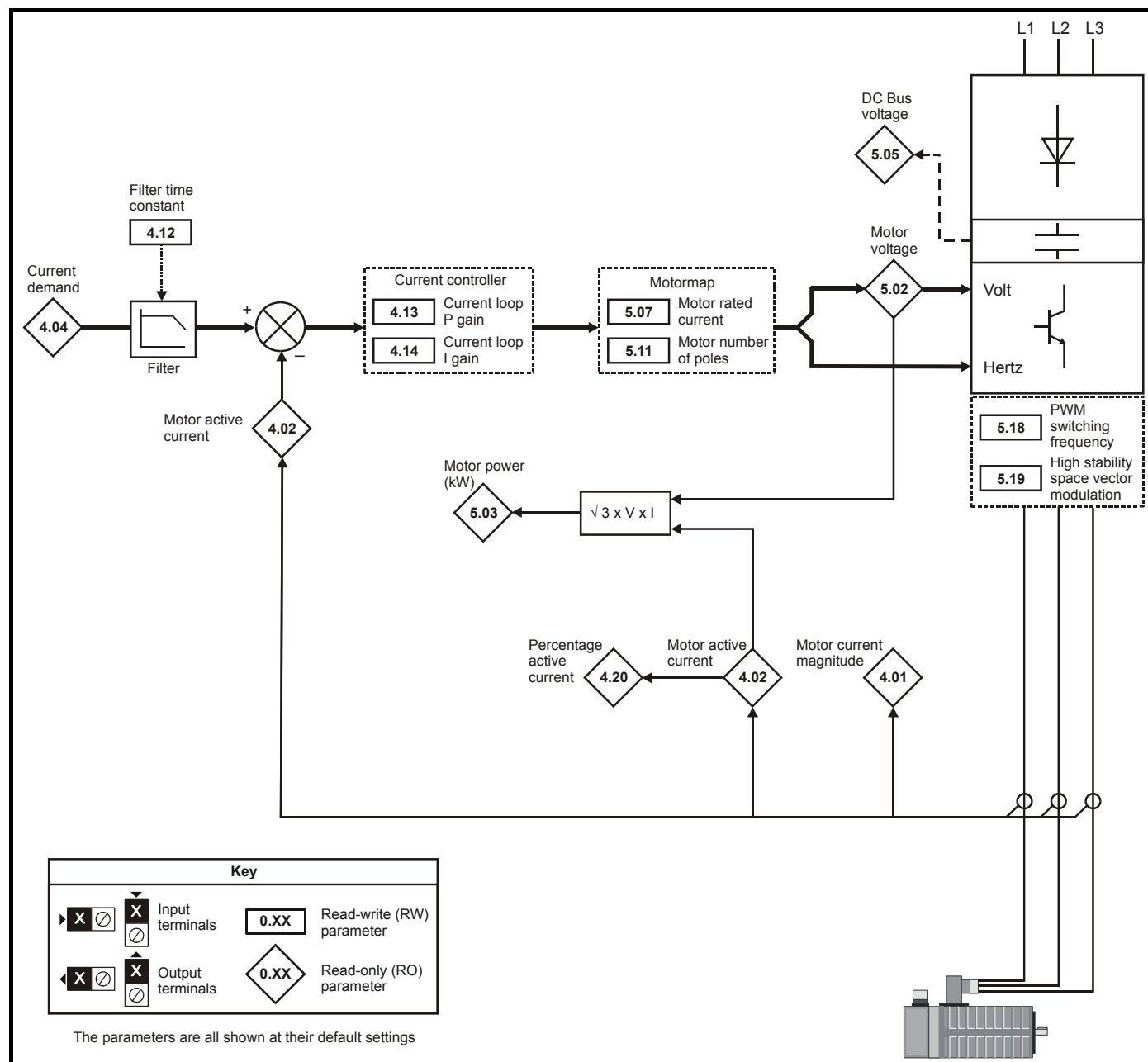


Figure 10-9 Menu 5 Closed-loop vector logic diagram



Figure 10-10 Menu 5 Servo logic diagram



Parameter		Range(⇅)		Default(⇨)			Type			
		OL	CL	OL	VT	SV				
5.01	Motor frequency	±[Pr 1.06]					RO	Bi		P
5.02	Motor voltage	200V drive: 0 to 264 V 400V drive: 0 to 528 V					RO	Uni		P
5.03	Total motor power	± P _{MAX} kW					RO	Bi		P
5.04	Estimated motor speed {0.10}	± 6000 rpm					RO	Bi		P
5.05	DC bus voltage	200V drive: 0 to 415 V 400V drive: 0 to 830 V					RO	Uni		P
5.06	Motor - rated frequency {0.47}	0 to 1000.0 Hz		EUR> 50, USA> 60			RW	Uni		
5.07	Motor - rated current {0.46}	0 to FLC A		FLC			RW	Uni		
5.08	Motor - rated speed {0.45}	0 to 6,000 rpm	0 to 30,000 rpm	0	EUR> 1,450 USA> 1,770		RW	Uni		
5.09	Motor - rated voltage {0.44}	200V drive: 0 to 240 V 400V drive: 0 to 480 V		200V drive: 220 400V drive: EUR> 400 USA> 460		0	RW	Uni		
5.10	Motor - rated power factor {0.43}	0 to 1.000		0.920			RW	Uni	S	P
5.11	Motor - number of poles {0.42}	2 to 32		4		6	RW	Txt		P
5.12	Magnetizing current test <i>enable</i> {0.40}	0 or 1		0			RW	Bit		P
5.13	Dynamic V/f <i>select</i> {0.09}	0 or 1		0			RW	Bit		
5.14	Voltage mode <i>selector</i> {0.07}	Ur_S (0), Ur_I (1), Ur (2), Fd (3)		Ur_I (1)*			RW	Uni		P
5.15	Boost voltage {0.08}	0 to 25.0 %		3			RW	Uni		
5.16	Jog boost-voltage	0 to 25.0 %		3			RW	Uni		
5.17	Stator resistance	0 to 32.000 Ω		0			RW	Uni	S	P
5.18	PWM switching frequency <i>selector</i> {0.41}	3 kHz (0), 4.5 kHz (1), 6 kHz (2), 9 kHz (3), 12 kHz (4)		3 (0)**			RW	Txt		
5.19	High-stability space-vector modulation <i>enable</i>	0 or 1		0			RW	Bit		
5.20	Quasi square-wave <i>enable</i>	0 or 1		0			RW	Bit		
5.21	Field-gain reduction <i>enable</i>			1			RW	Bit		
5.22	Maximum speed x10 <i>select</i>	0 or 1		0			RW	Bit		
5.23	Voltage offset	0 to 25.5 V		0			RO	Uni	S	P
5.24	Motor leakage inductance	0 to 320.00 mH		0			RW	Uni	S	P
5.25	Output frequency doubling <i>select</i>	0 or 1		0			RW	Bit		
5.26	Cross-coupling compensation <i>enable</i>	0 or 1		0			RW	Bit		
5.27	Slip compensation <i>enable</i>	0 or 1		1			RW	Bit		
	Auto-optimize rated speed <i>enable</i>			0			RW	Bit		
	Phasing test for motors with high inertia loads			0			RW	Bit		
5.28	Field-weakening gain compensation <i>disable</i>			0			RW	Bit		
5.29	Motor saturation breakpoint 1	0 to 100 %		50			RW	Uni		P
5.30	Motor saturation breakpoint 2	0 to 100 %		75			RW	Uni		P
5.31	Voltage-controller gain	0 to 30		1			RW	Uni		P
5.32	Motor full load speed fine trim	0 to 0.99 rpm		0			RW	Uni		P
5.33	Thermal model-protection <i>enable</i>	0 or 1		1			RW	Bit		

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

* This parameter has a default setting of Fd (3) in the VTC variant.

** This parameter has a default setting of 9kHz (3) in the LFT variant.

Power rating

$$P_{MAX} = \sqrt{3} \times I_{MAX} \times \frac{Pr\ 5.09}{1000}$$

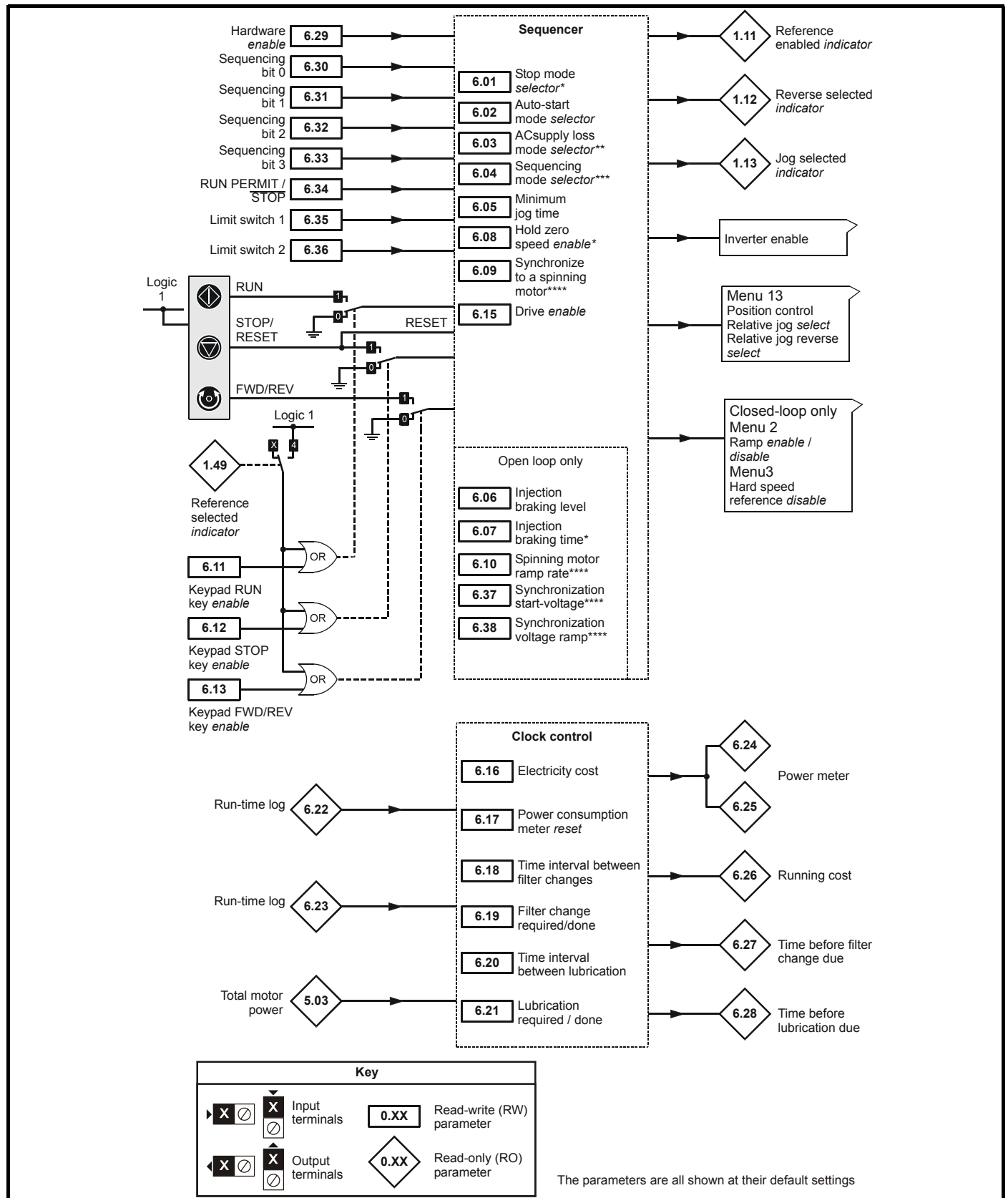
For definition of I_{MAX}, see section *Types of current range* on page 138.

NOTE

Where a parameter is represented by a text value, the value in brackets in the range column is the setting used for serial communications.

10.6 Menu 6: Sequencing logic

Figure 10-11 Menu 6 logic diagram



* For more information, refer to section 10.22.4 Stop Modes on page 184.

** For more information, refer to section 10.22.5 Mains loss modes on page 185.

*** For more information, refer to section 10.22.6 Sequencing Modes on page 186.

**** For more information, refer to section 10.22.7 Catch a spinning motor on page 187.

Parameter		Range(⇅)		Default(⇨)			Type			
		OL	CL	OL	VT	SV				
6.01	Stop mode <i>selector</i> * {0.16}	COAST (0), rP (1), rP-dcl (2), dcl (3), td.dcl (4)	COAST (0), rP (1), no.rP (2), rP-POS (3)	rP (1)		no.rP (2)	RW	Txt		
6.02	Auto-start mode <i>selector</i>	diS (0), ALYS (1), Pd.dP (2)		diS (0)			RW	Txt		
6.03	AC supply loss mode <i>selector</i> **	diS (0), StoP (1), ridE.th (2)		diS (0)			RW	Txt		P
6.04	Sequencing mode <i>selector</i> ***	0 to 4		4			RW	Uni		P
6.05	Minimum jog time	0 to 25.0 s		0.0			RW	Uni		
6.06	Injection braking level	0 to 100.0 %FLC		100.0			RW	Uni		
6.07	Injection braking time*	0 to 25.0 s		5.0			RW	Uni		
6.08	Hold zero speed <i>enable</i> *	0 or 1		0		1	RW	Bit		
6.09	Synchronize to a spinning motor**** {0.39}	0 or 1		0		1	RW	Bit		
6.10	Synchronization ramp rate****	0 to 25.0 s/100Hz		5			RW	Uni		
6.11	Keypad run key <i>enable</i>	0 or 1		0			RW	Bit		
6.12	Keypad stop key <i>enable</i>	0 or 1		0			RW	Bit		
6.13	Keypad fwd/rev key <i>enable</i>	0 or 1		0			RW	Bit		
6.15	Drive <i>enable</i>	0 or 1		1			RW	Bit		
6.16	Electricity cost / kWh	0 to 600.0 Currency/kWh		0			RW	Uni		
6.17	Power consumption meter <i>reset</i>	0 or 1		0			RW	Bit		
6.18	Time interval between filter changes	0 to 30,000 hr		0			RW	Uni		
6.19	Filter change required/done	0 or 1		1			RW	Bit		
6.20	Time interval between lubrication	0 to 30,000 hr		0			RW	Uni		
6.21	Lubrication required/done	0 or 1		1			RW	Bit		
6.22	Run-time log	0 to 30.365 years.days					RO	Uni	S	P
6.23	Run-time log	0 to 23.59 hr min					RO	Uni	S	P
6.24	Power meter	0 to 30,000 MWh					RO	Uni	S	P
6.25	Power meter	0 to 999.9 kWh					RO	Uni	S	P
6.26	Running cost	0 to 32,000 Currency/hr					RO	Uni	S	P
6.27	Time before filter change due	0 to 30,000 hr					RO	Uni	S	P
6.28	Time before lubrication due	0 to 30,000 hr					RO	Uni	S	P
6.29	Hardware <i>enable</i>	0 or 1					RO	Bit		P
6.30	Sequencing bit 0	0 or 1		0			RW	Bit		
6.31	Sequencing bit 1	0 or 1		0			RW	Bit		
6.32	Sequencing bit 2	0 or 1		0			RW	Bit		
6.33	Sequencing bit 3	0 or 1		0			RW	Bit		
6.34	Run permit / not stop	0 or 1		0			RW	Bit		
6.35	Limit switch 1	0 or 1					RO	Bit		
6.36	Limit switch 2	0 or 1					RO	Bit		
6.37	Spinning motor start-voltage****	0 to 100.0 %		25			RW	Uni		
6.38	Spinning motor voltage-ramp****	0 to 2.5 s		0.25			RW	Uni		

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

NOTE

Where a parameter is represented by a text value, the value in brackets in the range column is the setting used for serial communications.

* For more information, refer to section 10.22.4 *Stop Modes* on page 184.

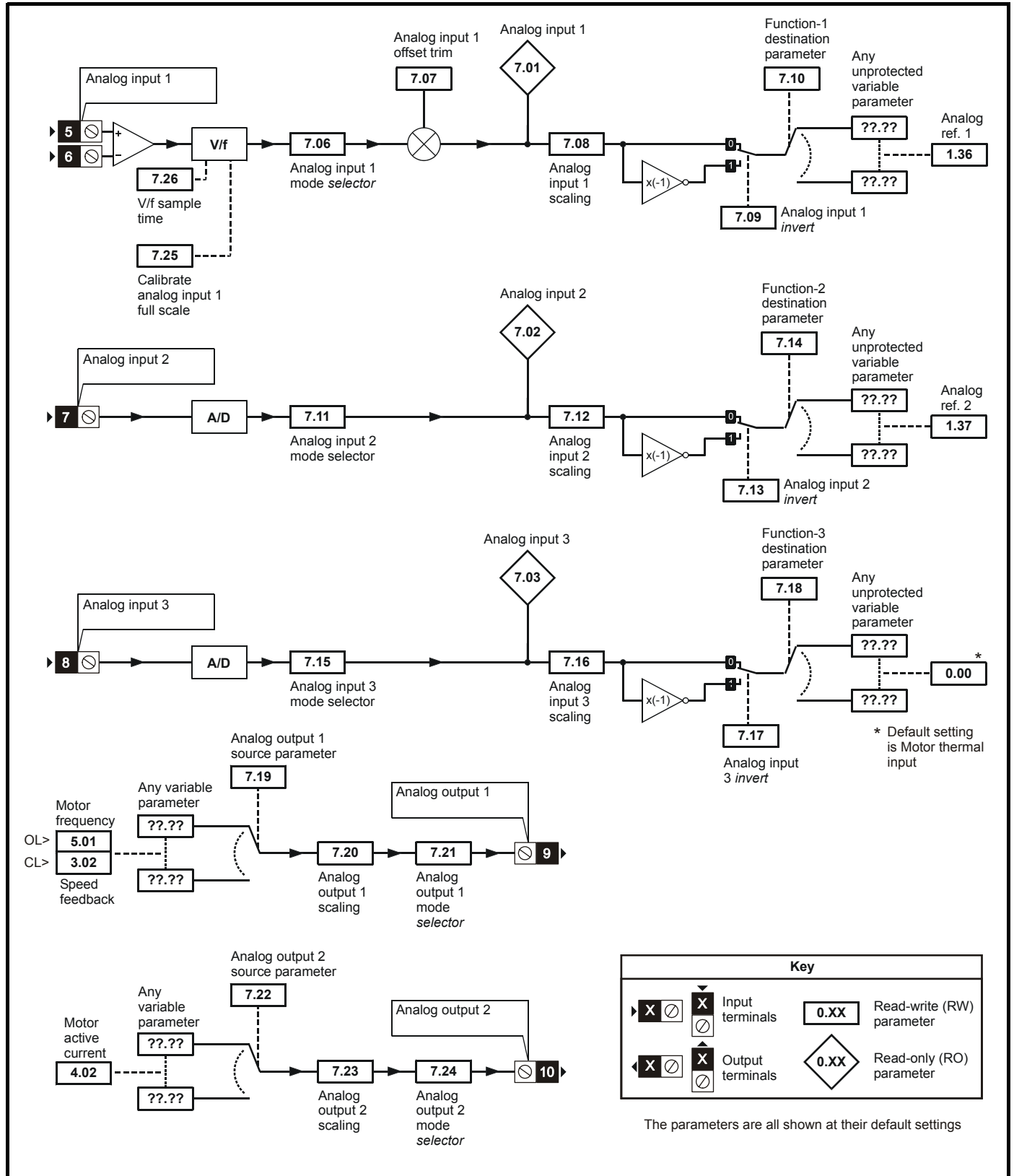
** For more information, refer to section 10.22.5 *Mains loss modes* on page 185.

*** For more information, refer to section 10.22.6 *Sequencing Modes* on page 186.

**** For more information, refer to section 10.22.7 *Catch a spinning motor* on page 187.

10.7 Menu 7: Analog I/O

Figure 10-12 Menu 7 logic diagram



Parameter		Range(↕)		Default(⇒)			Type			
		OL	CL	OL	VT	SV				
7.01	Analog input 1	±100.0 %					RO	Bi		P
7.02	Analog input 2	±100.0 %					RO	Bi		P
7.03	Analog input 3	±100.0 %					RO	Bi		P
7.04	Heatsink temperature	0 to 100 °C					RO	Uni		P
7.05	Control board temperature	0 to 100 °C					RO	Uni		P
7.06	Analog input 1 mode <i>selector</i> {0.24}	VOLT (0), 0 - 20 (1), 20 - 0 (2), 4 - 20.tr (3), 20 - 4.tr (4), 4 - 20.Lo (5), 20 - 4.Lo (6), 4 - 20.Pr (7), 20 - 4.Pr (8)		VOLT (0)			RW	Txt	R	
7.07	Analog input 1 offset trim	±10.000 %		0			RW	Bi		P
7.08	Analog input 1 scaling	0 to 4.000		1.000			RW	Uni		
7.09	Analog input 1 <i>invert</i>	0 or 1		0			RW	Bit		
7.10	Analog input 1 destination parameter	Pr 0.00 to Pr 20.50		Pr 1.36			RW	Uni	R	P
7.11	Analog input 2 mode <i>selector</i> {0.25}	(as Pr 7.06)		VOLT (0)			RW	Txt	R	
7.12	Analog input 2 scaling	0 to 4.000		1			RW	Uni		
7.13	Analog input 2 <i>invert</i>	0 or 1		0			RW	Bit		
7.14	Analog input 2 destination parameter {0.26}	Pr 0.00 to Pr 20.50		Pr 1.37			RW	Uni	R	P
7.15	Analog input 3 mode <i>selector</i>	VOLT (0), 0 - 20 (1), 20 - 0 (2), 4 - 20.tr (3), 20 - 4.tr (4), 4 - 20.Lo (5), 20 - 4.Lo (6), 4 - 20.Pr (7), 20 - 4.Pr (8), th.SC (9), th (10)		EUR> th (10), USA> VOLT (0)			RW	Txt	R	
7.16	Analog input 3 scaling	0 to 4.000		1.000			RW	Uni		
7.17	Analog input 3 <i>invert</i>	0 or 1		0			RW	Bit		
7.18	Analog input 3 destination parameter	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R	P
7.19	Analog output 1 source parameter	Pr 0.00 to Pr 20.50		Pr 5.01	Pr 3.02		RW	Uni	R	P
7.20	Analog output 1 scaling	0 to 4.000		1			RW	Uni		
7.21	Analog output 1 mode <i>selector</i>	VOLT (0), 0 - 20 (1), 4 - 20 (2)		VOLT (0)			RW	Txt	R	P
7.22	Analog output 2 source parameter	Pr 0.00 to Pr 20.50		Pr 4.02			RW	Uni	R	P
7.23	Analog output 2 scaling	0 to 4.000		1.000			RW	Uni		
7.24	Analog output 2 mode <i>selector</i>	VOLT (0), 0 - 20 (1), 4 - 20 (2)		VOLT (0)			RW	Txt	R	P
7.25	Calibrate analog input 1 full scale	0 or 1		0			RW	Bit		
7.26	V/f sample time		0 to 5.0 ms		4.0		RW	Uni		
7.27	Analog input 1 current-loop loss <i>indicator</i>	0 or 1					RO	Bit		P
7.28	Analog input 2 current-loop loss <i>indicator</i>	0 or 1					RO	Bit		P
7.29	Analog input 3 current-loop loss <i>indicator</i>	0 or 1					RO	Bit		P
7.30	Analog output set-up <i>enable</i>	0 or 1		0			RW	Bit		
7.31	UD78 large option module fitted <i>indicator</i>	0 or 1					RO	Bit		P
7.32	IGBT junction temperature	0 to 150 °C					RO	Uni		P

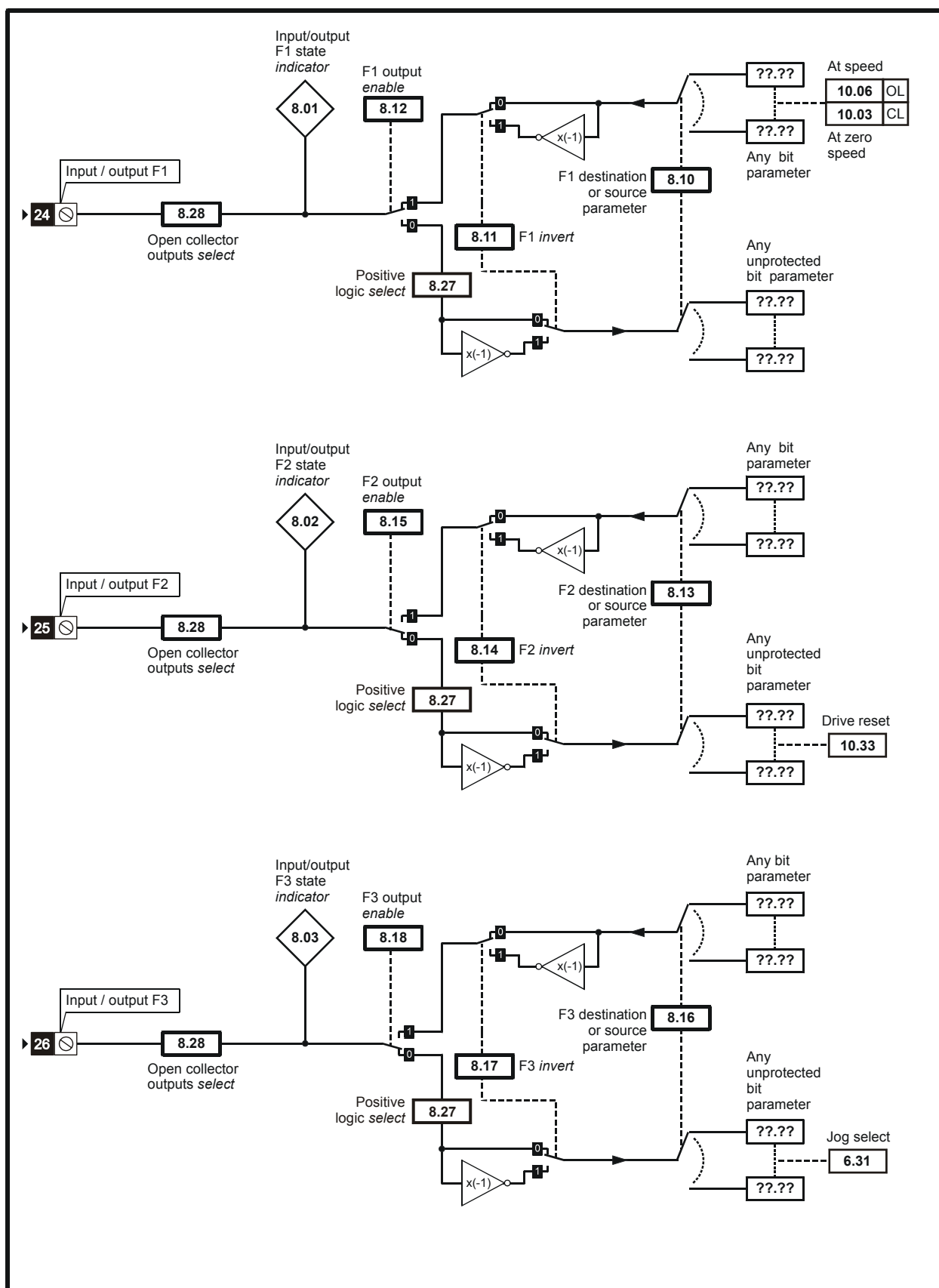
RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

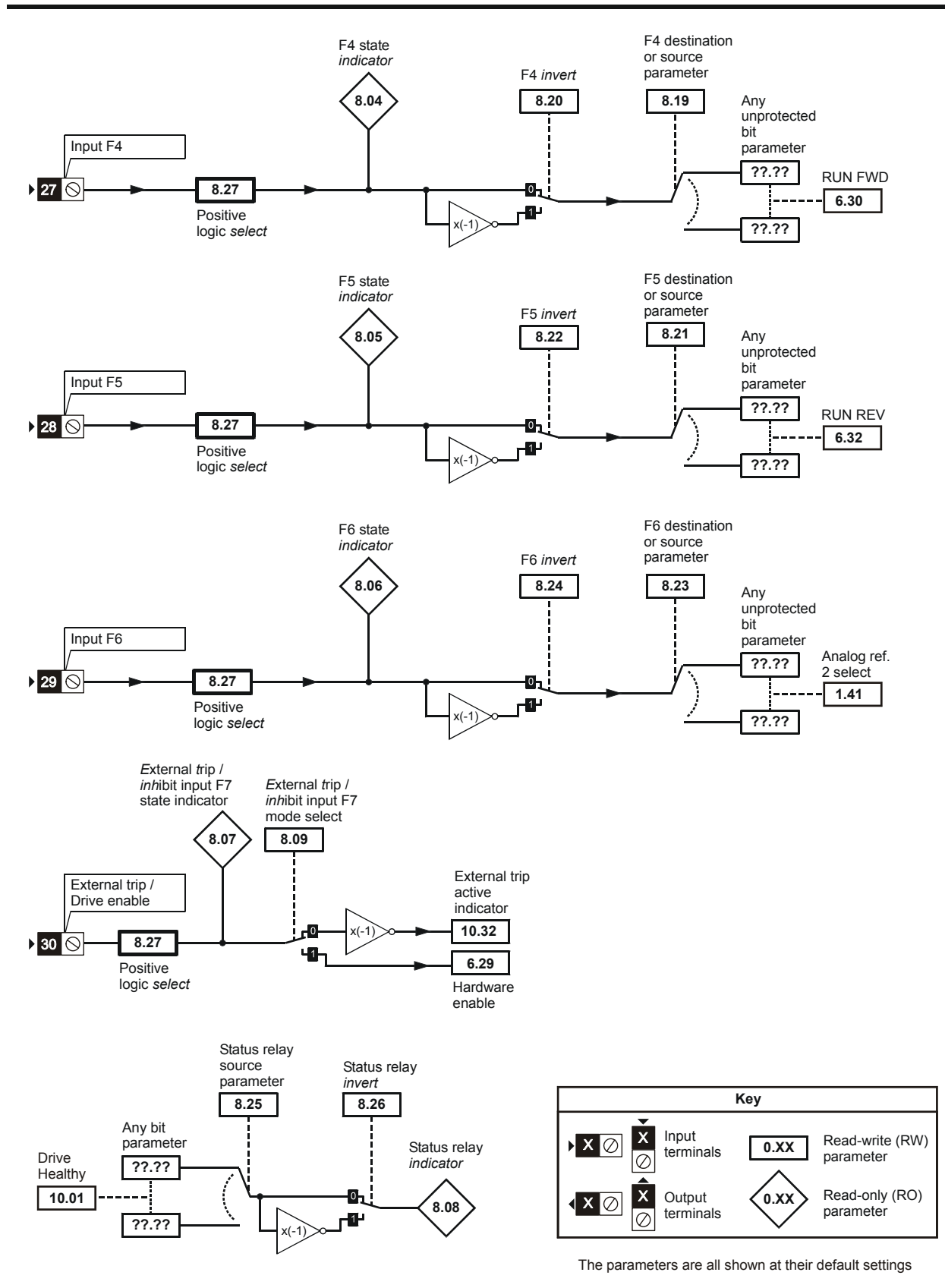
NOTE

Where a parameter is represented by a text value, the value in brackets in the range column is the setting used for serial communications.

10.8 Menu 8: Digital I/O

Figure 10-13 Menu 8 logic diagram



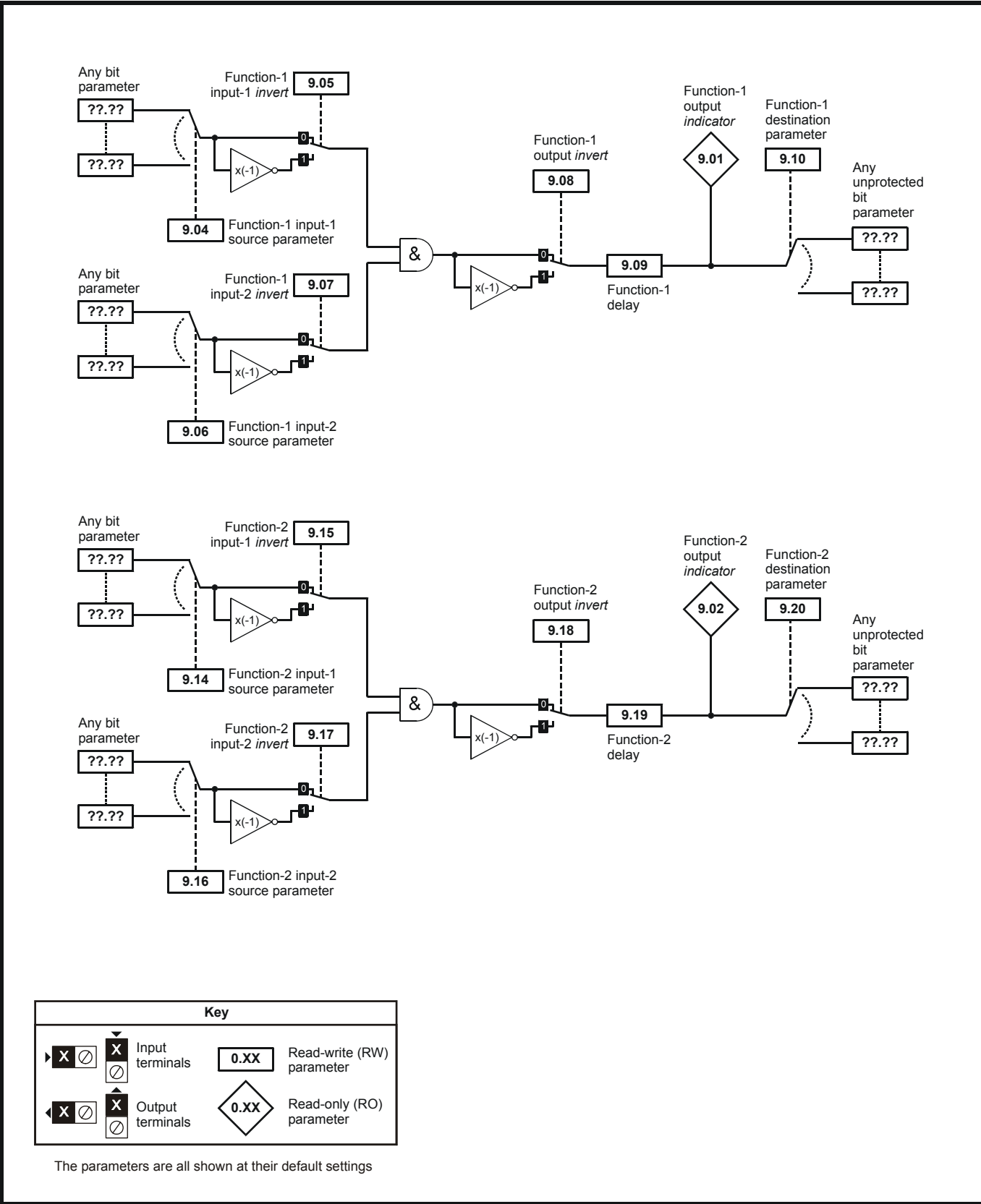


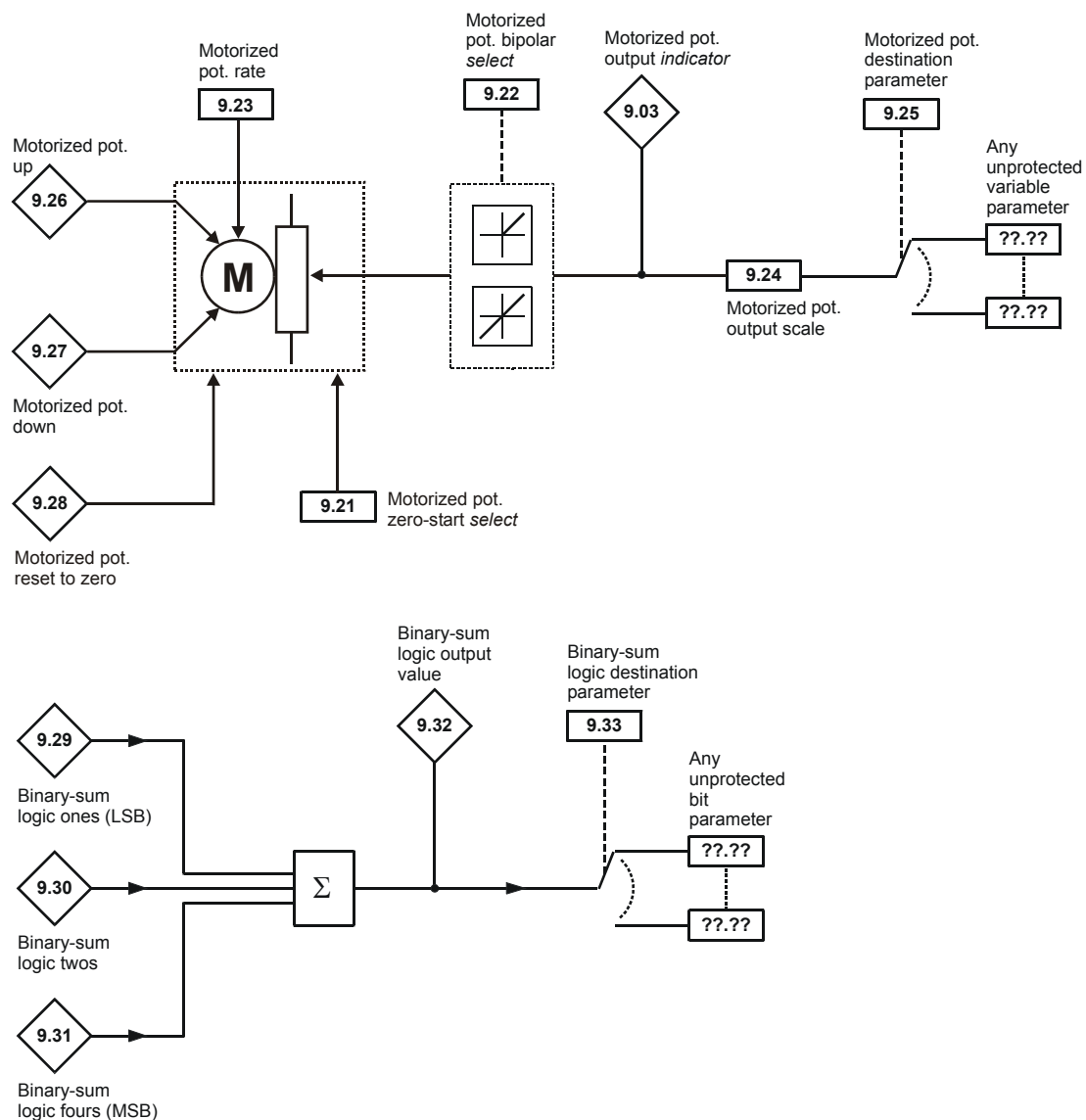
Parameter		Range(↕)		Default(⇒)			Type			
		OL	CL	OL	VT	SV				
8.01	Digital input/output F1 <i>state</i>	0 or 1					RO	Bit		P
8.02	Digital input/output F2 <i>state</i>	0 or 1					RO	Bit		P
8.03	Digital input/output F3 <i>state</i>	0 or 1					RO	Bit		P
8.04	Digital input F4 <i>state</i>	0 or 1					RO	Bit		P
8.05	Digital input F5 <i>state</i>	0 or 1					RO	Bit		P
8.06	Digital input F6 <i>state</i>	0 or 1					RO	Bit		P
8.07	Terminal 30 <i>state</i>	0 or 1					RO	Bit		P
8.08	Status relay output <i>indicator</i>	0 or 1					RO	Bit		P
8.09	Terminal 30 function <i>select</i>	0 or 1		0	1		RW	Bit		
8.10	F1 destination or source parameter	Pr 0.00 to Pr 20.50		Pr 10.06	Pr 10.03		RW	Uni	R	P
8.11	F1 <i>invert</i>	0 or 1		0			RW	Bit		
8.12	F1 output <i>enable</i>	0 or 1		1			RW	Bit	R	
8.13	F2 destination or source parameter	Pr 0.00 to Pr 20.50		Pr 10.33			RW	Uni	R	P
8.14	F2 <i>invert</i>	0 or 1		0			RW	Bit		
8.15	F2 output <i>enable</i>	0 or 1		0			RW	Bit	R	
8.16	F3 destination or source parameter	Pr 0.00 to Pr 20.50		Pr 6.31			RW	Uni	R	P
8.17	F3 <i>invert</i>	0 or 1		0			RW	Bit		
8.18	F3 output <i>enable</i>	0 or 1		0			RW	Bit	R	
8.19	F4 destination parameter	Pr 0.00 to Pr 20.50		Pr 6.30			RW	Uni	R	P
8.20	F4 <i>invert</i>	0 or 1		0			RW	Bit		
8.21	F5 destination parameter	Pr 0.00 to Pr 20.50		Pr 6.32			RW	Uni	R	P
8.22	F5 <i>invert</i>	0 or 1		0			RW	Bit		
8.23	F6 destination parameter	Pr 0.00 to Pr 20.50		Pr 1.41			RW	Uni	R	P
8.24	F6 <i>invert</i>	0 or 1		0			RW	Bit		
8.25	Status relay source parameter	Pr 0.00 to Pr 20.50		Pr 10.01			RW	Uni	R	P
8.26	Status relay <i>invert</i>	0 or 1		0			RW	Bit		
8.27	Positive logic <i>select</i>	0 or 1		0			RW	Bit	R	P
8.28	Open-collector outputs <i>select</i>	0 or 1		0			RW	Bit	R	P

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

10.9 Menu 9: Programmable logic

Figure 10-14 Menu 9 logic diagram





Parameter		Range(↕)		Default(⇒)			Type		
		OL	CL	OL	VT	SV			
9.01	Prog.-logic function 1 output <i>indicator</i>	0 or 1					RO	Bit	P
9.02	Prog.-logic function 2 output <i>indicator</i>	0 or 1					RO	Bit	P
9.03	Motorized pot. output <i>indicator</i>	±100.0 %					RO	Bi	S P
9.04	Prog.-logic function 1 input 1 source parameter	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	P
9.05	Prog.-logic function 1 input 1 <i>invert</i>	0 or 1		0			RW	Bit	
9.06	Prog.-logic function 1 input 2 source parameter	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	P
9.07	Prog.-logic function 1 input 2 <i>invert</i>	0 or 1		0			RW	Bit	
9.08	Prog.-logic function 1 output <i>invert</i>	0 or 1		0			RW	Bit	
9.09	Prog.-logic function 1 delay	0 to 25.0 s		0			RW	Uni	
9.10	Prog.-logic function 1 destination parameter	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R P
9.14	Prog.-logic function 2 input 1 source parameter	Pr 0.00 to Pr 20.50		0			RW	Uni	P
9.15	Prog.-logic function 2 input 1 <i>invert</i>	0 or 1		0			RW	Bit	
9.16	Prog.-logic function 2 input 2 source	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	P
9.17	Prog.-logic function 2 input 2 <i>invert</i>	0 or 1		0			RW	Bit	
9.18	Prog.-logic function 2 output <i>invert</i>	0 or 1		0			RW	Bit	
9.19	Prog.-logic function 2 delay	0 to 25.0 s		0			RW	Uni	
9.20	Prog.-logic function 2 destination parameter	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R P
9.21	Motorised pot. zero-start <i>select</i>	0 or 1		0			RW	Bit	
9.22	Motorised pot. bipolar <i>select</i>	0 or 1		0			RW	Bit	
9.23	Motorised pot. rate	0 to 250 s		20			RW	Uni	
9.24	Motorised pot. output scale factor	0 to 4.000		1			RW	Uni	
9.25	Motorised pot. destination	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R P
9.26	Motorised pot. up	0 or 1					RO	Bit	
9.27	Motorised pot. down	0 or 1					RO	Bit	
9.28	Motorised pot. reset	0 or 1					RO	Bit	
9.29	Binary-sum logic ones (MSB)	0 or 1					RO	Bit	
9.30	Binary-sum logic twos	0 or 1					RO	Bit	
9.31	Binary-sum logic fours	0 or 1					RO	Bit	
9.32	Binary-sum logic output value	0 to 7					RO	Uni	P
9.33	Binary-sum logic destination parameter	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R P

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 (0.33)

10.10 Menu 10: Status flags / trip log

Parameter		Range(⇅)		Default(⇒)			Type		
		OL	CL	OL	VT	SV			
10.01	Drive normal <i>indicator</i>	0 or 1					RO	Bit	P
10.02	Drive running <i>indicator</i>	0 or 1					RO	Bit	P
10.03	At zero speed <i>indicator</i>	0 or 1					RO	Bit	P
10.04	At or below min. speed <i>indicator</i>	0 or 1					RO	Bit	P
10.05	Below at-speed window <i>indicator</i>	0 or 1					RO	Bit	P
10.06	At speed <i>indicator</i>	0 or 1					RO	Bit	P
10.07	Above at-speed window <i>indicator</i>	0 or 1					RO	Bit	P
10.08	At 100% load <i>indicator</i>	0 or 1					RO	Bit	P
10.09	Current-limit active <i>indicator</i>	0 or 1					RO	Bit	P
10.10	Motor regenerating <i>indicator</i>	0 or 1					RO	Bit	P
10.11	Dynamic brake active <i>indicator</i>	0 or 1					RO	Bit	P
10.12	Dynamic brake alarm <i>indicator</i>	0 or 1					RO	Bit	P
10.13	Direction demanded <i>indicator</i>	0 or 1					RO	Bit	P
10.14	Direction running <i>indicator</i>	0 or 1					RO	Bit	P
10.15	AC supply loss <i>indicator</i>	0 or 1					RO	Bit	P
10.16	Motor thermistor over-temperature <i>indicator</i>	0 or 1					RO	Bit	P
10.17	Motor current overload alarm <i>indicator</i>	0 or 1					RO	Bit	P
10.18	Heatsink temperature alarm <i>indicator</i>	0 or 1					RO	Bit	P
10.19	Ambient temperature alarm <i>indicator</i>	0 or 1					RO	Bit	P
10.20	Last trip	0 to 200					RO	Txt	S P
10.21	Second last trip	0 to 200					RO	Txt	S P
10.22	Third last trip	0 to 200					RO	Txt	S P
10.23	Fourth last trip	0 to 200					RO	Txt	S P
10.24	Fifth last trip	0 to 200					RO	Txt	S P
10.25	Sixth last trip	0 to 200					RO	Txt	S P
10.26	Seventh last trip	0 to 200					RO	Txt	S P
10.27	Eighth last trip	0 to 200					RO	Txt	S P
10.28	Ninth last trip	0 to 200					RO	Txt	S P
10.29	Tenth last trip	0 to 200					RO	Txt	S P
10.30	Max. full-power braking time	0 to 400.0 s		0			RW	Uni	
10.31	Max. full-power braking interval	0 to 25.0 min		0			RW	Uni	
10.32	External trip active <i>indicator</i>	0 or 1					RO	Bit	
10.33	Drive reset	0 or 1		0			RW	Bit	
10.34	Number of auto- reset attempts	0 to 5		0			RW	Uni	
10.35	Auto-reset time delay	0 to 25.0 s		1.0			RW	Uni	
10.36	Hold drive healthy until last auto-reset attempt <i>select</i>	0 or 1		0			RW	Bit	
10.37	Stop drive on non-important trips	0 or 1		0			RW	Bit	
10.38	User trip	0 to 200		0			RW	Uni	P
10.39	Braking-energy overload accumulator	0 to 100.0 %					RO	Uni	P
10.40	Status word	0 to 32,767					RO	Uni	P
10.41	UD78 auxiliary power supply active <i>indicator</i>	0 or 1					RO	Bit	P
10.42	IGBT junction temperature above 135 °C <i>indicator</i>	0 or 1					RO	Bit	P

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

NOTE

Where a parameter is represented by a text value, the value in brackets in the range column is the setting used for serial communications.

10.11 Menu 11: Menu 0 customisation / drive specific ratings

Parameter	Range(↕)		Default(↔)			Type		
	OL	CL	OL	VT	SV			
11.01	Parameter 0.11 assignment	Pr 0.00 to Pr 20.50	Pr 1.03			RW	Uni	P
11.02	Parameter 0.12 assignment	Pr 0.00 to Pr 20.50	Pr 2.01			RW	Uni	P
11.03	Parameter 0.13 assignment	Pr 0.00 to Pr 20.50	Pr 4.02			RW	Uni	P
11.04	Parameter 0.14 assignment	Pr 0.00 to Pr 20.50	Pr 1.05			RW	Uni	P
11.05	Parameter 0.15 assignment	Pr 0.00 to Pr 20.50	Pr 2.04			RW	Uni	P
11.06	Parameter 0.16 assignment	Pr 0.00 to Pr 20.50	Pr 6.01			RW	Uni	P
11.07	Parameter 0.17 assignment	Pr 0.00 to Pr 20.50	Pr 4.11			RW	Uni	P
11.08	Parameter 0.18 assignment	Pr 0.00 to Pr 20.50	Pr 2.06			RW	Uni	P
11.09	Parameter 0.19 assignment	Pr 0.00 to Pr 20.50	Pr 2.07			RW	Uni	P
11.10	Parameter 0.20 assignment	Pr 0.00 to Pr 20.50	Pr 1.29			RW	Uni	P
11.11	Parameter 0.21 assignment	Pr 0.00 to Pr 20.50	Pr 1.30			RW	Uni	P
11.12	Parameter 0.22 assignment	Pr 0.00 to Pr 20.50	Pr 1.31			RW	Uni	P
11.13	Parameter 0.23 assignment	Pr 0.00 to Pr 20.50	Pr 1.32			RW	Uni	P
11.14	Parameter 0.24 assignment	Pr 0.00 to Pr 20.50	Pr 7.06			RW	Uni	P
11.15	Parameter 0.25 assignment	Pr 0.00 to Pr 20.50	Pr 7.11			RW	Uni	P
11.16	Parameter 0.26 assignment	Pr 0.00 to Pr 20.50	Pr 7.14			RW	Uni	P
11.17	Parameter 0.27 assignment	Pr 0.00 to Pr 20.50	EUR> Pr 8.27, USA> Pr 6.04			RW	Uni	P
11.18	Parameter 0.28 assignment	Pr 0.00 to Pr 20.50	EUR> Pr 4.13, USA> Pr 1.01			RW	Uni	P
11.19	Parameter 0.29 assignment	Pr 0.00 to Pr 20.50	EUR> Pr 4.14, USA> Pr 8.23			RW	Uni	P
11.20	Parameter 0.30 assignment	Pr 0.00 to Pr 20.50	Pr 6.13			RW	Uni	P
11.21	Parameter 0.30 scaling	0 to 4.000	1			RW	Uni	P
11.22	Initial parameter displayed {0.38}	Pr 0.00 to Pr 0.50	Pr 0.10*			RW	Uni	P
11.23	Serial comms. address {0.37}	0 to 9.9 group.unit	1.1			RW	Uni	P
11.24	Serial comms. mode {0.32}	ANSI 2 (0), ANSI 4 (1), OUTPut (2), INPut (3)	ANSI 4 (1)			RW	Txt	R P
11.25	Serial comms. baud rate {0.36}	4,800 (0), 9,600 (1), 19,200 (2), 2,400 (3) baud	4800 (0)*			RW	Txt	P
11.26	Serial comms two-wire mode delay	0 to 255 ms	0			RW	Uni	
11.27	Serial comms. source/ destination parameter	Pr 0.00 to Pr 20.50	0			RW	Uni	R P
11.28	Serial comms. parameter scaling	0 to 4.000	1			RW	Uni	
11.29	Drive software version {0.50}	1.00 to 99.99				RO	Uni	P
11.30	User security code {0.34}	0 to 255	149			RW	Uni	S P
11.31	Drive operating mode {0.48}	OPENLP (0), CL.VECT (1), SERVO (2), rEGEN (3)				RW	Txt	R P
11.32	Drive rated current (FLC) {0.33}	2.10 to 1920 A				RO	Uni	P
11.33	Drive voltage rating	220 to 690 V				RO	Uni	P
11.34	Drive software build number	0 to 99				RO	Uni	P
11.35	Number of size-5 modules connected	0 to 255				RO	Uni	P
11.36	Drive with slow speed fans	0 or 1	Unidrive & Unidrive VTC: 0 Unidrive LFT: 1			RO	Bit	P
11.37	Macro number {0.31}	0 to 9				RO	Uni	
11.38	Cloning module parameter set	0 to 8	0			RW	Uni	
11.39	Cloning module parameter set drive type	OPEN.LP (0), CL.Vect (1), SERVO (2), rEGEN (3), FrEE (4)	4			RO	Txt	P
11.40	Cloning module parameter checksum	0 to 16,383				RO	Uni	P

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

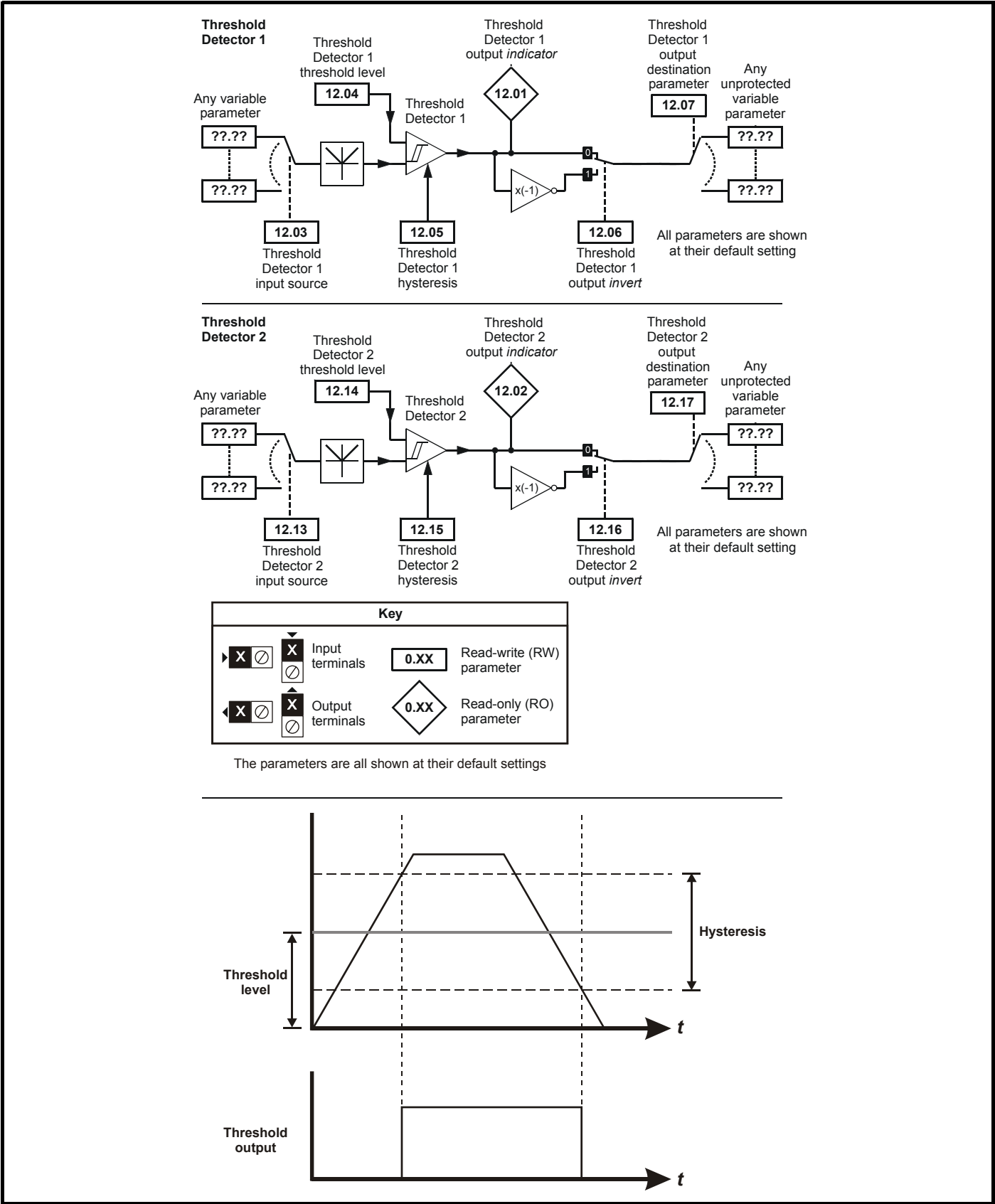
* Pr 11.22 and Pr 11.25 have default settings of Pr 0.12 and 9,600 (1) respectively in Unidrive VTC when USA defaults are loaded.

NOTE

Where a parameter is represented by a text value, the value in brackets in the range column is the setting used for serial communications.

10.12 Menu 12: Programmable thresholds

Figure 10-15 Menu 12 logic diagram

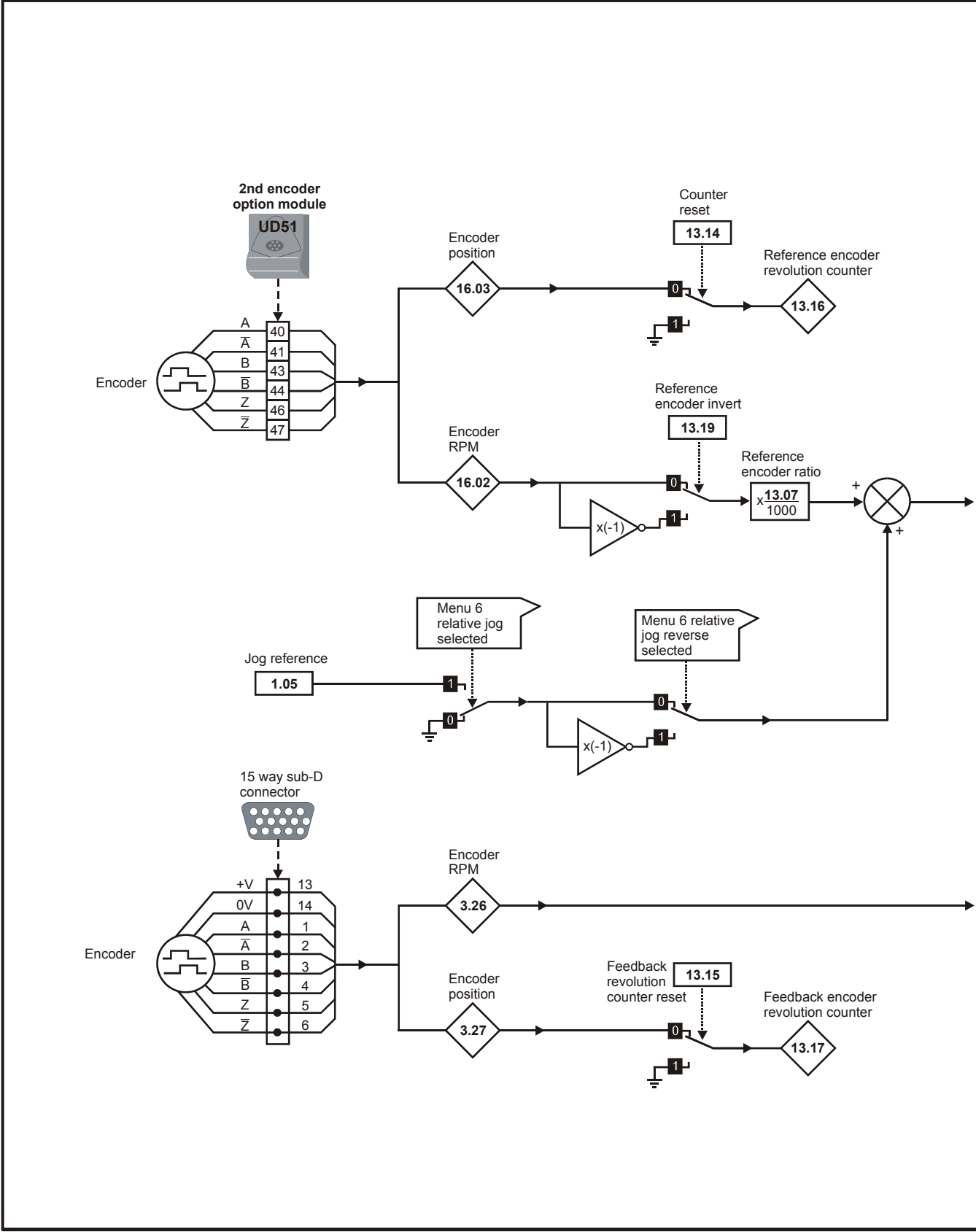


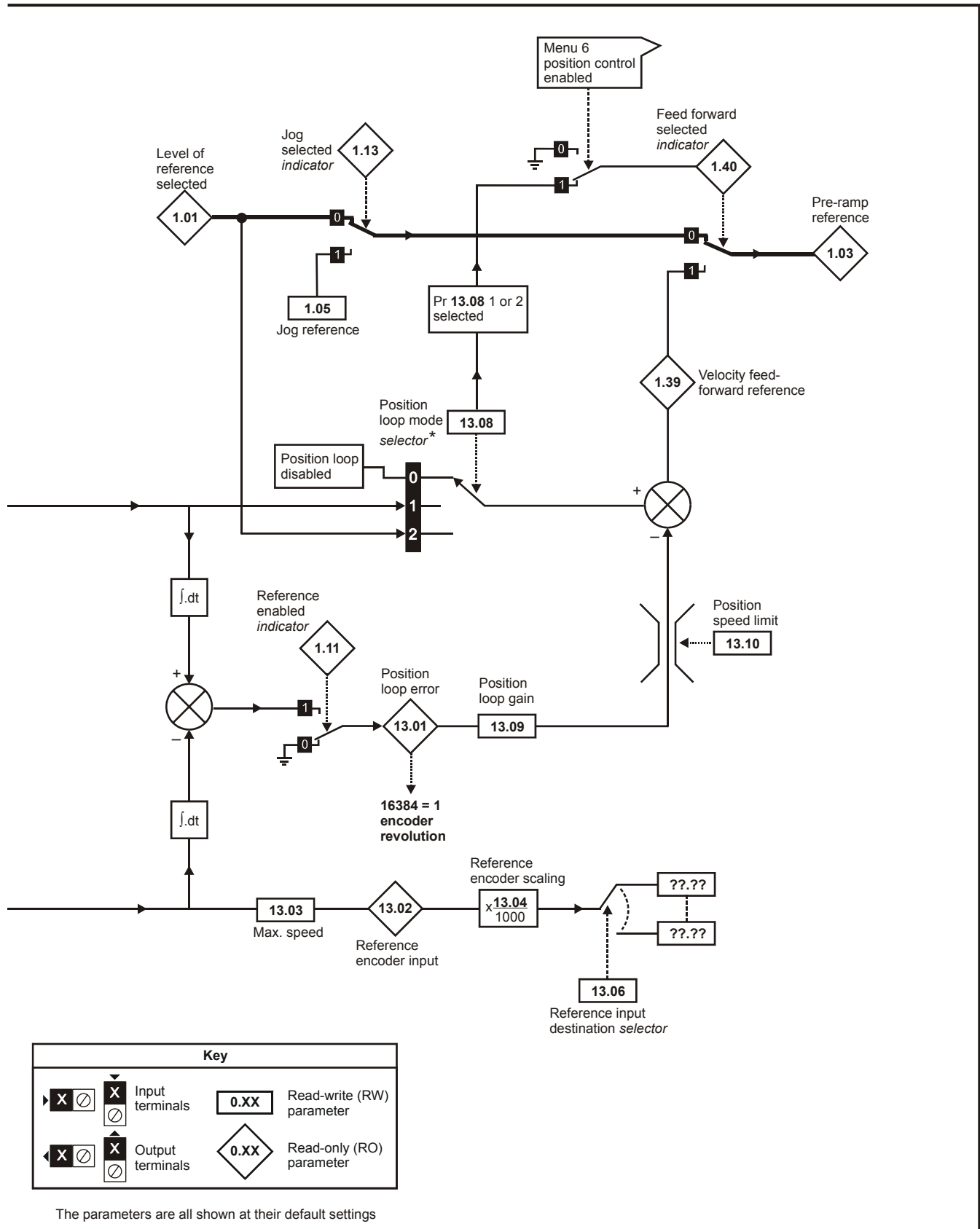
Parameter		Range(⇅)		Default(⇒)			Type			
		OL	CL	OL	VT	SV				
12.01	Comparator 1 output <i>indicator</i>	0 or 1					RO	Bit		P
12.02	Comparator 2 output <i>indicator</i>	0 or 1					RO	Bit		P
12.03	Comparator 1 input source parameter	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni		P
12.04	Comparator 1 threshold level	0 to 100.0 %		0			RW	Uni		
12.05	Comparator 1 hysteresis	0 to 25.0 %		0			RW	Uni		
12.06	Comparator 1 output <i>invert</i>	0 or 1		0			RW	Bit		
12.07	Comparator 1 output destination parameter	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R	P
12.13	Comparator 2 input source parameter	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni		P
12.14	Comparator 2 threshold level	0 to 100.0 %		0			RW	Uni		
12.15	Comparator 2 hysteresis	0 to 25.0 %		0			RW	Uni		
12.16	Comparator 2 output <i>invert</i>	0 or 1		0			RW	Bit		
12.17	Comparator 2 output destination parameter	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R	P

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

10.13 Menu 13: Digital lock / orientation

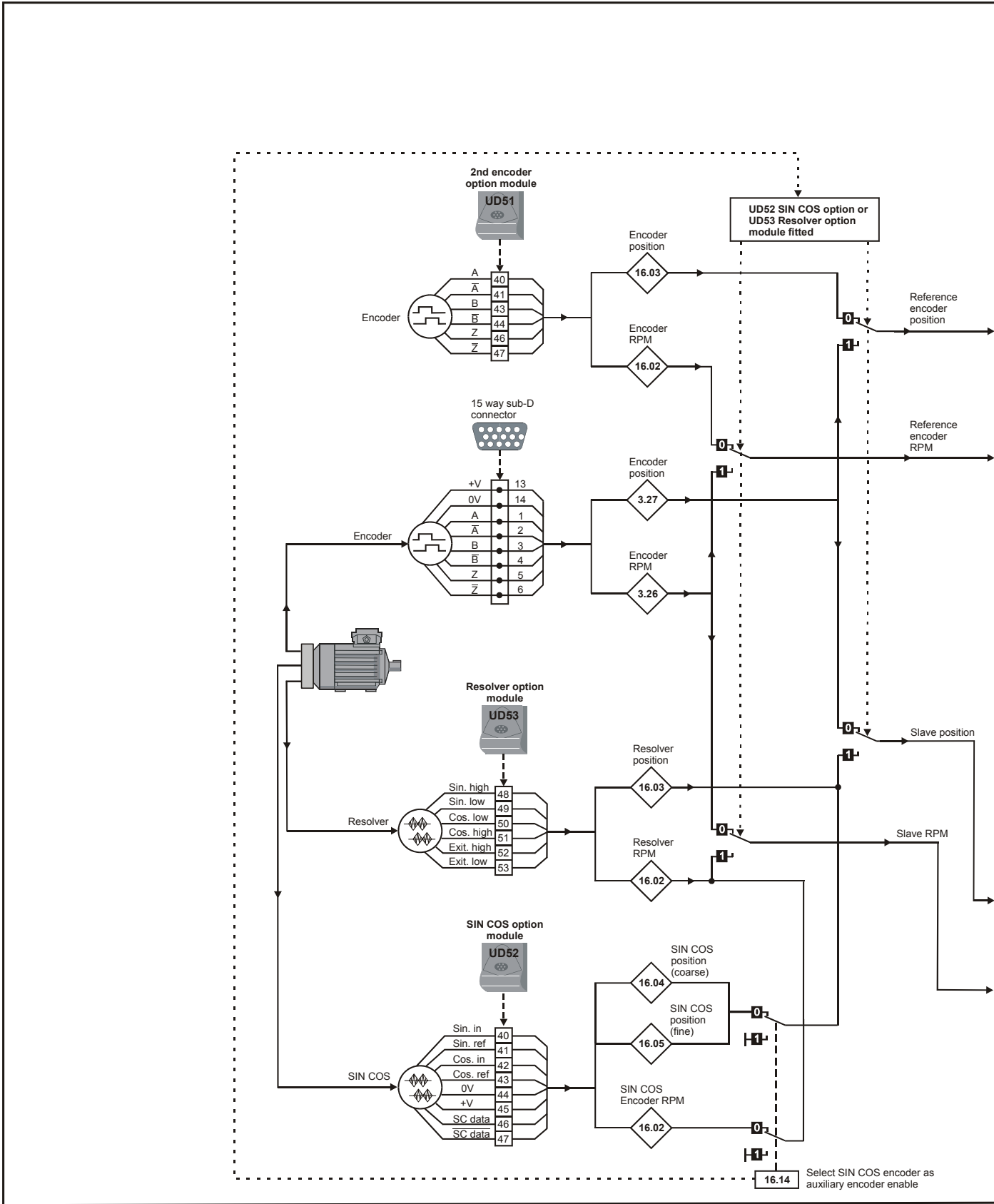
Figure 10-16 Menu 13 Open-loop logic diagram

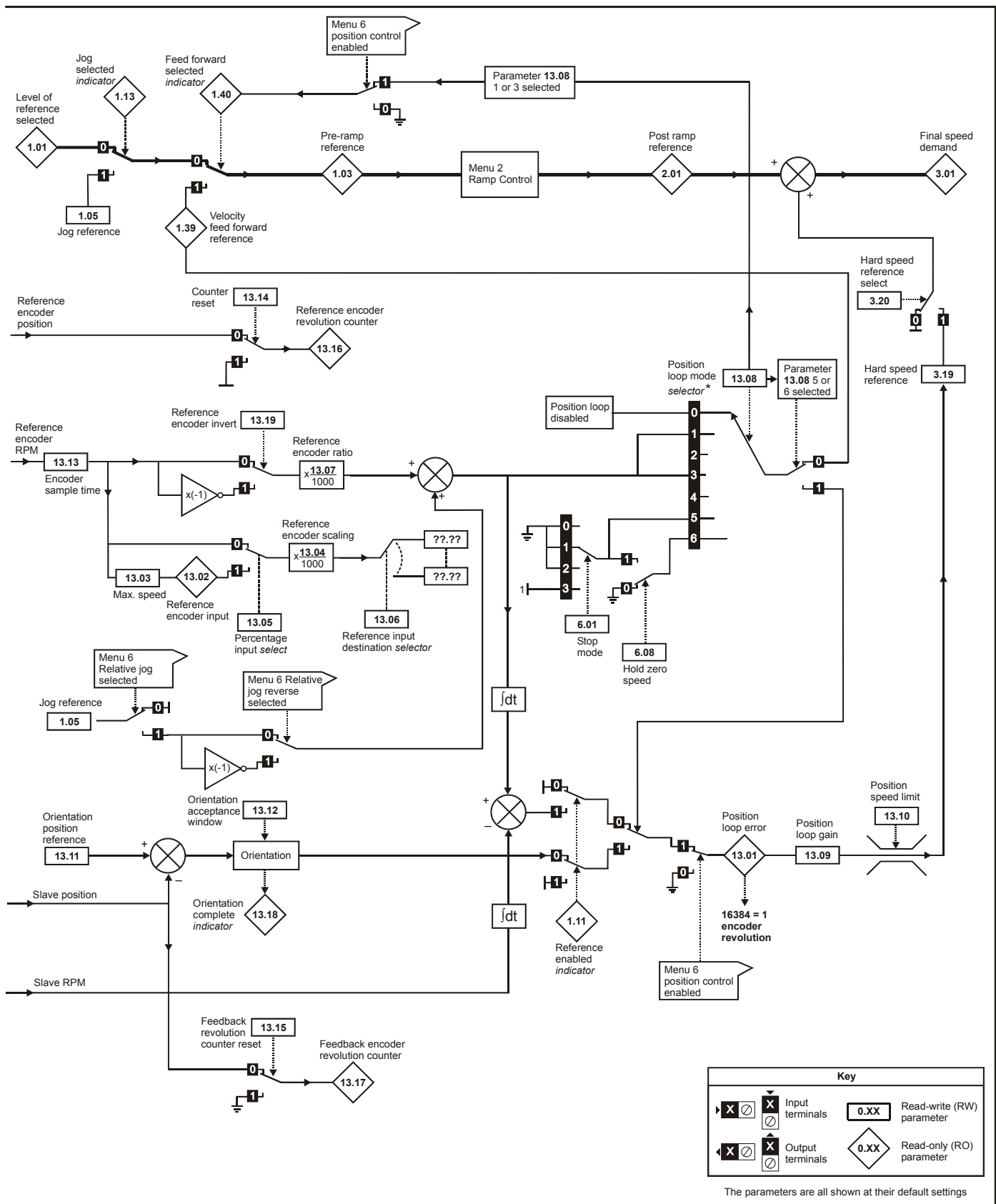




* For more information, see section 10.22.8 *Position loop modes* on page 188.

Figure 10-17 Menu 13 Closed-loop logic diagram





* For more information, see section 10.22.8 *Position loop modes* on page 188.

Parameter	Range(↕)		Default(⇒)			Type			
	OL	CL	OL	VT	SV				
13.01 Position-loop error	±16,384*					RO	Bi		P
13.02 Reference-encoder input	±100.0 %					RO	Bi		P
13.03 Maximum reference speed	0 to 30,000 rpm		1,500		3,000	RW	Uni		
13.04 Reference-encoder scaling	0.000 to 4.000		1			RW	Uni		
13.05 Percentage input <i>select</i>		0 or 1		0		RW	Bit		
13.06 Reference input destination parameter	Pr 0.00 to Pr 20.50		0			RW	Uni	R	P
13.07 Reference-encoder ratio	0 to 4.000		1			RW	Uni		
13.08 Position-loop mode <i>selector</i> ***	0 to 2	0 to 6	0			RW	Uni		
13.09 Position-loop gain	0 to 4.000		0.1			RW	Uni		
13.10 Positioning speed-limit	0 to 250 rpm		150			RW	Uni		
13.11 Orientation position reference		0 to 4095**		0		RW	Uni		
13.12 Orientation acceptance window		0 to 200**		20		RW	Uni		
13.13 Encoder sample time		0 to 5.0 ms		4.0		RW	Uni		
13.14 Reference revolution counter <i>reset</i>	0 or 1		0			RW	Bit		
13.15 Feedback revolution counter <i>reset</i>	0 or 1		0			RW	Bit		
13.16 Reference-encoder revolution counter	0 to 16,384 revolutions					RO	Bi		P
13.17 Feedback-encoder revolution counter	0 to 16,384 revolutions					RO	Bi		P
13.18 Orientation complete <i>indicator</i>		0 or 1				RO	Bit		P
13.19 Reference feedback <i>invert</i>	0 or 1		0			RW	Bit		

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 { 0.33 }

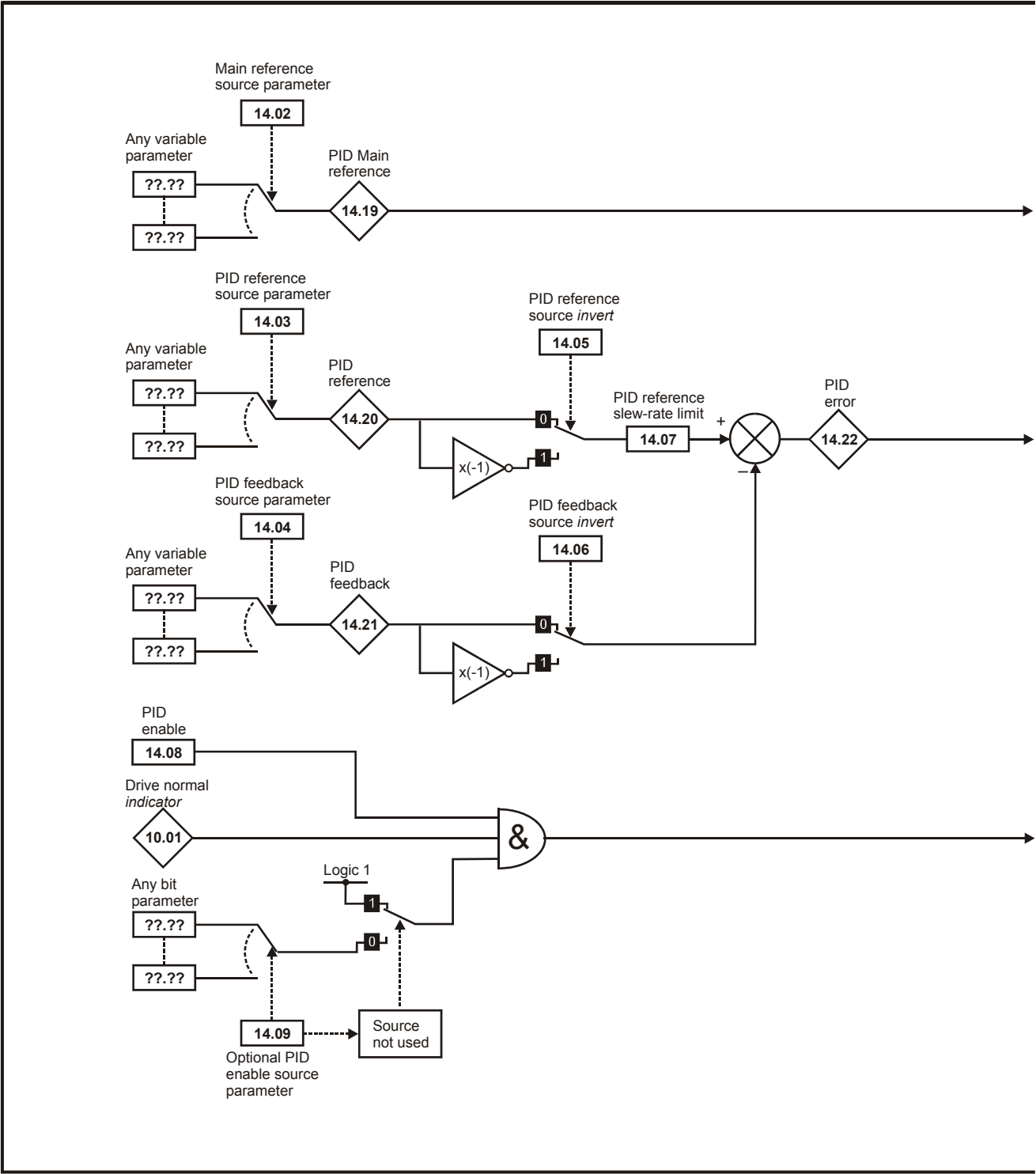
* The range of Pr **13.01** is ±16,384, where 16,384 equals 1 whole revolution. The parameter increments in steps of $1/16384$ parts of a revolution.

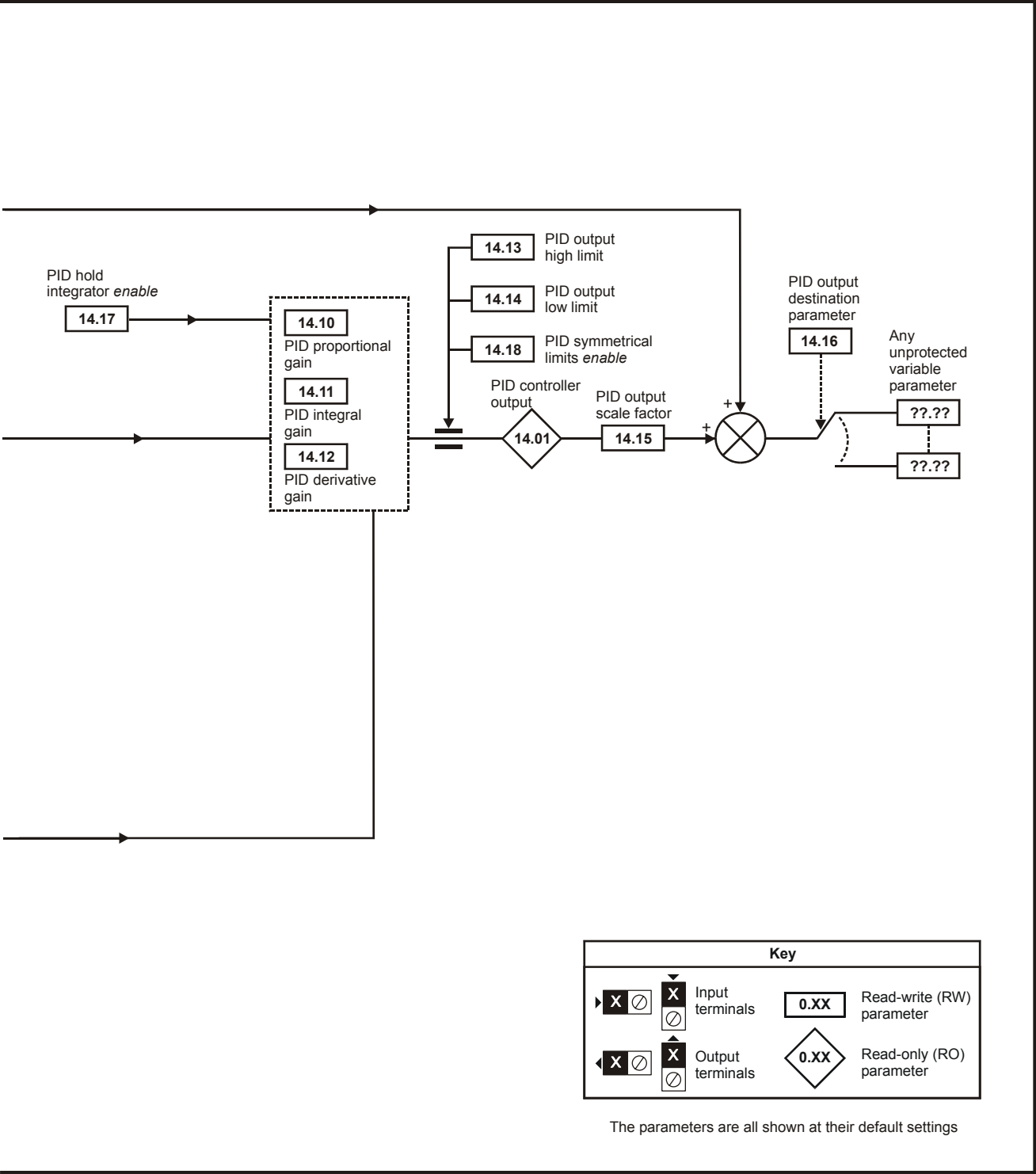
** The ranges of Pr **13.11** and Pr **13.12** are 0 to 4095 and 0 to 200 respectively. 200 is equivalent to a part of a revolution and 4095 equals 1 whole revolution. These parameters increment in steps of $1/4096$ parts of a revolution.

*** For more information, see section 10.22.8 *Position loop modes* on page 188.

10.14 Menu 14: Programmable PID function

Figure 10-18 Menu 14 logic diagram





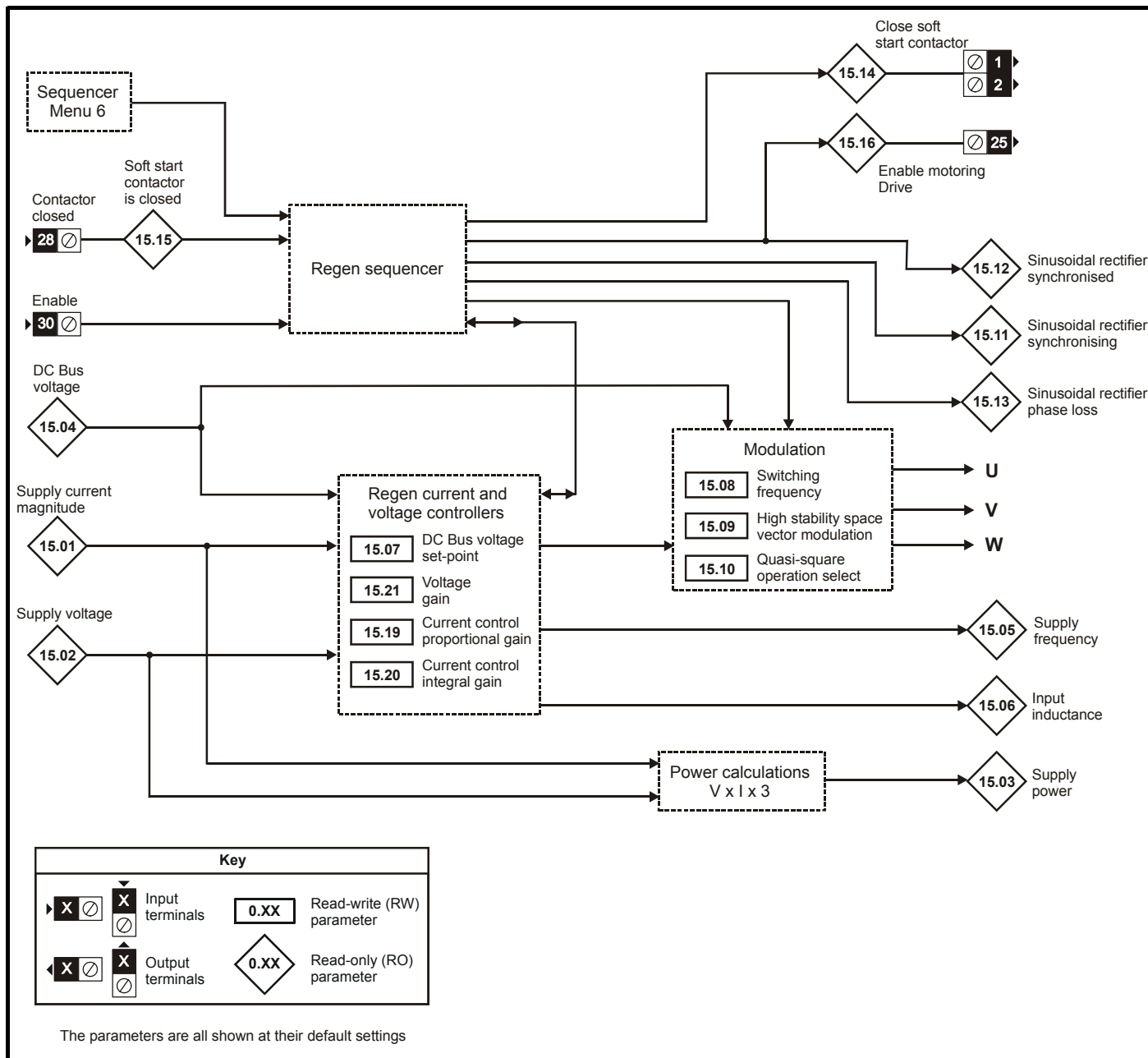
Parameter		Range(⇅)		Default(⇒)			Type			
		OL	CL	OL	VT	SV				
14.01	PID controller output	±100.0 %					RO	Bi		P
14.02	Main reference source parameter	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni		P
14.03	PID reference source parameter	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni		P
14.04	PID feedback source parameter	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni		P
14.05	PID reference <i>invert</i>	0 or 1		0			RW	Bit		
14.06	PID feedback source <i>invert</i>	0 or 1		0			RW	Bit		
14.07	PID reference slew-rate limit	0 to 3,200.0 s		0			RW	Uni		
14.08	PID <i>enable</i>	0 or 1		0			RW	Bit		
14.09	Optional PID-enable source parameter	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni		P
14.10	PID proportional gain	0 to 4.000		1			RW	Uni		
14.11	PID integral gain	0 to 4.000		0.5			RW	Uni		
14.12	PID derivative gain	0 to 4.000		0			RW	Uni		
14.13	PID output high limit	0 to 100.0%		100			RW	Uni		
14.14	PID output low limit	±100.0 %		-100			RW	Bi		
14.15	PID output scale factor	0 to 4.000		1			RW	Uni		
14.16	PID output destination parameter	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R	P
14.17	PID hold integrator <i>enable</i>	0 or 1		0			RW	Bit		
14.18	PID symmetrical limits <i>enable</i>	0 or 1		0			RW	Bit		
14.19	PID main reference	±100.0 %					RO	Bi		P
14.20	PID reference	±100.0 %					RO	Bi		P
14.21	PID feedback	±100.0 %					RO	Bi		P
14.22	PID error	±100.0 %					RO	Bi		P

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

10.15 Menu 15: Regen

Menu 15 is only available when Regen mode is selected. See the *Unidrive Regen Installation Guide* for more information.

Figure 10-19 Menu 15 logic diagram



Parameter			Range(↕)	Default(↔)	Type			
			Regen	Regen				
15.01	Supply current magnitude	{0.11}	±Maximum drive current A		RO	Bi		P
15.02	Supply voltage	{0.12}	400V drive: 0 to 528 V		RO	Uni		P
15.03	Supply power	{0.13}	± P _{max} kW		RO	Bi		P
15.04	DC Bus voltage	{0.14}	400V drive: 0 to 830 V		RO	Uni		P
15.05	Supply frequency	{0.15}	±100 Hz		RO	Bi		P
15.06	Input inductance	{0.16}	0.001 to 100 mH		RO	Uni		P
15.07	DC Bus voltage set-point	{0.17}	400V drive: 0 to 800 V	400V drive: 700	RW	Uni		
15.08	Switching frequency	{0.18}	3 (0), 4.5 (1), 6 (2), 9 (3), 12 (4) kHz	0	RW	Txt		P
15.09	High stability space vector modulation	{0.19}	0 or 1	0	RW	Bit		
15.10	Quasi-square operation select	{0.20}	0 or 1	0	RW	Bit		
15.11	Sinusoidal rectifier synchronising	{0.21}	0 or 1		RO	Bit		P
15.12	Sinusoidal rectifier synchronised	{0.22}	0 or 1		RO	Bit		P
15.13	Sinusoidal rectifier phase loss	{0.23}	0 or 1		RO	Bit		P
15.14	Close soft start contactor	{0.24}	0 or 1		RO	Bit		P
15.15	Soft start contactor is closed	{0.25}	0 or 1		RO	Bit		
15.16	Enable motor drive	{0.26}	0 or 1		RO	Bit		P
15.17	Line synchronisation trip enable	{0.27}	0 or 1	0	RO	Bit		
15.18	Line synchronisation status	{0.28}	SYNC (0), Ph Det (1), Fr Lo (2), Fr Hi (3), PLL OI (4), PLL Ph (5)		RO	Txt		P
15.19	Current control proportional gain		0 to 30,000	110	RW	Uni		
15.20	Current control integral gain		0 to 30,000	1,000	RW	Uni		
15.21	Voltage control proportional gain		0 to 30,000	4,000	RW	Uni		
15.22	Enable extra mains loss detection		0 or 1	0	RW	Bit		

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

FLC Full load current of the drive (maximum continuous output current up to 40°C ambient temperature). Displayed in Pr 11.32 {0.33}.

I_{MAX} A For definition of I_{MAX}, see section *Types of current range* on page 138.

$$P_{MAX} = \sqrt{3} \times I_{MAX} \times \frac{Pr\ 5.09}{1000}$$

NOTE

Where a parameter is represented by a text value, the value in brackets in the range column is the setting used for serial communications.

10.16 Menu 16 Small option module set-up

Menu 16 is only available when either a UD50, UD51, UD52 or UD53 small option module is fitted.

Figure 10-20 Menu 16 UD50 logic diagram, part 1

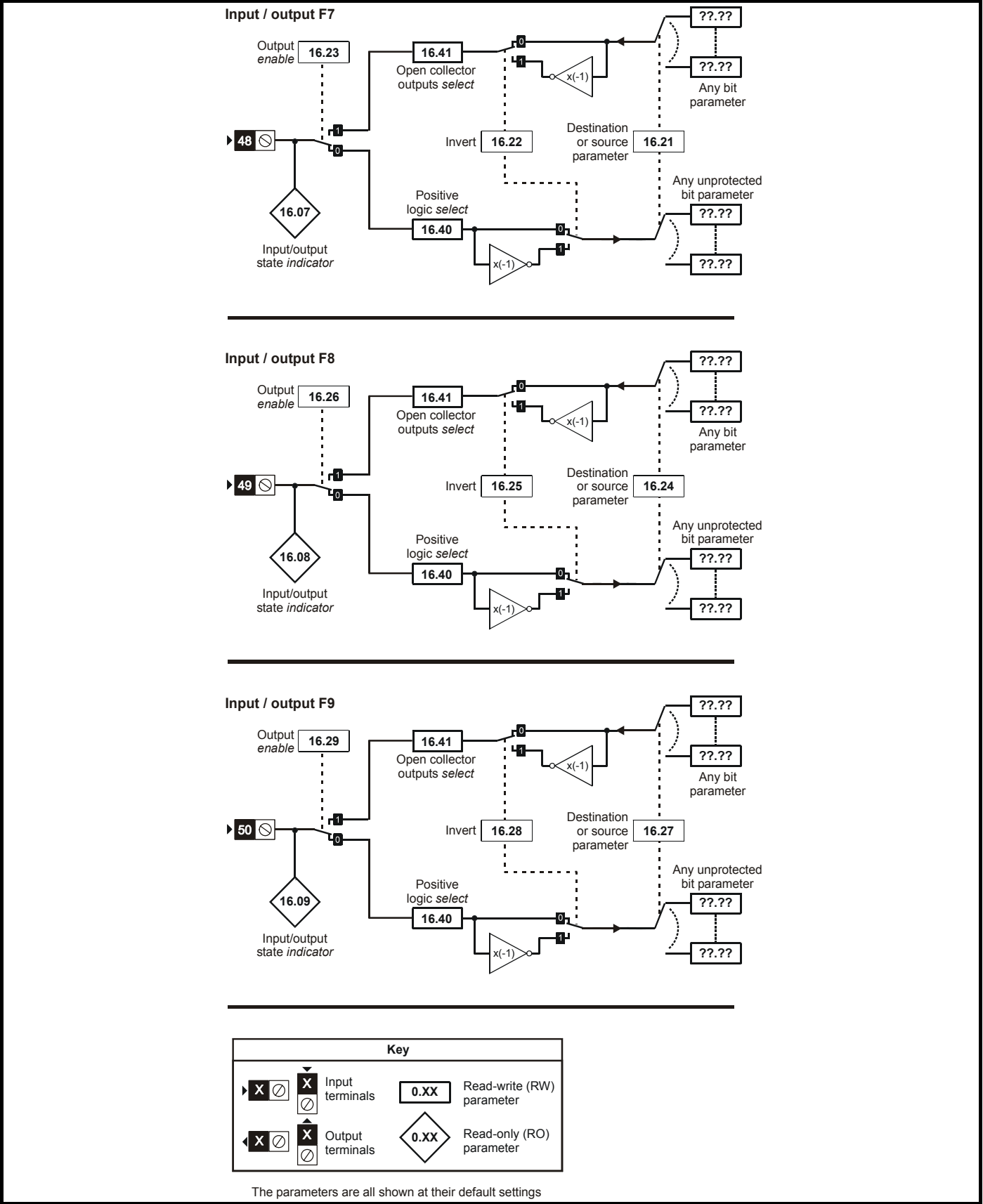
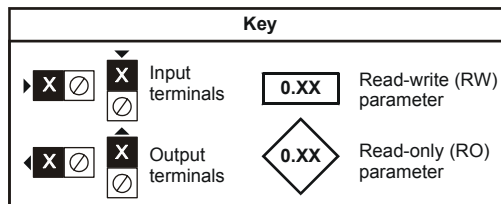
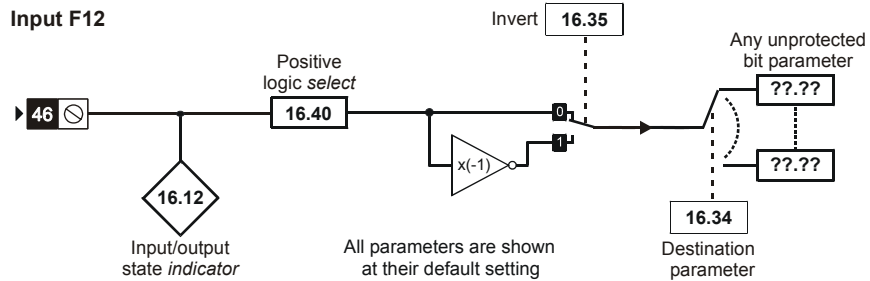
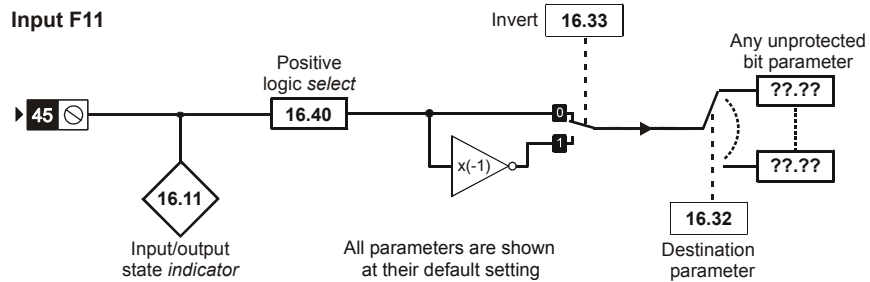
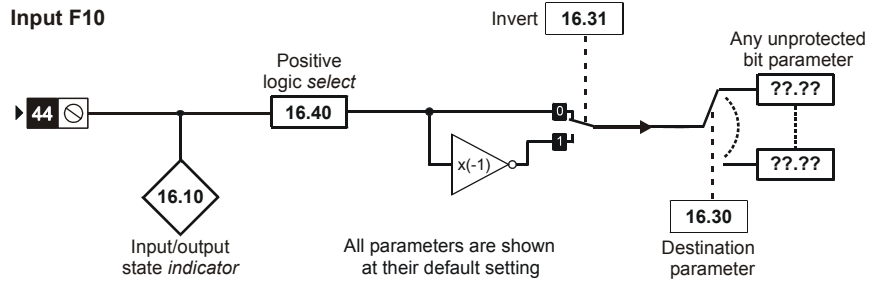


Figure 10-21 Menu 16 UD50 logic diagram, part 2



The parameters are all shown at their default settings

Figure 10-22 Menu 16 UD50 logic diagram, part 3

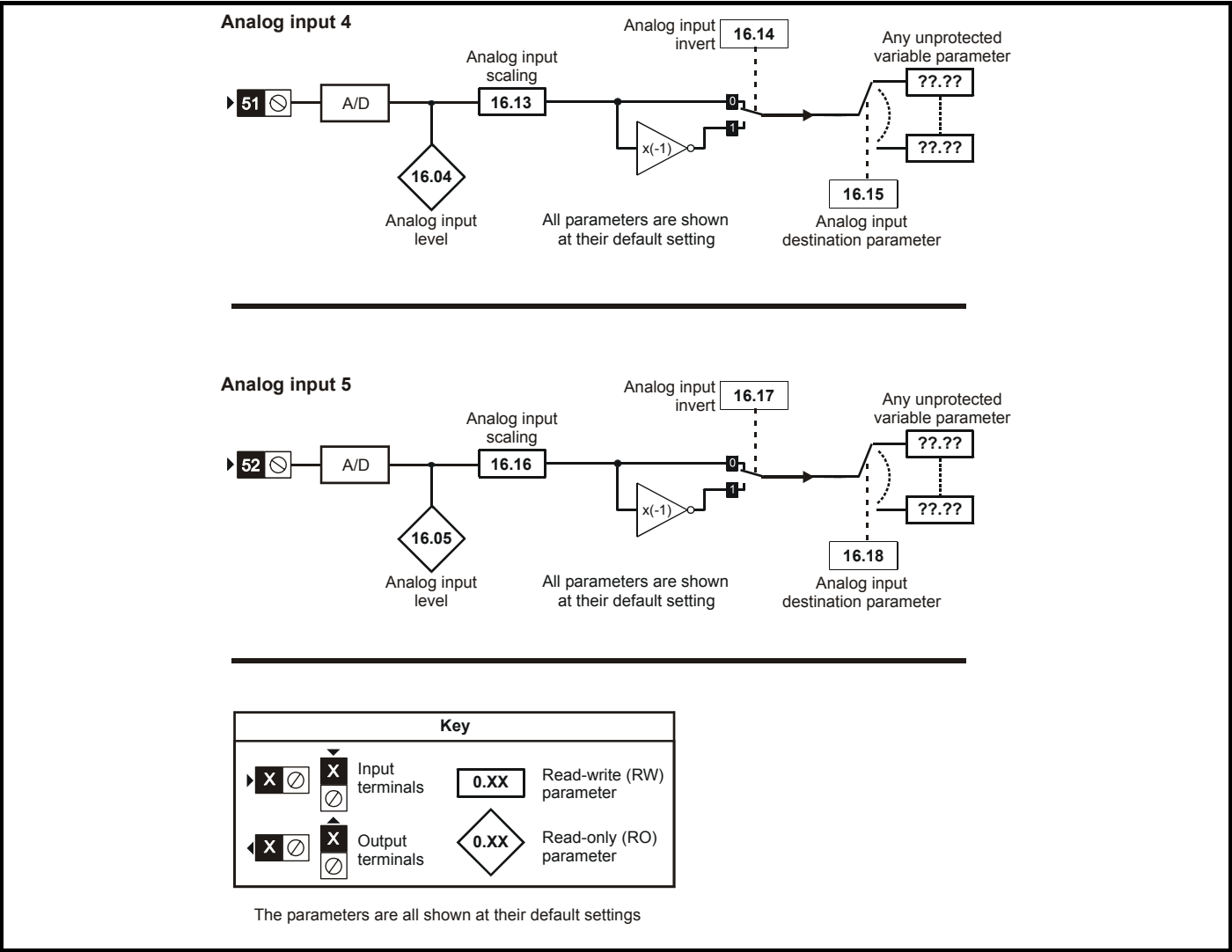
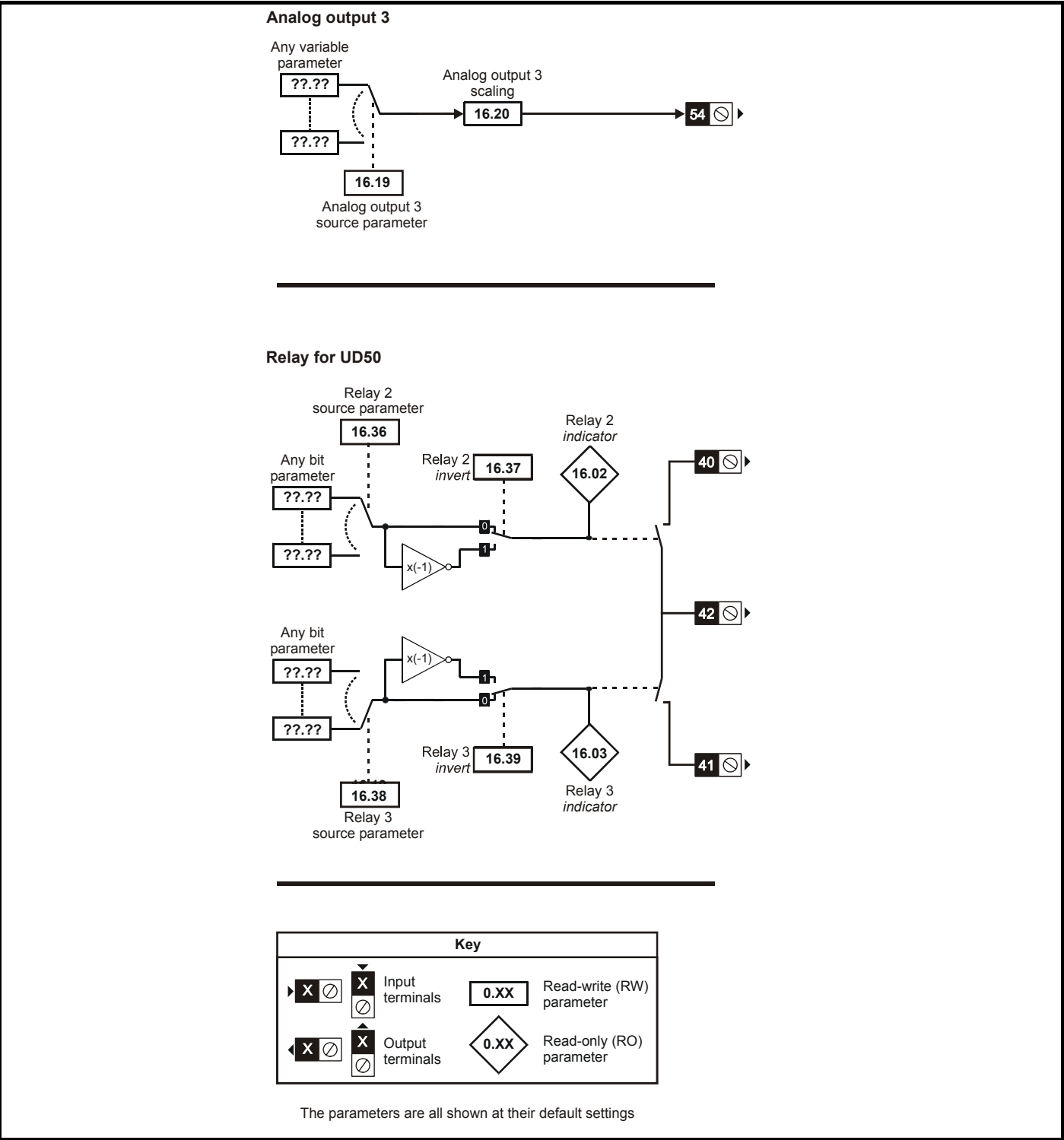


Figure 10-23 Menu 16 UD50 logic diagram, part 4

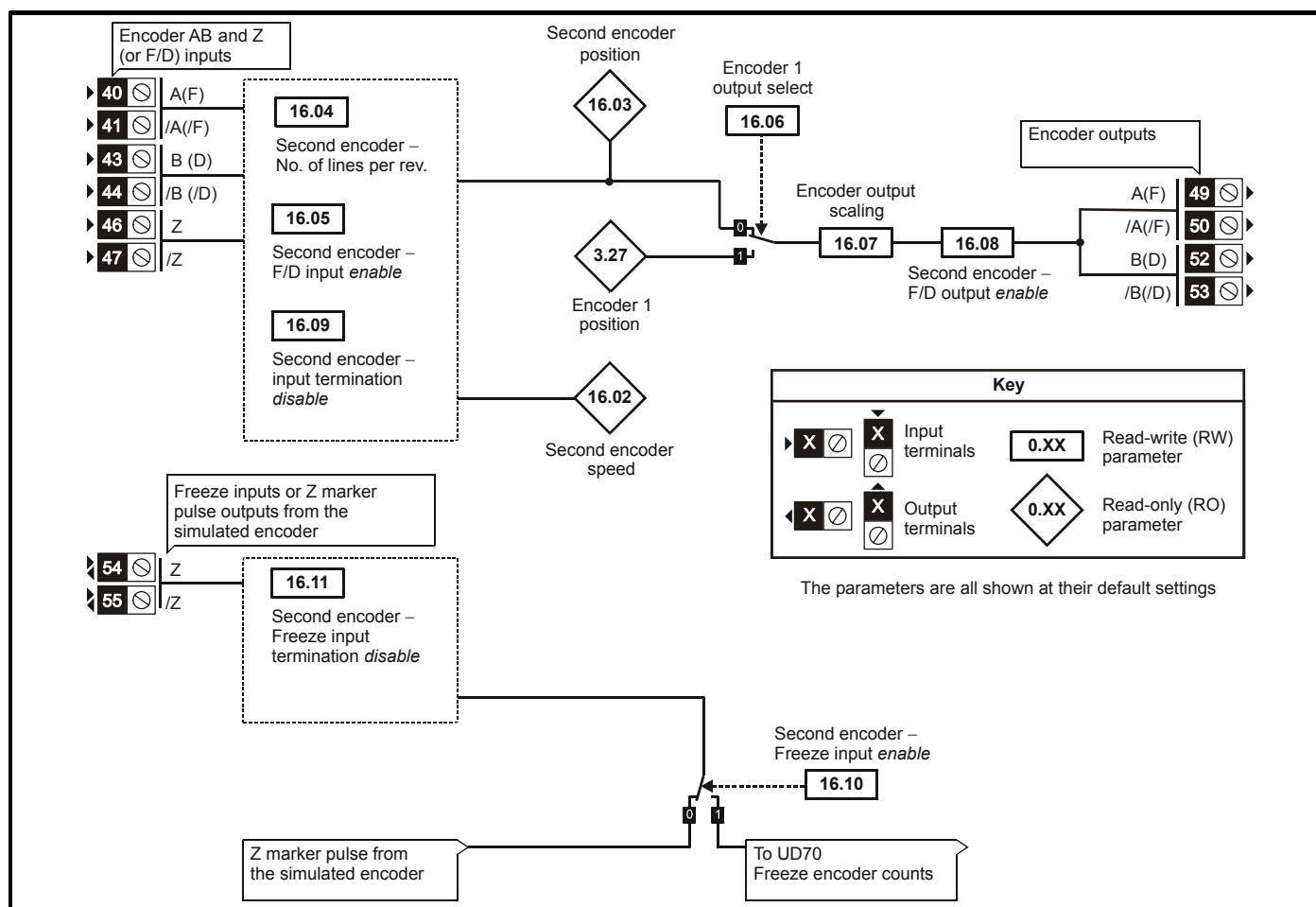


UD50 Additional I/O small option module parameter list

Parameter		Range(⇅)		Default(⇨)			Type			
		OL	CL	OL	VT	SV				
16.01	Option module code	0 to 100		1			RO	Uni		P
16.02	Relay 2 output indicator	0 or 1					RO	Bit		P
16.03	Relay 3 output indicator	0 or 1					RO	Bit		P
16.04	Analog input 4	±100.0 %					RO	Bi		P
16.05	Analog input 5	±100.0 %					RO	Bi		P
16.07	Logic input F7 / Output 7 indicator	0 or 1					RO	Bit		P
16.08	Logic input F8 / Output 8 indicator	0 or 1					RO	Bit		P
16.09	Logic input F9 / Output 9 indicator	0 or 1					RO	Bit		P
16.10	Logic input F10	0 or 1					RO	Bit		P
16.11	Logic input F11	0 or 1					RO	Bit		P
16.12	Logic input F12	0 or 1					RO	Bit		P
16.13	Analog input 4 scaling	0.000 to 4.000		1.000			RW	Uni		
16.14	Analog input 4 invert bit	0 or 1		0			RW	Bit		
16.15	Analog input 4 destination	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R	P
16.16	Analog input 5 scaling	0.000 to 4.000		1.000			RW	Uni		
16.17	Analog input 5 invert bit	0 or 1		0			RW	Bit		
16.18	Analog input 5 destination	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R	P
16.19	DAC Output 3 source	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R	P
16.20	DAC Output 3 scaling	0.000 to 4.000		1.000			RW	Uni		
16.21	F7 input destination / output source	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R	P
16.22	F7 input/output invert	0 or 1		0			RW	Bit		
16.23	F7 output enable	0 or 1		0			RW	Bit	R	
16.24	F8 input destination / output source	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R	P
16.25	F8 input/output invert	0 or 1		0			RW	Bit		
16.26	F8 output enable	0 or 1		0			RW	Bit	R	
16.27	F9 input destination / output source	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R	P
16.28	F9 input/output invert	0 or 1		0			RW	Bit		
16.29	F9 output enable	0 or 1		0			RW	Bit	R	
16.30	F10 input destination	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R	P
16.31	F10 input invert	0 or 1		0			RW	Bit		
16.32	F11 input destination	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R	P
16.33	F11 input invert	0 or 1		0			RW	Bit		
16.34	F12 input destination	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R	P
16.35	F12 input invert	0 or 1		0			RW	Bit		
16.36	Relay 2 source	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R	P
16.37	Relay 2 output invert	0 or 1		0			RW	Bit		
16.38	Relay 3 source	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni	R	P
16.39	Relay 3 output invert	0 or 1		0			RW	Bit		
16.40	Logic input polarity	0 or 1		0			RW	Bit	R	P
16.41	Open collector outputs	0 or 1		0			RW	Bit	R	P

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

Figure 10-24 Menu 16 UD51 logic diagram

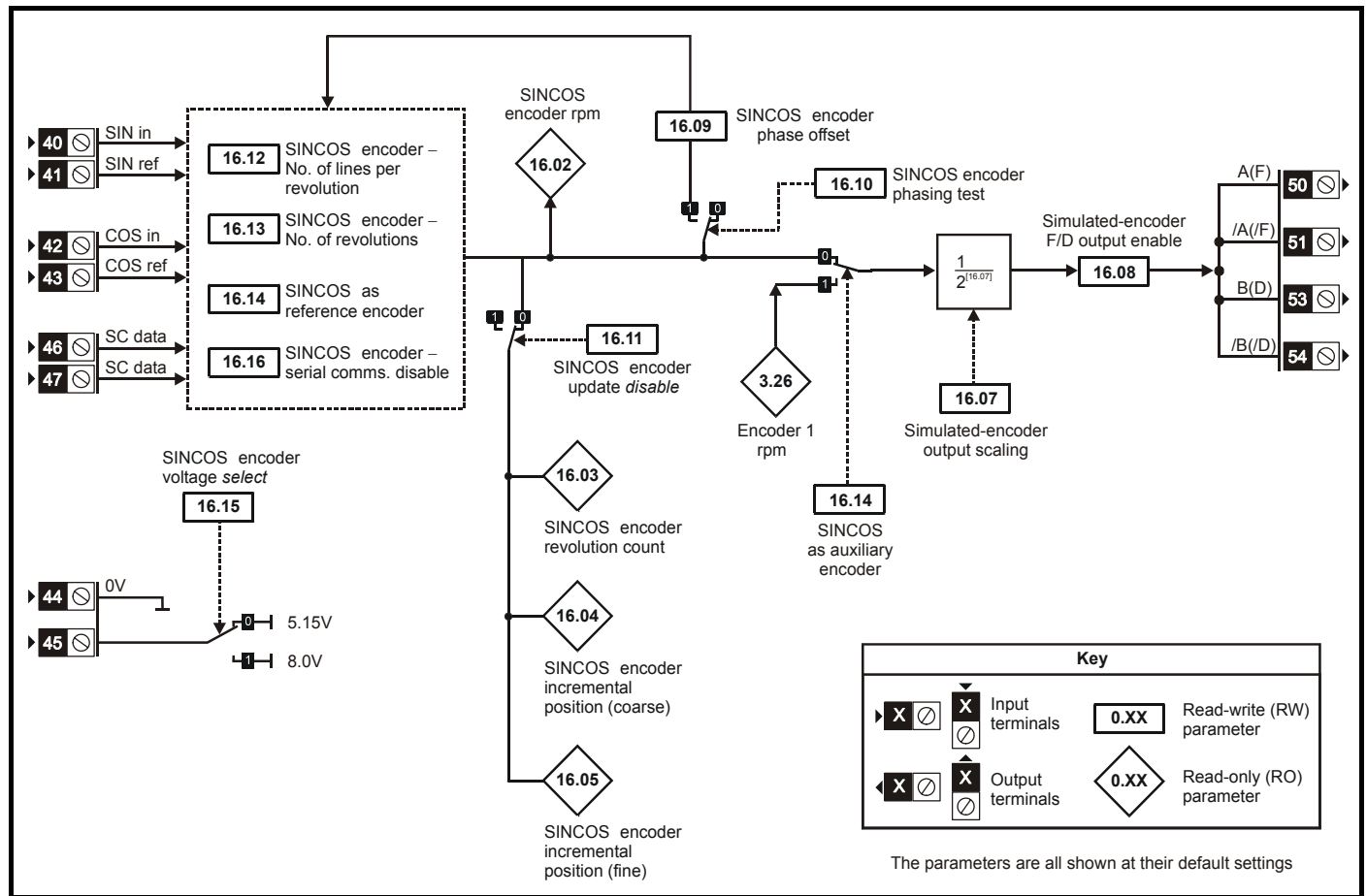


UD51 Second encoder small option module parameter list

Parameter	Range(↕)		Default(⇒)			Type
	OL	CL	OL	VT	SV	
16.01 Option module code	0 to 100		2			RO Uni P
16.02 Encoder 2 input rpm	±30,000 rpm					RO Bi P
16.03 Encoder 2 position	0 to 16,384 revolutions/16,384					RO Uni P
16.04 No. of Encoder lines / Pulses per rev	0 to 10,000 (F+D input, Pr 16.05 = 1) 0 to 5000 (Quadrature input, Pr 16.05 = 0)		1,024			RW Uni
16.05 Frequency input select	0 or 1		0			RW Bit
16.06 Encoder 1 output select	0 or 1		0			RW Bit
16.07 Encoder output scaling	0 to 15 (power of 2)		0			RW Uni
16.08 F/D output select	0 or 1		0			RW Bit
16.09 Encoder termination disable	0 or 1		0			RW Bit
16.10 Enable freeze input (disable Z output)	0 or 1		0			RW Bit
16.11 Disable freeze input termination	0 or 1		0			RW Bit
16.12 Encoder marker simulation synchronisation disable	0 or 1		0			RW Bit
16.13 Encoder marker simulation synchronisation inactive	0 or 1					RO Bit P

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous)

Figure 10-25 Menu 16 UD52 logic diagram

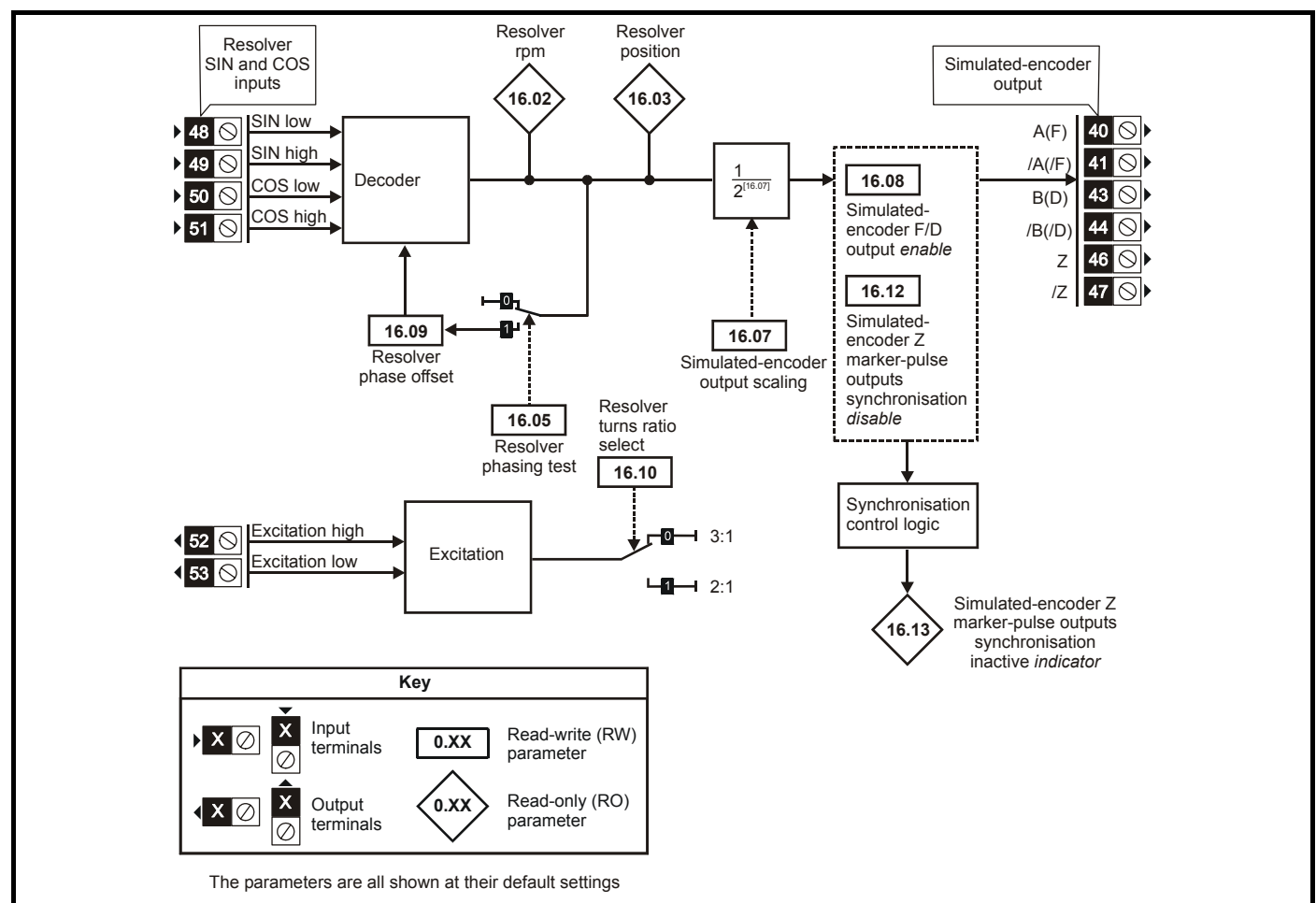


UD52 SINCOS small option module parameter list

Parameter	Range(↕)		Default(⇒)			Type		
	OL	CL	OL	VT	SV			
16.01	Option module code	0 to 100		4		RO	Uni	P
16.02	SINCOS encoder rpm	±30,000 rpm				RO	Bi	P
16.03	SINCOS encoder revolution count	0 to 32,767 revolutions				RO	Uni	P
16.04	SINCOS encoder position	0 to 16,383 revolutions/ 16,384				RO	Uni	P
16.05	SINCOS encoder position fine	0 to 255 revolutions/ 4,194,304				RO	Uni	P
16.06	SINCOS encoder 1 output select	0 or 1		0		RW	Bit	
16.07	SINCOS encoder output scaling	0 to 15 (power of 2)		0		RW	Uni	
16.08	F/D output select	0 or 1		0		RW	Bit	
16.09	Phasing offset	0 to 6143				RW	Uni	S P
16.10	SINCOS encoder phasing test	0 or 1		0		RW	Bit	
16.11	Update disable	0 or 1		0		RW	Bit	
16.12	Number of encoder lines per revolution	256 (0), 512 (1), 1024 (2), 2048 (3), 4096 (4) encoder lines per revolution		512 (1)		RW	Uni	
16.13	Number of encoder turns	0 to 15 (power of 2)		0		RW	Uni	
16.14	SINCOS as auxiliary encoder	0 or 1		0		RW	Bit	
16.15	SINCOS encoder supply voltage select	0 or 1		0		RW	Bit	
16.16	Serial comms disable	0 or 1		0		RW	Bit	
16.17	Interpolation disable	0 or 1		0		RW	Bit	

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous)

Figure 10-26 Menu 16 UD53 logic diagram



UD53 Resolver small option module parameter list

Parameter	Range(\updownarrow)		Default(\Rightarrow)			Type		
	OL	CL	OL	VT	SV			
16.01 Option module code		0 to 100		1		RO	Uni	P
16.02 Resolver rpm		$\pm 30,000$ rpm				RO	Bi	P
16.03 Resolver position		0 to 16,384 revolutions/ 16,384				RO	Uni	P
16.05 Resolver phasing test		0 or 1		0		RW	Bit	
16.06 Encoder select for encoder simulation		0 or 1		0		RW	Bit	
16.07 Encoder output scaling		0 to 15 (power of 2)		0		RW	Uni	
16.08 F/D output select		0 or 1		0		RW	Bit	
16.09 Phasing offset		0 to 6143				RW	Uni	S P
16.10 Low ratio resolver select		0 or 1		0		RW	Bit	
16.12 Encoder marker simulation synchronisation disable		0 or 1		0		RW	Bit	
16.13 Encoder simulation marker synchronisation inactive		0 or 1				RO	Bit	P

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

10.17 Menu 17: Large option module set-up

Parameter		Range(↕)		Default(↔)			Type			
		OL	CL	OL	VT	SV				
17.01	Option module code	0 to 100					RO	Uni		P
17.02	Option module software version	0.00 to 99.99					RO	Uni		P
17.03	DPL line number where trip occurred	0 to 32,000					RO	Uni		P
17.04	Available resource in %	0 to 100 %					RO	Uni		P
17.05	RS485 Address	1 to 99		11			RW	Uni		P
17.06	RS485 Mode	0 to 255		1			RW	Uni		P
17.07	RS485 Baud rate	300 (0), 600 (1), 1200 (2), 2400 (3), 4800 (4), 9600 (5), 19200 (6), 38400 (7), 76800 (8)		4800 (4)			RW	Txt		P
17.08	RS485 Parameter pointer 1	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni		P
17.09	RS485 Parameter pointer 2	Pr 0.00 to Pr 20.50		Pr 0.00			RW	Uni		P
17.10	Serial scaling factor	0.000 to 4.000		1.000			RW	Uni		
17.11	Clock task tick time	0 to 100 ms		10			RW	Uni		P
17.12	Position controller set-up	0 to 255		0			RW	Uni		P
17.13	Auto-run	0 or 1		1			RW	Bit		
17.14	Global run-time trip enable	0 or 1		0			RW	Bit		
17.15	RS485 Trip enable	0 or 1		0			RW	Bit		
17.16	IO link RS485 synchronisation source	0 or 1		0			RW	Bit		
17.17	Trip if parameter write over-ranges	0 or 1		0			RW	Bit		
17.18	Watchdog trip enable	0 or 1		0			RW	Bit		
17.19	Non-volatile data save request	0 or 1		0			RW	Bit		
17.20	Non-volatile data power down save	0 or 1		0			RW	Bit		
17.21	Enable dumb-terminal mode	0 or 1		0			RW	Bit		
17.22	LOM set-up parameter	0 or 1		0			RW	Bit		
17.23	LOM set-up parameter	0 or 1		0			RW	Bit		
17.24	LOM set-up parameter	0 or 1		0			RW	Bit		
17.25	LOM set-up parameter	0 or 1		0			RW	Bit		
17.26	LOM set-up parameter	0 or 1		0			RW	Bit		
17.27	LOM set-up parameter	0 or 1		0			RW	Bit		
17.28	LOM set-up parameter	0 or 1		0			RW	Bit		

NOTE

Where a parameter is represented by a text value, the value in brackets in the range column is the setting used for serial communications.

10.18 Menu 18: Application menu 1

Parameter		Range(↕)		Default(↔)			Type			
		OL	CL	OL	VT	SV				
18.01	Application menu 1 read write integer	±32,000		0			RW	Bi	S	
18.02 to 18.10	Application menu 1 read only integers	±32,000		0			RO	Bi		
18.11 to 18.30	Application menu 1 read write integers	±32,000		0			RW	Bi		
18.31 to 18.50	Application menu 1 read write bits	0 or 1		0			RW	Bit		

RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr 11.32 {0.33}

10.19 Menu 19: Application menu 2

Parameter		Range(⇅)		Default(⇒)			Type			
		OL	CL	OL	VT	SV				
19.01	Application menu 2 read write integer	±32,000		0			RW	Bi	S	
19.02 to 19.10	Application menu 2 read only integers	±32,000		0			RO	Bi		
19.11 to 19.30	Application menu 2 read write integers	±32,000		0			RW	Bi		
19.31 to 19.50	Application menu 2 read write bits	0 or 1		0			RW	Bit		

10.20 Menu 20: Large option module

Parameter		Range(⇅)		Default(⇒)			Type			
		OL	CL	OL	VT	SV				
20.00 to 20.50	LOM user integer parameters	±32,000		0			RW	Bi		

Menu 20 is only available when a UD70 large option module is fitted.

Parameters 20.01 to 20.20 and 20.50 are reserved for use with the high-speed communication UD70 option modules.

NOTE

The menu 20 parameters are stored in the non-volatile memory in the UD70 and not in the drive. To store these parameters set Pr 17.19 at 1. Parameters will be stored at power down when Pr 17.20 is set to 1.

Parameter	UD73 Profibus-DP		UD74 Interbus-S		UD75 CT NET	
	Description	Default	Description	Default	Description	Default
20.01	OUT Channel 2 Mapping	121	OUT Channel 2 Mapping	121	Node Address	0
20.02	OUT Channel 3 Mapping	408	OUT Channel 3 Mapping	408	Network Data Rate	0
20.03	IN Channel 2 Mapping	201	IN Channel 2 Mapping	201	Synchronisation Message	0
20.04	IN Channel 3 Mapping	402	IN Channel 3 Mapping	402	OUT Slot 1 Destination Node	0
20.05	Node Address	0	Reserved	0	OUT Slot 1 Source/Destination	0
20.06	OUT Channel 1 Mapping	9011	OUT Channel 1 Mapping	9011	OUT Slot 2 Destination Node	0
20.07	IN Channel 1 Mapping	9011	IN Channel 1 Mapping	9011	OUT Slot 2 Source/Destination	0
20.08	Reserved	0	Reserved	0	OUT Slot 3 Destination Node	0
20.09	Reserved	0	Reserved	0	OUT Slot 3 Source/Destination	0
20.10	Reserved	0	Reserved	0	IN Slot 1	0
20.11	Trip Delay Time (ms)	48	Trip Delay Time (ms)	48	IN Slot 2	0
20.12	Reserved	0	Reserved	0	IN Slot 3	0
20.13	Data Endian Format	0	Reserved	0	Reserved	0
20.14	Option ID Code		Option ID Code		Reserved	0
20.15	Firmware Version		Firmware Version		Reserved	0
20.16	Reserved	0	Reserved	0	Reserved	0
20.17	Reserved	0	Reserved	0	Reserved	0
20.18	Reserved	0	Reserved	0	Reserved	0
20.19	Reserved	0	Reserved	0	Reserved	0
20.20	Reserved	0	Reserved	0	Reserved	0
20.50	Fieldbus Diagnostic		Fieldbus Diagnostic		Fieldbus Diagnostic	

Parameter	UD76 Modbus Plus		UD77 Device Net		UD77 CAN / CAN Open	
	Description	Default	Description	Default	Description	Default
20.01	Node Address		OUT Channel 2 Mapping	121	RxPDO1 Word 2 Mapping	121
20.02	Negative Number Format	0	OUT Channel 3 Mapping	408	RxPDO1 Word 3 Mapping	408
20.03	Reserved	0	IN Channel 2 Mapping	201	TxPDO1 Word 2 Mapping	201
20.04	IN Slot 1 source node/slot	0	IN Channel 3 Mapping	402	TxPDO1 Word 3 Mapping	402
20.05	IN Slot 1 destination	0	Node Address	0	Node Address	0
20.06	IN Slot 2 source node/slot	0	OUT Channel 1 Mapping	9011	RxPDO1 Word 1 Mapping	9011
20.07	IN Slot 2 destination	0	IN Channel 1 Mapping	9011	TxPDO1 Word 1 Mapping	9011
20.08	IN Slot 3 source node/slot	0	Data Rate	0	Data Rate	0
20.09	IN Slot 3 destination	0	Node Status		SYNC Generation Time	0
20.10	OUT Slot 1 source	0	Network Status		Auto-Start Enable	0
20.11	OUT Slot 2 source	0	Trip Delay Time (ms)	48	Network Loss Trip Time (ms)	0
20.12	OUT Slot 3 source	0	Product Code Elaboration	0	Reserved	0
20.13	IN Slot 4, 5 source	0	Reserved	0	Reserved	0
20.14	IN Slot 6, 7 source	0	Option ID Code		Fieldbus ID Code	
20.15	IN Slot 8, 9 source	0	Firmware Version		CANopen Firmware	
20.16	IN Slot 10, 11 source	0	Reserved	0	RxPDO2 COB-ID	0
20.17	IN Slot 12, 13 source	0	Reserved	0	TxPDO2 COB-ID	0
20.18	Reserved	0	Reserved	0	Reserved	0
20.19	Reserved	0	Reserved	0	Reserved	0
20.20	Reserved	0	Reserved	0	Reserved	0
20.50	Fieldbus Diagnostic		Fieldbus Diagnostic		Fieldbus Diagnostic	

Shading denotes RO parameter

10.21 Unidrive VTC parameter range and default differences

The following parameters have a different range and/or default value between Unidrive VTC and open-loop Unidrive. Any parameter not listed below has the same range and default value as open-loop Unidrive.

Parameter			Range	Default	Type			
Menu 1								
1.06	Maximum frequency	{0.02}	0 to 250.0 Hz	EUR> 50.0, USA> 60.0	RW	Uni		
1.07	Minimum frequency	{0.01}	0 to [Pr 1.06], if Pr 1.08 = 0 -250.0 Hz to 0, if Pr 1.08 = 1	0	RW	Uni		
1.14	Reference selector	{0.05}	0 to 5	0	RW	Uni		
Menu 2								
2.07	S-ramp da/dt	{0.19}	0 to 3,000.0 s ² /100 Hz	450.0	RW	Uni		
2.11	Acceleration rate 1 / Forward acceleration rate 1	{0.03}	0 to 3,200.0 s/100Hz	60.0	RW	Uni		
2.12	Acceleration rate 2 / Forward acceleration rate 2		0 to 3,200.0 s/100Hz	60.0	RW	Uni		
2.13	Acceleration rate 3 / Forward acceleration rate 3		0 to 3,200.0 s/100Hz	60.0	RW	Uni		
2.14	Acceleration rate 4 / Forward acceleration rate 4		0 to 3,200.0 s/100Hz	60.0	RW	Uni		
2.15	Acceleration rate 5 / Reverse acceleration rate 1		0 to 3,200.0 s/100Hz	60.0	RW	Uni		
2.16	Acceleration rate 6 / Reverse acceleration rate 2		0 to 3,200.0 s/100Hz	60.0	RW	Uni		
2.17	Acceleration rate 7 / Reverse acceleration rate 3		0 to 3,200.0 s/100Hz	60.0	RW	Uni		
2.18	Acceleration rate 8 / Reverse acceleration rate 4		0 to 3,200.0 s/100Hz	60.0	RW	Uni		
2.21	Deceleration rate 1 / Forward deceleration rate 1	{0.04}	0 to 3,200.0 s/100Hz	60.0	RW	Uni		
2.22	Deceleration rate 2 / Forward deceleration rate 2		0 to 3,200.0 s/100Hz	60.0	RW	Uni		
2.23	Deceleration rate 3 / Forward deceleration rate 3		0 to 3,200.0 s/100Hz	60.0	RW	Uni		
2.24	Deceleration rate 4 / Forward deceleration rate 4		0 to 3,200.0 s/100Hz	60.0	RW	Uni		
2.25	Deceleration rate 5 / Reverse deceleration rate 1		0 to 3,200.0 s/100Hz	60.0	RW	Uni		
2.26	Deceleration rate 6 / Reverse deceleration rate 2		0 to 3,200.0 s/100Hz	60.0	RW	Uni		
2.27	Deceleration rate 7 / Reverse deceleration rate 3		0 to 3,200.0 s/100Hz	60.0	RW	Uni		
2.28	Deceleration rate 8 / Reverse deceleration rate 4		0 to 3,200.0 s/100Hz	60.0	RW	Uni		
Menu 3								
3.29	Over-speed threshold mode select		0	0	RW	Bit		
Menu 4								
4.05	Motoring current limit		0 to I _{MAX} %	120.0	RW	Uni		
4.06	Regenerating current limit		0 to I _{MAX} %	120.0	RW	Uni		
4.07	Symmetrical current limit	{0.06}	0 to I _{MAX} %	120.0	RW	Uni		
Menu 5								
5.06	Motor – rated frequency	{0.47}	0 to 250.0 Hz	EUR> 50.0, USA> 60.0	RW	Uni		
5.14	Voltage mode selector	{0.07}	Fd (3)	Fd (3)	RW	Uni		
5.15	Boost voltage	{0.08}	0 to 15.0 %	3.0	RW	Uni		
5.16	Jog boost voltage		0 to 15.0 %	3.0	RW	Uni		
Menu 7								
7.11	Analog input 2 mode selector		VOLT (0), 0 - 20 (1), 20 - 0 (2), 4 - 20.tr (3), 20 - 4.tr (4), 4 - 20.Lo (5), 20 - 4.Lo (6), 4 - 20.Pr (7), 20 - 4.Pr (8)	EUR> VOLT (0), USA> 4 - 20.Lo (5)	RW	Txt	R	
7.19	Analog output 1 source parameter		Pr 0.00 to Pr 20.50	Pr 2.01	RW	Uni	R	P
7.22	Analog output 2 source parameter		Pr 0.00 to Pr 20.50	Pr 4.01	RW	Uni	R	P
7.23	Analog output 2 output scaling		0 to 4.000	EUR> 1.000, USA> 1.250	RW	Uni		
Menu 8								
8.10	F1 destination or source parameter		Pr 0.00 to Pr 20.50	EUR> Pr 10.06 USA> Pr 10.02	RW	Uni	R	P
8.16	F3 destination or source parameter		Pr 0.00 to Pr 20.50	Pr 1.45	RW	Uni	R	P
8.21	F5 destination parameter		Pr 0.00 to Pr 20.50	EUR> Pr 6.32 USA> Pr 1.41	RW	Uni	R	P
8.23	F6 destination parameter		Pr 0.00 to Pr 20.50	Pr 1.42	RW	Uni	R	P
Menu 9								
9.23	Motorised pot. rate		0 to 250 s	30	RW	Uni		

Parameter		Range	Default	Type			
Menu 11							
11.04	Parameter 0.14 assignment	Pr 0.00 to Pr 20.50	Pr 4.01	RW	Uni		P
11.07	Parameter 0.17 assignment	Pr 0.00 to Pr 20.50	Pr 5.03	RW	Uni		P
11.12	Parameter 0.22 assignment	Pr 0.00 to Pr 20.50	Pr 11.32	RW	Uni		P
11.13	Parameter 0.23 assignment	Pr 0.00 to Pr 20.50	Pr 7.06	RW	Uni		P
11.14	Parameter 0.24 assignment	Pr 0.00 to Pr 20.50	Pr 1.21	RW	Uni		P
11.15	Parameter 0.25 assignment	Pr 0.00 to Pr 20.50	Pr 1.22	RW	Uni		P
11.16	Parameter 0.26 assignment	Pr 0.00 to Pr 20.50	Pr 2.08	RW	Uni		P
11.17	Parameter 0.27 assignment	Pr 0.00 to Pr 20.50	Pr 4.13	RW	Uni		P
11.18	Parameter 0.28 assignment	Pr 0.00 to Pr 20.50	Pr 4.14	RW	Uni		P
11.19	Parameter 0.29 assignment	Pr 0.00 to Pr 20.50	Pr 5.05	RW	Uni		P
11.20	Parameter 0.30 assignment	Pr 0.00 to Pr 20.50	Pr 10.20	RW	Uni		P
11.22	Initial parameter displayed	Pr 0.00 to Pr 0.50	EUR> Pr 0.10, USA> Pr 0.12	RW	Uni		P
11.25	Serial comms. Baud rate {0.36}	4800 (0), 9600 (1), 19200 (2), 2400 (3) baud	EUR> 4800 (0), USA> 9600 (1)	RW	Txt		P

10.22 Advanced Features

This section gives information on some of the commonly used advanced functions of the Unidrive.

Advanced Feature	Associated Parameters
Braking modes	Pr 2.04 and Pr 2.08
S ramps	Pr 2.06 and Pr 2.07
Torque modes	Pr 4.08 and Pr 4.11
Stop modes	Pr 6.01, Pr 6.07 and Pr 6.08
Main Loss modes	Pr 6.03
Sequence modes	Pr 6.04 and Pr 6.30 to Pr 6.34
Catch a spinning motor	Pr 6.09, Pr 6.10, Pr 6.37 and Pr 6.38
Position loop modes	Pr 13.08, Pr 3.19 and Pr 3.20

10.22.1 Braking modes

2.04 {0.15} Ramp mode selector	
RW	Txt
↕	Std.Hd (0), FAST (1), Std.Ct (2) ⇨ Std.Ct (2)

- 0 Std.Hd Standard ramp with ramp hold
- 1 FAST Fast ramp
- 2 Std.Ct Standard ramp with P control

The acceleration ramp is not affected by the ramp mode, and the ramp output will rise at the programmed acceleration rate (subject to the current limits programmed in the drive).

Std.Hd (0): Standard ramp with ramp hold

The deceleration ramp will be frozen if the DC Bus voltage rises above the standard ramp voltage (Pr 2.08). Normally the DC Bus voltage will then begin to fall as the machine should stop regenerating. Once the voltage drops below the standard ramp voltage, the ramp will again begin to fall. This type of control does not usually give smooth deceleration especially if the machine is lightly loaded, however it is easy to set up.

FAST (1): Fast ramp

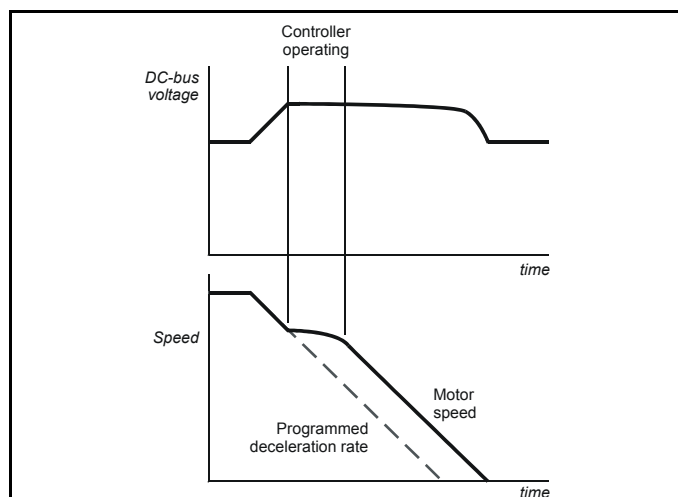
The output of the ramp will fall at the programmed deceleration rate (subject to the current limits programmed in the drive). This mode should be used when a braking resistor is fitted.

Std.Ct (2): Standard ramp with P control

The voltage rising to the standard ramp level (Pr 2.08) causes a proportional controller to operate, the output of which changes the demanded current in the motor. As the controller regulates the DC Bus voltage, the motor deceleration increases as the speed approaches zero speed. When the motor deceleration rate reaches the programmed deceleration rate the controller ceases to operate and the drive continues to decelerate at the programmed rate. This gives smoother control than standard hold mode. If the standard ramp voltage (Pr 2.08)

is set lower than the nominal DC Bus level the drive will not decelerate but will coast to rest. The standard controlled mode is most likely to be useful in applications where smooth deceleration is required, particularly with lightly loaded machines, or where the supply voltage is high where the drive would trip on OV (DC Bus over voltage) due to the transients produced in standard hold mode.

The output of the ramp controller (when active) is a current demand that is fed to the frequency changing current controller (open loop) or the torque producing current controller (closed loop). The gain of these controllers can be modified with Pr 4.13 and Pr 4.14.



2.08 Standard ramp voltage	
RW	Uni
↕	200V drive: 0 to 400 V 400V drive: 0 to 800 V ⇨ 200V drive: 375 400V drive: EUR> 750, USA> 775

This voltage is used as the level for both standard ramp modes. If hold mode is used and this is set too low the drive will never stop, and if it is too high and no braking resistor is used the drive may trip on OV (DC Bus over voltage). If standard ramp with P control is used and this parameter is set too low the machine will coast to rest, and if it is set too high and no braking resistor is used it may trip on OV. The minimum level should be greater than the voltage produced on the DC Bus by the highest supply voltage.

Normally the DC Bus voltage will be approximately the rms supply voltage x $\sqrt{2}$.



Care should be taken in the setting of this parameter. It is recommended that the setting should be at least 50V higher than the maximum expected level of the DC Bus voltage. If this is not done, the motor may fail to decelerate on a STOP command.

10.22.2 S ramps

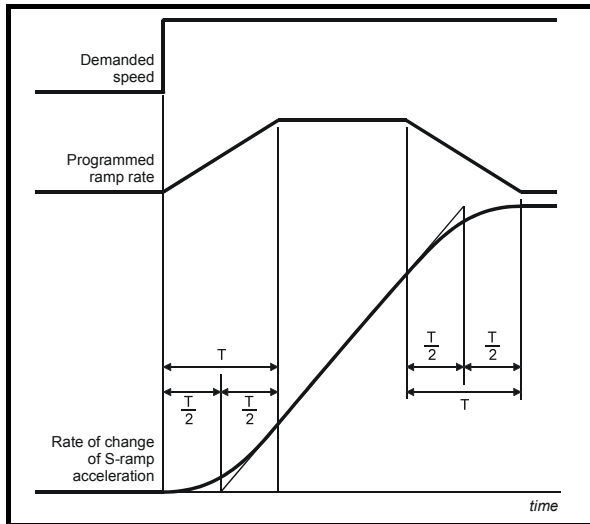
2.06 S-ramps enable	
RW	Bit
↕	0 or 1 ⇒ 0

Setting this parameter enables the S ramp function. S ramp is disabled during deceleration using Standard ramp with P control (Pr 2.04 = Std.Ct [2]). When the motor is accelerated again after decelerating in standard ramp with P control the acceleration ramp used by the S ramp function is reset to zero.

2.07 S-ramp da/dt	
RW	Uni
OL	↕ 0 to 3,000.0 s ² /100 Hz ⇒ 3.1
VT	↕ 0 to 30.000 ⇒ 1.5
SV	↕ s ² /1,000 rpm ⇒ 0.03

This parameter defines the maximum rate of change of acceleration/ deceleration that the drive will operate with. The default values have been chosen such that for the default ramps and maximum speed, the curved parts of the S will be 25% of the original ramp if S ramp is enabled.

Since the ramp rate is defined in s/100Hz or s/1000rpm and the S ramp parameter is defined in s²/100Hz or s²/1000rpm, the time T for the 'curved' part of the S can be determined from:



$$T = \text{S ramp rate of change} / \text{Ramp rate}$$

Enabling S ramp increases the total ramp time by the period T since an additional T/2 is added to each end of the ramp in producing the S.

10.22.3 Torque Modes

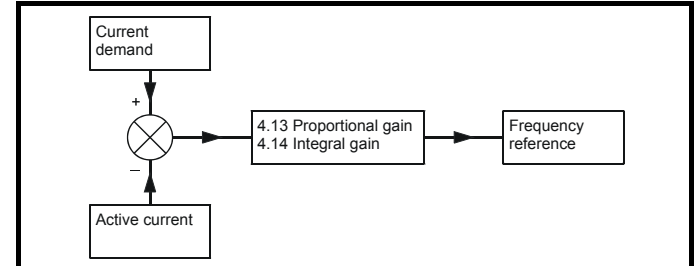
4.08 Torque reference	
RW	Bi
↕	Maximum current limit % rated active current ⇒ 0

Parameter for main torque reference. If connected to an analog input on this drive this parameter is updated every 345μs for 3, 6 and 12kHz switching frequency, and every 460μs for 4.5 and 9kHz switching frequency. This does not apply to the analog inputs of the UD50 Additional I/O Small Option Module.

4.11 Torque mode selector	
RW	Uni
OL	↕ 0 to 1 ⇒ 0
CL	↕ 0 to 4 ⇒ 0

Open loop

If this parameter is 0 normal frequency control is used. If this parameter is set to 1 the current demand is connected to the current PI controller giving closed loop torque/current demand as shown below. The current error is passed through proportional and integral terms to give a frequency reference which is limited to the range -maximum frequency to +maximum frequency as defined by Pr 1.06.



Closed loop

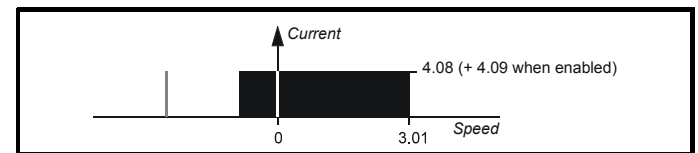
0: Speed control mode

The torque demand is equal to the speed loop output.

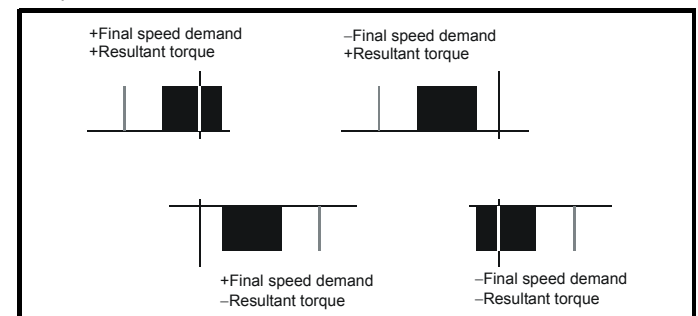
1: Torque control

The torque demand is given by the sum of the torque reference and the torque offset, if enabled. The speed is not limited in any way, however, the drive will trip at the overspeed threshold if runaway occurs.

2: Torque control with speed override



The output of the speed loop defines the torque demand, but is limited between 0 and the resultant torque reference [Pr 4.08 (+ Pr 4.09 when enabled)]. The effect is to produce an operating area as shown above if the final speed demand and the resultant torque reference are both positive. The speed controller will try and accelerate the machine to the final speed demand level with a torque demand defined by the resultant torque reference. However, the speed cannot exceed the reference because the required torque would be negative, and so it would be clamped to zero.



Depending on the sign of the final speed demand and the resultant torque the four areas of operation shown here are possible. This mode of operation can be used where torque control is required, but the maximum speed must be limited by the drive. In this mode ramps are not active whilst the drive is in the run state. When the drive is taken out of the run state, but not disabled, the appropriate stopping mode is used. It is recommended that only coast or stopping without ramps is used. If ramp stop mode is used the drive changes to speed control mode to

ramp to stop with a reference defined by the user speed demand. This causes the speed to increase towards the reference and then ramp to stop.

3: Coiler/uncoiler mode

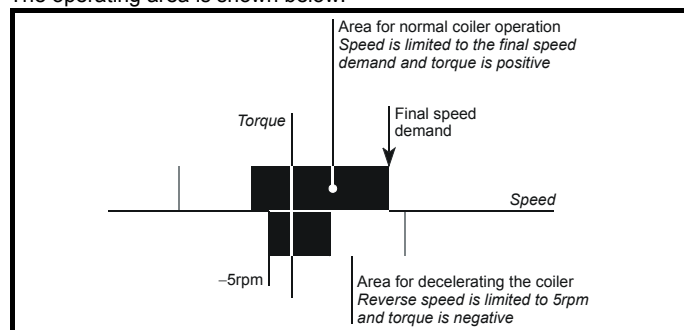
Positive final speed demand: a positive resultant torque will give torque control with a positive speed limit defined by the final speed demand. A negative resultant torque will give torque control with a negative speed limit of -5rpm.

Negative final speed demand: a negative resultant torque will give torque control with a negative speed limit defined by the final speed demand. A positive resultant torque will give torque control with a positive speed limit of +5rpm.

Example of coiler operation

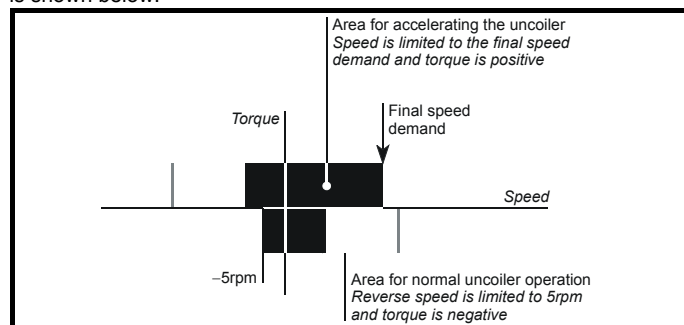
This is an example of a coiler operating in the positive direction. The final speed demand is set to a positive value just above the coiler reference speed. If the resultant torque demand is positive the coiler operates with a limited speed, so that if the material breaks the speed does not exceed a level just above the reference. It is also possible to decelerate the coiler with a negative resultant torque demand. The coiler will decelerate down to -5rpm until a stop is applied.

The operating area is shown below:



Example of uncoiler operation

This is an example for an uncoiler operating in the positive direction. The final speed demand should be set to a level just above the maximum normal speed. When the resultant torque demand is negative the uncoiler will apply tension and try and rotate at 5rpm in reverse, and so take up any slack. The uncoiler can operate at any positive speed applying tension. If it is necessary to accelerate the uncoiler a positive resultant torque demand is used. The speed will be limited to the final speed demand. The operating area is the same as that for the coiler and is shown below:



In this mode ramps are not active whilst the drive is in the run state. When the drive is taken out of the run state, but not disabled, the appropriate stopping mode is used. It is recommended that only coast or stopping without ramps is used. If ramp stop mode is used the drive changes to speed control mode to ramp to stop with a reference defined by the user speed demand. This causes the speed to increase towards the reference and then ramp to stop.

4: Speed control with torque feed-forward

The drive operates under speed control, but a torque value may be added to the output of the speed controller. This can be used to improve the regulation of systems where the speed loop gains need to be low for

stability.

10.22.4 Stop Modes

6.01		Stop mode selector			
RW		Txt			
OL	⇅	COAST (0), rP (1), rP-dcl (2), dcl (3), td.dcl		⇒	rP (1)
VT	⇅	COAST (0), rP (1), no.rP (2), rP-POS (3)		⇒	no.rP (2)
SV	⇅			⇒	

Open Loop

0	COAST	Coast stop
1	rP	Ramp stop
2	rP-dcl	Ramp stop + 1 second dc injection
3	dcl	Injection braking stop with detection of zero speed
4	td.dcl	Timed injection braking stop

Stopping is in two distinct phases: decelerating to stop, and stopped.

Stopping Mode	Phase 1	Phase 2	Comments
COAST (0)	Inverter disabled	Drive cannot be re-enabled for 2s	Delay in phase 2 allows rotor flux to decay in induction motors
rP (1)	Ramp down to zero frequency	Wait for 1s with inverter enabled	
rP.dcl (2)	Ramp down to zero frequency	Inject DC at level specified by Pr 6.06 for 1s	
dcl (3)	Low frequency current injection with detection of low speed before next phase.	Inject DC at level specified by Pr 6.06 for 1s	The drive automatically senses low speed and therefore it adjusts the injection time to suit the application. If the injection current level is too small the drive will not sense low speed (normally a minimum of 50-60% is required).
td.dcl (4)	Inject DC at level specified by Pr 6.06 for time specified by Pr 6.07 - 1s.	Inject DC at level specified by Pr 6.06 for 1s	The minimum total injection time is 1s for phase 1 and 1s for phase 2, i.e. 2s in total.

Once modes 3 or 4 have begun the drive must go through the ready state before being restarted either by stopping, tripping, or being disabled.

Closed loop

0	COAST	Coast stop
1	rP	Ramp stop
2	no.rP	Stop without ramps
3	rP-POS	Stop and orientate

In the closed loop mode the two stopping phases do not exist and the ready state is entered as soon as the single stopping action is complete.

Stopping Mode	Action	Comments
COAST (0)	Inhibits the inverter	
rP (1)	Stop with ramp	
no.rP (2)	Stop with no ramp	
td.dcl (3)	Stops with ramp and then rotates to a preset position.	The position system controlled by menu 13 is used to orientate the motor. Pr 13.08 must be set up correctly for use, and the hard speed reference enabled, Pr 3.19.

6.07		Injection braking time			
RW		Uni			
OL	↕	0.0 to 25.0 s		⇒	5.0

This parameter defines the low frequency braking time for phase 1 of stopping during a stop using stopping mode 4 in open loop drives (see Pr 6.01).

6.08		Hold zero speed enable			
RW		Bit			
OL	↕	0 or 1	⇒	0	
VT	↕		⇒		
SV	↕		⇒	1	

When this bit is set the drive will hold torque at standstill when not in the running state rather than disabling the output bridge. The drive status will be 'StoP' when the drive is at standstill rather than 'rdy'.

10.22.5 Mains loss modes

6.03		AC supply loss mode selector			
RW		Txt		P	
↕		diS (0), StoP (1), ridE.th (2)		⇒	diS (0)

- 0 diS Disabled
- 1 StoP Stop
- 2 ridE.th Ride through

diS (0): Disabled

There is no mains loss detection and the drive operates normally only as long as the DC Bus voltage remains within specification (above 330V).

StoP (1): Stop (Open loop)

The action taken by the drive is the same as for ride through mode, except the ramp down rate is at least as fast as the deceleration ramp setting and the drive will continue to decelerate and stop even if the mains is re-applied. If normal or timed injection braking is selected the drive will use ramp mode to stop on loss of the supply. For injection braking or ramp with DC injection modes, DC current will be applied to the motor for 1s after it has stopped. (Unless the mains has been reapplied the drive is likely trip UU before or during the 1s injection period.)

StoP (1): Stop (Closed Loop)

The speed reference is set to zero and the ramps are disabled allowing the drive to decelerate the motor to a stop under current limit. If the mains is re-applied whilst the motor is stopping any run signal is ignored until the motor has stopped. If the current limit value is set very low the drive may trip UU before the motor has stopped.

ridE.th (2): Ride through

The drive detects mains loss when the DC Bus voltage falls below a specific level (410V). The drive then enters a mode where a closed-loop controller attempts to hold the DC Bus level at a specific level (390V). This causes the motor to decelerate at a rate that increases as the speed falls. If the mains is re-applied it will force the DC Bus voltage above the detection threshold and the drive will continue to operate normally.

In open-loop mode the output of the mains loss controller is a current demand that is fed to the frequency changing current controller and therefore the gain parameters (Pr 4.13 and Pr 4.14) must be set up for optimum control. See Pr 4.13 and Pr 4.14 below for set-up details.

In closed-loop mode the output of the mains controller is also a current demand that is fed directly to the current loop. If the settings of Pr 4.13 and Pr 4.14 are suitable for normal operation, they should need no adjustment. See Pr 4.13 and Pr 4.14 below for set-up details.

4.13		Current loop proportional gain			
RW		Uni			
OL	↕	0 to 30,000	⇒	20	
VT	↕		⇒	150	
SV	↕		⇒	130	

4.14		Current loop integral gain			
RW		Uni			
OL	↕	0 to 30,000	⇒	40	
VT	↕		⇒	2000	
SV	↕		⇒	1200	

Open-loop

These parameters control the proportional and integral gains of the current controller used in the open loop drive. As already mentioned the current controller either provides current limits or closed loop torque control by modifying the drive output frequency. The control loop is also used in its torque mode during mains loss, or when the controlled mode standard ramp is active and the drive is decelerating, to regulate the flow of current into the drive. Although the default settings have been chosen to give suitable gains for less demanding applications it may be necessary for the user to adjust the performance of the controller. The following is a guide to setting the gains for different applications.

Current limit operation

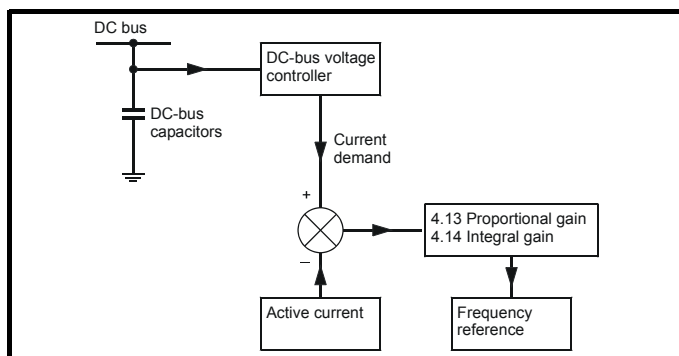
The current limits will normally operate with an integral term only, particularly below the point where field weakening begins. The proportional term is inherent in the loop. The integral term must be increased enough to counter the effect of the ramp which is still active even in current limit. For example, if the drive is operating at constant frequency and is overloaded the current limit system will try to reduce the output frequency to reduce the load. At the same time the ramp will try to increase the frequency back up to the demand level. If the integral gain is increased too far the first signs of instability will occur when operating around the point where field weakening begins. These oscillations can be reduced by increasing the proportional gain. A system has been included to prevent regulation because of the opposite actions of the ramps and the current limit. This can reduce the actual level that the current limit becomes active by 12.5%. This still allows the current to increase up to the current limit set by the user. However the current limit active indicator (Pr 10.09) could become active up to 12.5% below the current limit depending on the ramp rate used.

Torque control

Again the controller will normally operate with an integral term only, particularly below the point where field weakening begins. The first signs of instability will appear around base speed, and can be reduced by increasing the proportional gain. The controller can be less stable in torque control mode rather than when it is used for current limiting. This is because load helps to stabilise the controller, and under torque control the drive may operate with light load. Under current limit the drive is often under heavy load unless the current limits are set at a low level.

Mains loss and controlled standard ramp

The DC Bus voltage controller becomes active if mains loss detection is enabled and the drive supply is lost or controlled standard ramp is being used and the machine is regenerating. The DC Bus controller attempts to hold the DC Bus voltage at a fixed level by controlling the flow of current from the drive inverter into its DC Bus capacitors. The output of the DC Bus controller is a current demand which is fed into the current PI controller as showing the following diagram:



The DC Bus voltage controller cannot be adjusted, but it may be necessary to adjust the current controller gains to obtain the required performance. If the gains are not suitable it is best to set up the drive in torque control first. Set the gains to a value that does not cause instability around the point at which field weakening occurs. Then revert back to open loop speed control in standard ramp mode. To test the controller the supply should be removed whilst the motor is running. It is likely that the gains can be increased further if required because the DC Bus voltage controller has a stabilising effect, provided that the drive is not required to operate in torque control mode.

Closed-loop

The P and I gains are used in the voltage based current controller. The default values give satisfactory operation with most motors. However it may be necessary to change the gains especially for low inductance motors. The following procedure should be used:

Unless a particularly high bandwidth is required the proportional gain (Pr 4.13) should be set to a value of:

$$1800 \times \text{Pr } 5.24 \times 10^{-3} \times \text{Pr } 11.32$$

Where:

Pr 5.24 = per phase motor leakage inductance (mH).

Pr 11.32 = Drive rated current (A)

The inductance value is stored in Pr 5.24 after the autotune test is carried out. If an autotune cannot be carried out the leakage inductance can be found by other means:

For an induction motor this is the per phase total leakage inductance (Ls) which can be calculated from the steady state per phase equivalent circuit of the motor, $L_s = L_1 + (L_2 \cdot L_m / (L_2 + L_m))$. For a servo motor this is half the phase to phase inductance that is normally specified by the manufacturer. This will give a response with minimum overshoot after a step change of current reference and a current loop bandwidth of approximately 500Hz. If some overshoot can be tolerated then gain can be increased by a factor of 1.5, giving a bandwidth of 800Hz and 12.5% overshoot after a step change of current reference.

The integral gain (Pr 4.14) should be set to a value of:

$$0.044 \times \text{Pr } 4.13 \times R / (\text{Pr } 5.24 \times 10^{-3})$$

Where:

Pr 4.13 = current loop proportional gain calculated above

R = per phase stator resistance Ω

Pr 5.24 = per phase motor leakage inductance (mH).

10.22.6 Sequencing Modes

6.04 Sequencing mode selector				
RW	Uni			P
↕	0 to 4	⇒		4

There are five sequencing modes available as shown below. Any terminal can be used for any of the functions provided in each mode (see the following sequencing bits). The connection diagrams below show a possible method of using each sequencing mode and the parameter changes required (from defaults). Any terminals shown with no connection are as at default.

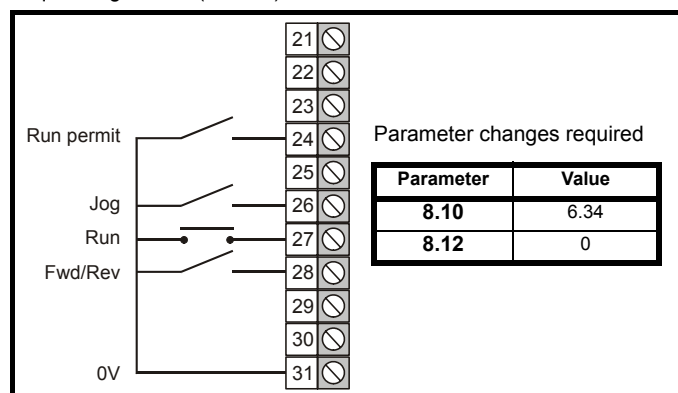
NOTE

By default the Unidrive uses sequencing mode 4 (Wire Proof PLC mode), where the necessary terminals are assigned as required. If any other sequencing mode is enabled the corresponding sequencing bits (Pr 6.30 to Pr 6.34) must also be programmed as destination for the specific input using the parameters in menu 8.

- 0 CD type interface
- 1 Mentor type interface
- 2 Wire proof mode
- 3 PLC mode
- 4 Wire proof PLC mode

Sequencing mode 0: CD type

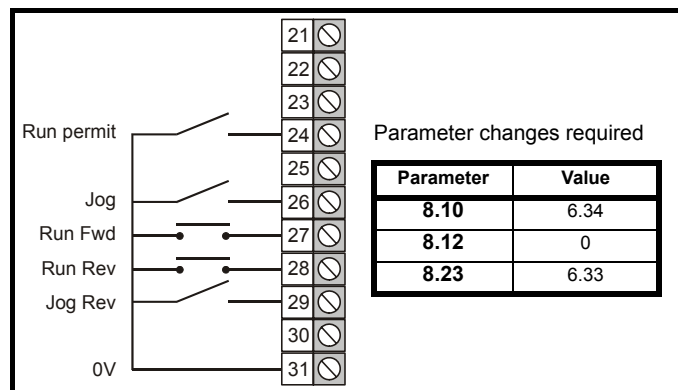
Run permit or /Stop (Pr 6.34)	Run permit or 'not stop' input
Sequencing bit 0 (Pr 6.30)	Run (Latching)
Sequencing bit 1 (Pr 6.31)	Jog
Sequencing bit 2 (Pr 6.32)	Forward/Reverse
Sequencing bit 3 (Pr 6.33)	Not used



To be able to run in this mode the Run Permit signal must be closed. Momentarily closing of the Run contact will make the drive latch in the run state. Opening the Run Permit contact will cause the drive to stop. It is also possible to enable the keypad buttons (Pr 6.11 to Pr 6.13). If any keypad button is enabled the corresponding terminal input is ignored. Any jog command received will only be accepted in the 'rdY' or 'StoP' states. Run commands override jog commands.

Sequencing mode 1: Mentor type

Run permit or /Stop (Pr 6.34)	Run permit or 'not stop' input
Sequencing bit 0 (Pr 6.30)	Run forward (latching)
Sequencing bit 1 (Pr 6.31)	Jog forward
Sequencing bit 2 (Pr 6.32)	Run reverse (latching)
Sequencing bit 3 (Pr 6.33)	Jog reverse



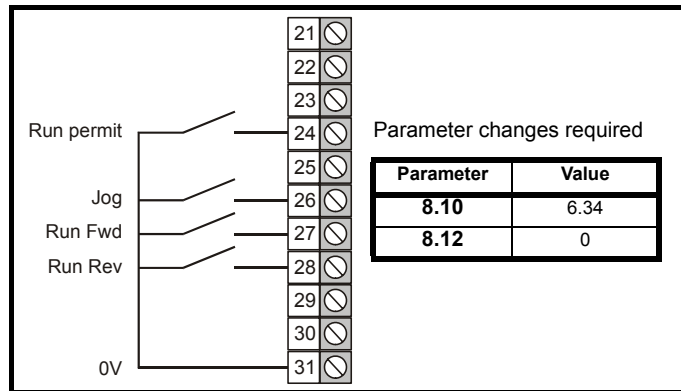
To be able to run in this mode the Run Permit signal must be closed. Momentary closing of the Run Forward or Run Reverse contact will

make the drive latch in the run state. Momentarily closing the run contact for the opposite direction will make the drive change direction. Opening the Run Permit contact will cause the drive to stop.

The drive run keypad button can also be used to latch a run state if it is enabled (Pr 6.11) and the fwd/rev keypad button can change direction if it is enabled (Pr 6.13) (unless one of the terminals is being held closed in which case they have priority). The stop keypad button can also stop the drive if it is enabled (Pr 6.12) and the terminals are not forcing a run condition. Any jog command received will only be accepted in the ready or stop states. Run commands override jog commands.

Sequencing mode 2: Wire Proof Mode

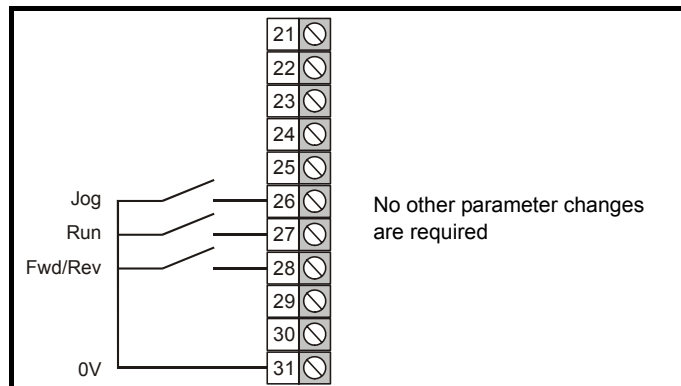
Run permit or /Stop (Pr 6.34)	Run permit or 'not stop' input
Sequencing bit 0 (Pr 6.30)	Run forward
Sequencing bit 1 (Pr 6.31)	Jog
Sequencing bit 2 (Pr 6.32)	Run reverse
Sequencing bit 3 (Pr 6.33)	Not used



In this mode the Run Permit, and either the Run Forward or Run Reverse contacts (but not both) must be closed for the drive to run. If Run Forward and Run Reverse are selected at the same time the drive will stop after a delay of 60ms. To jog forward or reverse, the Jog contact must be closed together with the appropriate direction contact. Any jog command received will only be accepted in the ready or stop states (i.e. the Jog contact must be closed before the Run contact). Because this mode requires terminals to be held in an active state at all times, the run, stop, and fwd/rev keypad buttons on the drive are ignored even if they are enabled.

Sequencing mode 3: PLC Mode

Run permit or /Stop (parameter 6.34)	Not used
Sequencing bit 0 (parameter 6.30)	Run
Sequencing bit 1 (parameter 6.31)	Jog
Sequencing bit 2 (parameter 6.32)	Forward/Reverse
Sequencing bit 3 (parameter 6.33)	Not used

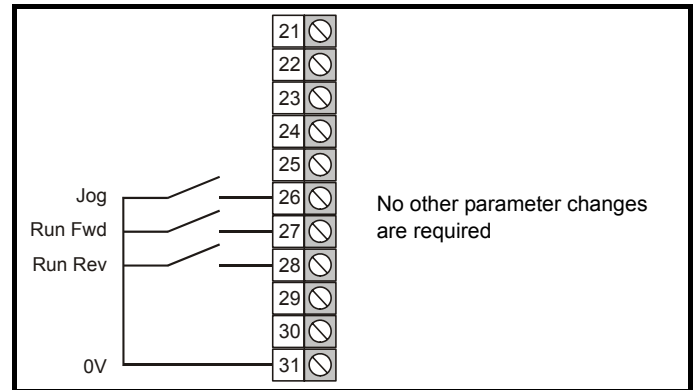


In this mode the drive will respond to the contacts as it finds them. To jog forward or reverse, the Jog contact must be closed together with the Run

contact and the appropriate direction selected. Any jog command received will only be accepted in the ready or stop states (i.e. the Jog contact must be closed before the Run contact). As with mode 2, this mode requires terminals to be held active and therefore the run, stop, and fwd/rev keypad buttons on the drive are ignored even if they are enabled.

Sequencing mode 4: Wire Proof PLC Mode

Run permit or /Stop (Pr 6.34)	Not used
Sequencing bit 0 (Pr 6.30)	Run forward
Sequencing bit 1 (Pr 6.31)	Jog
Sequencing bit 2 (Pr 6.32)	Run Reverse
Sequencing bit 3 (Pr 6.33)	Not used



In this mode either the Run Forward or Run Reverse contacts must be closed before the drive will run. All inputs are non-latching and when not asserted the drive will stop immediately using the mode defined by the stopping mode. If both Forward and Reverse contacts are closed then the drive will stop. If the drive is operating in open-loop mode there is a 60ms delay after both forwards and reverse are selected before a stop is initiated. To jog forward or reverse, the Jog contact must be closed before the appropriate direction contact. Any jog command received will only be accepted in the ready or Stop states. Because this mode requires terminals to be held in an active state at all times, the run, stop, and fwd/rev keypad buttons on the drive are ignored even if they are enabled.

10.22.7 Catch a spinning motor

6.09 Synchronize to a spinning motor	
RW	Bit
OL	0
CL	1

Open Loop

The drive performs a sequence of operations to determine the motor frequency before attempting to run the motor with full voltage applied. These tests are carried out with a voltage defined by Pr 6.37. The frequency is first set to maximum frequency in the direction in which the drive last ran. The frequency is ramped to zero at a rate defined by Pr 6.10. If the machine frequency is not detected, the frequency is set to maximum in the other direction and the test is repeated. If the frequency is detected at any point the test is stopped, the voltage is ramped up at a rate defined by Pr 6.37 and then the drive runs normally. If the frequency is not detected the drive starts from 0Hz. If the drive is powered down the previous direction of operation is not stored, and so the test begins in the forward direction. It is important that if spinning start is selected then the Voltage Mode, Pr 5.14, must be set to 'Fd' (3) and not left in the default value of 'Ur_1' (1).

Closed Loop

The ramp output is set to the actual motor speed when the drive is commanded to start.

6.10		Spinning motor ramp rate				
RW		Uni				
OL	↕	0 to 25.0 s/100Hz (seconds per 100Hz)			⇒	5.0

This parameter defines the rate at which the frequency is changed when trying to synchronise the motor speed. Motors and loads with very low inertias will require this parameter to be set low to ensure the speed is detected, while motors and loads with large inertias may require the parameter to be increased to prevent over voltage trips.

6.37		Spinning motor start-voltage							
RW		Uni							
OL	↕	0 to 100 % (of normal voltage)			⇒	25.0			

Defines the voltage applied during a spin start as a percentage of voltage that would be applied in normal operation. Setting this value too high causes the drive to current limit, setting it too low will give problems detecting low motor speeds.

6.38		Spinning motor voltage rate					
RW		Uni					
OL	↕	0 to 2.5 s			⇒	0.25	

When the software has detected the motor speed it ramps the drives output voltage from the level programmed in Pr 6.37 to its normal operating voltage. This parameter determines the time interval for this change in voltage. Setting the time too short will cause excessive current transients in the machine as the voltage rises, while setting it too long may cause the drive to lose synchronisation if the motor is decelerating quite quickly.

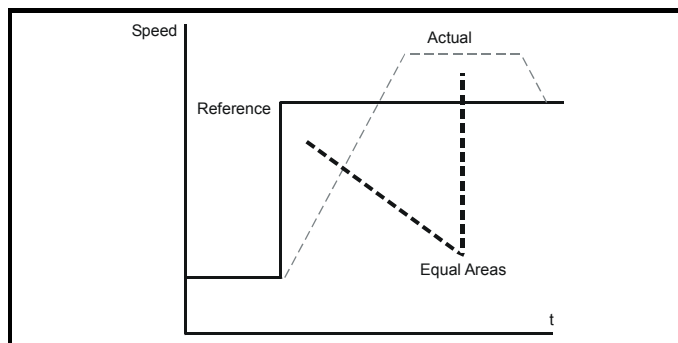
10.22.8 Position loop modes

13.08		Position loop mode selector					
RW		Uni					
OL	↕	0 to 2		⇒	0		
CL	↕	0 to 6		⇒			

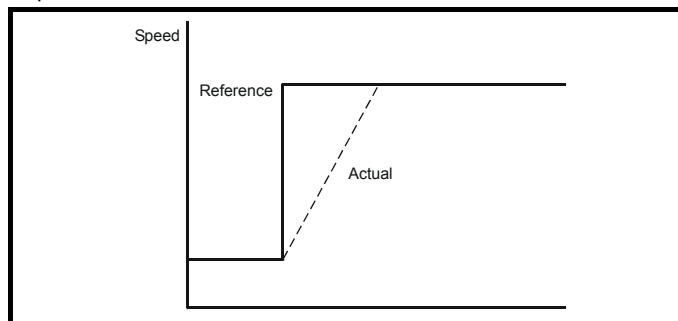
- 0 Position loop disabled
- 1 Rigid digital lock with digital Feed Forward
- 2 Rigid digital lock without digital Feed Forward
- 3 Non rigid digital lock with digital Feed Forward
- 4 Non rigid digital lock without digital Feed Forward
- 5 Orientate on stop command only
- 6 Orientate on stop command and when enabled

Sets the mode of operation of the position loop.

In rigid lock mode the position error is absolute relative to the time the position loop is closed. This means that if the slave shaft is slowed down due to excessive load, the target position will eventually be recovered by running at a higher speed when the load is removed.



In non-rigid lock mode the position loop is only closed when the 'At Speed' condition is met. This allows slippage to occur while the speed loop is not satisfied.



Digital lock can be implemented without digital feed forward, where the input frequency of the encoder being followed is too low to obtain a smooth feed forward term from it. In this case the user can provide an alternative speed reference to be used as the feed forward term and the position loop will provide the velocity correction only. It should be noted that if the alternative feed forward is not correct, the position loop will run with a constant error to provide the difference between the feed forward and the actual speed of the reference encoder. During relative jogging, digital feed forward is always used because the feed forward term has to be adjusted.

In order for the digital feed forward term to function in modes 1 and 3 the hard speed reference must be enabled (Pr 3.20 = 1). The correction term used in the feed forward modes is fed into the speed loop via the hard speed reference in menu 3 (see block diagrams). If a non-rigid mode is used and an independent correction term is required then this must be routed to the hard speed reference (Pr 3.19) by the user.

Two orientation modes are selectable. In mode 5, the drive orientates following a stop command with orientation stop enabled (see Pr 6.01 Stop mode). Mode 6 operates the same as mode 5 but in addition the drive always orientates when it is enabled providing that the 'Hold zero speed' parameter is set (Pr 6.08). This ensures that the spindle is always in the same position following the drive being enabled.

When orientating from a stop command the drive goes through the following sequence:

1. Ramps are enabled and the motor is decelerated or accelerated to the speed limit programmed in Pr 13.10 in the direction the motor was previously running.
2. When the speed set in Pr 13.10 is reached, ramps are disabled and the motor continues to rotate until the position is found to be close to the target position. At this point the speed demand is set to 0 and the position loop is closed.
3. When the absolute value of speed is less than 2 rpm and the position is within the window defined by Pr 13.12, the orientation complete signal is given.

3.19		Hard speed reference			
RW		Bi			
CL	↕	±30,000 rpm*		⇒	0

* This is the maximum range, for further restrictions see below.

The range of this parameter is limited depending on the maximum speed expected which is the maximum magnitude from Pr 1.06 or Pr 1.07.

The hard speed reference is a reference value which does not pass through the ramp system (menu 2). It is added to the normal post ramp speed reference. Its value may be written from the keypad, via serial comms, from an analog input or from an encoder input. This parameter can also be used by the position controller (menu 13) as the speed correction input.

This parameter is similar to the analog input parameters (Pr 1.36 and Pr 1.37) in that if an analog input programmed in voltage mode is directed to it, the scan rate of that analog input is increased (See menu 1). The scaling will be the same as for bipolar mode on Pr 1.36 and Pr 1.37. It is also possible to obtain a fast update rate if an encoder input is used to derive this speed reference.

3.20		Hard speed reference select			
RW		Bit			
CL	↕	0 or 1		⇒	0

Enables connection of the hard speed reference.

11 Technical Data

11.1 Drive

11.1.1 Power and current ratings

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

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 the worst-case condition with the unusual combination of stiff supply with bad balance. The value stated for the maximum continuous input current would only be seen in one of the input phases. The current in the other two phases would be significantly lower.

- The values of maximum input current for models 1201 to 1205 are stated for a 200Vac supply rated at ten times the kVA of the drive and a 2% negative phase-sequence imbalance.
- The values for models 2201 to 2203 and 3201 to 3204 are stated for a 200Vac supply having a 5kA short-circuit capability and a 2% negative phase-sequence imbalance.

- The values for models 1401 to 1405, 2401 to 2403, 3401 to 3405 and 4401 to 4405 are stated for a 380Vac having a 16kA short-circuit capability and a 2% negative phase-sequence imbalance.
- The values for model 5401 are stated for a 400Vac supply having an 18kA short-circuit capability and a 2% negative phase-sequence imbalance.

Typical input current

The values of typical input current are given to aid calculations for power flow and power loss.

- The values of typical input current for models 1201 to 1205, 2201 to 2203 and 3201 to 3204 are stated for a balanced 200Vac supply having a 5kA short-circuit capability.
- The values for models 1401 to 1405, 2401 to 2403 and 3401 to 3405 are stated for a balanced 400Vac supply having a 5kA short-circuit capability.
- The values for models 4401 to 4405 are stated for a balanced 400Vac supply having a 10kA short-circuit capability.
- The values for model 5401 are stated for a balanced 400V supply having an 18kA short-circuit capability.

Table 11-1 Unidrive and Unidrive VTC drive current ratings

Model	Nominal rating		Maximum permissible continuous output current at 40°C (104°F) ambient (A)					Maximum permissible continuous output current at 50°C (122°F) ambient (A)					Typical input current (A)	Maximum continuous input current (A)
	kW	hp	3kHz	4.5kHz	6kHz	9kHz	12kHz	3kHz	4.5kHz	6kHz	9kHz	12kHz		
UNI1201	0.37	0.5	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.4	4.0
UNI1202	0.55	0.75	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	3.5	6.0
UNI1203	0.75	1.0	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.3	4.6	8.0
UNI1204	1.1	1.5	5.6	5.6	5.6	5.6	4.5	5.6	5.6	5.1	4.0	3.3	6.5	10.0
UNI1205	2.2	3.0	9.5	9.5	8.5	7.0	5.5	6.9	5.9	5.1	4.0	3.3	8.6	12.5
UNI2201	3.0	4.0	12.0	12.0	12.0	12.0	11.7	12.0	12.0	12.0	11.6	9.7	10.8	13.9
UNI2202	4.0	5.0	16.0	16.0	16.0	14.2	11.7	16.0	16.0	14.7	11.6	9.7	14.3	16.9
UNI2203	5.5	10.0	25.0	21.7	18.2	14.2	11.7	20.0	17.3	14.7	11.6	9.7	19.8	27.0
UNI3201	7.5	15	34.0	34.0	34.0	28.0	23.0	34.0	34.0	28.0	21.0	17.9	26	28
UNI3202	11.0	20	46.0	46.0	40.0	32.0	26.6	44.0	36.0	31.0	24.0	20.6	39	43
UNI3203	15.0	25	60.0	47.0	40.0	32.0	26.7	44.0	36.0	31.0	24.0	20.9	53	56
UNI3204	22.0	30	74.0	56.0	46.0	35.0	28.0	50.0	41.0	34.0	26.0	23.0	78	84
UNI1401	0.75	1.0	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	3.0	4.5
UNI1402	1.1	1.5	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	4.3	5.5
UNI1403	1.5	2.0	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.3	5.8	6.8
UNI1404	2.2	3.0	5.6	5.6	5.6	5.6	4.5	5.6	5.6	5.1	4.0	3.3	8.2	8.6
UNI1405	4.0	5.0	9.5	9.5	8.5	7.0	5.5	6.9	5.9	5.1	4.0	3.3	10.0	12.0
UNI2401	5.5	7.5	12.0	12.0	12.0	12.0	11.7	12.0	12.0	12.0	11.6	9.7	13.0	16.0
UNI2402	7.5	10	16.0	16.0	16.0	14.2	11.7	16.0	16.0	14.7	11.6	9.7	17.0	20.0
UNI2403	11.0	15	25.0	21.7	18.2	14.2	11.7	20.0	17.3	14.7	11.6	9.7	21.0	25.0
UNI3401	15.0	25	34.0	34.0	34.0	28.0	23.0	34.0	34.0	28.0	21.0	17.9	27	34
UNI3402	18.5	30	40.0	40.0	37.0	28.0	23.0	40.0	34.0	28.0	21.0	17.9	32	39
UNI3403	22.0	30	46.0	46.0	40.0	32.0	26.6	44.0	36.0	31.0	24.0	20.6	40	53
UNI3404	30.0	40	60.0	47.0	40.0	32.0	26.7	44.0	36.0	31.0	24.0	20.9	52	66
UNI3405	37.0	50	70.0	56.0	46.0	35.0	28.0	50.0	41.0	34.0	26.0	23.0	66	82
UNI4401	45	75	96	96	88	70		95	85	75	60		76	98
UNI4402	55	100	124	104	88	70		105	85	75	60		91	114
UNI4403	75	125	156	124	105	80		135	105	85	65		123	152
UNI4404	90	150	180	175	145	110		180	150	125	95		145	205
UNI4405	110	150	202	175	145	110		190	150	125	95		181	224
UNI5401	160	200	300*					240					280	321
UNI5402	320	400	600*					480					560	642
UNI5403	480	600	900*					720					840	963
UNI5404	640	800	1,200*					960					1,120	1284
UNI5405	800	1000	1,500*					1,200					1,400	1605
UNI5406	960	1200	1,800*					1,440					1,680	1926
UNI5407	1120	1400	2,100*					1,680					1,960	2247
UNI5408	1280	1600	2,400*					1,920					2,240	2568

* Multiples of 300A output current with 120% overload or multiples of 240A with 150% overload

Table 11-2 Unidrive LFT drive current ratings (at 9kHz PWM switching frequency)

Model	Nominal rating		Maximum permissible output current (A)			Typical input current (A)	Maximum continuous input current (A)
	kW	hp	Standard duty cycle at 40°C	Continuous operation at 40°C	Continuous operation at 50°C		
UNI1201 LFT	0.37	0.5	2.1	2.1	2.1	2.4	4.0
UNI1202 LFT	0.55	0.75	2.8	2.8	2.8	3.5	6.0
UNI1203 LFT	0.75	1.0	3.8	3.8	3.3	4.6	8.0
UNI1204 LFT	1.1	1.5	5.6	4.0	3.3	6.5	10.0
UNI1205 LFT	2.2	3.0	9.5	4.3	3.3	8.6	12.5
UNI2201 LFT	3.0	4.0	12.0	12.0	11.0	10.8	13.9
UNI2202 LFT	4.0	5.0	16.0	14.2	11.0	14.3	16.9
UNI2203 LFT	5.5	10.0	25.0	14.2	11.0	19.8	27.0
UNI3201 LFT	7.5	15	34.0	28.0	21.0	26	28
UNI3202 LFT	11.0	20	46.0	32.0	24.0	39	43
UNI3203 LFT	15.0	25	60.0	33.0	24.0	53	56
UNI3204 LFT	22.0	30	74.0	35.0	26.0	78	84
UNI1401 LFT	0.75	1.0	2.1	2.1	2.1	3.0	4.5
UNI1402 LFT	1.1	1.5	2.8	2.8	2.8	4.3	5.5
UNI1403 LFT	1.5	2.0	3.8	3.8	3.3	5.8	6.8
UNI1404 LFT	2.2	3.0	5.6	4.0	3.3	8.2	8.6
UNI1405 LFT	4.0	5.0	9.5	4.3	3.3	10.0	12.0
UNI2401 LFT	5.5	7.5	12.0	12.0	11.0	13.0	16.0
UNI2402 LFT	7.5	10.0	16.0	14.2	11.0	17.0	20.0
UNI2403 LFT	11.0	15	25.0	14.2	11.0	25.0	21.0
UNI3401 LFT	15.0	25	34.0	28.0	21.0	27	34
UNI3402 LFT	18.5	30	40.0	28.0	21.0	32	39
UNI3403 LFT	22.0	30	46.0	32.0	24.0	40	53
UNI3404 LFT	30.0	40	60.0	33.0	24.0	52	66
UNI3405 LFT	37.0	50	70.0	35.0	26.0	66	82
UNI4401 LFT	45	75	96	70	57	76	98
UNI4402 LFT	55	100	124	70	57	91	114
UNI4403 LFT	75	125	156	80	61	123	152
UNI4404 LFT	90	150	180	100	77	145	205
UNI4405 LFT	110	150	202	100	77	181	224

11.1.2 Power dissipation (all versions)

Model	Nominal rating		Maximum total power dissipation (W)				
	kW	hp	3kHz	4.5kHz	6kHz	9kHz	12kHz
UNI1401	0.75	1.0	80	80	90	90	90
UNI1402	1.1	1.5	90	90	100	100	110
UNI1403	1.5	2.0	100	110	110	120	130
UNI1404	2.2	3.0	130	130	130	150	150
UNI1405	4.0	5.0	180	190	190	190	170
UNI2401	5.5	7.5	210	230	250	280	310
UNI2402	7.5	10	270	290	310	320	310
UNI2403	11.0	15	400	380	360	330	310
UNI3401	15.0	20	570	620	670	660	630
UNI3402	18.5	25	660	720	730	660	630
UNI3403	22.0	30	730	800	770	730	700
UNI3404	30.0	40	950	830	790	740	710
UNI3405	37.0	50	1,090	990	920	850	800
UNI4401	45	60	1,460	1,610	1,630	1,530	
UNI4402	55	75	1,910	1,780	1,670	1,560	
UNI4403	75	100	2,370	2,130	2,030	1,850	
UNI4404	90	125	2,640	2,890	2,700	2,470	
UNI4405	110	125	2,970	2,910	2,720	2,490	
UNI5401	160	200	4,700				

* Per Unidrive size 5 power module (e.g. UNI5402 is 9,400W etc.).

The default PWM switching frequency is as follows:

Unidrive and Unidrive VTC: 3kHz; Unidrive LFT: 9kHz.

Table 11-3 Unidrive losses in 'rdY' state

Unidrive model size	Losses in rdY state (W)
1	50
2	50
3	75
4	100
5	30 (control module) 700 (power module)

11.1.3 AC supply requirements

Voltage:

Unidrive: 380V to 480V $\pm 10\%$

Unidrive LV: 200V to 240V $\pm 10\%$

No. of phases: 3

Maximum supply imbalance:

2% negative phase sequence (equivalent to 3% voltage imbalance between phases)

Frequency range: 48 to 62 Hz

Unidrive Size 5 Heatsink fan

Voltage: 115V or 230V $\pm 10\%$ single-phase AC

Frequency range: 48 to 62 Hz

Current:

AC supply voltage	AC supply frequency	Fan current
115V	50Hz	1.02A
	60Hz	1.36A
230V	50Hz	0.51A
	60Hz	0.68A

Fan supply fuse or circuit breaker rating: 2A

11.1.4 Line reactors

Line reactors reduce the risk of damage to the drive resulting from severe disturbances on the supply network caused by, for example:

- Power factor correction equipment connected close to the drive.
- Large DC drives having no or ineffective line reactors connected to the supply.
- Direct-on-line started motor(s) that are connected to the supply and when any of these motors are started, a dip is produced in excess of 20% of the actual supply voltage.

Such disturbances may cause excessive peak currents flow in the input power circuit of the drive. This may cause nuisance tripping, or in extreme cases, failure of the drive.

When one of the following model sizes:

UNI1201 UNI1401 UNI1202 UNI1402

UNI1203 UNI1403 UNI1204 UNI1404

are used on an AC supply where one of the conditions described above is in existence, **OR** the supply is 175kVA or larger, it is recommended that a line reactor of 2% reactance is included between the AC supply and the drive. Model sizes 1205 & 1405, and larger have an internal DC bus choke so do not require AC line reactors except for cases of extreme supply conditions.

For three-phase drives, three individual reactors, or a single three-phase reactor should be used. Each drive must have its own reactor(s).

Current ratings

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

Continuous current rating:

Not less than the continuous current rating of the drive

Repetitive peak current rating:

Not less than *twice* the continuous current of the drive.

11.1.5 Motor requirements

No. of phases: 3

Maximum voltage:

Unidrive: 480V

Unidrive LV: 240V

11.1.6 Temperature, humidity and cooling method

Ambient temperature range:

0°C to 50°C (32°F to 122°F). Output current de-rating must be applied at ambient temperatures between 40°C (104°F) and 50°C (122°F) (absolute maximum).

Minimum temperature at power-up: -10°C (14°F)

Cooling method: Forced convection

Maximum humidity: 95% non-condensing at 40°C (104°F)

11.1.7 Storage

Maximum storage time:

Unidrive sizes 1 & 2: After each 12 months, the capacitors will need re-forming; refer to the supplier of the drive.

Unidrive sizes 3, 4 & 5: After every 4 years, the capacitors will need re-forming; refer to the supplier of the drive.

Storage temperature range: -40°C to 50°C (-40°F to 122°F)

11.1.8 Altitude

Altitude range: 0 to 4,000m (13,200 ft), subject to the following conditions:

1,000m to 4,000m (3,300 ft to 13,200 ft) above sea level: derate the maximum output current from the specified figure by 1% per 100m (330 ft)

For example at 4,000m (13,200ft) the output current of the drive would have to be derated by 30%.

11.1.9 Ingress protection

Size 1 to 4:

Gland plate(s) not fitted: IP00

Gland plate(s) fitted; cable glands not fitted: IP10

Gland plate(s) fitted; cable-glands fitted: IP40, NEMA 1

Size 5 power and control modules: IP00

11.1.10 Starts per hour

By electronic control: unlimited

By interrupting the AC supply:

Unidrive sizes 1 and 2: ≤ 20 (equally spaced)

Unidrive sizes 3 and 4: ≤ 10 (equally spaced)

Unidrive size 5: unlimited

11.1.11 Accuracy and resolution

The following data applies to the drive only; it does not include the performance of the source of the control signals.

Open-loop frequency resolution...

Preset frequency reference: 0.1Hz

Precision frequency reference: 0.001Hz

Open-loop frequency accuracy...

Preset frequency reference: 0.03Hz or 0.01% of the reference, whichever is the larger value

Precision frequency reference: 0.0001Hz or 0.01% of the reference, whichever is the larger value

Closed-loop speed resolution

Unidrive and Unidrive LFT only...

Preset speed reference: 1rpm

Precision speed reference: 0.01rpm

Analog input 1: 0 rpm *

* The speed-loop algorithm ensures that the steady-state speed can change by infinitely small amounts in response to changes in the reference from these inputs.

Closed-loop speed accuracy

Unidrive and Unidrive LFT only...

Preset or precision speed reference: 0.00016 rpm or 0.01% of the reference, whichever is the larger value.

11.1.12 Overall dimensions

- H Height including surface mounting brackets
W Width
D Projection forward of panel when surface mounted
F Projection forward of panel when through-panel mounted
R Projection rear of panel when through-panel mounted

Dimension	Model size				
	1	2	3	4	5
H	366mm 14.409in	366mm 14.409in	368mm 14.488in	765mm 30.118in	1,319mm 51.929in
W	95mm 3.740in	190mm 7.480in	375mm 14.764in	500mm 19.685in	355mm 13.976in
D	200mm 7.874in	200mm 7.874in	260mm 10.236in	260mm 10.236in	
F	120mm 4.724in	120mm 4.724in	120mm 4.724in	120mm 4.724in	340mm 13.386in
R	80mm 3.150in	80mm 3.150in	140mm 5.512in	140mm 5.512in	144mm 5.669in

11.1.13 Weights

Model size	kg	lb
1	4	8.8
2	8	17
3	22	49
4	70	154
5 Power module	102	225
5 Control module	1.2	3

11.1.14 Cable sizes and fuses

Model	Typical input current	Fuse rating	Cable size	
UNI1201	2.4 A	6A	1.5 mm ²	16 AWG
UNI1202	3.5 A	10A	2.5 mm ²	14 AWG
UNI1203	4.6 A	10A	2.5 mm ²	14 AWG
UNI1204	6.5 A	10A	2.5 mm ²	14 AWG
UNI1205	8.6 A	16A	2.5 mm ²	14 AWG
UNI2201	10.8 A	16A	2.5 mm ²	14 AWG
UNI2202	14.3 A	20A	4 mm ²	10 AWG
UNI2203	19.8 A	35A	4 mm ²	10 AWG
UNI3201	26 A	40A	6 mm ²	8 AWG
UNI3202	39 A	60A	10 mm ²	6 AWG
UNI3203	53 A	70A	16 mm ²	4 AWG
UNI3204	78 A	80A	25 mm ²	4 AWG
UNI1401	3.0 A	6A	1.5 mm ²	16 AWG
UNI1402	4.3 A	10A	2.5 mm ²	14 AWG
UNI1403	5.8 A	10A	2.5 mm ²	14 AWG
UNI1404	8.2 A	10A	2.5 mm ²	14 AWG
UNI1405	10.0 A	16A	2.5 mm ²	14 AWG
UNI2401	13.0 A	16A	2.5 mm ²	14 AWG
UNI2402	17.0 A	20A	4 mm ²	10 AWG
UNI2403	21.0 A	35A	4 mm ²	10 AWG
UNI3401	27 A	40A	6 mm ²	8 AWG
UNI3402	32 A	50A	10 mm ²	6 AWG
UNI3403	40 A	60A	10 mm ²	6 AWG
UNI3404	52 A	70A	16 mm ²	4 AWG
UNI3405	66 A	80A	25 mm ²	4 AWG
UNI4401	76 A	100A	35 mm ²	2 AWG
UNI4402	91 A	125A	35 mm ²	2 AWG
UNI4403	123 A	160A	50 mm ²	0 AWG
UNI4404	145 A	200A	70 mm ²	2/0 AWG
UNI4405	181 A	250A	95 mm ²	3/0 AWG
UNI5401	280 A	450A	120 mm ²	4/0 AWG

11.1.15 Motor cable lengths

Nominal AC supply voltage	200V	
Model	Maximum Permissible Motor Cable Length * (PWM switching frequency at 3kHz **)	
	m	ft
UNI1201	65	210
UNI1202	100	330
UNI1203	130	430
UNI1204	200	660
UNI1205	300	990
UNI2201 to UNI2203	300	990
UNI3201 to UNI3204	200	660

Nominal AC supply voltage	400V		480V	
Model	Maximum Permissible Motor Cable Length * (PWM switching frequency at 3kHz **)			
	m	ft	m	ft
UNI1401	65	210	50	160
UNI1402	100	330	75	250
UNI1403	130	430	100	330
UNI1404	200	660	150	490
UNI1405	300	990	250	820
UNI2401 to UNI2403	300	990	300	990
UNI3401 to UNI3405	200	660	124	410
UNI4401 to UNI4405	200	660	124	410
UNI5401	300	990	300	990
UNI5402	600	1,980	600	1,980
UNI5403	900	2,970	900	2,970
UNI5404	1,200	3,960	1,200	3,960
UNI5405	1,500	4,950	1,500	4,950
UNI5406	1,800	5,940	1,800	5,940
UNI5407	2,100	6,930	2,100	6,930
UNI5408	2,400	7,920	2,400	7,920

* Cable lengths in excess of the specified values may be used only when special techniques are adopted; refer to the supplier of the drive.

** The default switching frequency for all versions of Unidrive is 3kHz, except Unidrive LFT, which is 9kHz.

See section 4.5.1 *Cable types and lengths* on page 41 for further limitations on motor cable length.

11.1.16 Unidrive size 5 output sharing choke specification

Minimum inductance: 40μH

Frequency range: 0Hz to maximum motor frequency

Current rating: 300A RMS

Overload current: 120% rated current for 1 minute in a 10 minute period

Harmonic current: 10% at 3kHz

Saturation level: 200% rated current

Ambient temperature: 55°C (130°F) max.

Temperature rise: 100°C (212°F) max.

Cooling: Convection

Insulation class H (180 °C) or better

High-potential test – winding to core: 2.5kV at 50/60 Hz

High-potential test – between windings: 2.5kV at 50/60 Hz

11.1.17 Braking resistor values

Model	Minimum resistance	Instantaneous power rating
UNI1201 to UNI1205	20Ω	15kW
UNI2201	20Ω	15kW
UNI2202, UNI2203	15Ω	20kW
UNI3201 to UNI3205	5Ω	60kW
UNI1401 to UNI1405	40Ω	15kW
UNI2401	40Ω	15kW
UNI2402, UNI2403	30Ω	20kW
UNI3401 to UNI3405	10Ω	60kW
UNI4401 to UNI4405	5Ω	120kW

11.1.18 Acoustic noise

The fan generates the majority of the acoustic noise produced by the drive. The Unidrive LFT has a slower speed fan than the Unidrive or Unidrive VTC and hence generates less noise. Unidrive LFT sizes 1 and 2 are fitted with temperature controlled variable speed fans that run at the minimum speed until the temperature reaches 30°C (86°F) and increase in speed until the temperature reaches 45°C (113°F), where they will be running at the maximum speed.

Values quoted are at a distance of 1m from the drive.

Model size	Unidrive & Unidrive VTC	Unidrive LFT	
		Max fan speed	Min fan speed
1	56 dB(A)	45 dB(A)	28 dB(A)
2	53 dB(A)	42 dB(A)	28 dB(A)
3	64 dB(A)	53 dB(A)	
4	69 dB(A)	62 dB(A)	
5	75 dB(A)		

11.1.19 Torque settings (Drive and filters)

Table 11-4 Drive power terminal data

Model size	AC terminals	DC terminals	Ground terminal
1	Plug-in terminal block 0.5 N m / 4.4 lb in		M4 (Torx/slot-head screw) 3 N m / 2.2 lb ft
2	Plug-in terminal block 0.5 N m / 4.4 lb in		M4 (Torx/slot-head screw) 3 N m / 2.2 lb ft
3	M10 stud 15 N m / 11 lb ft		M10 stud 15 N m / 11 lb ft
4	M10 stud 15 N m / 11 lb ft		M10 stud 15 N m / 11 lb ft
5	M10 bolt & nut 25 N m / 22.1 lb ft	M10 hole 25 N m / 22.1 lb/ft	M10 stud 25 N m / 22.1 lb ft
Torque tolerance			±10%

Table 11-5 Drive control terminal data

Model	Connection type	Torque setting
All	Plug-in terminal block	0.5 N m 4.4 lb in

Table 11-6 Size 5 fan supply connection

Type	Torque setting
M4 Pozidriv screw	0.5 N m 4.4 lb in

Table 11-7 RFI Filter terminal data

CT part number	Schaffner part number	Power connections		Ground connections	
		Max cable size	Torque	Size	Torque
4200-6104	FS5101-10-07	4 mm ² 10 AWG	0.8 N m 7.1 lb in	M5	2.2 N m 19.5 lb in
4200-6105	FS5111-10-29	4 mm ² 10 AWG	0.8 N m 7.1 lb in	M5	2.2 N m 19.5 lb in
4200-6108	FS5106-16-07	4 mm ² 10 AWG	0.8 N m 7.1 lb in	M5	2.2 N m 19.5 lb in
4200-6109	FS5112-16-07	4 mm ² 10 AWG	0.8 N m 7.1 lb in	M5	2.2 N m 19.5 lb in
4200-6113	FS5106-25-07	4 mm ² 10 AWG	0.8 N m 7.1 lb in	M5	2.2 N m 19.5 lb in
4200-6114	FS5113-25-29	4 mm ² 10 AWG	0.8 N m 7.1 lb in	M5	2.2 N m 19.5 lb in
4200-6116	FS5113-50-53	10 mm ² 6 AWG	4.5 N m 3.3 lb ft	M5	2.2 N m 19.5 lb in
4200-6117	FS5113-63-34	10 mm ² 6 AWG	4.5 N m 3.3 lb ft	M6	4.0 N m 2.9 lb ft
4200-6106	FS5113-100-35	50 mm ² 1/0 AWG	8.0 N m 5.9 lb ft	M8	9.0 N m 6.6 lb ft
4200-6107	FS5113-150-40	95 mm ² 4/0 AWG	20.0 N m 14.7 lb ft	M10	18.0 N m 13.3 lb ft
4200-6111	FS5113-180-40	95 mm ² 4/0 AWG	20.0 N m 14.7 lb ft	M12	20.0 N m 14.7 lb ft
4200-6112	FS5113-220-37	150 mm ² 6/0 AWG	30.0 N m 22.1 lb ft	M12	20.0 N m 14.7 lb ft
4200-6115	FS5113-300-99	M12 stud	30.0 N m 22.1 lb ft	M12 stud	20.0 N m 14.7 lb ft

For all the RFI filters, except the size 5 (4200-6115), the power connections are screw terminals and the ground connections are stud terminals

11.1.20 Electromagnetic compatibility (EMC)

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

Immunity

Compliance with immunity standards does not depend on installation details. drives meet EN50082-2 (generic immunity standard for the industrial environment) and the following specifications from the IEC61000-4 group (derived from IEC801):

- Part 2 Electrostatic discharge: Level 3
- Part 3 Radio frequency field: Level 3
- Part 4 Transient burst
 - Level 4 at the control terminals
 - Level 3 at the power terminals
- Part 5 Surge (at the AC supply terminals)
 - (as specified by EN50082-2 informative annex):
 - Level 4 line-to-ground
 - Level 3 line-to-line
- Part 6 Conducted radio frequency: Level 3

Emission

Compliance with emission standards depends on rigorous adherence to the installation guidelines, including the use of the specified RFI filter in the AC supply circuit. Compliance also depends on the PWM switching frequency used in the output stage of the drive, and the length of the motor cable. For full details, refer to the *Unidrive EMC Data Sheet* which

can be obtained from the supplier of the drive.

When installed according to the instructions the drive can meet the emission requirements of CENELEC generic emission standards, as follows:

Table 11-8 Unidrive emission standards

Unidrive	EN50081-1 conducted	EN50081-1 radiated	EN50081-2 conducted	EN50081-2 radiated
1	Restricted motor cable length*	No	Yes	Yes
2	Restricted motor cable length*	No	Yes	Yes
3	No	No	Yes	Yes
4	No	No	Yes	Yes
5	No	No	Yes	Yes

* Compliance with EN50081-1 is restricted to motor cable lengths less than 100m.

For compliance the optional RFI filter specified below must be used:

Model	RFI filter		
	Mounting style	CT part number	Schaffner part number
UNI1201 to UNI1205 UNI1401 to UNI1405	Footprint or Bookcase	4200-6104	FS5101-10-07
	Bookcase	4200-6105	FS5111-10-29
UNI2201 to UNI2202 UNI2401	Footprint or Bookcase	4200-6108	FS5106-16-07
	Bookcase	4200-6109	FS5112-16-07
UNI2203 UNI2402 to UNI2403	Footprint or Bookcase	4200-6113	FS5106-25-07
	Bookcase	4200-6114	FS5113-25-29
UNI3201 to UNI3202 UNI3401 to UNI3403	Bookcase	4200-6116	FS5113-50-53
UNI3203 UNI3404	Bookcase	4200-6117	FS5113-63-34
UNI3204 UNI3405	Bookcase	4200-6106	FS5113-100-35
UNI4401 to UNI4402	Bookcase	4200-6107	FS5113-150-40
UNI4403 to UNI4404	Bookcase	4200-6111	FS5113-180-40
UNI4405	Bookcase	4200-6112	FS5113-220-37
UNI5401	Bookcase	4200-6115	FS5113-300-99

Power Drive Systems standard EN61800-3

The drive meets the immunity requirements of EN61800-3 irrespective of the environment in which it is operating.

The emission requirements of this standard are also met depending on the environment category, as shown in the table later on this page.

EN61800-3 defines the following:

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

NOTE

If a drive System is included as part of equipment covered by a separate EMC product standard, the EMC standard for the complete equipment applies.

Power Drive Systems standard EN61800-3			
Model size	Environment category		
	First environment		Second environment
	Restricted distribution	Unrestricted distribution	Either distribution
UNI1201 to UNI3204 UNI1401 to UNI4401 (Rated input current of drive <100A)	Specified RFI filter required	Using the specified RFI filters and following the wiring guidelines given in Figure 4-12 on page 48 may not ensure that the radiated emission limits are met. Additional filtering may be required in this environment.	Specified RFI filter required
UNI4402 to UNI5408 (Rated input current of drive >100A)	Specified RFI filter required	Using the specified RFI filters and following the wiring guidelines given in Figure 4-12 on page 48 may not ensure that the radiated emission limits are met. Additional filtering may be required in this environment.	No RFI filter required *

*RFI filter(s) are recommended where sensitive electronic systems are operating nearby.

11.2 Optional RFI filters

11.2.1 Ratings

CT part number	Schaffner part number	Max. continuous current @ 40°C (104°F)	Max. continuous current @ 50°C (122°F)	Power dissipation at rated current	Ground leakage current		IP rating	Discharge resistors
					Balanced supply phase-to-phase and phase-to-ground	1 phase open circuit		
4200-6104	FS5101-10-07	10 A	8.8 A	7.7 W	31 mA	143 mA	IP20	See Note 1 below
4200-6105	FS5111-10-29	10 A	8.8 A	7.7 W	31 mA	143 mA	IP20	
4200-6108	FS5106-16-07	16 A	14.1 A	10.4 W	31 mA	143 mA	IP20	
4200-6109	FS5112-16-07	16 A	14.1 A	10.4 W	31 mA	143 mA	IP20	
4200-6113	FS5106-25-07	25 A	22.0 A	25.5 W	35.5 mA	173 mA	IP20	
4200-6114	FS5113-25-29	25 A	22.0 A	25.5 W	35.5 mA	173 mA	IP20	
4200-6116	FS5113-50-53	50 A	44.1 A	12.8 W	31 mA	143 mA	IP20	See Note 2 below
4200-6117	FS5113-63-34	63 A	55.6 A	14.3 W	29 mA	126 mA	IP20	
4200-6106	FS5113-100-35	100 A	88.2 A	25.5 W	48.5 mA	209 mA	IP20	
4200-6107	FS5113-150-40	150 A	132.3 A	30.4 W	48.5 mA	209 mA	IP20	
4200-6111	FS5113-180-40	180 A	158.7 A	82.6 W	31 mA	143 mA	IP20	
4200-6112	FS5113-220-37	220 A	194.0 A	43.6 W	48.5 mA	209 mA	IP20	
4200-6115	FS5113-300-99	300 A	264.6 A	67.5 W	76.4 mA	407 mA	IP20	See Note 1 below

NOTE

- 1MΩ in a star connection between phases, with the star point connected by a 680k resistor to ground.
- 1.5MΩ in a star connection between phases, with the star point connected by a 680k resistor to ground.

Maximum current overload:

150% of rated current for 1 minute in a 1 hour period.

Voltage:

Phase-to-phase: 480V

Phase-to-ground: 275V

AC supply frequency:

48 to 62Hz

11.2.2 Overall dimensions

CT part number	Schaffner part number	Dimension			Weight	
		H	W	D	kg	lb
4200-6104	FS5101-10-07	390 mm (15.354 in)	85 mm (3.346 in)	68 mm (2.677 in)	2.1	5
4200-6105	FS5111-10-29	240 mm (9.449 in)	45 mm (1.772 in)	95 mm (3.740 in)	1.4	3
4200-6108	FS5106-16-07	397 mm (15.630 in)	180 mm (7.087 in)	68 mm (2.677 in)	2.1	5
4200-6109	FS5112-16-07	390 mm (15.354 in)	85 mm (3.346 in)	68 mm (2.677 in)	2.7	6
4200-6113	FS5106-25-07	397 mm (15.630 in)	180 mm (7.087 in)	68 mm (2.677 in)	2.1	5
4200-6114	FS5113-25-29	255 mm (10.039 in)	73 mm (2.874 in)	95 mm (3.740 in)	2.7	6
4200-6116	FS5113-50-53	337 mm (13.268 in)	90 mm (3.543 in)	100 mm (3.937 in)	3.8	9
4200-6117	FS5113-63-34	377 mm (14.843 in)	150 mm (5.906 in)	103 mm (4.055 in)	3.8	9
4200-6106	FS5113-100-35	380 mm (14.961 in)	150 mm (5.906 in)	107 mm (4.213 in)	7.8	17
4200-6107	FS5113-150-40	414 mm (16.299 in)	175 mm (6.890 in)	135 mm (5.315 in)	7.8	17
4200-6111	FS5113-180-40	502 mm (19.764 in)	170 mm (6.693 in)	157 mm (6.181 in)	15	33
4200-6112	FS5113-220-37	523 mm (20.591 in)	170 mm (6.693 in)	157 mm (6.181 in)	15	33
4200-6115	FS5113-300-99	655 mm (25.787 in)	230 mm (9.055 in)	156 mm (6.142 in)	16	35

12 Diagnostics



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.

WARNING

If a drive is faulty, it must be returned to an authorized Control Techniques distributor for repair.

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

12.1 Trip indications

If the drive trips, the output is disabled so that the drive stops controlling the motor. The lower display indicates that a trip has occurred and the upper display shows the trip.

Table 12-1 Trip indications

Trip	Diagnosis
AN1.diS	UD78> Servo large option module displaced
37	UD78 Servo large option module was displaced or removed. Ensure that the module is fitted correctly.
cL1	Current signal loss on analog input 1
27	Loss of signal current on Analog input 1 (terminals 5 and 6), when configured for 4 to 20mA trip on loss current signal input. (Trip level 3mA.)
cL2	Current signal loss on analog input 2
28	Loss of signal current on Analog input 2 (terminal 7), when configured for 4 to 20mA trip on loss current signal input. (Trip level 3mA.)
cL3	Current signal loss on analog input 3
29	Loss of signal current on Analog input 3 (terminal 8), when configured for 4 to 20mA trip on loss current signal input. (Trip level 3mA.)
ConF n	Configuration has changed to n modules
150 to 158	No. of modules has changed to n modules (size 5 only). Check DIP switches on control module correspond with the slide switch address settings on the power modules. Save parameters to clear this trip on next power-up.
EEF	EEPROM Fault
31	Fault in the internal EEPROM causing loss of parameter values. This trip can only be reset by loading default parameters and saving parameters.
ENC.OUL	Encoder power supply overload
10	Check encoder power supply wiring and encoder current requirement Maximum current = 300mA @ 15V and 5V
ENC.PH1	Encoder phase 1 trip
11	Encoder U phase commutation signal missing or the motor did not rotate.
ENC.PH2	Encoder phase 2 trip
12	Encoder V phase commutation signal missing.
ENC.PH3	Encoder phase 3 trip
13	Encoder W phase commutation signal missing.
ENC.PH4	Encoder phase 4 trip
14	Encoder U V W commutation signals connected incorrectly.
ENC.PH5	Encoder phase 5 trip
15	Encoder A channel signal missing.
ENC.PH6	Encoder phase 6 trip
16	Encoder B channel signal missing.
ENC.PH7	Encoder phase 7 trip
17	Encoder A and B channel signals connected incorrectly. Resolver or SINCOS encoder, SIN and COS connections connected incorrectly or the phase sequence of the motor is reversed.

Trip	Diagnosis
ENC.PH8	Encoder phase 8 trip
18	Autotune or servo phasing offset test failed, or was interrupted. This can be caused by the following: <ul style="list-style-type: none"> • Wrong test for operating mode • Limit switch operated • Drive tripped on another trip (a reset of the ENC.PH8 trip will show the actual trip) • A reset signal given during the test.
ENC.PH9	Encoder phase 9 trip
181	Servo phasing incorrect causing reverse torque to be produced. This can be caused by the following: <ul style="list-style-type: none"> • Incorrect encoder/resolver feedback connections. • Incorrect phase offset value. Check connections and perform phase offset test. Spurious ENC.PH9 trips can be seen in very dynamic applications. This trip can be disabled by setting Pr 3.31 = 1. Caution should be used before setting this parameter in case there is a genuine fault with the encoder feedback.
Et	External Trip
6	OL> External trip signal applied to terminal 30. Remove the trip signal, or connect together terminals 30 and 31, and then reset the drive.
FSH.20	UD55> Flash Menu 20
187	The selected parameter set in the UD55 small option module does not contain values for Menu 20 parameters (which relate to a specific large option module), but a large option module is fitted in the destination drive. Consequently, there are no values of Menu 20 parameters to be copied to the destination drive.
FSH.ACC	UD55> Flash Access
185	Write-access to the UD55 cloning small option module has not been enabled. Consequently, no values have been copied to the UD55. To enable write-access, connect together terminals 40 and 41 on the UD55.
FSH.cPr	UD55> Flash Compare
189	This trip is initiated when a parameter set stored in the UD55 cloning small option module has been compared to the parameter set in the drive and differences have been found.
FSH.dAt	UD55> Flash Data
183	No data has been found in the selected parameter set in the UD55 cloning small option module. Consequently, no values have been copied to the destination drive.
FSH.Err	UD55> Flash Error
182	The memory of the UD55 cloning small option module has been found to be corrupt. If the trip has occurred at power-up, the memory is automatically reformatted and all the parameter sets are erased. If the trip occurs after power-up, the memory and parameter-sets are unaffected. See the <i>UD55 User Guide</i> .
FSH.LO	UD55> Flash Large Option Module
186	The selected parameter set in the UD55 cloning small option module contains values for Menu 20 parameters (which relate to a specific large option module), but the related module is not fitted in the destination drive. Consequently, values of Menu 20 parameters have not been copied to the destination drive.
FSH.rm9	UD55> Flash Rating
188	The current rating or voltage rating of the destination drive is different from that relating to the selected parameter set in the UD55 cloning small option module. Consequently, all parameter values have been copied to the destination drive except rating dependent parameters which are listed in <i>Transferring parameter sets between drives of different ratings</i> in the <i>UD55 User Guide</i> .
FSH.TYP	UD55> Flash Type
184	The operating mode of the destination drive is different from that related to the selected parameter-set in the UD55 cloning small option module. Consequently, no values have been copied to the destination drive. Either select an appropriate parameter set, or change the operating mode of the destination drive.
It.AC	[I x t] thermal overload in the motor
20	The [I x t] thermal overload accumulator for the motor has reached 100% (see the OVLd alarm). Pr 4.19 displays the level of the overload accumulator. This can be caused by the following: <ul style="list-style-type: none"> • Excessive load or increased load applied to the motor (check mechanics) • Loss of motor phase • CL> Noise on speed feedback signals • CL> Loose feedback device mechanical coupling • SV> Phase offset value incorrect (Encoder Pr 3.28, SINCOS encoder or resolver Pr 16.09). Perform a phase offset test (see section 7.2.3 <i>Servo</i> on page 86 for more information), or enter the correct value for phase offset. See section 8.3 <i>Motor thermal protection</i> on page 99.
It.br	[I x t] thermal overload in the braking resistor
19	The [I x t] thermal overload accumulator for the braking-resistor motor has reached 100% (see the br.rS alarm). Pr 10.39 displays the level of the overload accumulator. See Pr 10.30 and Pr 10.31 in the <i>Unidrive Advanced User Guide</i> . Increase the power rating of the braking resistor and change Pr 10.30 and Pr 10.31 .

Trip	Diagnosis
L1.SYNC	Synchronisation to the AC supply failed
39	Regeneration sinusoidal rectifier failed to synchronise to the AC supply. Ensure that the AC supply voltage and frequency are within the specified limits. Ensure power connections are correct.
OA	Control PCB over temperature
23	The ambient temperature around the control PCB has reached the over temperature threshold of 95°C (203°F) (see the Air alarm). Check cubicle / drive fans are still functioning correctly Check cubicle ventilation paths Check cubicle door filters Check ambient temperature Reduce drive switching frequency
Oh1	IGBT junction over temperature (based on the drive thermal model)
21	IGBT junction temperature (based on the drive's thermal model) has reached the over temperature threshold of 145°C (293°F) and the drive was unable to reduce the switching frequency further. Pr 7.32 displays the estimated IGBT junction temperature calculated by the drive. Reduce drive switching frequency Reduce duty cycle Decrease acceleration / deceleration rates Reduce motor load
Oh2	Heatsink over temperature
22	Heatsink temperature (detected by thermistor) has reached the over temperature threshold of 94°C (201°F) (see the hot alarm). Check cubicle / drive fans are still functioning correctly Check cubicle ventilation paths Check cubicle door filters Increase ventilation Decrease acceleration / deceleration rates Reduce drive switching frequency Reduce duty cycle Reduce motor load
OI.AC	Over Current in output stage
3	Over current threshold on the output of the drive, of 225% of the drive's Full Load Current (FLC), has been reached. (The FLC of the drive is displayed in Pr 11.32) This can be caused by the following: <ul style="list-style-type: none"> • Pr 0.03 Acceleration rate set too low • Pr 0.04 Deceleration rate set too low • Short-circuit at the output of the drive • Break-down of motor insulation (check with Megger) • Incorrect motor map values see section 7.2 <i>Quick Start commissioning</i> on page 84 for details on how to enter the motor map • Excessive motor-cable length (increased cable capacitance charging current) • CL> Loss of speed feedback signals • CL> Noise on speed feedback signals • CL> Loose mechanical coupling on speed feedback device • CL> Reduce the values in the speed loop gain parameters (Pr 3.10, Pr 3.11 and Pr 3.12) • CL> Reduce the values in the current loop gain parameters (Pr 4.13 and Pr 4.14) • SV> Phase offset value incorrect (Encoder Pr 3.28, SINCOS encoder and Resolver Pr 16.09). Perform a phase offset test, see section 7.2.3 <i>Servo</i> on page 86 for more information. • OL & VT> If this trip occurs during an autotune (sometimes with large motors), decrease the voltage boost value in Pr 5.15.
OI.AC n	Over current in the output stage of module n
118 to 125	Over current threshold in the output of the stage of module n of 170% of the drive's Full Load Current (FLC), has been reached (size 5 only). This can be caused by the following: <ul style="list-style-type: none"> • Pr 0.03 Acceleration rate set too low • Pr 0.04 Deceleration rate set too low • Short-circuit at the output of the drive • Break-down of motor insulation (check with Megger) • Incorrect motor map values see section 7.2 <i>Quick Start commissioning</i> on page 84 for details on how to enter the motor map • Excessive motor-cable length (increased cable capacitance charging current) • CL> Loss of speed feedback signals • CL> Noise on speed feedback signals • CL> Loose mechanical coupling on speed feedback device • CL> Reduce the values in the speed loop gain parameters (Pr 3.10, Pr 3.11 and Pr 3.12) • CL> Reduce the values in the current loop gain parameters (Pr 4.13 and Pr 4.14) • SV> Phase offset value incorrect (Encoder Pr 3.28, SINCOS encoder and Resolver Pr 16.09). Perform a phase offset test, see section 7.2.3 <i>Servo</i> on page 86 for more information. • OL & VT> If this trip occurs during an autotune (sometimes with large motors), decrease the voltage boost value in Pr 5.15.

Trip	Diagnosis
Ol.br	Over Current in braking transistor
4	Over current threshold in the braking transistor has been reached. This can be caused by the following: <ul style="list-style-type: none"> • A short-circuit exists across the braking resistor terminals. • An insulation fault on the braking resistor or associated cables. • The ohmic value of the braking resistor is too low.
Ol.dc n	DC over current trip in module n
134 to 141	DC instantaneous over current trip in module n (size 5 only)
OP.OVLd	Control terminals output overload
26	The total current drawn from the user +24V supply (terminal 22) and any digital outputs (terminals 24, 25 and 26) exceeds 240mA.
Ot HS n	Heatsink over temperature in module n
102 to 109	Heatsink over temperature threshold has been reached in module n (size 5 only); detected by one of the two thermistors in the drive. Ensure that ventilation at the front and rear of the drive is adequate. Check cubicle / drive fans are still functioning correctly. Check cubicle ventilation paths. Check cubicle door filters. Increase ventilation. Decrease acceleration / deceleration rates. Reduce duty cycle. Reduce motor load.
Ot inP	Input stage over temperature
101	Input stage over temperature threshold has been reached (size 5 only). Ensure that ventilation at the front and rear of the drive is adequate. Check cubicle / drive fans are still functioning correctly. Check cubicle ventilation paths. Check cubicle door filters. Increase ventilation. Decrease acceleration / deceleration rates. Reduce duty cycle. Reduce motor load.
OU	Over Volts on the DC bus
2	Over voltage threshold on the DC bus has been reached. 400V Unidrive: >830Vdc 200V Unidrive LV: >415Vdc This is due to excessive AC supply voltage or excessive regenerated power being returned to the drive that can be caused by the following: <ul style="list-style-type: none"> • Pr 0.04 Deceleration rate set too low. • An external force acting on the motor shaft causing the drive to regenerate. • Braking resistor value is too high. • AC supply voltage too high. • Supply disturbance such as a voltage over-shoot as the supply recovers from a notch induced by a DC drive. • Motor insulation fault.
OU n	Over volts on the DC bus in module n
126 to 133	Over voltage threshold on the DC bus of module n of 830Vdc, has been reached (size 5 only). (The FLC of the drive is displayed in Pr 11.32) This is due to excessive regenerated power being returned to the drive that can be caused by the following: <ul style="list-style-type: none"> • Pr 0.04 Deceleration rate set too low. • An external force acting on the motor shaft causing the drive to regenerate. • Braking resistor value is too high. • AC supply voltage too high. • Supply disturbance such as a voltage over-shoot as the supply recovers from a notch induced by a DC drive. • Motor insulation fault.
OU.SPd	Over speed
7	The motor speed has reached the over speed threshold (Pr 3.08). This can be caused by the following: <ul style="list-style-type: none"> • Sudden removal of a large mechanical load from the motor shaft. • Pr 0.04 Deceleration rate set too low. • Inappropriate setting for Pr 0.16 Stop mode selector. • Pr 0.19 S-ramp da/dt set too high. • Pr 3.08 set below the maximum reference obtainable, i.e. set less than Pr 0.02 (or Pr 1.06). • Speed over-shoot due to high speed loop proportional gain (Pr 3.10)

Trip	Diagnosis
Ph	AC supply phase loss
32	<p>Loss of an AC supply phase detected by increased ripple on the DC bus. Ensure all 3 input phases are present and balanced.</p> <p>NOTE</p> <p>Load level must be between 50 and 100% for the drive to trip under phase loss conditions. The drive will attempt to stop the motor before this trip is initiated.</p>
Prc2	UD70> Second processor fault
8	<p>Indicates a trip in the Processor of the UD70 large option module. Possible causes of failure are as follows:</p> <ul style="list-style-type: none"> If the watchdog feature is enabled (Pr 17.18 = 1), then this trip indicates the WDOG instruction has not been executed, in the UD70 program, within 200ms of the last execution. See the WDOG command in the UD70 User Guide for more details. If the watchdog feature is not enabled (Pr 17.18 = 0), then this trip indicates an operating system failure. Contact the supplier of the module.
PS	Internal power supply fault
5	<p>Remove any option module and attempt a reset (to verify if the trip is caused by the option module). Check integrity of interface ribbon cables and connections (size 5 only). Hardware fault - return drive to supplier.</p>
PS n	Internal power supply fault in module n (size 5 only)
110 to 117	<p>Check integrity of interface ribbon cables and connections (size 5 only). Hardware fault - return drive to supplier.</p>
rS	Incorrect stator resistance value
33	<p>Incorrect measurement of stator resistance due to the following:</p> <ul style="list-style-type: none"> One or more motor phases disconnected when the measurement was being made Motor too small for the drive <p>If required, set Pr 0.07 (or Pr 5.14) <i>Voltage mode</i> at Ur and enter the value of stator resistance in parameter Pr 5.17.</p>
SCL	Serial Communications loss
30	<p>Loss of serial communications when slaving drives or using the universal remote keypad. Ensure that the communications device is working correctly and the interconnections are correctly made.</p>
SEP	UD5x> Small option module fault
9	<p>Indicates a trip in the UD5x small option module. Possible causes of failure are as follows:</p> <ul style="list-style-type: none"> UD50 Additional I/O> The total current drawn from digital outputs (terminals 48, 49 & 50) has reached the over current threshold. UD52 Sin-cos> Encoder power supply overloaded or short circuit (terminals 44 & 45). UD53 Resolver> Connections to the UD53 have not been made correctly or a wire break between the resolver and the UD53.
SEP.dis	UD5x> Small option module displaced
180	<p>The type of small option module that the drive has been programmed to operate with has been removed or is not fitted correctly. Perform either of the following:</p> <ul style="list-style-type: none"> Ensure the appropriate type of small option module is correctly fitted To operate the drive in the present configuration, set Pr xx.00 at 1000 and press the  (STOP/RESET) button.
SEP EC	UD52> SINCOS encoder communications failure
35	<p>Communications between SIN-COS encoder and UD52 small option module have failed. Absolute position information will not be obtained. Possible causes of failure are as follows:</p> <ul style="list-style-type: none"> Incorrect serial communications connections (terminals 46, 47). DC supply to the encoder is not connected (terminals 44, 45) or has failed. Incorrect DC supply voltage for the encoder (Pr 16.15). <p>After rectifying the fault, remove, and then re-apply the AC supply to the drive in order to obtain absolute position information.</p>
SEP EF	UD52> Sincos encoder fault
36	Internal fault within the SINCOS encoder. Contact the encoder or motor supplier.
St GL	Spurious trip
34	<p>Unrecognised trip on power-up (size 5 only). Hardware fault, contact the supplier of the drive.</p>
SuP.LSS	Regen supply loss
190	<p>The drive in Regen mode has detected AC supply loss. Check all three supply phases are present and at the correct level.</p>
th	Motor thermistor over temperature
24	<p>The motor thermistor has detected excessive motor temperature or the thermistor or associated wiring is open-circuit. Set Pr 7.15 = volt and save parameters to disable this function.</p>
thS	Motor thermistor short circuit
25	<p>The motor thermistor or wiring is short circuit. Set Pr 7.15 = volt and save parameters to disable this function.</p>

Trip	Diagnosis
tr XX	UD70 run time trips
40 to 69	<p>XX indicates the trip code number.</p> <p>Trip Code Description</p> <ul style="list-style-type: none"> 40 Unknown Error 41 Parameter does not exist 42 Parameter write failed: parameter is read only 43 Parameter read failed: parameter is write only 44 Parameter write failed: parameter value is over range 45 Virtual parameter access failed: IOLINK is not running 46 to 48 Internal error 49 Wrong system loaded 50 Maths error in the program, e.g. divide by zero, overflow, etc. 51 DPL array index is out of range 52 User generated trip from control word 53 DPL program incompatible 54 DPL overload – a task has run of time 55 RS485 trip (mode 3, mode 4, etc.) 56 Option module and system-file are incompatible 57 Illegal operating system call 58 to 59 Internal error 60 to 69 High-speed communications option generated trips <p>See the UD70 and/or the relevant high-speed communications option User guides for more information.</p>
tr XX	User trips 70 to 99, 159 to 179, 191 to 200
70 to 99, 159 to 179, 191 to 200	<p>Trip codes defined by the user. XX indicates the trip code number.</p> <p>For use with the UD70 Application modules by writing the trip code to Pr 10.38.</p>
UFLt n	Unidentified trip on module n
142 to 149	Unidentified fault on power-up in module n (size 5 only)
UU	Under Volts
1	<p>Under voltage threshold on the DC bus has been reached</p> <ul style="list-style-type: none"> 400V Unidrive: <350Vdc 200V Unidrive LV: <160Vdc <p>This also occurs when the AC supply has been removed.</p> <p>Ensure that the AC supply is above the minimum level.</p> <ul style="list-style-type: none"> 400V Unidrive: >380Vac -10% (342Vac) 200V Unidrive LV: >200Vac -10% (180Vac)

Table 12-2 Serial communications look-up table

No.	Trip	No.	Trip	No.	Trip
1	UU	22	Oh2	110 to 117	PS1 to PS8
2	OU	23	OA	118 to 125	OI.AC1 to OI.AC8
3	OI.AC	24	th	126 to 133	OU1 to OU8
4	OI.br	25	thS	134 to 141	OI.dc1 to OI.dc8
5	PS	26	OP.OVLd	142 to 149	UFLt1 to UFLt8
6	Et	27	cL1	150 to 158	ConF1 to ConF8
7	OU.SPd	28	cL2	159 to 179	tr159 to tr179
8	Prc2	29	cL3	180	SEP.diS
9	SEP	30	SCL	181	ENC.PH9
10	ENC.OUL	31	EEF	182	FSH.Err
11	ENC.PH1	32	Ph	183	FSH.dAt
12	ENC.PH2	33	rS	184	FSH.TYP
13	ENC.PH3	34	St GL	185	FSH.ACC
14	ENC.PH4	35	SEP EC	186	FSH.LO
15	ENC.PH5	36	SEP EF	187	FSH.20
16	ENC.PH6	37	AN1.diS	188	FSH.rn9
17	ENC.PH7	39	L1.SYNC	189	FSH.cPr
18	ENC.PH8	40 to 69	tr40 to tr69	190	SuP.LSS
19	It.br	70 to 99	tr70 to tr99	191 to 200	tr191 to tr200
20	It.AC	101	OtinP		
21	Oh1	102 to 109	OtHS1 to OtHS8		

12.1.1 HF - Hardware fault trip codes

HF trips are internal hardware faults within the drive. Powering the drive down and re-applying power could clear the fault. Resetting the drive will not clear a HF trip.

Below is a full list of hardware fault trip codes on Unidrive.

NOTE

If a HF trip occurs, the Drive Healthy relay will open to indicate this.

The serial communications will not function during a HF trip.

HF81	Software Error (odd address word)
HF82	Large option module removed
HF83	Power Board Code Failure
HF84	Current Offset Trim Failure
HF85	A to D failure (ES-CC step)
HF86	Interrupt Watchdog failure
HF87	Internal ROM check error
HF88	Watchdog Failure
HF89	Unused Interrupts (nmi as source)
HF90	Stack Overflow
HF91	Stack Underflow
HF92	Software Error (undefined op code)
HF93	Software Error (protection fault)
HF94	Software Error (odd address word)
HF95	Software Error (odd address inst.)
HF96	Software Error (illegal ext bus)
HF97	Level 1 Noise
HF98	Interrupt Crash
HF99	Level 1 Crash

The only HF trip that can be caused by the user is a HF82 trip where a large option module is removed while the drive is powered up. The drive should be powered down, the module re-fitted correctly and the power reapplied to clear the trip.

If the drive persistently trips on a HF trip, contact the supplier of the drive.

12.2 Alarm indications

If a critical condition is detected, the drive continues operating and the lower display shows an alarm indication in place of the status indication. If the condition is not rectified, the drive could trip.

The alarm indication flashes alternately with the normal display indication.

Lower display	Description
Air	Control PCB ambient temperature near maximum limit
	The ambient temperature around the control PCB has reached 90°C (194°F) and the drive will trip OA if the temperature continues to rise (see the OA trip).
br.rS	Braking resistor overload
	The braking-resistor [I x t] accumulator in the drive has reached 75% of the value at which the drive will be tripped.
hot	Heatsink temperature near maximum limit
	The drive heatsink has reached 90°C (194°F) and the drive will trip Oh2 if the temperature continues to rise (see the Oh2 trip).
OVLd	Motor overload
	The motor [I x t] accumulator in the drive has reached 75% of the value at which the drive will be tripped.

12.3 Status indications

Lower display	Description	Drive output stage
Act	Regeneration mode active	Enabled
	Regen mode> The Regen drive is enabled and synchronised to the supply.	
ACUU	AC Supply loss	Enabled
	The drive has detected that the AC supply has been lost and is attempting to maintain the DC bus voltage by decelerating the motor.	
dc	DC applied to the motor	Enabled
	The drive is applying DC injection braking.	
dEC	Decelerating	Enabled
	The drive is decelerating the motor.	
inh	Inhibit	Disabled
	The drive is inhibited and cannot be run. Drive enable signal not applied to terminal 30 or Pr 6.15 is set to 0.	
POS	Positioning	Enabled
	The drive is positioning/orientating the motor shaft.	
rdY	Ready	Disabled
	The drive is ready to be run.	
run	Running	Enabled
	The drive is running.	
SCAn	Scanning	Enabled
	OL> The drive is searching for the motor frequency when synchronising to a spinning motor. Regen> The drive is enabled and is synchronising to the line.	
StoP	Stop or holding zero speed	Enabled
	The drive is holding the motor at zero speed. Regen> The drive is enabled but the AC voltage is too low, or DC Bus voltage still rising or falling.	
triP	Trip condition	Disabled
	The drive has tripped and is no longer controlling the motor. The trip code appears on the upper display.	

When the drive is in normal operation, the lower display indicates the status of the drive.

12.4 Displaying the trip history

The drive retains a log of the last 10 trips that have occurred, in Pr 10.20 to Pr 10.29. Pr 10.20 is the most recent trip (or current trip if the drive is in the trip state) and Pr 10.29 is the oldest. When a trip occurs all the parameters move down one, such that the current trip is put in Pr 10.20 and the oldest trip is lost off the bottom of the log.

If any parameter between Pr 10.20 and Pr 10.29 inclusive is read by serial communications, then the trip number in section 12.1 *Trip indications* on page 198 is the value transmitted.

13 UL Listing Information

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

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

- The drive is installed in a type 1 enclosure, or better, as defined by UL50
- The correct UL-listed fuses are used as follows:
Unidrive size 1 to 4: Class RK1 600Vac
Unidrive size 5: Gould Shawmut Amp-Trap A50P, 500Vac, 450A
- Class 1 60/75°C (140/167°F) copper wire only is used in the installation
- The ambient temperature does not exceed 40°C (104°F) when the drive is operating
- The terminal tightening torques specified in section 3.12.2 *Terminal sizes and torque settings* on page 36

13.1 AC supply specification

The drive is suitable for use in a circuit capable of delivering not more than:

- Unidrive sizes 1 to 3: 5000 rms symmetrical Amperes
- Unidrive size 4: 10,000 rms symmetrical Amperes
- Unidrive size 5: 18,000 rms

at 268Vac rms for Unidrive LV and 528Vac rms for Unidrive, maximum.

13.2 Maximum continuous output current

The drive models are listed as having the maximum continuous output currents (FLC) shown in Table 13-1 and Table 13-2 (see Chapter 11 *Technical Data* on page 190 for details).

Table 13-1 Maximum continuous output current for low voltage models

Model	FLC (A)	
	STD / VTC	LFT
UNI1201	2.1	2.1
UNI1202	2.8	2.8
UNI1203	3.8	3.8
UNI1204	5.6	4.0
UNI1205	9.5	4.3
UNI2201	12	12
UNI2202	16	14.2
UNI2203	25	14.2
UNI3201	34	28
UNI3202	46	28
UNI3203	60	32
UNI3204	74	35

Table 13-2 Maximum continuous output current for 380V / 400V models

Model	FLC (A)	
	STD / VTC	LFT
UNI1401	2.1	2.1
UNI1402	2.8	2.8
UNI1403	3.8	3.8
UNI1404	5.6	4.0
UNI1405	9.5	4.3
UNI2401	12	12.0
UNI2402	16	14.2
UNI2403	25	14.2
UNI3401	34	28.0
UNI3402	40	28.0
UNI3403	46	32.0
UNI3404	60	33.0
UNI3405	70	35.0
UNI4401	96	70
UNI4402	124	70
UNI4403	156	80
UNI4404	180	100
UNI4405	202	100
UNI5401	300*	

* Unidrive size 5 is only available as a STD model.

13.3 Safety label

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

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