CONTROL TECHNIQUES

www.controltechniques.com

User Guide

Unidrive

Model sizes 1 to 5

Universal Variable Speed Drive
for induction and servo motors

Part Number: 0460-0083
Issue Number: 7

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.

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.

Issue Number: 7

Software: V03.xx.xx onwards

How to use this manual

This user guide provides information for installing and operating a Unidrive from start to finish. The information is provided in a chronological order from receiving the drive to fine tuning the parameter settings.

For personnel who are **not familiar** with the product it is recommended that you start at the beginning of the user guide and familiarise yourself with the product and the requirements of each part of the process of installing and running the drive.

For personnel who would like to **bench test** the product and require a **quick start up** section please go straight to Chapter 7 *Running the motor* on page 65 after reading Chapter 1 *Safety Information* on page 1.

For personnel already familiar with the product, block diagrams and single line descriptions are provided to allow quick and easy programming **references**.

A full list of **diagnostics** can be found in Chapter 12 *Diagnostics* on page 181.

If a specific piece of information is required please see the **index** at the back of the user guide or alternatively scan the contents page for the appropriate section.

NOTE

There are specific safety warnings throughout this guide which the user must be familiar with prior to operating the drive.

Contents

Declaration of Conformity

Control Techniques Ltd
The Gro
Newtown
Powys
UK
SY16 3BE

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:

EN60249	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
EN60529	Degrees of protection provided by enclosures (IP code)
UL94	Flammability rating of plastic materials
UL508C	Standard for power conversion equipment
EN50081-1[1]	Generic emission standard for the residential, commercial and light industrial environment
EN50081-2	Generic emission standard for the industrial environment
EN50082-2	Generic immunity standard for the industrial environment
EN61800-3	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.

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.

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:

97/37/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 ~ 240V ±10%)

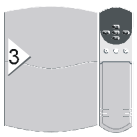
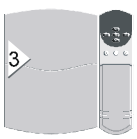
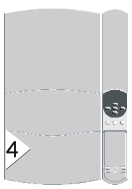
Model		Nominal rating		Output current* (A)	Typical Input current (A)
		kW	hp		
	1201	0.37	0.5	2.1	2.4
	1202	0.55	0.75	2.8	3.5
	1203	0.75	1	3.8	4.6
	1204	1.1	1.5	5.6	6.5
	1205	2.2	3	9.5	8.6
	2201	3	4	12	10.8
	2202	4	5	16	14.3
	2203	5.5	10	25	19.8
	3201	7.5	15	34	26
	3202	11	20	46	39
	3203	15	25	60	53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

Table 2-2 400V drive ratings (380V ~ 480V ±10%)

Model		Nominal rating		Output current* (A)	Typical Input current (A)
		@380V	@460V		
		kW	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

* Output current rating @ 3kHz switching frequency only

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

NOTE

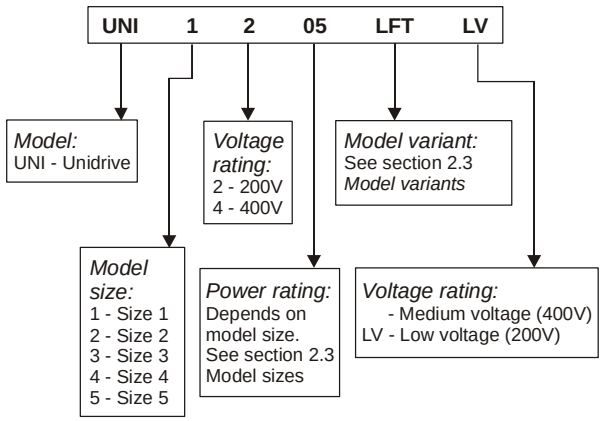
A Unidrive size 5 consists of a control module with one or more power modules connected in parallel.

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.

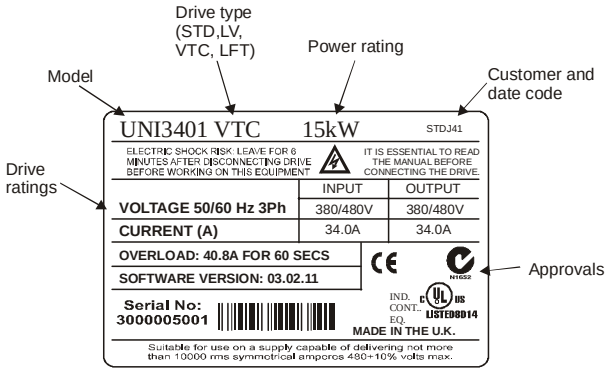


2.3 Nameplate description - drive identification

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

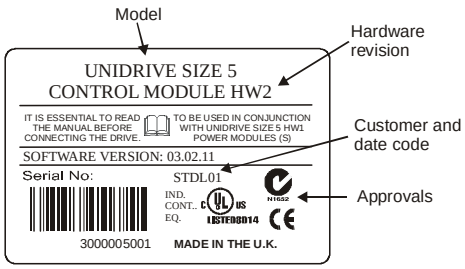
Unidrive size 1 ~ 4 rating label



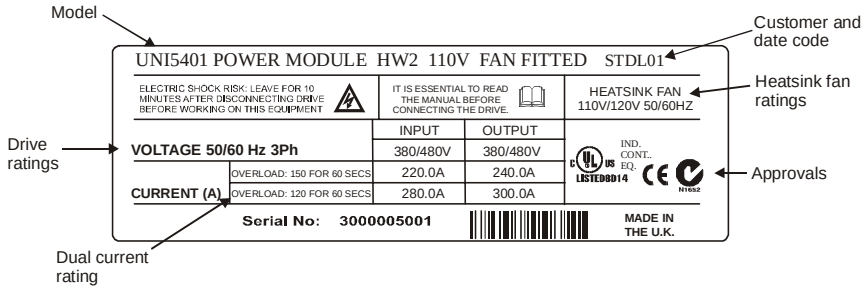
Key to Approvals

CE	CE approval	Europe
C Tick	C Tick approval	Australia
cULus	UL / cUL approval	USA & Canada

Unidrive size 5 control module rating label



Unidrive size 5 power module rating label



2.4 Model variants

2.4.1 Unidrive standard industrial (STD)

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

Operating modes:

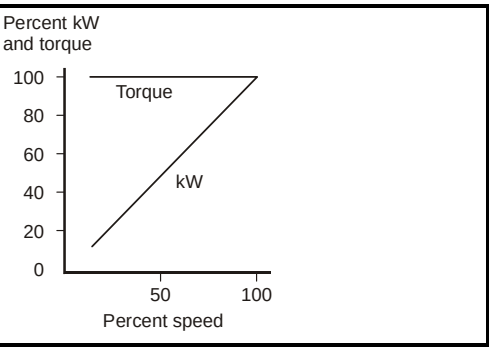
Open Loop
Closed Loop vector
Servo
Regen

Overload:

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



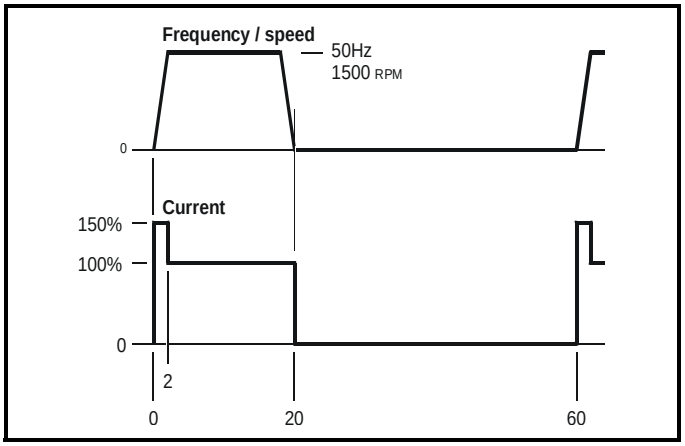
2.4.2 Unidrive LFT

...for lift applications

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

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

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



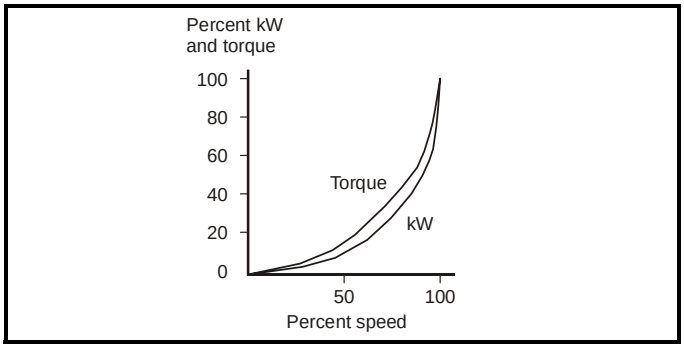
2.4.3 Unidrive VTC

...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, standard industrial 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

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 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.

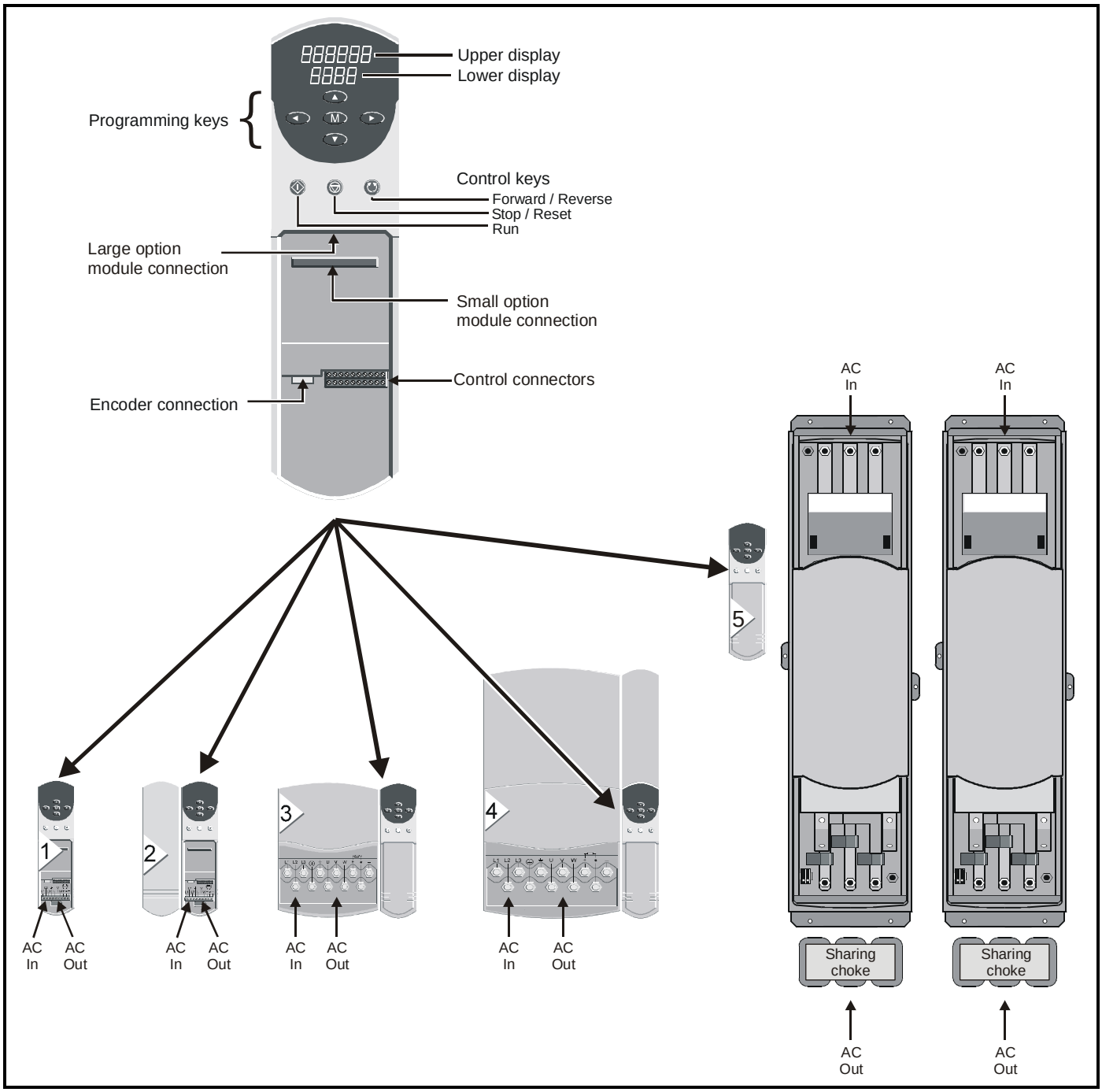
2.5.5 Key to operating mode abbreviations

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.

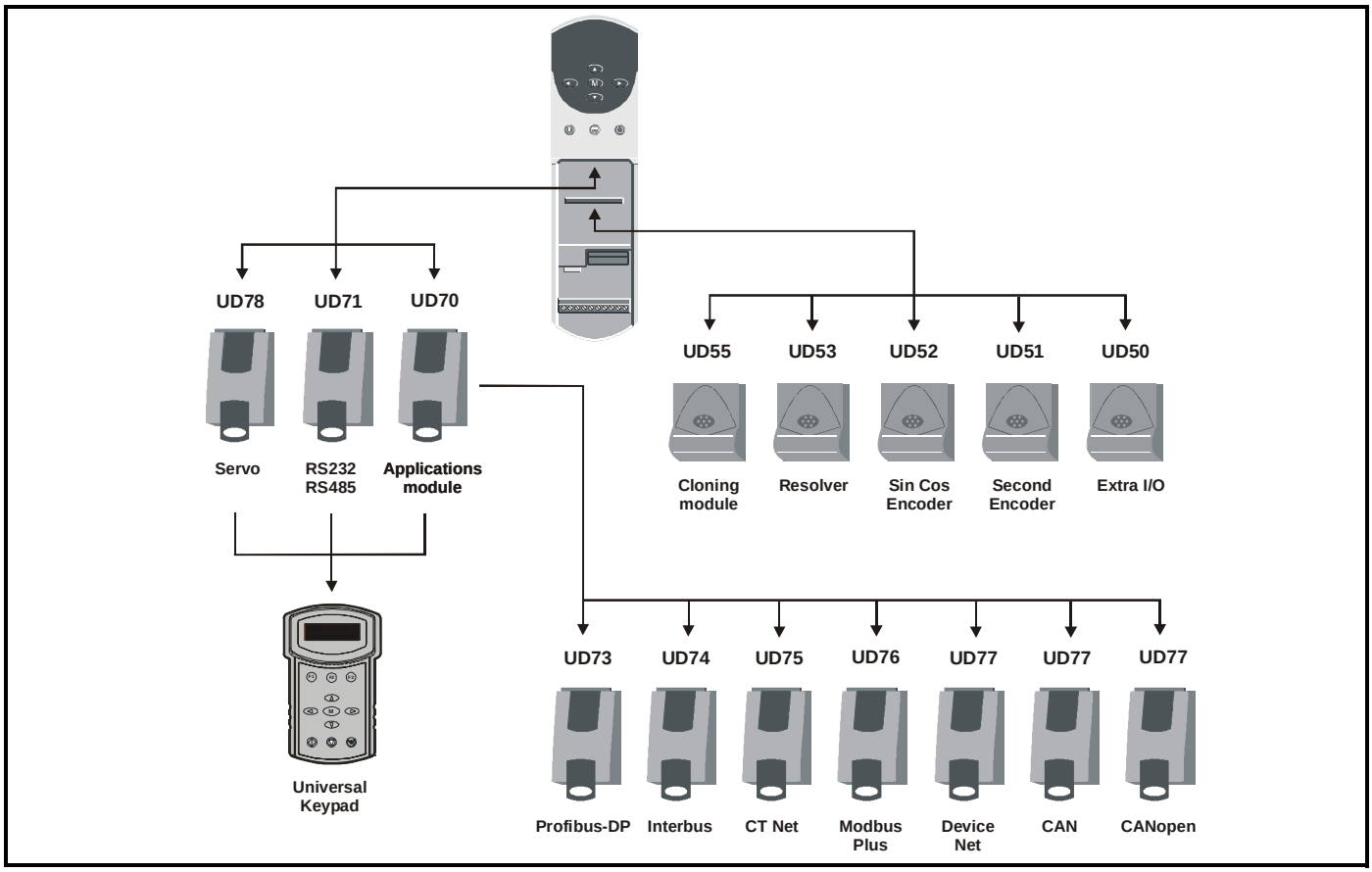
For power ratings greater than 160kW / 200hp, multiple power modules (up to a maximum of 8) can be connected in parallel.

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

2.7 Option Modules

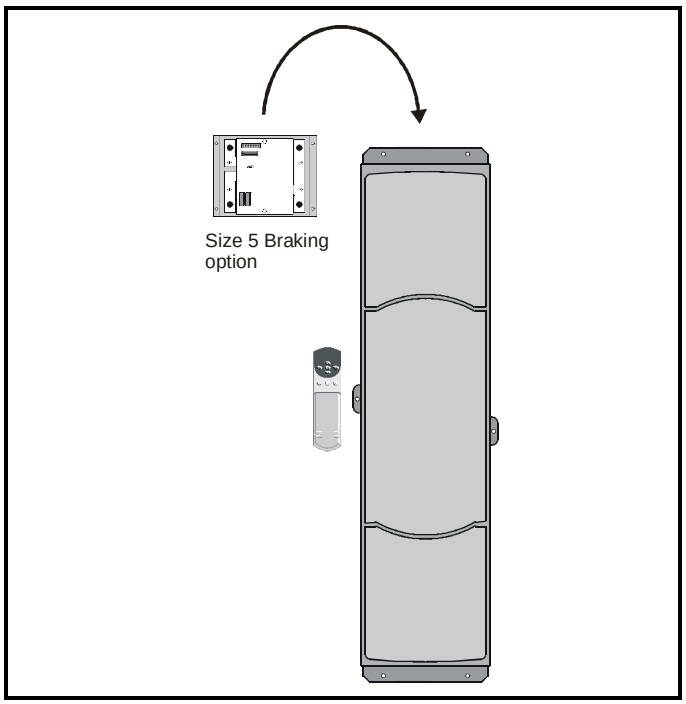
The following option modules are available for use with Unidrive.

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



WARNING

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

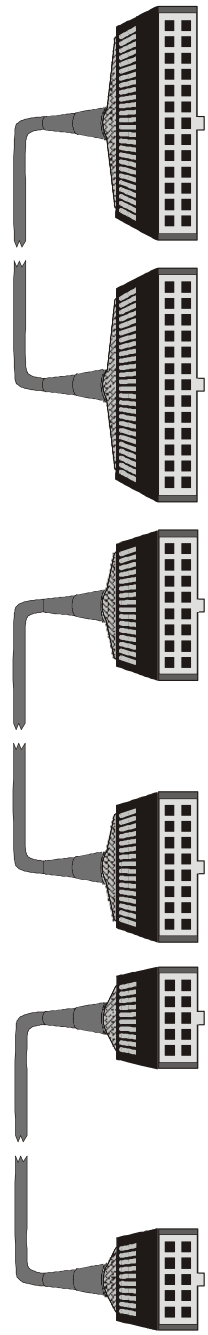
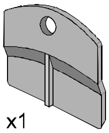
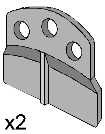
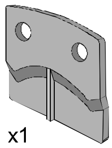
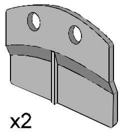
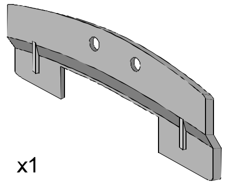
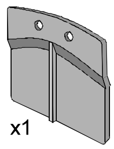
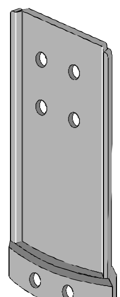
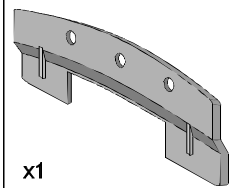
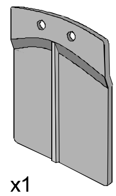
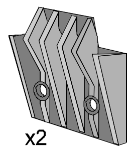
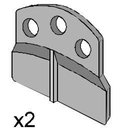
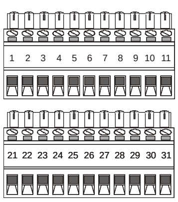
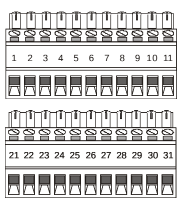
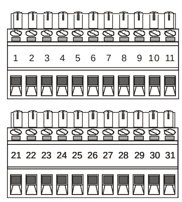
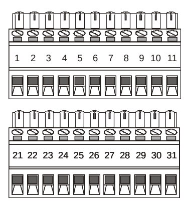
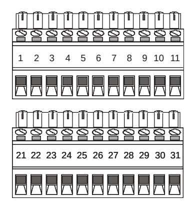
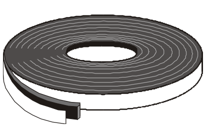
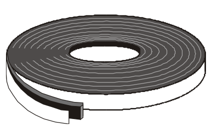
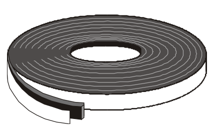
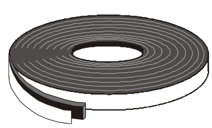
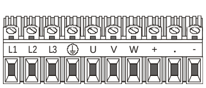
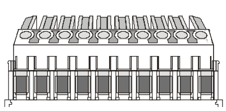
2.8 More information

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 CAUTION Risk of Electric Shock Power down unit 10minutes before removing cover	UL Warning label CAUTION Risk of Electric Shock Power down unit 10minutes before removing cover		
UL Warning label CAUTION Risk of Electric Shock Power down unit 10minutes before removing cover	UL Warning label CAUTION Risk of Electric Shock Power down unit 10minutes before removing cover				

3 Mechanical Installation

3.1 Safety information

WARNING

Follow the instructions

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

WARNING

Competence of the installer

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

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
- 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.

3.2.4 Electrical safety

The installation must be safe under normal and fault conditions. Electrical installation instructions are given later in this chapter.

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 given further on in this chapter.

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

WARNING

Isolation device

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

WARNING

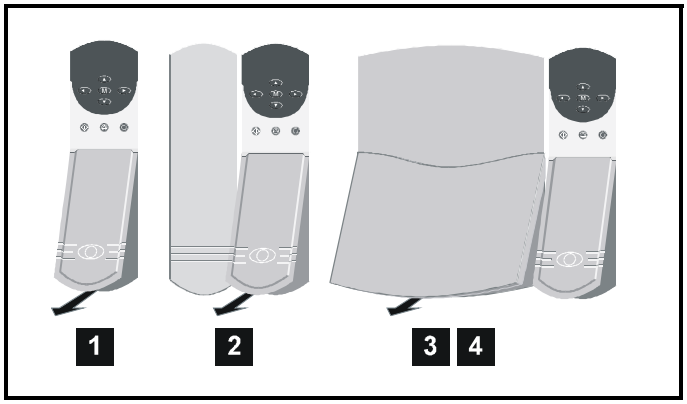
Stored charge

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

3.3.1 Removing the terminal covers

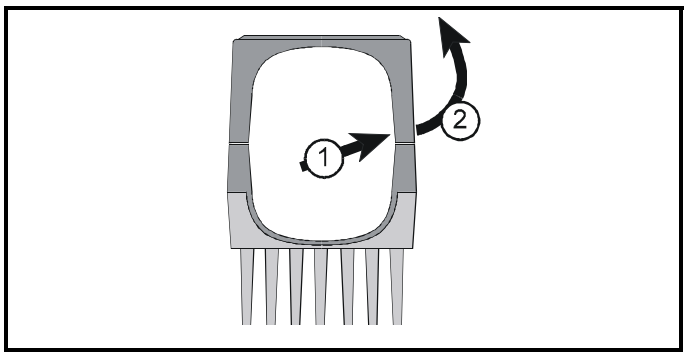
Unidrive sizes 1 ~ 4 and the size 5 control module are fitted with one or two terminal covers depending on the model size. When model sizes 1, 3 and 4 are through-panel mounted, the terminal cover(s) must first be removed in order for access to be gained to the lower mounting holes.

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

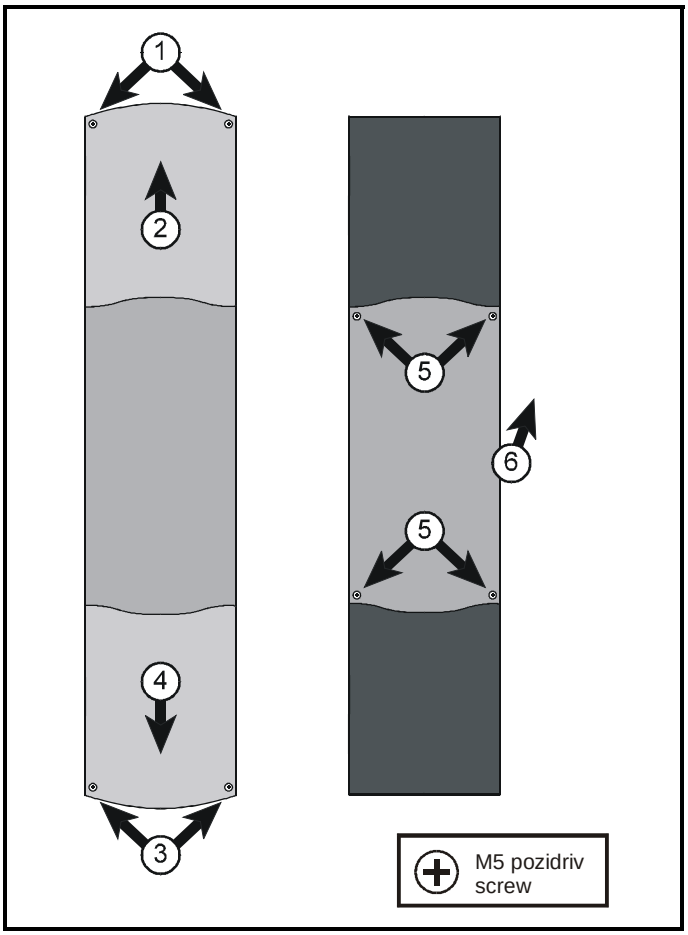


Remove terminal covers, as follows:

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.

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 ~ 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

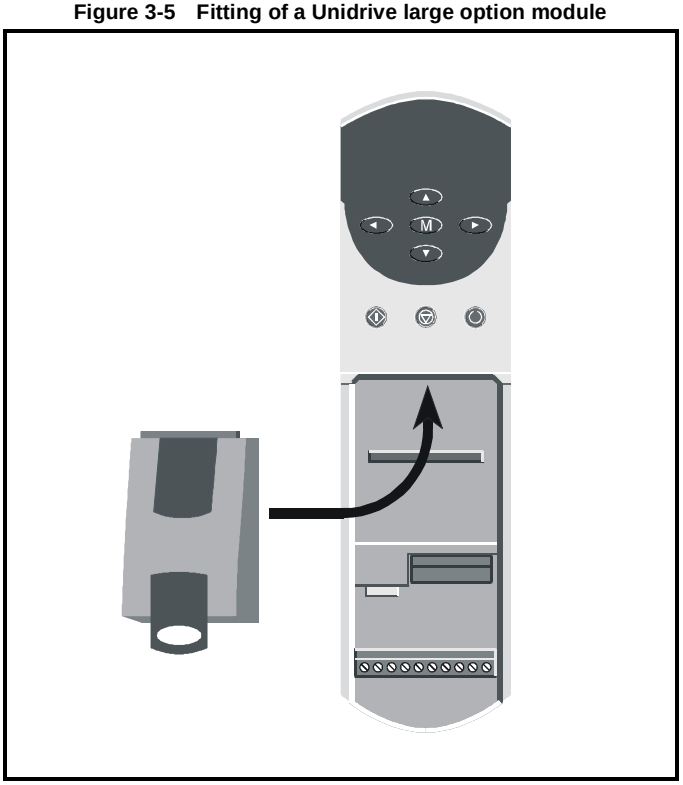
3.5 Option module fitting / removal

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~ 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

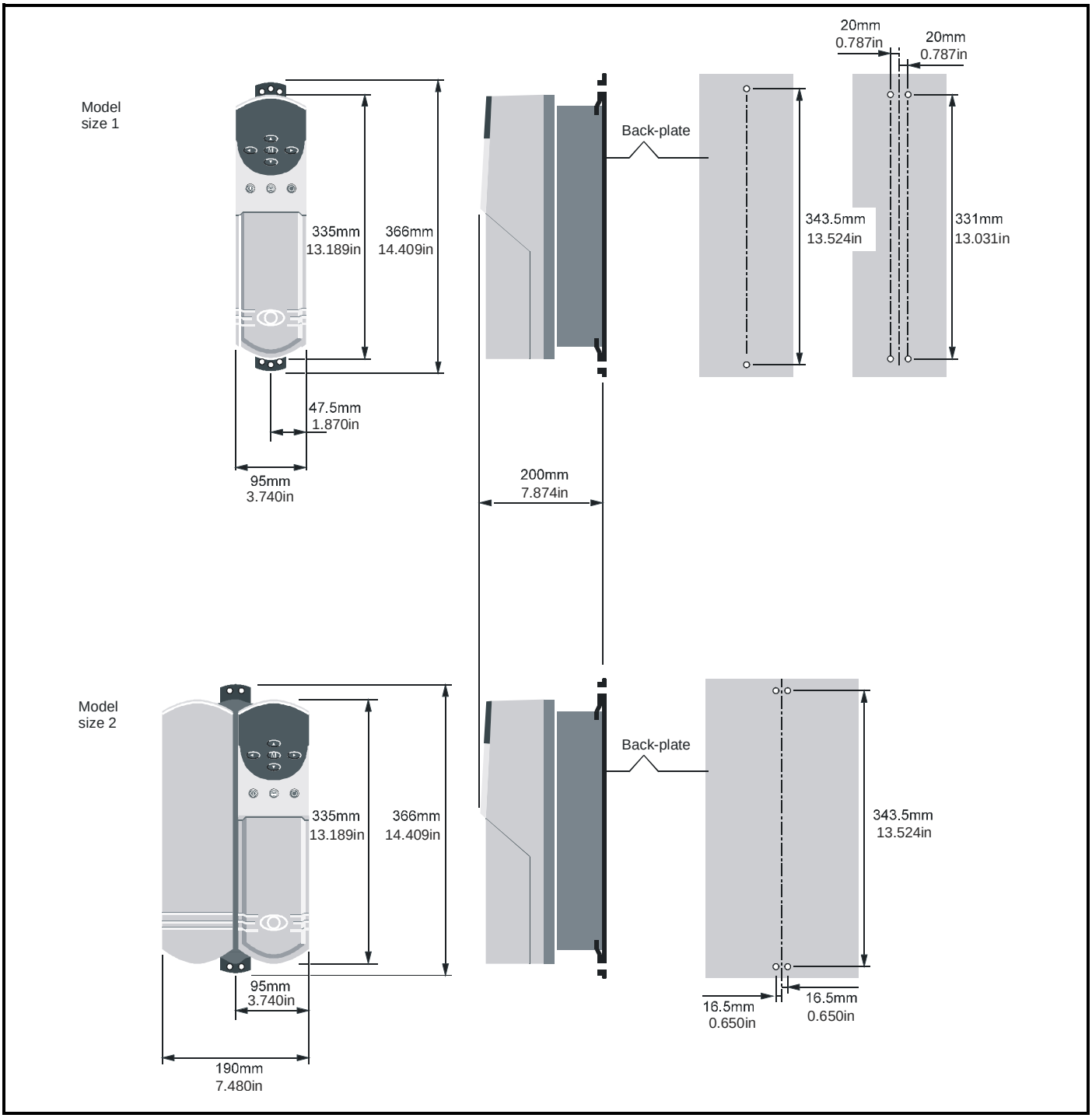


Figure 3-7 Surface mounting of model sizes 3 and 4

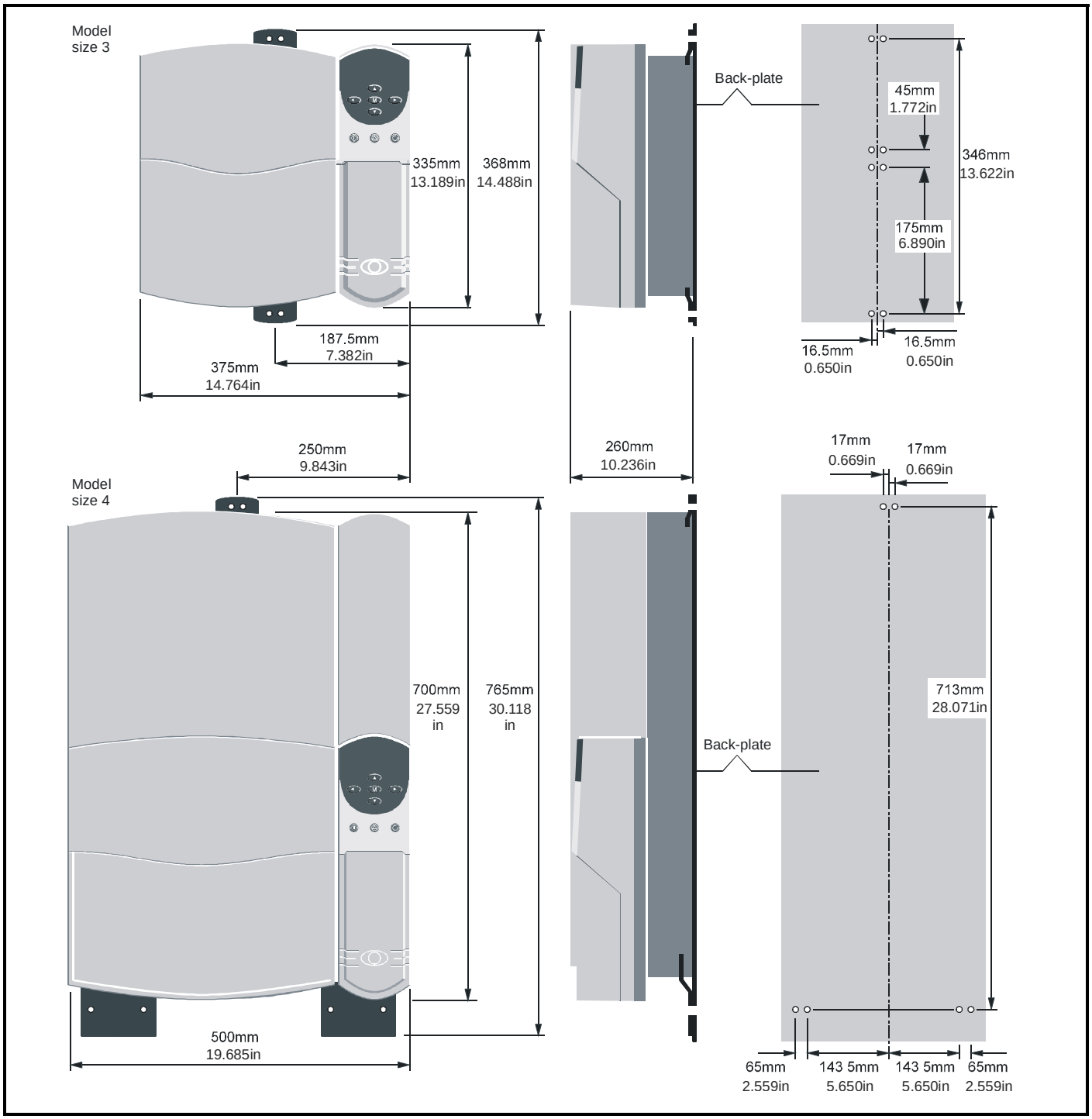
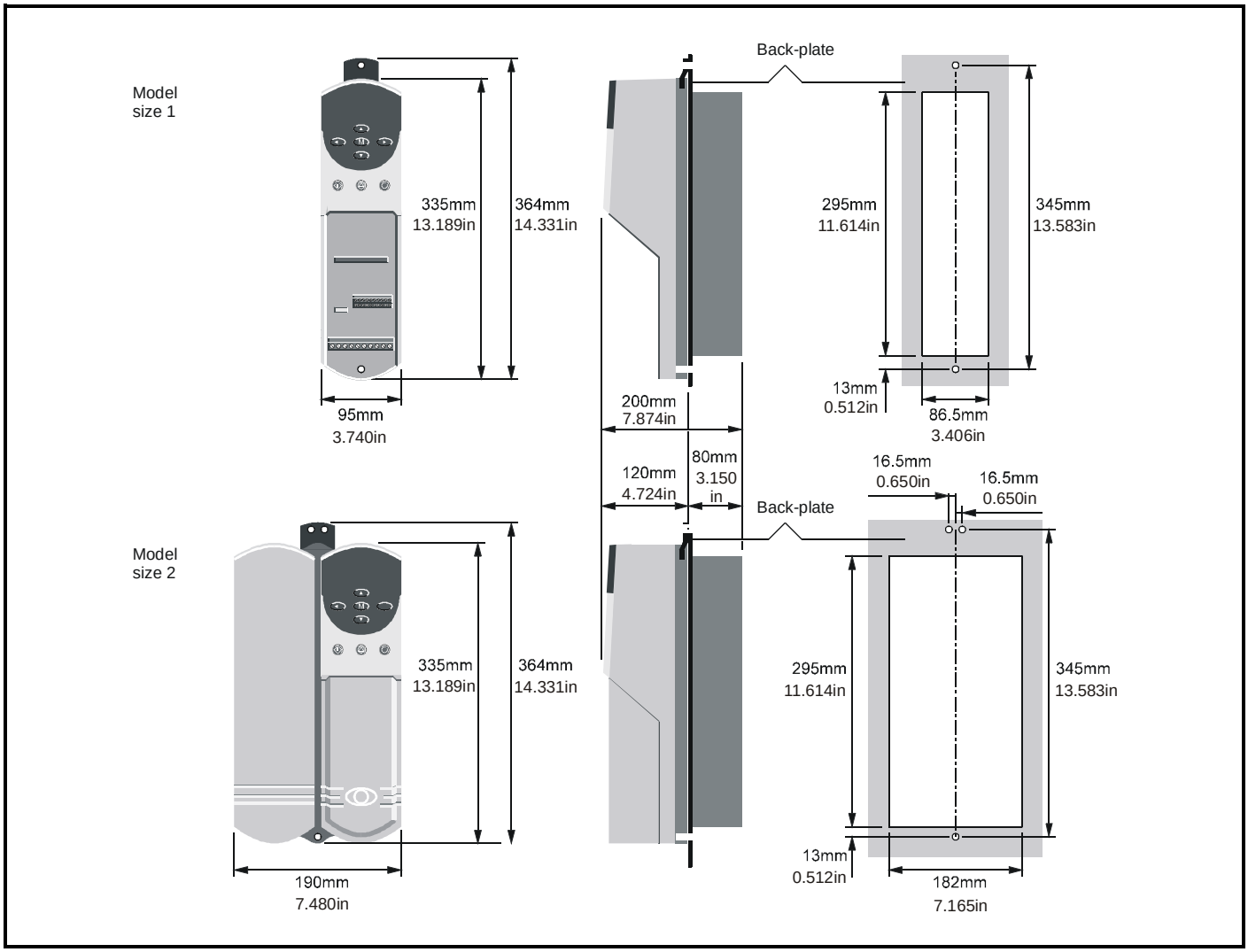


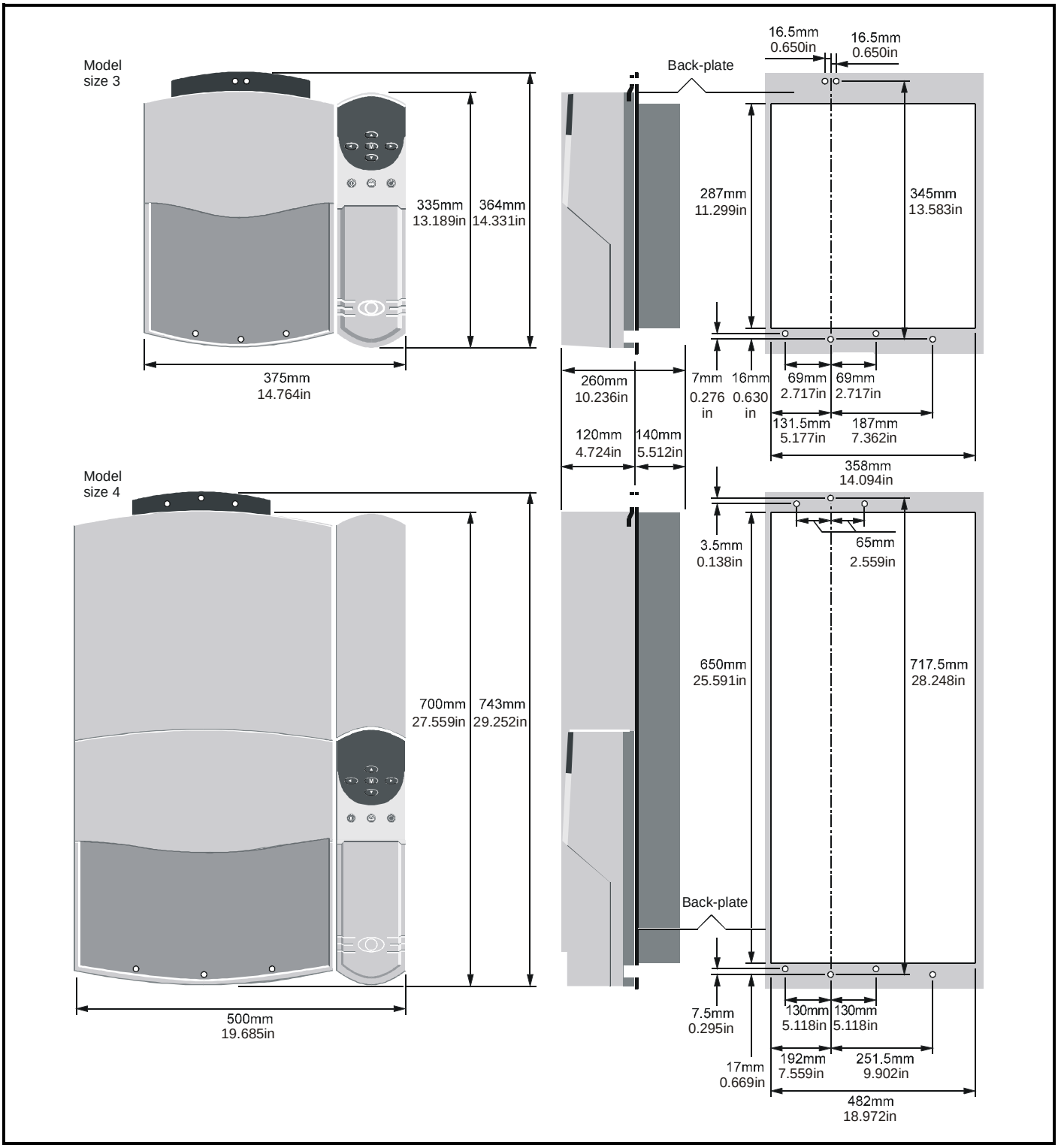
Figure 3-8 Through-panel mounting of model sizes 1 and 2



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 22.

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 22.

Figure 3-10 Unidrive Size 5 overall dimensions

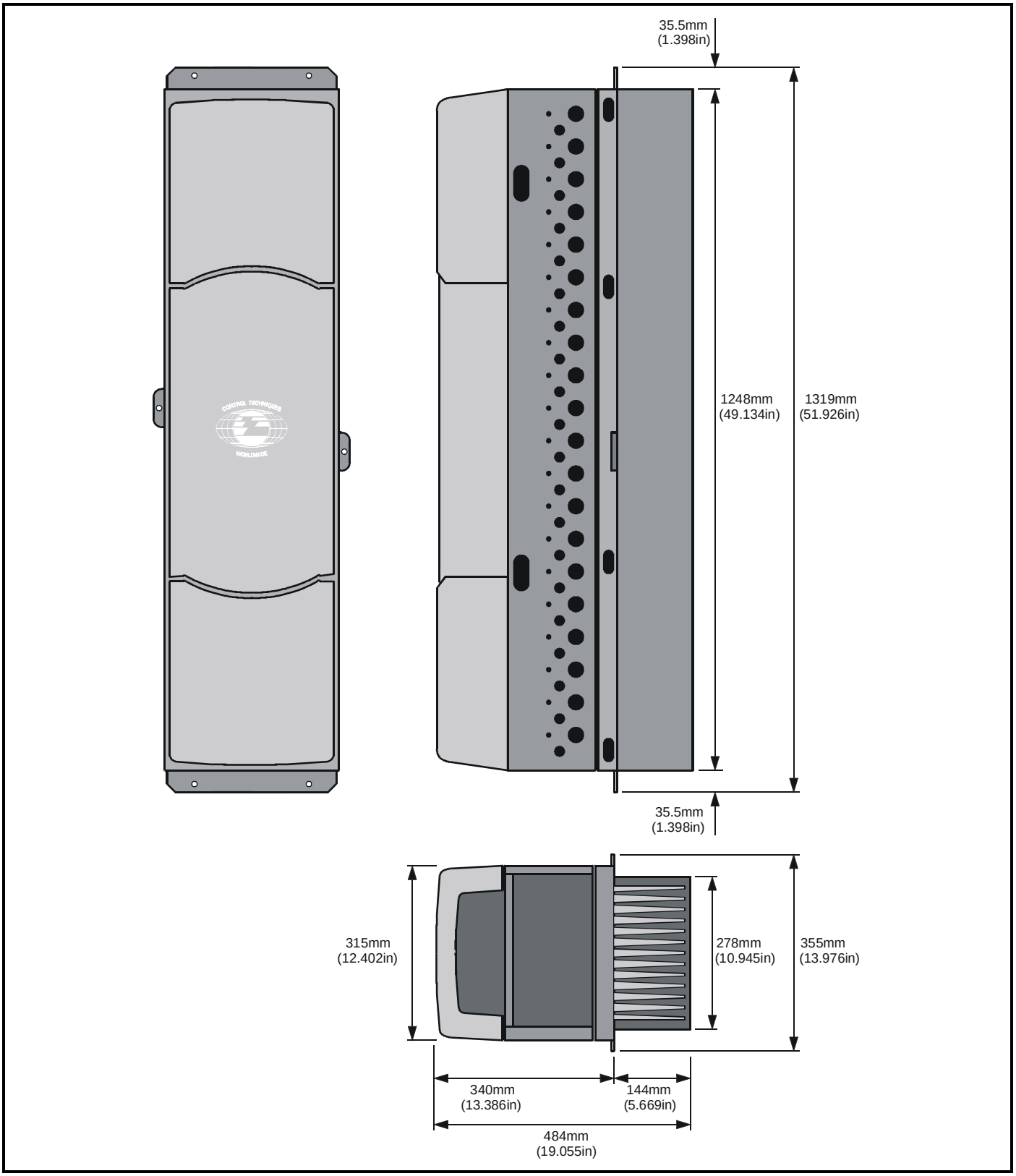


Figure 3-11 Unidrive Size 5 mounting dimensions

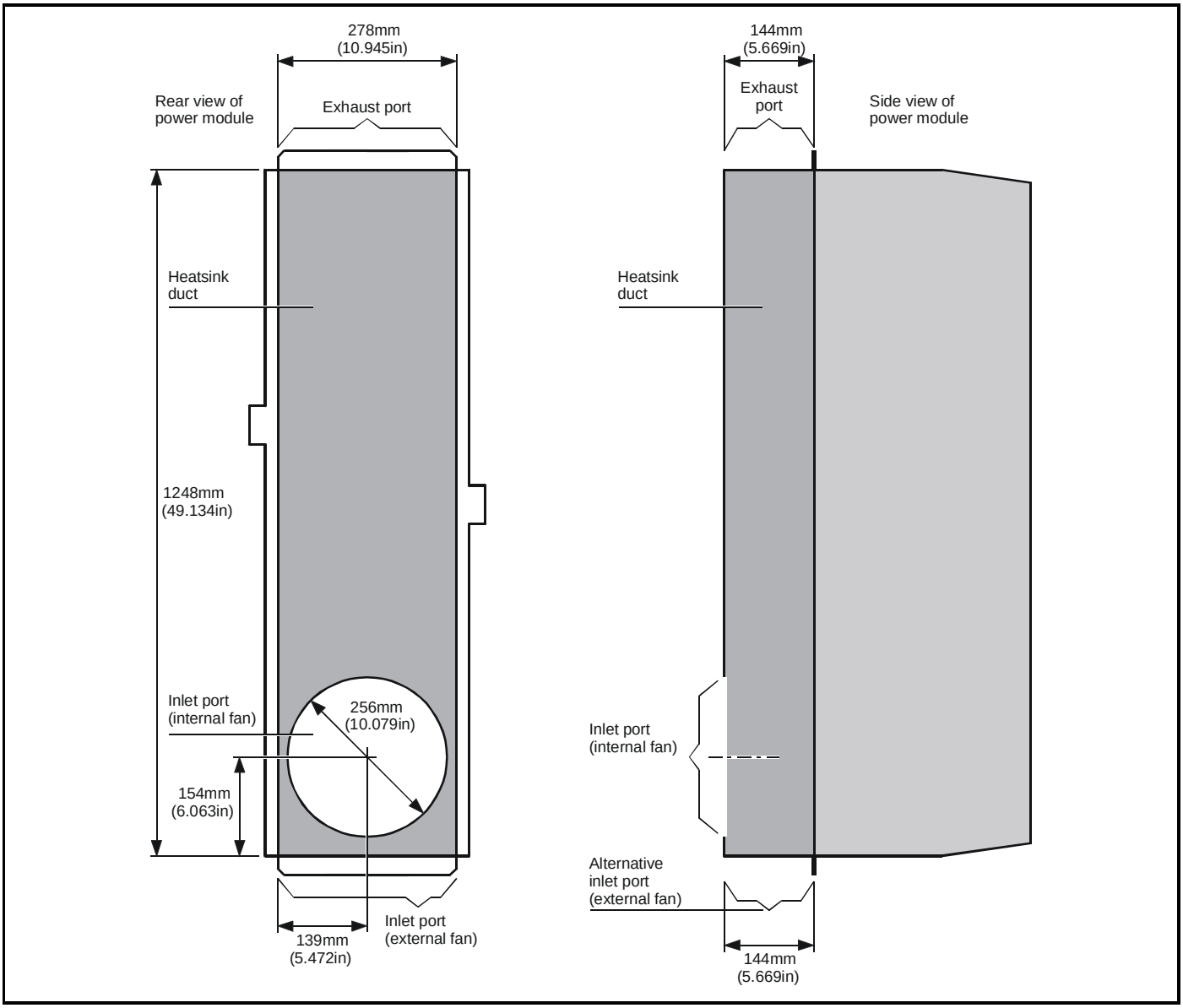


Figure 3-12 Unidrive size 5 backplate mounting holes and aperture

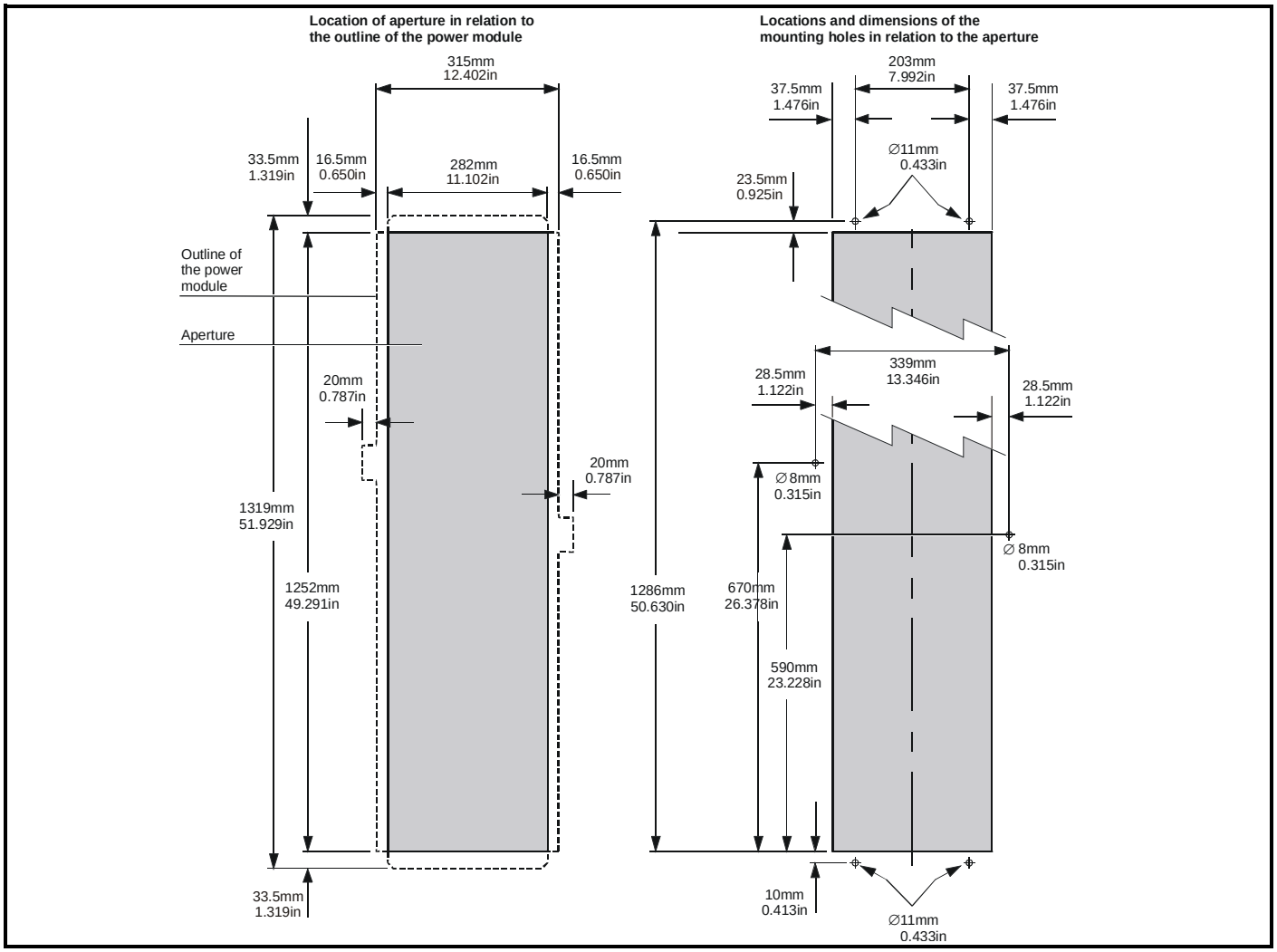
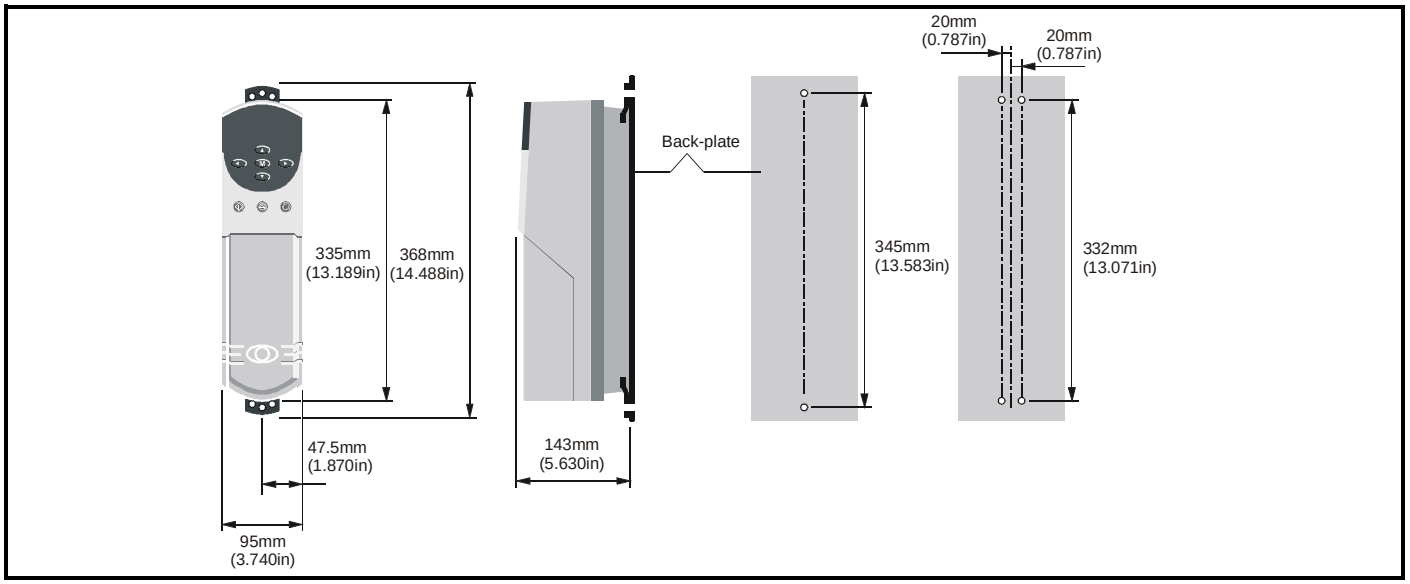


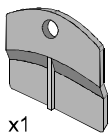
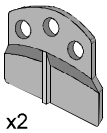
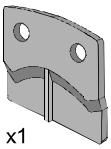
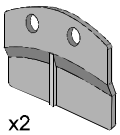
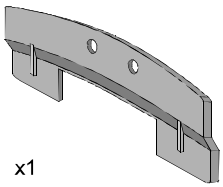
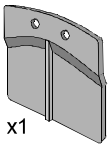
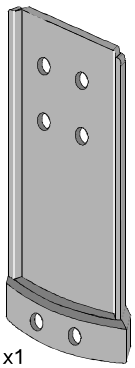
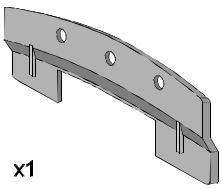
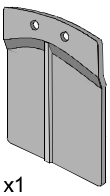
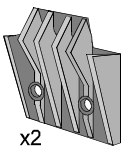
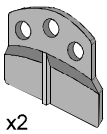
Figure 3-13 Unidrive Size 5 control module surface mounting



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

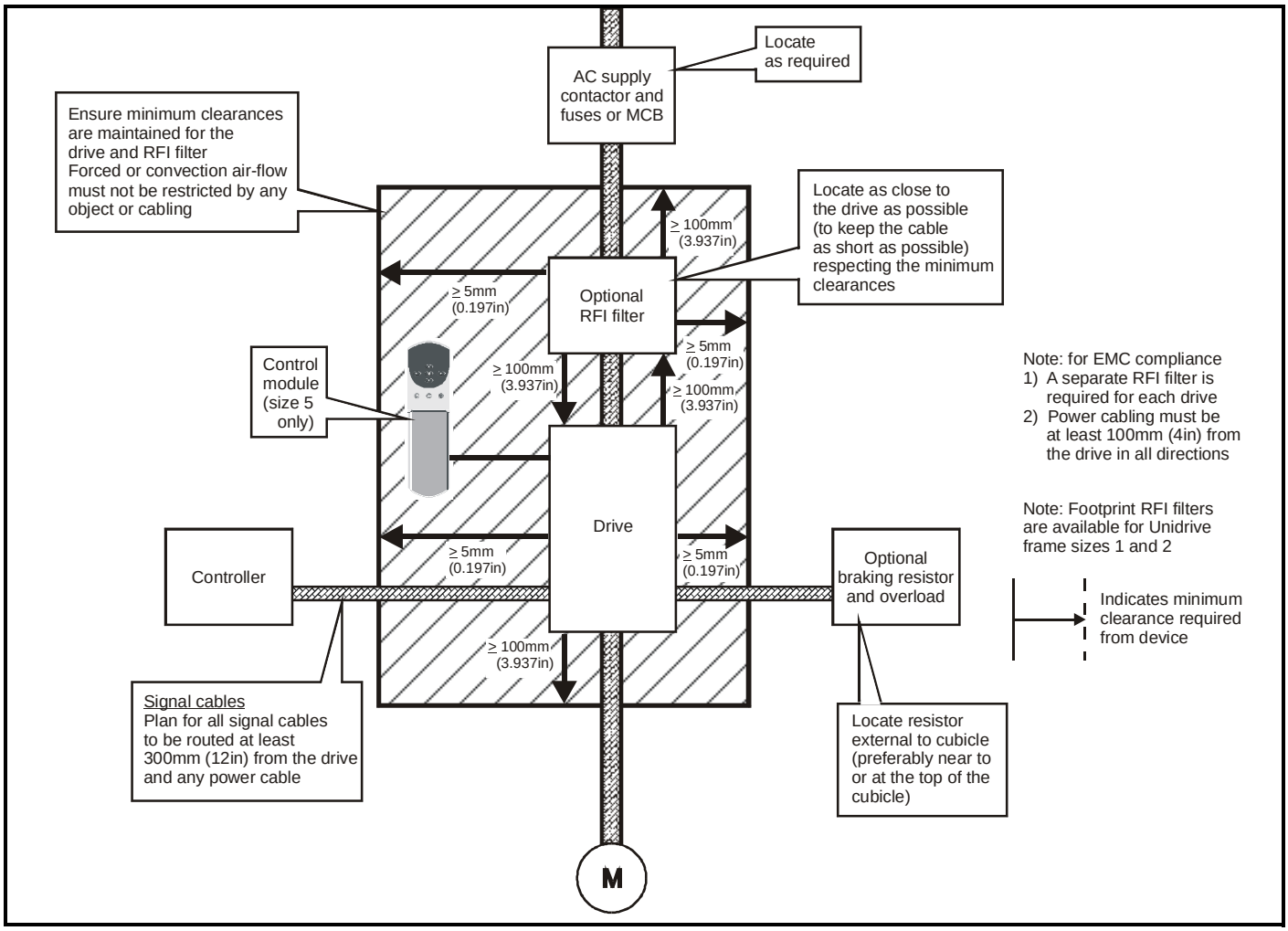
Model size	Through-panel	Surface	Hole size
1	 x1	 x2 Upper and lower	M6
2	 x1	 x2 Upper and lower	M6
3	 x1	 x1 Upper  x1 Lower	M6
4	 x1	 x1 Upper  x2 Lower	M6 (through-panel) M8 (surface)
5		 x2 Upper and lower	M6

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 174 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 180 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 $\mathbf{A_e}$ for the enclosure from:

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

Where:

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

Example

To calculate the size of an enclosure for the following:

- Two UNI 1405 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

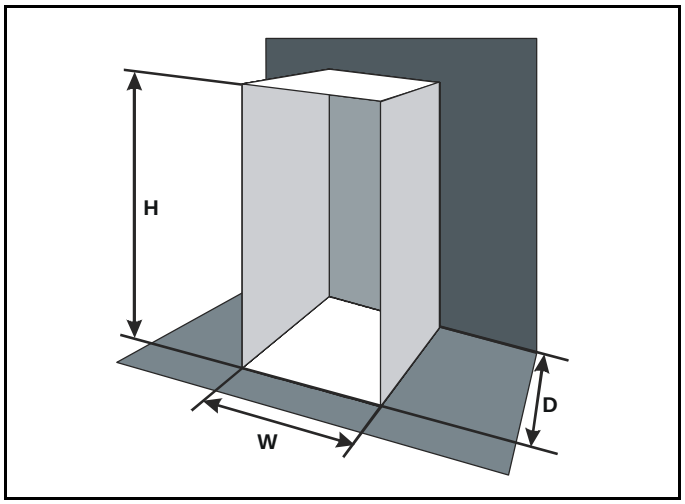
Dissipation of each drive: 190W

Dissipation of each RFI filter: 7.7W (max)

Total dissipation: 2 x (190 + 7.7) = 395.4W

The enclosure is to be made from painted 2mm (0.079 in) sheet steel having a heat transmission coefficient of 5.5W/m^2/^{o}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:

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

=7.2m^2 (78ft^2) (1m = 3.3 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** = 2m and **D** = 0.6m, obtain the minimum width:

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

=1.8m (5ft 10in)

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:

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

Where:

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

Where:

P_0 is the air pressure at sea level

P_l 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 UNI 3401 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^{o}C
- Maximum ambient temperature outside the enclosure: 30^{o}C

Dissipation of each drive: 670W

Dissipation of each RFI filter: 12.8W (max)

Total dissipation: 3 x (670 + 60) = 2048.4W

Insert the following values:

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

Then:

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

= 799m^3 / hr (471ft^3 / min)

(1m ^{3}/ hr = 0.59ft^3 /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.

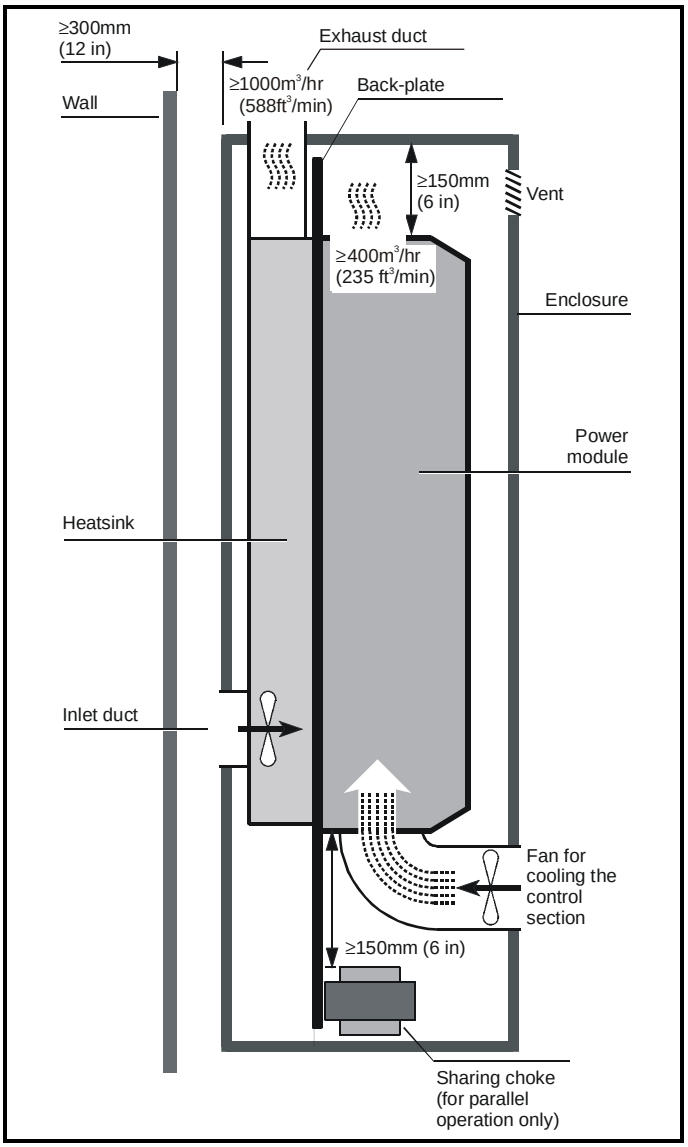
Two parallel independent paths must be provided as shown to ensure the heat produced is dispersed.

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).

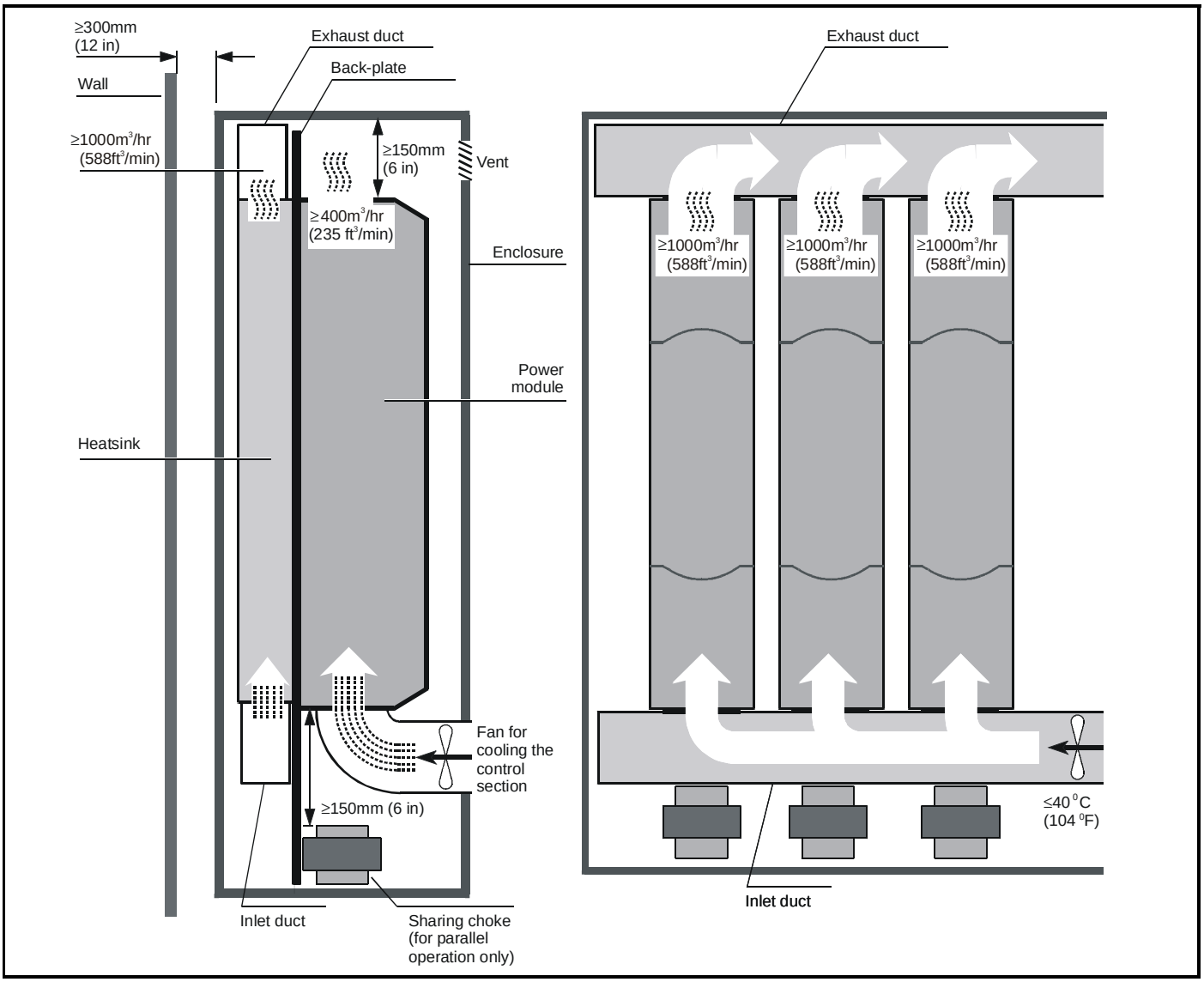
The air supply must be obtained from outside the enclosure and the exhaust air must exit the enclosure. The maximum permissible heatsink temperature is 95°C (203°F). Take the following precautions to help ensure this is not exceeded:

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 1,000m^3/hr (588ft^3/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

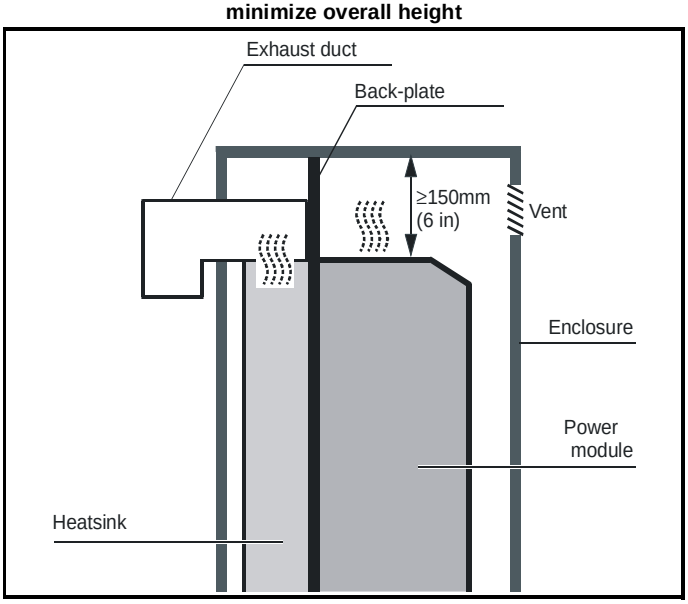


Cooling the control components in the Size 5 power module

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. Take the following precautions:

1. It is recommended that a ducted 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. The maximum temperature of the air in the enclosure must not exceed 40°C (104°F) and the air-flow must be at least 1,000m^3/hr (588ft^3/min), equivalent airspeed 7m/s (23 ft/s).

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

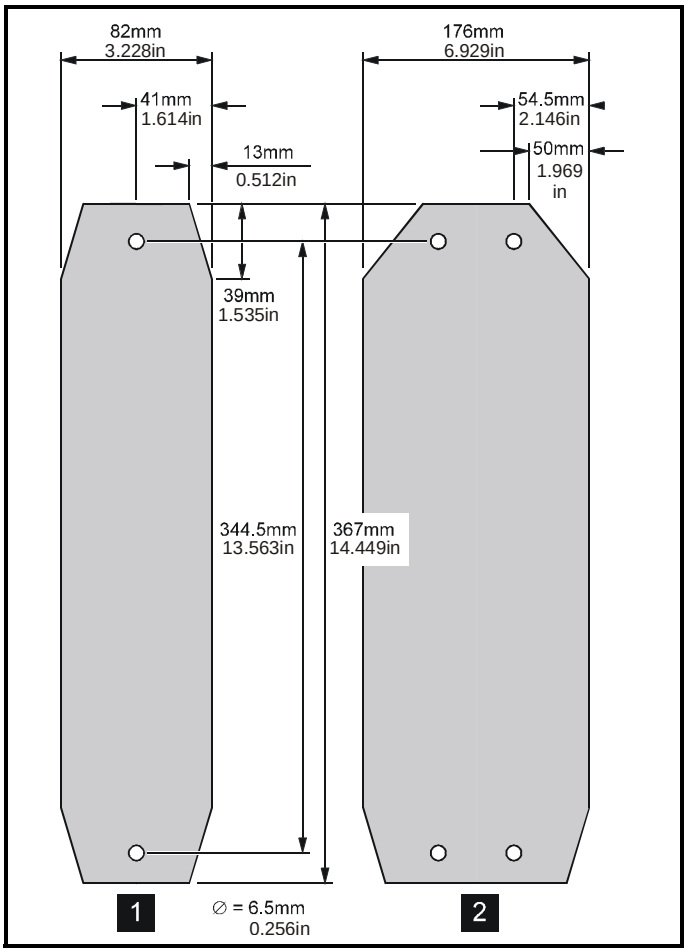


3.9 Baffle plates

When a Unidrive size 1 ~ 4 is through-panel mounted, the fitting of a baffle plate causes the heatsink to act as a chimney; this enhances the air flow along the heatsink fins to aid cooling (this naturally occurs when the drive is surface mounted).

You may make a baffle plate from any suitable conducting or non-conducting material and attach it to the heatsink by the method described as follows.

Figure 3-19 Dimensions for the fabrication of baffle plates for model sizes 1 and 2

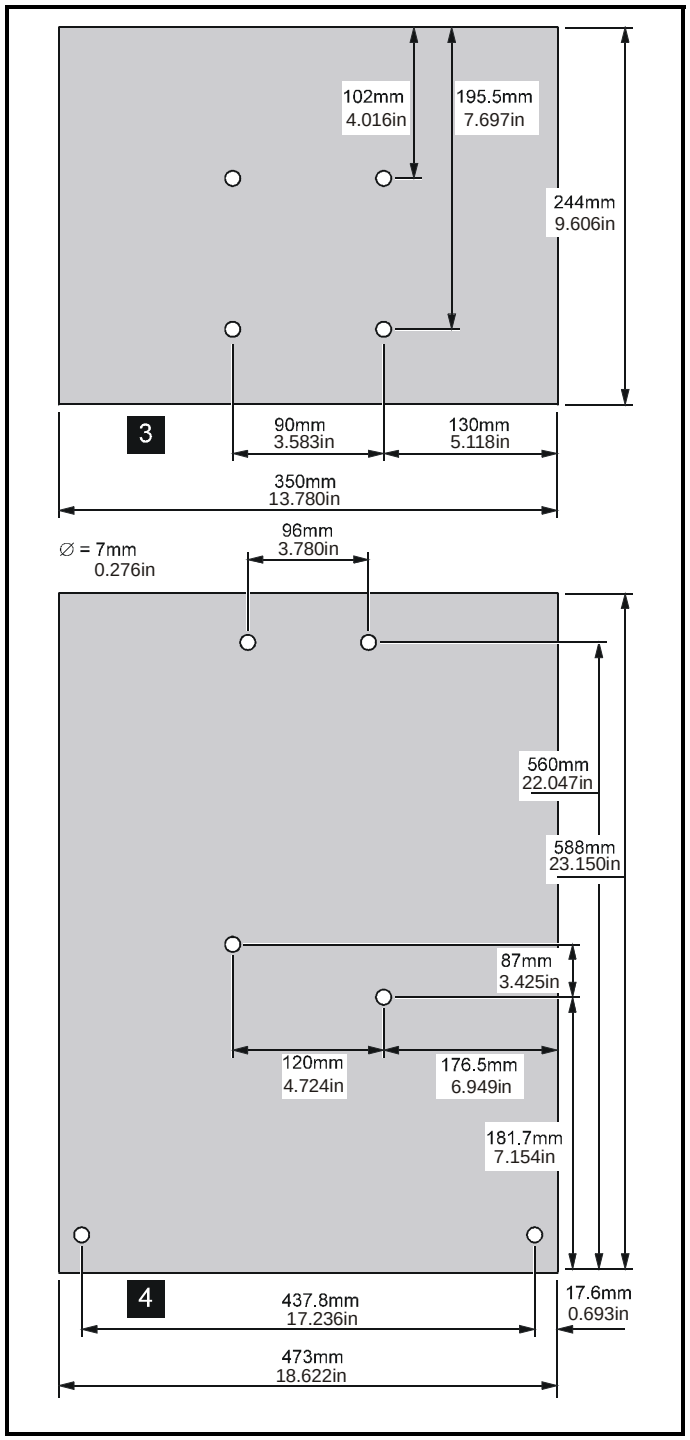


Attaching a fabricated baffle plate to the heatsink

Table 3-2 Methods of attaching the baffle plate

Model size	Method of attachment
1 2	Use the surface mounting brackets.
3 4	Use M6 x 12mm max (or equivalent) thread-forming screws to screw into the holes in the heatsink, or tap the holes to a suitable thread size.

Figure 3-20 Dimensions for the fabrication of baffle plates for model sizes 3 and 4



3.10 Ambient temperature

The maximum ambient temperature under which the drive can operate without derating is 40°C.

Derating can be applied to allow operation up to 50°C ambient temperature.

Please see section 11.1.1 *Power and current ratings* on page 173 if derating is required.

3.11 RFI filters

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

Table 3-3 200V drives and appropriate filters

Drive	Filter type	Schaffner part no.	CT part no.
UNI 1201 – 1205	Bookcase	FS5111-10-29	4200 – 6105
UNI 1201 – 1205	Footprint or Bookcase	FS5101-10-07	4200 – 6104
UNI 2201 – 2202	Bookcase	FS5112-16-07	4200 – 6109
UNI 2201 - 2202	Footprint or Bookcase	FS5106-16-07	4200 – 6108
UNI 2203	Bookcase	FS5113-25-29	4200 – 6114
UNI 2203	Footprint or Bookcase	FS5106-25-07	4200 – 6113
UNI 3201 - 3202	Bookcase	FS5113-50-34	4200 – 6116
UNI 3203	Bookcase	FS5113-63-34	4200 – 6117
UNI 3204	Bookcase	FS5113-100-35	4200 – 6106

Table 3-4 400V drives and appropriate filters

Drive	Filter type	Schaffner part no.	CT part no.
UNI 1401 - 1405	Bookcase	FS5111-10-29	4200-6105
UNI 1401 - 1405	Footprint or Bookcase	FS5101-10-07	4200-6104
UNI 2401	Bookcase	FS5112-16-07	4200-6109
UNI 2401	Footprint or Bookcase	FS5106-16-07	4200-6108
UNI 2402 – 2403	Bookcase	FS5113-25-29	4200-6114
UNI 2402 – 2403	Footprint or Bookcase	FS5106-25-07	4200-6113
UNI 3401 – 3403	Bookcase	FS5113-50-34	4200-6116
UNI 3404	Bookcase	FS5113-63-34	4200-6117
UNI 3405	Bookcase	FS5113-100-35	4200-6106
UNI 4401 - 4402	Bookcase	FS5113-150-40	4200-6107
UNI 4403 – 4404	Bookcase	FS5113-180-40	4200-6111
UNI 4405	Bookcase	FS5113-220-37	4200-6112
UNI5401	Bookcase	FS113-300-99	4200-6115

The RFI filters can be surface-mounted only.

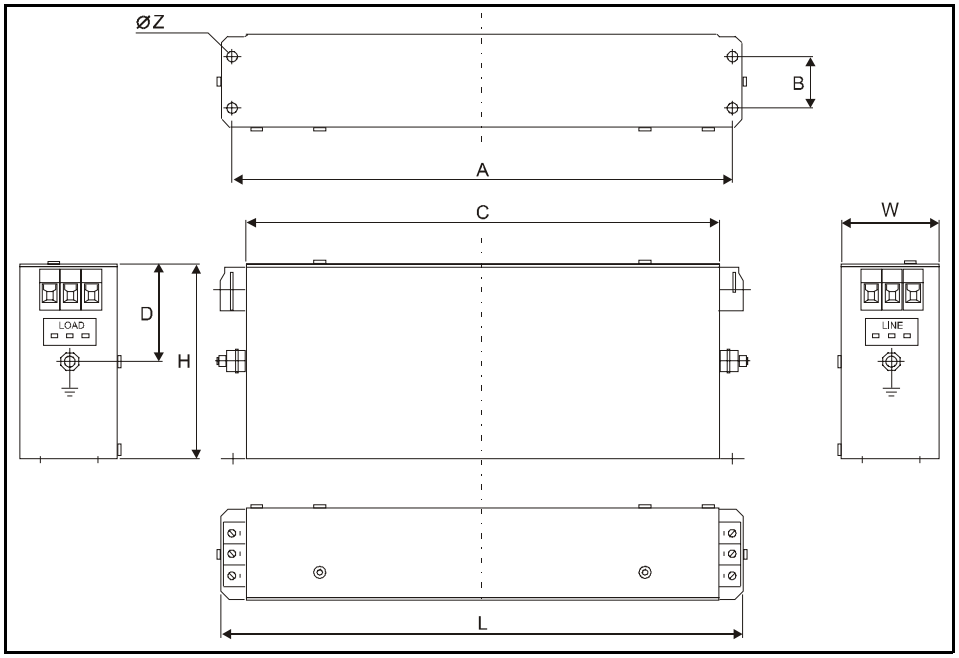
Mount the RFI filter following the guidelines in Figure 4-9 *EMC compliance* on page 40.

Table 3-5 Maximum RFI filter cable size

CT part no.	Schaffner part no.	Max cable size
4200-6104	FS5101-10-07	4 mm^2 10 AWG
4200-6105	FS5111-10-29	4 mm^2 10 AWG
4200-6108	FS5106-16-07	4 mm^2 10 AWG
4200-6109	FS5112-16-07	4 mm^2 10 AWG
4200-6113	FS5106-25-07	4 mm^2 10 AWG
4200-6114	FS5113-25-29	4 mm^2 10 AWG
4200-6116	FS5113-50-34	10 mm^2 6 AWG
4200-6117	FS5113-63-34	10 mm^2 6 AWG
4200-6106	FS5113-100-35	50 mm^2 1/0 AWG
4200-6107	FS5113-150-40	95 mm^2 4/0 AWG
4200-6111	FS5113-180-40	95 mm^2 4/0 AWG
4200-6112	FS5113-220-37	150 mm^2 6/0 AWG
4200-6115	FS5113-300-99	M12 stud

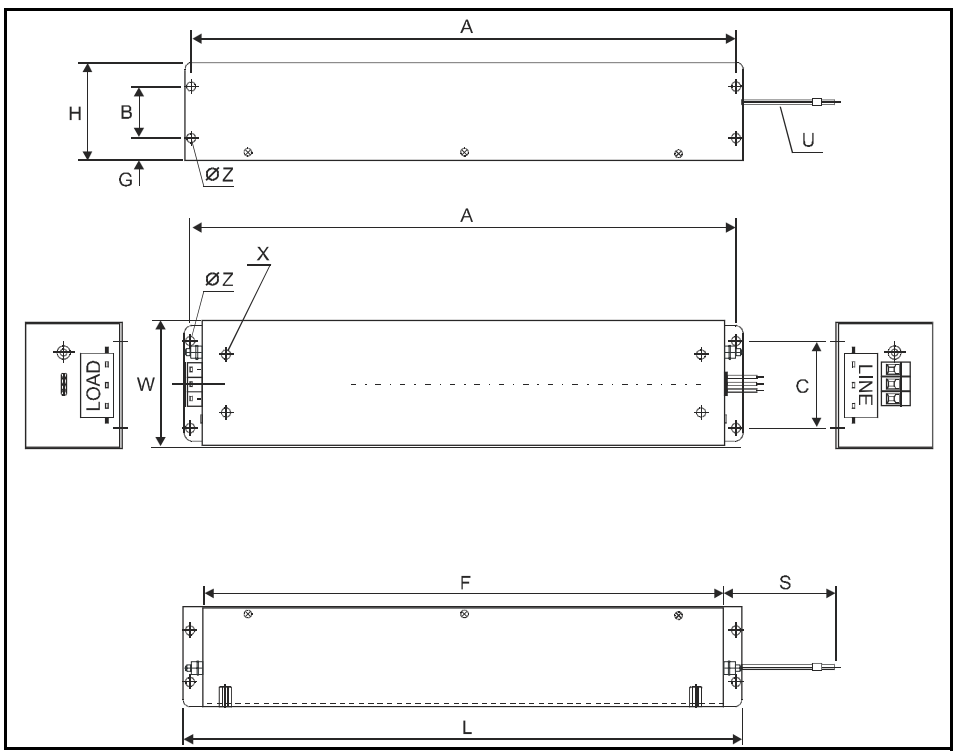
3.11.1 Unidrive size 1 filters

Figure 3-21 Unidrive size 1 bookcase mounted filter



Dimension	RFI Filter
	4200-6105 FS5111-10-29
Model	UNI1201 ~ UNI1205 UNI1401 ~ 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

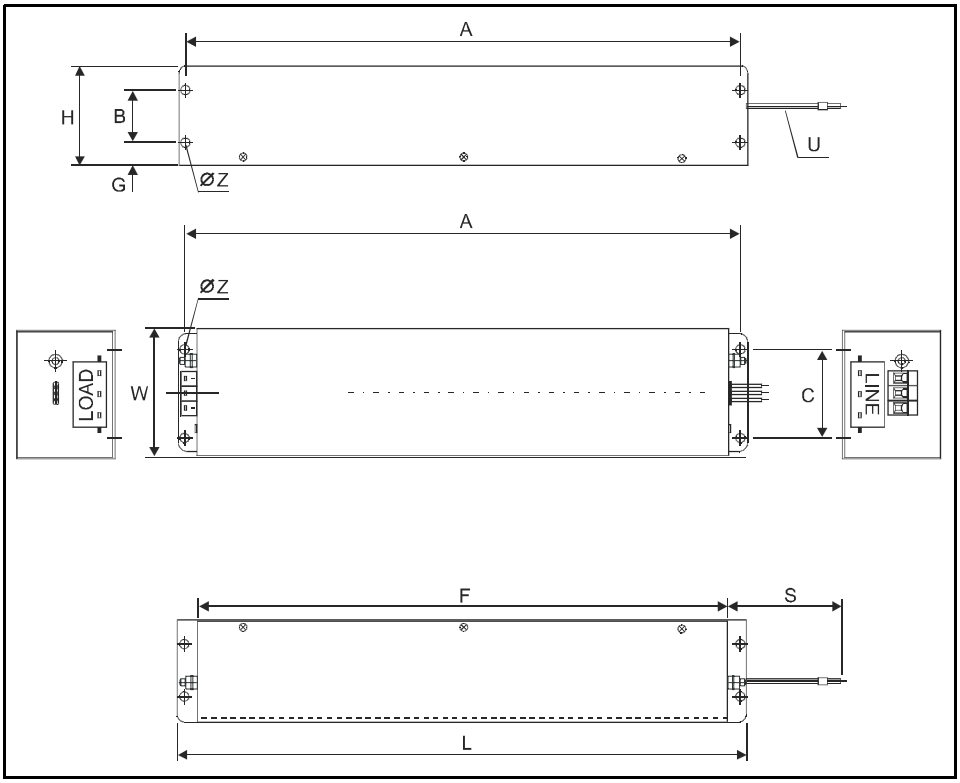
Figure 3-22 Unidrive size 1 footprint or bookcase mounted filter



Dimension	RFI Filter
	4200-6104 FS5101-10-07
Model	UNI1201 ~ UNI1205 UNI1401 ~ 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

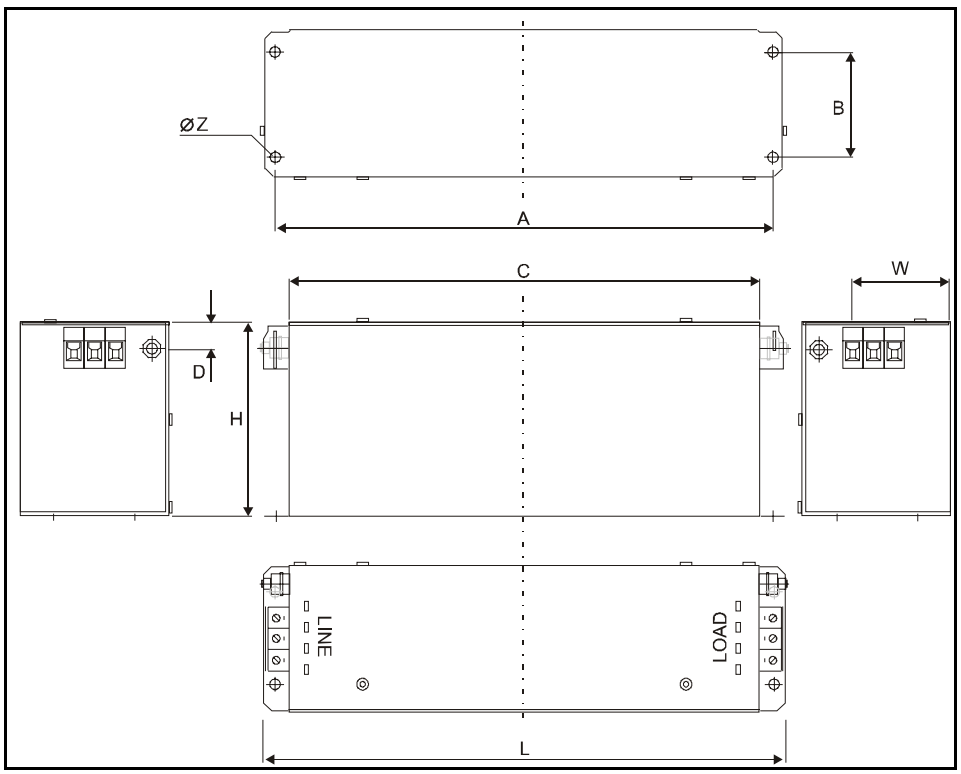
3.11.2 Unidrive size 2 filters

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



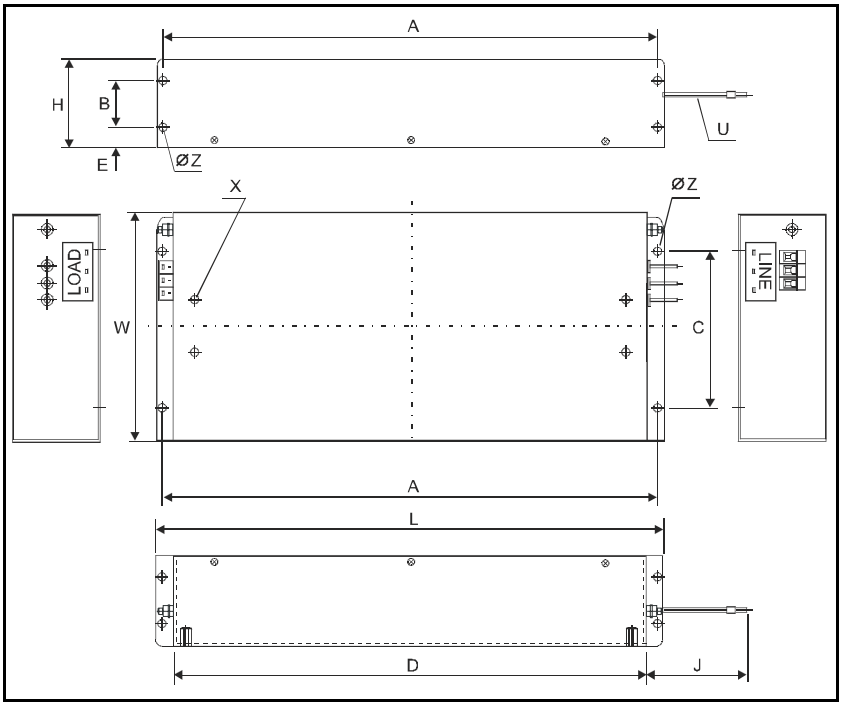
Dimension	RFI Filter
	4200-6109 FS5112-16-07
Model	UNI2201 ~ UNI2202 UNI2401
A	380mm (14.961in)
B	35mm (1.378in)
C	60mm (2.362in)
F	364mm (14.331in)
G	16.5mm (0.650in)
H	68mm (2.677in)
L	390mm (15.354in)
S	300mm ±5mm (11.811in ±0.197in)
U	3x 2.5mm^2 (AWG14)
W	85mm (3.346in)
Z	5.5mm (0.217in)
Ground Terminal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

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



Dimension	RFI Filter
	4200-6114 FS5113-25-29
Model	UNI2203 UNI2402 ~ 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

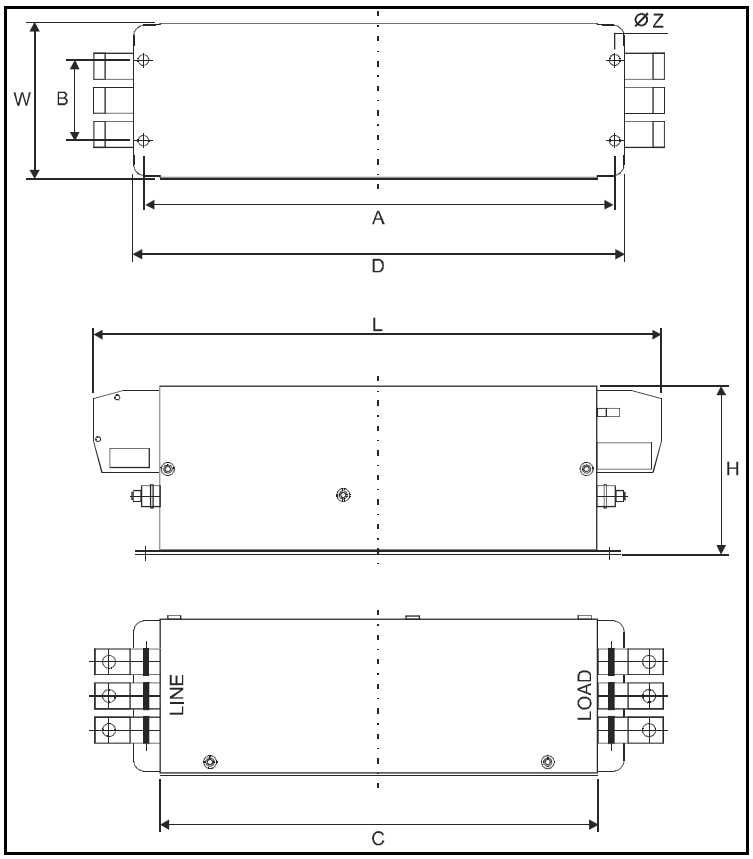


Dimension	RFI Filters	
	4200-6108 FS5106-16-07	**4200-6113 FS5106-25-07**
Model	**UNI2201 ~ UNI2202 UNI2401**	**UNI2203 UNI2402 ~ UNI2403**
A	385mm (15.157in)	385mm (15.157in)
B	35mm (1.378in)	35mm (1.378in)
C	120mm (4.724in)	120mm (4.724in)
D	364mm (14.331in)	364mm (14.331in)
E	16.5mm (0.650in)	16.5mm (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

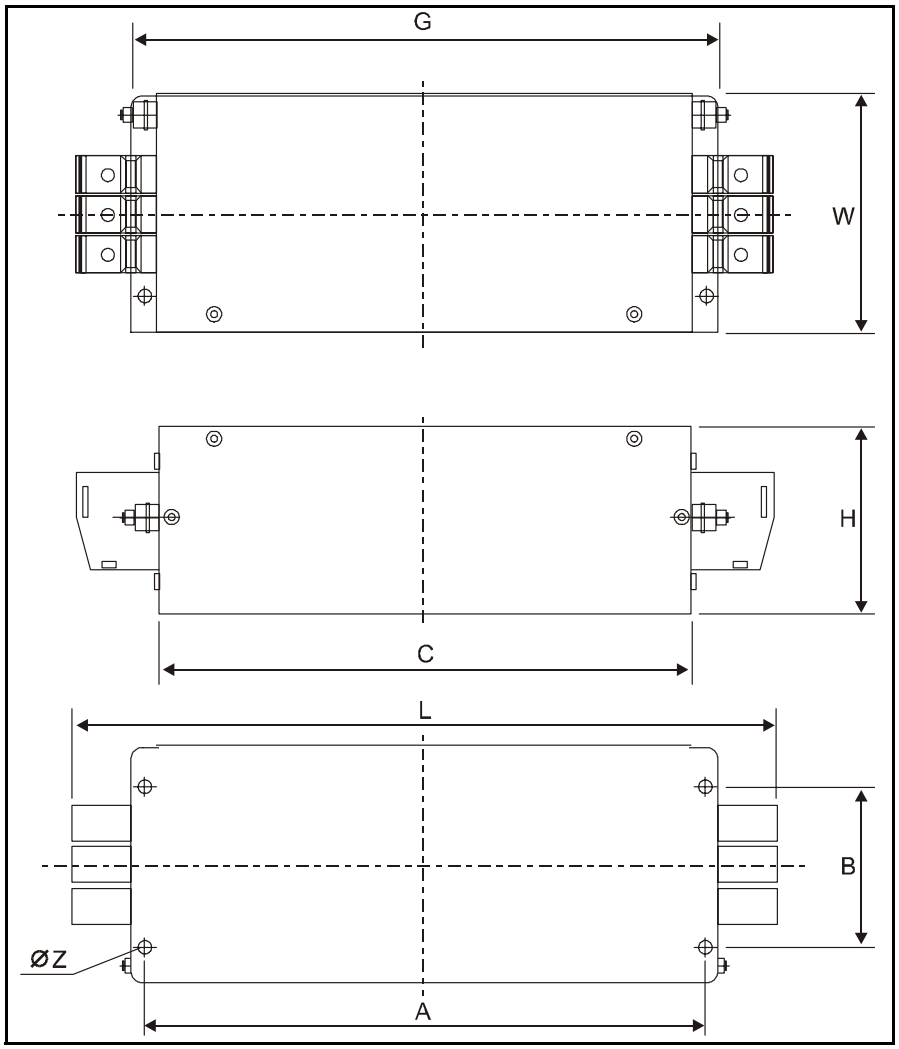
Ensure the LOAD terminals face the drive.

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



Dimension	RFI Filter
	4200-6116 FS5113-50-34
Model	**UNI3201 ~ UNI3202 UNI3401 ~ 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 ~ UNI3204, UNI3404 ~ UNI3405) & size 4 bookcase mounted filter

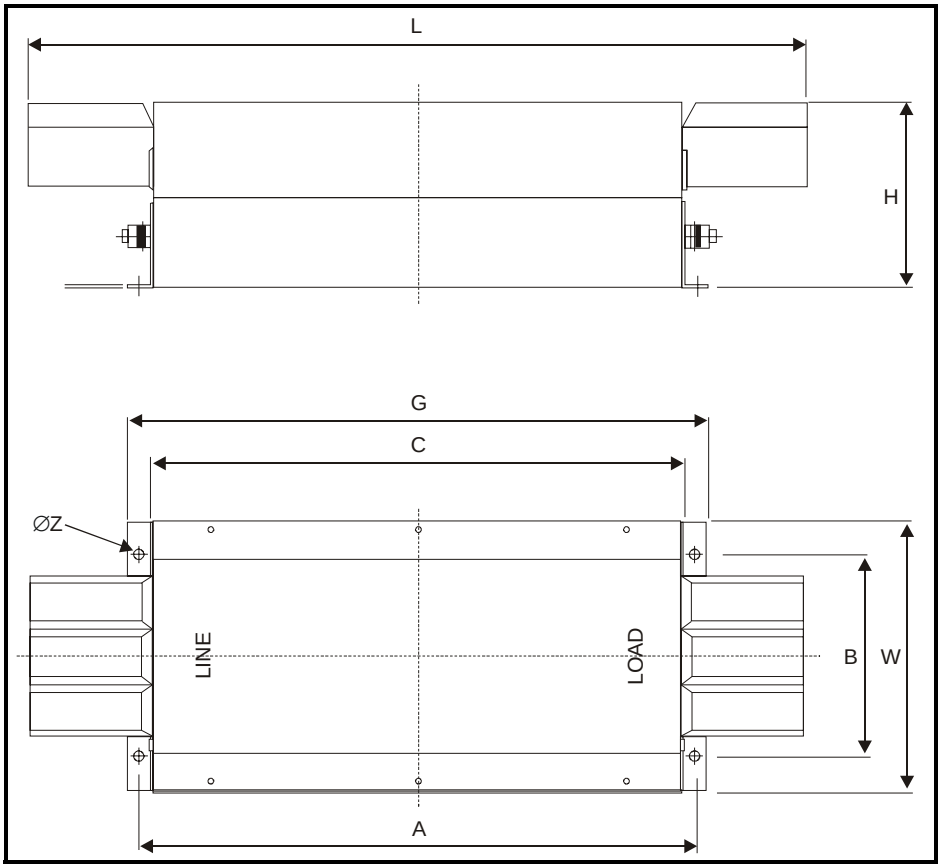


Dimension	RFI Filters				
	4200-6117 FS5113-63-34	**4200-6106 FS5113-100-35**	**4200-6107 FS5113-150-40**	**4200-6111 FS5113-180-40**	**4200-6112 FS5113-220-37**
Model	**UNI3203 UNI3404**	**UNI3204 UNI3405**	**UNI4401 ~ UNI4402**	**UNI4403 ~ UNI4404**	**UNI4405**
A	315mm (12.402in)	310mm (12.205in)	330mm (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 (9.055n)
Z	8.5mm (0.335in)
Ground Terminal	M12

3.12 Footprint filters and braking resistors

Dynamic braking resistor mounting brackets are available as an option for Unidrive size 1 and 2. These allow the SRF600 braking resistor to be mounted within the footprint of the drive and thus take up less enclosure space.

The brackets can be either mounted directly onto the enclosure backplate or if one of the following Schaffner footprint RFI filters are being used, between the filter and the drive.

Model	RFI filters	
	CT part number	Schaffner part number
UNI 1201 ~ UNI 1205 UNI 1401 ~ UNI 1405	4200-6104	FS5101-10-07
UNI 2201 ~ UNI2202 UNI 2401	4200-6108	FS5106-16-07
UNI 2203 UNI 2402 ~ UNI 2403	4200-6113	FS5106-25-07

These brackets are supplied as a kit with all the appropriate fasteners.

Model	Mounting plates	
	CT part number	Schaffner part number
Unidrive Size 1	6500-0356	295-634
Unidrive Size 2	6500-0357	295-635

Figure 3-29 Mounting arrangement of Unidrive Size 1 & 2, with footprint filter and braking resistors.

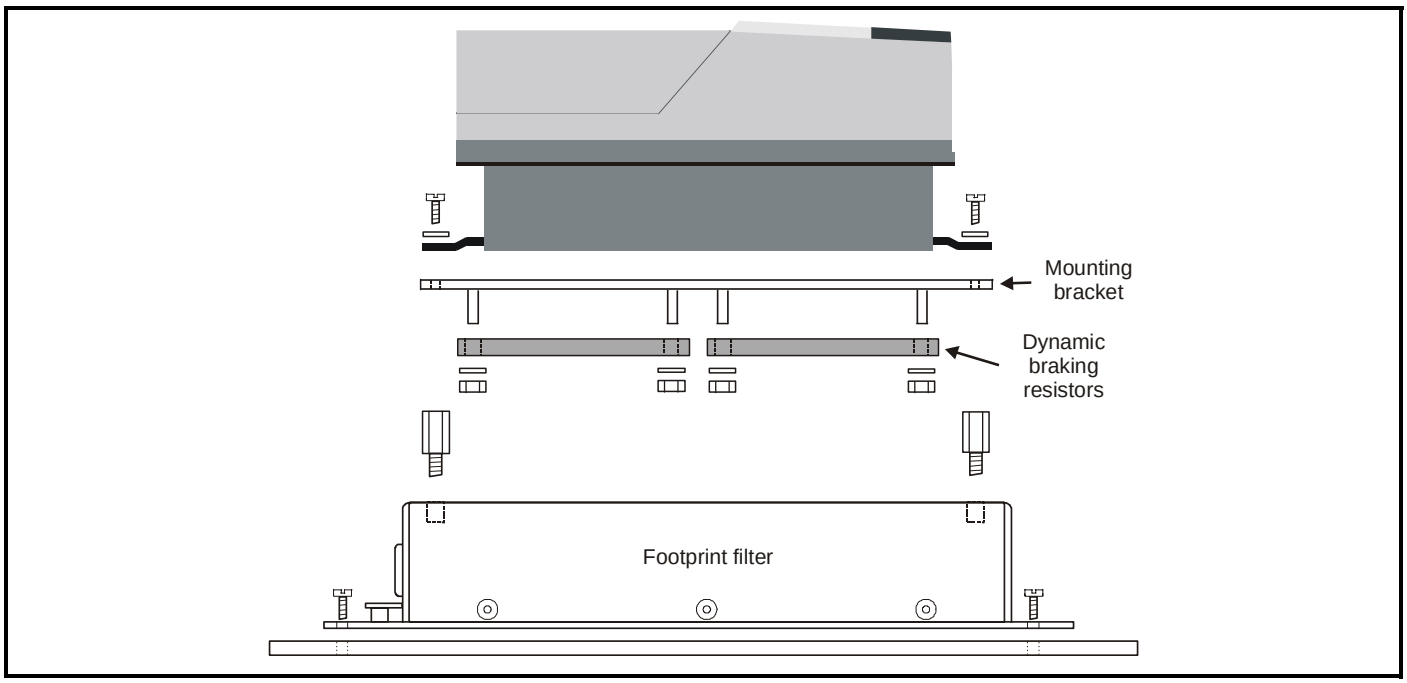
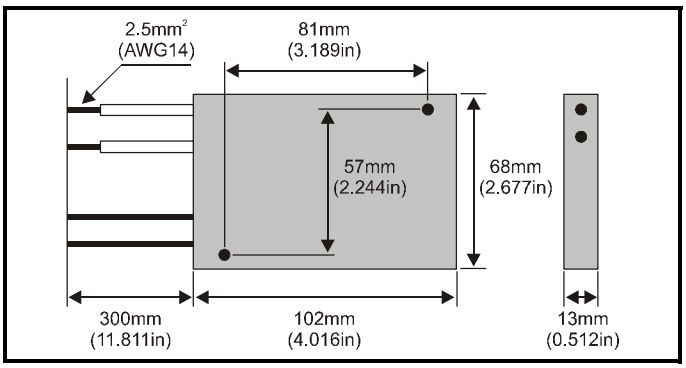


Figure 3-30 SRF600 zinc plated steel housed power wirewound resistor



The two lower wires in the diagram, above, are connected internally to a bi-metallic switch (normally closed) which operates at 160°C, and resets at 140°C. The capability of the switch contacts is 6A @ 230 Vac. This thermal switch must be used as part of a thermal protection circuit, removing the power supply from the drive when activated. For full details, see Figure 4-4 *Typical protection circuit for a braking resistor* on page 36.

Characteristics	SRF600
Power Rating, (with 0.5W/°C heat sink)	600 W
Temperature rise	390°C
Maximum power without heatsink	300 W
Resistance tolerance	±5%

Resistor values available

Ohmic Value	Part Number
15Ω	1220-2153
20Ω	1220-2203
30Ω	1220-2303
40Ω	1220-2403
50Ω	1220-2503
75Ω	1220-2753
100Ω	1220-3103
150Ω	1220-3153

3.13 Power terminals

3.13.1 Location of power and ground terminals

Figure 3-31 Locations of the power and ground terminals on Unidrive Size 1 ~ 4

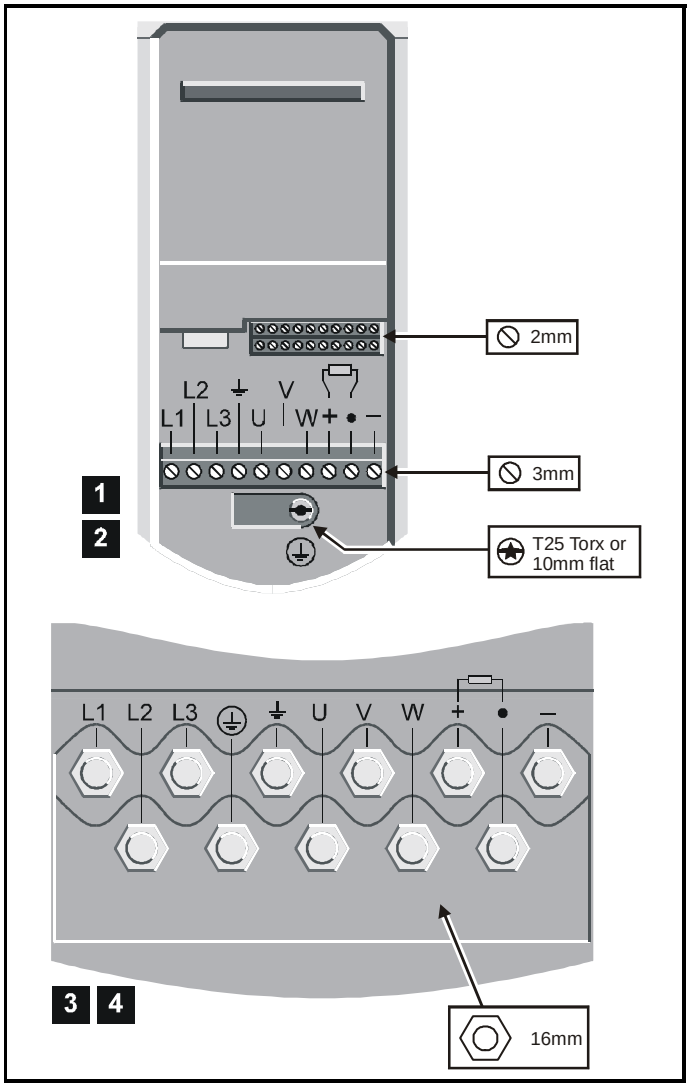
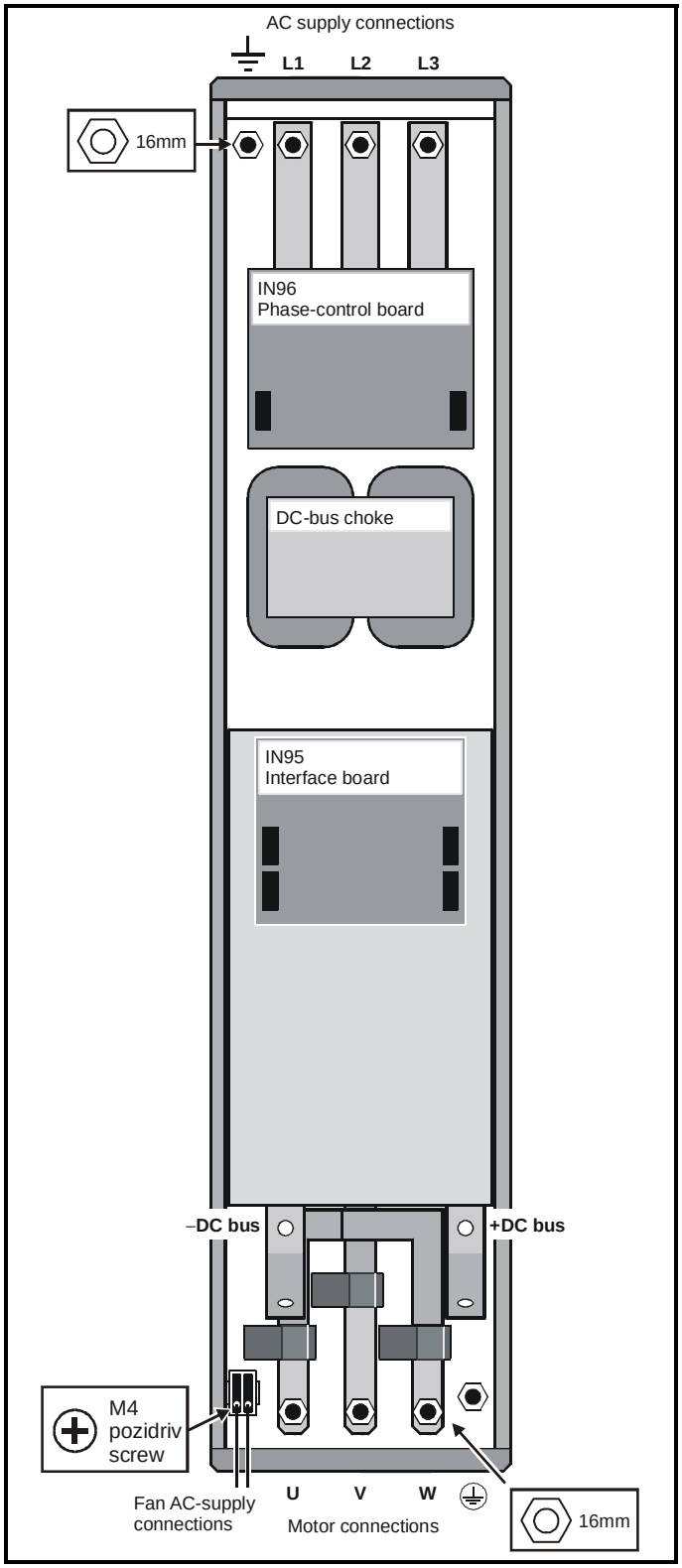


Figure 3-32 Locations of the power and ground terminals on the Size 5 power module



3.13.2 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.

Table 3-6 Drive control terminal data

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

Table 3-7 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 3-8 Size 5 fan supply connection

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

Table 3-9 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	FS5113-50-34	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.

3.14 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
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

WARNING

Electric shock risk

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

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

WARNING

Isolation device

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

WARNING

STOP function

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

WARNING

Stored charge

The drive contains capacitors that remain charged to a potentially lethal voltage after the AC supply has been disconnected. If the drive has been 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.

WARNING

AC supply 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 (eg. a latching relay).

4.1 Ratings

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

Model	Typical input current	Fuse rating	Cable size	
UNI 1201	2.4 A	6A	1.5 mm^2	16 AWG
UNI 1401	3.0 A			
UNI 1202	3.5 A	10A	2.5 mm^2	14 AWG
UNI 1402	4.3 A			
UNI 1203	4.6 A	10A	2.5 mm^2	14 AWG
UNI 1403	5.8 A			
UNI 1204	6.5 A	10A	2.5 mm^2	14 AWG
UNI 1404	8.2 A			
UNI 1205	8.6 A	16A	2.5 mm^2	14 AWG
UNI 1405	10.0 A			
UNI 2201	10.8 A	16A	2.5 mm^2	14 AWG
UNI 2401	13.0 A			
UNI 2202	14.3 A	20A	4 mm^2	10 AWG
UNI 2402	17.0 A			
UNI 2203	19.8 A	35A	4 mm^2	10 AWG
UNI 2403	21.0 A			
UNI 3201	26 A	40A	6 mm^2	8 AWG
UNI 3401	27 A			
UNI 3402	32 A	50A	10 mm^2	6 AWG
UNI 3202	39 A	60A	10 mm^2	6 AWG
UNI 3403	40 A			
UNI 3203	53 A	70A	16 mm^2	4 AWG
UNI 3404	52 A			
UNI 3204	78 A	80A	25 mm^2	4 AWG
UNI 3405	66 A			
UNI 4401	76 A	100A	35 mm^2	2 AWG
UNI 4402	91 A	125A	35 mm^2	2 AWG
UNI 4403	123 A	160A	50 mm^2	0 AWG
UNI 4404	145 A	200A	70 mm^2	2/0 AWG
UNI 4405	181 A	250A	95 mm^2	3/0 AWG
UNI 5401	280 A	450A	120 mm^2	4/0 AWG

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 dependant 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, 10kA for size 4 and 18kA for size 5.

WARNING

Fuses

The AC supply to the drive must be fitted with suitable protection against overload and short-circuits. The tables in Chapter 11 *Technical Data* show 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.

Fuse Types

- Europe: Type gG HRC industrial fuses to IEC 60269 (BS88)
- USA: RK1 600Vac

Ground connections

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

4.1.1 Main AC supply contactor

The recommended AC supply contactor type is:

Unidrive size 1 & 2: AC1
Unidrive sizes 3, 4 & 5: AC1

4.1.2 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).

Line reactors should be sourced locally.

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.

4.1.3 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 RFI filter (when used)
- AC supply (or RFI filter) to drive
- Drive to motor
- Drive to braking resistor

Table 4-2 Maximum motor cable lengths for all versions of 200V Unidrive (LV)

Nominal AC supply voltage	200V	
Model	Maximum Permissible Motor Cable Length * (PWM switching frequency at 3kHz **)	
	m	ft
UNI 1201	65	210
UNI 1202	100	330
UNI1203	130	430
UNI 1204	200	660
UNI 1205	300	990
UNI 2201 ~ UNI 2203	300	990
UNI 3201 ~ UNI 3204	200	660

Table 4-3 Maximum motor cable lengths for all versions of 400V / 480V Unidrive

Nominal AC supply voltage	400V		480V	
Model	Maximum Permissible Motor Cable Length * (PWM switching frequency at 3kHz **)			
	m	ft	m	ft
UNI 1401	65	210	50	160
UNI 1402	100	330	75	250
UNI 1403	130	430	100	330
UNI 1404	200	660	150	490
UNI 1405	300	990	250	820
UNI 2401 ~ UNI 2403	300	990	300	990
UNI 3401 ~ UNI 3405	200	660	124	410
UNI 4401 ~ UNI 4405	200	660	124	410
UNI 5401	300	990	300	990
UNI 5402	600	1,980	600	1,980
UNI 5403	900	2,970	900	2,970
UNI 5404	1,200	3,960	1,200	3,960
UNI 5405	1,500	4,950	1,500	4,950
UNI 5406	1,800	5,940	1,800	5,940
UNI 5407	2,100	6,930	2,100	6,930
UNI 5408	2,400	7,920	2,400	7,920

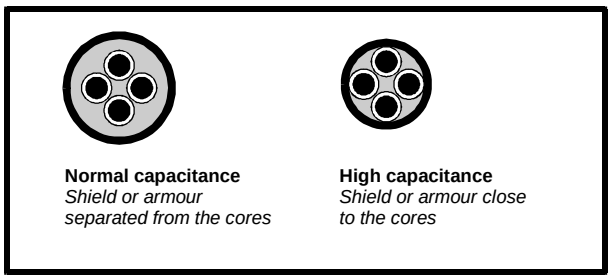
* Cable lengths in excess of the specified values may be used only when special techniques are adopted; refer to the supplier of the drive.

** The default switching frequency for all versions of Unidrive is 3kHz, except Unidrive LFT, which is 9kHz.

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 $^1/_3$ 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 4-1 shows how to identify the two types.)

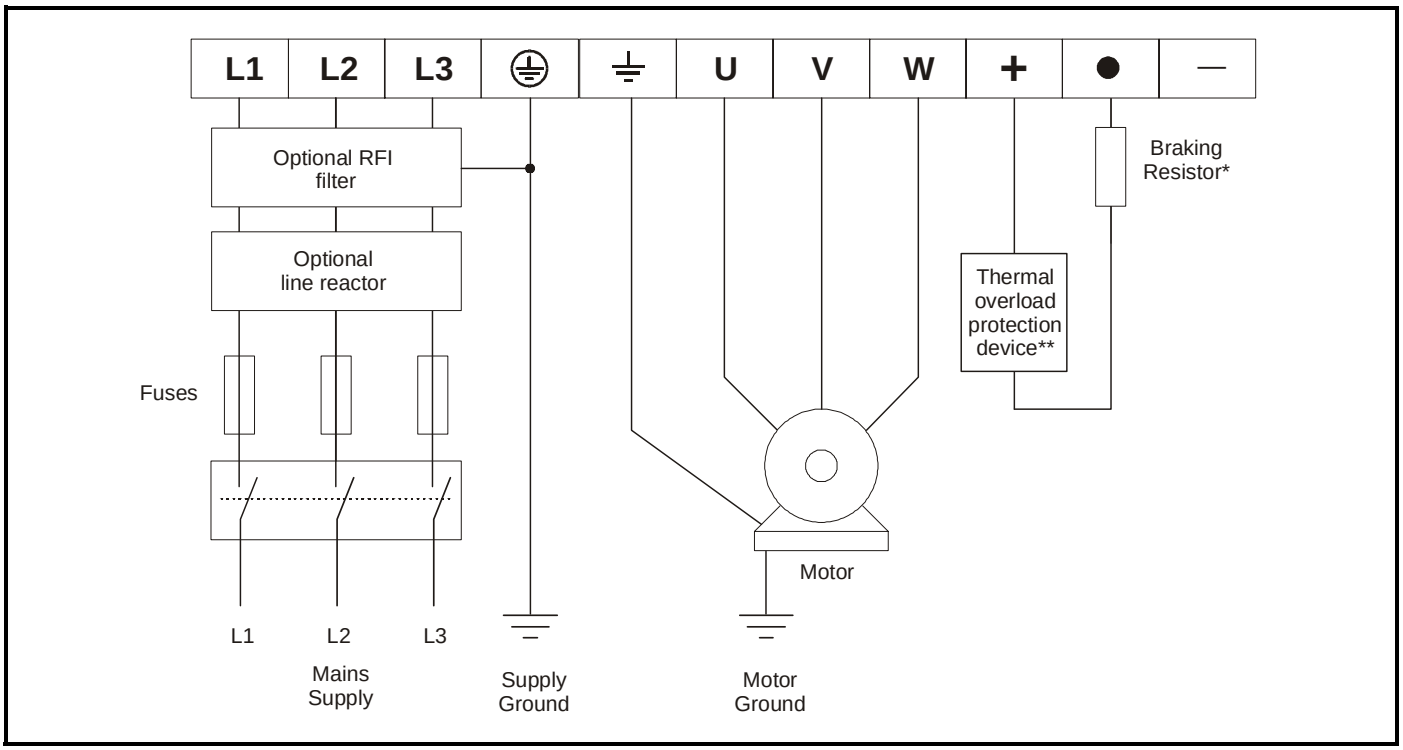
Figure 4-1 Cable construction influencing the capacitance



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.

4.2 Power connections

Figure 4-2 Unidrive Size 1 ~5 power connections

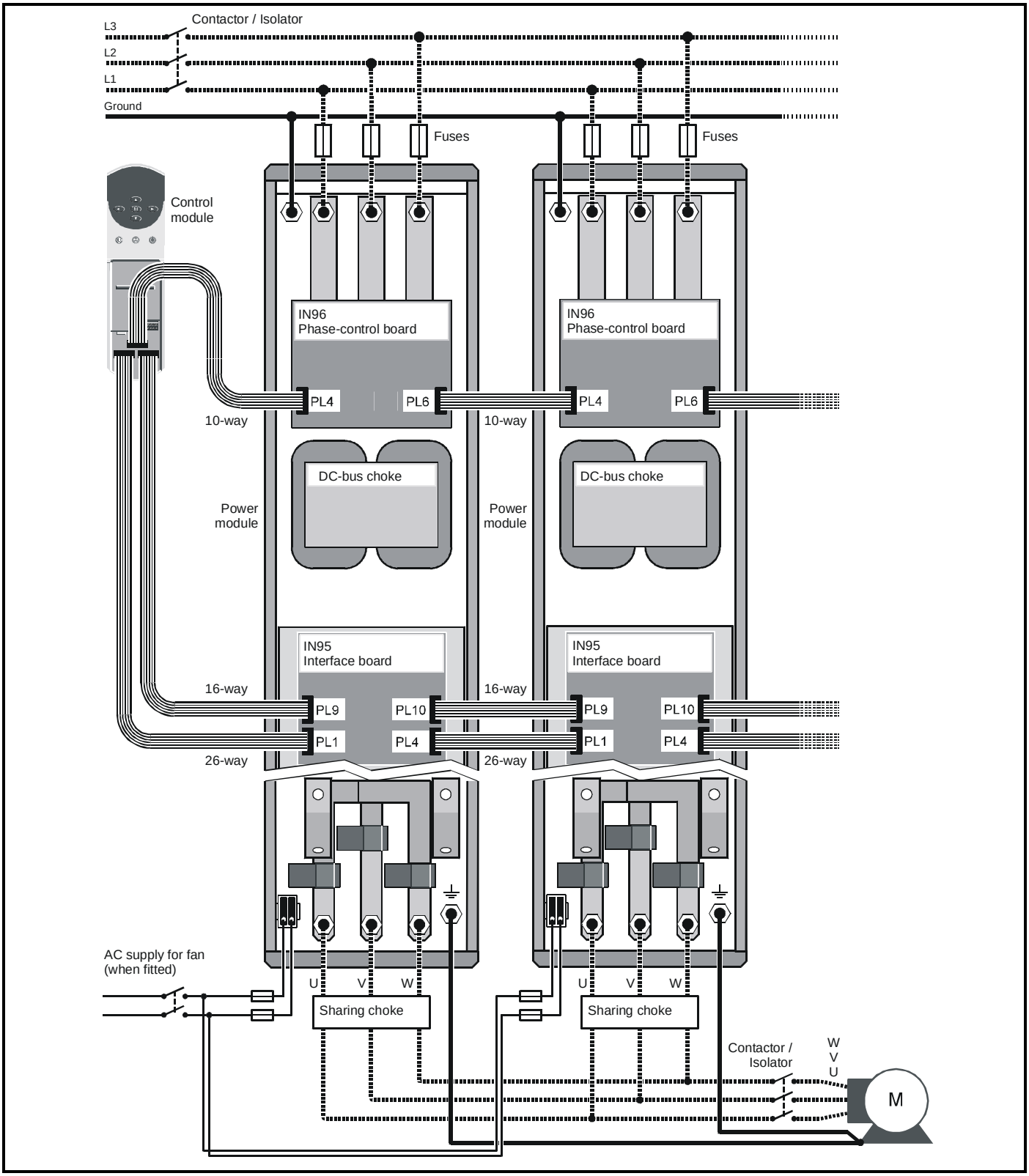


* A braking resistor can be connected as shown for Unidrive sizes 1~4 only. Unidrive size 5 requires a braking option module to be fitted.

** A thermal overload protection device should be connected as shown in Figure 4-4 on page 36 and must interrupt the AC supply on tripping. This applies to all sizes of Unidrive where a braking resistor is used.

4.3 Unidrive size 5 control / power module connections

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



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 173 and it should be sourced locally.

WARNING

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.

4.4 Braking

Braking occurs when the drive is decelerating the motor, or is preventing the motor from gaining speed due to mechanical influences. During braking, energy is returned to the drive by the motor.

When the motor is being braked by the drive, the maximum regenerated power that the drive can absorb is equal to the power dissipation (losses) of the drive.

When the regenerated power is likely to exceed these losses, a braking resistor must be connected.

By default, the drive brakes the motor under PI control which extends the deceleration time as necessary in order to keep the DC bus at a constant voltage.

NOTE

When a braking resistor is used, parameter **0.15** should be set to FASt ramp mode.

Housing the resistor, and routing the connecting cable

WARNING

High temperatures

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

WARNING

Overload protection

It is essential that an overload protection device is incorporated in the braking resistor circuit; this is described in *Figure 4-4 Typical protection circuit for a braking resistor* .

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

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

When compliance with EMC emission standards is required, external connection requires the cable to be armoured or shielded, since it is not fully contained in a metal enclosure.

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

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	Instantaneous power rating
UNI 1201 ~ UNI 1205	20Ω	15kW
UNI 1401 ~ UNI 1405	40Ω	
UNI 2201	20Ω	15kW
UNI 2401	40Ω	
UNI 2202, UNI 2203	15Ω	20kW
UNI 2402, UNI 2403	30Ω	
UNI 3201 ~ UNI 3205	5Ω	60kW
UNI 3401 ~ UNI 3405	10Ω	
UNI 4401 ~ UNI 4405	5Ω	120kW

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.

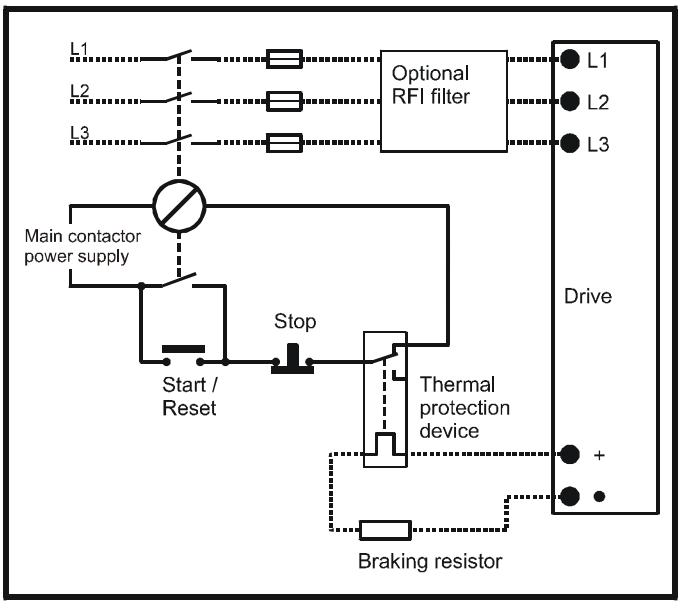
Optimisation of the braking resistor requires a careful consideration of the braking duty.

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 4-4 shows a typical circuit arrangement.

Figure 4-4 Typical protection circuit for a braking resistor



4.4.1 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 respectively.

4.4.2 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. OI.AC 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.

4.4.3 Ground leakage

Unidrive sizes 1, 2 and 5

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)

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

*9mA at 380V ~ 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.

A fixed ground connection must be made before AC power is applied. In some applications, safety regulations require a duplicate ground connection.

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 Inverters.
   - Type A can only be used with single phase Inverters
   - Type B must be used with three phase Inverters

If an 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.

For more information please contact the supplier of the drive.

4.4.4 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.

4.4.5 DC Bus paralleling

The 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 as to the combination of drives which can be used in this configuration.

Please contact the supplier of the drive for more information.

4.5 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 4.5.2 *EMC - Compliance* on page 40. 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 4.5.2 *EMC - Compliance* on page 40. Where an RFI filter is not required follow the guidelines given in section 4.5.1 *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 173 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 173

The correct RFI filter must be used and all of the guidelines in section 4.5.1 *EMC - General requirements* and section 4.5.2 *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.

4.5.1 EMC - General requirements

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.

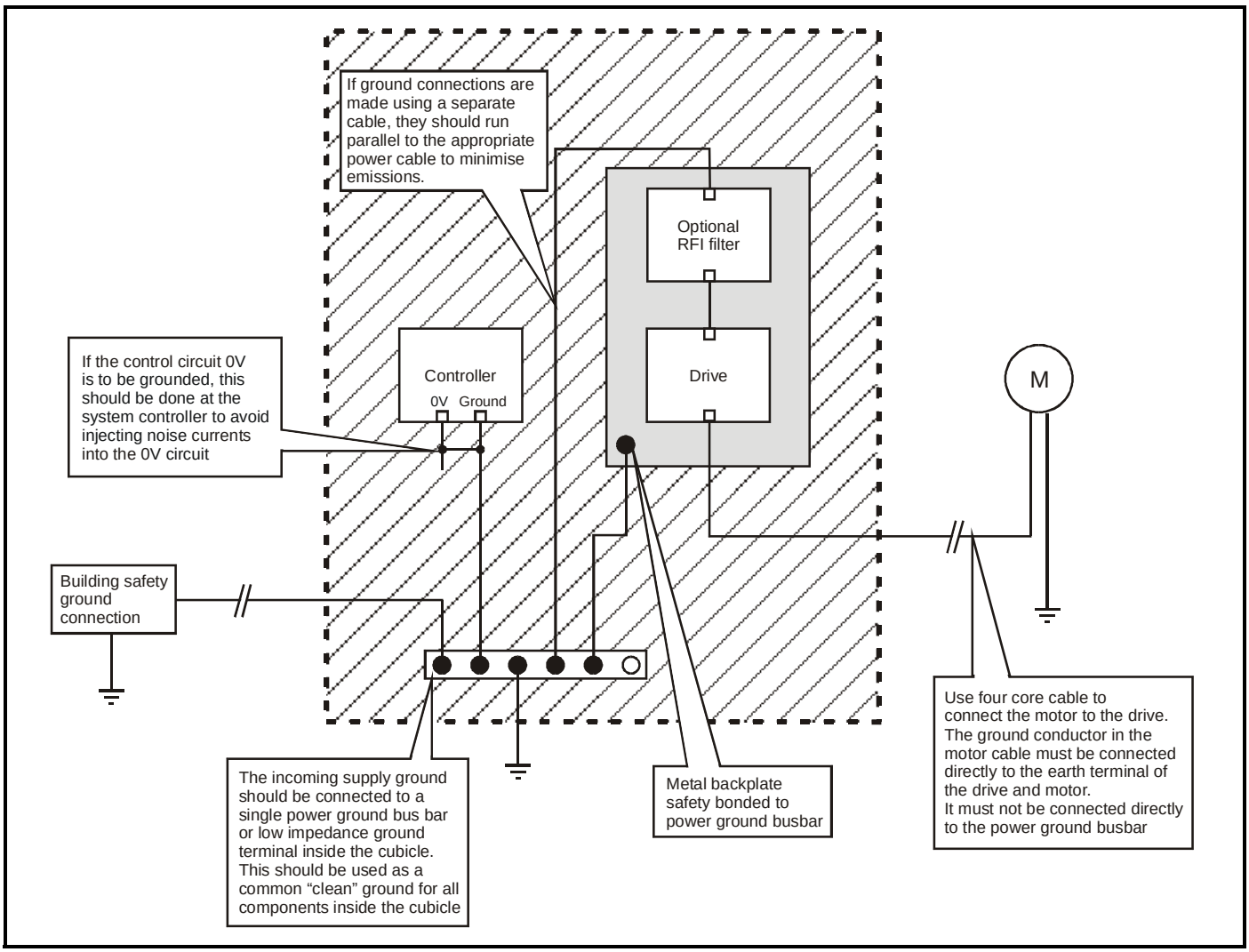
WARNING

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

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

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

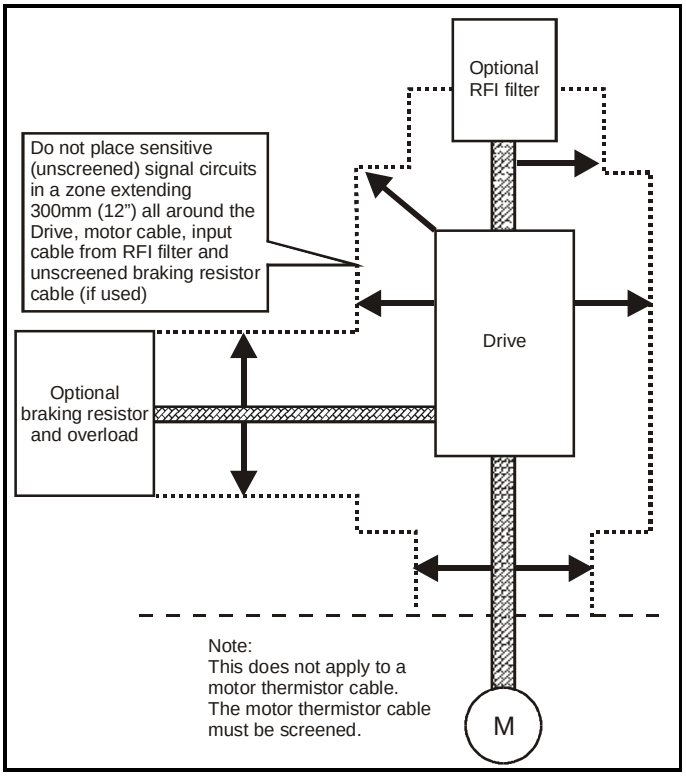
Figure 4-5 General EMC enclosure layout showing earth / ground connections



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 4-6 Drive clearances



Feedback device cable screening

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

Table 4-5 Feedback Device Properties

Input Type	Nature	Wiring Requirement
Resolver Inputs	Medium bandwidth e.g. 10kHz, sensitive	Screening recommended
Encoder Inputs	Wide bandwidth e.g. 500kHz. Good immunity but limited common mode range	Correct screening arrangement essential. Matched cable and correct termination recommended

- At the drive terminals the screen must be connected to 0V.
- At the feedback device the screen must be connected to 0V.
- It is strongly recommended that the screened cable should be run in a continuous length to the terminal, to avoid the injection of noise at intermediate pigtails and to maximise the screening benefit.
- The screen connections to the drive and f/b device should be kept as short as possible to avoid possible stray noise pickup.

Ground Connection

Grounding of the feedback cable screen prevents fast transients being passed along the feedback cable and should additionally be fitted to:

- Prevent radiated emissions from the drives 0V line being passed to the feedback device.
- Prevent radiated emissions from the feedback device / motor being passed onto the signal cable.
- Provide an alternative low impedance path for noise currents to flow.

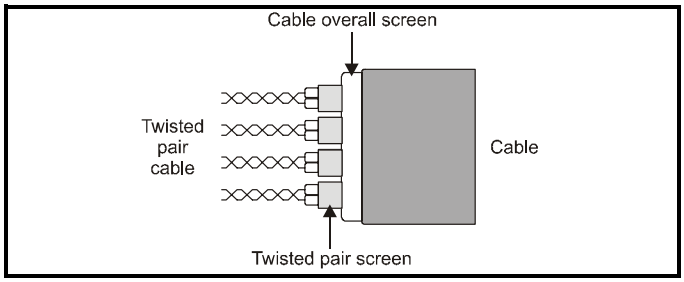
Table 4-6 Recommended Ground Connections

No.	Feedback device	Ground Connection	
		At the drive	At the feedback device
1	Isolated from Motor	Optional	Optional
2	Encoder circuit Isolated from Encoder Body	Optional	Yes
3	No Isolation from Motor	Yes	Yes

Recommended Cable

The recommended cable for feedback signals is a twisted pair, screened with an overall screen type as shown below:

Figure 4-7 Feedback cable, twisted pair



Using this type of cable allows for the connection of the outer shield to ground and the inner shields to 0V at both drive and encoder end when required. For example some local recommendations may insist that the cable screen has an ground at both ends, in this case the inner-screened cables would be connected to 0V of the drive and encoder.

NOTE

Ensure that feedback cables are kept as far away as possible from power cables and avoid parallel routing.

When placing ground connections at either the drive or f/b device end suitable ground clamps should be used as shown in Figure 4-8. The outer sheath of the cable should be stripped back enough to allow for the ground clamp to be fitted (the screen connection should not be broken). The ground clamps should be located as close as possible to the drive / feedback device with the ground connections being made to a common back plane.

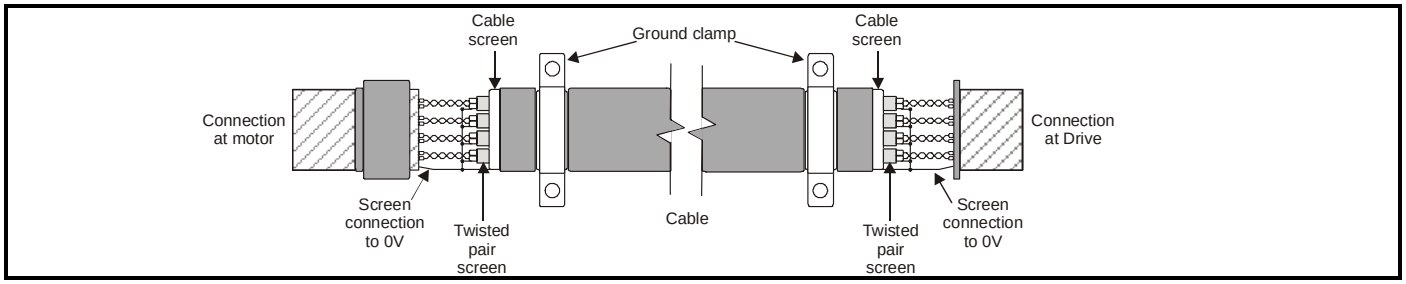
NOTE

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

In some cases single screening of each pair of differential signals cables is sufficient. The screens should be connected in the same way as detailed above except where the overall screen would be connected to ground, all of the individual screens should be connected to ground.

If the 0V is is required to be left floating a cable with individual screens and an overall screen as shown must be used.

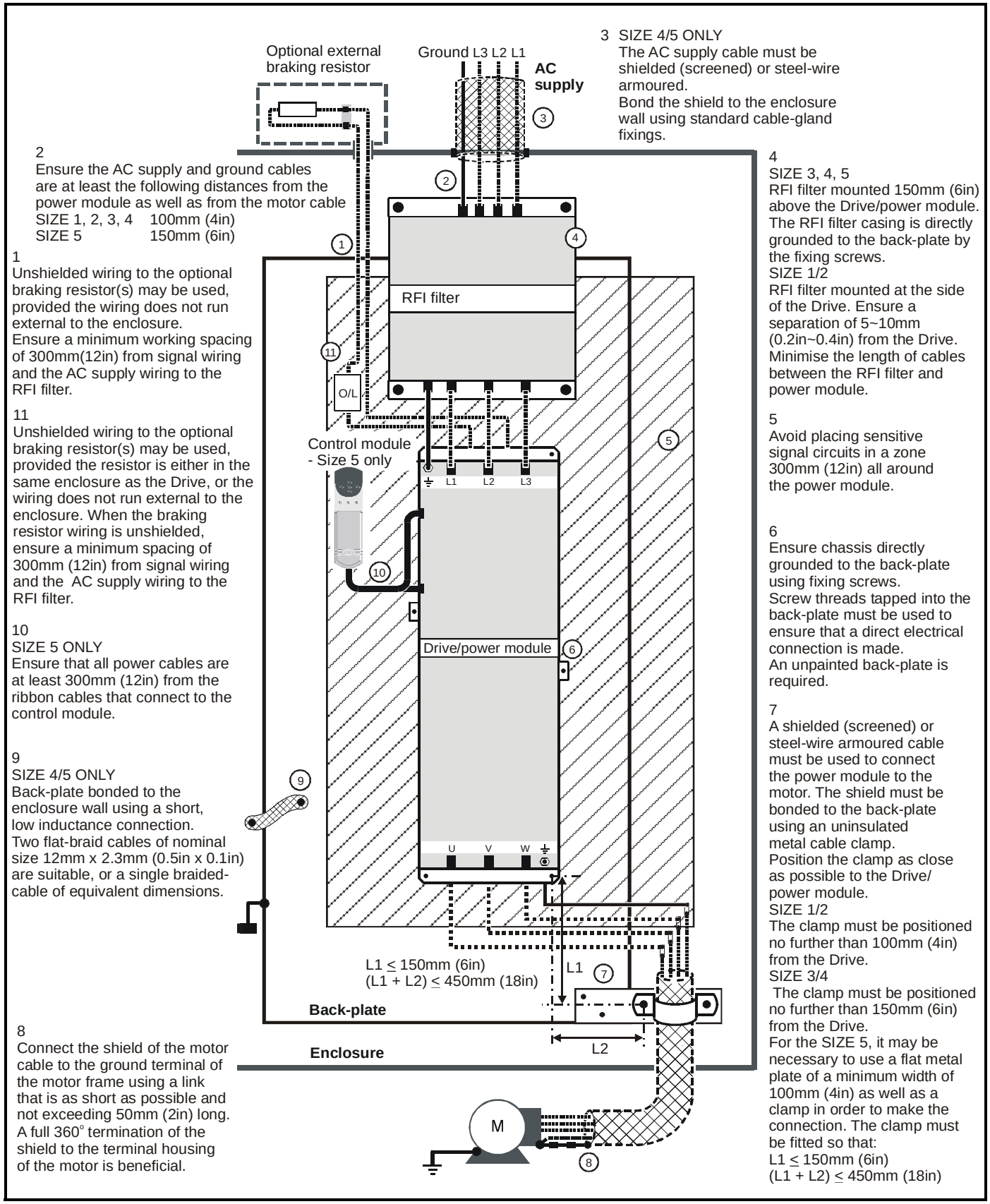
Figure 4-8 Feedback cable connections



4.5.2 EMC - Compliance

The following diagram 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 4-9 EMC compliance



2
Ensure the AC supply and ground cables are at least the following distances from the power module as well as from the motor cable
SIZE 1, 2, 3, 4 100mm (4in)
SIZE 5 150mm (6in)

1
Unshielded wiring to the optional braking resistor(s) may be used, provided the wiring does not run external to the enclosure.
Ensure a minimum working spacing of 300mm(12in) from signal wiring and the AC supply wiring to the RFI filter.

11
Unshielded wiring to the optional braking resistor(s) may be used, provided the resistor is either in the same enclosure as the Drive, or the wiring does not run external to the enclosure. When the braking resistor wiring is unshielded, ensure a minimum spacing of 300mm (12in) from signal wiring and the AC supply wiring to the RFI filter.

10
SIZE 5 ONLY
Ensure that all power cables are at least 300mm (12in) from the ribbon cables that connect to the control module.

9
SIZE 4/5 ONLY
Back-plate bonded to the enclosure wall using a short, low inductance connection.
Two flat-braid cables of nominal size 12mm x 2.3mm (0.5in x 0.1in) are suitable, or a single braided-cable of equivalent dimensions.

8
Connect the shield of the motor cable to the ground terminal of the motor frame using a link that is as short as possible and not exceeding 50mm (2in) long.
A full 360° termination of the shield to the terminal housing of the motor is beneficial.

3 SIZE 4/5 ONLY
The AC supply cable must be shielded (screened) or steel-wire armoured.
Bond the shield to the enclosure wall using standard cable-gland fixings.

4
SIZE 3, 4, 5
RFI filter mounted 150mm (6in) above the Drive/power module. The RFI filter casing is directly grounded to the back-plate by the fixing screws.
SIZE 1/2
RFI filter mounted at the side of the Drive. Ensure a separation of 5~10mm (0.2in~0.4in) from the Drive. Minimise the length of cables between the RFI filter and power module.

5
Avoid placing sensitive signal circuits in a zone 300mm (12in) all around the power module.

6
Ensure chassis directly grounded to the back-plate using fixing screws.
Screw threads tapped into the back-plate must be used to ensure that a direct electrical connection is made.
An unpainted back-plate is required.

7
A shielded (screened) or steel-wire armoured cable must be used to connect the power module to the motor. The shield must be bonded to the back-plate using an uninsulated metal cable clamp.
Position the clamp as close as possible to the Drive/ power module.
SIZE 1/2
The clamp must be positioned no further than 100mm (4in) from the Drive.
SIZE 3/4
The clamp must be positioned no further than 150mm (6in) from the Drive.
For the SIZE 5, it may be necessary to use a flat metal plate of a minimum width of 100mm (4in) as well as a clamp in order to make the connection. The clamp must be fitted so that:
L1 ≤ 150mm (6in)
(L1 + L2) ≤ 450mm (18in)

4.5.3 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:

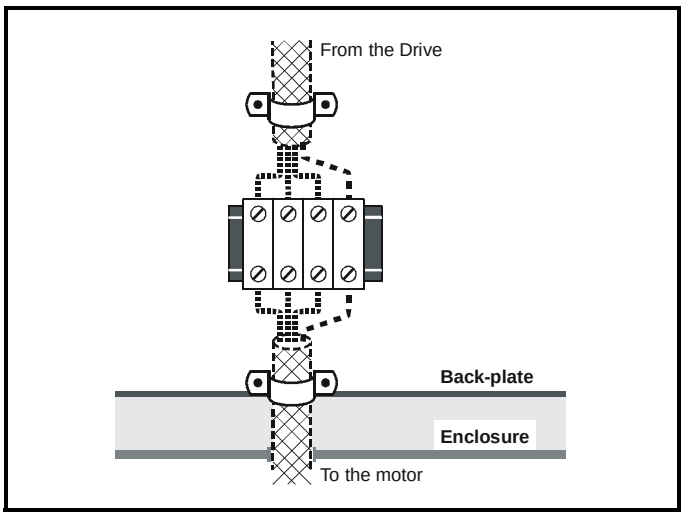
Connecting the motor cable to a terminal block in the drive enclosure
Fitting a motor isolator switch for safety when work is done on the motor

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 4-10 Connecting the motor cable to a terminal block in the enclosure



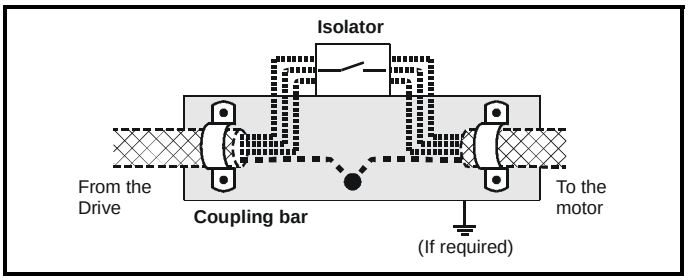
Using a motor isolator-switch

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 4-11 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 'pigtails' 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 4-11.

4.6 Control connections

4.6.1 General

Table 4-7 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

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 130 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 133 for more information on control terminal set-up.

CAUTION

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

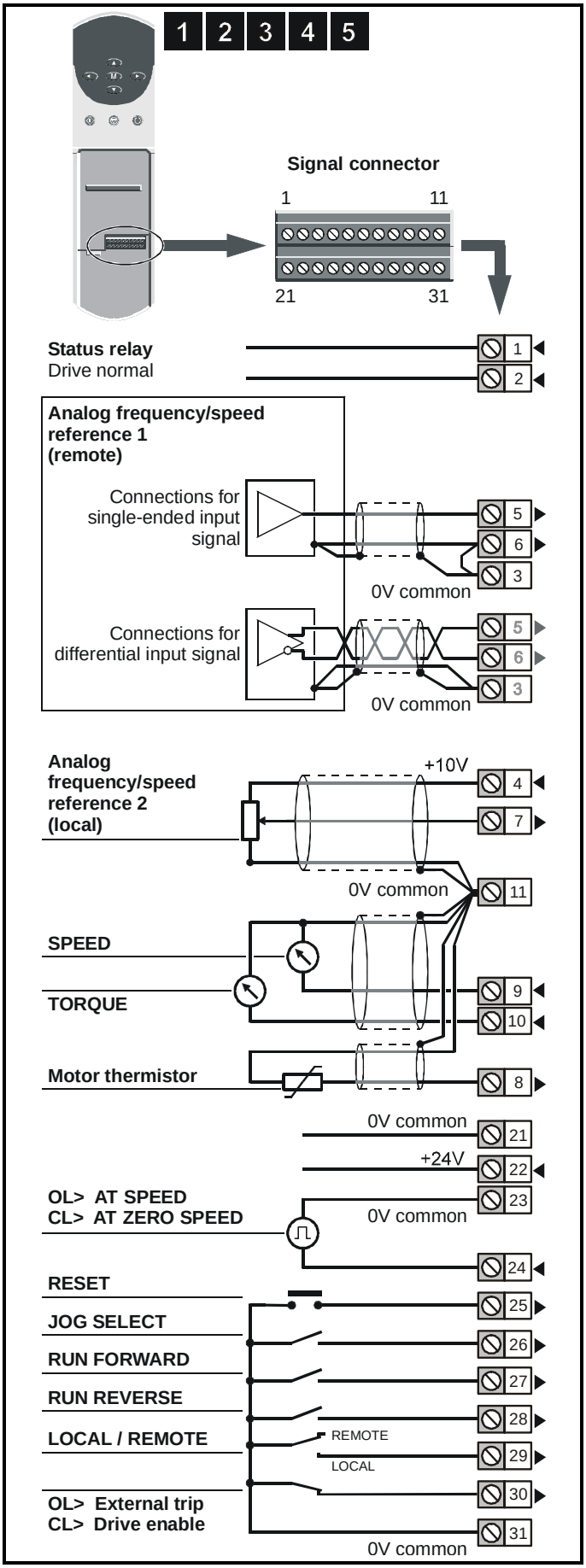
WARNING

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.

Figure 4-12 Unidrive default terminal functions



4.6.2 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

	Analog input 1
5	**Non-inverting input**
6	**Inverting input**
Default function	Remote 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 ~ 20mA 20mA ~ 0 4 ~ 20mA 20 ~ 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	Local 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 ~ 20mA 20mA ~ 0 4 ~ 20mA 20 ~ 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 ~ 20mA 20mA ~ 0 4 ~ 20mA 20 ~ 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 ~ 20mA 4 ~ 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 ~ +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 ~ +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	LOCAL / REMOTE SELECT input

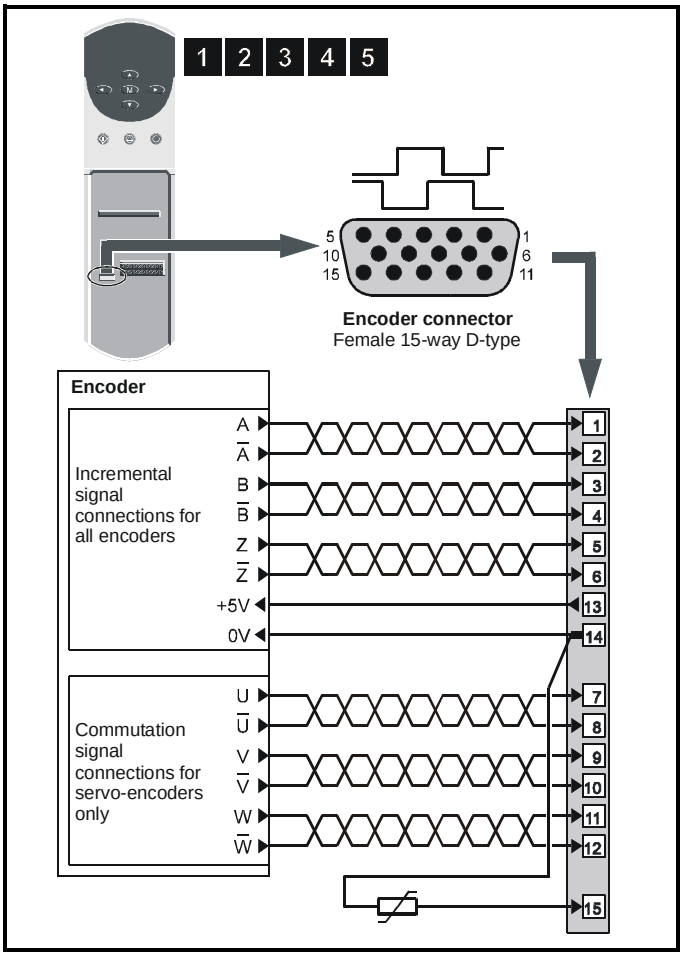
Type	Negative or positive logic digital inputs
Logic mode controlled by...	Parameter **8.27**
Voltage range	0V ~ +24V
Absolute maximum voltage range	–3V ~ +30V
Input current when 0V applied	≥3.2mA
Negative-logic levels	Inactive state (input open-circuit): >+15V Active state: <+5V
Positive-logic levels	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

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 ~ +24V
Absolute maximum voltage range		–3V ~ +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.

4.6.3 Encoder connections

Figure 4-13 Encoder connections (default configurations)



For encoder cable screening, see section *Feedback device cable screening* on page 39.

Descriptions of the Encoder connections

1	**Quadrature channel A**
2	**Quadrature channel $\overline{A}$**
3	**Quadrature channel B**
4	**Quadrature channel $\overline{B}$**
5	**Marker pulse channel Z**
6	**Marker pulse channel $\overline{Z}$**
7	**Phase channel U**
8	**Phase channel $\overline{U}$**
9	**Phase channel V**
10	**Phase channel $\overline{V}$**
11	**Phase channel W**
12	**Phase channel $\overline{W}$**

Type	RS422 differential receivers
Maximum data rate	250kHz
Line termination components	120Ω Parameter **3.24** is used to disable the termination resistors if required.

13	Encoder supply	
Supply voltage		+5.15V or 15V
Voltage tolerance		±2%
Nominal output current		300mA

The output voltage at terminal 13 is 5V when parameter **3.23** is set at 0 (default). When **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 if the encoder output is 15V.

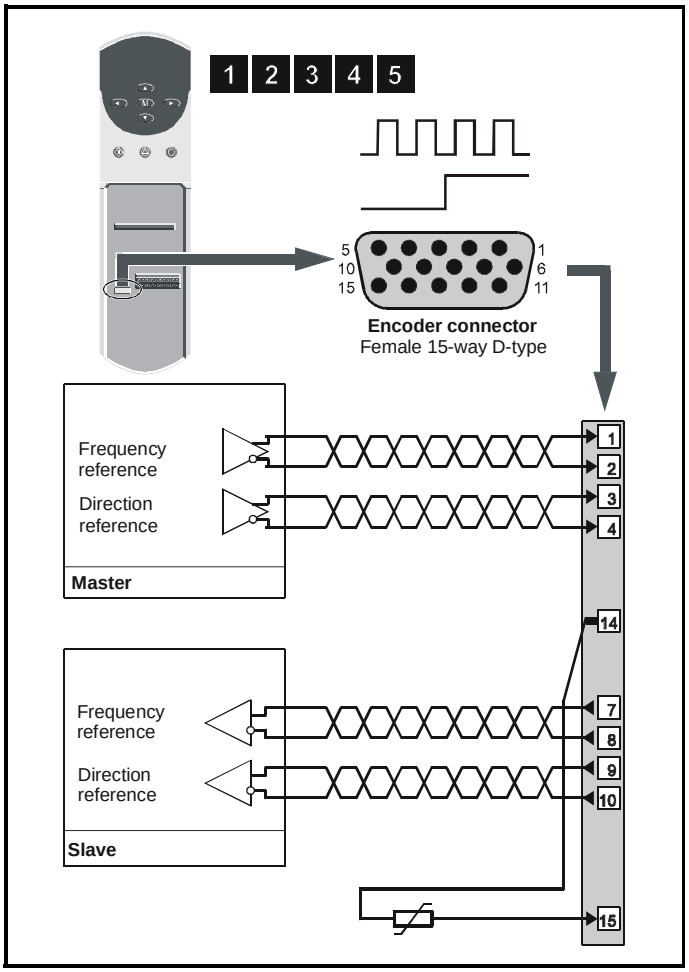
14	0V common

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).

4.6.4 Frequency and direction connections

Figure 4-14 Frequency and direction connections and alternative motor-thermistor connections



For encoder cable screening, see section *Feedback device cable screening* on page 39.

Description of the Frequency and Direction connections

1	**Frequency input FIN**
2	**Frequency input $\overline{F}$IN**
3	**Direction input DIN**
4	**Direction input $\overline{D}$IN**
7	**Frequency output FOUT**
8	**Frequency output $\overline{F}$OUT**
9	**Direction output DOUT**
10	**Direction output $\overline{D}$OUT**
11	**This terminal has no function when this mode is selected**
12	**This terminal has no function when this mode is selected**

Type	RS422 differential receivers
Maximum data rate	250kHz
Line termination components	120Ω Parameter **3.24** is used to disable the termination resistors if required.

13	**Encoder supply**
Supply voltage	+5.15V or 15V
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 Pr **3.24** = 1 if the encoder output is 15V.

14	**0V common**

15	**Motor thermistor input**

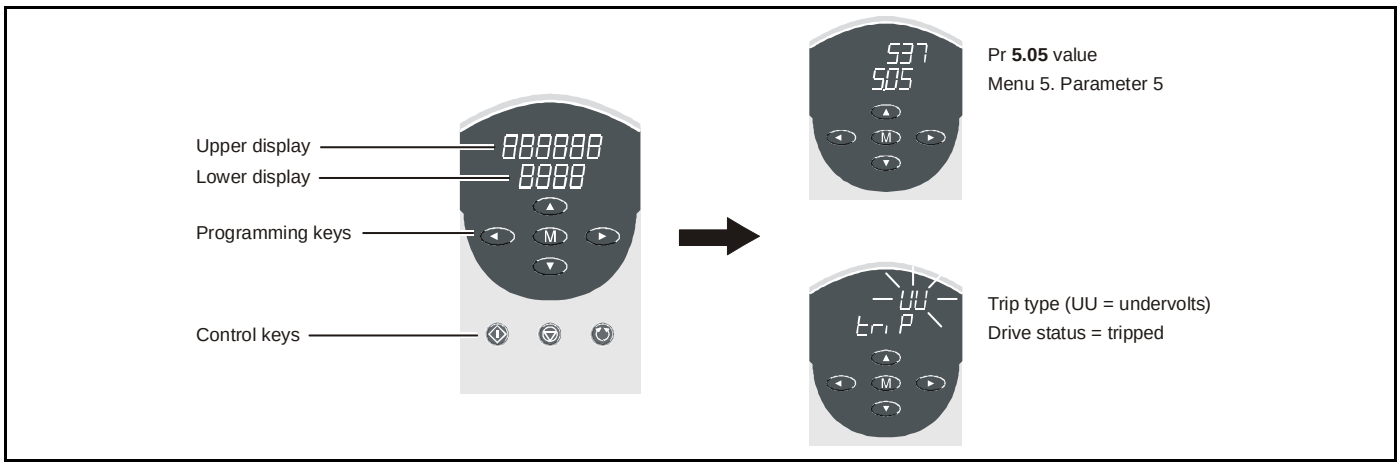
This terminal is connected internally to terminal 8 of the Signal connector Connect only one of these terminals to a motor thermistor. Analog input 3 must be in thermistor mode, Pr **7.15** = th.Sc (9) or th (10).

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)

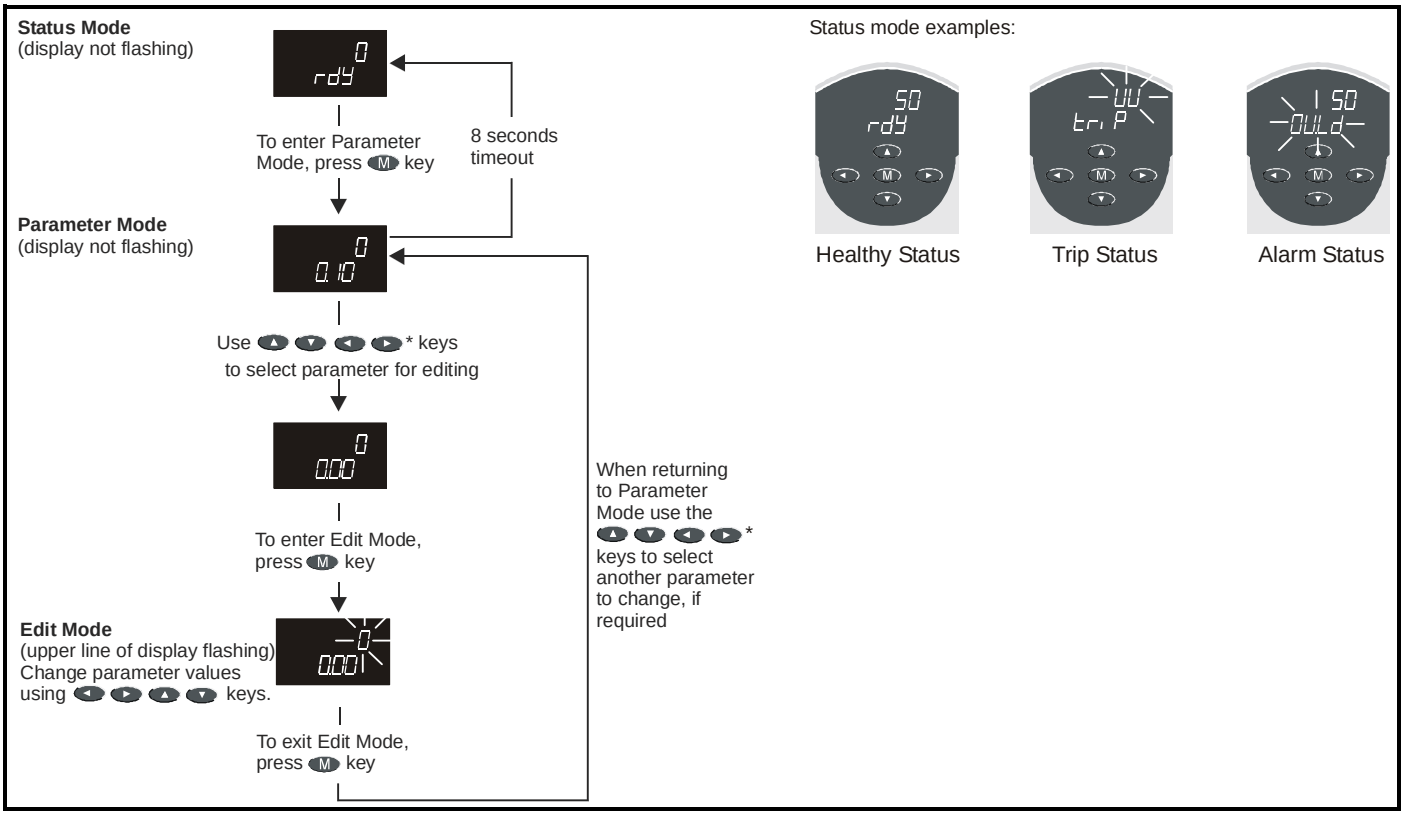
stop (red)

forward / reverse (blue)

NOTE

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

Figure 5-2 Display modes



* 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 51.

WARNING

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.

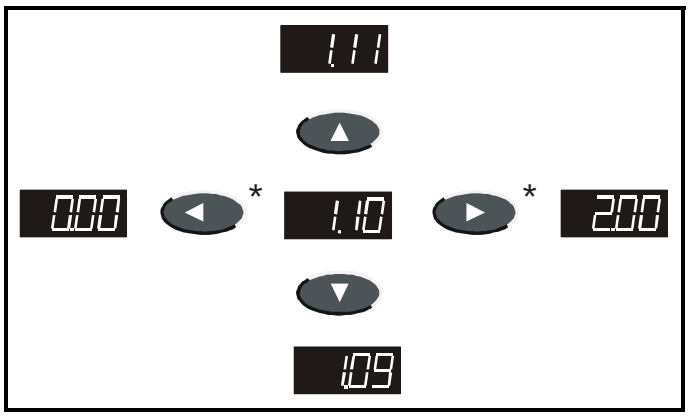
NOTE

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 50.

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.



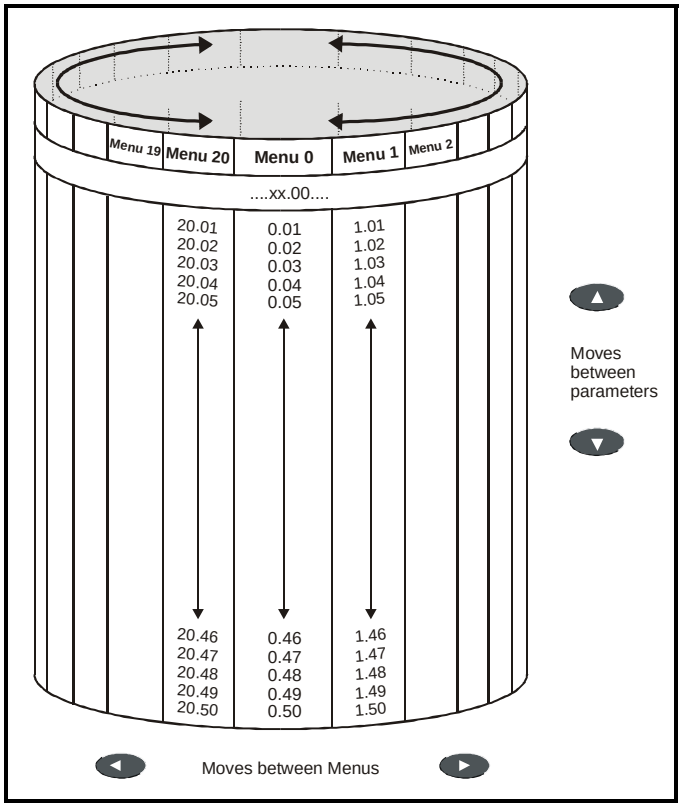
* can only be used to move between menus if standard security has been opened. For further information, refer to section 5.10 *Parameter security* on page 51.

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

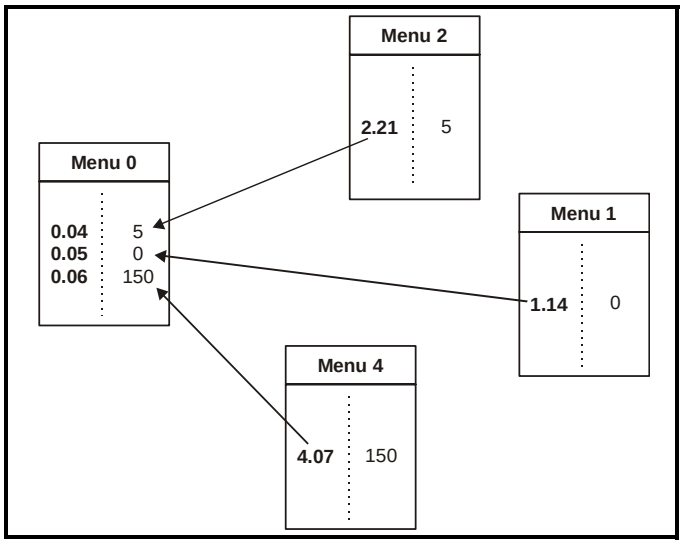
The following shortcuts can be used to speed up navigation of the drive parameters and editing of parameters.

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:

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:

0.48 setting		Operating mode
	0	Open-loop
	1	Closed-loop Vector
	2	Closed-loop Servo
	3	For operation in this mode, contact the supplier of the drive

The figures in the second column 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.

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 independant 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

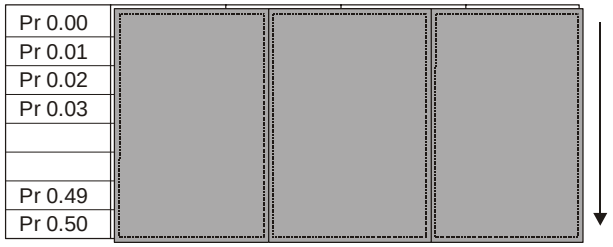
RO = Read only access

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.

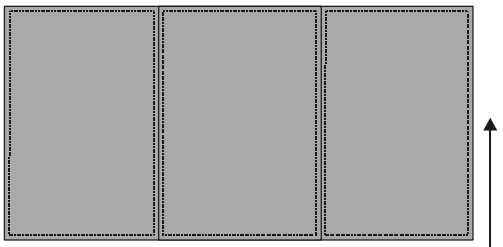
5.10.1 Standard security

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

Standard security closed - Menu 0 only visible



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.

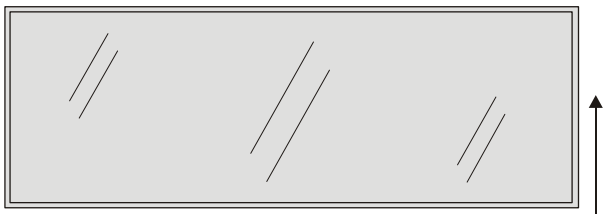
Enabling standard security

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.

6 Menu 0

6.1 Single line descriptions

Parameter			Range(⇳)		Default(⇨)			Type			
			OL	CL	OL	VT	SV				
0.00	Operating mode, Macro selection, Configuration, Saving		0 ~ 9,999		0			RW	Uni	R	
0.01	OL> Minimum frequency	{**1.07**}	0 ~ [**0.02**]Hz		0			RW	Uni		
	CL> Minimum speed	{**1.07**}		0 ~ [**0.02**]rpm		0		RW	Uni		
0.02	OL> Maximum frequency	{**1.06**}	0 ~ 1,000.0Hz		EUR> 50 USA> 60			RW	Uni		
	CL> Maximum speed	{**1.06**}		0 ~ 30,000rpm		EUR> 1,500 USA> 1,800	3000	RW	Uni		
0.03	Acceleration rate	{**2.11**}	0 ~ 3,200.0 s/100Hz	VT> 0~3,200 s/1000rpm SV> 0~32.000 s/1000rpm	5*	2	0.2	RW	Uni		
0.04	Deceleration rate	{**2.21**}	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 32.000 s/ 1000rpm SV> 0 ~ 32,000 s/ 1000rpm	10*	2	0.2	RW	Uni		
0.05	Reference *selector*	{**1.14**}	0 ~ 5		EUR> 0 USA> 4	EUR> 0 USA> 0		RW	Uni		
0.06	Current limit	{**4.07**}	0 ~ I_{max} %	0 ~ I_{max} %	150	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 ~ 32,000 %		200		RW	Uni		
0.08	OL> Voltage boost	{**5.15**}	0.0 ~ 25.0 %		3.0			RW	Uni		
	CL> Speed control I gain	{**3.11**}		0 ~ 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 ~ 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 ~ 400.0 Hz	0 ~ 4,000.0 rpm	1.5	50		RW	Uni		
0.15	Ramp mode *selector*	{**2.04**}	Stnd.Hd (0) FASt (1) Stnd.Ct (2)		Stnd.Ct (2)			RW	Txt		
0.16	Stop mode *selector*	{**6.01**}	COASt (0) rP (1) rP-dcI (2) dcI (3) td.dcI (4)	COASt (0) rP (1) no.rP (2) rP-POS (3)	rP (1)	rP (1)	no.rP (2)	RW	Txt		
0.17	Torque mode *select*	{**4.11**}	0 ~ 1	0 ~ 4	0	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 ~ 3,000.0 s^2/100 Hz	0 ~ 30,000 s^2/1000 rpm	3.1	1.5	0.03	RW	Uni		
0.20	Skip frequency/speed 1	{**1.29**}	0.0 ~ 1,000.0 Hz	0 ~ 30,000 rpm	0	0		RW	Uni		
0.21	Skip band 1	{**1.30**}	0.0 ~ 5.0 Hz	0 ~ 50 rpm	0.5	5		RW	Uni		
0.22	Skip frequency/speed 2	{**1.31**}	0.0 ~ 1,000.0 Hz	0 ~ 30,000 rpm	0	0		RW	Uni		
0.23	Skip band 2	{**1.32**}	0.0 ~ 5.0 Hz	0 ~ 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		P
0.25	Analog input 2 mode *selector*	{**7.11**}	(as Pr **0.24**)		VOLt (0)			RW	Txt		P
0.26	Analog input 2 *destination*	{**7.14**}	**0.00** ~ **20.50** Menu parameter		**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 ~ 4		4			RO	Uni		P
0.28	EUR> Current control P gain	{**4.13**}	0 ~ 30,000	0 ~ 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 ~ 30,000	0 ~ 30,000	40	2,000	1,200	RW	Uni		
	USA> Terminal-29 destination parameter	{**8.23**}	**0.00** ~ **20.50** Menu parameter		**1.41**			RW	Uni	R	P

Parameter			Range(⇳)		Default(⇨)			Type			
			OL	CL	OL	VT	SV				
0.30	Forward / reverse key *enable*	{**6.13**}	0 or 1		0			RW	Bit		
0.31	Macro number	{**11.37**}	0 ~ 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 ~ 1920 A					RO	Uni		P
0.34	User security code	{**11.30**}	0 ~ 255		149			RW	Uni	S	P
0.35	Keypad reference	{**1.17**}	± [**0.02**] Hz	± [**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 ~ 9.9 Group.Unit		1.1			RW	Uni		P
0.38	Initial parameter displayed	{**11.22**}	**0.00** ~ **0.50** Menu parameter		**0.10***			RW	Uni		P
0.39	Synchronise to a spinning motor	{**6.09**}	0 or 1	0 or 1	0	1		RW	Bit		
0.40	Autotune	{**5.12**} **(3.25)**	0 or 1	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		P
0.42	Motor - no. of poles	{**5.11**}	2 ~ 32 poles	2 ~ 32 poles	4	4	6	RW	Txt		P
0.43	Motor - rated power factor	{**5.10**}	0.000 ~ 1.000	VT> 0.000 ~ 1.000 SV> 1	0.92	0.92	1	RW	Uni	S	P
0.44	Motor - rated voltage	{**5.09**}	0 ~ 480 V	VT> 0 ~ 480 V SV> 0 V	400	460	0	RW	Uni		
0.45	Motor - rated speed	{**5.08**}	0 ~ 6,000 rpm	0 ~ 30,000 rpm	0	EUR> 1450 USA> 1770		RW	Uni		
0.46	Motor - rated current	{**5.07**}	0 ~ FLC A		FLC			RW	Uni		
0.47	Motor - rated frequency	{**5.06**}	0 ~ 1,000.0 Hz	VT> 0 ~ 1,000.0 Hz SV> 0	EUR> 50 USA> 60	EUR> 50 USA> 60	0	RW	Uni		
0.48	Drive operating mode *selector*	{**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 ~ 1,000		1			RO	Uni		P
0.50	Software version number	{**11.29**}	1.00 ~ 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** {**0.33**}.

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

Size 1 to 4> FLC x 220%
Size 5> FLC x 170%

I_{MAX} % The range is the maximum permissible percentage of I_{MAX} where this maximum is derived from the equations for the maximum value of Pr **0.06** in *section 6.2 Menu 0 full descriptions* on page 57.

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

*The following parameters have different default settings in the VTC variant :

Pr Pr**0.07** (**5.14**) = Fd (no other setting available)

Pr **0.03** (**2.11**) = 60s

Pr **0.04** (**2.21**) = 60s

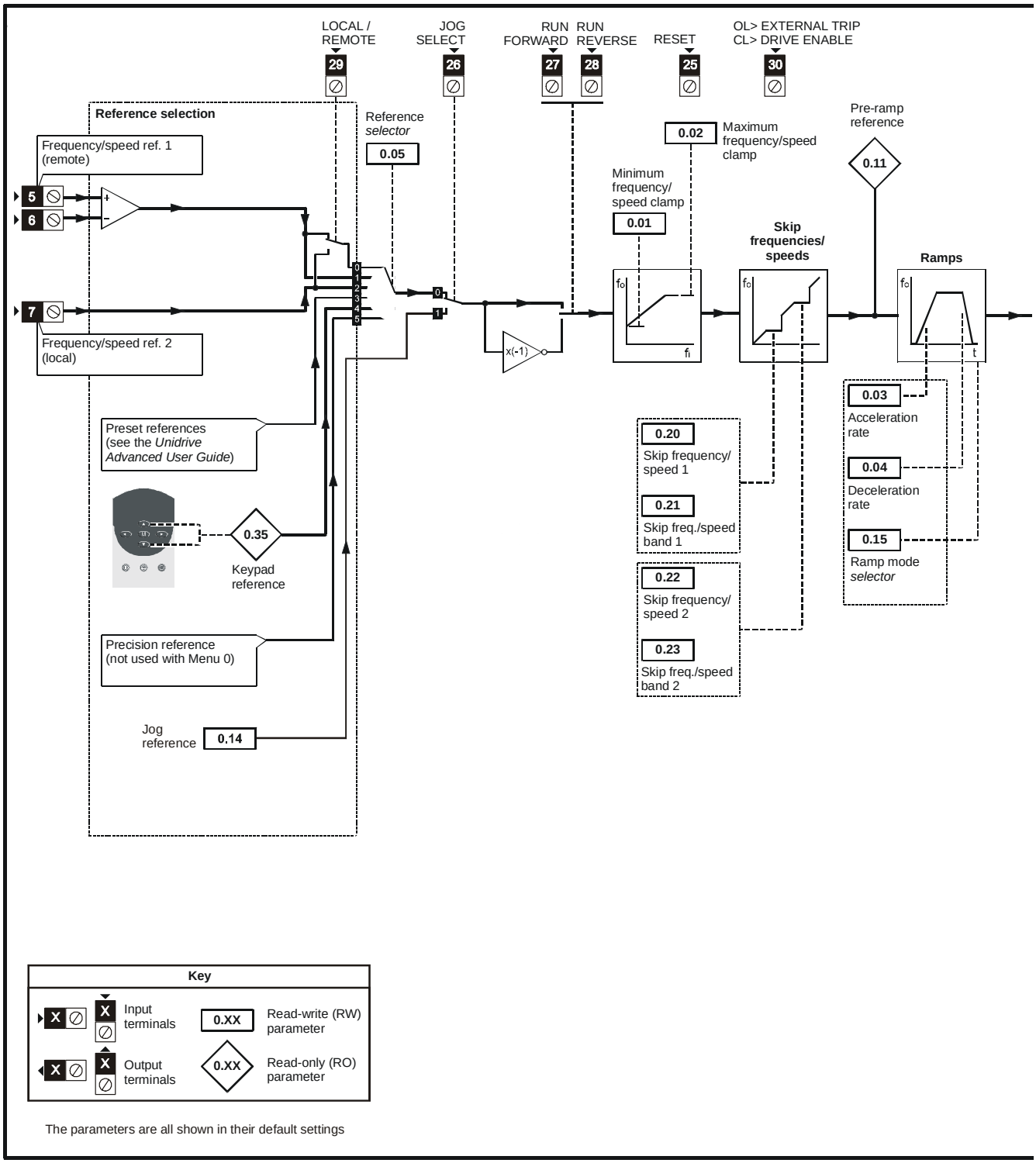
Pr **2.12** ~ **2.18** = 60s

Pr **2.22** ~ **2.28** = 60s

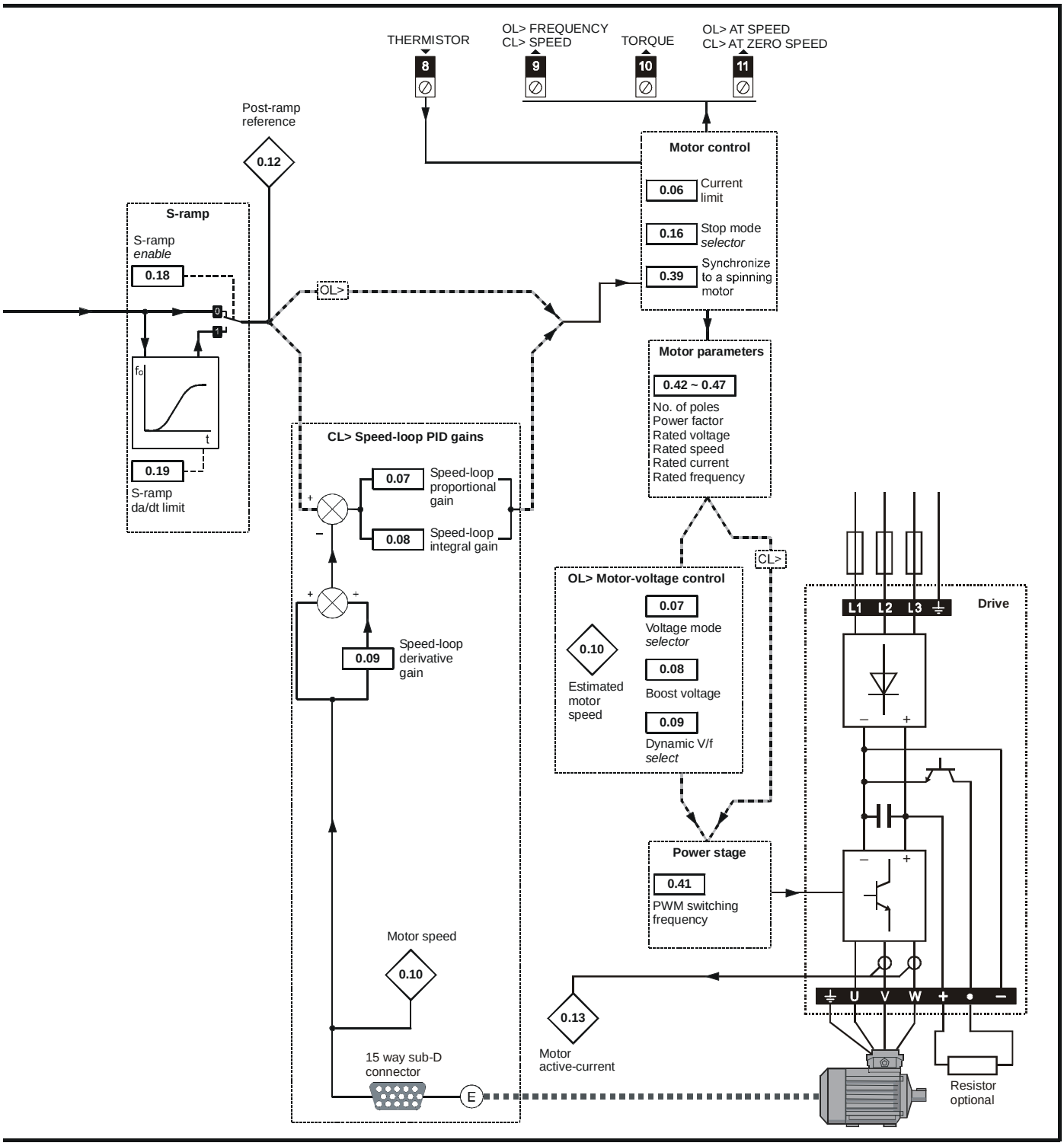
USA > Pr **0.36** (**11.25**) = 9,600

USA > Pr **0.38** (**11.22**) = **0.12**

Figure 6-1 Menu 0 Logic diagram



The parameters are all shown in their default settings


THERMISTOR
8
OL> FREQUENCY
CL> SPEED
9
TORQUE
10
OL> AT SPEED
CL> AT ZERO SPEED
11
Post-ramp reference
0.12
Motor control
0.06
Current limit
0.16
Stop mode selector
0.39
Synchronize to a spinning motor
S-ramp
S-ramp enable
0.18
OL>
Motor parameters
0.42 ~ 0.47
No. of poles
Power factor
Rated voltage
Rated speed
Rated current
Rated frequency
CL> Speed-loop PID gains
0.07
Speed-loop proportional gain
0.08
Speed-loop integral gain
0.09
Speed-loop derivative gain
0.19
S-ramp da/dt limit
CL>
OL> Motor-voltage control
0.10
Estimated motor speed
0.07
Voltage mode selector
0.08
Boost voltage
0.09
Dynamic V/f select
Drive
L1 L2 L3
Power stage
0.41
PWM switching frequency
Motor speed
0.10
0.13
Motor active-current
15 way sub-D connector
E
U V W + • –
Resistor optional

6.2 Menu 0 full descriptions

6.2.1 Menu 0 configuration

0.00	**Operating mode, Macro selection, Configuration, Saving**			
RW	Uni		R	
⇳	0 ~ 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 parameter **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 ~ [**0.02**]Hz	⇨	0
CL	⇳	0 ~ [**0.02**]rpm	⇨	0

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

Open-loop

Set **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.

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

Closed-loop

Set **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 ~ 1,000Hz	⇨	50 (EURO) 60 (USA)
CL	⇳	VT> 0 ~ 30,000rpm SV> 0 ~ 30,000rpm	⇨	1,500 (EURO) 1,800 (USA) 3,000

(The drive has additional over-speed protection.)

Open-loop

Set **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 [**0.02**].

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

Closed-loop

Set **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 [**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 ~ 3,200.0s/100Hz	⇨	5*
CL	⇳	VT> 0 ~ 3,200.0 s/1,000rpm SV> 0 ~ 32.000 s/1,000rpm	⇨	2 0.2

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

Set **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 ~ 3,200.0s/100Hz	⇨	10*
CL	⇳	VT> 0 ~ 3,200.0 s/1,000rpm SV> 0 ~ 32.000 s/1,000rpm	⇨	2 0.2

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

Set **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 ~ 5	⇨	0 (EURO) 4 (USA)
CL	⇳	0 ~ 5	⇨	0 (EURO) 0 (USA)

The default setting of **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 **0.05** to select the required frequency/speed reference, as follows:

Setting	Control mode	Function
0	Terminal	Analog frequency/speed reference selected by LOCAL/REMOTE 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	⇳	0 ~ I_{max} %	⇨	150
CL	⇳	VT> 0 ~ I_{max} % SV> 0 ~ I_{max} %	⇨	150 175

OL> $\mathbf{I_{max}\ \%} = \frac{\mathbf{FLC}}{[\mathbf{0.46}]} \times 150$

CL> $\mathbf{I_{max}\ \%} = \frac{\mathbf{FLC}}{[\mathbf{0.46}]} \times 175^*$

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

* This formula applies to Unidrive size 1~4 only. The closed loop $\mathbf{I_{max}\%}$ for Unidrive size 5, is the same as for open loop.

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

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

$$[\mathbf{0.06}] = \frac{\mathbf{T_R}}{\mathbf{T_{RATED}}} \times \mathbf{100\ (\%)}$$

Where:

$\mathbf{T_R}$ Required maximum torque

$\mathbf{T_{RATED}}$ 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:

$$[\mathbf{0.06}] = \frac{\mathbf{I_R}}{\mathbf{I_{RATED}}} \times \mathbf{100\ (\%)}$$

Where:

$\mathbf{I_R}$ Required maximum active current

$\mathbf{I_{RATED}}$ 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> P
OL	⇳	0 ~ 3	⇨	1*
CL	⇳	0 ~ 32,000 %	⇨	200

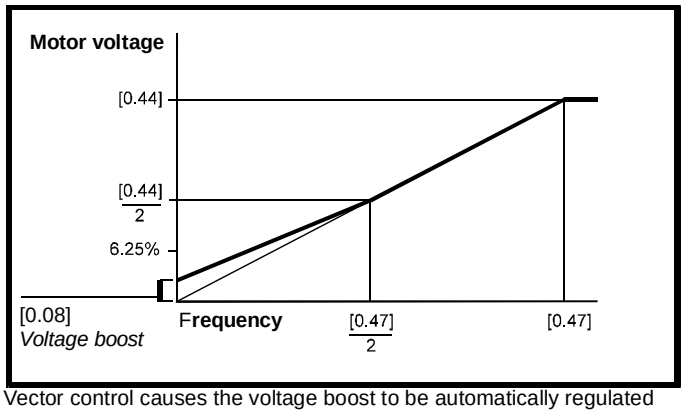
*This parameter has a default setting of 3 (Fd) in the VTC variant.

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 **0.07** (**5.14**) to select fixed voltage boost, or Vector control of voltage boost. Fixed boost requires a value to be set in **0.08** *Boost voltage* by the user. See Figure 6-2. Fixed boost should be used when **0.39** *Synchronize to a spinning motor* is set at 1.

Figure 6-2 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

0.07 (**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 ~ 25.0 % x [0.44]	⇨	3.0
CL	⇳	0 ~ 32,000	⇨	100

Open-loop

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

See Figure 6-2.

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

Closed-loop

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

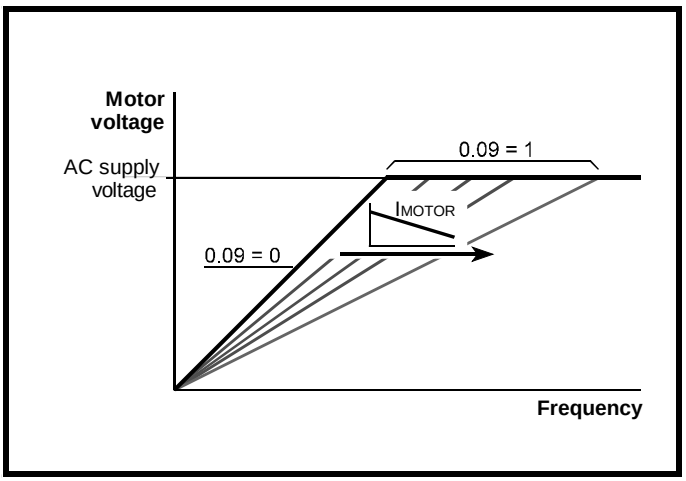
0.09 {5.13}	**Dynamic V/f select**			
RW	Bit			
OL ⇳	0 or 1	⇨	0	

Open-loop

Set **0.09** (**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 **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 6-3 shows the change in V/f slope when the motor current is reduced.

Figure 6-3 Fixed and variable V/f characteristics



0.09 {3.12}	**Speed control D gain**			
RW	Uni			
CL ⇳	0 ~ 32,000	⇨	0	

Closed-loop

0.09 (**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} / **0.10 {3.02}**	**OL> Estimated motor speed** / **CL> Motor speed**			
RO	Bi			
OL ⇳	±60,00rpm	⇨		
CL ⇳	±30,000rpm	⇨		

Open-loop

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

0.12 *Post-ramp frequency reference*
0.42 *Motor - no. of poles*

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

Closed-loop

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

The value of **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, [**0.12**] = [**0.11**]. During acceleration and deceleration, the two values may differ.

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

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

0.13 {4.02}	**Motor active-current**			
RO	Bi			
⇳	$\pm I_{max}$ A	⇨		

When the motor is being driven below its rated speed, the torque is proportional to [**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 ~ 400.0Hz	⇨	1.5	
CL ⇳	0 ~ 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)	⇨	Stnd.Ct (2)	

Select the required ramp mode as follows:

Stnd.Hd	**(0)**	Standard ramp with ramp hold
FASt	**(1)**	Fast ramp
Stnd.Ct	**(2)**	Standard ramp with proportional control (refer to the *Unidrive Advanced User Guide*)

For more information, see Pr **2.04** in section 10.21 *Advanced Features* on page 166.

0.16 {6.01}	**Stop mode *selector***				
RW	Txt				
OL	⇳	0 ~ 4 (see below)	⇨	rP (1)	
CL	⇳	0 ~ 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-dcI	(2)	Ramp followed by 1 second DC injection
dcI	(3)	AC injection braking followed by 1 second DC injection braking
td-dcI	(4)	DC injection braking for an adjustable time (see the *Unidrive Advanced User Guide*).
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 10.21 *Advanced Features* on page 166.

0.17 {4.11}	**Torque mode *select***			
RW	Uni			
OL	⇳	0 ~ 1	⇨	0
CL	⇳	0 ~ 4	⇨	0

Set **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 10.21 *Advanced Features* on page 166.

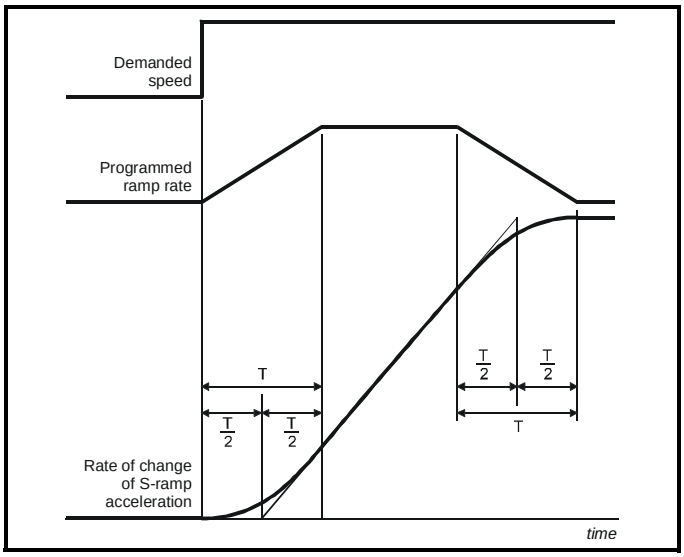
6.2.7 S-ramp

0.18 {2.06}	**S-Ramp *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 (**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			
OL	⇳	0.0 ~ 3,000.0s²/100Hz	⇨	3.1
CL	⇳	0.000 ~ 30,000 s²/1,000rpm	⇨	**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} **0.22 {1.31}**	**Skip frequency/speed 1** **Skip frequency/speed 2**			
RW	Uni			
OL	⇳	0.0 ~ 1,000.0Hz	⇨	0.0
CL	⇳	0 ~ 30,000rpm	⇨	0

See **0.21** and **0.23** *Skip bands*.

0.21 {1.30} **0.23 {1.32}**	**Skip band 1** **Skip band 2**			
RW	Uni			
OL	⇳	0 ~ 5.0Hz	⇨	0.5
CL	⇳	0 ~ 50rpm	⇨	5

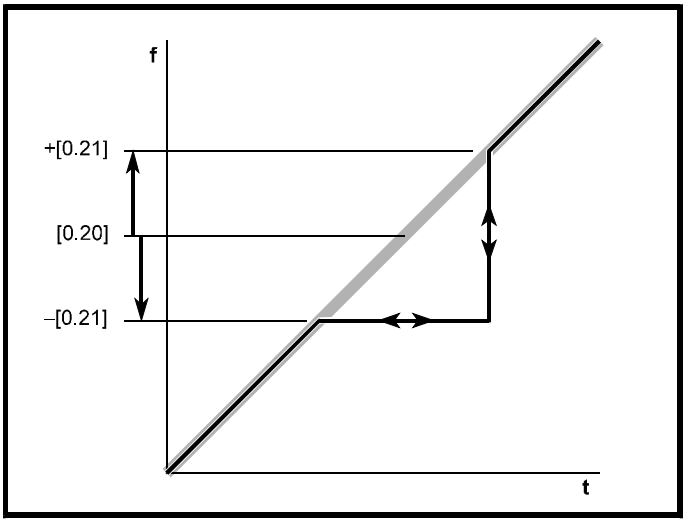
Use skip frequencies/speeds and skip bands to prevent the motor from running at speeds that cause mechanical resonances in the machine. During acceleration and deceleration, the drive passes through the skip bands, but it does not stabilize in a skip band.

Up to two skip frequencies/speeds can be programmed.

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

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

Figure 6-4 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 parameter **0.20**
Required skip band = 60rpm
Enter 30 in parameter **0.21**

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

6.2.9 Analog input modes

0.24 {7.06} / **0.25 {7.11}**				
Analog input 1 mode *selector* / **Analog input 2 mode *selector***				
RW	Txt			P
⇳	0 ~ 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		R	P
⇳	**0.00** ~ **21.50** (Menu param.)	⇨	**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 parameter **1.37** *Analog reference 2*. Use **0.26** to change the function of terminal 7.

6.2.10 Miscellaneous

0.27 {8.27}	**EUR> Positive logic *select***			
RW	Bit		R	P
⇳	0 or 1	⇨	0	

European configuration

Use **0.27** (**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			P
⇳	0 ~ 4	⇨	4	

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

0.28 {4.13}	**EUR> Current-loop proportional gain**			
RW	Uni			
OL ⇳	0 ~ 30000	⇨	20	
CL ⇳	VT> 0 ~ 30,000 SV> 0 ~ 30,000	⇨	150 130	

0.29 {4.14}	**EUR> Current-loop integral gain**			
RW	Uni			
OL ⇳	0 ~ 30,000	⇨	40	
CL ⇳	VT> 0 ~ 30,000 SV> 0 ~ 30,000	⇨	2000 1200	

European configuration

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

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

For information on adjusting these parameters, refer to parameters **4.13** and **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

0.28 differs from **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		R	P
⇳	**0.00 ~ 20.50** (Menu param.)	⇨	**1.41**	

USA configuration

Use **0.29** to change the function of the digital input on terminal 29.

The default setting (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 **0.30** *FWD/REV enable* at 1.

0.31 {11.37}	**Macro number**			
RO	Uni			
⇳	0 ~ 9	⇨		

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 **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 **11.27** *Serial comms. source/ destination parameter* (CT protocol)
INPUt (3)	Apply the received value to the parameter specified by the setting of **11.27** *Serial comms. source/ destination parameter* (CT protocol)

0.33 {11.32}	**Drive rated current (FLC)**			
RO	Uni			P
⇳	2.10 ~ 1,920 A	⇨		

0.34 {11.30}	**User security code**			
RW	Uni	S		P
⇳	0 ~ 255	⇨	149	

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

See *section 5.10 Parameter security* on page 51.

6.2.11 Keypad-reference monitoring

0.35 {1.17}	**Keypad control mode reference**				
RO		Bi	S		P
OL	⇳	±[**0.02**]Hz	⇨		
CL	⇳	±[**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 **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 ~ 9.9 (Group.Unit)	⇨	1.1	

Use **0.37** to select the required address for serial communications when a UD71 *Basic 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
⇳	**0.00** ~ **0.50**	⇨	**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, parameter **0.10** *Motor frequency/speed* is automatically pre-selected as the initial parameter to be displayed. This results in the following:

1. After the AC supply is connected to the drive, and before any other parameter is selected, the value of parameter **0.10** is shown on the upper display. This allows the motor frequency/speed to be monitored without the need to select the parameter.
2. 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 **0.38** (eg. to display **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 **0.39** at 1 for the drive always to 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 **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, parameter **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 **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

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

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

For more information, see section 10.21 *Advanced Features* on page 166.

0.40 {5.12}	**Autotune**			
RW	Bit			P
⇳	0 or 1	⇨	0	

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

0.40 is related to the advanced parameters as follows:

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

0.41 {5.18}	**PWM switching frequency**			
RW	Txt			P
⇳	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 **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 • *The values for model 5401 are stated for a balanced 400V supply having an 18kA short-circuit capability.* on page 173.

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 4.

6.2.14 Motor parameters

0.42 {5.11}	**Motor - number of poles**			
RW	Txt			P
OL ⇳	2 ~ 32 poles	⇨	4 (1)	
CL ⇳	VT> 2 ~ 32 poles SV> 2 ~ 32 poles	⇨	4 (1) 6 (2)	

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

0.43 {5.10}	**Motor - power factor**			
RW	Uni	S		P
OL ⇳	0 ~ 1.000	⇨	0.92	
CL ⇳	VT> 0 ~ 1.000 SV> 1	⇨	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 **0.43**. The value can be seen when **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 **0.43**.

0.44 {5.09}	**Motor - rated voltage**			
RW	Uni			
OL ⇳	0 ~ 480	⇨	400	
CL ⇳	VT> 0 ~ 480 SV> 0	⇨	460 0	

Open-loop / Closed-loop Vector

Enter the value from the rating plate of the motor.

0.45 {5.08}	**Motor - rated speed**			
RW	Uni			
OL ⇳	0 ~ 6,000rpm	⇨	0	
CL ⇳	VT> 0 ~ 30,000rpm SV> 0 ~ 30,000rpm	⇨	1,450 (EUR) 1,770 (USA) 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 **0.45** set at 0. This parameter is not used in this operating mode.

0.46 {5.07}	**Motor - rated current**			
RW	Uni			
⇳	0 ~ 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 ~ 1,000.0Hz	⇨	50 (EUR) 60 (USA)	
CL	VT> 0 ~ 1,000.0Hz SV> 0Hz	⇨	50 (EUR) 60 (USA) 0	

Open-loop
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:

Setting		Operating mode
	(0)	Open-loop
	(1)	Closed-loop Vector
	(2)	Closed-loop Servo
	(3)	For operation in this mode, refer to the *Unidrive Advanced User Guide*

See Chapter 8 *Optimisation* .

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

6.2.16 Status information

0.49	Security status			
RO	Uni			P
⇳	0 ~ 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 = Parameter 11.30 not equal to 149*

Thousands digit: 1 = Parameter 11.30 equal to zero*

* The value of Pr **11.30** is the last value written by the user. Parameter **11.30** always appears as 149 when first accessed by the key pad to hide the real value last written by the user. If **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 ~ 99.99	⇨		

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

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 parameter **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 77 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 Connections

7.1.1 Basic requirements

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

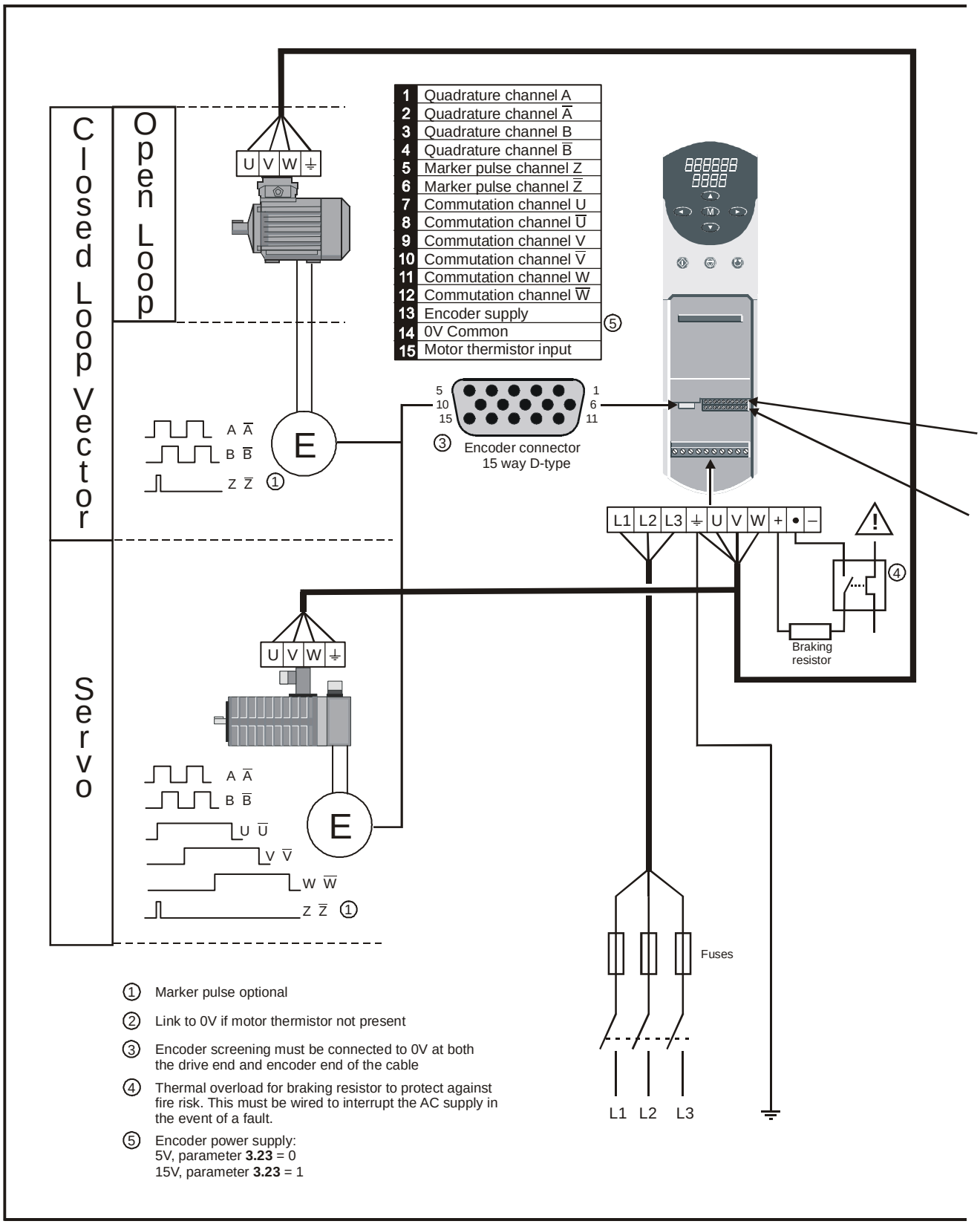
Operating mode	Requirements
Open loop mode	Induction motor
Closed loop vector mode	Induction motor with speed feedback
Servo	Permanent magnet motor with speed and position feedback

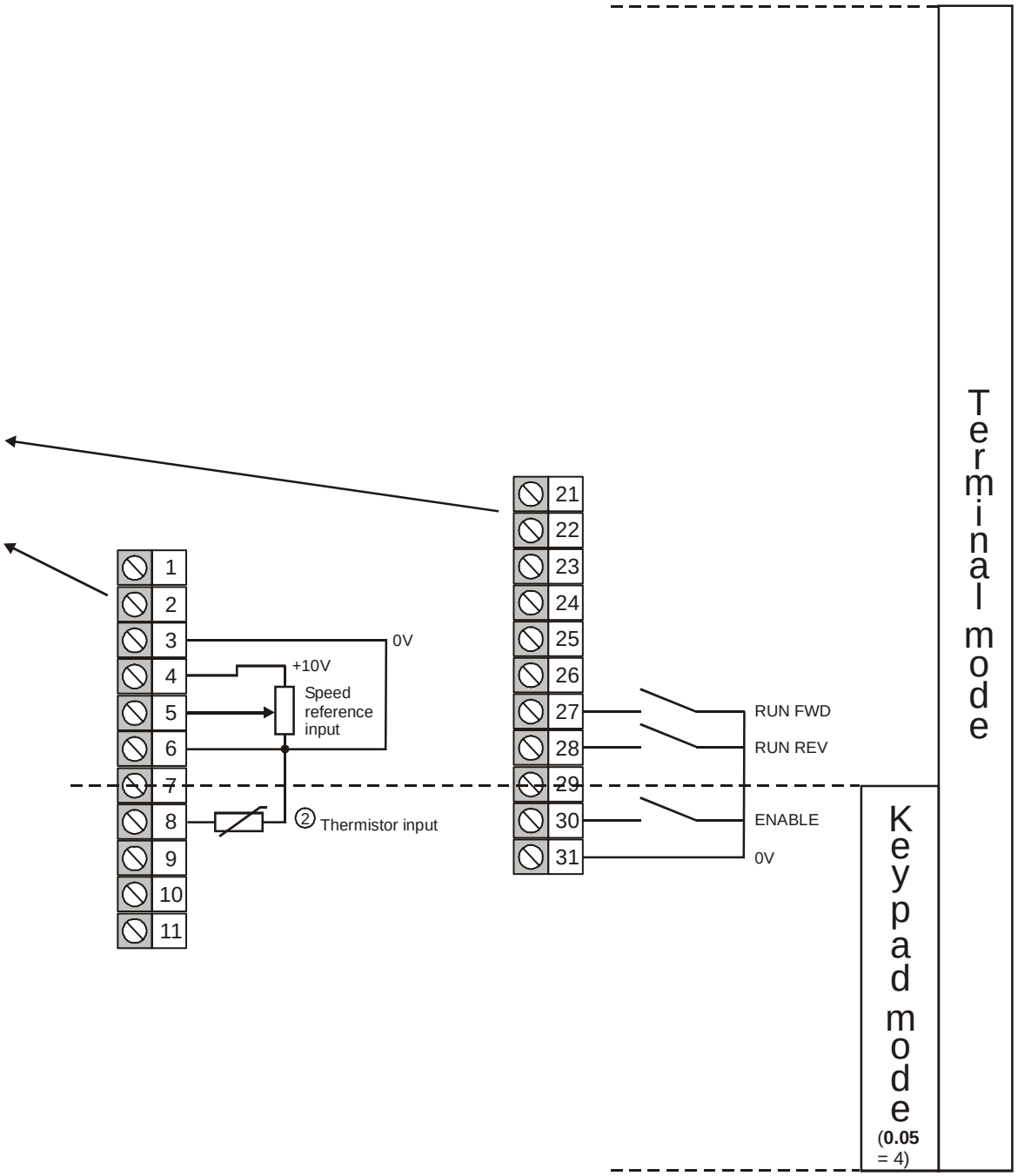
Speed feedback
Suitable devices are:
- Incremental encoder (A, B),
- Resolver with 0.33 or 0.5 transformation ratio
- SINCOS encoder

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 156 or the manual which is supplied with the option module.

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

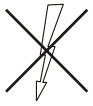
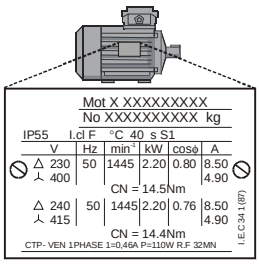
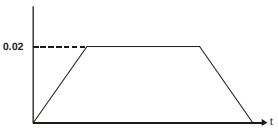
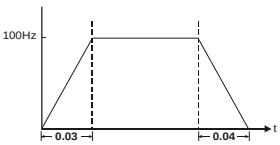
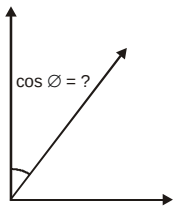
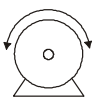



Terminal mode
Keypad mode
(0.05 = 4)
1
2
3
4
5
6
7
8
9
10
11
21
22
23
24
25
26
27
28
29
30
31
0V
+10V
Speed reference input
② Thermistor input
RUN FWD
RUN REV
ENABLE
0V

7.2 Quick Start commissioning

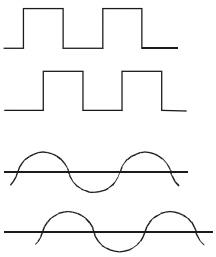
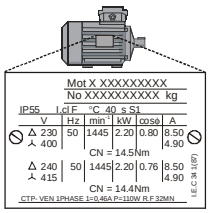
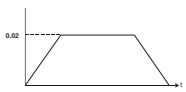
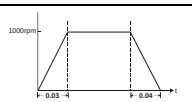
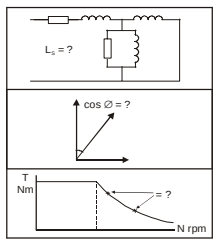
7.2.1 Open loop mode (including VTC variant)

Induction motor without feedback device

Action	Detail	
Before power-up	Ensure: • Enable is closed (terminal 30) • Motor thermistor is connected or terminal 8 is linked to 0V • Run signal is not given • Motor is connected **NOTE** The motor must be uncoupled from any gearbox or load before an autotune is carried out, as detailed below.	
Power-up the drive	Ensure: • Drive displays 'rdy' If the drive trips, see Chapter 12 *Diagnostics* on page 181.	
Enter motor nameplate details	Enter: • 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 ⅄ or △ connection • Number of poles in Pr **0.42** $P = \frac{f \times 120}{N_s}$ Where: **P** = Number of poles **f** = Rated frequency (Hz) N_s = Synchronous speed (rpm)	
Set maximum frequency	Enter: • Maximum frequency in Pr **0.02** (Hz)	
Set acceleration / deceleration rates	Enter: • Acceleration rate in Pr **0.03** (s/100Hz) • Deceleration rate in Pr **0.04** (s/100Hz)	
Autotune	**WARNING** 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. • Set Pr **0.40** = 1 and wait for the drive display to return to 'rdy' If the drive trips, see Chapter 12 *Diagnostics* on page 181. **NOTE** The motor must be uncoupled from any gearbox or load before an autotune is carried out.	
Save parameters	Enter 1000 in Pr **xx.00** Press the red reset button or toggle the reset digital input (ensure Pr **xx.00** returns to 0)	
Run	Drive is now ready to run	

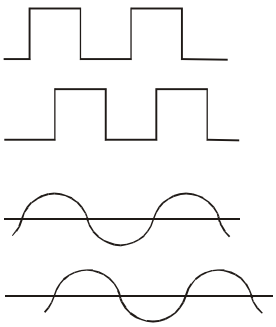
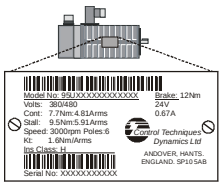
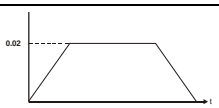
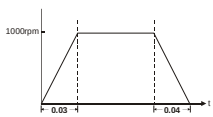
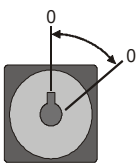
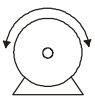
7.2.2 Closed loop vector mode

Induction motor with speed feedback

Action	Detail	
Before power-up	Ensure: • 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 **NOTE** The motor must be uncoupled from any gearbox or load before an autotune is carried out.	
Power-up the drive	• Change drive operating mode to closed loop vector Set Pr **xx.00** to 1253 / 1254 (USA). Change Pr **0.48** to 'CL.UECt' 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 *Diagnostics* on page 181.	
Set feedback device parameters	**Encoder** • 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** **Resolver** • 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 **SINCOS** • 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	Enter: • Motor rated power factor Pr **0.43** • Motor rated voltage in Pr **0.44** (V) - check if ⅄ or △ 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** $\mathbf{P} = \frac{\mathbf{f} \times \mathbf{120}}{\mathbf{N_s}}$ Where: **P** = Number of poles, **f** = Rated frequency (Hz), $\mathbf{N_s}$ = Synchronous speed (rpm)	
Set maximum speed	Enter: • Maximum speed in Pr **0.02** (rpm)	
Set acceleration / deceleration rates	Enter: • 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	• Close enable signal **WARNING** Once this parameter is set and the enable signal is given, 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. • Set Pr **0.40** = 1 and wait for the drive display to return to 'rdy' If the drive trips, see Chapter 12 *Diagnostics* on page 181. **NOTE** The motor must be uncoupled from any gearbox or load before an autotune is carried out.	
Save parameters	Enter 1000 in Pr **xx.00** Press the red reset button or toggle the reset digital input (ensure Pr **xx.00** returns to 0)	
Run	Drive is now ready to run	

7.2.3 Servo

Permanent magnet motor with speed and position feedback

Action	Detail	
Before power-up	Ensure: • 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) **NOTE** The motor must be uncoupled from any gearbox or load before an autotune is carried out.	
Power-up the drive	• 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 *Diagnostics* on page 181.	
Set feedback device parameters	**Encoder** • 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** **Resolver** • 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 **SINCOS** • 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	Enter: • Motor rated current in Pr **0.46** (A) • Number of poles in Pr **0.42**	
Set maximum speed	Enter: • Maximum speed in Pr **0.02** (rpm)	
Set acceleration / deceleration rates	Enter: • 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	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. **WARNING** • Set Pr **0.40** = 1, close the enable signal (terminal 30) and wait for the drive display to show 'StOP' If the drive trips, see Chapter 12 *Diagnostics* on page 181. **NOTE** The motor must be uncoupled from any gearbox or load before an autotune is carried out.	
Save parameters	Enter 1000 in Pr **xx.00** Press the red reset button or toggle the reset digital input (ensure Pr **xx.00** returns to 0)	
Run	Drive is now ready to run	

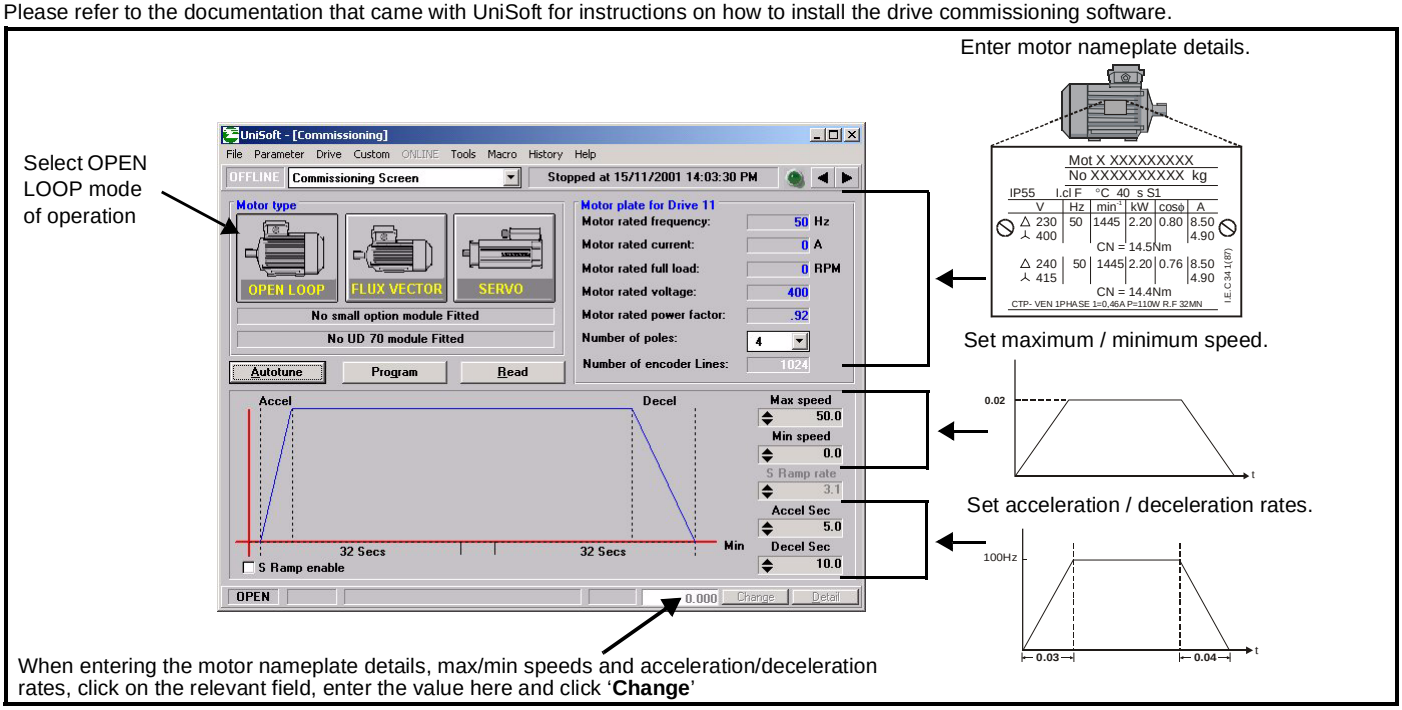
7.3 Quick start commissioning (P.C. UniSoft / VTCSoft)

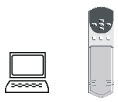
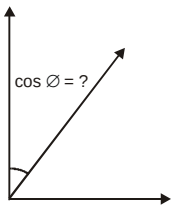
This section details how to get the motor running using Unisoft or VTCsoft pc commissioning software in each operating mode and with the various feedback devices.
Unisoft or VTCsoft is available free of charge and can be downloaded from www.controltechniques.com.

7.3.1 Open Loop

Induction motor without feedback device

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

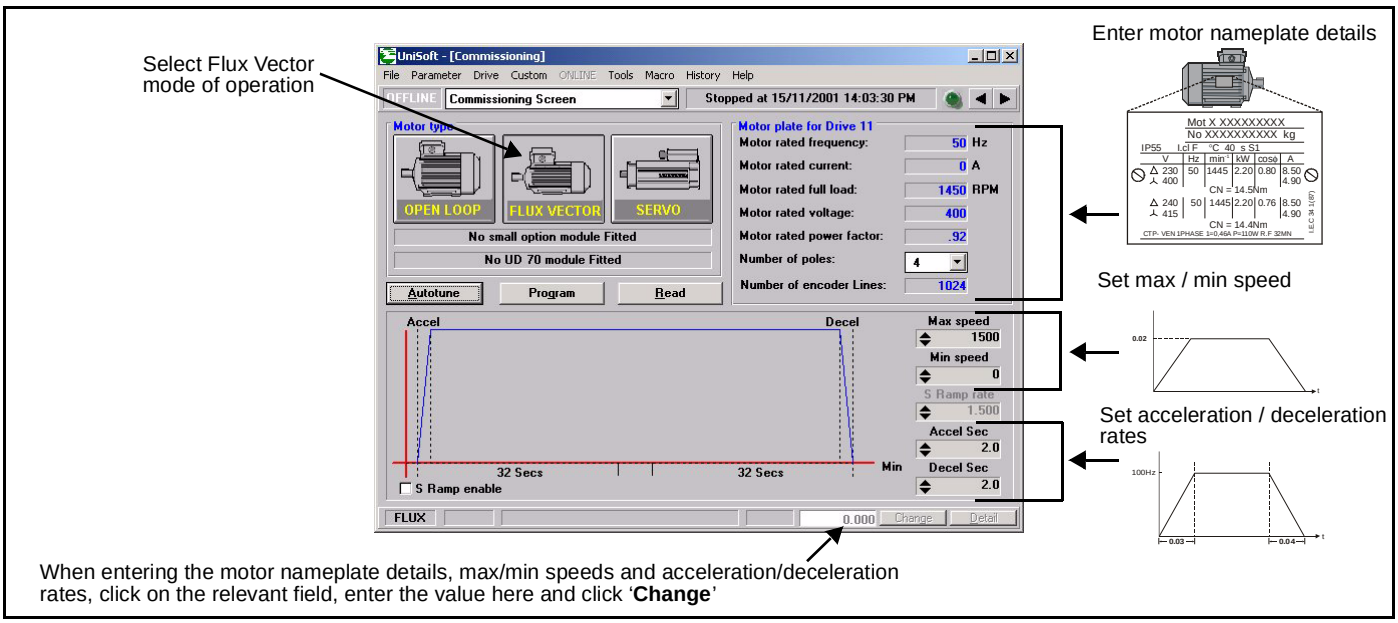


Action	Detail	
Before power-up	Ensure: • Enable is closed (terminal 30) • Motor thermistor is connected or terminal 8 is linked to 0V • Run signal is not given • Motor is connected • Feedback is connected and relevant small option module fitted (SINCOS or resolver feedback) • A UD71 serial communications module is fitted and is connected to the PC running UniSoft with the above screen displayed **NOTE** The motor must be uncoupled from any gearbox or load before an autotune is carried out.	
Power-up the drive	Ensure: • Drive displays 'inh' ('SEP.EC' if 8V SINCOS encoder feedback is being used). If the drive trips, refer to Chapter 12 *Diagnostics* on page 181.	
Program the drive	Click '**Program**' to upload the values to the drive.	
Autotune	**WARNING** Once this is selected, 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. • Click '**Autotune**' to enable the drive to perform the autotune If the drive trips, see Chapter 12 *Diagnostics* on page 181. **NOTE** The motor must be uncoupled from any gearbox or load before an autotune is carried out.	
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	

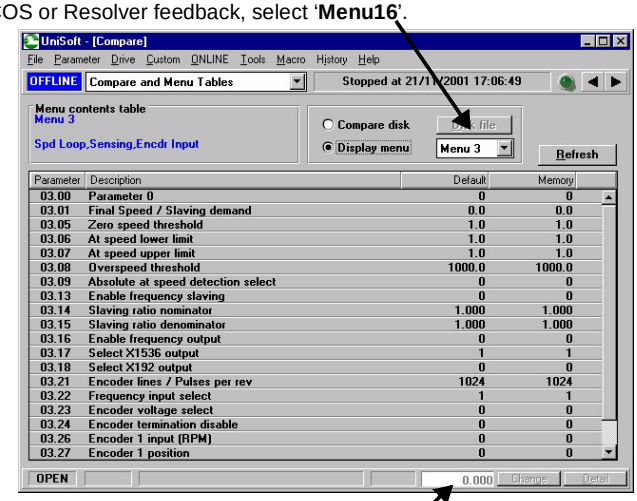
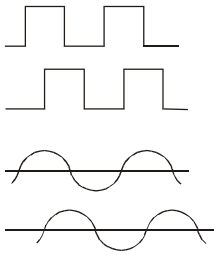
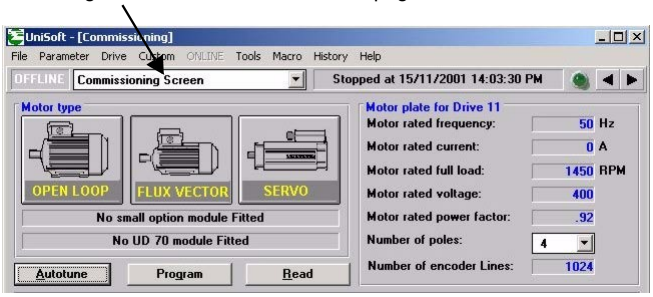
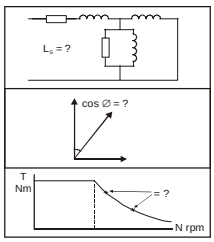
7.3.2 Closed Loop Vector

Induction motor with speed feedback

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



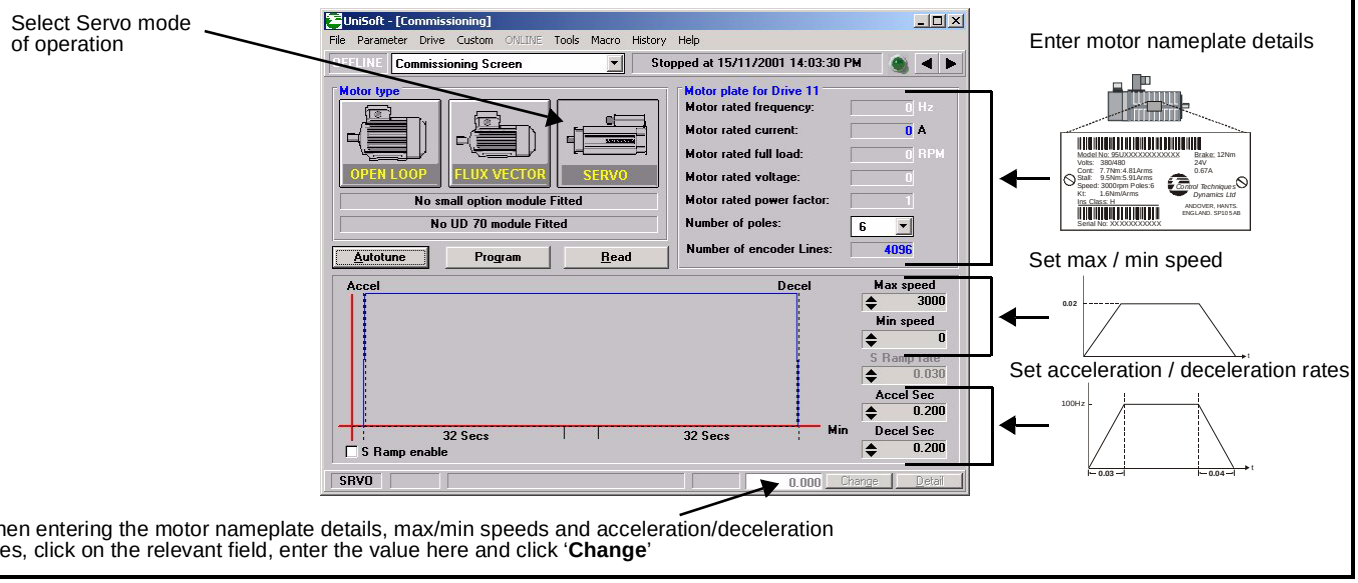
Action	Detail	
Before power-up	Ensure: • Enable is closed (terminal 30) • Motor thermistor is connected or terminal 8 is linked to 0V • Run signal is not given • Motor is connected • Feedback is connected and relevant small option module fitted (SINCOS or resolver feedback) • A UD71 serial communications module is fitted and is connected to the PC running UniSoft with the above screen displayed **NOTE** The motor must be uncoupled from any gearbox or load before an autotune is carried out.	
Power-up the drive	Ensure: • Drive displays 'inh' ('SEP.EC' if 8V SINCOS encoder feedback is being used). If the drive trips, refer to Chapter 12 *Diagnostics* on page 181.	
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.	

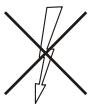
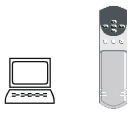
Action	Detail	
Set encoder parameters	• In the **Parameter** menu, select '**Display by menu**'. For incremental encoder feedback, select '**Menu 3**'. For SINCOS or Resolver feedback, select '**Menu16**'.  Select the parameter to change in the list above. Enter the required value in the field and click '**Change**'.	
	Encoder • 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**	
	Resolver • 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	
	SINCOS • 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	In the '**Drive**' menu select '**Program all parameters**' to upload the parameters to the drive.	
Autotune	Select 'Commissioning Screen' to return to the front page of UniSoft  **WARNING** Once this is selected, 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. • Close the enable signal (terminal 30) • Click '**Autotune**' to enable the drive to perform the autotune If the drive trips, see Chapter 12 *Diagnostics* on page 181. **NOTE** The motor must be uncoupled from any gearbox or load before an autotune is carried out.	
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	

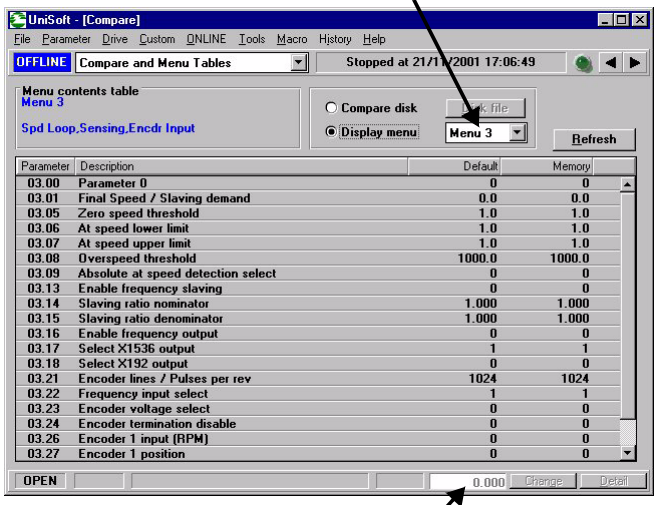
7.3.3 Servo

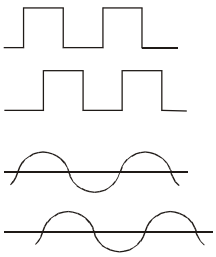
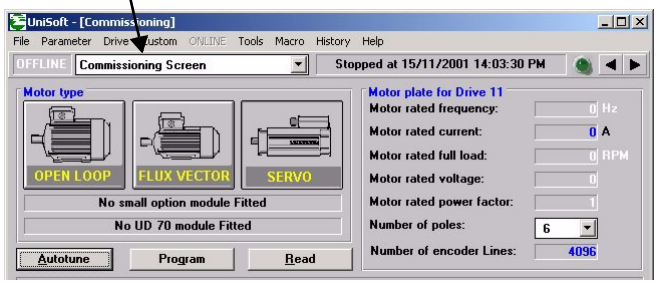
Permanent magnet motor with speed and position feedback

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



Action	Detail	
Before power-up	Ensure: • 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 **NOTE** The motor must be uncoupled from any gearbox or load before an autotune is carried out.	
Power-up the drive	Ensure: • Drive displays 'inh' ('SEP.EC' if 8V SINCOS encoder feedback is being used). If the drive trips, refer to Chapter 12 *Diagnostics* on page 181.	
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.	

<table>
<tr><th>Action</th><th colspan="2">Detail</th></tr>
<tr><td rowspan="4">Set encoder parameters</td><td colspan="2">• In the Parameter menu, select ‘Display by menu’.
For incremental encoder feedback, select ‘Menu 3’.
For SINCOS or Resolver feedback, select ‘Menu16’.
 

Select the parameter to change in the list above.
Enter the required value in the field and click ‘Change’.</td><td rowspan="4">  </td></tr>
<tr><td colspan="2">Encoder
• 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</td></tr>
<tr><td colspan="2">Resolver
• 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</td></tr>
<tr><td colspan="2">SINCOS
• 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</td></tr>
<tr><td>Programming the drive</td><td colspan="2">In the ‘Drive’ menu select ‘Program all parameters’ to upload the parameters to the drive.</td><td></td></tr>
<tr><td></td><td colspan="2">Select ‘Commissioning Screen’ to return to the front page of UniSoft
 

WARNING 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.
• Close the enable signal (terminal 30)
• Click ‘Autotune’ to enable the drive to perform the encoder phasing test
If the drive trips, see Chapter 12 Diagnostics on page 181.
NOTE
The motor must be uncoupled from any gearbox or load before an autotune is carried out.</td><td></td></tr>
<tr><td>Saving parameters</td><td colspan="2">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.</td><td></td></tr>
<tr><td>Run</td><td colspan="2">Drive is now ready to run</td><td>  </td></tr>
</table>

8 Optimisation

8.1 Motor map parameters

8.1.1 Open loop motor control

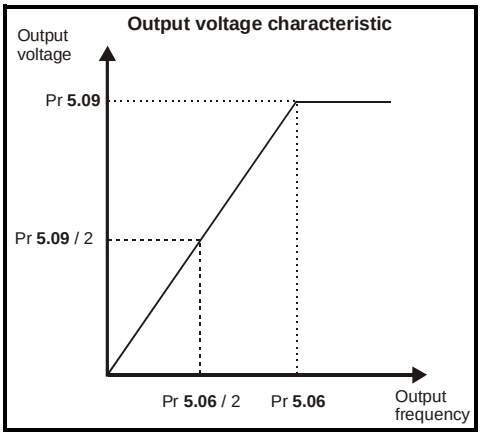
This section provides information on how to get the most from the Unidrive once an autotune and basic set up has been completed.

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.

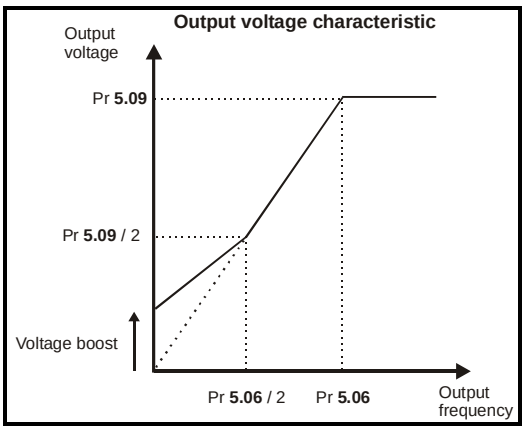
Information such as tuning the speed and current loop gains and also explanations of the effects of motor map parameters are included.

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:

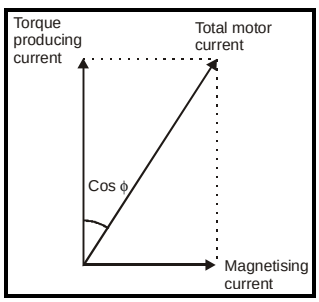


The volts / frequency ratio must be kept constant to ensure rated torque is available from the motor over the frequency range.
At low frequencies (from 0 Hz to ½ x Pr **5.06**) the voltage is increased from this characteristic by a level governed by either the voltage boost parameter or the motor parameters (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.

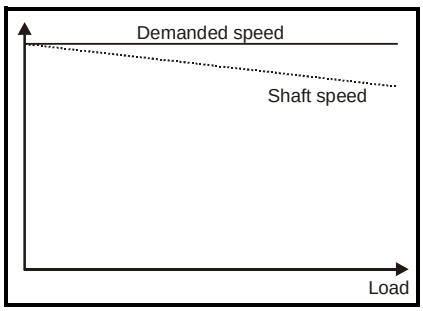
Pr 0.40 {5.12} Autotune

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**

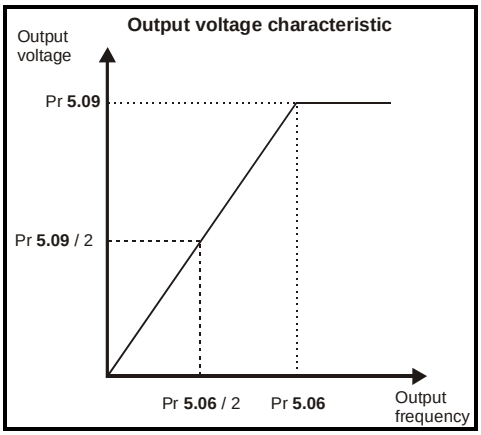
The motor rated current parameter must be set to the maximum continuous current of the motor to ensure the current limits in the drive function at the correct levels so that the motor is protected should an overload situation occur.

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.

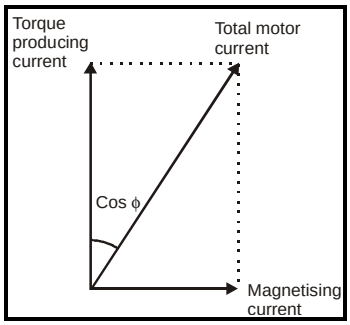
Pr 0.44 {5.09} Motor rated voltage	**Defines the voltage applied to the motor at rated frequency**
Pr 0.47 {5.06} Motor rated frequency	**Defines the frequency at which rated voltage is applied**

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.



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 to set the level at which the magnetising current is controlled.



Pr 0.45 {5.08} Motor rated speed	**Defines the motor rated speed**

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

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

The accuracy of this parameter is very important as it directly affects the torque produced at the shaft.

Often the value given on the motor nameplate is not 100% accurate which can lead to a loss of torque.

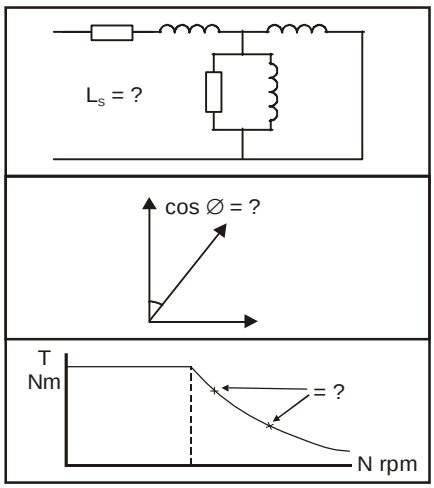
The parameter can be tuned by the drive using the slip optimiser - please see the description which follows.

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 $^{1}/_{8}$ x rated speed.
- At least $^{1}/_{8}$ 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 x Pr **5.24** x 10^{-3} x 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 x Pr **4.13** x $\dfrac{\mathbf{R}}{\mathbf{Pr\,5.24} \times \mathbf{10^{-3}}}$

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 x 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.

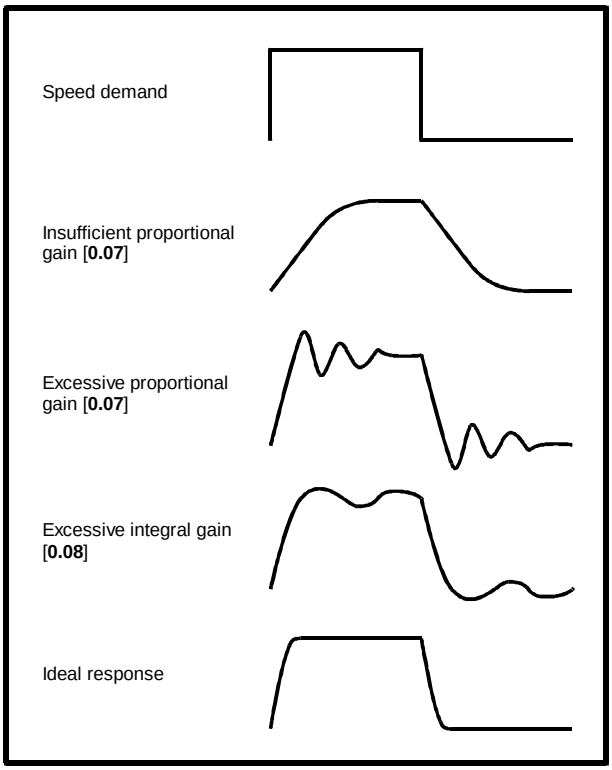
The proportional gain should be set up initially - the value should be increased up to the point where the speed overshoots and then reduced slightly.

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.



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**

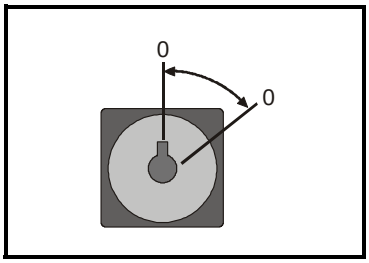
The motor number of poles parameter defines the number of electrical revolutions in one whole mechanical revolution of the motor.

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 x **L** x 10^{-3} x 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 x Pr **4.13** x $\frac{\mathbf{R}}{\mathbf{L} \times \mathbf{10^{-3}}}$

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.

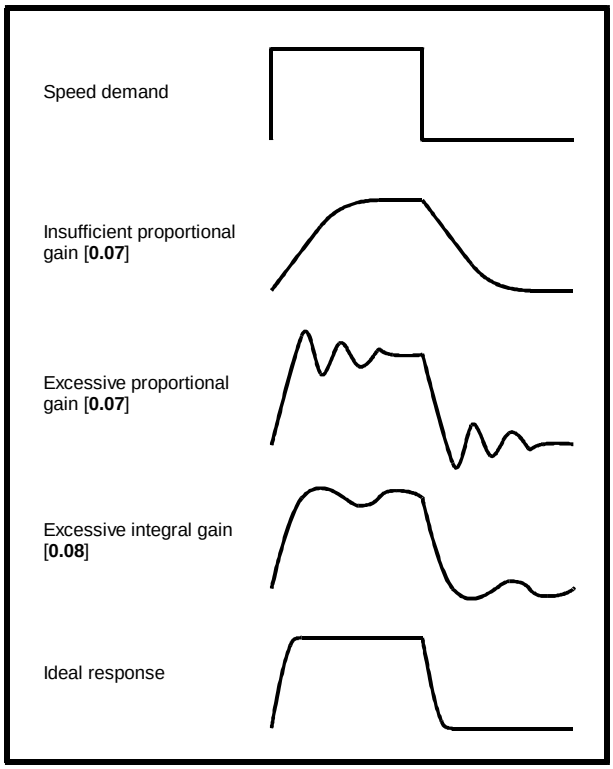
The proportional gain should be set up initially - the value should be increased up to the point where the speed overshoots and then reduced slightly.

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.



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.

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.

* 150% for Unidrive Size 5

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 173.
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

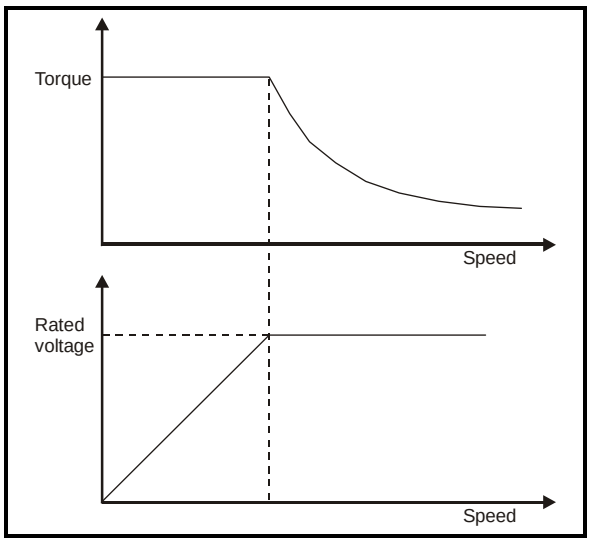
In the closed loop modes when using encoder feedback the maximum speed of the drive is limited by the maximum frequency limit of the encoder input as follows :

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 x 2,000 x 40,000 / 60,000 = 667Hz

Menu 2:

the ramp times (Pr **2.11** to **2.29**) need to be set at:

0.5 x 0.2 sec per 100Hz = 0.1

Menu 3:

the over-speed trip threshold (Pr **3.08**) should be set at

0.5 x 2,000 x 50,000 / 60,000 = 833Hz

Menu 5:

the rated motor voltage (Pr **5.09**) 400V

the rated frequency (Pr **5.06**)0.5 * 2,000 = 1,000Hz

the full load speed is (Pr **5.08**) 0.5 * 58,000 = 29,000rpm

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.

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 *selector*
0.06	Current limit
0.07	OL> Voltage mode *selector*
	CL> Speed-loop proportional gain
0.08	OL> Boost voltage
	CL> Speed-loop integral gain
0.09	OL> Dynamic V/f *select*
	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 *select*
0.39	Synchronise to a spinning motor
0.40	Autotune
0.41	PWM switching frequency *selector*
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 *selector*
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

* Only available in closed loop vector or servo operating modes.

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)

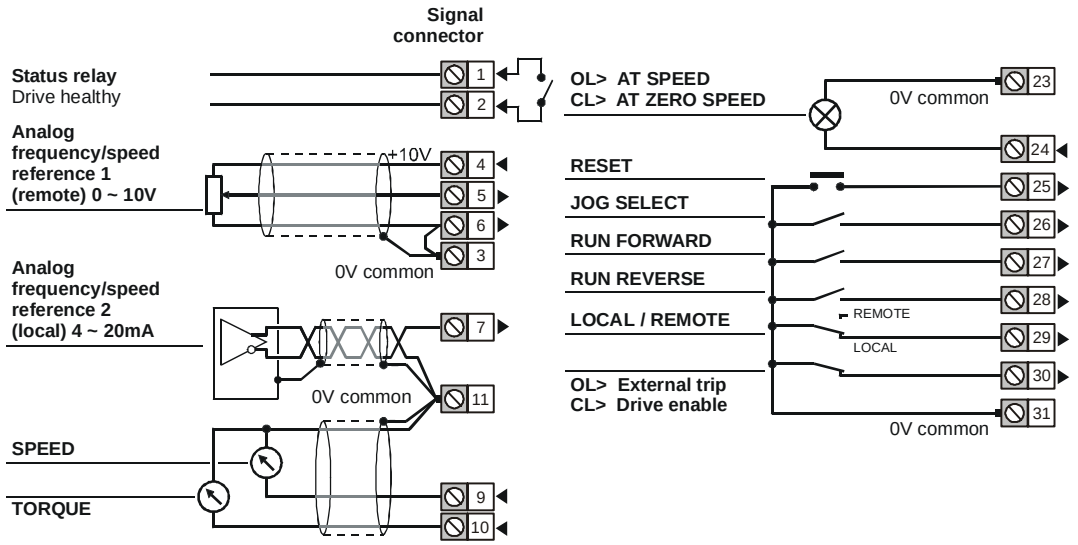
Perform a parameter save.

When changing between macros ensure that the drive is defaulted before the new macro is loaded.

9.3 Macro terminal connection changes

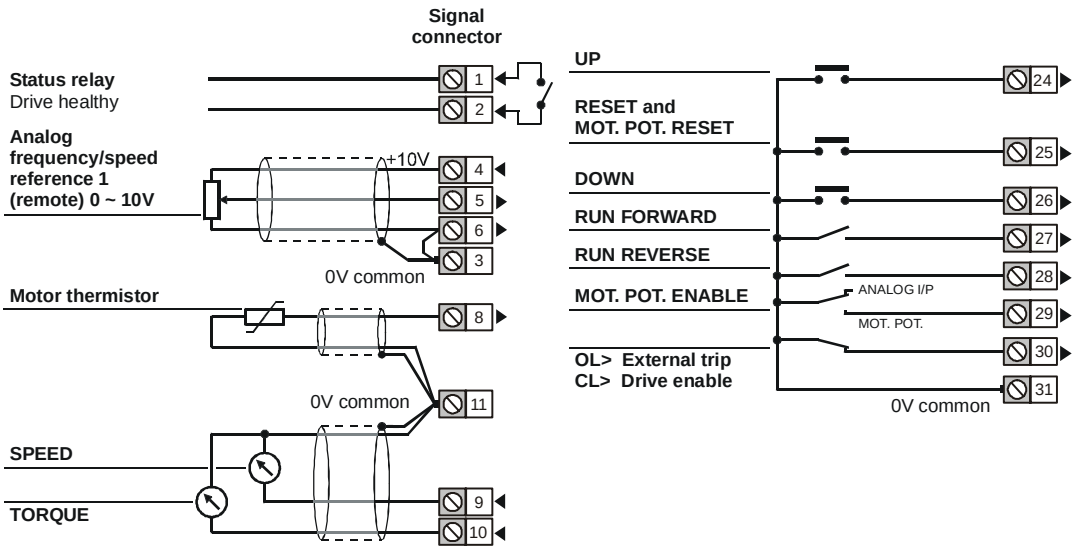
Macro 1	Easy mode	2001

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.



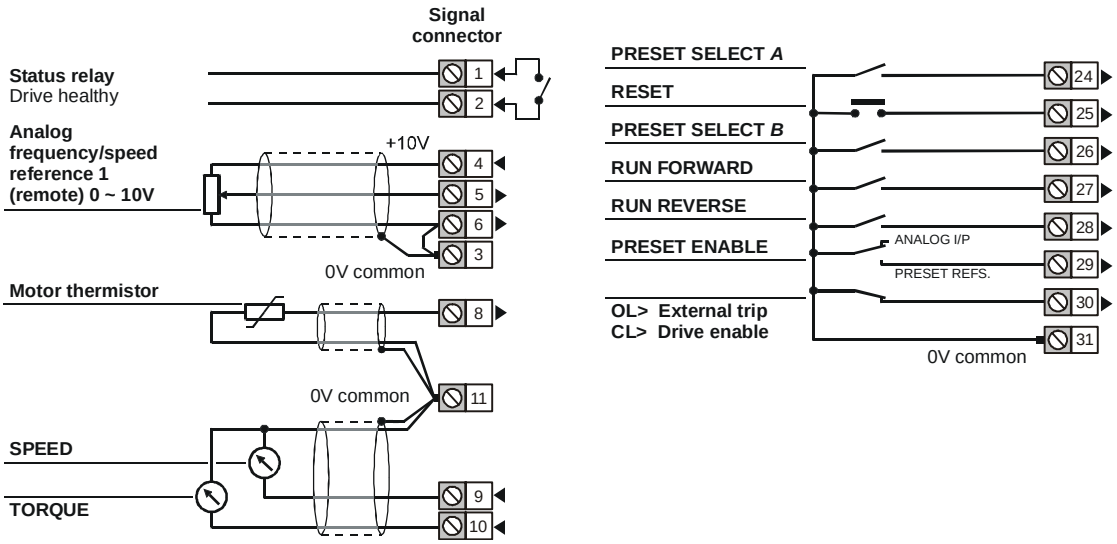
Macro 2	Motorised potentiometer	2002

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.



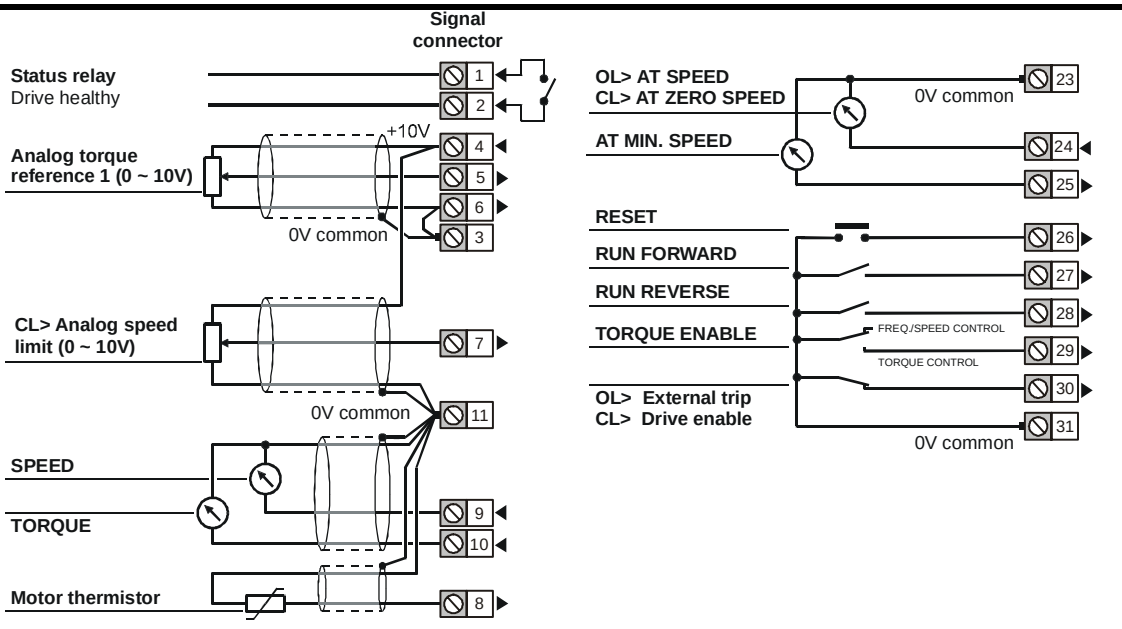
Macro 3	Preset frequencies / speeds	2003

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.



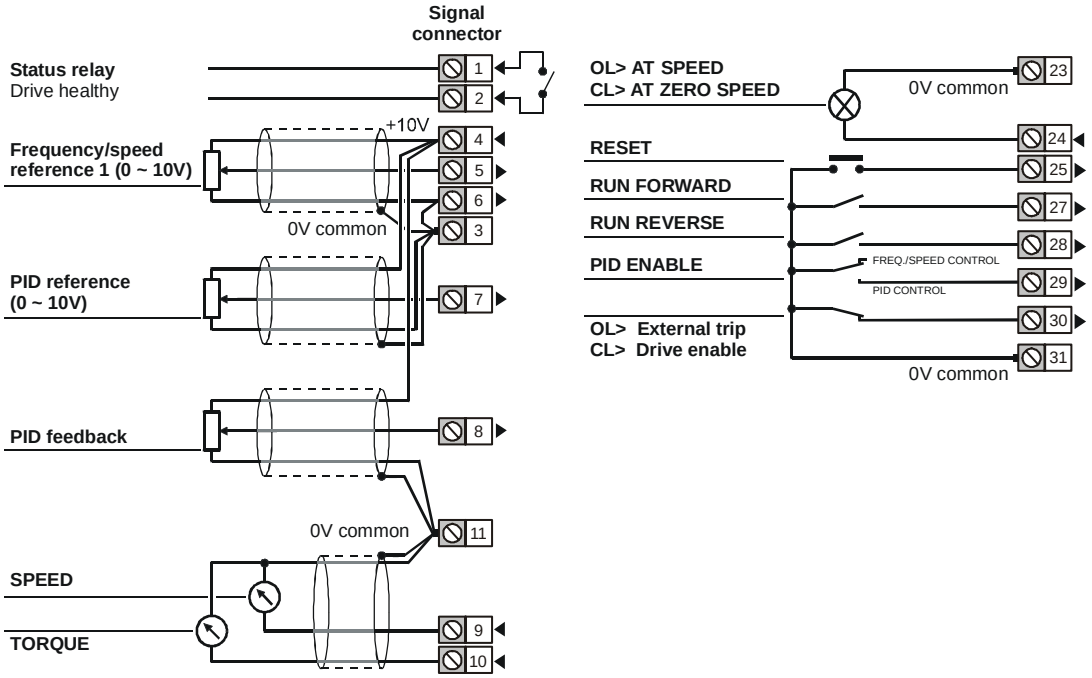
Macro 4	Torque control	2004

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.



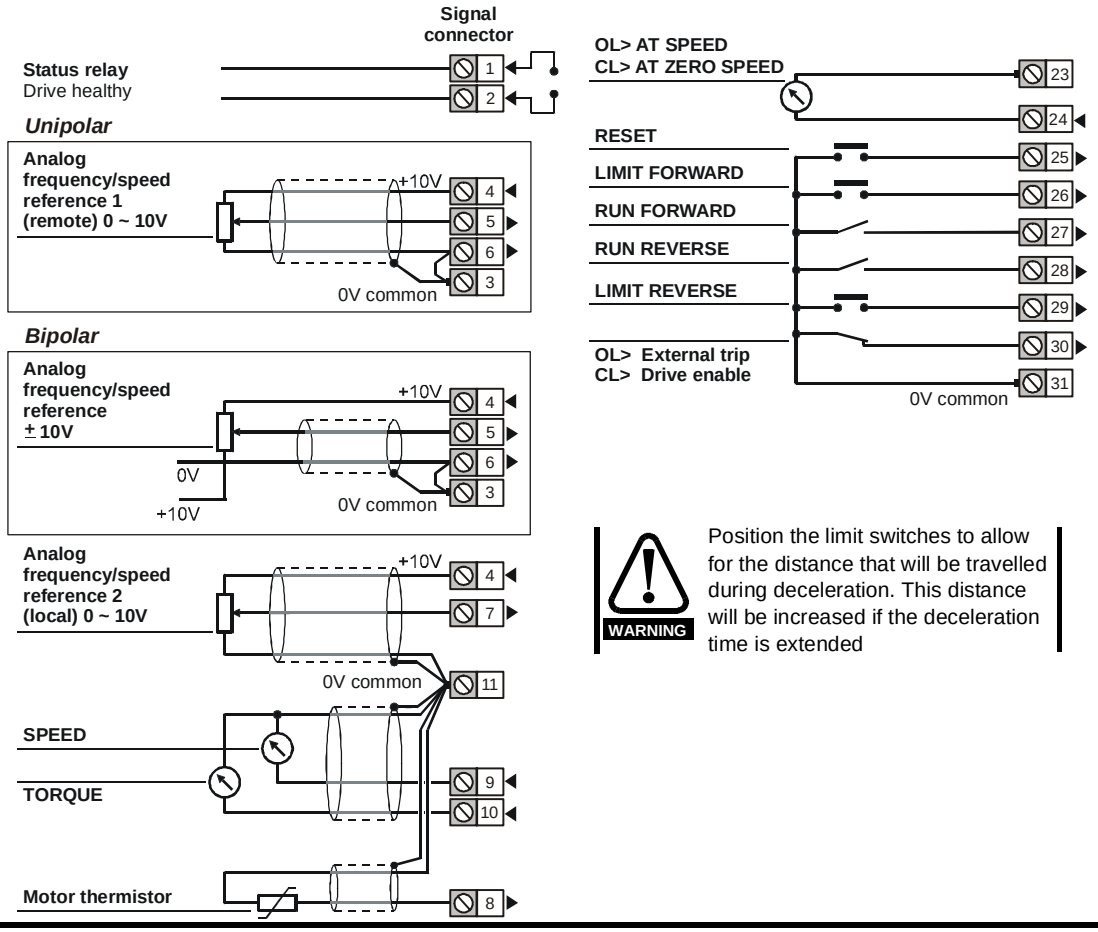
Macro 5	PID (set-point control)	2005

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.

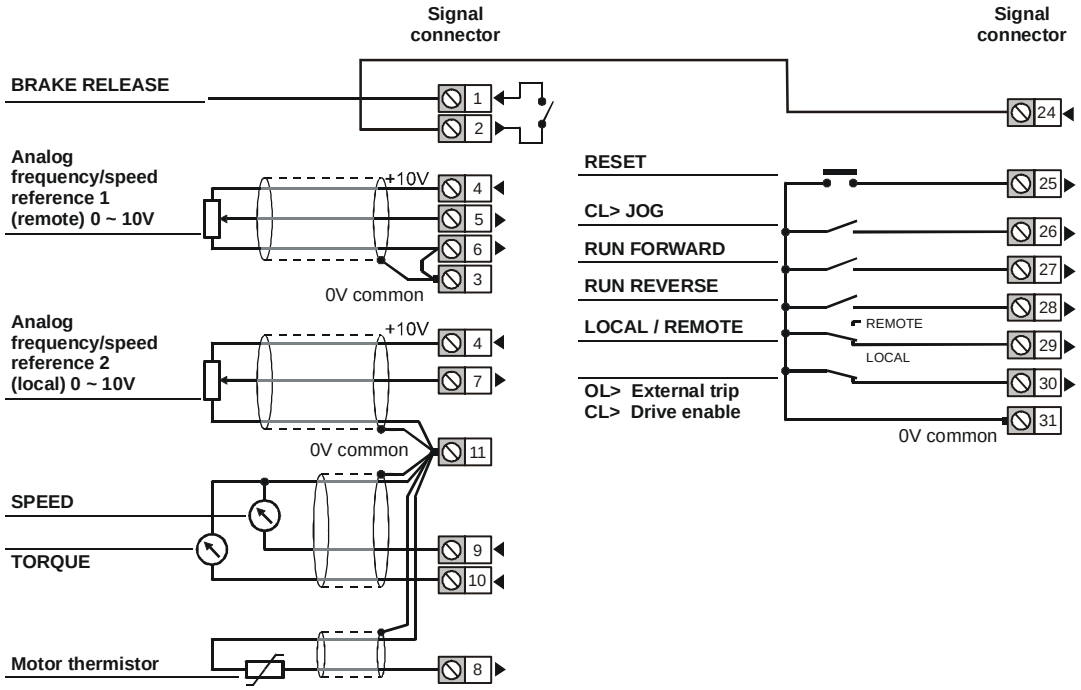


WARNING

Position the limit switches to allow for the distance that will be travelled during deceleration. This distance will be increased if the deceleration time is extended

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**}

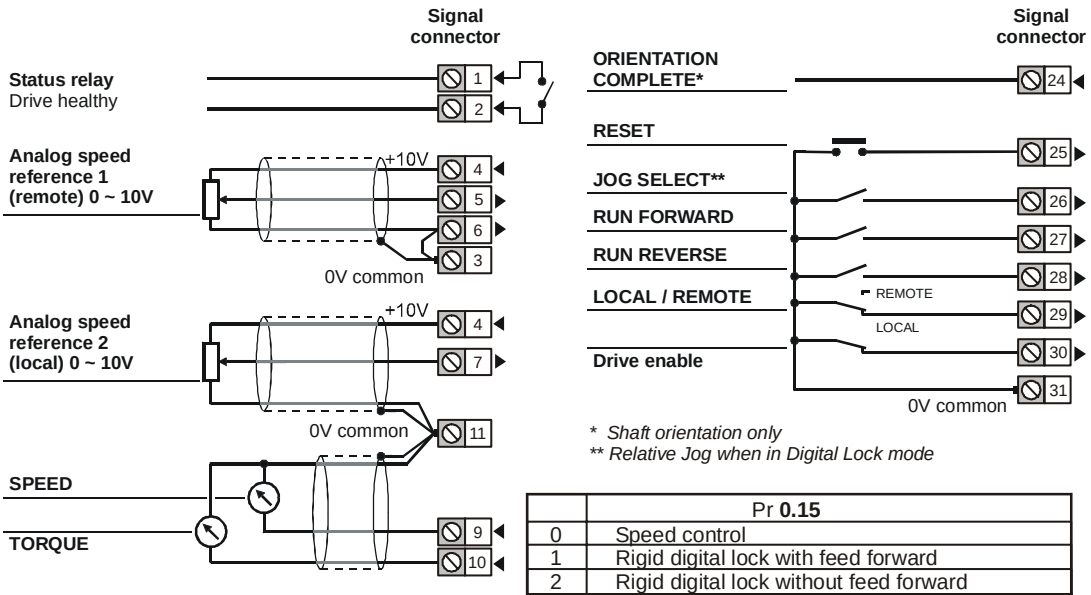
Digital lock

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.

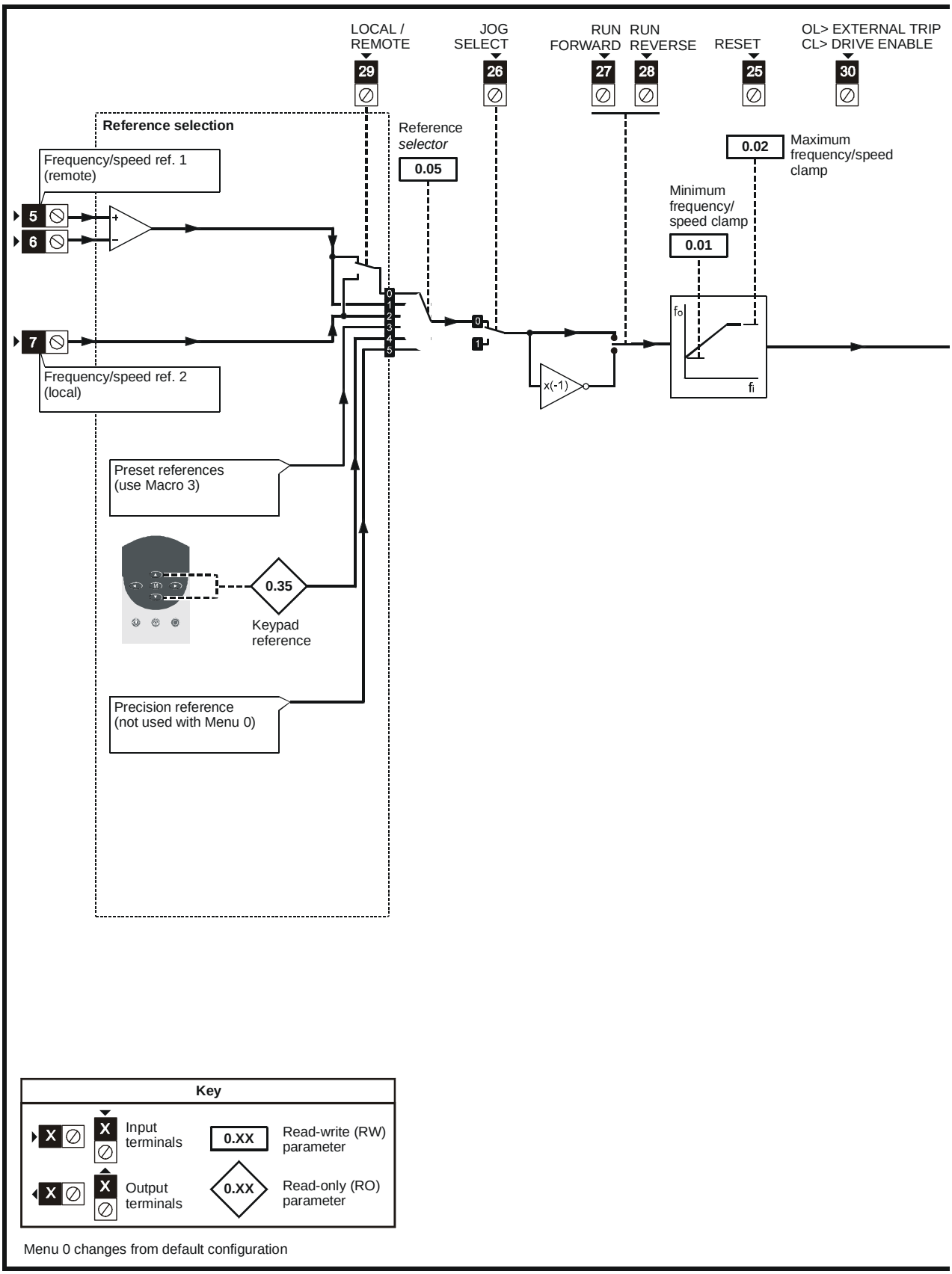


* *Shaft orientation only*
** *Relative Jog when in Digital Lock mode*

	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



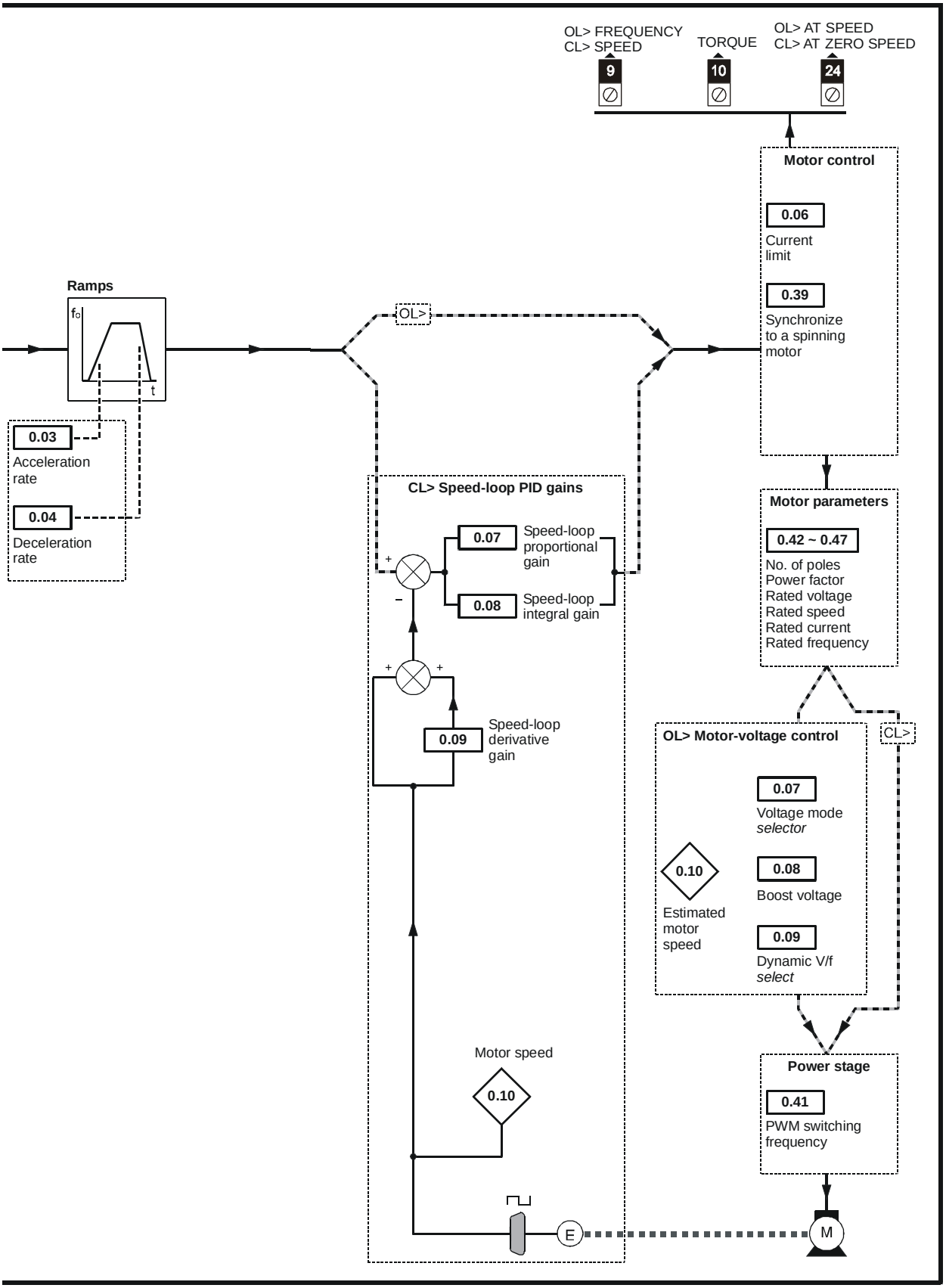
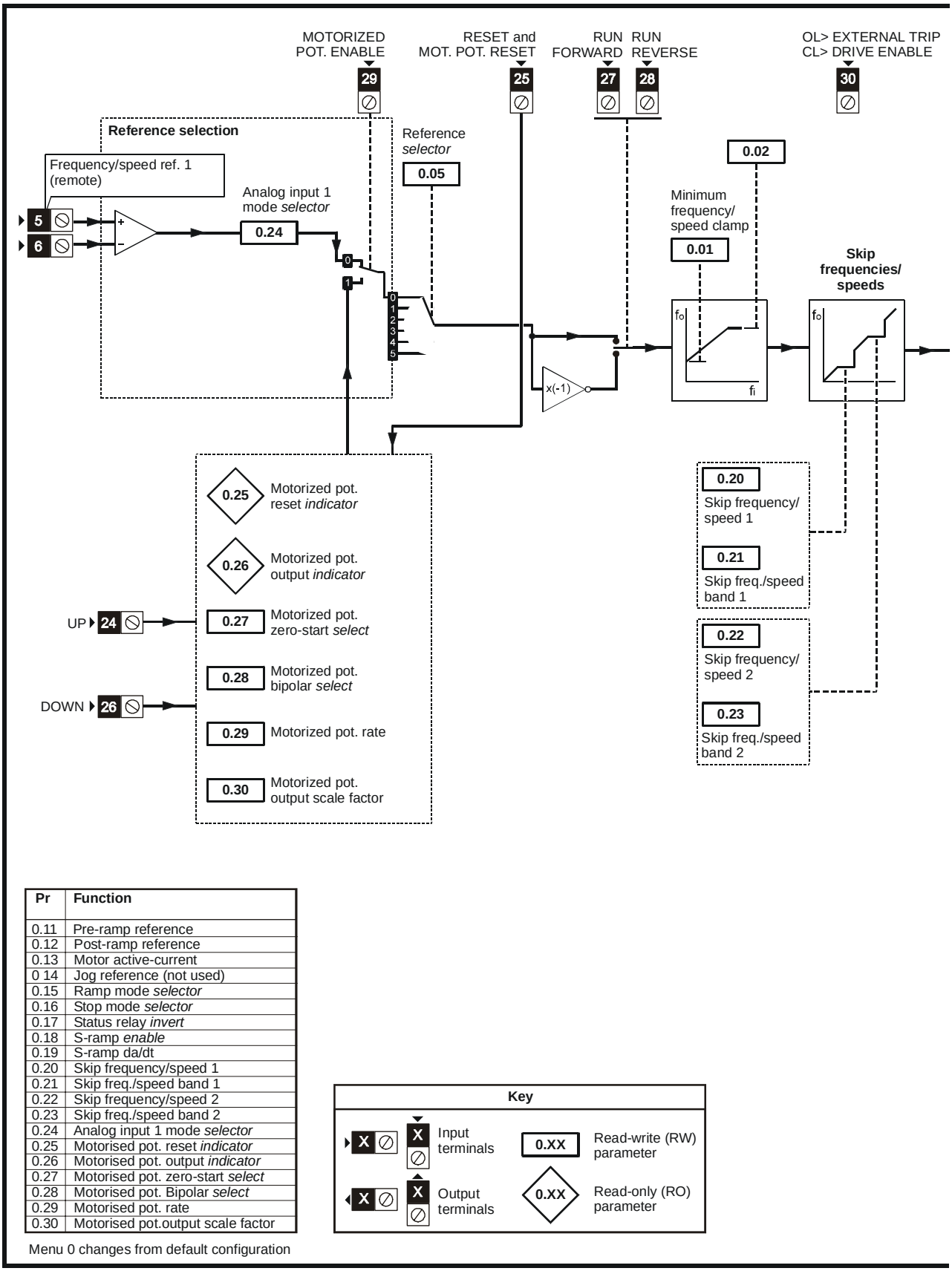

OL> FREQUENCY
CL> SPEED
TORQUE
OL> AT SPEED
CL> AT ZERO SPEED
9
10
24
Motor control
0.06
Current limit
0.39
Synchronize to a spinning motor
Ramps
fo
t
OL>
0.03
Acceleration rate
0.04
Deceleration rate
CL> Speed-loop PID gains
0.07
Speed-loop proportional gain
0.08
Speed-loop integral gain
0.09
Speed-loop derivative gain
Motor speed
0.10
Motor parameters
0.42 ~ 0.47
No. of poles
Power factor
Rated voltage
Rated speed
Rated current
Rated frequency
OL> Motor-voltage control
CL>
0.07
Voltage mode selector
0.10
Estimated motor speed
0.08
Boost voltage
0.09
Dynamic V/f select
Power stage
0.41
PWM switching frequency
E
M

Figure 9-2 Macro 2 Motorised potentiometer logic diagram



Pr	Function
0.11	Pre-ramp reference
0.12	Post-ramp reference
0.13	Motor active-current
0 14	Jog reference (not used)
0.15	Ramp mode *selector*
0.16	Stop mode *selector*
0.17	Status relay *invert*
0.18	S-ramp *enable*
0.19	S-ramp da/dt
0.20	Skip frequency/speed 1
0.21	Skip freq./speed band 1
0.22	Skip frequency/speed 2
0.23	Skip freq./speed band 2
0.24	Analog input 1 mode *selector*
0.25	Motorised pot. reset *indicator*
0.26	Motorised pot. output *indicator*
0.27	Motorised pot. zero-start *select*
0.28	Motorised pot. Bipolar *select*
0.29	Motorised pot. rate
0.30	Motorised pot.output scale factor

Menu 0 changes from default configuration

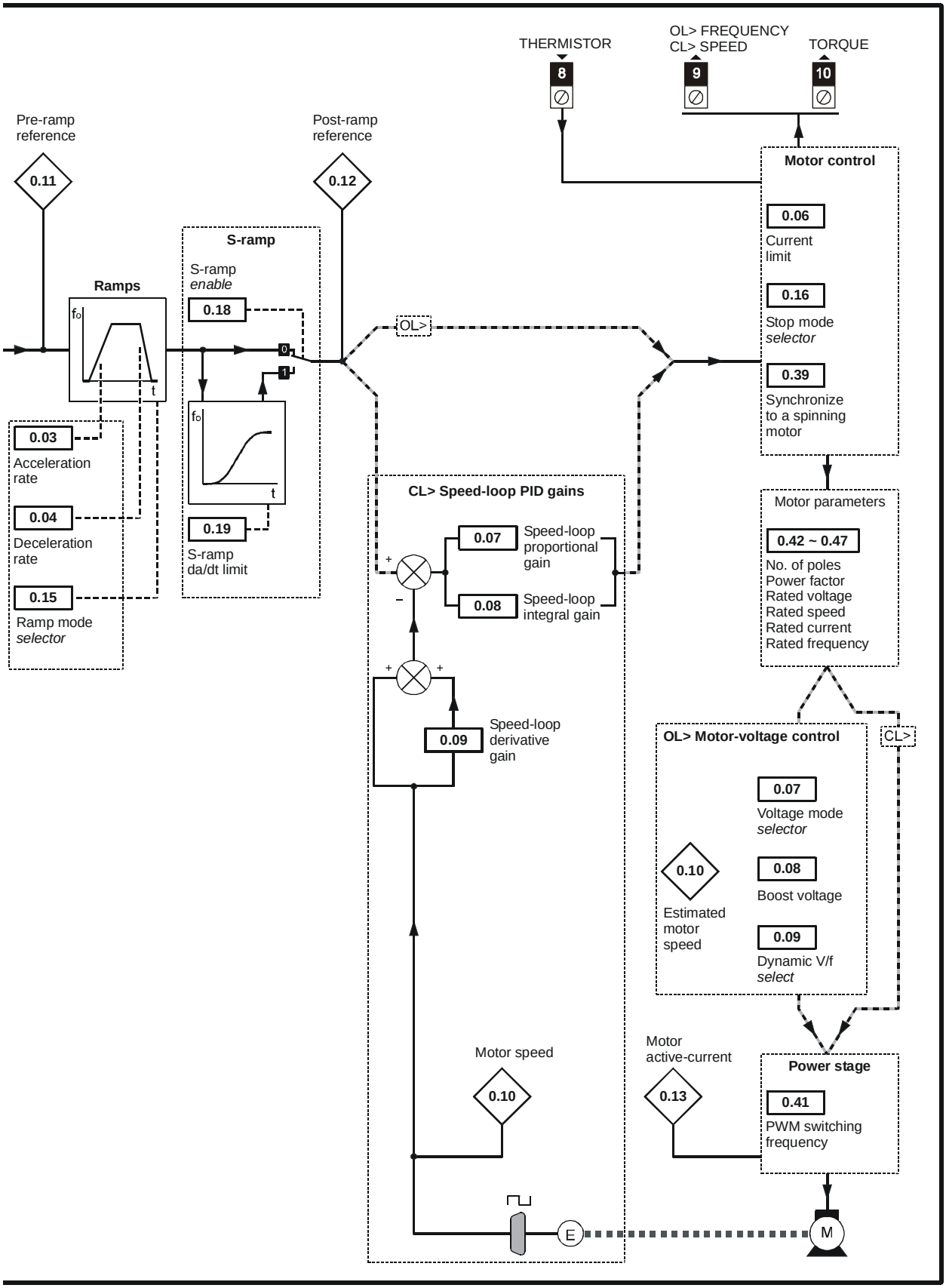
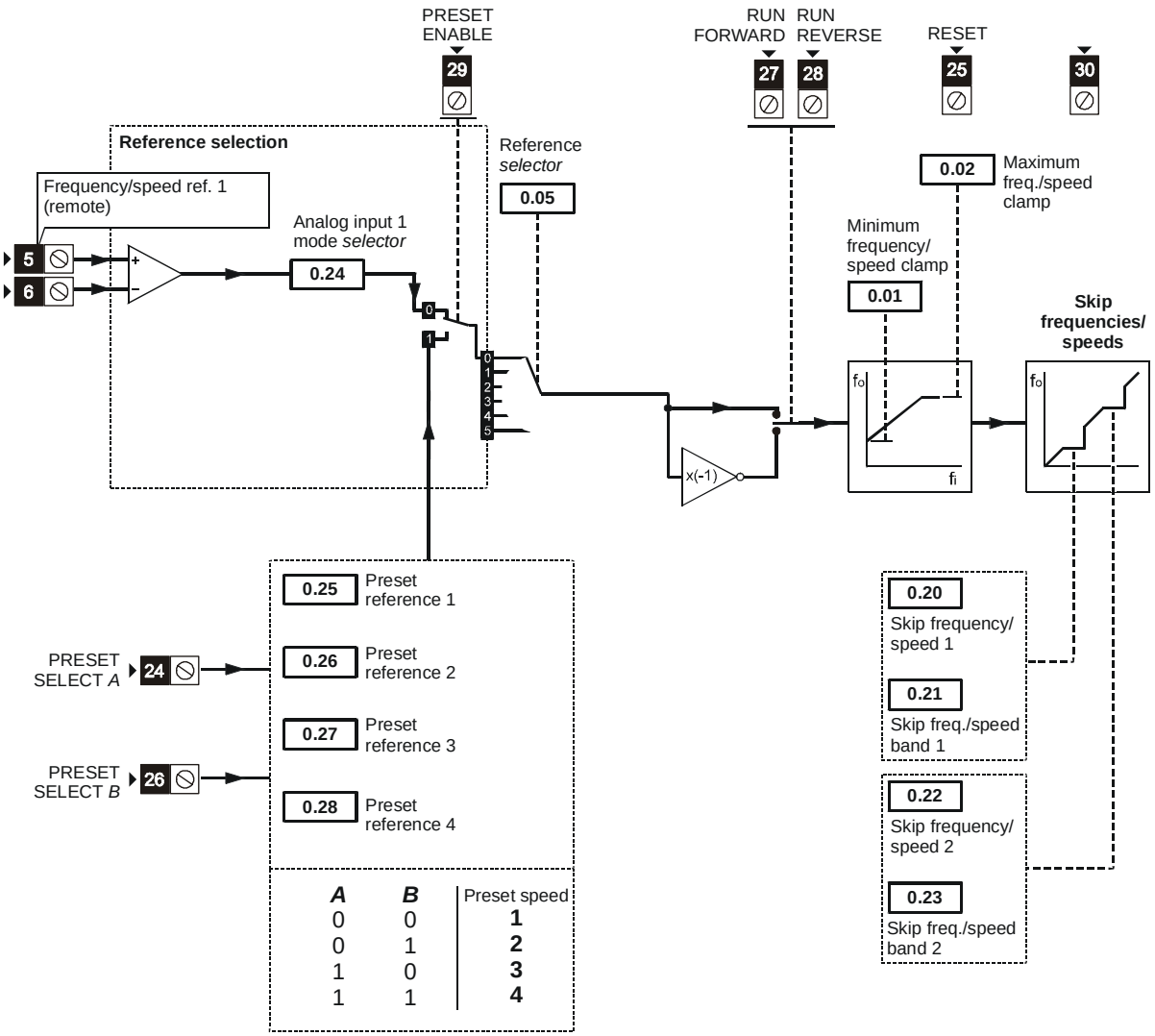
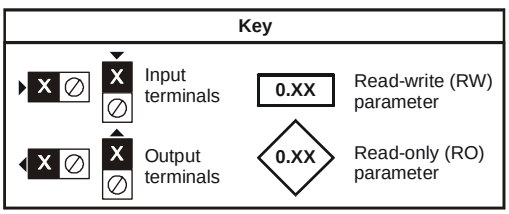

THERMISTOR
8
OL> FREQUENCY
CL> SPEED
9
TORQUE
10
Pre-ramp reference
0.11
Post-ramp reference
0.12
Motor control
0.06
Current limit
0.16
Stop mode selector
0.39
Synchronize to a spinning motor
S-ramp
S-ramp enable
0.18
Ramps
fo
t
OL>
0.03
Acceleration rate
0.04
Deceleration rate
0.15
Ramp mode selector
0.19
S-ramp da/dt limit
CL> Speed-loop PID gains
0.07
Speed-loop proportional gain
0.08
Speed-loop integral gain
0.09
Speed-loop derivative gain
Motor parameters
0.42 ~ 0.47
No. of poles
Power factor
Rated voltage
Rated speed
Rated current
Rated frequency
OL> Motor-voltage control
CL>
0.07
Voltage mode selector
0.10
Estimated motor speed
0.08
Boost voltage
0.09
Dynamic V/f select
Motor speed
0.10
Motor active-current
0.13
Power stage
0.41
PWM switching frequency
E
M

Figure 9-3 Macro 3 Preset speeds logic diagram



Pr	Function
0.11	Pre-ramp reference
0.12	Post-ramp reference
0.13	Motor active-current
0 14	Jog reference (not used)
0.15	Ramp mode *selector*
0.16	Stop mode *selector*
0.17	Status relay *invert*
0.18	S-ramp *enable*
0.19	S-ramp da/dt
0.20	Skip frequency/speed 1
0.21	Skip freq./speed band 1
0.22	Skip frequency/speed 2
0.23	Skip freq./speed band 2
0.24	Analog input 1 mode *selector*
0.25	Preset reference 1
0.26	Preset reference 2
0.27	Preset reference 3
0.28	Preset reference 4
0.29	(Not used)
0.30	(Not used)

Menu 0 changes from default configuration



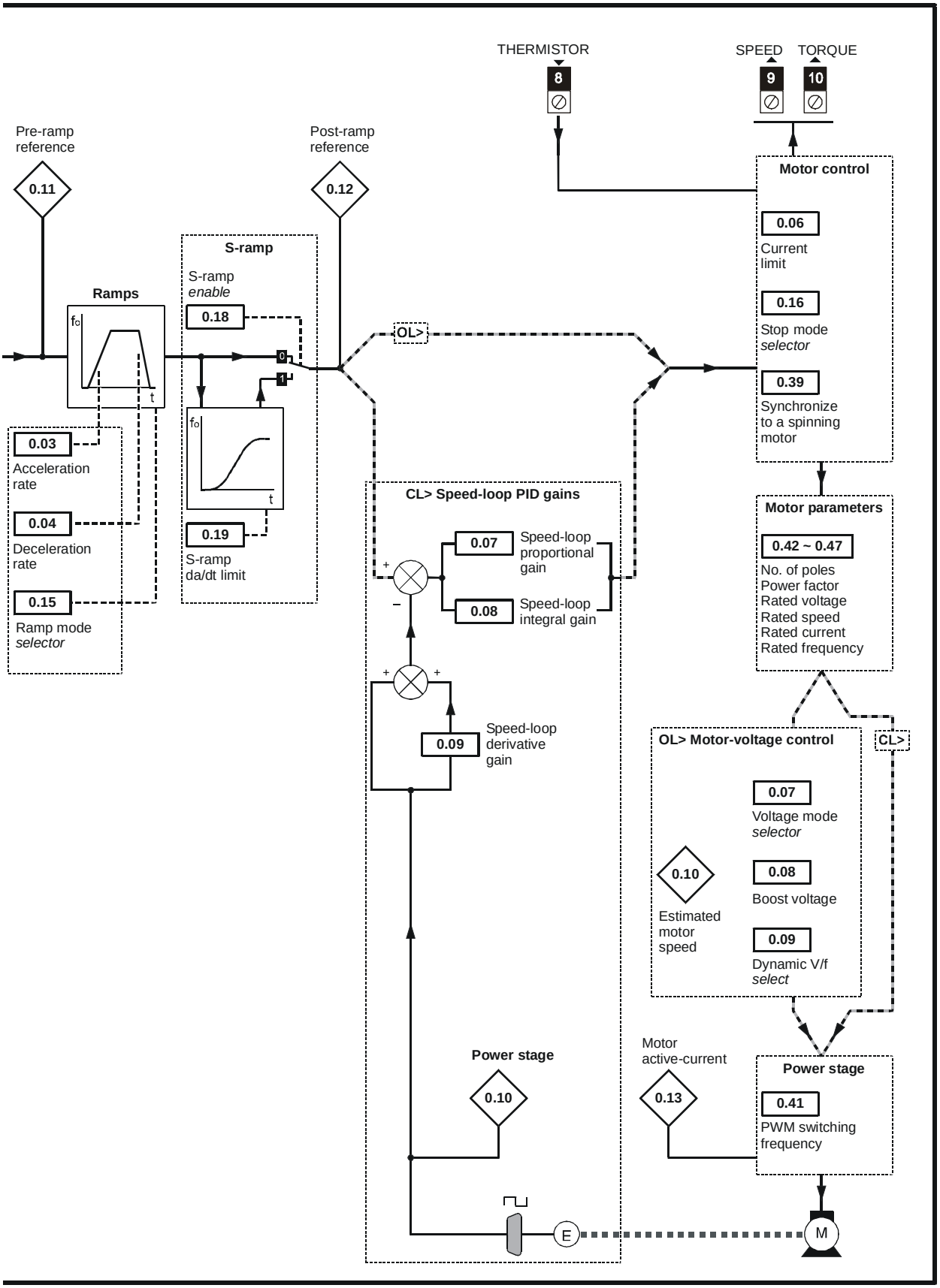
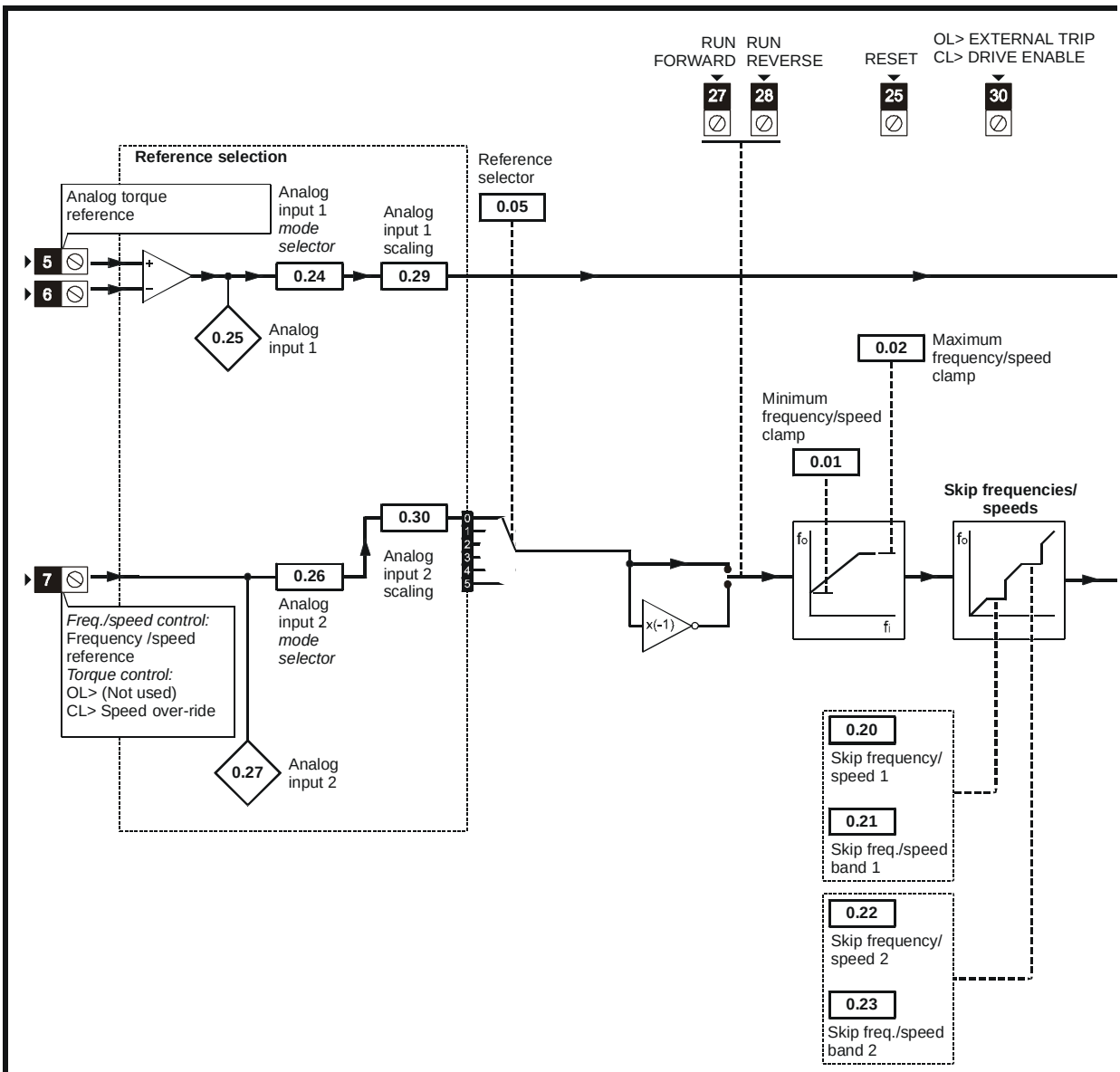
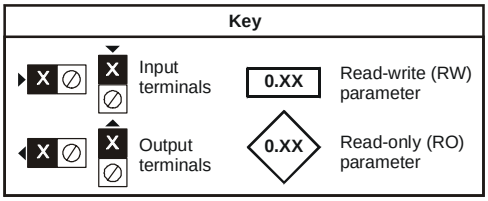

THERMISTOR
8
SPEED
9
TORQUE
10
Pre-ramp reference
0.11
Post-ramp reference
0.12
Motor control
0.06
Current limit
0.16
Stop mode selector
0.39
Synchronize to a spinning motor
S-ramp
S-ramp enable
0.18
Ramps
fo
t
OL>
0.03
Acceleration rate
0.04
Deceleration rate
0.15
Ramp mode selector
0.19
S-ramp da/dt limit
CL> Speed-loop PID gains
0.07
Speed-loop proportional gain
0.08
Speed-loop integral gain
0.09
Speed-loop derivative gain
Motor parameters
0.42 ~ 0.47
No. of poles
Power factor
Rated voltage
Rated speed
Rated current
Rated frequency
OL> Motor-voltage control
CL>
0.07
Voltage mode selector
0.10
Estimated motor speed
0.08
Boost voltage
0.09
Dynamic V/f select
Power stage
0.10
Motor active-current
0.13
Power stage
0.41
PWM switching frequency
E
M

Figure 9-4 Macro 4 Torque control logic diagram



Pr	Function
0.11	Pre-ramp reference
0.12	Post-ramp reference
0.13	Motor active-current
0 14	Jog reference (not used)
0.15	Braking mode *selector*
0.16	Stop mode *selector*
0.17	Status relay *invert*
0.18	S-ramp *enable*
0.19	S-ramp da/dt
0.20	Skip frequency/speed 1
0.21	Skip freq./speed band 1
0.22	Skip frequency/speed 2
0.23	Skip freq./speed band 2
0.24	Analog input 1 mode *selector*
0.25	Analog input 1(torque reference)
0.26	Analog input 2 mode *selector*
0.27	Analog input 2 (maximum speed override level)
0.28	Over-speed threshold
0.29	Analog input 1 scaling
0.30	Analog input 2 scaling



Menu 0 changes from default configuration

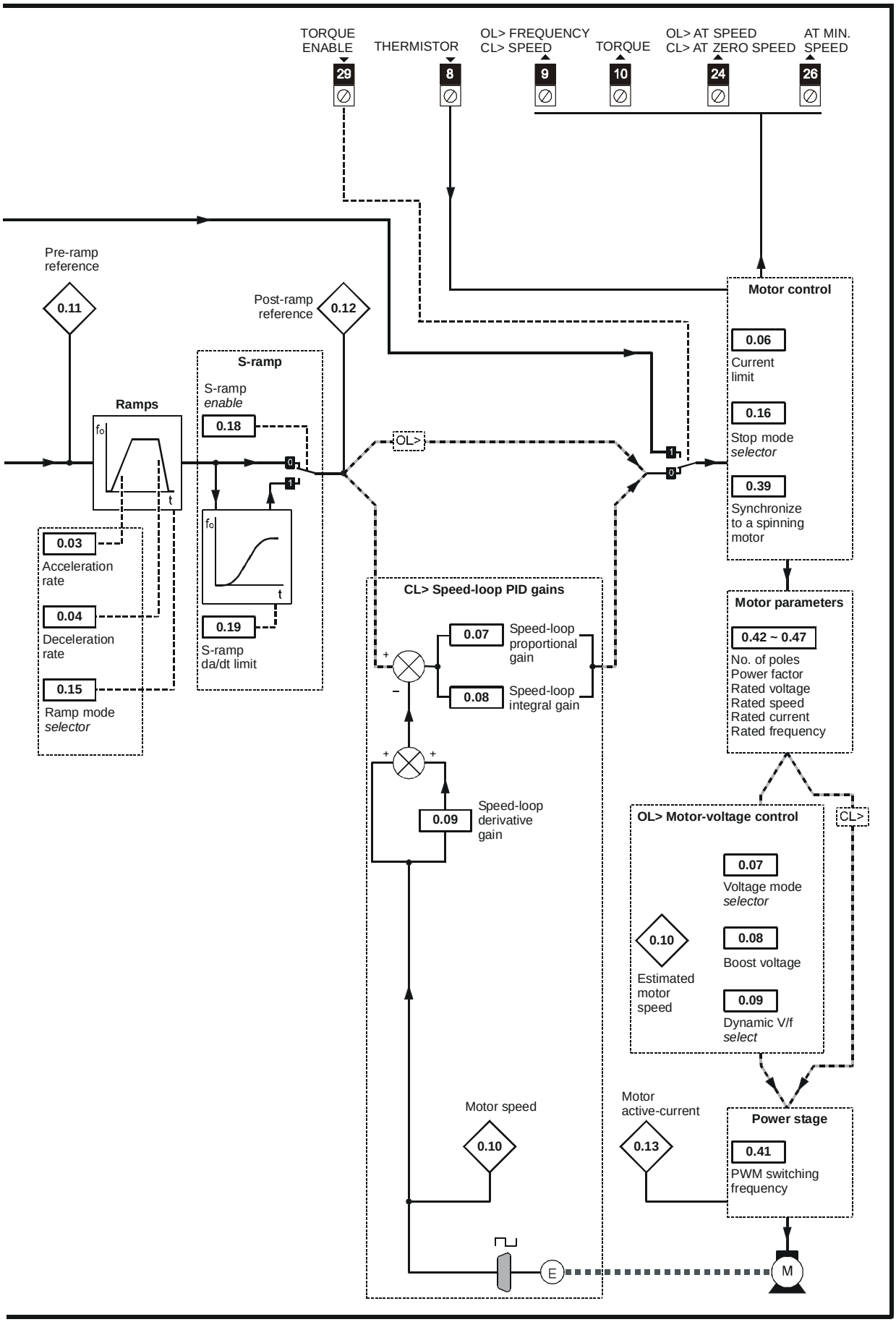
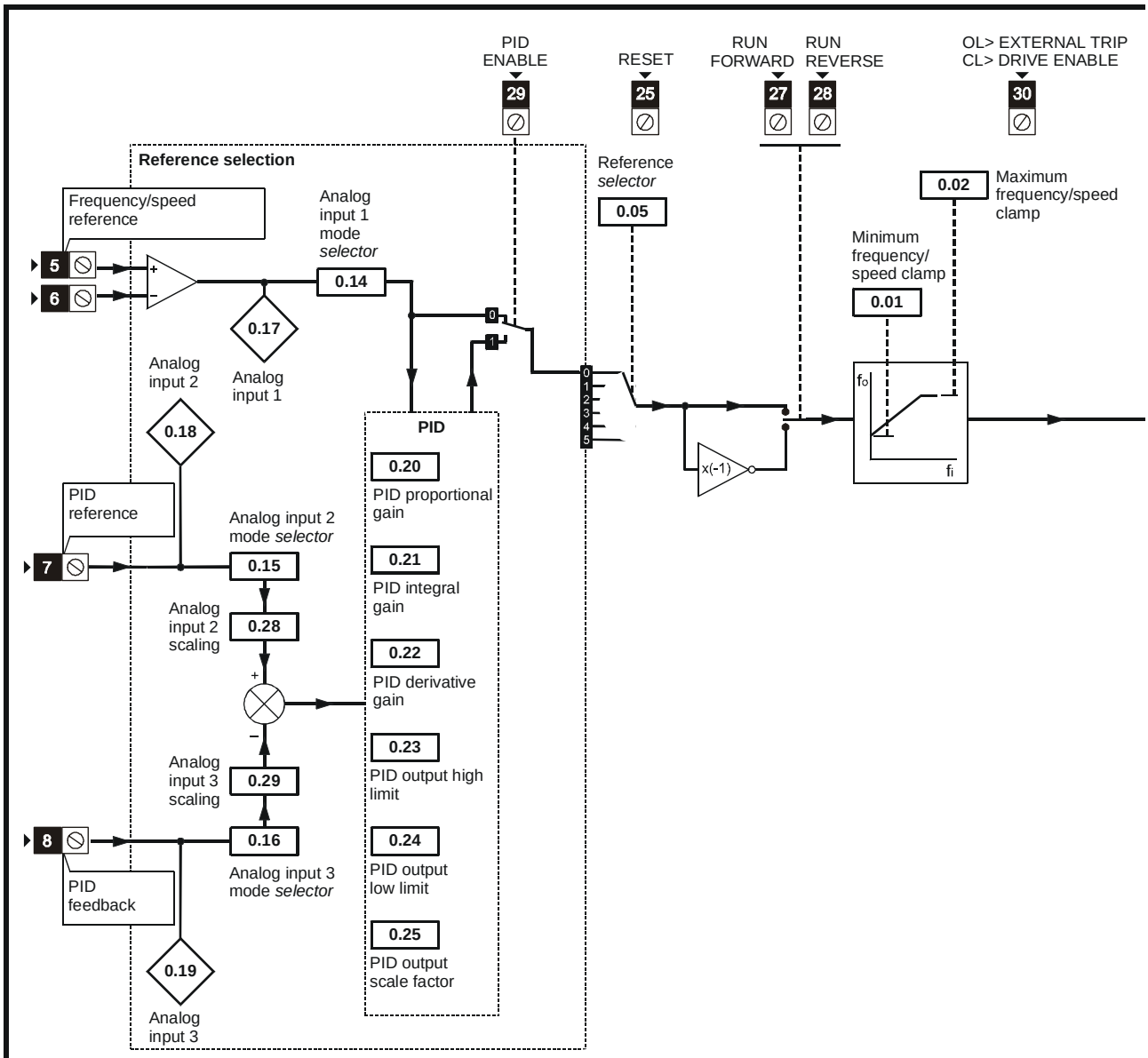

TORQUE ENABLE
29
THERMISTOR
8
OL> FREQUENCY
CL> SPEED
9
TORQUE
10
OL> AT SPEED
CL> AT ZERO SPEED
24
AT MIN. SPEED
26
Pre-ramp reference
0.11
Post-ramp reference
0.12
Ramps
S-ramp
S-ramp enable
0.18
S-ramp da/dt limit
0.19
0.03
Acceleration rate
0.04
Deceleration rate
0.15
Ramp mode selector
OL>
Motor control
0.06
Current limit
0.16
Stop mode selector
0.39
Synchronize to a spinning motor
CL> Speed-loop PID gains
0.07
Speed-loop proportional gain
0.08
Speed-loop integral gain
0.09
Speed-loop derivative gain
Motor parameters
0.42 ~ 0.47
No. of poles
Power factor
Rated voltage
Rated speed
Rated current
Rated frequency
OL> Motor-voltage control
CL>
0.07
Voltage mode selector
0.10
Estimated motor speed
0.08
Boost voltage
0.09
Dynamic V/f select
Motor speed
0.10
Motor active-current
0.13
Power stage
0.41
PWM switching frequency
E
M

Figure 9-5 Macro 5 PID (set-point control) logic diagram



Pr	Function
0.11	Pre-ramp reference
0.12	Post-ramp reference
0.13	Motor active-current
0 14	Analog input 1 (freq./speed ref.) Mode *selector*
0.15	Analog input 2 (PID reference) mode *selector*
0.16	Analog input 3 (PID feedback) mode *selector*
0.17	Analog input 1 (freq./speed ref.)
0.18	Analog input 2 (PID reference)
0.19	Analog input 3 (PID feedback)
0.20	PID proportional gain
0.21	PID integral gain
0.22	PID derivative gain
0.23	PID output high limit
0.24	PID output low limit
0.25	PID output scale factor
0.26	Preset reference 7
0.27	Preset reference 8
0.28	Analog input 2 scaling
0.29	Analog input 3 scaling
0.30	Optional PID-enable source *selector*

Menu 0 changes from default configuration

Key

Input terminals

Output terminals

0.XX Read-write (RW) parameter

0.XX Read-only (RO) parameter

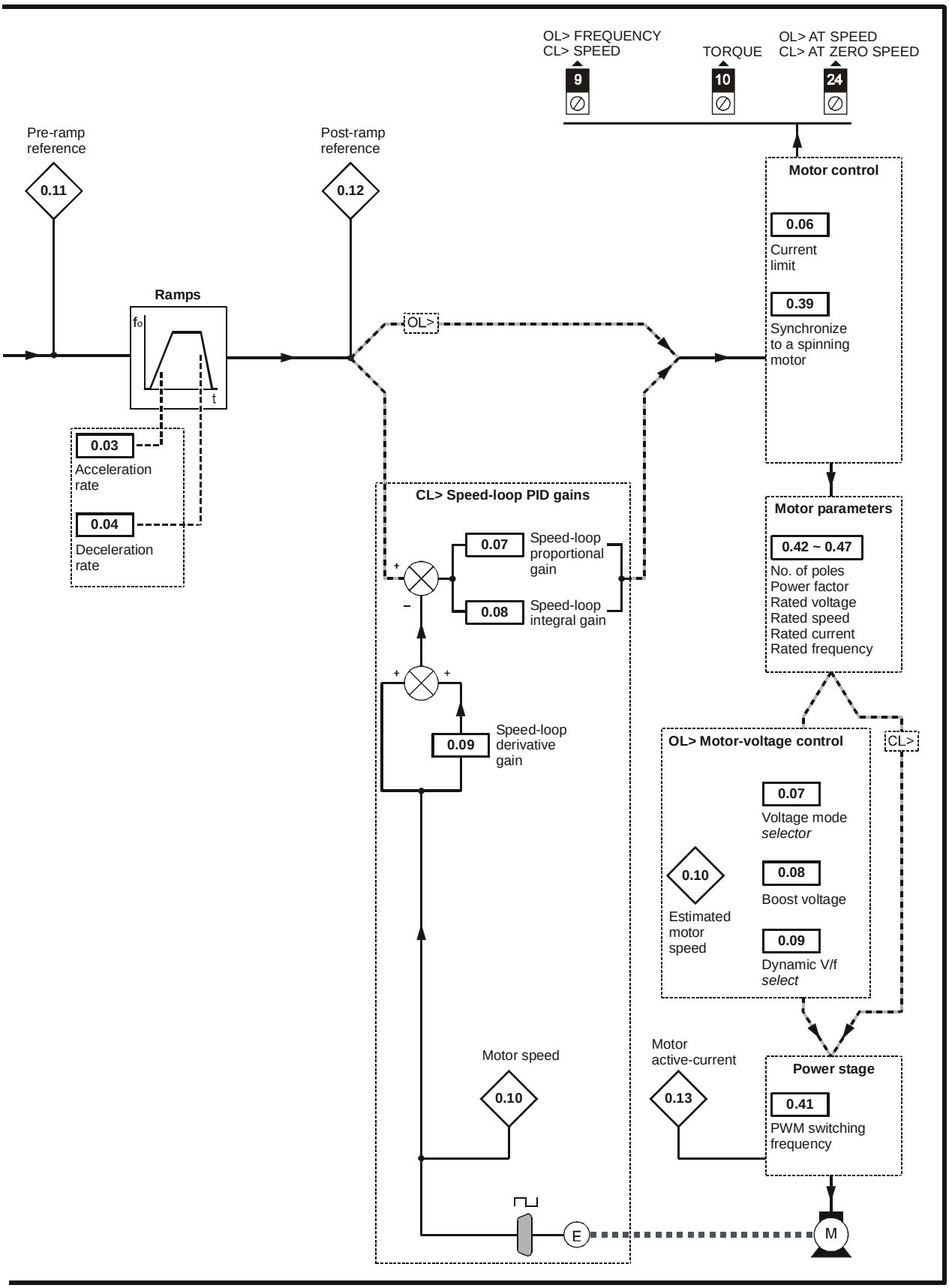
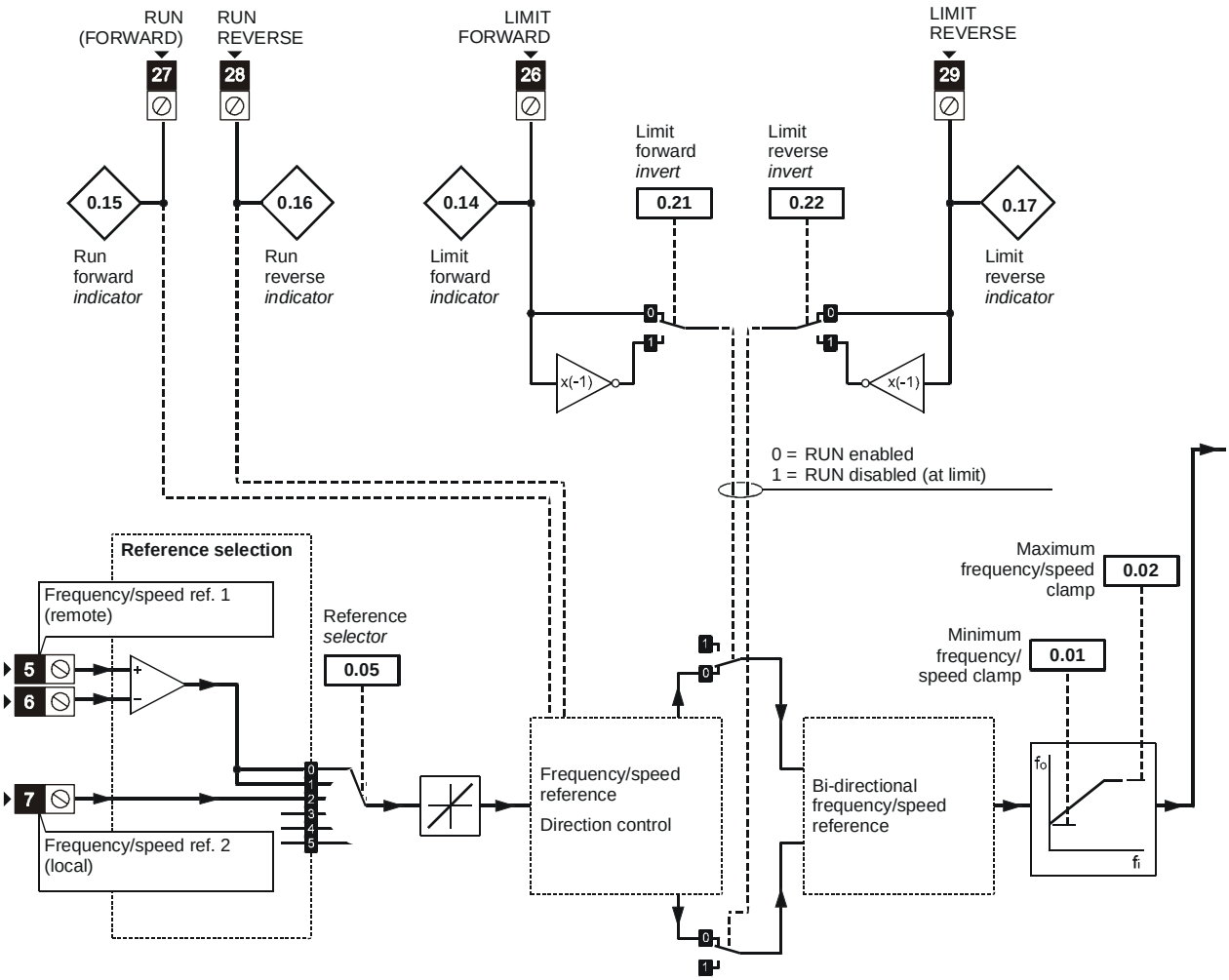
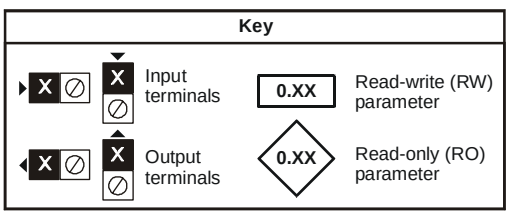

OL> FREQUENCY
CL> SPEED
TORQUE
OL> AT SPEED
CL> AT ZERO SPEED
9
10
24
Pre-ramp reference
0.11
Post-ramp reference
0.12
Motor control
0.06
Current limit
0.39
Synchronize to a spinning motor
Ramps
fo
t
OL>
0.03
Acceleration rate
0.04
Deceleration rate
CL> Speed-loop PID gains
0.07
Speed-loop proportional gain
0.08
Speed-loop integral gain
0.09
Speed-loop derivative gain
Motor parameters
0.42 ~ 0.47
No. of poles
Power factor
Rated voltage
Rated speed
Rated current
Rated frequency
OL> Motor-voltage control
CL>
0.07
Voltage mode selector
0.10
Estimated motor speed
0.08
Boost voltage
0.09
Dynamic V/f select
Motor speed
0.10
Motor active-current
0.13
Power stage
0.41
PWM switching frequency
E
M

Figure 9-6 Macro 6 Axis-limit control logic diagram



Pr	Function
0.11	Pre-ramp reference
0.12	Post-ramp reference
0.13	Motor active-current
0 14	Limit forward *indicator*
0.15	Run forward *indicator*
0.16	Run reverse *indicator*
0.17	Limit reverse *indicator*
0.18	Stop mode *selector*
0.19	Hold zero speed *enable*
0.20	OL> Limit deceleration rate CL> (not used)
0.21	Limit forward *invert*
0.22	Limit reverse *invert*
0.23	(not used)
0.24	(not used)
0.25	(not used)
0.26	(not used)
0.27	(not used)
0.28	(not used)
0.29	(not used)
0.30	(not used)



Menu 0 changes from default configuration

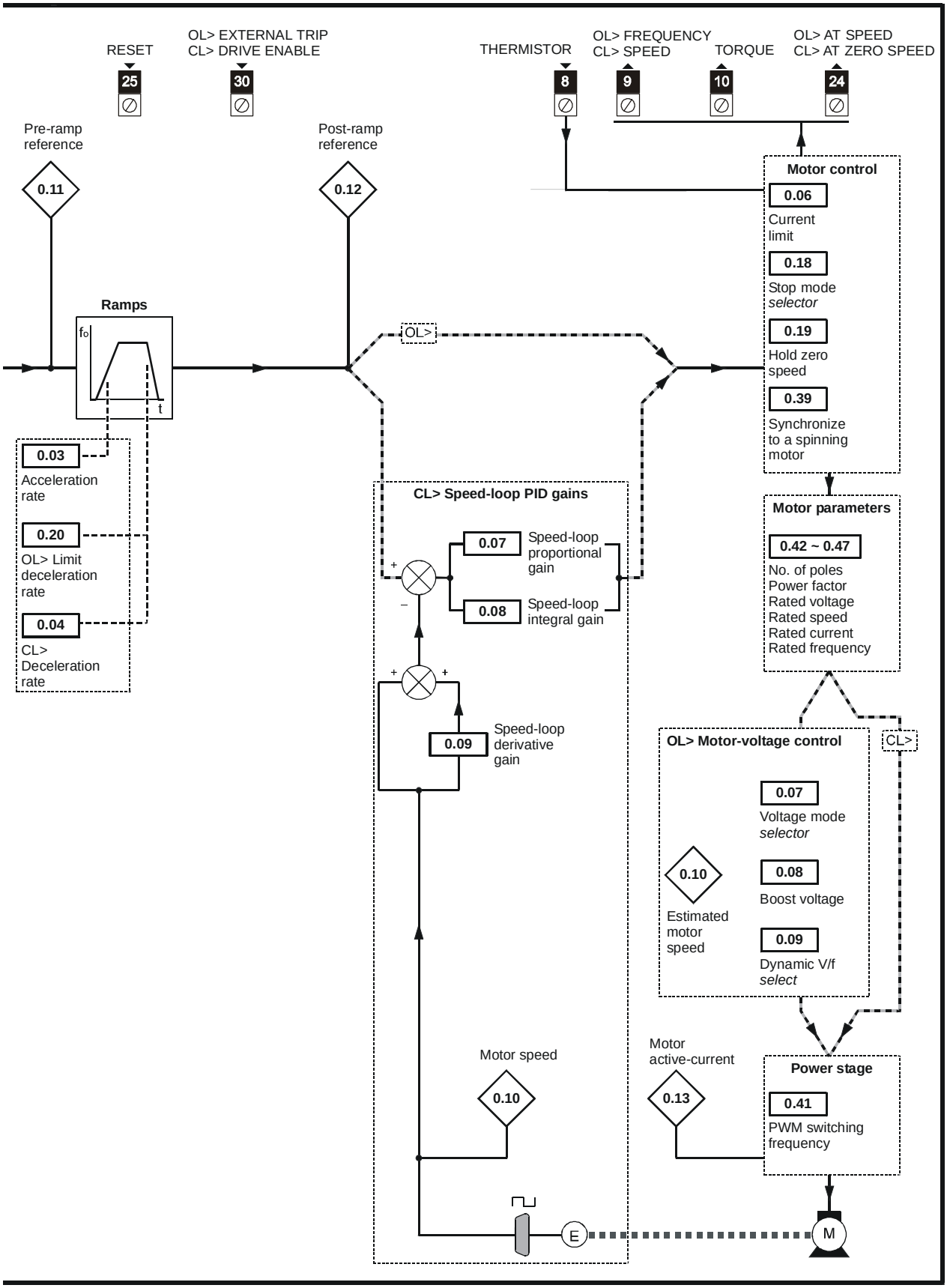
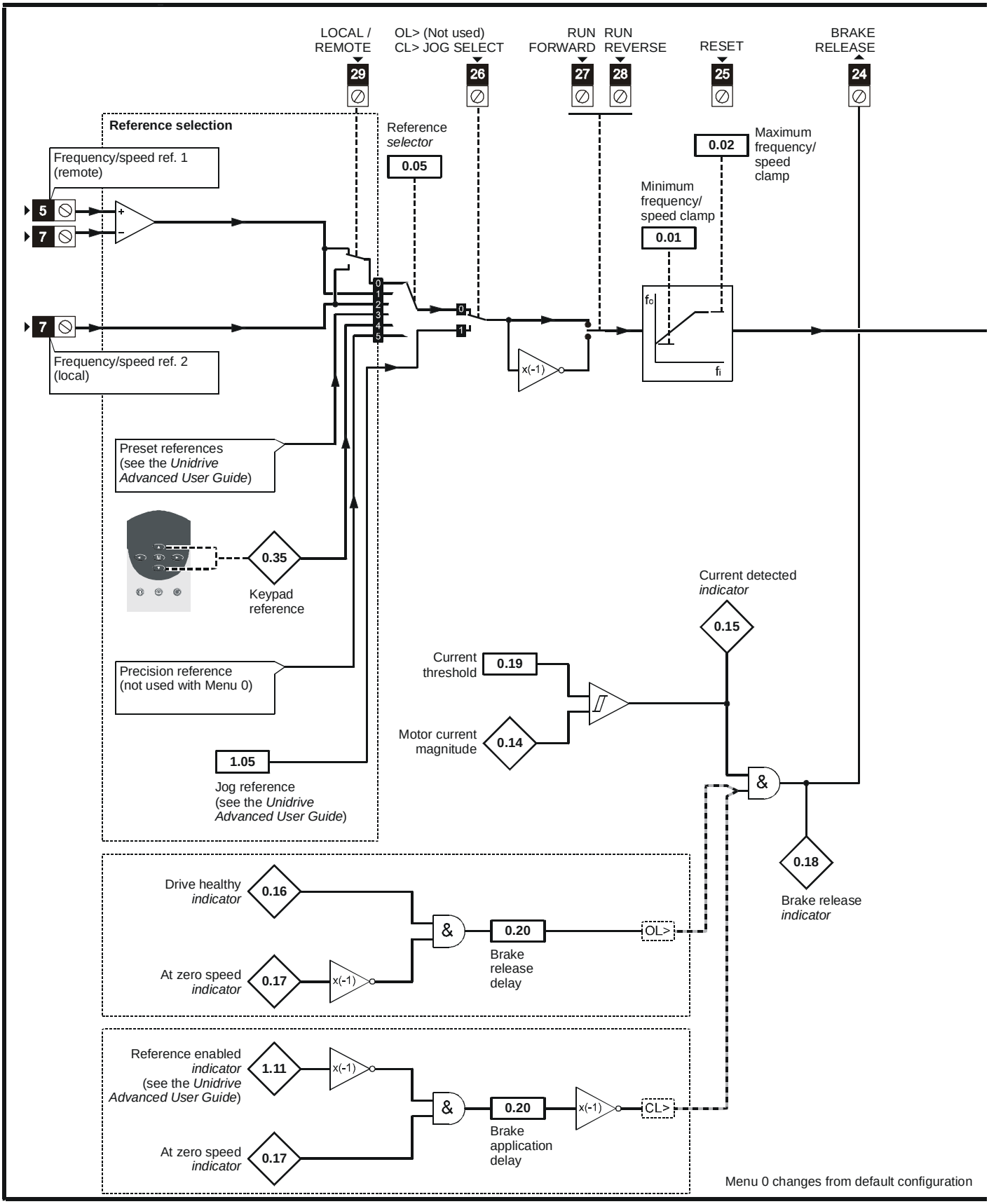
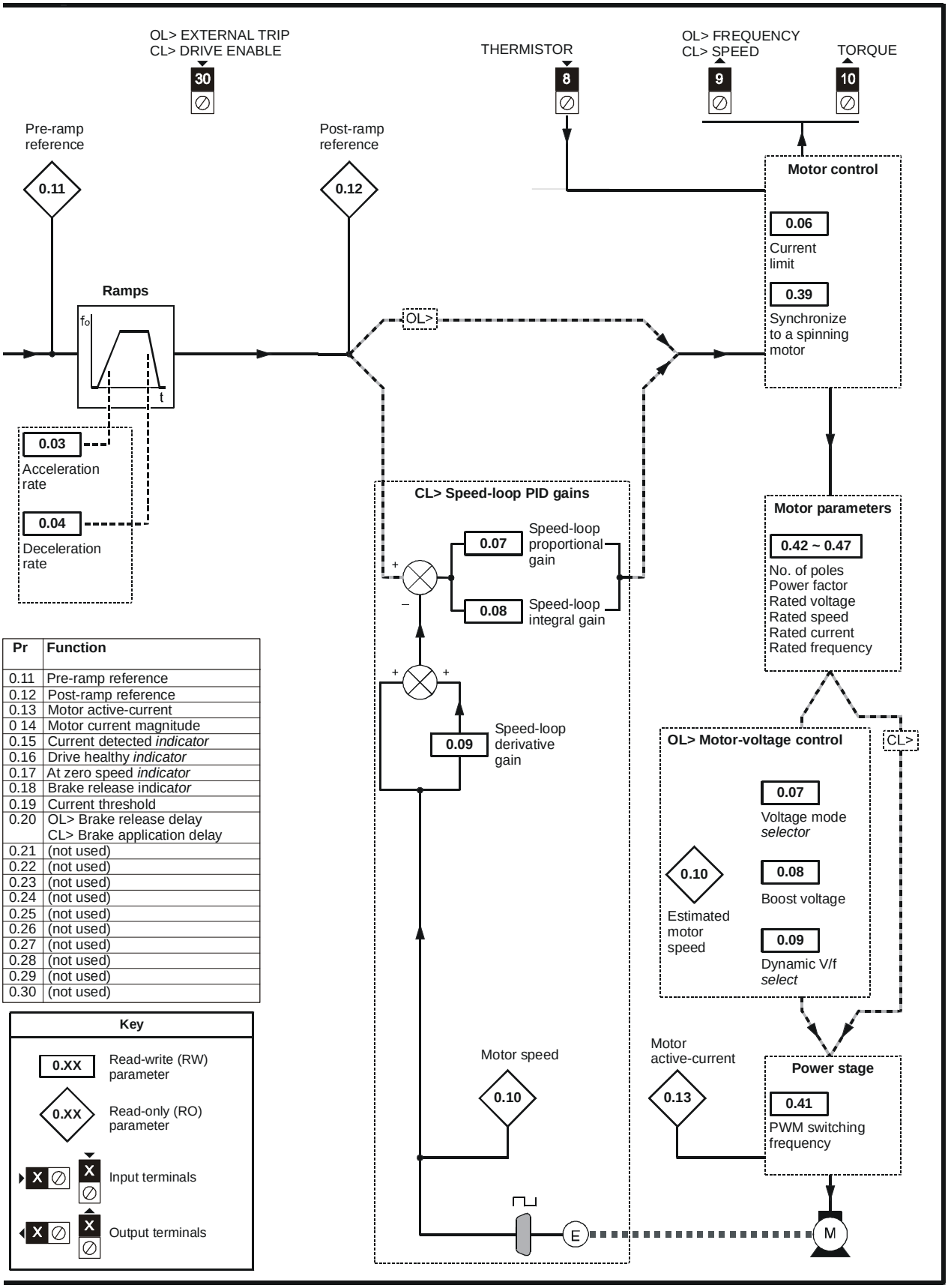

RESET
25
OL> EXTERNAL TRIP
CL> DRIVE ENABLE
30
THERMISTOR
8
OL> FREQUENCY
CL> SPEED
9
TORQUE
10
OL> AT SPEED
CL> AT ZERO SPEED
24
Pre-ramp reference
0.11
Post-ramp reference
0.12
Motor control
0.06
Current limit
0.18
Stop mode selector
0.19
Hold zero speed
0.39
Synchronize to a spinning motor
Ramps
fo
t
OL>
0.03
Acceleration rate
0.20
OL> Limit deceleration rate
0.04
CL> Deceleration rate
CL> Speed-loop PID gains
0.07
Speed-loop proportional gain
0.08
Speed-loop integral gain
0.09
Speed-loop derivative gain
Motor parameters
0.42 ~ 0.47
No. of poles
Power factor
Rated voltage
Rated speed
Rated current
Rated frequency
OL> Motor-voltage control
CL>
0.07
Voltage mode selector
0.10
Estimated motor speed
0.08
Boost voltage
0.09
Dynamic V/f select
Motor speed
0.10
Motor active-current
0.13
Power stage
0.41
PWM switching frequency
E
M

Figure 9-7 Macro 7 Brake Control logic diagram





Pr	Function
0.11	Pre-ramp reference
0.12	Post-ramp reference
0.13	Motor active-current
0 14	Motor current magnitude
0.15	Current detected *indicator*
0.16	Drive healthy *indicator*
0.17	At zero speed *indicator*
0.18	Brake release indic*ator*
0.19	Current threshold
0.20	OL> Brake release delay CL> Brake application delay
0.21	(not used)
0.22	(not used)
0.23	(not used)
0.24	(not used)
0.25	(not used)
0.26	(not used)
0.27	(not used)
0.28	(not used)
0.29	(not used)
0.30	(not used)

Key

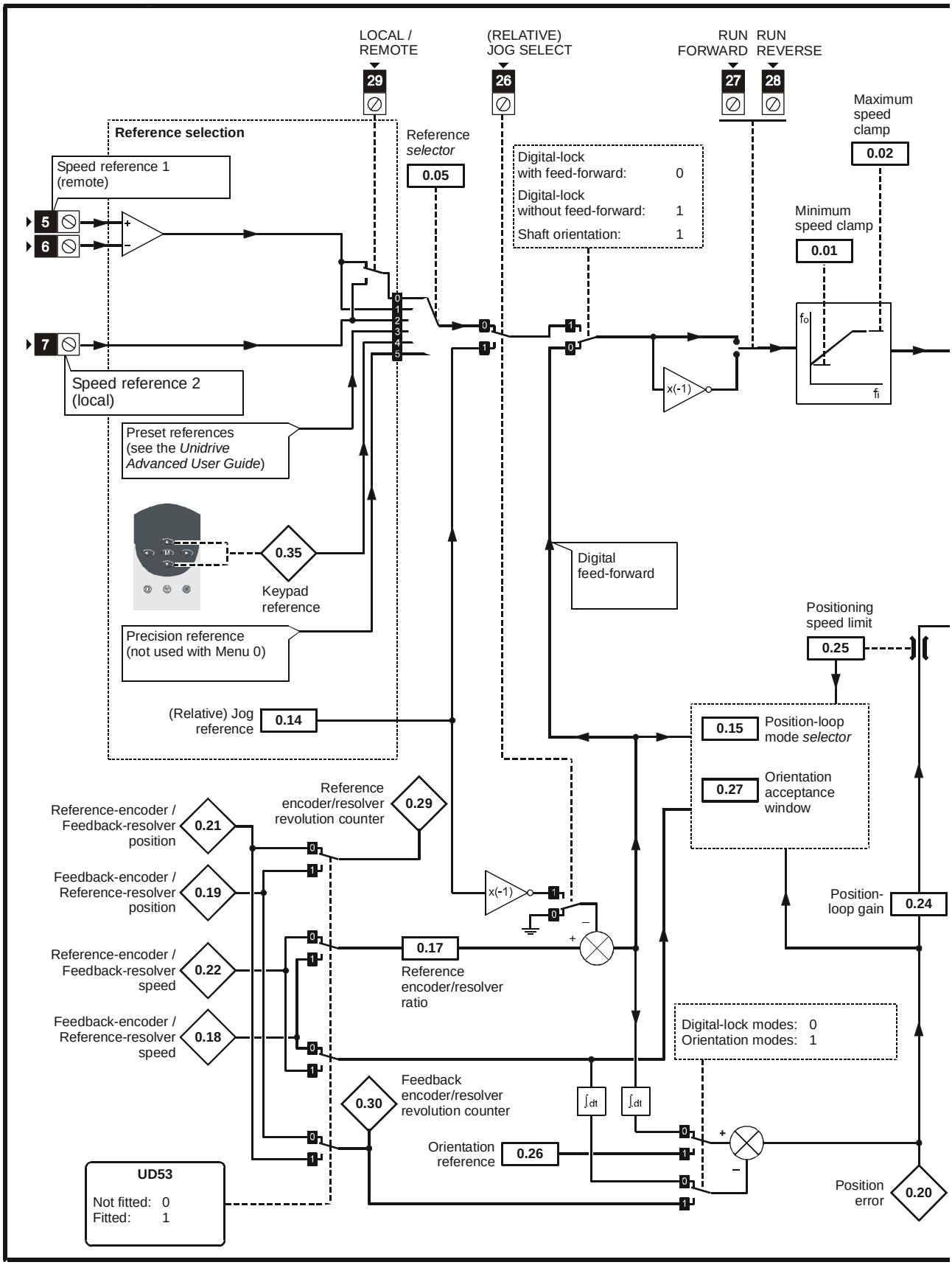
0.XX — Read-write (RW) parameter

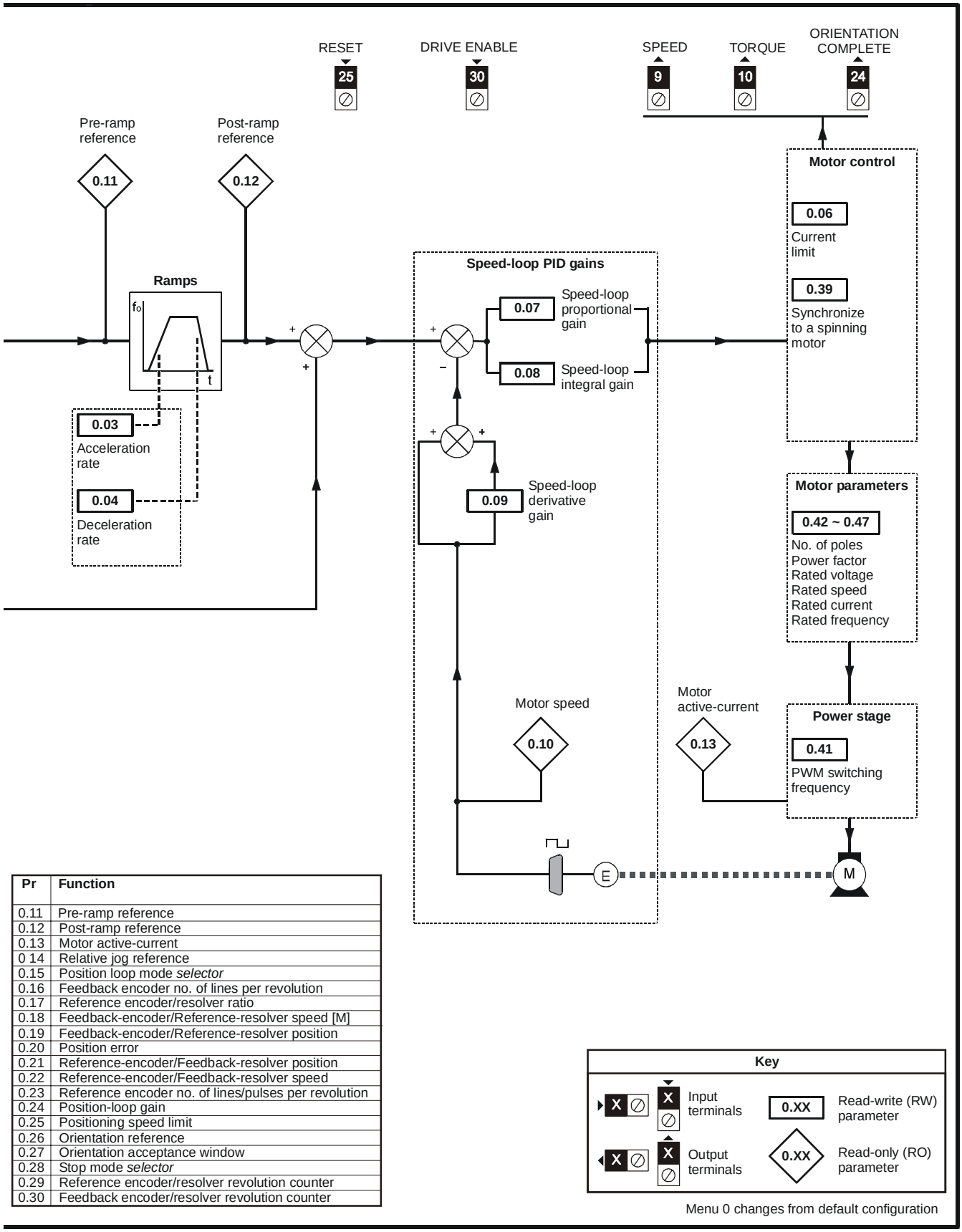
0.XX — Read-only (RO) parameter

Input terminals

Output terminals

Figure 9-8 Macro 8 Digital lock / shaft orientation logic diagram





Pr	Function
0.11	Pre-ramp reference
0.12	Post-ramp reference
0.13	Motor active-current
0 14	Relative jog reference
0.15	Position loop mode *selector*
0.16	Feedback encoder no. of lines per revolution
0.17	Reference encoder/resolver ratio
0.18	Feedback-encoder/Reference-resolver speed [M]
0.19	Feedback-encoder/Reference-resolver position
0.20	Position error
0.21	Reference-encoder/Feedback-resolver position
0.22	Reference-encoder/Feedback-resolver speed
0.23	Reference encoder no. of lines/pulses per revolution
0.24	Position-loop gain
0.25	Positioning speed limit
0.26	Orientation reference
0.27	Orientation acceptance window
0.28	Stop mode *selector*
0.29	Reference encoder/resolver revolution counter
0.30	Feedback encoder/resolver revolution counter

Menu 0 changes from default configuration

10 Advanced Parameters

WARNING

These advanced parameters are listed for reference purposes only. The lists in this chapter do not include sufficient information for adjusting these parameters. Incorrect adjustment can affect the safety of the system, and damage the drive and or external equipment. Before attempting to adjust any of these parameters, refer to the *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

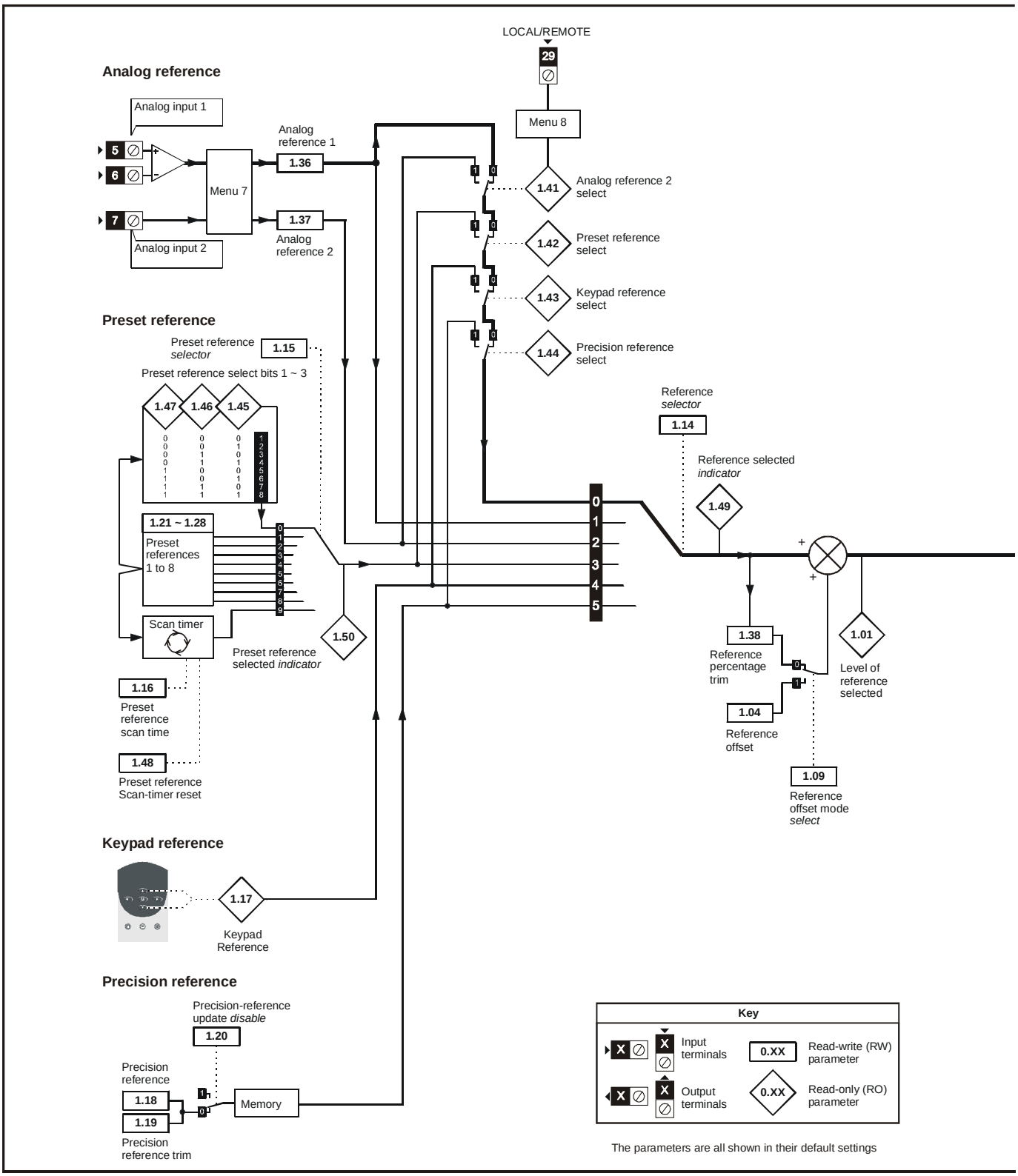
Parameter numbers shown in brackets {...} are the equivalent Menu 0 parameters. Some Menu 0 parameters appear twice since their function depends on the operating mode.

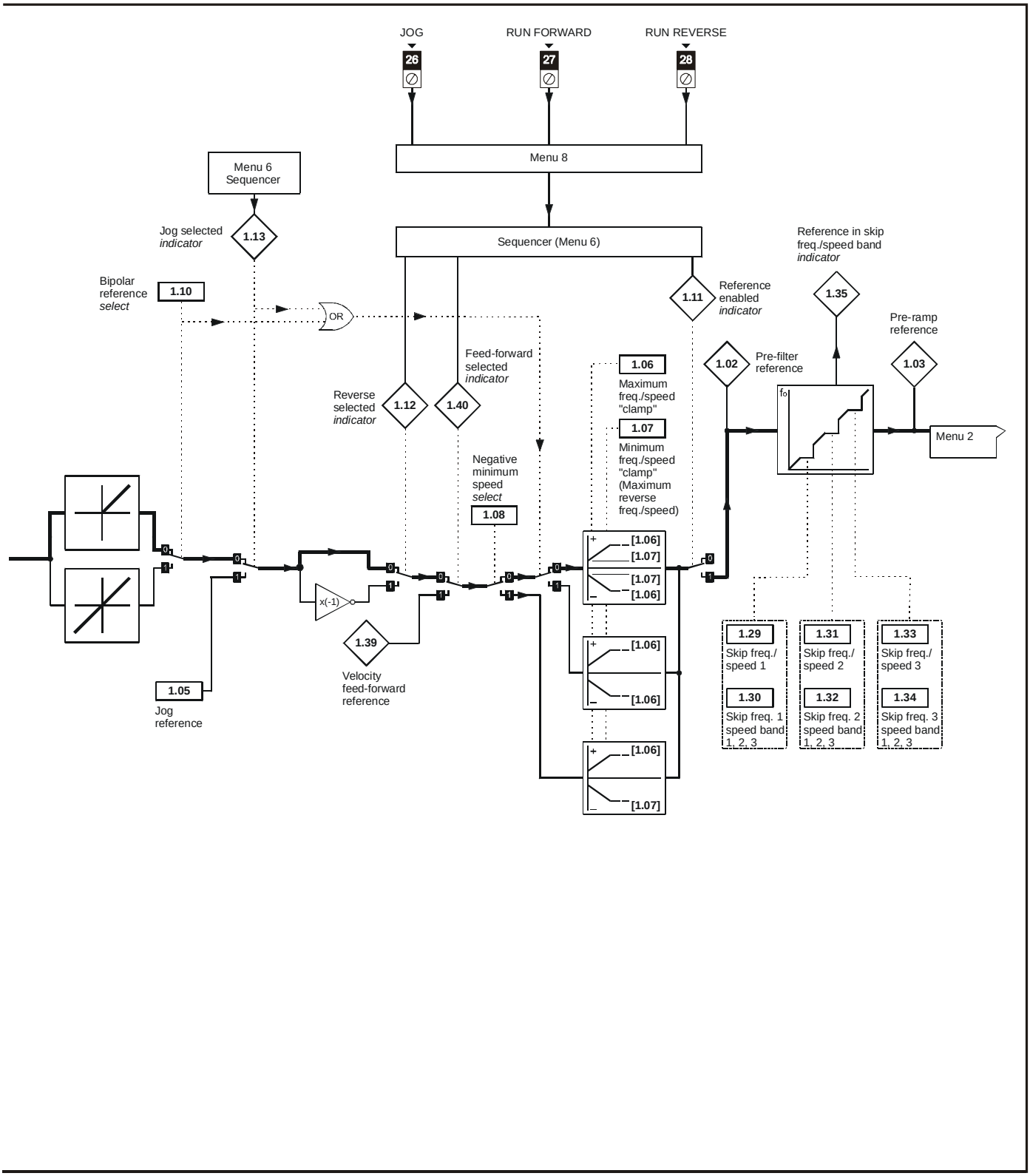
The Range - CL column applies to both Closed-loop Vector and Closed-loop Servo. For some parameters, this column applies only to one of these modes; this is indicated accordingly in the Default columns.

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.

10.1 Menu 1: Speed references and limits

Figure 10-1 Menu 1 logic diagram




JOG
RUN FORWARD
RUN REVERSE
26
27
28
Menu 8
Menu 6 Sequencer
Jog selected indicator
1.13
Sequencer (Menu 6)
Reference in skip freq./speed band indicator
Bipolar reference select
1.10
OR
1.11
Reference enabled indicator
1.35
Pre-ramp reference
1.02
Pre-filter reference
1.03
Feed-forward selected indicator
1.06
Maximum freq./speed "clamp"
Reverse selected indicator
1.12
1.40
1.07
Minimum freq./speed "clamp" (Maximum reverse freq./speed)
Negative minimum speed select
1.08
Menu 2
x(-1)
1.39
Velocity feed-forward reference
1.05
Jog reference
[1.06]
[1.07]
[1.07]
[1.06]
[1.06]
[1.06]
[1.06]
[1.07]
1.29
Skip freq./ speed 1
1.30
Skip freq. 1 speed band 1, 2, 3
1.31
Skip freq./ speed 2
1.32
Skip freq. 2 speed band 1, 2, 3
1.33
Skip freq./ speed 3
1.34
Skip freq. 3 speed band 1, 2, 3

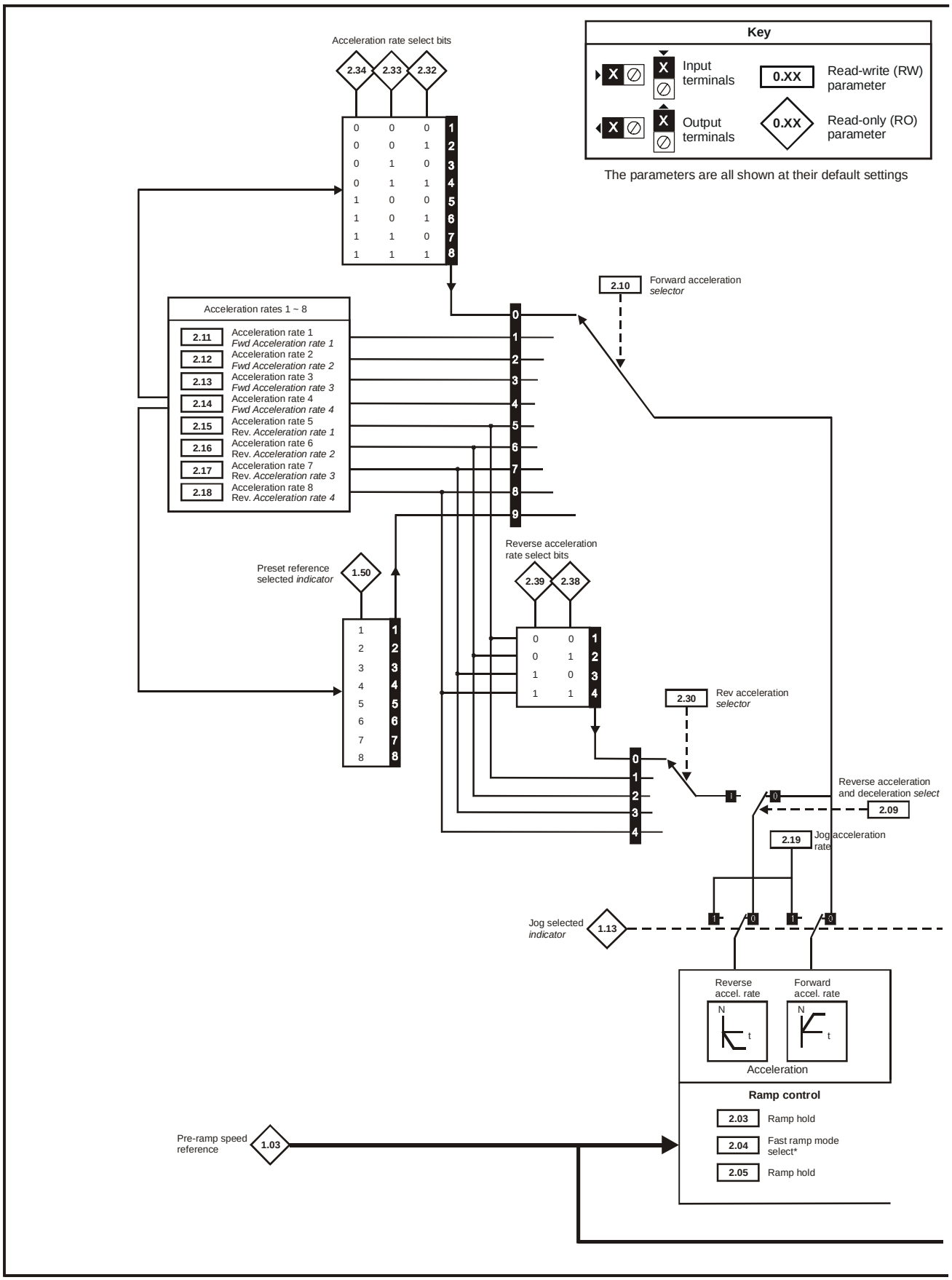
Parameter			Range(⇳)		Default(⇨)			Type			
			OL	CL	OL	VT	SV				
1.01	Final reference		±1,000.0 Hz *	±30,000 rpm *				RO	Bi		P
1.02	Pre-filter reference		±1,000.0 Hz *	±30,000 rpm *				RO	Bi		P
1.03	Pre-ramp reference	{**0.11**}	±1,000.0 Hz *	±30,000 rpm *				RO	Bi		P
1.04	Reference offset		±1,000.0 Hz	±30,000 rpm	0	0	0	RW	Bi		
1.05	Jog reference	{**0.14**}	0 ~ 400.0 Hz	0 ~ 4,000 rpm	1.5	50	50	RW	Uni		
1.06	Maximum frequency/speed	{**0.02**}	0 ~ 1,000.0 Hz	0 ~ 30,000 rpm	EUR> 50 USA> 60	EUR> 1,500 USA> 1,800	3000	RW	Uni		
1.07	Minimum frequency/speed	{**0.01**}	0 ~ [**1.06**]	0 ~ [**1.06**]	0	0	0	RW	Bi		
1.08	Negative minimum speed *select*		0 or 1	0 or 1	0	0	0	RW	Bit		
1.09	Reference offset *select*		0 or 1	0 or 1	0	0	0	RW	Bit		
1.10	Bipolar reference *select*		0 or 1	0 or 1	0	0	0	RW	Bit		
1.11	Reference enabled *indicator*		0 or 1	0 or 1				RO	Bit		P
1.12	Reverse selected *indicator*		0 or 1	0 or 1				RO	Bit		P
1.13	Jog selected *indicator*		0 or 1	0 or 1				RO	Bit		P
1.14	Reference *selector*	{**0.05**}	0 ~ 5	0 ~ 5	EUR> 0 USA> 4	EUR> 0 USA> 0	EUR> 0 USA> 0	RW	Uni		
1.15	Preset reference *selector*		0 ~ 9	0 ~ 9	0	0	0	RW	Uni		
1.16	Preset reference scan time		0 ~ 400.0 s	0 ~ 400.0 s	10	10	10	RW	Uni		
1.17	Keypad reference	{**0.35**}	±1,000.0 Hz	±30,000 rpm	0	0	0	RO	Bi	S	P
1.18	Precision reference		±1,000.0 Hz	±30,000 rpm	0	0	0	RW	Bi		
1.19	Precision reference trim		0 ~ 0.099 Hz	0 ~ 0.99 rpm	0	0	0	RW	Uni		
1.20	Precision-reference update *disable*		0 or 1	0 or 1	0	0	0	RW	Bit		
1.21	Preset reference 1		±1,000.0 Hz	±30,000 rpm	0	0	0	RW	Bi		
1.22	Preset reference 2		±1,000.0 Hz	±30,000 rpm	0	0	0	RW	Bi		
1.23	Preset reference 3		±1,000.0 Hz	±30,000 rpm	0	0	0	RW	Bi		
1.24	Preset reference 4		±1,000.0 Hz	±30,000 rpm	0	0	0	RW	Bi		
1.25	Preset reference 5		±1,000.0 Hz	±30,000 rpm	0	0	0	RW	Bi		
1.26	Preset reference 6		±1,000.0 Hz	±30,000 rpm	0	0	0	RW	Bi		
1.27	Preset reference 7		±1,000.0 Hz	±30,000 rpm	0	0	0	RW	Bi		
1.28	Preset reference 8		±1,000.0 Hz	±30,000 rpm	0	0	0	RW	Bi		
1.29	Skip freq./speed 1	{**0.20**}	0 ~ 1,000.0 Hz	0 ~ 30,000 rpm	0	0	0	RW	Uni		
1.30	Skip band 1	{**0.21**}	0 ~ 5.0 Hz	0 ~ 50 rpm	0.5	5	5	RW	Uni		
1.31	Skip freq./speed 2	{**0.22**}	0 ~ 1,000.0 Hz	0 ~ 30,000 rpm	0	0	0	RW	Uni		
1.32	Skip band 2	{**0.23**}	0 ~ 5.0 Hz	0 ~ 50 rpm	0.5	5	5	RW	Uni		
1.33	Skip freq./speed 3		0 ~ 1,000.0 Hz	0 ~ 30,000 rpm	0	0	0	RW	Uni		
1.34	Skip band 3		0 ~ 5.0 Hz	0 ~ 50 rpm	0.5	5	5	RW	Uni		
1.35	Reference in skip-band *indicator*		0 or 1	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 %	±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	0 or 1				RO	Bit		P
1.41	Analog reference 2 selected *indicator*		0 or 1	0 or 1				RO	Bit		
1.42	Preset reference selected *indicator*		0 or 1	0 or 1				RO	Bit		
1.43	Keypad reference selected *indicator*		0 or 1	0 or 1				RO	Bit		
1.44	Precision reference selected *indicator*		0 or 1	0 or 1				RO	Bit		
1.45	Preset reference select bit 0 (LSB)		0 or 1	0 or 1				RO	Bit		
1.46	Preset reference select bit 1		0 or 1	0 or 1				RO	Bit		
1.47	Preset reference select bit 2 (MSB)		0 or 1	0 or 1				RO	Bit		
1.48	Scan-timer reset		0 or 1	0 or 1	0	0	0	RW	Bit		
1.49	Reference selected *indicator*		1 ~ 5	1 ~ 5				RO	Uni		P
1.50	Preset reference selected *indicator*		1 ~ 8	1 ~ 8				RO	Uni		P

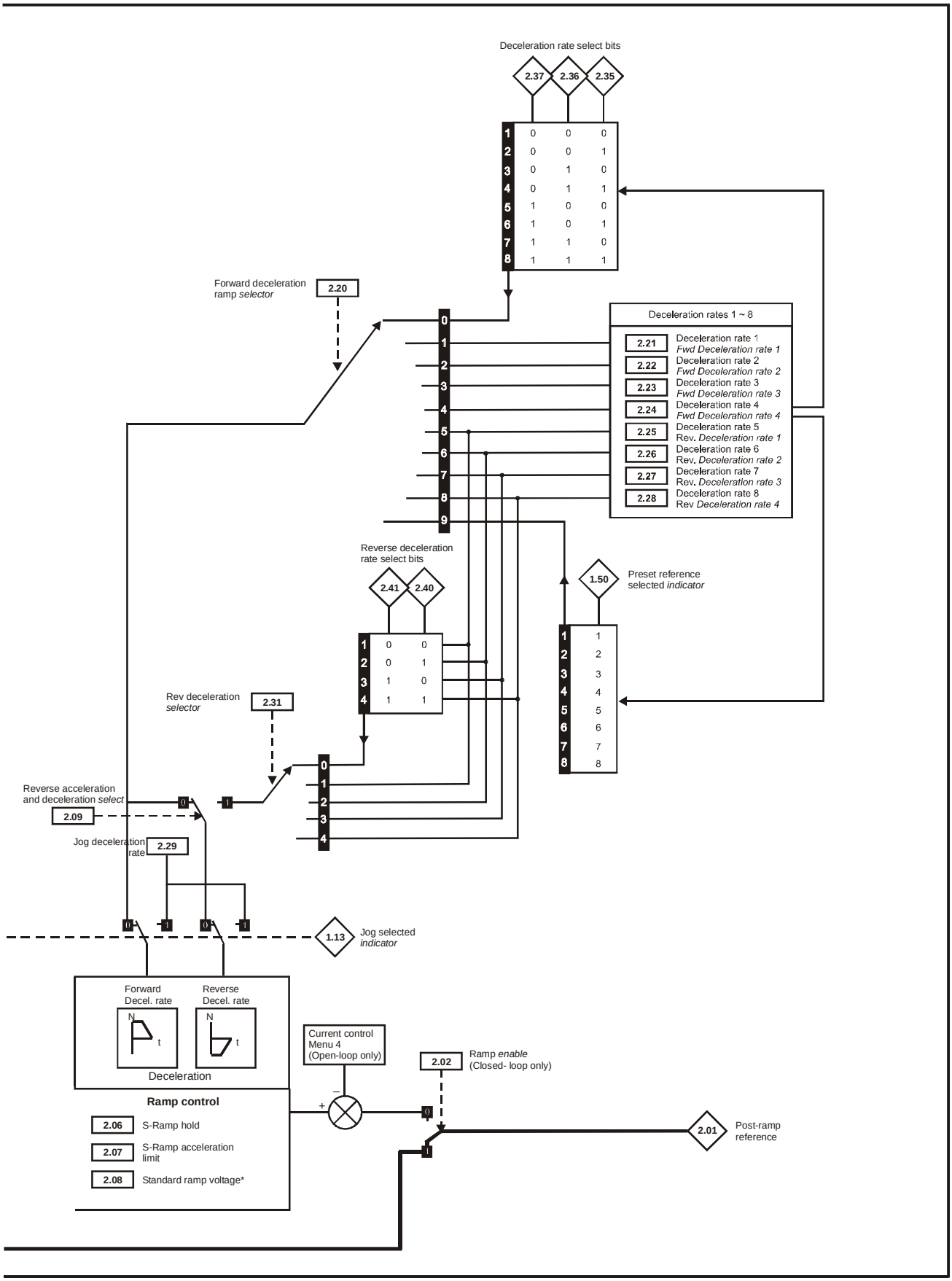
* The maximum value that can be used is limited to the larger value of parameters **1.06** and **1.07**.

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





* For more information, see section 10.21.1 *Braking modes* on page 166

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 or 1	0	0	0	RW	Bit		
2.04	Ramp mode selector* {**0.15**}	Stnd.Hd (0) FASt (1) Stnd.Ct (2)	Stnd.Hd (0) FASt (1) Stnd.Ct (2)	Stnd.Ct (2)	Stnd.Ct (2)	Stnd.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 or 1	0	0	0	RW	Bit		
2.07	S-ramp da/dt {**0.19**}	0 ~ 3,000.0 s^2/100 Hz	0 ~ 30.000 s^2/1,000 rpm	3.1	1.5	0.03	RW	Uni		
2.08	Standard ramp voltage*	0 ~ 800 V	0 ~ 800 V	EUR> 750 USA> 775	EUR> 750 USA> 775	EUR> 750 USA> 775	RW	Uni		
2.09	Reverse acceleration and deceleration select	0 or 1	0 or 1	0	0	0	RW	Bit		
2.10	Forward acceleration ramp selector	0 ~ 9	0 ~ 9	0	0	0	RW	Uni		
2.11	Acceleration rate 1 / Forward acceleration rate 1 {**0.03**}	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3,200 SV> 0~32.000 s/1,000rpm	5**	2	0.2	RW	Uni		
2.12	Acceleration rate 2 / Forward acceleration rate 2	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3200 SV> 0~32.000 s/1,000rpm	5**	2	0.2	RW	Uni		
2.13	Acceleration rate 3 / Forward acceleration rate 3	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3200 SV> 0~32.000 s/1,000rpm	5**	2	0.2	RW	Uni		
2.14	Acceleration rate 4 / Forward acceleration rate 4	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3200 SV> 0~32.000 s/1,000rpm	5**	2	0.2	RW	Uni		
2.15	Acceleration rate 5 / Reverse acceleration rate 1	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3200 SV> 0~32.000 s/1,000rpm	5**	2	0.2	RW	Uni		
2.16	Acceleration rate 6 / Reverse acceleration rate 2	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3200 SV> 0~32.000 s/1,000rpm	5**	2	0.2	RW	Uni		
2.17	Acceleration rate 7 / Reverse acceleration rate 3	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3200 SV> 0~32.000 s/1,000rpm	5**	2	0.2	RW	Uni		
2.18	Acceleration rate 8 / Reverse acceleration rate 4	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3200 SV> 0~32.000 s/1,000rpm	5**	2	0.2	RW	Uni		
2.19	Jog acceleration rate	0 ~ 3,200.0 s/100Hz	VT>0 ~ 32.0 s/1,000rpm SV>0 ~ 32.000 s/1,000rpm	0.2	0	0	RW	Uni		
2.20	Forward deceleration ramp *selector*	0 ~ 9	0 ~ 9	0	0	0	RW	Uni		
2.21	Deceleration rate 1 / Forward deceleration rate 1 {**0.04**}	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 32.000 s/1000rpm SV> 0 ~ 32,000 s/1000rpm	10**	2	0.2	RW	Uni		
2.22	Deceleration rate 2 / Forward deceleration rate 2	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3,200 SV> 0~32.000 s/1,000rpm	10**	2	0.2	RW	Uni		
2.23	Deceleration rate 3 / Forward deceleration rate 3	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3,200 SV> 0~32.000 s/1,000rpm	10**	2	0.2	RW	Uni		
2.24	Deceleration rate 4 / Forward deceleration rate 4	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3,200 SV> 0~32.000 s/1,000rpm	10**	2	0.2	RW	Uni		
2.25	Deceleration rate 5 / Reverse deceleration rate 1	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3,200 SV> 0~32.000 s/1,000rpm	10**	2	0.2	RW	Uni		
2.26	Deceleration rate 6 / Reverse deceleration rate 2	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3,200 SV> 0~32.000 s/1,000rpm	10**	2	0.2	RW	Uni		
2.27	Deceleration rate 7 / Reverse deceleration rate 3	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3,200 SV> 0~32.000 s/1,000rpm	10**	2	0.2	RW	Uni		
2.28	Deceleration rate 8 / Reverse deceleration rate 4	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3,200 SV> 0~32.000 s/1,000rpm	10**	2	0.2	RW	Uni		
2.29	Jog deceleration rate	0 ~ 3,200.0 s/100Hz	VT> 0 ~ 3,200 SV> 0~32.000 s/1,000rpm	0.2	0	0	RW	Uni		
2.30	Rev acceleration *selector*	0 ~ 4	0 ~ 4	0	0	0	RW	Uni		P
2.31	Rev deceleration *selector*	0 ~ 4	0 ~ 4	0	0	0	RW	Uni		P
2.32	Forward acceleration *select bit 0 (LSB)*	0 or 1	0 or 1	0	0	0	RO	Bit		
2.33	Forward acceleration *select bit 1*	0 or 1	0 or 1	0	0	0	RO	Bit		
2.34	Forward acceleration *select bit 2 (MSB)*	0 or 1	0 or 1	0	0	0	RO	Bit		
2.35	Forward deceleration *select bit 0 (LSB)*	0 or 1	0 or 1	0	0	0	RO	Bit		
2.36	Forward deceleration *select bit 1*	0 or 1	0 or 1	0	0	0	RO	Bit		
2.37	Forward deceleration *select bit (MSB)*	0 or 1	0 or 1	0	0	0	RO	Bit		
2.38	Reverse acceleration *select bit 0 (LSB)*	0 or 1	0 or 1	0	0	0	RO	Bit		
2.39	Reverse acceleration *select bit 1 (MSB)*	0 or 1	0 or 1	0	0	0	RO	Bit		
2.40	Reverse deceleration *select bit 0 (LSB)*	0 or 1	0 or 1	0	0	0	RO	Bit		
2.41	Reverse deceleration *select bit 1 (MSB)*	0 or 1	0 or 1	0	0	0	RO	Bit		

* The maximum value that can be used is limited to the larger value of parameters **1.06** and **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**}

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 info, see section 10.21.1 *Braking modes* on page 166.

** These parameters have a default setting of 60s in the VTC variant.

10.3 Menu 3: Speed feedback / frequency slaving

Figure 10-3 Menu 3 Open-loop logic diagram

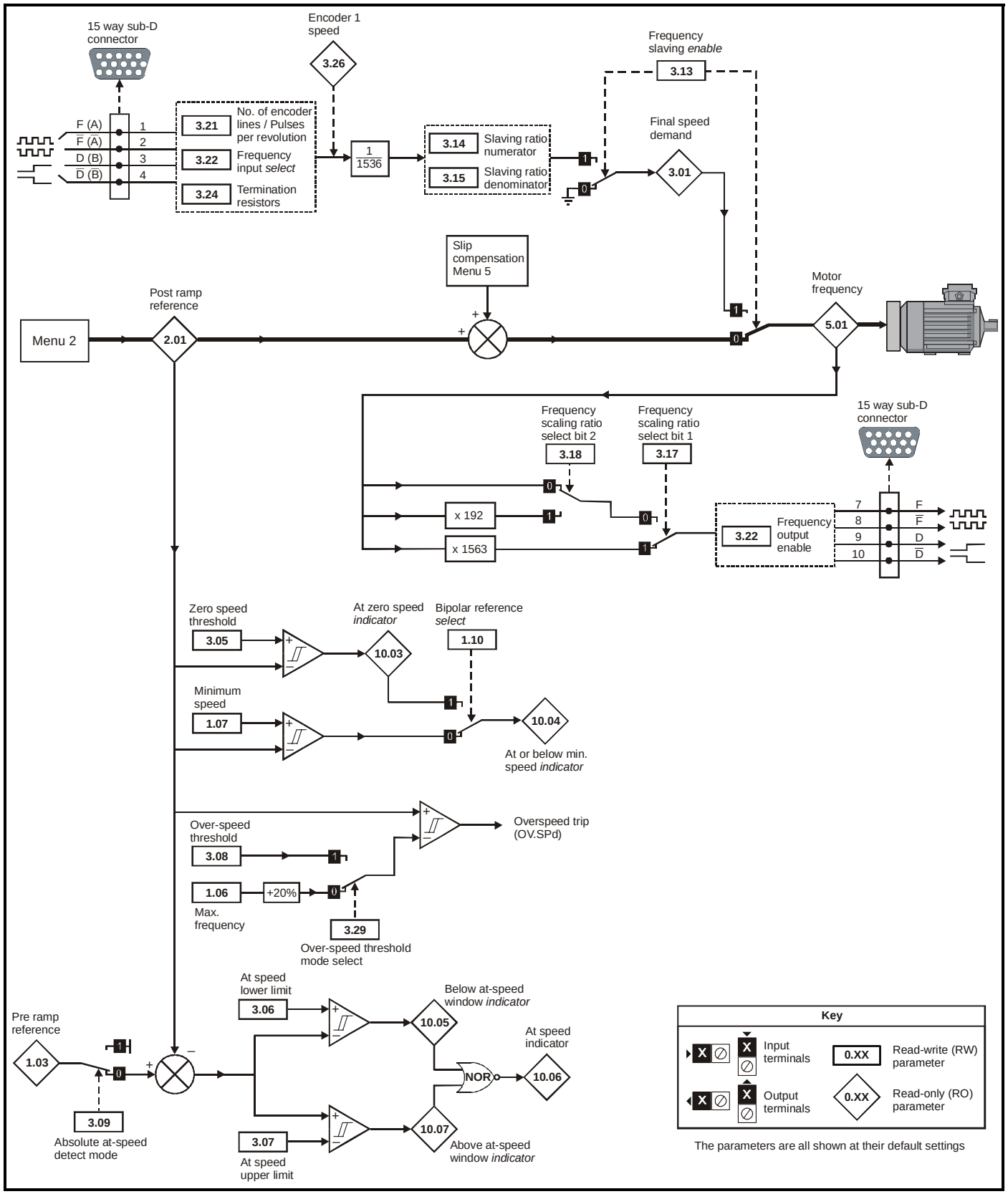
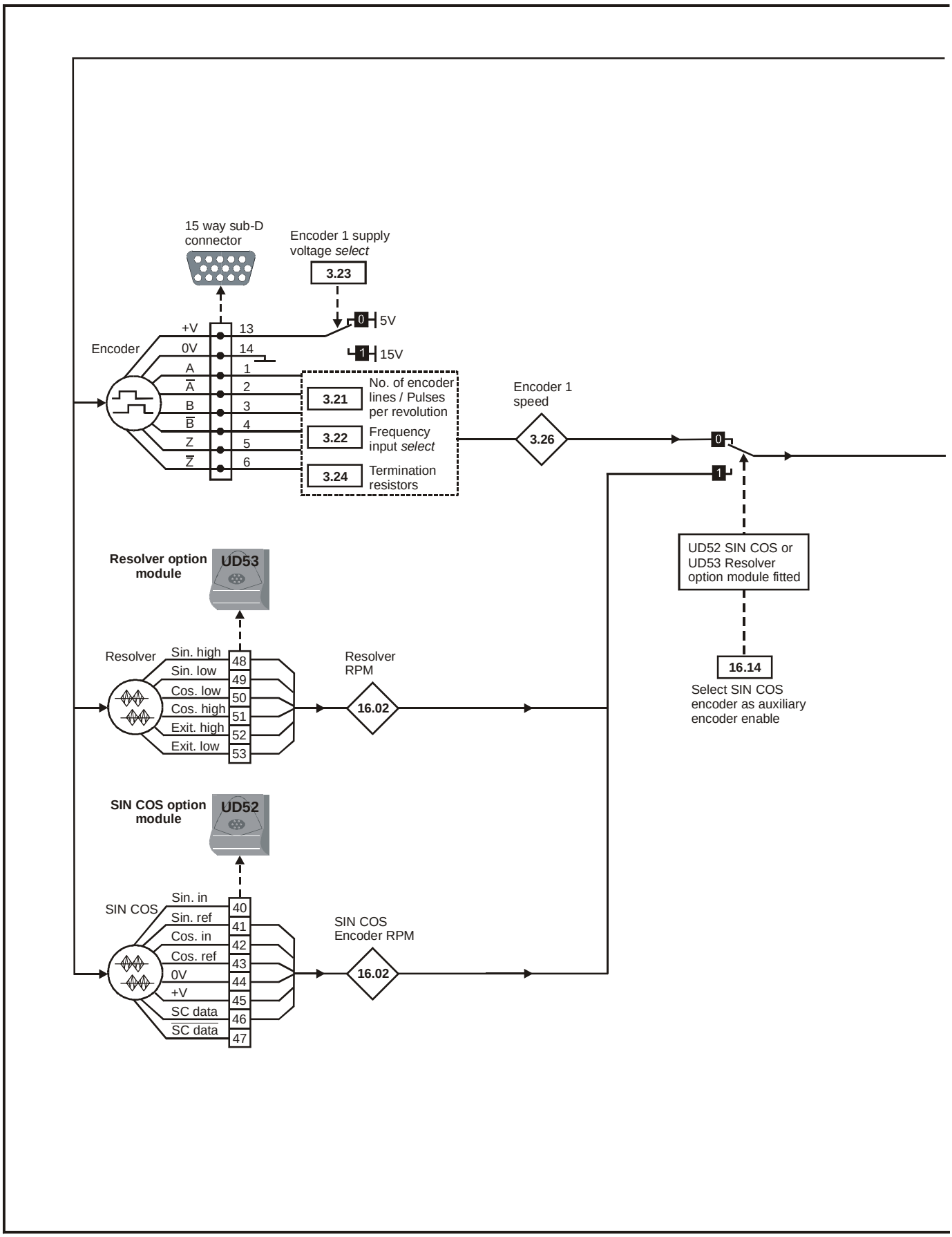
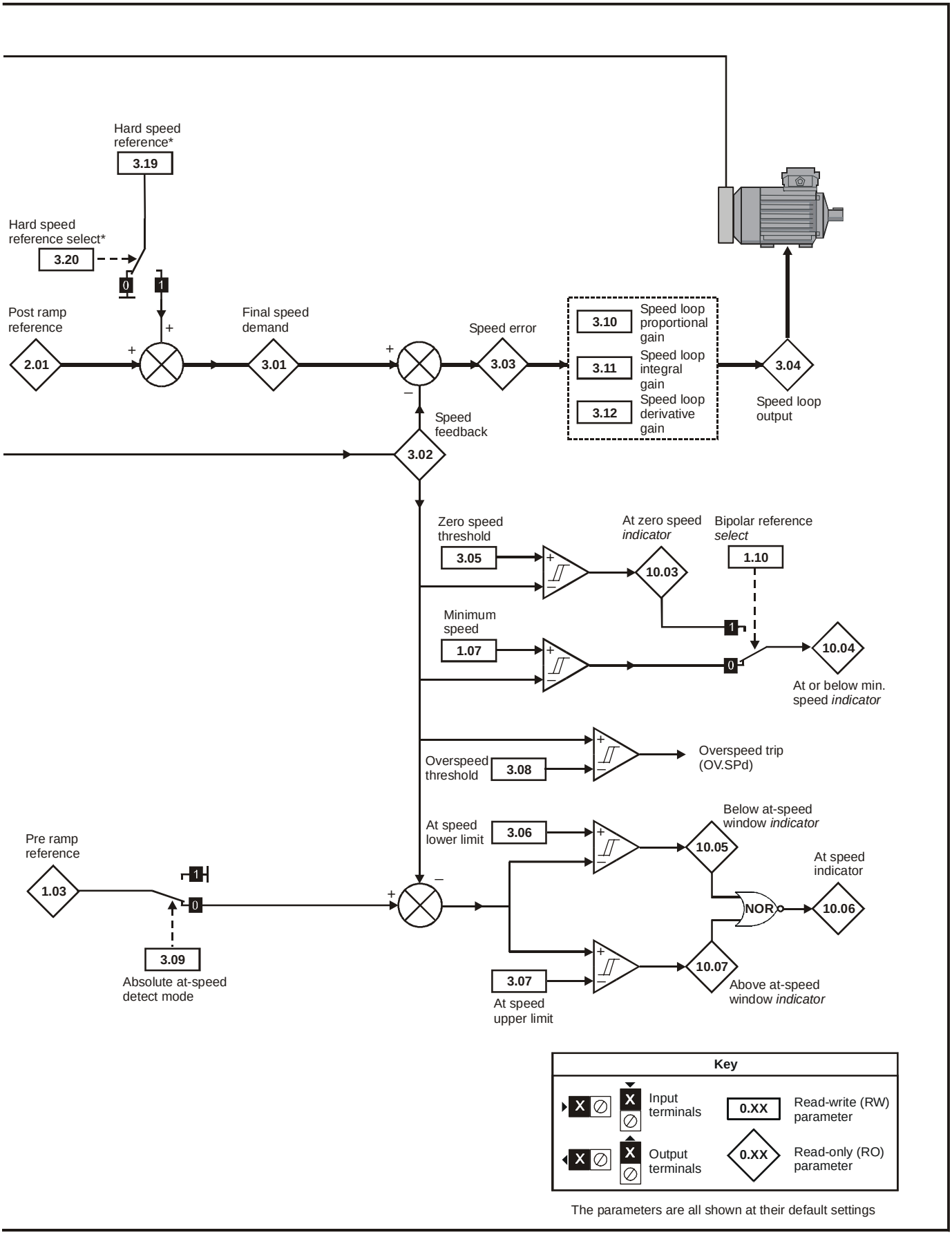


Figure 10-4 Menu 3 Closed-loop logic diagram





The parameters are all shown at their default settings

* For more information, refer to section 10.21.7 *Position loop modes* on page 172.

Parameter		Range(⇳)		Default(⇨)			Type			
		OL	CL	OL	VT	SV				
3.01	OL> Slave frequency-demand CL> Final speed demand	±1,000.0 Hz	±30,000 rpm				RO	Bi		P
3.02	Speed feedback {**0.10**}		±30,000 rpm				RO	Bi		P
3.03	Speed error		±30,000 rpm				RO	Bi		P
3.04	Speed loop output		$\pm I_{MAX}$ % *				RO	Bi		P
3.05	Zero-speed threshold	0 ~ 20.0 Hz	0 ~ 200 rpm	1	5	5	RW	Uni		
3.06	At-speed lower limit	0 ~ 1,000.0 Hz	0 ~ 30,000 rpm	1	5	5	RW	Uni		
3.07	At-speed upper limit	0 ~ 1,000.0 Hz	0 ~ 30,000 rpm	1	5	5	RW	Uni		
3.08	Over-speed threshold	0 ~ 1,000.0 Hz	0 ~ 30,000 rpm	1,000	2,000	4,000	RW	Uni		
3.09	Absolute at-speed detect mode	0 or 1	0 or 1	0	0	0	RW	Bit		
3.10	Speed-loop proportional gain {**0.07**}		0 ~ 32,000		200	200	RW	Uni		
3.11	Speed-loop integral gain {**0.08**}		0 ~ 32,000		100	100	RW	Uni		
3.12	Speed-loop derivative gain {**0.09**}		0 ~ 32,000		0	0	RW	Uni		
3.13	Frequency slaving *enable*	0 or 1		0			RW	Bit		
3.14	Slaving ratio numerator	0 ~ 1.000		1			RW	Uni		
3.15	Slaving ratio denominator	0.001 ~ 1.000		1			RW	Uni		
3.16	Frequency output *enable*	0 or 1		0			RW	Bit		
3.17	Frequency scaling ratio *select bit 1*	0 or 1		1			RW	Bit		
3.18	Frequency scaling ratio *select bit 2*	0 or 1		0			RW	Bit		
3.19	Hard speed reference**		±[**1.06**]		0	0	RW	Bi		
3.20	Hard speed reference *select***		0 or 1		0	0	RW	Bit		
3.21	No. of encoder lines / Pulses per revolution	256 ~ 10,000 Encoder lines / Pulses per rev	256 ~ 5,000 Encoder lines / Pulses per rev	1,024	1,024	4,096	RW	Uni		
3.22	Frequency input *select*	0 or 1	0 or 1	1	0	0	RW	Bit		
3.23	Encoder supply voltage *select*	0 or 1	0 or 1	0	0	0	RW	Bit		
3.24	Encoder termination *disable*	0 or 1	0 or 1	0	0	0	RW	Bit		
3.25 (0.40)	Encoder phasing test *enable*		0 or 1			0	RW	Bit		
3.26	Encoder 1 speed	±30,000 rpm	±30,000 rpm				RO	Bi		P
3.27	Encoder 1 position	0 ~ 16,383 revs /16,384	0 ~ 16,383 revs / 16,384				RO	Uni		P
3.28	Phase position		0 ~ 6,143 rev / 6143				RW	Uni	S	P
3.29	Over-speed threshold mode *select*	0 or 1		0			RW	Bit		
3.30	Speed feedback filter		0 ~ 10.0 ms		0	0	RW	Uni		
3.31	Servo phasing fail (ENCPH9) detection disable		0 or 1			0	RW	Bit		

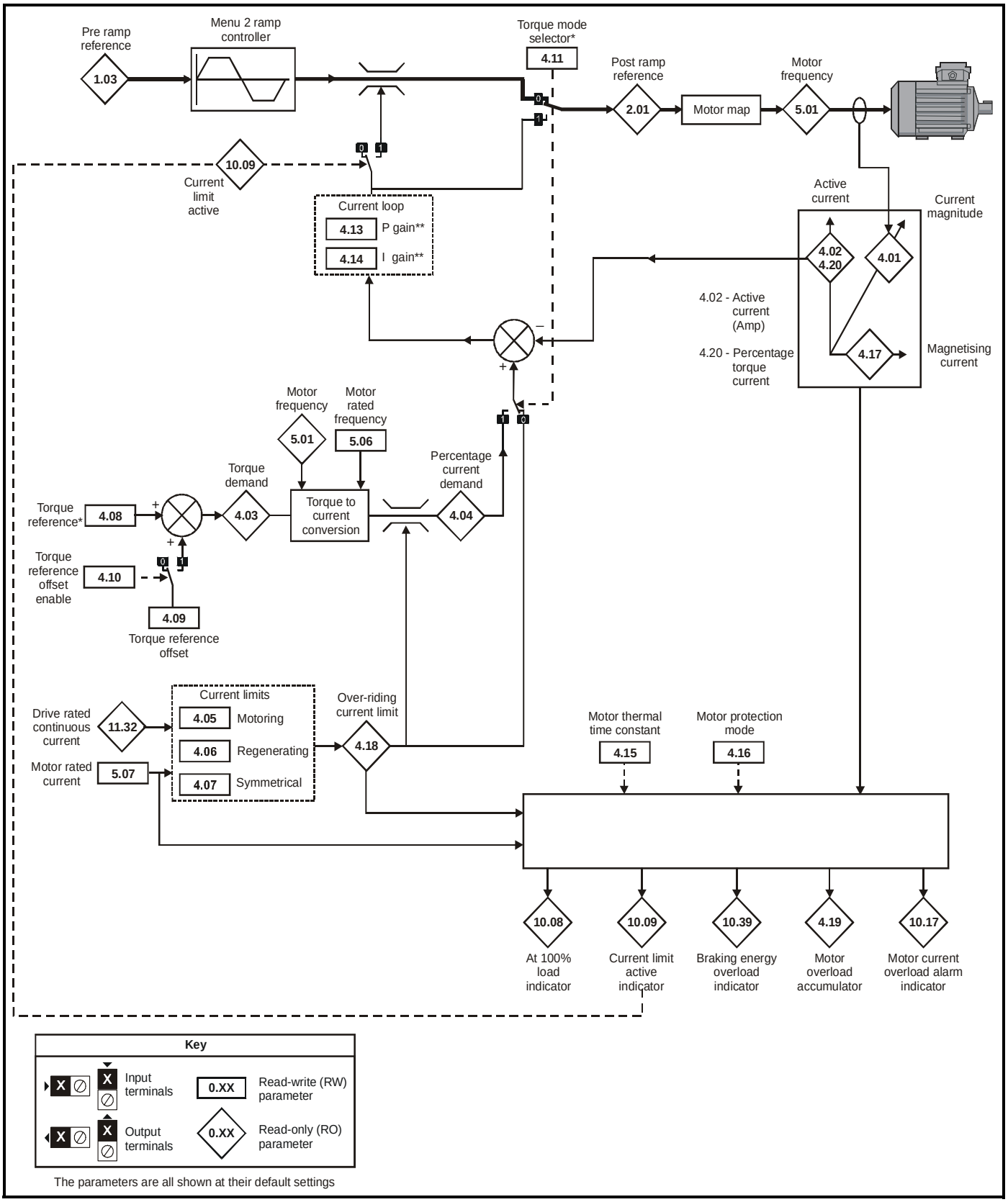
RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr **11.32** {**0.33**}

* For definition of $\pm I_{MAX}$ %, see Menu 4.

** For more information, refer to section 10.21.7 *Position loop modes* on page 172.

10.4 Menu 4: Current control

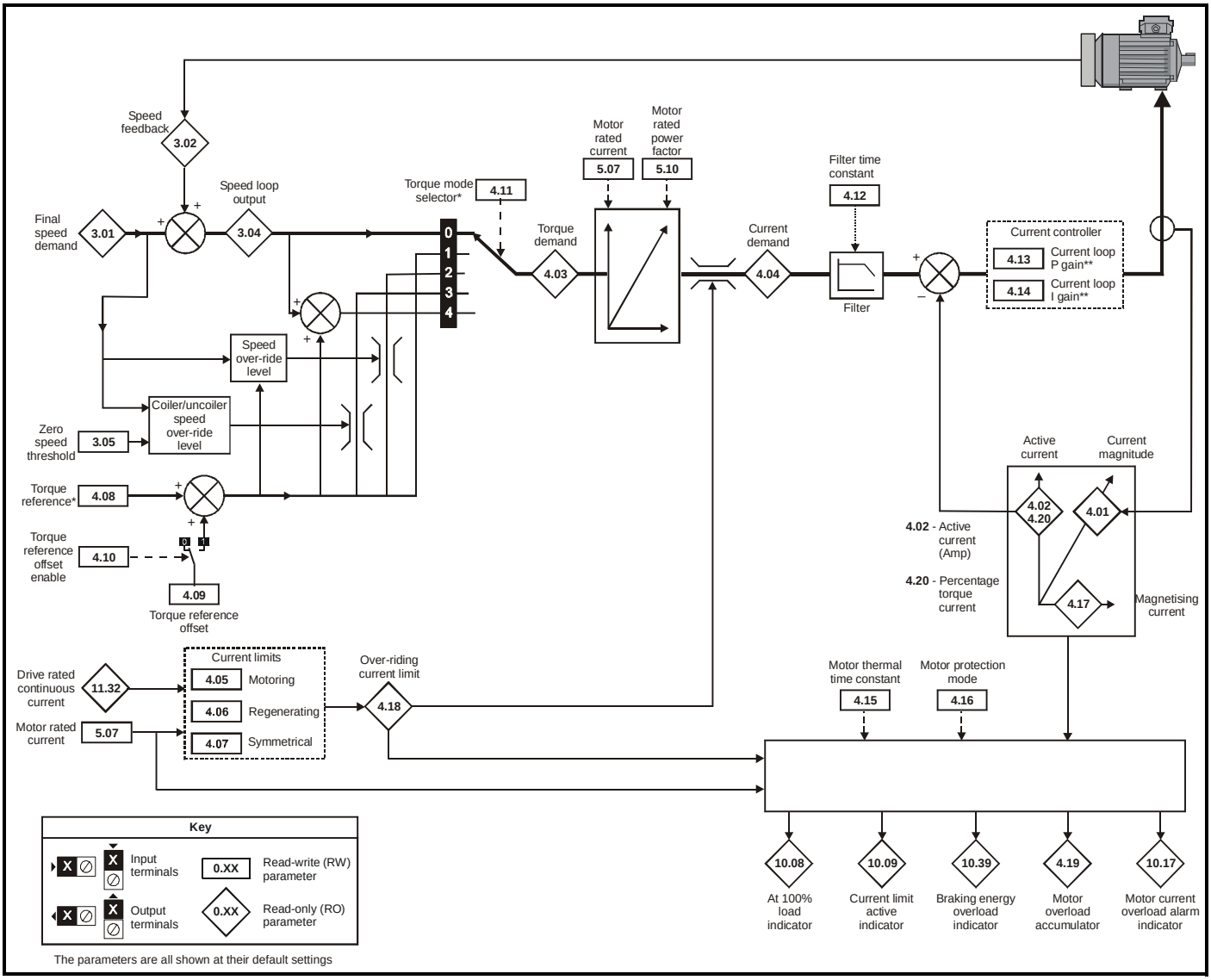
Figure 10-5 Menu 4 Open-loop logic diagram



* For more information, please refer to section 10.21.2 *Torque Modes* on page 166.

** For more information, please refer to section 10.21.4 *Mains loss modes* on page 168.

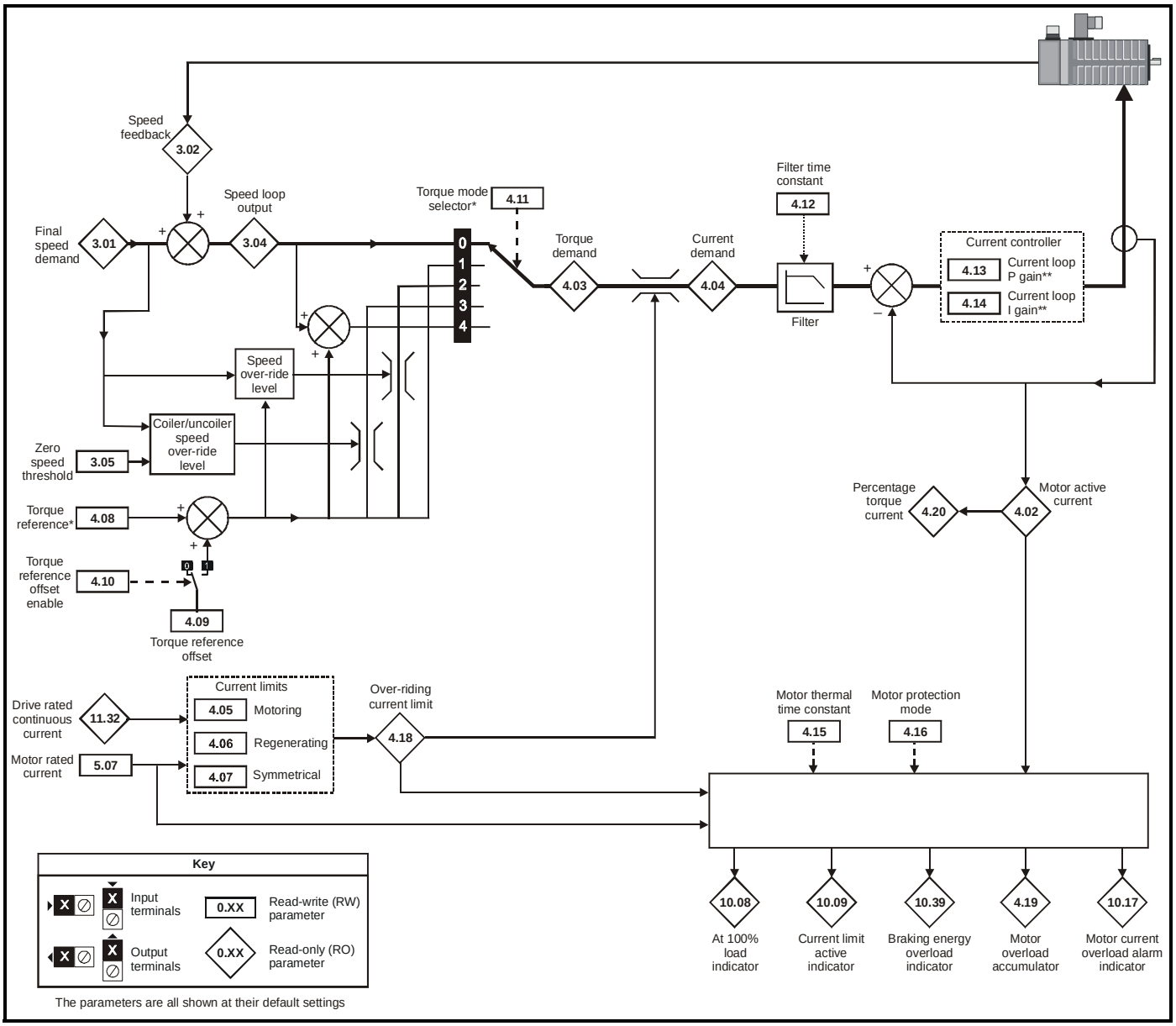
Figure 10-6 Menu 4 Closed-loop vector logic diagram



* For more information, please refer to section 10.21.2 *Torque Modes* on page 166.

** For more information, please refer to section 10.21.4 *Mains loss modes* on page 168. .

Figure 10-7 Menu 4 Servo logic diagram



* For more information, please refer to section 10.21.2 *Torque Modes* on page 166.

** For more information, please refer to section 10.21.4 *Mains loss modes* on page 168.

Parameter			Range(⇳)		Default(⇨)			Type			
			OL	CL	OL	VT	SV				
4.01	Motor current magnitude		0 ~ I_{MAX} A	0 ~ I_{MAX} A				RO	Uni		P
4.02	Motor active-current	{**0.13**}	± I_{MAX} A	± I_{MAX} A				RO	Bi		P
4.03	Torque demand		± I_{MAX} %	± I_{MAX} %				RO	Bi		P
4.04	Current demand		± I_{MAX} %	± I_{MAX} %				RO	Bi		P
4.05	Motoring current limit		0 ~ I_{MAX} %	0 ~ I_{MAX} %	150	150	175	RW	Uni		
4.06	Regenerating current limit		0 ~ I_{MAX} %	0 ~ I_{MAX} %	150	150	175	RW	Uni		
4.07	Symmetrical current limit	{**0.06**}	0 ~ I_{MAX} %	0 ~ I_{MAX} %	150	150	175	RW	Uni		
4.08	Torque reference*		± I_{MAX} %	± I_{MAX} %	0	0	0	RW	Bi		
4.09	Torque reference offset		± I_{MAX} %	± I_{MAX} %	0	0	0	RW	Bi		
4.10	Torque reference offset *enable*		0 or 1	0 or 1	0	0	0	RW	Bit		
4.11	Torque mode *selector**	{**0.17**}	0 ~ 1	0 ~ 4	0	0	0	RW	Uni		
4.12	Current-demand filter time-constant			0 ~ 250 ms		0	0	RW	Uni		
4.13	Current-loop proportional gain**		0 ~ 30,000	0 ~ 30,000	20	150	130	RW	Uni		
4.14	Current-loop integral gain**		0 ~ 30,000	0 ~ 30,000	40	2,000	1,200	RW	Uni		
4.15	Motor thermal time-constant		0 ~ 400.0 s	0 ~ 400.0 s	89	89	7	RW	Uni		
4.16	Motor protection mode *select*		0 or 1	0 or 1	0	0	0	RW	Bit		
4.17	Motor magnetizing current		± I_{MAX} A	± I_{MAX} A				RO	Bi		P
4.18	Over-riding current limit		0 ~ I_{MAX} %	0 ~ I_{MAX} %				RO	Uni		P
4.19	Overload accumulator		0 ~ 100 %	0 ~ 100 %				RO	Uni		P
4.20	Percentage torque current		0 ~ I_{MAX} %	0 ~ 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**}

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> FLC x 220%
Size 5> FLC x 170%

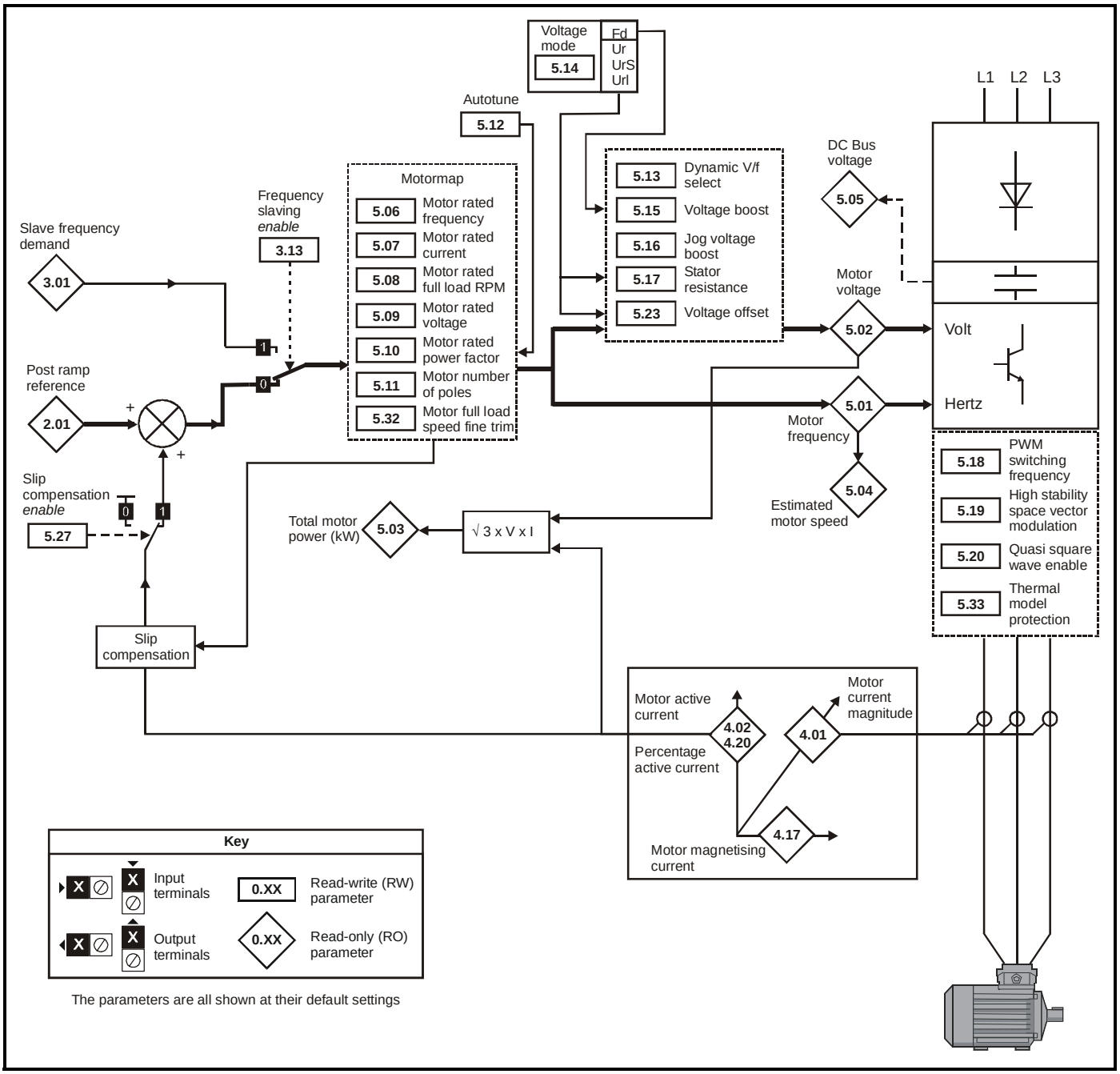
I_{MAX} % The range is the maximum permissible percentage of I_{MAX} where this maximum is derived from the equations for Pr **0.06** in *section 6.2 Menu 0 full descriptions* on page 57.

* For more information, please refer to section 10.21.2 *Torque Modes* on page 166.

** For more information, please refer to section 10.21.4 *Mains loss modes* on page 168.

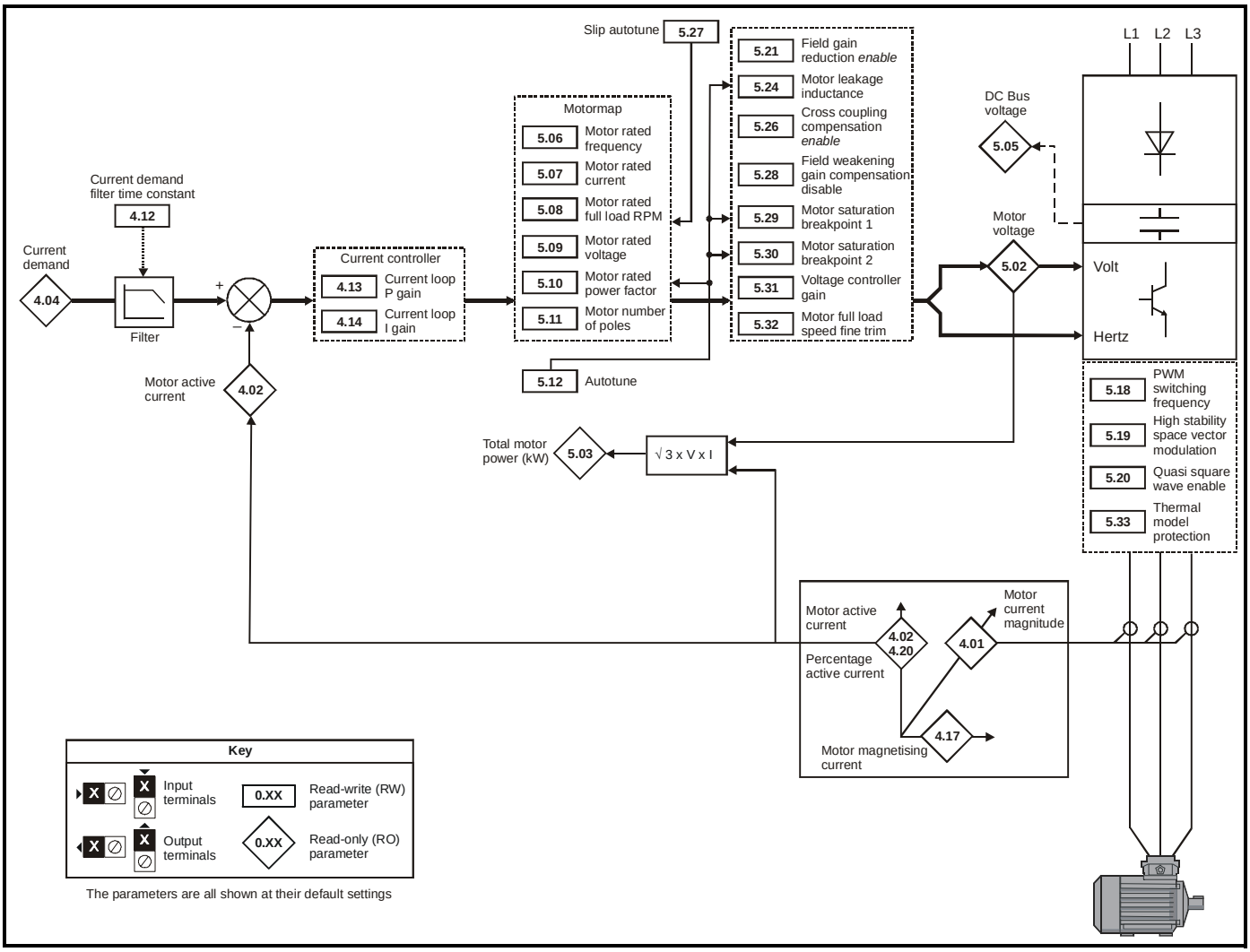
10.5 Menu 5: Machine control

Figure 10-8 Menu 5 Open-loop logic diagram



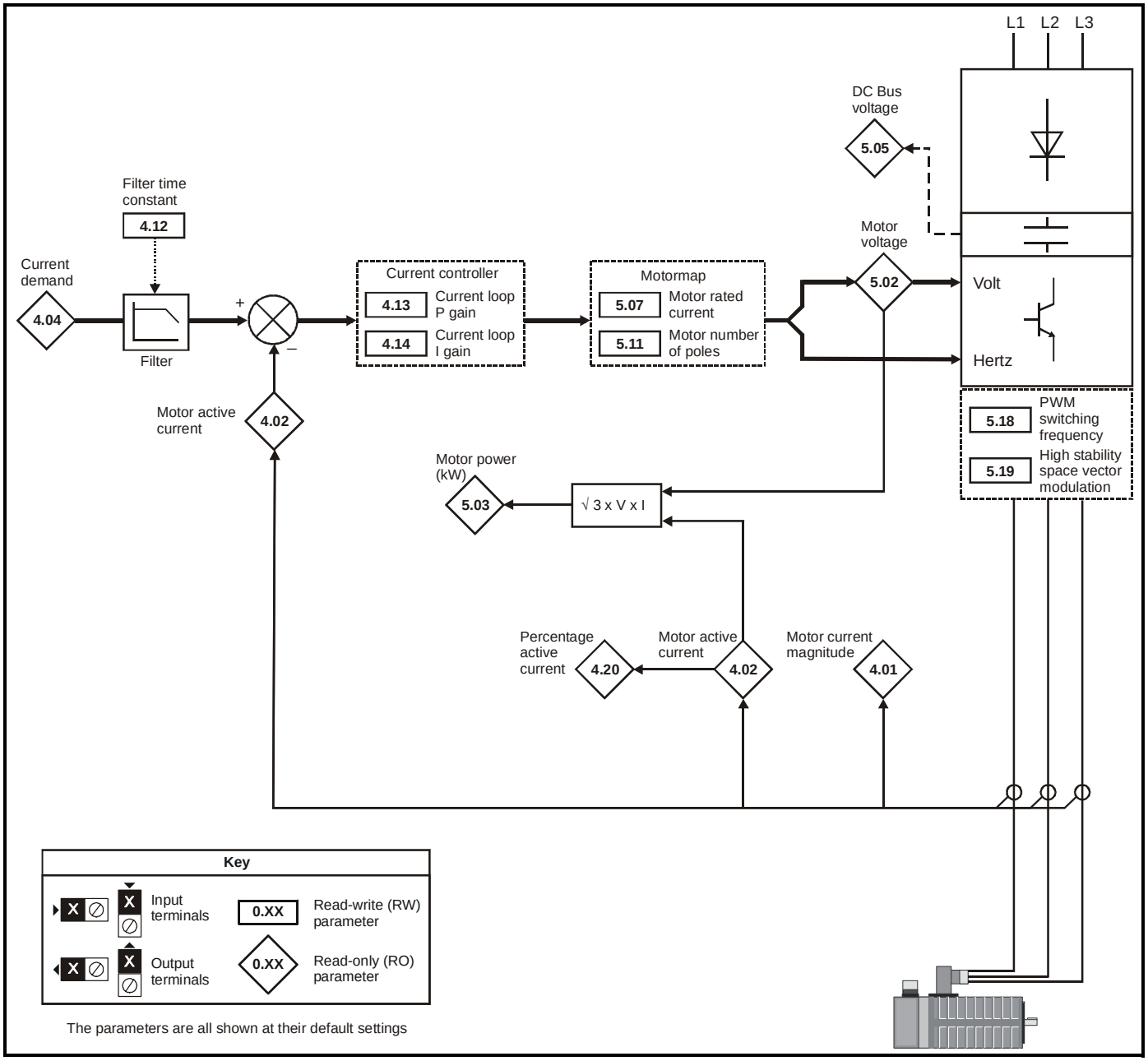
The parameters are all shown at their default settings

Figure 10-9 Menu 5 Closed-loop vector logic diagram



The parameters are all shown at their default settings

Figure 10-10 Menu 5 Servo logic diagram



Parameter			Range(⇳)		Default(⇨)			Type			
			OL	CL	OL	VT	SV				
5.01	Motor frequency		±[**1.06**]					RO	Bi		P
5.02	Motor voltage		0 ~ 528 V	0 ~ 528 V				RO	Bi		P
5.03	Total motor power		± P_{MAX} kW	± P_{MAX} kW				RO	Bi		P
5.04	Estimated motor speed	{**0.10**}	± 6000 rpm					RO	Bi		P
5.05	dc-bus voltage		0 ~ 830 V	0 ~ 830 V				RO	Uni		P
5.06	Motor - rated frequency	{**0.47**}	0 ~ 1000.0 Hz	0 ~ 1000.0 Hz	EUR> 50 USA> 60	EUR> 50 USA> 60		RW	Uni		
5.07	Motor - rated current	{**0.46**}	0 ~ FLC A	0 ~ FLC A	FLC	FLC	FLC	RW	Uni		
5.08	Motor - rated speed	{**0.45**}	0 ~ 6,000 rpm	0 ~ 30,000 rpm	0	EUR> 1,450 USA> 1,770		RW	Uni		
5.09	Motor - rated voltage	{**0.44**}	0 ~ 480 V	0 ~ 480 V	EUR> 400 USA> 460	EUR> 400 USA> 460		RW	Uni		
5.10	Motor - rated power factor	{**0.43**}	0 ~ 1.000	0 ~ 1.000	0.92	0.92		RW	Uni	S	P
5.11	Motor - number of poles	{**0.42**}	2 ~ 32	2 ~ 32	4	4	6	RW	Txt		P
5.12	Magnetizing current test *enable*	{**0.40**}	0 or 1	0 or 1	0	0		RW	Bit		P
5.13	Dynamic V/f *select*	{**0.09**}	0 or 1		0			RW	Bit		
5.14	Voltage mode *selector*	{**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 ~ 25.0 %	0 ~ 25.0 %	3	3		RW	Uni		
5.16	Jog boost-voltage		0 ~ 25.0 %		3			RW	Uni		
5.17	Stator resistance		0 ~ 32.000 Ω		0			RW	Uni	S	P
5.18	PWM switching frequency *selector*	{**0.41**}	3 kHz (0) 4.5 kHz (1) 6 kHz (2) 9 kHz (3) 12 kHz (4)	3 kHz (0) 4.5 kHz (1) 6 kHz (2) 9 kHz (3) 12 kHz (4)	3 (0)**	3 (0)**	3 (0)**	RW	Txt		
5.19	High-stability space-vector modulation *enable*		0 or 1	0 or 1	0	0	0	RW	Bit		
5.20	Quasi square-wave *enable*		0 or 1	0 or 1	0	0	0	RW	Bit		
5.21	Field-gain reduction *enable*			VT> 0 or 1		1		RW	Bit		
5.22	Maximum speed x10 *select*		0 or 1		0			RW	Bit		
5.23	Voltage offset		0 ~ 25.5 V		0			RO	Uni	S	P
5.24	Motor leakage inductance			0 ~ 320.00 mH		0	0	RW	Uni	S	P
5.25	Output frequency doubling *select*		0 or 1		0			RW	Bit		
5.26	Cross-coupling compensation *enable*			0 or 1		0	0	RW	Bit		
5.27	Slip compensation *enable*		0 or 1		1			RW	Bit		
5.27	Auto-optimize rated speed *enable*			0 or 1		0		RW	Bit		
5.27	Phasing test for motors with high inertia loads			0 or 1			0	RW	Bit		
5.28	Field-weakening gain compensation *disable*			0 or 1		0		RW	Bit		
5.29	Motor saturation breakpoint 1			0 ~ 100 %		50		RW	Uni		P
5.30	Motor saturation breakpoint 2			0 ~ 100 %		75		RW	Uni		P
5.31	Voltage-controller gain		0 ~ 30	0 ~ 30	1	1	1	RW	Uni		P
5.32	Motor full load speed fine trim		0 ~ 0.99 rpm	0 ~ 0.99 rpm	0	0		RW	Uni		P
5.33	Thermal model-protection *enable*		0 or 1	0 or 1	0	0	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**}

Power rating

$$P_{MAX} \quad \sqrt{3} \times I_{MAX} \times \frac{[5.09]}{1000}$$

For definition of I_{MAX}, see Menu 4

NOTE

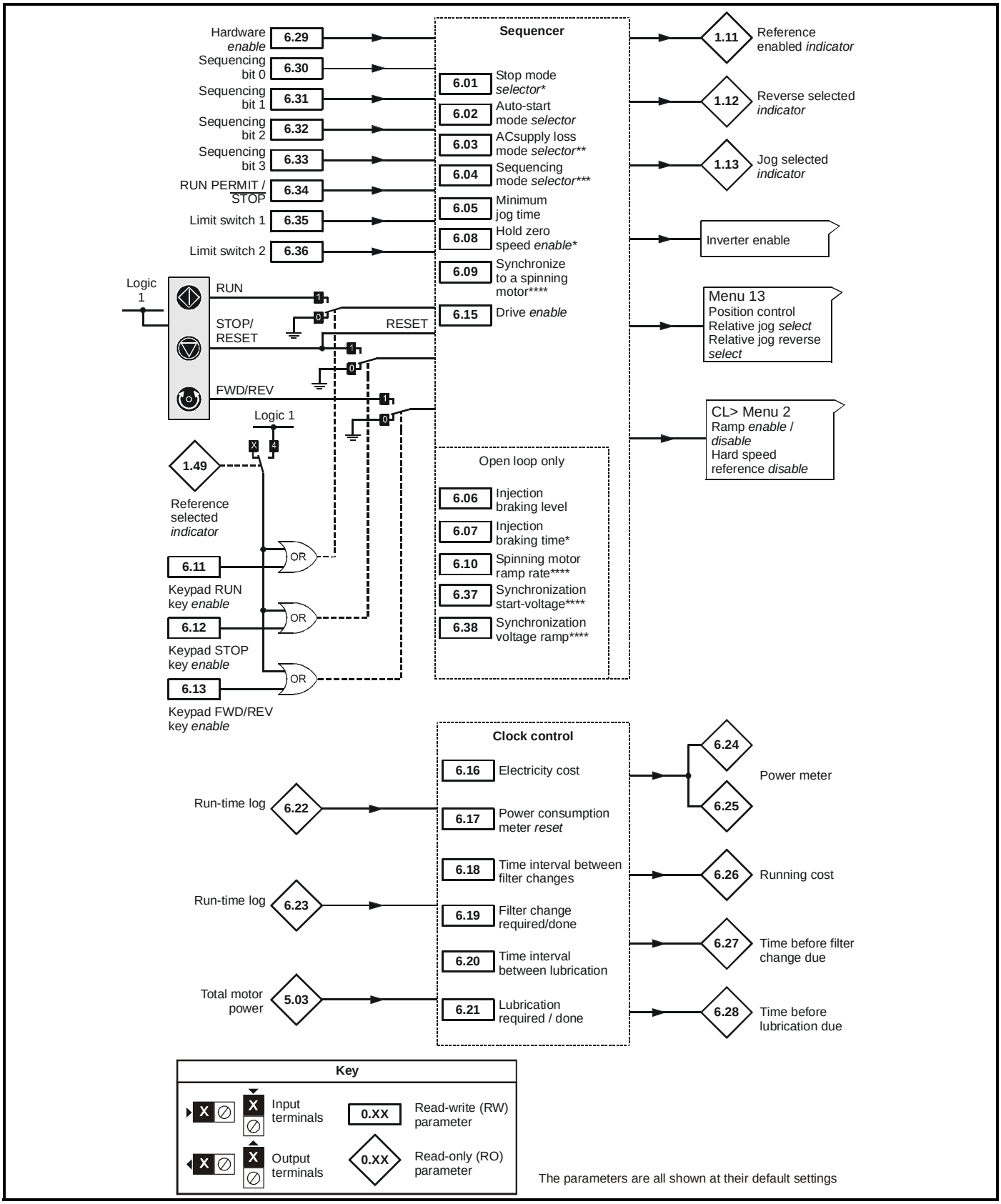
Where a parameter is represented by a text value, the value in brackets in the range column is the setting used for serial communications.

* 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.

10.6 Menu 6: Sequencing logic

Figure 10-11 Menu 6 logic diagram



* For more information, refer to section 10.21.3 *Stop Modes* on page 168.

** For more information, refer to section 10.21.4 *Mains loss modes* on page 168.

*** For more information, refer to section 10.21.5 *Sequencing Modes* on page 170.

**** For more information, refer to section 10.21.6 *Catch a spinning motor* on page 171.

Parameter		Range(⇳)		Default(⇨)			Type			
		OL	CL	OL	VT	SV				
6.01	Stop mode *selector** {**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)	rP (1)	no.rP (2)	RW	Txt		
6.02	Auto-start mode *selector*	diS (0) ALYS (1) Pd.dP (2)	diS (0) ALYS (1) Pd.dP (2)	diS (0)	diS (0)	diS (0)	RW	Txt		
6.03	AC supply loss mode *selector***	diS (0) StoP (1) ridE.th (2)	diS (0) StoP (1) ridE.th (2)	diS (0)	diS (0)	diS (0)	RW	Txt		P
6.04	Sequencing mode *selector****	0 ~ 4	0 ~ 4	4	4	4	RW	Uni		P
6.05	Minimum jog time	0 ~ 25.0 s	0 ~ 25.0 s	0	0	0	RW	Uni		
6.06	Injection braking level	0 ~ 100.0 %FLC		100			RW	Uni		
6.07	Injection braking time*	0 ~ 25.0 s		5			RW	Uni		
6.08	Hold zero speed *enable**	0 or 1	0 or 1	0	0	1	RW	Bit		
6.09	Synchronize to a spinning motor**** {**0.39**}	0 or 1	0 or 1	0	1	1	RW	Bit		
6.10	Synchronization ramp rate****	0 ~ 25.0 s/100Hz		5			RW	Uni		
6.11	Keypad run key *enable*	0 or 1	0 or 1	0	0	0	RW	Bit		
6.12	Keypad stop key *enable*	0 or 1	0 or 1	0	0	0	RW	Bit		
6.13	Keypad fwd/rev key *enable*	0 or 1	0 or 1	0	0	0	RW	Bit		
6.15	Drive *enable*	0 or 1	0 or 1	1	1	1	RW	Bit		
6.16	Electricity cost / kWh	0 ~ 600.0 Currency/kWh	0 ~ 600.0 Currency/kWh	0	0	0	RW	Uni		
6.17	Power consumption meter *reset*	0 or 1	0 or 1	0	0	0	RW	Bit		
6.18	Time interval between filter changes	0 ~ 30,000 hr	0 ~ 30,000 hr	0	0	0	RW	Uni		
6.19	Filter change required/done	0 or 1	0 or 1	0	0	0	RW	Bit		
6.20	Time interval between lubrication	0 ~ 30,000 hr	0 ~ 30,000 hr	0	0	0	RW	Uni		
6.21	Lubrication required/done	0 or 1	0 or 1	0	0	0	RW	Bit		
6.22	Run-time log	0 ~ 30.365 years.days	0 ~ 30.365 years.days				RO	Uni	S	P
6.23	Run-time log	0 ~ 23.59 hr min	0 ~ 23.59 hr min				RO	Uni	S	P
6.24	Power meter	0 ~ 30,000 MWh	0 ~ 30,000 MWh				RO	Uni	S	P
6.25	Power meter	0 ~ 999.9 kWh	0 ~ 999.9 kWh				RO	Uni	S	P
6.26	Running cost	0 ~ 32,000 Currency/hr	0 ~ 32,000 Currency/hr				RO	Uni	S	P
6.27	Time before filter change due	0 ~ 30,000 hr	0 ~ 30,000 hr				RO	Uni	S	P
6.28	Time before lubrication due	0 ~ 30,000 hr	0 ~ 30,000 hr				RO	Uni	S	P
6.29	Hardware *enable*	0 or 1	0 or 1				RO	Bit		P
6.30	Sequencing bit 0	0 or 1	0 or 1	0	0	0	RW	Bit		
6.31	Sequencing bit 1	0 or 1	0 or 1	0	0	0	RW	Bit		
6.32	Sequencing bit 2	0 or 1	0 or 1	0	0	0	RW	Bit		
6.33	Sequencing bit 3	0 or 1	0 or 1	0	0	0	RW	Bit		
6.34	run permit / ~~stop~~	0 or 1	0 or 1	0	0	0	RW	Bit		
6.35	Limit switch 1	0 or 1	0 or 1				RO	Bit		
6.36	Limit switch 2	0 or 1	0 or 1				RO	Bit		
6.37	Spinning motor start-voltage****	0 ~ 100.0 %		25			RW	Uni		
6.38	Spinning motor voltage-ramp****	0 ~ 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 10.21.3 *Stop Modes* on page 168.

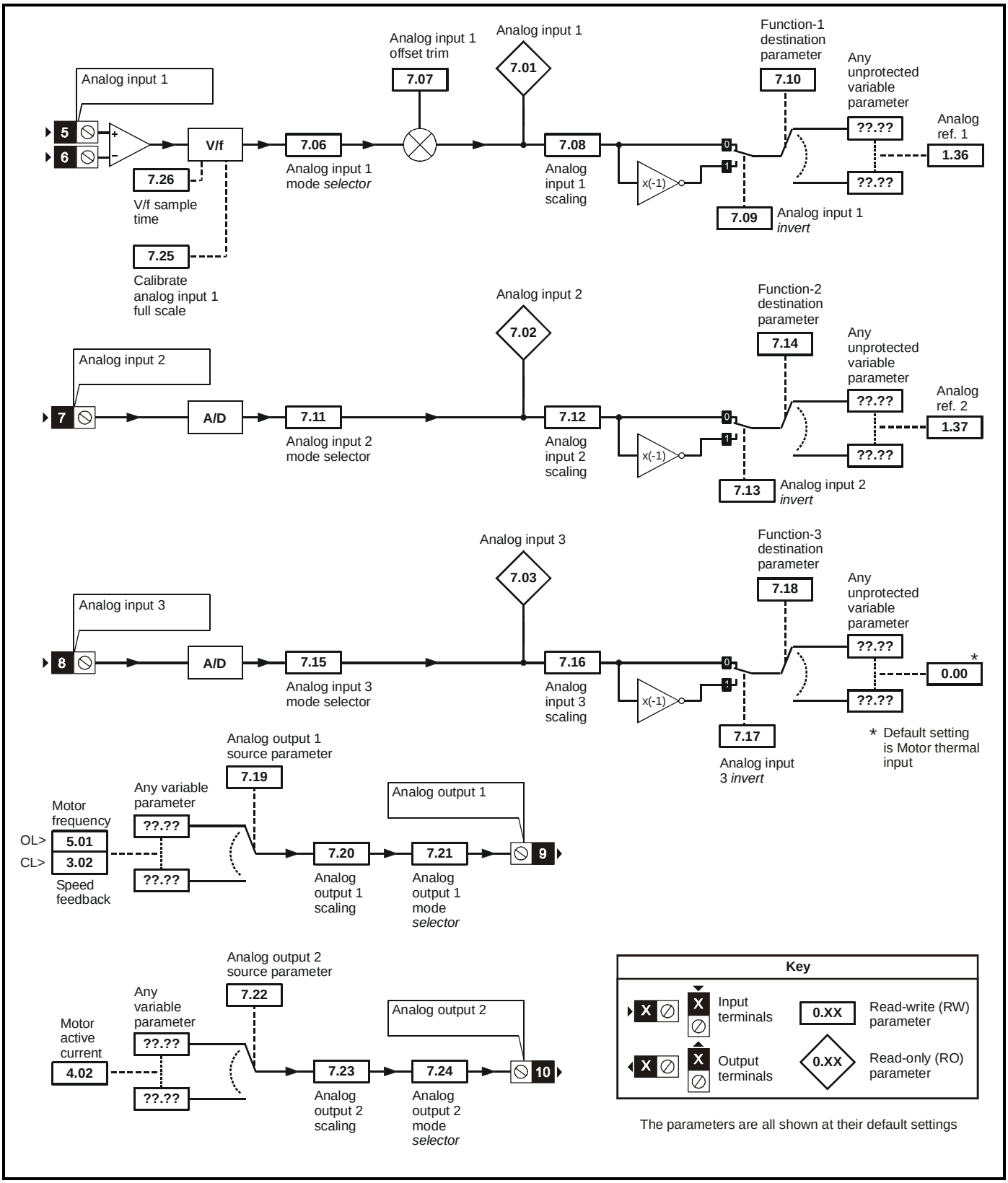
** For more information, refer to section 10.21.4 *Mains loss modes* on page 168.

*** For more information, refer to section 10.21.5 *Sequencing Modes* on page 170.

**** For more information, refer to section 10.21.6 *Catch a spinning motor* on page 171.

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 %	±100.0 %				RO	Bi		P
7.02	Analog input 2		±100.0 %	±100.0 %				RO	Bi		P
7.03	Analog input 3		±100.0 %	±100.0 %				RO	Bi		P
7.04	Heatsink temperature		0 ~ 100 °C	0 ~ 100 °C				RO	Uni		P
7.05	Control board temperature		0 ~ 100 °C	0 ~ 100 °C				RO	Uni		P
7.06	Analog input 1 mode *selector*	{**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) 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)	VOLt (0)	VOLt (0)	RW	Txt	R	
7.07	Analog input 1 offset trim		±10.000 %	±10.000 %	0	0	0	RW	Bi		P
7.08	Analog input 1 scaling		0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
7.09	Analog input 1 *invert*		0 or 1	0 or 1	0	0	0	RW	Bit		
7.10	Analog input 1 destination parameter		**0.00** ~ **20.50** Menu.parameter	**0.00** ~ **20.50** Menu.parameter	**1.36**	**1.36**	**1.36**	RW	Uni	R	P
7.11	Analog input 2 mode *selector*	{**0.25**}	(as **7.06**)	(as **7.06**)	VOLt (0)	VOLt (0)	VOLt (0)	RW	Txt	R	
7.12	Analog input 2 scaling		0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
7.13	Analog input 2 *invert*		0 or 1	0 or 1	0	0	0	RW	Bit		
7.14	Analog input 2 destination parameter	{**0.26**}	**0.00** ~ **20.50** Menu.parameter	**0.00** ~ **20.50** Menu.parameter	**1.37**	**1.37**	**1.37**	RW	Uni	R	P
7.15	Analog input 3 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) th.SC (9) th (10)	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)	EUR> th (10) USA> VOLt (0)	EUR> th (10) USA> VOLt (0)	RW	Txt	R	
7.16	Analog input 3 scaling		0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
7.17	Analog input 3 *invert*		0 or 1	0 or 1	0	0	0	RW	Bit		
7.18	Analog input 3 destination parameter		**0.00** ~ **20.50** Menu.parameter	**0.00** ~ **20.50** Menu.parameter	0	0	0	RW	Uni	R	P
7.19	Analog output 1 source parameter		**0.00** ~ **20.50** Menu.parameter	**0.00** ~ **20.50** Menu.parameter	**5.01**	**3.02**	**3.02**	RW	Uni	R	P
7.20	Analog output 1 scaling		0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
7.21	Analog output 1 mode *selector*		VOLt (0) 0 - 20 (1) 4 - 20 (2)	VOLt (0) 0 - 20 (1) 4 - 20 (2)	VOLt (0)	VOLt (0)	VOLt (0)	RW	Txt	R	P
7.22	Analog output 2 source parameter		**0.00** ~ **20.50** Menu.parameter	**0.00** ~ **20.50** Menu.parameter	**4.02**	**4.02**	**4.02**	RW	Uni	R	P
7.23	Analog output 2 scaling		0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
7.24	Analog output 2 mode *selector*		VOLt (0) 0 - 20 (1) 4 - 20 (2)	VOLt (0) 0 - 20 (1) 4 - 20 (2)	VOLt (0)	VOLt (0)	VOLt (0)	RW	Txt	R	P
7.25	Calibrate analog input 1 full scale		0 or 1	0 or 1	0	0	0	RW	Bit		
7.26	V/f sample time			0 ~ 5.0 ms		4	4	RW	Uni		
7.27	Analog input 1 current-loop loss *indicator*		0 or 1	0 or 1				RO	Bit		P
7.28	Analog input 2 current-loop loss *indicator*		0 or 1	0 or 1				RO	Bit		P
7.29	Analog input 3 current-loop loss *indicator*		0 or 1	0 or 1				RO	Bit		P
7.30	Analog output set-up *enable*		0 or 1	0 or 1	0	0	0	RW	Bit		
7.31	UD78 large option module fitted *indicator*		0 or 1	0 or 1				RO	Bit		P
7.32	IGBT junction temperature		0 ~ 150 °C	0 ~ 150 °C				RO	Uni		P

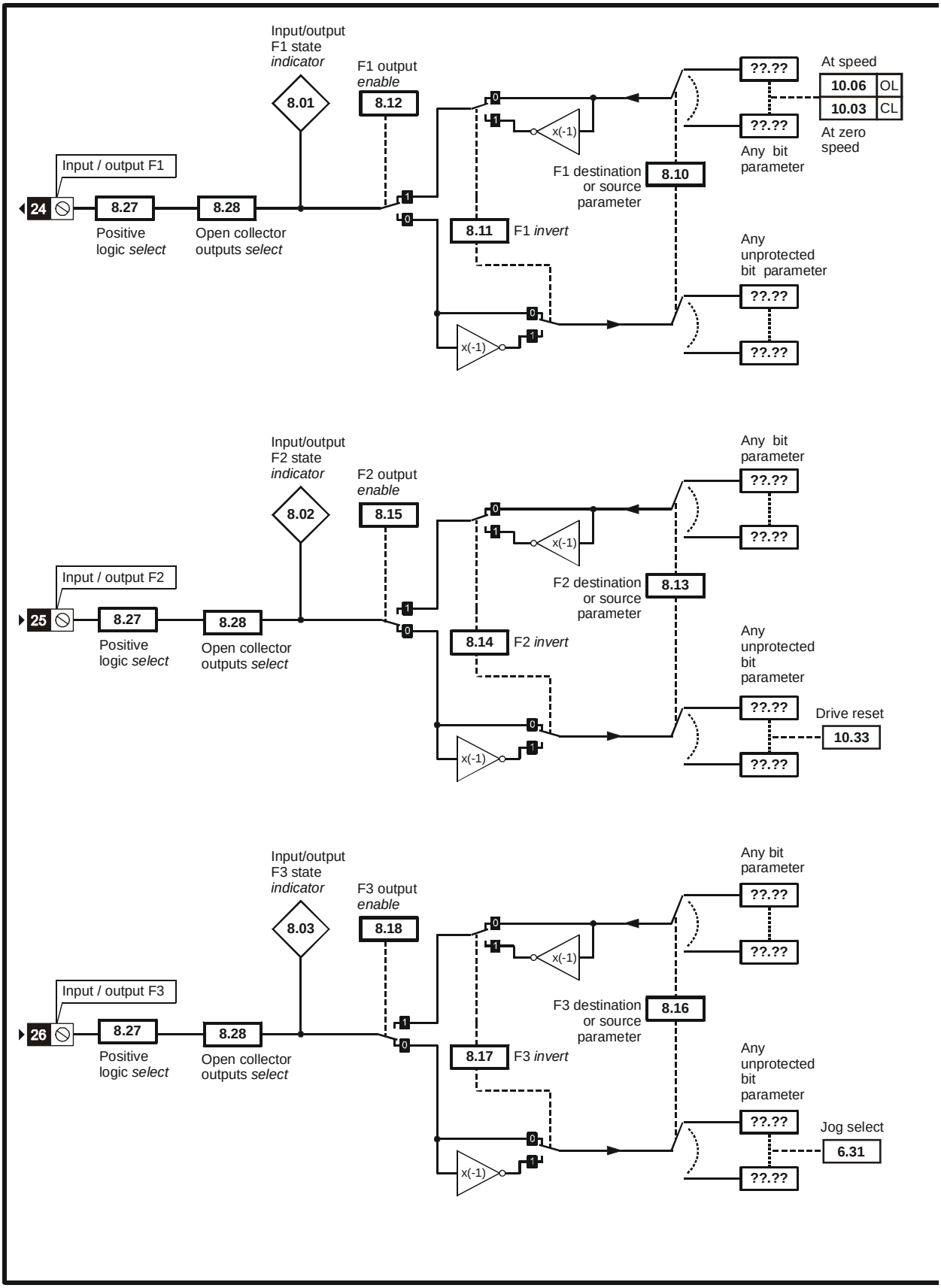
RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr **11.32** {**0.33**}

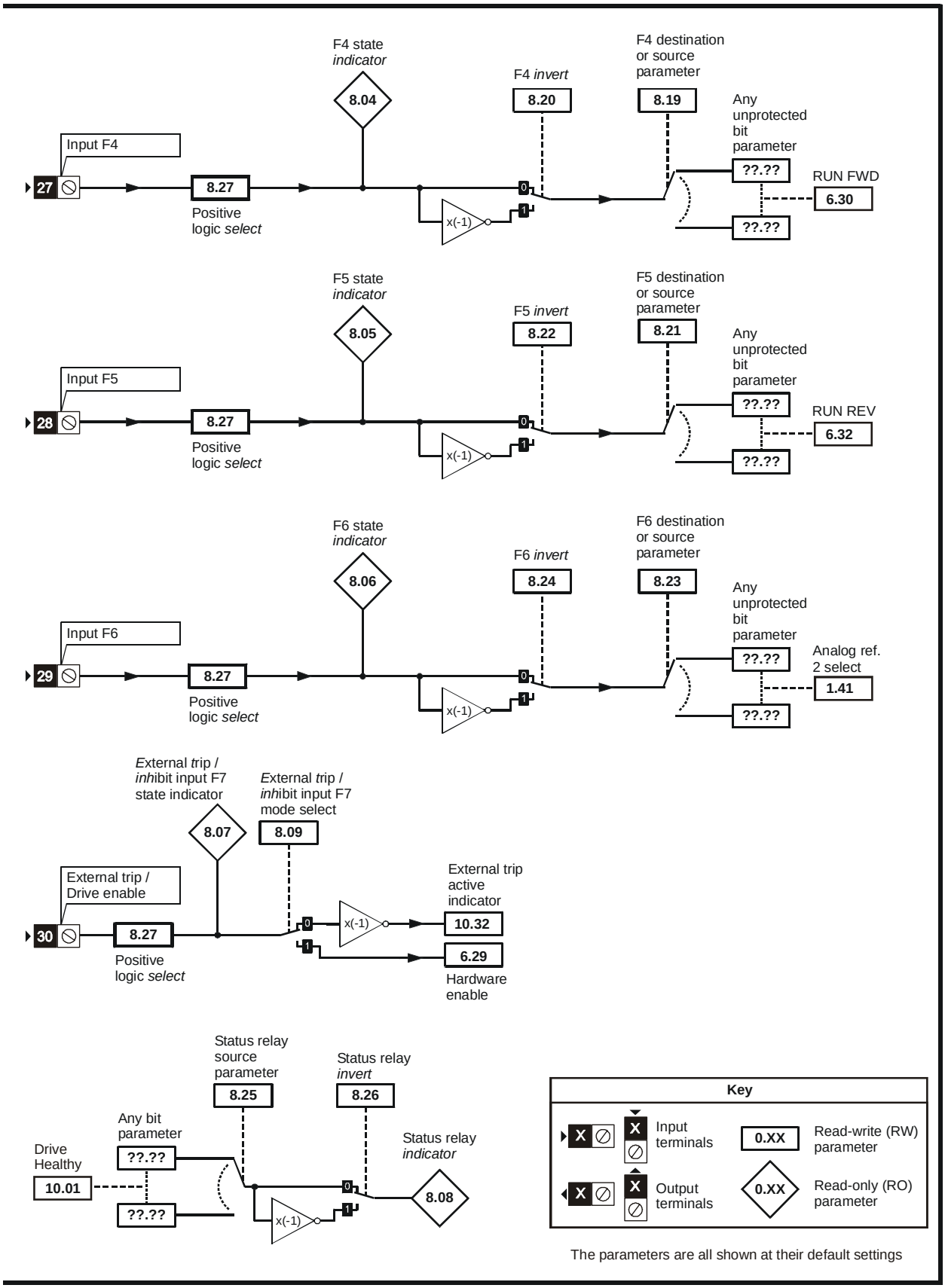
NOTE

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





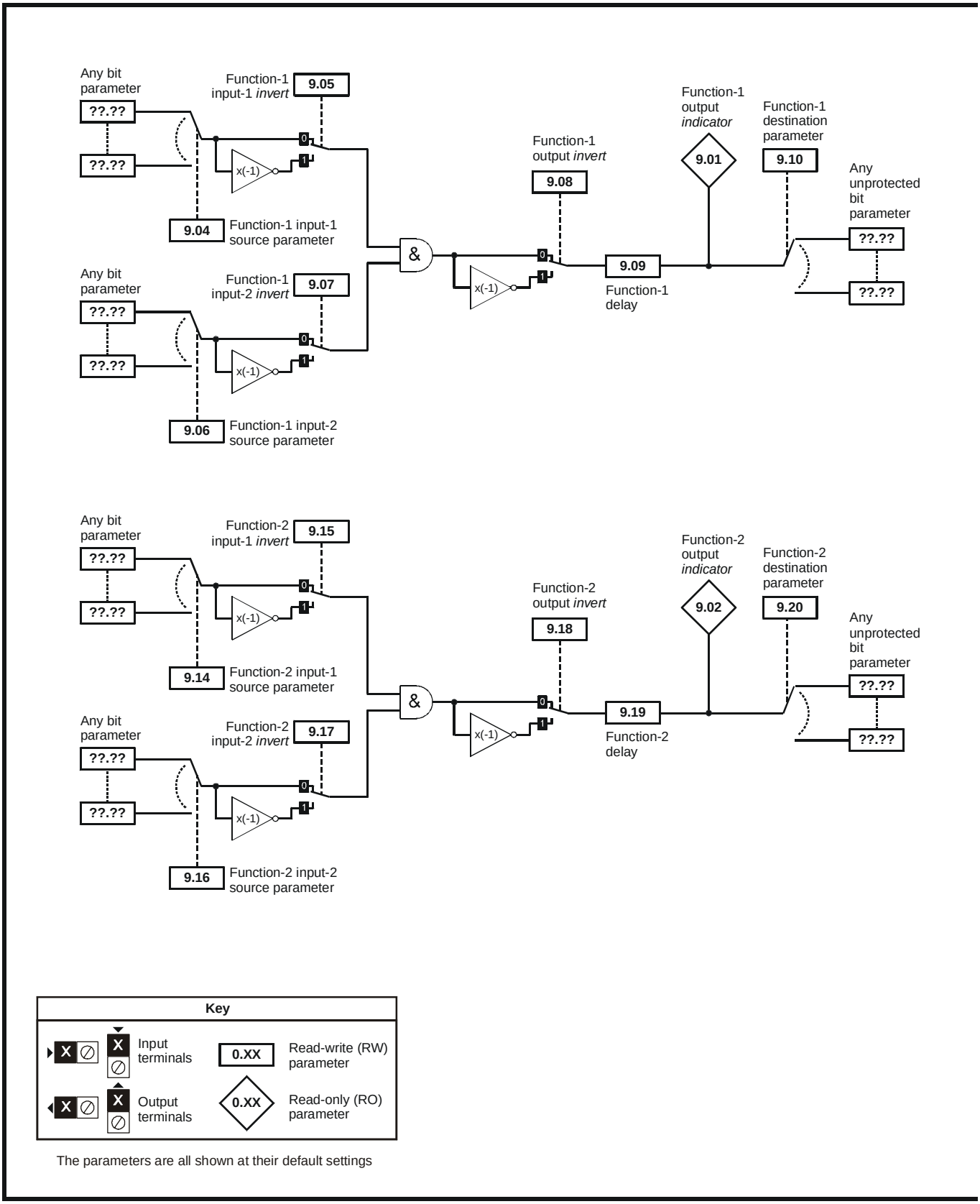
The parameters are all shown at their default settings

Parameter		Range(⇳)		Default(⇨)			Type			
		OL	CL	OL	VT	SV				
8.01	Digital input/output F1 *state*	0 or 1					RO	Bit		P
8.02	Digital input/output F2 *state*	0 or 1					RO	Bit		P
8.03	Digital input/output F3 *state*	0 or 1					RO	Bit		P
8.04	Digital input F4 *state*	0 or 1					RO	Bit		P
8.05	Digital input F5 *state*	0 or 1					RO	Bit		P
8.06	Digital input F6 *state*	0 or 1					RO	Bit		P
8.07	Terminal 30 *state*	0 or 1					RO	Bit		P
8.08	Status relay output *indicator*	0 or 1					RO	Bit		P
8.09	Terminal 30 function *select*	0 or 1		0			RW	Bit		
8.10	F1 destination or source parameter	**0.00** ~ **20.50** Menu.parameter		**10.06**			RW	Uni	R	P
8.11	F1 *invert*	0 or 1		0			RW	Bit		
8.12	F1 output *enable*	0 or 1		1			RW	Bit	R	
8.13	F2 destination or source parameter	**0.00** ~ **20.50** Menu.parameter		**10.33**			RW	Uni	R	P
8.14	F2 *invert*	0 or 1		0			RW	Bit		
8.15	F2 output *enable*	0 or 1		0			RW	Bit	R	
8.16	F3 destination or source parameter	**0.00** ~ **20.50** Menu.parameter		**6.31**			RW	Uni	R	P
8.17	F3 *invert*	0 or 1		0			RW	Bit		
8.18	F3 output *enable*	0 or 1		0			RW	Bit	R	
8.19	F4 destination parameter	**0.00** ~ **20.50** Menu.parameter		**6.30**			RW	Uni	R	P
8.20	F4 *invert*	0 or 1		0			RW	Bit		
8.21	F5 destination parameter	**0.00** ~ **20.50** Menu.parameter		**6.32**			RW	Uni	R	P
8.22	F5 *invert*	0 or 1		0			RW	Bit		
8.23	F6 destination parameter	**0.00** ~ **20.50** Menu.parameter		**1.41**			RW	Uni	R	P
8.24	F6 *invert*	0 or 1		0			RW	Bit		
8.25	Status relay source parameter	**0.00** ~ **20.50** Menu.parameter		**10.01**			RW	Uni	R	P
8.26	Status relay *invert*	0 or 1		0			RW	Bit		
8.27	Positive logic *select*	0 or 1		0			RW	Bit	R	P
8.28	Open-collector outputs *select*	0 or 1		0			RW	Bit	R	P

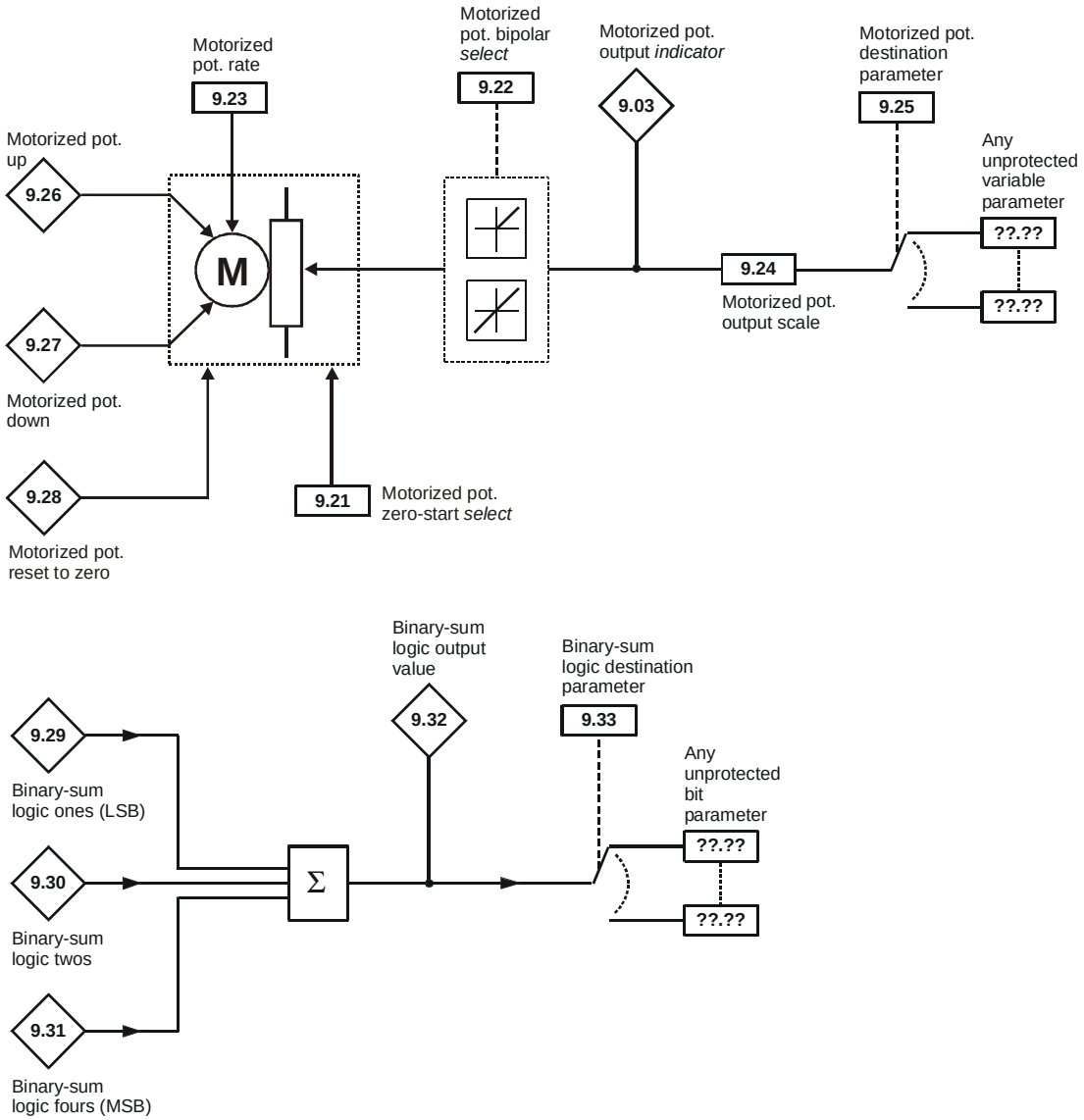
RO	Read Only parameter	Uni	Unipolar variable parameter	R	Reset required for new value to take effect
		Bi	Bipolar variable parameter	S	New parameter-value saved at power-down
RW	Read / Write parameter	Txt	Text variable parameter	P	Protected; forbidden as destination parameter
		Bit	Bit parameter	FLC	Full-load current (max. continuous), Pr **11.32** {**0.33**}

10.9 Menu 9: Programmable logic

Figure 10-14 Menu 9 logic diagram



The parameters are all shown at their default settings


Motorized pot. rate
9.23
Motorized pot. bipolar *select*
9.22
Motorized pot. output *indicator*
9.03
Motorized pot. destination parameter
9.25
Any unprotected variable parameter
??.??
??.??
Motorized pot. up
9.26
M
9.24
Motorized pot. output scale
9.27
Motorized pot. down
9.28
Motorized pot. reset to zero
9.21
Motorized pot. zero-start *select*
Binary-sum logic output value
9.32
Binary-sum logic destination parameter
9.33
Any unprotected bit parameter
??.??
??.??
9.29
Binary-sum logic ones (LSB)
9.30
Binary-sum logic twos
9.31
Binary-sum logic fours (MSB)
Σ

Parameter		Range(⇳)		Default(⇨)			Type			
		OL	CL	OL	VT	SV				
9.01	Prog.-logic function 1 output *indicator*	0 or 1					RO	Bit		P
9.02	Prog.-logic function 2 output *indicator*	0 or 1					RO	Bit		P
9.03	Motorized pot. output *indicator*	±100.0 %					RO	Bi	S	P
9.04	Prog.-logic function 1 input 1 source parameter	**0.00** ~ **20.50** Menu.parameter		0			RW	Uni		P
9.05	Prog.-logic function 1 input 1 *invert*	0 or 1		0			RW	Bit		
9.06	Prog.-logic function 1 input 2 source parameter	**0.00** ~ **20.50** Menu.parameter		0			RW	Uni		P
9.07	Prog.-logic function 1 input 2 *invert*	0 or 1		0			RW	Bit		
9.08	Prog.-logic function 1 output *invert*	0 or 1		0			RW	Bit		
9.09	Prog.-logic function 1 delay	0 ~ 25.0 s		0			RW	Uni		
9.10	Prog.-logic function 1 destination parameter	**0.00** ~ **20.50** Menu.parameter		0			RW	Uni	R	P
9.14	Prog.-logic function 2 input 1 source parameter	**0.00** ~ **20.50** Menu.parameter		0			RW	Uni		P
9.15	Prog.-logic function 2 input 1 *invert*	0 or 1		0			RW	Bit		
9.16	Prog.-logic function 2 input 2 source	**0.00** ~ **20.50** Menu.parameter		0			RW	Uni		P
9.17	Prog.-logic function 2 input 2 *invert*	0 or 1		0			RW	Bit		
9.18	Prog.-logic function 2 output *invert*	0 or 1		0			RW	Bit		
9.19	Prog.-logic function 2 delay	0 ~ 25.0 s		0			RW	Uni		
9.20	Prog.-logic function 2 destination parameter	**0.00** ~ **20.50** Menu.parameter		0			RW	Uni	R	P
9.21	Motorised pot. zero-start *select*	0 or 1		0			RW	Bit		
9.22	Motorised pot. bipolar *select*	0 or 1		0			RW	Bit		
9.23	Motorised pot. rate	0 ~ 250 s		20			RW	Uni		
9.24	Motorsed pot. output scale factor	0 ~ 4.000		1			RW	Uni		
9.25	Motorised pot. destination	**0.00** ~ **20.50** Menu.parameter		0			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 ~ 7					RO	Uni		P
9.33	Binary-sum logic destination parameter	**0.00** ~ **20.50** Menu.parameter		0			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 *indicator*	0 or 1					RO	Bit		P
10.02	Drive running *indicator*	0 or 1					RO	Bit		P
10.03	At zero speed *indicator*	0 or 1					RO	Bit		P
10.04	At or below min. speed *indicator*	0 or 1					RO	Bit		P
10.05	Below at-speed window *indicator*	0 or 1					RO	Bit		P
10.06	At speed *indicator*	0 or 1					RO	Bit		P
10.07	Above at-speed window *indicator*	0 or 1					RO	Bit		P
10.08	At 100% load *indicator*	0 or 1					RO	Bit		P
10.09	Current-limit active *indicator*	0 or 1					RO	Bit		P
10.10	Motor regenerating *indicator*	0 or 1					RO	Bit		P
10.11	Dynamic brake active *indicator*	0 or 1					RO	Bit		P
10.12	Dynamic brake alarm *indicator*	0 or 1					RO	Bit		P
10.13	Direction demanded *indicator*	0 or 1					RO	Bit		P
10.14	Direction running *indicator*	0 or 1					RO	Bit		P
10.15	AC supply loss *indicator*	0 or 1					RO	Bit		P
10.16	Motor thermistor over-temperature *indicator*	0 or 1					RO	Bit		P
10.17	Motor current overload alarm *indicator*	0 or 1					RO	Bit		P
10.18	Heatsink temperature alarm *indicator*	0 or 1					RO	Bit		P
10.19	Ambient temperature alarm *indicator*	0 or 1					RO	Bit		P
10.20	Last trip	0 ~ 200					RO	Txt		P
10.21	Second last trip	0 ~ 200					RO	Txt		P
10.22	Third last trip	0 ~ 200					RO	Txt		P
10.23	Fourth last trip	0 ~ 200					RO	Txt		P
10.24	Fifth last trip	0 ~ 200					RO	Txt		P
10.25	Sixth last trip	0 ~ 200					RO	Txt		P
10.26	Seventh last trip	0 ~ 200					RO	Txt		P
10.27	Eighth last trip	0 ~ 200					RO	Txt		P
10.28	Ninth last trip	0 ~ 200					RO	Txt		P
10.29	Tenth last trip	0 ~ 200					RO	Txt		P
10.30	Max. full-power braking time	0 ~ 400.0 s			0		RW	Uni		
10.31	Max. full-power braking interval	0 ~ 25.0 min			0		RW	Uni		
10.32	External trip active *indicator*	0 or 1					RO	Bit		
10.33	Drive reset	0 or 1			0		RW	Bit		
10.34	Number of auto- reset attempts	0 ~ 5			0		RW	Uni		
10.35	Auto-reset time delay	0 ~ 25.0 s			1		RW	Uni		
10.36	Hold drive healthy until last auto-reset attempt *select*	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 ~ 200			0		RW	Uni		P
10.39	Braking-energy overload accumulator	0 ~ 100.0 %					RO	Uni		P
10.40	Status word	0 ~ 32,767					RO	Uni		P
10.41	UD78 auxiliary power supply active *indicator*	0 or 1					RO	Bit		P
10.42	IGBT junction temperature above 135 ^{o}C *indicator*	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	**0.00** ~ **20.50** Menu.parameter		**1.03**	**1.03**	**1.03**	RW	Uni		P
11.02	Parameter **0.12** assignment	**0.00** ~ **20.50** Menu.parameter		**2.01**	**2.01**	**2.01**	RW	Uni		P
11.03	Parameter **0.13** assignment	**0.00** ~ **20.50** Menu.parameter		**4.02**	**4.02**	**4.02**	RW	Uni		P
11.04	Parameter **0.14** assignment	**0.00** ~ **20.50** Menu.parameter		**1.05**	**1.05**	**1.05**	RW	Uni		P
11.05	Parameter **0.15** assignment	**0.00** ~ **20.50** Menu.parameter		**2.04**	**2.04**	**2.04**	RW	Uni		P
11.06	Parameter **0.16** assignment	**0.00** ~ **20.50** Menu.parameter		**6.01**	**6.01**	**6.01**	RW	Uni		P
11.07	Parameter **0.17** assignment	**0.00** ~ **20.50** Menu.parameter		**4.11**	**4.11**	**4.11**	RW	Uni		P
11.08	Parameter **0.18** assignment	**0.00** ~ **20.50** Menu.parameter		**2.06**	**2.06**	**2.06**	RW	Uni		P
11.09	Parameter **0.19** assignment	**0.00** ~ **20.50** Menu.parameter		**2.07**	**2.07**	**2.07**	RW	Uni		P
11.10	Parameter **0.20** assignment	**0.00** ~ **20.50** Menu.parameter		**1.29**	**1.29**	**1.29**	RW	Uni		P
11.11	Parameter **0.21** assignment	**0.00** ~ **20.50** Menu.parameter		**1.30**	**1.30**	**1.30**	RW	Uni		P
11.12	Parameter **0.22** assignment	**0.00** ~ **20.50** Menu.parameter		**1.31**	**1.31**	**1.31**	RW	Uni		P
11.13	Parameter **0.23** assignment	**0.00** ~ **20.50** Menu.parameter		**1.32**	**1.32**	**1.32**	RW	Uni		P
11.14	Parameter **0.24** assignment	**0.00** ~ **20.50** Menu.parameter		**7.06**	**7.06**	**7.06**	RW	Uni		P
11.15	Parameter **0.25** assignment	**0.00** ~ **20.50** Menu.parameter		**7.11**	**7.11**	**7.11**	RW	Uni		P
11.16	Parameter **0.26** assignment	**0.00** ~ **20.50** Menu.parameter		**7.14**	**7.14**	**7.14**	RW	Uni		P
11.17	Parameter **0.27** assignment	**0.00** ~ **20.50** Menu.parameter		Eur> **8.27** USA> **6.04**	Eur> **8.27** USA> **6.04**	Eur> **8.27** USA> **6.04**	RW	Uni		P
11.18	Parameter **0.28** assignment	**0.00** ~ **20.50** Menu.parameter		Eur> **4.13** USA> **1.01**	Eur> **4.13** USA> **1.01**	Eur> **4.13** USA> **1.01**	RW	Uni		P
11.19	Parameter **0.29** assignment	**0.00** ~ **20.50** Menu.parameter		Eur> **4.14** USA> **8.23**	Eur> **4.14** USA> **8.23**	Eur> **4.14** USA> **8.23**	RW	Uni		P
11.20	Parameter **0.30** assignment	**0.00** ~ **20.50** Menu.parameter		**6.13**	**6.13**	**6.13**	RW	Uni		P
11.21	Parameter **0.30** scaling	0 ~ 4.000		1	1	1	RW	Uni		P
11.22	Initial parameter displayed {**0.38**}	**0.00** ~ **0.50** Menu.parameter		**0.10***	**0.10**	**0.10**	RW	Uni		P
11.23	Serial comms. address	0 ~ 9.9 group.unit		1.1	1.1	1.1	RW	Uni		P
11.24	Serial comms. mode	ANSI 2 (0) ANSI 4 (1) OUtPUt (2) INPUt (3)		ANSI 4 (1)	ANSI 4 (1)	ANSI 4 (1)	RW	Txt	R	P
11.25	Serial comms. baud rate	4,800 (0) 9,600 (1) 19,200 (2) 2,400 (3) baud		4800 (0)*	4800 (0)	4800 (0)	RW	Txt		P
11.26	Serial comms two-wire mode delay	0 ~ 255 ms		0	0	0	RW	Uni		
11.27	Serial comms. source/ destination parameter	**0.00** ~ **20.50** Menu.parameter		0	0	0	RW	Uni	R	P
11.28	Serial comms. parameter scaling	0 ~ 4.000		1	1	1	RW	Uni		
11.29	Drive software version	1.00 ~ 99.99					RO	Uni		P
11.30	User security code	0 ~ 255		149	149	149	RW	Uni	S	P
11.31	Drive operating mode	OPENLP (0) CL.VECT (1) SErVO (2) rEGEN (3)					RW	Txt	R	P
11.32	Drive rated current (FLC)	2.10 ~ 1920 A					RO	Uni		P
11.33	Drive voltage rating	220 ~ 690 V					RO	Uni		P
11.34	Drive software build number	0 ~ 99					RO	Uni		P
11.35	Number of size-5 modules connected	0 ~ 255					RO	Uni		P
11.36	Drive with slow speed fans	0 or 1					RO	Bit		P
11.37	Macro number	0 ~ 9					RO	Uni		
11.38	Cloning module parameter set	0 ~ 8		0	0	0	RW	Uni		
11.39	Cloning module parameter set drive type	OPEN.LP (0) CL.VEct (1) SErVO (2) rEGEN (3) FrEE (4)		4	4	4	RO	Txt		P
11.40	Cloning module parameter checksum	0 ~ 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**}

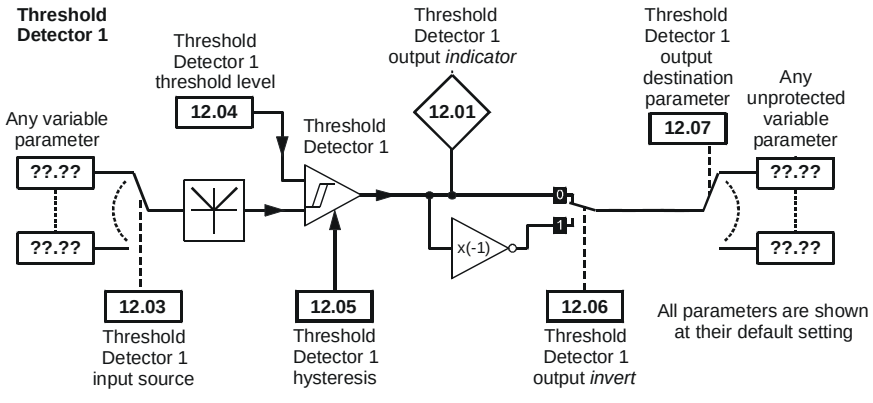
NOTE

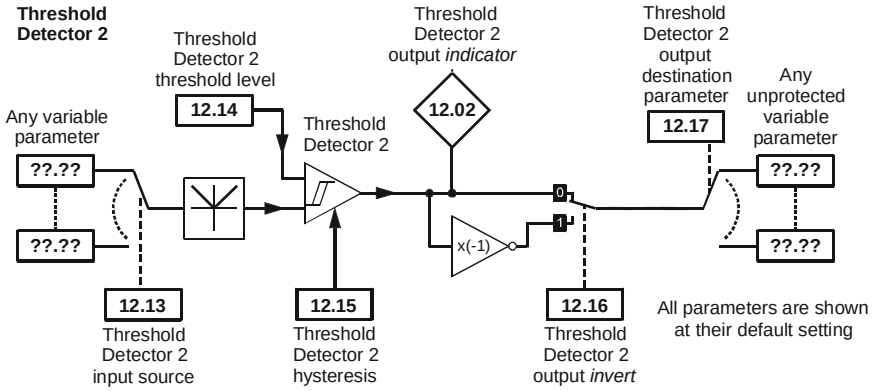
Where a parameter is represented by a text value, the value in brackets in the range column is the setting used for serial communications.

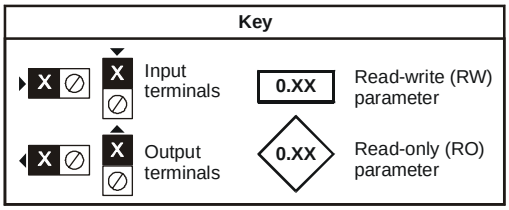
* These parameters have default settings of **0.12** and 9,600 in the VTC variant.

10.12 Menu 12: Programmable thresholds

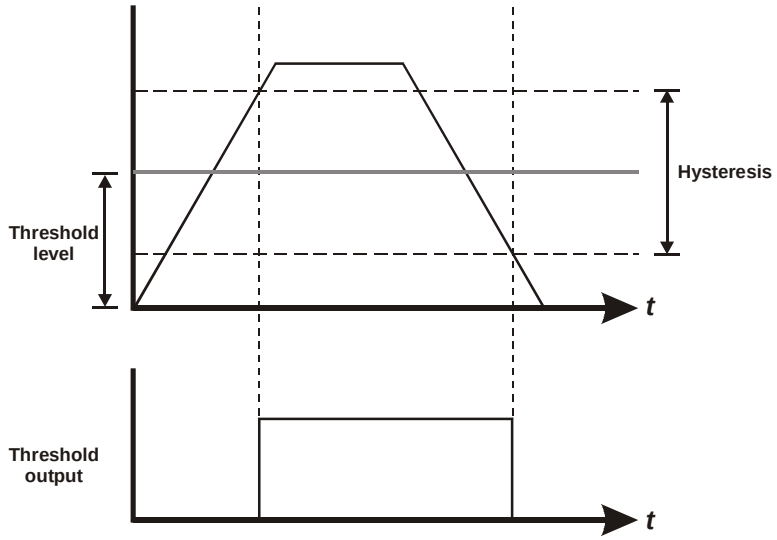
Figure 10-15 Menu 12 logic diagram







The parameters are all shown at their default settings

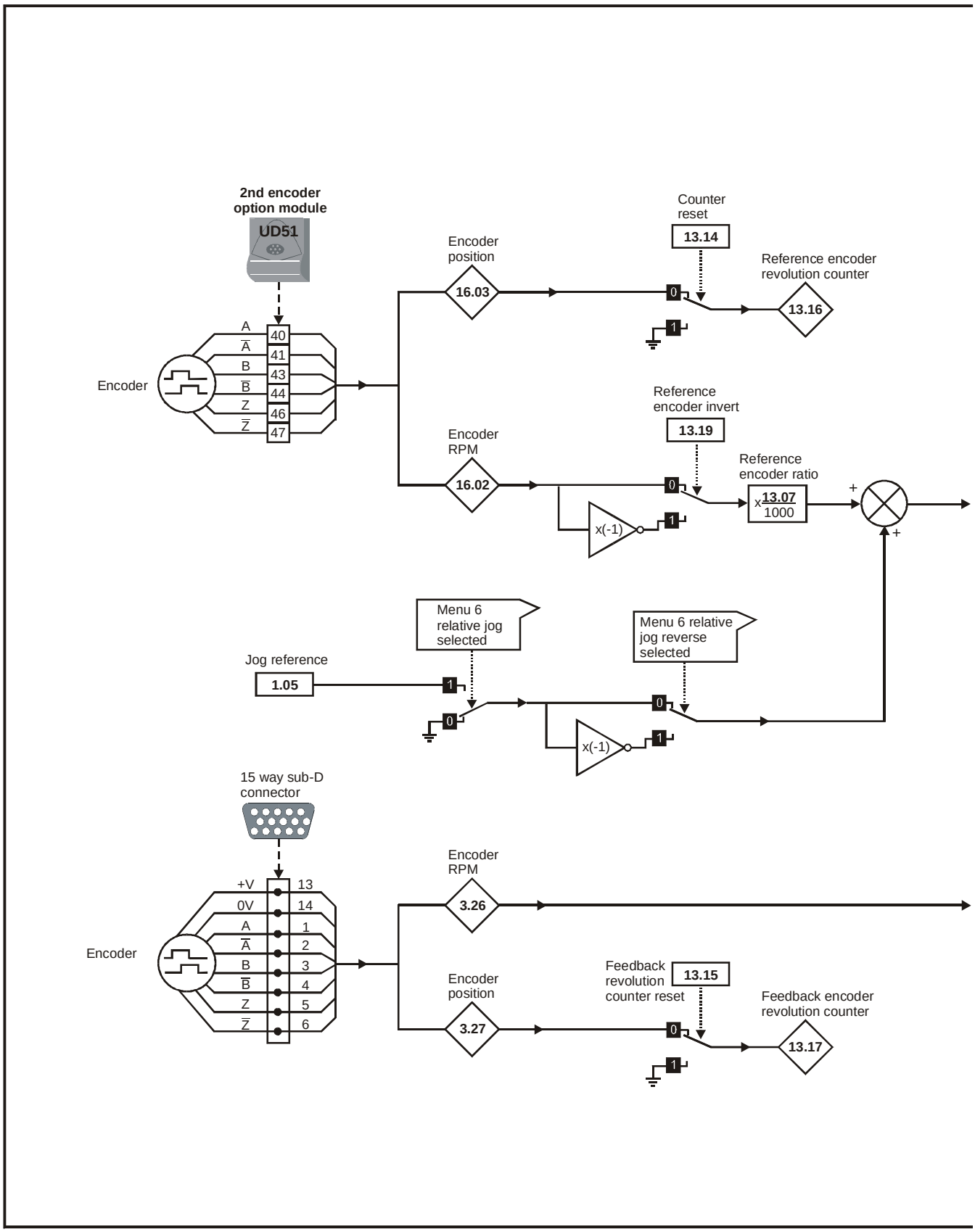


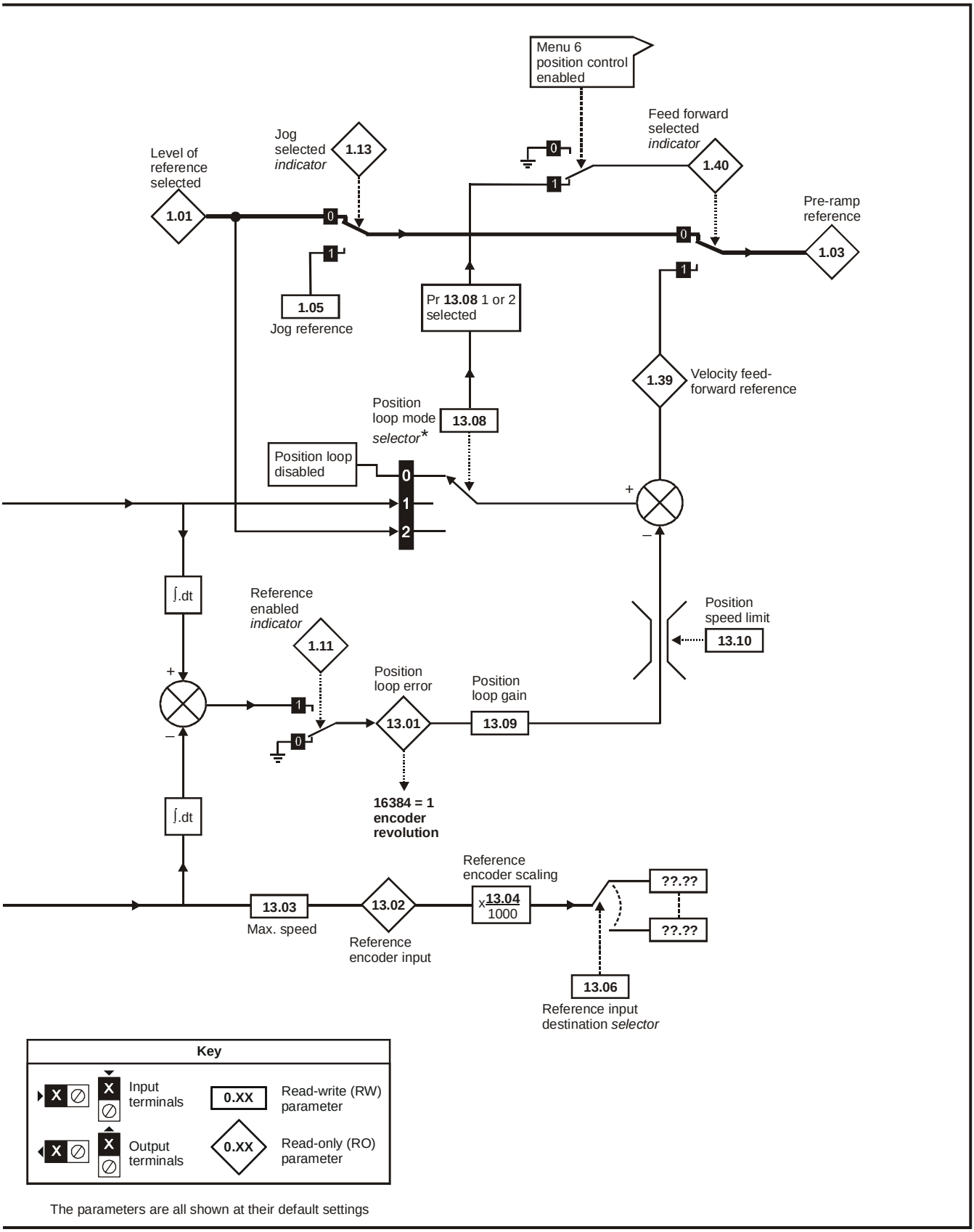
Parameter		Range(⇳)		Default(⇨)			Type			
		OL	CL	OL	VT	SV				
12.01	Comparator 1 output *indicator*	0 or 1					RO	Bit		P
12.02	Comparator 2 output *indicator*	0 or 1					RO	Bit		P
12.03	Comparator 1 input source parameter	**0.00** ~ **20.50** Menu.parameter		0			RW	Uni		P
12.04	Comparator 1 threshold level	0 ~ 100.0 %		0			RW	Uni		
12.05	Comparator 1 hysteresis	0 ~ 25.0 %		0			RW	Uni		
12.06	Comparator 1 output *invert*	0 or 1		0			RW	Bit		
12.07	Comparator 1 output destination parameter	**0.00** ~ **20.50** Menu.parameter		0			RW	Uni	R	P
12.13	Comparator 2 input source parameter	**0.00** ~ **20.50** Menu.parameter		0			RW	Uni		P
12.14	Comparator 2 threshold level	0 ~ 100.0 %		0			RW	Uni		
12.15	Comparator 2 hysteresis	0 ~ 25.0 %		0			RW	Uni		
12.16	Comparator 2 output *invert*	0 or 1		0			RW	Bit		
12.17	Comparator 2 output destination parameter	**0.00** ~ **20.50** Menu.parameter		0			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

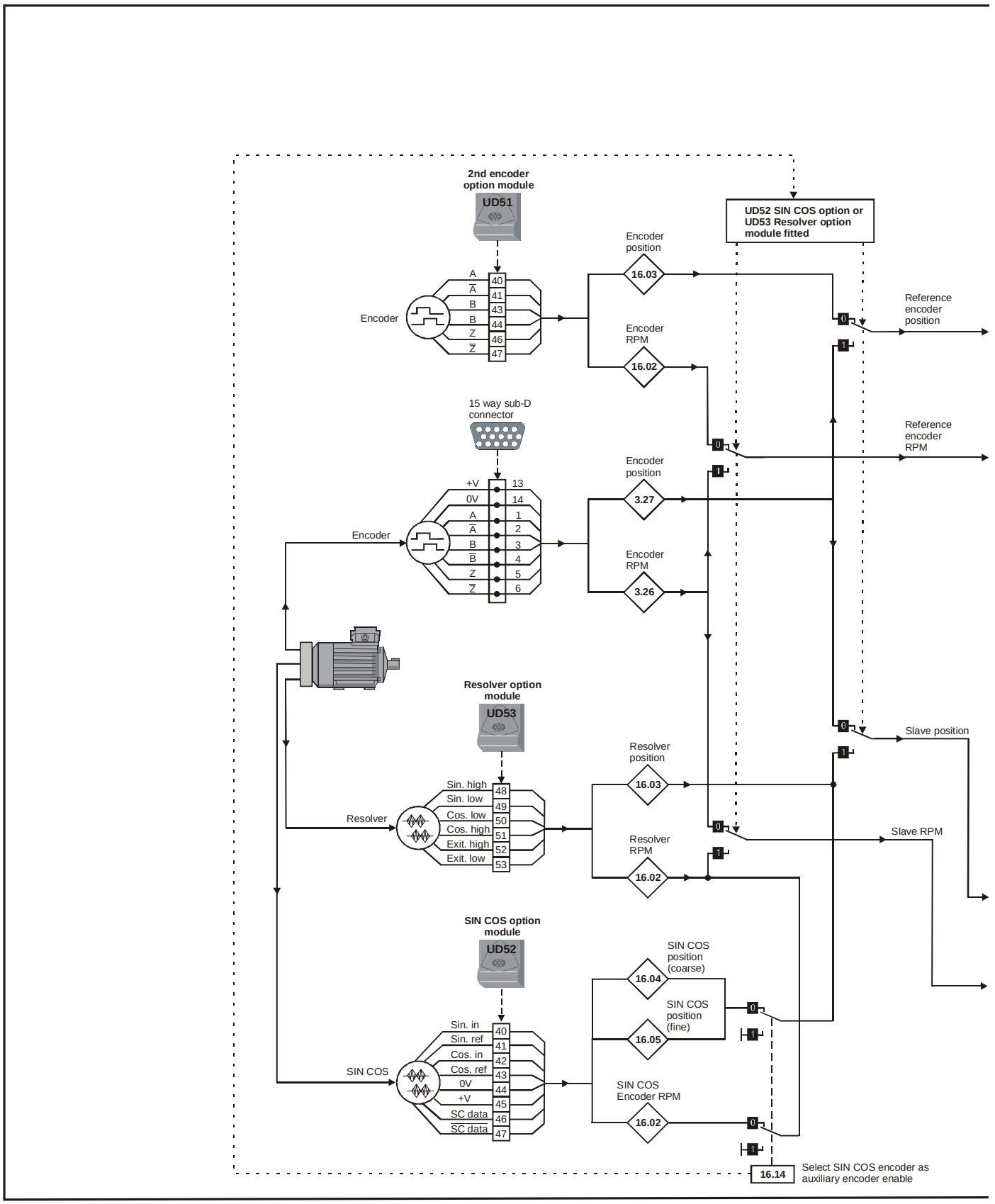


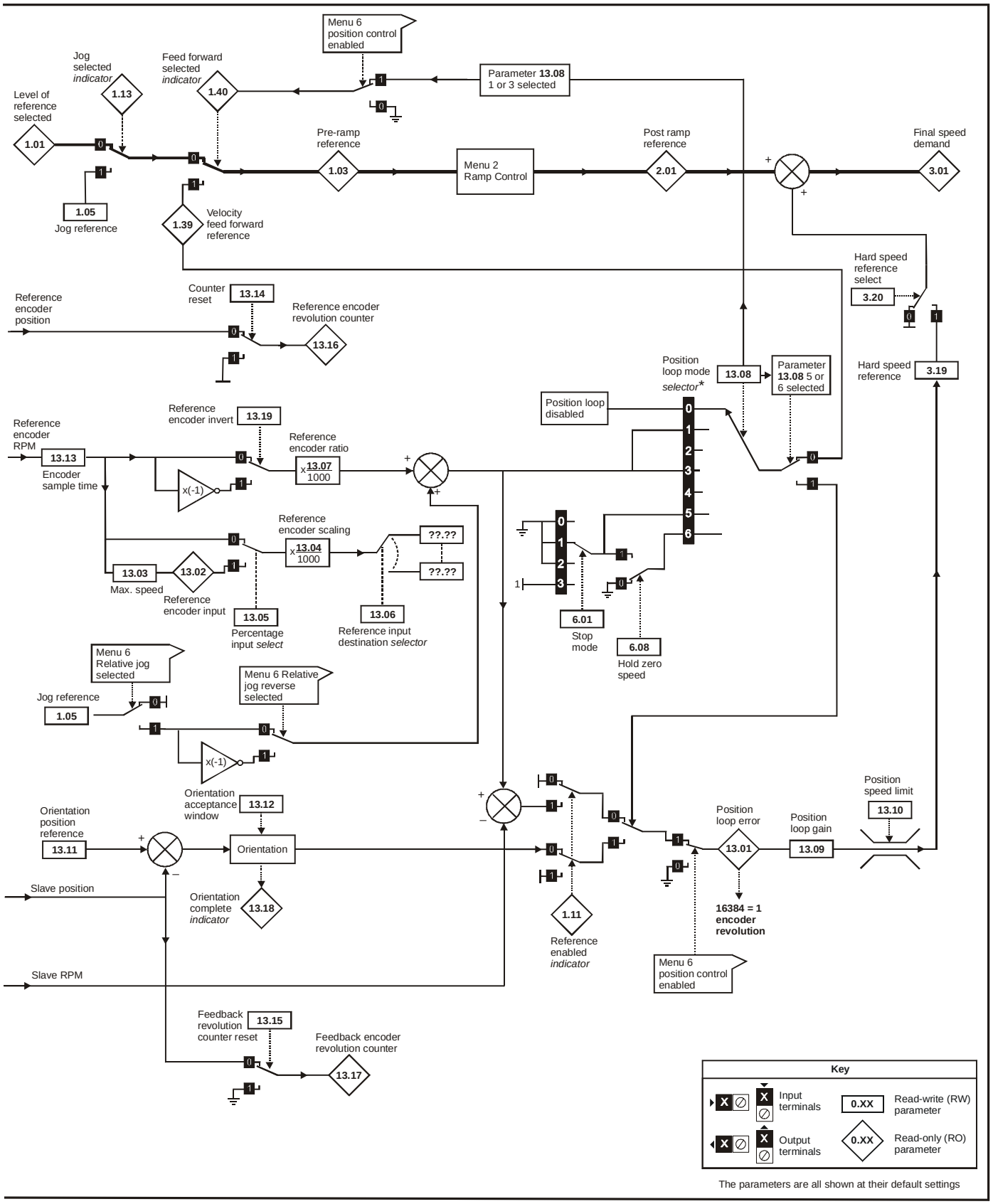


The parameters are all shown at their default settings

* For more information, see section 10.21.7 *Position loop modes* on page 172.

Figure 10-17 Menu 13 Closed-loop logic diagram





* For more information, see section 10.21.7 *Position loop modes* on page 172.

Parameter		Range(⇳)		Default(⇨)			Type			
		OL	CL	OL	VT	SV				
13.01	Position-loop error	±16,384*	±16,384*				RO	Bi		P
13.02	Reference-encoder input	±100.0 %	±100.0 %				RO	Bi		P
13.03	Maximum reference speed	0 ~ 30,000 rpm	0 ~ 30,000 rpm	1,500	1,500	3,000	RW	Uni		
13.04	Reference-encoder scaling	0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
13.05	Percentage input *select*		0 or 1		0	0	RW	Bit		
13.06	Reference input destination parameter	**0.00** ~ **20.50** Menu.parameter	**0.00** ~ **20.50** Menu.parameter	0	0	0	RW	Uni	R	P
13.07	Reference-encoder ratio	0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
13.08	Position-loop mode *selector***	0 ~ 2	0 ~ 6	0	0	0	RW	Uni		
13.09	Position-loop gain	0 ~ 4.000	0 ~ 4.000	0.1	0.1	0.1	RW	Uni		
13.10	Positioning speed-limit	0 ~ 250 rpm	0 ~ 250 rpm	150	150	150	RW	Uni		
13.11	Orientation position reference		0 to 4095**		0	0	RW	Uni		
13.12	Orientation acceptance window		0 ~ 200**		20	20	RW	Uni		
13.13	Encoder sample time		0 ~ 5.0 ms		4.0	4.0	RW	Uni		
13.14	Reference revolution counter *reset*	0 or 1	0 or 1	0	0	0	RW	Bit		
13.15	Feedback revolution counter *reset*	0 or 1	0 or 1	0	0	0	RW	Bit		
13.16	Reference-encoder revolution counter	0 ~ 16,384 revolutions	0 ~ 16,384 revolutions				RO	Bi		P
13.17	Feedback-encoder revolution counter	0 ~ 16,384 revolutions	0 ~ 16,384 revolutions				RO	Bi		P
13.18	Orientation complete *indicator*		0 or 1				RO	Bit		P
13.19	Reference feedback *invert*	0 or 1	0 or 1	0	0	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**}

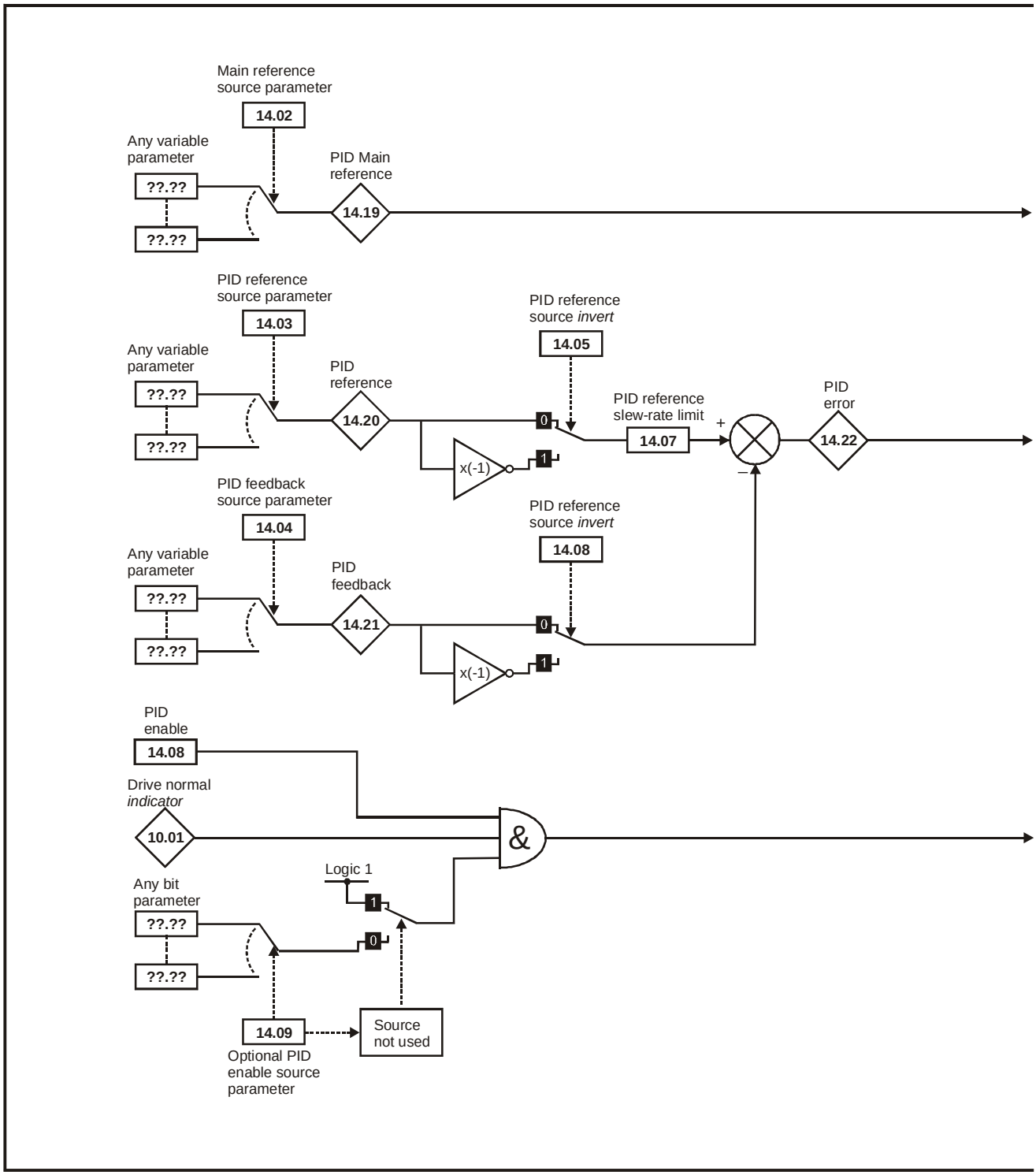
* The range of Pr **13.01** is ±16,384, where 16,384 equals 1 whole revolution. The parameter increments in steps of $^{1}/_{16384}$ parts of a revolution.

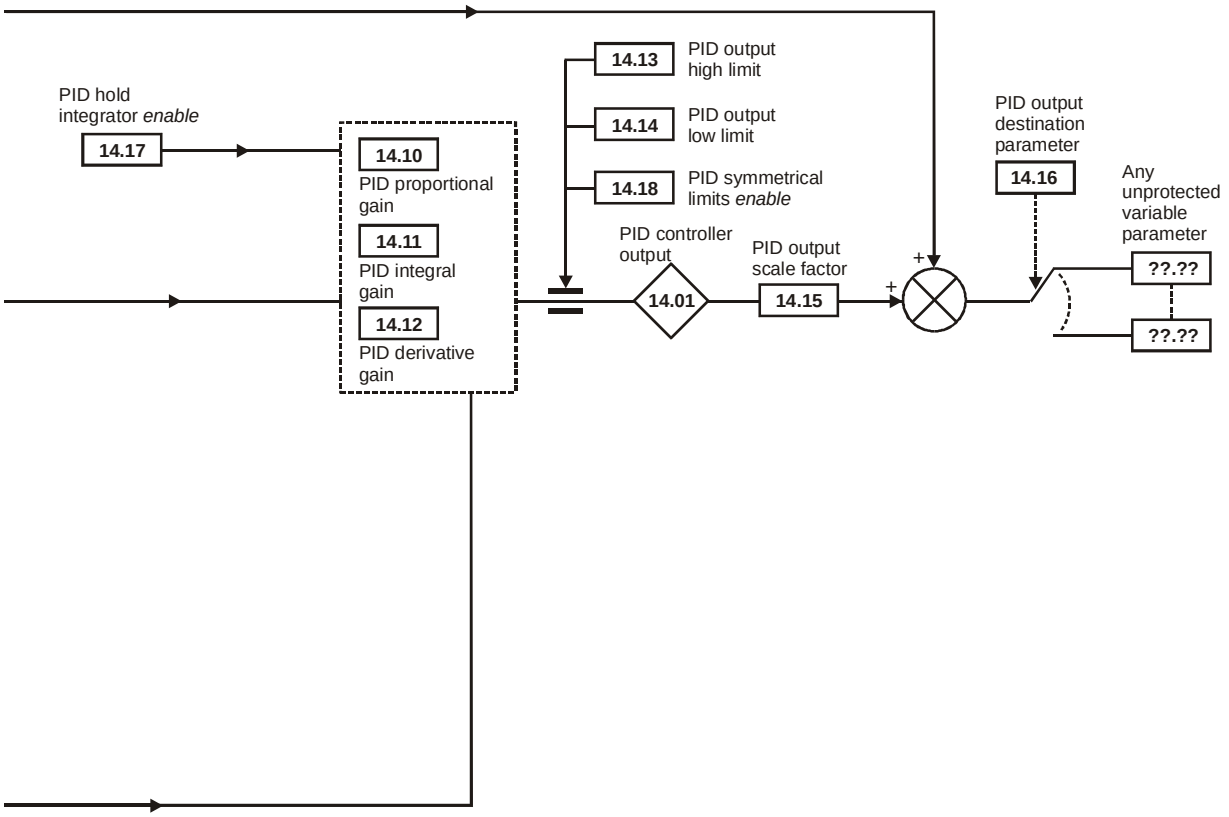
** The ranges of Pr **13.11** and Pr **13.12** are 0 ~ 4095 and 0 ~ 200 respectively. 200 is equivalent to a part of a revolution and 4095 equals 1 whole revolution. These parameters increment in steps of $^{1}/_{4096}$ parts of a revolution.

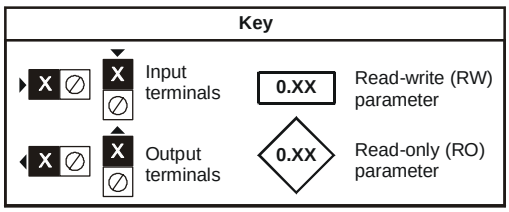
*** For more information, see section 10.21.7 *Position loop modes* on page 172.

10.14 Menu 14: Programmable PID function

Figure 10-18 Menu 14 logic diagram







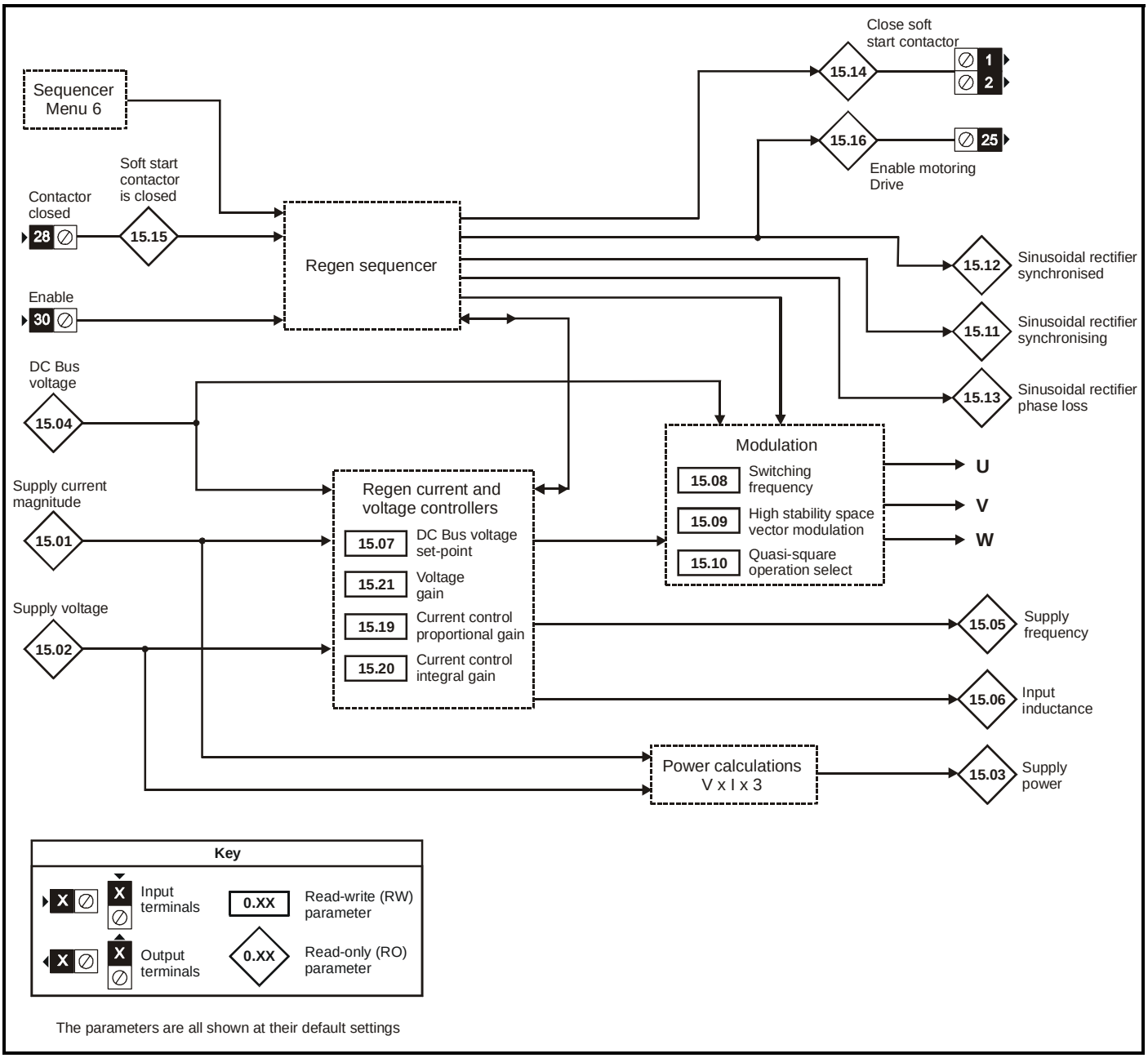
The parameters are all shown at their default settings

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	**0.00** ~ **20.50** Menu.parameter		0			RW	Uni		P
14.03	PID reference source parameter	**0.00** ~ **20.50** Menu.parameter		0			RW	Uni		P
14.04	PID feedback source parameter	**0.00** ~ **20.50** Menu.parameter		0			RW	Uni		P
14.05	PID reference *invert*	0 or 1		0			RW	Bit		
14.06	PID feedback source *invert*	0 or 1		0			RW	Bit		
14.07	PID reference slew-rate limit	0 ~ 3,200.0 s		0			RW	Uni		
14.08	PID *enable*	0 or 1		0			RW	Bit		
14.09	Optional PID-enable source parameter	**0.00** ~ **20.50** Menu.parameter		0			RW	Uni		P
14.10	PID proportional gain	0 ~ 4.000		1			RW	Uni		
14.11	PID integral gain	0 ~ 4.000		0.5			RW	Uni		
14.12	PID derivative gain	0 ~ 4.000		0			RW	Uni		
14.13	PID output high limit	0 ~ 100.0 %		100			RW	Uni		
14.14	PID output low limit	±100.0 %		-100			RW	Bi		
14.15	PID output scale factor	0 ~ 4.000		1			RW	Uni		
14.16	PID output destination parameter	**0.00** ~ **20.50** Menu.parameter		0			RW	Uni	R	P
14.17	PID hold integrator *enable*	0 or 1		0			RW	Bit		
14.18	PID symmetrical limits *enable*	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

Figure 10-19 Menu 15 logic diagram



The parameters are all shown at their default settings

Parameter			Range(⇳)		Default(⇨)			Type			
			OL	CL	OL	VT	SV				
15.01	Supply current magnitude	{**0.11**}	±Maximum drive current A					RO	Bi		P
15.02	Supply voltage	{**0.12**}	0 ~ 528 V					RO	Uni		P
15.03	Supply power	{**0.13**}	±Maximum drive current x Pr 5.09 x √3/1000 kW					RO	Bi		P
15.04	DC Bus voltage	{**0.14**}	0 ~ 830 V					RO	Uni		P
15.05	Supply frequency	{**0.15**}	±100 Hz					RO	Bi		P
15.06	Input inductance	{**0.16**}	0.001 ~ 100 mH					RO	Uni		P
15.07	DC Bus voltage set-point	{**0.17**}	0 ~ 800 V		700			RW	Uni		
15.08	Switching frequency	{**0.18**}	3 kHz (0) 4.5 kHz (1) 6 kHz (2) 9 kHz (3) 12 kHz (4)		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 ~ 30,000		110			RW	Uni		
15.20	Current control integral gain		0 ~ 30,000		1000			RW	Uni		
15.21	Voltage control proportional gain		0 ~ 30,000		4000			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**}

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> FLC x 220%

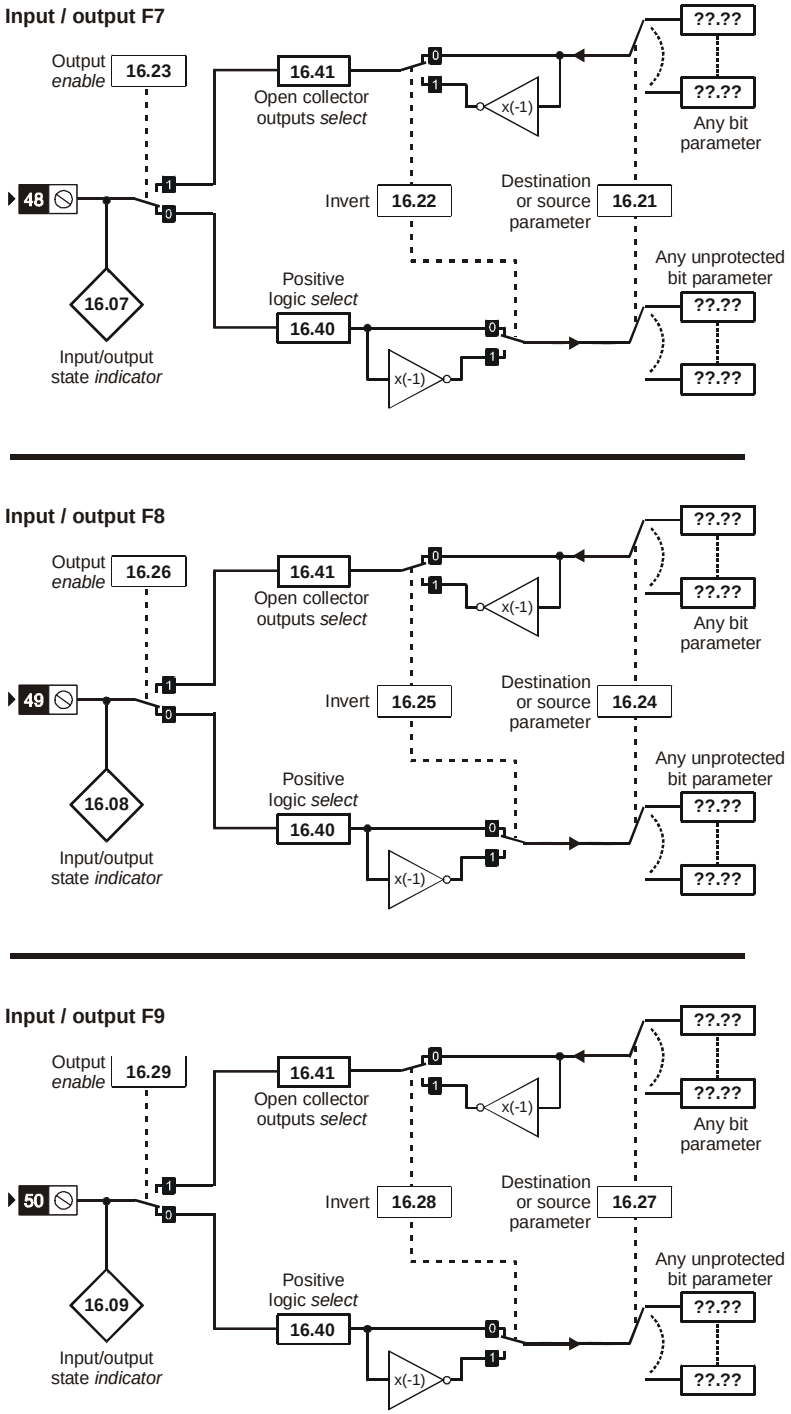
Size 5> FLC x 170%

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.

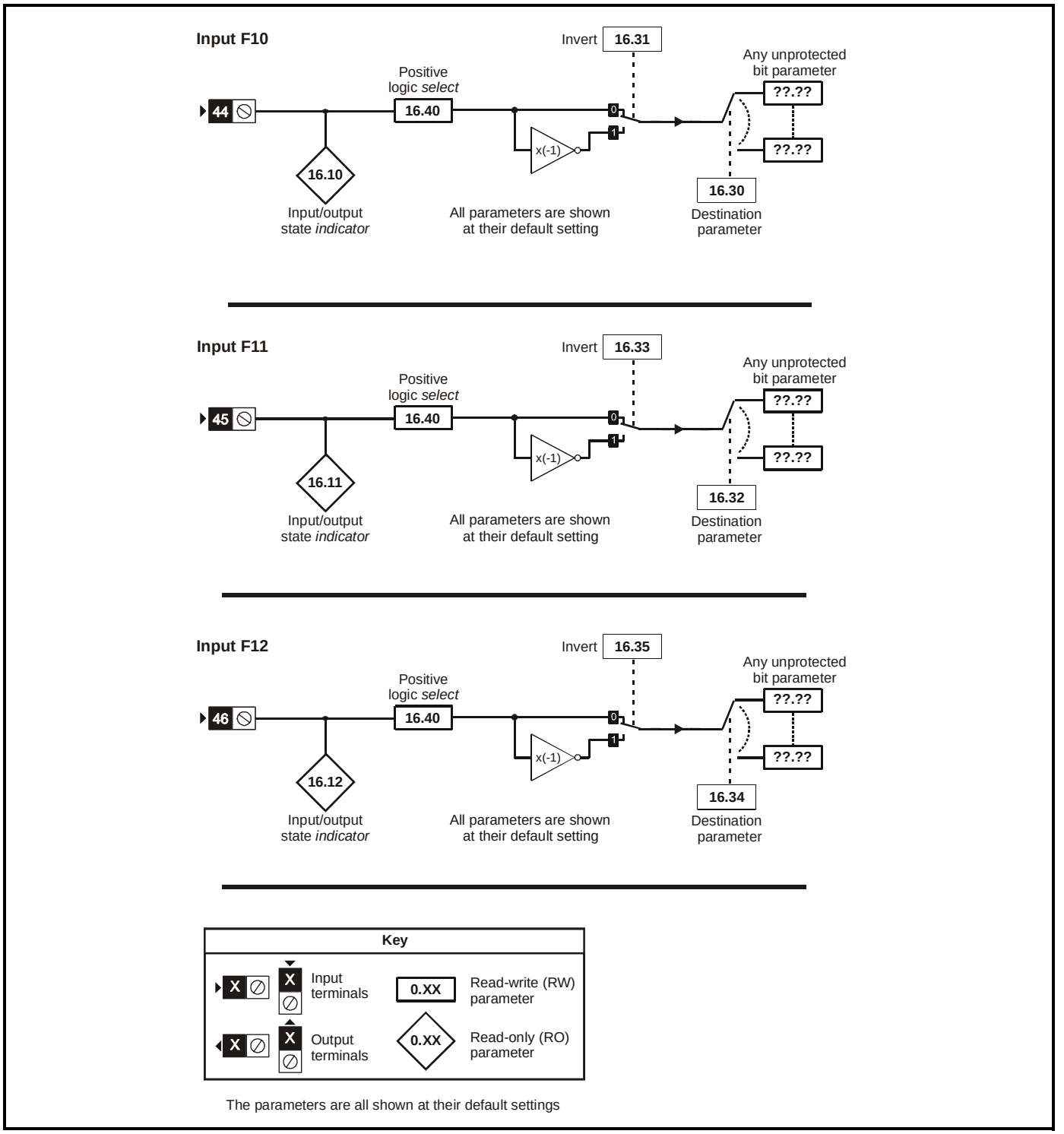
10.16 Menu 16 Small option module set-up

Figure 10-20 Menu 16 UD50 logic diagram, part 1



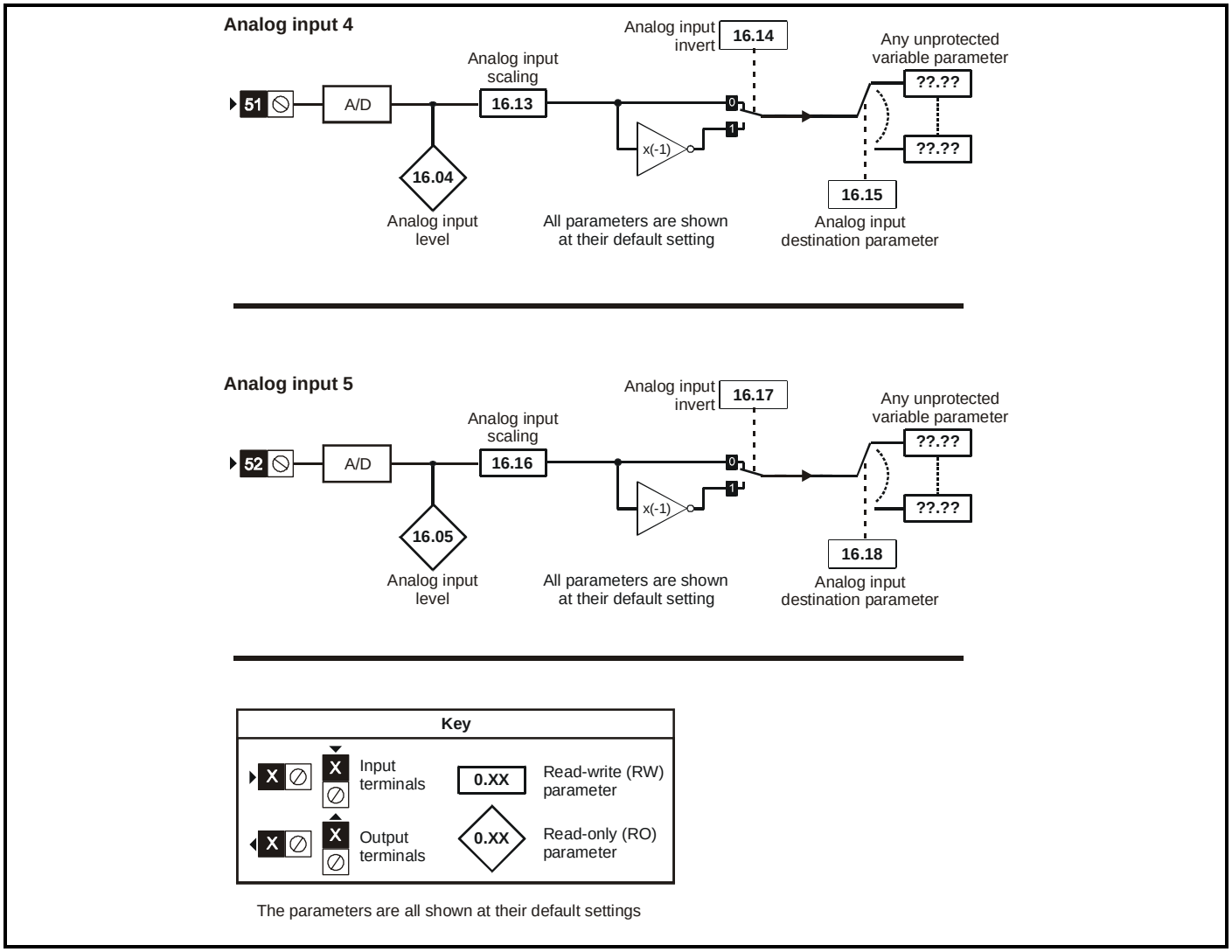
The parameters are all shown at their default settings

Figure 10-21 Menu 16 UD50 logic diagram, part 2



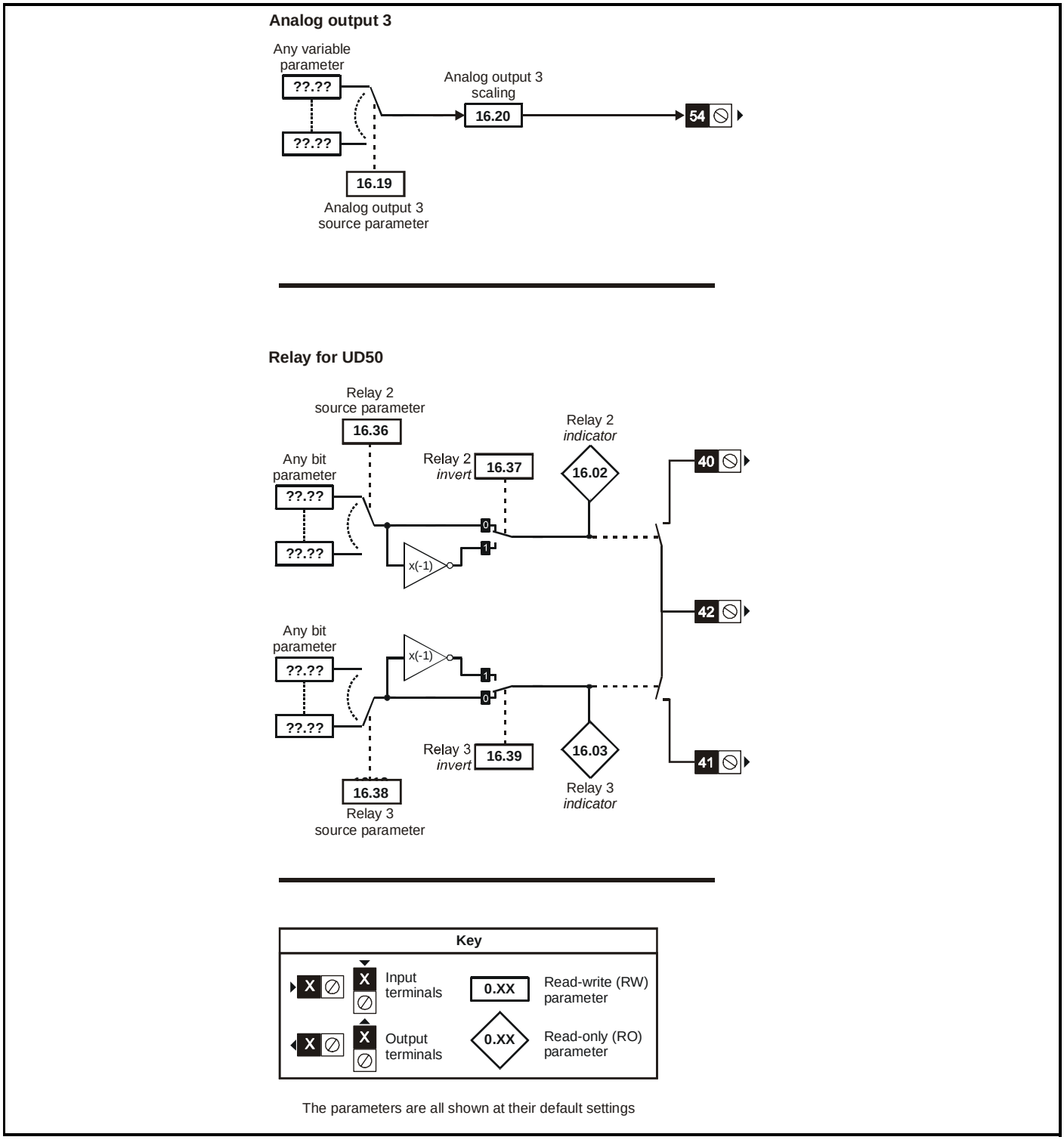
The parameters are all shown at their default settings

Figure 10-22 Menu 16 UD50 logic diagram, part 3



The parameters are all shown at their default settings

Figure 10-23 Menu 16 UD50 logic diagram, part 4



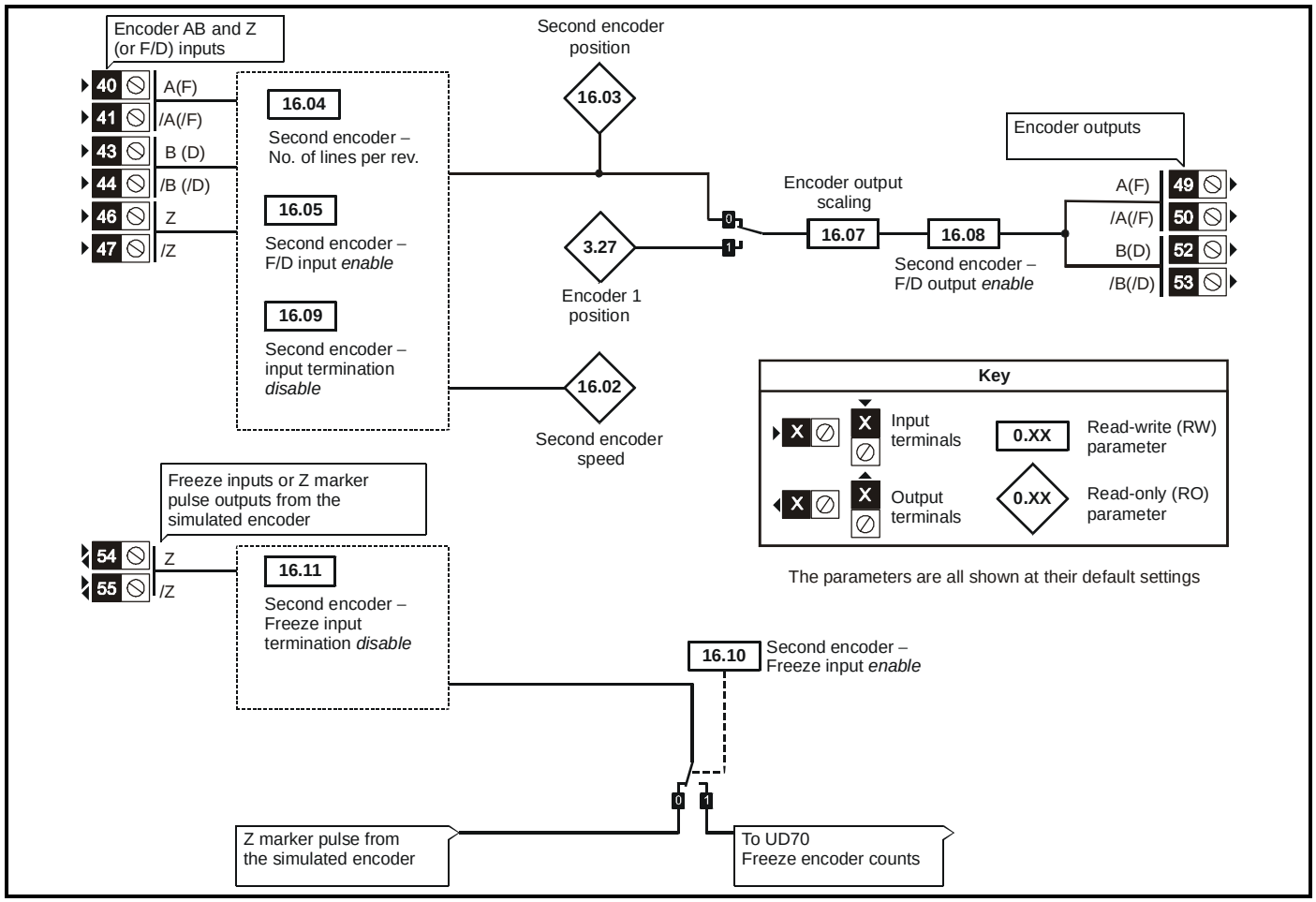
The parameters are all shown at their default settings

UD50 Additional I/O small option module parameter list

Parameter		Range(⇳)		Default(⇨)			Type			
		OL	CL	OL	VT	SV				
16.01	Option module code	0 ~ 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 ~ 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	**0.00** ~ **20.50** Menu.parameter		**0.00**			RW	Uni	R	P
16.16	Analog input 5 scaling	0.000 ~ 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	**0.00** ~ **20.50** Menu.parameter		**0.00**			RW	Uni	R	P
16.19	DAC Output 3 source	**0.00** ~ **20.50** Menu.parameter		**0.00**			RW	Uni	R	P
16.20	DAC Output 3 scaling	0.000 ~ 4.000		1.000			RW	Uni		
16.21	F7 input destination / output source	**0.00** ~ **20.50** Menu.parameter		**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	**0.00** ~ **20.50** Menu.parameter		**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	**0.00** ~ **20.50** Menu.parameter		**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	**0.00** ~ **20.50** Menu.parameter		**0.00**			RW	Uni	R	P
16.31	F10 input invert	0 or 1		0			RW	Bit		
16.32	F11 input destination	**0.00** ~ **20.50** Menu.parameter		**0.00**			RW	Uni	R	P
16.33	F11 input invert	0 or 1		0			RW	Bit		
16.34	F12 input destination	**0.00** ~ **20.50** Menu.parameter		**0.00**			RW	Uni	R	P
16.35	F12 input invert	0 or 1		0			RW	Bit		
16.36	Relay 2 source	**0.00** ~ **20.50** Menu.parameter		**0.00**			RW	Uni	R	P
16.37	Relay 2 output invert	0 or 1		0			RW	Bit		
16.38	Relay 3 source	**0.00** ~ **20.50** Menu.parameter		**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

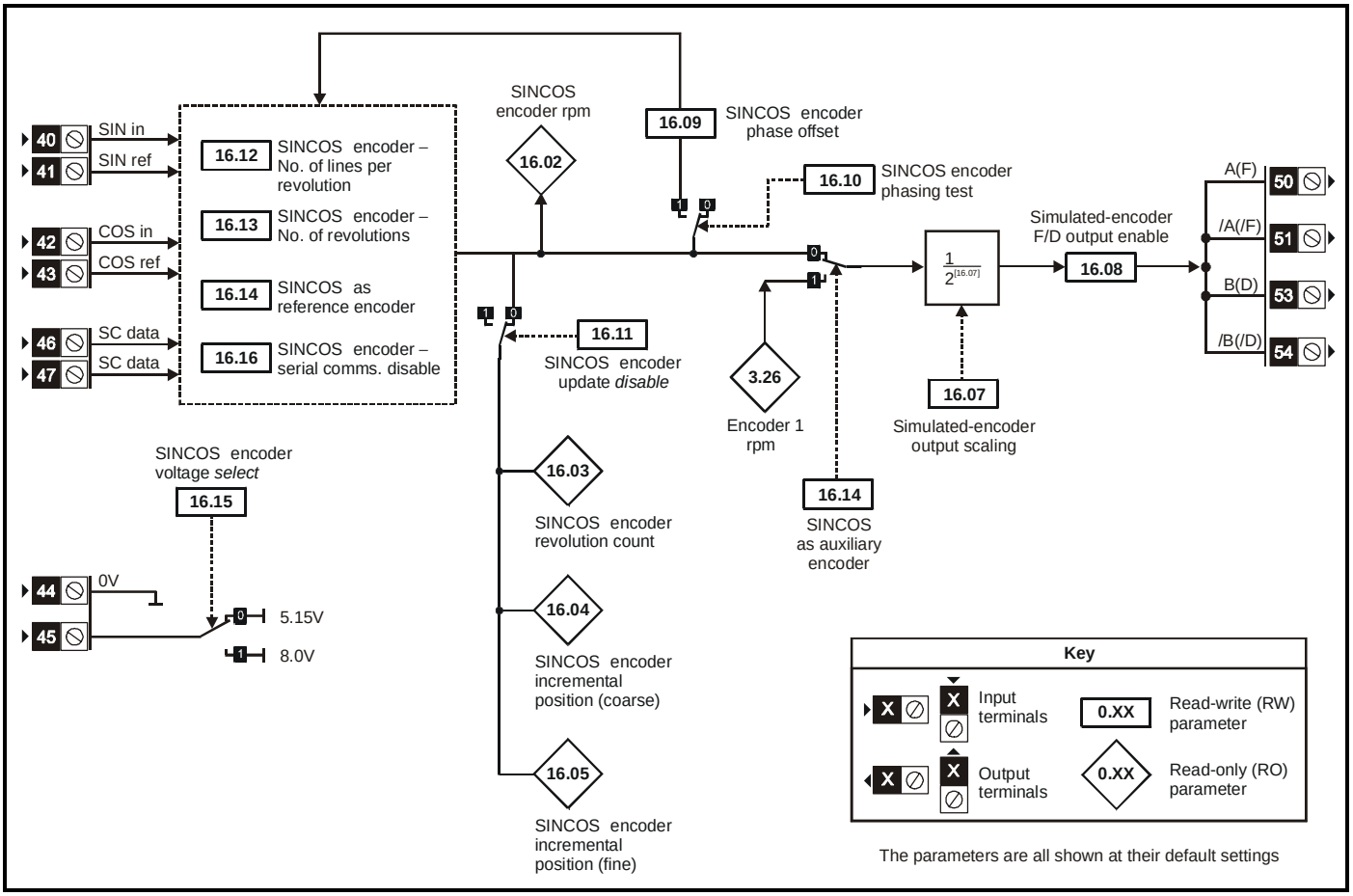


UD51 Second encoder small option module parameter list

Parameter		Range(⇳)		Default(⇨)			Type			
		OL	CL	OL	VT	SV				
16.01	Option module code	0 ~ 100		2			RO	Uni		P
16.02	Encoder 2 input rpm	±30,000 rpm					RO	Bi		P
16.03	Encoder 2 position	0 ~ 16,384 revolutions/16,384					RO	Uni		P
16.04	No. of Encoder lines / Pulses per rev	0 ~ 10,000 (F+D input, Pr **16.05** = 1) 0 ~ 5000 (Quadrature input, Pr **16.05** = 0)		1024			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 ~ 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

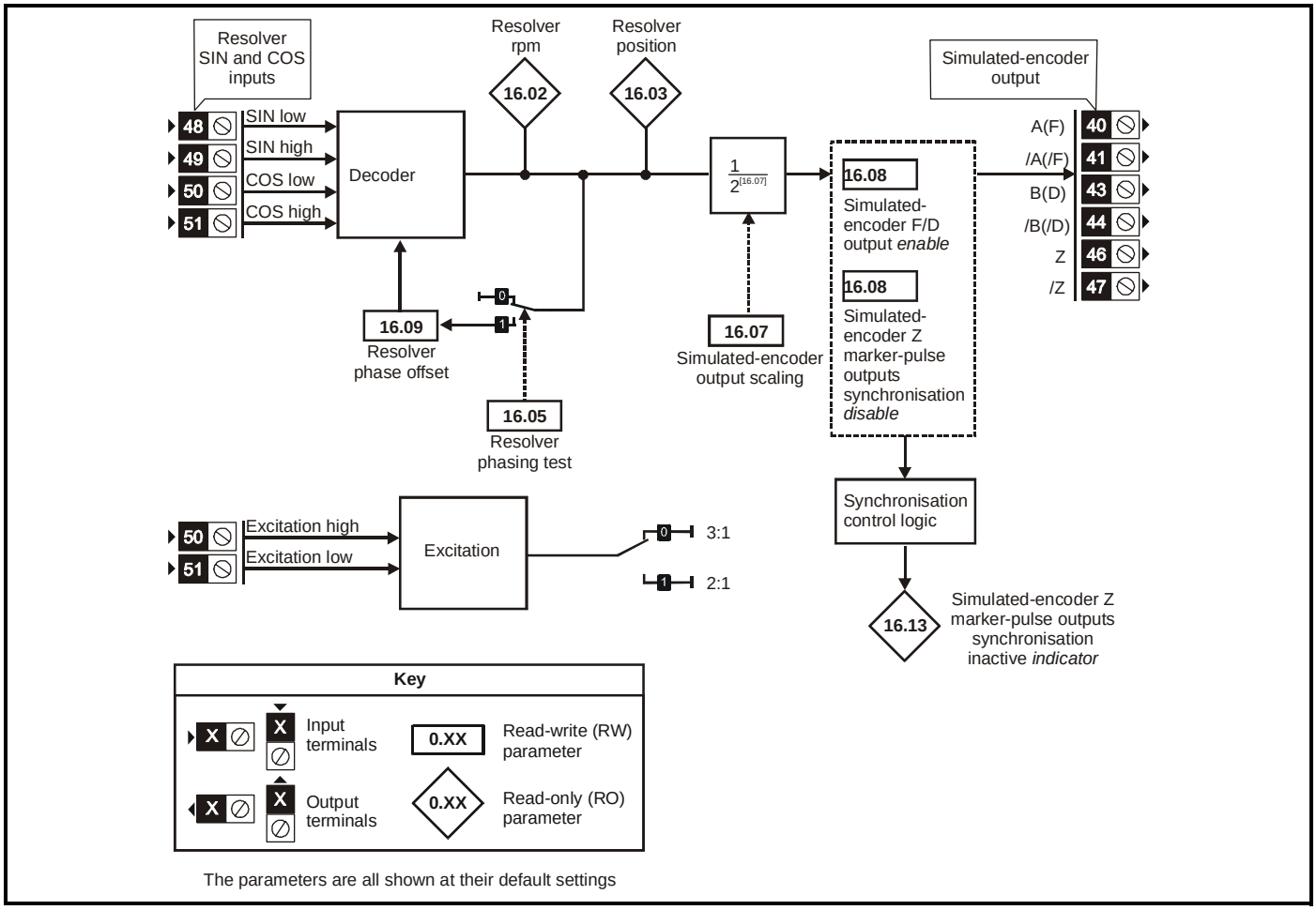


UD52 SINCOS small option module parameter list

Parameter		Range(⇳)		Default(⇨)			Type			
		OL	CL	OL	VT	SV				
16.01	Option module code	0 ~ 100		4			RO	Uni		P
16.02	SINCOS encoder rpm	±30,000 rpm					RO	Bi		P
16.03	SINCOS encoder revolution count	0 ~ 32,767 revolutions					RO	Uni		P
16.04	SINCOS encoder position	0 ~ 16,383 revolutions/16,384					RO	Uni		P
16.05	SINCOS encoder position fine	0 ~ 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 ~ 15 (power of 2)		0			RW	Uni		
16.08	F/D output select	0 or 1		0			RW	Bit		
16.09	Phasing offset	0 ~ 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 ~ 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(⇳)		Default(⇨)			Type			
		OL	CL	OL	VT	SV				
16.01	Option module code		0 ~ 100		1		RO	Uni		P
16.02	Resolver rpm		±30,000 rpm				RO	Bi		P
16.03	Resolver position		0 ~ 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 ~ 15 (power of 2)		0		RW	Uni		
16.08	F/D output select		0 or 1		0		RW	Bit		
16.09	Phasing offset		0 ~ 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 ~ 100					RO	Uni		P
17.02	Option module software version	0.00 ~ 99.99					RO	Uni		P
17.03	DPL line number where trip occured	0 ~ 32,000					RO	Uni		P
17.04	Available resource in %	0 ~ 100 %					RO	Uni		P
17.05	RS485 Address	1 ~ 99		11			RW	Uni		P
17.06	RS485 Mode	0 ~ 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	**0.00** ~ **20.50** Menu.parameter		**0.00**			RW	Uni		P
17.09	RS485 Parameter pointer 2	**0.00** ~ **20.50** Menu.parameter		**0.00**			RW	Uni		P
17.10	Serial scaling factor	0.000 ~ 4.000		1.000			RW	Uni		
17.11	Clock task tick time	0 ~ 100 ms		10			RW	Uni		P
17.12	Position controller set-up	0 ~ 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 ~ 18.10	Application menu 1 read only integers	±32,000		0			RO	Bi		
18.11 ~ 18.30	Application menu 1 read write integers	±32,000		0			RW	Bi		
18.31 ~ 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 ~ 19.10	Application menu 2 read only integers	±32,000		0			RO	Bi		
19.11 ~ 19.30	Application menu 2 read write integers	±32,000		0			RW	Bi		
19.31 ~ 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 ~ 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 Advanced Features

This section gives information on some of the commonly used advanced functions of the Unidrive.

Advanced Feature	Associated Parameters
Braking modes	**2.04** and **2.08**
S ramps	**2.06** and **2.07**
Torque modes	**4.08** and **4.11**
Stop modes	**6.01**, **6.07** and **6.08**
Main Loss modes	**6.03**
Sequence modes	**6.04** and **6.30** to **6.34**
Catch a spinning motor	**6.09**, **6.10**, **6.37** and **6.38**
Position loop modes	**13.08**, **3.19** and **3.20**

10.21.1 Braking modes

2.04	Ramp mode *selector*			
RW	Txt			
OL	⇳	0 ~ 2	⇨	2
CL	⇳	0 ~ 2	⇨	2

0 Stnd.Hd Standard ramp with ramp hold
1 FASt Fast ramp
2 Stnd.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).

0: Standard ramp with ramp hold

The deceleration ramp will be frozen if the DC Bus voltage rises above the standard ramp voltage (**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.

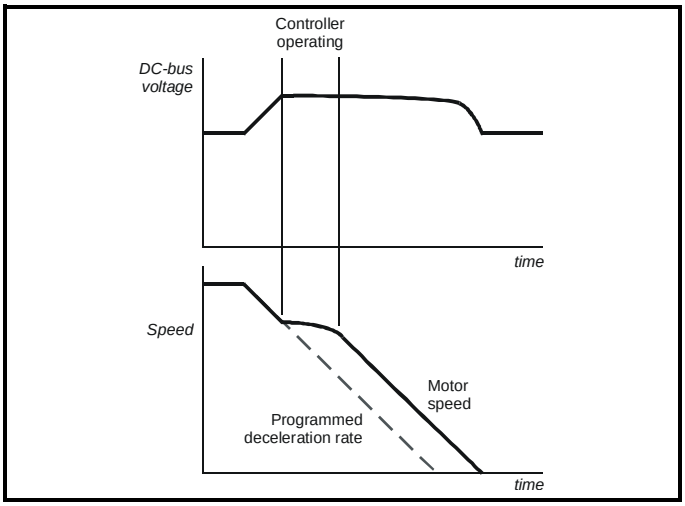
1: Fast ramp

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.

2: Standard ramp with P control

The voltage rising to the standard ramp level (**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 (**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 parameters **4.13** and **4.14**.



2.08	Standard ramp *voltage*			
RW	Uni			
EUR>				
OL	⇳	0 ~ 800 V	⇨	750
CL	⇳	0 ~ 800 V	⇨	750
USA>				
OL	⇳	0 ~ 800 V	⇨	775
CL	⇳	0 ~ 800 V	⇨	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 P controlled mode 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 √2.

WARNING

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.

10.21.2 Torque Modes

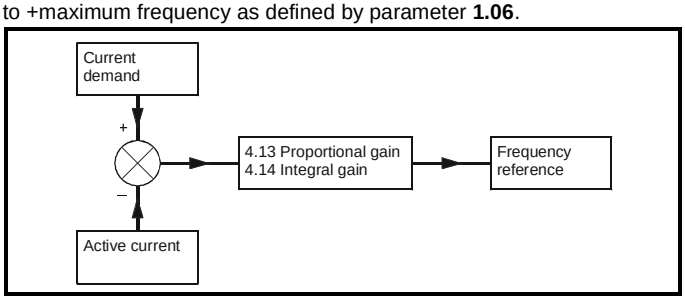
4.08	Torque reference			
RW	Bi			
OL	⇳	±maximum current limit % rated active current	⇨	0
CL	⇳		⇨	

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 ~ 1	⇨	0
CL	⇳	0 ~ 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 parameter **1.06**.



Closed loop

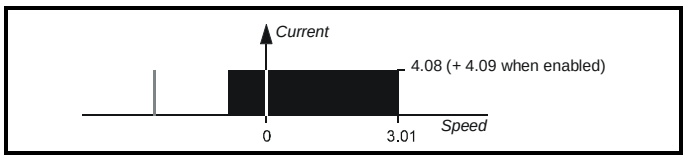
0: Speed control mode

The torque demand is equal to the speed loop output.

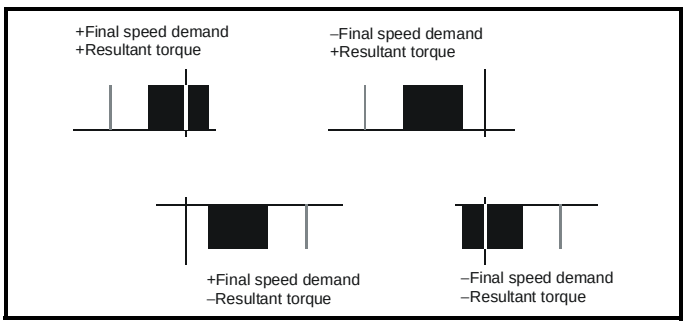
1: Torque control

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 [**4.08** (+ **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

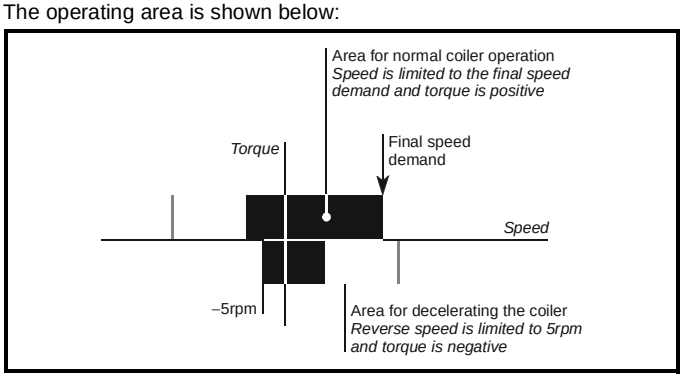
Positive final speed demand: a positive resultant torque will give torque control with a positive speed limit defined by the final speed demand. A negative resultant torque will give torque control with a negative speed limit of -5rpm.

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

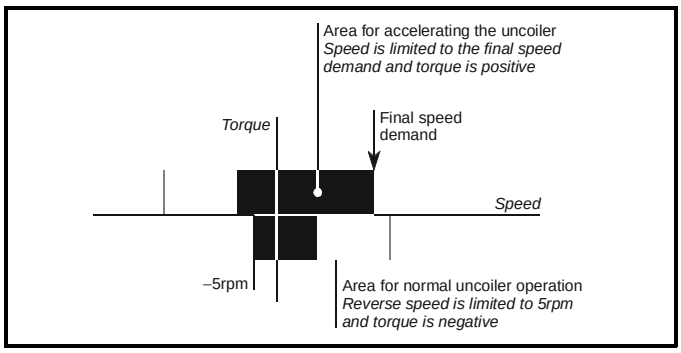
This is an example of a coiler operating in the positive direction. The final speed demand is set to a positive value just above the coiler reference speed. If the resultant torque demand is positive the coiler operates with a limited speed, so that if the material breaks the speed does not exceed a 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.

10.21.3 Stop Modes

6.01	**Stop mode *selector***			
RW	Txt			
OL ⇳	0 ~ 4	⇨	1	
VT ⇳	0 ~ 3	⇨	1	
SV ⇳		⇨	2	

Open Loop

0	COASt	Coast stop
1	rP	Ramp stop
2	rP-dcI	Ramp stop + 1 second dc injection
3	dcI	Injection braking stop with detection of zero speed
4	td.dcI	Timed injection braking stop

Stopping is in two distinct phases: decelerating to stop, and stopped.

Stopping Mode	Phase 1	Phase 2	Comments
0: Coast	Inverter disabled	Drive cannot be re-enabled for 2s	Delay in phase 2 allows rotor flux to decay in induction motors
1: Ramp	Ramp down to zero frequency	Wait for 1s with inverter enabled	
2: Ramp + 1s DC	Ramp down to zero frequency	Inject DC at level specified by parameter **6.06** for 1s	
3: DC with zero speed detection	Low frequency current injection with detection of low speed before next phase.	Inject DC at level specified by parameter **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).
4: Timed injection braking stop	Inject DC at level specified by parameter **6.06** for time specified by **6.07** - 1s.	Inject DC at level specified by parameter **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
0: Coast	Inhibits the inverter	
1: Ramp	Stop with ramp	
2: No ramp	Stop with no ramp	
3: Stop and orientate	Stops with ramp and then rotates to a preset position.	The position system controlled by menu 13 is used to orientate the motor. Parameter **13.08** must be set up correctly for use, and the hard speed reference enabled, parameter **3.19**.

6.07	**Injection braking time**			
RW	Uni			
OL ⇳	0.0 ~ 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 parameter **6.01**).

6.08	**Hold zero speed *enable***			
RW	Bit			
OL ⇳	0 or 1	⇨	0	
VT ⇳		⇨	0	
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**'.

10.21.4 Mains loss modes

6.03	**AC supply loss mode *selector***			
RW	Txt			P
OL ⇳	0 ~ 2	⇨	0	
CL ⇳		⇨		

0	diS	Disabled
1	StoP	Stop
2	ridE.th	Ride through

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).

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.)

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.

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 **4.13** and **4.14** must be set up for optimum control. See parameters **4.13** and **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 **4.13** and **4.14** are suitable for normal operation, they should need no adjustment. See parameter **4.13** and **4.14** below for set-up details.

4.13	**Current loop proportional gain**			
RW	Uni			
OL	⇳	0 ~ 30,000	⇨	20
VT	⇳		⇨	150
SV	⇳		⇨	130

4.14	**Current loop integral gain**			
RW	Uni			
OL	⇳	0 ~ 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

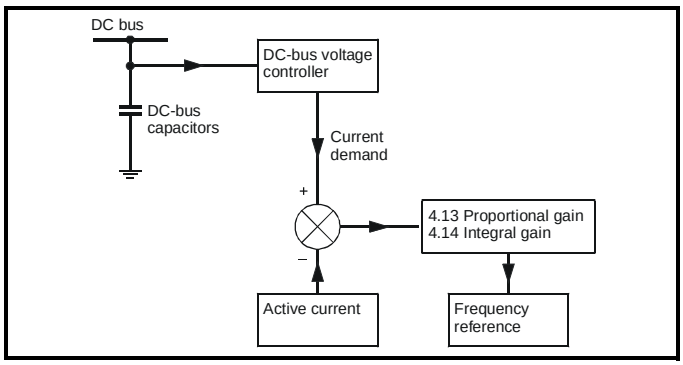
The current limits will normally operate with an integral term only, particularly below the point where field weakening begins. The proportional term is inherent in the loop. The integral term must be increased enough to counter the effect of the ramp which is still active even in current limit. For 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 indicator (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 shownin 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 (parameter **4.13**) should be set to a value of:

1800 x Pr **5.24** x 10^{-3} x 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 parameter **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, $L_s' = L_1 + (L_2 . L_m / (L_2 + L_m))$. 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 (parameter **4.14**) should be set to a value of:

0.044 x Pr **4.13** x R / (Pr **5.24** x 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).

10.21.5 Sequencing Modes

6.04	Sequencing mode *selector*			
RW	Uni			P
OL ⇳	0 ~ 4	⇨	4	
CL ⇳		⇨		

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 (parameters **6.30** to **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

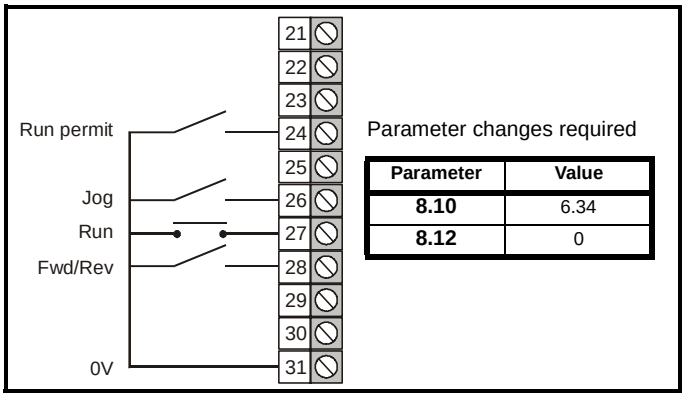
2 Wire proof mode

3 PLC mode

4 Wire proof PLC mode

Sequencing mode 0: CD type

Run permit or /Stop	(parameter **6.34**)	Run permit or 'not stop' input
Sequencing bit 0	(parameter **6.30**)	Run (Latching)
Sequencing bit 1	(parameter **6.31**)	Jog
Sequencing bit 2	(parameter **6.32**)	Forward/Reverse
Sequencing bit 3	(parameter **6.33**)	Not used



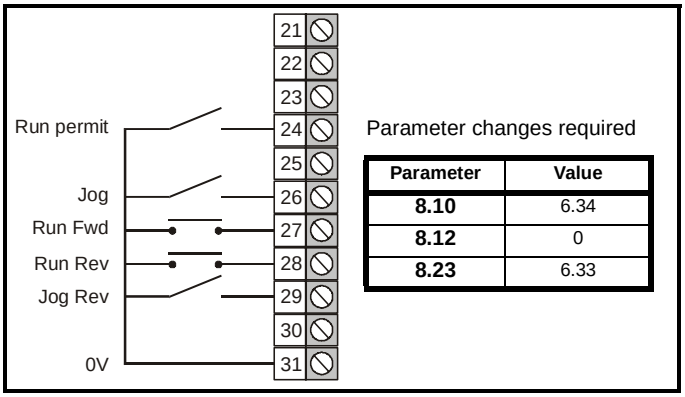
Parameter changes required

Parameter	Value
8.10	6.34
8.12	0

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 (**6.11** to **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	(parameter **6.34**)	Run permit or 'not stop' input
Sequencing bit 0	(parameter **6.30**)	Run forward (latching)
Sequencing bit 1	(parameter **6.31**)	Jog forward
Sequencing bit 2	(parameter **6.32**)	Run reverse (latching)
Sequencing bit 3	(parameter **6.33**)	Jog reverse



Parameter changes required

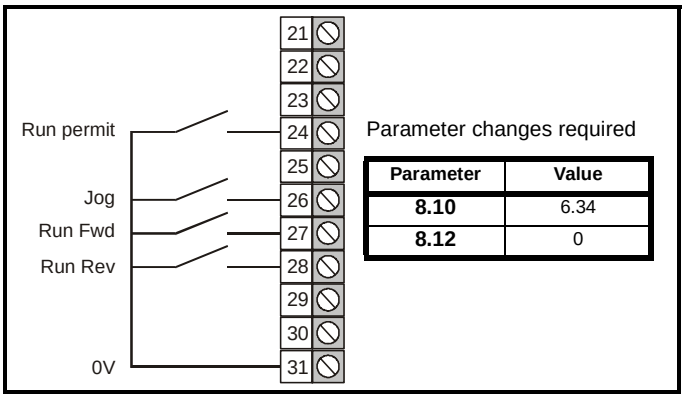
Parameter	Value
8.10	6.34
8.12	0
8.23	6.33

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 (**6.11**) and the fwd/rev keypad button can change direction if it is enabled (**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 (**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	(parameter **6.34**)	Run permit or 'not stop' input
Sequencing bit 0	(parameter **6.30**)	Run forward
Sequencing bit 1	(parameter **6.31**)	Jog
Sequencing bit 2	(parameter **6.32**)	Run reverse
Sequencing bit 3	(parameter **6.33**)	Not used



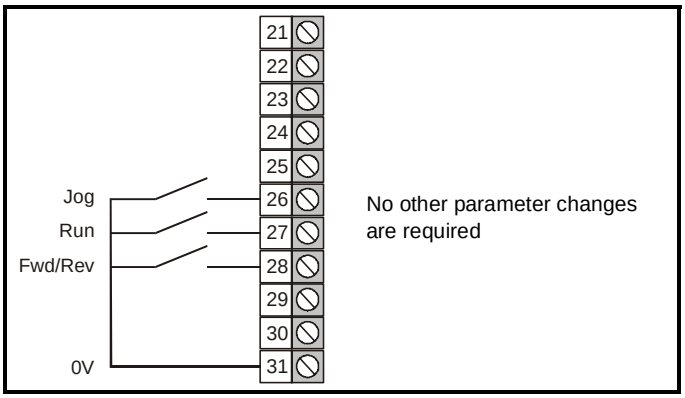
Parameter changes required

Parameter	Value
8.10	6.34
8.12	0

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

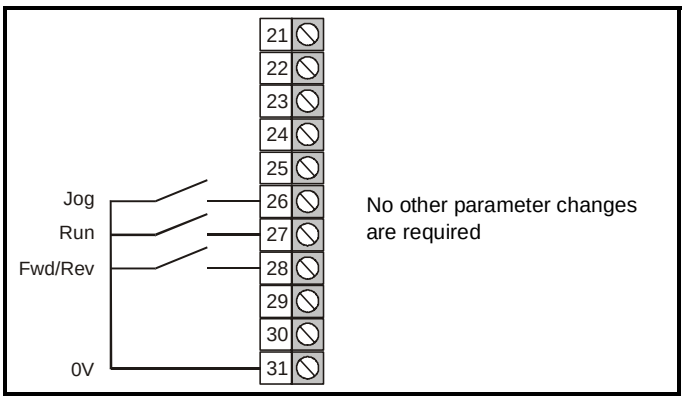
Run permit or /Stop	(parameter **6.34**)	Not used
Sequencing bit 0	(parameter **6.30**)	Run
Sequencing bit 1	(parameter **6.31**)	Jog
Sequencing bit 2	(parameter **6.32**)	Forward/Reverse
Sequencing bit 3	(parameter **6.33**)	Not used



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	(parameter **6.34**)	Not used
Sequencing bit 0	(parameter **6.30**)	Run forward
Sequencing bit 1	(parameter **6.31**)	Jog
Sequencing bit 2	(parameter **6.32**)	Run Reverse
Sequencing bit 3	(parameter **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.

10.21.6 Catch a spinning motor

6.09	Synchronize to a spinning motor			
RW	Bit			
OL	⇳	0 or 1	⇨	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 parameter **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 rated defined by parameter **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 parameter **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, parameter **5.14**, must be set to 'Fd' (3) and not left in the default value of 'Ur_I' (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 ~ 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 ~ 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 ~ 2.5 s	⇨	0.25

When the software has detected the motor speed it ramps the drives output voltage from the level programmed in parameter **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.

10.21.7 Position loop modes

13.08		Position loop mode *selector*			
RW		Uni			
OL	⇳	0 ~ 2	⇨	0	
CL	⇳	0 ~ 6	⇨	0	

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

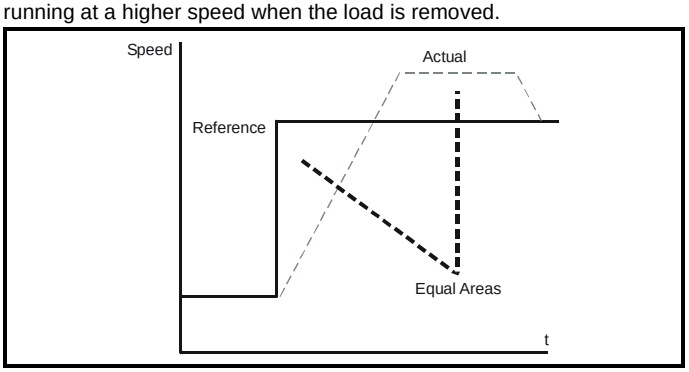
4 Non rigid digital lock without digital Feed Forward

5 Orientate on stop command only

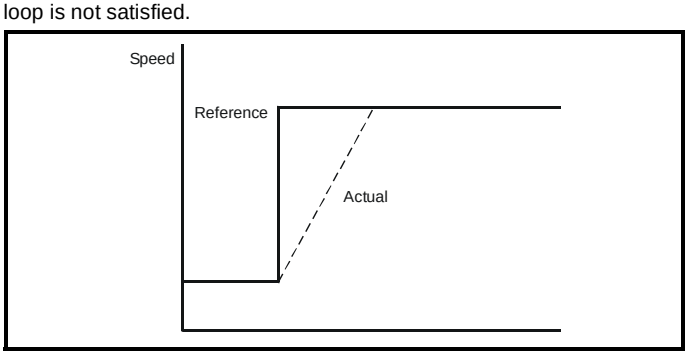
6 Orientate on stop command and when enabled

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 (**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 (**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 parameter **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 (**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 parameter **13.10** in the direction the motor was previously running.
2. When the speed set in parameter **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 parameter **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 **1.06** or **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 (**1.36** and **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 parameters **1.36** and **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

	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)
Model	kW	hp	3kHz	4.5kHz	6kHz	9kHz	12kHz	3kHz	4.5kHz	6kHz	9kHz	12kHz		
UNI 1201	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
UNI 1401	0.75	1.0											3.0	4.5
UNI 1202	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
UNI 1402	1.1	1.5											4.3	5.5
UNI 1203	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
UNI 1403	1.5	2.0											5.8	6.8
UNI 1204	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
UNI 1404	2.2	3.0											8.2	8.6
UNI 1205	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
UNI 1405	4.0	5.0											10.0	12.0
UNI 2201	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
UNI 2401	5.5	7.5											13.0	16.0
UNI 2202	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
UNI 2402	7.5	10											17.0	20.0
UNI 2203	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
UNI 2403	11.0	15											21.0	25.0
UNI 3201	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
UNI 3401	15.0	25											27	34
UNI 3402	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
UNI 3202	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
UNI 3403	22.0	30											40	53
UNI 3203	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
UNI 3404	30.0	40											52	66
UNI 3204	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
UNI 3405	37.0	50	70.0										66	82
UNI 4401	45	75	96	96	88	70		95	85	75	60		76	98
UNI 4402	55	100	124	104	88	70		105	85	75	60		91	114
UNI 4403	75	125	156	124	105	80		135	105	85	65		123	152
UNI 4404	90	150	180	175	145	110		180	150	125	95		145	205
UNI 4405	110	150	202	175	145	110		190	150	125	95		181	224
UNI 5401	160	200	300*					240					280	321
UNI 5402	320	400	600*					480					560	642
UNI 5403	480	600	900*					720					840	963
UNI 5404	640	800	1,200*					960					1,120	1284
UNI 5405	800	1000	1,500*					1,200					1,400	1605
UNI 5406	960	1200	1,800*					1,440					1,680	1926
UNI 5407	1120	1400	2,100*					1,680					1,960	2247
UNI 5408	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		
UNI 1201 LFT	0.37	0.5	2.1	2.1	2.1	2.4	4.0
UNI 1401 LFT	0.75	1.0				3.0	4.5
UNI 1202 LFT	0.55	0.75	2.8	2.8	2.8	3.5	6.0
UNI 1402 LFT	1.1	1.5				4.3	5.5
UNI 1203 LFT	0.75	1.0	3.8	3.8	3.3	4.6	8.0
UNI 1403 LFT	1.5	2.0				5.8	6.8
UNI 1204 LFT	1.1	1.5	5.6	4.0	3.3	6.5	10.0
UNI 1404 LFT	2.2	3.0				8.2	8.6
UNI 1205 LFT	2.2	3.0	9.5	4.3	3.3	8.6	12.5
UNI 1405 LFT	4.0	5.0				10.0	12.0
UNI 2201 LFT	3.0	4.0	12.0	12.0	11.0	10.8	13.9
UNI 2401 LFT	5.5	7.5				13.0	16.0
UNI 2202 LFT	4.0	5.0	16.0	14.2	11.0	14.3	16.9
UNI 2402 LFT	7.5	10.0				17.0	20.0
UNI 2203 LFT	5.5	10.0	25.0	14.2	11.0	19.8	27.0
UNI 2403 LFT	11.0	15				25.0	21.0
UNI 3201 LFT	7.5	15	34.0	28.0	21.0	26	28
UNI 3401 LFT	15.0	25				27	34
UNI 3402 LFT	18.5	30	40.0	28.0	21.0	32	39
UNI 3202 LFT	11.0	20	46.0	32.0	24.0	39	43
UNI 3403 LFT	22.0	30				40	53
UNI 3203 LFT	15.0	25	60.0	33.0	24.0	53	56
UNI 3404 LFT	30.0	40				52	66
UNI 3204 LFT	22.0	30	74.0	35.0	26.0	78	84
UNI 3405 LFT	37.0	50	70.0			66	82
UNI 4401 LFT	45	75	96	70	57	76	98
UNI 4402 LFT	55	100	124	70	57	91	114
UNI 4403 LFT	75	125	156	80	61	123	152
UNI 4404 LFT	90	150	180	100	77	145	205
UNI 4405 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
UNI 1401	0.75	1.0	80	80	90	90	90
UNI 1402	1.1	1.5	90	90	100	100	110
UNI 1403	1.5	2.0	100	110	110	120	130
UNI 1404	2.2	3.0	130	130	130	150	150
UNI 1405	4.0	5.0	180	190	190	190	170
UNI 2401	5.5	7.5	210	230	250	280	310
UNI 2402	7.5	10	270	290	310	320	310
UNI 2403	11.0	15	400	380	360	330	310
UNI 3401	15.0	20	570	620	670	660	630
UNI 3402	18.5	25	660	720	730	660	630
UNI 3403	22.0	30	730	800	770	730	700
UNI 3404	30.0	40	950	830	790	740	710
UNI 3405	37.0	50	1,090	990	920	850	800
UNI 4401	45	60	1,460	1,610	1,630	1,530	
UNI 4402	55	75	1,910	1,780	1,670	1,560	
UNI 4403	75	100	2,370	2,130	2,030	1,850	
UNI 4404	90	125	2,640	2,890	2,700	2,470	
UNI 4405	110	125	2,970	2,910	2,720	2,490	
UNI 5401	160	200	4,700				

* Per Unidrive size 5 power module (e.g. UNI 5402 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 ±10%
Unidrive LV: 200V to 240V ±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 ±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 10 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 ~ 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	200 mm 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	
UNI 1201	2.4 A	6A	1.5 mm^2	16 AWG
UNI 1401	3.0 A			
UNI 1202	3.5 A	10A	2.5 mm^2	14 AWG
UNI 1402	4.3 A			
UNI 1203	4.6 A	10A	2.5 mm^2	14 AWG
UNI 1403	5.8 A			
UNI 1204	6.5 A	10A	2.5 mm^2	14 AWG
UNI 1404	8.2 A			
UNI 1205	8.6 A	16A	2.5 mm^2	14 AWG
UNI 1405	10.0 A			
UNI 2201	10.8 A	16A	2.5 mm^2	14 AWG
UNI 2401	13.0 A			
UNI 2202	14.3 A	20A	4 mm^2	10 AWG
UNI 2402	17.0 A			
UNI 2203	19.8 A	35A	4 mm^2	10 AWG
UNI 2403	21.0 A			
UNI 3201	26 A	40A	6 mm^2	8 AWG
UNI 3401	27 A			
UNI 3402	32 A	50A	10 mm^2	6 AWG
UNI 3202	39 A	60A	10 mm^2	6 AWG
UNI 3403	40 A			
UNI 3203	53 A	70A	16 mm^2	4 AWG
UNI 3404	52 A			
UNI 3204	78 A	80A	25 mm^2	4 AWG
UNI 3405	66 A			
UNI 4401	76 A	100A	35 mm^2	2 AWG
UNI 4402	91 A	125A	35 mm^2	2 AWG
UNI 4403	123 A	160A	50 mm^2	0 AWG
UNI 4404	145 A	200A	70 mm^2	2/0 AWG
UNI 4405	181 A	250A	95 mm^2	3/0 AWG
UNI 5401	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
UNI 1201	65	210
UNI 1202	100	330
UNI1203	130	430
UNI 1204	200	660
UNI 1205	300	990
UNI 2201 ~ UNI 2203	300	990
UNI 3201 ~ UNI 3204	200	660

Nominal AC supply voltage	400V		480V	
Model	Maximum Permissible Motor Cable Length * (PWM switching frequency at 3kHz **)			
	m	ft	m	ft
UNI 1401	65	210	50	160
UNI 1402	100	330	75	250
UNI 1403	130	430	100	330
UNI 1404	200	660	150	490
UNI 1405	300	990	250	820
UNI 2401 ~ UNI 2403	300	990	300	990
UNI 3401 ~ UNI 3405	200	660	124	410
UNI 4401 ~ UNI 4405	200	660	124	410
UNI 5401	300	990	300	990
UNI 5402	600	1,980	600	1,980
UNI 5403	900	2,970	900	2,970
UNI 5404	1,200	3,960	1,200	3,960
UNI 5405	1,500	4,950	1,500	4,950
UNI 5406	1,800	5,940	1,800	5,940
UNI 5407	2,100	6,930	2,100	6,930
UNI 5408	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 4.1.3 *Cable types and lengths* on page 33 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
UNI 1201 ~ UNI 1205	20Ω	15kW
UNI 1401 ~ UNI 1405	40Ω	
UNI 2201	20Ω	15kW
UNI 2401	40Ω	
UNI 2202, UNI 2203	15Ω	20kW
UNI 2402, UNI 2403	30Ω	
UNI 3201 ~ UNI 3205	5Ω	60kW
UNI 3401 ~ UNI 3405	10Ω	
UNI 4401 ~ UNI 4405	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	FS5113-50-34	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
UNI 1201 ~ UNI 1205 UNI 1401 ~ UNI 1405	Footprint or Bookcase	4200-6104	FS5101-10-07
	Bookcase	4200-6105	FS5111-10-29
UNI 2201 ~ UNI 2202 UNI 2401	Footprint or Bookcase	4200-6108	FS5106-16-07
	Bookcase	4200-6109	FS5112-16-07
UNI 2203 UNI 2402 ~ UNI 2403	Footprint or Bookcase	4200-6113	FS5106-25-07
	Bookcase	4200-6114	FS5113-25-29
UNI 3201 ~ UNI 3202 UNI 3401 ~ UNI 3403	Bookcase	4200-6116	FS5113-50-34
UNI 3203 UNI 3404	Bookcase	4200-6117	FS5113-63-34
UNI 3204 UNI 3405	Bookcase	4200-6106	FS5113-100-35
UNI 4401 ~ UNI 4402	Bookcase	4200-6107	FS5113-150-40
UNI 4403 ~ UNI 4404	Bookcase	4200-6111	FS5113-180-40
UNI 4405	Bookcase	4200-6112	FS5113-220-37
UNI 5401	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**
UNI 1201 ~ UNI 3204 UNI 1401 ~ UNI 4401 (Rated input current of drive <100A)	Specified RFI filter required	Using the specified RFI filters and following the wiring guidelines given in Figure 4-9 on page 40 may not ensure that the radiated emission limits are met. Additional filtering may be required in this environment.	Specified RFI filter required
UNI 4402 ~ UNI 5408 (Rated input current of drive >100A)	Specified RFI filter required	Using the specified RFI filters and following the wiring guidelines given in Figure 4-9 on page 40 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	FS5113-50-34	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

1. 1MΩ in a star connection between phases, with the star point connected by a 680k resistor to ground.
2. 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	FS5113-50-34	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 (4.055in)	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

WARNING

Users must not attempt to repair a drive if it is faulty, nor carry out fault diagnosis other than through the use of the diagnostic features described in this chapter.

If a drive is faulty, it must be returned to an authorized Control Techniques distributor for repair.

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 ~ 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 be 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: • 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: • 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 *UD55 User Guide*.
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.rn9	**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 *Transferring parameter sets between drives of different ratings* in the *UD55 User Guide*.
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: • 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 *Servo* on page 71 for more information), or enter the correct value for phase offset. See section 8.3 *Motor thermal protection* on page 84.
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 *Unidrive Advanced User Guide*. 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: • 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 *Quick Start commissioning* on page 69 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 *Servo* on page 71 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 ~ 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: • 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 *Quick Start commissioning* on page 69 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 *Servo* on page 71 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
OI.br	**Over Current in braking transistor**
4	Over current threshold in the braking transistor has been reached. This can be caused by the following: • 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.
OI.dc n	**DC over current trip in module n**
134 ~ 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 ~ 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: • 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 ~ 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: • 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: • 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	Loss of an AC supply phase detected by increased ripple on the DC bus. Ensure all 3 input phases are present and balanced. **NOTE** 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 intiated.
Prc2	**UD70> Second processor fault**
8	Indicates a trip in the Processor of the UD70 large option module. Possible causes of failure are as follows: • 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	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.
PS n	**Internal power supply fault in module n (size 5 only)**
110 ~ 117	Check integrity of interface ribbon cables and connections (size 5 only). Hardware fault - return drive to supplier.
rS	**Incorrect stator resistance value**
33	Incorrect measurement of stator resistance due to the following: • One or more motor phases disconnected when the measurement was being made • Motor too small for the drive If required, set Pr **0.07** (or Pr **5.14**) *Voltage mode* at **Ur** and enter the value of stator resistance in parameter Pr **5.17**.
SCL	**Serial Communications loss**
30	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.
SEP	**UD5x> Small option module fault**
9	Indicates a trip in the UD5x small option module. Possible causes of failure are as follows: • 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	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: • 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	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: • 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**). After rectifying the fault, remove, and then re-apply the AC supply to the drive in order to obtain absolute position information.
SEP EF	**UD52> Sincos encoder fault**
36	Internal fault within the SINCOS encoder. Contact the encoder or motor supplier.
St GL	**Spurious trip**
34	Unrecognised trip on power-up (size 5 only). Hardware fault, contact the supplier of the drive.
SuP.LSS	**Regen supply loss**
190	The drive in Regen mode has detected AC supply loss. Check all three supply phases are present and at the correct level.
th	**Motor thermistor over temperature**
24	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.
thS	**Motor thermistor short circuit**
25	The motor thermistor or wiring is short circuit. Set Pr **7.15** = volt and save parameters to disable this function.

Trip	Diagnosis
tr XX	**UD70 run time trips**
40 ~ 69	**XX** indicates the trip code number. Trip Code Description 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 ~ 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 ~ 59 Internal error 60 ~ 69 High-speed communications option generated trips See the UD70 and/or the relevant high-speed communications option User guides for more information.
tr XX	**User trips 70 to 99, 159 to 179, 191 to 200**
70 ~ 99, 159 ~ 179, 191 ~ 200	Trip codes defined by the user. **XX** indicates the trip code number. For use with the UD70 Application modules by writing the trip code to **Pr 10.38**.
UFLt n	**Unidentified trip on module n**
142 ~ 149	Unidentified fault on power-up in module **n** (size 5 only)
UU	**Under Volts**
1	Under voltage threshold on the DC bus has been reached 400V Unidrive: <350Vdc 200V Unidrive LV: <160Vdc This also occurs when the AC supply has been removed. Ensure that the AC supply is above the minimum level. 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 ~ 117	PS110 ~ PS117
2	OU	23	OA	118 ~ 125	OI.AC118 ~ OI.AC125
3	OI.AC	24	th	126 ~ 133	OU126 ~ OU133
4	OI.br	25	thS	134 ~ 141	OI.dc134 ~ OI.dc141
5	PS	26	OP.OVLd	142 ~ 149	UFLt142 ~ UFLt149
6	Et	27	cL1	150 ~ 158	ConF150 ~ ConF158
7	OU.SPd	28	cL2	159 ~ 179	tr159 ~ 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 ~ 69	tr40 ~ tr69	190	SuP.LSS
19	It.br	70 ~ 99	tr70 ~ tr99	191 ~ 200	tr191 ~ tr200
20	It.AC	101	OtinP		
21	Oh1	102 ~ 109	OtHS102 ~ OtHS109		

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 181 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 ~ 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 3.13.2 *Terminal sizes and torque settings* on page 31

13.1 AC supply specification

The drive is suitable for use in a circuit capable of delivering not more than:

Unidrive sizes 1 ~ 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 173 for details).

Table 13-1 Maximum continuous output current for low voltage models

Model	FLC (A)	
	STD / VTC	LFT
UNI 1201	2.1	2.1
UNI 1202	2.8	2.8
UNI 1203	3.8	3.8
UNI 1204	5.6	4.0
UNI 1205	9.5	4.3
UNI 2201	12	12
UNI 2202	16	14.2
UNI 2203	25	14.2
UNI 3201	34	28
UNI 3202	46	28
UNI 3203	60	32
UNI 3204	74	35

Table 13-2 Maximum continuous output current for 380V / 400V models

Model	FLC (A)	
	STD / VTC	LFT
UNI 1401	2.1	2.1
UNI 1402	2.8	2.8
UNI 1403	3.8	3.8
UNI 1404	5.6	4.0
UNI 1405	9.5	4.3
UNI 2401	12	12.0
UNI 2402	16	14.2
UNI 2403	25	14.2
UNI 3401	34	28.0
UNI 3402	40	28.0
UNI 3403	46	32.0
UNI 3404	60	33.0
UNI 3405	70	35.0
UNI 4401	96	70
UNI 4402	124	70
UNI 4403	156	80
UNI 4404	180	100
UNI 4405	202	100
UNI 5401	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.

Index