EMERSON
Industrial Automation

Quick Start Guide

Unidrive M400

Frame sizes 1 to 4

Manufacturing Automation drive
Fast set-up and diagnosis with real-text display, plus integrated CODESYS based PLC

Part Number: 0478-0040-06
Issue: 6

This guide is intended to provide basic information required in order to set-up a drive to run a motor. For more detailed installation information, please refer to the *Unidrive M400 User Guide* which is available to download from:

http://www.emersonindustrial.com/en-EN/controltechniques/downloads/userguidesandsoftware/Pages/downloads.aspx.

or

www.emersonindustrial.com/en-EN/leroy-somer-motors-drives/downloads/Pages/manuals.aspx.

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.

This guide does not include safety information. Incorrect installation or operation of the drive, could cause personnel injury or equipment damage. For essential safety information, please refer to the *Unidrive M400 User Guide* or the safety booklet supplied with the drive.

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Issue Number: 6

Contents

1 Product information 7
1.1 Ratings 7
2 Options 8
3 Mechanical installation 9
4 Electrical installation 12
4.1 AC supply requirements 12
4.2 External braking resistor 12
4.3 Ground leakage 14
4.4 Control terminal configurations and wiring 15
4.5 EMC 21
4.6 Safe Torque Off (STO) 22
5 Optional LCD keypad and display 23
5.1 Saving parameters 24
5.2 Restoring parameter defaults 24
6 Basic parameters (Menu 0) 25
6.1 Menu 0: Basic parameters 25
6.2 Unidrive M400 parameter descriptions 30
7 Running the motor 49
8 Diagnostics 50
9 NV Media Card Operation 55
10 Machine Control Studio 56
11 UL listing information 57
11.1 General 57
11.2 Mounting 57
11.3 Environment 57
11.4 Electrical ratings 57
11.5 Opening of branch circuit 57
11.6 Electrical installation 57
11.7 Motor overload protection 58
11.8 Motor overspeed protection 58
11.9 Thermal memory retention 58
11.10 Group installation 59
11.11 UL listed accessories 59

Declaration of Conformity

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This declaration applies to the Unidrive-M product range comprising model numbers listed below:

Model No.	Interpretation	Format: Xaaa-bbc ddddde	Format: Xaa-bbc ddddde
X	Application	M = Manufacturing Automation, E = Elevator, F = Flow, H = HVAC, CSD = Compressor	HS = High Speed
aa(a)	Control System	100, 101, 200, 201, 300, 400, 600, 700, 701, 702	70, 71, 72
bb	Frame Size	01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11	
c	Voltage Rating	1 = 100 V, 2 = 200 V, 4 = 400 V, 5 = 575 V, 6 = 690 V	
ddddd	Current Rating	Example 01000 = 100 A	
e	Configuration	A = AC in AC out (with internal choke), D = DC in AC out (Inverter), C = AC in DC out (Rectifier), E = AC in AC out (without internal choke), T = AC in AC out with Dual Rectifier	

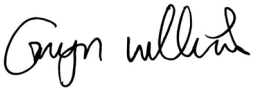
The model number may be followed by additional characters that do not affect the ratings.

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

EN 61800-5-1:2007	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
EN 61800-3: 2004	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
EN 61000-6-2:2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-4:2007	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
EN 61000-3-2:2006	Electromagnetic compatibility (EMC) - Part 3-2: Limits for harmonic current emissions (equipment input current ≤16 A per phase)
EN 61000-3-3:2008	Electromagnetic compatibility (EMC) - Part 3-3: Limitation of voltage changes, voltage fluctuations and flicker in public, low voltage supply systems, for equipment with rated current ≤16 A per phase and not subject to conditional connection

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

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



G. Williams
Vice President, Technology
Date: 30th July 2015
Place: Newtown, Powys, UK

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 installers who are familiar with requirements for safety and EMC. The assembler is responsible for ensuring that the end product or system complies with all the relevant laws in the country where it is to be used. Refer to the User Guide. An EMC data sheet is also available giving detailed EMC information.

Declaration of Conformity
(including 2006 Machinery Directive)

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X	Application	M = Manufacturing Automation, E = Elevator, F = Flow, H = HVAC, CSD = Compressor	HS = High Speed
aa(a)	Control System	100, 101, 200, 201, 300, 400, 600, 700, 701, 702	70, 71, 72
bb	Frame Size	01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11	
c	Voltage Rating	1 = 100 V, 2 = 200 V, 4 = 400 V, 5 = 575 V, 6 = 690 V	
ddddd	Current Rating	Example 01000 = 100 A	
e	Configuration	A = AC in AC out (with internal choke), D = DC in AC out (Inverter), C = AC in DC out (Rectifier), E = AC in AC out (without internal choke), T = AC in AC out with Dual Rectifier	

The model number may be followed by additional characters that do not affect the ratings.

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

These products fulfil all the relevant provisions of the Machinery Directive 2006/42/EC and the EMC Directive 2014/108/EC.

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

TUV Rheinland Industrie Service GmbH
Am Grauen Stein
D-51105 Köln
Germany

Notified body identification number: 0035

EC type-examination certificate numbers:

01/205/5270.01/14 dated 2014-11-11
01/205/5387.01/15 dated 2015-01-29
01/205/5383.02/15 dated 2015-04-21

The harmonised standards used are shown below:

EN 61800-5-1:2007	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
EN 61800-5-2:2007	Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional
EN ISO 13849-1:2008	Safety of Machinery, Safety-related parts of control systems, General principles for design
EN ISO 13849-2:2008	Safety of machinery, Safety-related parts of control systems. Validation
EN 61800-3: 2004	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
EN 62061:2005	Safety of machinery, Functional safety of safety related electrical, electronic and programmable electronic control systems

Person authorised to complete the technical file:
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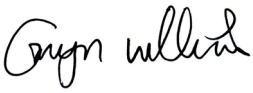


G. Williams
Vice President, Technology
Date: 1st July 2015
Place: Newtown, Powys, UK

IMPORTANT NOTICE

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. It is the responsibility of the installer to ensure that the design of the complete machine, including its safety-related control system, is carried out in accordance with the requirements of the Machinery Directive and any other relevant legislation. The use of a safety-related drive in itself does not ensure the safety of the machine.

Compliance with safety and EMC regulations depends upon installing and configuring drives correctly, including using the specified input filters. The drive must be installed only by professional installers who are familiar with requirements for safety and EMC. The assembler is responsible for ensuring that the end product or system complies with all relevant laws in the country where it is to be used. For more information regarding Safe Torque Off, refer to the *Drive User Guide*.

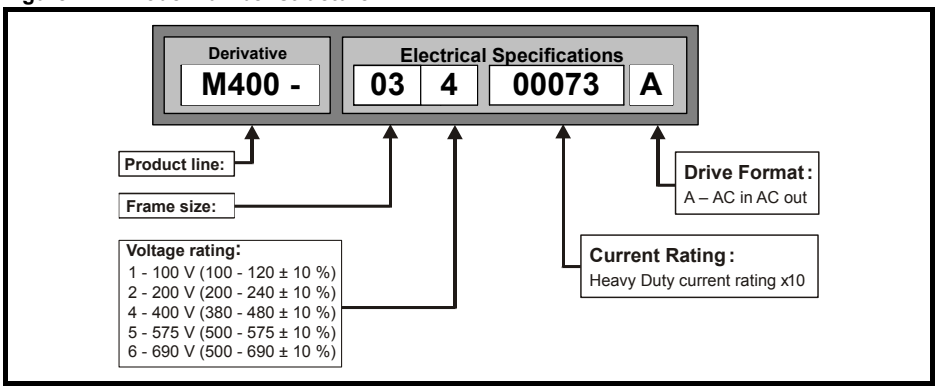
1 Product information

1.1 Ratings

Model	Input phases	Max. cont input current	Max input fuse rating		Nominal cable size				Output current		
					European		USA				
			1 Ph	3 Ph	Input	Output	Input	Output	Max. cont output current	Nominal power	Motor power
	ph	A	A	A	mm^2	mm^2	AWG	AWG	A	kW	hp
01100017	1	8.7	10		1	1	16	16	1.7	0.25	0.33
01100024	1	11.1	16		1	1	14	16	2.4	0.37	0.5
01200017	1	4.5	6		1	1	16	16	1.7	0.25	0.33
01200024	1	5.3	6		1	1	16	16	2.4	0.37	0.5
01200033	1	8.3	10		1	1	16	16	3.3	0.55	0.75
01200042	1	10.4	16		1	1	16	16	4.2	0.75	1
02100042	1	18.8	20		2.5	1	12	16	4.2	0.75	1
02100056	1	24	25		4	1	10	16	5.6	1.1	1.5
02200024	1 / 3	5.3/4.1	6	6	1	1	16	16	2.4	0.37	0.5
02200033	1 / 3	8.3/6.7	10	10	1	1	16	16	3.3	0.55	0.75
02200042	1 / 3	10.4/7.5	16	10	1	1	16	16	4.2	0.75	1
02200056	1 / 3	14.9/11.3	20	15	2.5/1.5	1	12/14	16	5.6	1.1	1.5
02200075	1 / 3	18.1/13.5	20	15	2.5	1	12	16	7.5	1.5	2
02400013	3	2.4		6	1	1	16	16	1.3	0.37	0.5
02400018	3	2.9		6	1	1	16	16	1.8	0.55	0.75
02400023	3	3.5		6	1	1	16	16	2.3	0.75	1
02400032	3	5.1		6	1	1	16	16	3.2	1.1	1.5
02400041	3	6.2		10	1	1	16	16	4.1	1.5	2
03200100	1 / 3	23.9/17.7	25	20	4	1.5	10/12	14	10	2.2	3
03400056	3	8.7		10	1	1	14	16	5.6	2.2	3
03400073	3	12.2		16	1.5	1	12	16	7.3	3	3
03400094	3	14.8		16	2.5	1.5	12	14	9.4	4	5
04200133	1 / 3	23.7/16.9	25	20	4/2.5	2.5	10	12	13.3	3	3
04200176	3	21.3		25	4	2.5	10	12	17.6	4	5
04400135	3	16.3		20	2.5	2.5	10	12	13.5	5.5	7.5
04400170	3	20.7		25	4	2.5	10	12	17	7.5	10

NOTE The nominal cable sizes shown in the table above, are provided as a guide only. Ensure that the cables used conform to the local wiring regulations.

Figure 1-1 Model number structure

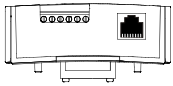
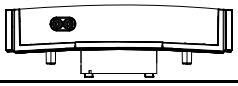


2 Options

Table 2-1 System Integration (SI) option module identification

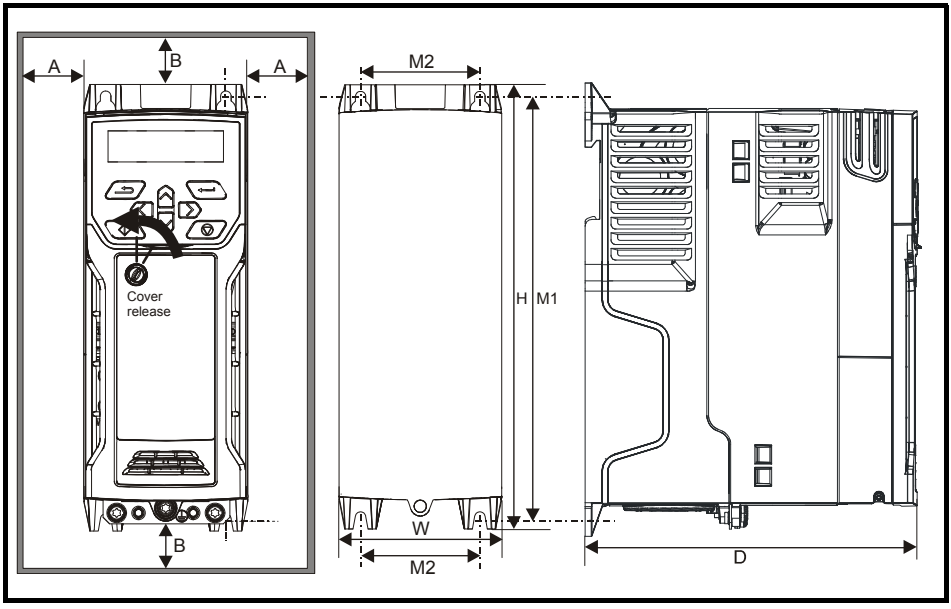
Type	Option module	Color	Name	Further details
Fieldbus		Purple	SI-PROFIBUS	See *relevant option module User Guide*
		Medium Grey	SI-DeviceNet	
		Light Grey	SI-CANopen	
		Beige	SI-Ethernet	
		Brown Red	SI-EtherCAT	
Automation (I/O expansion)		Orange	SI-I/O	

Table 2-2 Adaptor Interface (AI) option module identification

Type	Option module	Name	Further Details
Communications		AI-485 Adaptor	See *Drive User Guide*
Backup		AI-Backup Adaptor	
		AI-Smart Adaptor	

3 Mechanical installation

The drives can be panel mounted with 0 mm space between the drives. For further information on mechanical installation refer to the *Drive User Guide.*



To remove the terminal cover, use a flat bladed screwdriver to rotate the terminal cover locating clip by approximately 30° in a counter clockwise direction, and then slide the cover down.

Drive Size	H		W		D		M1		M2		Ø		A		B*	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
1	160	6.30	75	2.95	130	5.12	143	5.70	53	2.08	5	0.2	0	0.00	100	3.93
2	205	8.07	78	3.07	150	5.91	194	7.63	55	2.17	5	0.2				
3	226	8.90	90	3.54	160	6.30	215	8.46	70.7	2.80	5	0.2				
4	277	10.91	115	4.53	175	6.89	265	10.43	86	3.40	6	0.23				

NOTE A minimum clearance of 100 mm above and below Frame 01 to 04 products is required for applications where the product is subjected to rated load and rated ambient temperature.

NOTE * A minimum clearance of 50 mm above and below Frame 01 to 04 products is permissible in applications where either the ambient operating temperature is 35 °C or less or the average output current is derated by 20 %.

NOTE Derating for reduced clearances is to be applied in addition to the derating for increased switching frequency if operating above 3 kHz. Refer to the *Drive User Guide* for the current derating due to an increase in switching frequency.

NOTE If Din rail mounting is used in an installation, then mounting screws should be used to secure the drive to the back plate.

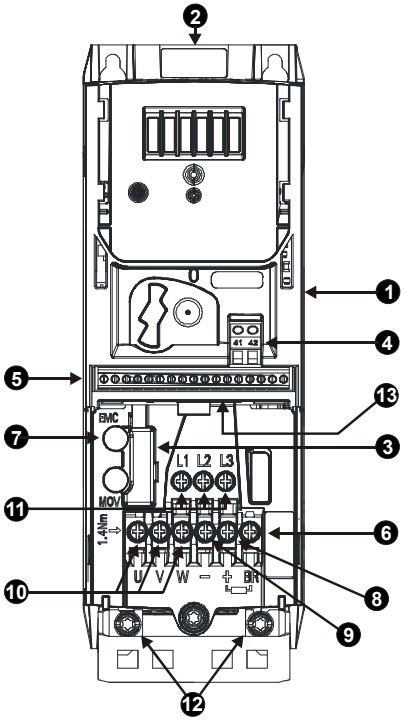
Table 3-1 Tools required

Tool	Location	Size 1	Size 2	Size 3	Size 4
Small terminal screwdriver	Control, relay and STO terminals	✓	✓	✓	✓
3 mm Flat-bladed screwdriver	Power terminals	✓			
5 mm Flat-bladed screwdriver	Terminal cover	✓	✓	✓	✓
4 mm Flat-bladed screwdriver	AC power terminals		✓		
Philips screwdriver	Power terminals		✓	✓	✓
Torx 10 driver	EMC & MOV screws	✓	✓	✓	✓
Torx 15 driver	Fan screw	✓			
Torx 20 driver	Fan screw		✓	✓	✓

Table 3-2 Recommended torque settings

Model size	Terminal block description	Torque settings
All	Control terminals	0.2 N m (0.15 lb ft)
	Relay terminals	0.5 N m (0.37 lb ft)
1	Power terminals	0.5 N m (0.37 lb ft)
2, 3, 4		1.4 N m (1.03 lb ft)

Figure 3-1 Feature diagram (size 2 shown)



Key

1. Rating label (On side of drive)
2. Identification label
3. Option module connection
4. Relay connections
5. Control connections
6. Braking terminal
7. Internal EMC filter screw
8. DC bus +
9. DC bus -
10. Motor connections
11. AC supply connections
12. Ground connections
13. Safe Torque Off connections

4 Electrical installation

An overlay of the electrical connections / terminals is included on the back page of this manual.

4.1 AC supply requirements

Voltage:

100 V drive: 100 V to 120 V ±10 %
200 V drive: 200 V to 240 V ±10 %
400 V drive: 380 V to 480 V ±10 %

Number of phases: 3

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

Frequency range: 45 to 66 Hz

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

NOTE On the size 2 110 V drives or when connecting single phase to a dual rated 200 V unit, the supply should be connected to L1 and L3. Also the DC bus (-) terminal on 110 V drives has no internal connection. The 110 V drives use a voltage doubler circuit on the input, therefore the default for *Motor Rated Voltage* (00.008) is 230 V.

4.2 External braking resistor

Overload protection
When an external braking resistor is used, it is essential that an overload protection device is incorporated in the braking resistor circuit; as shown in the electrical diagram on the back cover.

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

Table 4-1 Braking resistor resistance and power rating (100 V)

Model	Minimum resistance* Ω	Instantaneous power rating kW	Continuous power rating kW
01100017	130	1.2	0.25
01100024			0.37
02100042	68	2.2	0.75
02100056			1.1

Table 4-2 Braking resistor resistance and power rating (200 V)

Model	Minimum resistance* Ω	Instantaneous power rating kW	Continuous power rating kW
01200017	130	1.2	0.25
01200024			0.37
01200033			0.55
01200042			0.75
02200024	68	2.2	0.37
02200033			0.55
02200042			0.75
02200056			1.1
02200075			1.5
03200100	45	3.4	2.2
04200133	22	6.9	3.0
04200176			4.0

Table 4-3 Braking resistor resistance and power rating (400 V)

Model	Minimum resistance* Ω	Instantaneous power rating kW	Continuous power rating kW
02400013	270	2.3	0.37
02400018			0.55
02400023			0.75
02400032			1.1
02400041			1.5
03400056	100	6.1	2.2
03400073			3
03400094			4
04400135	50	12.2	5.5
04400170			7.5

* Resistor tolerance: ±10 %

4.3 Ground leakage

The ground leakage current depends upon whether the internal EMC filter is installed or not. The drive is supplied with the filter installed. Instructions for removing the internal filter are given in section 4.5.1 *Internal EMC filter* on page 21.

With internal filter installed:

Size 1:

2.5 mA* AC at 230 V 50 Hz (line to line supply, star point ground)
9.2 mA* AC at 230 V 50 Hz (line to neutral supply, star point ground)

Size 2:

9.36 mA* AC at 110 V, 50 Hz (2 phase, line to line supply, star point ground)
16.4 mA* AC at 110 V, 50 Hz (1 phase, line to neutral supply, star point ground)
5.3 mA* AC at 230 V, 50 Hz (3 phase supply, star point ground)
15.4 mA* AC at 230 V, 50 Hz (1 phase, line to neutral supply, star point ground)
9.6 mA* AC at 400 V, 50 Hz (3 phase supply, star point ground)

Size 3:

19.7 mA* AC at 400 V 50 Hz (star point ground)
47.4 mA* AC at 400 V 50 Hz (corner ground)

Size 4:

21 mA* AC at 230 V 50 Hz (3 phase, star point ground)
6.8 mA* AC at 230 V 50 Hz (1 phase, line to line supply, star point ground)
30 mA* AC at 230 V 50 Hz (1 phase, line to neutral supply, star point ground)
50 mA* AC at 400 V 50 Hz (3 phase, star point ground)

*Proportional to the supply voltage and frequency.

With internal filter removed:

Size 1: <1.5 mA (line to line supply, star point ground)

<1 mA (line to neutral supply, star point ground)

Size 2: <1.7 mA (line to line supply, star point ground)

<1.9 mA (line to neutral supply, star point ground)

Size 3: <3.3 mA (star point ground)

<4.9 mA (corner ground)

Size 4: < 3.5 mA (star point ground)

NOTE The above leakage currents are just the leakage currents of the drive with the internal EMC filter connected and do not take into account any leakage currents of the motor or motor cable.

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

When the leakage current exceeds 3.5 mA, a permanent fixed ground connection must be provided using two independent conductors each with a cross-section equal to or exceeding that of the supply conductors. The drive is provided with two ground connections to facilitate this. Both ground connections are necessary to meet EN 61800-5-1: 2007.

4.3.1 Use of residual current device (RCD)

There are three common types of ELCB / RCD:

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

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

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

4.4 Control terminal configurations and wiring

00.005		**Drive Configuration**							
RW		Txt					PT	US	
OL **RFC-A**	⇳	AV (0), AI (1), AV Preset (2), AI Preset (3), Preset (4), Keypad (5), Keypad Ref (6), Electronic Pot (7), Torque Control (8), Pid Control (9)			⇨	AV (0)			

The setting of Pr **00.005** automatically sets the drive configuration

Value	Text	Description
0	AV	Analog input 1 (voltage) Analog input 2 (voltage) selected by terminal (Local/Remote)
1	AI	Analog input 1 (current) or Analog input 2 (voltage) selected by terminal (Local/Remote)
2	AV Preset	Analog input 1 (voltage) or 3 presets selected by terminal
3	AI Preset	Analog input 1 (current) or 3 presets selected by terminal
4	Preset	Four presets selected by terminal
5	Keypad	Keypad reference
6	Keypad Ref	Keypad reference with terminal control
7	Electronic Pot	Electronic Potentiometer
8	Torque Control	Torque mode, Analog input 1 (current frequency reference) or Analog input 2 (voltage torque reference) selected by terminal
9	Pid Control	PID mode, Analog input 1 (current feedback source) and Analog input 2 (voltage reference source)

Defaults are loaded before drive configuration changes are made.

Action will only occur if the drive is inactive, not in UU state and no User Actions are running. Otherwise, the parameter will return to its pre altered value on exit from edit mode. All parameters are saved if this parameter changes. Otherwise, the parameter will return to its pre altered value on exit from edit mode. All parameters are saved if this parameter changes.

Figure 4-1 Pr 00.005 = AV (50 and 60 Hz)

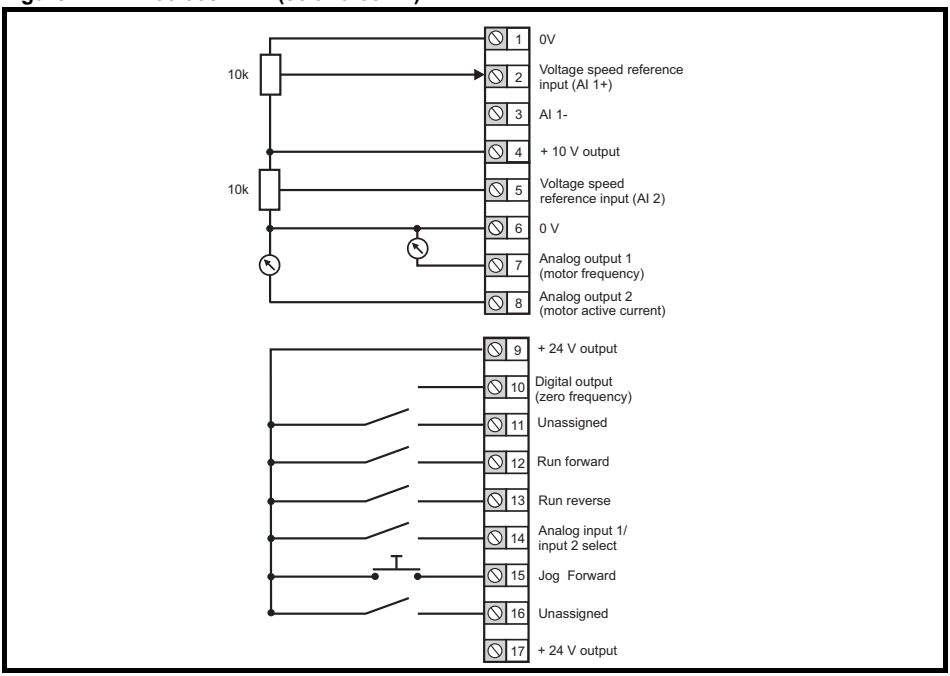


Figure 4-2 Pr 00.005 = AI (50 and 60 Hz)

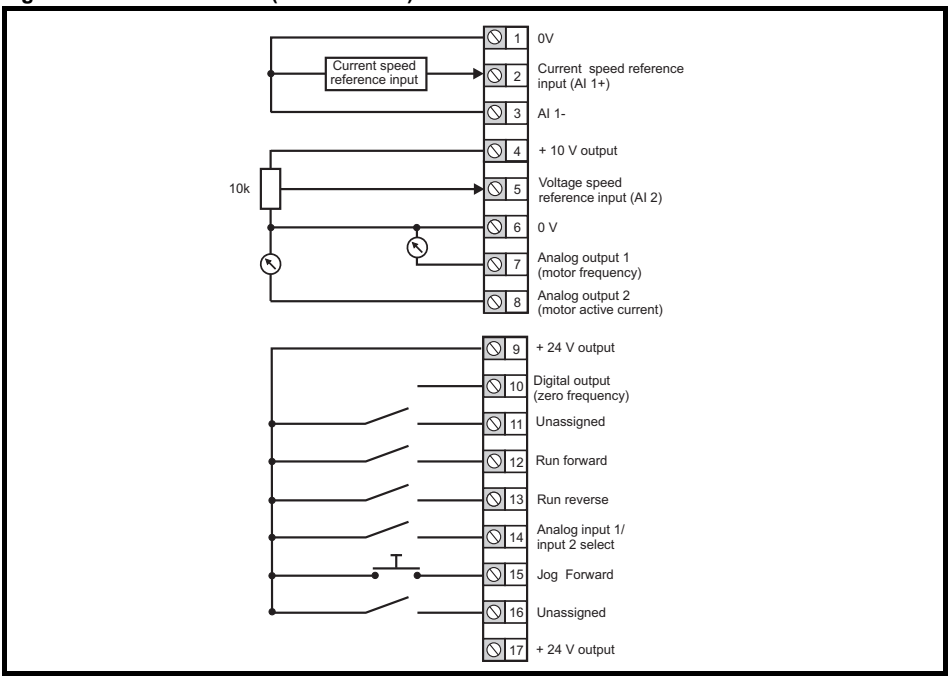
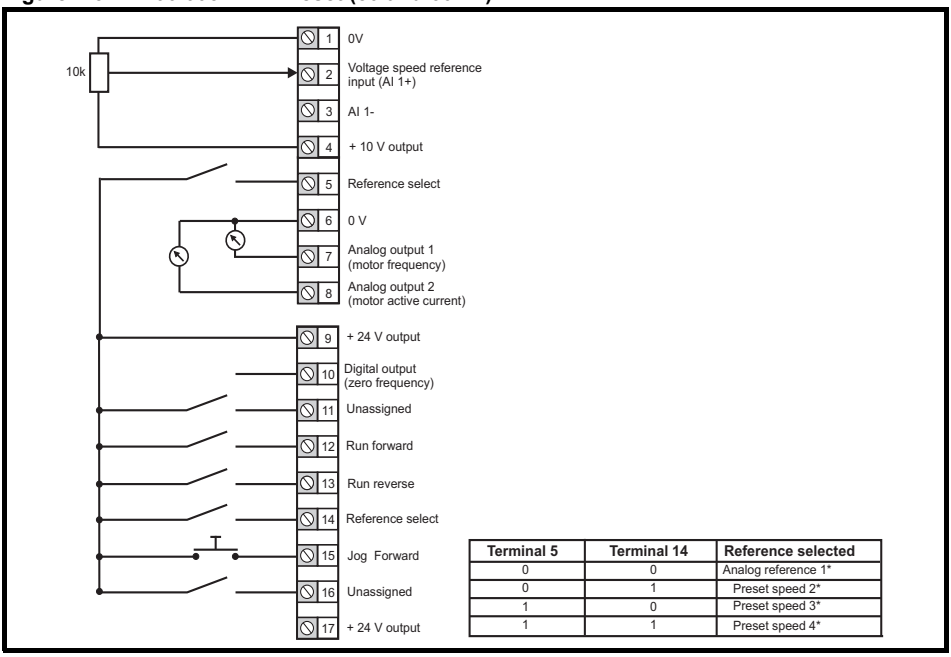
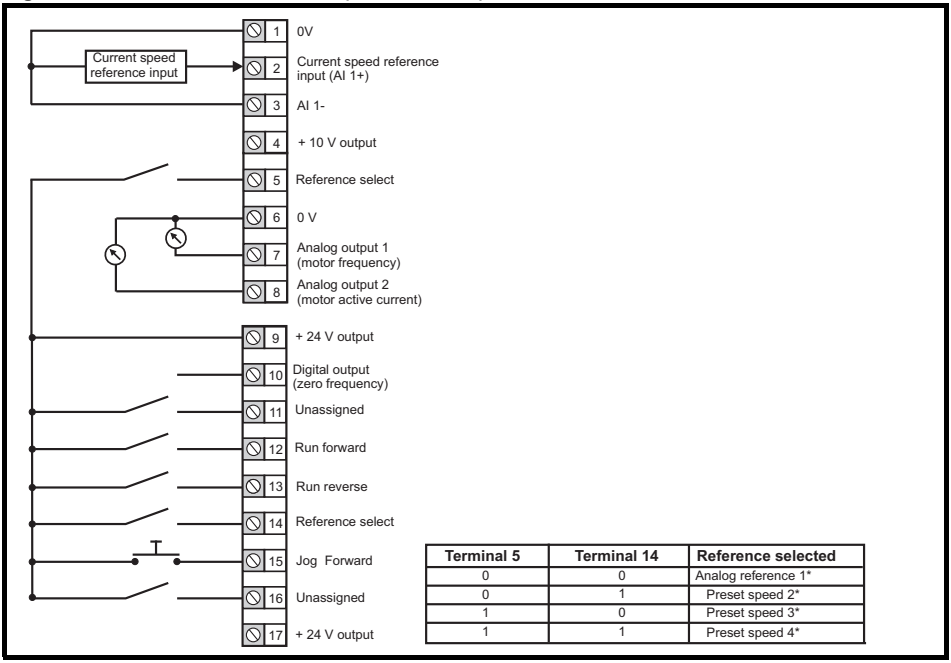


Figure 4-3 Pr 00.005 = AV Preset (50 and 60 Hz)



Terminal 5	Terminal 14	Reference selected
0	0	Analog reference 1*
0	1	Preset speed 2*
1	0	Preset speed 3*
1	1	Preset speed 4*

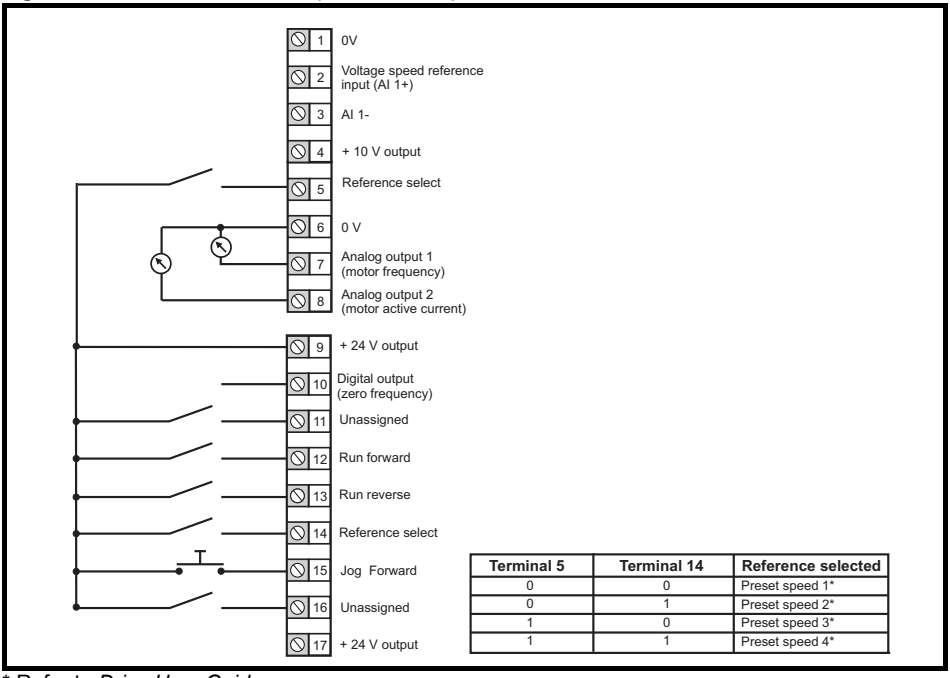
Figure 4-4 Pr 00.005 = AI Preset (50 and 60 Hz)



Terminal 5	Terminal 14	Reference selected
0	0	Analog reference 1*
0	1	Preset speed 2*
1	0	Preset speed 3*
1	1	Preset speed 4*

* Refer to *Drive User Guide*.

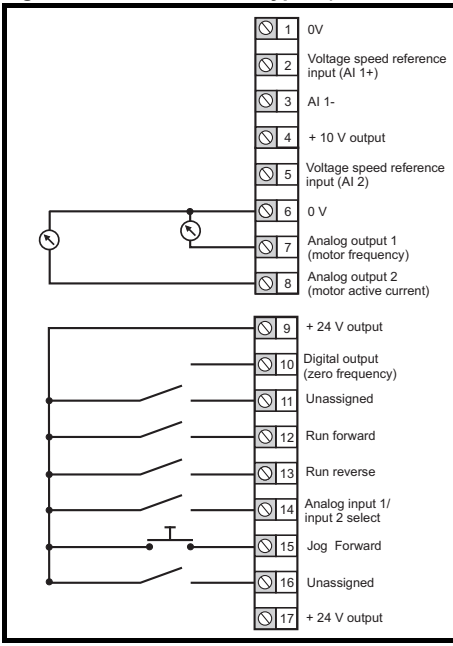
Figure 4-5 Pr 00.005 = Preset (50 and 60 Hz)



Terminal 5	Terminal 14	Reference selected
0	0	Preset speed 1*
0	1	Preset speed 2*
1	0	Preset speed 3*
1	1	Preset speed 4*

* Refer to *Drive User Guide*.

Figure 4-6 Pr 00.005 = Keypad (50 and 60 Hz)



When Pr **00.005** is set to Keypad, to run in reverse:

- Set Pr **00.017** to On

The Keypad reference can now be set to a negative frequency to run the motor in the reverse direction.

Figure 4-7 Pr 00.005 = Keypad Ref (50 and 60 Hz)

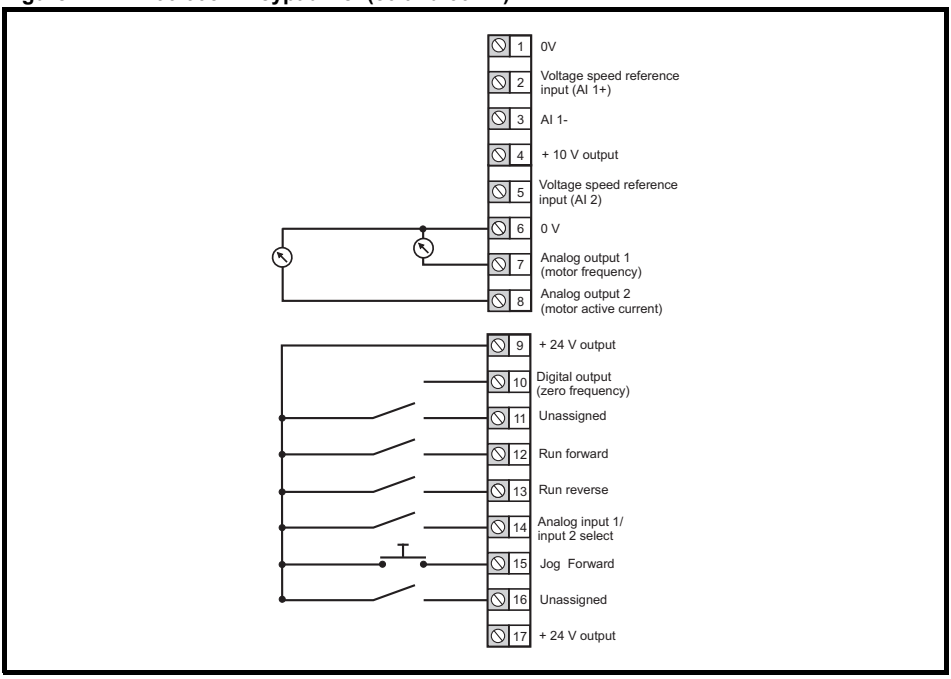
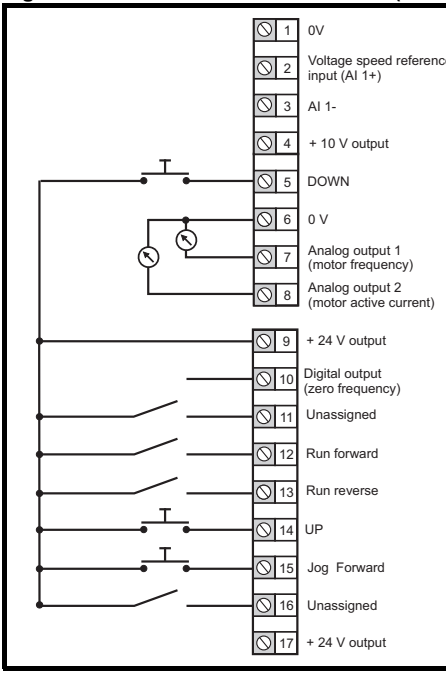


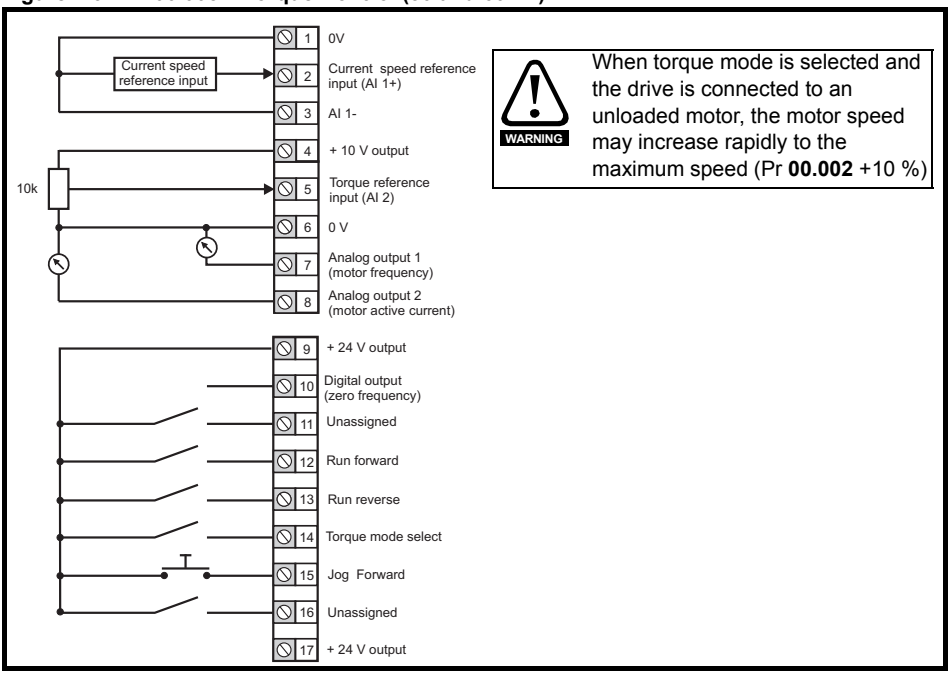
Figure 4-8 Pr 00.005 = Electronic Pot (50 and 60 Hz)



When Pr **00.005** is set to Electronic Pot, the following parameters may need to be adjusted:

- Motorized pot up/down rate (s/100 %)
- Motorized pot bipolar select (0 = unipolar, 1 = bipolar)
- Motorized pot mode: 0 = zero at power-up, 1 = last value at power-up, 2 = zero at power-up and only change when drive is running, 3 = last value at power-up and only change when drive is running, 4 = zero at power-up and drive disabled, only change when drive is running.

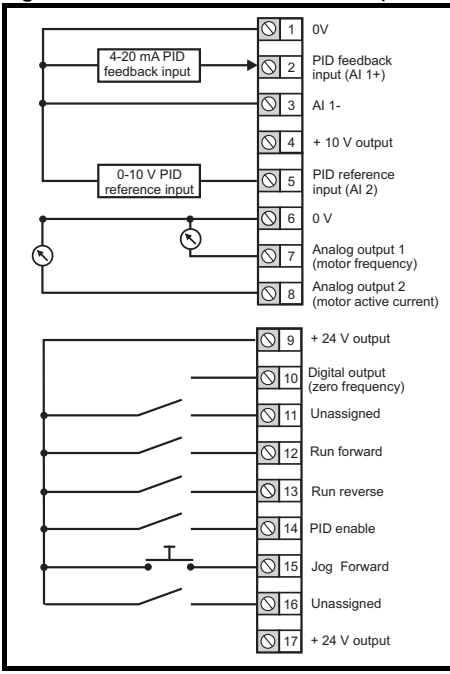
Figure 4-9 Pr 00.005 = Torque Control (50 and 60 Hz)



WARNING

When torque mode is selected and the drive is connected to an unloaded motor, the motor speed may increase rapidly to the maximum speed (Pr **00.002** +10 %)

Figure 4-10 Pr 00.005 = PID Control (50 and 60 Hz)



When Pr **00.005** is set to Pid, the following parameters may need to be adjusted:

- PID proportional gain
- PID integral gain
- PID feedback invert
- PID output upper limit (%)
- PID output lower limit (%)

4.5 EMC

4.5.1 Internal EMC filter

It is recommended that the internal EMC filter be kept in place unless there is a specific reason for removing it. If the drive is used as a motoring drive as part of a regen system, then the internal EMC filter must be removed.

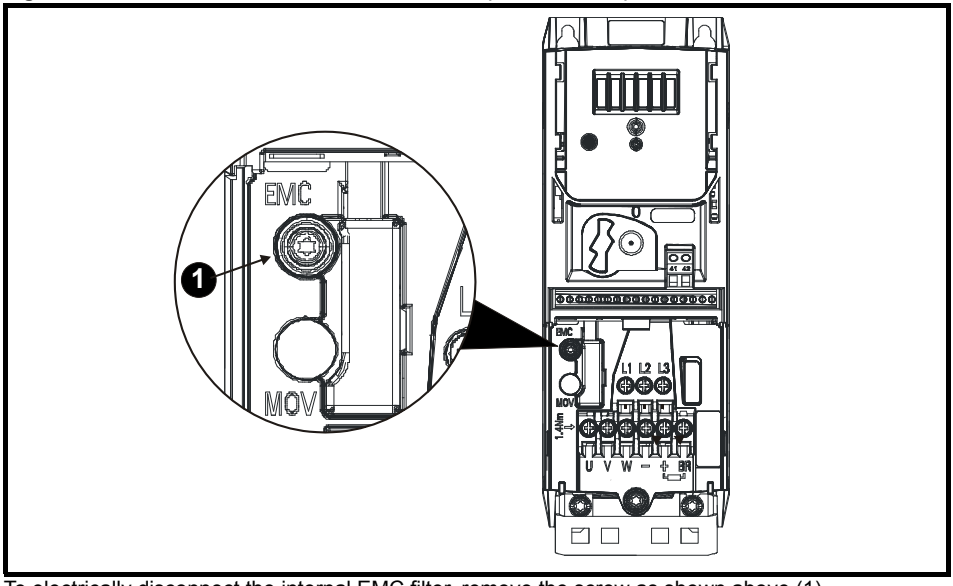
The internal EMC filter reduces radio-frequency emission into the line power supply.

For longer motor cables, the filter continues to provide a useful reduction in emission levels and when used with any length of shielded motor cable up to the limit for the drive, it is unlikely that nearby industrial equipment will be disturbed. It is recommended that the filter be used in all applications unless the instructions given above require it to be removed, or where the ground leakage current is unacceptable.

4.5.2 Removing the internal EMC filter

The supply must be disconnected before removing the internal EMC filter.

Figure 4-11 Removal of the internal EMC filter (size 2 shown)



To electrically disconnect the internal EMC filter, remove the screw as shown above (1).

4.5.3 Further EMC precautions

Further EMC precautions are required if more stringent EMC emission requirements apply:

- Operation in the first environment of EN 61800-3: 2004
- Conformity to the generic emission standards
- Equipment which is sensitive to electrical interference operating nearby

In this case it is necessary to use:

- The optional external EMC filter
- A shielded motor cable, with shield clamped to the grounded metal panel

• A shielded control cable, with shield clamped to the grounded metal panel

Full instructions are given in the *Drive User Guide.*

A full range of external EMC filters are also available for use with *Unidrive M400*.

4.6 Safe Torque Off (STO)

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

The safety function is active when either one or both STO inputs are in the logic-low state as specified in the control terminal specification. The function is defined according to EN 61800-5-2 and IEC 61800-5-2 as follows. (In these standards a drive offering safety-related functions is referred to as a PDS(SR)):

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

This safety function corresponds to an uncontrolled stop in accordance with stop category 0 of IEC 60204-1. The Safe Torque Off function makes use of the special property of an inverter drive with an induction motor, which is that torque cannot be generated without the continuous correct active behavior of the inverter circuit. All credible faults in the inverter power circuit cause a loss of torque generation.

The safe torque off function is fail-safe, so when the Safe Torque Off input is disconnected the drive will not operate the motor, even if a combination of components within the drive has failed. Most component failures are revealed by the drive failing to operate. Safe Torque Off is also independent of the drive firmware.

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

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

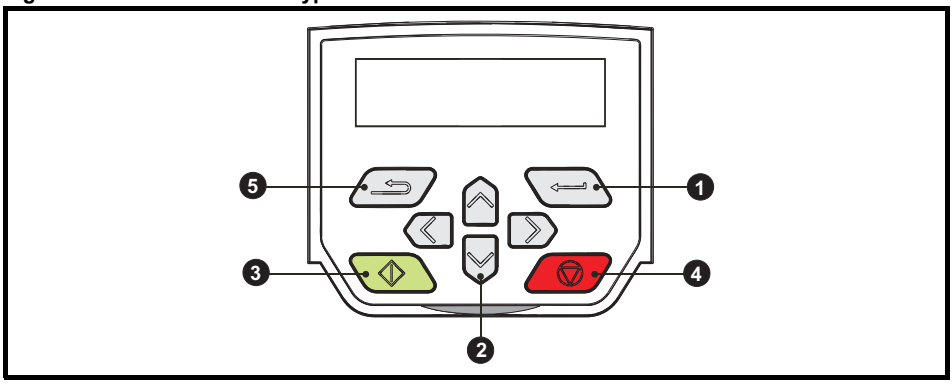
It is essential to observe the maximum permitted voltage of 5 V for a safe low (disabled) state of Safe Torque Off. The connections to the drive must be arranged so that voltage drops in the 0 V wiring cannot exceed this value under any loading condition. It is strongly recommended that the Safe Torque Off circuits be provided with a dedicated 0 V conductors which should be connected to terminals 32 and 33 at the drive.

For more information regarding the Safe Torque Off input, please see the *Drive User Guide.*

5 Optional LCD keypad and display

The keypad and display provide information to the user regarding the operating status of the drive and trip codes, and provide the means for changing parameters, stopping and starting the drive, and the ability to perform a drive reset.

Figure 5-1 Unidrive M400 keypad detail



(1) The *Enter* button is used to enter parameter view or edit mode, or to accept a parameter edit.

(2) The *Navigation* keys can be used to select individual parameters or to edit parameter values. In keypad mode, the '*Up*' and '*Down*' keys are also used to increase or decrease the motor speed.

(3) The *Start* key is used to start the drive in keypad mode.

(4) The *Stop / Reset* key is used to stop and reset the drive in keypad mode. It can also be used to reset the drive in terminal mode.

(5) The *Escape* key is used to exit from the parameter edit / view mode or disregard a parameter edit.

NOTE The keypad is not supplied with the drive.

NOTE It is possible to display alternative parameters on the multi line LCD display such as current magnitude. Refer to the *Drive User Guide* for further information.

Table 5-1 Status indications

Upper row string	Description	Drive output stage
Inhibit	The drive is inhibited and cannot be run. The Safe Torque Off signals are not applied to the Safe Torque Off terminals is set to 0.	Disabled
Ready	The drive is ready to run. The drive enable is active, but the drive inverter is not active because the final drive run is not active.	Disabled
Stop	The drive is stopped / holding zero frequency.	Enabled
Run	The drive is active and running.	Enabled
Supply Loss	Supply loss condition has been detected	Enabled
Deceleration	The motor is being decelerated to zero frequency because the final drive run has been deactivated.	Enabled
dc Injection	The drive is applying DC injection braking.	Enabled
Trip	The drive has tripped and no longer controlling the motor. The trip code appears in the lower display.	Disabled
Under Voltage	The drive is in the under voltage state either in low voltage or high voltage mode.	Disabled

5.1 Saving parameters

When changing a parameter in Menu 0, the new value is saved when pressing the Enter button to return to parameter view mode from parameter edit mode.

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

Procedure

1. Select ‘Save parameters'* in Pr **mm.000** (alternatively enter a value of 1001* in Pr **mm.000**)
2. Either:

- Press the red reset button
- Carry out a drive reset through serial communications by setting Pr **10.038** to 100

* If the drive is in the under voltage state (i.e. when the AI-Backup adaptor terminals are being supplied from a +24 Vdc supply) a value of 1001 must be entered into Pr **mm.000** to perform a save function.

5.2 Restoring parameter defaults

Restoring parameter defaults by this method saves the default values in the drives memory. *User security status* (00.010) and *User security code* (00.025) are not affected by this procedure).

Procedure

1. Ensure the drive is not enabled, i.e. terminal 31 & 34 is open or is OFF (0)
2. Select 'Reset 50 Hz Defs’ or 'Reset 60 Hz Defs' in Pr **mm.000**. (alternatively, enter 1233 (50 Hz settings) or 1244 (60 Hz settings) in Pr **mm.000**).
3. Either:

- Press the red reset button
- Carry out a drive reset through serial communications by setting Pr **10.038** to 100

6 Basic parameters (Menu 0)

Menu 0 is used to bring together various commonly used parameters for basic easy set up of the drive. All the parameters in Menu 0 appear in other menus in the drive. Menus 22 can be used to configure the parameters in Menu 0.

6.1 Menu 0: Basic parameters

Parameter		Range (⇳)		Default (⇨)		Type					
		OL	RFC-A	OL	RFC-A						
00.001	Minimum Reference Clamp	±VM_NEGATIVE_REF_CLAMP1 Hz		0.00 Hz		RW	Num				US
00.002	Maximum Reference Clamp	±VM_POSITIVE_REF_CLAMP Hz		50Hz default: 50.00 Hz 60Hz default: 60.00 Hz		RW	Num				US
00.003	Acceleration Rate 1	±VM_ACCEL_RATE s/100 Hz		5.0 s/100 Hz		RW	Num				US
00.004	Deceleration Rate 1	±VM_ACCEL_RATE s/100 Hz		10.0 s/100 Hz		RW	Num				US
00.005	Drive Configuration	AV (0), AI (1), AV Preset (2), AI Preset (3), Preset (4), Keypad (5), Keypad Ref (6), Electronic Pot (7), Torque Control (8), Pid Control (9)		AV (0)		RW	Txt			PT	US
00.006	Motor Rated Current	0.00 to VM_RATED_CURRENT A		Maximum Heavy Duty Rating A		RW	Num		RA		US
00.007	Motor Rated Speed	0.0 to 80000.0 rpm		50Hz default: 1500.0 rpm 60Hz default: 1800.0 rpm	50Hz default: 1450.0 rpm 60Hz default: 1750.0 rpm	RW	Num				US
00.008	Motor Rated Voltage	0 to VM_AC_VOLTAGE_SET V		110V drive: 230 V 200V drive: 230 V 400V drive 50 Hz: 400 V 400V drive 60 Hz: 460 V		RW	Num		RA		US
00.009	Motor Rated Power Factor	0.00 to 1.00		0.85		RW	Num		RA		US
00.010	User Security Status	Menu 0 (0), All Menus (1), Read only Menu 0 (2), Read only (3), Status Only (4), No Access (5)		Menu 0 (0)		RW	Num	ND	NC	PT	
00.012	Input Logic Polarity	Negative Logic (0) or Positive Logic (1)		Positive Logic (1)		RW	Txt				US
00.015	Jog Reference	0.00 to 300.00 Hz		1.50 Hz		RW	Num				US
00.016	Analog Input 1 Mode	4-20 mA Stop (-6), 20-4 mA Stop (-5), 4-20 mA Low (-4), 20-4 mA Low (-3), 4-20 mA Hold (-2), 20-4 mA Hold (-1), 0-20 mA (0), 20-0 mA (1), 4-20 mA Trp (2), 20-4 mA Trp (3), 4-20 mA (4), 20-4 mA (5), Voltage (6)		Voltage (6)		RW	Txt				US
00.017	Bipolar Reference Enable	Off (0) or On (1)		Off (0)		RW	Bit				US
00.018	Preset Reference 1	±VM_SPEED_FREQ_REF Hz		0.00 Hz		RW	Num				US
00.025	User Security Code	0 to 9999		0		RW	Num	ND	NC	PT	US
00.027	Power-up Keypad Control Mode Reference	Reset (0), Last (1), Preset (2)		Reset (0)		RW	Txt				US
00.028	Ramp Mode Select	Fast (0), Standard (1), Std boost (2), Fast boost (3)		Standard (1)		RW	Txt				US
00.029	Ramp Enable		Off (0) or On (1)		On (1)	RW	Bit				US

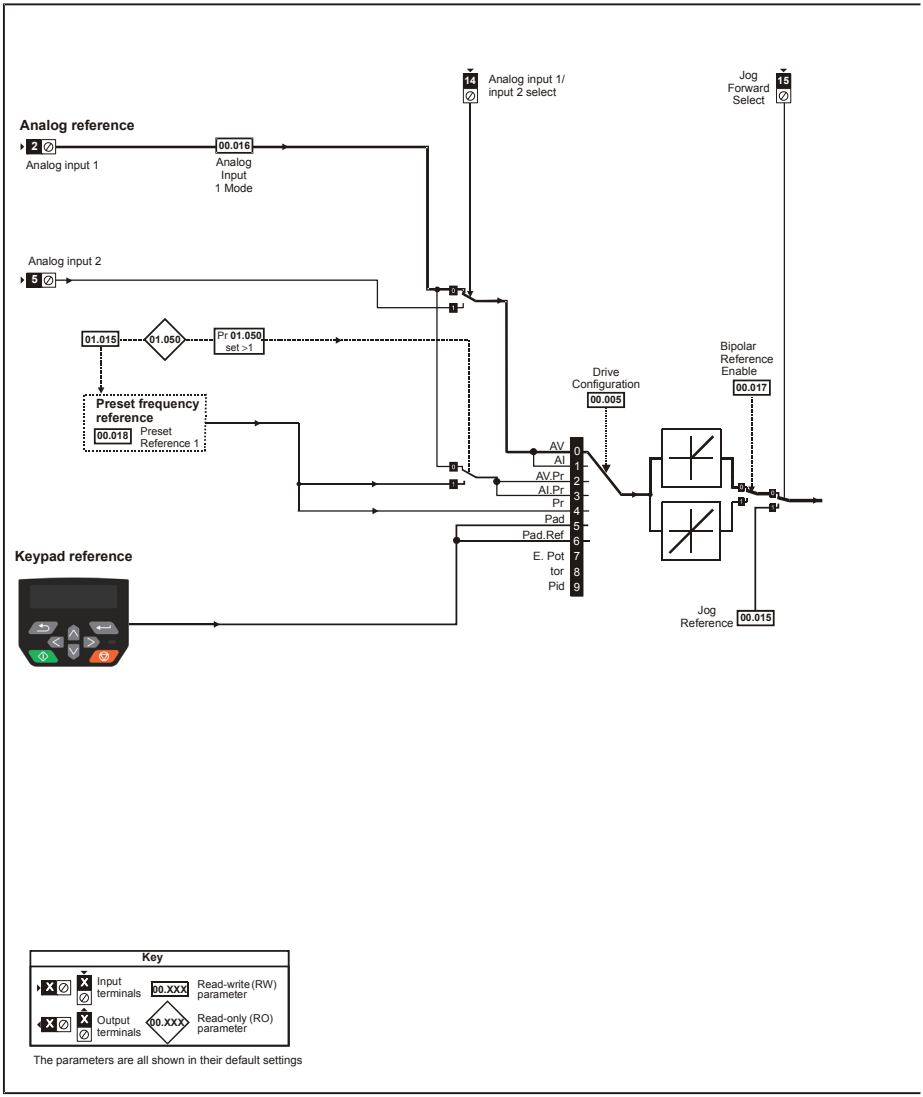
Parameter		Range (⇳)		Default (⇨)		Type					
		OL	RFC-A	OL	RFC-A						
00.030	Parameter Cloning	None (0), Read (1), Program (2), Auto (3), Boot (4)		None (0)		RW	Txt		NC		US
00.031	Stop Mode	Coast (0), Ramp (1), Ramp dc I (2), dc I (3), Timed dc I (4), Disable (5)	Coast (0), Ramp (1), Ramp dc I (2), dc I (3), Timed dc I (4), Disable (5), No Ramp (6)	Ramp (1)		RW	Txt				US
00.032	Dynamic V to F Select / Flux Optimization Select	0 to 1		0		RW	Num				US
00.033	Catch A Spinning Motor	Disable (0), Enable (1), Fwd Only (2), Rev Only (3)		Disable (0)		RW	Txt				US
00.034	Digital Input 5 Mode	Input (0), Therm Short Cct (1), Thermistor (2), Therm No Trip (3)		Input (0)		RW	Txt				US
00.035	Digital Output 1 Control	0 to 21		0		RW	Num				US
00.036	Analog Output 1 Control	0 to 14		0		RW	Txt				US
00.037	Maximum Switching Frequency	0.667 (0), 1 (1), 2 (2), 3 (3), 4 (4), 6 (5), 8 (6), 12 (7), 16 (8) kHz	2 (2), 3 (3), 4 (4), 6 (5), 8 (6), 12 (7), 16 (8) kHz	3 (3) kHz		RW	Txt				US
00.038	Autotune	0 to 2	0 to 3	0		RW	Num		NC		US
00.039	Motor Rated Frequency	0.00 to VM_SPEED_FREQ_REF_UNIPOLAR Hz		50Hz: 50.00 Hz 60Hz: 60.00 Hz		RW	Num				US
00.040	Number of Motor Poles*	Auto (0) to 32 (16)		Auto 0		RW	Num				US
00.041	Control Mode	Ur S (0), Ur (1), Fixed (2), Ur Auto (3), Ur I (4), Square (5), Fixed Tapered (6)		Url (4)		RW	Txt				US
00.042	Low Frequency Voltage Boost	0.0 to 25.0 %		3.0 %		RW	Num				US
00.043	Serial Baud Rate	300 (0), 600 (1), 1200 (2), 2400 (3), 4800 (4), 9600 (5), 19200 (6), 38400 (7), 57600 (8), 76800 (9), 115200 (10)		19200 (6)		RW	Txt				US
00.044	Serial Address	1 to 247		1		RW	Num				US
00.045	Reset Serial Communications	Off (0) or On (1)		Off (0)		RW		ND	NC		US
00.046	Brake Controller Upper Current Threshold	0 to 200 %		50 %		RW	Num				US
00.047	Brake Controller Lower Current Threshold	0 to 200 %		10 %		RW	Num				US
00.048	Brake Controller Brake Release Frequency	0.00 to 20.00 Hz		1.00 Hz		RW	Num				US
00.049	Brake Controller Brake Apply Frequency	0.00 to 20.00 Hz		2.00 Hz		RW	Num				US
00.050	Brake Controller Brake Delay	0.0 to 25.0 s		1.0 s		RW	Num				US
00.051	Brake Controller Post-brake Release Delay	0.0 to 25.0 s		1.0 s		RW	Num				US

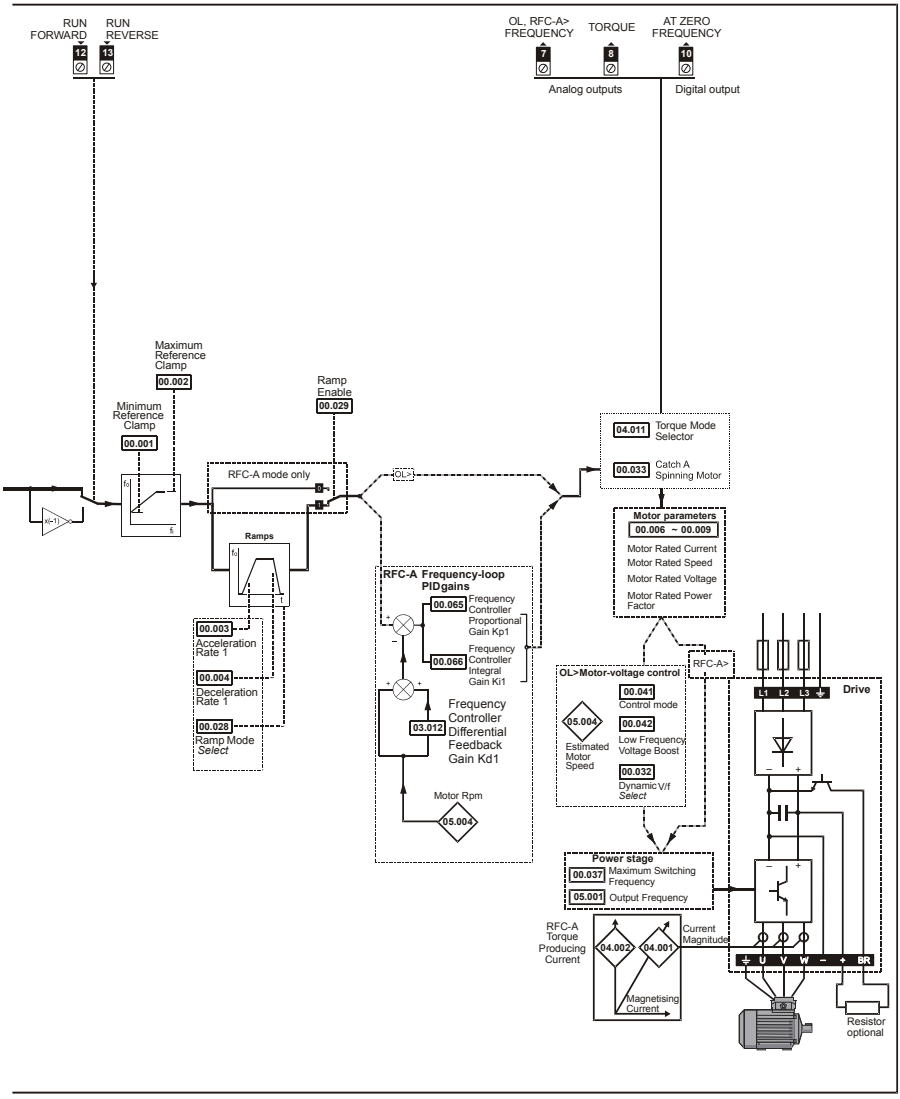
Parameter		Range (⇳)		Default (⇨)		Type					
		OL	RFC-A	OL	RFC-A						
00.053	Brake Controller Initial Direction	Ref (0), Forward (1), Reverse (2)		Ref (0)		RW	Txt				US
00.054	Brake Controller Brake Apply Through Zero Threshold	0.00 to 25.00 Hz		0.00 Hz		RW	Num				US
00.055	Brake Controller Enable	Disable (0), Relay (1), Digital IO (2), User (3)		Disable (0)		RW	Txt				US
00.059	OUP Enable	Stop (0) or Run (1)		Run (1)		RW	Txt				US
00.065	Frequency Controller Proportional Gain Kp1		0.000 to 200.000 s/rad		0.100 s/rad	RW	Num				US
00.066	Frequency Controller Integral Gain Ki1		0.00 to 655.35 s^2/rad		0.10 s^2/rad	RW	Num				US
00.067	Sensorless Mode Filter		4 (0), 5 (1), 6 (2), 8 (3), 12 (4), 20 (5) ms		4 (0) ms	RW	Txt				US
00.069	Spin Start Boost	0.0 to 10.0		1.0		RW	Num				US
00.076	Action on Trip Detection	0 to 31		0		RW	Num	ND	NC	PT	US
00.077	Maximum Heavy Duty Current Rating	0.00 to 9999.99 A				RO	Num	ND	NC	PT	
00.078	Software Version	0 to 999999				RO	Num	ND	NC	PT	
00.079	User Drive Mode	Open loop (1), RFC A (2)		Open loop (1)	RFC-A (2)	RW	Txt	ND	NC	PT	US

* If this parameter is read via serial communications, it will show pole pairs.

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

Figure 6-1 Menu 0 logic diagram




RUN FORWARD
RUN REVERSE
12
13
OL, RFC-A> FREQUENCY
TORQUE
AT ZERO FREQUENCY
7
8
10
Analog outputs
Digital output
Maximum Reference Clamp
00.002
Minimum Reference Clamp
00.001
Ramp Enable
00.029
RFC-A mode only
OL>
Ramps
00.003
Acceleration Rate 1
00.004
Deceleration Rate 1
00.028
Ramp Mode Select
RFC-A Frequency-loop PIDgains
00.065
Frequency Controller Proportional Gain Kp1
00.066
Frequency Controller Integral Gain Ki1
Frequency Controller Differential Feedback Gain Kd1
03.012
Motor Rpm
05.004
04.011
Torque Mode Selector
00.033
Catch A Spinning Motor
Motor parameters
00.006 ~ 00.009
Motor Rated Current
Motor Rated Speed
Motor Rated Voltage
Motor Rated Power Factor
RFC-A>
OL>Motor-voltage control
05.004
Estimated Motor Speed
00.041
Control mode
00.042
Low Frequency Voltage Boost
00.032
Dynamic V/f Select
Power stage
00.037
Maximum Switching Frequency
05.001
Output Frequency
RFC-A Torque Producing Current
04.002
04.001
Current Magnitude
Magnetising Current
L1 L2 L3
Drive
U V W BR
Resistor optional

6.2 Unidrive M400 parameter descriptions

Key:

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

00.001 {01.007}		**Minimum Reference Clamp**							
RW		Num						US	
OL	⇳	±VM_NEGATIVE_REF_CLAMP1 Hz	⇨	0.00 Hz					
RFC-A									

Set Pr **00.001** at the required minimum output frequency of the drive for both directions of rotation. The drive speed reference is scaled between Pr **00.001** and Pr **00.002**. Pr **00.001** is a nominal value; slip compensation may cause the actual frequency to be higher. When the drive is jogging, Pr **00.001** has no effect.

00.002 {01.006}		**Maximum Reference Clamp**							
RW		Num						US	
OL	⇳	±VM_POSITIVE_REF_CLAMP Hz	⇨	50.0 Hz default: 50.00 Hz 60.0 Hz default: 60.00 Hz					
RFC-A									

Set Pr **00.002** at the required maximum output frequency for both directions of rotation. The drive speed reference is scaled between Pr **00.001** and Pr **00.002**. Pr **00.002** is a nominal value; slip compensation may cause the actual frequency to be higher. The drive has additional over-speed protection.

00.003 {02.011}		**Acceleration Rate 1**							
RW		Num						US	
OL	⇳	±VM_ACCEL_RATE s/100 Hz	⇨	5.0 s/100 Hz					
RFC-A									

Set Pr **00.003** at the required rate of acceleration. Note that larger values produce lower acceleration. The rate applies in both directions of rotation.

00.004 {02.021}		Deceleration Rate 1								
RW		Num							US	
OL RFC-A	⇳	±VM_ACCEL_RATE s/100 Hz			⇨	10.0 s/100 Hz				

Set Pr **00.004** at the required rate of deceleration. Note that larger values produce lower deceleration. The rate applies in both directions of rotation.

00.005 {11.034}		Drive Configuration								
RW		Txt						PT	US	
OL	⇳	AV (0), AI (1), AV Preset (2), AI Preset (3), Preset (4), Keypad (5), Keypad Ref (6), Electronic Pot (7), Torque Control (8), Pid Control (9)			⇨	AV (0)				

Use Pr **00.005** to select the required frequency/speed reference as follows:

Value	Text	Description
0	AV	Analog input 1 (voltage) Analog input 2 (voltage) selected by terminal (Local/Remote)
1	AI	Analog input 1 (current) or Analog input 2 (voltage) selected by terminal (Local/Remote)
2	AV Preset	Analog input 1 (voltage) or 3 presets selected by terminal
3	AI Preset	Analog input 1 (current) or 3 presets selected by terminal
4	Preset	Four presets selected by terminal
5	Keypad	Keypad reference
6	Keypad Ref	Keypad reference with terminal control
7	Electronic Pot	Electronic Potentiometer
8	Torque Control	Torque mode, Analog input 1 (current frequency reference) or Analog input 2 (voltage torque reference) selected by terminal
9	Pid Control	PID mode, Analog input 1 (current feedback source) and Analog input 2 (voltage reference source)

NOTE A change to Pr **00.005** is set by pressing the MODE key on exit from parameter edit mode. The drive must be disabled, stopped or tripped for a change to take place. If Pr **00.005** is changed while the drive is running, when the MODE key is pressed on exit from parameter edit mode, Pr **00.005** will change back to its previous value.

NOTE When the setting of Pr **00.005** is changed, the appropriate drive configuration parameters are set back to their default values.

00.006 {05.007}		Motor Rated Current								
RW		Num					RA		US	
OL	⇳	0.00 to VM_RATED_CURRENT A				⇨	Maximum Heavy Duty Rating A			
RFC-A										

The rated current parameter must be set to the maximum continuous current of the motor (taken from the name plate). The motor rated current is used in the following:

- Current limits
- Motor thermal overload protection
- Vector mode voltage control
- Slip compensation (see *Enable Slip Compensation)*
- Dynamic V/F control

00.007 {05.008}		Motor Rated Speed								
RW		Num							US	
OL	⇳	0.0 to 80000.0 rpm				⇨	50 Hz default: 1500.0 rpm 60 Hz default: 1800.0 rpm			
RFC-A							50 Hz default: 1450.0 rpm 60 Hz default: 1750.0rpm			

Set to the rated speed of the motor (taken from the motor name plate). The motor rated speed is used to calculate the correct slip speed for the motor.

00.008 {05.009}		Motor Rated Voltage								
RW		Num					RA		US	
OL	⇳	0 to VM_AC_VOLTAGE_SET V				⇨	110 V drive: 230 V 200 V drive: 230 V 400 V drive 50 Hz: 400 V 400 V drive 60 Hz: 460 V			
RFC-A										

The *Rated Voltage* (00.008) and the *Rated Frequency* (00.039) are used to define the voltage to frequency characteristic applied to the motor. The *Rated Frequency* (00.039) is also used in conjunction with the *Motor Rated Speed* (00.007) to calculate the rated slip for slip compensation.

00.009 {05.010}		Motor Rated Power Factor								
RW		Num					RA		US	
OL	⇳	0.00 to 1.00				⇨	0.85			
RFC-A										

Enter the motor rated power factor cos φ (taken from the motor name plate).

The drive can measure the motor rated power factor by performing a rotating autotune (see Autotune (Pr **00.038**).

00.010 {11.044}		User Security Status								
RW		Num				ND	NC	PT	US	
OL RFC-A	⇳	Menu 0 (0), All Menus (1), Read only Menu 0 (2), Read only (3), Status Only (4), No Access (5)			⇨	Menu 0 (0)				

This parameter controls access via the drive keypad as follows:

Value	Text	Function
0	Menu 0	All writable parameters are available to be edited but only parameters in Menu 0 are visible.
1	All Menus	All writable parameters are visible and available to be edited.
2	Read-only Menu 0	All parameters are read-only. Access is limited to Menu 0 parameters only.
3	Read-only	All parameters are read-only however all menus and parameters are visible.
4	Status Only	The keypad remains in status mode and no parameters can be viewed or edited.
5	No Access	The keypad remains in status mode and no parameters can be viewed or edited. Drive parameters cannot be accessed via a comms/fieldbus interface in the drive or any option module.

00.015 {01.005}		Jog Reference								
RW		Num							US	
OL RFC-A	⇳	0.00 to 300.00 Hz			⇨	1.50 Hz				

Defines the reference when jog is enabled.

00.012 {08.010}		Input Logic Polarity								
RW		Txt							US	
OL RFC-A	⇳	Negative Logic (0) or Positive Logic (1)			⇨	Positive Logic (1)				

Can be set to zero to change the logic for DI/O1-7 to negative logic, so that the state parameter is 0 if the digital I/O is high or 1 if the digital I/O is low.

00.016 {07.007}		Analog Input 1 Mode								
RW		Txt							US	
OL	⇳	4-20 mA Stop (-6), 20-4 mA Stop (-5), 4-20 mA Low (-4), 20-4 mA Low (-3), 4-20 mA Hold (-2), 20-4 mA Hold (-1), 0-20 mA (0), 20-0 mA (1), 4-20 mA Trp (2), 20-4 mA Trp (3), 4-20 mA (4), 20-4 mA (5), Voltage (6)	⇨	Voltage (6)					

Defines the mode of analog input 1.

The table below gives all the possible analog input modes.

Value	Text	Function
-6	4-20 mA Stop	Stop on loss
-5	20-4 mA Stop	Stop on loss
-4	4-20 mA Low	4-20 mA switching to equivalent of 4 mA input current on loss
-3	20-4 mA Low	20-4 mA switching to equivalent of 20 mA input current on loss
-2	4-20 mA Hold	4-20 mA hold at level before loss on loss
-1	20-4 mA Hold	20-4 mA hold at level before loss on loss
0	0-20 mA	0-20 mA
1	20-0 mA	20-0 mA
2	4-20 mA Trp	4-20 mA trip on loss
3	20-4 mA Trp	20-4 mA trip on loss
4	4-20 mA	4-20 mA no action on loss
5	20-4 mA	20-4 mA no action on loss
6	Voltage	Voltage

NOTE In 4-20 mA and 20-4 mA modes loss of input is detected if the current falls below 3 mA.

NOTE If both analog inputs (A1 and A2) are to be set-up as voltage inputs, and if the potentiometers are supplied from the drive's +10 V rail (terminal T3), they must have a resistance >4 kΩ each.

00.017 {01.010}		Bipolar Reference Enable								
RW		Bit							US	
OL RFC-A	⇳	Off (0) or On (1)			⇨	Off (0)				

Pr **00.017** determines whether the reference is uni-polar or bi-polar.

See *Minimum Reference Clamp* (00.001). Allows negative speed reference in keypad mode.

00.018 {01.021}		Preset Reference 1								
RW		Num							US	
OL RFC-A	⇳	±VM_SPEED_FREQ_REF Hz			⇨	0.00 Hz				

If the preset reference has been selected (see Pr **00.005**), the speed at which the motor runs is determined by these parameters.

See *Drive Configuration* (00.005).

00.025 {11.030}		User Security Code								
RW		Num				ND	NC	PT	US	
OL RFC-A	⇳	0-9999			⇨	0				

If any number other than 0 is programmed into this parameter, user security can be applied so that no parameters except Pr **00.010** can be adjusted with the keypad. When this parameter is read via a keypad it appears as zero. Refer to the *Drive User Guide* for further information.

00.027 {01.051}		Power-up Keypad Control Mode Reference								
RW		Txt				ND	NC	PT	US	
OL RFC-A	⇳	Reset (0), Last (1), Preset (2)			⇨	Reset (0)				

Defines which value of keypad control mode reference is displayed at power-up.

Value	Text	Description
0	Reset	Keypad reference is zero
1	Last	Keypad reference is the last used value
2	Preset	Keypad reference is copied from *Preset Reference 1* (00.018)

00.028 {02.004}		Ramp Mode Select								
RW		Txt							US	
OL RFC-A	⇳	Fast (0), Standard (1), Std boost (2), Fast boost (3)			⇨	Standard (1)				

Defines the mode used by the ramp system.

0: Fast ramp

1: Standard ramp

2: Standard ramp with motor voltage boost

3: Fast ramp with motor voltage boost

Fast ramp is linear deceleration at programmed rate, normally used when a braking resistor is installed.

Standard ramp is controlled deceleration to prevent DC bus over-voltage trips, normally used when there is no braking resistor installed.

If a high motor voltage mode is selected, deceleration rates can be faster for a given inertia but motor temperatures will be higher.

00.029 {02.002}		Ramp Enable							
RW		Bit						US	
OL	⇳			⇨					
RFC-A		Off (0) or On (1)			On (1)				

Setting Pr **00.029** to 0 allows the user to disable the ramps. This is generally used when the drive is required to closely follow a speed reference which already contains acceleration and deceleration ramps.

00.030 {11.042}		Parameter Cloning							
RW		Txt					NC		US*
OL	⇳	None (0), Read (1), Program (2), Auto (3), Boot (4)			⇨	None (0)			
RFC-A									

* Only a value of 3 or 4 in this parameter is saved.

If Pr **00.030** is equal to 1 or 2, this value is not transferred to the EEPROM or the drive. If Pr **00.030** is set to a 3 or 4 the value is transferred.

Parameter string	Parameter value	Comment
None	0	Inactive
Read	1	Read parameter set from the NV Media Card
Program	2	Programming a parameter set to the NV Media Card
Auto	3	Auto save
Boot	4	Boot mode

For further information, please refer to Chapter 8 *Diagnostics* on page 50.

00.031 {06.001}		Stop Mode								
RW		Txt							US	
OL	⇳	Coast (0), Ramp (1), Ramp dc I (2), dc I (3), Timed dc I (4), Disable (5)				⇨	Ramp (1)			
RFC-A		Coast (0), Ramp (1), Ramp dc I (2), dc I (3), Timed dc I (4), Disable (5), No Ramp (6)								

Defines how the motor is controlled when the run signal is removed from the drive.

Value	Text	Description
0	Coast	Coast stop
1	Ramp	Ramp stop
2	Ramp dc I	Ramp stop + 1 second dc injection
3	dc I	Injection braking stop with detection of zero speed
4	Timed dc I	Timed injection braking stop
5	Disable	Disable
6	No Ramp	No ramp (RFC-A mode only)

See the *Drive User Guide* for further information.

00.032 {05.013}		Dynamic V To F Select / Flux Optimisation Select								
RW		Num							US	
OL	⇳	0 to 1				⇨	0			
RFC-A										

Set to 1 to enable Dynamic V to F mode.

0: Fixed linear voltage to frequency ratio (constant torque - standard load)

1: Voltage to frequency ratio dependant on load current. This gives a higher motor efficiency.

00.033 {06.009}		Catch a Spinning Motor								
RW		Txt							US	
OL RFC-A	⇳	Disable (0), Enable (1), Fwd Only (2), Rev Only (3)				⇨	Disable (0)			

If the drive is to be configured in fixed boost mode (Pr **00.041** = Fd or SrE) with catch a spinning motor software enabled, an autotune (see **Pr 00.038** on page 41) must be carried out to measure the motor's stator resistance beforehand. If a stator resistance is not measured, the drive may trip on 0 V or OI.AC while trying to catch a spinning motor.

Pr 00.033	Text	Function
0	Disable	Disabled
1	Enable	Detect all frequencies
2	Fwd Only	Detect positive frequencies only
3	Rev Only	Detect negative frequencies only

00.034 {08.035}		Digital Input 5 Mode								
RW		Txt							US	
OL RFC-A	⇳	Input (0), Therm Short Cct (1), Thermistor (2), Therm No Trip (3)				⇨	Input (0)			

This parameter selects the function of Digital Input 5.

Value	Text	Function
0	Input	Digital input
1	Therm Short Cct	Temperature measurement input with short circuit detection (Resistance <50 Ω)
2	Thermistor	Temperature measurement input without short circuit detection but with th trip
3	Therm No Trip	Temperature measurement input with no trips

00.035 {08.091}		DO1 Control (terminal 10)								
RW		Num							US	
OL	⇳	0-21			⇨	0				
RFC-A										

Defines the behaviour of digital output 1.

Value	Description
0	User defined by Digital IO1 Source/Destination A, Digital IO2 Source/Destination A, *Relay 1 Output Source A,* or Relay 2 Output Source A.
1	Drive running signal (RUN)
2	Frequency arrived signal (FAR)
3	Frequency level detection signal (FDT1)
4	Frequency level detection signal (FDT2)
5	Overload detection signal (OL)
6	Power off state (LU)
7	External fault stop (EXT)
8	Frequency upper limit (FHL)
9	Frequency lower limit (FLL)
10	Drive running at zero frequency
14	Drive (RDY)
15	Drive OK
18	Brake release
19	Torque limiting (Valid while the torque is limited by torque limiting value 1/2)
20	Forward or reverse
21	Motor 1 or 2

00.036 {07.055}		Analog Output 1 Control								
RW		Txt							US	
OL	⇳	0 to 14			⇨	0				
RFC-A										

Defines the functionality of Analog Output 1.

Value	Description
0	User defined by Analog Output 1 Source A
1	Frequency output
2	Frequency reference
3	Motor speed
4	Current Magnitude
6	Torque output
7	Torque current output
8	Voltage output
9	DC bus voltage (0~800 V)
10	Analog Input 1
11	Analog Input 2
12	Power output (0~2 x Pe)
13	Torque limitation
14	Torque reference (0~300 %)

00.037 {05.018}		Maximum Switching Frequency								
RW		Txt							US	
OL	⇳	0.667 (0), 1 (1), 2 (2), 3 (3), 4 (4), 6 (5), 8 (6), 12 (7), 16 (8) kHz			⇨	3 (3) kHz				
RFC-A		2 (2), 3 (3), 4 (4), 6 (5), 8 (6), 12 (7), 16 (8) kHz								

Defines the maximum switching frequency that can be used by the drive.

Pr 00.037	Text	Description
0	0.667	667 Hz switching frequency
1	1	1 kHz switching frequency
2	2	2 kHz switching frequency
3	3	3 kHz switching frequency
4	4	4 kHz switching frequency
5	6	6 kHz switching frequency
6	8	8 kHz switching frequency
7	12	12 kHz switching frequency
8	16	16 kHz switching frequency

See the *Drive User Guide* for drive derating data.

00.038 {05.012}		Autotune								
RW		Num					NC		US	
OL	⇳	0 to 2				⇨	0			
RFC-A		0 to 3								

Defines the auto-tune test to be performed.

There are two autotune tests available in open loop mode, a stationary and a rotating test. A rotating autotune should be used whenever possible so the measured value of power factor of the motor is used by the drive.

Open Loop and RFC-A:

1. A stationary autotune can be used when the motor is loaded and it is not possible to remove the load from the motor shaft. To perform a Stationary autotune, set Pr **00.038** to 1,
2. A rotating autotune should only be used if the motor is unloaded. A rotating autotune first performs a stationary autotune, as above, then a rotating test is performed in which the motor is accelerated with currently selected ramps up to a frequency of *Rated Frequency* (00.039) x 2/3, and the frequency is maintained at that level for 4 seconds. To perform a Rotating autotune, set Pr **00.038** to 2.

RFC-A only:

3. This test measures the mechanical characteristic of the motor and load by rotating the motor. This test should only be used provided all the basic control parameters have been set-up correctly. The test measures the motor and load inertia, which can be used in automatic set-up of the frequency controller gains and in producing a torque feed-forward term. It also measures the load compensation parameters to cancel resonance effects.

Following the completion of an autotune test the drive will go into the inhibit state. The drive must be placed into a controlled disable condition before the drive can be made to run at the required reference. The drive can be put in to a controlled disable condition by removing the Safe Torque Off signal from terminals, setting the *Drive Enable* to Off (0) or disabling the drive via the *Control Word* and *Control Word Enable*

A rotating autotune will cause the motor to accelerate up to 2/3 base speed in the direction selected regardless of the reference provided. Once complete the motor will coast to a stop. The enable signal must be removed before the drive can be made to run at the required reference.The drive can be stopped at any time by removing the run signal or removing the drive enable.

00.039 {05.006}		Motor Rated Frequency								
RW		Num							US	
OL	⇳	0.00 to VM_SPEED_FREQ_REF_ UNIPOLAR Hz				⇨	50 Hz: 50.00 Hz 60 Hz: 60.00 Hz			
RFC-A										

Enter the value from the rating plate of the motor. Defines the voltage to frequency ratio applied to the motor.

00.040 {05.011}		Number Of Motor Poles								
RW		Num							US	
OL	⇳	Auto (0) to 32 (16)			⇨	Auto (0)				
RFC-A										

Set to the number of poles of the motor. The auto mode calculates the number of motor poles from the settings of Pr **00.007** and Pr **00.039**.

00.041 {05.014}		Control Mode								
RW		Txt							US	
OL	⇳	Ur S (0), Ur (1), Fixed (2), Ur Auto (3), Ur I (4), Square (5), Fixed Tapered (6)			⇨	Ur I (4)				
RFC-A										

Defines the drive output mode, which can either be a voltage mode or a current mode.

Value	Text	Description
0	Ur S	Stator resistance and voltage offset measured at each start
1	Ur	No measurements
2	Fixed	Fixed boost mode.
3	Ur Auto	Stator resistance and voltage offset measured at first drive enable
4	Ur I	Stator resistance and voltage offset measured at each power-up
5	Square	Square law characteristic
6	Fixed Tapered	Fixed boost with taper

NOTE The drive default setting is Ur I mode which means that the drive will carry out an autotune every time the drive is powered-up and enabled. If the load is not going to be stationary when the drive is powered-up and enabled, then one of the other modes should be selected. Not selecting another mode could result in poor motor performance or OI.AC, It.AC or 0 V trips.

00.042 {05.015}		Low Frequency Voltage Boost								
RW		Num							US	
OL	⇳	0.0 to 25.0 %			⇨	3 %				
RFC-A										

Determines the boost level when Pr **00.041** is set to Fixed, Square or Fixed Tapered modes.

00.043 {11.025}		Serial Baud Rate								
RW		Txt							US	
OL	⇳	300 (0), 600 (1), 1200 (2), 2400 (3), 4800 (4), 9600 (5), 19200 (6), 38400 (7), 57600 (8), 76800 (9), 115200 (10)			⇨	19200 (6)			
RFC-A										

Defines the serial baud rate of the drive

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (00.045) for more details.

00.044 {11.023}		Serial Address								
RW		Num							US	
OL	⇳	1 to 247			⇨	1				
RFC-A										

Used to define the unique address for the drive for the serial interface. The drive is always a slave address 0 is used to globally address all slaves, and so this address should not be set in this parameter.

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (00.045) for more details.

00.045 {11.020}		Reset Serial Communications								
RW		Bit				ND	NC		US	
OL	⇳	Off (0) or On (1)			⇨	Off (0)				
RFC-A										

Set to On (1) to update communications set-up.

NOTE The display will briefly display On and return to Off on reset.

00.046 {12.042}		Brake Controller Upper Current Threshold								
RW		Num							US	
OL RFC-A	⇳	0 to 200 %			⇨	50 %				

Defines the upper current threshold for the brake. See Brake Controller Brake Release in *Drive User Guide*.

00.047 {12.043}		Brake Controller Lower Current Threshold								
RW		Num							US	
OL RFC-A	⇳	0 to 200 %			⇨	10 %				

Defines the lower current limit for the brake. See Brake Controller Brake Release in *Drive User Guide*.

00.048 {12.044}		Brake Controller Brake Release Frequency								
RW		Num							US	
OL RFC-A	⇳	0.00 to 20.00 Hz			⇨	1.00 Hz				

Defines the Brake Release Frequency. See Brake Controller Brake Release in *Drive User Guide.*

00.049 {12.045}		Brake Controller Brake Apply Frequency								
RW		Num							US	
OL RFC-A	⇳	0.00 to 20.00 Hz			⇨	2.00 Hz				

Defines the Brake Apply Frequency. See Brake Controller Brake Release in *Drive User Guide.*

00.050 {12.046}		Brake Controller Brake Delay								
RW		Num							US	
OL RFC-A	⇳	0.0 to 25.0 s			⇨	1.0 s				

Defines the pre-brake release delay. See Brake Controller Brake Release in *Drive User Guide*.

00.051 {12.047}		Brake Controller Post-brake Release Delay								
RW		Num							US	
OL RFC-A	⇳	0.0 to 25.0 s			⇨	1.0 s				

Defines the post-brake release delay.

00.053 {12.047}		Brake Controller Initial Direction								
RW		Txt							US	
OL RFC-A	⇳	Ref (0), Forward (1), Reverse (2)			⇨	Ref (0)				

Defines the initial direction of the brake.

Value	Text
0	Ref
1	Forward
2	Reverse

See Brake Controller Brake Release in *Drive User Guide*.

00.054 {12.051}		Brake Controller Brake Apply Through Zero Threshold								
RW		Num							US	
OL RFC-A	⇳	0.00 to 25.00 Hz			⇨	0.00 Hz				

Defines if the brake is applied through zero threshold. See Brake Controller Brake Release in *Drive User Guide*.

00.055 {12.041}		Brake Controller Enable								
RW		Txt							US	
OL RFC-A	⇳	Disable (0), Relay (1), Digital IO (2), User (3)			⇨	Disable (0)				

Value	Text
0	Disable
1	Relay
2	Digital IO
3	User

If *Brake Controller Enable* (00.055) = 0, the brake controller is disabled.

If *Brake Controller Enable* (00.055) = 1, the brake controller is enabled with I/O set up to control the brake via the relay output. Drive ok is re-routed to digital I/O.

If *Brake Controller Enable* (00.055) = 2, the brake controller is enabled with I/O set up to control the brake via digital I/O. Drive ok is routed to the relay output.

If *Brake Controller Enable* (00.055) = 3, the brake controller is enabled, but no parameters are set up to select the brake output.

00.059 {11.047}		OUP Enable								
RW		Txt							US	
OL / RFC-A	⇳	Stop (0) or Run (1)			⇨	Run (1)				

Enables the onboard user program.

Onboard user programming provides a background task that loops continuously and a timed task that is executed each time at a defined rate. For further information refer to the *Drive User Guide*.

00.065 {03.010}		Frequency Controller Proportional Gain Kp1								
RW		Num							US	
OL	⇳				⇨					
RFC-A		0.000 to 200.000 s/rad				0.100 s/rad				

Defines the proportional gain for frequency controller 1.

RFC modes only.

The controller includes a feed forward proportional gain (Kp), a feed forward integral gain (Ki), and a differential feedback gain (Kd).

Proportional gain (Kp)

If Kp is non-zero and Ki is zero the controller will only have a proportional term, and there must be a frequency error to produce a torque reference. Therefore as the motor load increases there will be a difference between the reference and actual frequencies.

Integral gain (Ki)

The integral gain is provided to prevent frequency regulation. The error is accumulated over a period of time and used to produce the necessary torque reference without any frequency error. Increasing the integral gain reduces the time taken for the frequency to reach the correct level and increases the stiffness of the system, i.e. it reduces the positional displacement produced by applying a load torque to the motor.

Differential gain (Kd)

The differential gain is provided in the feedback of the frequency controller to give additional damping.

00.066 {03.011}		Frequency Controller Integral Gain Ki1								
RW		Num							US	
OL	⇳				⇨					
RFC-A		0.00 to 655.35 s^2/rad				0.10 s^2/rad				

Defines the integral gain for frequency controller 1. See *Frequency Controller Proportional Gain Kp1* (00.065).

00.067 {03.079}		Sensorless Mode Filter								
RW		Txt							US	
OL	⇳				⇨					
RFC-A		4 (0), 5 (1), 6 (2), 8 (3), 12 (4), 20 (5) ms				4 (0) ms				

Defines the time constant for the filter applied to the output of the frequency estimator system.

00.069 {05.040}		Spin Start Boost								
RW		Num							US	
OL	⇳	0.0 to 10.0			⇨	1.0				
RFC-A										

Spin Start Boost (00.069) is used by the algorithm that detects the frequency of a spinning motor when the drive is enabled and *Catch A Spinning Motor* (00.033) ≥ 1. For smaller motors the default value of 1.0 is suitable, but for larger motors *Spin Start Boost* (00.069) may need to be increased.

If *Spin Start Boost* (00.069) is too small the drive will detect zero speed whatever the frequency of the motor, and if *Spin Start Boost* (00.069) is too large the motor may accelerate away from standstill when the drive is enabled.

00.076 {10.037}		Action On Trip Detection								
RW		Num				ND	NC	PT	US	
OL	⇳	0 - 31			⇨	0				
RFC-A										

Bit 0: Stop on defined non-important trips

Bit 1: Disable braking resistor overload detection

Bit 2: Disable phase loss stop

Bit 3: Disable braking resistor temperature monitoring

Bit 4: Disable parameter freeze on trip. Refer to *Drive User Guide.*

00.077 {11.032}		Maximum Heavy Duty Rating								
RO		Num				ND	NC	PT		
OL RFC-A	⇳	0.00 to 9999.99 A				⇨				

Displays the maximum heavy duty current rating of the drive.

00.078 {11.029}		Software Version								
RO		Num				ND	NC	PT		
OL RFC-A	⇳	0 to 999999				⇨				

Displays the software version in the drive.

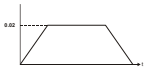
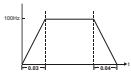
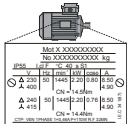
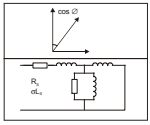
00.079 {11.031}		User Drive Mode								
RW		Txt				ND	NC	PT	US	
OL RFC-A	⇳	Open loop (1), RFC A (2)				⇨	Open loop (1) RFC-A (2)			

Defines the mode of the drive.

7 Running the motor

This section takes a new user through all the essential steps to running a motor for the first time.

Table 7-1 Open Loop and RFC-A

Action	Detail	
Before power up	Ensure: • The drive enable signal is not given, terminal 31 and 34 is open • The run signal is not given, terminal 12/13 is open • The motor is connected to the drive • The motor connection is correct for the drive Δ or Y • The correct supply voltage is connected to the drive	
Power up the drive	The default setting is Open Loop vector mode. For RFC-A mode set Pr **00.079** to RFC-A, then press the stop/reset button to save the parameters. Ensure: The drive displays: Inhibit	
Enter minimum and maximum speeds	Enter: • Minimum speed Pr **00.001** (Hz) • Maximum speed Pr **00.002** (Hz)	
Enter accel and decel rates	Enter: • Acceleration rate Pr **00.003** (s/100 Hz) • Deceleration rate Pr **00.004** (s/100 Hz)	
Enter motor nameplate details	Enter: • Motor rated current in Pr **00.006** (A) • Motor rated speed in Pr **00.007** (rpm) • Motor rated voltage in Pr **00.008** (V) • Motor rated power factor in Pr **00.009** • If the motor is not a standard 50/60 Hz motor, set Pr **00.039** accordingly	
Ready to autotune		
Autotune	The drive is able to perform either a stationary or a rotating autotune. The motor must be at a standstill before an autotune is enabled. To perform an autotune: • Set Pr **00.038** = 1 for a stationary autotune or set Pr **00.038** = 2 for a rotating autotune • Close the drive enable signal (apply +24 V to terminal 31 & 34). The drive will display 'Ready'. • Close the run signal (apply +24 V to terminal 12 or 13). The lower display will flash 'Auto Tune' while the drive is performing the autotune. • Wait for the drive to display 'Inhibit' and for the motor to come to a standstill. • Remove the drive enable and run signal from the drive.	
Autotune complete	When the autotune has been completed, Pr **00.038** will be set to 0	
Tuning of frequency controller gains (RFC-A mode only)	Depending on the application, the frequency controller gains (Pr **00.065** and Pr **00.066**) may need to be adjusted..	
Save parameters		
Save parameters	Select 'SAVE' in Pr **mm.000** (alternatively enter a value of 1001) and press the Stop / Reset button to save parameters.	
Ready to run		
Run	The drive is now ready to run the motor.	
Increasing and decreasing speed	Turning the speed potentiometer will increase and decrease the speed of the motor.	
Stopping	To stop the motor under ramp control, open either the run forward or run reverse terminal. If the enable terminal is opened while the motor is running, the motor will coast to a stop.	

8 Diagnostics

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

Table 8-1 Trip indications

Trip code	Condition	Description
An Input 1 Loss	Analog input 1 current loss	Current loss was detected in current mode on Analog input 1 (Terminal 2).
An Input 1 OI	Analog input 1 over-current	Current input on analog input 1 exceeds 24 mA.
An Input 2 Loss	Analog input 2 current loss	Current loss was detected in current mode on Analog input 2 (Terminal 5).
An Input 2 OI	Analog input 2 over-current	Current input on analog input 2 exceeds 24 mA.
Autotune	Measured inertia has exceeded the parameter range	The drive has tripped during a rotating autotune or mechanical load measurement test.
Autotune Stopped	Autotune test stopped before completion	The drive was prevented from completing an autotune test, because either the drive enable or the drive run signals were removed.
Brake R Too Hot	Braking resistor overload timed out (I^2t)	Braking resistor overload has timed out.
Card Access	NV Media Card Write fail	Unable to access the NV Media Card.
Card Boot	The Menu 0 parameter modification cannot be saved to the NV Media Card	The necessary boot file has not been created on the NV media card fitted to the drive to take the new parameter value. This occurs when *Parameter Cloning* (00.030) is changed to auto or boot mode, but the drive is not subsequently reset.
Card Busy	NV Media Card cannot be accessed as it is being accessed by an option module	The *Card Busy* trip indicates that an attempt has been made to access a file on NV Media Card, but the NV Media Card is already being accessed by an option module. No data is transferred.
Card Compare	NV Media Card file/data is different to the one in the drive	Trip is initiated if the parameters on the NV Media Card are different to the drive.
Card Data Exists	NV Media Card data location already contains data	Attempt has been made to store data on a NV Media Card in a data block which already contains data.
Card Drive Mode	NV Media Card parameter set not compatible with current drive mode	The drive mode in the data block on the NV Media Card is different from the current drive mode.
Card Error	NV Media Card data structure error	Attempt has been made to access the NV Media Card but an error has been detected in the data structure on the card. Resetting the trip will cause the drive to erase and create the correct folder structure.
Card Full	NV Media Card full	There is not enough space left on the card.
Card No Data	NV Media Card data not found	Attempt has been made to access non-existent file or block on the NV Media Card.
Card Option	NV Media Card trip; option modules installed are different between source drive and destination drive	The *Card Option* trip indicates that parameter data or default difference data is being transferred from the NV Media Card to the drive, but the option module category is different between the source and destination drives.
Card Product	NV Media Card data blocks are not compatible with the drive derivative	If *Drive Derivative* is different between the source and target drives. Refer to the *Drive User Guide*.

<table>
<tr><th>Trip code</th><th>Condition</th><th>Description</th></tr>
<tr><td>Card Rating</td><td>NV Media Card Trip; The voltage and / or current rating of the source and destination drives are different</td><td>The current and / or voltage ratings are different between source and destination drives.</td></tr>
<tr><td>Card Read Only</td><td>NV Media Card has the Read Only bit set</td><td>Attempt has been made to modify a read-only NV Media Card or a read-only data block.</td></tr>
<tr><td>Card Slot</td><td>NV Media Card trip; Option module file transfer has failed</td><td>The Card Slot trip is initiated, if the transfer of an option module file to or from a module failed because the option module does not respond correctly.</td></tr>
<tr><td>Control Word</td><td>Trip initiated from the Control Word</td><td>Initiated by setting bit 12 on the control word when the control word is enabled. Refer to the Drive User Guide</td></tr>
<tr><td>Current Offset</td><td>Current feedback offset error</td><td>Current offset is too large to be trimmed.</td></tr>
<tr><td>Data Changing</td><td>Drive parameters are being changed</td><td>A user action or a file system write is active that is changing the drive parameters and the drive has been commanded to enable.</td></tr>
<tr><td>Derivative ID</td><td>Derivative file error</td><td>Contact the supplier of the drive.</td></tr>
<tr><td>Derivative Image</td><td>Derivative product image error</td><td>Contact the supplier of the drive</td></tr>
<tr><td>Destination</td><td>Two or more parameters are writing to the same destination parameter</td><td>The dest trip indicates that destination output parameters of two or more logic functions (Menus 7 and 8) within the drive are writing to the same parameter.</td></tr>
<tr><td>Drive Config</td><td>Drive configuration</td><td>Contact the supplier of the drive.</td></tr>
<tr><td>EEPROM Fail</td><td>Default parameters have been loaded</td><td>The cause of the trip can be identified from the sub trip number displayed after the trip string.
<table><tr><th>Sub-trip</th><th>Reason</th></tr><tr><td>1</td><td>External Trip = 1</td></tr></table>Refer to Drive User Guide.</td></tr>
<tr><td>External Trip</td><td>External trip is initiated</td><td>The cause of the trip can be identified from the sub trip number displayed after the trip string.
<table><tr><th>Sub-trip</th><th>Reason</th></tr><tr><td>1</td><td>External Trip = 1</td></tr></table>Refer to Drive User Guide.</td></tr>
<tr><td>Fan Fail</td><td>Fan fail</td><td>Indicates the fan or fan circuitry has failed</td></tr>
<tr><td>File Changed</td><td>File changed</td><td>A file has been changed, power cycle to clear the trip</td></tr>
<tr><td>FW Incompatible</td><td>Firmware Incompatibility</td><td>The user firmware is incompatible with the power firmware.</td></tr>
<tr><td>HFxx trip</td><td>Hardware faults</td><td>Internal drive hardware fault (see the Drive User Guide).</td></tr>
<tr><td>Hot Rect/Brake</td><td>Hot rectifier/brake</td><td>Over-temperature detected on input rectifier or braking IGBT.</td></tr>
<tr><td>I cal. range</td><td>Current calibration range</td><td>Current calibration range error.</td></tr>
<tr><td>I/O Overload</td><td>Digital output overload</td><td>The total current drawn from 24 V user supply or from the digital output has exceeded the limit.</td></tr>
<tr><td>Keypad Mode</td><td>Keypad has been removed when the drive is receiving the reference from the keypad</td><td>The Keypad Mode trip indicates that the drive is in keypad mode [Reference Selector = 4 or 6] and the keypad has been removed or disconnected from the drive.
Refer to Drive User Guide.</td></tr>
</table>

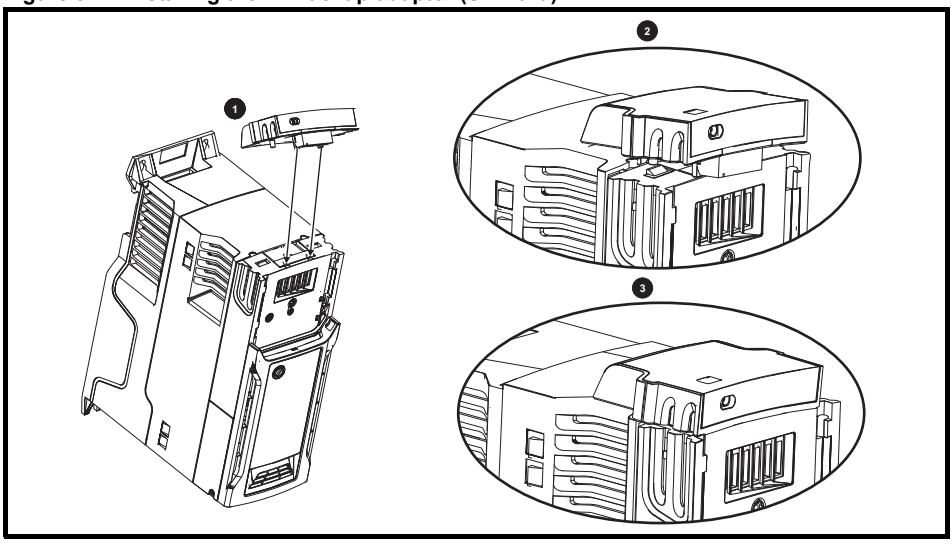
Trip code	Condition	Description
Motor Too Hot	Output current overload timed out (I^2t)	trip indicates a motor thermal overload based on the output current and motor thermal time constant. The drive will trip on It.Ac when the accumulator gets to 100 %. This can occur when: • There is excessive mechanical load • Ensure the load is not jammed / sticking • Check the load on the motor has not changed • Ensure the motor rated current is not zero
No power board	No power board	No communication between the power and control boards.
OHt Brake	Braking IGBT over-temperature	Braking IGBT over-temperature
OHt Control	Control stage over-temperature	Control stage over-temperature
OHt dc bus	DC bus over temperature	DC bus component over temperature based on a software thermal model.
OHt Inverter	Inverter over temperature based on thermal model	IGBT junction over-temperature has been detected based on a software thermal model.
OHt Power	Power stage over temperature	This trip indicates that a power stage over-temperature has been detected.
OHt Rectifier	Rectifier over temperature	The OHt Rectifier trip indicates that a rectifier over-temperature has been detected.
OI ac	Instantaneous output over current detected	The instantaneous drive output current has exceeded.The set limit. **Possible solutions:** • Increase acceleration/deceleration rate • If seen during autotune reduce the voltage boost • Check for short circuit on the output cabling • Check integrity of the motor insulation using an insulation tester • Is the motor cable length within limits for the frame size • Reduce the values in the current loop gain parameters
OI Brake	Braking IGBT over current detected: short circuit protection for the braking IGBT activated	Over current has been detected in braking IGBT or braking IGBT protection has been activated. **Possible cause:** • Check brake resistor wiring • Check braking resistor value is greater than or equal to the minimum resistance value • Check braking resistor insulation
Option Disable	Option module does not acknowledge during drive mode changeover	Option module did not acknowledge notifying the drive that communications with the drive has been stopped during the drive mode changeover within the allocated time.
Out Phase Loss	Output phase loss detected	Phase loss has been detected at the drive output.
Output phase s/c	Output phase short-circuit	Over-current detected on drive output when enabled.
Over Speed	Motor frequency has exceeded the over frequency threshold	Excessive motor speed (typically caused by mechanical load driving the motor).

Trip code	Condition	Description
Over Volts	DC bus voltage has exceeded the peak level or maximum continuous level for 15 seconds	The *OV* trip indicates that the DC bus voltage has exceeded the maximum limit. Possible solutions: • Increase *Deceleration Rate 1* (Pr **00.004**) • Decrease the braking resistor value (staying above the minimum value). • Check nominal AC supply level. • Check for supply disturbances which could cause the DC bus to rise. • Check motor insulation using a insulation tester.
Phase Loss	Supply phase loss	The drive has detected an input phase loss or large supply imbalance.
Power Board HF	Power board HF	Power processor hardware fault.
Power Comms	Communication has been lost / errors detected between power control	No communications between power control.
Power Data	Power system configuration data error	Error in the configuration data stored in the power system.
Power Down Save	Power down save error	Error has been detected in the power down save parameters saved in non-volatile memory.
PSU	Internal power supply fault	One or more internal power supply rails are outside limits or overloaded.
Resistance	Measured resistance has exceeded the parameter range	The measured stator resistance during an autotune test has exceeded the maximum possible value of *Stator Resistance*. Refer to the *Drive User Guide*.
Slot 1 Different	Option module in option slot 1 has changed	Option module in option slot 1 on the drive is a different type to that installed when parameters were last saved on the drive.
Slot 1 Error	Option module in option slot 1 has detected a fault	Option module in option slot 1 on the drive has detected an error.
Slot 1 HF	Option module 1 hardware fault	Option module in option slot 1 on the drive has indicated a hardware fault.
Slot 1 Not Fitted	Option module in option slot 1 has been removed	Option module in option slot 1 on the drive has been removed since the last power up.
Slot 1 Watchdog	Option module watchdog function service error	Option module installed in Slot 1 has started the option watchdog function and then failed to service the watchdog correctly.
Soft Start	Soft start relay failed to close, soft start monitor failed	Soft start relay in the drive failed to close or the soft start monitoring circuit has failed.
STO Error	No Safe Torque Off board installed	STO board not installed.
Stored HF	Hardware trip has occurred during last power down	Hardware trip (HF01 –HF19) has occurred and the drive has been power cycled. Enter 1299 to **xx.000** to clear trip
Sub-array RAM	RAM allocation error	The *Sub-array RAM* trip indicates that an option module derivative image has requested more parameter RAM than is allowed.
Temp Feedback	Internal thermistor has failed	Internal thermistor has failed.
Th Brake Res	Brake resistor over temperature	The th.br trip is initiated if the hardware based braking resistor thermal monitoring is connected and the resistor overheats.
Th Short Circuit	Motor thermistor short circuit	The *Th Short Circuit* trip indicates that the motor thermistor connected to terminal 14 (digital input 5) on the control connections, is short circuit or low impedance (<50 Ω).

Trip code	Condition	Description
Thermistor	Motor thermistor over-temperature	The *Thermistor* trip indicates that the motor thermistor connected to terminal 14 (digital input 5) on the control connections has indicated a motor over temperature.
User 24 V	User 24 V supply is not present on the adaptor interface terminals (1,2)	A *US.24* trip is initiated if the User Supply Select is set to 1 and no user 24 V supply is present on the user 24 V input on the AI-Backup adaptor. Refer to the *Drive User Guide.*
User OI ac	User OI ac	The *U.OI* trip is initiated if the output current of the drive exceeds the trip level set by *User Over Current Trip Level*. Refer to the *Drive User Guide*.
User Prog Trip	Trip generated by an onboard user program	This trip can be initiated from within an onboard user program
User Program	On board user program error	An error has been detected in the onboard user program image.
User Save	User Save error / not completed	The *U.S* trip indicates that an error has been detected in the user save parameters saved in non-volatile memory.
Watchdog	Control word watchdog has timed out	The Watchdog trip indicates that the control word has been enabled and has timed out

9 NV Media Card Operation

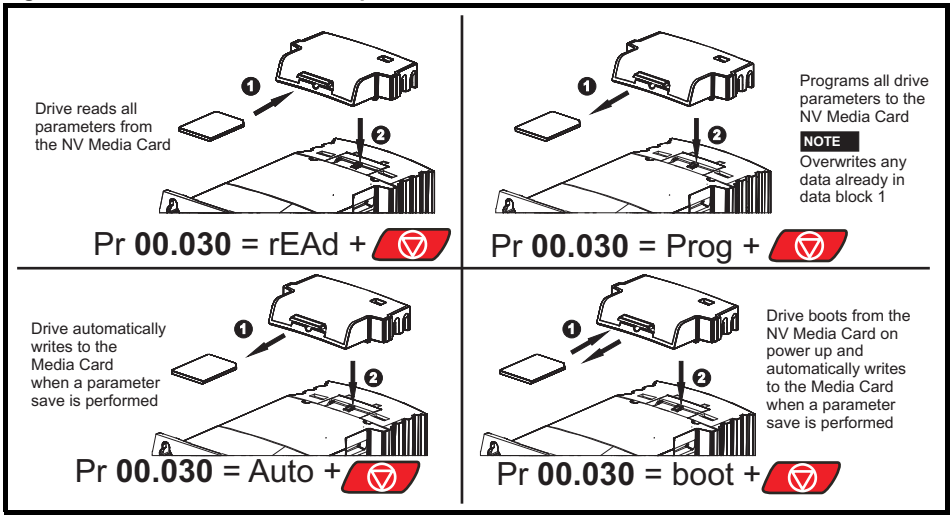
Figure 9-1 Installing the AI-Backup adaptor (SD Card)



1. Identify the two plastic fingers on the underside of the AI-Backup adaptor (1) - then insert the two fingers into the corresponding slots in the spring-loaded sliding cover on the top of the drive.
2. Hold the adaptor firmly and push the spring loaded protective cover towards the back of the drive to expose the connector block (2) below.

Press the adaptor downwards (3) until the adaptor connector locates into the drive connection below.

Figure 9-2 Basic NV Media Card operation



The whole card may be protected from writing or erasing by setting the read-only flag, refer to the *Drive User Guide* for further information. The card should not be removed during data transfer, as the drive will produce a trip. If this occurs then either the transfer should be reattempted or in the case of a card to drive transfer, default parameters should be loaded.

10 Machine Control Studio

Machine Control Studio programming software powered by CODESYS

Machine Control Studio software provides a flexible and intuitive environment for programming Unidrive M's new automation and motion control features. This new software offers programming for the Unidrive M400's onboard PLC.

Machine Control Studio is powered by CODESYS, the leading open software for programmable machine control. The programming environment is fully EN/IEC 61131-3 compliant, meaning that it is familiar and therefore fast and easy to use for control engineers around the world.

The following EN/IEC 61131-3 programming languages are supported:

- Structured Text (ST)
- Function Block Diagram (FBD)
- Structured Function Chart (SFC)
- Ladder Diagram (LD)
- Instruction List (IL)

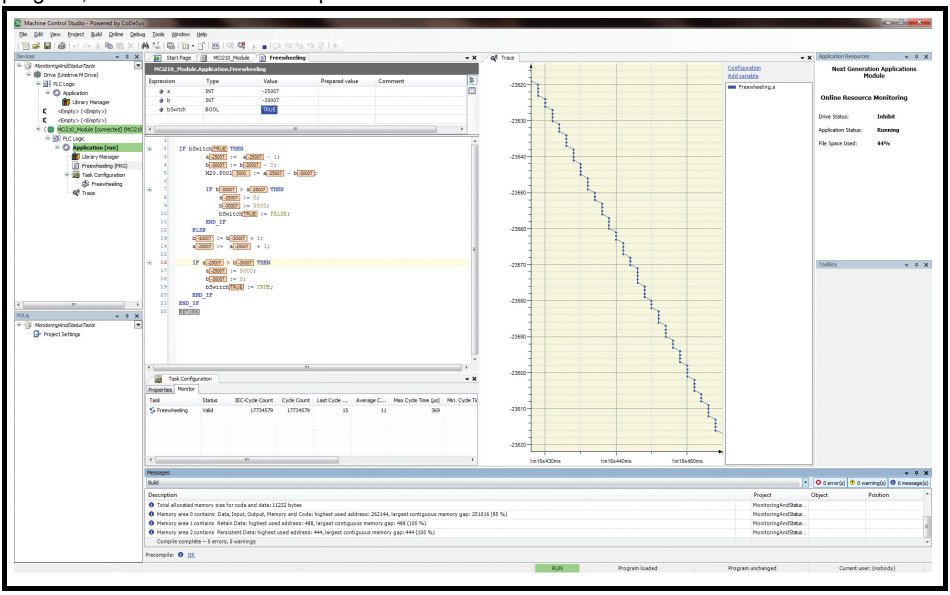
Also supported:

- Continuous Function Chart (CFC)

Onboard intelligence

- Programmable Logic Control (PLC) - memory: 12 kB
- 1 x Real-time task (16 ms), 1 x Background task

Intuitive IntelliSense functionality helps to write consistent and robust programming, speeding up software development. Programmers have access to a vibrant open-source community for function blocks. Machine Control Studio supports customers' own function block libraries, with on-line monitoring of program variables with user defined watch windows and help for on-line change of program, in line with current PLC practices.



Download Machine Control Studio from: http://www.emersonindustrial.com/en-EN/controltechniques/downloads/userguidesandsoftware/Pages/unidrivem.aspx under the 'Software' section **or** http://www.emersonindustrial.com/fr-FR/leroy-somer-motors-drives/downloads/Pages/softwares-and-drawings.aspx

11 UL listing information

11.1 General

Drive sizes 1 to 4 have been assessed to meet both UL and cUL requirements.

UL listings can be viewed online at www.UL.com. The UL file number is E171230.

11.2 Mounting

Drives can be installed in the following configurations:

- Standard or surface mounted. Refer to the *Drive User Guide* for further information.
- Bookcase mounted. Drives are mounted side by side with no space between them. This configuration minimizes the overall width of the installation.

11.3 Environment

Drives are able to meet the following UL/NEMA environmental ratings:

- Type 1. The drive must either be installed with a UL Type 1 kit or be installed in a Type 1 enclosure.
- Type 12. The drive must be installed in a Type 12 enclosure.
- The remote keypad is rated to both UL Type 1 and UL Type 12.
- Drives must be installed in a pollution degree 2 environment or better.

11.4 Electrical ratings

Suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, at the rated maximum AC voltage.

For information on power and current ratings, see the *Drive User Guide*.

Fuse and circuit breaker (size 1 only with short circuit rating of 10 kA) ratings are given in the *Drive User Guide*.

Unless indicated otherwise in the *Drive User Guide*, fuses may be any UL listed Class J or CC with a voltage rating of at least 600 Vac.

Unless indicated otherwise in the *Drive User Guide*, circuit breakers may be any UL listed type, category control number: DIVQ or DIVQ7, with a voltage rating of at least 600 Vac.

11.5 Opening of branch circuit

The opening of the branch-circuit protective device may be an indication that a fault has been interrupted. To reduce the risk of fire or electric shock, the equipment may be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.

Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local “codes”, or the equivalent.

11.6 Electrical installation

The following precautions must be observed:

- Drives are rated for use at 40 °C and 50 °C surrounding air temperature.
- Field wiring terminals are suitable for copper wire only, which must have a temperature rating of at least 75 °C.
- If the drive control stage is powered from an external power supply (+24 V), the power supply must be listed or recognized to UL class 2 with appropriate fusing.
- Ground connections must use UL listed closed loop (ring) terminals.

11.7 Motor overload protection

All models incorporate internal overload protection for the motor load that does not require the use of an external or remote overload protection device. The protection level is adjustable and the method of adjustment is provided within instructions/manual for the product. Maximum current overload is dependent on the values entered into the current limit parameters (*Motoring Current Limit* (04.005), *Regenerative Current Limit* (04.006) and *Symmetrical Current Limit* (04.007) entered as percentage) and the *Motor Rated Current* (00.006) entered in amperes). The duration of the overload is dependent on *Motor Thermal Time Constant* (04.015) variable up to a maximum of 3000 seconds. The default overload protection is set such that the product is capable of 150 % of the current value entered into the motor rated current parameter for 60 seconds. The product can be connected to a motor thermistor to protect the motor, in the event of a motor cooling fan failure.

11.8 Motor overspeed protection

The drive is installed with solid state motor overspeed protection.

However, this feature does not provide the level of protection provided by an independent, high-integrity overspeed protection device and should not be considered as a safety function.

11.9 Thermal memory retention

Drives incorporate thermal memory retention that complies fully with the requirements of UL508C.

The drive is provided with motor load and speed sensitive overload protection with thermal memory retention that complies with the US National Electrical Code (NFPA 70) clause 430.126 and Underwriters Laboratories Standard UL508C, clause 20.1.11 (a). The purpose of this protection is to protect both drive and motor from dangerous overheating in the event of repeated overload or failure to start, even if the power to the drive is removed between overload events.

For full explanation of the thermal protection system, refer to the *Drive User Guide* for further information.

In order to comply with UL requirements for thermal memory retention, it is necessary to set the *Thermal Protection Mode* (04.016) to zero; and the *Low Frequency Thermal Protection Mode* (04.025) must be set to 1 if the drive is operated in Heavy Duty mode.

Alternatively, an external thermal sensor or switch may be used as a means of motor and drive overload protection that complies with the requirements of UL508C, clause 20.1.11 (b). This protection method is particularly recommended where independent forced cooling of the motor is used, because of the risk of overheating if the cooling is lost.

External thermal sensor

The drive is provided with a means to accept and act upon a signal from a thermal sensor or switch imbedded in the motor or from an external protective relay. Refer to the *Drive User Guide* for further information.

11.10 Group installation

11.10.1 Definition

Group Installation Definition: A motor branch circuit for two or more motors, or one or more motors with other loads, protected by a circuit breaker or a single set of fuses.

11.10.2 Limitations on use

All motors rated less than 1 hp

The drives may be used in group installations where each of the motors is rated 1 hp or less. The full-load current rating of each motor must not exceed 6 A. The motor drive provides individual overload protection in accordance with the NEC clause 430.32.

Smallest motor protected

The drives may be used in group installations where the smallest motor is protected by the branch fuses or circuit breaker. Limits on the current rating of branch circuit protective fuses and circuit breakers are given in the NEC Table: 430.52.

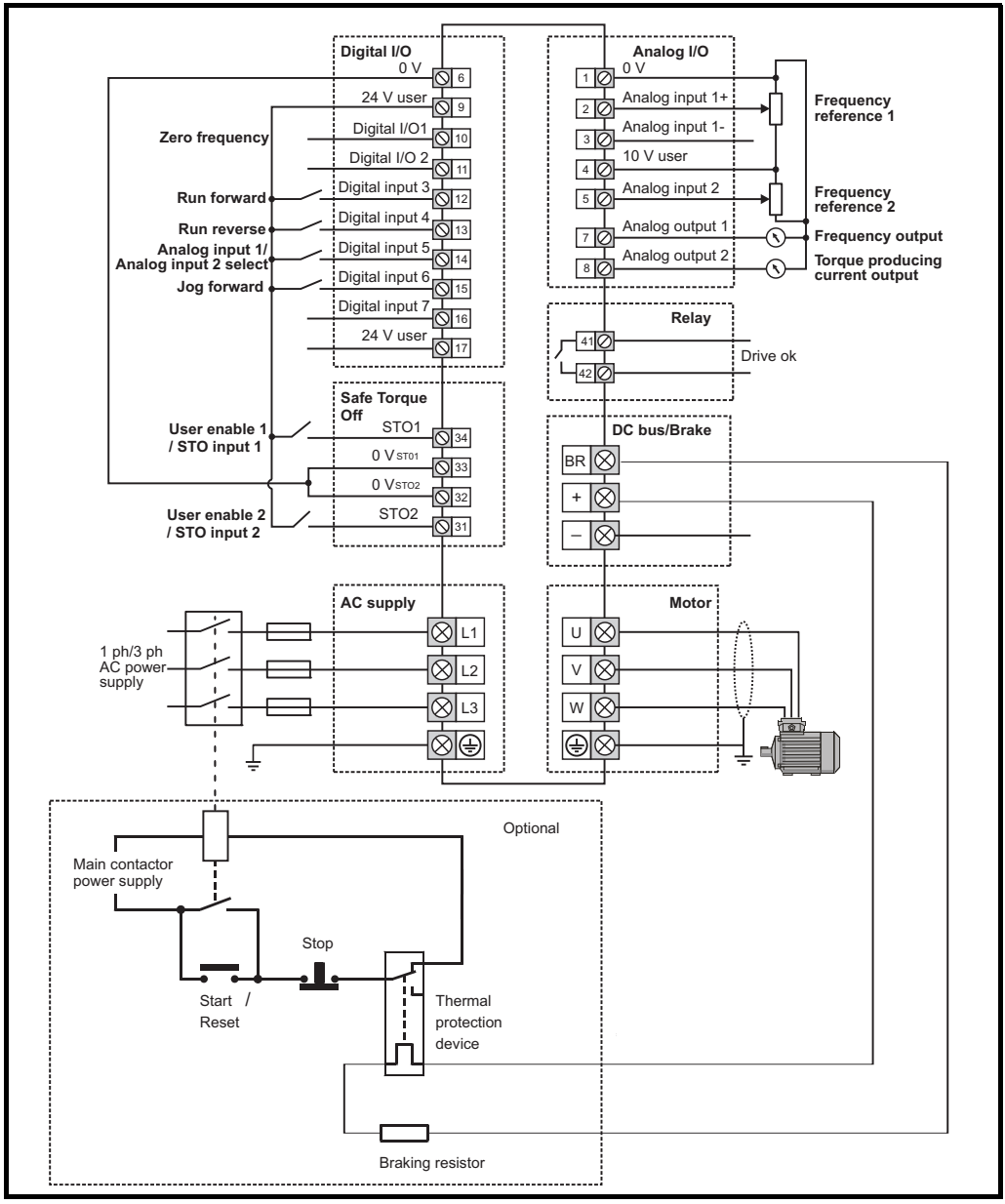
Other installations

The motor drives described in this user guide are not UL listed for group installation.

11.11 UL listed accessories

The following options are UL listed:

- CI-Keypad
- CI-485 Adaptor
- AI-485 Adaptor
- AI-Backup Adaptor
- Remote Keypad
- UL Type 1 kit
- NV Media card
- SI-PROFIBUS
- SI-DeviceNet
- SI-CANopen
- SI-Ethernet
- SI-EtherCAT
- SI-I/O



NOTE The 0 V terminals on the Safe Torque Off are isolated from each other and the 0 V common. On the size 2 110 V drives or when connecting single phase to a dual rated 200 V unit, the supply should be connected to L1 and L3.