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**Nidec**  
All for dreams



## Quick Start Guide

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# Unidrive M300/ HS30

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Frame sizes 1 to 4

Enhance throughput with  
Machine Safety

Part Number: 0478-0039-08

Issue: 8

## Original Instructions

For the purposes of compliance with the EU Machinery Directive 2006/42/EC, the English version of this manual is the Original Instructions. Manuals in other languages are Translations of the Original Instructions.

### Documentation

Manuals are available to download from the following locations: <http://www.drive-setup.com/ctdownloads>

The information contained in this manual is believed to be correct at the time of printing and does not form part of any contract. The manufacturer reserves the right to change the specification of the product and its performance, and the contents of the manual, without notice.

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Control Techniques Ltd operates an Environmental Management System (EMS) that conforms to the International Standard ISO 14001.

Further information on our Environmental Policy can be found at: <http://www.drive-setup.com/environment>

### Restriction of Hazardous Substances (RoHS)

The products covered by this manual comply with European and International regulations on the Restriction of Hazardous Substances including EU directive 2011/65/EU and the Chinese Administrative Measures for Restriction of Hazardous Substances in Electrical and Electronic Products.

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### Registered Office

**Nidec Control Techniques Ltd**  
**The Gro**  
**Newtown**  
**Powys**  
**SY16 3BE**  
**UK**

Registered in England and Wales. Company Reg. No. 01236886.

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# EU Declaration of Conformity

Control Techniques Ltd  
 The Gro  
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This declaration is issued under the sole responsibility of the manufacturer. The object of the declaration is in conformity with the relevant Union harmonization legislation. The declaration applies to the variable speed drive products shown below:

Model number	Interpretation	Nomenclature aaaa - bbc ddddde
aaaa	Basic series	M100, M101, M200, M201, M300, M400, M600, M700, M701, M702, F300, H300, E200,E300, HS30, HS70, HS71, HS72, M000, RECT
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
dddd	Current rating	Example 01000 = 100 A
e	Drive format	A = 6P Rectifier + Inverter (internal choke), D = Inverter, E = 6P Rectifier + Inverter (external choke), T = 12P Rectifier + Inverter (external choke)

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+A1:2012	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+ A1:2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
EN 61000-3-2:2014	Electromagnetic compatibility (EMC) - Part 3-2: Limits for harmonic current emissions (equipment input current $\leq 16$ A per phase)
EN 61000-3-3:2013	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 $\leq 16$ A per phase and not subject to conditional connection

EN 61000-3-2:2014 Applicable where input current < 16 A. No limits apply for professional equipment where input power  $\geq 1$  kW.

These products comply with the Restriction of Hazardous Substances Directive (2011/65/EU), the Low Voltage Directive (2014/35/EU) and the Electromagnetic Compatibility Directive (2014/30/EU).



**G Williams**

**Vice President, Technology**

**Date: 17th March 2016**

**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. Refer to the Product Documentation. An EMC data sheet is available giving detailed information. 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.**

# EU Declaration of Conformity (including 2006 Machinery Directive)

Control Techniques Ltd  
The Gro  
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This declaration is issued under the sole responsibility of the manufacturer. The object of the declaration is in conformity with the relevant Union harmonization legislation. The declaration applies to the variable speed drive products shown below:

Model No.	Interpretation	Nomenclature aaaa - bbc ddddde
aaaa	Basic series	M300, M400, M600, M700, M701, M702, F300, H300, E200, E300, HS30, HS70, HS71, HS72, M000, RECT
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
dddd	Current rating	Example 01000 = 100 A
e	Drive format	A = 6P Rectifier + Inverter (internal choke), D = Inverter, E = 6P Rectifier + Inverter (external choke), T = 12P Rectifier + Inverter (external choke)

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 Electromagnetic Compatibility Directive (2014/30/EU).

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

The harmonized standards used are shown below:

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

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+A1:2012	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:

P Knight

Conformity Engineer

Newtown, Powys, UK



**G. Williams**

**Vice President, Technology**

**Date: 17th March 2016**

**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. 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. Refer to the Product Documentation. An EMC data sheet is available giving detailed information. 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.**



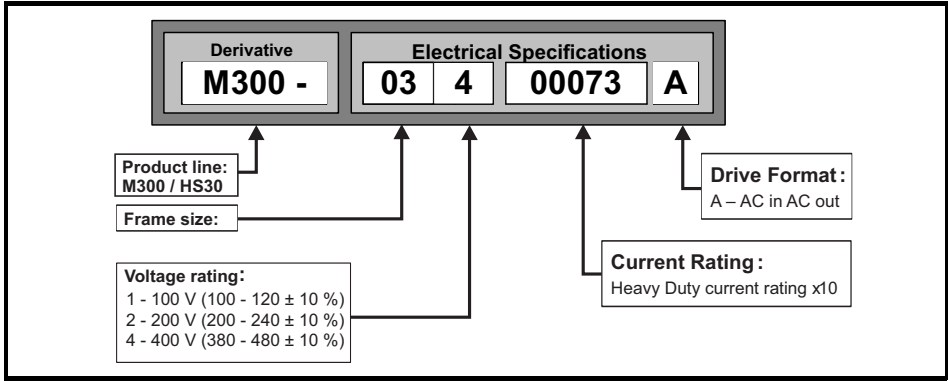
# 1 Product information

## 1.1 Ratings

Model	Input phases  ph	Max. cont input current  A	Max input fuse rating		Nominal cable size				Output current		
			1 Ph	3 Ph	European		USA		Max. cont output current  A	Nominal power  kW	Motor power  hp
					Input  mm <sup>2</sup>	Output  mm <sup>2</sup>	Input  AWG	Output  AWG			
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**

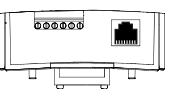



## 2 Options

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

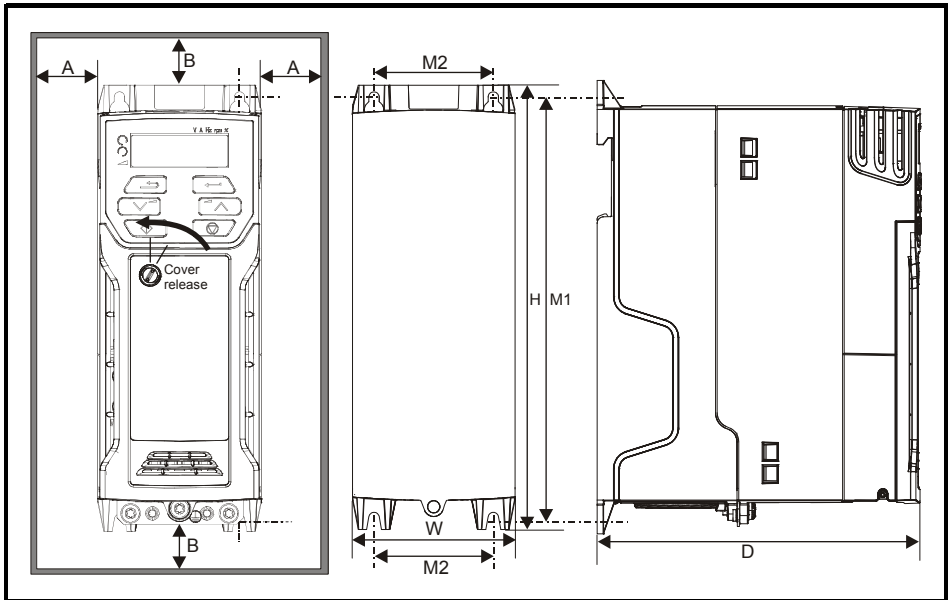
Type	Option module	Color	Name	Further details
Fieldbus		Purple	SI-PROFIBUS	See relevant option module User Guide
		Medium Grey	SI-DeviceNet	
		Light Grey	SI-CANopen	
		Beige	SI-Ethernet	
		Brown Red	SI-EtherCAT	
		Yellow Green	SI-PROFINET V2	
Automation (I/O expansion)		Orange	SI-I/O	

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

Type	Option module	Name	Further Details
Communications		AI-485 Adaptor	See Control User Guide
		AI-485 24V Adaptor	
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 *Power Installation 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	75	2.95	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 (3.94 in) 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 (1.97 in) above and below Frame 01 to 04 products is permissible in applications where either the ambient operating temperature is 35 °C (95 °F) 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 *Power Installation 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		✓	✓	✓

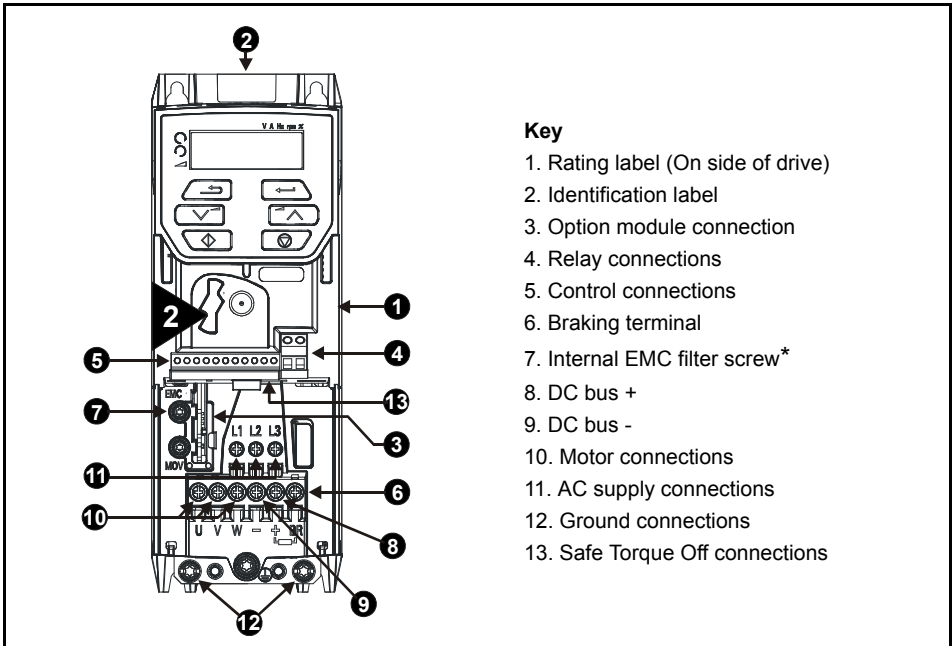
**Table 3-2 Recommended torque settings**

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)
	Ground terminals	1.5 N m (1.10 lb ft)
1	Power terminals	0.5 N m (0.37 lb ft)
2, 3, 4		1.4 N m (1.03 lb ft)

**Table 3-3 Tightening torque for mounting feet**

Drive size	Tightening torque
1 to 3	1.3 N m (1 lb ft) to 1.6 N m (1.2 lb ft)
4	2.5 N m (1.8 lb ft) to 2.8 N m (2.1 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

\* Before removing the screw, refer to section 4.5 EMC on page 23.

## 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  $\pm 10$  %

200 V drive: 200 V to 240 V  $\pm 10$  %

400 V drive: 380 V to 480 V  $\pm 10$  %

Number of phases: 3

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

Frequency range: 45 to 66 Hz

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

**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* (Pr 08) 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* $\Omega$	Instantaneous power rating kW	Continuous power rating kW
01100017	130	1.1	0.25
01100024			0.37
02100042	68	2.2	0.75
02100056			1.1

\* Resistor tolerance:  $\pm 10$  %

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

<b>Model</b>	<b>Minimum resistance* Ω</b>	<b>Instantaneous power rating kW</b>	<b>Continuous power rating kW</b>
01200017	130	1.1	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	3.3	2.2
04200133	22	6.0	3.0
04200176			4.0

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

<b>Model</b>	<b>Minimum resistance* Ω</b>	<b>Instantaneous power rating kW</b>	<b>Continuous power rating kW</b>
02400013	270	2.2	0.37
02400018			0.55
02400023			0.75
02400032			1.1
02400041			1.5
03400056	100	6.0	2.2
03400073			3
03400094			4
04400135	50	11.2	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 4.5.2 *Removing the internal EMC filter* on page 23.

With internal filter installed:

### Size 1:

- 8.1 mA\* AC at 110 V, 50 Hz
- 9.5 mA\* AC at 230 V, 50 Hz

### Size 2:

- 13 mA\* AC at 110 V, 50 Hz (1 phase)
- 6.3 mA\* AC at 230 V, 50 Hz (3 phase)
- 17.5 mA\* AC at 230 V, 50 Hz (1 phase)
- 9.2 mA\* AC at 415 V, 50 Hz (3 phase)

### Size 3:

- 17.1 mA\* AC at 230 V 50 Hz (1 phase)
- 5.9 mA\* AC at 230 V 50 Hz (3 phase)
- 5.7 mA\* AC at 415 V 50 Hz (3 phase)

### Size 4:

- 21.3 mA\* AC at 230 V 50 Hz (1 phase)
- 9.7 mA\* AC at 230 V 50 Hz (3 phase)
- 13.3 mA\* AC at 415 V 50 Hz (3 phase)

\*Proportional to the supply voltage and frequency.

With internal filter removed:

**Size 1:** <1 mA

**Size 2: 110 V:** < 1.2 mA

**230 V:** < 1 mA

**415 V:** < 2.3 mA

**Size 3: 230 V:** < 1.6 mA

**415 V:** < 1 mA

**Size 4:** < 1 mA

#### NOTE

The above leakage currents are just the leakage currents of the drive 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



**WARNING**

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

If an external EMC filter is used with an ELCB / RCD, 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

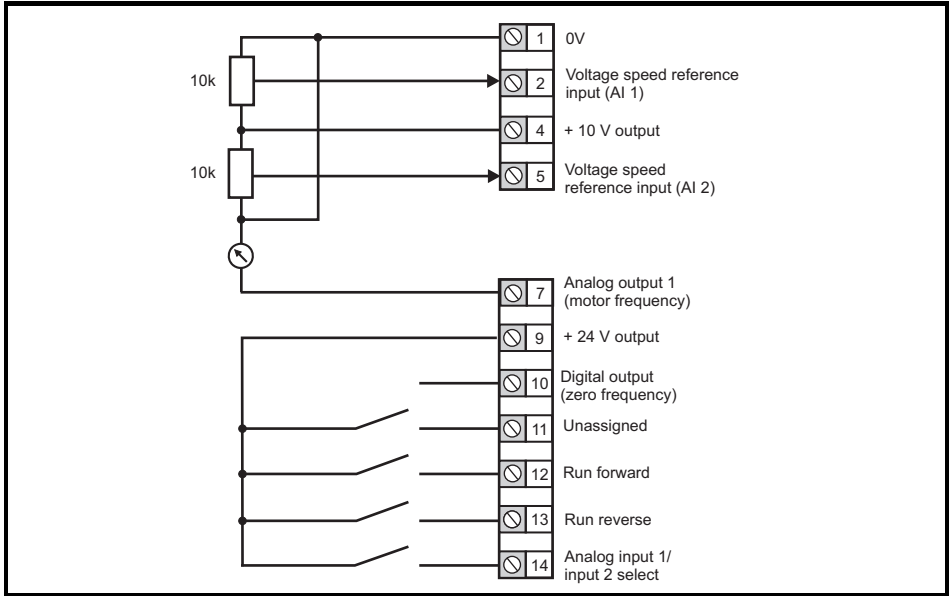
05		Drive Configuration								
RW	Txt						PT	US		
OL	⇕	AV (0), AI (1), AV.Pr (2), AI.Pr (3), PrESEt (4), PAd (5), PAd.rEF (6), E.Pot (7), torquE (8), Pid (9)				⇒	AV (0)			
RFC-A										

The setting of Pr **05** automatically sets the drive configuration.

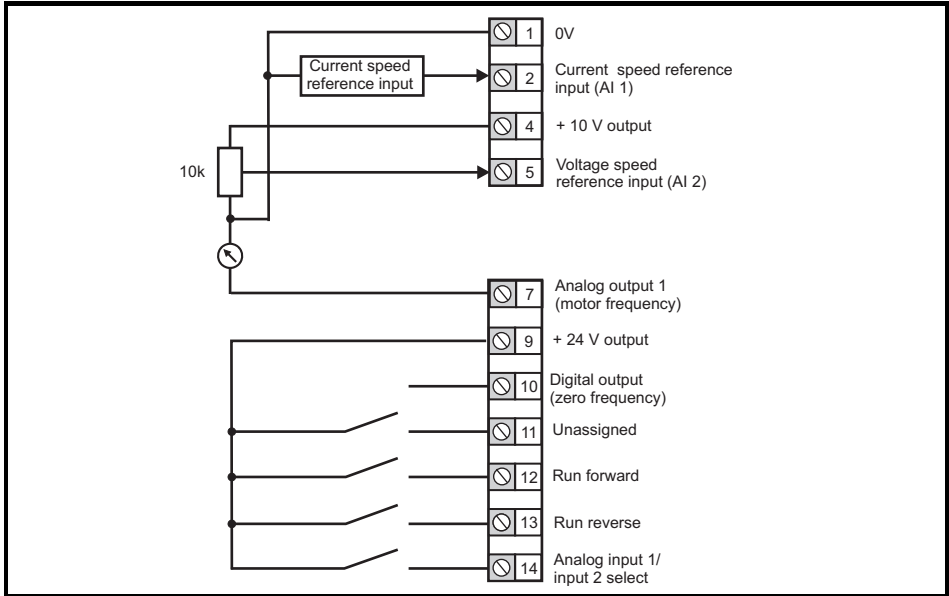
Value	Text	Description
0	AV	Analog input 1 (voltage) or Analog input 2 (voltage) selected by terminal (Local/Remote)
1	AI	Analog input 1 (current) or Analog input 2 (voltage) selected by terminal (Local/Remote)
2	AV.Pr	Analog input 1 (voltage) or 3 presets selected by terminal
3	AI.Pr	Analog input 1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

Action will only occur if the drive is inactive 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.

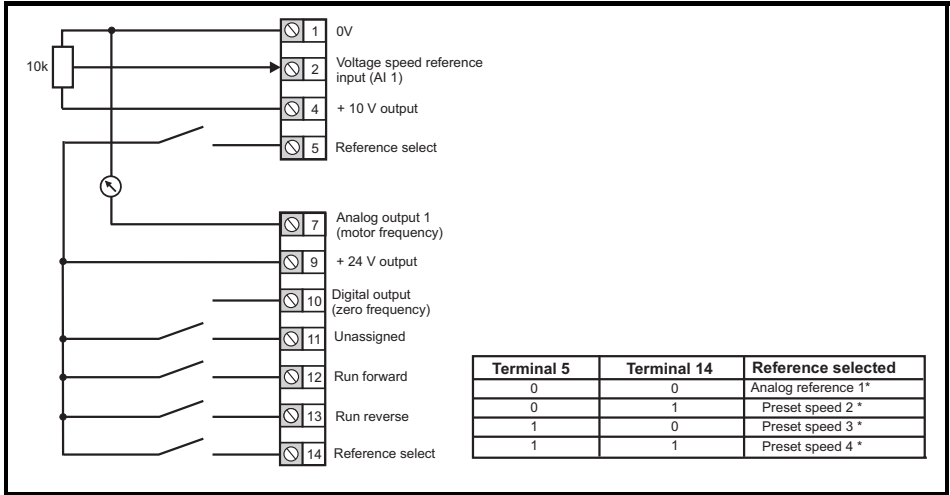
**Figure 4-1 Pr 05 = AV**



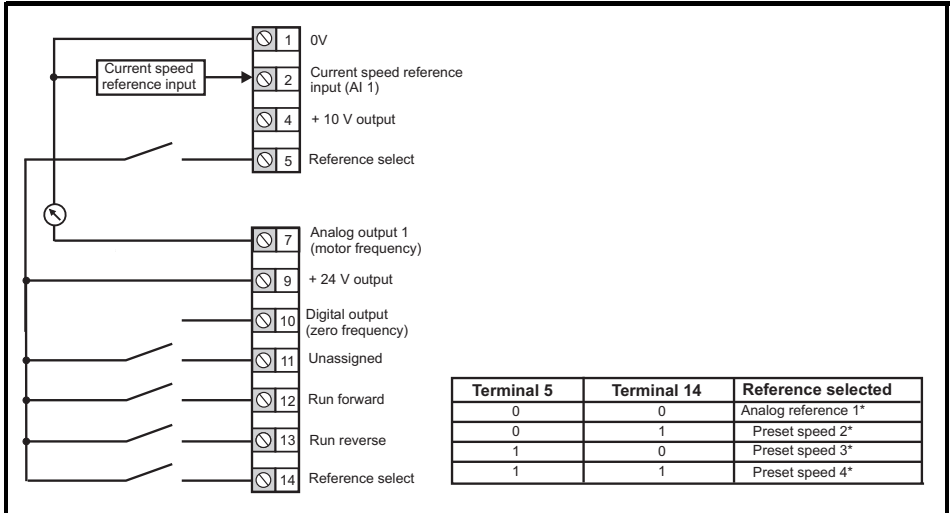
**Figure 4-2 Pr 05 = AI**



**Figure 4-3 Pr 05 = AV.Pr**

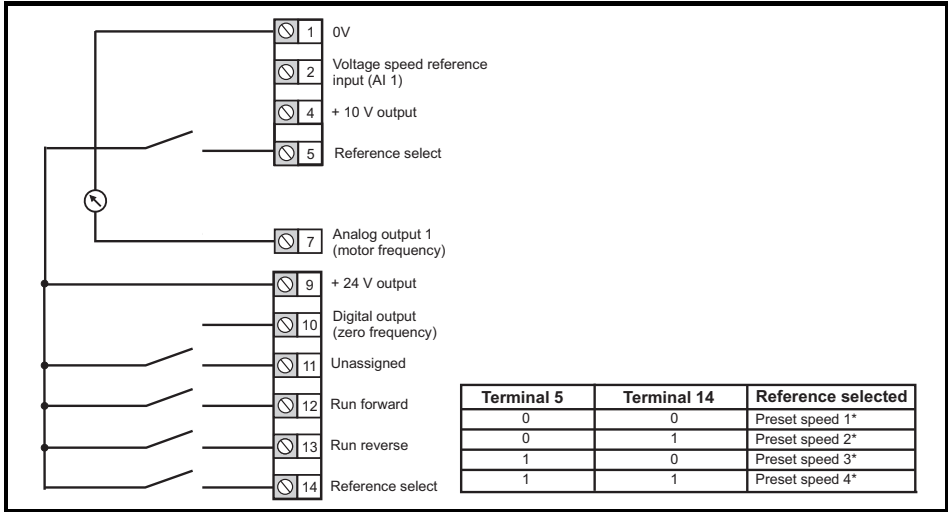


**Figure 4-4 Pr 05 = AI.Pr**



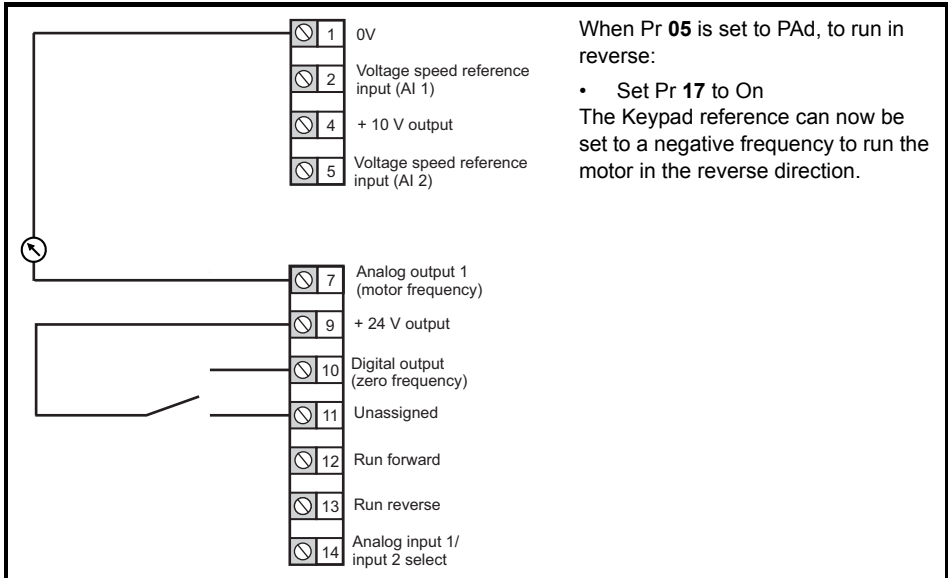
\* Refer to the *Control User Guide*.

**Figure 4-5 Pr 05 = PrESEt**

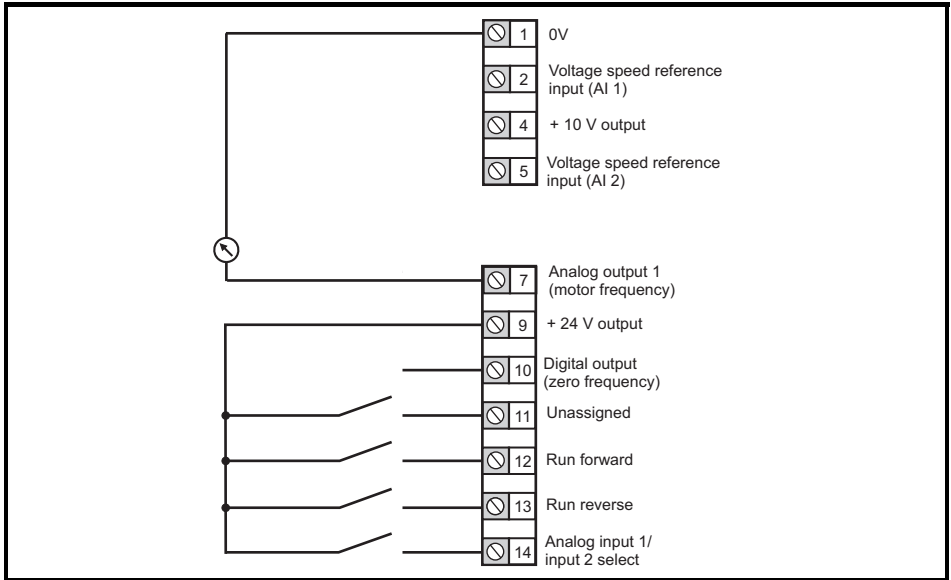


\* Refer to the *Control User Guide*.

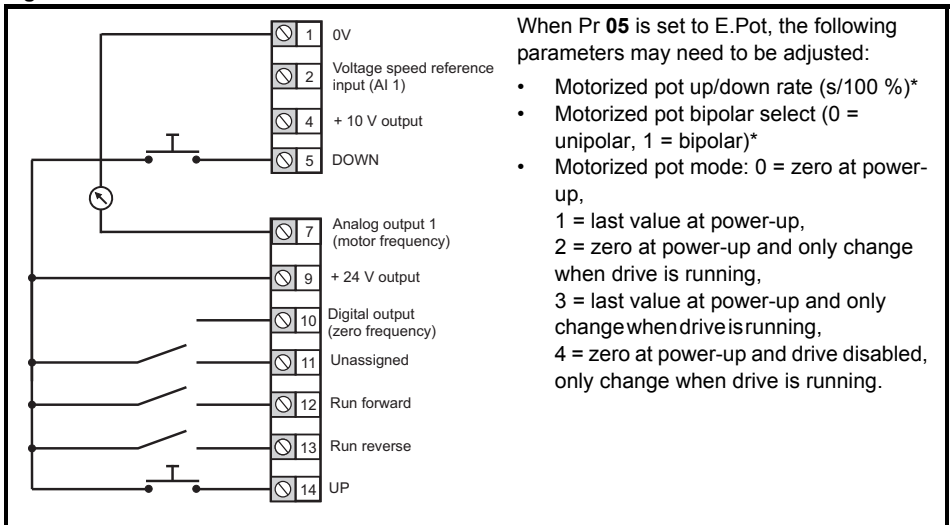
**Figure 4-6 Pr 05 = PAd**



**Figure 4-7 Pr 05 = PAd.rEF**



**Figure 4-8 Pr 05 = E.Pot**

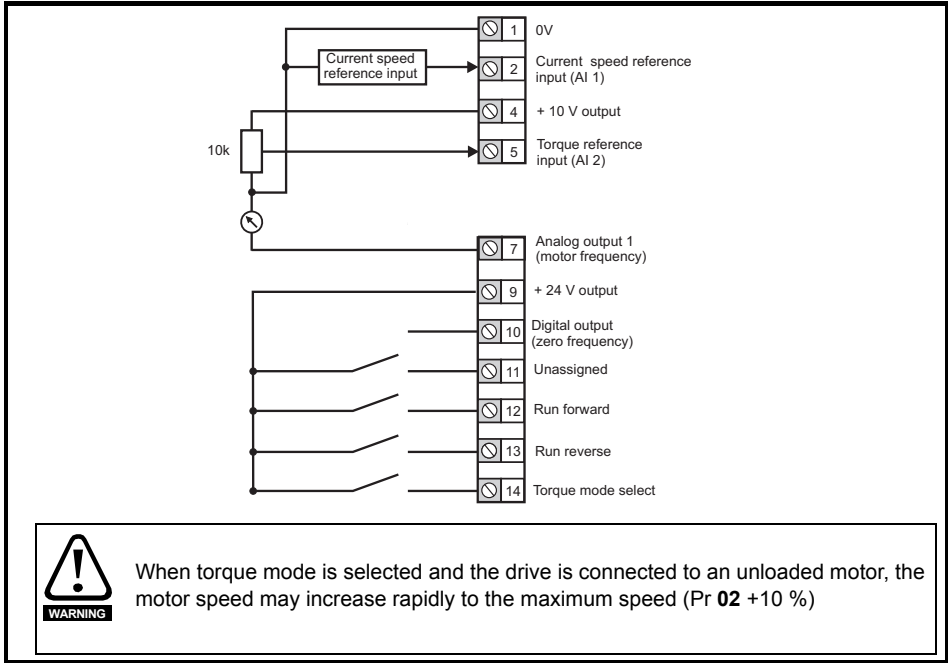


When Pr 05 is set to E.Pot, the following parameters may need to be adjusted:

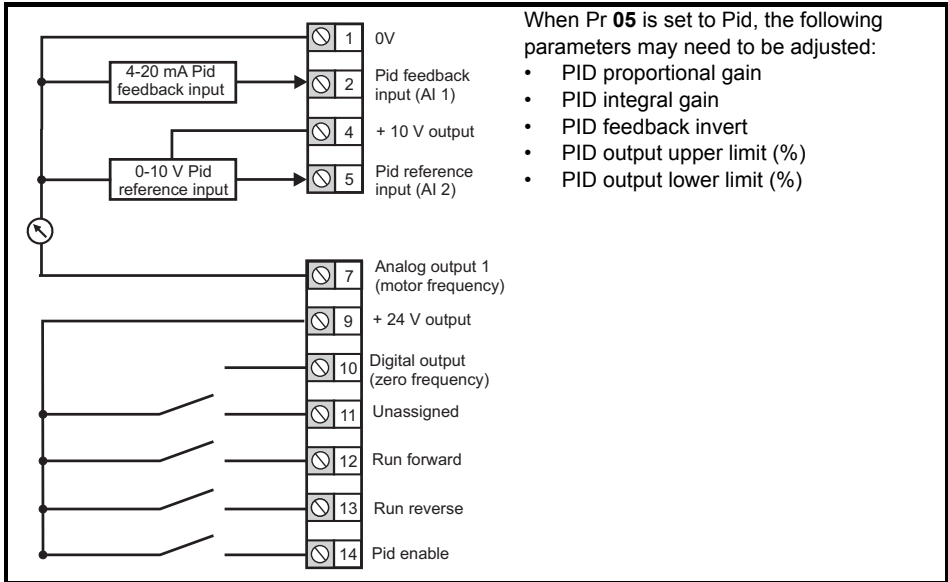
- Motorized pot up/down rate (s/100 %)\*
- Motorized pot bipolar select (0 = unipolar, 1 = bipolar)\*
- Motorized pot mode: 0 = zero at power-up, 1 = last value at power-up, 2 = zero at power-up and only change when drive is running, 3 = last value at power-up and only change when drive is running, 4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

\* Refer to the *Control User Guide*.

**Figure 4-9 Pr 05 = torqueE**



**Figure 4-10 Pr 05 = Pid**



## 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.

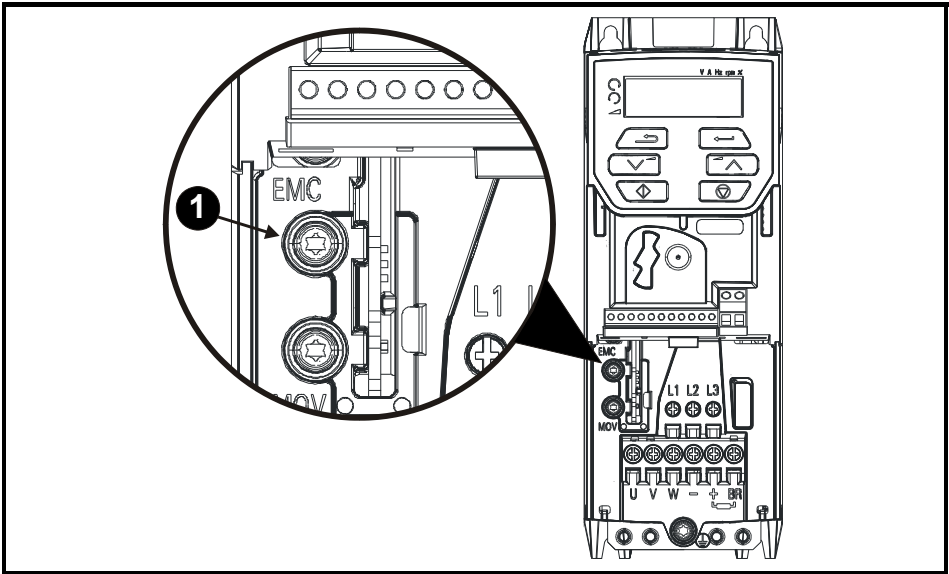
For longer motor cables, the filter continues to provide a useful reduction in emission levels and when used with any length of shielded motor cable up to the limit for the drive, it is unlikely that nearby industrial equipment will be disturbed. It is recommended that the filter be used in all applications 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+A1:2012
- 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 *Power Installation Guide*.

A full range of external EMC filters are also available for use with *Unidrive M300/HS30*, shown in the *Power Installation Guide*.

## 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.

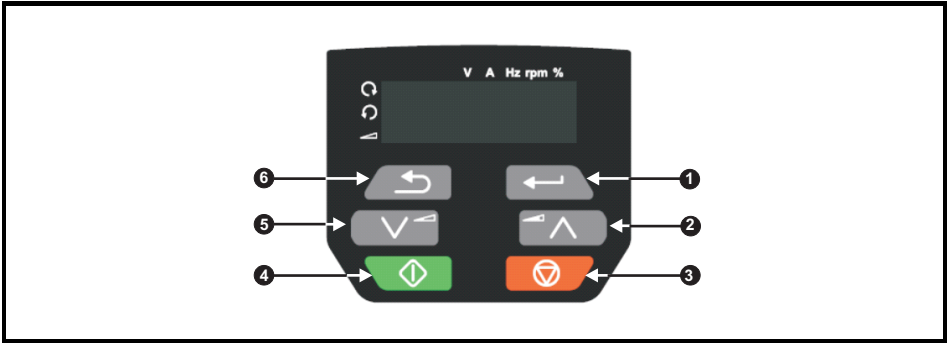
For more information regarding the Safe Torque Off input, please see the *Control User Guide*.



## 5 Keypad and display

The keypad and display provide information to the user regarding the operating status of the drive, alarms 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 M300/HS30 keypad detail**



- (1) The Enter button is used to enter parameter view or edit mode, or to accept a parameter edit.
- (2, 5) 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 Stop / Reset button (red) is used to stop and reset the drive in keypad mode. It can also be used to reset the drive in terminal mode.
- (4) The Start button (green) is used to start the drive in keypad mode.
- (6) The Escape button is used to exit from the parameter edit / view mode or disregard a parameter edit.

**Table 5-1 Status indications**

String	Description	Drive output stage
<b>inh</b>	The drive is inhibited and cannot be run. The Safe Torque Off signals are not applied to Safe Torque Off terminals or is set to 0.	Disabled
<b>rdy</b>	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
<b>StoP</b>	The drive is stopped / holding zero speed.	Enabled
<b>S.Loss</b>	Supply loss condition has been detected.	Enabled
<b>dc.inj</b>	The drive is applying DC injection braking.	Enabled
<b>Er</b>	The drive has tripped and no longer controlling the motor. The trip code appears in the display.	Disabled
<b>UV</b>	The drive is in the under voltage state either in low voltage or high voltage mode.	Disabled
<b>HEAt</b>	The motor pre-heat function is active.	Enabled

## 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' in Pr **00** or Pr **mm.000** (alternatively enter a value of 1001 in Pr **00** or 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

## 5.2 Restoring parameter defaults

Restoring parameter defaults by this method saves the default values in the drives memory. *User Security Status* (Pr **10**) and *User Security Code* (Pr **25**) are not affected by this procedure.

### Procedure

1. Ensure the drive is not enabled, i.e. drive is in inhibit or under voltage state.
2. Select 'Def.50' or 'Def.60' in Pr **00** or Pr **mm.000** (alternatively, enter 1233 (50 Hz settings) or 1244 (60 Hz settings) in Pr **00** or 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.

**NOTE** RFC-A is not available on Unidrive HS30 drives.

### 6.1 Menu 0: Basic parameters

Parameter	Range (⇅)		Default (⇒)		Type					
	OL	RFC-A	OL	RFC-A						
01	Minimum Speed	0.00 to Pr 02 Hz		0.00 Hz		RW	Num			US
02	Maximum Speed	0.00 to 550.00 Hz		Def.50: 50.00 Hz Def.60: 60.00 Hz		RW	Num			US
03	Acceleration Rate 1	0.0 to 32000.0 s/100 Hz		5.0 s/100 Hz		RW	Num			US
04	Deceleration Rate 1	0.0 to 32000.0 s/100 Hz		10.0 s/100 Hz		RW	Num			US
05	Drive Configuration	AV (0), AI (1), AV.Pr (2), AI.Pr (3), PrESEt (4), PAd (5), PAd.rEF (6), E.Pot (7), torquE (8), Pid (9)		AV (0)		RW	Txt			PT US
06	Motor Rated Current	0.00 to Drive Rating A		Maximum Heavy Duty Rating A		RW	Num		RA	US
07	Motor Rated Speed*	0.0 to 33000.0 rpm		Def.50: 1500.0 rpm Def.60: 1800.0 rpm	Def.50: 1450.0 rpm Def.60: 1750.0 rpm	RW	Num			US
08	Motor Rated Voltage	0 to 240 V or 0 to 480 V		110V drive: 230 V 200V drive: 230 V 400V drive Def.50: 400 V 400V drive Def.60: 460 V		RW	Num		RA	US
09	Motor Rated Power Factor**	0.00 to 1.00		0.85		RW	Num		RA	US
10	User Security Status	LEVEL.1 (0), LEVEL.2 (1), ALL (2), StAtUS (3), no.Acc (4)		LEVEL.1 (0)		RW	Num	ND		PT
11	Start/Stop Logic Select	0 to 6		0		RW	Num			US
15	Jog Reference	0.00 to 300.00 Hz		1.50 Hz		RW	Num			US
16	Analog Input 1 Mode	4-20.S (-6), 20-4.S (-5), 4-20.L (-4), 20-4.L (-3), 4-20.H (-2), 20-4.H (-1), 0-20 (0), 20-0 (1), 4-20.tr (2), 20-4.tr (3), 4-20 (4), 20-4 (5), Volt (6)		Volt (6)		RW	Txt			US
17	Bipolar Reference Enable	Off (0) or On (1)		Off (0)		RW	Bit			US
18	Preset Reference 1	0.00 to Pr 02 Hz		0.00 Hz		RW	Num			US
19	Preset Reference 2	0.00 to Pr 02 Hz		0.00 Hz		RW	Num			US
20	Preset Reference 3	0.00 to Pr 02 Hz		0.00 Hz		RW	Num			US
21	Preset Reference 4	0.00 to Pr 02 Hz		0.00 Hz		RW	Num			US
22	Status Mode Parameter 2	0.000 to 30.999		4.020		RW	Num			PT US
23	Status Mode Parameter 1	0.000 to 30.999		2.001		RW	Num			PT US
24	Customer Defined Scaling	0.000 to 10.000		1.000		RW	Num			US
25	User Security Code	0 to 9999		0		RW	Num	ND		PT US

Parameter		Range (⇄)		Default (⇒)		Type					
		OL	RFC-A	OL	RFC-A						
27	Power-up Keypad Control Mode Reference	rESET (0), LAST (1), PrESET (2)		rESET (0)		RW	Txt				US
28	Ramp Mode Select	Fast (0), Std (1), Std.bst (2), Fst.bst (3)		Std (1)		RW	Txt				US
29	Ramp Enable		Off (0) or On (1)		On (1)	RW	Bit				US
30	Parameter Cloning	NonE (0), rEAd (1), Prog (2), Auto (3), boot (4)		NonE (0)		RW	Txt		NC		US
31	Stop Mode	CoASt (0), rP (1), rP.dc I (2), dc I (3), td.dc I (4), diS (5),	CoASt (0), rP (1), rP.dc I (2), dc I (3), td.dc I (4), diS (5), No.rP (6)	rP (1)		RW	Txt				US
32	Dynamic V to F Select / Flux Optimization Select	0 to 1		0		RW	Num				US
33	Catch A Spinning Motor	dis (0), Enable (1), Fr.Only (2), Rv.Only (3)		dis (0)		RW	Txt				US
34	Digital Input 5 Select	Input (0), th.Sct (1), th (2), th.Notr (3), Fr (4)		Input (0)		RW	Txt				US
35	Digital Output 1 Control	0 to 21		0		RW	Num				US
36	Analog Output 1 Control	0 to 14		0		RW	Txt				US
37	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
38	Autotune	0 to 2	0 to 3	0		RW	Num		NC		US
39	Motor Rated Frequency***	0.00 to 550.00 Hz		Def.50: 50.00 Hz Def.60: 60.00 Hz		RW	Num		RA		US
40	Number of Motor Poles****	Auto (0) to 32 (16)		Auto (0)		RW	Num				US
41	Control Mode	Ur.S (0), Ur (1), Fd (2), Ur.Auto (3), Ur.I (4), SrE (5), Fd.tap (6)		Ur.I (4)		RW	Txt				US
42	Low Frequency Voltage Boost	0.0 to 25.0 %		3.0 %		RW	Num				US
43	Serial Baud Rate	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
44	Serial Address	1 to 247		1		RW	Num				US
45	Reset Serial Communications	Off (0) or On (1)		Off (0)		RW	Bit	ND	NC		US
46	Brake Controller Upper Current Threshold	0 to 200 %		50 %		RW	Num				US
47	Brake Controller Lower Current Threshold	0 to 200 %		10 %		RW	Num				US
48	Brake Controller Brake Release Frequency	0.00 to 20.00 Hz		1.00 Hz		RW	Num				US
49	Brake Controller Brake Apply Frequency	0.00 to 20.00 Hz		2.00 Hz		RW	Num				US
50	Brake Controller Brake Delay	0.0 to 25.0 s		1.0 s		RW	Num				US

Parameter		Range (ϕ)		Default (⇒)		Type						
		OL	RFC-A	OL	RFC-A							
51	Brake Controller Post-brake Release Delay	0.0 to 25.0 s		1.0 s		RW	Num					US
53	Brake Controller Initial Direction	rEF (0), For (1), rEv (2)		rEF (0)		RW	Txt					US
54	Brake Controller Brake Apply Through Zero Threshold	0.00 to 25.00 Hz		1.00 Hz		RW	Num					US
55	Brake Controller Enable	diS (0), rELAY (1), dig IO (2), USEr (3)		diS (0)		RW	Txt					US
56	Trip 0	0 to 255				RO	Txt	ND	NC	PT	PS	
57	Trip 1	0 to 255				RO	Txt	ND	NC	PT	PS	
58	Trip 2	0 to 255				RO	Txt	ND	NC	PT	PS	
59	OUP Enable	Stop (0) or Run (1)		Run (1)		RW	Txt					US
60	OUP Status	-2147483648 to 2147483647				RO	Num	ND	NC	PT		
65	Frequency Controller Proportional Gain Kp1		0.000 to 200.000 s/rad		0.100 s/rad	RW	Num					US
66	Frequency Controller Integral Gain Ki1		0.00 to 655.35 s <sup>2</sup> /rad		0.10 s <sup>2</sup> /rad	RW	Num					US
67	Sensorless Mode Filter		4 (0), 5 (1), 6 (2), 8 (3), 12 (4), 20 (5) ms		4 (0) ms	RW	Txt					US
69	Spin Start Boost	0.0 to 10.0		1.0		RW	Num					US
70	PID1 Output	±100.00 %				RO	Num	ND	NC	PT		
71	PID1 Proportional Gain	0.000 to 4.000		1.000		RW	Num					US
72	PID1 Integral Gain	0.000 to 4.000		0.500		RW	Num					US
73	PID1 Feedback Invert	Off (0) or On (1)		Off (0)		RW	Bit					US
74	PID1 Output Upper Limit	0.00 to 100.00 %		100.00 %		RW	Num					US
75	PID1 Output Lower Limit	±100.00 %		-100.00 %		RW	Num					US
76	Action on Trip Detection	0 to 31		0		RW	Num	ND	NC	PT	US	
77	Maximum Heavy Duty Current Rating	0.00 to Drive HD Current Rating A				RO	Num	ND	NC	PT		
78	Software Version	0 to 99.99.99				RO	Num	ND	NC	PT		
79	User Drive Mode	OPEn.LP (1), RFC-A (2)		OPEn.LP (1)	RFC-A (2)	RW	Txt	ND	NC	PT	US	
81	Reference Selected	-Pr 02 to Pr 02 or Pr 01 to Pr 02 Hz				RO	Num	ND	NC	PT	US	
82	Pre-ramp Reference	-Pr 02 to Pr 02 or Pr 01 to Pr 02 Hz				RO	Num	ND	NC	PT		
83	Final Demand Reference	-Pr 02 to Pr 02 or Pr 01 to Pr 02 Hz				RO	Num	ND	NC	PT	FI	
84	D.C. Bus Voltage	0 to 415 V or 0 to 830 V				RO	Num	ND	NC	PT	FI	
85	Output Frequency	± 550.00 Hz				RO	Num	ND	NC	PT	FI	
86	Output Voltage	0 to 325 V or 0 to 650 V				RO	Num	ND	NC	PT	FI	
87	Motor Rpm*****	± 33000.0 rpm				RO	Num	ND	NC	PT	FI	
88	Current Magnitude	0 to Drive Maximum Current A				RO	Num	ND	NC	PT	FI	
89	Torque Producing Current	± Drive Maximum Current A				RO	Num	ND	NC	PT	FI	
90	Digital I/O Read Word	0 to 2047				RO	Bin	ND	NC	PT		
91	Reference On	Off (0) or On (1)				RO	Bit	ND	NC	PT		
92	Reverse Select	Off (0) or On (1)				RO	Bit	ND	NC	PT		

Parameter		Range (⇄)		Default (⇒)		Type					
		OL	RFC-A	OL	RFC-A						
93	Jog Select	Off (0) or On (1)				RO	Bit	ND	NC	PT	
94	Analog Input 1	± 100.00 %				RO	Num	ND	NC	PT	FI
95	Analog Input 2	± 100.00 %				RO	Num	ND	NC	PT	FI

\* Setting Pr **07** to 0.0 will disable slip compensation. With the Unidrive HS30, the maximum is 80,000.0 rpm.

\*\* Following a rotating autotune, Pr **09** is continuously written to by the drive, calculated from the value of *Stator Inductance* (Pr **05.025**). To manually enter a value into Pr **09**, Pr **05.025** will need to be set to 0. Refer to the description of Pr **05.010** in the *Parameter Reference Guide* for further details.

\*\*\* With the Unidrive HS30, the maximum is 3000.00 Hz.

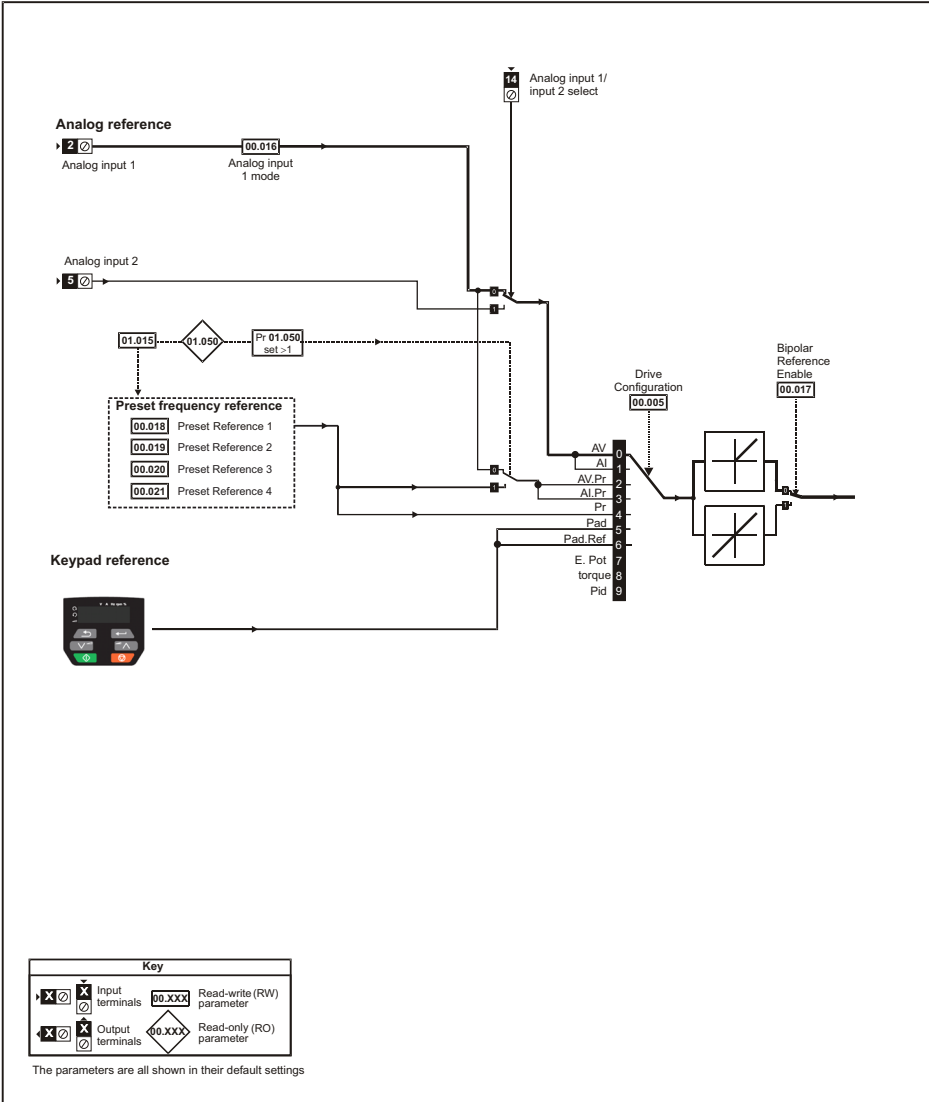
\*\*\*\* If this parameter is read via serial communications, it will show pole pairs.

\*\*\*\*\* With the Unidrive HS30, the maximum is 180,000.0 rpm.

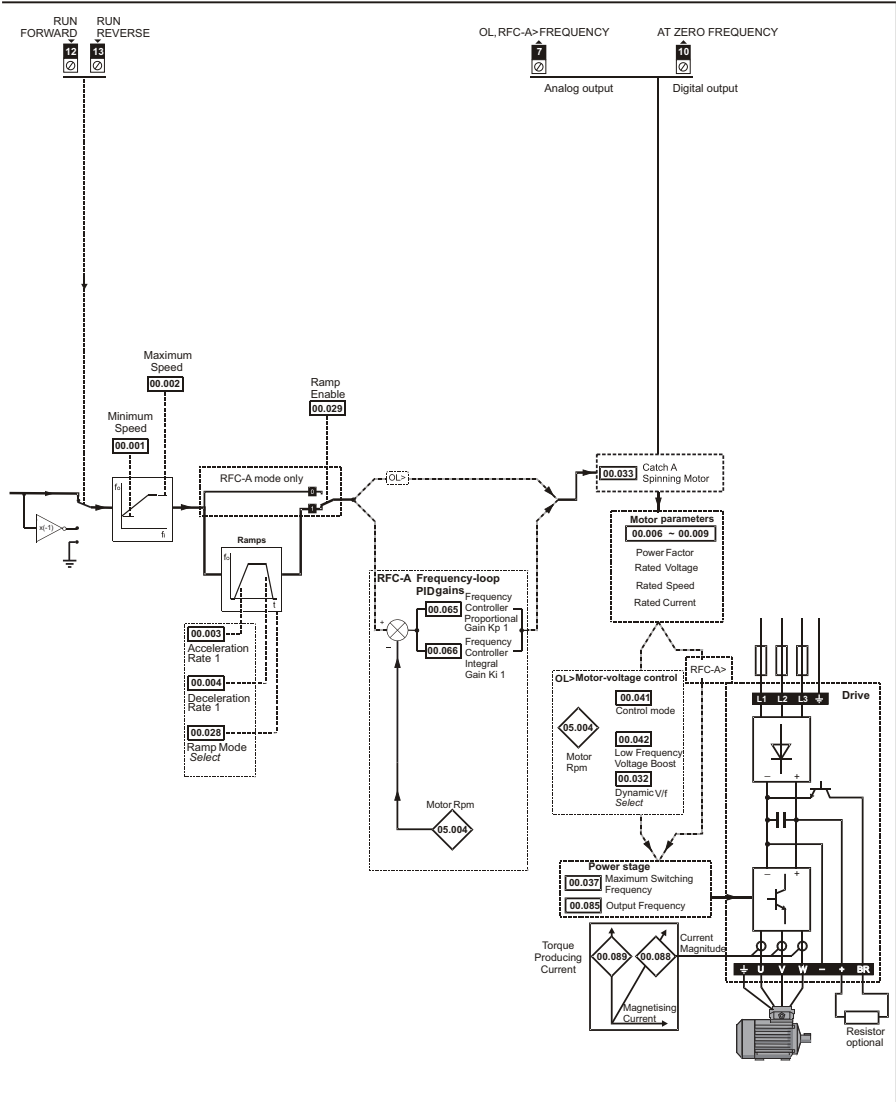
RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination



**Figure 6-1 Menu 0 logic diagram**







## 6.2 Unidrive M300/HS30 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

01		Minimum Speed											
RW		Num										US	
OL	↕	0.00 to Pr 02 Hz					⇒	0.00 Hz					
RFC-A													

Set Pr 01 at the required minimum output frequency of the drive for both directions of rotation. The drive speed reference is scaled between Pr 01 and Pr 02. Pr 01 is a nominal value; slip compensation may cause the actual frequency to be higher. When the drive is jogging, Pr 01 has no effect.

02		Maximum Speed											
RW		Num										US	
OL	↕	0.00 to 550.00 Hz					⇒	Def.50: 50.00 Hz Def.60: 60.00 Hz					
RFC-A													

Set Pr 02 at the required maximum output frequency for both directions of rotation. The drive speed reference is scaled between Pr 01 and Pr 02. Pr 02 is a nominal value; slip compensation may cause the actual frequency to be higher. The drive has additional over-speed protection.

03		Acceleration Rate 1											
RW		Num										US	
OL	↕	0.0 to 32000.0 s/100 Hz					⇒	5.0 s/100 Hz					
RFC-A													

Set Pr 03 at the required rate of acceleration. Note that larger values produce lower acceleration. The rate applies in both directions of rotation.

04		Deceleration Rate 1											
RW		Num										US	
OL	↕	0.0 to 32000.0 s/100 Hz					⇒	10.0 s/100 Hz					
RFC-A													

Set Pr 04 at the required rate of deceleration. Note that larger values produce lower deceleration. The rate applies in both directions of rotation.

05		Drive Configuration								
RW		Txt						PT	US	
<b>OL</b>	⇅	AV (0), AI (1), AV.Pr (2), AI.Pr (3), PrESEt (4), PAd (5), PAd.rEF (6), E.Pot (7), torquE (8), Pid (9)				⇒	AV (0)			

Use Pr **05** to select the required frequency/speed reference as follows:

Value	Text	Description
0	AV	Analog input 1 (voltage) or 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.Pr	Analog input 1 (voltage) or 3 presets selected by terminal
3	AI.Pr	Analog input 1 (current) or 3 presets selected by terminal
4	PrESEt	Four presets selected by terminal
5	PAd	Keypad reference
6	PAd.rEF	Keypad reference with terminal control
7	E.Pot	Electronic Potentiometer
8	torquE	Torque mode, Analog input 1 (current frequency reference) or Analog input 2 (voltage torque reference) selected by terminal
9	Pid	PID mode, Analog input 1 (current feedback source) and Analog input 2 (voltage reference source)

**NOTE** A change to Pr **05** is set by pressing the ENTER button on exit from parameter edit mode. The drive must be disabled, stopped or tripped for a change to take place. If Pr **05** is changed while the drive is running, when the ENTER button is pressed on exit from parameter edit mode, Pr **05** will change back to its previous value.

**NOTE** When the setting of Pr **05** is changed, the appropriate drive configuration parameters are set back to their default values.

06		Motor Rated Current								
RW		Num						RA	US	
<b>OL</b>	⇅	0.00 to Drive Rating A				⇒	Maximum Heavy Duty Rating A			
<b>RFC-A</b>										

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
- Dynamic V/F control

07		Motor Rated Speed								
RW		Num						US		
OL	⇕	0.0 to 33000.0 rpm*				⇒	Def.50: 1500.0 rpm			
RFC-A							Def.60: 1800.0 rpm			
							Def.50: 1450.0 rpm			
							Def.60: 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.

\* With Unidrive HS30, the maximum is 80,000.0 rpm.

08		Motor Rated Voltage								
RW		Num				RA		US		
OL	⇕	0 to 240 V or 0 to 480 V				⇒	110 V drive: 230 V			
RFC-A							200 V drive: 230 V			
							400 V drive 50 Hz: 400 V			
							400 V drive 60 Hz: 460 V			

The Rated Voltage (Pr 08) and the Rated Frequency (Pr 39) are used to define the voltage to frequency characteristic applied to the motor. The Rated Frequency (Pr 39) is also used in conjunction with the Motor Rated Speed (Pr 07) to calculate the rated slip for slip compensation.

09		Motor Rated Power Factor								
RW		Num				RA		US		
OL	⇕	0.00 to 1.00				⇒	0.85			
RFC-A										

Enter the motor rated power factor  $\cos \varphi$  (taken from the motor name plate).

The drive can measure the motor rated power factor by performing a rotating autotune (see Autotune (Pr 38)).

10		User Security Status								
RW		Num				ND		PT	US	
OL	⇕	LEVEL.1 (0), LEVEL.2 (1), ALL (2), StAtUS (3), no.Acc (4)				⇒	LEVEL.1 (0)			
RFC-A										

This parameter controls access via the drive keypad as follows:

Value	Text	Function
0	LEVEL.1	Access to first 10 parameters in Menu 0 only.
1	LEVEL.2	Access to all parameters in Menu 0.
2	ALL	Access to all menus.
3	STATUS	The keypad remains in status mode and no parameters can be viewed or edited.
4	no.Acc	The keypad remains in status mode and no parameters can be viewed or edited. Drive parameters cannot be accessed via a comms interface.

11		Start/Stop Logic Select								
RW	Num							US		
OL	⇕	0 to 6				⇒	5			
RFC-A										

This parameter changes the functions of the input terminals which are normally associated with the enabling, starting and stopping the drive.

Pr 11	Terminal 11	Terminal 12	Terminal 13	Latching
0	User programmable	Run Forward	Run Reverse	No
1	/Stop	Run Forward	Run Reverse	Yes
2	User programmable	Run	Forward/Reverse	No
3	/Stop	Run	Forward/Reverse	Yes
4	/Stop	Run	Jog Forward	Yes
5	User programmable	Run Forward	Run Reverse	No
6	User programmable	User programmable	User programmable	User programmable

Action will only occur if the drive is inactive. If the drive is active, the parameter will return to its pre-altered value on exit from edit mode.

15		Jog Reference								
RW	Num							US		
OL	⇕	0.00 to 300.00 Hz				⇒	1.50 Hz			
RFC-A										

Defines the reference when jog is enabled.

16		Analog Input 1 Mode							
RW	Txt							US	
<b>OL</b>	⇕	4-20.S (-6), 20-4.S (-5), 4-20.L (-4), 20-4.L (-3), 4-20.H (-2), 20-4.H (-1), 0-20 (0), 20-0 (1), 4-20.tr (2), 20-4.tr (3), 4-20 (4), 20-4 (5), Volt (6)				⇒	Volt (6)		

Defines the mode of analog input 1.

The table below gives all the possible analog input modes.

Value	Text	Function
-6	4-20.S	Stop on loss
-5	20-4.S	Stop on loss
-4	4-20.L	4-20 mA switching to equivalent of 4 mA input current on loss
-3	20-4.L	20-4 mA switching to equivalent of 20 mA input current on loss
-2	4-20.H	4-20 mA hold at level before loss on loss
-1	20-4.H	20-4 mA hold at level before loss on loss
0	0-20	0-20 mA
1	20-0	20-0 mA
2	4-20.tr	4-20 mA trip on loss
3	20-4.tr	20-4 mA trip on loss
4	4-20	4-20 mA no action on loss
5	20-4	20-4 mA no action on loss
6	Volt	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 T4), they must have a resistance >4 kΩ each.

17		Bipolar Reference Enable							
RW	Bit							US	
<b>OL</b>	⇕	Off (0) or On (1)				⇒	Off (0)		
<b>RFC-A</b>									

Pr 17 determines whether the reference is uni-polar or bi-polar.

See *Minimum Speed* (Pr 01). Allows negative speed reference in keypad mode.

18 to 21		Preset Reference 1 to 4								
RW	Num							US		
OL	⇕	0.00 to Pr 02 Hz				⇒	0.00 Hz			
RFC-A										

If the preset reference has been selected (see Pr 05), the speed at which the motor runs is determined by these parameters.

See *Drive Configuration* (Pr 05).

22		Status Mode Parameter 2								
RW	Num						PT	US		
OL	⇕	0.000 to 30.999				⇒	4.020			
RFC-A										

This parameter and *Status Mode Parameter 1* (Pr 23) define which parameters are displayed in Status mode. The values can be alternated by pressing the Escape key, if the drive is running.

23		Status Mode Parameter 1								
RW	Num						PT	US		
OL	⇕	0.000 to 30.999				⇒	2.001			
RFC-A										

See *Status Mode Parameter 2* (Pr 22).

24		Customer Defined Scaling								
RW	Num							US		
OL	⇕	0.000 to 10.000				⇒	1.000			
RFC-A										

This parameter defines the scaling applied to *Status Mode Parameter 1* (Pr 23). The scaling is only applied in the Status mode.

25		User Security Code								
RW	Num				ND		PT	US		
OL	⇕	0-9999				⇒	0			
RFC-A										

If any number other than 0 is programmed into this parameter, user security can be applied so that no parameters except Pr 10 can be adjusted with the keypad. When this parameter is read via a keypad it appears as zero. Refer to the *Control User Guide* for further information.

27		Power-up Keypad Control Mode Reference									
RW		Txt		ND		NC		PT		US	
OL	⇕	rESEt (0), LAsT (1), PrESEt (2)				⇒		rESEt (0)			
RFC-A											

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 <i>Preset Reference 1 (Pr 18)</i>

28		Ramp Mode Select									
RW		Txt		ND		NC		PT		US	
OL	⇕	Fast (0), Std (1), Std.bst (2), Fst.bst (3)				⇒		Std (1)			
RFC-A											

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.

29		Ramp Enable									
RW		Bit		ND		NC		PT		US	
OL	⇕					⇒					
RFC-A		Off (0) or On (1)						On (1)			

Setting Pr 29 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.



30		Parameter Cloning							
RW	Txt					NC		US*	
<b>OL</b>	⇕	NonE (0), rEAd (1), Prog (2), Auto (3), boot (4)	⇒	NonE (0)					
<b>RFC-A</b>									

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

If Pr 30 is equal to 1 or 2, this value is not transferred to the EEPROM or the drive. If Pr 30 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
Prog	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 9 *NV Media Card Operation* on page 63.

31		Stop Mode							
RW	Txt							US	
<b>OL</b>	⇕	CoASt (0), rP (1), rP.dc l (2), dc l (3), td.dc l (4), dis (5)	⇒	rP (1)					
<b>RFC-A</b>				CoASt (0), rP (1), rP.dc l (2), dc l (3), td.dc l (4), dis (5), No.rP (6)					

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

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

See the *Control User Guide* for further information.

32		Dynamic V To F Select / Flux Optimization Select							
RW	Num							US	
<b>OL</b>	⇕	0 to 1	⇒	0					
<b>RFC-A</b>									

#### Open-loop:

Set to 1 to enable Dynamic V to F mode in open-loop mode only.

**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.

**RFC-A:**

If this parameter is set to 1, the flux is reduced so that the magnetizing current is equal to the torque producing current, to optimize copper losses and reduce iron losses in the motor under low load conditions.

33		Catch a Spinning Motor							
RW	Txt							US	
<b>OL</b>	⇕	dis (0), Enable (1), Fr.Only (2), Rv.Only (3)			⇒	dis (0)			
<b>RFC-A</b>									

If the drive is to be configured in fixed boost mode (Pr 41 = Fd or SrE) with catch a spinning motor software enabled, an autotune (see Pr 38 on page 45) must be carried out to measure the motor's stator resistance beforehand. If a stator resistance is not measured, the drive may trip on OV or OI.AC while trying to catch a spinning motor.

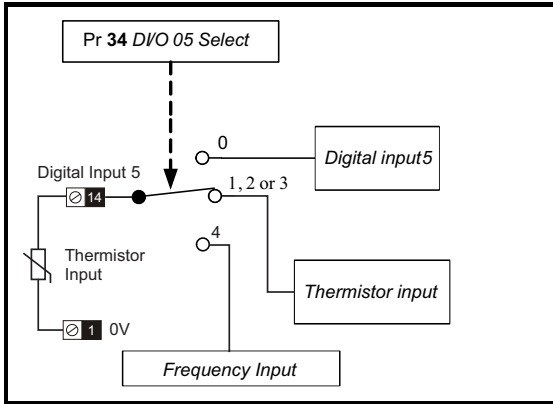
Pr 33	Text	Function
0	dis	Disabled
1	Enable	Detect all frequencies
2	Fr.Only	Detect positive frequencies only
3	Rv.Only	Detect negative frequencies only

34		Digital Input 5 Select							
RW	Txt							US	
<b>OL</b>	⇕	Input (0), th.Sct (1), th (2), th.Notr (3), Fr (4)			⇒	Input (0)			
<b>RFC-A</b>									

This parameter selects the function of Digital Input 5 (terminal 14).

Value	Text	Function
0	Input	Digital input
1	th.Sct	Temperature measurement input with short circuit detection (Resistance <50 Ω )
2	th	Temperature measurement input without short circuit detection but with <i>th</i> trip
3	th.Notr	Temperature measurement input with no trips
4	Fr	Frequency input

**Figure 6-1 Thermistor input**



35		Digital Output 1 Control								
RW	Num							US		
<b>OL</b>	↕	0-21				⇒	0			
<b>RFC-A</b>										

Defines the behaviour of digital output 1 (terminal 10).

Value	Description
0	User defined by Digital IO1 Source/Destination A
1	Drive running signal
2	Frequency arrived signal
3	Frequency level detection signal
4	Frequency level detection signal
5	Overload detection signal
6	Power off state
7	External fault stop
8	Frequency upper limit
9	Frequency lower limit
10	Drive running at zero frequency
14	Drive ready
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

36		Analog Output 1 Control								
RW		Txt							US	
<b>OL</b>	⇕	0 to 14					⇒	0		
<b>RFC-A</b>										

Defines the functionality of Analog Output 1 (terminal 7).

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 %)

37		Maximum Switching Frequency								
RW		Txt							US	
<b>OL</b>	⇕	0.667 (0), 1 (1), 2 (2), 3 (3), 4 (4), 6 (5), 8 (6), 12 (7), 16 (8) kHz					⇒	3 (3) kHz		
<b>RFC-A</b>		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 37	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 *Power Installation Guide* for drive derating data.

38		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 **38** 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* (Pr **39**) x 2/3, and the frequency is maintained at that level for 4 seconds. To perform a Rotating autotune, set Pr **38** to 2.

#### RFC-A only:

3. This test measures the total inertia of the load and the motor. A series of progressively larger torque levels are applied to the motor to accelerate the motor up to 3/4 x *Motor Rated Speed* (Pr **07**) to determine the inertia from the acceleration/deceleration time.

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 31 & 34.

	<p>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 Safe Torque Off signals 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.</p>
-----------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

39		Motor Rated Frequency								
RW		Num					RA		US	
OL	↕	0.00 to 550.00 Hz*				⇒	Def.50: 50.00 Hz Def.60: 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.

\* With the Unidrive HS30, the maximum is 3000.00 Hz.

40		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 07 and Pr 39.

41		Control Mode								
RW		Txt							US	
OL	⇕	Ur.S (0), Ur (1), Fd (2), Ur.Auto (3), Ur.I (4), SrE (5), Fd.tap (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	Fd	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	SrE	Square law characteristic
6	Fd.tap (6)	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 OV trips.

42		Low Frequency Voltage Boost								
RW		Num							US	
OL	⇕	0.0 to 25.0 %				⇒	3.0 %			
RFC-A										

Determines the boost level when Pr 41 is set to Fd, SrE or Fd.tap modes.

43		Serial Baud Rate								
RW	Txt							US		
OL	⇕	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* (Pr 45) for more details.

44		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* (Pr 45) for more details.

45		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.

46		Brake Controller Upper Current Threshold								
RW	Num							US		
OL	⇕	0 to 200 %				⇒	50 %			
RFC-A										

Defines the upper current threshold for the brake. See Brake Controller Brake Release in *Parameter Reference Guide*.

47		Brake Controller Lower Current Threshold								
RW		Num						US		
OL	⇕	0 to 200 %				⇒	10 %			
RFC-A										

Defines the lower current limit for the brake. See Brake Controller Brake Release in *Parameter Reference Guide*.

48		Brake Controller Brake Release Frequency								
RW		Num						US		
OL	⇕	0.00 to 20.00 Hz				⇒	1.00 Hz			
RFC-A										

Defines the Brake Release Frequency. See Brake Controller Brake Release in *Parameter Reference Guide*.

49		Brake Controller Brake Apply Frequency								
RW		Num						US		
OL	⇕	0.00 to 20.00 Hz				⇒	2.00 Hz			
RFC-A										

Defines the Brake Apply Frequency. See Brake Controller Brake Release in *Parameter Reference Guide*.

50		Brake Controller Brake Delay								
RW		Num						US		
OL	⇕	0.0 to 25.0 s				⇒	1.0 s			
RFC-A										

Defines the pre-brake release delay. See Brake Controller Brake Release in *Parameter Reference Guide*.

51		Brake Controller Post-brake Release Delay								
RW		Num						US		
OL	⇕	0.0 to 25.0 s				⇒	1.0 s			
RFC-A										

Defines the post-brake release delay.



53		Brake Controller Initial Direction								
RW	Txt							US		
OL	⇕	rEF (0), For (1), rEv (2)				⇒	rEF (0)			
RFC-A										

Defines the initial direction of the brake.

Value	Text
0	rEF
1	For
2	rEv

See Brake Controller Brake Release in *Parameter Reference Guide*.

54		Brake Controller Brake Apply Through Zero Threshold								
RW	Num							US		
OL	⇕	0.00 to 25.00 Hz				⇒	1.00 Hz			
RFC-A										

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

55		Brake Controller Enable								
RW	Txt							US		
OL	⇕	diS (0), rELAy (1), dig IO (2), USEr (3)				⇒	diS (0)			
RFC-A										

Value	Text
0	diS
1	rELAy
2	dig IO
3	USEr

If *Brake Controller Enable* (Pr 55) = diS, the brake controller is disabled.

If *Brake Controller Enable* (Pr 55) = rELAy, 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* (Pr 55) = dig IO, 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* (Pr 55) = USEr, the brake controller is enabled, but no parameters are set up to select the brake output.

56 to 58		Trip 0 to 2							
RO	Txt				ND	NC	PT	PS	
OL	⇕	0 to 255			⇒				
RFC-A									

These parameters show the last 3 trips.

59		OUP Enable							
RW	Txt							US	
OL	⇕	Stop (0) or Run (1)			⇒	Run (1)			
RFC-A									

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 *Control User Guide*.

60		OUP Status							
RO	Num				ND	NC	PT		
OL	⇕	-2147483648 to 2147483647			⇒				
RFC-A									

This parameter indicates the status of the user program in the drive. For further information, refer to the *Control User Guide*.

65		Frequency Controller Proportional Gain Kp1							
RW	Num							US	
OL	⇕	0.000 to 200.000 s/rad			⇒	0.100 s/rad			
RFC-A									

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.

66		Frequency Controller Integral Gain Ki1									
RW	Num							US			
OL	⇅	0.00 to 655.35 s <sup>2</sup> /rad				⇒				0.10 s <sup>2</sup> /rad	
RFC-A											

Defines the integral gain for frequency controller 1. See *Frequency Controller Proportional Gain Kp1* (Pr 65).

67		Sensorless Mode Filter									
RW	Txt							US			
OL	⇅	4 (0), 5 (1), 6 (2), 8 (3), 12 (4), 20 (5) ms				⇒				4 (0) ms	
RFC-A											

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

69		Spin Start Boost									
RW	Num							US			
OL	⇅	0.0 to 10.0				⇒				1.0	
RFC-A											

*Spin Start Boost* (Pr 69) is used by the algorithm that detects the frequency of a spinning motor when the drive is enabled and *Catch A Spinning Motor* (Pr 33)  $\geq 1$ . For smaller motors the default value of 1.0 is suitable, but for larger motors *Spin Start Boost* (Pr 69) may need to be increased.

If *Spin Start Boost* (Pr 69) is too small the drive will detect zero speed whatever the frequency of the motor, and if *Spin Start Boost* (Pr 69) is too large the motor may accelerate away from standstill when the drive is enabled.

70		PID1 Output									
RO	Num				ND	NC	PT				
OL	⇅	$\pm 100.00$ %				⇒					
RFC-A											

This parameter is the output of the PID controller. For further information, refer to the *Parameter Reference Guide*.

71		PID1 Proportional Gain									
RW	Num							US			
OL	⇅	0.000 to 4.000				⇒				1.000	
RFC-A											

Proportional gain applied to the PID error. For further information, refer to the *Parameter Reference Guide*.

72		PID1 Integral Gain								
RW		Num						US		
OL	⇕	0.000 to 4.000				⇒	0.500			
RFC-A										

Integral gain applied to the PID error. For further information, refer to the *Parameter Reference Guide*.

73		PID1 Feedback Invert								
RW		Bit						US		
OL	⇕	Off (0) or On (1)				⇒	Off (0)			
RFC-A										

This parameter allows the PID feedback source to be inverted. For further information, refer to the *Parameter Reference Guide*.

74		PID1 Output Upper Limit								
RW		Num						US		
OL	⇕	0.00 to 100.00 %				⇒	100.00 %			
RFC-A										

This parameter with *PID1 Output Lower Limit (Pr 75)* allows the output to be limited to a range. For further information, refer to the *Parameter Reference Guide*.

75		PID1 Output Lower Limit								
RW		Num						US		
OL	⇕	±100.00 %				⇒	-100.00 %			
RFC-A										

See *PID1 Output Upper Limit (Pr 74)*.

76		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 *Parameter Reference Guide*.

77		Maximum Heavy Duty Rating							
RO	Num				ND	NC	PT		
OL	⇅	0.00 to Drive HD Current Rating A			⇒				
RFC-A									

Displays the maximum heavy duty current rating of the drive.

78		Software Version							
RO	Num				ND	NC	PT		
OL	⇅	0 to 99.99.99			⇒				
RFC-A									

Displays the software version in the drive.

79		User Drive Mode							
RW	Txt				ND	NC	PT	US	
OL	⇅	OPEn.LP (1), RFC-A (2)			⇒	OPEn.LP (1)			
RFC-A									

Defines the mode of the drive.

81		Reference Selected							
RO	Num				ND	NC	PT		
OL	⇅	-Pr 02 to Pr 02 or Pr 01 to Pr 02 Hz			⇒				
RFC-A									

This is the basic reference selected from the available sources.

82		Pre-ramp Reference							
RO	Num				ND	NC	PT		
OL	⇅	-Pr 02 to Pr 02 or Pr 01 to Pr 02 Hz			⇒				
RFC-A									

The *Pre-ramp Reference* is the final output from the reference system that is fed into the ramp system.

83		Final Demand Reference								
RO	Num				ND	NC	PT	FI		
OL	⇕	-Pr 02 to Pr 02 or Pr 01 to Pr 02 Hz			⇒					
RFC-A										

**Open loop mode:**

*Final Demand Reference* shows the fundamental drive output frequency from the *Post Ramp Reference* and the *Hard Frequency Reference*.

**RFC mode:**

*Final Demand Reference* shows the reference at the input to the frequency controller, which is the sum of the *Post Ramp Reference*, if the ramp output is not disabled and the hard frequency reference (if enabled). If the drive is disabled *Final Demand Reference* shows 0.00.

84		D.C. Bus Voltage								
RO	Num				ND	NC	PT	FI		
OL	⇕	0 to 415 V or 0 to 830 V			⇒					
RFC-A										

Voltage across the internal DC bus of the drive.

85		Output Frequency								
RO	Num				ND	NC	PT	FI		
OL	⇕	± 550.00 Hz			⇒					
RFC-A										

**Open loop mode:**

The *Output Frequency* is the sum of the *Post Ramp Reference* and the motor slip compensation frequency.

**RFC-A mode:**

The output frequency is not controlled directly, but the *Output Frequency* is a measurement of the frequency applied to the motor.

86		Output Voltage								
RO	Num				ND	NC	PT	FI		
OL	⇕	0 to 325 V or 0 to 650 V			⇒					
RFC-A										

The *Output Voltage* is the r.m.s line to line voltage at the a.c. terminals of the drive.

87		Motor Rpm								
RO	Num				ND	NC	PT	FI		
OL	⇕	±33000.0 rpm*			⇒					
RFC-A										

*Motor Rpm* = 60 x Frequency / Pole pairs

where

Pole pairs = the numeric value of *Number Of Motor Poles* (Pr 40) (i.e. 3 for a 6 pole motor)

The frequency used to derive the *Motor Rpm* is the *Final Demand Reference* (Pr 83). The maximum and minimum values allow for a 10% over-shoot of the speed.

\* With the Unidrive HS30, the maximum is 180,000.0 rpm

88		Current Magnitude								
RO	Num				ND	NC	PT	FI		
OL	⇕	0 to Drive Maximum Current A			⇒					
RFC-A										

*Current Magnitude* is the instantaneous drive output current scaled so that it represents the r.m.s. phase current in Amps under steady state conditions.

89		Torque Producing Current								
RO	Num				ND	NC	PT	FI		
OL	⇕	± Drive Maximum Current A			⇒					
RFC-A										

*Torque Producing Current* is the instantaneous level of torque producing current scaled so that it represents the r.m.s. level of torque producing current under steady state conditions.

90		Digital I/O Read Word								
RO	Bin				ND	NC	PT			
OL	⇕	0 to 2047			⇒					
RFC-A										

*Digital I/O Read Word* reflects the state of digital inputs/outputs 1 to 5 and the relay.

91		Reference On								
RO	Bit				ND	NC	PT			
OL	⇕	Off (0) or On (1)			⇒					
RFC-A										

*Reference On*, which is controlled by the drive sequencer, indicates that the reference from the reference system is active.

92		Reverse Select							
RO	Bit				ND	NC	PT		
OL	⇕	Off (0) or On (1)			⇒				
RFC-A									

*Reverse Select*, which is controlled by the drive sequencer, is used to invert *Reference Selected* (Pr 81) or the *Jog Reference* (Pr 15).

93		Jog Select							
RO	Bit				ND	NC	PT		
OL	⇕	Off (0) or On (1)			⇒				
RFC-A									

*Jog Select*, which is controlled by the drive sequencer, is used to select the *Jog Reference* (Pr 15).

94		Analog Input 1							
RO	Num				ND	NC	PT	FI	
OL	⇕	±100.00 %			⇒				
RFC-A									

This parameter displays the level of the analog signal present at analog input 1 (terminal 2).

95		Analog Input 2							
RO	Num				ND	NC	PT	FI	
OL	⇕	±100.00 %			⇒				
RFC-A									

This parameter displays the level of the analog signal present at analog input 2 (terminal 5).




# 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: <ul style="list-style-type: none"> <li>The drive enable signal is not given, terminal 31 and 34 is open</li> <li>The run signal is not given, terminal 12/13 is open</li> <li>The motor is connected to the drive</li> <li>The motor connection is correct for the drive <math>\Delta</math> or Y</li> <li>The correct supply voltage is connected to the drive</li> </ul>	
Power up the drive	The default setting is Open Loop vector mode. For RFC-A mode set Pr <b>79</b> to RFC-A, then press the  stop/reset button to save the parameters. Ensure: The drive displays: inh (enable terminal(s) is open)	
Enter minimum and maximum speeds	Enter: <ul style="list-style-type: none"> <li>Minimum speed Pr <b>01</b> (Hz)</li> <li>Maximum speed Pr <b>02</b> (Hz)</li> </ul>	
Enter accel and decel rates	Enter: <ul style="list-style-type: none"> <li>Acceleration rate Pr <b>03</b> (s/100 Hz)</li> <li>Deceleration rate Pr <b>04</b> (s/100 Hz)</li> </ul>	
Enter motor nameplate details	<ol style="list-style-type: none"> <li>Motor rated current in Pr <b>06</b> (Amps)</li> <li>Motor rated speed in Pr <b>07</b> (rpm / min<sup>-1</sup>)</li> <li>Motor rated voltage in Pr <b>08</b> (Volts)</li> <li>Motor rated power factor in (cos <math>\phi</math>) Pr <b>09</b></li> </ol>	
<b>Ready to autotune</b>		
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: <ul style="list-style-type: none"> <li>Set Pr <b>38</b> = 1 for a stationary autotune or set Pr <b>38</b> = 2 for a rotating autotune</li> <li>Close the drive enable signal (apply +24 V to terminal 31 &amp; 34). The drive will display 'rdy'.</li> <li>Give a Run command (apply +24 V to terminal 12 - Run forward or terminal 13 - Run reverse). The display will flash 'tuning' while the drive is performing the autotune</li> <li>Wait for the drive to display 'inh' and for the motor to come to a standstill.</li> <li>Remove the drive enable and run signal from the drive.</li> </ul>	
Autotune complete	When the autotune has been completed, Pr <b>38</b> will be set to 0	
Tuning of frequency controller gains (RFC-A mode only)	Depending on the application, the frequency controller gains (Pr <b>65</b> and Pr <b>66</b> ) may need to be adjusted.	
<b>Save parameters</b>		
Save parameters	Select 'SAVE' in Pr <b>00</b> or Pr <b>mm.000</b> (alternatively enter a value of 1001) and press the  Stop / Reset button to save parameters.	

Action	Detail	
<b>Ready to run</b>		
Run	The drive is now ready to run the motor. Close the Run Forward or Run Reverse terminals.	
Increasing and decreasing speed	Changing the selected Analog frequency reference will increase and decrease the speed of the motor.	
Stopping	To stop the motor by following the selected deceleration rate, open either the run forward or run reverse terminal. If the enable terminal is opened while the motor is running, the drive output is immediately disabled and the motor will coast to a stop.	

## 8 Diagnostics

 <b>WARNING</b>	<p>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.</p> <p>If a drive is faulty, it must be returned to the supplier of the drive for repair.</p>
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**Table 8-1 Trip indications**

Trip code	Condition	Description
<b>C.Acc</b>	NV Media Card Write fail	Unable to access the NV Media Card.
<b>C.by</b>	NV Media Card cannot be accessed as it is being accessed by an option module	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.
<b>C.cPr</b>	NV Media Card file/data is different to the one in the drive	A <i>C.cPr</i> trip is initiated if the parameters on the NV Media Card are different to the drive.
<b>C.d.E</b>	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.
<b>C.dAt</b>	NV Media Card data not found	Attempt has been made to access non-existent file or block on the NV Media Card.
<b>C.Err</b>	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.
<b>C.FuL</b>	NV Media Card full	There is not enough space left on the card.
<b>C.Opt</b>	NV Media Card trip; option modules installed are different between source drive and destination drive	The 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.
<b>C.Pr</b>	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 <i>Control User Guide</i> .
<b>C.rdo</b>	NV Media Card has the Read Only bit set	Attempt has been made to modify a read-only NV Media Card or a read-only data block.
<b>C.rtg</b>	NV Media Card Trip; The voltage and / or current rating of the source and destination drives are different	The current and / or voltage ratings are different between source and destination drives.
<b>C.SL</b>	NV Media Card trip; Option module file transfer has failed	The <i>C.SL</i> 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.
<b>C.tyP</b>	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.
<b>cL.A1</b>	Analog input 1 current loss	Current loss was detected in current mode on Analog input 1 (Terminal 2).

Trip code	Condition	Description				
<b>CL.bt</b>	Trip initiated from the <i>Control Word</i>	Initiated by setting bit 12 on the control word when the control word is enabled. Refer to <i>Parameter Reference Guide</i>				
<b>Cur.c</b>	Current calibration range	Current calibration range error.				
<b>Cur.O</b>	Current feedback offset error	Current offset is too large to be trimmed.				
<b>d.Ch</b>	Drive parameters are being changed	A user action or a file system write is active that is changing the drive parameters and the drive has been commanded to enable.				
<b>dEr.E</b>	Derivative file error	Contact the supplier of the drive.				
<b>dEr.I</b>	Derivative product image error	Contact the supplier of the drive				
<b>dESt</b>	Two or more parameters are writing to the same destination parameter	The <i>dESt</i> trip indicates that destination output parameters of two or more logic functions within the drive are writing to the same parameter.				
<b>dr.CF</b>	Drive configuration	Contact the supplier of the drive.				
<b>EEF</b>	Default parameters have been loaded	The <i>EEF</i> trip indicates that default parameters have been loaded. The exact cause/reason of the trip can be identified from the sub-trip number (see <i>Control User Guide</i> ).				
<b>Et</b>	An External trip is initiated	<p>The cause of the trip can be identified from the sub trip number displayed after the trip string.</p> <table border="1"> <thead> <tr> <th>Sub-trip</th> <th>Reason</th> </tr> </thead> <tbody> <tr> <td>1</td> <td><i>External Trip = 1</i></td> </tr> </tbody> </table> <p>Refer to <i>Control User Guide</i>.</p>	Sub-trip	Reason	1	<i>External Trip = 1</i>
Sub-trip	Reason					
1	<i>External Trip = 1</i>					
<b>FAn.F</b>	Fan fail	Indicates the fan or fan circuitry has failed				
<b>Fi.Ch</b>	File changed	A file has been changed, power cycle to clear the trip				
<b>Fl.In</b>	Firmware Incompatibility	The user firmware is incompatible with the power firmware.				
<b>HFxx trip</b>	Hardware faults	Internal drive hardware fault (see <i>Control User Guide</i> ).				
<b>It.Ac</b>	Output current overload timed out ( $I^2t$ )	<p>The <i>It.Ac</i> trip indicates a motor thermal overload based on the output current and motor thermal time constant. The drive will trip on <i>It.Ac</i> when the accumulator gets to 100 %.</p> <p>This can occur when:</p> <ul style="list-style-type: none"> <li>• There is excessive mechanical load</li> <li>• Ensure the load is not jammed / sticking</li> <li>• Check the load on the motor has not changed</li> <li>• Ensure the motor rated current is not zero</li> </ul>				
<b>It.br</b>	Braking resistor overload timed out ( $I^2t$ )	Braking resistor overload has timed out. This can be caused by excessive braking resistor energy.				
<b>no.PS</b>	No power board	No communication between the power and control boards.				
<b>O.Ld1</b>	Digital output overload	The total current drawn from 24 V user supply or from the digital output has exceeded the limit.				
<b>O.SPd</b>	Motor frequency has exceeded the over frequency threshold	Excessive motor speed (typically caused by mechanical load driving the motor).				
<b>Oh.br</b>	Braking IGBT over-temperature	Braking IGBT over-temperature. Detected by thermal model				
<b>Oh.dc</b>	DC bus over temperature	DC bus component over temperature based on a software thermal model.				
<b>Oht.C</b>	Control stage over-temperature	Control stage over-temperature detected.				
<b>Oht.I</b>	Inverter over temperature based on thermal model	IGBT junction over-temperature has been detected based on a software thermal model.				
<b>Oht.P</b>	Power stage over temperature	This trip indicates that a power stage over-temperature has been detected.				
<b>OL.A1</b>	Analog input 1 over-current	Current input on analog input 1 exceeds 24 mA.				

Trip code	Condition	Description
OI.AC	Instantaneous output over current detected	The instantaneous drive output current has exceeded. The set limit. Possible solutions: <ul style="list-style-type: none"> <li>• Increase acceleration/deceleration rate</li> <li>• If seen during autotune reduce the voltage boost</li> <li>• Check for short circuit on the output cabling</li> <li>• Check integrity of the motor insulation using an insulation tester</li> <li>• Is the motor cable length within limits for the frame size</li> <li>• Reduce the values in the current loop gain parameters</li> </ul>
OI.br	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: <ul style="list-style-type: none"> <li>• Check brake resistor wiring</li> <li>• Check braking resistor value is greater than or equal to the minimum resistance value</li> <li>• Check braking resistor insulation</li> </ul>
OI.SC	Output phase short-circuit	Over-current detected on drive output when enabled.
OPT.d	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.P	Output phase loss detected	Phase loss has been detected at the drive output.
OV	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: <ul style="list-style-type: none"> <li>• Increase <i>Deceleration Rate 1</i> (Pr 04)</li> <li>• Decrease the braking resistor value (staying above the minimum value)</li> <li>• Check nominal AC supply level</li> <li>• Check for supply disturbances which could cause the DC bus to rise</li> <li>• Check motor insulation using a insulation tester</li> </ul>
P.dAt	Power system configuration data error	Contact the supplier of the drive.
PAd	Keypad has been removed	The PAd trip indicates that the drive is in keypad mode and the keypad has been disconnected from the drive.
Pb.bt	Power board is in bootloader mode	Power board is in bootloader mode
Pb.Er	Communication has been lost / errors detected between power control	Communications loss between power and control.
Pb.HF	Power board HF	Power processor hardware fault - contact the supplier of the drive
Pd.S	Power down save error	Error has been detected in the power down save parameters saved in non-volatile memory.
PH.Lo	Supply phase loss	The drive has detected an input phase loss or large supply imbalance.
PSU	Internal power supply fault	One or more internal power supply rails are outside limits or overloaded.
r.ALL	RAM allocation error	Option module derivative image has requested more parameter RAM than is allowed.
r.b.ht	Hot rectifier/brake	Over-temperature detected on input rectifier or braking IGBT.
rS	Measured resistance has exceeded the parameter range	The measured stator resistance during an autotune test has exceeded the maximum possible value of <i>Stator Resistance</i> . Refer to the <i>Control User Guide</i> .

Trip code	Condition	Description						
<b>SCL</b>	Control word watchdog has timed out	The control word has been enabled and has timed out						
<b>SL.dF</b>	Option module in option slot 1 has changed	Option slot 1 on the drive is a different type to that installed when parameters were last saved on the drive.						
<b>SL.Er</b>	Option module in option slot 1 has detected a fault	Option module in option slot 1 on the drive has detected an error.						
<b>SL.HF</b>	Option module 1 hardware fault	Option slot 1 on the drive has indicated a hardware fault.						
<b>SL.nF</b>	Option module in option slot 1 has been removed	The option module in option slot 1 on the drive has been removed since the last power up.						
<b>SL.tO</b>	Option module watchdog function service error	The option module installed in Slot 1 has started the option watchdog function and then failed to service the watchdog correctly.						
<b>So.St</b>	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.						
<b>St.HF</b>	Hardware trip has occurred during last power down	Hardware trip (HF01 –HF19) has occurred and the drive has been power cycled. Enter 1299 to Pr <b>00</b> or <b>xx.000</b> to clear trip						
<b>Sto</b>	No Safe Torque Off board installed	Safe Torque Off board not installed correctly.						
<b>th</b>	Motor thermistor over-temperature	The motor thermistor connected to terminal 14 (digital input 5) on the control connections has indicated a motor over temperature.						
<b>th.br</b>	Brake resistor over temperature	The th.br trip is initiated if the hardware based braking resistor thermal monitoring is connected and the resistor overheats.						
<b>tH.Fb</b>	Internal thermistor has failed	Internal thermistor has failed.						
<b>thS</b>	Motor thermistor short circuit	The motor thermistor connected to terminal 14 (digital input 5) on the control connections, is short circuit or low impedance (<50 Ω).						
<b>tun.S</b>	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.						
<b>tun.1</b>	Autotune 1	The drive has tripped during a rotating autotune. The cause of the trip can be identified from the sub-trip number.						
		<table border="1"> <thead> <tr> <th>Sub-trip</th> <th>Reason</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>The motor did not reach the required speed during rotating auto-tune or mechanical load measurement.</td> </tr> </tbody> </table> <p>Refer to the <i>Control User Guide</i>.</p>	Sub-trip	Reason	2	The motor did not reach the required speed during rotating auto-tune or mechanical load measurement.		
Sub-trip	Reason							
2	The motor did not reach the required speed during rotating auto-tune or mechanical load measurement.							
<b>tun.3</b>	Autotune 3	<b>RFC-A mode only.</b> The drive has tripped during a rotating auto-tune or mechanical load measurement. The cause of the trip can be identified from the associated sub-trip number.						
		<table border="1"> <thead> <tr> <th>Sub-trip</th> <th>Reason</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Measured inertia has exceeded the parameter range during a mechanical load measurement.</td> </tr> <tr> <td>3</td> <td>The mechanical load test has been unable to identify the motor inertia</td> </tr> </tbody> </table> <p>Refer to the <i>Control User Guide</i>.</p>	Sub-trip	Reason	1	Measured inertia has exceeded the parameter range during a mechanical load measurement.	3	The mechanical load test has been unable to identify the motor inertia
		Sub-trip	Reason					
1	Measured inertia has exceeded the parameter range during a mechanical load measurement.							
3	The mechanical load test has been unable to identify the motor inertia							
<b>U.OI</b>	User OI ac	The <i>U.OI</i> trip is initiated if the output current of the drive exceeds the trip level set by <i>User Over Current Trip Level</i> . Refer to the <i>Control User Guide</i> .						

Trip code	Condition	Description
U.S	User Save error / not completed	The <i>U.S</i> trip indicates that an error has been detected in the user save parameters saved in non-volatile memory.
UP.uS	User Program trip	This trip can be initiated from within an onboard user program. Refer to the <i>Control User Guide</i> .
UPrG	User Program	An error has been detected in the onboard user program image. Refer to the <i>Control User Guide</i> .

## 8.1 Alarm indications

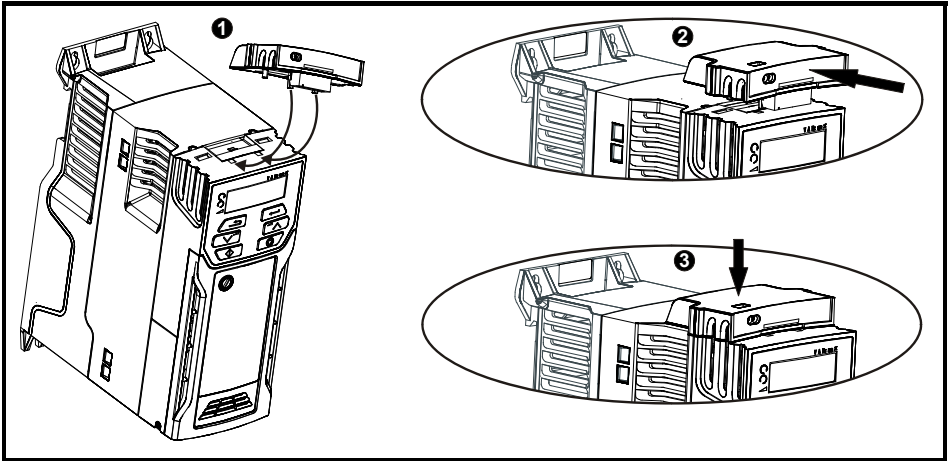
In any mode, an alarm is an indication given on the display by alternating the alarm string with the drive status string display. If an action is not taken to eliminate any alarm except "tuning", "LS" or "24.LoSt" the drive may eventually trip. Alarms are not displayed when a parameter is being edited.

**Table 8-2 Alarm indications**

Alarm string	Description
br.res	Brake resistor overload. <i>Braking Resistor Thermal Accumulator</i> in the drive has reached 75.0 % of the value at which the drive will trip. Refer to the <i>Power Installation Guide</i>
OV.Ld	<i>Motor Protection Accumulator</i> in the drive has reached 75.0 % of the value at which the drive will trip and the load on the drive is >100 %, reduce motor current (load). Refer to the <i>Parameter Reference Guide</i>
d.OV.Ld	Drive over temperature. <i>Percentage Of Drive Thermal Trip Level</i> in the drive is greater than 90 %. Refer to the <i>Parameter Reference Guide</i>
tuning	The autotune procedure has been initialized and an autotune in progress.
LS	Limit switch active. Indicates that a limit switch is active and that is causing the motor to be stopped.
Lo.AC	Low voltage mode. See <i>Low AC Alarm</i> in <i>Control User Guide</i> .
I.AC.Lt	Current limit active. See <i>Current Limit Active</i> in <i>Control User Guide</i> .
24.LoSt	24V backup not present. See <i>24V Alarm Loss Enable</i> in the <i>Control User Guide</i> .

# 9 NV Media Card Operation

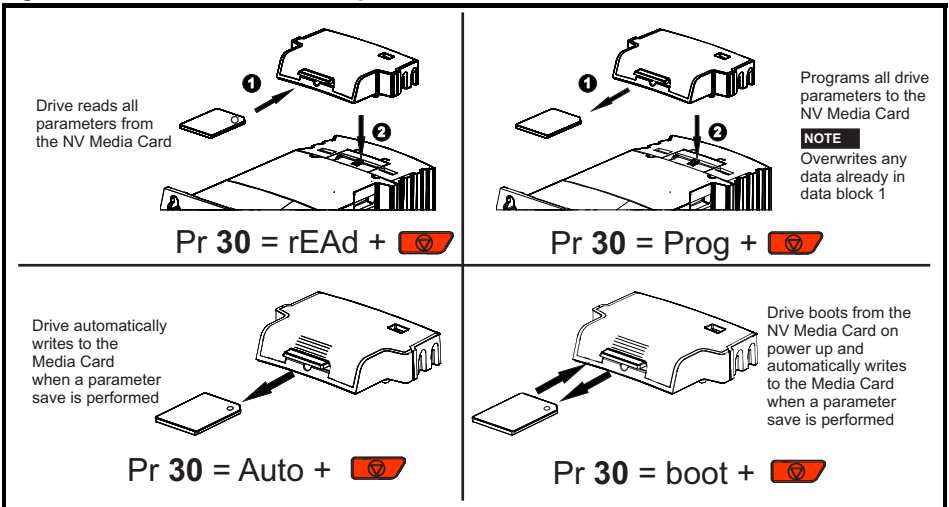
Figure 9-1 Installing the AI-Backup adaptor (SD Card)



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 *Control 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.

**NOTE** The drive supports SD cards formatted with the FAT32 file system only.

# 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 M300'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)

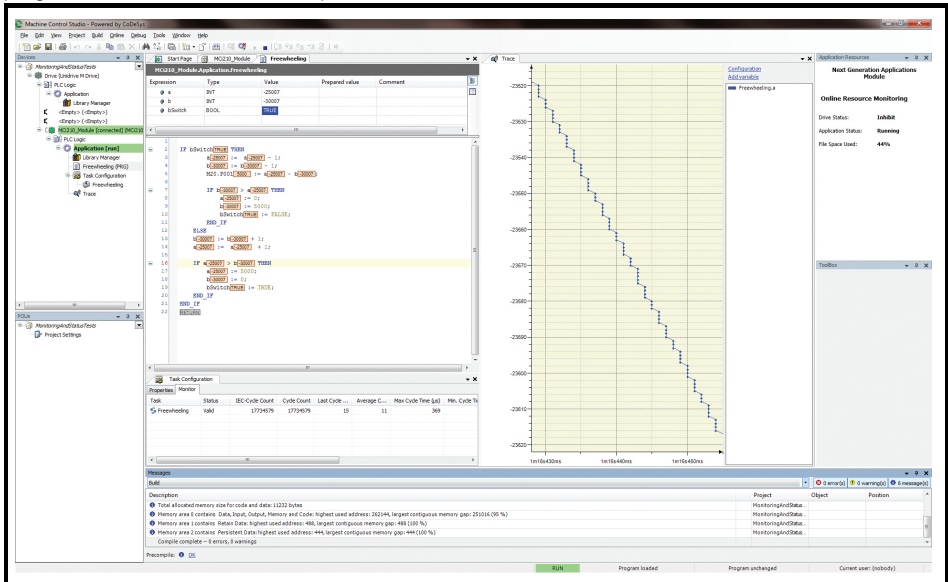
Also supported:

- 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: [www.drive-setup.com](http://www.drive-setup.com) under the 'Software' section.



# 11 UL listing information

## 11.1 UL file reference

All models are UL Listed to both Canadian and US requirements. The UL file reference is: NMMS/7.E171230.

## 11.2 Option modules, kits and accessories

Option Modules, Control Pods, Installation Kits and other accessories for use with these drives are UL Listed.

## 11.3 Enclosure ratings

All models are Open Type as supplied.

The drive enclosure is not classified as a fire enclosure. A separate fire enclosure must be provided. A UL/ NEMA Type 12 enclosure is suitable.

When fitted with a conduit box the drives meet the requirements for UL Type 1. Type 1 enclosures are intended for indoor use, primarily to provide a degree of protection against limited amounts of falling dirt.

Remote Keypads are UL Type 12 when installed with the sealing washer and fixing kit provided. When installed in a Type 1 or Type 12 enclosure, the drives may be operated in a compartment handling conditioned air.

## 11.4 Mounting

Drives may be surface mounted using the appropriate brackets. Drives may be mounted singly or side by side with suitable space between them (bookcase mounting).

## 11.5 Environment

Drives must be installed in a Pollution Degree 2 environment or better (dry, non-conductive pollution only).

The drives have been evaluated for use at ambient temperatures up to 40 °C. The drives have additionally been evaluated for 50 °C and 55 °C ambient air temperatures with a derated output.

## 11.6 Electrical Installation

### OVERVOLTAGE CATEGORY

OVC III

### SUPPLY

The drives are suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 600 Volts AC Maximum.

### TERMINAL TORQUE

Terminals must be tightened to the rated torque as specified in the Installation Instructions.

### WIRING TERMINALS

Drives must be installed using cables rated for 75 °C operation, copper wire only.

Where possible, UL Listed closed-loop connectors sized according to the field wiring shall be used for all field power wiring connections.

### GROUND CONNECTION INSTRUCTIONS

UL Listed closed-loop connectors sized according to the field wiring shall be used for grounding connections.

## **BRANCH CIRCUIT PROTECTION**

The fuses and circuit breakers required for branch circuit protection are specified in the Installation Instructions.

### **OPENING OF BRANCH CIRCUIT**

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 should 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 (NEC), The Canadian Electrical Code, and any additional local codes.

### **DYNAMIC BRAKING**

M100, M101, M200, M201, M300 or M400, frame sizes 1 to 4 have been evaluated for dynamic braking applications. Other drive models have not been evaluated for dynamic braking.

## **11.7 Motor overload protection and thermal memory retention**

All drives 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 in the *Control User Guide*. Maximum current overload is dependent on the values entered into the current limit parameters (motoring current limit, regenerative current limit and symmetrical current limit entered as percentage) and the motor rated current parameter (entered in amperes).

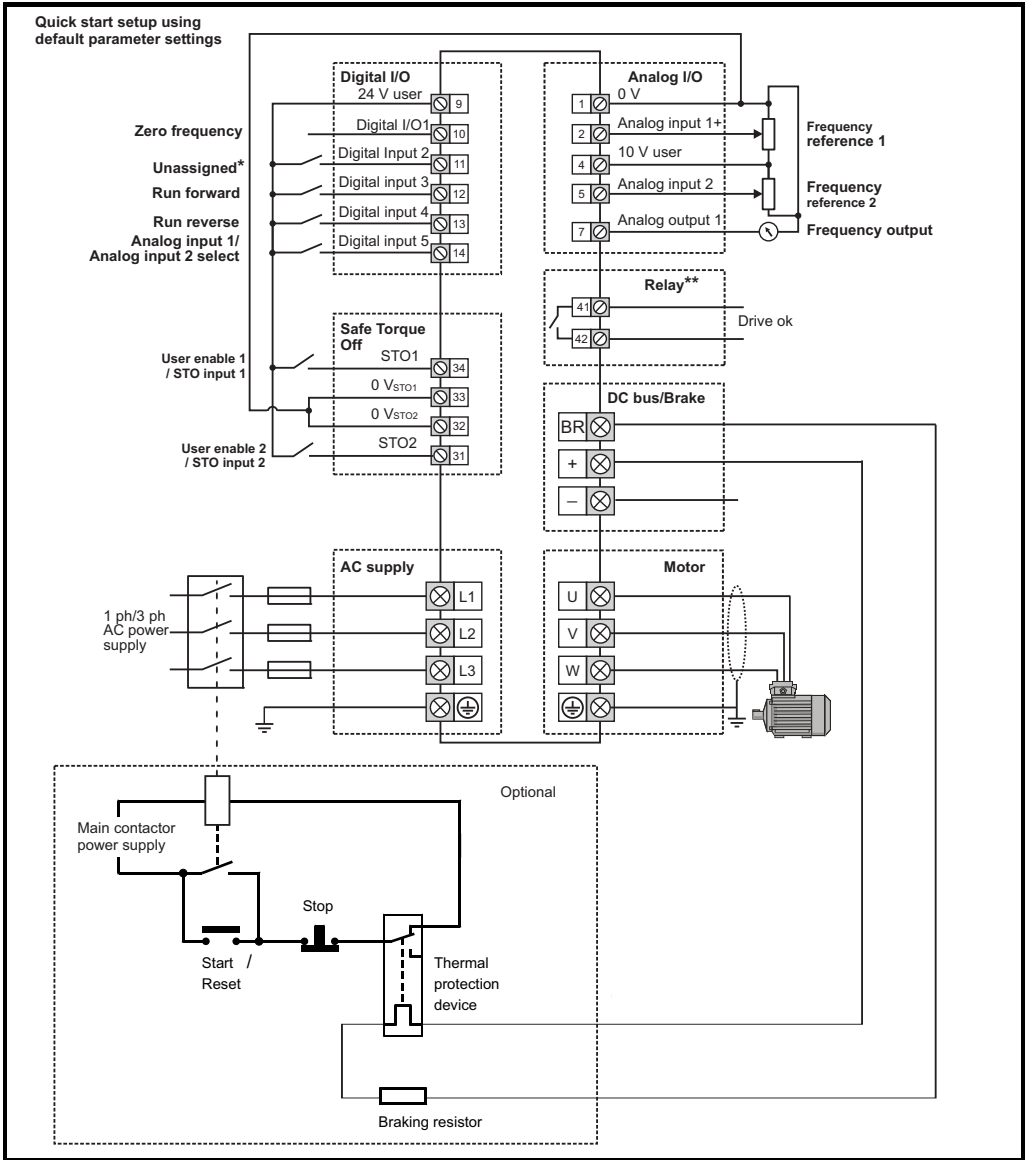
The duration of the overload is dependent on motor thermal time constant. The maximum programmable time constant depends on the drive model. The method of adjustment of the overload protection is provided.

The drives are provided with user terminals that can be connected to a motor thermistor to protect the motor from high temperature, in the event of a motor cooling fan failure.

## **11.8 External Class 2 supply**

The external power supply used to power the 24 V control circuit shall be marked: "UL Class 2". The power supply voltage shall not exceed 24 Vdc.





\* Unidrive M300/HS30 uses Safe Torque Off (Drive enable) inputs and terminal 11 is unassigned.

\*\* 250 Vac maximum (UL class 1).

**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.



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