EMERSON
Industrial Automation

Getting Started Guide

Unidrive M702

Part Number: 0478-0003-01
Issue: 1

CONTROL TECHNIQUES

www.controltechniques.com

For the purposes of compliance with the EC Machinery Directive 2006/42/EC:

General Information

This guide covers the basic information that is required to set-up and run the drive, in applications where a drive malfunction does not result in a mechanical hazard. When the drive is used in a safety related application, i.e. where a malfunction might result in a hazard, it is essential to refer to the full user guide. The *Unidrive M702 User Guide* is available for download from www.controltechniques.com/userguides.

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation or adjustment of the optional operating parameters of the equipment or from mismatching the variable speed drive with the motor.

The contents of this guide are believed to be correct at the time of printing. In the interests of a commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or its performance, or the contents of the guide, without notice.

Drive firmware version

This product is supplied with the latest firmware version. If this drive is to be connected to an existing system or machine, all drive firmware versions should be verified to confirm the same functionality as drives of the same model already present. This may also apply to drives returned from a Control Techniques Service Centre or Repair Centre. If there is any doubt please contact the supplier of the product.

The firmware version of the drive can be checked by looking at Pr **11.029**
The firmware version of the Ethernet interface can be checked by looking at Pr **24.002**

Environmental statement

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

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

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

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

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

REACH legislation

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

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

Issue Number: 1

Drive Firmware:00.10.00.00 onwards
Ethernet Firmware: 01.00.02.02 onwards

Contents

1 Safety information

1.1 Warnings, Cautions and Notes

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

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

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

1.2 Electrical safety - general warning

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

1.3 System design and safety of personnel

The drive is intended as a component for professional incorporation into complete equipment or a system. If installed incorrectly, the drive may present a safety hazard.

The drive uses high voltages and currents, carries a high level of stored electrical energy, and is used to control equipment which can cause injury.

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

The STOP and SAFE TORQUE OFF functions of the drive do not isolate dangerous voltages from the output of the drive or from any external option unit. The supply must be disconnected by an approved electrical isolation device before gaining access to the electrical connections.

With the sole exception of the SAFE TORQUE OFF function, none of the drive functions must be used to ensure safety of personnel, i.e. they must not be used for safety-related functions.

Careful consideration must be given to the functions of the drive which might result in a hazard, either through their intended behavior or through incorrect operation due to a fault. In any application where a malfunction of the drive or its control system could lead to or allow damage, loss or injury, a risk analysis must be carried out, and where necessary, further measures taken to reduce the risk - for example, an over-speed protection device in case of failure of the speed control, or a fail-safe mechanical brake in case of loss of motor braking.

The SAFE TORQUE OFF function may be used in a safety-related application. The system designer is responsible for ensuring that the complete system is safe and designed correctly according to the relevant safety standards.

1.4 Environmental limits

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

1.5 Access

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

1.6 Fire protection

The drive enclosure is not classified as a fire enclosure. A separate fire enclosure must be provided. For further information, refer to the *Unidrive M702 User Guide*.

1.7 Compliance with regulations

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

This guide contains instruction for achieving compliance with specific EMC standards.

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

2006/42/EC: Safety of machinery.
2004/108/EC: Electromagnetic Compatibility.

1.8 Motor

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

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

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

The values of the motor parameters set in the drive affect the protection of the motor. The default values in the drive should not be relied upon.

It is essential that the correct value is entered in Pr **00.046** motor rated current. This affects the thermal protection of the motor.

1.9 Mechanical brake control

The brake control functions are provided to allow well co-ordinated operation of an external brake with the drive. While both hardware and software are designed to high standards of quality and robustness, they are not intended for use as safety functions, i.e. where a fault or failure would result in a risk of injury. In any application where the incorrect operation of the brake release mechanism could result in injury, independent protection devices of proven integrity must also be incorporated.

1.10 Adjusting parameters

Some parameters have a profound effect on the operation of the drive. They must not be altered without careful consideration of the impact on the controlled system. Measures must be taken to prevent unwanted changes due to error or tampering.

1.11 Electrical installation

1.11.1 Electric shock risk

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

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

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

1.11.2 Stored charge

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

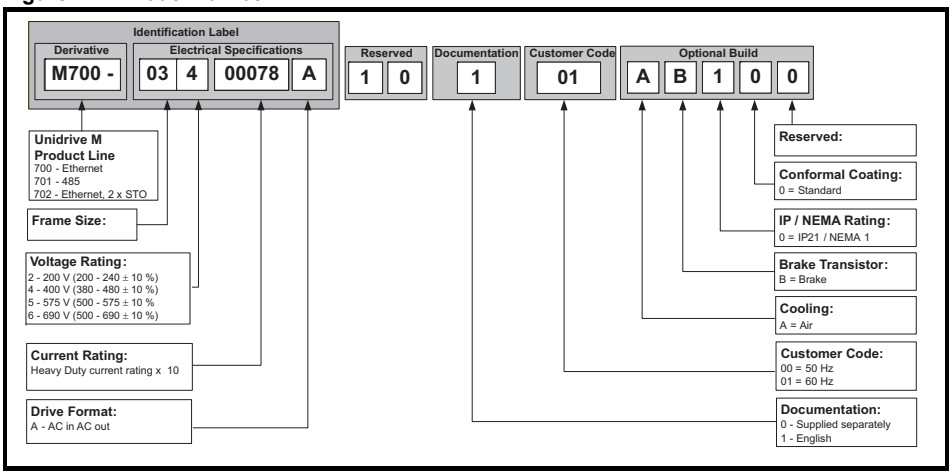
2 Product information

The *Unidrive M702* product offers Ethernet fieldbus communications and provides dual SAFE TORQUE OFF inputs.

2.1 Model number

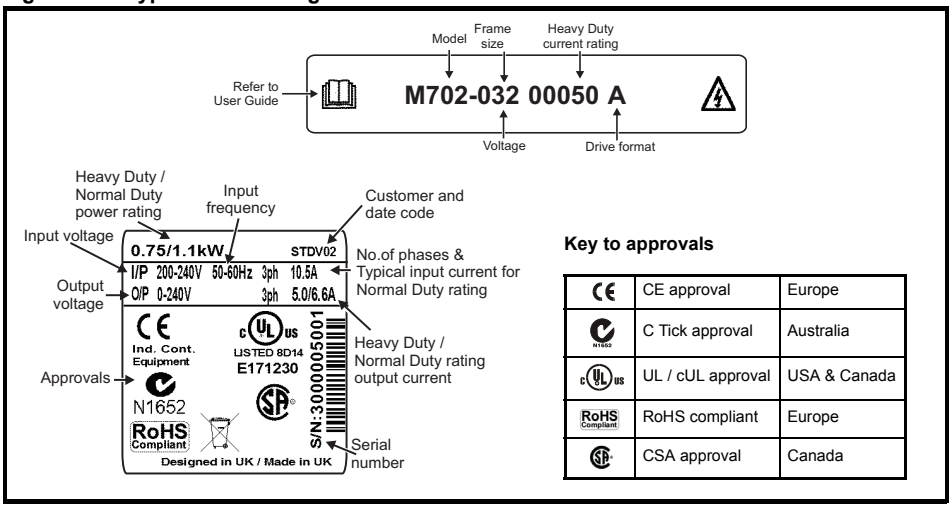
The way in which the model numbers for the Unidrive M product range is formed is illustrated below:

Figure 2-1 Model number



2.2 Nameplate description

Figure 2-2 Typical drive rating labels



Key to approvals

CE	CE approval	Europe
C Tick	C Tick approval	Australia
cULus	UL / cUL approval	USA & Canada
RoHS Compliant	RoHS compliant	Europe
CSA	CSA approval	Canada

2.3 Ratings

Fuses
The AC supply to the drive must be installed with suitable protection against overload and short-circuits. The following section shows recommended fuse ratings. Failure to observe this requirement will cause risk of fire.

NOTE Nominal cables sizes below are provided as a guide only. Ensure cables used suit local wiring regulations.

Table 2-1 200 V drive ratings, cable sizes and fuse ratings

Model	Max. cont. input current	Fuse		Nominal cable size				Normal Duty			Heavy Duty		
				European		USA							
	3ph	IEC gG	Class CC or Class J	Input	Output	Input	Output	Max. cont. output current	Nom power @ 230V	Motor power @ 230V	Max. cont. output current	Nom power @ 230V	Motor power @ 230V
	A	A	A	mm^2	mm^2	AWG	AWG	A	kW	hp	A	kW	hp
03200050	10.7	16	16	1.5	1.5	14	14	6.6	1.1	1.5	5	0.75	1.0
03200066	13	20	20	1.5	1.5	14	14	8.0	1.5	2.0	6.6	1.1	1.5
03200080	17.8	25	25	4	4	12	12	11.0	2.2	3.0	8.0	1.5	2.0
03200106	20.6	25	25	4	4	12	12	12.7	3.0	3.0	10.6	2.2	3.0
04200137	20.1	25	25	6	6	10	10	18.0	4.0	5.0	13.7	3.0	3.0
04200185	26.8	32	30	8	8	8	8	24.0	5.5	7.5	18.5	4.0	5.0
06200330	48.8	63	60	16	16	4	4	50.0	11.0	15.0	33.0	7.5	10.0
06200440	56.6	63	70	25	25	3	3	58.0	15.0	20.0	44.0	11.0	15.0

Table 2-2 400 V drive ratings, cable sizes and fuse ratings

Model	Max. cont. input current	Fuse		Nominal cable size				Normal Duty			Heavy Duty		
				European		USA							
	3ph	IEC gG	Class CC or Class J	Input	Output	Input	Output	Max. cont. output current	Nom power @ 400V	Motor power @ 460V	Max. cont. output current	Nom power @ 400V	Motor power @ 460V
	A	A	A	mm^2	mm^2	AWG	AWG	A	kW	hp	A	kW	hp
03400025	5	6	10	1.5	1.5	18	18	3.4	1.1	1.5	2.5	0.75	1.0
03400031	6.6	10	10	1.5	1.5	16	16	4.5	1.5	2.0	3.1	1.1	1.5
03400045	9.1	10	10	1.5	1.5	14	14	6.2	2.2	3.0	4.5	1.5	2.0
03400062	13.1	20	20	2.5	2.5	14	14	7.7	3.0	5.0	6.2	2.2	3.0
03400078	13.4	20	20	2.5	2.5	14	14	10.4	4.0	5.0	7.8	3.0	5.0
03400100	15.8	20	20	2.5	2.5	12	12	12.3	5.5	7.5	10.0	4.0	5.0
04400150	18.7	25	25	6	6	10	10	18.5	7.5	10.0	15.0	5.5	10.0
04400172	24.3	32	30	8	8	8	8	24.0	11.0	15.0	17.2	7.5	10.0

Table 2-3 400 V drive ratings, cable sizes and fuse ratings (size 6 only)

Model	Max. cont. input current	Fuse		Nominal cable size				Normal Duty			Heavy Duty		
				European		USA							
	3ph	IEC gR	Ferraz HSJ Bussman DFJ	Input	Output	Input	Output	Max. cont. output current	Nom power @ 400V	Motor power @ 460V	Max. cont. output current	Nom power @ 400V	Motor power @ 460V
	A	A	A	mm^2	mm^2	AWG	AWG	A	kW	hp	A	kW	hp
06400350	36.5	63	40	10	10	6	6	38.0	18.5	25.0	35.0	15.0	25.0
06400420	46.2	63	50	16	16	4	4	48.0	22.0	30.0	42.0	18.5	30.0
06400470	60.6	63	70	25	25	3	3	63.0	30.0	40.0	47.0	22.0	30.0

Table 2-4 575 V drive ratings, cable sizes and fuse ratings

Model	Max. cont. input current	Fuse		Nominal cable size				Normal Duty			Heavy Duty		
				European		USA							
	3ph	IEC gG	Class CC or Class J	Input	Output	Input	Output	Max. cont. output current	Nom power @ 575V	Motor power @ 575V	Max. cont. output current	Nom power @ 575V	Motor power @ 575V
	A	A	A	mm^2	mm^2	AWG	AWG	A	kW	hp	A	kW	hp
06500100	13.2	20	20	2.5	2.5	14	14	12.0	7.5	10.0	10.0	5.5	7.5
06500150	18.7	32	25	4	4	10	10	17.0	11.0	15.0	15.0	7.5	10.0
06500190	24.3	40	30	6	6	10	10	22.0	15.0	20.0	19.0	11.0	15.0
06500230	29.4	50	35	10	10	8	8	27.0	18.5	25.0	23.0	15.0	20.0
06500290	37.1	50	40	10	10	6	6	34.0	22.0	30.0	29.0	18.5	25.0
06500350	46.9	63	50	16	16	6	6	43.0	30.0	40.0	35.0	22.0	30.0

Table 2-5 Protective ground cable ratings

Model	Ground conductor size
200 V	
03200050, 03200066, 03200080, 03200106, 04200137, 04200185, 06200330	Either use 10 mm^2 cable **or** 2 cables of the same cross sectional area as the recommended phase cables
06200440	Either use 16 mm^2 cable **or** 2 cables of the same cross sectional area as the recommended phase cables
400 V	
03400025, 03400031, 03400045, 03400062, 03400078, 03400100, 04400150, 04400172, 06400420	Either use 10 mm2 cable **or** 2 cables of the same cross sectional area as the recommended phase cables
06400470	Either use 16 mm^2 cable **or** 2 cables of the same cross sectional area as the recommended phase cables
575 V	
06500100, 06500150, 06500190, 06500230, 06500290, 06500350	Either use 10 mm2 cable **or** 2 cables of the same cross sectional area as the recommended phase cables

Typical short term overload limits

The maximum percentage overload limit changes depending on the selected motor. Variations in motor rated current, motor power factor and motor leakage inductance all result in changes in the maximum possible overload. The exact value for a specific motor can be calculated using the equations detailed in the *Parameter Reference Guide*. Typical values are shown in the table below:

Table 2-6 Typical overload limits

Operating mode	RFC from cold	RFC from 100 %	Open loop from cold	Open loop from 100 %
Normal Duty overload with motor rated current = drive rated current	110 % for 165 s	110 % for 9 s	110 % for 165 s	110 % for 9 s
Heavy Duty overload with motor rated current = drive rated current	200 % for 28 s	200 % for 3 s	150 % for 60 s	150 % for 8 s

Generally the drive rated current is higher than the matching motor rated current allowing a higher level of overload than the default setting.

The time allowed in the overload region is proportionally reduced at very low output frequency on some drive ratings.

NOTE The maximum overload level which can be attained is independent of the speed.

Output current

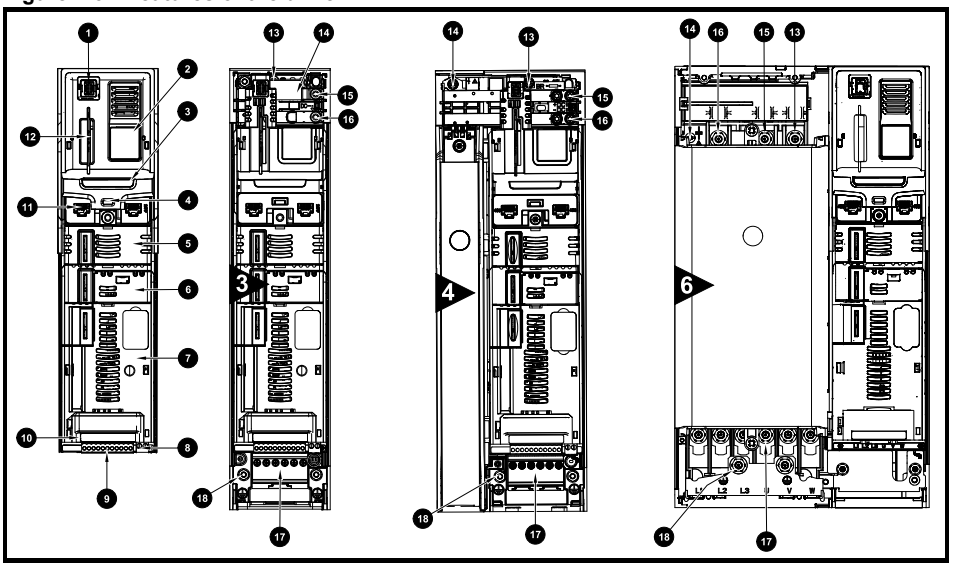
The continuous output current ratings given on the rating label are for maximum 40 °C (104 °F), 1000 m altitude and 2.0 kHz switching. Derating is required for higher switching frequencies, ambient temperatures >40 °C (104 °F) and higher altitude. For derating information, refer to the *Unidrive M702 User Guide*.

Input current

The input current is affected by the supply voltage and impedance. The input current given on the rating label is the typical input current and is stated for a balanced supply.

2.4 Drive features

Figure 2-3 Features of the drive

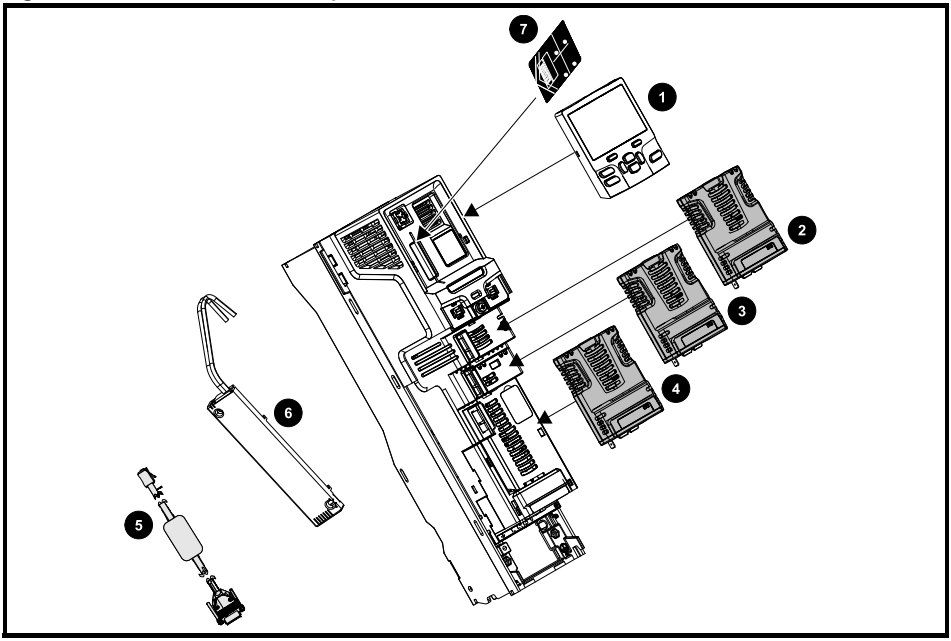


Key

1. Keypad connection
2. Rating label
3. Identification label
4. Status LED
5. Option module slot 1
6. Option module slot 2
7. Option module slot 3
8. Relay connections
9. Position feedback connections
10. Control connections
11. Communications port
12. NV media card slot
13. Braking terminal
14. Internal EMC filter
15. DC bus +
16. DC bus -
17. AC supply / motor connections
18. Ground connections

2.5 Options / Accessories

Figure 2-4 Drive features and options



1. Keypad
2. Option module slot 1
3. Option module slot 2
4. Option module slot 3
5. CT Comms cable
6. Internal braking resistor
7. NV media card

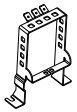
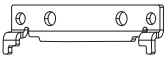
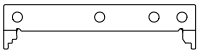
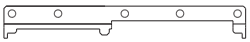
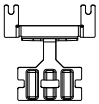
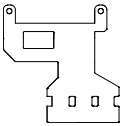
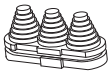
Table 2-7 Option module identification

Type	Option module	Color	Name
Feedback		N/A	15-way D-type converter
		N/A	Single ended encoder interface (15 V or 24 V)
Fieldbus		Purple	SI-PROFIBUS
Automation (Applications)		Black	SI-Applications Plus
			SI-Applications Lite V2
			SI-Register

Table 2-8 Keypad identification

Type	Keypad	Name
Keypad		SI-Keypad

Table 2-9 Parts supplied with the drive

Description	Size 3	Size 4	Size 6
Control connector	 x 1		
Relay connector	 x 1		
24 V power supply connector			 x 1
Grounding bracket	 x 1		
Surface mounting brackets	 x 2	 x 2	 x 2
Grounding clamp	 x 1		 x 1
DC terminal cover grommets	 x 2		
M6 Nuts			 x 11
M4 x 10 Taptite screws			 x 2
Supply and motor connector	 x 1		
Finger guard grommets			 x 2

3 Mechanical installation

3.1 Safety information

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

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

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

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

Enclosure
The drive is intended to be mounted in an enclosure which prevents access except by trained and authorized personnel, and which prevents the ingress of contamination. It is designed for use in an environment classified as pollution degree 2 in accordance with IEC 60664-1. This means that only dry, non-conducting contamination is acceptable.

3.2 Fire protection

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

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

For installation outside the USA, refer to the *Unidrive M702 User Guide*.

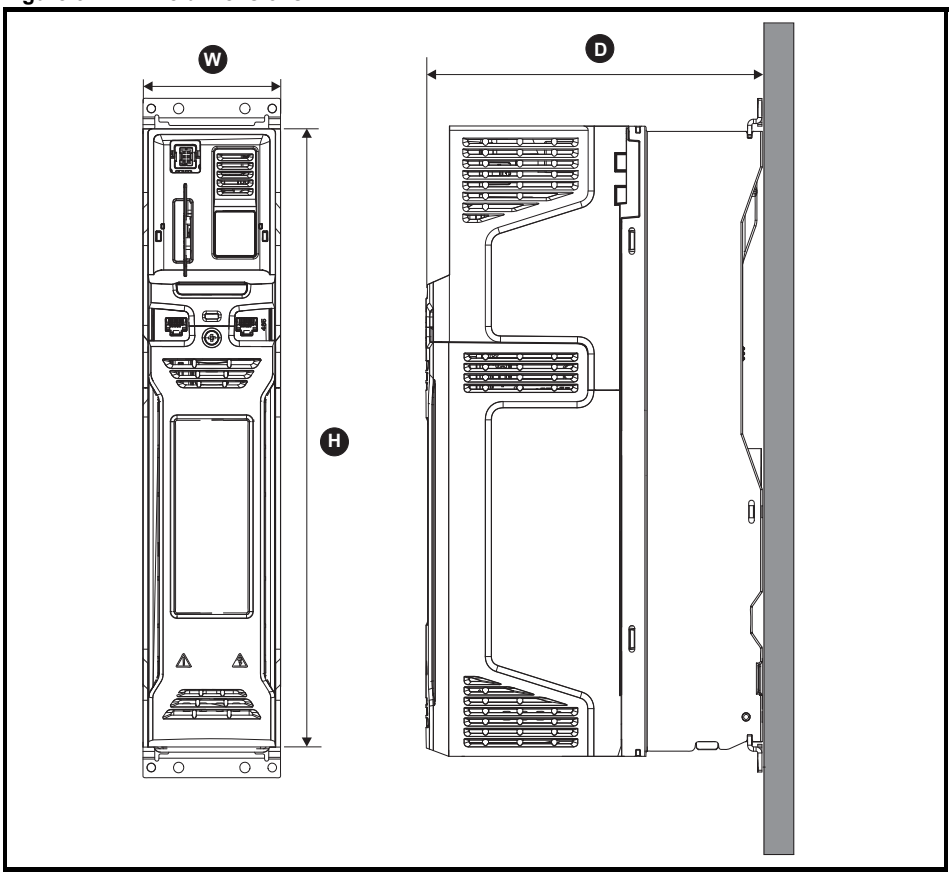
3.3 Mounting methods

Drive sizes 3, 4 and 6 can be either surface or through-panel mounted using the appropriate brackets.

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

3.4 Drive dimensions

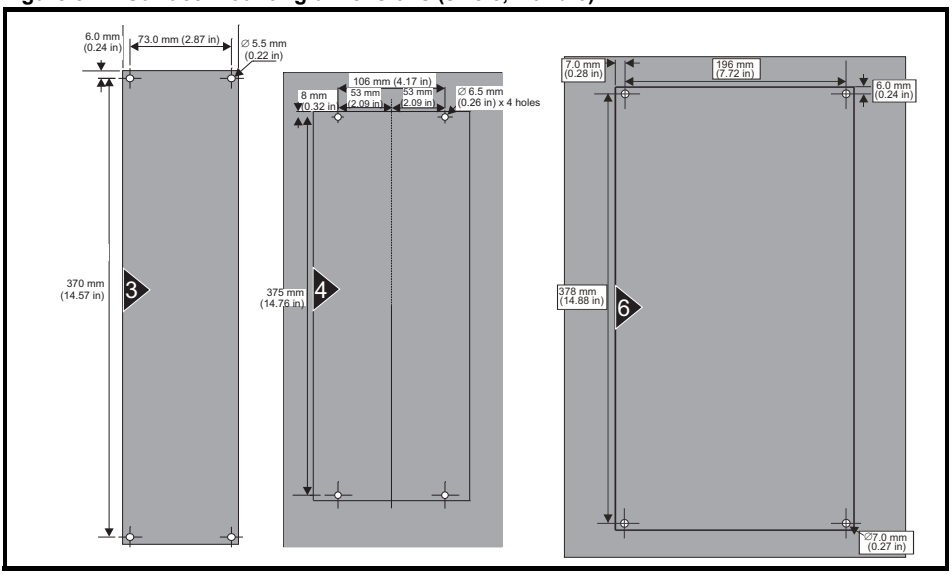
Figure 3-1 Drive dimensions



Size	H		W		D	
	mm	in	mm	in	mm	in
3	365	14.37	83	3.27	200	7.87
4			124	4.88		
6			210	8.27	227	8.94

3.5 Surface mounting

Figure 3-2 Surface mounting dimensions (size 3, 4 and 6)

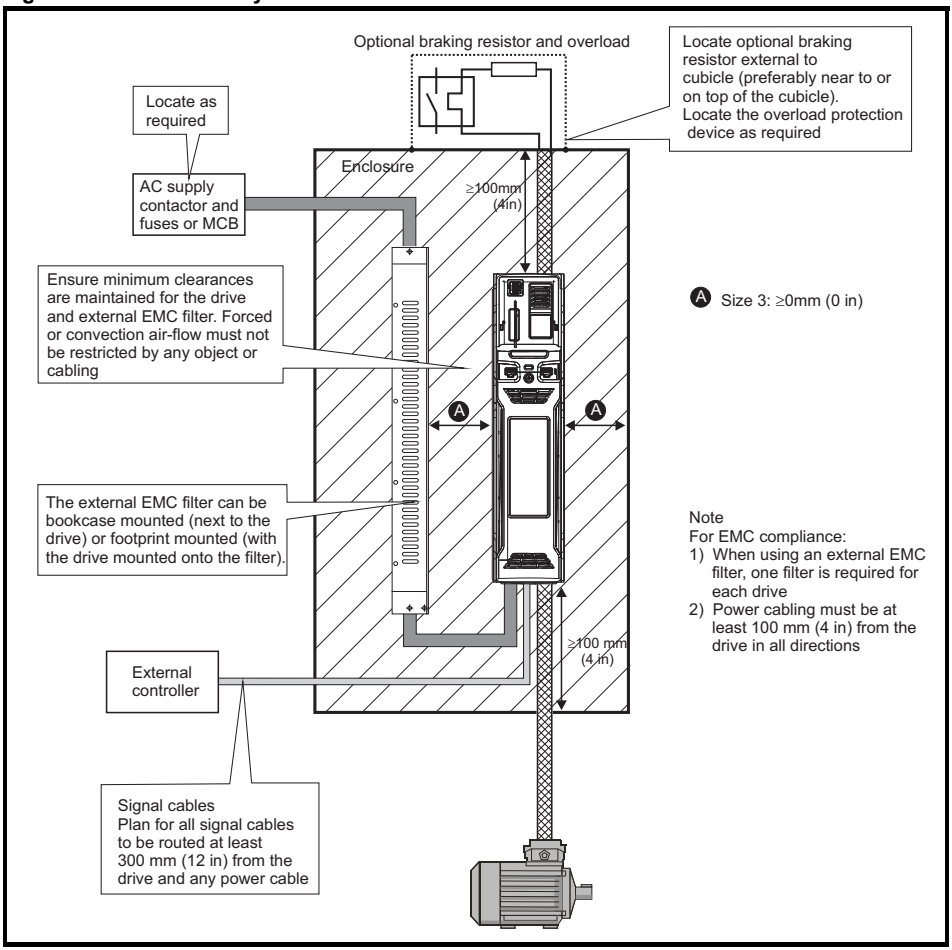


3.6 Enclosure

Enclosure Layout

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

Figure 3-3 Enclosure layout



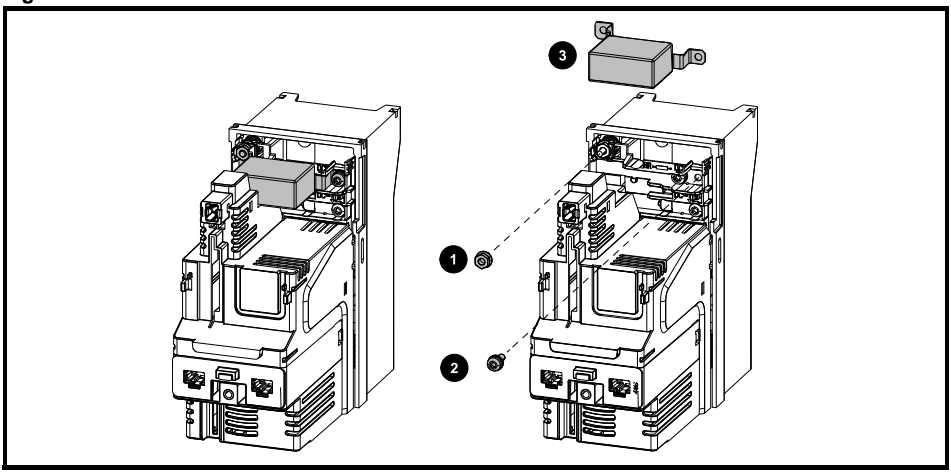
3.7 EMC filters

3.7.1 Internal 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 part of a regen system or it is connected to an IT supply then the internal EMC filter must be removed.

The internal EMC filter reduces radio-frequency emission into the line power supply. Where the motor cable is short, it permits the requirements of EN 61800-3:2004 to be met for the second environment - for further information see the *Unidrive M702 User Guide*. For longer motor cables the filter continues to provide a useful reduction in emission level, 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 the ground leakage current of the drive is unacceptable.

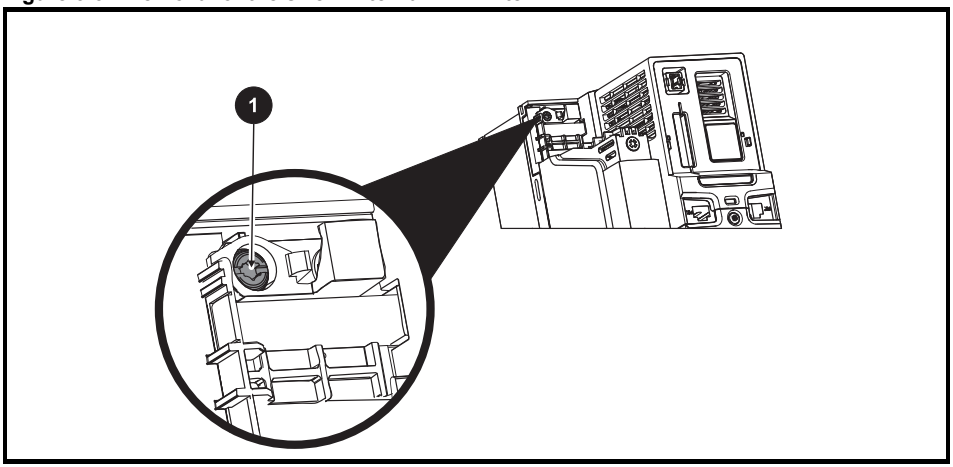
Figure 3-4 Removal of the Size 3 internal EMC filter



Remove the screw and nut as shown (1) and (2).

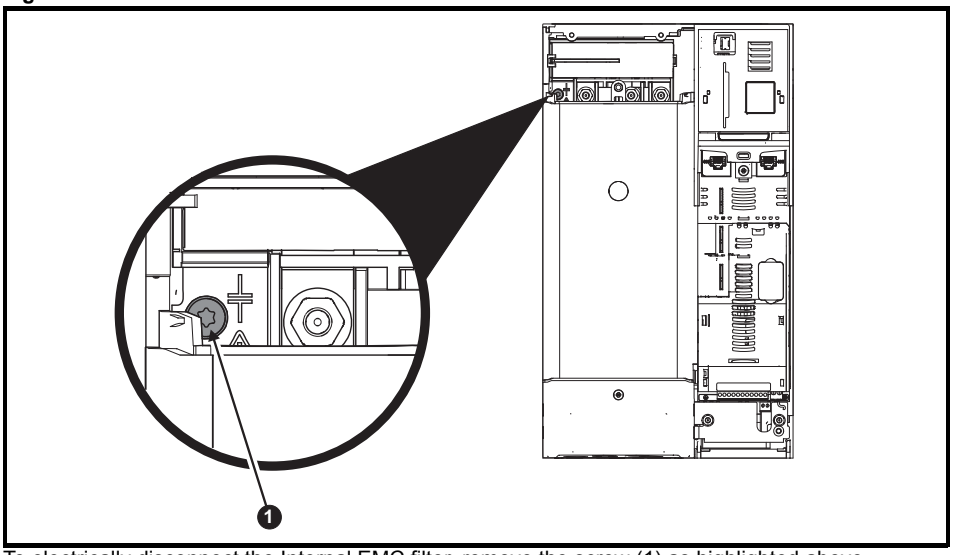
Lift away from securing points and then rotate away from the drive. Ensure the screw and nut are replaced and re-tightened with a maximum torque of 2 N m (1.47 lb ft).

Figure 3-5 Removal of the size 4 internal EMC filter



To electrically disconnect the Internal EMC filter, remove the screw (1) as highlighted above.

Figure 3-6 Removal of the size 6 internal EMC filter



To electrically disconnect the Internal EMC filter, remove the screw (1) as highlighted above.

3.7.2 External filter

The external EMC filter for size 3, 4 and 6 can be footprint or bookcase mounted.

For information on drive and EMC filter cross reference, refer to the *Unidrive M702 User Guide*.

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

For further information refer to the *Unidrive M702 User Guide*.

4 Electrical installation

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

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

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

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

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

SAFE TORQUE OFF function
The SAFE TORQUE OFF function does not remove dangerous voltages from the drive, the motor or any external option units.

Stored charge
The drive contains capacitors that remain charged to a potentially lethal voltage after the AC and / or DC power supply has been disconnected. If the drive has been energized, the AC and / or DC power supply must be isolated at least ten minutes before work may continue. Normally, the capacitors are discharged by an internal resistor. Under certain, unusual fault conditions, it is possible that the capacitors may fail to discharge, or be prevented from being discharged by a voltage applied to the output terminals. If the drive has failed in a manner that causes the display to go blank immediately, it is possible the capacitors will not be discharged. In this case, consult Control Techniques or their authorized distributor.

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

Permanent magnet motors
Permanent magnet motors generate electrical power if they are rotated, even when the supply to the drive is disconnected. If that happens then the drive will become energized through its motor terminals. If the motor load is capable of rotating the motor when the supply is disconnected, then the motor must be isolated from the drive before gaining access to any live parts.

4.1 Supply types

All drives are suitable for use on any supply type i.e TN-S, TN-C-S, TT and IT.

Supplies with voltage up to 600 V may have grounding at any potential, i.e. neutral, centre or corner ("grounded delta")

Supplies with voltage above 600 V may not have corner grounding

If an SI-Applications Plus or SI-Register module is installed in the drive, then the drive must not be used on a corner-grounded or centre-grounded delta supply if the supply voltage is above 300 V. If this is required, please contact the supplier of the drive for more information.

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

NOTE If the drive is to be used on an IT (ungrounded) supply, refer to the *Unidrive M702 User Guide* for more information.

4.2 Ratings

See section 2.3 *Ratings* on page 8.

Maximum continuous input current

The values of maximum continuous input current are given to aid the selection of cables and fuses. These values are stated for the worst case condition with the unusual combination of stiff supply with high imbalance. The value stated for the maximum continuous input current would only be seen in one of the input phases. The current in the other two phases would be significantly lower.

The values of maximum input current are stated for a supply with a 2 % negative phase-sequence imbalance and rated at the maximum supply fault current given in section 2.3 *Ratings* on page 8.

The nominal cable sizes in section 2.3 *Ratings* on page 8 are only a guide. Refer to local wiring regulations for the correct size of cables. In some cases a larger cable is required to avoid excessive voltage drop.

NOTE The nominal output cable sizes in section 2.3 *Ratings* on page 8 assume that the motor maximum current matches that of the drive. Where a motor of reduced rating is used the cable rating may be chosen to match that of the motor. To ensure that the motor and cable are protected against over-load, the drive must be programmed with the correct motor rated current.

Fuses

The AC supply to the drive must be installed with suitable protection against overload and short-circuits. section 2.3 *Ratings* on page 8 shows nominal fuse ratings. Failure to observe this requirement will cause risk of fire.

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

An MCB (miniature circuit breaker) or MCCB (moulded-case circuit-breaker) with type C may be used in place of fuses for size 3 under the following conditions:

- The fault-clearing capacity must be sufficient for the installation

Fuse Types

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

4.3 Power connections

Figure 4-1 Size 3 power and ground connections

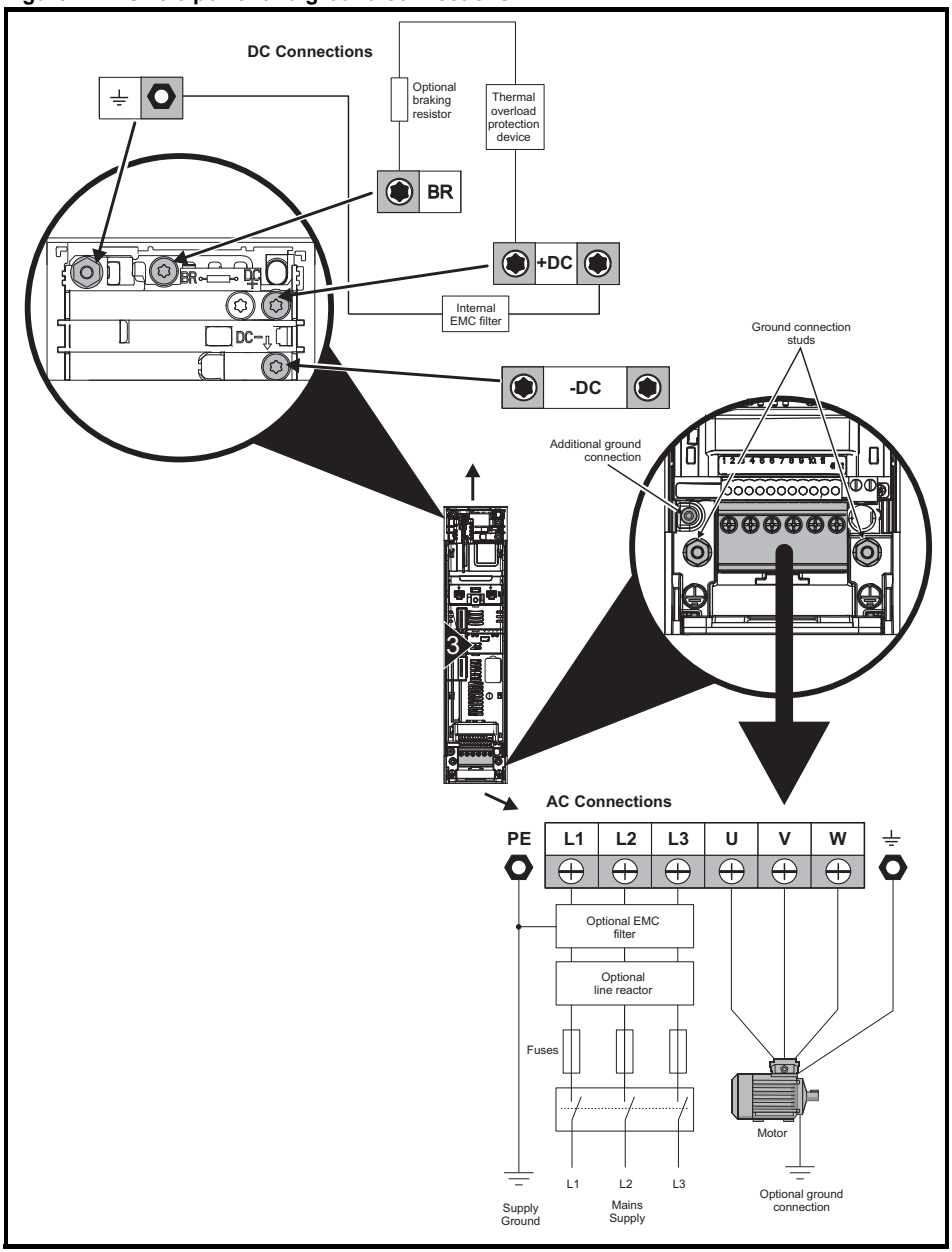


Figure 4-2 Size 4 power and ground connections

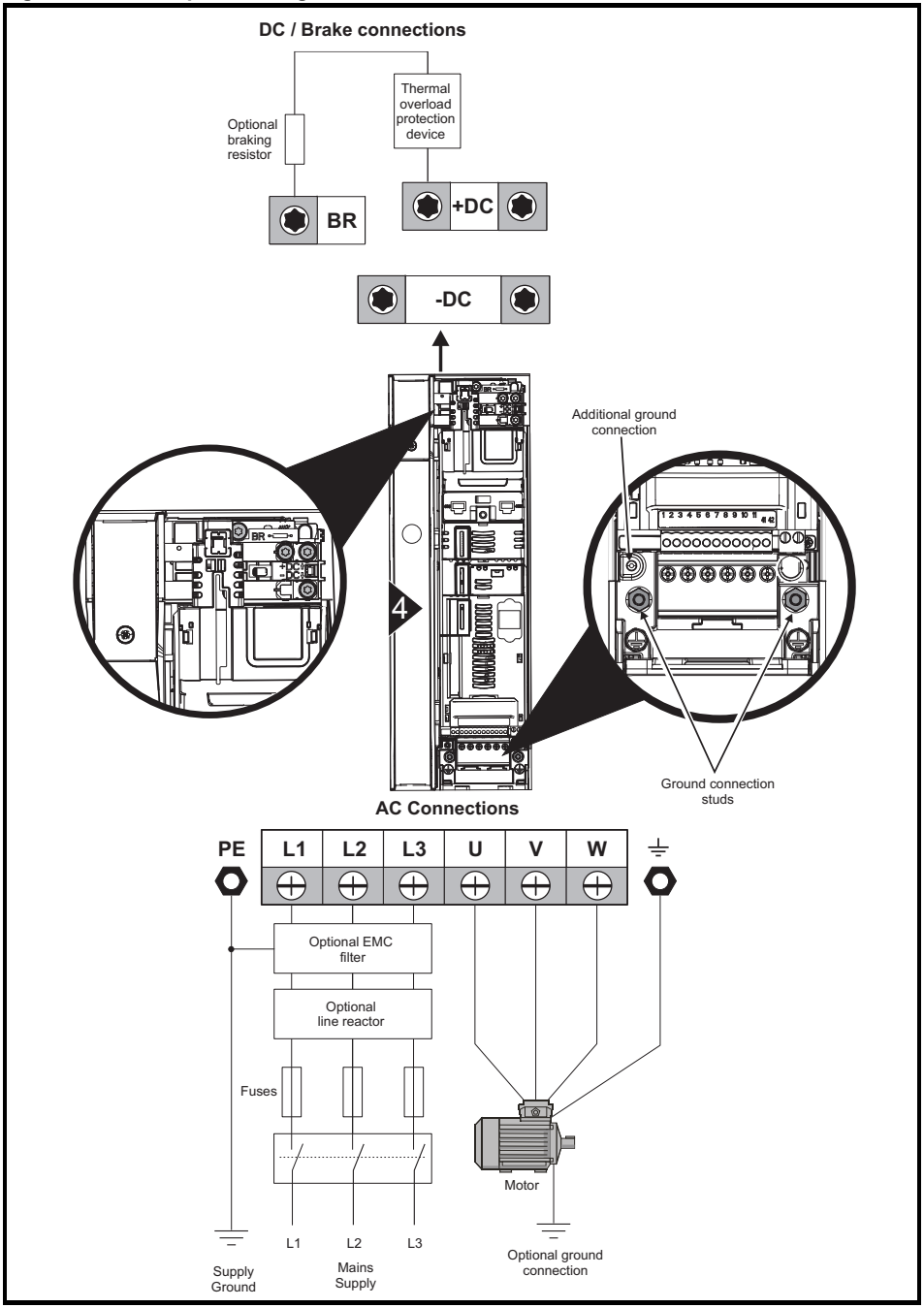
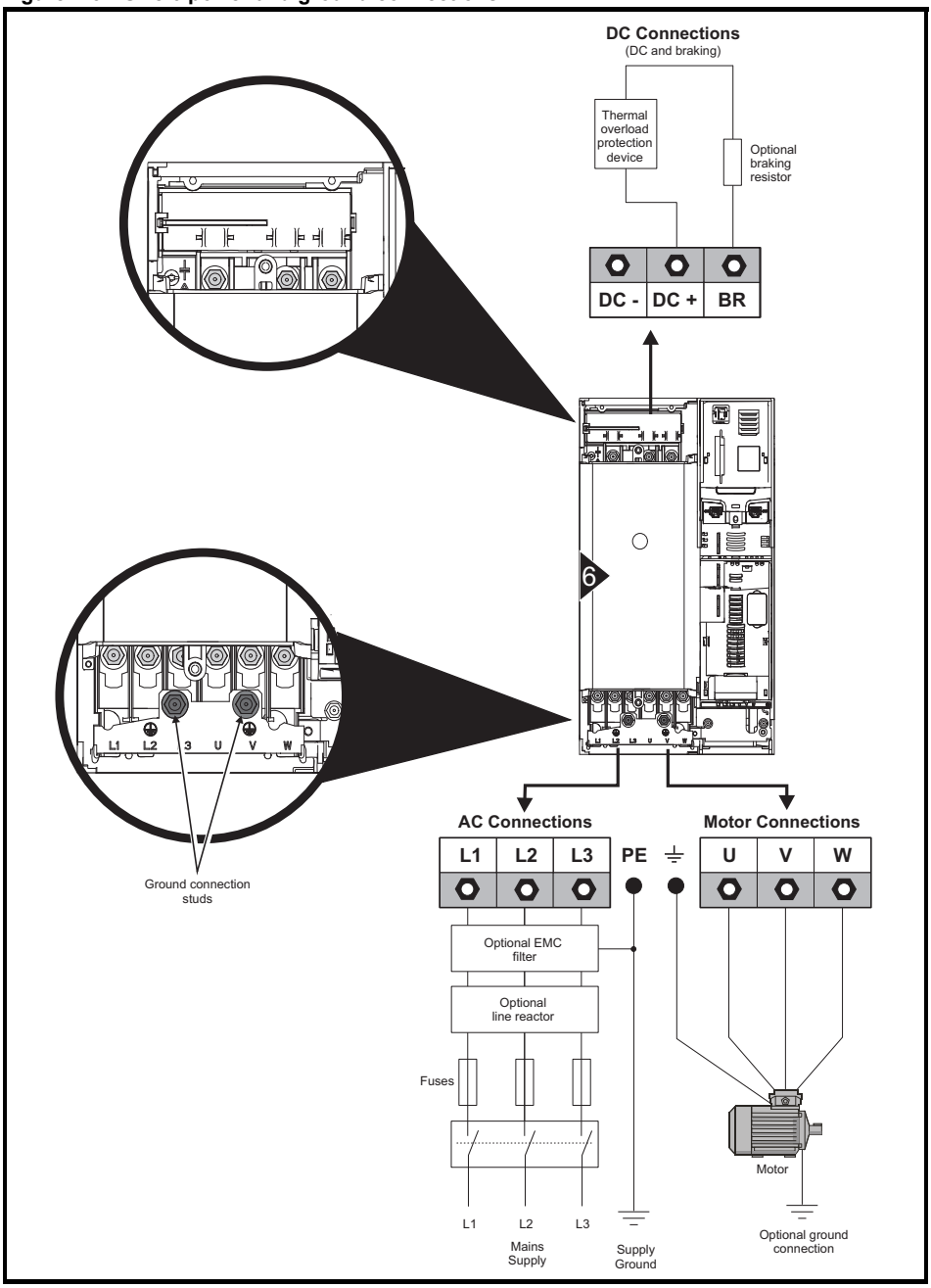


Figure 4-3 Size 6 power and ground connections



4.4 Ground connections

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

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

NOTE For further information on ground cable sizes, refer to Table 2-5 *Protective ground cable ratings* on page 10.

On size 3 and 4, the supply and motor ground connections are made using the M4 studs located either side of the drive near the plug-in power connectors. See Figure 4-1 for details.
On a size 6, the supply and motor ground connections are made using the M6 studs located above the supply and motor terminals. Refer to Figure 4-2.

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

4.5 Position feedback connections

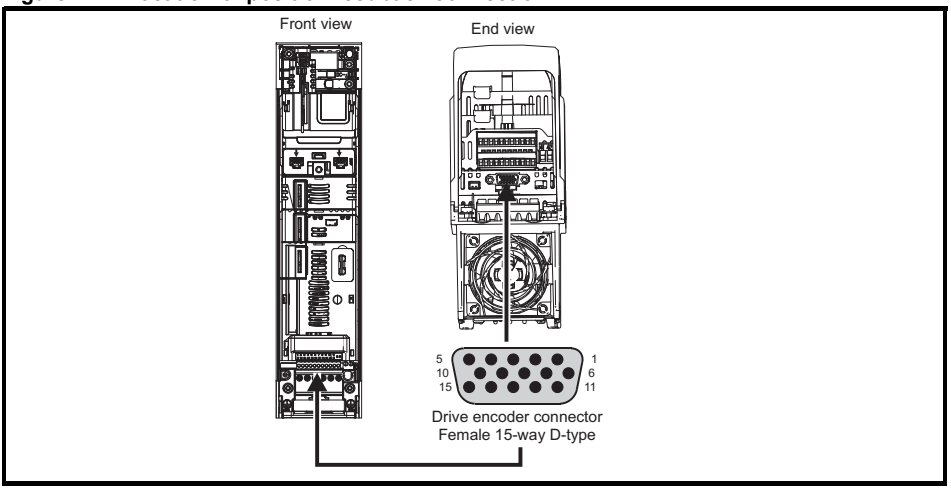
The following functions are provided via the 15-way high density D-type connector on the drive:

- Two position feedback interfaces (P1 and P2).
- One encoder simulation output.
- Two freeze trigger inputs (marker inputs).
- One thermistor input.

The P1 position interface is always available but the availability of the P2 position interface and the encoder simulation output depends on the position feedback device used on the P1 position interface.

NOTE Refer to the *Unidrive M702 User Guide* for information regarding the supported feedback devices on the P1 and P2 position interface and the encoder stimulation output.

Figure 4-4 Location of position feedback connection



4.5.1 Position feedback connection details

Table 4-1 P1 position feedback connection details

P1 Position feedback interface Pr 03.038	Connections														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
AB (0)	A	A\	B	B\	Z	Z\									
FD (1)	F	F\	D	D\	Z	Z\									
FR (2)	F	F\	R	R\	Z	Z\									
AB Servo (3)	A	A\	B	B\	Z	Z\	U	U\	V	V\	W	W\			
FD Servo (4)	F	F\	D	D\	Z	Z\	U	U\	V	V\	W	W\			
FR Servo (5)	F	F\	R	R\	Z	Z\	U	U\	V	V\	W	W\			
SC (6)	A (Cos)	A\ (Cos\)	B (Sin)	B\ (Sin\)	Z	Z\									
SC Hiperface (7)	Cos	Cosref	Sin	Sinref	DATA	DATA\									
EnDat (8)	DATA	DATA\	CLK	CLK\	Frz*3	Frz*3							+V*4	0 V	Th
SC EnDat (9)	A	A\	B	B\	DATA	DATA\					CLK	CLK\			
SSI (10)	DATA	DATA\	CLK	CLK\	Frz*3	Frz*3									
SC SSI (11)	A (Cos)	A\ (Cos\)	B (Sin)	B\ (Sin\)	DATA	DATA\					CLK	CLK\			
SC Servo (12)	A (Cos)	A\ (Cos\)	B (Sin)	B\ (Sin\)	Z	Z\	U	U\	V	V\	W	W\			
BiSS (13)	DATA	DATA\	CLK	CLK\	Frz*3	Frz*3									
Resolver (14)	Cos H	Cos L	Sin H	Sin L	Ref H	Ref L									
SC SC (15)	A (Cos)	A\ (Cos\)	B (Sin)	B\ (Sin\)	Z	Z\	C*1	C*1	D*2	D*2	Frz2*3	Frz2*3			
Commutation Only (16)							U	U\	V	V\	W	W\			

*1 - One sine wave per revolution

*2 - One cosine wave per revolution

*3 - Freeze inputs are shown in the table above as ‘Frz’.

*4 - The encoder power supply is selectable through parameter configuration to 5 Vdc, 8 Vdc and 15 Vdc.

Greyed cells are for P2 position feedback connections or simulated encoder outputs., refer to the Unidrive M702 User Guide for further information.

NOTE Frz and Frz\ on terminals 5 and 6 are for Freeze input 1. Frz2 and Frz2\ on terminals 11 and 12 are for Freeze input 2.

4.6 Braking resistor values

Model	Minimum resistance * Ω	Instantaneous power rating kW	Continuous power rating kW
200 V			
03200050	43	3.5	
03200066			
03200080			
03200106	29	5.3	
06200330	5	30.3	
06200440			
400 V			
03400025	74	8.3	
03400031			
03400045			
03400062			
03400078	58	10.6	
03400100			
06400350	18	35.5	
06400420			
06400470			
575 V			
06500100	18	50.7	
06500150			
06500190			
06500230			
06500290			
06500350			

* Resistor tolerance: ±10 %.

4.7 Communications connections

The drive offers Ethernet fieldbus communications. This enables the drive set-up, operation and monitoring to be carried out with a PC or controller if required.

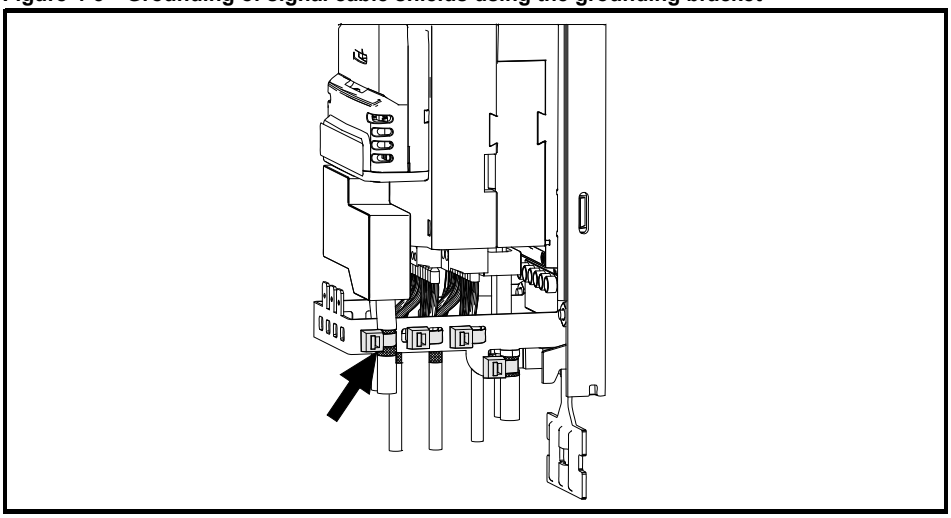
The drive provides two RJ45 connections with an Ethernet switch for easy network creation.

4.8 Shield connections

The following guidelines should be followed to ensure suppression of radio-frequency emission and good noise immunity. It is particularly recommended that the guidelines for the encoder cable be followed closely in order to avoid disturbance to the encoder operation from electrical noise.

Use the grounding bracket and grounding clamp supplied with the drive to terminate the shields at the drive.

Figure 4-5 Grounding of signal cable shields using the grounding bracket



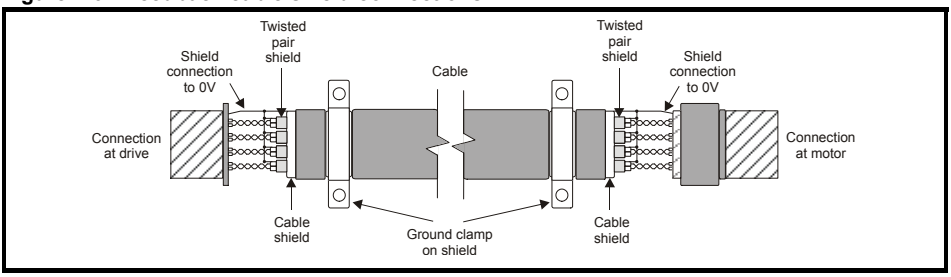
Motor cable: Use a motor cable with an overall shield. Connect the shield of the motor cable to the ground terminal of the motor frame using a link that is as short as possible and not exceeding 50 mm (2 in) long. A full 360 ° termination of the shield to the terminal housing of the motor is beneficial.

Encoder cable: For best shielding use cable with an overall shield and individual shields on twisted pairs, connect the cable as illustrated in Figure 4-6. Clamp the overall shield to grounded metallic surfaces at both the encoder and the drive.

Brake resistor cable: The optional braking resistor should also be wired with shielded cable. If unshielded wire is required refer to the *Unidrive M702 User Guide* for guidance.

Control cables: If the control wiring is to leave the enclosure, it must be shielded and the shield(s) clamped to the drive using the grounding bracket. Remove the outer insulating cover of the cable to ensure the shield(s) make contact with the bracket, but keep the shield(s) intact until as close as possible to the terminals.

Figure 4-6 Feedback cable shield connections



4.9 Control connections

For information on control connections, refer to the back cover of this guide.

5 Getting started

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

5.1 Understanding the display

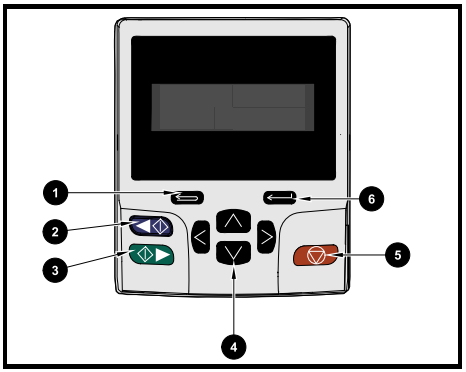
The keypad can only be mounted on the drive.

5.1.1 SI-Keypad

The SI-Keypad display consists of two rows of text. The upper row shows the drive status or the menu and parameter number currently being viewed. The lower row of the display line shows the parameter value or the specific trip type. The last two characters on the first row may display special indications. If more than one of these indications is active then the indications are prioritized as shown in Table 5-2.

When the drive is powered up the lower row will show the power up parameter defined by *Parameter Displayed At Power-up* (11.022).

Figure 5-1 SI-Keypad



1. Escape button
2. Start reverse (Auxiliary button)
3. Start forward
4. Navigation keys (x4)
5. Stop / Reset (red) button
6. Enter button

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

Table 5-1 Active action icon

Active action icon	Description	Priority
	Alarm active	
	Keypad real-time clock battery low	
	Drive security active	
	Motor map 2 active	
	User program running	
	Motor map 2 and User program running	

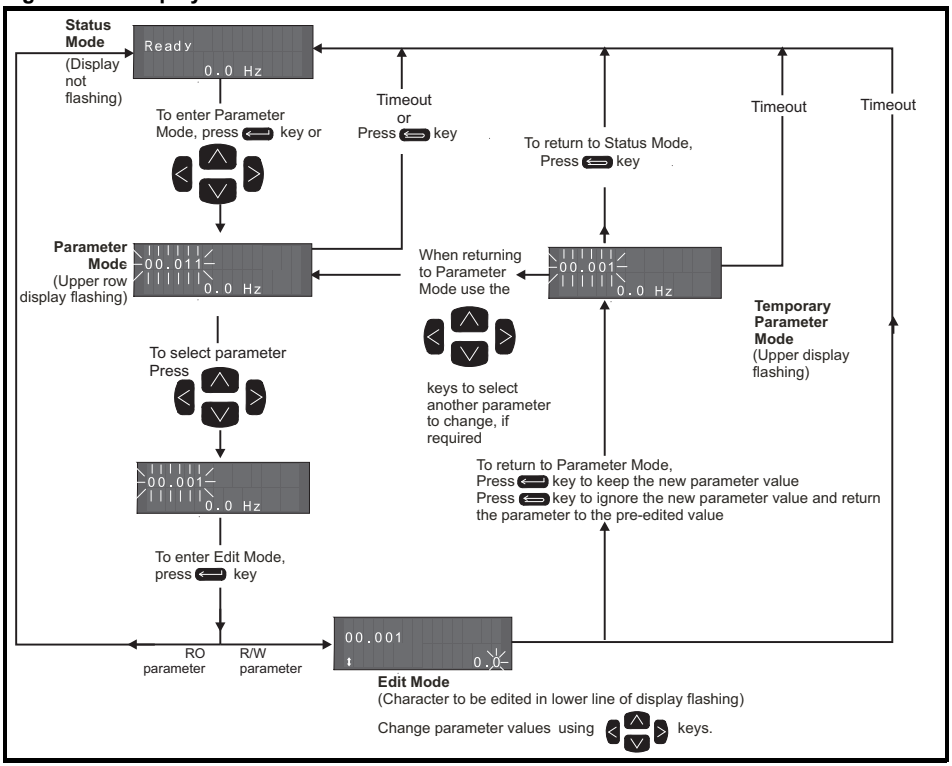
5.2 Keypad operation

5.2.1 Control buttons

The keypad consists of:

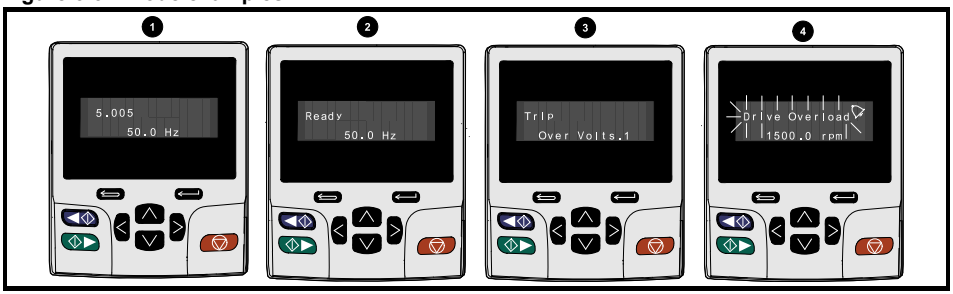
- Navigation Keys - Used to navigate the parameter structure and change parameter values.
- Enter / Mode button - Used to toggle between parameter edit and view mode.
- Escape / Exit button - Used to exit from parameter edit or view mode. In parameter edit mode, if parameter values are edited and the exit button pressed the parameter value will be restored to the value it had on entry to edit mode.
- Start forward button - Use to provide a 'Run' command if keypad mode is selected.
- Start reverse button - Used to control the drive if keypad mode is selected and the reverse button is activated.
- Stop / Reset button - Used to reset the drive. In keypad mode can be used for 'Stop'.

Figure 5-2 Display modes



The navigation keys can only be used to move between menus if Pr **00.049** has been set to show 'All Menus'

Figure 5-3 Mode examples



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

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

NOTE For new parameter-values to apply after the AC supply to the drive is interrupted, new values must be saved. Refer to section 5.7 *Saving parameters* on page 34.

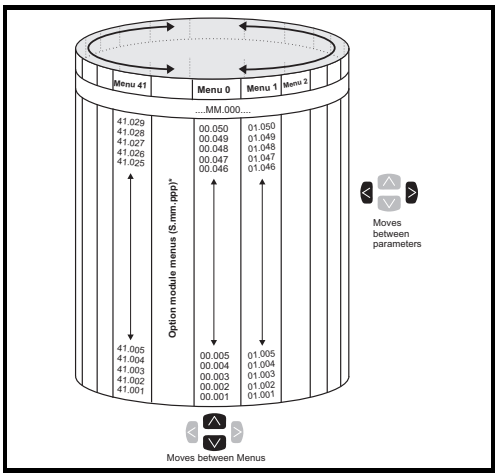
5.3 Menu 0

Menu 0 is used to bring together various commonly used parameters for basic easy set up of the drive. Appropriate parameters are copied from the advanced menus into menu 0 and thus exist in both locations. For further information, refer to Chapter 6 *Basic parameters (Menu 0)* on page 36.

5.4 Menu structure

The drive parameter structure consists of menus and parameters. The drive initially powers up so that only Menu 0 can be viewed. The up and down arrow buttons are used to navigate between parameters and once Pr **00.049** has been set to 'All Menus' the left and right buttons are used to navigate between menus. For further information, refer to section 5.11 *Parameter access level and security* on page 35.

Figure 5-4 Menu structure



The menus and parameters roll over in both directions. i.e. if the last parameter is displayed, a further press will cause the display to rollover and show the first parameter.

When changing between menus the drive remembers which parameter was last viewed in a particular menu and thus displays that parameter.

* The option module menus (S.mm.ppp) are only displayed if option modules are installed. Where S signifies the option module slot number and the mm.ppp signifies the menu and the parameter number of the option module's internal menus and parameter.

5.5 Advanced menus

The advanced menus consist of groups or parameters appropriate to a specific function or feature of the drive. Menus 0 to 41 can be viewed on the SI-Keypad. The option module menus are displayed as S.mm.ppp. Where S signifies the option module slot number and the mm.ppp signifies the menu and parameter number of the option module's internal menus and parameter. Menu 4.00.xxx is the same as menu 24.xxx.

Table 5-2 Advanced menu descriptions

Menu	Description
0	Commonly used basic set-up parameters for quick / easy programming
1	Frequency / Speed reference
2	Ramps
3	Frequency slaving, speed feedback and speed control
4	Torque and current control
5	Motor control
6	Sequencer and clock
7	Temperature monitoring
8	Digital I/O
9	Programmable logic, motorized pot, binary sum, timers and scope
10	Status and trips
11	Drive set-up and identification, serial communications
12	Threshold detectors and variable selectors
13	Standard motion control
14	User PID controller
15	Option module slot 1 set-up menu
16	Option module slot 2 set-up menu
17	Option module slot 3 set-up menu
18	General option module application menu 1
19	General option module application menu 2
20	General option module application menu 3
21	Second motor parameters
22	Menu 0 set-up
23	Not allocated
24	Ethernet module (slot 4) set-up menu
25	Option module slot 1 application parameters
26	Option module slot 2 application parameters
27	Option module slot 3 application parameters
28	Option module slot 4 application parameters
29	Reserved menu
30	Onboard user programming application menu
31-41	Advanced motion controller setup parameters
Slot 1	Slot 1 option menus*
Slot 2	Slot 2 option menus*
Slot 3	Slot 3 option menus*
Slot 4	Ethernet menus

*Only displayed when the option modules are installed.

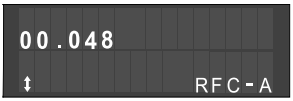
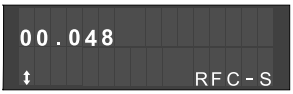
5.6 Changing the operating mode

Changing the operating mode returns all parameters to their default value, including the motor parameters. *User security status* (00.049) and *User security code* (00.034) are not affected by this procedure).

Procedure

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

1. Ensure the drive is not enabled, i.e. terminals 11 and 13 are open or Pr **06.015** is Off (0)
2. Enter either of the following values in Pr **mm.000**, as appropriate:
   1253 (50 Hz AC supply frequency)
   1254 (60 Hz AC supply frequency)
3. Change the setting of Pr **00.048** as follows:

Pr 00.048 setting		Operating mode
	1	Open-loop (Induction motor)
	2	RFC-A (Induction motor with position feedback)
	3	RFC-S (Permanent magnet motor with position feedback)

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

4. Either:

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

NOTE Entering 1253 or 1254 in Pr **mm.000** will only load defaults if the setting of Pr **00.048** has been changed.

5.7 Saving parameters

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

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

Procedure

1. Select 'Save Parameters'* in Pr **mm.000** (alternatively enter a value of 1000* in Pr **mm.000**)
2. Either:

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

* If the drive is in the under voltage state (i.e. when the control terminal 9 and 10 are being supplied from a low voltage DC supply) a value of 1001 must be entered into Pr **mm.000** to perform a save function.

5.8 Restoring parameter defaults

Restoring parameter defaults by this method saves the default values in the drives memory. *User security status* (00.049) and *User security code* (00.034) are not affected by this procedure).

Procedure

1. Ensure the drive is not enabled, i.e. terminals 11 and 13 are open or Pr **06.015** is Off (0)
2. Select 'Reset 50 Hz Defs' or 'Reset 60 Hz Defs' in Pr **mm.000**. (alternatively, enter 1233 (50 Hz settings) or 1244 (60 Hz settings) in Pr **mm.000**).
3. Either:

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

5.9 Displaying parameters with non-default values only

By selecting 'Show non-default' in Pr **mm.000** (Alternatively, enter 12000 in Pr **mm.000**), the only parameters that will be visible to the user will be those containing a non-default value. This function does not require a drive reset to become active. In order to deactivate this function, return to Pr **mm.000** and select 'No action' (alternatively enter a value of 0). Please note that this function can be affected by the access level enabled, refer to section 5.8 *Restoring parameter defaults* on page 35 for further information regarding access level.

5.10 Displaying destination parameters only

By selecting 'Destinations' in Pr **mm.000** (Alternatively enter 12001 in Pr **mm.000**), the only parameters that will be visible to the user will be destination parameters. This function does not require a drive reset to become active. In order to deactivate this function, return to Pr **mm.000** and select 'No action' (alternatively enter a value of 0).

Please note that this function can be affected by the access level enabled, refer to section 5.11 *Parameter access level and security* on page 35 for further information regarding access level.

5.11 Parameter access level and security

The parameter access level determines whether the user has access to Menu 0 only or to all the advanced menus (Menus 1 to 41) in addition to Menu 0. The User Security determines whether the access to the user is read only or read write. Both the User Security and Parameter Access Level can operate independently of each other as shown in Table 5-3.

Table 5-3 Parameter access level and security

User security status (11.044)	Access level	User security	Menu 0 status	Advanced menu status
0	Menu 0	Open	RW	Not visible
		Closed	RO	Not visible
1	All Menus	Open	RW	RW
		Closed	RO	RO
2	Read-only Menu 0	Open	RO	Not visible
		Closed	RO	Not visible
3	Read-only	Open	RO	RO
		Closed	RO	RO
4	Status only	Open	Not visible	Not visible
		Closed	Not visible	Not visible
5	No access	Open	Not visible	Not visible
		Closed	Not visible	Not visible

The default settings of the drive are Parameter Access Level Menu 0 and User Security Open i.e. read / write access to Menu 0 with the advanced menus not visible.

6 Basic parameters (Menu 0)

Parameter		Range			Default			Type[1]
		OL	RFC-A	RFC-S	OL	RFC-A	RFC-S	
00.001	Minimum Reference Clamp	±VM_NEGATIVE_REF_CLAMP1 Hz / rpm			0.0 Hz	0.0 rpm		RW
00.002	Maximum Reference Clamp	±VM_POSITIVE_REF_CLAMP Hz / rpm			50Hz default: 50.0 Hz 60Hz default: 60.0 Hz	50Hz default: 1500.0 Hz 60Hz default: 1800.0 Hz	3000.0 rpm	RW
00.003	Acceleration Rate 1	±VM_ACCEL_ RATE s /100 Hz	±VM_ACCEL_RATE s /1000 rpm		5.0 s/100 Hz	2.000 s/1000 rpm	0.200 s/1000 rpm	RW
00.004	Deceleration Rate 1	±VM_ACCEL_ RATE s /100 Hz	±VM_ACCEL_RATE s /1000 rpm		10.0 s/100 Hz	2.000 s/1000 rpm	0.200 s/1000 rpm	RW
00.005	Reference Selector	Preset (3), Keypad (4), Precision (5), Keypad Ref (6)			Preset (3)			RW
00.006	Symmetrical Current Limit	±VM_MOTOR1_CURRENT_LIMIT %			0.0 %			RW
00.007	Open-loop Control Mode	Ur S (0), Ur (1), Fixed (2), Ur Auto (3), Ur I (4), Square (5), Current 1P (6)			Ur I (4)			RW
	Speed Controller Proportional Gain Kp1		0.0000 to 200.000 s/rad			0.0300 s/rad	0.0100 s/rad	RW
00.008	Low Frequency Voltage Boost	0.0 to 25.0 %			3.0 %			RW
	Speed Controller Integral Gain Ki1		0.00 to 655.35 s^2/rad			0.10 s^2/rad	1.00 s^2/rad	RW
00.009	Dynamic V to F Select	Off (0) or On (1)			Off (0)			RW
	Speed Controller Differential Feedback Gain Kd 1		0.00000 to 0.65535 1/rad			0.00000 1/rad		RW
00.010	Motor Rpm	±180000 rpm			0 rpm			RW
	Speed Feedback		±VM_SPEED rpm					RO
00.011	Output Frequency	±VM_SPEED_FREQ_REF Hz						RO
	P1 Position			0 to 65535				RO
00.012	Current Magnitude	±VM_DRIVE_CURRENT_UNIPOLAR A						RO
00.013	Torque Producing Current	±VM_DRIVE_CURRENT A						RO
00.014	Torque Mode Selector	0 or 1	0 to 5		0			RW
00.015	Ramp Mode Select	Fast (0), Standard (1), Std boost (2)	Fast (0), Standard (1)		Standard (1)			RW
00.016	Ramp Enable		Off (0) or On (1)			On (1)		RW
00.017	Current Reference Filter Time Constant		0.0 to 25.0 ms			0.0 ms		RW
00.022	Bipolar Reference Enable	Off (0) or On (1)			Off (0)			RW
00.023	Jog Reference	0.0 to 400.0 Hz	0.0 to 4000.0 rpm		0.0			RW
00.024	Preset Reference 1	±VM_SPEED_FREQ_REF rpm			0.0			RW
00.025	Preset Reference 2	±VM_SPEED_FREQ_REF rpm			0.0			RW
00.026	Preset Reference 3	±VM_SPEED_ FREQ_REF Hz			0.0			RW
	Overspeed Threshold		0 to 50000 rpm			0.0		RW

Parameter		Range			Default			Type[1]
		OL	RFC-A	RFC-S	OL	RFC-A	RFC-S	
00.027	Preset Reference 4	±VM_SPEED_FREQ_REF Hz			0.0			RW
	P1 Rotary Lines Per Revolution		1 to 100000			1024	4096	RW
00.028	Enable Auxiliary Key	0 to 2			0			RW
00.029	NV Media Card Data Previously Loaded	0 to 999						RO
00.030	Parameter copying	None (0), Read (1), Program (2), Auto (3), Boot (4)			None (0)			RW
00.031	Drive Rated Voltage	200 V (0), 400 V (1), 575 V (2), 690 V (3)						RO
00.032	Maximum Heavy Duty Rating	0.000 to 99999.999 A						RO
00.033	Catch A Spinning Motor	Disable (0), Enable (1), Fwd Only (2), Rev Only (3)			Disable (0)			RW
	Motor Parameter Adaptive Control		0 to 2			0		RW
00.034	User Security Code	0 to 2^{31}-1			0			RW
00.037	Active IP Address	000.000.000.000 to 255.255.255.255						RO
00.038	Current Controller Kp Gain	0 to 30000			20	150		RW
00.039	Current Controller Ki Gain	0 to 30000			40	2000		RW
00.040	Auto-tune	0 to 2	0 to 3	0 to 4	0			RW
00.041	Maximum Switching Frequency	2 kHz (0), 3 kHz (1), 4 kHz (2), 6 kHz (3), 8 kHz (4), 12 kHz (5), 16 kHz (6)			3kHz (1)			RW
00.042	Number Of Motor Poles	Automatic (0) to 480 Poles (240)			Automatic (0)		6 Poles (3)	RW
00.043	Rated Power Factor	0.000 to 1.000			0.850			RW
	Position Feedback Phase Angle			0.0 to 359.9 °				RW
00.044	Rated Voltage	±VM_AC_VOLTAGE_SET			200 V drive: 230 V 50 Hz default 400 V drive: 400 V 60 Hz default 400 V drive: 460 V 575 V drive: 575 V 690 V drive: 690 V			RW
00.045	Rated Speed	0 to 180000 rpm	0.00 to 50000.00 rpm		50Hz default: 1500 rpm 60Hz default: 1800rpm	50Hz default: 1450 rpm 60Hz default: 1750rpm		RW
	Motor Thermal Time Constant 1			1.0 to 3000.0 s			89.0 s	RW
00.046	Rated Current	±VM_RATED_CURRENT			Maximum Heavy Duty Rating (11.032)			RW
00.047	Rated Frequency	0.0 to 3000.0 Hz	0.0 to 1667.0 Hz		50Hz default: 50.0 Hz 60Hz default: 60.0 Hz			RW
00.048	Drive Mode	Open-loop (1), RFC-A (2), RFC-S (3), Regen (4)			Open-loop (1)	RFC-A (2)	RFC-S (3)	RW
00.049	User Security Status	Menu 0 (0), All Menus (1), Read-only Menu 0 (2), Read-only (3), Status Only (4), No Access (5)			Menu 0 (0)			RW
00.050	Software Version	0 to 99999999						RO
00.051	Action On Trip Detection	0 to 31			0			RW

[1] RW = Read Write, RO = Read Only.

6.1 Parameter descriptions

6.1.1 Pr mm.000

Pr **mm.000** is available in all menus, commonly used functions are provided as text strings in Pr **mm.000** shown in Table 6-1. The functions in Table 6-1 can also be selected by entering the appropriate numeric values (as shown in Table 6-2) in Pr **mm.000**. For example, enter 7001 in Pr **mm.000** to erase the file in NV media card location 001.

Table 6-1 Commonly used functions in Pr mm.000

String	Action
Save parameters	Save parameters when under voltage is not active and low voltage threshold is not active
Load file 1	Load the drive parameters or user program file from NV media card file 001
Save to file 1	Transfer the drive parameters to parameter file 001
Load file 2	Load the drive parameters or user program file from NV media card file 002
Save to file 2	Transfer the drive parameters to parameter file 002
Load file 3	Load the drive parameters or user program file from NV media card file 003
Save to file 3	Transfer the drive parameters to parameter file 003
Show non-default	Displays parameters that are different from defaults
Destinations	Displays parameters that are set
Reset 50Hz Defs	Load parameters with standard (50 Hz) defaults
Reset 60Hz Defs	Load parameters with US (60 Hz) defaults
Reset modules	Reset all option modules
Read Enc.NP P1	Transfer electronic nameplate motor parameters to the drive from the P1 encoder
Read Enc.NP P2	Transfer electronic nameplate motor parameters to the drive from the P2 encoder

Table 6-2 Functions in Pr mm.000

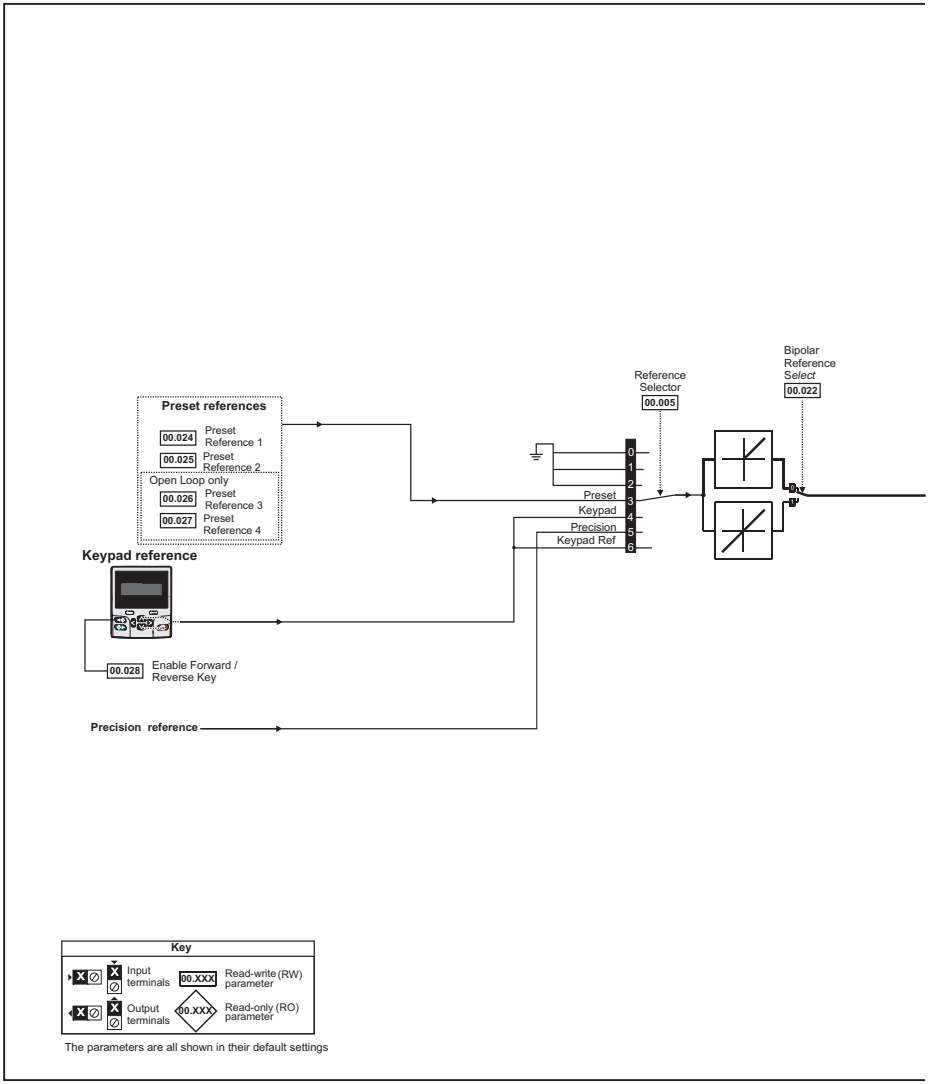
Value	Action
1000	Save parameters when *Under Voltage Active* (Pr 10.016) is not active and *Low Under Voltage Threshold Select* mode (Pr 06.067 = Off) is not active.
1001	Save parameter under all conditions
1070	Reset all option modules
1233	Load standard (50 Hz) defaults
1234	Load standard (50 Hz) defaults to all menus except option module menus (i.e 15 to 20 and 24 to 28)
1244	Load US (60 Hz) defaults
1245	Load US (60 Hz) defaults to all menus except option module menus (i.e 15 to 20 and 24 to 28)
1253	Change drive mode and load standard (50 Hz) defaults
1254	Change drive mode and load US (60 Hz) defaults
1255	Change drive mode and load standard (50 Hz) defaults except for menus 15 to 20 and 24 to 28
1256	Change drive mode and load US (60 Hz) defaults except for menus 15 to 20 and 24 to 28
1299	Reset {Stored HF} trip.
2001*	Create a boot file on a non-volatile media card based on the present drive parameters including all Menu 20 parameters
4yyy*	NV media card: Transfer the drive parameters to parameter file xxx
5yyy*	NV media card: Transfer the onboard user program to onboard user program file xxx
6yyy*	NV media card: Load the drive parameters from parameter file xxx or the onboard user program from onboard user program file xxx
7yyy*	NV media card: Erase file xxx

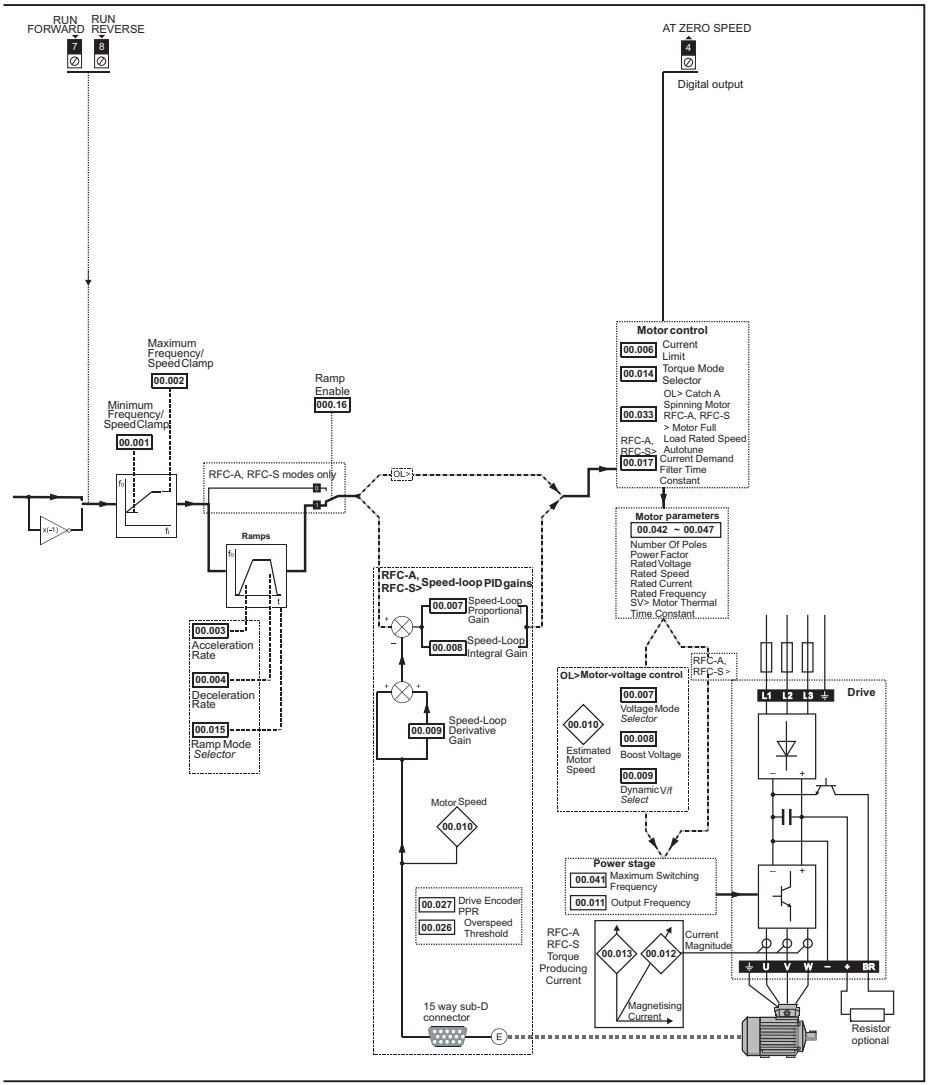
Value	Action
8yyy*	NV Media card: Compare the data in the drive with file xxx
9555*	NV media card: Clear the warning suppression flag
9666*	NV media card: Clear the warning suppression flag
9777*	NV media card: Clear the read-only flag
9888*	NV media card: Set the read-only flag
9999*	NV media card: Erase and format the NV media card
110S0	Transfer electronic nameplate motor object parameters from the drive to an encoder connected to the drive or an option module.
110S1	Transfer electronic nameplate motor objects parameters from an encoder connected to the drive or option module to the drive parameters.
110S2	As 110S0, but for performance object 1
110S3	As 110S1, but for performance object 1
110S4	As 110S0, but for performance object 2
110S5	As 110S1, but for performance object 2
110S6	Transfer electronic nameplate motor object parameters from the drive to an encoder connected to the drive or an option module in the Unidrive SP format.
12000**	Only display parameters that are different from their default value. This action does not require a drive reset.
12001**	Only display parameters that are used to set-up destinations (i.e. DE format bit is 1). This action does not require a drive reset.
15xxx*	Transfer the user program in an option module installed in slot 1 to a non-volatile media card file xxx
16xxx*	Transfer the user program in an option module installed in slot 2 to a non-volatile media card file xxx
17xxx*	Transfer the user program in an option module installed in slot 3 to a non-volatile media card file xxx
18xxx*	Transfer the user program from file xxx in a non-volatile media card to an option module installed in slot 1.
19xxx*	Transfer the user program from file xxx in a non-volatile media card to an option module installed in slot 2.
20xxx*	Transfer the user program from file xxx in a non-volatile media card to an option module installed in slot 3.
21xxx*	Transfer the user program in an option module installed in slot 4 to a non-volatile media card file xxx.
22xxx*	Transfer the user program from file xxx in a non-volatile media card to an option module installed in slot 4.

* See section 8 *NV Media Card Operation* on page 51 for more information on these functions.

** These functions do not require a drive reset to become active. All other functions require a drive reset to initiate the function.

Figure 6-1 Menu 0 logic diagram




RUN FORWARD
RUN REVERSE
7
8
AT ZERO SPEED
4
Digital output
Maximum Frequency/ Speed Clamp
00.002
Minimum Frequency/ Speed Clamp
00.001
Ramp Enable
000.16
RFC-A, RFC-S modes only
Ramps
00.003
Acceleration Rate
00.004
Deceleration Rate
00.015
Ramp Mode Selector
RFC-A, RFC-S>
Speed-loop PID gains
00.007
Speed-Loop Proportional Gain
00.008
Speed-Loop Integral Gain
00.009
Speed-Loop Derivative Gain
Motor Speed
00.010
00.027
Drive Encoder PPR
00.026
Overspeed Threshold
15 way sub-D connector
Motor control
00.006
Current Limit
00.014
Torque Mode Selector
00.033
OL> Catch A Spinning Motor
RFC-A, RFC-S > Motor Full Load Rated Speed
RFC-A, RFC-S>
00.017
Autotune
Current Demand Filter Time Constant
Motor parameters
00.042 ~ 00.047
Number Of Poles
Power Factor
Rated Voltage
Rated Speed
Rated Current
Rated Frequency
SV> Motor Thermal Time Constant
OL>Motor-voltage control
00.007
Voltage Mode Selector
00.010
Estimated Motor Speed
00.008
Boost Voltage
00.009
Dynamic V/f Select
Power stage
00.041
Maximum Switching Frequency
00.011
Output Frequency
RFC-A RFC-S Torque Producing Current
00.013
00.012
Current Magnitude
Magnetising Current
Drive
L1 L2 L3
+ U V W – BR
Resistor optional

7 Running the motor

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

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

The values of the motor parameters affect the protection of the motor.
The default values in the drive should not be relied upon.
It is essential that the correct value is entered in Pr **00.046** *Rated Current*. This affects the thermal protection of the motor.

If the drive is started using the keypad it will run to the speed defined by the keypad reference (Pr **01.017**). This may not be acceptable depending on the application. The user must check in Pr **01.017** and ensure that the keypad reference has been set to 0.

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

7.1 Quick start Connections

7.1.1 Basic requirements

This section shows the basic connections which must be made for the drive to run in the required mode. For minimal parameter settings to run in each mode please see the relevant part of section 7.2 *Quick Start commissioning / start-up* on page 45.

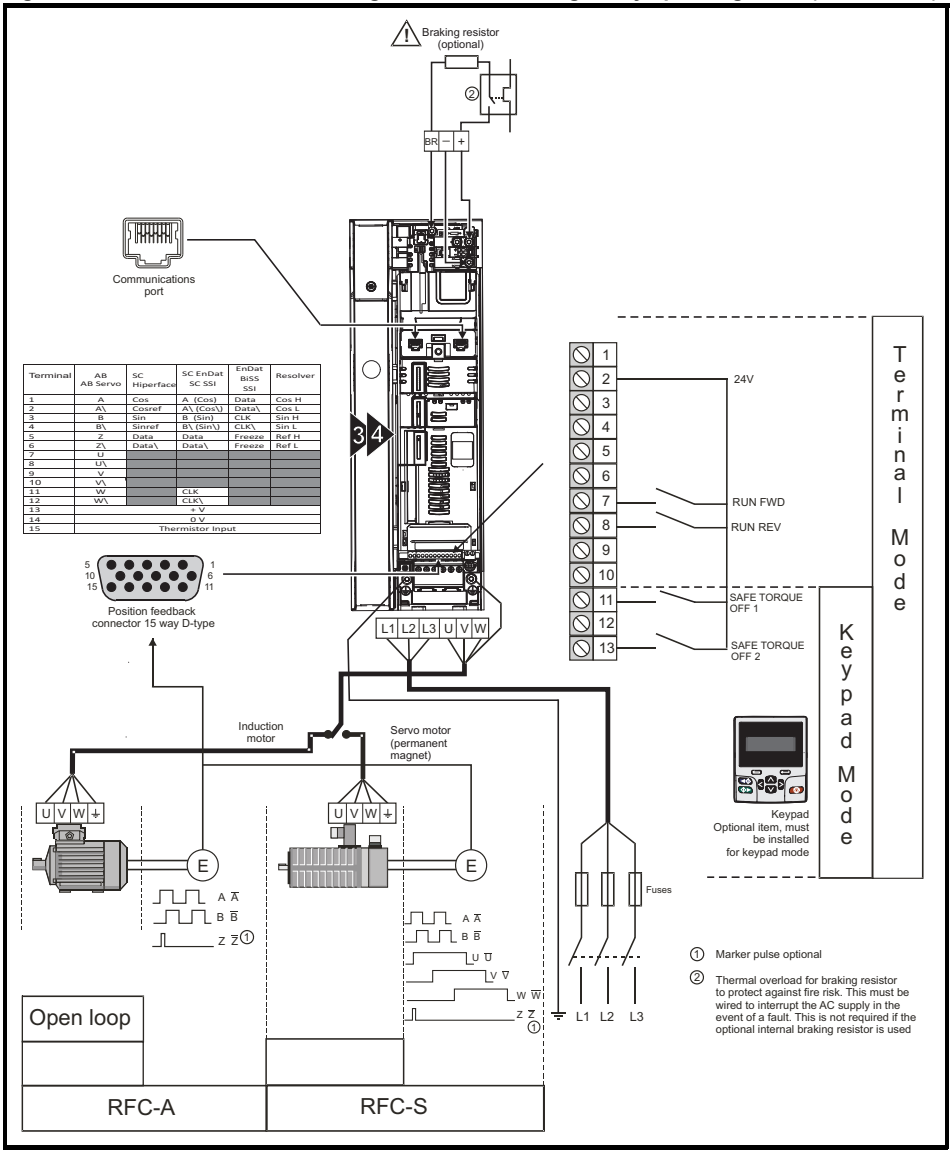
Table 7-1 Minimum control connection requirements for each control mode

Drive control method	Requirements
Terminal mode	Drive enable Speed / Torque reference Run forward / Run reverse
Keypad mode	Drive enable
Communications	Drive enable Communications link

Table 7-2 Minimum control connection requirements for each mode of operation

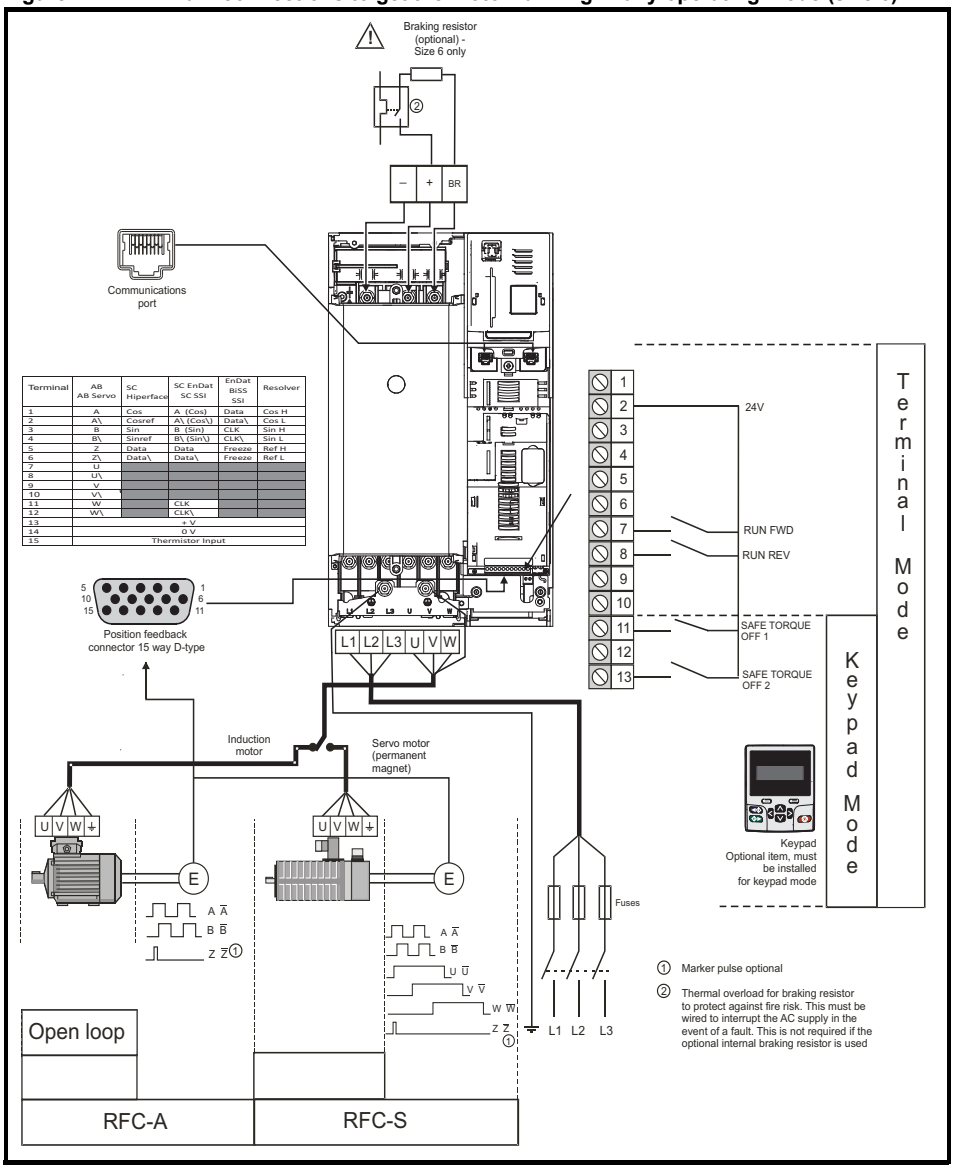
Operating mode	Requirements
Open loop mode	Induction motor
RFC-A mode (with position feedback)	Induction motor with position feedback
RFC-S mode (with position feedback)	Permanent magnet motor with position feedback

Figure 7-1 Minimum connections to get the motor running in any operating mode (size 3 and 4)



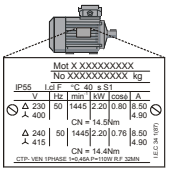
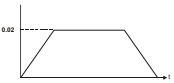
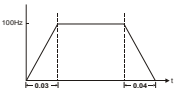
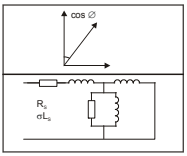
Terminal	AB AB Servo	SC Hiperface	SC EnDat SC SSI	EnDat BiSS SSI	Resolver
1	A	Cos	A (Cos)	Data	Cos H
2	A\	Cosref	A\ (Cos\)	Data\	Cos L
3	B	Sin	B (Sin)	CLK	Sin H
4	B\	Sinref	B\ (Sin\)	CLK\	Sin L
5	Z	Data	Data	Freeze	Ref H
6	Z\	Data\	Data\	Freeze	Ref L
7	U				
8	U\				
9	V				
10	V\				
11	W		CLK		
12	W\		CLK\		
13	+ V				
14	0 V				
15	Thermistor Input				

Figure 7-2 Minimum connections to get the motor running in any operating mode (size 6)



7.2 Quick Start commissioning / start-up

7.2.1 Open loop

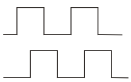
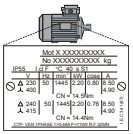
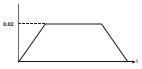
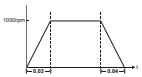
Action	Detail	
Before power-up	Ensure: • The drive enable signal is not given (terminal 11and 13) • Run signal is not given • Motor is connected	
Power-up the drive	Verify that Open Loop mode is displayed as the drive powers up. If the mode is incorrect see section 5.6 *Changing the operating mode* on page 34. Ensure: • Drive displays 'Inhibit'	
Enter motor nameplate details	Enter: • Motor rated frequency in Pr **00.047** (Hz) • Motor rated current in Pr **00.046** (A) • Motor rated speed in Pr **00.045** (rpm) • Motor rated voltage in Pr **00.044** (V) - check if ⅄ or Δ connection	
Set maximum frequency	Enter: • Maximum frequency in Pr **00.002** (Hz)	
Set accel. / decel. rates	Enter: • Acceleration rate in Pr **00.003** (s /100 Hz) • Deceleration rate in Pr **00.004** (s /100 Hz) (If braking resistor installed, set Pr **00.015** = FAST. Also ensure Pr **10.030,** Pr **10.031** and Pr **10.061** are set correctly, otherwise premature 'Brake R Too Hot' trips may be seen).	
Motor thermistor set-up	The motor thermistor connection is made through the drive encoder port (terminal 15). The thermistor type is selected in *P1 Thermistor Type* (03.118).	
Autotune	The drive is able to perform either a stationary or a rotating auto-tune. The motor must be at a standstill before an auto-tune is enabled. A rotating auto-tune should be used whenever possible so the measured value of power factor of the motor is used by the drive **WARNING** A rotating auto-tune will cause the motor to accelerate up to $^{2}/_{3}$ base speed in the direction selected regardless of the reference provided. Once complete the motor will coast to a stop. The enable signal must be removed before the drive can be made to run at the required reference. The drive can be stopped at any time by removing the run signal or removing the drive enable. • A stationary auto-tune can be used when the motor is loaded and it is not possible to uncouple the load from the motor shaft. A stationary auto-tune measures the stator resistance of the motor and the voltage offset in the drive. These are required for good performance in vector control modes. A stationary auto-tune does not measure the power factor of the motor so the value on the motor nameplate must be entered into Pr **00.043**.	

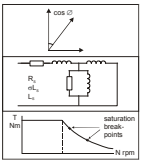
Action	Detail	
Autotune (cont)	• A rotating auto-tune should only be used if the motor is uncoupled. A rotating auto-tune first performs a stationary auto-tune before rotating the motor at $^{2}/_{3}$ base speed in the direction selected. The rotating auto-tune measures the power factor of the motor. **To perform an auto-tune:** • Set Pr **00.040** = 1 for a stationary auto-tune or set Pr **00.040** = 2 for a rotating auto-tune • Close the Drive Enable signal (terminal 11 and 13). The drive will display 'Ready'. • Close the run signal (terminal 7 or 8). The lower display will flash 'Autotune' while the drive is performing the auto-tune. • Wait for the drive to display 'Ready' or 'Inhibit' and for the motor to come to a standstill. • Remove the drive enable and run signal from the drive.	
Save parameters	Select 'Save Parameters' in Pr **mm.000** (alternatively enter a value of 1000 in Pr **mm.000**) and press red  reset button or toggle the reset digital input.	
Run	Drive is now ready to run	

7.2.2 RFC-A mode (with position feedback)

Induction motor with position feedback

For simplicity only an incremental quadrature encoder will be considered here. For information on setting up one of the other supported speed feedback devices, refer to *Setting up a feedback device* in the *Unidrive M702 User Guide.*

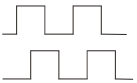
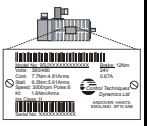
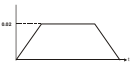
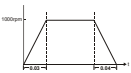
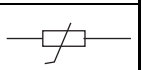
Action	Detail	
Before power-up	Ensure: • Drive Enable signal is not given (terminal 11 and 13) • Run signal is not given • Motor and feedback device are connected	
Power-up the drive	• Verify that RFC-A mode is displayed as the drive powers up. If the mode is incorrect see section section 5.6 *Changing the operating mode* on page 34. Ensure: • Drive displays 'Inhibit'	
Set motor feedback parameters	**Incremental encoder basic set-up** Enter: • Drive encoder type in Pr **03.038** = AB (0): Quadrature encoder • Encoder power supply in Pr. **03.036** = 5 V (0), 8 V (1) or 15 V (2). **NOTE** If output voltage from the encoder is >5 V, then the termination resistors must be disabled Pr **03.039** to 0. **CAUTION** Setting the encoder voltage supply too high for the encoder could result in damage to the feedback device. • Drive encoder Lines Per Revolution (LPR) in Pr **03.034** (set according to encoder) • Drive encoder termination resistor setting in Pr **03.039**: **0** = A-A\, B-B\, Z-Z\ termination resistors disabled **1** = A-A\, B-B\, termination resistors enabled, Z-Z\ termination resistors disabled **2** = A-A\, B-B\, Z-Z\ termination resistors enabled	
Enter motor nameplate details	Enter: • Motor rated frequency in Pr **00.047** (Hz) • Motor rated current in Pr **00.046** (A) • Motor rated speed in Pr **00.045** (rpm) • Motor rated voltage in Pr **00.044** (V) - check if ⅄ or △ connection	
Set maximum speed	Enter: • Maximum speed in Pr **00.002** (rpm)	
Set acceleration / deceleration rates	Enter: • Acceleration rate in Pr **00.003** (s/1000 rpm) • Deceleration rate in Pr **00.004** (s/1000 rpm) (If braking resistor installed, set Pr **00.015** = FAST. Also ensure Pr **10.030**, Pr **10.031** and Pr **10.061** are set correctly, otherwise premature 'Brake R Too Hot' trips may be seen).	

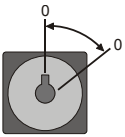
Action	Detail	
Motor thermistor set-up	The motor thermistor connection is made through the drive encoder port (terminal 15). The thermistor type is selected in *P1 Thermistor Type* (03.118).	
Autotune	The drive is able to perform either a stationary or a rotating auto-tune. The motor must be at a standstill before an auto-tune is enabled. A stationary auto-tune will give moderate performance whereas a rotating auto-tune will give improved performance as it measures the actual values of the motor parameters required by the drive. **WARNING** A rotating auto-tune will cause the motor to accelerate up to $^2/_3$ base speed in the direction selected regardless of the reference provided. Once complete the motor will coast to a stop. The enable signal must be removed before the drive can be made to run at the required reference. The drive can be stopped at any time by removing the run signal or removing the drive enable. • A stationary auto-tune can be used when the motor is loaded and it is not possible to uncouple the load from the motor shaft. The stationary auto-tune measures the stator resistance and transient inductance of the motor. These are used to calculate the current loop gains, and at the end of the test the values in Pr **00.038** and Pr **00.039** are updated. A stationary auto-tune does not measure the power factor of the motor so the value on the motor nameplate must be entered into Pr **00.043**. • A rotating auto-tune should only be used if the motor is uncoupled. A rotating auto-tune first performs a stationary auto-tune before rotating the motor at $^2/_3$ base speed in the direction selected. The rotating auto-tune measures the stator inductance of the motor and calculates the power factor. **To perform an auto-tune:** • Set Pr **00.040** = 1 for a stationary auto-tune or set Pr **00.040** = 2 for a rotating auto-tune • Close the drive enable signal (terminal 11 and 13). The drive will display 'Ready'. • Close the run signal (terminal 7 or 8). The lower display will flash 'Autotune' while the drive is performing the auto-tune. • Wait for the drive to display 'Ready' or 'Inhibit' and for the motor to come to a standstill • Remove the drive enable and run signal from the drive.	
Save parameters	Select 'Save Parameters' in Pr **mm.000** (alternatively enter a value of 1000 in Pr **mm.000**) and press red  reset button or toggle the reset digital input.	
Run	Drive is now ready to run	

7.2.3 RFC-S mode (with position feedback)

Permanent magnet motor with a position feedback

For simplicity only an incremental quadrature encoder with commutation outputs will be considered here. For information on setting up one of the other supported speed feedback devices, refer to *Setting up a feedback device* in the *Unidrive M702 User Guide.*

Action	Detail	
Before power-up	Ensure: • The drive enable signal is not given (terminal 11 and 13) • Run signal is not given • Motor and feedback device are connected	
Power-up the drive	Verify that RFC-S mode is displayed as the drive powers up. If the mode is incorrect see section 5.6 *Changing the operating mode* on page 34. Ensure: • Drive displays 'inhibit'	
Set motor feedback parameters	**Incremental encoder basic set-up** Enter: • Drive encoder type in Pr **03.038** = AB Servo (3): Quadrature encoder with commutation outputs • Encoder power supply in Pr **03.036** = 5 V (0), 8 V (1) or 15 V (2). **NOTE** If output voltage from the encoder is >5 V, then the termination resistors must be disabled Pr **03.039** to 0. **CAUTION** Setting the encoder voltage supply too high for the encoder could result in damage to the feedback device • Drive encoder Pulses Per Revolution in Pr **03.034** (set according to encoder) • Drive encoder termination resistor setting in Pr **03.039**: **0** = A-A\, B-B\, Z-Z\ termination resistors disabled **1** = A-A\, B-B\, termination resistors enabled, Z-Z\ termination resistors disabled **2** = A-A\, B-B\, Z-Z\ termination resistors enabled	
Enter motor nameplate details	Enter: • Motor rated current in Pr **00.046** (A) Ensure that this equal to or less than the Heavy Duty rating of the drive otherwise 'Motor Too Hot' trips may occur during the auto-tune. • Number of poles in Pr **00.042** • Motor rated voltage in Pr **00.044** (V)	
Set maximum speed	Enter: • Maximum speed in Pr **00.002** (rpm)	
Set acceleration / deceleration rates	Enter: • Acceleration rate in Pr **00.003** (s/1000 rpm) • Deceleration rate in Pr **00.004** (s/1000 rpm) (If braking resistor installed, set Pr **00.015** = Fast. Also ensure Pr **10.030**, Pr **10.031** and Pr **10.061** are set correctly, otherwise premature 'Brake R Too Hot' trips may be seen).	
Motor thermistor set-up	The motor thermistor connection is made through the drive encoder port (terminal 15). The thermistor type is selected in *P1 Thermistor Type* (03.118).	

<table>
<tr><th>Action</th><th colspan="2">Detail</th></tr>
<tr><td>Autotune</td><td colspan="2">The drive is able to perform either a stationary or a rotating auto-tune. The motor must be at a standstill before an auto-tune is enabled. A stationary auto-tune will give moderate performance whereas a rotating auto-tune will give improved performance as it measures the actual values of the motor parameters required by the drive.The drive is able to perform a stationary, rotating, mechanical load measurement or locked rotor test auto-tune. The motor must be at a standstill before an auto-tune is enabled. It is suggested that a rotating auto tune is used for accurate measurement for position feedback phase angle.
• A stationary auto-tune can be used when the motor is loaded and it is not possible to uncouple the load from the motor shaft. A stationary auto-tune is performed to locate the flux axis of the motor. The stationary auto-tune measures the stator resistance, inductance in flux axis, voltage offset at zero current, maximum voltage offset, inductance in torque axis with no load on the motor and current at maximum voltage offset of the motor. These are used to calculate the current loop gains, and at the end of the test the values in Pr 00.038 and Pr 00.039 are updated. If Sensorless mode is not selected then Position Feedback Phase Angle (03.025) is set-up for the selected position feedback.
• A rotating auto-tune should only be used if the motor is uncoupled. The rotating auto-tune will rotate the motor by up to 2 mechanical revolutions in the direction selected, regardless of the reference provided to obtain the position feedback phase angle. A stationary auto-tune is then performed to obtain stator resistance, inductance in flux axis, voltage offset at zero current, maximum voltage offset, inductance in torque axis with no load on the motor and current at maximum voltage offset of the motor. From the above obtained parameters the current loop gains are calculated, and at the end of the test the values in Pr 00.038 and Pr 00.039 are updated.
WARNING The rotating auto-tune will rotate the motor by up to 2 mechanical revolutions in the direction selected, regardless of the reference provided. After a short delay, the motor is further rotated through a electrical revolution. The enable signal must be removed before the drive can be made to run at the required reference. The drive can be stopped at any time by removing the run signal or removing the drive enable.
To perform an auto-tune:
• Set Pr 00.040 = 1 for a stationary auto-tune, Pr 00.040 = 2 for a rotating auto-tune.
• Close the run signal (terminal 7 or 8).
• Close the drive enable signal (terminal 11 and 13). The lower display will flash 'Autotune' while the drive is performing the test.
• Wait for the drive to display 'Ready' or 'Inhibit' and for the motor to come to a standstill.
If the drive trips it cannot be reset until the drive enable signal (terminal 11 and 13) has been removed.
• Remove the drive enabled and run signal from the drive.</td><td>  </td></tr>
<tr><td>Save parameters</td><td colspan="2">Select 'Save Parameters' in Pr mm.000 (alternatively enter a value of 1000 in Pr mm.000) and press red  reset button or toggle the reset digital input.</td></tr>
<tr><td>Run</td><td colspan="2">Drive is now ready to run</td><td>  </td></tr>
</table>

8 NV Media Card Operation

8.1 Introduction

The Non-Volatile Media Card feature enables simple configuration of parameters, parameter back-up and drive copying using a SMARTCARD or SD card in the future. The drive offers backward compatibility for a Unidrive SP SMARTCARD.

The SMARTCARD can be used for:

- Parameter copying between drives
- Saving drive parameter sets

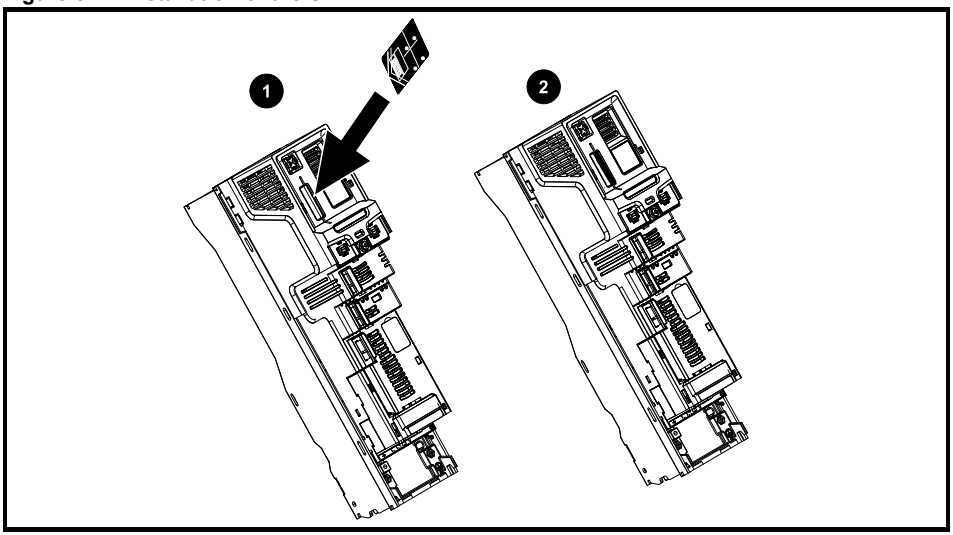
The NV Media Card (SMARTCARD) is located at the top of the module under the drive display (if installed) on the left-hand side.

Ensure the SMARTCARD is inserted with the contacts facing the right-hand side of the drive.

The drive only communicates with the NV Media Card when commanded to read or write, meaning the card may be "hot swapped".

Be aware of possible live terminals when inserting or removing the SMARTCARD

Figure 8-1 Installation of the SMARTCARD



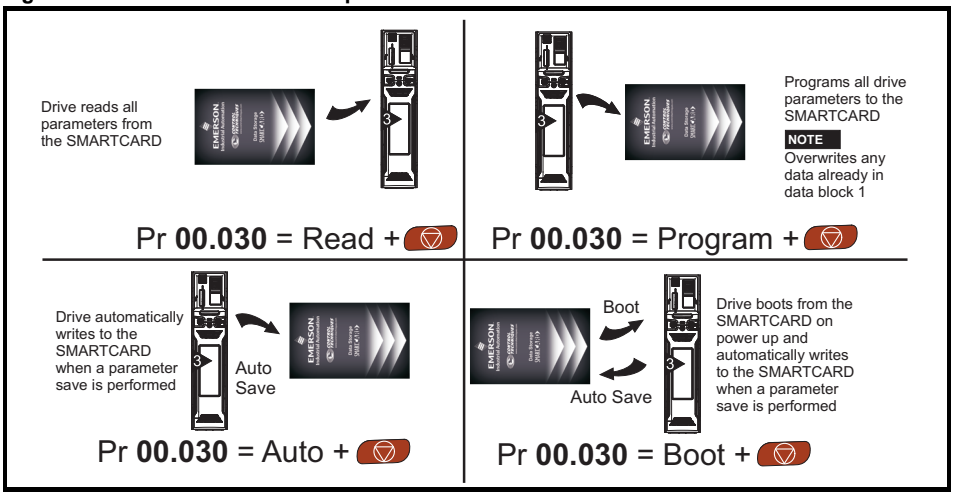
1. Installing the SMARTCARD
2. SMARTCARD installed

8.2 SMARTCARD support

The SMARTCARD can be used to store one drive parameter set from the Unidrive M in data block 001 on the SMARTCARD. The Unidrive M is compatible with a Unidrive SP SMARTCARD and is able to read and translate the Unidrive SP parameter set into a compatible parameter set for Unidrive M. This is only possible if the Unidrive SP parameter set was transferred to the SMARTCARD using the difference from defaults transfer method (i.e. 4yyy transfer). The Unidrive M is not able to read any other type of Unidrive SP data block on the card. Although it is possible to transfer difference from default data blocks from a Unidrive SP into the Unidrive M, the following should be noted:

1. If a parameter from the source drive does not exist in the target drive then no data is transferred for that parameter.
2. If the data for the parameter in the target drive is out of range then the data is limited to the range of the target parameter.
3. If the target drive has a different rating to the source drive then the normal rules for this type of transfer apply.

Figure 8-2 Basic SMARTCARD operation



8.3 Transferring data

Data transfer, erasing and protecting the information is performed by entering a code in Pr **mm.000** and then resetting the drive as shown in Table 8-1.

Table 8-1 SMARTCARD codes

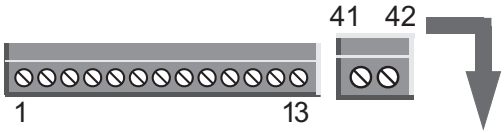
Code	Action
2001	Transfer drive parameters as difference from defaults to a bootable SMARTCARD block in data block number 001
4001	Transfer drive data as difference from defaults to SMARTCARD block number 001
6yyy	Transfer SMARTCARD data block yyy to the drive
9555	Clear SMARTCARD warning suppression flag
9666	Set SMARTCARD warning suppression flag
9777	Clear SMARTCARD read-only flag
9888	Set SMARTCARD read-only flag
9999	Erase SMARTCARD

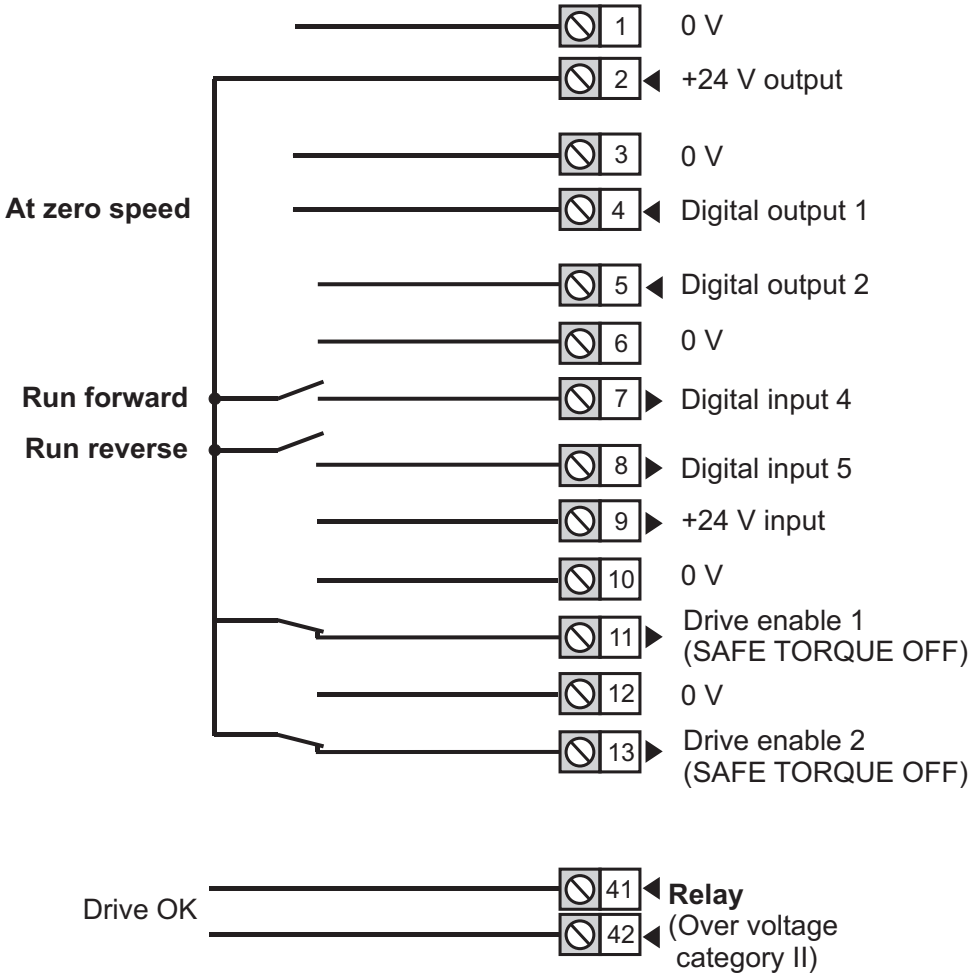
Where yyy indicates the block number 001 to 999.

9 Further information

9.1 Diagnostics

For further information on diagnostics including trips and alarms, refer to the *Unidrive M702 User Guide*.


41 42
1
13


1
0 V
2
+24 V output
3
0 V
At zero speed
4
Digital output 1
5
Digital output 2
6
0 V
Run forward
7
Digital input 4
Run reverse
8
Digital input 5
9
+24 V input
10
0 V
11
Drive enable 1
(SAFE TORQUE OFF)
12
0 V
13
Drive enable 2
(SAFE TORQUE OFF)
Drive OK
41
Relay
42
(Over voltage
category II)

0478-0003-01