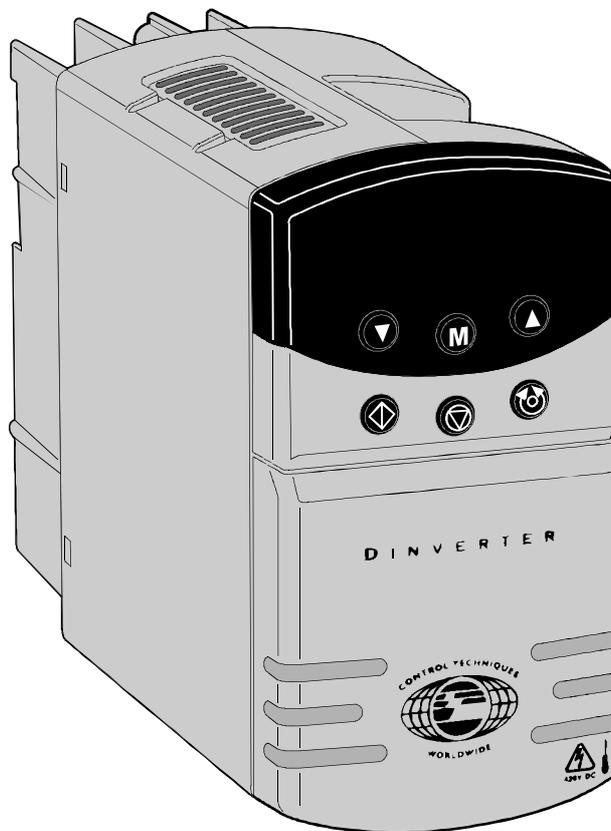


Dinverter A



Variable Speed Drive
for 3-phase induction motors
0.25kW to 0.75kW

General information

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

The contents of this User 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 User Guide, without notice.

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Use within the European Union, etc

The following information applies where the end use of the Drive is within the European Union, the European Economic Area, or other regions which have implemented Directives of the European Council or equivalent measures.

The Drive complies with the Low Voltage Directive 73/23/EEC.

The installer is responsible for ensuring that the equipment into which the Drive is incorporated complies with all relevant Directives.

The complete equipment into which the Drive is incorporated must comply with the EMC Directive 89/336/EEC.

If the Drive is incorporated into a machine, the manufacturer is responsible for ensuring that the machine complies with the Machinery Directive 89/392/EEC. In particular, the electrical equipment should generally comply with European Harmonised Standard EN60204-1.

Important... *Drive software version*

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

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

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Author:	RFD
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Declaration of Conformity

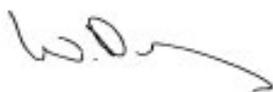
Control Techniques plc,
The Gro, Newtown, Powys, UK, SY16 3BE

DIN1220025A	DIN1220037A	DIN1220055A	DIN1220075A
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The AC variable speed drive products listed above have been designed and manufactured in accordance with the following European harmonized, national and international standards:

EN60249	Base materials for printed circuits
IEC326-1	Printed boards: general information for the specification writer
IEC326-5	Printed boards: specification for single- and double-sided printed boards with plated-through holes
IEC326-6	Printed boards: specification for multilayer printed boards
IEC664-1	Insulation co-ordination for equipment within low-voltage systems: principles, requirements and tests
EN60529	Degrees of protection provided by enclosures (IP code)
UL94	Flammability rating of plastic materials
UL508C	Standard for power conversion equipment
EN50081-1	Generic emission standard for the residential, commercial and light industrial environment
EN50081-2	Generic emission standard for the industrial environment
EN50082-2	Generic immunity standard for the industrial environment
EN61800-3	Adjustable speed electrical power drive systems – Part 3: EMC product standard including specific test methods

This product complies with the Low Voltage Directive 73/23/EEC, the Electromagnetic Compatibility (EMC) Directive 89/336/EEC and the CE Marking Directive 93/68/EEC.



W. Drury
Technical Director
Newtown

Date: 22nd January 1997

These electronic Drive products are intended to be used with an appropriate motor, controller, electrical protection components and other equipment to form a complete end product or system. The Drive must be installed only by a professional assembler who is familiar with requirements for safety and electromagnetic compatibility (EMC). The assembler is responsible for ensuring that the end product or system complies with all the relevant laws in the country where it is to be used. Refer to this *User Guide* or the *Dinverter A EMC Data Sheet* for further information on EMC standards complied with by the product, and for guidelines on installation.

Dinverter A
Issue code: d2au9

1 Introduction

1.1 How this User Guide can help you

By following this User Guide chapter-by-chapter, you will be taken in a logical sequence through the steps required for installing, performing basic programming and setting up the DInverter for basic applications.

Your and other people's safety, and the requirements of EC directives (when applicable), depend on your understanding the information and adhering to the instructions in this User Guide.

1.2 Advanced functions

This User Guide covers the basic functions of the DInverter which are intended for the majority of applications. The DInverter also has advanced functions which are covered in the ***DInverter A Technical Reference Manual***. (This can be obtained from a Control Techniques distributor or Drive Centre listed at the end of this User Guide.) The advanced functions are as follows:

Speed control

- Second analog speed reference input (20mA current loop having four options plus a low-voltage high-impedance input)
- 8 adjustable preset speed references
- Adjustable preset precision speed reference
- Remote selection of speed references
- Incremental speed control from external contacts (motorized potentiometer)
- Separate speed limits for forward and reverse operation
- 3 adjustable skip-speed bands
- Slip compensation
- Selection of PWM switching frequencies allowing output frequencies up to 960Hz
- Adjustable preset jog speed

Torque control

- Torque control with maximum speed limit

Ramps

- 8 preset acceleration ramps plus 8 preset deceleration ramps which can be split into 4 forward and 4 reverse
- Separate acceleration and deceleration ramps for jogging
- Remote selection of ramps

Starting

- 2 auto-start modes

Stopping and braking

- Dynamic control of braking with or without an external braking resistor
- Selection of 4 ways to stop the motor including by DC injection braking

Digital control

- Selection of 5 digital control modes for remote control of start, stop, reverse and jog
- Control from the keypad or by remote signals, or a combination of these

Programmable I/O

- Analog and digital I/O fully programmable for alternative functions

Security

- Two security levels for protection against unauthorized adjustment of the software

Motor protection

- Current limit (short-term overload)
- Thermal protection (long-term overload)
- Protection trips with a trip log

Monitoring

- *Zero speed* and *at speed* indications
- Pre-warning for motor overheating
- Status and diagnostic information

Auxiliary functions

- Serial communications (2-wire RS485 half-duplex) for remote control by a system controller, and/or for expansion of the I/O
- The Dinverter can be stopped by process-generated trips
- Programmable motorized potentiometer
- Un-dedicated programmable logic
- Un-dedicated programmable comparator

In addition to information for the advanced functions, the *Dinverter A Technical Reference Manual* contains the following:

- Advanced data
- Calculating enclosure sizes and cooling
- Connecting a braking resistor
- EMC wiring variations

1.3 **Bench-testing the DInverter**

If this is your first encounter with a DInverter, you may wish to understand more fully how it works by performing a bench-test before installing it. In this case, after reading Chapter 1, refer to Chapter 2 *Safety information*, then *Bench-testing the Drive – making temporary connections* in Chapter 4 *Installing the Drive*.

1.4 **Methods of control**

The Drive can be controlled by any of the following methods:

Terminal mode

Applying signals from electrical contacts, a controller or PLC to digital inputs on the Drive.

Keypad mode

Manual operation of the keypad on the front panel of the Drive; apart from two wire-links to be connected to a terminal block, no external signal connections are made to the Drive.

Serial communications

Using a system controller or PLC connected to the Drive by a 2-wire RS485 serial communications link (can be used in conjunction with Terminal mode or Keypad mode).

2 Safety Information



2.1 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.

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

2.2 Electrical safety – general warning

The voltages used in the Drive can cause severe electric 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 beginning of the installation instructions in this User Guide.

The installation must comply with all relevant safety legislation in the country of use.

2.3 System design

The Drive is intended as a component for professional incorporation into complete equipment or systems. 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 mechanical equipment which can cause injury.

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

To ensure mechanical safety, additional safety devices such as electro-mechanical interlocks may be required. The Drive must not be used in a safety-critical application without additional protection.

2.4 Environmental limits

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

2.5 Compliance with regulations

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

This User Guide contains instructions for achieving compliance with specific EMC standards.

2.6 Risk analysis

In any application where a malfunction of the Drive could lead to damage, loss or injury, a risk analysis must be carried out, and where necessary, further measures taken to reduce the risk. This would normally be an appropriate form of independent safety back-up system using simple electro-mechanical components.

2.7 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 over-heat because the cooling fan becomes less effective. The motor should then be fitted with a protection thermistor. If necessary, a separate cooling fan should be used.

2.8 **Adjusting parameters**

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

2.9 **Safety of personnel**

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

The DC bus will remain energized if a voltage is applied to the output terminals of the Drive.

Under certain conditions, the Drive can suddenly discontinue control of the motor. If the load on the motor could cause the motor speed to be increased, a separate method of braking and stopping the motor should be used (eg. a mechanical brake).

Before connecting the AC supply to the Drive, it is important that you understand the operating controls and their operation. If in doubt, do not adjust the Drive. Damage may occur, or lives put at risk. Carefully follow the instructions in this User Guide.

Before making adjustments to the Drive, ensure all personnel in the area are warned. Make notes of all adjustments that are made.

Never work on a variable speed drive on your own: ensure that a suitably qualified person is present to assist in an emergency.

3 Data

3.1 DInverter

Table 3–1 Power, voltage and current ratings

150% overload output current for 60 seconds maximum								
Max. continuous 100% RMS output current (FLC)								
Max. continuous 100% RMS AC input current								
Continuous motor shaft power								
AC supply voltage								
Model	Number of AC supply phases	V	kW		HP		A	
DIN1220025A	1	200 ~ 240 ±10%	0.25	0.33	3.9	1.5	2.3	
DIN1220037A	1	200 ~ 240 ±10%	0.37	0.50	5.7	2.3	3.5	
DIN1220055A	1	200 ~ 240 ±10%	0.55	0.75	8.4	3.0	4.5	
DIN1220075A	1	200 ~ 240 ±10%	0.75	1.00	11.5	4.3	6.5	

Motor requirements Number of phases: 3
Voltage: 200V to 240V ±10% (normally delta connected)
Power rating: 0.25kW (0.33HP) to 0.75kW (1HP)

Temperature, humidity and cooling method Ambient temperature range: –10°C to 50°C (14°F to 122°F). Output current derating may apply at high ambient temperatures.
Storage temperature range: –40°C to 50°C (–40°F to 122°F)
Humidity: 85% non-condensing
Cooling method: Natural convection

Ingress protection Gland plate not fitted: IP00
Gland plate fitted; cable glands not fitted: IP10
Cable-glands fitted: IP20

Overall dimensions These dimensions exclude the mounting brackets.
Height: 140mm (5½ in)
Width: 75mm (3 in)
Depth: 192mm (7½ in)

Weight Approximate weight of each model: 1.2kg (2lb 11oz)

Electro-magnetic compatibility (EMC) This is a summary of the EMC performance of the Drive. For full details, refer to the *Dinverter A EMC Data Sheet* which can be obtained from a Drive Centre or distributor listed at the end of this User Guide.

Immunity

Compliance with immunity standards does not depend on installation details. Single and parallel Drive modules meet EN50082-2 (generic immunity standard for the industrial environment) and the following specifications from the IEC1000-4 group (derived from IEC801):

Part 2, Electrostatic discharge: Level 3

Part 3, Radio frequency field: Level 3

Part 4 Transient burst:

Level 4 at the control terminals

Level 3 at the power terminals

Part 5, Surge (at the AC supply terminals) (as specified by EN50082-2 informative annex):

Level 4 line-to-ground

Level 3 line-to-line

Part 6, Conducted radio frequency: Level 3

Emission

Compliance with emission standards depends on rigorous adherence to the installation guidelines, including the use of the specified RFI filter in the AC supply circuit. Compliance also depends on the PWM switching frequency used in the output stage of the Drive, and the length of the motor cable. For full details, refer to the *Dinverter A EMC Data Sheet* which can be obtained from a Drive Centre or distributor listed at the end of this User Guide.

Conducted emission from the Drive meets the requirements of EN50081-2 (generic emission standard for the industrial environment) over a wide range of conditions. In addition, the Drive meets the radiated emission requirements of this standard. The emission limits in EN50081-2 are similar to CISPR11 and EN55011 Class A.

Under restricted conditions, the conducted emission meets EN50081-1 (generic emission standard for the residential, commercial and light industrial environment. This is similar to CISPR11 and EN55011 Class B.

The optional RFI filter model number DIN 1012F must be used.

Power Drive Systems standard EN61800–3

The Drive meets the immunity requirements of EN61800–3 irrespective of the environment in which it is operating.

The emission requirements of this standard are also met depending on the environment category, as follows:

First environment: Restricted distribution only: specified RFI filter required

Second environment: No RFI filter required (but RFI filter(s) are recommended where sensitive electronic systems are operating nearby); emission limits are *under consideration*

EN61800–3 defines the first environment as one that includes domestic premises. It also includes establishments directly connected without intermediate transformers to a low-voltage power supply network which supplies buildings used for domestic purposes.

The second environment is one that includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.

Restricted distribution is defined as a mode of sales distribution in which the manufacturer restricts the supply of equipment to suppliers, customers or users who separately or jointly have technical competence in the EMC requirements of the application of Drives.

Note

If a Power Drive System is included as part of equipment covered by a separate EMC product standard, the EMC standard for the complete equipment applies.

Frequencies AC supply frequency: 50Hz to 60Hz ± 2 Hz
PWM switching frequency: 3kHz nominal (selectable up to 12kHz)
Maximum output frequency: 240Hz (up to 960Hz)
For operation at PWM switching frequencies above 3kHz, refer to the *Dinverter A Technical Reference Manual*.

Accuracy and resolution The following data applies to the Drive only; it does not include the performance of the source of the control signals.

Output frequency accuracy: $\pm 0.01\%$

Output frequency resolution:

0.001Hz up to 480Hz

0.002Hz from 480Hz to 960Hz

Output voltage accuracy: depends on AC supply stability

Output voltage resolution: 0.4%

Tracking-accuracy of output current to changes in load:

$\pm 10\%$ above 20Hz (with a motor matched to the Drive)

Tracking-resolution of output current to changes in load: 0.1%

Table 3–2 Heat dissipation and surge-current

Model	Maximum dissipation at...				Surge-current at power-up *	
	3kHz	6kHz	9kHz	12kHz	50Hz	60Hz
	W	W	W	W	A	A
DIN1220025A	17.3	19.1	19.9	21.3	55	66
DIN1220037A	22.1	24.4	27.1	29.9	55	66
DIN1220055A	26.1	29.3	34.5	38.3	110	130
DIN1220075A	39.9	45.7	50.9	55.9	110	130

* Surge current at the instant the AC supply is connected to the Drive: worst-case values of half sine-wave current pulse of a quarter-cycle duration; unlimited repetition rate.

3.2 Optional RFI filter (DIN1012F)

Electrical ratings	Maximum current: 12ARMS Maximum power dissipation: 8W Voltage-drop at 12A: 1V maximum
Ambient temperature	Above 40°C (104°F), the current rating is reduced by 0.2A/°C (0.11A/°F).
Weight	0.65kg (1lb 6oz)
Overall dimensions	These dimensions exclude the mounting brackets. Height: 140mm (5 ¹ / ₂ in) Width: 40mm (1 ⁹ / ₁₆ in) Depth: 192mm (7 ¹ / ₂ in)

Table 3–3 Conducted emission

Maximum length of motor cable		PWM switching frequency of the Drive			
metres	feet	3kHz	6kHz	9kHz	12kHz
5	16.5	[R]	[R]	[R]	[R]
10	33	[R] *	[R] *	[I] *	[I] *
15	50	R *	I *	I *	I *
20	65	R *	I *	I *	I *
50	165	I *	I *	I *	I *
100	330	X	I *	I *	X

- [R] Residential requirements are met when the RFI filter is in standard mode or long-cable mode
- R Residential requirements are met only when the the RFI filter is in long-cable mode
- [I] Industrial requirements are met when the RFI filter is in standard mode or long-cable mode
- I Industrial requirements are met only when the the RFI filter is in long-cable mode
- * The AC supply cable must be shielded
- X industrial limit is exceeded

Table 3–4 Maximum ground leakage current

Standard mode	2.7mA at 240V 50Hz 3.0mA at 220V 60Hz
Long-cable mode	52.5mA at 240V 50Hz 57.5mA at 220V 60Hz

4 Installing the Drive



Warning

Adhere to 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.

Installation in an enclosure

The Drive case conforms to IP10 or IP20 in accordance with IEC529 (see Chapter 3 *Data*). The Drive is designed for installation in an enclosure (type 1 as defined in UL508C, Table 7.1) to protect the Drive from contamination.

Authorized access

The enclosure should prevent access by all personnel except for authorized, trained service personnel.

Fire enclosure

The Drive case is not classified as a fire enclosure. To meet this requirement, the Drive must be installed in a fire enclosure.

Electric shock risk

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

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

Isolation device

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

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 eight 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 be discharged, 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.

AC supply by plug and socket

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

Water ingress

The Drive has no protection against water ingress.

Ventilation holes

When the vent covers are not fitted, objects less than 3mm ($\frac{1}{8}$ in) diameter can pass through the vent holes and possibly make contact with live parts inside the Drive.

Cable entry

When cable glands are not fitted, objects less than 25mm (1 in) wide can pass through the cable entry opening and possibly make contact with live parts inside the Drive.

STOP function

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

4.1 EMC considerations

Depending on the requirements of the installation, one of the following levels of electromagnetic compatibility (EMC) should be adopted:

Routine EMC precautions

These precautions are recommended when strict compliance with emission standards is not required. The risk of disturbing adjacent electronic equipment is minimized by adopting these precautions.

Compliance with EMC emission standards

These precautions are recommended when strict compliance with emission standards is required. In addition, it is recommended that these precautions are taken when the Drive is installed in a residential area, or adjacent to sensitive electronic equipment such as radio receivers or similar.

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

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

Operation in the first environment

Observe the guidelines given in *Power Drives System standard* in Chapter 3 *Data*. An RFI filter will always be required.

Operation in the second environment

An RFI filter may not be required. Follow the guidelines given in *Power Drives System standard* later in this chapter depending on the requirements of the end user.



Caution

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

Instructions are given later in this chapter for these levels of EMC. Refer to Chapter 3 *Data* for further information on compliance with EMC standards and definitions of environments.

Detailed instructions and EMC information are given in the *Dinverter A EMC Data Sheet* which is available from the Drive Centres and distributors listed at the end of the User Guide.

Note

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

The Drive will comply with the standards for emission, such as EN50081-2, only when the instructions given in *Planning the installation and Wiring recommendations* later in this chapter are followed closely.

4.2 Environmental requirements

The environment must be acceptable (see Chapter 3 *Data*). Note that, for models DIN1220055A and DIN12200075A, a high ambient temperature can limit the maximum output current.

When compliance with EMC emissions standards is required, the enclosure must be made of metal but does not require special EMC features. The requirements given in *Wiring recommendations* later in this chapter must be observed.

If condensation is likely to occur when the Drive is not in use, an anti-condensation heater must be installed. This heater must be switched off when the Drive is in use; automatic switching is recommended.

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

If the Drive is to be mounted directly above any heat-generating equipment (such as another Drive), the maximum temperature of the air immediately below the Drive should be taken as the ambient temperature for the Drive.

If the Drive is to be mounted beneath other equipment, such as another Drive, the Drive should not cause the ambient temperature requirements of the equipment to be exceeded.

When compliance with EMC emissions standards is required, an RFI filter must be installed at the side of each Drive.

The installation must meet the electrical safety requirements specified by the end-user.

The planned size of the installation will not exceed the space available.

4.3 Planning the installation

Temperature de-rating

- 1 Refer to Figure 4–1 to find the maximum ambient temperature that is permissible at the required maximum output current. Make a note of this value.

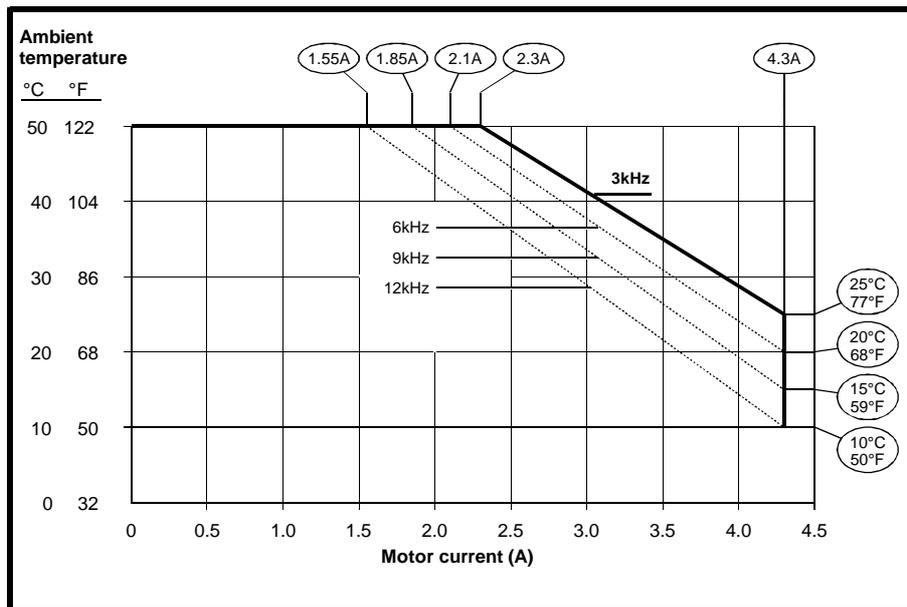


Figure 4–1 De-rating curves for all model sizes at 3kHz PWM switching frequency (other frequencies shown for reference)

Length of motor cable

RFI-filter ground-leakage current

When compliance with EMC emissions standards is required, and the length of the motor cable is to exceed 15 metres (50 feet), it is possible a compromise will need to be made for the following:

- Motor cable length
- The ground-leakage current of the RFI filter

Note

When compliance with EMC emission standards is required, the length of the motor cable must not exceed 100 metres (330 feet).

- 2 Establish the intended length of motor cable and refer to the conducted emissions table for the RFI filter in Chapter 3 *Data* to find out if the RFI filter must be used in long-cable mode. Note that the ground leakage current of the RFI filter is then increased (see Chapter 3 *Data*)

Enclosure layout

- 3 Use one of the following enclosure layouts, depending on the requirements of the installation:
Routine EMC precautions Refer to Figure 4–2 which shows the recommended layout for two Drives, and the signal and power cables.
Compliance with EMC emission standards Refer to Figure 4–3 which shows two Drives, two RFI filters, and the signal and power cables.
- 4 Ensure the enclosure is of adequate size, and/or has adequate forced-air cooling to ensure the maximum permissible ambient temperature is not exceeded (from step 1).
- 5 For compliance with EMC emission standards, ensure the enclosure is fitted with an unpainted metal back-plate for mounting the Drive and RFI filter. For example, a zinc plated steel back-plate is suitable (see Figure 4–3).
- 6 Ensure the Drive is installed vertically for best flow of cooling air through the Drive and heatsink.
- 7 Ensure the clearance above and below the Drive will be at least 100mm (4 in). Ensure the clearance each side of the Drive will be at least 5mm ($\frac{1}{4}$ in).
- 8 Mount the RFI filter at the left side of the Drive in order to minimize the cable length between the Drive and filter.
- 9 Decide whether the Drive and RFI filter are to be mounted on a DIN-rail.

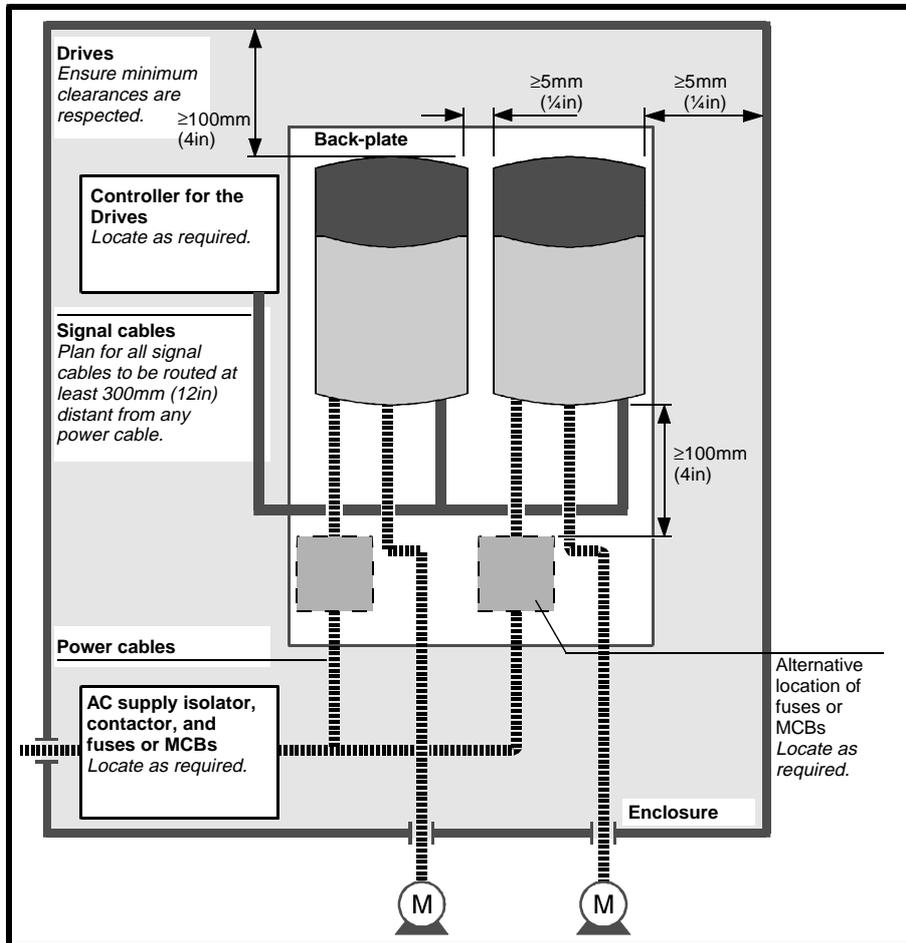


Figure 4–2 Recommended layout for routine EMC precautions (wiring recommendations are given in Figure 4–7)

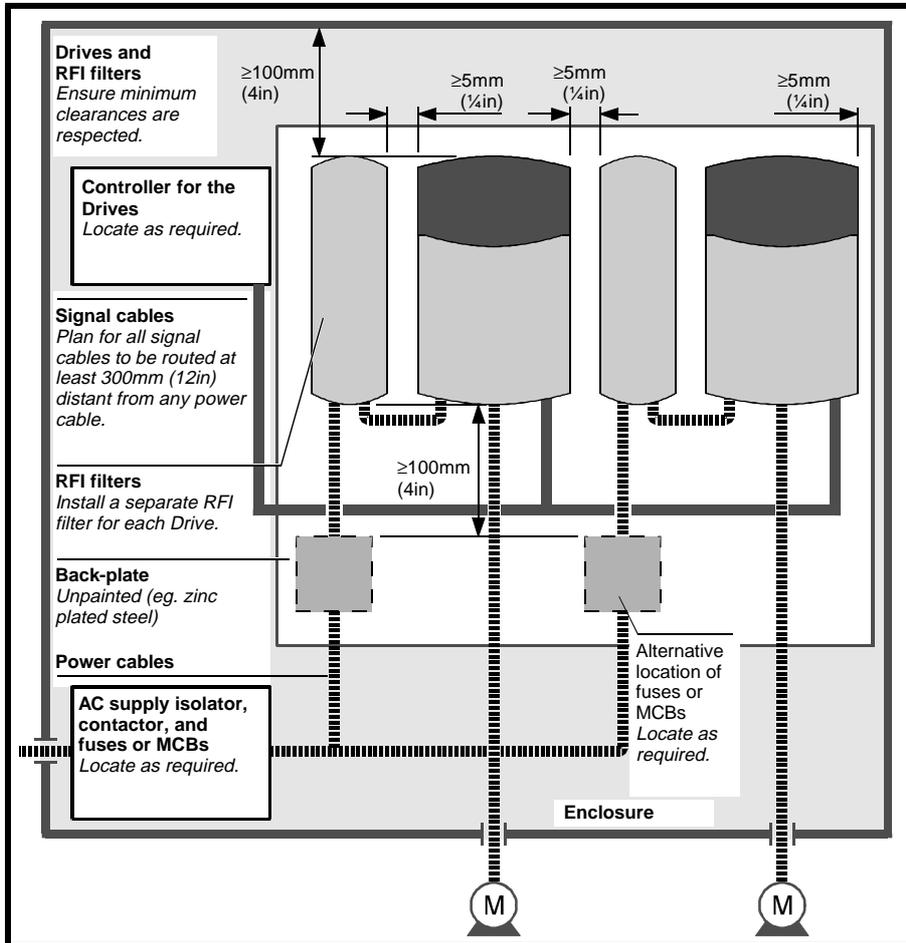


Figure 4-3 Recommended layout for compliance with EMC emissions standards (wiring recommendations are given in Figure 4-8)

4.4 Installing the Drive and optional RFI filter

Grounding the Drive heatsink

For compliance with EMC emission standards, the Drive heatsink must be directly grounded to the enclosure back-plate, (see Figures 4–8 and 4–9). When surface-mounting the Drive or mounting the Drive on a DIN-rail, this can be achieved in either of the following ways.

If the Drive is supplied with metal mounting feet, these can be used to directly ground the heatsink to the enclosure back-plate.

If the Drive is supplied with plastic mounting feet, the earthing spring supplied with the Drive must be used as shown in Figure 4–4.

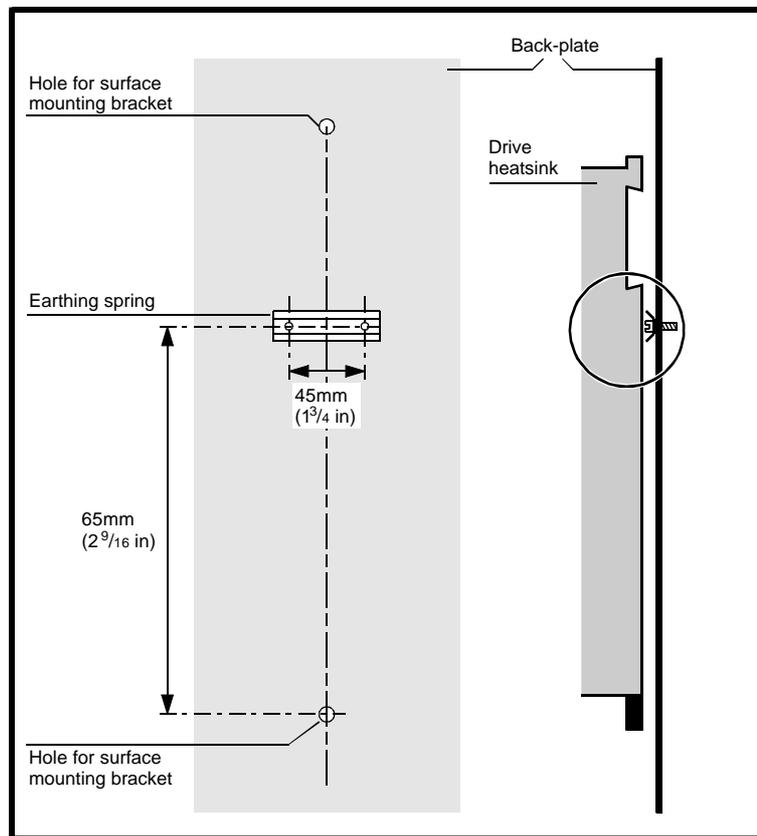
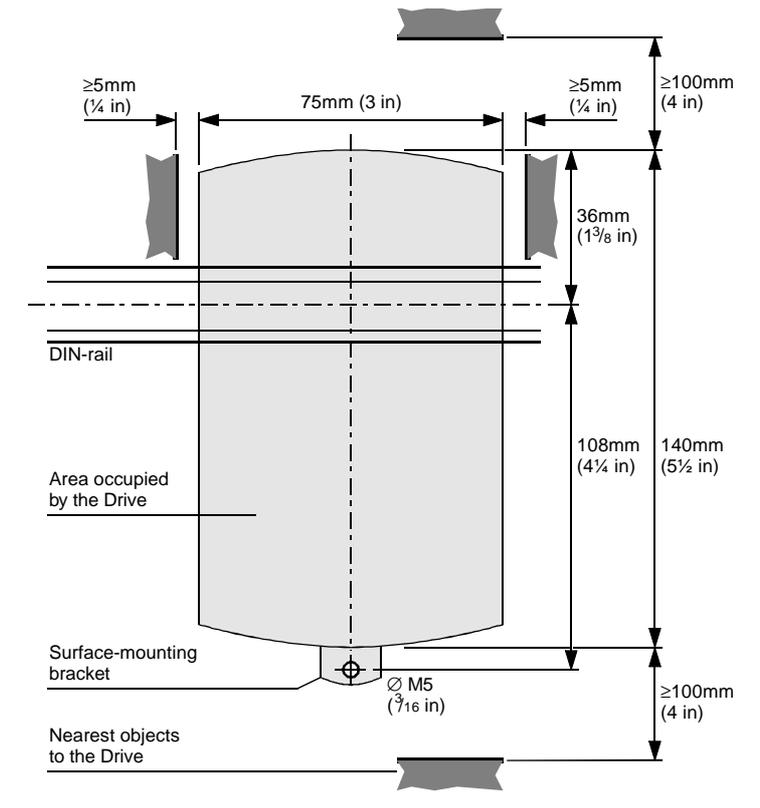


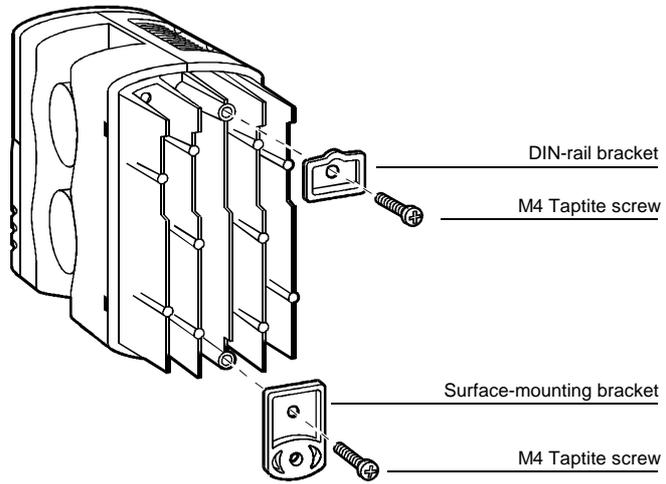
Figure 4–4 Mounting the earthing spring

Mounting the Drive on a DIN-rail

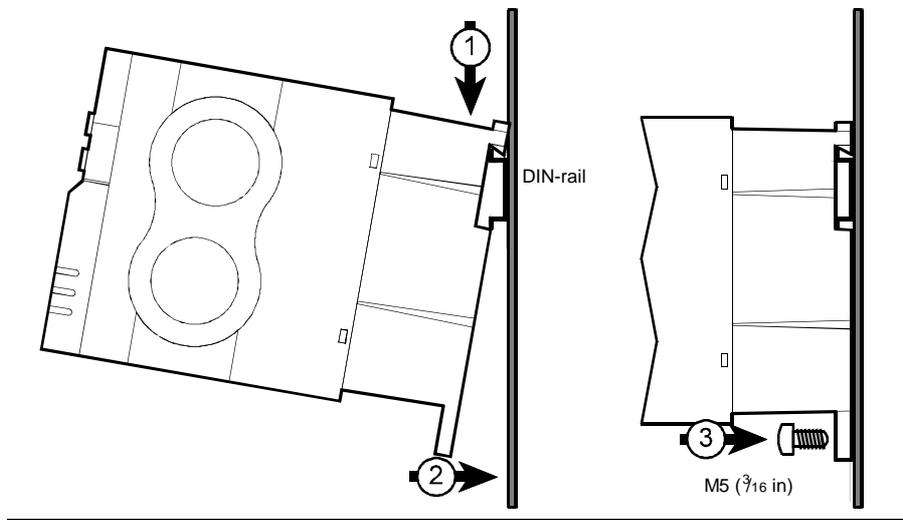
- 1 Allow clearances around the Drive. Make a threaded hole for securing the Drive to the back-plate



- 2 Fit brackets for DIN-rail mounting.

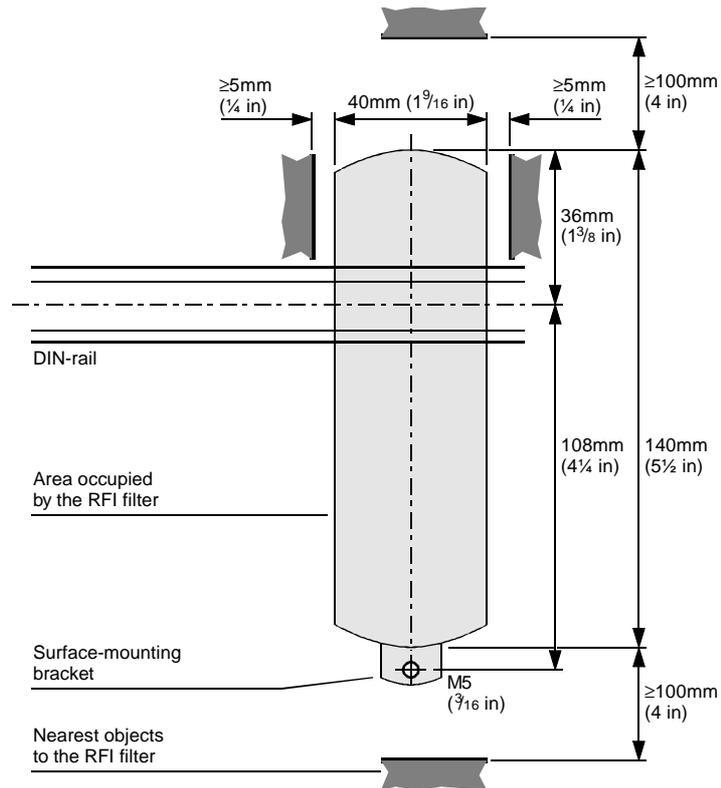


- 3 Locate the Drive on a DIN-rail and secure the Drive to the back-plate using an M5 ($\frac{3}{16}$ in) screw.



Mounting the RFI filter on a DIN-rail

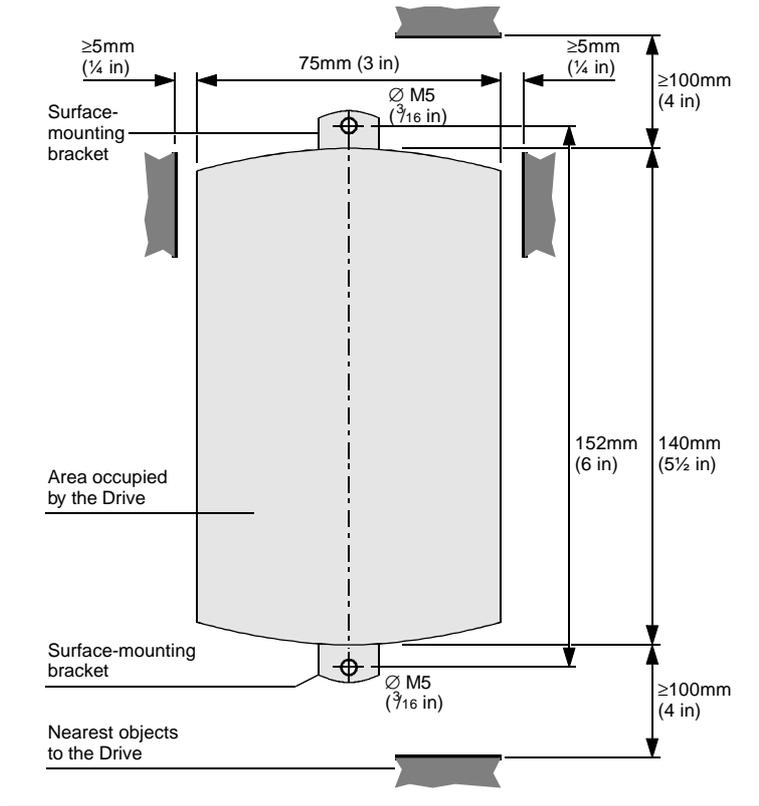
- 1 Allow clearances around the RFI filter. Make a threaded hole for securing the RFI filter to the back-plate



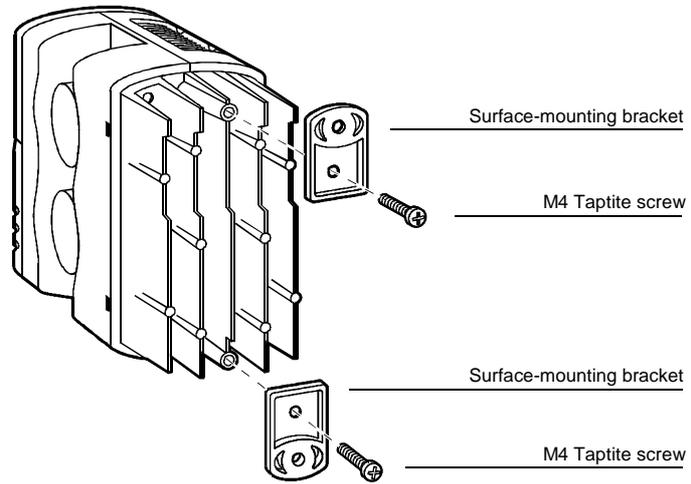
- 2 Fit the DIN-rail bracket and a surface-mounting bracket to the rear panel of the RFI filter, in the same manner as for the Drive.
- 3 Locate the RFI filter on the DIN-rail and secure the surface-mounting bracket in the same manner as for the Drive.

Surface-mounting the Drive

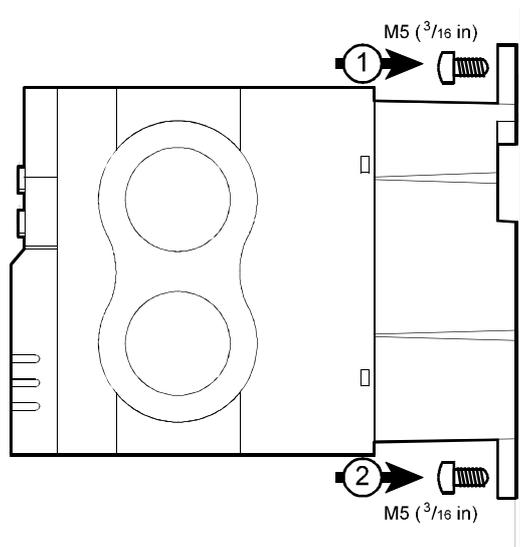
- 1 Allow clearances around the Drive. Make two threaded holes for securing the Drive to the back-plate



- 2 Fit brackets for surface mounting.

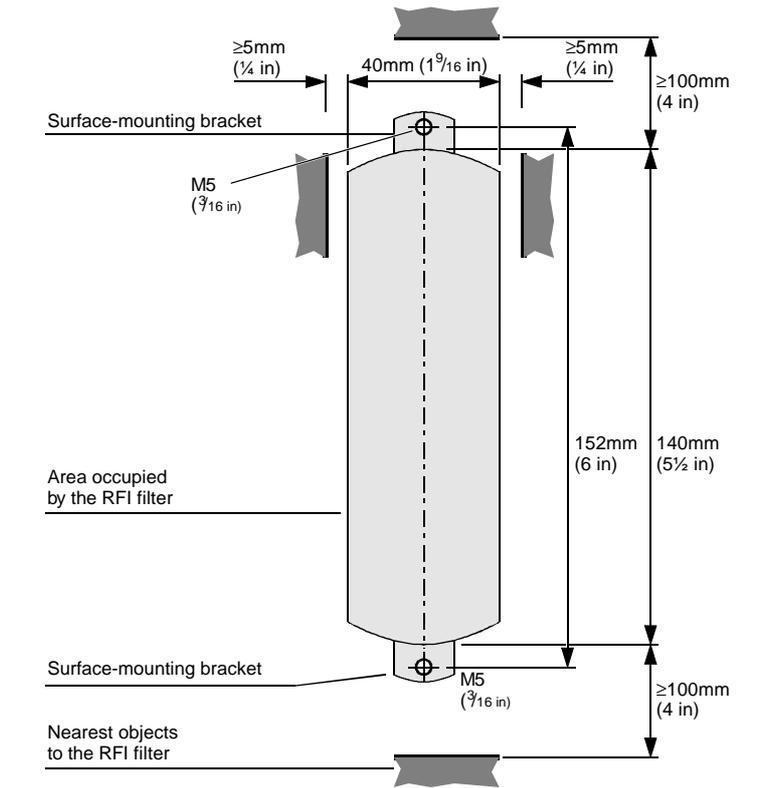


- 3 Secure the Drive to the back-plate using two M5 ($\frac{3}{16}$ in) screws.



Surface-mounting the RFI filter

- 1 Allow clearances around the RFI filter. Make two threaded holes for securing the RFI filter to the back-plate



- 2 Fit both surface-mounting brackets to the rear panel of the RFI filter, in the same manner as for the Drive.
- 3 Secure the surface-mounting brackets to the back-plate in the same manner as for the Drive.

AC supply requirements

Use either of the following types of AC supply:

- Single-phase (ie. between one phase and neutral of a star-connected three-phase supply)
- Between two phases of a delta-connected three-phase supply (one phase can be grounded)

Ground connections

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

Refer to *Wiring recommendations* later in this chapter.



Warning

The ground loop impedance must conform to the requirements of local safety regulations. The ground connections must be inspected and tested at appropriate intervals.

Power cables



Warning

Wiring must be in accordance with local regulations and codes of practice. The table below shows typical cable sizes for power input and output wiring. In the event of a conflict, local regulations prevail.

Use pvc-insulated cable having copper conductors as shown in Table 4–1.

Table 4–1 Typical sizes of the power cables

Model	AC supply to RFI filter (or Drive)	AC supply from RFI filter to Drive	Drive to motor	Drive to braking resistor *
DIN1220025A	1.0mm ² (18AWG) 240VAC min	1.0mm ² (18AWG) 240VAC min	1.0mm ² (18AWG) 240VAC min	1.0mm ² (18AWG) 400VDC min
DIN1220037A	1.0mm ² (18AWG) 240VAC min	1.0mm ² (18AWG) 240VAC min	1.0mm ² (18AWG) 240VAC min	1.0mm ² (18AWG) 400VDC min
DIN1220055A	1.5mm ² (16AWG) 240VAC min	1.5mm ² (16AWG) 240VAC min	1.0mm ² (18AWG) 240VAC min	1.0mm ² (18AWG) 400VDC min
DIN1220075A	2.5 mm ² (14AWG) 240VAC min	2.5mm ² (14AWG) 240VAC min	1.0mm ² (18AWG) 240VAC min	1.0mm ² (18AWG) 400VDC min

* When a braking resistor is required, you must refer to the *Dinverter A Technical Reference Manual*. Minimum value: 100Ω.

Type of motor cable

Refer also to *Wiring recommendations* later in this chapter.

Routine EMC precautions

Use either of the following:

- Cable containing three power conductors plus a ground conductor
- Three separate power conductors plus a ground conductor

Compliance with EMC emissions standards

Use shielded (screened) or steel-wire armoured cable having three power conductors plus an optional ground conductor.

Interruption in the motor cable

If the cable between the Drive and motor is to be interrupted by a contactor or circuit breaker, ensure the Drive is disabled before the contactor or circuit breaker is opened or closed.

Fuses



Warning

The AC supply to the Drive must be fitted with suitable protection against overload and short-circuits. Table 4–2 shows recommended fuse ratings. Failure to observe this recommendation will cause a risk of fire.

When a single-phase supply is used, a fuse of the specified rating should be included in the live connection of the AC supply. When two phases of a three-phase are used, a fuse of the specified rating should be included in both phases of the AC supply.

As an alternative to fuses, an MCB (miniature circuit breaker) or MCCB (motor control circuit breaker) may be used if equipped with adjustable thermal and magnetic trip devices of suitable ratings.

Table 4–2 Fuse ratings

Model	Fuse rating
DIN1220025A	6A
DIN1220037A	6A
DIN1220055A	10A
DIN1220075A	16A

UL listing The Drive complies with the UL listing only when a fuse of the following type is used:
 Bussmann Limitron KTK–XXA (fast-acting type)
 (600VAC 100kA breaking capacity 10.3 x 38mm midget fuse)

AC supply disturbances – use of line reactors

When a Drive is connected to an AC supply which is subject to severe disturbances – for example, if any of the following conditions apply...

- Capacity exceeds 200kVA
- Fault current exceeds 5kA
- Power-factor correction equipment is connected close to the Drive
- Large DC Drives having no or ineffective line reactors are connected to the supply
- Direct-on-line started motor(s) are connected to the supply and, when any of these motors are started, a dip is produced in excess of 20% of the actual supply voltage

... excessive peak current may flow in the input power circuit of the Drive. This may cause nuisance tripping or, in extreme cases, failure of the Drive.

In such cases install a line reactor between the AC supply and the Drive (when an RFI filter is used, install the line reactor between the RFI filter and the Drive). This will reduce transient currents to a level that can be tolerated by the input rectifier of the Drive.



Caution **RFI filters (for EMC purposes) do not give adequate protection against these conditions.**

Note

When an AC line reactor is installed, at power-up it may cause current-ringing in conjunction with the DC-bus

capacitors in the Drive. If this causes the Drive to trip, the Drive can be programmed to be reset automatically. In this case, make a note to set parameter 10.34 at 1.

Table 4–3 Typical line-reactor values

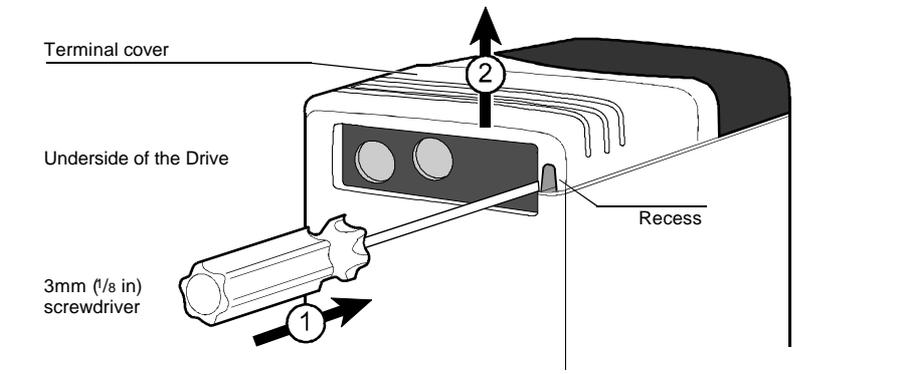
Model	Value
DIN1220025A	1.5mH
DIN1220037A	1.5mH
DIN1220055A	1.5mH
DIN1220075A	1.5mH

Current ratings

Continuous: Not less than the continuous input current rating of the Drive
Repetitive peak: Not less than *twice* the continuous input current rating of the Drive

Working in the terminal chamber of the Drive

- 1 Use a 3mm flat-blade screwdriver to remove the terminal cover from the Drive.



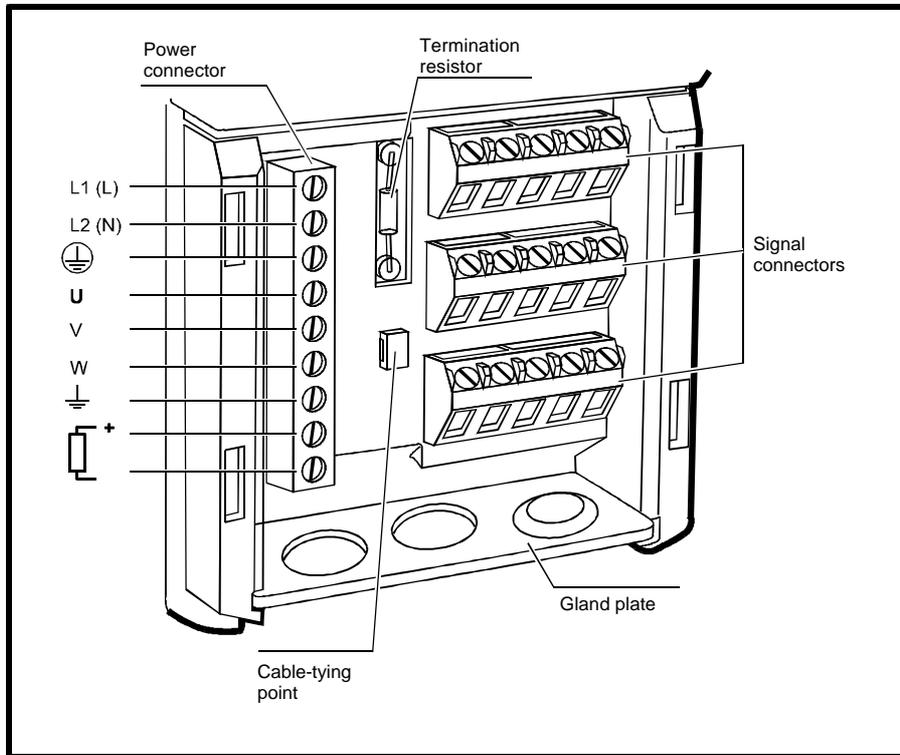


Figure 4–5 Locations of the power and signal connectors, gland plate, cable-tying point and termination resistor in the terminal chamber of the Drive

Table 4–4 Connector sizes and data

	Power connector	Signal connectors
Maximum wire size	2.5mm ² (14AWG)	
Use screwdriver type...	3mm (1/8 in) flat-blade	
Tightening-torque	0.5Nm (4.4 lb.in)	0.4Nm (3.5 lb.in)

- 2 When the Drive must meet IP20, fit three glands to the gland plate when the Drive is to be used in Terminal mode; fit two glands when the Drive is to be used in Keypad mode. (See *Methods of control* in Chapter 1 *Introduction*.)
- 3 When glands are used, refer to Figure 4–6.

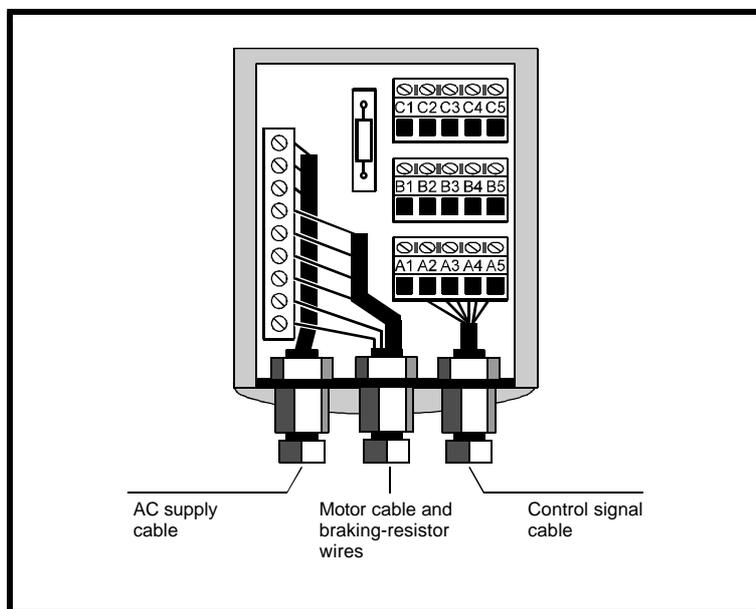
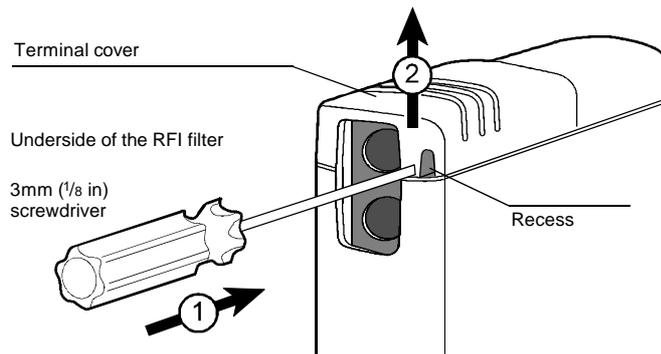


Figure 4–6 Assignments of the glands (when used) in the terminal chamber of the Drive

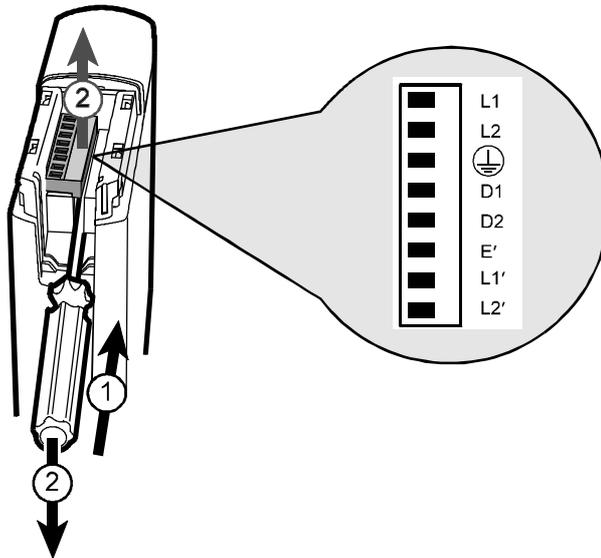
- 4 Use the cable-tying point with a cable tie to secure the power cables as required.

Connecting and setting up an RFI filter

- 1 Use a 3mm flat-blade screwdriver to remove the terminal cover from the RFI filter.



- 2 Use the screwdriver to lever the power connector from the terminal chamber.



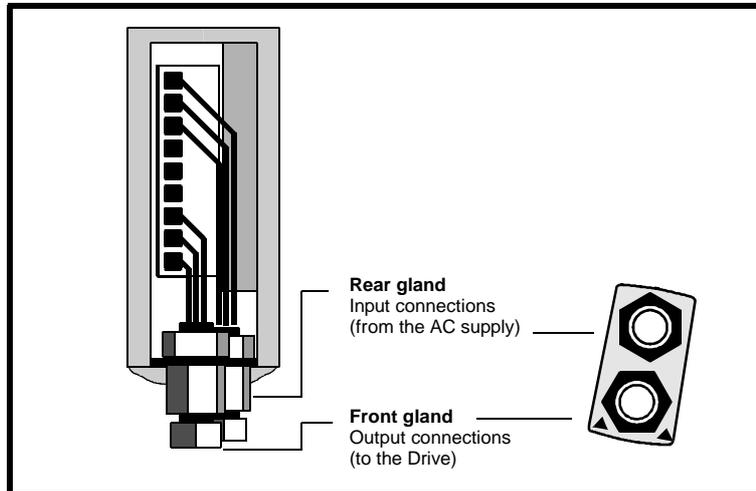


Figure 4–7 Assignments of the glands (when used) in the terminal chamber of the RFI filter

- 3 If required, fit two glands to the gland plate.
- 4 Make the connections shown in Figure 4–9.
- 5 If required, connect terminal D1 to terminal D2 to set the RFI filter in long-cable mode.

4.5 Wiring recommendations



Caution

When the motor phase connections are made (U-to-U, V-to-V, W-to-W) and a RUN FORWARD command is given to the Drive, the motor runs in the reverse direction (anticlockwise rotation as seen from the shaft-end of the motor). To make the motor run in the opposite direction, exchange two of the phase connections.

Observe the wiring recommendations given in this section. The details of individual installations may vary, but details which are indicated in the recommendations to be important for EMC must be adhered to closely.

When external signal connections are to be made to the Drive, also refer to *Signal connections for operation in Terminal mode* later in this chapter.

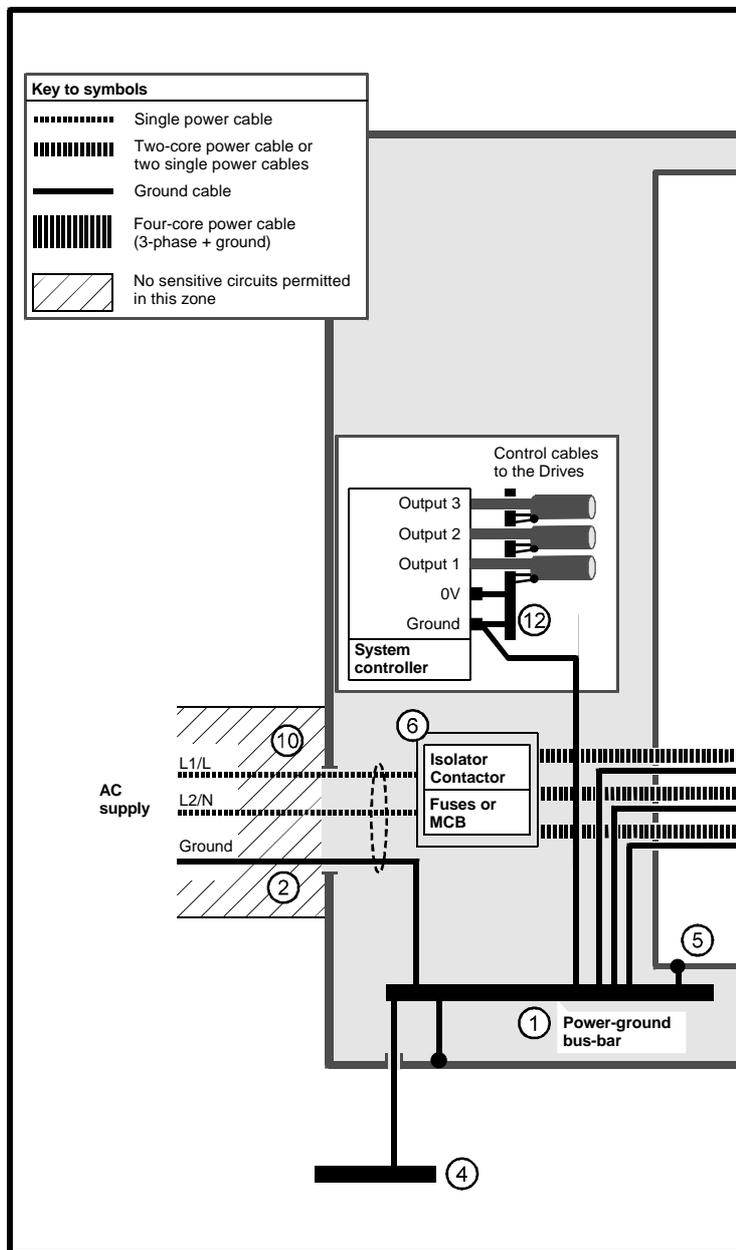
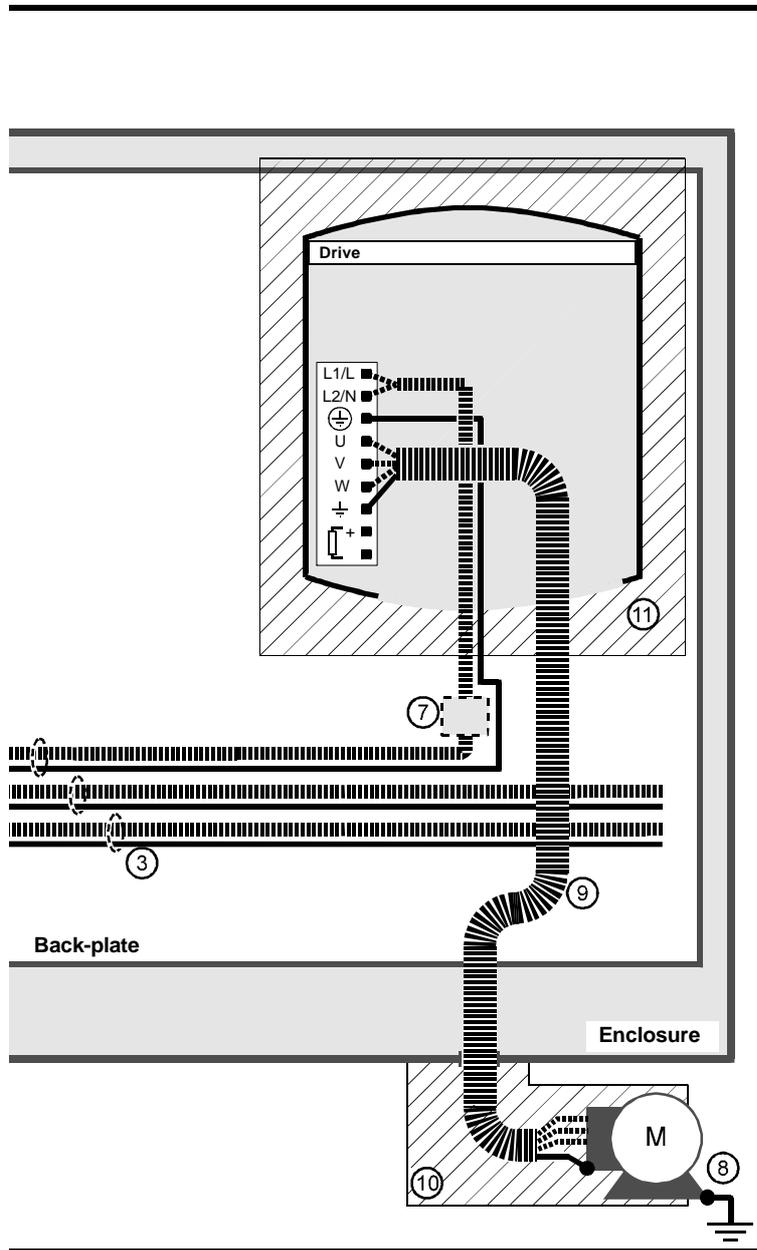


Figure 4–8 *Wiring guidelines for routine EMC precautions*



Routine EMC precautions (Figure 4-8)

General features

- 1 Single power-ground bus-bar, or low-impedance ground terminal.
- 2 Incoming AC supply ground connected to the power ground bus-bar.
- 3 Connect grounds of any other circuits to the power ground bus-bar.
- 4 Site ground, if required.
- 5 Metal back-plate, safety bonded to the power ground bus-bar.
- 6 System isolator, circuit contactors and fuses/MCB.
- 7 Alternative position for Drive fuses/MCB.
- 8 Motor-frame ground connection, if required.

Routine EMC precautions

- 9 Use four-core cable to connect the motor to the Drive as shown. The ground conductor in the motor cable must be connected only to the ground terminals of the Drive and motor; it must not be connected directly to the power-ground bus-bar.
- 10 If the wiring for sensitive signal circuits is to be parallel to an unshielded motor cable (or cables for an unfiltered power supply) for more than 1 metre (3 feet), ensure the separation is at least 0.3m (12 in).
If the parallel run is to exceed 10 metres (30 feet), increase the separation proportionally. For example, if the parallel run is to be 40 metres, the spacing must be $0.3 \times 40 \div 10 = 1.2$ metres.
When a motor-thermistor is used, this constraint does not apply to the cable connecting the thermistor to the Drive. The motor-thermistor cable must be shielded (as shown in Figure 4-14).
- 11 Do not place sensitive signal circuits in a zone extending 0.3m (12 in) all around the Drive.
- 12 If the control circuit 0V is to be grounded, this should be done at the system controller (eg. PLC) and not at the Drive. This is to avoid injecting noise currents into the 0V circuit.

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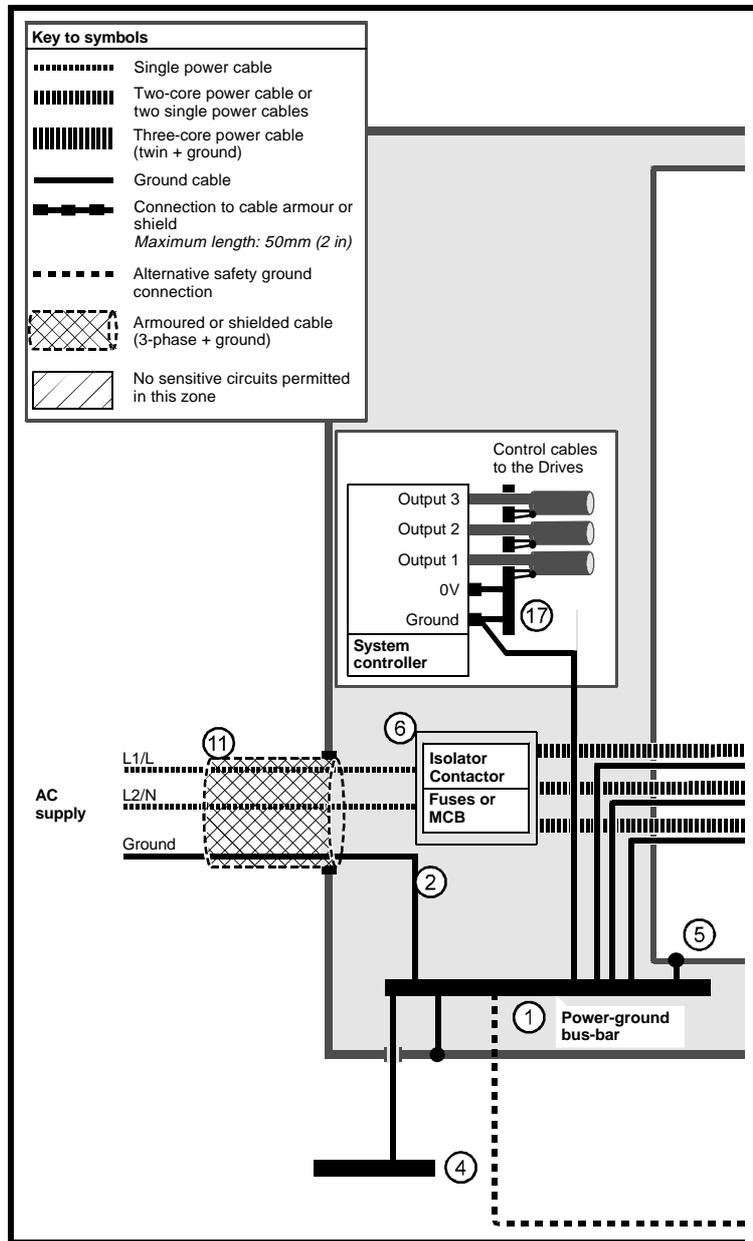
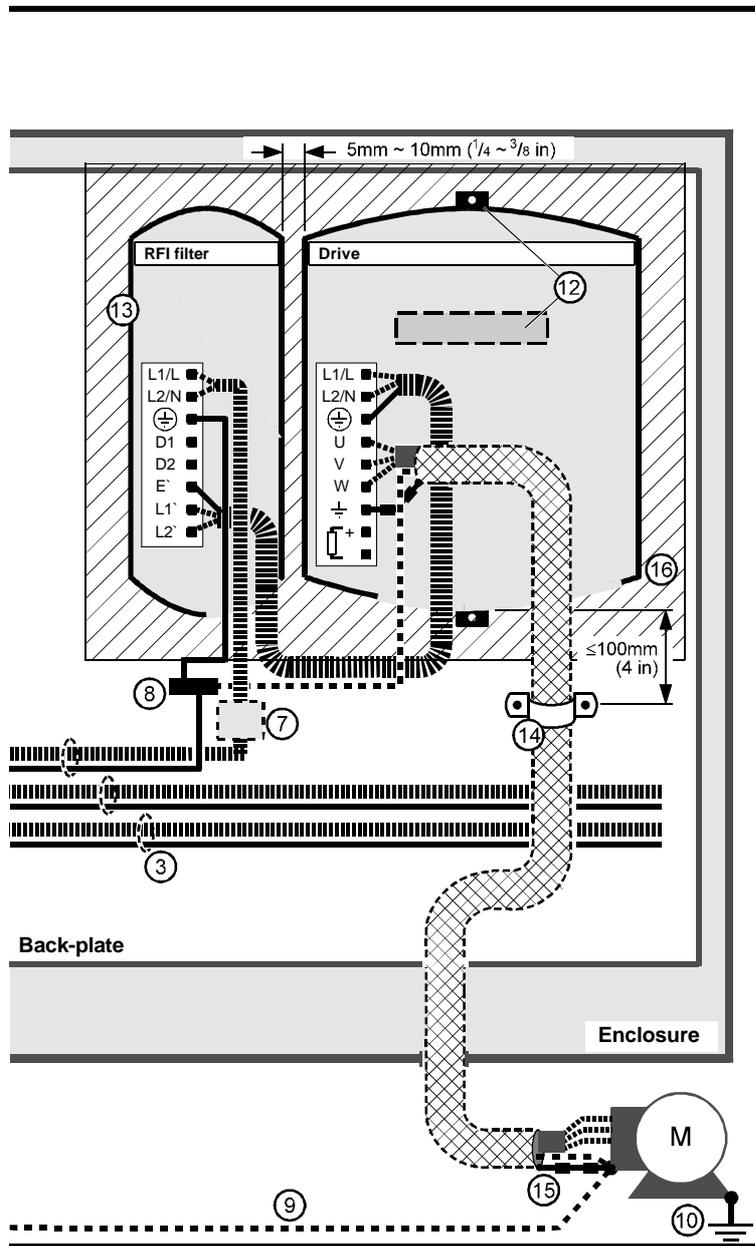


Figure 4–9 Wiring guidelines for compliance with EMC emission standards



Compliance with EMC emission standards (Figure 4-9)

General features

- 1 Single power ground bus-bar, or low-impedance ground terminal.
- 2 Incoming AC supply ground connected to the power ground bus-bar.
- 3 Connect grounds of any other circuits to the power ground bus-bar.
- 4 Site ground, if required.
- 5 Metal back-plate, safety bonded to the power ground bus-bar.
- 6 System isolator, circuit contactors and fuses/MCB.
- 7 Alternative position for Drive fuses/MCB.
- 8 When the motor ground connection is made at the Drive, fit a local ground bus-bar close to the Drive.
- 9 Alternative safety ground for the motor.
- 10 Motor-frame ground connection, if required.

Special features for EMC

- 11 When the length of the motor cable exceeds 5m (16 feet), the AC supply cable must be shielded (screened) or steel-wire armoured. Bond the shield or armour to the enclosure using standard cable-gland fixings.
- 12 Drive heatsink directly grounded to the back-plate using metal mounting brackets. If plastic mounting brackets are supplied, the earthing spring must be used for grounding the heatsink. The back-plate must be unpainted (eg. zinc-plated steel).
- 13 Mount the RFI filter at the left side of the Drive. Ensure a separation of 5 to 10mm ($\frac{1}{4}$ to $\frac{3}{8}$ in) from the Drive. Minimize the length of cables between the Drive and RFI filter.
- 14 A shielded (screened) or steel-wire armoured cable must be used to connect the Drive to the motor. The shield of the cable must be connected to the motor ground terminal in the Drive by a connection no longer than 50mm (2 in). The shield must also be bonded to the back-plate by an un-insulated metal cable clamp. The clamp must be positioned no further than 100mm (4 in) from the Drive.
- 15 Connect the shield of the motor cable to the ground terminal of the motor frame using a link that is as short as possible and not exceeding 50mm (2 in) in length.
- 16 Do not place sensitive signal circuits in a zone extending 0.3m (12 in) all around the Drive.
- 17 If the control circuit 0V is to be grounded, this should be done at the system controller (eg. PLC) and not at the Drive. This is to avoid injecting noise currents into the 0V circuit.

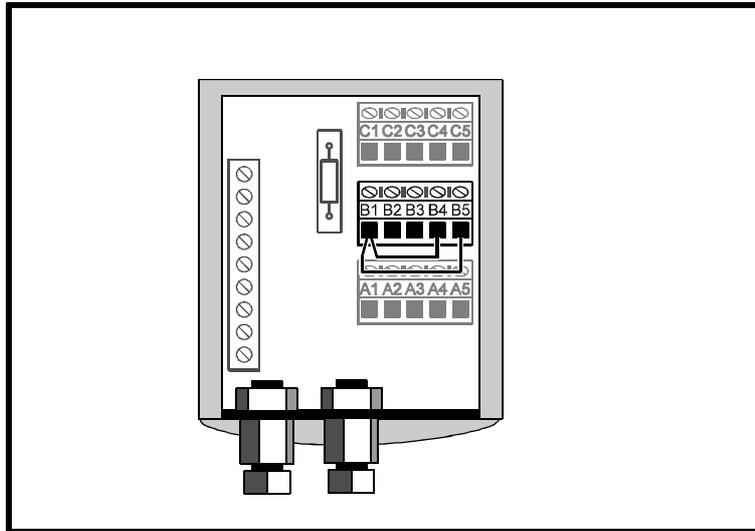
Refer to the *Dinverter A EMC Data Sheet* for advice on the following variations to the wiring:

- Connecting the motor cable to a terminal block in the enclosure
- Fitting a motor isolator for safety when work is to be carried out on the motor
- Connecting a braking resistor

Signal connections for operation in Keypad mode

- 1 Connect terminal B4 to B1.
- 2 Connect terminal B5 to B1.

When the Drive is operated in Keypad mode, the Drive can be started, stopped and reversed by the user pressing keys on the keypad of the Drive. It is also possible to control and monitor the Drive using serial communications. Refer to *Control signal connections* later in this chapter.



(Set parameter **0.05** at 4.)

Figure 4–10 Signal connections to be made for operation in Keypad mode

Signal connections for operation in Terminal mode

The Drive can be started, stopped and reversed by closing switches or contacts that must be connected to the digital inputs of the Drive. This is operation in Terminal mode and the Drive is supplied configured for operation in this mode.



Warning

The control circuits and terminals are isolated from the power circuits only by basic insulation. The installer must ensure that all external control circuits are separated from human contact by at least one layer of insulation rated for use at the AC supply voltage.

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

If the control signal connections are to be accessible to personnel, a 0V-common terminal (A1, B1 or C1) must be connected to a safety ground by a wire which is capable of carrying the fault current before the AC supply fuse disconnects the supply. Alternatively, a second isolation barrier must be used for making signal connections to the signal connectors.



Caution

The Drive is configured for negative logic. Connecting the Drive to a positive-logic PLC could cause the Drive to start the motor automatically when the AC supply is connected to the Drive.

Control signal connections

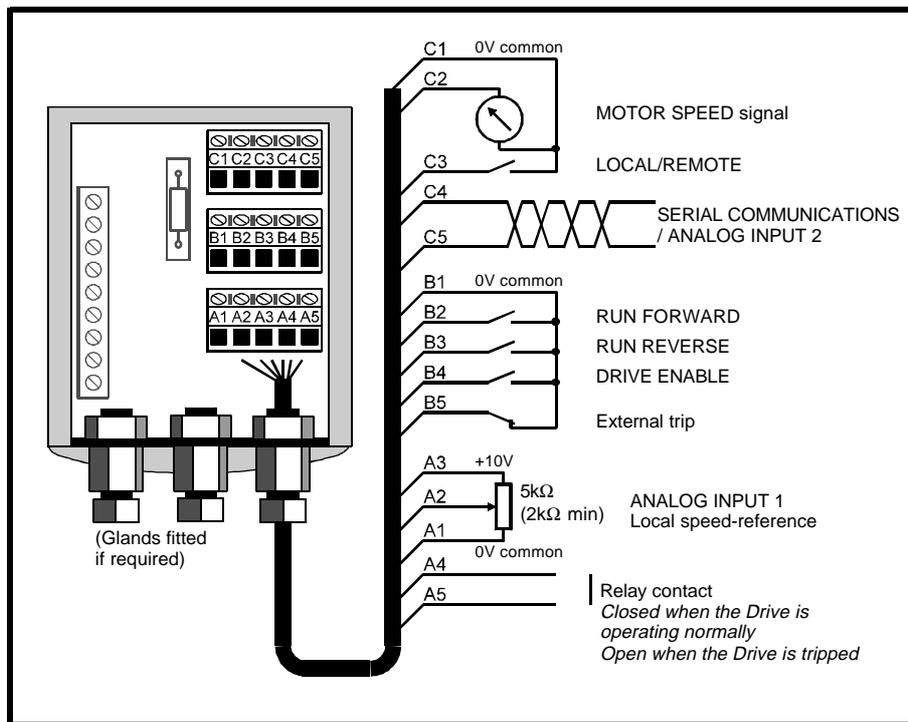


Figure 4–11 Control signal connections

Analog signal wiring must be shielded unless it is totally contained in the enclosure. The shield must be grounded at the system controller not at the Drive-end of the cable.

The Drive is configured for the signal connections shown in Figure 4–11. Terminals C4 and C5 can alternatively be configured for connection to a *remote speed-reference* current-signal (0 to 20mA, etc). See the descriptions which follow for terminals C4 and C5.

The functions of the two analog inputs are selected by the user using two parameters as shown in Table 4–5. Make a note of the parameter settings for the required functions.

Table 4–5 Parameters that control the functions of the analog inputs

Analog input 1 (A2)	Analog input 2 (C4 ~ C5)	Parameter 0.25	Parameter 0.05	Local/Remote switch
Speed reference (local)	Serial communications	ANS (ANSI comms.)	0	Open
Speed reference (local)	Speed reference (remote)	0.20 (0 ~ 20mA) 4.20 (4 ~ 20mA) 20.0 (20mA ~ 0) 20.4 (20 ~ 4mA)	2	Open/closed
Not used (Keypad mode)	Serial communications	ANS (ANSI comms.)	4	Not used

Note

Since the Drive operates in open-loop control, the speed reference cannot give precise control of the motor speed.

Descriptions of the signal connections

A1	0V common
-----------	------------------

A2		Analog input 1
Function	Local speed-reference	
Type of input	Single-ended	
Voltage range (programmable)	0 to +10V	
Absolute maximum voltage range	–50V to +50V relative to 0V common	
Input resistance	94kΩ	
Resolution	10-bit + polarity sign	
Absolute accuracy	±200mV	
Sampling period	16ms (60Hz)	

A3	+10V reference output
Voltage tolerance	±3%
Nominal output current	5mA
Protection	Tolerates continuous short-circuit to 0V

A4 A5	Volt-free relay contact
Function	Drive status
Contact rating	2A resistive at 250VAC or 24VDC
Contact resistance	100mΩ maximum
Update time	32ms (30Hz)
Open-contact withstand voltage	750VAC
Voltage isolation from all other circuits in the Drive	2.5kVAC (meets IEC664-1 with over-voltage category III)
Operation of the contact	<p>Closed AC supply is applied to the Drive and the Drive is ready to run (not tripped)</p> <p>Open AC supply removed from the Drive, or AC supply is applied to the Drive and the Drive has tripped</p>



Warning

The relay must not be connected to an AC supply of over-voltage category greater than II, as defined in IEC664-1 Insulation co-ordination for equipment within low voltage systems, section 2.2.2.1.1.

B1	0V common
-----------	------------------

B2 B3 B4	Digital input F3 Digital input F4 Digital input F5
Function	Digital control signals
Voltage range	0V to +24V
Absolute maximum voltage range	-3V to +30V relative to 0V common
Sampling period	8ms (120Hz)
Switching thresholds when operating in negative logic (default)...	
Inactive (logic high)	$\geq 11.1V$, or $\geq 21.2k\Omega$ connected to 0V
Active (logic low)	$\leq 4.4V$, or $\leq 2.6k\Omega$ connected to 0V
Input resistance	5.6k Ω pull-up resistor
Switching thresholds when operating in positive logic...	
Active (logic high)	$\geq 11.1V$
Inactive (logic low)	$\leq 4.4V$
Input resistance	5.6k Ω pull-down resistor

B5 C3	Digital input/output F1 Digital input/output F2
Function of terminal B5	External-trip input
Function of terminal C3	LOCAL/REMOTE
Voltage range	0V to +24V
Absolute maximum voltage range	-3V to +30V relative to 0V common
Sampling period (minimum period of momentary contact operation)	8ms (120Hz)
Switching thresholds when operating in negative logic (default)...	
Inactive (logic high)	$\geq 11.1V$, or $\geq 21.2k\Omega$ connected to 0V
Active (logic low)	$\leq 4.4V$, or $\leq 2.6k\Omega$ connected to 0V
Input resistance	5.6k Ω pull-up resistor
Switching thresholds when operating in positive logic...	
Active (logic high)	$\geq 11.1V$
Inactive (logic low)	$\leq 4.4V$
Input resistance	5.6k Ω pull-down resistor

C1	0V common
-----------	------------------

C2		Analog output
Function	Output frequency signal	
Signal type (programmable)	Voltage or current	
Voltage range	0 to +10V	
Scaling	+10V represents the value of parameter 0.02 <i>Maximum speed</i>	
Minimum load impedance	2k Ω	
Output current (in voltage mode)	5mA maximum	
Current range (programmable)	0 to 20mA or 4 to 20mA	
Output voltage (in current mode)	+10V maximum	
Maximum continuous external voltage that can be applied	+15V relative to 0V common	
Protection	Tolerates continuous short-circuit to 0V	
Update time	32ms (30Hz)	
Resolution	10 bits (from 0 to 20mA or 10V)	
Absolute accuracy	\pm 500mV (voltage mode) \pm 1mA (current mode)	

C4 C5		Serial communications port / Analog input 2
Default function	Serial communications port	
Type of input	2-wire RS485 (half-duplex)	
Maximum operating common-mode voltage	-5V to +10V on both terminals relative to 0V	
Absolute maximum common-mode voltage	-7V to +12V on both terminals relative to 0V	
Input resistance	100 Ω (termination resistor in the terminal chamber)	
Serial communications protocol	CT-ANSI	
Baud rate	4800	
Transmit delay (programmable) (after receipt of message)	20 milliseconds	

Alternative function (1)	Remote speed-reference
Signal type	Unipolar current
Current range (programmable)	0 to 20mA 4mA to 20mA 20mA to 0 20mA to 4mA
Maximum operating common-mode voltage	-5V to +10V on both terminals relative to 0V
Absolute maximum common-mode voltage	-7V to +12V on both terminals relative to 0V
Input resistance	100Ω (termination resistor in the terminal chamber)
Resolution	10-bit (from 0 to 20mA)
Absolute accuracy	±0.6mA
Sampling period	16ms (60Hz)
Alternative function (2)	Motor thermistor input
Trip threshold	3.3kΩ
Reset threshold	1.8kΩ
Recommended motor-thermistor value	250Ω (embedded in the motor by the manufacturer)
Multiple thermistors	Up to six thermistors can be connected in series

Serial communications requirements



Warning

The RS485 serial communications connections in the Drive are not isolated from the other control circuits and are separated from the live parts by basic insulation; if the serial communications circuit is to be accessible to personnel, an isolation unit must be used. When multiple RS485 networks are to be used, each network will require its own isolation unit.

If more than one Drive is to be connected to a serial link, make connections as shown in Figure 4-12. If only one Drive is to be connected, make the connections shown for the last Drive.

- 1 A 100Ω termination resistor **must** be fitted in the last (or only) Drive on the serial link. Use wire-cutters to remove the termination resistor from all Drives except the last Drive on the serial link.
- 2 Connect two 2.2kΩ ±10% resistors as shown in Figure 4-12 to the last (or only) Drive, on the serial link. Adding these resistors improves noise immunity.

- 3 The serial communications cable must be shielded. The shield(s) must be connected as shown in Figure 4–12.
- 4 Ensure the total cable length does not exceed 1200 metres (4,000 feet).

For detailed information on using the Drive with serial communications, see the *Dinverter A Technical Reference Manual*.

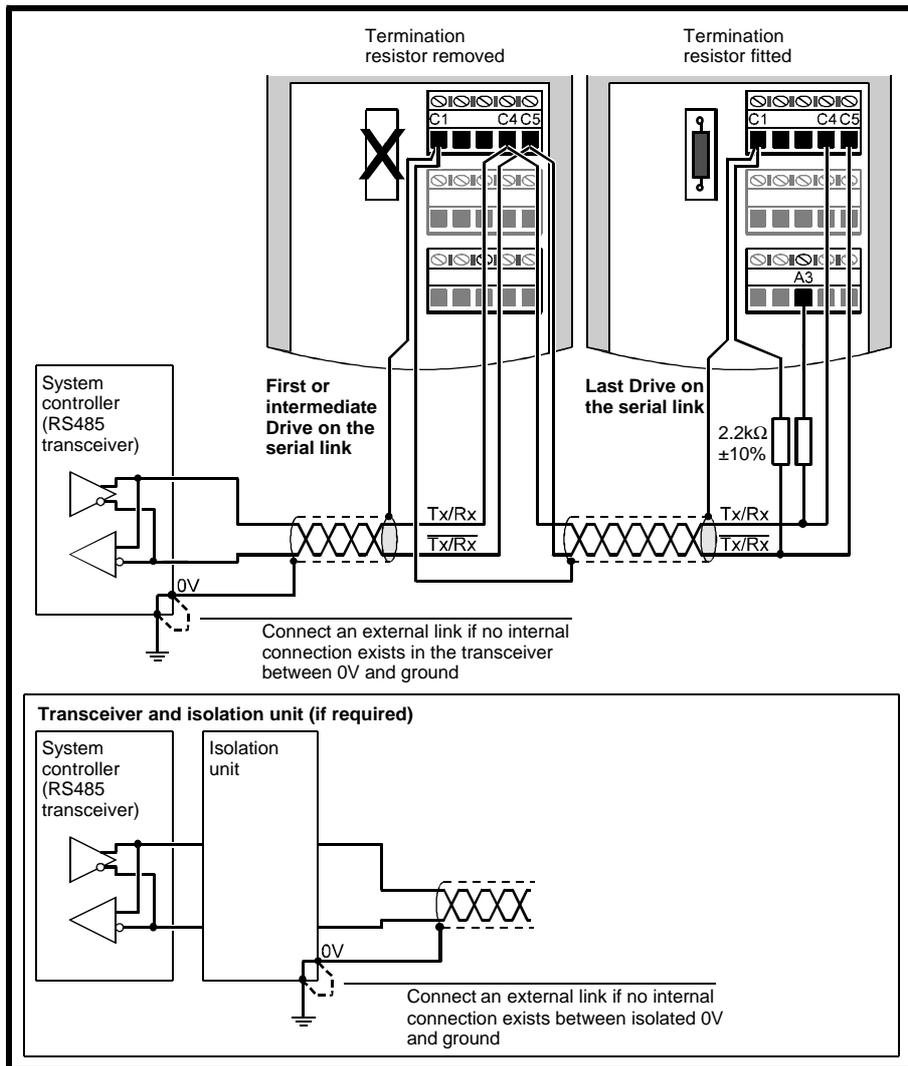


Figure 4–12 RS485 2-wire serial communications connections

Connecting a remote speed reference

- 1 Make a note to set parameter **0.25** at **0.20**, **20.0**, **4.20** or **20.4**.
- 2 When a signal current is applied to terminals C4 and C5, a voltage is developed across the terminals due to the input resistance supplied by the termination resistor. The full-scale voltage is 2V which is produced when the input current is 20mA and the termination resistor is 100Ω.
- 3 If a different input current is required to produce 2V full-scale voltage, the 100Ω termination resistor can be replaced with a 0.5W resistor of a suitable value.
- 4 If the Drive is used with the resistor removed, the input can be used as a unipolar voltage input having a 2V full-scale value. Parameter **0.25** must then be set at **0.20** for 0-to-2V operation, or at **20.0** for 2V-to-0 operation.

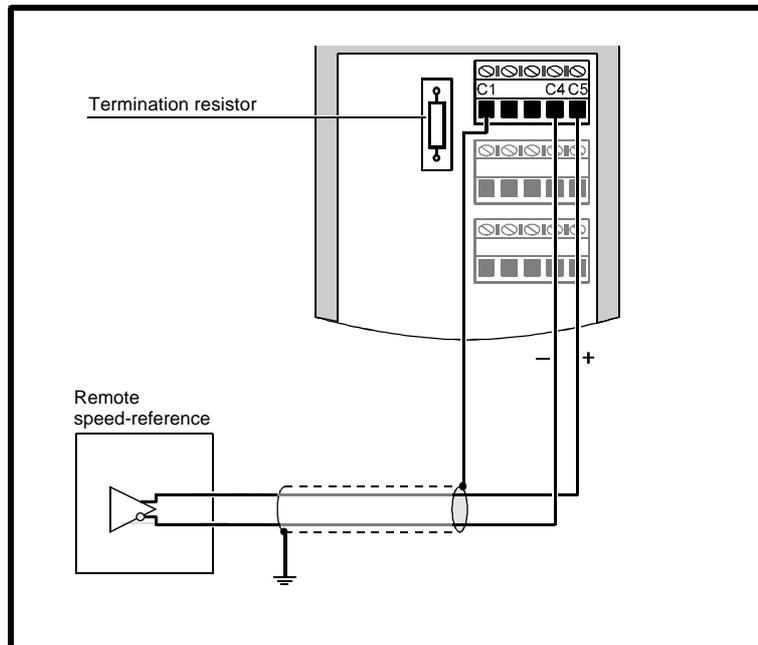


Figure 4–13 Remote speed-reference connections

Connecting a motor thermistor to terminals C4 and C5

- 1 Make a note to set parameter **0.25** at th.
- 2 Connect a motor thermistor to terminals C4 and C5, as shown in Figure 4–14.
- 3 Remove the termination resistor.

Note

Do not connect the shield of the thermistor cable to the motor frame, or to the ground point for the motor.

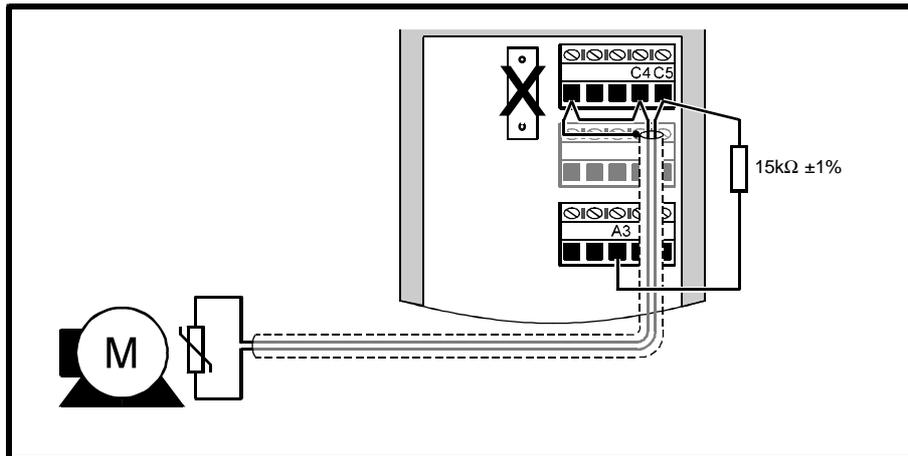
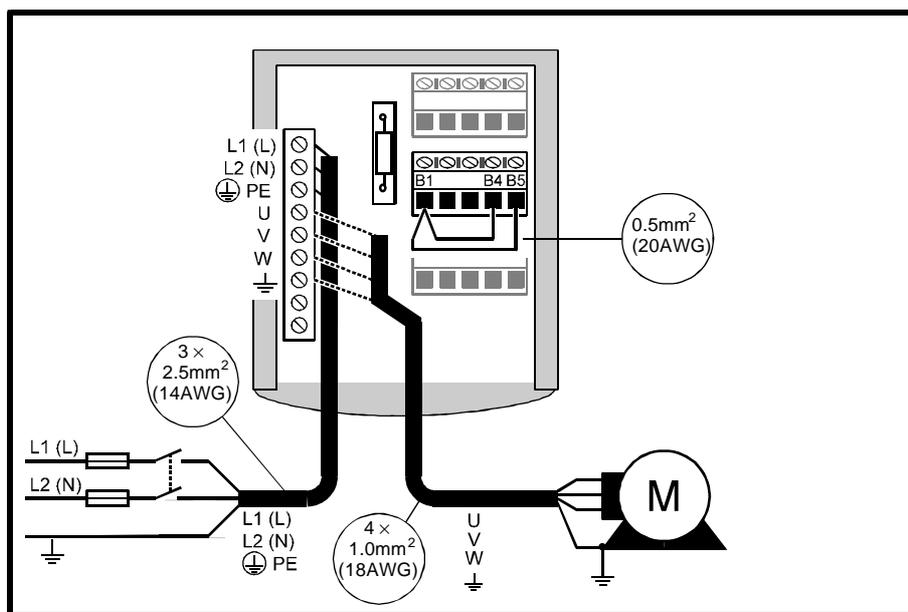


Figure 4–14 Connecting a motor thermistor to terminals C4 and C5

4.6 Bench-testing the Drive – making temporary connections



(Set parameter **0.05** at 4.)

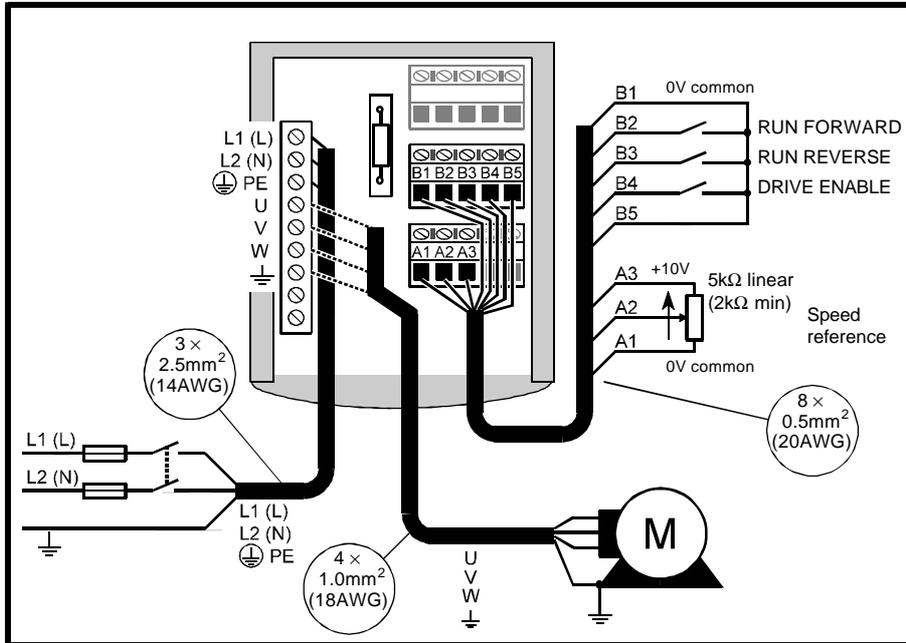
Figure 4–15 Temporary connections for bench-testing the Drive in Keypad mode

The Drive can be operated in Keypad mode or Terminal mode when bench-testing.

- 1 Observe the safety warnings and cautions given in this chapter and refer to *Working in the terminal chamber of the Drive* earlier in this chapter.
- 2 Make the signal and power connections for operation in Keypad or Terminal mode as shown in Figure 4–15 or 4–16 as required. These diagrams show optional connections to a motor. At this stage, do not make these connections; you will be informed later when it will be safe to do so.

It is not essential to connect a motor, but if a motor is to be connected, the motor shaft must not be attached to any equipment, or exposed. Note the Caution in *Wiring recommendations* earlier in this chapter.

- 3 After the terminal cover is re-fitted, the Drive can be used. Refer to Chapter 5 *Programming instructions*.



(Parameter **0.05** set 0 (default).)

Figure 4-16 Temporary connections for bench-testing the Drive in Terminal mode

5 Programming Instructions

5.1 Introduction to the display and keypad

Electrical connections

Before following the instructions in this chapter ensure the Drive has been connected in accordance with the instructions in Chapter 4 *Installing the Drive*, either for installing or bench-testing the Drive.

When following the instructions in this chapter, It is your responsibility to connect and disconnect the AC supply as required.

The terminal cover must be fitted to the Drive before the AC supply is connected. If the cover needs to be removed, the AC supply must first be disconnected for eight minutes.



Warnings

Before operating the Drive you will be required to connect the AC supply to the Drive. Ensure that it will be safe to do so.

This product uses software which is controlled by parameters. The product will perform to specification with the setting of correct and logical values. Incorrect setting of parameters is potentially hazardous.

Adjustment of the parameters must be carried out only by skilled and trained personnel.

Special features of the parameters

Making new values effective, and saving

When a parameter value is changed, the new value of most parameters takes effect as soon as the procedure is completed. Some parameters in the advanced menus require the Drive to be reset before the new value takes effect.

Unless a *save* procedure is carried out, the new value will be lost when the AC supply is disconnected from the Drive (described in *Saving the value of a new parameter* later in this chapter).

Parameter .00

Parameter **.00** is a special parameter that is used for the following:

- Saving new values given to parameters
- Controlling security
- Configuring the Drive

These functions are controlled by entering specific values. In some cases, the Drive must be reset to make the function take effect. The values and functions are shown in Table 5–1.

Table 5–1 Functions of the settings of parameter .00

No.	Function	Reset required
149	Unlock standard security	No
533	Reset parameters to their default values for 50Hz AC supply frequency	Yes
544	Reset parameters to their default values for 60Hz AC supply frequency	Yes
800	Lock standard and user security	No
900	Save new parameter-values	Yes

These functions are described in the appropriate sections later in this chapter.

Display and keypad

The display and keypad are used for the following:

- Reading and changing parameter values
- Displaying the operating status of the Drive
- Displaying fault and trip codes

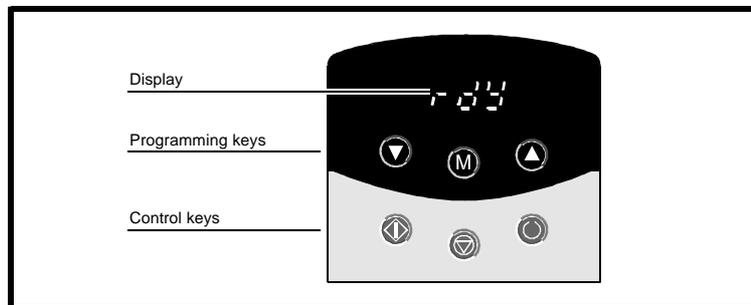


Figure 5–1 Display and keypad as seen when the AC supply is connected to the Drive

Display

The display has four display modes as shown in Table 5–2.

Table 5–2 The four display modes

Display mode	Displays...	Mode entered by...
Status mode	Status of the Drive	Normally displayed
Parameter mode	Menu number Parameter number	User pressing the programming keys
Edit mode	Value of the selected parameter	User pressing the programming keys
Trip mode	Trip code	Automatically entered

Keypad

Programming keys

These are used for the following:

- Changing the mode of operation of the display
- Selecting a parameter to edit
- Editing the selected parameter
- Saving changes to parameter values

The functions of the programming keys are as follows:

-  and  Increase and decrease
-  Change the display mode

Control keys

By default, the control keys are active only when the Drive is operating in Keypad mode (except for the **RESET** key). They are used for the following:

- Starting and stopping the motor
- Reversing the motor
- Resetting the Drive to make new values given to certain parameters become effective, or after the Drive has tripped.

By changing the settings of certain parameters, the control keys can be made active or inactive irrespective of the operating mode (terminal or keypad); see Menu 6.

The functions of the control keys are as follows:

-  Start the Drive running (**RUN**)
-  Stop or reset the Drive (**STOP/RESET**) (when the Drive is operating in Terminal mode, it can still be reset using this key)
-  Change the direction of rotation of the motor (**FWD/REV**)

5.2 Procedures for displaying, changing and saving a parameter value

The following instructions take you step-by-step through learning how to use the display and keypad, and alert you to avoid actions that could cause confusion. It is in your interests to follow these instructions carefully.

The instructions can be used when the Drive is operating in Keypad or Terminal mode. They cover the basic procedure for accessing a numerical variable parameter. Instructions for accessing other types of parameter, as well as for more advanced operations, are given in *Variations in operation* later in this chapter.



Warning

It is strongly recommended that a motor is not connected to the Drive while you learn how to use the display and keypad. Bit parameters can be adjusted when the Drive is running. Some bit parameters are used to make extensive changes to the configuration of the Drive. Before adjusting a bit parameter, make sure that it is safe to do so.

Preparation

- 1 Ensure that terminals B4 and B5 are connected to terminal B1 (0V common), or that contacts connected to these terminals are closed. This will allow the Drive to be operated.
- 2 Ensure that terminals B2 and B3 are open-circuit, or that contacts connected to these terminals are open. This will prevent a motor (if connected) from being driven.
- 3 Ensure that if a SPEED potentiometer is connected, it is set at minimum (wiper at 0V common).
- 4 Connect the AC supply to the Drive.

The display should show **rdY** (as shown in Figure 5–1). The display is in *Status mode*.

If the display shows either of the following instead of **rdY**, check the connection to the terminal indicated:

Indication	Check terminal...	Function
inh	B4	Drive enable
Et	B5	External trip

Entering Parameter mode and returning to Status mode

- 1 Momentarily press **M**. The display enters *Parameter mode*.
The display alternately shows a menu number and a parameter number. The menu number displayed is **0.**, and the parameter number is **.10**, as shown in Figure 5–2. A different parameter number could be shown if the Drive has been used previously.

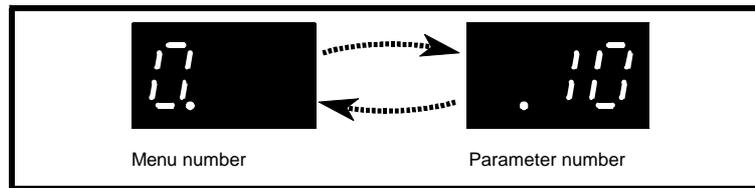


Figure 5–2 Display in Parameter mode

- 2 Do not press any keys. After eight seconds, the display returns to Status mode. This shows that the display always returns from Parameter mode to Status mode when no keys are pressed within eight seconds.
You may repeat these two steps as many times as required to obtain an understanding of the operation.
- 3 You can cause the display to return from Parameter mode to Status mode without waiting eight seconds. Press the following keys at the same time to return the display immediately to Status mode:
▲ and **▼**

Selecting a parameter to access

If the display returns to Status mode during the course of selecting parameters (because no keys have been pressed for eight seconds), to re-enter Parameter mode, press:

M

The number of the last selected parameter will be displayed.

- 1 Momentarily press **M**. The display enters Parameter mode.
The display alternately shows the menu and parameter number as before.
- 2 Within eight seconds, and irrespective of whether the menu or parameter number is momentarily displayed, momentarily press:

▲

Notice that the menu and parameter numbers appear at the same time and the parameter number increases by one. You can repeat this step as many times as required.

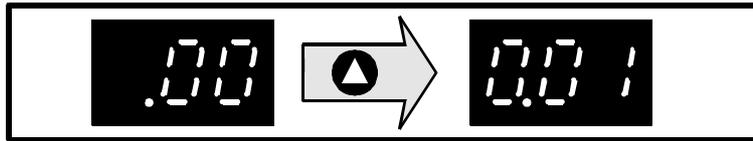


Figure 5-3 Increasing the parameter number (parameter 0.01 is shown)

Scrolling

- 3 Within eight seconds, press and hold down 
Notice that the parameter number continuously increases (scrolls upward) until the highest numbered parameter in the menu is reached. To start scrolling upward again from parameter **00** in the menu, release then re-press:



- 4 Repeat steps 2 and 3 using 
The parameter numbers will now decrease. In step 3, when parameter **00** is reached, releasing and re-pressing the key will re-start downward scrolling from the highest numbered parameter in the menu.

Select a parameter

- 5 Using these techniques, select parameter **0.06**.

Changing the value of a parameter

- 1 Within eight seconds of selecting parameter **0.06**, press:



The display enters *Edit mode*.

If more than eight seconds have elapsed, the display will have returned to Status mode. In this case, twice press:



On the first press, the display will re-enter Parameter mode where parameter **0.06** will again be displayed; on the second press, the display will enter Edit mode.

When the display is in Edit mode, it shows the value of the parameter. The least significant digit flashes, as shown in Figure 5-4. (The value shown is the default value for **0.06**; the value displayed may be different if the Drive has been used previously.)

Note that when the display is in Edit mode, it will not return to Status mode after eight seconds. You can spend as much time as required changing the value of a parameter.

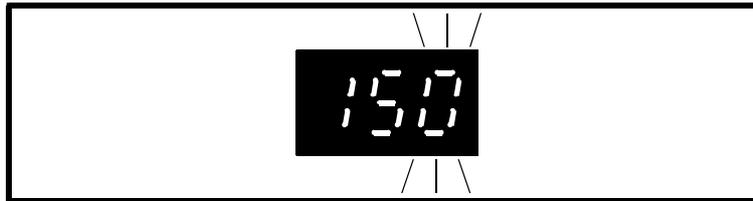


Figure 5-4 Display in Edit mode showing the value of a parameter

- 2 The value shown in Figure 5-4 is the maximum value of **0.06**. In this case, the value can only be decreased. To decrease the value, momentarily press:



Notice that the value of the flashing digit decreases by one as shown in Figure 5-5. You can repeat this step as many times as required.

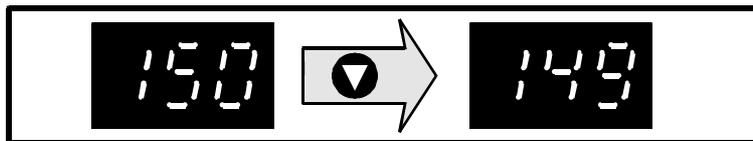


Figure 5-5 Decreasing the value of a parameter

- 3 Press and hold down . Notice that the value scrolls downward. Release the key when the required value is reached. The new value takes effect immediately. To increase the value, press .
- 4 When the required value is displayed in Edit mode, press .
- 5 The display returns to Parameter mode. If no keys are pressed within eight seconds, the display enters Status mode.

Making large changes in value quickly

So far the value has been changed by incrementing or decrementing the least significant digit. The speed of change can be increased by selecting, then scrolling either of the more significant digits, as follows:

- 1 When the display is in Edit mode, momentarily press  and  at the same time. When the keys are released, the digit at the left of the least significant digit flashes. This operation can be repeated to select the most significant digit of the display. If this digit is not currently displayed, it can still be selected. When selected, a bar appears in its place.

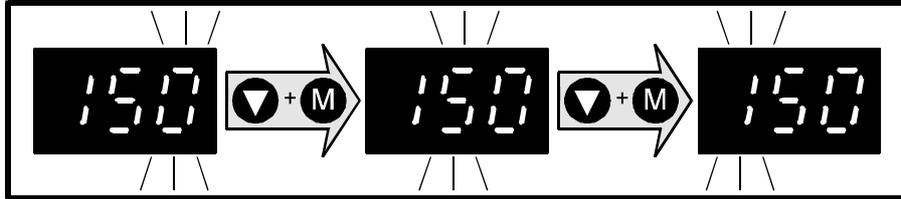


Figure 5-6 *Selecting the next most-significant digit*

- 2 Press  or  (alone) as required to change the value of the flashing digit.

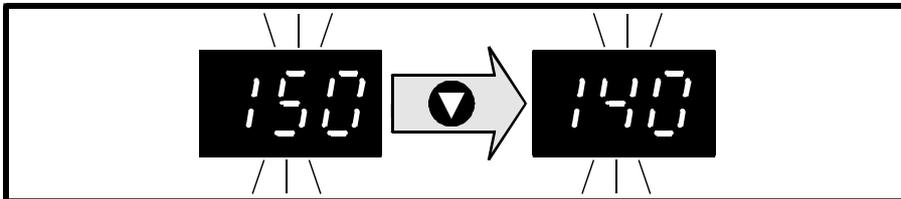


Figure 5-7 *Decreasing the value of the flashing digit*

- 3 To select the digit at the right of the flashing digit, momentarily press at the same time:
 and 

Quick selection from least to most significant digit

To select the most significant digit when the least significant digit is flashing, momentarily press at the same time:

-  and 

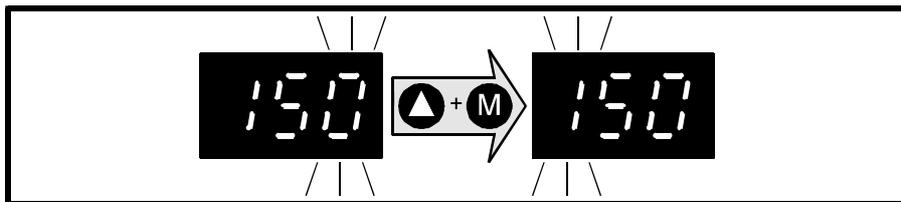


Figure 5-8 *Selecting the most-significant digit when the least significant digit is flashing*

Quick selection from most to least significant digit

When the most significant digit is flashing, to select the least significant digit, momentarily press at the same time:



Reaching the maximum or minimum value

A special condition arises when both the following occur:

- The value of a digit other than the least significant digit is increased, and the maximum value is reached.
- The least significant digit has a value that is not the same as the value of the least significant digit of the maximum value. Using **0.06** as an example: the maximum permissible value is **150**; so the least significant digit is **0**. If the value has already been set at, say, **124**, the least significant digit is **4**, which differs from zero.

The special condition allows the value to be set at either of the following:

- The highest permissible value that contains the displayed least significant digit (eg. **4**)
- The maximum value for the parameter

Use the following procedure to see how the operation works:

- 1 Ensure the selected digit is not the least significant digit.
- 2 Press and hold down . When the maximum value is reached, the entire display flashes the maximum value (eg. **150**). Release the key within three flashes of the display. The display now shows the highest permissible value (eg. **144**) that contains the value of the least significant digit.
- 3 Again press and hold down . When the maximum value is reached, the entire display again flashes the maximum value (eg. **150**). Release the key after four flashes of the display. The display now shows the maximum value.

When setting the value at maximum in normal operation, it is not necessary to follow step 2.

The same principles apply when reaching the minimum value.

Setting the value at zero

Momentarily press at the same time  and .

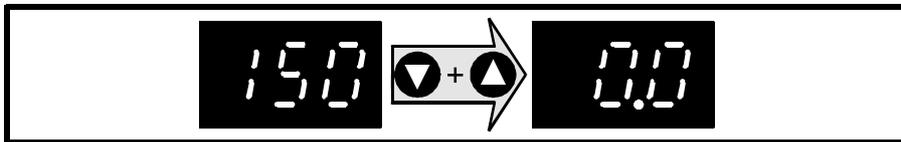


Figure 5–9 Setting the value of a parameter at zero

Bench-testing? Return to default value

If you have followed this procedure while bench-testing the Drive, return the value to **150** before returning the display to Parameter mode.

Saving the new value of a parameter

Use the following procedure to save new parameter-values. The new values will then apply each time the AC supply is subsequently applied to the Drive. If new parameter-values are not saved, the previously saved (or default) values will apply each time the AC supply is applied to the Drive.

- 1 Set parameter **0.00** at **900**.
- 2 Press **M**. The display returns to Parameter mode. If no keys are pressed within eight seconds, the display enters Status mode.
- 3 Momentarily press **▽** to reset the Drive. The new parameter-value(s) are now saved.

Variations in operation

Flashing and non-flashing digits

When the display is in Edit mode, the flashing of a digit indicates that the value of the digit can be changed. If no digits flash, the parameter cannot be edited due to either of the following:

- The selected parameter is read-only or protected.
- Security is preventing access. Refer to *Introduction to the security system* in Chapter 9 *Security*.

Negative values

When the value of a bipolar variable parameter is negative, a minus sign appears at the left of the displayed value.

Changing the setting of a bit parameter

When a bit parameter is selected and Edit mode entered, the display appears as shown in Figure 5–10. The letter **b** at the left of the display indicates *bit*. **0** or **1** is displayed at the right. If security is not preventing access, the parameter can be edited. This is indicated by the **0** or **1** flashing.

When **0** is displayed, press  to select **1**.

When **1** is displayed, press  to select **0**.

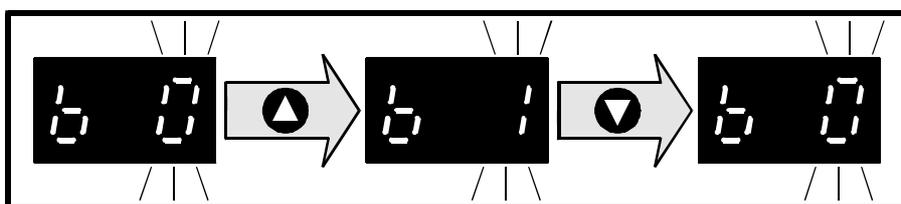


Figure 5–10 Changing the setting of a bit parameter

Selecting a parameter in an advanced menu

- 1 Unlock standard security (see *Introduction to the security system* and *Security procedures* in Chapter 9 *Security*).
- 2 Enter Parameter mode. The display alternately shows the menu and parameter number.

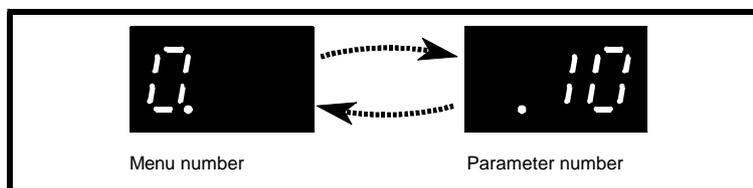


Figure 5–11 Display in Parameter mode

- 3 Momentarily press at the same time  and . The menu number changes to 1. Repeat the action to select the required menu number. If the menu number does not change, this indicates that standard security has not been unlocked (see *Security procedures* in Chapter 9 *Security*).
- 4 To select a lower-numbered menu, press  and .
- 5 To scroll through the menu numbers, hold down the keys.

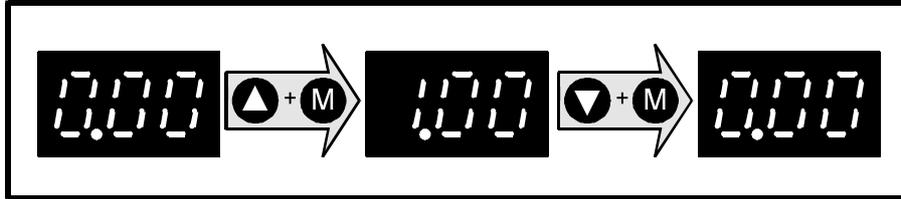


Figure 5–12 Selecting a different menu

Changing the initial parameter to be displayed

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

- 1 When **M** is pressed to enter Parameter, the pre-selected parameter **0.10** is displayed.
- 2 When the Drive is subsequently running, the display shows the value of **0.10**.
- 3 If other parameters are selected by a user for display or editing, the value of the last parameter selected will be displayed when the Drive is next running.
- 4 To select a different parameter to be displayed initially, enter the required **menu.parameter** number in parameter **0.38** *initial parameter displayed selector* (eg. to display **0.12** *Post-ramp speed reference*, enter **0.12**). Only Menu 0 parameter numbers can be selected.

Restoring all parameters to the default values

Default values can be restored only when the Drive is not running. See Chapter 7 *Menu 0 parameters* for the default values.

- 1 Set parameter **.00** as follows:
533 for a Drive operating on 50Hz AC supply frequency
544 for a Drive operating on 60Hz AC supply frequency
- 2 Momentarily press **⏏** to reset the Drive. The default values now take effect.

Saving the default values

If new parameter-values had previously been saved, these (not the default) values will apply when the AC supply is next connected to the Drive. If the default values are required instead, they must be saved in the same way as new values. Refer to *Saving the new value of a parameter* earlier in this chapter to save the default values.

6 Setting up the Drive for the Application



Warnings

Before connecting the AC supply to the Drive you will need to check the following:

The power and signal wiring is correct

Motor installation is correct and safe

The motor shaft is not exposed

Terminals B2 and B3 of the Drive are open-circuit, or contacts connected to them are open

Terminals B4 and B5 of the Drive are connected to 0V common, or contacts connected to them are closed

The SPEED potentiometer is set at minimum (wiper at 0V common)

This product uses software which is controlled by parameters. The product will perform to specification with the setting of correct and logical values. Incorrect setting of parameters is potentially hazardous.

Adjustment of the parameters must be carried out only by skilled and trained personnel.

In this User Guide, when the value of a parameter is referred to, the number of the parameter is shown in square brackets [...]. For example, the value of **0.01** is shown as [0.01].

6.1 Preparation

- 1 Ensure the Drive has been connected in accordance with the instructions in Chapter 4 *Installing the Drive*.
- 2 Ensure the motor is connected to the Drive, but the motor shaft is not connected to a machine, or is exposed.
- 3 When the Drive is connected for operation in Terminal mode, ensure the following:
 - EXTERNAL TRIP** contact is closed
 - RUN FORWARD** and **RUN REVERSE** contacts are open
 - SPEED** potentiometer is set at minimum (wiper at 0V common)
- 4 Ensure the terminal cover is fitted to the Drive. If the cover needs to be removed, the AC supply must first be disconnected for eight minutes.

Connect the AC supply to the Drive. The display should show **rdY**.

6.2 Configuring the Drive for the motor



Warning

The values of the motor parameters affect the protection of the motor and the safety of the system.



Caution

When entering values, make sure they are relevant to the motor that is to be used. The default values in the Drive should not be relied upon.

The motor parameters should be set to within 10% of the required values for the motor. Failure to do this may result in poor response.

Keep a note of the values given to the motor parameters, since motor parameters are restored to their default values when the *Restore to default values* function is used. After restoring parameters to their default values, and before starting the Drive, re-enter the appropriate values for the motor parameters.

Check that the motor current-rating applies to the winding configuration used (typically 220V delta-wound). Enter the motor current-rating in parameter **0.46** *Motor – rated current*.

Table 6–1 Maximum continuous current

Model	I _{max}
DIN1220025A	1.5A
DIN1220037A	2.3A
DIN1220055A	3.0A
DIN1220075A	4.3A

Note

It is essential that the correct value is entered in parameter **0.46**. This affects the thermal protection of the motor.

6.3 Checking operation in Terminal mode



During the following procedure, the Drive will power the motor and cause the shaft to rotate. Before starting, make sure it will be safe for the motor to be run.

The following procedure applies when all the parameters are at their default values, except for those adjusted as instructed earlier in this chapter.

- 1 Close the **DRIVE ENABLE** switch.
- 2 Check the display indicates **rdY**.
- 3 If another parameter has been selected on the display since the AC supply was last connected, select parameter **0.10**.
- 4 Close the **RUN FORWARD** switch. The display now shows **0** (the value of **0.10 Motor frequency**).
- 5 Slowly advance the **SPEED** potentiometer to maximum. Check that the motor speed and displayed motor frequency change accordingly. If the direction is incorrect, open the **RUN FORWARD** switch and close the **RUN REVERSE** switch. Two phases of the motor connections can be reversed later (see *Setting up the Drive for the machine*). When the **RUN REVERSE** switch is closed, a minus sign appears on the display to indicate negative phase sequence at the output of the Drive.
- 6 Open the **RUN FORWARD** (or **RUN REVERSE**) switch. Check that the motor decelerates to a stop and the display indicates **dEC** (decelerating) until the motor stops and the display returns to **rdY**.
- 7 If the Drive stops working and the display shows flashing text, this indicates the Drive has tripped. The text indicates the cause of the trip. Refer to Chapter 8 *Diagnostics*.

Press  to reset the Drive.

- 8 Disconnect the AC supply. (This completes bench-testing.)

6.4 Checking operation in Keypad mode



During the following procedure, the Drive will power the motor and cause the shaft to rotate. Before starting, make sure it will be safe for the motor to be run.

The following procedure applies when all the parameters are at their default values, except for those adjusted as instructed earlier in this chapter. Follow the procedure when bench-testing the Drive.

- 1 Make the control signal connections shown in *Signal connections for operation in Keypad mode* in Chapter 4 *Installing the Drive*
- 2 Check the display indicates **rdY**.
- 3 If another parameter has been selected on the display since the AC supply was last connected, select parameter **0.10**.
- 4 Press  to start the Drive running. The display now shows **0** (the value of **0.10** Motor frequency).
- 5 Press momentarily or hold down  to increase the speed. If the direction of rotation is incorrect, two phases of the motor connections can be reversed later (see *Setting up the Drive for the machine*). Check that the motor speed and displayed frequency increase. Release the key when the required speed is reached.
- 6 Press momentarily or hold down  to decrease the speed. Check that the motor speed decreases and the displayed frequency decreases. Release the key when the required speed is reached.
- 7 Press momentarily . Check the motor decelerates to a stop then accelerates to the same speed in the reverse direction. Check also that the displayed frequency decreases, and then increases when a negative sign appears.
Press  to change the direction again.
- 8 To stop the Drive, press . Check that the motor speed decreases and the display indicates **dEC** (decelerating) until the motor stops and the display returns to **rdY**.
- 9 If the Drive stops working and the display shows flashing text, this indicates the Drive has tripped. The text indicates the cause of the trip. Refer to Chapter 8 *Diagnostics*.
Press  to reset the Drive.
- 10 Disconnect the AC supply. Note that next time the Drive is started, it will accelerate the motor to the last speed setting. (This completes bench-testing.)

6.5 Making adjustments

You can optimize the Drive for the majority of applications by making further adjustments to the parameters in Menu 0. For applications that require more advanced programming, refer to the *Dinverter A Technical Reference Manual*.

7 Menu 0 Parameters

Key

Type of parameter



RO Read-only



RW Read-write

Limitations of use

- R The Drive must be reset for a new value to take effect
- S A new parameter-value is saved when the AC supply is disconnected from the Drive

Range

- Bi Variable parameter having bipolar value range
 - Uni Variable parameter having unipolar value range
 - Txt Variable parameter having text displayed; the number stated in brackets (...) is used by the software, and displayed on the system controller when accessed using serial communications
 - Bit Bit parameter

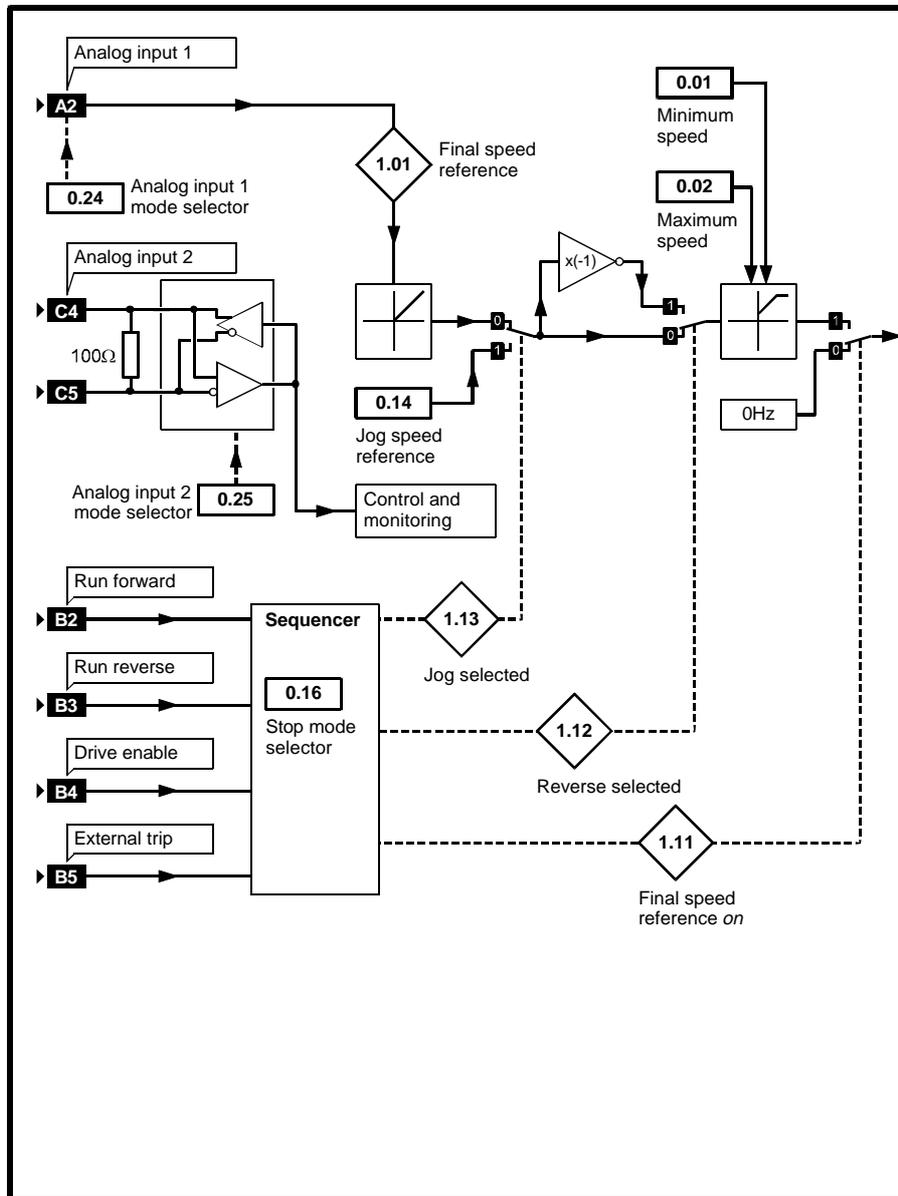
 - ULF Upper-limit frequency (see Chapter 3 *Data*)
 - FLC Full-load current (see Chapter 3 *Data*)
- Values stated in brackets (...) are used by serial communications.

Categories

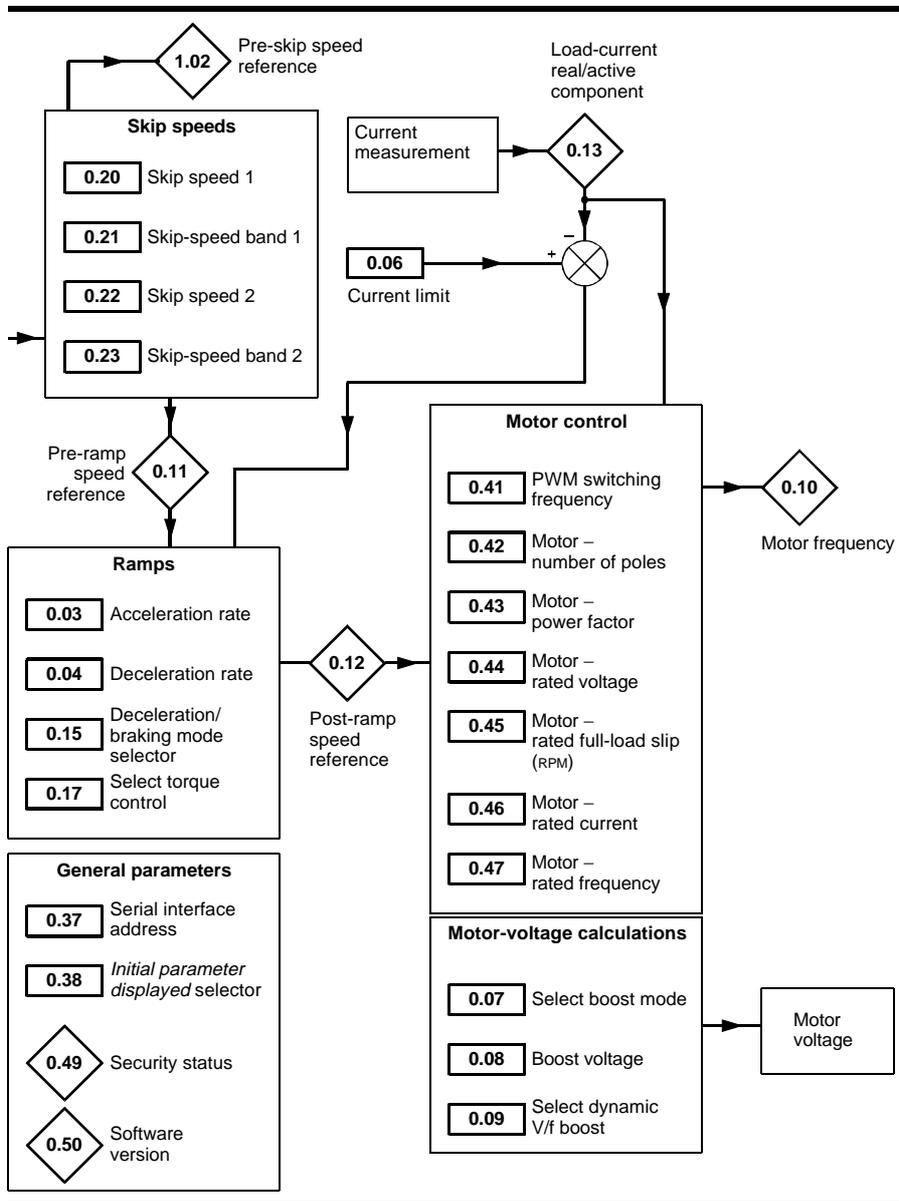
The parameters are arranged in the following categories:

- 0.01 ~ 0.02** Speed clamp
- 0.03 ~ 0.06** Ramps, speed reference selection, current limit
- 0.07 ~ 0.09** Voltage boost
- 0.10 ~ 0.13** Monitoring
- 0.14 ~ 0.17** Deceleration selectors
- 0.20 ~ 0.23** Skip speeds
- 0.24 ~ 0.35** Analog input modes, keypad reference monitoring
- 0.36 ~ 0.38** Serial communications
- 0.41** PWM switching frequency
- 0.42 ~ 0.47** Motor parameters
- 0.49 ~ 0.50** Status

Refer to the *Dinverter A Technical Reference Manual* for details of parameters in the advanced menus.



Menu 0 logic diagram



Note

Parameters that are related to speed (eg. 0.01 Minimum speed) actually control frequency. When making adjustments, set the value at the frequency that will give the required motor speed.

No.	Function	Type	User value						
			Limitations			Range		Default value	
0.00	Security, configuration, saving	RW			R	Uni	0 ~ 999	0	

Speed clamp

0.01	Minimum speed	RW				Uni	0 ~ [0.02] Hz	0	
-------------	----------------------	----	--	--	--	-----	---------------	---	--

Set at the frequency that will give the required minimum motor speed.

0.02	Maximum speed	RW				Uni	0 ~ ULF Hz	50 (EUR) 60 (USA)	
-------------	----------------------	----	--	--	--	-----	------------	----------------------	--

Set at the frequency that will give the required maximum motor speed.

Note that the output frequency of the Drive can exceed the value set in **0.02** due to the actions of slip compensation and current limiting.

If [0.02] is set below [0.01], [0.01] is automatically set at the new value of **0.02**.

Ramps
Speed reference selection
Current limit

0.03	Acceleration rate	RW				Uni	0 ~ 999 seconds/100Hz	5	
0.04	Deceleration rate	RW				Uni	0 ~ 999 seconds/100Hz	10	

This acceleration and deceleration rate applies to both directions of rotation. Note that the rates are related to frequency in Hz not speed in RPM.

0.05	Speed reference selector	RW		P		Uni	0 ~ 5	0	
-------------	---------------------------------	----	--	---	--	-----	-------	---	--

Set as follows to select the required source for the speed reference:

- 0** Analog input 1 (this setting is also used when control signal(s) applied to digital input(s) are used to select the speed reference source – see the *Dinverter A Technical Reference Manual*)
- 1** Analog input 1
- 2** Analog input 2
- 3** Preset speed reference
(see the *Dinverter A Technical Reference Manual*)
- 4** Keypad ▲ and ▼ keys
- 5** Precision speed reference
(see the *Dinverter A Technical Reference Manual*)

The LOCAL/REMOTE switch operates only when **0.05** is set at 0.

0.06	Current limit	RW				Uni	0 ~ 150 % (FLC ÷ [0.46])	150	
-------------	----------------------	----	--	--	--	-----	-----------------------------	-----	--

Set **0.06** at the required value to limit the maximum output current of the Drive to protect the Drive and/or motor from overload. The maximum value depends on the values of FLC, **0.46** *Motor rated current* and **0.43** *Motor power factor*. Refer to Chapter 3 *Data* for values of FLC.

$$\text{Current limit} = \frac{[0.06]}{100} \times [0.46] \times [0.43]$$

Example

$$[0.06] = 150\%, [0.46] = 4.3, [0.43] = 0.85$$

$$\text{Current limit} = 150\% \times 4.3 \times 0.85 = 5.5A$$

Current limit

The current limit can operate when the Drive is driving the motor (motoring) or when the Drive is braking the motor (regenerating).

If the current limit is reached during motoring, the output frequency of the Drive is reduced. If this occurs during acceleration, the acceleration ramp is stopped.

If the current limit is reached during motor regeneration, the output frequency of the Drive is increased under PI control. If this occurs during deceleration, the deceleration ramp is stopped.

When the active/real (torque-producing) component of the motor current exceeds 105% of the motor rated current, motor overload detection in the Drive becomes active. If the overload reaches the limit (based on the model in the Drive of the thermal time-constant of the motor), the Drive trips. A higher overload current increases the risk of the Drive tripping.

If the motor current rating is lower than the Drive current rating, **0.46** *Motor – rated current* should be set accordingly by the user at a value lower than FLC. **0.06** can then be set at a value proportionally greater than 150%.

Voltage boost

0.07	Select voltage mode	RW			Bit	0 ~ 1	1	
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Set at 0 for fixed boost at the level set in **0.08** *Boost voltage*.

Set at 1 for automatic boost given by:

$$[0.08] \times [\text{Percentage current load}] \div 100 (\%)$$

0.08	Boost voltage	RW			Uni	0 ~ 25.5 % [0.44]	10	
-------------	----------------------	----	--	--	-----	-------------------	----	--

The boost voltage increases the motor current over the frequency range up to 50% of [0.47] *Motor rated frequency*.

$$V_b = \frac{[0.08]}{100} \times \frac{[0.44]}{100}$$

Where V_b is the boost voltage expressed as a percentage of the AC supply voltage.

0.09	Select dynamic V/f	RW			Bit	0 ~ 1	0	
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Set at 0 for fixed linear voltage-to-frequency ratio. Use this setting for constant-load or constant-torque applications.

Set at 1 for voltage-to-frequency ratio to be dependent on load current; this will save power and reduce acoustic noise in the motor when lightly loaded. Use this setting for fan or pump applications.

Monitoring

0.10	Motor frequency	RO				Bi	$0 \sim \approx[0.02] \text{ Hz}$		
-------------	------------------------	----	--	--	--	----	-----------------------------------	--	--

The value of **0.10** is displayed by default when the Drive is running. To select a different parameter to be displayed when the Drive is running, see **0.38** *initial parameter displayed selector*.

0.11	Pre-ramp speed reference	RO				Bi	$\pm[0.02] \text{ Hz}$		
0.12	Post-ramp speed reference	RO				Bi	$\approx \pm[0.02] \text{ Hz}$		

0.11 and **0.12** indicate the speeds before and after the acceleration and deceleration ramps.

0.13	Load-current (real/active component)	RO				Bi	$\pm[0.43] \times [0.46] \text{ A}$		
-------------	---	----	--	--	--	----	-------------------------------------	--	--

0.13 indicates the value of the torque-producing current in the motor.

Deceleration selectors

0.14	Jog speed reference	RW				Uni	$0 \sim 400 \text{ Hz}$	1.5	
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(See the *Dinverter A Technical Reference Manual*.)

0.15	Deceleration/braking mode selector	RW				Txt	Std (0) Fst (1)	Std (0)	
-------------	---	----	--	--	--	-----	--------------------	---------	--

Set at **Std** (0) when maximum braking is demanded from the Drive. This setting selects *deceleration with ramp-hold*. If motor regeneration causes the DC-bus voltage to reach its upper limit, the deceleration ramp is held until the DC-bus voltage reduces sufficiently. The ramp then continues until the next time the DC-bus voltage reaches its limit, resulting in maximum deceleration occurring in steps.

Set at **Fst** (1) for deceleration to be continuous under maximum braking conditions. This setting selects *deceleration with no ramp hold*. This can give faster deceleration but causes more regenerated power to be dissipated which could cause the Drive to trip due to over-voltage.

0.16	Stop-mode selector	RW			Txt	Cst (0)	rP (1)	
						rP (1)		
						rP.I (2)		
						dcl (3)		

Set as follows:

- Cst** (0) The motor coasts to stop. The output stage of the Drive is disabled as soon as a stop command is received.
- rP** (1) The Drive decelerates the motor to rest, then disables the output stage after one second.
- rP.I** (2) The Drive decelerates the motor to rest, then applies a DC injection current for one second to lock the motor at stand-still; after this the output stage is disabled (see the *Dinverter A Technical Reference Manual*).
- dcl** (3) As soon as a stop command is received, the Drive applies a DC injection current to the motor for the programmed time.

0.17	Select torque control	RW			Bit	0 (Speed. control)	0	
						1 (Torque control)		

Ensure **0.17** is set at 0 for speed control.

(For torque control, see the *Dinverter A Technical Reference Manual*.)

Skip speeds

0.20	Skip speed 1	RW				Uni	0 ~ ULF Hz	0	
0.21	Skip-speed band 1	RW				Uni	0 ~ 5 Hz	0.5	
0.22	Skip speed 2	RW				Uni	0 ~ ULF Hz	0	
0.23	Skip-speed band 2	RW				Uni	0 ~ 5 Hz	0.5	

If required, enter values in the skip-speed parameters to prevent the Drive running the motor at speeds that cause unwanted vibration in the machine. If vibration occurs over a band of speeds, skip-speed bands can be set up. Two independent skip bands can be set up in Menu 0. Set these parameters at the frequencies that correspond with the required motor speeds.

Set a skip-speed parameter at the centre frequency of the required band to be skipped. Set the related skip-speed band parameter at the range of frequencies to be skipped *each side* of the skip frequency. The total skip band is twice the value of the skip-speed band parameter. When a skip-speed parameter is set at zero, the skip band does not occur.

When the speed reference ascends into a skip band, the output frequency of the Drive is held at the lower edge of the band. When the speed reference has passed through the skip band, the output frequency rises under ramp control to the value of the speed reference. The same principle applies when the speed reference descends into a skip band.

Analog-input modes, Keypad speed reference monitoring

0.24	Analog input 1 mode selector	RW				Txt	ULt (0) th (1)	ULt (0)	
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Ensure **0.24** is set at **ULt** for signal voltage input.

(For use as a motor thermistor input, see the *Drive A Technical Reference Manual*.)

0.25	Analog input 2 mode selector	RW				Txt	ANS (0)	ANS (0)	
							0.20 (1)		
							20.0 (2)		
							4.20 (3)		
							20.4 (4)		
							th (5)		

Select the function of analog input 2 (terminals C4 and C5) as follows:

- ANS** (0) RS485 serial communications
- 0.20** (1) Current signal 0 to 20mA
- 20.0** (2) Current signal 20mA to 0
- 4.20** (3) Current signal 4 to 20mA
- 20.4** (4) Current signal 20mA to 4
- th** (5) Motor thermistor

0.35	Keypad speed reference	RO				Bi	±[0.02]		Hz

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



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

Serial communications

0.36	Serial comms. baud rate	RW				Txt	4.8	4.8	kB
							9.6		

When serial communications are used, set **0.36** at the required baud rate.

0.37	Serial comms. address	RW				Uni	0.0 ~ 9.9 group.unit	1.1	

When the Drive is to be controlled and monitored using serial communications, the Drive must be given an address. If necessary, change the value of **0.37** to the required address.

0.38	initial parameter displayed selector	RW				Uni	0 ~ 50	0.10	

See *Changing the initial parameter to be displayed* in Chapter 5.

PWM switching frequency

0.41	PWM switching frequency	RW				Txt	3 (0) 6 (1) 9 (2) 12 (3)	3 (0)	
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Motor parameters

0.42	Motor – number of poles	RW				Txt	2P (0) 4P (1) 6P (2) 8P (3)	4P (1)	
0.43	Motor – power factor	RW				Uni	0 ~ 1	0.85	
0.44	Motor – rated voltage	RW				Uni	0 ~ 100 % [AC supply voltage]	100	
0.45	Motor – rated full-load slip	RW				Uni	0 ~ 250 RPM	0	
0.46	Motor – rated current	RW				Uni	0 ~ FLC A	FLC	
0.47	Motor – rated frequency	RW				Uni	0 ~ ULF Hz	50 (EUR) 60 (USA)	

The values entered in these parameters should be obtained from the rating plate on the motor. Refer to *Configuring the Drive for the motor* in Chapter 6.

[0.46] is the total current rating of the motor. The Drive derives the rated torque-producing (real/active) component of the total motor current from: $[0.46] \times [0.43]$

Status

0.49	Security status	RO				Uni	(See below)		
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Refer to *Identifying the security status* in Chapter 5.

0.50	Software version	RO				Uni	1.00 ~ 9.99		
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Software version 02.01.XX is displayed as **2.01**

8 Diagnostics



Warning

The Drive contains hazardous electrically live parts. Do not attempt to repair a defective Drive. Return the Drive to a Control Techniques Drive Centre or distributor for repair

8.1 Status messages

When in Status mode, the display shows one of the following status messages:

Display	Status	Conditions
rdY	The Drive is ready to receive a <i>start</i> command, but is not applying power to the motor.	A DRIVE ENABLE signal is applied to terminal B4 (connected to 0V common). An External trip signal is not present (B5 connected to 0V common).
inh	The Drive is disabled, and is not applying power to the motor. If the motor is already running, it will coast to rest.	The DRIVE ENABLE signal has been removed from terminal B4.
dEC	The Drive is decelerating the motor to rest.	A <i>stop</i> command has been received.
dc	DC injection braking current is being applied by the Drive to the motor.	A <i>stop</i> command has been received and 0.16 Stop mode selector is set at rP.I or dcl .
trP	The Drive has tripped, and is not applying power to the motor.	See <i>Changing a parameter value after a trip occurs</i> later in this chapter.
[Value]	The Drive is running.	The value displayed relates to the initial parameter selected by parameter 0.38 or the parameter last selected by the user. The initial parameter displayed by default is 0.10 Motor frequency .

8.2 Warning indications

If one of the conditions shown in the following table approaches its trip level when the Drive is running, the display will show a warning message alternating with the value of the displayed parameter. If the condition is not rectified, the Drive may trip.

Display	Status
OUL	Motor [I x t] is approaching the trip level
hot	The heatsink is approaching maximum temperature 95°C (203°F) to 100°C (212°F)

8.3 When a trip occurs

When a trip occurs, a trip code is displayed with the characters flashing. The display is now in Trip mode. On most trips, the Drive output is immediately disabled and the motor coasts to rest.

Clearing a trip

The Drive must be reset to clear a trip. Perform either of the following to reset the Drive:

Press 

Disconnect and re-connect the AC supply

Trips numbered 12 to 15 can be cleared only by disconnecting the AC supply.

Changing a parameter value after a trip occurs

When a trip has occurred, the value of any parameter can be changed while the Drive is tripped. This allows appropriate parameters to be changed without first having to reset the Drive.

- 1 When the trip code is being displayed, press . The display shows **trP**.
- 2 Again press . The display enters Parameter mode. If necessary, unlock security, and select the required parameter. Change the value of the parameter by following the instructions in Chapter 5 *Programming Instructions*.
- 3 The display will return to Status mode and display **trP**.
- 4 Ensure the cause of the trip has been removed (eg. remove an external trip signal).

- 5 Press  to clear the trip. The display will briefly show **inh**, then **rdY**.
The Drive can now be re-started.

8.4 Trip codes

Internal trips

Display	Trip number	Condition	Possible cause
UU	1	Insufficient voltage on the DC bus	Low AC supply voltage
OU	2	Excessive voltage on the DC bus	Excessive inertia in the machine [0.04] <i>Deceleration rate</i> too low
OI	3	Excessive output current	Insufficient ramp times Short-circuit at the Drive output <i>Wait at least one second before resetting the Drive to clear this trip.</i>
PS	4	Internal power supply has tripped	Internal short-circuit <i>If the trip persists, consult a Drive Centre.</i>
Et	5	External trip	Trip signal has been received at terminal B5
O.SP	6	Excessive motor speed	Excessive motor speed (typically caused by the mechanical load driving the motor)
It	7	Motor overloaded on current x time	
cL	8	Loss of current loop on analog input 2 when used as 4-to-20mA or 20-to-4mA current-signal input	Input current is less than 3mA
Oh2	9	Excessive heatsink temperature	Temperature exceeds 100°C (212°F)
EEF	10	Failure of the internal EEPROM	Possible loss of parameter values Corruption due to severe electrical noise <i>Try restoring default values, then re-enter the values for the application. If the trip persists, consult a Drive Centre.</i>
th	11	Excessive motor temperature (detected by motor thermistor)	

Display	Trip number	Condition	Possible cause
Er1	12	DC output-current present when AC supply is connected	Faulty Drive Severe electrical noise <i>If the trip persists, consult a Drive Centre.</i>
Er2	13	Microprocessor fault	<i>If the trip persists, consult a Drive Centre.</i>
Er3	14	Software fault	<i>If the trip persists, consult a Drive Centre.</i>
Er4	15	Keypad button depressed when AC supply is connected	A key is pressed at the time the AC supply is connected <i>If the trip persists, consult a Drive Centre.</i>

9 Security

9.1 Introduction to the security system

Refer to this chapter only if you require the Menu 0 parameters to be protected against unauthorized or inadvertant adjustment.

The security system has the following two levels:

- Standard security
- User security

Features of the security system

Unlocked and locked	<p>Security has two states: <i>locked</i> and <i>unlocked</i>.</p> <p>When User security has been set up, both security levels are automatically locked when the AC supply is disconnected from the Drive (ie. when the AC supply is connected, security is already locked), or when locking code 800 is entered in parameter 0.00.</p> <p>Each security level is unlocked independently of the other by the user entering an appropriate security code number in parameter 0.00.</p> <p>When security is <i>unlocked</i>, parameters can be <i>accessed</i>, which means the parameter numbers can be displayed; the values can be read and, if appropriate, changed. When security is <i>locked</i>, access to parameters is limited to an extent determined by the security level that applies at the time.</p>
Standard security	<p>Standard security always operates and can be unlocked by the user entering the number 149 in parameter 0.00.</p>
User security	<p>User security operates only after it has been set up by the user entering a suitable three-digit user-security code number in parameter B.30; the Drive is supplied with no user-security code. User security is unlocked by the user entering the same code in parameter 0.00.</p>

Logic table for the security system

The two levels of security are logically related, as follows:

Standard security	User security	Conditions	Parameters that can be read	Parameters that can be edited
Locked	Not set up	Each time the AC supply is connected, or the user enters 800 in parameter 0.00	Menu 0	Menu 0
Unlocked	Not set up	The user enters the number 149 in parameter 0.00	All	All
Locked	Locked	Each time the AC supply is connected (subsequent to user-security being set up), or the user enters 800 in parameter 0.00	Menu 0	None
Locked	Unlocked	The user enters the user-security number in parameter 0.00	Menu 0	Menu 0
Unlocked	Locked	Each time the AC supply is connected (subsequent to user-security being set up), or the user enters 149 in parameter 0.00	All	None
Unlocked	Unlocked	The user enters separately the numbers for the user-security code and standard-security code in parameter 0.00	All	All

In all cases, parameter **0.00** can be accessed. See *Security procedures* later in this chapter.

Identifying the security status

The prevailing security status can be identified by displaying the value of parameter **0.49**. The three-digit value is coded as follows:

Value	First digit	Second digit	Third digit
0	User security not set up	User security is unlocked	Standard security is unlocked
1	A user-security number has been entered in parameter B.30	User security is locked	Standard security is locked

For example, the value **110** indicates the following:

A user-security number has been entered in parameter **B.30**

User security is locked

Standard security is unlocked

9.2 Security procedures

Unlock standard security

Enter **149** in parameter **0.00**.

Set up user security

- 1 Unlock standard security.
- 2 Select parameter **B.30**, and enter Edit mode to display the value. The displayed value is always **149**.
- 3 Change the value of **B.30**, to the required three-digit number for user security.

Note

If default values are subsequently restored, parameter B.30 is not affected.

Unlocking user security

Enter the user security number in parameter **0.00**. This may be done before or after unlocking standard security.