Control Techniques Unidrive

UNI1401, 1402, 1403, 1404, 1405, UNI2401, 2402, 2403,
UNI3401, 3402, 3403, 3404, 3405,
UNI4401, 4402, 4403, 4404, 4405

Control Techniques Unidrive VTC & LFT

Presented by - MRO Electric and Supply Company, Inc.

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Installation Guide

Unidrive
Unidrive VTC
Unidrive LFT

model sizes 1 to 4

Universal Variable Speed Drive
for induction and servo motors
0.75kW to 110kW
(1HP to 125HP)

Part Number: 0447–0088
Issue Number: 5

Contents

Chapter

Appendix

A Motor Connections

A.1 Cable length

It is not recommended that a Drive is operated with a motor-cable length greater than that specified in the table in *Planning the installation* in Chapter 2. If this is unavoidable, it is recommended that a sinusoidal filter is used to prevent the PWM switching components from entering the motor cable. Sinusoidal filters are available from specialist filter suppliers.

A.2 Multiple motors

Open-loop only

If the Drive is to control more than one motor, make connections as shown in Figure A–1. The maximum cable lengths given in the table in Chapter 2 *Installing the Drive* apply to the total length of cable from the Drive to the farthest motor.

It is recommended that each motor is connected through a protection relay since the Drive cannot protect each motor. For star connection, a sinusoidal filter or an output inductor must be connected as shown in Figure A–1, even when the cable lengths are less than the maximum permissible. For details, of inductor sizes refer to a Drive Centre or distributor listed at the end of the User Guide.

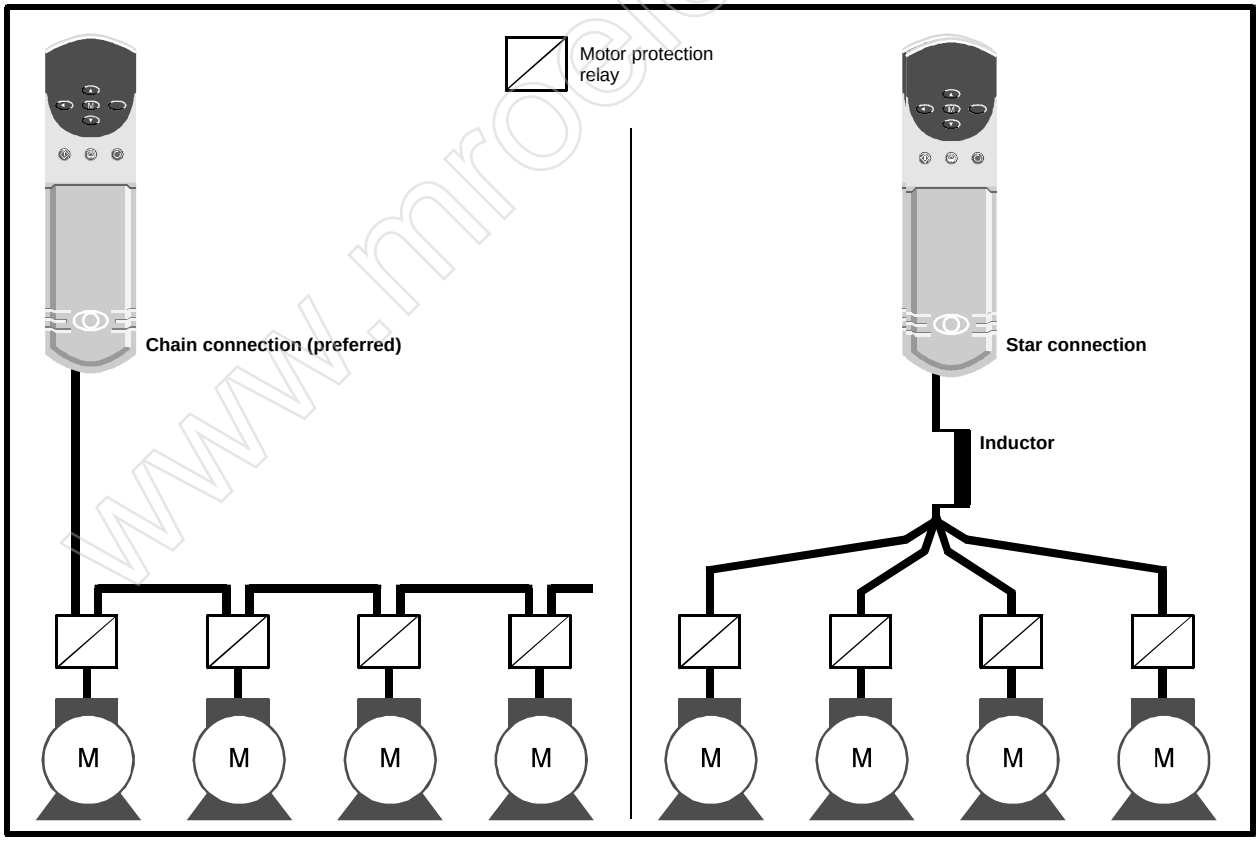


Figure A–1 Connecting motors in parallel

B UL Listing Information

The Drive conforms to UL listing requirements only when the following are observed:

- The Drive is installed in a type 1 enclosure, or better, as defined by UL50
- UL-listed fuses class RK1 600VAC are used in the AC supply
- Class 1 60/75°C (140/167°F) copper wire only is used in the installation
- The ambient temperature does not exceed 40°C (104°F) when the Drive is operating
- The terminal tightening torques specified in the table in *Terminal sizes and tightening torques* in Chapter 2 *Installing the Drive* are used

B.1 AC supply specification

The Drive is suitable for use in a circuit capable of delivering not more than 5000 RMS symmetrical Amperes (10 000 RMS symmetrical Amperes for model size 4) at 528VAC RMS maximum.

B.2 Maximum continuous output current

The Drive models are listed as having the maximum continuous output currents (FLC) shown in Tables B–1 and B–2 (see Appendix C *Data* for details).

Table B–1 Maximum continuous output current for standard and VTC models

Model	FLC (A)
UNI 1401	2.1
UNI 1402	2.8
UNI 1403	3.8
UNI 1404	5.6
UNI 1405	9.5
UNI 2401	12
UNI 2402	16
UNI 2403	25
UNI 3401	34
UNI 3402	40
UNI 3403	46
UNI 3404	60
UNI 3405	70
UNI 4401	96
UNI 4402	124
UNI 4403	156
UNI 4404	180
UNI 4405	202

Table B–2 Maximum continuous output current for LFT models

Model	FLC (A)
UNI 1401 LFT	2.1
UNI 1402 LFT	2.8
UNI 1403 LFT	3.8
UNI 1404 LFT	4.0
UNI 1405 LFT	4.3
UNI 2401 LFT	12.0
UNI 2402 LFT	14.2
UNI 2403 LFT	14.2
UNI 3401 LFT	28.0
UNI 3402 LFT	28.0
UNI 3403 LFT	32.0
UNI 3404 LFT	33.0
UNI 3405 LFT	35.0
UNI 4401 LFT	70
UNI 4402 LFT	70
UNI 4403 LFT	80
UNI 4404 LFT	100
UNI 4405 LFT	100

C Data

C.1 Drive

Power and current ratings

Unidrive and Unidrive VTC
(at 40°C ambient temperature)

Model	Nominal rating		Maximum permissible continuous output current					Nominal AC supply current
	380V	460V	3kHz	4.5kHz	6kHz	9kHz	12kHz	
UNI 1401	0.75 kW	1.0 HP	2.1 A	2.1 A	2.1 A	2.1 A	2.1 A	3.1 A
UNI 1402	1.1 kW	1.5 HP	2.8 A	2.8 A	2.8 A	2.8 A	2.8 A	3.2 A
UNI 1403	1.5 kW	2.0 HP	3.8 A	3.8 A	3.8 A	3.8 A	3.8 A	5.5 A
UNI 1404	2.2 kW	3.0 HP	5.6 A	5.6 A	5.6 A	5.6 A	4.5 A	8.4 A
UNI 1405	4.0 kW	5.0 HP	9.5 A	9.5 A	8.5 A	7.0 A	5.5 A	9.5 A
UNI 2401	5.5 kW	7.5 HP	12.0 A	12.0 A	12.0 A	12.0 A	11.7 A	13.7 A
UNI 2402	7.5 kW	10 HP	16.0 A	16.0 A	16.0 A	14.2 A	11.7 A	16.3 A
UNI 2403	11.0 kW	15 HP	25.0 A	21.7 A	18.2 A	14.2 A	11.7 A	24.3 A
UNI 3401	15.0 kW	25 HP	34.0 A	34.0 A	34.0 A	28.0 A	23.0 A	34.0 A
UNI 3402	18.5 kW	30 HP	40.0 A	40.0 A	37.0 A	28.0 A	23.0 A	39.0 A
UNI 3403	22.0 kW	30 HP	46.0 A	46.0 A	40.0 A	32.0 A	26.6 A	46.0 A
UNI 3404	30.0 kW	40 HP	60.0 A	47.0 A	40.0 A	32.0 A	26.7 A	59.0 A
UNI 3405	37.0 kW	50 HP	70.0 A	56.0 A	46.0 A	35.0 A	28.0 A	74.0 A
UNI 4401	45 kW	75 HP	96 A	96 A	88 A	70 A		96 A
UNI 4402	55 kW	100 HP	124 A	104 A	88 A	70 A		120 A
UNI 4403	75 kW	125 HP	156 A	124 A	105 A	80 A		151 A
UNI 4404	90 kW	150 HP	180 A	175 A	145 A	110 A		173 A
UNI 4405	110 kW	150 HP	202 A	175 A	145 A	110 A		190 A

1 Safety Information

1.1 Warnings, Cautions and Notes

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

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

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

1.2 Electrical safety – general warning

The voltages used in the Drive can cause severe 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 relevant places in this Installation Guide and the accompanying User Guide.

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

1.3 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 Installation 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 high-integrity protection against hazards arising from a malfunction.

1.4 Environmental limits

Instructions in this Installation 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.

1.5 Compliance with regulations

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

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

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

89/392/EEC: Safety of Machinery

89/336/EEC: Electromagnetic Compatibility.

1.6 Safety of personnel

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

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.

Careful consideration must be given to the functions of the Drive which might result in a hazard, either through their intended functions (eg. Auto-start) or through incorrect operation due to a fault or trip (eg. stop/start, forward/reverse, maximum speed).

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 (eg. hoists and cranes), a separate method of braking and stopping the motor should be used (eg. a mechanical brake).

2 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.

Warning

Competence of the installer

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

Note

Unless otherwise stated, instructions and information in this Installation Guide relate to all versions of the Unidrive.

2.1 Environmental requirements

Warning

Installation in an enclosure

The Drive must be protected against water, condensation and electrically conductive contamination. When the gland plate and appropriate glands are fitted, the Drive can attain ingress protection to NEMA 1 and IP40 (in accordance with IEC529). UL listing is valid when the Drive is installed in a type 1 enclosure as defined in UL 50.

Warning

Authorized access

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

Warning

Fire enclosure

The Drive case is not classified as a fire enclosure. When this protection is required, the Drive should be installed in a fire enclosure.

Warning

Hazardous areas

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.

Warning

Before a Drive is used in the fully sinusoidal Regeneration mode, the Drive and the accompanying motoring Drive(s) must be modified. Contact the supplier of the Drive for details.

1. Refer to Appendix C *Data* for details of the environmental requirements.
2. 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.
3. 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.
4. 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.
5. When compliance with EMC emission standards is required, the enclosure must be made of metal but does not require special EMC features.

UL-listing requirements are given in Appendix B.

2.2 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 *Compliance with EMC emission standards*. An RFI filter will always be required. Some model sizes may require additional filtering techniques to be applied.

Operation in the second environment

An RFI filter may not be required. Follow the guidelines given in *Routine EMC* precautions or *Compliance with EMC emission standards* 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 Appendix C *Data* for further information on compliance with EMC standards and definitions of environments.

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

Compliance data is given in Appendix C *Data*.

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.

2.3 Planning the installation

Instructions in numbered steps

The instructions in this section are contained in numbered steps. In some of these steps you will need to make a note of a value for future reference and, to help with identification, the number of the step.

AC supply protection

Warning

The AC supply to the Drive must be fitted with suitable protection against overload and short-circuits. Table 2–1 shows recommended fuse ratings. Failure to observe this recommendation will cause a risk of fire.

STEP 1 Include a fuse of the specified rating in each phase of the AC supply. The use of the following types of fuse is recommended:

- Europe: Type gG HRC industrial fuses to IEC 269 (BS88)
- USA: RK1 600VAC

An MCB or MCCB having the correct thermal and magnetic trip ratings may be used in place of fuses, on condition the fault-current clearing capacity is sufficient for the installation.

Note

UL listing is dependent on the use of the correct type of UL-listed fuse, and applies when the symmetrical short-circuit current does not exceed 5kA for model sizes 1 to 3, and 10kA for model size 4. Refer to Appendix B *UL Listing Information*.

Table 2–1 Fuse ratings for all versions of the Unidrive

Model	Fuse rating	Model	Fuse rating
UNI 1401	6A	UNI 3401	40A
UNI 1402	10A	UNI 3402	50A
UNI 1403	10A	UNI 3403	60A
UNI 1404	10A	UNI 3404	70A
UNI 1405	16A	UNI 3405	80A
UNI 2401	16A	UNI 4401	100A
UNI 2402	20A	UNI 4402	125A
UNI 2403	35A	UNI 4403	160A
		UNI 4404	200A
		UNI 4405	250A

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.

Cable type and size

STEP 2 For the following power connections...

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

... use 105°C (221°F) pvc-insulated cable of suitable voltage rating and having copper conductors, as shown in Table 2–2.

Table 2–2 Cable sizes for all versions of the Unidrive

Model	Cable size	
UNI 1401	1.5 mm²	16 AWG
UNI 1402	2.5 mm²	14 AWG
UNI 1403	2.5 mm²	14 AWG
UNI 1404	2.5 mm²	14 AWG
UNI 1405	2.5 mm²	14 AWG
UNI 2401	2.5 mm²	14 AWG
UNI 2402	4 mm²	10 AWG
UNI 2403	4 mm²	10 AWG
UNI 3401	6 mm²	8 AWG
UNI 3402	10 mm²	6 AWG
UNI 3403	10 mm²	6 AWG
UNI 3404	16 mm²	4 AWG
UNI 3405	25 mm²	4 AWG
UNI 4401	35 mm²	2 AWG
UNI 4402	35 mm²	2 AWG
UNI 4403	50 mm²	0 AWG
UNI 4404	70 mm²	2/0 AWG
UNI 4405	95 mm²	3/0 AWG

When EMC emission requirements are to be met, shielded cable or steel wire armoured cable may be required for the following:

- AC supply to enclosure
- Drive to motor
- Drive to braking resistor when part of the cable is outside the enclosure

For further details, see *Wiring guidelines* later in this chapter.

Motor cable

STEP 3 Since capacitance in the motor cable causes loading on the output of the Drive, ensure the cable length does not exceed the values given in Table 2–3.

Table 2–3 Maximum cable lengths for all versions of the Unidrive

Nominal AC supply voltage	400V		480V	
Model	**Maximum cable length * (PWM switching frequency at 3kHz)**			
	m	**ft**	**m**	**ft**
UNI 1401	65	210	50	160
UNI 1402	100	330	75	250
UNI 1403	130	430	100	330
UNI 1404	200	660	150	490
UNI 1405	300	990	250	820
UNI 2401 ~ UNI 2403	300	990	300	990
UNI 3401 ~ UNI 3405	200	660	120	410
UNI 4401 ~ UNI 4405	200	660	120	410

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

The maximum cable length is reduced from that shown in the table under the following conditions:

- **PWM switching frequency exceeding 3kHz in model sizes 3 and 4**
  The maximum cable length is reduced in proportion to the increase in PWM switching frequency, eg. at 9kHz, the maximum length is $^1/_3$ of that shown.
- **High-capacitance cables** Most cables have an insulating jacket between the cores and the armour or shield; these cables have a low capacitance and are recommended. Cables that do not have an insulating jacket tend to have high capacitance; if a cable of this type is used, the maximum cable length is half that quoted in the table. (Figure 2–1 shows how to identify the two types.)

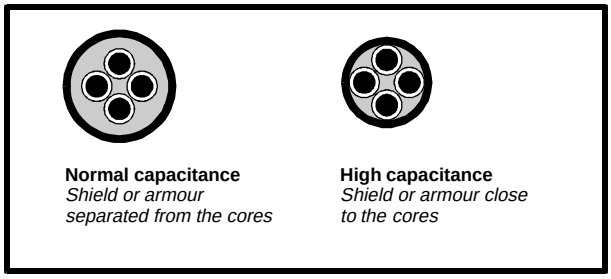


Figure 2–1 Cable construction influencing the capacitance

Multiple motors

Special requirements apply when the Drive is to control more than one motor. Refer to Appendix A *Motor Connections*.

Isolator switch in the motor cable

An isolator switch may be connected in the motor cable for safety purposes. Refer to the following Warning and Note.

Warning

The isolator switch must not be operated when the Drive is enabled. (If an AC-rated switch is used and the Drive is producing a low output frequency when the switch is opened, severe arcing can occur which will prevent the switch from breaking the circuit.)

A suitable interlock arrangement can be used, such as an isolator switch fitted with additional contacts that open before the main contacts. These additional contacts should be used to disable the Drive.

Note

If the isolator switch is closed when the Drive is enabled, the Drive may trip.

When EMC compliance is required, refer to *Variations in the EMC wiring recommendations* later in this chapter.

Output current, PWM switching frequency, Ambient temperature

Thermal protection

Note

The Drive can supply the rated current up to an ambient temperature of 40°C (104°F) (depending on the PWM switching frequency used).

The Drive can be operated in an ambient temperature up to 50°C (122°F) at de-rated output current. In this case, ensure the value of parameter 0.46 *Motor rated current* does not exceed the value given in Table 2-5.

The Drive has two forms of thermal protection for the power output stage (IGBT bridge), as follows:

1. A thermistor mounted on the heatsink monitors the heatsink temperature. If this exceeds 95°C (203°F), the thermistor will cause the Drive to trip. The display will indicate **Oh2**.

2. Intelligent thermal modelling estimates (by calculation) the junction temperature of the IGBTs. There are two temperature thresholds which cause the following to occur:

   - If the first threshold is reached, the PWM switching frequency is halved in order to reduce dissipation in the IGBTs. (When the frequency is halved, the value of parameter **0.41** *PWM switching frequency* remains at the value set by the user; if the frequency is 3kHz or 4.5kHz, no halving occurs). Then at one second intervals, the Drive will attempt to restore the original PWM switching frequency. This will be successful if the estimated temperature has reduced sufficiently.
   - If the estimated temperature has continued to rise and reaches a second threshold, the Drive will trip. The display will indicate **Oh1**.

STEP 4 Note that the Drive can deliver an overload current, as shown in Table 2–4.

Table 2–4 Overload current

Unidrive
Open-loop
Up to 150% of the rated current for 60 seconds
Closed-loop Vector
Up to 175% of the rated current for 60 seconds
Closed-loop Servo
Up to 175% of the rated current for 4 seconds
Unidrive VTC
For a variable-torque load
Up to 120% of the rated current for 60 seconds
Unidrive LFT operating on standard S4/S5 duty cycle
Open-loop
Up to 150% of the rated current
Closed-loop Vector
Up to 175% of the rated current
Closed-loop Servo
Up to 175% of the rated current

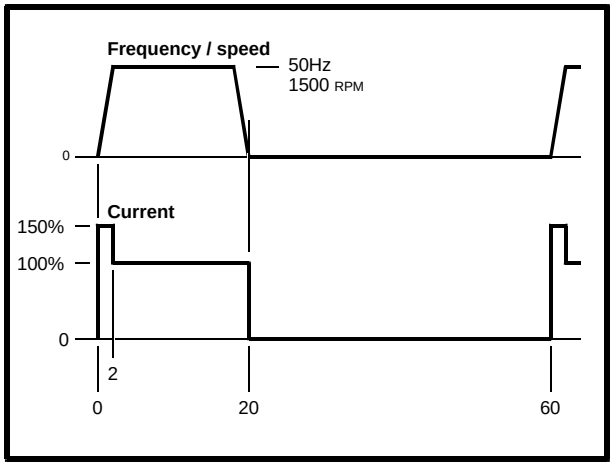


Figure 2–2 Standard S4/S5 duty cycle (Unidrive LFT)

Unidrive and Unidrive VTC Refer to Table 2–5 to find the maximum continuous output current that can be obtained for the required ambient temperature and PWM switching frequency. The maximum ambient temperature can be 40°C or 50°C (104°F or 122°F). Note that the nominal power rating of the Drive may not be achieved above 40°C.

Caution

Operation in a maximum ambient temperature of 50°C (122°F)

Unless the precaution described here is taken, the Drive will limit the maximum continuous output current only to the value for 40°C, and not to the value stated in Table 2–5 for 50°C.

Make a note of the value for 50°C; you will need to refer to it when you reach *Configuring the Drive for the motor* in Chapter 3 of the *User Guide*.

At that point, ensure that the value to be entered in parameter 0.46 *Motor – rated current* does not exceed the noted value.

Unidrive LFT Refer to Table 2–6 to find the maximum continuous output current that can be obtained for the ambient temperature for a standard **S4/S5** duty-cycle or for continuous operation. Refer to a Drive Centre or distributor for information on other duty ratios.

Make a note of this step number and the following:

- **Unidrive and Unidrive VTC** Chosen maximum ambient temperature.
- **Unidrive and Unidrive VTC** Chosen **PWM switching frequency** for each Drive.
- **All Unidrive versions** From Table 2–7, the maximum **power dissipation** (heat) figure (P_{DISS}) at the chosen PWM switching frequency for each Drive (this figure is the total power dissipation at the maximum continuous output current available at the chosen PWM switching frequency, and includes power dissipated in option modules when fitted). Power dissipation in the Unidrive LFT is the same as that for the standard Unidrive when operating at 9kHz PWM switching frequency.
- **Unidrive and Unidrive VTC** If the maximum ambient temperature will be 50°C (122°F), note the value of the maximum permissible output current obtained from Table 2–5. This will be the maximum value that parameter **0.46** *Motor – rated current* should be set at.

Table 2–5 Maximum permissible continuous output current for Unidrive and Unidrive VTC

40°C (104°F) ambient	Nominal rating		Maximum permissible continuous output current				
Model			**3kHz**	**4.5kHz**	**6kHz**	**9kHz**	**12kHz**
UNI 1401	0.75 kW	1.0 HP	2.1 A	2.1 A	2.1 A	2.1 A	2.1 A
UNI 1402	1.1 kW	1.5 HP	2.8 A	2.8 A	2.8 A	2.8 A	2.8 A
UNI 1403	1.5 kW	2.0 HP	3.8 A	3.8 A	3.8 A	3.8 A	3.8 A
UNI 1404	2.2 kW	3.0 HP	5.6 A	5.6 A	5.6 A	5.6 A	4.5 A
UNI 1405	4.0 kW	5.0 HP	9.5 A	9.5 A	8.5 A	7.0 A	5.5 A
UNI 2401	5.5 kW	7.5 HP	12.0 A	12.0 A	12.0 A	12.0 A	11.7 A
UNI 2402	7.5 kW	10 HP	16.0 A	16.0 A	16.0 A	14.2 A	11.7 A
UNI 2403	11.0 kW	15 HP	25.0 A	21.7 A	18.2 A	14.2 A	11.7 A
UNI 3401	15.0 kW	20 HP	34.0 A	34.0 A	34.0 A	28.0 A	23.0 A
UNI 3402	18.5 kW	25 HP	40.0 A	40.0 A	37.0 A	28.0 A	23.0 A
UNI 3403	22.0 kW	30 HP	46.0 A	46.0 A	40.0 A	32.0 A	26.6 A
UNI 3404	30.0 kW	40 HP	60.0 A	47.0 A	40.0 A	32.0 A	26.7 A
UNI 3405	37.0 kW	50 HP	70.0 A	56.0 A	46.0 A	35.0 A	28.0 A
UNI 4401	45 kW	60 HP	96 A	96 A	88 A	70 A	
UNI 4402	55 kW	75 HP	124 A	104 A	88 A	70 A	
UNI 4403	75 kW	100 HP	156 A	124 A	105 A	80 A	
UNI 4404	90 kW	125 HP	180 A	175 A	145 A	110 A	
UNI 4405	110 kW	125 HP	202 A	175 A	145 A	110 A	
50°C (122°F) ambient	**Nominal rating**		**Maximum permissible continuous output current**				
Model			**3kHz**	**4.5kHz**	**6kHz**	**9kHz**	**12kHz**
UNI 1401	0.75 kW	1.0 HP	2.1 A	2.1 A	2.1 A	2.1 A	2.1 A
UNI 1402	1.1 kW	1.5 HP	2.8 A	2.8 A	2.8 A	2.8 A	2.8 A
UNI 1403	1.5 kW	2.0 HP	3.8 A	3.8 A	3.8 A	3.8 A	3.3 A
UNI 1404	2.2 kW	3.0 HP	5.6 A	5.6 A	5.1 A	4.0 A	3.3 A
UNI 1405	4.0 kW	5.0 HP	6.9 A	5.9 A	5.1 A	4.0 A	3.3 A
UNI 2401	5.5 kW	7.5 HP	12.0 A	12.0 A	12.0 A	11.6 A	9.7 A
UNI 2402	7.5 kW	10 HP	16.0 A	16.0 A	14.7 A	11.6 A	9.7 A
UNI 2403	11.0 kW	15 HP	20.0 A	17.3 A	14.7 A	11.6 A	9.7 A
UNI 3401	15.0 kW	20 HP	34.0 A	34.0 A	28.0 A	21.0 A	17.9 A
UNI 3402	18.5 kW	25 HP	40.0 A	34.0 A	28.0 A	21.0 A	17.9 A
UNI 3403	22.0 kW	30 HP	44.0 A	36.0 A	31.0 A	24.0 A	20.6 A
UNI 3404	30.0 kW	40 HP	44.0 A	36.0 A	31.0 A	24.0 A	20.9 A
UNI 3405	37.0 kW	50 HP	50.0 A	41.0 A	34.0 A	26.0 A	23.0 A
UNI 4401	45 kW	60 HP	95 A	85 A	75 A	60 A	
UNI 4402	55 kW	75 HP	105 A	85 A	75 A	60 A	
UNI 4403	75 kW	100 HP	135 A	105 A	85 A	65 A	
UNI 4404	90 kW	125 HP	180 A	150 A	125 A	95 A	
UNI 4405	110 kW	125 HP	190 A	150 A	125 A	95 A	

Table 2–6 Maximum permissible output current for Unidrive LFT (at 9kHz PWM switching frequency)

Model	Nominal rating		Maximum permissible output current		
			Standard duty cycle at 40°C	Continuous operation at 40°C	Continuous operation at 50°C
UNI 1401 LFT	0.75 kW	1.0 HP	2.1 A	2.1 A	2.1 A
UNI 1402 LFT	1.1 kW	1.5 HP	2.8 A	2.8 A	2.8 A
UNI 1403 LFT	1.5 kW	2.0 HP	3.8 A	3.8 A	3.3 A
UNI 1404 LFT	2.2 kW	3.0 HP	5.6 A	4.0 A	3.3 A
UNI 1405 LFT	4.0 kW	5.0 HP	9.5 A	4.3 A	3.3 A
UNI 2401 LFT	5.5 kW	7.5 HP	12.0 A	12.0 A	11.0 A
UNI 2402 LFT	7.5 kW	10 HP	16.0 A	14.2 A	11.0 A
UNI 2403 LFT	11.0 kW	15 HP	25.0 A	14.2 A	11.0 A
UNI 3401 LFT	15.0 kW	20 HP	34.0 A	28.0 A	21.0 A
UNI 3402 LFT	18.5 kW	25 HP	40.0 A	28.0 A	21.0 A
UNI 3403 LFT	22.0 kW	30 HP	46.0 A	32.0 A	24.0 A
UNI 3404 LFT	30.0 kW	40 HP	60.0 A	33.0 A	24.0 A
UNI 3405 LFT	37.0 kW	50 HP	70.0 A	35.0 A	26.0 A
UNI 4401 LFT	45 kW	60 HP	96 A	70 A	57 A
UNI 4402 LFT	55 kW	75 HP	124 A	70 A	57 A
UNI 4403 LFT	75 kW	100 HP	156 A	80 A	61 A
UNI 4404 LFT	90 kW	125 HP	180 A	100 A	77 A
UNI 4405 LFT	110 kW	125 HP	202 A	100 A	77 A

Table 2–7 Maximum total power dissipation (Unidrive, Unidrive VTC and Unidrive LFT)

Unidrive, Unidrive VTC and Unidrive LFT							
Model	**Nominal rating**		**Maximum total power dissipation**				
			3kHz	**4.5kHz**	**6kHz**	**9kHz**	**12kHz**
UNI 1401	0.75kW	1.0HP	80 W	80 W	90 W	90 W	90 W
UNI 1402	1.1kW	1.5HP	90 W	90 W	100 W	100 W	110 W
UNI 1403	1.5kW	2.0HP	100 W	110 W	110 W	120 W	130 W
UNI 1404	2.2kW	3.0HP	130 W	130 W	140 W	150 W	150 W
UNI 1405	4.0kW	5.0HP	180 W	190 W	190 W	190 W	170 W
UNI 2401	5.5kW	7.5HP	210 W	230 W	250 W	280 W	310 W
UNI 2402	7.5kW	10HP	270 W	290 W	310 W	320 W	310 W
UNI 2403	11.0kW	15HP	400 W	380 W	360 W	330 W	310 W
UNI 3401	15.0kW	20HP	570 W	620 W	670 W	660 W	630 W
UNI 3402	18.5kW	25HP	660 W	720 W	730 W	660 W	630 W
UNI 3403	22.0kW	30HP	730 W	800 W	770 W	730 W	700 W
UNI 3404	30.0kW	40HP	950 W	830 W	790 W	740 W	710 W
UNI 3405	37.0kW	50HP	1090 W	990 W	920 W	850 W	800 W
UNI 4401	45kW	60HP	1460 W	1610 W	1630 W	1530 W	
UNI 4402	55kW	75HP	1910 W	1780 W	1670 W	1560 W	
UNI 4403	75kW	100HP	2370 W	2130 W	2030 W	1860 W	
UNI 4404	90kW	125HP	2640 W	2890 W	2700 W	2470 W	
UNI 4405	110kW	125HP	2970 W	2910 W	2720 W	2490 W	

The default PWM switching frequency is a follows...

Unidrive and Unidrive VTC: 3kHz
Unidrive LFT: 9kHz

Using an RFI filter

STEP 5 For compliance with the emission standards such as EN 50081-1 or EN 50081-2, use the recommended RFI filter as shown in Table 2–8. Use one RFI filter for each Drive. (Standards that are met are specified in Appendix C *Data*)

Make a note of this step number and the following for each filter to be used:

- Size code or part number
- Maximum power dissipation figure
- IP rating

Table 2–8 RFI filter data

Model	RFI filter			
	Size	Part number	Maximum power dissipation (W)	IP rating
UNI 1401	*A*	4200–0010	25	IP20
UNI 1402	*A*	4200–0010	25	IP20
UNI 1403	*A*	4200–0010	25	IP20
UNI 1404	*A*	4200–0010	25	IP20
UNI 1405	*A*	4200–0010	25	IP20
UNI 2401	*B*	4200–0027	40	IP20
UNI 2402	*B*	4200–0027	40	IP20
UNI 2403	*B*	4200–0027	40	IP20
UNI 3401	*C*	4200–1051	60	IP00
UNI 3402	*C*	4200–1051	60	IP00
UNI 3403	*C*	4200–1051	60	IP00
UNI 3404	*D*	4200–1071	100	IP00
UNI 3405	*D*	4200–1071	100	IP00
UNI 4401	*E*	4200–1111	120	IP00
UNI 4402	*F*	4200–1171	150	IP00
UNI 4403	*F*	4200–1171	150	IP00
UNI 4404	*F*	4200–1171	150	IP00
UNI 4405	*H*	4200–1220	200	IP00

Model size 1

When the motor cable is to exceed 50m (165 feet), use RFI filter size *B* (4200–0027).

Using a braking resistor

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

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

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

By default, the Drive brakes the motor under PI control which extends the deceleration time as necessary in order to keep the DC bus at a constant voltage. The method of braking can be changed; if required, refer to Appendix D Menu 0 Parameters in the *User Guide*.

Housing the resistor, and routing the connecting cable

Warning

High temperatures

Braking resistors can reach high temperatures. Locate braking resistors so that damage cannot result.

Use cable having insulation capable of withstanding high temperatures.

Warning

Overload protection

It is essential that an overload protection device is incorporated in the braking resistor circuit; this is described in *Protection circuit for an optional braking resistor* in STEP 8.

STEP 6 When a braking resistor is to be mounted outside the enclosure, ensure that it is mounted in a ventilated metal housing that will perform the following functions:

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

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

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

Minimum resistances and power ratings

Table 2–9 Minimum resistance values and peak power rating for the braking resistor at 40°C (104°F)

Model	Minimum resistance	Instantaneous power rating
UNI 1401 ~ UNI 1405	40Ω	15kW
UNI 2401	40Ω	15kW
UNI 2402, UNI 2403	30Ω *	20kW
UNI 3401 ~ UNI 3405	10Ω	60kW
UNI 4401 ~ UNI 4405	5Ω	120kW

* For Drives having date code earlier than ***G50***, the minimum resistance is 40Ω.

The minimum resistance allows the braking resistor to dissipate up to approximately 150% of the power rating of the Drive for up to 60 seconds.

For high-inertia loads or under continuous braking, the *continuous power* dissipated in the braking resistor may be as high as the power rating of the Drive. The total *energy* dissipated in the braking resistor is dependent on the amount of energy to be extracted from the load.

The instantaneous power rating refers to the short-term maximum power dissipated during the *on* intervals of the pulse width modulated braking control cycle. The braking resistor must be able to withstand this dissipation for short intervals (milliseconds). Higher resistance values require proportionately lower instantaneous power ratings.

In most applications, braking occurs only occasionally. This allows the continuous power rating of the braking resistor to be much lower than the power rating of the Drive. It is essential, though, that the instantaneous power rating and energy rating of the braking resistor are sufficient for the most extreme braking duty that is likely to be encountered.

Optimization of the braking resistor requires a careful consideration of the braking duty. This is described more fully in *Optimizing an optional braking resistor* in the *Unidrive Advanced User Guide*.

STEP 7 Select a value of resistance for the braking resistor that is not less than the specified minimum resistance. Larger resistance values may give a cost saving, as well as a safety benefit in the event of a fault in the braking system. Braking capability will then be reduced, which may cause the Drive to trip during braking. If this occurs, refer to *Adjusting the deceleration rate* in the *User Guide*.

STEP 8 Estimate the average power that will be dissipated in the resistor. A method of estimating this power is described in *Optimizing an optional braking resistor* in the *Unidrive Advanced User Guide*. Make a note of this step number and the average power to be dissipated in the resistor.

Thermal protection circuit for the braking resistor

The thermal protection circuit must disconnect the AC supply from the Drive if the resistor becomes overloaded. Figure 2–3 shows a typical circuit arrangement.

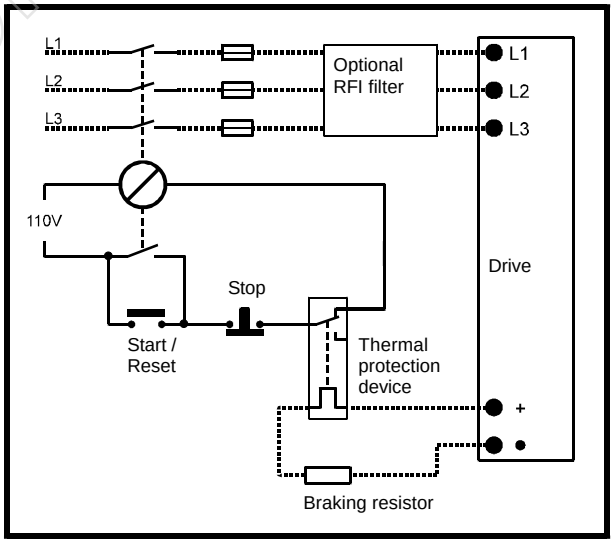


Figure 2–3 Typical protection circuit for a braking resistor

Enclosure layout

STEP 9 Use one of the following enclosure layouts, depending on the requirements of the installation:

Routine EMC precautions Refer to Figure 2–4 which shows the recommended layout for two Drives, and the signal and power cables.

Compliance with EMC emission standards Refer to Figure 2–5 which shows the recommended layout for two Drives, two RFI filters, and the signal and power cables.

STEP 10 Decide whether the enclosure is to be sealed or ventilated, as follows:

A sealed enclosure can give a high ingress-protection rating, but with reduced heat removal capabilities. If possible, locate heat-generating equipment (other than braking resistors) in the lower part of the enclosure to encourage internal convection. If necessary, a taller enclosure, and/or air-circulation fans inside the enclosure, can be used. For calculating the minimum size of sealed enclosure that will adequately cool the Drive(s), refer later in this chapter to *Calculating the size of a sealed enclosure.*

If a high ingress-protection rating is not required, a ventilated enclosure can be used with a fan to supply forced air cooling; this can give a lower ambient temperature than a sealed enclosure. For calculating the minimum required volume of cooling air, refer later in this chapter to *Calculating the air-flow in a ventilated enclosure*.

STEP 11 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 2–5).

STEP 12 Ensure the Drive is installed vertically for best flow of cooling air through the Drive and heatsink.

STEP 13 Ensure the clearances around the Drive are as follows:

Above and below: ≥100mm (4 in)

Both sides: ≥5mm ($^1/_4$ in)

For overall dimensions and weights of the Drive and RFI filter, see Appendix C *Data*.

STEP 14 When compliance with EMC emission standards is required, the RFI filter must be installed at the specified position for each Drive (see Figure 2–5).

STEP 15 When a braking resistor is to be used, it can be installed outside or inside the enclosure. When installed inside, it must be mounted in the upper part of the enclosure to prevent it heating the other equipment by convection.

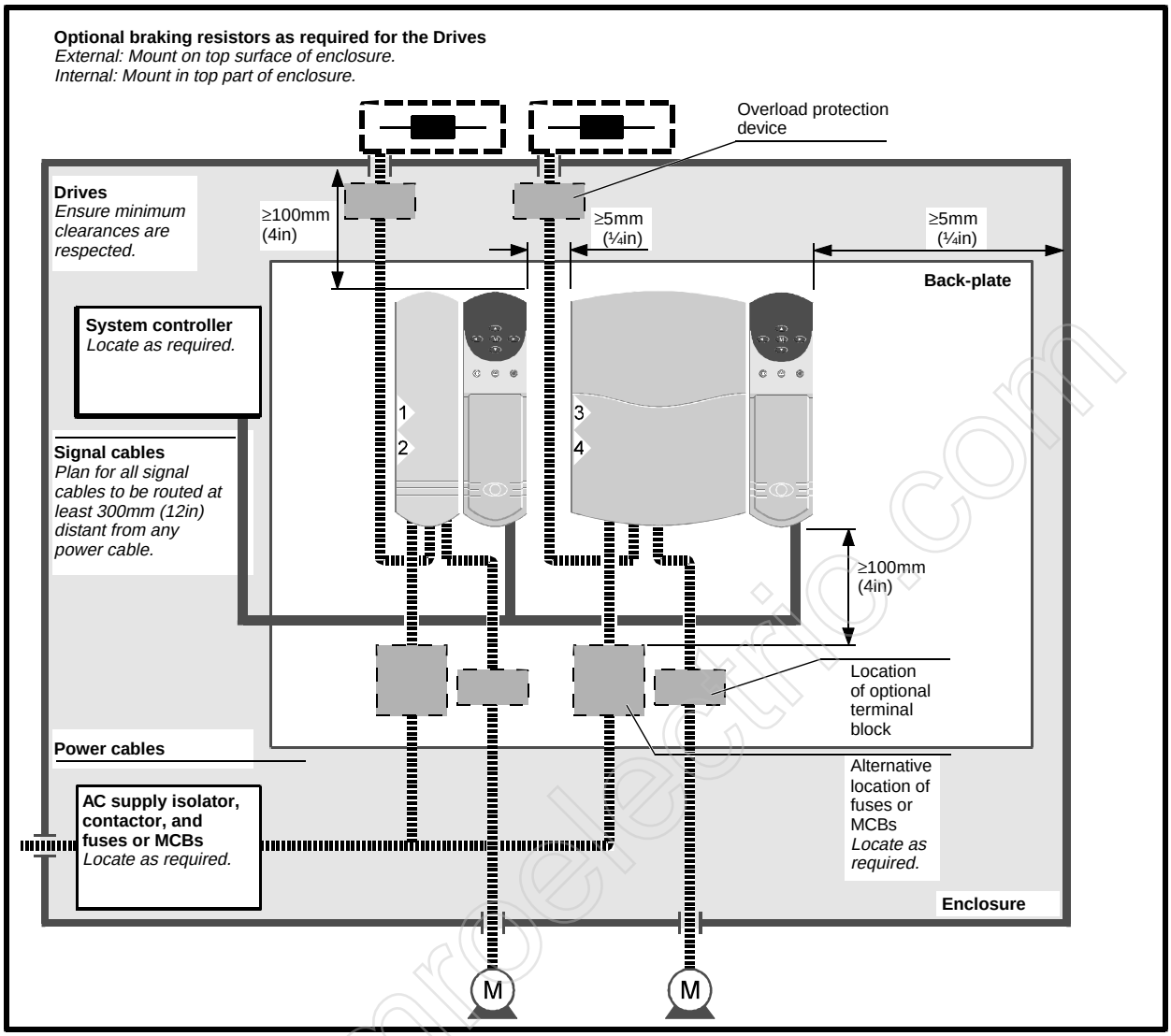


Figure 2–4 Recommended layout for routine EMC precautions (wiring recommendations are given in Figure 2–21)

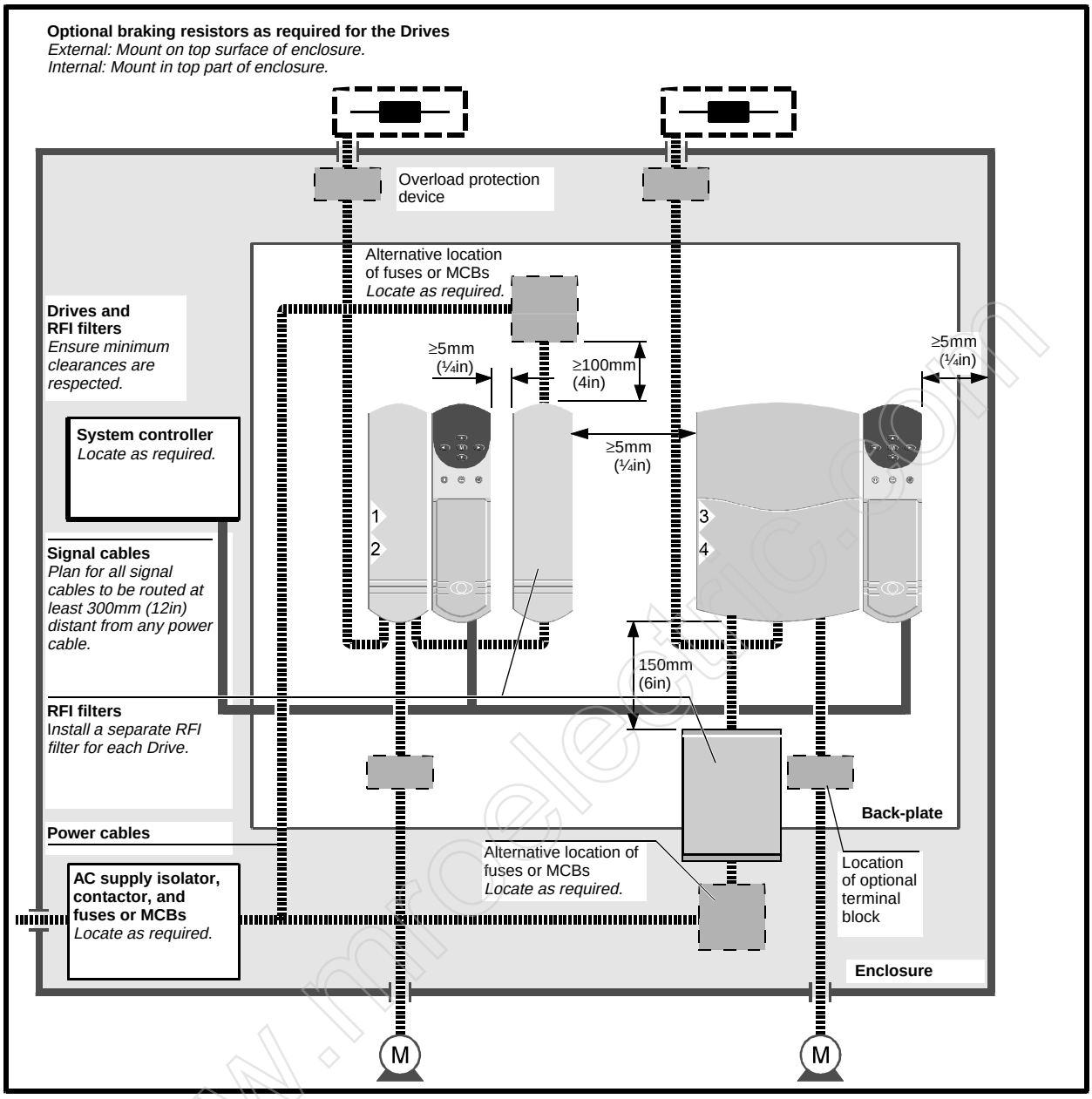


Figure 2–5 Recommended layout for compliance with EMC emission standards (wiring recommendations are given in Figures 2–22 and 2–23)

2.4 Calculating the enclosure size

STEP 1 Add the dissipation figures from step 4 of *Planning the installation* for each Drive that is to be installed in the enclosure. Make a note of this step number and the total value.

STEP 2 If an RFI filter is to be used with each Drive, add the dissipation figures from step 5 of *Planning the installation* for each RFI filter that is to be installed in the enclosure. Make a note of this step number and the total value.

STEP 3 If the braking resistor is to be mounted inside the enclosure, add the average power figures from step 8 of *Planning the installation* for each braking resistor that is to be installed in the enclosure. Make a note of this step number and the total value.

STEP 4 Make a note of this step number and the total heat dissipation (in Watts) of any other equipment to be installed in the enclosure.

STEP 5 Add the heat dissipation figures obtained (as appropriate) from steps 1, 2, 3 and 4 above. This gives a figure in Watts for the total heat that will be dissipated inside the enclosure. Make a note of this figure and the step number.

Calculating the size of a sealed enclosure

The enclosure transfers internally generated heat into the surrounding air by natural convection (or external forced air flow); the greater the surface area of the enclosure walls, the better is the dissipation capability. Only the surfaces of the enclosure that are unobstructed (not in contact with a wall or floor) can dissipate heat.

Calculate the minimum required unobstructed surface area A_e for the enclosure from:

$$A_e = \frac{P}{k(T_i - T_{amb})}$$

Where:

Ae Unobstructed surface area in m^2 ($1m^2 = 10.8\ ft^2$)

T_{amb} Maximum expected ambient temperature in °C *outside* the enclosure

T_i Maximum permissible ambient temperature in °C *inside* the enclosure

P Power in Watts dissipated by *all* heat sources in the enclosure

k Heat transmission coefficient of the enclosure material in $W/m^2/°C$

Example

To calculate the size of an enclosure for the following:

- Two UNI 1405 models
- Each Drive to operate at 4.5kHz PWM switching frequency
- RFI filter for each Drive
- Braking resistors are to be mounted outside the enclosure
- Maximum ambient temperature inside the enclosure: 40°C
- Maximum ambient temperature outside the enclosure: 30°C

Dissipation of each Drive: 190W (from step 4 in *Planning the installation*)

Dissipation of each RFI filter: 25W (max) (from step 5 in *Planning the installation*)

Total dissipation: 2 x (190 + 25) = 430W

The enclosure is to be made from painted 2mm ($^3/_{32}$in) sheet steel having a heat transmission coefficient of $5.5W/m^2/°C$. Only the top, front, and two sides of the enclosure are to be free to dissipate heat.

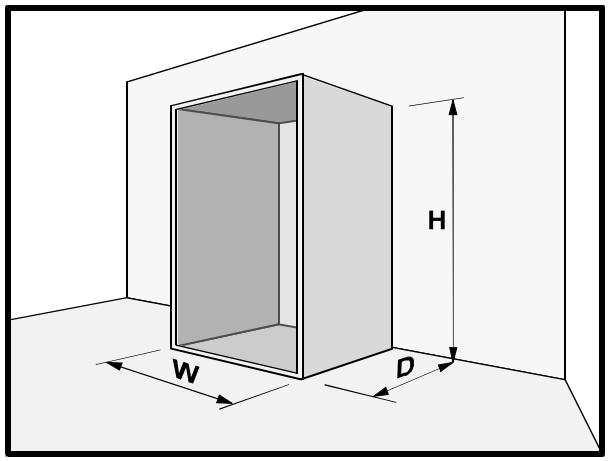


Figure 2–6 Enclosure having front, sides and top panels free to dissipate heat

Insert the following values:

T_i	40°C
T_{amb}	30°C
k	5.5
P	430W

The minimum required heat conducting area is then:

$$A_e = \frac{430}{5.5(40 - 30)} = 7.8m^2\ (85ft^2)$$

(1m = 3.3 ft)

Estimate two of the enclosure dimensions — the height (H) and depth (D), for instance. Calculate the width (W) from:

$$W = \frac{A_e - 2HD}{H + D}$$

Inserting **H** = 2m and **D** = 0.6m, obtain the minimum width:

$$W = \frac{7.8 - (2 \times 2 \times 0.6)}{2 + 0.6} = 2.1m\ \ (6ft\ 10in)$$

If the enclosure is too large for the space available, it can be made smaller only by attending to one or all of the following:

- Using a lower PWM switching frequency to reduce the dissipation in the Drives (return to step 4 in *Planning the installation*)
- Reducing the ambient temperature outside the enclosure, and/or applying forced-air cooling to the outside of the enclosure
- Reducing the number of Drives in the enclosure
- Removing other heat-generating equipment

Calculating the air-flow in a ventilated enclosure

The dimensions of the enclosure are required only for accommodating the equipment. The equipment is cooled by the forced air flow.

Calculate the minimum required volume of ventilating air from:

$$V = \frac{3kP}{T_i - T_{amb}}$$

Where:

V	Air-flow in m^3 per hour
T_{amb}	Maximum ambient temperature in °C outside the enclosure
T_i	Maximum ambient temperature in °C inside the enclosure
P	Power in Watts dissipated by *all* heat sources in the enclosure
k	Ratio of $\frac{p_0}{P_i}$

Where:

P_0 is the air pressure at sea level

P_I is the air pressure at the installation

Typically use a factor of 1.2 to 1.3, to allow also for pressure-drops in dirty air-filters.

Example

To calculate the size of an enclosure for the following:

- Three UNI 3401 models
- Each Drive to operate at 6kHz PWM switching frequency
- RFI filter for each Drive
- Braking resistors are to be mounted outside the enclosure
- Maximum ambient temperature inside the enclosure: 40°C
- Maximum ambient temperature outside the enclosure: 30°C

Dissipation of each Drive: 670W (from step 4 in *Planning the installation*)

Dissipation of each RFI filter: 60W (max) (from step 5 in *Planning the installation*)

Total dissipation: 3 x (670 + 60) = 2190W

Insert the following values:

T_i	40°C
T_{amb}	30°C
k	1.3
P	2190W

Then:

$$V = \frac{3 \times 1.3 \times 2190}{40 - 30} = 854m^3\ /\ hr\ (504\ ft^3\ /\ min)$$

($1m^3/hr = 0.59ft^3/min$)

2.5 Installing the Drive and RFI filter

Warning

Lifting the Drive

The weights of model sizes 3 and 4 are 22kg (49 lbs) and 70kg (154 lbs) respectively. Use appropriate safeguards when lifting these models.

Removing the terminal covers

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

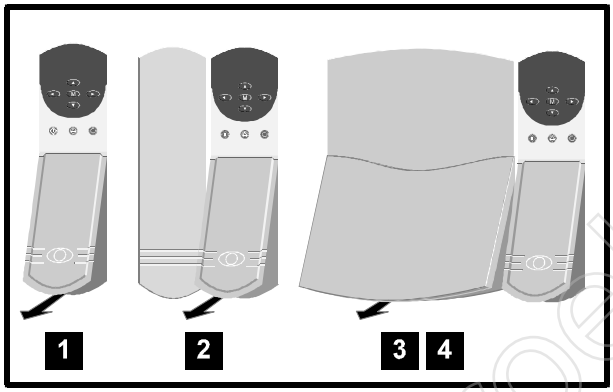


Figure 2–7 Removing the terminal covers

The terminal cover(s) of all models must be removed for access to the electrical connectors.

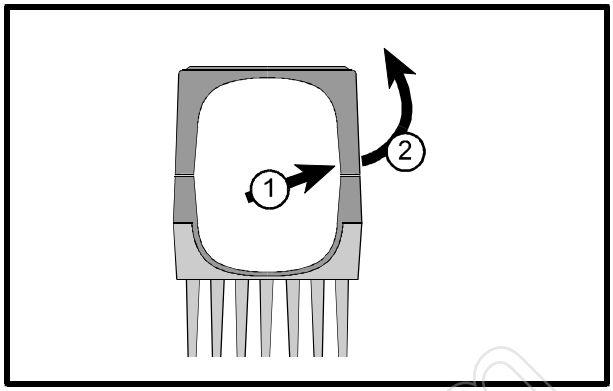


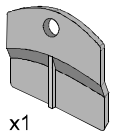
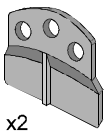
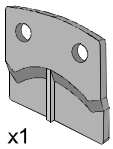
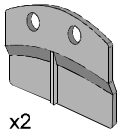
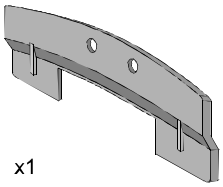
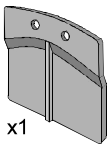
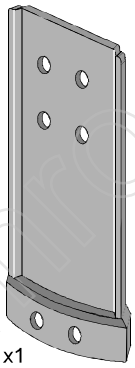
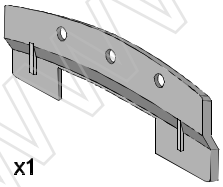
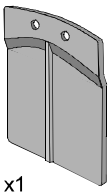
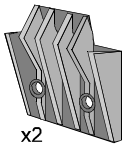
Figure 2–8 View from the underside showing how a terminal cover is removed from the Drive

Remove terminal covers, as follows:

1. Working on either side of the terminal cover, push the inner edge of the cover firmly outward until it becomes unclipped.
2. Swing the side of the cover outward and upward until the remaining clips become released.
3. Remove the gland plate (you may need to replace it later).

Mounting brackets supplied with the Drive

Table 2–10 General views of the mounting brackets

Model size	Through-panel	Surface
1	 x1	 x2 Upper and lower
2	 x1	 x2 Upper and lower
3	 x1	 x1 Upper  x1 Lower
4	 x1	 x1 Upper  x2 Lower

Rear view of the brackets (except for the lower bracket for model size 4). The brackets are not shown to scale.

Surface-mounting the Drive

1. Use the two surface-mounting brackets. These are manufactured from metal. Ensure the brackets make direct electrical contact with the back-plate; for example, tap M5 ($^{3}/_{16}$ in) threaded holes in the back-plate in the positions shown in Figure 2–10 to accept the mounting screws. (For model size 1, you may use the central or, preferably, the two outer screw holes in the mounting bracket.)
2. Insert the surface mounting brackets into the slots in the top and bottom of the Drive heatsink, as shown in Figure 2–9.

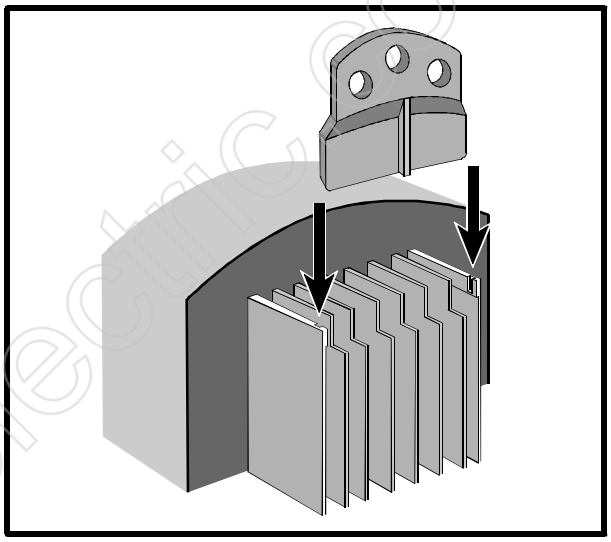


Figure 2–9 General representation showing the fitting of a surface mounting bracket in a heatsink

3. Retain the mounting brackets to the back-plate using electrically conducting screws.

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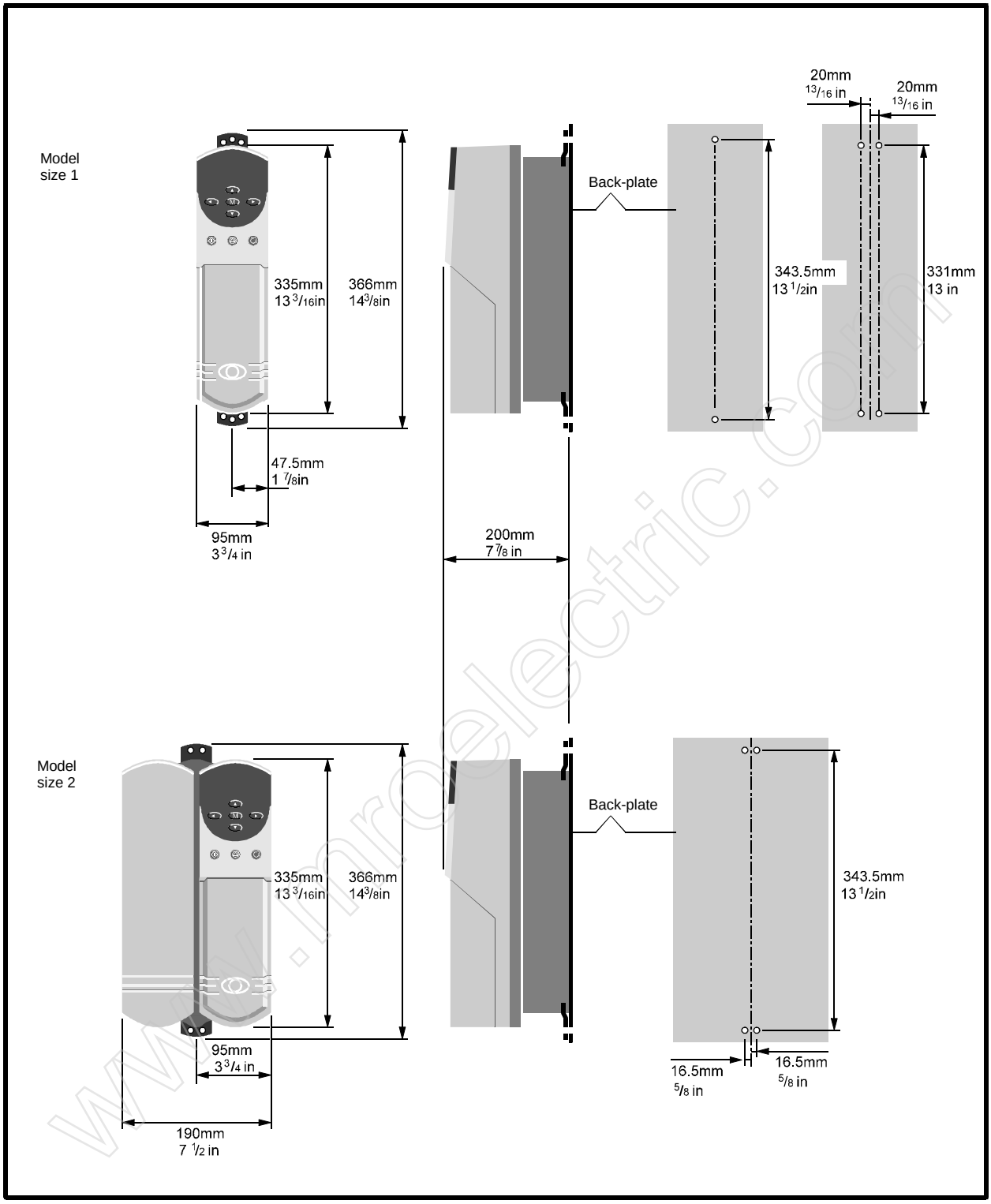

Figure 2–10 Surface mounting of model sizes 1 and 2

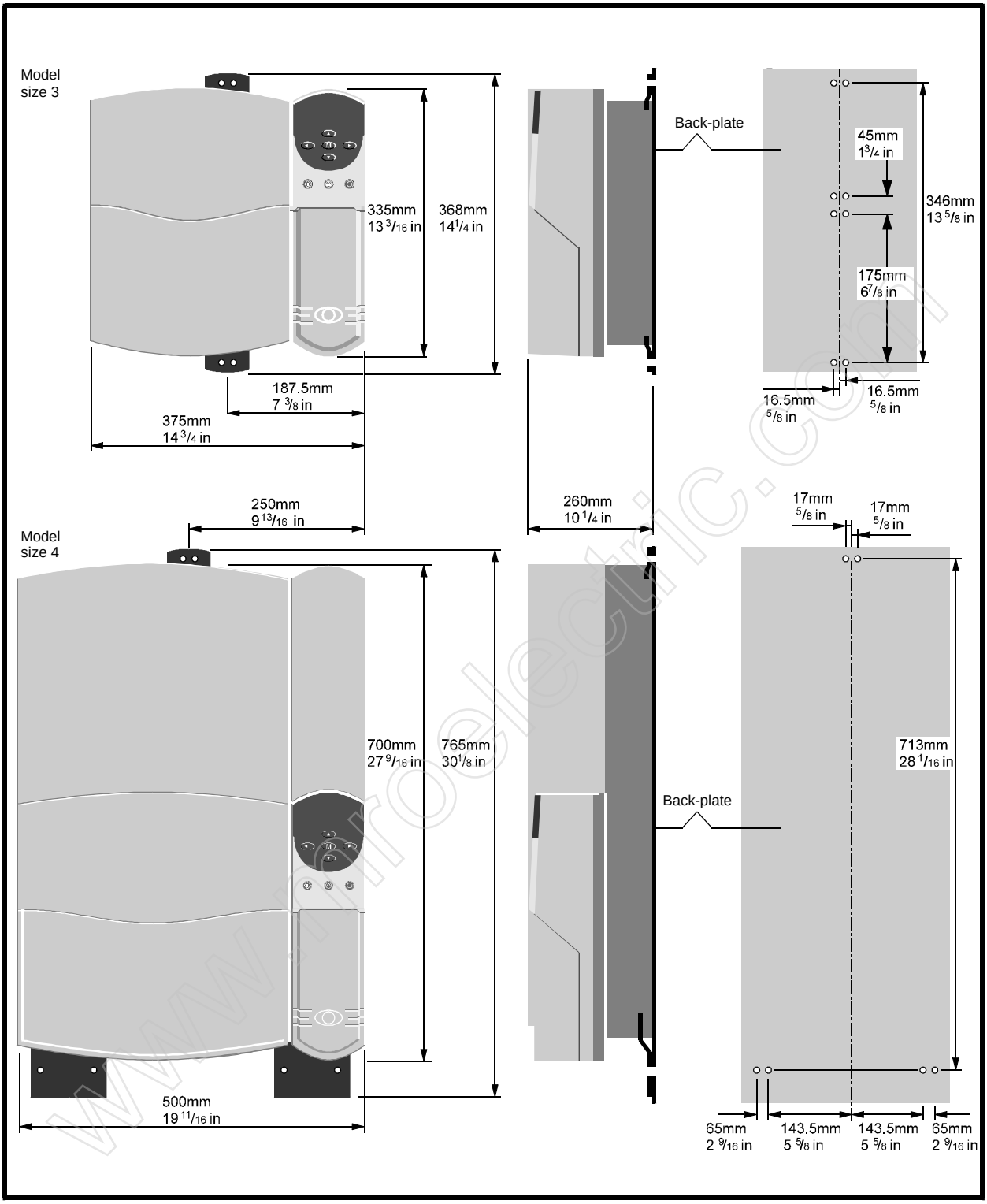

Figure 2–11 Surface mounting of model sizes 3 and 4

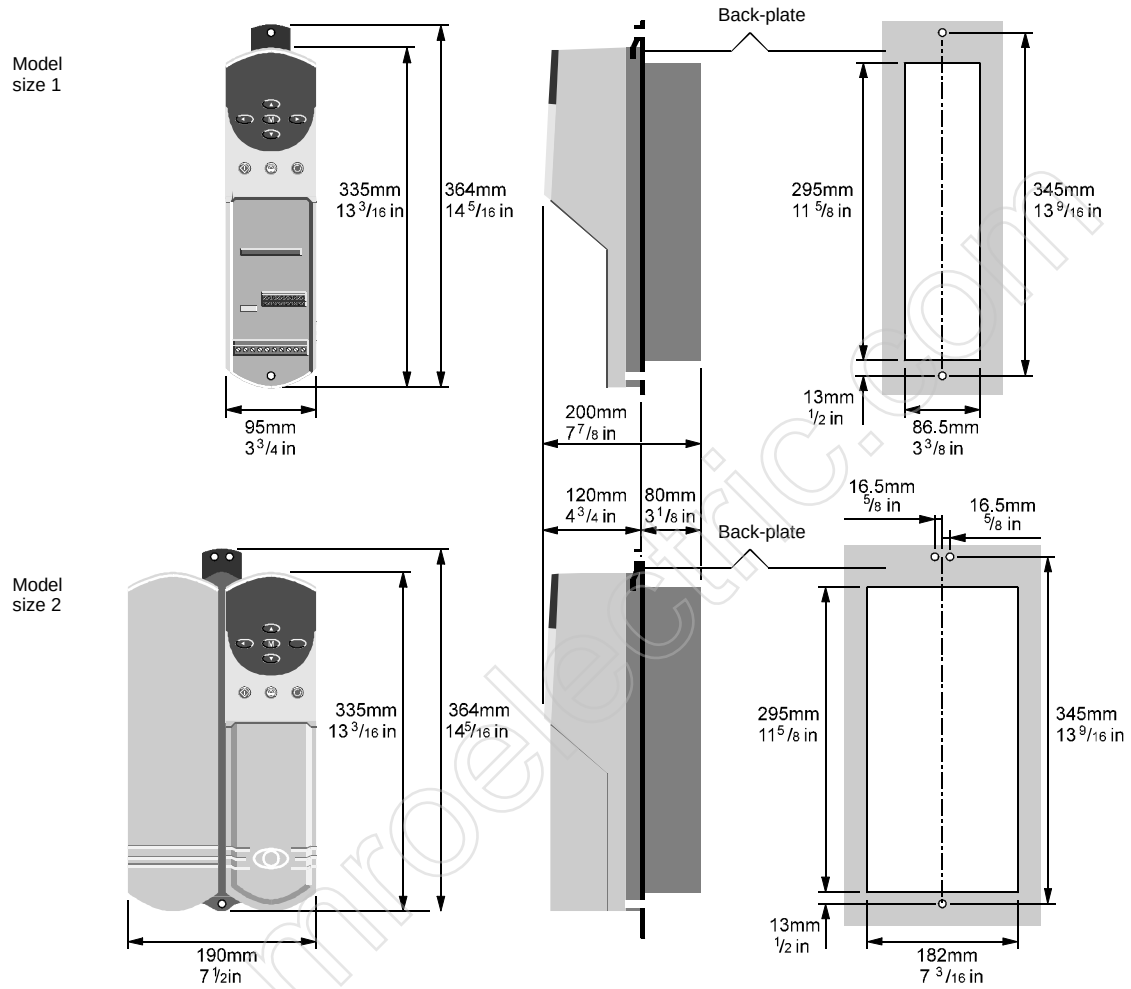

Figure 2–12 Through-panel mounting of model sizes 1 and 2

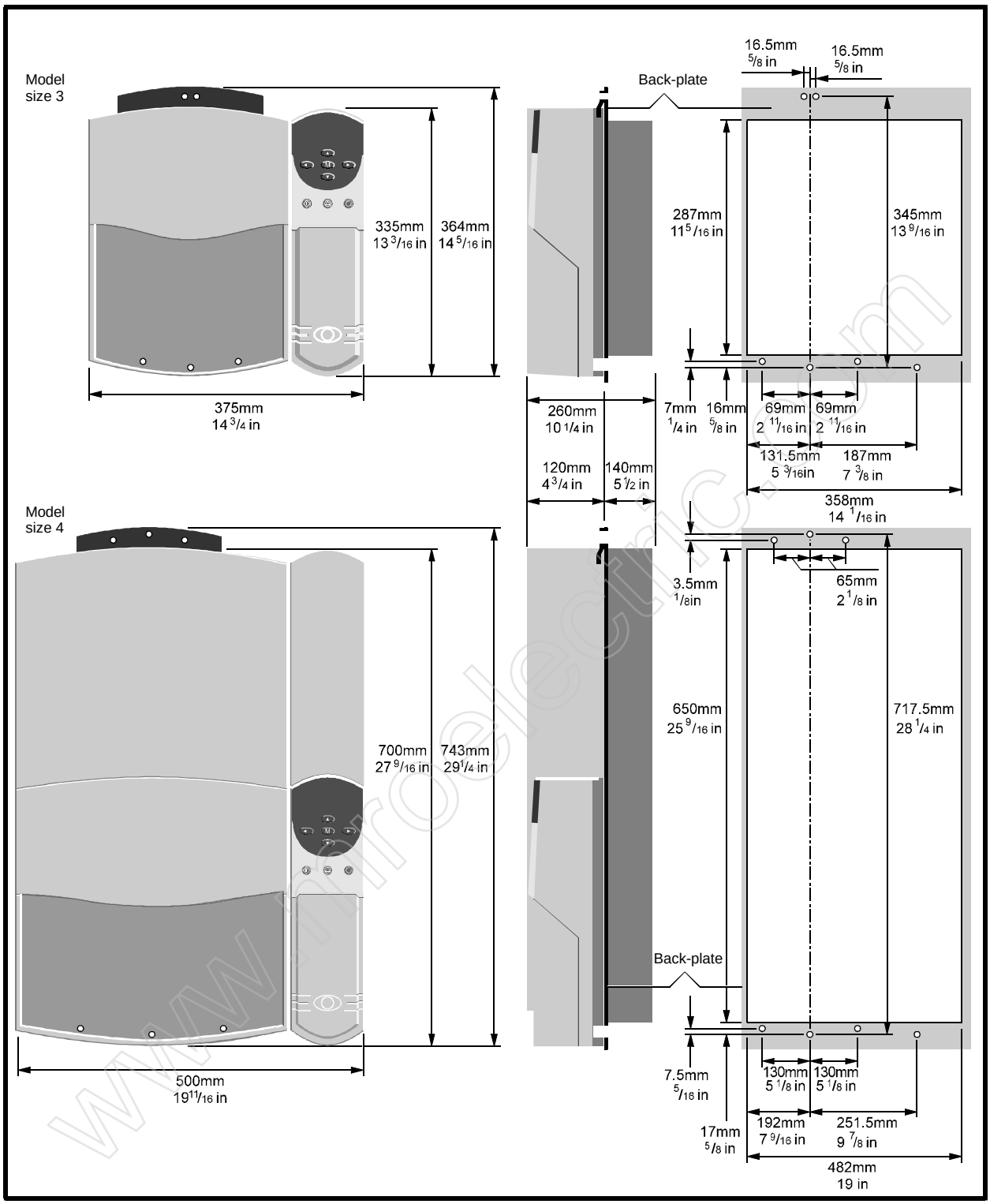

Figure 2–13 Through-panel mounting of model sizes 3 and 4

Through-panel mounting the Drive

1. Cut an aperture in the back-plate as shown in Figure 2–12 or 2–13 as appropriate.
2. Use the through-panel mounting bracket. This is manufactured from metal and is used to secure the top of the Drive to the back-plate; the bottom of the Drive is secured to the back-plate by screw(s) passed through a hole in the casing and heatsink.

   Ensure the bracket and heatsink make direct electrical contact with the back-plate; for example, tap M5 ($^{3}/_{16}$ in) threaded holes in the back-plate in the positions shown in Figure 2–12 or 2–13 to accept the mounting screws.
3. Insert the through-panel mounting bracket into the recess in the top of the Drive heatsink, as shown in Figure 2–14.

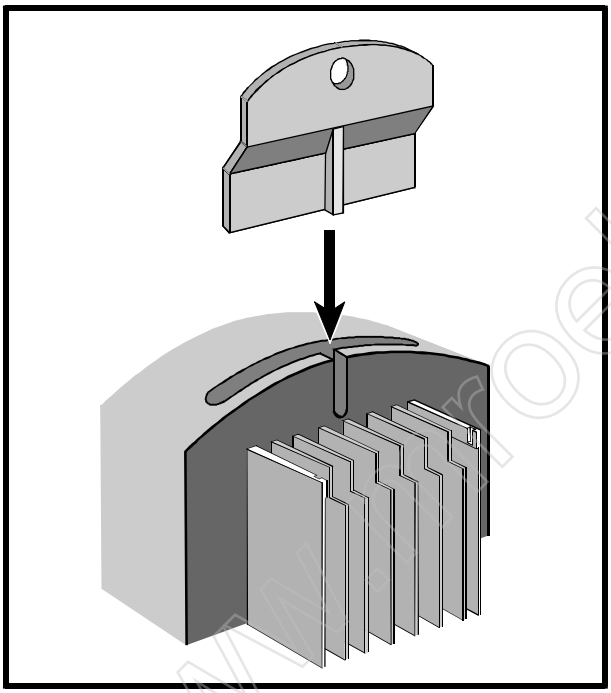

Figure 2–14 General representation showing the fitting of a through-panel mounting bracket in the top of the Drive

4. If a seal is required between the Drive and the back-plate, attach the foam sealing strip (supplied with the Drive) around the edges of the aperture in the back-plate so that the flange on the heatsink will press against the foam strip.
5. Insert the Drive into the aperture.
6. Secure the bottom of the Drive to the panel using electrically conducting screw(s).
7. Secure the through-panel mounting bracket to the panel using electrically conducting screw(s).
8. If the maximum permissible continuous output current (from step 4 in *Planning the installation*) is required, a baffle plate must be fitted to the rear of the Drive heatsink. See *Fitting a baffle plate* later in this chapter. If a baffle plate is not fitted, the maximum output current must be limited to 80% of the specified value. In this case, adjust the value noted at step 4 in *Planning the installation*.

Fitting a baffle plate

Warning

If the Drive has been used, the heatsink may be hot. Human contact with the heatsink should be restricted.

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

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

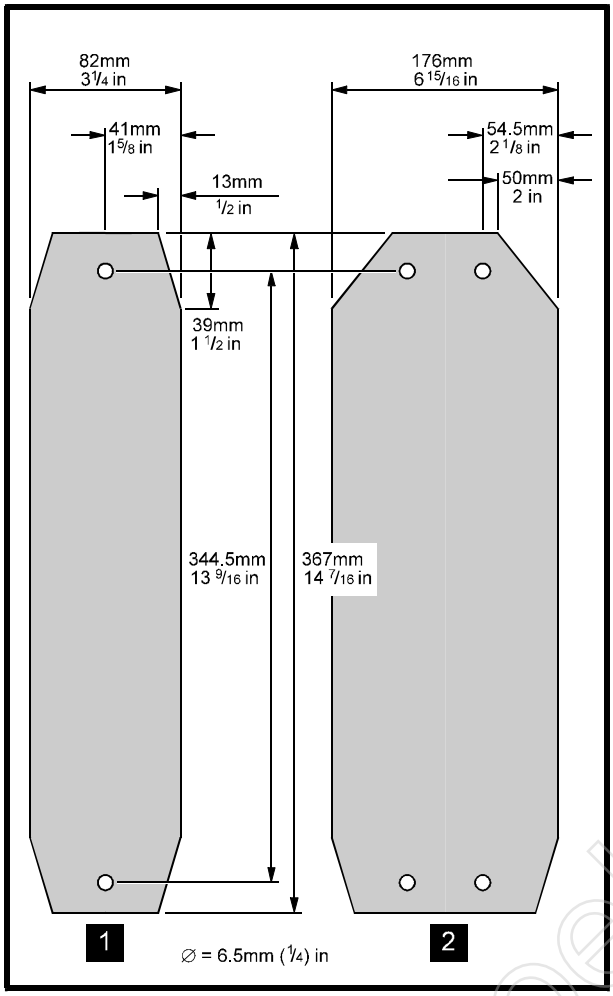

Figure 2–15 Dimensions for the fabrication of baffle plates for model sizes 1 and 2

Attaching a fabricated baffle plate to the heatsink

Table 2–12 Methods of attaching the baffle plate

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

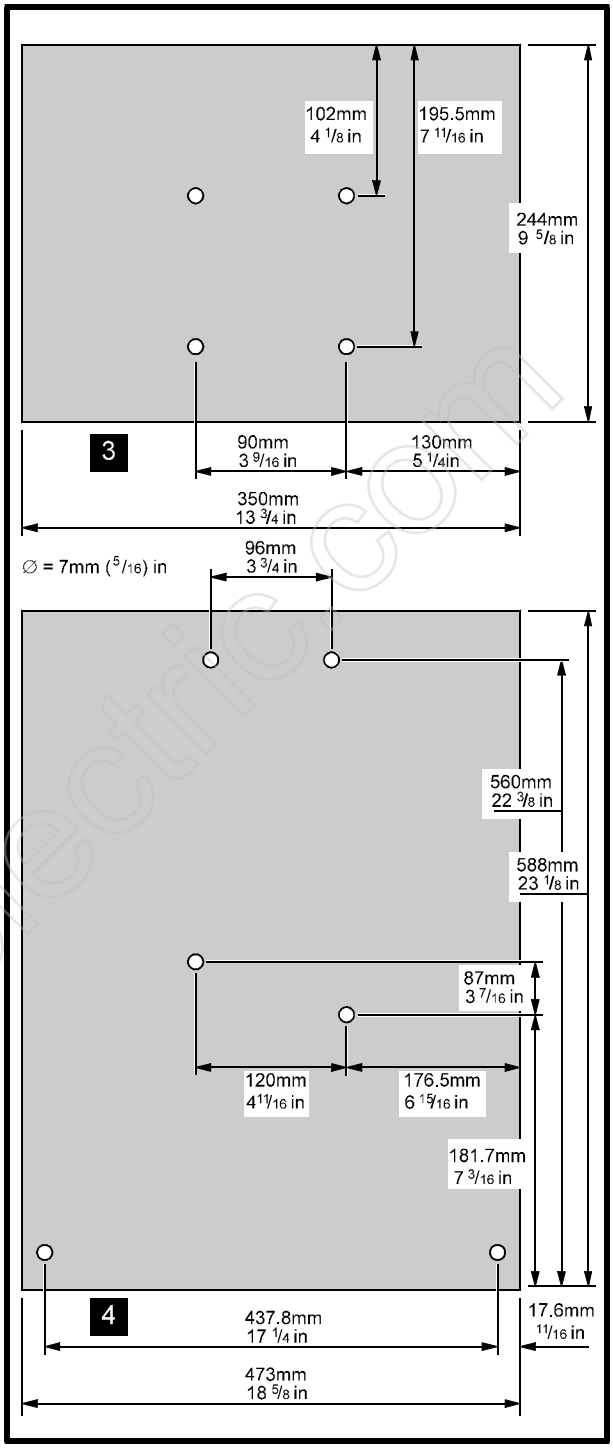

Figure 2–16 Dimensions for the fabrication of baffle plates for model sizes 3 and 4

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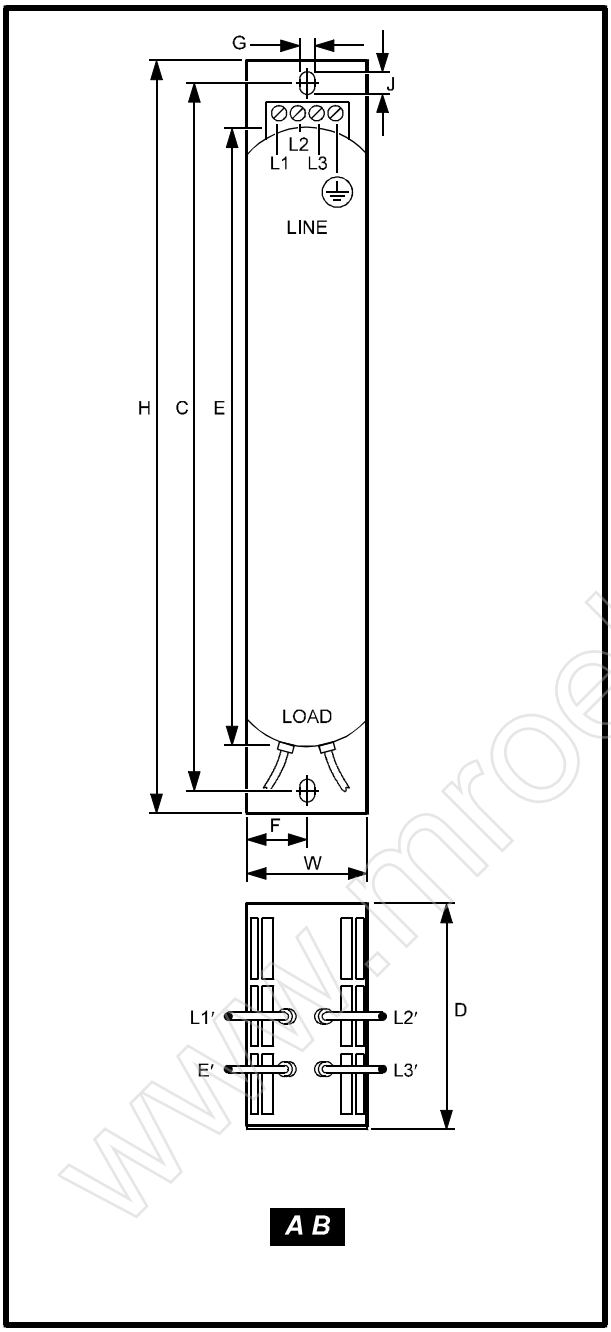
Mounting the RFI filter

The RFI filters can be surface-mounted only.

Mount the RFI filter at the specified location in relation to the Drive. In the case of filter sizes C to G, ensure the LOAD terminals face the Drive.



Dimension	RFI filter size	
	A **4200-0010**	***B*** **4200-0027**
C	378mm $14^{7}/_{8}$ in	388mm $15^{1}/_{4}$ in
D	114.5mm $4^{1}/_{2}$ in	114.5mm $4^{1}/_{2}$ in
E	335mm $13^{3}/_{16}$ in	335mm $13^{3}/_{16}$ in
F	25mm 1 in	37.5mm $1^{1}/_{2}$ in
G	6.4mm $^{1}/_{4}$ in	6.4mm $^{1}/_{4}$ in
H	396mm $15^{9}/_{16}$ in	406mm 16 in
J	10mm $^{3}/_{8}$ in	10mm $^{3}/_{8}$ in
W	50mm $1^{15}/_{16}$ in	75mm $2^{15}/_{16}$ in

Figure 2-17 Principal dimensions of RFI filters sizes A and B, and the locations of the terminals

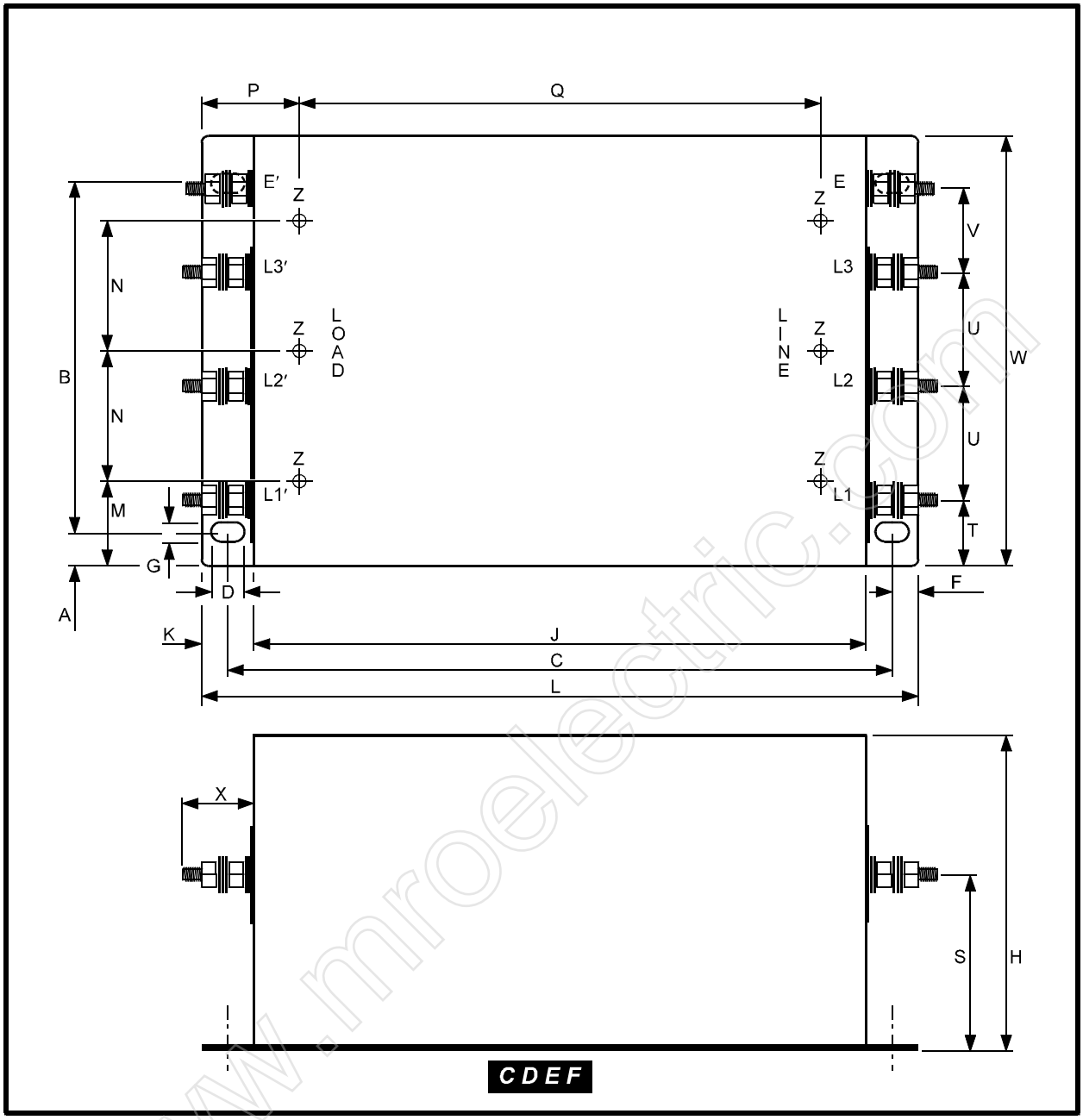


Figure 2–18 Principal dimensions of RFI filters sizes C to F, and the locations of the terminals

Dimension	RFI filter size			
	C **4200-1051**	***D*** **4200-1071**	***E*** **4200-1111**	***F*** **4200-1171**
A	15mm $^{9}/_{16}$ in	15mm $^{9}/_{16}$ in	15mm $^{9}/_{16}$ in	15mm $^{9}/_{16}$ in
B	160mm $6^{5}/_{16}$ in	160mm $6^{5}/_{16}$ in	170mm $6^{11}/_{16}$ in	170mm $6^{11}/_{16}$ in
C	305mm 12 in	305mm 12 in	400mm $15^{3}/_{4}$ in	400mm $15^{3}/_{4}$ in
D	15mm $^{9}/_{16}$ in	15mm $^{9}/_{16}$ in	15mm $^{9}/_{16}$ in	15mm $^{9}/_{16}$ in
F	12.5mm $^{1}/_{2}$ in	12.5mm $^{1}/_{2}$ in	20mm $^{3}/_{4}$ in	15mm $^{9}/_{16}$ in
G	6.5mm $^{1}/_{4}$ in	6.5mm $^{1}/_{4}$ in	6.5mm $^{1}/_{4}$ in	6.5mm $^{1}/_{4}$ in
H	145mm $5^{11}/_{16}$ in	145mm $5^{11}/_{16}$ in	145mm $5^{11}/_{16}$ in	145mm $5^{11}/_{16}$ in
J	280mm $11^{3}/_{16}$ in	280mm $11^{3}/_{16}$ in	340mm $13^{3}/_{8}$ in	430mm $16^{15}/_{16}$ in
K	25mm 1 in	25mm 1 in	50mm $1^{15}/_{16}$ in	50mm $1^{15}/_{16}$ in
L	330mm 13 in	330mm 13 in	440mm $17^{5}/_{16}$ in	490mm $19^{1}/_{4}$ in
M	35mm $1^{3}/_{8}$ in	35mm $1^{3}/_{8}$ in	35mm $1^{3}/_{8}$ in	20mm $^{3}/_{4}$ in
N	60mm $2^{3}/_{8}$ in	60mm $2^{3}/_{8}$ in	65mm $2^{9}/_{16}$ in	80mm $3^{1}/_{8}$ in
P	45mm $1^{3}/_{4}$ in	45mm $1^{3}/_{4}$ in	70mm $2^{3}/_{4}$ in	50mm 2 in
Q	240mm $9^{7}/_{16}$ in	240mm $9^{7}/_{16}$ in	300mm $11^{13}/_{16}$ in	390mm $15^{3}/_{8}$ in
S	80mm $3^{1}/_{8}$ in	80mm $3^{1}/_{8}$ in	80mm $3^{1}/_{8}$ in	80mm $3^{1}/_{8}$ in
T	30mm $1^{3}/_{16}$ in	30mm $1^{3}/_{16}$ in	30mm $1^{3}/_{16}$ in	30mm $1^{3}/_{16}$ in
U	50mm 2 in	50mm 2 in	50mm 2 in	50mm 2 in
V	40mm $1^{9}/_{16}$ in	40mm $1^{9}/_{16}$ in	40mm $1^{9}/_{16}$ in	40mm $1^{9}/_{16}$ in
W	190mm $7^{1}/_{2}$ in	190mm $7^{1}/_{2}$ in	200mm $7^{7}/_{8}$ in	200mm $7^{7}/_{8}$ in
X	40mm $1^{9}/_{16}$ in	40mm $1^{9}/_{16}$ in	40mm $1^{9}/_{16}$ in	40mm $1^{9}/_{16}$ in
Z	M5 x 10mm	M5 x 10mm	M5 x 10mm	M5 x 10mm
Terminals	M8	M8	M10	M10

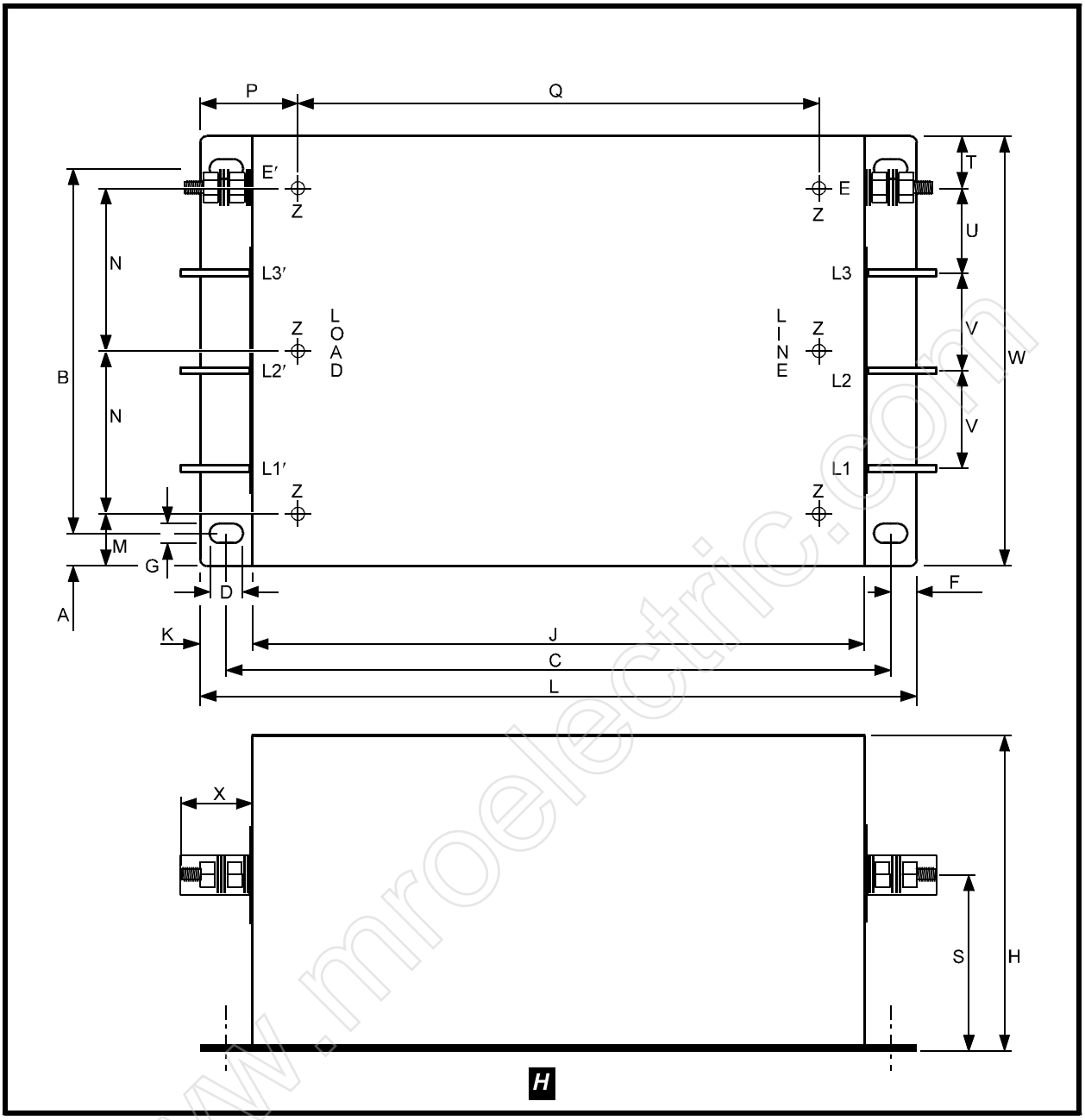


Figure 2–19 Principal dimensions of RFI filter size H, and the locations of the terminals

Dimension	RFI filter size
	H **4200–1220**
A	15mm $^{9}/_{16}$ in
B	170mm 6 $^{11}/_{16}$
C	560mm 22 $^{7}/_{16}$
D	15mm $^{9}/_{16}$ in
F	15mm $^{9}/_{16}$ in
G	6.5mm $^{1}/_{4}$
H	145mm 5 $^{11}/_{16}$
J	530mm 20 $^{7}/_{8}$
K	30mm 1 $^{3}/_{16}$ in
L	590mm 23 $^{1}/_{4}$
M	20mm $^{3}/_{4}$ in
N	80mm 3 $^{1}/_{8}$
P	50mm 1 $^{15}/_{16}$
Q	490mm 19 $^{5}/_{16}$
S	72.5mm 2 $^{7}/_{8}$
T	20mm $^{3}/_{4}$ in
U	50mm 1 $^{15}/_{16}$
V	45mm 1 $^{3}/_{4}$
W	200mm 7 $^{7}/_{8}$
X	40mm 1 $^{9}/_{16}$ in

2.6 Power connections

Warning

Electric shock risk

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

AC supply cables and connections

Output cables and connections

Many internal parts of the Drive, and external option units

Warning

Isolation device

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

Warning

Stored charge

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

Warning

AC supply by plug and socket

Special attention must be given if the Drive is installed in equipment which is connected to the AC supply by a plug and socket. The AC supply terminals of the Drive are connected to the internal capacitors through rectifier diodes which do not give 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).

Warning

STOP function

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

Warning

Ground leakage current – model sizes 3 and 4

Ground leakage current is typically 9mA*. A fixed ground connection must be made before AC power is applied. In some applications, safety regulations require a duplicate ground connection.

*** 9mA at 380V ~ 415V 50Hz AC supply; up to 14mA at 480V 60Hz AC supply. Measured by the method described in IEC950 Annex D.**

Ground connections (earthing, equi-potential bonding)

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

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

Power and ground terminals

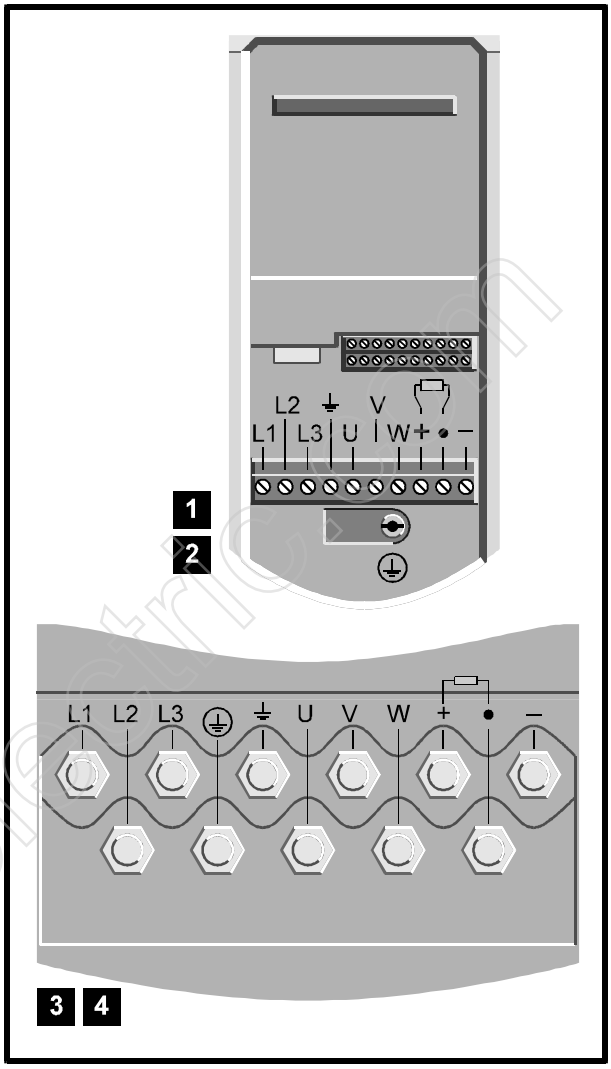


Figure 2–20 Locations of the power and ground terminals

Terminal sizes and tightening torques

Warning

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

Drive

Table 2–13 Mechanical data for the Drive terminals

Model size	Power terminals		Ground terminal	
	Size Type	Torque	Size Type	Torque
1	Plug-in terminal block	0.5 N.m 4.4 lb.in	M4 (Torx/ slot-head screw)	3 N.m 2.2 lb.ft
2	Plug-in terminal block	0.5 N.m 4.4 lb.in	M4 (Torx/ slot-head screw)	3 N.m 2.2 lb.ft
3	M10 stud	15 N.m 11 lb.ft	M10 stud	15 N.m 11 lb.ft
4	M10 stud	15 N.m 11 lb.ft	M10 stud	15 N.m 11 lb.ft
Torque tolerance			±10%	

RFI filter

Table 2–14 Mechanical data for the RFI filter terminals

Size	Power terminals		Ground terminal	
	Size Type	Torque	Size Type	Torque
A	Screw terminals	0.7 N.m 6. lb.in	Screw terminals	0.7 N.m 6. lb.in
B	M8 stud	1.6 N.m 14 lb.in	M8 stud	1.6 N.m 14 lb.in
C	M8 stud	12.6 N.m 9 lb.ft	M8 stud	12.6 N.m 9 lb.ft
D	M8 stud	12.6 N.m 9 lb.ft	M8 stud	12.6 N.m 9 lb.ft
E	M10 stud	25 N.m 18 lb.ft	M10 stud	25 N.m 18 lb.ft
F	M10 stud	25 N.m 18 lb.ft	M10 stud	25 N.m 18 lb.ft
H	M10 bus-bar hole	25 N.m 18 lb.ft	M10 stud	25 N.m 18 lb.ft
Torque tolerance			±10%	

Using the gland plate and cable glands

Warning

When the gland plate(s) are not fitted, objects less than 60mm ($2^{1}/_{2}$ in) wide can pass through the cable entry opening and possibly make contact with live parts inside the Drive.

Fit the gland plate and cable glands as required. Before fitting cable glands, push out sufficient blanking caps from the gland plate.

Note that the IP rating of the Drive is reduced if any holes in the gland plate are left open. The rating is affected as follows:

Gland plate not fitted	IP00
Gland plate fitted Unused holes uncovered	IP10
Gland plate and glands fitted Blanking caps covering unused holes	IP40

Table 2–15 Diameters of the holes in the gland plate

Model size	Gland plate hole diameter	
	Control signal wiring	Power cables
1	20mm $^{3}/_{4}$ in	20mm $^{3}/_{4}$ in
2	20mm $^{3}/_{4}$ in	20mm $^{3}/_{4}$ in
3	20mm $^{3}/_{4}$ in	28mm $1^{1}/_{16}$
4	20mm $^{3}/_{4}$ in	28mm $1^{1}/_{16}$

2.7 Wiring recommendations

Observe the wiring recommendations given in this section. Recommendations are given separately for the following:

Routine EMC precautions

- Recommended when strict compliance with emission standards is not required.
- Minimized risk of disturbing adjacent electronic equipment.

Compliance with EMC emission standards

- Strict compliance with emission standards.
- When the Drive is installed in a residential area, or adjacent to sensitive electronic equipment such as radio receivers or similar.

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.

For further details when EMC emission requirements are to be met, refer to the *Unidrive EMC Data Sheet* for the size of Drive used.

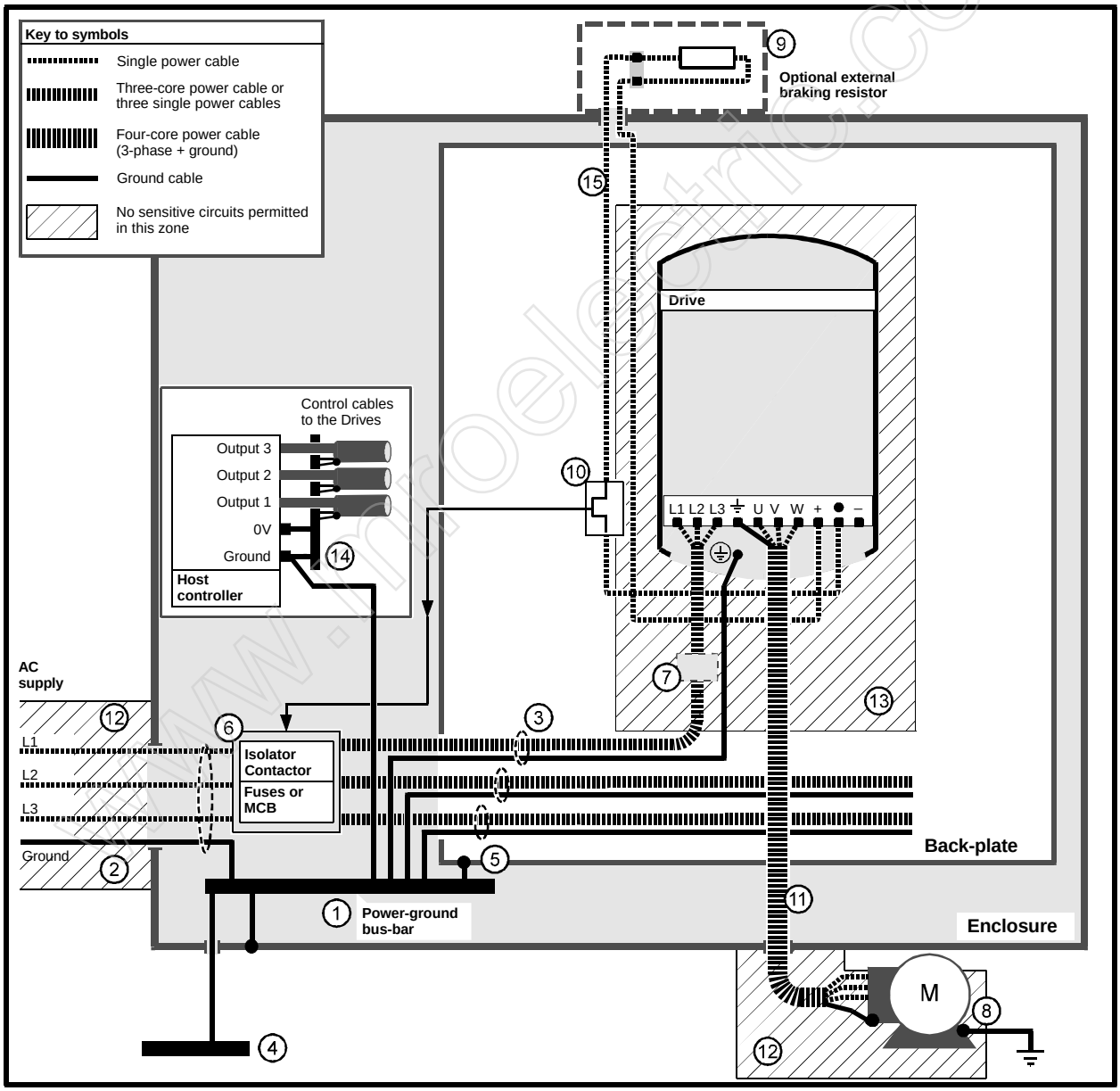


Figure 2–21 Wiring guidelines for routine EMC precautions (model sizes 1 to 4)

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.
9. Optional braking resistor mounted externally, protected by a metal grille.
10. Thermal protection device to protect the braking resistor.

Routine EMC precautions

11 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.

12. 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 x 40 ÷ 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 Figures 3–4 and 3–5 in the *User Guide*).

13. Do not place sensitive signal circuits in a zone extending 0.3m (12 in) all around the Drive.
14. 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.
15. When the braking-resistor wiring is unshielded, ensure a minimum spacing of 0.3m (12 in) from signal wiring.

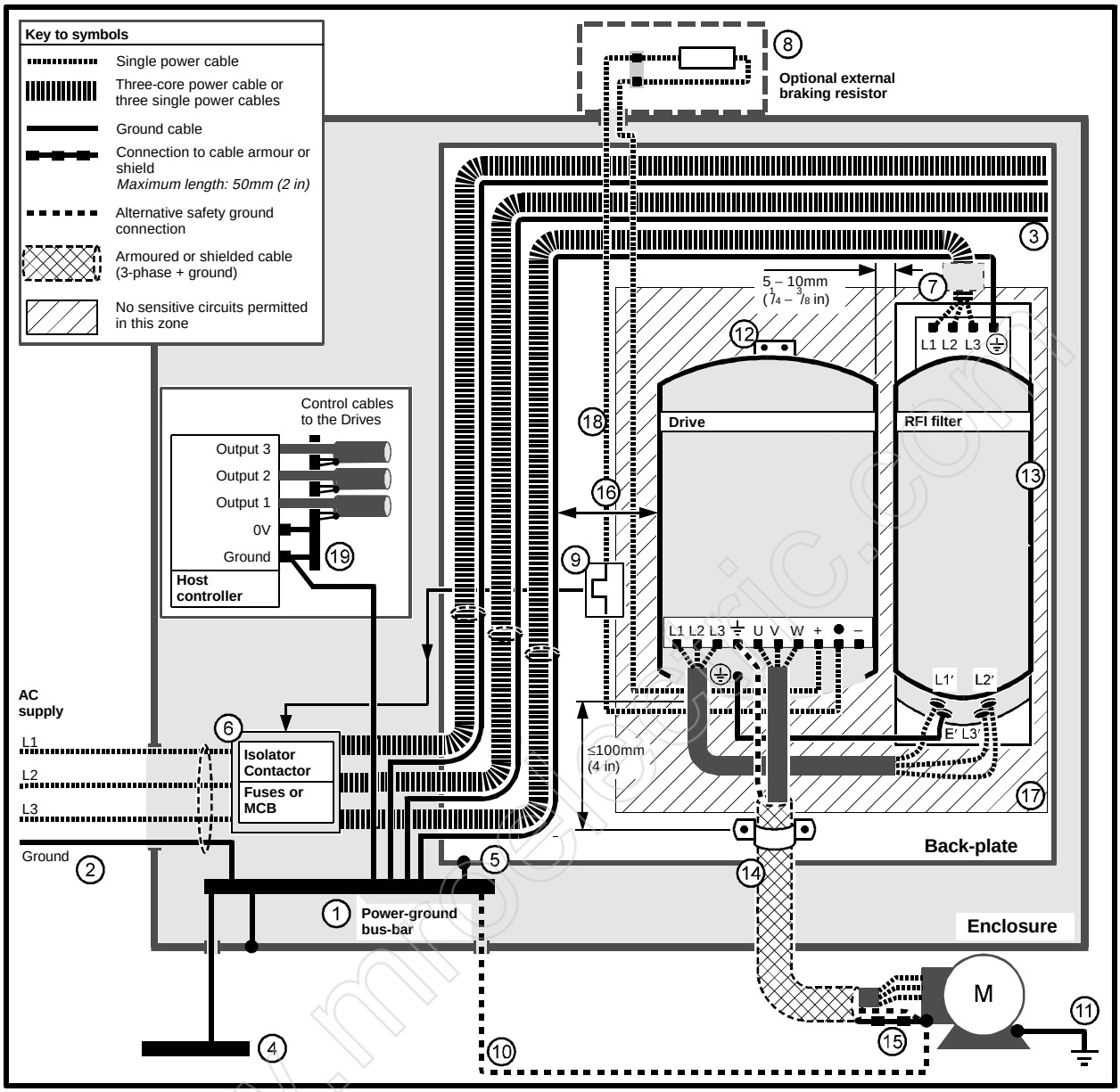


Figure 2–22 Wiring guidelines for compliance with EMC emission standards (model sizes 1 and 2)

Compliance with EMC emission standards (model sizes 1 and 2)

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 power ground bus-bar.
6. System isolator, circuit contactors and fuses/MCB.
7. Alternative position for Drive fuses.
8. Optional braking resistor mounted externally, protected and shielded by a metal grille.
9. Thermal overload device to protect the braking resistor.
10. Alternative safety ground for the motor.
11. Motor-frame ground connection, if required.

Special features for EMC

12. Drive heatsink directly grounded to the back-plate using the metal mounting-brackets. Ensure that the screws make direct electrical connection to the back-plate, for example by using screw threads tapped in the backplate.
13. RFI filter mounted at the side of the Drive. Ensure a separation of 5 to 10mm ($^1/_4$ to $^3/_8$ in) from the Drive. The RFI filter casing is directly grounded to the back-plate by the fixing screws.
14. A shielded (screened) or steel-wire armoured cable must be used to connect the Drive to the motor. The shield must be bonded to the back-plate using an uninsulated 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. A full 360° termination of the shield to the terminal housing of the motor is beneficial.
16. Ensure the AC supply and ground cables are at least 100mm (4 in) from the Drive.
17. Avoid placing sensitive signal circuits in a zone extending 0.3m (12 in) all around the Drive.
18. Unshielded wiring to the optional braking resistor(s) may be used, provided the resistor is either in the same enclosure as the Drive or the wiring does not run external to the enclosure. When the braking-resistor wiring is unshielded, ensure a minimum spacing of 0.3m (12 in) from signal wiring and the AC supply wiring to the RFI filters.
19. If the control circuit 0V is to be grounded, this should be done at the host controller (eg. PLC) and not at the Drive. This is to avoid injecting noise currents into the 0V circuit.

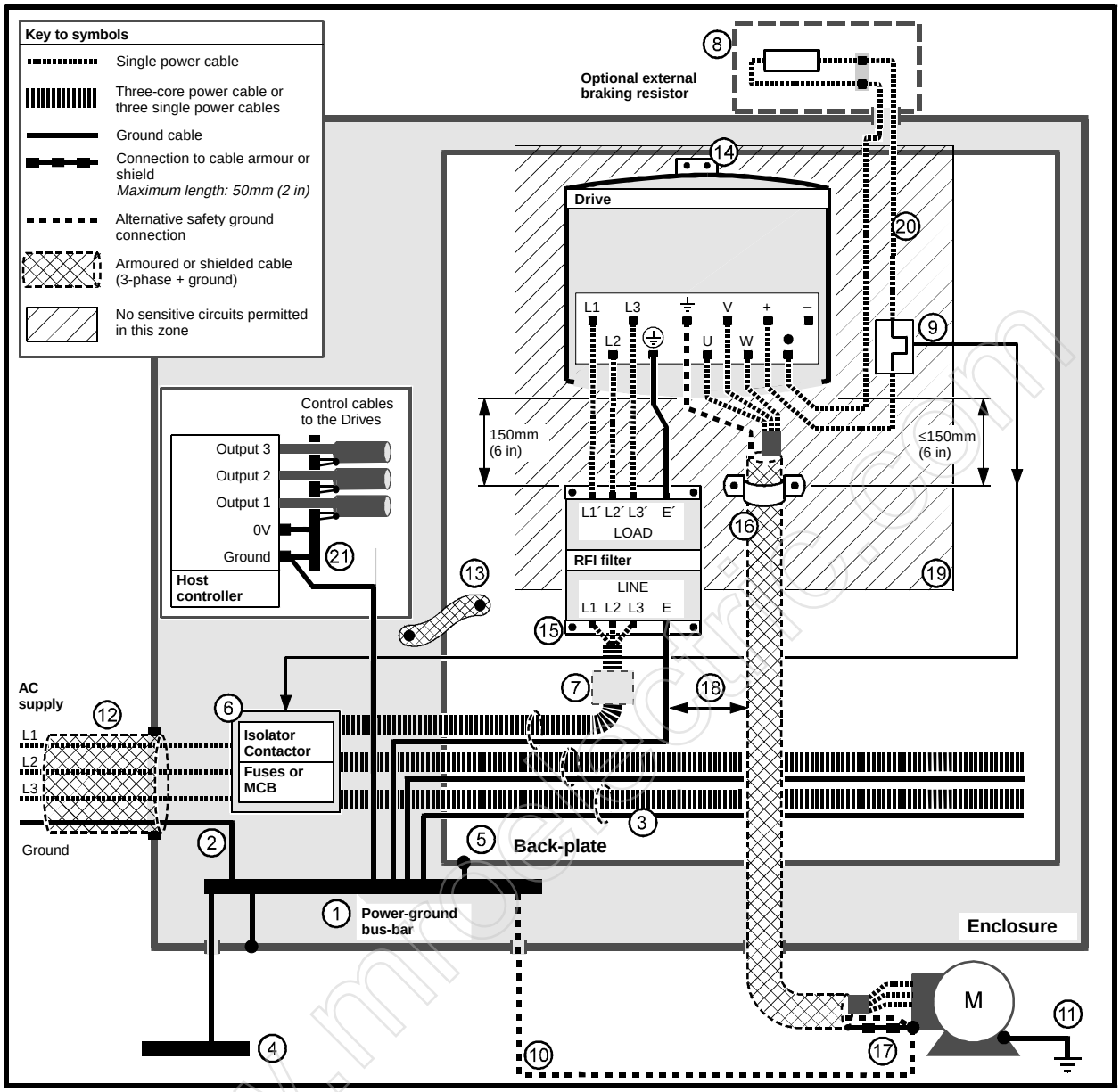


Figure 2–23 Wiring guidelines for compliance with EMC emission standards (model sizes 3 and 4)

Compliance with EMC emission standards (model sizes 3 and 4)

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 power ground bus-bar.
6. System isolator, circuit contactors and fuses/MCB.
7. Alternative position for Drive fuses.
8. Optional braking resistor mounted externally, protected and shielded by a metal grille.
9. Thermal overload device to protect the braking resistor.
10. Alternative safety ground for the motor.
11. Motor-frame ground connection, if required.

Special features for EMC

12. **Size 4 models only** The AC supply cable must be shielded (screened) or steel-wire armoured. Bond the shield or armour to the enclosure wall using standard cable and gland fixings.
13. **Size 4 models only** Back-plate electrically bonded to the enclosure wall using a short, low-inductance connections (eg. two flat, braided cables of 12mm x 2.3mm ($^1/_2$ x $^1/_8$ inch) nominal size, or a single braided cable of equivalent dimensions).
14. Drive heatsink directly grounded to the back-plate using fixing screws. Screw threads tapped into the back-plate must be used to ensure that a direct electrical connection is made. An unpainted back-plate (eg. zinc-plated steel) is required.
15. RFI filter mounted 150mm (6 in) from the Drive. The RFI filter casing is directly grounded to the back-plate by the fixing screws. Minimize the length of cables between the Drive and RFI filter.
16. A shielded (screened) or steel-wire armoured cable must be used to connect the Drive to the motor. The shield must be bonded to the back-plate using an uninsulated metal cable-clamp. The clamp must be positioned no further than 150mm (6 in) from the Drive.
17. 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. A full 360° termination of the shield to the terminal housing of the motor is beneficial.
18. Ensure the AC supply and ground cables are at least 100mm (4 in) from the motor cable.
19. Avoid placing sensitive signal circuits in a zone extending 0.3m (12 in) all around the Drive.
20. Unshielded wiring to the optional braking resistor(s) may be used, provided the resistor is either in the same enclosure as the Drive or the wiring does not run external to the enclosure. When the braking-resistor wiring is unshielded, ensure a minimum spacing of 0.3m (12 in) from signal wiring and the AC supply wiring to the RFI filters.
21. If the control circuit 0V is to be grounded, this should be done at the host controller (eg. PLC) and not at the Drive. This is to avoid injecting noise currents into the 0V circuit.

2.8 Variations in the EMC wiring recommendations

Control wiring

Control wiring that connects to the following in the control module...

- Terminals 3 to 11, and 22 to 31
- Encoder D-type connector
- Option module connectors

... and exits the enclosure must have either of the following additional treatments:

- Pass the control cable(s) through a ferrite ring (part number 3225-1004). More than one cable can pass through a ferrite ring. Ensure the length of cable between the ferrite ring and the Drive is not greater than 125mm (5 in).
- Use one or more cables having a separate overall shield. Bond this shield(s) to the back-plate using an uninsulated metal clamp. Position the clamp not further than 100mm (4 in) from the Drive. Do not make any other connections to either end of the overall shield.

Interruptions to the motor cable

The motor cable should ideally be a single piece of shielded or armoured cable having no interruptions. In some situations it may be necessary to interrupt the cable, as in the following examples:

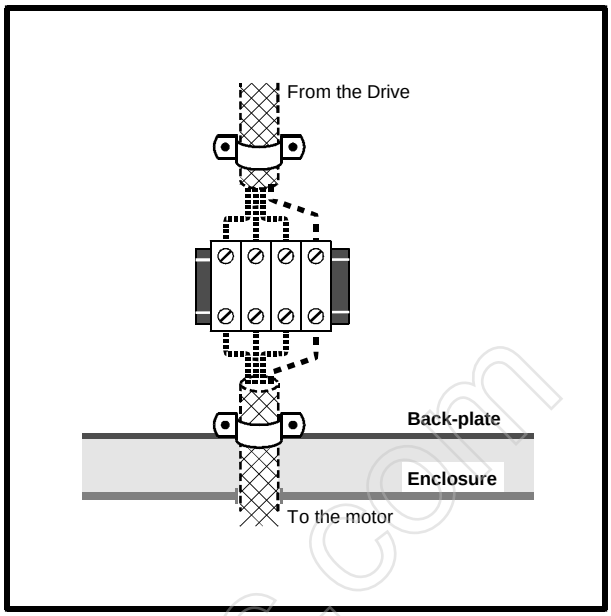
Connecting the motor cable to a terminal block in the Drive enclosure

Fitting a motor isolator switch for safety when work is done on the motor

In these cases the following guidelines should be followed.

Terminal block in the enclosure

The motor cable shields should be bonded to the back-plate using uninsulated metal cable-clamps which should be positioned as close as possible to the terminal block. Keep the length of power conductors to a minimum and ensure that all sensitive equipment and circuits are at least 0.3m (12 in) away from the terminal block.



(Refer to *Key to symbols* in Figure 2–22)

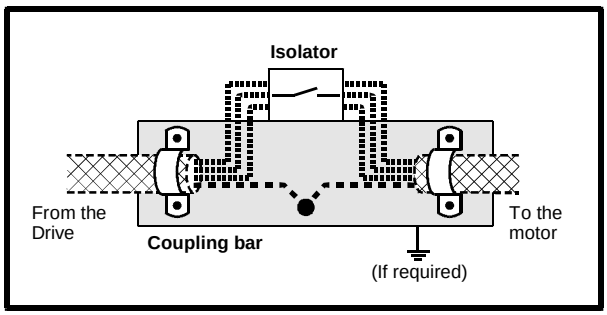
Figure 2–24 Connecting the motor cable to a terminal block in the enclosure

Using a motor isolator-switch

The motor cable shields should be connected by a very short conductor having a low inductance. The use of a flat metal coupling-bar is recommended; conventional wire is not suitable.

The shields should be bonded directly to the coupling-bar using uninsulated metal cable-clamps. Keep the length of the exposed power conductors to a minimum and ensure that all sensitive equipment and circuits are at least 0.3m (12 in) away.

The coupling-bar may be grounded to a known low-impedance ground nearby, for example a large metallic structure which is connected closely to the Drive ground.



(Refer to *Key to symbols* in Figure 2–22)

Figure 2–25 Connecting the motor cable to an isolator switch

2.9 Signal connections

The signal connections to be made depend on the method of control to be used. Refer to Chapter 2 *Getting Started*, Chapter 3 *Setting up the Drive* and Appendix C *Signal Connections* in the *User Guide*.

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 Installation Guide.

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

1.7 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.

1.8 Motor

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

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

Low speeds may cause the motor to 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.

If a Drive is to be used to control a number of motors, special measures need to be taken to ensure protection of the motors; refer to *Motor protection* in Appendix A *Motor Information*.

1.9 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.

Unidrive and Unidrive VTC (at 50°C ambient temperature)

Model	Maximum permissible continuous output current				
	3kHz	4.5kHz	6kHz	9kHz	12kHz
UNI 1401	2.1 A	2.1 A	2.1 A	2.1 A	2.1 A
UNI 1402	2.8 A	2.8 A	2.8 A	2.8 A	2.8 A
UNI 1403	3.8 A	3.8 A	3.8 A	3.8 A	3.3 A
UNI 1404	5.6 A	5.6 A	5.1 A	4.0 A	3.3 A
UNI 1405	6.9 A	5.9 A	5.1 A	4.0 A	3.3 A
UNI 2401	12.0 A	12.0 A	12.0 A	11.6 A	9.7 A
UNI 2402	16.0 A	16.0 A	14.7 A	11.6 A	9.7 A
UNI 2403	20.0 A	17.3 A	14.7 A	11.6 A	9.7 A
UNI 3401	34.0 A	34.0 A	28.0 A	21.0 A	17.9 A
UNI 3402	40.0 A	34.0 A	28.0 A	21.0 A	17.9 A
UNI 3403	44.0 A	36.0 A	31.0 A	24.0 A	20.6 A
UNI 3404	44.0 A	36.0 A	31.0 A	24.0 A	20.9 A
UNI 3405	50.0 A	41.0 A	34.0 A	26.0 A	23.0 A
UNI 4401	95 A	85 A	75 A	60 A	
UNI 4402	105 A	85 A	75 A	60 A	
UNI 4403	135 A	105 A	85 A	65 A	
UNI 4404	180 A	150 A	125 A	95 A	
UNI 4405	190 A	150 A	125 A	95 A	

Unidrive LFT
(at 9kHz PWM switching frequency)

Model	Nominal rating *		Maximum permissible output current			Nominal AC supply current
			Standard duty-cycle operation at 40°C	Continuous operation at 40°C	Continuous operation at 50°C	
UNI 1401LFT	0.75 kW	1.0 HP	2.1 A	2.1 A	2.1 A	3.1 A
UNI 1402LFT	1.1 kW	1.5 HP	2.8 A	2.8 A	2.8 A	3.2 A
UNI 1403LFT	1.5 kW	2.0 HP	3.8 A	3.8 A	3.3 A	5.5 A
UNI 1404LFT	2.2 kW	3.0 HP	5.6 A	4.0 A	3.3 A	8.4 A
UNI 1405LFT	4.0 kW	5.0 HP	9.5 A	4.3 A	3.3 A	9.5 A
UNI 2401LFT	5.5 kW	7.5 HP	12.0 A	12.0 A	11.0 A	13.7 A
UNI 2402LFT	7.5 kW	10 HP	16.0 A	14.2 A	11.0 A	16.3 A
UNI 2403LFT	11.0 kW	15 HP	25.0 A	14.2 A	11.0 A	24.3 A
UNI 3401LFT	15.0 kW	20 HP	34.0 A	28.0 A	21.0 A	34.0 A
UNI 3402LFT	18.5 kW	25 HP	40.0 A	28.0 A	21.0 A	39.0 A
UNI 3403LFT	22.0 kW	30 HP	46.0 A	32.0 A	24.0 A	46.0 A
UNI 3404LFT	30.0 kW	40 HP	60.0 A	33.0 A	24.0 A	59.0 A
UNI 3405LFT	37.0 kW	50 HP	70.0 A	35.0 A	26.0 A	74.0 A
UNI 4401LFT	45 kW	60 HP	96 A	70 A	57 A	96 A
UNI 4402LFT	55 kW	75 HP	124 A	70 A	57 A	120 A
UNI 4403LFT	75 kW	100 HP	156 A	80 A	61 A	151 A
UNI 4404LFT	90 kW	125 HP	180 A	100 A	77 A	173 A
UNI 4405LFT	110 kW	125 HP	202 A	100 A	77 A	190 A

* The nominal rating applies when the AC supply voltage is 400V. The absolute maximum rating is determined by the maximum continuous output current and maximum permissible AC supply voltage.

AC supply requirements

Voltage: 380V to 480V ±10%

No. of phases: 3

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

Frequency range: 48 to 62 Hz

Line reactors

When one of the following model sizes...

UNI 1401
UNI 1402
UNI 1403
UNI 1404

... is used on an AC supply of 175kVA or larger, it is recommended that a line reactor of 2% reactance is included between the AC supply and the Drive. Model sizes 1405 and larger have an internal DC-bus choke.

A line reactor reduces the risk of damage to the Drive resulting from severe disturbances on the supply network.

Motor requirements

Number of phases: 3

Voltage: 380V ~ 480V ±10%

Temperature, humidity and cooling method

Ambient temperature range:
0°C to 50°C (32°F to 122°F). Output current de-rating must be applied at ambient temperatures between 40°C and 50°C (122°F) (absolute maximum).

Minimum temperature at power-up: −10°C (14°F)

Cooling method: Forced convection

Maximum humidity:
95% non-condensing at 40°C (104°F)

Storage temperature range:
−40°C to 50°C (−40°F to 122°F)

Maximum storage time: After each 12 months, the capacitors will need re-forming; refer to the supplier of the Drive.

Altitude

Altitude range: 0 to 4000m (13000 ft), subject to the following conditions:

1000m to 4000m (3300 ft to 13000 ft) above sea level: de-rate the maximum output current from the specified figure by 1% per 100m (330 ft)

Vibration

Tested to ≤0.5g as specified in IEC 68−2−34

Ingress protection

Gland plate(s) not fitted: IP00

Gland plate(s) fitted; cable glands not fitted: IP10

Gland plate(s) fitted; cable-glands fitted:
IP40, NEMA 1

Overall dimensions

H Height including surface mounting brackets
W Width
D Projection forward of panel when surface mounted
F Projection forward of panel when through-panel mounted
R Projection rear of panel when through-panel mounted

Dimension	Model size			
	1	2	3	4
H	366mm 14 3/8	366mm 14 3/8	368mm 14 1/4 in	765mm 30 1/8
W	95mm 3 3/4 in	190mm 7 1/2 in	375mm 14 3/4 in	500mm 19 11/16 in
D	200mm 7 7/8 in	200 mm 7 7/8 in	260mm 10 1/4	260mm 10 1/4
F	120mm 4 1/4 in	120mm 4 1/4 in	120mm 4 1/4 in	120mm 4 1/4 in
R	80mm 3 1/8 in	80mm 3 1/8 in	140mm 5 1/2 in	140mm 5 1/2 in

Weights

Model size	kg	lb
1	4	8.8
2	8	17
3	22	49
4	70	154

Electromagnetic compatibility (EMC)

This is a summary of the EMC performance of the Drive. For full details, refer to the *Unidrive EMC Data Sheet* which can be obtained from a Drive Centre or distributor listed at the end of the User Guide.

Immunity

Compliance with immunity standards does not depend on installation details. Drives meet EN50082–2 (generic immunity standard for the industrial environment) and the following specifications from the 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 *Unidrive EMC Data Sheet* which can be obtained from a Drive Centre or distributor listed at the end of the 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, Drive model sizes 1 to 3 meet 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 specified below must be used:

Drive model	Use RFI filter...	
	Type	Part number
UNI 1401	*A*	4200–0010
UNI 1402	*A*	4200–0010
UNI 1403	*A*	4200–0010
UNI 1404	*A*	4200–0010
UNI 1405	*A*	4200–0010
UNI 2401	*B*	4200–0027
UNI 2402	*B*	4200–0027
UNI 2403	*B*	4200–0027
UNI 3401	*C*	4200–1051
UNI 3402	*C*	4200–1051
UNI 3403	*C*	4200–1051
UNI 3404	*D*	4200–1071
UNI 3405	*D*	4200–1071
UNI 4401	*E*	4200–1111
UNI 4402	*F*	4200–1171
UNI 4403	*F*	4200–1171
UNI 4404	*F*	4200–1171
UNI 4405	*H*	4200–1220

Power Drive Systems standard EN61800–3

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

The emission requirements of this standard are also met depending on the environment category, as shown in the table at the bottom of the page:

EN61800–3 defines the following:

- The **first environment** as one that includes domestic premises. It also includes establishments directly connected without intermediate transformers to a low-voltage power supply network which supplies buildings used for domestic purposes.
- The **second environment** is one that includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.
- **Restricted distribution** is defined as a mode of sales distribution in which the manufacturer restricts the supply of equipment to suppliers, customers or users who separately or jointly have technical competence in the EMC requirements of the application of Drives.

Note

If a 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 and speed

PWM switching frequency

Unidrive and Unidrive VTC: 3kHz nominal (selectable up to 12kHz)

Unidrive LFT: 9kHz nominal (selectable from 3kHz to 12kHz)

Maximum output frequency (open-loop): 2000Hz
Maximum speed (closed-loop): 30 000 RPM

Speed regulation:
(open-loop): 1 ~ 2%
(closed-loop): 0.01%

Speed control range:
(open-loop): >50:1
(closed-loop): >1000:1

Starts per hour

By electronic control: unlimited

By interrupting the AC supply:
model sizes 1 and 2: ≤20
model sizes 3 and 4: ≤10

Power Drive Systems standard EN61800–3		
Model size	**Environment category**	
	First environment	**Second environment**
UNI 1401 ~ UNI 1405 (Rated input current of Drive <25A)	Restricted distribution only: specified RFI filter required	No RFI filter required *
UNI 2401, UNI 2402 (Rated input current of Drive <25A)	Restricted distribution only: specified RFI filter required	No RFI filter required *
UNI 2403 (Rated input current of Drive >25A)	Specified RFI filter required	No RFI filter required *
UNI 3401 ~ UNI 3405 (Rated input current of Drive >25A)	Specified RFI filter required	No RFI filter required *
UNI 4401 ~ UNI 4405	Using the specified RFI filters and following the wiring guidelines given in Figure 2–23 may not ensure that the radiated emission limits are met. Additional filtering may be required in this environment.	No RFI filter required *

* RFI filter(s) recommended where sensitive electronic systems are operating nearby.

Accuracy and resolution

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

Open-loop frequency resolution...

Preset frequency reference: 0.1Hz

Precision frequency reference: 0.001Hz

Open-loop frequency accuracy...

Preset frequency reference: 0.03Hz or 0.01% of the reference, whichever is the larger value

Precision frequency reference: 0.0001Hz or 0.01% of the reference, whichever is the larger value

Closed-loop speed resolution
Unidrive and Unidrive LFT only...

Preset speed reference: 1 RPM

Precision speed reference: 0.01 RPM

Analog input 1: 0 RPM *

* The speed-loop algorithm ensures that the steady-state speed can change by infinitely small amounts in response to changes in the reference from these inputs.

Closed-loop speed accuracy
Unidrive and Unidrive LFT only...

Preset or precision speed reference: 0.00016 RPM or 0.01% of the reference, whichever is the larger value

Dissipation (all version)

Model	Nominal rating		Maximum total power dissipation				
			3kHz	4.5kHz	6kHz	9kHz	12kHz
UNI 1401	0.75kW	1.0HP	80 W	80 W	90 W	90 W	90 W
UNI 1402	1.1kW	1.5HP	90 W	90 W	100 W	100 W	110 W
UNI 1403	1.5kW	2.0HP	100 W	110 W	110 W	120 W	130 W
UNI 1404	2.2kW	3.0HP	130 W	130 W	140 W	150 W	150 W
UNI 1405	4.0kW	5.0HP	180 W	190 W	190 W	190 W	170 W
UNI 2401	5.5kW	7.5HP	210 W	230 W	250 W	280 W	310 W
UNI 2402	7.5kW	10HP	270 W	290 W	310 W	320 W	310 W
UNI 2403	11.0kW	15HP	400 W	380 W	360 W	330 W	310 W
UNI 3401	15.0kW	20HP	570 W	620 W	670 W	660 W	630 W
UNI 3402	18.5kW	25HP	660 W	720 W	730 W	660 W	630 W
UNI 3403	22.0kW	30HP	730 W	800 W	770 W	730 W	700 W
UNI 3404	30.0kW	40HP	950 W	830 W	790 W	740 W	710 W
UNI 3405	37.0kW	50HP	1090 W	990 W	920 W	850 W	800 W
UNI 4401	45kW	60HP	1460 W	1610 W	1630 W	1530 W	
UNI 4402	55kW	75HP	1910 W	1780 W	1670 W	1560 W	
UNI 4403	75kW	100HP	2370 W	2130 W	2030 W	1860 W	
UNI 4404	90kW	125HP	2640 W	2890 W	2700 W	2470 W	
UNI 4405	110kW	125HP	2970 W	2910 W	2720 W	2490 W	

The default PWM switching frequency is as follows...

Unidrive and Unidrive VTC: 3kHz

Unidrive LFT: 9kHz

C.2 Optional RFI filters

Ratings

Type	Part number	Max. continuous current	Ingress protection
A	4200–0010	10 A	IP20
B	4200–0027	27 A	IP20
C	4200–1051	50 A	IP 00
D	4200–1071	75 A	IP 00
E	4200–1111	110 A	IP 00
F	4200–1171	170 A *	IP 00
H	4200–1220	300 A	IP 00

* Above 40°C (104°F), the current rating is reduced by 1.6A/°C (0.88A/°F) up to 50°C.

Maximum current overload:
150% of rated current for 1 minute in a 10 minute period.

Voltage (phase-to-phase and phase-to-ground):
480V +10%

AC supply frequency: 48 to 62 Hz

Temperature

Type	Part number	Maximum ambient temperature at rated current	Case temperature rise at rated current
A	4200–0010	50 °C (122°F)	<30°C (86°F)
B	4200–0027	50 °C (122°F)	<40°C (104°F)
C	4200–1051	50 °C (122°F)	<40°C (104°F)
D	4200–1071	50 °C (122°F)	<40°C (104°F)
E	4200–1111	50 °C (122°F)	<40°C (104°F)
F	4200–1171	40 °C (104°F) *	<55°C (131°F)
H	4200–1220	40 °C (104°F) *	<40°C (104°F)

* Above 40°C (104°F), the current rating is reduced by 1.6A/°C (0.88A/°F) up to 50°C (122°F).

Power dissipation

Type	Part number	Power dissipation at rated current
A	4200–0010	25 W
B	4200–0027	40 W
C	4200–1051	60 W
D	4200–1071	100 W
E	4200–1111	120 W
F	4200–1171	150 W
H	4200–1220	200 W

Ground leakage current

Ground-leakage current when the AC supply is 400V at 50Hz is as follows:

Condition	*A*	*B*	*C* to *H*
Balanced supply phase-to-phase and phases to ground	5.6mA	7.4mA	55mA
One phase disconnected	41mA	57.9mA	350mA

For other AC supply voltages and frequencies, scale the values of leakage current proportionally.

Discharge resistors

A and *B*: 330KΩ in a star network between phases, with the star point connected by a 1MΩ resistor to ground.

C to *H*: 10MΩ between each phase and ground.

The discharge resistors are fitted internally.

Overall dimensions

Type	Part number	Dimension		
		H	W	D
A	4200–0010	396mm $15^{9}/_{16}$ in	50mm $1^{15}/_{16}$ in	114.5mm $4^{1}/_{2}$ in
B	4200–0027	406mm 16 in	75mm $2^{15}/_{16}$ in	114.5mm $4^{1}/_{2}$ in
C	4200–1051	330mm 13 in	190mm $7^{1}/_{2}$ in	145mm $5^{11}/_{16}$ in
D	4200–1071	330mm 13 in	190mm $7^{1}/_{2}$ in	145mm $5^{11}/_{16}$ in
E	4200–1111	440mm $17^{5}/_{16}$ in	200mm $7^{7}/_{8}$ in	145mm $5^{11}/_{16}$ in
F	4200–1171	490mm $19^{1}/_{4}$ in	200mm $7^{7}/_{8}$ in	145mm $5^{11}/_{16}$ in
H	4200–1220	590mm $23^{1}/_{4}$ in	200mm $7^{7}/_{8}$ in	145mm $5^{11}/_{16}$ in

Weights

Type	Part number	kg	lb
A	4200–0010	2	5
B	4200–0027	2.7	6
C	4200–1051	7.4	16
D	4200–1071	8	18
E	4200–1111	12.3	27
F	4200–1171	16	35
H	4200–1220	26	57

Declaration of Conformity

Control Techniques plc
The Gro
Newtown
Powys
UK
SY16 3BE

UNI 1401	UNI 1402	UNI 1403	UNI 1404	UNI 1405
UNI 2401	UNI 2402	UNI 2403		
UNI 3401	UNI 3402	UNI 3403	UNI 3404	UNI 3405
UNI 4401	UNI 4402	UNI 4403	UNI 4404	UNI 4405

The AC variable speed drive products listed above, including the VTC and LFT variants, have been designed and manufactured in accordance with the following European harmonised, national and international standards:

EN60249	Base materials for printed circuits
IEC326-1	Printed boards: general information for the specification writer
IEC326-5	Printed boards: specification for single- and double-sided printed boards with plated-through holes
IEC326-6	Printed boards: specification for multilayer printed boards
IEC664-1	Insulation co-ordination for equipment within low-voltage systems: principles, requirements and tests
EN60529	Degrees of protection provided by enclosures (IP code)
UL94	Flammability rating of plastic materials
UL508C	Standard for power conversion equipment
EN50081-1	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

These products comply with the Low Voltage Directive 73/23/EEC, the Electromagnetic Compatibility (EMC) Directive 89/336/EEC and the CE Marking Directive 93/68/EEC.

W. Drury
Technical Director
Newtown

Date: 5th February 1998

These electronic Drive products are intended to be used with appropriate motors, controllers, electrical protection components and other equipment to form complete end products or systems. Compliance with safety and EMC regulations depends upon installing and configuring Drives correctly, including using the specified input filters. The Drives must be installed only by professional assemblers who are familiar with requirements for safety and EMC. The assembler is responsible for ensuring that the end product or system complies with all the relevant laws in the country where it is to be used. Refer to the Installation Guide. A *Unidrive EMC Data Sheet* is also available giving detailed EMC information.

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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Issue Code: udiu5

Issue Date: September 1998

S/W Version: 03.XX.XX