4 Installing the Drive

Warning

Adhere to the instructions

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

Warning

Installation in an enclosure

The Drive case is classified as IP20 according to IEC529 (see Chapter 3 *Data*). The Drive is listed by UL as an *Enclosed type AC motor controller*.

The Drive is designed for installation in an enclosure to prevent unauthorized access and to avoid contamination from conductive dust or condensation.

Warning

Authorized access

Only authorized, trained service personnel should be allowed access to the Drive.

Warning

Fire enclosure

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

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 15 minutes before work may continue.

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

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 reliable isolation. If the plug terminals can be touched when the plug is disconnected from the socket, a means of automatically isolating the plug from the Drive must be used (eg. a latching relay).

Warning

Water ingress

The Drive has no protection against water ingress.

Warning

STOP function

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

4.1 EMC considerations

Installation and use

The Drive is 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 the Drive being installed and configured correctly, including the use of the specified RFI filter.

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. Detailed EMC information is given in the *Dinverter B EMC Data Sheet* which is available from the Drive Centres listed at the end of this User Guide.

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 Chapter 3 *Data* for further information on compliance with EMC standards and definitions of environments.

Detailed instructions and EMC information are given in the *Dinverter 2B EMC Data Sheet* which is available from the Drive Centres and distributors listed at the end of this *User Guide*.

Compliance data is given in Chapter 3 *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.

4.2 Declaration of conformity

The specification of the Drive includes compliance with specific EMC standards. The Drive carries a **CE** mark and has a manufacturer's Declaration of Conformity with the EMC Directive of the European Union.

The Drive is a complex component which has been designed for incorporation into a complete product, system or installation, the details of which are beyond the control of Control Techniques, but which will affect the EMC behaviour of the installed Drive. Furthermore, other equipment installed in the same system may affect the overall EMC behaviour. Therefore, the declaration of conformity applies only to the Drive when installed in a typical assembly in accordance with the instructions given in this chapter.

Note

The installer of the Drive is responsible for ensuring that the complete system or installation meets the prevailing regulations for EMC.

4.3 Environmental requirements

1. The environment must be acceptable (see Chapter 3 Data).
2. In accordance with the IP20 rating of the Drive, the Drive must be located in an environment that is free from dust, corrosive vapours, gases and all liquids, including condensation of atmospheric moisture.
3. 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.
4. The Drive must not be located in a classified hazardous area unless the Drive is installed in an approved enclosure and the complete installation is certified.
5. The maximum permissible ambient temperature of the Drive must not be exceeded. Take into account heat generated by nearby equipment.

4.4 Type of enclosure

The recommendations are based on the use of a standard industrial metal enclosure. A special EMC enclosure is not required unless more stringent EMC standards must be met.

If no enclosure is used, a considerable benefit can be achieved by mounting the Drive, RFI filter and motor-cable shield on a metal back-plate in the same way as shown in Figures 4–15 and 4–16. In this case, some increase in radiated emission in the 30 to 60MHz range may occur.

4.5 Installation parts supplied

The following are supplied with the Drive:

DIN-rail mounting bracket
Mounting bracket
Mounting foot

4.6 RFI filter and ferrite rings

EMC requirements

For compliance with EMC emissions standards, use the recommended RFI filter and ferrite rings, as shown in the following table. Use one RFI filter and (when required) two ferrite rings for each Drive.

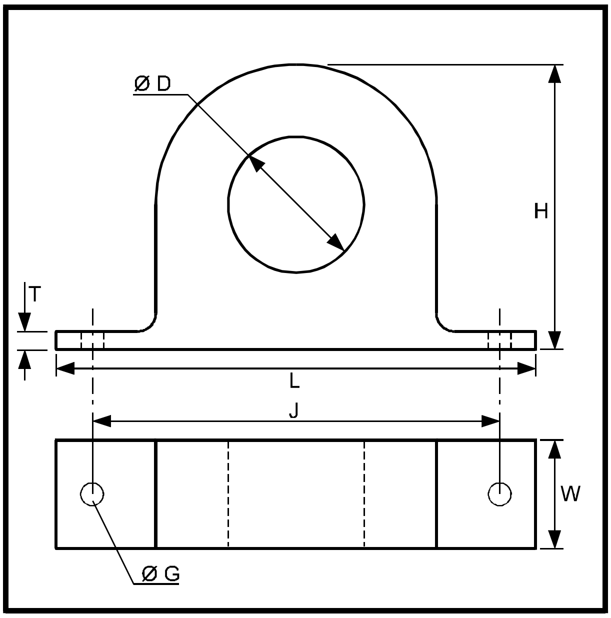
Model	Part numbers	
	RFI filter (x1)	Ferrite rings (×2)
DIN 122075B	4200-2515	Not required
DIN 1220150B	4200-2425	Not required
DIN 1220220B	4200-2425	Not required
DIN 3220075B	4200-4810 *	4200-0000
DIN 3220150B	4200-4820 *	4200-0000
DIN 3220220B	4200-4820 *	4200-0000
DIN 3380075B	4200-4810 *	4200-0000
DIN 3380110B	4200-4810 *	4200-0000
DIN 3380150B	4200-4810 *	4200-0000
DIN 3380220B	4200-4810 *	4200-0000
DIN 3380300B	4200-4820 *	4200-0000
DIN 3380400B	4200-4820 *	4200-0000

***** When the length of motor cable exceeds 50 metres (165 feet), use RFI filter part number 4200-4830.

Length of motor cable

Ensure that the motor cable is shielded and its length does not exceed 150 metres (465 feet). (See the *Dinverter B EMC Data Sheet* for further information.)

Ferrite ring



Dimension	mm	in
L	105	$4^{3}/_{16}$
W	24	1
H	62	$2^{1}/_{2}$
T	5	$^{3}/_{16}$
D	28	$1^{1}/_{8}$
J	90	$3^{5}/_{8}$
G	5	$^{3}/_{16}$

Figure 4–1 Dimensions of the ferrite ring

RFI filters

Single-phase models

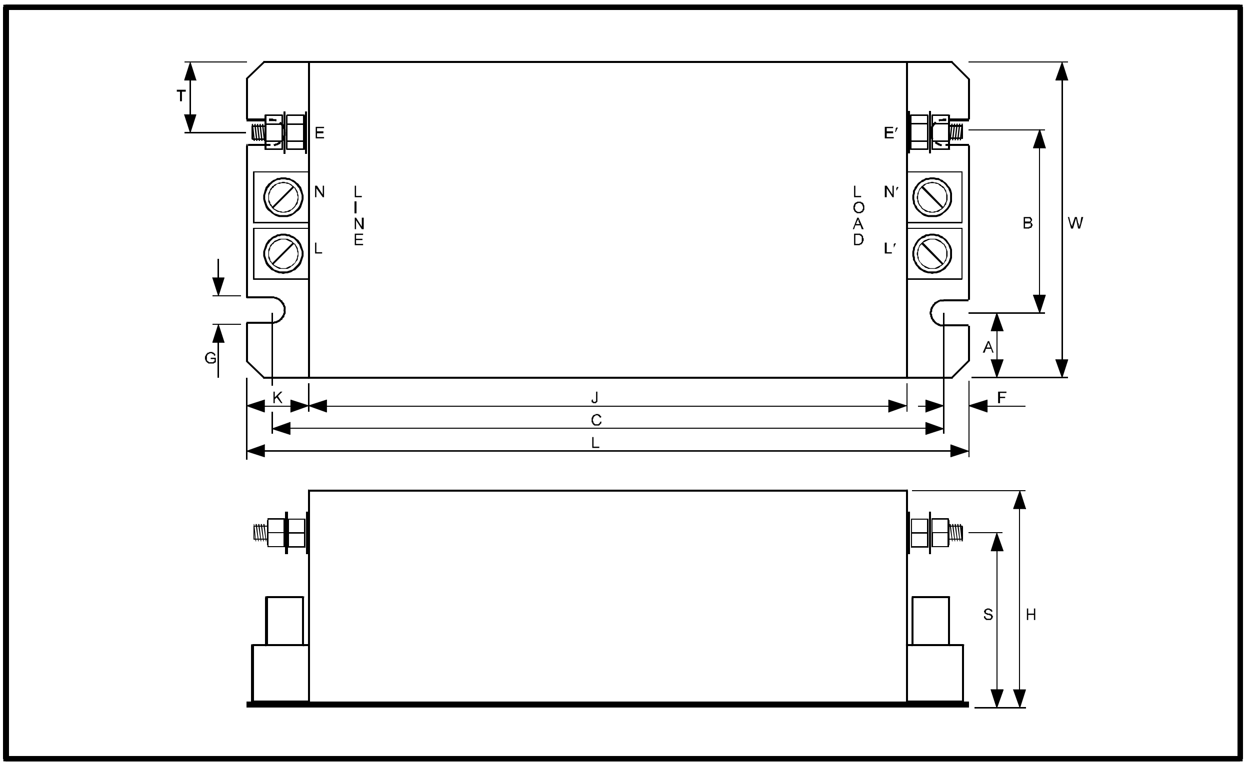


Figure 4–2 Dimensions of the RFI filters for the single-phase models

Drive model	**DIN1220075B**		**DIN1220150B DIN1220220B**	
Filter part number	**4200–2515**		**4200–2425**	
Dimension	**mm**	**in**	**mm**	**in**
L	170	$6^{11}/_{16}$	170	$6^{11}/_{16}$
W	75	$2^{15}/_{16}$	75	$2^{15}/_{16}$
H	50	2	50	2
C	158	$6^{1}/_{4}$	158	$6^{1}/_{4}$
B	41	$1^{5}/_{8}$	41	$1^{5}/_{8}$
F	6	$^{1}/_{4}$	6	$^{1}/_{4}$
A	17	$^{5}/_{8}$	17	$^{5}/_{8}$
G	7	$^{1}/_{4}$	7	$^{1}/_{4}$
J	142	$5^{5}/_{8}$	142	$5^{5}/_{8}$
K	14	$^{9}/_{16}$	14	$^{9}/_{16}$
S	35	$1^{3}/_{8}$	35	$1^{3}/_{8}$
T	16	$^{5}/_{8}$	16	$^{5}/_{8}$
Ground stud	M5 x 15mm			

Three-phase models

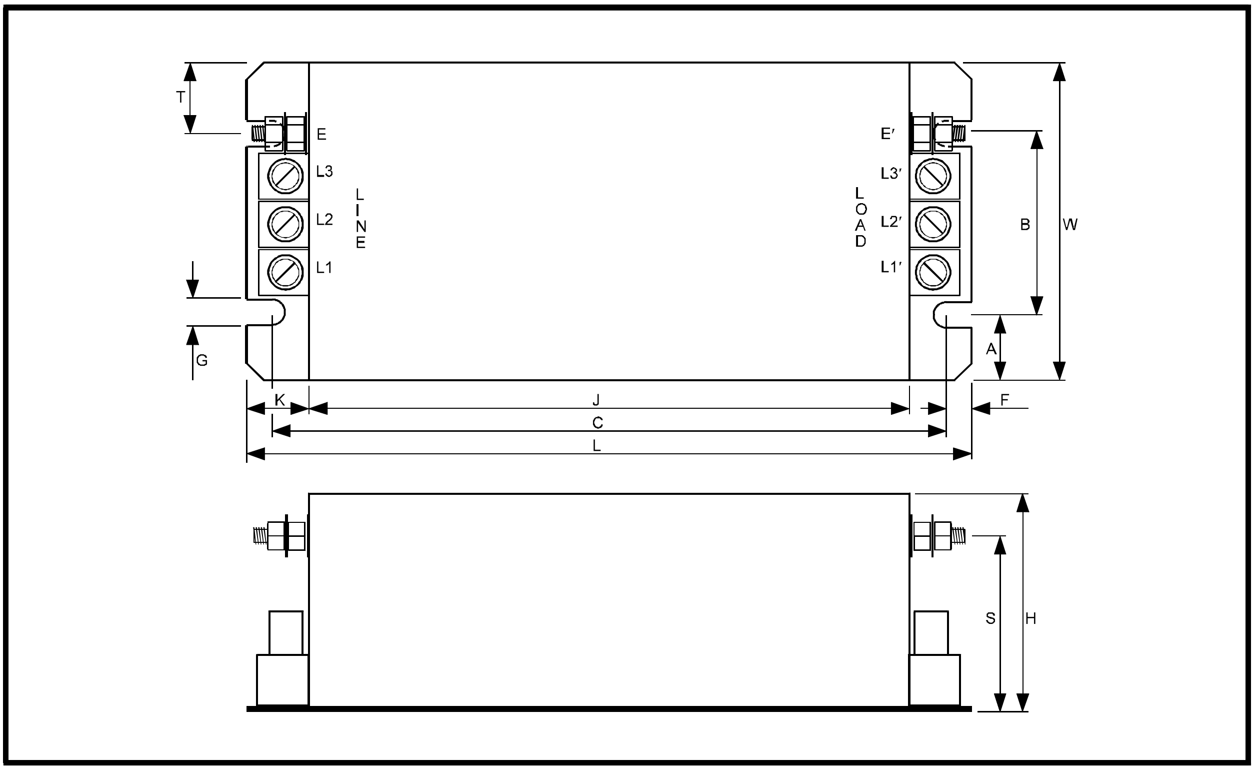


Figure 4–3 Dimensions of the RFI filters for the three-phase models

Drive model	**DIN3220075B** **DIN3380075B** **DIN3380110B** **DIN3380150B** **DIN3380220B**	**DIN3220150B** **DIN3220220B** **DIN3380300B** **DIN3380400B**
Filter part number	**4200–4810**	**4200–4820** **4200–4830**

Dimension	**mm**	**in**	**mm**	**in**
L	250	$9\,^{13}/_{16}$	270	$10\,^{5}/_{8}$
W	110	$4\,^{5}/_{16}$	140	$5\,^{1}/_{2}$
H	60	$2\,^{3}/_{8}$	60	$2\,^{3}/_{8}$
C	238	$9\,^{3}/_{8}$	258	$10\,^{3}/_{16}$
B	76	3	106	$4\,^{3}/_{16}$
F	6	$^{1}/_{4}$	6	$^{1}/_{4}$
A	17	$^{5}/_{8}$	17	$^{5}/_{8}$
G	7	$^{1}/_{4}$	7	$^{1}/_{4}$
J	220	$8\,^{5}/_{8}$	240	$9\,^{7}/_{16}$
K	15	$^{9}/_{16}$	15	$^{9}/_{16}$
S	47	$1\,^{3}/_{8}$	47	$1\,^{3}/_{8}$
T	17	$^{5}/_{8}$	17	$^{5}/_{8}$
Ground stud	M5 x 15mm			

4.7 Planning the installation

The following conditions must be met when planning the installation of the Drive or a number of Drives in an enclosure:

- The conditions stated in *Environmental requirements*
- The appropriate EMC requirements
- Electrical safety requirements for the installation as specified by the end-user
- The planned size of the installation does not exceed the space available

1. Use one of the following enclosure layout diagrams, depending on the requirements of the installation:

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

   Compliance with EMC emission standards Refer to Figure 4–5 which shows three Drives, three RFI filters, ferrite rings, and the signal and power cables.

2. When compliance with EMC emissions standards is required, the enclosure must be made of metal but does not require special EMC features.

3. Ensure the enclosure is fitted with an un-insulated metal back-plate for mounting the Drive, RFI filters and (when required) the ferrite rings.

4. The Drive must be installed vertically for best flow of cooling air.

5. The Drive should be installed as low as possible in the enclosure without contravening EMC requirements (when applicable).

6. Allow at least 100mm (4in) clearance above and below the Drive.

7. Allow at least 5mm ($^1/_4$in) clearance each side of the Drive.

8. When compliance with EMC emissions standards is required, mount an RFI filter at the left side of the Drive in order to minimize the cable length between the Drive and filter.

9. Decide how the Drives are to be mounted in the enclosure, as follows:
   - DIN-rail mounted
   - Surface-mounted
   - Through-panel mounted

   DIN-rail and surface mounting give:

   Better ingress protection

   Heat dissipated inside the enclosure

   Through-panel mounting gives:

   Heat dissipated outside the enclosure

   Reduced ingress protection

10. If the Drives are to be surface or DIN-rail mounted in the enclosure, refer to either of the following:

    If the enclosure is to be sealed, perform the calculations in *Heat dissipation in a sealed enclosure* (later in this chapter) in order to determine the minimum permissible size of enclosure for heat dissipation.

    If the enclosure is to be ventilated, perform the calculation in *Heat dissipation in a ventilated enclosure* (later in this chapter) in order to determine the required volume of air-flow.

11. If necessary, adjust the size of the enclosure, and re-plan the internal equipment accordingly. Repeat these instructions as many times as required to meet all the requirements.

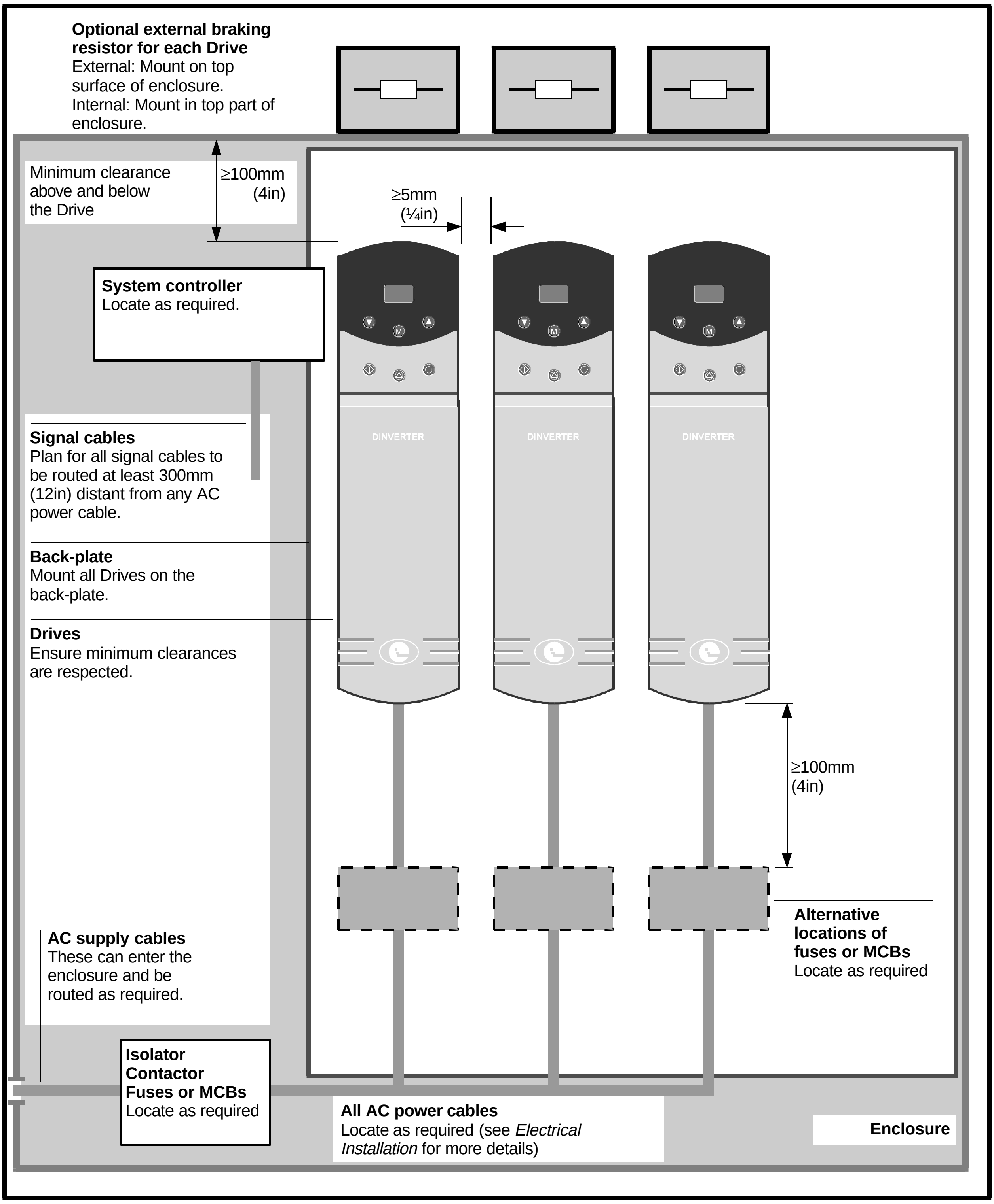


Figure 4–4 Recommended layout for routine EMC precautions (wiring recommendations are shown in Figure 4–14)

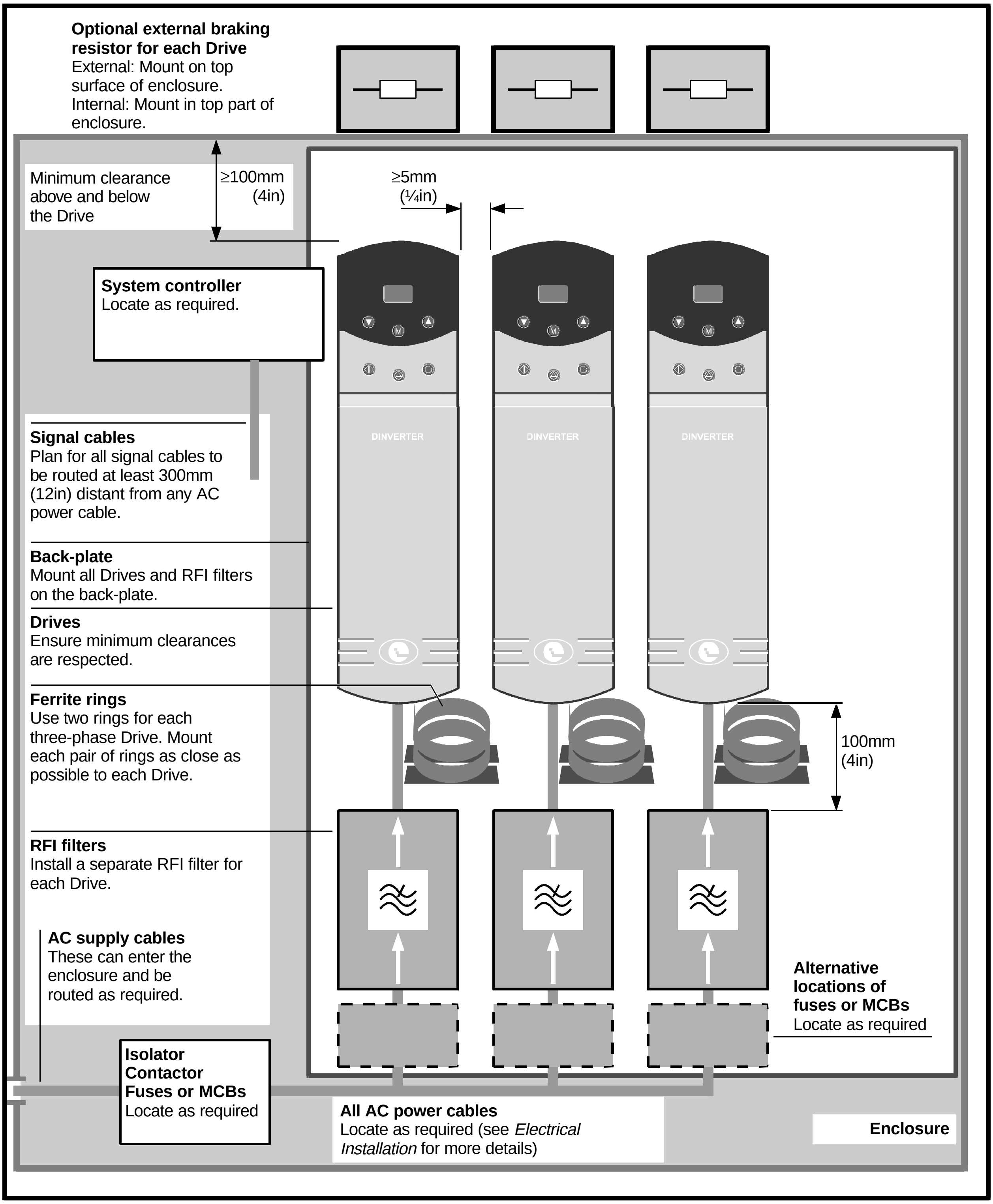


Figure 4–5 Recommended layout for compliance with EMC emission standards (wiring recommendations are shown in Figures 4–15 and 4–16)

4.8 Heat dissipation in a sealed enclosure

If possible, locate heat-generating equipment in the lower part of the enclosure to encourage internal convection. Otherwise, use a taller enclosure or install stirrer fans.

To maintain sufficient cooling of the Drive when it is installed inside a sealed enclosure, heat generated by all the equipment in the enclosure must be taken into account, and the enclosure must be of adequate size.

To calculate the minimum acceptable size of enclosure, use the following procedure:

Calculate the minimum required surface area **Ae** for the enclosure from:

$$A_e = \frac{P}{k(Ti - Tamb)}$$

Where:

Tamb	Maximum ambient temperature in °C outside the enclosure
Ae	Unobstructed heat-conducting area in m^2
k	Heat transmission coefficient of the enclosure material
Ti	Maximum permissible ambient temperature in °C inside the enclosure
P	Power in Watts dissipated by all heat sources in the enclosure

Example

To calculate the size of an enclosure for model DIN1220150B (1.5kW, 2HP).

The following conditions are assumed:

The Drive is surface-mounted inside the enclosure

Only the top, front, and two sides of the enclosure are free to dissipate heat

The enclosure is made from painted 2mm ($^3/_{32}$in) sheet steel

Maximum external air temperature: 30°C (86°F)

Drive PWM frequency: 5.9kHz

Insert the following values:

Ti =	50°C
Tamb =	30°C
k =	5.5 (typical for painted 2mm ($^3/_{32}$in) sheet steel)
P =	73 (from *Heat dissipation and cooling* in Chapter 3 *Data*)

Note

It is essential to include any other heat sources in the value of P.

The minimum required heat conducting area is then:

$$Ae = \frac{73}{5.5(50 - 30)} = 0.67m^2$$

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** = **D** = 0.5m, obtain the minimum width:

$$W = \frac{0.67 - (2 \times 0.5 \times 0.5)}{0.5 + 0.5} = 0.42m$$

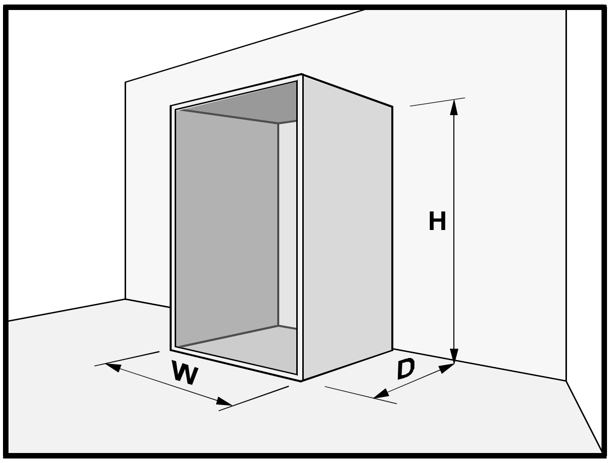


Figure 4–6 Enclosure having front, sides and top panels free to dissipate heat

4.9 Heat dissipation in a ventilated enclosure

If a high ingress protection rating is not required, the enclosure may be smaller. A ventilating fan can be used to exchange air between the inside and outside of the enclosure.

To calculate the volume of ventilating air, use the following equation:

$$V = \frac{3.1P}{T_i - T_{amb}}$$

Where V = Air-flow in m^3 per hour

Example

P = 73
T_i = 50°C
Tamb = 30°C

Then:

$$V = \frac{3.1 \times 73}{50 - 30} = 11.3m^3 / hr$$

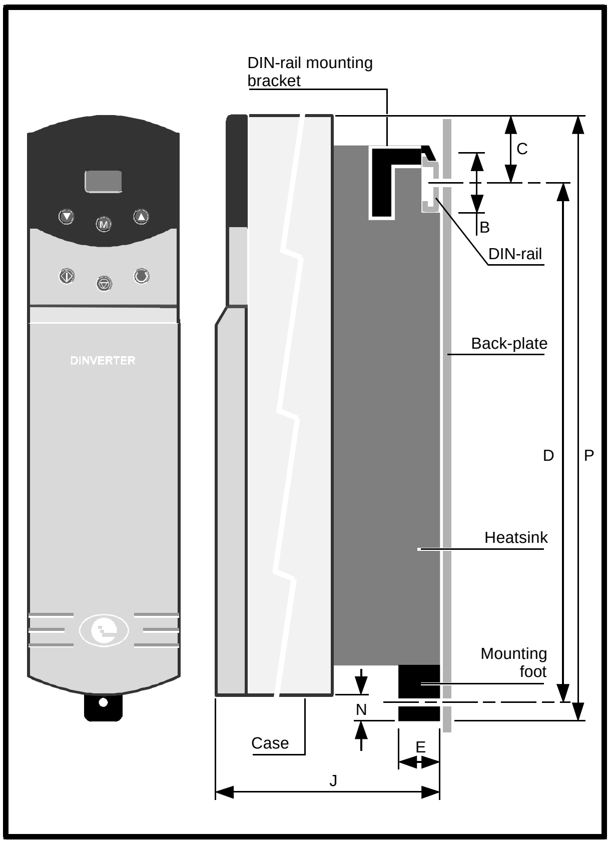
4.10 Motor cooling

When a motor is driven at low speed, its internal cooling fan becomes less effective. If necessary, provide it with additional cooling (such as forced ventilation).

4.11 Grounding the Drive heatsink

For compliance with EMC emission standards, the heatsink of the Drive is required to make a good direct electrical connection to the metal back-plate on which the Drive is to be mounted. The metal mounting brackets supplied with the Drive must be used for achieving this.

4.12 DIN-rail mounting



Dimension	mm	in
B	35	$1^{3}/_{8}$
C	37.5	$1^{1}/_{2}$
D	258	$10^{3}/_{16}$
E	15	$^{9}/_{16}$
F	200	$7^{7}/_{8}$
J	200	$7^{7}/_{8}$
N	8	$^{5}/_{16}$
P	301	$11^{7}/_{8}$
Hole diameter	5.5	$^{3}/_{16}$

Figure 4–7 Mounting the Drive on a DIN-rail

1. Slide the DIN-rail mounting bracket into the square recess in the top of the heatsink.
2. Retain the mounting bracket to the heatsink with the M5 self-tap slot-head screw supplied.
3. Locate the Drive on the DIN-rail.
4. Slide the mounting foot into the flanged recess in the bottom of the heatsink.
5. The DIN-rail mounting bracket and mounting foot supplied with the Drive are manufactured from metal. Ensure the mounting foot and DIN-rail make direct electrical contact with the back-plate; for example, tap threaded holes in the back-plate to accept the mounting screws.

4.13 Through-panel mounting

1. Cut an aperture in the panel of the dimensions given in Figure 4–8.
2. Prepare the panel as required for mounting the Drive.
3. Orientate the mounting bracket as shown in Figure 4–8 and slide the mounting bracket into the rectangular recess in the top of the heatsink.
4. Retain the mounting bracket to the heatsink with the M5 self-tap slot-head screw supplied.
5. Slide the mounting foot into the T-shape hole in the bottom of the case.
6. The mounting bracket and mounting foot supplied with the Drive are manufactured from metal. Ensure the bracket and foot make direct electrical contact with the back-plate; for example, tap threaded holes in the back-plate to accept the mounting screws.

Dimension	mm	in
A	16	$^{5}/_{8}$
B	6.5	$^{1}/_{4}$
C	7.5	$^{5}/_{16}$
D	321	$11^{15}/_{16}$
E	15	$^{9}/_{16}$
F	269	$10\,^{9}/_{16}$
G	78	$3^{1}/_{16}$
H	20	$^{3}/_{4}$
J	244	$9^{5}/_{8}$
K	56	$2^{1}/_{8}$
M	15	$^{5}/_{8}$
N	26	1
P	334	$13^{1}/_{8}$
Hole diameter	5.5	$^{3}/_{16}$

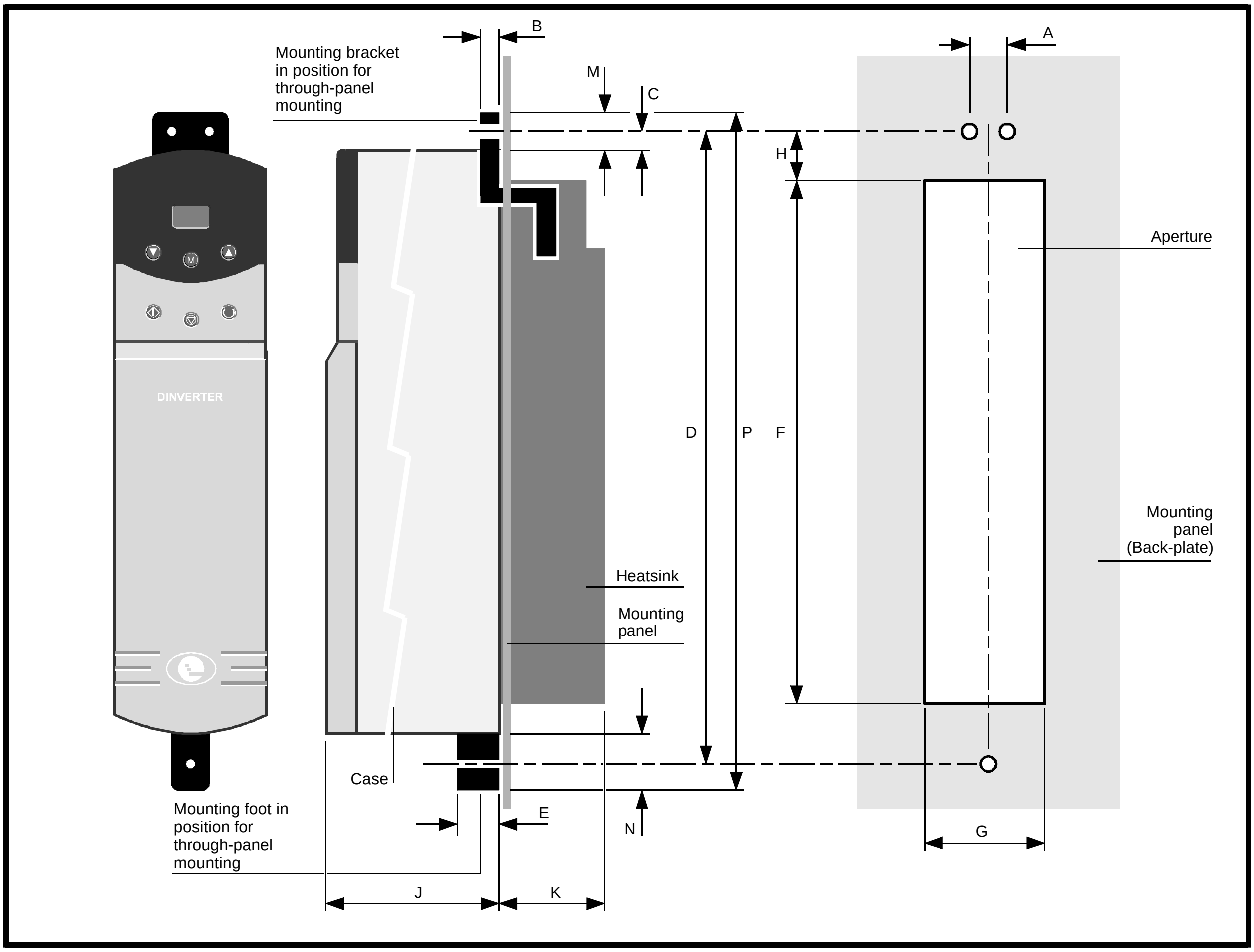
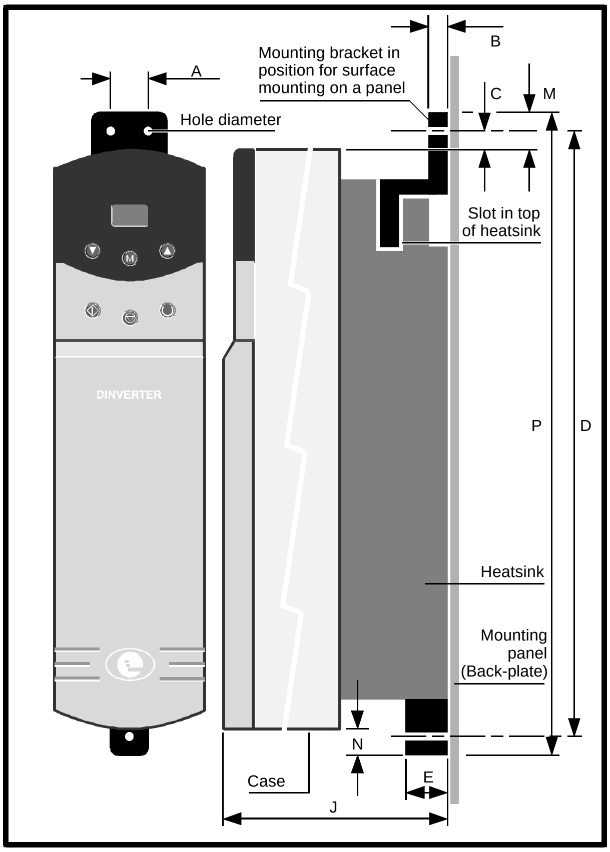


Figure 4–8 Through-panel mounting of the Drive

4.14 Surface mounting on a panel



Dimension	mm	in
A	16	$^5/_8$
B	6.5	$^1/_4$
C	7.5	$^5/_{16}$
D	303	$11^7/_8$
E	15	$^9/_{16}$
J	200	$7^7/_8$
M	15	$^5/_8$
N	8	$^5/_{16}$
P	316	$12^7/_{16}$
Hole diameter	5.5	$^3/_{16}$

Figure 4–9 Surface mounting the Drive on a panel

1. Prepare the panel as required for mounting the Drive.
2. Orientate the mounting bracket as shown in Figure 4–9, then slide the mounting bracket into the rectangular recess in the top of the heatsink.
3. Retain the mounting bracket to the heatsink with the M5 self-tap slot-head screw supplied.
4. Slide the mounting foot into the flanged recess in the bottom of the heatsink.
5. The mounting bracket and mounting foot supplied with the Drive are manufactured from metal. Ensure the bracket and foot make direct electrical contact with the back-plate; for example, tap threaded holes in the back-plate to accept the mounting screws.

4.15 Access to the connectors

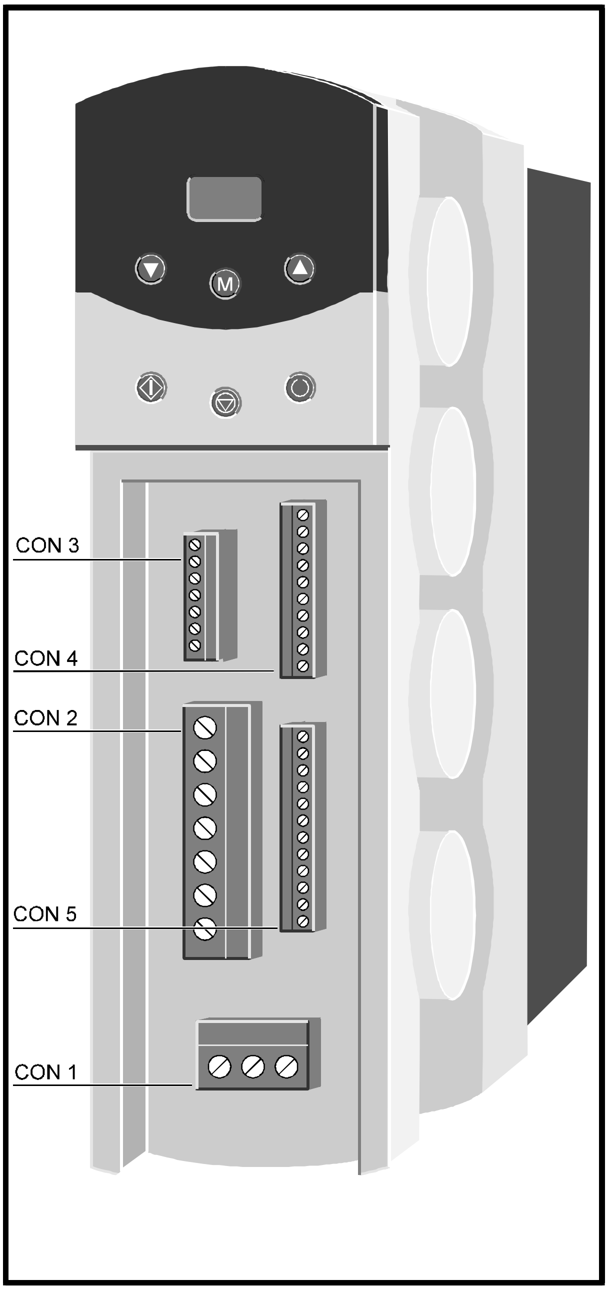


Figure 4–10 Locations of the connectors

Remove the front clip-on cover to gain access to the connectors.

The following signal connectors are in two parts allowing the wiring to be unplugged from the Drive:

CON 3
CON 4
CON 5

4.16 Power connections

AC supply connections

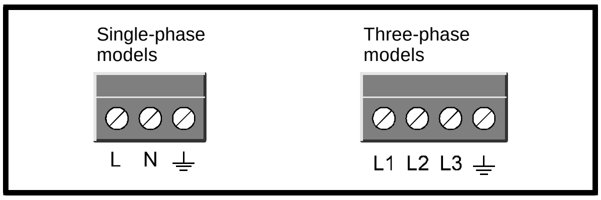


Figure 4–11 CON 1 connections

Motor and braking-resistor connections

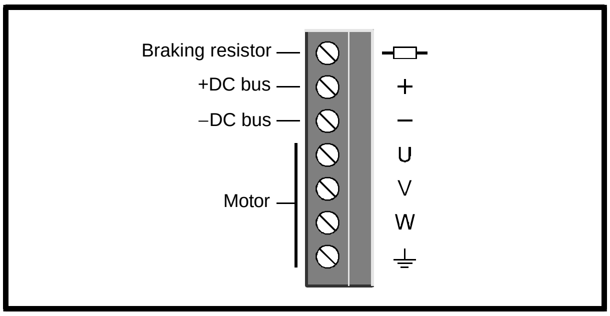


Figure 4–12 CON 2 connections (all models)

4.17 AC supply requirements

Single-phase models

Use either of the following types of AC supply of the correct voltage:

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

Three-phase models

Use a three-phase star or delta supply of the correct voltage.

4.18 Cables and fuses

Warning

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

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

For the following power connections...

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

... use pvc-insulated cable having a voltage rating shown in the following table and having copper conductors rated at 105°C (221°F).

Cable sizes must be selected for 100% of the RMS currents.

The table below is only a guide to cable sizes. Refer to local wiring regulations for the correct size of cables.

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

AC supply to the enclosure
Drive to the motor
Drive to external braking resistor (when used and when part of the cable is outside the enclosure)

Since a current surge can occur when AC power is applied to the Drive, the use of slow-blow fuses is recommended. In a single-phase system, a fuse of the specified rating should be included in the live connection of the AC supply. In a three-phase system, a fuse of the specified rating should be included in each phase of the AC supply.

Fuse types

Use the following type of fuse:

Europe: Type gG HRC industrial fuses to IEC269 (BS88)
USA: RK1 600VAC

As an alternative to fuses, an MCB or MCCB may be used if equipped with adjustable thermal and magnetic trip devices of a suitable rating.

Model	Fuse rating	AC supply cables			Motor cables			Braking resistor cables		
	A	mm^2	AWG	Voltage rating	mm^2	AWG	Voltage rating	mm^2	AWG	Voltage rating
DIN1220075B	16	1.0	18	300VAC	1.0	18	300VAC	1.0	18	500VDC
DIN1220150B	20	1.5	16	300VAC	1.0	18	300VAC	1.0	18	500VDC
DIN1220220B	32	2.5	14	300VAC	1.0	18	300VAC	1.0	18	500VDC
DIN3220075B	10	1.0	18	300VAC	1.0	18	300VAC	1.0	18	500VDC
DIN3220150B	16	1.0	18	300VAC	1.0	18	300VAC	1.0	18	500VDC
DIN3220220B	16	1.5	16	300VAC	1.0	18	300VAC	1.0	18	500VDC
DIN3380075B	6	1.0	18	600VAC	1.0	18	600VAC	1.0	18	1000VDC
DIN3380110B	6	1.0	18	600VAC	1.0	18	600VAC	1.0	18	1000VDC
DIN3380150B	6	1.0	18	600VAC	1.0	18	600VAC	1.0	18	1000VDC
DIN3380220B	10	1.0	18	600VAC	1.0	18	600VAC	1.0	18	1000VDC
DIN3380300B	16	1.5	16	600VAC	1.0	18	600VAC	1.0	18	1000VDC
DIN3380400B	16	1.5	16	600VAC	1.0	18	600VAC	1.0	18	1000VDC

4.19 Protecting the Drive with line reactors

When a Dinverter 2B is connected to an AC supply which is subject to severe disturbances, as a result of the following for example...

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

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

A line reactor should be connected in each phase of the supply to each Drive. Line reactor(s) add the required impedance to the AC supply in order to reduce current transients to a level that can be tolerated by the Drive.

Caution

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

For single-phase Drives, one line reactor is adequate; for three-phase Drives, three individual reactors, or a single three-phase reactor should be used. Each Drive must have its own reactor(s).

Typical values

Model	Value mH	Model	Value mH
DIN1220075B	2.0	DIN3380075B	6.0
DIN1220150B	1.5	DIN3380110B	5.0
DIN1220220B	1.0	DIN3380150B	4.5
DIN3220075B	5.0	DIN3380220B	3.0
DIN3220150B	3.0	DIN3380300B	2.0
DIN3220220B	2.0	DIN3380400B	2.0

Current ratings

Continuous: Not less than the continuous current rating of the Drive

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

4.20 Parallel connection of DC buses

When two or more Drives are to be used in an application, it is possible to connect their DC buses in parallel. This allows the braking resistor on one Drive to be shared by a number of Drives.

For fuse ratings, see *Connecting an external supply to the DC bus* (below).

Although any two phases can be used when supplying single-phase models from two phases of a low-voltage three-phase supply, ensure the same two phases are used for each Drive in a paralleled system (see Figure 4–13).

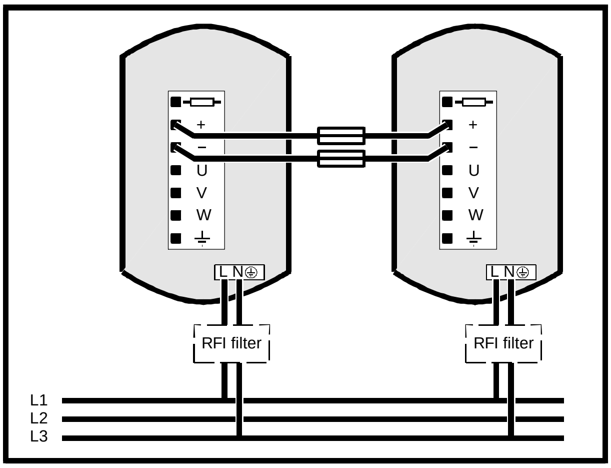


Figure 4–13 Using the same AC supply phase connections for single-phase models supplied by a low-voltage three-phase supply and having their DC buses connected in parallel

4.21 Connecting an external supply to the DC bus

The Drive can be powered by applying a DC voltage to the DC bus instead of using an AC supply. The applied voltage must be as shown in the following table.

Warning

Do not allow the maximum permissible voltage to be exceeded. Exceeding this voltage will cause the braking transistor in the Drive to be permanently conducting. A risk of fire would be caused if the Drive (or any other Drive on the DC supply) has a braking resistor connected.

Model	Minimum permissible voltage	Maximum permissible voltage	DC supply fuse (A)
DIN1220075B	250	370	10A, 500VDC
DIN1220150B	250	370	16A, 500VDC
DIN1220220B	250	370	20A, 500VDC
DIN3220075B	250	370	10A, 500VDC
DIN3220150B	250	370	16A, 500VDC
DIN3220220B	250	370	20A, 500VDC
DIN3380075B	440	740	5A, 1000VDC
DIN3380110B	440	740	5A, 1000VDC
DIN3380150B	440	740	6A, 1000VDC
DIN3380220B	440	740	10A, 1000VDC
DIN3380300B	440	740	12A, 1000VDC
DIN3380400B	440	740	16A, 1000VDC

4.22 Motor-cable driving capability

Model	Maximum permissible length	
	metres	feet
DIN1220075B	250	775
DIN1220150B	200	660
DIN1220220B	100	330
DIN3220075B	250	775
DIN3220150B	200	660
DIN3220220B	100	330
DIN3380075B	75	250
DIN3380110B	75	250
DIN3380150B	75	250
DIN3380220B	75	250
DIN3380300B	125	410
DIN3380400B	125	410

Cable lengths are based on a torque overload capability of 125%.

Cable lengths stated in the table are typical values. Using greater cable lengths may cause the Drive to trip on overcurrent (trip **OI**), or to reduce the output frequency.

4.23 Ground connections

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

Refer to *Wiring recommendations* later in this chapter.

Warning

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

4.24 Electromagnetic compatibility (EMC)

This section outlines the main considerations for ensuring that the installation meets the requirements for electromagnetic compatibility. Further information is given in *Wiring recommendations* (later in this chapter) and in the *Dinverter B EMC Data Sheet*, which is available from the Drive Centres and distributors listed at the end of this User Guide.

Emission

PWM inverter Drives produce significant levels of radio frequency energy from the PWM switching frequency up to about 30MHz. This frequency range is below the frequency bands used by television and personal communications systems, but can affect radio equipment working in the long, medium, and short wavebands. Also, if the emissions are carried along unscreened wiring or inadequate ground wiring, they can be coupled into other possibly sensitive electronic circuits and may cause disturbance. This disturbance can be prevented by a combination of appropriate shielding and filtering.

Figures 4–15 and 4–16 show the full precautions which must be taken where very low emission levels are required in order to comply with specific emission standards.

Figure 4–14 shows simplified precautions where no special EMC requirements apply. Most modern industrial electrical and electronic equipment has good immunity from disturbance. If this is the only equipment located near to the Drive, the simplified precautions should be sufficient.

Where sensitive equipment is located near to the Drive (particularly radio equipment) or where residential areas are within a distance of 30 metres (100 feet) from any part of the Drive and motor installation, it is recommended that the full EMC precautions be applied.

Some examples of industrial equipment which have been found to be particularly sensitive are:

- Proximity detectors using capacitance techniques
- Strain-gauge amplifiers
- Thermocouple amplifiers
- Equipment using a radio-based time clock
- Digital data communications systems, only where there are unscreened runs of data lines or the screens have been terminated incorrectly

Immunity

The immunity of the Drive meets severe industrial standards and is sufficient for most practical applications. Under exceptional circumstances, the Drive may be disturbed by emissions from external sources. The following possible sources of disturbance should be avoided by the fitting of suitable suppression:

- Relay and contactor-coil circuits where wiring runs close to the Drive control wiring
- Other inductive DC circuits – for example, solenoid-operated brakes
- Control wiring which runs outside buildings, even when the wiring is underground, because there may be a risk of high-voltage surges from lightning strikes.

In all cases the local laws on EMC and RFI must be complied with.

4.25 Wiring recommendations

Note

This section contains instructions which relate to the shielding of some signal connections. This shielding is needed for ensuring correct operation of the Drive. Where strict compliance with EN50081–2 or similar is required, the guidance given in *Electromagnetic compatibility* (earlier in this chapter) must also be followed.

Wiring recommendations are given for the following:

- Routine precautions where full compliance with EMC standards is not required
- Compliance with EMC emission standards

The recommendations are given in the following sections:

- Routine EMC precautions
- Compliance with EMC emission standards

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

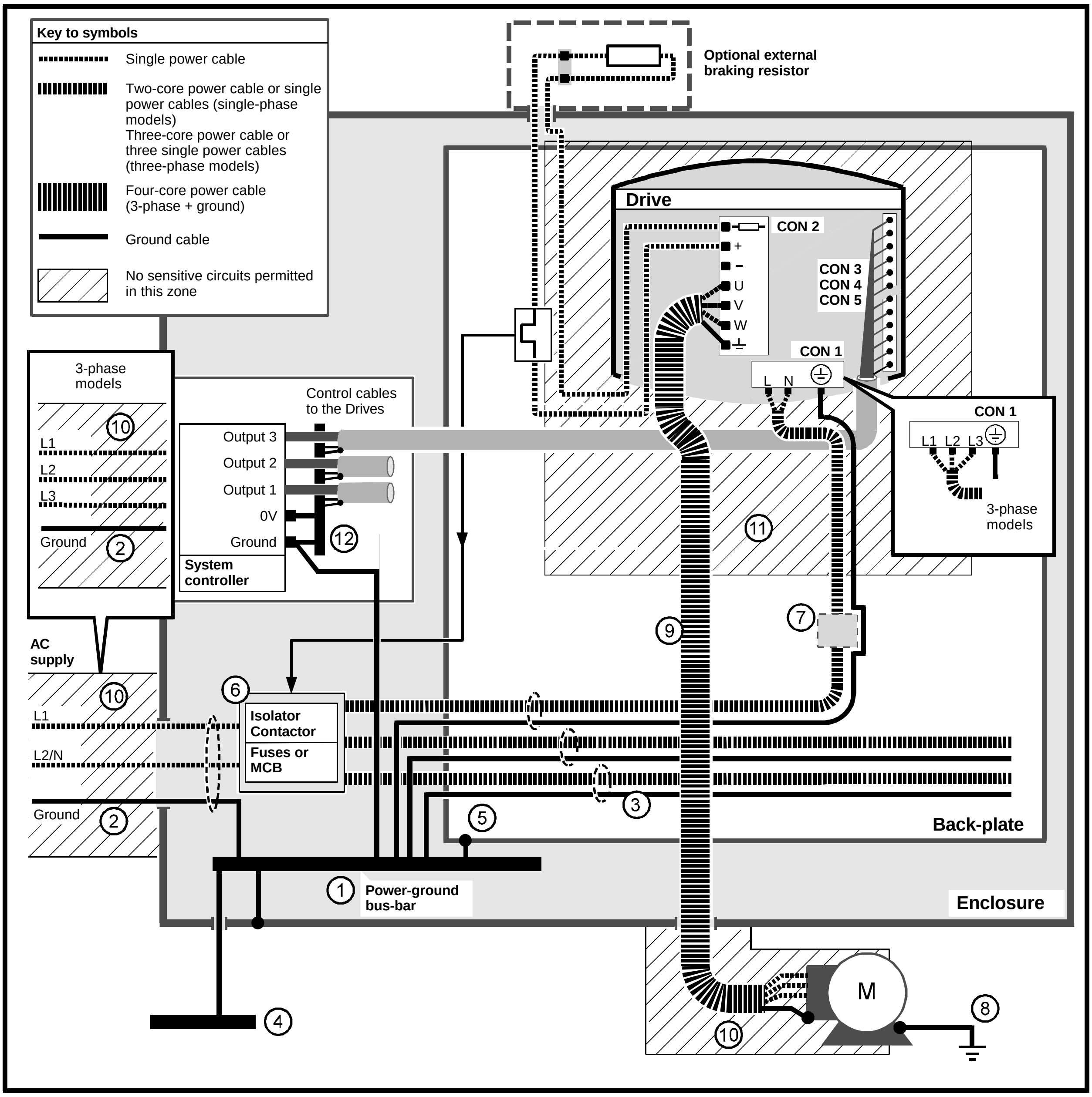


Figure 4–14 Wiring guidelines for routine EMC precautions

Routine EMC precautions for single- and three-phase models (Figure 4–14)

General features

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

Routine EMC precautions

9 Use four-core cable to connect the motor to the Drive as shown. The ground conductor in the motor cable must be connected only to the ground terminals of the Drive and motor; it must not be connected directly to the power-ground bus-bar.

10. If the wiring for sensitive signal circuits is to be parallel to an unshielded motor cable (or cables for an unfiltered power supply) for more than 1 metre (3 feet), ensure the separation is at least 0.3m (12 in).

    If the parallel run is to exceed 10 metres (30 feet), increase the separation proportionally. For example, if the parallel run is to be 40 metres, the spacing must be: $0.3 \times 40 \div 10 = 1.2$ metres.

    When a motor-thermistor is used, this constraint does not apply to the cable connecting the thermistor to the Drive. The motor-thermistor cable must be shielded (as shown in Figure 4-20).

11. Do not place sensitive signal circuits in a zone extending 0.3m (12 in) all around the Drive.

12. If the control circuit 0V is to be grounded, this should be done at the system controller (eg. PLC) and not at the Drive. This is to avoid injecting noise currents into the 0V circuit.

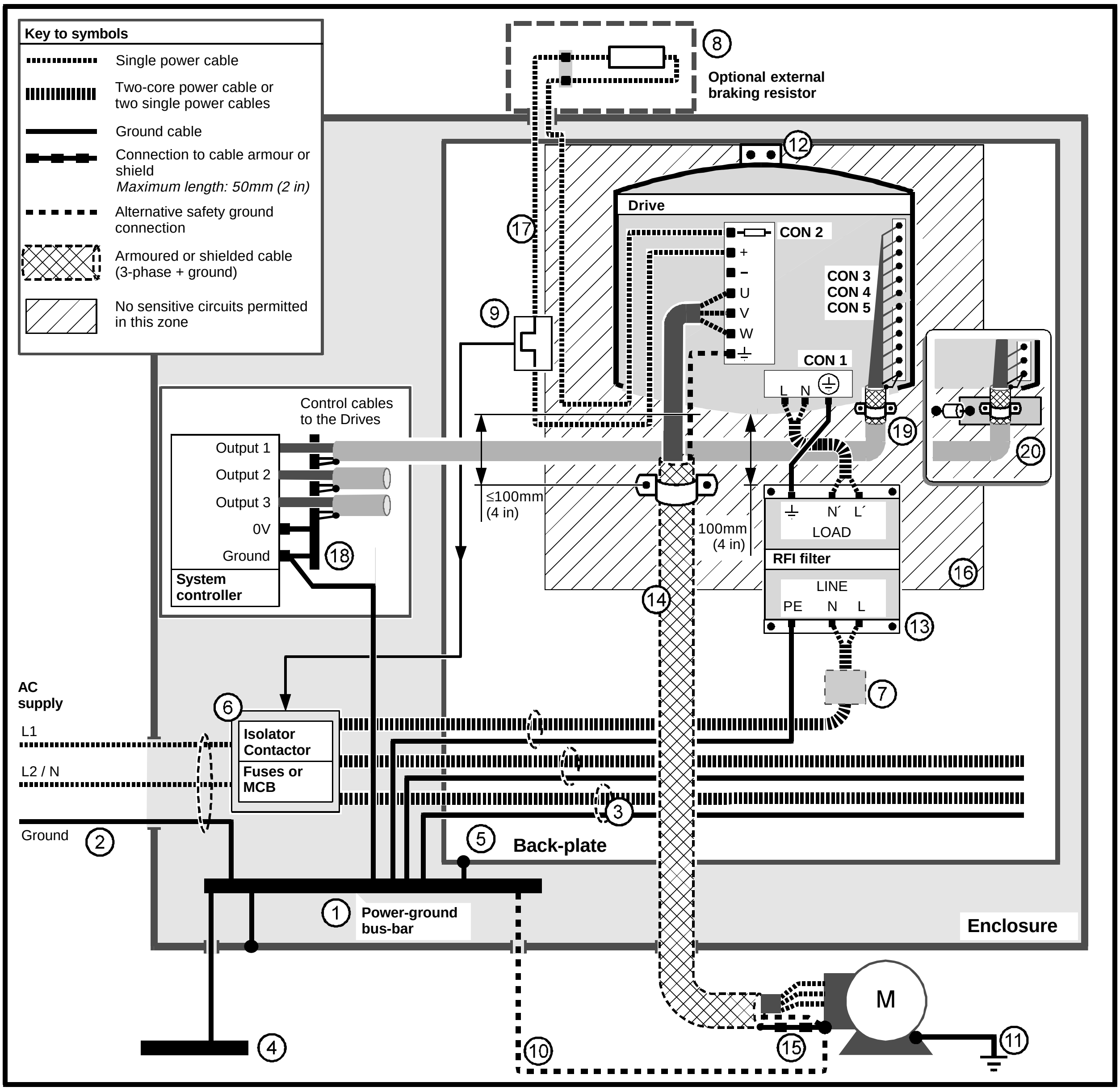


Figure 4–15 Single-phase models – Wiring guidelines for compliance with EMC emission standards

Compliance with EMC emission standards for the single-phase models (Figure 4–15)

Model numbers: DIN1220075B to 1220220B

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. Ensure that the grounding arrangement prevents high-frequency noise currents circulating in the back-plate.
6. System isolator, circuit contactors and fuses/MCB.
7. Alternative position for Drive fuses/MCB.
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 connected to the back-plate by the mounting bracket(s). Ensure that the screws make a good electrical connection between the mounting bracket(s) and the back-plate.
13. RFI filter mounted 100mm (4 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.
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.
16. Avoid sensitive signal circuits in a zone extending 0.3m (12 in) all around Drive.
17. 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.
18. At the controller, connect the shield of the control signal cable(s) to 0V.

The following two points may be omitted only if slightly increased radiated emission is acceptable.

19. At the Drive, connect the shield of the control signal cable(s) to 0V as well as directly to the back-plate.
20. Alternative connections to avoid low-frequency ground-loop currents (see step 19). Instead of connecting the shield of the control signal cable(s) directly to the back-plate, connect the shield to a metal bar that is insulated from the back-plate. Connect a 1nF capacitor between the metal bar and a stud on the back-plate. Ensure the capacitor leads are as short as possible.

Note

The shield must cover *all* the control wiring. The status-relay wiring must also be contained in this shield or in a separate shield.

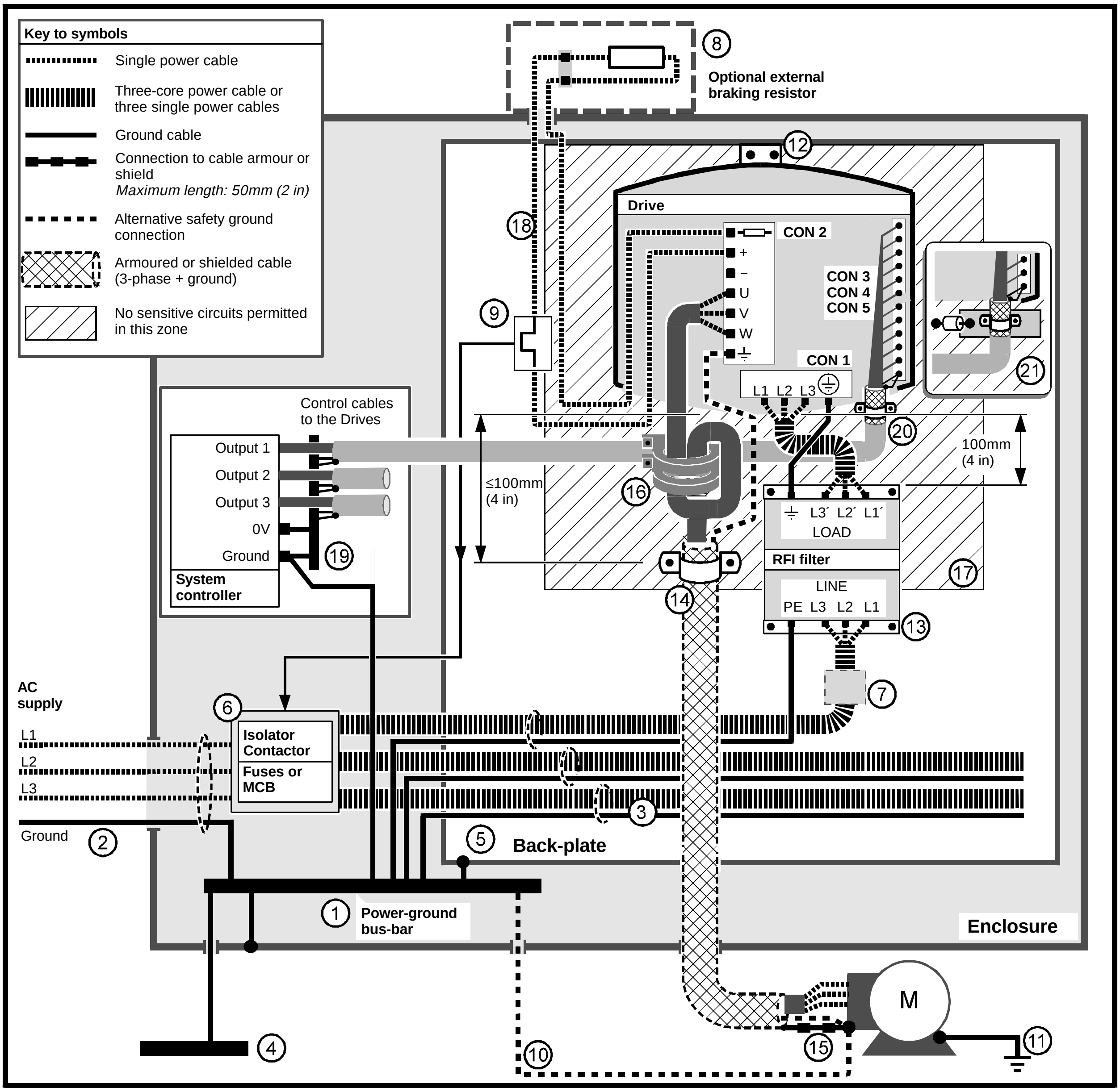


Figure 4–16 Three-phase models – Wiring guidelines for compliance with EMC emission standards

Compliance with EMC emission standards for the three-phase models (Figure 4–16)

Model numbers: DIN3220075B to 3220220B and DIN3380075B to 3380400B

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. Ensure that the grounding arrangement prevents high-frequency noise currents circulating in the back-plate.
6. System isolator, circuit contactors and fuses/MCB.
7. Alternative position for Drive fuses/MCB.
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 connected to the back-plate by the mounting bracket(s). Ensure that the screws make a good electrical connection between the mounting bracket(s) and the back-plate.
13. RFI filter mounted 100mm (4 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.
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.
16. Where ferrite rings are specified, pass 2 turns of the output phases (UVW) around the rings as shown. See *RFI filter and ferrite rings* earlier in this chapter.
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. At the controller, connect the shield of the control signal cable(s) to 0V.

The following two points may be omitted only if slightly increased radiated emission is acceptable.

20. At the Drive, connect the shield of the control signal cable(s) to 0V as well as directly to the back-plate.
21. Alternative connections to avoid low-frequency ground-loop currents (see step 20). Instead of connecting the shield of the control signal cable(s) directly to the back-plate, connect the shield to a metal bar that is insulated from the back-plate. Connect a 1nF capacitor between the metal bar and a stud on the back-plate. Ensure the capacitor leads are as short as possible.

Note

The shield must cover *all* the control wiring. The status-relay wiring must also be contained in this shield or in a separate shield.

Variations

Interruptions to the motor cable

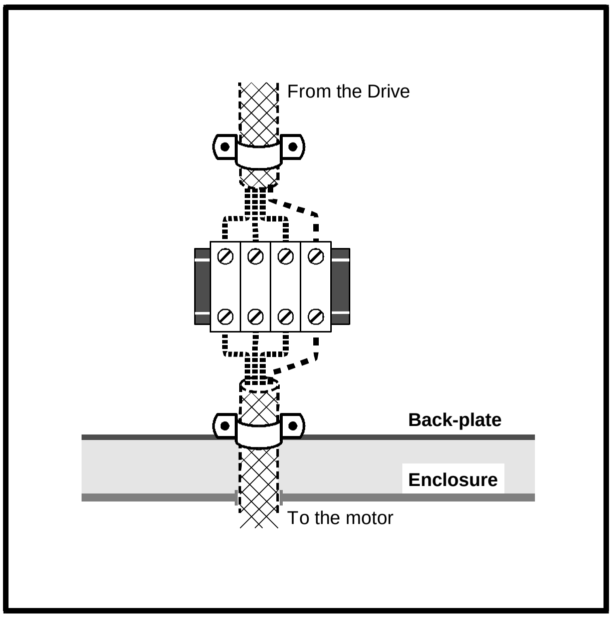
The motor cable should ideally be a single piece of shielded or armoured cable having no interruptions. In some situations it may be necessary to interrupt the cable, as in the following examples:

- 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 4–15)

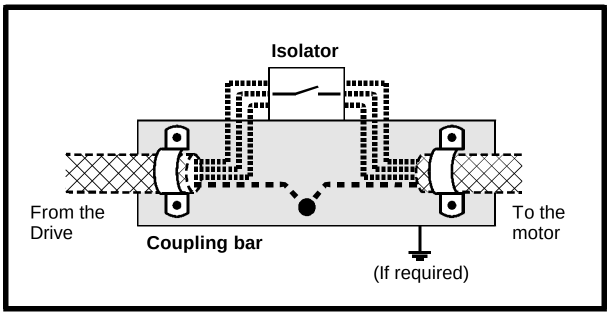
Figure 4–17 Connecting the motor cable to a terminal block in the enclosure

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 4–15)

Figure 4–18 Connecting the motor cable to an isolator switch

4.26 External braking resistor

Connecting the resistor

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; see below.

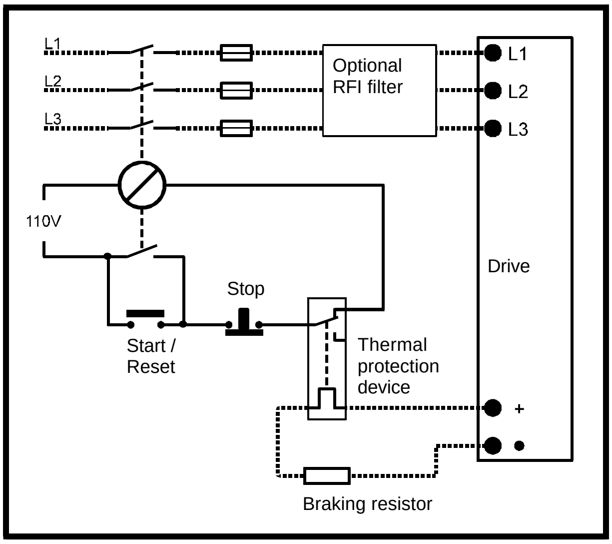


Figure 4–19 External braking resistor connections

Connect an external braking resistor in series with a thermal protection device. The thermal protection device is used to avoid the resistor causing a fire hazard if the braking transistor in the Drive becomes permanently switched on or short-circuit. The thermal protection device must disconnect the AC supply from the Drive.

Resistor value

Calculate the maximum peak power (**P_{max}**) to be dissipated in the braking resistor from:

$$P_{max} = \left(\frac{ULF}{t_{min}}\right) J \left(\frac{4\pi}{p}\right)^2 \times f_{max}$$

Where:

- **J** Load inertia in kg.m^2
- **f_{max}** Maximum operating frequency of the Drive in Hz
- **p** Number of motor poles (2, 4, 6, 8 etc)
- **t_{min}** The lowest value for parameter **p3** that will be used in the application
- **ULF** Upper Limit Frequency set in parameter **b14**

Note

P_{max} must be less than 1.5 times the Drive rating to ensure that the Drive can tolerate the braking duty.

Use the following equation to calculate the maximum suitable value for the braking resistor:

$$R \le \frac{V_R^2}{P_{max}}$$

Where:

- **V_R** Voltage across the braking resistor (Low-voltage models: 377V) (High-voltage models: Value set in parameter **p64**)
- **P_{max}** Maximum peak power to be dissipated

Minimum values

Model	Minimum value of external braking resistor
Low-voltage (200V to 240V)	33Ω
High-voltage (380V to 480V)	82Ω

Average power dissipation

Calculate the maximum energy to be dissipated in the braking resistor from:

$$E_{Loss} = (0.5)\ J \left(\frac{4\pi}{p}\right)^2 \times \left[f1^2 - f2^2\right]$$

Where:

- **E_{loss}** Energy to be removed
- **J** Inertia in kgm^2
- **f1** Highest operating frequency
- **f2** Minimum frequency after deceleration

For repetitive deceleration, the average power dissipation is as follows:

$$P_{avloss} = \frac{E_{loss}}{t1 + t2}$$

Where:

- **t1** Length of a braking period
- **t2** Interval between braking periods

Peak power rating

Check that the resistor has a peak power dissipation rating as follows:

$$P_{PK} > 1.15 \left(\frac{V_R^{\ 2}}{R}\right)$$

4.27 Signal connections

Warning

Isolation

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

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

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

Control signal wire size

Recommended size:

$0.5mm^2$ (20AWG) with overall shield where required

Shielding

Analog signal wiring must be shielded unless it is totally contained in the enclosure. Refer to Figures 4–14 to 4–16 as appropriate for connecting each end of the shield.

Logic sense

The Drive is supplied operating in negative logic. The logic signal connections described in this section apply to negative logic.

The setting may be changed to positive logic using parameter **b5** *Logic selector*. Refer to **b5** in Chapter 10 *List of Parameters*.

Warning

Connecting a Drive configured in negative logic to a positive-logic PLC could cause the Drive to start the motor automatically when power is connected to the Drive.

CON 3

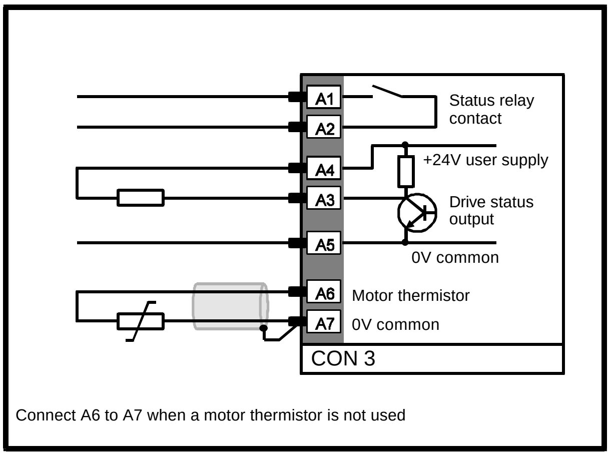


Figure 4–20 Signal connections to CON 3

A1 A2	**Status relay contact**

Contact rating: 240VAC, 4A resistive

Update time: 65ms

Warning

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

When the Status relay contact is used to switch a device operating on the AC supply, it is recommended that the contact is connected as shown in Figure 4–21.

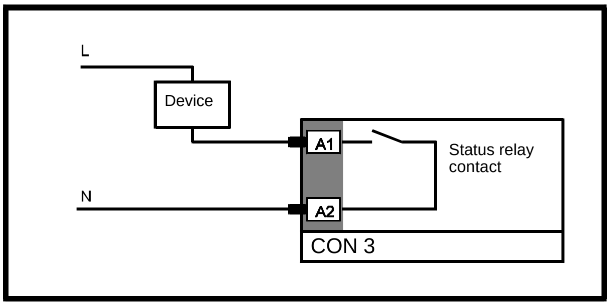


Figure 4–21 Arrangement for connecting a device operating on the AC supply

The function of the Status relay is controlled by parameter **b50** *Status relay selector*.

b50 set at 0

When the Drive is in **normal** operation, the status relay contact connects terminal A1 to terminal A2 (relay energized).

When the Drive is tripped, or when AC power is removed from the Drive, the status relay contact is open.

b50 set at 1

When the Drive is **at speed**, the status relay contacts connect terminal A1 to terminal A2 (relay energized).

When any of the following conditions occurs, the status relay contact is open:

The Drive is not at speed
The Drive is tripped
AC power is removed from the Drive

A3	DRIVE STATUS output

Open-collector output
Internal pull-up resistor to +24V: 6kΩ
Output voltage range: 0V to +24V
Maximum sink current: 100mA
Maximum source current: 4mA
Update time: 65ms

The output may be used to energize an external relay connected between terminals A3 and A4 (+24V).

The function of this output is controlled by the settings of parameters **b53** *Status output selector* and **b5** *Logic selector*.

Negative logic (b5 set at 1)

b53 set at 0

When the Drive is running, the transistor is on. When the Drive is not running, the transistor is off.

b53 set at 1

When the Drive is above **Minimum speed**, the transistor is on. When the Drive is at or below **Minimum speed**, the transistor is off.

Positive logic (b5 set at 0)

b53 set at 0

When the Drive is running, the transistor is off. When the Drive is not running, the transistor is on.

b53 set at 1

When the Drive is above **Minimum speed**, the transistor is off. When the Drive is at or below **Minimum speed**, the transistor is on.

A4	+24V user supply

Voltage tolerance: ±10%
Maximum output current: 100mA
Short-circuit protected

Supply for external devices.

A5	0V common

A6	Motor thermistor

Voltage applied to thermistor: 2.5V
Trip resistance: 3kΩ
Reset resistance: 1.8kΩ

A positive temperature co-efficient thermistor may be used to protect the motor. Connect the thermistor between terminals A6 and A7 (0V common). A motor thermal-switch may instead be used.

When a motor thermistor is not used, connect terminal A6 to terminal A7 (0V).

Note

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

A7	0V common

CON 4

Warning

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

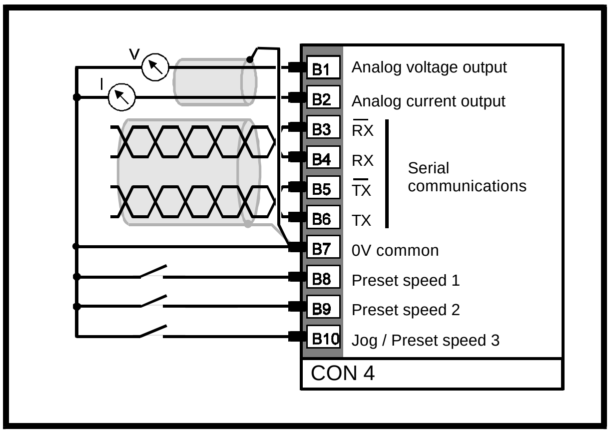


Figure 4–22 Signal connections to CON 4

B1 — Analog voltage output

Output voltage range: 0 to ±10V
Maximum output current: 5mA
Accuracy: ±5% of full-scale
Update time: 65ms

The function of this output is controlled by the settings of the following parameters:

b24 and **b25** *Analog output selector*

Frequency signal
b24 = 0   b25 = 0

An analog voltage signal proportional to the **output frequency** of the Drive is produced on terminal B1. The signal is as follows:

0V when the frequency is 0Hz
+10V when the frequency is at the value of +**p1**
−10V when the frequency is at the value of −**p1**

Load signal
b24 = 0   b25 = 1

An analog voltage signal proportional to the **load** on the motor is produced on terminal B1. The signal is as follows:

0V at 0% full load current (FLC)
+10V at 150% FLC motoring
−10V at 150% FLC regenerating

Load detection
b24 = 1   b25 = 0 or 1

A signal of +10V is produced on terminal B1 when the **maximum continuous current** set in parameter **p5** is reached. When the current is below this level, the output signal is 0V.

B2 — Analog current output

Output current range: 4mA to 20mA
Accuracy: ±5% of full-scale
Update time: 65ms

The function of this output is controlled by the settings of the following parameters:

b24 and **b25** *Analog output selector*

Load signal
b24 = 0 or 1   b25 = 0

An analog current signal proportional to the **load** on the motor is produced on terminal B2. The signal is as follows:

4mA at 0% FLC
20mA at 150% FLC motoring or regenerating

(FLC = Full-load current)

Frequency signal
b24 = 0 or 1   b25 = 1

An analog current signal proportional to the **output frequency** of the Drive is produced on terminal B2. The signal is as follows:

4mA at 0Hz
20mA when the frequency is at the value of ±**p1** *Maximum frequency*

B3 — $\overline{RX}$ input
B4 — RX input

Serial communications differential inputs.

Signal level: 0V to +5V
Differential input impedance: 3.7kΩ
Logic high: (RX to $\overline{RX}$) > 0.2V
Logic low: (RX to $\overline{RX}$) < −0.2V

B5 — $\overline{TX}$ output
B6 — TX output

Serial communications tri-state differential outputs.

Signal level: 0V to +5V
Maximum current: ±60mA
Logic low: $\overline{TX}$ = +5V, TX = 0V
Logic high: $\overline{TX}$ = 0V, TX = +5V

When not transmitting, the Transmit outputs are disabled (tri-state).

Internal pull-up resistor on $\overline{TX}$ output:

10kΩ connected to +5V

Internal pull-down resistor on TX output:

10kΩ connected to 0V

B7 — 0V common

B8 — Preset speed 1
B9 — Preset speed 2
B10 — Jog / Preset speed 3

Default logic sense: Negative
Logic high (input open-circuit): >15V
Logic low (input connected to 0V): <5V
Input impedance: 2.9kΩ
Sample period: 8 to 16ms

The input signal must be maintained for at least 16ms to ensure accurate sampling.

The functions of these inputs are controlled by **b20** *Preset speed selector*, as follows:

b20 set at 0

Three preset speeds and one Jog speed are available. Terminals B8 and B9 may be configured to give the following four settings (terminal B10 is configured for Jog).

B10	B9	B8	Output	Display
0	0	0	Normal speed control	run
0	0	1	Preset speed 1	run
0	1	0	Preset speed 2	run
0	1	1	Preset speed 3	run
1	0	0	Jog	rdY

The Drive must be enabled, and the display must show **rdY** to allow Jog to be activated.

b20 set at 1

Seven preset speeds are available. Terminals B8, B9 and B10 may be configured to give the following seven settings:

B10	B9	B8	Output
0	0	0	Normal speed control
0	0	1	Preset speed 1
0	1	0	Preset speed 2
0	1	1	Preset speed 3
1	0	0	Preset speed 4
1	0	1	Preset speed 5
1	1	0	Preset speed 6
1	1	1	Preset speed 7

CON 5

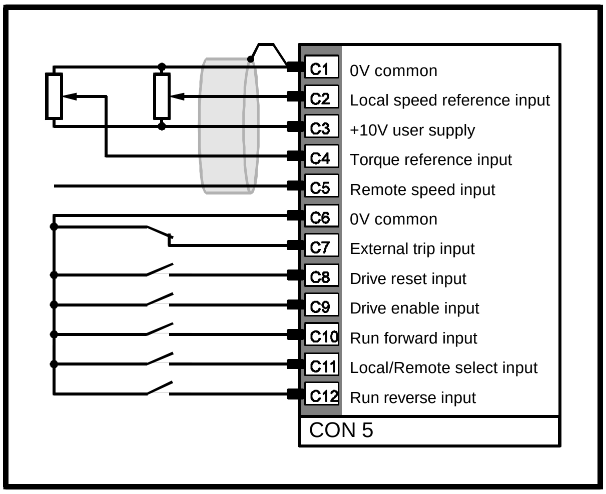


Figure 4–23 Signal connections to CON 5

C1	0V common

C2	LOCAL SPEED REFERENCE input

Voltage range: −10V to +10V
Input impedance: 94kΩ
Sample time: 8 to 16ms

The function of this input is controlled by the setting of **b4** *Bipolar select*.

b4 set at 1

Uni-polar speed reference is selected. The local speed reference can be obtained from a 10kΩ potentiometer connected between terminal C1 (0V common) and terminal C3 (+10V user supply).

When the speed reference signal is 0V, the motor speed is the value held in parameter **p0** *Minimum frequency*.

When the speed reference signal is +10V, the motor speed is the value held in parameter **p1** *Maximum frequency*.

b4 set at 0

Bi-polar speed reference is selected. A positive input signal produces forward rotation of the motor; a negative signal produces reverse rotation.

When the speed reference signal is +10V or −10V, the motor speed is the value held in parameter **p1** *Maximum frequency*.

C3	+10V user supply

Voltage: 10.18V ±2%
Maximum output current: 5mA
Short-circuit protected

C4	TORQUE REFERENCE input

Voltage range: 0V to +10V
Input impedance: 27.6kΩ
Sample time: 8 to 16ms

The torque reference can be obtained from a 10kΩ potentiometer connected between terminal C1 (0V common) and terminal C3 (+10V user supply).

When the torque reference signal is 0V, the torque is 10% of full load current (FLC).

When the torque reference signal is +10V, the torque is the value held in parameter **p4** *Timed current limit*.

Terminal C4 is active irrespective of the setting of parameter **b0** *Speed or torque reference selector*.

C5	**REMOTE SPEED REFERENCE input**

Current input

Input impedance = 100Ω

Sample time: 8 to 16ms

Current ranges:

- 4mA to 20mA
- 0 to 20mA
- 20mA to 4mA

Current range is selected using parameter **b11** *Remote speed reference input selector* as follows:

b11 setting	Speed reference Input current mA	Speed defined in...
4.20	4	p0
	20	p1
20.4	20	p0
	4	p1
0.20	0	p0
	20	p1

C6	**0V common**

C7	**EXTERNAL TRIP input**

The external trip input can be used to trip the Drive from an external source.

The default logic sense is negative. When terminal C7 is connected to 0V, the Drive runs (provided no other trips have occured). When terminal C7 is open-circuit, the Drive trips. The trip code **Et** will be displayed.

When this function is not required, connect terminal C7 to terminal C6 (0V common).

C8	**DRIVE RESET input**

The default logic sense is negative. Momentarily connect terminal C8 to 0V common to reset the Drive after a trip.

C9	**DRIVE ENABLE input**

The default logic sense is negative. Connect terminal C9 to 0V common to enable the Drive.

When the Drive is running and C9 is disconnected from 0V to disable the Drive, the Drive decelerates using the braking mode selected using parameters **b2**, **b7** and **b27** *Stopping mode selectors.*

C10	**RUN FORWARD input**

The default logic sense is negative. Connect terminal C10 to 0V common to select forward direction.

When the Drive is running and C10 is disconnected from 0V while C9 remains connected to 0V, the Drive decelerates to a halt using the Standard ramp for deceleration (see parameters **b2**, **b7** and **b27**).

C11	**LOCAL/REMOTE SELECT input**

The default logic sense is negative. When terminal C11 is connected to 0V, a remote analog current signal may be applied to terminal C5 to control the speed of the Drive (See terminal C5 and parameter **b11** *Remote reference input selector*).

When terminal C11 is open-circuit, a local analog voltage signal may be applied to terminal C2 to control the speed of the Drive (See terminal C2 and parameter **b4** *Bipolar select*).
(See parameter **b28** *PI control selector* in Chapter 10 *List of parameters.*)

C12	**RUN REVERSE input**

The default logic sense is negative. Connect terminal C12 to 0V common to run the motor in the reverse direction.

When the Drive is running and C12 is disconnected from 0V while C9 remains connected to 0V, the Drive decelerates to a halt using the Standard ramp for deceleration (see parameters **b2**, **b7** and **b27**).

Drive enable and direction control

Enable	Run forward	Run reverse	Action
Terminal C9	Terminal C10	Terminal C12	
O/C	O/C	O/C	Drive stopped
0V	O/C	O/C	Drive stopped
0V	O/C	0V	Run reverse
0V	0V	O/C	Run forward
0V	0V	0V	Drive stopped

4.28 Connecting digital inputs in parallel

Make the following connections when the digital inputs of a number of Dinverter 2B Drives are to be controlled from the same source:

Connect the relevant digital input (eg. terminal C10) on all the Drives in parallel.

Use an external +24V supply, or use the +24V user supply on terminal A4. When using terminal A4 for more than three Drives, connect in parallel terminal A4 from a number of Drives. See Figure 4–25. Make each connection through a 300mA diode. For each additional three Drives, connect another terminal A4 through a diode.

Ensure that the controlling signal produces definite logic states; a logic state must not be assumed by leaving an input disconnected (eg. use a change-over relay, not a single contact).

Provided these conditions are met, any number of Drives can be controlled in parallel using positive or negative logic.

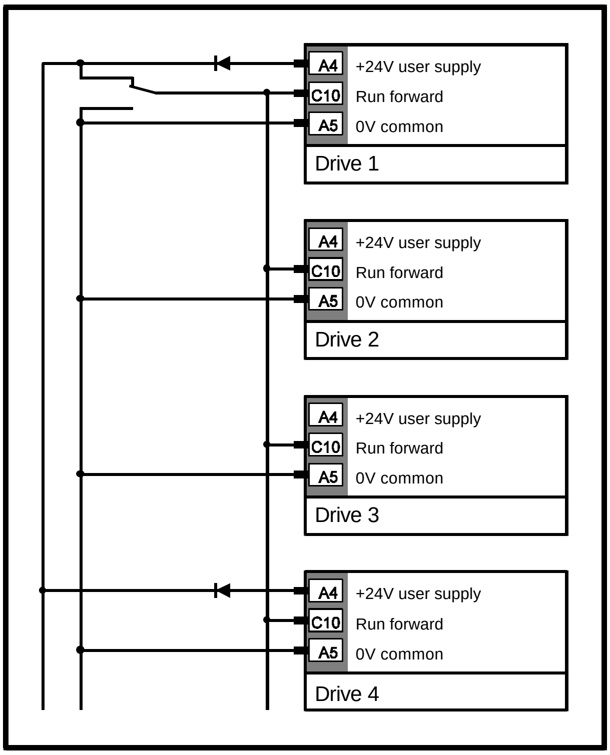


Figure 4–24 Example parallel signal connections using the 24V user supply of the Drive

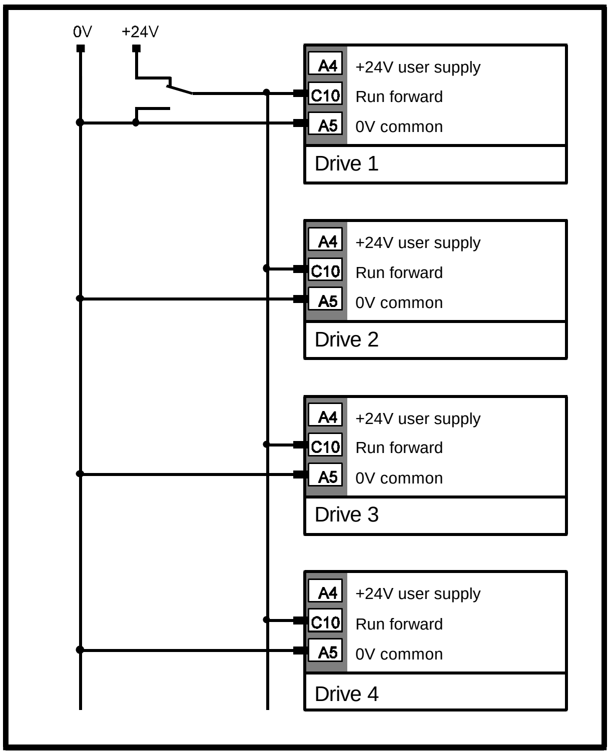


Figure 4–25 Example parallel signal connections using an external 24V supply