INSTALLATION

Installation Options

CD Series drives must be installed by competent personnel familiar with the the installation, commissioning and operation of motion control equipment. In the final application the equipment must be enclosed to prevent the operator coming into contact with any high voltages. This includes the transformer, drive and motor terminations, but excludes the front panel.

The CD Series of drives are not EMC compliant, they are sold as a complex component for use by professional assemblers of motion control systems. Where a system is not required to conform with the European EMC directive the installation procedure described in this section may be followed. Systems which are to conform to the European EMC directive should be assembled using these procedures and additionally the EMC specific installation recommendations, described at the end of this Section. Digiplan cannot guarantee EMC compliance.

Metal equipment cabinets offer the most advantages for siting the equipment since they can provide operator protection, EMC screening and can be readily fitted with interlocks arranged to remove all power when the cabinet door is opened. This form of installation also allows the fitting of metal trays beneath the equipment to act as a flame barrier, which should be provided in the final installation, in accordance with LVD requirements.

Drive Link Settings

You can adjust the performance of a particular drive by altering the setting of links mounted upon the PSU and Translator card. The layout of the links, as fitted in the factory, is shown in Figure 5.

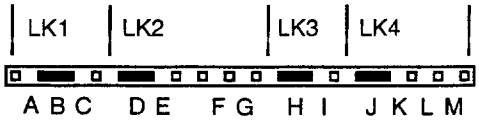


Figure 5. CD60M/CD80M Link Layout

CAUTION - risk of electric shock
Do not remove drive modules while power is applied to them.
Remove power and wait for capacitors to discharge.

The 4 links allow the adjustment of standby current reduction, resolution, the selection of a permanent or selectable energise function and motor current. The range of options available is shown in Table 10.

Link No.	Option	Link Position	Value	
LK1	Standby current reduction	A	80% of full load	
		B*	50% of full load	
		C	Permanent (50%) standby	
LK2	Resolution	D*	4,000 steps/rev	
		E	2,000 steps/rev	
		F	1,000 steps/rev	
		G	400 steps/rev	
LK3	Energise	H*	Permanently energised	
		I	Energise externally controllable	
			CD60M	CD80M
LK4	Motor current	J*	6A	7.8A
		K	5.5A	7A
		L	4.4A	5.6A
		M	3.8A	4.9A

* Factory settings

Note: LK2 can occupy positions D, E, F or G - there is an unused position between E and F.

Table 10. Link Setting Options

.Standby Current Reduction

The standby current reduction links allow you to reduce the motor current by a percentage of the programmed current when the motor is stationary. Permanent standby reduces the motor current by 50% of its programmed value and may be used in combination with motor current link settings to achieve half the value of the load currents given in Table 10, although no standby current reduction is possible when used in this manner.

Resolution

The CD60M and CD80M drives offer ministepping as standard, enabling a maximum resolution of 4,000 steps/rev. Ministepping operation results in both higher resolution positioning and smooth low speed rotation.

Energise

The energise edge connector signal allows a drive to be remotely selected, depending upon the logic state of the controlling signal. When the drive is used with a motherboard, the indexer connection 'shutdown' is optically coupled to the energise edge connector input.

When a drive is shutdown or de-energised the motor may be turned slowly by hand to allow the re-positioning of mechanical components.

If you wish to use the indexer control signal 'shutdown' to de-energise the drive, link setting 'I' must be made.

Motor Current

Motor current may be link adjusted to the values given in Table 10 depending upon your application requirements. The motor currents quoted in Table 10 are RMS values and the chosen setting must not exceed the current rating of the motor. Peak currents are approximately 40% higher than the RMS values - the peak current from the CD80M is therefore 11A.

Drive Mounting

Each drive consists of 2 printed circuit boards separated by spacers. The Translator card is 111.7mm high and the power card is 100mm high. The different card sizes allow either 4.4 inches (111.7mm) EuroModule or 100mm EuroCard guides to be used.

Drives need to be mounted vertically within a card frame rack to ensure the maximum flow of cooling air over the surface of the integral heatsink. In high duty cycle applications, fan cooling may be required during prolonged operation at speeds below 15 rps and at full current. Connections to a drive can be made via a Digiplan opto-isolated motherboard, the circuit of which is provided in Appendix A.

CD60M and CD80M drives can be used with 10HP opto motherboards or 14HP opto motherboards.

10HP Motherboard

The 10HP opto-isolated motherboard provides a convenient way of making system connections to a drive. Motor, supply and signal connections are brought from the drive's edge connector to separate system connection points on the rear of the 10HP motherboard, as shown in Figure 6.

Drive parameters are set using the links on the drive's Translator card, no adjustments are provided on the 10HP motherboard.

Layout of 10HP motherboard

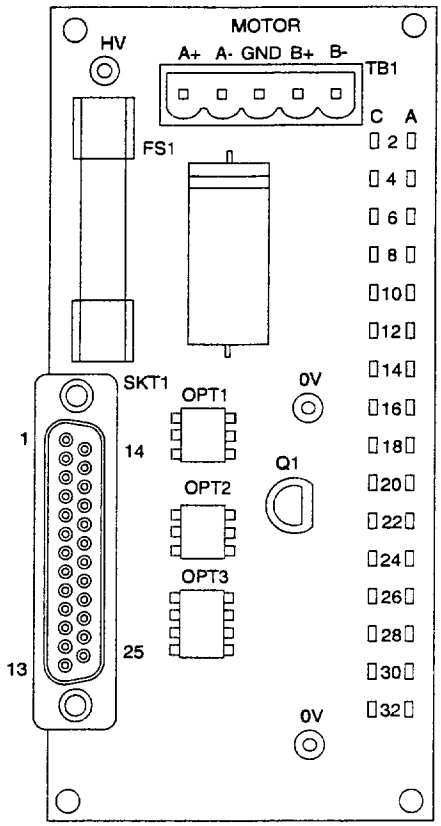


Figure 6. 10HP Motherboard

Indexer Connections

Indexer connections are made via the 25-way D-type connector (SKT1), shown in Figure 6. Pin connections are detailed in Table 8.

10HP Interface Circuits

Indexer connections are made via opto-couplers. The STEP and DIRECTION inputs use identical input circuits detailed in Figure 7.

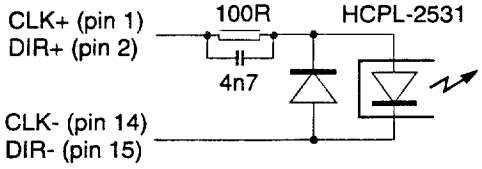


Figure 7. STEP and DIRECTION Input Circuit

The SHUTDOWN input circuit is shown in Figure 8. The +12V supply is generated within the drive and is made available at the drive's edge connector (pins 10A & 10C) via a 1KΩ resistor.

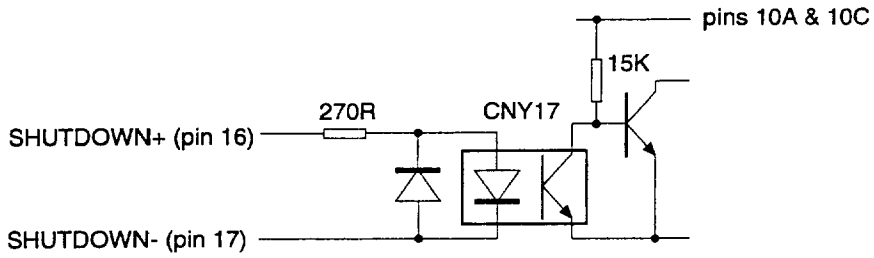


Figure 8. SHUTDOWN Input Circuit

The FAULT output circuit is shown in Figure 9.

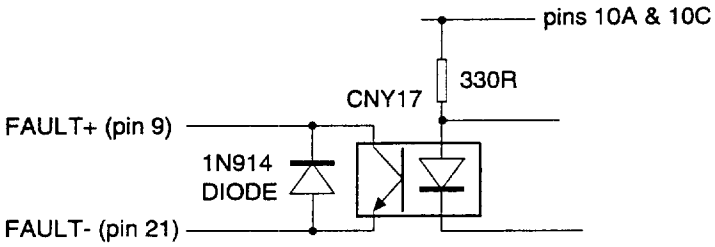


Figure 9. FAULT Output Circuit

Power Connections

The CD60M/CD80M drives only require a single DC motor supply taken to 10HP motherboard power bus connection points HV (+48 to 140V DC) and 0V. Note the drive 0V connection must be earthed.

The insulation ratings for power connections (DC input and motor output) should be at least 600V where the insulation is between power and signal wiring. A higher insulation rating is needed to insulate this wiring from the mains.

Motor Connections

Motor connections are made via connector TB1 - see Figure 6. If you are unsure which motor wires correspond to Phase A and Phase B refer to Tables 6 and 7.

The motor body should be reliably earthed (less than 0.1Ω resistance).

To reverse motor rotation relative to the direction input, interchange connections to A+ and A-.

Motor Insulation Motor insulation must be capable of withstanding voltages of at least 500V.

Motor Cable The recommended gauge for CD drives is 1.5mm^2. Use a cable containing five conductors plus the braided screen, the fifth (green) wire being used to provide a safety earth return to the drive. Note that this wire should be directly connected to earth, do not use the 'Gnd' pin of the motherboard motor connector. The temperature rating of the cable must be greater than or equal to the motor case temperature and should be at least 80°C.

Motor Earth The motor body must be reliably earthed. Also see **Motor Connections** in the **EMC Installation** sub-section.

WARNING: The case of a motor can become very hot. precautions may need to be taken to prevent operator contact.

Motor Selection

Usually optimum performance will be obtained when the current rating of the motor is between 1 and 1.5 times the drive rating (refer to specification). Do not use a drive setting which gives an output current greater than the motor rating.

With 4 lead motors the bipolar rating is quoted.

With 6 lead motors the unipolar rating is quoted, but for best performance with the CD Series the centre tap of each winding should be left unconnected and the connections made between the winding ends. This will give a bipolar rating 70% of the quoted motor unipolar rating.

With 8 lead motors the bipolar rating of the motor, which is normally quoted, refers to a parallel winding connection. With the windings connected in series the current rating of the motor connection will be 50% that of the bipolar rating, and the motor will give improved low-speed torque, but reduced high-speed torque.

Long Motor Leads Using a motor with long leads will cause the cabling resistance to become significant when compared to the resistance of the motor.

The DC volt drop of the cable and motor connection, when measured at the drive, should not exceed 5 volts in order to limit power dissipation in the drive and maintain maximum system performance. However, the motor case earth connection must be kept less than 0.1Ω.

Using the CD60M/ CD80M with Compumotor 6000 Series Controllers

The CD60M/CD80M directly connects to 6000 series stepper controllers using the Indexer-Drive cable supplied with the 6000 product. When setting up the controller, the following commands should be used to match drive and indexer:

PULSE: Must be set to 1µs or greater
DRES: Set indexer to the same resolution as the drive(s). Settings are 400, 1000, 2000 or 4000 steps per rev.
DRFLVL: Set to active high (default for 6000 series is active low).

Example of 2 axis of CD60M/CD80M connected to 6200 controller:

Command	Description
PULSE1,1	Sets the 6200 to 1µs pulse width
DRES4000,4000	Set indexer to same resolution as drives (4000 steps/rev).
DRFLVL11	Fault signals are active high
INFEN1	Enable input functions

Note that if a drive fault occurs and is cleared, a 6000 controller can automatically reset the drive latch by toggling the shutdown input signal as follows:

Command	Description
DRIVE00	Shutdown both axis (motors de-energised)
DRIVE11	Enable both drives

Environmental Considerations

The CD60M/CD80M drive system should be operated in temperatures from 0 to 50C° (32 to 122°F) and at a relative humidity between 0 and 95% (non-condensing). Make sure the system is stored in temperatures from -40°C to 85°C (-40°F to 185°F).

Refer to the manufacturer's environmental specifications for the maximum motor case temperature when it is in operation. This may be a hazard to system operators.

The mains input to the Digiplan isolating transformer is Installation Category III maximum.

The CD Series of drives can be used in a Pollution Degree 2 environment i.e., one in which only non-conductive pollution occurs.

Enclosure Considerations

You should install the CD60M/CD80M drive system in an enclosure to protect it against atmospheric contaminants such as oil, moisture, and dirt and also to prevent operator access. Ideally, you should install the system in a rack cabinet. The National Electrical Manu-facturers Association (NEMA) has established standards that define the degree of protection that electrical enclosures provide. The en-closure should conform to NEMA Type 12 standards if the intended environment is industrial and contains airborne contaminants. Proper layout of components is required to ensure sufficient cooling of equipment within the enclosure. Operators must be denied access to the circuit boards. Service/Installation personnel must keep clear of the PCBs when power is applied because of a potential electrical safety hazard.

Wiring Guidelines

Proper grounding of electrical equipment is essential to ensure the safety of personnel. You can reduce the effects of electrical noise due to electromagnetic interference (EMI) by grounding.

In general, all components and enclosures must be connected to earth ground to provide a low impedance path for ground fault or noise-induced currents. All earth ground connections must be continuous and permanent. We recommend using a central earth stud mounted on the rack end-plate or close to it. AC ground (mains earth) the transformer shield, the rack 0V bus, and the enclosure metalwork should all be connected to this stud. In particular, you should connect the rack 0V bus with a 18AWG (1mm^2) cable kept as short as possible.

Power Supply Options

CD60M/CD80M drives can be used over a wide input voltage operating range (48 - 140V) allowing you a number of power supply options, depending upon the target application. Where a motor voltage of up to 85V DC is sufficient, Digiplan's PM1200CN power supply may be used with either transformers TO92 or TO73. For fast positioning, high-speed applications you will need to use the PM2000CN power supply with transformer TO182.

Power Supply Connections

Both the PM1200CN and PM2000CN power supplies use similar motherboard connections, shown in Figure 10. A PM2000CN power supply can be powered from a 3-phase supply wired to terminals 4, 5 & 6. Note: generally supplies are configured for single phase operation with a fuse fitted in each input AC line (32A TL HB), the third input line fuse (used for 3-phase supplies) is not normally fitted.

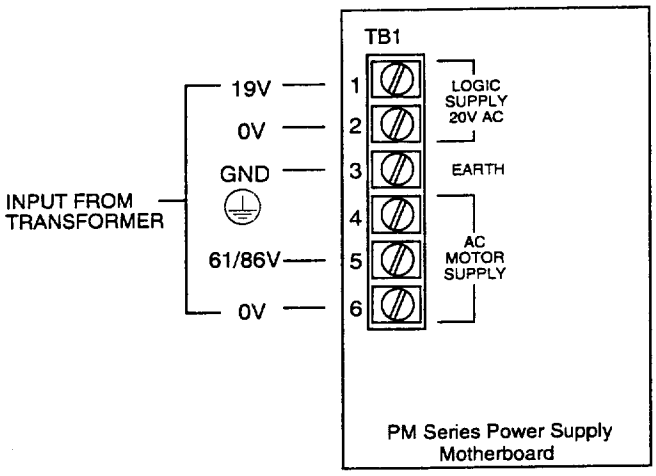


Figure 10. PM Series Power Supply Inputs

Transformer Wiring

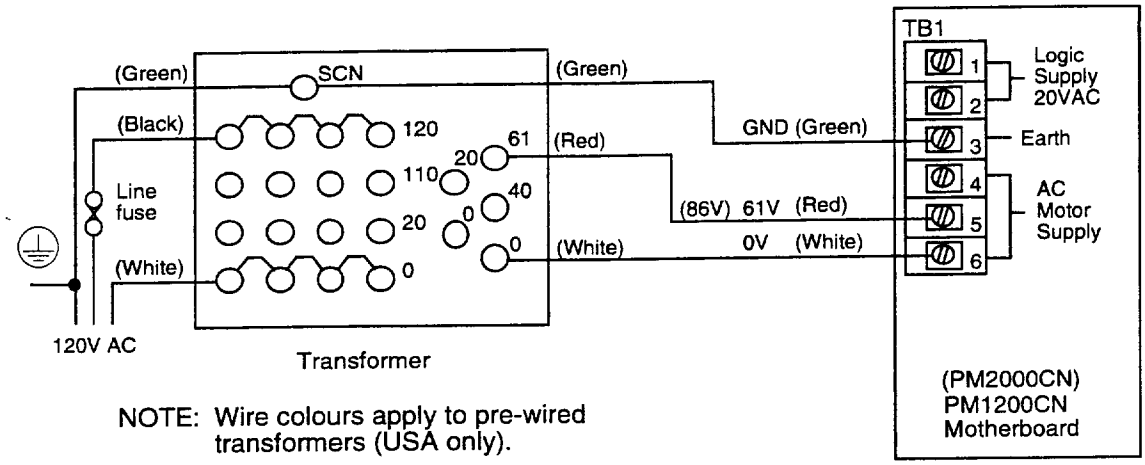
Depending on your application, the CD60M/CD80M drive systems can be supplied with transformer model TO73 (1200VA), TO92 (600VA) or the TO182 (1000VA). Each of these transformers for the CD60M/CD80M drives has a four-winding primary arrangement. Use Table 11 to select the appropriate wiring.

Use approved mains cable (at least 0.75mm^2) for primary wiring and take care to route it away from the secondary and signal wiring. Secondary wiring should be selected to have adequate current carrying capacity. When full rated power is required from the power supply, wire with a cross-sectional area (CSA) of at least 2mm^2 should be used.

A disconnect device must be provided which isolates all mains supply current carrying conductors. If the mains supply is permanently connected, a switch or circuit breaker must be included in the wiring. It must be placed close to the equipment (less than 1 metre) and marked as the disconnecting device for the equipment.

If an alternative transformer is used it must have an earthed screen between the primary and secondary windings and the insulation rating between primary and secondary should be adequate to ensure safety (minimum of 2300V AC rms).

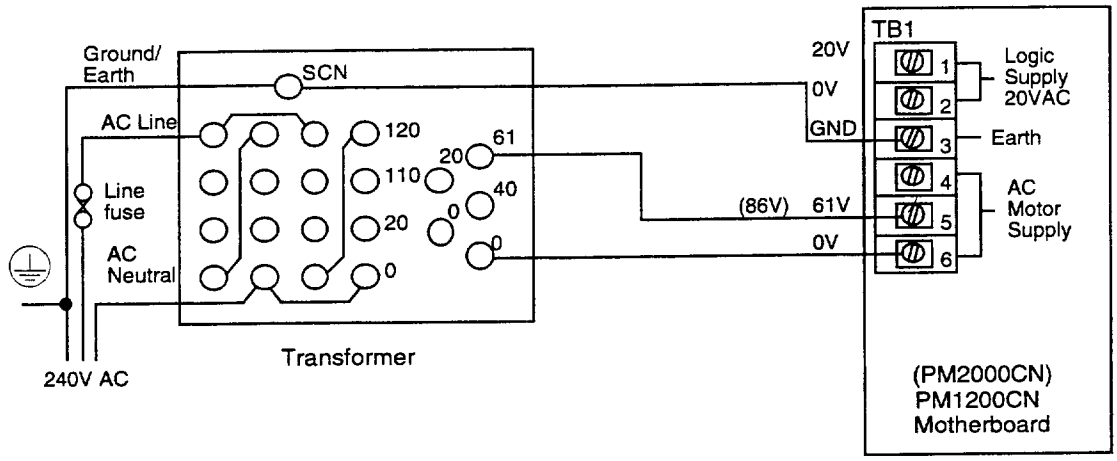
The PM1200CN power supply receives AC from the transformer and generates DC to the drive. Figures 11 and 12 show 120V AC and 240V AC primary wiring for the TO92 transformer.



NOTE: Wire colours apply to pre-wired transformers (USA only).

Note: If the live wire cannot be readily identified, fuse both phase conductors.

Figure 11 120V Primary Transformer Wiring



Note: If the live wire cannot be readily identified, fuse both phase conductors.

Figure 12. 240V Primary Transformer Wiring

Input Voltage	Connect AC Line to:	Connect AC Neutral to:	Connect Studs:
100	1	9	1, 2, 3 & 4; 9, 10, 11 & 12
110	5	13	5, 6, 7 & 8; 13, 14, 15 & 16
120	1	13	1, 2, 3 & 4; 13, 14, 15 & 16
200	1	10	9 & 2; 11 & 4; 1 & 3; 10 & 12
220	5	14	13 & 6; 15 & 8; 5 & 7; 14 & 16
230	1	14	1 & 3; 13 & 6; 15 & 8; 14 & 16
240	1	14	1 & 3; 13 & 2; 15 & 4; 14 & 16
360	5	12	9 & 6; 10 & 7; 11 & 8
380	5	16	9 & 6; 10 & 7; 11 & 8
400	1	12	9 & 2; 10 & 3; 11 & 4
420	1	16	9 & 2; 10 & 3; 11 & 4
440	5	16	13 & 6; 14 & 7; 15 & 8
460	5	16	13 & 6; 14 & 3; 15 & 4
480	1	16	13 & 2; 14 & 3; 15 & 4

Table 11. Default and Optional Transformer Settings

Line Fuses

Line fuses need to be added to protect the transformer and associated wiring. If the live wire cannot be readily identified. fuse both phase conductors. The value of fuse required is given by:

$$\frac{1.5 \times VA}{\text{supply volts}} \quad \text{in amps}$$

Fuse types should be anti-surge HBC.

Secondary Fusing

If a low-power secondary (e.g. 0-20V) is used, it is necessary to incorporate an in-line fuse close to the transformer. The value should be twice the current rating of the low power secondary, with a time delay characteristic.

Dimensional Drawings

Transformers

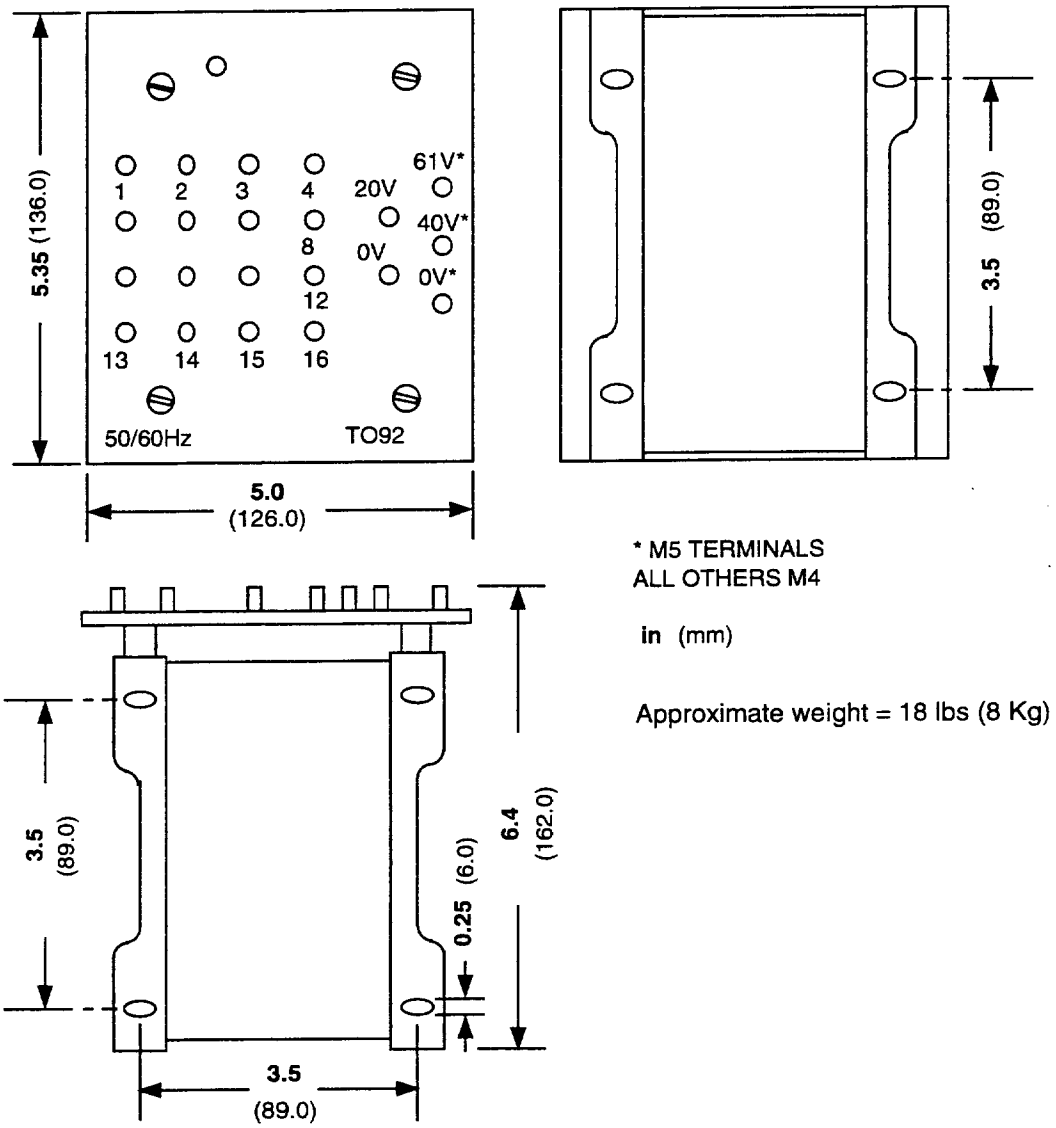


Figure 13. Transformer Model TO92 Dimensions

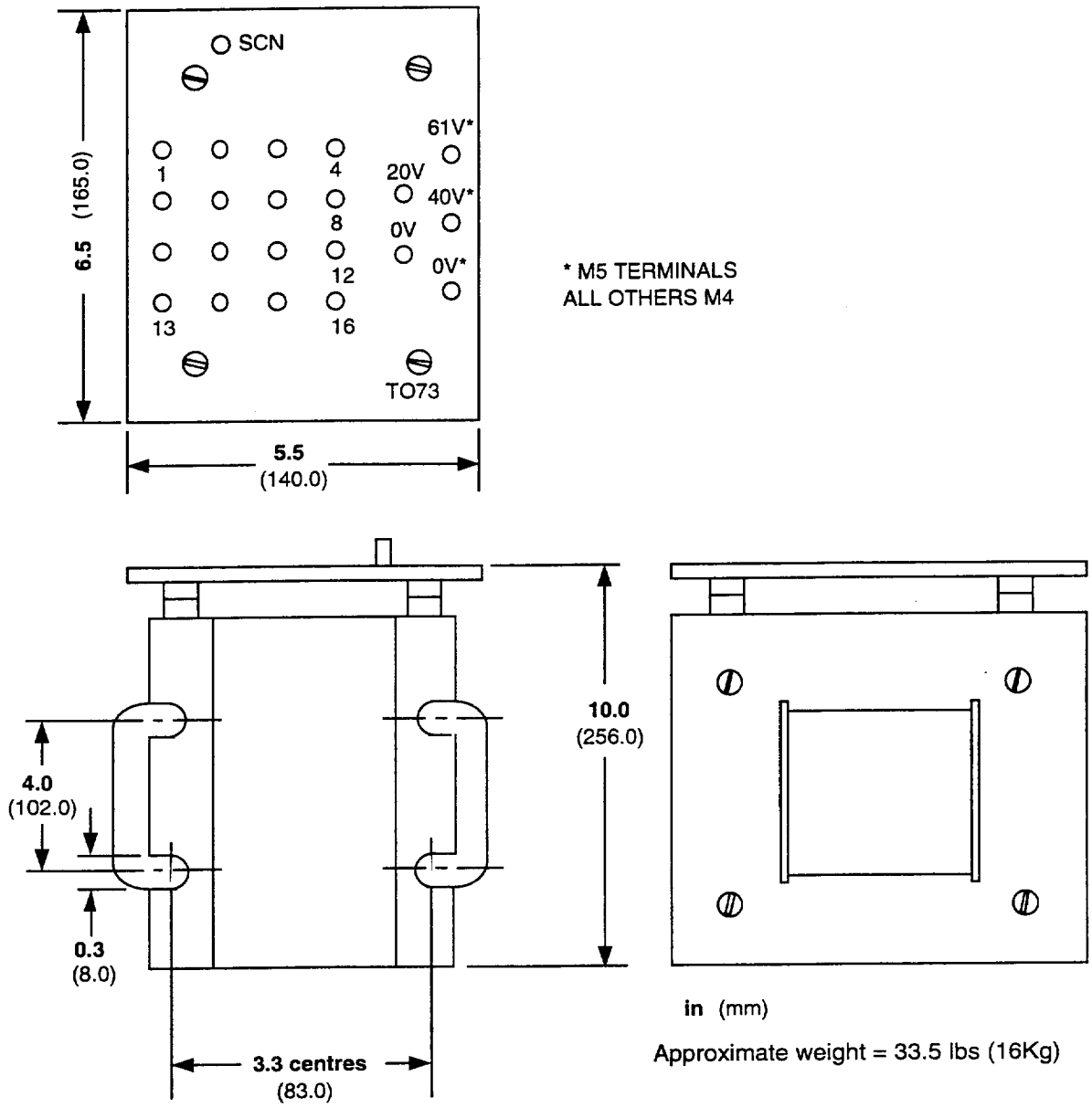


Figure 14. Transformer Model TO73 Dimensions

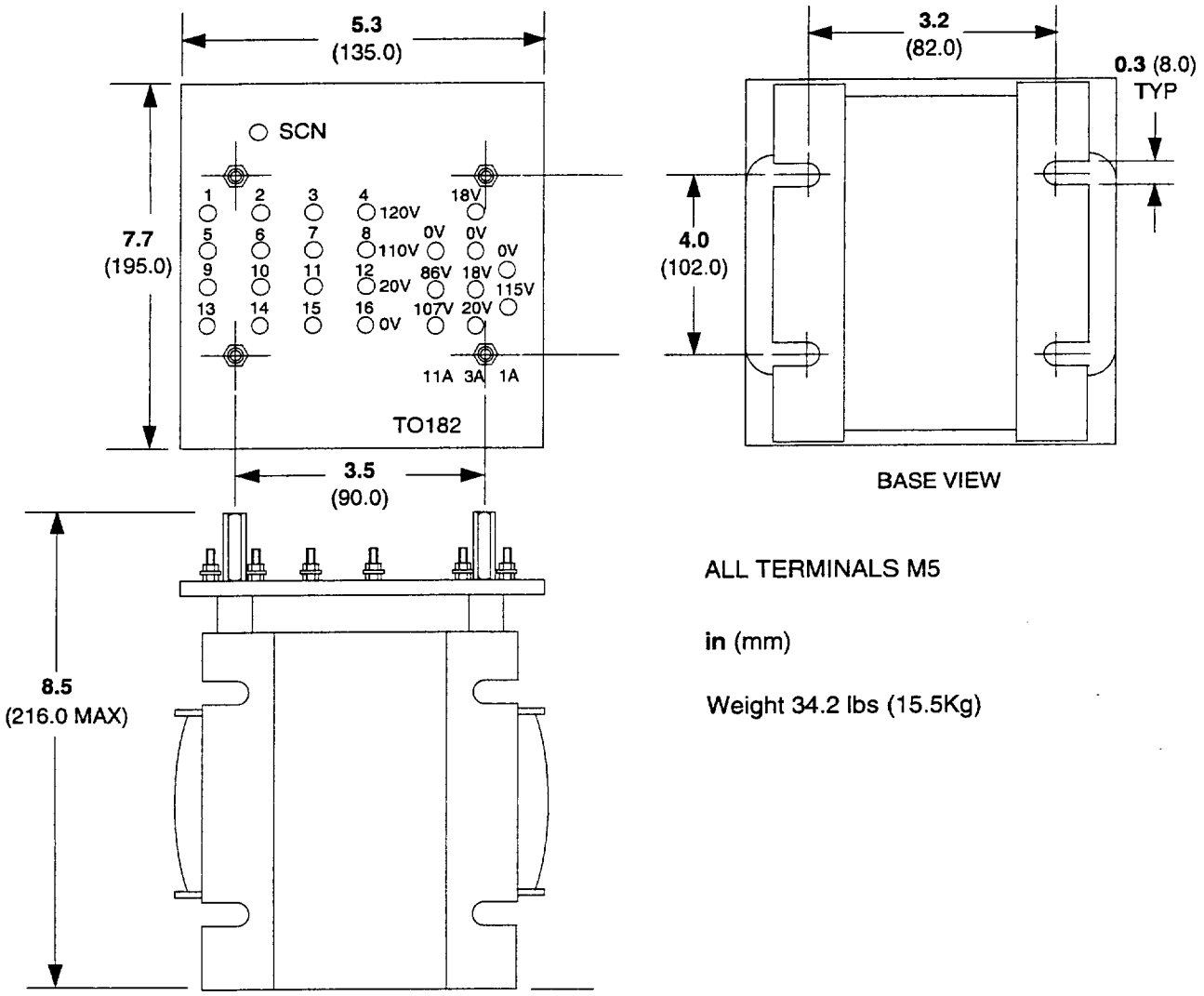


Figure 15. Transformer Model TO182 Dimensions

Note: All height dimensions include safety cover and fixings.

CAUTION

Take care when lifting larger transformers. Do not lift by the terminal plate or cover, as these could break.

EMC Installation

It should be stressed that although these recommendations are based on the expertise acquired during the development of fully compliant products, and on tests carried out on each of the product types, it is impossible for Digiplan to guarantee the compliance of any particular installation. This will be strongly influenced by the physical and electrical details of the installation and the performance of other system components. Nevertheless it is important to follow *all* the installation instructions if an adequate level of compliance is to be realisable.

External enclosures

The measures described in these recommendations are primarily for the purpose of controlling mains conducted emissions. To control radiated emissions, all CD drives and rack systems must be installed in a steel equipment cabinet which gives adequate screening against radiated emissions. This external enclosure is also required for safety reasons. With the exception of drive front panels in rack-based units, there must be *no user access* while the equipment is operating. This is usually achieved by fitting an isolator switch to the door assembly. Drives and filters must be in electrical contact with the panel to which they are mounted. If the panel has a paint finish, it will be necessary to remove the paint in certain areas where required.

To achieve adequate screening of radiated emissions, all panels of the enclosure must be bonded to a central earth point. The enclosure may also contain other equipment such as motion controllers, and the EMC requirements of these must be considered during installation. Always ensure that drives and rack systems are mounted in such a way that there is adequate ventilation.

RA and CC Series Racks

These racks are designed to house CD series drives and are fitted with opto-isolated motherboards (CC series) or non-isolated motherboards (RA series). The use of the isolated CC series is strongly recommended, particularly if the control signal source is remote from the rack.

For EMC-compliant installation, both these rack systems can be fitted with an earth bonding strip running across the back of the rack (see Figure 16). This is for the bonding of screened motor leads and transformer feed leads to the rack system. The rack metalwork is also earth-bonded to this tie bar. The tie bar is available from Digiplan: Part SC/CC - EMCKIT or CN-EMCKIT for CN racks.

External enclosure

It is not necessary to fit front panels to the drives if the rack system is wholly contained within the enclosure. However, if a 19" case is used with no door or cover in front of the rack, then all drive front panels must be fitted.

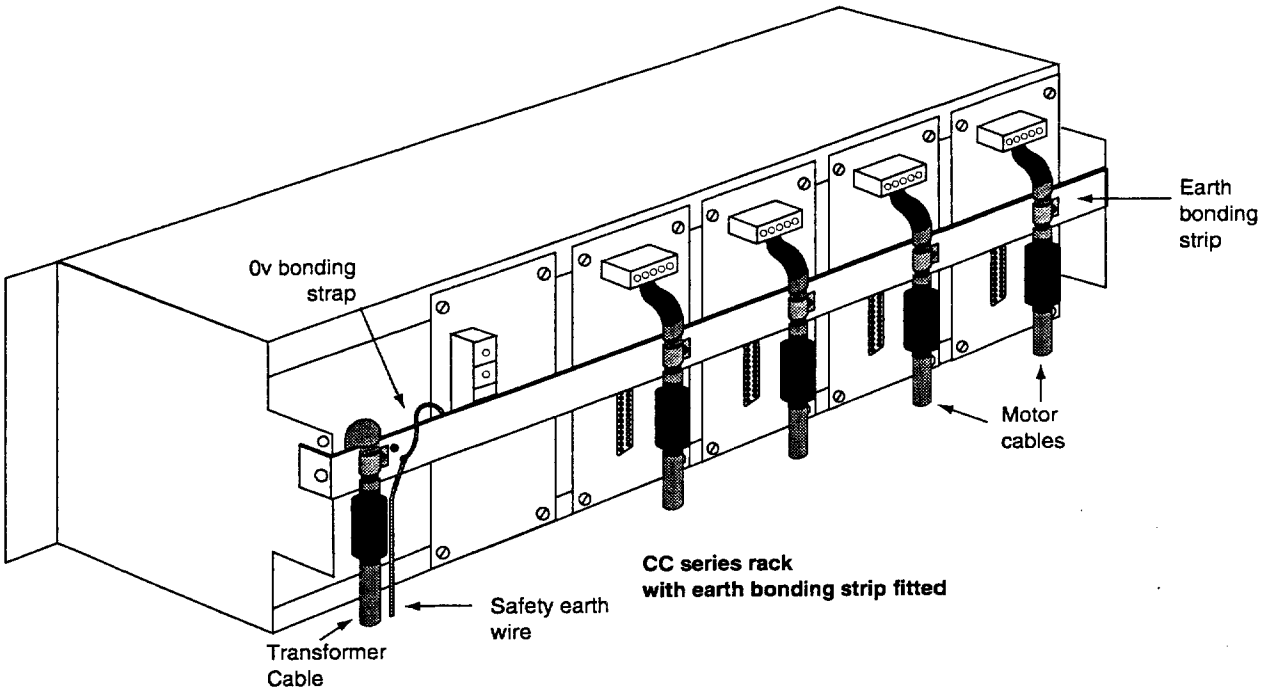


Figure 16. CC Rack EMC Wiring

Filtering the AC mains supply

A filter must be installed between the incoming AC supply and the mains transformer. A suitable filter is Ducati S-221-16, available in the UK from R-S Components as 240-731. Mount the filter within 50mm of the transformer as shown in Fig. 17. Ensure that there is no paint on the mounting panel under the filter mounting lugs - it is vital that there is good large-area contact between the filter and the panel.

Connect the incoming AC supply cable to the push-on terminals on the filter, with the earth lead connected to a local earth stud or bus bar. Route the supply cable so that it runs close to the walls of the enclosure. Connect the filter output terminals to the transformer primary, keeping the leads twisted together and as short as possible. Take an earth connection from the stud to the SCN terminal on the transformer, and run this lead close to the AC supply leads (see Fig. 17).

5-core 1.5mm^2 screened cable (with a braided screen) should be used between the transformer and the power supply motherboard in the rack. A recommended type is Lapp 34905. The green wire is not used and should be cut off (although only 4 cores are actually required, the use of 4-core cable would mean using a green wire as a 'live' conductor). Two of the remaining cores are used for the 19V logic supply and the other two for the 61V motor supply. Run the cable back towards the mounting panel, expose a short length of the screen and anchor the cable close to the filter with a P-clip. When routing this cable to the rack, keep it away from the input cable to the filter.

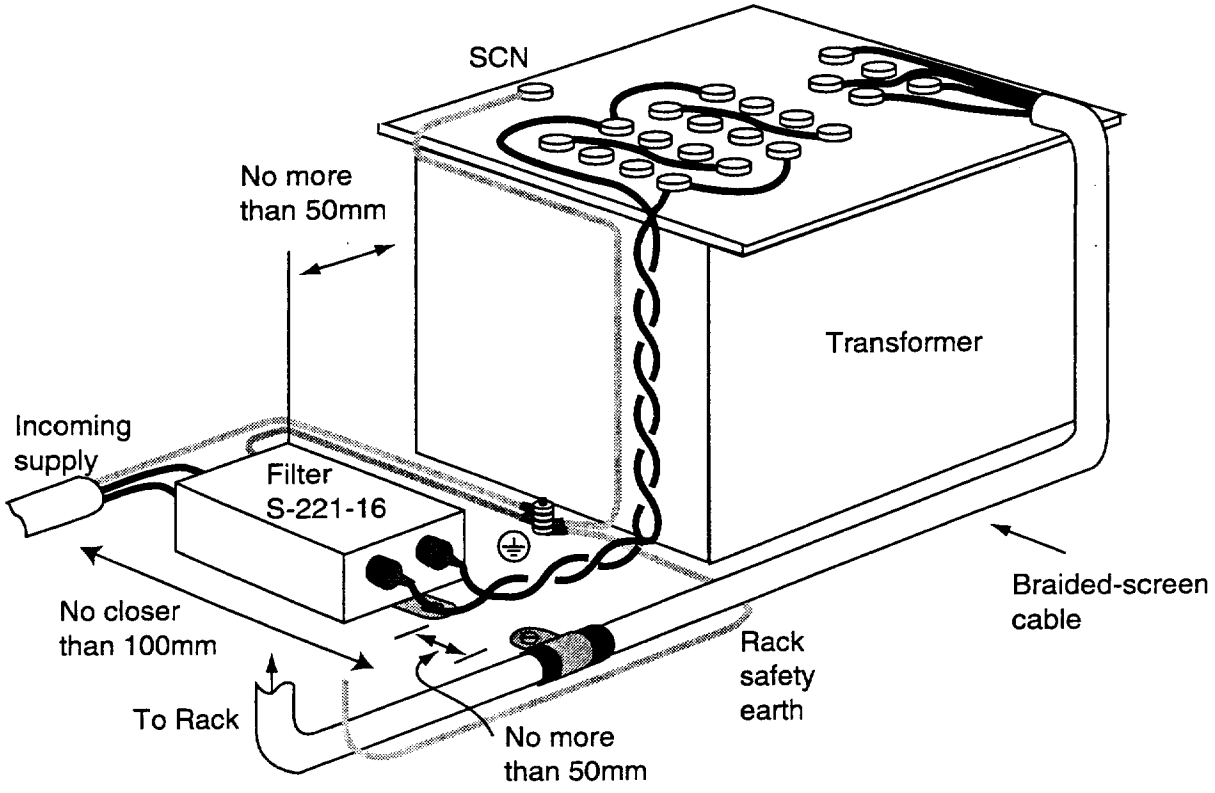


Figure 17. RA/CC Rack Transformer Wiring

At the rack end, fit a ferrite absorber over the cable and connect the appropriate wires to the logic and motor supply terminals on the power supply motherboard. Remove the existing M4 brass earth stud, together with the earth wire connecting it to the power supply motherboard. Next fit the earth bonding strip to the rack end plates using the second hole down from the top. When fitting the bonding strip, use spring washers underneath the nuts and tighten securely - this is to ensure continuity between the bonding strip and the rack metalwork. Reconnect the earth wire from the power supply motherboard to the M4 stud on the earth bonding strip.

Route the cable over the earth bonding strip and identify the location of the mounting point for the P-clip (refer to Fig. 11). Expose approximately 12mm of the braided screen at this point and anchor the cable to the bonding strip. Locate the absorber 15-25mm from the P-clip using heat-shrink sleeving. Connect a separate safety earth wire (2.5mm^2 green/yellow) from the M4 stud on the earth bonding strip down to the stud beside the transformer. Route this earth wire alongside the screened cable from the transformer to the rack.

Motor Connections

The recommended gauge for CD drives is 1.5mm^2. Use a cable containing five conductors plus the braided screen, the green wire being used to provide an earth return to the drive. The same type of cable as used for the transformer connection is suitable (Lapp 34905). Termination at the motor must be made using a 360° bond to the motor body, and this may be achieved by using a suitable clamp. Many stepper motors are designed to accommodate an appropriate terminal gland which can be used for this purpose.

At the rack end, prepare the end of the cable as shown in Fig. 18 and fit a ferrite absorber. Anchor the cable screen to the earth tie bar using a P-clip behind the corresponding drive. Ensure that the P-clip grips the exposed screen securely, if necessary by slightly flattening the clip. Connect the four wires from the motor windings to the appropriate terminals on the motor connector (please refer to the relevant drive User Guide). Connect the green (earth) wire to the tie bar adjacent to the P-clip holding the braided screen. (Terminal 3 on 5-way motor connectors should not be used as a safety earth since the connector can be unplugged without the use of a tool).

If the motor cable is more than 6 metres long, a separate safety earth connection will be required since the impedance of the 1.5mm^2 wire inside the screened cable will be too high. Use a 2.5mm^2 cable connected to the motor body and terminate it on the tie bar next to the P-clip for that axis. Run this cable close to the screened cable from the motor. If there is no suitable termination point on the motor body, remove the paint from the area of one of the mounting bolts and use an appropriate ring terminal. When a separate safety earth connection is used, the earth wire in the screened cable may be connected to terminal 3 on the 5-way motor connector.

The non-isolated RA rack is fitted with 4-way motor connectors. In this case the safety earth connection is always made to the tie bar.

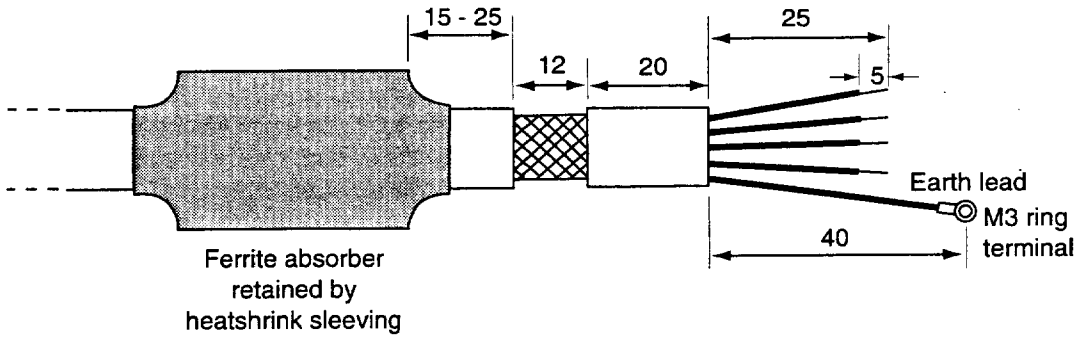


Figure 18. Motor Cable Preparation (Drive End)

Control signal wiring

To ensure adequate immunity it is necessary for control circuits leaving the enclosure to be adequately screened, with the screen of the cable bonded back to the tie bar on the rack. Cable with a braided screen should be used, not metallised foil, and should consist preferably of twisted pairs to minimise magnetic coupling. It is strongly recommended to use opto-isolated drive motherboards where the controller is mounted outside the main enclosure.

Where screened leads are used in control circuits that are only opto-isolated at one end, the screen must be referenced to earth at the non-isolated end. When using an RA rack with non-opto-isolated motherboards, bond the screen to the earth tie bar close to the corresponding drive.

Ferrite absorber specifications

The absorbers described in these installation instructions are made from a low-grade ferrite material which has high losses at radio frequencies. They therefore act like a high impedance in this waveband.

The recommended components are produced by Parker Chomerics and are suitable for use with cable having an outside diameter up to 10mm. The specification is as follows:

Chomerics part number	H8FE-1115-NC
Outside diameter	17.5mm
Inside diameter	10.7mm
Length	28.5mm
Impedance at 25MHz	80Ω
Impedance at 100MHz	120Ω
Curie temperature	130°C (the device should not be operated near this temperature)

Handling and installing the ferrite absorbers

Take care when handling the absorbers - they can shatter if dropped on a hard surface. For this reason the suggested method of installation is to use a short length of 19mm diameter heat-shrink sleeving. This gives a degree of physical protection while the cable is being installed. The sleeving should have a shrink ratio of at least 2.5:1. Cable ties may be used as an alternative, however they give no physical protection to the absorber.