Appendix D

EMC Installation Guidelines

General Product Philosophy

The ZETA6xxx was not designed originally for EMC compliance. Therefore, it will require specific measures to be taken during installation. The ultimate responsibility for ensuring that the EMC requirements are met rests with the systems builder.

It is important to remember that for specific installations, the full protection requirements of the EMC Directive 89/336/EEC need to be met before the system is put into service. This must be verified either by inspection or by testing. The following EMC installation instructions are intended to assist in ensuring that the requirements of the EMC directive are met. It may be necessary to take additional measures in certain circumstances and at specific locations.

It should be stressed that although these recommendations are based on expertise acquired during tests carried out on the ZETA6xxx, it is impossible for Compumotor 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 achieved.

Safety Considerations

The ZETA6xxx is intended for installation according to the appropriate safety procedures including those laid down by the local supply authority regulations. The recommendations provided are based on the requirements of the Low Voltage Directive and specifically on EN60204. It should be remembered that safety must never be compromised for the purpose of achieving EMC compliance. Therefore in the event of a conflict occurring between the safety regulations and the following recommendations, ***the safety regulations always take precedence.***

Ferrite Absorbers and P-Clips

Ferrite Absorber Specifications

The absorbers described in these installation recommendations 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 (617-935-4850) and are suitable for use with cable having an outside diameter up to 10-13mm. The specification is as follows:

Chomerics part #	83-10-M248-1000	83-10-A637-1000
Outside diameter	17.5mm	28.5mm
Inside diameter	10.7mm	13.77mm
Length	28.5mm	28.57mm
Impedance at 25MHz	80Ω	135Ω
Impedance at 100MHz	120Ω	210Ω
Curie temperature	130°C	130°C

(*the device should not be operated near this temperature*)

Handling & Installing 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 (see Figure 1). 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.

Figure 1. Ferrite Sleeve Installation

P-Clip Installation Details

The function of the P-clip is to provide a 360-degree metallic contact and thus a convenient means of ensuring a proper R.F. ground. When dealing with EMI issues, it is important to remember that continuity, a DC connection, does not at all speak to the integrity of an AC (high-frequency) connection. High-Frequency bonding typically involves wide, flat cabling to establish a suitable system

ground. When applied properly, the P-clip has been shown to give an adequate high-frequency contact.

When installing a P-clip (see Figure 2), install as close to the cable end as possible, provided a suitable ground, backplane, earth stud or bus bar is accessible, (this may mean removing the paint from a cabinet or panel). Remove only the outer (vinyl) jacket of the braided screen cable (this allows the braid to continue to the cable connector), be careful not to damage the braid. Snap the P-clip over the exposed braid, and adjust for a tight fit. Secure the clip to the designated ground with a machine screw and lock washer. The use of brass or other inert conductive metal P-clip is recommended. Cover any exposed bare metal with petroleum jelly to resist corrosion.

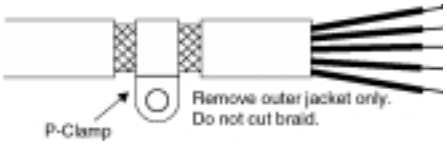


Figure 2. P-Clip Installation

Installation

External Enclosure

Introduction

The measures described in this section are primarily for the purpose of controlling conducted emissions. To control radiated emissions, all drive and control systems must be installed in a steel equipment cabinet which will give adequate screening against radiated emissions. This external enclosure is also required for safety reasons. There must be no user access while the equipment is operating. This is usually achieved by fitting an isolator switch to the door assembly.

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 and the EMC requirements of these must be considered during installation. Always ensure that drives and controllers are mounted in such a way that there is adequate ventilation.

Preparing the ZETA6xxx: The ZETA6xxx must be mounted to a conductive panel. Notice that the mounting flanges have an area free of any paint. If necessary, remove the paint from the corresponding area on the rear panel of the enclosure (see Figure 3). This is to guarantee a good high-frequency connection between the drive case and the cabinet. After mounting the unit use petroleum jelly on the exposed metal to minimize the risk of future corrosion.

Filtering the AC Supply

Introduction

These recommendations are based on the use of proprietary screen filter units which are readily available. However, the full EMC test includes a simulated lightning strike which will damage the filter unless adequate surge suppression devices are fitted. These are not normally incorporated into commercial filters since the lightning strike test can be destructive. This test is normally carried out on the overall system and not on individual components; therefore, the surge protection should be provided at the system boundary.

A filter must be installed between the incoming AC supply and the input to the drive. The manufacturer's part numbers for suitable filters are:

Corcom 10EP1	**Schaffner FN2070-10-06**
Corcom World Headquarters	Schaffner EMC Inc.
Phone: 847-680-7400	Phone: 201-379-7778
Fax: 847-680-8169	Fax: 201-379-1151

For applications requiring the full 12 amps of current from the ZETA12, we recommend the SHAFFNER part number, **FN2070-12-06**. There is no comparable CORCOM 12 amp filter.

You will need one of these filters for each drive. Compumotor's EMC Kit includes a suitable AC mains filter.

Mount the filter within 2 inches (50mm) of the ZETA6xxx as shown in Figure 3. 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, bus bar or metal back-plane. Route the supply cable so that it runs close to the walls of the enclosure. Connect the earth terminal on the filter case to the earth stud.

Fit a ferrite absorber over the cable before wiring the filter output terminals to the AC input on the drive. Locate the absorber as close as possible to the drive using heat-shrink sleeving (see Figure 1 above). Take the ZETA6xxx earth connection from the same stud that retains the filter case earth, as shown in Figure 3.

Motor Connections

Motors in General

The Compumotor R & T Series motors should be used with the C10 (or C10H) cable kit (see page 67) for optimum performance in EMC installations. See Appendix E for installation instructions. This combination provides an appropriatly shielded cable. However, many other step motor systems ship with motors that do not incorporate the use of a braided screen for the control of conducted emissions. Therefore, when used in installations where the

motor cable is not within earthed conduit the entire length of travel, the standard motor cable should not be used.

At the drive end of the motor cable, fit a ferrite absorber over the cable before wiring to the motor connector (it may be necessary to remove the existing connector). Locate the absorber as close as possible to the connector using heat-shrink sleeving.

For motors with exposed cabling (not within earthed conduit), follow the guidelines below:

- Removable Cabling: Remove the motor cable from the standard motor, and replace with a suitable cable described below, see *Motor Cables.*
- Permanent Cabling: Cut off cable in excess of approximately 4 inches (10 cm). Configure the motor for series or parallel operation and attach a suitable braided screen cable to the motor, see *Motor Cables* below.

Termination of the braid shield 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. If this is not the case, P-clip the braid to the rear end bell of the motor housing, as shown in Figure 4. This will not only provide a good high-frequency bond, but strain relief as well.

At the drive end, run the motor cable down to the mounting panel, expose a short length of braiding and anchor to the panel with a P-clip. The ZETA Series require a safety earth connection to the motor (see green and yellow striped wire in Figure 4) — take this from the stud or bus bar. Run the safety earth lead alongside the motor lead. Note that the motor cable should be kept away from I/O cables carrying control signals.

Motor Cables

For 10 foot (replacement) cable lengths, use 4-core 1mm^2 (AWG 18) (SWG 20) braided screen cable for the motor connections on the ZETA6xxx. At the drive end, fit a ferrite absorber over the cable before wiring to the motor connector. Locate the absorber as close as possible to the connector using heat-shrink sleeving (use AWG 16 cable for motors above 10 amperes).

All after-market motor connections must be made using a high quality braided-screen cable. Cables using a metallized plastic foil for an earth screen are unsuitable and provide very little screening. Terminating to the screen in a mechanically stable manner is difficult because the screen itself is comparatively fragile — bending it in a tight radius can seriously affect the screening performance.

There must be no break in the 360° coverage that the screen provides around the cable conductors. If a connector must be used it should retain the 360° coverage, possibly by the use of an additional metallic casing where it passes through the bulkhead of the enclosure. The cable screen must *not* be connected to the cabinet at the point of entry. Its function is to return high-frequency chopping current back to the drive or controller. This may require mounting the connector on a sub-panel insulated from the main cabinet, or using a connector having an internal screen which is insulated from the connector housing.

Within the cabinet itself, all the motor cables should lie in the same trunking as far as possible. They must be kept separate from any low-level control signal cables. This applies particularly where the control cables are unscreened and run close to the drive or other sources of electrical noise.

Motor Feedback Cables

Feedback devices such as encoders, tachometers and Hall effect sensors also require the use of high-quality braided screen cable. If it is necessary to replace the standard feedback cable, select a braided screen cable that matches the gage of the devices original cable and attach as close to the transducer as possible. Avoid complex and bulky connections that can cause degradation in feedback signal quality. If possible, use in-line cable splicing techniques, and cover the splice point with heat-shrink tubing. Remove a section of the braided shield cable's insulation to expose the braid, and tie the braid to earth using the same P-clip 360° bond as shown in Figure 2. Differential signals should use twisted pair cable to minimize magnetic coupling. At the receiving end, fit a ferrite absorber over the feedback cable before wiring the connector, then P-clip the braid to a suitable ground (metal back-plane of drive mounting panel, or earth point of device that receives the feedback)— see Figure 3.

Step Motors

It is preferable to use motors with screw terminations whenever possible. If flying-lead motors are used, it is important that the unscreened leads are converted into a braided-screen cable within 4 inches (10cm) of the motor body. A separate terminal box may be used for this purpose but the braided cable screen must be properly strapped to the motor body, as shown in Figure 4. Motors fitted with terminal boxes also allow local selection of series or parallel connection, reducing the cost of the cable running back to the drive.

Control Signal Connections

High-quality braided screen cable should be used for control connections. In the case of the ZETA6xxx, which has differential step-direction inputs, it is preferable to use a cable with twisted pairs to minimize magnetic coupling. No connection is made to the cable screen at the drive itself. Fit a ferrite absorber close to the I/O connector and run the cable down to the mounting panel as shown in Figure 3. Expose a short length of the braided screen and anchor to the panel with a P-clip.

The level at which the I/O operates means that the signals are unlikely to meet EMC immunity requirements if taken outside the enclosure without proper screening.

50-Pin Ribbon Cable: It is recommended when using the 50-Pin Ribbon Cable I/O found on the ZETA6xxx that a terminal break out box such as the VM50 be used (see Figure 3). Mount the VM50 close to the ZETA6xxx, keeping the ribbon cable as short as possible. Bundle any excess ribbon cable and secure close to a panel wall. Individual I/O points will require the use of individually shielded cable runs, with braids bonded to the panel (close to VM50) with a P-clip.

Communications: In applications that require serial communications with the ZETA6xxx, take special care to assure proper wiring practices are utilized. Good quality braided screen cable should be used for the communication cabling. In the specific case of differential mode (RS-485) protocol, twisted pair cable shall be used. No connection is made to the cable screen at the drive itself. Fit a ferrite absorber close to the communications connector and run the cable down to the mounting panel as shown in Figure 3. Expose a short length of the braided screen and anchor to the panel with a P-clip. Avoid routing communication cables near high power lines, and sources of high energy impulses.

Remember to route control signal connections well away (at least 8 inches) from relays and contactors. Control wiring should not be laid parallel to power or motor cables and should only cross the path of these cables at right angles. Bear in mind that control cables connected to other equipment within the enclosure may interfere with the controller, particularly if they have come from outside the cabinet. Take particular care when connecting external equipment with the cabinet door open, for instance a computer or terminal; static discharge may cause damage to unprotected inputs.

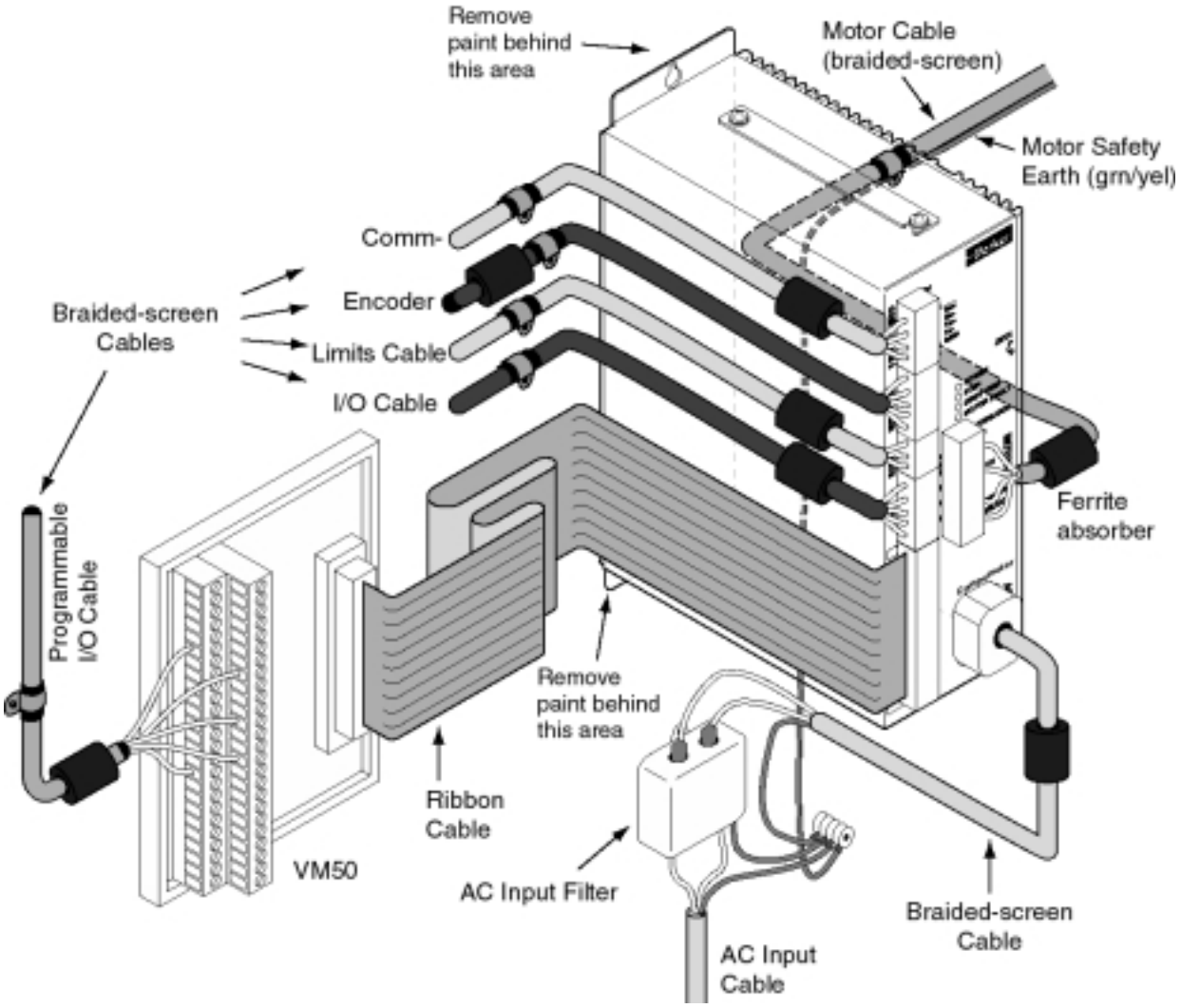


Figure 3. EMC Connections for ZETA6xxx (shown for non C10 motor installations)

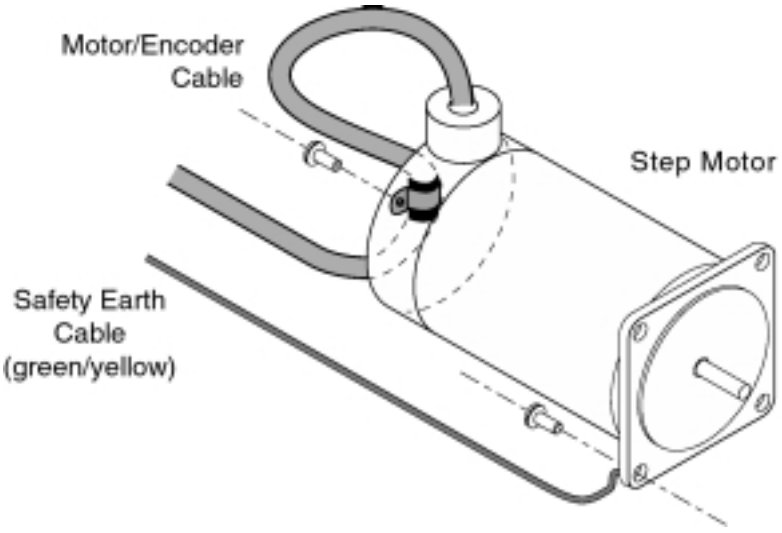
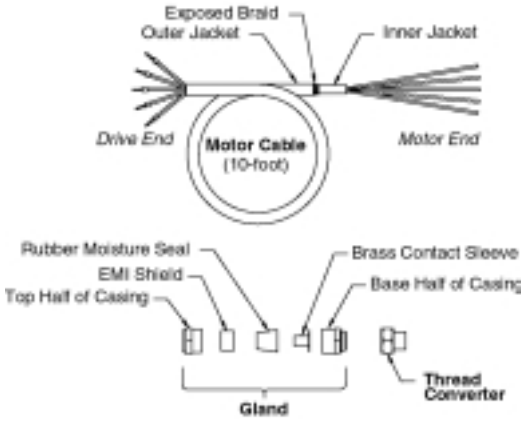


Figure 4. EMC Connections for Step Motor — P-Clip, Safety Earth (shown for non C10 motor installations)

LVD/EMC Compliance for RS and TS Motors

Compumotor's R and T Series motors may be used with the C10 (or C10H) cable kit for LVD/EMC compliance. The C10 cable kit is ordered separately (part number is **C10**)*. Instructions for assembling the cable are provided in the C10 cable kit.



*Note: we recommend the C10H for use with motors run above 10 amperes.