BALDOR • RELIANCE

Recommended Practices for Installation for EC Directive 2014/30/EU Relating to EMC

10/16 Supplement to Installation & Operating Manual MN1383

Important:

Be sure to check www.baldor.com to download the latest version of this manual in Adobe Acrobat PDF format.

Section 1

Preface

This manual is a supplement to the “Installation and Operating Manual” and is intended to assist the installer in understanding the nature of EMI (Electro Magnetic Interference) and to present installation recommendations which will assist the installer toward attaining Electro Magnetic Compliance (EMC).

The information contained herein is for your guidance only and does not guarantee that the installation will meet the requirements of the Council Directive 2014/30/EU.

The purpose of the EU (European Union) Directive is to state a minimum technical requirement common to all the member states within the European Union. In turn, these minimum technical requirements are intended to enhance the levels of safety both directly and indirectly.

Council Directive 2014/30/EU relating to Electro Magnetic Compliance (EMC) indicates that it is the responsibility of the system integrator to ensure that the entire system complies with ALL relative Directives at the time of installing into service.

Motors and controls are used as components of a system, per the EMC directive. Hence all components, installation of the components, interconnection between components, and shielding and grounding of the system as a whole determines EMC compliance.

Baldor products which meet the EMC Directive requirements are indicated with a “CE” mark. A duly signed EC Declaration of Conformity is available from Baldor.

The CE mark does not inform the purchaser which Directive the product complies with. It rests upon the manufacturer or his Authorized Representative to ensure the item in question complies fully with ALL the relative Directives in force at the time of installing into service, in the same way as the system integrator previously mentioned. Remember, it is the instructions of installation and use, coupled with the product, that comply with the Directive.

There is no requirement for the supplier/manufacturer to include a Declaration of Conformity with every product. They are however, available upon request.

Section 2

Directives

General

The three directives relevant to Baldor's products are listed below. Baldor's policy is to comply with these directives.

The EMC Directive

The purpose of this directive is to ensure that Baldor's products conform to the Electro Magnetic Compliance (EMC) Directive. This applies to any Baldor product that is capable of emitting Electro Magnetic Interference (EMI) and/or is susceptible to interference.

The Machinery Directive

The purpose of this directive is to ensure the health and safety of persons and property when installing and using a product to its intended purpose.

The Low Voltage Directive

The purpose of this directive is to ensure that electrical equipment for use with a rated voltage between 50 and 1000 volts AC and 75 and 1500 volts DC is constructed in such a way as not to endanger the health and safety of persons and property.

Section 3

Installation

Overview

Using CE approved components will not guarantee a CE compliant system!

1. The components used in the drive, installation methods used, materials selected for interconnection of components are important.
2. The installation methods, interconnection materials, shielding, filtering and grounding of the system as a whole will determine CE compliance.
3. The responsibility of CE mark compliance is rests entirely with the party who offers the ends system for sale (such as an OEM or system integrator).

Baldor products which meet the EMC Directive requirements are indicated with a “CE” mark. A duly signed EC Declaration of Conformity is available from Baldor.

Baldor offers a variety of products, for a variety of market needs. Please contact your Baldor district office to review your application requirements and to verify the products that meet your needs.

General Instructions for Installation and Compliance with EMC Directive

EMI is usually generated by high frequency switching circuits. There are two points that the system integrator/ builder must consider for each installation:
1. EMI generated within the enclosure is not conducted outside the enclosure.
2. EMI generated within the enclosure is not radiated outside the enclosure.

Figure 3-1 EMI radiated directly onto the supply cable

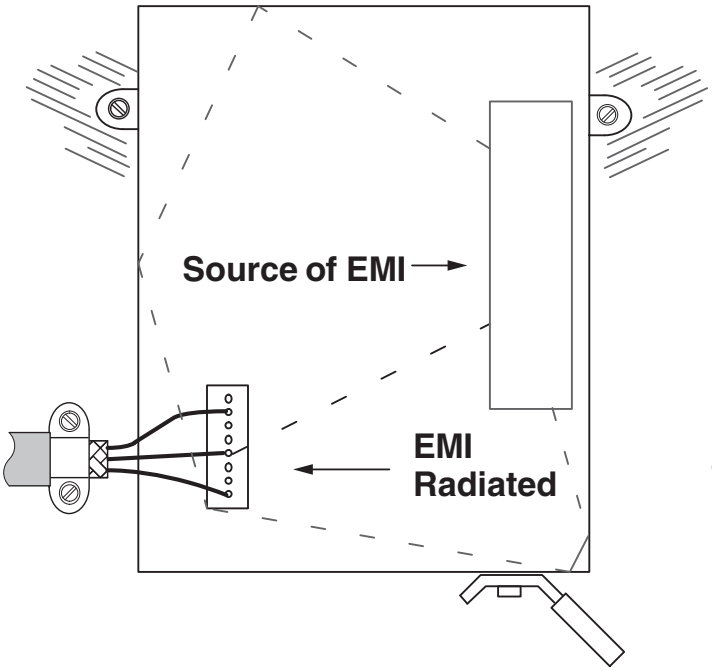
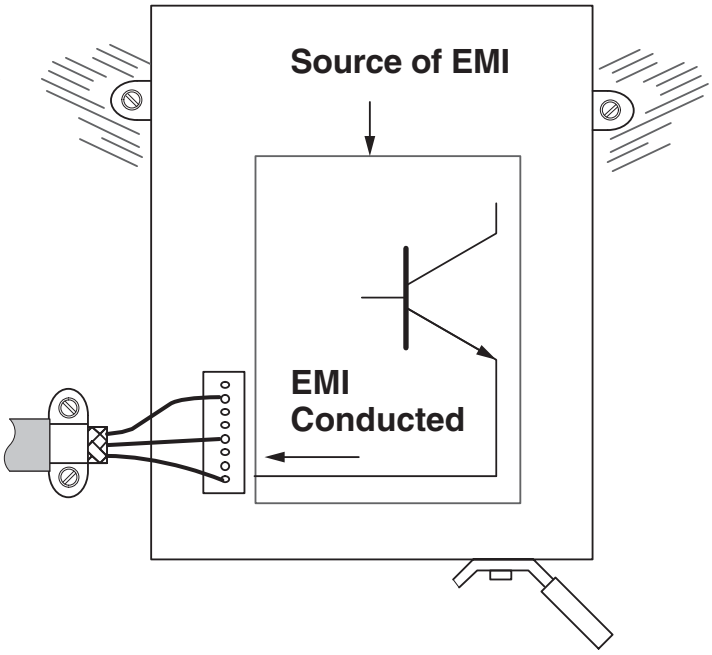


Figure 3-2 EMI conducted directly onto the cable supply



To reduce the “conducted” high frequency noise, an EMI filter should be connected in series with the main power source. Several things should be considered when selecting an EMI filter. These are:

1. The filter should block the frequencies causing the interference. Only suitable EMI filters and input chokes should be installed.
2. The filter should not saturate at current levels required for normal operation.
3. The filter should be installed so that it blocks EMI conduction to the main power supply.
4. Shielded/screened cables must be used where appropriate.

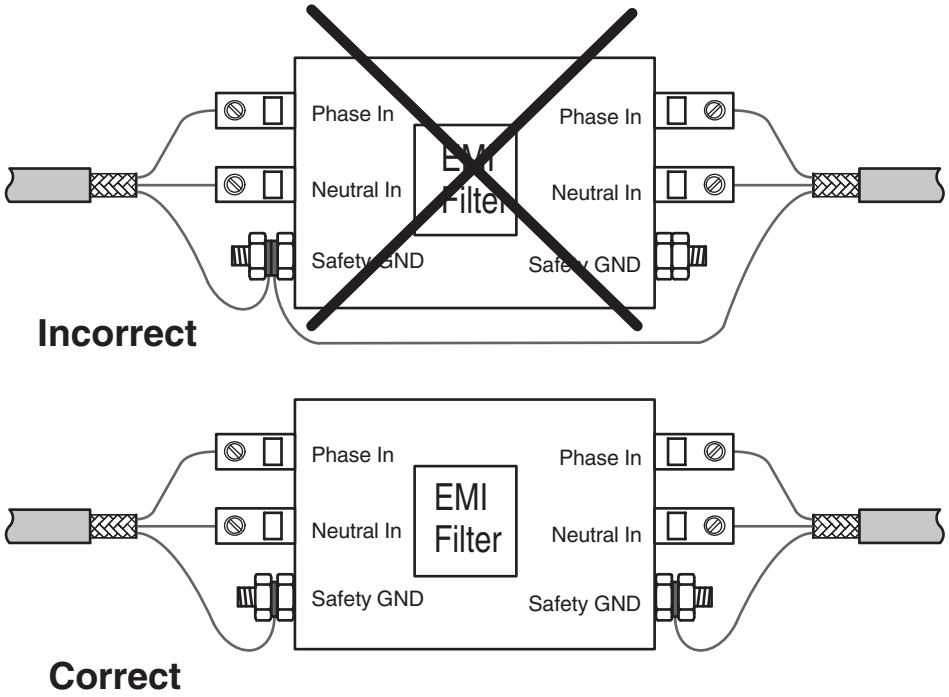
Several things should be considered when installing an EMI filter. These are:

1. Power supply cables must be kept away from signal cables.
2. Shielded/screened cables should be terminated at both ends.
3. Paint must be removed from metal surfaces where electrical contact is required.
4. Cables must be kept as short as possible.
5. Skin effect is also an important consideration. High frequency current is conducted in the outer portion of the conductor (skin). Therefore, ground wires must have sufficient cross sectional area to conduct EMI to ground.
6. Remember, EMI can and will find its way into other cables that enter and exit the enclosure. Prevent radiated or conducted EMI through grounding and shielding.

Note: The words Shielded and Screened are used interchangeably in this text. These words refer to a conductive layer of the cable that is generally grounded.

7. The EMI filter must be properly installed. Figure 3-3 shows the correct way.
8. Reference Schaffner publication 2902E “EMI Installation Guidelines for Motor Drives” for more information.

Figure 3-3 EMI Filter



Radiated Interference

Radiated EMI (Figure 3-4) can become a problem by several different causes. Here are some things to consider during installation:

1. Large holes in enclosures should be avoided. Use small holes because they radiate less EMI.
2. Seams at door closures are particularly prone to radiate energy. Use EMI tape or a conducting gasket where openings or access hole covers exist. EMI tape looks like woven metal strands which compress between the closed surfaces. It must make good electrical contact along the entire seam. Avoid gaps more than 2 inches (50mm) in length.
3. Avoid shields/screens only grounded at one end. These act as a very efficient antenna. Excessively long screws can act in a similar manner if both ends are not at ground potential (for example, where they are used to secure a deep plastic cover). When a metallic object is in contact with a radiated energy source it should be grounded at both ends.
4. Plastic covers are generally not effective in blocking EMI unless they are specifically manufactured with conductive material for EMI protection.
5. Proper EMI mating plugs or sockets should be used where cables enter enclosures. Remove the paint from adjacent enclosure surfaces to ensure proper ground contact.
6. If you suspect that a cable is conducting EMI, it can sometimes be reduced by the use of ferrite beads as shown in Figure 3-5. (A ferrite cable clamp can be used).

Figure 3-4 EMI radiated interference

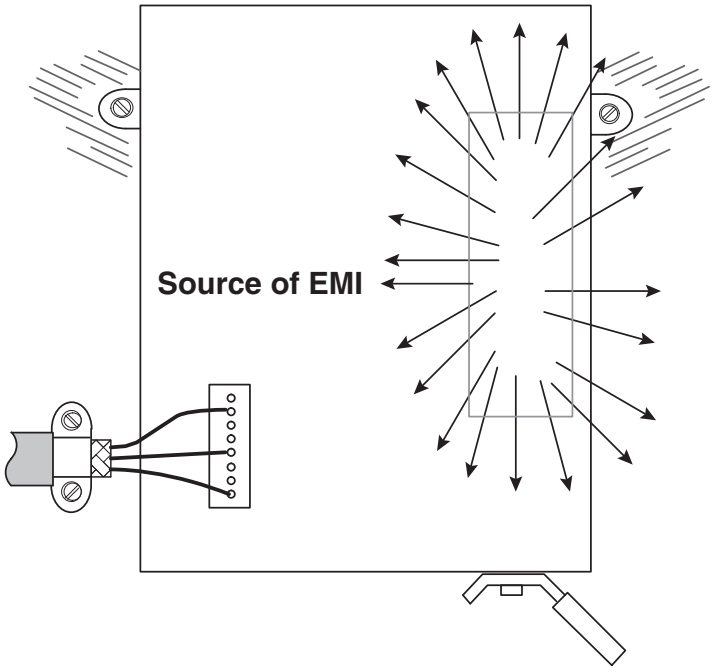
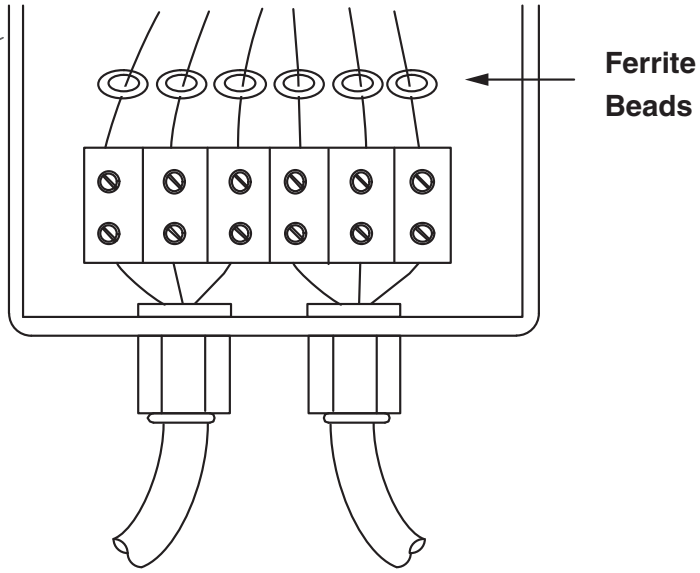


Figure 3-5 Ferrite Beads to reduce conducted interference



Considerations to reduce radiated

1. All cables that connect to the motor control must be shielded.
2. Signal, Input (AC Power), and motor cables are to be separate and positioned independently of each other.
3. Lay all cables close to the ground plane (Grounded Panel) or ground structural member.
4. A grounding bar (copper plated) can be used to tie all grounds together. Be sure that a suitable ground connection is made from a central structural ground to the copper grounding bar.
5. If several mounting plates are used, tie all mounting plates together by using good ground connections.
6. If a contactor, inductor, motor protection switch, or other power component is used, the shields of all the associated cables must be connected to the grounded panel.
7. For installations in residential environments, a suitably designed enclosure may be required. The enclosure provides additional attenuation for radiated EMI.
8. Other devices that do not conform to EN61000-6-2 and operated close to the motor control may experience EMI interference.

Typical Panel Layout

A typical panel layout is shown in Figure 3-6. The Electro Magnetic Compatibility (EMC) of the system depends on the installation method including EMI filter, shielding/screening of cables and proper grounding.

Be sure that the control, EMI filter, input line choke, and regen resistor/dynamic brake resistor are all mounted onto a grounded plate. Zinc coated mounting plates provide good grounding of system components.

The motor cable shield/screen should be connected to motor ground at the motor terminals. A metal strain relief properly installed and grounded at the motor is recommended.

Control cables like the input command, resolver/encoder cable, should use additional shielding (second outer shield) on the cable with the shield/screen grounded at both ends.

The shield/screen of all cables connected to the control must be grounded to the control by connecting the shield to the control's "Ground" terminal. The cables include the motor cable, input cables, feedback cables regen/dynamic resistor cables and other control cables. Clamping the shield/screen of all the cables onto the plate as illustrated in Figure 3-6 is recommended. Wide cross section, bare metal to metal ground clamps should be used. Wherever possible, minimize the length of the cables.

Figure 3-6 Shield Grounding

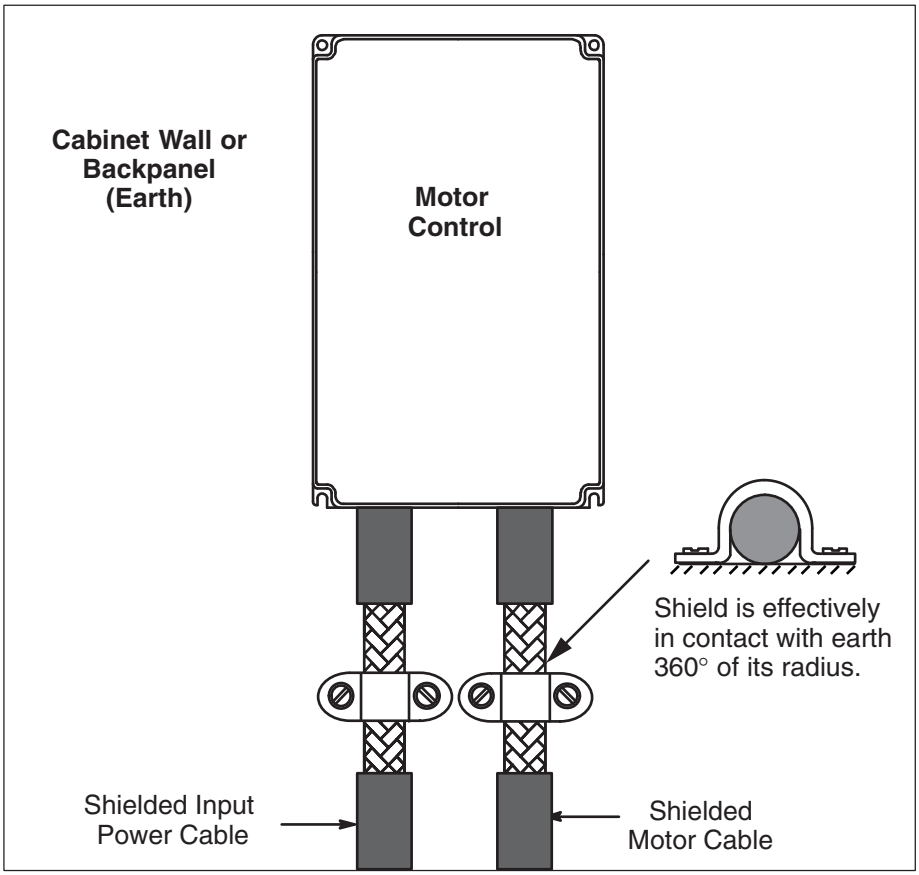
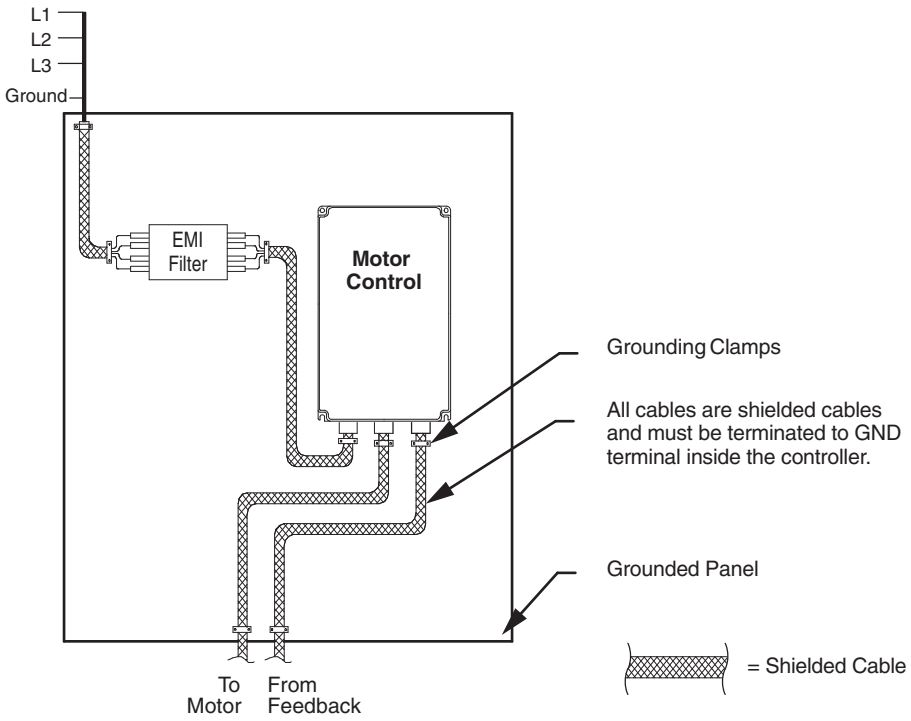


Figure 3-7 Panel Grounding



Cables

Shielded cables come in different forms. It is important to select the correct type for the installation. In general, the larger the surface area of the shield/screen, the greater the attenuation of EMI.

1. 1. Foil shield.
   These cables offer an effective type of EMI shielding. Some considerations are:
   a. Do not use the thin wire to terminate the shield/screen. Use a wire with sufficient cross sectional area to conduct EMI to ground.
   b. Exercise great care when handling the exposed foil shield material as it is easily torn. Once torn, the EMI shielding is reduced.
   c. Use a grounding connector suitable for this type of cable. A spring compression with 360 degrees contact, is probably the best type (see Figure 3-8).
   d. When terminating the foil shield, be sure you connect the ground wire to the conducting side of the foil. Some foil shields have only one conducting surface (a plastic film with a metalized surface).

Figure 3-8 Cable Grounding Connector

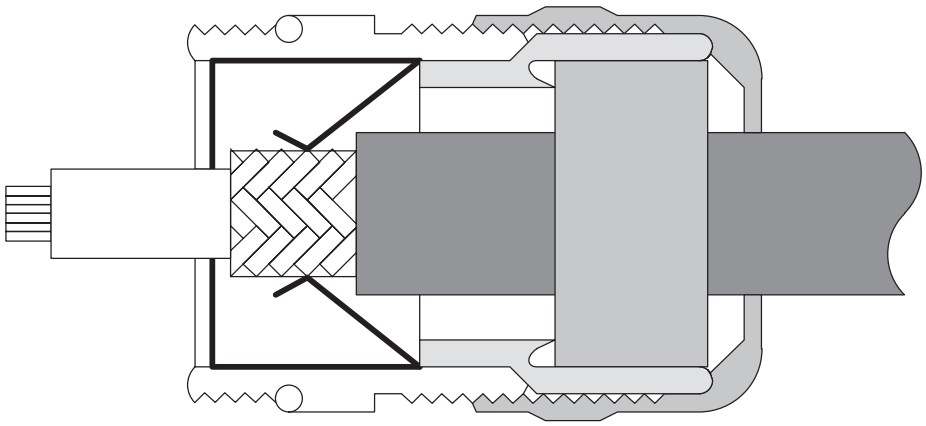
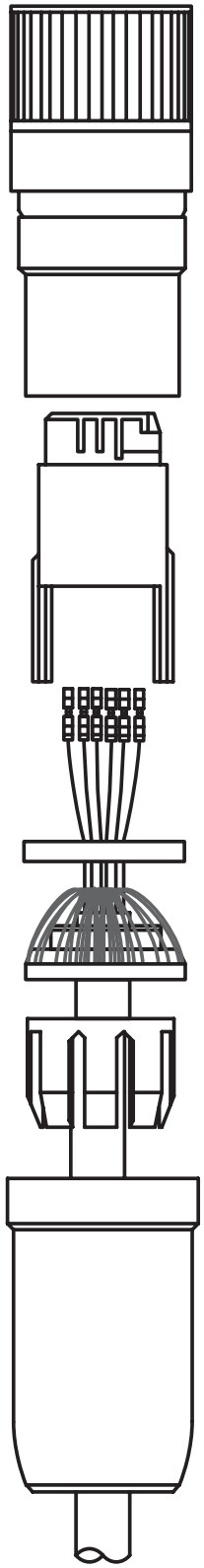
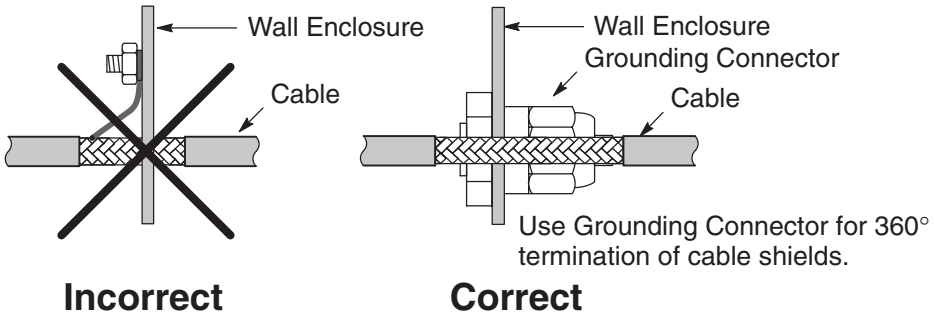


Figure 3-9 CE Type connector braided shielded cable



2. Woven or braided shield/screen cables.
   These cables offer these advantages:
   a. Can, under certain circumstances, offer mechanical protection as well as radiation protection.
   b. Mechanically more robust and easier to handle.
   c. Easy termination with crimp style connectors. May even be soldered.
   d. A strain relief is normally used (refer to Figure 3-9).
   e. When the cable must through a wall, a gland connector that provides full 360° contract must be used (refer to Figure 3-10).

Figure 3-10 Grounding at Wall Enclosures



3. Ribbon cables.

These cables require some special attention. The drain wire shown in Figure 3-11 is not an effective conductor of EMI. A grounded metal plug/socket combination should be used. Otherwise, a conductive foil should be inserted across the full width of the ribbon cable and grounded across its full width.

Keep wire lengths as short as possible as shown in Figure 3-12. Shield as much of the cable as possible.

Figure 3-11 Termination of a ribbon cable

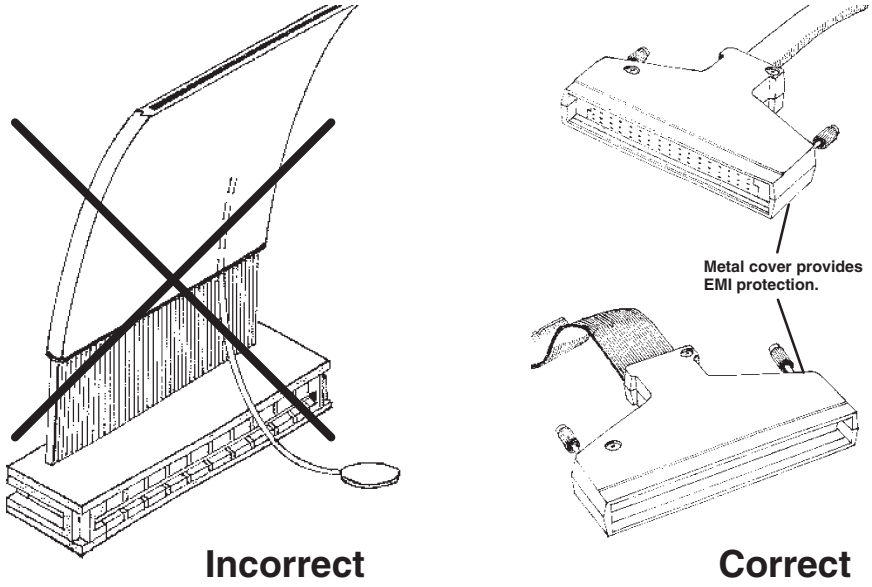
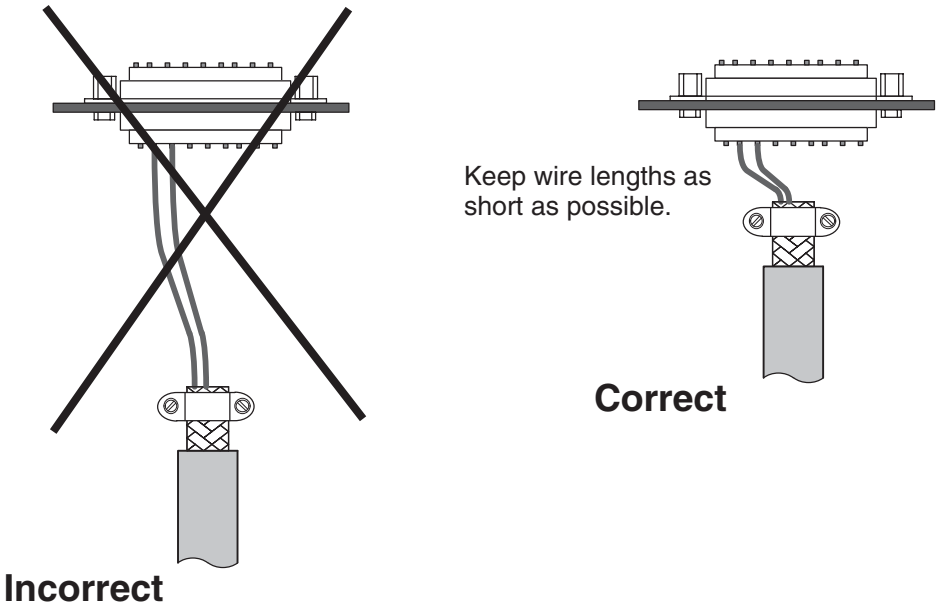


Figure 3-12 Wire Lengths



Motor Connections

Motor leads entering or exiting the control must be shielded. The shield must be grounded at the exit point of the control. Safety ground connections should be shielded. Any wire that connects to a terminal inside the control must be shielded and the shield must be grounded at the exit point of the control.

1. Motors with flying leads that exit the motor using a strain relief are probably the most difficult to deal with, especially if the strain relief is plastic. Although this approach is difficult, it is not impossible. Figure 3-13 shows a method of terminating a shield/screen.
   In general, the cable used in these cases will not be manufactured with a shield/screen built in. It is recommended that a piece of shield/screen is placed over the cable, and terminated into a junction box with EMI cable strain relief. The cable can then be connected to the control using shielded/screened cable.
2. Motors with metal conduit or terminal boxes are the easiest to deal with. Tests have shown that no special gasket material is required between the mating surfaces of the lid and the box itself as long as it is a good fit. It is still important to use an EMI strain relief for terminating the cable
   (Figure 3-14) and a shielded/screened cable must be used. If an insulating sealing gasket has to be used, then care must be taken to ensure that the bolts that hold the lid in place also have good electrical contact with the lid and the body of the terminal box.
3. Motors with connectors can be confusing (Figure 3-15). Since a connector that may appear to be compliant may not be. An example of this is the
   “military” style drab cadmium colored connector. The problem with some of these connectors is that there may not be a location to connect the shield/screen.
   In general, if the connector has provisions to terminate the shield/screen through 360 degrees of contact then it is a suitable connector (Figure 3-9).
4. Termination/connection of feedback devices such as resolvers or encoders are easy to deal with. To function properly, these devices must be installed to minimize interference. However, if the cables are connected to a positioning card with high frequency signals, there is a possibility for EMI to be conducted back along the cable. In these cases, a good policy is to install ferrite beads on each wire (or a ferrite cable clamp).
   If it is necessary to install a junction box, first the general rules shown in Figure 3-4 and described in the associated text should be followed carefully. Second, if sub–D connectors are used, care should be taken to ensure the continuity of the screen through the outer covers (see Figure NO TAG).

Figure 3-13 A method of terminating a motor with flying heads

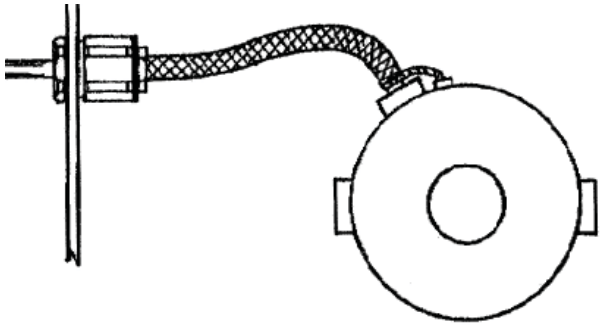


Figure 3-14 Motor with conduit or terminal box

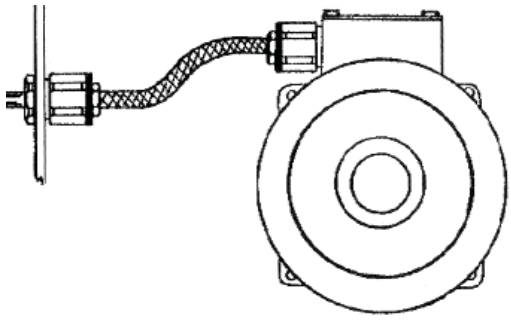
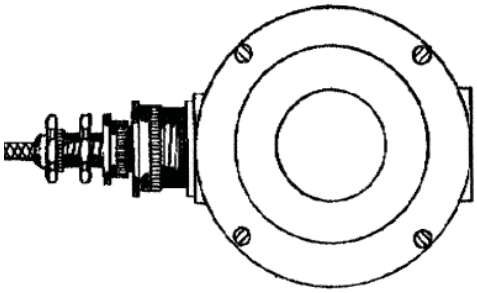


Figure 3-15 Motor with a mating connector



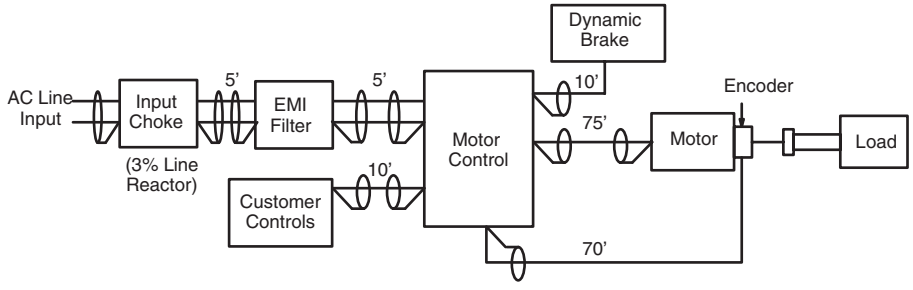
Installing Baldor Controls for EMC Compliance

Baldor controls that meet EMC directive requirements are marked with “CE” on the product label. A duly signed CE Declaration of Conformity is available from Baldor upon written request.

For compliance to the EMC directive, the drive system as a whole is required to comply with the directive. This means system components, installation methods, interconnection materials, and the filtering, shielding and grounding techniques of the system must be all be CE compliant for the system to be compliant.

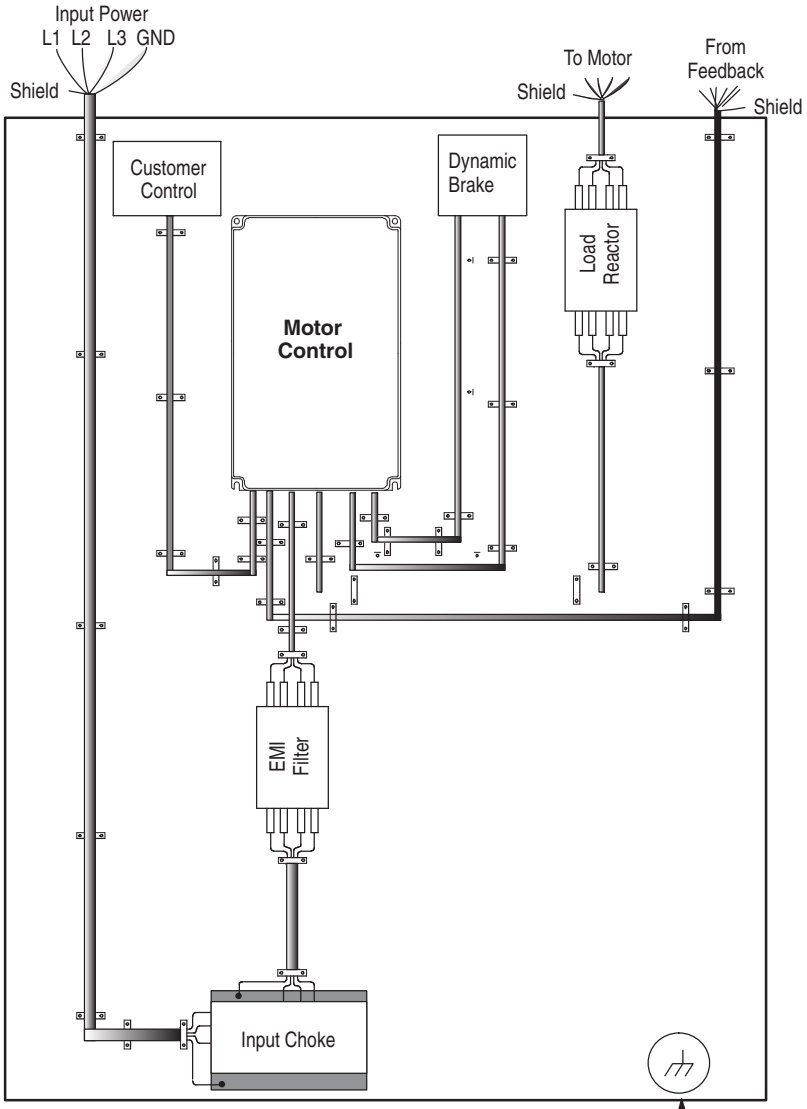
A typical CE system diagram is shown in Figure 3-16. A typical panel mounted layout is shown in Figure 3-17.

Figure 3-16 Typical CE Drive



1. The EMI Filter, Input Choke, motor control and Dynamic Brake components are all mounted to a grounded plate. Zinc coated mounting plates provide good grounding connection of the mounted components.
2. The Input Choke reduces low frequency harmonics and is a typical requirement for all controllers (even with no CE approval).
   Baldor Line Reactors are recommended.
3. The shield wires of the Input Cables, Motor Cables, the Dynamic Brake cables and other cables connected to the control are to be grounded at the motor control. Ground connection is made by using cable glands and/or connection of shields to the GND " ⏚ " terminal inside the motor control.
4. Clamping the shield of all shielded cables to the grounded panel is recommended. Clamps that have a wide cross section and bare metal to metal contact should be used. Keep all cables as short as possible.
5. The motor cable shield must be connected to motor ground at the motor terminals. Metal cable glands properly installed at the motor terminal box is recommended.

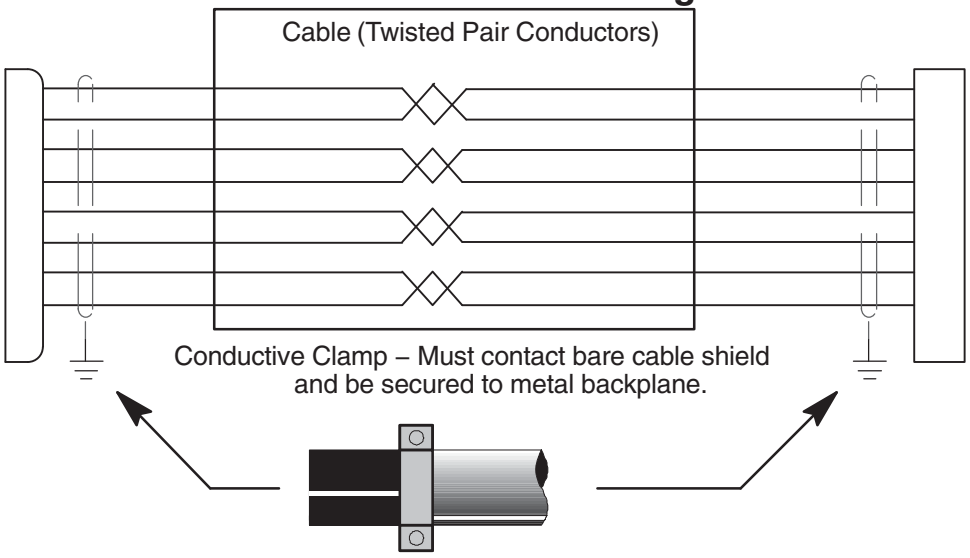
Figure 3-17 Typical Panel Layout



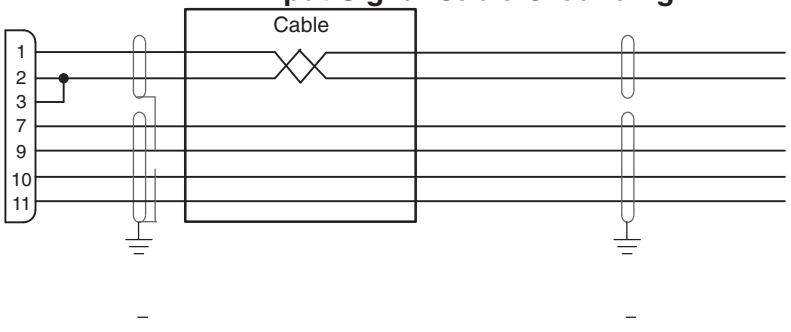
Note: Input choke and Load Reactor are installed if necessary.

6. A motor inductor (Load Reactor) is recommended for Inverter or Vector applications where the motor cable lengths exceed 95 ft. (30 meters).
7. Control cables (like the feedback cable) should use additional shielding (second outer shield) on the cable and the shields should be grounded at both ends.
8. Signal, Input (AC Power) and Motor cables are to be separate and positioned independently of each other.
9. Lay all cables close to the ground plane (Grounded Panel) or ground structural member.
10. A grounding bar (copper plated) can be used to tie all grounds together. Be sure that a suitable ground connection is made from a central structural ground to the copper grounding bar. If several mounting plates are used, tie all mounting plates together to make a good ground connection.
11. If a contactor, inductor, motor protection switch or other power component is used, the shields of all the associated cables must be connected to the grounded panel.
12. Be sure to follow all safety notices, precautions and installation guidelines that are described in the Installation & Operating Manual that is provided with the motor control.

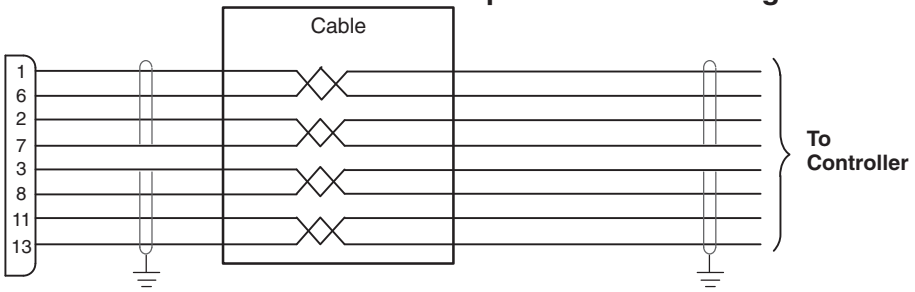
Cable Screens Grounding



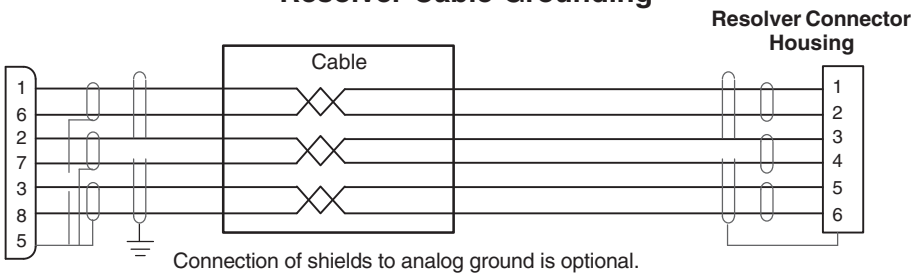
Input Signal Cable Grounding



Simulated Encoder Output Cable Grounding

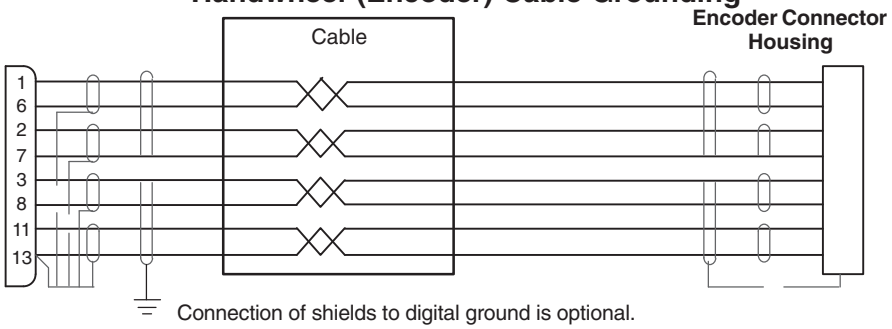


Resolver Cable Grounding



Connection of shields to analog ground is optional.

Handwheel (Encoder) Cable Grounding



Connection of shields to digital ground is optional.

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