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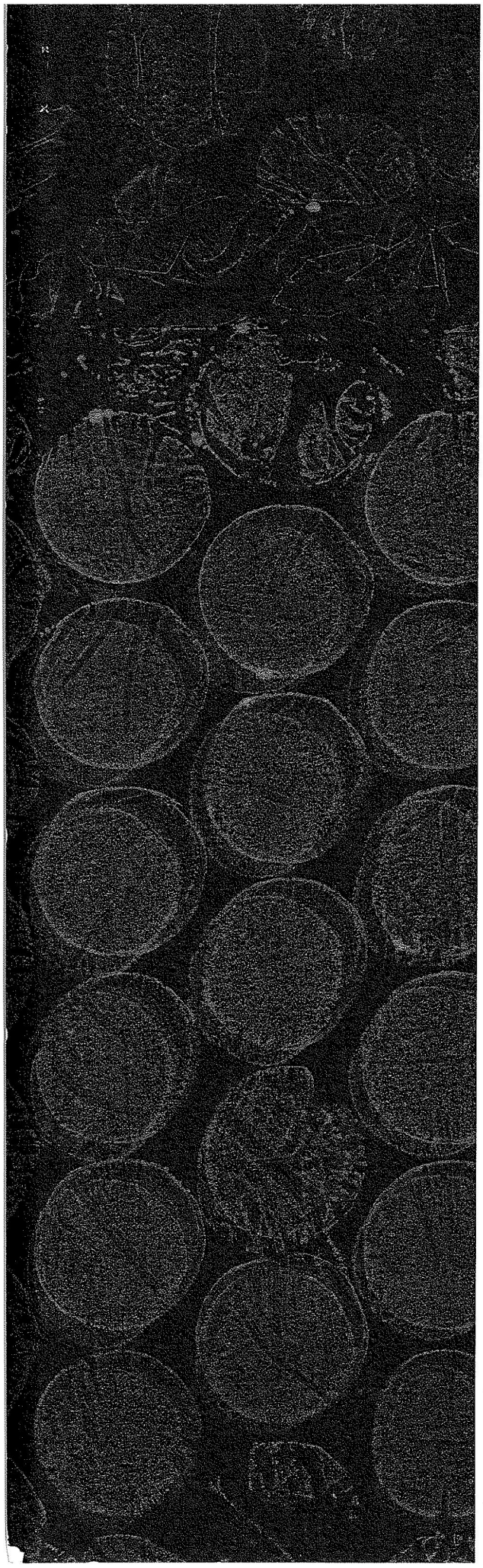
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KOLLMORGEN

Motion Technologies Group

EMC Installation and Application Guidelines for ServoStar Series

Manual #: M-SU-001-H

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1 Introduction

Kollmorgen SERVOSTAR™ drives and systems have been successfully tested and evaluated to the limits and requirements of the EC Directive on EMC (89/336/EEC) and the EC Directive on Low Voltage (72/73/EEC). Additionally, these electronic products were designed and tested in accordance with UL 508C.

This document has been prepared to provide guidance for installing Kollmorgen SERVOSTAR™ drives and systems. The installation of the equipment is critical in designing for system and machine electromagnetic compatibility (EMC). Particular attention must be addressed concerning filtering, wiring, cable screening, grounding, and bonding.

The EMC of a system can be identified in two parts: emissions and immunity. Emissions refers to the generation of EMI (electromagnetic interference) and immunity refers to the susceptibility levels of the equipment. The SERVOSTAR™ series of drives and power supplies have been tested for both emissions and immunity. The equipment has been evaluated per EMC directive 89/336/EEC and harmonized standards. Limits were derived from generic standards EN55081-2 and EN55082-2 for heavy industrial environment. The SERVOSTAR™ series of drives and power supplies have been tested for radiated emissions, conducted emissions, EFT, ESD, surge, conducted immunity, and radiated immunity. These tests have been done in accordance with EN55011, EN61000-4-2, ENV50140, IEC 1000-4-4, EN61000-4-5, and ENV50141.

2 Installation / Mounting

The Kollmorgen SERVOSTAR™ series of electronic system components are designed for panel assemble which in turned is mounted in a metallic enclosure. Enclosures are supplied by the manufacturers of the final product. To optimize EMC, the enclosure should have continuous ground continuity maintained between all metal panels. This ground continuity is intended to be both a safety ground and a high frequency ground. The units should be mounted on a back plane which is installed into the enclosure. Ideally, the back plane will be an unpainted metallic surface. The unpainted surface will allow more surface area to be in contact with the filters, allowing for a lower impedance path between the filters and the back plane. The back panel should have a high frequency ground strap connection to the enclosure frame and/or earth ground.

3 Power Supply Filtering

One method of reducing conducted noise is to use EMI filters in the input power leads. These filters will block conducted type emissions from exiting onto the power lines, and will also provide a barrier for EMI that might be present on the power lines which may affect the equipment. These filters should be sized for the voltage and current rating of the system. A single input line filter may be used for multi-axis control. These filters should be mounted as close to the incoming power as possible so noise is not capacitively coupled into other signal leads and cables. Similar care should be taken when routing wires from the load side of the filter to the power supply. These lines may be noisy and should be separated from other sensitive cabling to avoid unwanted coupling of noise. These filters will be either single or 3 phase design depending on the input power. Several manufacturers of these filters are Corcom, Delta, Eichhoff, Schaffner, and Tokin. Most manufactures will be able to recommend the best filter design for motor control application. Kollmorgen has provided in this document specific filters that will adequately attenuate the conducted noise to levels well below the appropriate CE limits.

The Kollmorgen SERVOSTAR™ series of electronic system components require EMI filters in the input power leads to meet the conducted emission requirements for the industrial environment. The implementation of the EMI filter should be done in accordance with the following guidelines:

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- Filter must be mounted on the same panel as the motor drive and power supply.
- Filter must be mounted as close as possible to incoming cabinet power.
- Filter must be mounted as close as possible to power supply.. If separation exceeds 30 cm (1 ft.) flat cable (braid) may be used for the high frequency connection between filter and power supply.
- When mounting the filter to the panel, paint or other covering material should be removed before mounting the filter - use an unpainted metallic back panel if possible.
- Filters are provided with an earth connection. All ground connections should be tied to ground.
- Filter can produce high leakage currents. ***Filter must be earthed before connecting the supply!***
- Filters should not be touched for a period of 10 seconds after removal of the supply.

Power Supply Model Number	Recommended EMI Line Filter	Kollmorgen Part Number
PA08 (Single phase)	Filter Concepts SF10	**********
PA08 (3 phase)	Schaffner FN258-30/07	A-96776-003
PA28	Schaffner FN258-30/07	A-96776-003
PA50	Schaffner FN258-55/07	A-96776-005
PA75	Schaffner FN258-75/34	A-96777-001
PA85	Schaffner FN258-100/35	A-96777-002
PALM	Corcom F7202A	A-97181
PA14 (single phase)	Filter Concepts SF15	**********
PA14 (3 phase)	Schaffner FN258-30/07	A-96776-003

4 Motor Line Filtering

Motor filtering may not be necessary for CE compliance on the SERVOSTAR™ systems; however, this additional filtering may increase the reliability of the system. Factors which may lead to motor lead filter incorporation are poor non-metallic enclosure usage and unbonded (or unshielded) motor cables coupled with lengthy cables. This filtering may be in the form of differential mode or common mode. The common mode currents will exist on all lines feeding the motor (with respect to ground) and the differential mode currents will exist from line to line. The filtering of the lines feeding the motor will provide additional attenuation of noise currents that may enter surrounding cables and I/O ports of equipment in close proximity One situation that may require filtering is in the use of lengthy motor cables. While every final system is different and every application of the product may cause a slightly different emission profile, it may become necessary to provide additional noise attenuation for the purpose of radiated emissions. Differential mode currents due to line to line capacitance of the cable will be attenuated with the use of differential mode chokes. The use of a ferrite on each motor lead placed at the drive end can attenuate noise levels to within specification. The use of ferrite cores (one in each motor lead will reduce differential mode noise currents and lower frequency (30-60 MHz) broadband emissions. Fair-Rite P/N 263665702 or equivalent may be used as the ferrite core.

Fair-Rite P/N 263665702 or equivalent

Another method of filtering is the use of common mode chokes. The use of a ferrite or iron powder core toroid will place common mode impedance in the line between the motor and the drive. Noise spikes as a result of the PWM switching frequency may be reduced with the use of common mode chokes. The use of a common mode choke on the motor leads may increase signal integrity of encoder outputs and associated input/output signals. The following is a list of toroidal cores that can be used to make common mode chokes.

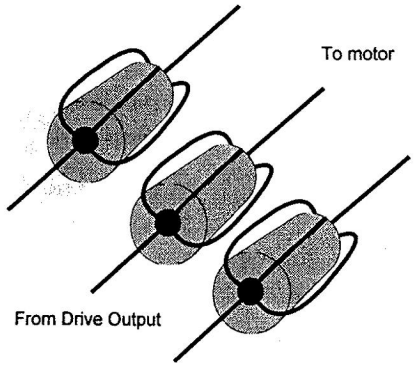
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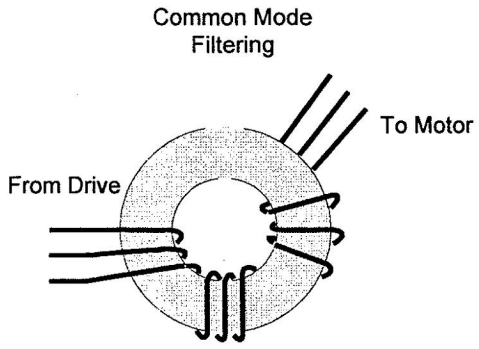
Manufacturer	Manufacturer's Part Number	Size
Micrometals	T400-26D	OD 4in (102mm) ID 2.25in (57.2mm) HT 1.3in (33mm)
Micrometals	ST102-267	OD 1.025 in (26mm) ID .6 in (15.2mm) HT .475 in (12.1mm)
Micrometals	ST150-275B	OD 1.52 in (38.6mm) ID ..835 in (21.2mm) HT .825 in (21mm)
Micrometals	ST200-275B	OD 2.01 in (51.1mm) ID 1.24 in (31.5mm) HT 1.025 in (26mm)
Magnetics	77930-A7	OD 1.09 in (27.7mm) ID .555in (14.1mm) HT .472in (11.99mm)
Fair-Rite	2643803802	OD 2.4in (61mm) ID 1.4in (35.55mm) HT .5in (12.7mm)

The following is a list of pre-wound common-mode chokes available from Kollmorgen or Schaffner.

Manufacturer	Manufacturer's Part Number	Kollmorgen Part Number	Description
Schaffner	RD7137-36-0m5	A-96843-005	500µH 3 phase common mode choke. 36 amps continuous.
Schaffner	RD8137-64-0m5	A-96843-010	500µH 3 phase common mode choke. 64 amps continuous.

Differential Mode Filtering





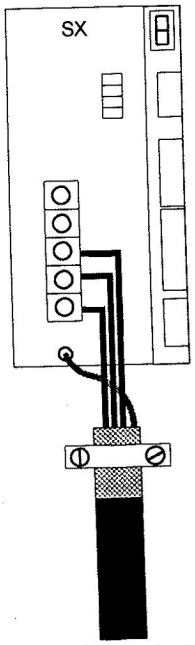
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5 Grounding / Bonding

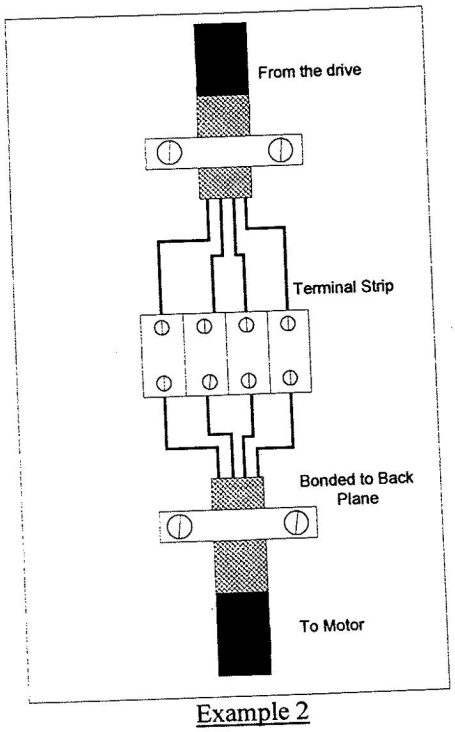
System grounding is essential for proper performance from the drive system. A ground bus bar may be used as a single point ground for the system. Safety grounding should be provided to all pieces of equipment from a star point. In addition to the safety grounding, a high frequency ground must be provided that connects the back panel to the enclosure and ultimately to earth ground. The objective is to provide an extremely low impedance path between the filters, drives, power supplies, and earth ground. This high frequency ground can be accomplished with the use of a flat braid or copper bus bar. It is important not to rely on a standard wire for the high frequency ground. In general, a wire has an inductance of 8 nH/in regardless of diameter. At higher frequencies, this unwanted inductance between grounds equates to limited filter performance. When connecting high frequency grounds, use as short a braid as possible.

Bonding of shielded cables is *imperative* for compliance. The motor cables must have the shield exposed as close to the drive as possible. This exposed shield should be bonded to the back panel using Phoenix (or similar) components (outlined below) or an uninsulated metal cable clamp. Bonding is done in an effort to reduce the impedance between the cable shield and the back panel. Feedback cables should also be bonded to the back panel, and it is recommended that all shielded cables be bonded to the back panel. Proper bonding will reduce emissions from the system and increase immunity levels of the system. Power input wiring is not required to be shielded (screened) if the power is fed to the cabinet (enclosure) via metallized conduit. If the metallized conduit is used with proper high frequency grounds, bonding technology, and recommended wire routing, then power wire shielding will have no affect. In the event that metallized conduit is not implemented into the system, shielded cable will be required on the power input wires and proper bonding technologies should be implemented.

The following are examples of cable bonding close to the drive using a non-insulated metallic cable clamp and cable bonding when the use of a terminal strip is implemented. If it is possible to avoid the terminal strip, do so. It is best to have no breaks in the armor (shielding) of the cable.



Example 1



Example 2

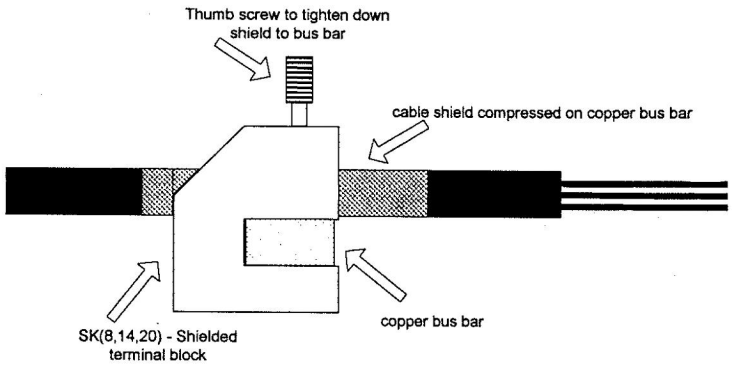
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Phoenix Contact Parts

Another option is to use cable bonding clamps offered by Phoenix Contact and others. When using the Phoenix Contact parts, make sure that a low impedance (high frequency) ground is connected from the ground bus bar to the back panel. This can be done with a flat braid or a copper bus bar. The SK parts from Phoenix (SK8, SK14, & SK20) slide onto the bus bar. The cable (with exposed shield) is inserted through the SK piece and the thumbscrew on top of the SK piece is used to tighten the connection between the cable shield and the bus bar.

Phoenix Contact Part Number	Description	Cable Diameter Range
3025163 Type SK8	Shielded terminal block - for placing the shield on bus bars.	SK8 up to 8mm or 0.315 inches
3025176 TypeSK14	Shielded terminal block - for placing the shield on bus bars.	SK14 8mm to 14mm or 0.551 inches
3025189 Type SK20	Shielded terminal block - for placing the shield on bus bars.	SK20 14mm to 20mm or 0.787 inches
0404428 Type AB/SS	Support for bus bar. 2 needed to mount ground bus.	N/A
0402174 Type NLS-CU 3/10	Bus bar material - 10mm x 3mm copper at varying lengths.	N/A

The following represents a side view of the SK device that clamps down on the shield of the cable. The use of the Phoenix SK device is an excellent method for providing a low impedance path between cable shield and the back panel.

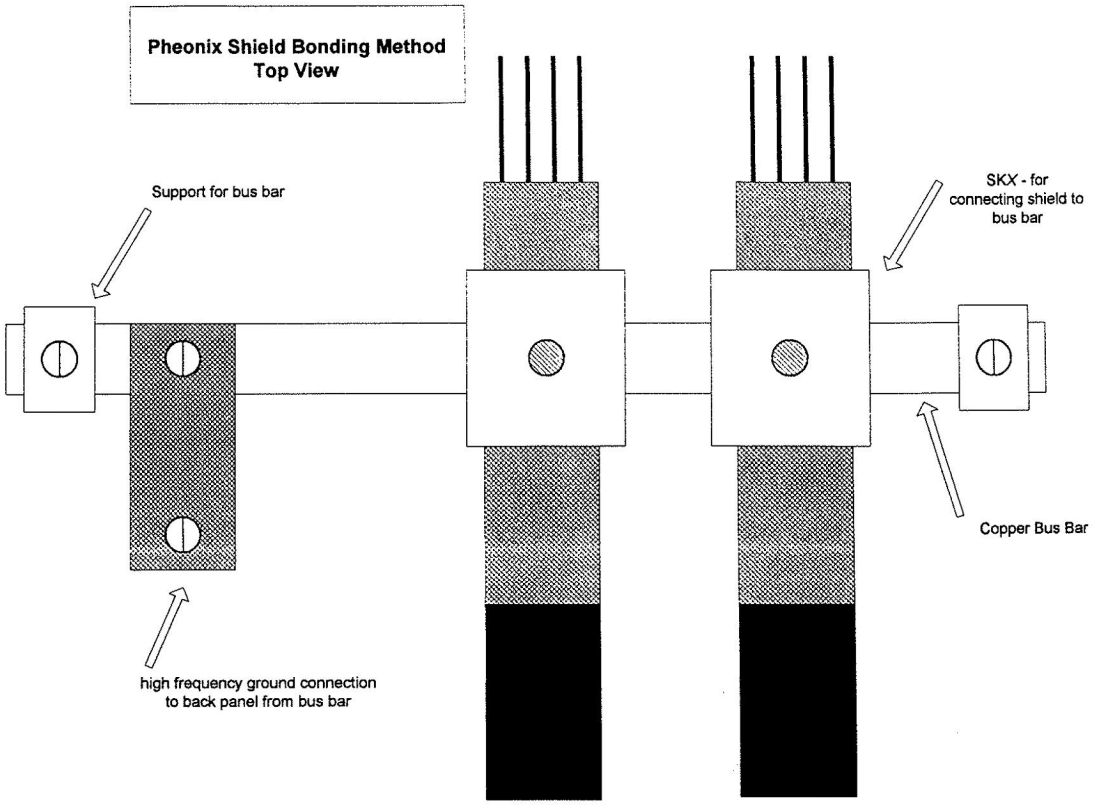


Side View

Example 3

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The following is a top view of (2) cables being clamped using the Phoenix Contact devices. Note that the cable shields are clamped to the bus bar and the bus bar has a high frequency strap connecting it to the back panel. This connection is imperative.



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6 Wiring Practices

Particular care should be used when layout of an enclosure is designed. Efforts to separate power wires from small signal wires should be taken. The following guidelines highlight some important wiring practices to implement.

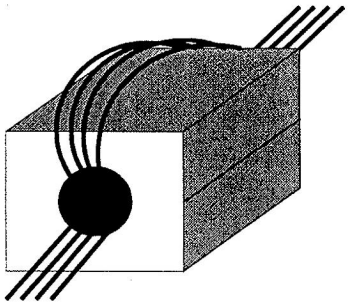
- Control and signal cables must be separated from power and motor cables. Distance of 20 cm (8 in) will be sufficient in most cases.
- Control and signal cables must be shielded to reduce the effects of radiated interference.
- Where control cables must cross power or motor cables, they should be done with an angle of 90 degrees if possible. This will reduce the coupling effect.

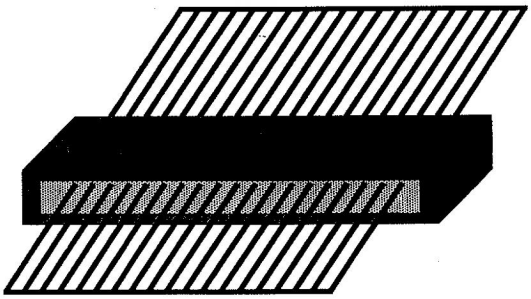
7 Additional I/O Filtering

I/O filtering, while not a necessity for CE compliance, may be desired depending on system installation, application, and integration with other equipment. It may be necessary to place ferrite cores on I/O lines to avoid unwanted signals entering and disturbing the drive system or other associated equipment. The following chart lists some ferrite parts that may be used for I/O filtering and noise attenuation. These parts are ideal for providing an in line common mode impedance for I/O lines.

Manufacturer	Manufacturer's Part Number	Kollmorgen Part Number	Description
Ferrishield	SS33B2032	A-96770-003	Clamp on core
Ferrishield	SS33B2036	A-96769-005	Clamp on core
Ferrishield	FA28B2480	A-96771-003	Clamp on core - flat cable clamp
Ferrishield	SA28B4340	A-96772-009	Clamp on core - flat cable clamp

The following illustrates the use of multiple turns through a clamp on core. The more turns that are put through, the more impedance is added to the line. Avoid putting the shield in clamp on core. It is undesirable to place an impedance in line with the shield. The use of ribbon cable may be common in many cabinets. Some ferrite clamps are designed just for ribbon cable use as shown below.

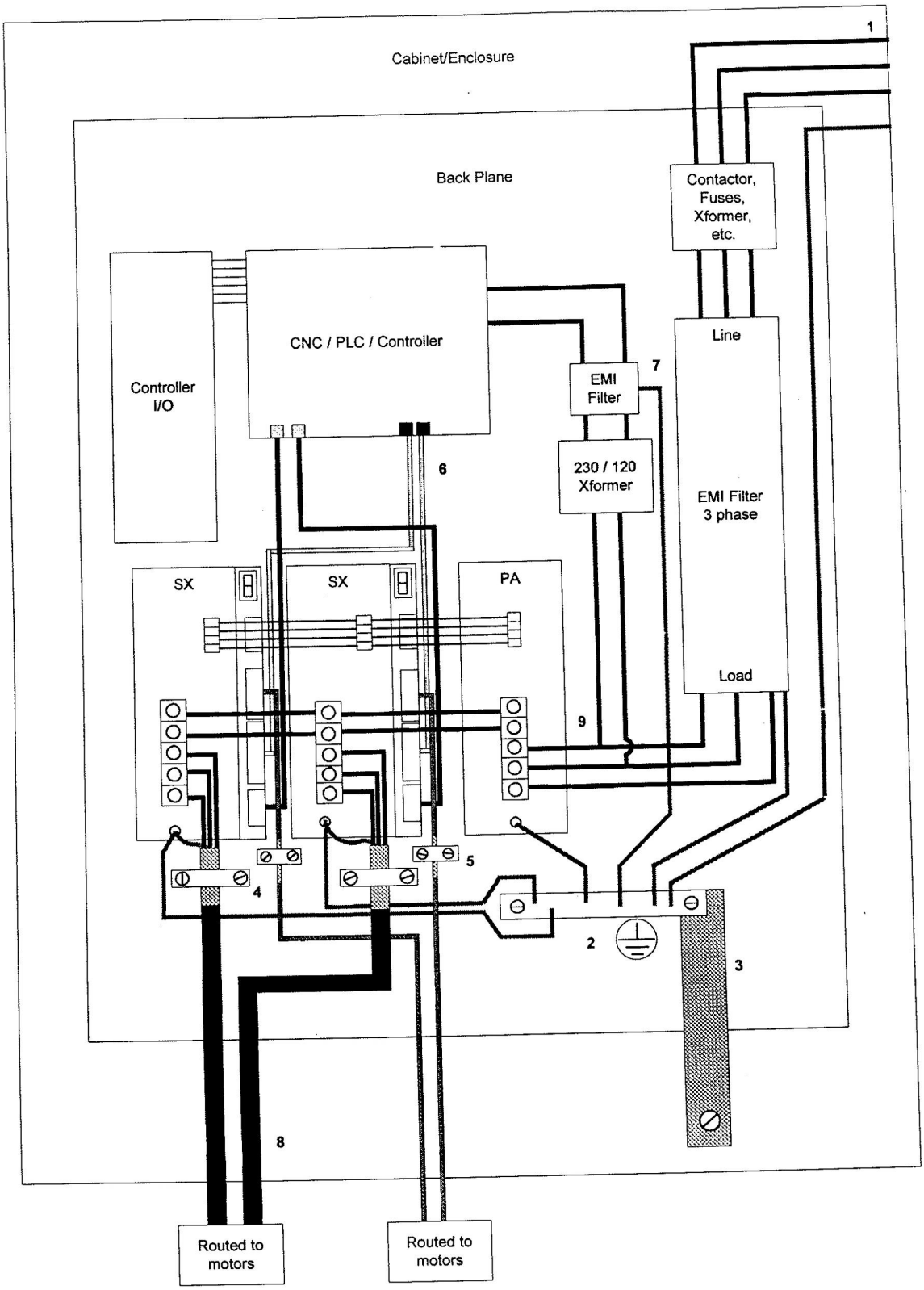




Flat cable clamp used with ribbon cable

Also, Fair-Rite Products Corporation has a varied selection which can suit most any application.

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SEE NUMBERED DESCRIPTIONS - NEXT PAGE

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Descriptions from numbers on drawing - from previous page

1. Input power - Enters enclosure from metal conduit. This bars the need for shielded input power cable.

2. Single point ground. A bus bar (ground bus) is an excellent way to achieve this.

3. High frequency ground between non conductive back panel and enclosure. A high frequency ground is required between the enclosure and earth ground also.

4. Bonding of the motor cables. The use of armored (screened) motor cables that are bonded as close to the drive as possible is essential for CE compliance and strongly recommended to better the overall performance and reliability of the system.

5. Screened and bonded feedback cabling is recommended for increased immunity and lower risk of radiation. Since the motor cable and feedback cable are in close proximity at the motor this feedback cable bonding is necessary. Also, separate the feedback and motor cables as much as possible. This will decrease the chances of the feedback signals getting corrupted.

6. Control signals (I/O) should be kept separate from all power and motor cables. Keep all control wiring as short as possible and use screened wire. Separation distance of 20cm (8in) should be sufficient in most cases. Where control cables must cross power cables, they should cross with an angle of 90 degrees.

7. Connect safety grounds to filters. This is critical to keep ground currents from causing personal injury.

8. When motor cables exit enclosure, keep in separate wireway or conduit from feedback and other control wiring. Separation distance of 20cm (8in) should be sufficient.

9. Input power wires should be kept clear of I/O and signal wires.

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8 Manufacturers

Schaffner

Schaffner Electronik AG
Nordstrasse 11
CH-4708 Luterbach
Switzerland
Phone 065 802 626
Fax 065 802 641

North America
Schaffner EMC Inc.
9-B Fadem Road
Springfield, NJ 07081
Phone 201 379-7778
Fax 201 379-1151

Corcom

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844 E. Rockland Road
Livertyville, Il 60048
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West Coast Sales Office
6700 Fallbrook Ave.
Suite 160
West Hills, CA 91307
USA
Phone 818 226-4306
Fax 818 704-1757

Filter Concepts

Filter Concepts Inc.
2624 South Rouselle Street
Santa Ana, CA 92707 USA
Phone 714 545-7003
Fax 714 545-4607

FerriShield

FerriShield Interference Control Components
Empire State Building
350 Fifth Ave., Suite 7505
New York, NY 10118-7591
Phone 212 268-4020
Fax 212 268-4023

Fair-Rite

Fair-Rite Products Corp.
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Wallkill, NY 12589
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Fax 914 8985-2629
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