KOLLMORGEN

Motion Technologies Group

EMC Installation and Application Guidelines for BDS4/5 Goldline Series

MB4000H Issue 3

CE

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Declaration of Conformity

This apparatus conforms to the protection requirements of Council directive 89/336/EEC 0n the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC) when used with external line filters, common mode chokes, and shielded cables. Refer to system wiring diagram and EMC installation guide lines (M96100) for suggested wiring instruction. Reference TCF (Technical Construction File) A-96812-001 for test information and criteria, EC Declaration of Conformity A-96877 through A96880 and Technical Certificate C173KOL1.MGS.

1. INTRODUCTION

The document has been prepared to provide guidance and requirements when installing Kollmorgen Goldline series components into the finial product by other manufactures. Motor drives may be operated in velocity, current, or position modes. The motor drives are intended for use in an Industrial environment.

2. EMC Environment

Products have been evaluated per EMC directive 89/336/EEC and harmonized standards. Appropriate test methods and levels for test have be done in accordance to EN 50081-2, EN 50082-2 and other standards for Industrial environment.

3. EMC TEST

Testing has been performed to evaluate the emissions performance with respect to EN 55011 and immunity to Electrostatic Discharge, Fast Transient Bursts, Lightning Transient, and Radiated Radio Frequency Immunity. Results from these test have provided the information needed to make recommendation to meet the EMC requirements. Test limits, results, and performance criteria are contained in TCF (Technical Construction File) A-96812-001. Technical Certificate (C173KOL1.MGS) for EMC directive 89/336/EEC has been completed by Interference Technology International Limited.

- Unexpected shutdowns.
- System communication errors.
- Erroneous I/O status.
- Equipment hardware failure such as fuse rupture, operation of overload devices.
- Actual component damage.

Any or all of the above effects may be regarded as a failure of the equipment depending on the severity of the disturbance and according to the performance criteria applicable to the test. In all cases it should be established that the recorded response of the equipment can be ascribed solely to the influence of the electromagnetic disturbance on the EUT (equipment under test).

4. Installation

The Kollmorgen **GOLD**line series of electronic system components are designed for panel assembly which in turned is mounted in a metallic enclosure. Enclosures are supplied by the manufacturers of the final product. To optimize EMC shielding, the enclosure should have continuous ground continuity maintained between all metal panels. Enclosure that have been designed to optimize EMC shielding may be used. Test were performed with shielded motor and resolver cables 10 meters in length. Control cables were also shielded and 4 meters in length.

In obtaining high quality servo operation and performance with high frequency controllers, proper wiring, grounding, and shielding techniques must be considered. Noise from today's servo controllers has several paths into the equipment. This noise is classified as either radiated or conducted. Most of the noise injected into the equipment is in the form of conducted noise. This noise may come from either the power leads or by being capacitively coupled from the controller into the system ground.

5. Filtering

5.1 Power Supply Filtering

One method of reducing conducted noises is to use EMI filters in the input power leads. These filters should be sized for voltage and current rating of the system. A single input line filter for each power input may be used for multi axis control. These filters should be as close to the power supply as possible so noise is not capacitively coupled into other signal leads. These filters will be either single or 3 phase design depending on the input power. Several manufactures 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.

The Kollmorgen **GOLD**line series of electronic system components require EMI filters in the input power leads to meet the conducted emission for industrial environment. This has been accomplished per the following recommendations.

- Filter must be mounted on the same panel as the motor drive and power supply.
- Filter must be mounted as close as possible to power supply.. If separation exceeds 30 cm (1 ft.) flat cable 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.
- 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 filter for 3 phase input or equivalent		Recommended filter for single phase control input or equivalent		Kollmorgen model number for EMI filter kits
	Manufacture	Model	Manufacture	Model	
PSR4/5A-X12	Schaffner	258-16/07	Corcom	F7202A	FLP-01
		or			
		258-30/07			
PSR4/5A-X20	Schaffner	258-30/07	Corcom	F7202A	FLP-01
PSR4/5A-250	Schaffner	258-55/07	Corcom	F7202A	FLP-20
		or			
		258-75/34			
PSR4/5A-275	Schaffner	258-75/34	Corcom	F7202A	FLP-21

Power Supply Filter recommendation for CE requirements:

5.2 Motor Filtering

Another filtering technique is the insertion of a common mode choke in the motor leads. A common mode choke acts to reduce the amplitude of the high frequency current pulses in the ground by adding impedance into the motor leads when the phase currents are not balanced. In order to reduce the noise the choke design should have a low impedance in the 1M to 25M Hz range for today's controllers. This would require using material with high permeability such as material 73. This material has a high permeability of 2500 μ_i , low resistivity (10² ohm-cm). A common mode choke can be constructed by wrapping multiple turns of all motor leads

through a ferrite "donut" core. Remember to wind all leads the same number of times and in the same direction. Inductance of the common mode choke should be 40 μ h or greater. Only the motor leads, not the ground lead should be used to create the choke. The ferrite used is designed for EMI attenuating and should be sized for the diameter wire and turns to be used. Multiple chokes may be used to lower the impedance to the desired level. For design considerations 3 to 10 turns should be considered. Several manufactures of this type of produce are Steward, Chomerics, Fair-Rite, Tokin, and TDK

The motor filter may also be an L C filter. The inductance of an L C filter will depend on the switching frequency of the controller and as a guide line .5 milli henry will be needed. Never tie a capacitor directly to the controller output leads as this could result in damage to the power stage of the controller.

Common mode filters should be sized for the proper voltage and current rating of the amplifier. Tokin's KA and KB series of filters are designed for motor controllers. The KB series would be the recommended series for a 230 volt system.

The Kollmorgen **GOLD**line series of electronic system components require common mode choke in the motor leads to meet the conducted emission for industrial environment. This has been accomplished per the following recommendations.

- Common mode choke must be mounted on the same panel as the motor drive.
- Common mode choke must be mounted as close as possible to motor drive.

Motor Drive Model no.	3 phase choke in motor leads for conducted emission testing (Chokes or presently under evaluation)	Kollmorgen model number for Commonmode choke assembly
BDS4A and BDS5A-X03	150 uh 3 phase choke (Schaffner RD 7137-36-0m5)	FLC-64
BDS4A and BDS5A-X06	150 uh 3 phase choke or(Schaffner RD 7137-36-0m5)	FLC-64
BDS4A and BDS5A-X10	150 uh 3 phase choke or (Schaffner RD 7137-36-0m5)	FLC-64
BDS4A and BDS5A-X20	150 uh 3 phase choke or (Schaffner RD 7137-36-0m5)	FLC-64
BDS4A and BDS5A-230	150 uh 3 phase choke or (Schaffner RD 7137-36-0m5)	FLC-64
BDS4A, BDS5A, and VFS5-240	150 uh 3 phase choke or (Schaffner RD 8137-64-0m5)	FLC-65
BDS4A, BDS5A, and VFS5-255	150 uh 3 phase choke or (Schaffner RD 8137-64-0m5)	FLC-65
VFS5-275	150 uh 3 phase choke	
VFS5-285	150 uh 3 phase choke	

Amplifier recommendation for CE requirements:

6. Wiring

PWM controller's noise is coupled into the ground when the PWM voltage is applied to the motor terminals. In most systems, the rate of change in voltage is less than 1 micro second and for a 230 VAC system the voltage applied to the motor terminals is 325 VDC. During both the rising and falling edges of the PWM voltages the motor case tends to follow the voltage applied due to the capacitive coupling from motor winding to motor case. Current will flow in the ground wire of a grounded motor when the voltage rises and falls. In order to prevent shock hazard the motor case will be grounded. For the ideal system, the motor ground needs to be tied as close as possible to the motor controller so that the lowest impedance ground path is obtained.

These current pulses are short in duration and occur at the PWM frequency. Electrical noise due to these pulses can radiate if proper techniques are not used. In order to prevent radiated or capacitive coupled noise to other cables, it is recommended that shielded motor cables with ground be used. For best results these motor wires are tightly bundled or twisted with the ground wire with a braided shield. This will typically reduce radiated or capacitive couple noise to other cables to an acceptable level.

Recommended input power leads should also be shielded or twisted to reduce radiated or capacitive couple noise. For best results the input power wires are tightly bundled or twisted with the ground wire.

6.1 Earthing

All chassis ground, signal ground, or common points need to be tied together at a star connection internal to the equipment. A star connection is a single point ground. This star connection is then tied with a single conductor to an earth ground point. Practicing this grounding technique will prevent ground loops and insure properly grounded equipment against shock hazards.

The single conductor used in this technique is to be sized per local electrical codes and should be low in inductance. This conductor and any other ground conductors may need to be braided cable for equipment using high frequency controllers. Braided cable will give high frequency noise a lower impedance to ground than standard stranded wire cable.

Recommendation for both Motor controllers and Power supplies.

- Use the largest area as ground conductor
- Keep all ground connections as short as physically possible
- Connect different parts of the ground system together using low impedance connections
- Follow all local safety regulations with regard to grounding.

6.2 Screening

The purpose of screening is to prevent any electromagnetic radiation escaping, or entering the system. The cabinet as well as the cables shields are parts of the screening.

Motor and power leads should be kept as far away as possible from the feedback transducer wiring and any other signal level wiring. Use shielded cable for all feedback and signal wiring to reduce the risk of noise problems. Also any unused wires should be terminated to ground to reduce risk of noise problems.

- Cables from motor drive or controller to the motor must be screened
- Cabinet, cable screen, and motor housing must be connected together to effectively form one screen
- Inside cabinets, is important that all panels are bonded together and have a low impedance at high frequencies. This may be accomplished be using braided cable to tie panels together.

7. Additional Measures

In addition to the earthing, screening and filtering measures, other additional methods may be implemented to reduce interference.

- Control and signal cables must be separated from power and motor cables. A 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.
- The motor case may also be isolated from the motor mounting. The motor case would then be grounded close to the controller to obtain the lowest impedance to the current source. This reduces the noises in the machine grounds. The expense of this technique may make it undesirable. Also local electric codes may not accept grounding the motor back to the controller.

To reduce interference from Electrostatic Discharge, Fast Transient Bursts, Surge, and Radiated Radio Frequency Immunity, the following clamp-on cores are recommended. FLA-40 shuld be used when encoder option board is used. This clamp on core reduces the possibility of interference on the leads. FLA-41 and 42 would be used on the serial communication cable for either the BDS5 or VFS5. The FLA-42 also is used with the extended I/O option.

Motor Drive Model no.	Modifications and Recommendations	Kollmorgen model number
BDS4A-XXX	FerriShield clamp on core model no. SS33B2036	FLA-40
BDS5A-XXX	FerriShield clamp on core model no. SS33B2032	FLA-41
and	FerriShield clamp on core model no. FA28B2480	or
VFS5-XXX	FerriShield clamp on core model no. SA28B4340	FLA-42

Amplifier recommendation for CE requirements

8. Typical Connection

Reference manual M93100 for complete hookup for BDS4. Reference manual M93101 for complete hookup for BDS5 and VFS5.

8.1. Simplified Connection Diagram



Figure 1

8.2. Bonding of Shielded Cables





8.3. Long Cables



To improve performance of Motor Drive with long cables install 150 ohm 50 watt resistors in parallel with each phase of choke.

8.4. Typical set up





9. Manufactures

9.1 Schaffner

Schaffner Elektronik 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 USA Phone 201 379-7778 Fax 201 379-1151

9.2 Corcom

World H	Ieadquarters	East Coa	ast Sales Office	West Co	oast Sales Office
844 E. R	Rockland Road	17 Sarah	n's Way	6700 Fa	llbrook Avenue,
Livertyv	ille, IL 60048	Fairhave	en, MA 02719	Suite 16	0
USA		USA		West Hi	lls, CA 91307
Phone	708 680-7400	Phone	508 992-4495	USA	
Fax	708 680-8169	Fax	508 992-3798	Phone	818 226-4306
				Fax	818 704-1757

9.3 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

10. Annexes

Kollmorgen purchase specification

10.1 Corcom Filter Kollmorgen No. Corcom No. A-97181 F7202A

10.2 Schaffner Filter

Kollmorgen No.	Schaffner No.
A-96776-003	FN258-30/07
A-96776-005	FN258-55/07
A-96777-001	FN258-75/34
A-96778	FN258-180/07

10.3 Schaffner Commonmode Choke

Kollmorgen No.	Schaffner No.
A-96843-005	RD 7137-36-0m5
A-96843-010	RD 8137-64-0m5

A-96874 (Outline for FLC-6X kits)

10.4 Ferrishield Core

Ferrishield No.
SS33B2036
SS33B2032
SS28B2480
SS28B4340