MMC-SD SERCOS Drive™

Hardware Manual

Version 1.0

G&L Motion Control, LLC

NOTE

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Should information not covered in this document be required, contact the Customer Service Department, G&L Motion Control, LLC 672 South Military Road, P.O. Box 1960, Fond du Lac, WI 54936-1960. Telephone us at (800) 558-4808 (within the United States only) or (920) 921–7100.

Release 0204

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MMC-SD SERCOS Drive Hardware Manual

1 Introduction

1.1 Overview

Features include:

- 460V, Three Phase drives available with power ratings of 1.3kW through 24kW
- Drive firmware in user upgradeable Flash memory
- Internal switch to control a mechanical brake
- Motor feedback types include incremental encoder, high resolution encoder, and resolver.
- UL Listed and CE Marked.

1.2 Contents of This Manual

This manual includes the following major topics:

- Information to safely operate and maintain the equipment in a safe manner.
- User responsibilities for product acceptance and storage.
- Power and environmental information for general power, control cabinet, grounding, heat control and handling.
- Procedures for mounting, wiring, and connecting the MMC Smart Drive and standard G&L Motion Control motors recommended for use with the MMC Smart Drive.
- Recommended drive system wiring guidelines for signal separation and differential devices. Methods to ensure ElectroMagnetic Compatibility.
- The location of connectors on the drive and descriptions of their functionality.
- Physical, electrical, environmental and functional specifications/ dimensions.
- Description of the minimal maintenance necessary.
- A troubleshooting chart of potential problems and possible solutions.
- Part numbers and descriptions for the drive and related equipment.

1.3 G&L Motion Control Support Contact

Contact your local G&L Motion Control representative for

- Sales and order support
- Product technical training
- Warranty support
- Support service agreements

G&L Motion Control Technical Support can be reached:

- In the United States, telephone (800) 558-4808
- Outside the United States, telephone (920) 921-7100
- In Europe, telephone (+44)151-546-2010,
  fax (+44)151-547-2801
- E-mail address:
  tech.support@giddings.com

2 Safety Precautions

READ AND UNDERSTAND THIS SECTION IN ITS ENTIRETY BEFORE UNDERTAKING INSTALLATION OR ADJUSTMENT OF THE DRIVE AND ANY ASSOCIATED SYSTEMS OR EQUIPMENT

The instructions contained in this section will help users to operate and maintain the equipment in a safe manner.

PLEASE REMEMBER THAT SAFETY IS EVERYONE'S RESPONSIBILITY

2.1 System Safety

The basic rules of safety set forth in this section are intended as a guide for the safe operation of equipment. This general safety information, along with explicit service, maintenance and operational materials, make up the complete instruction set. All personnel who operate, service or are involved with this equipment in any way should become totally familiar with this information prior to operating.

2.1.1 User Responsibility

It is the responsibility of the user to ensure that the procedures set forth here are followed and, should any major deviation or change in use from the original specifications be required, appropriate procedures should be established for the continued safe operation of the system. It is strongly recommended that you contact your OEM to ensure that the system can be safely converted for its new use and continue to operate in a safe manner.

2.1.2 Safety Instructions

1. Do not operate your equipment with safety devices bypassed or covers removed.
2. Only qualified personnel should operate the equipment.
3. Never perform service or maintenance while automatic control sequences are in operation.
4. To avoid shock or serious injury, only qualified personnel should perform maintenance on the system.

ATTENTION

Do not touch the main power supply fuses or any components internal to the power modules while the main power supply switch is ON. Note that when the main power switch is OFF, the incoming supply cable may be live.

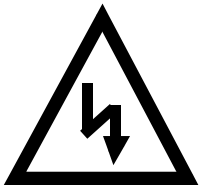
5. **GROUNDING (Protective Earth)**
   The equipment must be grounded (connected to the protective earth connection) according to OEM recommendations and to the latest local regulations for electrical safety. The grounding (protective earth) conductor must not be interrupted inside or outside the equipment enclosures. The wire used for equipment grounding (connection to protective earth) should be green with a yellow stripe.

2.2 Safety Signs

The purpose of a system of safety signs is to draw attention to objects and situations which could affect personal or plant safety. It should be noted that the use of safety signs does not replace the need for appropriate accident prevention measures. Always read and follow the instructions based upon the level of hazard or potential danger.

2.3 Warning Labels

Hazard warning



Danger Electric
Shock Risk

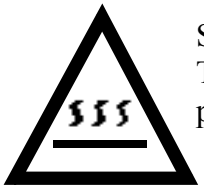
When you see this safety sign on a system, it gives a warning of a hazard or possibility of a hazard existing. The type of warning is given by the pictorial representation on the sign plus text if used.

To ignore such a caution could lead to severe injury or death arising from an unsafe practice.

Danger, Warning, or Caution warning

Symbol plus DANGER, WARNING or CAUTION:
These notices provide information intended to prevent potential personal injury and equipment damage.

Hot Surface warning



Symbol plus HOT SURFACE:
These notices provide information intended to prevent potential personal injury.

2.4 Safety First

G&L Motion Control equipment is designed and manufactured with consideration and care to generally accepted safety standards. However, the proper and safe performance of the equipment depends upon the use of sound and prudent operating, maintenance and servicing procedures by trained personnel under adequate supervision.

For your protection, and the protection of others, learn and always follow these safety rules. Observe warnings on machines and act accordingly. Form safe working habits by reading the rules and abiding by them. Keep these safety rules handy and review them from time to time to refresh your understanding of them.

2.5 Safety Inspection

2.5.1 Before Starting System

1. Ensure that all guards and safety devices are installed and operative and all doors which carry warning labels are closed and locked.
2. Ensure that all personnel are clear of those areas indicated as potentially hazardous.
3. Remove (from the operating zone) any materials, tools or other objects that could cause injury to personnel or damage the system.
4. Make sure that the control system is in an operational condition.
5. Make certain that all indicating lights, horns, pressure gauges or other safety devices or indicators are in working order.

2.6 After Shutdown

Make certain all controlled equipment in the plant is safe and the associated electrical, pneumatic or hydraulic power is turned off. It is permissible for the control equipment contained in enclosures to remain energized provided this does not conflict with the safety instructions found in this section.

2.7 Operating Safely

1. Do not operate the control system until you read and understand the operating instructions and become thoroughly familiar with the system and the controls.
2. Never operate the control system while a safety device or guard is removed or disconnected
3. Where access to the control system is permitted for manual operation, only those doors which provide that access should be unlocked. They should be locked immediately after the particular operation is completed.
4. Never remove warnings that are displayed on the equipment. Torn or worn labels should be replaced.
5. Do not start the control system until all personnel in the area have been warned.
6. Never sit or stand on anything that might cause you to fall onto the control equipment or its peripheral equipment.

7.

ATTENTION

Know the emergency stop procedures for the system.

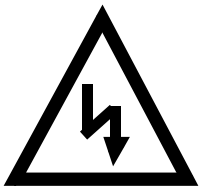
8. Never operate the equipment outside specification limits.
9. Keep alert and observe indicator lights, system messages and warnings that are displayed on the system.
10. Do not operate faulty or damaged equipment. Make certain proper service and maintenance procedures have been performed.

2.8 Electrical Service & Maintenance Safety

1. **ALL ELECTRICAL OR ELECTRONIC MAINTENANCE AND SERVICE SHOULD BE PERFORMED BY TRAINED AND AUTHORIZED PERSONNEL ONLY.**
2. It should be assumed at all times that the POWER is ON and all conditions treated as live. This practice assures a cautious approach which may prevent accident or injury.
3. To remove power:
   LOCK THE SUPPLY CIRCUIT DISCONNECTING MEANS IN THE OPEN POSITION.
   APPLY LOCKOUT/TAGOUT DEVICES IN ACCORDANCE WITH A DOCUMENTED AND ESTABLISHED POLICY.
4. Make sure the circuit is safe by using the proper test equipment. Check test equipment regularly
5.

ATTENTION

Care should be taken if you are manually discharging the bus capacitors.

WARNING
 Even after power to the drive is removed, it may take up to 10 minutes for bus capacitors to discharge to a level below 50 VDC. To be sure the capacitors are discharged, measure the voltage across the + and - terminals for the DC bus.

6. There may be circumstances where troubleshooting on live equipment is required. Under such conditions, special precautions must be taken:
   - Make sure your tools and body are clear of the areas of equipment which may be live.
   - Extra safety measures should be taken in damp areas.
   - Be alert and avoid any outside distractions.
   - Make certain another qualified person is in attendance.
7. Before applying power to any equipment, make certain that all personnel are clear of associated equipment.
8. Control panel doors should be unlocked only when checking out electrical equipment or wiring. On completion, close and lock panel doors.
9. All covers on junction panels should be fastened closed before leaving any job.
10. Never operate any controls while others are performing maintenance on the system.
11. Do not bypass a safety device.
12. Always use the proper tool for the job.
13. Replace the main supply fuses only when electrical power is OFF (locked out).

2.9 Safe Cleaning Practices

1. Do not use toxic or flammable solvents to clean control system hardware.
2. Turn off electrical power (lock out) before cleaning control system assemblies.
3. Keep electrical panel covers closed and power off when cleaning an enclosure.
4. Always clean up spills around the equipment immediately after they occur.

5. Never attempt to clean a control system while it is operating.
6. Never use water to clean control equipment unless you are certain that the equipment has been certified as sealed against water ingress. Water is a very good conductor of electricity and the single largest cause of death by electrocution.

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3 Installing the Drive

Note: The National Electrical Code and any other governing regional or local codes overrule the information in this manual. G&L Motion Control does not assume responsibility for the user's compliance or non-compliance with any code, national, local or otherwise, for the proper installation of this drive and associated systems or equipment. Failure to abide by applicable codes creates the hazard of personal injury and/or equipment damage.

3.1 Storing the Drive Before Installation

The drive should remain in the shipping container prior to installation. If the equipment is not to be used for a period of time, store it as follows:

- Use a clean, dry location
- Maintain the storage temperature and humidity as shown in the specifications section of this manual.
- Store it where it cannot be exposed to a corrosive atmosphere
- Store it in a non-construction area

3.2 Unpacking the Drive

Remove all packing material, wedges, and braces from within and around the components. After unpacking, check the name plate Material Number against the purchase order of the item(s) against the packing list. The model number, serial number and manufacturing date code are located on the side of the unit.

3.3 Handling a Drive

The case protects the drive's internal circuitry against mechanical damage in shipping and handling.

However, like any electronic device, the circuitry can be destroyed by:

- Conditions exceeding those detailed in the specifications tables shown in the Specifications sections in this manual.
- moisture condensing inside the module
- static discharge
- exposure to a magnetic field strong enough to induce a current in the circuitry
- vibration, and other hazards

3.4 Inspecting the Drive Before Installation

Inspect the unit for any physical damage that may have been sustained during shipment.

If you find damage, either concealed or visible, contact your buyer to make a claim with the shipper. If degraded performance is detected when testing the unit, contact your distributor or G&L Motion Control. Do this as soon as possible after receipt of the unit.

3.5 Complying with European Directives

For industrial products installed within the European Union or EEC regions, certain directives and standards apply. See "Conformity" in the Specifications sections of this manual for applicable directives.

Servo amplifiers are considered to be subsystems when incorporated into electrical plants and machines for industrial use. G&L Motion Control servo amplifiers have been designed and tested as such. They bear the CE mark and are provided with a Declaration of Conformance. However, it is the overall machine or system design that must meet European Directives and standards. To help the manufacturer of the machine or plant meet these directives and standards, specific guidelines are provided in this documentation. These include such things as shielding, grounding, filters, treatment of connectors and cable layout.

3.6 Conforming with UL and cUL Standards

G&L Motion Control drives meet safety and fire hazard requirements as outlined in "Conformity" in the Specifications sections in this manual.

3.7 General Installation and Ventilation Requirements

- The drive must be enclosed in a grounded NEMA12 enclosure offering protection to IP55 such that they are not accessible to an operator or unskilled person, in order to comply with UL® and CE requirements. A NEMA 4X enclosure exceeds these requirements providing protection to IP66.
- The environmental conditions must not exceed those detailed in the specifications tables shown in the Specifications sections in this manual.
- Install the panel on a properly bonded, flat, rigid, non-painted galvanized steel, vertical surface that won't be subjected to shock, vibration, moisture, oil mist, dust, or corrosive vapors.

- Maintain minimum clearances for proper airflow, easy module access, and proper cable bend radius.
- Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the drive removed from the enclosure. Because the drive is of the open type construction, be careful to keep any metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry, which can result in damage to components.

The drive is suitable for operation in a pollution degree 2 environment (i.e., normally, only non-conductive pollution occurs). Install the drive away from all sources of strong electromagnetic noise. Such noise can interfere with drive operation.

Protect the drive system from all the following:

- conductive fluids and particles
- corrosive atmosphere
- explosive atmosphere

Diagrams included with this manual and recommendations may be modified if necessary so the wiring conforms to current NEC standards or government regulations.

Table 3-1: Cabinet Clearance Dimensions

Location	Minimum Clearance
Above Drive Body	4.0 in. (100 mm)
Below Drive Body	4.0 in. (100 mm)
Each Side of Drive	None
In Front of Drive (for cabling)	3.0 in. (76.2 mm)

NOTE

Use filtered or conditioned air in ventilated cabinets. The air should be free of oil, corrosives, or electrically conductive contaminants.

3.8 Controlling Heat Within the System

The drive hardware case is designed to promote air circulation and dissipate heat. Normally no fans or air conditioners are needed. However, if the environment outside the control cabinet is hot or humid, you may need to use a fan, heat exchanger, dehumidifier or air conditioner to provide the correct operating environment.

Make sure that the temperature and humidity within the drive cabinet does not exceed that which is shown in the specifications sections of this manual.

Make sure that components installed in the cabinet with the drive do not raise the temperature above system limits and that any hot spots do not exceed specifications. For example, when heat-generating components such as transformers, other drives or motor controls are installed, separate them from the drive by doing one of the following:

- Place them near the top of the control cabinet so their heat output rises away from the drive.
- Put them in another control cabinet above or to one side of the cabinet with the drive. This protects the drive from both heat and electrical noise.

The drive itself is a source of heat, though in most installations its heat dissipates without harmful effects. System heat is generated from power dissipated by:

- the drive
- field side input/output components
- other drives in the cabinet
- the logic power supply
- external shunt resistors
- line reactors

CAUTION
If the drive is operated outside the recommended environmental limits, it may be damaged. This will void the warranty.

3.9 Bonding

Connecting metal chassis, assemblies, frames, shields and enclosures to reduce the effects of electromagnetic interference (EMI) is the process of bonding.

Most paints act as insulators. To achieve a good bond between system components, surfaces need to be paint-free or metal plated. Bonding metal surfaces creates a low-impedance exit path for high-frequency energy. Improper bonding blocks this direct exit path and allows high-frequency energy to travel elsewhere in the cabinet. Excessive high-frequency energy can negatively affect the operation of the drive.

3.9.1 Bonding a Subpanel Using a Stud

1. Weld threaded mounting studs to the back of the enclosure.
2. Brush off any non-conductive materials (e.g. paint) from the studs.
3. Remove any non-conductive materials from the front of the subpanel.
4. Position the mounting holes on the subpanel over the mounting studs on the back of the enclosure and slide the subpanel onto the studs.
5. Attach the subpanel to the mounting stud by sliding a star washer over the stud and then turn and tighten a nut onto the stud.

3.9.2 Bonding a Ground Bus Using a Stud

1. Weld threaded mounting studs to the back of the subpanel.
2. Brush off any non-conductive materials (e.g. paint) from the studs.
3. Slide a flat washer over the studs.
4. Remove any non-conductive materials from around the mounting hole on the chassis mounting bracket or ground bus.
5. Position the mounting hole of the chassis or ground bus over the studs on the back of the subpanel and slide the mounting bracket or ground bus onto the stud.
6. Attach the subpanel to the subpanel stud by sliding a star washer and then a flat washer over the stud. Turn and tighten a nut onto the stud.

3.9.3 Bonding a Ground Bus or Chassis Using a Bolt

1. Brush off any non-conductive materials (e.g. paint) from the threaded bolt (s).
2. Slide a star washer over the threaded bolt (s).
3. Use a subpanel having tapped mounting holes. Remove any non-conductive materials from around the mounting holes on both sides of the subpanel.
4. Turn the threaded bolts into the subpanel mounting holes.
5. Slide a star washer onto the threaded end of the bolt.
6. Turn and tighten a nut onto the stud.
7. Slide a flat washer onto the threaded end of the bolt.
8. Position the mounting holes on the groundbus or mounting bracket over the threaded bolts and turn the bolts until they come through the grounding bus or mounting bracket.
9. Slide a star washer onto the threaded end of the bolt.
10. Slide a flat washer onto the threaded end of the bolt.
11. Turn and tighten a nut onto the bolt.

3.9.4 Grounding Multiple Drive Cabinets

1. Mount one bonded ground bus in each cabinet.
2. Designate the cabinet ground bus in one and only one of the cabinets as the common ground bus for all of the cabinets in the system.
3. Connect the ground wires from the ground bus in each individual cabinet ground bus to the designated common ground bus (mounted in only one of the cabinets).
4. Connect the common cabinet ground bus to an external ground system that is connected to a single point ground.

3.9.5 Bonding Multiple Subpanels

G&L Motion Control recommends bonding both the top and bottom of subpanels sharing the same enclosure. Use a 25.4 mm (1.0 in.) x 6.35 mm (0.25) wire braid. Be sure the area around each wire braid fastener is clear of any non-conductive materials. Bond the cabinet ground bus to at least one of the subpanels.

NOTE

Subpanels that are not bonded together may not share a common low impedance path. This difference in impedance may affect networks and other devices that span multiple panels.

3.10 Drive Mounting Guidelines

- A control cabinet for the drive should have a NEMA-12 rating or better. A cabinet with this rating protects its contents from dust and mechanical damage.
- The cabinet must be large enough to provide adequate air circulation for the drive and other components. Always allow for adequate air flow through the drive vents.
- The cabinet must have a rigid non-painted galvanized metal surface to mount the drive on.
- The cabinet door should open fully for easy access.

IMPORTANT

Post warnings according to National, State, or local codes for the voltage present in the control cabinet. Diagrams included with this manual and recommendations may be modified if necessary so the wiring conforms to current NEC standards or government regulations.

NOTE

This drive contains parts and assemblies that are sensitive to ESD (Electrostatic Discharge). Follow static control precautions during installation, testing, service, or repair of this assembly. Parts and assemblies can be damaged if proper precautions are not taken.

1. Lay out the positions for the drive and accessories in the enclosure.
2. Attach the drive to the cabinet, first using the upper mounting slots of the drive and then the lower. The recommended mounting hardware is M5 metric (#10-32).
3. Tighten all mounting fasteners.

3.11 Drive System Grounding Procedures

The ground of the drive power source must be connected directly to a ***Single Point Ground*** **(SPG)** tie block. The tie block should be made of brass or copper, bolted or brazed to the control cabinet. If the tie block is bolted rather than brazed, scrape away paint or grease at the point of contact. Put star washers between the tie block and the cabinet to ensure good electrical contact.

Metal enclosures of power supplies, drives, etc., should also have good electrical contact with the SPG.

CAUTION
The Single Point Ground should be the only common point for all the ground lines. If not, ground loops may cause current flow among components of the system which can interfere with proper operation of the drive.

Devices to be connected directly to the Single Point Ground include:

- Plant safety ground.
- Protective earth ground(s) from the drive power terminals.
- The metal panel or cabinet on which the drive is mounted.
- "Common" or "0 V" lines from power supplies that provide +24 power to devices and external power to the I/O modules and the devices to which they are connected.
- Protective grounds from the devices themselves, such as device drivers, machinery, and operator interface devices.
- Protective earth ground from line and load sides of any AC line filters.
- The ground of the power source of the computer workstation or laptop, if any, from which you monitor the system operation. An AC outlet in the control cabinet is recommended.
- Single point grounds from other control cabinets, if any, in the system.

IMPORTANT

You must ensure that the "0V" or "Common" of all devices connected to the drive are connected to Single Point Ground (SPG). Failure to do so may result in erratic operation or damage to the drive and devices connected to it. Examples of devices connected to the drive include the power source that supplies power to the drive and devices connected to the Serial Communications Port. Note that some devices (for example, a Personal Computer) may have their "0V" and "Protective Earth Ground" connected together internally, in which case only one connection has to be made to SPG for that device. Also note that the AC/DC converter for some portable PCs have chassis connected from the wall plug to the PC. The ground for the AC outlet must be connected to the SPG.

Also, you must ensure that the drive "Protective Earth Ground" connection is connected to SPG, and that the drive is mounted to a metal panel or enclosure that is connected to SPG.

3.11.1 Grounding Multiple Drives in the Same Cabinet

1. Mount a common bonded ground bus in the cabinet.
2. Connect the ground wires for all drives to the common bonded cabinet ground bus.
3. Connect the common bonded cabinet ground bus to an external ground system that is connected to a single point ground.

3.12 System Wiring Guidelines

The drive relies on electrical signals to report what is going on in the application and to send commands to it. In addition, signals are constantly being exchanged within the system. The drive is designed for use in industrial environments, but some guidelines should be followed.

This section contains common system wiring configurations, size, and practices that can be used in a majority of applications. National Electrical Code, local electrical codes, special operating temperatures, duty cycles, or system configurations take precedence over the values and methods provided.

Wherever possible, install wiring and related components in the following order:

1. main power line disconnecting means
2. transformer (optional)
3. fuses (SCPD)
4. motor control
5. line reactor (as required)
6. line filter (optional)
7. device protection fuses (as required)
8. drive
9. shunt resistors (optional)

3.12.1 Recommended Signal Separation

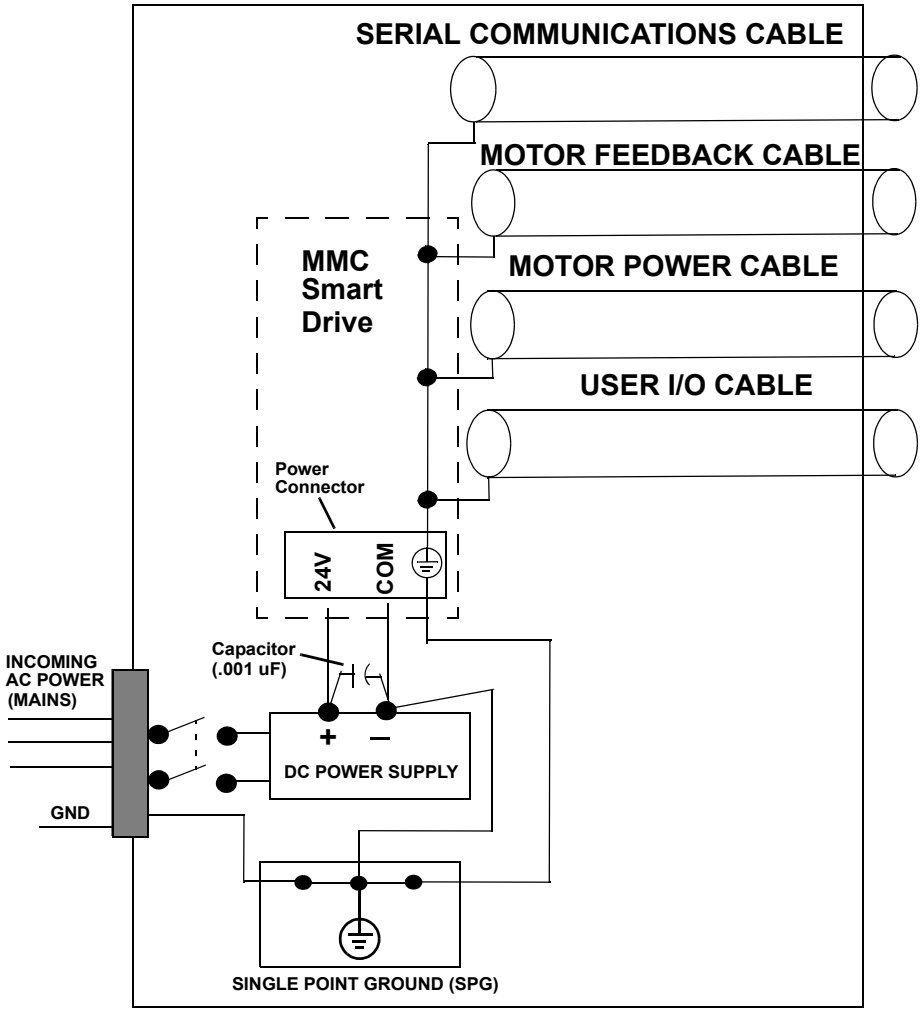
G&L Motion Control recommends separation of low level signals (encoder, analog, communications, fast DC inputs) from high voltage or high current lines. Maintain at least two inches of separation.

Inside a control cabinet, connect the shields of shielded cables at the drive. It is recommended that factory cables (from G&L Motion Control) are used between MMC drives, controls, and motors to ensure CE compliance.

WARNING

Use care when wiring I/O devices to the drive and when plugging in cables. Wiring the wrong device to the connector or plugging a connector into the wrong location could cause intermittent or incorrect machine operation or damage to equipment.

Figure 3-1: Recommended Signal Separation



To prevent excessive conducted emissions from a DC power source (typically 24V) used for digital I/O, a .001 micro farad capacitor should be used. Connect the capacitor from the +24V DC to COMMON at the distribution terminals.

3.12.2 Building Your Own Cables

- Connect the cable shield to the connector shells on both ends of the cable for a complete 360 degree connection.
- Use a twisted pair cable whenever possible, twisting differential signals with each other, and single-ended signals with the appropriate ground return.

NOTE
G&L Motion Control cables are designed to minimize EMI and are recommended over hand-built cables.

3.12.3 Routing Cables

Guidelines for routing cables in a cabinet include the following:

- Always route power and control cables separately.
- Do not run high and low voltage wires/cable in the same wireway.
- Cross high and low voltage conductors at 90 degree angles.
- On parallel cable runs, maximize the distance between high and low voltage cables.
- Maintain the least amount of unshielded cable leads.

3.13 Wiring the Drive

These procedures assume you have bonded and mounted your drive to the subpanel and that there is no power applied to the system.

3.13.1 Sizing the 24V Power Supply

When you size your power supply, you must ensure that the supply is large enough to handle the total load. Refer to the specification tables for the +24VDC input power requirements.

In most cases, one power supply can be used for an entire control system. However, depending upon the drives and external I/O used in the application, the power distribution may be split into two or more power supplies.

Use of switches in series with the 24VDC power input is not recommended. The drive contains energy storage capacitors at the inputs. While no harm is done to the drive, this much capacitance across the 24VDC source may cause voltage dips when the switch in series with the 24VDC power is closed.

CAUTION

A possible ignition hazard within the drive exists if excessive current is drawn from the 24 VDC powering the drive. To prevent this possibility (due to improper wiring or 24 VDC supply failure), a fuse should be used in series with the 24 VDC to the drive. Specifically, a 4 A max. "UL248 Series" fuse should be used. In addition, the 24 VDC shall be supplied by an isolating source such that the maximum open circuit voltage available to the drive is not more than 30 VDC.

The +24V power to the drive is connected through a Wieland 6-pin (X100) connector with a plug-in terminal block. The ground from the power source and the ground from the drive must be connected to the Single-Point Ground (SPG). Devices connected to the User I/O may have their own power sources for input or output control signals provided that each one is:

- at the correct voltage and current levels for the module and the device.
- connected to the same Single-Point Ground that the drive uses.

It is recommended that the same main disconnect switch be used for the drive and for all devices in the application.

IMPORTANT

No matter how the system is installed, before you connect the MMC Smart Drive to the application, make sure that power is off to the system and to the devices that are wired to the drive.

3.13.2 System AC Power Wiring Guidelines

NOTE
In addition to the guidelines listed below, follow all national and local electrical codes and regulations.

- Install a supply circuit disconnecting means.
- Install a Short Circuit Protective Device (SCPD).
- Due to high inrush current at power-up, use dual element time delay fuses for the SCPD.
- Install additional device protection fusing. Only high speed type fuses provide proper protection.
- Refer to the Specifications section of this manual for device and conductor requirements.
- Clamp the motor power cable shield to the drive.
- Use shielded cables and AC line filters (for CE Compliance). Make sure that wiring from the drive to the line filter is as short as possible. Locate common grounding bus bars as close as possible to the drive. The braid shield of the cable should be clamped at the drive or mounting panel.
- Power connections for each drive in a system should be separately connected directly to the AC power supply. Do not daisy chain drive power connections.
- Make sure the phase to neutral ground voltage does not exceed the input ratings of the drive when using an autotransformer.

3.13.3 Connecting Interface Cables

IMPORTANT

This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Follow static control precautions when installing, testing, servicing, or repairing components in a drive system.

- Plug the 9-pin D-shell, serial PiCPro cable into the X1 port.
- Plug the one 15-pin D-shell, Feedback cable into the ENC-02 connector.
- Plug in the SERCOS Transmit and Receive fiber optic cables.
- Tighten the attachment screws for all cables to the drive connectors.

WARNING

To avoid personal injury and/or equipment damage:

- Ensure installation complies with specifications regarding wire types, conductor sizes, branch circuit protection, and disconnect devices. The National Electrical Code (NEC) and local codes outline provisions for safely installing electrical equipment.
- Ensure motor power connectors are used for connection purposes only. Do not use them to turn the unit on and off.
- To avoid personal injury and/or equipment damage, ensure shielded power cables are grounded to prevent potentially high voltages on the shield.

3.13.4 Preparing Motor Connection Wires

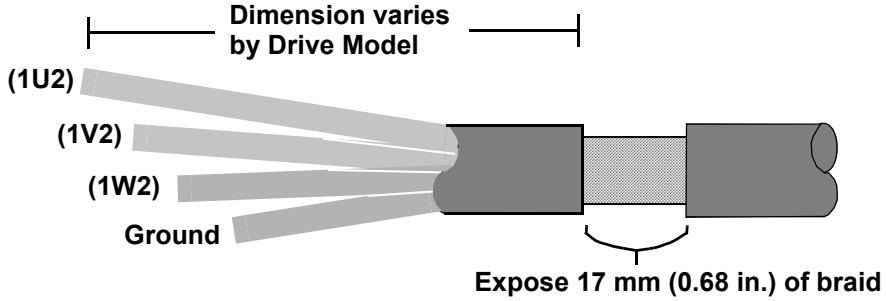
NOTE
It is recommended that G&L Motion Control cables be used. G&L Motion Control cables are designed to minimize EMI and are recommended over hand-built cables.

1. Strip back cable jacket approximately 152 mm (6.0 in.) from the end of the cable.
2. Strip approximately 12 mm (0.50 in.) of insulation from the end of each conductor. Do not tin ends after stripping.

IMPORTANT
Do not nick, cut or damage wire strands while removing wire insulation.

3. Strip the cable jacket away from the cable until the shield braid is visible. Expose 17 mm (0.68 in.) of cable shield braid.

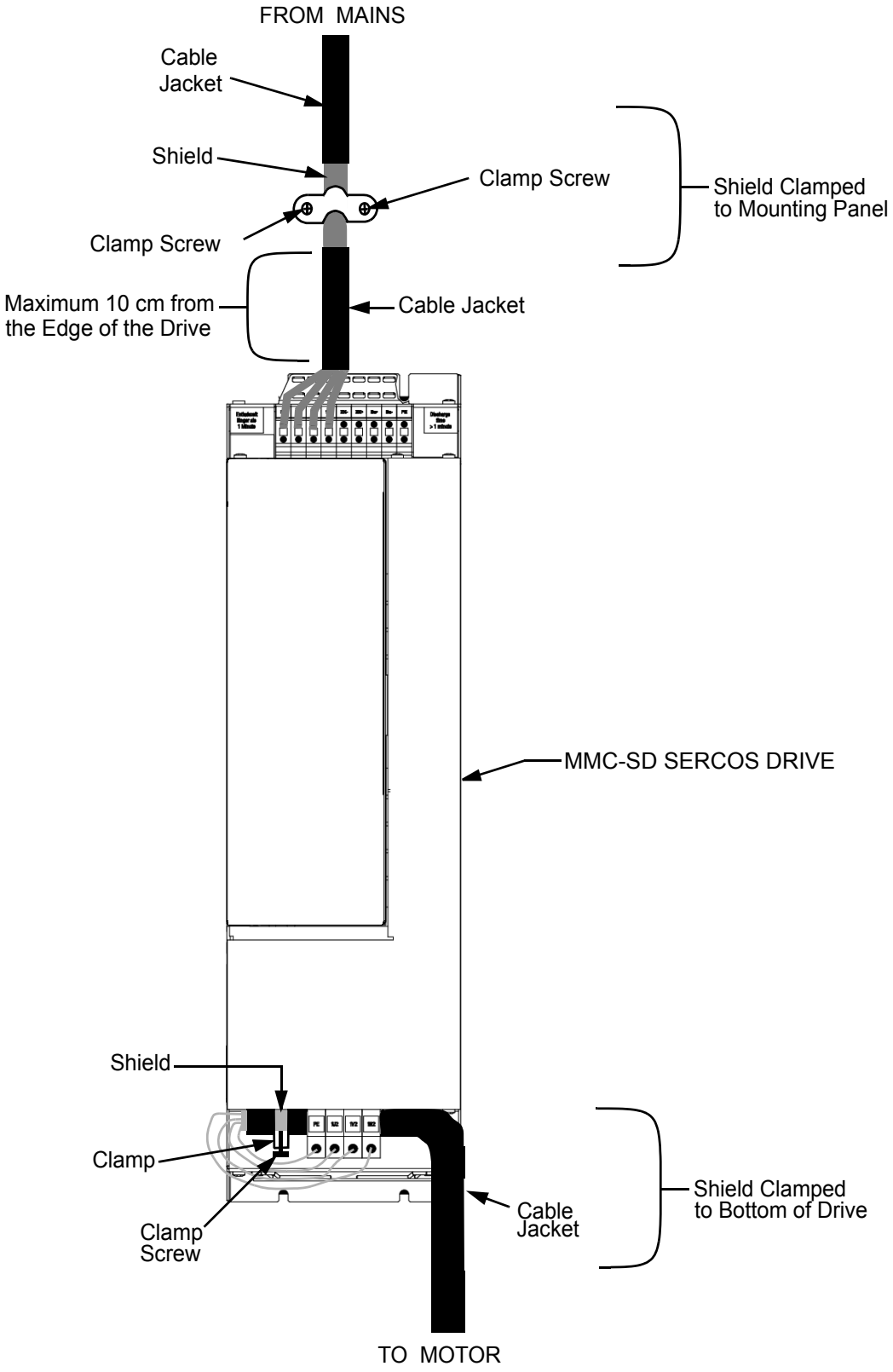
Figure 3-2: : Motor Cable



4. Attach the individual wires from the motor cable to their assigned terminal. Refer to Chapters 5 and 6 for front panel connectors and terminal assignments.
5. Tighten each terminal screw.
6. Gently pull on each wire to make sure it does not come out of its terminal. Reinsert and tighten any loose wires.
7. Attach the plastic cover to terminal block

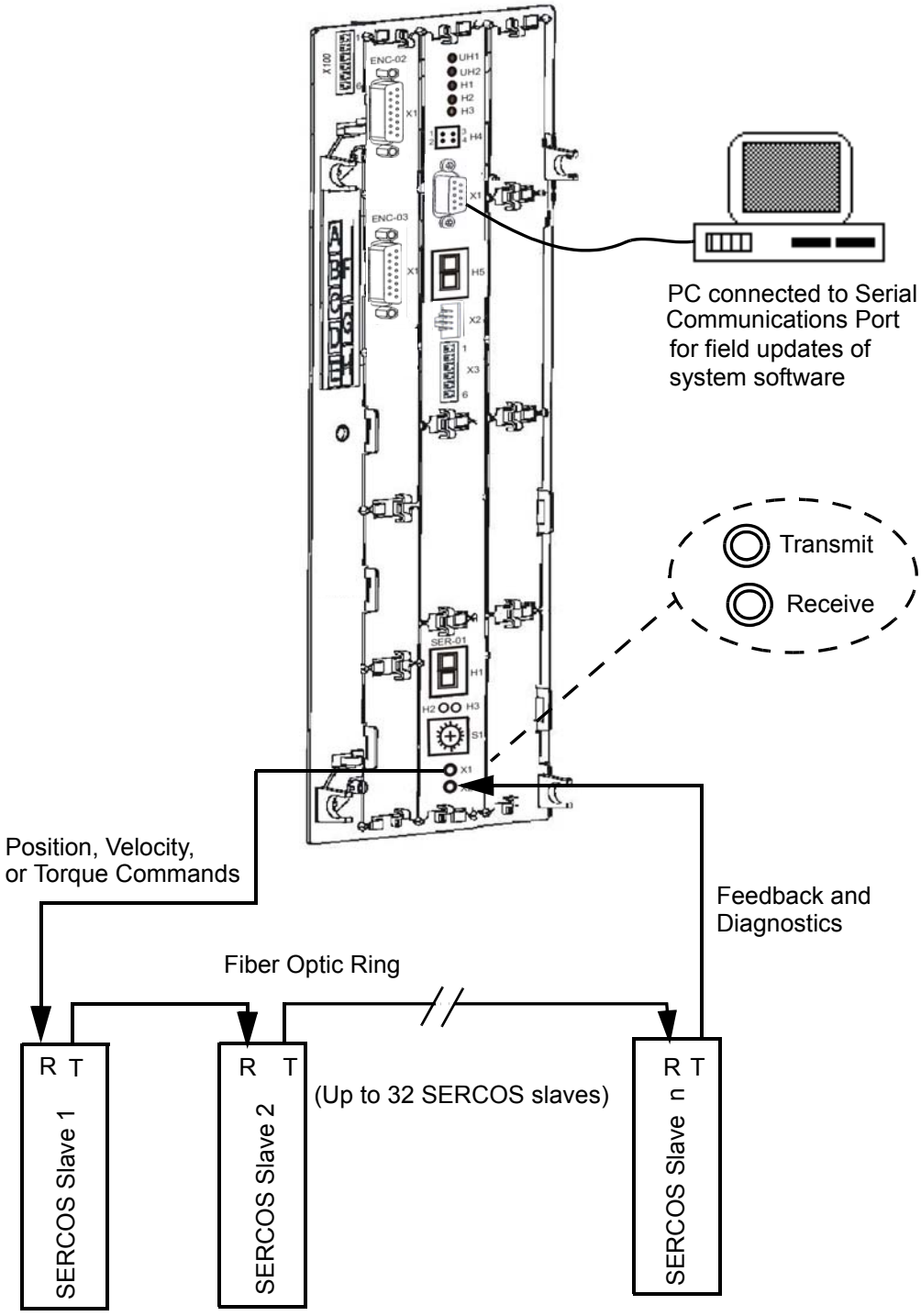
Factory supplied motor power cables for LSM and MSM Series motors are shielded, and the power cable is designed to be terminated at the drive during installation. A small portion of the cable jacket is removed which exposes the shield braid. The exposed shield braid must be clamped to the drive chassis using a cable clamp and clamp screws.

Figure 3-3: Terminating Incoming AC Power (Mains) Cable for the Drive



3.14 MMC SERCOS Connections for Motion Control

The SERCOS port can connect to one SERCOS ring. The connection to this ring is made through a pair of female fiber optic SMA connectors. The module's transmitter is connected to the first receiver in the loop and the module's receiver is connected to the last transmitter in the loop.



The following procedure assumes the controller interface and drive SERCOS interface system is mounted and ready for connecting the fiber optic cables.

1. Insert one end of a fiber optic cable into the Receive SERCOS connector on the drive.
2. Thread the connector on finger tight.
3. Insert the other end of the cable (from step 1) into the Transmit SERCOS connector.
4. Thread the connector on finger tight.
5. Insert one end of another fiber optic cable into the Transmit SERCOS connector on the drive.
6. Thread the connector on finger tight.
7. Insert the other end of the cable (from step 5) into the Receive SERCOS connector.
8. Thread the connector on finger tight.

4 System Power Protection and Related Devices

4.1 Motor Overload Protection

The drive utilizes solid state motor overload protection in accordance with UL508C that operates:

- within 8 minutes at 200% overload
- within 20 seconds at 600% overload

4.2 Fuses

4.2.1 Fuse Sizing

Branch Circuit Protection must be provided for the drive in accordance with NFPA 79 7.2.3 and 7.2.10. Bussmann or equivalent Class RK1, J, or CC dual element time delay type fuses should be used as the branch circuit SCPD (Short Circuit Protection Device). Supplemental UL1007 protectors shall not be used to provide Branch Circuit Protection. Fuses are sized based on the drive input current rating and maximum SCPD rating designations shown in NFPA 79 Table 7.2.10.1. Input mains conductor size is based on designations shown in NFPA Table 7.2.10.4 and 13.5.1.

Table 4-1: AC Input Power Requirements

Drive Model	Requirements			
	Input Current	Branch Circuit Fuse (Amps)	Conductor (AWG)	Transformer (kVA)*
MMC-SD-1.3-460-SER	2.5	4	14	1.94
MMC-SD-2.4-460-SER	4.2	7	14	3.33
MMC-SD-4.0-460-SER	7	12	14	5.6
MMC-SD-6.0-460-SER	10.8	17.5	14	8.6
MMC-SD-8.0-460-SER	14.8	25	12	11.8
MMC-SD-12.0-460-SER	16.7	25	12	13.3
MMC-SD-16.0-460-SER	21.1	35	10	16.8
MMC-SD-24.0-460-SER	33.1	50	8	26.3

* See Section 4.5 for calculating application transformer requirements.

Table 4-2: NFPA 79 Table 7.2.10.1 (Extraction)

Fuse Class with Time Delay	Full Load Current (%)
	AC-2
RK-1	150
J	150
CC	150

Table 4-3: NFPA 79 Table 7.2.10.4 (Extraction)

Conductor Size (AWG)	Maximum Rating
	Time Delay-Dual Element Fuse (amps)
14	30
12	40
10	50
8	80
6	100

4.2.2 Device Protection

To comply with UL508C, additional device protection is required for the MMC-SD 460V model drives. High Speed (semiconductor) type fuses must be applied in series with the Branch Circuit protection and wired directly before the drive input mains. Reference Figure 4-8 on page 51.

Table 4-4 on page 38 lists the maximum I^2t allowed for each drive. Table 4-5 on page 39 provides a list of Bussman High Speed fuses that meet these requirements.

Table 4-4: Device Protection

Drive Model	Maximum Load Value [1)]
MMC-SD-1.3-460-SER	$\leq 310\ A^2s$
MMC-SD-2.4-460-SER	$\leq 310\ A^2s$
MMC-SD-4.0-460-SER	$\leq 450\ A^2s$
MMC-SD-6.0-460-SER	$\leq 450\ A^2s$
MMC-SD-8.0-460-SER	$\leq 450\ A^2s$
MMC-SD-12.0-460-SER	$\leq 1,500\ A^2s$
MMC-SD-16.0-460-SER	$\leq 1{,}500\ A^2s$
MMC-SD-24.0-460-SER	$\leq 1{,}500\ A^2s$

[1)] Use fuses that fall in the operating point below the stated release integral (I^2t)

Table 4-5: Bussmann Fuses for Device Protection

Drive Model	High Speed Device Protection Fuse	
MMC-SD-1.3-460-SER	25 A / 690 V	Bussmann 170M1561
MMC-SD-2.4-460-SER	25 A / 690 V	Bussmann 170M1561
MMC-SD-4.0-460-SER	25 A / 690 V	Bussmann170M1561
MMC-SD-6.0-460-SER	25 A / 690 V	Bussmann 170M1561
MMC-SD-8.0-460-SER	40 A / 690 V	Bussmann 170M1563
MMC-SD-12.0-460-SER	63 A / 690 V	Bussmann 170M1565
MMC-SD-16.0-460-SER	63 A / 690 V	Bussmann 170M1565
MMC-SD-24.0-460-SER	80 A / 690 V	Bussmann 170M3811

NOTE

Fuses from other manufacturers can be used if they meet the requirements in Figure 4-4 on page 38. The approved fuses in Table 4-5 are UL recognized.

4.3 Short Circuit Protection

Table 4-6: Motor Short Circuit Protection Ratings

Drive	Short Circuit Current Rating with No Fuse Restrictions	Short Circuit Current Rating with Fuse Restrictions
460V Drives	Suitable for use on a circuit capable of delivering not more than 5000 RMS symmetrical short circuit Amperes, 480 Volts maximum.	Suitable for use on a circuit capable of delivering not more than 18,000 RMS symmetrical Amperes, 480 Volts maximum, when protected by high speed (semiconductor) fuses as listed.

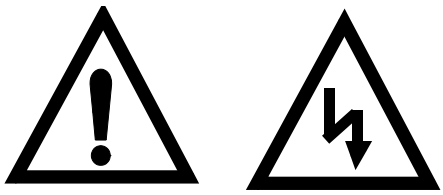
4.4 Line Reactors

AC Line Reactors are required when using some models of the drives. They protect the drive from impermissible rates of current and reduce harmonic current distortions. When required, they are mounted between the drive and the mains input power source.

NOTE

Multiple drives or inverters on a common power line require one reactor per drive. Individual reactors provide filtering between each drive (and thereby reduce crosstalk) and also provide optimum surge protection for each unit. A single reactor serving several drives does not provide adequate protection, filtering or harmonic reduction when the system is partially loaded. Refer to Figure 4-1 for an example of one line reactor connected to one drive.

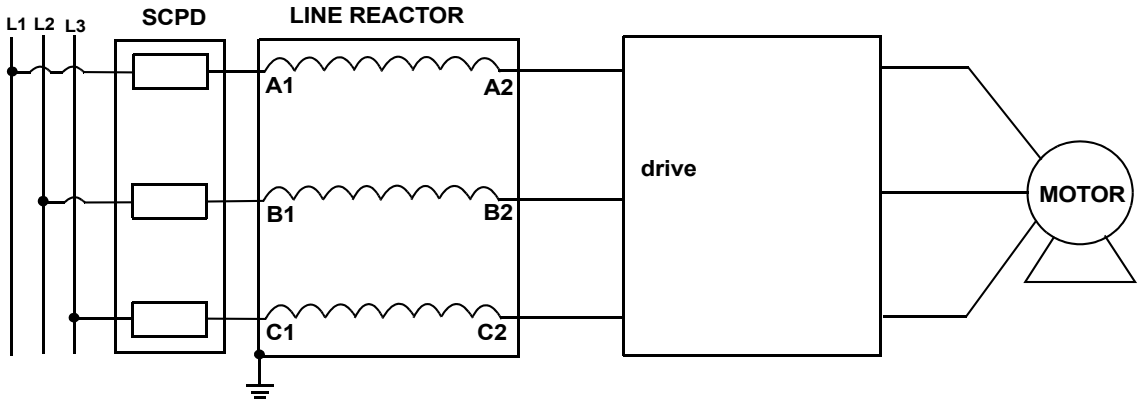
WARNING



Danger Electric Shock Risk

The frame of line/load reactors must be grounded at one of the reactor mounting holes typically by using a star washer under the heads of the mounting bolts. INJURY OR DEATH MAY RESULT IF THESE SAFETY PRECAUTIONS ARE NOT OBSERVED.

Figure 4-1: Line Reactor Connection (Simplified)



Line reactors are not necessary for the size 1 and 2 drives. Line reactors are required for the size 3 drives.

4.4.1 Specifications and Dimensions for Required Line Reactors

Table 4-7: MMC-SD-12-460-SER Specifications and Dimensions				
Fundamental Amperage	**Power Loss**	**Inductance**	**Weight**	**Part Number**
25 A	52 W	1.2 mH	14 lbs.	M.1302.7373

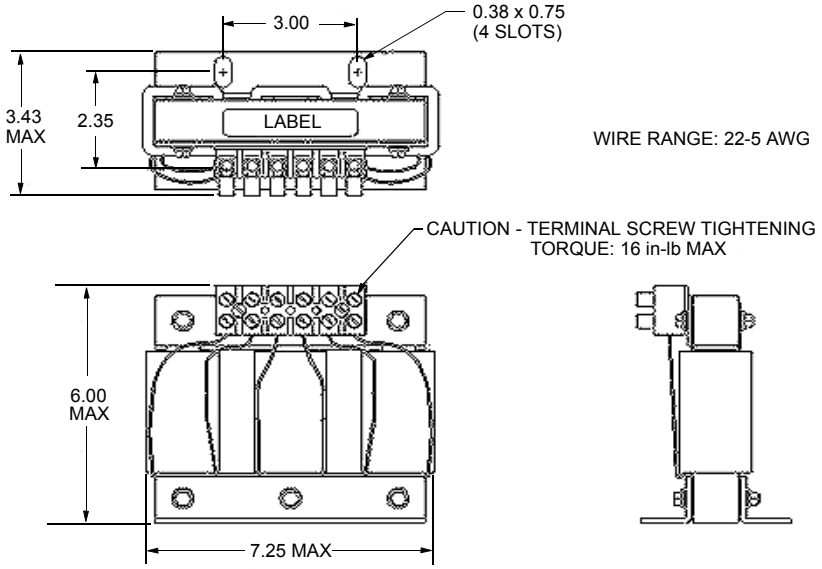


Table 4-8: MMC-SD-16-460-SER Specifications and Dimensions				
Fundamental Amperage	**Power Loss**	**Inductance**	**Weight**	**Part Number**
35 A	54 W	0.8 mH	16 lbs.	M.1302.7374

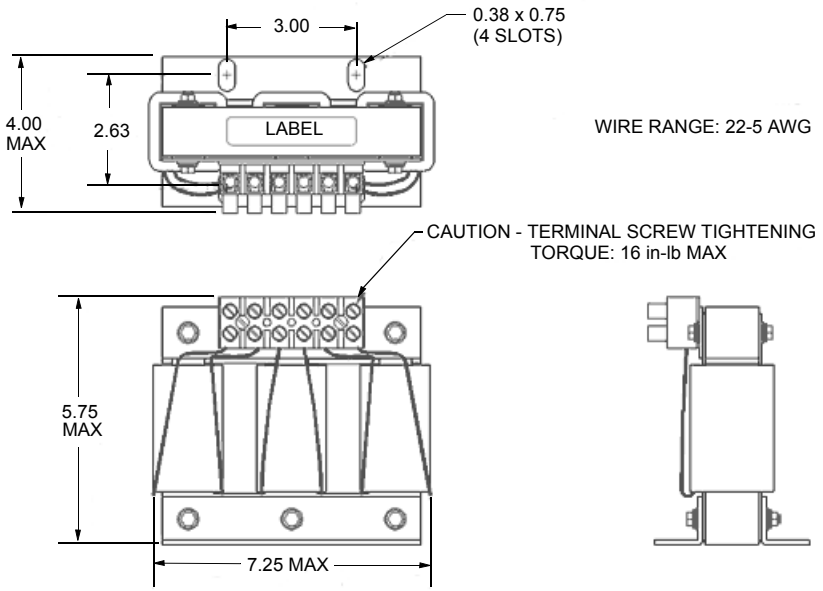
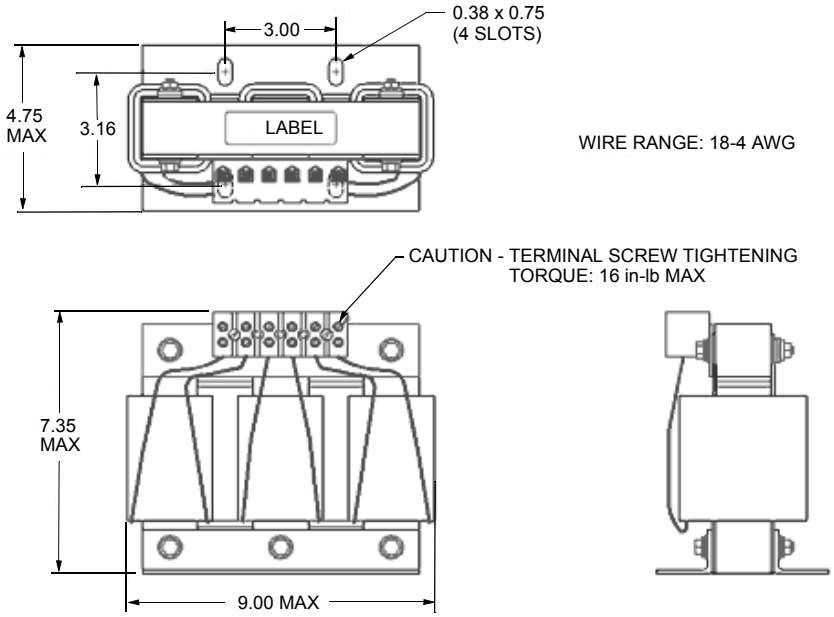


Table 4-9: MMC-SD-24-460-SER Specifications and Dimensions				
Fundamental Amperage	**Power Loss**	**Inductance**	**Weight**	**Part Number**
45 A	62 W	0.7 mH	28 lbs.	M.1302.7375



4.5 Isolation Transformers

The drive does not require the use of isolation transformers. However, a transformer may be required to match the voltage requirements of the controller to the available service. To size a transformer for the main AC power inputs, the power output (KVA) of each axis must be known. This can be derived by calculating the horsepower for each axis and converting that horsepower into units of watts. If power is being supplied to more than one motor and a drive, simply add the kW ratings together from each calculation to get a system kW total.

For an autotransformer, ensure that the phase to neutral/ground voltages do not exceed the input voltage ratings of the drive.

If you are using the Motions Solutions Sizing Software, the average speed and average torque data has already been calculated and can be used in the equation. If you are not sure of the exact speed and torque in your application, record the speed/torque curve for your drive/motor combination and use the resulting values as a worst case continuous speed and torque.

Calculations are multiplied by a factor to compensate for the power and loss elements within a power system. A factor of 1.5 is used with a three phase system. This factor should minimize the effects of the secondary line voltage sagging in the transformer during peak current periods.

The speed/torque curve information for 230V motors is based upon a drive input voltage of 230V AC. For a 115V AC input voltage, the maximum speed can be reduced up to one half.

Example 460V Formula:

$$KVA = \frac{Speed(RPM) \cdot Torque(lb-in)}{63,025} \cdot \frac{0.746 \cdot KVA}{HP} \cdot 1.5$$

NOTE
The 3-Phase source powering the drive has to be a center-grounded "Y" configuration. Do not exceed 304 Volts RMS from any phase to ground.

4.6 External Shunts

4.6.1 Choosing an External Shunt

Power from the motor is returned to the drive during motor deceleration. Excessive power may have to be dissipated from the drive when large inertia loads are present. External shunts should be used to avoid excessive bus over voltage faults.

G&L Motion Control recommends you use the Motion Solutions Sizing Software to determine the need for and type of external shunt. However, you may perform the following calculations to choose the external shunt for your application.

1. Obtain the Peak Generating Power for the drive in watts (W).
2. Perform the following calculation:

   W x T = Watts/sec or Joules

   where:

   W is watts from Step 1 above,

   T is decel time required by the application
3. Obtain the Absorption Energy in Joules for the drive from the Specifications section of the drive manual.
4. Determine the Peak Shunt Power from the drive that would be delivered to the shunt resistor for your application:
   - (Number calculated in Step 2 above) - (Absorption Energy from the drive Specifications table in either Chapter 5 or 6)
     = Watt-seconds
   - (Watt-seconds computed in 5a. above) ÷ (Decel Time for the application) = Peak Shunt Power in Watts
5. Determine the Continuous Shunt Power that would be delivered to the shunt resistor for this application:
   - (Duty Cycle of Peak or Peak x Decel Time) ÷ (Total Cycle Time) = Continuous Shunt Power in Watts
6. Choose an external shunt from Figure 4-10 on page 46.

4.6.2 External Shunt Resistor Kits

Table 4-10: Shunt Resistors

For Drive	Shunt Resistor Module	Part Number
MMC-SD-1.3-460-SER MMC-SD-2.4-460-SER	130 Ω, 450 W Cont. Power, 5.4 W Peak Power, 820 V, 240 sec. Time Constant, 121 mm x 93 mm x 605 mm	M.1302.7048
MMC-SD-4.0-460-SER	95 Ω, 700 W Cont. Power, 8 W Peak Power, 820 V, 250 sec. Time Constant, 121 mm x 93 mm x 705 mm	M.1302.7049
MMC-SD-6.0-460-SER MMC-SD-8.0-460-SER	50 Ω, 1400 W Cont. Power, 17 W Peak Power, 850 V, 250 sec. Time Constant, 130 mm x 182 mm x 710 mm	M.1302.7060
MMC-SD-12.0-460-SER MMC-SD-16.0-460-SER	25 Ω, 2800 W Cont. Power, 32 W Peak Power, 850 V, 60 sec. Time Constant, 171 mm x 430 mm x 550 mm	M.1302.7061
MMC-SD-24.0-460-SER	18 Ω, 3900 W Cont. Power, 70 W Peak Power, 850 V, 70 sec. Time Constant, 180 mm x 445 mm x 490 mm	M.1302.7063

4.6.3 Mounting Dimensions for External Shunts

Figure 4-2: Mounting Dimensions for 460V External Shunt (P/N M.1302.7048)

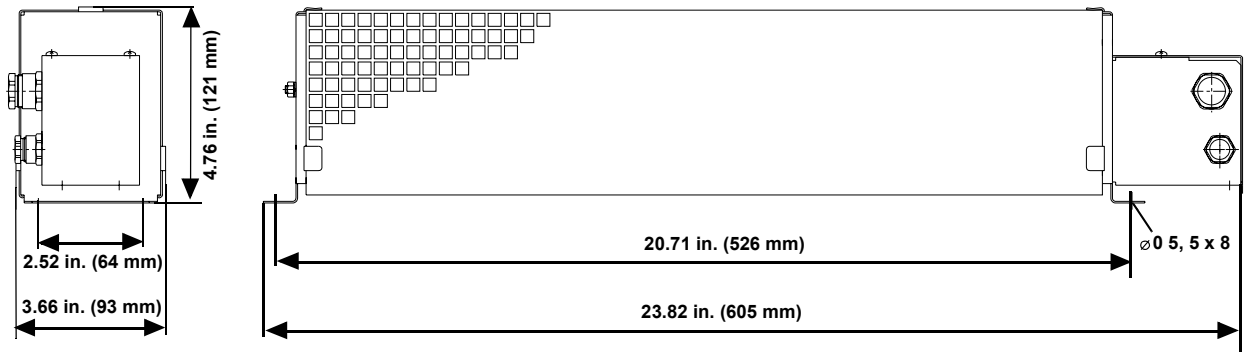


Figure 4-3: Mounting Dimensions for 460V External Shunt (P/N M.1302.7049)

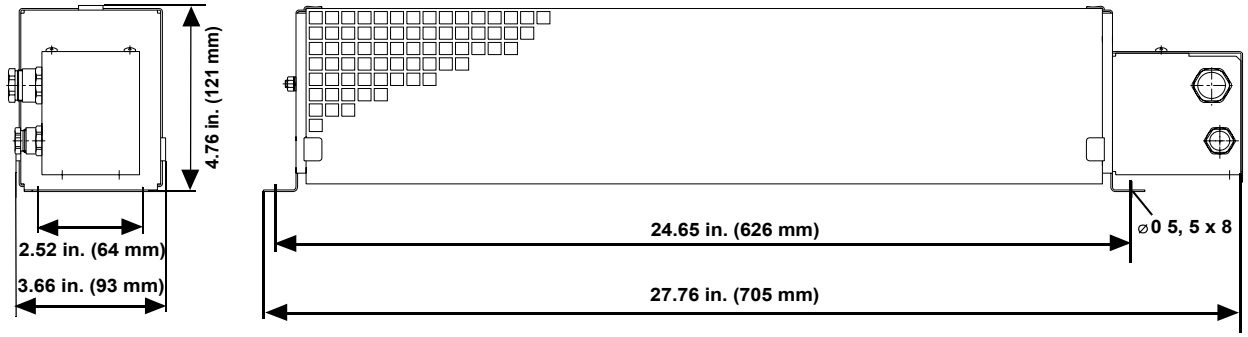


Figure 4-4: Mounting Dimensions for 460V External Shunt (P/N M.1302.7060)

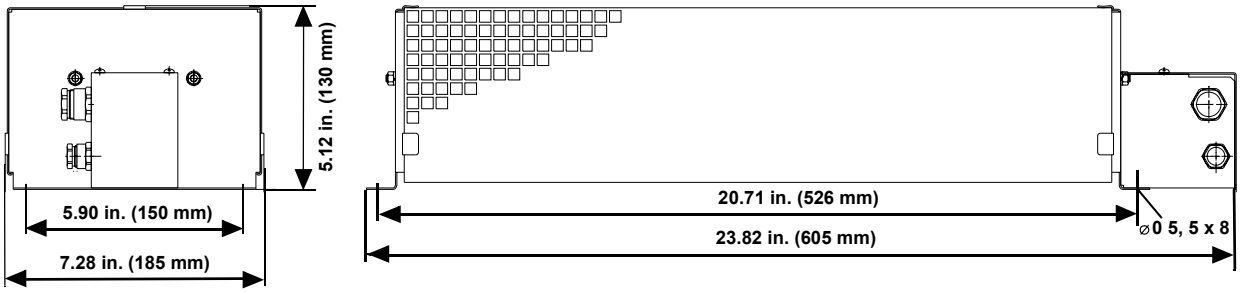


Figure 4-5: Mounting Dimensions for 460V External Shunt (P/N M.1302.7061)

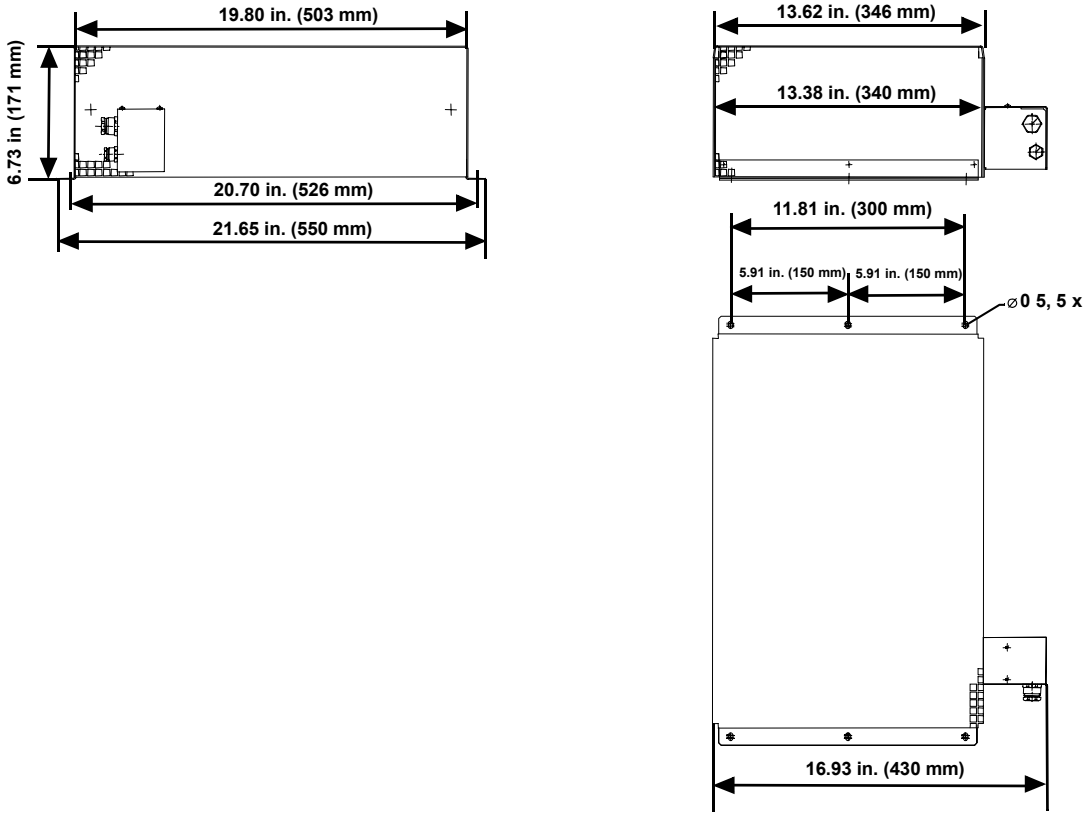
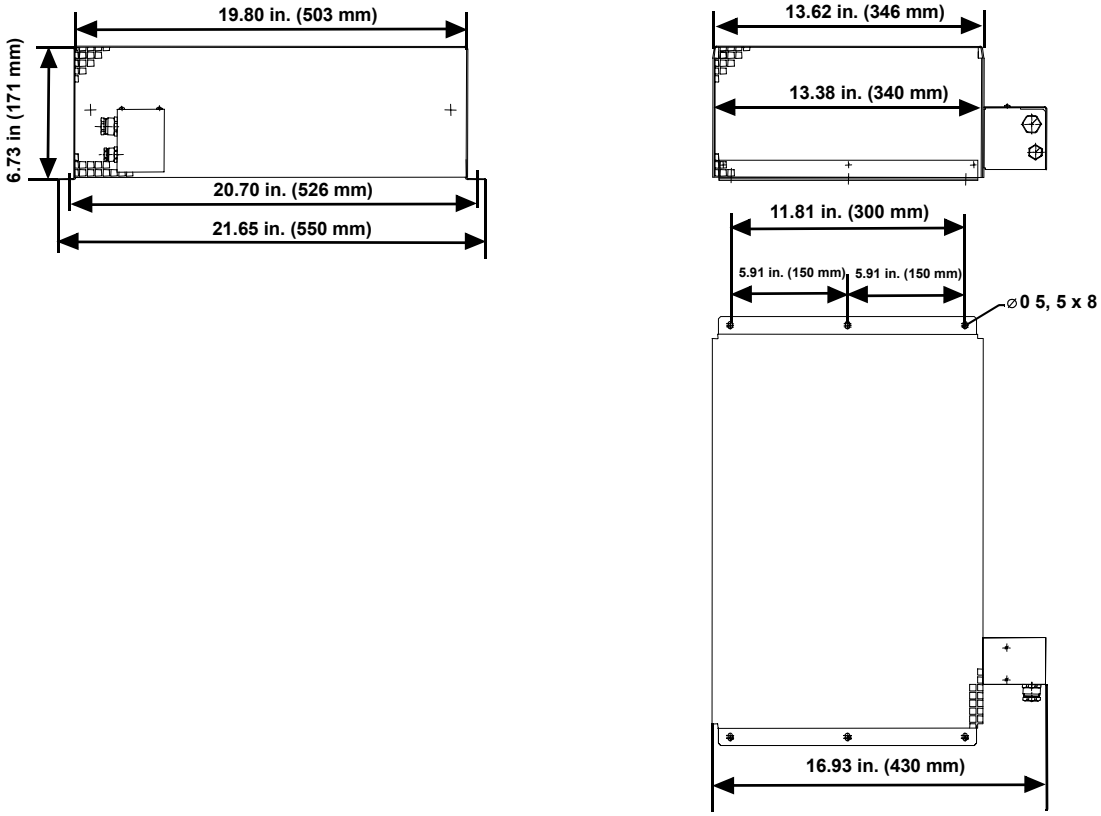


Figure 4-6: Mounting Dimensions for 460V External Shunt (P/N M.1302.7063)



4.7 Line Filters

Line Filters consist of combinations of capacitors, reactors, resistors and voltage limiters that are intended to reduce the electromagnetic influence of the environment.

4.7.1 Line Filters and CE Compliance

The direction of influence is bi-directional, i.e. there is a reaction in the units of emission of conducted disturbances, and, at the same time, an improvement in the immunity of the drive to interference that occurs in the case of lightning strikes, tripped fuses, or simple switching activities.

1. The filter should be mounted to a grounded conductive surface.
2. The filter must be mounted close to the drive input terminals. If the distance exceeds 2 feet (600 mm), then a shielded cable should be used to connect the drive and filter, rather than a wire.
3. The wires connecting the AC source to the filter should be shielded from, or at least separated from the wires (or strap) connecting the drive to the filter. If the connections are not segregated from each other, then the EMI on the drive side of the filter can couple over to the source side of the filter, thereby reducing, or eliminating the filter effectiveness. The coupling mechanism can be radiation, or stray capacitance between the wires. The best method of achieving this is to mount the filter where the AC power enters the enclosure. Figure 4-8 shows a simplified connection diagram.

Figure 4-7: Block Diagram Simplified for 3-Phase Line Filter

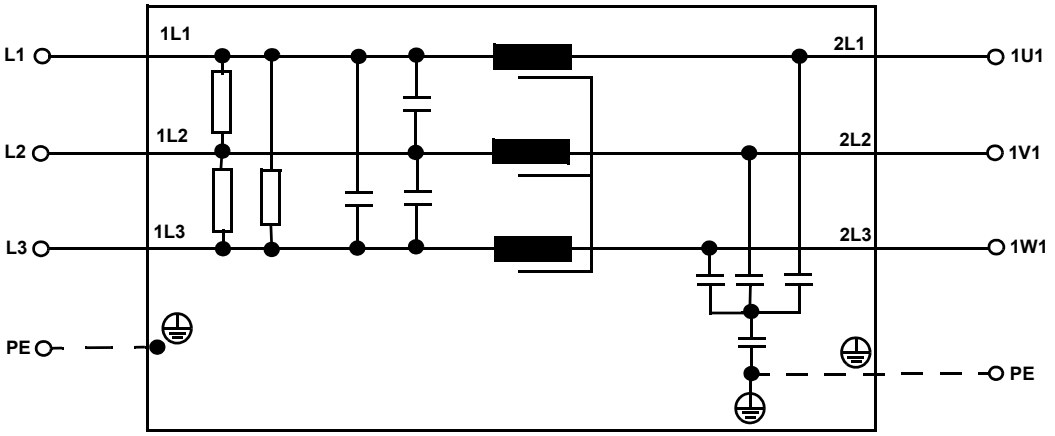
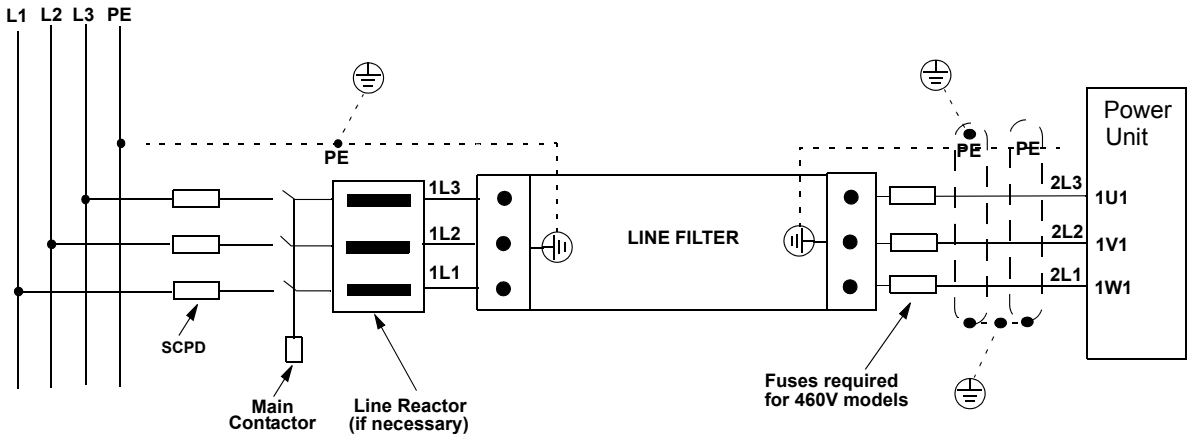


Figure 4-8: Connection Diagram for 3-Phase Line Filter



WARNING

High leakage currents exist in AC line filters. The filters must be grounded properly before applying power. Filter capacitors retain high voltages after removal. Measure voltages to determine safe levels prior to handling the equipment. Failure to do so could result in severe bodily injury.

NOTE

To be able to route the interference currents at low impedance back to the interference sources, the filter, the power unit, and the contact area of the motor cable shield must have a junction with the common mounting plate over as wide a surface as possible that has good conductive properties. The best way to ensure this is to use unpainted zinc-coated mounting plates.

4.7.2 Part Numbers for AC Line Filters

Table 4-11: Part Numbers for AC Line Filters

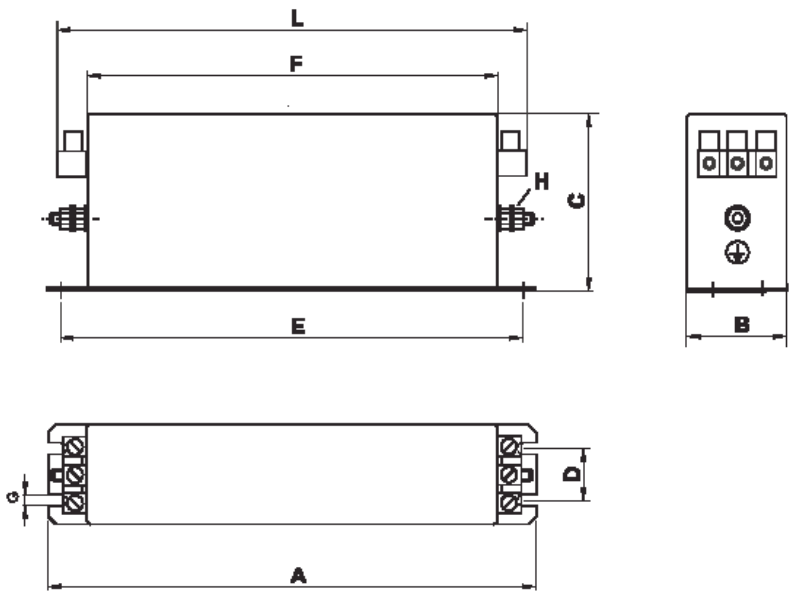
Current	For Drive	Part Number
7 A, 480 V, 3 Phase	MMC-SD-1.3-460 MMC-SD-2.4-460	M.1302.5241
16 A, 480 V, 3 Phase	MMC-SD-4.0-460 MMC-SD-6.0-460 MMC-SD-8.0-460	M.1302.5244
30 A, 480 V, 3 Phase	MMC-SD-12.0-460 MMC-SD-16.0-460	M.1302.5245
42 A, 480 V, 3 Phase	MMC-SD-24.0-460	M.1302.5246
56 A, 480 V, 3 Phase	For filtering multiple drives	M.1302.5247
75 A, 480 V, 3 Phase	For filtering multiple drives	M.1302.5248

4.8 Technical Data for AC Line Filters

Item	Part Number					
	M.1302.5241	M.1302.5244	M.1302.5245	M.1302.5246	M.1302.5247	M.1302.5248
Maximum Supply Voltage	3 x 480 VAC, 50/60 Hz					
Rated current (at 40°C)	7 A	16 A	30 A	42 A	56 A	75 A
Peak current	1.5 x I_N for < 1 min. per hour at T_B = 40°					
Test Voltage Phase/Phase Phase/Ground	2.1 kVDC for 2 sec. at 25°C 2.7 kVDC for 2 sec. at 25°C					
Maximum Connection Cross-section	4 mm^2	4 mm^2	10 mm^2	10 mm^2	4 mm^2	25 mm^2
Operational Environmental Temperature Range T_B	-25°C ... +55°C Reduction of rated current from 40°C onwards by 1.4% / °C					
Power Loss (typical)	4 W	8 W	12 W	15 W	18 W	24 W
Site Altitude	Below 2000 m above sea level (higher altitudes on request)					

Item	Part Number					
	M.1302.5241	**M.1302.5244**	**M.1302.5245**	**M.1302.5246**	**M.1302.5247**	**M.1302.5248**
Maximum Supply Voltage	3 x 480 VAC, 50/60 Hz					
Storage Temperature Range	-25°C ... +85°C					
Type of Protection	IP20					
Weight	0.6 kg	1.0 kg	1.3 kg	1.6 kg	1.9 kg	2.6 kg

4.8.1 Dimensions for AC Line Filters



Part Number	A	B	C	D	E	F	L	G	H
M.1302.5241	190	40	70	20	180	160	185	5.4	M5
M.1302.5244	250	50	70	25	235	220	245		
M.1302.5245	270	50	85	30	255	240	265		
M.1302.5246	310	50	85	30	295	280	305		M6
M.1302.5247	250	85	90	60	235	220	258		
M.1302.5248	270	80	135	60	255	240	278	6.5	

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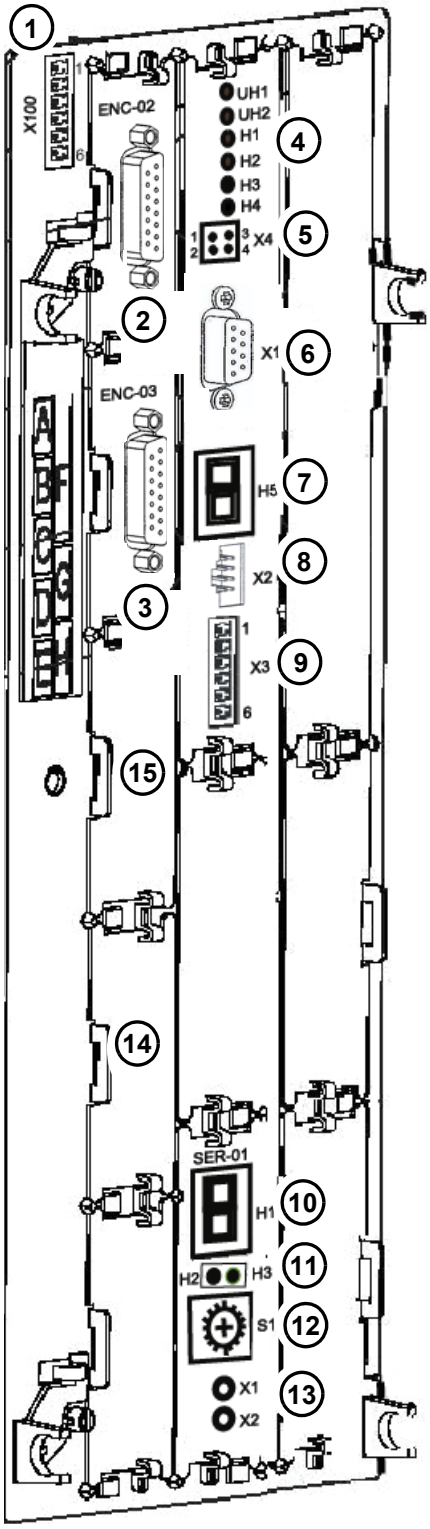
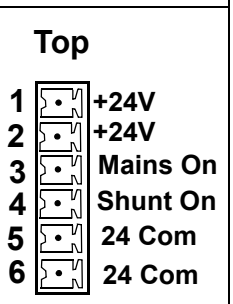
5 LEDs and Connectors

5.1 Connectors and LEDs on the Face Plate



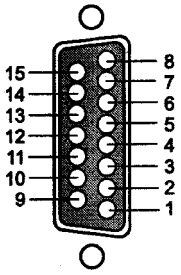
Item	Name
1	**24V Power Connector (X100)** (See Section 5.1.1)
2	**Feedback Connector ((ENC-02)** (See Section 5.1.2)
3	**Feedback Connector (ENC-03)** (See Section 5.1.3)
4	**Operating Condition LEDs** **(UH1, UH2, H1, H2, H3, H4)** (See Section 5.1.4)
5	**Connector (X4)** (See Section 5.1.5)
6	**Serial Communications Port (X1)** (See Section 5.1.6)
7	**Control Status 7 Segment Display (H5)** (See Section 5.1.7)
8	**Memory Module Connector (X2)** (See Section 5.1.8)
9	**Enable/Quick Stop Connector (X3)** (See Section 5.1.9)
10	**SERCOS Communication Phase** **7 Segment Display (H1)** (See Section 5.1.10)
11	**SERCOS Communication LEDs (H2, H3)** (See Section 5.1.11)
12	**Node Address Rotary Switch (S1)** (See Section 5.1.12)
13	**SERCOS Interface Ports (X1, X2)** (See Section 5.1.13)
14	**OPTIONAL: Digital I/O Module** (Contact G&L Motion Control)
15	**OPTIONAL: Incremental Encoder Emulator** (Contact G&L Motion Control)

5.1.1 24V Power Connector X100

Table 5-1: Size 1 24V Power Connector (X100)					
Signal Type	**Signal Description**	**Pin**	**Terminal Label**	**In/Out**	**Terminal**
Power	24 VDC input power	1	+24V	In	
		2	+24V		
24V Logic Output	Reserved for future use, do not use !	3	Mains On	Out	
24V Logic Input	When this input is active, the shunt resistor (if installed) between Ba+ and Ba- is connected across the DC bus.	4	Shunt On	In	
Power	24 VDC input common to the drive.	5	24V Com	In	
		6	24V Com		

5.1.2 Feedback Connector ENC-02

Table 5-2: Pin Assignments ENC-02, SinCos-Encoder Hiperface



15-pin D-sub

Pin no.	Pin assignment
1	GND encoder supply
2	+ 8V encoder supply
3	Reserved*
4	Reserved*
5	COS +
6	Reserved*
7	SIN -
8	SIN +
9	COS -
10	Temperature sensor +
11	Temperature sensor -
12	RS485 +
13	Reserved*
14	Reserved*
15	RS485 -

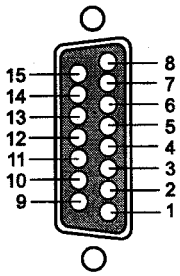
* do not assign

All encoders that comply to the following technical specifications may also be used:

Power Supply	Current
8V	250 mA max.

5.1.3 Feedback Connector ENC-03

Table 5-3: Pin Assignments ENC-03, 5V Square Wave Incremental Encoder



15-pin D-sub

Pin no.	Pin assignment
1	GND encoder supply
2	+ 5V encoder supply
3	RS422 incremental encoder track +0
4	RS422 incremental encoder track -0
5	RS422 incremental encoder track +B
6	Reserved*
7	RS422 incremental encoder track -A
8	RS422 incremental encoder track +A
9	RS422 incremental encoder track -B
10	Reserved*
11	Reserved*
12	Sense + 5V encoder supply
13	Sense GND encoder supply
14	Temperature sensor +
15	Temperature sensor -

* do not assign

All encoders that comply to the following technical specifications may also be used:

Power Supply	Signal Level	Current
5V	RS422	250 mA max.

5.1.4 Operating Condition LEDs

Table 6-4: Operating Condition LEDs Description

LED	Color	Description When Illuminated
UH1	Contact G&L Motion Control	
UH2	Contact G&L Motion Control	
H1	Green	Motor rotates in Torque direction 1
	Orange	Motor rotates in Torque Direction 2
H2	Green	Impulse Release. Motor power is supplied by power section.
	Orange	Power ON. DC voltage is being supplied to the drive and drive is ready for use. If illuminated during operation, the impulse release may be missing or quickstop was activated.
H3	Red	Current limit has been reached
H4	Red	Indicates Error.

5.1.5 Connector X4

Contact G&L Motion Control.

5.1.6 Serial Communications Port X1

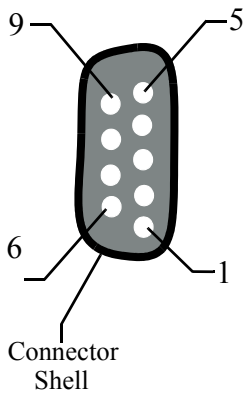
The Serial Communications Port provides serial communication for the programming interface.

Table 5-5: Pin Description for Serial Communications Port

Serial Communications Port Signals		
Function	**Notes**	**Pin**
Receive Data	Receives parameter and control data from the PiCPro for Windows software loaded on a PC.	2
Transmit Data	Transmits data from the user application via the drive to the PiCPro for Windows software loaded on a PC.	3
Data Terminal Ready	Indicates that the drive is ready to send data to the PiCPro for Windows software loaded on a PC.	4
Protective Ground	Provides a path for the ground signal to an external single point ground.	5
Request to send	Sends a request to the PiCPro for Windows software loaded on a PC to send data from the drive to PiCPro.	7
Clear to send	Indicates it is OK for the drive to send data to the PiCPro for Windows software loaded on a PC.	8

Table 5-6: Pin Assignment for Serial Communications Port

Pin Assignment Serial Communications Port			
Pin	**Label**	**In/Out**	**Pin Sequence**
1	NC	N/A	9-pin Male D-sub
2	Receive Data	In	
3	Transmit Data	Out	
4	Data Terminal Ready	Out	
5	Signal Ground	In/Out	
6	NC	N/A	
7	Request to Send	Out	
8	Clear to Send	In	
9	NC		
Connector Shell	Shield	N/A	



5.1.7 Control Status 7 Segment Display

This LED displays the operating status of the drive as follows. Contact G&L Motion Control for specific information for this feature.

5.1.8 Memory Module Connector

Contact G&L Motion Control for specific information for this feature.

5.1.9 Enable/Quick Stop Connector

Table 5-7: Pin Assignment

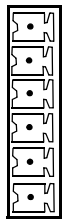
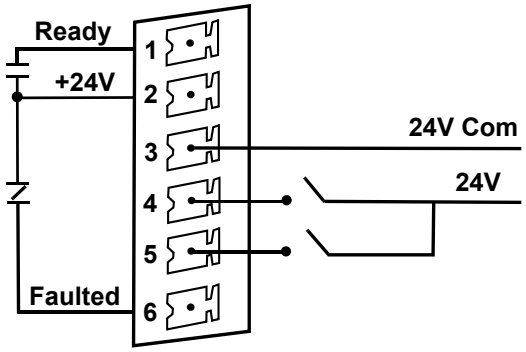
Pin Assignment			
Pin	**Label**	**Description**	**Pin Sequence**
1	Ready (NO contact)	Contacts open when Fault occurs	
2	Ready (center contact)	+24V	
3	Ground for 4 and 5 below	As stated	
4	Quick stop	24V to allow motor to run	
5	Enable	24V to enable	
6	Faulted (NC contact)	Contacts close when fault occurs	

Figure 5-1: Enable/Quick Stop Connector Electrical Drawing



5.1.10 SERCOS Communication Phase 7 Segment Display

This LED displays the SERCOS communication phase of the drive as follows:

Phase	Display
Start-up	1...2...3...4
Running	4 displayed continuously

5.1.11 SERCOS Communication LEDs

Table 6-8: Operating Condition LEDs Description

LED	Color	Description When Illuminated
H2	Green	Running in Phase 4.
	Red	Distortion exists or Ring is interrupted.
H3	Red	General malfunction exists.

5.1.12 Node Address Rotary Switch

This switch is used to set the SERCOS address from 1 through 15 (all other addresses are selected through software). Manually rotate the switch to the desired address. An address may not be used twice within a SERCOS ring.

5.1.13 SERCOS Interface Ports

The SERCOS motion control board provides a fiber optic input and output for one SERCOS ring.

Table 6-9: SERCOS Ports Description

Port	Description
X1	Transmit
X2	Receive

The SERCOS board is controlled by an LDO created in PiCPro. An on-board processor interprets the functions and performs appropriate operations according to the SERCOS communications protocol.

The data transfer rate is 4M Baud with user-defined update rate.

If a scan loss occurs, SERCOS communications are reset. There is no communication with the SERCOS slaves until you reinitialize.

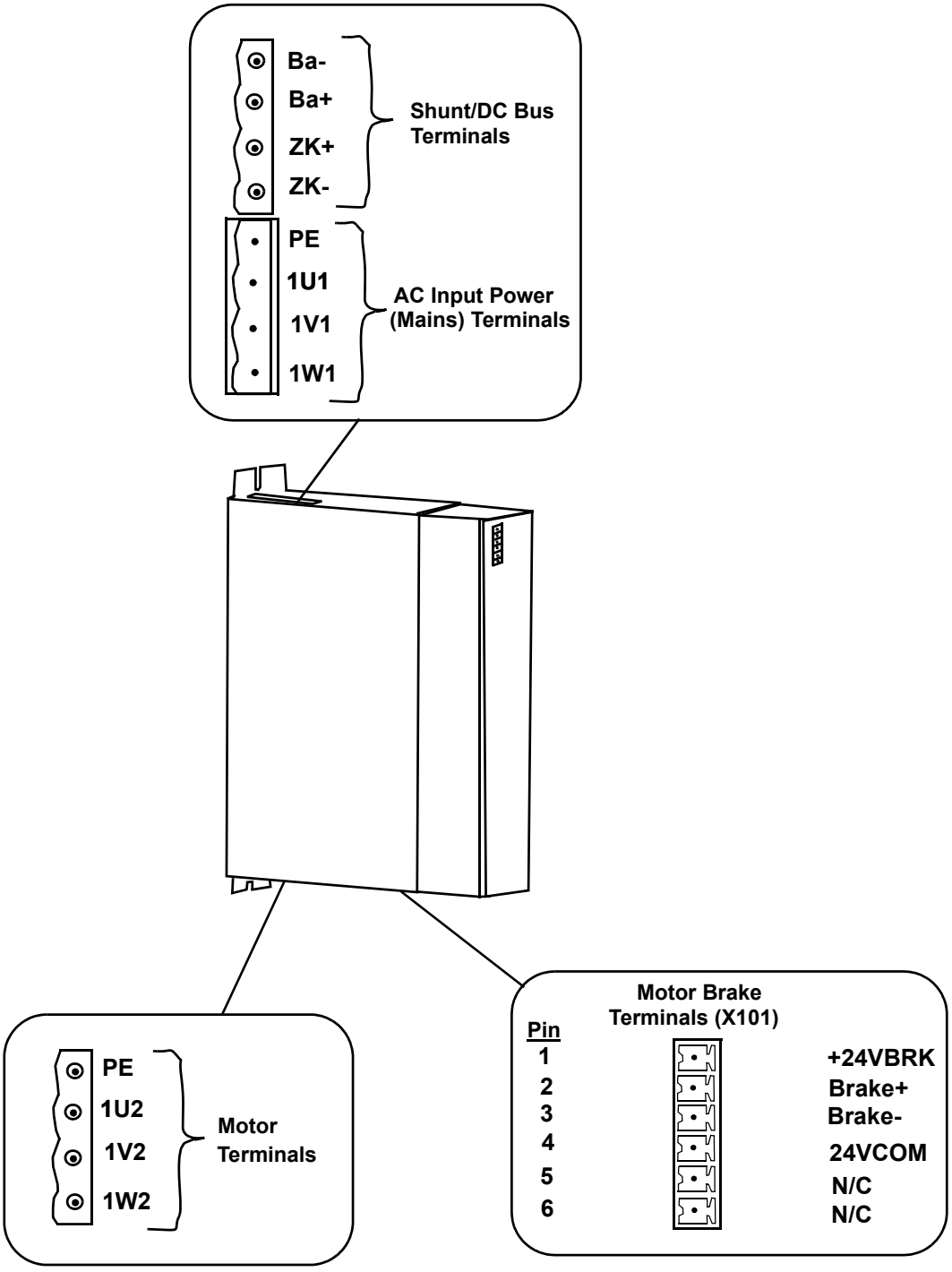
SERCOS	
SERCOS Interface	Interfaces with one ring with from one to eight digital drives
SERCOS port	SMA female connectors for interfacing to 1000 µ meter plastic fiber optic cable with SMA male connectors. Fiber optic receiver specifications: Peak input power (optical level low) -31.2dBm max Peak input power (optical level high) -20.0 dBm min, 0.0dBm max Fiber optic transmitter specifications: Peak output power (optical level high) -10.5 dBm min, -5.5 dBm max

NOTE
The fiber optic transmit intensity for cable length can be adjusted through software.

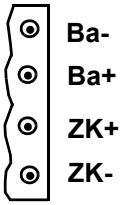
5.2 Connectors on Drive Chassis

5.2.1 Connectors on Size 1 Drive Chassis

Figure 6-2: Connectors on Size 1 Drive Chassis



5.2.1.1 Shunt/DC Bus Terminals

Table 5-10: Size 1 Shunt/DC Bus Terminals				
Signal Type	**Signal Description**	**Terminal Label**	**In/Out**	**Terminal**
Power	External Shunt Resistor. Used to dissipate energy returned to the drive by the motor.	Ba-	Out	
		Ba+		
DC Bus Power	Direct DC bus connection	ZK+	N/A	
		ZK-		

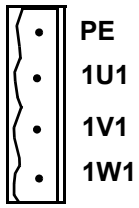
NOTE

The shunt resistor (if installed) across Ba+ and Ba- will be connected across the DC bus when the DC bus reaches the "shunt switch threshold" as shown in the specfication table.

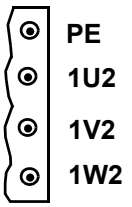
NOTE

This drive is designed for use with G&L Motion Control LSM and MSM motors.

5.2.1.2 AC Power Terminal Strip

Table 5-11: Size 1 AC Power Terminals				
Signal Type	**Signal Description**	**Terminal Label**	**In/Out**	**Terminal**
Protective Ground	Protective Earth Ground	PE	Out	
Power	3 phase input power AC source must be centered grounded Y system.	1U1	In	
		1V1		
		1W1		

5.2.1.3 Motor Terminals

Table 5-12: Size 1 Motor Terminals				
Signal Type	**Signal Description**	**Terminal Label**	**In/Out**	**Terminal**
Protective Ground	Protective Earth Ground	PE	Out	
Power	Drive output power to motor.	1U2	Out	
		1V2		
		1W2		

5.2.1.4 Motor Brake Terminals (X101)

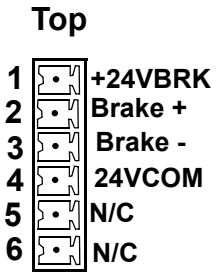
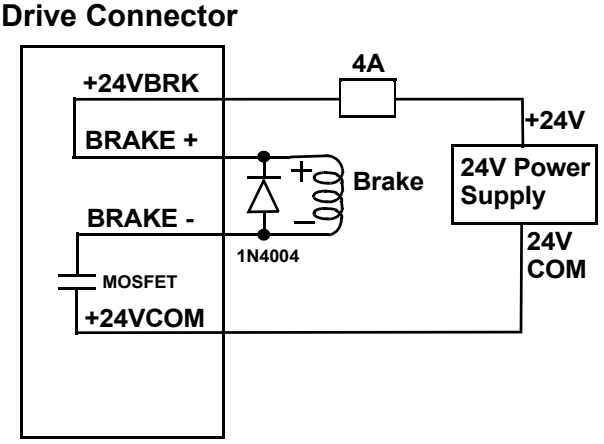
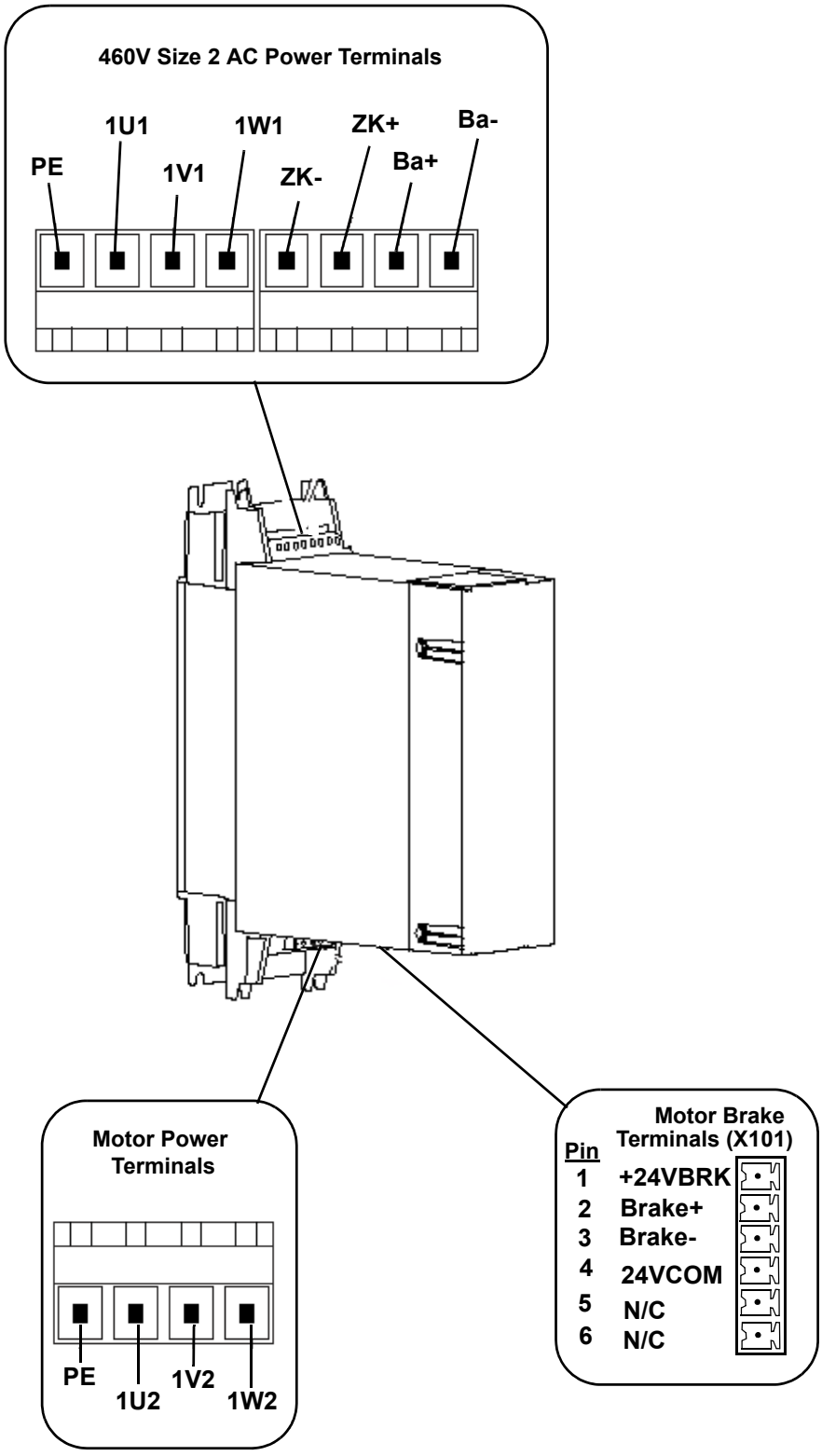
Table 5-13: 460V Size 1 Motor Brake Terminals (X101)					
Signal Type	**Signal Description**	**Pin**	**Terminal Label**	**In/Out**	**Terminal**
Power	24 VDC brake input power	1	+24VBRK	In	
Brake control	Brake connections	2	Brake +	Out	
		3	Brake -	In	
Power	24 VDC common	4	24VCOM	Out	
Not Used.		5	N/C	Not Used	
		6			

Figure 5-3: Wiring Example for X101 Connector



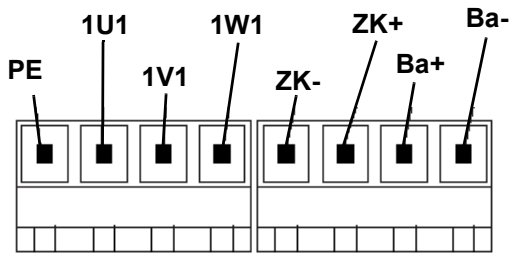
5.2.2 Connectors on the Size 2 Drive Chassis

Figure 5-4: Connectors on the Size 2 Drive Chassis



5.2.2.1 AC Power Terminals

Table 5-14: Size 2 AC Power Terminals

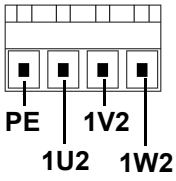


Signal Type	Signal Description	Terminal Label	In/Out
Ground	Protective Ground (Earth)	PE	Out
Power	Three phase AC input power in to drive	1U1	In
		1V1	
		1W1	
DC Bus Power	Direct DC bus connection	ZK-	Out
		ZK+	
Power	External Shunt Resistor used to dissipate energy returned to the drive from motor	Ba+	Out
		Ba-	

NOTE

The shunt resistor (if installed) across Ba+ and Ba- will be connected across the DC bus when the DC bus reaches the "shunt switch threshold" as shown in the specfications table.

5.2.2.2 Motor Power Terminals

Table 5-15: 460V Size 2 Motor Power Terminals				
Signal Type	**Signal Description**	**Terminal Label**	**In/Out**	**Terminal**
Ground	Protective Ground (Earth)	PE	Out	
Motor	Power U-phase from the drive to the motor	1U2	Out	
	Power V-phase from the drive to the motor	1V2	Out	
	Power W-phase from the drive to the motor	1W2	Out	

5.2.2.3 Motor Brake Terminals (X101)

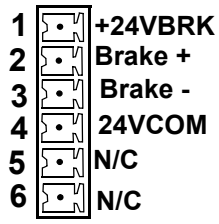
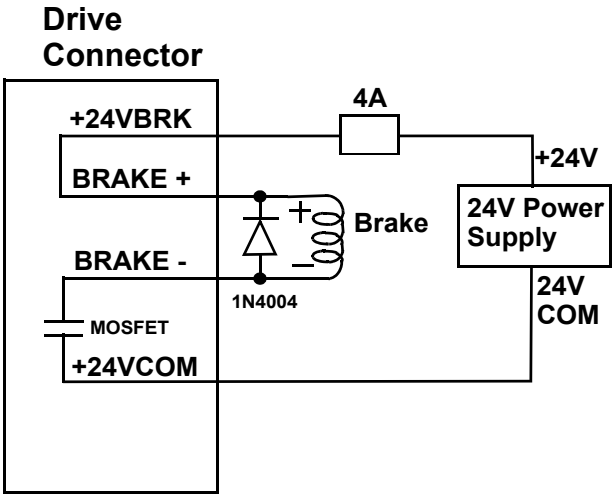
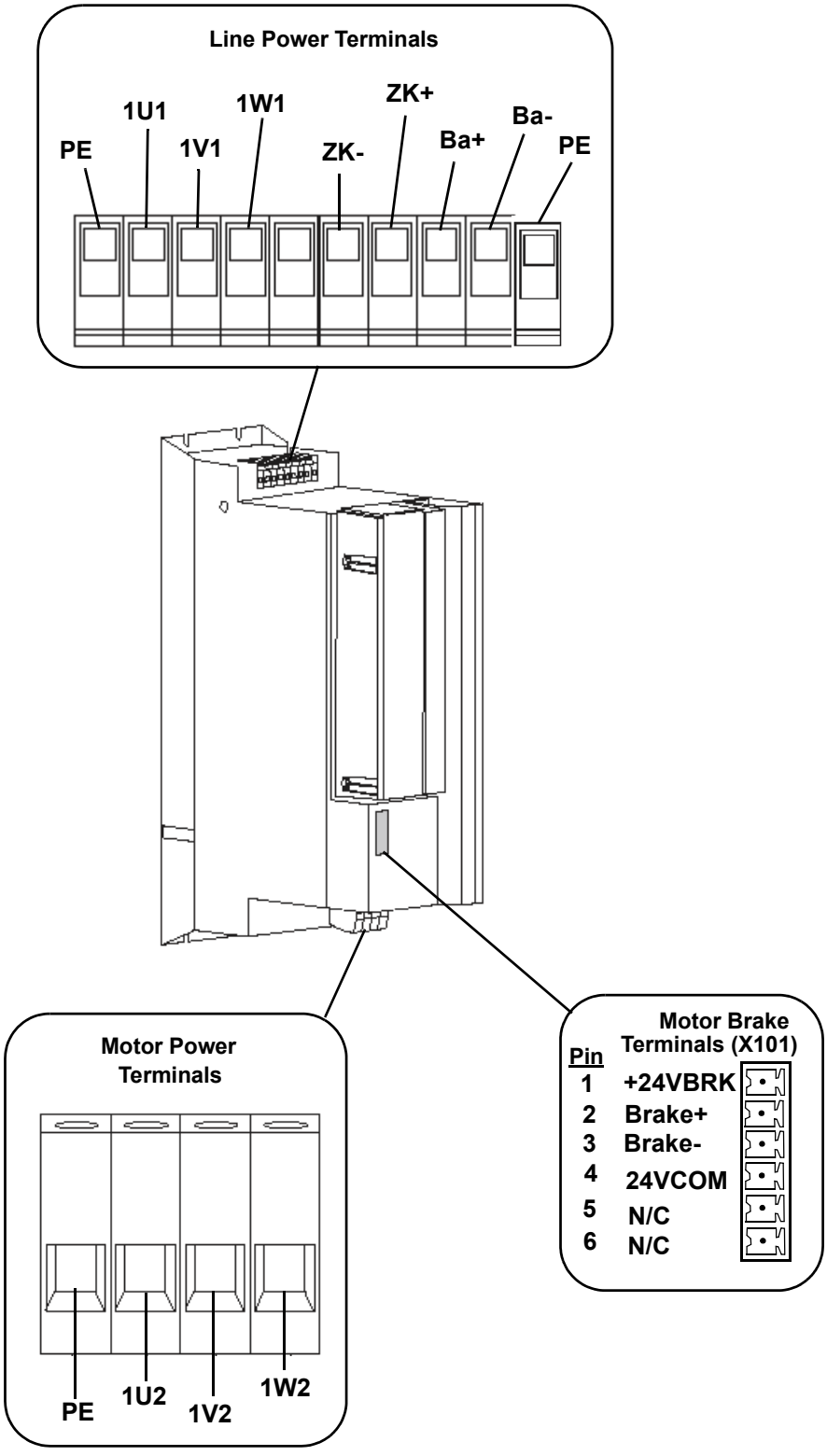
Table 5-16: 460V Size 2 Motor Brake Terminals (X101)					
Signal Type	**Signal Description**	**Pin**	**Terminal Label**	**In/Out**	**Terminal**
Power	24 VDC brake input power	1	+24VBRK	In	
Brake control	Brake connections	2	Brake +	Out	
		3	Brake -	In	
Power	24 VDC common (supply and magnet)	4	24VCOM	Out	
Not Used.		5	N/C	Not Used	
		6			

Figure 5-5: Wiring Example for X101 Connector



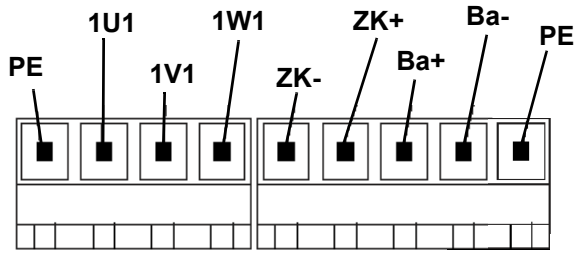
5.2.3 Connectors on the Size 3 Drive Chassis

Figure 5-6: Connectors on the Size 3 Drive Chassis



5.2.3.1 AC Power Terminals

Table 5-17: 460V Size 3 AC Power Terminals

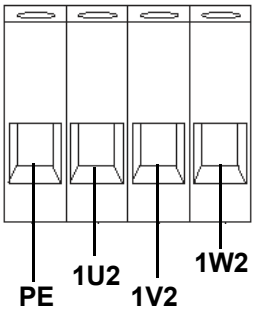


Signal Type	Signal Description	Terminal Label	In/Out
Ground	Protective Ground (Earth)	PE	Out
Power	Three phase AC input power in to drive	1U1	In
		1V1	
		1W1	
DC Bus Power	Direct DC bus connection	ZK-	Out
		ZK+	
	External Shunt Resistor used to dissipate energy returned to the drive from motor	Ba+	Out
		Ba-	

5.2.3.2 Motor Power Terminals

NOTE
The shunt resistor (if installed) across Ba+ and Ba- will be connected across the DC bus when the DC bus reaches the "shunt switch threshold" as shown in the specfication table.

Table 5-18: 460V Size 3 Motor Power Terminals

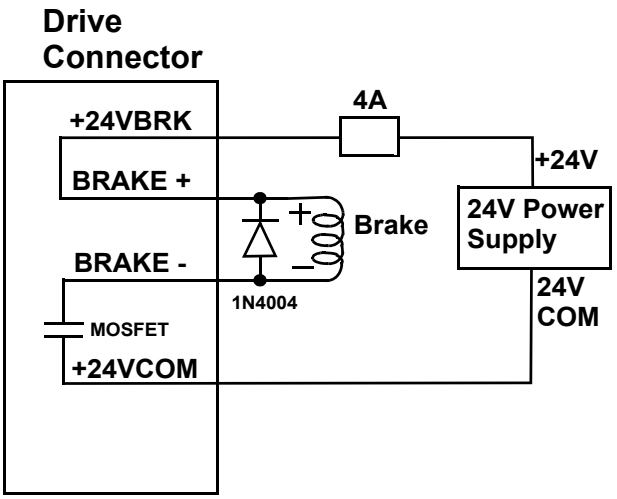
Signal Type	Signal Description	Terminal Label	In/Out	Terminal
Ground	Protective Ground (Earth)	PE	Out	
Motor	Power U-phase from the drive to the motor	1U2	Out	
	Power V-phase from the drive to the motor	1V2	Out	
	Power W-phase from the drive to the motor	1W2	Out	

5.2.3.3 Motor Brake Terminals (X101)

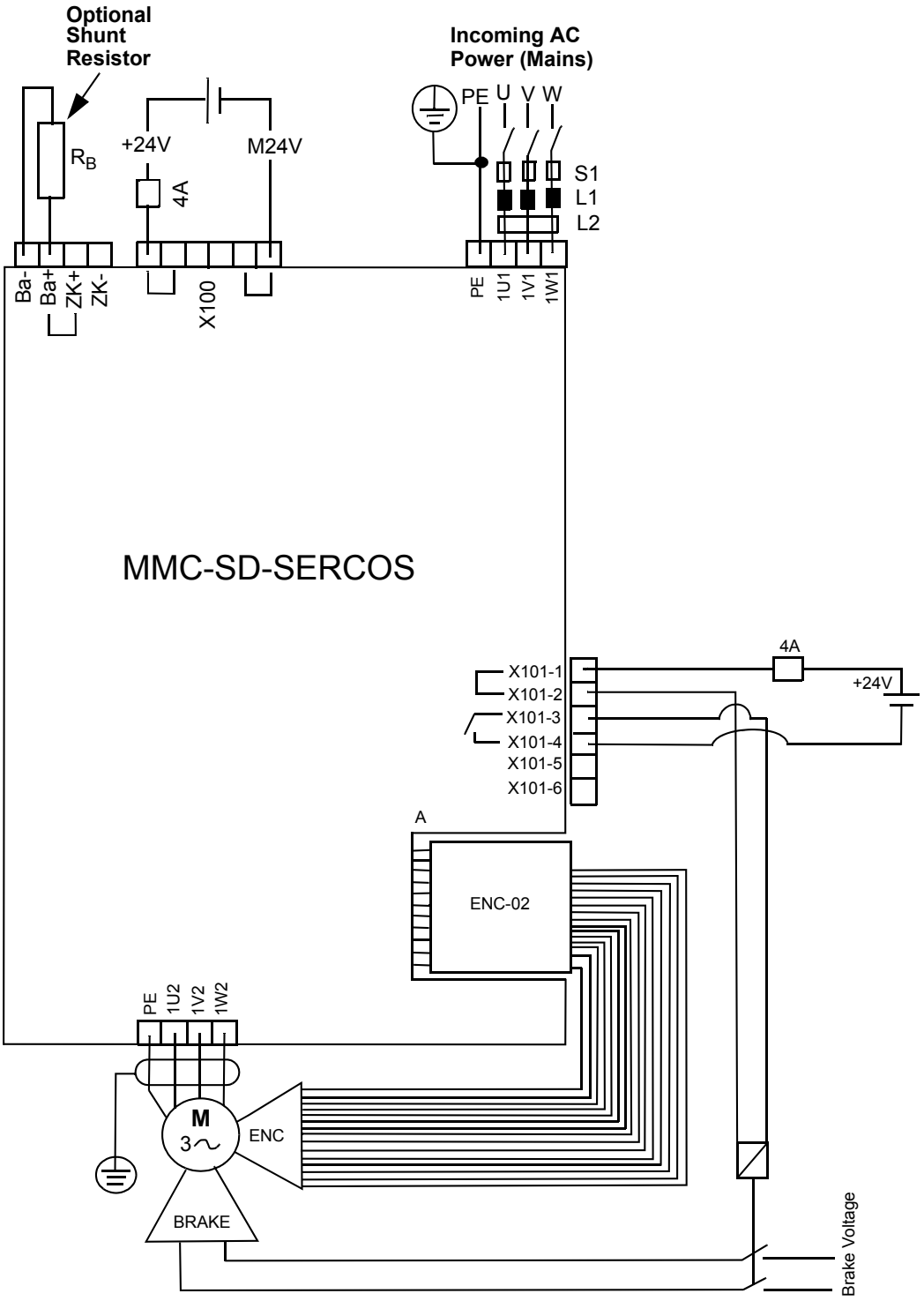
Table 5-19: Size 3 Motor Brake Terminals (X101)

Signal Type	Signal Description	Pin	Terminal Label	In/Out	Terminal
Power	24 VDC brake input power	1	+24VBRK	In	Top 1 +24VBRK 2 Brake + 3 Brake - 4 24VCOM 5 N/C 6 N/C
Brake control	Brake connections	2	Brake +	Out	
		3	Brake -	In	
Power	24 VDC common (supply and magnet)	4	24VCOM	Out	
Not Used.		5	N/C	Not Used	
		6			

Figure 5-7: Wiring Example for X101 Connector



5.3 Typical Drive Connection Layout



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6 Cables and Connections to External Devices

6.1 LSM and MSM Motors Cable Pin Assignments

Table 6-1: Motor Encoder Cable to LSM or MSM Motors

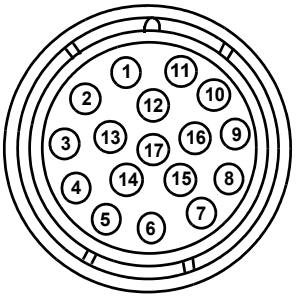
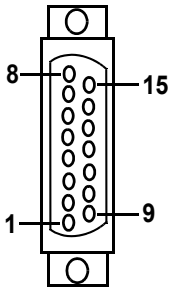
WIRES	SIGNAL	PIN NUMBERS	
(Twisted Pair, 5 pair 26 AWG 1 pair 20 AWG)		**Connector to Motor** 	**Connector to Drive** 
26 AWG Black Violet	sin+ sin-	1 2	8 7
26 AWG Brown White	cos+ cos-	3 4	5 9
26 AWG Yellow Green	485+ 485-	5 6	12 15
26 AWG Grey Red	N/C N/C	7 8	3 4
N/A	N/C	10	N/A
20 AWG Red Blue	8-12VDC GND	9 11	2 1
N/A	N/C	12	6
20 AWG Grey Pink	Temp+ Temp-	13 14	10 11
N/A	N/C	15	13
	N/C	16	14
	N/C	17	N/A
Drain	N/A	N/A	

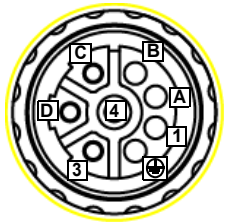
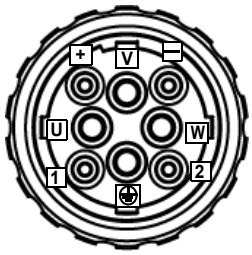
Table 6-2: Motor Power Connector to LSM or MSM Motors					
			Pin Number		
					
Wire Color	Wire Number	Signal Type	Size 1 Power Connector	Size 1.5.1 Power Connector	Size 1.5.2 Power Connector
Black (1)	1U2	Out	1	U	
Black (2)	1V2	Out	3	V	
Black (3)	1W2	Out	4	W	
Green/ Yellow	PE	Ground	2	⏚	
Black (5)	Brake+	Out	A	+	
Black (6)	Brake-	Out	B	-	

Table 6-3: Fan Motor Power Connector to LSM or MSM Motors			
			Pin Number
			
Wire Color	Wire Number	Signal Type	Pin
Brown	U	Out	1
Black	N	Out	2
Green/Yellow	PE	Ground	3

6.2 SERCOS (Heavy Duty) Fiber-Optic Cables

Model Number	Length (Meters)	Part Number
SERCOS-0.50m-6mm-AA	0.5	M.1302.6379
SERCOS-1.00m-6mm-AA	1.0	M.1302.6400
SERCOS-2.00m-6mm-AA	2.0	M.1302.6401
SERCOS-3.00m-6mm-AA	3.0	M.1302.6402
SERCOS-5.00m-6mm-AA	5.0	M.1302.6403
SERCOS-10.00m-6mm-AA	10.0	M.1302.6404
SERCOS-15.00m-6mm-AA	15.0	M.1302.6405
SERCOS-30.00m-6mm-AA	30.0	M.1302.6406

6.3 Connecting Shunt Modules

Use shielded, high temperature 180° C (356° F), 1000 V copper wire.

1. G&L Motion Control Shung resistors have integrated temperature switches. Terminal R-R is the connection to the resistor, and terminal T-T is the connection to the temperature switch (see the resistor datasheet drawing). The temperature switch is usually wired as a warning signal to the MMC Controller input or can be hardwired to the drive enable or the E-Stop circuit. The shunt resistor is wired to terminals Ba+and Ba- of the MMC-SD drive. The temperature switch contact opens at a temperature that varies depending on the type of resistor and is specified in the resistor technical data (see table 1 below).

Shunt Resistor Type	Switching Temperatures	Part Number
N/A	210° C (410° F) ± 7.5K	N/A
N/A	220° C (428° F) ± 7.5K	N/A
Shunt Resistor 450 Watt 130 Ohm	240° C (464° F) ± 7.5K	M.1302.7048
Shunt Resistor 700 Watt 95 Ohm	260 ° C (500° F) ± 7.5K	M.1302.7049
N/A	260° C (500° F) ± 7.5K	N/A
Shunt Resistor 1400 Watt 50 Ohm	260° C (500° F) ± 7.5K	M.1302.7060
Shunt Resistor 2800 Watt 25 Ohm	120° C (248° F) ± 5K	M.1302.7061
Shunt Resistor 3800 Watt 18 Ohm	120° C (248° F) ± 5K	M.1302.7063

2. The wires to a shunt resistor shall be suitable for temperatures of up to 180° C (356° F) directly at the resistor. At a distance of more than 20 cm (7.87 in.), a temperature limit of 80° C (176° F) is enough.
3. The wires to the Shunt resistor shall be suitable for a minimum of 830 VDC high voltage insulation.
4. The wires to the Shunt resistor must be suitable for a current equal to the power of the resistor divided by the switch on voltage of the IGBT Shunt. For example, if the resistor power is 250 watts and the switch on voltage is 780 VDC, the current is 320 mA (250 ÷ 780 = 320).

Follow one of the methods given below to reduce the effects of EMI noise:

- Install wires using twisted pairs (two turns per foot minimum), as shown in Figure 6-1 and Figure 6-2 below. Keep unshielded wires as short as possible.
- Use shielded, twisted cable (ground shield at shunt and drive).
- Use shielded metal conduit (ground conduit at shunt and drive).

When two shunt modules are connected in parallel, the shunt capacity is doubled.

WARNING

Do not connect more than two shunt modules to a drive.

Figure 6-1: Wiring Drive to 450 Watt, 130Ω Shunt Module / 700 Watt, 95Ω Shunt Module / 1400 Watt, 50Ω Shunt Module

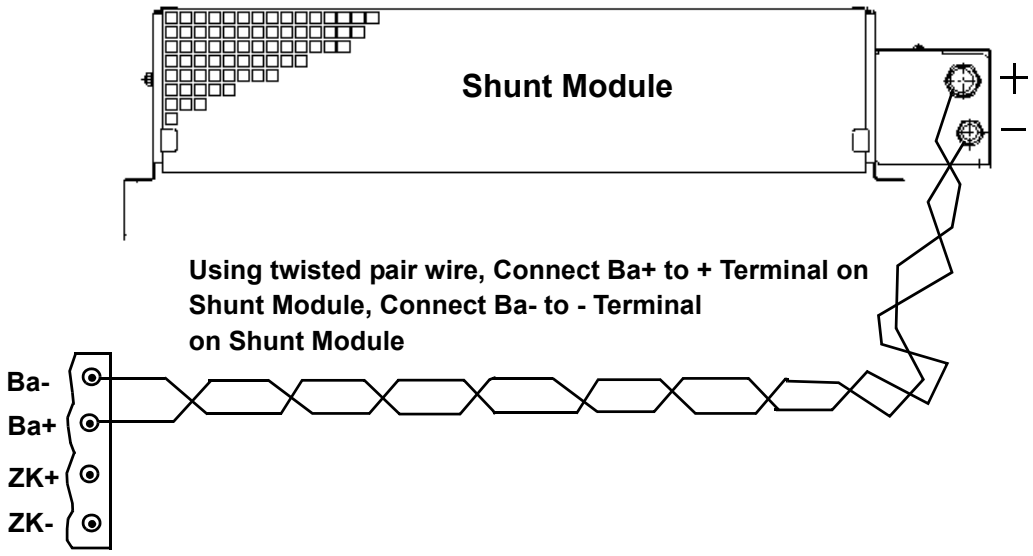
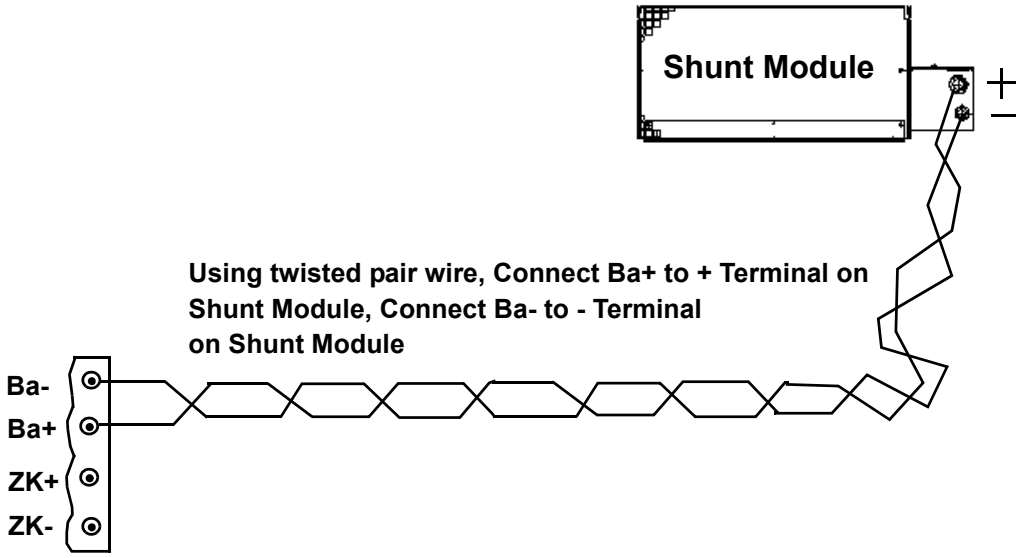


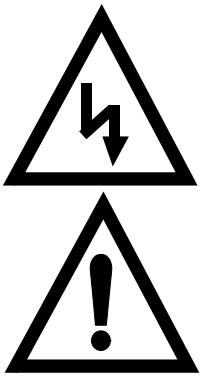
Figure 6-2: Wiring Drive to 2800 Watt, 25Ω Shunt Module / 3900 Watt, 18Ω Shunt Module



7 Maintenance and Troubleshooting

7.1 Maintenance

WARNING



Disconnect input power before touching cables or connections.

DC bus capacitors may retain hazardous voltages after input power has been removed.

Before working on the drive, measure the DC bus voltage to verify it has reached a safe level.

Failure to observe this precaution could result in severe bodily injury or loss of life.

1. Remove superficial dust and dirt from the drive.
2. Check cable insulation and connections.
3. Clean exterior surfaces and airflow vents using an OSHA approved nozzle that provides compressed air under low pressure of less than 20 kPa (30 psi).
4. Visually check for cable damage. Replace all damaged cables.
5. Inspect D-shell connectors for proper seating and signal continuity end-to-end.

7.2 Troubleshooting

7.2.1 General Troubleshooting

Table 7-1: General Troubleshooting Symptoms, Causes, Remedies

Symptom	Possible Cause	Remedy
Power (P) indicator not ON	No 24VDC input power. Internal power supply malfunction.	Verify 24 VDC power is applied to the drive. Contact your G&L Motion Control representative.
Motor jumps when first enabled	Motor wiring error. Incorrect motor chosen. Incorrect or faulty encoder	Check motor feedback and power wiring. Verify the proper motor is selected. Replace the encoder with correct and/ or functional encoder.
I/O not working correctly	I/O power supply disconnected.	Verify connections and I/O power source.

7.2.2 Troubleshooting Fault Error Codes

When a fault is detected the Status LED on the face of the drive will flash an error code. The LED will continue to flash until the fault is eliminated.

The type of Reaction is defined as follows:

- IS = Impulse Inhibit
- no reaction = drive is continuing to work and red error LED is blinking

7.2.2.1 Processor System Errors P0201

Error No.	Description	Reaction	Possible Remedies
0	Reserved		
1	Watchdog Error	IS	Restart the drive.
2	Wrong Interrupt		Restart the drive.
3	NMI-Interrupt/bus error		Restart the drive.
4 to 15	Reserved Idle = 0	n/a	n/a

7.2.2.2 Operating System Errors P0202

Error No.	Description	Reaction	Possible Remedies
16	System boot error	IS	Restart the drive.
17	Software error (among others switch)		
18	Error configuring time-slice operating system		
19	time-slice time overflow		Restart the drive. Change configuration of the time slice operation system.
20	No spare memory left		Restart the drive.
21	Software error: Invalid error code		
22	Software error: Invalid warning code		
23 to 31	Reserved Idle = 0	n/a	n/a

7.2.2.3 Communications Errors P0203

Error No.	Description	Reaction	Possible Remedies
32	Timeout	no reaction	Restart the drive.
33	Protocol error		
34	Wrong module type		Contact G&L Motion Control
35	too much data in the list and telegram		
36	too little data in the list and telegram		
37	Invalid operand		
38	LC only supports VARSTAT_MEMORY		Test RAM
39	Invalid operand address (log. address)		Enter a valid address
40	Value smaller than minimum allowable value		Check the data record and adjust it accordingly
41	Value is bigger than maximum allowable value		
42	Parameter is write protected		
43	Parameter cannot be altered because of operational condition		Check the operating condition and parameterization
44	Invalid parameter value		Enter a valid value
45 to 47	Reserved Idle = 0	n/a	n/a

7.2.2.4 Power Supply Errors P0205

Error No.	Description	Reaction	Possible Remedies
64	Mains failure (Net fail)	Adjustable	Restore the connection to the power supply
65 t0 79	Reserved Idle = 0	n/a	n/a

7.2.2.5 Power Unit Errors P0206

Error No.	Description	Reaction	Possible Remedies
80	Hiperface specification communication error	IS	Reduce high EMC disturbances
81	Temperature threshold of heatsink exceeded		Let the device cool down and/or reduce the load
82	DC link overvoltage		Reduce the DC link voltage
83	Overcurrent		Reduce the load
84	Earth current		Check all device installation and check motor for earth fault
85	Temperature threshold		Make sure there is sufficient ventilation in the device
86	lxt > than limiting value		Leave the drive in inhibited condition until lxt-actual value decreases under 100%
87	safety relay off (or faulty)		Check the safety realy. If it is defective, replace it.
88	Jumper end		Restart the drive.
89	Power unit not ready-for-use		Complete the opereational readiness to the power unit.
45 to 47	Reserved Idle = 0	n/a	n/a

7.2.2.6 Motor Errors P0207

Error No.	Description	Reaction	Possible Remedies
96	Short-circuit temperature senso	no reaction	Remove the short circuit in the temperature sensor
97	Temperature sensor - motor not connected		Remove the open circuit in the temperature sensor card
98	Overtemperature	IS	Remove the motor over temperature by cooling down and/or reducing the load
99	I^2t overload		Leave the drive in inhibited condition until I^2t actual value decreases under 100%
100 to 111	Reserved Idle = 0	n/a	n/a

7.2.2.7 Encoder 1 (ENC-02) System Errors P0208

Error No.	Description	Reaction	Possible Remedies
112	Hiperface specifications communications error	IS	Reduce high EMC disturbances
113	Invalid module code		Use a different encoder
114	Reserved		n/a
115	Wire brake in encoder 1		Remove the wire break in line of encoder 1
116	Overspeed encoder 1		Check permissable speed of encoder 1
117	Permissable limit of $\sqrt{\sin 2x + \cos 2x}$ exceeded		Use a different encoder
118	Unknown encoder type		Check if the correct encoder is connected or use a different encoder
119	Invalid data field for motor data		Use a different encoder
120	Invalid motor data		
121	Error saving motor data		
122	Motor data write protected. Overwrite not allowed		
123	Field angle error		Check the screening of the encoder cable
124	Encoder without temperture measuring	no reaction	Use an encoder module with temperature measuring
100 to 111	Not used	n/a	n/a

7.2.2.8 Encoder 2 (ENC-02) System Errors P0209

Error No.	Description	Reaction	Possible Remedies
128	Hiperface specifications communications error	IS	Reduce high EMC disturbances
129	Invalid module code		Use a different encoder
130	Reserved		n/a
131	Wire brake in encoder 2		Remove the wire break in line of encoder 2
132	Overspeed encoder 2		Check permissable speed of encoder 2
133	Permissable limit of $\sqrt{\sin 2x + \cos 2x}$ exceeded		Use a different encoder
134	Unknown encoder type		Check if the correct encoder is connected or use a different encoder
135	Invalid data field for motor data		Use a different encoder
136	Invalid motor data		
137	Error saving motor data		
138	Motor data write protected. Overwrite not allowed		
139	Field angle error		Check the screening of the encoder cable
140	Encoder without temperture measuring	no reaction	Use an encoder module with temperature measuring
141 to 143	Not used	n/a	n/a

7.2.2.9 Encoder Manager Errors P0210

Error No.	Description	Reaction	Possible Remedies
144	Absolute position of encoder 1 for motor control	IS	Use a different encoder
145	Absolute position of encoder 2 for motor control		
146	Encoder module 1 required and missing		Check if the correct encoder is connected to slot A
147	Encoder module 2 required and missing		Check if the correct encoder is connected to slot B
148	Measured value storage shall be released but there is no encoder module existing		Install the encoder module
149	Measured value storage shall be encoder is a resolver		Use a SinCos or incremental encoder
150	Triggering on zero impulse and encoder is no incremental encoder		Use an incremental encoder
151	Digital I/O module is necessary and missing		Install the digital I/O module
152	Incremental encoder emulation module is necessary and missing		Install the incremental encoder emulation module
153	Encoder module 1 is necessary and missing		Install the encoder module in slot A
154	Encoder module 2 is necessary and missing		Install the encoder module in slot B
155	Timeout during initialization of the communication controller		Restart system
156	Communication controller indicates error		Restart system. If error message reoccurs chang the module
157	Option Start after the first zero impulse selected for non-incremental encoder		Use an incremental encoder
158	SSI encoder emulation module is necessary and is missing		Install the SSI encoder emulation module
159	not used = 0	n/a	n/a

7.2.2.10 Drive Manager Errors P0211

Error No.	Description	Reaction	Possible Remedies
160	Timeout Proprog	no reaction	Remove the timeout from the Proprog communication
161	Timeout BACI		Remove the timeout from the BACI communication
162	Timeout cyclic communication		
163	Timeout required data		Remove the timeout for the required data communication
164	Field bus error		Check the field bus communication
165	Controller not synchrnous to external signal	adjustable	Adjust the Sync Offset and/or Sync tolerance
165 to 175	Reserved Idle = 0		

7.2.2.11 Data Record Management Errors P0212

Error No.	Description	Reaction	Possible Remedies
176	EEPROM copy error	no reaction	Copy the data record once more
177	Write timeout EEPROM		The data in the EEPROM is invalid, save all data records
178	Checksum error EEPROM		EEPROM faulty or described faulty
179	No boot data set		The data in the EEPROM is invalid, save all data records
180	Incompatible software		
181	Data record is nonexistent	no reaction	
165 to 175	Reserved Idle = 0		

7.2.2.12 Position Controller Errors P0213

Error No.	Description	Reaction	Possible Remedies
192	Deviation dynamic	adjustable	Remove the dynamic position deviation error
193	Deviation static		Remove the static position deviation error
194	Encoder 1 for position control used but not active	no reaction	Activate encoder 1
195	Encoder 2 for position control used but not active		Activate encoder 2
196	Software position switch monitoring 1 active		n/a
197	Software position switch monitoring 2 active		
198	Hardware position switch monitoring 1 active		
199	Hardware position switch monitoring 2 active		
200	Homing necessary and not yet executed		Execute homing
201 to 207	Idle = 0	n/a	n/a

7.2.2.13 Speed Control Errors P0214

Error No.	Description	Reaction	Possible Remedies
208	Drive blocked	IS	
209	Encoder 1 is paramertized as the encoder for motor control but the evaluation is not active. OR Faulty positioning in one of the inactive data records		
210	Encoder 2 is paramertized as the encoder for motor control but the evaluation is not active. OR Faulty positioning in one of the inactive data records		Activate the encoder 2 in the encoder 2 mode or adjust ecoder 1 as the encoder for the position contol parameter
211	Overspeed Open Loop		Check the parameterization and reduce the rotational speed
212 to 223	Idle = 0	n/a	n/a

7.2.2.14 CAN-Synchron Errors P0216

Error No.	Description	Reaction	Possible Remedies
240 to 245	Idle = 0	no reaction	Check parameters for this function
246	Wrong adjustment of DIP switch	according to adjustment	Correct the wrong adjustment in the DIP switches on the module
247 to 255	Idle = 0	n/a	n/a

7.2.2.15 Communication to Power Unit Errors P0233

Error No.	Description	Reaction	Possible Remedies
9	Communication	Parity error	Restart the drive
10		Checksum error	Contact G&L Motion Control
11		Unknown instruction code	
12		Data number error	
13		Unpermissible argument	
14		Data field is write protected	
15		Wrong access code	
16		Data field is not changeable in its size	
17		Word address outside of data field	
18		Data field is non-existent	
36		Wrong data checksum	
37		No answer	

7.2.2.16 Encoder Hiperface Specification Errors

1	Communication	Analog signals out specification	Check encoder line and make sure the correct encoder is attached
2		Internal angle offset error	
3		Data field partitioning table destroyed	
4		Analog threshold value not available	Use a different encoder
5		Internal I^2C bus no function	
6		Internal checksum error	
7		Internal watchdog error - encoder reset	Check encoder line and make sure the correct encoder is attached
9		Parity error	
10		False checksum of transmitted data	
11		Unknown instruction code	Use a different encoder
12		False number of transmitted data	
13		Invalid argument	Check encoder line and make sure the correct encoder is attached
14		Data field is write protected	
15		False access code	
16		Data field size cannot be altered	Use a different encoder
17		Stated word address outside data field	
18		Access on non-existing data field	Check encoder line and make sure the correct encoder is attached
28		Absolute value monitoring of analog signals	
29		Critical send current	
30		Critical encoder temperature	
31		Speed too high - position determination not possible	
36		False motor data checksum	
37		Absolutely no response from encoder	
38		Encoder address unknown	
39		Error reading absolute angle position	
40		Unknown encoder type	
41		Unknown encoder type	

7.2.3 Troubleshooting Warning Error Codes

Table 7-2: Power Supply Warnings

Error Code	Warning	Possible Remedies
0	Reserved warning	
1		
2	Mains input undervoltage	Assure compliance with specifications
3	Mains input overvoltage	
4	Mains input failure	Restore the mains supply
5	Phase failure	Check to see that all of the phases are correctly connected and carrying voltage
6 to 15	Reserved warning	n/a

7.2.3.1 Power Unit Warnings

ErrorCode	Warning	Possible Remedies
16	Drive internal temperature	Establish the specified environmental conditions and assure correct ventilation conditions
17	Heatsink temperature	Reduce the power output. Check the drive ventilators
18 to 19	Reserved	n/a
20	Error safety relay	Check the cabling of the safety relay
21 to 22	Reserved	n/a
23	Undervoltage DC	Check the power terminals
24	Lxt threshold exceeded	Make sure the lxt actual value doesn't exceed 100%
25 to 31	Reserved warning	n/a

7.2.3.2 Motor Warnings

Error Code	Warning	Possible Remedies
32	Temperature threshold hold 1 exceeded	Reduce the power output of the motor
33	Temperature threshold hold 2 exceeded	
34	I^2t threshold 2 exceeded	
35 to 47	Reserved	

8 Specifications

8.1 Common Data for Size 1/Size 2/Size 3 (All Models)

General Drive Data	
Minimum wire size for input power wires	2.5mm2 (14 AWG) 75° C copper
Maximum tightening torque for power wire terminals	1.25 Nm (11 in-lbs.)
Commutation	3 Phase Sinusoidal, Space Vector Modulated (SVM)
Current Regulator	Digital PI 125 µsec update rate
Velocity Regulator	Digital PID - 250 µsec update rate
General Operating Data	
Operating Temperature Range	7^{o} C to 50^{o} C (45^{o} F to 122^{o} F)
Storage Temperature Range	-30^{o} C to 70^{o} C (-22^{o} F to 158^{o} F)
Humidity	5% to 95% non-condensing
Altitude	1500 m (5000 ft) Derate 3% for each 300 m above 1500m
Vibration Limits (per IEC 68-2-6) Operating/Non-operating	10-57 Hz (constant amplitude .15 mm) 57 - 2000 Hz (acceleration 2 g)
Shock (per IEC 68-2-27) Non-operating	15g/11 msec per axis

User I/O Connector Encoder Emulation Output		
ENC-02 Motor Feedback Type	**Input Limit**	**Encoder Emulation Output (A quad B Differential Output)**
High Resolution Encoder	100 KHz 400 K counts/sec.	The encoder SIN/COS signals are electrically squared and retransmitted as A/B. The index mark "I" is synthesized by the drive control DSP. Absolute position information is not available via the Encoder Emulation Output.
Resolver	500 RPS 2.00 M counts/sec.	The field-installable resolver interface module converts the motor resolver to 1024 lines/ 4096 counts per revolution of A/B encoder output. The module synthesizes the index mark "I" once per revolution of the resolver. Absolute position information is not available via the Encoder Emulation Output.
Conformity		
CE Marked	Conforms to Low Voltage Directive 73/23/EEC (amended by 93/68/EEC) and EMC Directive 89/336/EEC (amended by 92/31/EEC and 93/68/EEC). Conformance is in accordance with the following standards: EN 50178 and EN61800-3	
UL and C/UL Listed	E233454	

8.1.1 Physical/Electrical Data for Size 1 Drives

	Model	
	MMC-SD-1.3-460-SER	**MMC-SD-2.4-460-SER**
Physical		
Weight	10 lbs.	
Electrical Specifications		
AC Input Specifications		
Nominal Input Power	1.94 kVA	3.33 kVA
Input Voltage	200-460 VAC (nominal), Three Phase, 180-528 VAC (absolute limits)	
Input Frequency	47-63 Hz	
Nominal Input Current	2.44 A_{RMS}	4.18 A_{RMS}
Maximum Inrush Current	4.56 A_{RMS}	7.81 A_{RMS}
Power Loss	34 W	60 W
AC Output Specifications		
Continuous Output Current (0-peak)	3.0 A	5.5 A
Continuous Output Power		
Input = 230 VAC	.65 kW	1.2 kW
Input = 460 VAC	1.3 kW	2.4 kW
Peak Output Current (0-Peak)	6.0 A	11.0 A
Output Frequency	0-300 Hz	
DC Input Power Specifications (24VDC)		
Input Voltage Range	24 VDC +15% -10%	
Typical Input Current	700 mA	
Typical Input Wattage	17 W	
Inrush Current	4 A for 10 ms	

NOTE: AC Current is specified for nominal input voltage of 460 VAC. Currrent for input voltages between 400 and 480 VAC equals approximately:
(current for 460 VAC) x 460/input voltage

Internal Holding Brake Driver		
Maximum Current	0.5 A	
Energy Absorbtion Specifications		
DC Bus Capacitance (Internal)	110 µF	240 µF
Shunt Switch Threshold	780 VDC	
Joules available for energy absorption		
230V motor w/ 230V line input	3 joules	7 joules
460V motor w/ 230V line input	28 joules	60 joules
460V motor w/ 460V line input	10 joules	22 joules
Exteranl Shunt		
Maximum shunt resistor current	5.9 A (AC)	
Minimum shunt resistor	130 Ω	
Maximum shunt resistor power at minimum shunt resistor	4.5 kW	5 kW

8.1.2 Physical/Electrical Data for Size 2 Drive

	Model		
	MMC-SD-4.0-460-SER	**MMC-SD-6.0-460-SER**	**MMC-SD-8.0-460-SER**
Physical			
Weight	16 lbs.		
Electrical Specifications			
AC Input Specifications			
Nominal Input Power	5.6 kVA	8.6 kVA	11.8 kVA
Input Voltage	200-460 VAC (nominal), Three Phase, 180-528 VAC (absolute limits)		
Input Frequency	47-63 Hz		
Nominal Input Current	7 A_{RMS}	10.8 A_{RMS}	14.8 A_{RMS}
Maximum Inrush Current	13.2 A_{RMS}	20.2 A_{RMS}	27.7 A_{RMS}
Power Loss	102 W	150 W	204 W
AC Output Specifications			
Continuous Output Current (0-Peak)	9.0 A	13.5 A	18.0 A
Continuous Output Power			
Input = 230 VAC	2.0 kW	3.0 kW	4.0 kW
Input = 460 VAC	4.0 kW	6.0 kW	8.0 kW
Peak Output Current (0-peak)	18 VA	27.0 kVA	36.0 kVA
Output Frequency	0 Hz to 300 Hz		
Internal Holding Brake Driver			
Maximum Current	0.5 A		

NOTE: AC Current is specified for nominal input voltage of 460 VAC. Currrent for input voltages between 400 and 480 VAC equals approximately:
(current for 460 VAC) x 460/input voltage

DC Input Power Specifications (24VDC)			
Input Voltage Range	24 VDC +15% -10%		
Typical Input Current	1050 mA		
Typical Input Wattage	25 W		
Inrush Current	4 A for 10 ms		
Energy Absorbtion Specifications			
DC Bus Capacitance (Internal)	470 µF		705 µF
Shunt Switch Threshold	780 VDC		
Joules available for energy absorption			
230V motor w/ 230V line input	13 joules		19 joules
460V motor w/ 230V line input	188 joules		177 joules
460V motor w/ 460V line input	44 joules		66 joules
External Shunt			
Maximum shunt resistor current	9 A (AC)	9 A (AC)	9 A (AC)
Minimum shunt resistor	86 Ω	60 Ω	44 Ω
Maximum shunt resistor power at minimum shunt resistor	7 kW	10 kW	14 kW

8.1.3 Physical/Electrical Data for Size 3 Drive

	Model		
	MMC-SD-12.0-460-SER	**MMC-SD-16.0-460-SER**	**MMC-SD-24.0-460-SER**
Physical			
Weight	35 lbs.		
Electrical Specifications			
AC Input Specifications			
Nominal Input Power	13.3 kVA	16.8 kVA	26.3 kVA
Input Voltage	200-460 VAC (nominal), Three Phase, 180-528 VAC (absolute limits)		
Input Frequency	47-63 Hz		
Nominal Input Current	16.7 A_{RMS}	21.1 A_{RMS}	33.1 A_{RMS}
Maximum Inrush Current	32.2 A_{RMS}	39.2 A_{RMS}	61.8 A_{RMS}
Power Loss	300 W	390 W	600 W
AC Output Specifications			
Continuous Output Current (0-Peak)	27.5 A	36.5 A	55.0 A
Continuous Output Power			
Input = 230 VAC	6.0 kW	8.0 kW	12.0 kW
Input = 460 VAC	12.0 kW	16.0 kW	24.0 kW
Peak Output Current (0-peak)	55.0 VA	73.0 kVA	110.0 kVA
Output Frequency	0 Hz to 300 Hz		
Internal Holding Brake Driver			
Maximum Current	0.5 A		

NOTE: AC Current is specified for nominal input voltage of 460 VAC. Currrent for input voltages between 400 and 480 VAC equals approximately:
(current for 460 VAC) x 460/input voltage

DC Input Power Specifications (24VDC)			
Input Voltage Range	24 VDC +15% -10%		
Typical Input Current	1050 mA		
Typical Input Wattage	25 W		
Inrush Current	4 A for 10 ms		
Energy Absorbtion Specifications			
DC Bus Capacitance (Internal)	820 µF	1230 µF	1640 µF
Shunt Switch Threshold	780 VDC		
Joules available for energy absorption			
230V motor w/ 230V line input	22 joules	33 joules	45 joules
460V motor w/ 230V line input	206 joules	309 joules	412 joules
460V motor w/ 460V line input	76 joules	114 joules	152 joules
External Shunt			
Maximum shunt resistor current	36 A (AC)		50 A (AC)
Minimum shunt resistor	22 Ω		16 Ω
Maximum shunt resistor power at minimum shunt resistor	29 kW		40 kW

9 Dimensions

Figure 9-1: Size 1 Drive

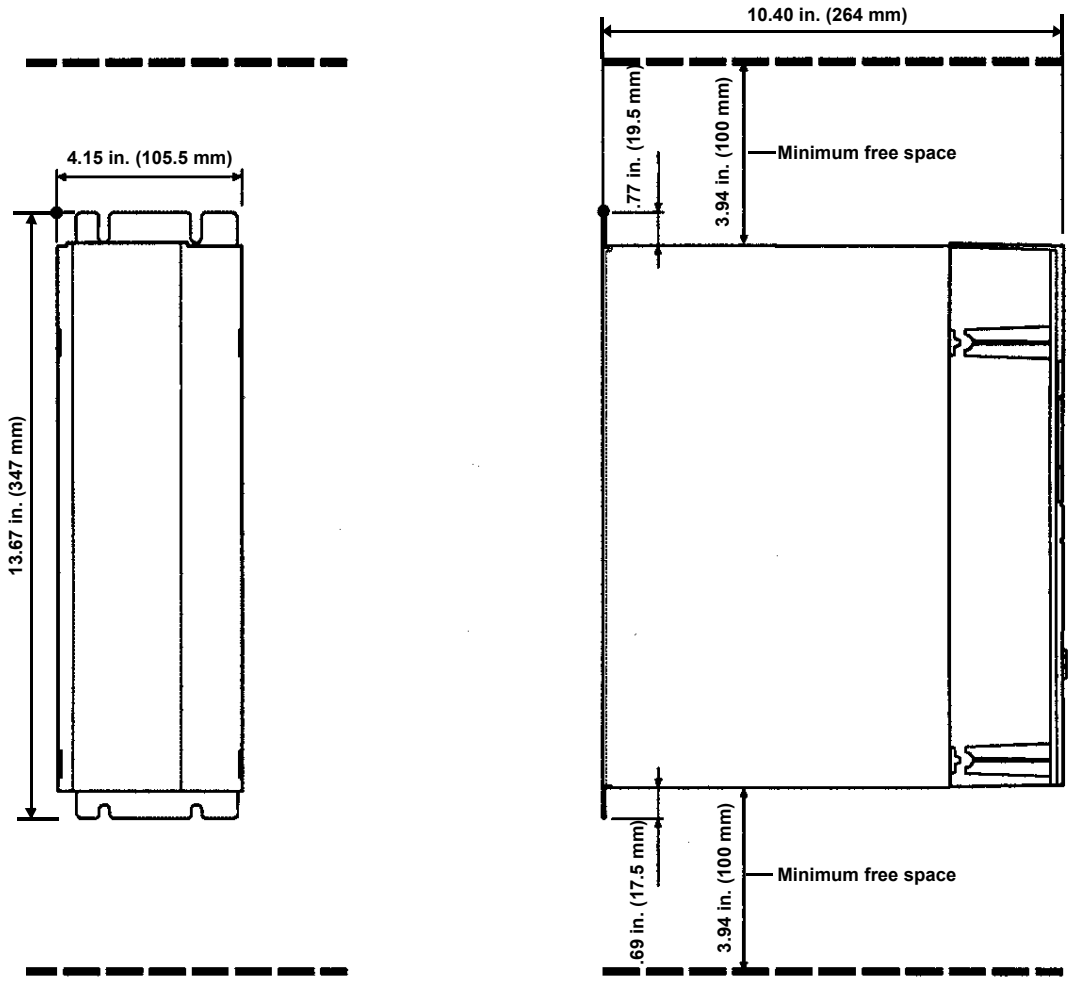


Figure 9-2: Size 2 Drive

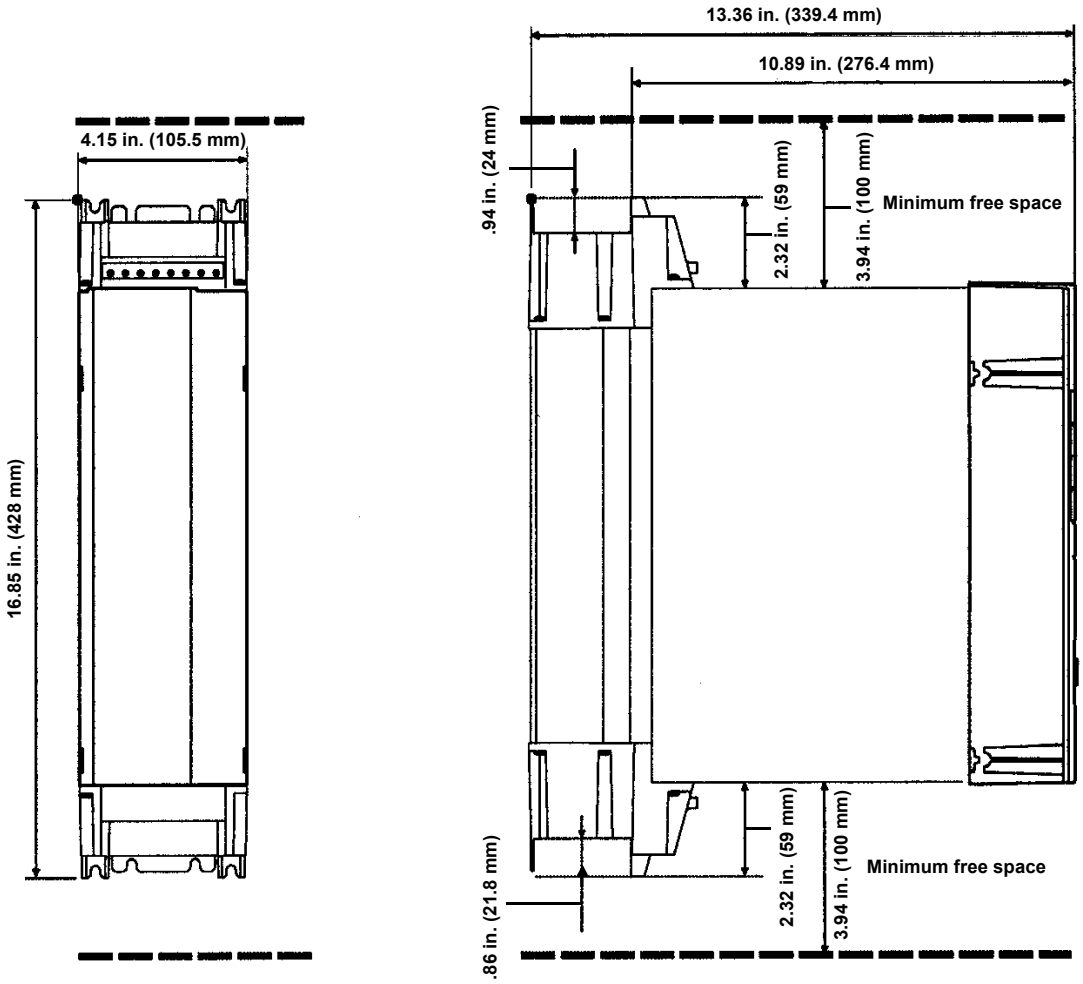
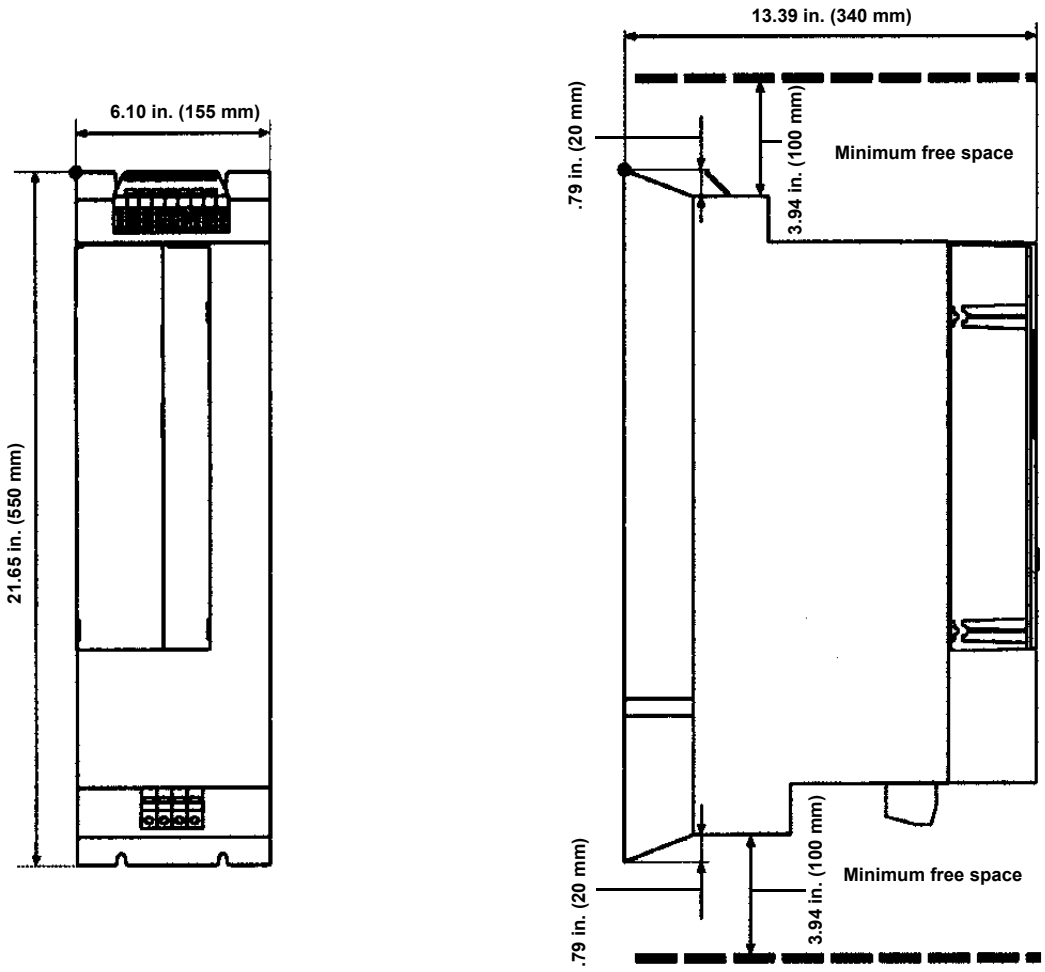


Figure 9-3: Size 3 Drive



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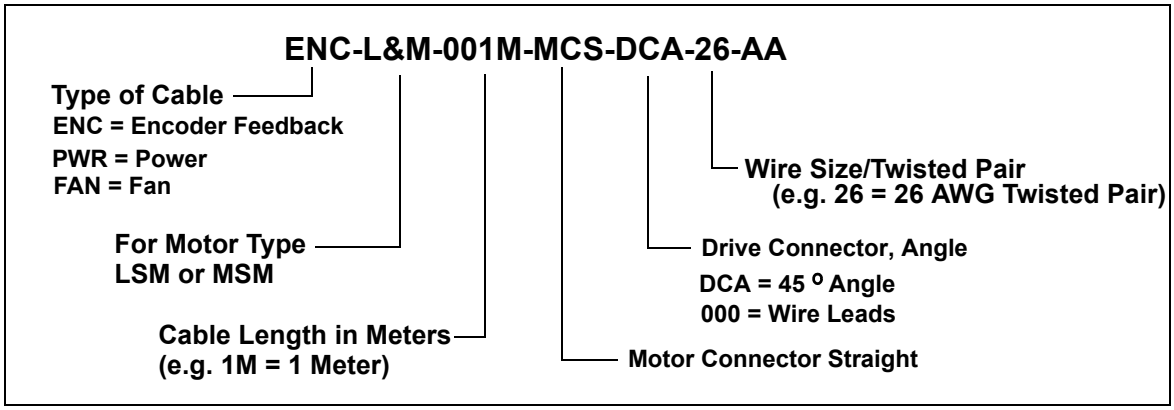
10 Part Numbers

10.1 Drives

Description	Model Number	Part Number
1.3 kW	MMC-SD-1.3-460-SER	M.1302.7812
2.4 kW	MMC-SD-2.4-460-SER	M.1302.7813
4.0 kW	MMC-SD-4.0-460-SER	M.1302.7802
6.0 kW	MMC-SD-6.0-460-SER	M.1302.7814
8.0 kW	MMC-SD-8.0-460-SER	M.1302.7815
12.0 kW	MMC-SD-12.0-460-SER	M.1302.7816
16.0 kW	MMC-SD-16.0-460-SER	M.1302.7817
24.0 kW	MMC-SD-24.0-460-SER	M.1302.7818

10.2 Feedback Cables for LSM and MSM Motors



10.2.1 Feedback Cables for LSM and MSM Motors

Feedback Cable	Part Number
Flexing Type	
ENC-L&M-001M-MCS-DCA-26-AA	M.1302.8170
ENC-L&M-003M-MCS-DCA-26-AA	M.1302.8171
ENC-L&M-009M-MCS-DCA-26-AA	M.1302.8082
ENC-L&M-015M-MCS-DCA-26-AA	M.1302.8172
ENC-L&M-030M-MCS-DCA-26-NA	M.1302.8173

10.2.2 Power Cables for LSM and MSM Motors

Power Cable	Part Number
Flexing Type	
PWR-L&M-001M-MCS-000-16-6H	M.1302.1114
PWR-L&M-003M-MCS-000-16-6H	M.1302.1115
PWR-L&M-009M-MCS-000-16-6H	M.1302.1116
PWR-L&M-015M-MCS-000-16-6H	M.1302.1117
PWR-L&M-030M-MCS-000-16-6H	M.1302.1118
PWR-L&M-001M-MCS-000-14-6H	M.1302.1119
PWR-L&M-003M-MCS-000-14-6H	M.1302.1130
PWR-L&M-009M-MCS-000-14-6H	M.1302.1131
PWR-L&M-015M-MCS-000-14-6H	M.1302.1132
PWR-L&M-030M-MCS-000-14-6H	M.1302.1133
PWR-L&M-001M-MCS-000-12-6H	M.1302.1134
PWR-L&M-003M-MCS-000-12-6H	M.1302.1135
PWR-L&M-009M-MCS-000-12-6H	M.1302.1136
PWR-L&M-015M-MCS-000-12-6H	M.1302.1137
PWR-L&M-030M-MCS-000-12-6H	M.1302.1139
PWR-L&M-001M-MCS-000-10-6H	M.1302.1140
PWR-L&M-003M-MCS-000-10-6H	M.1302.1142
PWR-L&M-009M-MCS-000-10-6H	M.1302.1143
PWR-L&M-015M-MCS-000-10-6H	M.1302.1144
PWR-L&M-030M-MCS-000-10-6H	M.1302.1145
PWR-L&M-001M-MCS-000-08-6H	M.1302.1146
PWR-L&M-003M-MCS-000-08-6H	M.1302.1147
PWR-L&M-009M-MCS-000-08-6H	M.1302.1148
PWR-L&M-015M-MCS-000-08-6H	M.1302.1149
PWR-L&M-030M-MCS-000-08-6H	M.1302.1150

10.2.3 Power Cables for Blower Fan (LSM and MSM Motors)

Power Cable	Part Number
FAN-L&M-001M-MCS-000-16	M.1302.6310
FAN-L&M-003M-MCS-000-16	M.1302.6311
FAN-L&M-009M-MCS-000-16	M.13026312
FAN-L&M-015M-MCS-000-16	M.1302.6313
FAN-L&M-030M-MCS-000-16	M.1302.6314

10.3 Connector Kits

Description	Part Number
CONN-FBK-17POS-16-28AWG	M.1302.0510
CONN-PWR-BRK-8POS-16AWG	M.1302.0479
CONN-PWR-BRK-8POS-12-14AWG	M.1302.1998
CONN-PWR-BRK-8POS-8-10AWG	M.1302.2354
CONN-PWR-FAN-6POS-16AWG	M.1302.6219
CONN-X100-X101	M.1302.7099
CONN-4TERM-MAINS	M.1302.7158
CONN-4TERM-MOTOR	M.1302.7159

10.4 Optional External Devices

10.4.1 AC Line Filters

For Drive Model	AC Line Filter Description	Line Filter Part Number
MMC-SD-1.3-460-SER MMC-SD-2.4-460-SER	7 A, 480 V, Three phase	M.1302.5241
MMC-SD- 4.0-460-SER MMC-SD-6.0-460-SER MMC-SD- 8.0-460-SER	16 A, 480 V, Three phase	M.1302.5244
MMC-SD-12.0-460-SER MMC-SD-16.0-460-SER	30 A, 480 V, Three phase	M.1302.5245
MMC-SD-24.0-460-SER	42 A, 480 V, Three phase	M.1302.5246

10.4.2 AC Line Reactors

Drive Model	Required Line Reactor (Amps)	Watt Loss (Watts)	Impedance (Volts)	Weight (Pounds)	Part Number
MMC-SD-12-460-SER	25	59	11.1	13.2	M.1302.7038
MMC-SD-16-460-SER	25				
MMC-SD-24-460-SER	41	97		15.4	M.1302.7039

10.4.3 External Shunt Resistor Kits

For Drive	Shunt Resistor Module	Part Number
MMC-SD-1.3-460-SER MMC-SD-2.4-460-SER	130 Ω, 450 W Cont. Power, 5.4 W Peak Power, 820 V, 240 sec. Time Constant, 121 mm x 93 mm x 605 mm	M.1302.7048
MMC-SD-4.0-460-SER	95 Ω, 700 W Cont. Power, 8 W Peak Power, 820 V, 250 sec. Time Constant, 121 mm x 93 mm x 705 mm	M.1302.7049
MMC-SD-6.0-460-SER MMC-SD-8.0-460-SER	50 Ω, 1400 W Cont. Power, 17 W Peak Power, 850 V, 250 sec. Time Constant, 130 mm x 182 mm x 710 mm	M.1302.7060
MMC-SD-12.0-460-SER MMC-SD-16.0-460-SER	25 Ω, 2800 W Cont. Power, 32 W Peak Power, 850 V, 60 sec. Time Constant, 171 mm x 430 mm x 550 mm	M.1302.7061
MMC-SD-24.0-460-SER	18 Ω, 3900 W Cont. Power, 70 W Peak Power, 850 V, 70 sec. Time Constant, 180 mm x 445 mm x 490 mm	M.1302.7063

11 Declarations of Conformity

EC DECLARATION OF CONFORMITY

The undersigned, representing the supplier

G&L Motion Control, LLC
672 South Military Road
Fond du Lac, Wisconsin 54936-1960

herewith declares that all **three-phase current synchronous motors, type LSM**
are in conformity with the provisions of the following EC Directive when installed in accordance with the installation instructions contained in the product documentation:

Low Voltage Directive 73/23 EWG

Conformity of the specified product with the guidelines of this directive will be proved by the total compliance with the following harmonic European standards:

EN 60034-1: September 2000 *Rotating Electrical Machines*
+A11 May 2002
EN 60034-5: December 2001
EN 60034-9: June 1998

Year of Marking: 2002

Signature	Robert J Kollmeyer
Full Name	Robert J. Kollmeyer
Position	Director of Engineering
Place	G&L Motion Control, LLC
Date	11-JAN-05

EC DECLARATION OF CONFORMITY

The undersigned, representing the supplier

G&L Motion Control, LLC
672 South Military Road
Fond du Lac, Wisconsin 54936-1960

herewith declares that all **three-phase current synchronous motors, type MSM**
are in conformity with the provisions of the following EC Directive when installed in accordance with the installation instructions contained in the product documentation:

Low Voltage Directive 73/23 EWG

Conformity of the specified product with the guidelines of this directive will be proved by the total compliance with the following harmonic European standards:

EN 60034-1: November 1995 *Rotating Electrical Machines*
EN 60034-5: April 1998
EN 60034-9: May 1996

Year of Marking: 1999

Signature	Robert J. Kollmeyer
Full Name	Robert J. Kollmeyer
Position	Director of Engineering
Place	G&L Motion Control, LLC
Date	11-JAN-05

EC DECLARATION OF CONFORMITY

The undersigned, representing the supplier

G&L Motion Control, LLC
672 South Military Road
Fond du Lac, Wisconsin 54936-1960

herewith declares that all **PiC900™/PiC90™/PiC9™/MMC and Block I/O modules**, labeled with the CE mark, are in conformity with the provisions of the following EC Directives when installed in accordance with the installation instructions contained in the product documentation:

Low Voltage Directive 73/23/EEC as amended by 93/68/EEC
EMC Directive 89/336/EEC as amended by 92/31/EEC and 93/68/EEC

Conformity of the specified product is based upon application of the following standards and/or technical specifications referenced below:

EN 50081-2:1993	*EMC Generic Industrial Emissions*
EN 50082-2:1995	*EMC Generic Industrial Immunity*
EN 61131-2:1994/A11:1996	*Low voltage requirements for programmable controllers*
EN61326:1997	*Electrical Equipment for measurement, control and Laboratory use – EMC requirements*

Year of Marking: 2002

Signature	
Full Name	Robert J. Kollmeyer
Position	Director of Engineering
Place	G&L Motion Control, LLC
Date	11-JAN-05

EC DECLARATION OF CONFORMITY

The undersigned, representing the supplier

G&L Motion Control, LLC
672 South Military Road
Fond du Lac, Wisconsin 54936-1960

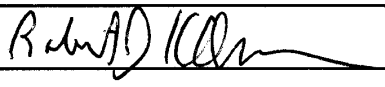
herewith declares that all **MMC Smart Drives (MMC-SD-XXX-230-XXX, MMC-SD-XXX-460-XXX) and accessories** are in conformity with the provisions of the following EC Directive(s) when installed in accordance with the installation instructions contained in the product documentation:

73/23/EEC	*Low Voltage Directive as amended by 93/68/EEC*
89/336/EEC	*EMC Directive as amended by 92/31/EEC and 93/68/EEC*

and that the standards and/or technical specifications referenced below have been applied:

EN 50178:1998	*Electronic equipment for use in power installations*
EN 61800-3:1996 /A11:2000	*Adjustable speed electrical power drive systems – EMC product standard including specific test methods*

Year of Marking: 2003

Signature	
Full Name	Robert J. Kollmeyer
Position	Director of Engineering
Place	G&L Motion Control, LLC
Date	11-JAN-05

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