Allen-Bradley

1394 SERCOS Interface Multi-Axis Motion Control System

(Catalog Numbers 1394C-SJT05-D, 1394C-SJT10-D, 1394C-SJT22-D)

Installation Manual

Rockwell Automation

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Allen-Bradley® does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen-Bradley publication SGI-1.1, *Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control* (available from your local Allen-Bradley office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

Throughout this manual we use notes to make you aware of safety considerations:

ATTENTION

Identifies information about practices or circumstances that can lead to personal injury or death, property damage or economic loss.

Attention statements help you to:

- identify a hazard
- avoid a hazard
- recognize the consequences

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

Chapter 3

Connecting Your 1394 SERCOS Interface System

Appendix B

Interconnect Diagrams

Appendix C

Catalog Numbers and Accessories

Preface

Read this preface to familiarize yourself with the rest of the manual. The preface covers the following topics:

- Who Should Use this Manual
- Purpose of this Manual
- Contents of this Manual
- Product Receiving and Storage Responsibility
- Related Documentation
- Conventions Used in this Manual
- Allen-Bradley Support

Who Should Use this Manual

Use this manual for designing, installing, and wiring your 1394 SERCOS interface™ Multi-Axis Motion Control System. The manual is intended for engineers or technicians directly involved in the installation and wiring of the 1394.

If you do not have a basic understanding of the 1394, contact your local Allen-Bradley representative for information on available training courses before using this product.

Purpose of this Manual

This manual provides the mounting, wiring, and connecting procedures for the 1394 and standard Rockwell Automation/Allen-Bradley motors recommended for use with the 1394.

For power up procedures, troubleshooting, and system integration with the ControlLogix™ and SoftLogix™ SERCOS module/PCI card (see table below) refer to the *1394 SERCOS Interface Integration Manual* (publication 1394-IN024*x*-EN-P). Manuals are available electronically (as a .pdf) or in hardcopy from www.theautomationbookstore.com.

Interface	ControlLogix Module	SoftLogix PCI Card
SERCOS interface	1756-M*xx*SE	1784-PM16SE

Contents of this Manual

Refer to the following listing for the descriptive contents of this installation manual.

Chapter	Title	Contents
	Preface	Describes the purpose, background, and scope of this manual. Also specifies the audience for whom this manual is intended.
1	*Installing Your 1394 SERCOS Interface System*	Provides system mounting information for the 1394 SERCOS interface components.
2	*1394 SERCOS Interface Connector Data*	Provides system module and axis module connector locations, signal descriptions, and I/O specifications.
3	*Connecting Your 1394 SERCOS Interface System*	Provides connection and wiring information for the 1394 SERCOS interface components.
4	*Troubleshooting Status Indicators*	Provides troubleshooting tables that define the 1394 status LEDs and fault codes.
Appendix A	*Specifications and Dimensions*	Provides mounting dimensions, and power, weight, environmental, and functional specifications for the 1394.
Appendix B	*Interconnect Diagrams*	Provides power, shunt, and drive/motor interconnect diagrams for the 1394.
Appendix C	*Catalog Numbers and Accessories*	Provides catalog numbers and descriptions of the 1394 and related products.

Product Receiving and Storage Responsibility

You, the customer, are responsible for thoroughly inspecting the equipment before accepting the shipment from the freight company. Check the item(s) you receive against your purchase order. If any items are obviously damaged, it is your responsibility to refuse delivery until the freight agent has noted the damage on the freight bill. Should you discover any concealed damage during unpacking, you are responsible for notifying the freight agent. Leave the shipping container intact and request that the freight agent make a visual inspection of the equipment.

Store the product in its shipping container prior to installation. If you are not going to use the equipment for a period of time, store using the following guidelines.

- Use a clean, dry location
- Maintain an ambient temperature range of -40 to 70° C (-40 to 158° F)
- Maintain a relative humidity range of 5% to 95%, non-condensing
- Store it where it cannot be exposed to a corrosive atmosphere
- Store it in a non-construction area

Related Documentation

The following documents contain additional information concerning related Allen-Bradley products. To obtain a copy, contact your local Allen-Bradley office, distributor, or download them from TheAutomationBookstore.com.

For:	Read This Document:	Publication Number:
Information on configuring and troubleshooting your 1394 SERCOS interface	*1394 SERCOS interface Integration Manual*	1394-IN024*x*-EN-P
A description and specifications for the 1394 family including motors and motor accessories	*Motion Control Selection Guide*	GMC-SG001*x*-EN-P
Application sizing and configuration information	Motion Book Servo Sizing CD (v4.0 or above)	Motion Book-*mmmyy*
Information on the use of ControlLogix motion features and application examples	*ControlLogix Motion Module Programming Manual*	1756-RM086*x*-EN-P
ControlLogix SERCOS interface module installation instructions	*8 or 16 Axis SERCOS interface Module Installation Instructions*	1756-IN572*x*-EN-P
SoftLogix SERCOS interface PCI card installation instructions	*16 Axis PCI SERCOS interface Card Installation Instructions*	1784-IN041*x*-EN-P
The instructions needed to program a motion application	*Logix™ Controller Motion Instruction Set Reference Manual*	1756-RM007*x*-EN-P
Information on configuring and troubleshooting your ControlLogix motion module	*ControlLogix Motion Module Setup and Configuration Manual*	1756-UM006*x*-EN-P
Information on configuring and troubleshooting your SoftLogix PCI card	*SoftLogix Motion Card Setup and Configuration Manual*	1784-UM003*x*-EN-P
Information on proper handling, installing, testing, and troubleshooting fiber-optic cables	*Fiber-Optic Cable Installation and Handling Instructions*	2090-IN010*x*-EN-P
Information, examples, and techniques designed to minimize system failures caused by electrical noise	*System Design for Control of Electrical Noise Reference Manual*	GMC-RM001*x*-EN-P
For declarations of conformity (DoC) currently available from Rockwell Automation	Rockwell Automation Product Certification website	www.ab.com/certification/ce/docs
An article on wire sizes and types for grounding electrical equipment	*National Electrical Code*	Published by the National Fire Protection Association of Boston, MA.
A glossary of industrial automation terms and abbreviations	*Allen-Bradley Industrial Automation Glossary*	AG-7.1

Conventions Used in this Manual

The conventions starting below are used throughout this manual.

- Bulleted lists such as this one provide information, not procedural steps
- Numbered lists provide sequential steps or hierarchical information
- Words that you type or select appear in bold
- When we refer you to another location, the section or chapter name appears in italics

Allen-Bradley Support

Allen-Bradley offers support services worldwide, with over 75 Sales/ Support Offices, 512 authorized Distributors and 260 authorized Systems Integrators located throughout the United States alone, plus Allen-Bradley representatives in every major country in the world.

Local Product Support

Contact your local Allen-Bradley representative for:

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

Technical Product Assistance

If you need technical assistance, contact your local Allen-Bradley representative or Rockwell Automation Technical Support at (440) 646-5800 / www.ab.com/support. Please have the catalog numbers of your products available when you call.

Comments Regarding this Manual

To offer comments regarding the contents of this manual, go to www.ab.com/manuals/gmc and download the Motion Control Problem Report form. Mail or fax your comments to the address/fax number given on the form.

Installing Your 1394 SERCOS Interface System

Chapter Objectives

This chapter covers the following topics:

- Complying With European Union Directives
- Before Mounting Your System
- Unpacking Modules
- System Mounting Requirements
- HF Bonding Your System
- Planning Your Panel Layout
- Mounting Your 1394 SERCOS interface System
- Mounting Your External Shunt Resistor Kit

ATTENTION

The following information is a guideline for proper installation. The National Electrical Code and any other governing regional or local codes overrule this information. The Allen-Bradley Company cannot assume responsibility for the compliance or the noncompliance with any code, national, local or otherwise, for the proper installation of this system or associated equipment. If you ignore codes during installation, hazard of personal injury and/or equipment damage exists.

Complying With European Union Directives

If this product is installed within the European Union or EEC regions and has the CE mark, the following regulations apply.

For more information on the concept of electrical noise reduction, refer to *System Design for Control of Electrical Noise Reference Manual* (publication GMC-RM001*x*-EN-P).

EMC Directive

This unit is tested to meet Council Directive 89/336 Electromagnetic Compatibility (EMC) using a technical construction file and the following standards, in whole or in part:

- EN 50081-2 EMC - Emission Standard, Part 2 - Industrial Environment
- EN 50082-2 EMC - Immunity Standard, Part 2 - Industrial Environment
- EN 61800-3 EMC - Adjustable Speed Electrical Power Drive Systems - Second Environment, Restricted Distribution Class

The product described in this manual is intended for use in an industrial environment.

Meeting CE Requirements

To meet CE requirements, the following components are required:

- You must install a power line filter (Allen-Bradley catalog number SP-74102-006-01, SP-74102-006-02, SP-74102-006-03 or equivalent based on system current) between the three-phase input line and the system module input.
- For MP-Series and 1326AB (M2L/S2L) motors use 2090 series motor power and feedback cables and terminate the cable shields to the chassis clamps provided (refer to *Chapter 3* for wiring instructions).
- For 1326AB/AS (resolver) motors use 1326 series motor power and feedback cables and terminate the cable shields to the chassis clamps provided (refer to *Chapter 3* for wiring instructions).
- Combined motor power cable length for all (up to 4) axes must not exceed 360 m (1181 ft).

- Install the 1394 SERCOS interface system inside an enclosure. Run input power wiring (grounded to the enclosure) in conduit outside of the enclosure. Separate signal and power cables as shown in *Planning Your Panel Layout* of this chapter.

Low Voltage Directive

These units are tested to meet Council Directive 73/23/EEC Low Voltage Directive. The *EN 50178-1 Electronic Equipment for Use in Power Installations* and *EN 60204-1 Safety of Machinery-Electrical Equipment of Machines, Part 1-Specification for General Requirements* standards apply in whole or in part.

Refer to *Appendix B* of this document for interconnect information.

1394 System Component Overview

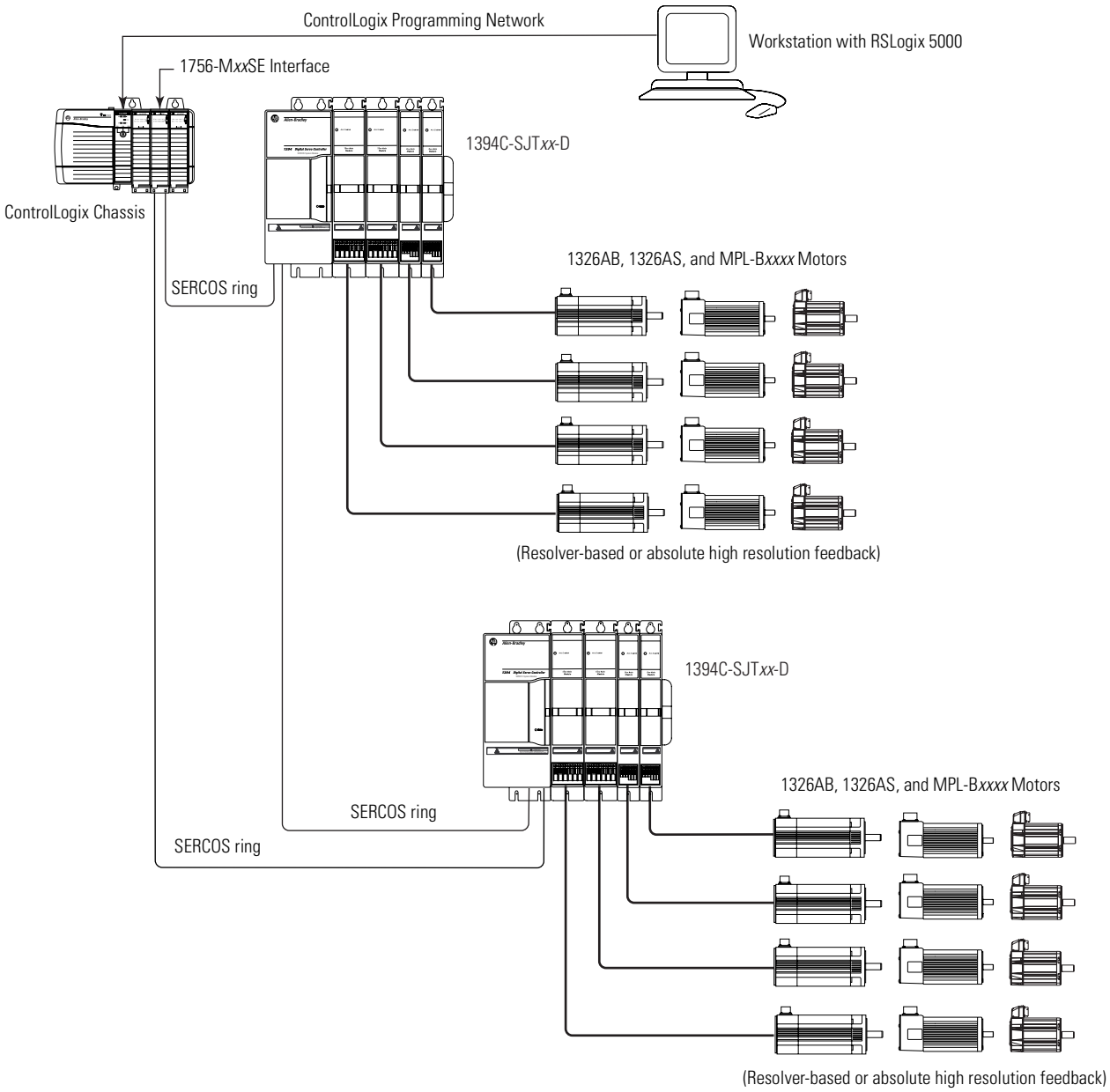
This section provides an overview of the 1394 system components and a typical installation.

1394 Component:	Catalog Numbers:	Description:
System Module	1394C-SJT*xx*-D	The 1394 multi-axis System Modules are available with 5, 10, or 22 kW continuous output and 360V/480V ac input power. Each system module accommodates up to four axis modules.
Axis Module	1394C-AM*xx*	The 1394 Axis Modules are available with 2, 3, 5, 15.6, and 23.8 kW continuous output.
ControlLogix/ SoftLogix Platforms	1756-M*xx*SE module 1784-PM16SE PCI card	The SERCOS interface module/PCI card serves as a link between the ControlLogix/SoftLogix platform and 1394 system. The communication link uses the IEC 61491 SErial Real-time COmmunication System (SERCOS) protocol over a fiber-optic cable.
RSLogix™ 5000 software	9324-RLD300ENE	RSLogix 5000 provides support for programming, commissioning, and maintaining the Logix family of controllers.
Servo Motors	MP-Series, 1326AB, and 1326AS servo motors	The MP-Series (low inertia) 460V, 1326AB (M2L/S2L), and 1326AB (resolver) motors are available for use with the 1394 SERCOS interface system.
Cables	Motor Power, Feedback, and Brake cables	Motor power, feedback, and brake cables include integral molded, bayonet style, quick connect/quick-release connectors at the motor. Power and brake cables have flying leads on the drive end and straight connectors that connect to servo motors. Standard feedback cables have a straight connector on the motor end and flying leads that wire to a feedback connector on the drive end.
	Fiber-Optic cables	SERCOS fiber-optic cables are available in enclosure only, PVC, nylon, and glass with connectors at both ends.
AC Line Filters	SP-74102-006-01	The SP-74102-006-01 three-phase AC line filter is suitable for 1394C-SJT05-D system modules.
	SP-74102-006-02	The SP-74102-006-02 three-phase AC line filter is suitable for 1394C-SJT10-D system modules.
	SP-74102-006-03	The SP-74102-006-03 three-phase AC line filter is suitable for 1394C-SJT22-D system modules.
External Shunt Modules	1394-SR10A	The Bulletin 1394-SR10A external passive shunt resistor is available when the 1394C-SJT05/10-D internal shunt capability is exceeded.
	1394-SR-*xxxx*	One Bulletin 1394 external passive shunt module is required for each 1394C-SJT22-D system module.

Note: Refer to *Appendix C* for a complete list of catalog numbers for the 1394 components listed above.

The typical 1394 SERCOS interface system installation includes the following components.

Figure 1.1
Typical 1394 SERCOS interface System Installation



Before Mounting Your System

Before you mount your 1394 SERCOS interface system make sure you understand the following:

- how to unpack the 1394 system and axis modules
- the system mounting requirements
- how to determine your mounting hole layout

Unpacking Modules

Each 1394 system module ships with the following:

- One system module
- One system terminator
- One installation manual (publication 1394-IN002*x*-EN-P)
- Mating power connectors (5 and 10 kW only)
- Mating I/O and feedback connectors
- Cable shield grounding clamps

Each 1394 axis module ships with the following:

- One 1394 axis module
- TB1 and TB2 connectors
- Cable shield grounding clamp
- One 1394 axis module information sheet (publication 1394-5.5)

Remove all packing material, wedges, and braces from within and around the components. After unpacking, check the item(s) nameplate catalog number against the purchase order. Refer to *Appendix C* for more information on catalog numbers.

System Mounting Requirements

There are several things that you need to take into account when preparing to mount the 1394:

- The ambient temperature of the location in which you will install the 1394 must not exceed *Environmental Specifications* as shown in *Appendix A*.
- You must install the panel on a flat, rigid, vertical surface that won't be subjected to shock, vibration, moisture, oil mist, dust, or corrosive vapors.
- You have to mount the system vertically.
- You need to maintain minimum clearances (see Figure 1.2) for proper airflow, easy module access, and proper cable bend radius.
- The 1394 can operate at elevations to 1000 m (3300 ft) without derating, however, the continuous current rating must be de-rated by 3% for each additional 300 m (1000 ft) up to 3000 m (10,000 ft). Consult your local Allen-Bradley representative prior to operating at over 3000 m (10,000 ft)

Refer to *Appendix A* for mounting dimensions, power dissipation, and environmental specifications for the 1394.

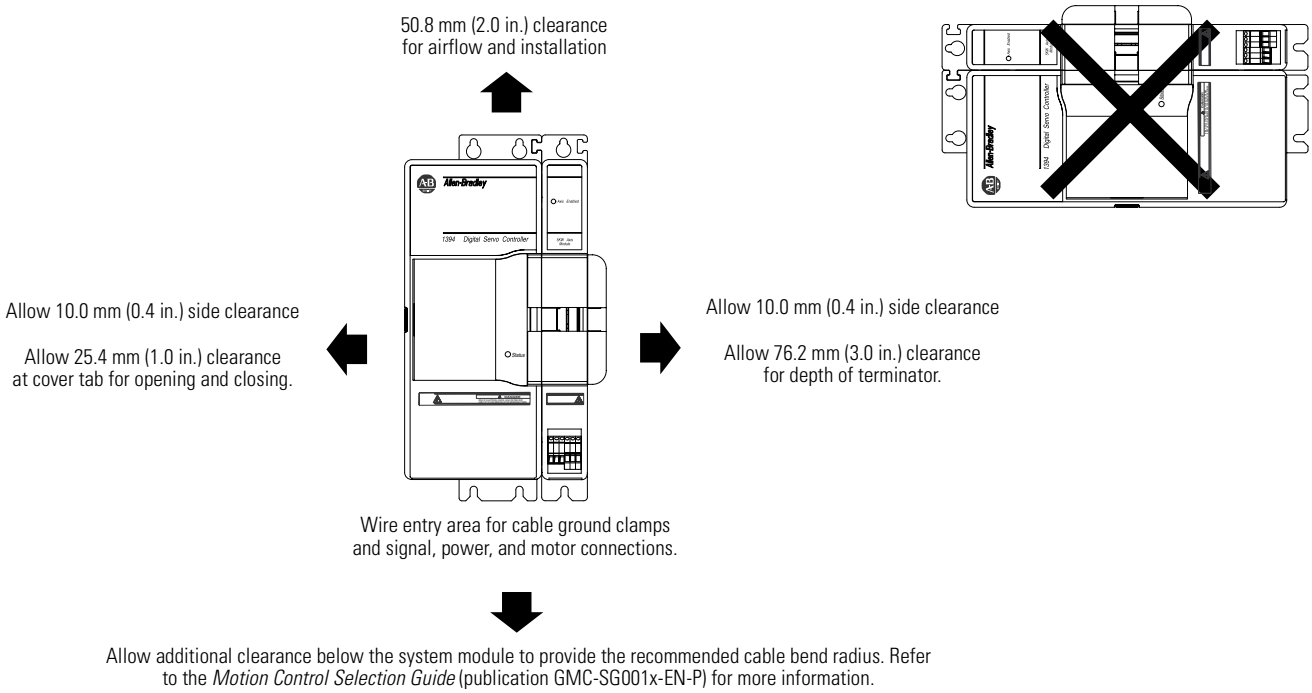
ATTENTION

Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system 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.

Ventilation Requirements

This section provides information to assist you in sizing your cabinet and locating your 1394 system components. Refer to Figure 1.2 for minimum clearance requirements for power rail components mounted inside the cabinet.

Figure 1.2
Minimum System and Axis Module Mounting Requirements



IMPORTANT If the cabinet is ventilated, use filtered or conditioned air to prevent the accumulation of dust and dirt on electronic components. The air should be free of oil, corrosives, or electrically conductive contaminates.

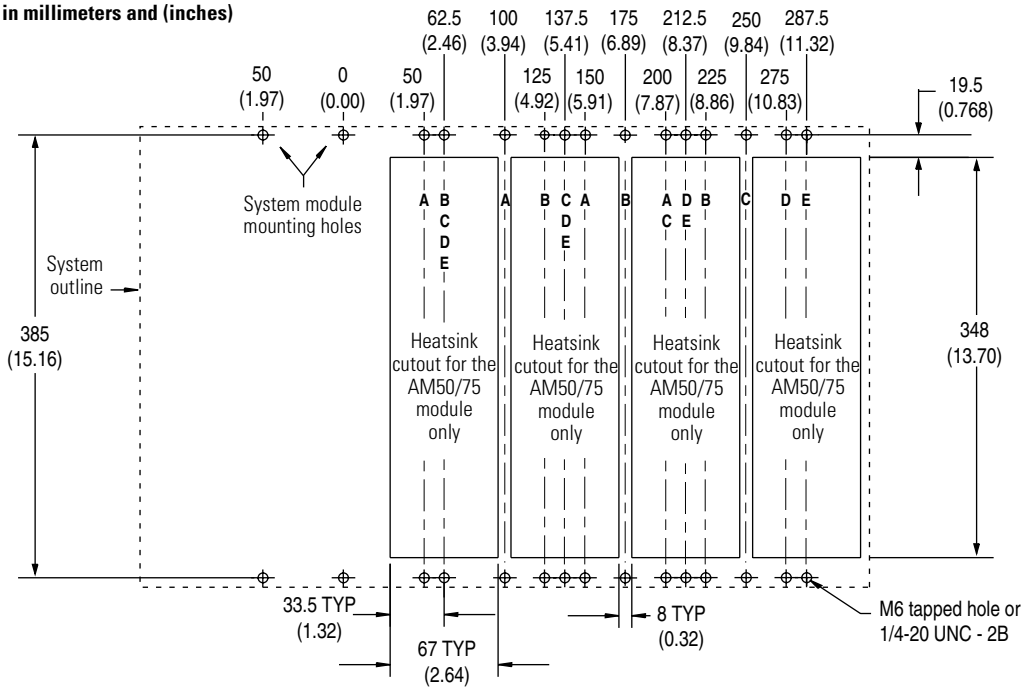
Refer to *Appendix A* for 1394 power dissipation specifications.

Determining Your System Mounting Hole Layout

Based on your actual axis module combination, use the following illustration and table to modify your subpanel using the dimensions that correspond to that specific combination.

Figure 1.3
1394 Mounting Hole Layout

Dimensions are in millimeters and (inches)



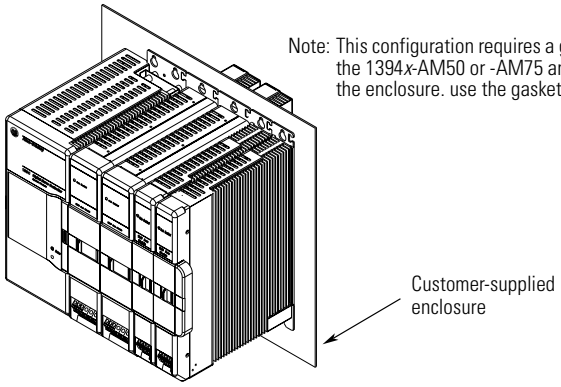
Axis Module Combination	Type of Axis Module	Number of Axes	Cutout Needed?
A	1394*x*-AM50, or -AM75, and 1394C-AM50-IH, or -AM75-IH	0	no
	1394*x*-AM03, AM04, or AM07	up to 4	no
B	1394*x*-AM50, or -AM75, and 1394C-AM50-IH, or -AM75-IH	1	yes (1394*x*-AM50 or -AM75) no (1394C-AM50-IH or -AM75-IH)
	1394*x*-AM03, AM04, or AM07	up to 3	no
C	1394*x*-AM50, or -AM75, and 1394C-AM50-IH, or -AM75-IH	2	yes (1394*x*-AM50 or -AM75) no (1394C-AM50-IH or -AM75-IH)
	1394*x*-AM03, AM04, or AM07	up to 2	no
D	1394*x*-AM50, or -AM75, and 1394C-AM50-IH, or -AM75-IH	3	yes (1394*x*-AM50 or -AM75) no (1394C-AM50-IH or -AM75-IH)
	1394*x*-AM03, AM04, or AM07	up to 1	no
E	1394*x*-AM50, or -AM75, and 1394C-AM50-IH, or -AM75-IH	4	yes (1394*x*-AM50 or -AM75) no (1394C-AM50-IH or -AM75-IH)

Note: When mounting axis module combinations, you must mount the 1394*x*-AM50, -AM75, -AM50-IH, and -AM75-IH closest to the system module and ahead of the 1394*x*-AM03, -AM04, and -AM07 axis modules.

Mounting Your 1394 Through the Back of the Cabinet

The figure below shows an example of the typical mounting of a 1394 system with 1394*x*-AM50 or -AM75 axis modules. The 1394*x*-AM50 and -AM75 have heatsinks that mount through the back of the electrical cabinet.

Figure 1.4
Mounting the 1394 with heatsinks through the back of the cabinet



HF Bonding Your System

Bonding is the practice of connecting metal chassis, assemblies, frames, shields and enclosures to reduce the effects of electromagnetic interference (EMI). For more information on the concept of high-frequency (HF) bonding, the ground plane principle, and electrical noise reduction, refer to *System Design for Control of Electrical Noise* (publication GMC-RM001*x*-EN-P).

Bonding Modules

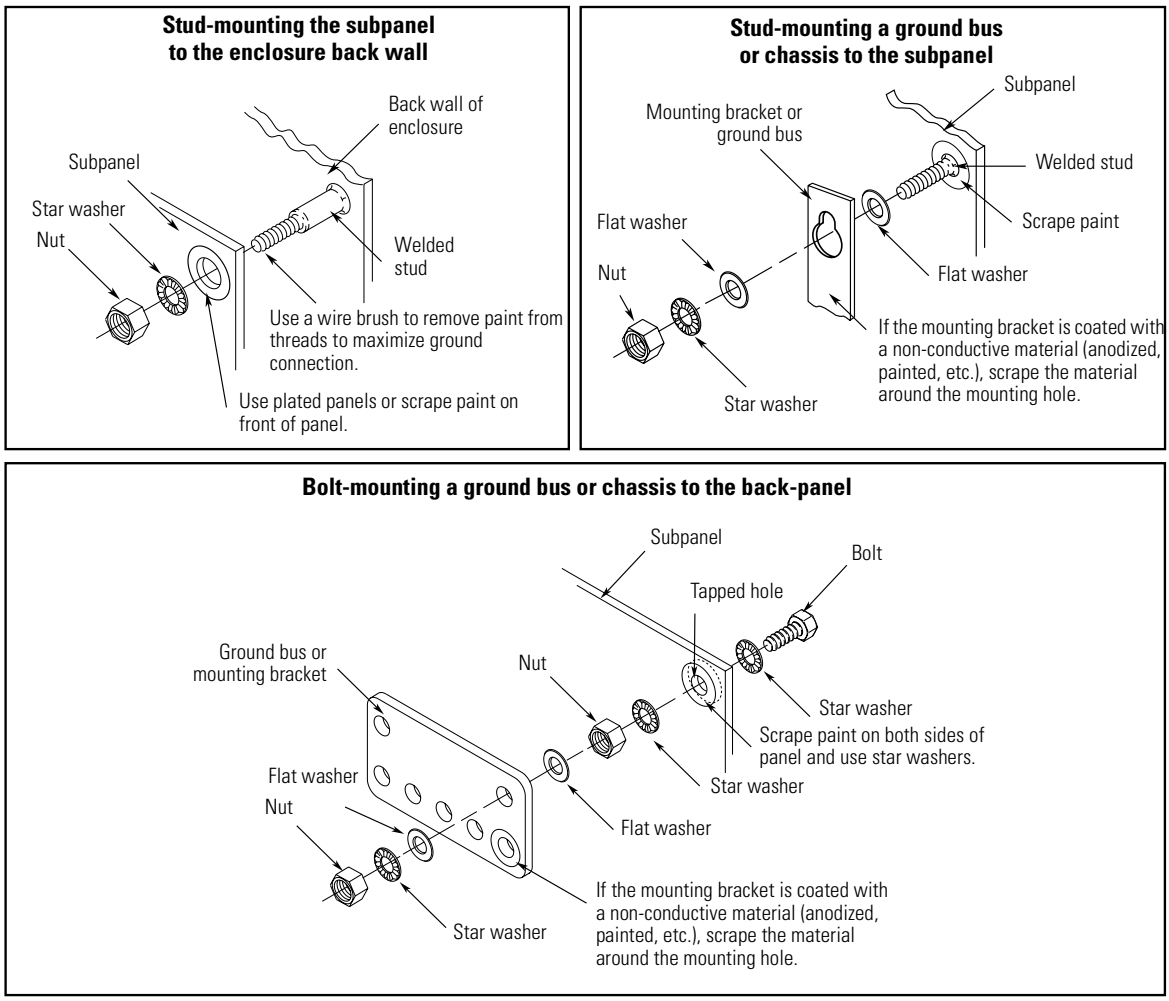
Unless specified, most paints are not conductive and they act as insulators. To achieve a good bond between power rail and the subpanel, surfaces need to be paint-free or plated. Bonding metal surfaces creates a low-impedance return path for high-frequency energy.

IMPORTANT To improve the bond between the 1394 SERCOS interface system and subpanel, construct your subpanel out of zinc plated (paint-free) steel.

Improper bonding blocks the direct return path and allows high-frequency energy to travel elsewhere in the cabinet. Excessive high-frequency energy can effect the operation of other microprocessor controlled equipment.

The illustrations that follow (Figure 1.5) show details of recommended bonding practices for painted panels, enclosures, and mounting brackets.

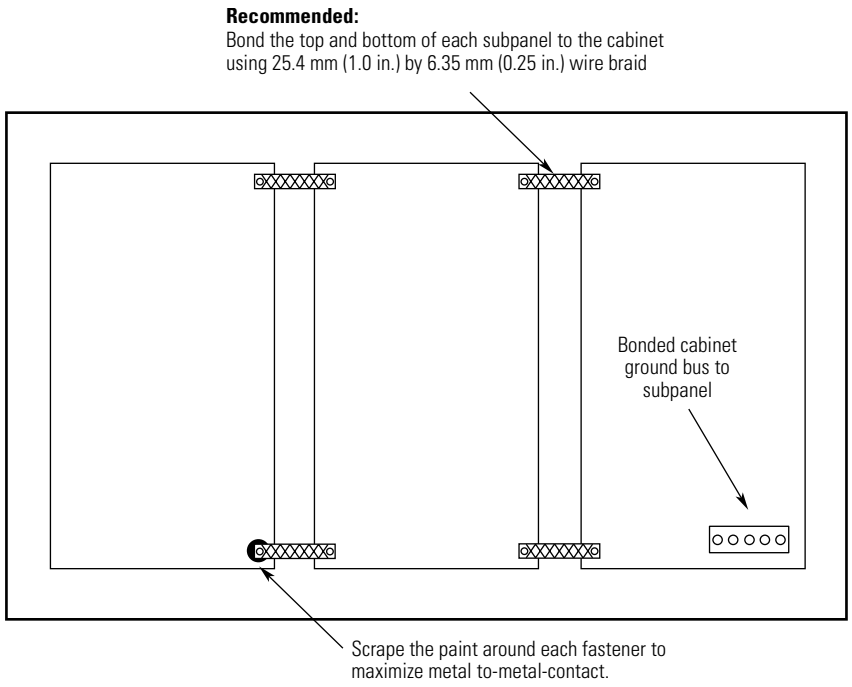
Figure 1.5
Recommended Bonding Practices for Painted Panels



Bonding Multiple Subpanels

Bonding multiple subpanels creates a common low impedance exit path for the high frequency energy inside the cabinet. 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.

Figure 1.6
Bonding Multiple Subpanels



Planning Your Panel Layout

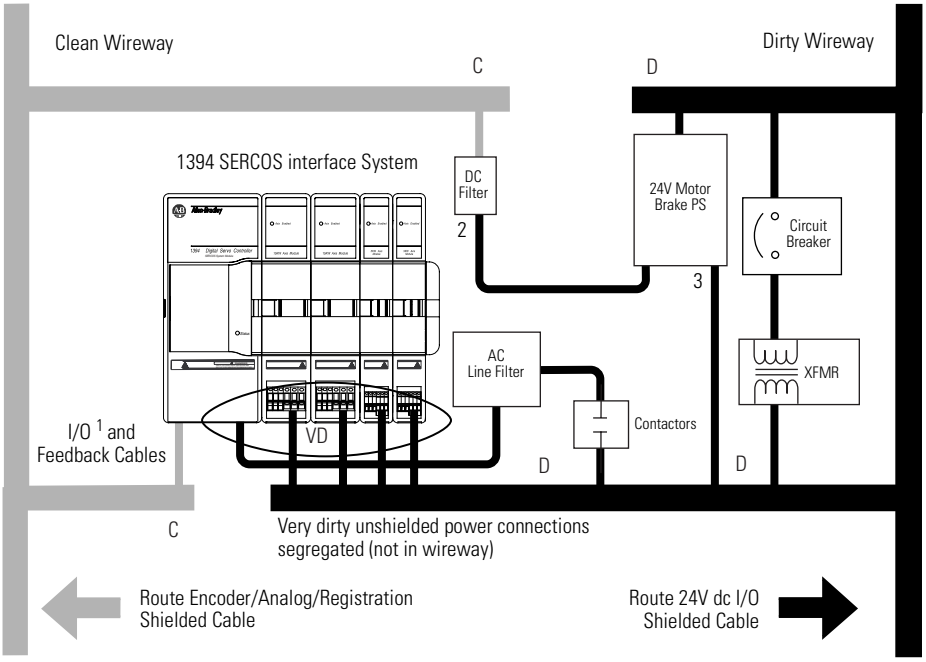
This section outlines the practices which minimize the possibility of noise-related failures as they apply specifically to 1394 installations. For more information on the concept of electrical noise reduction, refer to *System Design for Control of Electrical Noise Reference Manual* (publication GMC-RM001*x*-EN-P).

Establishing Noise Zones

Observe the following guidelines when laying out your panel (refer to Figure 1.7 for zone locations).

- The clean zone (C) is to the left of the 1394 and includes the I/O wiring, feedback cable, and DC filter (grey wireway).
- The dirty zone (D) is beneath and to the right of the 1394 (black wireway) and includes the circuit breakers, transformer, 24V dc power supply, contactors, AC line filter, and motor power cables.
- The very dirty zone (VD) is limited to where the AC line (EMC) filter VAC output jumpers over to the 1394. Shielded cable is required only if the very dirty cables enter a wireway.
- The SERCOS fiber-optic cables are immune to electrical noise, but are relatively fragile and best run with other light weight cables.

Figure 1.7
Establishing Noise Zones



1 If I/O cable contains (dirty) relay wires, route wires in dirty wireway.

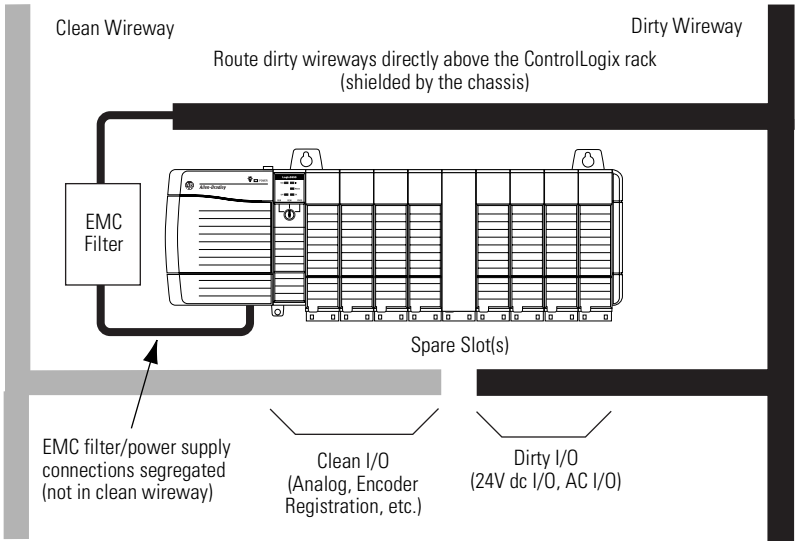
2 This is a clean 24V dc available for any device that may require it. The 24V enters the clean wireway and exits to the left.

3 This is a dirty 24V dc available for motor brakes and contactors. The 24V enters the dirty wireway and exits to the right.

Observe the following guidelines when installing your 1756-M*xx*SE SERCOS interface module (refer to Figure 1.8 for zone locations).

- The clean zone (C) is beneath the less noisy modules (I/O, analog, encoder, registration, etc. (grey wireway).
- The dirty zone (D) is above the chassis and below the noisy modules (black wireway).
- The SERCOS fiber-optic cables are immune to electrical noise, but are relatively fragile and best run with other light weight cables.

Figure 1.8
Establishing Noise Zones (ControlLogix)



Cable Categories for the 1394

The table below indicates the zoning requirements of cables connecting to the 1394.

Wire/Cable	Connections	Zone			Method	
		Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
AC input power from filter to system module (unshielded option)	U, V, W, PE	X				
AC input power from filter to system module (shielded option)			X			X
Motor Power (must be shielded)	U1, V1, W1, PE2		X			X
Thermal wires	TB1/TB2		X			
Brake wires (requires suppression)			X			
24V dc logic power	W1, W2			X		
COM, PWR (24V dc), filtered [1]	Discrete Inputs			X		
COM, PWR (24V dc), unfiltered [2]	Discrete Inputs		X			
Feedback	Motor			X		X
	Auxiliary			X		X
Registration Inputs	Discrete Inputs			X		X
Enable, Overtravel, and Home inputs	Discrete Inputs		X			
Analog Outputs	Analog Outputs			X		X
Relay Outputs	Relay Outputs		X			
DPI/SCANport™	DPI/SCANport			X		X
Fiber-Optic	Rx and Tx	No Restrictions				

[1] Refer to Footnote 2 on page 1-12.

[2] Refer to Footnote 3 on page 1-12.

The table below indicates the zoning requirements of cables connecting to the External Shunt Resistor Kit.

Wire/Cable	Connections	Zone			Method	
		Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
Shunt Power (shielded option)	COL, INT, DC+		X			X
Shunt Power (unshielded option)		X				
Thermal Switch	N/A		X			X
Fan (if present)	N/A		X			

Mounting Guidelines to Reduce Electrical Noise

When mounting an AC line (EMC) filter, external shunt resistor, or wiring the motor brake and thermal switch, refer to the sections below for guidelines designed to reduce system failures caused by excessive electrical noise.

AC Line Filters

Observe the following guidelines when mounting your AC line (EMC) filter (refer to Figure 1.7 for an example).

- Mount the AC line filter on the same panel as the 1394 along the right side of the right-most axis module.
- Good HF bonding to the panel is critical. For painted panels, refer to Figure 1.5.
- Segregate input and output wiring as far as possible.

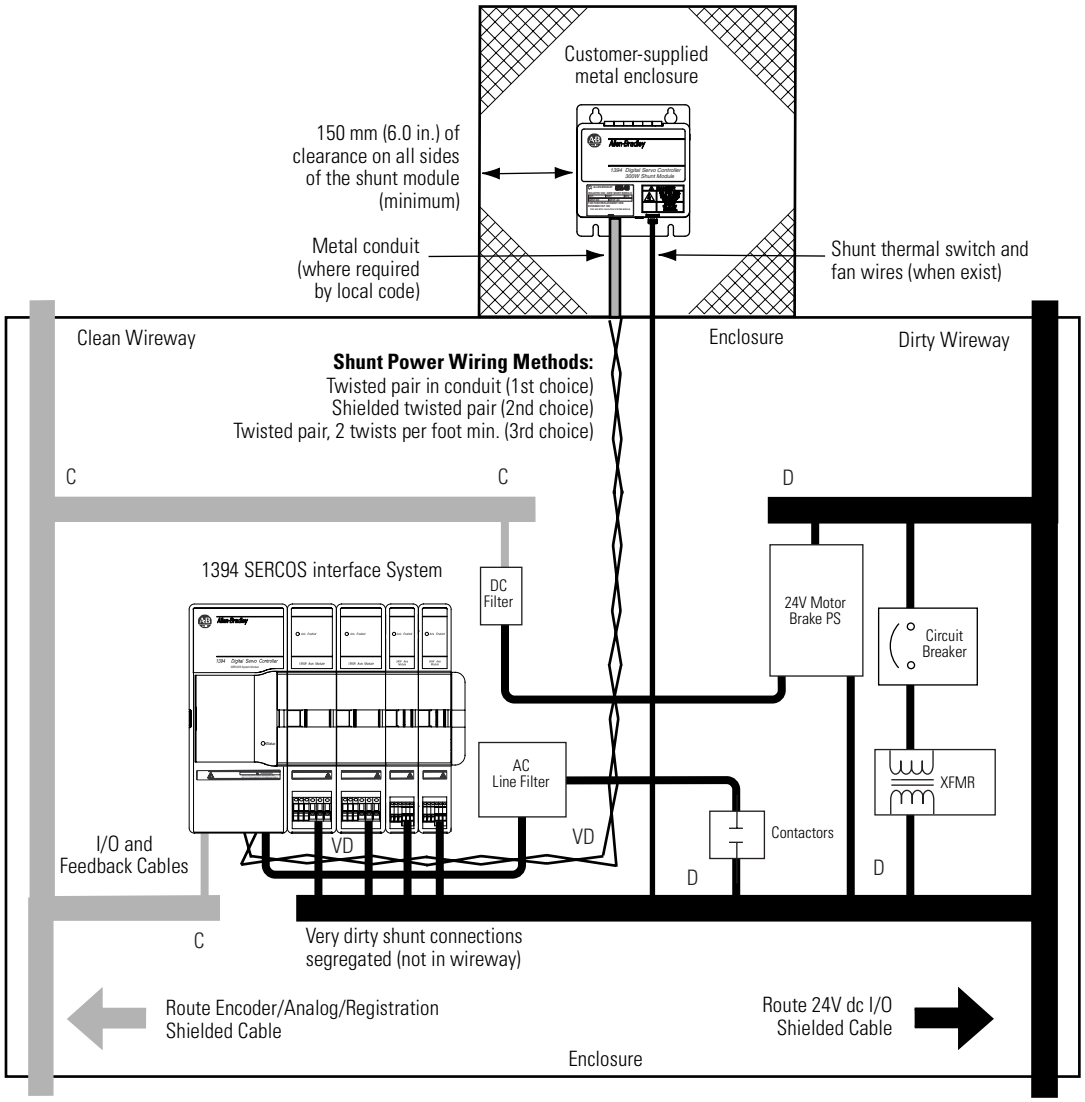
IMPORTANT CE test certification applies only to AC line filter and single 1394 drive. Multiple drive loads may perform satisfactorily, but the user takes legal responsibility.

External Shunt Modules

Observe the following guidelines when mounting your external shunt module (refer to Figure 1.9 and for an example).

- Mount circuit components and wiring in the very dirty zone or in an external shielded enclosure. Run shunt power and fan wiring inside metal conduit to minimize the effects of EMI and RFI.
- Mount resistors (other than metal-clad) in a shielded and ventilated enclosure outside the cabinet.
- Keep unshielded wiring as short as possible. Keep shunt wiring as flat to the cabinet as possible.
- Route thermal switch and fan wires separate from shunt power.

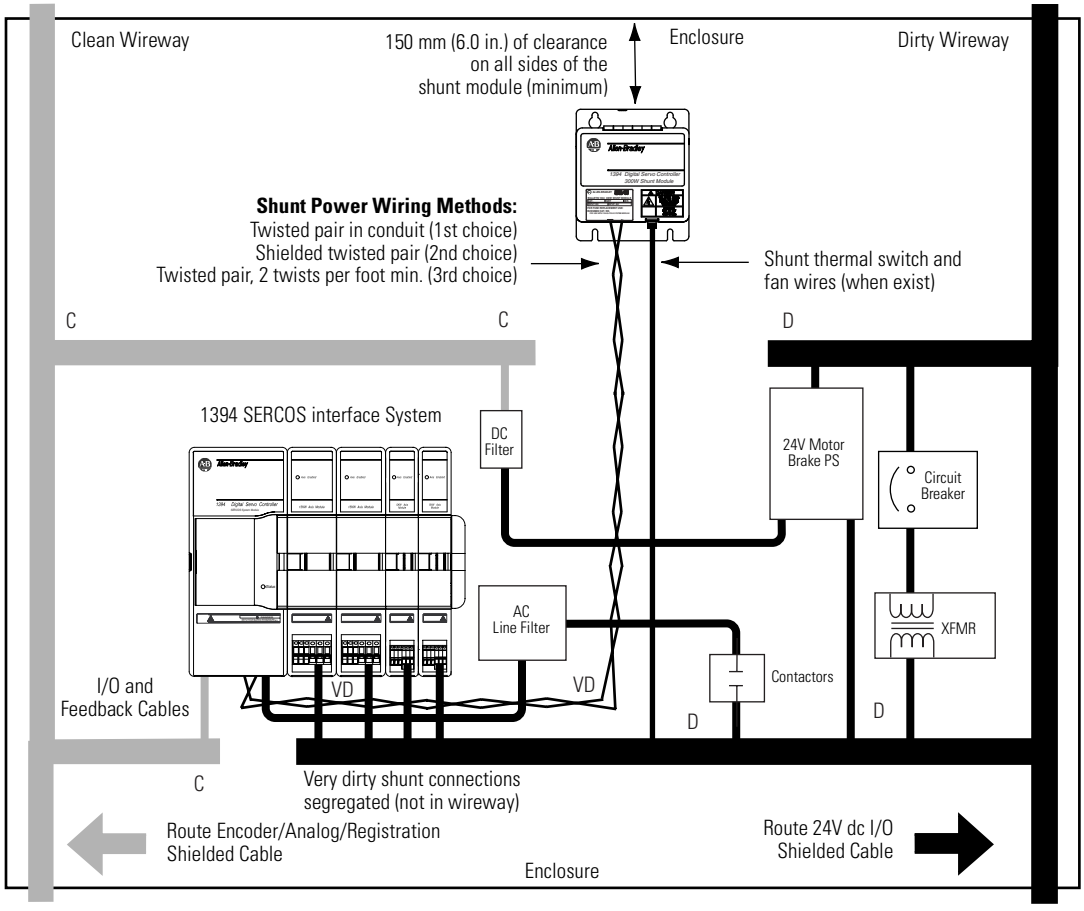
Figure 1.9
External Shunt Module Outside the Enclosure



When mounting your shunt module inside the enclosure, follow these additional guidelines (refer to Figure 1.10 and for an example).

- Metal-clad modules can be mounted anywhere in the dirty zone, but as close to the 1394 as possible.
- Shunt power wires can be run with motor power cables.
- Keep unshielded wiring as short as possible. Keep shunt wiring as flat to the cabinet as possible.
- Separate shunt power cables from other sensitive, low voltage signal cables.

Figure 1.10
External Shunt Module Inside the Enclosure



Motor Brake and Thermal Switch

The thermal switch and brake are mounted inside the motor, but how you connect to the axis module depends on the motor series. Refer to *Connecting Motor Power, Thermal Switch, and Brake* in *Chapter 3* for wiring guidelines specific to your drive/motor combination. Refer to *Axis Module/Motor Interconnect Diagrams* in *Appendix B* for the interconnect diagram for your drive/motor combination.

Mounting Your 1394 SERCOS interface System

The procedures in this section assume you have prepared your panel and understand how to bond your system. For installation instructions regarding equipment and accessories not included here, refer to the instructions that came with those items.

ATTENTION

This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. You are required to follow static control precautions when you install, test, service, or repair this assembly. If you do not follow ESD control procedures, components can be damaged. If you are not familiar with static control procedures, refer to Allen-Bradley publication 8000-4.5.2, *Guarding Against Electrostatic Damage* or any other applicable ESD Protection Handbook.

1. Layout the position for your 1394 in the enclosure (refer to *Establishing Noise Zones* for panel layout recommendations). Mounting hole dimensions for the 1394 are shown in *Appendix A*.

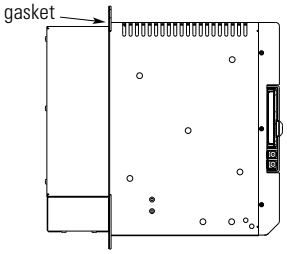
   Note: For help with the mounting hole layout for any combination of axis modules, refer to *Determining Your System Mounting Hole Layout* on page 1-8.

2. Install the top mounting fasteners on the subpanel for the system module and all axis modules. The heads of the fasteners should be at least 6.35 mm (0.25 in.) from the panel. Make sure the 1394 is properly bonded to the subpanel. Refer to the section *HF Bonding Your System* for proper bonding techniques.

   IMPORTANT To improve the bond between the 1394 and subpanel, construct your subpanel out of zinc plated (paint-free) steel.

3. Hang the 1394 system module on the two fasteners on the left side of the subpanel.

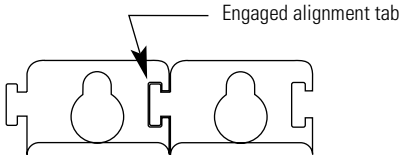
4.

If you are mounting a:	Do this:
1394*x*-AM03, -AM04 or -AM07; 1394C-AM50-IH, or -AM75-IH axis module	1. Hang the axis module on the next mounting fastener. 2. Go to main step 6.
1394*x*-AM50 or -AM75 axis module with the heat sink through the back of the enclosure (refer to Figure 1.4)	1. Remove the paper backing from the gasket that came with the AM50/75 axis module. 2. Position the gasket so that the sticky side faces the axis module and the small hole side is on top. 3. Slide the gasket over the heat sink and attach it to the back of the axis module. **Figure 1.11 Gasket Position**  4. Go to main step 5.

5. Hang the AM50/75 axis module on the next mounting fastener.

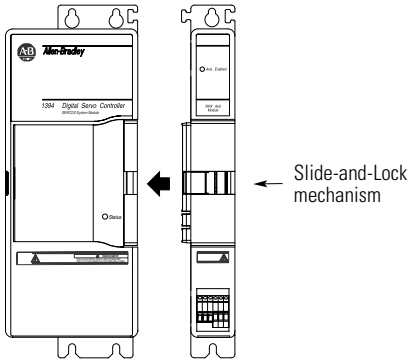
6. Engage the alignment tab (refer to Figure 1.12).

Figure 1.12 Alignment Tab



7. Slide the slide-and-lock mechanism on the axis module to the left until it locks into place.

Figure 1.13
Slide-and Lock Mechanism



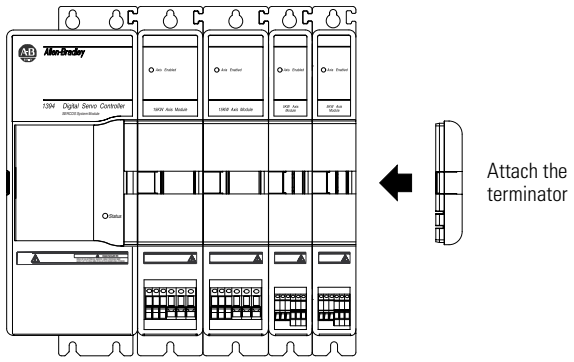
8.

If you:	Do this:
Have more axis modules for this system module	Go to step 4.
Do not have more axis modules for this system module	Go to step 9.

9. Install the lower fasteners for the system module and all axis modules.

10. Attach the terminator to the last axis module. Slide it to the left until it locks in place.

Figure 1.14
Attaching the Terminator



IMPORTANT The terminator terminates the serial ring. The 1394 system will not operate without the terminator.

11. Tighten all mounting fasteners.

Mounting Your External Shunt Resistor Kit

If your 1394 requires a means of dissipating regenerative energy that exceeds the capacity of the shunt module, install an External Shunt Resistor Kit (refer to *Appendix C* for catalog numbers).

ATTENTION

To avoid the hazard of shock or burn and ignition of flammable material, appropriate guarding must be provided. These resistors can reach temperatures in excess of 350° C (662° F). Install per local codes.

To install your External Shunt Resistor Kit:

1. Layout the position for your shunt resistor in the enclosure (refer to *Establishing Noise Zones* for panel layout recommendations).

2. Attach the shunt resistor to the cabinet. The recommended mounting hardware is M6 metric (1/4 in.) bolts. Make sure all fasteners are properly bonded to the subpanel. Refer to the section *HF Bonding Your System* for proper bonding techniques.

3. Tighten all mounting fasteners.

For mounting dimensions, refer to the *Motion Control Selection Guide* (publication GMC-SG001*x*-EN-P).

1394 SERCOS Interface Connector Data

Chapter Objectives

This chapter provides power, feedback, and I/O connector locations and signal descriptions for your 1394 SERCOS interface system. This chapter includes:

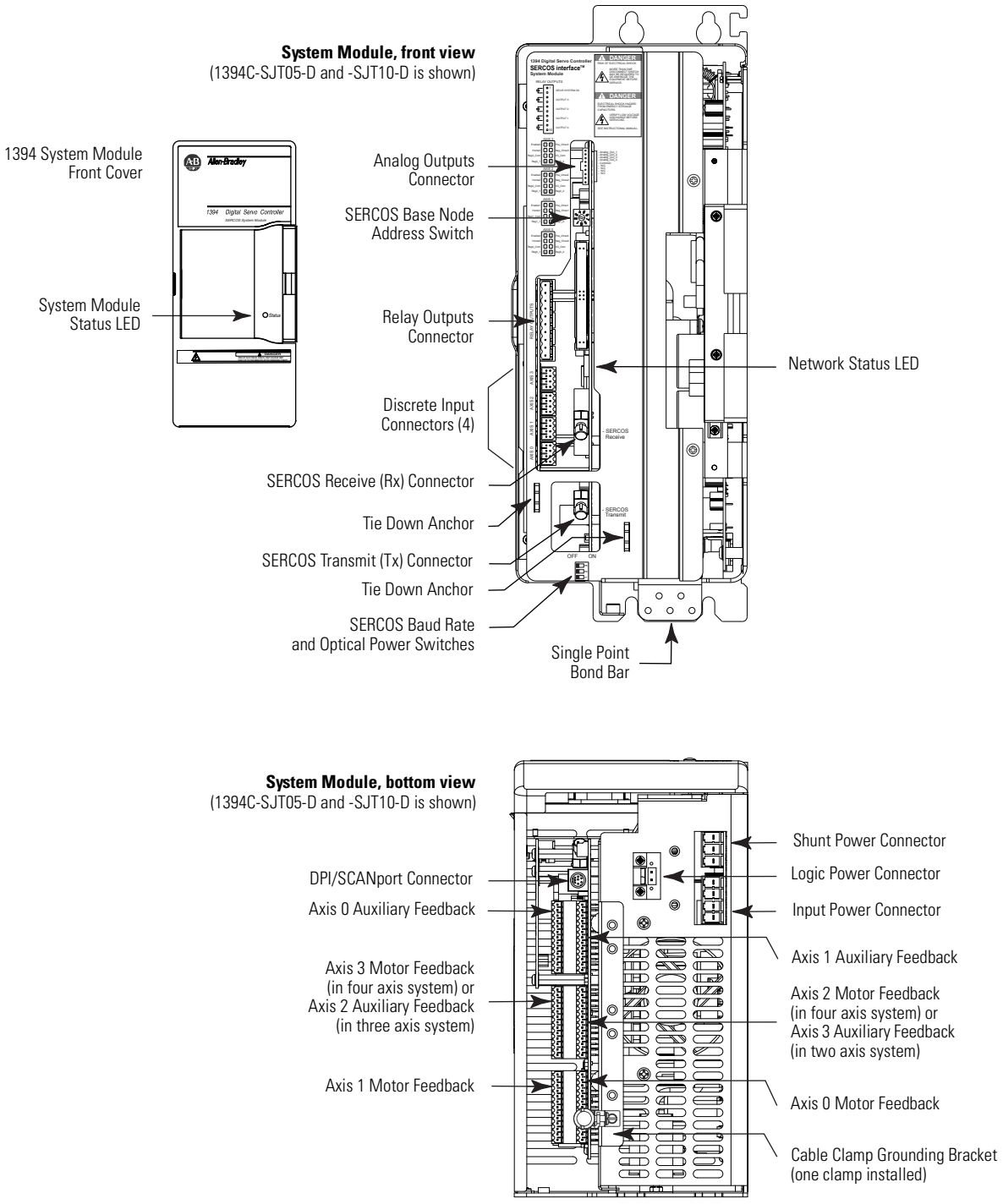
- Locating System Module Connectors and Indicators
- System Module Connector Pin-outs
- Locating Axis Module Connectors and Indicators
- Axis Module Connector Pin-outs
- Understanding I/O Specifications
- Understanding Feedback Specifications

Switch and LED locations are shown, however for switch and LED configuration, refer to the *1394 SERCOS Interface Integration Manual* (publication 1394-IN024*x*-EN-P).

Locating System Module Connectors and Indicators

Use the figure below to locate the 1394C-SJT05-D and -SJT10-D System Module connectors and indicators.

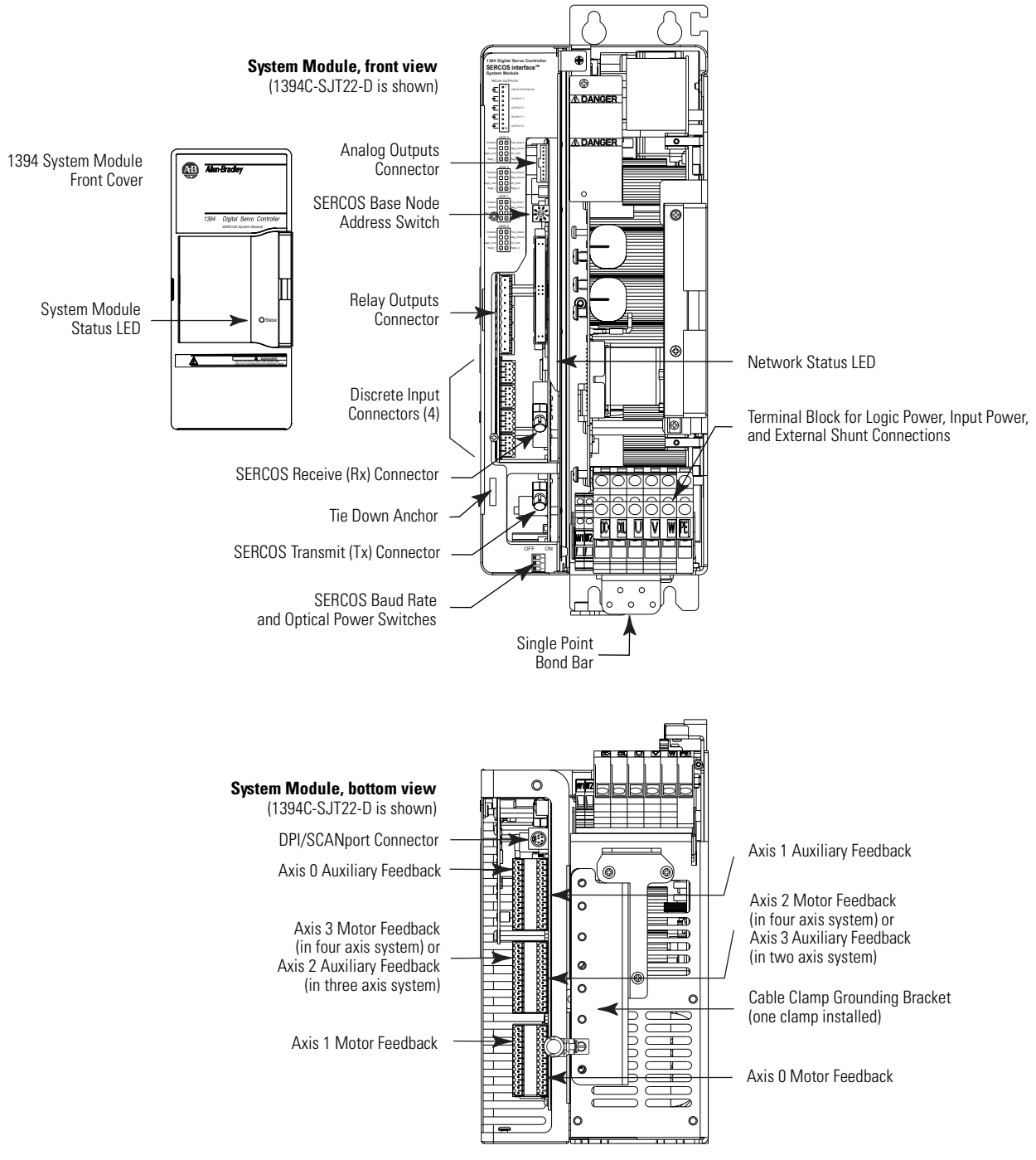
Figure 2.1
1394 System Modules (1394C-SJT05-D and -SJT10-D)



Note: Switch and LED locations are shown, however for switch and LED configuration, refer to the *1394 SERCOS Interface Integration Manual* (publication 1394-IN024*x*-EN-P).

Use the figure below to locate the 1394C-SJT22-D System Module connectors and indicators.

Figure 2.2
1394 System Modules (1394C-SJT22-D)



Note: Switch and LED locations are shown, however for switch and LED configuration, refer to the *1394 SERCOS Interface Integration Manual* (publication 1394-IN024*x*-EN-P).

System Module Connector Pin-outs

The System Module connectors are described in the table below. System Module connector pin-outs and signal descriptions follow.

System Module Connectors

Description	Connector	Present on this 1394 System Module
Main Input Power	4-position connector housing	1394C-SJT05-D / 1394C-SJT10-D
Logic Power	2-position connector housing	
Shunt Power	3-position connector housing	
Logic, Shunt, and Main Input Power Terminal Block	8-position terminal block	1394C-SJT22-D
Single Point Bond Bar	5-position grounding bar	1394C-SJT05-D, 1394C-SJT10-D, or 1394C-SJT22-D
Motor/Auxiliary Feedback	13-position connector housing	
Relay Outputs	10-position connector housing	
Analog Outputs	9-position connector housing	
Discrete Input	8-position connector housing (4)	
SERCOS Transmit and Receive	SERCOS fiber-optic (2)	
DPI/SCANport	DPI/SCANport	

Discrete Input Connector Pin-out

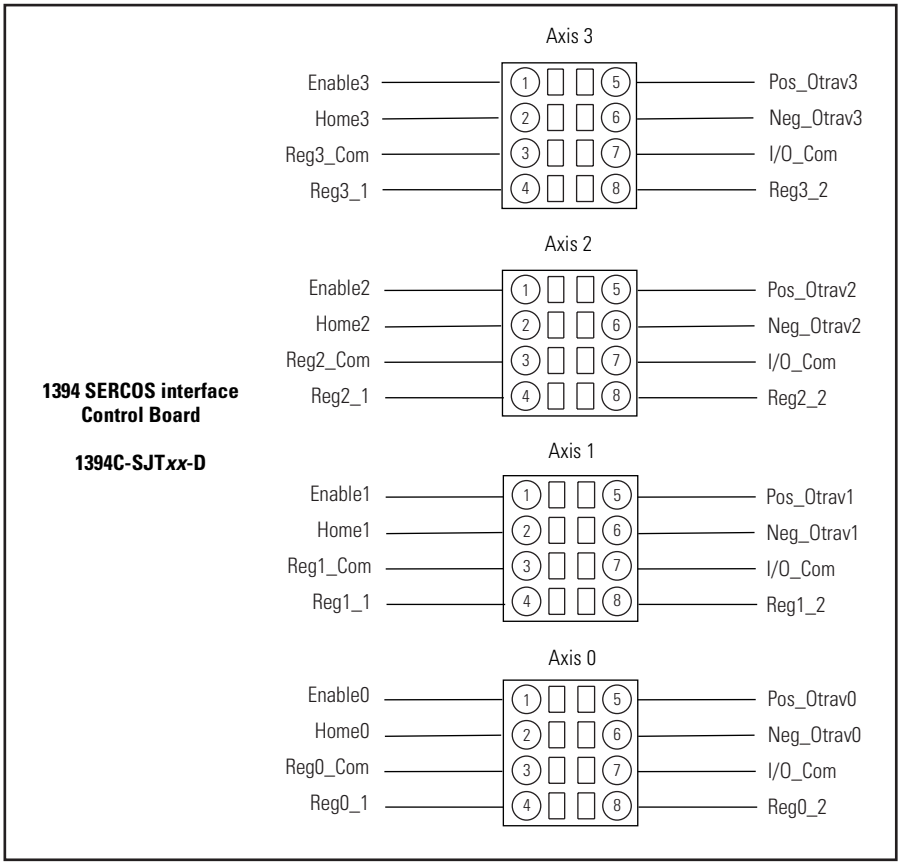
The following table and figure below provides the signal descriptions and pin-out for the Axis 0-3 (8-pin) discrete inputs connector. Refer to *Discrete Input Specifications* on page 2-15 and *Analog Output Specifications* on page 2-17 for I/O signal specifications.

IMPORTANT The 24V dc supplies for use with discrete inputs and registration inputs are user-supplied. Connect the 24V dc common (pins 3 and 7, not internally connected) as described in the table below.

Axis *x* Pin	Description	Signal
1	Hardware Enable	ENABLE*x*
2	Home Switch Input	HOME*x*
3	Common for Registration	REG*x*_COM
4	High Speed Registration 1 Input	REG*x*_1

Axis *x* Pin	Description	Signal
5	Positive limit switch	POS_OTRAV*x*
6	Negative limit switch	NEG_OTRAV*x*
7	Common for HOME, ENABLE, and POS/ NEG_OTRAV Signals	I/O_COM
8	High Speed Registration 2 Input	REG*x*_2

Figure 2.3
Pin Orientation for 8-pin Discrete Inputs Connector

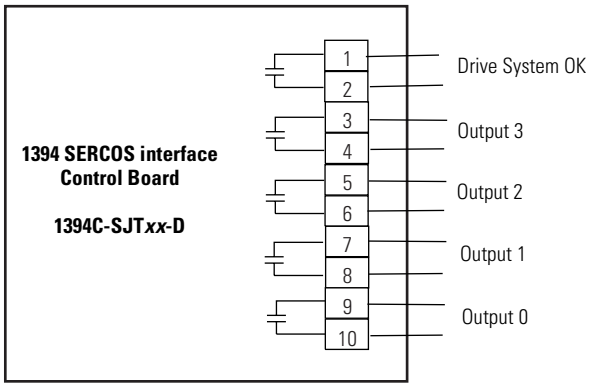


Relay Output Connector Pin-out

The following table and figure below provides the signal descriptions and pin-out for the Relay Output (10-pin) connector. Refer to *Drive System OK Relay Specifications* on page 2-18 and *Motor Brake Relay Specifications* on page 2-19 for relay signal specifications.

Pin	Description	Signal
1	When wired properly in the control string, this relay opens the main power contactor if a drive system fault occurs. Refer to figures B.1 and B.2 for examples.	DRIVE SYSTEM OK
2		
3	Allows control of motor brake using Enable/Disable parameters for Axis 3.	OUTPUT 3
4		
5	Allows control of motor brake using Enable/Disable parameters for Axis 2.	OUTPUT 2
6		
7	Allows control of motor brake using Enable/Disable parameters for Axis 1.	OUTPUT 1
8		
9	Allows control of motor brake using Enable/Disable parameters for Axis 0.	OUTPUT 0
10		

Figure 2.4
Pin Orientation for 10-pin Relay Output Connector

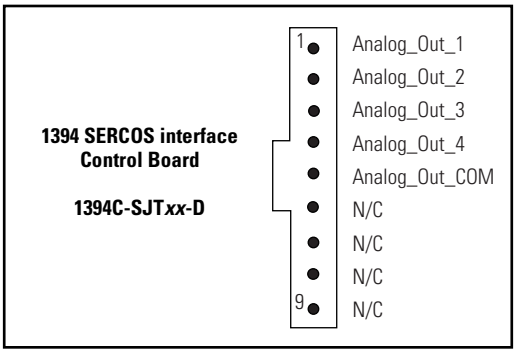


Analog Output Connector

The following table provides the signal descriptions and pin-outs for the analog output (9-pin) connector. Refer to *Analog Output Specifications* on page 2-17 for analog output signal specifications.

Pin	Description	Signal
1	Test Point	ANALOG_OUT_1
2	Test Point	ANALOG_OUT_2
3	Test Point	ANALOG_OUT_3
4	Test Point	ANALOG_OUT_4
5	Common	ANALOG_OUT_COM
6	N/C	—
7	N/C	—
8	N/C	—
9	N/C	—

Figure 2.5
Pin Orientation for 9-pin Analog Output Connector



Motor Feedback Connector Pin-outs

The following table provides the signal descriptions and pin-out for the motor and auxiliary feedback (13-pin) connectors. *Motor and Auxiliary Feedback Specifications* begin on page 2-21.

Stegmann Hiperface (SRS/SRM)

Refer to *Appendix B* for interconnect drawings showing how to connect Stegmann Hiperface® feedback to MPL-B*xxxx*-M and -S, -A*xxxx*-M and -S, and 1326AB-B*xxxx*-M2L and -S2L 460V motors.

Pin	Description	Signal
1	Sine Differential Input+	SINE+
2	Sine Differential Input-	SINE-
3	Cosine Differential Input+	COS+
4	Cosine Differential Input-	COS-
5	Common	ECOMM
6	Encoder Power (+9V)	EPWR_9VM
7	Reserved	—

Pin	Description	Signal
8	Hiperface data channel	DATA+
9	Hiperface data channel	DATA-
10	Reserved	—
11	Reserved	—
12	Motor Thermal Switch (normally closed)	TS+
13	Motor Thermal Switch (normally closed)	TS-

Resolver Transmitter TR = 0.25

Note: TR=0.25 is an abbreviation for *Transformation Ratio 0.25*.

Refer to *Appendix B* for interconnect drawings showing how to connect resolver transmitter feedback to MPL-B*xxxx*-R and 1326AB-B*xxxx*-21 Series 460V motors.

Pin	Description	Signal
1	Sine Differential Input+	S2
2	Sine Differential Input-	S4
3	Cosine Differential Input+	S1
4	Cosine Differential Input-	S3
5	Reserved	—
6	Reserved	—
7	Reserved	—

Pin	Description	Signal
8	Reserved	—
9	Reserved	—
10	Resolver Excitation	R1
11	Resolver Excitation	R2
12	Motor Thermal Switch (normally closed)[1]	TS+
13	Motor Thermal Switch (normally closed)[1]	TS-

[1] When using 1326AB (resolver-based) motors, the thermal switch wires pass through the TB1/TB2 noise filter circuitry on the bottom of the axis module.

IMPORTANT To meet CE requirements, combined motor power cable length for all (up to 4) axes must not exceed 360 m (1181 ft).

Auxiliary Feedback Connector Pin-outs

The following tables provide the signal descriptions and pin-outs for the auxiliary feedback (13-pin) connectors when used with different feedback devices. *Motor and Auxiliary Feedback Specifications* begin on page 2-21.

Note: For TTL devices, the position count will increase when A leads B. For sinusoidal devices, the position count will increase when cosine leads sine.

Stegmann Hiperface (SRS and SRM)

Pin	Description	Signal
1	Sine Differential Input+	SINE+
2	Sine Differential Input-	SINE-
3	Cosine Differential Input+	COS+
4	Cosine Differential Input-	COS-
5	Hiperface data channel	DATA+
6	Common	ECOM
7	Encoder Power (+5V)	EPWR_5V

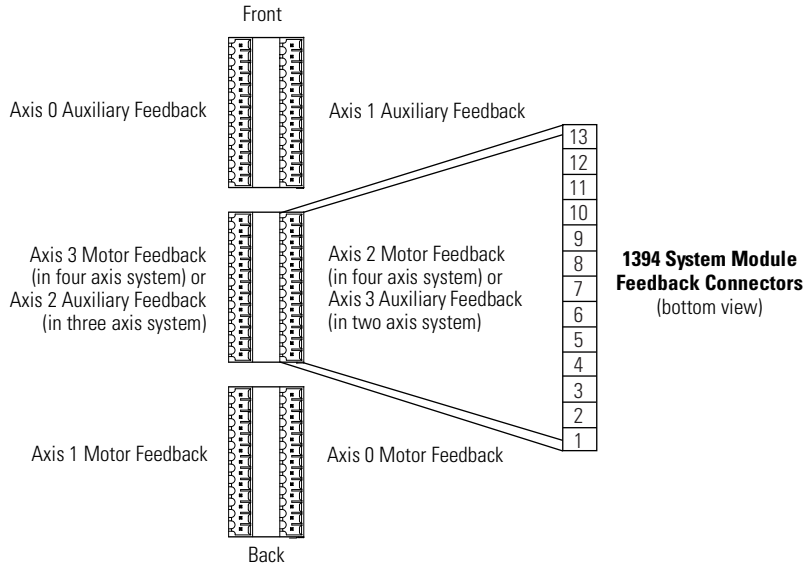
Pin	Description	Signal
8	Reserved	—
9	Reserved	—
10	Hiperface data channel	DATA-
11	Reserved	—
12	Reserved	—
13	Reserved	—

TTL or Sine/Cosine with Index Pulse

Pin	Description	Signal
1	A+ / Sine Differential Input+	A+ / SINE+
2	A- / Sine Differential Input-	A- / SINE-
3	B+ / Cosine Differential Input+	B+ / COS+
4	B- / Cosine Differential Input-	B- / COS-
5	Index Pulse+	I+
6	Common	ECOM
7	Encoder Power (+5V)	EPWR_5V

Pin	Description	Signal
8	Reserved	—
9	Reserved	—
10	Index Pulse-	I-
11	Reserved	—
12	Reserved	—
13	Reserved	—

Figure 2.6
Pin Orientation for 13-pin Motor/Auxiliary Feedback Connectors



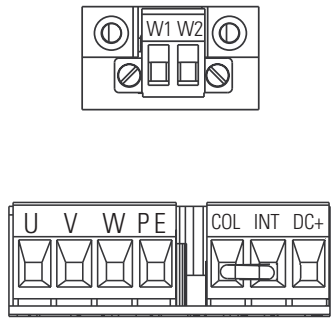
System Module Input Power Pin-outs

The following table provide the signal descriptions and pin-outs for the system module input power connections.

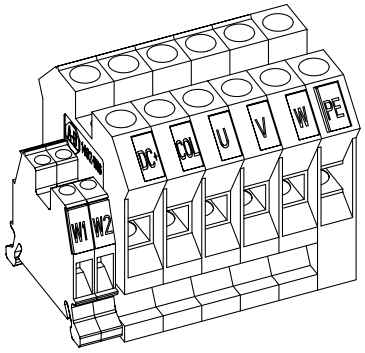
For the location of 1394C-SJT05-D and -SJT10-D input connectors, refer to Figure 2.1 on page 2-2. For the location of 1394C-SJT22-D input terminal block, refer to Figure 2.2 on page 2-3. Refer to *Logic Power Input Specifications* on page 2-20 for signal specifications.

Pin	Description	Signal
W1	Logic power input	W1
W2		W2
U	Three-phase main input power	U
V		V
W		W
PE	Chassis Ground	⏚
DC+	External Shunt Connections	DC+
INT		INT
COL		COL

Figure 2.7
1394C-SJT*xx*-D Input Power



1394C-SJT05-D and -SJT10-D
Input Power Connectors



1394C-SJT22-D
Input Power Terminal Blocks

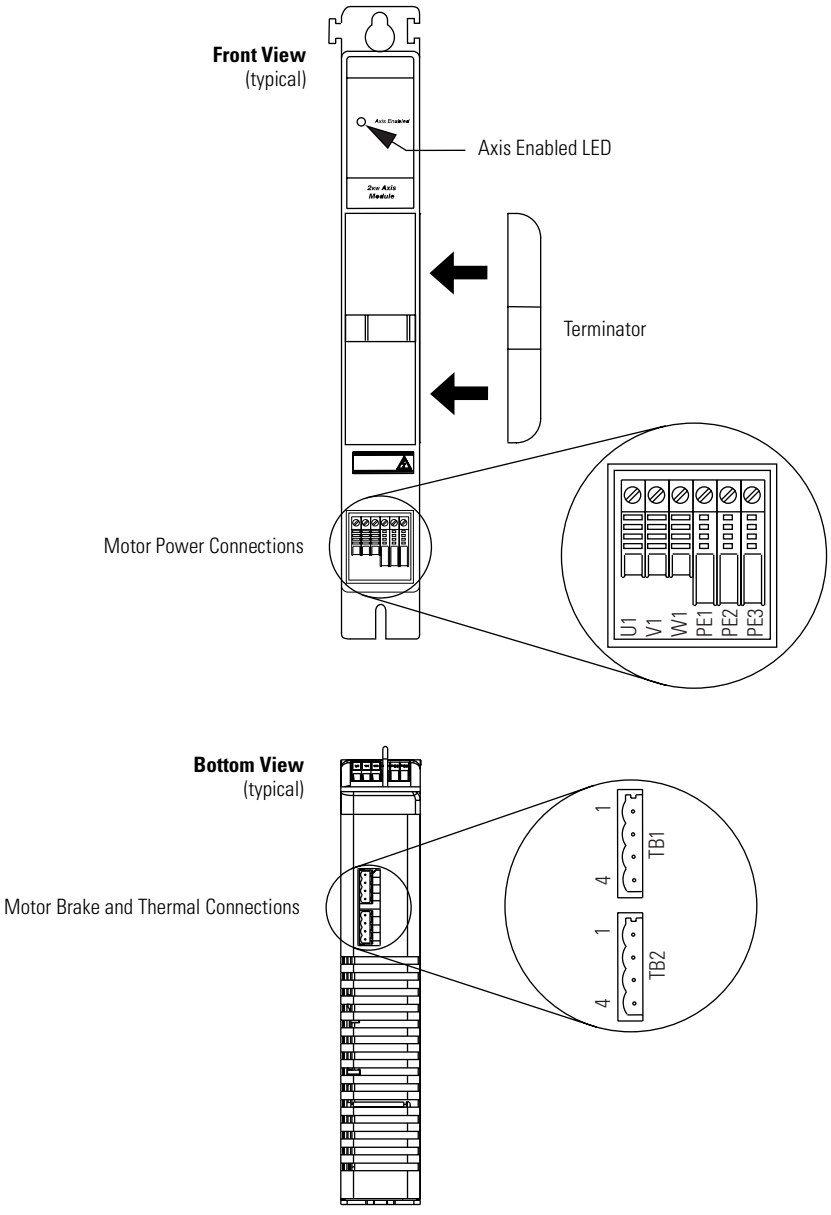
SCANport Adapter

This port allows you to connect a SCANport device, such as a Human Interface Module (HIM), to the 1394 SERCOS Interface system. Refer to figures 2.1 and 2.2 for SCANport location. Refer to the *1394 SERCOS Interface Integration Manual* (publication 1394-IN024*x*-EN-P) for information on using the HIM.

Locating Axis Module Connectors and Indicators

Use the figure below to locate the axis module connectors and indicators. Shown below are typical 1394C-AM03, -AM04, and -AM07 axis modules. Although the physical size of the 1394C-AM50-*xx* and AM75-*xx* model is larger, the location of the connectors and indicators is identical.

Figure 2.8
1394 Axis Modules (1394C-AM*xx* and -AM*xx*-IH)



Axis Module Connector Pin-outs

The Axis Module connectors are described in the table below. Axis Module connector pin-outs and signal descriptions follow.

Axis Module Connectors

Description	Connector
Motor Power Terminal Block	6-position terminal block
Motor Brake/Thermal (TB1/TB2)	4-position connector housing (2)

Motor Power and Brake Connector Pin-outs

The following tables provide the signal descriptions and pin-outs for the Axis Module motor power and brake connections. Refer to *Motor Brake Relay Specifications* on page 2-19 for signal specifications.

Motor Power Connections

The following table provides the signal descriptions and pin-outs for the motor power (6-position) terminal block.

Terminal	Description	Signal
U1	Three-phase motor power	U1
V1		V1
W1		W1
PE1	Axis Ground	⏚
PE2	Motor Ground	⏚
PE3	No Connection	⏚
Cable Clamp	Overall Shield	⏚

IMPORTANT To meet CE requirements, combined motor power cable length for all (up to 4) axes must not exceed 360 m (1181 ft).

Motor Brake/Thermal Connectors

The following table provides the signal descriptions and pin-outs for the motor brake and thermal (4-pin) TB1 and TB2 connectors.

TB1 Pin	Description	Signal
1	Thermal Sensor Input from Motor Cable	TS+
2		TS-
3	Brake wires from Motor Power Cable	BR+
4		BR-

TB2 Pin	Description	Signal
1	Filtered brake wires from Fault System or System Module	Filtered TS+
2		Filtered TS-
3	Filtered thermal sensor output to Fault System or System Module	Filtered BR+
4		Filtered BR-

Understanding I/O Specifications

A description of the 1394 discrete inputs, analog outputs, relay outputs, SERCOS connections, and logic power connections is provided on the following pages.

IMPORTANT To improve registration input EMC performance, refer to the *System Design for Control of Electrical Noise Reference Manual* (GMC-RM001*x*-EN-P).

Discrete Input Specifications

Two fast registration inputs and four other inputs are available for the machine interface on the four discrete input connectors. These are sinking inputs that require a sourcing device.

IMPORTANT The discrete input 24V dc power supply is user-supplied.

IMPORTANT Overtravel limit input devices must be normally closed and configured in RSLogix 5000.

Discrete Input Pin:	Signal:	Description:	Capture Time	Edge/Level Sensitive
Axis 0-3 input pin 1	ENABLE	A 24V dc input is applied to these terminals to enable each axis.	50 ms	Level
Axis 0-3 input pin 2	HOME	The Home switch input is a normally open or normally closed contact configured in RSLogix 5000. Inputs for each axis require 24V dc (nominal), 15 mA (max) to energize. Each input is optically isolated and filtered to minimize switch bounce. Refer to Figure 2.9.	50 ms	Level
Axis 0-3 input pin 5 Axis 0-3 input pin 6	POS_OTRAV NEG_OTRAV	The positive/negative limit switch input is a normally closed contact configured in RSLogix 5000. Inputs for each axis require 24V dc (nominal), 15 mA (max) to energize. Each input is optically isolated and filtered to minimize switch bounce. Refer to Figure 2.9.	50 ms	Level
Axis 0-3 input pin 7	I/O_Com	Common grounding point for input signals (Home, Enable, Pos/Neg_Otrav)	N/A	N/A
Axis 0-3 input pin 3 Axis 0-3 input pin 4 Axis 0-3 input pin 8	REG_COM REG_1 REG_2	24V dc high-speed, optically-isolated filtered registration input for each axis. Refer to Figure 2.10.	500 ns	Edge

Figure 2.9
Enable, Home, and Overtravel Digital Input Circuits

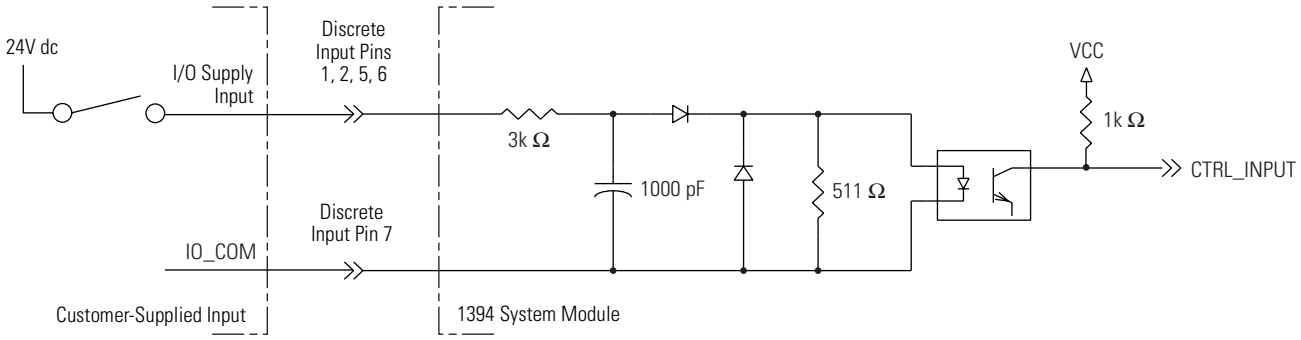
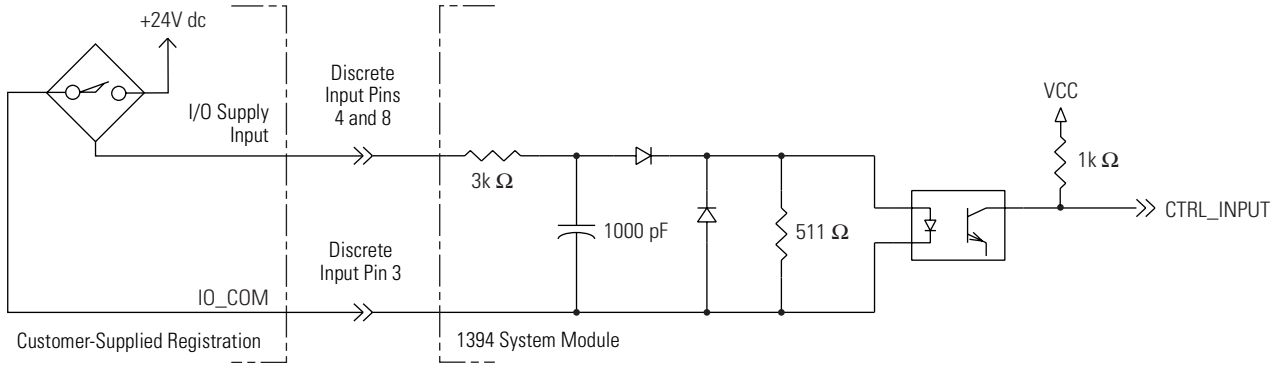


Figure 2.10
Registration Digital Input Circuits



The following table provides a description of the digital input specifications, as shown in figures 2.9 and 2.10.

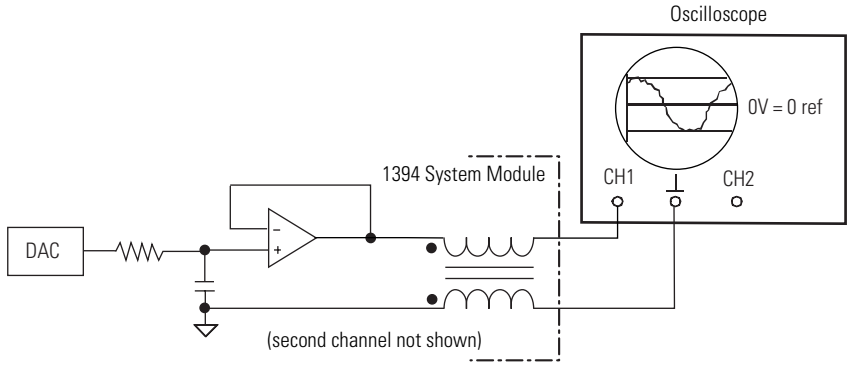
Parameter	Description	Minimum	Maximum
ON State Voltage	Voltage applied to the input, with respect to IOCOM, to guarantee an ON state.	17.5V dc	38V dc
ON State Current	Current flow to guarantee an ON State	5.0 mA	15.0 mA
OFF State Voltage	Voltage applied to the input, with respect to IOCOM, to guarantee an OFF state.	—	6.9V dc

Analog Output Specifications

The 1394 SERCOS interface drive includes two analog outputs that can be configured through software to represent drive variables. Figure 2.11 shows the configuration of the analog outputs. The table below provides a description of the analog outputs.

Note: Refer to *Analog Output Connector* on page 2-7 for connector pin-outs and figures 2.1 and 2.2 for the connector location.

Figure 2.11
Analog Output Configuration



IMPORTANT Output values can vary during power-up until the specified power supply voltage is reached.

The following table provides a description of the analog output specifications.

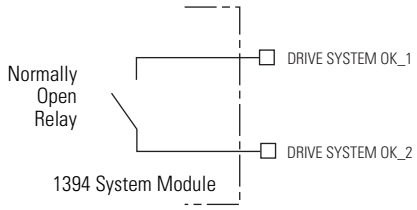
Parameter	Description	Minimum	Maximum
Resolution	Number of states that the output signal is divided into, which is $2^{(\text{to the number of bits})}$.	—	±11 bits
Output Current	Current capability of the output.	0	+2 mA
Output Signal Range	Range of the output voltage.	-10V	+10V
Offset Error	Deviation when the output should be at 0V.	—	1 mV
Bandwidth	Frequency response of the analog output	DC	3.6k Hz (3 db)

For configuration/setup of the analog outputs, refer to the *1394 SERCOS Interface Integration Manual* (publication 1394-IN024*x*-EN-P).

Drive System OK Relay Specifications

The Drive System OK output is intended to be wired into the drive's start/stop string to open the main power contactor if a drive system fault occurs. This configuration will cause the Drive System OK contacts to close after 24V logic power is applied and no system faults are detected. It is capable of handling 120V ac at 1A or less. An active state indicates the drive is operational and does not have a fault.

Figure 2.12
Drive System OK Relay



The following table provides a description of the relay output specifications.

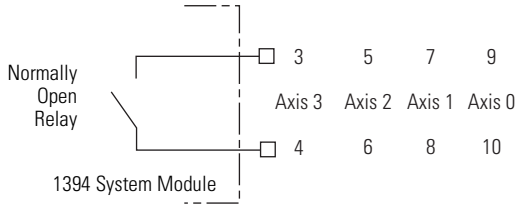
Parameter	Description	Minimum	Maximum
ON State Current	Current flow when the relay is closed	—	1A
ON State Resistance	Contact resistance when the relay is closed	—	1Ω
OFF State Voltage	Voltage across the contacts when the relay is open	—	120V ac 24V dc
Maximum switched load		—	1A Inductive

Motor Brake Relay Specifications

The connections are rated for +24V, 1A operation. An active signal releases the motor brake. The brake signal uses the turn-on and turn-off delays specified by the brake active delay and brake inactive delay. The delay times are software configurable in RSLogix 5000. For the list of motors rated for 1A operation, the delay times and example diagram, refer to *Brake Interconnect Diagrams* on page B-15.

IMPORTANT For motors requiring more than 1A, a relay must be added. For the list of motors rated at greater than 1A operation, the delay times and example diagram, refer to *Brake Interconnect Diagrams* on page B-16.

Figure 2.13
Relay Outputs



The following table provides a description of the relay output specifications.

Parameter	Description	Minimum	Maximum
ON State Current	Current flow when the relay is closed	—	1A
ON State Resistance	Contact resistance when the relay is closed	—	1Ω
OFF State Voltage	Voltage across the contacts when the relay is open	—	30V
Maximum switched load		—	1A Inductive

Refer to *Brake Interconnect Diagrams* beginning on page B-14 for wiring examples.

SERCOS Connection Specifications

Two fiber-optic connectors (transmit and receive) are provided on the 1394 system module. The table below lists SERCOS communication specifications.

Specification	Description
Data Rates	2, 4, and 8 MBd
Node Addresses	Determined by hardware configuration. Refer to the *1394 SERCOS Interface Integration Manual* (publication 1394-IN0024x-EN-P).

Logic Power Input Specifications

The 1394 system module must be wired with a logic power input. Refer to figures 2.1 and 2.2 for the location of the logic power connector/terminal blocks and page A-6 for the *24V Logic Input Power Specifications*.

Understanding Feedback Specifications

The 1394 SERCOS interface system module can accept *motor* feedback signals from the following types of encoders:

- Stegmann Hiperface
- Resolver Transmitter TR = 0.25
- TTL AQB or Sine/Cosine (Feedback Only axis configuration in RSLogix 5000)

The 1394 SERCOS interface system module can accept *auxiliary* feedback signals from the following types of encoders:

- Stegmann Hiperface
- TTL AQB or Sine/Cosine with index pulse

Note: Auto-configuration in RSLogix 5000 software of intelligent absolute or high-resolution is possible only with Allen-Bradley motors.

Motor and Auxiliary Feedback Specifications

The table below lists motor encoder feedback specifications.

Specification	Description
Encoder Types	Sine/Cosine, Intelligent, Resolver, and Absolute
Maximum Input Frequency	200 kHz (Sine/Cosine input)

The following table provides a description of the AM, BM, and IM inputs for auxiliary (TTL) motor encoders.

Parameter	Description	Minimum	Maximum
AM, BM, and IM ON State Input Voltage	Input voltage difference between the + input and the - input that is detected as an ON state.	+1.0V	+7.0V
AM, BM, and IM OFF State Input Voltage	Input voltage difference between the + input and the - input that is detected as an OFF state.	-1.0V	-7.0V
Common Mode Input Voltage	Potential difference between any encoder signal and logic ground.	-7.0V	+12.0V
DC Current Draw	Current draw into the + or - input.	-30 mA	30 mA
AM, BM Input Signal Frequency	Frequency of the AM or BM signal inputs. The count frequency is 4 times this frequency, since the circuitry counts all four transitions.	—	1.0 MHz
IM Pulse Width	Pulse width of the index input signal. Since the index is active for a percentage of a revolution, the speed will determine the pulse width.	125 nS	—
AM, BM Phase Error 2.5 MHz Line Frequency	Amount that the phase relationship between the AM and BM inputs can deviate from the nominal 90°.	-22.5°	+22.5°
AM, BM Phase Error 1 MHz Line Frequency	Amount that the phase relationship between the AM and BM inputs can deviate from the nominal 90°.	-45°	+45°

The following table provides a description of the AM and BM inputs for Sine/Cosine encoders when used as motor or auxiliary feedback.

Parameter	Description	Minimum	Maximum
Sine/cosine Input Signal Frequency	Frequency of the Sine or Cosine signal inputs.	—	200 kHz
Sine/cosine Input Voltage	Peak-to-peak input voltages of the Sine or Cosine inputs.	0.5V (p-p)	2.0V (p-p)

Feedback Power Supply

The 1394 system module generates the +5V and +9V dc for the motor and auxiliary feedback power supplies. Short circuit protection and separate common mode filtering for each channel is included. Refer to the table below for specifications.

Supply	Reference	Voltage			Current mA	
		Minimum	Nominal	Maximum	Minimum	Maximum
+5V dc	EPWR_5V	5.13	5.4	5.67	10	400 [1]
+9V dc	EPWR_9V	8.3	9.1	9.9	10	275 [2]

[1] 5 volt total for all axes.

[2] 9 volt total for all axes.

Connecting Your 1394 SERCOS Interface System

Chapter Objectives

This chapter covers the following topics:

- Understanding Basic Wiring Requirements
- Determining Your Type of Input Power
- Setting the Ground Jumper in Ungrounded Power Configurations
- Grounding Your 1394 SERCOS Interface System
- Power Wiring Requirements
- Connecting Input Power
- Connecting Motor Power, Thermal Switch, and Brake
- Understanding Feedback and I/O Cable Connections
- Understanding External Shunt Connections
- Connecting Your SERCOS Fiber-Optic Cables

Understanding Basic Wiring Requirements

This section contains basic wiring information for the 1394.

ATTENTION

Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system 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.

IMPORTANT

This section contains common PWM servo 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.

Building Your Own Cables

IMPORTANT Factory made cables are designed to minimize EMI and are recommended over hand-built cables to ensure system performance.

When building your own cables, follow the guidelines listed below.

- Connect the cable shield to the motor end connector with a complete 360° connection and the cable clamp on the drive end.
- Use a twisted pair cable whenever possible. Twist differential signals with each other and twist single-ended signals with the appropriate ground return.

Refer to *Appendix C* for MP-Series and 1326AB (M2L/S2L) motor end connector kit descriptions and catalog numbers.

Routing Power and Signal Wiring

Be aware that when you route power and signal wiring on a machine or system, radiated noise from nearby relays, transformers, and other electronic drives, can be induced into motor or encoder feedback, communications, or other sensitive low voltage signals. This can cause system faults and communication problems.

Refer to *Chapter 1* for examples of routing high and low voltage cables in wireways. Refer to *System Design for Control of Electrical Noise* (publication GMC-RM001*x*-EN-P) for more information.

Input Power Conditioning

In most applications, you can connect the 1394 system module directly to a three-phase, AC power line. However, if certain power line conditions exist, the input power component can malfunction. If either of the following is true, you can use a line reactor or isolation-type transformer to reduce the possibility of this type of malfunction:

- The AC line supplying the drive has power factor correction capacitors.
- The AC line frequently experiences transient power interruptions or significant voltage spikes.

IMPORTANT Line conditioning is not typically required. If you have experienced power problems in the past on a power distribution line, you may need to consider input power conditioning.

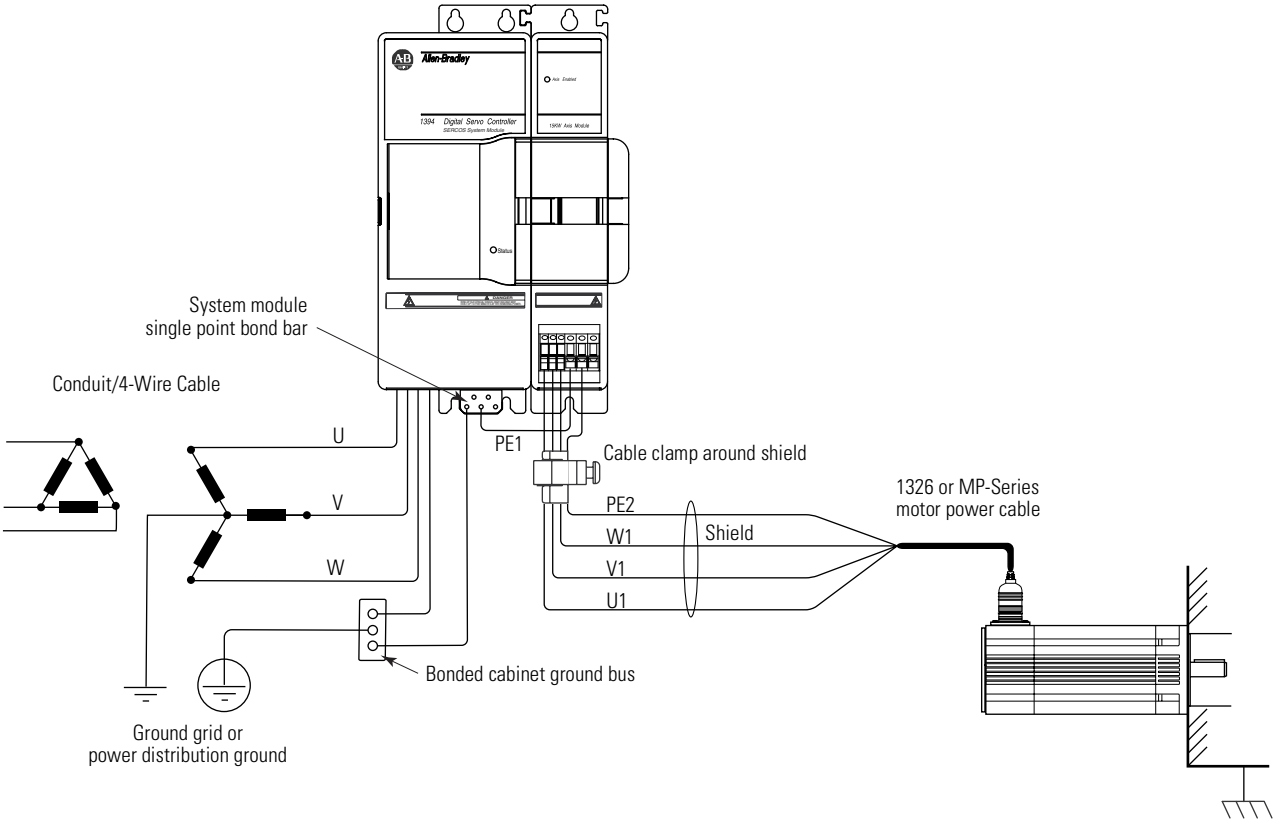
Determining Your Type of Input Power

Before you ground or wire your 1394 system you must determine the type of power distribution system you will be connecting to for main input power. The 1394 system is designed to operate in both grounded and ungrounded environments.

Grounded Power Configuration

The grounded power configuration allows you to ground your three-phase power at a neutral point. The 1394 system module has a factory installed jumper configured for grounded power distribution. If you determine that you have grounded power distribution in your plant you do not need to modify your system.

Figure 3.1
Grounded Power Configuration

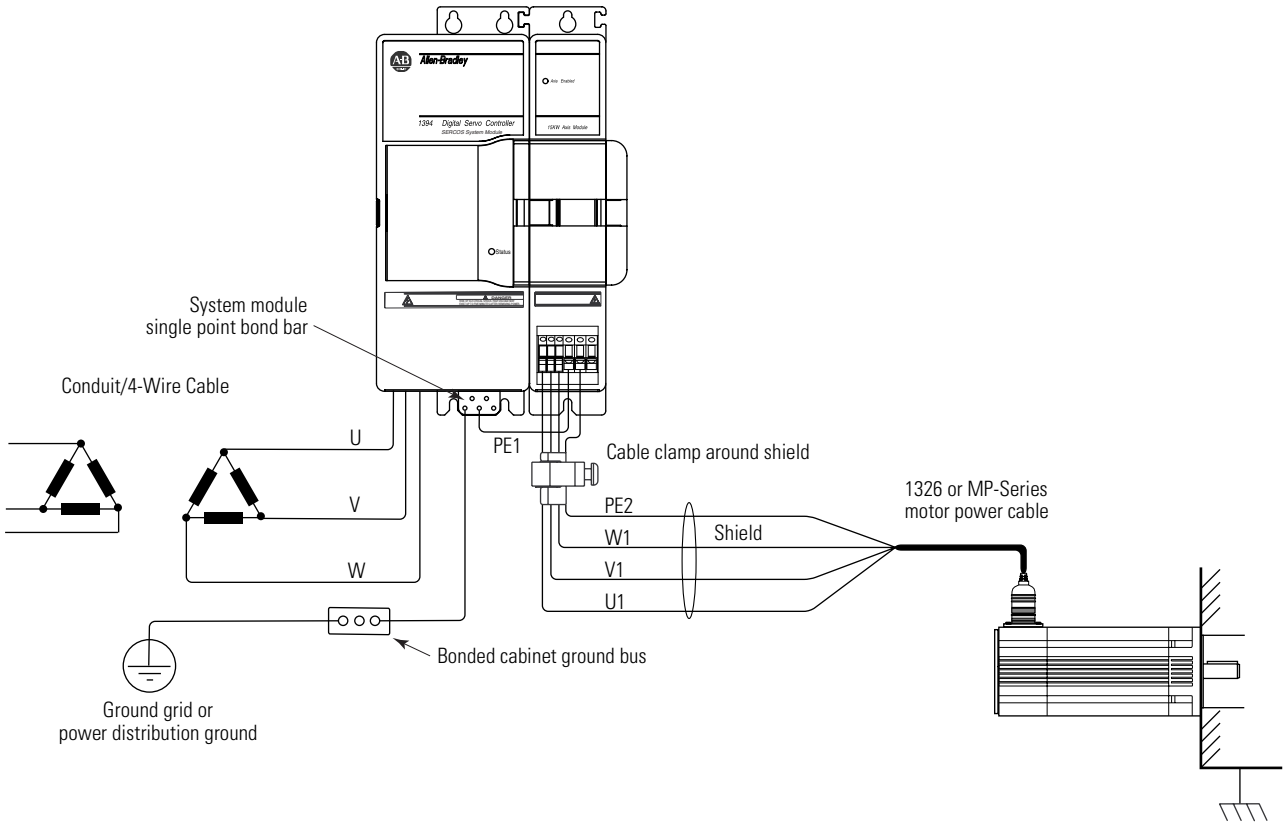


Note: The input power terminal designated PE is electrically common to the system module single point bond bar.

Ungrounded Power Configuration

The ungrounded power configuration does not allow for a neutral ground point. If you determine that you have ungrounded power distribution in your plant, you need to move the factory installed jumper to the ungrounded power distribution position to prevent electrostatic buildup inside the 1394. Refer to the instructions on page 3-6 for 5 and 10 kW system modules, and starting on page 3-7 for 22 kW system modules.

Figure 3.2
Ungrounded Power Configuration



ATTENTION

Ungrounded systems do not reference each phase potential to a power distribution ground. This can result in an unknown potential to earth ground.

Note: The input power terminal designated PE is electrically common to the system module single point bond bar.

Setting the Ground Jumper in Ungrounded Power Configurations

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

IMPORTANT If you have grounded power distribution, you do not need to set the ground jumper. Go to *Grounding Your 1394 SERCOS Interface System*.

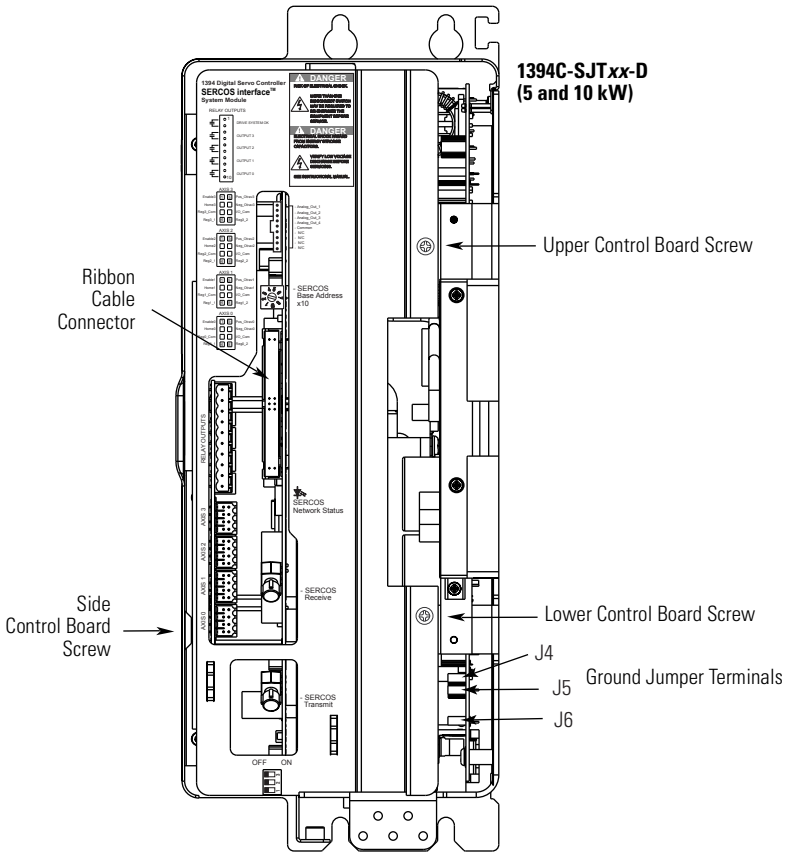
Setting the Ground Jumper in 5 and 10 kW System Modules

This procedures applies to 1394C-SJT05-D and -SJT10-D system modules. To set the ground jumper for an ungrounded system:

1. Verify that all 24V logic and main input power has been removed from the system.
2. Open the system module door.
3. Remove the three control board screws (refer to Figure 3.3 for locations).
4. Remove ribbon cable from control board (refer to Figure 3.3 for location).

   Note: You should not find it necessary to remove both ends of the ribbon cable. Remove only the control board end.
5. Remove the control board for easy access to ground jumpers (pull it straight out from system module).
6. Locate the jumper connecting J4 and J5 on the assembly adjacent to the control board, and move one end of the jumper from J5 to J6 (refer to Figure 3.3 for locations).
7. Re-install the control board. Align the guide pins in the rear of the enclosure with the holes in the control board.
8. Re-install ribbon cable into the control board connector.
9. Re-install the three control board screws.
10. Close the system module door.
11. Go to *Grounding Your 1394 SERCOS Interface System*.

Figure 3.3
Ground Jumper Locations for the 5 and 10 kW System Modules



Setting the Ground Jumper in 22 kW System Modules

This procedures applies to 1394C-SJT22-D system module. To set the ground jumper for an ungrounded system:

1. Verify that all 24V logic and main input power has been removed from the system.

2. Open the system module door.

3. Locate the ground jumper inside the system module (refer to Figure 3.4 for jumper location).

4. Without removing the circuit board, unplug the jumper and move it to the ungrounded power distribution position. Refer to Figure 3.5 for the jumper positions.

IMPORTANT Do not remove circuit board from 1394 system module.

Figure 3.4
Location of the 22 kW System Module Ground Jumper

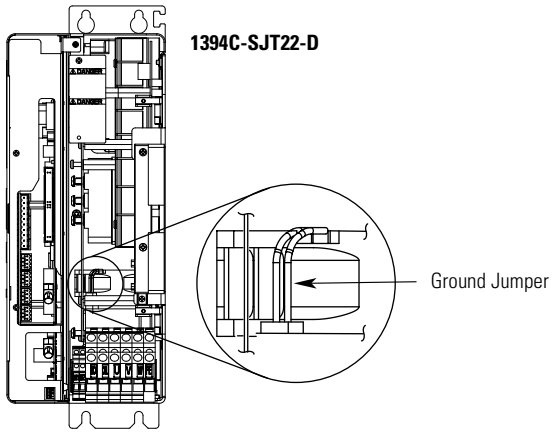
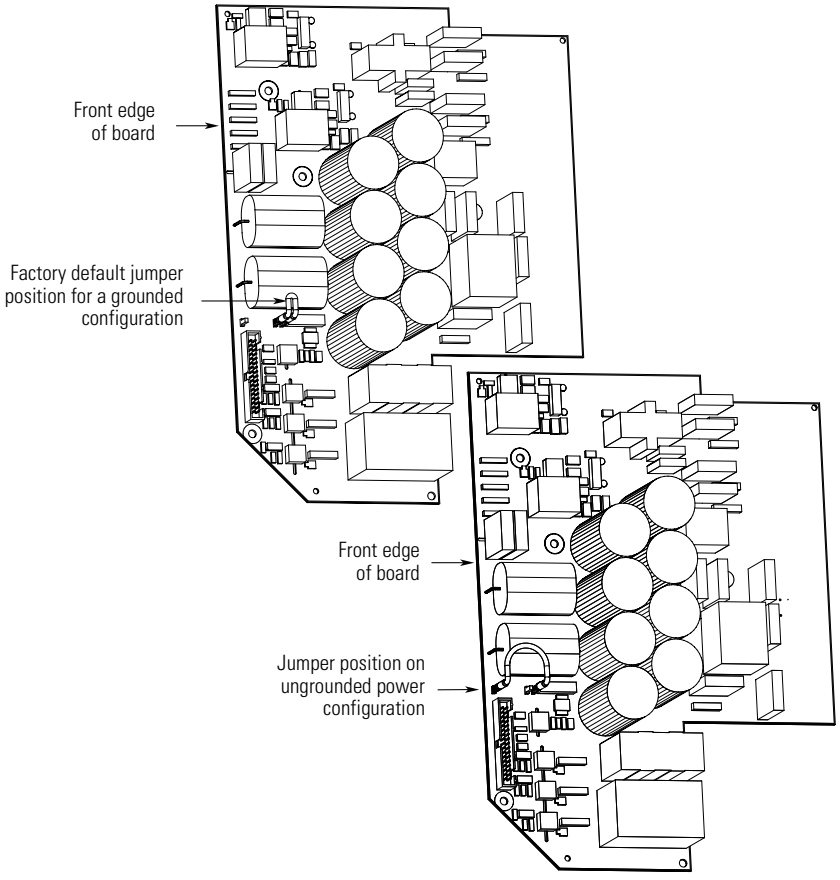


Figure 3.5
22 kW System Module Jumper Positions



5. Close the system module door.

6. Go to *Grounding Your 1394 SERCOS Interface System*.

Grounding Your 1394 SERCOS Interface System

We recommend that all equipment and components of a machine or process system have a common earth ground point connected to their chassis. A grounded system provides a safety ground path for short circuit protection. Grounding your modules and panels minimizes shock hazards to personnel and damage to equipment caused by short circuits, transient overvoltages, and accidental connection of energized conductors to the equipment chassis. For CE grounding requirements, refer to *Chapter 1*.

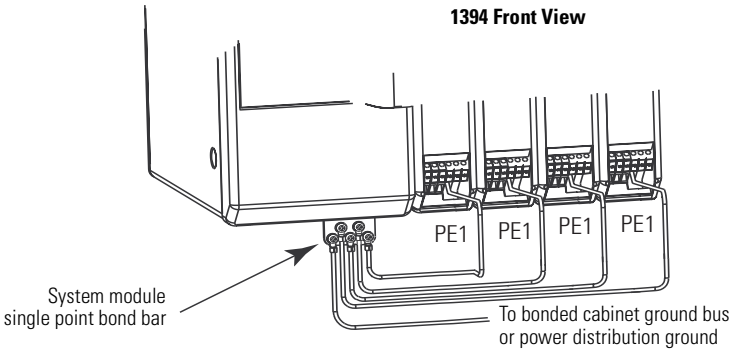
IMPORTANT To improve the bond between your 1394 and the subpanel, construct your subpanel out of zinc plated (paint-free) steel.

Grounding Your System to the Subpanel

This section provides examples for connecting the chassis ground to your 1394 and the subpanel. The 1394 system module provides a grounding bar as a common point of chassis ground for the system and axis modules, as shown in Figure 3.6.

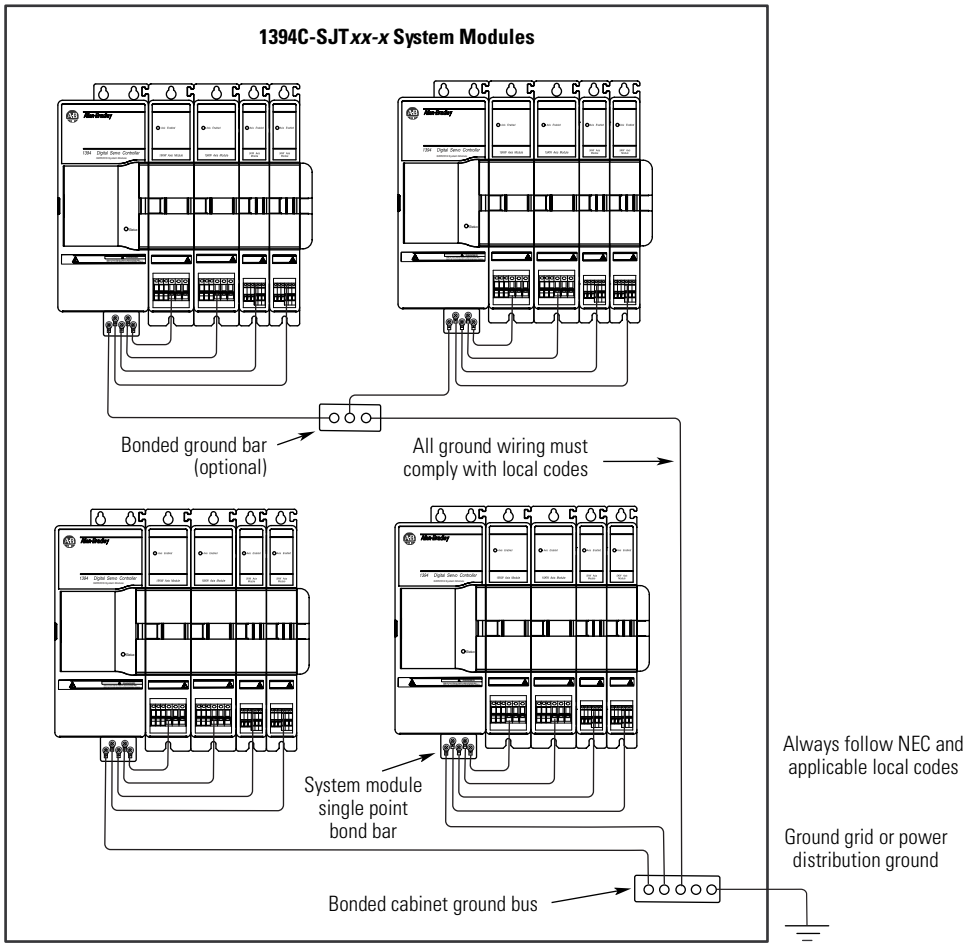
ATTENTION The National Electrical Code contains grounding requirements, conventions, and definitions. Follow all applicable local codes and regulations to safely ground your system. Refer to *Appendix B* for the 1394 interconnect diagrams.

Figure 3.6
1394 Ground Wire Connections



The system module single point bond bar wires to the bonded system ground bus on the sub-panel. Refer to Figure 3.7 for grounding configuration examples.

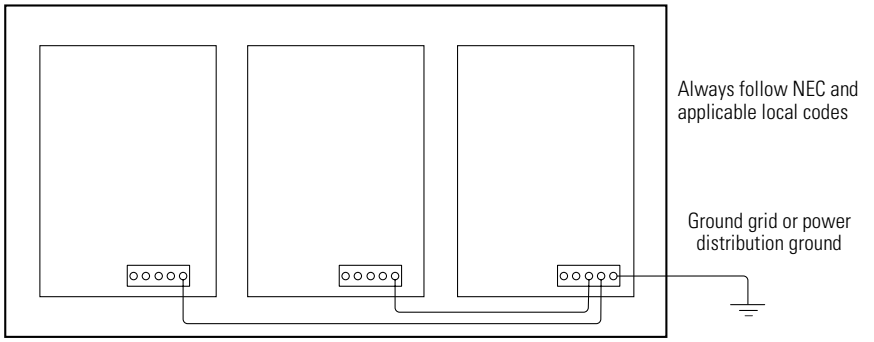
Figure 3.7
PE Safety Ground Configuration with Multiple 1394 Systems on One Panel



Grounding Multiple Subpanels

To extend the chassis ground to multiple subpanels, refer to the figure below.

Figure 3.8
Subpanels Connected to a Single Ground Point



Motor Power Cable Shield Termination

Factory supplied motor power cables for MP-Series and 1326AB/AS motors are shielded, and the braided cable shield must terminate at the drive during installation. A small portion of the cable jacket must be removed to expose the shield braid. The exposed area must be clamped (using the clamp provided) in front of the axis module, as shown in Figure 3.9, and the power wires terminated in the axis module terminal block.

ATTENTION

To avoid hazard of electrical shock, ensure shielded power cables are grounded at a minimum of one point for safety.

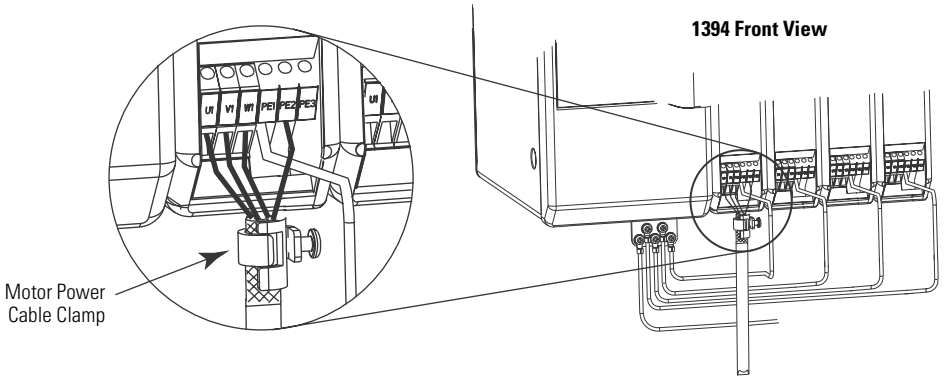
IMPORTANT

Cable clamps, designed to accommodate cables 1.5 to 6 mm^2 (16 to 10 AWG) in size, are shipped with each axis module. If your axis module (1394*x*-AM75) /motor combination requires 10 mm^2 (8 AWG) cable, a larger cable clamp (catalog number 1394C-8AWG-GCLAMP) is necessary to accommodate the larger diameter cable.

Connecting MP-Series (Low Inertia) and 1326AB Motor Power

When using MP-Series (low inertia) or 1326AB (M2L/S2L) motors, only the three-phase motor power wires are included in power cable, as shown in the figure below. These motors have a separate connector on the motor for brake connections and thermal switch wires are included in the feedback cable.

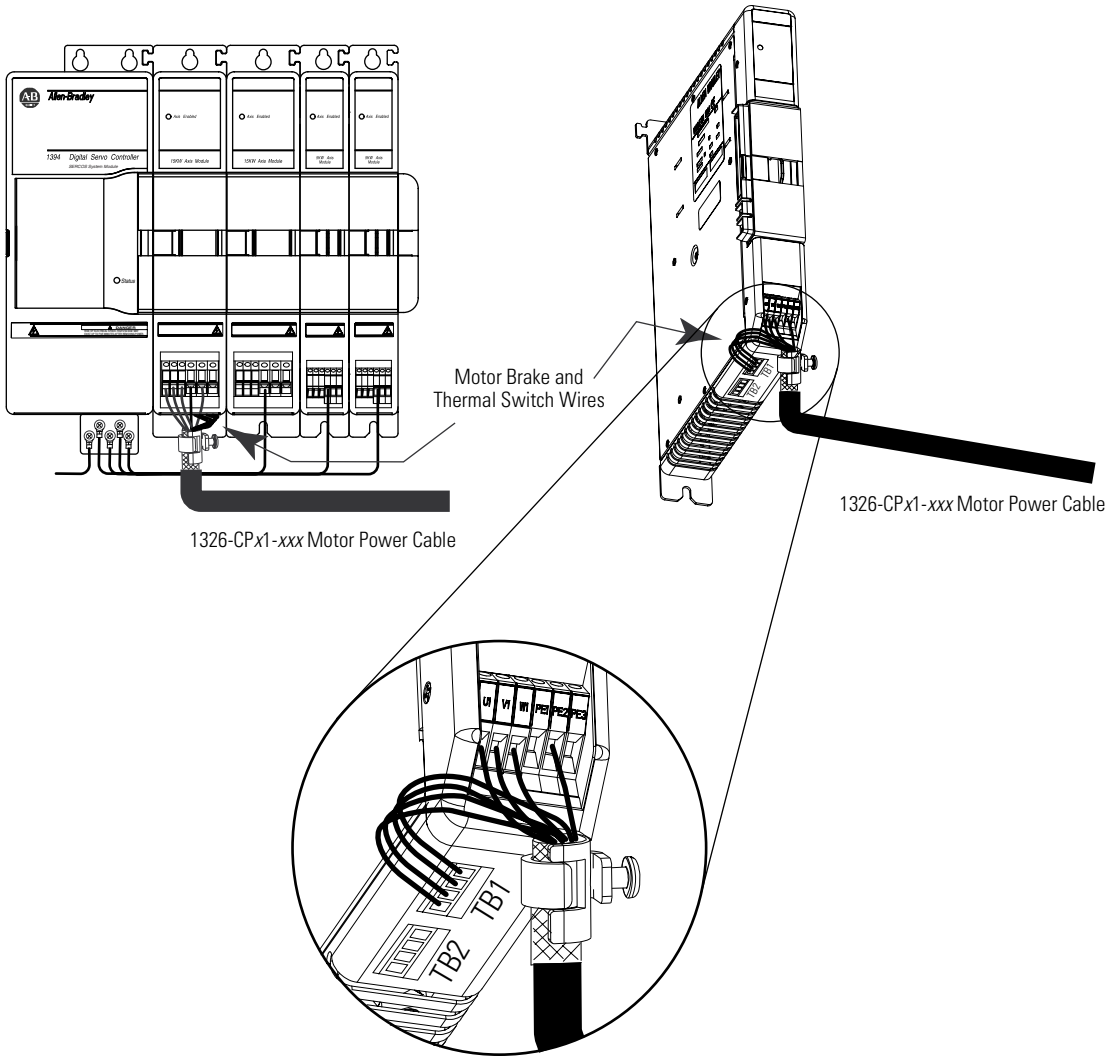
Figure 3.9
Motor Power Cable (2090-XXNPMP-*xx*S*xx* or -CDNBPMP-*xx*S*xx*)



Connecting 1326AB/AS (resolver) Motor Power

When using 1326AB/AS motors with resolver feedback, the thermal switch and brake wires are included in the motor power cable (1326-CP*x*1-*xxx*). To improve the EMC performance of your system, route the motor brake and thermal switch wires to TB1 (as shown in Figure 3.10) and reference *Thermal Switch and Brake Interconnect Diagrams* on page B-9 for the interconnect diagram.

Figure 3.10
Motor Power Cable (1326-CP*x*1-*xxx*)



Power Wiring Requirements

Power wiring requirements are given in the tables below. Wire should be copper with 75° C (167° F) minimum rating, per NFPA 79 unless otherwise noted. Phasing of main input power is arbitrary and earth ground connection is required for safe and proper operation.

IMPORTANT The National Electrical Code and local electrical codes take precedence over the values and methods provided.

1394 Power Wiring Requirements

Module	Description	Connects to Terminals	Recommended Wire Size mm^2 (AWG)	Torque Value Nm (lb-in.)
System Module 1394C-SJT05-D or 1394C-SJT10-D	Main Input Power	U, V, W, PE [1]	6 (10)	0.56 - 0.62 (5.0 - 5.6)
	Input Logic Power	W1, W2	4 (12)	
	Shunt Resistor Connections	COL, INT, DC+	6 (10) [2]	
System Module 1394C-SJT22-D	Main Input Power	U, V, W, PE [1]	10 (8)	2.21 - 2.66 (20.0 - 24.0)
	Input Logic Power	W1, W2	4 (12)	
	External Shunt Module Connections	DC+, COL	10 (8) [2]	
System Module 1394C-SJT*xx*-D	Ground	Single Point Bond Bar	10 (8)	1.6 (14)
	Drive System OK and Brake Relay Circuits	Relay Outputs	0.2-4.0 (26-12)	0.56 - 0.62 (5.0 - 5.6)
Axis Module 1394C-AM03, -AM04, and -AM07	Motor Power	U1, V1, W1, and PE2	Motor power cable depends on motor/drive combination, 6 (10) maximum	
	Ground	PE1	6 (10)	
Axis Module 1394C-AM50, -AM75, -AM50-IH, and -AM75-IH	Motor Power	U1, V1, W1, and PE2	Motor power cable depends on motor/drive combination, 10 (8) maximum	1.55 - 2.0 (14.0 - 18.0)
	Ground	PE1	10 (8)	
Axis Module 1394C-AM*xx* and -AM*xx*-IH	Thermal Switch and Brake Filter Circuits	TB1/TB2	0.2-4.0 (26-12)	0.56 - 0.62 (5.0 - 5.6)

[1] The input power terminal designated PE is electrically common to the system module single point bond bar, so the ground connection at PE is optional. However, the ground connection at the single point bond bar is mandatory.

[2] 105° C (221° F), 600V.

Note: Refer to the section *Understanding External Shunt Connections* on page 3-34 for more information regarding the COL, INT, and DC+ connections.

For additional information refer to *Power Specifications* in *Appendix A*. Refer to *Appendix B* for the 1394 interconnect diagrams.

ATTENTION

This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. You are required to follow static control precautions when you install, test, service, or repair this assembly. If you do not follow ESD control procedures, components can be damaged. If you are not familiar with static control procedures, refer to Allen-Bradley publication 8000-4.5.2, *Guarding Against Electrostatic Damage* or any other applicable ESD Protection Handbook.

ATTENTION

To avoid personal injury and/or equipment damage, 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.

Connecting Input Power

The system module provides terminating points for the main input power, logic power, feedback, and various other control signals. The slide-and-lock mechanism transfers power and commutation signals to each axis module. This procedure assumes you have the 1394 SERCOS interface system mounted on your panel and are ready to wire the input power.

Each individual application requires different wiring. This section provides guidelines for wiring your system. Because of the diversity of applications and systems, no single method of wiring is applicable in all cases.

IMPORTANT When tightening screws to secure the wires, refer to the tables beginning on page 3-13 for torque values.

IMPORTANT To ensure system performance, run wires and cables in the wireways as established in *Chapter 1*.

Refer to *Appendix B* for the 1394 interconnect diagrams.

If you have this System Module:	Then Go To:
1394C-SJT05-D (5 kW) or 1394C-SJT10-D (10 kW)	*Connecting Power Wiring for 5 and 10 kW System Modules* beginning below.
1394C-SJT22-D (22 kW)	*Connecting Power Wiring for 22 kW System Modules* beginning on page 3-17.

Connecting Power Wiring for 5 and 10 kW System Modules

The 1394C-SJT05-D and 1394C-SJT10-D system modules use connectors for wiring the main input power and logic power. You will wire the system using connector plugs that mate with connector housings. Refer to Figure 2.1 for the connector locations.

ATTENTION

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.

Wiring Main Input Power

To wire the main input power connector:

1. Prepare the incoming three-phase power wires for attachment to the input power connector by removing 10 mm (0.375 in.) of insulation.

IMPORTANT Use caution not to nick, cut, or otherwise damage strands as you remove the insulation.

2. Route the three-phase power wires (U, V, W, and PE) to your 1394 system module.

3. Connect the system module ground wire from the system module single point bond bar to the bonded ground bar or bonded cabinet ground bus on the subpanel (as shown in Figure 3.7). For more information on bonding, refer to *Chapter 1*.

4. Insert the incoming power wires into the input power connector plug as follows and tighten the four connector plug screws.

Insert the wires labeled:	Into connector terminals labeled:
U	U
V	V
W	W
Ground	PE

5. Gently pull on each wire to make sure it does not come out of its terminal. Re-insert and tighten any loose wires.

ATTENTION

To avoid personal injury or damage to equipment, verify that keys are inserted into the beveled slots above terminals V and W of the input power connector plug and PE and COL on the system module input and shunt power connectors, respectively. If the keys are missing, refer to *Installing Your 1394C Power Connector Key Kit Installation Instructions* (publication 1394-IN023*x*-EN-P).

6. Insert the input power connector plug into the input power connector on the bottom of the system module (refer to Figure 2.1 for the connector location).

Wiring Logic Power

To wire the logic power connector:

1. Prepare the incoming 24V dc logic power wires for attachment to the logic power connector by removing 10 mm (0.375 in.) of insulation.

IMPORTANT Use caution not to nick, cut, or otherwise damage strands as you remove the insulation.

2. Route the 24V dc power wires (W1 and W2) to your 1394 system module.

3. Insert the incoming 24V dc logic power wires into the logic power connector plug as follows and tighten the connector plug screws.

Insert the wires labeled:	Into the connector terminals labeled:
W1	W1
W2	W2

4. Gently pull on each wire to make sure it does not come out of its terminal. Re-insert and tighten any loose wires.

5. Insert the logic power connector plug into the logic power connector on the bottom of the system module (refer to Figure 2.1 for the connector location).

6. Go to *Connecting Motor Power, Thermal Switch, and Brake.*

Connecting Power Wiring for 22 kW System Modules

The 1394C-SJT22-D system module use IEC terminal blocks instead of connectors for making power connections. You will wire the system module using the power terminal blocks. Refer to Figure 2.2 for the terminal block location.

ATTENTION 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.

Wiring Main Input Power

To wire the main input power terminal block:

1. Prepare the incoming three-phase power wires for attachment to the input power terminals by removing 10 mm (0.375 in.) of insulation.

IMPORTANT Use caution not to nick, cut, or otherwise damage strands as you remove the insulation.

2. Route the three-phase power wires (U, V, W, and PE) to your 1394 system module.

3. Connect the system module ground wire from the system module single point bond bar to the bonded ground bar or bonded cabinet ground bus on the subpanel (as shown in Figure 3.7). For more information on bonding, refer to *Chapter 1*.

4. Open the front door of the system module and locate the 22 kW system module terminal blocks (refer to Figure 2.2).

5. Insert the incoming power wires into the terminal blocks as follows and tighten the four terminal block screws.

Insert the wires labeled:	Into the terminal blocks labeled:
U	U
V	V
W	W
Ground	PE

6. Gently pull on each wire to make sure it does not come out of its terminal block. Re-insert and tighten any loose wires.

Wiring Logic Power

To wire the logic power terminal block:

1. Prepare the incoming 24V dc logic power wires for attachment to the logic power terminals by removing 10 mm (0.375 in.) of insulation.

IMPORTANT Use caution not to nick, cut, or otherwise damage strands as you remove the insulation.

2. Route the 24V dc power wires (W1 and W2) to your 1394 system module.

3. Open the front door of the system module and locate the 22 kW system module terminal blocks (refer to Figure 2.2).

4. Insert the incoming 24V dc logic power wires into the terminals as follows and tighten the terminal block screws.

Insert the wires labeled:	Into the terminal blocks labeled:
W1	W1
W2	W2

5. Gently pull on each wire to make sure it does not come out of its terminal block. Re-insert and tighten any loose wires.

6. Go to the section *Connecting Motor Power, Thermal Switch, and Brake*.

Connecting Motor Power, Thermal Switch, and Brake

These procedures assume you have mounted your 1394 SERCOS interface system, wired your three-phase input power, logic power, and are ready to wire the motor power, thermal switch, and brake connections.

Note: We recommend that you start at either the first or last axis module, wire it completely, then wire the adjacent module completely, and so on until all axis modules are wired.

IMPORTANT When tightening screws to secure the wires, refer to the tables beginning on page 3-13 for torque values.

IMPORTANT To ensure system performance, run wires and cables in the wireways as established in *Chapter 1*.

Refer to *Appendix B* for the 1394 interconnect diagrams. For motor power cable catalog numbers, refer to *Motor Power Cables* in *Appendix C*.

Connecting the Ground Wire and Cable Clamp

IMPORTANT To improve the bond between the motor cable shield and the axis module PE ground, a cable shield clamp is included with the Series C axis modules.

To wire your PE1 ground wire and cable clamp:

1. Connect one end of the axis module ground wire to the system module single point bond bar.
2. Connect the other end of the ground wire to PE1 terminal block.
3. Route the motor power cable to your axis module. For the location of motor power connections, refer to Figure 2.8.
4. Prepare the motor cable for attachment to the cable shield clamp by removing the outer insulation and braided shield from the motor cable. Ensure approximately 51 mm (2.0 in.) of the insulated cable wires are exposed (refer to Figure 3.11).

5. Remove another 22 mm (0.875 in.) of insulation to expose the braided shield underneath for clamp attachment.

IMPORTANT When cutting into the insulation use care not to cut into the braided shield underneath.

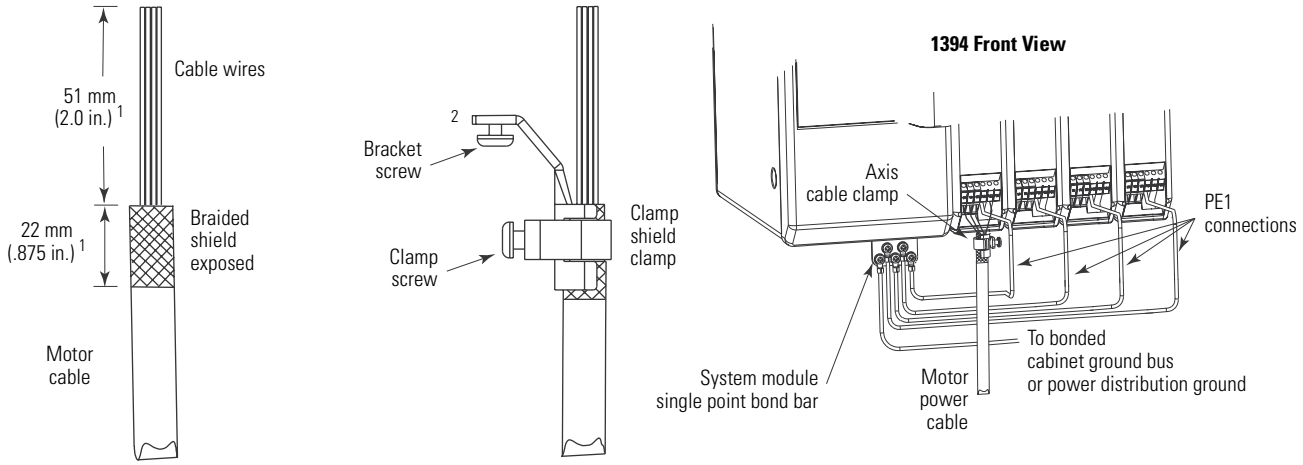
6. Position the cable shield clamp over the exposed braided shield (ensure clamp screw is behind clamp and not braided shield).

7. Tighten the clamp screw.

IMPORTANT Do not overtighten the clamp screw or damage to the braided shield may result.

8. Thread the bracket screw into the bottom of the axis module and tighten.

Figure 3.11
Motor Power Cable Clamp Preparation



[1] Dimensions given are approximate and will vary depending on the specific installation. Keep wires as short as possible while maintaining adequate stress relief.

[2] Remove plastic (captive) washer, if present.

IMPORTANT If your 1394*x*-AM75 axis module requires 10 mm^2 (8 AWG) cable, replace the clamp that shipped with your axis module with catalog number 1394C-8AWG-GCLAMP.

Wiring the Motor Power Connector

To wire your motor power connections:

1. Prepare your conductors by removing the precut insulation or stripping approximately 10 mm (0.375 in.) of insulation from the end of each wire.

IMPORTANT Use caution not to nick, cut, or otherwise damage strands as you remove the insulation.

2. Insert the motor power wires into the axis module terminal block as follows and tighten the terminal block screws.

Insert this wire (number/color):		Into this axis module terminal block:
1326AB/AS (resolver) motors:	**MP-Series and 1326AB (M2L/S2L) motors:**	
1 / Black	U / Brown	U1
2 / Black	V / Black	V1
3 / Black	W / Blue	W1
Green/Yellow	PE / Green/Yellow	PE2

3. Gently pull on each wire to make sure it does not come out of its terminal. Re-insert and tighten each loose wire.

4.

If your motor:	Do the following:
Includes the brake option	Go to step 5.
Does not include the brake option	Go to *Understanding Feedback and I/O Cable Connections*.

5.

For this motor:	Using this motor power cable:	Do the following:
MP-Series (low inertia) and 1326AB (M2L/S2L) motors	2090-XXNPMP-*xx*S*xx* 2090-CDNBPMP-*xx*S*xx*	Go to *Wiring the Relay Outputs Connector*.
1326AB/AS (resolver) motors	1326-CP*x*1-*xxx*	Go to *Wiring the TB1/TB2 Connectors (1326AB/AS Motors)*.

Wiring the TB1/TB2 Connectors (1326AB/AS Motors)

This procedure assumes you are using 1326AB/AS (resolver) motors, have the motor cable attached to the shield clamp, have wired the axis module terminal block, and are ready to connect the thermal switch and brake wires to the TB1 and TB2 connectors. Refer to Figure 2.8 to locate the TB1/TB2 connectors.

The 1326AB/AS (resolver) motor thermal switch and brake wires are in the motor power cable and must pass through noise filters (TB1 and TB2) on the bottom of each axis module.

IMPORTANT One axis module connector kit (included with each axis module) is for thermal switch and brake inputs. You will need one kit per axis module as each kit contains two identical connectors. Refer to *Appendix C* for the connector kit replacement part number.

IMPORTANT Noise filters on the motor thermal sensor and brake connectors (TB1 and TB2) add capacitance (1.0 µF) from each leg of the thermal switch and motor brake leads to ground. This should be considered when selecting ground fault circuits.

To wire your thermal switch and brake connections:

1. Prepare your conductors by removing the precut insulation or stripping approximately 10 mm (0.375 in.) of insulation from the end of each wire.

   IMPORTANT Use caution not to nick, cut, or otherwise damage strands as you remove the insulation.

2. Using the operating tool, insert the thermal switch and brake wires into the first connector (TB1) as follows and tighten the TB1 screws.

Insert this 1326-CP*x*1-*xxx* motor power wire: wire (signal)		**Into this TB1 connector plug terminal:**
9 (K2)	Thermal switch connections	1
5 (K1)		2
4 (B2)	Brake connections	3
6 (B1)		4

3. Gently pull on each TB1 wire to make sure it does not come out of its terminal. Re-insert and tighten each loose wire.

4. Insert the first connector plug (TB1) into the front-most mating half under the axis module.

5. Connect the appropriate thermal switch control wires to the second connector plug (TB2) in the kit (pins 3 and 4) and tighten the TB2 screws. Refer to *Appendix B* for thermal switch interconnect diagrams.

ATTENTION

To avoid damage to your motor, monitor the thermal switch for overheat conditions.

6. Connect the appropriate brake control wires to the second connector plug (TB2) in the kit (pins 1 and 2) and tighten the screws. Refer to *Appendix B* for brake interconnect diagrams.

7. Gently pull on each TB2 wire to make sure it does not come out of its terminal. Re-insert and tighten each loose wire.

8. Insert the second connector plug (TB2) into the rear-most mating half under the axis module.

9. Go to *Wiring the Relay Outputs Connector* on page 3-25.

Wiring the Relay Outputs Connector

This procedure assumes you have brake wires (user-supplied) leading from the TB2 connector or a brake cable (2090-UXNBMP-18S*xx*) leading from your motor brake connector and are ready to connect your brake wires to the relay outputs connector on the 1394 system module.

To wire your relay outputs connector:

1. Prepare your relay wires, 0.82 mm^2 (18 AWG) maximum, by stripping approximately 10 mm (0.375 in.) of insulation from the end.

IMPORTANT Use caution not to nick, cut, or otherwise damage strands as you remove the insulation.

2. Route the cable to your 1394 system module. For the location of the relay outputs connector, refer to figures 2.1 and 2.2.

3. Reference *Brake Interconnect Diagrams* beginning on page B-14 for typical brake interconnect diagrams.

4.

If you:	Do this:
Have more axis modules to wire	1. Move to the next axis module. 2. Go to *Connecting the Ground Wire and Cable Clamp*.
Have wired all of your axis modules	Go to *Understanding Feedback and I/O Cable Connections*.

Understanding Feedback and I/O Cable Connections

The procedure in this section assumes that your 1394 system and axis modules are already mounted and your power is wired. In this section you will:

- Prepare the feedback and I/O cables for wiring to connector housings.
- Make the connections and plug the housings into mating connectors on the bottom of the 1394 system module.
- Attach the feedback cable clamp to the feedback cable shield.

For this motor series:	Using this type of feedback:	Use this feedback cable:
MP-Series (low inertia) or 1326AB (M2L/S2L)	High-resolution encoder	2090-CDNFDMP-S*xx*
MP-Series	Motor resolver	
1326AB/AS	Motor resolver	1326-CCU*x-xxx*

IMPORTANT To improve the bond between the feedback cable shield and the system module chassis ground, cable shield clamps are included with system modules.

Motor Feedback Connector Pin-outs

The following table provides the signal descriptions and pin-outs for the motor feedback (13-pin) connector to MP-Series and 1326AB (M2L/S2L) motors.

Motor Connector Pin	High Resolution Feedback Signals for: MPL-B*xxx*-M/-S and 1326AB-B*xxx*-M2L/-S2L 460V Motors	System Module Connector Pin
A	Sine+	1
B	Sine-	2
C	Cos+	3
D	Cos-	4
E	Data+	8
F	Data-	9
N	EPWR_9V	6
P	ECOM	5
R	TS+	12
S	TS-	13
Shield	Shield	Shield Clamp

The following table provides the signal descriptions and pin-outs for the motor feedback (13-pin) connector to MP-Series (resolver-based) motors.

Motor Connector Pin	Resolver Feedback for MPL-B*xxxx*-R 460V Motors	System Module Connector Pin
A	S2	1
B	S4	2
C	S1	3
D	S3	4
G	R1	10
H	R2	11
R	TS+	12
S	TS-	13
Shield	Overall Shield	Shield Clamp

The following table provides the signal descriptions and pin-outs for the motor feedback (13-pin) connector to 1326AB (resolver-based) motors.

Motor Connector Pin	Resolver Feedback for 1326AB-B*xxxx*-21 460V Motors	System Module Connector Pin [1]
A	R1	10
B	R2	11
Drain	Drain	Shield Clamp
D	S1	3
E	S3	4
Drain	Drain	Shield Clamp
G	S2	1
H	S4	2
Drain	Drain	Shield Clamp
Shield	Overall Shield	Shield Clamp

Axis Module Connector Pin [2]	Resolver Feedback for 1326AB-B*xxxx*-21 460V Motors	System Module Connector Pin [2]
TB2-3	TS+	12
TB2-4	TS-	13

[1] For termination of individual drain wires, use the feedback cable clamp provided and reference Figure 3.10.

[2] Thermal switch wires (5 and 9) are in the motor power cable (1326-CP*x*1-*xxx*). Route these wires through the noise filter (TB1/TB2) and reference Figure 3.10.

The following table provides the signal descriptions and pin-outs for the motor feedback (13-pin) connector to motors with the 845H quadrature encoder feedback using the 1326-CEU-*xxx* cable.

Motor Connector Pin	845H Quadrature Encoder Feedback 460V Motors	System Module Connector Pin
A	AM+	1
H	AM-	2
Drain	Drain	Shield Clamp
B	BM+	3
I	BM-	4
Drain	Drain	Shield Clamp
F	COM	5
D	+5V dc	7
Drain	Drain	Shield Clamp
C	IM+	8
J	IM-	9
Drain	Drain	Shield Clamp
Shield	Overall Shield	Shield Clamp

Wiring Feedback Connectors

To wire your 1394 feedback connectors:

1. Begin preparation of the feedback cable by cutting off the pins already crimped to the wires.

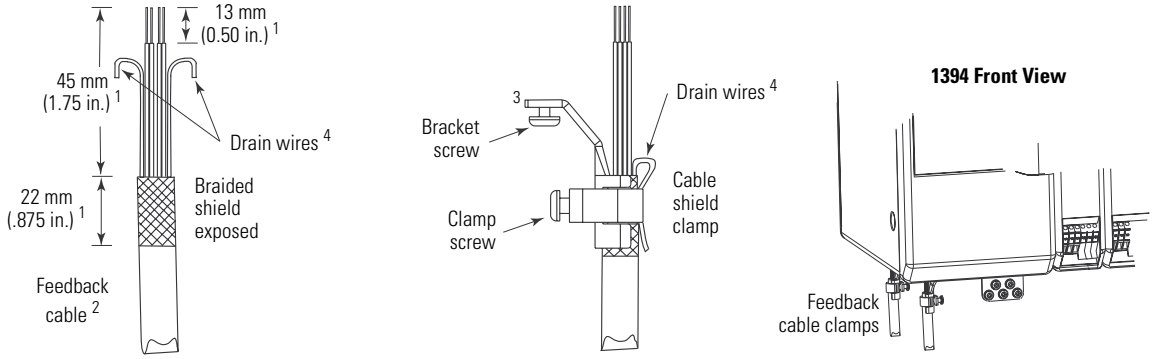
2. If not already done, remove approximately 45 mm (1.75 in.) of the outer insulation, braided shield, and foil shield to expose the individual insulated wires and drain wires (refer to Figure 3.12).

   Note: 2090-CDNFDMP-S*xx* motor feedback cables do not include drain wires.

3. Strip approximately 13 mm (0.50 in.) of insulation from the end of the individual wires (refer to Figure 3.12).

IMPORTANT Use caution not to nick, cut, or otherwise damage strands as you remove the insulation.

Figure 3.12
Feedback Cable Clamp Preparation



1 Dimensions given are approximate and will vary depending on the specific installation. Keep wires as short as possible while maintaining adequate stress relief.

2 Only two sets of wires are shown.

3 Remove plastic (captive) washer, if present.

4 Drain wires are not included with 2090-CDNFDMP-S*xx* motor feedback cables.

IMPORTANT Ensure enough insulation is removed or the connector housing spring will make contact with the insulation and not the bare wire.

4. Select one of the six feedback connector housings shipped with your system module, depress the clamp spring with a small screw driver, insert the wire, and release the spring.

   Note: Refer to the tables beginning on page 3-26 for motor/drive pin-out information and figures 3.13 and 3.14 for an illustration. Refer to *Appendix B* for interconnect drawings.

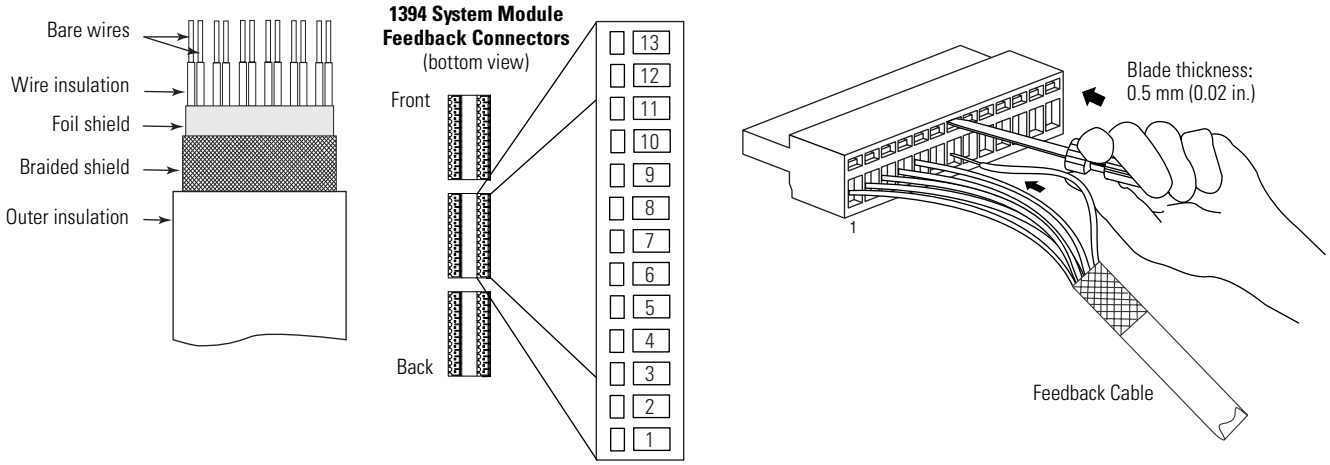
5. Gently pull on each wire to make sure it does not come out of its terminal. Re-insert and test any loose wires.

6. Plug the connector housing into the appropriate feedback connector on the bottom of the system module (refer to Figure 2.6).

IMPORTANT The connectors and connector housings are keyed and cannot be connected backwards. However, each housing is identical so care should be taken to match the proper feedback cable with the appropriate connector.

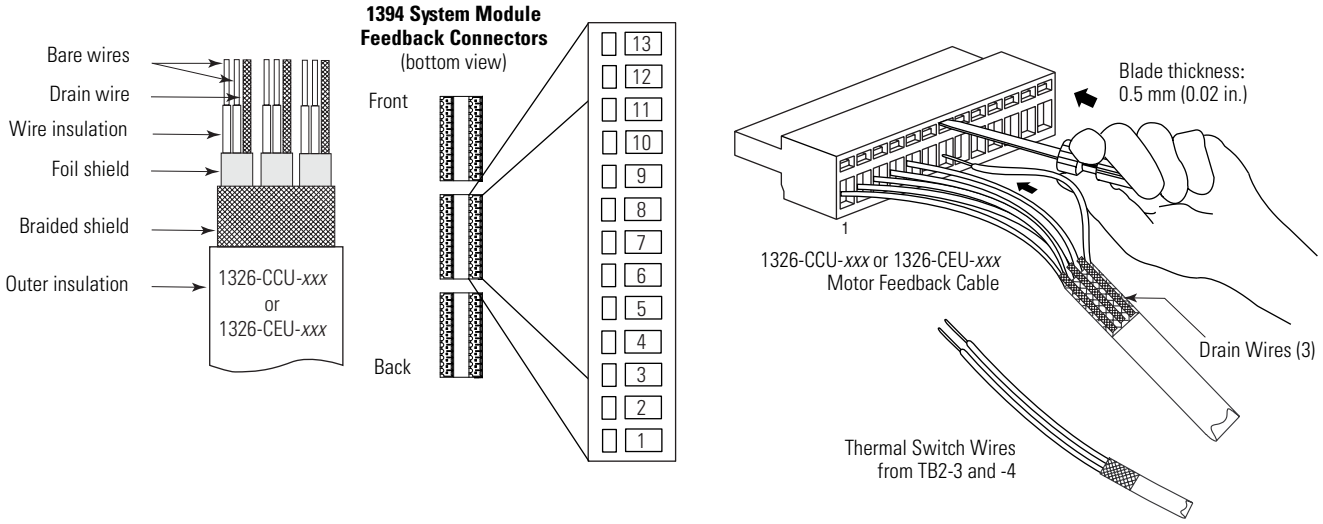
Note: Six feedback channels are available. Refer to Figure 2.6 on page 2-10 for connector function and pin-out information.

Figure 3.13
Wiring 2090-CDNFDMP-S*xx* Feedback Cables



Replacement connector housings are included in the system module connector kit (part number 1394C-CCK-D). Each terminal has a spring type clamping mechanism which firmly grips the bare wire.

Figure 3.14
Wiring 1326-CCU-*xxx* Feedback Cables



Replacement connector housings are included in the system module connector kit (part number 1394C-CCK-D). Each terminal has a spring type clamping mechanism which firmly grips the bare wire.

Attaching the Cable Shield Clamp

IMPORTANT To improve the HF bond (and reduce electrical noise) between the feedback cable shield and the system module chassis ground, use the cable shield clamps included with your system module.

To attach the cable shield clamp:

1. Thread the cable clamp bracket screw into the bottom of the system module and tighten using 1.6 Nm (14 lb-in.) torque.

2. Remove another 22 mm (.875 in.) of outer insulation from the feedback cable to expose the braided shield underneath for clamp attachment (refer to Figure 3.12).

IMPORTANT When cutting into the outer insulation use care not to cut into the braided shield underneath.

3. Fold drain wires back over the braided shield and position the cable shield clamp over the braided shield and drain wires (refer to Figure 3.12).

   Note: 2090-CDNFDMP-S*xx* motor feedback cables do not include drain wires.

IMPORTANT Ensure clamp screw is behind clamp and not braided shield.

4. Tighten the clamp screw.

IMPORTANT Do not overtighten the clamp screw or damage to the braided shield may result.

5.

If you have:	Do this:
More motor feedback or auxiliary feedback to wire	1. Move to the next motor or auxiliary feedback device. 2. Go to *Wiring Feedback Connectors*.
Wired all of your motors	Go to *Wiring Discrete Input Connectors*.

Wiring Discrete Input Connectors

To wire the discrete input connectors:

1. Prepare your I/O wires, 0.82 mm^2 (18 AWG) maximum, by stripping approximately 6 mm (0.25 in.) of insulation from the end.

IMPORTANT Use caution not to nick, cut, or otherwise damage strands as you remove the insulation.

2. Using a small blade type screw driver, 0.5 mm (0.02 in.), depress the housing connector spring clamp next to the pin you are prepared to wire and insert the wire. Refer to Figure 3.15 for an example of how to insert wires.

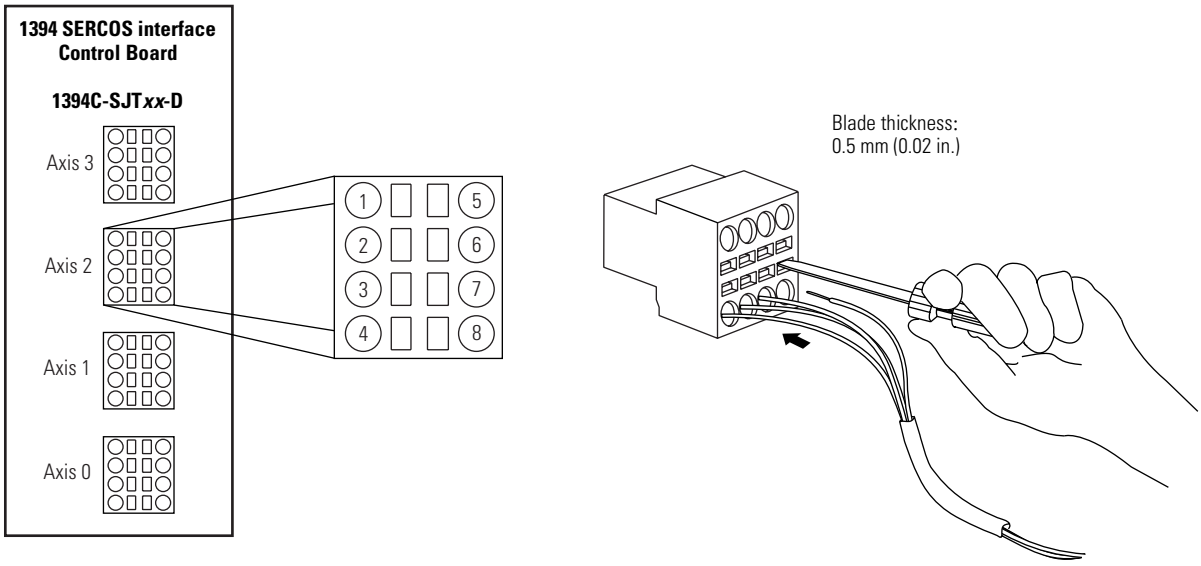
3. Remove the screw driver and gently pull on the wire to make sure it does not come out of its terminal. Re-insert and test any loose wires.

4. Repeat steps 2 and 3 for all remaining I/O connector housing wires.

5. Plug the connector housings into the appropriate I/O connector on the front of the system module (refer to figures 2.1 or 2.2 for connector locations).

6. Secure the I/O wires by slipping a plastic tie-down through the tie-down anchor (refer to figures 2.1 or 2.2 for tie down anchor locations) and bundle the wires together.

Figure 3.15
Wiring I/O Cables



Replacement connector housings are included in the system module connector kit (part number 1394C-CCK-D). Each terminal has a spring type clamping mechanism which firmly grips the bare wire.

Understanding External Shunt Connections

Follow these guidelines when wiring your Bulletin 1394 External Shunt Resistor/Module.

IMPORTANT When tightening screws to secure the wires, refer to the tables beginning on page 3-13 for torque values.

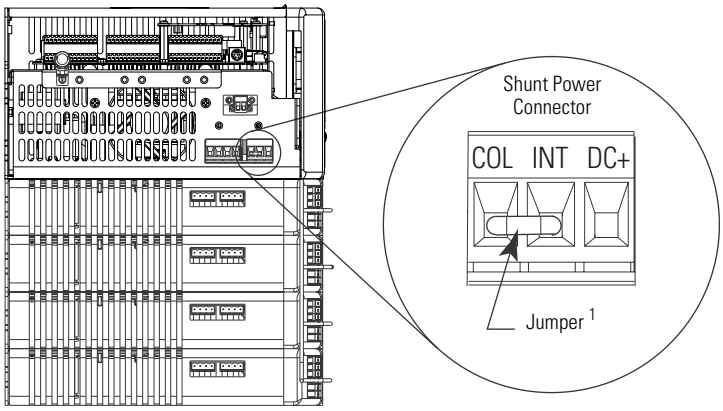
IMPORTANT To ensure system performance, run wires and cables in the wireways as established in *Chapter 1*.

Refer to *Appendix B* for the 1394 interconnect diagrams.

If your application requires an:	Catalog Number:	And you are wiring to this 1394C system module:	Then:
Internal Passive Shunt Resistor	N/A	1394C-SJT05-D or 1394C-SJT10-D	• Verify the internal shunt jumper is in place between COL and INT, as shown in Figure 3.16.
External Passive Shunt Resistor	1394-SR10A		• Remove the internal shunt jumper between COL and INT. • Refer to *Planning Your Panel Layout* and *Mounting Your External Shunt Resistor Kit* in *Chapter 1*. • Refer to *System Module Input Power Pin-outs* in *Chapter 2*. • Refer to The *Shunt Module Interconnect Diagrams* in *Appendix B*.
External Passive Shunt Module	1394-SR*xxxx*	1394C-SJT22-D	

Figure 3.16
System Module Jumper

1394C-SJT05-D or -SJT10-D System Module (bottom view)



1 This is the factory default jumper setting.

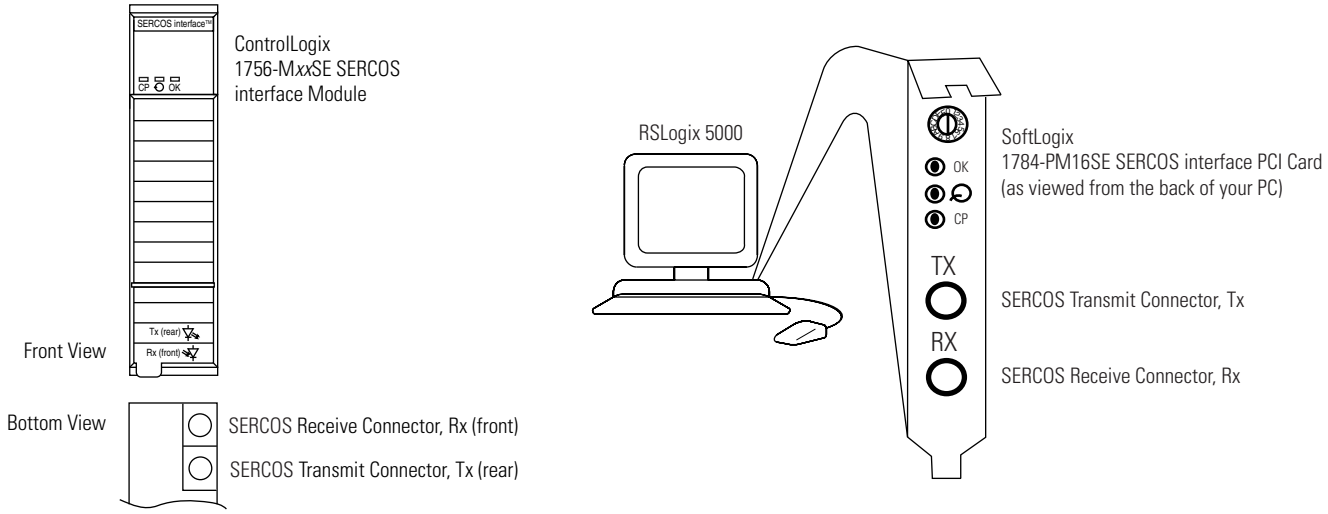
Connecting Your SERCOS Fiber-Optic Cables

This procedure assumes you have your ControlLogix chassis with 1756-M*xx*SE interface module or personal computer with 1784-PM16SE PCI card and 1394 SERCOS interface system(s) mounted and are ready to connect the fiber-optic cables.

The SERCOS fiber-optic ring is connected using the SERCOS Receive and Transmit connectors. Refer to *Chapter 2* for the location of the connectors on your 1394 drive(s) and Figure 3.17 to locate the connectors on your SERCOS interface module or PCI card.

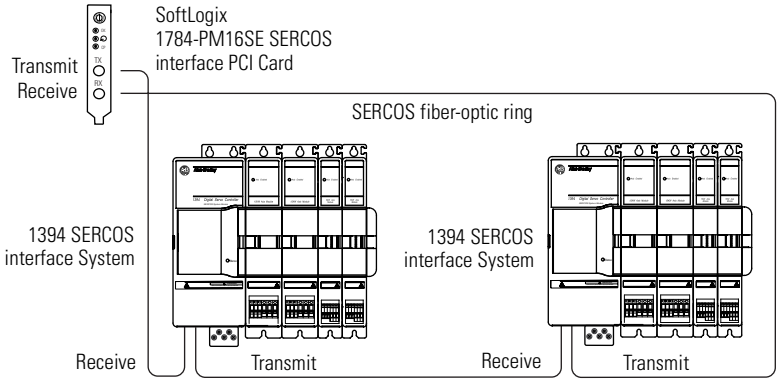
Note: Plastic cable is available in lengths up to 32 m (105.0 ft). Glass cable is available in lengths up to 200 m (656.7 ft).

Figure 3.17
ControlLogix and SoftLogix SERCOS Connector Locations



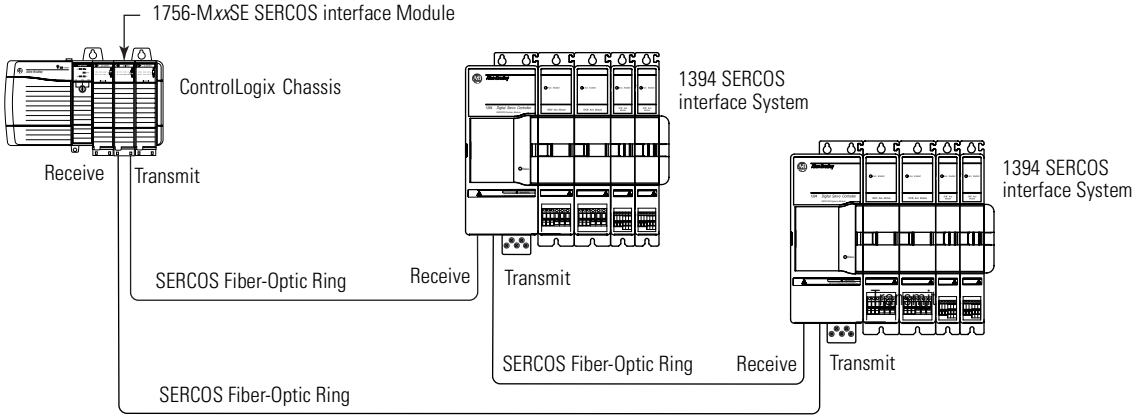
Refer to Figure 3.18 for an example of fiber-optic ring connections between the 1394 SERCOS interface drive(s) and the SoftLogix SERCOS interface PCI card.

Figure 3.18
Fiber-Optic Ring Connection (Example 1)



Refer to figures 3.19 and 3.20 for examples of fiber-optic ring connections between the 1394 SERCOS interface drive(s) and the ContolLogix SERCOS interface module.

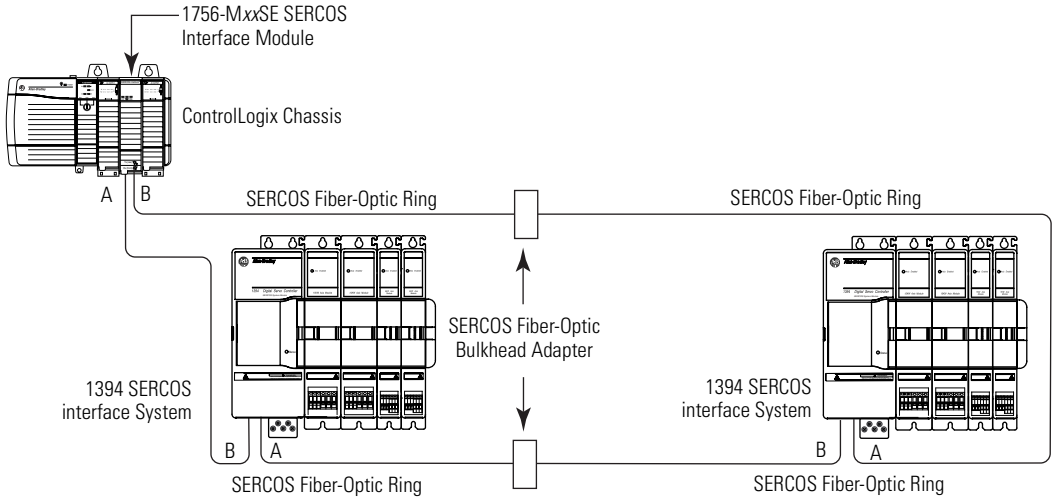
Figure 3.19
Fiber-Optic Ring Connection (Example 2)



Cable lengths of 32 m (105 ft) for plastic cable and 200 m (656.7 ft) for glass cable are possible for each transmission section (point A to B). In Figure 3.20, the second 1394 system is located in a separate cabinet and connected with bulkhead adapters.

IMPORTANT To avoid signal loss, do not mix glass and plastic cables when connecting to a bulkhead adapter. Use glass-to-glass or plastic-to-plastic cable on both sides of the adapter.

Figure 3.20
Fiber-Optic Ring Connection (Example 3)



IMPORTANT Clean the fiber-optic cable connectors prior to installation. Dust in the connectors can reduce signal strength. For more information, refer to *Fiber Optic Cable Installation and Handling Instructions* (publication 2090-IN010*x*-EN-P).

To connect the SERCOS fiber-optic cables:

1. Insert one end of a fiber-optic cable into the Receive SERCOS connector on the 1394 system module and thread the connector on finger tight.
2. Insert the other end of the cable (from step 1) into the Transmit SERCOS connector on the ControlLogix module/SoftLogix PCI Card and thread the connector on finger tight.
3. Insert one end of another fiber-optic cable into the Transmit SERCOS connector on the last 1394 system module in the ring and thread the connector on finger tight.
4. Insert the other end of the cable (from step 3) into the Receive SERCOS connector on the ControlLogix module/SoftLogix PCI Card and thread the connector on finger tight.
5. Complete the ring by connecting the Transmit and Receive connectors from one drive to the next until all are connected (refer to the examples above).

Refer to *Appendix C* for SERCOS fiber-optic cable and bulkhead adapter catalog numbers.

Troubleshooting Status Indicators

Chapter Objectives

This chapter covers:

- Understanding How to Detect a Problem
- Troubleshooting System and Axis Module LEDs
- Troubleshooting the SERCOS Network Status LED
- Troubleshooting General System Problems
- Troubleshooting System and Axis Module Faults
- Troubleshooting General System Problems

For power up procedures and system integration with the ControlLogix and SoftLogix SERCOS modules/PCI cards (see table below) refer to the *1394 SERCOS interface Integration Manual* (publication 1394-IN024*x*-EN-P). Manuals are available electronically (as a .pdf) or in hardcopy from www.theautomationbookstore.com.

Interface	ControlLogix Module	SoftLogix PCI Card
SERCOS interface	1756-M*xx*SE	1784-PM16SE

Understanding How to Detect a Problem

When a drive fault occurs, the LED on the front panel changes and a fault message is transmitted to the position controller.

The majority of 1394 faults cause the Drive System OK contact to open. If a drive fault occurs, you can reset the fault detection circuitry by removing and reapplying logic power. However, if it is a hardware fault, you need to correct the fault before restarting.

IMPORTANT You can also reset a fault condition using RSLogix 5000 software.

This material, along with the diagnostic/troubleshooting information included with the position controller, will help you identify most common system malfunctions and determine which module that problem pertains to.

Troubleshooting System and Axis Module LEDs

The system module Status LED is visible from the front of the module. Refer to figures 2.1 and 2.2 for the location of the system module status LED.

If the System Module LED is:	Potential Cause is:	Possible Resolution is:
Steady red	Terminator not installed.	• Install terminator.
	Malfunctioning system module.	• Verify wiring. • Secure wiring connections. • Replace the module. • Check logic supply ratings. • Contact your local Allen-Bradley Support Representative.
Flashing red	A fault has occurred in the system (check for faults through the RSLogix 5000, DriveExplorer™, or the HIM).	• Reset faults. • Verify wiring. • Secure wiring connections. • Check SERCOS fiber-optic connections.
Alternating red and green	DC bus is not up.	Apply three-phase power.
	Open fuse or malfunctioning contactor on user-supplied 3 phase input.	• Check wiring to start/stop circuitry. • Check the user program. • Check fuse.
	Malfunctioning system module.	Replace the module.
Steady green	The bus is up and axes are enabled.	None needed.
Flashing green	The bus is up, but no axis is enabled.	• Check axes and enable them, if necessary. • Verify that enable wiring is correct and not open.
	Enable signal from position controller is not present.	• Check axes and enable them, if necessary. • Verify that enable wiring is correct and not open. • Check I/O connections on control board.
	Controller has detected a machine system malfunction and will not enable the 1394.	• Check controller. • Check the machine.
Not illuminated	There is no power to the system module.	• Check 24V ac/dc logic power supply. • Check main ac input power supply.

The axis module status LED is visible from the front of the module. Refer to Figure 2.8 for the location of the axis module status LED.

If the Axis Module LED is:	Potential Cause is:	Possible Resolution is:
Steady red	Malfunctioning axis module.	• Verify wiring. • Verify that the slider and terminator connections are secure. • Secure wiring connections. • Replace the module.
Flashing red	Axis fault has occurred.	• Verify wiring. • Secure wiring connections. • Check fault status on the controller. • Check main ac input power. • Check axis status on the controller. • Verify that the terminator is present on the last axis.
Alternating red and green	DC bus is not up.	• Check the system module LED. • Check slider connections to verify that they are properly seated.
Steady green	The bus is up and axes are enabled.	None needed.
Flashing green	Axis is not enabled.	• Check axes and enable them, if necessary. • Verify that enable wiring is correct and not open.
	Enable signal from controller is not present.	• Check axes and enable them, if necessary. • Verify that enable wiring is correct and not open.
	Incorrect wiring or loose connections.	Check I/O connections on the control board.
	Axis setups may not be correct for the application.	• Verify that axis definitions are correct. • Check tuning parameters.
Not illuminated	There is no power to the axis module.	• Verify that the slider connections are secure. • Verify that the terminator is secure on the last axis.
	There is no power to the system.	• Check system module power supply. • Verify that the terminator is present on the last axis.

Troubleshooting the SERCOS Network Status LED

The SERCOS Network Status LED is located on the system module control board and visible with the system module door open. Refer to figures 2.1 and 2.2 for the location of the SERCOS Network Status LED.

If the SERCOS Network Status LED is:	Status is:	Potential Cause is:	Possible Resolution is:
Steady Green	Communication ready	No faults or failures.	System is ready.
Steady Orange	Control board failure	Control board failure.	• Cycle power. • Replace system module.
		Hardware failure.	Replace system module.
Flashing Green	Establishing communication	System is still in the process of establishing SERCOS communication.	Wait for steady green LED status.
		Node address setting on the 1394 system module does not match SERCOS controller configuration.	Verify proper SERCOS base address switch setting (refer to figures 2.1 and 2.2 for switch location).
Flashing Red	No communication [1]	Loose fiber-optic connection.	Verify proper fiber-optic cable connections.
		Dirty fiber-optic cable connectors.	Remove foreign material from connector.
		Broken fiber-optic cable.	Replace fiber-optic cable.
		Weak fiber-optic signal due to long fiber-optic cable.	Set SERCOS transmit level to HIGH.
		Distorted fiber-optic signal due to short fiber-optic cables.	Decrease SERCOS transmit level of previous device in SERCOS ring.
		Receive fiber-optic cable connected to SERCOS transmit connector and visa versa.	Check proper SERCOS fiber-optic cable connections.

[1] Refer to *Fiber Optic Cable Installation and Handling Instructions* (publication 2090-IN010A-EN-P) for more information.

Troubleshooting System and Axis Module Faults

Fault messages are transmitted to the SERCOS controller through the SERCOS ring and/or SCANport. The tables on the following pages provide a description of system and axis module faults, the potential cause, and possible resolutions.

Note: Fault messages are shown as seen in RSLogix software (bold) and when using the HIM or DriveExplorer (not bold).

System Module Faults

Use the table below for troubleshooting system module faults.

Fault Message RSLogix (HIM)**:**	**Description:**	**Potential Cause is:**	**Possible Resolution is:**
DriveOvercurrent Fault (Bus Overcurrent)	System module exceeded current rating.	Motor or transmission malfunction.	• Check for proper motor sizing. • Check/replace transmission device. • Check/replace motor.
		System module not properly sized.	• Check for proper system module sizing. • Install larger kW rated system module.
DriveOvervoltage Fault (Bus Overvoltage)	The DC bus voltage is above limits. If it exceeds (830V dc), a fault is sensed and the power supply is disabled. Bus Voltage Operation Shunt turns on at 805V dc. Shunt turns off at 750V dc. Over voltage trip point is 825V dc. Under voltage trip point is 275V dc. Under voltage fault clears at 300V dc.	If this fault occurs when you power up the system module with the M-contactor, the power distribution impedance might be stiff or line voltage might be too high.	• Perform line conditioning. • Verify that line voltage is within specifications.
		The position controller acceleration / deceleration rate is incorrectly set.	Change the command profile to reduce speed or increase time.
		The system inertia is too high causing excessive energy to be returned to the power supply bus.	• Change the command profile to reduce speed or increase time. • Use a larger external shunt resistor.
		A vertical axis with insufficient counterbalancing is overdriving the servo motor and causing excessive energy to be returned to the power supply bus.	• Use the external shunt resistor. • Increase the mechanical counter-balance on the machine.
		Input line voltage exceeds the maximum input voltage rating.	Verify incoming main ac input voltage and change the supply source, if needed.
		Power Driver Board is malfunctioning and is incorrectly sensing the bus voltage.	Replace the system module.
		The shunt regulator or transistor has malfunctioned.	Replace the system module.
		External shunt regulator fuse has blown.	Check and possibly replace the shunt resistor.
		Shunt type not selected properly.	Select proper shunt type.
DriveUndervoltage Fault (Bus Precharge)	The system module pre-charge cycle has failed.	The precharge circuit has malfunctioned.	• Check main ac line voltage. • Check fusing. • Replace the system module.
DriveUndervoltage Fault (Bus Undervoltage)	The DC power bus activates undervoltage limit when the bus drops to 275V dc or less. It will clear at 300V dc.	The voltage on the main ac input power is low.	• Verify incoming AC voltage and change the supply source, if needed. • Check fusing.
DriveHardFault (Can Init)	SCANport hardware initialization fault detected.	Control board hardware failure.	• Cycle all input power. • If fault persists, replace system module.

Fault Message RSLogix (HIM)**:**	**Description:**	**Potential Cause is:**	**Possible Resolution is:**
DriveHardFault (Contactor Fault)	Three-phase power is either detected when it shouldn't be or not detected when it should be.	The contactor is welded or failed to open.	• Correct wiring. • Replace the contactor.
		The input wiring to your contactor is incorrect.	Correct wiring.
MotFeedbackFault (Fdbk Watch Dog)	A feedback hardware or software fault detected.	The feedback processor has faulted.	• Cycle all input power. • If fault persists, replace system module.
GroundShortFault (Ground Short)	Excessive ground current in the system module was detected.	Incorrect wiring.	• Verify motor and ground wiring. • Replace cables.
		Motor malfunction.	Check the resistance of each motor winding phase to case ground with an ohm meter. Readings should be in mega ohms.
		Axis Module IGBT malfunction.	Replace the axis module.
		Short to ground.	• Replace the system or axis module. • Check grounding and incoming power wiring.
DriveHardFault (IDMA Load)	Motor feedback hardware initialization fault detected.	Control board hardware failure.	• Cycle all input power. • If fault persists, replace system module.
DriveHardFault (Memory Init)	Memory hardware initialization fault detected.	Incorrect motor feedback wiring.	• Load default parameters, save to non-volatile memory, and recycle power. • Reset the drive. • Replace the system module.
		Improper feedback cable clamp attachment.	
		Control board hardware failure.	• Cycle all input power. • If fault persists, replace system module.
DriveHardFault (NV Mem Init)	Non-volatile memory is corrupt.	Control board software error.	• Load default parameters, save to non-volatile memory, and recycle power. • Reset the drive. • Replace the system module.
DriveHardFault (Objects Init)	Non-volatile memory is corrupt.	Control board hardware failure.	• Load default parameters, save to non-volatile memory, and recycle power. • Reset the drive. • Replace the system module.
PowerPhaseLoss Fault (Phase Loss Flt)	The three-phase input line is monitored and a fault will be issued whenever a phase loss is detected.	One or more input line fuses have opened.	Check fuses and replace, as necessary.
		Input line contactor malfunction.	• Correct wiring. • Replace contactor.
		Incorrect wiring.	Check main ac input power at system module.
DriveHardFault (SCANport Comm)	SCANport/DPI Communication Failed.	The SCANport/DPI device or cable is faulty.	Check SCANport/DPI connections.
SERCOSFault (SERCOS Ring Flt)	SERCOS ring not active after being active and operational.	SERCOS ring is physically broken.	• Check fiber optic cable connections. • Replace fiber optic cable.
		ControlLogix program is downloaded during operation (this causes SERCOS ring to cycle).	Wait for SERCOS ring to cycle and fault to reset.
DriveHardFault (SERCOS Init)	SERCOS hardware initialization fault detected.	Control board hardware failure.	• Cycle all input power. • If fault persists, replace system module.
DriveHardFault (Serial Ring Init)	Intermodule serial communication failed.	Terminator is not installed.	• Verify that the slider and terminator connections are secure.
		System module failure.	Replace the system module.

Fault Message RSLogix (HIM)**:**	**Description:**	**Potential Cause is:**	**Possible Resolution is:**
SERCOSFault (SERCOS Same Addr)	Duplicate node address detected on SERCOS ring.		Verify that each SERCOS drive is assigned a unique node address.
DriveOvervoltage Fault (Shunt Time Out)	Shunt resistor continuous rating exceeded.	The regenerative energy produced by the motor exceeded the limit of the shunt resistor.	• Use a properly sized shunt or modify duty cycle of the application. • System uses internal shunt and requires external shunt for additional capacity.
DriveOvertemp Fault (Sys Overtemp)	The 1394 thermal sensor tripped when internal ambient temperature exceeded rating.	The fan on the system module or an axis module failed.	Replace the system or axis module.
		The cabinet ambient temperature is above rating.	Check the cabinet temperature.
		The machine duty cycle requires an RMS current exceeding the continuous rating of the controller.	Change the command profile to reduce speed or increase time.
		Changes in mechanics have occurred causing an increased torque output for the application move profiles.	• Check mechanics for improper operation. • Verify operating torque.
		The airflow access to the 1394 is limited or blocked.	Check airflow and re-route cables away from the 1394.
DriveHardFault (Sys Mod Unknown)	Active when serial ring detects unknown system module.	Unknown system module.	Replace the system module.
DriveHardFault (Task Init)	Software initialization fault detected.	Control board hardware failure.	• Cycle all input power. • If fault persists, replace system module.
DriveHardFault (Unknown Fault)	Fault is detected but source is unknown.	Wrong version of software for the hardware or loose internal or external connection.	• Check system terminator. • Reset drive.

Axis Module Faults

Use the table below for troubleshooting axis module faults.

Fault Message RSLogix (HIM)**:**	**Description:**	**Potential Cause is:**	**Possible Resolution is:**
No Fault Message (condition indicated by on-screen message) (A*x*: ATune Flt)	Auto tune procedure failed to complete successfully.	Motor or feedback device malfunction.	• Check motor power/feedback wiring. • Refer to on-screen message for resolution.
No Fault Message (condition indicated by on-screen message) (Axis *x* Hookup Fault)	Hookup procedure failed to complete successfully.	Motor or feedback device malfunction.	• Check motor power/feedback wiring. • Refer to on-screen message for resolution.
DriveHardFault (Axis *x* Unknown)	Active when serial ring detects unknown axis module.	Unknown axis module.	• Check the slider connections. • Replace the axis module.
AuxFeedbackFault (A*x*: Aux Fdbk AQB)	Auxiliary Encoder State Error	Auxiliary encoder has encountered an illegal state transition.	• Use shielded cables with twisted pair wires. • Route the feedback away from potential noise sources. • Check the system grounds. • Replace the motor/encoder.
AuxFeedbackFault (A*x*: Aux Fdbk Comm)	Drive unable to communicate with auxiliary Smart feedback device.	The auxiliary encoder feedback signal is lost.	• Check auxiliary feedback wiring. • Reset faults.
AuxFeedbackFault (A*x*: Aux Fdbk Loss)	The feedback wiring is open, shorted, or missing.	Open or short circuit has occurred on feedback wiring.	Check the feedback cable connectors/wiring to the system module and motor.
		The feedback wiring or termination to system module is incorrect.	Check the feedback cable connectors/wiring to the system module and motor.
		Motor feedback failure.	Replace the motor feedback.
AuxFeedback NoiseFault (A*x*: Aux Fdbk Noise)	Excessive noise detected on feedback signals.	Poor grounding.	• Check ground clamp connectors. • Check system module grounding.
DriveUndervoltage Fault (A*x*: Bus Loss)	The DC bus supply to the axis module was lost.	The slider connections may not be secure.	Check slider connections.
		An axis module's bus link fuse has blown.	Replace the axis module.
DriveOvercurrent Fault (A*x*: Desat)	Too much current in the axis module.	Power module malfunction.	Replace the axis module.
DriveEnableInput Fault (Drive Enable Flt)	Missing Drive Enable Input Signal	• An attempt was made to enable the axis through software while the Drive Enable hardware input was inactive. • The Drive Enable input transitioned from active to inactive while the axis was enabled.	• Disable the Drive Enable Input fault. • Verify that Drive Enable hardware input is active whenever the drive is enabled through software.

Fault Message RSLogix (HIM)**:**	**Description:**	**Potential Cause is:**	**Possible Resolution is:**
PositionErrorFault (A*x*: Follow Error)	Axis position error limit has been exceeded. This fault can be configured for status only.	The motor cannot keep up with the position command.	• Check motor load for binding. • Increase position loop proportional gain. • Increase the allowable following error.
DriveOvercurrent Fault (A*x*: I(t) Fault)	The output current is exceeding the time-current rating.	Accel/decel command from position controller is requiring peak current for an excessive amount of time.	Change the command profile to reduce speed or increase time.
		The machine friction, inertial load, and/or viscous load is excessive.	• Change the command profile to reduce speed or increase time. • Check for mechanical problems on the machine.
		The motor has been improperly sized.	• Check motor size for your application. • Contact your Allen-Bradley Support Representative.
		A short circuit exists across the drive output terminals.	Check wiring between the axis and the motor.
		Logic supply circuits have malfunctioned or AC output is incorrectly wired.	• Check wiring between the axis and the motor. • Check power wiring between the axis and the motor. • Check resolver wiring between the system module and the motor.
PosSoftOvertravel Fault (A*x*: +Soft Ovrtrvl)	Axis position exceeded maximum software positive travel limit.	Positive travel limit set too high.	• Jog motor to within limits. • Increase travel range limits.
NegSoftOvertravel Fault (A*x*: -Soft Ovrtrvl)	Axis position exceeded maximum software negative travel limit.	Negative travel limit set too low.	• Jog motor to within limits. • Increase travel range limits.
PosHardOvertravel Fault (A*x*: +Hard Ovrtrvl)	Axis tripped positive hard overtravel limit switch.	Axis moved beyond the physical travel limits.	• Disable checking and jog motor to within limits. • Move motor manually to within limits.
NegHardOvertravel Fault (A*x*: -Hard Ovrtrvl)	Axis tripped negative hard overtravel limit switch.	Axis moved beyond the physical travel limits.	• Disable checking and jog motor to within limits. • Move motor manually to within limits.
MotFeedbackFault (A*x*: Mtr Fdbk AQB)	Motor Encoder State Error	Motor encoder has encountered an illegal state transition.	• Use shielded cables with twisted pair wires. • Route the feedback away from potential noise sources. • Check the system grounds. • Replace the motor/encoder.
MotFeedbackFault (A*x*: Mtr Fdbk Comm)	Communication was not established with an intelligent (i.e. Stegmann) encoder.	The encoder feedback signal is lost.	• Check motor feedback wiring • Reset faults
MotFeedbackFault (A*x*: Mtr Fdbk Loss)	The feedback wiring is open, shorted, or missing.	Open or short circuit has occurred on feedback wiring.	Check the feedback cable connectors/wiring to the system module and motor.
		The feedback wiring or termination to system module is incorrect.	Check the feedback cable connectors/wiring to the system module and motor.
		The motor feedback might be bad.	Replace the motor feedback.

Fault Message RSLogix (HIM)**:**	**Description:**	**Potential Cause is:**	**Possible Resolution is:**
MotFeedback NoiseFault (A*x*: Mtr Fdbk Noise)	Excessive noise detected on feedback signals.	Poor grounding.	• Check ground clamp connectors. • Check system module grounding.
MotorOvertemp Fault (A*x*: Motor *x* Overtemp)	The motor thermal switch was tripped.	Motor overload.	• Allow motor to cool down and investigate the cause of the motor overload. • Motor not sized properly.
OverSpeedFault (A*x*: Overspeed)	Motor velocity exceeded the overspeed trip limit.	Axis speed has reached 150% of the maximum rated setting. The 100% trip point is dictated by the lesser of the user velocity limits or the motor maximum speed rating.	• Verify operating parameters. • Verify application requirements.
DriveOvertemp Fault (A*x*: Overtemp)	Axis module temperature limit exceeded	The fan on the system module or an axis module failed.	Replace the system or axis module.
		The cabinet ambient temperature is above rating.	Check the cabinet temperature.
		The machine duty cycle requires an RMS current exceeding the continuous rating of the controller.	Change the command profile to reduce speed or increase time.
		The airflow access to the 1394 is limited or blocked.	Check airflow and re-route cables away from the 1394.
DriveOvercurrent Fault (A*x*: Power Fault)	The current through any one of the power IGBTs has exceeded 300% of the 1394's current rating.	The motor lead has shorted.	• Check the motor cable. • Check the resistance of each power phase wire to ground. It should be Mega ohms. • Make sure ferrite cores are not installed on motor power conductors.
		The motor is malfunctioning.	• Check the resistance of each motor winding phase to case ground with an ohm meter. Readings should be in Mega ohms. • Return motor for repairs.
		Power IGBTs are malfunctioning.	Replace the axis module.

Troubleshooting General System Problems

Use the tables below for troubleshooting general system faults.

Condition:	Potential Cause is:	Possible Resolution is:
Axis or System runs uncontrollably	The position feedback device is incorrect or open.	Check wiring.
	Unintentionally in torque mode.	Check to see what primary operation mode was programmed.
	An internal malfunction exists.	Replace system or axis module.
Axis or System is unstable	Motor tuning parameters are set too high.	Run auto tune.
	Position loop gain or position controller accel/decel rate is improperly set.	Run auto tune.
	Improper grounding or shielding techniques are causing noise to be transmitted into the position feedback or velocity command lines, causing erratic axis movement.	Check wiring and ground.
	Motor Select parameter is incorrectly set (servo motor is not matched to 1394).	• Check setups. • Run auto tune.
You cannot obtain the motor acceleration/deceleration that you want	Torque Limit parameters are set too low.	Verify that current limits are set properly.
	Motor Select parameter is incorrectly set.	Program the correct motor and run auto tune again.
	The system inertia is excessive.	• Check motor size vs. application need. • Review servo system sizing.
	The system friction torque is excessive.	Check motor size vs. application need.
	Available current is insufficient to supply the correct accel/decel rate.	• Check motor size vs. application need. • Review servo system sizing.
	Acceleration parameter is incorrect.	Verify parameter settings and correct them, as necessary.
	Velocity Limit parameters are incorrect.	Verify parameter settings and correct them, as necessary.
Motor does not respond to a Velocity Command	Check for possible faults.	Verify parameter settings and correct them, as necessary.
	The axis cannot be enabled for 1.5 seconds after disabling.	Disable the axis, wait for 1.5 seconds, and enable the axis.
	Enable signal has not been applied or the enable wiring is incorrect.	• Check the controller. • Check the wiring.
	The motor wiring is open.	Check the wiring.
	The motor thermal overload has tripped.	• Check for a fault. • Check the wiring.
	The motor has malfunctioned.	Repair or replace the motor.
	The coupling between motor and machine has broken (i.e., the motor moves, but the load/machine doesn't).	Check and correct the mechanics.
	Primary operation mode is set incorrectly.	Check and properly set the parameter.
	Velocity limit parameters are set incorrectly.	Check and properly set the parameter(s).
	The axis module has a malfunction.	Replace the axis module.

Condition:	Potential Cause is:	Possible Resolution is:
Presence of noise on Command or resolver signal wires	Recommended grounding per installation instructions and *Appendix B* has not been followed.	• Verify grounding. • Route wire away from noise sources.
	External 50/60 Hz line frequency may be present.	• Verify grounding. • Route wire away from noise sources.
	External 100/120 Hz from a single phase logic supply may be present.	• Verify grounding. • Route wire away from noise sources.
	External180 or 360 Hz from other adjustable speed drives may be present.	• Verify grounding. • Route wire away from noise sources.
	Variable frequency may be velocity feedback ripple or a disturbance caused by gear teeth or ballscrew balls etc. The frequency may be a multiple of the motor power transmission components or ballscrew speeds resulting in velocity disturbance.	• Decouple the motor for verification. • Check and improve mechanical performance of the gearbox, ballscrew, etc.
No Rotation	The motor connections are loose or open.	Check motor wiring and connections.
	Foreign matter is lodged in the motor.	Remove foreign matter.
	The motor load is excessive.	Size the servo system.
	The bearings are worn.	Return the motor for repair.
	The motor brake is engaged (if supplied).	• Check brake wiring and function. • Return the motor for repair.
	The motor is not connect to the load.	Check coupling.
Overheating	The duty cycle is excessive.	Change the command profile to reduce accel/decel or increase time.
	The rotor is partially demagnetized causing excessive motor current.	Return the motor for repair.
Abnormal Noise	Motor tuning parameters are set too high.	Run auto tune again.
	Loose parts are present in the motor.	• Return motor for repair. • Replace motor.
	Mounting bolts are loose.	Tighten bolts.
	Shaft key loose.	Check coupling.
	The bearings are worn.	Return motor for repair.
Erratic Operation - Motor locks into position, runs without control or with reduced torque	Phases U1 and V1, U1 and W1 or V1 and W1 reversed.	Check and correct motor power wiring.
	Sine, Cosine or Rotor leads are reversed in the feedback cable connector.	Check and correct motor feedback wiring.
	Sine, Cosine, Rotor lead sets of resolver feedback are reversed.	Check and correct motor feedback wiring.

Specifications and Dimensions

Chapter Objectives

This appendix covers the following topics:

- Certifications
- Power Specifications
- General Specifications
- Dimensions

Certifications

The 1394 SERCOS interface system is certified for the following when the product or package is marked:

- UL® Listed to U.S. and Canadian safety standards (UL 508C File E59272)
- CE marked for all applicable directives

Note: Refer to www.ab.com/certification/ce/docs for more information.

Power Specifications

This section contains power specifications for the 1394 SERCOS interface system.

System Module Power Specifications

The:	For the 1394C-SJT05-D is:	For the 1394C-SJT10-D is:	For the 1394C-SJT22-D is:
Rated AC input voltage	324-528V AC, 50/60 Hz Three phase	324-528V AC, 50/60 Hz Three phase	324-528V AC, 50/60 Hz Three phase
AC input current (A_{rms})	6.5A	13.0A	28.6A
Peak inrush current[1, 2]	8A	8A	8A
Line loss ride through	20 ms	20 ms	20 ms
Nominal bus output voltage	530/680V dc	530/680V dc	530/680V dc
Continuous power output	4/5 kW	8/10 kW	17/22 kW
Peak power output[3]	28 kW	28 kW	136 kW
Efficiency	99%	99%	98%
Weight	10.68 kg (23.5 lb)	10.68 kg (23.5 lb)	12.9 kg (28.5 lb)
Continuous current output (A_{dc})	7.36A	14.73A	33.8A
Intermittent current output (A_{dc})	15.0A	29.46A	200A
Capacitance	220 µF	345 µF	660 µF
Inductance	1000 µH	750 µH	500 µH
Internal shunt resistor	200W continuous, 40,000W peak (two second maximum on time)		No internal Shunt Resistor

[1] 1394C-SJT05-D, -SJT10-D, and -SJT22-D system modules are limited to four contactor cycles per minute.

[2] Peak inrush current is limited by an internal 80 ohm resistor. The 8A peak inrush current for all Series C system modules will experience no more than a 40A peak loss (less 1 ms).

[3] The peak power output rating is based on a current limit of 105% of two times the rated continuous current output for 600ms or the rated peak power output for a duration equal to the equivalent watt-seconds.

Axis Module Power Specifications

The:	For the 1394*x*-AM03 is:	For the 1394*x*-AM04 is:	For the 1394*x*-AM07 is:	For the 1394*x*-AM50 and 1394C-AM50-IH is:	For the 1394*x*-AM75 and 1394C-AM75-IH is:
Speed Regulation[1]	0 to 0.05% of base speed with 100% torque disturbance	0 to 0.05% of base speed with 100% torque disturbance	0 to 0.05% of base speed with 100% torque disturbance	0 to 0.05% of base speed with 100% torque disturbance	0 to 0.05% of base speed with 100% torque disturbance
Static Gain (rms A/mV)[1]	1.28	2.6	4.9	22.8	22.8
Peak Current Limit Adjust	200%	200%	200%	143%	143%
Modulation Frequency	5 kHz ±10%	5 kHz ±10%	5 kHz ±10%	5 kHz ±10%	5 kHz ±10%
Drift	0.03 rpm/degree C	0.03 rpm/degree C	0.03 rpm/degree C	0.03 rpm/degree C	0.03 rpm/degree C
Nominal Input Voltage	530/680V dc	530/680V dc	530/680V dc	530/680V dc	530/680V dc
Continuous Current (rms)	3.0A	4.5A	7.5A	23.3A	35.0A
Peak Current (rms - 1 second)	6.0A	9.0A	15.0A	33.2A	50.0A
Continuous Power Out 360/460V nominal	1.6/2 kW	2.4/3 kW	4/5 kW	11.34/15.6 kW	17.8/23.8 kW
Efficiency	98%	98%	98%	98%	98%
Weight	5 kg (11.02 lb)	5 kg (11.02 lb)	5 kg (11.02 lb)	7 kg (15.44 lb) (-AM50) 6.73 kg (14.8 lb) (-AM50-IH)	7 kg (15.44 lb) (-AM75) 6.73 kg (14.8 lb) (-AM75-IH)
Capacitance	110 µF	110 µF	220 µF	465 µF	660 µF

[1] When used with the controller in the 1394*x*-SJT*xx-x* system module.

Axis Module Series Information

Axis Module Features	Feature Availability	
	Series C	Series A and B
Cable Clamp (strain relief, shield bond)	Yes	No
EMI filter[1] (motor brake and thermal circuit)	Yes	No

[1] Voltage rating = 24V ac.

Note: Series A, B and C axis modules are physically interchangeable with each other.

Note: Series A axis modules (1394-AM03, -AM04, and -AM07) are not functionally compatible with the 1394C-SJT*xx*-D system module.

Circuit Breaker Specifications

While circuit breakers offer some convenience, there are limitations for their use. Circuit breakers do not handle high current inrush as well as fuses. The 1394 needs to be protected by a device having a short circuit interrupt current rating of the service capacity provided or a maximum of 100,000A.

If an upstream circuit protection device is rated for the overload current and short circuit rating, a supplementary circuit protection device (such as the 1492) can be used as the only 1394 branch circuit protection device. The upstream fully rated device let-through must be less than or equal to the 10 kA interrupt rating of the 1492.

The wiring interconnection in Figure A.1 and Figure A.2 provide examples of the needed protection and follows UL and NEC codes. Full compliance is dependent on final wiring design and installation.

Figure A.1
Circuit Protection under NEC 1999 110-10 (preferred fully rated devices)

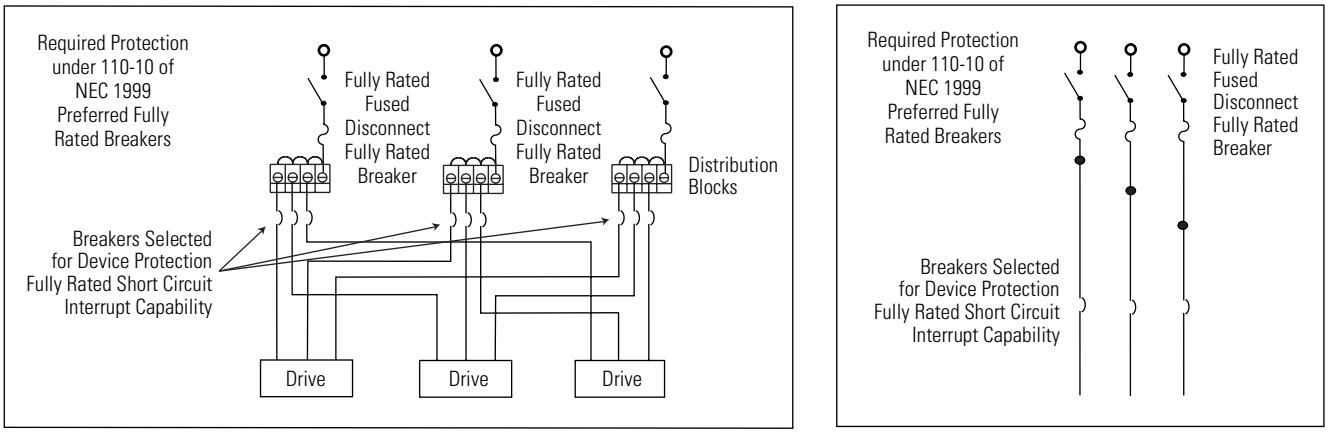
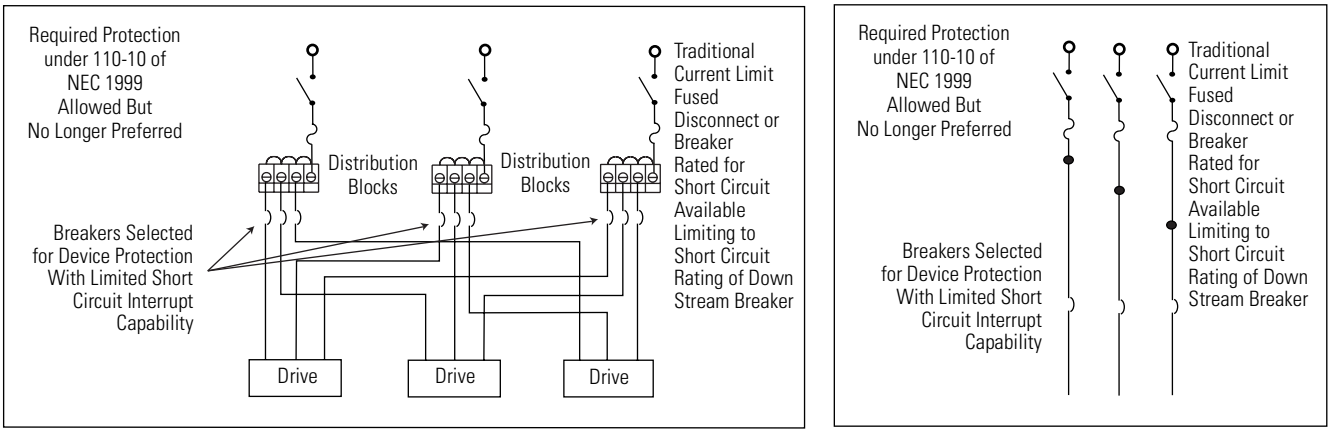


Figure A.2
Circuit Protection under NEC 1999 110-10 (allowed but no longer preferred)



To avoid nuisance tripping, refer to the following table and select the appropriate combination of system module, supplementary circuit protection device, and axis modules.

Use System Module:	With Supplementary Circuit Protection Device:	And Axis Module Combination:
1394C-SJT05-D	1492-CB3-H300	Any combination of AM03 and AM04 up to 4 axis modules. Any combination of AM03, AM04, and AM07 where no more than two AM07s are being used. Use of other combinations of axis modules with this system module may result in nuisance tripping on power up due to a higher inrush current.
	A 1492 device is not recommended for this option.	Other combinations of AM07, AM50, and AM75s. Some local electrical codes require that the circuit breaker rating not exceed 400% of the full load device current. The inrush current draw of the 1394 in some combinations exceeds the 30A breaker and will result in nuisance tripping.
1394C-SJT10-D	1492-CB3-H500	All
1394C-SJT22-D	1492-CB3-H500	All

Fuse Specifications

System		Fuse Description	Rating
1394-SJT05 systems	Series A and B	Bussmann® FRS-R-20A or equivalent	600V ac, 20A
1394C-SJT05 systems	Series C and D	Bussmann KTK-R-20 or equivalent	600V ac, 20A
		Bussmann LPJ-SP 20 or equivalent	600V ac, 20A
1394-SJT10 systems	Series A and B	Bussmann FRS-R-30A or equivalent	600V ac, 30A
1394C-SJT10 systems	Series C and D	Bussmann KTK-R-30 or equivalent	600V ac, 30A
		Bussmann LPJ-SP 30 or equivalent	600V ac, 30A
1394*x*-SJT22 systems		Bussmann FRS-R-35 or equivalent	600V ac, 35A
		Bussmann LPS-RK-SP 40 or equivalent	600V ac, 40A
		Bussmann LPJ-SP 45 or equivalent	600V ac, 45A

Contactor (M1) Specifications

Contactor		1394-SJT05 and -SJT10 (Series A and B)	1394C-SJT05 and -SJT10 (Series C and D)	1394*x*-SJT22
Rating		600V ac, 43A[1]	600V ac, 23A	600V ac, 37A
Recommended types:	AC Coil Operation	Allen-Bradley 100-C43*x*10[2,3]	Allen-Bradley 100-C23*x*10[2,3]	Allen-Bradley 100-C37*x*10[2,3]
	DC Coil Operation	Allen-Bradley 100-C43Z*x*10[2]	Allen-Bradley 100-C23Z*x*10[2]	Allen-Bradley 100-C37Z*x*10[2]

[1] Consider using a 60A contactor when the total capacitance of the axis modules is greater than 880 µF.

[2] *x* indicates coil voltage.

[3] A surge suppressor is required.

Relay Contact Specifications

1394C-SJT*xx*-D SERCOS Interface System	
Specification	**Description**
Drive System OK	115V AC/24V dc, 1A inductive
Relay Outputs 0-3	

24V Logic Input Power Specifications

24V Logic Input Voltage	Frequency	Current		Recommended Fuse
		Axis	Maximum User-Supplied Power Supply	
19-28V ac RMS, single phase	50/60 Hz	1 axis	3.5A	Bussmann MDA-15 or equivalent
		2 axis	4.4A	
18.75-31.25V dc		3 axis	5.2A	
		4 axis	6.0A	

Note: The power supply should be rated for 15A or greater inrush current upon power up.

Input Transformer Specifications for 24V Logic Power

Specification	Description	
	480V System	360V System
Input volt-amperes	200 to 259 VA	200 to 259 VA
Input voltage	480V RMS	360V RMS
Output voltage	24V RMS	24V RMS
Load regulation	2 to 5%	2 to 5%

Note: If the input volt-amperes is more than 350VA, adjust the load regulation to make the transformer leakage the same as or greater than the 250VA transformer with 2% regulation.

1394 System Power Dissipation Specifications

The following section contains the power dissipation characteristics of the 1394 system modules, axis modules, and internal shunt resistors.

IMPORTANT Use the power dissipation figures shown below to calculate cumulative system heat dissipation to ensure that the ambient temperature inside the enclosure does not exceed 50° C (122° F). To calculate total power dissipation, add the dissipation of the system module to the dissipation of the axis module(s).

System Modules

Percentage of Rated Power Output	Power Dissipation Watts		
	1394*x*-SJT05-*x*	**1394*x*-SJT10-*x***	**1394*x*-SJT22-*x***
20	66	70	100
40	70	77	150
60	73	84	200
80	77	81	250
100	80	98	300

Axis Modules

Percentage of Rated Power Output	Power Dissipation Watts								
	Total					Inside Cabinet		Outside Cabinet	
	AM03	**AM04**	**AM07**	**AM50[1] and AM50-IH[2]**	**AM75[1] and AM75-IH[2]**	**AM50[1]**	**AM75[1]**	**AM50[1]**	**AM75[1]**
20	24	27	33	56	85	18	18	38	67
40	30	36	48	95	145	18	18	77	127
60	36	45	63	139	212	18	18	138	194
80	42	54	78	183	279	18	18	165	261
100	48	63	93	227	346	18	18	209	324

[1] The AM50/75 are designed to mount with the rear heat sink extended outside the customer-supplied enclosure. If the modules are mounted entirely inside the customer supplied enclosure, the full power dissipation is inside the cabinet (the sum of the inside/outside columns).

[2] The AM50/75-IH are designed to mount entirely inside the customer-supplied enclosure.

Internal Shunt Resistor

The 1394C-SJT05-D and -SJT10-D system modules include an internal shunt resistor. Shunt specifications are shown in the table below.

The:	Is:
Rating of the internal shunt resistor	200W continuous, 40,000W peak (two second maximum on time)
Resistance of the internal shunt resistor	16 ohms

Note: When the shunt resistor is active, some additional power will be dissipated at the system module. Its maximum dissipation is 200W. Most applications will use less than 10% of this capacity.

General Specifications

The following sections provide environmental, AC line filter, external shunt module, resistive brake module, maximum feedback cable lengths, and dedicated discrete I/O specifications for the 1394 SERCOS interface system.

Environmental Specifications

Specification	Description	
Ambient Operating Temperature: System Module	1394*x*-SJT*xx-x*	0° C to 50° C (32° F to 122° F)
Ambient Operating Temperature Axis Module	1394*x*-AM03, -AM04, -AM07, -AM50-IH, -AM75-IH (Inside Cabinet)	0° C to 50° C (32° F to 122° F)
	1394-AM50 or -AM75 (Inside Cabinet)	0° C to 50° C (32° F to 122° F)
	1394-AM50 or -AM75 (Outside Cabinet)	0° C to 40° C (32° F to 104° F)
Relative Humidity	5-95% noncondensing	
Altitude	1000 m (3300 ft) - Derate 3% per 300 m (984.3 ft) up to 3000 m (10,000 ft)	
Vibration	Operating:	1g
	Non-operating:	2.5g
Shock	Operating:	15g
	Non-operating:	30g

AC Line Filter Specifications

The following AC line filters are compatible with the 1394 drive family.

1394 System Modules	AC Line Filter Catalog Number	Specifications							
		Voltage	Phase	Current	Power Loss	Weight	Humidity	Vibration	Operating Temperature
1394*x*-SJT05-*x*	SP-74102-006-01	460V ac 50/60 Hz	Three	23A @ 50° C (122° F)	20W	1.6 kg (4.16 lb)	90% RH	10-200 Hz @ 1.8 g	-25 to 85° C (-13 to 185° F)
1394*x*-SJT10-*x*	SP-74102-006-02			30A @ 50° C (122° F)	38W	2.7 kg (7.02 lb)			
1394*x*-SJT22-*x*	SP-74102-006-03			75A @ 50° C (122° F)	57W	5.2 kg (13.52 lb)			

External Shunt Module/Resistor Specifications

The passive external shunt resistor kit (1394-SR10A) is available for 5 and 10 kW systems with regenerative loads that exceed the capacity of the internal 200W shunt resistor provided. Most 5 and 10 kW systems will not require an external shunt resistor kit.

All 22 kW 1394 system modules require an external shunt module (1394-SR9A*x* or 1394-SR36A*x*). Shunt modules with (rms) power output of 300, 900, 1800 and 3600W continuous, 160,000W peak are available for use with the smart power 22 kW system module. You must use one shunt module with each 22 kW smart power system module. Available in two sizes, each package contains an integral fuse and terminal block. The 3600W package is available with a 115/230V ac cooling fan. Choose your shunt module based on the shunt requirements from analysis using Motion Book v4.0 (or later).

1394 System Modules	Shunt Module Catalog Number	Specifications						Fuse Replacement
		Drive Voltage VAC	Resistance Ohms	Peak Power kW	Peak Current Amps	Continuous Power Watts	Weight kg (lbs)	
1394*x*-SJT05-*x* and -SJT10-*x*	1394-SR10A	460	16	40	40	1400	4.99 (11.0)	1394-SR10A-FUSE-A
1394*x*-SJT22-*x*	1394-SR9A		4	160	200	300	3.63 (8.0)	FWP-50A14F[1]
	1394-SR9AF					900	3.63 (8.0)	
	1394-SR36A					1800	8.6 (19.0)	
	1394-SR36AF					3600 (fan cooled)	9.0 (20.0)	

[1] Bussmann part number.

Note: CE marked and UL Listed to U.S. and Canadian safety standards.

Maximum Feedback Cable Lengths

Although motor feedback cables are available in standard lengths up to 90 m (295.3 ft), the drive/motor/feedback combination may limit the maximum cable length, as shown in the tables below. These tables assume the use of recommended cables as shown in the *Motion Control Selection Guide* (publication GMC-SG001*x*-EN-P).

The maximum cable lengths for 1394 system/axis modules with MP-Series (460V) and 1326AB/AS motors are given in the table below.

Drive Family	MPL-B (460V) Motors		1326AB (M2L/S2L) (460V) Motors	1326AB/AS (460V) Motors
	Absolute High-Res [1] m (ft)	**Resolver** [2] m (ft)	**Absolute High-Resolution** [3] m (ft)	**Resolver** [4] m (ft)
1394C-SJT*xx*-D	90 (295.3)	90 (295.3)	90 (295.3)	90 (295.3)

[1] Refers to MPL-B*xxxx*S/M (single-turn or multi-turn) low inertia motors with absolute high-resolution feedback.

[2] Refers to MPL-B*xxxx*R low inertia motors with 2-pole resolver feedback.

[3] Refers to 1326AB-B*xxxx*-M2L/S2L (single-turn or multi-turn) motors with absolute high-resolution feedback.

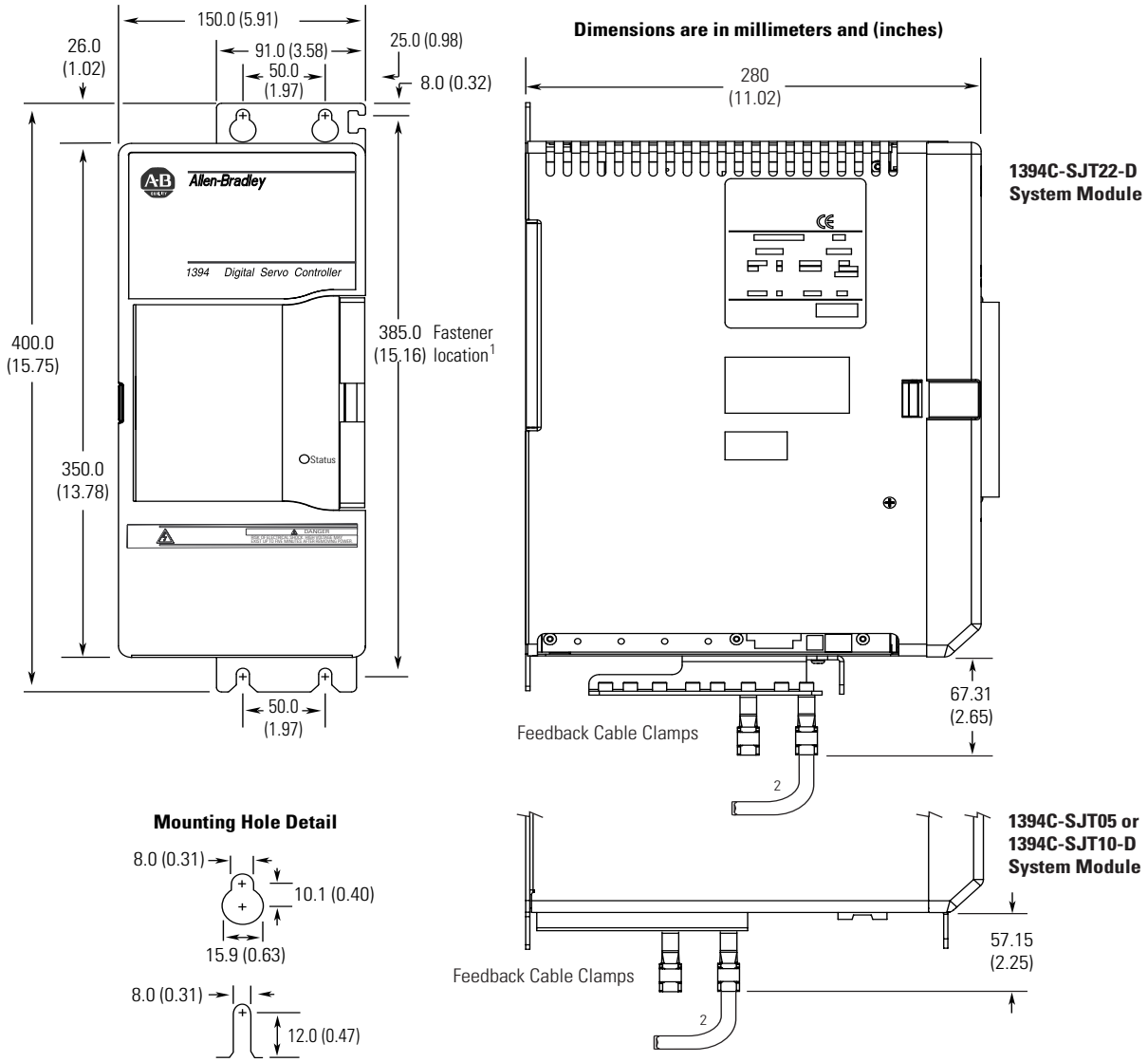
[4] Refers to 1326AB/AS-B*xxxx*-21 motors with resolver feedback.

Dimensions

Within this section, you will find dimensions for the 1394 SERCOS interface system modules and axis modules.

1394 System Module Dimensions

Figure A.3
1394C-SJT05-D, 1394C-SJT10-D and 1394C-SJT22-D System Module

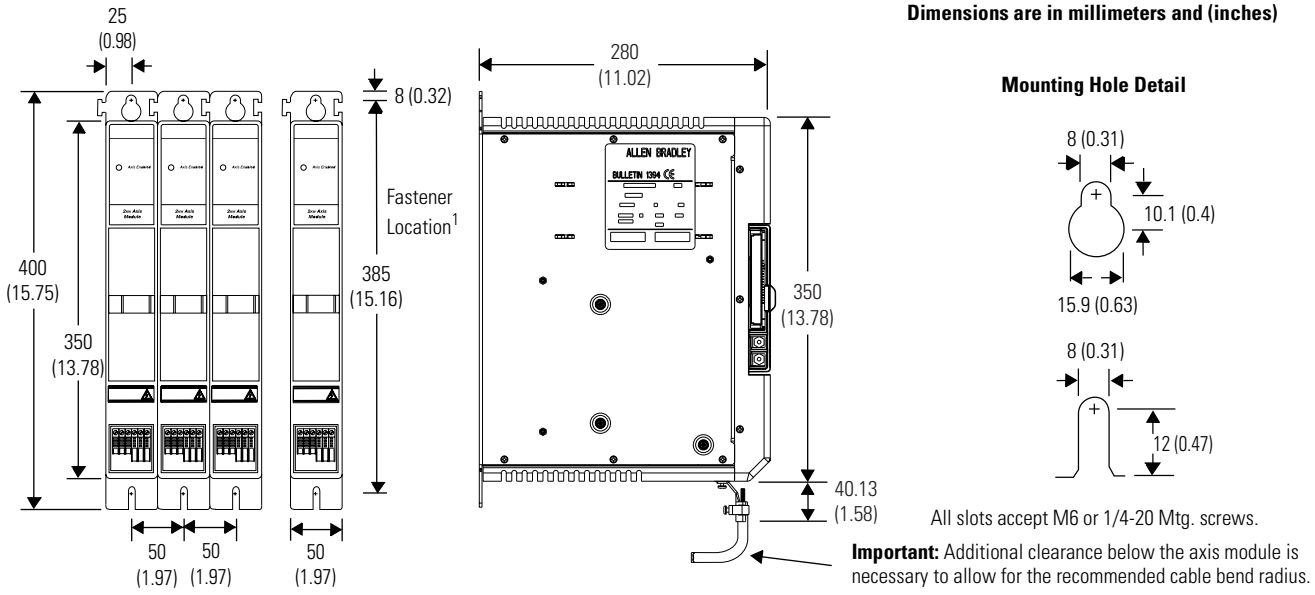


[1] Dimension shown is for mounting hardware location and does not reflect the location of the lower slot radius.

[2] **Important:** Additional clearance below the system module is necessary to provide the recommended cable bend radius. Refer to the *Motion Control Selection Guide* (publication GMC-SG001*x*-EN-P) for more information.

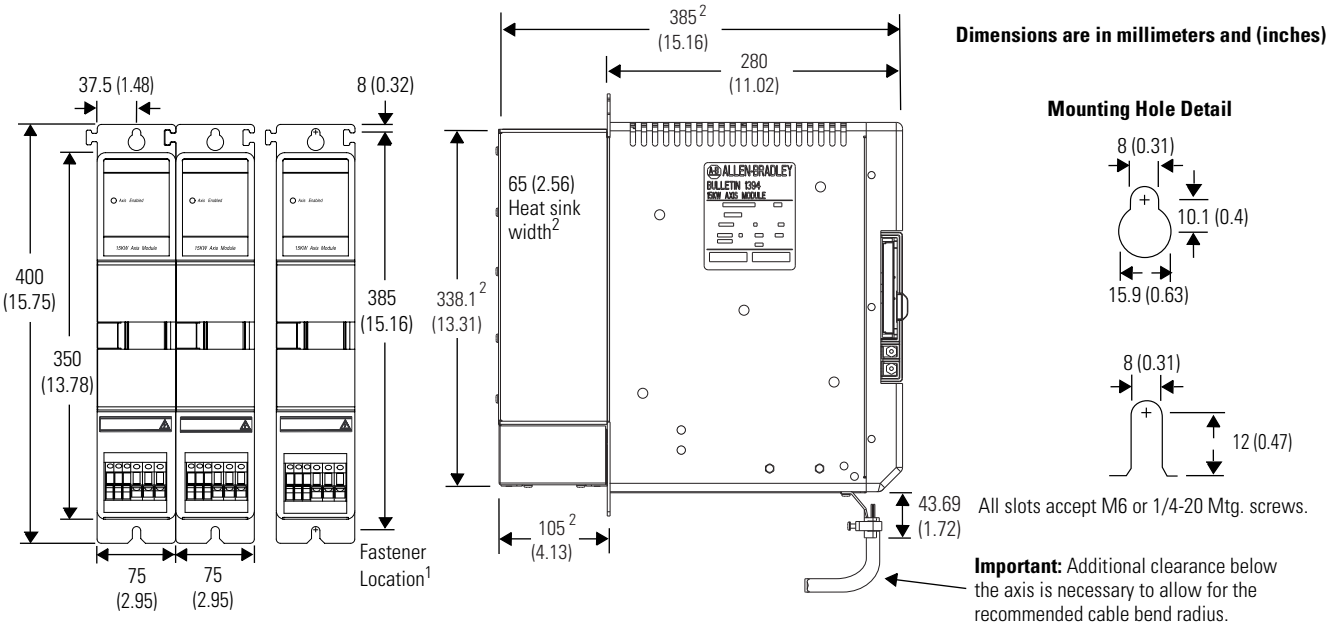
Axis Module Dimensions

Figure A.4
1394 Axis Module Dimensions (1394*x*-AM03, -AM04, and -AM07)



[1] Dimension shown is for mounting hardware location and does not reflect the location of the lower slot.

Figure A.5
1394 Axis Module Dimensions (1394*x*-AM50, -AM50-IH, -AM75, and -AM75-IH)



[1] Dimension shown is for mounting hardware location and does not reflect the location of the lower slot.
[2] This dimension does not apply to 1394C-AM*xx*-IH (internal heatsink) axis modules.

Interconnect Diagrams

Chapter Objectives

This appendix covers the following:

- Power Interconnect Diagrams
- Shunt Module Interconnect Diagrams
- Axis Module/Motor Interconnect Diagrams
- Understanding Motor Thermal Switches
- Brake Interconnect Diagrams

1394 SERCOS Interface Interconnect Diagram Notes

This section provides interconnect diagrams to assist you in wiring the 1394 system. The notes in the table below apply to the interconnect diagrams on the pages that follow.

Note:	Information:
1	For power wiring specifications, refer to *Power Wiring Requirements* in *Chapter 3*.
2	For input fuse and circuit breaker sizes, refer to *Circuit Breaker Specifications* and *Fuse Specifications* in *Appendix A*.
3	For AC line filter specifications, refer to *AC Line Filter Specifications* in *Appendix A*.
4	Contactor coil (M1) needs integrated surge suppressors for AC coil operation. Refer to *Contactor (M1) Specifications* in *Appendix A*.
5	Drive Enable input must be opened when main power is removed, or a drive fault will occur. A delay of at least 1.0 second must be observed before attempting to enable the drive after main power is restored.
6	Cable shield clamp must be used in order to meet CE requirements. No external connection to ground required.
7	Jumper is factory set, indicating grounded system at user site. Ungrounded sites must jumper the bleeder resistor to prevent high electrostatic buildup. Refer to *Determining Your Type of Input Power* in *Chapter 3* for more information.
8	**ATTENTION**  Implementation of safety circuits and risk assessment is the responsibility of the machine builder. Please reference international standards EN1050 and EN954 estimation and safety performance categories. For more information refer to *Understanding the Machinery Directive* (publication SHB-900).
9	The recommended minimum wire size for wiring the safety circuit to the contactor enable connector is 1.5 mm^2 (16 AWG).
10	If an external shunt resistor is used, remove the jumper between INT and COL.
11	There is no internal shunt resistor in the 22 kW system module. An external shunt resistor module (1394-SR*x* A*x*) must be used.
12	The thermal switch and brake circuits are a source of conducted noise. Isolation from customer control devices may be required. A separate 24V dc supply or relay can be used. Axis modules (Series C or later) include a thermal switch and motor brake filter to eliminate the need for a separate 24V dc supply.
13	Use a flyback diode for noise suppression of the motor brake coil. For more information, refer to *System Design for Control of Electrical Noise Reference Manual* (publication GMC-RM001*x*-EN-P).
14	For motor cable specifications, refer to *Motion Control Selection Guide* (publication GMC-SG001*x*-EN-P).
15	User supplied auxiliary contact is recommended. Use safety rated, mechanically linked contactor for M1.

Power Interconnect Diagrams

The power interconnect wiring for the 1394 SERCOS interface system module is shown in the figures below.

Figure B.1
1394C-SJT05-D or -SJT10-D Interconnect Diagram

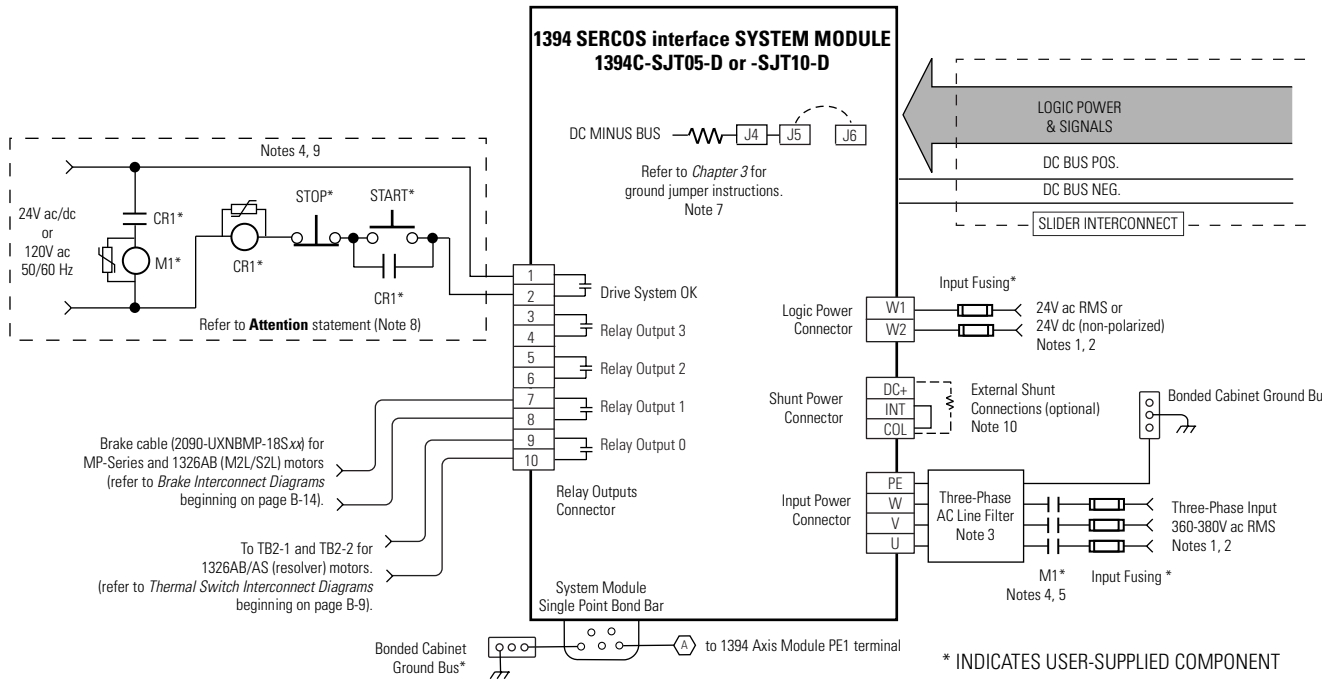
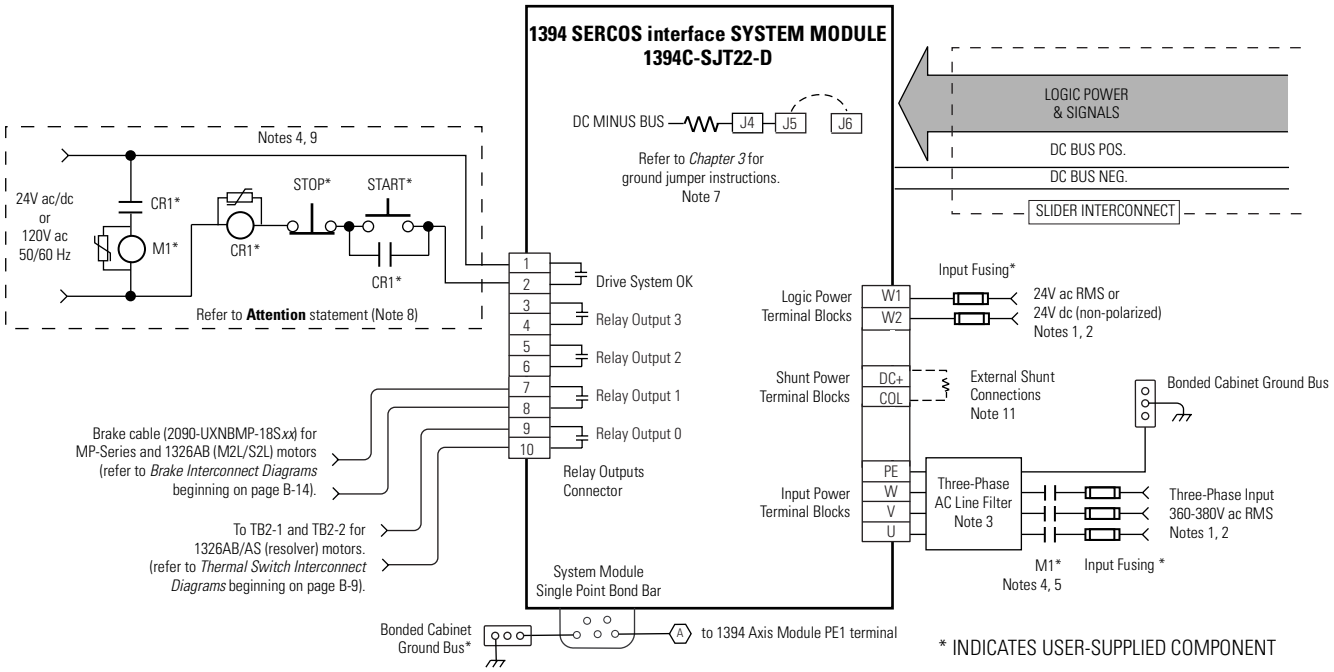


Figure B.2
1394C-SJT22-D Interconnect Diagram

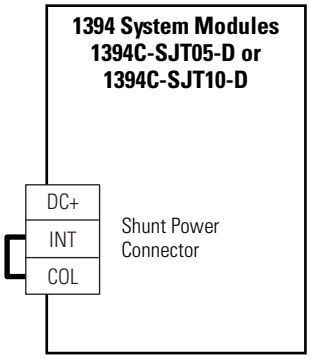


Shunt Module Interconnect Diagrams

In the figure below, the 1394 system module is shown wired for internal shunt operation. This is the factory default jumper setting.

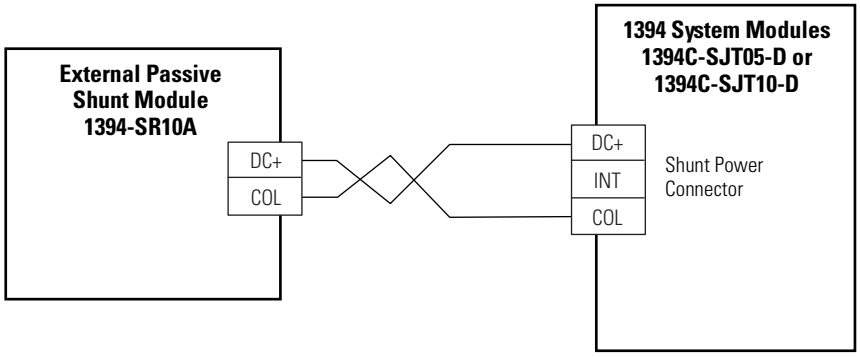
IMPORTANT Internal shunt operation is only present on the 1394 system modules listed in Figure B.3.

Figure B.3
Internal Shunt Interconnect Diagram



In the figure below, the 1394C-SJT05-D and -SJT10-D system modules are shown wired with the optional external shunt resistor.

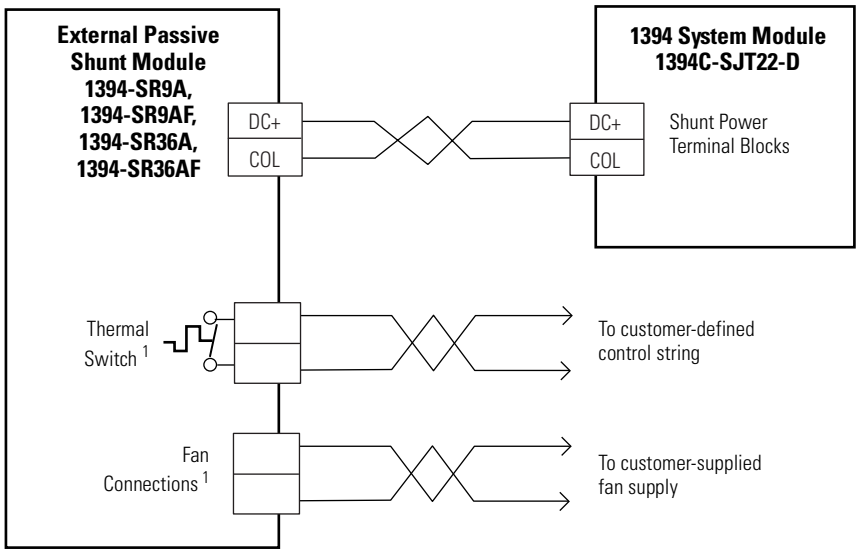
Figure B.4
External Shunt Module Interconnect Diagram (optional)



In the figure below, the 1394C-SJT22-D system module is show wired with an external shunt resistor.

IMPORTANT All 1394 configurations with 22 kW system modules require an external shunt module.

Figure B.5
External Shunt Module Interconnect Diagram (required)



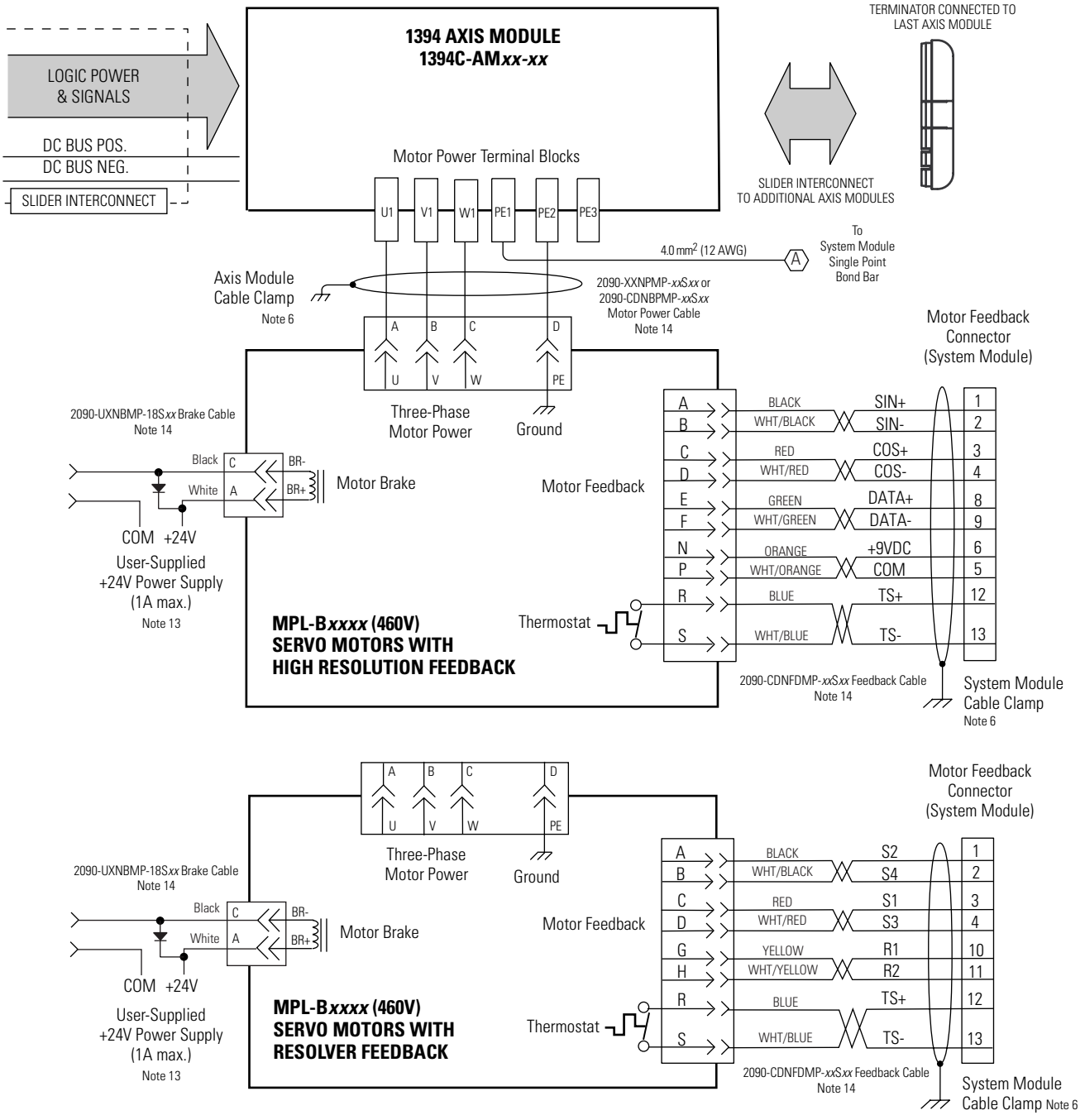
[1] The thermal switch and fan connections are only included with the 1394-SR36A and -SR36AF shunt modules.

Axis Module/Motor Interconnect Diagrams

This section contains the motor power, brake, and feedback signal interconnect diagrams between an Axis Module and MP-Series, 1326AB, and 1326AS servo motors.

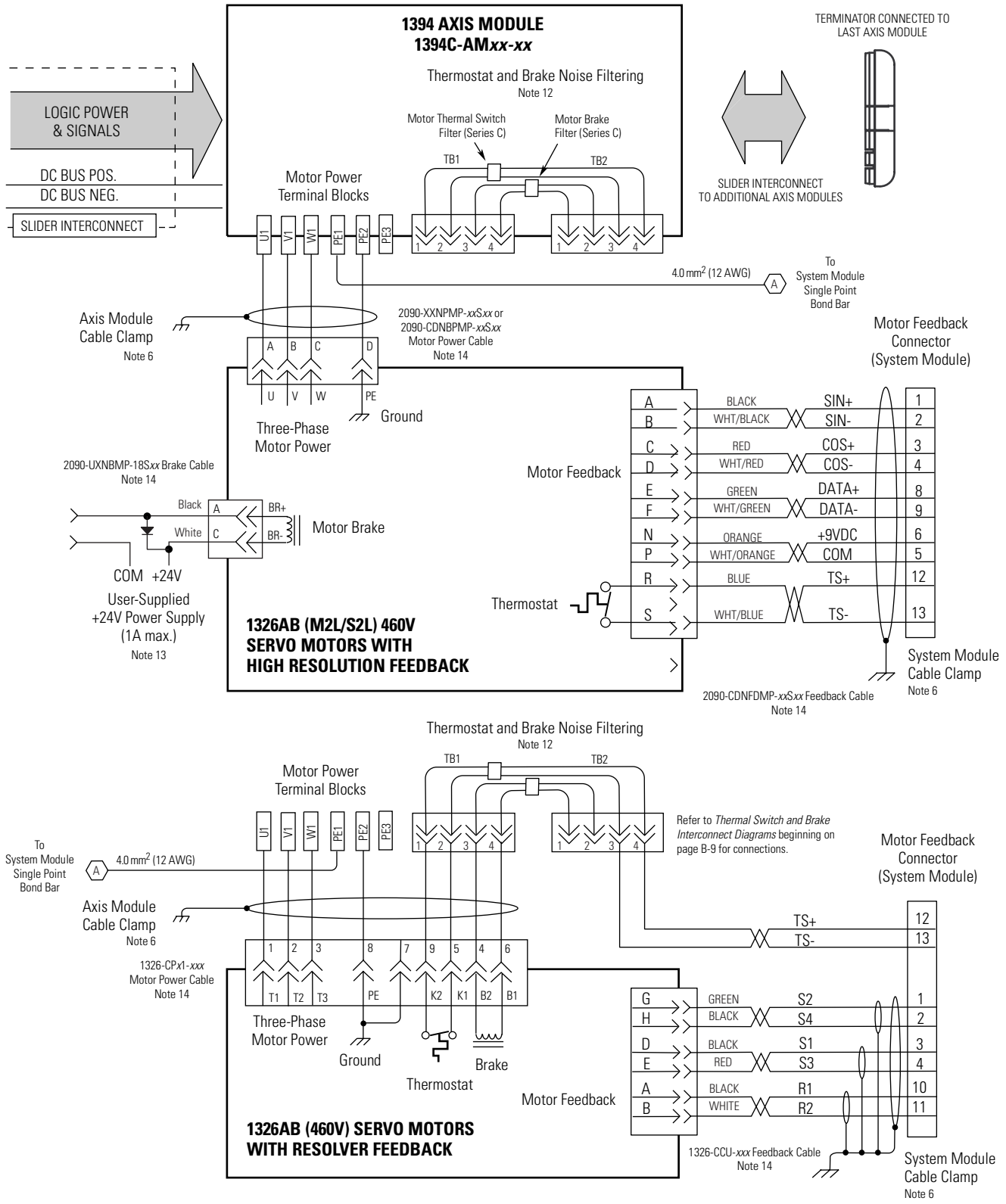
In the figure below, the 1394 axis module is shown connected to MP-Series Low Inertia (460V) motors.

Figure B.6
Axis Module to MP-Series Low Inertia Motors Interconnect Diagram



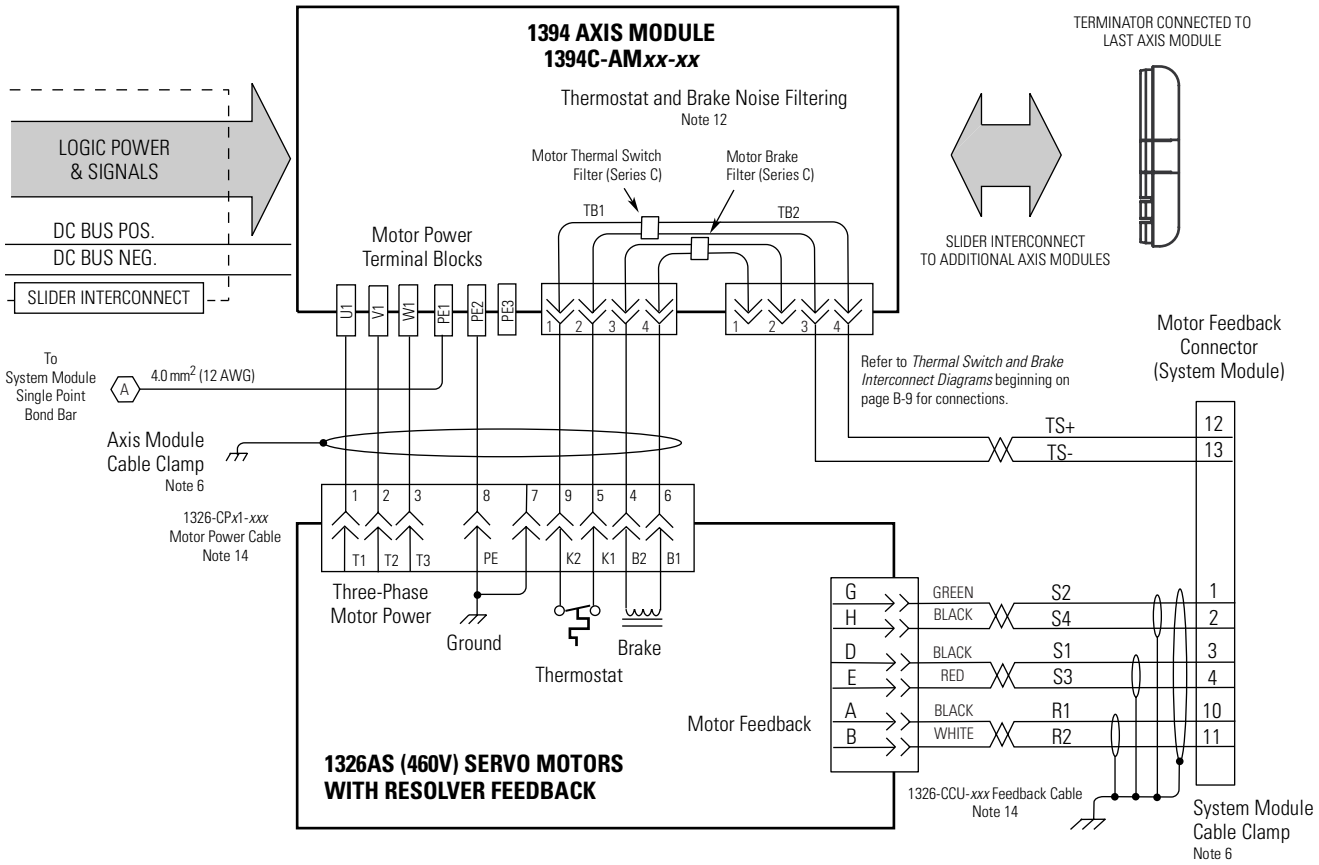
In the figure below, the 1394 axis module is shown connected to 1326AB (460V) servo motors.

Figure B.7
Axis Module to 1326AB Motors Interconnect Diagram



In the figure below, the 1394 axis module is shown connected to 1326AS (460V) servo motors.

Figure B.8
Axis Module to 1326AS Motors Interconnect Diagram



Thermal Switch and Brake Interconnect Diagrams

This section provides thermal switch and brake interconnect diagrams.

Understanding Motor Thermal Switches

Thermal switches, internal to each servo motor, can be wired in series to protect the motor from overheating. In the event of a fault condition, the switch opens and the motor responds to the system configuration. The explanation and example diagrams that follow show how to wire motor thermal switches to your system module.

Depending on the series of your 1394 axis module, your customer control devices may require isolation from the motor's conducted noise. When using 1394 (Series A and B) axis modules, an isolated 24V dc power supply and relay is recommended. 1394 (Series C) axis modules contain internal motor brake and thermal switch filtering and do not require the isolation power supply and relay.

Individual thermal fault monitoring can be achieved by wiring each of the motor thermal switches from the motor, through TB1/TB2 on the axis module, or directly from the motor to one of four dedicated thermal fault inputs on the system module. Your 1394 system can then be configured to monitor and disable one or all four of the axes. As an alternative, you can wire the thermal switches into the start/stop string to disable all axes when a fault occurs.

How Your Feedback Cable Affects Thermal Switch Wiring

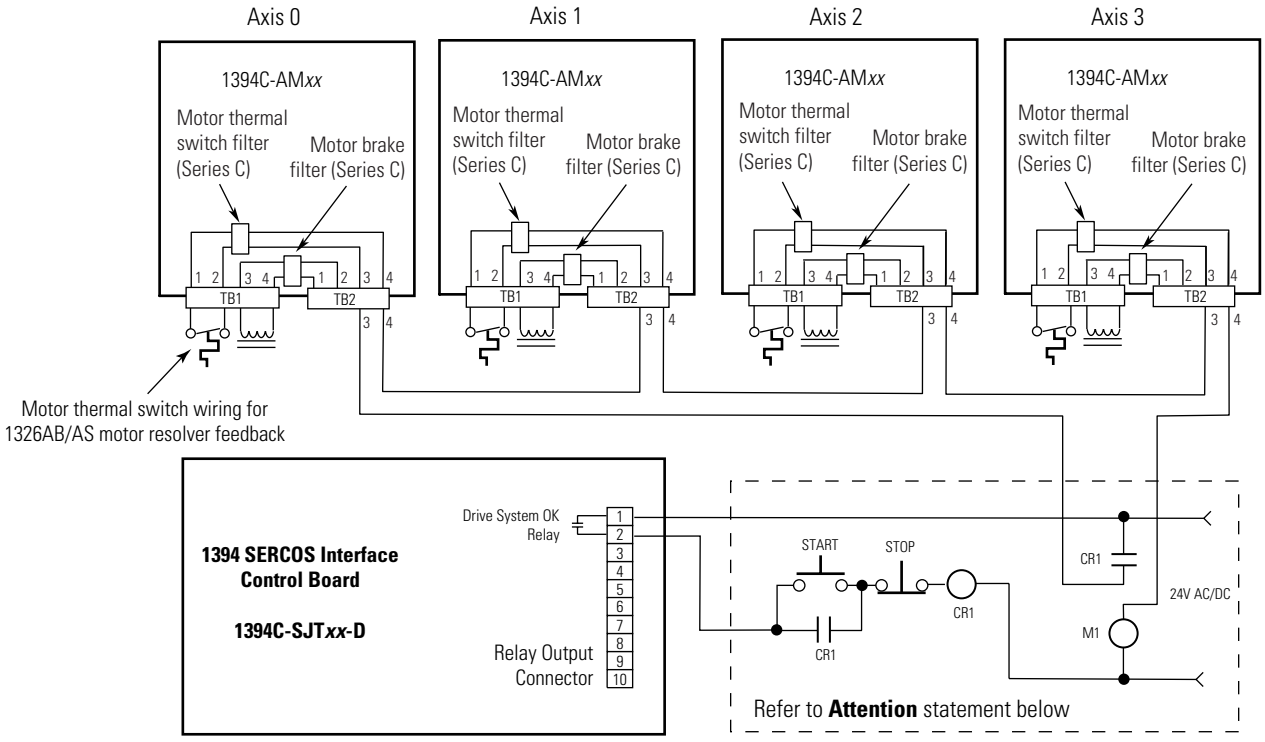
The examples shown on the following pages are for 1326AB/AS servo motors with resolver feedback (using 1326-CCU-*xxx* feedback cables). The motor thermal switch leads are in the motor power cable and attach to TB1 of the axis module (refer to figures B.7 and B.8 for motor/axis module interconnect diagrams).

1326AB (M2L/S2L) motors and MP-Series motors (both resolver and high resolution feedback) use 2090-CDNFDMP-S*xx* feedback cables. The motor thermal switch wires are in the motor feedback cable and attach directly to the feedback connector on the bottom of the 1394 system module. Refer to figures B.6 and B.7 for motor/system module interconnect diagrams).

Thermal Switch Interconnect Diagrams

The example in Figure B.9 shows 1394 (Series C) axis modules with internal brake and thermal switch filtering. Separate isolation power supply and relay are not required. Using this start/stop string configuration all axes are disabled when any one motor faults.

Figure B.9
Non-Isolated Series Start/Stop String



IMPORTANT The thermal circuit includes filtering on the TB1/TB2 connector board that is rated for 24V only. For TB1/TB2 wiring alternatives, refer to the table below.

If:	Then:
120V ac is used on the start/stop string	Option 1: Install a 24V pilot relay on the thermal switch circuit.
	Option 2: Bypass the TB1/TB2 terminations [1].
24V is used on the start/stop string	Follow the wiring shown in Figure B.9 above.

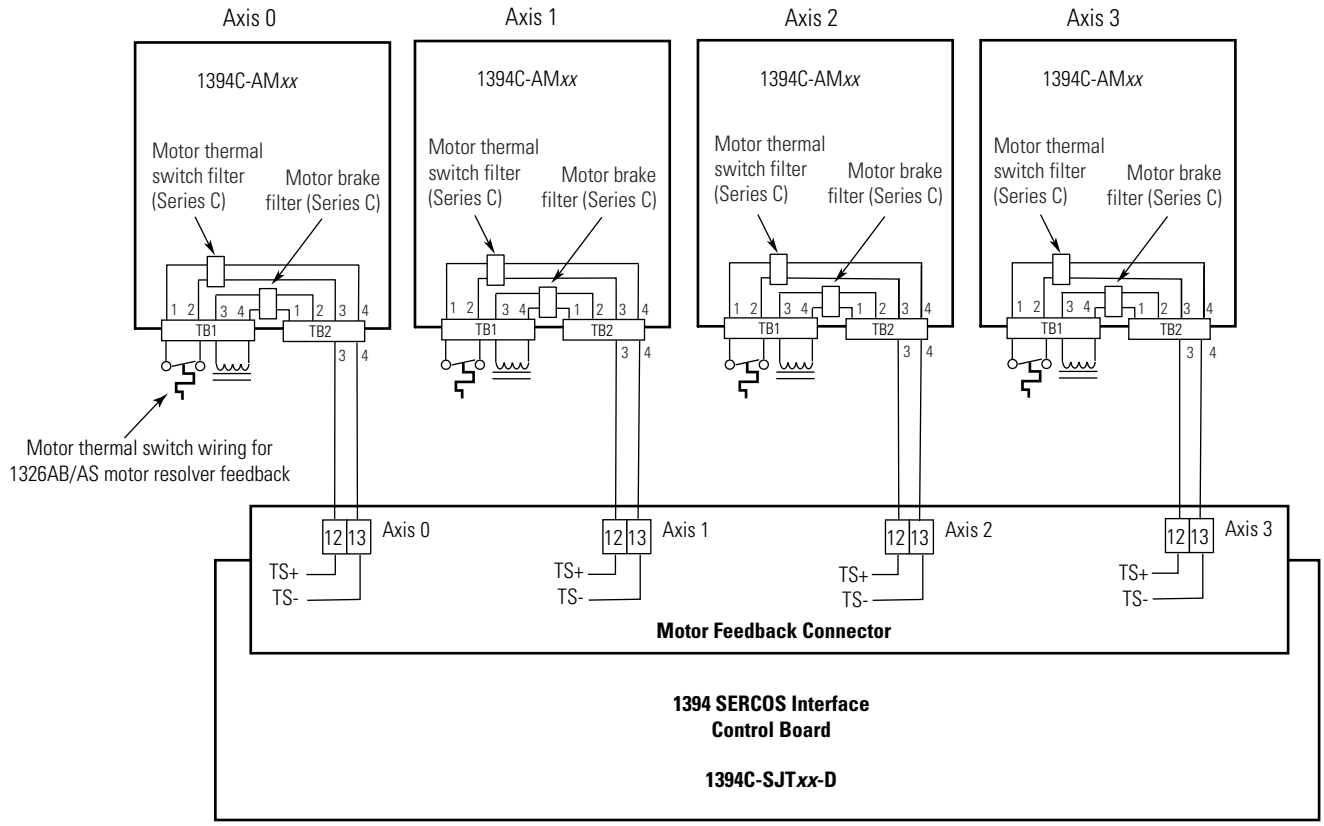
[1] When bypassing the TB1/TB2 terminations, ensure that unshielded motor power conductors are kept as short as possible at the drive, as they will radiate high levels of electrical noise.

Note: Refer to Figure 2.8 for the location of the TB1/TB2 connectors and pin-out diagram.

ATTENTION Implementation of safety circuits and risk assessment is the responsibility of the machine builder. Please reference international standards EN1050 and EN954 estimation and safety performance categories. For more information refer to *Understanding the Machinery Directive* (publication SHB-900).

The example below shows 1394 (Series C) axis modules wired for thermal fault monitoring. Depending on how the 1394 system is configured, the fault can be used to disable one or all of the four axis modules.

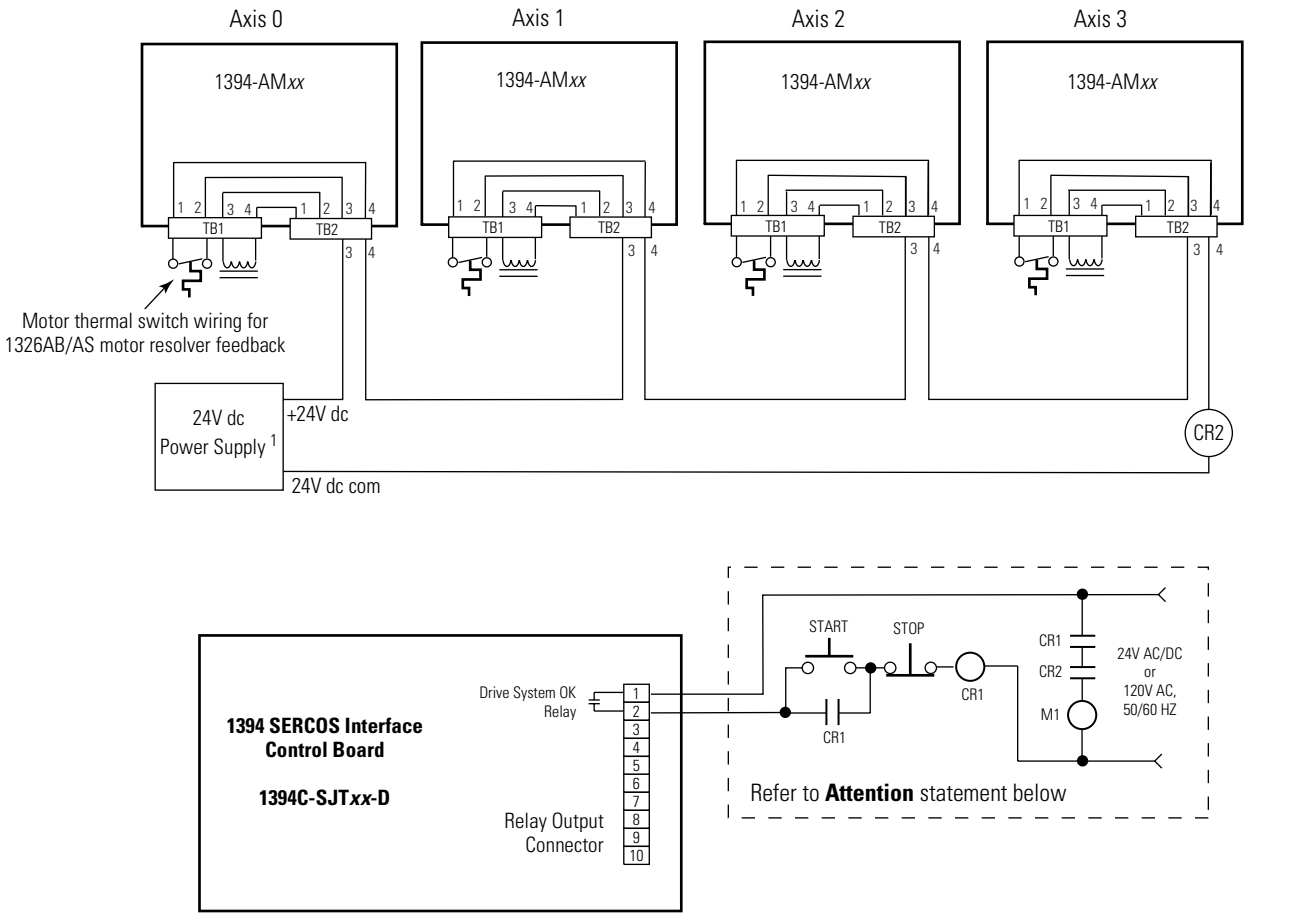
Figure B.10
Non-Isolated with Thermal Fault Monitoring



Note: Refer to Figure 2.8 for the location of the TB1/TB2 connectors and pin-out diagram.

The example below shows 1394 (Series A and B) axis modules (no internal brake or thermal switch filter). Separate 24V dc isolation power supply and relay (CR2) are recommended. Using this start/stop string configuration all axes are disabled when any one motor faults.

Figure B.11
Isolated Series Start/Stop String



[1] 120V ac (50/60 Hz) power may be used in place of 24V dc for motor thermal switch circuits in Series A and B axis modules.

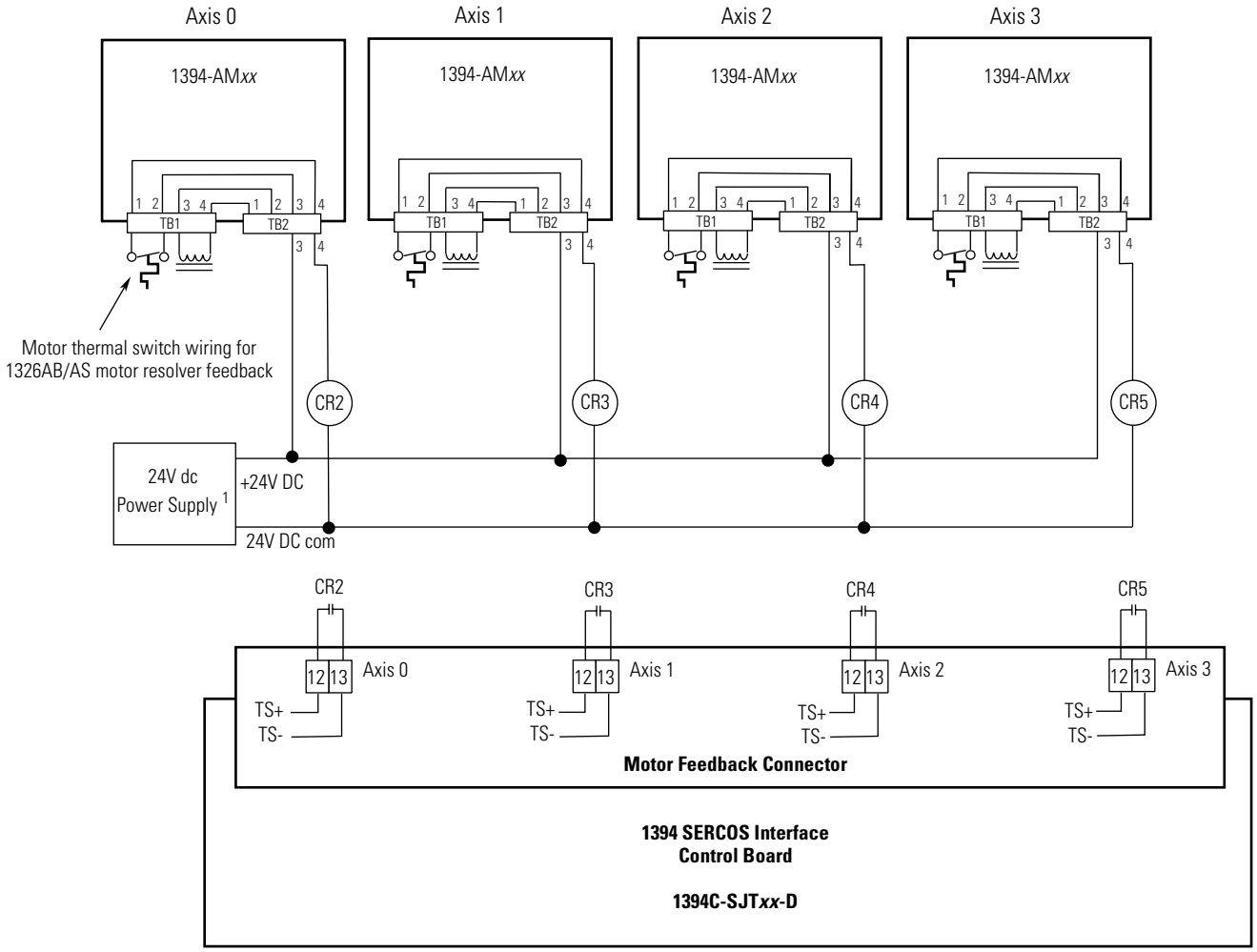
Note: Refer to Figure 2.8 for the location of the TB1/TB2 connectors and pin-out diagram.

ATTENTION

Implementation of safety circuits and risk assessment is the responsibility of the machine builder. Please reference international standards EN1050 and EN954 estimation and safety performance categories. For more information refer to *Understanding the Machinery Directive* (publication SHB-900).

The example below shows 1394 (Series A and B) axis modules wired for thermal fault monitoring. Depending on how the 1394 system is configured, the fault can be used to disable one or all of the four axis modules. Two separate 24V dc power supplies and four relays (CR2-CR5) are included to isolate the thermal inputs from conducted noise.

Figure B.12
Isolated with Thermal Fault Monitoring



[1] 120V ac (50/60 Hz) power may be used in place of 24V dc for motor thermal switch circuits in Series A and B axis modules.

Note: Refer to Figure 2.8 for the location of the TB1/TB2 connectors and pin-out diagram.

Brake Interconnect Diagrams

The relay outputs (Output 0-3) are linked to the Brake Enable/Disable configuration in RSLogix 5000 axis properties to allow control of a motor brake for each axis. When an axis is enabled, the configured output relay contact will close to disengage the associated motor brake. At the same time, the axis will command sufficient torque to hold the motor's position while the brake is disengaging. The length of time that the axis will apply this torque is set by the Brake Off Delay parameter for each axis. When an axis is disabled and the motor has reached zero velocity, the configured output relay contact will open to engage the associated motor brake. At the same time, the axis will command sufficient torque to hold the motor's position while the brake is engaging. The length of time that the axis will apply this torque is set by the Brake On Delay parameter for each axis. Refer to the *1394 SERCOS Interface Integration Manual* (publication 1394-IN024*x*-EN-P) to configure the brake parameters.

Depending on the series of your 1394 axis module, your brake circuitry may require isolation from the motor's conducted noise. When using 1394 Series B axis modules, an isolated 24V dc power supply and relay is recommended. 1394 Series C axis modules contain an internal motor brake filter and do not require the isolation power supply and relay. The Series C brake filter also contains a bi-directional snubber diode to protect the user-supplied 24V dc brake power supply.

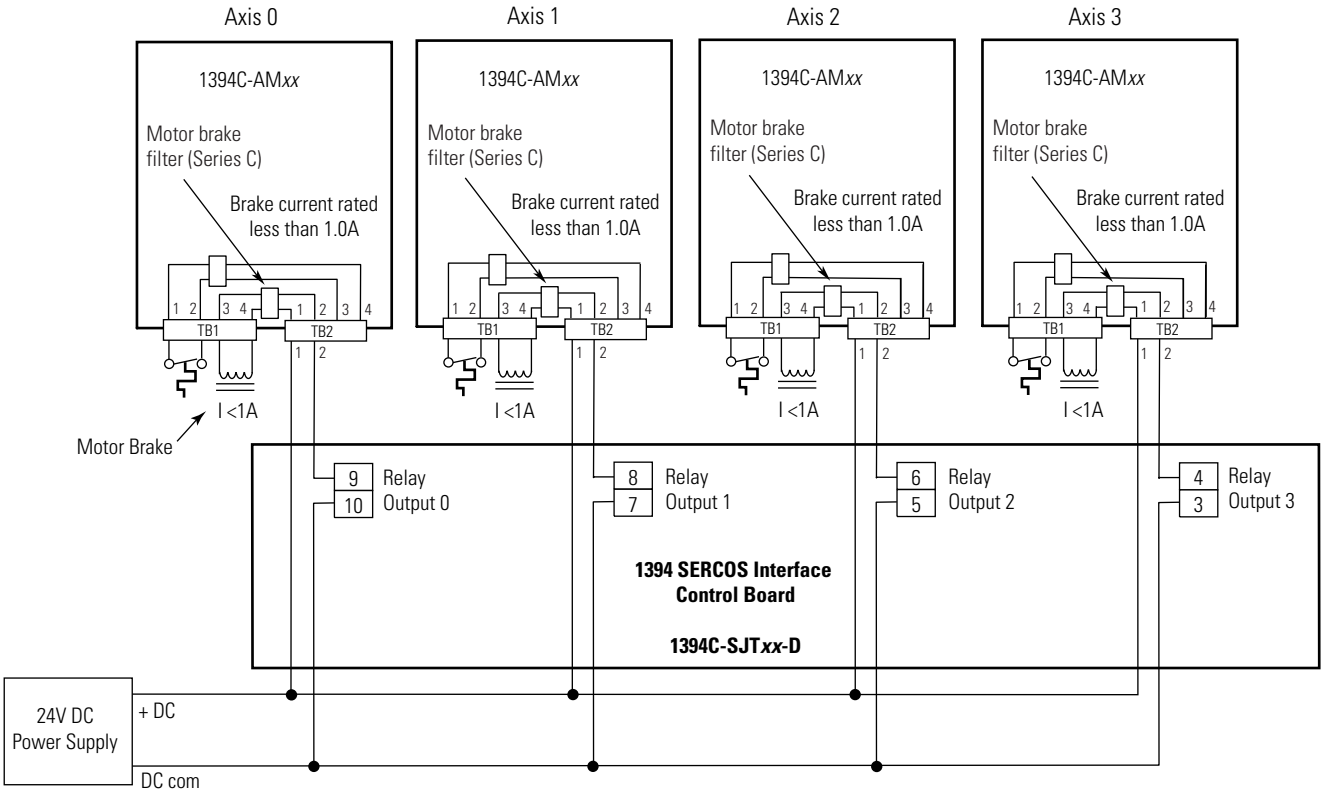
IMPORTANT The output relay contacts are rated to control a 24V dc motor brake rated up to 1A. Motor brakes rated greater than 1A require an additional relay or contactor with sufficient rating to handle the higher current.

The example below shows 1394 series C axis modules with internal brake filtering. Each axis is connected to a motor with a brake rated at less than 1A. A separate pilot relay is not required. Motor brakes that do not require a pilot relay are shown in the table below.

Note: Suppression devices and pilot relays impact motor brake response time.

Motor Series:	Brake Option:	Brake Response Time Pickup/Dropout mSec
1326AB-B4	K4	120/20
1326AS-B3	K3	38/10
1326AS-B4	K4	44/13
MPL-B3 (460V)	4	50/20
MPL-B4 (460V)	4	110/25
MPL-B45 (460V)	4	

Figure B.13
Brake Interconnect Diagram



Note: Refer to Figure 2.8 for the location of the TB1/TB2 connectors and pin-out diagram.

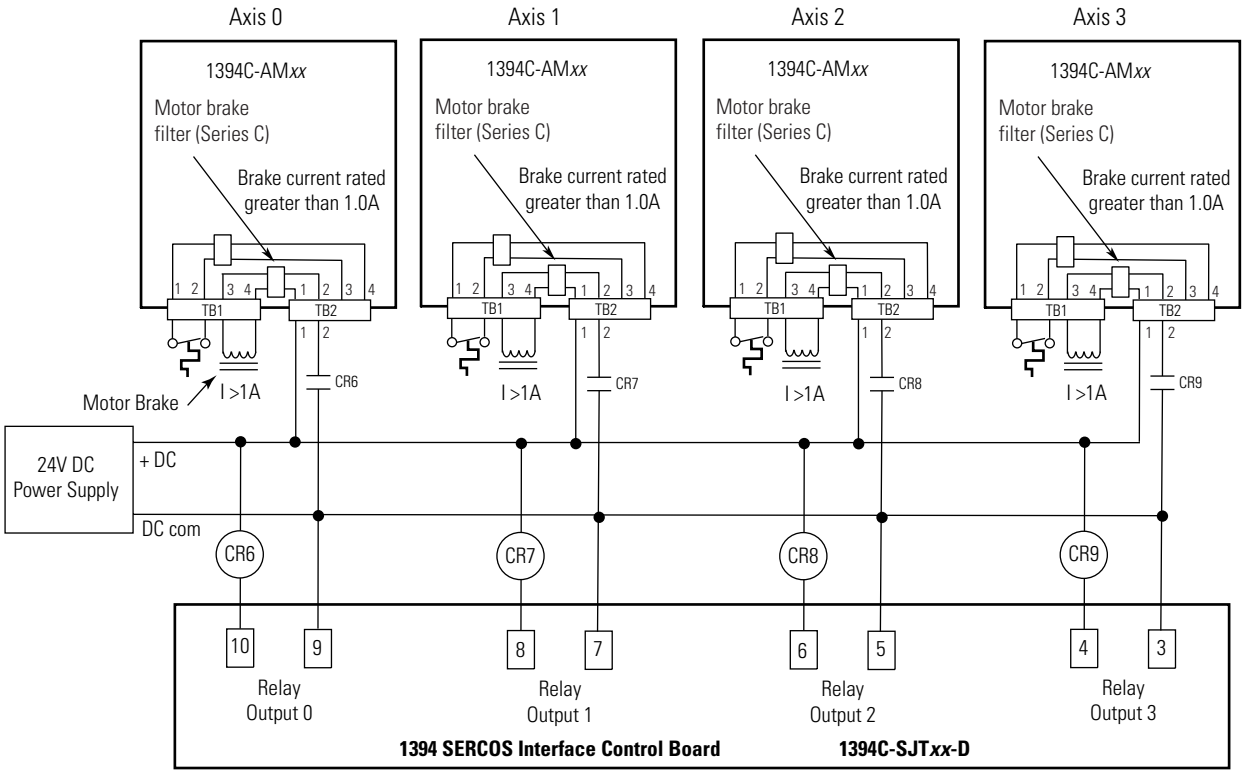
Note: Refer to figures 2.1 and 2.2 for the location of the 10-pin relay output connector.

The example below also shows 1394 series C axis modules with internal brake filtering. Each axis is connected to a motor with a brake rated at greater than 1A. A separate pilot relay is required for brake current handling.

Note: Suppression devices and pilot relays impact motor brake response time.

Motor Series:	Brake Option:	Brake Response Time Pickup/Dropout mSec
1326AB-B5	K5	150/25
1326AB-B7	K7	120/30
1326AS-B6	K6	114/11
1326AS-B8	K8	200/12
MPL-B5 (460V)	4	70/50
MPL-B6 (460V)	4	200/120
MPL-B8 (460V)	4	250/200
MPL-B9 (460V)	4	300/200

Figure B.14
Isolated Brake (with pilot relay) Interconnect Diagram

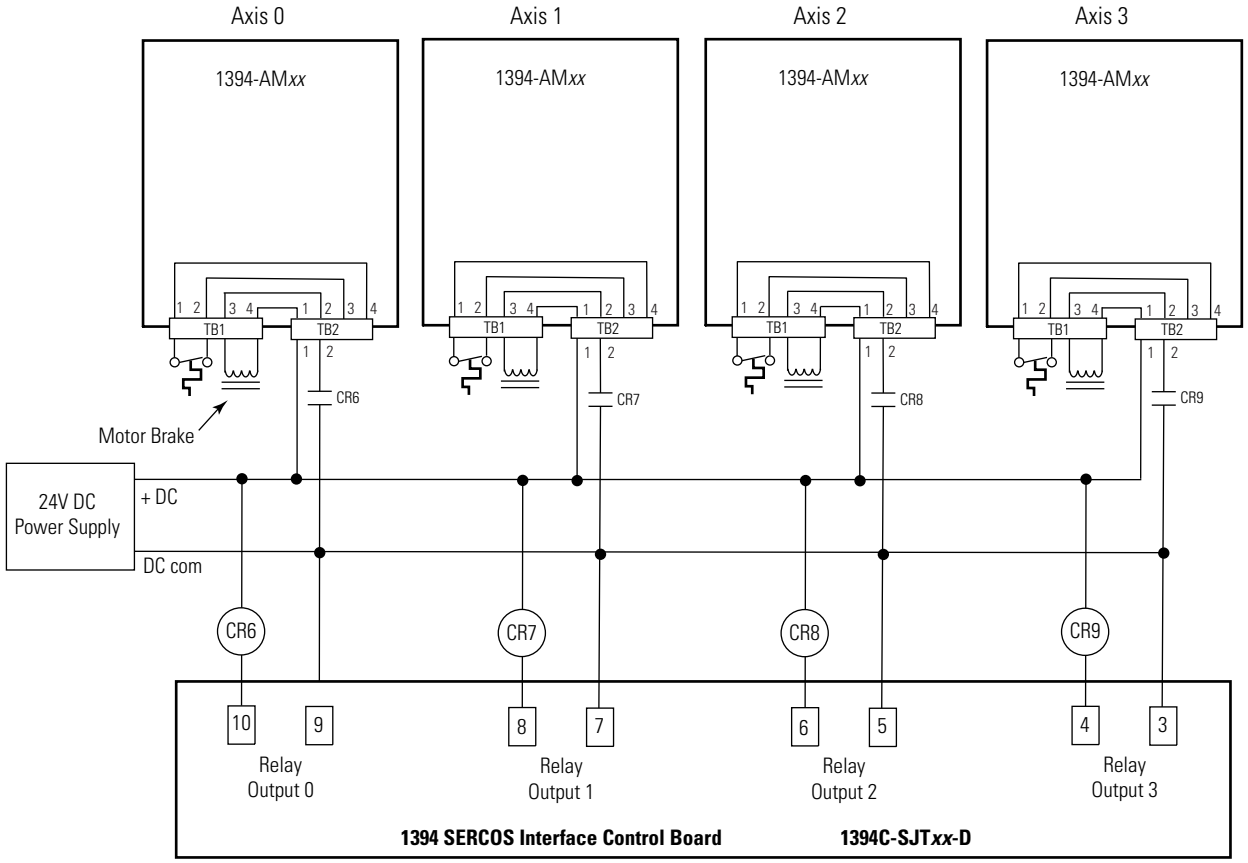


Note: Refer to Figure 2.8 for the location of the TB1/TB2 connectors and pin-out diagram.

Note: Refer to figures 2.1 and 2.2 for the location of the 10-pin relay output connector.

The example below shows 1394 Series B axis modules without internal brake filtering. Any axis connected to a motor with a brake requires a separate pilot relay for noise isolation.

Figure B.15
Isolated Brake (with pilot relay) Interconnect Diagram



Note: Refer to Figure 2.8 for the location of the TB1/TB2 connectors and pin-out diagram.

Note: Refer to figures 2.1 and 2.2 for the location of the 10-pin relay output connector.

Catalog Numbers and Accessories

Chapter Objectives

This appendix lists the 1394 system components and accessory items in tables by catalog number, providing detailed descriptions of each. This appendix describes catalog numbers for:

- 1394 System Modules
- 1394 Axis Modules
- RSLogix 5000 Software
- AC Line Filters
- External Shunt Modules
- Cables
- 1394 Accessories

Contact your local Allen-Bradley sales office for additional information. Refer to the *Motion Control Selection Guide* (publication GMC-SG001*x*-EN-P) for detailed information on products.

1394 System Modules

1394 system modules have power ratings of 5, 10, and 22 kW. Available 1394 system modules are listed in the table below.

Description	Catalog Number
System Module, 5 kW with SERCOS interface, Series C, controls up to four axes	1394C-SJT05-D
System Module, 10 kW with SERCOS interface, Series C, controls up to four axes	1394C-SJT10-D
System Module, 22 kW with SERCOS interface, Series C, controls up to four axes	1394C-SJT22-D

1394 Axis Modules

1394 axis modules have power ratings of 2, 3, 5, 10, and 15 kW. Available 1394 axis modules are listed in the table below.

Description	Catalog Number
Axis Module, 2 kW, 3.0A continuous with 6.0A peak	1394C-AM03
Axis Module, 3 kW, 4.5A continuous with 9.0A peak	1394C-AM04
Axis Module, 5 kW, 7.5A continuous with 15.0A peak	1394C-AM07
Axis Module, 10 kW, 23.3A continuous with 33.2A peak, external heatsink	1394C-AM50
Axis module, 15 kW, 35.0A continuous with 50.0A peak, external heatsink	1394C-AM75
Axis Module, 10 kW, 23.3A continuous with 33.2A peak, internal heatsink	1394C-AM50-IH
Axis module, 15 kW, 35.0A continuous with 50.0A peak, internal heatsink	1394C-AM75-IH

RSLogix 5000 Software

The 1394 SERCOS interface system is configured using RSLogix 5000 software. RSLogix 5000 is a Windows® based application that allows drive configuration to be done off-line and saved to disk.

Description	Catalog Number
RSLogix 5000 Software (version 11.0 or above)	9324-RLD300ENE

AC Line Filters

Use the following table to identify the AC line filters for your system.

Description	Catalog Number
Three-phase, 23A	SP-74102-006-01
Three-phase, 30A	SP-74102-006-02
Three-phase, 75A	SP-74102-006-03

External Shunt Modules

Use the following table to identify the Bulletin 1394 external shunt module/kit for your system.

Description	Catalog Number
External shunt module for 22 kW system, 300W continuous, 160,000W peak (no fan)	1394-SR9A
External shunt module for 22 kW system, 900W continuous, 160,000W peak (no fan)	1394-SR9AF
External shunt module for 22 kW system, 1800W continuous, 160,000W peak (no fan)	1394-SR36A
External shunt module for 22 kW system, 3600W continuous, 160,000W peak (fan-cooled module)	1394-SR36AF
External shunt resistor kit for 5 and 10 kW system, 1400W continuous, 40,000W peak	1394-SR10A

Cables

Use the following tables to identify motor power, feedback, SERCOS fiber-optic, and brake cables for your 1394 SERCOS interface system. For standard available cable lengths, refer to the *Motion Control Selection Guide* (publication GMC-SG001*x*-EN-P).

Motor Power Cables

Description		Catalog Number
MPL-B*xxxx* or 1326AB (M2L/S2L) motors, non flex, 1.5 mm^2 (16 AWG), straight		2090-CDNBPMP-16S*xx*
		2090-XXNPMP-16S*xx*
MPL-B*xxxx* or 1326AB (M2L/S2L) motors, non flex, 6.0 mm^2 (10 AWG), straight		2090-CDNBPMP-10S*xx*
1326AB-B4, -B5, and 1326AS-B3, -B4 motors (resolver feedback), non flex, 1.5 mm^2 16 AWG	Single-ended	1326-CPB1-*xxx*
	Double-ended	1326-CPB1-D-*xxx* [1, 2]
	Bulkhead connector	1326-CPB1-E-*xxx* [1, 2]
	Right-angle, shaft exit	1326-CPB1-RA-*xxx* [1, 2]
	Right-angle, rear exit	1326-CPB1-RB-*xxx* [1, 2]
	Double-ended bulkhead, flex (the -L option is not available for this cable)	1326-CPB1T-EE-*xxx*
1326AB-B7, and 1326AS-B6, -B8 motors (resolver feedback), non flex, 6.0 mm^2 10 AWG	Single-ended	1326-CPC1-*xxx* [1, 2]
	Double-ended	1326-CPC1-D-*xxx* [1, 2]
	Bulkhead connector	1326-CPC1-E-*xxx* [1, 2]
	Right-angle, shaft exit	1326-CPC1-RA-*xxx* [1, 2]
	Right-angle, rear exit	1326-CPC1-RB-*xxx* [1, 2]
	Double-ended bulkhead, flex (the -L option is not available for this cable)	1326-CPC1T-EE-*xxx*

[1] High flex option for these cables is indicated by the letter T after CP*x*1. For example, 1326-CP*x*1T-RB-*xxx*.

[2] IP67 environmental protection (single or double-ended) is available for these cables (used on -L motors) and indicated by the letter L. For example, 1326-CPB1T-RBL-*xxx*.

Motor Feedback Cables

Motor	Description	Catalog Number
MPL-B*xxxx* motors with resolver or high-resolution feedback		2090-CDNFDMP-S*xx*
1326AB (M2L/S2L) motors with high-resolution feedback		
1326AB and 1326AS motors with resolver feedback	Single-ended	1326-CCU-*xxx* [1, 2]
	Double-ended	1326-CCU-D-*xxx* [1, 2]
	Bulkhead connector	1326-CCU-E-*xxx* [1, 2]
	Right-angle, shaft exit	1326-CCU-RA-*xxx* [1, 2]
	Right-angle, rear exit	1326-CCU-RB-*xxx* [1, 2]
	Double-ended bulkhead, flex (the -L option is not available for this cable)	1326-CCUT-EE-*xxx*

[1] High flex option for these cables is indicated by the letter T after CCU. For example, 1326-CCUT-RB-*xxx*.

[2] IP67 environmental protection (single or double-ended) is available for these cables (used on -L motors) and indicated by the letter L. For example, 1326-CCU-RBL-*xxx*.

MP-Series Motor Brake Cable

Description	Catalog Number
MP-Series motor brake cable, 0.75 mm^2 (18 AWG)	2090-UXNBMP-18S*xx*

SERCOS Interface Fiber-Optic Cables

Use the following table to identify the SERCOS interface fiber-optic cables for your 1394 system module. Connectors are provided at both ends.

Description	Catalog Number
SERCOS fiber-optic plastic cable (for use inside enclosure only)	2090-SCEP*x-x*
SERCOS fiber-optic plastic (PVC) cable (for use outside enclosure)	2090-SCVP*x-x*
SERCOS fiber-optic plastic (nylon) cable (for use outside enclosure in harsh environments)	2090-SCNP*x-x*
SERCOS fiber-optic glass (PVC) cable	2090-SCVG*x-x*
SERCOS fiber cable bulkhead adapter (2 per pack)	2090-S-BLHD

Note: Cable length (*x-x*) is in meters. Plastic cable is available in lengths up to 32 m (105.0 ft). Glass cable is available in lengths up to 200 m (656.7 ft).

Motor End Connector Kits

Motor Series	Description	Catalog Number
MP-Series and 1326AB (M2L/S2L)	Straight Power Connector Kit	2090-MPPC-S
	Straight Feedback Connector Kit	2090-MPFC-S
	Straight Brake Connector Kit	2090-MPBC-S

1394 Accessories

Accessory	A-B Catalog Number	Manufacturer's Number
Feedback and I/O connector kit for 1394C-SJT*xx*-D	1394C-CCK-D	N/A
SERCOS fiber cable bulkhead adaptor (2 per pack)	2090-S-BLHD	N/A
Brake and thermal axis connector kit	1394-199	N/A
Cable ground clamp kit for cables 1.5 to 6 mm^2 (16 to 10 AWG) in size.	1394C-GCLAMP	N/A
Cable ground clamp kit for cables 10mm^2 (8 AWG) in size	1394C-8AWG-GCLAMP	N/A
1394-CCFK resolver feedback connector kit, (includes the connector, pins, and extraction tool to connect to 1326-CCU-*xxx* motor feedback cables). It does not apply to 1394-SJT*xx*-D.	1394-CCFK	N/A
Brake and thermal connector operating tool	N/A	Wago 231-304
Kit, fuse, for 1394-SR10A (5 and 10 kW system modules)	1394-SR10A-FUSE-A	Bussmann FWP-40A14F
Kit, fuse, for 1394-SR9A (Series B)	1394-SR9A-FUSE-B	Bussmann FWP-50A14F
Kit, fuse, for 1394-SR9AF (Series B)	1394-SR9AF-FUSE-B	
Kit, fuse, for 1394-SR36A (Series B)	1394-SR36A-FUSE-B	
Kit, fuse, for 1394-SR36AF (Series B)	1394-SR36AF-FUSE-B	

Numerics

A

B

C

D

E

F

G

H

I

L

M

N

P

R

S

T

U

W

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