

## External Shunt Modules

### Catalog Numbers

1394-SR9A, 1394-SR9AF, 1394-SR36A, 1394-SR36AF,  
2090-SR120-09, 2090-SR040-09, 2090-SR040-18

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### About the External Shunt Modules

These externally-mounted passive shunt modules provide a means for servo drives to dissipate excess regenerative energy from the DC bus. This is needed when system loads require power dissipation beyond the capability of the shunt resistor internal to the servo drive. These are passive shunt resistors and require transistor activation by the servo drive.

A properly-sized shunt module regulates excessive bus voltage by passing current through a resistor, which dissipates the current as heat and minimizes drive faults caused by excess bus voltage.

#### Shunt Module Compatibility

Shunt Cat. No.	Drive Cat. No.
2090-SR120-09	2098-xxx-HV030 and 2098-xxx-HV050
2090-SR040-09	2098-xxx-HV100
2090-SR040-18	2098-xxx-HV100
1394-SR9A	2094-BSP2 <sup>(1)</sup> and 1394x-SJT22-x
1394-SR9AF	
1394-SR36A	
1394-SR36AF	

<sup>(1)</sup> The 2094-BSP2 shunt module is mounted on the Bulletin 2094 power rail and provides connections to an external shunt module.

## Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication [SGL-1.1](#) available from your local Rockwell Automation sales office or online at <http://literature.rockwellautomation.com>) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

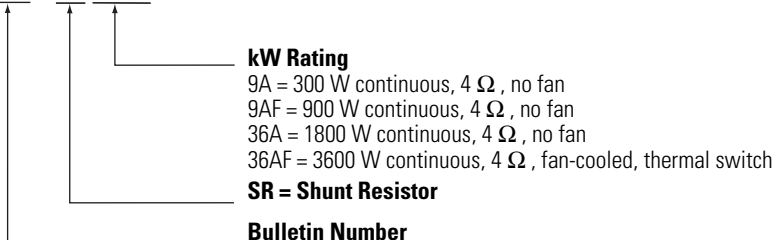
<p><b>WARNING</b></p> 	<p>Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.</p>
<p><b>IMPORTANT</b></p>	<p>Identifies information that is critical for successful application and understanding of the product.</p>
<p><b>ATTENTION</b></p> 	<p>Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you to identify a hazard, avoid a hazard, and recognize the consequences.</p>
<p><b>SHOCK HAZARD</b></p> 	<p>Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.</p>
<p><b>BURN HAZARD</b></p> 	<p>Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.</p>

## Catalog Number Explanation

Catalog numbers consist of various characters, each of which identifies a specific version or option for that component. Use the catalog numbering charts below to understand the configuration of your shunt module.

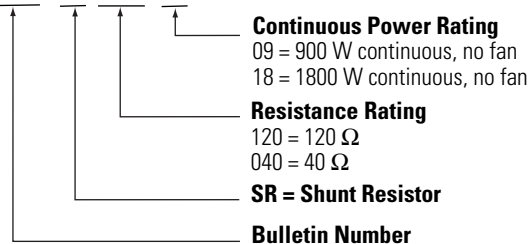
### Bulletin 1394 External Shunt Modules

**1394 - SR xxxx**



### Bulletin 2090 External Shunt Modules

**2090 - SR xxx - xx**



## Before You Begin

Before you begin mounting your shunt module, make sure you:

- have the required tools and materials.
- understand the mounting requirements.
- understand high-frequency bonding.
- know how to establish noise zones.

## Required Tools and Materials

These tools and materials are required to complete the installation of an external shunt module:

- Screwdrivers
- User-supplied power wiring
- Mounting fasteners

## Mounting Requirements

**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.

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These requirements apply when preparing to mount your shunt module:

- Mount the shunt in an enclosure providing protection against dust and splashing water (IP54), or dust free and protected against water jets (IP65).

Many NEMA (National Electrical Manufacturers Association) Type 4 cabinets provide this level of protection.

- Install the panel for mounting your system components inside the enclosure on a flat, rigid, vertical surface that won't be subjected to shock, vibration, moisture, oil mist, dust, or corrosive vapors.

Refer to [Environmental Specifications](#) on [page 21](#) for specific recommendations.

- Maintain minimum clearances for proper airflow, easy module access, and proper bend radius for the cables as shown in the figures beginning on [page 5](#).
- Use high-frequency (HF) bonding techniques to connect the module, enclosure, machine frame, and motor housing, and to provide a low-impedance return path for high-frequency (HF) energy and reduce electrical noise.

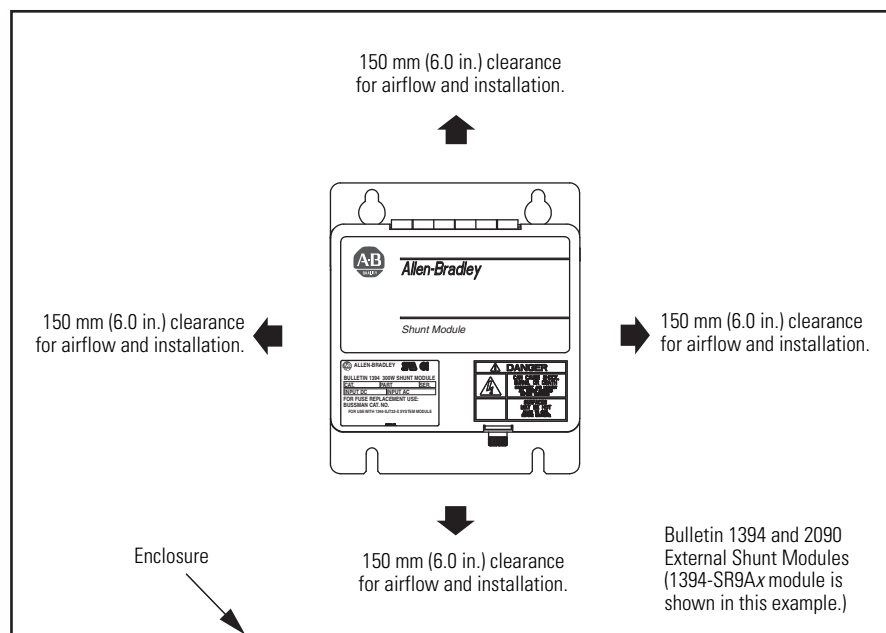
Refer to [HF Bonding Your Shunt Module](#), on [page 6](#), for more information.

- Segregate DC-bus wiring from control wiring and motor feedback cables. Do not run shunt wiring in wireways. Use twisted pair cable from the drive to external shunt module.

Refer to [Establishing Noise Zones](#), beginning on [page 6](#), for specific recommendations.

**IMPORTANT**

Mount the shunt module in an upright position. Do not mount the shunt module on its side.

**Minimum Clearance Requirements (within an enclosure)****BURN HAZARD**

The shunt resistors can reach temperatures in excess of 350 °C (662 °F). Do not handle a shunt module that has been operational until it has cooled sufficiently.

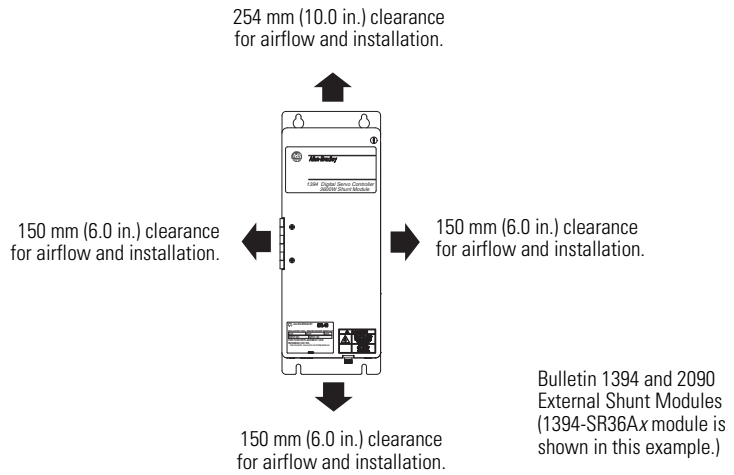
Combustible materials above the shunt module or its enclosure may need the protection of a metal plate to shield them from the heat.

Failure to observe these precautions could result in damage to surrounding materials, possibly leading to a fire or personal injury.

**ATTENTION**

The shunt resistors release large amounts of heat. When mounted inside an enclosure, you must provide adequate ventilation so the maximum ambient temperature of 50 °C (122 °F) is not exceeded. Failure to observe this precaution could result in damage to the module.

### Minimum Clearance Requirements (outside the enclosure)



### HF Bonding Your Shunt Module

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 Reference Manual, publication [GMC-RM001](#).

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

### Establishing Noise Zones

This table provides the zoning requirements of cables connecting to the external shunt module.

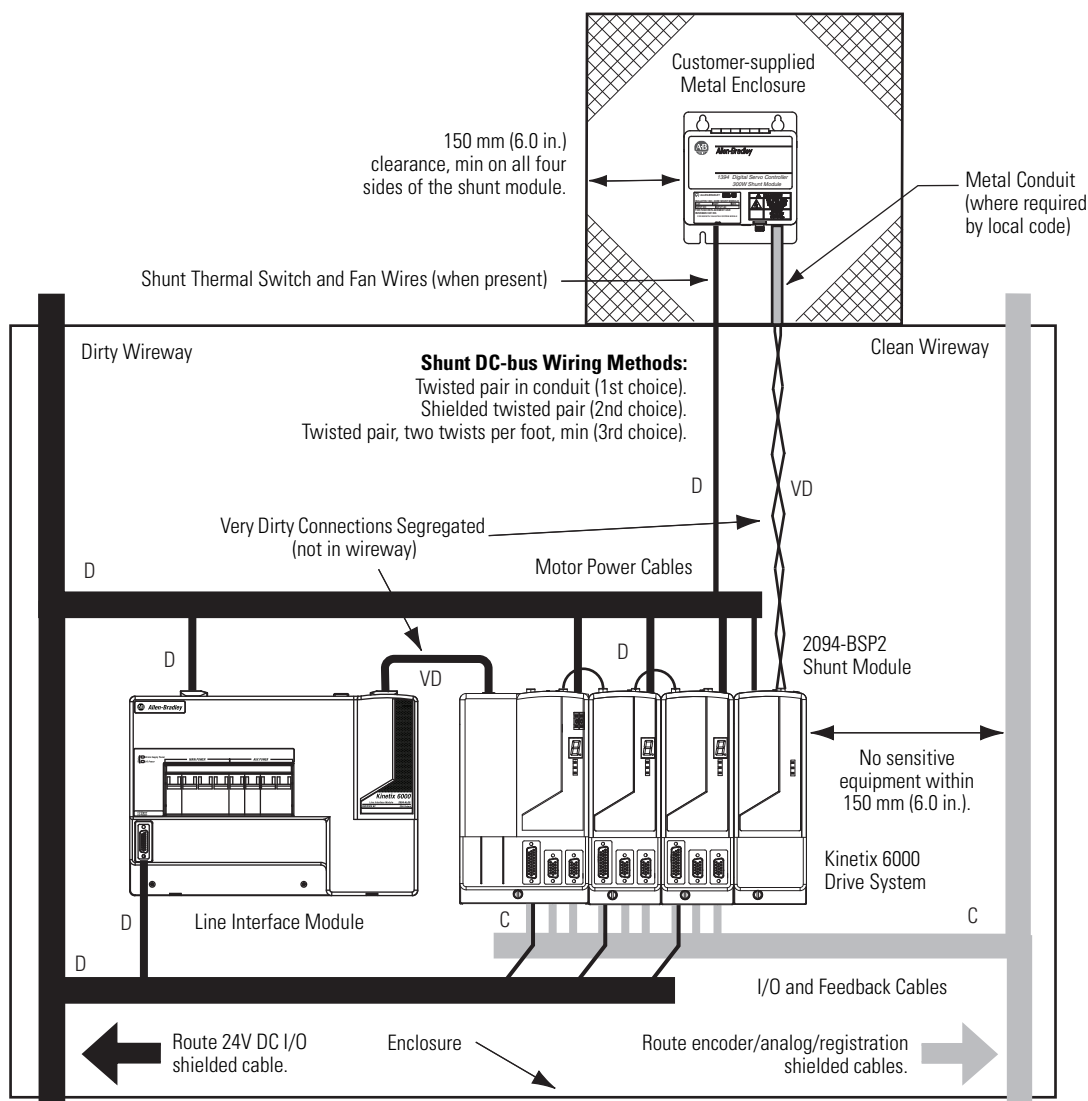
Wire/Cable	Zone			Method	
	Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
COL, DC+ (shielded option)		X			X
COL, DC+ (unshielded option)	X				
Thermal switch		X			X
Fan (if present)		X			

### Noise Zones for Kinetix 6000 Drives

Observe these guidelines when mounting your external shunt module outside the enclosure:

- Mount circuit components and wiring in the very dirty zone or in an externally shielded enclosure. Run shunt DC-bus 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 DC-bus wiring as flat to the cabinet as possible.
- Route thermal switch and fan wires separate from shunt DC-bus.

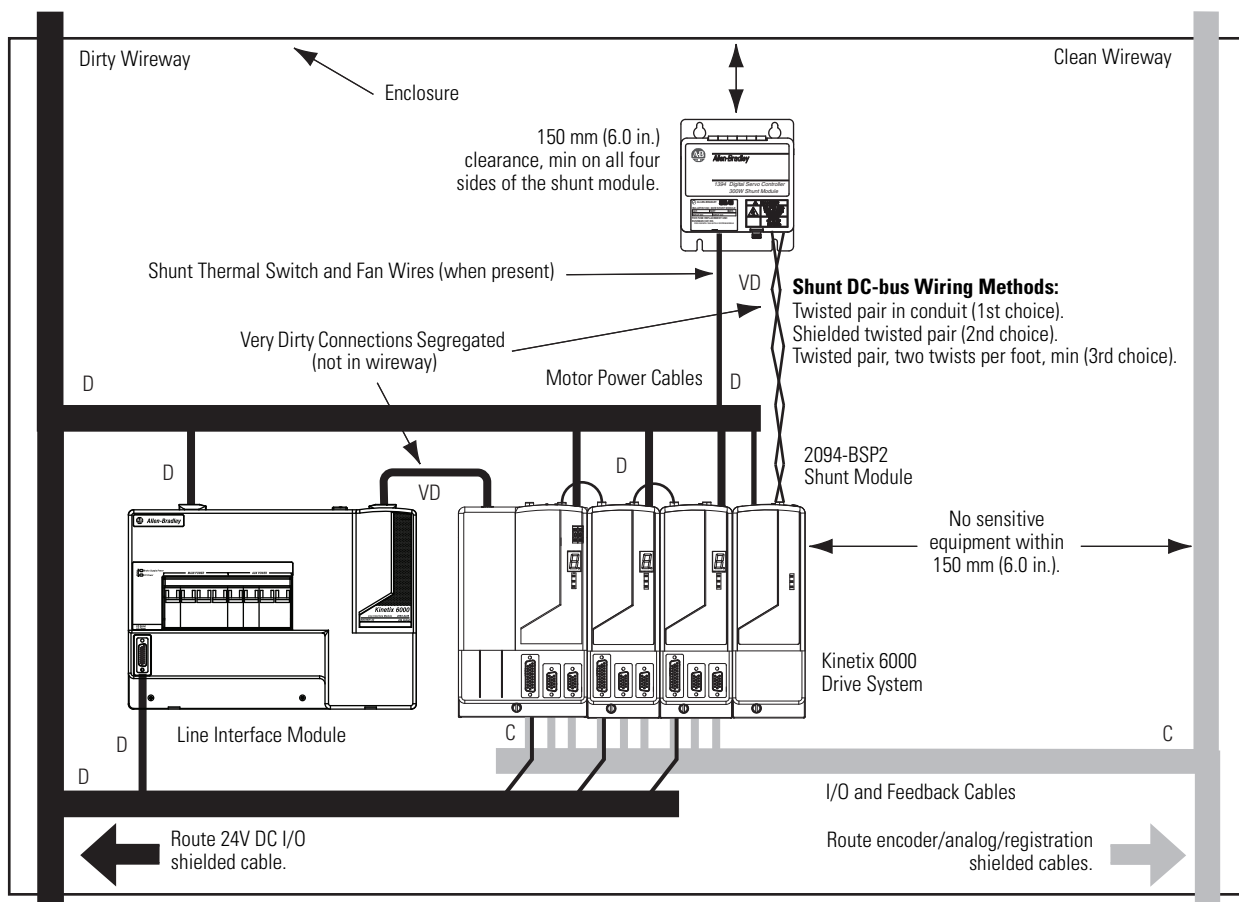
### External Shunt Module Mounted Outside the Enclosure



When mounting your shunt module inside the enclosure, follow these additional guidelines:

- Metal-clad modules can be mounted anywhere in the dirty zone, but as close to the Kinetix 6000 system as possible.
- Shunt DC-bus 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 DC-bus cables from other sensitive, low voltage signal cables.

**External Shunt Module Mounted Inside the Enclosure**



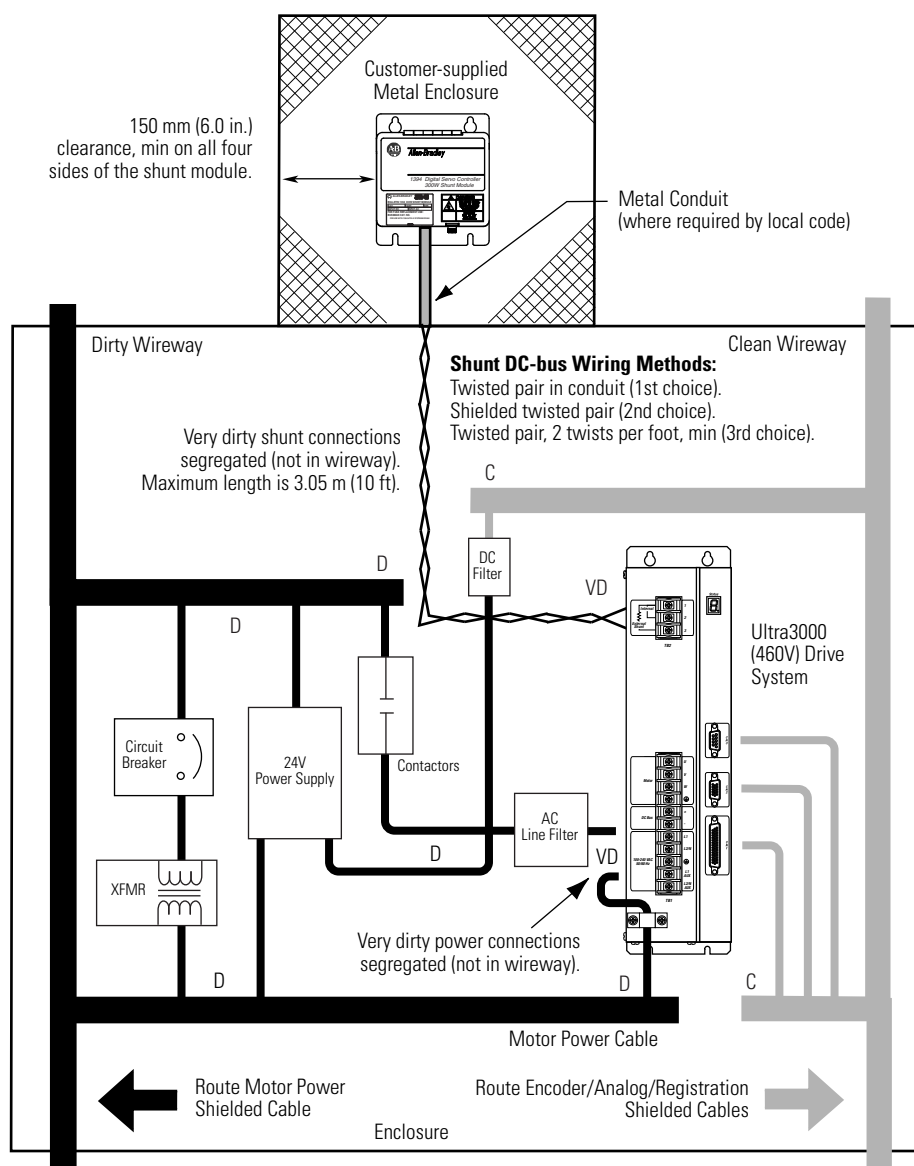


### Noise Zones for Ultra3000/Ultra5000 Drives

Observe these guidelines when mounting your external shunt module outside the enclosure:

- Mount circuit components and wiring in the very dirty zone or in an externally shielded enclosure. Run shunt DC-bus 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 DC-bus wiring as flat to the cabinet as possible.

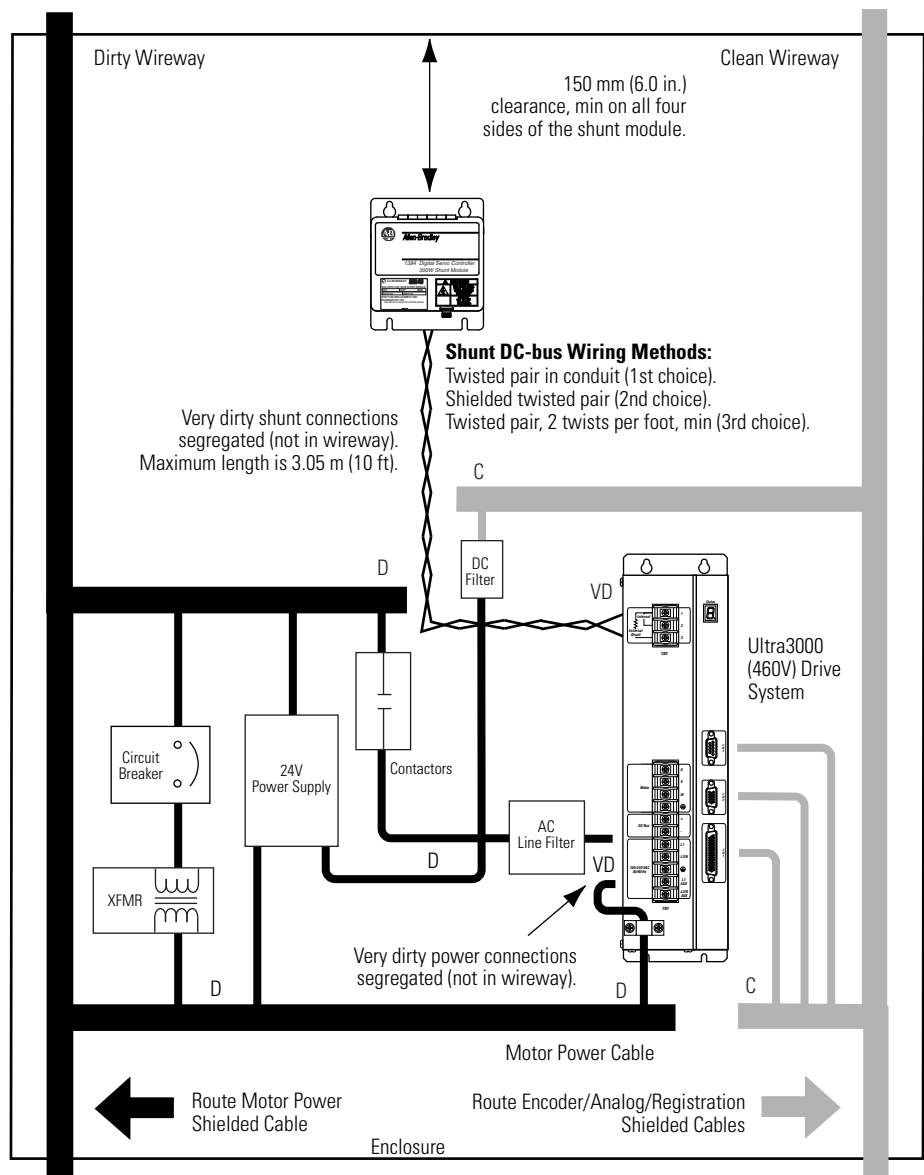
#### External Shunt Resistor Mounted Outside the Enclosure



When mounting your shunt module inside the enclosure, follow these additional guidelines:

- Metal-clad modules can be mounted anywhere in the dirty zone, but as close to the Ultra3000 drive as possible.
- Shunt DC-bus wires can be run with motor power cables.
- Keep unshielded wiring as short as possible. Keep shunt DC-bus wiring as flat to the cabinet as possible.
- Separate shunt DC-bus cables from other sensitive, low voltage signal cables.

**External Shunt Resistor Mounted Inside the Enclosure**

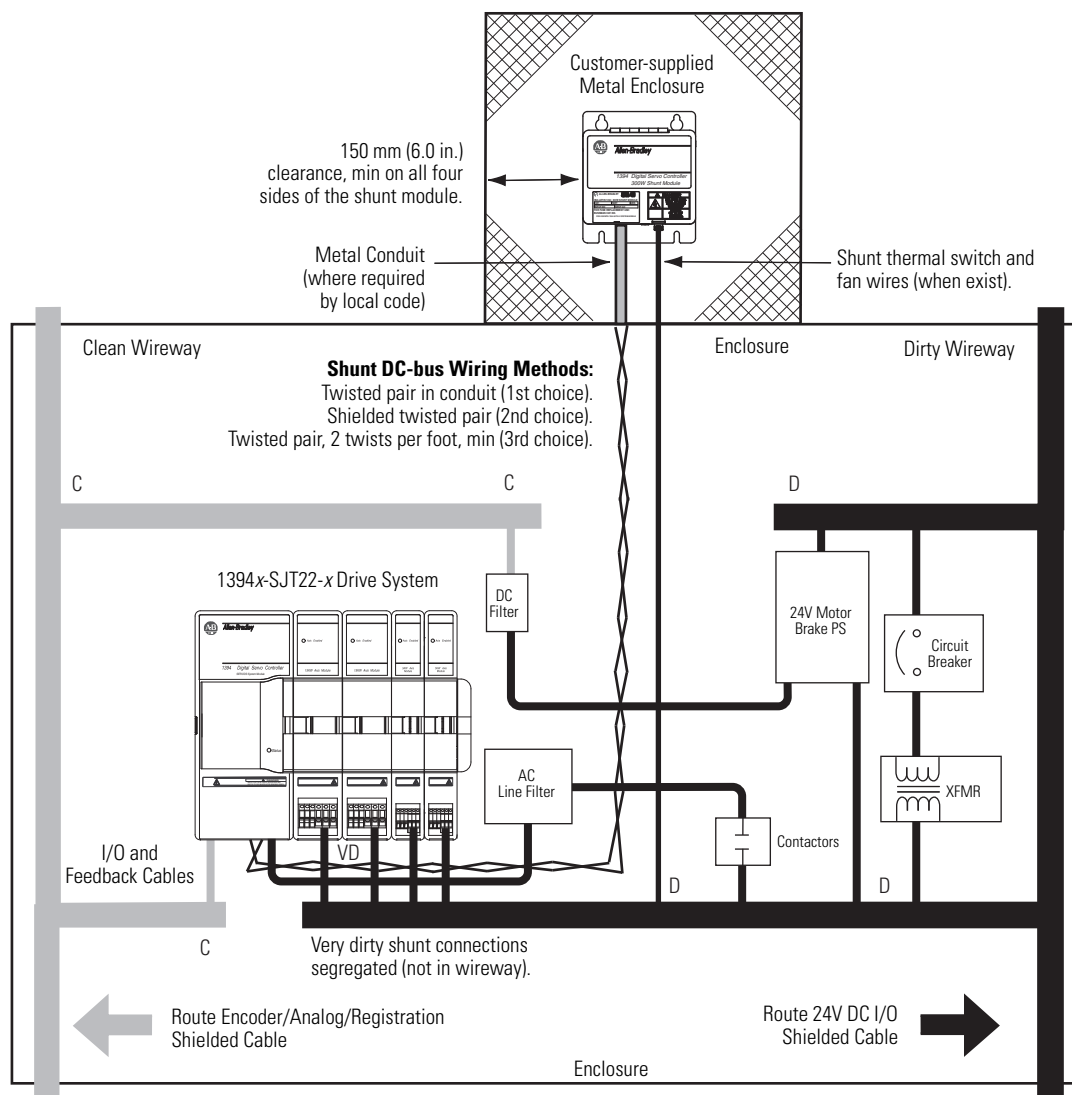


### Noise Zones for 1394 Drives

Observe these guidelines when mounting your external shunt module outside the enclosure:

- Mount circuit components and wiring in the very dirty zone or in an externally shielded enclosure. Run shunt DC-bus 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 DC-bus wiring as flat to the cabinet as possible.
- Route thermal switch and fan wires separate from shunt DC-bus.

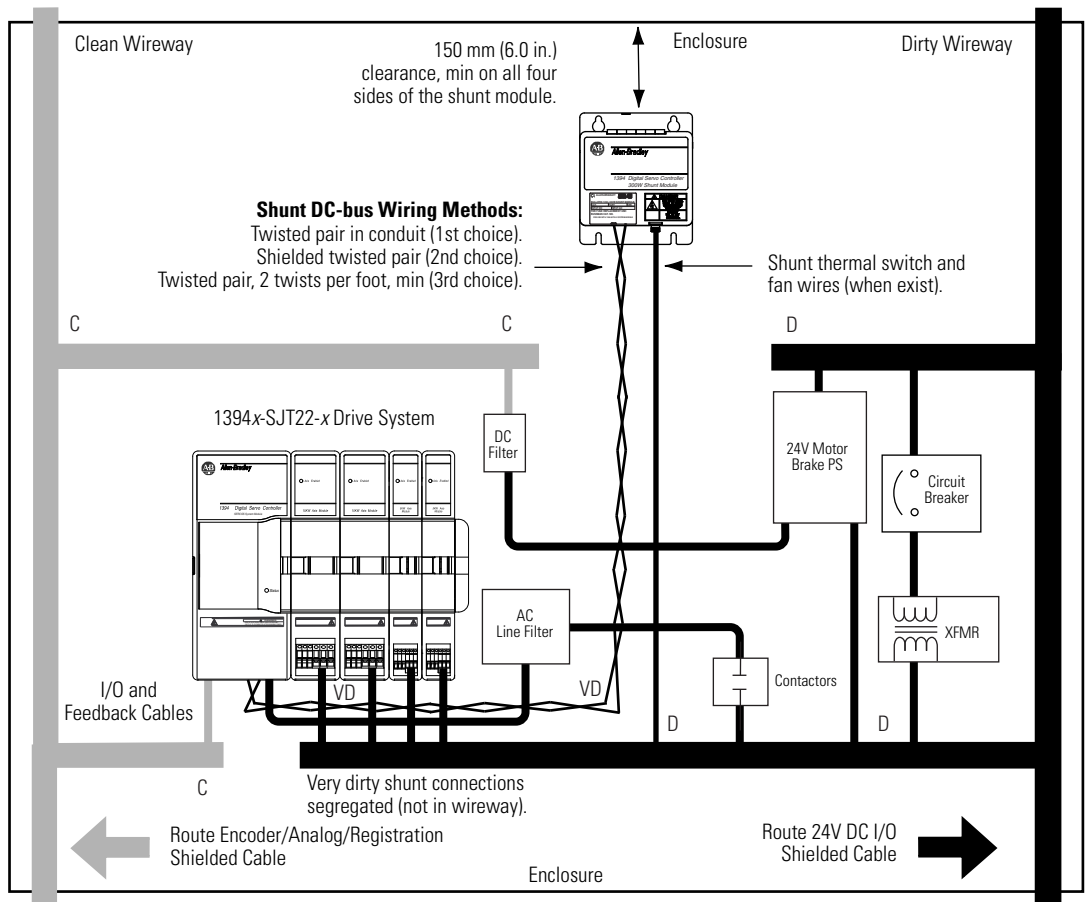
### External Shunt Module Mounted Outside the Enclosure



When mounting your shunt module inside the enclosure, follow these additional guidelines:

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

**External Shunt Module Mounted Inside the Enclosure**



## Install the External Shunt Module

These procedures assume you have prepared your mounting panel and understand how to bond your system components.

### Mount the External Shunt Module

Follow these steps to mount your external shunt module.

1. Lay out the position for your shunt module.

Refer to [Establishing Noise Zones](#), beginning on [page 6](#), for panel layout recommendations. Refer to [Product Dimensions](#), beginning on [page 14](#), for locating the mounting holes.

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**IMPORTANT**

To improve EMC performance, mount the module on the same panel as the drive and as close to the drive as possible.

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2. Attach the shunt module to the cabinet by using M6 (0.25 in.) bolts.

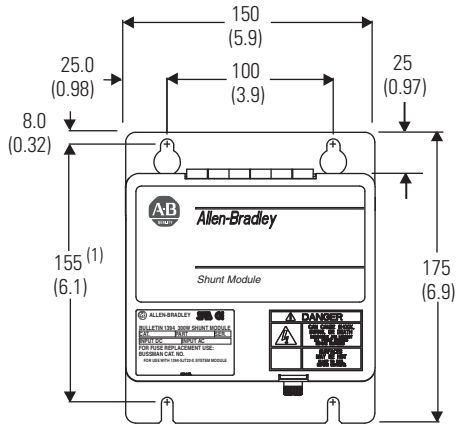
Make sure all fasteners are properly bonded to the subpanel.

3. Tighten all mounting fasteners.

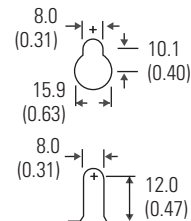
## Product Dimensions

### Mounting Dimensions

(2090-SR120-09, 2090-SR040-09, 1394-SR9A, and 1394-SR9AF shunt modules)



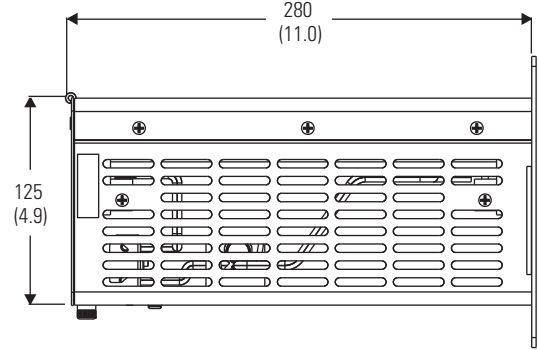
Front View



Mounting Hole Detail

All slots accept M6 or 1/4-20 mounting screws.

Dimensions are in mm (in.)

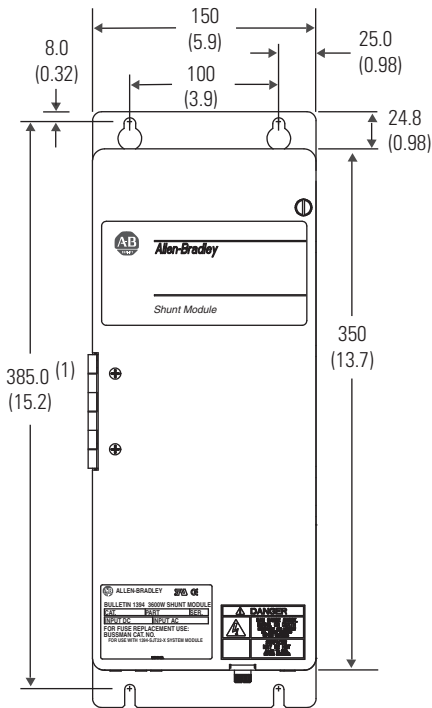


Side View

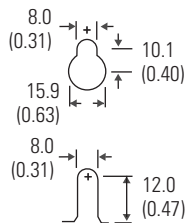
(1) Dimension shown is for mounting hardware location and does not reflect the location of the lower slot radius.

### Mounting Dimensions

(1394-SR36A, 1394-SR36AF, and 2090-SR040-18 shunt modules)



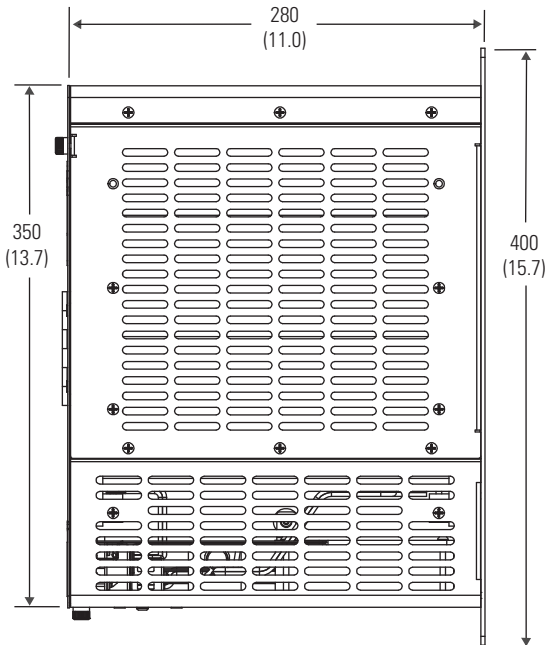
Front View



Mounting Hole Detail

All slots accept M6 or 1/4-20 mounting screws.

Dimensions are in mm (in.)



Side View

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

## Wire the External Shunt Module

This section assumes you have mounted your external shunt module and are ready to wire the shunt module power connections.

Refer to [Additional Resources](#) on [page 22](#) for the servo drive user manual with the drive-end installation instructions.

### IMPORTANT

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

Wire should be copper with 105 °C (221 °F) 600V minimum rating.

### DC-bus Wiring Requirements

External Shunt Cat. No.	Drive Module Cat. No.	Shunt Module Terminal Connections	Recommended Wire Size mm <sup>2</sup> (AWG)	Torque Value N•m (lb•in)
2090-SRxxx-xx	2098-xxx-HV030 2098-xxx-HV050 2098-xxx-HV100	COL	6 (10)	1.25 (11)
		DC+		
1394-SR9Ax, 1394-SR36Ax	2094-BSP2 1394x-SJT22-x	COL	8.4 (8)	2.5 (22.1)
		DC+		

Follow these steps to wire your external shunt module.

1. Remove power from your drive system that includes the Bulletin 1394 or 2090 shunt module.

### ATTENTION



This system may have multiple sources of power. More than one disconnect switch may be required to de-energize the system. To avoid shock hazard or personal injury, verify that all power has been removed before proceeding.

### ATTENTION



This product contains stored energy devices. To avoid hazard of electrical shock, verify that all voltage on the capacitors has been discharged before attempting to service, repair, or remove this unit. You should only attempt the procedures in this document if you are qualified to do so and familiar with solid-state control equipment and the safety procedures in publication NFPA 70E.

2. Prepare the shunt DC-bus wires for attachment to the shunt power terminals by removing 10 mm (0.39 in.) of insulation.

**IMPORTANT**

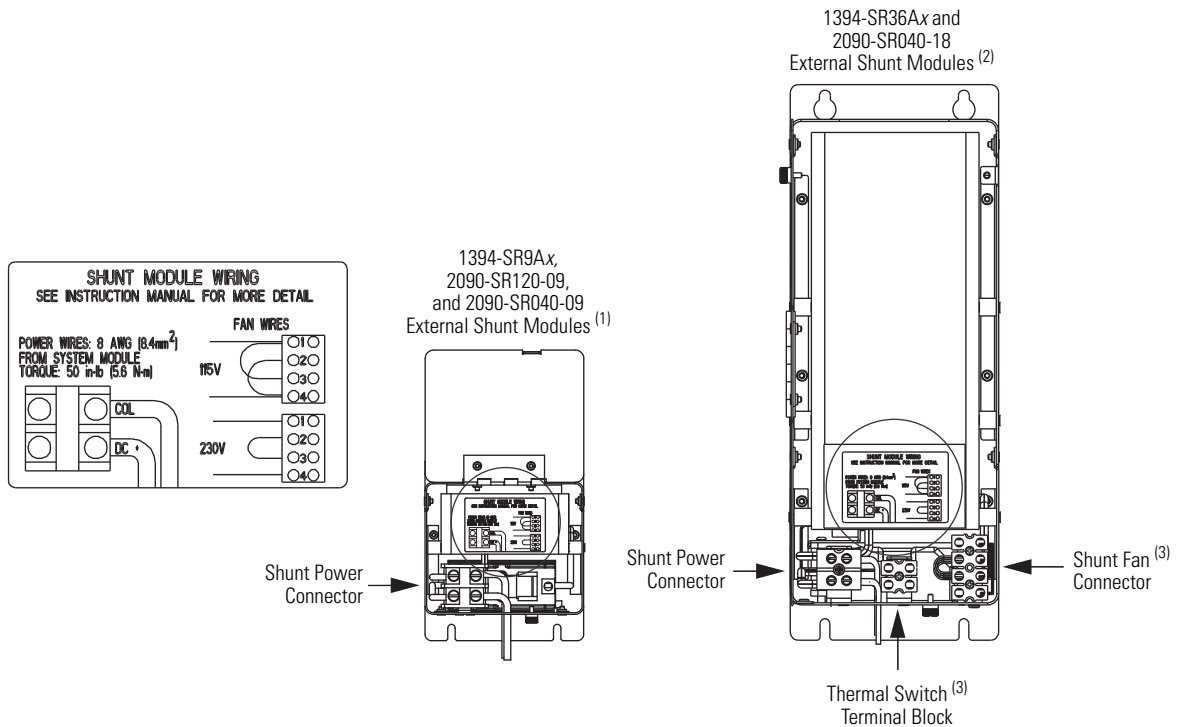
Use caution not to nick, cut, or otherwise damage strands as you remove the insulation.

3. Insert one wire into the shunt power terminal labeled COL.
4. Insert the other wire into the shunt power terminal labeled DC+.
5. Tighten both screw terminals.

Refer to torque values in the table on [page 15](#).

6. Gently pull on each wire to make sure it does not come out of its terminal; reinsert and tighten each loose wire.

**Shunt Module Terminations**



- (1) Shunt module is shown with front cover open.
- (2) Shunt module is shown with front cover removed.
- (3) Only the 1394-SR36AF shunt module has the fan and thermal switch connections.



## Wire the Shunt Module Fan

This procedure applies to only the 1394-SR36AF shunt module and assumes that you have mounted the module and wired the shunt DC-bus connections.

Refer to [Additional Resources](#) on [page 22](#) for the servo drive user manual with the drive-end installation instructions.

You can wire the shunt fan connections for 115V or 230V AC input power. Wire should be copper with 75 °C (167 °F) minimum rating.

### Fan Power Specifications

Input Power	Current
115V AC	0.2 A
230V AC	0.1 A

#### IMPORTANT

If you mount the shunt module outside the cabinet, the shunt fan power wiring must be inside metal conduit to minimize the levels of EMI and RFI.

### Fan Power Wiring Requirements

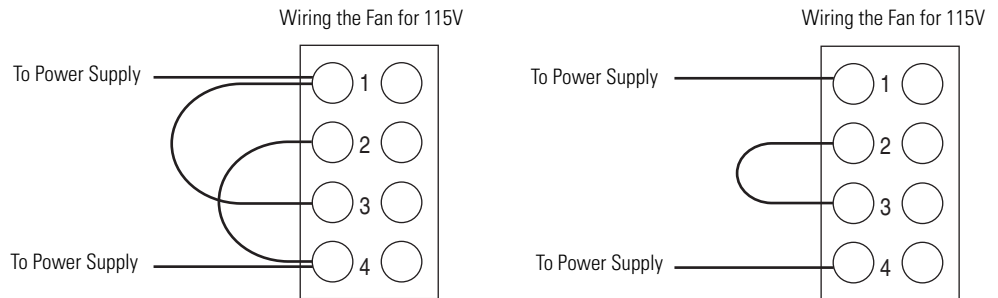
External Shunt Module Cat. No.	Fan Terminal Connections		Recommended Wire Size mm <sup>2</sup> (AWG)	Torque Value N•m (lb•in)
	Pin	Voltage (V AC)		
1394-SR36AF	1	115, 230	1.3 (16)	0.6 (6)
	4	115, 230		
	1...3	115		
	2...4	115		
	2...3	230		

Follow these steps to wire the shunt fan.

1. Verify that all power is removed from the system.
2. Open the front door of the shunt module.
3. Using a screwdriver, remove the plate that covers the fan wire access hole on the bottom right side of the module.

Refer to the figure on [page 16](#) for the location of the fan power terminal block.

4. Insert the jumper wires that came with your shunt module to support the input power used in your application.
5. Insert one wire from the AC power supply into terminal 1.



6. Insert the other wire from the AC power supply into terminal 4.
7. Tighten all screw terminals.

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**IMPORTANT**

When tightening screws to secure the wires, refer to the table [page 17](#) for torque values.

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8. Gently pull on each wire to make sure it does not come out of its terminal; reinsert and tighten any loose wires.

## Wire the Thermal Switch

This procedure applies to only the 1394-SR36AF shunt module and assumes that you have mounted the module, wired the power connections, and are ready to connect the thermal switch wires.

Refer to [Additional Resources](#) on [page 22](#) for the servo drive user manual with the drive-end installation instructions.

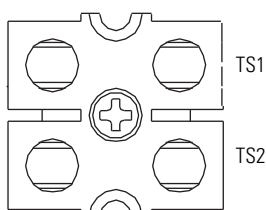
Wire should be copper with 75 °C (167 °F) minimum rating.

### Thermal Switch Wiring Requirements

External Shunt Module Cat. No.	Thermal Switch Connections	Recommended Wire Size mm <sup>2</sup> (AWG)	Torque Value N•m (lb•in)
1394-SR36AF	TS1	0.75 (18)	0.6 (6)
	TS2		

Follow these steps to wire the thermal-switch terminal block.

1. Verify that all power is removed from the system.
2. Open the front door of the shunt module.
3. Insert one wire into the top terminal of the thermal-switch terminal block.



4. Insert the other wire into the lower terminal of the thermal-switch terminal block.  
Refer to the figure on [page 16](#) for the location of the thermal-switch terminal block.
5. Tighten all screw terminals.
6. Gently pull on each wire to make sure it does not come out of its terminal; reinsert and tighten any loose wires.

## Replace the Shunt Module Fuse

Follow these steps to replace the fuse in your external shunt module.

1. Remove power from your drive system that includes the Bulletin 1394 or 2090 shunt module.

### ATTENTION



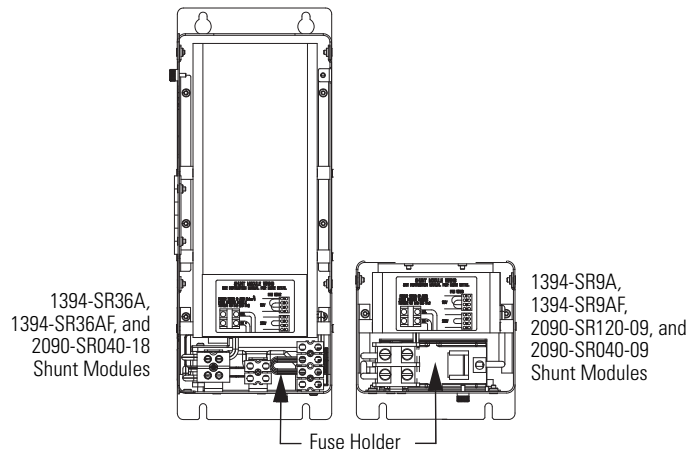
This system may have multiple sources of power. More than one disconnect switch may be required to de-energize the system. To avoid shock hazard or personal injury, verify that all power has been removed before proceeding.

### ATTENTION



This product contains stored energy devices. To avoid hazard of electrical shock, verify that all voltage on the capacitors has been discharged before attempting to service, repair, or remove this unit. You should only attempt the procedures in this document if you are qualified to do so and familiar with solid-state control equipment and the safety procedures in publication NFPA 70E.

2. Open the front door panel and locate the fuse holder.



In each case, the fuse holder is located in the bottom center of the shunt enclosure, in some cases, behind terminal blocks.

3. Remove the fuse from the fuse holder.

You may need a fuse puller or screwdriver to remove the fuse.

4. Replace the fuse.

Refer to [External Shunt Module Specifications](#) on [page 21](#), for the properly rated fuse.

5. Close and secure the door panel.

6. Apply power to your system and verify proper operation.

## External Shunt Module Specifications

This section provides specifications for the Bulletin 1394 and Bulletin 2090 external shunt modules.

### External Shunt Module Specifications

External Shunt Module Cat. No.	Drive Voltage V AC	Specifications					Bussmann Replacement Fuse
		Resistance Range $\Omega$	Peak Power kW	Peak Current Amps	Cont. Power Watts	Shipping Weight kg (lbs)	
1394-SR9A	230 <sup>(1)</sup>	4	41.0	101.25	300	3.63 (8)	FNQ-R-20-R1 <sup>(1)</sup>
	460		160.0	200			FWP50A14F
1394-SR9AF	230 <sup>(1)</sup>	4	41.0	101.25	900	3.63 (8)	FNQ-R-20-R1 <sup>(1)</sup>
	460		160.0	200			FWP50A14F
1394-SR36A	230 <sup>(1)</sup>	4	41.0	101.25	1800	8.6 (19)	FNQ-R-20-R1 <sup>(1)</sup>
	460		160.0	200			FWP50A14F
1394-SR36AF	230 <sup>(1)</sup>	4	41.0	101.25	3600	9.0 (20)	FNQ-R-25-R1 <sup>(1)</sup>
	460		160.0	200			FWP50A14F
2090-SR120-09	230 <sup>(1)</sup>	120-148	1.33	3.35	900	3.63 (8.0)	FNQ-R-3/4-R1 <sup>(1)</sup>
	460		5.3	6.7			FWP-2.5A14F
2090-SR040-09	230 <sup>(1)</sup>	40-51	4.0	10.0	900	3.63 (8.0)	FNQ-R-2-R1 <sup>(1)</sup>
	460		16.0	20.0			FWP-5A14F
2090-SR040-18	230 <sup>(1)</sup>	40-49	4.0	10.0	1800	8.6 (19.0)	FNQ-R-2-R1 <sup>(1)</sup>
	460		16.0	20.0			FWP-6.3A14F

<sup>(1)</sup> Requires the use of an FNQ fuse with an adapter to allow the smaller body fuse to fit the larger FWP fuse holder.

#### ATTENTION



The Bulletin 1394 and 2090 shunt modules ship with fuses rated for 460V operation. For operation with drive systems using 230V input power, you must replace the 460V shunt fuse with a 230V fuse. Failure to observe this precaution could result in equipment damage.

### Environmental Specifications

Attribute	Value
Ambient operating temperature <sup>(1)</sup>	0...50 °C (32...122 °F)
Vibration	2g at 10...2000 Hz
Shock	15g 11 ms half sine
Altitude	1500 m (5000 ft)
Humidity	5...95% noncondensing

<sup>(1)</sup> Power performance increases about 5.5 W for every 1°C (3.1 W/°F) drop in ambient temperature.

## Additional Resources

These documents contain additional information concerning related Rockwell Automation products.

Resource	Description
900 Watt Passive Shunt Installation Instructions, publication <a href="#">2090-IN001</a>	Mounting and wiring instructions for use with ULTRA 100, ULTRA 200, ULTRA Plus, Ultra3000, and Ultra5000 230V drives.
300 Watt Active Shunt Regulator Installation Instructions, publication <a href="#">2090-IN002</a>	
200 Watt Passive Shunt Regulator Installation Instructions, publication <a href="#">2090-IN003</a>	
1394 External Shunt Resistor Kit Installation Instructions, publication <a href="#">1394-5.6</a>	Mounting and wiring instructions for use with Bulletin 1394 (5 and 10 kW) 460V drives.
Kinetix 6000 Multi-axis Servo Drive User Manual, publication <a href="#">2094-UM001</a>	Mounting, wiring, setup with RSLogix 5000 software, power-up, troubleshooting, and application diagrams.
Ultra3000 Digital Servo Drives Installation Manual, publication <a href="#">2098-IN003</a>	Mounting, wiring, applying power, troubleshooting, and application diagrams.
Ultra5000 Intelligent Positioning Drives Installation Manual, publication <a href="#">2098-IN001</a>	
1394 SERCOS interface Multi-axis Motion Control System Installation Manual, publication <a href="#">1394-IN002</a>	
1394 Digital AC Multi-axis Motion Control System User Manual, publication <a href="#">1394-5.0</a>	Mounting, wiring, setup with the HIM module, power-up, troubleshooting, and application diagrams.
System Design for Control of Electrical Noise Reference Manual, publication <a href="#">GMC-RM001</a>	Information, examples, and techniques designed to minimize system failures caused by electrical noise.
EMC Noise Management DVD, GMC-SP004	

You can view or download publications at <http://literature.rockwellautomation.com>. To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

**Notes:**

# Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At <http://support.rockwellautomation.com>, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit <http://support.rockwellautomation.com>.

## Installation Assistance

If you experience a problem within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your product up and running.

United States	1.440.646.3434 Monday – Friday, 8 a.m. – 5 p.m. EST
Outside United States	Please contact your local Rockwell Automation representative for any technical support issues.

## New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor in order to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

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