User Guide
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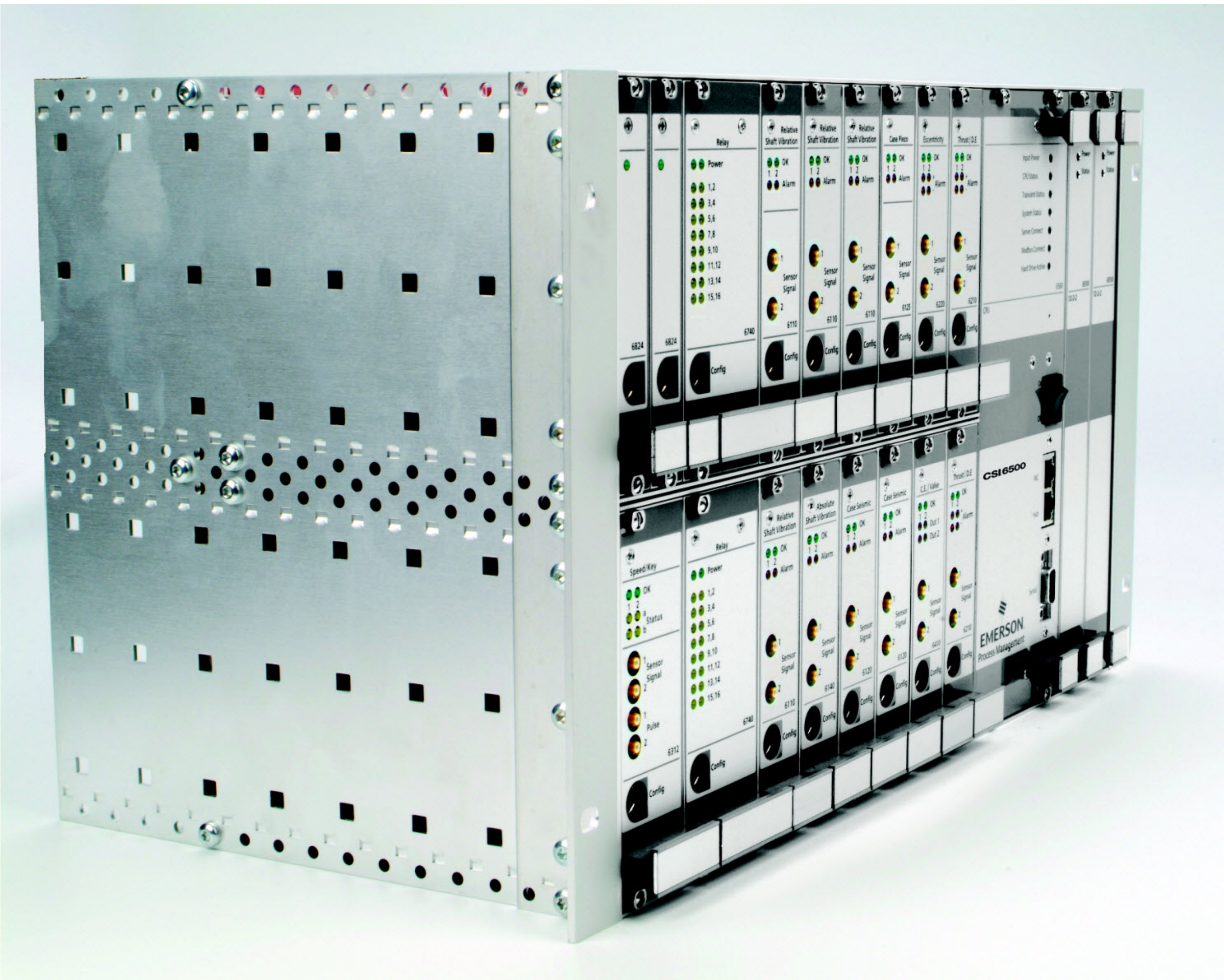
CSI 6500 Machinery Health™ Monitor Hardware Installation Guide

User Guide



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Contents

Appendices and reference

1 CSI 6500 Machinery Health Monitor

Topics covered in this chapter:

1.1 About this manual

This installation and configuration manual covers the standard online system components. For some installations, non-standard components may be purchased with the online system; for each of these components, Emerson will include an installation guide supplement. If the product component cannot be found in the installation guide, please contact your CSI 6500 project manager to request an installation guide supplement.

This manual focuses on the CSI 6500's prediction capabilities. Other available manuals detail the CSI 6500's protection capabilities.

⚠ WARNING!

All wiring should be installed by a qualified electrician. Wiring must conform to all applicable local codes and regulations. Local codes and regulations regarding wire type, wire size, color codes, insulation voltage ratings, and any other standards must be followed.

1.2 User Guide conventions

The following conventions are used throughout this User Guide.

Note

A note paragraph contains special comments or instructions.

⚠ CAUTION!

A caution paragraph alerts you to actions that may have a major impact on the equipment or stored data.

⚠ WARNING!

A warning paragraph alerts you to actions that may have extremely serious consequences for equipment and/or personnel.

1.3 Technical support

When you contact Technical Support, be ready with a screen capture of the error message and details such as when and how the error occurred.

Hardware Technical Help

Have the number of the current version of your firmware ready when you call.

Software Technical Help

Provide the software version numbers of both your Microsoft® Windows operating system and AMS Suite: Machinery Health Manager, and your AMS Machinery Manager serial number. To find AMS Machinery Manager version and serial numbers, select Help > About.

Be at your computer when you call. We can serve you better when we can work through the problem together.

Software Technical Support

Emerson provides technical support through the following for those with an active support agreement:

- Telephone assistance and communication via the Internet.
- Mass updates that are released during that time.
- Interim updates upon request. Please contact Emerson Technical Support for more information.

Contact us

For Emerson Technical Support and Customer Service Toll Free numbers, email addresses, and hours of operation, please visit *http://www2.emersonprocess.com/en-US/brands/sureservice/Pages/TechnicalSupport.aspx*

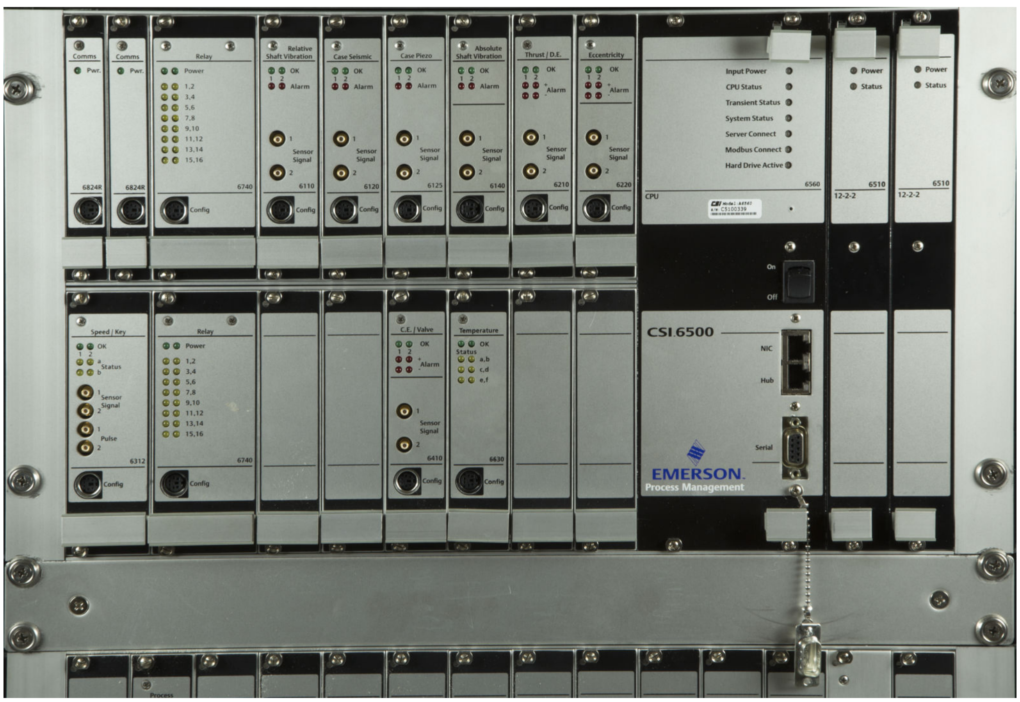
2 Introduction to the CSI 6500

Topics covered in this chapter:

- *CSI 6500 front view*
- *System walkthrough*
- *System documentation*

2.1 CSI 6500 front view

Figure 2-1: CSI 6500 in cabinet



2.2 System walkthrough

Perform a system component review to ensure that the proper system components have been shipped, and that nothing has been lost or damaged during shipment. Unpack and inspect to confirm all system components are present. Physically walk through each part of the installation to review:

- ☐ Sensor mounting locations—see *Section 3.1.3*
- ☐ Cable pulls—see *Section 4.2.3*
- ☐ Conduit/cable tray use—see *Section 5.1*

- ☐ Enclosure mounting locations—see *Chapter 4*
- ☐ Environmental concerns—see *Section A.1*

2.3 System documentation

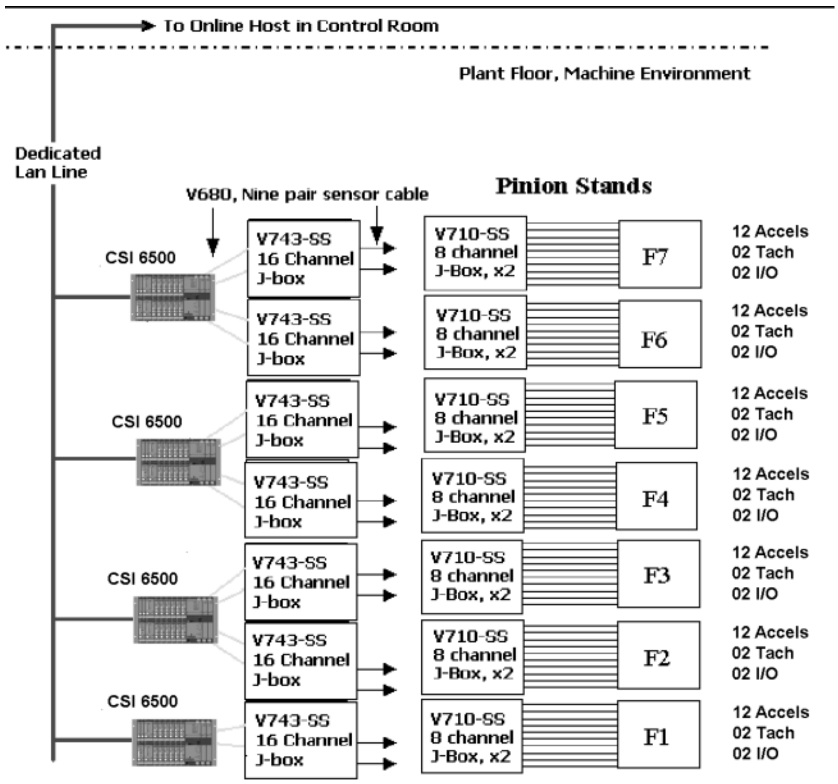
Your system will include a System Overview Drawing, System Layout Drawings, a Cabin Administration Chart, and other info from the Online Services team.

2.3.1 System overview drawings

CSI 6500 system documentation should include system overview drawings that illustrate how system components interconnect. These drawings are normally prepared by a CSI 6500 Online Business Development Manager and included in the online system proposal during the sales process. Create or update these drawings if they were not part of the proposal, or if the system has changed significantly from the time the proposal was created.

Figure 2-2 is an example of a system overview drawing:

Figure 2-2: Example system overview drawing



In general, the system overview drawing should display the following information:

- CSI 6500 units
- Junction/switch boxes
- Cables
- CSI 6500 Network Segment Cables
- Tags for each CSI 6500, junction/switch box, and cable

2.3.2 System layout drawings

The system layout drawings illustrate exact locations for enclosure mounting, conduit installation, cable pulls, and sensor mounting. The most common method for preparing these drawings is to copy blueprints of the plant floor/production line and mark the system installation locations. Use color-coded highlights and symbols to mark the different types of cable runs and enclosure mountings.

Table 2-1: Example system layout marking guidelines

Symbol	Description	Labels
TYPE TAG	Enclosure	Type: 701 (2,3), 745, 6500 Tag: defined by plant
○ TYPE TAG LOCATION	Instrumentation	Type: CSI sensor part # Tag: defined by plant Location: • I—Inboard • O—Outboard • A—Axial • H—Horizontal • V—Vertical
————	Exposed cable	
– – – – – – – –	Cable in conduit	
—-—-—-—	Cable tray	

Table 2-1: Example system layout marking guidelines

Color codes	Cable type
Red	Instrumentation
Blue	Multi-pair bundled cable
Green	CSI 6500 network cabling

2.3.3 Cable administration charts

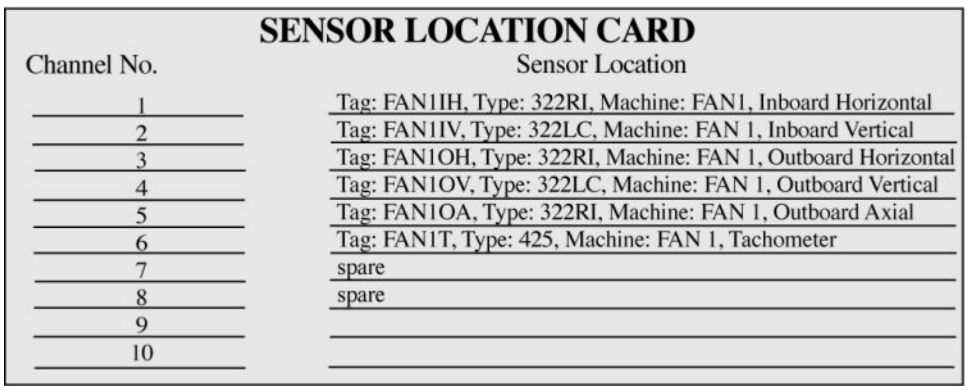
Cable administration charts document wire terminations within system enclosures. Tag names should be consistent and represent physical locations or machines. For instance, instead of naming a sensor 23001, use a name like FAN1OV (fan number 1 outboard vertical) to make system maintenance and troubleshooting easier. After tags are assigned, document them in cable administration charts. All enclosures for the CSI online system need cable administration charts.

There are two types of cable administration charts for the online system: junction box and CSI 6500 enclosure.

Junction box cable administration chart

The online system junction boxes provide a junction between the instrumentation cable and the multi-pair bundled cable that is pulled back to the CSI 6500. The cable administration chart for a junction box documents the channel number, wire tag, sensor type, and sensor location if the wire tag does not contain location information. *Figure 2-3* shows a typical installation.

Figure 2-3: Junction box cable administration chart



SENSOR LOCATION CARD

Channel No.	Sensor Location
1	Tag: FAN1IH, Type: 322RI, Machine: FAN1, Inboard Horizontal
2	Tag: FAN1IV, Type: 322LC, Machine: FAN 1, Inboard Vertical
3	Tag: FAN1OH, Type: 322RI, Machine: FAN 1, Outboard Horizontal
4	Tag: FAN1OV, Type: 322LC, Machine: FAN 1, Outboard Vertical
5	Tag: FAN1OA, Type: 322RI, Machine: FAN 1, Outboard Axial
6	Tag: FAN1T, Type: 425, Machine: FAN 1, Tachometer
7	spare
8	spare
9	
10	

CSI 6500 enclosure cable administration chart

The CSI 6500 has cable terminations for sensors, tachometers, discrete I/O, network, and power; it also has configurable DIP switches and jumpers.

The cable terminations and DIP switch settings should be documented in cable administration charts or CAD drawings. *Table 2-2* is an example cable administration chart for the prediction side of the CSI 6500.

Table 2-2: CSI 6500 cable administration chart

Processor module	
CSI 6500 tag name:	
Main Processor MAC address:	
Transient Processor MAC address:	
Network cable tag:	

Table 2-2: CSI 6500 cable administration chart *(continued)*

MSIG #1 sensor inputs					
Channel #	**Junction box tag**	**Wire tag**	**Sensor type**	**DIP setting**	**Sensor location**
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
Tachometer inputs					
1					
2					
Discrete I/O					
1					
2					
MSIG #2 sensor inputs					
Channel #	**Junction box tag**	**Wire tag**	**Sensor type**	**DIP setting**	**Sensor location**
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Table 2-2: CSI 6500 cable administration chart *(continued)*

Tachometer inputs					
1					
2					
Discrete I/O					
1					
2					

2.3.4 Documentation storage

Make copies of system overview drawings and system layout drawings, and keep them in the system enclosure to allow easy reference by analysts and service personnel.

3 Sensor installation

Topics covered in this chapter:

- *Accelerometers*
- *Tachometer*
- *Eddy current sensors*

3.1 Accelerometers

3.1.1 Handling accelerometers

General purpose accelerometers are susceptible to mechanical shock. Take precautions when handling sensors. When magnetically mounting sensors, it is possible to generate shock loads that will damage sensors and void the manufacturer's warranty. To prevent damage, gently rock magnetic sensors into place.

⚠ WARNING!

Do not drop, hammer, or impact the sensor housing before, during, or after installation.

⚠ CAUTION!

Do not exceed specified torque when tightening stud-mounted accelerometers. Over-tightening accelerometers will damage sensing elements and void the manufacturer's warranty.

Although the integral cable has built-in strain relief, avoid excessive pulling force during cable pulls. Secure cable to the machine near the point of sensor installation.

⚠ CAUTION!

Do not exert more than 5 lbs pull force directly on sensor/cable connection during wire pulls.

If you mount sensors before pulling cable in conduit or raceway to junction box, leave the cable bundled and secured to the machine. Do not step on or kink sensor cable, or the signal will be permanently degraded. Do not place cable bundle in such a manner that it causes strain at the sensor/cable connection.

3.1.2 Tools and supplies

Mounting tools

- Drill
- Spot face or end mill tool

The spot face tool attaches to a standard electric drill and provides a machined surface at least 1.1 times greater than the diameter of the sensor. At the same time, the spot face tool also drills a pilot hole that can then be tapped for the stud mounted sensor.

The spot face tool can be purchased from Emerson or a spot face tool with similar characteristics may be substituted as required. Contact your local sales representative for assistance.

Figure 3-1: Spot face or end mill tool

For epoxy mounting, the following are also necessary:

- 2-part epoxy (e.g. Loctite Depend [Emerson P/N A92106] or comparable)
- A212 Mounting Pads
- (Optional) Grinder – to create a sufficiently flat mounting surface

Accelerometer attachment tools and supplies

- 40-200 in. lb torque wrench with 1/8 in. hex bit

  Suggested vendor: Grainger

  Part number: 4JW57

  Description: 3/8-in. drive in. lb torque wrench. Any torque wrench with a range of 40 to 70 in. lb and less than 5 in. lb increments can be substituted.
- 1/4 in. 28 taps and tap handle
- 9/16 in. open-end wrench
- 1/8 in. hex Allen key
- Wire brush
- Plant-approved cleaner/degreaser
- Plant-approved semi-permanent thread locker (e.g. Loctite)

3.1.3 Surface preparation: stud mount

Note

The mounting location must provide a flat surface, 1 in. in diameter. If this is not possible, use an alternative mounting procedure. Contact the project manager.

Note

The mounting location must provide a case thickness exceeding 0.4 in. If this is not possible, use an alternative mounting procedure. Contact the project manager.

Stud mount

1. Prepare the spot face or end mill tool by setting the drill bit depth to a minimum of 0.325 in. (325 mils).
2. Using a wire brush and plant-approved cleaner, clean and degrease the surface area.
3. Keeping the spot face/end mill tool perpendicular to the machine surface, drill into the mounting location until the surface is smooth to the touch with no noticeable irregularities. This may require the spot face tool to remove as much as 0.04 in. (40 mils) or more from the surface.

   Note

   If the spot face is not uniform on all sides, this is an indication that the spot face tool is not perpendicular to the mounting surface and the resulting surface will not allow the sensor to be mounted properly.

4. Using 1/4 in.-28 tap set, tap a pilot hole to a minimum depth of 0.25 in. (250 mils).

Refer to *Figure 3-2*, *Figure 3-3*, and *Figure 3-4* for illustrations on the stud mount method.

Figure 3-2: Correct (left) and incorrect (right) milling processes

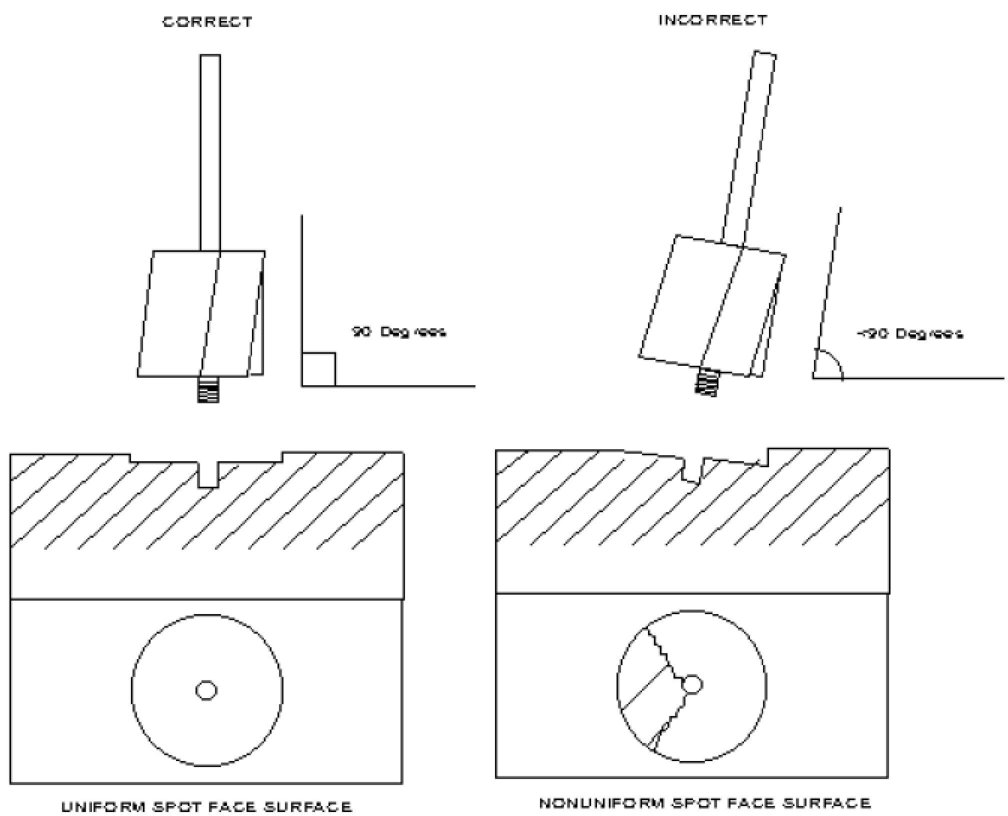


Figure 3-3: Milling process for sensor mounting

This spot facing should result in a uniform seat being created.

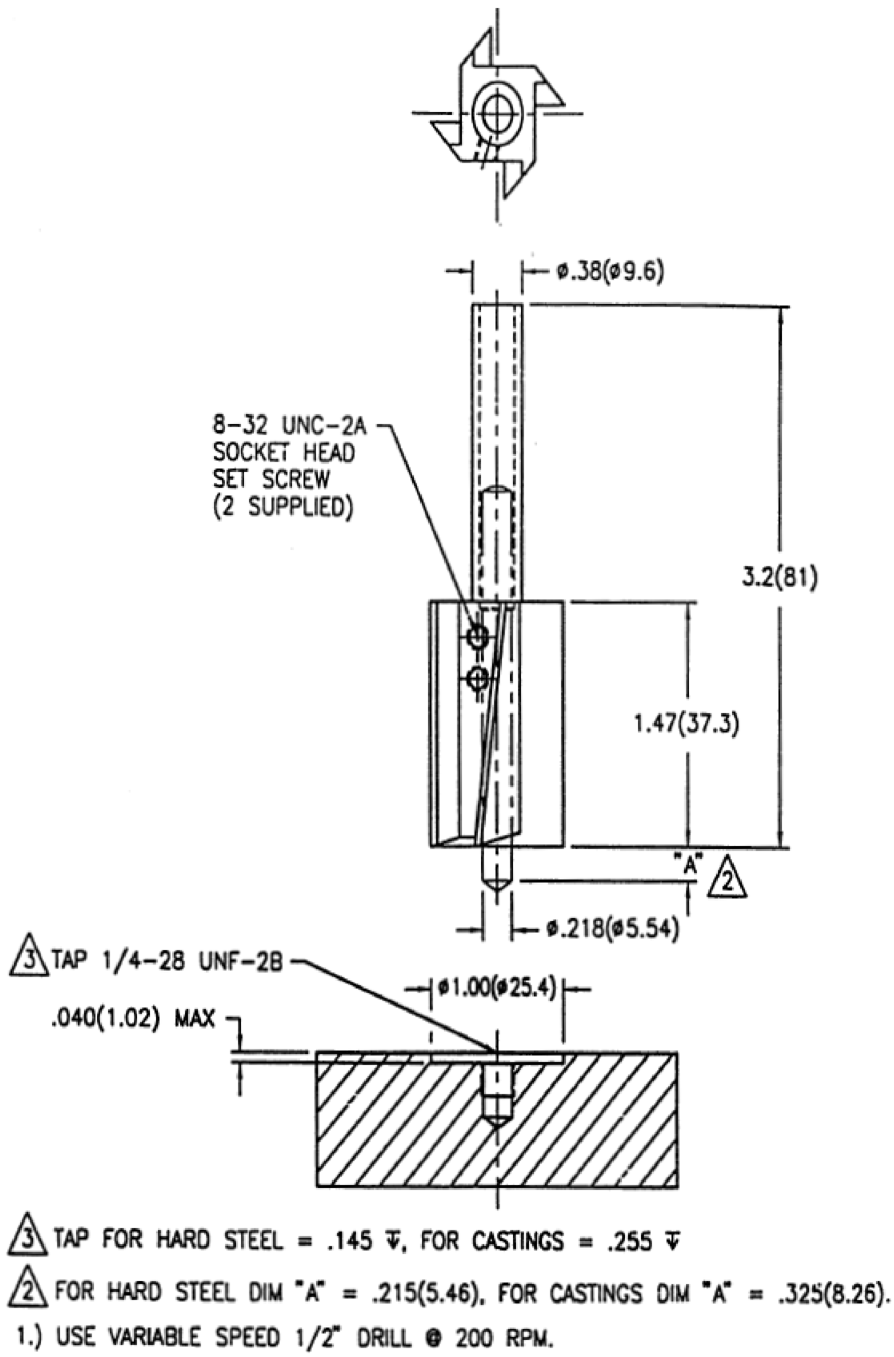
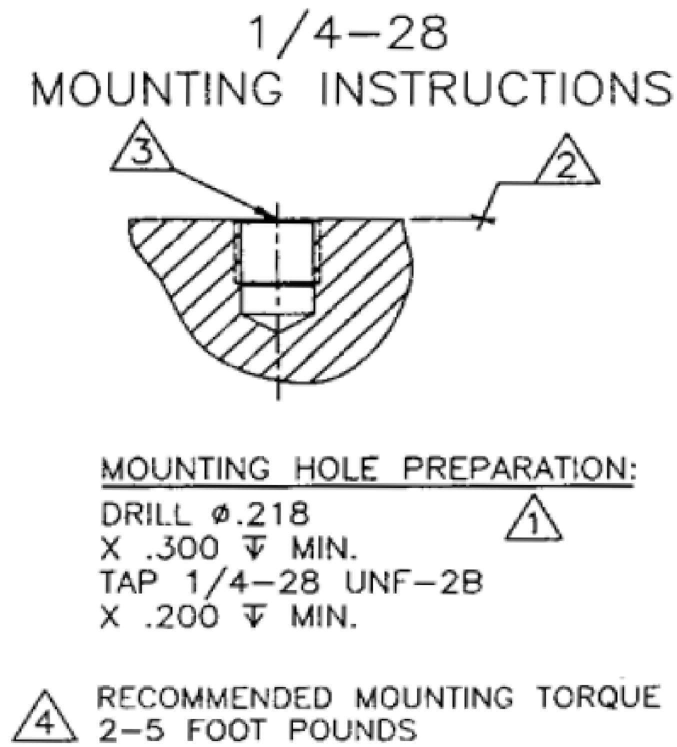


Figure 3-4: Tapping a pilot hole



3.1.4 Surface preparation: epoxy mount

Note

The mounting location must provide a flat surface, 1 in. in diameter. If this is not possible, use an alternative mounting procedure. Contact the project manager.

Epoxy mount

1. If the equipment surface has a radius of curvature that is less than 4 in., grind a flat surface approximately 0.5 in. diameter.
2. Using the wire brush and plant-approved cleaner, clean and degrease the surface area.
3. Using a 2-part epoxy (such as Emerson P/N A92016), spray the activator onto the mounting surface.
4. Place a light coat of epoxy on the surface of the mounting pad (such as Emerson P/N A212) and hold firmly against the machine spot face surface for 1 minute.

   If the adhesive does not set within 1 minute, it is an indication that too much epoxy is applied or that the mounting surface is not prepared properly. Repeat steps 2 through 4.

3.1.5 Install mounting studs

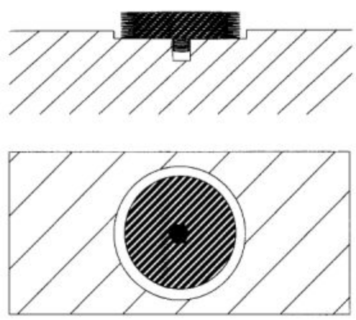
For use when installing A911 mounting stud or A0322 Quick-Connect base.

Procedure

1. Using a plant-approved degreaser, remove any lubricating fluid used during the tapping process.
2. Using a plant-approved epoxy, rub a small amount of epoxy onto spot face.
3. Using a 0.25 in. allen wrench, loosely screw a mounting base into the mounting location.
4. Using a torque wrench with a 0.25 in. hex bit, torque to 7-8 ft-lbs.

   If the mounting base is not seated against the spot face after torquing, the tap was not deep enough.
5. If the sensor will not be mounted immediately, cover exposed quick-connect threads to prevent contamination. Industrial tape is recommended.

Figure 3-5: A911 Quick-Connect



3.1.6 Mount accelerometers

Prerequisites

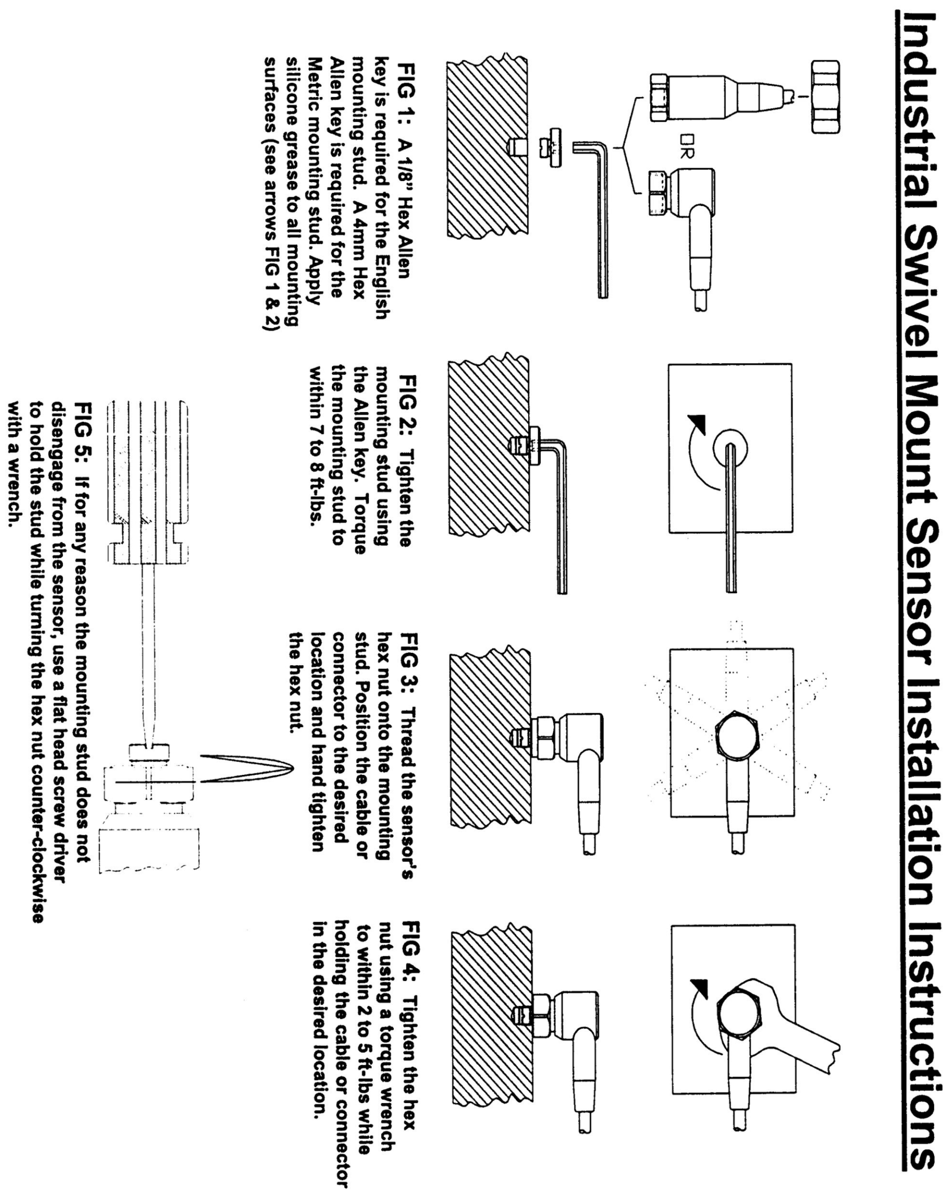
Note
If you are not ready to pull cables, do not mount sensors on the machine. If you must mount a sensor, secure the bundled cable to the machine and protect it from damage.

Procedure

1. Using a plant-approved cleaner/degreaser, remove any lubricating fluid used during the tapping process and clean the mounting stud threads.
2. Rub a small amount of semi-permanent thread locker onto the mounting location.

3. Place the sensor onto the mounting stud and hold it to create the least amount of cable strain and cable exposure. While holding the sensor, hand-tighten the 9/16 in. captive nut and use a torque wrench with the 9/16 in. open end to finish tightening to 50–60 in-lbs.
4. Secure sensor cable to the machine approximately 4–5 in. from the mounting location using an appropriately sized cable clamp. Do not exceed bending radius of 2.8 in.

Figure 3-6: Sensor installation for industrial swivel mounts



3.1.7 Mount accelerometers without Quick-Connect

Prerequisites

Note
If you are not ready to pull cables, do not mount sensors on the machine. If you must mount a sensor, secure the bundled cable to the machine and protect it from damage.

Procedure

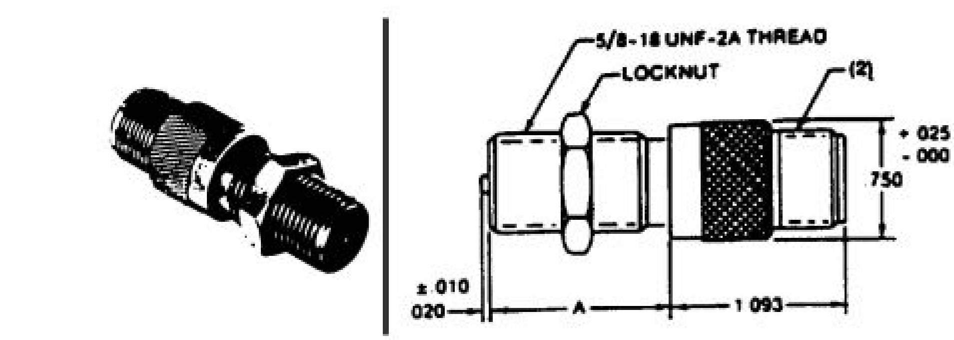
1. Using a plant-approved cleaner/degreaser, remove any lubricating fluid used during the tapping process and clean the mounting stud threads.
2. Rub a small amount of semi-permanent thread locker onto the mounting location.
3. Hand-tighten the mounting stud into the sensor housing, and use a 9/16 in. torque wrench to tighten the sensor and mounting stud into mounting location to 5 ft-lbs.
4. Secure sensor cable to the machine approximately 4–5 in. from the mounting location using an appropriately sized cable clamp. Do not exceed bending radius of 2.8 in.

⚠ CAUTION!

Mount the sensor to the machine before terminating or securing cable to the machine.

3.2 Tachometer

Figure 3-7: V425 passive magnetic tachometer



Passive magnetic tachometers are industrial tachometers used to measure the rotational speed of machinery. This sensor is commonly used to sense an actuator (target) on a rotating shaft giving a once per revolution trigger.

3.2.1 Handling passive magnetic tachometers

The passive magnetic tachometer is installed near moving machinery—typically a rotating shaft. Observe clearances between the sensor and the target, and observe cable clearances.

⚠ CAUTION!

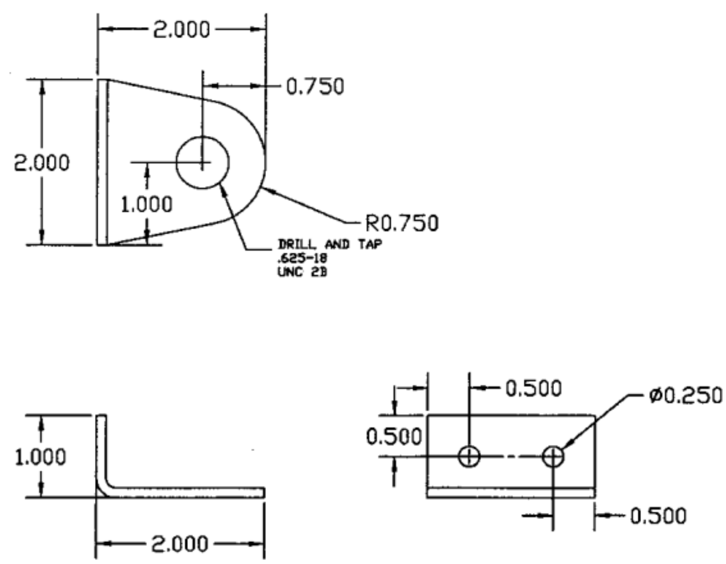
The tachometer can be damaged if proper clearance is not maintained between the sensor and the actuator. Follow installation procedures to set proper clearance.

3.2.2 Tools and supplies

The included mounting bracket and locking nut are required to install passive magnetic tachometers.

The universal mounting bracket will fit a variety of applications. If the included bracket will not work, then you will have to fabricate a custom bracket.

Figure 3-8: Mounting bracket for a passive magnetic tachometer

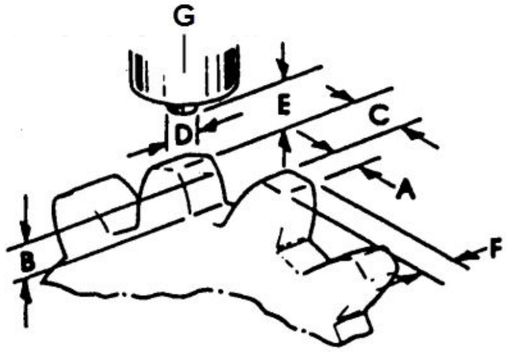


3.2.3 Actuator choice: guidelines

Actuator dimensions

Some passive magnetic tachometers are designed to be used with a key meeting the following minimum specifications:

Figure 3-9: Actuator dimensions



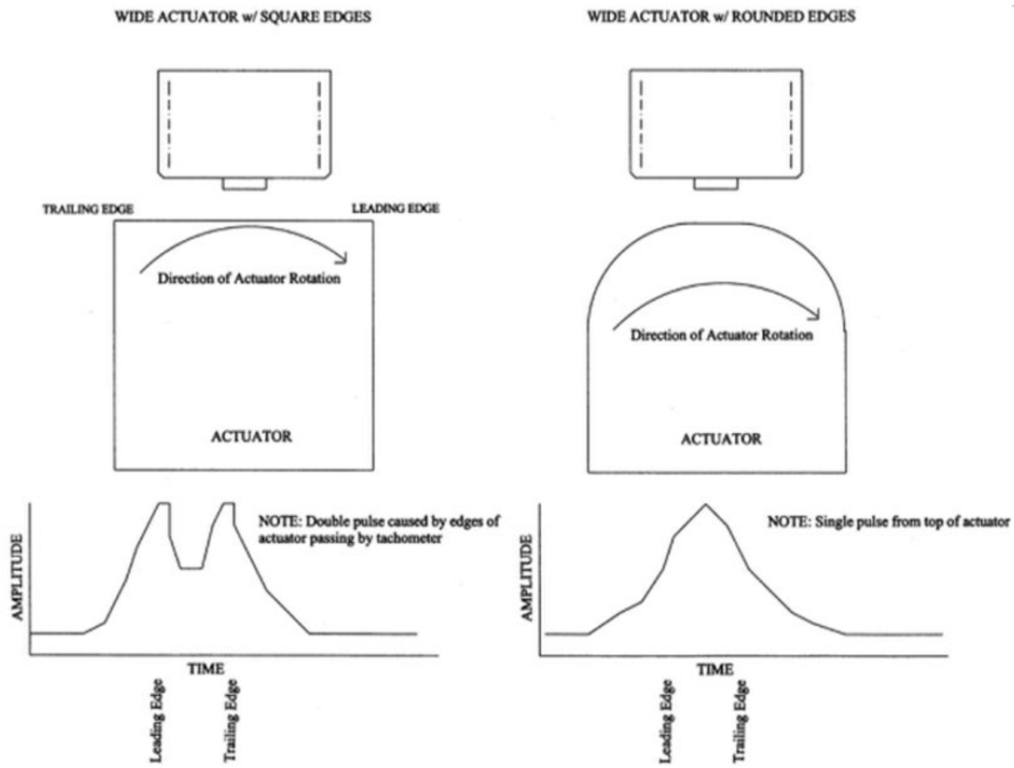
A. Dimension of top tooth
B. Height of tooth
C. Space between teeth
D. Diameter of pole piece
E. Clearance
F. Gear thickness
G. Magnetic sensor

Table 3-1: Key actuator dimensions

A	Dimension of top of tooth	>0.15 in.
B	Height of tooth	>0.5 in.
F	Gear thickness	>0.3 in.

If the chosen actuator has a dimension that must be greater than 0.5 in., round the edges of the actuator to allow the sensor to be as close as possible to actuator.

Figure 3-10: Modifying large actuators



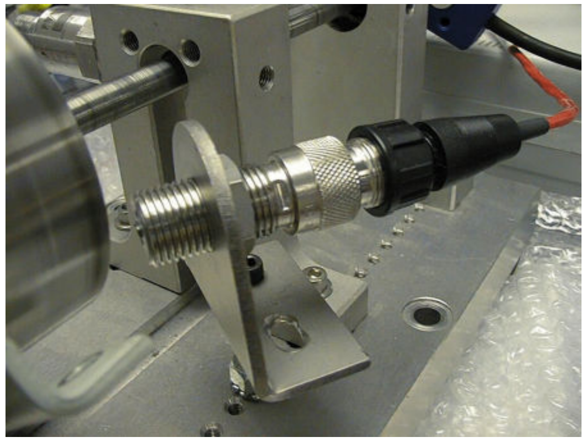
Actuator material

The actuator must be made of a metallic material with a high permeability. Ideal actuators are soft iron, cold-rolled steel, and #400 stainless steel.

3.2.4 Mount the sensor bracket

1. Turn the machinery shaft so that the actuator is at the mounting location.
2. Place the sensor in the mounting bracket and screw the sensor into the bracket, exposing an equal amount of thread on the back and front of the mounting bracket.
3. Place the sensor/bracket assembly into the mounting location and center the sensor pole piece over the actuator so the pole piece touches the actuator. Mark the hole locations on the bracket.
4. Drill and tap hole locations for an appropriately sized bolt to fit a 0.25 in. opening on the mounting bracket.
5. Secure the bracket to the mounting location and torque to bolt specifications.

Figure 3-11: Mounted passive magnetic tachometer



3.2.5 Mount tachometers

1. Screw the locking nut onto the sensor and thread completely onto the sensor.
2. Screw the sensor into the mounting bracket until the sensor pole piece contacts the actuator.
3. Back off the sensor 1 full turn.
4. While holding the sensor in place, thread the locking nut against the mounting bracket. Torque to 15 ft-lbs.
5. Slowly turn the shaft and confirm that the actuator does not contact the sensor.

   If sensor is contacting the shaft, loosen the lock nut and repeat steps 3 and 4.
6. Run the machinery at full speed and confirm that the sensor does not contact the actuator. Let the machine reach normal operating temperature and run through all operational speeds.
7. Observe the machinery during coastdown, and confirm that the sensor does not contact the actuator.
8. Cover exposed connector threads with the included protective cap to prevent contamination.

3.3 Eddy current sensors

The CSI 6500 also supports eddy current sensors.

Installation instructions for eddy current sensors PR6422–PR6426 and probe drivers CON011–CON041 are part of the manuals packaged with your sensors.

4 Enclosure mounting

Topics covered in this chapter:

- *Junction boxes*
- *CSI 6500 rack chassis*

4.1 Junction boxes

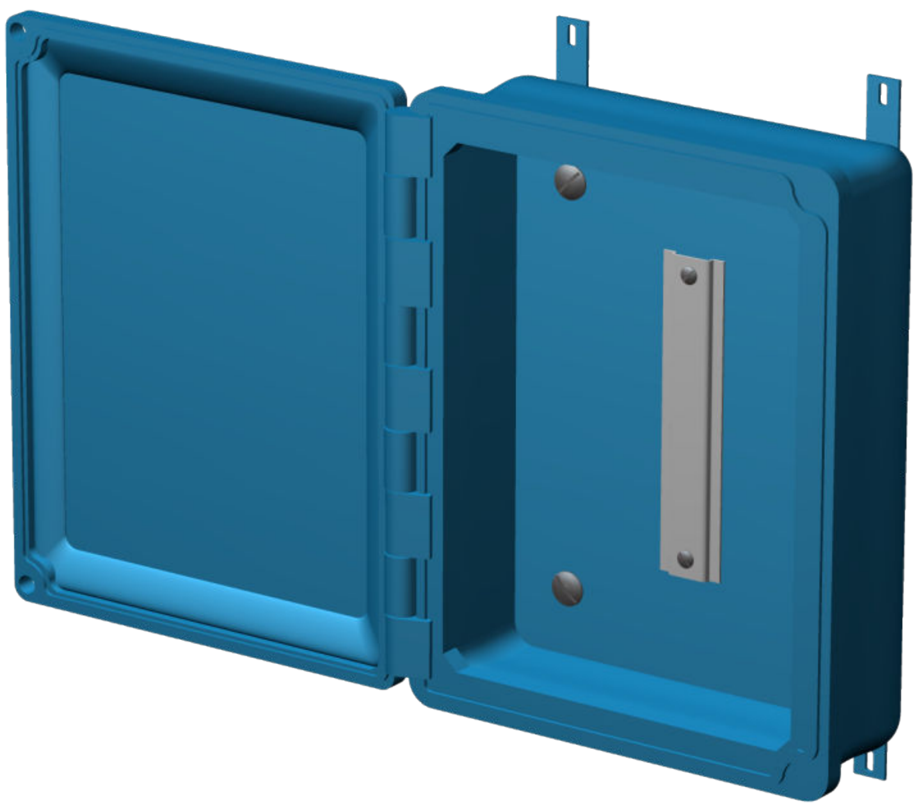
Junction boxes are used to terminate online instrumentation wiring. Emerson recommends junction boxes with 12 channels, housed in a fiberglass or stainless steel enclosure. They should consist of individual, 3-lug terminal blocks mounted on a DIN rail.

4.1.1 Mount junction boxes

1. Ensure the chosen mounting location is well lit and allows proper clearance for maintenance access.

Figure 4-1: Junction box access requirements

Junction boxes require a 180° opening.



2. Prepare the mounting bracket using the outline drawing as a template for the mounting hole locations.
3. Use the machine screws to attach the mounting feet to the back of the enclosure. Align mounting feet vertically to ensure proper access.

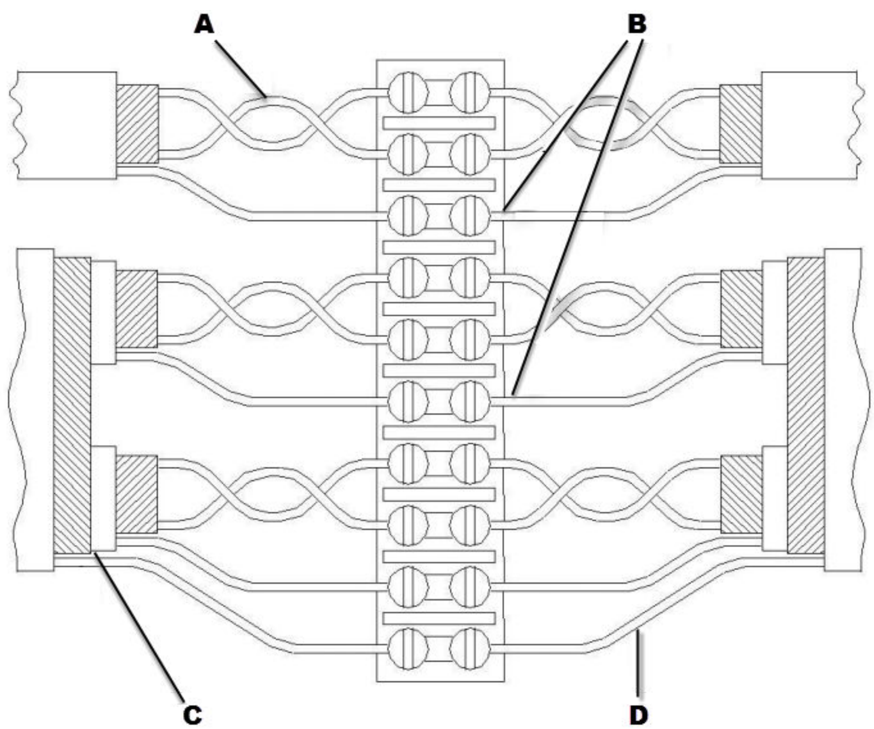
   Torque screws to 31 in-lb.
4. Using bolts provided by the contractor, attach the enclosure to the mounting bracket.

4.1.2 Junction box wiring notes

⚠ CAUTION!

Never cross-connect shields from different sensors in junction boxes.

Figure 4-2: Junction box wiring notes



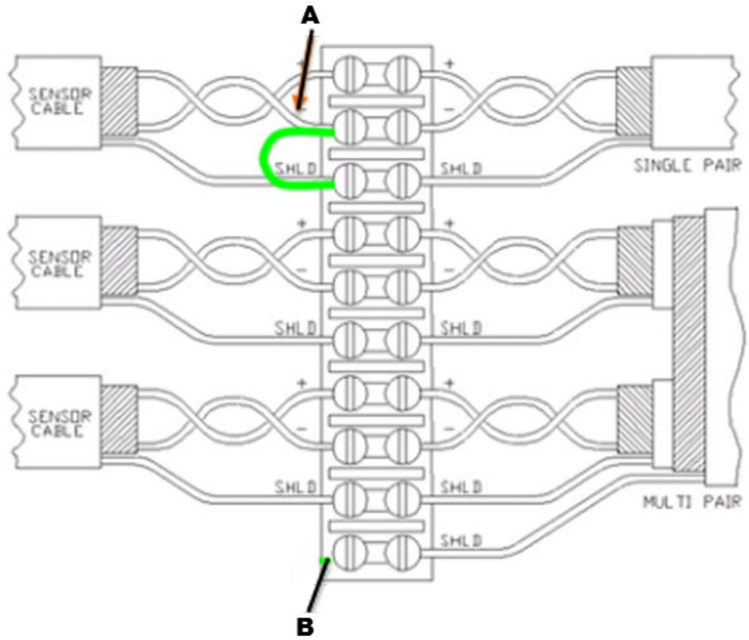
A. Maintain cable pair twists as close to the terminal block as possible.

B. Do not allow shield drain wires or foil from individual cables to short. Use heat shrink and dress wire ends as necessary.

C. Strip the insulation and shield as close to the terminal block as possible.

D. Connect multiple-pair shield drain wire individually. Do not allow shield drain wires or foil from individual cables to short. Use heat shrink and dress wire ends as necessary.

Figure 4-3: Modifications for junction box wiring



A. *Connecting the shield line to the sensor "-" conductor at the sensor end may reduce RF and static interference. You must isolate sensor shield and "-" conductors from earth ground or the shield connection at the 6500 side may cause ground loops.*

B. *Connecting a multi-pair cable overall shield to earth ground at both ends may reduce RF and static interference. This connection may cause ground loops.*

4.2 CSI 6500 rack chassis

To protect it from harsh industrial environments, the CSI 6500 rack chassis is either mounted on 19 in. rack mounting rails in a cabinet enclosure with rear termination panels, or in a stainless steel housing with a front termination panel.

Note

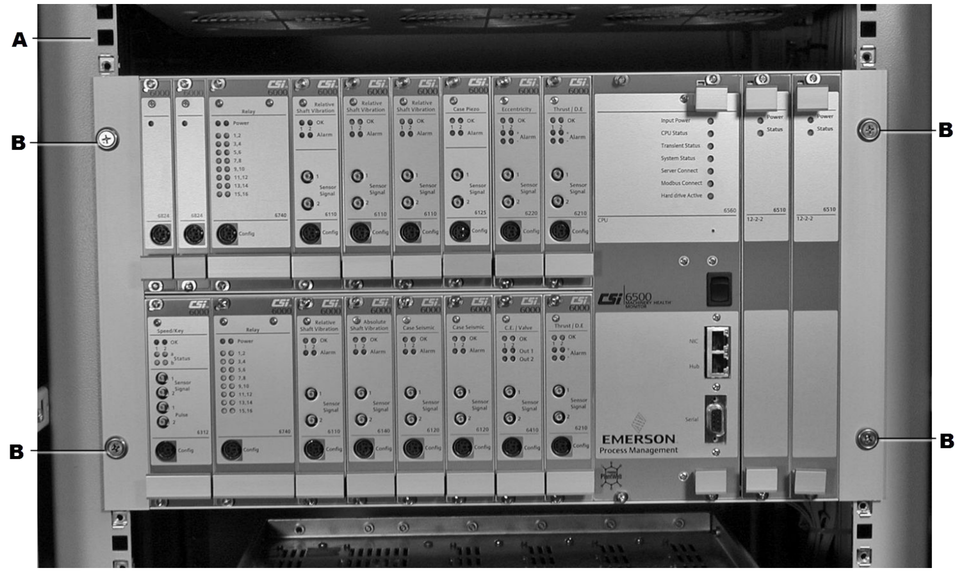
All CSI 6500 enclosures must be grounded to earth. Ground the enclosure through conduit or mounting structure if it is grounded to earth. Otherwise, use a bonding wire to connect the enclosure to earth ground.

4.2.1 Mount the rack chassis in a 19 in. cabinet enclosure

The CSI 6500 is generally installed in a cabinet enclosure with 19 in. rack mounting rails.

Example mounting hardware would include four sets of M5 captive nuts, M5 cone washers, and M5x12 screws.

Figure 4-4: CSI 6500 mounted in a 19 in. cabinet enclosure



A. *Mounting rail*
B. *Screws*

Prerequisites

You need two people to lift the unit and place it on the mounting rails.

Procedure

1. Attach the captive nuts in the mounting rails.
2. Using the screws and cone washers, fasten the system frame to the mounting rails through the two oblong holes on each side of the frame.
3. When mounting multiple units in one cabinet, place a cooling fan rack between each unit to maintain the specified environmental operating conditions for all components.

   See *Section A.1* for temperature specifications.

4.2.2 Mount the rack chassis in a stainless steel enclosure

Prerequisites

If you are not running conduit into a stainless steel enclosure, confirm that the mounting location provides a path to earth ground.

Procedure

1. Ensure the mounting location allows the door to open completely and allows enough room to run conduit into the bottom of the box.
2. Using hardened steel bolts, attach all four mounting feet to unistrut rails.
3. Torque lock washers to 50 ft-lb.

4.2.3 Cable access

As a best practice, conduit should enter from the bottom of the enclosure. Power, sensor, and communication cables should enter through separate conduit and be routed separately inside the enclosure.

Prepare multi-pair bundled cable pulls

1. Determine the number of pulls you need based on the size and number of channels supported by the junction box. In general, you need one pull per 6 channels.

   The multi-pair cable normally has a diameter of 0.5 in., and will require a 1.5 in. conduit run. Two multi-pair cable pulls will require a 2 in. conduit run.
2. Make multi-pair sensor cable pulls on the bottom left so you can easily route cables along left side of enclosure.

Prepare power cables

1. Size the conduit according to plant codes and local regulations for running power in the plant.
2. Make the power line pull to the bottom right rear of the enclosure to route power cable along the right rear of the enclosure.

Prepare Ethernet cables

1. The CAT5 cable requires a minimum 0.5 in. conduit run.
2. Route the CAT5 cable along the bottom right front so that it is as far as possible from the unit's power supply.

Prepare discrete input/output cables

CSI 6500 discrete input/output cable pulls are low voltage DC only, so they can be routed with sensor cables or routed separately. They consist of either multi-pair bundled cable pulls or single twisted pair cable.

Procedure

1. For multi-pair bundled cable pulls, prepare 1.5 in. conduit for one cable and 0.5 in. extra for each additional cable.
2. Run single twisted-pair cable in conduit or pull through the enclosure using 0.25 in. cord grips.

4.2.4 Install a module

1. Line up the guide rails and push the module into the slot until fully seated.
2. Tighten the mounting screws.

4.2.5 Remove a 3U high module

1. Loosen the mounting screws.
2. Pull the module out of the slot by the handle.

4.2.6 Remove a 6U high module

1. Loosen the mounting screws.
2. Push outward on the handles to eject the module from the backplane connectors.
3. Pull the module out of the slot by the handle.

Figure 4-5: Remove a module

Use the handles to remove modules.

5 Cabling requirements

Topics covered in this chapter:

This chapter covers conduit installation guidelines, network cabling guidelines, power line specifications, and pulling the online instrumentation cabling and multi-pair bundled cable from junction boxes to the CSI 6500.

5.1 Guidelines for conduit installation

Note

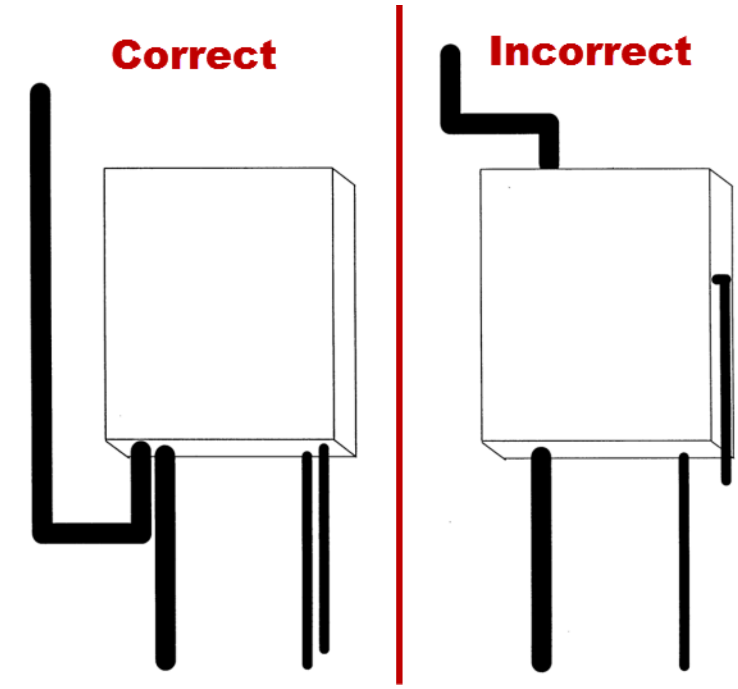
All conduit must be bonded to earth ground and adhere to IEEE 1100 specifications for grounding.

- The following cables must be pulled in conduit:
  - any cable between junction boxes and the unit
  - any CSI 6500-dedicated network segment cables not pulled in existing plant network infrastructure
  - power cables for the unit power supplies
  - any instrumentation cables that exceed 50 ft
- The conduit must be sized to not exceed a 40% fill.
- Steel conduit must be used. If plant codes will not allow steel conduit, contact the project manager.
- Route conduit away from power trays according to the following guidelines:

Distance from power tray	Voltage
6 in.	110 VAC
12 in.	220 VAC
24 in.	440 VAC

- Conduit must enter the unit enclosure and junction boxes from the bottom of enclosures.

Figure 5-1: Proper conduit installation



5.2 Online instrumentation cable

The online instrumentation wiring is a polyurethane-jacketed, twisted-pair, shielded instrumentation cable used to transmit millivolt level instrumentation signals to the online system. The cable is designed to provide noise shielding and protection within harsh industrial environments. It is pulled to the junction/switch boxes where it is joined to bundled, multi-pair cabling routed back to the unit. Typically, the instrumentation-to-junction box pull is relatively short (<50 ft) and close to the machinery. It is not enclosed in conduit except when conduit is required for specific applications. Secure exposed cabling to machinery and plant infrastructure to avoid maintenance hazards and safety hazards.

5.2.1 Install online instrumentation cable

⚠ CAUTION!

If you are installing through conduit, the cable pull force should not exceed 25 lbs. Excessive force will deform twisted-pair cable and degrade performance.

Procedure

1. If you are using the A612-I-30 cable, apply a thin coating of dielectric grease to the connector and screw into sensor housing using hand force only.
2. Label the cable on both ends using plant-approved wire labels. The wire label designation must be the same on both ends of the cable.

3. Choose a physical path for the sensor cable pull according to the following guidelines:
   - Follow plant standards for segregating instrumentation, communication, and power cable runs.
   - Do not pull cable across machinery maintenance access areas such as guards, shields, and access panels.
   - Do not pull cable in machinery control/starting cable trays.
   - Do not run any cable on the floor.
   - Do not run cable near pathways where it will be exposed to damage from moving machinery.
4. Starting at the sensor housing, use cable tie-downs to secure cable at 2 ft intervals to machinery and plant infrastructure.
5. At junction/switch boxes, pull the cable through an existing PGME07 cord grip.
   - Tighten the cord grip with 9/16 in. wrench until cable is secure. Do not overtighten.
   - Blunt cut the cable, leaving approximately 2 ft inside the box. Relabel the wire if necessary.
   - If you are using armored cable, remove the armor before pulling the cable through the cord grip; cut the end of the armor with wire cutters and unravel the length to remove. Use a heat shrink to seal the end of the armor.

5.3 Pull cable from the junction box to the unit

Use the cables in *Section 5.3.1* to extend the online instrumentation wiring from the junction boxes to the unit enclosure.

Procedure

1. Starting at the junction box, pull the cable through the conduit run.
2. At the unit enclosure, blunt cut the cable, leaving enough cable inside the enclosure for routing to terminal connectors.
3. Label wire according to project specifications and place the label within 6 in. of the cable access plate, with the label facing the front of the enclosure.
4. At the junction box, blunt cut the cable, leaving 2 ft inside the box for routing.

5.3.1 Recommendations for junction box-to-unit cables

Note

For cables with overall braided shield, ground the shield to the CSI 6500 enclosure.

Table 5-1: Cable recommendations

Cable pull location	Belden #	Application	Description
In steel conduit	9732	V707 / V727	9-pair, 24 AWG, individual foil shield, PVC jacket
	9731	V727 / V745	12-pair, 24 AWG, individual foil shield, PVC jacket
In tray or aluminum conduit	8168	V707	8-pair, 24 AWG, individual foil shield, PVC jacket, overall braid shield
	8175	V727 / V745	15-pair, 24 AWG, individual foil shield, PVC jacket, overall braid shield

5.4 Physical network segment for the unit

Emerson recommends that customers run a dedicated physical network segment between the database server and the unit, and follow these guidelines:

- Handling & Care Guidelines, per EIA/TIA 568/569.

  Note
  EIA/TIA 568/569 requires only CAT5 cabling, but Emerson recommends that customers run at least CAT5e to be compatible with future upgrades.

- Pathways & Cable Trays, per EIA/TIA 569.

  Note
  Network cabling to the CSI 6500 should be in steel conduit.

5.5 Power circuit guidelines for the unit enclosure

The CSI 6500 is a laboratory grade instrument measuring millivolt level instrument signals. The quality of the power provided to the unit is very important; follow specific plant guidelines when running power to the unit enclosure.

Note
Adhere to IEEE 1100 specifications for powering and grounding electronic equipment.

Table 5-2: Prediction side power specifications

DC	
Nominal input voltage range	12 VDC – 24 VDC
Absolute input voltage range	10 VDC – 36 VDC
Maximum current draw	3.5 A
Nominal current draw	1.5 A

Table 5-2: Prediction side power specifications *(continued)*

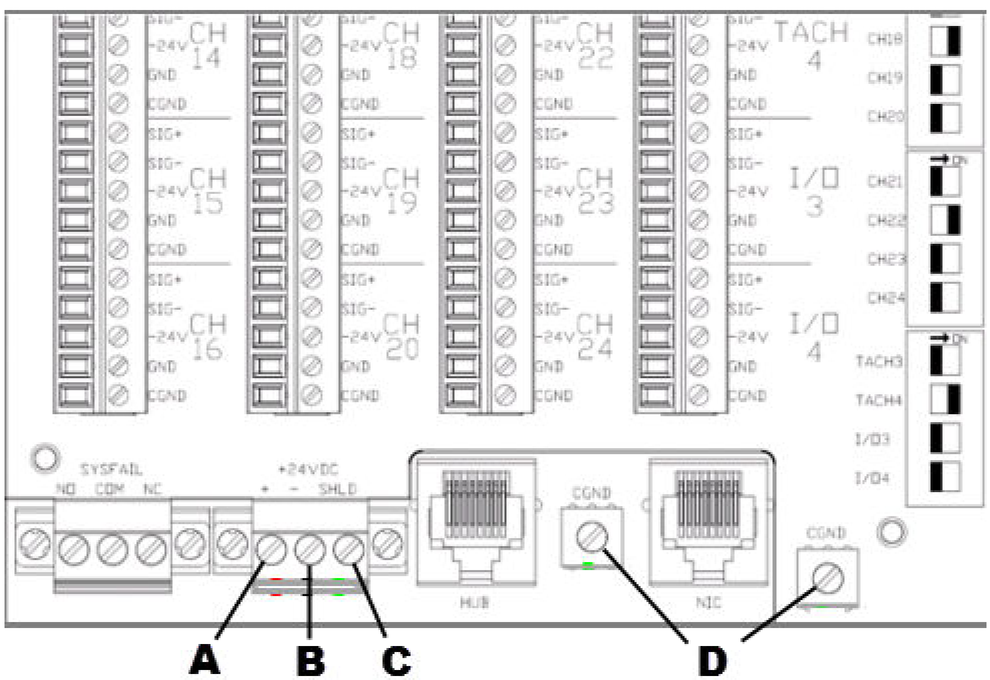
Minimum wire gauge	16 AWG
Cable	Shielded twisted pair
AC	
Nominal voltage	110 VAC to power 24 V power supply
Circuit breaker	10 A (with duplex receptacle)
Power ground	Isolated (from production equipment)

5.5.1 Power and ground wiring on CSI 6500 backplane

⚠ CAUTION!

You cannot use the same 24 VDC source for both +24 VDC and -24 VDC. You must use separate power supplies, or a power supply with separate, isolated outputs.

Figure 5-2: Power and ground wiring on CSI 6500 backplane



A. *+24 VDC*

B. *24 VDC return*

C. *Cable shield or rack ground—use 14 AWG minimum wire size and ring type terminal lugs to ground wires. Use 14 AWG minimum wire size for power wiring.*

D. *To rack ground—you must connect both backplane ground wires to the cabinet ground. You should connect a separate ground wire to the 6500 rack chassis.*

5.6 Recommendations for improving signal quality

The data collected by the CSI 6500 system can only be as good as the signals presented at the CSI 6500 inputs. The system is capable of resolving microvolt-level dynamic signal components. Typically, signals from accelerometers mounted on operating machinery are millivolt level signals. Signals of a magnitude this low can easily be overwhelmed by interference from many sources in an industrial environment.

5.6.1 Choosing a sensor cable

Emerson recommends low capacitance shielded-twisted-pair cable for all CSI 6500 system sensor inputs. This cable protects from low frequency interference such as 50 Hz–60 Hz sources due to conductor twisting, and from RF and static discharge sources due to overall shielding. Conductor size may vary from 22–16 AWG.

Excessive cable capacitance will affect the high frequency response of accelerometer signals. Emerson recommends low capacitance cable (<15 pF/ft) for longer cable runs, especially for channels used for PeakVue measurements. There is evidence that braided shield cables are more effective than foil shield cables because they reduce impedance of the shield conductor. Consider using braided shield cable for long cable runs, electrically noisy installations, or critical sensor channels.

Emerson does not recommend coaxial cable or other non-twisted cable types because they have lower immunity to 50 Hz–60 Hz interference than twisted pair cable. When using multiple-conductor cable, consider individual isolated shields for each twisted signal pair and an overall shield isolated from all cable pair shields.

5.6.2 Routing sensor cables

Route sensor cables in grounded conduit or in cable trays reserved for low voltage control type signals. Do not route sensor cables in conduit or in cable trays containing AC power lines, including the unit enclosure cable entries. If low voltage sensor cables are routed in cable trays containing AC power cables, line frequency components will likely be induced into the sensor signals.

When electrical equipment is switched on or off, the changes in current can induce large spikes in nearby sensor signals. Maintain a minimum of 3 ft between sensor lines and AC power lines. Allow larger distances for higher voltage AC power lines.

Limit the distance of accelerometer, velometer, and passive magnetic tachometer cable to 500 ft. Limit the distance between the displacement sensor cable and the amplifier to 1,000 ft.

Note

When high amplitude, high frequency signals are measured, particularly for PeakVue measurements, the maximum cable length may be much shorter unless low capacitance cable is used.

5.6.3 Routing Ethernet cables

Route Ethernet cables in grounded conduit or in cable trays reserved for low voltage control type signals. Do not route Ethernet cables through conduit or cable trays containing AC power lines. If ethernet cables are routed in cable trays containing AC power cables, line frequency components will likely be induced into the ethernet cable.

5.6.4 Shield terminations

The shield termination of each shielded twisted pair cable requires a particular installation. Some installations require the shield drain wire to be tied in only at the CSI 6500 input. If the sensor cable shield drain wire is grounded at the sensor side, do not connect the shield drain wire at the CSI 6500 input side. The shield connection at the CSI 6500 input is connected directly to the CSI 6500 chassis ground. Therefore, if a grounded shield connection has also been made at the sensor side, a noise current, typically at line frequency, can flow in the shield conductor. This noise current flow will induce a noise voltage into the sensor signal lines, causing a ground loop.

To reduce the effects of RF and static interferences, tie the sensor side shield to the sensor side negative (–) conductor; isolate both the sensor side negative conductor and shield from ground to prevent ground loops.

There is no comprehensive way to terminate cable shields. You may need to determine the shield termination method on a sensor-by-sensor basis to correct the noise problems of a particular installation.

5.6.5 Cable terminations

Terminate cables at the CSI 6500 system inputs. Do not strip the outer cable coverings farther than necessary, and do not allow the exposed cable shields to touch. Cut the shields to expose a minimum of unshielded signal conductors.

Clearly mark cables at the CSI 6500 inputs with labels indicating the sensor location.

Note

Do not cut unused shield drain wires; instead, fold back and tape unused shield drain wires. Later, it may be necessary to make a double shield tie to reduce RF or static interference.

Tie overall shields in multiple conductor cables to earth ground at one end.

5.6.6 Junction boxes

In most installations, sensor cables are routed through junction boxes. When using a junction box, maintain the cable +, –, and shield connections from input to output. Do not allow exposed shield cables to touch, or connect to the local junction box earth ground.

Ground junction box enclosures to earth ground. If possible, route accelerometer cables through junction boxes dedicated for accelerometers cables only. Do not route AC power signals through a sensor junction box.

5.6.7 System grounding

Bolt the unit enclosure to a grounded beam or wall. Connect a ground bonding wire from the unit enclosure to a nearby earth ground. Use a minimum 14 AWG stranded cable for grounding.

Inside the unit enclosure, verify that grounding wires from the unit chassis, the unit power supply, the enclosure frame, the enclosure door, and the AC power cable ground have been installed; connect them to the main enclosure earth ground.

5.6.8 Operating temperature

The CSI 6500 system is designed to withstand moderate industrial conditions. To prevent condensation and water leaks, seal the unit system enclosure and do not mount it in direct sunlight.

Table 5-3: CSI 6500 operation guidelines based on ambient temperature

Ambient temperature=	Guideline
<32°F	Actively heat the system enclosure.
86°F	Do not exceed this ambient temperature for systems equipped with the Transient Daughterboard. Use the CSI 6500 cooling fan.
100–120°F	Install a CSI 6500 cooling fan in the system enclosure.
>120°F	Actively cool the system enclosure to keep system electronics below 100°F.

Note

To maintain a consistent temperature for system operation, install a thermostat in system enclosures that are being actively heated or cooled; keep temperatures between 50°F and 100°F.

⚠ CAUTION!

The CSI 6500 system has been tested to operate reliably up to 140°F, but the unit's electronics will age much quicker than electronics maintained below 100°F.

For information on internal operating temperatures, see *Section A.1*.

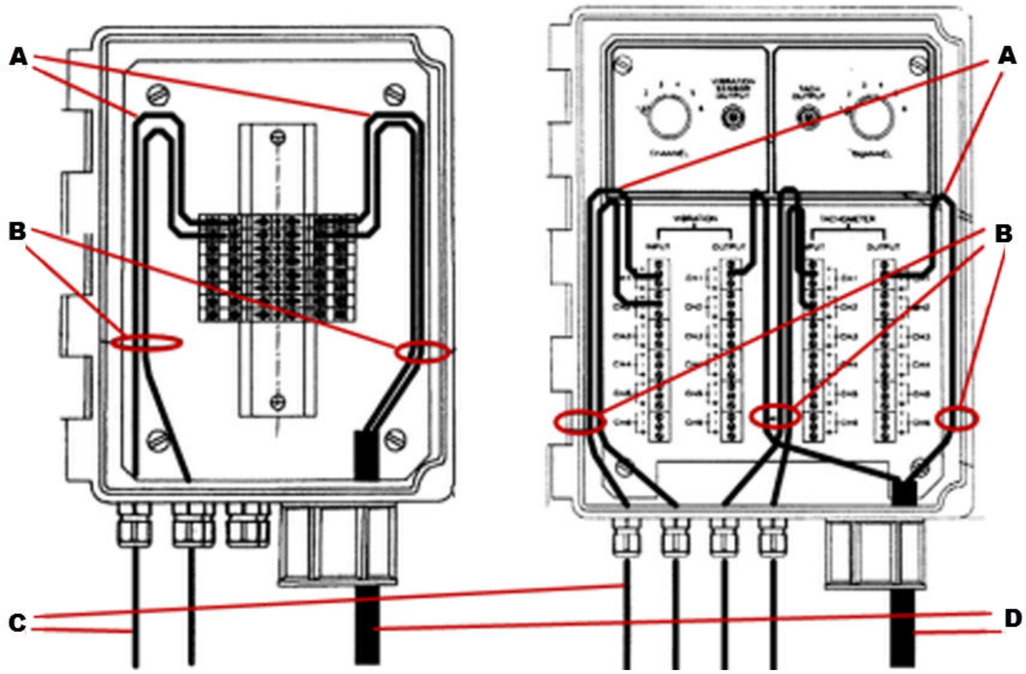
6 Wire terminations

Topics covered in this chapter:

6.1 Terminate instrumentation wiring

Junction boxes have single twisted-pair instrumentation wire pulled through cable grips on the left side of the box, and one or more bundled 9 twisted-pair cable pulled through a 1.5 in. conduit fitting on the right side of the box. Route cables through the box, leaving a service loop, and terminate them to 3-lug terminal blocks or industry standard Phoenix connectors.

Figure 6-1: Junction box routing



A. Service loops
B. Permanent cable tie-downs
C. Sensor cables
D. Multi-pair cables

⚠ CAUTION!

Use correct gauge strippers on individual conductors. Do not strip more than 0.25 in. off a conductor. Do not over-tighten. Turn terminal screw clockwise until you make contact with the wire, then make an additional ¼ turn.

Note

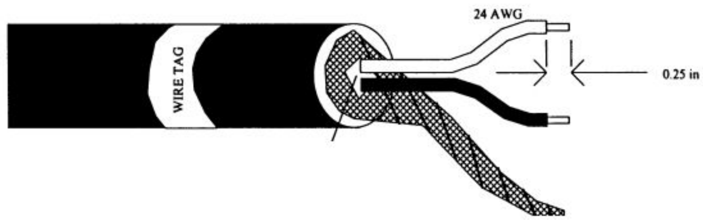
Shield connections pass through junction boxes and are not grounded at the box.

Procedure

1. Starting at the cord grip, pull the wire to the top of the box on the left side. Pull the service loop as shown in *Figure 6-1*.
2. Strip one inch of polyurethane jacket from the cable.
3. Carefully pull twisted-pair conductors out of the braided shield without removing the braided shield.

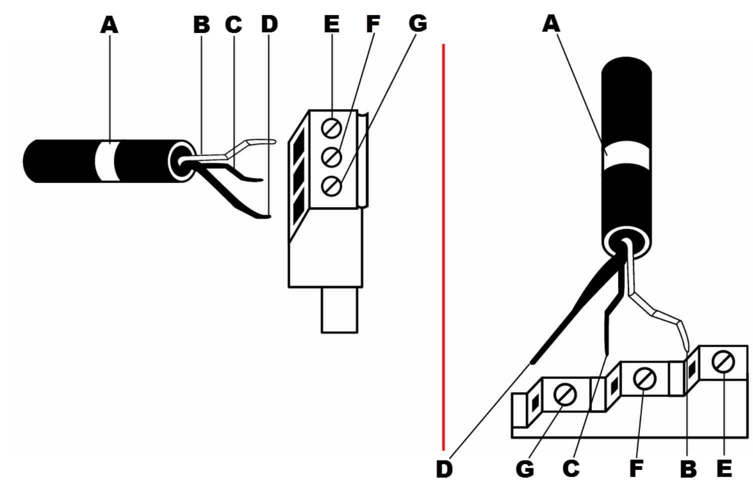
Figure 6-2: Prepare twisted-pair conductors for termination

Spread braided shield apart and pull the conductors through the separation. Twist the braided shield together before termination.



4. Strip 0.25 in. from each conductor and twist the end of the braided shield.
5. Terminate the wire into the proper terminal block according to the following:
   a. Connect sensor positive input to the upper level of the terminal block.
   b. Connect sensor negative input to the middle level of the terminal block.
   c. Connect braided shield to the lower level of the terminal block.

Figure 6-3: Make terminal connections with 24 AWG twisted-pair conductors



A. Wire tag
B. White
C. Black
D. Shield
E. +
F. -
G. Shield

6. Relabel the wire at the phoenix connector.
7. After all cables are terminated, bundle cables and secure against the side of the junction box using a cable tie down.

6.2 Terminate bundled cable

⚠ CAUTION!

Use correct gauge strippers on individual conductors. Do not strip more than 0.25 in. off a conductor. Do not over-tighten. Turn terminal screw clockwise until you make contact with the wire, then make an additional ¼ turn.

Procedure

1. Starting at the cord grip, strip cable jacket and braided shield off the cable.
2. Pull cable to the terminal block, using the following pair sequence:

Table 6-1: Terminal block conductor pairs

Terminal Blocks	Positive Conductor	Negative Conductor	Shield Drain
1 and 9	Yellow	Black	Black
2 and 10	Blue	Black	Blue
3 and 11	Brown	Black	Blue
4 and 12	Orange	Black	Blue
5 and 13	White	Black	Red
6 and 14	Red	Black	Red
7 and 15	Green	Black	Green
8 and 16	Red	White	Blue

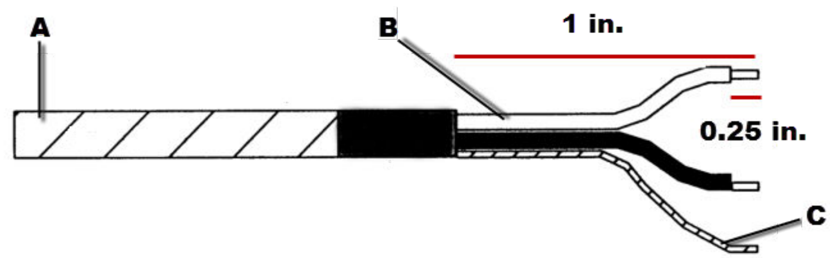
Note
For a 16-channel box, start the sequence over on terminal block 9.

3. Pull individual twisted-pair (with foil shield in place) to the top of the box on the right side. Pull service loop as shown in *Figure 6-1*.
4. Pull to the terminal block and blunt cut any extra wire.
5. Remove one inch of foil shield from twisted-pair and seal the foil shield using heat shrink or electrical tape.
6. Strip 0.25 in. from each conductor and terminate to the terminal block as follows:
   a. Positive Conductor on the upper level of the terminal block
   b. Negative Conductor on the middle level of the terminal block
   c. Shield Drain on the lower level of the terminal block

Figure 6-4: Prepare individual twisted pair cable for termination

Measurements are not to scale.

Foil shield requires wire tag or heat shrink to prevent unraveling.



A. *Foil shield*
B. *24 AWG*
C. *Shield drain*

6.3 Wire termination at the CSI 6500

CSI 6500 sensor cables terminate in three different ways:

1. Directly into the 12-2-2 modules at a A6500-M-FTRM front termination panel.
2. Directly into the 12-2-2 modules at a A6500-M-RTRM rear termination panel.
3. At the inputs on the A6500-P-RTRM termination panel.

   Buffered outputs can then be routed to the 12-2-2 modules with DIP switches.
4. At DIN rail-mounted terminal blocks inside the cabinet/enclosure, then connected to prediction modules or protection module inputs with additional short wiring runs.

6.3.1 Rear termination panel

The A6500-M-RTRM rear termination panel is the prediction (or **M**onitoring) side of the CSI 6500. It plugs onto the A6500-M-BP backplane.

This termination panel has connectors for sensor inputs, tachometer inputs, and discrete input/output relays into the 12-2-2 modules. It provides DIP switches for routing signals from the A6500-P-RTRM (or **P**rotection) side of the rack. Additionally, there are DIP switches for turning accelerometer power on or off, and an output connector for the internal signal generator.

Connectors for +24 V DC power supply, SysFail relay output, and network connections are below the termination panel.

Figure 6-5: A6500-M-RTRM

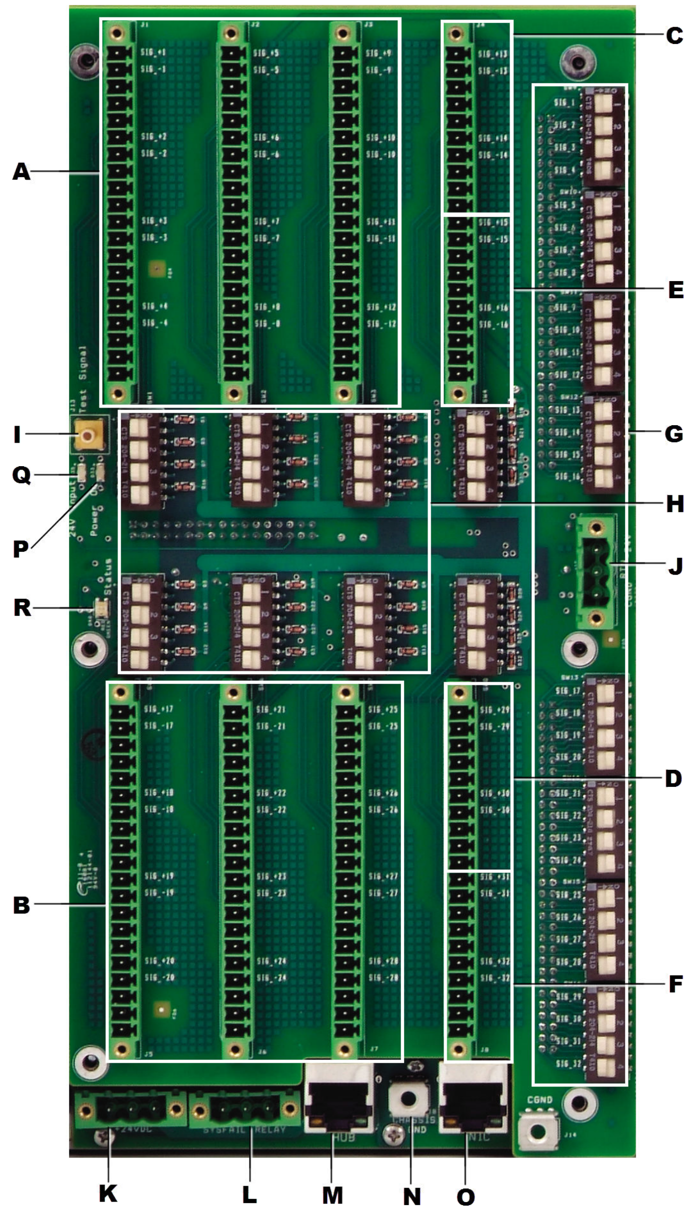


Table 6-2: A6500-M-RTRM

Termination panel	
A	Sensor inputs: MSIG1 (Ch1–12)
B	Sensor inputs: MSIG2 (Ch13–24)
C	Tach inputs[1]: MSIG1 (Ch1–2)
D	Tach inputs: MSIG2 (Ch 3–4)
E	Relay I/O: MSIG1 (I/O 1–2)
F	Relay I/O: MSIG2 (I/O 3–4)

Table 6-2: A6500-M-RTRM *(continued)*

Termination panel	
G	DIP switches for routing buffered sensor/tach inputs from the A6500-P-RTRM side of the rack
H	DIP switches for configuring sensor power On or Off(2) (SW1, SW2, SW3, SW5, SW6, and SW7)
I	Calibration test signal output port (SMB connector)
J	-24 V sensor power input for eddy current sensors

(1) For Tach and Relay channels, leave the sensor power DIP switches in the OFF position.

(2) SW4 and SW8 correspond to tach and relay channels, and are not used.

Table 6-3: A6500-M-BP backplane components

Backplane	
K	SysFail relay connector
L	DC Power input connector for Prediction Side
M	HUB network connector
N	Chassis Ground lug
O	NIC network connector
P	Power On LED
Q	+24 V Input LED
R	Status LED

6.3.2 Terminate bundled cable instrumentation wiring

⚠ CAUTION!

Use correct gauge strippers on individual conductors. Do not strip more than 0.25 in. off a conductor. Do not over-tighten. Turn terminal screw clockwise until you make contact with the wire, then make an additional ¼ turn.

Each signal input channel has an associated DIP switch for connecting accelerometer power. For accelerometer channels that require power, set the associated DIP switch to the ON position. For sensor channels that do not require power from the unit, set the associated DIP switch to the OFF position.

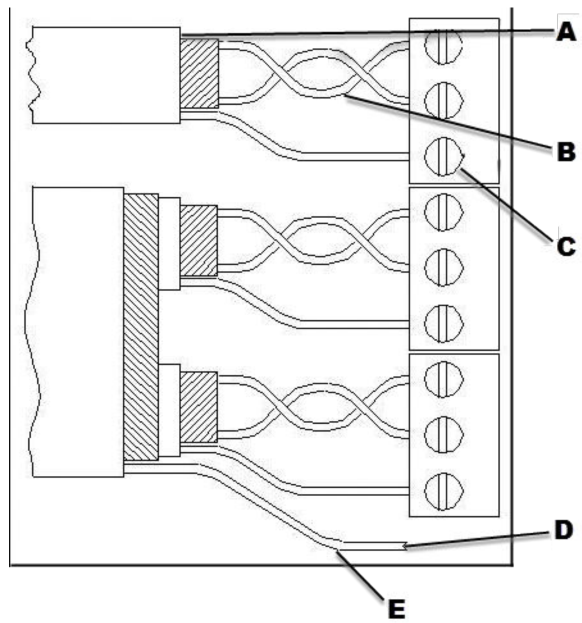
Procedure

1. Pull cable to the terminal blocks.
2. Secure the cable to the side of the enclosure with a cable tie down.

3. Blunt cut any excess wire. Strip the cable jacket beginning where it first reaches the terminal blocks.
4. Pull individual pairs down to the proper channel inputs on the terminal blocks.
5. Remove 1 in. of foil shield and place a wire label around the end of the foil shield. Wire label must match the sensor wire label in the junction box.
6. Strip 0.25 in. from each conductor and terminate to the screw terminals following the pinouts in *Section 6.3.3*.
7. Document the sensor name, wire label name, and unit channel number on the cable administration chart.

Signal, Tachometer, and I/O module wiring notes

Figure 6-6: Signal, Tachometer, and I/O module wiring notes



A. *Strip the insulation and shield as close to the terminal block as possible.*
B. *Maintain cable pair twists as close to the terminal block as possible.*
C. *Connect the cable shield on only one end. Prioritize connecting the shield on the sensor end.*
D. *Connect the multiple-pair cable shield drain wire to earth ground on only one end.*
E. *Do not allow shield drain wires or foil from individual cables to short. Use heat shrink and dress wire ends as necessary.*

6.3.3 Terminal descriptors

Each channel has five terminals. The first two are for the plus (+) and minus (-) signal inputs. If the associated DIP switch is set to ON, these terminals will also supply +24 V constant current accelerometer power.

The second two are for the -24 V power supply for eddy current probes. These terminals only supply power if an external -24 V power supply is connected to the J19 power input terminal at the edge of the termination panel.

The last terminal for each channel is a chassis ground for connecting the sensor cable shield.

Table 6-4: Terminal descriptors for MSIG 1

J1		J2		J3		J4	
CH1	SIG+1/+24V	CH5	SIG+5/+24V	CH9	SIG+9/+24V	TACH1	Tach+1
	SIG-1/+24V return		SIG-5/+24V return		SIG-9/+24V return		Tach-1
	-24V		-24V		-24V		-24V
	Gnd (-24V return)		Gnd (-24V return)		Gnd (-24V return)		Gnd (-24V return)
	Chassis GND (Shield)		Chassis GND (Shield)		Chassis GND (Shield)		Chassis GND (Shield)
CH2	SIG+2/+24V	CH6	SIG+6/+24V	CH10	SIG+10/+24V	TACH2	Tach+2
	SIG-2/+24V return		SIG-6/+24V return		SIG-10/+24V return		Tach-2
	-24V		-24V		-24V		-24V
	Gnd (-24V return)		Gnd (-24V return)		Gnd (-24V return)		Gnd (-24V return)
	Chassis GND (Shield)		Chassis GND (Shield)		Chassis GND (Shield)		Chassis GND (Shield)
CH3	SIG+3/+24V	CH7	SIG+7/+24V	CH11	SIG+11/+24V	I/O1	I/O+1
	SIG-3/+24V return		SIG-7/+24V return		SIG-11/+24V return		I/O-1
	-24V		-24V		-24V		-24V
	Gnd (-24V return[1])		Gnd (-24V return[1])		Gnd (-24V return[1])		Gnd (-24V return[1])
	Shield		Shield		Shield		Shield
CH4	SIG+4/+24V	CH8	SIG+8/+24V	CH12	SIG+12/+24V	I/O2	I/O+2
	SIG-4/+24V return		SIG-8/+24V return		SIG-12/+24V return		I/O-2
	-24V		-24V		-24V		-24V
	Gnd (-24V return)		Gnd (-24V return)		Gnd (-24V return)		Gnd (-24V return)
	Chassis GND (Shield)		Chassis GND (Shield)		Chassis GND (Shield)		Chassis GND (Shield)

(1) -24 V terminals on I/O channels are not used for I/O connections.

Table 6-5: Terminal descriptors for MSIG 2

J5		J6		J7		J8	
CH13	SIG+13/+24V	CH17	SIG+17/+24V	CH21	SIG+21/+24V	TACH3	Tach+3
	SIG-13/+24V return		SIG-17/+24V return		SIG-21/+24V return		Tach-3
	-24V		-24V		-24V		-24V
	Gnd (-24V return)		Gnd (-24V return)		Gnd (-24V return)		Gnd (-24V return)
	Shield		Shield		Shield		Shield
CH14	SIG+14/+24V	CH18	SIG+18/+24V	CH22	SIG+22/+24V	TACH4	Tach+4
	SIG-14/+24V return		SIG-18/+24V return		SIG-22/+24V return		Tach-4
	-24V		-24V		-24V		-24V
	Gnd (-24V return)		Gnd (-24V return)		Gnd (-24V return)		Gnd (-24V return)
	Shield		Shield		Shield		Shield
CH15	SIG+15/+24V	CH19	SIG+19/+24V	CH23	SIG+23/+24V	I/O3	I/O+3
	SIG-15/+24V return		SIG-19/+24V return		SIG-23/+24V return		I/O-3
	-24V		-24V		-24V		-24V
	Gnd (-24V return)		Gnd (-24V return)		Gnd (-24V return)		Gnd (-24V return)
	Shield		Shield		Shield		Shield
CH16	SIG+16/+24V	CH20	SIG+20/+24V	CH24	SIG+24/+24V	I/O4	I/O+4
	SIG-16/+24V return		SIG-20/+24V return		SIG-24/+24V return		I/O-4
	-24V		-24V		-24V		-24V
	Gnd (-24V return)		Gnd (-24V return)		Gnd (-24V return)		Gnd (-24V return)
	Shield		Shield		Shield		Shield

6.4 Signal routing from the monitoring panel to the prediction panel

You can set DIP switches on the A6500-M-RTRM termination panel to route sensor and tachometer signals from the A6500-P-RTRM termination panel. Set these switches to the ON position to connect to their respective A6500-P-RTRM buffered outputs. See *Figure 1* for DIP switch locations.

The external input connectors on the A6500-M-RTRM are connected to the 12-2-2 module signal inputs, regardless of whether the DIP switches are set to ON or OFF. Therefore, if a DIP switch is set to route an input from the A6500-P-RTRM, do not connect an external sensor to the associated external input of the A6500-M-RTRM. Set the DIP switches for accelerometer power to OFF while routing inputs from the A6500-P-RTRM.

6.4.1 Signal input cross reference

Figure 6-7: CSI 6500 rear termination panel with signal input cross references

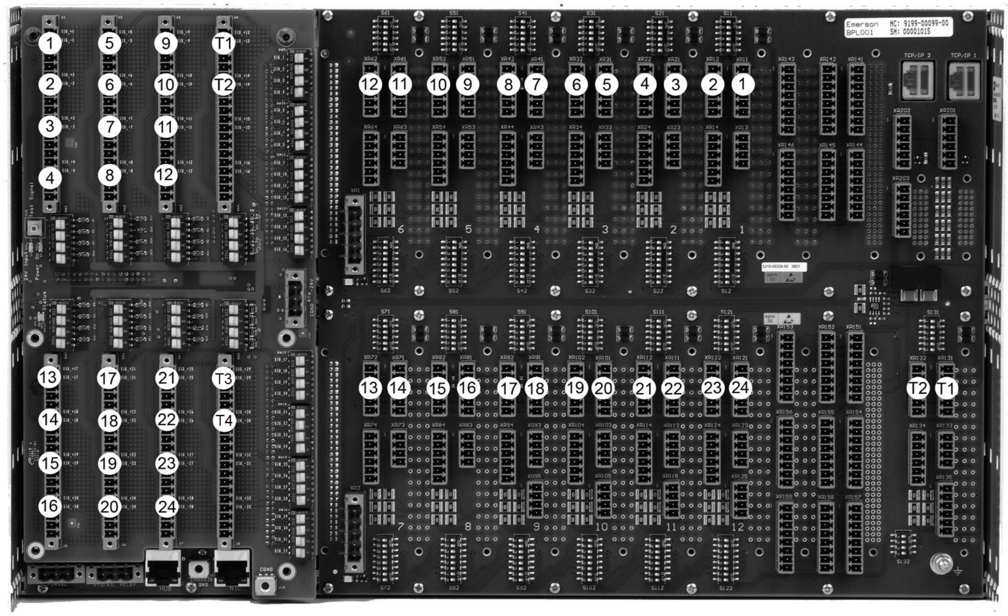


Table 6-6: A6500-M-RTRM signal inputs

A6500-M-RTRM inputs	Output	Connector label
Sensor inputs 1–12	A6500-P-RTRM buffered output, monitor positions 1–6	XR11–XR64
Sensor inputs 13–24	A6500-P-RTRM buffered output, monitor positions 7–12	XR71–XR125
Tach inputs 1 and 3 (T1 & T3)	CSI 6312 pulse output, channel 1 (T1)	XR131
Tach inputs 2 and 4 (T2 & T4)	CSI 6312 pulse output, channel 2 (T2)	XR132
Relay I/O channels 1–4	not connected	not used

6.5 Terminate discrete I/O

⚠ CAUTION!

Use correct gauge strippers on individual conductors. Do not strip more than 0.25 in. off a conductor. Do not over-tighten. Turn terminal screw clockwise until you make contact with the wire, then make an additional ¼ turn.

Procedure

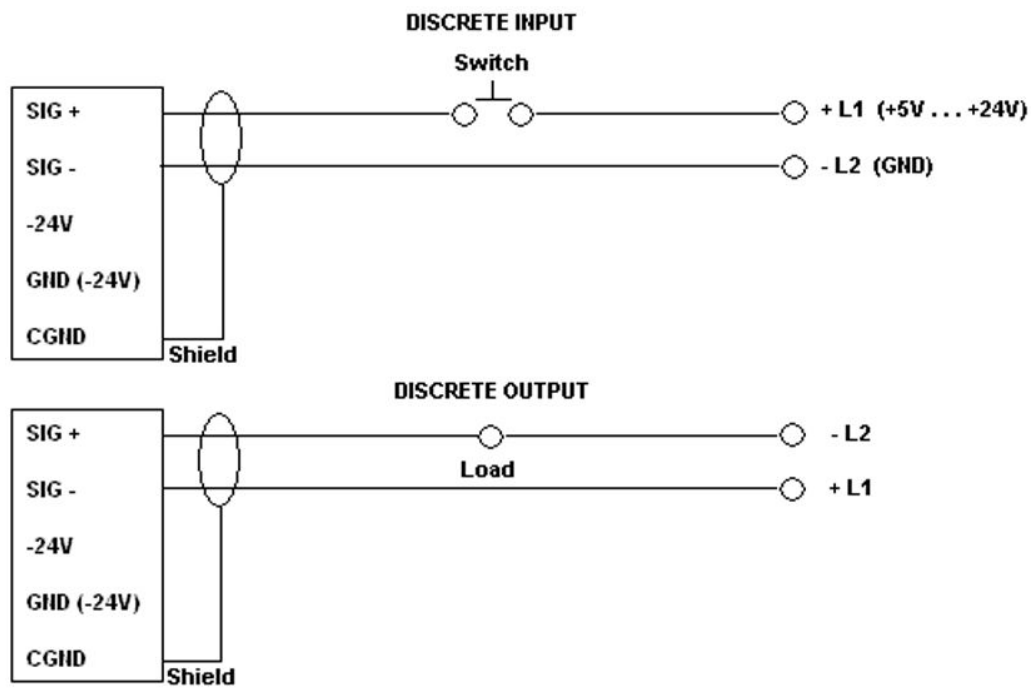
1. Pull cable to the I/O relay channel inputs on the termination panel.
2. Blunt cut excess wire. Strip 1 in. from the cable jacket and 0.25 in. from each conductor.
3. Terminate according to *Table* 6-4, and the following:

Relay Excitation Voltage	SIG+
Voltage Return	SIG-
Shield Drain	Shield

4. Relabel wire at the connector.
5. After all wires are pulled, bundle the wires, and secure the bundle to the side of the enclosure.
6. Document the discrete I/O name, wire label name, and the CSI 6500 channel number on the cable administration chart.

Figure 6-8: Discrete I/O cable termination

Load may be placed on either -L2 or +L1.



6.6 Rear shield/Adapter panel—A6500-M-RSH

The rear shield panel is a modified version of the front termination panel. It routes signals to the backplane (A6500-M-BP) from the front termination panel instead of the rear termination panel.

If you will route all sensor and tach inputs from the A6500-P-RTRM, you can use the rear shield panel (A6500-M-RSH) instead of the rear termination panel (A6500-M-RTRM). The rear shield panel provides a simpler adapter for Jumper connections to the A6500-P-RTRM sensor and tach signals, and connectors for the 4 external relay I/O termination.

6.7 Front termination panel—A6500-M-FTRM

Figure 6-9: CSI 6500 with A6500-M-FTRM

Use the A6500-M-FTRM when no protection monitors are required, and when front-mounted wire terminations are preferred. It provides the same sensor input connectors as the A6500-M-RTRM. It also has LED indicators, and connectors for +24 V system power, -24 V proximity probe power, SysFail relay, and test signal.

Ribbon cables connect the signal inputs from the front termination panel to an adapter board at the rear of the backplane. Additional cables connect the Power and SysFail relay inputs from the front panel to the backplane. DIP switches are also located on the rear of the panel for turning accelerometer power on or off for each channel.

6.8 Terminate +24 V power for the CSI 6560 and CSI 6510 modules

The +24 V power input for the CSI 6560 and CSI 6510 prediction modules is located on the A6500-M-BP backplane and on the A6500-M-FTRM. This connector is isolated from the protection modules, which are powered separately. Emerson recommends a separate power supply for protection modules.

⚠ CAUTION!

- **The CSI 6500 +24 V power terminals are not wired the same as the CSI 4500 power terminals. Do not use a connector that was previously wired for a CSI 4500 without reconfiguring the wiring.**
- **The +24 V power input for the CSI 6560 and CSI 6510 modules requires a +24 V power supply. Do not connect the -24 V power supply intended to power the Eddy Current sensor to this input. Verify all power supply connections are wired and connected properly before powering the unit.**

Procedure

1. Route cable to the power connector.
2. Leave a service loop.
3. Strip conductors 0.25 in. and terminate to Phoenix connections according to the following diagram:

Table 6-7: Power termination for CSI 6560 and CSI 6510 prediction modules

Wire	Termination panel
+DC	+
-DC	-
Shield	SHLD

Note

When connecting a 24 V power supply to the CSI 6500, connect the DC side of the power supply to the CSI 6500 before connecting the AC side of the power supply to AC line power.

4. Secure the power cable to the side of the enclosure with a cable tie-down.

6.8.1 Power input specifications

Table 6-8: Power input specifications

Power requirement	Range
DC input voltage	18–31 VDC (24 VDC nominal)

Table 6-8: Power input specifications *(continued)*

Power requirement	Range
DC input current (with Transient)	1.0 A @ 24 VDC (no termination panel) 1.25 A @ 24 VDC (with termination panel, all channels powered)
DC input current (without Transient)	0.65 A @ 24 VDC (no termination panel) 0.9 A @ 24 VDC (with termination panel, all channels powered)
Maximum input surge current (all versions)	7 A @ 24 VDC for 1 ms 3 A @ 24 VDC for 20 ms
Maximum power dissipation	22 W 30 W with Transient

6.9 Eddy Current sensor: -24 V power supply

The power input connector for Eddy Current sensors is located on the A6500-M-RTRM, and on the A6500-M-FTRM.

When using Eddy Current sensors, feed in a -24 V sensor supply at this connector. This connector then supplies all the -24 V sensor supply terminals on the termination panel.

The supply terminals at each channel have built-in auto-resetting breakers to protect against a short circuit on one channel disrupting the power supply for all channels.

Note

The CSI 6500 performs an internal test to verify that -24 V power is connected. If a -24 V supply is not connected, the CPU Status LEDs on the CPU, and the Status LED on the left side of the termination panel will turn from green to red. If Eddy Current sensor power is not required, this internal test can be disabled by installing a jumper on the termination panel at the pins labeled -24 V Disable.

⚠ CAUTION!

The -24 V Eddy Current sensor power input requires a -24 V power supply. Do not connect the +24 V power supply intended for CSI 6560 or CSI 6510 power to this input. Verify all power supply connections are wired and connected properly before powering the unit.

6.10 SysFail relay termination

The SysFail relay output connector is labeled SYSFAIL RELAY, and located on the bottom left corner of the A6500-M-BP backplane, and on the A6500-M-FTRM.

The SysFail relay output can be terminated as either normally-open (terminate to C and NO) or normally-closed (terminate to C and NC).

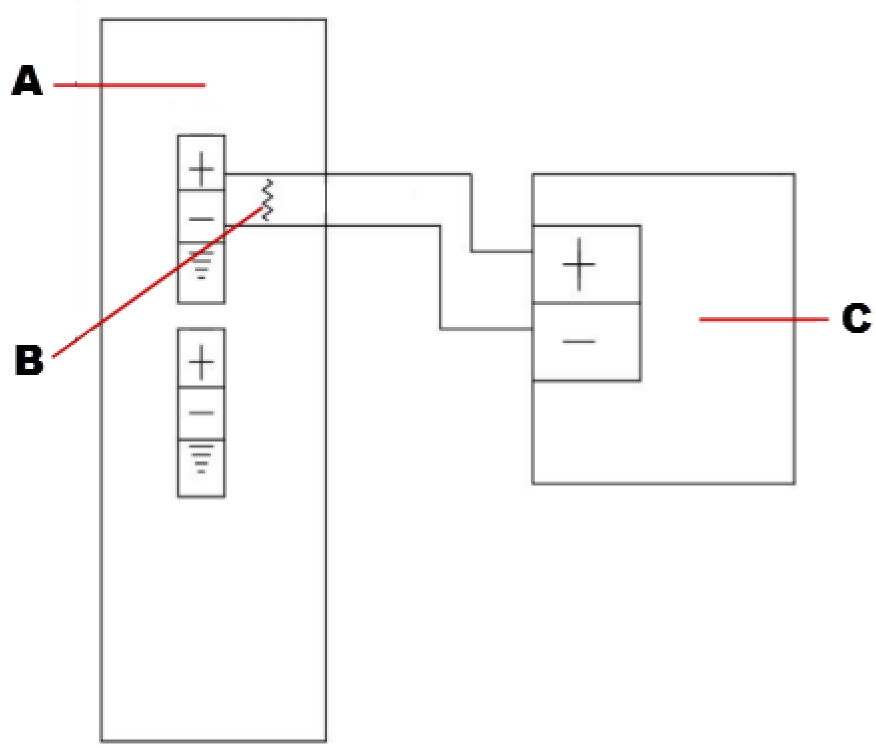
⚠ CAUTION!

The SysFail relay connection is an output for relays only. Do not connect the +24 V power supply intended for CSI 6560 or CSI 6510 power, or the -24 V power supply intended for Eddy Current Probe power to this output. Verify all power supply connections are wired and connected properly before powering the unit.

6.11 Loop interconnection for 4-20 mA current

To convert the milliamp signal to a voltage signal, install a 250 ohm resistor between the + and - signal inputs when connecting 4-20 mA signal inputs.

Figure 6-10: CSI 6500 transmitter connection for 4-20 mA current



A. *CSI 6500 input sensors*
B. *250 ohm resistor*
C. *4-20 mA transmitter*

Note
CSI 6500 MUX (SIG) channels do not provide loop power to 4-20 mA devices. A separate module is required to provide loop power.

6.12 Terminate Ethernet connection

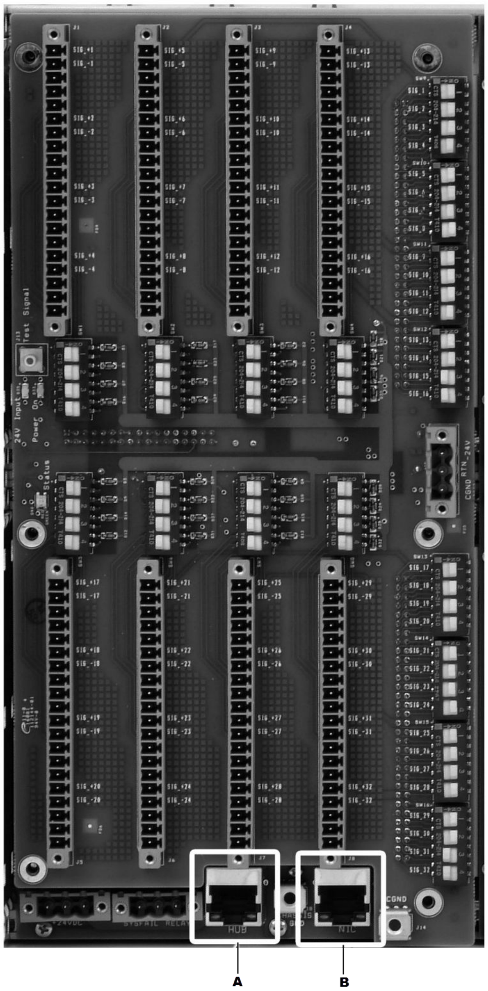
⚠ CAUTION!

Do not daisy-chain multiple units using the NIC or HUB. If one network connection fails, it will disrupt network communication for multiple units.

Procedure

1. Route the network cable to RJ45 connectors, at either the front of the CSI 6560 module, or at the rear of the A6500-M-BP backplane.
2. Blunt cut excess wire and attach the RJ45 CAT5 according to your plant's standards for 10/100 Base-T connections.
3. Connect the terminated Ethernet cable to the NIC.
4. Secure the network cable to the right side of enclosure using a cable tie-down.

Figure 6-11: NIC and HUB connectors



A. Rear HUB connector
B. Rear NIC connector

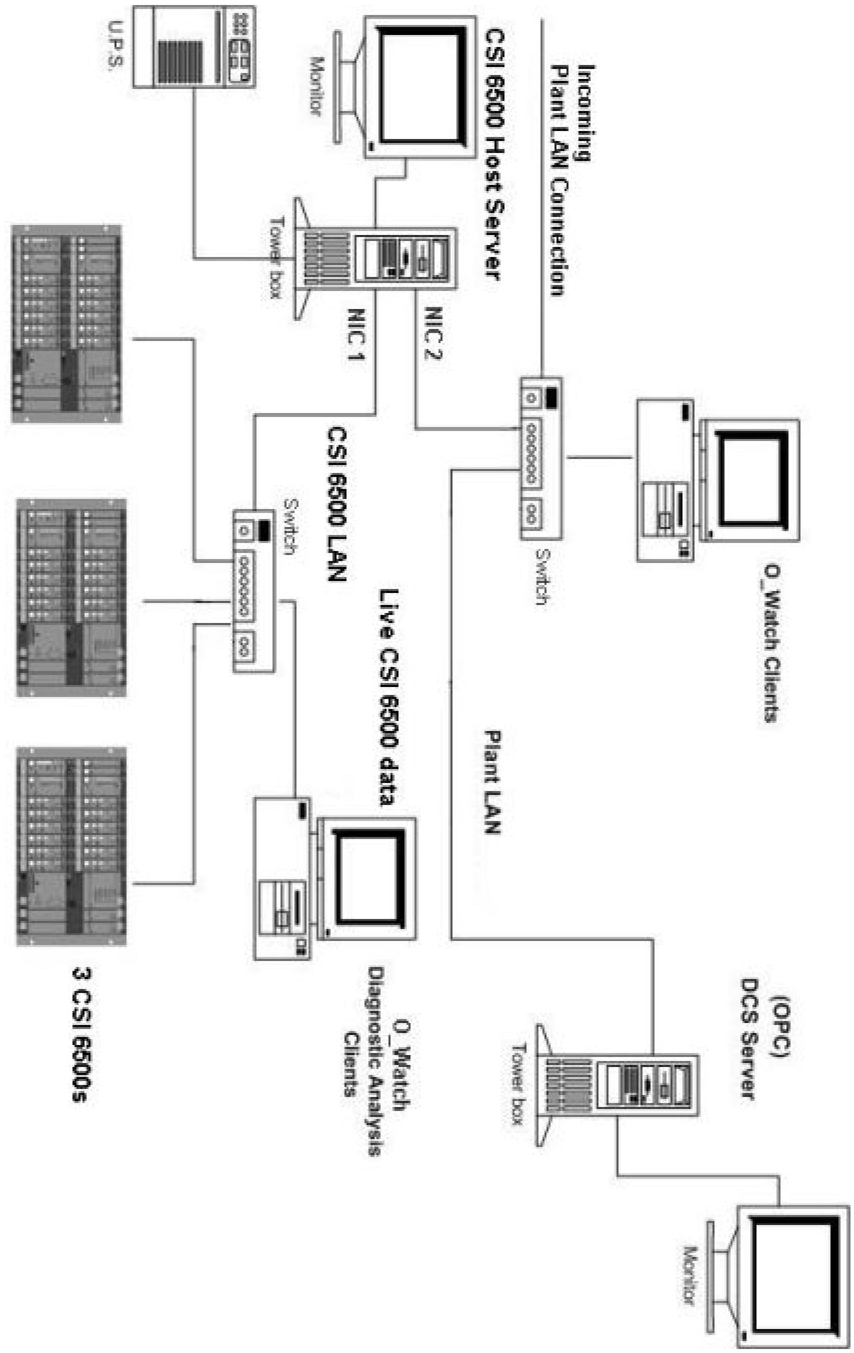
Use the NIC connector when connecting to an Ethernet hub or switch.

Use the HUB connector when connecting directly to a PC (the HUB connector provides the same function as a crossover cable).

6.13 Default schema for network addressing

The network arrangement shown assumes one of the CSI 6500 units is a transient model (CSI 6500T).

Figure 6-12: Default schema for network addressing



7 Hardware configuration

Topics covered in this chapter:

7.1 Hardware configuration: overview

The CSI 6560 Processor Module, in combination with the CSI 6510 Signal Input Module, is a multi-channel, multi-tasking, multi-processor data acquisition system primarily intended for monitoring heavy industrial rotating machinery. Typical signal inputs are dynamic AC machine vibration signatures from accelerometers, velocity probes, or eddy current sensors. These signals include two components: the dynamic AC component, which represents machine vibration, and a DC component, which represents the sensor bias level. In the case of an eddy current sensor, the DC component represents the gap, or average distance between the probe tip and the machine shaft. Other signal inputs include process signals; these are DC parameters such as temperature or pressure.

Tachometer inputs are used to determine machine speed. These tachometer signals are typically generated from an eddy current sensor or passive magnetic sensor positioned at a machine shaft keyway or gear, producing a pulse train (not necessarily 1x machine speed) representing the machine phase and running speed.

Discrete inputs represent machine states such as running, off, and starting. These inputs are used to control or modify the data acquisition based on machine state. Common state control inputs are relay closures or machine RPM. AC or DC signal levels can also be used for state control.

7.1.1 Gross Scan monitoring

Gross Scan monitoring includes:

- the acquisition of the overall level of the dynamic AC vibration signal, typically the RMS value of the signal.
- the DC sensor bias level.
- the measurement of a DC process signal.

All these signal inputs are DC values (the RMS value is a DC value proportional to the overall energy content of the AC signal). The Gross Scan inputs are multiplexed into a fast successive approximation ADC controlled by the CSI 6560 Processor module. Gross Scan monitoring measures all input channels AC+DC twice per second. When the Transient option is included, true waveform peak-to-peak may be included in Gross Scan monitoring.

7.1.2 Spectral Scan

Spectral Scan is defined as the acquisition and analysis of dynamic AC signals only. The signals are acquired, two channels at a time (referred to as CHX and CHY), with a dual channel delta-sigma ADC controlled by the system DSP. The DSP performs analysis of the acquired time waveforms and transmits the results to the CPU host processor. Preprogrammed groups of Spectral Scan measurement parameters (AP Sets) may be assigned to specific machine state conditions to tailor data acquisition to specific machine operational states.

7.1.3 Transient data capture

Transient data capture is the acquisition of continuous time waveforms of dynamic AC signals. Transient data is captured in parallel for all channels. Other data stored along with the Transient data include Gross Scan data captured once per second, tach pulse records, and acquisition timestamps. The Transient data is stored on hard disk, and is available for real-time analysis via Ethernet.

7.2 The CSI 6560 and CSI 6510 modules

The CSI 6500M has a Processor module and either one or two CSI 6510 Signal Input modules.

The CSI 6500T has a Processor module with a Transient Daughterboard and either one or two CSI 6510 Signal Input modules with Transient Filter Boards.

7.2.1 CSI 6560 Processor module

The CSI 6560 Processor module provides all data acquisition, data storage, and data communication functions for the CSI 6500 system. The CSI 6560 is capable of up to 24 simultaneous, continuous waveform measurements for detailed Spectral analysis, up to 24 RMS and DC values for Gross Scan measurements, up to 4 tachometers for machine speed measurement, and up to 4 digital state inputs.

Gross Scan values, tachometer values, and digital input states may be combined logically to determine machine operating state and define specific data acquisition states. The system can be configured to transmit and store data on either time interval or based on the amount of change of the data values.

The Processor module provides four 100 Base-T Ethernet ports and one RS-232 serial port for system communications and diagnostics. Additional connections are available for the calibration signal and a dry contact SPDT SysFail relay. This relay is energized when the Processor CPU successfully boots. On a CPU failure or power loss, the relay will de-energize.

The Processor module may be configured to download its operational firmware via Ethernet upon boot, or to operate on firmware that has been stored in FLASH memory.

The Processor module has an on-board signal generator capable of producing sinusoidal and DC signals that are routed to the input modules during system calibration and on Power On Self Test (POST). Recalibrate the function generator at least once a year with a NIST traceable volt meter. See *Section A.2* for specific calibration information.

The Processor module automatically detects input module type and configuration, and only permits database configuration based on the existing channel set.

The Processor module supports the CSI 6500 Transient Daughterboard, which adds parallel time waveform acquisition capabilities for all channels.

Figure 7-1: CSI 6560 Processor module

Transient Daughterboard

The Transient Daughterboard adds the capability for parallel, continuous time waveform acquisition on all channels. All collected time waveform data, along with Gross Scan data and up to four tachometer pulse records is stored on an internal hard drive, which provides approximately 80 minutes per GB of storage.

The Transient Daughterboard can also stream data via Ethernet to analysis applications in near real time, without affecting data collection or on-board data storage.

While collecting time waveforms and tachometer pulses, the Transient Daughterboard continuously calculates the peak-to-peak value of each channel's waveform. When configured, this value may be sent to the CSI 6560 Processor module for use as the Gross Scan instead of the RMS value produced by the CSI 6510 Signal Input module.

The hard drive used on the Transient Daughterboard is specially rated for continuous operation. This drive should be replaced annually. In emergencies, any 2.5 in. parallel IDE drive may be used temporarily, but these drives are not generally rated for continuous operation.

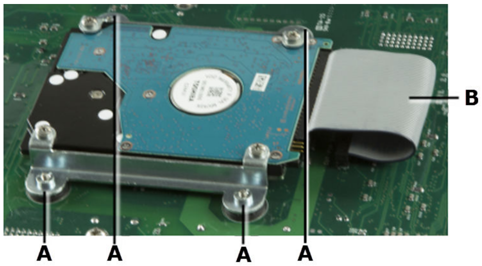
When installing the Transient Daughterboard on the CSI 6560 Processor module, make sure all five mating connectors are fully engaged, and then install all six mounting screws.

Figure 7-2: Transient Daughterboard PCB mounted on Processor module

A. Mounting screw positions
B. Transient Daughterboard hard drive

Replace the Transient Daughterboard hard drive

Figure 7-3: Transient Daughterboard hard drive inset



A. Hard drive mounting screws
B. Ribbon cable

Procedure

1. Remove the four hard drive mounting screws.
2. Gently remove the hard drive ribbon cable from the hard drive, and then remove the old hard drive.
3. Install the new hard drive in the bracket and tighten the four screws.

⚠ CAUTION!

Do not over tighten the screws.

4. Insert the ribbon cable into the new hard drive. Take care to line it up correctly.

Format the Transient Daughterboard hard drive

Before the new hard drive can be used, it must first be formatted by the Transient Daughterboard.

Procedure

1. Power on the system and ignore any hard drive error messages produced by the Transient Daughterboard on the HyperTerminal monitor.
2. When the system has booted, launchDHM_III.exe (located in the C:\inetpub\ftproot\bin \Tools directory) to format the hard drive.
3. From the main menu, select Transient > Format Hard Drive.
4. When the drive has been formatted, reboot the unit. Ignore any hard drive error messages produced by the Transient Daughterboard on the HyperTerminal monitor.

   When the POST process is complete, the firmware will automatically prepare the hard drive with the Transient File System. This process may take up to an hour.

5. Reboot the unit.

   The boot process should now complete normally with no hard drive error messages. If configured, Transient data collection should begin, indicated by a flashing hard drive indicator on the CSI 6560 Processor front panel.

7.2.2 CSI 6510 Signal Input module

The CSI 6510 Signal Input module combines the features of Signal Input, Tachometer Input, and I/O Relays to allow a combination of sensor and relay types in one module.

The CSI 6510 provides 12 channels of vibration or process sensor inputs, 2 channels of tachometer sensor inputs, and 2 optically-isolated I/O relay channels.

See *Section A.3* for specific calibration information.

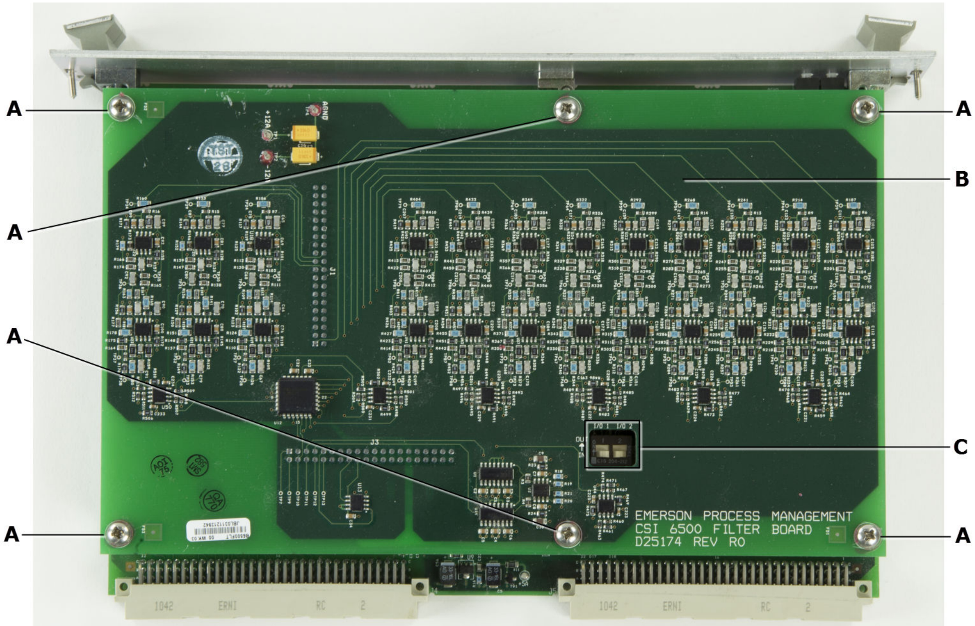
Figure 7-4: CSI 6510 Signal Input module

Transient Filter Board for the CSI 6510

The Transient Filter Board provides parallel anti-aliasing filters for the signal channels on the Signal Input module. Either one or two Transient Filter Boards may be used to configure either a 12- or 24-channel Transient System.

When installing the Transient Filter Board on the Signal Input module, make sure both mating connectors are fully engaged, then install all six mounting screws.

Figure 7-5: Transient Filter Board PCB mounted on a Signal Input module



A. *Mounting screw positions*
B. *Transient Filter Board*
C. *I/O relay DIP switches*

Vibration signal inputs

The vibration sensor types include accelerometer, passive velocity, active velocity, and displacement. The Signal Input module will also accept non-specific AC or DC inputs from any source that conforms to the input range limits.

The vibration inputs provide the following programmable functions for each channel: Input Attenuator /1, /2, Gain x1, x10, integrator on/off. In *Table 7-1*, the combination of input attenuator and gain setting provide four input range combinations.

Table 7-1: Signal input module input ranges

Attenuator	Gain	Input Range +/-
/2	x1	10.0 V, 100 g, 100 ips, 50 mil
/1	x1	5.0 V, 50 g, 50 ips, 25 mil
/2	x10	1.0 V, 10 g, 50 ips, 5 mil
/1	x10	0.5 V, 5 g, 5 ips, 2.5 mil

The integrator allows acceleration signals to be converted to velocity.

The CSI 6510 Signal Input module selects 2 of the 12 vibration channels at a time and routes them to the Processor module for spectral analysis. RMS-to-DC conversion is performed on all 12 channels. The RMS and DC signals are routed to the Processor module for Gross Scan collection.

The Transient Filter Board is required for Transient data acquisition.

To measure 4-20 mA signals, add a resistor across the channel input. A typical value is 250 ohms, which converts 4-20 mA to 1-5 V. Maximum series resistor value is 1000 ohms.

Tachometer inputs

The Tachometer inputs allow measurement of two pulse tachometer sources per module. Tachometer sensor types may include, but are not limited to: eddy current sensor, Hall effect sensor, or TTL pulse type from various sources.

The Tachometer Input module features either fixed voltage trigger or “adaptive” automatic triggering. Triggering parameters may be set independently for each tachometer sensor input.

An input gain selection of x1 or x5 may be selected for each channel. A gain of x5 is recommended for tachometer inputs smaller than 1 V pk-pk. If the x5 input gain is used, care should be taken to make sure that the input signal remains within +/-24 V, including any sensor bias or gap voltage.

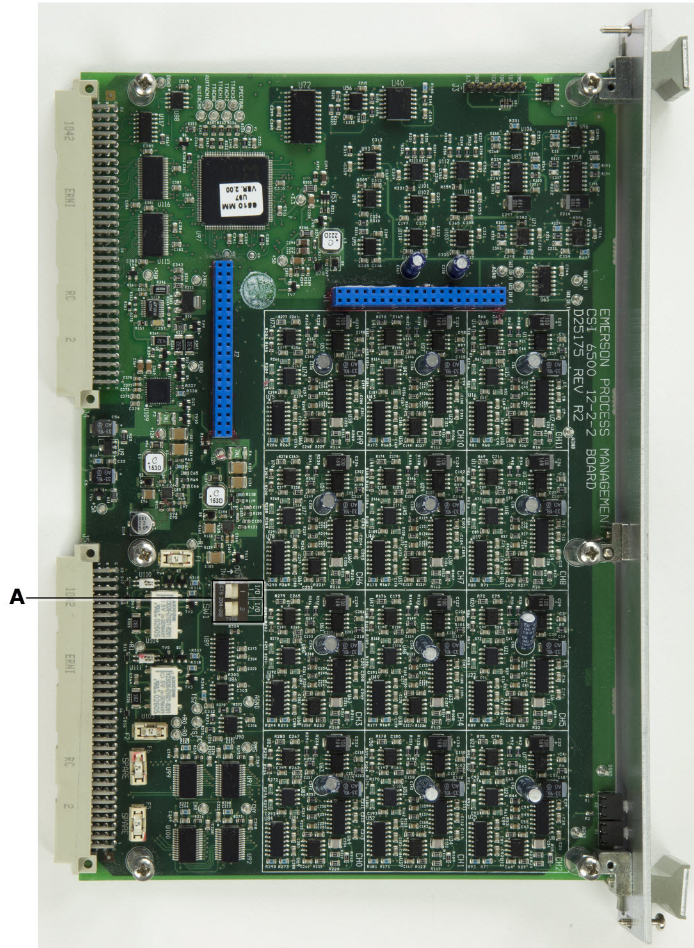
I/O relay channels

Each CSI 6510 Signal Input module has two I/O relay channels that provide optically isolated discrete inputs or dry contact outputs. Inputs can be between 5 V and 24 VDC. Outputs are limited to 24 VDC @ 0.5 A.

Note

AC relays are not provided.

Figure 7-6: Signal Input module PCB



A. *I/O relay DIP switches*

Each I/O Relay channel on the CSI 6510 Signal Input module contains both input and output hardware. The relays are configurable as either input or output relays, with a DIP switch (SW) on the circuit board. A relay channel that is configured in software cannot be used unless the corresponding DIP switch is set to the correct position. The firmware will detect the DIP switch state at startup and generates a flag in the HyperTerminal session if the software configuration does not match the DIP switch setting. The DIP switches are used to protect a user input device from inadvertently being shorted by a relay output configuration.

Set the corresponding DIP switch to the ON position for output relays, and to the OFF position for input relays. The factory default state of the DIP switches is OFF (Input). DIP switch 1 is for the first relay channel and DIP switch 2 is for the second relay channel.

The shelf-state of the output relays is normally open, meaning that when the power to the unit is disconnected, the relays are open. While operating the unit, the relays are typically closed until activated by an alarm, but they can be configured either way.

7.3 Configure a CSI 6500 with a terminal emulator

7.3.1 Configure access to a CSI Machinery Health Monitor from a computer

Use a terminal emulator such as Telnet or HyperTerminal to connect to the CSI Machinery Health Monitor using a serial cable or an ethernet cable.(1) Configure the settings in *Table 7-2* in the terminal emulator's connection settings.

Prerequisites

You need a username and password to log on to a CSI Machinery Health Monitor with Telnet.

Table 7-2: Serial connection setup

Setting	Value
serial port	COM1
baud rate	9600
data bits	8
stop bit	1
parity	none
flow control	none

7.3.2 Configure boot parameters with a terminal emulator

During normal usage, it is unlikely that you will need to change the initial boot parameters. However, two situations may require changes to boot parameters:

- The CPU or Transient board is being replaced, and the replacement board has different boot settings.
- The unit is added to an existing Ethernet network that is not directly connected to the online server through a dedicated cable.

Note
Do not add a unit to an existing network until its IP addresses (CPU board, Transient board) have been verified and changed, if necessary, to be compatible with addresses already in use on the existing network.

Procedure

1. Turn on the unit and start a terminal session.

   A screen similar to the following will appear during the boot process:

(1) *Telnet and HyperTerminal are Windows Features that are available but are not enabled by default. You can use other terminal emulator programs.*

VxWorks System Boot

Copyright 1984-2002 Wind River Systems, Inc.

CPU: CSI 6500

Version: 5.5

BSP version: 1.2/4.00f

Creation date: May 5, 2008, 10:38:03

Image: bootrom

Press any key to stop auto-boot...

2. When the boot process has completed, type bootChange and press Enter to configure the unit. This command is case-sensitive.

   A list of boot parameters appears one line at a time. When configuring the Main Processor, the screen will look similar to this:

boot device	: shend0
processor number	: 0
host name	:
file name	: bin/6500
inet on ethernet (e)	: 192.168.0.10:ffffff00
inet on backplane (b)	:
host inet (h)	: 192.168.0.1
gateway inet (g)*	:
user (u)	: anonymous
ftp password (pw) (blank = use rsh)	: anonymous
flags (f)	: 0x1008
target name (tn)	:
startup script (s)	:
other (o)	:

* If a gateway is used, the address must be specified as a boot parameter.

   When configuring a Transient Processor, the screen will look similar to this (note the difference in the file name value, which includes a "t" for Transient, and the different boot flags:

boot device	: shend0
processor number	: 0
host name	:
file name	: bin/6500t
inet on ethernet (e)	:192.168.0.11ffffff00

inet on backplane (b)	:
host inet (h)	:192.168.0.1
gateway inet (g)	:
user (u)	:anonymous
ftp password (pw) (blank = use rsh)	:anonymous
flags (f)	:0x1408
target name (tn)	:
startup script (s)	:
other (o)	:(IP Address of WINS server, if configured)

Note
Only change boot flags under the direction of Emerson Product Support.

If allowed to complete without interruption, the boot process should finish with a screen similar to this:

Cfg Table Last "Put" (GUID: 0x774059b0-e72b-4e09-a690fc0c10ab007d)

(GUID time: 2008-08-13 19:09:29)

Component	Last Calibrated
----------------	-------------------------------------
DIO	2008-08-13 19:09:25
GS	2008-08-13 19:09:25
TACH	2008-08-13 19:09:25
SCHED	2008-08-13 19:09:26
PRED	2008-08-13 19:09:25
LIMIT	2008-08-13 19:09:26
TRANS	2008-08-13 19:09:29
EGU_FAC	Default Table
EGU_ASN	Default Table

BRS_initRamdisk_i32f: No browser disk image found in FLASH

Initializing empty browser RAM disk /browser...Succeeded.

/browser/ - Volume is OK

Base Modbus register table size (excluding DCS info): 0xcf8a (53130)

This unit will begin announcing its availability in 84 seconds

0x7942148 (t_startup): HLTMON_sysCheck_i32f: All expected modules were successfully registered

7.3.3 HyperTerminal navigation after boot interrupt

You may interrupt the boot process by immediately pressing Space after the VxWorks copyright is displayed. If you interrupt the boot process, use the following commands to navigate the boot configuration console.

The most commonly used commands are ?, @, P, and C.

Note
When modifying an entry, type the new setting. Do not attempt to backspace over an existing entry.

⚠ CAUTION!

Use only the first four commands (?, @, P, C) in *Table 7-3*. Contact Emerson Product Support before using the other commands.

Table 7-3: Boot interrupt navigation commands

Command	Description
?	Print this list
@	Continue boot (load and go)
P	Print boot parameters
C	Change boot parameters
g adrs	Go to adrs
d adrs[,n]	Display memory
z adrs	Modify memory
f adrs, nbytes, value	Fill memory
t adrs, adrs, nbytes	Copy memory
e	Print fatal exception
n netif	Network interface device address and other important information

7.3.4 HyperTerminal navigation after boot complete

After typing bootChange in a HyperTerminal session, use the following commands to navigate:

Note
When modifying an entry, type the new setting. Do not attempt to backspace over an existing entry.

Table 7-4: HyperTerminal navigation commands

Key sequence	Description
Enter	Accept the value.

Table 7-4: HyperTerminal navigation commands *(continued)*

Key sequence	Description
. (period)	Clear the value when you press the period key followed by Enter.
– (dash)	Go back to the previous parameter when you press dash followed by Enter.
Ctrl + B	Toggle between Main Processor and Transient Processor.
Ctrl + T	Display/hide label that identifies the processor producing output to the screen.
reboot (case sensitive)	Reboot the board with new boot settings.

7.3.5 General boot flag notes

For the CSI 6500 Main Processor and Transient systems, boot flags can be listed by typing a question mark (?) into HyperTerminal at the VxWorks boot prompt.

For Transient systems, if redirect is used, do not connect internal transient board com port to PC, since all output will be directed to the external com port.

7.3.6 Boot flags

Notes

- This table covers DCMII, DCMIII, and Transient units.
  - DCMIII units include the CSI 6500 and CSI 6500T.
  - DCMII units include the CSI 4500 and CSI 4500T with blue faceplate (with or without display screens).
- Boot flags below are expressed in hexadecimal. To activate more than one boot flag at the same time, add them together using the Windows Calculator. Select View > Programmer, and select Hex math.

Table 7-5: Complete list of boot flags

Boot Flag	Description
0x0001	Skip SDRAM testing on cold boot (for testing).
0x0002	Load local system symbols (for debug).
0x0004	Don't autoboot (for testing).
0x0008	Quick autoboot (no countdown).
0x0010	Disable input from shell.
0x0020	Disable login security.
0x0040	Use BOOTP to get boot parameters (network boot only).
0x0080	Use TFTP to get boot image (network boot only).
0x0100	Use Proxy ARP (network boot only).

Table 7-5: Complete list of boot flags *(continued)*

Boot Flag	Description
0x0200	Ignore BOOTROM update image in FLASH (for testing).
0X0400	Change Ethernet speed from 100 Mbps to 10 Mbps (Main Processor only).
0x0400	Redirect the console I/O to COM1 (Transient only).
0x0800	Disable boot file update in FLASH (for development).
0x0800	Boot over a WAN, requiring extended FTP timeouts. This flag applies only if one of three flags is set: 0x1000, 0x2000, 0x4000.
0x1000	Attempt network, fallback on FLASH boot (legacy 4500 mode).
0x2000	Boot ALWAYS from network, never fallback on FLASH.
0x4000	Boot ONCE from network. This flag clears itself after one boot.

7.3.7 Subnet masks

A subnet mask is normally represented in Windows as a series of four decimal numbers, each of which can have a value from 0 to 255, separated by periods (255.255.248.0).

In the CSI 6560 Processor module, the subnet mask is represented as a series of four hexadecimal pairs with no separators (that is, 255.255.248.0 is represented as fffff800). A hexadecimal conversion table can be used to convert the subnet mask numbers from decimal to hexadecimal. The calculator in the Windows Accessories folder will also perform this conversion when it is set to Programmer Mode.

Specify a subnet mask

The subnet mask on a CSI 6560 Processor module defaults to 255.255.255.0 (ffffff00).

Procedure

1. The subnet mask should be set to match the subnet mask used on the server PC.

   If they do not match, network communication failure is possible.

2. On the configuration labeled `inet on ethernet`, enter the IP address of the unit followed by a colon and then the subnet mask in the hexadecimal format.

Appendix A Specifications

Topics covered in this appendix:

- *CSI 6500 environmental specifications*
- *CSI 6560 Processor module specifications*
- *CSI 6510 Signal Input module specifications*

A.1 CSI 6500 environmental specifications

The CSI 6500 conforms to the following standards to meet the requirements for application of the CE mark:

1. EN 61000-6-2: 2005
2. EN 61000-6-4: 2007

Table A-1: Environmental specifications

Internal temperature range	
Operating	32–150°F
Relative humidity	5–95%, non-condensing
Internal temperature range, with Transient	
Operating	32–120°F
Relative humidity	0–50%, non-condensing

A.2 CSI 6560 Processor module specifications

A.2.1 CSI 6560 Processor module specifications at 25°C

Table A-2: CSI 6560 Processor module specifications at 25°C

Memory Capacity	32 MB SDRAM, 32 MB Flash
Network Communication	10/100Base-T Ethernet dual RJ45 jacks wired for NIC and HUB, with two additional jacks on backplane
Local Communication	RS232 (up to 38.4 Kbs)
Onboard Test Generator	All sensor channels, tachometer channels, AC, DC amplitude, phase (0 V - 3 V pk, 0.25 Hz - 50 kHz sine +/- 7.2 VDC, GND +/- 1 mV)
Rack Health Relay	SPDT 24

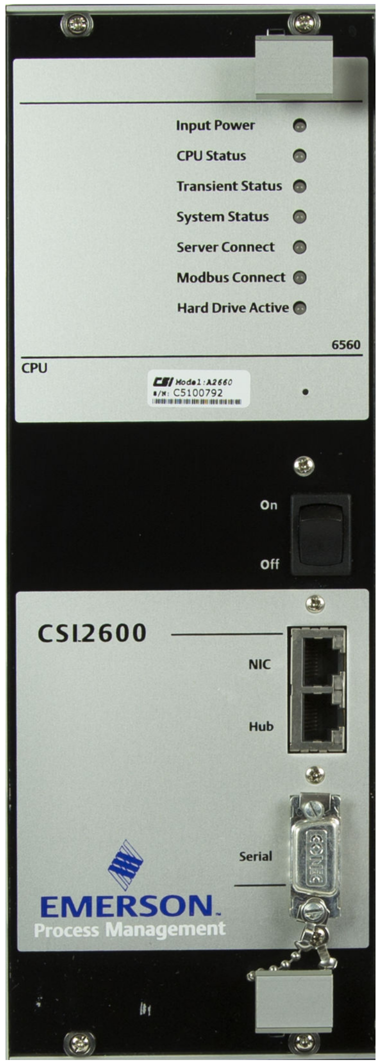
Table A-2: CSI 6560 Processor module specifications at 25°C *(continued)*

Sensor Channel Scan	RMS + DC, rate equivalent to16 ch per 500 ms
Overall Vibration Units	RMS, RMS or peak-to-peak with Transient Option
DC Scan	Simultaneously scanned with overall vibration scan (includes DC Gap, temperature, and accelerometer bias)
Gross Scan and DC Accuracy	1% at input channel range full scale amplitude @ 1 kHz
Gross Scan ADC Resolution	16 bit
Data Acquisition Event Basis	Relay input, RPM, DC, AC or software controlled
Data Collection	Event-based adaptive
Data Collection Interval	Event-based and/or time-based
Data Storage Interval	Exception-based and/or time-based
Spectral ADC Resolution	24 bit, 2 channel simultaneous
Dynamic Range	100 dB, all frequency ranges
Spectral Resolution	100 to 6400 lines
Analysis Bandwidth	10 Hz to 40 kHz, discrete steps
Spectral Scan Rate	Depends on analysis configuration (1 second per two channels @ 400 lines, 400 Hz 1 avg)
Spectral Amplitude Accuracy	5% 0.2 Hz - 0.5 Hz 2% 0.5 Hz - 25 kHz 4% 25 kHz - 40 kHz
Frequency Accuracy	0.01%, crystal based
Total Harmonic Distortion	<-90 dB, all ranges
1X Synchronous Peak Accuracy	3% 0.5 Hz - 3 Hz 2% 3 Hz - 1 kHz 5% 1 kHz - 5 kHz
1X Synchronous Phase Accuracy	4^{0} 1 Hz - 1 kHz (not calibrated below 1 Hz) 5^{0} >1 kHz
Analysis and Trend Types	Configurable, with user-defined parameter names, multiple analysis types per machine and per sensor. (Total Energy, Energy in a range. Non-sync energy in a range, Sync energy in a range, Sync peak, Sync phase, True peak, HFD, Waveform peak-to-peak, RPM, Gap, Orbit)
Averaging Types	Normal, PeakVue, Order Tracking, Synchronous Time Averaging
Units Types	English, Metric, HZ, CPM, Order
Scaling Types	Linear, Log, dB
Windows Types	Hanning, Uniform

A.2.2 CSI 6560 Processor module LEDs

The CSI 6560 Processor module has seven two-color LEDs. From top to bottom these are: Input Power, CPU Status, Transient Status, System Status, Server Connect, Modbus Connect, and Hard Drive Active.

Figure A-1: CSI 6560 Processor module LEDs



Input Power LED

The Input Power LED indicates the status of the power converters that distribute various voltages within the CSI 6560 Processor module. A steady green color indicates that all power converters are within the proper voltage ranges, while a steady or blinking red condition indicates a power fault somewhere inside the CSI 6560 Processor module.

CPU Status LED

The CPU Status LED indicates the status of the Main Processor board. The four status conditions are listed in *Table A-3* along with their assigned priorities.

More than one status condition may be active at one time. When this happens, the LED will indicate the active status condition with the highest priority. For example, if the module is both Uncalibrated (Priority 3) and is also currently In POST (Priority 1), the LED would indicate In POST.

Table A-3: CPU status conditions

LED Color	Status	Priority	Comments
Blinking Green	In POST	1	Typically only seen during system startup. Indicates that POST (Power On Self Test) is being performed, which involves Processor board resources.
Solid Red	Failure	2	Power supply POST failure, or other hardware failure on processor board.
Alternating Red/ Green	Uncalibrated	3	The onboard Test Function generator is uncalibrated.
Solid Green	OK	4	Normal operation.

Transient Status LED

The Transient Status LED indicates the status of the Transient Daughterboard. The LED is always off when a Transient board is not installed in the system. The four status conditions are listed in *Table A-4* with their assigned priorities.

More than one status condition may be active at one time. When this happens, the LED will indicate the active status condition with the highest priority.

Table A-4: Transient Daughterboard status conditions

LED Color	Status	Priority	Comments
Blinking Green	In POST	1	Typically only seen during system startup. Indicates that POST (Power On Self Test) is being performed, which involves Processor board resources.
Solid Red	Failure	2	Power supply POST failure, or other hardware failure on processor board.
Alternating Red/ Green	Uncalibrated	3	One or more Transient channels are uncalibrated.
Solid Green	OK	4	Normal operation.

System Status LED

The System Status LED indicates the status of the overall system. It indicates the active status condition with the highest priority of all boards in the system. For example, if the Test Function generator on the Main Processor board is uncalibrated and the first MSIG module has a power fault, the LED will show a solid red color to indicate the MSIG module power fault, which is a “Failure” state.

When all the firmware components are operating as expected, this LED overlays a "heartbeat" pulse pattern on top of the system status. The heartbeat pattern occurs in a four-count cycle. The LED is pulsed off briefly during each of the first and second counts, and then left on during the 3rd and 4th counts. In practice, it gives the appearance of a human heartbeat. If the heartbeat stops, it indicates a firmware fault has occurred. Many times the system is capable of recovering from a missed heartbeat. However, if the system cannot recover quickly, it will automatically reboot itself to clear the fault and will then resume monitoring.

Server Connect LED

The Server Connect LED indicates when Machinery Health Manager software or the DHM diagnostic software are connected.

- A green color indicates that at least one Machinery Health Manager software client is connected or that the DHM software is connected in the client mode.
- A red color indicates the DHM software is connected in the Single User mode. In this state, no other clients can connect.
- If the LED is off, it indicates that neither of these types of software clients are connected.

There is no indication of client data transfer, only the presence of at least one established connection.

Modbus Connect LED

The Modbus Connect LED indicates when a Modbus client, Web Browser, or Transient Live client are connected.

- A green color indicates that at least one of these types of clients has established a connection.
- If the LED is off, it indicates that none of these types of clients is connected.

The red color is not used with this LED.

There is no indication of client data transfer, only the presence of at least one established connection.

Hard Drive Active LED

The Hard Drive Active LED indicates when the onboard Transient hard drive is being accessed with read/write activity.

The green LED blinks on each time a read or write activity accesses the Transient hard drive. The more time the LED is green, the more hard drive activity.

This LED is always off if there is no Transient board installed in the system.

A.2.3 Transient Daughterboard specifications for CSI 6500T

Table A-5: Transient Daughterboard specifications @ 25°C

Number of Channels	Up to 24 channels
Memory Capacity	64 Mb SDRAM,16 Mb Flash
AC Channel Spectral Accuracy	5% 0.2 Hz – 0.5 Hz 2% 0.5 Hz – 2 KHz
Frequency Accuracy	0.01%, crystal based
1X Synchronous Peak Accuracy	3% 0.5 Hz – 3 Hz 2% 3 Hz – 1 KHz 5% 1 KHz – 5 KHz
1X Phase Accuracy	4 0 ° 1 Hz – 1 KHz (not calibrated below 1 Hz) 5 0 ° >1 KHz
THD	70 dB, all ranges
Overall Levels Accuracy	2% 0.5 – 2 KHz, TruePeak-to-Peak
ADC Resolution	16 bits
Spectral Resolution	200 lines – 6400 lines
Dynamic Range	>80 dB
Number of Tach Channels	4
On-Board Data Storage	60 GB, upgradeable
Communication	10/100Base-T Ethernet HUB and NIC 100Base-T recommended for Transient

A.3 CSI 6510 Signal Input module specifications

A.3.1 CSI 6510 Signal Input module specifications at 25°C

Table A-6: CSI 6510 Signal Input module specifications at 25°C

Sensor Input Types	Dynamic displacement probe, Accelerometer, Velocity probe, AC input - custom definable (for example, Flux, Dynamic pressure sensor, Dynamic basis weight input, etc.), DC input - custom definable (for example, Temperature or other process input), 4-20 mA Signal (with external shunt resistor).
Number of Sensor Inputs	16 inputs per module (12 sensor, 2 tach, 2 I/O, 2 modules per rack)
Analysis Bandwidth	0.2 Hz to 40 kHz (0.2 Hz to 2 kHz for Transient Analysis)
AC Coupling Corner Frequency	0.5 Hz
RMS Conversion Accuracy	1% at full scale amplitude 30 Hz - 40 kHz 2.5% at full scale amplitude 20 Hz 5% at full scale amplitude 10 Hz (uncalibrated below 10 Hz)
DC Accuracy	1% at full scale amplitude
Analog Integration	1 per channel (acceleration to velocity or velocity to displacement)
Analog Integrator Accuracy	2% (frequency and amplitude)
AC Input Range	Software configurable: ± 5 V pk, ± 10 V pk
DC Input Range	± 22 VDC
Maximum AC + DC Input Range	± 22 V
Powered Sensor Types	ICP Accelerometer and velocity probes by each sensor channel, and displacement probes by fused -24 VDC power supply on each channel
Sensor Power	4 mA (nominal) constant current, with 22 V compliance per current
Powered Channel Input Impedance	500 kOhm (single ended)
Non-Powered Channel Input Impedance	1 MOhm (differential)
Non-Powered Sensor Type	Displacement, AC or DC process
RMS to DC Converter	1 per channel, 1 Hz to 40 kHz
Number of Tachometer Channels	2 inputs per module, 4 total per rack
Tachometer Frequency Range	0.1 Hz to 2 kHz (6 RPM to 120,000 RPM)
Tachometer Frequency Accuracy	0.1%
Tachometer Resolution	0.002 Hz @ 60 Hz (0.1 RPM)
Tachometer Types	Eddy current displacement probe, TTL, passive magnetic
Tachometer Amp. Range	Input and trigger pulse range ± 0.5 V pk to ± 22 V pk
Pulse Characteristics	1 pulse per revolution, 500 uS minimum pulse width, tach divider on module

Table A-6: CSI 6510 Signal Input module specifications at 25°C *(continued)*

Modes	Volt compare, automatic adaptive, divide by N (N=1-1024)
Input Impedance	1 MOhm (differential)
Number of Digital I/O Channels	2 per module (configurable as input or output), 4 total per rack
Relay Type	SPST 24 VDC @ 0.5 ADC dry contact
Digital Input Current Max.	10 mA @ 24 VDC
Digital Input High Voltage	5 VDC - 24 VDC
Digital Input Low Voltage	<3 VDC

A.3.2 CSI 6510 Signal Input module LEDs

Every CSI 6510 Signal Input module has two, two-color LEDs. The top LED indicates the power converter status and the bottom LED indicates overall module status.

Figure A-2: CSI 6510 Signal Input module LEDs

Power LED

The Power LED indicates the status of the MSIG module power converters.

A steady green color indicates that all voltage levels are OK, while a steady or blinking red condition indicates a power fault somewhere within the module.

Status LED

The Status LED indicates the overall status of the module. The four status conditions are listed in *Table A-7* along with their assigned priorities.

More than one status condition may be active at a time. When this happens, the LED will indicate the active status condition with the highest priority.

If the Status LED is off, the Signal Input module is being ignored by the CSI 6560 Processor module. This is a special case which should not be encountered in practice. Modules are only ignored if the addition of the module would exceed the maximum channel count limits that the CSI 6560 Processor module can support (24 analog, 4 Tach, 4 I/O). Channels are counted starting in the left-most.

Table A-7: Signal Input Module status conditions

LED Color	Status	Priority	Comments
Blinking Green	In POST	1	Typically only seen during system startup. Indicates that POST (Power On Self Test) is being performed, which involves Processor board resources.
Solid Red	Failure	2	Power supply POST failure, or other hardware failure on processor board.
Alternating Red/ Green	Uncalibrated	3	One or more channels are uncalibrated.
Solid Green	OK	4	Normal operation.

A.3.3 Transient Filter Board specifications

Table A-8: Transient Filter Board specifications

Number of channels	12
Filter type	8th order elliptic low pass
Filter passband frequency	DC to 2 kHz
Attenuation	80 dB
Passband ripple	<1 dB
Stop band frequency	3.12 kHz

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