Reference Manual
MHM-97125-PBF-EN, Rev 0
April 2023

AMS 6500 Machinery Health Monitor

A6560R Processor Module and A6510 Signal Input Module

EMERSON

Contents

1 Introduction

Topics covered in this chapter:

1.1 About this manual

This document covers the standard system components of the prediction system. 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 project manager to request an installation guide supplement.

Other available manuals detail 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 Documentation conventions

The following conventions are used throughout:

Note

A note paragraph contains special comments or instructions.

⚠ CAUTION!

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

⚠ WARNING!

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

1.3 Technical Support and Customer Service

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 Machinery 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.

Customer Service

Contact Customer Service for all non-technical issues, such as ordering replacement parts.

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

1.4 Disclaimer

This manual is provided for informational purposes. EMERSON MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THIS MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Emerson shall not be liable for errors, omissions, or inconsistencies that may be contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material. Information in this document is subject to change without notice and does not represent a commitment on the part of Emerson. The information in this manual is not all-inclusive and cannot cover all unique situations.

1.5 China RoHS Compliance

Our products manufactured later than June 30, 2016 and which are sold in the People's Republic of China are marked with one of the following two logos to indicate the Environmental Friendly Use Period in which it can be used safely under normal operating conditions.

Products without below mentioned marking are either manufactured before June 30 or are non Electrical Equipment Products (EEP).

Circling arrow symbol with "e": The product contains no hazardous substances over the Maximum Concentration Value and it has an indefinite Environmental Friendly Use Period.

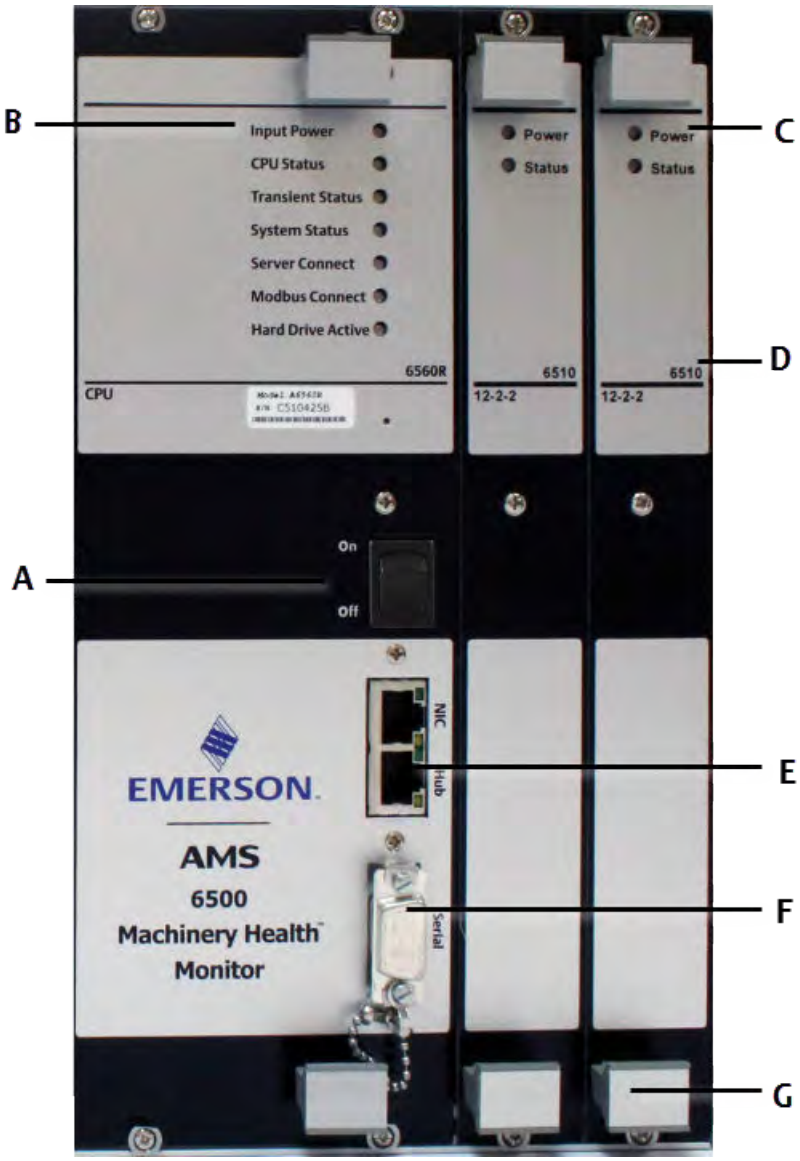
Circling arrow symbol with a number: This product contains certain hazardous substances over the Maximum Concentration Value and it can be used safely under normal operating conditions for the number of years indicated in the symbol. The names and contents of hazardous substances can be found in folder "China RoHS Compliance Certificates" on the documentation CD or DVD enclosed with the product.

2 Product Introduction

Topics covered in this chapter:

2.1 AMS 6500 front view

Figure 2-1: AMS 6500 front view with A6560R and A6510 modules



A. Front power switch
B. A6560R Status LEDs
C. A6510 Status LEDs
D. Module name
E. 2 Ethernet ports — NIC and Hub
F. Serial port
G. Handles

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. After installation, physically walk through each part of the installation to review:

- ☐ Sensor mounting locations
- ☐ Cable pulls
- ☐ Conduit/cable tray use
- ☐ Enclosure mounting locations
- ☐ Environmental concerns

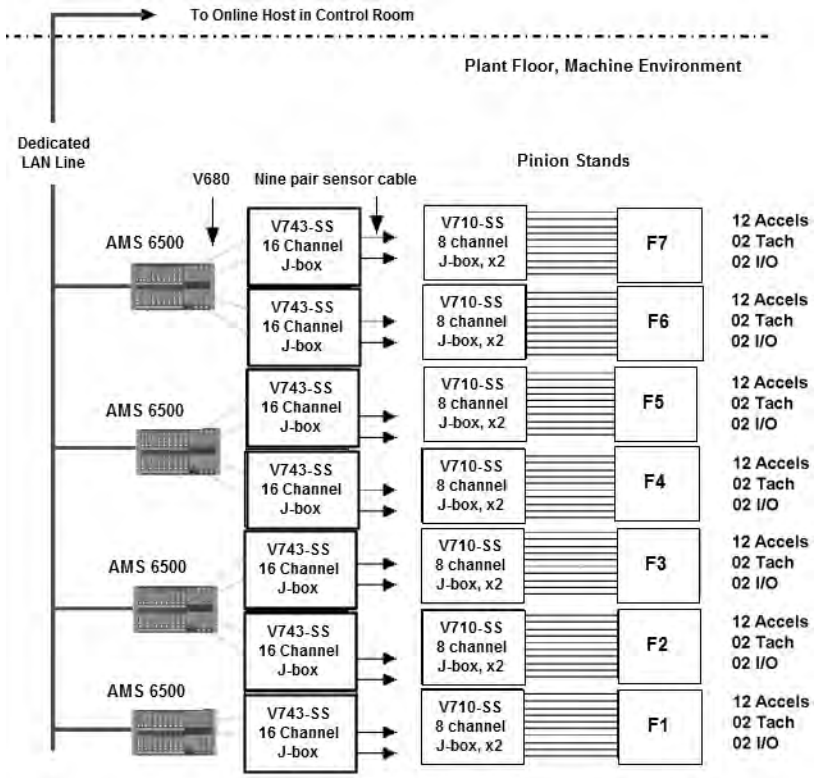
2.3 System documentation

Typical system documentation includes at least a System Overview Drawing, System Layout Drawings, a Cable Administration Chart.

2.3.1 System overview drawings

AMS 6500 system documentation should include system overview drawings that illustrate how system components interconnect. Create system overview drawings for your system and update them as you make any changes to your system.

Figure 2-2: Example system overview drawing



A system overview drawing typically includes the following information:

- AMS 6500 units
- Junction/switch boxes
- Cables
- AMS 6500 Network Segment Cables
- Tags for each AMS 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
	Enclosure	Type: 701 (2,3), 745, 6500 Tag: defined by plant
	Instrumentation	Type: 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	AMS 6500 network cabling

2.3.3 Cable administration charts

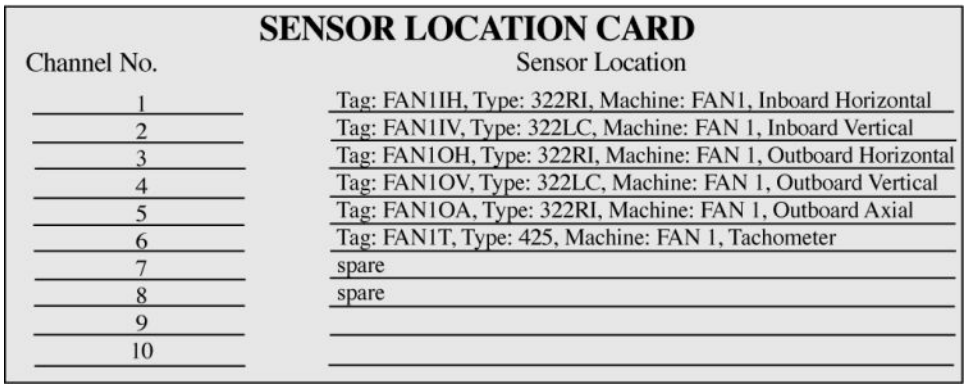
Cable administration charts document wire terminations within system enclosures. Tag names should be consistent and represent physical locations or machines. For instance, instead of naming a sensor 23001, use a name like FAN1OV (fan number 1 outboard vertical) to make system maintenance and troubleshooting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

There are two types of cable administration charts for the online system: junction box and AMS 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 AMS 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	

AMS 6500 enclosure cable administration chart

The AMS 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: Example AMS 6500 cable administration chart

Processor module					
AMS 6500 tag name:					
A6560R CPU module MAC address:					
Network cable tag:					
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					

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

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					
Tachometer inputs					
1					
2					
Discrete I/O					
1					
2					

2.3.4 Documentation storage

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

3 Sensor installation

Ensure sensors are installed according to instructions provided by the sensor manufacturer and industry best practices.

4 Enclosure mounting

Topics covered in this chapter:

4.1 Junction boxes

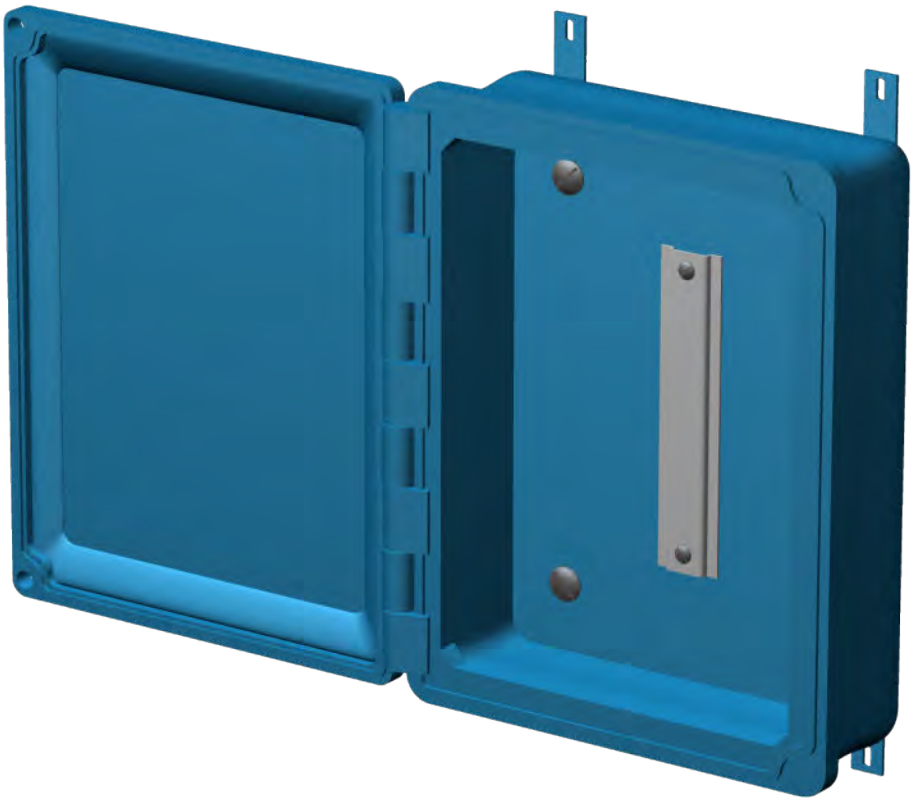
Junction boxes are used to terminate online instrumentation wiring. Emerson recommends junction boxes with 12 channels, housed in a fiberglass or stainless steel enclosure. They should consist of individual, 3-lug terminal blocks mounted on a DIN rail.

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.

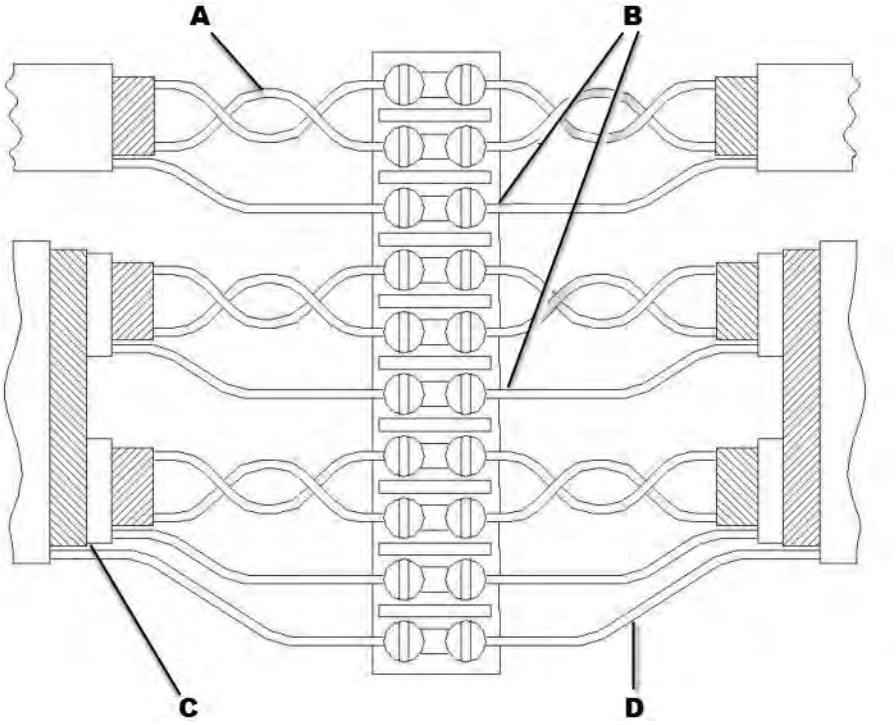
   Torque screws to 31 in-lb.
4. Using bolts provided by the contractor, attach the enclosure to the mounting bracket.

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



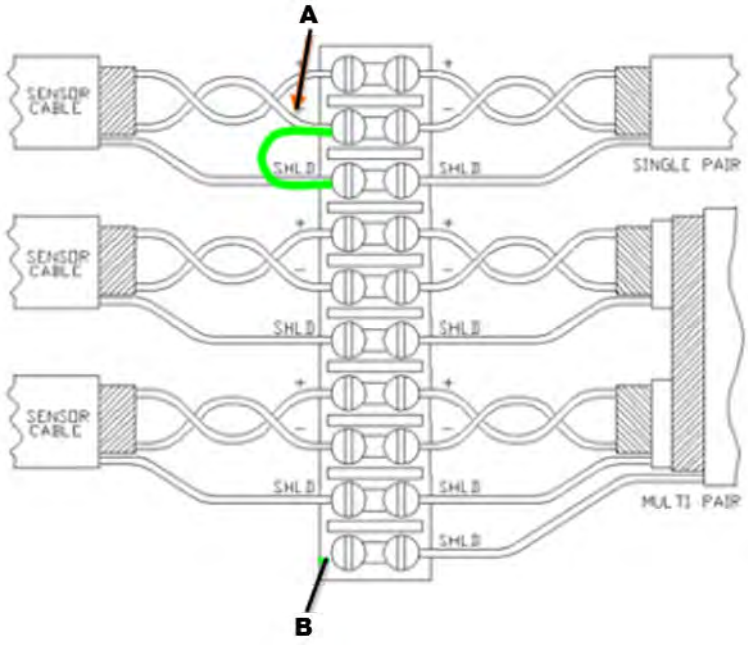
A. Maintain cable pair twists as close to the terminal block as possible.

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 Wall mount enclosures

The prediction racks are designed to easily mount inside a standard size enclosure. Emerson offers pre-wired wall mount enclosures for AMS 6500 prediction systems:

Wall mount cabinet	System	Channels	Dimensions	Rack size
A6500MS-24-ENCL-IC	A6500MS	12 or 24	24”H x 16”W x 12”D	7.5 inch
A6500PRE-SS-WM-24-IC	A6500MR	12 or 24	36”H x 24”W x 12”D	19 inch
A6500PRE-SS-WM-48-IC	A6500MR	36 or 48	36”H x 24”W x 12”D	19 inch

Note

Install cabinets using guidelines provided by Emerson projects.

- Install at a reasonable height for easy access.
- All cable and conduit piercing should be through the bottom of the cabinet. See *Chapter 5*.

Figure 4-4: A6500MS in a compact wall-mount enclosure

Figure 4-5: A6500MR in a full wall-mount enclosure (48 channels shown)

4.3 AMS 6500 rack chassis

To protect it from harsh industrial environments, the AMS 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

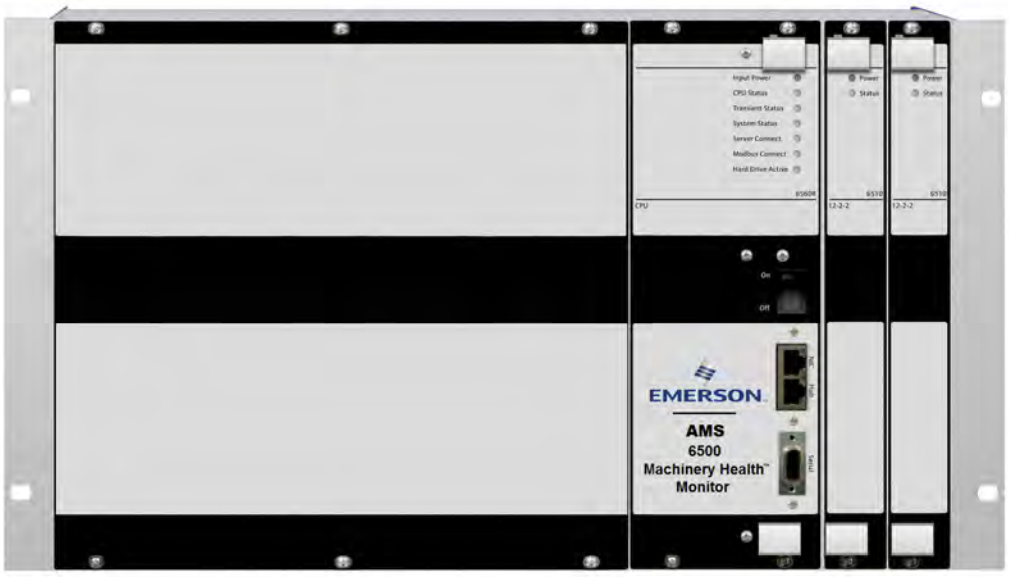
All AMS 6500 enclosures must be grounded to earth. Ground the enclosure through conduit or mounting structure if it is grounded to earth. Otherwise, use a bonding wire to connect the enclosure to earth ground.

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

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

Mounting hardware includes four each of cage nuts, finishing washers, and screws.

Figure 4-6: AMS 6500 for mounting in a 19 in. cabinet enclosure



Prerequisites

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

Procedure

1. Attach the cage nuts in the mounting rails.
2. Using the screws and finishing washers, fasten the system frame to the mounting rails through the two oblong holes on each side of the frame.

Figure 4-7: Cage nuts and screws in the mounting rails

A. Cage nut
B. Screw

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.

4.3.2 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.

4.3.3 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. Do not exceed 40% conduit fill.

   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

AMS 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.

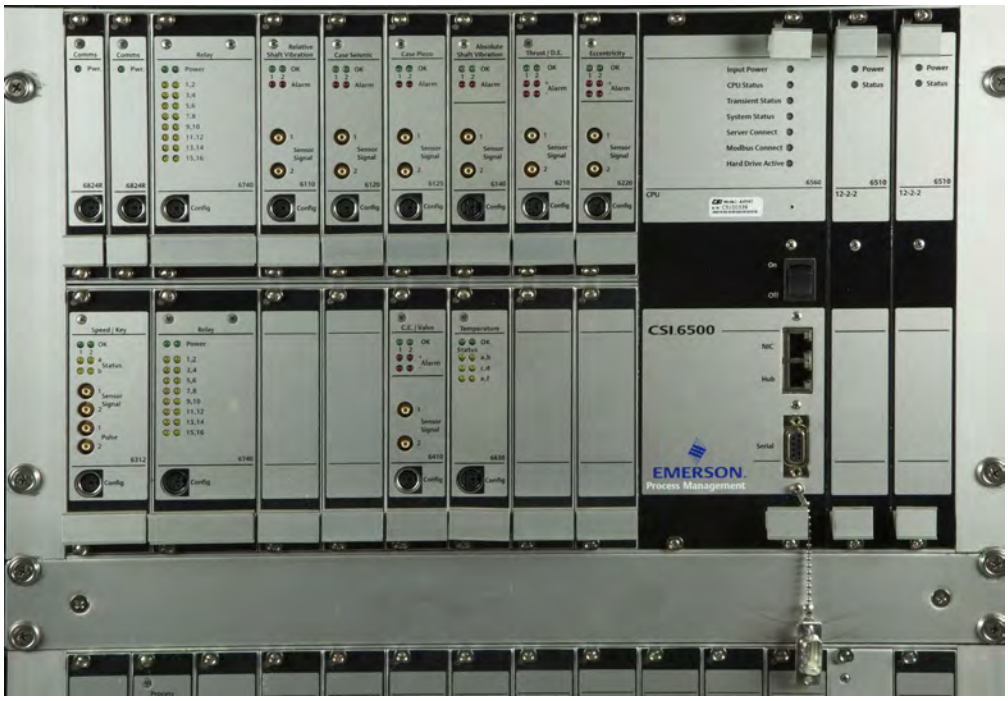
Procedure

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.

4.3.4 Install and remove modules

The AMS 6500 system cabinet can be configured to contain both prediction and protection modules. In *Figure 4-8*, the protection modules (3U high modules) are shown on the left; the prediction modules (6U high modules) are shown on the right.

Figure 4-8: AMS 6500 with 3U and 6U high modules



Install or remove 3U high protection module

Install or remove protection monitor cards, relay modules, and communication modules. Protection modules are hot-swappable and can be installed or removed while the rack is powered. Refer to the A6500 protection cards manual for instructions.

⚠ CAUTION!

Any work at the system may impair machine protection.

Install or remove a 6U high module

⚠ WARNING!

Turn off power before installing or removing prediction cards. Prediction cards are NOT hot swappable.

Procedure

- Install a module:

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

- Remove a 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 4-9: Install or remove a module

Use the handles to install or 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 AMS 6500.

5.1 Guidelines for conduit installation

Note

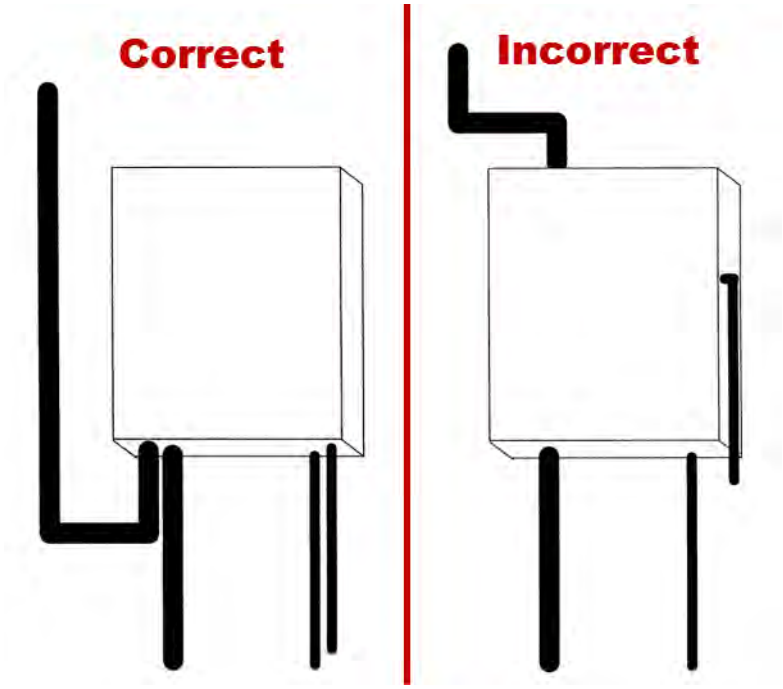
All conduit must be bonded to earth ground and adhere to IEEE 1100 specifications for grounding.

- The following cables must be pulled in conduit:
  - any cable between junction boxes and the unit
  - any AMS 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-NA-09-0 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 AMS 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 AMS 6500 should be in steel conduit.

5.5 Power circuit guidelines for the unit enclosure

The AMS 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)*

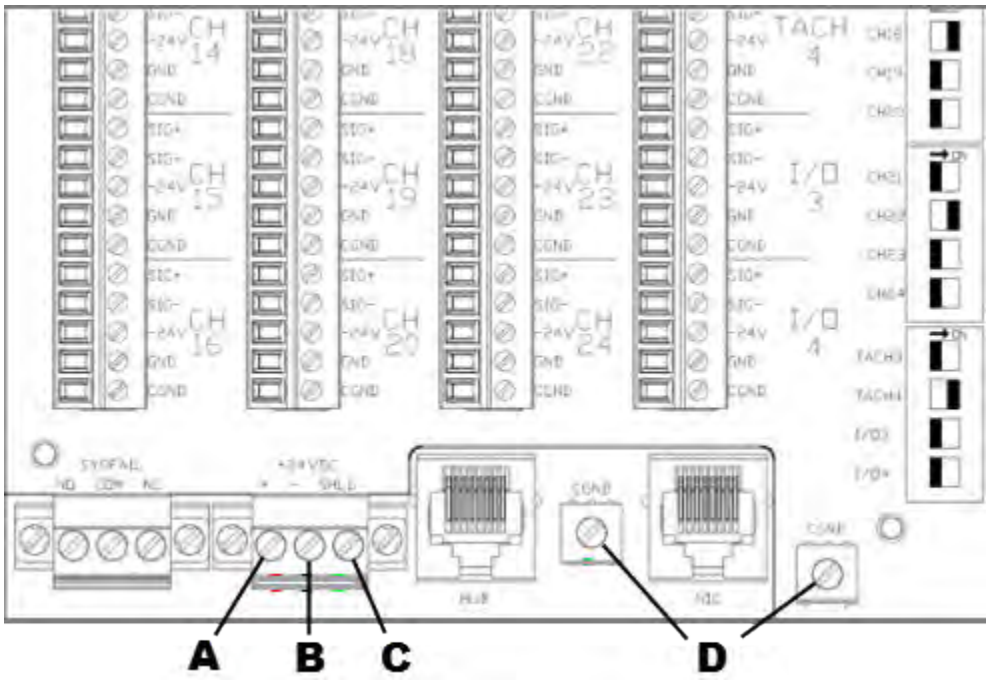
DC	
Minimum wire gauge	16 AWG
Cable	Shielded twisted pair
AC	
Nominal voltage	110 VAC to power 24 V power supply
Circuit breaker	10 A (with duplex receptacle)
Power ground	Isolated (from production equipment)

5.5.1 Power and ground wiring on AMS 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 AMS 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 AMS 6500 system can only be as good as the signals presented at the AMS 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 AMS 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 AMS 6500 input. If the sensor cable shield drain wire is grounded at the sensor side, do not connect the shield drain wire at the AMS 6500 input side. The shield connection at the AMS 6500 input is connected directly to the AMS 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 AMS 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 AMS 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 AMS 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: AMS 6500 operation guidelines based on air temperature inside enclosure

Air temperature	Guideline
<-20°C (-4°F)	The system should be enclosed and actively heated above -20°C (-4°F)
49-60°C (120-140°F)	Install a AMS 6500 cooling fan in the system enclosure.
>60°C (140°F)	Actively cool the system enclosure to keep system electronics below 60°C (140°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 10–38°C (50–100°F).

⚠ CAUTION!

The AMS 6500 system has been tested to operate reliably up to 60°C (140°F), but the unit's electronics will age more quickly than electronics maintained below 38°C (100°F).

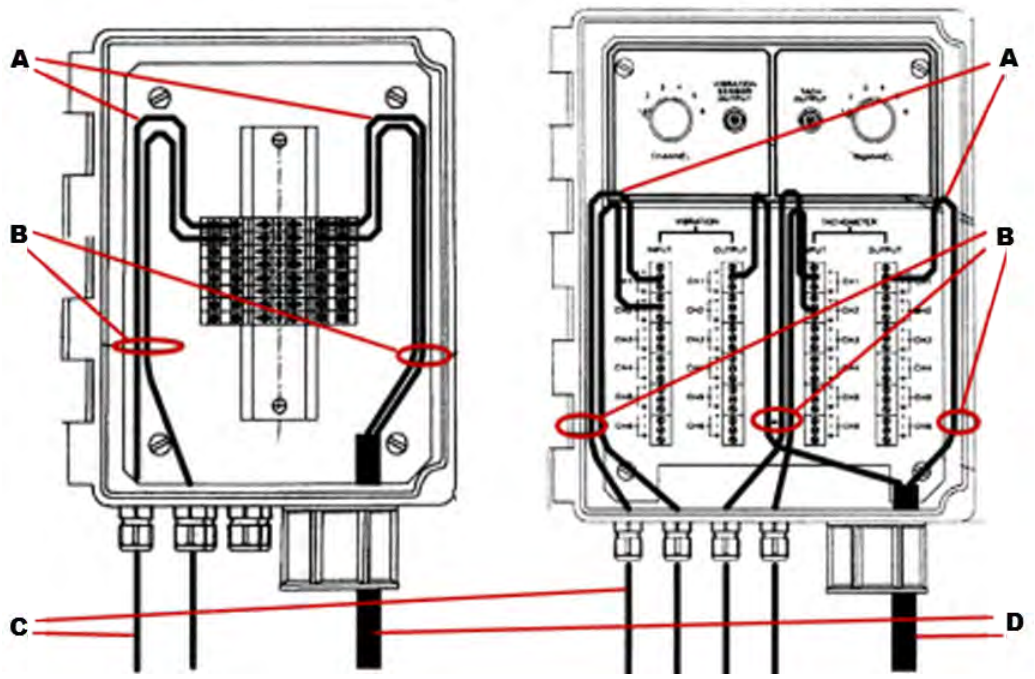
6 Wire terminations

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

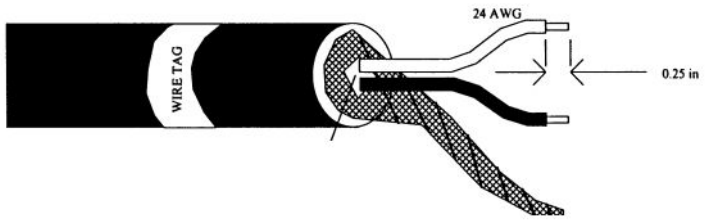
Shield connections pass through junction boxes and are not grounded at the box.

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.

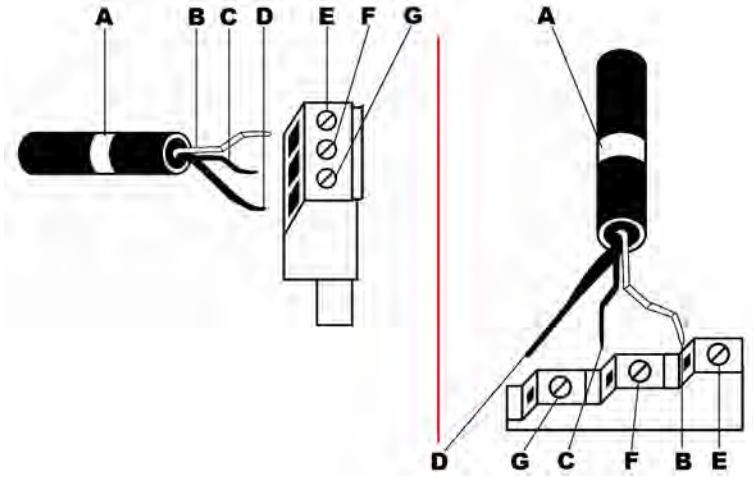
Figure 6-2: Prepare twisted-pair conductors for termination

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

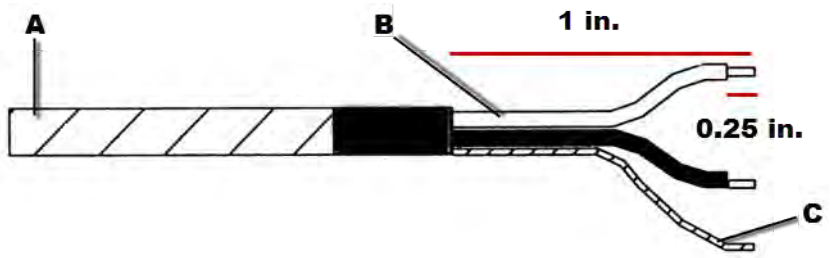
For a 16-channel box, start the sequence over on terminal block 9.

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 AMS 6500

AMS 6500 sensor cables terminate in three different ways:

1. Directly into the 12-2-2 modules at a A6500-M-RTRM rear termination panel.
2. 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.
3. 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 rear termination panel plugs directly onto the backplane. This termination panel has connectors for sensor inputs, tachometer inputs, and discrete input/output relays into the 12-2-2 modules. All these connections are available through BNC connectors on the rear of the AMS 2600.

Figure 6-5: A6500-M-RTRM

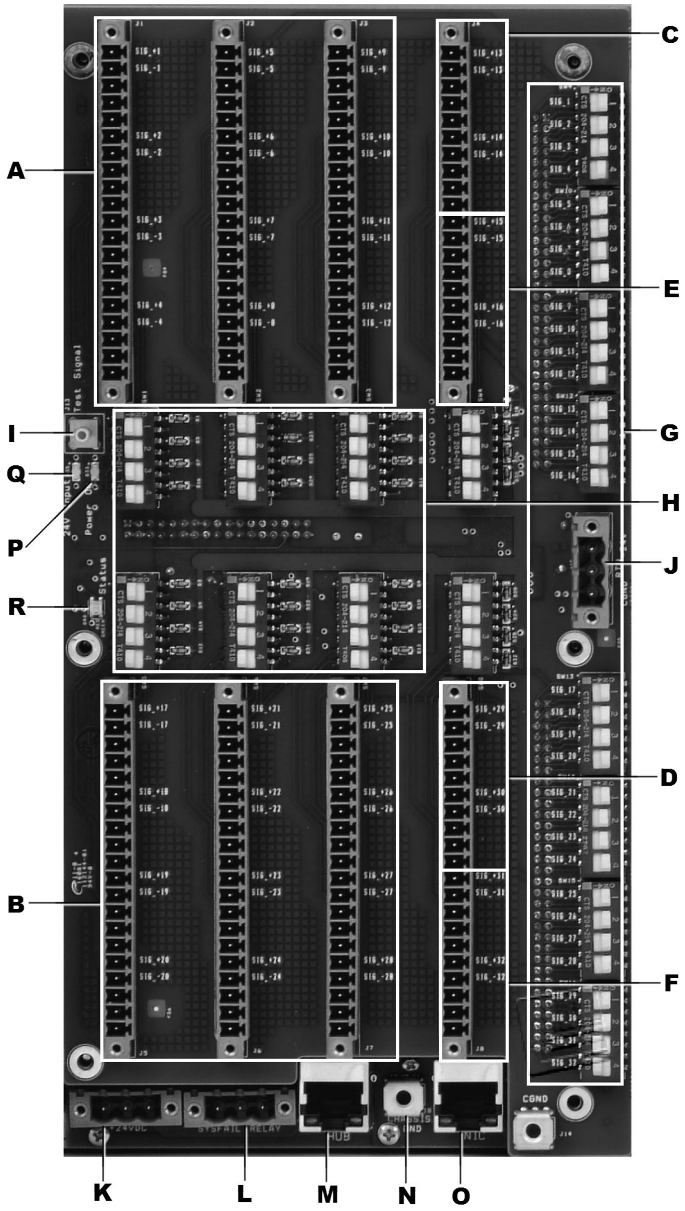


Table 6-2: A6500-M-RTRM

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

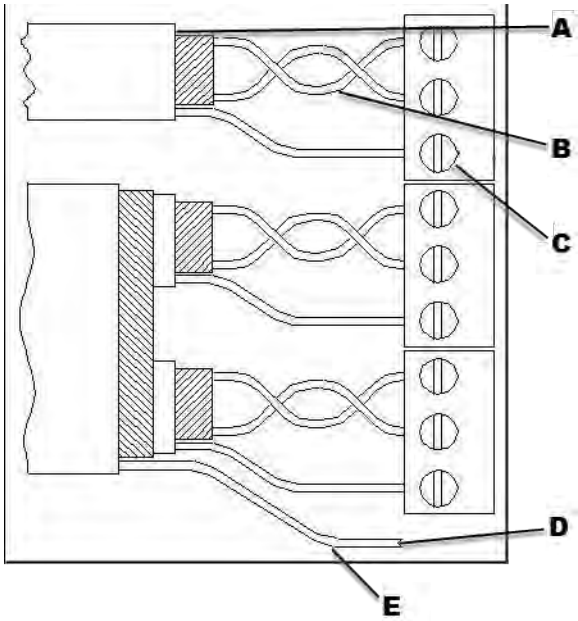
Procedure

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/+24 V	CH5	SIG+5/+24 V	CH9	SIG+9/+24 V	TACH1	Tach+1
	SIG-1/+24 V return		SIG-5/+24 V return		SIG-9/+24 V return		Tach-1
	-24 V		-24 V		-24 V		-24 V
	Gnd (-24 V return)		Gnd (-24 V return)		Gnd (-24 V return)		Gnd (-24 V return)
	Chassis GND (Shield)		Chassis GND (Shield)		Chassis GND (Shield)		Chassis GND (Shield)
CH2	SIG+2/+24 V	CH6	SIG+6/+24 V	CH10	SIG+10/+24 V	TACH2	Tach+2
	SIG-2/+24 V return		SIG-6/+24 V return		SIG-10/+24 V return		Tach-2
	-24 V		-24 V		-24 V		-24 V
	Gnd (-24 V return)		Gnd (-24 V return)		Gnd (-24 V return)		Gnd (-24 V return)
	Chassis GND (Shield)		Chassis GND (Shield)		Chassis GND (Shield)		Chassis GND (Shield)
CH3	SIG+3/+24 V	CH7	SIG+7/+24 V	CH11	SIG+11/+24 V	I/O1	I/O+1
	SIG-3/+24 V return		SIG-7/+24 V return		SIG-11/+24 V return		I/O-1
	-24 V		-24 V		-24 V		-24 V
	Gnd (-24 V return(1))		Gnd (-24 V return(1))		Gnd (-24 V return(1))		Gnd (-24 V return(1))
	Shield		Shield		Shield		Shield
CH4	SIG+4/+24 V	CH8	SIG+8/+24 V	CH12	SIG+12/+24 V	I/O2	I/O+2
	SIG-4/+24 V return		SIG-8/+24 V return		SIG-12/+24 V return		I/O-2
	-24 V		-24 V		-24 V		-24 V
	Gnd (-24 V return)		Gnd (-24 V return)		Gnd (-24 V return)		Gnd (-24 V 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/+24 V	CH17	SIG+17/+24 V	CH21	SIG+21/+24 V	TACH3	Tach+3
	SIG-13/+24 V return		SIG-17/+24 V return		SIG-21/+24 V return		Tach-3
	-24 V		-24 V		-24 V		-24 V
	Gnd (-24 V return)		Gnd (-24 V return)		Gnd (-24 V return)		Gnd (-24 V return)
	Shield		Shield		Shield		Shield
CH14	SIG+14/+24 V	CH18	SIG+18/+24 V	CH22	SIG+22/+24 V	TACH4	Tach+4
	SIG-14/+24 V return		SIG-18/+24 V return		SIG-22/+24 V return		Tach-4
	-24 V		-24 V		-24 V		-24 V
	Gnd (-24 V return)		Gnd (-24 V return)		Gnd (-24 V return)		Gnd (-24 V return)
	Shield		Shield		Shield		Shield
CH15	SIG+15/+24 V	CH19	SIG+19/+24 V	CH23	SIG+23/+24 V	I/O3	I/O+3
	SIG-15/+24 V return		SIG-19/+24 V return		SIG-23/+24 V return		I/O-3
	-24 V		-24 V		-24 V		-24 V
	Gnd (-24 V return)		Gnd (-24 V return)		Gnd (-24 V return)		Gnd (-24 V return)
	Shield		Shield		Shield		Shield
CH16	SIG+16/+24 V	CH20	SIG+20/+24 V	CH24	SIG+24/+24 V	I/O4	I/O+4
	SIG-16/+24 V return		SIG-20/+24 V return		SIG-24/+24 V return		I/O-4
	-24 V		-24 V		-24 V		-24 V
	Gnd (-24 V return)		Gnd (-24 V return)		Gnd (-24 V return)		Gnd (-24 V 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 *Rear termination panel* 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: AMS 6500 rear termination panel with signal input cross references

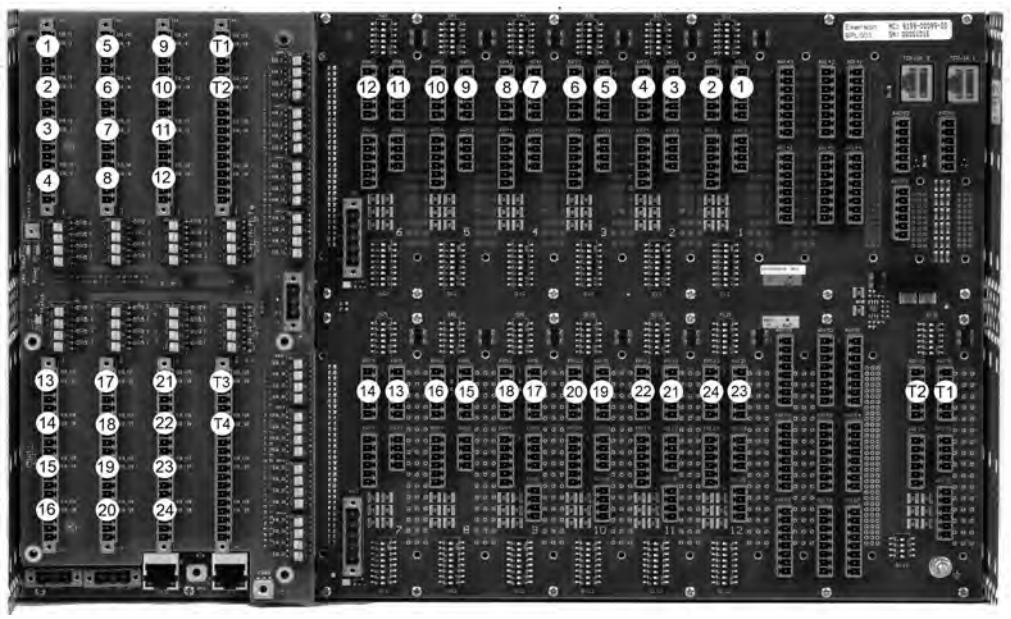


Table 6-6: A6500-M-RTRM signal inputs

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)	A6312 pulse output, channel 1 (T1)	XR131
Tach inputs 2 and 4 (T2 & T4)	A6312 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.

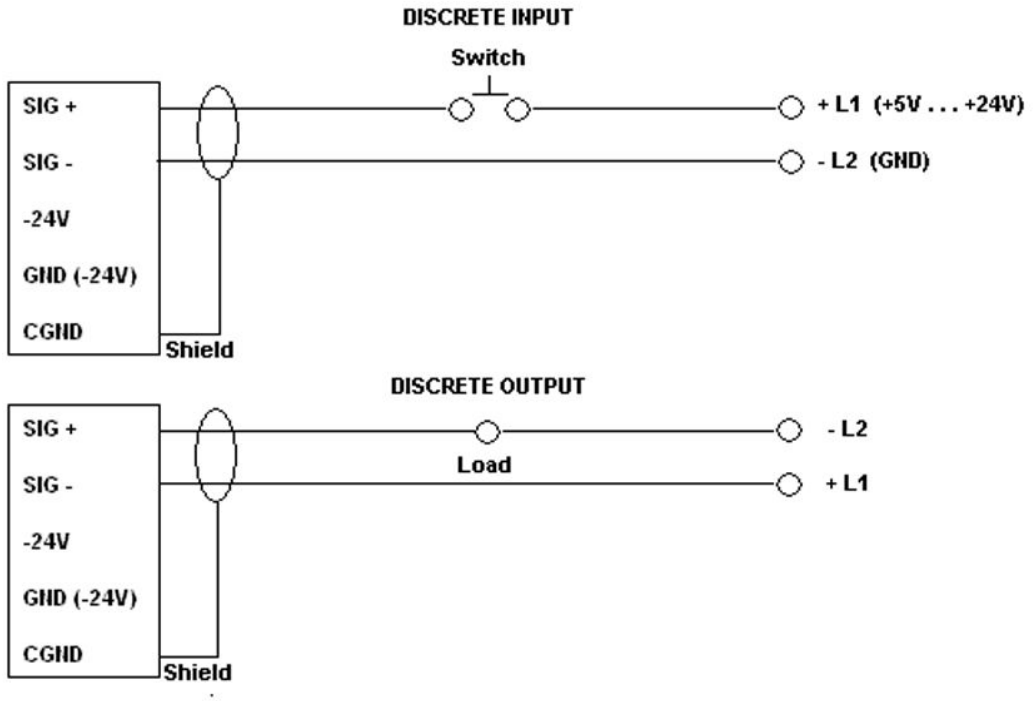
Procedure

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 AMS 6500 channel number on the cable administration chart.

Figure 6-8: Discrete I/O cable termination



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 Terminate +24 V power for the A6560 and A6510 modules

The +24 V power input for the A6560 and A6510 prediction modules is located on the A6500-M-BP backplane. This connector is isolated from the protection modules, which are powered separately. Emerson recommends a separate power supply for protection modules.

⚠ CAUTION!

- **The AMS 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 A6560 and A6510 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 A6560 and A6510 prediction modules

Wire	Termination panel
+DC	+
-DC	-
Shield	SHLD

Note

When connecting a 24 V power supply to the AMS 6500, connect the DC side of the power supply to the AMS 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.

6.7.1 Power input specifications

Table 6-8: Power input specifications

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

6.8 Eddy Current sensor: -24 V power supply

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

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 AMS 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 powering the A6560, A6560R, or A6510 to this input. Verify all power supply connections are wired and connected properly before powering the unit.

6.9 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.

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

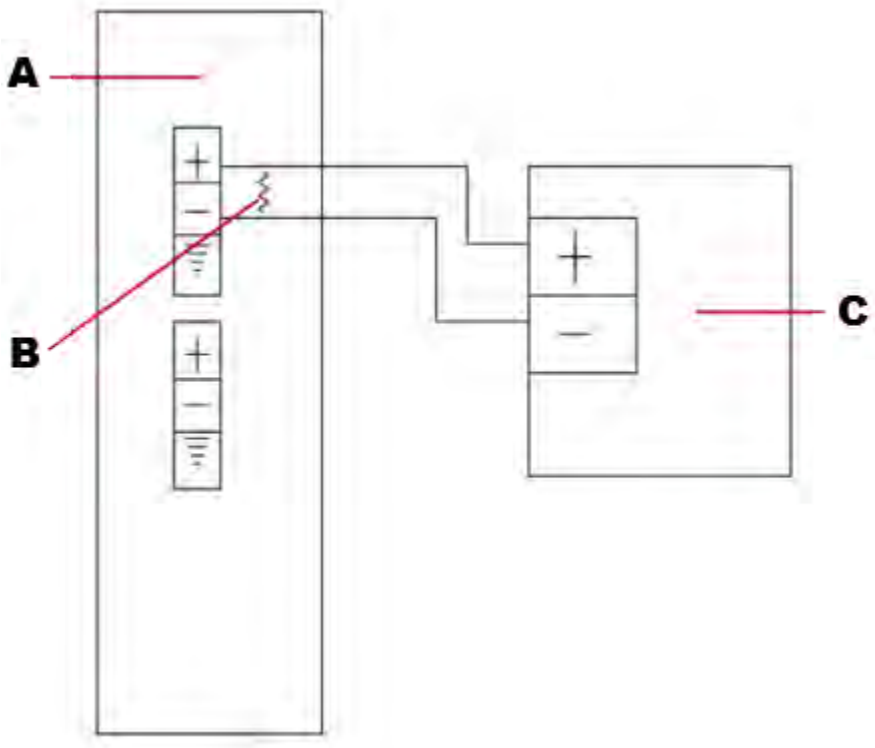
⚠ CAUTION!

The SysFail relay connection is an output for relays only. Do not connect the +24 V power supply intended for powering the A6560, A6560R or A6510, 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.

6.10 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 6-9: AMS 6500 transmitter connection for 4-20 mA current



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

Note

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

6.11 Terminate Ethernet connection

⚠ CAUTION!

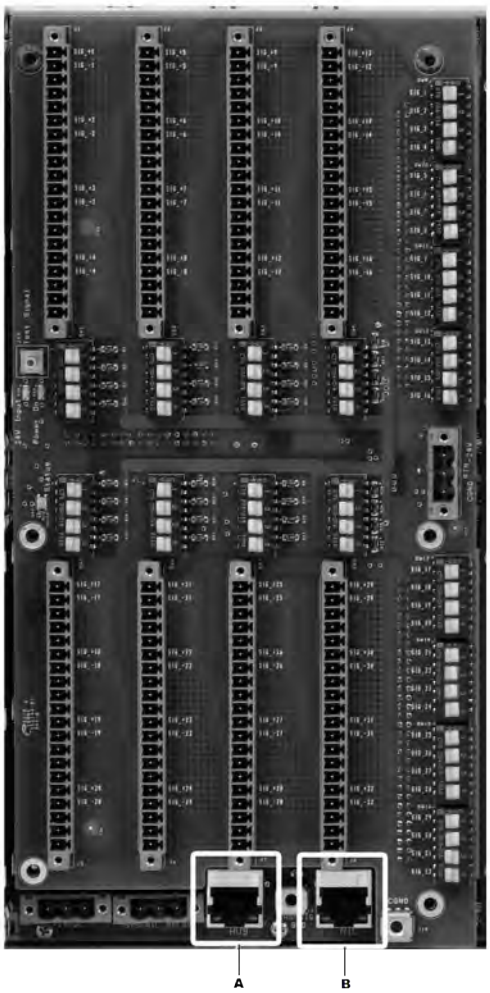
Do not daisy-chain multiple units using the NIC or HUB. If one network connection fails, it will disrupt network communication for multiple units.

Procedure

1. Route the network cable to RJ45 connectors, at either the front of the A6560 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 6-10: NIC and HUB connectors



A. Rear HUB connector
B. Rear NIC connector

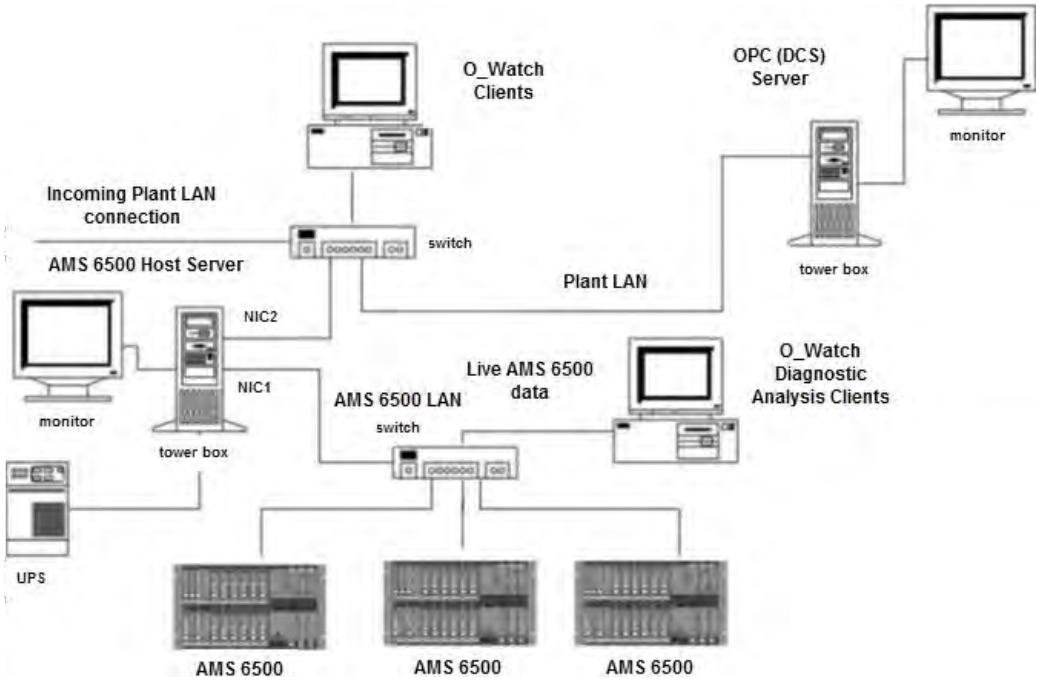
Use the NIC connector when connecting to an Ethernet hub or switch.

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

6.12 Default schema for network addressing

The network arrangement shown assumes one of the AMS 6500 units include Transient functionality.

Figure 6-11: Default schema for network addressing



7 Hardware configuration

Topics covered in this chapter:

7.1 Hardware configuration: overview

The AMS 6500 Machinery Health™ Monitor (A6560R CPU module, in combination with the A6510 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 A6560R CPU 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). 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 A6560R and A6510 modules

The AMS6500M has an A6560R Processor module and either one or two A6510 Signal Input modules.

The AMS6500T has an A6560R Processor module with a solid-state drive and either one or two A6510 Signal Input modules, each with Transient Filter Boards.

7.2.1 A6560R Processor module

The A6560R Processor module provides all data acquisition, data storage, and data communication functions for the AMS 6500 system and the AMS 2600 system. The A6560R 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).

Note

If the unit experiences frequent extreme temperature changes, recalibrate the signal generator more frequently.

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

Figure 7-1: A6560R Processor module

Transient capability

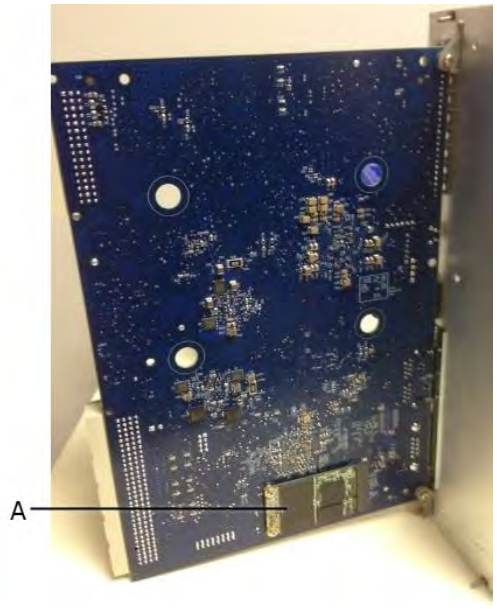
The A6560R CPU module, is capable of parallel, continuous time waveform acquisition on all channels. All collected time waveform data, along with Gross Scan data and up to four tachometer pulse records, is stored on an internal solid-state drive (SSD). The SSD is specially rated for industrial operation and provides approximately 100 hours of DCR (Digital Condition Recorder) transient data. There is also room on the drive to store transient archives manually and automatically.

Transient data can be streamed via Ethernet to analysis applications in near real time, without affecting data collection or on-board data storage.

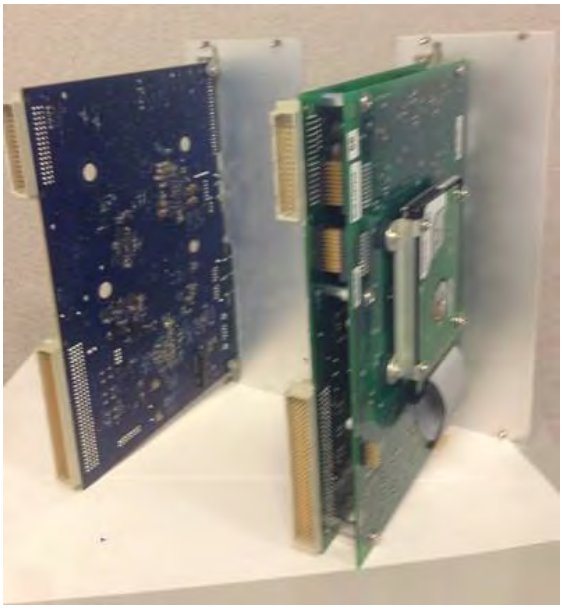
While collecting time waveforms and tachometer pulses, the processor continuously calculates the peak-to-peak value of each channel's waveform. When configured, this value can be used as the Gross Scan instead of the RMS value produced by the A6510 Signal Input module.

Figure 7-2: A6560R CPU module with and without Transient capability

An A6560RT with mounted SSD.



An A6560R next to the older A6560RT.



A. SSD

Replace the Transient SSD

Only replace the Transient SSD if directed by Emerson Product Support.

⚠ CAUTION!

Follow the same safety precautions as replacing a card in the unit. Always power down the unit.

Procedure

Replace the SSD as directed by Emerson Product Support.

Postrequisites

Format the Transient SSD.

Format the Transient SSD

You must format the new solid-state drive before you can use it.

Procedure

1. Power on the system and ignore any hard drive error messages on the HyperTerminal monitor.
2. When the system has booted, launch DHM_III.exe.

   DHM_III.exe is located at C:\inetpub\ftproot\bin\Tools directory.
3. In DHM, connect to the unit in "Single User" mode.
4. From the main menu, select Transient > Format Hard Drive.
5. When the drive has been formatted, reboot the unit. Ignore any hard drive error messages.

   When the POST process is complete, the firmware automatically prepares the hard drive with the Transient File System. This process can take up to 15 minutes.
6. Disconnect DHM.

   The unit will reboot automatically.

When the unit boots, there should be no hard drive error messages. If configured, Transient data collection should begin, indicated by a flashing hard drive indicator on the A6560R CPU module front panel.

7.2.2 A6510

The A6510 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 A6510 provides 12 channels of vibration or process sensor inputs, 2 channels of tachometer sensor inputs, and 2 optically-isolated I/O relay channels.

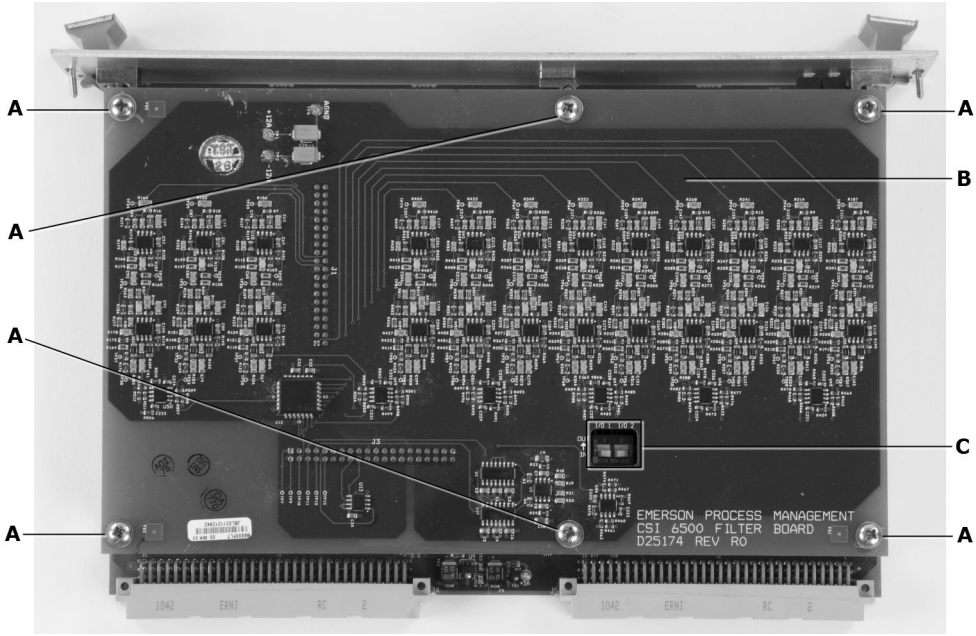
Figure 7-3: A6510

Transient Filter Board for the A6510

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 7-4: 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 A6510 Signal Input module will also accept non-specific AC or DC inputs from any source that conforms to the A6560R 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

Table 7-1: Signal Input module input ranges *(continued)*

Attenuator	Gain	Input Range +/-
/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 A6510 Signal Input module selects 2 of the 12 vibration channels at a time and routes them to the Processor module for spectral analysis. 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.

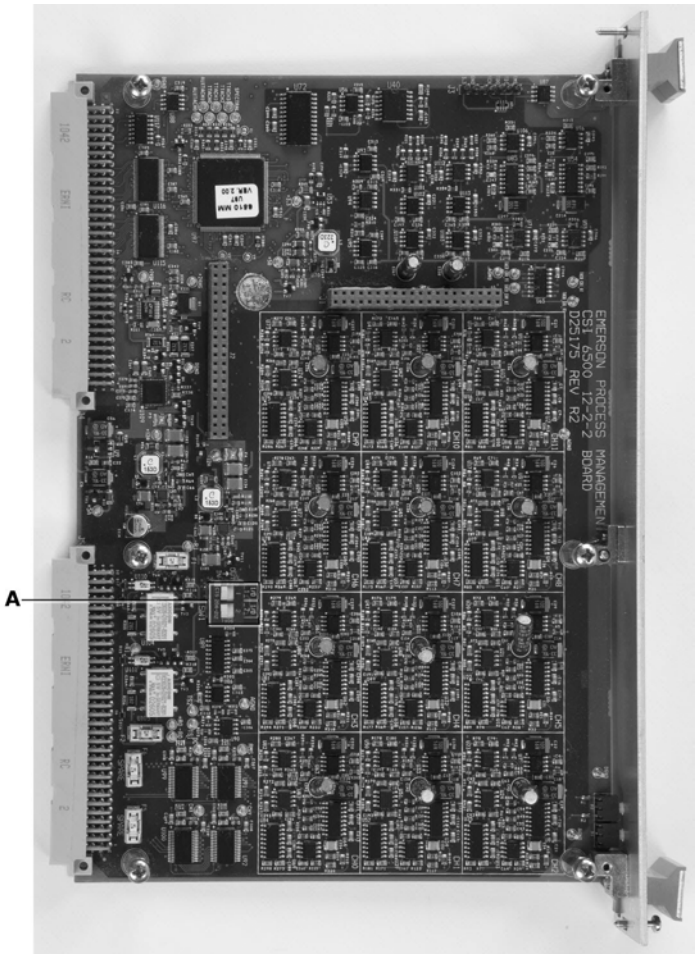
I/O relay channels

Each A6510 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 7-5: Signal Input module PCB



A. I/O relay DIP switches

Each I/O Relay channel on the A6510 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 Telnet 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 the A6560R with a terminal emulator

7.3.1 Configure a serial port connection from a computer

Use a terminal emulator such as Telnet or HyperTerminal to connect to the AMS 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 AMS Machinery Health Monitor with Telnet.

Table 7-2: Serial port 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 A6560R boot parameters with a terminal emulator

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

- If you replace the processor module. You may replace an A6560 with an A6560R.
- 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 processor board IP addresses have been verified and changed, if necessary, to be compatible with addresses already in use on the existing network.

Procedure

1. Start a terminal session, and turn the unit on.

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

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

```
VxWorks System Boot
Copyright 1984-2016 Wind River Systems, Inc.
CPU: Freescale P1010E — Sty Engine
Version: VxWorks 6.9
BSP version: 6.9/5.00g
Creation date: Jul 18 2016 09:26:09
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.

Important

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

A list of boot parameters appears one line at a time. When configuring the A6560R, the screen will look similar to this:

```
boot device                     : motetsec0
processor number                : 0
host name                       : host
file name                       : bin/6500R
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) :
flags (f)                       : 0x1008
target name (tn)                :
startup script (s)              :
other (o)                       :
```

⚠ CAUTION!

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" Time
----------	----------
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 Console session 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 menu.

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* to navigate in a console session. Contact Emerson Product Support before using any other commands.

VxWorks commands are case-sensitive.

Table 7-3: Console session navigation after boot interrupt

Command	Description
?	Print this list
@	Continue boot (load and go)

Table 7-3: Console session navigation after boot interrupt *(continued)*

Command	Description
p	Print boot parameters
c	Change boot parameters
e	Print fatal exception
v	Print version
M	Change MAC address

7.3.4 Console session navigation after boot complete

After typing bootChange in a console 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.

VxWorks commands are case-sensitive.

Table 7-4: Console session navigation commands

Key sequence	Description
Enter	Accept the value.
. (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.
safeReboot_vf	Reboot the system with new boot settings.

7.3.5 Boot flags

For the A6560R, you can list boot flags by typing a question mark (?) into in a console session at the VxWorks boot prompt.

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 the Hex radio button.

Table 7-5: Complete list of boot flags

Boot Flag	Description
0x0002	Load local system symbols (for debug).
0x0004	Don't autoboot (for testing).
0x0008	Quick autoboot (no countdown).
0x0040	Use DHCP to get IP address parameters (not recommended).

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

Boot Flag	Description
0x0080	Use TFTP to get boot image (network boot only).
0x0200	Ignore BOOTROM update image in FLASH (for testing).
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.
0x8000	Boot over a WAN, requiring extended FTP timeouts. This flag applies only if one of the following flags is set: • 0x1000 • 0x2000 • 0x4000

7.3.6 Subnet masks

A subnet mask is normally represented 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 system boot parameters, 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 an A6560R 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 computer or laptop.

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

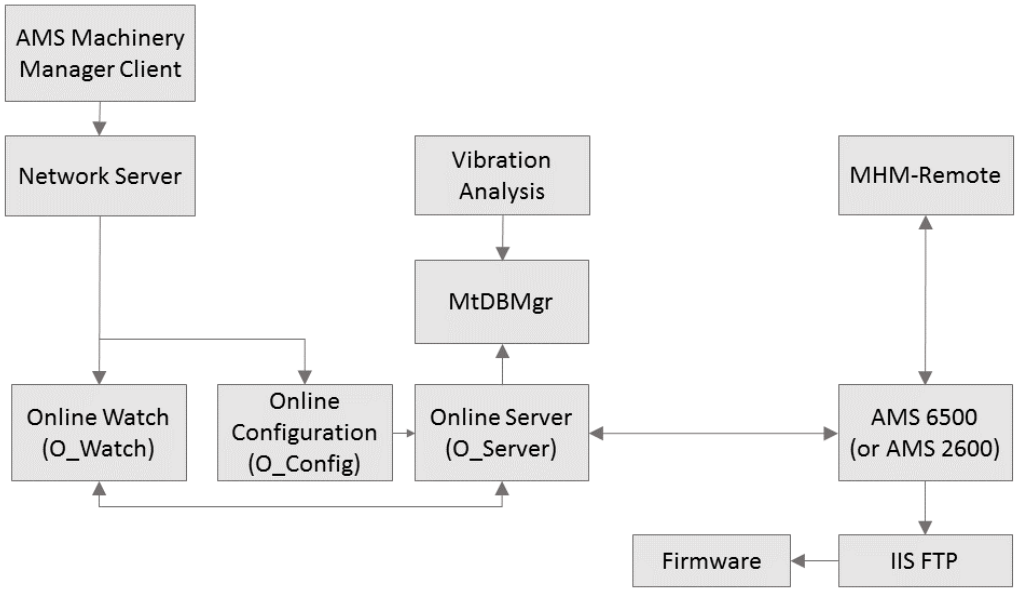
2. Subnet mask is applied on the IP address of the system boot parameter inet on ethernet. Enter the IP address of the unit followed by a colon and then the subnet mask in the hexadecimal format.

8 Software configuration

Topics covered in this chapter:

8.1 System overview diagram

Figure 8-1: System overview diagram



- Network Server—Service responsible for handling the user's access to the various programs within the AMS Machinery Manager software.
- Online Watch (O_Watch)—Graphic interface that allows:
  - viewing of data sent to the server by the A6560R CPU module
  - management of transient acquisition and auto-extraction
  - adjustment of alarm levels
  - on-demand data acquisition

- Online Configuration (O_Config)—Program that allows the creation and modifying of databases for use with the online system, along with system commissioning.
- Vibration Analysis (Diagnostics)—Application that allows the user to request and save transient data and view live streaming data. It provides a variety of analysis functions necessary for analyzing the data generated by the AMS 6500 or AMS 2600.
- CSIMtDbMgr Service—Handles most of the reading and writing operations performed on databases stored on the server. It also indexes and verifies the integrity of databases.
- Online Server (O_Server)—The central process service which handles all predictive activity on the online system. It is responsible for processing requests from the client, sending configuration information to the AMS 6500 or AMS 2600.
- MHM Remote—Service that handles transient data generated by the AMS 6500 or AMS 2600, and database access required by the Vibration Analysis program.
- AMS 6500 or AMS 2600 — Hardware portion of the monitoring system. The AMS 6500 is a fixed installation of the monitoring unit and the AMS 2600 is a portable unit that is connected to the server through Ethernet. Both the AMS 6500 and AMS 2600 use the A6560R with A6510 modules.
- IIS FTP—Microsoft's IIS includes an FTP server which needs to be installed to allow the A6560R to load firmware from the server.
- Firmware—The firmware for the A6560R is loaded from the computer when the unit powers on. This allows system updates to be installed on the computer like any other program update without the requirement of any special interaction with the A6560R beyond rebooting it to allow the new version to load.

8.2 System configuration overview

The A6560R CPU module communicates through an Ethernet connection. When you are using the AMS 6500, AMS Machinery Manager is on a server and connected through a network. When you are using the AMS 2600, the AMS Machinery Manager is on a laptop and connected directly to the unit.

In order for the unit and the server to successfully communicate, both must have addresses known to each other. Also, A6560R must contain the IP address of the FTP server from which to download firmware updates.

1. Set up the computer:
   - Set the computer's IP address, as needed.
   - Install AMS Machinery Manager on the computer as a Network system.
   - Set up an FTP server to host the firmware, as needed.
   - Install the A6560R firmware on the FTP server.
2. Set up the unit to communicate with AMS Machinery Manager.
   - Connect the computer to the unit with an Ethernet or Serial cable
   - Connect to the unit from a computer using a terminal emulator.
   - Set the unit's IP address.

- Set the IP address of the FTP server for the unit to obtain firmware updates.

3. Connect equipment to be monitored to the unit:
   a. In AMS Machinery Manager, add an online server to RBM Network Administration.
   b. In Online Configuration, add the unit's IP address, create a database for the equipment to be monitored, and save it to the unit.
4. Set up the database in AMS Machinery Manager:
   a. In AMS Machinery Manager, add an online server to RBM Network Administration.
   b. In Online Configuration, add the unit's IP address, create a database that matches the configuration of the equipment to be monitored, and save it to the unit.

Note

If a computer is purchased from Emerson with the AMS 2600 order, the computer and the unit are already set up.

8.3 Install AMS Machinery Manager

Install AMS Machinery Manager on your computer with the following options checked:

- Network Server
- Online Server
- AMS Machinery Manager Client

Refer to your software user guide for these details.

8.4 Configure the FTP server to download firmware

Each time a AMS Machinery Health Monitor powers up, it checks for firmware on the FTP server. If it finds firmware, it compares the version with the firmware stored in internal flash memory. If the versions are different, the version on the server is downloaded to the AMS Machinery Health Monitor.

Unless otherwise specified, AMS Machinery Health Monitor systems are pre-configured and set up during commissioning.

The FTP server must be configured on a computer on the network so that a AMS Machinery Health Monitor can obtain firmware updates. If an FTP site is not available, the AMS Machinery Health Monitor boots from the firmware stored in memory. The FTP service is available but not enabled by default on Microsoft Windows. Refer to your Microsoft

Windows Operating System instructions to enable the FTP web server and set up an FTP site. These instructions are an overview of the steps to configure an FTP Server for the AMS Machinery Health Monitor firmware on the Windows operating system.

Prerequisites

Install AMS Machinery Health Monitor firmware on the computer where you will configure the FTP service. The default location for the firmware on the FTP server is C:\Inetpub\ftproot \bin\.

Procedure

1. Enable an FTP server in Internet Information Services (IIS)

   The Windows' built-in web service is called Internet Information Services (IIS).

2. Complete the steps and configure the settings to match the FTP settings on the AMS Machinery Health Monitor according to the following example.

Table 8-1: AMS Machinery Health Monitor FTP configuration

Setting	Description
Site name	The FTP site name to display in IIS Manager. This is for your reference.
Physical path	The path to the bin directory where the firmware will be installed on the FTP server (do not include the bin directory). C:\Inetpub\ftproot, for example.
Binding	Set Binding to All Unassigned or the IP address or a range of IP addresses assigned to this computer. Do NOT enable virtual host names.
Start FTP site automatically	Allow the site to start automatically. Check Start FTP site automatically.
Security	On Windows 7, choose Allow SSL and do not select a certificate. On Windows 8 and Windows 10, choose No SSL.
Authentication	Choose Anonymous if the AMS Machinery Health Monitor's user (u) and password (pw) boot parameters are set to anonymous.
Authorization	Choose Anonymous users if the AMS Machinery Health Monitor's user (u) and password (pw) boot parameters are set to anonymous.
Permissions	Read
Port	21

Table 8-2: AMS Machinery Health Monitor FTP settings

Boot parameter	Definition	Default settings
host inet (h)	The IP address of the FTP server	192.168.0.1
user (u)	The username for the FTP account	anonymous
ftp password (pw)	The password for the FTP user	anonymous

The FTP site name appears in the Connections pane and the site is started.

8.4.1 AMS Machinery Health Monitor firmware update

Emerson Process Management periodically releases updates to firmware. When you update your AMS Machinery Manager software, it is a good practice to update the firmware if a new version is available. Refer to the Readme file (Readme.rtf) on the Software Installation DVD for information about the current firmware version. These instructions apply to the following AMS Machinery Health Monitor systems:

- AMS 6500 Machinery Health Monitor
- AMS 2600 Machinery Health Expert
- CSI 4500 Machinery Health Monitor

Install the firmware on the FTP server

Prerequisites

You need the AMS Machinery Manager Software Installation DVD.

Procedure

1. Log on to the computer that hosts the FTP Server for your AMS Machinery Health Monitor.
2. Insert the AMS Machinery Manager Software Installation DVD.
3. Open the DVD in Windows Explorer and browse to Install/Online Firmware.
4. Double-click setup.exe and continue through the installation.

   Important
   On Windows 7, right click setup.exe and select Run as administrator.

5. Accept the license agreement.
6. Select the type of installation.
   - Select Typical to install the firmware and tools.
   - Select Custom to choose to install either the firmware or the tools.
7. Follow instructions presented by the installation program.

The online firmware is installed in C:\Inetpub\ftproot\bin\.

Postrequisites

Cycle the power on each AMS Machinery Health Monitor that uses this FTP server.

Reboot the AMS Machinery Health Monitor

Cycle power on the AMS Machinery Health Monitor and verify the system is in good status after it boots.

Procedure

1. Cycle the power on each AMS Machinery Health Monitor that needs to get the new firmware update from the FTP server.
2. Wait approximately 5 minutes for the system to complete the boot process.
3. Verify the system is powered on and in good status.

   Refer to the Installation Manual for your specific hardware model for more information.

Check the firmware version in AMS Machinery Manager

1. Log on to AMS Machinery Manager Client with the Administrator user account or a user that has permission to use online technology.
2. Go to Tools > Setup/Communications > Online Configuration.

   The Online Config window appears.

3. Go to File > Online Server > Open.

   The Select Online Server Host Computer dialog appears.

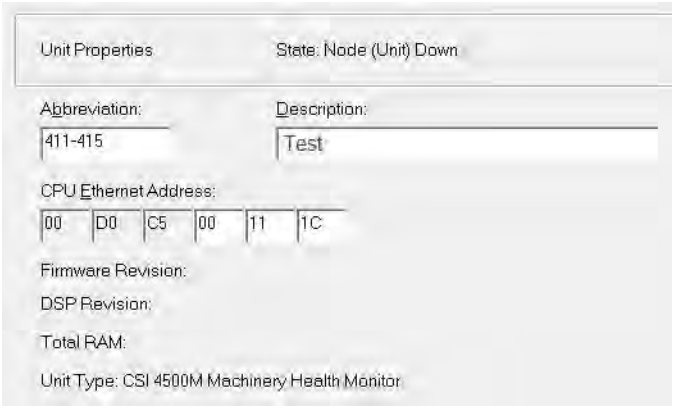
4. Choose a server name from the menu and click OK.

   The Online Server opens and a tree structure appears in the left pane of the Online Config window.

5. In the tree structure, expand Units folder, and right-click the icon next to the AMS Machinery Health Monitor you want to check and select Properties.

   The Unit Properties screen appears in the right pane and displays the State, Firmware Revision, DSP Revision, Total RAM, and Unit Type.

Figure 8-2: Unit properties



6. In the Unit Properties pane, verify State is `Node(Unit)` UP and Firmware Revision matches the version you installed.

Contact Product Support for help if the firmware version does NOT match.

8.5 Connect the A6560R CPU to AMS Machinery Manager

The A6560R CPU must be connected to AMS Machinery Manager through an Ethernet connection to transfer data for storage or analysis. Both the unit and the computer must be configured with an IP address in the same logical network.

Procedure

- To connect to AMS Machinery Manger on a laptop, connect a standard Ethernet cable (included) from to the unit's Hub port to the computer.
- To connect to AMS Machinery Manager network server on a Local Area Network, connect a standard Ethernet cable from your network to the unit's NIC port.

8.5.1 IP addresses for network configuration

IP addresses are unique addresses that systems on a network use to communicate with each other.

Table 8-3: Example IP addresses

A6560R CPU module	192.168.0.10
Computer	192.168.0.1

Notes

- The IP addresses shown are defaults. If two or more A6560R will be used, each should be given a unique IP address.
- Depending on the computer network IP addresses may require subnet masks. Transient extraction may fail without them. See *Specify a subnet mask*.

In short, the A6560R must “know” its server address, and the computer must “know” the IP address of any A6560R.

8.5.2 Set the computer's IP address

Follow your operating system's instructions for changing the computer's IP address before connecting a laptop to an AMS 2600.

Procedure

1. Make a note of your computer's current settings.
2. Change the IP address assigned to the computer Ethernet port to the address expected by the AMS 2600.

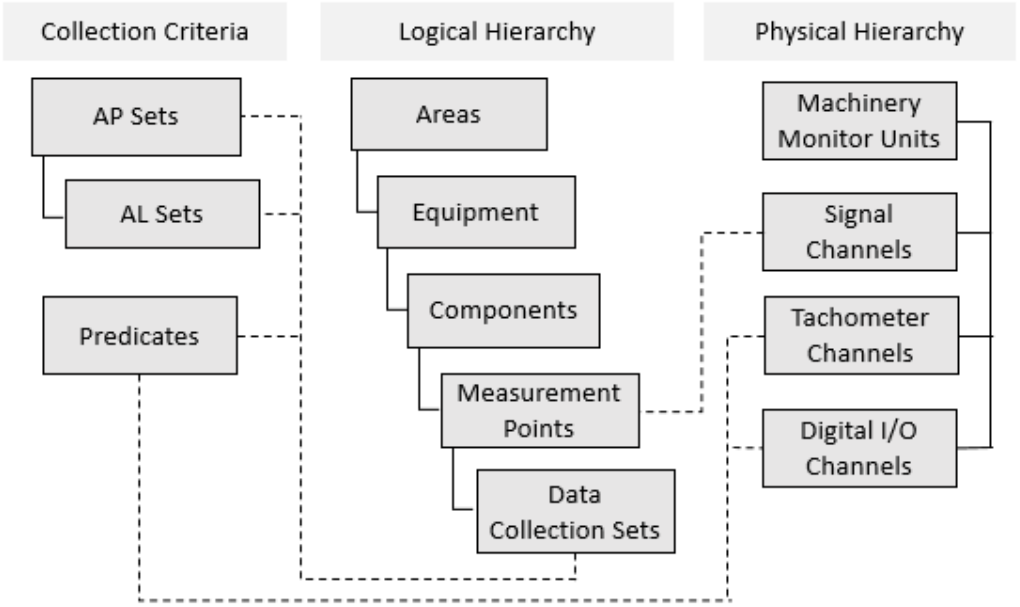
9 Data collection and analysis

Topics covered in this chapter:

9.1 Online database diagram

The structure of an online database is designed to mirror the structure of the equipment being monitored. *Figure 9-1* shows the relationships of the elements of an online database to the equipment being monitored.

Figure 9-1: Online database diagram



9.1.1 Collection criteria

Analysis Parameter (AP) Set

Defines a particular way to collect spectral and waveform data, and specifies:

- the number of lines of resolution.
- any averaging modes and windowing.
- whether to be order-based or frequency-based.
- what FMax to use.
- what parameters are to be collected.

Alarm Limits (AL) Set

Each AL Set is associated with a specific AP Set. You may define multiple AL Sets for any given AP Set to accommodate changing monitoring conditions. The alarm limit definition determines when alarms occur, data is stored, and output relays are set.

Predicate

A collection predicate is an expression that compares the conditions of vibration levels, input relay states, or machine speeds to determine when data is collected and Transient auto-archives are extracted.

9.1.2 Logical hierarchy

Area

A user-defined grouping of equipment. An area often corresponds to a building or section of a process line within a plant.

Equipment	A group of coupled devices that logically should be monitored together. Most often a machine train is made up of a driver component (such as a motor) and one or more driven components (such as a pump or fan).
Component	A specific, single asset to be monitored. Motors, engines, turbines, pumps, and fans are examples of components.
Measurement Point	Corresponds to a single physical sensor. A Measurement Point groups together all the data from all the collections that have been defined for a particular sensor. Any Gross Scan data collected on the sensor and reported for storage is logically associated with the Measurement Point in the database.
Data Collection Set (DCS)	The DCS is a single collection of data on a single Measurement Point. Multiple DCSs allow multiple collections on a single Measurement Point. The DCS combines a particular predicate (when to collect), with a particular AP Set (what and how to collect, including parameter bands), and a specific AL Set (alarm set points).

9.1.3 Physical hierarchy

Machinery Monitor (unit)	The physical monitoring unit.
Signal Channels	An AC vibration or DC process input.
Tachometer Channels	A speed measurement input.
Digital I/O Channels	A discrete relay, Input or Output.

9.2 View or edit IP addresses with the unit

Verify the network addresses of the computer, the unit, and the database.

Procedure

1. Start a terminal session on the AMS Machinery Health Monitor.

   If you use a serial connection with PuTTy or HyperTerminal, you do not need a username and password.

   If you use a Telnet connection, log in with the following credentials. Both are case-sensitive:

   - username:csi
   - password: csiSupport

2. At the prompt, type bootChange and press Enter. This command is case-sensitive.

   A list of boot parameters appears one line at a time.

3. Press Enter to advance down the list of parameters.
4. Note the IP addresses in the following fields:

The value in inet on ethernet is the IP address of the A6560R CPU module .

The value in host inet is the IP address of the computer where the FTP server has the unit's firmware installed.

5. On your computer, view the IP address of the FTP server by following Windows' instructions for viewing IP addresses. Verify that this address matches the one shown in host inet.

9.3 Verify or assign a unit IP address to the Online Server in RBM Network Administration

The online database must have the IP addresses of assigned monitoring units.

Procedure

1. Log in to AMS Machinery Manager and click on RBM Network Administration.
2. In the RBMadmin window, double-click the server listed under the Online Server panel.
3. In the Online Server Setup window, the Active Units panel lists the IP addresses of units available for the online server.

   If the system is configured to store data in a database, a database will be displayed in the Machinery Health Manager Database frame, the two Edit buttons will be inactive, and the Stop Data Collection button will be inactive.

4. If necessary, assign the IP address of an AMS 6500 or AMS 2600 to Active Units.

   a. In the Online Server Setup window, click Stop Data Collection.
   b. Beside the Active Units panel, click Edit.
   c. In the Edit Online Server's Active Unit List window, type the IP address of an AMS 6500 or AMS 2600 in the New Unit field.
   d. Click Add New.

      The IP address appears in the Active Units panel.

   e. Click OK.

      The Edit Online Server's Active Unit List window will close.

   f. In the Online Server Setup window, click Start Data Collection.

Once an AMS 6500 or AMS 2600 IP address is listed in RBM Network Administration, that address may be used for any existing or future database built with the online server. This task does not need to be performed each time a new database is built.

9.4 Add a unit's IP address to the Online Server in RBM Network Administration

Prerequisites

Add an online server in RBM Network Administration.

The unit must have an IP address in the same network as that of the online server.

Procedure

1. In RBM Network Administration, select Online Server > Online Server Setup.

   The Online Server Setup window appears.

2. Select a server name from the Online Server menu.

   The Online Server box displays the AMS Machinery Manager database assigned to the selected Online Server. Active Units lists the AMS Machinery Health Monitors monitored by the selected Online Server.

3. If data is being collected, click Stop Data Collection.

   Data collection must be stopped to make changes.

   The Edit buttons become active.

4. Click Edit beside the Active Units box.

   A New Unit field appears.

5. Type in the IP address in New Unit and click Add New.

   The unit appears in the Active Units list.

9.5 Online database configuration: overview

Configuring a database for an online monitoring application includes understanding how each sensor is attached to the equipment and the corresponding connection to the AMS 6500 or AMS 2600.

In most cases, a AMS 2600 is not connected directly to sensors. Rather, it is connected through coax cable with BNC connectors to a panel of monitoring modules. These modules are connected to field wiring. Therefore, when building a database, it is important to have a diagram that shows what sensors are connected to which monitoring modules. In addition, an analyst who builds an online database needs to know if the monitoring modules perform any signal conditioning on the input signals before passing them through to their output connectors.

The AMS 2600 has the capability to provide bias voltage and current (+24 V / 4 mA) for accelerometers and must be in this configuration if connecting directly to accelerometers. However, if connecting to a module, it is likely that the module powers/biases the accelerometers and sensor power should not be turned on at each AMS 2600 signal connection.

9.5.1 Database configuration pre-requisites

Have the following information available before you begin to build a database:

- Sensors connected to each channel; sensitivity, offset (eddy current sensors, thrust probes), signal range.
- Source of sensor power for accelerometers.
- Definition of the transient event (speed drops below 3585 RPM, input relay from external control system changes state, etc.)
- Sensors for which transient measurements are desired.
- IP address of each system.
- Bearing clearances (radial eddy current sensors).
- Resting DC voltage measurements for radially mounted eddy current sensors.

9.5.2 Collection predicates

Predicates are conditions that have a value of True or False, and are used to guide measurement operations.

A Collection Predicate tells the system when to perform a routine data collection based upon the definition created in the database. Inputs into this type of predicate include:

- speed
- Gross Scan AC amplitude
- Gross Scan DC amplitude
- discreet input signal
- another predicate

An example of a Collection Predicate for a transient operation would be "Speed below 3585 RPM". This predicate will have a value of False if speed is above 3585 RPM. It would have a value of True if speed is below 3585 RPM.

9.5.3 Create a collection predicate

Use Online Configuration to create a collection predicate.

In AMS Machinery Manager, open Online Configuration and connect to the Online Server.

The database is collecting data.

Procedure

1. In the tree structure in the left panel, expand Units, expand the AMS 6500 that will collect data, right-click the Predicates folder, and select Add Collection Predicate.
2. Enter a name for the predicate. Do not include spaces.
3. Click the Tach drop-down menu and select the tachometer to be used for acquisition.

   This will be a tachometer connected to Tach location 1, 2, 3, or 4.

   The Tach Clause dialog opens.
4. Click the Comparison drop-down menu and select an equation for the predicate.
5. Enter an RPM value in the Speed1 field.
6. Click OK.
7. Click Apply to finish.

9.5.4 Configure a database for transient operation

The online system may be used to simultaneously monitor machinery under normal operating conditions and to create a large archive of information for those signals designated (while building the database) as transient. All sensor connections to the unit are configured for predictive operation. Some (or all) of these are also designated as transient and are configured for transient operation.

Procedure

1. Create collection predicate for transient auto-archive operation.

   When you create an auto-archive definition, this collection predicate will cause the unit to automatically transfer an archive of transient measurements to the online server, where they can be viewed by an analyst. Archives stored on the transient hard drive will eventually be written over by new measurements.
2. Configure the Measurement Points to associate tach channels with vibration channels.

   a. In Online Configuration, right-click Areas, select Add Area.
   b. Enter an Abbreviation and Description, and click Apply.
   c. Right-click the newly created Area and select Add Equipment.
   d. Enter an Abbreviation and Description, and click Apply.
   e. Right-click the newly created Equipment and select Add Component.
   f. Enter an Abbreviation and Description, and click Apply.
   g. Right-click the newly created Component and select Add Measurement Pt.
   h. Enter an Abbreviation and Description, and click Apply.
   i. With Component Properties still open, click the Monitoring Unit tab.

Figure 9-2: Online Configuration—Component Properties

j. In the Online Monitoring Unit field, click Attach.

k. Select the unit and click Okay.

l. In the Component Properties field, click Apply.

3. Commission transient channels.

Transient channels may be commissioned all at once, unlike prediction channels. An analyst may designate some or all of the already commissioned predictive channels for transient operation. Some signals, such as case expansion may not include valuable transient information. In this case, they do not need to be commissioned as transient—only as predictive signals.

a. In the Online Configuration tree structure, right-click on the unit and select Commission Transient Channels.

The Commission Transient Channels dialog appears, showing signals already commissioned for predictive operation.

b. Select the desired tach channel, and click the check box for each signal input you want to associate with the tach channel.

c. Click the Acquire button.

Measurements for the entire set of signals are shown.

d. Click Commission to commission the channels for transient operation.

Data collection starts when you save the configuration to the O_server, which also downloads it to the unit.

4. Create an Auto-Archive definition.

   This tells the unit when to automatically send an archive of measurements to the online server.

   a. Right-click the Transient Tachometer and select Transient Auto-Archive Properties.

      The Auto-Archive Properties dialog appears.

   b. Set the Pre-trigger time (in minutes) and Post-trigger time (in minutes).

      Pre-trigger time indicates how long the auto-archive will take measurements before the collection predicate changes to TRUE. Post-trigger time indicates how long the auto-archive will take measurements after the collection predicate changes to TRUE.

      After all measurements have been collected, the archive will be sent from the unit to the online server.

9.5.5 Review and save a transient database

After creating a database, create a report to review your database configuration. The report includes:

- firmware revision used by the unit
- calibration information for the unit
- predicates and their definitions
- signal connections, transient or predictive
- tachometer definitions
- relay definitions

Procedure

1. In the Online Configuration tree structure, right-click on the unit and select Report.
2. Select File > Online Server > Save.

   The database configuration is downloaded to the unit.

9.6 Online Watch overview

AMS Machinery Manager Online Watch monitors system status and views the latest measurements.

To open Online Watch, log in to AMS Machinery Manager, click the Tools tab, and in the left panel, click Analysis.

Online Watch can perform four specific transient operations:

- Create archives manually.
- Disable archive predicates.
- Stop and start transient streaming.
- Remove archives from the Transient Archive Status tab.

Transient system status includes:

- Streaming/not streaming to HDD
- Time of oldest recorded information
- Progress of archive creation

The Online Watch screen displays the system status, and the status of any archives. This display has two tabs, Transient Status and Transient Archive Status.

Transient archives are stored under the server folder ...\CustData. Two items will be created in this folder. One is the actual online database file, with an .rbm extension. The other is a sub-folder with the same name as the online database. Inside this sub-folder is a collection of other folders, including one named archives. Transient archives are stored under this archives folder, with a separate folder for each archive.

9.6.1 Online Watch—Transient Status tab

Figure 9-3: Online Watch—Transient Status

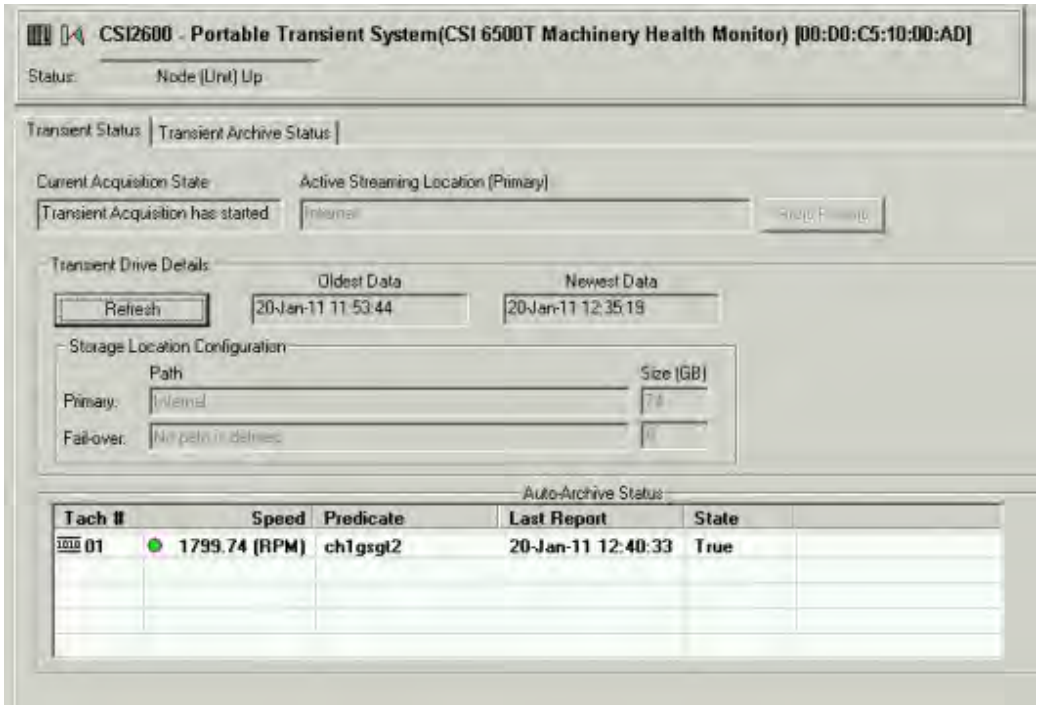


Table 9-1: Transient Status tab fields

Field	Message	Description
Status	Node(Unit)Up	Unit is ready to monitor using the database definition.
	Acknowledged	Unit is reorganizing internal software and schedules to conform to the database definition.
Current Acquisition State	Transient Acquisition has started	Transient measurement is proceeding normally.
	Transient Acquisition has stopped	Transient measurement was manually stopped.
	Unknown	Temporary message after a database is downloaded.
Active Streaming Location(1)	Primary	Transient system is recording to the primary drive, as specified in Online Configuration > Unit Properties.
	Failover	Transient system has detected a problem with the primary drive and is recording to a Failover drive, as specified in Online Configuration > Unit Properties.
Transient Drive Details	Oldest Data	Date and time of the oldest measurements currently stored in the unit. Update this field by clicking Refresh.
	Newest Data	Date and time of the newest measurements currently stored in the unit. Update this field by clicking Refresh.
Storage Location Configuration	Primary	Path displays which drive—Internal, External, No Path—has been specified as the primary streaming location. Size displays how much memory is available.
	Failover	Path displays which drive—Internal, External, No Path—has been specified as the secondary streaming location. Size displays how much memory is available.
Auto-Archive Status	Tach #	Tachometer input associated with a group of transient vibration channels.
	Speed	Current speed measured by the Tach input.
	Predicate	Name of the predicate used for triggering the auto-archive.
	Last Report	Date and time of the most recent archive.
	State	`True` means the parameters of the auto-archive predicate are being met and data is being recorded to the drive. An analyst can select the Transient Archive Status tab to monitor the progress of archive creation. `False` means the parameters of the auto-archive predicate are not being met and data is not being recorded. `Disabled` means the automatic archive predicate has been disabled.

(1) The Active Streaming Location is where transient data is recorded during normal/constant system operation. Measurements from this drive are extracted when an archive is created, and sent as a folder (archive to the online server).

9.6.2 Online Watch—Transient Archive Status tab

The Transient Archive Status tab shows archives that are currently being created.

Figure 9-4: Online Watch—Transient Archive Status

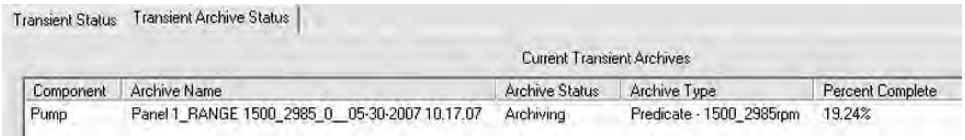


Table 9-2: Transient Archive Status fields

Field	Message	Description
Component	(variable)	Displays the machine component associated with the transient archive group.
Archive Name	(variable)	Displays the name of the archive that was specified in Online Configuration. `Range 1500_2985` indicates that the collection predicate is TRUE for speeds between 1500 and 2985 RPM. The number in `_0___` is reserved to ensure the filename is always unique. `05-30-2007` indicates the date the archive was created, in mm-dd-yyyy format. `10.17.07` indicates the time the archive was created, in hh.mm.ss format.
Archive Status	Pending	The system is waiting for post-trigger data to be collected, before sending that data to the database.
	Archiving	The system is sending a complete set of measurements to the online server.
	Complete	All measurements have been sent to the online server.
Archive Type	Predicate - parameters	The archive was initiated by a predicate.
	Manual	The archive was initiated on-demand by a user.
Percent Complete	00.00%–100.00%	Displays progress while the system sends measurements to the online server.

9.7 Archive management

Archives are stored in folders in C:\RBMnet\RBMsuite\CustData\.

Computers have a finite amount of video display memory that may limit the amount of graphic data viewed in an archive. To achieve efficient system operation, an analyst should regularly review extracted archives and keep only those of interest or only the portions of interest in each archive. An analyst can extract smaller archives from large ones using the program Vibration Analysis. To extract and view large amounts of information, an analyst should sequentially extract individual archives of 1 - 2 hours of measurements.

9.8 Create an archive manually

There are three major differences between manually created archives and automatically created archives:

- Manual archives only include information already stored in the A6560R. Automatically-generated archives can include information which is received after the transient collection predicate = TRUE.
- Manual archives do not automatically have a date-time stamp appended to them. You can assign each archive a unique name.
- Manual archives can specify a custom length of time. Automatically generated archives have a maximum of 60 minutes of measurements.

Procedure

1. In Online Watch, select a component that has transient signals.
2. Right-click and select Start Transient Archive.
3. Define the manual archive characteristics.

Postrequisites

Observe the progress of manual archives in the Transient Archive Status tab.

9.9 Disable archive predicates

An analyst can disable the creation of automatic archives during startup or when the machine is being cycled and multiple archives are not desired.

Procedure

1. In the Transient Status tab, right-click on the archive predicate and select Disable Archive Predicate.

   A caution window appears.

2. Click Okay to confirm disabling.

The predicate State on the Transient Status tab reads `Disabled`.

To re-enable the archive, right-click on the archive predicate and select Enable Archive Predicate.

Example: Archive creation

When an archive predicate changes from `DISABLED` to `TRUE`, no archive is created. Consider the following sequence:

1. Archive predicate is false.
2. Archive predicate is disabled prior to machinery start-up.
3. Machine starts up and increases to a speed of 1800 RPM.

4. Archive predicate is re-enabled.
5. Archive predicate immediately changes to value of TRUE.
6. No archive is created.
7. Machine speed continues to rise and reaches a speed of 3000 RPM.
8. Archive predicate changes to value of FALSE.
9. Machine trips and speed drops below 2985 RPM.
10. Archive predicate changes to value of TRUE.
11. Archive is automatically created and sent to online server.

Disabling or re-enabling archive predicates only controls if the A6560R sends an archive to the online server. This does not stop the A6560R from recording measurements. In the above sequence, an analyst could extract a manual archive starting at the time when the archive predicate was initially false and ending at the time that the machine was at 3000 RPM.

9.10 Stop transient acquisition

An analyst can command the AMS 2600 to stop recording transient data.

Procedure

1. In the Online Watch tree structure, right-click on the AMS 2600 and select Stop Transient Acquisition.

   A caution window appears.

2. Click Okay to confirm.

In the Transient Status tab, Current Acquisition State displays the message `Transient Acquisition has stopped`, and the AMS 2600 is no longer streaming data to the designated drive.

9.11 Remove an archive from the Transient Archive Status tab

In the Transient Archive Status tab, right-click on the archive and select Acknowledge Transient Archive.

Note

Removing archives does not delete archives from the online server; it only removes them from the list in the Transient Archive Status tab.

9.12 Change databases when moving the AMS 2600 to a new machine

Because the AMS 2600 is a portable system, ensure that measurements from the connected machine are stored in the correct database.

⚠ CAUTION!

Change the database when you move the AMS 2600 from one monitoring rack or machine to another. Data from one machine could be stored in the database of another machine if this sequence is performed incorrectly.

⚠ CAUTION!

Changing databases will reinitialize the Transient HDD, which eliminates all stored data. Extract any data before changing databases.

Prerequisites

Before disconnecting from the first machine, log in to AMS Machinery Manager.

From the Tools tab, click Setup/Communication and open RBM Network Administration.

Procedure

1. In the bottom center panel labeled Online Servers, double-click the server.

   The Online Server Setup dialog opens.

2. Click Stop Data Collection.
3. Disconnect the unit from the first machine.
4. Connect the unit to the second machine.
5. In Online Server Setup, click the Edit button next to Machinery Health Manager Database—not next to Active Units.
6. Select the second machine's database when prompted.
7. In Online Server Setup, click Start Data Collection.

The system will now store any measurements or archives in the second database.

10 Specifications

Topics covered in this chapter:

10.1 AMS 6500 Machinery Health™ Monitor specifications

Table 10-1: AMS 6500 Machinery Health™ Monitor (General)

Analog Channels	12 or 24 (1 or 2 A6510)
Tachometer Channels	2 or 4 (0.1-2 kHz, up to 60kHz divided to ≤2 kHz), (0.5 V to 24 V)
Relay Channels	2 or 4 (SPDT 24 V at 0.5 A dry contact)
Max. Frequency Range / Sampling Rate	40 kHz / 102,400 samples per second
ADC Resolution/Dynamic Range	24 bit / 100 dB conservatively measured
Lines of Resolution	100 up to 6400
Voltage Input Type / Impedance	±24V AC + DC / 1 MΩ (differential)
Sensor Power (ICP) / Impedance	4 mA at 22 V / 500 KΩ (single ended)
Channel Scan	2 Channel simultaneous
Channel Scan Rate	1 second; 2 CH, 400 LOR, 400 Hz, 1 average
Gross Scan	All channels continuous
Units	English, Metric, Hz, CPM, order
Scaling	Linear and Log
Windows	Hanning, Uniform
Averaging	Summation, Exponential, Synchronous Time
High frequency detection	PeakVue (Optional)
Hardware Communications	Modbus (Optional)
Vibration IEC60068-2-6 (operating)	5 g @ 57-500 Hz (3 axes)
Shock IEC60068-2-27 (operating)	30 g @11 ms (3 axes)
Shock IEC60068-2-27 (non-operating)	50 g @8 ms (3 axes)

Table 10-2: AMS 6500 Machinery Health™ Monitor Transient, Digital Condition Recorder (Optional)

DCR Analog Channels	12 or 24 (1 or 2 A6510-T)
DCR Tachometer Channels	2 or 4
DCR Maximum Frequency Range	DC to 2 kHz
DCR ADC Resolution/Dynamic Range	16 bit / >80 dB
DCR Lines of Resolution	200 up to 51200
DCR (Digital Condition Recorder)	100 hours all channels / FIFO
DCR Channel Scan	All channels simultaneous
DCR Transient	up to 60 minutes from Alert/Scheduled/Demand
DCR Transient Modes	Live viewing up to 11 channels
(in AMS Machinery Manager)	Replay with speed control
DCR Advanced Analysis Tools (in AMS Machinery Manager)	Bode / Nyquist, Shaft Centerline, Full Spectrum and many more

10.2 Environmental specifications

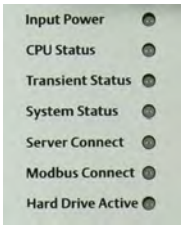
Table 10-3: Environmental specifications

Operating temperature	-20–60°C (-4–140°F)
Relative humidity	5–95%, non-condensing

10.3 A6560R Processor module LEDs

The A6560R 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 10-1: A6560R Processor module LEDs



10.3.1 Input Power LED

The Input Power LED indicates the status of the power converters that distribute various voltages within the A6560R Processor card. 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 A6560R Processor card.

10.3.2 CPU Status LED

The CPU Status LED indicates the status of the A6560R Processor card. The four status conditions are listed in *Table 10-4* 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 10-4: 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.

10.3.3 Transient Status LED

The Transient Status LED indicates the status of the Transient system components. For the A6560R module, the LED is always off when transient capability is not enabled.

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 10-5: Transient 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.

Table 10-5: Transient status conditions *(continued)*

LED Color	Status	Priority	Comments
Solid Green	OK	4	Normal operation.

10.3.4 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 A6560R Processor card 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" pattern on top of the system status. The pattern occurs in a four-count cycle. The LED is pulsed off for the first and second counts, and then on for the third and fourth counts. In practice, it gives the appearance of a human heartbeat. If the pulse pattern stops, it indicates a firmware fault has occurred. Many times the system is capable of recovering. However, if the system cannot recover quickly, it will automatically reboot itself to clear the fault and will then resume monitoring.

10.3.5 Server Connect LED

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

- A green color indicates that at least one AMS Machinery 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.

10.3.6 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.

10.3.7 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 functionality installed in the system.

10.4 A6510 Signal Input module LEDs

Every A6510 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 10-2: A6510 Signal Input module LEDs

10.4.1 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.

10.4.2 Status LED

The Status LED indicates the overall status of the module. The four status conditions are listed in *Table 10-6* 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 A6560R 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 A6560R Processor module can support (24 analog, 4 Tach, 4 I/O). Channels are counted starting in the left-most.

Table 10-6: 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.

11 System calibration

System calibration compensates for slight measurement variations that can occur across the temperature, voltage ranges, and variations in individual electronic components used by processing circuitry. Each A6560R is calibrated when it is assembled and verified at the factory. The calibration corrections are applied automatically during signal measurement and processing.

System calibration includes three procedures:

1. Calibrate the on-board signal generator, Test Signal Generator (TSG)
2. Calibrate the Gross Scan (GS).
3. Calibrate the Digital Signal Processor (DSP).

The system should be recalibrated at least once a year, or when the processor or a signal input module has been replaced. To recalibrate an installed system, contact a local Emerson Product Support to schedule recalibration. Calibrations can be completed in less than an hour, but units cannot monitor equipment during that time.

11.1 System calibration overview

The Test Signal Generator (TSG) provides a precise output signal for input to each of the circuit calibrations.

During calibrations, the TSG output is routed internally in the A6560R CPU to processing electronics, and calibration tables for each circuit (shown in *Calibration circuits input and output*) are created and stored in non-volatile memory.

Optionally, the calibration tables can be uploaded to an Online Server. Contact Emerson Product Support for assistance with this operation.

Table 11-1: Calibration circuits input and output

Calibration circuit	Input	Output
TSG (Test Signal Generator)	(external) signal	TSG table (internal) TSG signal
GS (Gross Scan)	TSG signal	GS table
DSP (Digital Signal Processor)	TSG signal	DSP table

11.1.1 Test Signal Generator (TSG) calibration

All CPU boards provided by Emerson are shipped with a calibrated TSG circuit. If the CPU board is purchased as part of a system, the entire system is calibrated using the TSG circuit. Recalibrate the function generator every three years with a NIST traceable volt meter.

TSG calibration requires the following equipment:

- Digital Multi Meter (such as the HP 34401A)
- computer configured as online server
- special calibration utility program (DHM)
- cable that connects the computer to the 6560 Processor module Ethernet port
- cable that connects the computer to the Digital Multi Meter
- cable that connects the Digital Multi Meter to the test port on the unit

Emerson recommends that qualified Emerson Online Systems Engineers perform TSG calibration or recalibration.

11.1.2 Gross Scan (GS) calibration

GS calibration requirements:

- uses the A6560 CPU module TSG output signal.
- does not require that any wire harnesses be disconnected.
- is completed in about 10 minutes.
- does not require any special cables or test equipment.
- uses a special calibration utility program (DHM).

GS recalibration should be performed:

- annually.
- whenever an A6560R CPU module A6560R CPU module is replaced.
- whenever an A6560 CPU module is replaced.
- if the calibration table has a status of "Unknown".

Product Support personnel can guide a technician through GS calibration over the phone.

11.1.3 Digital Signal Processor (DSP) calibration

Digital Signal Processor (DSP) calibration requirements:

- uses a CPU board's TSG output signal.
- does not require that any wire harnesses be disconnected.
- is completed in about 30-40 minutes.
- does not require any special cables or test equipment.
- uses a special calibration utility program (DHM).

DSP recalibration should be performed:

- annually.
- whenever an A6510 Signal Input module is replaced.
- whenever an A6560R CPU module is replaced.
- if the calibration table has a status of “Unknown”.

Product Support personnel can guide a technician through DSP calibration over the phone.

12 Data types

Topics covered in this chapter:

12.1 Gross Scan analysis

Includes Overall RMS Level, Sensor DC Bias, Gap, DC, or AC Process signals.

Note

Some DC Process Inputs could provide pk, pk-pk, or other Measurement Units.

Gross Scan parameters

All Gross Scan inputs must be DC in nature. Any Gross Scan input of a dynamic nature must be fed through the RMS/DC converter path. It is not technically valid to convert RMS values from an RMS/DC converter to pk or pk-pk Measurement Units unless the input is sinusoidal in nature. However, the AMS 6500 allows this. RMS values are multiplied by 1.414 or 2.828 to convert from RMS to pk and pk-pk, respectively.

12.1.1 Gross Scan units conversion

Table 12-1: Gross Scan units conversion

Input Type	Input Unit	HW Int.	RMS/DC	Meas. Unit	Disp. Unit
DC	V / E.U.	no	no	DC	E.U.
AC	V / E.U.	no	yes	RMS	E.U.
ACCEL	V / 32.2 ft/s	no	yes	RMS	g
	V / 32.2 ft/s	yes	yes	RMS	in./s
	V / 9.81 m/s	no	yes	RMS	g
	V / 9.81 m/s	yes	yes	RMS	mm/s
VEL	V / i/s	no	yes	RMS	i/s
	V / i/s	yes	yes	RMS	mil
	V / mm/s	no	yes	RMS	mm/s
	V / mm/s	yes	yes	RMS	micron

Table 12-1: Gross Scan units conversion *(continued)*

Input Type	Input Unit	HW Int.	RMS/DC	Meas. Unit	Disp. Unit
DISP	V / mil	no	yes	RMS	mil
	V / micron	no	yes	RMS	micron

12.2 Spectral analysis

Spectral analysis includes:

- Total Energy
- Energy within a Frequency Range
- Synchronous Energy within a Frequency Range
- Non-Synchronous Energy within a Frequency Range
- HFD
- Relative Synchronous Harmonics
- Average
- Synchronous Peak

Note

Total Energy, Energy within a Frequency Range, Synchronous Energy within a Frequency Range, Non-Synchronous Energy within a Frequency Range, HFD, Relative Synchronous Harmonics, Average, Synchronous Peak.RMS, pk, pk-pk Measurement Units are valid and can be freely converted.

Spectral Scan parameters

All Spectral Scan parameters must be AC in nature. It is possible to convert some analysis type results between Measurement Unit types and Display Unit types.

12.2.1 Spectral units conversion

Table 12-2: Spectral units conversion

Input Type	Input Unit	HW Int.	SW Int.	SW Diff.	Disp. Unit
AC	V / E.U.	no	no	no	E.U.

Table 12-2: Spectral units conversion *(continued)*

Input Type	Input Unit	HW Int.	SW Int.	SW Diff.	Disp. Unit
ACCEL	V / 32.2 ft/s	no	no	no	g
	V / 32.2 ft/s	no	single	no	in./s
	V / 32.2 ft/s	no	double	no	mil
	V / 32.2 ft/s	yes	no	no	i/s
	V / 32.2 ft/s	yes	single	no	mil
	V / 32.2 ft/s	yes	no	single	g
	V / 9.81 m/s	no	no	no	g
	V / 9.81 m/s	no	single	no	mm/s
	V / 9.81 m/s	no	double	no	micron
	V / 9.81 m/s	yes	no	no	mm/s
	V / 9.81 m/s	yes	single	no	micron
	V / 9.81 m/s	yes	no	single	g
VEL	V / i/s	no	yes	no	i/s
	V / i/s	no	yes	no	mil
	V / i/s	yes	yes	no	mil
	V / i/s	no	yes	single	g
	V / i/s	yes	no	single	i/s
	V / mm/s	no	single	no	mm/s
	V / mm/s	no	no	no	micron
	V / mm/s	yes	no	no	micron
	V / mm/s	no	no	single	g
	V / mm/s	yes		single	mm/s
DISP	V / mil	no	no	no	mil
	V / mil	no	no	single	i/s
	V / mil	no	no	double	g
	V / micron	no	no	no	micron
	V / micron	no	no	single	mm/s
	V / micron	no	no	double	g

12.3 Time Waveform analysis

Time Waveform analysis includes:

- Variance
- True Peak
- Waveform pk-pk

Note
Measurement Unit type is specific to Analysis type.

12.3.1 Time Waveform units conversion

Table 12-3: Time Waveform units conversion

Input Type	Input Unit	HW Int.	Disp. Unit
AC	V / E.U.	no	E.U.
ACCEL	V / 32.2 ft/s V / 32.2 ft/s V / 9.81 m/s V / 9.81 m/s	no yes no yes	g in./s g mm/s
VEL	V / i/s V / i/s V / mm/s V / mm/s	no yes no yes	i/s mil mm/s micron
DISP	V / mil V / micron	no no	mil micron

12.4 Non-Vibration unit analysis types

Non-Vibration unit analysis includes:

- Peak to Average Ratio
- Average to Minimum Ratio
- Kurtosis
- Skewness
- Synchronous Phase

These analysis types produce non-unit ratios or specific unit types such as degrees of phase. Measurement Unit Type will not apply to these parameters.

12.5 Set DC offset

For thrust probes, the input channel is defined as a DC Process input. Set the DC offset so that the thrust reading may be zeroed.

Procedure

1. Use a DC voltmeter (or the DHM program) to measure the DC voltage as seen directly on the inputs.

2. In Online Configuration, right-click on a unit and select Configure Unit.
3. Right-click a channel icon and select Define.
4. Set the Signal Type to Process.
5. Select Properties and select the Sensor button.
6. Highlight New and select OK to define a new sensor.
7. Enter the voltage value into Offset Field.

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