9000 Series Sensor Installation Guide

Your Guide to Permanent 9000 Series Sensor Installation

Rockwell Automation Entek

P/N 48204

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9000 Series Sensor Installation

This manual shows you how to install the 9000 series sensors. It is intended for anyone who installs or maintains a predictive maintenance system with permanently mounted sensors.

Introduction

A sensor (also called a transducer) is a device that measures a physical quantity and converts it into a proportional electrical signal, typically voltage or current. This signal is sent through a cable to a central monitoring station. There the signal is converted into a measurement with meaningful units. For example, the voltage signal from an accelerometer is converted into a measurement with units of acceleration.

In order for a sensor to function correctly and accurately, several things must be true:

- It must be mounted correctly. For an accelerometer, the best method is to bolt or stud mount the sensor at the correct location on the machine. Adhesive mounting is a suitable option when stud mounting is not feasible.
- The cable must be able to carry the signal without degrading the signal at the frequencies of interest over the length of the cable.
- The cable must be correctly connected to the monitoring device. In some cases, this is a station where the signal may be processed and tested against one or more alarm setpoints. In addition, the monitoring device may convert the signal for transmission over a network. Monitoring devices include data collectors, Enwatch™ units, 6600 Series Protection Monitors, XM™ series, Entrx®, and other vibration analysis systems.
- Proper grounding techniques must be observed at all times, and particularly when running a cable through a junction box.

This manual covers sensors, permanent mounting, and cable installation. Refer to the specific monitoring device manual for information about connecting the sensor signal to the monitoring device.

9000 Series Sensors

The 9000 series accelerometers cover a wide range of applications including low frequency (less than 0.1 Hz or 6 CPM), high frequency (up to 30 kHz or 1500 kCPM), high temperature (over 250° C), and velocity output (internal integrator). The following table lists the sensors and characteristics.

Model Number	Part No	Bias Output	Sensitivity	Description	Notes
General Purpose					
9000A	43781I	8–12 VDC	100 mV/g	General purpose accelerometer	Top exit, Mil Spec connector.
9000A-LBV	43783I	6–8 VDC	100 mV/g	General purpose accelerometer	Top exit, Mil Spec connector. Low bias voltage (6–8 V).
9000B	43782I	8–12 VDC	100 mV/g	General purpose accelerometer	Top exit, integral cable 10', 2-conductor shielded, polyurethane jacket.
9008	46255I	8–12 VDC	100 mV/g	Low cost general purpose accelerometer	Top exit, integral cable 10', 2-conductor shielded, polyurethane jacket.
9100	43784I	8–12 VDC	100 mV/g	General purpose precision accelerometer	Top exit, Mil Spec connector.
9100AT	43810I	8–12 VDC	100 mV/g 10 mV/°C	General purpose precision accelerometer, temperature sensor	Top exit, Mil Spec connector.
9100CSA	43786I	8–12 VDC	100 mV/g	General purpose precision accelerometer	Top exit, Mil Spec connector. Intrinsic Safety Certification by Canadian Standards Association.
9100EX	43787I	8–12 VDC	100 mV/g	General purpose precision accelerometer	Top exit, Mil Spec connector. Intrinsic Safety Certification to CENELEC EEx ia iic T4.
9100FM	43785I	8–12 VDC	100 mV/g	General purpose precision accelerometer	Top exit, Mil Spec connector. Intrinsic Safety Certification by Factory Mutual.
9200	47086I	8–12 VDC	100 mV/g	General purpose, precision low profile ring style accelerometer	Side exit, Mil Spec connector.
9200AT	43811I	8–12 VDC	100 mV/g 10 mV/°C	General purpose, precision low profile ring style accelerometer, temperature sensor	Side exit, Mil Spec connector.
9200CSA	43790I	8–12 VDC	100 mV/g	General purpose, precision low profile ring style accelerometer	Side exit, Mil Spec connector. Intrinsic Safety Certification by Canadian Standards Association.
9200EX	43791	8–12 VDC	100 mV/g	General purpose precision accelerometer	Side exit, Mil Spec connector. Intrinsic Safety Certification to CENELEC EEx ia iic T4.

Model Number	Part No	Bias Output	Sensitivity	Description	Notes
9200FM	43789I	8–12 VDC	100 mV/g	General purpose, precision low profile ring style accelerometer	Side exit, Mil Spec connector. Intrinsic Safety Certification by Factory Mutual.
9300	43792I	8–12 VDC	100 mV/g	Low cost accelerometer	Top exit, Mil Spec connector.
9400	47090I	8–12 VDC	100 mV/g	General purpose, low profile side exit accelerometer	Side exit, Mil Spec connector.
Low Frequency					
9100L	43794I	8–12 VDC	500 mV/g	Low frequency accelerometer	Top exit, Mil Spec connector.
9200L	43795I	8–12 VDC	500 mV/g	Low frequency, low profile ring style accelerometer	Side exit, Mil Spec connector.
9500LF	43796I	6–9 VDC	500 mV/g	Low frequency accelerometer	Top exit, Mil Spec connector.
9500HLF	43797I	8–12 VDC	1000 mV/g	Low frequency accelerometer	Top exit, Mil Spec connector.
9600	43798I	8–12 VDC	10 V/g	Ultra low frequency accelerometer	Top exit, Mil Spec connector.
High Frequency					
9700A	43799I	8–12 VDC	10 mV/g	High frequency accelerometer	Top exit, 5-44 microdot connector.
9700B	43800I	8–12 VDC	100 mV/g	High frequency accelerometer	Side exit, 10-32 coaxial connector.
Triaxial					
9900A	43802I	8–12 VDC	100 mV/g	Triaxial accelerometer with positioning pin	Side exit, Mil Spec 4-pin connector.
9900B	43803I	8–12 VDC	100 mV/g	Triaxial accelerometer with positioning pin	Side exit, integral cable 10', 4-conductor shielded, polyurethane jacket.

Model Number	Part No	Bias Output	Sensitivity	Description	Notes
High Temperature					
9100T	43805I	8–14 VDC	100 mV/g	High temperature accelerometer	Top exit, Mil Spec connector, -54 to 163 deg C operating range.
9150HT	43807I	12–15 VDC	100 mV/g	High temperature charge mode accelerometer system	Top exit, 2-Pin Mil Spec connector, -54 to 260 deg C operating range.
9150HTA	46496	12–15 VDC	100 mV/g	High temperature charge mode accelerometer system	Top exit, 2-Pin Mil Spec connector, -54 to 260 deg C operating range. Armored cable.
9200T	43806I	11–14 VDC	100 mV/g	High temperature, low profile ring style accelerometer	Side exit, Mil Spec connector, -54 to 163 deg C operating range.
Velocity Output					
9100VO	43808I	8–12 VDC	100 mV/in/sec	Velocity output accelerometer	Top exit, Mil Spec connector.
9200VO	43809I	8–12 VDC	100 mV/in/sec	Velocity output, low profile ring style accelerometer	Side exit, Mil Spec connector.

Sensor Mounting

Next to choosing the correct sensor, the sensor mounting is the most important consideration in getting accurate readings from the sensor.

Types of Sensor Mounting

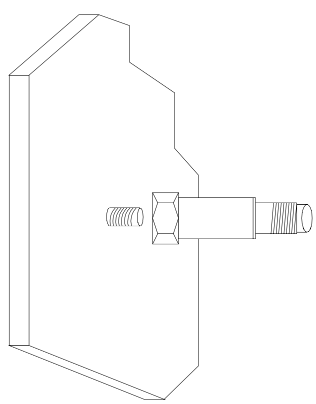
The actual frequency range of a sensor depends on how well it is attached to the machine.

Mounting sensors directly on the case

Mounting sensors directly to the machine is the most common mounting technique for many vibration sensors. Sensors designed for stud mounting have a base that is drilled and tapped for that purpose. There are two common methods of stud mounting a sensor. In both cases, it is crucial to prepare a flat, smooth, and clean area at least as large as the base of the sensor. If the surface is not prepared properly, some of the vibration energy will be lost, and will not be transmitted to the sensor. Improper mounting can also allow chatter, creating false data.

Note: Entek recommends following the API 670 requirements for surface finish and flatness, even for non-API installations. If the surface is not properly prepared, it can reduce the detection of higher frequencies.

1. The first method is to spot face the surface, then drill and tap a hole in the machine case or bearing housing where you want to install the sensor. Per the requirements of API 670 Appendix C.2.1, the surface finish should be within 0.8 micrometers (.032 mil, or 32 µinches) and the flatness should be below 25 micrometers (1 mil).
2. Clean the finished area to remove any rust, dirt, paint, or grease.
3. Insert a set screw leaving enough of the screw above the case to attach the sensor, typically 1/4 inch. Some sensors come with captive mounting screw and do not need a separate set screw.
4. Apply a thin coating of grease or silicone lubricant to the surface.
5. Use a torque wrench to attach the sensor. Refer to the following table.

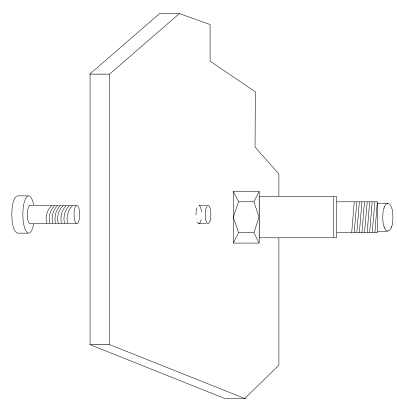


Follow the specific sensor's guidelines for the dimensions of the hole, the type of set screw, and the torque for attaching the sensor. The table below lists the data for the 9000 sensors.

Sensor	Screw Type	Hole Depth	Torque
9100 Series	1/4-28 stud	3/8 inch	26 inch-pounds
9200 Series	1/4-28 captive screw	3/8 inch	30 inch-pounds
9300 Series	1/4-28 stud	3/8 inch	26 inch-pounds
9400 Series	1/4-28 captive screw	3/8 inch	30 inch-pounds
9500 Series	1/4-28 stud	3/8 inch	26 inch-pounds
9600 Series	3/8-16 stud	1/2 inch	60 inch-pounds
9700A	5-40 stud	3/8 inch	12 inch-pounds
9700B	10-32 stud	3/8 inch	20 inch-pound

Note: For 3/8 deep holes, make sure 1/4 inch of the stud engages the base of the sensor. If you screw a 1/2 inch stud fully into a 3/8 inch deep hole, that leaves only 1/8 inch of stud to hold the sensor, which is not sufficient.

The second method is to drill through the machine case or housing, and use a machine screw to secure the sensor. Spot face the surface, then drill the hole in the machine case or bearing housing where you want to install the sensor. Follow the sensor's guidelines for the dimensions of the hole, the type of machine screw, and the torque for attaching the sensor.



Mounting sensors on an insulated housing

In some cases, the sensor is mounted on an insulated housing that cannot or should not be grounded. For this type of installation, we recommend that you use a sensor with a ground-isolated case. Many of the 9000 Series sensors have ground-isolated cases. Note that the 9700 does not have isolated case. The 9700B and 9150HT are base isolated, not case isolated. Contact Rockwell Automation Integration Condition Monitoring Technical Support for more information on the Entek sensors.

When connecting cables for sensors with ground-isolated cases, make sure that the cable shield is not grounded at the sensor end. There are two possible cable configurations:

- In coaxial cable, the center conductor carries the signal and power, while the outer braid provides shielding and signal return. Grounding the shield at the monitoring device and not at the sensor isolates the sensor and prevents ground loops.
- In cable with two wires and shield, the signal and power are carried on one lead and the signal return on the other lead. The outer braid provides shielding. To isolate the sensor and prevent ground loops, ground the shield at the monitoring device.

Note: It is very important to properly ground the cable shield. Failing to do so can result in interference with the signal and possible damage to the sensor in high electromagnetic interference/electrostatic discharge environments.

Mounting sensors with adhesive

If a mounting hole cannot be drilled into the machine surface, you can mount the sensor using adhesive. There are two ways to do this: you can mount the sensor directly to the machine; or you can mount a flat plate with a threaded stud, and attach the sensor to the stud. Note that mounting the sensor using adhesive may limit the detection of high frequencies. Suggested adhesives are listed in the following table.

Adhesive	Comments
Loctite 325 with 707 Activator	Cyanoacrylate adhesive. Single component; sets up quickly; use at temperatures below 200° F; surface must be clean and smooth, and remove by twisting the sensor.
Versilok 406–Lord Chemical Products	Structural adhesive. Water resistant; useful to 250° F; cures to full properties at room temperature in 24 hours.

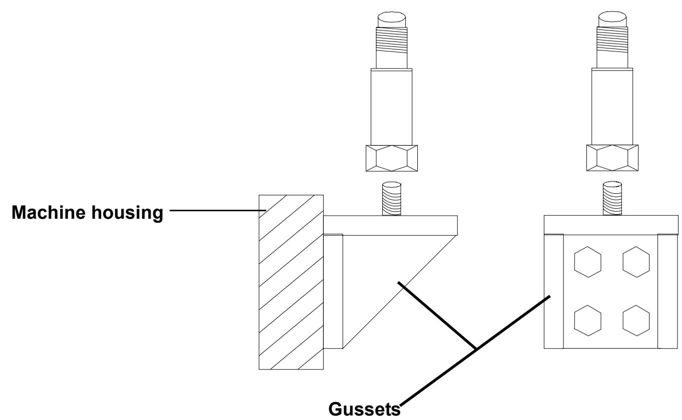
Note: Entek recommends following the API 670 requirements for surface finish and flatness, even for non-API installations. If the surface is not properly prepared, it can reduce the detection of higher frequencies.

1. Spot face the surface on the machine case or bearing housing where you want to install the sensor. Per the requirements of API 670 Appendix C.2.1, the surface finish should be within 0.8 micrometers (.032 mil, or 32 µinches) and the flatness should be below 25 micrometers (1 mil).
2. Prepare the surface following standard adhesive bonding practice. Abrade and then thoroughly clean the spot on the machine with solvent.
3. Mix the adhesive according to its directions.
4. Attach the sensor or plate to the machine.
5. Allow the recommended time for the adhesive to cure.
6. Make sure the sensor is grounded through the cable shield to a good electrical ground.

Mounting sensors with a bracket

Sometimes a sensor will not fit at the desired location on or near the bearing housing because of an obstruction or because a suitable flat surface is not available. In these cases, it may be necessary to use a bracket extending from the desired measurement point to an area where the sensor can be mounted properly.

Make sure that the bracket itself does not introduce any extraneous vibrations. The bracket must not bend or flex. Even a small amount of flexing in the bracket may result in unreliable readings. Only a stiff bracket is able to transfer the vibration from the machine to the sensor without adding vibration due to the natural resonance frequency of the bracket. As a general rule, even the shortest bracket will require fabrication from 1/2-inch steel plate.



All brackets should be tested for resonance in the frequencies that the sensor will monitor. If possible, the bracket design should be approved by your sensor or system supplier. Contact Technical Support for assistance.

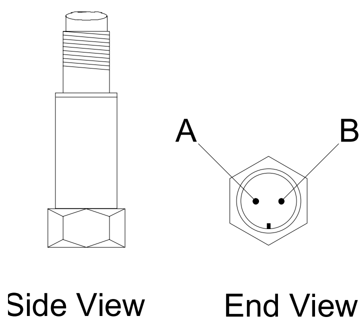
Sensor Cable Guidelines

This section describes some common cable guidelines to get the signal from the sensor to the monitoring device.

Sensor Connections and Power

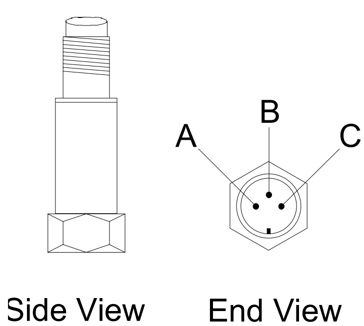
Most of the 9000 series sensors are two-wire, IEPE accelerometers. There are also 9000 series sensors that have a built-in integrator to produce a velocity signal, as well as combination accelerometer/temperature sensors. The pin connections on the sensors are listed in the following table.

Connector Pin	Function
Shell	Ground, connected to cable shield
A	IEPE sensor power and signal
B	IEPE sensor signal return (signal common)



Combination accelerometer/temperature sensors have three pins.

Connector Pin	Function
Shell	Ground, connected to cable shield
A	IEPE sensor power and signal
B	IEPE sensor signal return (signal common) and temperature common
C	Temperature sensor signal and power



Cable Installation

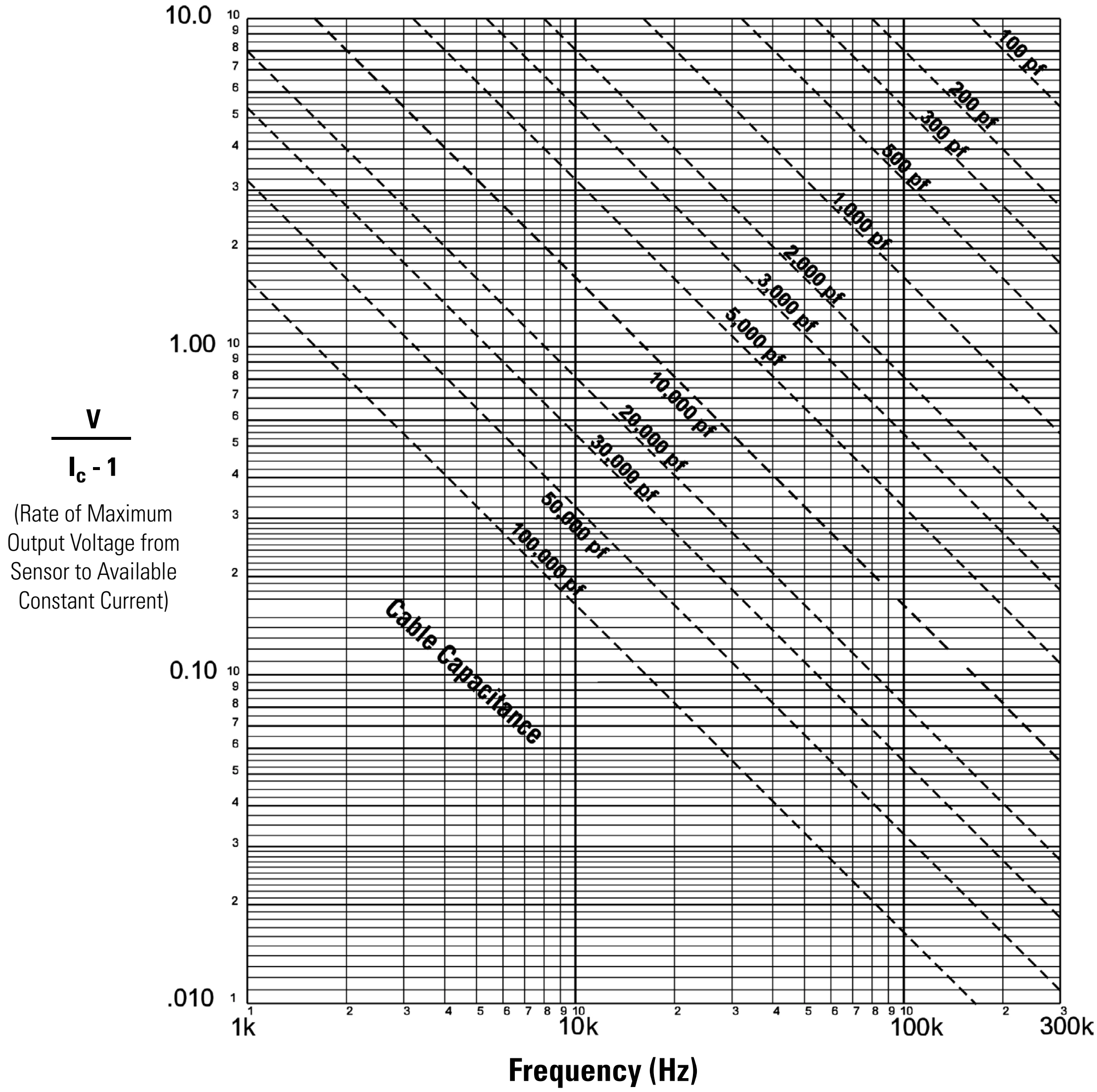
The cable from the sensor is a critical component in getting the signal to the monitoring device. The 2-wire cables with shield listed below are dedicated, one per sensor, to carry sensor signals to the monitoring device.

Cable run at 10 kHz	**Maximum attenuation**	**No. of channels/ cable**	**Cable diam.**	**Belden No.**	**Max. Temp.**	**Alpha No.**
Up to 500 ft (152 m)	6 dB (2:1)	1	0.168 in 4.27 mm	8641	140° F 60° C	2400C
Up to 500 ft (152 m)	12 dB (4:1)	1	0.175 in 4.45 mm	8761	140° F 60° C	2401C
		3	0.310 in 7.87 mm	8777	176° F 80° C	6010C
		6	0.390 in 9.91 mm	8778	176° F 80° C	6012C
		12	0.480 in 12.2 mm	9768	176° F 80° C	6017C
Up to 1000 ft (304 m)	6 dB (2:1)	3	0.370 in 9.40 mm	9730	140° F 60° C	6073C
		6	0.480 in 12.12 mm	9731	140° F 60° C	6076C
Up to 1500 ft (457 m)	12 dB (4:1)	12	0.660 in 16.7 mm	9734	140° F 60° C	6079/ 12C

Cable run at 10 kHz	**Maximum attenuation**	**No. of channels/ cable**	**Cable diam.**	**Belden No.**	**Max. Temp.**	**Alpha No.**
Up to 4000 ft (1219 m)	6 dB (2:1)	1	0.204 in 5.18 mm	8762	140° F 60° C	2411C
		3	0.340 in 8.64 mm	9873	176° F 80° C	6033C
		6	0.430 in 10.9 mm	9874	176° F 80° C	6036C
		12	0.590 in 15.0 mm	9877	176° F 80° C	6042C

Cable length

The nomograph below provides a simple, graphical method for obtaining the expected maximum frequency capability of an IEPE measurement system. The maximum peak signal voltage amplitude, cable capacitance, and supplied constant current must be known or presumed.



f_{max} = Maximum frequency given the following characteristics

C = Cable capacitance (pF)

V = Maximum output voltage from sensor (volts

I_c = Constant current level from power unit (mA)

10^9 = Scale factor to equate units

For example, when running a 100ft. cable with a capacitance of 30 pF/ft, the total capacitance is 3000 pF. This value can be found along the diagonal cable capacitance lines. Assuming the sensor operates at a maximum output range of 5 volts and the constance current signal conditioner is set at 2 mA, the ratio on the vertical axis can be calculated to equal 5. The intersection of the total cable capacitance and this ratio result in a maximum frequency of approximately 10.2 kHz.

The nomograph does not indicate whether the frequency amplitude response at a point is flat, rising, or falling. For precautionary reasons, it is good general practice to increase the constant current (if possible) to the sensor (within its maximum limit) so that the frequency determined from the nomograph is approximately 1.5 to 2 times greater than the maximum frequency of interest.

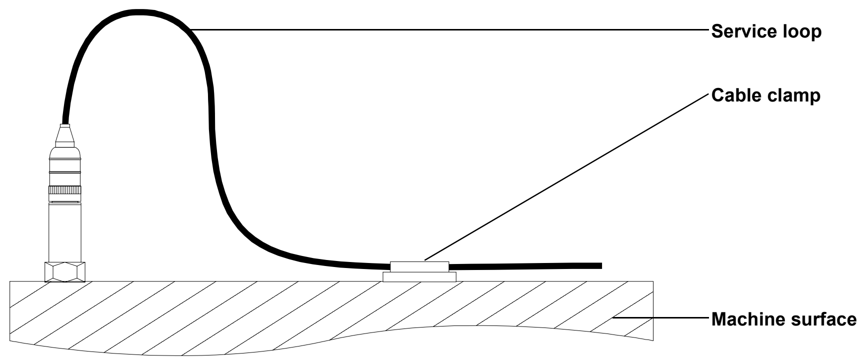
Reducing electrical interference

The small electrical signal coming from a sensor can be affected by electrical interference. Make every effort to reduce the electrical interference in cables to the lowest acceptable levels. Interference can come from many sources, including power cables, switching devices, motor controllers, walkie-talkies, robot transmitters, arc welders, induction heating equipment, motors, and high voltage ignition systems.

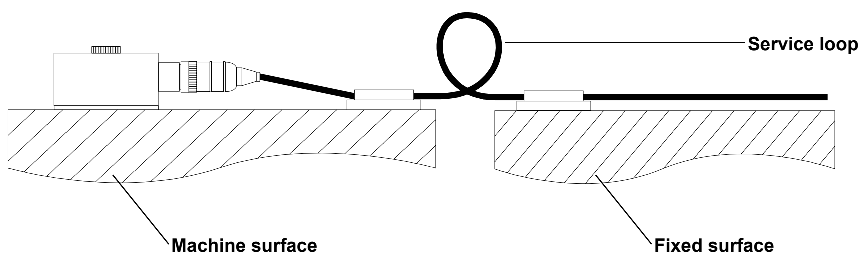
The following methods are effective for minimizing electrical interference:

- Use twisted pair wires in each cable.
- Use individual foil shields around each pair, with a shield drain wire grounded at only one point for each shield. Do not ground the shield at both ends of the cable. Grounding the cable shield at both ends causes a “ground loop.” This can cause interference because in most cases the ground potential differs at the two ends.
- Electrically isolate (insulate) each sensor circuit from all others.
- Surround all cables with grounded steel conduit where possible.
- Do not use conduits containing sensor cables for any other circuits.
- Avoid running 9000 series sensor cables parallel to other cables, such as non-9000 series sensor, or communication cables.
- Avoid running sensor cables parallel to power wiring. When this cannot be avoided, make sure that sensor cables are at least 12 inches away from all power wiring carrying 120 V or less. For power circuits of 120–240 V, the minimum spacing is 24 inches. For circuits of 480 V or higher, the minimum spacing is 48 inches.
- If the cable must cross power wiring, maintain the above spacing between the wires. Cross the wires at a right angle (90°) to minimize interference.
- Make sure the cable is securely fastened to reduce low frequency noise from cable movement. This is particularly important at the sensor end of the cable.

For a sensor with a top exit cable connection, make sure there is at least 6 inches of clearance above the machine surface to allow for movement of the sensor and cable. Clamp the cable within 6 inches of the sensor, allowing enough room for the cable to bend without damage. Clamp the cable at intervals to prevent movement.



For sensors with a side exit cable connection, clamp the cable 3–4 inches from the sensor. Clamp the cable at intervals to prevent movement.



Cable construction

The sensor cable should be twisted pair with its own foil shield. Do not ground the cable shield drain wire at both ends. The shield connections should be carried through any junction boxes without connecting to a ground or other shields.

If the end of the sensor cable is in a location where it will be splashed or hosed down, coat it with RTV silicone rubber sealant to prevent fluids from entering the cable.

- At the sensor end, use RTV in and around the connector and cable entry to the connector.
- At the opposite end to the sensor, terminate the cable in a NEMA housing using proper cable entry connectors that create a tight seal around the cable and the entry hole of the housing.

Splicing cables

Splices in cables are acceptable if the connections are soldered. Splices must be located in a junction or conduit box for access. Coil any excess cable in the junction or conduit box, making sure that any exposed (bare) cable shield is taped off so it cannot touch the junction or conduit box. If necessary, you can shorten the armored cable from an accelerometer or velocity sensor by carefully cutting away the armor. Grind or file the cut armor to remove all sharp edges.

Cable Conduit Guidelines

All signal wiring should be run in grounded conduit, where it is protected from damage and external influences. The conduit must be installed with proper drain points so that water from condensation and other sources does not build up around the cable.

Cables in conduit

When cables are run in steel conduit, the conduit must be grounded per NEC and local code requirements. Where necessary, flexible interlocked steel conduit can be used. Note that flexible conduit is not as effective against RF/EM interference as solid conduit. No wires or cables other than sensor wires or cables should be run in the same conduit.

In high humidity areas, outdoors, or where the sensor may get wet, the conduit should be protected to prevent water from entering. If the conditions could cause condensation in the conduit, use rigid metallic conduit or liquid-tight flexible conduit with suitable fittings.

The “far” end of the conduit should be protected to prevent water from entering. Provide appropriate condensate drains at low points in the conduit runs to allow condensation to escape.

If a water-resistant seal is required, you can also use pipe joint sealing compound on fittings before screwing connectors to the sensor body. Coat the terminal strip inside the junction box with RTV silicone rubber after the cables are connected. Do not use sealant on the gasket surfaces.

Conduit runs to panels

Make sure the conduits are large enough to accommodate the signal cables plus space for servicing. The maximum acceptable cable length from sensor to monitoring device depends on the type of sensor, the frequencies of interest, the grade of cable, and the monitoring device. Follow the manufacturer’s specifications for cable length and grade, or refer to the table under “Cable Installation” on page 10.

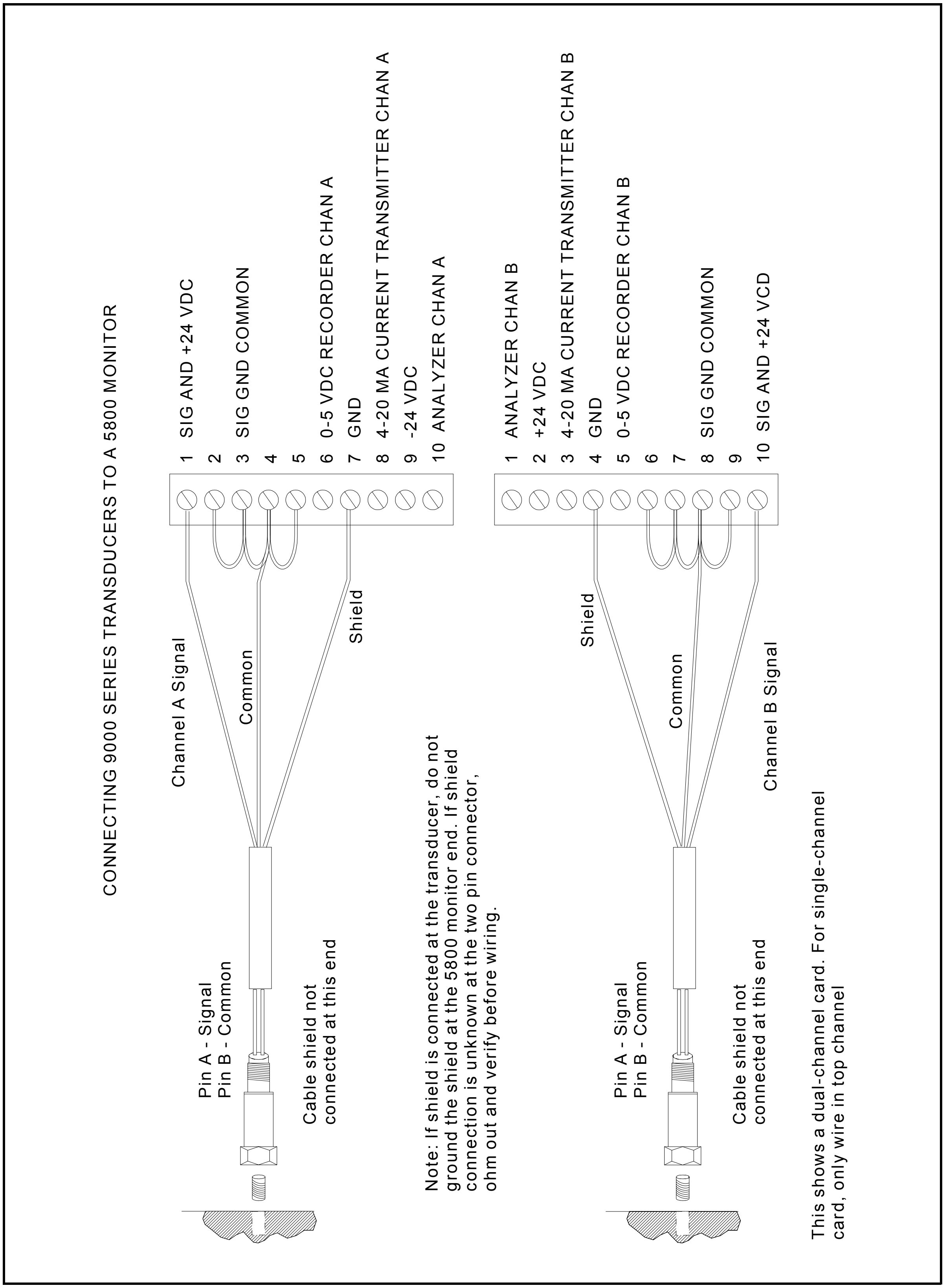
Conduit boxes

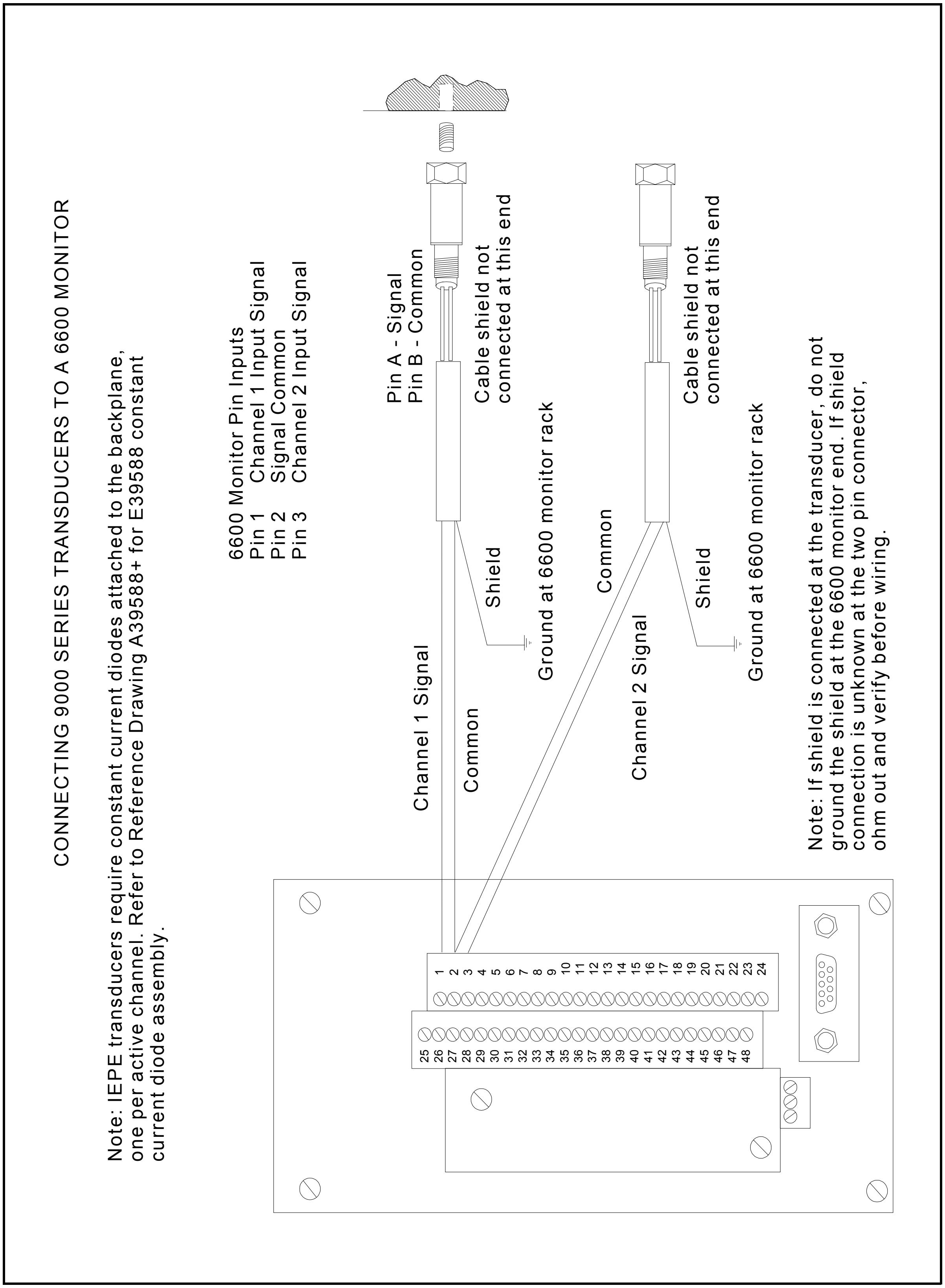
Use a conduit or junction box to protect any connections or splices in the sensor cable.

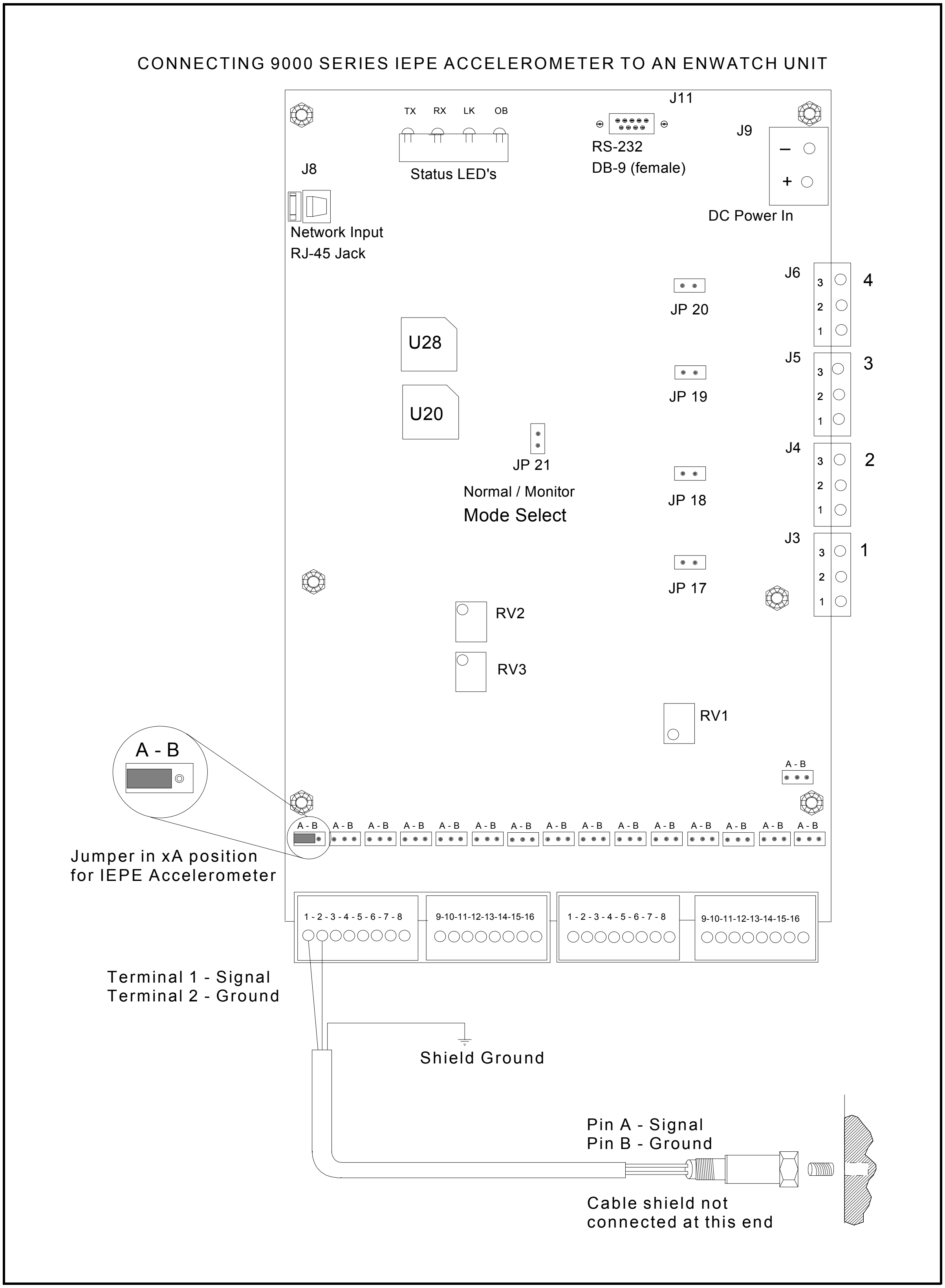
- In wet areas, use NEMA-4X rated box. You can also use a 1/2 or 3/4-inch trade size conduit body with gasketed cover, mounted vertically to prevent water entry into the box.
- Locate the conduit box so that 1–2 inches of cable from the sensor extends into the box.
- Use rigid thin wall or liquid-tight flexible conduit on the output cable.
- Ground the box and conduit to avoid electrical and radio frequency interference.

Connecting 9000 Series Sensors to Monitors

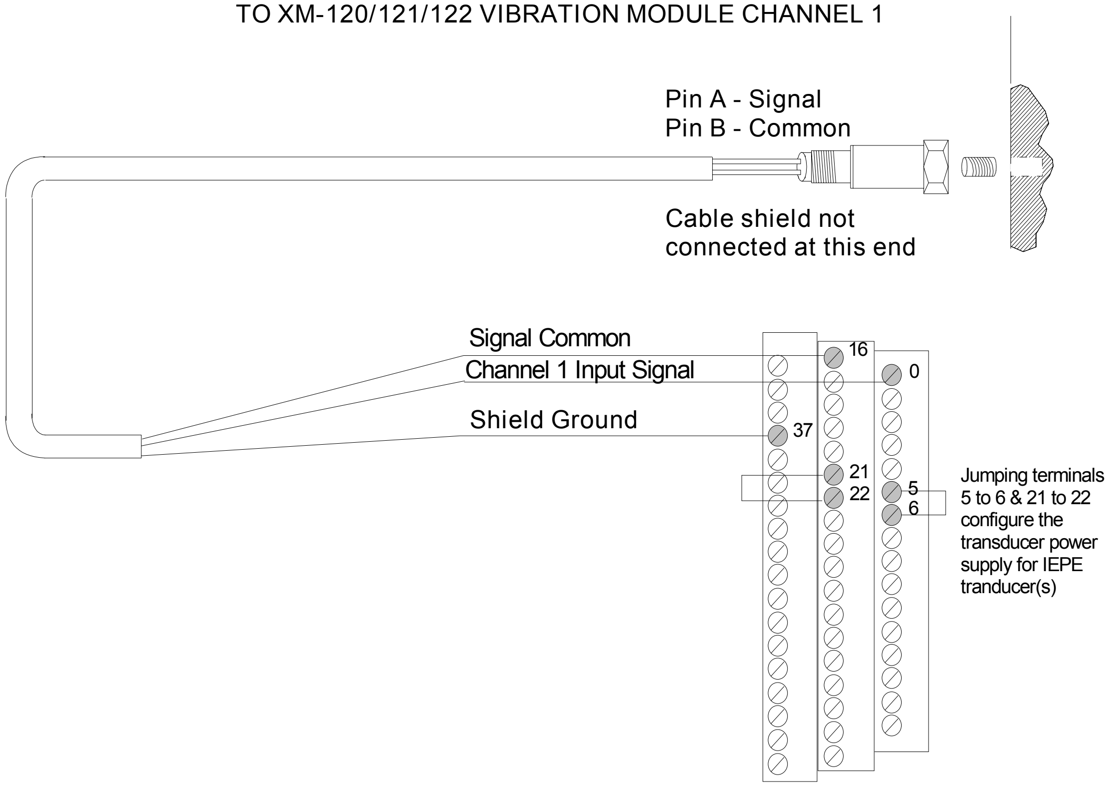
This following drawings show the connections between 9000 series sensors and the following types of monitors: 5800 monitors, 6600 monitors, XM modules, and Enwatch units. These show the most common connections. Refer to the manual for your particular monitor for the wiring specific to your monitor.


CONNECTING 9000 SERIES TRANSDUCERS TO A 5800 MONITOR
1 SIG AND +24 VDC
2
3 SIG GND COMMON
4
5
6 0-5 VDC RECORDER CHAN A
7 GND
8 4-20 MA CURRENT TRANSMITTER CHAN A
9 -24 VDC
10 ANALYZER CHAN A
Channel A Signal
Common
Shield
Pin A - Signal
Pin B - Common
Cable shield not
connected at this end
Note: If shield is connected at the transducer, do not
ground the shield at the 5800 monitor end. If shield
connection is unknown at the two pin connector,
ohm out and verify before wiring.
1 ANALYZER CHAN B
2 +24 VDC
3 4-20 MA CURRENT TRANSMITTER CHAN B
4 GND
5 0-5 VDC RECORDER CHAN B
6
7
8 SIG GND COMMON
9
10 SIG AND +24 VCD
Shield
Common
Channel B Signal
Pin A - Signal
Pin B - Common
Cable shield not
connected at this end
This shows a dual-channel card. For single-channel
card, only wire in top channel


CONNECTING 9000 SERIES TRANSDUCERS TO A 6600 MONITOR
Note: IEPE transducers require constant current diodes attached to the backplane, one per active channel. Refer to Reference Drawing A39588+ for E39588 constant current diode assembly.
6600 Monitor Pin Inputs
Pin 1 Channel 1 Input Signal
Pin 2 Signal Common
Pin 3 Channel 2 Input Signal
Pin A - Signal
Pin B - Common
Cable shield not connected at this end
Channel 1 Signal
Common
Shield
Ground at 6600 monitor rack
Common
Cable shield not connected at this end
Channel 2 Signal
Shield
Ground at 6600 monitor rack
Note: If shield is connected at the transducer, do not ground the shield at the 6600 monitor end. If shield connection is unknown at the two pin connector, ohm out and verify before wiring.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48

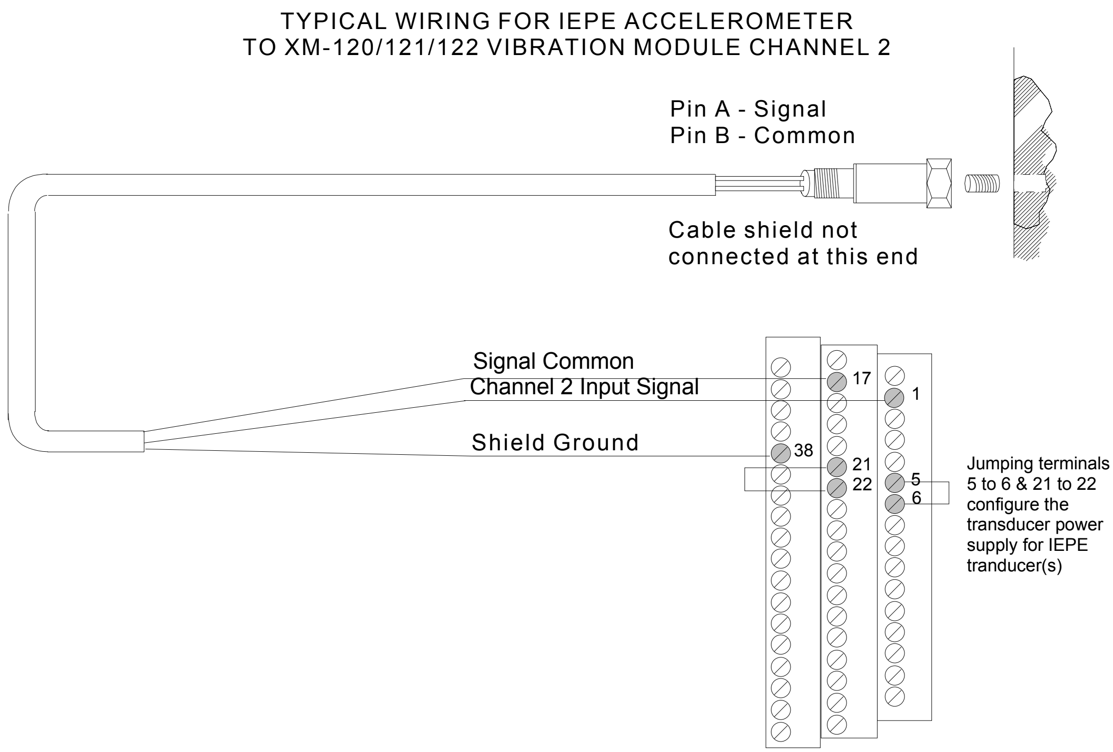

CONNECTING 9000 SERIES IEPE ACCELEROMETER TO AN ENWATCH UNIT
TX RX LK OB
Status LED's
J11
RS-232
DB-9 (female)
J9
DC Power In
J8
Network Input
RJ-45 Jack
J6
J5
J4
J3
JP 20
JP 19
JP 18
JP 17
U28
U20
JP 21
Normal / Monitor
Mode Select
RV2
RV3
RV1
A - B
Jumper in xA position
for IEPE Accelerometer
1 - 2 - 3 - 4 - 5 - 6 - 7 - 8
9-10-11-12-13-14-15-16
Terminal 1 - Signal
Terminal 2 - Ground
Shield Ground
Pin A - Signal
Pin B - Ground
Cable shield not
connected at this end

CONNECTING 9000 SERIES SENSORS
TO XM-120/121/122 VIBRATION MODULE CHANNEL 1



Note: You may ground the cable shield at either end of the cable. Do not ground the shield at both ends. Recommended practice is to ground the cable shield at the XM terminal base and not the sensor.

Note: The internal transducer power supply is providing power to the 9000 sensor.



Note: You may ground the cable shield at either end of the cable. Do not ground the shield at both ends. Recommended practice is to ground the cable shield at the XM terminal base and not the sensor.

Note: The internal transducer power supply is providing power to the 9000 sensor.

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