MX5000-SIM Signal Interface Module

Installation Manual

MX5000-SIM

OVERVIEW

The MX5000-SIM Signal Interface Module is a next generation DIN rail mounted Smart Vibration Signal Conditioner and Monitoring System. It has been designed to accept signals from machine casing mounted velocity sensors, accelerometers or shaft observing proximity probe systems and produce a 4-20 mA output proportional to the measured variable as well as the dynamic signal. It provides the user with a configurable signal input type for one to four independent channels. It also has the ability to stack MX5000-SIM modules to add additional channels, up to 6 modules or 24 channels. For each channel, a green LED indicates sensor and cable integrity. In the event of sensor failure, the LED changes to red and the output current is driven below 3.6 mA, thereby signaling a malfunction. The alarm status is indicated by the LED flashing yellow for Alert and flashing red for Danger. A BNC connector gives access to the dynamic input signal prior to any filtering for local analysis. Isolation is provided between input, outputs and supply. In the MX5000-SIM, there are four Solid-State relays which can be configured with AND/OR logic from any channel's Alert or Danger status. The alarm levels and relays can be configured using the free Metrix MX5000 software downloaded from the Metrix website.

Designed for ease of use, the USB-C interface is fitted for quick and easy configuration. Just connect a standard USB to USB-C cable between the MX5000-SIM and your PC. Using our free configuration software, you can configure the device in the field to meet your application requirements. All four channels can be independently configured. Depending upon the sensor arrangement, one can obtain direct overall amplitude as well as other static variables via a Modbus link.

PENDING APPROVALS

WARNING - DO NOT CONNECT OR DISCONNECT WHEN ENERGIZED. FIELD WIRING TO SIGNAL CONDITIONER/SMART SWITCH MUST COMPLY WITH LOCAL CODE. SIGNAL CONDITIONER PROVIDES INCREASED SAFETY CIRCUIT TO 5485C, SV6300 AND OTHER COMPATIBLE VELOCITY TRANSDUCERS AND SA6200A, SA6250 AND OTHER COMPATIBLE ACCELEROMETERS AND MX2033, MX2034 AND OTHER COMPATIBLE PROXIMITY SENSORS WHEN INSTALLED PER DRAWING NO. XXXXX (MX5000-SIM).

DO NOT APPLY POWER TO CHANNNEL 2 TO AVOID DAMAGE. ONLY APPLY POWER TO CHANNEL 1.

INSTALLATION

The MX5000-SIM can be mounted on the DIN rail in the explosion proof housing Metrix Part #8156. For non-explosion proof applications, Metrix Part #8173 weatherproof housing may be specified for this DIN rail mounted monitoring system. For the best results, the MX5000-SIM should be installed within 1000 feet (300 m) of the transducer.

INSTALLATION CONSIDERATIONS

Many variables exist in vibration monitoring system installations (e.g. MX5000-SIM) such as location, type of enclosure, proximity and type of other devices, type and length of wiring, etc.

In general, the MX5000-SIM should be located in a separate enclosure from electrical systems, which switch electrical power at large voltages or currents, such as motor controls. Grounded metal enclosures are much preferred to nonmetallic ones in areas where strong AC power or radio frequency (RF) fields are present, even on an intermittent basis. Possible sources of electrical interference are electrical motors and generators, SCR drives, motor contacts, RF heaters, engine ignition systems, handheld transceivers (walkie-talkies), cell phones, etc.

Handheld transceivers (radios) are capable of interfering with the proper operation of the MX5000-SIM, especially with the enclosure door open and the device held in close proximity to wiring. The RF filtering components in the monitoring system protect against normally expected RF levels, but excessive levels can cause interference. It is good practice to keep operating RF sources as far away from electronic devices as possible. In severe cases a ferrite core (Metrix Part# 97007-006) may be required to be added on power or signal wiring. These commonly available devices are either snapped over the wiring or the wiring is looped several times through the device.

The 24VDC power supply must be connected to the MX5000-SIM. If more than one SIM is connected to each other, only one SIM needs to be powered to power the other SIMs. If redundant power supplies are desired, one can connect the power to a single SIM or to another SIM (See Figure 4). On each SIM, there's a local Reset button and each SIM has remote reset capability via Modbus. In some installations, the 24VDC power source can have significant electrical noise present. Common sources of noise are battery chargers, unregulated power supplies and switching type power supplies. 24VDC relays and solenoids that are not protected with snubbing diodes or transient protectors will generate voltage transients that may interfere with the proper operation of the MX5000-SIM. Ensure that the 24VDC power source is a regulated type and free from electrical noise under all conditions.

WARNING - DO NOT CONNECT OR DISCONNECT WHEN ENERGIZED. FIELD WIRING TO SIGNAL CONDITIONER/SMART SWITCH MUST COMPLY WITH LOCAL CODE. SIGNAL CONDITIONER PROVIDES INCREASED SAFETY CIRCUIT TO 5485C, SV6300 AND OTHER COMPATIBLE VELOCITY TRANSDUCERS AND SA6200A, SA6250 AND OTHER COMPATIBLE ACCELEROMETERS AND MX2033, MX2034 AND OTHER COMPATIBLE PROXIMITY SENSORS WHEN INSTALLED PER DRAWING NO. XXXXX (MX5000-SIM).

DO NOT APPLY POWER TO CHANNNEL 2 TO AVOID DAMAGE. ONLY APPLY POWER TO CHANNEL 1.

None of the wiring connected to the MX5000-SIM or other devices within the enclosure should, with the exception of the power supply wiring, be run in conduits or cable trays with plant power wiring or control relay and solenoid wiring. All inputs and outputs should be wired with shielded cables. Totally shielded (100% foil) cables are preferred to 90% braided type shielded cables. The shield should be continued to within 1 to 2 inches (25 to 50mm) of the MX5000-SIM terminals. The shield itself should be connected to the provided shield terminal. The shield connection should be as short as possible. Ensure that all shields are connected only at one end, preferably at the control cabinet. Alternate shield connections are possible such as to instrumentation grounds, etc. In general, connection of shields to earth grounds should be avoided except at one central earth grounding point for a complete system as “ground loops” may be created, which can introduce unwanted power frequency pickup.

SENSOR MALFUNCTION

The monitoring system is provided with a sensor malfunction detector. In the event of an open circuit, the 4-20 mA output current will drop below 3.6 mA and the LED is solid red for Not OK. The monitoring system also detects incorrect polarity or shorted cable conditions.

WIRING

4-20 mA (Current Source Output): Wire the receiving device to these terminals, observing correct polarity. The total resistance of the receiver input and wiring must be between 25 and 600 ohms (See Figure 3).

SIG OUT (Signal Output): This signal is identical to the input signal and is buffered for driving remote vibration analysis instruments. The terminal block terminals can send a signal up to 300 meters (1000 ft). The BNC can send the raw signal 5 meters (16 ft) (See Figure 3).

SENSOR (Signal Input): Connect the transducer output cable leads to these terminals. If the transducer is a self-generating velocity pickup, polarity is arbitrary unless the signal polarity at the SIG OUT BNC connector is important for analysis purposes. If proximity sensor, accelerometer, piezoelectric velocity transducer or 4-20 mA output sensor is used, correct polarity must be observed (See Figure 4).

RELAYS: There are four solid-state relays available to connect to a control system or indicator panel (See Figure 4).

SIM DIAGRAMS

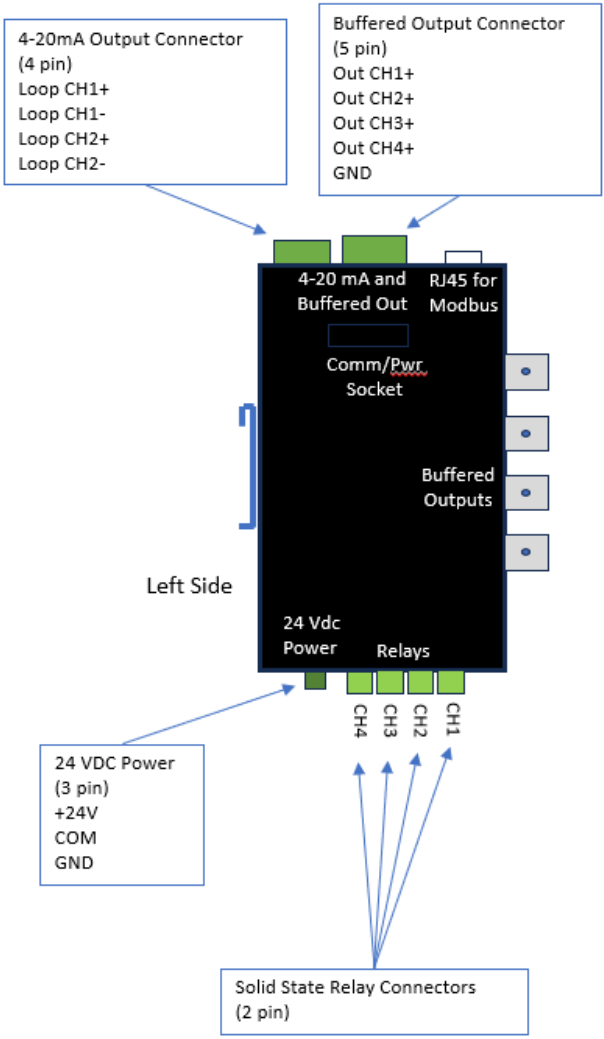


Figure 1: SIM Left-Side View

24 VDC (Power Input): For best results, the sum of the DC power voltage, plus or minus AC ripple and noise, should be within 20 to 30 volts DC. Power applied to 1 SIM is shared to all connected SIMs. A second power supply can be connected to an individual SIM. Power can be applied to an individual SIM or redundant power can be added to a second SIM.

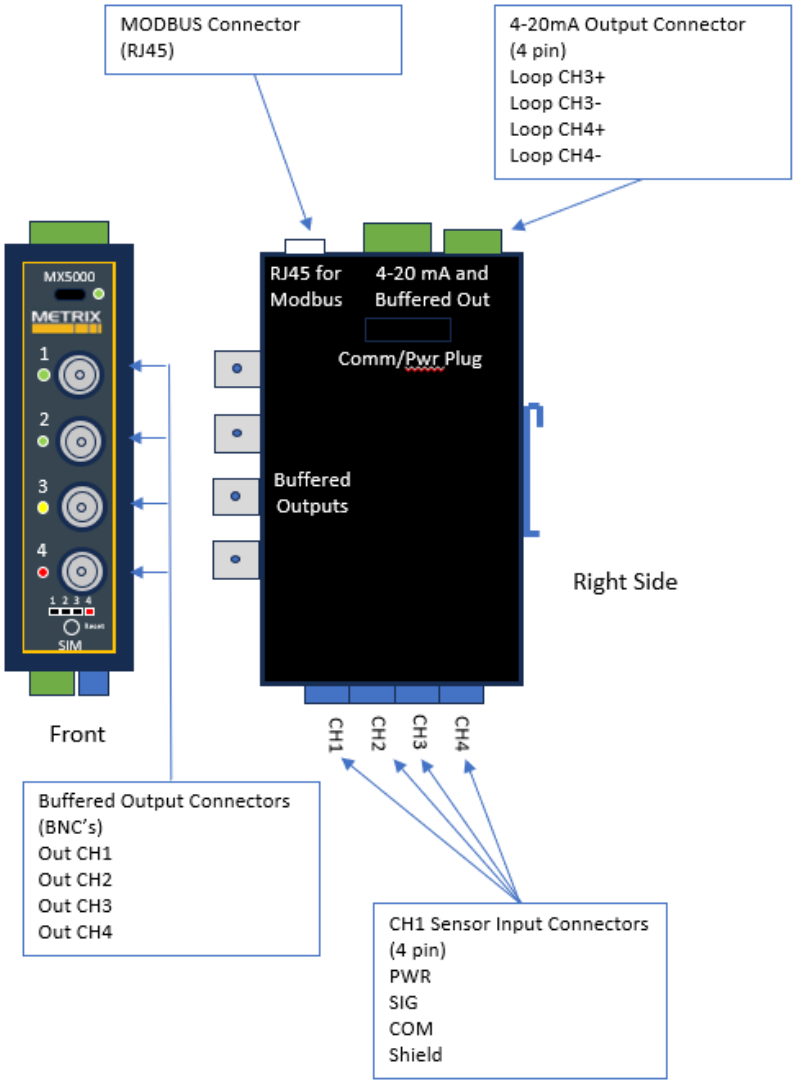
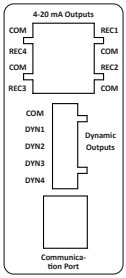


Figure 2: SIM Front and Right-Side View

MODBUS (Data Output RS485 Protocol): RJ45 Connector for Modbus connection to plant control system and/or local HMI display (See Figure 3).

If the sensors going to the MX5000-SIM are in a Class I, Div 1 or Zone 0 or 1 Hazardous Area then barriers will be required in accordance with the approved sensor drawings.

MX5000-SIM WIRING CONNECTIONS (TOP)



4-20 mA Outputs
4 Recorder Outputs (1 per Channel)

Dynamic Outputs
4 Buffered Outputs (1 per Channel)

Communication Port
RJ45 Connector (Modbus 485 Output)

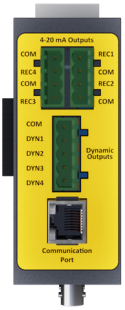
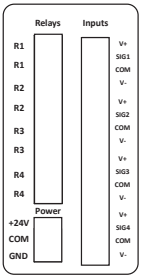


Figure 3: SIM Top Connection View

MX5000-SIM WIRING CONNECTIONS (BOTTOM)

Relay Contacts
4 Solid State Relays
Configurable AND/OR Logic
Limited to 100 mA each

Power Input
+24 VDC Power
Redundant Power Allowed



Signal Inputs
4 Channel Inputs
Proximity Sensor (mV)
Velocity Sensor (mV)
Accelerometer (mV)
Process Variable (4-20 mA)

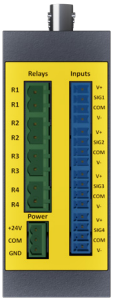


Figure 4: SIM Bottom Connection View

WEIGHT & DIMENSIONS

Weight: 1.1 lbs (0.5 kg)
Maximum Power: 8.0W
Recommended Wire Gauge: 0.8 mm2 (18 AWG),
Allowed: 0.2 to 1.3 mm2 (16 to 24 AWG)
Relay Wiring: Solid State Relays - Allowed: 0.2 to 1.3 mm2 (16 to 24 AWG)
Mounting: 35mm DIN rail mounting clip
Temperature Limits: -40° C to +65° C (-40° F to +149° F)
Casing Material: ABS PA765 Durable Plastic

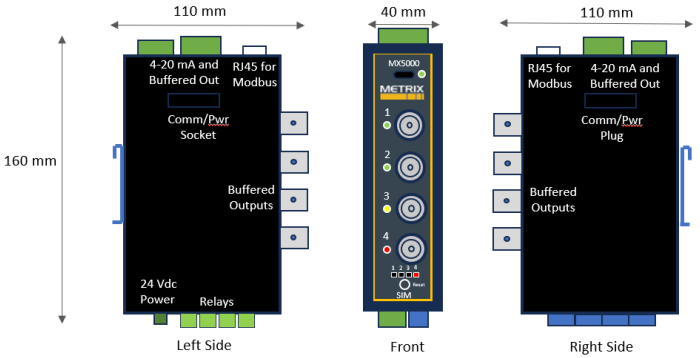


Figure 5: SIM Dimensions

ELECTROMAGNETIC COMPATIBILITY (EMC)

PENDING APPROVALS

Standards:
CISPR 11:2009Ed.5+A1
Industrial, Scientific and Medical Equipment – Radio Frequency Disturbance Characteristics - Limits and Methods of Measurement
IEC 61000-4-4 Ed. 2.1:2011
Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test
IEC 61000-4-6 Ed.3: 2008
Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields

POSSIBLE MEASUREMENTS

The MX5000-SIM supports most commercially available acceleration, velocity, and proximity sensors, including the provision of any necessary sensor power. A single +24Vdc connection powers the device, its 4-20mA output(s), and its connected sensor(s) –including the -24Vdc power required by proximity transducers and the constant current required by IEPE accelerometers and piezo-velocity sensors.

- Shaft-relative radial vibration
- Shaft axial position (Thrust Measurements)
- Casing vibration (radial or axial)
- Shaft rotative speed
- Reciprocating compressor rod drop
- Reciprocating compressor rod position
- Reciprocating compressor crosshead acceleration
- Reciprocating machine impact measurements
- Reciprocating compressor frame vibration
- Process variables via any 4-20mA output sensor
- Dual Path measurements (single channel input with multiple variable output via Modbus)
    - One accelerometer input may generate an accelerometer output (4-20 mA and Modbus) and an integrated velocity output (Modbus)
    - One accelerometer input may generate an accelerometer output (4-20 mA and Modbus) and an impact output (Modbus)
    - One velocity input may generate a vibration output (4-20 mA and Modbus) and an integrated position output (Modbus)
    - One proximity input may generate a position (gap) output (4-20 mA and Modbus) and a vibration output (Modbus)

USB-C CONNECTION

Designed for ease of use, the USB-C interface is fitted for quick and easy configuration. Just connect a standard USB cable between the MX5000 and a PC. Using the free configuration software, one may configure the device in the field to meet application requirements. The USB-C port supports standard USB connections of up to 5m (16 feet).

CHANNEL LED

For each channel, a green LED indicates sensor and cable integrity. In the event of sensor failure, the LED changes to red and the output current is driven below 3.6 mA, thereby signaling a malfunction. The alarm status is indicated by the LED flashing yellow for Alert and flashing red for Danger.

RELAY LED

For each relay, there is an LED to indicate relay status.

SIM LED

There is one LED adjacent to the USB-C Connector that indicates device status.

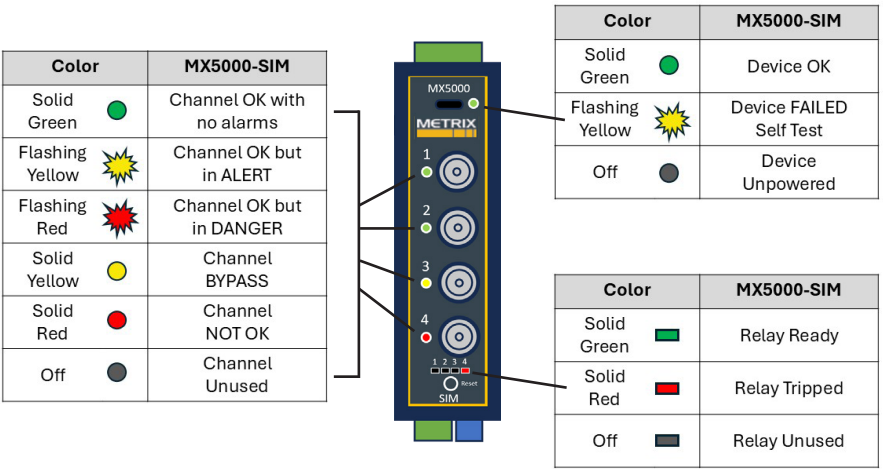


Figure 6: SIM LED Status Indicators

BNC

Conventional BNC connectors for each channel are provided for easy connection to portable instruments such as data collectors, DVMs, and analyzers where the cable length does not exceed 16 feet (5 meters). These outputs are isolated from the 4-20mA outputs to ensure connection of external devices do not compromise the integrity of the monitoring or protective functions.

AMPLIFIED BUFFERED OUTPUTS

When devices are mounted in junction boxes at the machine, it can be inconvenient to open the box to connect portable instruments. In prior generations of Metrix devices, and on most commercially available monitors, the buffered outputs are not suitable for wiring runs exceeding 5-10 meters without use of an external amplifier to drive the raw signals over long distances. The MX5000-SIM overcomes this limitation by employing integrated signal amplification, allowing buffered output signals to be driven up to 1000 feet (300 meters). The amplified signal is available at wiring terminals and is intended for permanent connection to remote patch panels or other condition monitoring systems.

NOT OK ANNUNCIATION

In addition to NOT OK status annunciation via the device's LEDs, the current loop (4-20mA) output for each channel will clamp to a value below 4mA, ensuring that a NOT OK condition can be distinguished from other conditions. NOT OK status is also indicated via Modbus link.

Condition	4-20mA output
No Power	0 mA
NOT OK	3.6 mA
OK, bottom scale	4 mA
OK, mid-range	Between 4 and 20 mA
OK, full scale	20 mA

Table 1: 4-20mA Output Status

SOLID STATE RELAYS

The MX5000 has four (4) solid-state relays. Each relay can be driven by the alert or danger status of any channel, either singularly or as a boolean, AND/OR combination of a number of channels. The relays can be configured for latching or non-latching operation, normally energized or normally de-energized. Solid-state relays are typically used for providing logic-level alarm status to controllers and other devices. Relay status is also indicated via Modbus link.

Additional and comprehensive notes related to relay configuration are as follows:

1. Engineering units are the same as selected for the full-scale range.
2. With regard to Relays, “Fail Safe*” means the Relay’s state is the same as in the Alarm Condition, Open or Shut, when the Relay is not powered.
3. Normal State, Normally Open or Normally Shut, refers to a Relay’s not powered, de-energized, or Shelf State.
4. "Active (Fail Safe)” applies power to the Relay and forces the Relay to change state in a non-Alarm condition. In an Alarm condition, or if Power is lost, the relay changes to the de-energized “Shelf State”. This is Fail Safe*.
5. "Passive (Not Fail Safe)” does not apply power to the Relay in a non-Alarm condition. In an Alarm condition the Relay is energized to change state. On a loss of power the Relay reverts back to the de-energized non-alarm “Shelf State”, even if an Alarm is present, so therefore, the Relay is Not Fail Safe.
6. The relay indicators on the front of the SIM indicate if the relay is configured, tripped, or not used.

*Fail-safe modes are required for SIL ratings.

SHUTDOWN VERSUS ALARMING CONSIDERATIONS

Two levels of setpoints are available in the MX5000: Alert (pre-shutdown) and Danger (shutdown). Where alarm settings are available from the OEM, those levels should be implemented by default and then adjusted over time as process, operating conditions, and experience dictate. Although there can be numerous, vibration and position measurements associated with rotating and reciprocating machines, most industry standards suggest that only a small number be used for machinery protection (i.e., auto-shutdown) purposes with the rest being used for condition monitoring purposes.

REMOTE RESET

Latching-type alarms and relays can be reset remotely by using the reset terminal on the device. Using “Reset” will release all cleared latched alarms.

HAZARDOUS AREA APPROVALS

AREA	MX5000-SIM
North America	CLASS I, DIVISION 2, GROUPS A, B, C & D, CLASS I, ZONE 2, AEx ec nC IIC T4 Gc -40°C ≤Ta≤ +65°C Increased Safety
International ATEX/IECEX/ UKEX	Ex ec nC IIC T4 Gc -40°C ≤Ta≤ +65°C II 3 G Increased Safety

PENDING APPROVALS

WARNING – EXPLOSION HAZARD. DO NOT CONNECT OR DISCONNECT WHEN ENERGIZED.

AVERTISSEMENT - RISQUE D'EXPLOSION. NE PAS CONNECTER OU DÉCONNECTER UNE FOIS SOUS TENSION.

SPECIAL CONDITIONS FOR SAFE USE

- The 24VDC power supply must be connected to Channel 1 and not Channel 2.
- The maximum internal equipment surface temperature measured according test conducted per Clause 26.5.1 IEC/EN/UL/CSA 60079-0 Standard was 91.84˚C (@ 65°C ambient). End user must verify that the enclosure in which this equipment is installed is suitably rated for service per these temperatures.
- Equipment shall be installed in an Ex certified enclosure that is tool secured which provides a minimum ingress protection of IP54. The equipment must be mounted on a vertical or horizontal rail within the enclosure.
- Coaxial connections provided for the access to the input signal reference circuit ground. Care shall be taken whilst installing the equipment to ensure a dielectric isolation of 500Vrms is maintained.
- The equipment shall only be used in an area of at least pollution degree 2, as defined in IEC 60664-1.
- Equipment shall be installed in an Ex certified tool secured enclosure which provides a minimum ingress protection of IP54.
- Transient protection shall be provided on the supply to limit transients not to exceed 33.6VDC.

POWER SUPPLY CONSIDERATIONS

A 24VDC power supply must be connected to power the device. The power supply can be selected from any reputable provider and for added reliability, redundant schemes can be used if desired. When selecting a power supply, use the following sizing considerations.

	MX5000-SIM
Max Power Consumption	8.0W

The table above assumes worst-case conditions where all relays are energized, all transducers are accelerometers consuming a maximum power of 20mA @ 24V each, all recorder outputs are at full scale of 20 mA, and all buffered outputs are driving the maximum allowable length of field wiring at maximum signal amplitude.

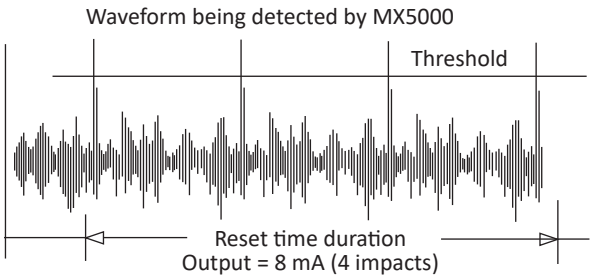
ENCLOSURE CONSIDERATIONS

When mounting the system at the machine, a suitable enclosure is recommended to protect the electronics from the elements. Additionally, an enclosure may be mandatory for installation in NRTL Class 1 Div 2, IECEx and ATEX Zone 2 hazardous environments. Where local display of status and current values is required, select an enclosure with a window.

When sizing the enclosure, refer to the MX5000-SIM datasheet (doc #1986617) for heat dissipation requirements to ensure adequate airflow and that temperature rise does not subject the devices to operation outside of maximum ratings. Make certain to include the power supply in these calculations as well. Consult the factory or your local Metrix sales professional for assistance, including installation and project advice.

IMPACT MEASUREMENT

The impact measurement uses an accelerometer input and outputs a 4-20 mA signal proportional to the number of impact events over the threshold in a set time period. The relationship between the mA signal and the number of impact events remains the same. The time frame (reset time) over which the events are measured can be changed using the MX5000 software. This allows you to match the measuring time frame with the RPM range of your equipment. Table 2 indicates mA output vs. impact events over the set threshold.

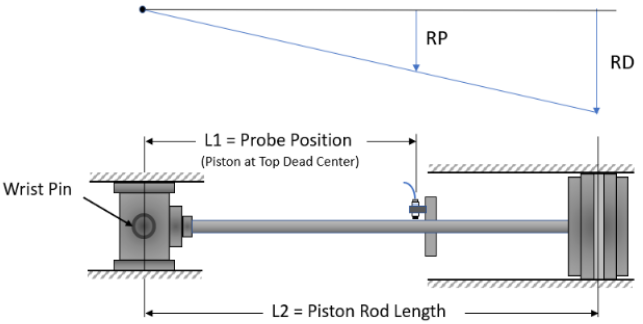


Impact to mA Conversion	
Severity Level	**Output**
16 impacts > threshold	20 mA
14 impacts > threshold	18 mA
12 impacts > threshold	16 mA
10 impacts > threshold	14 mA
8 impacts > threshold	12 mA
6 impacts > threshold	10 mA
4 impacts > threshold	8 mA
2 impacts > threshold	6 mA
No impacts > threshold	4 mA
Loss of Power	0 mA

Table 2: Number of impact events into 4-20 mA signal

ROD DROP MEASUREMENT

The rod drop measurement has its root at the vertical rod position measurement in the machine. What we infer from the similar triangle methodology is that the vertical rod position measurement correlates with the actual rod drop and rider band wear within the cylinder. The correlation has to do with the ratio of the piston rod length (L2) to the probe position length (L1). The logic being, if the piston rod position moves downward relative to the probe, then the piston must move downward, and for this to happen, the rider bands have to be wearing. It should be noted that the rider bands are sacrificial parts within the reciprocating compressor, they are intended to wear. The rider bands support the piston, allowing the piston rings to remain centered, this allows the piston within the cylinder to do its job and compress the gas. As the rider bands wear with time, there comes a point when the rider band has to be changed out or risk the piston coming into contact with the cylinder, which is a major fault and needs to be avoided.



RP = Rod Position
RD = Rod Drop

By Similar Triangles

$$\frac{RP}{L1} = \frac{RD}{L2}$$

$$(RP)\ \frac{L2}{L1} = RD$$

WARNING:
CSA Equipment Installation Requirement per ordinary locations standards, C22.2/UL 61010-1:

Applicable for permanently connected equipment:
a. A switch or circuit-breaker must be included in the installation;
b. It must be suitably located and easily reached;
c. It must be marked as the disconnecting device for the equipment
d. Under normal operation, the BNC and USB must not be connected to any equipment

Equipment environment Ratings:
a. Pollution Degree 3
b. Input Voltage: 24 VDC +/- 10%, (Input power to Channel 1 only), Max Power: 4W
c. Altitude 2000m or less
d. Outdoor: installed in a minimum IP54 enclosure
e. Temperature: -40° C to +65° C
f. Overvoltage Category II

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

ENVIRONMENTAL INFORMATION

This electronic equipment was manufactured according to high quality standards to ensure safe and reliable operation when used as intended. Due to its nature, this equipment may contain small quantities of substances known to be hazardous to the environment or to human health if released into the environment. For this reason, Waste Electrical and Electronic Equipment (commonly known as WEEE) should never be disposed of in the public waste stream. The “Crossed-Out Waste Bin” label affixed to this product is a reminder to dispose of this product in accordance with local WEEE regulations. If you have questions about the disposal process, please contact Metrix Customer Service.

Note: Metrix is continuously improving our products. Please refer to our website to download the latest version of this document.