

## SW6000 SEISMIC VIBRATION SWITCH

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### Installation Manual



### OVERVIEW

The SW6000 Seismic Vibration Switch offers basic protection against gross changes in structural seismic acceleration.

This electronic switch is a versatile excessive vibration protection instrument. In its standard configuration, the SW6000 is an economical single set point vibration switch with standard features and packaged in industrial grade housing with available hazardous area certifications. Fully configured, the SW6000 provides for local machine control with optional LCD readout and real time remote operator interface via a 4-20 mA output.

### SUPPLEMENTARY INFORMATION

Refer to Metrix Datasheet #1009462 and Metrix Installation Manual for Hazardous Areas #100867 available at [www.metrixvibration.com](http://www.metrixvibration.com).

# INSTALLATION

The sensitive axis of the switch can be mounted on any radial axis, although the horizontal axis is preferred so the unit sees maximum vibration. The horizontal axis also reduces the temperature exposure versus a vertical axis. If a bracket is required, it should be rigidly constructed to prevent spurious mechanical resonances in the SW6000 frequency range.

## Stud Mount Unit

The Stud Mount Unit requires a tapped hole, see Metrix Datasheet (doc #1009462) Option "F" or use a Metrix model 7084 flange mount adapter. If an NPT mounting stud is selected, the stud will tighten before the switch casing touches the machine case. The SW6000 should be hand tightened and then wrench tightened to bring the conduit connections to the appropriate location. Studs with straight threads are provided with a locking nut.

The optional display can be rotated in 90 degree increments to bring it to a readable position. Refer to the Wiring Section for further information.

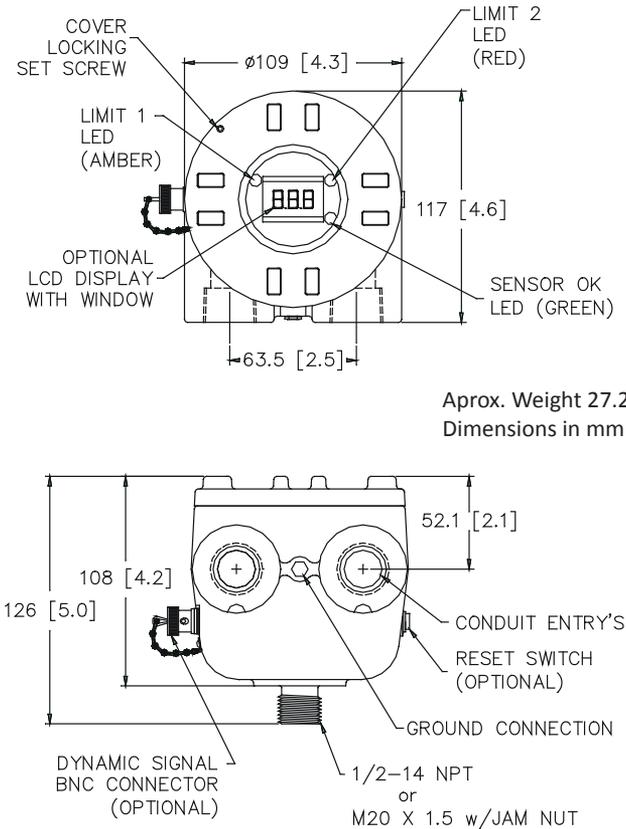
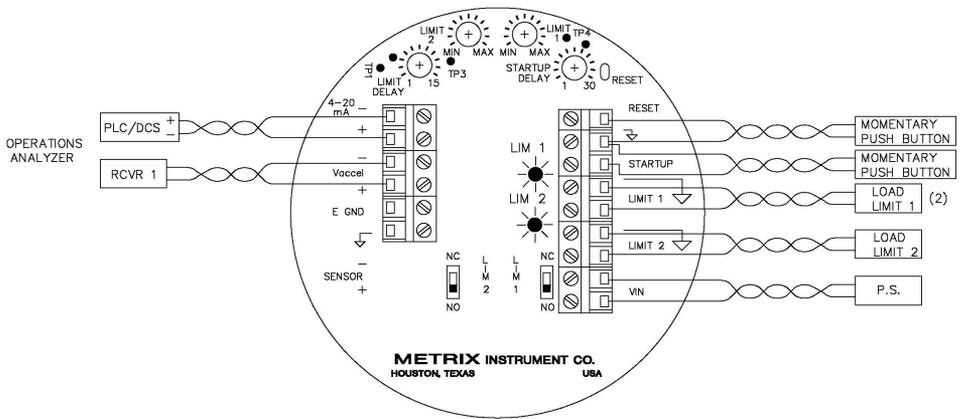


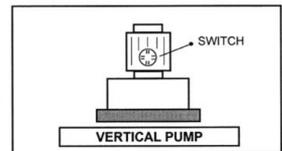
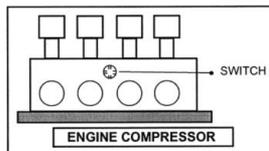
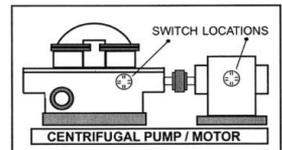
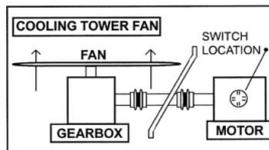
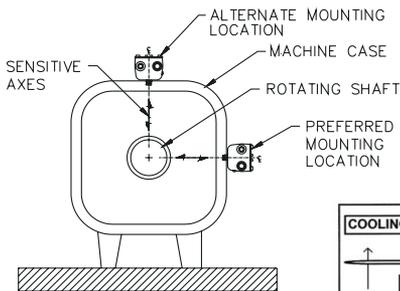
Figure 1: Housing



**Figure 2: Wiring Diagram (LCD option not shown)**

**NOTES:**

1. Diagrams show all available options, see SW6000 datasheet (doc# 1009462) to verify options on your particular unit.
2. On Single Limit Models, use Load Limit Two (2).



**Figure 3: Typical Mounting Locations**

**Baseefa Special Conditions for Safe Use:**

Ambient Operating Temperature: -40°C to +85°C (model without display),  
-10°C to +70°C (model with display)

## **WIRING**

### **Terminal Wiring**

If you have selected the optional display, the display circuit board must be removed (two screws) to expose the terminal strips. The display board cable should not be disconnected. Simply place the display board out of the way to allow wiring to the terminal strips. The display may be reinstalled in any of the four possible orientations. Connection to the unit is through one or two conduit entries (See Metrix Drawing 9030). The cable gland or conduit entries shall be in accordance with 13.1 of EN60079-1 and IEC60079-1. The user must provide appropriate seal and sealing materials for the rates installation. Unused conduit entries must be plugged with a plug that conforms to Clause 13.2 of EN60079-1 and IEC60079-1. The internal ground connector allows for the connection of a 14 AWG wire. This has a cross section of 2 mm<sup>2</sup>. The external ground terminal can accommodate a 10 AWG wire that has a cross section area of 5 mm<sup>2</sup>. It is comprised of an M5 bolt with two flat washers and one lock washer.

Refer to Figure 2 for wiring information. For incoming power and switch output(s) use approved wire of 14 AWG (1.5 mm<sup>2</sup>) or smaller.

For the current and dynamic signal outputs, a shielded twisted pair is recommended. By convention, the shield should be tied to common only at the receiver end. A cable consisting of separate shielded twisted pairs can also be used. For the dynamic signal output, the capacitance of the cable run must not exceed 0.03  $\mu$ F (typically 1000 ft).

**NOTE:** On ATEX/IECEX approved units, a locking set screw must be loosened prior to lid removal.

**CAUTION:** Conduit seals are highly recommended to prevent the entry of moisture into the switch. Moisture will damage the switch and void the warranty. Internal and external protective earth connections must be connected to the installation protective earth circuits.

### **Power Wiring**

It is highly recommended that all power and triac/FET wiring be routed separately from the external sensor, the dynamic signal and 4-20mA wiring in order to reduce AC/transient noise pickup. The power required is indicated on the nameplate. The voltage supply must be within the following limits:

**24 VDC:** 20 VDC to 28 VDC  
**115 VAC:** 95 VDC to 125 VAC, 50/60 Hz  
**230VAC:** 190 VDC to 250 VAC, 50/60 Hz

Polarity does not need to be observed when wiring for DC power. The preferred method of operation is to continuously apply power to the SW6000. If power is to be applied as a part of the machine startup sequence it is advisable to apply power to the SW6000 30 seconds prior to starting the machine in order to allow the electronics circuits to stabilize. This is particularly important if the adjustable startup delay option is utilized and the delay is set to less than 20 seconds.

### Alarm Limit Triac Output Wiring

The triac output(s) are electro-optically isolated from each other, power, and the internal circuit. These are medium-power devices with high immunity to electrical transients. If desired, each triac can be supplied from an AC voltage source different from the main supply. The triacs can be connected in series with the triacs of other units. See Figure 4. Parallel connection of two switches doubles the triac holding (minimum load) current requirements. The maximum triac supply voltage is 250 VAC. The worst case triac leakage (off) current is 2 mA. The maximum triac holding current is 35 mA at 25°C (60mA at -40°C) which requires that the relay pull-in current have a greater value. Do not use a DC supply. The triacs can be set for N.C. or N.O. operation by positioning the Limit 1 / Limit 2 switches accordingly.

### Typical Control Circuits SW6000 w/AC Power Wired to Interrupt Motor Starter (series connection)

- a. Set each SW6000 for N.C. (normally closed) operation. (See Figure 2)
- b. M2, M3 and remote reset contacts must each be isolated.

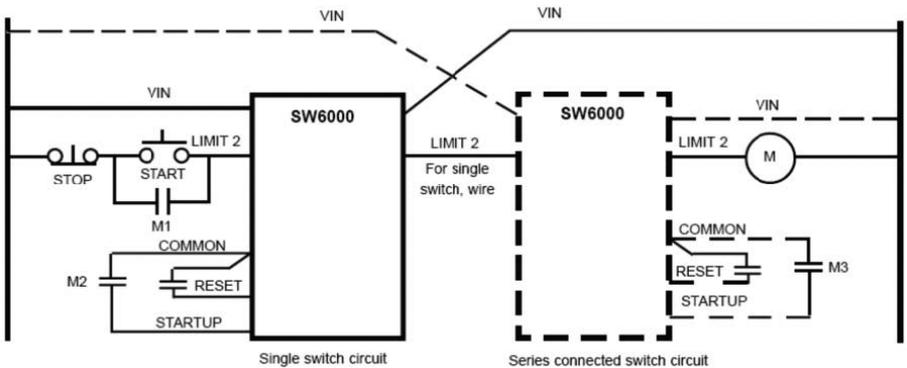


Figure 4: Parallel connection of two SW6000

- a. Set each SW6000 for N.C. (normally closed) operation. (See Figure 2)
- b. M2, M3 and remote reset contacts must each be isolated.

### Alarm Limit FET Output Wiring (optional)

The optional FET limit output(s) provide a low leakage switch for DC inputs to PLC's or other devices. Do not use on an AC supply. Observe proper polarity when wiring the FET(s) (See figure 2). Damage to the FET(s) will result from improper wiring. As with the triacs, the FET(s) can be set for N.C. or N.O. operation by positioning the Limit 1/Limit 2 switches accordingly.

### Limit Trip Delay

The base unit has an adjustable (1-15 sec.) limit trip delay. The vibration level must be continuously above the limit setting for the duration of the time delay before the output devices switch. The 4-20 mA output is not affected by this time delay. To reset the limit output devices, the internal reset push-button or the optional external reset push-button must be pressed. Remote reset by a N.O. push-button or momentary contacts may be made by wiring to the remote reset terminals. Note that the vibration level must be below the trip level for the reset to function.

### Startup Trip Delay

Some machines generate vibration levels during startup which are higher than normal running levels. These high vibration levels can exceed the Alarm Trip Limits which are set above the normal running vibration level. The standard SW6000 has a fixed time delay which inhibits alarm trips for 30 seconds from the closing of the startup contacts.

An optional adjustable startup trip delay (1-30 sec.) permits the Alarm Trip Limits to become operative in less than 30 seconds. Protection of machines with short startup times can be improved by utilizing the adjustable Startup Trip delay.

The Startup Trip Delay is triggered by closing a set of contacts (momentary or continuous) connected to the startup terminals. The contacts must be opened before the internal startup delay timer can be initiated again. Connecting these terminals to a set of isolated auxiliary N.O. contacts in a motor starter is a method commonly used to initiate the startup trip delay. The 4-20 mA current output is inhibited (set to 4.0 mA) during the startup trip delay.

### Remote Reset Wiring (optional)

If remote reset capability is desired, connect Reset terminals (see Figure 2) to a remotely located, momentary N.O. pushbutton switch. Observe hazardous area requirements if applicable.

### 4-20 mA Current Source Output (optional)

If the optional 4-20 mA output is installed, it may be connected to a remote receiver, as shown on the wiring diagram (see Figure 2). This output is a current source (at 15VDC) and requires no external loop power supply. Full scale current (20 mA) corresponds to the full scale vibration response marked on the face plate. A current of 4.0 mA represents a zero vibration condition. The maximum load resistance is 600 ohms. In high electrical noise locations a shielded, twisted pair cable is recommended.

**FORMULA:** 
$$\frac{\text{Measured mA} - 4\text{mA}}{20\text{mA} - 4\text{mA}} \times \text{Full scale vibration} = \text{Actual vibration}$$

### EXAMPLE:

Measured mA	Full Scale Vibration	Actual Vibration
4.0	1.0 ips, peak	0.0 ips, peak
12.0	1.0 ips, peak	0.5 ips, peak
20.0	1.0 ips, peak	1.0 ips, peak

### Dynamic Outputs

The sensor (acceleration) signal is available at the terminal block and is capable of driving a cable with a capacitance of up to 0.03  $\mu\text{F}$  (typically 300m/1000 feet). Longer runs with greater than 0.03  $\mu\text{F}$  of capacitance can be used without the buffer becoming unstable. However, the frequency response will be reduced due to the increased capacitance.

### RECEIVER CONFIGURATION / CALIBRATION

Signal Conditioning Module Output: 4 - 20 mA Source Option

The SW6000 can be factory configured to provide a 4 - 20 mA current source output proportional to the specified full scale vibration response (velocity or displacement). Figure 5 shows suggested programming for a 4-20 mA receiver (PLC, DCS, monitor or computer).

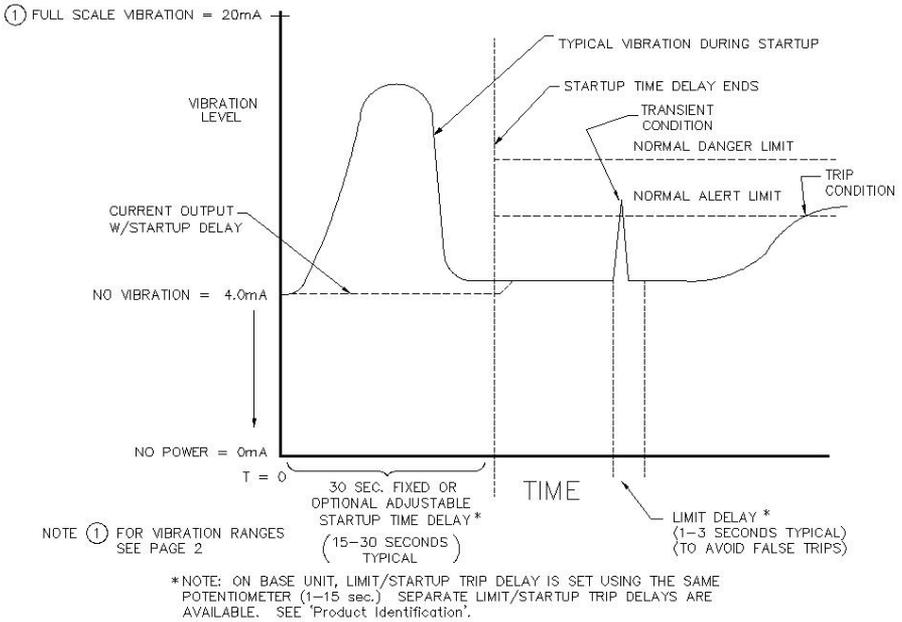


Figure 5: Suggested programming for a 4-20 mA receiver

### Vibration Switch Calibration

The SW6000 has been factory calibrated to standards traceable to the U.S. National Institute of Standards and Technology (NIST). If the accuracy is in question, the SW6000 output response can be compared (on an operating machine) with an independent vibration measurement made in the same axis and at the same location with a calibrated vibration analyzer. Ensure that the analyzer is configured with the same frequency response as the SW6000 and with the same unit of measure (i.e. ips pk.). To prevent tampering, there are no user accessible adjustments available for field recalibrating. If recalibration is required, the SW6000 should be returned to the factory for recalibration to a traceable standard. In field installations, the calibration should be verified at least once per year. In test cell applications, depending upon the severity of handling, correct operation and calibration should be verified each 90-180 days.

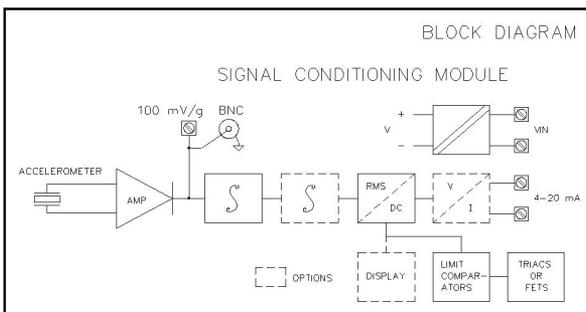


Figure 6

### Determining Output Voltage

If it is desired to determine either the acceleration or velocity amplitude when one measurement is unknown, the following formulas can be employed.

If g's (A) are known and you wish to determine the velocity output:  $V = \frac{3687}{F} \times A$

If velocity is known and you wish to determine the displacement output:  $D = \frac{19,100}{F} \times V$

If g's (A) are known and you wish to determine the displacement output:  $D = \left(\frac{8383}{F}\right)^2 \times V$

V = ips, peak

F = RPM

A = g peak

D = mils, peak-to-peak

$$\text{Example } V = \frac{3687}{1800 \text{ RPM}} \times 0.5g = 1.02 \text{ ips, peak}$$

## USER ADJUSTMENTS

### Limit Trip Delay

The Limit Trip Delay adjustment allows the user to set the time delay from 1 to 15 seconds. This is useful in avoiding false trips from transient conditions while the machine is running.

### Adjustable Startup Trip Delay (optional)

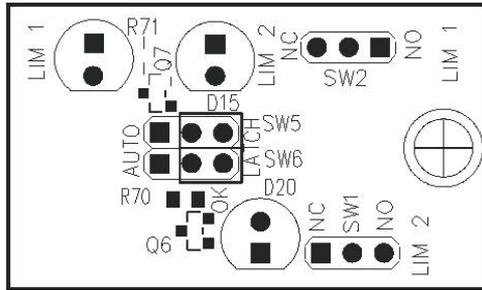
The optional Startup Trip Delay adjustment allows the user to set the time delay from 1 to 30 seconds. This is useful in tailoring the Startup Trip Delay for a particular machine's startup vibration characteristics.

### Limit Settings

The Limit Setting adjustment allows the user to set the vibration levels at which a limit will trip. The adjustment has a range of -10% to 110% of the full scale vibration level. A midscale adjustment corresponds to a 50% vibration level limit. The limit setting can be set precisely by measuring the limit voltage with a DVM. The test points for measuring this voltage are labeled TP3 (Limit 2), TP4 (limit 1) and COM (common) on Figure 2. The DC voltage represents a percentage of full scale. For example, .46 VDC would represent a limit setting of 46% of full scale. Turning the adjustment to its minimum value (CCW) allows the user to test the trip circuitry, including LED's, time delays and triac (FET) switches.

## AUTO RESET

The switch outputs (triacs or FETs) are configured at the factory for latching operation. The switch outputs can be configured for non-latching operation so they automatically reset when the vibration level falls below the alarm limit threshold. To do this, remove power to the unit. Remove the transmitter cover and the display board if present. Refer to Figure 7. (Move both jumpers to the auto position). Reassemble the display board and transmitter cover. The switch outputs will now reset when the vibration level falls below the alarm limits.



**Figure 7: Auto reset**

**CAUTION:** This test should be performed with the machinery not running or switch outputs by-passed. After testing, reset the limits to the proper operational values.

## **TROUBLESHOOTING**

### **1. The unit appears to be functioning, but limit operation is in question.**

**CAUTION:** Disconnect or disarm the machine alarms and/or shutdown circuits prior to testing the vibration switch outputs.

a) Operation of the limit triac/FET and the attached relay can be verified by toggling the NO/NC switch.

b) The limit setting can be rotated to the minimum (-10%) setting in order to exercise all of the limit control logic and trip delay circuits. The limit triac/FET should operate and the limit LED should turn on after the set trip delay expires. REMEMBER to return the limit setting to the original position after this test.

c) If the LED is lit but the limit is not functioning, check to make sure the triac/FET load is wired properly and power is present at the limit terminal block and relay. CAUTION: voltages at the limit switch terminal block can be dangerous. Exercise caution when checking for voltage at the terminal block. For AC loads, ensure the minimum current through the load is 35 mA for temperatures above 25°C or 60 mA below 25°C. For DC loads, ensure proper wiring polarity has been observed.

### **2. The unit appears to be functioning, but the 4-20 mA operation is in question.**

a) Ensure that the current loop is wired properly and that the total loop resistance does not exceed 600 ohms. The Model SW6000 4-20 mA circuit is a current source. A voltage source (power supply) must not be used in the circuit.

b) Verify current output with separate current meter connected in series with the 4-20 mA output and the receiving instrument input. Verify the current is correct. Current output with zero vibration should be 4.0 mA. A 20 mA current represents full scale vibration.

**3. The unit does not respond to a vibration input during the first few seconds of operation.**

a) The startup time delay circuit prevents the transmitter from reacting to a vibration input during the startup delay time period. The standard time delay is fixed at 30 seconds. If the unit has the optional variable startup delay, it can be varied from 1 to 30 seconds. The current output is held at 4.0 mA and the display is held at 000 until the startup time delay has expired.

**4. The unit trips the limits shortly after applying power to the unit.**

a) Units with an adjustable startup time delay which is set close to the minimum setting can have the limits trip at power up. This is due to the settling time of the circuitry in the Model SW6000 switch. If a short startup delay is desired, it is suggested that power first be applied to the unit for a minimum of 20 seconds. Power may also be applied continuously. The limits may need to be reset depending on the particular application. Afterwards, the machine can be started in a normal fashion.

**5. The unit is functioning but accuracy is in question.**

a) The vibration output can be verified by placing a separate vibration pickup near the base of the Model SW6000 and comparing the two readings. Remember that the vibration meter or analyzer must utilize true RMS detection and have similar frequency response characteristics. Even then, significant differences can exist due to dissimilar sensor orientations, hand-held versus rigid mounting, meter or analyzer time constant differences, and other factors. The calibration of the Model SW6000 should be verified on a yearly basis as a minimum.

b) Alternately, the unit can be removed and placed on a calibrated shaker system in order to verify the calibration. Metrix Instrument Co. can provide factory calibration traceable to NIST standards.

**6. The unit does not appear to be functioning.**

a) Ensure that all wiring connections to the terminal block are correct, terminal screws are tight and that the correct voltage is present at the terminal block power (Vin) terminals. DC voltage polarity is arbitrary. Refer to Figure 4 and Product Identification page 2 for specific details. If power is applied, the LCD display (if present) should be functioning, and the current output should be between 4.0 and 20.0 mA.

## HAZARDOUS AREA APPROVALS

<p><b>IECEx Approval (World)</b></p> 	<p><b>IEC Markings:</b></p> <p>Ex d IIB + H2 T4 Gb  Ta -20°C to +85°C  (no display)  Ta -10°C to +70°C (display)  IECEx LCI 11.0016X</p>	<p><b>IEC Standards:</b></p> <p>IEC60079-0:2011  IEC60079-1:2007</p>	<p>WARNING-EXPLOSION HAZARD-DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS.</p>
<p><b>ATEX Approval (Europe)</b></p> 	<p><b>ATEX Markings:</b></p> <p> II 2G Ex d IIB + H2 T4 Gb  Ta -20°C to +85°C  (no display)  Ta -10°C to +70°C (display)</p> <p> LCIE 02 ATEX 6157X</p>	<p><b>EN Standards:</b></p> <p>EN60079-0:2012  EN60079-1:2007</p>	<p>AVERTISSEMENT-RISQUE D'EXPLOSION. NE PAS DEBRANCHER TANT QUE LE CIRCUIT EST SOUS TENSION, A MOINS QU'IL NE S'AGISSE D'UN EMPLACEMENT NON DAN-GEREUX.</p>
<p><b>UL Approval (North America)</b></p> 	<p><b>CSA Markings:</b></p> <p>  Class I, Div 1, Groups B,C,D, T4A, NEMA 4/4X  Class I, Div 2, Groups B,C,D, T4A, NEMA 4/4X</p>	<p><b>UL/CSA Standards:</b></p> <p>UL 50  UL 508  UL 1203  UL 61010  CSA C22.2 No.25  CSA C22.2 No. 30  CSA C22.2 No. 94  CSA C22.2 No. 142  CSA C22.2 No. 213  CSA C22.2 No. 61010  ANSI/ISA 12.12.01-2007</p>	<p></p>



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 (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.

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