OVERVIEW

The ST5484E-SW is a loop powered seismic velocity transmitter and configurable switch. The compact vibration switch incorporates a piezoelectric accelerometer, signal integrator, RMS or peak detector, 4-20 mA signal conditioner and a digital microcontroller into a single package. It is mounted directly on a machine case or bearing housing without intervening signal conditioning equipment. The switches can be used in an auto-shutdown or alarm circuit that trips the machine under high vibration conditions. Two independent configurable alarm setpoints and corresponding discrete outputs allow implementation of ALERT (pre-shutdown) and DANGER (shutdown) levels by the machine control system. A separate 4-20 mA proportional velocity output is also provided, allowing connection to PLCs, DCSs, strip chart recorders, or other process monitoring systems where vibration levels can be trended. The unit comes with an 8-Pin MIL Style Connector or bundled flying leads, and includes the dynamic raw acceleration signal provided through two of the 8 pins.

The 8-Pin MIL Style Connector comes with a non-incendive rating and can be used with barriers for special installations. For explosion proof installations, wire directly to explosion-proof conduit fittings using the flying lead version with the included elbow.

The switch has no moving parts and is encapsulated in a 316 stainless-steel housing. Each switch is factory calibrated to the sensitivity marked on the label. The setpoint and time delay of the two switch channels can be configured from software.
MOUNTING

It is important to solidly mount the transmitter body to the machine surface. Refer to section 6 on transducer placement. Different machine preparations are required for the two basic transmitter mounting styles; NPT (National Pipe Thread) and machine thread (UNF and Metric). Transmitters with the NPT type mounting stud are secured by the thread engagement and the base of the transmitter does not contact the machine surface. Transmitters with the machine thread studs must contact the machine surface. The base of the transmitter must make square and direct contact. This requires preparing the surface of the machine with a 1 1/2 inch counter bore (surfacing tool). This tool can be used with a portable drill equipped with a magnetic base but care must be taken so that the tapped and threaded hole is perpendicular to the machined surface. The transmitter must make contact all the way around its base.

Solid State Relays

The solid state relays included in the switch can carry a maximum current load of 150 mA. If you need a higher current carrying capacity use an interposing relay with a 50 mA holding current like:

- idec: RSSDN-10A DC Input Solid State Relay
- RSSAN-10A AC Input Solid State Relay
- RU2 Series DPDT Universal Relay

Note: Units sold with an explosion proof rating will include an 8200 explosion proof elbow that will be affixed at the factory.
base surface. Contact Metrix for more detailed counter bore instructions.

If installing a transmitter with a standard 1/4 inch NPT stud, drill a hole using a 7/16 inch bit, 5/8-7/8 inch deep. Then tap using a 1/4 - 18 NPT (tapered pipe tap). Hand-tighten the transmitter and then turn an additional 1 to 2 turns using a wrench on the wrench flats. **Do not use a pipe wrench.** A pipe wrench can apply extreme forces to the body and potentially damage electronic components. A minimum of five (5) threads of engagement should be made. A 1/4 inch to 1/2 inch NPT bushing is available for mounting the transmitter in existing 1/2 inch NPT holes. Also, a Metrix model 7084 Flange Adapter can be used between the transmitter and the machine surface when there is not enough surface thickness to drill and tap a hole. The flange adaptor mounts with three small screws (1/4” X 28).

If installing a transmitter with one of the straight machined thread sizes, follow standard drill and tap procedures. Do not drill a hole larger that the counter bore pilot diameter before using the counter bore to prepare the machine surface. Drill out the hole with the correct tap drill size after preparing the surface.

The sensitive axis of the transmitter is in line with the mounting stud. The transmitter can be oriented in any (0 to 360 degree) position.

**WIRING**

### 3.1 General
The ST5484E-SW is connected like other loop powered transmitters. The following is a summary based on area designations.

**CAUTION:** Use of a high-speed torque screwdriver may damage the terminal blocks.

Connect the field wiring in accordance with the appropriate portion of Figure 1.

The ST5484E-SW requires a minimum of 11 VDC for proper operation. This is the minimum voltage required at the transmitter (not the power supply), after all other voltage drops across field wiring and receiver input impedance have been accounted for with the maximum 20mA of loop current flowing. The minimum loop power supply voltage required is therefore 11 VDC plus 1 volt for each 50 Ω of total loop resistance.

**Figure 1:**

![Diagram of wiring connections](image_url)
Example:

<table>
<thead>
<tr>
<th>Component</th>
<th>Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal wiring</td>
<td>10 Ω</td>
</tr>
<tr>
<td>DC Input Impedance of receiver</td>
<td>250 Ω</td>
</tr>
<tr>
<td><strong>TOTAL LOOP RESISTANCE</strong></td>
<td><strong>260 Ω</strong></td>
</tr>
</tbody>
</table>

Minimum supply voltage = 260 Ω (1 V/50 Ω) + 11 V = 16.2 VDC

The maximum loop power supply voltage that may be applied is 30VDC (explosion proof and non-incendive). The maximum loop resistance (LR) is calculated by the equation: \( LR = 50 \left( \frac{Sv}{260} - 1 \right) \), \( Sv=Supply\ Voltage \)
Example: \( LR = 50 \left( \frac{24}{260} - 1 \right) = 650 \, \Omega \) for a 24 VDC loop supply.

The maximum raw signal distance from the switch is 10 meters (33 feet). Length longer than this will result in raw signal degradation.

### 3.2 Explosion-Proof Installation In Hazardous Locations (CSA)

Some models of ST5484E-SW are CSA certified explosion-proof, CSA US/C, Class I, Div 1, Grps B-D and Class II, Div 1, Grps E-G (explosion proof). Connect the field wiring in accordance with the appropriate installation as shown in Figure 1. Refer to section 3.1 for loop voltage and resistance requirements. All conduit and junction boxes used must be certified explosion-proof for the class, division, and group required by the application. Installation of the transmitter must meet all of the explosion-proof installation requirements of the local governing agency and facility safety procedures. The Metrix part 8200-000 elbow is required to meet this approval.

### 3.3 Flame-Proof Installation In Hazardous Locations (ATEX, IECEx)

Some models of ST5484E-SW are ATEX/IECEx certified flame-proof, Ex d IIC T4 Gb. Connect the field wiring in accordance with the appropriate installation as shown in Figure 1. Refer to section 3.1 for loop voltage and resistance requirements. All conduit and junction boxes used must be certified flame-proof for the area required by the application. Installation of the transmitter must meet all of the flame-proof requirements of the local governing agency and facility safety procedures. The Metrix part 8200-000-IEC elbow is required to meet this approval.

### 3.4 Software

**A. Two independently adjustable setpoints** – The use of two setpoints\(^*\) (one for ALERT and one for SHUTDOWN) is recommended for applications where it is desirable to remotely announce an ALERT condition to operators and/or maintenance personnel. This allows appropriate intervention to occur before the machine reaches SHUTDOWN levels. Switches with only a single setpoint are not capable of pre-shutdown warnings unless the 4-20mA output is connected to a PLC or other trending device, and appropriate pre-shutdown alarm limits are programmed in the PLC.

\(^*\) **NOTE:** The two setpoints are set at the factory at one half (1/2) and two thirds (2/3) of the full scale range, and they can both be adjusted through Metrix software.

**B. LOCKOUT (Power-Up Alarm Inhibit) capabilities** – Configurable LOCKOUT capability is available for suppressing alarm activation during tranducer startup conditions.

\(^*\) **NOTE:** This delay is set at the factory for 15 seconds and can be adjusted in the field by using Metrix software up to 300 seconds.
C. Flexible Discrete Output Types

Discrete outputs are used to externally annunciate alarm conditions and to use the switch as part of an auto-shutdown (i.e., trip) circuit. Switches provide two discrete outputs—one for ALARM and one for SHUTDOWN. The outputs can individually be field-configured to have separate time delays and separate shelf states (open on alarm or close on alarm). Solid-state relays are designed primarily for applications where the discrete outputs will be connected to a light load, such as a PLC, DCs, or an interposing relay with a maximum 50mA holding current.
WARNING:
ATEX Conditions for Safe Use (Ex d)
For temperature classification and safety:

- Use conduit elbow, Metrix reference 8200-000-IEC, which is a Killark product with reference: Y-3-EX.
- Ambient Operating Temperature: -40°C to +100°C

NOTE: Metrix also strongly recommends the use of our ferrite bead kit (Metrix p/n 100458) as an extra precaution against electromagnetic interference that may be induced in field wiring from subsequently bleeding into the transmitter.

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.
Equipment environmental Ratings:
   a) Pollution degree 3
   b) Installation category I
   c) Altitude 2000m
   d) Outdoor: Type 4x
   e) Temperature -40°C to 100°C

4. ELECTROMAGNETIC COMPATIBILITY

In order to meet the requirements of electromagnetic compatibility in areas of high electromagnetic interference, the field wiring must be:

- Shielded twisted pair cable enclosed in grounded metallic conduit, or
- Double shielded twisted pair cable with a metallic body cable gland fitting and with the outer shield grounded.

Use standard two-conductor, twisted pair, shielded wiring for the long run to the instrumentation enclosure. The transmitter is connected like other loop-powered end devices.
5. CONNECTION TO PLC OR OTHER INDICATING INSTRUMENT

The first step in configuring the PLC, DCS, or other recording instrument is to determine the source of power. The ST5484E-SW requires loop power. Some analog input channels on a PLC or DCS, for example, provide this power from within. If they do not provide power, an external power supply must be provided. Connect the transmitter field wiring using standard instrumentation practices. Scaling of the display is on the basis of the range of the transmitter. The measurement parameter name is “vibration” and the units are “in/s” (inches per second) or “mm/s” (millimeters per second). The example below is based on a standard 1.0 in/s transmitter.

<table>
<thead>
<tr>
<th>When vibration level at transmitter is...</th>
<th>Transmitter output will be...</th>
<th>PLC (or other) should read...</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 in/s (i.e. no vibration)</td>
<td>4.0 mA (± 0.1 mA)</td>
<td>0.00 in/sec</td>
</tr>
<tr>
<td>1.0 in/s (i.e. full scale vibration)</td>
<td>20.0 mA (± 0.5 mA)</td>
<td>1.00 in/sec</td>
</tr>
</tbody>
</table>

Momentary “jolts” that can occur at start-up, or during some operating condition changes, do not reflect a machine’s steady-state operating condition. To prevent such occurrences from generating nuisance alarms, program a time delay into the alarm such that the indicated vibration level must persist above the alarm setpoint for a preset period of time before an alarm is generated. The indicated vibration level must cross the threshold level and stay above it for a preset time before any alarm action is taken. A 2 to 3 second delay is normally applied to most machinery. Consult Metrix if you have a question about your machine’s operating characteristics.

The ST5484E-SW has a start-up time lockout for alarms. A start-up lockout is different than a time delay. A start-up lockout functions the same as a time delay, but is usually set to a much longer time. Both may be needed.

6. TYPICAL TRANSMITTER PLACEMENT

The ST5484E-SW measures seismic vibration (i.e., vibration velocity) at the attachment point on the machine, using engineering units of in/s (inches per second) or mm/s (millimeters per second) depending on the selected ordering option. The transmitter’s sensitive direction is through the long axis of its cylindrical body. It will not measure side-to-side motion.

Typical transmitter mounting for casing vibration measurements is in the horizontal direction at the bearing housings as depicted in Figure 2. The horizontal direction usually incurs more vibration because most machines’ foundation constrains vertical vibration more than horizontal vibration. A horizontal mounting arrangement is also depicted in Figure 3, but with additional detail showing typical accessories. When flying leads are ordered, a 24- or 72-inch length may be specified using ordering option D on the Metrix product datasheet 1004457. These leads may be cut to length and then spliced to field wiring as shown in Figure 3.
When attaching conduit to the transmitter, observe the following:

- Because the transmitter is sensitive to vibration, avoid unsupported lengths of conduit and excessive mass (such as large hubs or junctions) hanging directly off the end of the transmitter. These can introduce unwanted vibrations that do not reflect actual machinery vibration and cause mechanical stresses that can lead to premature transducer failure.

- A “Y” type conduit elbow, such as the Metrix 8200 series, is preferred because it prevents the conduit from extending too far away from the transmitter, thus limiting the likelihood of breakage. It also precludes long unsupported lengths of conduit directly aligned with the transmitter’s bore (longitudinal axis) as noted in the bullet above.

- Avoid attachment of rigid conduit directly to the transmitter; instead, use a small length of flexible conduit to mechanically isolate the transmitter from vibration that might occur in rigid conduit.

- If a 1-inch to 3/4-inch reducer is used at the elbow, a smaller diameter flexible conduit can be used.

**NOTE:** Hazardous area locations do not allow a splice at the location shown in Figure 3. Instead, the splice must be made in a second conduit hub (meeting splicing requirements) located at the end of flexible conduit.
7. CALIBRATION

The ST5484E-SW transmitter has been factory calibrated for the full-scale vibration level marked on the label. If the calibration is in doubt, the unit can be verified in the field by following the procedures outlined below. Note that there are no Zero and Span adjustments on the transmitter. Additionally, the transmitter uses a true RMS amplitude detection circuit; units supplied with a full scale range in peak units scale the underlying RMS measurement by a factor of 1.414 to provide a “derived peak” rather than true peak measurement.

7.1 Zero Verification
In the absence of vibration the output current should be 4 mA ± 0.1 mA. If the ambient vibration exceeds 2% of full scale, the transmitter should be removed from the machine and placed on a vibration free surface for this measurement. Often a piece of foam can be used to isolate the transmitter from external motion.

7.2 Span Verification
Subject the transmitter to a known vibration within the full scale range marked on the label. If you are using a portable vibration shaker where it can be tested at full scale, the output should be 20 mA ± 0.5 mA.

8. OPTIONAL DYNAMIC OUTPUT

The transmitter includes the dynamic output is an acceleration signal with a sensitivity of 100 mV/g, filtered to the same frequency band as used for the 4-20mA velocity measurement (refer to options E and F on the Metrix Datasheet 1862019).

Observe the following when using this output:

- Only an electrically-isolated or battery-powered portable vibration analyzer should be used when connecting to this output. Since this is a loop-powered device, an external ground will affect the loop output and could cause a false alarm.
- When using a portable vibration analyzer or data collector, be sure to turn the instrument sensor power off.
- Most portable vibration analyzers have a low input impedance and they will load this signal, resulting in attenuation of as much as 20% to 30%. Refer to Table 1 which shows the nominal attenuation expected for a given input impedance.
- In all cases for all locations, the use of this signal is for temporary connection only. Permanent connection could violate hazardous location installation requirements.
- Avoid impacting the transmitter or introducing other mechanical vibrations when connecting to this output. Such vibration could result in spurious alarms or machinery trips.
- When output is not in use, be sure leads cannot touch conduit or each other as this will affect the 4-20 mA current output.
- Avoid introducing electrical noise when using this output. Do not use this output with leads longer than 10m (33 feet). Use of longer leads can introduce electrical noise and attenuate high-frequency signal content that may be present in the raw acceleration signal.
### Connect In Type

<table>
<thead>
<tr>
<th>MIL-C-5015 8-Wire</th>
<th>Brown</th>
<th>Brown/White</th>
<th>Blue</th>
<th>Blue/White</th>
<th>Orange</th>
<th>Orange/White</th>
<th>Green</th>
<th>Green/White</th>
</tr>
</thead>
</table>

### Dynamic Signal Connections

- 1 = Switch 1 -
- 2 = Switch 1 +
- 3 = Switch 2 -
- 4 = Switch 2 +
- 5 = Power +
- 6 = Power -
- 7 = Dynamic Signal +
- 8 = Dynamic Signal -

### Table 1

<table>
<thead>
<tr>
<th>Input Impedance of Analyzer</th>
<th>dB Attenuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MEG</td>
<td>0.01</td>
</tr>
<tr>
<td>5 MEG</td>
<td>0.02</td>
</tr>
<tr>
<td>2 MEG</td>
<td>0.04</td>
</tr>
<tr>
<td>1 MEG</td>
<td>0.09</td>
</tr>
<tr>
<td>500 K</td>
<td>0.18</td>
</tr>
<tr>
<td>200 K</td>
<td>0.43</td>
</tr>
<tr>
<td>100 K</td>
<td>0.84</td>
</tr>
<tr>
<td>50 K</td>
<td>1.61</td>
</tr>
<tr>
<td>20 K</td>
<td>3.57</td>
</tr>
<tr>
<td>10 K</td>
<td>6.10</td>
</tr>
</tbody>
</table>

### 9. SPECIFICATIONS, ORDERING INFORMATION AND OUTLINE DIMENSIONAL DIAGRAMS

Refer to Metrix product datasheet 1004457 for additional information.

**Figure 4:** Outline dimensions of the ST5484E-SW Flying Lead Version. Dimensions in mm [inches]. 8200-000 IEC conduit elbow shown installed, necessary for Explosion Proof rating.

* NOTE: 8200-000-IEC elbow is mandatory for ATEX/IECEx/INMETRO/KOSHA/EAC Ex d (flame-proof) approved installations. The 8200-000 elbow is mandatory for CSA Ex d (flameproof) approved installations.
Figure 5: Outline dimensions of the ST5484E-XXX-XX4-XX (MIL-Style Connector). Dimensions in mm [inches].

10. 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.

info@metrixvibration.com
www.metrixvibration.com
8824 Fallbrook Dr. Houston, TX 77064, USA
Tel: 1.281.940.1802 • Fax: 1.713.559.9421
After Hours (CST) Technical Assistance: 1.713.452.9703