Operation manual
Electronic vibration switch

VSW-100

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1.0 Safety considerations

Please read the following information before installing the VSW-100.

- This installation information is intended for all VSW-100 models. A visual inspection of this product before installation for any damage during shipping is recommended.
- Before beginning installation of the VSW-100, make certain all safety precautions including lock out/tag out procedures are followed where required for the intended machine.
- Installation is to be done only by a qualified technician according to the National Electrical Code.
- Observe all warnings and cautions at each section in these instructions.
- Please contact Wilcoxon Sensing Technologies immediately if you have any questions.

Wilcoxon Sensing Technologies has made efforts to ensure the reliability of the electronic vibration switch VSW-100 and to recommend safe usage practices in system applications. Please note that in any application, operations and device failures can occur. These failures may result in full control outputs or other outputs which may cause damage to or unsafe conditions in the equipment or process connected to the VSW-100.

Good engineering practices, electrical codes, and insurance regulations require using independent external protective devices to prevent potentially dangerous or unsafe conditions. Assume that Wilcoxon's VSW-100 system can fail with outputs full on, outputs full off, or that other unexpected conditions can occur.

2.0 General description

The VSW-100 vibration switch enables low-cost vibration monitoring for stand-alone or process related machines and auxiliary equipment (e.g. fans, pumps, centrifuges, mills, gears).

The 4-20 mA velocity signal and the time delay relay contact signals can be fed into an associated PLC controller for alarming notifications.

Wilcoxon's VSW-100 protects against equipment failure by monitoring velocity-based vibration levels and providing an early warning or shutdown notification when abnormal vibration levels are reached.

2.1 Features

- Mount at any angle
- Sensing piezoelectric-crystal with built-in microelectronics for reduced noise sensitivity
- Electronically integrated signal measures and trips on velocity (IPS peak)
- Two independently adjustable time delay trip relays
- Shutdown setpoint measured in velocity (IPS peak)
- 4-20 mA output for continuous monitoring
    - Adjustable time delay to help prevent false tripping on start-ups or non-repetitive transient events
    - AC acceleration output 100 mV/g for full spectrum analysis

2.2 Applications

The VSW-100 can be used on any equipment including:

- Cooling fans
- Engines
- Pumps
- Compressors
- Gear boxes
- Motors
- Generator sets

The VSW-100 monitors and can alert the operator of abnormal vibration caused by a variety of possible factors, including:

- Imbalance
- Misalignments
- Worn sleeve bearings
- Broken tie down bolts
- Worn ball or roller bearings
- Gear mesh
- Blade pass frequencies

3.0 Functional description

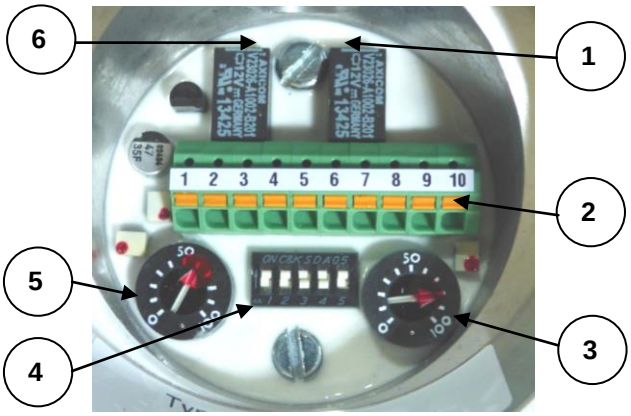
3.1 Two channel LED indicators

The VSW-100 includes two independent, adjustable level detectors with selectable delay times equipped with corresponding relays typically used for Alarm and Shutdown. The selected full scale vibration level, 0.1 or 0.5 ips applies to both channels.

Red and yellow LED indicators representing these two channels illuminate during normal use. When a fault is activated, the corresponding LED indicators turn off.

NOTE: Because the VSW-100 uses non-latching relays, it is important to ensure that the fault has been addressed before restarting the equipment.

Figure 1: internal view of component locations



1	Red channel 2 LED (K2)
2	Spring terminal 16 - 24 AWG
3	Channel 2 (K2) vibration set point potentiometer (Pot)
4	DIP switches for vibration ranges and time delays
5	Channel 1 (K1) vibration set point potentiometer (Pot)
6	Yellow channel 1 (K1) LED

4.0 Mounting

To prevent damage to the VSW-100 vibration switch, the following vibrations may not be exceeded:

- Vibration: 10 – 2,000 Hz, 15 g
- Shock: 150 g

The VSW-100 must be mounted and set in accordance with the guidelines in this manual to obtain the specified performance and equipment protection. The VSW-100 is intended to be mounted using the ½" NPT hole located at the bottom of the sensor.

Figure 2 illustrates an example mounting using a simple pipe plug welded to the machine surface. The tightening torque is hand tight plus 2 to 3 turns.

NOTE: A hollow pipe close nipple is NOT recommended for installations.

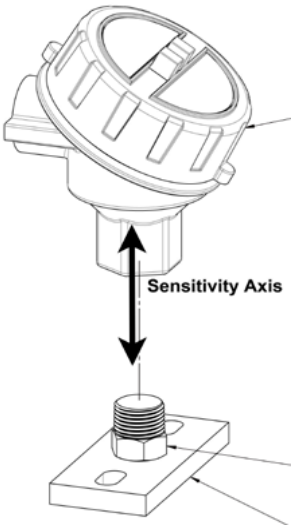


Figure 2 : bracket installation option

Care must also be taken so the mounting surface does not contribute to the measured vibration. A simple bump test should be performed to ensure the resonance of the mounting surface is outside the frequency of interest.

NOTE: Exceeding the torque specification will damage the aluminum housing. If there is concern of the device becoming loose due to excessive vibration, use a permanent thread locker such as Loctite 271 (RED).

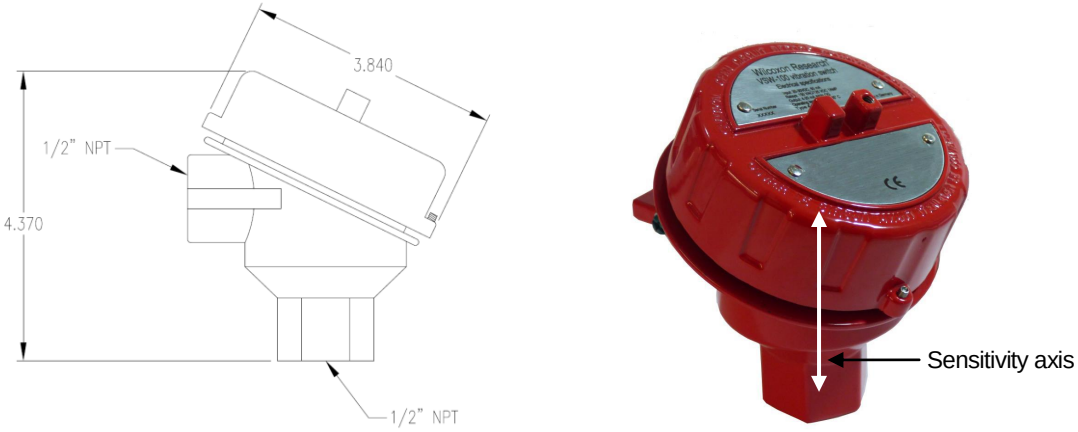


Figure 3: product dimensions and sensitivity axis

5.0 Electrical supply

The method chosen to electrically connect to the switch should be mechanically flexible to eliminate the measurement of vibration induced from conduit and to provide a moisture barrier as well. Although Sealtite and other flexible conduit have been used successfully, in areas of extreme humidity or moisture Meggitt recommends using an “SO” type cable along with a Division 2 suitable rain-tight CGB gland/strain relief fitting. No stress should be placed on the wiring to the terminal block. If such protection is not provided by the conduit system, some form of stress relief must be installed.

To assure compatibility with EMI compliance standards, any signal level wiring such as transducer or 4-20 mA wiring should use shielded cable in EMI proof conduit, separate from any power wiring except the DC power for the VSW-100. AWG 16-26 wire can be used.

5.1 Terminal assigment

Terminal assignment		
1	PS	+ 24 V DC
2		0 V DC
3	Relay K1	NC
4		COM
5		NO
6	Relay K2	NC
7		COM
8		NO
9	Analog output 20 mA	
10	RAW Signal 100 mV/g	

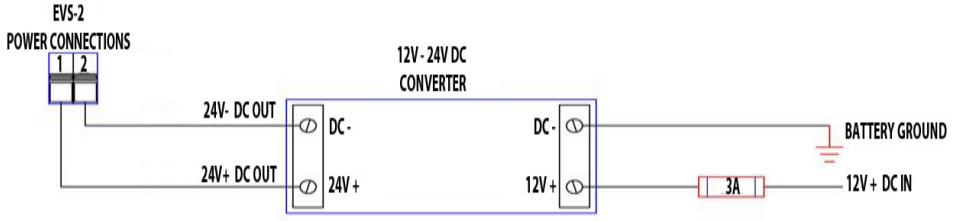
NOTE:
During NORMAL operation the COM and NO will have continuity.

On a SHUTDOWN or POWER LOSS, the COM and NC will have continuity.

The power supply +24 VDC voltage is connected via terminals 1 and 2.

Minimum voltage acceptable for normal operation is 20 - 30 VDC.

A DC to DC converter can be used for 12V systems.



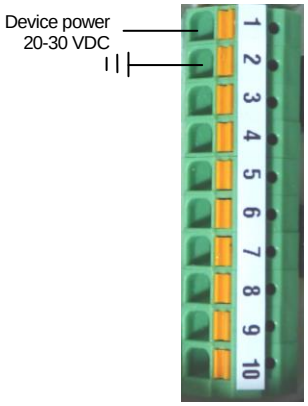
Non-latching relay outputs for Channel 1 (K1) and Channel 2 (K2) are present on terminals 3 through 8.

NOTE: On initial power-up relays do not activate until the 4-20 mA reading settles below the trip point for the corresponding channel.

Example: if Channel 1 is set at 50%, the relay will not activate on power-up until the 4-20 settles below 12 mA. This typically takes 7 seconds but could be more depending on the application.

If the trip point is higher (90%) then it will take less time. If the trip point is lower (10%) then it will take more time.

4-20 mA output requires approximately 30 seconds to reach full resolution. AWG 16 to AWG 24 wire can be used. Only 1 AWG conductor or 2 AWG 20, or 4 AWG 22 wires can be used per terminal.



1: PS: +24 VDC
2: PS: 0 VDC
3: RELAY K1: NC
4: RELAY K1: COM
5: RELAY K1: NO
6: RELAY K2: NC
7: RELAY K2: COM
8: RELAY K2: NO
9: Analog output 4-20 mA
10: RAW signal 100 mV/g

Figure 4: VSW-100 hook up showing how to wire channel 1 (K1)

6.0 Settings

6.1 Setting the set point in inches per second (IPS), peak

Factory settings:
- 1.5 IPS
- 1 sec time delay
- 50% limit value

NOTE: The unit must be set per the application upon installation

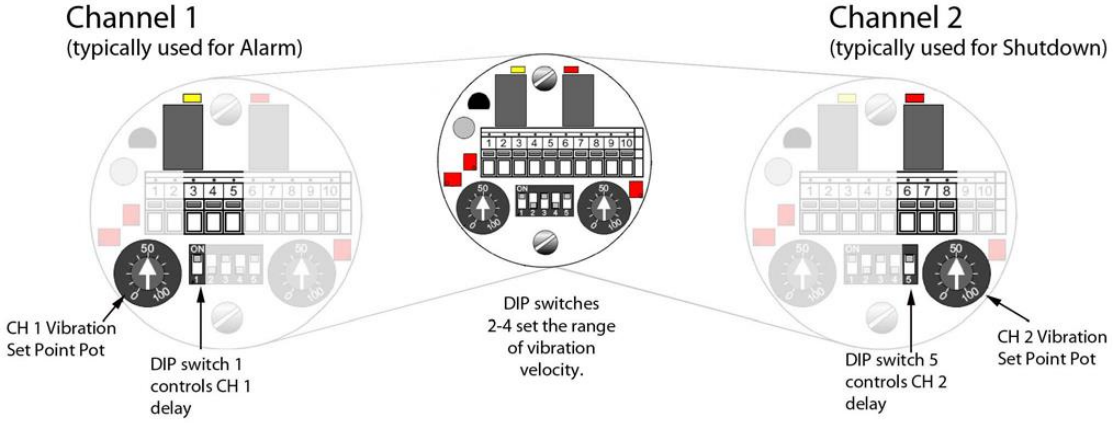


Figure 5: detail for setting IPS and delay setpoints

6.2 Procedure

Refer to the monitored machine recommended setting and mounting information and make appropriate adjustments. To adjust the setpoint, open the VSW-100 cover and follow these steps:

1. Select the appropriate delay settings and ranges using the DIP switches.
    A. Time delays for each channel are set to either 1 second or 5 seconds via DIP switch 1 for Channel 1, and DIP switch 5 for Channel 2.
    (ON=1 sec; OFF=5 sec)
    B. Select a range that allows normal vibration and preferred trip points to exist near mid range. Range selection affects both channels. The measurement range in vibration velocity (in/sec peak) is established when:
    DIP switch 2: ON=0.75 in/sec peak (DIP switches 3, 4=OFF)
    DIP switch 3: ON=1.50 in/sec peak (DIP switches 2, 4=OFF)
    DIP switch 4: ON=3.00 in/sec peak (DIP switches 2, 3=OFF)

2. Use a slotted, narrow blade screwdriver to adjust both of the vibration set point potentiometers:
    - To increase the vibration set point, turn the potentiometer clock-wise.
    - To decrease the vibration set point, turn the potentiometer counter clockwise.

3. Make sure that the machine to be monitored is powered on and in normal operation.

6.3 Determining and adjusting the delay setpoint (1 or 5 seconds)

The delay setpoint value can define the line between sensitivity and nuisance faults. A 1 second delay allows a potentially catastrophic failure to be detected quickly. A 5 second delay helps prevent normal start-up vibrations from triggering an alarm. An evaluation of these two conditions should be made for each unique installation before setting the delay setpoint. When used with a PLC system, the input can be timed out for startup in the PLC.

There are two independently adjustable channels. Each channel has its own delay setting.

Useful vibration formulas	
$V = \pi fD$	D (displacement) = inches peak-to-peak
$V = 61.44\ g/f$	V (velocity)=inches/second=IPS
$g = 0.0511\ f^2D$	g (acceleration) = 386.1 inches/second^2
$g = 0.0162\ Vf$	f (frequency) = RPM/60
$D = 0.3183\ V/f$	rms (root mean squared) = 0.707 x peak
$D = 19.57\ g/f^2$	peak-to-peak = 2 x peak
	$\pi = 3.1416$

6.3.1 Pot settings

The vibration setpoint potentiometers (pots) adjust the level of detection based on the scale set in DIP switches 2 through 4. These pots adjust to a percentage of the scale (range) chosen. If 0 to 1.5 IPS is selected as the range, then a pot setting of 50% would cause the VSW-100 to trip at a vibration of 0.75 IPS. Figures 5 and 6 illustrate pot settings for the VSW-100.

		Range (IPS)		
		0.75	1.5	3.0
Vibration set point (% of selected range	0%	0.0	0.0	0.0
	25%	0.2	0.4	0.8
	50%	0.4	0.8	1.5
	75%	0.6	1.1	2.3
	100%	0.8	1.5	3.0

Figure 6: vibration set points of selected IPS range

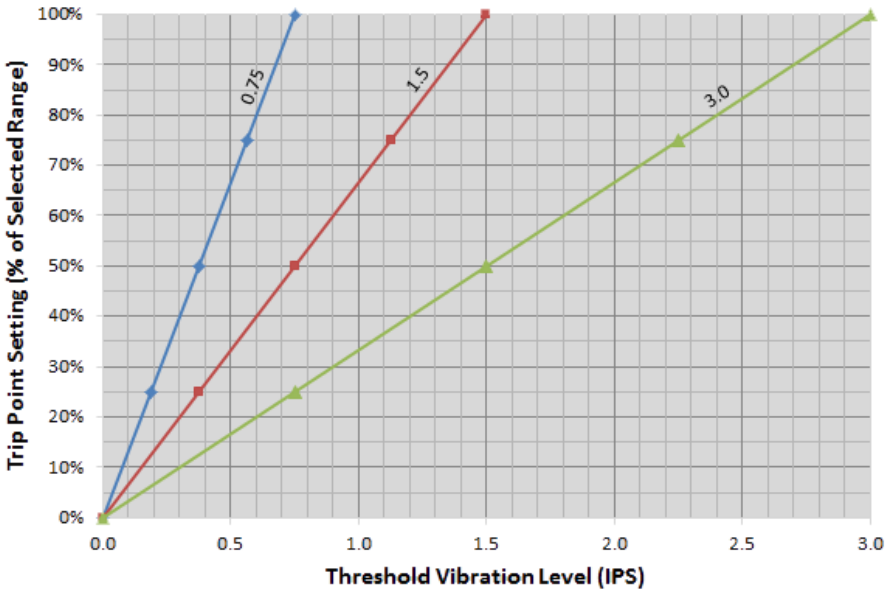


Figure 7: pot settings

6.4 Setting of alarms

The alarm values may vary considerably, up or down, for different machines. The values chosen will normally be set relative to a baseline value determined from experience for the measurement position or direction for that particular machine.

As a guideline ISO 10816 establishes recommended alarm values based on machinery group and power ratings. See the reference chart shown below. More information from is available from the International Organization for Standardization http://www.iso.org/iso/home.html .

In practice, after a short period of time the steady-state baseline value established by the

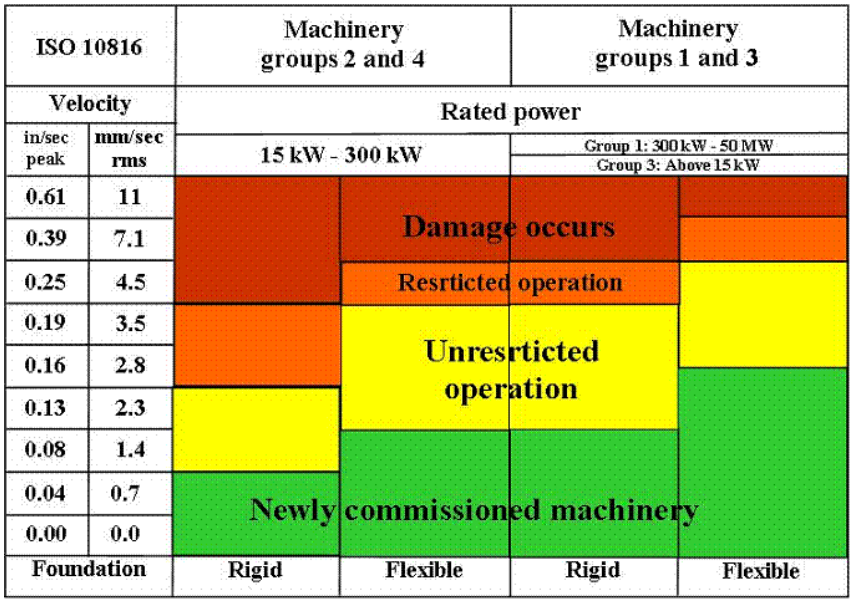
machine is used to determine the alarm setting value. An engineering rule of thumb is to use increases of ~25% to reflect a change in conditions. Actual results may vary in actual usage.

6.4.1 Recommended alarm settings

The following guidelines are based on industry standards. Actual settings will vary depending on mounting and unit installation. Experience with a given installation should be the major factor in deciding the settings.

It is recommended that the alarm value should not normally exceed 1.25 times the upper limit of the yellow zone for your machine group.

6.5 Vibration limits based on class of equipment based on ISO 10816-3



6.6 Typical vibration alarm settings of various installations

The values listed are guidelines only, actual vibration limits must be related to stress levels, which can be measured with strain gage equipment. In general, if vibration levels are below the guidelines mentioned below, the stress levels are well below the fatigue level of the equipment. If vibration problem is perceived, a spectral analysis should be performed on the unit by a qualified specialist.

Type of equipment	Velocity (IPS peak)	
	Low	High
Compressor, centrifugal	0.2	0.4
Compressor, reciprocating	0.5	0.7
Conveyors	0.3	0.5
Electric motors	0.1	0.3
Engines	0.2	0.7

Fans, blowers	0.2	0.4
Gearboxes	0.1	0.3
Generator sets, electric driven	0.2	0.3
Generator sets, engine driven	0.5	0.7
Machine tools (unloaded)	0.05	0.2
Pumps, centrifugal	0.1	0.3
Pumps, gear	0.1	0.3
Pumps, reciprocating	0.5	0.7
Turbines	0.05	0.2

6.7 Reciprocating compressor vibration setting guidelines

The values listed are guidelines only, cyclical failures generally occur in the range of 10 to 100 cycles. High velocity at high frequency will result in failure at a much greater rate than high velocities at a low frequency. Experience should also be a guideline in determining acceptance limits for a particular compressor package.

Type of equipment	**Velocity (IPS peak)**	
	IPS	mm/sec
Motor frame	0.3 – 0.5	8 – 12
Compressor frame	0.2 – 0.3	5 – 8
Compressor cyliner (outer end)	0.5 – 1.0	12 – 25
Pulsation bottles (outer center)	0.5 – 1.0	12 – 25
Skid frame	0.1 – 0.3	2.5 – 8
Scrubber (6' – 6" elevation)	0.8 – 1.0	20 – 25
Piping (saddles and 12" spans)	0.5 – 0.8	12 – 20
PSVs (top of valves)	0.6 – 0.8	15 – 20

7.0 Technical data

7.1 Performance

- Vibration range: customer selectable DIP switches: 0.75, 1.50 or 3.00 IPS (peak)
- Frequency range: 5 to 1,000 Hz (± 5%)
- Analog output (R_{load}): 4 to 20 mA ≤ 500 Ω (±5% FS; 1.5 IPS, 21° C) (±10% FS @ 100 Hz; 1.5 IPS, -30 to +85° C)
- Raw signal (R_{load}): 100 mV/g (offset + 5 VDC) > 20 kΩ

7.2 Environment

- Operating temperature: -22 to +185° F (-30 to +85° C)
- Storage temperature: -40 to +185° F (-40 to +85° C)
- Enclosure classification: IP68 (housing)

7.3 Electrical

- Power required: 20 to 30 VDC
- Current draw: <40 mA

7.4 Relay

- Switch contact capacity: 30 VAC/30 VDC @ 1A
- Relay function: non-latching
- Normally energized (NE): fail safe

7.5 Physical

- Housing material: aluminum/epoxy paint (red)
- Weight: 1.54 lb (0.7 kg)
- Size (H x W): 4.9 x 3.9 in (125 x 100 mm)

7.6 Indicators

- Alarm LED: yellow
- Shutdown LED: red

8.0 Technical assistance

8.1 Technical assistance

For technical assistance, please contact Wilcoxon Sensing Technologies customer service at 301-330-8811 or email info@wilcoxon.com.

8.2 Customer service

To obtain a return materials authorization number, please email info@wilcoxon.com using 'RMA request' in the subject line. Please provide return contact information including name and phone number or contact customer service directly at 301-330-8811