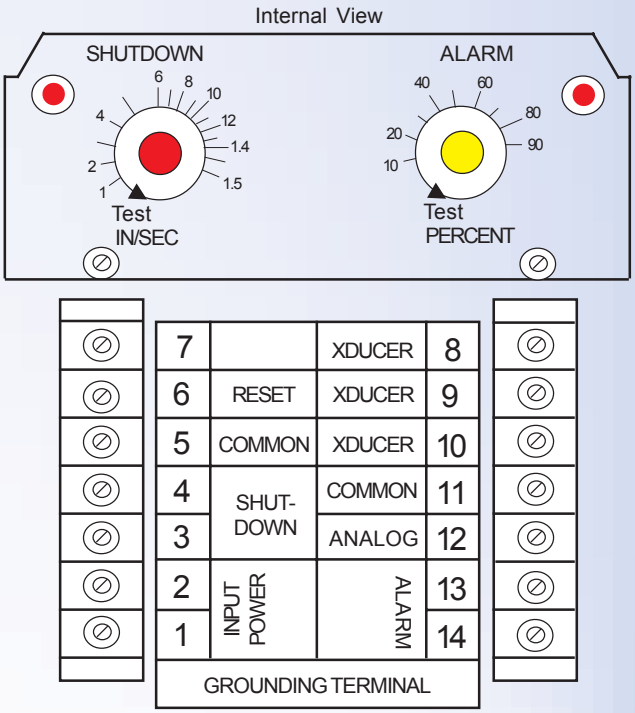
SOLID STATE VIBRATION SWITCHES

The PMC/BETA electronic vibration switch makes available in a relatively low-cost device many of the benefits formerly found only in high-end protection systems.

- **Adjustable time delay**
- **High accuracy**
- **No false triggering**
- **Analog output available**
- **Self-test function**
- **Built-in or remote transducer**



Model 450

Model 440

METRIX INSTRUMENT CO.

PMC/BETA

Machinery Vibration Protection

Protect Your Rotating Machinery with Solid State Vibration Switches for Alarm and Shutdown

Provide Early Warning Avoid Catastrophic Failure

Vibration is an excellent early warning of machine deterioration.

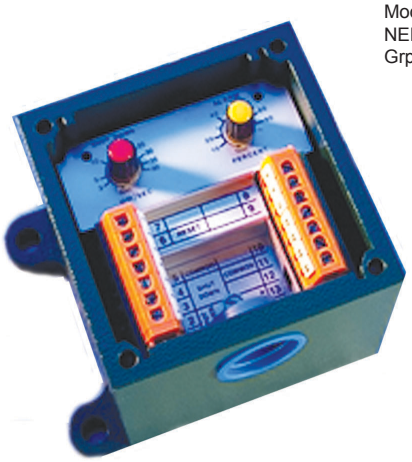
The PMC/BETA 440 Series vibration switches sense the causes of excessive machine vibration and machine failure. The major causes are: imbalance of a rotating member (about 40% of the time), misalignment (15%), defective bearings (15%) and defective belts (15%).

The PMC/BETA vibration switch responds to destructive vibration by shutting down your machine when the vibration trip level is exceeded, preventing catastrophic damage and extensive repairs and downtime.

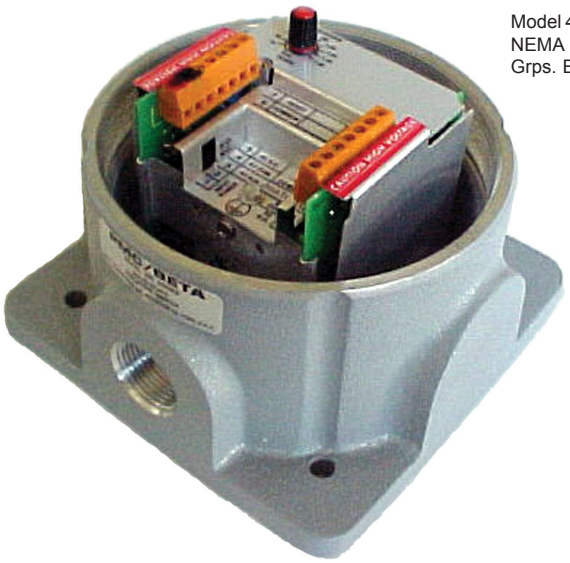
Small and gradual machine deterioration shows up as significantly increased vibration. Early detection usually permits continued operation until a scheduled shutdown.

Unique Features

- Built-in time delay, field adjustable.
- No false triggering.
- Velocity triggering provides protection at all frequencies. Displacement triggering available for low speed machinery.
- Sensitivity is not affected by rotating speed of machinery.
- Calibrated dial for setting limits.
- Solid state relay contacts used for alarm and/or shutdown. Field settable for N.O. or N.C.
- Remote reset capability.
- Provision for self-test and calibration.
- 4-20 mA output proportional to vibration level (on Models 440SR and 440DR) can be used for remote readout and trending of vibration levels.
- Built-in transducer or optional remote transducer.
- Cast aluminum enclosures meet NEMA 3, 4, and 12 standards. Explosion-proof models (450 Series) available.



Model 440D,
NEMA 4, Class I, Div. 2,
Grps. B,C & D



Model 450D,
NEMA 4, Class I, Div. 1,
Grps. B, C & D

Model 440S/450S (Single Trip)
One limit for alarm or shutdown.

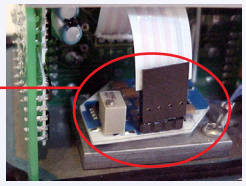
Model 440SR/450SR (Single Trip w/4-20 mA output)
One limit for alarm or shutdown, and 4-20 mA output for remote vibration readout or computer interface.

Model 440D/450D (Dual Trip)
One limit for alarm, a second limit for shutdown.

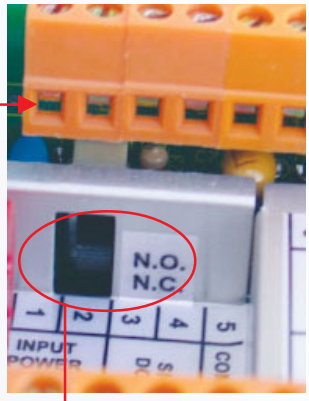
Model 440DR/450DR (Dual Trip w/4-20 mA output)
One limit for alarm, a second limit for shutdown, and 4-20 mA output for remote vibration readout or computer interface.

Unique Design Features

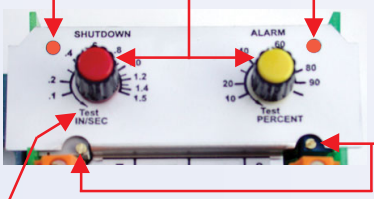
Built-in piezoelectric transducer module with integral amplifier provides 120 to 60,000 CPM capability.



VDE approved terminal strip accepts #12 wire. Screw adjustable clamping yoke rather than screw terminal permits easy, vibration proof connection. All hardware is captive.



Calibrated set point controls enable operator to set specific velocity trip points.



Light comes on immediately when vibration exceeds set point (alarm or shutdown will trip after 3 second time delay).

Adjustable time delay of 2-15 seconds. Factory set at 3 seconds.

Each solid-state contact is independently field settable to open on alarm (N.C.) or close on alarm (N.O.).

Test position sets in minimum set point so that any vibration will cause trip condition. Light will come on immediately, and trip will occur after duration of the time delay, proving that the complete system is operational. If test position is maintained for less than the duration of the time delay, trip will not occur, thus permitting system test without shutdown.

Specifications

Model No.	440S	440SR	440D	440DR
No. of Trips	ONE: for alarm or shutdown. Set in in/sec (velocity model) or mils (displacement model).		TWO: One for alarm and one for shutdown. Shutdown set in in/sec (velocity model) or mils (displacement model). Alarm set as percent of shutdown.	
Analog Output for Remote Indication	N/A	± 10% accuracy over 4-20 mA DC range. 4 mA is 0 vibration; 14 mA is set point; 20 mA is 160% of setpoint. Termination load resistance, less than 450 ohms	N/A	± 10% accuracy over 4-20 mA DC range. 4 mA is 0 vibration; 14 mA is set point; 20 mA is 160% of setpoint. Termination load resistance, less than 450 ohms
Velocity Set Point	0.1 to 1.5 in/sec or 0.2 to 3 in/sec peak. Metric ranges: 3 to 40 mm/sec or 6 to 80 mm/sec peak (Select one)			
Displacement Model	1 to 15 mils or 10 to 150 mils peak to peak. Metric ranges: 30µm to 400µm or 300µm to 4 mm peak to peak (Select one)			
Frequency Range	2 to 1000 Hz (120 to 60,000 RPM)			
Time Delay	Field adjustable 2-15 sec. Factory set for 3 sec unless specified otherwise			
Alarm or Shutdown Output(s)	Solid state relay (triac). One in 440S, 440SR; Two in 440D, 440DR Isolated (dry) contact Each triac field settable for close on alarm (N.O.) or open on alarm (N.C.) 5 A continuous, 100A for 10 msec. Max. off-state leakage current: 1 mA Min holding current: 50 mA typical Max. voltage across SS relay: 140VAC (280VAC on 230V input units)		**NOTE:** If the relay output is connecting to a PLC or DCS, DO NOT use 5A Triac. See options for D & E on Designation page.	
Remote Reset	Connection between terminals 5 and 6 latches triac output in alarm state after setpoint is exceeded. Opening the connection will reset the output to non-alarm state.			
Set Point Accuracy	± 10% of setting with repeatability of ± 2%. Circuitry utilizes RMS detector			
Vibration Sensitive Axis	Perpendicular to base. Unit can be mounted in any orientation without affecting setting			
Temperature Limits	-20°F to +140°F (-30°C to +60°C) including internal transducer. -65°F to +190°F (-55°C to +88°C) for optional external transducer			
Humidity	1% to 100% (non-condensing)			
Input Power	100-130 VAC 50/60 Hz standard. 200-260 VAC 50/60 Hz optional. DC input power optional. 440S, 3 Watt, 440D, 4 Watt			
Enclosure	Rugged, water-tight, dust-tight, cast aluminum. Meets NEMA, 3, 4 and 12 standards. Optional explosion-proof Model 450 available.			
Weight	3.5 lbs (1.6 Kg)			
Mounting	1/4" hardware, 3 mounting bosses			
Terminals	All terminals will accept #12 AWG wire in clamping type yoke without need for termination hardware. ALL hardware is captive.			
Self Test	Test position on set point control and light emitting diode provide functional test of trip circuitry, time delay and triac closure. Also permits on-line calibration of switch.			
Circuitry	Proprietary hybrid circuitry throughout for minimum size and maximum reliability in vibration environment.			
Remote Transducer Option	The standard 440 includes a built-in transducer. A separate transducer can be specified. Please request separate transducer when placing order. See Designation page. We recommend Model 165 ICP Accelerometer with Cable 031L-XX, where XX is the length of the cable in feet.			

More Features and Benefits

Single or Dual Trip Switches Provide Early Warning

The 440S provides a single switch closure which can be used for alarm or shutdown. However, it is often desired to provide a warning before shutdown. The 440D is ideal for this requirement. It provides two trips: one for alarm and one for shutdown.

The first trip is set at a vibration alarm level to provide early warning that the condition of the machine is deteriorating. When the alarm trip occurs, the operator can evaluate the condition and schedule corrective maintenance - at a time that does not interrupt the production schedule. If the machine condition continues to deteriorate, the shutdown trip provides protection against catastrophic failure.

The 440/450 as a Vibration Transmitter

The 4-20 mA output available on Models 440SR and 440DR can be utilized for remote readout of vibration level or as a transmitter to interface with customer computers and data handling systems presently used with pressure, flow and temperature transmitters, etc. The user can detect vibration levels which may be increasing, but which are not yet serious enough to trip the alarm.

How the 440/450 Works

These electronic switches utilize a solid state crystal accelerometer which provides an electrical output when it is deformed by the vibration forces. The output is electronically converted to a signal proportional to velocity. This signal is compared with a present limit and triggers a solid state relay if the limit is exceeded. There are no moving parts in the 440 vibration switches except when configured with mechanical relays.

While the 440 costs more than a mechanical switch, it uses the same technology as sophisticated remote monitoring systems and provides most of the capabilities of these systems at 1/3 to 1/2 the cost per monitor point.

Velocity Trip

The different causes of machinery failure (imbalance, misalignment, bearings, etc.) result in increased vibration at different frequencies (CPM) on a given machine. Therefore, it is important that the vibration protection device be equally sensitive to damaging vibration at all frequencies.

International standards for rotating machinery (ISO 2372, 3945) specify that vibration severity is directly related to vibratory velocity. The PMC/BETA 440/450 series electronic vibration switches measure and trip on velocity.

In mechanical switches, sensing and tripping are inherently limited to impact/acceleration. Since severity (damage potential) is proportional to velocity, acceleration tripping is oversensitive to some frequencies and not sensitive enough to others - with the result of either false trips in some cases, or not enough protection in others.

Built-in Time Delay Avoids False Trips

An important feature of PMC/BETA switches is the built-in time delay. This prevents triggering of the alarm or shutdown functions from transient increases in vibration levels. It also avoids shutdown due to transitory vibrations occurring during start-up.

Almost all machines experience a few seconds of high vibration during start-up before reaching operating speed. When no time delay function is included, as with mechanical switches, this start-up vibration causes a trip. Frequently, the operator turns the trip setting up until he can get through start-up. The resultant trip level is too high to afford protection at the machine's operating speed.

Three-second time delay is provided as standard on all PMC/BETA switches. The time delays are independently adjustable in the field over a range of 2 to 15 seconds.

Why Use Remote Sensors

Vibration switches can be configured to work with external sensors (accelerometers, velocity pickups or transmitters). When an external sensor is used, the internal accelerometer is not present.

Mounting location size, temperature considerations, vibrating environment and application would determine when to use an external sensor. For example, if the vibration switch is too large to fit a machine location, consider using a remote accelerometer and an interconnecting cable.

Model 440/450 Designation

Model 440 A - BCDE - FGHI - JKLMN Model 450 A - BCDE - FGHI - JKLMN

Notes:
1 440 units, except those w/ mechanical relays and external transducers carry a CSA label.
2 450 enclosure is coated with epoxy paint. Rated CSA, NEMA 4, Class I, Grps B, C & D; Class II, Grps, E, F & G
3 Special modifications and options will receive an "M" number, assigned by the factory.

A = Single or Dual Trip/Analog Signal Output

S = Single Trip
SR = Single Trip, Analog Signal Output
D = Dual Trip
DR = Dual Trip, Analog Signal Output

B = Analog Signal Output

0 = None
1 = 4-20 mA, dependent
2 = 4-20 mA, absolute
3 = 0-10 Vdc, absolute
4 = 0-10 Vdc, dependent
5 = 0-1 Vdc, absolute
6 = 0-1 Vdc, dependent

C = Scale

0 = 0.1 - 1.5 in/sec
1 = 0.2 - 3.0 in/sec
2 = 3 - 40 mm/sec
3 = 6 - 80 mm/sec
4 = 1 - 15 mils displacement, pk-pk
5 = 10-150 mils displacement, pk-pk
6 = 30 - 400 microns displacement, pk-pk
7 = 0.3 - 4 mm displacement, pk-pk
8* = 0 - 16 Impacts
9* = 0 - 100% of transmitter scale

*NOTE: For use with a 24 Vdc loop-powered transmitter.

D = Shutdown Circuit

0 = Triac, 5A, SPST (for switching heavy AC loads)
2 = 170 mA, 250 Volts, Pk, analog, SPST switch, good selection for use with PLC or DCS
3 = OBSOLETE, .5 Amp SPDT relay (replace w/ x4, 10A SPST relay)
4*= 10A SPDT relay
5 = 10A DPDT relay where A = S or SR only
6 = 1A, 200V pk, Analog Switch
7 = 150 mA, 400 V, pk, Analog Switch

E = Alarm Circuit (Always 0 if A = S or SR)

0 = None
1 = Triac, 5A Standard
2 = 170 mA, 250 Volts Pk, Analog SPST Switch (Use for PLC or DCS)
3 = OBSOLETE, .5 Amp SPDT relay (replace w/ x4, 10A SPST relay)
4 = 10A SPDT relay Alarm Only
5 = OBSOLETE, 2A DPDT Relay, Internal Xducer only
6 = 200V, pk, 1A Analog Switch
7 = 150 mA, 400 V, pk, Analog Switch

F = Enclosure

0 = Standard
1 = OBSOLETE, All 450's have epoxy paint
2 = Pushbutton reset
3 = OBSOLETE, See F = 1 or 2
4 = OBSOLETE, All 450's are Grps B,C & D
5 = Velocity signal out via BNC connector, 278 mV, rms/ips, pk
6 = Pushbutton reset and Velocity out
7 = Acceleration signal out via BNC connector, 100 mV/g
8 = Pushbutton reset and BNC Accel. out

G = Input Power

0 = 115 Vac, 50/60 Hz
1 = 230 Vac, 50/60 Hz
2 = 24 Vdc ± 10%
3 = OBSOLETE, 12 Vdc ± 10%
4 = OBSOLETE, 48 Vac, 50/60 Hz

H = Lockout Function

0 = None
1 = Lockout
2 = 20 sec startup, lockout delay
3 = OBOLETE, 30-90 sec variable startup, lockout delay
4 = OBSOLETE, 24 Vdc enabled lockout, input power must be 24 Vdc

I = Configured for which Transducer

0 = Internal
1 = 160A, FM or E Accelerometer
2 = 258 Velocity Xducer
3 = 260C Piezo-Velocity Xducer
4 = 160A-E X-proof Accelerometer
5 = 165 Constant Current Accelerometer
6 = 258E X-proof velocity Xducer
7 = Other Constant Current 100 mV/g Accelerometer
8* = 24 Vdc loop-power transmitter

*NOTE: Available with 0 to 100% of transmitter input range or 0 to 16 impacts.

J = Other Special

7 = CE mark for 440 only
Leave BLANK if not applicable.

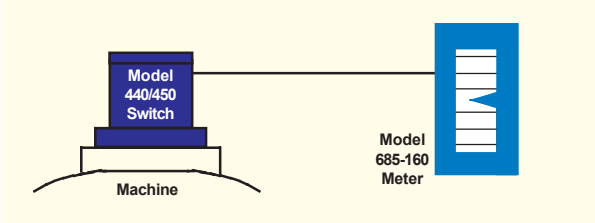
K = Type Scale

0 = 0 to pk
1 = RMS
2 = pk to pk

L, M, N = External Transducer Sensitivity mV/unit use when applicable

Please contact factory for options and pricing.

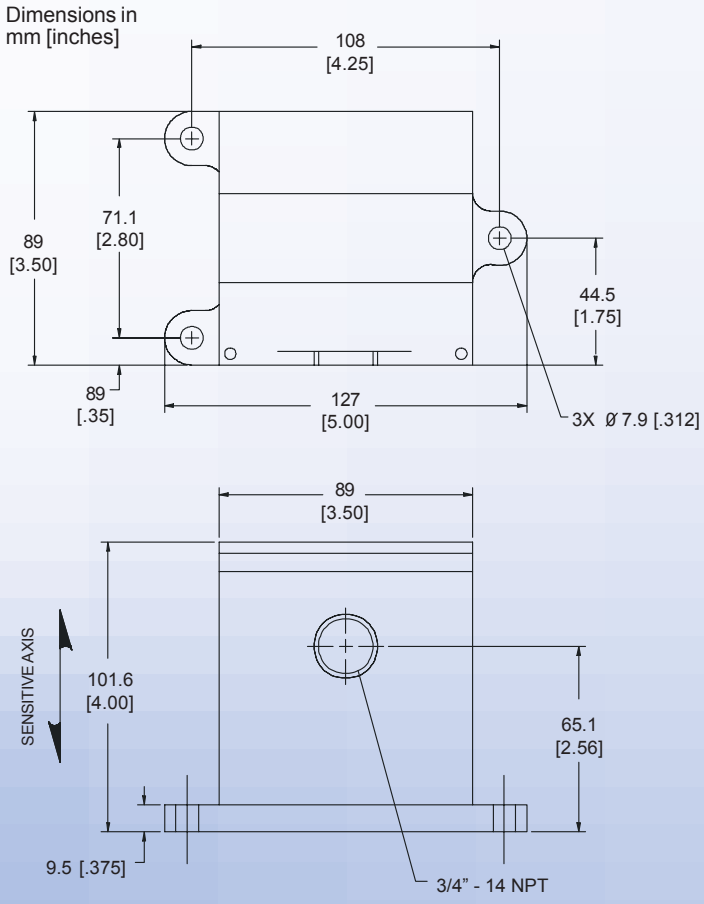
Remote Readout and Remote Transducer Options



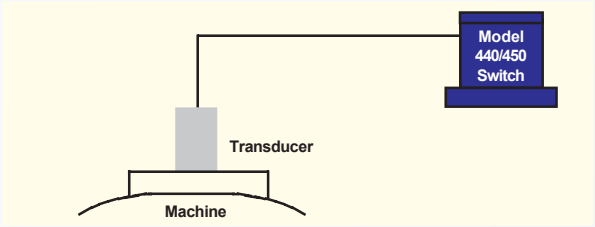
Remote indicator with Model 440/450 vibration switch.

The Model 685-160 meter will provide continuous readings of vibration level from the 4-20 mA analog output of the 440SR or the 440DR. The meter reads from 0 to 160% of shutdown setpoint. The 4-20 mA output can also be used to drive a strip chart recorder or PLC input.

Outline Drawing of Model 440



Weight: 1.6 kg [3.5 lbs]



Remote sensors with Model 440/450.

The standard 440/450 includes a built-in transducer. For some applications, a remotetransducer is desirable as an option in place of the internal transducer. The 440 can then be mounted in any convenient location up to 1,000 feet away. The 440/450 can be configured for up to 2 remote sensors with a variety of input sensors and transmitters.

Available Transducers

- SA6200 Accelerometer, available with two pin MS style connector or integrated cable.
- 258 Velocity Transducer, available with a three pin MS style connector
- SA6350 High Temp. Accelerometer, available with two pin MS style connector
- ST5484E or 162VTS Slim design Velocity Transmitter, available with flying leads, terminal blocks or MS connector

Available Cables

- Two (2) pin socket connector with integral, molded splash proof boot with 6.4 mm (0.25') diameter polyurethane jacketed cable with twisted shielded pair wires. XXX.X = cable length in meters. P/N 8978-111-XXXX Splashproof Cable Assembly
- Two (2) pin socket connector with integral, molded splash proof boot with 7.1 mm (0.28") diameter, SS armored jacket with cable, twisted shielded pair wires. XXX.X = cable length in meters. P/N 9334-111-XXXX Splashproof Cable Assembly w/SS Armor
- Two (2) pin socket connector w/o cable. P/N 8978-200-0000 Connector Assembly
- Three (3) pin socket MS style connector with cable. P/N 031L-XX.

March 2004

METRIX INSTRUMENT CO. PMC/BETA

Machinery Vibration Protection

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Reliability and Innovation since 1965

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