Vibration Switches

For 24/7 Protection of Cooling Towers, Fin Fans, HVAC Systems, Blowers, Motors and Other Critical Machinery
What is a vibration switch?

A vibration switch is a device that (1) recognizes the amplitude of the vibration to which it is exposed and (2) provides some sort of response when this amplitude exceeds a predetermined threshold value. The switch response is typically an electrical contact closure or contact opening. The electrical contact may be either an electromechanical relay or solid-state triac.

Why use a vibration switch?

Vibration switches are primarily used for protecting critical machinery from costly destructive failure by initiating an alarm or shutdown when excessive vibration of the machinery is detected. Conversely, a vibration switch can be utilized to warn of the absence of vibration, such as when a conveyor ceases to function due to a broken drive belt.

Vibration switches offered by IMI Sensors

Highlighted in this brochure are two common categories of vibration switches – electronic and mechanical. In general, electronic vibration switches offer more precision than mechanical switches.

Electronic switches require power to operate and utilize an input signal that is provided by an electronic vibration sensor, or accelerometer. This sensor may be built into the switch enclosure, or remotely located. A remote sensor is advantageous when the vibration switch enclosure will not fit within the installation location, or if the temperature at the installation location exceeds the capability of the switch’s electronic components. The amplitude of the electrical signal generated by the sensor is proportional to the experienced vibration. Circuitry within the switch compares this signal amplitude against a predetermined threshold value.

Mechanical switches do not require power and utilize the resistive force and travel of a spring as a measure of vibration amplitude. When the travel of a spring exceeds the predetermined threshold, the switch is actuated and latched by magnetic attraction. The threshold value is adjustable by changing the proximity of the magnet to the spring and hence the spring travel required for actuation. Switch reset is accomplished manually by disengaging the magnet from the spring.

Series 685B: Electronic, AC or DC power, dual switches

This precision electronic vibration switch is AC or DC powered, utilizes an on-board or remote accelerometer, provides two relay or triac outputs, generates a 4-20 mA vibration output signal, and offers an analog vibration signal for FFT analysis and fault diagnostics.

Series 686A: Electronic, universal power, single switch

This revolutionary two-wire electronic switch offers the simplicity of a mechanical switch with the precision of an electronic switch. The unit operates from universal power that is scavenged from a load’s power source. It is microprocessor controlled, has a built-in accelerometer, installs easily with a single stud, and has the smallest footprint of any vibration switch on the market.

Series 685AX1: Electronic, DC power, single switch

This general-purpose electronic vibration switch is DC powered, utilizes an on-board accelerometer, and offers a single, 5-amp, Form C relay output.

Series 685: Mechanical, single switch

This mechanical vibration switch is available in either in a NEMA 4 (IP66) or explosion proof housing, and offers a single, 5-amp, Form C relay output.
Series 685B Electronic Vibration Switch

- Offers two set points with individual alert and alarm relays
- 4-20 mA output signal for vibration monitoring
- Analog, 100 mV/g output signal for fault diagnostics
- Utilizes built-in or remote vibration sensor
- Choice of AC or DC power
- Adjustable time delay
- Accepts 4-20 mA calibrator input signal for accurate threshold value set-up
- Optional adaptors for retrofitting existing switch installations
- Explosion proof models available (contact factory for details)

Specifications

<table>
<thead>
<tr>
<th>Series 685B</th>
<th>Performance</th>
<th>English</th>
<th>SI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement Range</td>
<td>see model matrix</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency Range (± 3 dB)</td>
<td>120 to 60k cpm</td>
<td>2 to 1000 Hz</td>
<td></td>
</tr>
<tr>
<td>Threshold Set Point (alarm)</td>
<td>10 to 100% FS measurement range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Threshold Set Point (alert)</td>
<td>10 to 100% of Alarm Set Point</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay Time Delay (both relays)</td>
<td>0 to 45 Seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start-up Delay</td>
<td>20 Seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay Action (switch selectable)</td>
<td>latching or non-latching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output (Analog Vibration Signal)</td>
<td>100 mV/g</td>
<td>10.2 mV/(m/s²)</td>
<td></td>
</tr>
<tr>
<td>Output (Proportional to Range)</td>
<td>4-20 mA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Environmental

- Operating Temperature Range | -22 to +158 °F | -30 to +70 °C |
- Storage Temperature Range | -40 to +257 °F | -40 to +125 °C |
- Enclosure Rating | NEMA 4X | IP66 |
- Hazardous Area Approval* | Class 1 Div 1 & Class 1 Div 2 |

Electrical

- Power Supply Requirement | see model matrix |
- Current Draw | < 150 mA |
- Integral Sensor Type | piezoelectric accelerometer |
- Remote Sensor Option | see model matrix |
- Wire Size for Screw Terminals | 24 to 14 AWG | 0.2 to 2.5 mm |
- Enclosure Ports | see model matrix |
- Mounting Holes | 0.21 inch | 5.4 mm |

Indicators/Controls

- Power-on LED | green |
- Alert LED | yellow |
- Alarm LED | red |
- Alarm Set Point Adjustment | single turn potentiometer |
- Reset Function | internal momentary push button or remote contact closure |
- Relay Latch Selection Option | internal slide switch |
- Normally Open | |
- Normally Closed Option | internal slide switch |

Optional Accessory

- Model 080A209 adaptor plate for retrofit of existing switch installations |

* Hazardous area approval available for some configurations. Contact factory for details.
Series 686A Smart Vibration Switch

- Smallest footprint of any vibration switch
- Offers one set point with solid-state relay
- Utilizes built-in vibration sensor
- Microprocessor controlled
- AC or DC powered
- Magnetically Adjustable Vibration Threshold (MAVT™) automatically sets trip level
- Installs using same mounting technique as conventional vibration sensors
- Connects with industry standard MIL-C-5015 connector or integral cable
- Patent pending
- USB programmable parameters

Specifications

<table>
<thead>
<tr>
<th>Series 686A</th>
<th>Performance</th>
<th>English</th>
<th>SI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement Range</td>
<td>see model matrix</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency Range (± 3 dB)</td>
<td>180 to 60k cpm</td>
<td>3 to 1000 Hz</td>
<td></td>
</tr>
<tr>
<td>Threshold Range</td>
<td>0.25 to 6.0 ips pk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Threshold Hysteresis</td>
<td>6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm Time Delay (selectable, see matrix)</td>
<td>3 to 12 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay Action (selectable, see matrix)</td>
<td>latching or non-latching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start Up Delay (if selected, see matrix)</td>
<td>20 ± 5 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power On Delay (fixed, all versions)</td>
<td>20 ± 5 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transverse Sensitivity</td>
<td>&lt; 3%</td>
<td></td>
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</tbody>
</table>

Environmental

- Operating Temperature Range: -40 to +185 °F, -40 to +85 °C

Electrical

- Power Required: 24 to 240 VDC or VAC
- Leak Current in Open Condition: 1 mA
- Sensor Type: piezoelectric accelerometer
- Relay Type and Contact Capacity: SPST Form A or B, N.O. or N.C., 24 to 240 VAC or VDC @ 0.5 Amp

Physical

- Housing Material: 316 stainless steel
- Sealing: welded hermetic
- Electrical Connectors: see model matrix
- Mounting Thread: 1/4-28 female
- Size (hex × height): 1.25 × 2.5 inch, 63.5 mm
- Weight: 7 oz, 198 gm

Supplied Accessories

- Model 081A40 mounting stud
- 1/4-28 male to 1/4-28 female

Example

686A 1 00 06 3 1 Smart, two-wire, electronic vibration switch
Series 686A Operating Principle

The Series 686A Smart Vibration Switch operates over just two wires. It installs in series with any load, which can be an annunciator, PLC, or relay coil. To energize itself, the vibration switch scavenges power from the load’s power source. When a threshold exceedance is encountered, the switch is activated and the load’s power circuit is completed to facilitate the desired alarm or shutdown.

Benefits of Solid State Relays

A solid state relay is an electronic component that functions in the same way as an electromechanical relay, but without any moving parts. A solid state relay offers the most reliable switch action, especially for vibration applications where moving relay components run a greater risk of malfunction. They are purely electronic devices composed of a low current control side and a high current load side for switching action.

What is MAVT™?

Magnetically Adjustable Vibration Threshold (MAVT)™ is an optional feature of the Series 686A smart vibration switch that permits the set threshold value to be adjusted at the switch’s installation location or in a calibration laboratory. The Series 686A has no accessible mechanical adjustments, such as screw pots, that are found on other style electronic vibration switches, however, when fitted with the MAVT™ option the 686A becomes adjustable through magnetic actuation. By exposing a specified location on the housing to a strong magnetic field, an internal switch is actuated, which initiates a test sequence within the unit’s microprocessor. For a 30-second period of time, the unit will measure the vibration amplitude to which it is exposed and then determine the average vibration value (x). This average value is then doubled (2x) and the threshold value is then automatically set to this 2x value. This convenient feature permits any machine to become vibration switch protected within seconds and without hassle. For a more accurate adjustment, the 686A can be mounted to a vibrating shaker to set its threshold value at 2x the known input vibration that is delivered by the shaker.
Series 685AX1 Electronic Vibration Switch

- Utilizes built-in vibration sensor
- Offers one set point with electromechanical relay
- DC powered
- Fixed time delay

Specifications

<table>
<thead>
<tr>
<th>Series 685A</th>
<th>Performance</th>
<th>English</th>
<th>SI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement Range</td>
<td>see model matrix</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency Range (± 3 dB)</td>
<td>180 to 60k cpm</td>
<td>3 to 1000 Hz</td>
<td></td>
</tr>
<tr>
<td>Set Point Adjust (single alarm)</td>
<td>10 to 100% FS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm Time Delay (fixed)</td>
<td>5 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay Action (switch selectable)</td>
<td>latching or non-latching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start Up Delay (fixed)</td>
<td>3 seconds</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Environmental

- Operating Temperature Range: -13 to +158 °F (-25 to +70 °C)
- Storage Temperature Range: -40 to +257 °F (-40 to +125 °C)
- Enclosure Rating: NEMA 4X

Electrical

- Power Required: 10 to 30 VDC
- Current Draw: <100 mA
- Sensor Type (built-in): piezoelectric accelerometer
- Relay Type: electromechanical relay
- Switch Contact Capacity: see model matrix

Physical

- Housing Material: Aluminum alloy
- Electrical Connections: power, alarm, remote reset
- Electrical Connectors: removable screw terminals
- Wire Size (accommodated by screw terminals): 24 to 14 AWG, 0.2 to 2.5 mm²
- Enclosure Ports: (2 places) 1/2 inch NPT
- Mounting Holes Diameter (2 places): 0.310 inch (7.9 mm)
- Size (w × h × d): 5.1 × 3.0 × 4.0 inch (130 × 76.2 × 102 mm)
- Weight: 1.4 lb (635 gm)

Indicators/Controls

- Power-on LED: green
- Alarm LED: red
- Alarm Set Point Adjustment: single turn potentiometer
- Reset Function: internal momentary push button or remote contact closure
- Latching/Non-latching Selection: slide switch
- NO/NC Select: slide switch

How to Order

Series 685AX1

Electronic Vibration Switch with one set point relay, internal reset pushbutton, and remote reset via contact closure, 10 to 30 VDC powered.

Version

- 01: 0 to 10 g (98.1 m/s²) pk measurement range.
  - HI set point with 5 Amp Form C relay (230 VAC/30 VDC).
  - 10 g vibration limit for N.O. contact setting, 5 g vibration limit for N.C. contact setting.
- 10: 0 to 10 g (98.1 m/s²) pk measurement range.
  - HI set point with 5 Amp Form C relay (230 VAC/30 VDC).
  - 10 g vibration limit for N.O. contact setting, 5 g vibration limit for N.C. contact setting.
- 20: 0 to 10 g (98.1 m/s²) pk measurement range.
  - HI set point with 5 Amp Form C relay (230 VAC/30 VDC).
  - 10 g vibration limit for N.O. or N.C. contact setting.
- 30: 0 to 10 g (98.1 m/s²) pk measurement range.
  - HI set point with 1 Amp Form C relay (230 VAC/30 VDC).
  - 10 g vibration limit for N.O. or N.C. contact setting.
- 40: 0 to 10 g (98.1 m/s²) pk measurement range.
  - HI set point with 1 Amp Form C relay (230 VAC/30 VDC).
  - 20 g vibration limit for N.O. or N.C. contact setting.
- 50: 0 to 10 g (98.1 m/s²) pk measurement range.
  - HI set point with 1 Amp Form C relay (230 VAC/30 VDC).
  - 20 g vibration limit for N.O. or N.C. contact setting.
- 60: 0 to 10 g (98.1 m/s²) pk measurement range.
  - HI set point with 1 Amp Form C relay (230 VAC/30 VDC).
  - 20 g vibration limit for N.O. or N.C. contact setting.

Example

685A 01 Electronic vibration switch with 0 to 10 g pk measurement range HI set point relay with 5 Amp, Form C contacts, 10 to 30 VDC powered.

Relay Switch Configurations

- Form A contacts are also called N.O. (Normally Open) contacts or make contacts. Form A contacts are based on a SPST switch that is wired in a normally open state.

- Form B contacts are also called N.C. (Normally Closed) contacts or break contacts. Form B contacts are based on a SPST switch that is wired in a normally closed state.

- Form C contacts are also called changeover contacts or transfer contacts. Form C contacts are based on a SPDT switch that can be independently wired in either a normally open state or normally closed state by the user. It is also possible to utilize both states simultaneously.

A TRIAC is a bidirectional electronic switch which can conduct current in either direction when it is triggered by either a positive or a negative voltage. The TRIAC can be configured as a Form A or Form B switch, however, it is only suitable for switching AC voltages.
# Mechanical Vibration Switches

- Offers cost effective protection for less critical situations
- Utilizes spring-loaded, magnetically coupled sensor
- Provides single set point electromechanical relay
- Requires no power
- Weatherproof and explosion proof versions

## Specifications

<table>
<thead>
<tr>
<th>Models</th>
<th>685A07</th>
<th>685A08</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td><strong>English</strong></td>
<td><strong>SI</strong></td>
</tr>
<tr>
<td>Vibration Range (FS) pk</td>
<td>0 to 7 g</td>
<td>0 to 68.7 m/s²</td>
</tr>
<tr>
<td>Frequency Range</td>
<td>120 to 60k cpm</td>
<td>0 to 100 Hz</td>
</tr>
<tr>
<td>Threshold Set Point (single alarm)</td>
<td>10 to 100% FS</td>
<td>10 to 100% FS</td>
</tr>
<tr>
<td>Relay Action</td>
<td>latching</td>
<td>latching</td>
</tr>
</tbody>
</table>

| **Environmental** | N/A | class I, div 1, groups C and D |
| **Operating Temperature Range** | -40 to +140 °F | -40 to +60 °C |
| **Enclosure Rating** | NEMA 4X | IP66 |
| **Hazardous Area Approval** | N/A | class 1, div 1, groups C and D |

| **Electrical** | **English** | **SI** | **English** | **SI** |
| Power Required | none | none |
| Sensor Type (built-in) | spring loaded magnet | spring loaded magnet |
| Relay Type | Form C, electromechanical relay | Form C, electromechanical relay |
| Switch Contact Capacity | 5 Amp, 480 VAC | 2 Amp, 30 VDC |

| **Physical** | **English** | **SI** | **English** | **SI** |
| Housing Material | aluminum alloy | aluminum alloy |
| Electrical Connections | alarm | alarm |
| Electrical Connectors | screw terminals | screw terminals |
| Wire Size (screw terminals) | 24 to 14 AWG | 0.2 to 2.5 mm² | 24 to 14 AWG | 0.2 to 2.5 mm² |
| Enclosure Ports (1 place) | 3/4-14 NPT | 3/4-14 NPT |
| Mounting Holes (4 places) | 0.25 inch | 6.4 mm | 0.375 inch | 10 mm |
| Size (w x h x d) | 4.35x3.35x4.35 inch | 110.5x83.8x110.5 mm | 4.375x4.875x5.625 inch | 110.5x124x143 mm |
| Weight | 2.1 lb | 953 gm | 5.5 lb | 2200 gm |

| **Indicators/Controls** | **English** | **SI** | **English** | **SI** |
| Alarm Set Point Adjustment | control screw | control screw |
| Reset Function | push button switch | push button switch |

© Mechanical Vibration Switches

For machines requiring simplified contact closure protection, Models 685A07 and 685A08 offer a cost-effective approach to vibration protection. They offer the smallest mechanical switch footprint available in either NEMA 4 or explosion proof housings. The three axis protection allows confident, reliable monitoring of small plant equipment in less critical situations, where the precision of an electronic switch isn’t necessarily required. Both the weatherproof and explosion proof versions contain manual internal adjustability with an external reset switch for ease of operation.
The IMI Sensors Division of PCB® Piezotronics, Inc. specializes in the development, application, and support of industrial vibration sensors, transmitters, meters, and accessories for machinery condition monitoring and predictive maintenance requirements. This product focus, coupled with the strengths and resources of PCB®, permits the IMI Sensors division to offer exceptional customer service, 24-hour technical assistance, and a Total Customer Satisfaction guarantee.

Visit [www.imi-sensors.com](http://www.imi-sensors.com) to locate your nearest sales office.

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**Series 682A06 Universal Transmitter**
- Provides loop power for two-wire, 4-20 mA sensors and transmitters
- Accepts mA, VDC, RTD, TC, linear resistance, and potentiometer inputs
- Delivers current and voltage output signals
- Offers two set points with Form A relay outputs (2 amp AC, 1 amp DC)
- Fully programmable via detachable pushbutton display (Model 070A80)
- Operates from 19.2 to 300 VDC or 21.5 to 253 VAC power

**Model 682A05 Bearing Fault Detector**
- Provides early warning of bearing and gear faults
- Detects impacting associated with spalling, cracking, and lubrication problems
- Outputs 4-20 mA signals for peak acceleration and overall vibration
- Operates with PLC, DCS, SCADA, alarm, and control systems
- Offers analog output signal for spectral analysis and diagnostics
- Conducts continuous vibration monitoring — 24/7
- Accepts input from ICP® accelerometers
- Patented technology (US Patent No. 6,889,553)
- Easy to install

**Model 682A03 Vibration Transmitter**
- Provides ICP® sensor excitation
- Adjustable low-pass and high-pass filtering
- Peak or rms proportional output
- Selectable acceleration, velocity, or displacement output signal
- 24 VDC powered
- Optional 4-20 mA temperature output

**Model 699A04 Portable Calibration Shaker**
- Fully integrated vibration exciter with adjustability and digital readout
- Choice of acceleration, velocity, or displacement modes
- Variable frequency
- Variable amplitude
- Built-in NIST-traceable reference accelerometer
- 110 to 220 VAC 50 to 60 Hz powered

**Model 699A05 Portable 4-20 mA Loop Calibrator**
- Provides both transmitter readout and transmitter simulation functionality
- Powers two-wire transmitters and displays transmitter output current
- Simulates a two-wire transmitter and provides output current for testing readout or control devices
- Easy-to-read, high-contrast display
- Pocket sized portability and includes belt clip