Vibration Monitor

1-WIRE® Sensor Bus

mVM001

mVM001
Vibration Sensor
Technical Manual

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Revision Notes

First Release – February 5, 2009

Revision A – May 12, 2009

- Minor revisions to text

Revision B – May 9, 2011

- Add installation diagram

1. Overview

The mVM001 Vibration Sensor measures both the RMS and peak vibration levels in a single axis. The unit incorporates a MEMS accelerometer capable of measuring peak velocities up to 2.5KHz. The sensor is mounted in a stainless steel housing and mounts with an industry standard ¼" x 28 fine thread stud. The sensor is fully temperature compensated.

Each sensor has a unique digital serial number and will be automatically recognized by CMCIEL Bus Converters. Communications utilize the Dallas 1-Wire® bus standard. Power for the sensor is supplied by the bus system.

The sensors are packaged in a stainless housing utilizing a fully potted construction. Each sensor comes complete with 2 meters of heavy-duty industrial cable rated for use in direct sunlight. The cable is terminated with an RJ-11 connector for direct connection to CMCIEL wiring accessories. The housing incorporates a ½" female conduit fitting for attaching liquid tight conduit.

When used with the mBC081 Bus Converter the device is Intrinsically Safe.

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2. Description of Indicators

Figure 1 - Illustration of Indicators

The sensor requires no settings. There is one indicator lamp:

Description	Color	Flash Rate	Operation
Status	Green	1	Ok, no communications
		2	Ok, communication active
		3	Power on self test fault
		4	Calibration parameter fault
		5	Firmware fault
		6	Serial number fault

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3. Installation

The vibration sensor measures movement through its vertical access. The sensor is mounted to a ¼" x 28 fine thread stud. The stud must not penetrate the sensor body by more than 0.4"; locknuts should be used on longer mounts. The mount should be securely attached to the device being monitored.

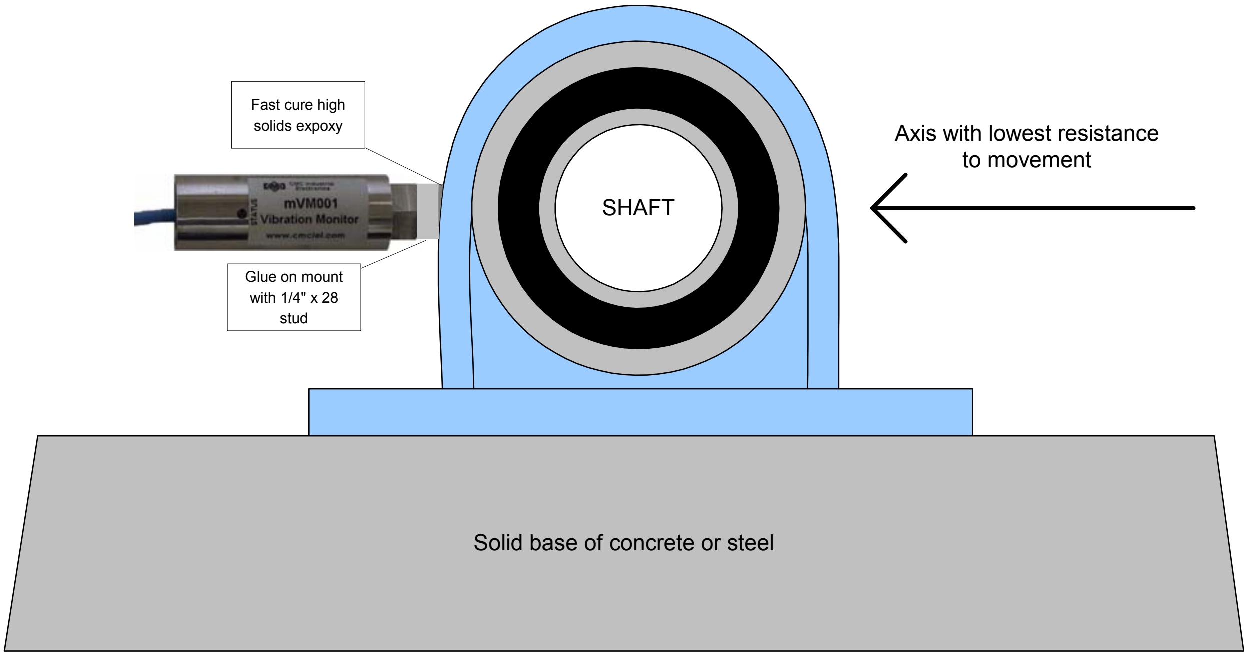

Figure 2 – Application of Force

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When selecting a point on the device to measure, attention should be given to the devices mounting. The best readings are obtained from the weakest point of mounting. For example if a motor were mounted to a concrete or steel pad at the bottom, the top of the motor would not be the best location for the sensor. Either side of the motor would provide greater movement and provide better readings.

An analysis of the device to be monitored by a vibration analysis expert is advised to obtain the best data from the sensor. More than one sensor may be needed for machines that have vibration in multiple axes.

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4. Digital Signal Processing

The sensor has two software algorithms to calculate the vibration. The purpose of the sensor is to provide baseline readings of a machines vibration that can be monitored over time. Any significant changes in the readings indicate that something has changed with the machinery. Changes in RMS vibration would most likely be related to machine balance. Changes in peak readings would likely indicate metal to metal contact or a serious impeding fault with a machines bearings.

The first algorithm is a standard RMS calculation that provides the average vibration applied to the sensor over a wide range of frequencies and waveforms. Samples are collected for 100 milliseconds and then the root mean square is taken for all of the samples. This method of averaging provides the best average calculation for complex vibration waveforms.

The second algorithm is a unique peak detector system that measures the largest sensed velocity over a sample period. The default setting for this period is 500 microseconds. The period can be adjusted using the CMCIEL configuration software tool for the mVM001. Larger peak period values will detect peak movements that occur at a slower rate. The peak value interval timer can be set in 100 microsecond increments. The default setting for the peak interval timer is 5.
The sensors output has been calibrated under the following conditions:

Mode	**Waveform**	**Frequency**	**Velocity**
RMS	Sine	100 HZ	2.00 ips
Peak	Square	100 Hz	2.00 ips

The sensors value is provided in a single 16 bit integer value with a 0.00 implied decimal point. An integer value of 100 represents 1.00 ips of velocity. The sensor can be configured to read RMS velocity, peak velocity or both using multiplexing.

If the sensor is setup to read a single value, either RMS or peak, the value will be a single integer with implied decimal point, with no multiplex bits present.

If multiplexed mode is selected, The multiplex bits are 14 and 15. The value is contained in the remaining 14 bits with the same implied decimal point as the non-multiplexed values. In multiplex mode the 16 bit value is decoded using the following table:

Value	**Bit 14**	**Bit 15**
Peak	0	1
RMS	1	1

If bit 15 is 0, then the sensor is configured for non-multiplexed output in either RMS or peak output.

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5. Communications

The mVM001 Vibration Sensor is a fully compliant Dallas 1-Wire® device. The sensor is supplied with 2m of cable terminated with a RJ-11 plug. The sensor connects to the CMCIEL wiring system through a CMCIEL Field Interconnect.

The output of the sensor is a single signed 16 bit word. The resolution is 0.01% inches per second and the range is 0.0 – 15.00 ips.

The sensor requires a bus converter to convert the Dallas 1-Wire® signaling system to a system recognized by commercial programmable controllers. The Bus Converters provide a Modbus485 RTU interface. CMCIEL manufactures Bus Converters for both commercial and hazardous areas. The vibration value in inches per second, with 2 implied decimal places, is represented as a single signed word in the Bus Converter Modbus register map. See section 4 for information on the values presented. The Bus Converters will automatically acquire the serial number of the sensor on request.

As a Dallas 1-Wire® device, the sensor value is returned using the read scratch function as 3 bytes, the first 2 bytes a signed word containing the process value and the 3rd byte the Dallas 1-Wire® - 8 bit CRC. The family code for the sensor is 161 decimal or A1 Hex. The sensor responds to the following Dallas function codes:

Code Decimal	**Code Hex**	**Function**
240	F0	Search ROM
85	55	Match ROM
15	0F	Read ROM
51	33	Read ROM
204	CC	Skip ROM
190	BE	Read Scratch, 3 bytes, low byte + high byte + Dallas 8 bit CRC

Refer to Dallas Semiconductor documentation for complete details on the operation of the Dallas 1-Wire® signaling system.

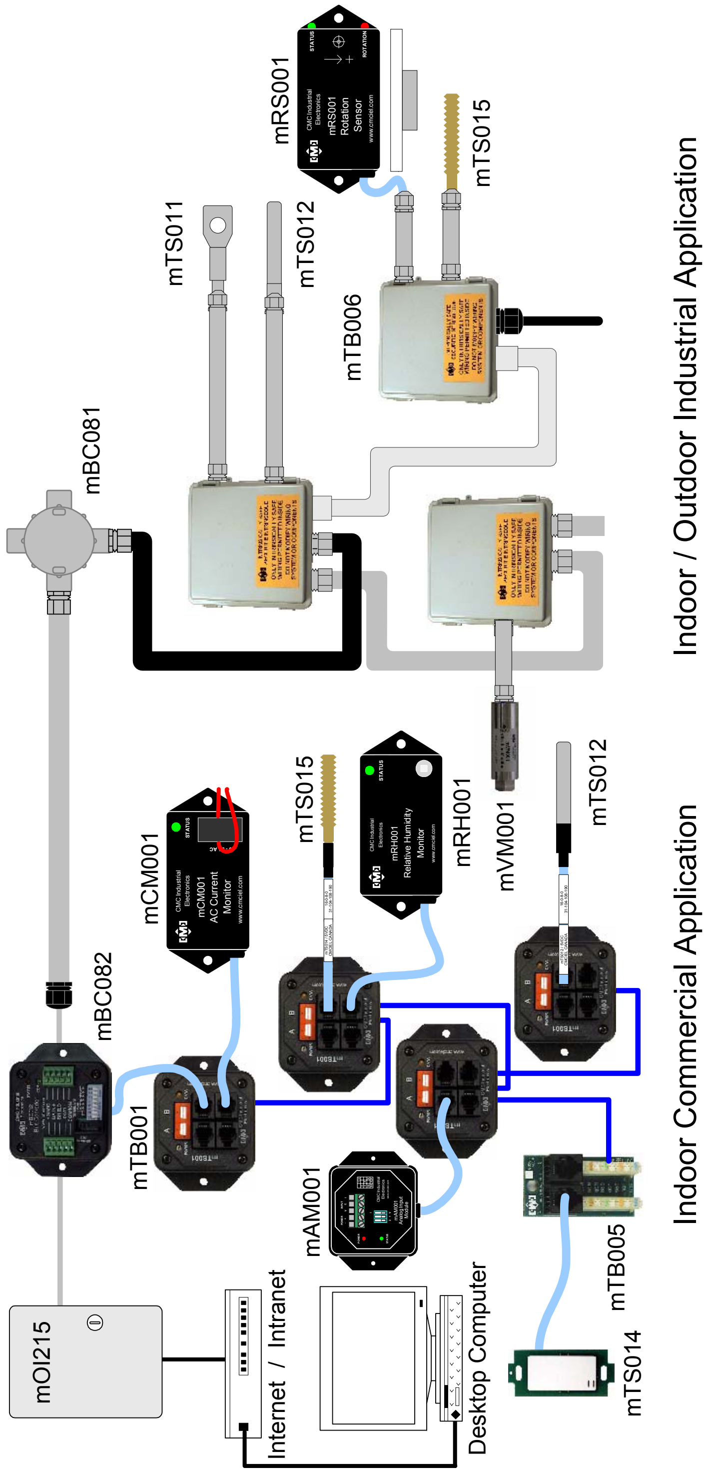

Figure 4 - Typical Network Layout

6. Specifications

Description	Characteristic
Sensor bus	
Voltage	5 VDC
Current	3.0 mA max
Communications	1-Wire® Bus
Output	
RMS Velocity	0 - 15 in/sec
Peak velocity	0 - 15 in/sec
Resolution	0.01 in/sec
Accuracy	Calibrated to 2.00 in/sec @ 100hz ± 5%
Environment	
Temperature	-40 to 70°C (-40 to 165°F)
Relative Humidity	0 to 100% non-condensing
Dimensions	
Length	80 mm (3.125 in)
Body diameter	26 mm (1.000 in)
Base diameter	22 mm (0.850 in)
Mounting	¼"x28NF threaded hole, maximum penetration is 0.400"

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