

Machine Condition Transmitter™ (MCT) CMSS530(A) and CMSS590(A)

SKF Condition Monitoring

User Manual Part No. 31871000-EN

Revision A

User Manual

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The MACHINE CONDITION TRANSMITTER is guaranteed free of defects in material and workmanship.

Electronic components are guaranteed for a period of twelve (12) months, mechanical components, transducers, and cable assemblies are guaranteed for a period of ninety (90) days. The warranty period begins on the date the system is shipped from the SKF Condition Monitoring factory.

This warranty does not extend to units that have been misused, altered, or repaired without manufacturer's authorization. Defects or failures

experienced during the warranty period will be corrected at no charge at the manufacturer's facility. If, upon examination, it is found that the defect is not within the scope of this warranty, an estimate of repair charges and a request for authorization to proceed with repair will be submitted, along with a statement of the reasons the repairs are not considered to be covered by the warranty.

This warranty does not extend to system components such as transducers, drivers, and cable assemblies manufactured by others. Warranty for these components will be their manufacturer's standard.

Manufacturer's liability under this warranty is limited to repair or replacement of any defective instrument at the discretion of the manufacturer.

In the event that any of the above limitations are held unenforceable, our liability to you shall not exceed the license fee you paid, regardless of the form of any claim. Because of the extreme diversity of ways that the product can be used, you are advised to test the product thoroughly for your purposes before relying on it.

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Machine Condition Transmitter (MCT)

SKF Reliability Systems' Machine Condition Transmitter (MCT) modules are compact rail-mounted devices that convert part of a wide-band input signal to a signal proportional to machine vibration.

The MCT Transmitter

There are two MCT versions, **CMSS530** is a 4-20 mA velocity transmitter, and **CMSS590** is an enveloped acceleration transmitter. Each is factory configured for use with a low-impedance accelerometer. The velocity transmitter can also be configured for use with a low-impedance velocity sensor, or electro-mechanical velocity sensor. The sensor input signal is processed to determine its overall vibration level in terms of either velocity (RMS or Peak) or enveloped acceleration. Output is a standard 4-20 mA current proportional to this level, within a specified full range such as 0-1 IPS RMS for velocity, or 0-10 gE for enveloped acceleration. The 4-20 mA output is suitable for a direct connection to a Programmable Logic Controller (PLC) or Distributed Control System (DCS). A BNC connector on the front of the unit provides access to the buffered transducer signal for use with portable monitoring equipment, such as the SKF Reliability Systems' MicrologTM.

Machine Condition Transmitter (MCT)
The MCT Transmitter

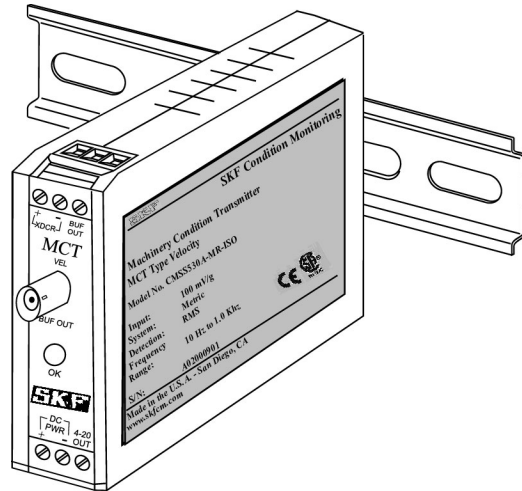


Figure 1 - 1.
The MCT – Transmitter.

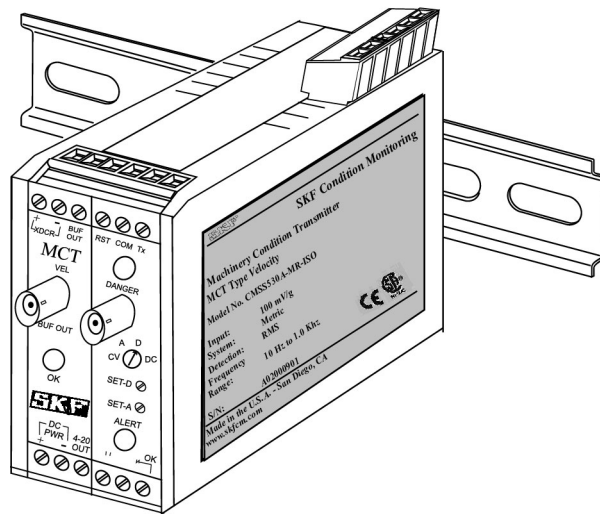


Figure 1 - 2.
The MCT – Transmitter/Monitor.

The MCT Monitor

CMSS530-	Velocity Transmitter without Monitor
CMSS530A	Velocity Transmitter with Monitor
CMSS590-	Enveloped Acceleration Transmitter without Monitor
CMSS90A	Enveloped Acceleration Transmitter with Monitor

Table 1 - 1.
MCT Module Configurations.

MCT modules can be ordered as stand alone Monitors by adding the suffix "A" to the basic model number (i.e., **CMSS530A** and **CMSS590A**). When ordered as a stand alone monitor, the unit includes an alarm module front panel and an output relay that can be jumper configured for either latching or non-latching operation. The **ALERT** or **DANGER** LED will turn "ON" and the corresponding relay will actuate whenever overall vibration levels exceed the corresponding setpoint for more than a preset delay time (jumper selectable). The alarm module has a front panel accessible BNC connector and associated selector switch for reading the analog current vibration level (**CV**) or alarm setpoints (**A** or **D**) with a standard digital voltmeter. The alarm module also provides a transducer **OK** relay contact, and a trip multiply function (**Tx**). Trip multiply allows the alarm levels to be temporarily increased by a factor of two or three to avoid false alarms, for example, during the start-up phase of a machine.

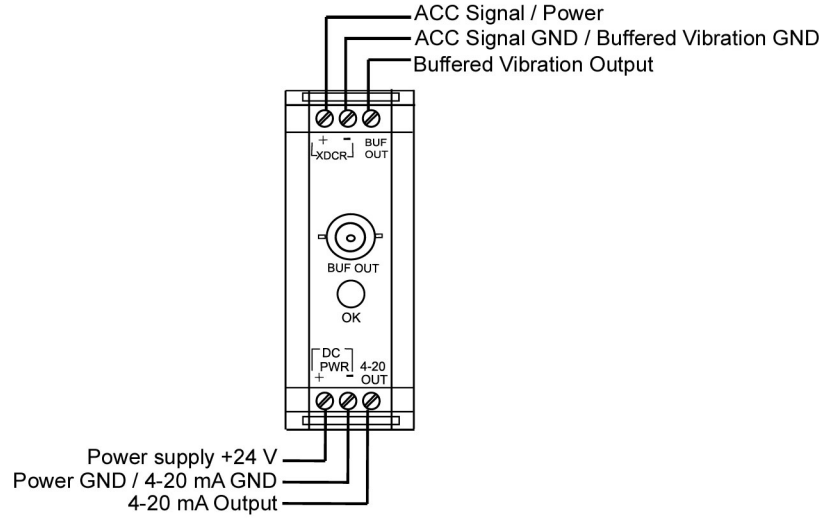


Figure 1 - 3.
 MCT Transmitter General Pin Assignment.

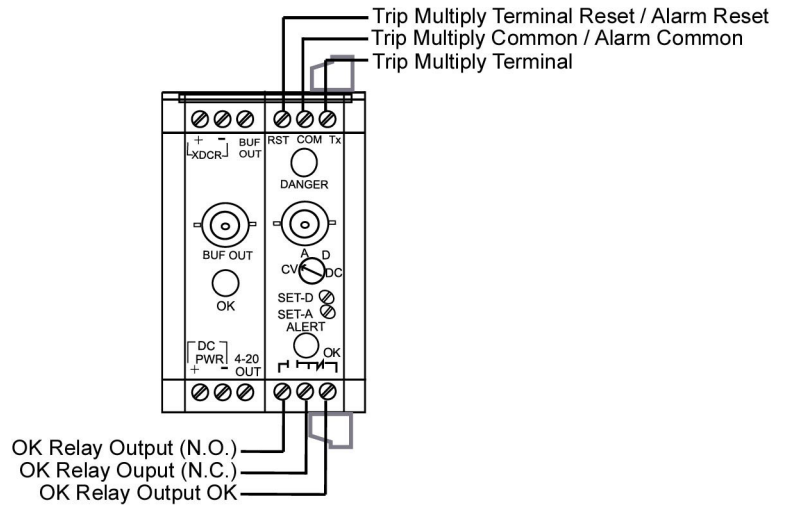


Figure 1 - 4.
 MCT Transmitter / Monitor General Pin Assignment.

Machine Condition Transmitter (MCT) Identification Label

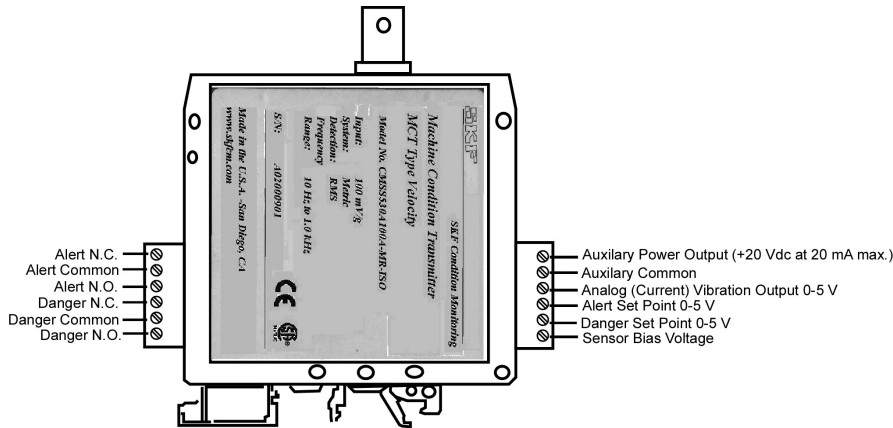


Figure 1 - 5.
MCT Transmitter / Monitor Top and Bottom Pluggable Terminals.

- Both monitors and transmitters mount on standard DIN rail.
- For more information concerning the alarm settings, reference **Setting Monitor Alarms** in **Chapter 2**.

Identification Label

An identification label on the right side of the module provides information about the module type including a unique model number identifying data of the module's basic configuration, such as the factory configured sensor type, the measurement method and the installed filter characteristics.

For example:

Standard Units

CMSS530A100A-ER-ISO

Velocity
Transmitter

100 mV/g
Input
Sensitivity

A: with Monitor
- : without Monitor

E: English (IPS), RMS Detection
M: Metric (mm/sec), RMS Detection

ISO: Standard 10 Hz to 1 KHz
ISOLF: Low Frequency 2 Hz to 2 KHz

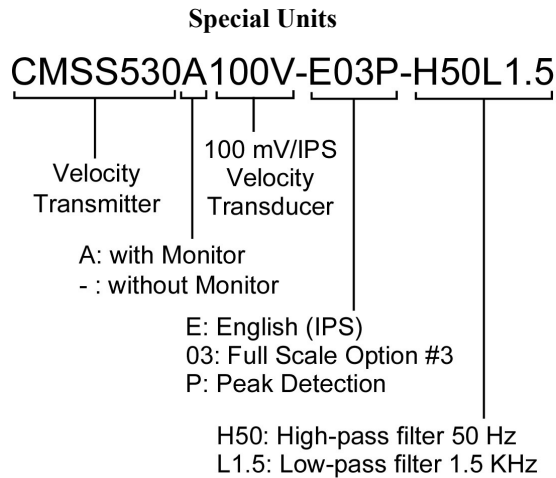
CMSS590A100A

Enveloped
Acceleration
Transmitter

100 mV/g
Input
Sensitivity

A: with Monitor
- : without Monitor

- Each enveloped acceleration transmitter provides three band-pass filters. Reference Table 2-1 for details.



The unique serial number identifies individual transmitters and is used for warranty, quality control, and service purposes. The label also has the CSA and CE approval marks.

Full Scale Range

Preset Options

The MCT comes factory with the most common full scale range. Other ranges may be implemented by installing jumpers as shown in Tables 1-2 and 1-3.

- See **Opening the Case** in **Chapter 2** for information on gaining access to jumpers. Changing ranges by jumper selection only will introduce an additional error of .5% typical, 2% max. For greater accuracy, the system range must be re-calibrated.

Range:	Full Scale:		Jumper
	English	Metric	
01	.5 IPS	12.5 mm/sec	E2
02*	1.0 IPS	25 mm/sec	E3
03	1.5 IPS	37.5 mm/sec	E2 and E3
04	2.0 IPS	50 mm/sec	E3 and E4
05	2.5 IPS	62.5 mm/sec	E2 and E3 and E4

Table 1 - 2.
MCT VEL.

- Full scale option for all velocity transmitter units is factory preset to 02, for 0 to 1.0 IPS or to 25.0 mm/sec if not otherwise specified in the model number.

Range:	Full Scale:	Jumper
01*	10 gE	E8
02	30 gE	E9
03	80 gE	E10

Table 1 - 3.
MCT ENV.

- Full scale option for all enveloped acceleration transmitter units is factory preset to 10 gE. The Filter option is set to Filter 3 (500 Hz to 10 Hz), unless otherwise specified in the model number.
- In the tables above, * indicates the factory preset range.

Jumper Locations



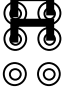




Setting	Jumper	Configuration
Range Settings		
E2 E3 E4		E2 0 to 0.5 IPS or 12.5 mm/sec Option: 01
E2 E3 E4		E3 0 to 1.0 IPS or 25.0 mm/sec /*factory preset Option: 02
E2 E3 E4		E2 and E3 0 to 1.5 IPS or 37.5 mm/sec Option: 03
E2 E3 E4		E3 and E4 0 to 2.0 IPS or 50.0 mm/sec Option: 04
E2 E3 E4		E3 and E4 and E5 0 to 2.5 IPS or 62.5 mm/sec Option: 05
Special Filters		
E1		Remove to install Filter 1
E5		Remove to install Filter 2

Table 1 - 4.
MCT Velocity Options.

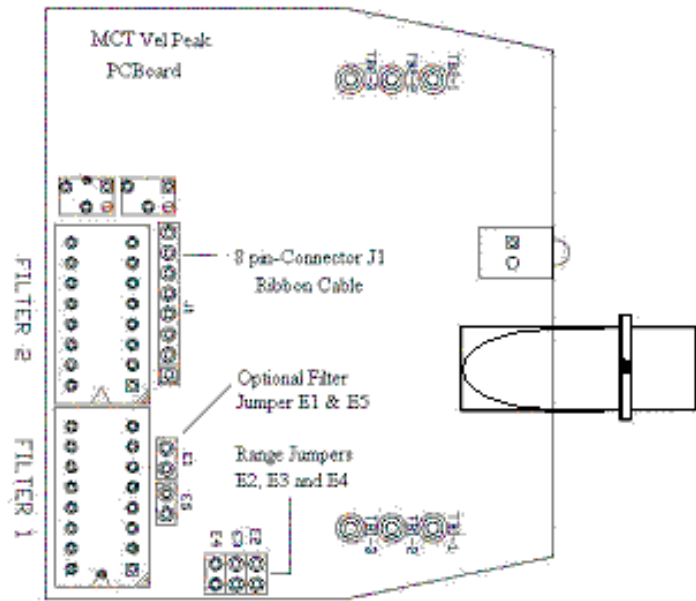


Figure 1 - 6.
MCT Velocity Peak Detection Jumper Locations.

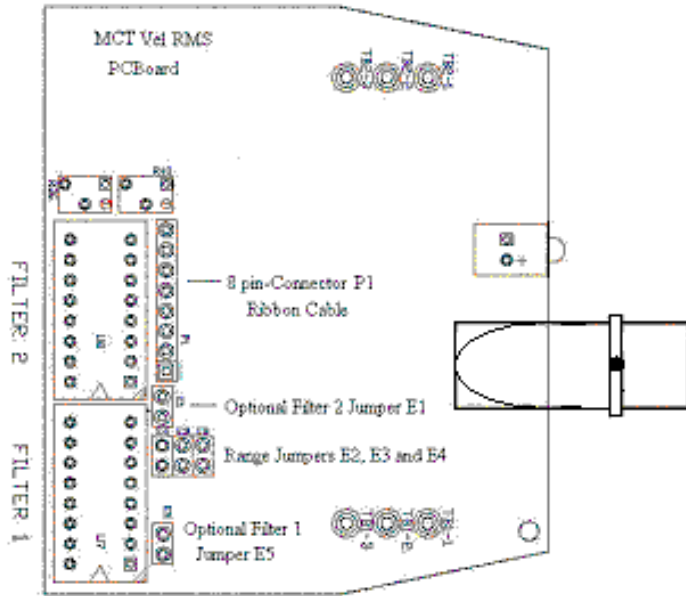


Figure 1 - 7.
MCT Velocity RMS Detection Jumper Locations.

Machine Condition Transmitter (MCT)
Full Scale Range








Setting	Jumper	Configuration
		Constant Current Source
E1*		Provides constant current / *factory preset No current supply, uses buffered output as signal input
		Selectable Filterbands
E2 E5		ENV Filter #4 (5 kHz to 40 kHz)
E3* E6*		ENV Filter #3 (500 Hz to 10 kHz) / *factory preset *factory preset
E4 E7		ENV Filter #2 (50 Hz to 1.0 kHz)
		Range Settings
E8*		Range 1 (0 to 10 gE) / *factory preset
E9		Range 2 (0 to 30 gE)
E10		Range 3 (0 to 80 gE)

Table 1 - 5.
MCT Enveloped Acceleration Options.

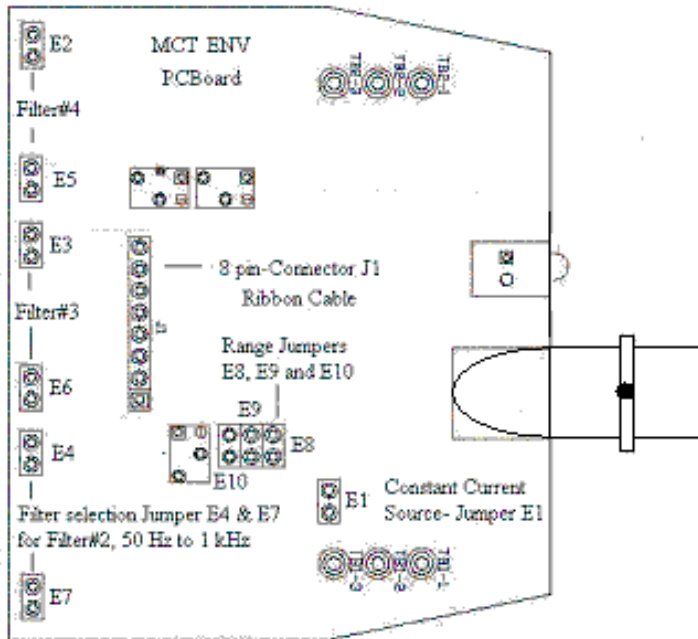


Figure 1 - 8.
MCT Enveloped Acceleration Jumper Locations.

Powering the MCT

The MCT requires externally supplied dc power. The selected power supply should have a nominal output of +24 Vdc and be capable of supplying minimum currents noted in Table 1-4:

Model Number	Minimum Power Supply/Unit
CMSS530-	55 mA
CMSS530A	110 mA
CMSS590-	75 mA
CMSS590A	125 mA

Table 1 - 6.
MCT Minimum Currents.

A regulated power supply dedicated to the vibration monitoring system is recommended. It is also recommended that connections between the power-supply and the transmitter/monitors be made with shielded twisted instrument cable. The cable shield should float at the transmitter/monitor, and connect to ground at the power supply / system common end only. The MCT regulates dc power internally to prevent a fault on the output of one channel from affecting other channels. When power is first applied to a transmitter/monitor after connecting the transducer, a delay of approximately 30 seconds will occur before the **OK** LED turns "ON".

Power Supply Distribution

If more than one MCT module is installed, terminal blocks for power and ground must be used. From these terminal blocks, 24 Vdc power is distributed to each individual module. It is recommended to use individual fuse terminals for each positive supply line so a power failure in a single MCT module will not affect the other modules.

Machine Condition Transmitter (MCT) Powering the MCT

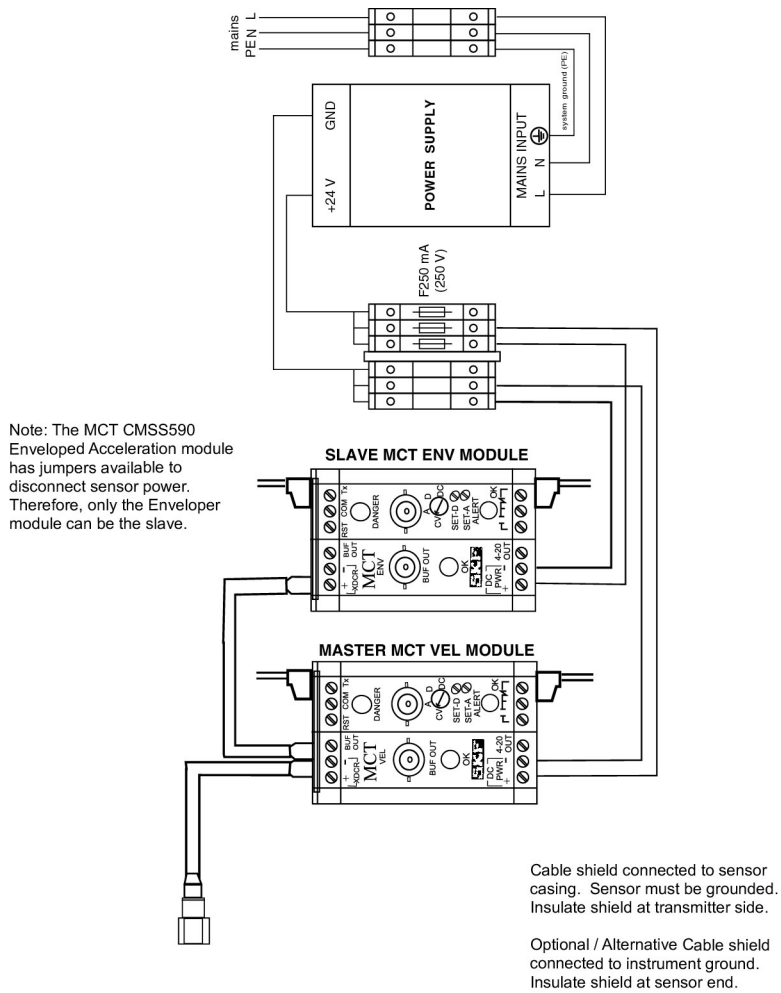


Figure 1 - 9.
Typical Power Wiring Configuration.

Grounding

When experiencing interference on the output signals due to common ground connections, it is recommended to connect the +24 V GND at the power distribution terminals to the protective ground (PE).

- For CE-approved systems, it is recommended to use shielded twisted pair cables for all signal connections. Except for the sensor signal (for example, accelerometer), all shields must be connected to PE.

Transducer

The velocity transmitter unit is factory configured for use with one of three transducer types. The specific type is identified by four digits (for example, 100A) immediately following the basic model number on the side label. This number is the transducer sensitivity in either mV/g or mV/IPS (see Table 1-5 below).

Type I.D.	Transducer Type	Sensitivity
100A	low-impedance, constant current powered accelerometer	mV/g
100V	low-impedance, constant current powered velocity sensor	mV/IPS
500E	self-generating, electro-mechanical velocity sensor	mV/IPS

Table 1 - 7.
Identifying Transducer Type and Sensitivity.

For example: **100A** indicates the transducer is a 100 mV/g low-impedance accelerometer. Other sensitivities are available by special order.

The enveloped acceleration transmitter unit always uses a 100 mV/g low-impedance, constant current powered accelerometer.

Transducer Cable

The MCT provides power for the transducer via a nominal 4.4 mA constant current source. This is generally enough current to allow operation with transducer cables extending up to about 100 ft. Longer cables may be used, depending on the sensor and cable specifications. However, it is strongly recommended that the transmitter/monitor be mounted as close as practical to the associated transducer. This will prevent signal distortion associated with current drive limitations, and will minimize interference from external electro-magnetic noise sources (EMI). A well shielded, properly installed transducer cable is necessary to obtain reliable operation. Shielded twisted pair cables designed and pre-fitted with the proper transducer connector or sensors with integral cable, which are sold for this specific purpose, are recommended. The cable shield should be open at the transmitter end and connected to ground through the sensor casing. Alternatively, the cable shield could be open at the transmitter end, and connected to common **xdcr-** terminal at the transmitter/monitor input only.

Transducer OK Circuit

The MCT incorporates a transducer **OK** circuit. This feature continuously monitors the transducer bias and signal voltage. If this voltage exceeds preset limits, the 4-20 mA output current is reduced to less than 2 mA (typically 0 mA) to allow detection of the fault condition at the associated PLC or DCS system. A green **OK** LED on the front of the unit (normally "ON" in an **OK** condition) turns "OFF" to provide a local indication of the fault condition. For low-impedance, constant current powered transducers, this circuit will effectively detect open, shorted, or reversed transducer connections. When a

detected fault is remedied, a delay of approximately 30 seconds occurs before the unit returns to the **OK** condition and the **OK** LED turns back "ON". A detected fault will also disable the **ALERT** and **DANGER** alarms / relays until the fault is removed and an **OK** condition exists.

- When configured for use with an electro-mechanical transducer (**E**), the **OK** circuit will *only* detect an open circuit condition of the transducer / cable.

Output

4-20 mA Output

The primary output of the transmitter/monitor is the 4-20 mA current output, which is scaled proportional to the full scale range of the unit. For example, if the range is 0 - 1 IPS peak, then 4 mA indicates a reading of 0.00 IPS, and 20 mA indicates a reading of 1.00 IPS peak. This output is intended to drive a maximum resistive load of 500 Ohms with respect to system common at the PLC / DCS input. A precision 0.25 watt, 250 Ohm resistor is the recommended load. This will convert the 4-20 mA current reading to a 1 to 5 Vdc reading for the PLC / DCS. For example, if the range is 0 to 0.5 IPS, then 1 Vdc indicates a reading of 0 IPS, and 5 Vdc indicates a reading of 0.5 IPS. A short to ground (common) on this output will not cause damage.

The relationship of the measured vibration parameter to the output current is displayed in the following equation:

$$\text{Units of Vibration} = \frac{\text{Measured Current} - 4 \text{ mA}}{16 \text{ mA}} \times \text{Full Scale Value}$$

Example

Measured Current = 12 mA; Full Scale = 1 IPS

$$\text{Converted Output Reading} = \frac{12 \text{ mA} - 4 \text{ mA}}{16 \text{ mA}} \times 1 \text{ IPS} = 0.5 \text{ IPS}$$

The relationship of the measured vibration parameter to the output voltage, when using a 250 Ohm resistor, is displayed in the following equation:

$$\text{Units of Vibration} = \frac{\text{FullScaleValue}}{4V} \times (\text{Measured Voltage} - 1)$$

Example:

Measured Voltage = 3V; Full Scale 0.5 IPS

$$\text{Converted Output Reading} = \frac{0.5 \text{ IPS}}{4V} \times (3V - 1) = 0.25 \text{ IPS}$$

Buffered Output

The MCT provides access to the buffered transducer signal using a BNC connector on the front of the unit and on a screw terminal at the top of the unit. These buffered outputs have the same sensitivities, units, and bias voltages as the transducer itself (i.e., mV/g for an accelerometer or mV/IPS for a velocity transducer). This output can be connected to portable monitoring equipment or analyzers (i.e., SKF Reliability Systems' MicrologTM), or can be used to check the bias output voltage (BOV) of low-impedance transducers using a digital voltmeter. The buffered output is unfiltered.

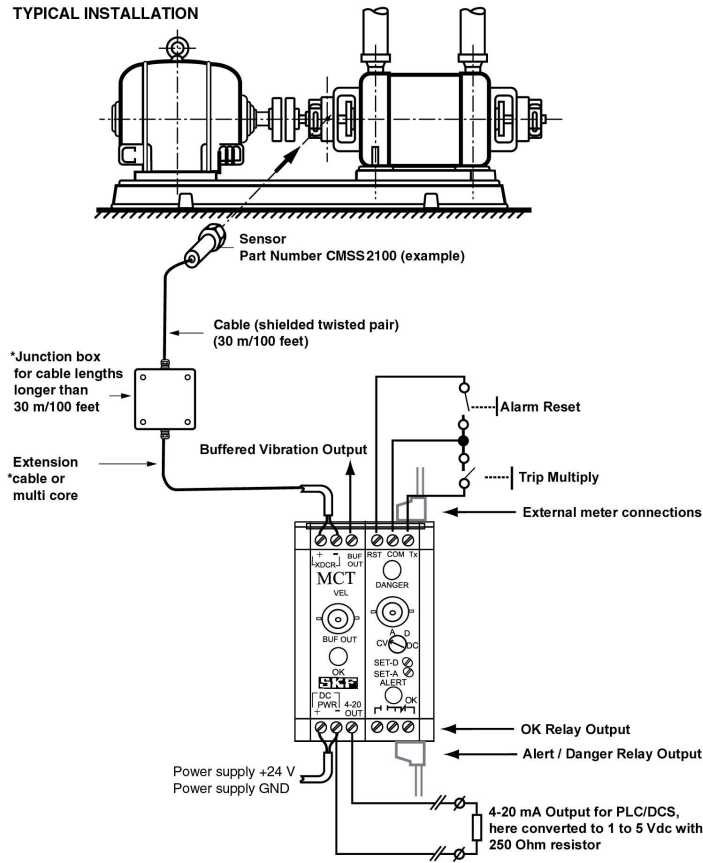
- For electro-mechanical velocity transducers only: The buffered output sensitivity is scaled to 100 mV/IPS, regardless of the actual input sensitivity. For example, a 145 mV/IPS transducer will have a scaled buffered output sensitivity of 100 mV/IPS.

User Manual

Installing the Machine Condition Transmitter

MCT Typical Installation

TYPICAL INSTALLATION



Opening the Case

Opening the MCT case is best done with a small flat-blade screwdriver. On transmitters (1 inch / 26 mm wide units), insert the tip of the screwdriver between the right side cover (as viewed from the front of the unit) and the DIN rail mounting foot at the back of the unit, as shown in Figure 2-1, and gently leverage the blade to begin separating the cover from the rest of the unit. Carefully work your way around to the front of the unit to complete removal of the cover, exposing the circuit board components.

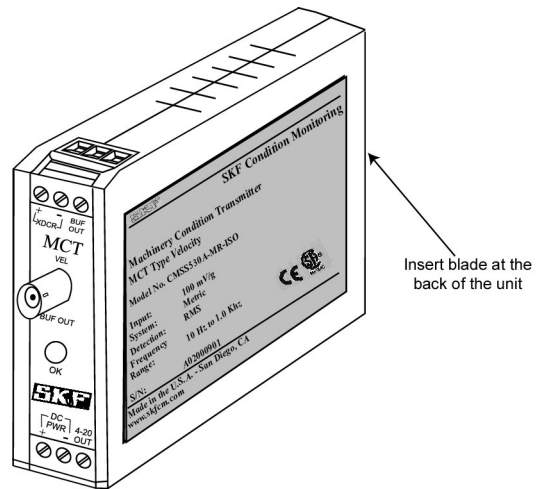


Figure 2 - 1.
Blade Insertion Point on Transmitter.

On Monitors (1.6 inch / 41 mm wide units), you must first carefully separate the two halves of the unit at the center (see Figure 2-2). The sides do not need to be removed. This is done by working the screwdriver around the middle of the unit in the same general manner described above.

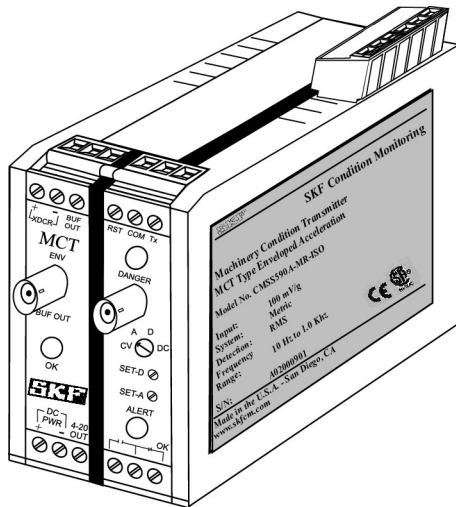


Figure 2 - 2.
Transmitter/Monitor Separated at Center.

As the two sides start to separate, you will see that a short ribbon cable inside holds them together. To remove this cable, carefully pull it away from the left hand side of the unit (as viewed from the front). The cable stays with the right hand side permanently.

Important - When reinstalling this cable, make sure it is properly connected to the mating connector, and that the bend in the cable goes towards the front panel side of the unit.

If the unit is closed with the bend towards the back, the ribbon cable can be damaged.

Also, make sure the ribbon cable connector does not catch on the relays when pressing the unit back together.

MCT Enveloped Acceleration Filter Selection

The enveloped acceleration transmitter is delivered with three standard band-pass filters. Table 2-1 shows the available filters for each unit.

Filter Band Number (Microlog)	BandPass Filter Frequencies (Hz)	Fmax Setting for Microlog When Compared (Hz)	Old MCM Filter Range for Reference	Jumper Setting
2	50 to 1,000	100	-44	E4 and E7
3	500 to 10,000	1,000	-66	E3 and E6
4	5,000 to 40,000	10,000	-88	E2 and E5

Table 2 - 1.
Integrated Enveloped Acceleration Filter Settings.

- The factory preset for the enveloped acceleration transmitter module is Filter 3 (500 to 10,000Hz).

Use the following guideline to define the proper band-pass for the application.

The low frequency roll-off of the band-pass filter to eliminate rotational components is:

$$F_{min} \geq 10 \times \text{RPM} / 60$$

Setting Monitor Alarms

- This section applies only to the Monitor units (CMSS530A and CMSS590A).

- For a brief overview of vibration severity levels, reference the **General Severity Level Guidelines** appendix.

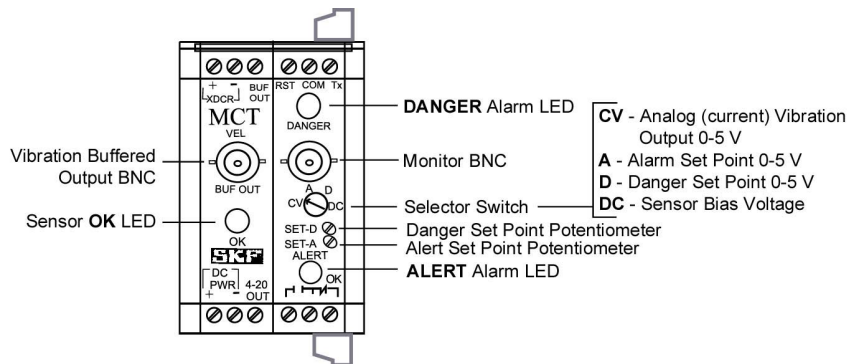


Figure 2 - 3.
MCT Front View With Monitor Options Explained.

Alert and Danger Alarm Setpoint Adjustment

ALERT and **DANGER** alarm setpoints can be independently set in the field by turning the front panel selector switch to the associated position (**A** or **D**) and adjusting the associated front panel potentiometer until the correct dc voltage is measured at BNC connector located directly above the selector switch. Adjusting the setpoint requires the use of a digital voltmeter, knowledge of the transmitter's full scale range, and the desired setpoint as a percentage of the full scale range. The voltage measured at the BNC will vary between 0 Vdc and 5 Vdc, corresponding to 0 to full scale. For example, 2.5 Vdc represents 50% of full scale, 3.75 Vdc represents 75% of full scale. To calculate the required setpoint voltage, use the equation, $5(.xx)$ where $.xx$ is the desired percentage expressed as a decimal fraction of the full scale range. For example, $5(.60) = 3.00$ Vdc for a setpoint of 60% of the full scale range. Turning the potentiometer clockwise increases the setpoint voltage.

Installing the Machine Condition Transmitter
Setting Monitor Alarms

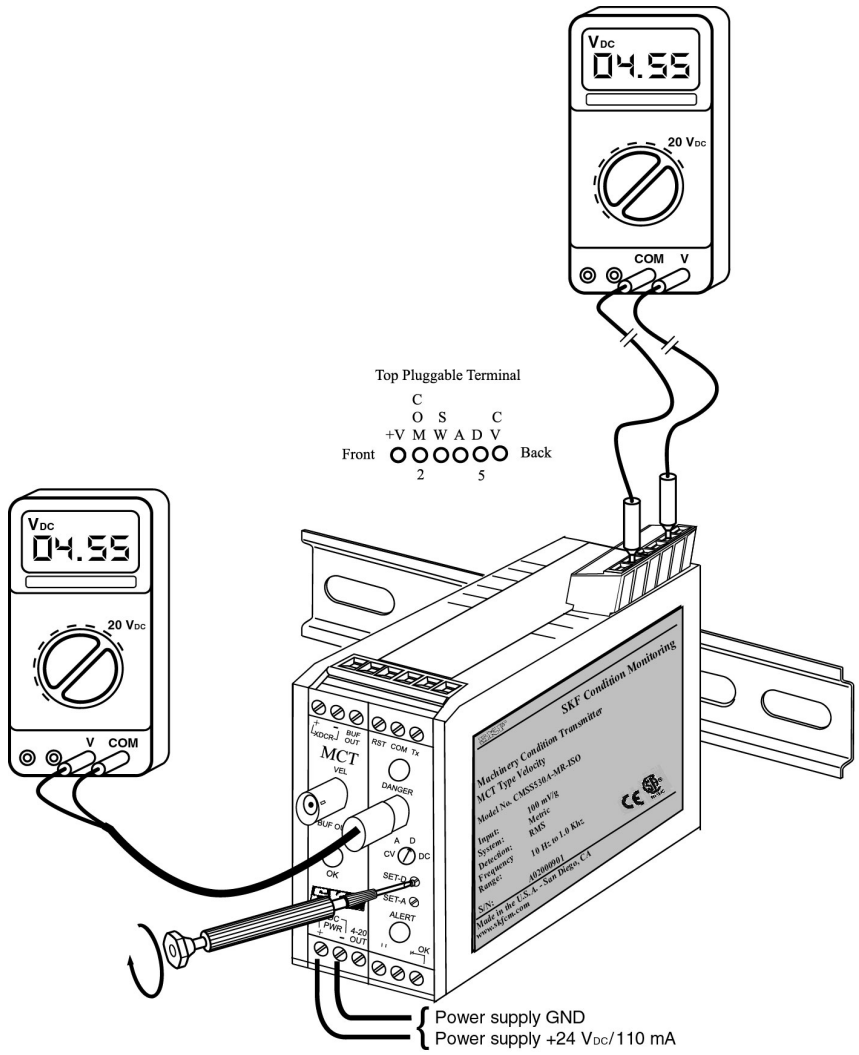


Figure 2 - 4.
 Setting Alarm Levels.

Alert and Danger Alarm Delays Adjustment

The Alert and Danger alarm delays can be independently set by internal jumper selection to .1, 1, 3, 6, or 10 seconds. The purpose of the delay is to reduce nuisance alarms caused by external electrical noise and/or transient vibration events. Both the Alert and Danger delays are factory set to the 3-second position. To change the delay, open the unit and move the delay jumpers to the proper position.














Setting	Jumper	Configuration
Alert Time Delay		
E1		0.1 sec
E2		1 sec
E3*		3 sec / *factory preset
E4		6 sec
E5		10 sec
Danger Time Delay		
E6		0.1 sec
E7		1 sec
E8*		3 sec / *factory preset
E9		6 sec
E10		10 sec
Latching / Non-latching Alarms		
E11*		Open: Alert Non-latching / *factory preset Closed: Alert Latching
E12*		Open: Danger Non-latching / *factory preset Closed: Danger Latching
Trip Multiply factor		
E13*		Open: factor 2x /*factory preset Closed: factor 3x

Table 2 - 2.
Monitor Jumper Options.

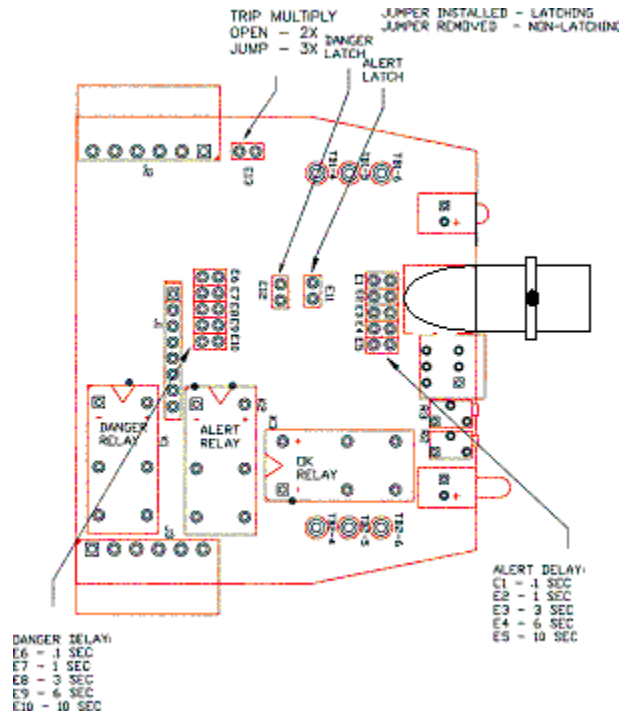


Figure 2 - 5.
 Monitor Jumper Locations.

Latching / Non-latching Alarms

The Alert and Danger alarms are factory set for non-latching operation. This means that whenever the vibration level drops below the associated setpoint for more than about 1 second, the associated relay will de-energize and the alarm LED will turn off. The alarms can also be set for latching operation by installing shunts on jumpers E1 and E2 on the Alarm module circuit board. Latched alarms may be reset by closing the RESET (**RST**) and COMMON (**COM**) contacts at the top of the unit. This may be done with an external switch, dry contact relay, or by shorting the terminals together by hand.

Important - Do not apply voltage to either the **RST** or **COM** terminals.

- If several monitors are mounted together, the **RST** terminals may be daisy-chained together and switched to **COM** (system common) as a group.

Trip Multiply

The alarm module provides a trip multiply feature. This feature allows the user to temporarily double (standard) or triple (jumper selectable) the normal setpoints during periods of normal high vibration, such as start-ups. To actuate the trip multiply feature, the **Tx** terminal at the top of the alarm module must be closed to the adjacent **COM** terminal. This may be done with an external switch, dry contact relay, or by shorting the terminals together by hand.

Important - Do not apply voltage to either the **Tx** or **COM** terminals.

- If several monitors are mounted together, the **Tx** terminals may be daisy-chained together and switched to **COM** (system common) as a group.

Alarm Relays

The **ALERT**, **DANGER** and **OK** relays are independent, single-pole-double throw relays. NO, ARM, and NC contacts are available through a plugable screw connector at the bottom of the monitor. **OK** relay contacts are available on fixed screw terminals at the bottom front of the alarm module. Relay contacts are rated 5 Amps at 30 Vdc or 125 Vac, resistive load. This rating includes any inrush current the load draws. For loads that are not purely resistive, the contact switching capability needs to be considered carefully in terms of this inrush current and rated accordingly.

- The user is reminded to take care when applying relays.

The factory intended purpose of providing relay contacts is to operate relatively low power alarm annunciators, act as a dry or low dc voltage contact closure input to other systems, or act to actuate an appropriately sized slave relay for larger loads such as shutting down a motor. Relays are socketed and can be replaced.

Rated Amps	Voltage
5A	30 Vdc
5A	125 Vac
2.5A	250 Vac

Table 2 - 3.
Relay Contacts Rating.

Interfacing the MCT with Other Monitoring Systems

The MCT CMSS530 and CMSS590 modules interface with equipment used for process control and data analysis.

Interfacing to Process Control Systems

Interface options for process control systems are the static output 4-20 mA dc and the low power change-over relay contacts. The maximum load resistance of all connected instruments in the current loop is 500 Ohms.

Reference the section **4-20 mA Output** in **Chapter 1** for more information.

Interfacing to SKF Reliability Systems Products

Consider the following interface options:

Installing the Machine Condition Transmitter Interfacing the MCT with Other Monitoring Systems

- Use SKF Reliability Systems equipment to analyze MCT module readings.
- Use MCT modules as a front end to on-line condition monitoring equipment.

Figure 2-6 shows a combination of the above mentioned interface options.

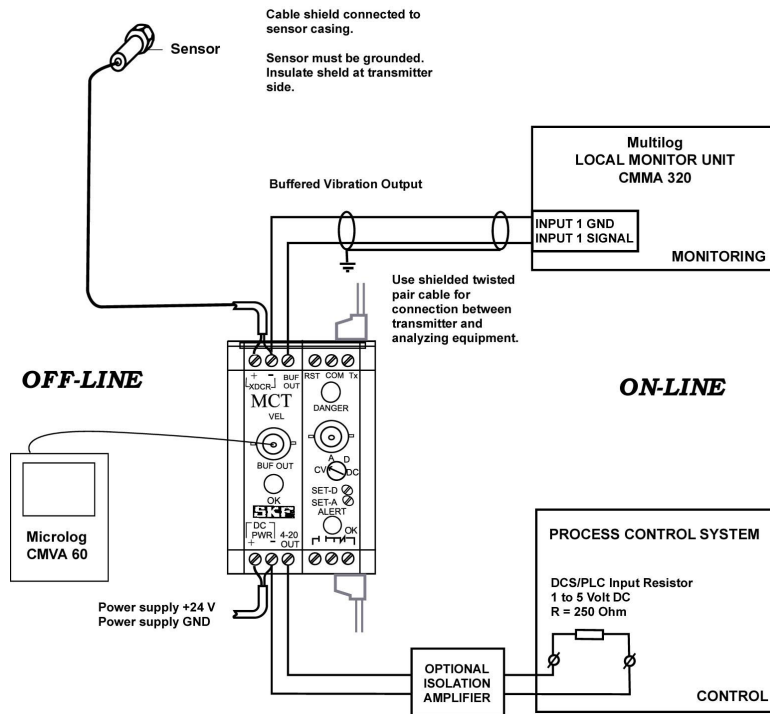


Figure 2 - 6.
MCT CMSS530/590 Interfacing.

Analyzing MCT Readings

Unlike other SKF Reliability Systems' analyzing products that use digital signal processing (i.e., Microlog, Multilog

CMMA320 and Monitor Interface Module (MIM) CMMA162), MCT modules use analog signal processing techniques, so be careful when comparing results with digital instruments. For enveloped acceleration (gE) applications, the filter ranges in the Microlog and Multilog are equal, but the filter range of the envelope circuitry in the Vib Pen Plus is fixed between 5 kHz and 10 kHz to obtain a general bandwidth where low frequency influences, due to hand held operation, are eliminated.

Detection methods of the Microlog and Multilog are, in general, based upon detecting a maximum and minimum peak value within the whole time period of the measurement. From this peak-to-peak value, the zero peak value is calculated. The RMS value is always derived from the calculated spectrum and is not a true RMS conversion on the dynamic time signal (unlike the MCT modules).

Furthermore, MCT modules use averaging methods to prevent unwanted fluctuations. The number of averages for the Multilog and Microlog are free selectable. It is advised to select 4 to 8 averages to create a comparable total measurement time period.

Guidelines for using the Microlog as an analysis instrument in combination with the MCT modules are provided:

**Peak-to-Peak Measurements with the Microlog
(Acceleration and Enveloped Acceleration)**

The buffered vibration output is used as an input signal to the Microlog. The selected enveloped acceleration filter setting for the Microlog must be equal to the filter choice on the enveloped acceleration transmitter. The maximum frequency must be set at twice the value of the selected low corner cut off frequency of the enveloped acceleration filter (for example, filter 500 Hz to 10 kHz results in a maximum analyzing frequency of 1 kHz).

Peak to Peak readings on the Microlog can be compared to the Peak reading of the MCT module. This difference of detection method is based upon the fact that the Microlog

has an AC coupled signal processing path, while the MCT modules use a dc coupling.

RMS Measurements with the Microlog (Acceleration and Velocity)

The buffered vibration output is used as an input to the Microlog. The Microlog's frequency settings must be equal to the filter bandwidth settings of the (Velocity) MCT CMSS530 module. The detection method must be set to RMS.

Important - The MCT VEL module uses an analog filter and integrator which measure continuously.

The Multilog and Microlog calculate the RMS value from the spectrum, which is not continuously processed. This discontinuity, which is minimized by selecting the Hanning window, may cause low frequency problems which result in ski-slopes after integration. These possible ski-slope effects may have large influences on the RMS overall velocity reading.

Peak Detection in Velocity

The MCT velocity modules with peak detection provide a true peak reading, in contrary to the older MCM modules, which provided a "pseudo" peak, derived from the RMS reading. True peak detection typically results in higher values when data is collected at the same measurement location over the same frequency range. The data can be trended and analyzed, nonetheless. If the user is more familiar with the Calculated Peak (RMS x 1.414), specify the RMS detection when ordering. Select an approximate 1.4 times higher full scale value to get the same results. For example, the older MCM has a full scale of 1 IPS and peak (pseudo) detection. An MCT velocity module with a full scale of 1.5 IPS and RMS detection will deliver the same results.

User Notes

Appendix

General Severity Level Guidelines

When considering severity levels, be aware that standards can only provide general guidelines to determine initial alarm settings. Such guidelines should never substitute experience and good judgement. The most reliable method of determining alarm settings is to trend vibration readings over time, establish baseline values and alarm settings above baseline values.

Vibration measured in Velocity

For vibration velocity, ISO standards, such as ISO 10816, First Edition 1995, or VDI 2056 guidelines, are generally accepted. ISO 10816 with the title 'Mechanical vibration – Evaluation of machine vibration by measurements on non-rotating parts' consists of six parts. Part 1 (10816-1) determines general guidelines and is followed by the additional parts of ISO 10816, for example Part 2 (10816-2) for land-based steam turbines and generators in excess of 50 MW with normal operating speeds of 1500 RPM, 1800 RPM, 3000 RPM and 3600 RPM.

The following severity chart is in accordance with the ISO 10816-2 guidelines. For exceptions to this guideline and for more information, reference the ISO 10816-2 document.

ISO 10816-2	Steam Turbines and Generators	
Speed (RPM)	1500 or 1800	3000 or 3600
Velocity		
mm/sec RMS	Damage	occurs
11.8		
10.0		
8.5		
7.5	Restricted	Operation
5.3		
3.8	Unrestricted	Operation
2.8		
1.4	Newly	Commissioned
0.0		Machinery

Table A - 1.
 Vibration Severity Chart ISO 10816-2.

Industrial machines with nominal power above 15 kW and nominal speeds between 120 RPM and 15000 RPM when measured in position are covered by ISO 10816-3.

The machines are separated into 4 different groups:

Group 1: Large machinery and electrical machines with shaft height greater than 315 mm that are normally equipped with sleeve bearings.

Group 2: Medium-size machines and electrical machines with shaft height between 160 mm and 315 mm that are normally equipped with rolling element bearings and operate at speeds above 600 RPM.

Group 3: Pumps with multivane impellers and separate drivers with rated power above 15 kW. Machines of this

General Severity Level Guidelines
Vibration Enveloped Acceleration Measurements

group may be equipped with sleeve or rolling element bearings.

Group 4: Pumps with multivane impellers and with integrated drivers that are equipped with sleeve or rolling element bearings.

ISO 10816-3	Machinery Group 2 & 4		Machinery Group 1 & 3	
Rated Power	15 kW – 300 kW		Group 1: 300 kW – 50 MW Group 3: above 15 kW	
Velocity				
mm/sec RMS		Damage	occurs	
11.0				
7.1				
4.5		Restricted	Operation	
3.5				
2.8		Unrestricted	Operation	
2.3				
1.4				
0.7		Newly	Commissioned	Machinery
0.0				
Foundation	Rigid	Flexible	Rigid	Flexible

Table A - 2.
Vibration Severity Chart ISO 10816-3.

Vibration Enveloped Acceleration Measurements

Severity levels for machine vibration and bearing defect detection by means of the enveloping technique are needed to classify the machine condition according to standards and practical guidelines.

For enveloped acceleration in all forms, severity levels are related to speed and bearing size. The bearing size is generally related to the load capabilities of the machine.

The higher the speed, the higher the energy generated by impacts as elements roll over bearing damage.

The relation: Maximum shaft speed times shaft diameter has a maximum, depending on the bearing technology.

Notice that for bigger bearings the speed is limited, and therefore, the severity levels are also limited. Carefully select the severity levels for enveloped acceleration using machine knowledge. Sensor location and sensor installation is important for successful machine monitoring. The boundaries between different states of severity conditions are less defined. Comparative and relative judgement methods are preferred above absolute judgement and the application of standards.

For creating a comparative measurement, the process control system is able to create a trend of the vibration signal. This signal can be compared against a 'baseline' overall measurement of that measurement point, with the knowledge that the machine is running under normal conditions.

In many cases, periodic measurements have been performed on equipment before a permanent monitor (such as the MCT system) is installed. The knowledge of those measurements and the machine behavior provides a good indication of effective alarm level settings.

General Severity Level Guidelines
Vibration Enveloped Acceleration Measurements

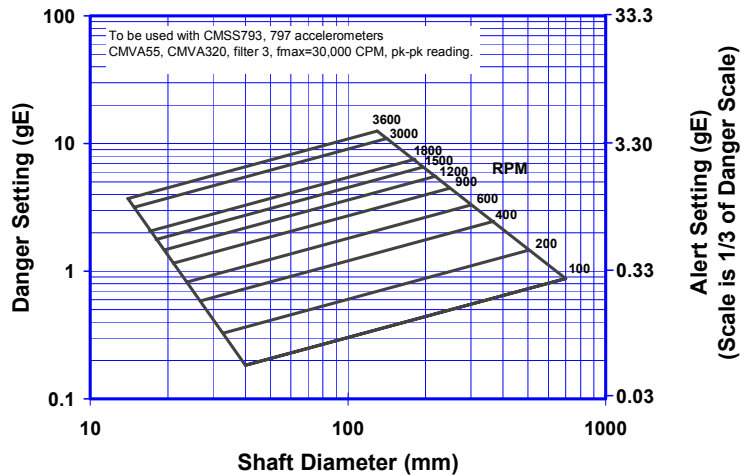


Figure A - 1.
Enveloped Acceleration Alarm Guidelines (Fmax = 60,000 CPM).

To utilize the above chart, the following parameters must be known:

- Bearing bore diameter in mm (indicates load)
- Shaft speed in RPM

Assumptions for using the above chart are necessary as deviations from standardized data collection greatly affect enveloped acceleration readings. Assumptions are as follows:

- Filter 3 = 500-10,000 Hz
- Fmax = 60,000 CPM / 1,000 Hz
 - A scaling factor is required for other Fmax values. A scaling equation is provided in Part II.
- Sensor = CMSS793 or CMSS797 or MCD probe
- Detection = Peak to Peak

Perform measurements with the machine operating under normal conditions. For example, when the rotor and the main bearings have reached their normal steady operating temperatures and with the machine running under its normal rated condition (at rated voltage, flow, pressure, and load).

To obtain the most accurate readings, enveloped acceleration measurements require probe placement in the maximum load zone, or as close as possible to the maximum load zone within the measured bearing or gear box.

Example

Bearing bore diameter: 100 mm
Shaft speed: 1800 RPM
Fmax: 60,000 CPM

Use the chart in Figure A-1 to determine this enveloped acceleration measurement's alert and danger alarm settings:

- Locate 100 mm on the *shaft diameter* axis.
- Follow the vertical line representing 100 mm to the point where it intersects the 1800 RPM running speed line. This is your reference point.
- From your reference point, follow the horizontal lines left to the *danger settings* axis to determine your initial danger alarm setting (7.5 gE).
- From your reference point, follow the horizontal lines right to the alert *settings* axis to determine your initial alert alarm setting (2.5 gE).
- Use the Scaling Factor chart (Figure A-2).

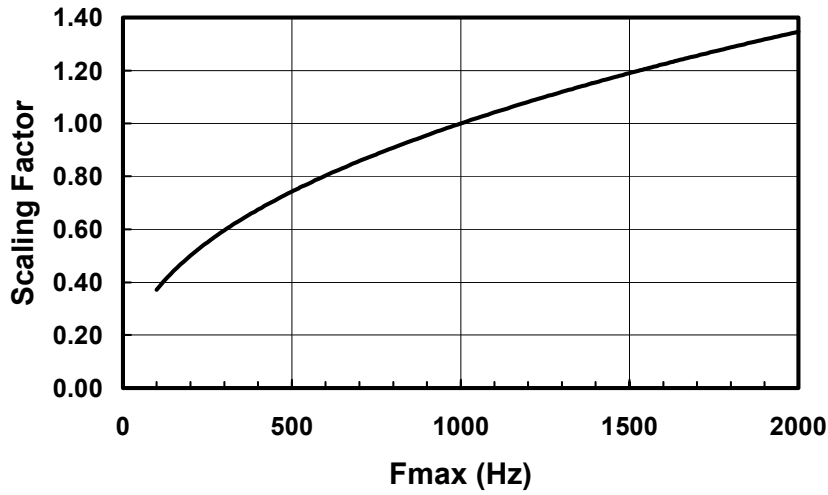


Figure A - 2.
Scaling Factor for Fmax Compensation for Enveloped Acceleration Measurements.

The definition for an alarm condition for the enveloped acceleration transmitter module also depends on the application. Alarms can be a warning that a certain condition has occurred and that further analysis is required. Based upon those results, a decision must be made on further required actions. The MCT is then used as a monitoring device.

The alarm condition can also be used to take direct action. In this case the MCT module is fulfilling a protective task together with the process control / relay system.

- The software CMSW5000 'Atlas For Windows' features a calculator for enveloped acceleration alarm settings and is based on identical assumptions.

- For more information please visit our website www.skfcm.com, select **News** and download Revolution 6, Number 2 with the complete article, "General Alarm Guidelines for Enveloped Acceleration Measurements."

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