

PREDICTECH

HOUSTON, TEXAS 77036

USERS MANUAL

TM Series Transmitter-Monitor

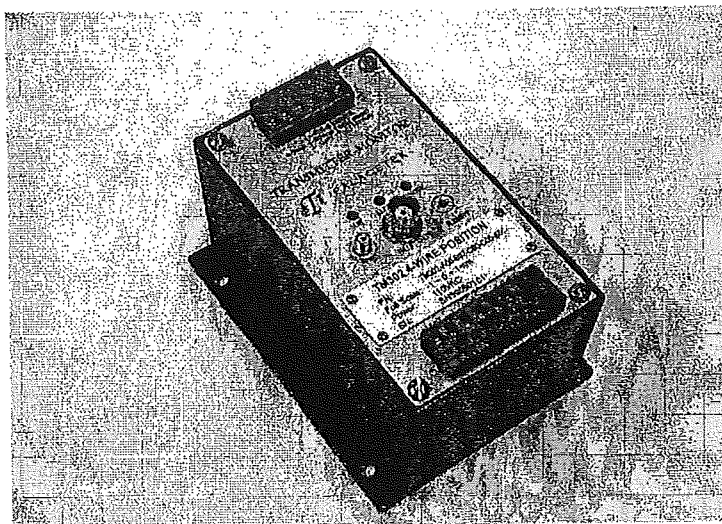
TM-CAT-ENG-6.0-8406

Seismic -> Case Vibration

Eddy Probe -> Shaft Vibration

Eddy Probe -> Shaft Position

Eddy Probe -> Rotation Speed



PREDICTECH = TM User's Manual

Fax: (+1-413)793-8109, Email: pti@predictech.com, Web: www.predictech.com

Table of Content

INTRODUCTION TO THE TM SERIES TRANSMITTER-MONITOR	6
I. History of Rotation Machinery Monitoring and Protection	6
II. New Feather	6
III. Common Feature.....	7
IV. TM Series Transmitter-Monitor Function Table	8
TM101 VIBRATION TRANSMITTER-MONITOR	9
I. General.....	9
II. TM101 Vibration Transmitter-Monitor Technical Specification.....	9
III. Order Information.	11
IV. Field Wire Diagram.....	13
V. Field Alarm Set-up.....	14
VI. Field Operation.....	14
VII. 4-20mA Calibration Procedure (For Certified Engineer Only).....	16
TM201 VIBRATION TRANSMITTER-MONITOR	17
I. General.....	17
II. TM201 Vibration Transmitter-Monitor Technical Specification.....	17
III. Order Information.	20
IV. Field Wiring Diagram (1).	21
V. Field Wiring Diagram (2).....	22
VI. Field Set-up.....	23
VII. Field Operation	24
VIII. Calibration Procedure (For Certified Engineer only).....	25
TM202 POSITION TRANSMITTER-MONITOR	27

PREDICTECH = TM User's Manual

Fax: (+1-413)793-8109, Email: pti@predictech.com, Web: www.predictech.com

I. General.....	27
II. TM202 Position Transmitter-Monitor Technical Specification	27
III. Order Information.	30
IV. Field Wiring Diagram.	31
V. Field Set-up.....	33
VI. Field Operation.....	35
VII. Calibration Procedure (For Certified Engineer only)	36
 TM301 VIBRATION TRANSMITTER-MONITOR	 38
I. General.....	38
II. TM301 Vibration Transmitter-Monitor Technical Specification.....	38
III. Order Information.	41
IV. Field Wiring Diagram.	43
V. Field Set-up.....	44
VI. Field Operation.....	45
VII. 4-20mA Calibration Procedure (for certified Engineer only).....	46
 TM302 POSITION TRANSMITTER-MONITOR	 48
I. General.....	48
II. TM302 Position Transmitter-Monitor Technical Specification	48
III. Order Information.	51
IV. Field Wiring Diagram.	52
V. Field Set-up.....	53
VI. Field Operation.....	55
VII. Calibration Procedure (for Certified Engineer only)	56
 TM401 2-WIRE VIBRATION TRANSMITTER-MONITOR	 58
I. General.....	58
II. TM401 Vibration Transmitter-Monitor Technical Specification.....	58
III. Order Information.	60

PREDICTECH = TM User's Manual

Fax: (+1-413)793-8109, Email: pti@predictech.com, Web: www.predictech.com

IV. Field Wiring Diagram.....	61
V. Field Set-up.....	63
VI. Field Operation.....	63
VII. 4-20mA Calibration Procedure (for certified Engineer only).....	64
TM402 TWO-WIRE POSITION TRANSMITTER-MONITOR.....	65
I. General.....	65
II. TM402 Position Transmitter-Monitor Technical Specification	65
III. Order Information.	67
IV. Field Wiring Diagram.	68
V. Field Set-up.....	70
VI. Field Operation.....	70
VII. Calibration Procedure (for Certified Engineer only)	72
TM501 SPEED TRANSMITTER-MONITOR	73
I. General.....	73
II. TM501 Vibration Transmitter-Monitor Technical Specification.....	73
III. Order Information.	76
IV. Field Wiring Diagram.	77
V. Field Set-up.....	79
VI. Field Operation.....	80
VII. Calibration Procedure (for certified Engineer only)	82
TM502 SPEED TRANSMITTER-MONITOR	84
I. General.....	84
II. TM502 Vibration Transmitter-Monitor Technical Specification.....	84
III. Order Information.	87
IV. Field Wiring Diagram.	88
VI. Field Operation.....	90
VII. Calibration Procedure (for certified Engineer only)	92

PREDICTECH = TM User's Manual

Fax: (+1-413)793-8109, Email: pti@predictech.com, Web: www.predictech.com

TM503 OVER-SPEED TRANSMITTER-MONITOR	94
I. General.....	94
II. TM503 Vibration Transmitter-Monitor Technical Specification.....	94
III. Order Information.	96
IV. Field Wiring Diagram.....	98
V. Over-speed Protection Alarm Table.	99
VI. Field Operation.....	100
VII. Calibration Procedure (for certified Engineer only)	101
 TM900 POWER SUPPLY	 103
I. General.....	103
II. TM900 Specification.....	103
 TM0200 DISPLAY UNIT	 105
Electrical.....	105
Environment.....	105
Order Information:	105
 APPENDIX.....	 106
Appendix. 1. Field Wiring Diagram for TM101 as filter (LP 1.3KHz) to interface M800A.....	106

Figures

FIGURE 1. TM101 FIELD WIRING DIAGRAM.....	13
FIGURE 2. TM101 HAZARDOUS AREA FIELD WIRING DIAGRAM.....	13
FIGURE 3. TM201 VIBRATION TRANSMITTER-MONITOR OUTLINE.....	19
FIGURE 4. TM201 FIELD WIRING DIAGRAM.....	21
FIGURE 5. TM201 HAZARDOUS AREA FIELD WIRING DIAGRAM.....	22
FIGURE 6. TM202 POSITION TRANSMITTER-MONITOR OUTLINE	29
FIGURE 7. TM202 FIELD WIRING DIAGRAM.....	31
FIGURE 8. TM202 HAZARDOUS AREA FIELD WIRING DIAGRAM.....	32
FIGURE 9. TM301 VIBRATION TRANSMITTER-MONITOR OUTLINE.....	40
FIGURE 10. TM301 FIELD WIRING DIAGRAM.....	43
FIGURE 11. TM302 POSITION TRANSMITTER-MONITOR OUTLINE	50
FIGURE 12. TM302 FIELD WIRING DIAGRAM.....	52
FIGURE 13. TM401 TWO-WIRE VIBRATION TRANSMITTER-MONITOR OUTLINE	59
FIGURE 14. TM401 FIELD WIRING DIAGRAM.....	61
FIGURE 15. TM401 HAZARDOUS AREA FIELD WIRING DIAGRAM.....	62
FIGURE 16. TM402 POSITION TRANSMITTER-MONITOR OUTLINE	66
FIGURE 17. TM402 FIELD WIRING DIAGRAM.....	68
FIGURE 18. TM402 HAZARDOUS AREA FIELD WIRING DIAGRAM.....	69
FIGURE 19. TM501 SPEED TRANSMITTER-MONITOR OUTLINE	75
FIGURE 20. TM501 FIELD WIRING DIAGRAM.....	77
FIGURE 21. TM501 HAZARDOUS AREA FIELD WIRING DIAGRAM.....	78
FIGURE 22. TM502 SPEED TRANSMITTER-MONITOR OUTLINE	86
FIGURE 24. TM503 AND TM503-IO OVER-SPEED TRANSMITTER-MONITOR OUTLINE	95
FIGURE 25. TM503 SYSTEM FIELD WIRING DIAGRAM.....	98
FIGURE 26. TM900 POWER OUTLINE	103

Introduction to the TM Series Transmitter-Monitor

I. History of Rotation Machinery Monitoring and Protection

The concept of rotation machinery monitoring was introduced after the Second World War by military research laboratory. The research indicated that the failure of machines severely affected the productivity. The result of the study was then introduced to industry in early 1950s. After years of progress, the monitoring and protection becomes quite mature.

To accurately measure the running condition of rotation machine, the major physical parameters to be monitored are radial vibration of the shaft, thrust, and case vibration. For further machine diagnostics, phase reference is also needed.

The typical configuration of the monitoring system is composed of sensors and a monitor. The sensors are divided into non-contacting eddy probe for relative measurement and accelerometer for absolute vibration measurement. The monitor will indicate displacement, velocity and acceleration units.

Due to the development of solid-state electronics, DCS and PLC are widely used in machinery control and automation. Most of the features of monitoring system can be achieved by DCS or PLC. Nowadays, customer only needs a 4-20mA overall vibration to interface of their system. An optional Alert Relay and a Danger Relay contacting to direct interface to their control system may be a more reliable way of alarming.

By using PredicTech's Transmitter-Monitor series, you just need sensors plus the TM Transmitter-Monitor to monitor your machines. The TM series will give you the 4-20mA, Alert, and Danger, with the addition of Buffer Output, Local Reset, Remote Reset, and Local Set Point and adjustment. All the functions are compacted in the little Transmitter-Monitor.

II. New Feather

1. Alert and Danger Relays.

The Transmitter-Monitor is equipped with two SPDT relays, Alert and Danger. This two relays has isolated contact (>1000VDC isolation), with current rating up to 5A/220V.

PREDICTECH = TM User's Manual

Fax: (+1-413)793-8109, **Email:** pti@predictech.com, **Web:** www.predictech.com

The relays' set points are adjustable. The set points can be field programmed. The calibration procedure will be displayed via the 4-20mA output.

Switches on the Transmitter-Monitor can guide for normal operation and set point calibration.

2. Local and Remote Reset.

There is a Local Reset building in the Transmitter-Monitor. There is also connectors for the Remote Reset option.

3. LED Status Indication.

Three LEDs will be integrated in the TM (Transmitter-Monitor). A green LED indicates OK, a yellow one Alert and a red one Danger.

III. Common Feature

In addition to the new features above, there are common features required by API 670 standard as below.

1. Buffer Signal Output

A standard BNC connector can output Buffer vibration signal. This output can drive cable of 1,000 feet (300 meters).

2. Integrated solution

The TM101 series with the accelerometer, cable, and display module are integrated in one package.

3. User-selectable in acceleration, velocity, and displacement.

All the TM series can run with unit in displacement. The TM101 Transmitter-Monitor even can indicate acceleration and velocity in addition to displacement.

The eddy-probe series can output vibration and thrust.

4. Power-up Inhibit

PREDICTECH = TM User's Manual

Fax: (+1-413)793-8109, Email: pti@predictech.com, Web: www.predictech.com

It can help to develop the reliability of the Transmitter-Monitor.

IV. TM Series Transmitter-Monitor Function Table

	TM101	TM201	TM202	TM301	TM302	TM401	TM402	TM501	TM502
Vibration		✓		✓		✓			
Position			✓		✓		✓		
Case Vibration	✓								
Speed								✓	✓
Process Variable									
Rolling-Element Bearing	✓								
Sleeve Bearing	✓	✓	✓	✓	✓	✓	✓		
Acceleration, Velocity	✓								
Eddy-probe		✓	✓	✓	✓	✓	✓	✓	✓
Extension cable		✓	✓	✓	✓	✓	✓	✓	✓
Driver		✓	✓					✓	
Hazardous Area	✓	✓	✓			✓	✓	✓	
Power	✓	✓	✓	✓	✓			✓	
Two-wire transmitter						✓	✓		
4—20mA Output	✓	✓	✓	✓	✓	✓	✓	✓	✓
1—5V Output	✓	✓	✓	✓	✓			✓	✓

TM301 Vibration Transmitter-Monitor

I. General

The newly-designed TM301 will directly interface with many models of eddy-probe systems. Such as TM018X, 3300, 7200 series. TM301 has distinguished features among the other TM transmitter-monitors. TM301 does not need probe driver, it integrates the driver and the monitoring into one unit, eliminate the need for separate driver. This greatly simplifies the system design and integration procedure, and the reliability has been enhanced due to the less of components.

TM301 will measure radial vibration, process the signal, and output 4-20mA which proportional to the relative vibration. The TM301, like any other TM of its family, will also direct drive two alarm relays to give latched ALERT and DANGER output. Please see the "introduction" section for other features.

II. TM301 Vibration Transmitter-Monitor Technical Specification

1. Electrical

Power Supply:

+24Vdc:

Voltage: 20 - 30VDC (nominal 24VDC)
with ripple less than $\pm 50\text{mV}$.

Current: Nominal 100mA.

220/110Vac:

Voltage: 190 - 250Vac for 220Vac version.
95 - 125Vac for 110Vac version.

Current: Less than 50mA.

Frequency Response (+/-3dB):

Normal: 2.0 - 5,000Hz.

Low Frequency: 0.5 - 100Hz.

Full Scale Range (4 - 20mA):

0—200um pk-pk

0—1000um pk-pk

0—100um pk-pk

0—10mil pk-pk

0—50mil pk-pk

PREDICTECH = TM User's Manual

Fax: (+1-413)793-8109, Email: pti@predictech.com, Web: www.predictech.com

- 0—5mil pk-pk
- 0—200um pk-pk (0.5-100Hz)
- 0—1000um pk-pk (0.5-100Hz)
- 0—100um pk-pk (0.5-100Hz)

Eddy Probe Sensitivity:

8.0mV/um (200mV/mil).

Buffer Output:

Original signal output with 500Ω output impedance.

Overall Vibration Output:

4.0 - 20mA. or

1.0 - 5.0V.

Alert and Danger Output:

Set-point Range:

Alert: 0 - Full Scale.

Danger: 0 - Full Scale.

(Recommend from 20% - 90% range).

Set-point Accuracy:

Less than ± 1% of Full Scale.

Set-point Sensitivity:

10 turn potentiometer.

Set-point Cross-talk:

Better than 60dB.

Relay Specification:

Seal: Epoxy sealed.

Capacity: 5A/220VAC. or 5A/24VDC (recommend
2A max).

Contact Type: SPDT.

Isolation from the circuitry:

1000VDC isolation.

Alarm Factory Default Setting:

Latching;

Normally de-engaged;

3 seconds nominal time defeat.

LED indicator:

System OK (Green):

Sensor input in the range from about -1.5 to -19.5V;

No short and open in the input.

Transmitter-Monitor self-checking passed.

Alert (Yellow): While above the specified set point.

Danger (Red): While above the specified set point.

PREDICTECH = TM User's Manual

Fax: (+1-413)793-8109, Email: pti@predictech.com, Web: www.predictech.com

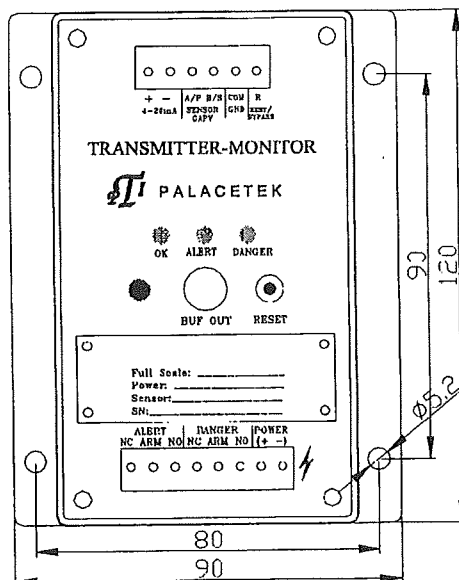


Figure 9. TM301 Vibration Transmitter-Monitor Outline

2. Physical.

Size: 90(3.5")W × 120(4.6")L × 75(3.0")H. - See Figuration
Weight: about 250gm.
Connectors:
Signal: 4-20mA(2), Reset(1), GAP(A/P, B/S)(2), COM(1)
Power: Power(2).
Buf Out: BNC connector
Alarm: Alert(3), Danger(3).

3. Environment.

Temperature:
Operation: -25°C to +65°C.
Storage: -40°C to +100°C.
Humidity:
90% non-condense.

4. Factory default.

The factory default for the relay options is:

- Power-up-inhibit about 20sec.
- Alert and Danger time delay 3sec.
- Latching.
- Normally de-energized.

PREDICTECH = TM User's Manual

Fax: (+1-413)793-8109, Email: pti@predictech.com, Web: www.predictech.com

Please contact factory for options that differ from the default.

III. Order Information.

TM301—AXX—BXX—CXX—DXX—EXX—FXX

Standard Configuration:

TM301—A00—B00—C00—D00—E00—F00

AXX: Full Scale

- A00*: 0—200um pk-pk
- A01: 0—500um pk-pk
- A02: 0—100um pk-pk
- A03: 0—10mil pk-pk
- A04: 0—25mil pk-pk
- A05: 0—5mil pk-pk
- A06: 0—200um pk-pk (0.5-100Hz)
- A07: 0—500um pk-pk (0.5-100Hz)
- A08: 0—100um pk-pk (0.5-100Hz)

BXX: Power

- B00*: +24VDC
- B01: 220VAC
- B02: 110VAC

CXX: Alarm

- C00*: Epoxy Sealed Relays
- C01: No Alarm

DXX: Output

- D00*: 4—20mA
- D01: 1—5V

EXX: Eddy-Probe System

- E00*: TM0180, 5m System
- E01: TM0180, 9m System
- E02: 3300, 5m System
- E03: 3300, 9m System
- E04: 7200, 5m System
- E05: 7200, 9m System

FXX: Buf Out

- F00*: With Buffer Output

PREDICTECH = TM User's Manual

Fax: (+1-413)793-8109, Email: pti@predictech.com, Web: www.predictech.com

F01: No Buffer output

* Denote factory default.

PREDICTECH = TM User's Manual

Fax: (+1-413)793-8109, Email: pti@predictech.com, Web: www.predictech.com

IV. Field Wiring Diagram.

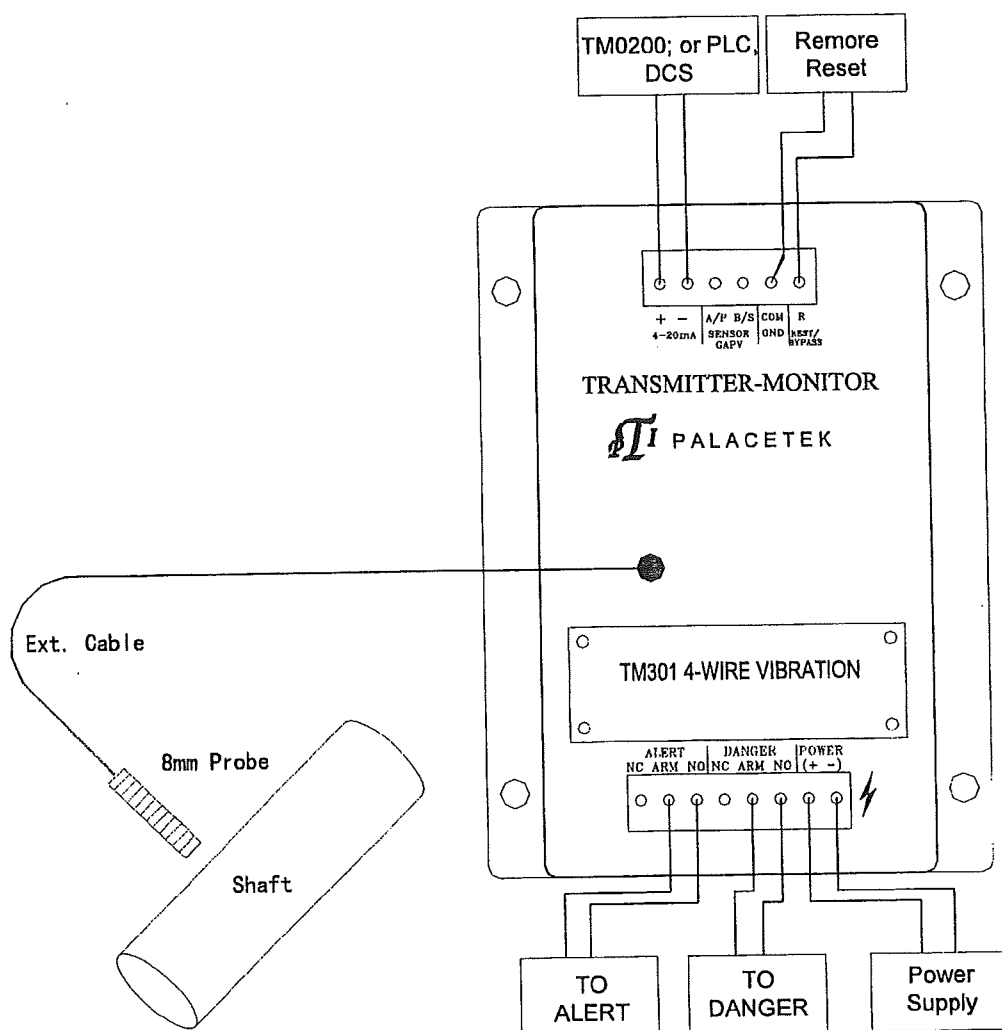


Figure 10. TM301 Field Wiring Diagram

PREDICTECH = TM User's Manual

Fax: (+1-413)793-8109, Email: pti@predictech.com, Web: www.predictech.com

V. Field Set-up

1. Probe Gap Set-Up

A. General

The eddy-probe gap can be set-up in the field via. measure the gap voltage (GAP V).

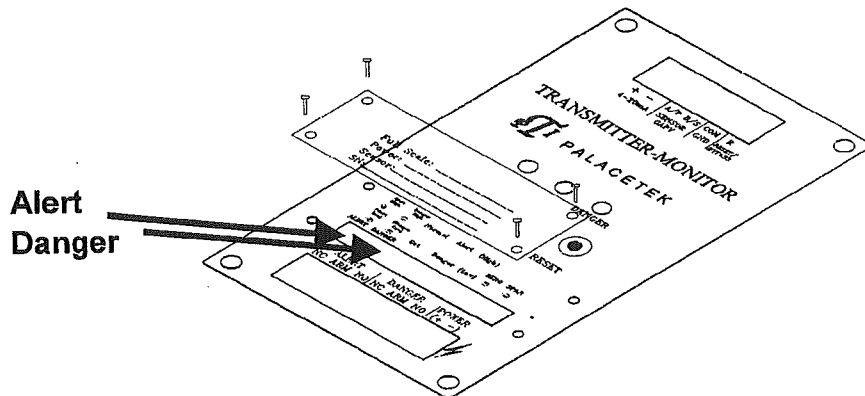
B. What do you need for set-up

You need a voltmeter to set-up the proper gap.

C. Set-up Procedure(1) – Utilize Voltmeter

- Mount the probe against the shaft.
- Connect the probe, the extension cable, and the TM301.
- Connect the voltmeter to A/P and B/S on TM301.
- Turn the power of TM301 on.
- Gap the probe against the shaft, read the voltmeter until it shows 8V +/- 0.5V.
- Tighten the probe.

2. Alert and Danger Set-Up



A. General

The Alert and Danger level can be set-up in the field or by factory if you forward the information to the manufacture with the order.

B. What do you need for set-up

You need one of the following equipment to process the set-up.

- A multi-meter with current measurement capability. Or,
- The TM0200 display unit.

PREDICTECH = TM User's Manual

Fax: (+1-413)793-8109, Email: pti@predictech.com, Web: www.predictech.com

C. Set-up with TM0200

- a.> Connect the TM0200 display unit (to 4-20mA connectors) and connect the power supply. Wait for about 30 second. The OK LED will be on. Press the local "RESET".
- b.> Remove the 4 screws from the front panel (see Fig).
- c.> Turn the left switch from "NORMAL" to "SET", the right one to "ALERT".
- d.> Slowly turn the ALERT potential-meter until the TM0200 indicate the correct set-point.
- e.> Repeat the procedure above to set "DANGER" level.
- f.> Turn the switch from "SET" back to "NORMAL".
- g.> Put the front panel back to the monitor.
- h.> Press the "RESET" button again to de-engage the relays.

D. Set-up with Multi-Meter

- a) Calculate the set-point vs. current value.

The current value for the multi-meter set-point $I(\text{set})$ based on the position set-point $V(\text{set})$ vs. position full-scale $V(\text{fs})$ is based on the following equation (mA):

$$I(\text{set}) = 4 + 16 \times V(\text{set}) / V(\text{fs}).$$

For Example, if the set-point is 100um, and the full scale range is 200um, the set-point is:

$$I(\text{set}) = 4 + 16 \times 100/200 = 12(\text{mA})$$

- b) Connect the current meter to 4-20mA terminals.
- c) Repeat procedure "V.2.C", be aware to use the calculated current value to replace the TM0200 indication.

VI. Field Operation

1. Power-up

During power up, the Transmitter-Monitor will engaged in the self-test mode. The self-test will testing the transducer OK, the Transmitter-Monitor circuitry. The total time is roughly 20 seconds. After the inhibit time period, the green OK LED will be on.

2. Operation

A. OK status

The OK LED will remain on if the transducer and the Transmitter-Monitor work properly unless one of the following condition meet:

- a.> Power supply failure.
- b.> Transducer failure.

- c.> Field wiring from the transducer to the Transmitter-Monitor shorted or opened.
- d.> Transmitter-Monitor internal circuitry failure.
- e.> Gap is not properly set.

B. Alarm status

The alarm (Alert or Danger) will be engaged if all the following condition meets:

- a.> Transmitter-Monitor and transducer works OK (green LED on).
- b.> Position goes over the set-point (higher or lower), and remains over for about 3 seconds.

C. Transmitter-Monitor Reset

After the alarm been engaged, it will keep until one of the following condition meet:

- a.> Local "RESET" been pushed.
- b.> or the remote "RESET" been pushed.
- c.> or the power supply been disconnected.

CAUTION

DO NOT touch any switches during normal operation. Turning switches will cause abrupt signal change and possibly engaged the alarms.

DO NOT try to adjust set-point during normal operation, this will also likely engaged the alarms.

D. Buffer Output

Buffer output will directly interface with any diagnostics or condition monitoring equipment. The Buffer output will have the same unit as the overall vibration output.

CAUTION

It is not recommended that the diagnostics instrument been directly connected with the Buffer output in the middle of the operation. This will likely been engaged in the ground loop problem and will possibly generate false vibration signal.

If you insist to connect the instrument to the Buffer output during the machine operation, you must isolate the instrument from ground. In another word, you must make sure the diagnostics instrument and the Transmitter-Monitor only has one ground.

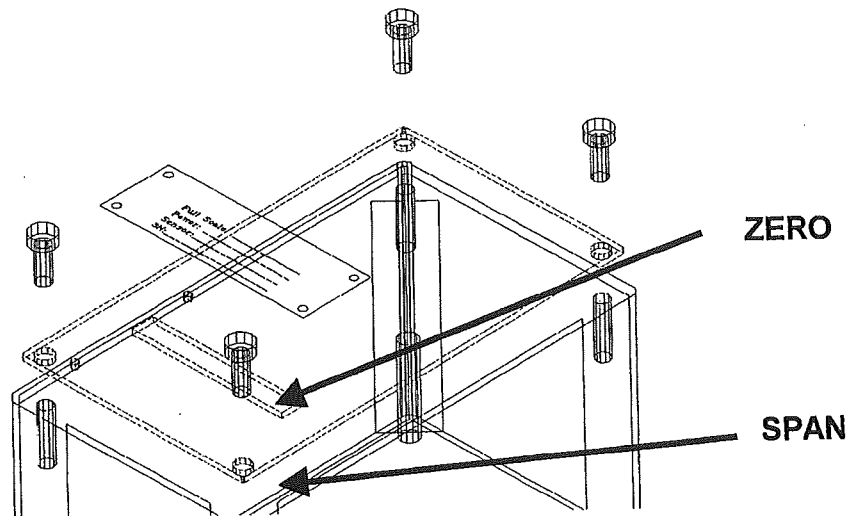
VII. 4-20mA Calibration Procedure (for certified Engineer only)

PREDICTECH = TM User's Manual

Fax: (+1-413)793-8109, Email: pti@predictech.com, Web: www.predictech.com

The main task for calibration is to adjust the "ZERO" and "SPAN" to conform to the output 4-20mA. This can only be done with experienced(certified) engineer. with special equipment. Please contact with PredicTech for more details.

- 1) Remove the four screws from the corner of the monitor.
- 2) Connect the driver, extension cable and eddy probe to shaker, gap the eddy-probe



to until the gap voltage shows $8V \pm 0.1V$.

- 3) Remove the 4 screws from the front cover.
- 4) With the shaker standstill, turn the "ZERO" potential-meter till the 4-20mA output indicate 4.00mA.
- 5) Turn the shaker to the full-scale vibration. Turn the "SPAN" potential-meter on the side of low-right corner of the monitor, till the 4-20mA output indicate 20.0mA.
- 6) Repeat procedure 4) and 5) four times.
- 7) Put the monitor back to normal.

CAUTION

The 4-20mA output has been factory calibrated before the shipment. Unless you are sure you understand the conversion factor, and you have the special tools, otherwise, please do not try to calibrate it.