



# **INSTRUCTION MANUAL**

## **VIBRATING WIRE READOUT UNIT**

### **Model MB-6T**

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This product should be installed and operated only by qualified personnel. Its misuse is potentially dangerous. The Company makes no warranty as to the information furnished in this manual and assumes no liability for damages resulting from the installation or use of this product. The information herein is subject to change without notification.

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# TABLE OF CONTENTS

<b>1</b>	<b>INTRODUCTION .....</b>	<b>1</b>
1.1	DESCRIPTION.....	1
1.2	FRONT PANEL .....	1
<b>2</b>	<b>SET-UP.....</b>	<b>5</b>
2.1	INSPECTION .....	5
2.2	BATTERY CHARGING.....	5
2.3	GAGE CONNECTION.....	5
2.4	GROUNDING.....	6
<b>3</b>	<b>GAGE READING .....</b>	<b>6</b>
3.1	NORMAL MODE READING.....	6
3.2	CONVERTED READINGS .....	6
3.2.1	Linear reading .....	7
3.2.2	Frequency reading.....	7
3.3	GAGE CONSTANT .....	7
3.4	TEMPERATURE READING .....	7
<b>4</b>	<b>READINGS .....</b>	<b>8</b>
<b>5</b>	<b>TROUBLESHOOTING.....</b>	<b>10</b>
5.1	MB-6T SELF TEST .....	10
5.2	GAGE READING.....	11
5.3	TEMPERATURE READING .....	13
<b>6</b>	<b>MAINTENANCE.....</b>	<b>13</b>
6.1	BATTERY .....	13
6.2	ELECTRICAL CONNECTORS.....	13
6.3	UNIT .....	13
<b>7</b>	<b>SPECIFICATIONS .....</b>	<b>14</b>

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# 1 INTRODUCTION

## 1.1 DESCRIPTION

The MB-6T readout is a self-powered, portable unit. It is designed to read vibrating wire instruments. In order to read a vibrating wire gage, the MB-6T readout unit performs the following operations:

1. It generates a frequency sweep to cause the wire to vibrate. This step is the wire “excitation”.
2. Once the wire is excited, the MB-6T amplifies the signal created by the wire vibrating in proximity to the coil, and measures the vibration period.

Use of a differential circuit with sinusoidal excitation eliminates harmonic problems. The latter may occur in readout units which use square wave scanning techniques.

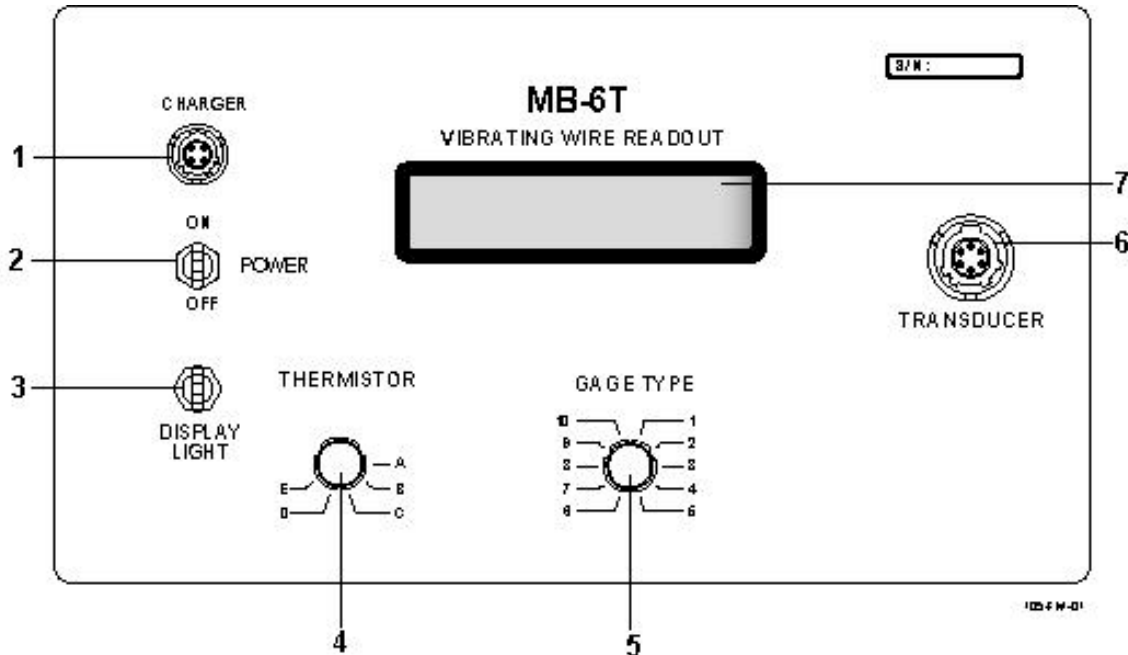
The MB-6T is equipped with a differential reading circuit which provides immunity against electrical noise. The sensitivity of this circuit enables the reading of very weak signals. This allows the MB-6T to read gages that are not readable with other readouts.

The readout unit simultaneously displays the **NORMAL (N)** and **LINEAR (L)** values as well as the temperature in °C and °F. For **NORMAL** readings, the period of the wire vibration is displayed directly in microseconds ( $1\mu\text{s} = 10^{-6}$  seconds). For **LINEAR** readings, the vibration period is used in a linearization function to calculate the “linearized reading”. Positions 1 and 7 are used to read the VBS and MSMS-4 gages, the linearized reading is replaced by the **FREQUENCY (F)** in hertz (Hz).

The MB-6T electronics are mounted inside a splash proof sealed case. It is not submersible.

## 1.2 FRONT PANEL

The MB-6T front panel consists of various switches, connecting sockets for the gage/battery charger cables, and a liquid crystal display screen. Each of these items is described in the following sections.



**FIGURE 1: MB-6T front panel**

### **Battery Charger Input Socket CHARGER (#1)**

This socket is used to connect the battery charger. The charger has an input of 120V, 60 Hz (or 220V AC, 50 Hz, depending on the model) and an output of 20V DC, 280 mA. A complete battery charge lasts up to 14 hours. The readout unit can take readings during battery charging.

### **ON/OFF Switch (#2)**

The ON/OFF switch is a spring loaded, double position switch. By momentarily turning the switch "ON", a timer circuit starts and activates the readout unit for a few minutes if the gage or thermistor is not connected 90 minutes if the gage or thermistor is connected. For any operation of a rotary switch or selector, the timer circuit is reset and the readout unit will remain ON for another 10 or 90 minutes. To turn the readout unit off, hold the switch for few seconds to the "OFF" position.

### **DISPLAY LIGHT (#3)**

This is used to illuminate the display and enhance the contrast when the ambient lighting is dim. To activate this function, press the "DISPLAY LIGHT" button and hold it until the display lights up. To turn off the light, press the "DISPLAY LIGHT" button and hold it until the light goes out.

**NOTE: THE DISPLAY LIGHT DOUBLES THE MB-6T POWER CONSUMPTION. THIS FEATURE SHOULD BE USED AS SELDOM AS POSSIBLE IN ORDER TO EXTEND BATTERY LIFE.**

#### **THERMISTOR Selector (#4)**

This switch allows the user to select the type of thermistor of the gage. The correspondence between the letters A through E is shown below and listed in the summary instructions printed in the front cover. In the case of gages using the  $R_{25} = 2 \text{ k}\Omega$  thermistor, switch the selector to the A (2k) position. For gages using the  $R_{25} = 3 \text{ k}\Omega$  and  $10 \text{ k}\Omega$  thermistors, select the B (3k) and C (10k) positions respectively.

*Note:  $R_{25}$  = Thermistor value at 25°C.*

The D (OHMS) position activates an ohmmeter function which measures resistance. This feature is useful when integrated thermistor in the gage does not have  $R_{25}$  equal to either  $2 \text{ k}\Omega$ ,  $3 \text{ k}\Omega$  or  $10 \text{ k}\Omega$ . The display will then show the resistance value in  $\Omega$  or  $\text{k}\Omega$ , as well as the battery voltage. If the gage has no thermistor, the readout unit will display: "---- $\Omega$ ". This function may also be used to check the continuity of the gage cable (refer to **Section 5**).

The E (BATTERY) displays the battery voltage instead of the temperature. If this option is selected, the display will show "BATT." and the voltage in volts along with the gage readings.

Position	Function
A	2K Thermistor
B	3K Thermistor
C	10K Thermistor
D	OHMS mode
E	BATTERY Check

**TABLE 1: Thermistor Type or Function vs. Selector Position**

#### **GAGE TYPE Selector (#5)**

A 10 position rotary switch enables the user to read up to 10 different gage types. Position 1 to 9 refers to standard gages listed inside the MB-6T cover. Position 10 is intended for special situations; for instance: the gage in use does not correspond to any other types listed in the MB-6T cover. The rotary switch position determines the excitation frequencies as well as the linearization equation with the appropriate gage factor. If the gage reading is out of the range specified by the switch position, then the readout unit will display the following error message "SIGNAL OUT OF RANGE CHECK V.W. SELECTION".

The table below shows gage type corresponding to each switch position.

Position	Gage type	Gage constant	Readout operating range
1	VBS-2	N/A*	175 - 380 $\mu$ s
2	JM	1.0000	300 - 900 $\mu$ s
3	SM-2, VH, IRHP	0.3911	310 - 780 $\mu$ s
4	PWS -P -F, TPC, EPC	1.0156	420 - 1000 $\mu$ s
5	EM-3	1.1560	620 - 1390 $\mu$ s
6	EM-5, SM-5	4.0624	900 - 2300 $\mu$ s
7	(Not used)	N/A*	460 - 1030 $\mu$ s
8	CL1, CLX	N/A*	740 - 1600 $\mu$ s
9	C, F, SC	N/A*	580 - 2300 $\mu$ s
10	All gages	1.0000	180 - 2300 $\mu$ s

\* Gage type without gage constant will display their readings in frequency instead of linearized units.

**TABLE 2: Gage type vs. selector position**

**NOTE: POSITION 10 "ALL GAGES" IS INTENDED FOR SPECIAL APPLICATIONS. ALWAYS USE THE POSITION CORRESPONDING TO GAGE TYPE.**

### GAGE SOCKET (#6)

A cannon type socket is used to connect the gages.

**WARNING: THE JUMPER CABLE LEADS SHOULD NEVER BE SHORT-CIRCUITED WHEN CONNECTED TO THE READOUT UNIT'S FRONT PANEL.**

### LCD Display Screen (#7)

The display is a liquid crystal display with 2 lines of 20 characters each. The characters are 4.8 mm high. The display may be backlit by using the display light feature.

## 2 SET-UP

### 2.1 INSPECTION

Unpack the MB-6T readout unit, and make sure there is no noticeable damage. The carrying pouch should include the patch cords and battery charger.

### 2.2 BATTERY CHARGING

The readout unit has an integral lead-acid battery which produces 12V, 2.3 Ah. The MB-6T is equipped with a floating charge circuit. The charger may be plugged in permanently maintaining the battery at its maximum charge.

**NOTE: KEEP THE READOUT UNIT FULLY CHARGED ESPECIALLY IF IT IS NOT USED FOR A LONG PERIOD OF TIME. A BATTERY DISCHARGED UNDER 11 VOLTS CAN SUFFER PERMANENT DAMAGE.**

The readout unit has a battery life of approximately 20 hours (10 hours if the display light is kept on). If the battery voltage goes below 12 volts, the following message will be displayed: "BATTERY TOO LOW, PLEASE RECHARGE". Nevertheless, the readout unit will still operate. If the battery voltage goes below 11 volts, then the same message will be displayed and the readout unit will automatically turn off.

To charge the battery, connect the charger plug into the CHARGER socket located on the front panel, then connect the charger to the appropriate power source. Approximately 14 hours are needed for a complete charge.

### 2.3 GAGE CONNECTION

Connect the multicore cable male in the six electrical contact female connector on the front panel. Then connect the 4 alligator clips to the gage. The conductor's insulation is color coded to match that of the alligator clips and the instrument cable conductors insulation jacket. Connect the alligator clips to the gage lead wire according to **Table 3**.

Cable	Connections				
	WIRE HI (RED)	WIRE LO (BLACK)	THERM HI (WHITE)	THERM LO/SHIELD (GREEN)	
IRC-31	Red	Black	White	Shield	-
IRC-41A	Red	Black	White	Green	Shield

**TABLE 3: Wiring Code for Electrical Cable**

## 2.4 GROUNDING

Vibrating wire gages and thermistors are not usually affected by polarity changes (HI and LO reversal). However, if problems occur during gage readings, check the polarity referring to the wiring code shown in **Table 3**.

**CAUTION: IF THE READINGS APPEAR TO BE UNSTABLE, CONNECT THE CABLE SHIELD TO THE SHIELD INPUT (GROUND) ON THE READOUT UNIT. THE JUMPER CABLES SHOULD NEVER BE SHORT-CIRCUITED WHEN THEY ARE CONNECTED TO THE READOUT UNIT'S FRONT PANEL.**

## 3 GAGE READING

### 3.1 NORMAL MODE READING

**NORMAL** readings are displayed in the format: N=324.47 $\mu$ s. These readings correspond to the vibrating wire period. The period is displayed with a 0.01 $\mu$ s accuracy.

### 3.2 CONVERTED READINGS

Depending on the gage type selected (refer to **Table 2**), the readout unit will display the **NORMAL (N)** reading and the **LINEAR (L)** reading or the **FREQUENCY (F)**.

**NOTE: THE MB-6T DISPLAYS NORMAL (N) READINGS WITH TWO DECIMAL PLACES, BUT USES THREE DECIMAL PLACES FOR INTERNAL PROCESSING. FOR THIS REASON, THE LINEAR OR FREQUENCY VALUES DISPLAYED BY THE MB-6T MAY VARY SLIGHTLY (LESS THAN 0.01%) WITH RESPECT TO THE VALUES COMPUTED MANUALLY, USING THE EQUATIONS BELOW. THE VALUES DISPLAYED BY THE MB-6T ARE MOST ACCURATE ONES.**

### 3.2.1 LINEAR READING

In the linear mode, the vibrating wire period is linearized using the following equation:

$$L = \frac{K \times 10^9}{N^2}$$

Where:  $K$  = gage constant, specific to each kind of gage (refer to **Table 2**)

$N$  = NORMAL reading in  $\mu$ seconds

$L$  = LINEAR reading

The use of the **LINEAR** readings simplifies data conversion to engineering units. The conversions are described in the individual gage manuals.

### 3.2.2 FREQUENCY READING

When the selected gage type does not use a gage constant (refer to **Table 2**), then the **LINEAR (L)** reading is not displayed. It is replaced by a **FREQUENCY (F)** reading, according to the following equation:

$$F = \frac{10^6}{N}$$

Where:  $N$  = NORMAL reading in  $\mu$ seconds

$F$  = FREQUENCY in Hertz

## 3.3 GAGE CONSTANT

The gage constant is used in the linearization function. This constant depends on the gage type as well as on the wire length. **Table 2** summarizes the gage constants for the different gage instruments.

## 3.4 TEMPERATURE READING

The MB-6T readout unit reads the thermistor integrated in the gage, then converts the resistance value into temperature and displays the temperature in  $^{\circ}$ C and  $^{\circ}$ F. To obtain correct readings, position the selector switch to the position corresponding to the type of thermistor in the gage (see **Table 1**). The thermistor response corresponds to the DALE curve 1, either for the 2k, 3k and 10k. If the thermistor is not one of the above, then position the switch to D (OHMS) and record the resistance value.

The resistance is converted to temperature using conversion tables appropriate for the thermistor.

If the gage has no thermistor or if the readout unit is not connected to the gage thermistor, then the default temperature is displayed. This is the internal readout unit temperature.

## 4 READINGS

To take a reading, perform the following steps:

1. First, connect a gage to the MB-6T readout unit.
2. Turn the power switch to “ON”.

The screen will successively display:

**\*\* VIBRATING WIRE \*\***

**\*\* READOUT UNIT \*\***

and

**\*\*\*\* SELF TEST \*\*\*\***

**(V1234567890)**

The readout unit then displays the gage type and gage factor for the current position of the rotary switch. The display then shows the current setting of the thermistor selector switch and the current battery voltage.

**GAGE TYPE = EM-5, SM-5**

**GAGE FACTOR = 4.0624**

<b>THERMISTOR</b>	<b>= IRAD-2k</b>
<b>BATTERY</b>	<b>= 12.4V</b>

The readings are then displayed as follows:

NORMAL reading	-->	<b>N = 512.43 <math>\mu</math>s</b>	<b>20.4°C</b>	<--	temperature in °C
LINEAR reading	-->	<b>L = 1547.1</b>	<b>68.7°F</b>	<--	temperature in °F

If there is no thermistor present, or if its temperature exceeds the readout unit range, then the internal temperature of the readout unit will be displayed in °C or °F.

NORMAL reading	-->	<b>N = 512.43 <math>\mu</math>s</b>	<b>20.4°C</b>	<--	temperature in °C
LINEAR reading	-->	<b>L = 1547.1</b>	<b>(int.)</b>	<--	MB-6T temp.

If the gage type position selected uses the frequency calculation, the display will look as follows:

NORMAL reading	-->	<b>N = 512.43 <math>\mu</math>s</b>	<b>20.4°C</b>	<--	temperature in °C
FREQUENCY	-->	<b>F = 1951.5 Hz</b>	<b>68.7°F</b>	<--	temperature in °F

If the thermistor selector is positioned on "D" (OHMS), the display will look as follows:

NORMAL reading	-->	<b>N = 512.43 <math>\mu</math>s</b>	<b>2.52k<math>\Omega</math></b>	<--	resistance
LINEAR reading	-->	<b>L = 1547.1</b>	<b>12.6v</b>	<--	battery voltage

If the thermistor is positioned on "E" (BATTERY), the display will look as follows:

NORMAL reading	-->	<b>N = 512.43 <math>\mu</math>s      BATT.</b>	
LINEAR reading	-->	<b>L = 1547.1              12.6V</b>	<-- battery voltage

3. During the display, record the current NORMAL and LINEAR readings as well as the gage serial number.

**NOTE: IF A ROTARY SWITCH IS TURNED WHILE THE READOUT UNIT IS DISPLAYING READINGS, THEN THE READOUT UNIT WILL DISPLAY THE NEW ROTARY SWITCH POSITION, BEFORE IT DISPLAYS READINGS AGAIN.**

## 5 TROUBLESHOOTING

### 5.1 MB-6T SELF TEST

When the MB-6T readout unit is powered up, it performs a basic check of its internal circuit and it displays the following message:

**\*\*\*\* SELF TEST \*\*\*\***

**(V1234567890)**

The results of this test are displayed inside brackets, on the second screen line. The first character “V” is displayed if the internal voltage regulator operates properly.

The following characters (**1234567890**) refer to gage type numbers and are displayed successively, as the checking goes along. If an error is found during the test, one or several of the characters will be replaced by: “#”, “+”, “-”.

**Example:**

**\*\*\*\* SELF TEST \*\*\*\***

**(V123#567890)**

The previous example indicates that the readout unit cannot operate properly when the gage selector is positioned on 4. The readout unit will function for the other gage types.

When a gage is connected to the readout unit, tests should be done without anomalies. However, if one or more errors are detected, a new test should be done by disconnecting the gage from the unit. To carry out a new "SELF-TEST" shut the unit off and put it back on. If the anomaly persists, contact the manufacturer.

## 5.2 GAGE READING

Other error messages that may appear are:

### 1. MESSAGE:

<p><b>BAD QUALITY SIGNAL</b></p> <p><b>READING MAY BE WRONG</b></p>
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### DIAGNOSIS:

The readout unit received a low quality signal which may affect the reading accuracy or may produce false readings. The message is displayed in between readings.

Check the selected gage type and its connection (refer to **Section 2.3**). Refer to the gage operation manual for gage testing procedures.

### 2. MESSAGE:

<p><b>SIGNAL OUT OF RANGE</b></p> <p><b>GAGE DISCONNECTED?</b></p>
--

in turn with:

<p><b>N = _____ 20.4°C</b></p> <p><b>68.7°F</b></p>
---

**DIAGNOSIS:**

The readout unit does not receive the output signal from the gage. Check the patch cords connecting the readout unit and the gage. A damaged gage or a broken cable may produce this type of error.

To check the continuity of the gage cable, insert the gage patch cord in the transducer socket and position the thermistor selector to D (OHMS). The following reading: “----kΩ” means that a cable is severed or that a gage is broken.

The resistances of Gage coils in good working conditions are as follows:

Gage Type	Resistance OHMS
SM-2W	144
VBS	115
SM-2A	57
SM-A, SM-B, EM, VH	90 or 140
PWS, JM, TPC, EPC	187

For other types, refer to the manufacturer’s manual.

**3. MESSAGE:**

**SIGNAL OUT OF RANGE  
CHECK V.W. SELECTION**

in turn with:

**N = \_\_\_\_\_ 20.4°C  
68.7°F**

**DIAGNOSIS:**

The wire frequency is outside the selected gage type range (refer to **Table 2**). Most likely, the selected gage type does not match the gage being read.

Make sure that the gage type rotary switch position is in accordance with **Table 2** or with the chart in the readout unit cover. If the gage type was properly selected and the trouble remains, then switch off the readout unit and switch it on again in order to perform the “self-test” procedure. Make sure that no fault is detected concerning the gage type used. If no error is indicated by the “self-test” procedure, check the gage connection as well as the gage itself.

### 5.3 TEMPERATURE READING

Extreme temperatures (cold as well as hot) may significantly influence the readings. Therefore, the gage temperature should be recorded during each data reading and added into the conversion calculations.

If the displayed temperature shows “(int.)” and the gage is equipped with a thermistor, then a bad connection or a temperature out of the MB-6T range (-40°C to 65°C) is most likely the problem.

## 6 MAINTENANCE

### 6.1 BATTERY

To optimize battery life, always keep the readout unit's battery fully charged and avoid extensive discharges. To charge the battery, follow the procedure described in **Section 2.2**.

<p><b>NOTE: IF AFTER CHARGING, THE MESSAGE “BATTERY TOO LOW, PLEASE RECHARGE”, IS STILL DISPLAYED, THEN RETURN THE READOUT UNIT ALONG WITH THE CHARGER TO ROCTEST FOR TESTING AND/OR REPAIR. BATTERY REPLACEMENT MUST BE PERFORMED BY A QUALIFIED TECHNICIAN.</b></p>
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### 6.2 ELECTRICAL CONNECTORS

To ensure good electrical contact, periodically clean the alligator clips as well as the cable connectors using a clean rag dampened with alcohol. Do not use any harsh cleaners on the MB-6T front panel, mild soapy water is recommended.

During readings, avoid water or mud splashes on the contacts.

### 6.3 UNIT

As with all electronic instruments, this unit must be protected against shock as well as against water and dust. Avoid storage and use of the unit in extreme temperatures.

## 7 SPECIFICATIONS

<b>Dimensions:</b>	15 cm x 15 cm x 25 cm	
<b>Weight:</b>	3.1 kg	
<b>Measuring Range:</b>	Vibrating wire:	180 to 2300 $\mu$ sec (435 to 5600 Hz)
	Temperature:	-40°C to +65°C
	Resistance:	0 to 100 k $\Omega$
<b>Excitation mode:</b>	Sine wave	
<b>Displayed Resolution:</b>	Wire:	0.01 $\mu$ sec (NORMAL) 0.01 units (LINEAR) 0.01 Hz (FREQUENCY)
	Temperature:	0.1°C (0.1°F)
	Resistance:	0.1% of full scale
<b>Pre-programmed thermistor type:</b>	2, 3 and 10 k $\Omega$	
<b>Battery:</b>	12 VDC, 2.3 A h, lead-acid rechargeable	
<b>Battery Life (typical):</b>	20 hours of continuous operation (10 hours with backlight activated)	
<b>Operating Temperature:</b>	-5°C to +45°C	
<b>Storage Temperature:</b>	-30°C to +55°C	
<b>Display:</b>	Liquid crystal, 2 lines, 20 characters each, with selectable backlight	