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*Instruction Manual*  
**Model RB-500**  
**MEMS Sensor Readout Box**



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## **1. INTRODUCTION**

The Geokon Model RB-500 MEMS (Micro Electro Mechanical Structure) Sensor Readout Box is a portable battery powered instrument for reading the voltage output from the Geokon 6150 and 6155 MEMS In Place Inclinerometers, the Geokon 6160 MEMS tilt sensors, and the Model 6101 Portable Tiltmeter.

The Readout Box incorporates a 12 volt, 1.2 Ahr Lead acid battery, a 4½ digit liquid crystal display (LCD), a power on/off switch, an A/B selector switch, a battery charger circuit, an AC adaptor connector, and a 10-pin Bendix connector and a terminal strip.

The RB-500 instrument supplies +12V power to the MEMS sensor and displays the output in Volts which is proportional to the sine of the angle of inclination.

## **2. INCLINATION MEASUREMENT**

Complete the following steps:

- 1) Connect the MEMS Sensor to the readout box by means of the 10-pin plug or, if bare leads, by means of the terminal strip on the face panel following the printed color code on the panel.

Wire Color	Description
RED	+12V Power
RED'S BLACK	GROUND
WHITE	Channel A +Voltage Output
WHITE'S BLACK	Channel A –Voltage Output
SHIELD	Cable overall shield
GREEN	Uniaxial sensors: Thermistor +
	Biaxial sensors: Channel B +Voltage Output
GREEN'S BLACK	Uniaxial sensors: Thermistor –
	Biaxial sensors: Channel B –Voltage Output
BLUE	Biaxial sensors: Thermistor +
BLUE'S BLACK	Biaxial sensors: Thermistor –

**Table 1 - Wiring Chart**

**Warning! Do not allow the RED and RED'S BLACK leads to touch each other, if the leads do touch each other it will blow the internal 0.6A Slo-Blo fuse. Additional fuses are supplied with the readout box.**

- 2) Switch the power switch to the "ON" position.
- 3) Switch the selector switch to the "A" position.
- 4) Read the display and record the reading.
- 5) If a Biaxial sensor is connected, switch the selector switch to the "B" position.
- 6) Read the display and record the reading.
- 7) Power the unit off with the "OFF" switch.

## 2.1 Data Interpretation

The calculated Tilt is derived from the equation:

$$\text{Tilt} = (R_1 - R_0)G$$

**Equation 1 - Tilt Calculation**

Where;

G = The gauge factor, (sin  $\theta$ /volt) **or** (degrees/volt) from the calibration report provided with the sensor. (A sample calibration report is provided in Appendix C.)

$R_0$  = The initial reading in volts as displayed on the RB-500

$R_1$  = The current readings in volts as displayed on the RB-500.

## 2.2 Reading Temperature

The RB-500 does not read temperatures.

The thermistor built into the sensor gives a varying resistance output as the temperature changes. To read the thermistor using an ohmmeter, complete the following:

- 1) Connect the ohmmeter to the two thermistor leads (refer to Table 1). Since the resistance changes with temperature are large, the effect of cable resistance is usually insignificant. For long cables a correction can be applied, equal to approximately  $14.7\Omega$  for every 1000 ft., or  $48.5\Omega$  per km at 20 °C. Multiply these factors by two to account for both directions.
- 2) Look up the temperature for the measured resistance in Table 3 in Appendix B

### **3. MAINTENANCE**

#### **3.1 General Maintenance**

Keep the following points in mind when using the RB-500 MEMS Sensor Readout to maximize reliability and accuracy of the unit.

- The readout box is splash proof, but it will not withstand complete immersion in water.
- The face plate should be kept clean and dry and the box should be stored in a warm dry area when not in use.
- The transducer connector is waterproof.
- The battery charger connector is not waterproof.
- In very wet or humid conditions, the connector should be kept sealed using the plug provided.
- **Do not spray oil or WD40 into the connections.** If they become wet, they must be dried prior to use or errors will likely result. Clean the connections with soap and water and dry thoroughly before use.

#### **3.2 Calibration**

The readout should be sent periodically (every 12 months) back to the manufacturer for inspection, cleaning, and calibration. A nominal fee will be charged for the service, but it is highly recommended.

#### **3.3 Battery Charging**

Battery charging is accomplished by plugging the AC adapter provided into the 3-pin connector on the readout box face plate and into the 120 VAC mains (230 VAC adaptor also available). The charger is automatic and can be left connected to the battery indefinitely. This will preserve the maximum charge condition with no danger to the battery.

CAUTION: Lead acid batteries are good in that they do not have the memory effect of Ni-Cad batteries. However, they do suffer from the disadvantage that they do not always recover from a deep discharge if the battery is allowed to go absolutely flat or dead. It is important, if the battery is not to be used for an extended period, that the charger be left plugged in. Also, avoid draining the battery completely.



## **4. TROUBLE SHOOTING**

If the readout box fails to put out any power, it may be because the 12-volt power lead was inadvertently shorted to ground. To check, remove the face plate and replace the 6/10 Amp fuse to be found in the fuse holder. Additional fuses are included with a new readout box. If the readout box fails to power up it may be that the internal two-amp fuse has blown. This fuse protects the battery in case of major internal malfunction. Additional fuses are included with a new box.

## **APPENDIX A. SPECIFICATIONS**

### **A.1 RB-500 Specifications**

<b>Range:</b>	$\pm 4.000$ Volts input.
<b>Resolution:</b>	$100\mu\text{V}$
<b>Accuracy:</b>	$\pm 0.06\%$
<b>Power Requirements:</b>	12 VDC @ 50 mA
<b>Battery Type:</b>	Lead acid 12 volt, 1.2 Ahr
<b>Operating Time:</b>	$\approx 24$ hours
<b>AC Adaptor:</b>	120 VAC: 50-60 Hz, 18 VDC, 533 mA 230 VAC: 50-60 Hz, 15 VDC, 800 mA
<b>Dimensions:</b>	$6.5 \times 4 \times 8.5$ ", $165 \times 102 \times 216$ mm
<b>Weight:</b>	5 lbs., 2.3 kg.
<b>Materials:</b>	Aluminum case and lid
<b>Operating Temperature:</b>	-20 to +120° F, -30 to +50° C
<b>Display:</b>	4½ digit LCD
<b>Input connection:</b>	Bulkhead: Bendix PTO2A-12-10S Mating: Bendix PY06A-12-10P(SR)
<b>Fuse</b>	Two 2A Slo-Blo (Geokon p/n ELC-412) One 0.6A Slo-Blo (Geokon p/n ELC-104)
<b>Charger connection:</b>	Bulkhead: Lemo EGG OK 303 CNL(N&W) Mating: Lemo FGG OK 303 CNA C/3.7

Table 2 - Specifications

### **A.2 Thermistor (Installed in MEMS Sensor)**


(see Appendix B also)

Range: -80 to +150° C

Accuracy:  $\pm 0.5^\circ\text{C}$

### Table 3 - Thermistor Resistance versus Temperature

## APPENDIX C. EXAMPLE CALIBRATION SHEET

 48 Spencer St. Lebanon, N.H. 03766 USA						
<h3>MEMS Tilt Sensor Calibration</h3>						
Model Number: <u>MEMS Tilt Sensor</u>				Calibration Date: <u>February 06, 2008</u>		
Serial Number: <u>Sensor A 08-542</u>				Temperature: <u>25.5 °C</u>		
Technician: _____						
Inclination (degrees)	Inclination (sinθ)	* Reading 1st Cycle (Volts)	* Reading 2nd Cycle (Volts)	* Average Reading (Volts)	Error in Calculated θ (%FS)	Error in Calculated sinθ (%FS)
10.00	0.1737	2.7616	2.7590	2.7603	-0.05	0.02
8.002	0.1392	2.2190	2.2165	2.2178	0.01	0.00
6.000	0.1045	1.6743	1.6727	1.6735	0.05	0.00
4.002	0.0698	1.1281	1.1280	1.1281	0.05	0.00
2.002	0.0349	0.5803	0.5802	0.5802	0.03	-0.01
0.000	0.0000	0.0322	0.0320	0.0321	0.00	0.00
-2.002	-0.0349	-0.5155	-0.5157	-0.5156	-0.02	0.02
-4.002	-0.0698	-1.0625	-1.0632	-1.0629	-0.03	0.02
-6.000	-0.1045	-1.6081	-1.6089	-1.6085	-0.03	0.02
-8.002	-0.1392	-2.1524	-2.1538	-2.1531	0.00	0.02
-10.00	-0.1737	-2.6947	-2.6958	-2.6953	0.07	0.00
<b>6150 and 6155 In-Place Inclinometer Gage Factor (G): <u>0.06368</u> (sinθ/ Volt)</b>						
<b>Temperature Correction Factor -0.0003 (T<sub>1</sub>-T<sub>0</sub>) Volts / °C</b>						
<b>Deflection = GL(R<sub>1</sub>-R<sub>0</sub>) mm (inches)</b>						
<b>6160 Tiltmeter Gage Factor (G): <u>3.6617</u> (degrees/ Volt)</b>						
<b>Temperature Correction Factor -0.0003 (T<sub>1</sub>-T<sub>0</sub>) Volts / °C</b>						
<b>Calculated Tilt = G(R<sub>1</sub> - R<sub>0</sub>) degrees</b>						
<b>Wiring Code: See manual for further information</b>						
The above instrument was found to be in tolerance in all operating ranges. The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1. This report shall not be reproduced except in full without written permission of Geokon Inc.						

**Figure 1 - Sample Calibration Sheet**