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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 ElectroMechanical Structure) Sensor Readout Box is a portable battery powered instrument for reading the voltage output from the Geokon 6150 and 6155 MEMS In Place InclInometers, and the Geokon 6160 MEMS tilt sensors.

## **2. DESCRIPTION:**

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 an Input Junction Box Assembly.

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.

Note that the RB500 does not read temperatures. To read temperature with uniaxial sensors only, connect a digital ohmmeter to the Green and Green's Black leads and read the resistance in ohms.

Use the table in Appendix 1 to find the temperature.

## **3. INCLINATION MEASUREMENT:**

Note the following steps...

- 1) Connect the MEMS Sensor to the readout box by means of the Input Junction Box Assembly. Connect the various colored wires from the MEMS Sensor to the appropriate Input Connector Assembly connection posts:

RED: +12V Power  
RED'S BLACK: GROUND

WHITE: Channel A +Voltage Output  
WHITE'S BLACK: Channel A -Voltage Output

SHIELD: Cable overall shield

GREEN: Channel B +Voltage Output (Biaxial sensors only) or  
Thermistor + (Uniaxial sensors)  
GREEN'S BLACK: Channel B -Voltage Output (Biaxial sensors only) or  
Thermistor - (Uniaxial sensors)

Plug the 10 pin Bendix connector from the Input Junction Box Assembly into the 10 pin Bendix Receptacle on the RB-500 front panel.

- 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.

### **3.1 Data Interpretation**

The calculated Tilt is derived from the equation:

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

Where;  $G$  = the gage factor, (sin  $\theta$ /volt) **or** (degrees/volt) – see typical calibration sheet. Appendix B.

And;  $R_1, R_0$  are the current and initial readings in volts as displayed on the RB-500 display.

## **4. MAINTENANCE:**

### **4.1 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.

## **4.2 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.

## **4.3 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. So it is important, if the battery is not to be used for an extended period of time, that the charger be left plugged in. Also, one should avoid draining the battery completely.

## **5. 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 2 Amp Slow-Blow fuze to be found in the fuse holder.

**6. RB 500 SPECIFICATIONS:****General**

Range:	±4.000 Volts input.
Resolution:	100µV
Accuracy:	0.0125%
Power Requirements:	12 VDC @ 50 mA
Battery Type:	Lead acid 12 volt, 1.2 Ahr
Operating Time:	≈24 hours
AC Adaptor:	120 VAC: 50-60 Hz, 18 VDC, 533 mA 230 VAC: 50-60 Hz, 15 VDC, 800 mA
Dimensions:	6.5 × 4 × 8.5", 165 × 102 × 216mm
Weight:	5 lbs., 2.3 kg.
Materials:	Aluminum case and lid
Operating Temperature:	-20 to +120° F, -30 to +50° C
Display:	4½ digit LCD
Input connection:	Bulkhead: Bendix PTO2A-12-10S Mating: Bendix PY06A-12-10P(SR)
Fuse	2 Amp Slow-Blow
Charger connection:	Bulkhead: Lemo EGG OK 303 CNL(N&W) Mating: Lemo FGG OK 303 CNA C/3.7

APPENDIX A - THERMISTOR TEMPERATURE DERIVATION

**Thermistor Type: YSI 44005, Dale #1C3001-B3, Alpha #13A3001-B3**

**Resistance to Temperature Equation:**

$$T = \frac{1}{A + B(\ln R) + C(\ln R)^3} - 273.2$$


Equation C-1 Convert Thermistor Resistance to Temperature

where: T = Temperature in °C.  
 LnR = Natural Log of Thermistor Resistance  
 A =  $1.4051 \times 10^{-3}$  (coefficients calculated over the -50 to +150° C. span)  
 B =  $2.369 \times 10^{-4}$   
 C =  $1.019 \times 10^{-7}$

Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp
201.1K	-50	16.60K	-10	2417	+30	525.4	+70	153.2	+110
187.3K	-49	15.72K	-9	2317	31	507.8	71	149.0	111
174.5K	-48	14.90K	-8	2221	32	490.9	72	145.0	112
162.7K	-47	14.12K	-7	2130	33	474.7	73	141.1	113
151.7K	-46	13.39K	-6	2042	34	459.0	74	137.2	114
141.6K	-45	12.70K	-5	1959	35	444.0	75	133.6	115
132.2K	-44	12.05K	-4	1880	36	429.5	76	130.0	116
123.5K	-43	11.44K	-3	1805	37	415.6	77	126.5	117
115.4K	-42	10.86K	-2	1733	38	402.2	78	123.2	118
107.9K	-41	10.31K	-1	1664	39	389.3	79	119.9	119
101.0K	-40	9796	0	1598	40	376.9	80	116.8	120
94.48K	-39	9310	+1	1535	41	364.9	81	113.8	121
88.46K	-38	8851	2	1475	42	353.4	82	110.8	122
82.87K	-37	8417	3	1418	43	342.2	83	107.9	123
77.66K	-36	8006	4	1363	44	331.5	84	105.2	124
72.81K	-35	7618	5	1310	45	321.2	85	102.5	125
68.30K	-34	7252	6	1260	46	311.3	86	99.9	126
64.09K	-33	6905	7	1212	47	301.7	87	97.3	127
60.17K	-32	6576	8	1167	48	292.4	88	94.9	128
56.51K	-31	6265	9	1123	49	283.5	89	92.5	129
53.10K	-30	5971	10	1081	50	274.9	90	90.2	130
49.91K	-29	5692	11	1040	51	266.6	91	87.9	131
46.94K	-28	5427	12	1002	52	258.6	92	85.7	132
44.16K	-27	5177	13	965.0	53	250.9	93	83.6	133
41.56K	-26	4939	14	929.6	54	243.4	94	81.6	134
39.13K	-25	4714	15	895.8	55	236.2	95	79.6	135
36.86K	-24	4500	16	863.3	56	229.3	96	77.6	136
34.73K	-23	4297	17	832.2	57	222.6	97	75.8	137
32.74K	-22	4105	18	802.3	58	216.1	98	73.9	138
30.87K	-21	3922	19	773.7	59	209.8	99	72.2	139
29.13K	-20	3748	20	746.3	60	203.8	100	70.4	140
27.49K	-19	3583	21	719.9	61	197.9	101	68.8	141
25.95K	-18	3426	22	694.7	62	192.2	102	67.1	142
24.51K	-17	3277	23	670.4	63	186.8	103	65.5	143
23.16K	-16	3135	24	647.1	64	181.5	104	64.0	144
21.89K	-15	<b>3000</b>	<b>25</b>	624.7	65	176.4	105	62.5	145
20.70K	-14	2872	26	603.3	66	171.4	106	61.1	146
19.58K	-13	2750	27	582.6	67	166.7	107	59.6	147
18.52K	-12	2633	28	562.8	68	162.0	108	58.3	148
17.53K	-11	2523	29	543.7	69	157.6	109	56.8	149
								55.6	150

Table C-1 Thermistor Resistance versus Temperature

## Appendix B Calibration Sheet.

		48 Spencer St. Lebanon, N.H. 03766 USA				
<b>MEMS Tilt Sensor Calibration</b>						
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 θ (%FS)	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 Inclinator 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>						
Wiring Code: See manual for further information						
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.						