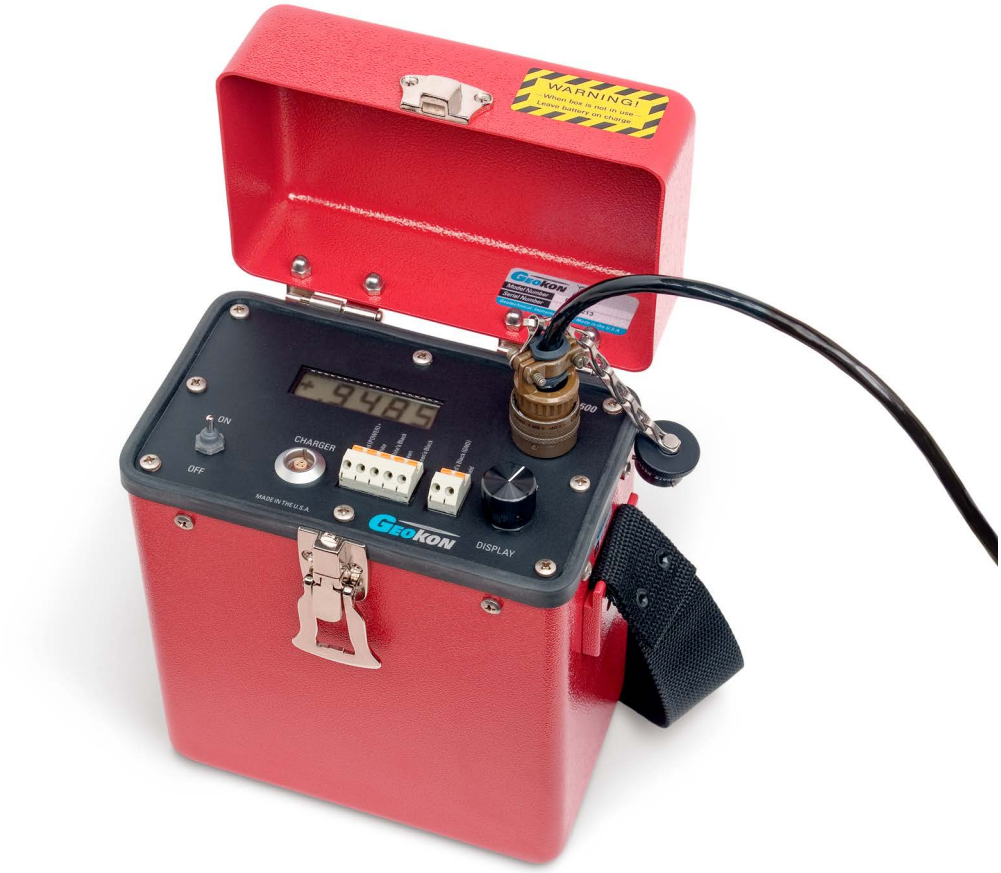
Model RB-500

MEMS Sensor Readout Box

Instruction Manual



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GEOKON warrants its products to be free of defects in materials and workmanship, under normal use and service for a period of 13 months from date of purchase. If the unit should malfunction, it must be returned to the factory for evaluation, freight prepaid. Upon examination by GEOKON, if the unit is found to be defective, it will be repaired or replaced at no charge. However, the WARRANTY IS VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion or current, heat, moisture or vibration, improper specification, misapplication, misuse or other operating conditions outside of GEOKON's control. Components that wear or are damaged by misuse are not warranted. This includes fuses and batteries.

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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 GEOKON Model 6100 Series MEMS sensors.

The readout box incorporates a 12 volt, 1.2 Ahr Lead acid battery, a 4 1/2 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. TAKING READINGS

Complete the following steps to take an inclination measurement.

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.

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.

Wire Color	Description
RED	+12 V 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*

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 MEASURING TEMPERATURES:

The RB-500 does not read temperatures. Most sensors are equipped with a thermistor for reading temperature. The thermistor gives a varying resistance output as the temperature changes.

USING AN OHMMETER TO READ TEMPERATURES:

Connect an ohmmeter to the thermistor leads indicated on 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 48.5Ω per km (14.7Ω per 1000') at 20 °C. Multiply these factors by two to account for both directions

Look up the temperature for the measured resistance in Appendix B.

3. DATA REDUCTION

3.1 STANDARD TILT CALCULATION

The calculated Tilt is derived from the equation:

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

EQUATION 1: *Standard Tilt Calculation*

Where:
G = Gauge factor (sin θ/volt) **or** (degrees/volt) from the calibration report provided with the sensor.
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.

3.2 SERIAL NUMBER 1123750 AND PRIOR TILT CALCULATION

$$\text{Tilt} = 2(R_1 - R_0) \times G$$

EQUATION 2: *Serial Number 1123750 and Prior Tilt Calculation*

Where:
G = Gauge factor (sin θ/volt) **or** (degrees/volt) from the calibration report provided with the sensor.
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.

4. MAINTENANCE

4.1 GENERAL MAINTENANCE

Keep the following points in mind when using the Model 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. 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.

5. TROUBLESHOOTING


Technical Support

Maintenance and troubleshooting of the sensor is confined to periodic checks of cable connections and maintenance of terminals. The transducers themselves are sealed and are not user serviceable. **Sensors should not be opened in the field.**

Should difficulties arise, consult the following list of problems and possible solutions. For additional troubleshooting and support visit geokon.com/Technical-Support.

SYMPTOM: READOUT BOX FAILS TO PUT OUT POWER

☐ The 12-volt power lead may have inadvertently shorted to ground. 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.

SYMPTOM: READOUT BOX FAILS TO POWER UP

☐ The internal two-amp fuse may have been blown. This fuse protects the battery in case of major internal malfunction. Remove the face plate and replace the two-amp fuse to be found in the fuse holder. Additional fuses are included with a new readout box.

APPENDIX A. SPECIFICATIONS

A.1 MODEL RB-500 SPECIFICATIONS

Range	Standard: ±9.999 Volts Input Serial Number 1223750 and Prior: ±4.000 Volts Input
Display Resolution	Standard: ±9.999 Volts Input Serial Number 1223750 and Prior: ±1.999 Volts Input
Resolution	100 μ V
Accuracy	±0.06% F.S.
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	102 × 165 × 232 mm (4 x 6.5 x 9.1")
Weight	2.3 kg (5 lbs)
Materal	Aluminum Case and Lid
Operating Temperature	-30 to +50 °C (-20 to +120 °F)
Display	4 1/2 digit LCD
Input Connection	Bulkhead: Bendix PTO2A-12-10S Mating: Bendix PY06A-12-10P (SR)
Fuse	Two 2 A Slo-Blo (GEOKON p/n ELC-412) One 0.6 A Slo-Blo (GEOKON p/n ELC-104)
Charger Connection	Bulkhead: Lemo EGG OK 303 CNL (N&W) Mating: Lemo FGG OK 303 CNA C/3.7

TABLE 2: *Model RB-500 MEMS Readout Box Specifications*

A.2 THERMISTOR

(See Appendix B also)

Range: –80 to +150 °C

Accuracy: ±0.5 °C

APPENDIX B. THERMISTOR TEMPERATURE DERIVATION

B.1 3KΩ THERMISTOR RESISTANCE

Thermistor Types include YSI 44005, Dale #1C3001–B3, Alpha #13A3001–B3, and Honeywell 192–302LET–A01

Resistance to Temperature Equation:

$$T = \frac{1}{A + B(LnR) + C(LnR)^3} - 273.15$$

EQUATION 3: *3KΩ Thermistor Resistance*

Where:
T = Temperature in °C
LnR = Natural Log of Thermistor Resistance
A = 1.4051×10^{-3}
B = 2.369×10^{-4}
C = 1.019×10^{-7}
Note: Coefficients calculated over the –50 to +150 °C span.

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

TABLE 3: *3KΩ Thermistor Resistance*

APPENDIX C. TYPICAL CALIBRATION REPORT

GEOKON 48 Spencer St. Lebanon, N.H. 03766 USA

MEMS Tilt Sensor Calibration

Model Number: MEMS Tilt Sensor

Calibration Date: February 06, 2008

Serial Number: Sensor A 08-542

Temperature: 25.5 °C

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

6150 and 6155 In-Place Inclinometer Gage Factor (G): 0.06368 (sinθ/ Volt)

Temperature Correction Factor -0.0003 (T_1-T_0) Volts / °C

Deflection = GL(R_1-R_0) mm (inches)

6160 Tiltmeter Gage Factor (G): 3.6617 (degrees/ Volt)

Temperature Correction Factor -0.0003 (T_1-T_0) Volts / °C

Calculated Tilt = G(R_1 - R_0) degrees

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.

FIGURE 1: *Typical Calibration Report*

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