Model 3800

Model 3810

Model 3800 & 3810

Thermistors & Thermistor Strings

Instruction Manual

GEOKON®

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Note: The Model 3800HT High Temperature Thermistor is not CE

WARRANTY STATEMENT

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

GEOKON Model 3800 and 3810 Thermistors and Thermistor Strings are semiconductors that behave as thermal resistors. In other words, they are resistors with a high (usually negative) temperature coefficient of resistance. Thermistors of ±0.5 °C or ±0.2 °C accuracy are available, along with a variety of cable options.

Model 3800 Thermistor Probes consist of one thermistor, allowing for measurement at a single point. Thermistors can be housed in several different housing options, such as a PVC housing which includes standard and milled flat options. Stainless steel housings are offered, including a High Temperature option. Bead only thermistors, the most compact option with no housing, is also available.

Model 3810 Thermistor Strings consist of multiple thermistor nodes spaced along a multi-conductor cable at predetermined depths, with one terminating thermistor at the end of the string. These models allow for thermal measurement at predetermined depths along one length of cable. Each thermistor along the length is encased in a form of melted beads. The Beads are made from a mixture of metal oxides encased in epoxy or glass, they are small and extremely robust, with a high degree of stability over a long-life span.

2. MODELS

GEOKON offers several thermistor options that are designed for a variety of installation applications. Each series offers options on accuracy (±0.5 °C or ±0.2 °C) and a variety of cable options.

2.1 MODEL 3800-1 THERMISTOR PROBES

2.1.1 MODELS 3800-1-1, 3800-1-1-3, 3800-1-2, AND 3800-1-2-3

These models are the standard option, with the thermistor encased in a PVC housing. The temperature range is -20 to +80 °C.

FIGURE 1: *Model 3800-1-1 and 3800-1-2 (Top), 3800-1-1-3 and 3800-1-2-3 (Bottom) Thermistor Probes*

2.1.2 MODELS 3800-1-1-1 AND 3800-1-2-1

Models 3800-1-1-1 and 3800-1-2-1 Bead Only Thermistor Probes are not installed inside a housing, instead the thermistor is attached to the end of the cable and encased with a small amount of epoxy.

As the most compact thermistor offered, these models can be used in installations where space is limited. Without the housing, this option offers superior thermal properties and will reach thermal equilibrium faster than the PVC options. This style is typically installed on 0.187" O.D. cable.

Note: Because there is no protective housing, the bead only models are more susceptible to moisture ingress.

FIGURE 2: *Model 3800-1-1-1 and 3800-1-2-1 Bead Only Thermistor Probes*

2.2 MODEL 3800-2 THERMISTOR PROBES

With Models 3800-2-1, 3800-2-1-3, 3800-2-2, and 3800-2-2-3 Thermistor Probes (Figure 3), the thermistor is encased in a more rugged stainless steel housing. The stainless steel housing has superior thermal properties and will allow the thermistor to reach thermal equilibrium faster than its PVC counterpart.

FIGURE 3: *Model 3800-2-1 and 3800-2-2 (Top), 3800-2-1-3 and 3800-2-2-3 (Bottom) Thermistor Probes*

2.3 MODEL 3800-3 THERMISTOR PROBES

With Models 3800-3-1 and 3800-3-2 Thermistor Probes, the thermistor is encased in a PVC housing will one milled flat side meant for mounting directly to a surface with an epoxy adhesive. The temperature range is -20 to +80 °C.

FIGURE 4: *Model 3800-3 Thermistor Probe with Milled Flat*

2.4 MODEL 3800HT HIGH TEMPERATURE THERMISTOR

Models 3800HT and 3800HT-SS High Temperature Thermistors, with a temperature rating of -30 to + 230 °C, are used in high temperature applications. The thermistor is encased in a stainless steel housing. Both of these models have a thermistor accuracy of ±0.5°C.

Model 3800HT is attached to white teflon cable, rated up to 200 °C.

Model 3800HT-SS is attached to stainless steel encapsulated cable, rated up to 300 °C, usable up to 230 °C with the installed high temperature thermistor.

FIGURE 5: *Model 3800HT (Top) and 3800HT-SS (Bottom) High Temperature Thermistors*

2.5 MODEL 3810 THERMISTOR STRING

Models 3810-1 and 3810-2 Thermistor Strings have several thermistor nodes spaced along a multi-conductor cable at predetermined depths, with one terminating thermistor at the end of the string. Nodes along the length are encased in a waterproof thermoplastic polyurethane molding. These models allow for thermal measurement at predetermined depths along one length of cable. Minimum spacing between sensors is 127 mm (5").

FIGURE 6: *Model 3810 Thermistor String*

3. INSTALLATION

Before installation read and record all the thermistors to check that they are functional and to establish ambient temperature readings. Read and record once again as soon as the thermistors have been deployed, and again after a certain length of time has elapsed to allow the temperatures stabilize so as to establish good base line temperature readings.

Thermistor probes and strings are fully waterproof and can be installed onto a structure, inside boreholes, buried in fill, or cast inside concrete with no particular requirements needed.

For borehole installation, push the thermistor probe/string into the borehole by whatever means are chosen. This may include attachment to grout pipes, special installation rods or other apparatuses being inserted into the borehole at the same time.

3.1 SPLICING AND JUNCTION BOXES

Because their resistance change is so great, variations in cable resistance have little effect on readings. However, for high accuracy work the cable resistance can be taken into account. If multiple sensors are installed in a borehole, and the distance from the borehole to the terminal box or datalogger is great, a splice (or junction box) could be made to connect the individual cables to a single multi-conductor cable. This multi-conductor cable would then be run to the readout station. For these types of installations, it is recommended that the thermistor be supplied with enough cable to reach the installation depth, plus extra cable to pass through drilling equipment (rods, casing, etc.).

Cable used for making splices should be a high-quality twisted pair type, with 100% shielding and an integral shield drain wire. **When splicing, it is very important that the shield drain wires be spliced together.** Splice kits recommended by GEOKON incorporate casts that are placed around the splice and then filled with epoxy to waterproof the connections. When properly made, this type of splice is equal or superior to the cable in strength and electrical properties. Contact GEOKON for splicing materials and additional cable splicing instructions.

Junction boxes and terminal boxes are available from GEOKON for all types of applications. In addition, portable readouts and dataloggers are also available. Contact GEOKON for specific application information.

4. TAKING READINGS

Model 3800 Thermistor Probes, which comprise of a single thermistor, can be used with any GEOKON vibrating wire dataloggers. The Model 3800 is wired into the datalogger in the same manner as the thermistor conductors from a vibrating wire gauge.

Model 3810 Thermistor Strings are usually read using GEOKON Model 8600 Dataloggers. See Section 4.3 for instruction on how to connect the Model 3810 Thermistor String to a Model 8600 Datalogger.

GeoNet Dataloggers may be used with Model 3810, however, with some models modifications of the datalogger may be necessary. Contact GEOKON for more information. See Appendix C for an example wiring table.

4.1 COMPATIBLE READOUTS AND DATALOGGERS

GEOKON can provide several readout and datalogger options. Devices compatible with this product are listed below. For further details and instruction consult the corresponding Manual(s) at geokon.com/Readouts and geokon.com/Dataloggers.

Readouts

DIGITAL READOUTS:

- **GK-404**

  The Model GK-404 VW Readout is a portable, low-power, hand-held unit capable of running for more than 20 hours continuously on two AA batteries. It is designed for the readout of all GEOKON Vibrating Wire (VW) instruments, and is capable of displaying the reading in digits, frequency (Hz), period (µs), or microstrain (µε). The GK-404 displays the temperature of the transducer (embedded thermistor) with a resolution of 0.1 °C.

- **GK-406**

  The Model GK-406 is a field-ready device able to quickly measure a sensor, save data, and communicate results with custom PDF reports and spreadsheet output. Measurements are geo-located with the integrated GPS allowing the GK-406 to verify locations and lead the user to the sensor locations. The large color display and VSPECT^{TM} technology create confidence of getting the best measurement possible both in the field and in the office.

Dataloggers

DATALOGGERS:

- **8600 Series**

  The MICRO-6000 Datalogger is designed to support the reading of a large number of GEOKON instruments for various unattended data collection applications through the use of GEOKON Model 8032 Multiplexers. Weatherproof packaging allows the unit to be installed in field environments where inhospitable conditions prevail. The Nema 4X enclosure also has a provision for locking to limit access to responsible field personnel.

- **GeoNet Series**

  The GeoNet series is designed to collect and transfer data from vibrating wire, RS-485, and analog instruments. GeoNet offers a wide range of telemetry options, including LoRa, cellular, Wi-fi, satellite, and local. Loggers can work together to operate in a network configuration, or be used separately as standalone units. GeoNet devices arrive from the factory ready for deployment and may commence with data acquisition in minutes.

  Data is transferred to a secure cloud-based storage platform where it can be accessed through the GEOKON OpenAPI. Industry leading data visualization software, such as the free GEOKON Agent Software, can be used with the OpenAPI for data viewing and reporting. Dataloggers without network capabilities are also available.

4.2 MEASURING TEMPERATURES

Connect the thermistor probe or string to the GEOKON readout. The thermistor gives a varying resistance output as the temperature changes. The GK-404 and GK-406 readouts will read the thermistor and display the temperature in degrees Celsius.

Note: High temperature versions require a GK-406 readout.

USING AN OHMMETER TO READ TEMPERATURES:

Thermistors probes and strings may also be read using an ohmmeter. Connect an ohmmeter to the thermistor leads. 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 C.

4.3 CONNECTING A MODEL 3810 THERMISTOR STRING TO A MODEL 8600 DATALOGGER

Model 8600 Dataloggers are available in two options:

- The Model 8600-1 Datalogger must be used with at least one Model 8032-16-1S Multiplexer. Up to six multiplexers can be connected, this allows the datalogger to read up to 96 thermistors.
- The Model 8600-2 Datalogger has an internal multiplexer board that can read up to 16 thermistors.

Thermistor strings have a single common conductor that requires a jumper assembly for connection to a datalogger. Strings of 16 thermistors or less will require the Model 3810-16 Jumper Assembly, while strings of 17 to 32 thermistors will require the Model 3810-32 Jumper Assembly.

To connect the thermistor string to a Model 8600 Datalogger:

1. Locate the DIP switch marked "SW1" on the multiplexer circuit board. Move switch 1 to the ON position, as shown in Figure 1, to put the circuit board into "32-channel mode".

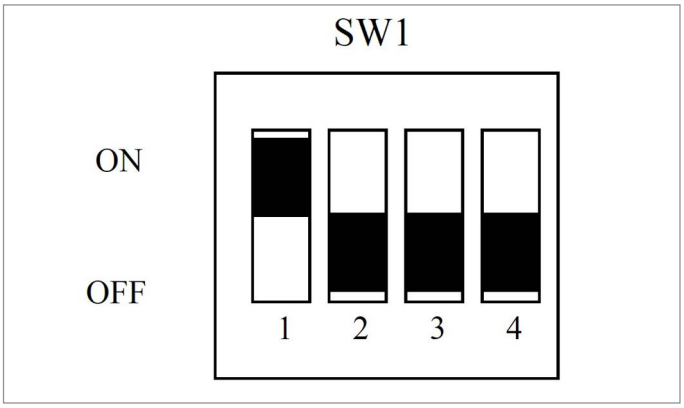

FIGURE 7: *Switch Position for 32-Channel Mode*

2. Connect the common (black) conductor from the thermistor string to the jumper assembly by lifting up the orange tab without pre-wired conductors, inserting the common conductor fully into the receptacle, and then pushing down on the orange tab until it snaps into place.

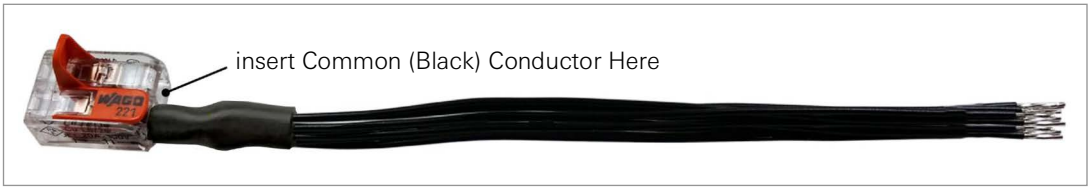

FIGURE 8: *Jumper Assembly*

3. Wire the thermistor wires and jumper cable common wires to the datalogger as shown in Table 1. Thermistor wire colors are indicated on the test report provided with the string (see an example in Appendix D). Figure 9 shows an example of a six-thermistor string wired to a multiplexer.

Multiplexer Circuit Board	Description
1H	Model 3810 Thermistor #1 (+)
1L	Jumper Wire (Common-)
2H	Model 3810 Thermistor #2 (+)
2L	Jumper Wire (Common-)
S1	No Connection
3H	Model 3810 Thermistor #3 (+)
3L	Jumper Wire (Common-)
4H	Model 3810 Thermistor #4 (+)
4L	Jumper Wire (Common-)
S2	No Connection
Etc.	

TABLE 1: *Thermistor String to Multiplexer Board Using the Jumper Assembly*

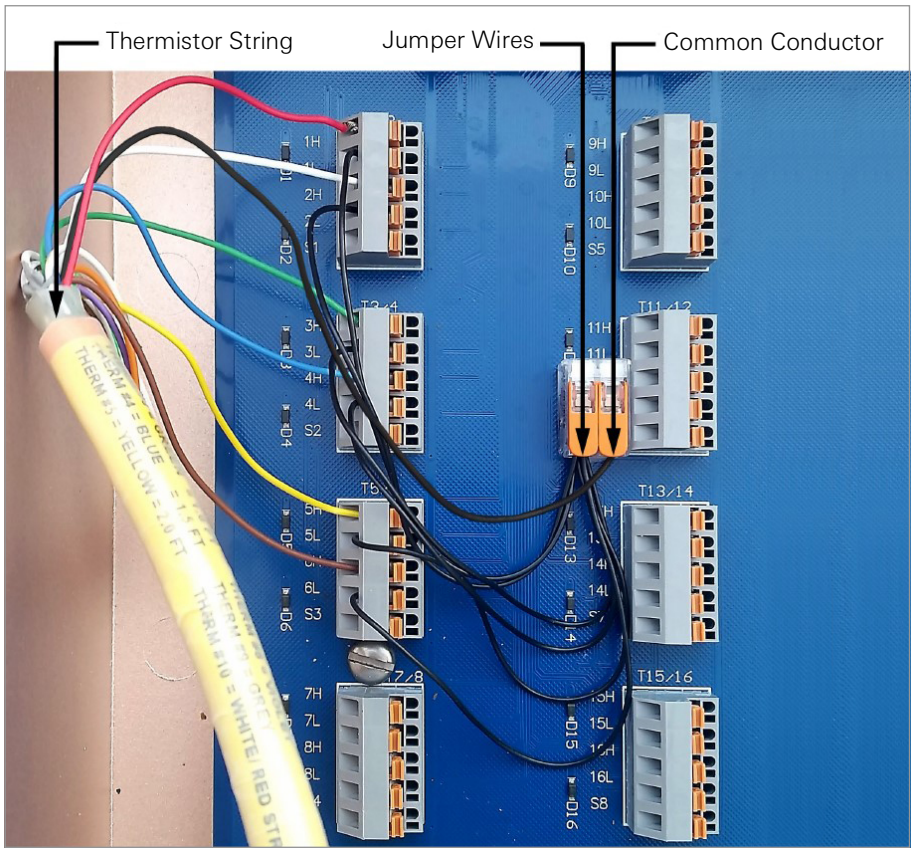

FIGURE 9: *Example Wiring of a Thermistor String to a Multiplexer Board*

The 8600-2 may now be used to collect data from the thermistor string.

For Model 8600-1, the 8032-16-1S Multiplexer must now be connected to the CR6 unit inside the datalogger. This can be done using a Model 8032-5 Multiplexer Cable, or, if bare leads are being used, by wiring the units together per the wiring diagram in Table 2.

CR6 inside Model 8600-1 Datalogger	Model 8032-16-1S Multiplexer	Description
12V	12V	12 VDC Output
G	G	Power Ground
U5	RES	Universal Port # / Reset
C4	CLK	Digital I/O Port # / Clock
AG	AG	Analog Ground
U1	1H	Universal Port Thermistor +
U2	1L	Universal Port Thermistor -

TABLE 2: *CR6 Wiring for Model 8032 Reading Thermistor String in 32-Channel Mode*

Model 8600 Manual

For further information, refer to the Model 8600 Instruction Manual.

5. TROUBLESHOOTING

Technical Support

Maintenance and troubleshooting of the thermistors are confined to periodic checks of cable connections and maintenance of terminals. The thermistors themselves are sealed and are not user serviceable. **Thermistors 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: THERMISTOR RESISTANCE IS TOO HIGH

☐ Check for an open circuit. Check all connections, terminals, and plugs. If a cut is in the cable, splice according to instructions in Section 3.1.

SYMPTOM: THERMISTOR RESISTANCE IS TOO LOW

☐ Check for a short circuit. Check all connections, terminals, and plugs. If a short is in the cable, splice according to instructions in Section 3.1.

SYMPTOM: THERMISTOR READING UNSTABLE

☐ Make sure the shield drain wire is connected to ground, if applicable.

☐ Isolate the readouts from the ground by placing it on a piece of wood or another insulator.

☐ Check for sources of nearby electrical noise such as motors, generators, antennas, or electrical cables. Move the sensor cable away from these sources if possible. Contact the factory for available filtering and shielding equipment.

☐ The thermistor may have been damaged by shock.

☐ Check the readouts with another thermistor to ensure it is functioning properly.

SYMPTOM: THERMISTOR FAILS TO GIVE A READING

☐ The thermistor may have been damaged by shock.

☐ Check the readouts with another thermistor to ensure it is functioning properly.

APPENDIX A. SPECIFICATIONS

A.1 MODEL 3800 SPECIFICATIONS

Model	3800-1-1	3800-1-1-1	3800-1-1-3	3800-1-2	3800-1-2-1	3800-1-2-3	3800-2-1
Available Ranges[1]	-20 to +80 °C						
Resolution	0.1 °C						
Accuracy[2]	±0.5 °C			±0.2 °C			±0.5 °C
O.D. of Installed Cable	4.7 mm (0.187″)	4.7 mm (0.187″)	6.4 mm (0.250″)	4.7 mm (0.187″)″	4.7 mm (0.187″)	6.4 mm (0.250″)	4.7 mm (0.187″)
Housing	PVC	Thermistor Bead Only	PVC	PVC	Thermistor Bead Only	PVC	Stainless Steel
Housing Length	50 mm (2″)	N/A	50 mm (2″)	50 mm (2″)	N/A	50 mm (2″)	50 mm (2″)
Housing Diameter	12 mm (0.5″)	N/A	12 mm (0.5″)	12 mm (0.5″)	N/A	12 mm (0.5″)	12 mm (0.5″)
Thermal Time Constant[3]	63 seconds	33 seconds	63 seconds	63 seconds	33 seconds	63 seconds	26 seconds
Time for Thermal Equilibrium to be Obtained[4]	225 seconds	135 seconds	225 seconds	225 seconds	135 seconds	225 seconds	150 seconds

Model	3800-2-1-3	3800-2-2	3800-2-2-3	3800-3-1	3800-3-2	3800HT	3800HT-SS
Available Ranges[1]	-20 to +80 °C					-30 to +230 °C	
Resolution	0.1 °C						
Accuracy[2]	±0.5 °C	±0.2 °C	±0.2 °C	±0.5 °C	±0.2 °C	±0.5°C	
O.D. of Installed Cable	6.4 mm (0.250″)	4.7 mm (0.187″)	6.4 mm (0.250″)	4.7 mm (0.187″)		Teflon Cable Only (02-250T)	Stainless Steel Encapsulated Cable Only (02-250PEP-316)
Housing	Stainless Steel			PVC		Stainless Steel	
Housing Length	50 mm (2″)					75 mm (3″)	
Housing Diameter	12 mm (0.5″)			12 mm (0.5″), with a Milled Flat (See Figure 4)		19 mm (0.7″)	
Thermal Time Constant[3]	26 seconds			63 seconds		84 seconds	
Time for Thermal Equilibrium to be Obtained[4]	150 seconds			225 seconds		335 seconds	

TABLE 3: *Model 3800 Thermistor Probe Specifications*

Note:

[1] Other ranges available on request.
[2] Stated accuracy is for the thermistor sensor only, between 0 °C and 70 °C. The cable used to connect the thermistor to the readout adds resistance and measurement error.
[3] 63.2% of an instantaneous temperature change.
[4] 99% of temperature change.

A.1.1 MODEL 3800-3 DIMENSIONS

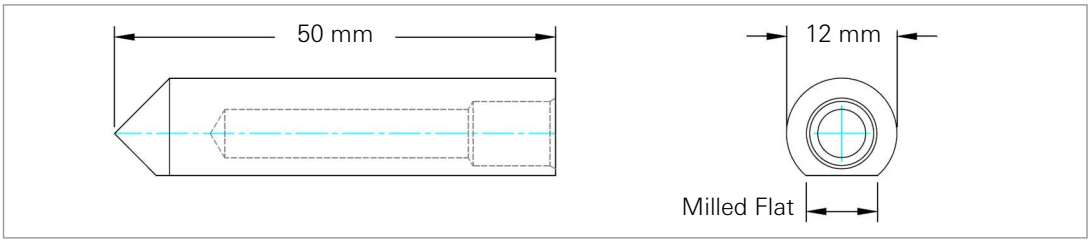

FIGURE 10: *Model 3800-3 Thermistor Probe Dimensions*

A.1.2 MODEL 3800 CABLE SPECIFICATIONS

Model	02-187P6	02-187V3	02-250P4	02-250PEP-2205	02-250PEP-316	02-250T	02-250V6
Conductors	2 twisted pairs, 22 AWG 7/30			4 conductor, 24 AWG Solid		2 twisted pairs, 22 AWG 19/34	2 twisted pairs, 22 AWG 7/30
Conductor Insulation	8 mil (0.008") HDPP			8 mil (0.008") PTFE		10 mil (0.01") FEP	10 mil (0.01") HDPP
Drain Wire	24 AWG			N/A		22 AWG	24 AWG
Cable Jacket[1]	Blue PU	Red PVC	Green PU	Duplex 2205	316 SS	White Teflon with aluminum polyester foil shielding	Blue PVC
Nominal O.D.	4.7 mm (0.187")		6.4 mm (0.250")			5.20 mm (0.204")	6.4 mm (0.250")
Temperature Range	-20 to +80 °C			-150 to +300 °C		-80 to +200 °C	-20 to +80 °C

TABLE 4: *Model 3800 Thermistor Probe Cable Specifications*

Note:

HDPP = High Density Polypropylene

PTFE = Polytetrafluoroethylen

FEP = Fluorinated Ethylene Propylene

[1] All outer cable jackets are pressure extruded. In addition, other cable jackets are available for special applications.

A.2 MODEL 3810 SPECIFICATIONS

Model	3810-1	3810-2
Available Ranges[1]	-20 to +80 °C	
Resolution	0.1 °C	
Accuracy[2]	±0.5 °C	±0.2 °C
Pressure Rating	3.5 MPa[1]	
Length x Diameter of Thermistor Pods Based on Connected Cable	If 9.5 mm (0.375") O.D. Cable is Connected: Thermistor Pods are 45 x 16 mm (1.8 x 0.6") If 12.5 mm (0.500") O.D. Cable is Connected: Thermistor Pods are 64 x 22 mm (2.5 x 0.9")	

TABLE 6: *Model 3810 Thermistor String Specifications*

Note:

[1] Other ranges available on request.
[2] Stated accuracy is for the thermistor sensor only, between 0 °C and 70 °C.

A.2.1 MODEL 3810 CABLE SPECIFICATIONS

Model	17-375V7	17-375P7	17-375P13	33-500V4	33-500P6
Measurement	1-16			1-32	
Minimum Spacing	127 mm (5")				
Cable Diameter	9.5 mm (0.375")			12.5 mm (0.500")	
Cable Jacket	Orange PVC	Orange Polyurethane	Brown Polyurethane	Green PVC	Blue Polyurethane

TABLE 7: *Model 3810 Thermistor String Cable Specifications*

APPENDIX B. THERMISTOR TEMPERATURE DERIVATION

B.1 3KΩ THERMISTOR RESISTANCE (STANDARD)

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 1: *3KΩ Thermistor Resistance*

Where:
T = Temperature in °C
LnR = Natural Log of Thermistor Resistance
$A = 1.4051 \times 10^{-3}$
$B = 2.369 \times 10^{-4}$
$C = 1.019 \times 10^{-7}$
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 8: *3KΩ Thermistor Resistance*

B.2 10KΩ THERMISTOR RESISTANCE (HIGH TEMP)

Thermistor Type: US Sensor 103JL1A

Resistance to Temperature Equation:

$$T = \frac{1}{A + B(LnR) + C(LnR)^3 + D(LnR)^5} - 273.15$$

EQUATION 2: *10KΩ Thermistor Resistance*

Where:
T = Temperature in °C
LnR = Natural Log of Thermistor Resistance
A = 1.127670×10^{-3}
B = 2.344442×10^{-4}
C = 8.476921×10^{-8}
D = 1.175122×10^{-11}
Note: Coefficients optimized for a curve **J** Thermistor over the temperature range of 0 °C to +250 °C.

Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp
32,650	0	7,402	32	2,157	64	763.5	96	316.6	128	148.4	160	76.5	192	42.8	224
31,029	1	7,098	33	2,083	65	741.2	97	308.7	129	145.1	161	75.0	193	42.1	225
29,498	2	6,808	34	2,011	66	719.6	98	301.0	130	142.0	162	73.6	194	41.4	226
28,052	3	6,531	35	1,942	67	698.7	99	293.5	131	138.9	163	72.2	195	40.7	227
26,685	4	6,267	36	1,876	68	678.6	100	286.3	132	135.9	164	70.8	196	40.0	228
25,392	5	6,015	37	1,813	69	659.1	101	279.2	133	133.0	165	69.5	197	39.3	229
24,170	6	5,775	38	1,752	70	640.3	102	272.4	134	130.1	166	68.2	198	38.7	230
23,013	7	5,545	39	1,693	71	622.2	103	265.8	135	127.3	167	66.9	199	38.0	231
21,918	8	5,326	40	1,637	72	604.6	104	259.3	136	124.6	168	65.7	200	37.4	232
20,882	9	5,117	41	1,582	73	587.6	105	253.1	137	122.0	169	64.4	201	36.8	233
19,901	10	4,917	42	1,530	74	571.2	106	247.0	138	119.4	170	63.3	202	36.2	234
18,971	11	4,725	43	1,480	75	555.3	107	241.1	139	116.9	171	62.1	203	35.6	235
18,090	12	4,543	44	1,432	76	539.9	108	235.3	140	114.5	172	61.0	204	35.1	236
17,255	13	4,368	45	1,385	77	525.0	109	229.7	141	112.1	173	59.9	205	34.5	237
16,463	14	4,201	46	1,340	78	510.6	110	224.3	142	109.8	174	58.8	206	33.9	238
15,712	15	4,041	47	1,297	79	496.7	111	219.0	143	107.5	175	57.7	207	33.4	239
14,999	16	3,888	48	1,255	80	483.2	112	213.9	144	105.3	176	56.7	208	32.9	240
14,323	17	3,742	49	1,215	81	470.1	113	208.9	145	103.2	177	55.7	209	32.3	241
13,681	18	3,602	50	1,177	82	457.5	114	204.1	146	101.1	178	54.7	210	31.8	242
13,072	19	3,468	51	1,140	83	445.3	115	199.4	147	99.0	179	53.7	211	31.3	243
12,493	20	3,340	52	1,104	84	433.4	116	194.8	148	97.0	180	52.7	212	30.8	244
11,942	21	3,217	53	1,070	85	421.9	117	190.3	149	95.1	181	51.8	213	30.4	245
11,419	22	3,099	54	1,037	86	410.8	118	186.1	150	93.2	182	50.9	214	29.9	246
10,922	23	2,986	55	1,005	87	400.0	119	181.9	151	91.3	183	50.0	215	29.4	247
10,450	24	2,878	56	973.8	88	389.6	120	177.7	152	89.5	184	49.1	216	29.0	248
10,000	25	2,774	57	944.1	89	379.4	121	173.7	153	87.7	185	48.3	217	28.5	249
9,572	26	2,675	58	915.5	90	369.6	122	169.8	154	86.0	186	47.4	218	28.1	250
9,165	27	2,579	59	887.8	91	360.1	123	166.0	155	84.3	187	46.6	219		
8,777	28	2,488	60	861.2	92	350.9	124	162.3	156	82.7	188	45.8	220		
8,408	29	2,400	61	835.4	93	341.9	125	158.6	157	81.1	189	45.0	221		
8,057	30	2,316	62	810.6	94	333.2	126	155.1	158	79.5	190	44.3	222		
7,722	31	2,235	63	786.6	95	324.8	127	151.7	159	78.0	191	43.5	223		

TABLE 9: *10KΩ Thermistor Resistance*

APPENDIX C. EXAMPLE WIRING TO GEONET DATALOGGERS

The wiring chart below shows wiring from an eight-thermistor string to an eight-channel GeoNet Datalogger using the Model 3810-16 or 3810-32 Jumper Assembly in the same manner as described in Section 4.3.

Channel	Description
1 VW+	No Connection
1 VW-	No Connection
1 TH+	Model 3810 Thermistor #1 (+)
1 TH-	Jumper Wire (Common-)
1 SHD	No Connection
2 VW+	No Connection
2 VW-	No Connection
2 TH+	Model 3810 Thermistor #2 (+)
2TH-	Jumper Wire (Common-)
2 SHD	No Connection
3 VW+	No Connection
3 VW-	No Connection
3 TH+	Model 3810 Thermistor 3 (+)
3TH-	Jumper Wire (Common-)
3 SHD	No Connection
4 VW+	No Connection
4 VW-	No Connection
4 TH+	Model 3810 Thermistor 4 (+)
4 TH-	Jumper Wire (Common-)
4 SHD	No Connection
5 VW+	No Connection
5 VW-	No Connection
5 TH+	Model 3810 Thermistor 5 (+)
5 TH-	Jumper Wire (Common-)
5 SHD	No Connection
6 VW+	No Connection
6 VW-	No Connection
6 TH+	Model 3810 Thermistor 6 (+)
6 TH-	Jumper Wire (Common-)
6 SHD	No Connection
7 VW+	No Connection
7 VW-	No Connection
7 TH+	Model 3810 Thermistor 7 (+)
7 TH-	Jumper Wire (Common-)
7 SHD	No Connection
8 VW+	No Connection
8 VW-	No Connection
8 TH+	Model 3810 Thermistor 8 (+)
8 TH-	Jumper Wire (Common-)
8 SHD	No Connection

TABLE 10: *GeoNet Wiring (Eight-Channel Logger with String of Eight Thermistors Shown)*

APPENDIX D. TYPICAL 3810 TEST REPORTS

3810 Test Report
CAB-603 Orange Cable: 17-375V7

GEOKON

Job #: _____
Customer: _____
I.D. Code: _____

Therm # (Part ID): **[THERM-100 3k]** **[THERM-101 10k]** **[ELC-177 3k]**

Readout: **METER** **DATALOGGER** **404** or **CONNECTOR**

Total Length:

White/	Top- Readout End	Thermistor #	2 FT EXTRA	FINAL THERM READING
White/	Black Stripe	16		
White/	Orange Stripe	15		
White/	Brown Stripe	14		
White/	Yellow Stripe	13		
White/	Blue Stripe	12		
White/	Green Stripe	11		
White/	Red Stripe	10		
	Grey	9		
	Violet	8		
	Orange	7		
	Brown	6		
	Yellow	5		
	Blue	4		
	Green	3		
	White	2		
	Red	1	0	
	Black	COMMON		

CAB-603 Orange PVC Cable, 0.375", 17 Conductor Thermistor String Cable – Bright Orange 16 Thermistors Maximum on cable with black used as the common wire.

All Therms are reading in acceptable range.

Final Check _____

*We certify that the product supplied has been inspected and tested, as applicable, in conformance to the relevant specifications and drawings of the Geokon, Inc. registered ISO 9001:2015 Quality Program. Testing standards are maintained per ANSI-Z540-1 and are traceable to the N.I.S.T.

Title: CAB-603 Orange PVC Cable REV: Initial

FIGURE 11: *Typical 3810 Thermistor String Test Report (17-375V7 Cable)*

3810 Test Report
CAB-606 Orange Cable: 17-375P7

GEOKON

Job #: _____
Customer: _____
I.D. Code: _____

Therm # (Part ID): **[THERM-100 3k] [THERM-101 10k] [ELC-177 3k]**

Readout: **METER DATALOGGER 404** or **CONNECTOR**

Total Length:

White/	Top- Readout End	Thermistor #	2 FT EXTRA	FINAL THERM READING
White/	Black Stripe	16		
White/	Orange Stripe	15		
White/	Brown Stripe	14		
White/	Yellow Stripe	13		
White/	Blue Stripe	12		
White/	Green Stripe	11		
White/	Red Stripe	10		
	Grey	9		
	Violet	8		
	Orange	7		
	Brown	6		
	Yellow	5		
	Blue	4		
	Green	3		
	White	2		
	Red	1	0	
	Black	COMMON		

CAB-606 Orange Poly Cable, 0.375", 17 Conductor thermistor String Cable – 16 Thermistors Maximum on cable with black used as the common wire.

All Therms are reading in acceptable range.

Final Check _____

*We certify that the product supplied has been inspected and tested, as applicable, in conformance to the relevant specifications and drawings of the Geokon, Inc. registered ISO 9001:2015 Quality Program. Testing standards are maintained per ANSI-Z540-1 and are traceable to the N.I.S.T.

Title: CAB-606 Orange Poly Cable REV: Initial

FIGURE 12: *Typical 3810 Thermistor String Test Report (17-375P7 Cable)*

3810 Test Report
CAB-562 Brown Cable: 17-375P13

GEOKON

Job #: _____
Customer: _____
I.D. Code: _____

Therm # (Part ID): [**THERM-100 3k]** [**THERM-101 10k]** [**ELC-177 3k]**

Readout: **METER** **DATALOGGER** **404** or **CONNECTOR**

Total Length:

White/	Top- Readout End	Thermistor #	2 FT EXTRA	FINAL THERM READING
White/	Black Stripe	16		
White/	Orange Stripe	15		
White/	Brown Stripe	14		
White/	Yellow Stripe	13		
White/	Blue Stripe	12		
White/	Green Stripe	11		
White/	Red Stripe	10		
	Grey	9		
	Violet	8		
	Orange	7		
	Brown	6		
	Yellow	5		
	Blue	4		
	Green	3		
	White	2		
	Red	1	0	
	Black	COMMON		

CAB-562 Brown Poly Cable, 0.375", 17 Conductor thermistor String Cable – 16 Thermistors Maximum on cable with black used as the common wire.

All Therms are reading in acceptable range.

Final Check _____

*We certify that the product supplied has been inspected and tested, as applicable, in conformance to the relevant specifications and drawings of the Geokon, Inc. registered ISO 9001:2015 Quality Program. Testing standards are maintained per ANSI-Z540-1 and are traceable to the N.I.S.T.

Title: CAB-562 Brown Poly Cable REV: Initial

FIGURE 13: *Typical 3810 Thermistor String Test Report (17-375P13 Cable)*

3810 Test Report
CAB-560 Green PVC Cable: 33-500V4

GEOKON

Job #: _____
Customer: _____
I.D. Code: _____

Therm # (Part ID): **[THERM-100]** **[THERM-101]** **[ELC-177]** Total Length:

Readout: **[METER]** **[DATALOGGER]** **[404]** or **[CONNECTOR]**

White/	Cable Color READOUT END	Thermistor #	2FT EXTRA	FINAL THERM READING
White/	**Black & Grey Stripe**	32		
White/	**Black & Yellow Stripe**	31		
White/	**Black & Blue Stripe**	30		
White/	**Black & Violet Stripe**	29		
White/	**Black Stripe**	28		
White/	**Orange & Brown Stripe**	27		
White/	**Yellow & Brown Stripe**	26		
White/	**Green & Brown Stripe**	25		
White/	**Blue & Brown Stripe**	24		
White/	**Violet & Brown Stripe**	23		
White/	**Violet Stripe**	22		
White/	**Grey Stripe**	21		
White/	**Black & Brown Stripe**	20		
White/	**Black & Red Stripe**	19		
White/	**Black & Orange Stripe**	18		
White/	**Black & Green Stripe**	17		
White/	**Red-Brown Stripe**	16		
White/	**Orange Stripe**	15		
White/	**Brown Stripe**	14		
White/	**Yellow Stripe**	13		
White/	**Blue Stripe**	12		
White/	**Green Stripe**	11		
White/	**Red Stripe**	10		
	Grey	9		
	Violet	8		
	Orange	7		
	Brown	6		
	Yellow	5		
	Blue	4		
	Green	3		
	White	2		
	Red	1	0	
	Black	COMMON		

PVC Housing over Bottom Therm (PVC Housing Part#): A3810-3
CAB-560 Green PVC Cable ½ 33 Conductor thermistor String Cable – Light Green 32 Thermistors Maximum on cable with black used as the common wire.

All Therms are reading in acceptable range.
Final Check by:_____
*We certify that the product supplied has been inspected and tested, as applicable, in conformance to the relevant specifications and drawings of the Geokon, Inc. registered ISO 9001:2015 Quality Program. Testing standards are maintained per ANSI-Z540-1 and are traceable to the N.I.S.T.

Title: CAB-560 Green PVC Cable REV: Initial

FIGURE 14: *Typical 3810 Thermistor String Test Report (33-500V4 Cable)*

3810 Test Report
CAB-561 Blue Cable: 33-500P6

GEOKON

Job #: _____
Customer: _____
I.D. Code: _____

Therm # (Part ID): **[THERM-100]** **[THERM-101]** **[ELC-177]** Total Length:

Readout: **[METER]** **[DATALOGGER]** **[404]** or **[CONNECTOR]**

White/	Cable Color READOUT END	Thermistor #	2FT EXTRA	FINAL THERM READING
White/	**Black & Grey Stripe**	32		
White/	**Black & Yellow Stripe**	31		
White/	**Black & Blue Stripe**	30		
White/	**Black & Violet Stripe**	29		
White/	**Black Stripe**	28		
White/	**Orange & Brown Stripe**	27		
White/	**Yellow & Brown Stripe**	26		
White/	**Green & Brown Stripe**	25		
White/	**Blue & Brown Stripe**	24		
White/	**Violet & Brown Stripe**	23		
White/	**Violet Stripe**	22		
White/	**Grey Stripe**	21		
White/	**Black & Brown Stripe**	20		
White/	**Black & Red Stripe**	19		
White/	**Black & Orange Stripe**	18		
White/	**Black & Green Stripe**	17		
White/	**Red-Brown Stripe**	16		
White/	**Orange Stripe**	15		
White/	**Brown Stripe**	14		
White/	**Yellow Stripe**	13		
White/	**Blue Stripe**	12		
White/	**Green Stripe**	11		
White/	**Red Stripe**	10		
	Grey	9		
	Violet	8		
	Orange	7		
	Brown	6		
	Yellow	5		
	Blue	4		
	Green	3		
	White	2		
	Red	1	0	
	Black	COMMON		

.

All Therms are reading in acceptable range.
Final Check by:_____

*We certify that the product supplied has been inspected and tested, as applicable, in conformance to the relevant specifications and drawings of the Geokon, Inc. registered ISO 9001:2015 Quality Program. Testing standards are maintained per ANSI-Z540-1 and are traceable to the N.I.S.T.

Title: CAB-561 Blue Poly Cable REV: Initial

FIGURE 15: *Typical 3810 Thermistor String Test Report (33-500P6 Cable)*

GEOKON

GEOKON
48 Spencer Street
Lebanon, New Hampshire
03766, USA

Phone: +1 (603) 448-1562
Email: info@geokon.com
Website: www.geokon.com