

SENSORS

MANUAL - TEMPERATURE SENSOR P/N M100093 Rev E

1.0 INTRODUCTION

Climatronics' P/N 100093 Series Temperature sensors consist of an epoxy coated thermistor composite housed in a variety of probe casings. The thermistor composite exhibits relatively large resistance changes in response to small temperature changes and is interchangeable within specifications.

Depending on the type of thermistor composite and casing used, virtually any meteorological temperature range can be precisely measured. The P/N 100093 air temperature sensor consists of a two thermistor composite encased in a stainless steel sheath. The P/N 100093-2 air temperature sensor is similarly encased but utilizes a three thermistor composite to extend the measurement range. The P/N 100093-3 air temperature sensor is used when a fast response measurement is required. This sensor is constructed with the two thermistor composite directly exposed to the air but surrounded by a protective cage. The P/N 100093-4 Water/Soil temperature sensor also includes the two thermistor composite which is coated in a special plastic material for protection from water and soil environments. The sensors are typically installed in one of Climatronics' temperature shields and can be provided with calibration traceable to NIST.

2.0 SPECIFICATIONS

P/N 100093: Air

P/N 100093-4: Water/Soil

Accuracy & Interchangeability:

$\pm 0.15^{\circ}\text{C}$ ($\pm 0.27^{\circ}\text{F}$) over Full range

Range: -30.0° to 50.0°C (-22.0° to 122.0°F)

Time Constant: 3.6 seconds

Linearity: $\pm 0.16^{\circ}\text{C}$ ($\pm 0.29^{\circ}\text{F}$)

P/N 100093-2: Expanded Range

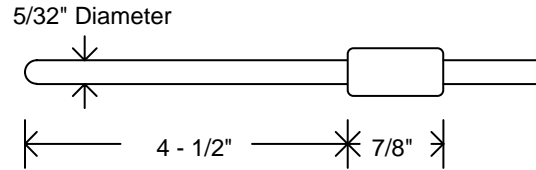
Accuracy & Interchangeability:

$\pm 0.10^{\circ}\text{C}$ ($\pm 0.18^{\circ}\text{F}$) over Full range

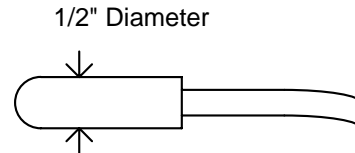
Range: -50° to $+50^{\circ}\text{C}$ (-58.0° to 122.0°F)

Time Constant: 3.6 seconds

Linearity: $\pm 0.16^{\circ}\text{C}$ ($\pm 0.29^{\circ}\text{F}$)



100093, 100093-2



100093-4

P/N 100093-3: Fast Response

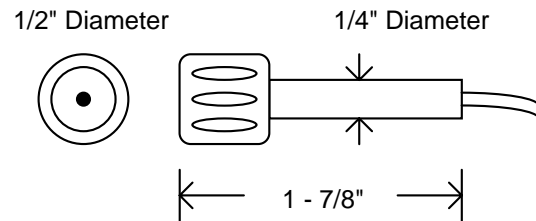
Accuracy & Interchangeability:

$\pm 0.15^{\circ}\text{C}$ ($\pm 0.27^{\circ}\text{F}$) over Full range

Range: -30.0° to 50.0°C (-22.0° to 122.0°F)

Time Constant: 0.6 seconds

Linearity: $\pm 0.16^{\circ}\text{C}$ ($\pm 0.29^{\circ}\text{F}$)



100093-3

3.0 INSTALLATION

When purchased with a Climatronics system, the sensor is usually preinstalled in one of our temperature shields. For test, calibration or replacement, installation instructions are included in the appropriate Climatronics Temperature Shield Manual Section.

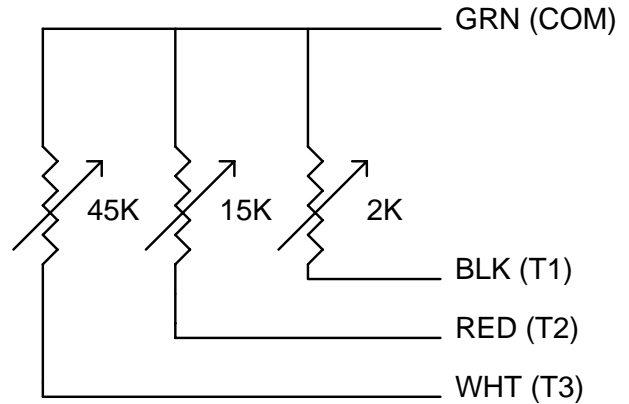
4.0 USER DEFINED OPTIONS

Not Applicable

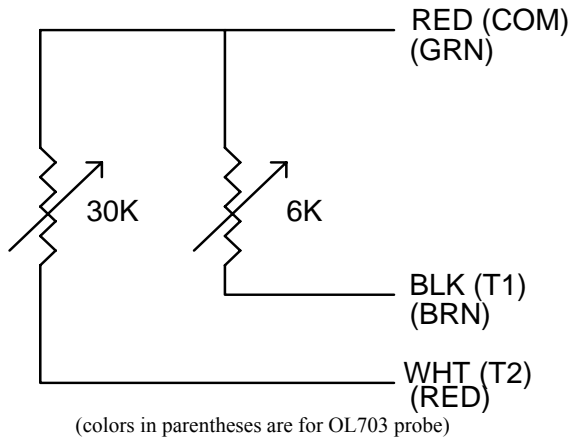
5.0 THEORY OF OPERATION

The resistance of each thermistor, which makes up the thermistor composite, varies as the temperature changes. This variation of resistance with temperature is a known function but is not linear. When the thermistor is connected in a network of the type shown on Pages 3 and 4, a voltage that varies as the temperature changes is obtained. This voltage is approximately linear with temperature ($\pm 0.16^\circ\text{C}$). The thermistor signal is used by a Climatronics Temperature Signal Conditioner, which includes the non-sensor portion of the network as part of its circuitry.

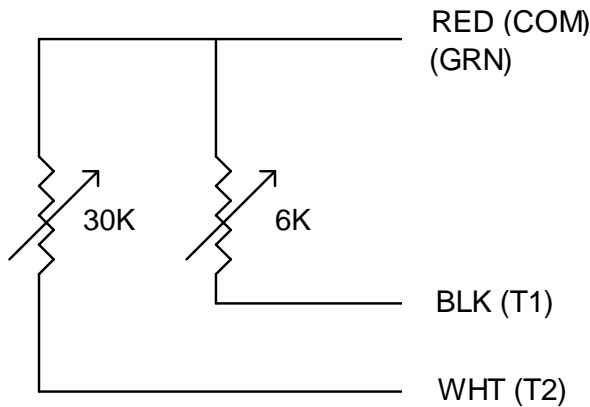
The wiring of the various types of thermistor probes is shown below:



100093-2



100093, 100093-3



100093-4

6.0 CALIBRATION

To check the calibration of the sensor, a calibration bath should be used. Follow the instructions below:

Equipment Needed:

1. The sensor to be checked.
2. A transfer standard sensor, accurate to $\pm 0.05^\circ\text{C}$ at 0.0°C .
3. A Thermos type container
4. Crushed, distilled water ice.
5. A thermal Mass*.
6. Precision Ohm meter.

* A thermal mass is used to keep the sensor and transfer standard in a thermally stable environment during calibration. An aluminum block or another metal block with a similar high heat transfer factor is suggested.

Procedure:

The object is to measure the accuracy of the sensor. To do this, the sensor output must be monitored. You should disconnect the sensor from the signal conditioner. If the sensor is wired into a system and cannot be removed, be sure the system electronics are calibrated within their tolerances. This last method checks the accuracy of the entire system.

- A. Remove the sensor from its shield.
 - B. Pour some crushed ice and distilled water mixture into the container.
 - C. Put the sensor and the transfer standard in the thermal mass (if used). Place the thermal mass in the container; or, put both sensors in the container.
- NOTE: The sensors should be making good mechanical contact with the thermal mass, use a heat sink compound if available.
- D. Fill the container up with more of the crushed ice and distilled water mixture.
 - E. Occasionally, stir the mixture and compare the sensor's values. The Standard should measure $0.0^{\circ}\text{C} \pm 0.1^{\circ}\text{C}$. The sensor being tested should measure the same value as the Standard \pm its accuracy tolerance. As the ice melts add more crushed ice to keep the mixture at equilibrium.

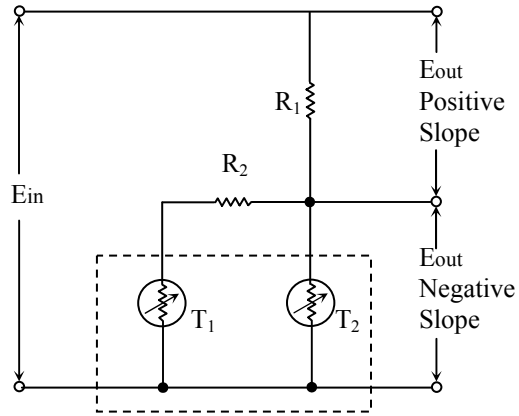
F. It is recommended that at least one additional calibration point be checked. Use a liquid bath with a temperature in the middle to high range of the sensor (i.e., 16°C or 61°F).

7.0 MAINTENANCE

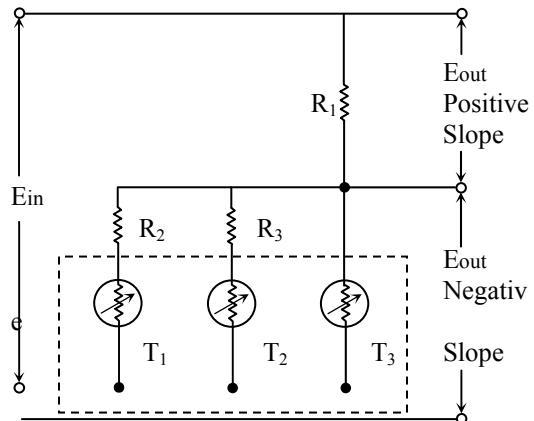
The sensor is virtually maintenance free and needs only to be periodically cleaned of any foreign substances which may have adhered to it. If the sensor should fail, it must be replaced. Consult Climatronics if this occurs.

Note: Probes used in Delta temperature configurations have been matched for greater accuracy than standard configuration probes.

Electrical Circuit for: 100093
100093-3
100093-4



Electrical Circuit for: 100093-2



Resistance versus Temperature -30 to +100° C
100093, 100093-3, 100093-4

Temp °C	T ₁ Res. Ω	T ₂ Res. Ω	Temp °C	T ₁ Res. Ω	T ₂ Res. Ω
-30	106.2K	481.0K	36	3760	18.96K
29	99.82K	453.5K	37	3610	18.21K
28	93.88K	427.7K	38	3466	17.49K
27	88.32K	403.5K	39	3328	16.80K
26	83.12K	380.9K	40	3196	16.15K
25	78.26K	359.6K	41	3070	15.52K
24	73.72K	339.6K	42	2950	14.92K
23	69.46K	320.9K	43	2836	14.35K
22	65.48K	303.3K	44	2726	13.80K
21	61.74K	286.7K	45	2620	13.28K
20	58.26K	271.2K	46	2520	12.77K
19	54.98K	256.5K	47	2424	12.29K
18	51.90K	242.8K	48	2334	11.83K
17	49.02K	229.8K	49	2246	11.39K
16	46.32K	217.6K	50	2162	10.97K
15	43.78K	206.2K	51	2080	10.57K
14	41.40K	195.4K	52	2004	10.18K
13	39.16K	185.2K	53	1930	9807
12	37.04K	175.6K	54	1859	9450
11	35.06K	166.6K	55	1792	9109
10	33.20K	158.0K	56	1727	8781
9	31.49K	150.0K	57	1664	8467
8	29.80K	142.4K	58	1605	8166
7	28.24K	135.2K	59	1547	7876
6	26.78K	128.5K	60	1493	7599
5	25.45K	122.1K	61	1440	7332
4	24.10K	116.0K	62	1389	7076
3	22.88K	110.3K	63	1341	6830
2	21.72K	104.9K	64	1294	6594
1	20.62K	99.80K	65	1249	6367
0	19.59K	94.98K	66	1207	6149
+1	18.62K	90.41K	67	1165	5940
2	17.70K	86.09K	68	1126	5738
3	16.83K	81.99K	69	1087	5545
4	16.01K	78.11K	70	1051	5359
5	15.24K	74.44K	71	1016	5180
6	14.50K	70.96K	72	981.8	5007
7	13.81K	67.66K	73	949.4	4842
8	13.15K	64.53K	74	918.0	4682
9	12.53K	61.56K	75	888.0	4529
10	11.94K	58.75K	76	859.0	4381
11	11.38K	56.07K	77	831.2	4239
12	10.85K	53.54K	78	804.4	4102
13	10.35K	51.13K	79	773.6	3970
14	9878	48.84K	80	753.8	3843
15	9428	46.67K	81	729.8	3720
16	9000	44.60K	82	706.8	3602
17	8594	42.64K	83	684.4	3489
18	8210	40.77K	84	663.0	3379
19	7844	38.99K	85	642.4	3273
20	7496	37.30K	86	622.6	3172
21	7166	35.70K	87	603.4	3073
22	6852	34.17K	88	584.4	2979
23	6554	32.71K	89	567.0	2887
24	6270	31.32K	90	549.8	2799
25	6000	30.00K	91	533.2	2714
26	5744	28.74K	92	517.2	2632
27	5500	27.54K	93	501.8	2552
28	5266	26.40K	94	486.8	2476
29	5046	25.31K	95	472.4	2402
30	4834	24.27K	96	458.6	2331
31	4634	23.28K	97	445.2	2262
32	4442	22.33K	98	432.2	2195
33	4260	21.43K	99	419.6	2131
34	4084	20.57K	100	407.6	2069
35	3918	19.74K			

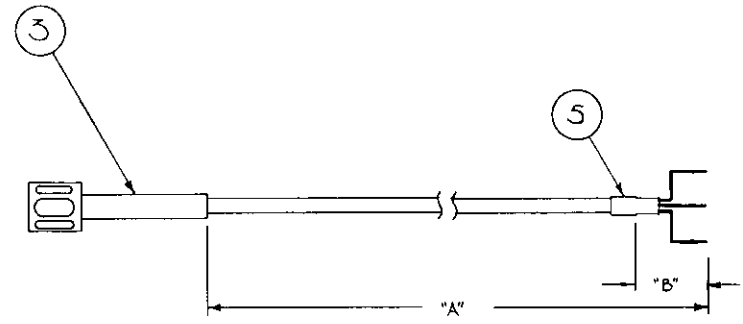
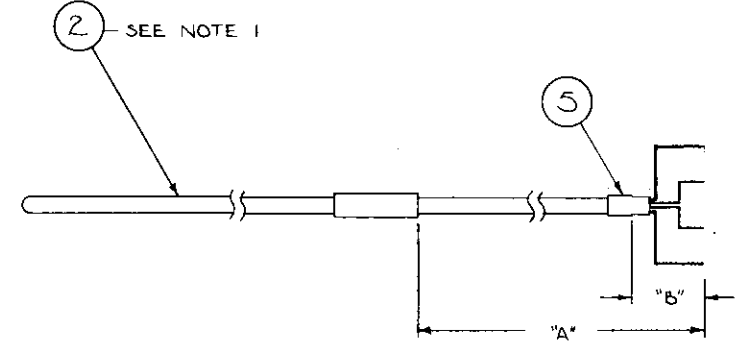
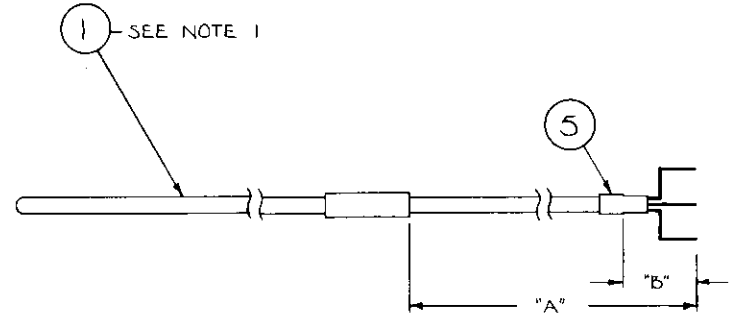
Resistance versus Temperature -50 to +50° C
100093-2

Temp °C	T ₁ Res. Ω	T ₂ Res. Ω	T ₃ Res. Ω	Temp °C	T ₁ Res. Ω	T ₂ Res. Ω	T ₃ Res. Ω
-50	134.1K	662.1K	2540K	+1	6205	42.24K	135.6K
49	124.9K	621.8K	2376K	2	5899	40.34K	129.1K
48	116.4K	584.2K	2223K	3	5610	38.54K	123.0K
47	108.5K	549.1K	2081K	4	5337	36.82K	117.2K
46	101.2K	516.3K	1949K	5	5078	35.20K	111.7K
45	94.41K	485.7K	1826K	6	4834	33.65K	106.4K
44	88.14K	457.0K	1712K	7	4603	32.18K	101.5K
43	82.33K	430.2K	1605K	8	4384	30.78K	96.79K
42	76.94K	405.2K	1506K	9	4177	29.45K	92.34K
41	71.93K	381.7K	1413K	10	3980	28.18K	88.12K
40	67.29K	359.7K	1327K	11	3794	26.98K	84.11K
39	62.97K	339.2K	1246K	12	3618	25.83K	80.30K
38	58.96K	319.9K	1171K	13	3451	24.73K	76.69K
37	55.22K	301.8K	1101K	14	3293	23.70K	73.26K
36	51.75K	284.9K	1035K	15	3143	22.71K	69.99K
35	48.52K	269.0K	973.7K	16	3000	21.76K	66.90K
34	45.51K	254.0K	916.3K	17	2865	20.86K	63.95K
33	42.71K	240.0K	862.6K	18	2736	20.00K	61.15K
32	40.09K	226.9K	812.3K	19	2614	19.18K	58.49K
31	37.65K	214.5K	765.3K	20	2499	18.40K	55.95K
30	35.38K	202.9K	721.2K	21	2389	17.66K	53.54K
29	33.25K	192.0K	698.0K	22	2284	16.95K	51.25K
28	31.27K	181.7K	641.3K	23	2185	16.27K	49.06K
27	29.42K	172.0K	605.0K	24	2090	15.62K	46.98K
26	27.69K	162.9K	571.0K	25	2000	15.00K	45.00K
25	26.07K	154.4K	539.1K	26	1915	14.41K	43.11K
24	24.56K	146.3K	509.2K	27	1833	13.84K	41.31K
23	23.14K	138.7K	481.1K	28	1756	13.30K	39.60K
22	21.81K	131.5K	454.7K	29	1682	12.79K	37.96K
21	20.57K	124.8K	429.9K	30	1611	12.30K	36.40K
20	19.41K	118.4K	406.5K	31	1544	11.82K	34.91K
19	18.31K	112.4K	384.6K	32	1480	11.37K	33.50K
18	17.29K	106.7K	364.0K	33	1420	10.94K	32.14K
17	16.33K	101.4K	344.6K	34	1362	10.53K	30.85K
16	15.43K	96.34K	326.3K	35	1306	10.13K	29.61K
15	14.58K	91.56K	309.1K	36	1253	9752	28.43K
14	13.79K	87.05K	292.9K	37	1203	9390	27.31K
13	13.04K	82.79K	277.7K	38	1155	9042	26.23K
12	12.34K	78.76K	263.3K	39	1109	8710	25.20K
11	11.68K	74.94K	249.8K	40	1065	8391	24.22K
10	11.06K	71.34K	237.0K	41	1023	8085	23.28K
9	10.48K	67.92K	224.9K	42	983.1	7792	22.38K
8	9928	64.69K	213.5K	43	944.9	7511	21.52K
7	9410	61.63K	202.8K	44	908.3	7242	20.70K
6	8922	58.73K	192.6K	45	873.4	6984	19.91K
5	8463	55.98K	183.1K	46	839.9	6736	19.16K
4	8029	53.38K	174.0K	47	808.0	6498	18.44K
3	7621	50.91K	165.4K	48	777.4	6270	17.75K
2	7236	48.57K	157.4K	49	748.1	6051	17.09K
1	6873	46.35K	149.7K	50	720.1	5840	16.45K
0	6529	44.24K	142.5K				

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Revision	Description	Date	Approved
E	See ECN 5637	1/22/07	D.A.

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	ECN 1809	9/24/82	
	B	ECN 2589	6/4/85	



NEXT ASSY	"A" DIM.	"B" DIM.	ITEM 5
100325	46"	4"	1
100552	28"	STRIP 1" TIN 1/4"	NONE

ITEM NO	QTY	FRAC	IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION
5	1/2"	1/2"	RNF 100-5/16	SHRINK TUBING	RAYCHEM
3	1		705	TEMPERATURE SENSOR, FAST RESPONSE	YSI
2	1		703-15133	TEMPERATURE SENSOR, EXTENDED RANGE	YSI
1	1		705	TEMPERATURE SENSOR, STANDARD	YSI
-3	-2				

NOTES:
1. REMOVE JACK SUPPLIED WITH ITEMS 1,2,+3

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± .015 ± .0025 ± .01		CONTRACT NO.			
MATERIAL		APPROVALS	DATE	TEMPERATURE SENSOR	
FRESH		DRAWN	5/14/81		
NEXT ASSY USED ON		CHECKED	7/13/81		
APPLICATION		ISSUED	8/15/81	SIZE	FSCM NO.
DO NOT SCALE DRAWING				SCALE	DWG. NO. 100093
				REV. B	

SH 100093 ON DWG