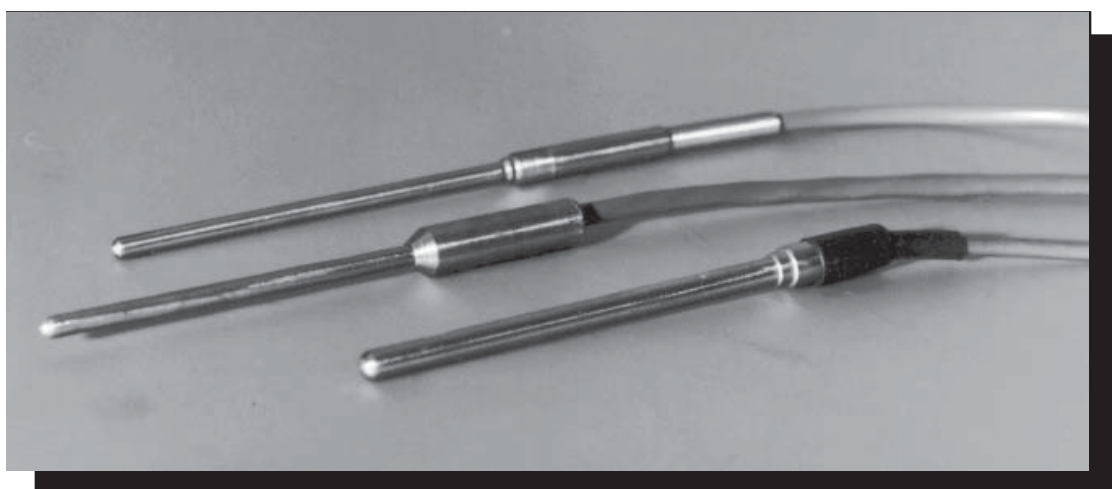


Water Temperature Probe Model 4485



User's Manual

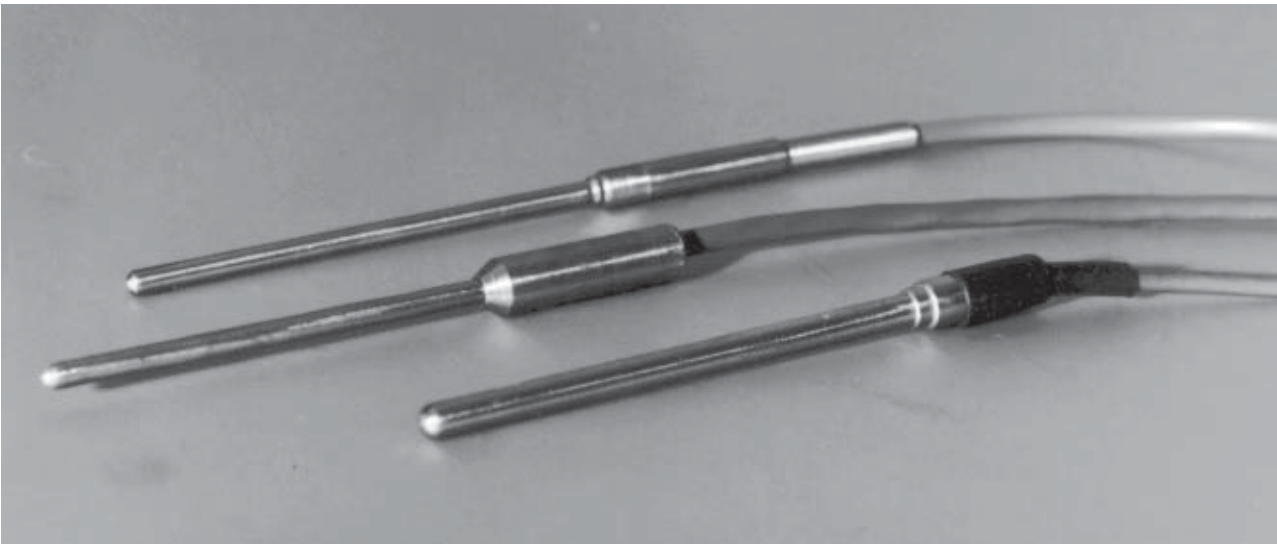


Introduction

The 4485 Water Temperature Probe uses a precision three-element thermistor as a sensing element. Thermistors are semiconductors that exhibit rapid and extremely large changes in resistance for relatively small changes in temperature. Most thermistors are non-linear, but that limitation has been eliminated in the 4485 series with the addition of a resistor network that reduces linearity deviations to less than 0.1°C over the range of $\pm 50^{\circ}\text{C}$. Fifty feet of interconnecting cable is standard with each probe.

The Model 4485 can be used in conjunction with the Model 1410 Temperature Module to provide an analog output voltage proportional to temperature.

Neoprene rubber cable is used to provide a waterproof assembly. The four-conductor, shielded cable has a wire gauge of 20. The probe housing is a single-piece stainless steel assembly. A waterproof potting compound seals the thermistor element into the housing. The sensor housing can be clamped into position for installation when required.



Contents

Installation 1
 Mounting 1
 Connection 1

Theory of Operation 2

Calibration 3

Maintenance 4

Warranty 5

Specifications 6

Parts Lists and Drawings 7

Installation

This instrument is thoroughly tested and fully calibrated at the factory and is ready for installation. Please refer to the return authorization card included in the packing box if damage has occurred. Also, notify All Weather Inc.

Upon receipt, all items must be carefully inspected to assure that no damage has occurred during shipment. Do not discard any packing materials until you are certain that no freight damage exists and all items are accounted for.

If any item has been damaged during shipment, contact your freight handler and file a claim for loss. The claim must be filed at the receiving location. Keep instruments and shipping material in “as received” condition until the freight handler has finished his inspection.

If damage has occurred, notify All Weather Inc. for repair. We will provide a return authorization number to expedite the repair. When returning instruments, please enclose complete details of dam-

age and include your name, address, and return authorization number.

Mounting

Note: Care should be taken to avoid installing the sensor near heat conducting surfaces or structures.

The temperature probe should be mounted in an area typical of the study being performed. The active area of the probe is the first 0.75" of the tip. The cable and sensor should be securely anchored to prevent damage. Use cable ties or suitable clamps.

Connection

A four-conductor cable is connected between the temperature sensor and the signal conditioning module. Connect the probe to the module using Figure 3.1 as a wiring aid. When the installation is complete, the system is ready for operation.



CAUTION

- This instrument is ruggedly constructed—however, a severe blow (such as dropping the sensor onto a hard surface) could damage the internal connections.
- Electrical currents in excess of 700 μA or voltages in excess of 3.5 VDC will increase the error band due to self-heating of the probe.
- Damage caused by failure to observe these cautions voids all warranties.

Theory of Operation

Refer to the temperature probe schematic (4485-004) while reading the following text.

As shown in the schematic, the probe consists of three thermistor elements. Figure 4.1 shows the resistance values for each element as a function of temperature in degrees Celsius. Fahrenheit values can be obtained using the following formula:

$$^{\circ}F = \frac{9}{5}^{\circ}C + 32$$

Where $^{\circ}F$ is the temperature in degrees Fahrenheit and $^{\circ}C$ is the temperature in degrees Celsius.

The three-element probe along with resistors R302 and R303 form an equivalent resistance (R_{eq}) as shown in the schematic. This value is substituted in the temperature module as a low and high calibration resistor and can be determined from the following formula:

$$R_{eq} = \frac{23100C}{1-C}$$

Where R_{eq} is the equivalent resistance in ohms and C is the conversion factor for temperature—

$$C = 0.5930 - 0.00559149T \text{ for } ^{\circ}C$$

$$C = 0.6924 - 0.00310638T \text{ for } ^{\circ}F$$

Where T is the corresponding temperature.

Figure 2 shows calculated values of R_{eq} for corresponding temperatures.

Temperature		Resistance R_{eq} (ohms)
$^{\circ}C$	$^{\circ}F$	
-55.0	-67.0	209135.4
-50.0	-58.0	158182.3
-22.8	-9.0	59543.43
-17.8	0.0	52028.91
+37.8	+100.0	14256.98
+42.8	+109.0	12641.04
+48.9	+120.0	10849.43
+53.9	+129.0	9509.56

Figure 2
 R_{eq} vs. Temperature

T ₁ Resistance Versus Temperature -50° to +50°C		T ₂ Resistance Versus Temperature -50° to +50°C		T ₃ Resistance Versus Temperature -50° to +50°C	
TEMP. °C.	RES.	TEMP. °C.	RES.	TEMP. °C.	RES.
-50	134.10K Ω	-50	662.06K Ω	-50	2539.7K Ω
49	124.88K	49	621.78K	49	2375.6K
48	116.36K	48	584.19K	48	2223.1K
47	108.47K	47	549.09K	47	2081.2K
46	101.17K	46	518.30K	46	1949.2K
45	94.408K	45	485.66K	45	1826.4K
44	88.140K	44	457.02K	44	1711.9K
43	82.329K	43	430.23K	43	1605.3K
42	76.937K	42	405.16K	42	1506.0K
41	71.933K	41	381.70K	41	1413.4K
-40	67.288K	-40	359.73K	-40	1326.9K
39	62.969K	39	339.16K	39	1246.3K
38	58.956K	38	319.88K	38	1171.0K
37	55.224K	37	301.80K	37	1100.7K
36	51.752K	36	284.85K	36	1035.1K
35	48.519K	35	268.95K	35	973.66K
34	45.509K	34	254.03K	34	916.25K
33	42.705K	33	240.02K	33	862.56K
32	40.090K	32	226.86K	32	812.31K
31	37.652K	31	214.50K	31	765.28K
-30	35.378K	-30	202.88K	-30	721.23K
29	33.254K	29	191.96K	29	679.96K
28	31.272K	28	181.69K	28	641.29K
27	29.420K	27	172.02K	27	605.03K
26	27.688K	26	162.93K	26	571.03K
25	26.070K	25	154.36K	25	539.12K
24	24.555K	24	146.30K	24	509.18K
23	23.139K	23	138.70K	23	481.07K
22	21.812K	22	131.54K	22	454.66K
21	20.569K	21	124.78K	21	429.85K
-20	19.405K	-20	118.42K	-20	406.53K
19	18.314K	19	112.41K	19	384.61K
18	17.291K	18	106.74K	18	363.99K
17	16.331K	17	101.39K	17	344.59K
16	15.430K	16	96.335K	16	326.33K
15	14.584K	15	91.562K	15	309.13K
14	13.789K	14	87.051K	14	292.94K
13	13.043K	13	82.787K	13	277.68K
12	12.341K	12	78.756K	12	263.31K
11	11.682K	11	74.943K	11	249.75K
-10	11.061K	-10	71.335K	-10	236.97K
9	10.477K	9	67.921K	9	224.91K
8	9927.6	8	64.689K	8	213.53K
7	9410.0	7	61.629K	7	202.78K
6	8922.4	6	58.730K	6	192.64K
5	8463.0	5	55.983K	5	183.06K
4	8029.0	4	53.379K	4	174.00K
3	7621.4	3	50.911K	3	165.44K
2	7236.1	2	48.570K	2	157.35K
-1	6872.6	-1	46.349K	-1	149.70K
0	6529.4	0	44.242K	0	142.46K
+1	6205.4	+1	42.242K	+1	135.61K
2	5899.3	2	40.342K	2	129.13K
3	5610.1	3	38.538K	3	122.99K
4	5336.8	4	36.824K	4	117.17K
5	5078.3	5	35.196K	5	111.66K
6	4833.9	6	33.649K	6	106.44K
7	4602.6	7	32.177K	7	101.49K
8	4383.7	8	30.778K	8	96.792K
9	4176.5	9	29.447K	9	92.340K
+10	3980.2	+10	28.181K	+10	88.115K
11	3794.3	11	26.976K	11	84.106K
12	3618.1	12	25.829K	12	80.301K
13	3451.1	13	24.736K	13	76.687K
14	3292.7	14	23.696K	14	73.255K
15	3142.5	15	22.705K	15	69.994K
16	3000.0	16	21.760K	16	66.895K
17	2864.8	17	20.860K	17	63.950K
18	2736.4	18	20.001K	18	61.149K
19	2614.4	19	19.183K	19	58.485K
+20	2498.6	+20	18.402K	+20	55.951K
21	2388.6	21	17.657K	21	53.540K
22	2284.0	22	16.946K	22	51.245K
23	2184.5	23	16.267K	23	49.061K
24	2090.0	24	15.619K	24	46.980K
25	2000.0	25	15.000K	25	44.998K
26	1914.5	26	14.409K	26	43.110K
27	1833.0	27	13.844K	27	41.311K
28	1755.5	28	13.304K	28	39.596K
29	1681.6	29	12.788K	29	37.961K
+30	1611.3	+30	12.295K	+30	36.401K
31	1544.3	31	11.823K	31	34.914K
32	1480.4	32	11.372K	32	33.495K
33	1419.5	33	10.940K	33	32.140K
34	1361.5	34	10.527K	34	30.847K
35	1306.1	35	10.131K	35	29.613K
36	1253.3	36	9752.4	36	28.434K
37	1202.9	37	9389.7	37	27.308K
38	1154.8	38	9042.4	38	26.232K
39	1108.9	39	8709.7	39	25.204K
+40	1065.0	+40	8390.8	+40	24.221K
41	1023.1	41	8085.2	41	23.281K
42	983.11	42	7792.3	42	22.383K
43	944.87	43	7511.4	43	21.523K
44	908.31	44	7242.1	44	20.701K
45	873.37	45	6983.7	45	19.914K
46	839.94	46	6735.9	46	19.161K
47	807.98	47	6498.0	47	18.441K
48	777.39	48	6269.7	48	17.750K
49	748.12	49	6050.6	49	17.089K
+50	720.11	+50	5840.2	+50	16.456K

T₁, T₂, T₃ Resistance
vs.
Temperature
Figure 4.1

Calibration

The probe is comparison tested with a second probe that has been tested and certified by the thermistor manufacturer to meet or exceed the specifications of the Model 4485. Calibration of the standards and test equipment used is traceable to the

National Institute of Standards and Technology (formerly the *National Bureau of Standards*).

A useful method for checking the calibration of a probe is to compare it to a known temperature at both ambient temperature and in an ice bath.

Model 4485 Thermistor Temperature Probe Calibration Certificate

All Weather Inc. certifies that the Model 4485 Temperature Probe has been comparison tested against a standard reference probe certified by the thermistor manufacturer to meet or exceed the specifications of the Model 4485. It was determined that the accuracy and interchangeability was within $\pm 0.1^{\circ}\text{C}$ at ambient and ice bath temperatures. All Weather Inc. further certifies that the nonlinearity of the probe is less than $\pm 0.1^{\circ}\text{C}$ over the temperature range of -50° to $+50^{\circ}\text{C}$. Testing of the Model 4485 Temperature Probe and the standard reference probe was accomplished using instruments with calibration traceable to the *National Institute of Standards and Technology*.

Maintenance

Normally, no maintenance is required with this instrument other than periodic calibration checks. Should the probe be in need of service, it should be

returned to the factory with a detailed written description of the problem.

Warranty

Unless specified otherwise, All Weather Inc. (the Company) warrants its products to be free from defects in material and workmanship under normal use and service for one year from date of shipment, subject to the following conditions:

- a. The obligation of the Company under this warranty is limited to repairing or replacing items or parts which have been returned to the Company and which upon examination are disclosed, to the Company's satisfaction, to have been defective in material or workmanship at time of manufacture.
- b. The claimant shall pay the cost of shipping any part or instrument to the Company. If the Company determines the part to be defective in material or workmanship, the Company shall prepay the cost of shipping the repaired instrument to the claimant. Under no circumstances will the Company reimburse claimant for cost incurred in removing and/or reinstalling replacement parts.
- c. This warranty shall not apply to any Company products which have been subjected to misuse, negligence, or accident.
- d. This warranty and the Company's obligation thereunder is in lieu of all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose, consequential damages, and all other obligations or liabilities.

No other person or organization is authorized to give any other warranty or to assume any additional obligation on the Company's behalf, unless made in writing and signed by an authorized officer of the Company.

Specifications

Range	-50 to +50°C
Sensitivity	0.00559149 Ein/°C
Linearity deviation	±0.08°C
Absolute accuracy and interchangeability.....	+0.1°C
Time constant.....	15 seconds
Load resistance	1M ohm or greater
Cable length	50 feet (15 m)
Number of conductors	four, shielded
Active element size	0.75" of tip
Weight/Shipping	0.5 lbs/lb (0.22 kg/0.45 kg)

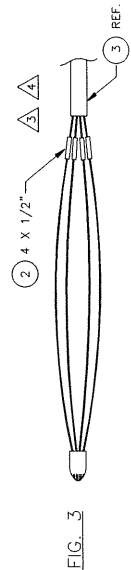
Parts Lists and Drawings

The following pages include a parts list and reference drawings to assist in installation and maintenance of this instrument.

REV	ECN	DESCRIPTION	DATE	APPROVED
A	4485	INITIAL RELEASE OF DRAWING	10/13/93	SP
B	4717	EDIT W/ TYPING TO ADD "WELD FLUSH" ENDING TO BRETTE SHIELD WIRE MOUNTINGS.	6-13-97	PK
C	4738	ADD CE LABEL (IT-8, LABEL IT-7 & NOTE B & 9		

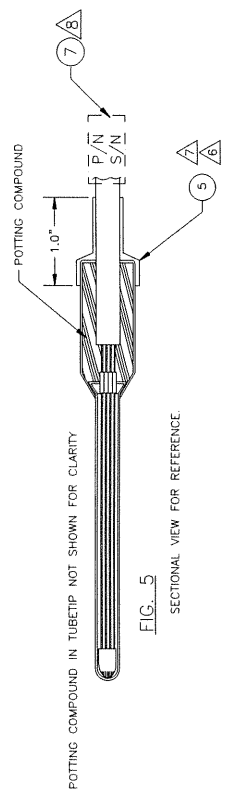
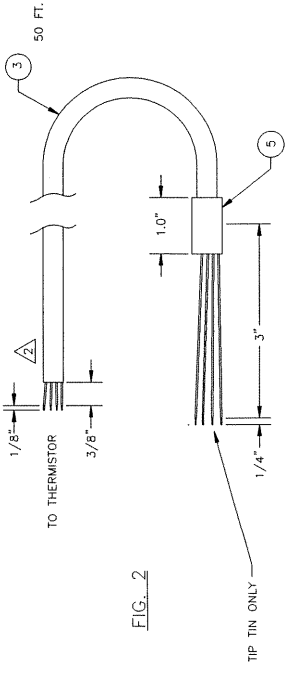
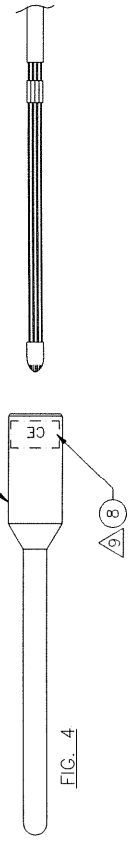
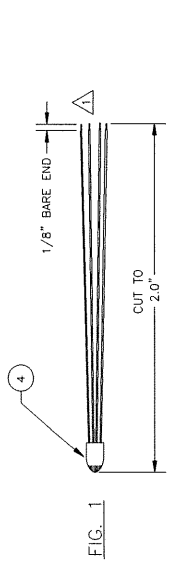
NOTES: UNLESS OTHERWISE SPECIFIED

- 1 REMOVE INSULATION AND TIN WITH SOLDER.
- 2 STRIP INSULATION AND TIN LEADS WITH SOLDER ON THERMISTOR END OF CABLE.
- 3 SOLDER LEADS AND SHRINK.
- 4 WHEN HEAT SHRINKING DO NOT EXPOSE TIP OF PROBE TO HIGH TEMPERATURES. PROBE CAN BE DESTROYED. SHIELD PROBE WITH HAND, AND ATTACH HEAT SINK CLIP TO THERMISTOR LEADS WHILE APPLYING HEAT.
- 5 A. FILL TIP OF TUBE (IT-1) WITH POTTING COMPOUND (IT-6)
B. INSERT PROBE (THERMISTOR) INTO TUBE CAREFULLY UNTIL THE THERMISTOR SITS IN THE TIP OF THE TUBE.
- 6 FILL TUBE WITH POTTING COMPOUND (IT-6) UNTIL IT FORMS A BEAD AT THE TOP OF THE TUBE WHERE THE CABLE EXITS.
- 7 AFTER POTTING COMPOUND HAS CURED, SHRINK 1" LONG SECTION OF 3/4" DIA. SHRINK TUBE (ITEM-5) OVER TOP 1/4" OF TUBE, OVERLAPPING THE CABLE.
- 8 MARK LABEL (IT-7) WITH PART NUMBER, ECN NUMBER AND SERIAL NUMBER.
- 9 AFFIX 1/2" SQUARE BLACK-ON-SILVER CE LABEL (ITEM B) AS SHOWN.



THERMISTOR LEADS	SENSOR WIRE	SHIELD WIRE
4485	WHT	WHT
BLU	BLK	BLK
BRN	RED	RED
GRN	GRN	GRN

THERMISTOR	CABLE
BLU	WHT
BRN	BLK
RED	RED
GRN	GRN

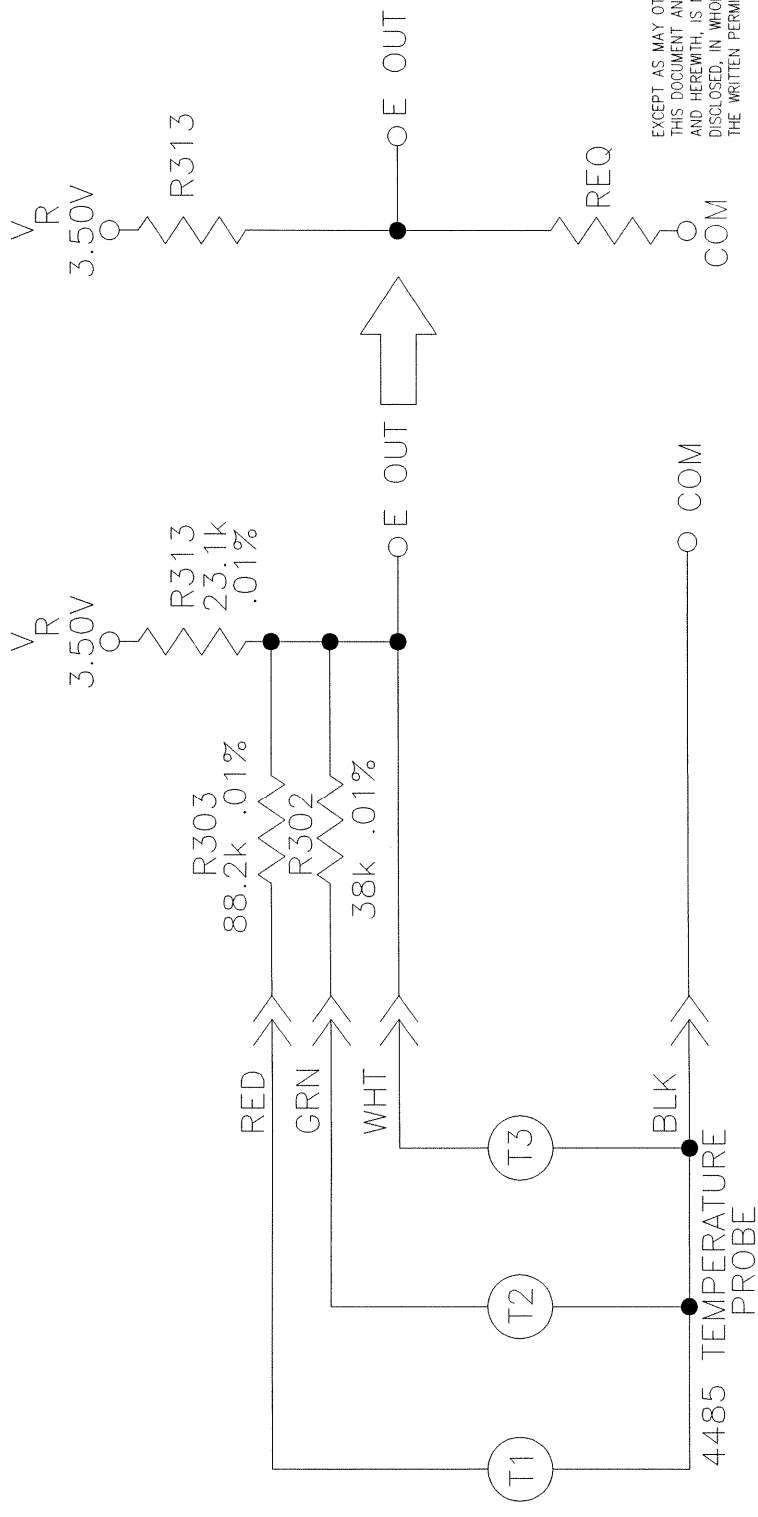


UNLESS OTHERWISE SPECIFIED: DIMENSIONS IN INCHES. ANGLES 25/75. TOLERANCES AS SHOWN. FINISHES TO BE AS SHOWN. DO NOT SCALE DRAWING.	DATE	SCALE	RELEASE DATE	SHEET
DRAWN BY: PETE SANCHEZ	15/JAN/93			1 OF 1
REVISOR BY: P. KOONMAN	19/AUG/97			
CHECKED BY:				
DESIGN ENGINEER:				
PROJECT MANAGER: JM ANDERSON	9-30-93			
APPROVALS:				

PROBE	CABLE	CONDUCTORS	OVERALL LENGTH	RECD	APPLICATIONS
4485	T600704	4	50 FT.		

EXCEPT AS MAY OTHERWISE BE SPECIFIED BY CONTRACT, THIS DOCUMENT AND THE DATA DISCLOSED HEREIN AND HEREWITH, IS NOT TO BE USED, REPRODUCED OR DISCLOSED, IN WHOLE OR IN PART, TO ANYONE WITHOUT THE WRITTEN PERMISSION OF QUALIMETRICS, INC.

REVISIONS		4485-004
REV	ECN	DESCRIPTION
A		INITIAL RELEASE
B	4121	REDRAWN, UPDATE TO CURRENT FORMAT
		DATE
		6/16/83
		APPROVED



EXCEPT AS MAY OTHERWISE BE SPECIFIED BY CONTRACT, THIS DOCUMENT AND THE DATA DISCLOSED HEREIN AND HEREWITH, IS NOT TO BE USED, REPRODUCED OR DISCLOSED, IN WHOLE OR IN PART, TO ANYONE WITHOUT THE WRITTEN PERMISSION OF QUALIMETRICS, INC..

DRAWN BY: PETE SANCHEZ		15JULY92
CHECKED BY:		
DESIGN ENGINEER:		
PROJECT MANAGER:		
PROGRAM MANAGER:		
APPROVALS		DATE
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES XX=±.010 ANGLES ±1/2° XXX=±.005 FRACTIONS=±.02 DO NOT SCALE DRAWING		
MATERIAL SEE BILL OF MATERIALS		
FINISH AS ISSUED		
TREATMENT		
NEXT QTY REQD	NEXT ASSY	USED ON APPLICATIONS
QUALIMETRICS, Inc.		TITLE
SCHEMATIC		
THERMISTOR TEMP. PROBE		
SIZE	DWG NO.	
A	4485-004	
SCALE	NONE	RELEASE DATE
		6/84
SHEET	1 OF 1	

EXCEPT AS MAY OTHERWISE BE SPECIFIED BY CONTRACT, THIS DOCUMENT AND THE DATA DISCLOSED HEREIN AND HEREWITH, IS NOT TO BE USED, REPRODUCED OR DISCLOSED, IN WHOLE OR IN PART, TO ANYONE WITHOUT THE WRITTEN PERMISSION OF QUALIMETRICS, INC..

REVISIONS		4485-005
REV	ECN	DESCRIPTION
A		INITIAL RELEASE
B	4121	REDRAWN TO CURRENT FORMAT
		DATE
		6-16-82

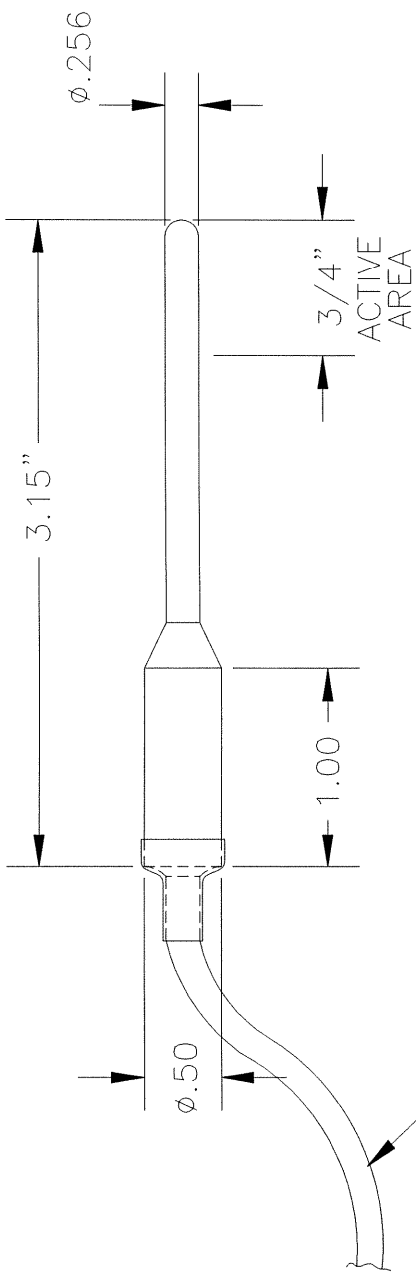


TABLE A

PROBE	CABLE	CONDUCTORS	OVERALL LENGTH
4485	T600704	4	50 FT.

DRAWN BY: PETE SANCHEZ		DATE 11 FEB 93		QUALIMETRICS, Inc.	
CHECKED BY:				TITLE OUTLINE	
DESIGN ENGINEER:				THERMISTOR TEMPERATURE PROBE	
PROJECT MANAGER:				SIZE A	
PROGRAM MANAGER:				DWG NO. 4485-005	
APPROVALS		DATE		SCALE NONE	
				RELEASE DATE	
				SHEET 1 OF 1	

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES	
TOLERANCES	
XX=±.010	ANGLES ±1/2°
XXX=±.005	FRACTIONS=±.02
DO NOT SCALE DRAWING	
MATL	SEE BILL OF MATERIALS
FINISH	AS ISSUED
TREATMENT	
NEXT QTY REQD	USED ON APPLICATIONS

05/06/98 35
4.28.3

** QUALIMETRICS, INC. **
BILL OF MATERIAL INQUIRY - 4485

05/06/98 PAGE 1
9:25 AM (R070IZ)

LINE NO	RUN/ SET UP	COMPONENT	QTY EACH	UOM
10		ECN ENGR CHANGE NUMBER ECN @ 4738, LAST CHG AS OF 5SEPT97	.0000	EA
20		4485-001 MANUAL USERS 4485	1.0000	EA
30		M432003 TUBE SHRNK 1/8 BLK IT-2	2.0000	IN
40		M432015 HEAT SHRINK 1/2 BLK DUAL WALL IT-5	2.0000	IN
50		T160002 POTTING COMPOUND IT-6	.0000	EA
60		T535004 THERMISTOR 3 ELEM THERMOLINER IT-4	1.0000	EA
70		T600704 CABLE 4 CND 18 GA SJ0-4 NEO IT-3	50.0000	FT
80		T800264 BODY TEMP PROBE IT-1	1.0000	EA
90		M434026 CABLE MARKER WRITE-ON BOOK IT-7	.0000	EA
100		M909327 LABEL CE MARK .5" BLK ON SVR IT-8	1.0000	EA
9030	.3000 .2000	TEST	3.0000	
9050	.7000 .1000	CABLE ASSEMBLY	3.0000	EA



All Weather Inc.

1165 National Drive
Sacramento, CA 95834
Fax: 916.928.1165
Phone: 916.928.1000
Toll Free: 800.824.5873
www.allweatherinc.com

4485-001
ECN 4121
May, 1993