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Service Note

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TROUBLESHOOTING TEMPERATURE CIRCUITS FOR API MODEL 700 CALIBRATOR

NOTE: ALL THERMISTORS USE A TWISTED PAIR OF YELLOW WIRES. ANYTIME YOU SEE A TWISTED PAIR OF YELLOW WIRES, THAT IS A THERMISTOR CIRCUIT. BECAUSE THERMISTOR WIRES OFTEN SHARE A CONNECTOR WITH HEATERS, **BE SURE YOU MEASURE RESISTANCE OR SUBSTITUTE RESISTORS ON THE YELLOW WIRES TO AVOID RISK OF ELECTRICAL SHOCK.**

1. All temperature circuits use thermistors to sense temperature. The thermistor is a resistor which varies resistance with temperature. Higher temperature equals lower resistance, and vice versa.

2. The thermistor sensing circuits are located on the I2C/MUX pcb which is attached to the CPU card. A simple voltage divider is created by the thermistor and a 15K ohm resistor found on the RN1 resistor pack (refer to schematic #01562). The voltage divider creates a voltage based on the resistance of the thermistor. This voltage is muxed through U4 and buffered by U7. The output of U7 goes to the V/F card to be converted to a number. The CPU converts the number to temperature and makes a decision to turn on or off a heater, or do nothing.

3. The trick to troubleshooting these circuits is to divide them into two parts; a temperature sensing circuit and a control circuit. The sensing circuit consists of the thermistor, the I2C/MUX card and the V/F. The control circuit consists of the heater element, the power supply for the element, the switch to turn the element on or off, and the V/F card which uses an I/O port to control the switch.

   CAUTION! SOME THERMISTORS SHARE CONNECTORS WITH HEATERS! PAIRS OF RED WIRES ARE HEATERS (115 volts AC)! USE EXTREME CAUTION IN THE FOLLOWING STEPS TO AVOID ELECTRICAL SHOCK!

4.
   a. In troubleshooting the sensing circuits, unplug the thermistor in question and plug an 11K ohm resistor into the connector where the thermistor was connected. Observe the front panel test function for a value of 50 degrees C. A correct reading indicates the CPU, V/F and I^2C/mux are working. Incorrect reading is most likely the V/F card.

b. If the readings are correct, ohm from one side of the thermistor to chassis. A reading other than infinite indicates the thermistor is shorted internally to case, indicating a failed thermistor which must be replaced.

c. Ohm across the thermistor. Verify the reading is correct for the temperature of the thermistor based on the attached chart.

5. The control circuits for the heaters are all the same. They consist of a heater, a 15VAC power source and an optoisolator switch or solid-state relay. The most common control failure is a complaint that the temperature is too high and moves around. This is caused by the relay shorting in one direction allowing 1/2 wave voltage to the heater always. This will be characterized by the heater LED never coming on. With the heater off, measure the voltage across the heater with the heater plugged in. If you have 50-70VAC, the relay is shorted and must be replaced. On a working unit, this voltage should be less than 10VAC with the heater LED off.

   a. First verify the heater isn't open by unplugging it at the molex connector and using an ohmmeter to verify the resistance usually between 100 and 750 ohms (on a good heater). A failed heater will read greater than 1K ohm or close to zero ohms.

   b. Next verify that the heater LED is on. It is located on the power supply module. The LED is powered by the 115VAC supplied to the heater. If the LED is on, then the heater is receiving power and the problem is a bad heater or bad connection.

   c. If the heater resistance is correct, but 115VAC is absent, look at the power supply schematic (attached) and verify that the +5VDC logic signal is present at the Power Supply Module. This signal turns the relay on. If the signal is there, the relay is bad. If the +5VDC is missing, the V/F is bad or a connection problem exists between the V/F and the PSM.

RESISTANCE VERSUS TEMPERATURE —40° to +150°C

TEMP°C	RES	TEMP°C	RES	TEMP°C	RES	TEMP°C	RES	TEMP°C	RES	TEMP°C	RES	TEMP°C	RE
— 40	884.6K	— 10	158.0K	+ 20	37.30K	+ 50	10.97K	+ 80	3843	+ 110	1550	+ 140	701.2
39	830.9K	9	150.0K	21	35.70K	51	10.57K	81	3720	111	1507	141	684.1
38	780.8K	8	142.4K	22	34.17K	52	10.18K	82	3602	112	1465	142	667.5
37	733.9K	7	135.2K	23	32.71K	53	9807	83	3489	113	1425	143	651.3
36	690.2K	6	128.5K	24	31.32K	54	9450	84	3379	114	1386	144	635.6
35	649.3K	5	122.1K	25	30.00K	55	9109	85	3273	115	1348	145	620.0
34	611.0K	4	116.0K	26	28.74K	56	8781	86	3172	116	1311	146	605.5
33	575.2K	3	110.3K	27	27.54K	57	8467	87	3073	117	1276	147	591.1
32	541.7K	2	104.9K	28	26.40K	58	8166	88	2979	118	1241	148	577.1
31	510.4K	— 1	99.80K	29	25.31K	59	7876	89	2887	119	1208	149	563.5
— 30	481.0K	0	94.98K	+ 30	24.27K	+ 60	7599	+ 90	2799	+ 120	1176	+ 150	550.2
29	453.5K	+ 1	90.41K	31	23.28K	61	7332	91	2714	121	1145		
28	427.7K	2	86.09K	32	22.33K	62	7076	92	2632	122	1114		
27	403.5K	3	81.99K	33	21.43K	63	6830	93	2552	123	1085		
26	380.9K	4	78.11K	34	20.57K	64	6594	94	2476	124	1057		
25	359.6K	5	74.44K	35	19.74K	65	6367	95	2402	125	1029		
24	339.6K	6	70.96K	36	18.96K	66	6149	96	2331	126	1002		
23	320.9K	7	67.66K	37	18.21K	67	5940	97	2262	127	976.3		
22	303.3K	8	64.53K	38	17.49K	68	5738	98	2195	128	951.1		
21	286.7K	9	61.56K	39	16.80K	69	5545	99	2131	129	926.7		
— 20	271.2K	+ 10	58.75K	+ 40	16.15K	+ 70	5359	+ 100	2069	+ 130	903.0		
19	256.5K	11	56.07K	41	15.52K	71	5180	101	2009	131	880.0		
18	242.8K	12	53.54K	42	14.92K	72	5007	102	1950	132	857.7		
17	229.8K	13	51.13K	43	14.35K	73	4842	103	1894	133	836.1		
16	217.6K	14	48.84K	44	13.80K	74	4682	104	1840	134	815.0		
15	206.2K	15	46.67K	45	13.28K	75	4529	105	1788	135	794.6		
14	195.4K	16	44.60K	46	12.77K	76	4381	106	1737	136	774.8		
13	185.2K	17	42.64K	47	12.29K	77	4239	107	1688	137	755.6		
12	175.6K	18	40.77K	48	11.83K	78	4102	108	1640	138	736.9		
11	166.6K	19	38.99K	49	11.39K	79	3970	109	1594	139	718.8