



## Technical Service Bulletin

**TBJ005**

**Date:** September 11, 2007

**Issue:** Nuisance Faults caused by FP1 and FP2 sensor calibration

**Product:** All units

### **Purpose of technical bulletin:**

We are experiencing an increase in the number of FP2 sensors returned from the field. When found defective, the sensors have much higher resistance than they should at a given temperature. This falsely indicates lower than actual temperatures to the CXM or DXM control boards, which usually leads to nuisance lock-outs on air coil low temperature protection (FP2, code 5). This technical bulletin will aid in accurately diagnosing a failed FP1 or FP2 sensor.

### **Function of FP1 and FP2 sensors:**

These sensors are negative temperature coefficient thermistors, meaning that resistance increases as temperature decreases. They are used to sense the temperature of the refrigerant entering the heat exchangers to protect against low temperature conditions and to indicate other abnormal operating conditions.

### **Indications of a defective FP1 or FP2 sensor:**

A faulty thermistor will cause nuisance lock-outs on low temperature protection for the water coil (FP1, code 4) or air coil (FP2, code 5), and can cause flashing of the Unit Performance Sentinel (UPS, code 8), and may also indicate swapped thermistors (code 9) when the unit is placed into test mode. If the unit performance does not seem to support any cause for these faults, you should check the calibration of the FP1 and FP2 sensors.

The FP1 sensor has gray wires and protects the water coil against low temperature conditions in the heating mode. This sensor is located on the refrigerant line between the expansion valve (or cap tube) and the water coil (coax). The FP2 sensor has violet wires and protects the air coil against low temperature conditions in the cooling mode. This sensor is located on the refrigerant line between the expansion valve (or cap tube) and the air coil. UPS monitors the temperatures of both the FP1 and FP2 sensors during operation to ensure they are in a normal range. If one of the sensors is out of calibration it can cause the CXM or DXM control to indicate the system is operating inefficiently via the UPS code. A swapped thermistor fault can only be indicated while the unit is in test mode. The CXM or DXM control expects the temperature on the evaporator side of the expansion valve (or cap tube) to be lower than that on the condenser side (entering liquid). If the swapped thermistor fault is displayed, it usually indicates that the FP1 and FP2 sensors are installed in the wrong (or opposite) locations. It can also be displayed if one of the sensors is out of calibration, or if the heat/cool mode of the unit has just been changed. Please review the CXM/DXM manual for more details about these codes.

### **How to diagnose a defective FP1 or FP2 sensor:**

Disconnect supply voltage to unit using lock-out tag-out procedures. Connect an accurate temperature meter to the refrigerant line close to the thermistor being tested. Allow 5-10 minutes for the temperature and sensors to stabilize. Disconnect the 12-pin connector from the CXM or DXM control (see photo below), locate the wires leading to the thermistor under test and measure

the resistance with an ohmmeter. Translate the ohm measurement to temperature using the conversion table attached. Compare this translated temperature to the temperature reading being measured on the refrigerant line. Although this is not a precise testing method, the two temperatures should be reasonably close to each other. The defective thermistors being returned are generally FAR out of calibration, and should be readily detected using this test.

A more precise testing method is to remove the thermistor and immerse both it and the temperature meter probe to approximately the same location within a glass of water. As the water quickly brings the sensors to thermal equilibrium, the two temperatures should be very close with this test method.

If the thermistor is out of calibration, it should be replaced. If the thermistor is within calibration, make sure the sensor leads are making good contact in the 12-pin harness to the CXM or DXM circuit board. If no problems are detected with the thermistor or its connections, continue diagnosing the unit as you would normally for the fault being investigated using the guidelines below:

**Operating conditions that can cause Low Water Coil Temperature fault (code 4):**

Code 4 is most commonly caused by low entering water temperature or low water flow through the water coil during heating mode. Check the entering water temperature and verify that water flow is in a normal range. Water flow can be checked by measuring the pressure drop across the water coil and comparing it to the “coax water pressure drop” chart in the unit IOM. If pressure drop can not easily be determined, an excessive water temperature drop across the coil during heating mode indicates low water flow. Correct the water flow if required. This fault can also be caused if the JW3 jumper has not been clipped in systems utilizing antifreeze that operate at low temperatures. If JW3 has been clipped, verify that the concentration of antifreeze is adequate. Too little antifreeze will lead to a slow buildup of ice inside the water coil during prolonged heating run cycles, which will eventually cause FP1 lock-out. There are other less common causes for code 4 faults such as a defective expansion device or low refrigerant charge. Smaller units are critically charged. By connecting refrigerant gauges you can remove enough refrigerant to create an undercharge issue, so connect gauges only after all other diagnostic methods have been exhausted.

**Operating conditions that can cause Low Air Coil Temperature fault (code 5):**

Code 5 is most commonly caused by low entering air temperature or low airflow across the air coil during cooling mode. Check the entering air temperature and verify that air filters, the air coil, and the blower wheel are clean, that registers are open, and that ductwork is properly sized. Excessive air temperature drop across the coil during cooling mode indicates low air flow. Correct the air flow if required. There are other less common causes for code 5 faults such as a defective expansion device or low refrigerant charge. Smaller units are critically charged. By connecting refrigerant gauges you can remove enough refrigerant to create an undercharge issue, so connect gauges only after all other diagnostic methods have been exhausted.

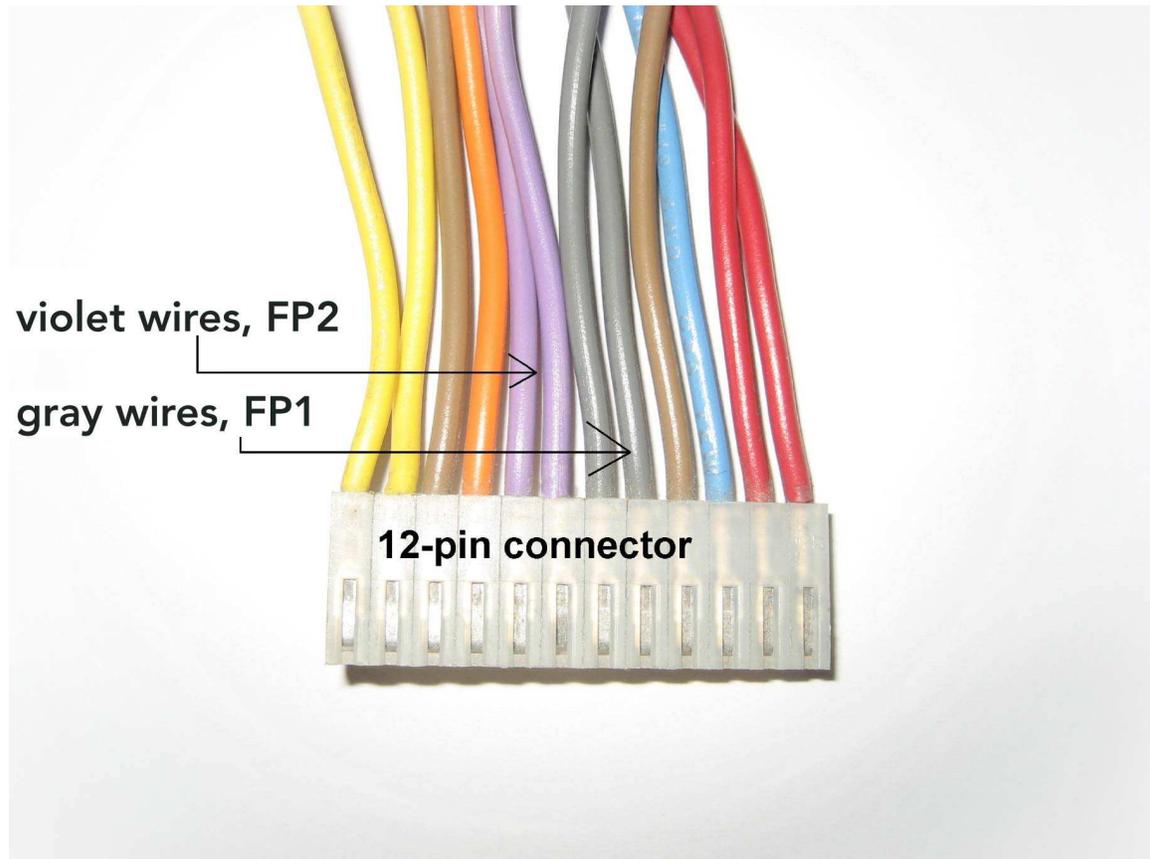
**Operating conditions that can cause a Unit Performance Sentinel indication (code 8):**

Code 8 and a flashing UPS signal at the thermostat are indications that the unit is operating under inefficient conditions, but not to the point of a lock-out. In heating mode, UPS indicates a high condensing temperature. The causes of high condensing temperature during heating mode would generally be high entering air temperature, low air flow, dirty air coil, or an overcharged system. In cooling mode, UPS can indicate either a high condensing temperature or a low evaporating temperature. The causes of high condensing temperature during cooling mode would generally be high entering water temperature, low water flow, fouled water coil, or an overcharged system. The causes of low evaporating temperature during cooling mode would generally be low entering air temperature, low air flow, dirty air coil, an undercharged system, or a defective expansion device.

**Operating conditions that can cause a Swapped Thermistor Indication (code 9):**

If code 9 is displayed during test mode, it indicates that the *measured* liquid line temperature is less than the *measured* evaporator temperature. This is generally caused by the FP1 and FP2 sensors being installed in the opposite of normal locations. If the heat/cool mode of the unit has recently been switched this condition can temporarily occur.

NOTE: For water-to-water units, FP2 protects the load water coil rather than an air coil.



If you have checked these conditions and still require assistance, please contact ClimateMaster's Technical Service Department at 1-800-299-9747.

Thank you,

ClimateMaster

Temp (°C)	Temp (°F)	Resistance (kOhm)	Temp (°C)	Temp(°F)	Resistance (kOhm)
-17.8	0.0	85.41	55	131.0	2.99
-17.5	0.5	84.16	56	132.8	2.88
-16.9	1.5	81.43	57	134.6	2.77
-12	10.4	61.70	58	136.4	2.67
-11	12.2	58.40	59	138.2	2.58
-10	14.0	55.30	60	140.0	2.49
-9	15.8	52.40	61	141.8	2.40
-8	17.6	49.60	62	143.6	2.32
-7	19.4	47.00	63	145.4	2.23
-6	21.2	44.60	64	147.2	2.16
-5	23.0	42.30	65	149.0	2.08
-4	24.8	40.10	66	150.8	2.01
-3	26.6	38.10	67	152.6	1.94
-2	28.4	36.10	68	154.4	1.88
-1	30.2	34.30	69	156.2	1.81
0	32.0	32.60	70	158.0	1.75
1	33.8	31.00	71	159.8	1.69
2	35.6	29.40	72	161.6	1.64
3	37.4	28.00	73	163.4	1.58
4	39.2	26.60	74	165.2	1.53
5	41.0	25.30	75	167.0	1.48
6	42.8	24.10	76	168.8	1.43
7	44.6	23.00	77	170.6	1.38
8	46.4	21.90	78	172.4	1.34
9	48.2	20.80	79	174.2	1.30
10	50.0	19.90	80	176.0	1.26
11	51.8	18.97	81	177.8	1.22
12	53.6	18.09	82	179.6	1.18
13	55.4	17.25	83	181.4	1.14
14	57.2	16.46	84	183.2	1.10
15	59.0	15.71	85	185.0	1.07
16	60.8	15.00	86	186.8	1.04
17	62.6	14.32	87	188.6	1.00
18	64.4	13.68	88	190.4	0.97
19	66.2	13.07	89	192.2	0.94
20	68.0	12.49	90	194.0	0.92
21	69.8	11.94	91	195.8	0.89
22	71.6	11.42	92	197.6	0.86
23	73.4	10.92	93	199.4	0.84
24	75.2	10.45	94	201.2	0.81
25	77.0	10.00	95	203.0	0.79
26	78.8	9.57	96	204.8	0.76
27	80.6	9.17	97	206.6	0.74
28	82.4	8.78	98	208.4	0.72
29	84.2	8.41	99	210.2	0.70
30	86.0	8.06	100	212.0	0.68
31	87.8	7.72	101	213.8	0.66
32	89.6	7.40	102	215.6	0.64
33	91.4	7.10	103	217.4	0.62
34	93.2	6.81	104	219.2	0.60
35	95.0	6.53	105	221.0	0.59
36	96.8	6.27	106	222.8	0.57
37	98.6	6.02	107	224.6	0.56
38	100.4	5.78	108	226.4	0.54
39	102.2	5.55	109	228.2	0.53
40	104.0	5.33	110	230.0	0.51
41	105.8	5.12	111	231.8	0.50
42	107.6	4.92	112	233.6	0.48
43	109.4	4.73	113	235.4	0.47
44	111.2	4.54	114	237.2	0.46
45	113.0	4.37	115	239.0	0.45
46	114.8	4.20	116	240.8	0.43
47	116.6	4.04	117	242.6	0.42
48	118.4	3.89	118	244.4	0.41
49	120.2	3.74	119	246.2	0.40
50	122.0	3.60	120	248.0	0.39
51	123.8	3.47	121	249.8	0.38
52	125.6	3.34	122	251.6	0.37
53	127.4	3.22	123	253.4	0.36
54	129.2	3.10			