Testing of Self Powered 4-20mA Temperature Transmitter Options
Option #s 7203-AV, 7203FMS, 7204, 7205TA
(or 4-20mA loops in general)

Main parts – 326518H01 through H04 TempTrans (Minco TT518), 327624H01 24v DC Power Supply or 16.5v DC Power Supply and a dummy load resistor (1/4w 5%) – 25 ohms or 250 ohms
Refer to instructional drawing #s 311977I02, 325436H01 FMS and wiring diagram #s 325439H01 FMS, 326861H01 General, and 327987H01 TSX.

Theory in general –

The power supply provides 24v DC to the loop. The acceptable voltage range is 8 to 30v DC for customers who supply their own power to the loop. The Minco TempTrans converts the sensor (RTD) reading into a milli Amp signal based on Ohm's Law (V=IR). 4mA represents the coldest end of the scale printed on the back of the TempTrans, and 20mA represents the warmest end of the scale.

For	326518H01 (Frzs -20/-30/-86s),	4mA = -100°C	& 20mA = 0°C
	326518H02 (Refrigerators),	4mA = 0°C	& 20mA = 40°C
	326518H04 (FMS 2320, & 2305),	4mA = -66°C	& 20mA = 54°C

Testing -

Testing can be done by current or voltage measurements. A dummy load resistor will need to be added temporarily across the terminal strip connections "TempTrans Neg" and "24v Supply Neg" or "16.5 Supply Neg" (see 311977I02 or 327987H01). The resistor simulates the customers test equipment (see wiring diagrams for "control room - R1"). The size of the resistor is limited based on maximum resistance of the loop formula:

R loop max = (V supply – 8v) / 0.023 amps, in our 24v case, R loop max = 696 ohms
Note: for HPLRF TSX, the supply is 16.5v, so R loop max = 370 ohms

Measurements only need to reflect that the transmitter is functioning near the expected range since actual readings will be dependent on additional factors at the customer's site. The best time to test is while the cabinet is operating within its TempTrans range, but for cabinets that are out of range (-86 at ambient), the TempTrans will show the "out of range" value of 3.5mA if the circuit is connected correctly.

Current Method

For current measurements, the size of the resistor just needs to be less than R loop max or the resistor can be replaced at the terminal strip by a DC ammeter. Break into the circuit with an Amp meter set to the mA DC scale. The current reading from the meter can be compared to the calculated expected value to confirm that it corresponds to the cabinet temperature. To calculate the expected value, use the formula:

Current for Tsensor = ((Tsensor – Tzero / Tspan – Tzero) *16mA) + 4mA

Tsensor = the temp at the sensor
Tzero = the printed temp for 4mA (H02 = 0°C)
Tspan = the printed temp for 20mA (H02 = 40°)

For example: If a cabinet using 38197H02 is reading +4°C
Then 4°C = ((4-0 / 40-0)*16) + 4 = 5.6mA

Or

A cabinet using H01 is reading –86°C
Then –86°C = ((-86+100 / 0+100)*16) + 4 = 6.24mA

Reduced °C formulas: for H01, current at Tsensor = (Tsensor * .16) + 4mA
for H02, current at Tsensor = (Tsensor * .4) + 4mA
for H04, current at Tsensor = (Tsensor * .1333) + 4mA

Voltage Method

For voltage measurements, the size of the resistor effects the voltage range. For example: a 250 ohm resistor will cause a voltage range of 1v to 5v DC, and a 25 ohm resistor will cause a range of .1v to .5v DC. Other values up to R loop max are acceptable, but require recalculating with Ohms Law (V=IR) to generate the expected voltage range.

Place the meter leads across the dummy load resistor to read the voltage. To calculate the expected voltage, use the calculated current value times the resistor value.

For a 250 ohm resistor with H02, the voltage at the dummy load resistor of a refrigerator at +4°C = 5.6mA * 250 = 1.4v
and using a 250 ohm resistor with H01, the voltage at the dummy load resistor of a ULT at –86°C = 6.24mA * 250 = 1.56v

You can also use percentage approximation to tell if the TempTrans is working. Based on a 250 ohm resistor and the 1v to 5v range, temps at 50% of the range will read ~ 3v, 25% will read ~2v, 75% will read ~ 4v, etc. For example, a refrigerator at ambient will be in the 3.0v to 3.5v area, since 20°C = 3v and 25°C = 3.5v; and a refrigerator at normal operating temp should be in the 1.0v to 1.5v range since 0°C = 1v and 10°C = 1.5v.

Quick Reference Charts are available mapping out the TempTrans ranges with both 25 and 250 ohm resistors as are Resistance vs. Temperature charts for 100 PRTD with .385 coefficient.

Possible problems – other than a bad component, open/shorted circuits (low voltage or line voltage), reversed polarity on the power supply circuit, or R loop max being exceeded by the customer -

1) Power Supply accepts 100v to 240v AC as an input. Output should be 24v DC and the green LED should be on. In the 16.5v case, the TempTrans is piggybacking off of the units supply, so there is no green LED

2) The voltage across the TempTrans should read 24v (16.5) minus the voltage drop of the dummy load resistor (building system). When the TempTrans sees less than 8v, it will not be able to regulate the loop at the 20mA end, so mA values will start dropping off.

3) Reversing the 24v wires at the power supply **or** the TempTrans causes the voltage across the dummy load to read 0v.

Additional resource – www.minco.com