MAVAM ESPRESSO, LLC

TECHNICAL DOCUMENT

4000 RTD testing and advanced RTD error tracing

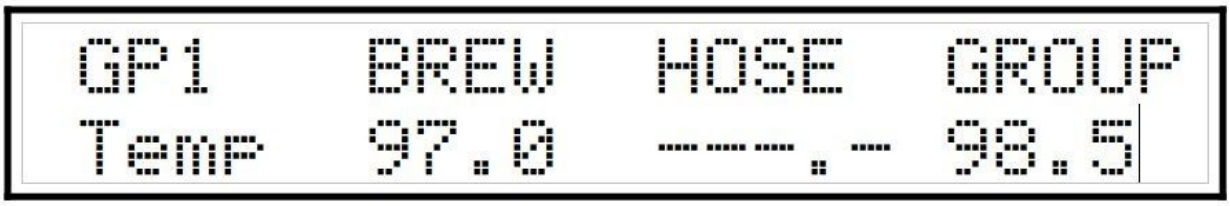
What is an RTD?

We use RTDs ,**(resistance temperature detectors)**, to measure the temperature of our brew boilers, hoses, and group heads. RTDs work by changing resistance in response to temperature. We use a precision sensor chip to measure the resistance, getting a precise temperature, for each component. Sometimes there are errors with the RTD or the wiring between the RTD and the sensor chip. This document will help you with what to look for and how to locate the problem.

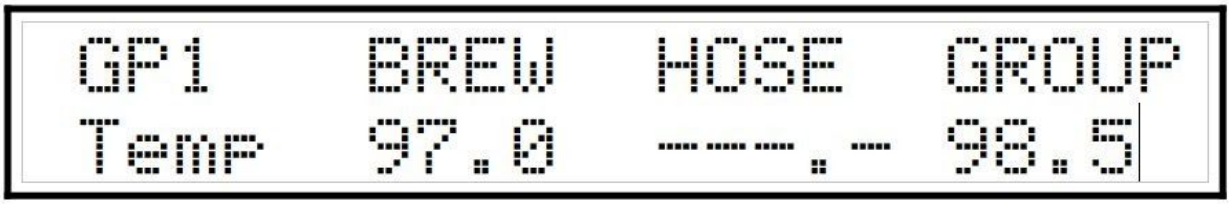
What to look for

BCU or RTD?

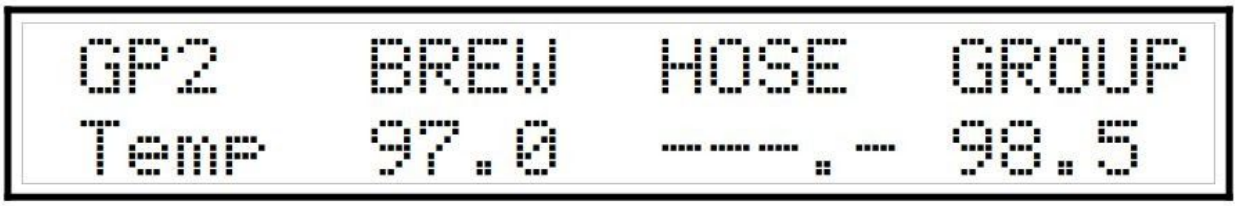
First step is to find out if the error is on the BCU circuit board sensor chip or the RTD and associated wiring harness. Before proceeding verify which Group and Component shows the fault. Then verify that one of the other groups has no errors (if this is a single group machine skip this step). Turn the machine OFF and get access to the BCU circuit board. Swap the nine pin connector from the group with the error with the one that is OK. Turn the machine back on and see where the error is. If the error is still on the same Group and Component then the problem is the BCU circuit board. If the error moved to the good Group and Component then the RTD or harness is at fault. If the error is the BCU then there is no need to continue with the further steps.



BEFORE SWAP: BCU Screen showing temperature error for Group 1, Hose



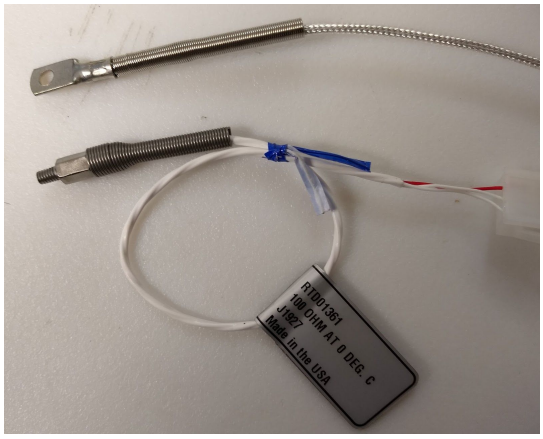
AFTER SWAP: BCU Screen showing temperature error for Group 1, Hose
This scenario indicates that the error is on the BCU circuit board. The error stayed the same.



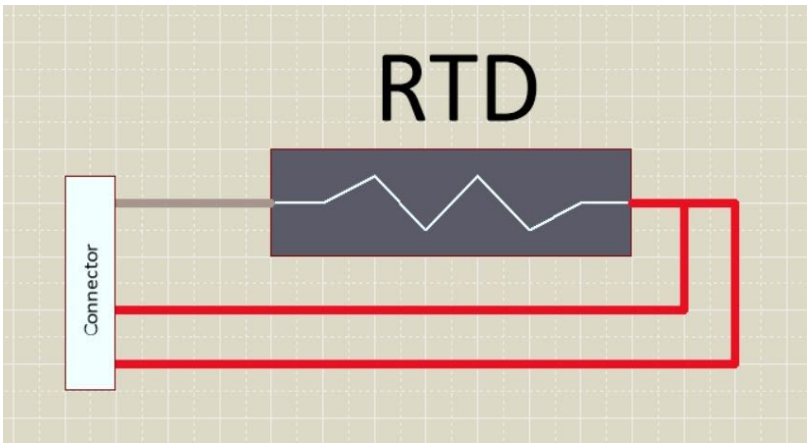
AFTER SWAP: BCU Screen showing temperature error for Group 2, Hose
This scenario indicates that the error is with the RTD or wiring harness. The error moved with the RTD.

RTD or Harness identified as the problem

You will need a multimeter for all the steps below. ***The machine must be OFF for all of the following steps.*** The multimeter will be used to measure the resistance of the RTD using the OHMS setting. The range of readings will be from zero ohms to 150 ohms. If autorange is not available set the meter to the closest range possible. If the resistance is in the normal range then the RTD and wiring from the measurement point is GOOD. Normal range is 105 ~ 110 ohms at room temperature and 130 ~ 140 ohms at operating temperature. There are different styles of RTD, ring, stud, or other. Two of the RTDs used in our machines are shown below.

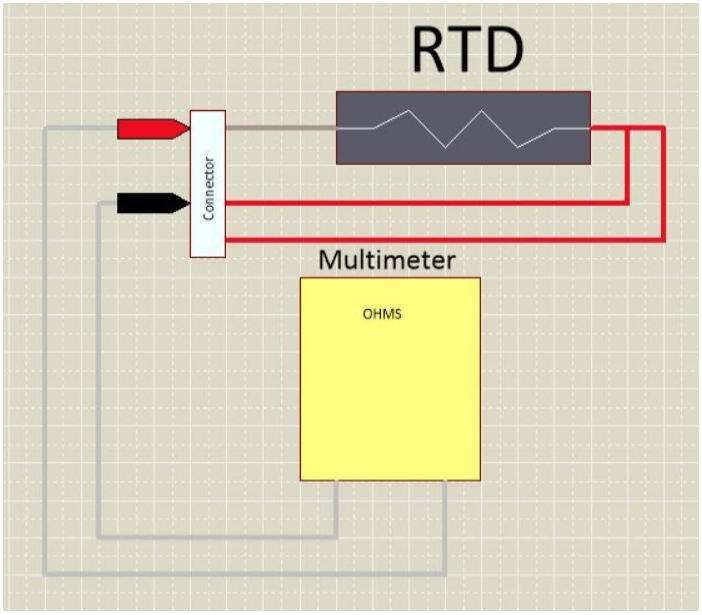


Wiring and connector of typical RTD.



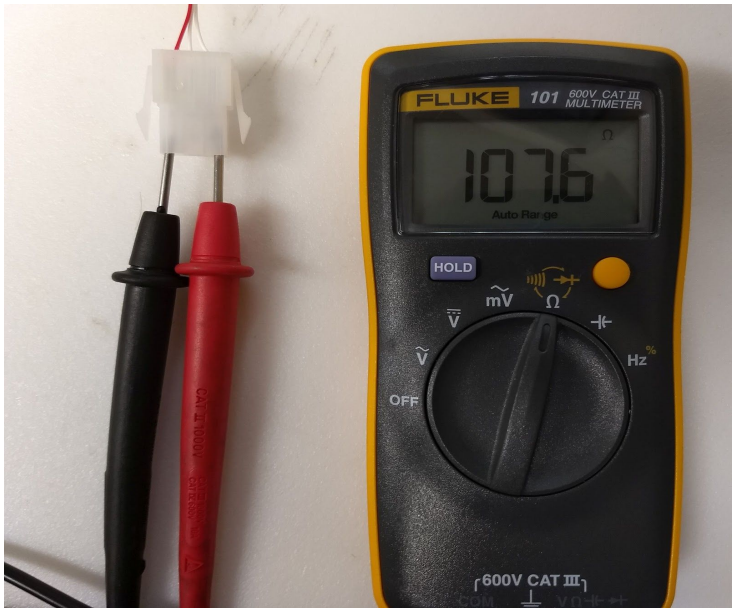
Note: wires may be (Red, Red, Silver), or (White, White, Red), or other combination. The same pair of colored wires will always be connected together at the RTD. The connector will also have different styles.

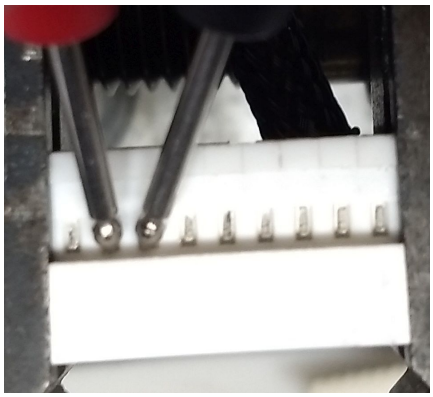
Measuring the resistance of the RTD



Starting by measuring the resistance of the RTD when disconnected from the machine is the start of the troubleshooting steps. To measure the resistance, disconnect the RTD from the harness, then place one lead of the multimeter on the Silver or Red wire, and the other on one of the other colored wires. Read the resistance then move the probe from one of the two same colored wires to the other, the resistance should be very close to the first reading. If this is within expected range the connector, wires and RTD are GOOD. If not the RTD and wiring is the issue. This image shows measuring the RTD, wiring, and connector when it is not connected to the rest of the wiring harness. Make sure to reconnect the RTD to the harness for the following steps.

Using a multimeter to measure the RTD resistance. Room temperature shown.





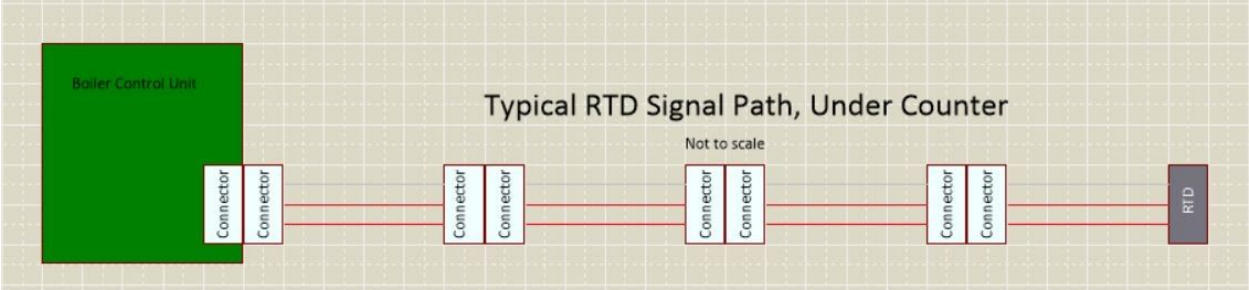
Measuring at the BCU Board

Locating the problem

If the error is not the RTD itself then the issue may be somewhere in the rest of the harness or connectors. Measuring the resistance of the RTD disconnected from the machine will detect a bad RTD or wiring. If harness length allows you may also swap a known good RTD on another component with the suspected bad one. The machine will have to be turned ON to use this method. Make sure you turn the machine OFF to do further troubleshooting. If the problem "follows" the suspected bad RTD then the RTD is bad. If the problem stays with the same component then the error may be the wiring harness or BCU circuit board. The BCU board should have been eliminated in the first step so the harness is the most likely problem.

Wiring Harness Troubleshooting

Representation of Harness

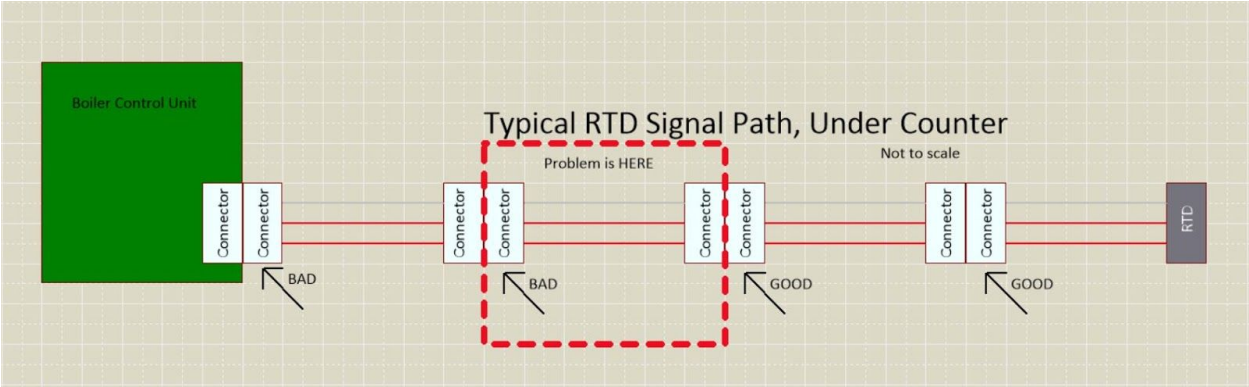


This is not a specific wiring diagram. You will need to get the correct one for the actual machine you are working on. The diagram demonstrates the typical signal path for the RTD signal. The signal must pass through multiple connectors and through many segments of wiring. If the BCU board AND the RTD are good then the issue has to be between them. To find the section of harness where the issue is, each section has to be tested separate of the others. To do this start at one end, either the BCU or RTD, either is ok. The following steps assume an Under Counter machine but the principle works for all machines. Please adapt the following steps for the specific machine you are working on. Make sure the machine is OFF for the following steps.

Step1: Remove the cable from the countertop connector. Measure the resistance from the connector on the countertop to the RTD. Measure both sets of wires. If GOOD, reconnect the cable to the countertop. If BAD then the harness between the countertop input and RTD connector has a problem.

Step2: Remove the cable from the back of the boiler box and measure the resistance of the RTD in the same manner as above. If GOOD, reconnect the cable. If BAD then the cable between the boiler box and countertop has an issue.

Step 3: Continue doing this with each section of harness. Doing this verifies each section of harness one at a time. When a problem is found the issue is in the last section of harness tested.



Sample of bad harness section detected.

NOTE: If did not matter what end the process was started from.

Result

By following a methodical and measured testing procedure a problem that had many potential fault points was narrowed down to a precise problem area. This method of "cutting the problem up" can be used for troubleshooting almost anything.