

Documenting temperature indicator performance with the 740 Series DPC

Using custom units and user-entered values

One of the most powerful capabilities of the Fluke 740 Series Documenting Process Calibrators (DPCs) is the custom units feature. This extends the documenting capabilities of the DPC to include the capturing of data outside its functional source and measurement capabilities. When this custom unit capability is coupled with the enhanced user-entered value capability for both source and measurement functions, the documentation applications for the DPC are almost limitless.



Using the Custom Units feature, it is possible to convert and scale actual measurement units into alternative measurement units. For example, imagine you are using a temperature probe that measures 0 °C to 100 °C and converts that to an output voltage of 0 mV to 100 mV. The Custom Units feature allows you to convert and scale the 0 mV to 100 mV probe output such that the measurements are displayed and captured on the 740 Series DPC as 0 °C to 100 °C.

There are two distinct implementations of Custom Units on the DPCs.

1. Custom Units are used to set decade relationships for mV output accessories or current shunts and are used only in the MEASURE mode of the DPC. User entered values are not available with this feature.
2. Custom Units are used to convert and scale, to any desired units, the MEASURE and/or SOURCE functions inside an automated DPC calibration procedure. User entered values are available for the MEASURE and/or SOURCE values.

1. Setting decade relationships for MEASURE functions

This is the least complex of the custom unit implementations. This format of custom units requires that there is a decade relationship between native (the mV dc actually being measured) and the custom units displayed (C), that the measurement mode is VDC and that there is no baseline offset.

Application Note

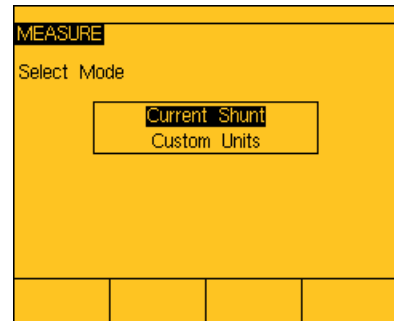


Figure 1.

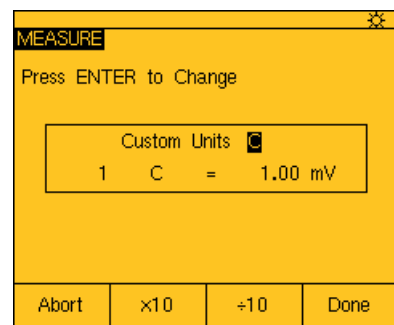


Figure 2.

To set this type of custom units up on the DPC, go to the VDC measurement screen and select the "Custom Units" softkey. You should be presented with the menu shown in Figure 1.

If you were using the Fluke 700-IV shunt with the DPC and wanted to measure and source current simultaneously, you would depress enter and install the shunt into the VDC measurement terminals. For this example however, depress the key and the key twice. Move the cursor to the "C" with the key and depress and then the "Done" softkey. Now the DPC should display the setup information shown in Figure 2.

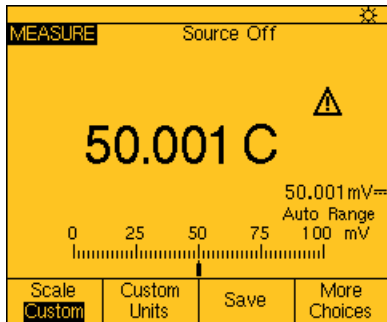


Figure 3.

If the decade relationship between native units (mV DC) and custom units (C) needs to be changed the x10 and ÷10 softkeys will do so. Depress the “Done” softkey and the DPC will now display in units of “C.” Figure 3 shows the DPC configured as described with the transducer measuring 50 °C and the 50 mV output measured by the DPC. The triangular box with the ! inside in the custom unit indication, native units measured continues to be displayed in the “fine print” screen text in the lower right hand corner of the screen.

2. Using Custom Units in calibration procedures

The other custom unit scaling capability of the DPC accommodates more complex relationships in which both linear relationships and offset values can be correlated. An example of this might be a 4-20 mA current output of a transmitter that is representative of an input temperature between 100 °C - 300 °C.

An application example where this might be useful and also utilizes the user entered value will be described in the following example. Figure 4 is an example of a process control loop circuit.

The process variable being measured is temperature and is sensed by the thermocouple (type K) shown. The transmitter shown has a span of 100 °C - 300 °C, senses the thermocouple output and converts it to 4-20 mA. In series with this transmitter is a temperature controller located remotely in a control room. In this example the controller interprets the 4 mA as 100 °C and 20 mA as 300 °C and provides a digital display in degrees C for the operator. This device (a form of limit switch) also has a setpoint that is capable of controlling the temperature of the process variable.

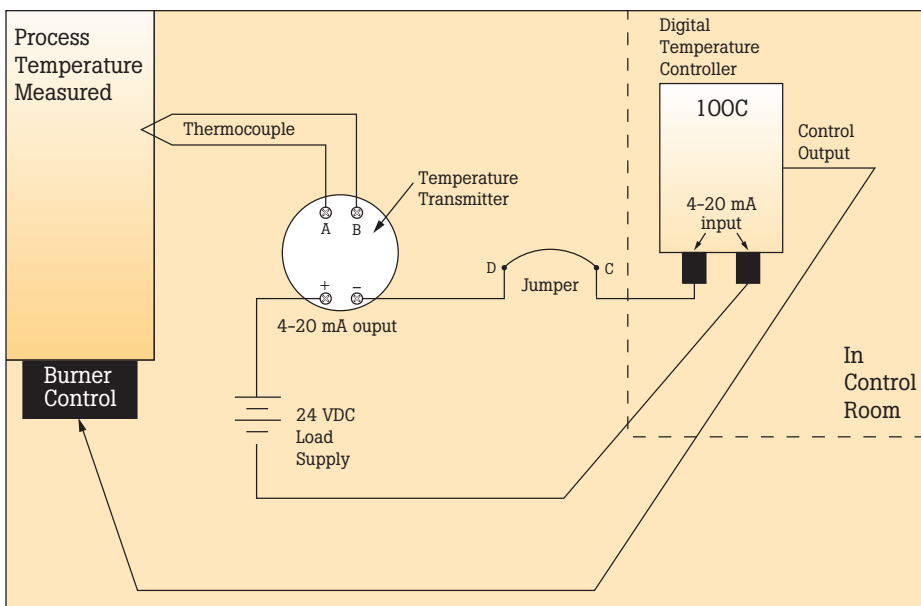


Figure 4.

To calibrate this instrumentation, it is often preferable to calibrate the entire loop all at once rather than calibrate the transmitter and the temperature controller individually. To begin this calibration, first set the temperature control of the process to manual override operating mode such that it will be isolated from the calibration in process. Next, disconnect the thermocouple from the transmitter and connect a thermocouple jumper from transmitter connections "A" and "B" (in Figure 4) to the TC mini-connection of the DPC. Power up the DPC and depress the **mA** key. Then open the jumper between connection points "C" and "D" and connect the black center terminal to point "C" and the red center terminal to point "D." Next depress the **MEAS** key of the DPC, then the **TC RTD** key. Move the cursor down to highlight "K" and depress **ENTER**, and **ENTER** again to select "linear T." Next depress "100" and **ENTER**. Depress the **MEAS SOURCE** key once and the display should be as per Figure 5.

Next, depress the "As Found" softkey and **ENTER** to select "Instrument." Fill in the template as per Figure 6.

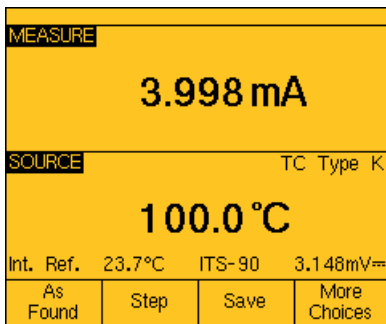


Figure 5.

Next select the "Custom Units" softkey, depress the **ENTER** key, move the cursor to "C" and depress the **ENTER** key, then the "Done" softkey. Depress the **↵** to 0 % and key in "100" and depress the **ENTER** key. Then key in "300" and depress the **ENTER** key for 100 %. The display of the DPC should be as per Figure 7.

Depress the "Done" softkey once. Next select the "User Value" softkey, depress **ENTER** and **↵** to highlight "Enabled" and depress **ENTER** and then the "Done" softkey twice. The display should now be similar to Figure 8.

The DPC is now configured to source the correct thermocouple values into the transmitter, monitor the mA current drawn against loop power, display a reading in °C scaled linearly to the 4-20 mA current measured and prompt the user to enter the actual indicated value in °C from the temperature controller's digital display in a (3) point test.

To start the test, depress the "Autotest" softkey and the DPC simulates a Type K temperature of 100 °C into the transmitter and measures for a nominal 4 mA. Once that measurement is complete a dialog box opens as per Figure 9.

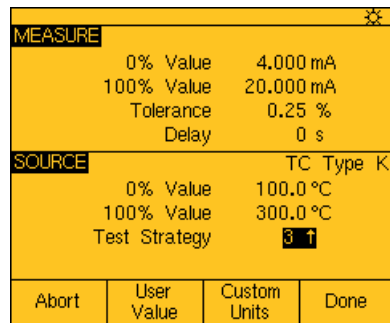


Figure 6.

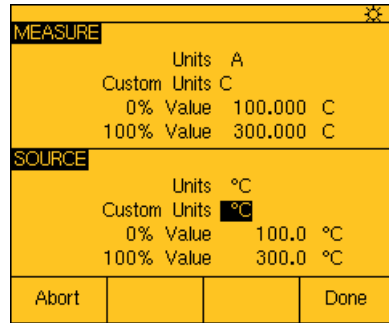


Figure 7.

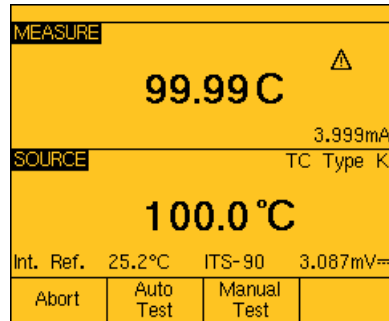


Figure 8.

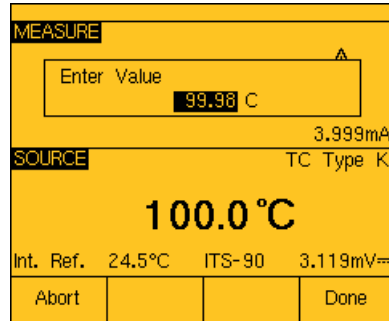



Figure 9.

Hot tip

Since the digital readout of the temperature controller is in the control room and the transmitter is most often in a remote location the technician performing the calibration will need to either request the digital reading via walkie-talkie or walk to the control room for the reading. Next, key that reading into the DPC and depress . Repeat that test for 200 °C and 300 °C. Once the test is complete, the result should be similar to the result in Figure 10.

While the second, more general implementation of Custom Units is nominally intended for use inside of automated calibration procedures, here's a trick that will let you convert and scale while making routine measurements. Simply program your DPC using Custom Units for the MEASURE mode as part of an As Found procedure, as described above. Begin the test as usual, but when you get to the point where you would

launch an Auto Test or Manual Test (in Figure 8), simply hit the Abort soft key. The automated test is terminated, but you will find that the MEASURE function of the DPC has "remembered" the custom units and scaling from the automated. These units and scaling will remain until you deselect them using the Scale soft key, or until you change MEASURE functions, or until you power down your DPC.

SOURCE	U.E.V.	ERROR %
100.0 °C	100.35 C	0.17
200.0 °C	201.00 C	0.50
300.0 °C	301.00 C	0.50

Abort	Prev. Page	Next Page	Done
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Figure 10.

Depress the "Done" softkey, fill in your tag information and depress "Done" to return to the split screen. Select the "Adjust" softkey and adjust the zero on the transmitter until a satisfactory value is displayed in the control room. Select "Go To 100 %" and adjust the transmitter span until a satisfactory reading is displayed in the control

room. Once adjustments are complete, run the As Left test and if all error indications in the post test summary are in forward video, the loop calibration is complete. Using the user entered data and custom units, the data is captured in degrees C with errors calculated based on the manually entered numbers.

Other applications of custom units include capturing results in weight (lbs), revolutions per minute (RPM), relative humidity (RH) and many other process parameters. The custom unit and user-entered value capability for both source and measure are a key component to increasing the workload coverage of the 740 Series DPCs.

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Printed in U.S.A. 7/2004 1263925 A-US-N Rev E