

		311A Field Calibration Procedure	DOCUMENT NO. P100904-970	REV. A
Created by: Doug Neff		Date: 09Nov99	Sheet 1 of 10	

Rev	Date	Appd	DCN								
A	29DEC99		10754								

### Suggested Equipment:

1. Precision DMM with the following specifications:

Resistance	Constant Current Source	Accuracy
1K $\Omega$	100uA	$\pm 0.100\Omega$
1K $\Omega$	1mA	$\pm 0.044\Omega$
10 $\Omega$	10mA	$\pm 0.019\Omega$

Voltage	Accuracy
1.00V	$\pm 47\mu V$

2. Ohms Source with the following accuracy:

Resistance	Accuracy
10 $\Omega$	$\pm 0.019\Omega$
250 $\Omega$	$\pm 0.025\Omega$
500 $\Omega$	$\pm 0.031\Omega$

3. Current Source with accuracy of  $\pm 1.65\mu A$  at 10mA

### ENABLING CALIBRATION:

Remove the battery cover and four corner screws. While holding the UUT face down in one hand, carefully separate the top and bottom housing. Place the unit into Calibration mode by placing the jumper (XCAL) located on the upper right side of the circuit board into the shorted position (See Figure 1). Verify the UUT is in Calibration mode by turning on the UUT and viewing the top of the LCD for the word SETUP. Place fresh batteries into the UUT before any calibration adjustments are made.

### CALIBRATION:

**NOTE:** During calibration, pressing the *STORE/RESET* button will cause  $\alpha=$  to illuminate on the LCD. Then pressing either  $^{\circ}C/^{\circ}F$  or 2, 3,4 WIRE will cause the display to blank out and pause, indicating the UUT received the calibration. While the display is blanked out, do not proceed until the display is restored.

**NOTE:** Before calibrating the UUT, factory reset the unit by holding the *STORE/RESET* button while turning the power on. Continue to hold the *STORE/RESET* button until the display starts to flash.

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### **HARDWARE CAL:**

1. Connect the 311A output (4-Wire) to the DMM (See Figure 2) and set the DMM to DCV mode.
2. Turn the knob to the  $\Omega$  position.
3. Press the *POWER* button to turn the UUT on.
4. Press the *SOURCE/READ* button until *SOURCE* is displayed on the UUT LCD.
5. Set the toggle switch to the LO position and adjust pot R260 (See Figure 1) so the DMM reads 0.000mV  $\pm$ 0.005mV.
6. Now place the toggle switch to the HI position and adjust pot R244 (See Figure 1) so the DMM reads 0.000mV  $\pm$ 0.005mV.

**NOTE:** R260 and R244 are interactive. Thus, it will be necessary to repeat steps 5 and 6 several times.

### **ZERO OFFSET CAL:**

1. Make sure the output leads are open (disconnected).
2. Press the *STORE/RESET* button and then the  $^{\circ}C/^{\circ}F$ . The right side of the UUT LCD will display 0C when pressing  $^{\circ}C/^{\circ}F$ .

### **SOURCE OHMS ZERO CAL:**

1. Connect the 311A output (4-Wire) to the DMM (See Figure 2).

#### 100uA Excitation Current

2. Set the Ohmmeter to 4-Wire Ohms mode and to the lowest range that sources 100uA.
3. Check to see that the right side of the UUT LCD displays a 1. This indicates that the excitation current is 100uA.
4. Place the Quik-Chek switch to the LO position and dial the UUT so the meter reads  $0.00\Omega \pm 0.15\Omega$  and press the *STORE RESET* button and then the  $^{\circ}C/^{\circ}F$  button.

#### 1mA Excitation Current

5. Change the Ohmmeter to the lowest range that sources 1mA.
6. Check to see that the right side of the UUT LCD displays a 2. This indicates that the excitation current is 1mA.
7. Dial the UUT so the meter reads  $0.00\Omega \pm 0.04\Omega$  and press the *STORE RESET* button and then the  $^{\circ}C/^{\circ}F$  button.

#### 10mA Excitation Current

8. Change the Ohmmeter to the lowest range that sources 10mA.
9. Check to see that the right side of the UUT LCD displays a 3. This indicates that the excitation current is 10mA.
10. Dial the UUT so the meter reads  $0.00\Omega \pm 0.04\Omega$  and press the *STORE RESET* button and then the  $^{\circ}C/^{\circ}F$  button.

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### **SOURCE OHMS CAL:**

#### 100uA Excitation Current

1. Set the Ohmmeter to the lowest range with a constant current of 100uA that will measure 500Ω.
2. Check to see that the right side of the UUT LCD displays a 1. This indicates that the excitation current is 100uA.
3. Place the Quik-Chek switch to the HI position and dial the UUT so the Ohmmeter reads  $500.00\Omega \pm 0.18\Omega$  and press the *STORE RESET* button and then the 2, 3, 4 *WIRE* button.

#### 100uA Reverse Wire

4. Flip the leads (See Figure 9). Dial the UUT so the Ohmmeter reads  $500.00\Omega \pm 0.18\Omega$  and press the *STORE RESET* button and then the 2, 3, 4 *WIRE* button.
5. Flip the leads back to original position (See Figure 2).

#### 1mA Excitation Current

6. Set the Ohmmeter to the lowest range with a constant current of 1mA that will measure 500Ω.
7. Check to see that the right side of the UUT LCD displays a 2. This indicates that the excitation current is 1mA.
8. Dial the UUT so the Ohmmeter reads  $500.00\Omega \pm 0.06\Omega$  and press the *STORE RESET* button and then the 2, 3, 4 *WIRE* button.

#### 10mA Excitation Current

9. Connect a Current Source (set to 10mA) to the UUT output leads. Also connect a Voltmeter to the UUT output leads. (See Figure 3).
10. Check to see that the right side of the UUT LCD displays a 3. This indicates that the excitation current is 10mA.
11. Place the Quik-Chek switch to the SET position and dial the UUT so the Voltmeter reads  $1.0000V \pm 0.0004V$  and press the *STORE RESET* button and then the 2, 3, 4 *WIRE* button.

### **2-WIRE COMPENSATION:**

1. Connect the 311A Output to the Ohmmeter as shown in Figure 4.
2. Set the Ohmmeter to the lowest range with a constant current of 1mA that will measure 500Ω.
3. Check to see that the right side of the UUT LCD displays a 2. This indicates that the excitation current is 1mA.
4. Place the Quik-Chek switch to the HI Position and dial the UUT so the Ohmmeter reads  $500.00\Omega \pm 0.06\Omega$  and press the *STORE RESET* button and then the *SETUP* button. The UUT LCD will display 2-WIRE when pressing *SETUP*.

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**HARDWARE CHECK:**

1. Connect the 311A output (4-Wire) to the DMM (See Figure 2).
2. Turn the knob to select Ni.

**100uA Excitation Current**

3. Set the Ohmmeter to the lowest range with a constant current of 100uA that will measure 500Ω.
4. Dial the UUT to the following values and verify that the DMM reads within specification.

UUT Setting	Ohmmeter
10.00Ω	10.00 ±0.30Ω
250.00Ω	250.00 ±0.33Ω
500.00Ω	500.00 ±0.35Ω

**1mA Excitation Current**

5. Set the Ohmmeter to the lowest range with a constant current of 1mA that will measure 500Ω.
6. Dial the UUT to the following values and verify that the DMM reads within specification.

UUT Setting	Ohmmeter
10.00Ω	10.00 ±0.08Ω
250.00Ω	250.00 ±0.10Ω
500.00Ω	500.00 ±0.13Ω

**10mA Excitation Current**

7. Set the Ohmmeter to the lowest range with a constant current of 10mA that will measure 10Ω.
8. Dial the UUT to the following values and verify that the DMM reads within specification.

UUT Setting	Ohmmeter
1.00Ω	1.00 ±0.08Ω
5.00Ω	5.00 ±0.08Ω
10.00Ω	10.00 ±0.08Ω

**READ OHMS CAL:**

1. Turn the knob on the UUT back to Ω mode.
2. Press the *SOURCE/READ* button once to place the UUT into Read Mode.
3. Short all 4 input terminals of the UUT and press the *STORE RESET* button and then the °C/°F button (See Figure 5).
4. Connect a precision 500Ω standard resistor to the UUT inputs (4-Wire) and press *STORE RESET* and then 2, 3, 4 *WIRE* (See Figure 6).

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## CHECK ACCURACY

Turn the UUT off and place the unit into Normal Operating Mode by placing the jumper (XCAL) located on the upper right side of the circuit board into the open position (See Figure 7).

### **Read Ohms 3 and 4-Wire:**

Turn the knob to the  $\Omega$  position and then press the *POWER* button to turn the UUT on. Press the *SOURCE/READ* button until READ is displayed on the UUT LCD. Press the 2, 3, 4 *WIRE* button until 4 (or 3) Wire is displayed on the UUT. Set the Ohms Source to the values in the table below and verify the accuracy.

Ohms Source	UUT Reading
10.00 $\Omega$	10.00 $\pm$ 0.08 $\Omega$
250.00 $\Omega$	250.00 $\pm$ 0.10 $\Omega$
500.00 $\Omega$	500.00 $\pm$ 0.13 $\Omega$

### **Read Ohms 2-Wire:**

Using the same lead wires that will be used for the Read Ohms 2-Wire test, connect them to a Ohmmeter and short the ends of the wires together. Set the Ohmmeter to the lowest range with a constant current of 1mA and measure the Lead Resistance. Now connect the UUT to the Ohms Source in 2-Wire (See Figure 8). Press the 2, 3, 4 *WIRE* button until 2 Wire is displayed on the UUT.

Ohms Source	UUT Reading
10.00 $\Omega$	10.00 + Lead Resistance $\pm$ 0.08 $\Omega$
250.00 $\Omega$	250.00 + Lead Resistance $\pm$ 0.10 $\Omega$
500.00 $\Omega$	500.00 + Lead Resistance $\pm$ 0.13 $\Omega$

### **Source Ohms 4-Wire: (100uA Excitation Current)**

Connect the UUT to the Ohmmeter in 4-Wire (See Figure 2). Set the Ohmmeter to the lowest range with a constant current of 100uA that will measure 500 $\Omega$ . Change the UUT to Source Mode by pressing the *SOURCE/READ* button. Be sure to press the 2, 3, 4 *WIRE* button until 4-Wire is displayed on the UUT. Set the UUT to the values in the table below and verify the accuracy.

UUT Setting	Ohmmeter
10.00 $\Omega$	10.00 $\pm$ 0.30 $\Omega$
250.00 $\Omega$	250.00 $\pm$ 0.33 $\Omega$
500.00 $\Omega$	500.00 $\pm$ 0.35 $\Omega$

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**Source Ohms 4-Wire: (1mA Excitation Current)**

Change the Ohmmeter to the lowest range with a constant current of 1mA that will measure 500Ω. Set the UUT to the values in the table below and verify the accuracy.

UUT Setting	Ohmmeter
10.00Ω	10.00 ±0.08Ω
250.00Ω	250.00 ±0.10Ω
500.00Ω	500.00 ±0.13Ω

**Source Ohms 4-Wire: (10mA Excitation Current)**

Change the Ohmmeter to the lowest range with a constant current of 10mA that will measure 10Ω. Set the UUT to the values in the table below and verify the accuracy.

UUT Setting	Ohmmeter
1.00Ω	1.00 ±0.08Ω
5.00Ω	5.00 ±0.08Ω
10.00Ω	10.00 ±0.08Ω

**Source Ohms 4-Wire--Reverse Wire: (100uA Excitation Current)**

Reverse the leads (See Figure 9). Set the Ohmmeter to the lowest range with a constant current of 100uA that will measure 500Ω. Set the UUT to the values in the table below and verify the accuracy.

UUT Setting	Ohmmeter
10.00Ω	10.00 ±0.30Ω
250.00Ω	250.00 ±0.33Ω
500.00Ω	500.00 ±0.35Ω

**Source Ohms 4-Wire--Reverse Wire: (1mA Excitation Current)**

Change the Ohmmeter to the lowest range with a constant current of 1mA that will measure 500Ω. Set the UUT to the values in the table below and verify the accuracy.

UUT Setting	Ohmmeter
10.00Ω	10.00 ±0.08Ω
250.00Ω	250.00 ±0.10Ω
500.00Ω	500.00 ±0.13Ω

**Source Ohms 4-Wire--Reverse Wire: (10mA Excitation Current)**

Change the Ohmmeter to the lowest range with a constant current of 10mA that will measure 10Ω. Set the UUT to the values in the table below and verify the accuracy.

UUT Setting	Ohmmeter
1.00Ω	1.00 ±0.08Ω
5.00Ω	5.00 ±0.08Ω

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10.00Ω	10.00 ±0.08Ω
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**Source Ohms 2-Wire: (10mA Excitation Current)**

Connect the UUT to the Ohmmeter in 2-Wire (See Figure 4). Set the Ohmmeter to the lowest range with a constant current of 10mA that will measure 10Ω. Press the 2, 3, 4 *WIRE* button until 2-Wire is displayed on the UUT. Set the UUT to the values in the table below and verify the accuracy.

UUT Setting	Ohmmeter
1.00Ω	1.00 ±0.08Ω
5.00Ω	5.00 ±0.08Ω
10.00Ω	10.00 ±0.08Ω

**Source Ohms 2-Wire: (1mA Excitation Current)**

Change the Ohmmeter to the lowest range with a constant current of 1mA that will measure 500Ω. Set the UUT to the values in the table below and verify the accuracy.

UUT Setting	Ohmmeter
10.00Ω	10.00 ±0.08Ω
250.00Ω	250.00 ±0.10Ω
500.00Ω	500.00 ±0.13Ω

**Source Ohms 2-Wire: (100uA Excitation Current)**

Change the Ohmmeter to the lowest range with a constant current of 100uA that will measure 500Ω. Set the UUT to the values in the table below and verify the accuracy.

UUT Setting	Ohmmeter
10.00Ω	10.00 ±0.30Ω
250.00Ω	250.00 ±0.33Ω
500.00Ω	500.00 ±0.35Ω

Disconnect UUT and turn the UUT off.

Reset the unit by holding the *STORE/RESET* button while turning the power on. Continue to hold the *STORE/RESET* button until the display starts to flash.

**This completes the procedure.**

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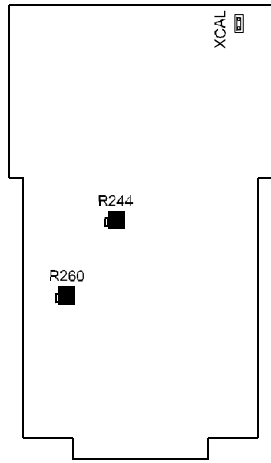


FIGURE 1

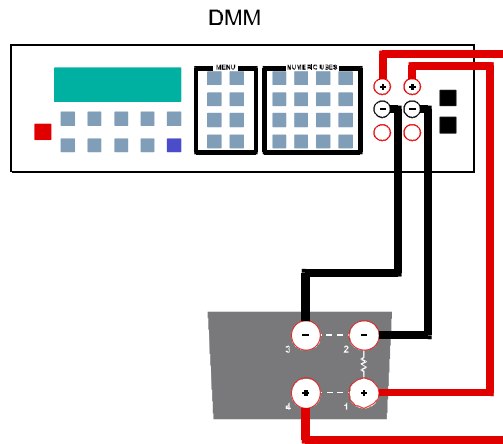


FIGURE 2

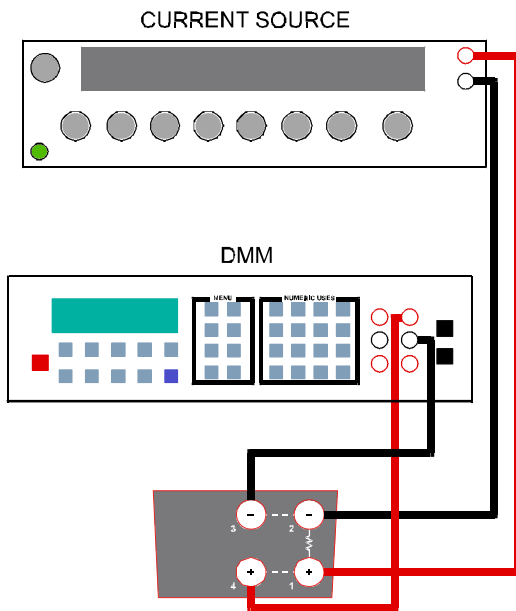


FIGURE 3

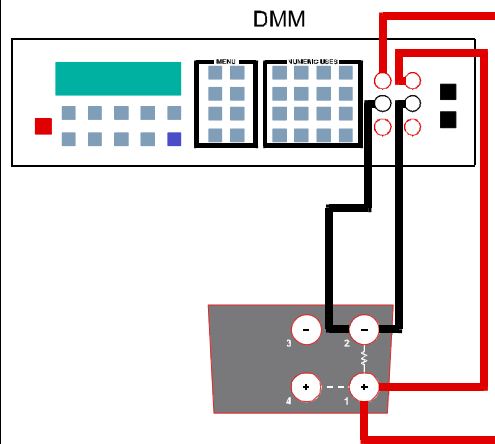


FIGURE 4



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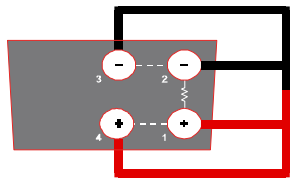


FIGURE 5

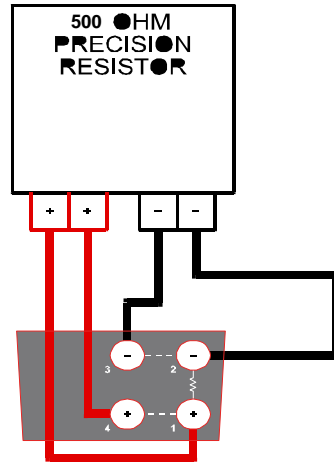


FIGURE 6

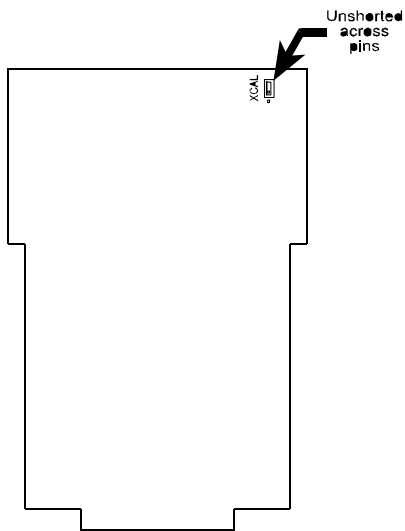


FIGURE 7

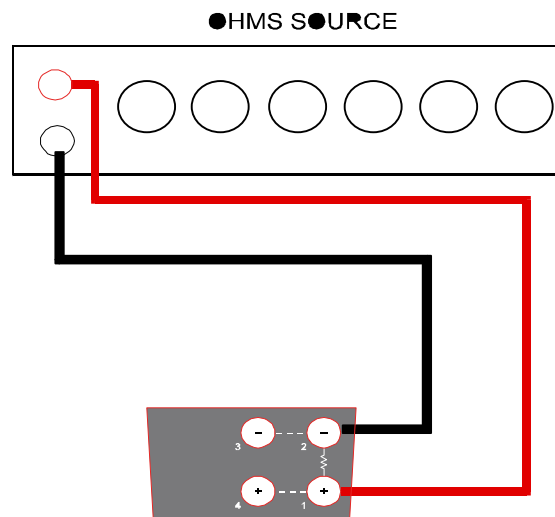


FIGURE 8

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# DMM

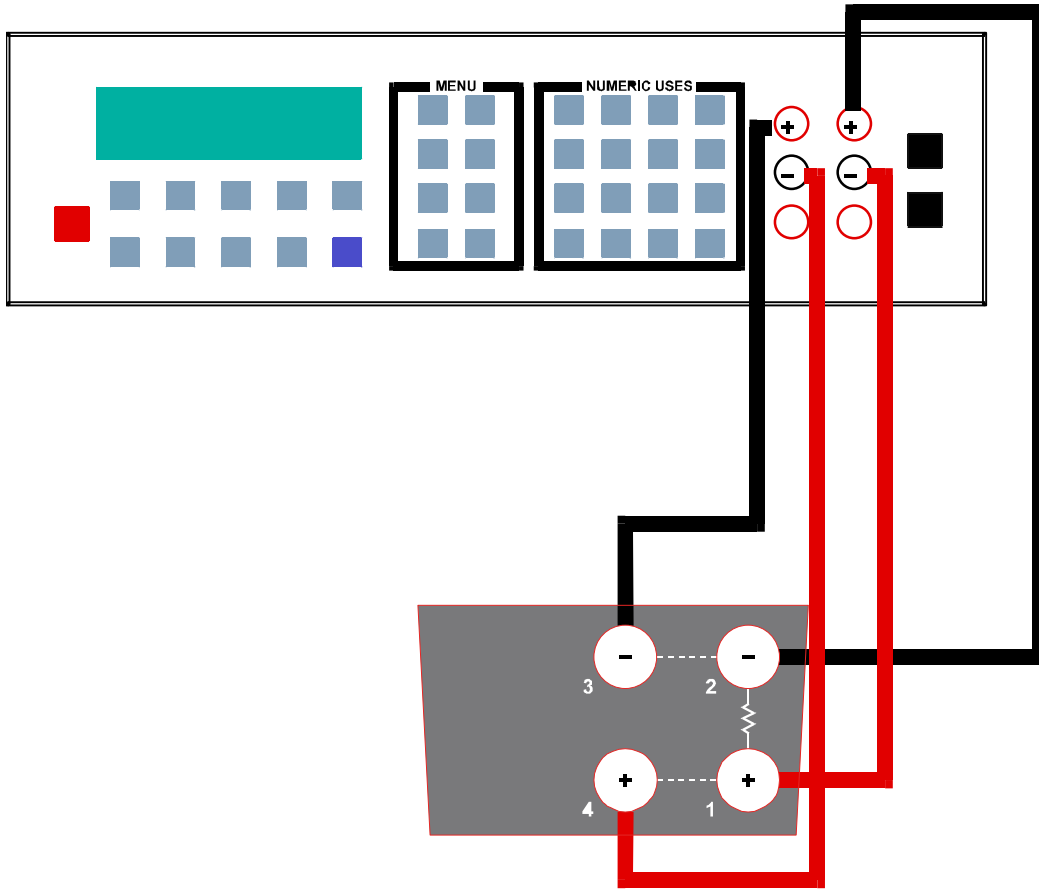


FIGURE 9