

SECTION V 2110A & 2111A CALIBRATION

5-1. General

The following procedures should be performed at routine intervals to ensure that the Power Analyzer remains within specified limits. In addition, calibration should be performed following repairs involving accuracy determining components.

Access the adjustments by removing the four feet screws and the top cover. The locations of the adjustments are listed on the boards and on drawings numbered 2110-600 and 2110-601 at the back of this manual. Apply power to the 2110A and test equipment and allow at least 30 minutes for stabilization.

Note that the 2110A may also be returned to the factory for calibration traceable to NIST.

5-2. Recommended Test Equipment

- (1) Two DC Voltage Calibrators (Valhalla Scientific Model 2701C or equivalent)
- (2) AC Voltage and Phase Standard (Valhalla Scientific Model 2703 and 2705 or equivalent)
- (3) AC-DC Current Calibrator (Valhalla 2500EP or equivalent)
- (4) DC Voltmeter, $\pm 0.5\%$ accuracy

5-3. Model 2110A Calibration Procedure

The following procedure applies only to the Model 2110A. Refer to Section 5-4 for the Model 2111A procedure.

CAUTION!

The neutral input terminal (N) is connected to the internal common bus (ground). In normal use, the plastic case and other insulators isolate the operator from the high voltages on the input terminals. However, if the unit is opened for service and the N terminal is connected to a high potential, serious injury may result from contact with the internal circuitry.

5-3-1. Reference Adjustments

- (1) Connect the positive terminal of the DVM to pin 7 of IC17 and the negative terminal to analog ground (E2). Adjust R100 if necessary for a DVM reading of +1.000 volts.
- (2) Connect the positive terminal of the DVM to pin 7 of IC20 and the negative terminal to analog ground (E2). Adjust R107 if necessary for a DVM reading of +1.000 volts.

5-3-2. Voltage Adjustments

- (1) Connect the 2110A to the DC Standards per Figure 5-1. Select the "Volts" display and perform the adjustments listed in Table 5-1. Connect the DVM between E2 (ground) and TP1 shown in Figure 5-2. These adjustments should be made *in the order shown*.

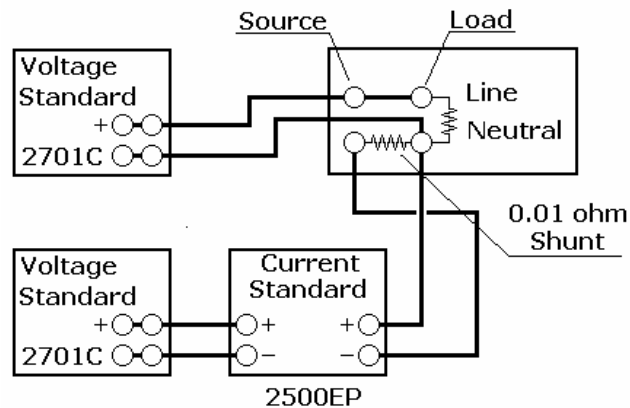
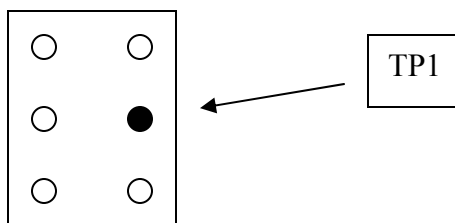


Figure 5.1
Calibration Equipment Connections

Table 5-1. Model 2110A Voltage Adjustments

Range	Input	Adjust	TP1	Adjust	2110A Display
150	10.00VDC	-	-	R8*	≈10.00
150	150.00VDC	R2	-5.000VDC	R45	150.00
150	10.00VDC	-	-	R117	10.00
300	300.0VDC	R4	-5.000VDC	R49	300.0
600	600.0VDC	R6	-5.000VDC	R47	600.0

* Alternate input polarity and balance R8 for the same display reading at both polarities.

**Figure 5-2. TP1 Location at Switch S5 (Amps) ***

* TP1 may also be obtained at the hook for IC6, pin 1 (if installed).

Table 5-2. Model 2110A/2111A Current Adjustments (located under shield)

Range	Input	Adjust	2110/11 Current Display
20A	10.000ADC	R65	-2.500V @ TP1
20A	10.000ADC	R52	Adjust R52 for 10.00 on current display
2A	1.0000ADC	R71	Alternate polarity and balance for same reading on display
2A	1.0000ADC	R74	Adjust for 1.000 on display
.2A	.10000ADC	R83	Alternate polarity and balance for same reading on display
.2A	.10000ADC	R85	Adjust for .1000 on display

5-3-3. Current Adjustments

- (1) Select the "Amps" display. Perform the adjustments in Table 5-2 in the order shown.

5-3-4. Watts Adjustments

- (1) Monitor the "Watts" display. Select the 2 amp/600 volt (300V for 2111A) ranges. Apply 1 amp and reduce the input voltage to zero. Alternate the input current polarity and adjust R29 for the same reading at both polarities. Adjust R43 for 000.0 on the watts display.
- (2) Reduce the input current to zero. Apply 150 volts and alternate the input voltage polarity, adjusting R28 for the same reading at both polarities. The balanced reading should be ± 1 digit from 000.0. If reading is not within the specified limits, adjust R43 for a reading of 000.0, then repeat step 1.
- (3) Apply 1 amp and 600 volts to the 2110A (skip this step for 2111A). Adjust R36 for a reading of 600.0 on the watts display. Reverse the current and volts polarity and adjust R36 for the same reading at both polarities.
- (4) Select the 300 volt range and apply 300.0 volts. Adjust R34 for 300.0 on the watts display. Reverse the input voltage and current polarity, and adjust R34 for a balance between both polarities.
- (5) Reduce the input voltage to 150.00 VDC and select the 150 volt range. Adjust R32 for 150.0 on the watts display. Reverse the input voltage and current polarity, and adjust R32 for a balance between both polarities.
- (6) For 2111A only, select the 30V and 2A ranges. Apply 30.00 volts and 1 amp and check that the watts display indicates 30.00 (no adjustment).

5-3-5. AC Adjustments and Checks

- (1) Replace the DC voltage standards illustrated in Figure 5-1 with the AC Wattmeter Calibration System (Valhalla 2703 Master, 2705 Slave). Select the 150 volt and the 20 amp ranges.
- (2) Apply 150 volts AC and 10 amps AC (100 Hz) with a 0° phase difference. Adjust R69 for 10.00 on the current display.
- (3) Verify that all volts, current, and watts ranges are within specifications. If the Valhalla 2703/2705 Wattmeter Calibration System is used, verify the power factor response at 90°, 120°, 180° and 240° phase shift.

5-4. Model 2111A Procedure Changes

The Model 2111A is calibrated similarly to the Model 2110A with the following exceptions:

- (1) Make the adjustments of Table 5-3 in the order shown in place of those of Table 5-1.
- (2) Omit step 3 in Section 5-3-4.
- (3) DO NOT apply 600 volts to the 2111A.
- (4) Current and watts adjustments are the same.

5-5. Model 2111A-20mA Changes

The Model 2111A-20mA uses the same procedure of Section 5-4 with the following exceptions:

- 1) The voltage adjustments are the same as for Model 2111A.
- 2) The current adjustments of Table 5-2 shall be 10% of those indicated for the 2110A/2111A. For example, 10 milliamps instead of .1000 amps. DO NOT apply 10 amps to the 2111A-20mA.
- 3) The watts adjustments will be 10% of those indicated for the 2111A.

Table 5-3. Model 2111A Voltage Adjustments

Range	Input	Adjust	TP1	Adjust	2111A Display
150	10.00VDC	-	-	R8 ♦	≈10.00
150	10.00VDC	-	-	R117	10.00
30	30.00VDC	R2	-5.000VDC	♠	30.00
150	150.00VDC	R4	-5.000VDC	R45 ♦	150.00
300	300.0VDC	R6	-5.000VDC	R49 ♦	300.0

♦ Alternate input polarity and adjust for the same reading at both polarities.

♠ The 30V and 300V ranges share a common adjustment at R49.

5-6. Power Factor Calibration

The following adjustments are made to the Power Factor Board, shown in drawing number 2110-601:

- 1) Connect the positive terminal of the DVM to IC3 pin 7 and the negative terminal to test point GYSHA. Adjust RV6 if necessary for a DVM reading of +1.000 volts. Remove DVM. Install a shorting link on PL6 (cal mode).
- 2) Connect the 2110A or 2111A to the AC Reference Standards per Figure 5-1.
- 3) Select the 150 volt, 2 amp ranges and the AMPS display.
- 4) Set the voltage source to 10 volts. Adjust RV1 for a reading of 1000 on the Watts/PF display.

Note: When the link on PL6 is installed, the decimal point and polarity sign of the left display are meaningless and should be ignored.

- 5) Set the voltage source to 150 volts. Adjust RV2 for a Watts/PF display of 15000.
- 6) Select the 300 volt range. Set the voltage source to 300 volts and adjust RV4 for a Watts/PF display of 3000.
- 7) Select the 600 volt range (2110A only). Set the voltage source to 600 volts and adjust RV3 for a Watts/PF display of 6000.
- 8) Select the VOLTS display. Set the current source to 1 amp and adjust RV5 for a WATTS/PF display of 1000.

Lead-Lag Comparator Check

Remove the link from PL6. Apply 150V and 1 Amp at 100 Hz. Select the P.F. display. The current source should be driven from the 2705 Phase Standard. Vary the phase angle and make the checks below:

From $0^\circ \pm 2^\circ$ to $180^\circ \pm 2^\circ$, the polarity sign should be negative (-).

From $180^\circ \pm 2^\circ$ to $360^\circ \pm 2^\circ$, the polarity should be positive (+).

In the first case, the current leads the voltage and in the latter case it lags the voltage.

Power Factor Calculation Check

With the link at PL6 removed, apply 150V and 1 Amp at 100 Hz. The power factor display should indicate the following readings as the phase angle is adjusted (± 5 counts):

0° → ± 1.000
60° → -0.500
90° → -0.000
120° → -0.500
180° → ± 1.000
240° → +0.500

These readings apply to any combination of voltage and current ranges, provided that the user remembers that the minimum input for accurate power factor response is 10% of both the voltage and current ranges.