Technical Note

Power Meter Accuracy Test

To Calibrate EPM Series Power Meters to Option G12 or Option H12 Specifications

Agilent Technologies

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Power Meter Accuracy Test

This test is intended for power meters used in testing the PNA series network analyzers. The "Test Port Receiver Dynamic Accuracy Test" for the PNA series analyzers requires the use of a power meter that has been calibrated to a higher accuracy than the standard power meter.

Power meters with options G12 and H12 specify an improved instrumentation accuracy over a limited power range. (These power meters do not contain unique hardware.) A power meter may be returned to the factory to have one of these options added to an existing power meter or to renew the calibration for one of these options.

This test procedure is an alternative to returning the power meter to the factory. When a power meter passes this test, it is considered to be *calibrated* for the G12 or H12 option even though it has not been returned to the factory.

This test procedure is also included in the service guide for PNA series network analyzers, with a print date of June 2001 or later.

EPM Series Power Meters That Can Be Tested Using This Procedure

This procedure assumes that the recommended model number power meter is being tested. The alternate model numbers can be tested but the necessary procedural steps may differ.

Recommended Model Number	**Alternate Model Numbers**
E4419B	E4418A/B, E4419A, EPM-441A, EPM-442A

NOTE It is recommended that the revision number for the power meter "Main Firmware" be Ax.03.00 or higher. This applies to all power meter model numbers listed above (both recommended and alternate).

Equipment Used for the Power Meter Accuracy Test

Equipment Type	**Recommended Model Number**	**Alternate Model Number**
Range calibrator	11683A	None
Precision digital voltmeter	3458A	Any with the required accuracy and resolution[a]
Power sensor cable	8120-8319, 11730A	Any equivalent
BNC cable, 50 Ω	Any	Any
Adapter for connecting BNC cable to DVM inputs	Any	Any

a. Required accuracy and resolution at the following voltage levels:

14 mV input:	0.0100% accuracy	10 nV resolution
0.140 V input:	0.0050% accuracy	100 nV resolution
0.450 V input:	0.003% accuracy	100 nV resolution

Description of the Test

The power meter accuracy is verified for various power inputs and the actual readings are recorded in a test record. A range calibrator is used to provide the reference inputs.

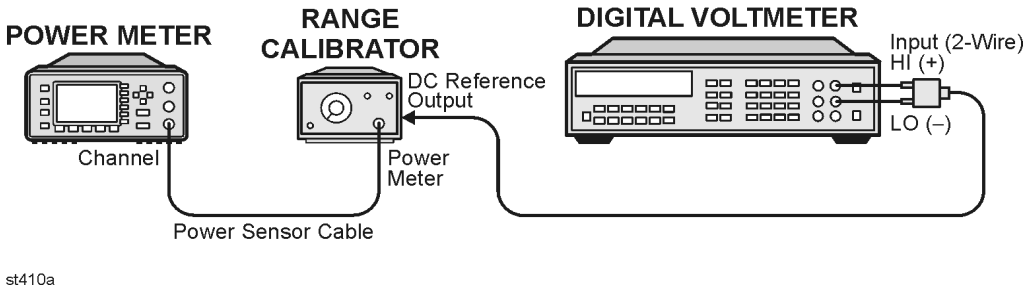
NOTE It is recommended that a copy of the test record in this document be made, and the values be recorded on the copy, thus preserving the original for future use.

Test Procedure

NOTE This procedure assumes the use of the recommended equipment model numbers. The actual steps required, therefore, may differ for other model numbers of equipment used.

1. Setup the equipment as shown in Figure 1:
   a. Connect the DC REFERENCE OUTPUT connector on the rear panel of the range calibrator to the DVM voltage input.
   b. Connect the POWER METER output of the range calibrator to the input of the power meter being tested.
   c. Switch on the power to the power meter, the range calibrator, and the digital voltmeter.

Figure 1 Setup for the Power Meter Accuracy Test



2. Preset the power meter: Press **[Preset/Local]**, then **Confirm**.
3. Perform the following steps for each channel on the power meter:
   a. Set to read in dBm: Press **[dBm/W]**, then **dBm**.
   b. Set the ref cal factor to 100%: Press **[Zero/Cal]**, **Cal**, **A/B Ref CF**, then set to **100.0**, if necessary.
   c. Set the cal factor to 100%: Press **[Frequency/Cal Fac]**, **A/B Cal Fac**, then set to **100.0**, if necessary.
   d. Set readout to 0.001 dBm: Press **[Meas Setup]**, then **Resolution 1 2 3 4**, to highlight **4**.
   e. Set filter step detect on and filter length to 512: Press **[System/Inputs]**, channel **A** or **B Input Settings**, **[More]**, **Ch A/B Filter**, **Step Det On**, **Filter On**, **Mode MAN**, **Length**, then set the filter length to **512**.

4. Setup the digital voltmeter (DVM) as follows:
   a. Reset the DVM: Press the **blue key** followed by **Reset**.
   b. Set the sample period to a value greater than one second: Press NPLC, 5, 0, then Enter.
5. Set the range calibrator controls as follows:

   POLARITY . . . . . NORMAL

   RANGE . . . . . 1 mW

   FUNCTION. . . . . CALIBRATE
6. Allow the equipment to warm up for approximately 30 minutes. Do not change any connections or control settings during this time.
7. Zero and calibrate the power meter channel to which the range calibrator is connected:
   a. The range calibrator's RANGE switch should be set to 1 mW.
   b. Set the range calibrator's FUNCTION switch to STANDBY.
   c. Press **[Zero/Cal]**, then **Zero A** or **Zero B** (as appropriate). Wait for the operation to complete.
   d. Set the range calibrator's FUNCTION switch to CALIBRATE.
   e. Press **[Zero/Cal]**, **Cal**, then **Cal A** or **Cal B** (as appropriate). Wait for the operation to complete.
8. Monitor the drift rate of the power meter reading: Five minutes following calibration, the meter must read 0.001, 0.000, or -0.001 dBm. If the power meter reading is not one of these values, allow additional warm up time and then check the drift rate again. The range calibrator must remain connected to the power meter during this warm up time.
9. Zero and calibrate the power meter channel to which the range calibrator is connected:

NOTE After a channel on the power meter is calibrated, do not allow more than 5 minutes to elapse before completing the remaining measurement steps for that channel.

   a. The range calibrator's RANGE switch should be set to 1 mW.
   b. Set the range calibrator's FUNCTION switch to STANDBY.
   c. Press **[Zero/Cal]**, then **Zero A** or **Zero B** (as appropriate). Wait for the operation to complete.
   d. Set the range calibrator's FUNCTION switch to CALIBRATE.
   e. Press **[Zero/Cal]**, **Cal**, then **Cal A** or **Cal B** (as appropriate). Wait for the operation to complete.
10. Record the DVM voltage reading as value A in the test record on page 7.

NOTE All DVM readings in this procedure should be recorded showing five significant digits.

11. The reading on the power meter should be 0.000 ±0.001 dBm.

12. Switch the range calibrator RANGE to 300 µW.
13. Record the DVM voltage reading as value B in the test record.
14. Wait for the power meter reading to settle (no settling drift within 20 seconds).
15. Record the power meter reading as value C in the test record.
16. Switch the range calibrator RANGE to 100 µW.
17. Record the DVM voltage reading as value D in the test record.
18. Wait for the power meter reading to settle (no settling drift within 20 seconds).
19. Record the power meter reading as value E in the test record.
20. If testing a dual-channel power meter, perform steps 7 through 19 for the other channel.
21. Perform the pass/fail calculations indicated on the test record.

NOTE If a channel of the power meter does not pass this test, the power meter cannot be used in applications that require Option G12 or H12. There are no adjustments that can be performed to improve the performance of the power meter. Typically, replacing the A6 measurement assembly associated with the failed channel will correct the problem.

TEST RECORD FOR POWER METER ACCURACY TEST

Power Meter Tested: Model No.: _____ Serial No: _____

Date: _____ **Tested by:** _____

Test Equipment Used

Range Calibrator: Model No.: **11683A** Serial No.: _____

Digital Voltmeter: Model No.: _____ Serial No.: _____

Test Results

Range Calibrator Setting	Channel A		Channel B	
	DVM Reading (Vdc)	Power Meter Reading (dBm)	DVM Reading (Vdc)	Power Meter Reading (dBm)
1 mW	A =	0.000 ±0.001	A =	0.000 ±0.001
300 µW	B =	C =	B =	C =
100 µW	D =	E =	D =	E =

Pass/Fail Calculations

300 µW	R = B/A = _____ S = $10^{(C/10)}$ = _____ % ERROR = ((R-S)/R) × 100 = _____ % Limits: ±0.13% Pass ☐ Fail ☐	R = B/A = _____ S = $10^{(C/10)}$ = _____ % ERROR = ((R-S)/R) × 100 = _____ % Limits: ±0.13% Pass ☐ Fail ☐
100 µW	T = D/A = _____ U = $10^{(E/10)}$ = _____ % ERROR = ((T-U)/T) × 100 = _____ % Limits: ±0.10% Pass ☐ Fail ☐	T = D/A = _____ U = $10^{(E/10)}$ = _____ % ERROR = ((T-U)/T) × 100 = _____ % Limits: ±0.10% Pass ☐ Fail ☐