Technical Note

Power Meter Accuracy Test

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

The information contained in this document is subject to change without notice.

Agilent Technologies makes no warranty of any kind with regard to this material, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Agilent shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

© Copyright 2001 Agilent Technologies, Inc. All rights reserved.
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.

<table>
<thead>
<tr>
<th>Recommended Model Number</th>
<th>Alternate Model Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>E4419B</td>
<td>E4418A/B, E4419A, EPM-441A, EPM-442A</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Recommended Model Number</th>
<th>Alternate Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range calibrator</td>
<td>11683A</td>
<td>None</td>
</tr>
<tr>
<td>Precision digital voltmeter</td>
<td>3458A</td>
<td>Any with the required accuracy and resolution(^a)</td>
</tr>
<tr>
<td>Power sensor cable</td>
<td>8120-8319, 11730A</td>
<td>Any equivalent</td>
</tr>
<tr>
<td>BNC cable, 50 (\Omega)</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>Adapter for connecting BNC cable to DVM inputs</td>
<td>Any</td>
<td>Any</td>
</tr>
</tbody>
</table>

\(a\). 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 $\mu$W.
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 $\mu$W.
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**

<table>
<thead>
<tr>
<th>Power Meter Tested:</th>
<th>Model No.:</th>
<th>Serial No.:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Date:</th>
<th>Tested by:</th>
</tr>
</thead>
</table>

**Test Equipment Used**

<table>
<thead>
<tr>
<th>Range Calibrator:</th>
<th>Model No.:</th>
<th>11683A</th>
<th>Serial No.:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Digital Voltmeter:</th>
<th>Model No.:</th>
<th>Serial No.:</th>
</tr>
</thead>
</table>

**Test Results**

<table>
<thead>
<tr>
<th>Range Calibrator Setting</th>
<th>Channel A</th>
<th>Channel B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DVM Reading (Vdc)</td>
<td>Power Meter Reading (dBm)</td>
</tr>
<tr>
<td>1 mW</td>
<td>A =</td>
<td>0.000 ± 0.001</td>
</tr>
<tr>
<td>300 µW</td>
<td>B =</td>
<td>C =</td>
</tr>
<tr>
<td>100 µW</td>
<td>D =</td>
<td>E =</td>
</tr>
</tbody>
</table>

**Pass/Fail Calculations**

| 300 µW | R = B/A = | S = 10^(C/10) = | % ERROR = ((R-S)/R) × 100 = ||\% |
|--------|-----------|-----------------|----------------------------------|
|        |           |                 | Pass ☐ Fail ☐                     |

| 100 µW | T = D/A = | U = 10^(E/10) = | % ERROR = ((T-U)/T) × 100 = ||\% |
|--------|-----------|-----------------|----------------------------------|
|        |           |                 | Pass ☐ Fail ☐                     |