TB 9-6625-2376-24

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR POWER METER AGILENT MODEL N1911A

Headquarters, Department of the Army, Washington, DC
4 February 2009

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can improve this manual. If you find any mistakes or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to: Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also send in your comments electronically to our E-mail address: 2028@redstone.army.mil or by fax 256-842-6546/DSN 788-6546. For the World Wide Web use: https://amcom2028.redstone.army.mil. Instructions for sending an electronic 2028 can be found at the back of this manual.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Power Meter, Agilent, Model N1911A. The manufacturer's manual was used as the prime data source in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

a. Model Variations. None

b. Time and Technique. The time required for this calibration is approximately 2 hours, using the dc and low frequency and microwave techniques.

2. Forms, Records, and Reports

a. Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25.

b. Adjustments to be reported are designated (R) at the end of the sentence in which they appear. When adjustments are in tables, the (R) follows the designated adjustment. Report only those adjustments made and designated with (R).

3. Calibration Description. TI parameters and performance specifications which pertain to this calibration are in table 1.

Table 1. Calibration Description

Test instrument parameters	Performance specifications
Power reference	Frequency: 50 MHz Range: 1 mW Accuracy: ±0.9%
Time Base	Range: 10 MHz Accuracy: ± 10 ppm
Zero set	Accuracy: CW ± 0.0000175% Peak ± 0.0150%
Linearity	Accuracy: ± 0.8%

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment to be used in this calibration procedure. This equipment is issued with Secondary Transfer Calibration Standards Set AN/GSM-286, AN/GSM-287, or AN/GSM-705 and Secondary Reference Calibration Standards Set, NSN 4931-00-621-7878. Alternate items may be used by the calibrating activity. The items selected must be verified to perform satisfactorily prior to use and must bear evidence of current calibration. The equipment must meet or exceed the minimum use specifications listed in table 2. The accuracies listed in table 2 provide a four-to-one ratio between the standard and TI. Where the four-to-one ratio cannot be met, the actual accuracy of the equipment selected is shown in parenthesis.

5. Accessories Required. The accessories required for this calibration are common usage accessories, issued as indicated in paragraph **4** above, and are not listed in this calibration procedure. The following peculiar accessory is required: Instrument Controller, with National Instruments Automation Explorer software.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
FREQUENCY COUNTER	Range: 10 MHz Accuracy: ±2.5 ppm	Fluke, Model PM6681/656 (PM6681/656)
MULTIMETER	Range: 0 to 20 V dc Accuracy: ±0.04% Range: 200 Ω Accuracy: ±0.04%	Hewlett-Packard, Model 3458A (3458A)
POWER METER	Frequency range: 50 MHz Range: 1 mW Power accuracy: ± 0.225% (± 0.5%) Must have V_{COMP} and V_{RF} Outputs	Hewlett-Packard, Model E12-432A (MIS-30525) w/thermistor mount Hewlett-Packard, Model 478A-H75 (7915907)

SECTION III
CALIBRATION PROCESS

6. Preliminary Instructions

a. The instructions outlined in paragraphs **6** and **7** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name as listed in table 2.

c. Unless otherwise specified, verify the results of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in the manufacturer's manual for this TI.

d. Unless otherwise specified, all controls and control settings refer to the TI.

7. Equipment Setup

WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUTPUT(S) to minimum after each step within the performance check where applicable.

a. Connect TI to a 115 V ac source.

b. Set TI **POWER** switch to on position and allow 30 minutes for warm-up.

c. Connect instrument controller via IEEE cable to TI.

8. Power Reference Level

a. Performance Check

(1) Set power meter power **OFF ON** pushbutton to **OFF** position.

(2) Disconnect thermistor mount from power meter interconnect cable.

(3) Connect multimeter (resistance mode) between **VRF t**erminal center conductor on power meter (rear panel) and pin 1 of thermistor mount end of power meter interconnect cable.

(4) Record this value as power meter internal bridge resistance as R. (Round multimeter indication to two decimal places. Value will be approximately 200 Ω).

(5) Connect thermistor mount to power meter interconnect cable.

(6) Connect equipment as shown in figure 1.

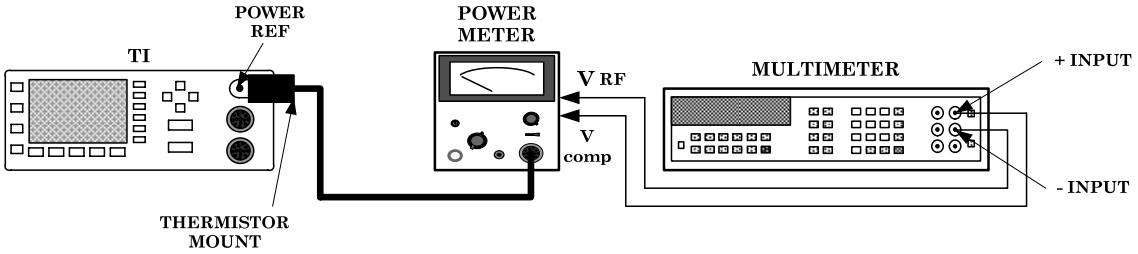

Figure 1. Power reference level - equipment setup.

(7) Set power meter **OFF ON** pushbutton to **ON** position. Allow time to stabilize.

(8) Set power meter **RANGE** switch to **COARSE ZERO** and adjust front panel **COARSE ZERO** control for a zero meter indication.

(9) Fine zero power meter on most sensitive range then set power meter **RANGE** switch to **1 mW**.

(10) Ensure multimeter input terminals are isolated from chassis ground for (11) below.

(11) Configure multimeter to measure DCV.

(12) If multimeter indication is 400 μVDC or less, record multimeter indication and proceed to (14) below; if not, proceed to (13) below.

(13) Hold power meter **FINE ZERO CONTROL** and adjust **COARSE ZERO** control for a multimeter indication 200 μVDC or less. Record multimeter indication.

(14) Record value in step (12) or (13) above as V0 (Round to two decimal places).

(15) Set power meter to highest range.

(16) Use the instrument controller to configure the TI for a power reference level measurement by performing (a) through (e) below:

(a) Open the National Instruments Measurement and Automation Explorer program.

(b) Under the CONFIGURATON tab, expand DEVICES AND INTERFACES.

(c) Select GPIB0, right click, then SCAN FOR INSTRUMENTS.

(d) Double click on TI from the list of instruments found.

(e) From the toolbar, select COMMUNICATE WITH INSTRUMENT.

(17) On the display of the instrument controller, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

*RST

(18) Click the WRITE button.

(19) On the display of the instrument controller, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

OUTP:ROSC:STAT ON

(20) Click the WRITE button.

(21) Allow time for TI output to stabilize then record multimeter indication as V1 (rounded to two decimal places).

(22) Disconnect multimeter negative lead from power meter **VRF** (fig. 1) and connect multimeter negative lead to power meter chassis ground. Record multimeter indication as VCOMP (rounded to two decimal places).

(23) Calculate the POWER REF output level PRF from the below listed formula:

$$PRF = \frac{2\,V_{COMP}(V_1 - V_0) + V_0^2 - V_1^2}{4\,R\ (\text{calibration factor})}$$

Where:

PRF = power reference oscillator output power level

V_{COMP} = value recorded in (22) above

V_1 = value recorded in (21) above

V_0 = value recorded in (14) above

R = value recorded in (4) above

Calibration factor = value from test report for thermistor mount at 50 MHz

(24) If calculated PRF is not between 0.991 and 1.009 mW, perform **b** below.

(25) On the display of the instrument controller, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

OUTP:ROSC:STAT OFF

(26) Disconnect equipment setup.

b. Adjustments

(1) Set power meter power **OFF ON** pushbutton to **OFF** position.

(2) Disconnect thermistor mount from power meter interconnect cable.

(3) Connect multimeter (resistance mode) between VRF terminal center conductor on power meter (rear panel) and pin 1 of thermistor mount end of power meter interconnect cable.

(4) Record this value as power meter internal bridge resistance as R. (Round multimeter indication to two decimal places. Value will be approximately 200 Ω).

(5) Connect thermistor mount to power meter interconnect cable.

(6) Connect equipment as shown in figure 1.

(7) Set power meter **OFF ON** pushbutton to **ON** position. Allow time to stabilize.

(8) Set power meter **RANGE** switch to **COARSE ZERO** and adjust front panel **COARSE ZERO** control for a zero meter indication.

(9) Fine zero power meter on most sensitive range then set power meter **RANGE** switch to **1 mW**.

(10) Ensure multimeter input terminals are isolated from chassis ground for (11) below.

(11) Configure multimeter to measure dcV.

(12) If multimeter indication is 400 μVdc or less, record multimeter indication and proceed to (14) below; if not, proceed to (13) below.

(13) Hold power meter FINE ZERO CONTROL and adjust COARSE ZERO control for a multimeter indication 200 μVdc or less. Record multimeter indication.

(14) Record value in (12) or (13) as V0. (Round to two decimal places).

(15) Set power meter to highest range.

(16) Disconnect multimeter negative lead from power meter V_{RF} (fig. 1) and connect multimeter negative lead to power meter chassis ground.

(17) On the display of the instrument controller, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

*RST

(18) Click the WRITE button.

(19) On the display of the instrument controller, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

OUTP:ROSC:STAT ON

(20) Click the WRITE button.

(21) Round off the indication to two decimal places and record this value as V_{COMP}.

(22) Reconnect multimeter negative lead to power meter V_{RF} input.

(23) The multimeter is now set up to measure V_1.

(24) Calculate the required value of V_1 using the following formula:

$$V_1 = V_{COMP} + V_0 - \sqrt{[V_{COMP}^2 - (10)^{-3} (4R)(\text{Calibration Factor})]}$$

(25) On the display of the instrument controller, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

SERV:CAL:ADJ:COUR 834

(26) On the display of the instrument controller, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

SERV:CAL:ADJ:FINE 550

(27) Increment or decrement the value of the COURSE control by 1 using the command in (25) until the output just crosses the value of V_1 established in (24) above.

(28) Increment or decrement the value of the FINE control by 1 using the command in (26) above until the output is as close to the value of V_1 as possible established in (24) above.

(29) On the display of the instrument controller, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

OUTP:ROSC:STAT OFF

(30) Disconnect equipment setup.

9. Time Base Frequency Accuracy

a. Performance Check

(1) Connect frequency counter Channel A, set to 50 Ohms, to the TI **TRIG OUT**.

(2) On the display of the instrument controller, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

SERV:BIST:TBAS:STAT ON

(3) Click the WRITE button.

(4) Measure the frequency of the 10 MHz time base. Frequency counter will indicate between 9.999,900 and 10,000.10 MHz.

(5) On the display of the instrument controller, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

SERV:BIST:TBAS:STAT OFF

(6) Click the WRITE button.

(7) Disconnect equipment setup.

b. Adjustments. No adjustments can be made.

10. Zero Set (Average Path)

a. Performance Check

(1) Ensure that no sensor or other test equipment except the instrument controller is connected to the TI.

(2) On the instrument controller display, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

SERV:BIST:PEAK:ZSET

(3) Click the WRITE button.

(4) Wait a few minutes for the TI to complete the routine.

(5) On the display of the instrument controller, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

SERV:BIST:CW:ZSET:NUM?

(6) Click the WRITE button followed immediately by the READ button.

(7) TI will indicate between -0.0000175 and +0.0000175 (-1.75E-005 and +1.75E-005).

b. Adjustments. No adjustments can be made**.**

11. Zero Set (Peak Path)

a. Performance Check

(1) Ensure that no sensor or other test equipment except the instrument controller is connected to the TI.

NOTE

The command, SERV:BIST:PEAK:ZSET initiates the zero set and noise test for both Peak and CW (Average). It is not necessary to perform steps (2) through (4) below again if minimal time has elapsed since zeroing the CW (average) path in paragraph **10.a.**(2) above.

(2) On the instrument controller display, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

SERV:BIST:PEAK:ZSET

(3) Click the WRITE button.

(4) Wait a few minutes for the TI to complete the routine.

(5) On the display of the instrument controller, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

SERV:BIST:PEAK:ZSET:NUM?

(6) Click the WRITE button followed immediately by the READ button.

(7) TI will indicate between -0.150 and +0.150 (-1.50E-001 and +1.50E-001)

b. Adjustments. No adjustments can be made.

12. Linearity (Average Path)

a. Performance Check

(1) Ensure that no sensor or other test equipment except the instrument controller is connected to the TI.

(2) On the instrument controller display, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

SERV:BIST:CW:LIN

(3) Click the WRITE button.

(4) Wait a few minutes for the TI to complete the routine.

(5) On the display of the instrument controller, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

SERV:BIST:CW:LIN:PERR?

(6) Click the WRITE button followed immediately by the READ button.

(7) TI will indicate between -0.80 and 0.80 (-8.0E-001 and +8.0E-001).

b. Adjustments. No adjustments can be made.

13. Linearity (Peak Path)

a. Performance Check

(1) Ensure that no sensor or other test equipment except the instrument controller is connected to the TI.

(2) On the instrument controller display, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

SERV:BIST:PEAK:LIN 0

(3) Click the WRITE button.

(4) Wait a few minutes for the TI to complete the measurement.

(5) On the display of the instrument controller, in the COMMUNICATOR dialog box, enter the following command on the SEND line:

SERV:BIST:PEAK:LIN:PERR?

(6) Click the WRITE button followed immediately by the READ button.

(7) TI will indicate between -0.80 and +0.80 (-8.0E-001 and +8.0E-001)

b. Adjustments. No adjustments can be made.

14. Final Procedure

a. Deenergize and disconnect all equipment.

b. Annotate and affix DA label/form in accordance with TB 750-25.

By Order of the Secretary of the Army:

GEORGE W. CASEY, JR.
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army

0834302

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 344947, requirements for calibration procedure TB 9-6625-2376-24.

Instructions for Submitting an Electronic 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however, only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: "Whomever" whomever@redstone.army.mil
To: <2028@redstone.army.mil

Subject: DA Form 2028

1. **From**: Joe Smith
2. Unit: home
3. **Address**: 4300 Park
4. **City**: Hometown
5. **St**: MO
6. **Zip**: 77777
7. **Date Sent**: 19-OCT –93
8. **Pub no:** 55-2840-229-23
9. **Pub Title**: TM
10. **Publication Date**: 04-JUL-85
11. Change Number: 7
12. Submitter Rank: MSG
13. **Submitter FName**: Joe
14. Submitter MName: T
15. **Submitter LName**: Smith
16. **Submitter Phone**: 123-123-1234
17. **Problem**: 1
18. Page: 2
19. Paragraph: 3
20. Line: 4
21. NSN: 5
22. Reference: 6
23. Figure: 7
24. Table: 8
25. Item: 9
26. Total: 123
27. **Text**

This is the text for the problem below line 27.