

***TB 9-6625-108-50**

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR SLOTTED LINE, HEWLETT-PACKARD, MODELS 805A, 805C, 805D, S810A, G810B, J810B, H810B, AND X810B; AND IM-92/U AND IM-92A/U (NASSAU MODEL 230)

Headquarters, Department of the Army, Washington, DC
10 December 1973

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**SECTION I
IDENTIFICATION AND DESCRIPTION**

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Slotted Line, Hewlett-Packard Models 805A, 805C, 805D, S810A, G810B, J810B, H810B, and X810B; and IM-92/U and IM-92A/U (Nassau Model 230). The manufacture's instruction manual was used as the prime data source in compiling these instructions. These slotted lines will be referred to as the "TI" (test instrument) throughout this bulletin.

a. Model Variations. Variations among, models are described in table 1 and in text.

b. Time and Technique. The time required for this calibration is approximately 2 hours per unit, using the microwave technique.

2. Calibration Data Card (DA Form 2416). Maintenance forms, records, and reports which are to be used by calibration personnel at all calibration levels are listed in and prescribed by TM 38-750.

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

Table 1. Calibration Description

Test instrument parameters.	Performance specifications
Frequency range	500 to 4000 MHz ^{1 2 3}
	2.60 to 3.95 GHz (H-P S810A).
	3.95 to 5.85 GHz (H-P G810B).
	5.30 to 8.20 GHz (H-P J810B).
	7.05 to 10.0 GHz (H-P H810B).
8.0 to 12.4 GHz (H-P X810B).	
Characteristic impedance. ⁵	50 ohms ^{1 3}
	46.3 ohms ²
Residual SWR	Less than 1.04:1 ^{1 3}
	Less than 1.02:1 ²
Slope and irregularities	Less than 1.01:1 ⁴

¹H-P Models 805A and 805C.

²H-P Model 805D.

³IM-92/U and IM-92A/U.

⁴H-P Models S810A, G810B, J810B, and X810B.

⁵This specification is for information only and is not verified in this bulletin.

**SECTION II
EQUIPMENT REQUIREMENTS**

4. Equipment Required. Tables 2 and 4 identify the specific equipment used in this calibration procedure. This equipment is issued with secondary transfer calibration standards set 4931-621-7877 and is to be used in performing this procedure. Alternate

items may be used by the calibrating activity when the equipment listed in tables 2 and 4 is not available. 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 tables 2 and 4. The accuracies listed in tables 2 and 4 provide a four-to-one accuracy 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 listed in tables 3 and 5 are issued with secondary transfer calibration standards set 4931-621-7877 and are to be used in this calibration procedure. When necessary, these items may be substituted by equivalent items unless specifically prohibited.

Table 2. Minimum Specifications of Equipment Required

Item	Common name	Minimum use specifications.	Manufacturer, model, and part number.
A1	MODULATOR	Range: 2 to 4 GHz Type: Square wave	Hewlett-Packard, Model C108403A (7912321).
A2	PIN MODULATOR	Range: Square wave modulation: from 2 to 4 GHz.	Hewlett-Packard, Model 8732B (7912581).
A3	SIGNAL SOURCE	Range: 2 to 4 GHz Power output: 10 MW min	(7923114)
A4	SLIDING TERMINATION	Range: 2 to 4 GHz	Narda, Model 22487 (7923224).
A5	SWR METER	Range: 1.01 to 1.1	Hewlett-Packard, Model Y10-415E (7910160-3).

Table 3. Accessories Required

Item	Common Name	Description And Part Number
B1	ADAPTER ¹	N plug to N plug (MS-15507-57B)
B2	ADAPTER	N jack to GR900 (7911051) or N plug to GR900 (7911052). ²
B3	ADAPTER ²	N jack to 7/8 in., jack (8899714)
B4	ADAPTER ²	N plug to 7/8 in., plug (10528698)
B5	ADAPTER ²	90° bend with N plug to N jack (MS90156-27D)
B6	VARIABLE ATTENUATOR	0 to 15 db, 1 to 4 GHz (7923130)
B7	CABLE	18 in., RG-9 () /U with N plug terminations (10519072).
B8	CABLE ¹	24 in., RG-58 () /U with BNC plug terminations (10519141).
B9	ISOLATOR	1 to 4 GHz (7913127-2)

¹Two required.

²Used for H-P Model 805D.

**SECTION III
CALIBRATION PROCESS FOR SLOTTED LINES,
HEWLETT-PACKARD MODELS 805A, 805C, AND 805D;
AND IM-92/U AND IM-92A/U (NASSAU MODEL 230)**

6. Preliminary Instructions

a. The instructions outlined in this paragraph are preparatory to the calibration process. Personnel should become familiar with the entire section before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name and item identification number as listed in tables 2 and 3. For the identification of equipment referenced by item numbers prefixed with A, see table 2, and for prefix B, see table 3.

WARNING

HIGH VOLTAGE is used during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions.

NOTE

Unless otherwise specified, verify the results of each test and take corrective action whenever the test requirement is not met before continuing with the calibration.

- c.** Connect the equipment as shown in figure 1.
- d.** Energize the equipment and allow sufficient time for warmup.
- e.** Adjust signal source (A3) for a 2-GHz leveled output.

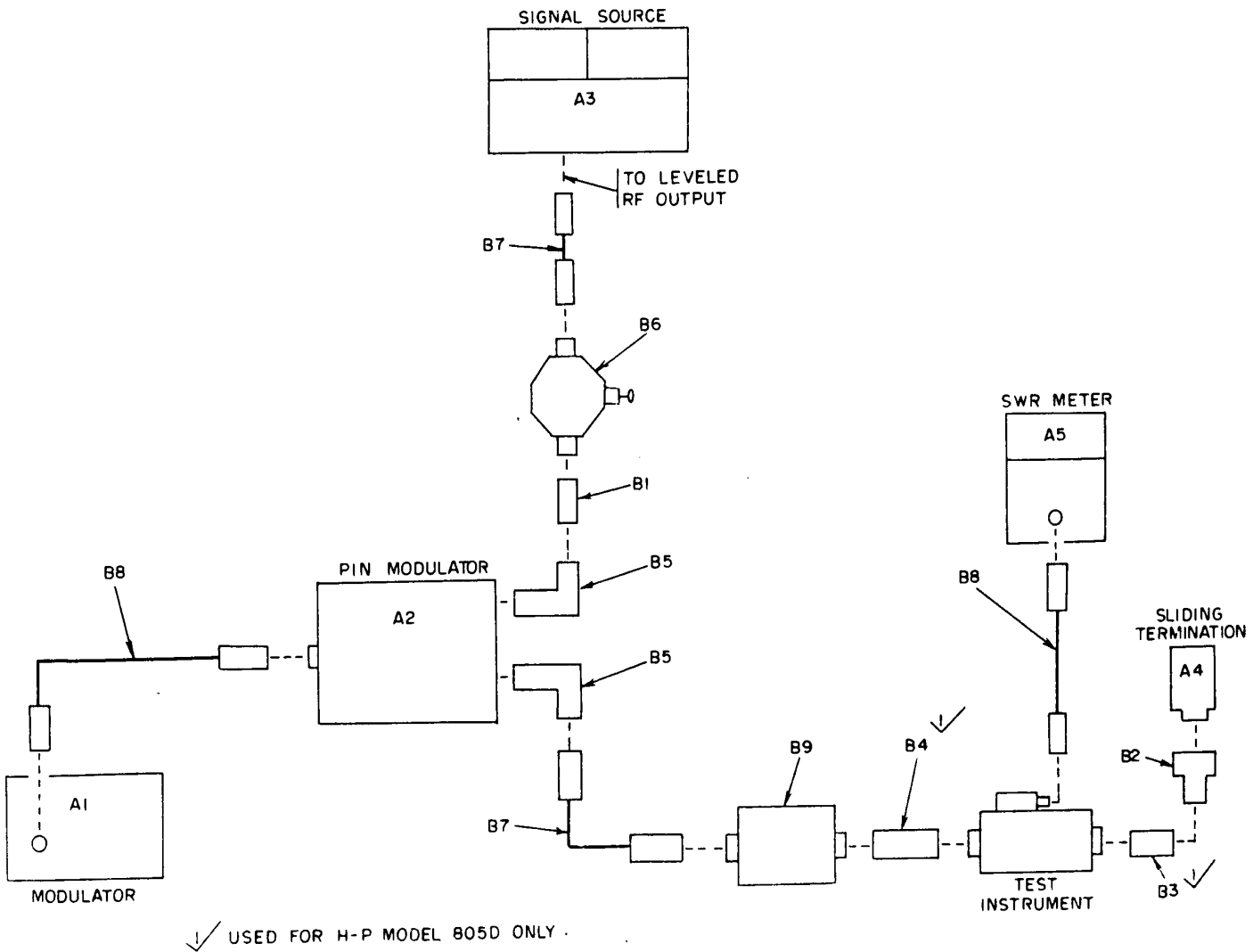
7. Residual VSWR

NOTE

The VSWR should be measured on the 30-db range of SWR meter (A5). To set up a reference for this measurement, adjust modulator (A1) frequency, variable attenuator (B6), and the TI probe tuning and depth controls until the SWR meter indicates full scale with minimum TI probe depth.

a. Performance Check

(1) Adjust sliding termination (A4) and the TI until the measured SWR is maximum. Record SWR meter (A5) indication as SWR max.



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Figure 1. Residual VSWR - equipment setup for Hewlett-Packard Models 805() and IM-92()/U.

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(2) Calculate maximum reflection coefficient (Pmax), using formula:

$$P_{\max} = \frac{SWR_{\max} - 1}{SWR_{\max} + 1}$$

(3) Adjust sliding termination until measured SWR is minimum. Record SWR meter indication as SWRmin.

(4) Calculate minimum reflection coefficient (Pmin), using formula:

$$P_{\min} = \frac{SWR_{\min} - 1}{SWR_{\min} + 1}$$

(5) Substitute calculated values in following equations and solve for maximum and minimum reflection coefficient of sliding termination (PL) or TI (Ps).

$$(a) P_L \text{ or } P_s = \frac{P_{\max} + P_{\min}}{2}$$

$$(b) P_L \text{ or } P_s = \frac{P_{\max} - P_{\min}}{2}$$

(6) Record the values obtained in (5) above.

(7) With the TI probe carriage in a fixed position, move the sliding termination back and forth and record the SWR indication.

(8) Calculate the reflection coefficient of sliding termination (PL) from measured SWR recorded in (7) above, using formula:

$$P = \frac{SWR - 1}{SWR + 1}$$

(9) Compare the result with (5)(a) and (b) above. The identical value or nearly same value is the reflection coefficient of the sliding termination (PL). The other value, (5)(a) or (b) above, is the TI reflection coefficient (Ps).

(10) Compute residual SWR of TI, using formula:

$$SWR_s = \frac{1 + P_s}{1 - P_s}$$

It will be 1.04 or less.

NOTE

To verify SWR of sliding termination, use formula:

$$SWR_L = \frac{1 + P_L}{1 - P_L}$$

(11) Repeat technique of (1) through (10) above at test frequencies of 3 and 4 GHz. Residual SWR will be less than 1.04 for each test frequency.

(12) Disconnect sliding termination and the isolator (B9) from the TI and connect them to the opposite ends of the TI from which they were disconnected. Reverse adapters as necessary.

(13) Repeat (1) through (11) above.

b. Adjustments. No adjustment can be made.

8. Final Procedure

a. Deenergize and disconnect all equipment.

b. In accordance with TM 38-750, annotate and affix DA Label 80 (US Army Calibration System). When the TI cannot be adjusted within tolerance, annotate and affix DA Form 2417 (Unserviceable or Limited Use tag).

**SECTION IV
CALIBRATION PROCESS FOR SLOTTED LINES,
HEWLETT-PACKARD MODELS S810A, G810B, J810B, H810B, AND X810B**

9. Preliminary Instructions

a. The instructions outlined in this paragraph are preparatory to the calibration process. Personnel should become familiar with the entire section before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name and item identification number as listed in tables 4 and 5. For the identification of equipment referenced by item numbers prefixed with A, see table 4, and for prefix B, see table 5. When the standards referenced in table 4 are not available, refer to table 2 before selecting substitutes.

Table 4. Minimum Specifications of Equipment Required

Item	Common name	Minimum use specifications	Manufacturer, model, and part number.
A1	MODULATOR	Range: 2.8 to 12.4 GHz Type: Square wave (1 kHz)	Hewlett-Packard, Model C10-8403A (7912321).
A2	PIN MODULATOR	Range: Square wave modulation from 2.8 to 12.4 GHz.	Hewlett-Packard, Model 8732B (7912581).
A3	SIGNAL SOURCE	Range: 2.8 to 12.4 GHz at 10 mw output.	(7923114)
A4	SLIDING TERMINATION	Range: 1 to 8 GHz 8 to 12.4 GHz.	Narda, Model 22487 (7923224). PRD, Model 1131 MOD (7923205-6).
A5	SWR METER	Range: 1.01 to 1.1	Hewlett-Packard Model Y10-415E (7910160-3).

Table 5. Accessories Required

Item	Common Name	Description And Part Number
B1	ADAPTER	N plug to N plug (MS-15507)
B2	ADAPTER	N plug to GR900 (7911051)
B3	ADAPTER ¹	90° bend with N plug to N jack (MS-90156-27D)
B4	COAXIAL TO WAVEGUIDE ADAPTER ¹	2.6 to 3.95 GHz (10519427) 3.95 to 5.85 GHz (10519426) 5.4 to 8.2 GHz (10519425) 8.2 to 12.4 GHz (10519423).
B5	VARIABLE ATTENUATOR	1 to 8 GHz (7923130) 8 to 12.4 GHz (7923131)
B6	CABLE ²	18 in., RG-9 () /U with N terminations (10519072).
B7	CABLE ¹	24 in., RG-58 () /U with BNC terminations (10519141).
B8	ISOLATOR	2 to 4 GHz (7913127-1) 4 to 8 GHz (7913127-2) 8 to 12.4 GHz (7923167)
B9	WAVEGUIDE PROBE ³	10519399

¹Two required.

²Three required.

³Furnished with test instrument.

WARNING

HIGH VOLTAGE is used during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions.

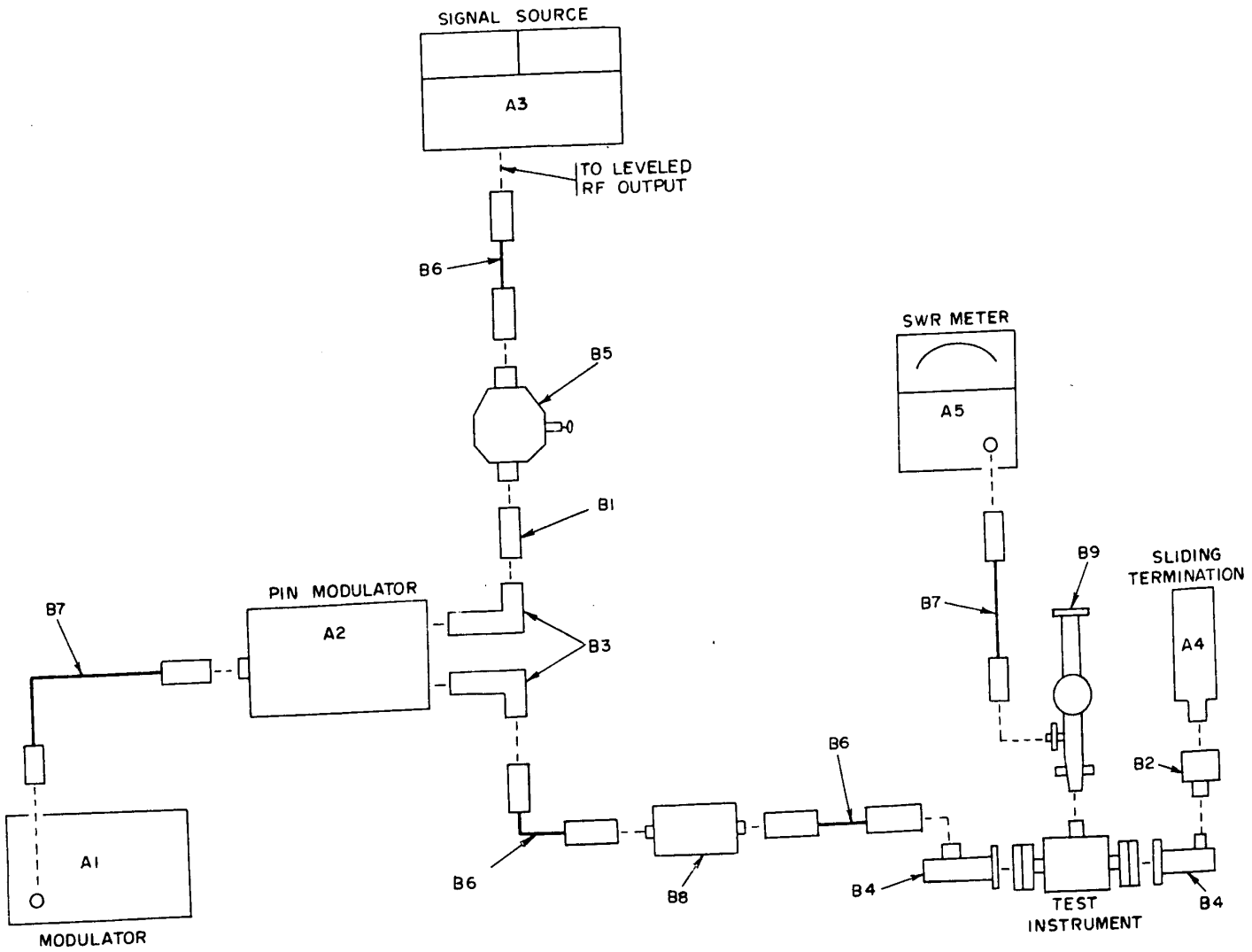
NOTE

Unless otherwise specified, verify the results of each test and take corrective action whenever the test requirement is not met before continuing with the calibration.

10. Equipment Setup

- a. Connect equipment as shown in figure 2.
- b. Adjust variable attenuator (B5) for maximum attenuation.
- c. Adjust waveguide probe (B9) for minimum probe penetration.
- d. Adjust signal source (A3) for leveled output of appropriate frequencies, listed in (1) through (5) below:
 - (1) Model S810A - 2.8 GHz.
 - (2) Model G810B - 4.0 GHz.
 - (3) Model J810B - 5.5 GHz.

Figure 2. Slope and irregularity measurement - equipment setup for Hewlett-Packard Model 810 series.



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(4) Model H810B - 7.5 GHz.

(5) Model X810B - 8.5 GHz.

e. Adjust modulator (A1) for 1000 Hz.

11. Slope and Irregularities

NOTE

The slope and irregularities should be measured on the 30-db range of SWR meter (A5). To set up a reference for this measurement, adjust modulator (A1) frequency, variable attenuator (B5), and waveguide probe (B9) tuning and depth controls until the SWR meter indicates full scale with minimum TI probe depth.

a. Performance Check

(1) Move TI carriage along slotted line; measure and record VSWR at two different positions along slotted line. Difference between values recorded will not exceed 0.01. Example: $1.015 - 1.005 = 0.010$

(2) Repeat technique of (1) above at test frequencies listed in (a) through (e) below:

(a) Model S810A - 3.4 and 3.8 GHz.

(b) Model G810B - 4.8 and 5.8 GHz.

(c) Model J810B - 7 and 7.8 GHz.

(d) Model H810B - 8.5 and 9.5 GHz.

(e) Model X810B - 10.0 and 11.5 GHz.

(3) Disconnect cable (B6) and adapter (B2) from the waveguide adapters. Reverse the direction of the TI and reconnect the cable and adapter. Repeat (1) and (2) above.

b. Adjustments. No adjustment can be made.

12. Final Procedure

a. Deenergize and disconnect all equipment.

b. In accordance with TM 38-750, annotate and affix DA Label 80 (US Army Calibration System). When the TI cannot be adjusted within tolerance, annotate and affix DA Form 2417 (Unserviceable or Limited Use tag).

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