DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR BB SWEEPER ACCESSORY HEWLETT-PACKARD MODEL 3744A

Headquarters, Department of the Army, Washington, DC
31 August 1978

REPORTING OF ERRORS

You can help improve this publication by calling attention to errors and by recommending improvements and stating your reasons for the recommendations. Your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) should be mailed direct to Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-MA-Q, Fort Monmouth. NJ, 07703. A reply will be furnished direct to you.

Section I. IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of BB Sweeper Accessory, Hewlett. Packard Model 3744A. The manufacturer's instruction 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 Var*iations None

b. The and Technique. The time required for this calibration is approximately 2 hours, using the dc direct current) **and** low frequency technique.

2. Calibration Data Card, DA Form 2414. a. Forms, records, and reports required for calibration personnel at all levels are prescribed by TM 38-750. DA Form 2416 must be annotated in accordance with TM 38-750 for each calibration performed.

b. Adjustments to be reported on DA Form 2416 are designated (R) at the end of the sentence in which they appear. Report only those adjustments made and designated with (R).

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
BB flatness (at IF input level of 0 dBm)	100 kHz to 15 MHz <0.2 dB 100 kHz to 10 MHz <0.12 dB 100 kHz to 8.5 MHz <0.1 dB
BB output harmonics	Harmonics are at least 35 dB below a 0 dBm input signal
Attenuator	Range: 0 to 61 dB in 1 dB steps Accuracy: * ±0.1 dB for 1, 2, 4 dB steps ±0.2 dB for 8, 16, 30 dB steps
Calibrate amplitude	1 dB ±0.1 dB
Calibrate frequency	2 MHZ ±100 Hz

*This parameter is only certified to +0.5 dB because

Section II. EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment used in this calibration procedure. This equipment is issued with Secondary Transfer Standards Calibration Sets NSN 6695-00-621-7877 and is to be used in performing this procedure. Alternate items may be used by the calibrating activity when the equipment listed in table 2 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 table 2. The accuracies listed in table 2 provide a four-to-one ratio between the standard and TI.**

5. Accessories Required. The accessories listed in table 3 are issued as indicated in paragraph 4 above 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 Equipment Required

Item	Common name and/or (official nomenclature)	Minimum use specifications	Manufacturer, model, and part number
A1	ATTENUATOR (VARIABLE ATTENUATOR)	Range: 0 to 31 dB in 1 dB steps Accuracy ±0 12 dB	Hewlett-Packard, Model 355C (7910807) with Kay, Model 464A (MIS-10263) and BNC plug to BNC plug adapter (MS35176-491b)
A2	DIGITAL VOLTMETER	Ac Range 0 to 1 V Accuracy: ±0 5% Dc Range: 0 to 15 V Accuracy: ±0.1%	Dana, Model 5600 (7912073-3)
A3	ELECTRONIC COUNTER	Frequency: 100 kHz to 2 MHz Accuracy: ±0.005%	Systron-Donner, Model 1037M (7910823)
A4	MICROWAVE * LINK ANALYZER (MLA)	No substitute	Hewlett-Packard, Model 3710A (IF/BB transmitter) with Hewlett-Packard, Model 3702B (IF/BB receiver) (used as an oscilloscope)
A5	SPECTRUM ANALYZER	Frequency: 10 to 50 MHz Sensitivity: At least −60 dBm	Tektronix, Model R491 (MIS-10218)
A6	TEST OSCILLATOR	Frequency. 100 kHz to 15 MHz Output: At least 2 V rms	Hewlett-Packard, Model 652A or Preston, Model 1S4A (MIS-10224)
A7	TRUE RMS VOLTMETER	Frequency: 100 kHz to 9 MHz Range .01 mV to 1 V rms Accuracy ±0.5%	Singer, Model 3574M (MIS-10299) or Hewlett-Packard, Model Y10-3400AMOD (7911056-3)

* Must be furnished with test instrument at time of calibration

Table 3 Accessories Required

Item	Common name and/or (official nomenclature)	Description and part number
B1	ADAPTER 1 (CONNECTOR ADAPTER)	BNC Tee Type (MS35173-274C)
B2	ADAPTER 2 (CONNECTOR ADAPTER)	BNC plug to BNC plug terminations (MS35176-491B)
B3	ADAPTER 1 (ELECTRICAL CONNECTOR PLUG)	BNC plug to double banana jack terminations (MS90578-1441)

Table 3 Accessories Required - Continued

Item	Common name and/or (official nomenclature)	Description and part number
B4	ADAPTER	75 ohms to 600 ohms double banana plug to BNC jack (7912056-2)
B5	ADAPTER (CONNECTOR ADAPTER)	BNC jack to BNC jack termination (MS35184-914)
B6	CABLE ASSEMBLY (RADIO FREQUENCY CABLE ASSEMBLY)	24 in., RG-58 ( )/U, BNC plug terminations (10519141)
B7	CABLE ASSEMBLY [3]	75 ohms, BNC terminations
B8	CABLE ASSEMBLY (RADIO FREQUENCY CABLE ASSEMBLY)	36 in, RG-58( )/U, BNC plug and alligator clips terminations (7909410)
B9	DUMMY LOAD (ELECTRICAL DUMMY LOAD)	50-ohm feed thru, BNC plug and jack termination (Hewlett-Packard, Model 11048B)
B10	DUMMY LOAD (ELECTRICAL DUMMY LOAD)	75-ohm, BNC plug termination (7622751)
B11	DUMMY LOAD (ELECTRICAL DUMMY LOAD)	600-ohm, BNC plug termination (8898497)
B12	IMPEDANCE TRANSFORMER [1]	50 to 75 ohms, BNC jack terminations, Anzac, Model TP-75 (7913106-1)

[1] Two required.
[2] Three required
*Six required. Must be furnished with item *(A4)* at time of calibration.

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 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 to observe safety precautions.

NOTE

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. Additional maintenance information is contained in the manufacturer's manual for this TI.

NOTE

When indications specified in paragraphs 8 and 11 are not within tolerance, perform the power supply check prior to making adjustments. After adjustments are made, repeat paragraphs 8 and 11. Do not perform power supply check if all other parameters are within tolerance.

NOTE

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

7. Equipment Setup. a Connect equipment as shown in figure 1.

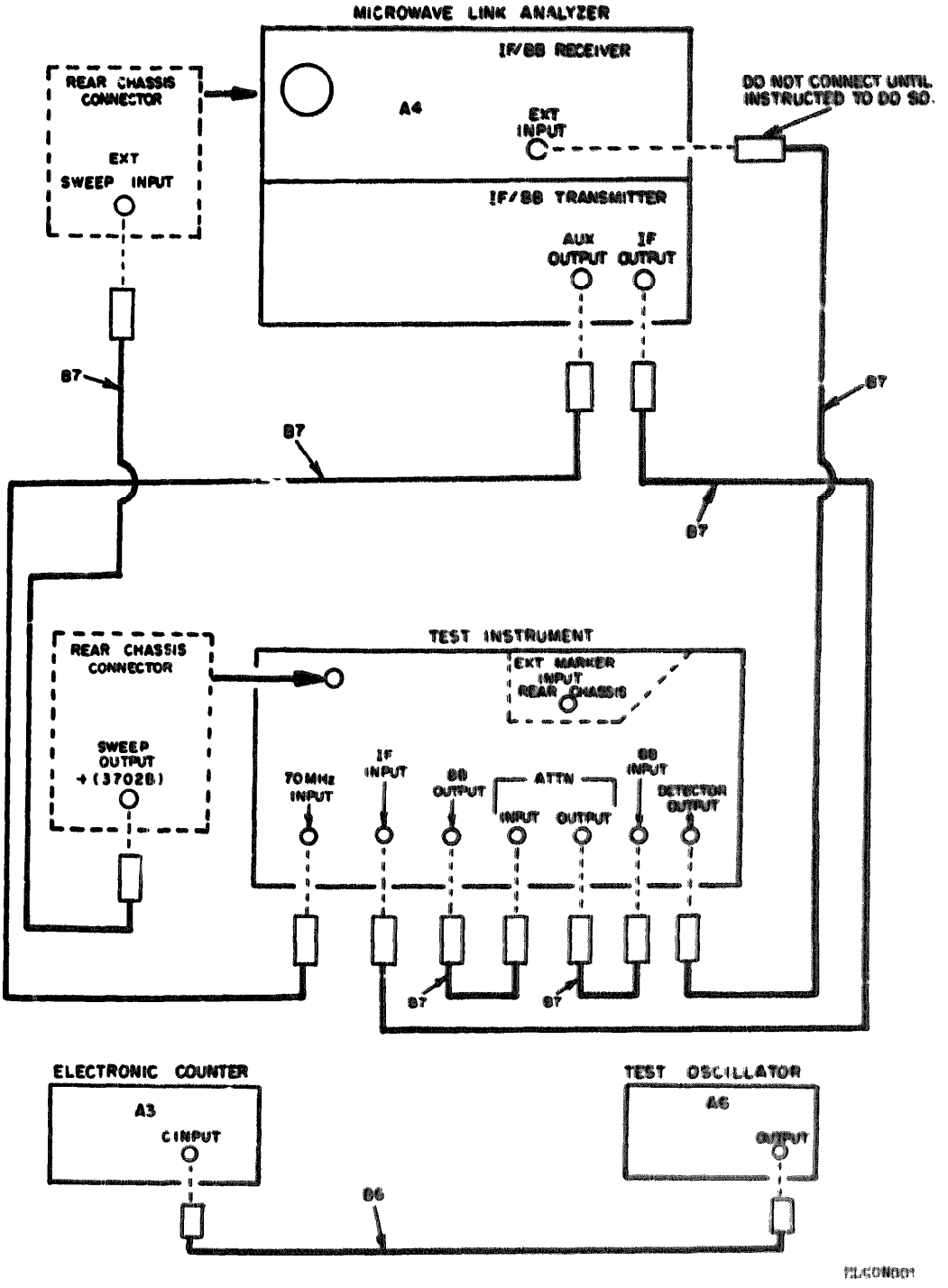


Figure 1. Back-to-back flatness clutch - equipment setup

b. Position controls of microwave link analyzer (MLA) (A4) as listed in (1) through (3) below:

NOTE

The p&ion settings listed below are applicable to Hewlett-Packard Models 3702B and 3710A. If other models have been furnished, these settings will require modification. Refer to the Microwave Link Analyzer Operator's Handbook.

(1) Position MLA oscilloscope (IF/BB receiver) controls as follows for preliminary adjustment of oscilloscope.

(a) Y2 DISPLAY switch to IF.

(b) Y1 and Y2 GAIN controls fully counterclockwise.

(c) Y1 and Y2 POSITION control to midposition.

(d) INTENSITY control adjusted as necessary to obtain two spots on MLA oscilloscope.

(e) FOCUS and ASTIGMATISM controls adjusted for two sharp, round spots on MLA oscilloscope.

(f) X2 DISPLAY switch to SPECTRUM.

(g) X GAIN and X POSITION controls adjusted for a 10 cm (centimeter) display on MLA oscilloscope.

(h) TRACE ALIGN control should be adjusted to obtain parallel traces on the ***MLA*** oscilloscope.

(L) Y2 POSITION control fully counterclockwise.

(2) Position MLA signal generator (IF/BB transmitter) controls as follows:

(a) SWEEP selector switch to INT.

(b) SWEEP WIDTH control set to 15 MHz (megahertz).

(c) BB FREQUENCY selector switch to OFF.

(d) IF FREQUENCY control set to 77.5 MHz.

(e) IF ATTENUATOR 10 dB pushbutton depressed.

(f) IF VERNIER control set to 0.

(g) AUX OUTPUT switch to 70 MHZ XTAL.

(3) Position MLA oscilloscope controls as follows to complete the preliminary setup.

(a) CALIBRATION switch to OFF.

(b) SWEEP SOURCE switch to EXT.

(c) BLANKING switch to OFF.

(d)) Y1 DISPLAY switch to EXT.

(e) Y2 DISPLAY switch to IF.

(f) 71 Y2 CALIBRATION switch to OFF.

(*g*) MARKERS switch to OFF.

(*h*) Y1 POSITION control to center the Y1 **TRACE on MLA oscilloscope.**

c. **Position controls of TI as** listed in (1) through (3) **below:**

(1) ATTENUATOR (dB) 30 dB pushbutton switch **pressed.**

(2) GAIN switch set to X10.

(3) CALIBRATE switch set to OFF.

d Energize equipment and allow sufficient time *for* equipment to warmup and stabilize.

8. Back-to-Back Flatness Check

NOTE

The following procedure describes a comprehensive operational check of the TI.

a Performance Check

(1) Adjust the MLA (A4) oscilloscope Y1 GAIN control fully clockwise and adjust the Y EXT OFFSET control to return the Y1 TRACE as near as possible to the center of the MLA oscilloscope.

(2) Adjust the MLA oscilloscope Y1 GAIN control to mid-position.

(3) Connect cable assembly (B7) to the MLA oscilloscope EXT INPUT connector as shown in fig. 1.

(4) Adjust the ***MLA*** IF/BB receiver IF FREQUENCY control to display a zero beat "birdie" at the left end graticule line of the MLA oscilloscope.

(5) Set TEST INSTRUMENT CALIBRATE switch to 2 MHz.

(6) Adjust the MLA oscilloscope X PHASE SHIFT control to superimpose the 2 MHz marker birdies on both traces.

('7) Set MLA oscilloscope BLANKING switch to ON.

(8) Set TI CALIBRATE switch to 1 dB (decibel).

(9) Adjust MLA Y1 GAIN control to obtain an 8 cm display on MLA oscilloscope (1 dB/8 cm-O.125 dB/cm).

(10) Adjust test oscillator (A6) for an output level of +3 dBm (decibel referred to one milliwatt) and frequency for a 100 kHz (kilohertz) indication on electronic counter (AS).

(11) Disconnect cable assembly (B6) (fig. 1) *from* electronic- counter and connect it to the TI EXT MARKER INPUT connector.

(12) Adjust the MLA transmitter IF FREQUENCY control to 71 MHz and the SWEEP WIDTH control to 2 MHZ.

(13) Set TI CALIBRATE switch to 2 MHz.

(14) Readjust these controls slightly as necessary to position a 2 MHz marker birdie at the right hand graticule line and a 100 KHz marker birdie at the *left* hand graticule line on MLA oscilloscope display. (These adjustments must be made carefully because harmonic signals are also present on the display).

(15) Disconnect cable assembly (B6) from the TI EXTERNAL MARKER INPUT connector.

(16) The MLA oscilloscope trace now displays signals between 100 kHz and 2 MHz.

(17) Adjust *MLA* oscilloscope Y-EXT OFFSET control to place the 2 MHz part of the trace on the center horizontal graticule line.

(18) Set TI CALIBRATE switch to OFF. The amplitude "ariations of the trace between 100 kHz and *2* MHz will be leas than 0.8 cm. (1 cm- 0.125 dB).

(19) Set TI CALIBRATE switch to 2 MHz.

(20) Set the MLA transmit&r IF **FREQUENCY** control to 79 MHz and the SWEEL WIDTH control to **14 MHz.**

(21) Adjust the IF FREQUENCY and SWEEP WIDTH controls slightly to place the 2 MHz marker birdie at the left hand graticule line and a 16 MHz (8th harmonic of 2 MHz) maarker birdie at the right hand graticule line.

(22) Adjut MLA oscilloscope Y-EXT OFFSET control to position the 2 MHz part of the trace to the center horizontal graticule line.

(23) Set TI CALIBRATE switch to OFF.

(24) The amplitude variations of the trace, between 2 MHz and 8.5 MHz will be less than 0.8 cm, between 8.5 MHz and 10 MHz, less than 0.9 cm, and between 10 MHz and 15 MHz, less than 1.6 cm.

(25) Set TI GAIN switch to X1 position.

(26) Adjust MLA oscilloscope Y-EXT OFFSET control to position the MLA trace display to the center horizontal graticule line.

(27) Press the TI attenuation (dB) 1 switch.

(28) Note the change in the MLA trace AMPLITUDE (in centimeters).

(29) RELEASE TI attenuation (dB) 1 switch and set TI CALIBRATE switch to 1 dB. The difference in the split trace amplitude will equal the change in trace position noted in (28) above ±10%.

(30) Set TI GAIN switch to X10 and CALIBRATE switch to OFF.

b. Adjustments. No adjustments have been listed for this check. Adjustments can be made only if special test equipment is available with the TI. REFER to the adjustment instructions contained in the manufacturer's manual for the TI.

9. BB Output Harmonics. *a. Performance Check*

(1) Connect equipment as shown in figure 2.

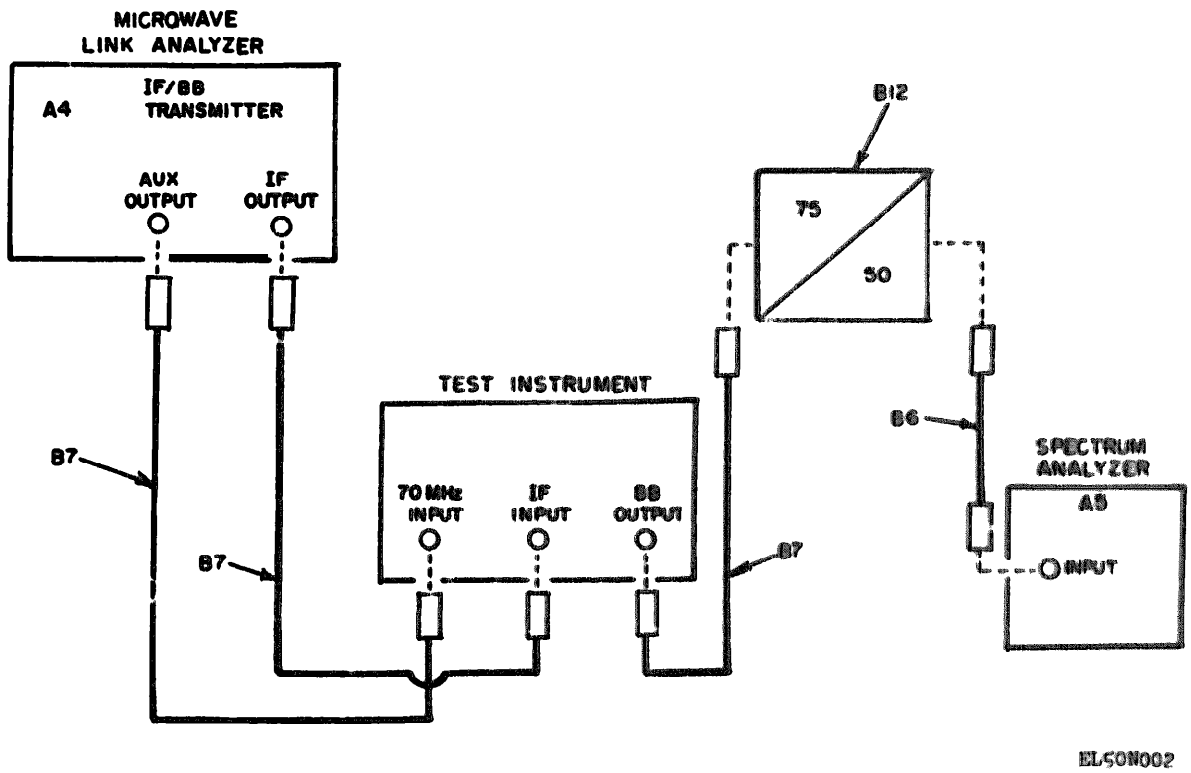


Figure 2 BB output harmonus - equipment setup.

(2) Position MLA (A4) controls as listed in (*a*) through (*f*) below:

(*a*) SWEEP selector switch to OFF.

(*b*) BB FREQUENCY selector switch to OFF.

(*c*) IF VERNIER control to 0.

(*d*) AUX OUTPUT switch to 70 MHz XTAL.

(*e*) IF ATTENUATOR 10 dB pushbutton pressed.

(*f*) IF FREQUENCY control set to 80 MHz.

(3) Adjust controls of spectrum analyzer (A5) as necessary to observe a signal display at 10 MHz. Establish a reference display amplitude on the spectrum analyzer. Use the MLA IF VERNIER control as necessary.

(4) Adjust the MLA IF FREQUENCY control slowly between 75 and 85 MHz. This provides a funda-

mental input signal to the spectrum analyzer that varies from 5 to 15 MHz.

(5) Observe the spectrum analyzer display for harmonic signals between 10 and 45 MH. All harmonic signals will be at least 35 dB below the reference established in (3) above.

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

10. Attenuator accuracy. ***a. Performance Check***

(1) Connect equipment as shown in figure 3.

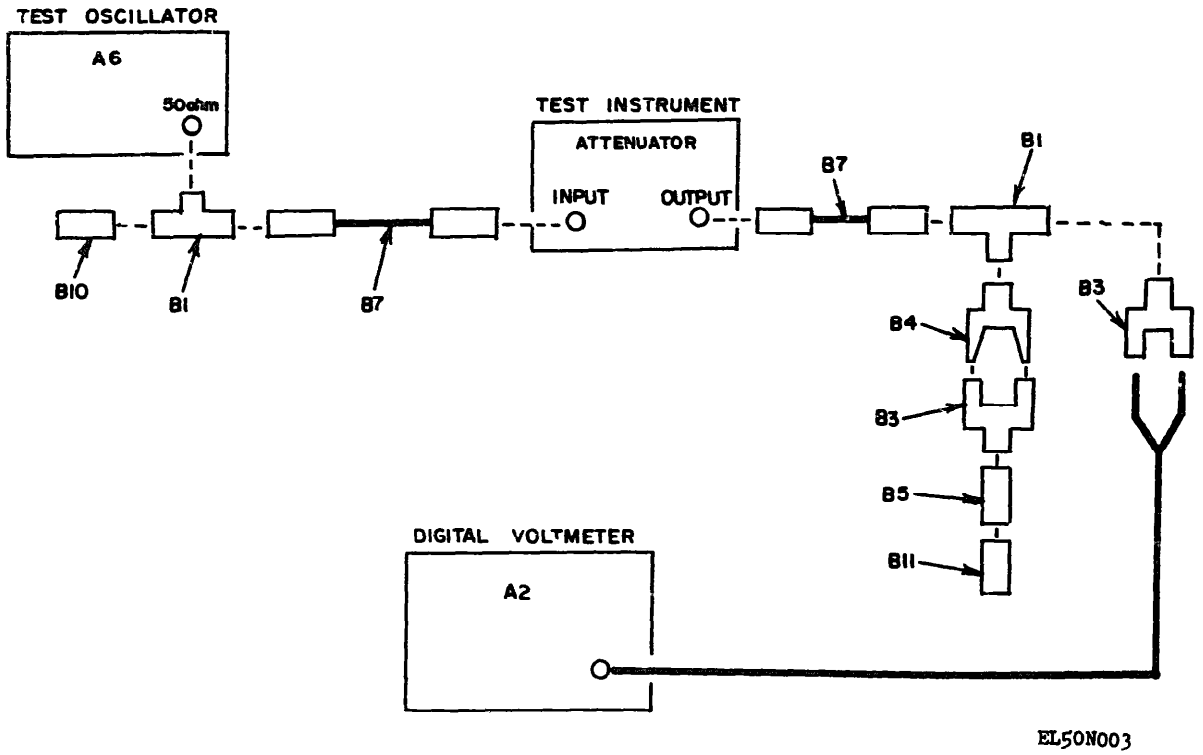


Figure 3 Attenuator accuracy (100 kHz) - equipment setup

(2) Set TI ATTENUATION (dB) pushbutton switches at 0 dB (all pushbuttons out).

(3) Adjust frequency of test oscillator (A6) to 100 kHz and output amplitude for a 1.600 V (volt) ac indication on digital voltmeter (A2).

(4) Press TI 1 dB pushbutton switch. Digital voltmeter will indicate between 0.341 and 0.944 V ac.

(5) Release the TI 1 dB pushbutton switch to out and press the pushbuttons listed in table 4. The digital voltmeter indications will be within the limits specified for each pushbutton setting.

Table 4. Attenuato - Accuracy (100 kHz)

Test instrument Attenuation (dB) pushbutton switch pressed *	Digital voltmeter indication (V ac)	
	Min	Max
2	0.750	0.841
4	0.596	0.668
8	0.376	0.422
16	0.150	0.168
30	0.080	0.084

* Release all pushbuttons to out position before pressing listed pushbuttons.

(6) Connect equipment as shown in figure 4.

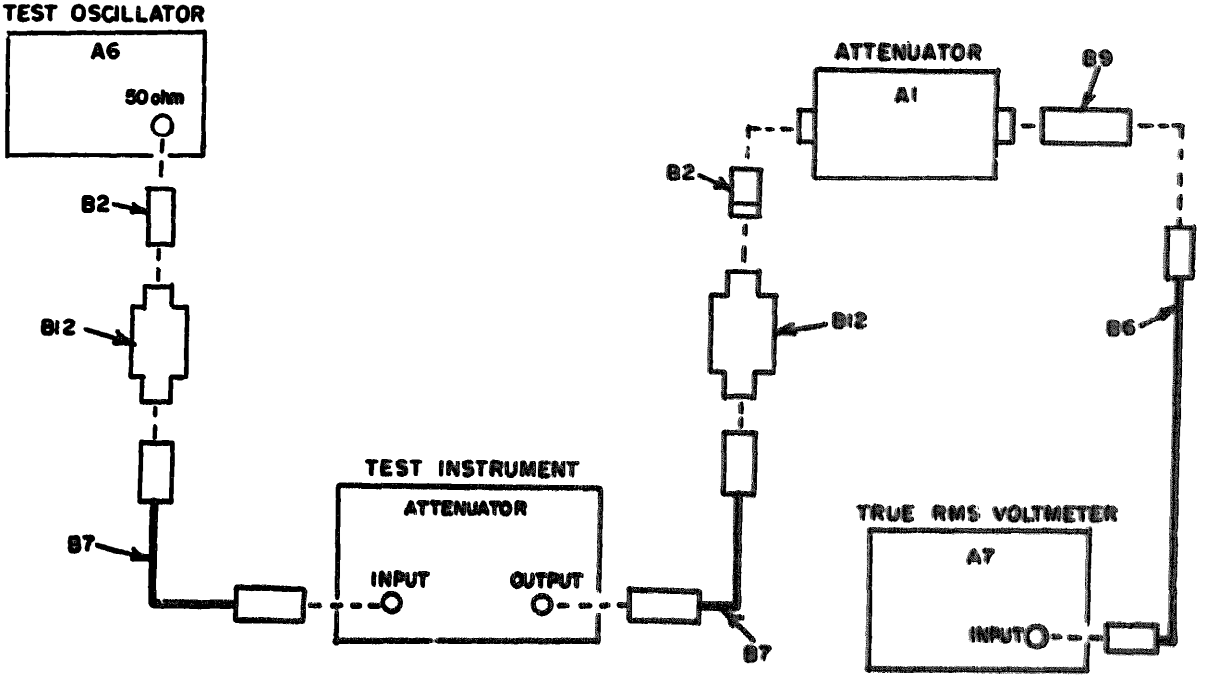


Figure 4 Attenuation accuracy - (9 MHz) - equipment setup.

(7) Position TI attenuation (dB) pushbutton switches for 0 dB (pushbuttons out).

(8) Set attenuator (A1) controls for 31 dB total attenuation.

(9) Adjust test oscillator frequency to 9 MHz and output level for a reference indication of 10 mV (millivolts) indication on true rms voltmeter (A7).

(10) Press TI 1 dB pushbutton switch.

(11) Reduce attenuator (A1) setting to 30 dB. True rms voltmeter will indicate between 0.00944 and 0.0106 V rms (-0.5 and +0.5 dB) ± error correction. Error correction can be calculated from the calibration chart furnished with attenuator (A1).

(12) Release TI 1 dB pushbutton switch and press the 2 dB pushbutton switch.

(13) Reduce the setting of attenuator (A1) to 29 dB. True rms voltmeter will indicate as stated in (11) above.

(14) Repeat technique of (11) through (13) above for each remaining TI ATTENUATION (dB) pushbutton. Attenuator (A1) setting must be reduced from 31 dB by amount equal to the TI pushbutton being tested.

b. Adjustments. No adjustments can be made.

11. Calibrate Frequency Accuracy. *a. Performance Check*

(1) Remove TI top cover.

(2) Connect electronic counter (A8) to A8TP8 (fig. 5), using cable assembly (B8).

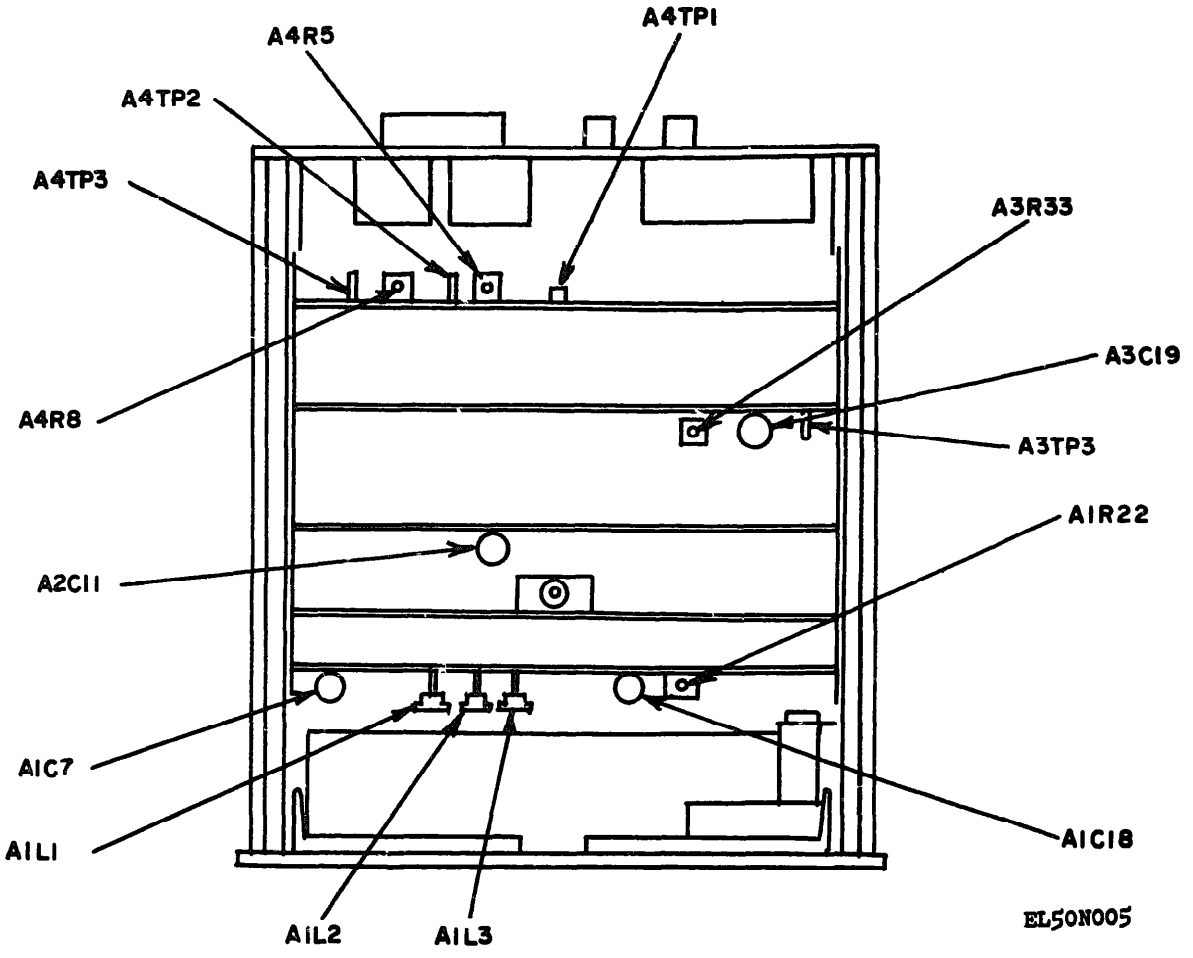


Figure 5. Adjustment locations-test instrument top view.

(3) Set TI CALIBRATE switch to 2 MHz. If electronic counter does not indicate between 1,9999 and 2.0001 MHz, perform *b* below.

(4) Install TI top cover.

b. Adjustments Adjust A3C19 (fig. 5) to obtain an indication on electronic counter between 1.9999 and 2.0001 MHz.

12. Power supply

NOTE

Do not perform power supply check if all other parameters are within tolerance.

a Performance Check (Fig. 5)

(1) Remove TI top cover and connect digital voltmeter (A2) to TI A4TP2. If digital voltmeter does not indicate between 14.98 and 15.02 V dc, perform b(1) below.

(2) Connect digital voltmeter to TI A4TP1. If digital voltmeter does not indicate between -14.98 and -16.02 V dc, perform b(2) below.

(3) Connect digital voltmeter to TI A4TP3, Digital voltmeter will indicate between 4.7 and 5.3 V dc.

b. Adjustments (fig. 5)

(1) Adjust A4R5 for an in-tolerance indication.

(2) *Adjust A4R8* for **an** in-tolerance indication.

13. Final Procedure. a. Deenergize and disconnect all equipment and install TI protective cover.

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.

By Order of the Secretary of the Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

Official:
J. C. PENNINGTON
Brigadier General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-34A requirements for Calibration Procedures Publications.

☆U.S. GOVERNMENT PRINTING OFFICE: 1978-765096/1055

DEPARTMENT OF THE ARMY
US ARMY AG PUBLICATIONS CENTER
1655 WOODSON ROAD
ST LOUIS MISSOURI 63114

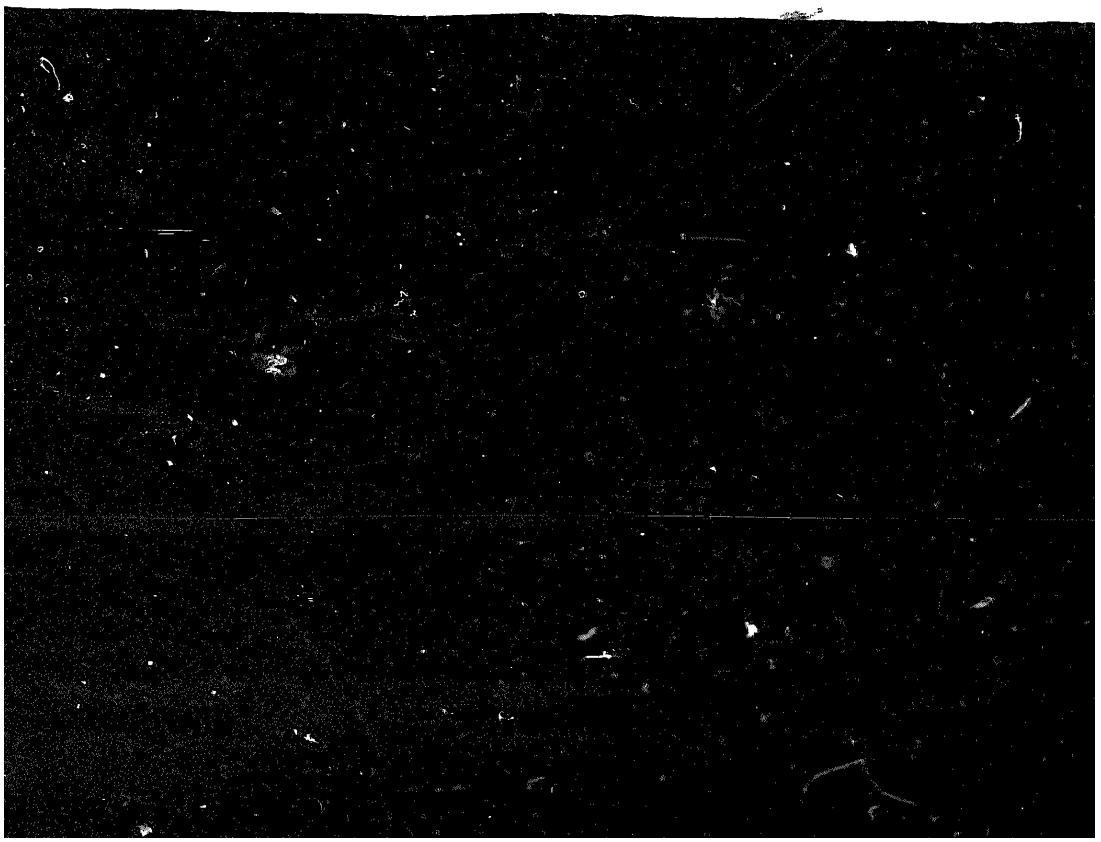
OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD 314

END

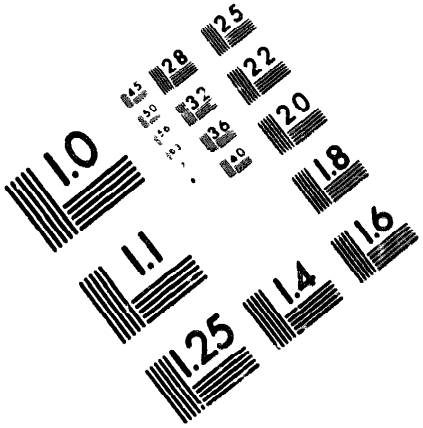
9-13-83

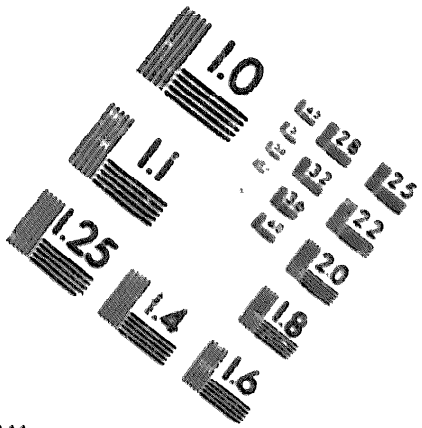
DATE



DEPARTMENT OF THE ARMY

MICROFORM
TEST TARGET





150 MM

15 mm (e= 1.09 mm)

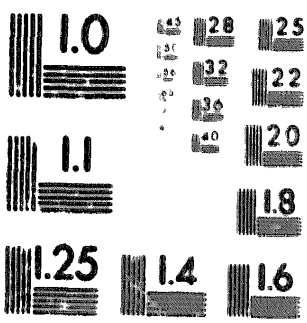
ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

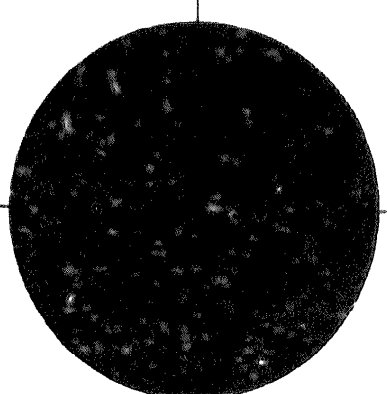
20 mm (e= 1.37 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

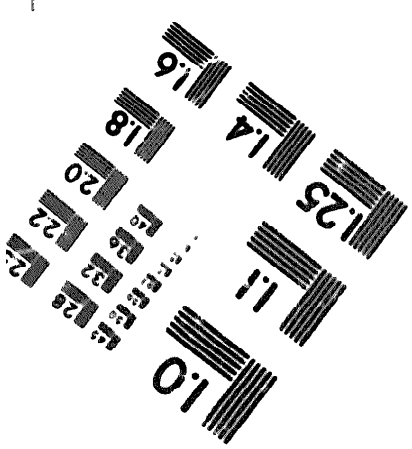
2.5 mm (e= 1.77 mm)

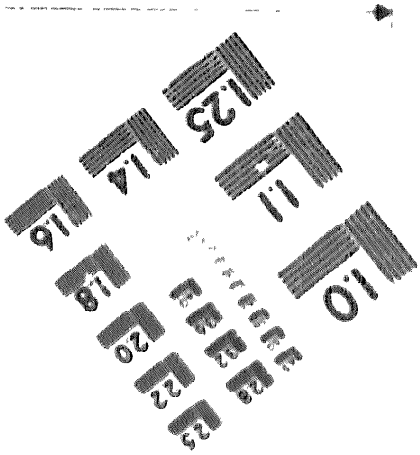
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*





200 MM





250 MM