TB 9-6625-862-35

CHANGE 2

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR AUDIO OSCILLATORS, TS-421( )/U (DATA ROYAL, MODEL F370A) AND SIGNAL GENERATOR HEWLETT-PACKARD, MODEL 205AG

Headquarters, Department of the Army, Washington, DC
18 July 1989

TB 9-6625-862-35, 3 July 1987, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin of the page.

Remove pages	***Insert pages***
9 and 10	9 and 10

2. File this change sheet in front of the publication for reference purposes.

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN II
Brigadier General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-34C, Block No. 319, requirements for calibration procedures publications.

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TB 9-6625-862-35

CHANGE 1

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR AUDIO OSCILLATORS, TS-421( )/U (DATA ROYAL, MODEL F370A) AND SIGNAL GENERATOR HEWLETT-PACKARD, MODEL 205AG

Headquarters, Department of the Army, Washington, DC
28 December 1988

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REPRINT INCLUDES CHANGES 1 AND 2

*TB 9-6625-862-35

SUPERSEDED COPY DATED 30 APRIL 1981

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR AUDIO OSCILLATORS, TS-421 ( )/U (DATA ROYAL, MODEL F370A) AND SIGNAL GENERATOR HEWLETT-PACKARD, MODEL 205AG

Headquarters, Department of the Army, Washington, DC
3 July 1987

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♦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, should be mailed directly to Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-TMD-EP, Redstone Arsenal, AL 35898-5000. FAX to DSN 788-2313 (commercial 256-842-2313). A reply will be furnished directly to you.

*This bulletin supersedes TB 9-6625-862-35, 30 April 1981, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Audio Oscillators, TS-421( )/U (Data Royal, Model F370A); and Signal Generator, Hewlett-Packard, Model 205AG. The manufacturers' manuals and TM 11-6625-355-15-1 were 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. Variations are described in text.

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

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 listed in table 1.

Table 1. Calibration Description

Test instrument parameters	Performance specifications
Line voltage	115 V ac, ± 10%, 60 Hz
Frequency	Range: 20 Hz to 20 kHz Dial accuracy: ± 2%
Frequency response	Range: 20 Hz to 20 kHz Accuracy: ± 1 dB from 20 Hz to 20 kHz at output levels < + 30 dbm w/output meter reading held at + 37 dB ± 1.5 dB from 20 Hz to 20 kHz at output levels ≥ + 30 dBm w/output meter held at + 37 dB (reference 1 kHz)
Distortion	< 1% at frequencies above 30 Hz
Input meter	Range: -5 to +8 dBm (0 to 2 V rms) Accuracy: ± 5% of FS
input attenuator	Range: 0 to 40 dB Accuracy: ± 0.1 dB
Output meter	Range: 0 to 65 V ac at 600Ω Accuracy: ± 5%
Output attenuator 10 dB steps 1 dB steps	Range: 0 to 110 dB Accuracy: ± 05 dB, 0 to 80 dB at 1 kHz ± 1.5 dB, 90 to 100 dB at 1 kHz ± 2.5 dB, 0 to 100 dB at 20 kHz ± 0.25 dB, 0 to 10 dB at 20 kHz

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. 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. 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 table 3 are issued as indicated in paragraph 4 above and are 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 (official nomenclature)	Minimum use specifications	Manufacturer and model (part number)
A1	ATTENUATOR	Range: 40 dB Voltage: 50 V	Hewlett-Packard Model 350D (7904453)
A2	AUTOTRANSFORMER (VARIABLE POWER TRANSFORMER)	Range: 105 to 125 V ac Accuracy: 1%	General Radio, Model W10MT3AS3, or Ridge, Model 9020F (7910809)
A3	DIGITAL VOLTMETER	Range: 0.46 mV to 79 V Accuracy: ± 0.29%	Hewlett-Packard Model 3490AOPT060 w/K25-3490A (3490AOPT060 w/K25-3490A)
A4	DISTORTION ANALYZER	Range: 35 Hz to 20 kHz Distortion: < 1%	Hewlett-Packard, Model C41-334A (7911957)
A5	FREQUENCY COUNTER	Range: 20 Hz to 21 kHz Accuracy: ± 0.5%	Hewlett-Packard Model 5345) (MIS-28754/1 Type 1)

Table 3. Accessories Required

Item	Common name	Description (part number)
B1	CABLE	36-in., RG-58/U; BNC plug to double banana plug terminations (7907471)
B2	CABLE[1]	30-in., RG-58/U double banana plug terminations (7907470)
B3	LEAD	24-in., No 18; single banana plug terminations (red) (7907497-1)

[1] Two required.

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.

c. Unless otherwise specified, verify the result 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 manufacturers' manuals and TM 11-6625-355-15-1 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.

a. Remove protective cover from TI.

b. Connect TI to autotransformer (A2).

c. Connect autotransformer to a 115-V ac source and adjust for a 115-V ac output.

d. Connect shorting bar between TI lower **OUTPUT** and ground (**GND** on some models) connectors.

e. Position controls as listed in (1) through (7) below:

(1) **OUTPUT ATTENUATOR (DB) (OUTPUT DB) 0** to **10** switch to **0**.

(2) **OUTPUT ATTENUATOR (DB) (OUTPUT DB) 0** to **100** switch to **0**.

(3) **LOAD** switch to **OFF**.

(4) **IMPEDANCE** switch to **600**.

(5) **FREQUENCY RANGE** switch to **X10**.

(6) **FREQUENCY** dial to **20**.

(7) **AMPLITUDE** (**OUTPUT**) to **0**.

f. Energize and allow 30 minutes for warm-up and stabilization.

8. Frequency and Stability

a. Performance Check

(1) Connect TI **OUTPUT** terminals to digital voltmeter (A3) using cable (B2). Also connect TI **OUTPUT** terminals to frequency counter (A5) using cables and attenuator (B1, B2, and A1).

(2) Set attenuator (A1) to 40 dB.

(3) Set frequency counter (A5) impedance to 1 mΩ.

(4) Adjust **AMPLITUDE (OUTPUT)** control for a 50-V indication on digital voltmeter (A3). If frequency counter does not indicate between 196 and 204 Hz, perform **b** below.

(5) Vary autotransformer (A2) output between 105 and 125 V ac. If frequency indication does not remain between 196 and 204 Hz, perform **b** below.

(6) Adjust autotransformer output to 115 V ac.

(7) Set **FREQUENCY** dial to settings listed in table 4. If frequency counter indications are not within limits specified, perform **b**(1) through (8) below.

(8) Set **FREQUENCY RANGE** switch and **FREQUENCY** dial to settings listed in table 5. If frequency counter does not indicate within limits specified, perform b(9) through (12) below.

Table 4. X10 Frequency Range Check

FREQUENCY dial settings	Frequency counter indications (Hz)	
	Min	Max
25	245	255
40	392	408
70	686	714
100	980	1020
160	1568	1632
200	1960	2040

Table 5. X1 and X100 Frequency Range Check

Test instrument		Frequency counter indications (Hz)	
FREQUENCY RANGE switch settings	**FREQUENCY** dial settings	Min	Max
X100	20	1960	2040
X100	30	2940	3060
X100	50	4900	5100
X100	100	9800	10,200
X100	200	19,600	20,400
X1	200	196	204
X1	100	98	102
X1	50	49	51
X1	20	19.6	20.4

b. Adjustments

(1) (For models with calibrating dot or extra line at one end or other on **FREQUENCY** dial.) Turn **FREQUENCY** dial to bring calibrating dot under the indicator hairline. If necessary, loosen set screws and slip dial on shaft for proper alignment. Tighten set screws.

NOTE

When only C1 and C22 (C10 and C12 for TS-421C/U and model F370A) are provided, perform (7) below only.

(2) Turn **FREQUENCY** dial to **20**.

(3) Set **AMPLITUDE (OUTPUT)** control to 50-V indication on digital voltmeter (A3).

(4) Change dial setting to 200.

(5) Use adjustments below for ± 2 V and 2000 Hz ± 2%.

NOTE

TI range, adjustments (figs. 1, 2, and 3) exist in combinations as listed in **(a)** through **(e)** below for different models:

(a) Adjust C1 and C22 for best compromise (interact for both frequency and amplitude).

(b) C1, R7, R8, and R9.

(c) C2, R7, R8, and R9.

(d) C1, C22, R7, and R9.

(e) C10 and C12 on TS-421C/U and model F370A (interact for both frequency and amplitude).

(6) Adjust R8 (fig. 2) for a 200-Hz indication on frequency counter (R).

(7) Turn **FREQUENCY** dial to **200** and adjust either C1 or C2 (C10 and C12 on TS-421C/U and model F370A) as applicable for a 2000-Hz indication on frequency counter. If provided, adjust both C1 and C22 (C10 and C12 for TS-421C/U and model F370A) for best compromise between frequency counter indication of 2000 Hz and digital voltmeter indication of 50 V (R).

(8) Repeat a(1) through (7) above.

(9) Set **FREQUENCY RANGE** switch to **X100** and turn **FREQUENCY** dial to **20**.

NOTE

When only C1 and C22 (C10 and C12 for TS-421C/U and model F370A) are provided, no adjustments can be made.

(10) Adjust R7 (fig. 2) for a 2000-Hz indication on frequency counter (R).

(11) Set **FREQUENCY RANGE** switch to **X1** and turn **FREQUENCY** dial to **100**.

(12) Adjust R9 (fig. 2) for a 100-Hz indication on frequency counter (R).

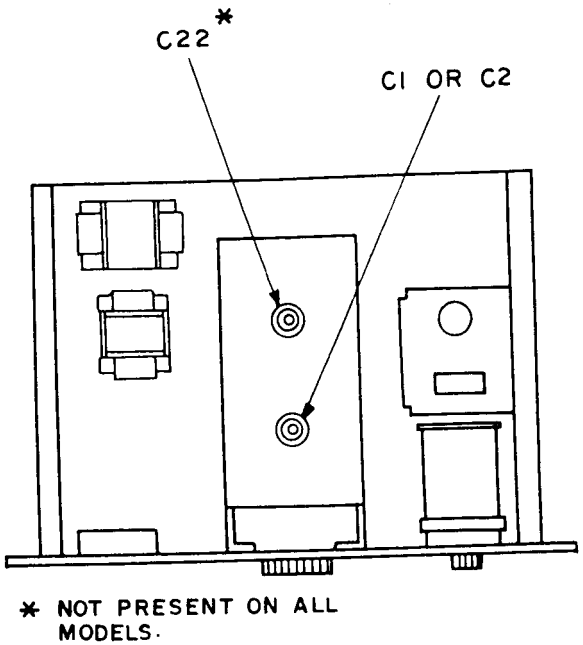

Figure 1. Test instrument - top view.

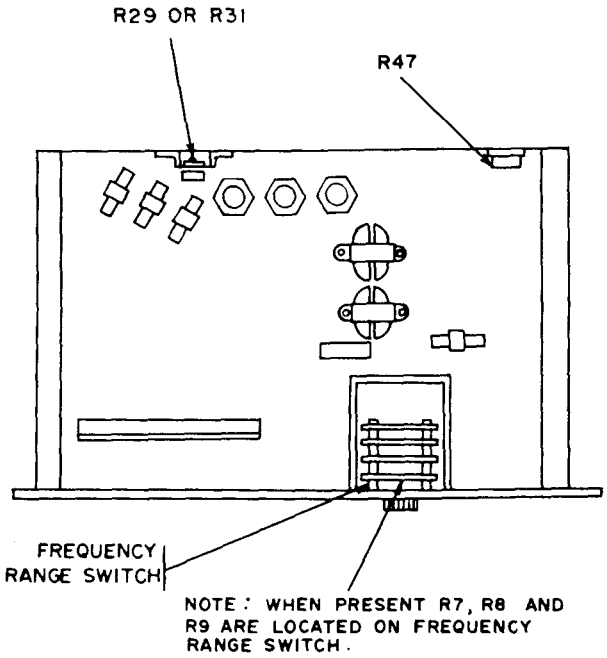

Figure 2. Test instrument - bottom view.

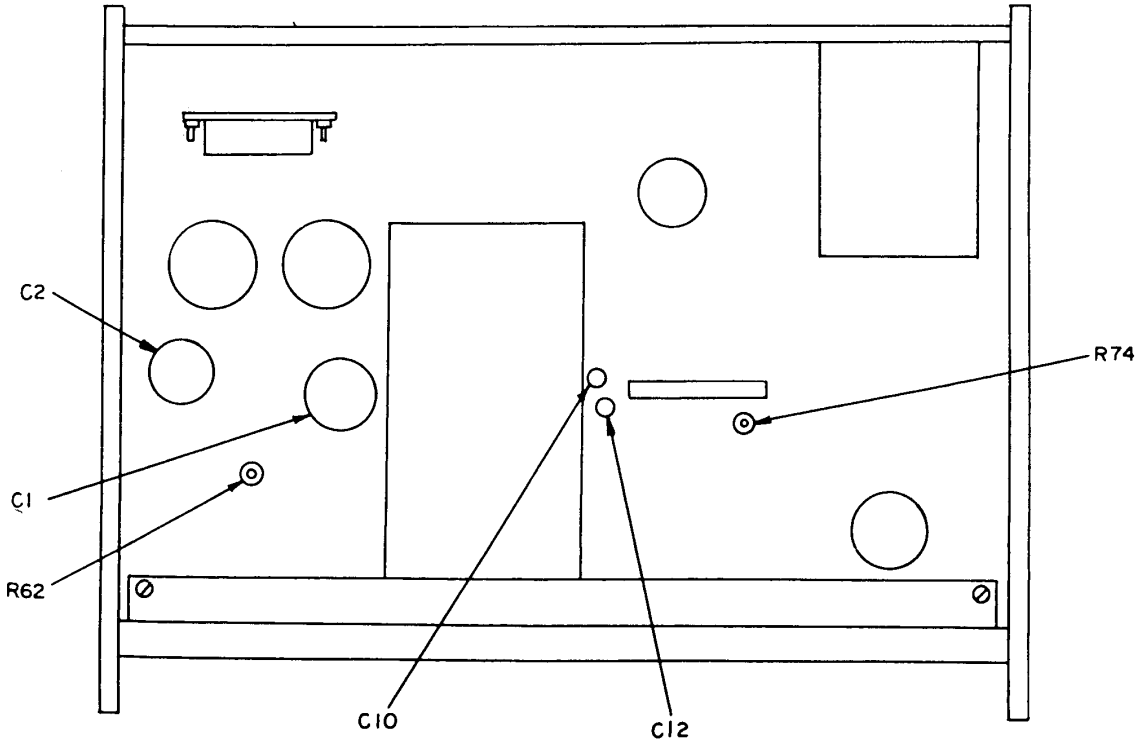

Figure 3. Test instrument - (TS-421C/U and model F370A).

9. Output Distortion

a. Performance Check

(1) Adjust **AMPLITUDE (OUTPUT)** control to minimum.

(2) Connect **OUTPUT** connector to distortion analyzer (A4) connector, using cable (B2).

(3) **LOAD** switch to **ON**.

(4) Set **FREQUENCY RANGE** switch to **X10** and turn **FREQUENCY** dial to **50**.

(5) Adjust **AMPLITUDE (OUTPUT)** control for a +37-indication on upper scale of **OUTPUT LEVEL** meter. Distortion analyzer will indicate less than one percent distortion.

(6) Repeat technique of (4) and (5) above, using **FREQUENCY RANGE** switch and **FREQUENCY** dial settings listed in table 6. Distortion analyzer will indicate less than one percent distortion.

b. Adjustments. No adjustments can be made.

Table 6. Output Distortion Check

FREQUENCY RANGE switch settings	**FREQUENCY** dial settings
X10	35
X10	100
X10	200
X1	35
X1	50
X1	100
X1	200
X100	35
X100	100
X100	200

10. Output Level Meter and Attenuation

a. Performance Check

(1) Adjust **AMPLITUDE (OUTPUT)** control to 0 and adjust meter pointer to 0 using 0 adjustment screw on the meter.

(2) Set **FREQUENCY RANGE** switch to **X1** and turn **FREQUENCY** dial to **100**.

(3) Connect **OUTPUT** to digital voltmeter (A3) input connector, using cable (B2).

(4) Adjust **AMPLITUDE (OUTPUT)** control for +37-dB indication on **OUTPUT LEVEL** meter. If digital voltmeter does not indicate between 52.12 and 57.6 V ac, perform b below.

(5) Set **FREQUENCY RANGE** switch to **X10**.

(6) Adjust **AMPLITUDE** control for a 54.86-V indication on digital voltmeter. Record **OUTPUT LEVEL** meter indication.

(7) While maintaining **OUTPUT LEVEL** meter indication recorded in (6) above, set **OUTPUT ATTENUATOR (DB) (OUTPUT DB) 0** to **100** switch to settings listed in table 7. Digital voltmeter indications will be within limits specified.

(8) Set **OUTPUT ATTENUATOR (DB) (OUTPUT DB) 0** to **100** switch to **20**.

(9) Set **FREQUENCY RANGE** switch to **X100** and turn **FREQUENCY** dial to **200**.

(10) Adjust **AMPLITUDE (OUTPUT)** control for a 5.0-V indication on digital voltmeter Record **OUTPUT LEVEL** meter indication.

(11) While maintaining **OUTPUT LEVEL** meter indication recorded in (10) above, set **OUTPUT ATTENUATOR (DB) (OUTPUT DB) 0** to **10** switch to settings listed in table 8. Digital voltmeter indications will be within limits specified.

Table 7. Output Attenuator Check 0 to 100 dB

Test instrument **OUTPUT ATTENUATOR (DB)** switch settings	Digital voltmeter indications (V or (dB))			
	Min		Max	
10	16.38	(26.5)	18.38	(27.5)
20	5.18	(16.5)	5.81	(17.5)
30	1.63	(6.5)	1.83	(7.5)
40	0.518	(-3.5)	0.581	(-2.5)
50	0.:63	(-13.5)	0.183	(-12.5)
60	0.0518	(-23.5)	0.0581	(-22.5)
70	0.0163	(-33.5)	0.0183	(-32.5)
80	0.00518	(-43.5)	0.00581	(-42.5)
90	0.00145	(-54.5)	0.00206	(-51.5)
100	0.00046	(-64.5)	0.00065	(-61.5)

Table 8. Output Attenuator Check 0 to 10 dB

Test instrument **OUTPUT ATTENUATOR (DB)** switch settings	Digital voltmeter indications (V or (dB))			
	Min		Max	
1	4.32	(-0.75)	4.58	(-1.25)
2	3.85	(-1.75)	4.08	(-2.25)
3	3.43	(-2.75)	3.64	(-3.25)
4	3.06	(-3.75)	3.24	(-4.25)
5	2.73	(-4.75)	2.89	(-5.25)
6	2.43	(-5.75)	2.57	(-6.75)
7	2.17	(-6.75)	2.29	(-7.25)
8	1.93	(-7.75)	2.04	(-8.25)
9	1.72	(-8.75)	1.82	(-9.25)
10	1.53	(-9.75)	1.62	(-10.25)

b. Adjustments

(1) Adjust **AMPLITUDE (OUTPUT)** control for a 54.86-V indication on digital voltmeter.

(2) Adjust R29 (fig. 2) (R31 on some models) (R74 on TS-421C/U and model F370A, fig. 3) for a +37-dB indication on **OUTPUT LEVEL** meter.

11. Output Level Frequency Response

a. Performance Check

(1) Position controls as listed in (a) through (d) below:

(a) **OUTPUT ATTENUATOR (DB) (OUTPUT DB) 0** to **100** switch to **0**.

(b) **OUTPUT ATTENUATOR (DB) (OUTPUT DB) 0** to **10** switch to **6.**

(c) **FREQUENCY RANGE** switch to **X10**.

(d) **FREQUENCY** dial to **100**.

(2) Adjust **AMPLITUDE (OUTPUT)** control for a 27.483-indication on digital voltmeter (A1). Record **OUTPUT LEVEL** meter indication.

(3) While maintaining **OUTPUT LEVEL** meter indication recorded in (2) above, set **FREQUENCY RANGE** switch and **FREQUENCY** dial for 40 Hz, 200 Hz, 2 kHz, and 20 kHz. Digital voltmeter indication will be between 23.12 and 32.66 V.

(4) Adjust **AMPLITUDE (OUTPUT)** control to **0**.

b. Adjustments. No adjustments can be made.

12. Input Level Meter

a. Performance Check

(1) Connect **INPUT** connector to **INPUT** ground connector, using lead (B3).

(2) Adjust zero adjustment screw on **INPUT LEVEL** meter for a 0-V indication.

(3) Remove test lead from **INPUT** connectors.

(4) Position controls as listed in (a) through (g) below:

(a) **INPUT ATTENUATOR (DB) (INPUT DB)** switch to **0**.

(b) **OUTPUT ATTENUATOR (DB) (OUTPUT DB) 0** to **100** switch to **30**.

(c) **OUTPUT ATTENUATOR (DB) (OUTPUT DB) 0** to **10** switch to **6**.

(d) **LOAD** switch to **OFF**.

(e) **IMPEDANCE** switch **5000**.

(f) **FREQUENCY RANGE** switch to **X10**.

(g) **FREQUENCY** dial to **40**.

(5) Connect digital voltmeter (A3) between **INPUT** connector and **INPUT** ground connector, using cable (B2).

(6) Connect upper **INPUT** connector to upper **OUTPUT** connector, using test lead (B3).

(7) Adjust **AMPLITUDE (OUTPUT)** control for a 2.0-V indication on **INPUT LEVEL** meter. If digital voltmeter does not indicate between 1.9 and 2.1 V ac, perform b below.

(8) Repeat technique of (7) above while adjusting **AMPLITUDE (OUTPUT)** control for **INPUT LEVEL** meter indications listed in table 9. Digital voltmeter indications will be within limits specified.

(9) Adjust **AMPLITUDE (OUTPUT)** control to **0**.

b. Adjustments

(1) Adjust **AMPLITUDE (OUTPUT)** control for a 2.0-V ac indication on digital voltmeter.

(2) Adjust R47 (fig. 2) (R62 (fig. 3) on TS-421C/U and model F370A) for a 2.0-V ac indication on **INPUT LEVEL** meter (R).

Table 9. Input Level Meter Linearity Check

Test instrument **INPUT LEVEL** meter indications	Digital voltmeter indications (V ac)	
	Min	Max
1.5	1.4	1.6
1.0	0.9	1.1
0.5	0.4	0.6

13. Input Attenuation

a. Performance Check

(1) Set **OUTPUT ATTENUATOR (DB) (OUTPUT DB) 0** to **10** switch to **0**.

(2) Adjust **AMPLITUDE (OUTPUT)** control for a 0.775-V ac indication on digital voltmeter (A3). Record **INPUT LEVEL** meter indications.

(3) Set **INPUT ATTENUATOR (DB) (INPUT DB)** switch to settings listed in table 10, while adjusting **AMPLITUDE** control setting **OUTPUT ATTENUATOR (DB) (OUTPUT DB)** switches as required for **INPUT LEVEL** meter indication recorded in (2) above. Digital voltmeter indications will be within limits specified.

b. Adjustments. No adjustments can be made.

Table 10. Input Attenuator Check

Test instrument **INPUT ATTENUATOR (DB)** switch settings	Digital voltmeter indications (V or (DB))			
	Min		Max	
5	1.362	(4.9)	1.394	(5.1)
10	2.422	(9.9)	2.479	(10.1)
15	4.308	(14.9)	4.408	(15.1)
20	7.661	(19.9)	7.839	(20.1)
25	13.623	(24.1)	13.941	(25.1)
30	24.227	(29.9)	24.791	(30.1)
35	43.082	(34.9)	44.086	(35.1)
40	76.612	(39.9)	78.397	(40.1)

14. Final Procedure

a. Deenergize and disconnect all equipment.

b. Annotate and affix DA Label/Form in accordance with TB 750-25.

TB 9-6625-862-35

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief Of Staff

Official:

R. L. DILWORTH
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