*TB 9-6625-2237-24

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR RADIO TEST SET TS-24 (B)

Headquarters, Department of the Army, Washington, DC
2 October 2008

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.

*This bulletin supersedes TB 9-6625-2237-35, dated 13 July 1992.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Radio Test Set TS-24 (B). TO 33K3-4-1961 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 microwave 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 adjustments. 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
Dc module battery:	
Voltage threshold	Range: 10.8 V dc Accuracy: ±0.1 Vdc
Currency threshold	Range: 150 mA (0. 1 50 V dc) Accuracy: ±10 mA (±0.010 V dc)
Short circuit	Range: 300 mA (0.30 V dc) Accuracy: -50, +100 mA (-0.050, +0.10 V dc)
Receiver:	Frequency range: 243.0 MHz
Frequency out	Accuracy: ±3 kHz Frequency range: 282.8 MHz Accuracy: ±4 kHz
Amplitude output threshold	Range: 14 μV (-84 dBM) Accuracy: ±6 μV (-3.1 +4.9 dB)
Audio output	Range: 1000 μs (1 kHz) Accuracy: 667 to 2000 μs (±500 Hz) Amplitude output: ≥3 V p-p

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Transmitter:	
Power measurement	Frequency range: 243.0 and 282.8 MHz Power range: 82.5 mW (19.16 dBm) Accuracy: ±10 mW (±0.5 dB)
Percent modulation	Range: 70% Accuracy: ±10% modulation

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-287 and AN/GSM-705. 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.

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

Common name	Minimum use specifications	Manufacturer and model (part number)
MEASURING RECEIVER	Frequency range: 242.997 to 282.804 Frequency accuracy: ±0.0003% Untuned power range: -9.2 to +19.6 dBm Tuned power range: -80.9 to -88.9 dBm Attenuator accuracy: 0.025/10 dB	Measuring receiver system N5530S consisting of: Spectrum Analyzer, Agilent Model E4440A (E4440A), Power meter, Agilent Model E4419B (E4419B), and Sensor module, Agilent Model N5532A opt. 504 (504)
MULTIMETER	Range: 140 mV to 13.5 V dc Accuracy: ±0.1% V dc	Hewlett-Packard, Model 3458A (3458A)
OSCILLOSCOPE	Range: 667 to 2000 μS ≥3 V p-p Accuracy: ±3%	Agilent, OS-303/G (OS-303/G)
SIGNAL GENERATOR	Range: 243 to 282.8 MHz Power range: 15 to 19.6 dBm Modulation: 60%, 70%, and 80% at 1 kHz Accuracy : ±1.0%	Aeroflex, Model 2023B (2023B) or (SG-1207/U)
VSWR BRIDGE	Frequency range: 243.0 to 282.8 MHz Directivity: 40 dB minimum	Wiltron, Model 60NF50-SC3522 (7916686)

Table 3. Accessories Required

Common name	Description (part number)
ANTENNA PLATE ASSEMBLY[1]	ACR Electronic, A3-06-0109, 6625-01-151-7662
CALIBRATION ANTENNA NO.1[1]	ACR Electronic, A3-01-0299, 243.0 MHz, 6625-01-152-9382
CALIBRATION ANTENNA NO. 2[1]	ACR Electronic, A3-01-0300, 282.8 MHz, 6625-01-152-9381
CALIBRATION PLUG[1]	ACR Electronic, A3-06-0991, 6625-01-151-9595
DC POWER SUPPLY	Kepco, Model HB525 (7915935)
FLEXIBLE NYLON LEDGER POST[2]	7510-00-128-0064

[1]Supplied with TI.
[2]Locally provided.

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 tables 2 and 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. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in TM 11-6625-3203-23P.

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.

NOTE

Verify the proper CAL FACTORS are loaded for the measuring receiver's sensor module.

a. Set the measuring receiver to measure power. Zero and calibrate measuring receiver sensor module. Connect sensor module to signal generator **RF OUTPUT**.

b. Adjust signal generator frequency controls to signal generator frequency setting listed in table 4.

c. Adjust signal generator amplitude controls for a measuring receiver **FREQUENCY/LEVEL** display indication equal to the value listed in table 4 test settings.

d. Record signal generator indication in signal generator amplitude output indication column of table 4.

e. Repeat **b** through **d** above for remaining test settings listed in table 4.

f. Disconnect measuring receiver sensor module from signal generator **RF OUTPUT**.

Table 4. Signal Generator Characterization

Test settings (dBm)	Signal generator	
	Frequency settings (MHz)	Amplitude output indications (dBm)
19.1	243.0	
19.6	243.0	
18.6	243.0	
19.1	282.8	
19.6	282.8	
18.6	282.8	
15.0	282.8	

8. Dc Module Check

a. Performance Check

(1) Close and latch TI test chamber cover. Remove any batteries from PRC-90/106 battery chamber.

(2) Connect dc power supply to **EXT. PWR PRC-90/106** (fig. 1) test points.

NOTE

Monitor dc power supply with multimeter (dc mode).

(3) Connect calibration plug to TI connector 2J1 on right side of dc module.

(4) Adjust dc power supply for a 10.90 V dc indication on multimeter.

(5) The TI **BATTERY VOLTAGE PASS** indicator must be illuminated and the **FAIL** indicator must be off; if not perform **b** (1) below.

(6) Adjust dc power supply for a 10.70 V dc indication on multimeter.

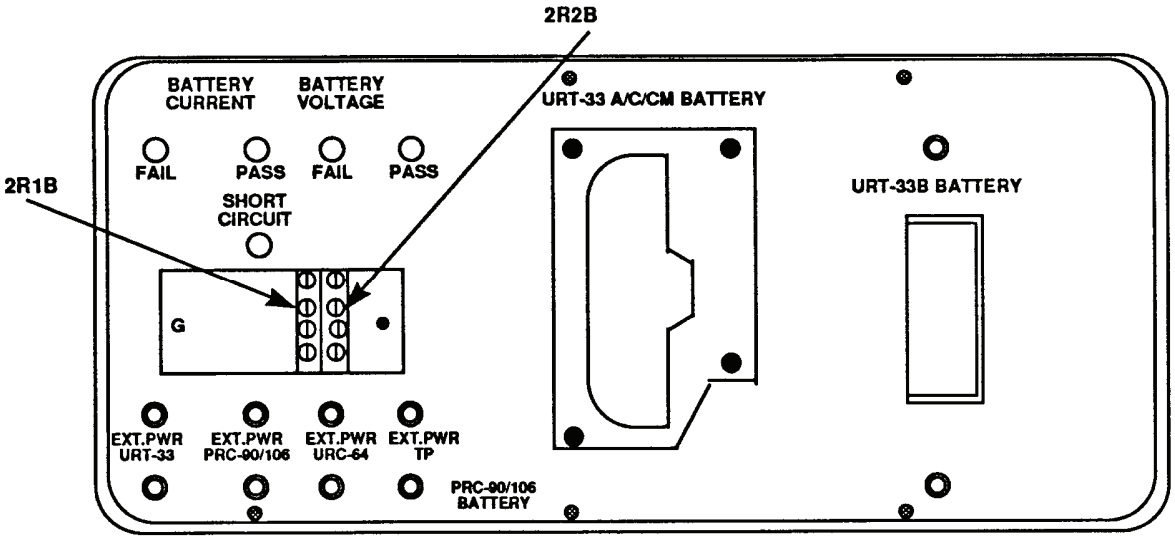

Figure 1. Dc module adjustment.

(7) The TI **BATTERY VOLTAGE FAIL** indicator must be illuminated and the **PASS** indicator must be off; if not perform **b** (1) below.

(8) Connect multimeter to TI **CURRENT** test point

(9) Adjust dc power supply for a multimeter indication of 0.160 V dc.

(10) The TI **BATTERY CURRENT FAIL** indicator must be illuminated and the **PASS** indicator must be off; if not perform **b** (2) below.

(11) Adjust dc power supply for a multimeter indication of 0.140 V dc.

(12) The TI **BATTERY CURRENT PASS** indicator must be illuminated and the **FAIL** indicator must be off; if not perform **b** (2) below.

(13) Connect a jumper across the resistor on the calibration plug.

(14) The TI red **SHORT CIRCUIT** indicator must be illuminated.

(15) The multimeter must indicate between 250 and 400 mV dc.

(16) Set dc power supply to minimum and disconnect from TI.

(17) Remove the calibration plug.

b. Adjustments

NOTE

Remove TI protective cover as required for adjustment.

(1) Adjust 2R2B (fig. 1) so both the **BATTERY VOLTAGE** red **FAIL** and the green **PASS** indicators flicker randomly (R).

(2) Adjust 2R1B (fig. 1) so both the **BATTERY CURRENT** red **FAIL** and the green **PASS** indicators flicker randomly (R).

9. Power Measurement

a. Performance Check

(1) Remove TI **CALIBRATION ADJUSTMENT RF MODULE** cover plate.

(2) Install calibration antenna as listed in (a) through (e) below:

(a) Unlatch and open TI test chamber cover.
(b) Install the calibration antenna No. 1 (243.0 MHz) on the antenna plate assembly.
(c) Move the load carriage fully toward antenna base.
(d) Attach antenna plate assembly to the key slots on the end of the test chamber and place antenna between load carriage contacts.
(e) Close and latch test chamber cover.

(3) Set **RADIO SELECT** switch to **PRC-90 (243.0)** position.

NOTE

The test chamber interlock switch will not disable RF transmission during this calibration process if the test chamber is unlatched or open. Do not unlatch or open test chamber during calibration process unless the signal generator **RF OFF/ON** switch has been pressed to **OFF** position.

NOTE

To prepare TI for minimum power reflected power measurement, perform either (a) or (b) below:

(a) Insert flexible nylon ledger post through antenna base plate into small hole of load carriage.
(b) Slightly twist nylon ledger post.
(c) Load carriage can now be moved back and forth for null indication with RF power on.
(d) Drill 1/4" hole to right of BNC connector.
(e) Insert flexible nylon ledger post through hole.
(f) Same as (3) (a) above.

(4) Set **REC TEST/XMIT TEST** switch to **XMIT TEST** position.

NOTE

Observe polarity connections for (5) below and monitor dc power supply with multimeter (dc mode).

(5) Connect dc power supply to RF module **EXT PWR TEST SET** test points. Adjust dc power supply controls for a multimeter indication between 12.5 and 13.5 V dc.

(6) Connect equipment as shown in figure 2.

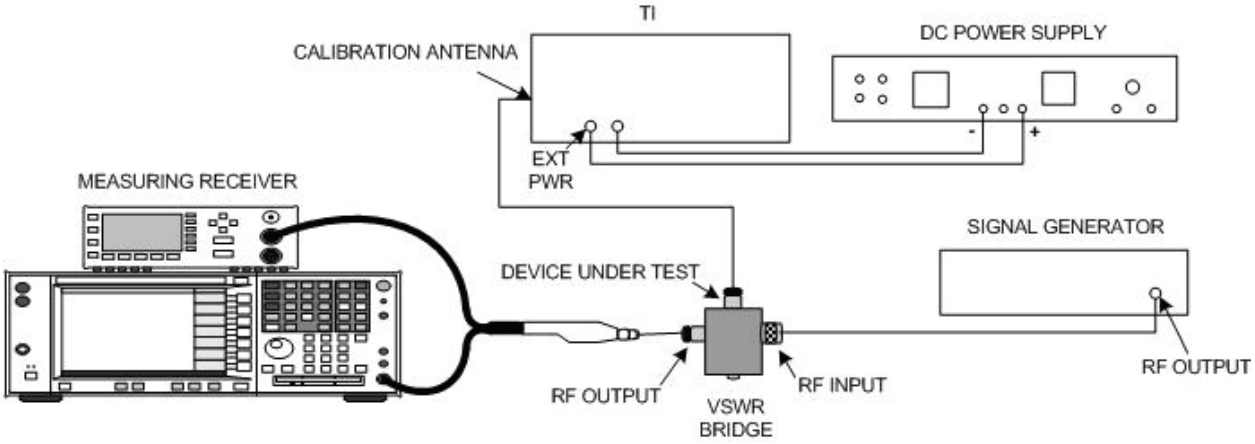

Figure 2. Minimum antenna power equipment setup.

(7) Set signal generator frequency controls for 243.0 MHz output and adjust amplitude output controls to same value as recorded in table 4 for signal generator amplitude output indication for test setting of 19.1 dBm.

(8) Set measuring receiver to measure frequency then power level.

(9) Adjust antenna load carriage assembly for a minimum indication on measuring receiver **FREQUENCY/LEVEL** display (-9.2 dBm maximum).

(10) Press signal generator **RF OFF/ON** key to **OFF** position.

(11) Connect equipment as shown in figure 3.

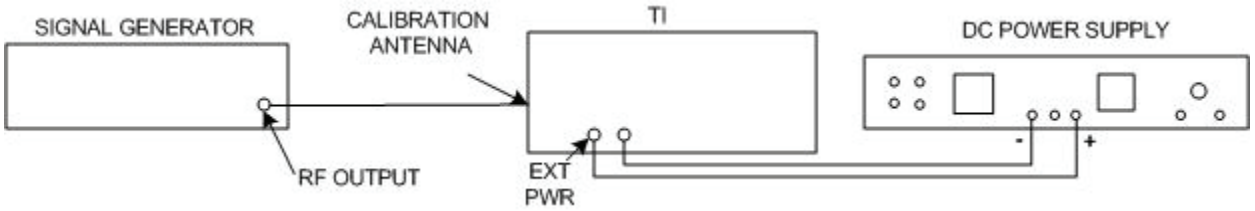

Figure 3. Threshold point - equipment setup.

(12) Adjust dc power supply controls for a multimeter indication between 12.5 and 13.5 V dc.

(13) Open antenna carriage assembly and carefully tighten load carriage assembly locking knob. Record position of the carriage.

(14) Close antenna chamber assembly.

(15) Remove **CALIBRATION ADJUSTMENT RF MODULE** cover plate.

(16) Press signal generator **RF OFF/ON** key to **ON** position.

(17) Press and hold **RF POWER PRESS** button. The red **FAIL** and green **PASS** indicators will blink randomly; if not, perform **b** (l) below for 243.0 MHz or **b** (2) below for 282.8 MHz.

(18) Adjust signal generator amplitude output controls to signal generator amplitude output indication value recorded in table 4 for test setting of 19.6 dBm.

(19) Press and hold **RF POWER PRESS** button. The green **PASS** indicator will be illuminated and the red **FAIL** indicator will be off; if not, repeat (6) through (17) above.

(20) Adjust signal generator amplitude output controls to signal generator amplitude output indication value recorded in table 4 for test setting of 18.6 dBm.

(21) Press and hold **R.F. POWER PRESS** button. The red **FAIL** indicator will be illuminated and the green **PASS** indicator will be off; if not, repeat (6) through (17) above.

(22) Press signal generator **RIF OFF/ ON** key to **OFF** position.

(23) Repeat technique of (2) above to install calibration antenna NO. 2 (282.8 MHz).

(24) Set **RADIO SELECT** switch to **PRC-90 (282.8).**

(25) Repeat (6) through (22) for 282.8 MHz frequency setting.

(26) Do not disconnect equipment setup. Equipment setup will be used in next paragraph.

b. Adjustments

(1) Press and hold **RF POWER PRESS** button and adjust 1R6B 243.0 MHz (fig. 4) until both **PASS** and **FAIL** indicators blink randomly.

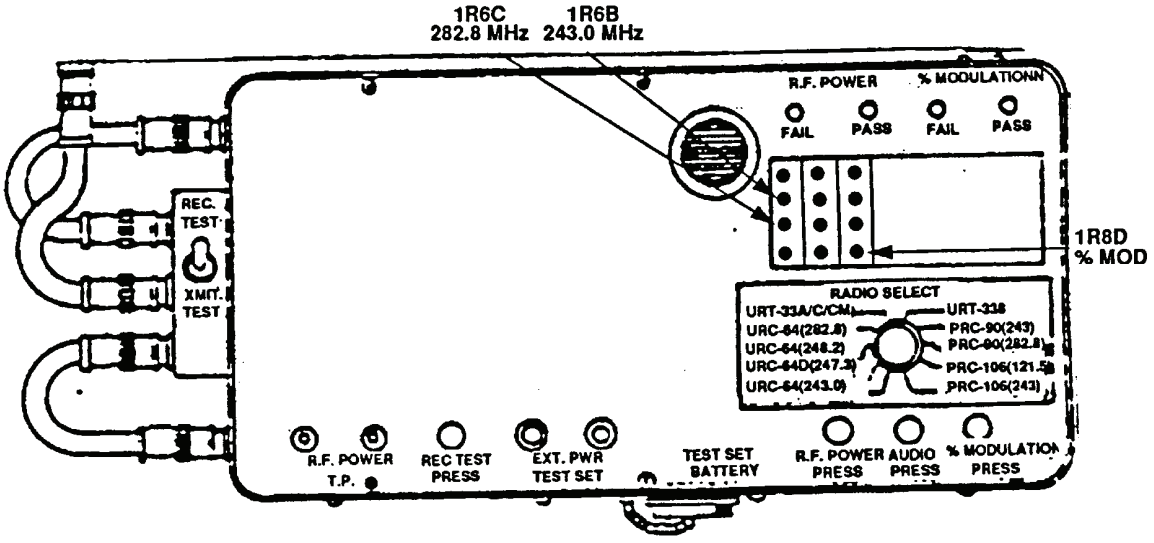

Figure 4. RF power and modulation percentage threshold adjustment.

(2) Press and hold **RF POWER PRESS** button and adjust 1R6C 282.8 MHz (fig. 4) until both **PASS** and **FAIL** indicators blink randomly.

10. Percent Modulation Check

a. Performance Check

NOTE
Ensure equipment is setup as shown in figure 3.

(1) Position signal generator controls to settings as listed in (a) through (f) below:

(a) Adjust frequency controls to 282.8 MHz.
(b) Output amplitude equal to value recorded in table 4 for signal generator amplitude output indication for test setting of 15 dBm.
(c) Press **SHIFT** key.
(d) Press **INSTRUMENT PRESET** key.
(e) Press **INT** key.
(f) Press **MOD FREQ** key.

(2) Press signal generator **AM** key and select 70 percent modulation with signal generator controls.

(3) Press and hold **% MODULATION PRESS** button. After 3 seconds, the **% MODULATION** red **FAIL** and green **PASS** indicators will blink randomly; if not, perform **b** below.

(4) Press signal generator **AM** key and select 80 percent modulation with the signal generator controls.

(5) Press and hold **% MODULATION PRESS** button. After 3 seconds, the **% MODULATION** green **PASS** indicator must be illuminated and the red **FAIL** indicator must be off; if not, repeat (2) and (3) above.

(6) Press signal generator **AM** key and select 60 percent modulation with signal generator controls.

(7) Press and hold **% MODULATION PRESS** button. After **3** seconds, the **% MODULATION** red **FAIL** indicator must be illuminated and the green **PASS** indicator must be off; if not, repeat (2) and (3) above.

(8) Reinstall TI cover plate.

(9) Disconnect signal generator from TI.

b. Adjustments. Adjust 1R8D % MOD (fig. 4) so both the **% MODULATION** red **FAIL** and green **PASS** indicators blink randomly (threshold point).

11. Amplitude and Frequency Outputs

a. Performance Check

NOTE

To gain access to the RF oscillator in RF module assembly, remove six screws and lift panel assembly away from case.

(1) Connect dc power supply as shown in figure 5.

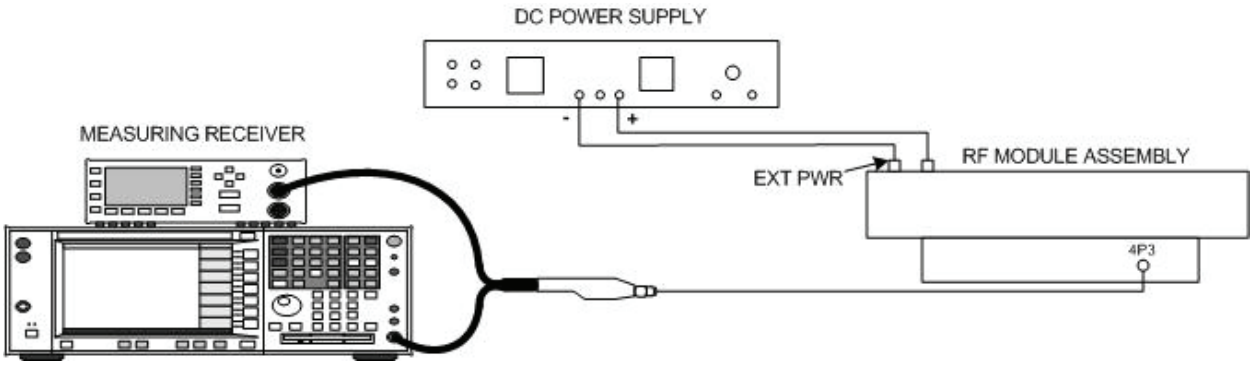

Figure 5. Receiver frequency - equipment setup.

NOTE

Monitor dc power supply with multimeter (dc mode).

(2) Adjust dc power supply controls for a multimeter indication between 12.5 and 13.5 V dc.

(3) Perform (4) below to install the calibration antenna No. 1 (243.0 MHz).

(4) Perform (a) through (e) to install calibration antennas:

(a) Unlatch and open test chamber assembly.
(b) Install calibration antenna on the antenna plate assembly.
(c) Set load carriage assembly to value recorded in **9 a** (13) above.
(d) Attach antenna plate assembly to the key slots on the end of the test chamber and place antenna between load carriage contacts.
(e) Close test chamber cover and latch.

(5) Set **RADIO SELECT** switch to **PRC-90 (243.0)**.

(6) Set **REC TEST/XMIT TEST** switch to **REC TEST** position.

(7) Disconnect RF cable from 4P3 (fig. 5).

(8) Set the measuring receiver to measure power. Zero and calibrate measuring receiver sensor module. Set measuring receiver to measure frequency.

(9) Connect equipment as shown in figure 5.

(10) Press and hold **REC TEST PRESS** button. Measuring receiver indication will be between 242.997 and 243.003 MHz; if not perform **b** (l) below.

(11) Set **RADIO SELECT** switch to **PRC-90 (282.8)**.

(12) Install calibration antenna No. 2 (282.8 MHz) on the antenna plate assembly as described in (4) (a) through (e) above.

(13) Press and hold **REC TEST PRESS** button. Measuring receiver indication will be between 282.796 and 282.804 MHz; if not, perform **b** (2) below.

(14) Disconnect measuring receiver power sensor from 4P3 (fig. 5) and connect RF cable to 4P3 (fig. 5).

(15) Set **RADIO SELECT** switch to **PRC-90 (243.0).**

(16) Install calibration antenna No. 1 (243.0 MHz) on the antenna place assembly as described in (4) (a) through (e) above.

(17) Connect measuring receiver sensor module to calibration antenna No. 1 (243.0 MHz).

(18) Press **REC TEST PRESS** button. Set measuring receiver to measure tuned RF level. Measuring receiver will indicate between -80.9 and -88.9 dBm, if not perform **b** (3) below.

(19) Disconnect measuring receiver sensor module from calibration antenna No. 1 (243.0 MHz).

(20) Repeat (4) and (6) above using calibration antenna No. 2 (282.8 MHz).

(21) Set **RADIO SELECT** switch to **PRC-90 (282.8)**.

(22) Connect measuring receiver sensor module to calibration antenna No. 2 (282.8 MHz).

(23) Press **REC TEST PRESS** button. Set measuring receiver to measure tuned RF level. Measuring receiver will indicate between -80.9 and -88.9 dBm, if not perform **b** (4) below.

(28) Disconnect measuring receiver sensor module from calibration antenna No. 2 (282.8 MHz).

b. Adjustments

(1) Press and hold **REC TEST PRESS** button while adjusting 3L42 (fig. 6) for a measuring receiver indication between 242.997 and 243.003 MHz (R).

(2) Press and hold **REC TEST PRESS** button while adjusting 3L12 (fig. 6) for a measuring receiver indication between 282.796 and 282.804 MHz (R).

(3) Press **REC TEST PRESS** button while adjusting 3R46 (fig. 6) for a measuring receiver indication between -80.9 and -88.9 dBm (R).

(4) Press **REC TEST PRESS** button while adjusting 3R16 (fig. 6) for a measuring receiver indication between -80.9 and -88.9 dBm (R).

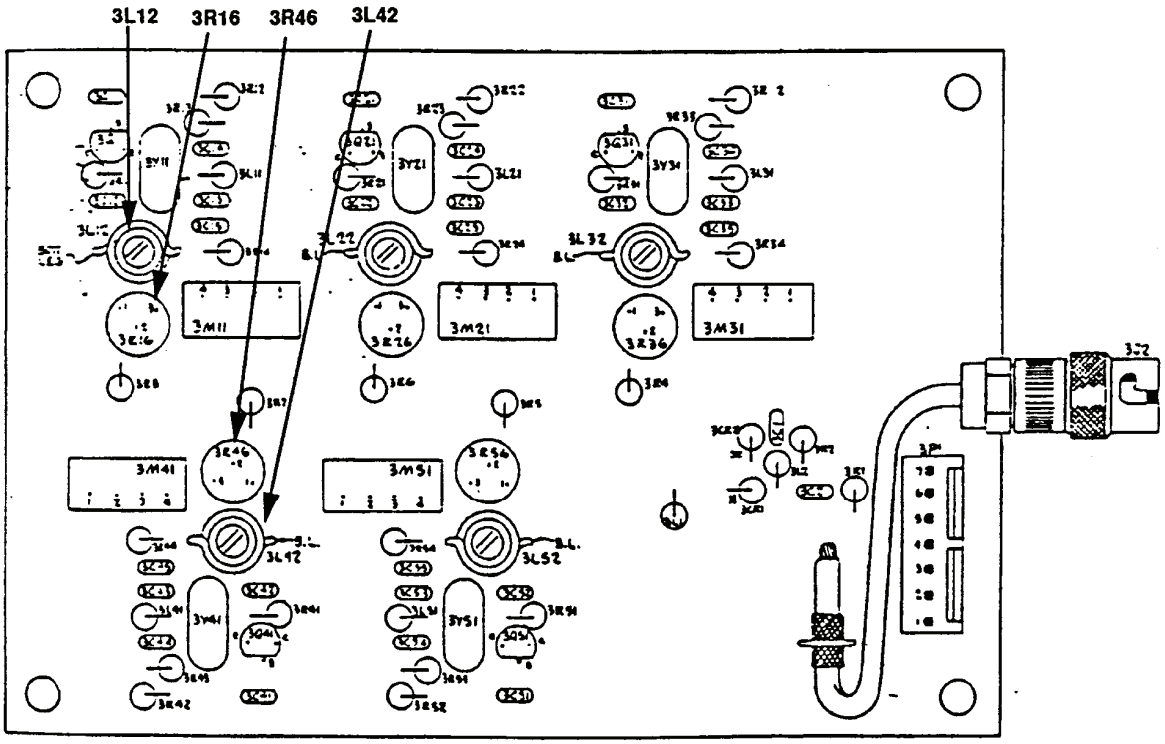

Figure 6. RF oscillator circuit card assembly adjustment.

12. Audio Output Test

a. Performance Check

(1) Connect oscilloscope **SOURCE/MEASURE CHAN 1** input to **AUDIO OUTPUT** tip jack (right side of test set.)

(2) Press and hold **AUDIO PRESS** button. Signal period displayed on oscilloscope must be between 667 and 2000 µs with an amplitude equal to or more than 3 V p-p.

(3) Release **AUDIO PRESS** button.

b. Adjustments. No adjustments can be made.

13. 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
0719018

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 344121, requirements for calibration procedure TB 9-6625-2237.

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.

PIN: 085055-000