

# TB 9-6625-2355-35

CHANGE 1

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

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## CALIBRATION PROCEDURE FOR RADAR TEST SET, TS-4530( )/UPM (JcAIR Part Number: 50-1045-70)

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Headquarters, Department of the Army, Washington, DC  
2 February 2005

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*Distribution Statement A: Approved for public release; distribution is unlimited.*

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TB 9-6625-2355-35, 30 June 2004, 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**

5 and 6

**Insert pages**

5 and 6

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

By Order of the Secretary of the Army:

Official



SANDRA R. RILEY

*Administrative Assistant to the  
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*General, United States Army  
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0434103

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Headquarters, Department of the Army, Washington, DC

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### 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, US Army Aviation and Missile Command, AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also provide DA Form 2028 information to AMCOM via e-mail, fax, or the World Wide Web. Our fax number is DSN 788-6546 or Commercial 256-842-6546. Our e-mail address is [2028@redstone.army.mil](mailto:2028@redstone.army.mil). Instructions for sending an electronic 2028 may be found at the back of this manual. For the World Wide Web, use <https://amcom2028.redstone.army.mil>.

SECTION		Paragraph	Page
	I. IDENTIFICATION AND DESCRIPTION		
	Test instrument identification .....	1	2
	Forms, records, and reports .....	2	2
	Calibration description .....	3	2
	II. EQUIPMENT REQUIREMENTS		
	Equipment required .....	4	2
	Accessories required.....	5	3
	III. CALIBRATION PROCESS		
	Preliminary instructions.....	6	3
	Equipment setup .....	7	4
	Generator frequency calibration .....	8	5
	Generator amplitude calibration.....	9	5
	Receiver amplitude calibration .....	10	6
	Antenna calibration factor .....	11	8
	Antenna verification.....	12	8
	Final procedure.....	13	8

**SECTION I  
IDENTIFICATION AND DESCRIPTION**

**1. Test Instrument Identification.** This bulletin provides instructions for the calibration of Radar Test Set, TS-4530( )/UPM (JcAIR Part Number: 50-1045-70). 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 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 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
Signal Generator: Frequency  Power	Range: 1030 or 1090 MHz Accuracy: ± 0.01 MHz Range: + 4 to – 44 dBm Accuracy: ± 1.5 dB at antenna connector Range: – 40 to – 88 dBm Accuracy: ± 1.5 dB at direct port
Measurement receiver Power	Range: 1030 or 1090 MHz +68 to +20 dBm at direct port +24 to –24 dBm at antenna port Accuracy: ± 1.5 dB
Antenna	Difference ( $\Delta$ ) port or Sum ( $\Sigma$ ) port Resistance: 25 $\Omega$ Accuracy: ± 3 $\Omega$

**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. Where the four-to-one ratio cannot be met, the actual accuracy of the equipment selected is shown in parenthesis.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
ATTENUATOR	Range: 20 dB Accuracy: <sup>1</sup>	Weinschel, Model 9918-20dB (9918)
DIRECTIONAL COUPLER	Range: 1000 to 1100 MHz Accuracy: 20 dB coupling <sup>1</sup>	Hewlett-Packard, Model 778D, (M15370/11-001)
MEASURING RECEIVER	Range: 1030 or 1090 MHz +15 to -50 dBm Accuracy: ± 0.1 dB Range: 1030 to 1090 MHz @ 10 Hz resolution Accuracy: ± 0.01 ppm	Hewlett-Packard, Model 8902A w/sensor, Hewlett-Packard, Model 11722A (11722A)
MULTIMETER	Resolution: 0.1 ohm Accuracy: ± 0.5%	Fluke, Model 8840A/AF05 (AN/GSM-64D)
SYNTHESIZED SIGNAL GENERATOR	Range: 1030 to 1090 MHz + 5 to - 50 dBm Accuracy: ± 0.1 dB	Wiltron, Model 68347M (68347M)

<sup>1</sup>Characterized in the procedure.

**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 3. Accessories Required

Common name	Description (part number)
ADAPTER	N female to SMA female (7002-13)
ADAPTER	N female to TNC male
DC POWER SUPPLY	HDL, Model LR-10 (LR-10), or NJE, Model CS36CR30 (7907346-2)
INSTRUMENT CONTROLLER	Polywell (MIS-45854)
POWER AMPLIFIER	JcAir (15-0777-M0)
TS-4530 BENCH UTILITY	JcAir (60-0694-B2 )

### 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 listed in table 2.

## TB 9-6625-2355-35

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 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. Remove the test set **antenna (A5)** by removing the six (6) Phillips head screws on the top of the antenna. Disconnect **difference port coax cable W3 (A5P1)** from connector **A5J1**, and **sum port coax cable W4 (A5P2)** from **A5J2**.

b. Connect TI to **KIT/KIR-1C** interface cable with **RS-232 serial cable** and **external power supply (parts of TI)**.

c. Connect TI **RS-232 serial cable** to instrument controller RS-232 port.

d. Observe the TI display through the eyepiece while connecting **external power supply** to 115 V ac source. Verify the test set displays: "**BIT Test: PASS**" at the end of the BIT sequence. If BIT test fails, repair is needed.

e. Start the 60-0694-B2 Bench Utility program. Press the "**Maintenance**" button located to the left of the screen. Check "**Information**" section of screen for error messages each time a calibration function is pressed.

f. Determine actual coupling value of directional coupler at 1090 and 1030 MHz for use in paragraph 10 by measuring the nominal loss between the primary input port and the auxiliary side arm port, with the output port terminated in the paragraphs below.

g. Connect measuring receiver to synthesized signal generator output.

h. Set synthesized signal generator output for 1090 MHz at 0 dBm.

i. Set measuring receiver to measure frequency then measure tuned level.

j. Set reference level on measuring receiver.

k. Connect directional coupler input port to the synthesized signal generator output and auxiliary output to measuring receiver. Ensure that the output and the reflected arm of the directional coupler are terminated.

l. Record the measuring receiver indication for use in paragraph 10.

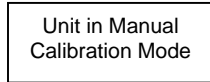
m. Repeat technique in paragraphs g through l above at 1030 MHz at 0 dB.

n. Repeat technique in paragraphs g through l above for 20 dB attenuator at 1030 MHz and 1090 MHz for use in paragraph 10.

**8. Generator Frequency Calibration**

**a. Performance Check**

(1) On the computer, press the “TX Osc Freq 1030” button. If the self-calibration passes, the TI will display:



**NOTE**

This message will be displayed throughout the remainder of the calibration procedure.

(2) Connect measuring receiver directly to coax cable **W4 (A5P2)** using adapter.

(3) Set measuring receiver to measure frequency and SPCL 7.1. Measuring receiver will indicate 1029.990 and 1030.010 MHz. If not, perform **b** below.

**b. Adjustments.** Press up or down arrow key to adjust the calibration factor shown in red. Press “Temporary Write” to test the new value while observing measuring receiver indication.

**9. Generator Amplitude Calibration**

**a. Performance Check**

(1) Perform zero and cal of measuring receiver.

(2) Connect measurement receiver directly to coax cable **W4 (A5P2)** using adapter only.

(3) On the computer, press the “TX Sum -5dB 1030” button.

(4) Using tuned level mode on measuring receiver, verify level is -5.0 dBm ±1.5 dB. If not, perform **b** below.

(5) On the computer, press the “TX Diff -5dB 1030” button.

(6) Connect measurement receiver directly to coax cable **W3 (A5P1)** using adapter.

(7) Verify level is -5.0 dBm ±1.5 dB on measuring receiver. If not, perform **b** below.

(8) On the computer, press the “TX Diff -5dB 1090” button.

(9) Set measuring receiver to measure frequency.

(10) Verify level is -5.0 dBm ±1.5 dB on measuring receiver. If not, perform **b** below.

(11) On the computer, press the “TX Sum -5dB 1090” button.

(12) Connect measurement receiver directly to coax cable **W4 (A5P2)** using adapter.

(13) Verify level is -5.0 dBm ±1.5 dB on measuring receiver. If not, perform **b** below.

(14) On the computer, press the “TX Dir -50dB 1090” button.

## TB 9-6625-2355-35

(15) If measuring receiver “RECAL” annunciator is lit, press “CALIBRATE” button, wait for the “CALIBRATE” annunciator to extinguish.

(16) Connect measurement receiver directly to the **direct port, J102** (located on the underside of the test set) using adapter.

(17) Verify level is  $-50.0 \text{ dBm} \pm 1.5 \text{ dB}$  on measuring receiver. If not, perform **b** below.

(18) On the computer, press the “**TX Dir -50dB 1030**” button.

(19) Connect measuring receiver to synthesized signal generator output. Set synthesized signal generator to 1030 MHz at 0 dBm.

(20) On measuring receiver, press “FREQ”, then “S”, then “TUNED RF LEVEL”.

(21) If measuring receiver “RECAL” annunciator is lit, press “CALIBRATE” button; wait for the “CALIBRATE” annunciator to extinguish.

(22) Set synthesized signal generator output level to  $-40 \text{ dBm}$ .

(23) If measuring receiver “RECAL” annunciator is lit, press “CALIBRATE” button; wait for the “CALIBRATE” annunciator to extinguish.

(24) Set output of synthesized signal generator to “OFF”.

(25) Connect measurement receiver directly to the **direct port, J102** (located on the underside of the test set) using adapter.

(26) Verify level is  $-50.0 \text{ dBm} \pm 1.5 \text{ dB}$  on measuring receiver. If not, perform **b** below.

**b. Adjustments.** Press up or down arrow key to adjust the calibration factor shown in red. Press “**Temporary Write**” to test the new value while observing measuring receiver indication.

## 10. Receiver Amplitude Calibration

### a. Performance Check

(1) On the computer, press the “**RX Sum -5dB 1030**” button.

(2) Set synthesized signal generator to 1030 MHz at  $-5 \text{ dBm} \pm 0.1 \text{ dB}$  at the output end of the cable using measuring receiver in tuned level mode.

(3) Connect synthesized signal generator with cable directly to coax cable **W4 (A5P2)** using adapter.

(4) Press the “**Temporary Write**” button. The TI’s measured power level is displayed on the computer in the window to the right of the calibration factor.

(5) Verify the measured value displayed on the monitor is  $-5.0 \text{ dBm} \pm 1.5 \text{ dB}$ . If not, perform **b** below.

(6) On the computer, press the “**RX Sum -5dB 1090**” button.

(7) Set synthesized signal generator to 1090 MHz at  $-5 \text{ dBm} \pm 0.1 \text{ dB}$  at the output end of the cable using measuring receiver in tuned level mode.

## 6 CHANGE 1

- (8) Repeat (3) above.
- (9) Press the “**Temporary Write**” button. The TI’s measured power level is displayed on the computer in the window to the right of the calibration factor.
- (10) Verify the measured value displayed on the monitor is  $-5.0 \text{ dBm} \pm 1.5 \text{ dB}$ . If not, perform **b** below.
- (11) Set output of synthesized signal generator to “OFF”.
- (12) On the computer, press the “**RX Dir +40dB 1090**” button.
- (13) Connect the power amplifier to +13 V output of dc power supply, monitored with multimeter.
- (14) Connect the synthesized signal generator to the power amplifier input.
- (15) Connect power amplifier output to directional coupler.
- (16) Connect the main output of the directional coupler to the TI **direct port, J102**.
- (17) Connect the  $-20 \text{ dB}$  sample output of the directional coupler and  $-20 \text{ dB}$  attenuator to the measuring receiver.
- (18) Compute the measuring receiver indication by algebraically adding the attenuator value and directional coupler coupling value recorded in **7 1** above, then subtracting the total from  $+40 \text{ dBm}$ .

EXAMPLE: Directional Coupler value recorded in **7 1** above =  $19.90 \text{ dB}$   
Attenuator value recorded in **7 1** above =  $19.81 \text{ dB}$   
 $39.71 \text{ dB}$   
Measuring receiver indication:  $40\text{dB} - 39.71\text{dB} = 0.29 \text{ dB}$

- (19) Set the synthesized signal generator frequency to  $1090 \text{ MHz}$  and power level to produce  $+40.0 \text{ dBm} \pm 0.1 \text{ dB}$  at the **direct port, J102** as monitored by the measuring receiver in tuned level mode.
- (20) Press the “**Temporary Write**” button. The TI’s measured power level is displayed on the computer in the window to the right of the calibration factor.
- (21) Verify the measured value displayed on the monitor is  $+40.0 \text{ dBm} \pm 1.5 \text{ dB}$ . If not, perform **b** below.

**NOTE**

Set the synthesizer signal generator output power to off after measurement is taken to prevent overheating of power amplifier.

- (22) Set the synthesizer signal generator output power to off.
- (23) On the computer, press the “**RX Dir +40dB 1030**” button.
- (24) Set the synthesizer signal generator output power to on.
- (25) Repeat 18 above.



## **TB 9-6625-2355-35**

(26) Set the synthesized signal generator frequency to 1030 MHz and power level to produce +40.0 dBm  $\pm$ 0.1 dB at the **direct port, J102** as monitored by the measuring receiver in tuned level mode.

(27) Press the “**Temporary Write**” button. The TI’s measured power level is displayed on the computer in the window to the right of the calibration factor.

(28) Verify the measured value displayed on the monitor is +40.0 dBm  $\pm$ 1.5 dB. If not, perform **b** below.

(29) Set the synthesizer signal generator output power to “OFF”.

(30) On the computer, press the “**Send All**” button to permanently store the calibration factors in the TI.

**b. Adjustments.** Press up or down arrow key to adjust the calibration factor shown in red. Press “**Temporary Write**” to test the new value while observing measuring receiver indication.

### **11. Antenna Calibration Factor**

#### **a. Performance Check**

(1) On the computer, verify the “**Antenna TX/RX 1030**” is **0**.

(2) On the computer, verify the “**Antenna TX/RX 1090**” is **0**.

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

### **12. Antenna Verification**

#### **a. Performance Check**

(1) Carefully measure the resistance between the center and outer conductor of the difference ( $\Delta$ ) port J1 on the antenna.

(2) Should measure  $25 \pm 3$  ohms. If not, replace antenna.

(3) Carefully measure the resistance between the center and outer conductor of the sum ( $\Sigma$ ) port J2 on the antenna.

(4) Should measure  $25 \pm 3$  ohms. If not, replace antenna.

### **13. Final Procedure**

**a.** Deenergize and disconnect all equipment.

**b.** Reattach antenna A5 to test set ensuring the coaxes are within the antenna channels without pinching between the antenna and cover. Ensure the two center screw holes line up with the test set holes.

**c.** If the screws do not line up, recheck the coax connections, as reversing the long and short coaxes will orient the antenna backwards.

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

By Order of the Secretary of the Army:

Official:

**PETER J. SCHOOMAKER**  
*General, United States Army*  
*Chief of Staff*



**JOEL B. HUDSON**  
*Administrative Assistant to the*  
*Secretary of the Army*

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Distribution:

To be distributed in accordance with the initial distribution number (IDN) 344799, requirements for TB 9-6625-2355-35.

### 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: "Whoever" [whomever@redstone.army.mil](mailto:whomever@redstone.army.mil)T  
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.

