*TB 9-6625-2163-24

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR OR TRANSPONDER TEST SET TS-1809 (AN/APM-123(V)1)

Headquarters, Department of the Army, Washington, DC
8 February 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 9-6625-2163-35, dated 30 July 2003, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Transponder Test Set TS-1809 (AN/APM-123(V)1). TM 11-6625-667-45 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 12 hours, using the dc and low frequency and microwave techniques.

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
Transmitter:	
Frequency	Range: 1030 MHz (crystal controlled) Accuracy: ±0.02% (± 206 kHz)
Power output	Range: -6 dBm (at antenna terminal)
Sidelobe suppression	Range: 3 pulses

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Transmitter:	
Pulse repetition	Range: 220 to 235 pps
Pulse spacing (P1 and P3)	
Mode 1	Range: 3 μs Accuracy: ±0.2 μs
Mode 2	Range: 5 μs Accuracy: ±0.2 μs
Mode 3/A	Range: 3 μs Accuracy: ±0.2 μs
Test	Range: 6.5 μs Accuracy: ±0.2 μs
Mode C	Range: 21 ms Accuracy: ±0.2 μs
Mode 4	Consecutive replies Radiate mode: pass 56 of 64 ±1 Direct mode: pass 16 of 64 ±1
Sidelobe suppression pulse spacing (P1 and P2)	Range: 2 μs Accuracy: ±.015 μs
Receiver:	
Frequency	Range: 1090 MHz Accuracy: ± 0.05% (center)
Frequency bandwidth (3 decibels down)	Range: 6.5 MHz Accuracy: ± 1.0 MHz
Sensitivity	Range: -9 dBm Accuracy: ± 1 dBm

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 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 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 required for this calibration are common usage accessories issued as indicated in paragraph **4** above and are not listed in this calibration procedure. The following peculiar accessories are also required for this calibration: Variable Attenuator, Weinchel, Model 2971-1 (5985-00-160-2296) or Weinchel, Model 905LS (5985-00-107-2724).

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
CIRCULATOR	Range: 0.960-1.1 GHz Isolation: 20dB min	(7916840)
FREQUENCY COUNTER	Range: 1.025 to 1.099 GHz Accuracy: ±.005%	Fluke, Model PM6681/656 (PM6681/656)
MULTIMETER	Range: 5 to 150 V dc Accuracy: ± 0.3%	Fluke, Model 8840A/AF05 (AN/GSM-64D)
PEAK POWER METER	Range: -5 to -21 dBm Accuracy: ±5%	Wavetek, Model 8502A (8502-16934-17071) w/sensor power, Wavetek Model 16934 (16934)
PULSE GENERATOR	Range: 4 to 8 V Pulse width: 0.5 to 25 μs Trigger Delay: 65 μs	LeCroy, Model 9210MOD200 (9210MOD200) w/plug-ins, LeCroy, Models 9211 (9211) and 9215 (9215) (MIS 45839)
RADAR TEST SET (RTS)	Input: Frequency: 1030 ±0.05 MHz Width Measurement: ±0.025 μs Spacing Measurement: ±0.025 μs Power Level: 0 to –10 dBm Pulse Range: 0 to 3907 ms ±3% Output: Frequency: 1080 to 1099 MHz Accuracy: ±0.01% Pulse Source: 0 to 1 μs Power Level: 0 to –10 dBm Oscilloscope: Timebase: 0.01 μs to 4 ms ±0.01% Amplitude: 0 to 8 Vpp ±3%	(AN/UPM-155) w/accessory kit

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 table 2.

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 11-6625-667-45.

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 OUTPUTS to minimum after each step within the performance check where applicable.

a. Remove TI from its case and then remove metal shield covering circuit card assembly.

b. Set switches as listed in (1) through (5) below:

(1) **FUNCTION** switch to **SELF-TEST**.

(2) **MODE** switch to **1**.

(3) **REFERENCE CODE** switches to **7777**.

(4) **ISLS** switch to **OFF**.

(5) **MODE 4** switches to **DOWN** position.

c. Connect TI to appropriate power source (115 V ac or 28 V dc) and set **POWER** switch to **ON**. Allow 15 minutes for warm-up.

d. Press **PUSH TO TEST** switch and turn to **LOCK** position. **ACCEPT** lamp will glow.

e. Set **MODE** switch to **2**, **3/A**, **C**, and **TEST** positions and repeat step **d** above for each setting. The **ACCEPT** lamp will glow in each position.

f. Set **FUNCTION** switch to **SYSTEM** and **MODE** switch to **2**.

g. Connect equipment as shown in figure 1.

h. Set radar test set (RTS) **INTERROGATOR Menus** as listed in (1) through (6) below. For the remainder of this procedure these settings will be identified as the INITIAL RTS settings.

(1) **Menu 2** – **M1** through **MC** to **OFF**.

(2) **Menu 3** – **REPLY SIGNAL** to **SIF**, **M2** through **MC** to **7777** and **ON**, **RANGE DELAY** to **0 μs**, **CHAL SOURCE** to **UUT**, **F2**: to **ON**, and **SIF2** to **OFF**.

(3) **Menu 10** – **MAIN FREQ** to **1090 MHZ** and **ON**.

(4) **Menu 11** – **MODULATION** and **1ST REPLY** to **ON**, all other settings to **OFF**.

(5) **Menu 14** – **PRF** to **267PPS** and **O TRIGGER** to **INTERNAL**.

(6) **Menu 16 – SOURCE** to **LOW PWR**, and **RF** to **0**.

NOTE

Store INITIAL menu setups in **h** (1) through (6) above by pressing keys **FUNC** and **5** on keypad and choosing a memory location at 1 through 4.

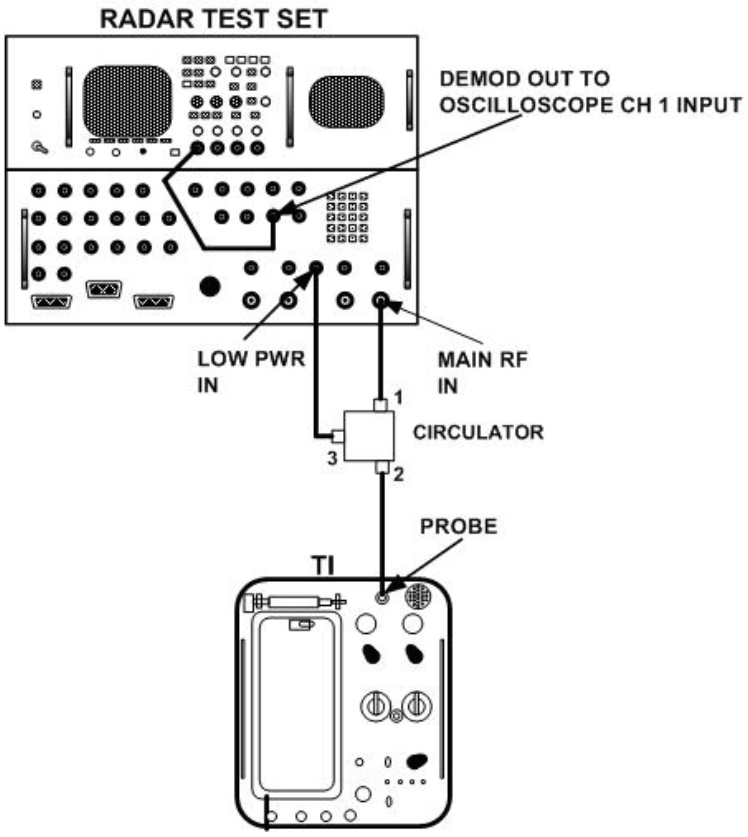


Figure 1. Preliminary equipment setup.

i. Press **PUSH TO TEST** switch and turn to **LOCK** position.

j. Perform a power measurement on RTS (on **Menu 16** select **POWER** then press the **ENTER** key on keypad. When reading is obtained, press **UP** or **DOWN ARROW** on keypad to stop measurement). TI **ACCEPT** light will glow.

8. Receiver Sensitivity

a. Performance Check

(1) On RTS select **Menu 11** and decrease **RF** power until the **REJECT** light glows.

(2) Increase **RF** power until **ACCEPT** light just triggers **ON**.

(3) Set **Menu 11 CW** selection to **ON**. Move cable from **PROBE** connector to peak power meter and take a reading. If reading is not between –8 and –10 dBm, perform **b** below.

(4) On **Menu 11** set **CW** to **OFF**. Disconnect cable from peak power meter and reconnect to **PROBE** connector.

(5) Increase **Menu 11 RF** power by **3 dBm**. The **ACCEPT** light will glow.

b. Adjustments

(1) Install variable attenuator between RTS **Main RF I/O** connector and circulator **PORT 1**. Set **Menu 11 RF** power to **0 dBm** and adjust variable attenuator for -9 dBm on peak power meter.

(2) On **Menu 11** set **CW** to **OFF**.

(3) Disconnect cable from peak power meter and reconnect to TI **Probe** connector. Adjust A8R5 (fig. 2) until **ACCEPT** light glows. Decrease RTS **RF** power by 1 dBm. TI **REJECT** indicator will glow.

(4) Remove variable attenuator and reconnect circulator to **MAIN RF I/O**.

(5) Repeat **a** (1) through (5).

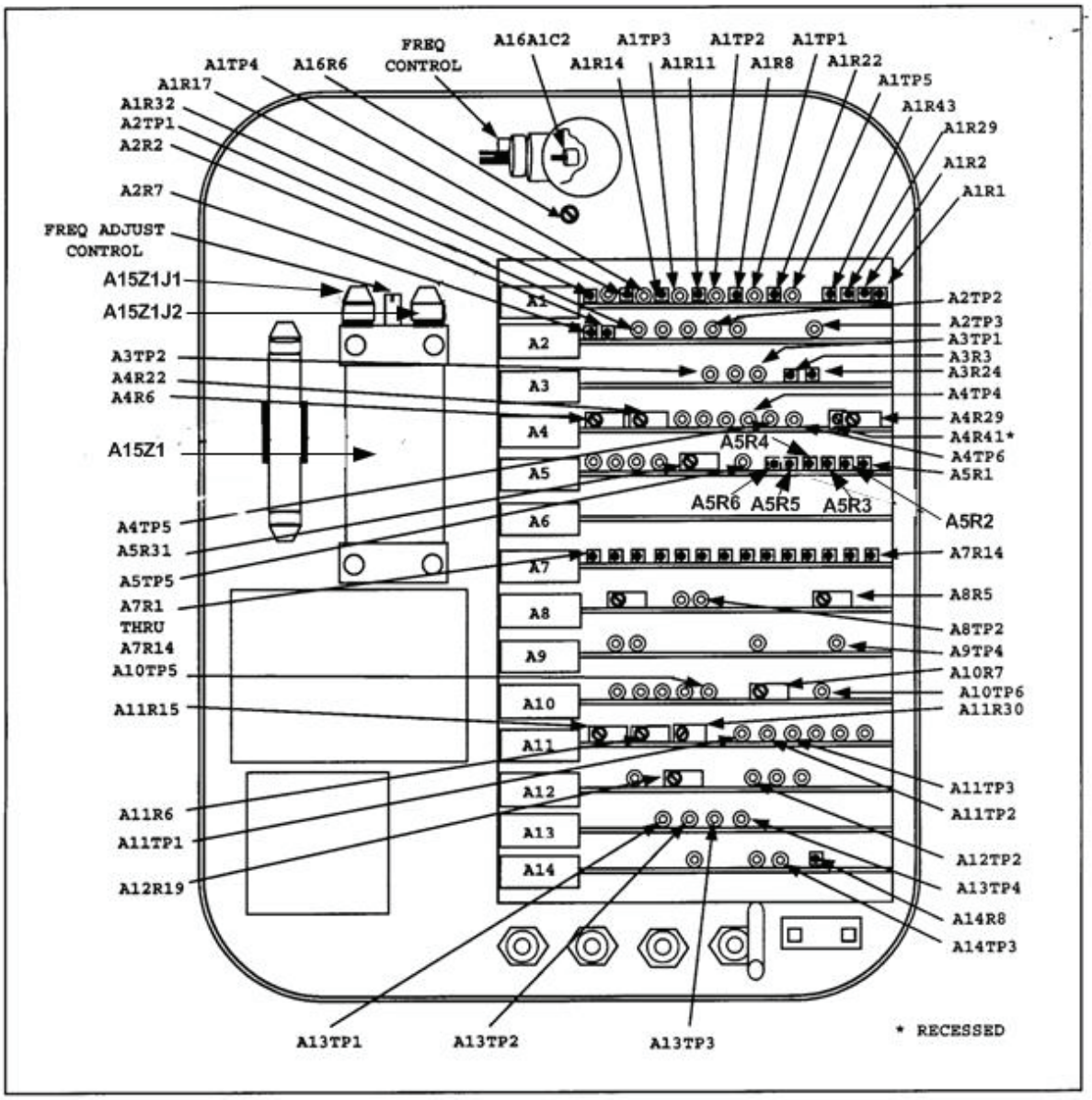


Figure 2. Test instrument adjustments and test points.

9. Receiver Bandwidth and Frequency

a. Performance Check

(1) Select **Menu 10** and increase **MAIN FREQ** until TI **REJECT** lamp comes on. Slowly decrease **MAIN FREQ** until **ACCEPT** lamp just lights and record frequency.

(2) Decrease **MAIN FREQ** until TI **REJECT** lamp comes on. Slowly increase **MAIN FREQ** until **ACCEPT** lamp just lights and again record frequency.

(3) Determine center frequency by adding values recorded in (2) and (3) above and dividing by 2. If TI center frequency is not between 1089.5 and 1090.5 MHz, perform, **b** (1) through (5) below.

(4) Determine bandwidth by subtracting value recorded in (2) from value recorded in (1) above. If bandwidth is not between 5.5 and 7.5 MHz, perform **b** (6) through (13) below.

b. Adjustments

NOTE

Be extremely careful when performing these adjustments because they are critical to equipment performance. Steps (1) through (4) below shall be used, if necessary, to peak the receiver frequency. Steps (6) through (13) below shall be used only if the bandwidth is not within limits.

(1) Disconnect cable from RTS oscilloscope **CH 1** to **DEMOD OUT** connector and connect oscilloscope **CH 1** (using X10 probe in RTS accessory kit) to test point A8TP2 of TI (fig. 2).

(2) On RTS select **Menu 10** and set **FREQUENCY** to **1090 MHz**.

(3) Loosen (slightly) locknut of TI **FREQ ADJ** control at preselector A15Z1 (fig. 2) and adjust **FREQ ADJ** control until displayed pulse is peaked (R).

(4) Retighten **FREQ ADJ** control locknut, while using a screwdriver to maintain a peaked pulse.

NOTE

Steps (3) and (4) may have to be repeated for optimum results.

(5) Repeat **a** (1) through (3) above.

NOTE

During factory calibration, a red mark may have been placed on each jack to identify probe position. If these marks are not present, start with (6) below. If the marks are present, start with (11) below.

(6) Loosen base plate of jack A15Z1J1 (fig. 2) and A15Z1J2 (fig. 2).

(7) Remove jacks A15Z1J1 (fig. 2) and A15Z1J2 (fig. 2) from TI. Observe direction of each probe and mark position of one side on each jack.

(8) Replace each jack and fasten A15Z1J1 (fig. 2) in position (mark pointing at **FREQ ADJ CONTROL**).

(9) Position jack A15Z1J2 (fig. 2) using mark approximately 10 degrees from A15Z1J1 (fig. 2) mark. Fasten A15Z1J2 (fig. 2) in position.

(10) Perform **a** (1), (2), and (4) above.

(11) If the bandwidth is too broad, rotate the mark on jack A15Z1J2 (fig. 2) slightly toward mark on jack A15Z1J1 (fig. 2). If bandwidth is too narrow, adjust it slightly away from mark at A15Z1J1 (fig. 2).

(12) Fasten jack A15Z1J1 (fig. 2) by replacing base plate.

(13) Determine bandwidth as described in **a** (1), (2), and (4) above. If necessary, repeat (11) and (12) above.

10. Video Enable Delay and Gating

a. Performance Check

(1) Disconnect cable from RTS oscilloscope **CH 1** and **DEMOD OUT** connector and connect X10 oscilloscope probe from **CH 1** to test point A10TP5 (fig. 2).

(2) Connect second X10 probe (also from RTS kit) from oscilloscope **CH 2** to test point A4TP6 (fig 2).

(3) Press oscilloscope **AUTO-SCALE** pushbutton and set **TIME/DIV** switch to **1 μs**. Delay from leading edge of second pulse on **CH 2** to trailing edge of pulse on **CH 1** should be between 1.6 and 2.0 μs; if not, perform **b** below.

(4) Disconnect oscilloscope **CH 1** probe from A10TP5 (fig. 2) and connect to test point A8TP2 (fig. 2).

(5) Disconnect oscilloscope **CH 2** probe from A4TP6 and connect to test point A9TP4 (fig. 2).

(6) Press oscilloscope **AUTO-SCALE** pushbutton once again and set **TIME/DIV** switch to **2 μs**. Delay between leading edge of last pulse on **CH 1** and trailing edge of pulse on **CH 2** will not exceed 6 μs.

b. Adjustments. Adjust test instrument video enable delay control A10R7 (fig. 2) until delay from leading edge of second pulse on **CH 1** to trailing edge of pulse on **CH 2** is 1.8 μs (R).

11. Video Reply and Comparison Pulse Width

a. Performance Check

(1) Disconnect oscilloscope probes from test points A8TP2 and A9TP4 (fig. 2). Connect **CH 1** probe to test point A11TP1 (fig. 2).

(2) Set oscilloscope **TIME/DIV** switch to **100 ns**, **TRIGGER SOURCE** to **CH 1,** and adjust **HORIZONTAL POSITION** control to position pulse on **CH 1** for a pulse width measurement. If video pulse width is not between 0.65 and 0.7 μs, perform **b**(1) below.

(3) Disconnect oscilloscope **CH 1** probe from test point A11TP1 (fig. 2) and connect it to A11TP2 (fig. 2). If width of comparison pulse is not between 0.49 and 0.51 μs, perform **b** (2) below.

NOTE

When visual accuracy of oscilloscopes timing is questionable (as in the paragraph above and subsequent paragraphs), use oscilloscope width measurement or cursor function to obtain required accuracy.

b. Adjustments

(1) Adjust control A11R6 (fig. 2) until pulse width is 0.675 μs (R).
(2) Adjust control A11R15 (fig. 2) until pulse width is 0.5 μs (R).

12. Comparison Pulse Position

a. Performance Check

(1) Disconnect oscilloscope **CH 1** probe from test point A11TP2 (fig. 2) and connect it to test point A11TP1 (fig. 2).

(2) Connect oscilloscope **CH 2** probe to test point A11TP2 (fig. 2).

(3) Set **FUNCTION** switch to **I/P** and press **PUSH TO TEST** switch and turn to **LOCK** position.

(4) Set RTS **INTERROGATOR Menu 3 REPLY SIGNAL** to **ID OF POS**.

(5) Perform a power measurement on RTS. Stop measurement after reading has been obtained.

(6) Press oscilloscope **AUTO-SCALE** pushbutton and set **TIME/DIV** switch to obtain two pulse trains shown in figure 3. Pulse C1 (fig. 3) of each train shall be present and **ACCEPT** lamp will glow.

(7) Set **TIME/DIV** switch to **500 ns** and adjust **HORIZONTAL POSITION** control to reference C1 pulses on **CH 1** and **CH 2** to center graticule line on display. If pulse on **CH 2** is not centered within pulse on **CH 1**, perform **b** (1).

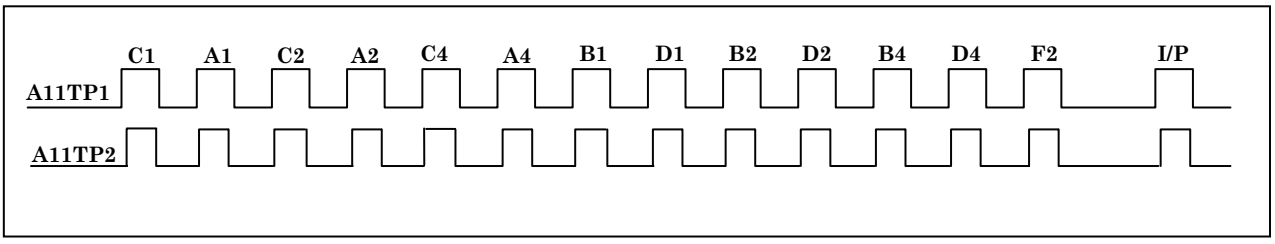


Figure 3. Comparison pulse position.

(8) Repeat technique of (7) above for each of the following pulses: A1, C2, A2, C4, A4, B1, D1, B2, D2, B4, D4, F2, and I/P (fig. 3). If pulse positions are not as specified, perform **b** (2) below for appropriate pulses.

(9) Disconnect oscilloscope probes from TI.

b. Adjustments

(1) Adjust oscilloscope **HORIZONTAL POSITION** control to reference C1 pulse on **CH 1** and **CH 2** to center graticule line on display. Adjust TI control A7R1 (fig. 2) to center C1 (fig. 3) pulse on **CH 2** with respect to C1 (fig. 3) pulse on **CH 1** (R).

(2) Adjust **HORIZONTAL POSITION** control to reference respective pulse on **CH 1** and **CH 2** to center graticule line on display. Adjust controls as indicated in (a) through (m) below to center pulses on **CH 2 V** (fig. 3) within respective pulse on **CH 1** (fig. 3):

(a) Pulse A1 A7R2 (R)
(b) Pulse C2 A7R3 (R)
(c) Pulse A2 A7R4 (R)
(d) Pulse C4 A7R5 (R)
(e) Pulse A4 A7R6 (R)
(f) Pulse B1 A7R7 (R)
(g) Pulse D1 A7R8 (R)
(h) Pulse B2 A7R9 (R)
(i) Pulse D2 A7R10 (R)
(j) Pulse B4 A7R11 (R)
(k) Pulse D4 A7R12 (R)
(l) Pulse F2 A7R13 (R)
(m) Pulse I/P A7R14 (R)

13. Decoder Replies

a. Performance Check

(1) Press **PUSH TO LOCK** switch and turn to **LOCK** position.

(2) Set **FUNCTION**, **MODE**, and **CODE** switches and RTS menu functions as listed in table 4 below. **ACCEPT** and **REJECT** lamps will indicate as listed.

Table 4. Decoder Replies

Test instrument			Radar test set		Test instrument
FUNC	**MODE**	**CODE**	Menu 3 **CODES**	Menu 3 **REPLY SIGNAL**	**ACCEPT/REJECT** lamp
SYSTEM	2	7777	M2: 0000	SIF	REJECT
SYSTEM	2	0000	M2: 0000	SIF	ACCEPT
SYSTEM	2	1111	M2: 0000	SIF	REJECT
SYSTEM	2	1111	M2: 1111	SIF	ACCEPT
SYSTEM	2	2222	M2: 1111	SIF	REJECT
SYSTEM	2	2222	M2: 2222	SIF	ACCEPT
SYSTEM	2	3333	M2: 2222	SIF	REJECT
SYSTEM	2	3333	M2: 3333	SIF	ACCEPT
SYSTEM	2	4444	M2: 3333	SIF	REJECT
SYSTEM	2	4444	M2: 4444	SIF	ACCEPT
SYSTEM	2	5555	M2: 4444	SIF	REJECT
SYSTEM	2	5555	M2: 5555	SIF	ACCEPT

Table 4. Decoder Replies - Continued

Test instrument			Radar test set		Test instrument
FUNC	**MODE**	**CODE**	Menu 3 **CODES**	Menu 3 **REPLY SIGNAL**	**ACCEPT/REJECT** lamp
SYSTEM	2	6666	M2: 5555	SIF	REJECT
SYSTEM	2	6666	M2: 6666	SIF	ACCEPT
SYSTEM	2	7777	M2: 6666	SIF	REJECT
SYSTEM	2	7777	M2: 7777	SIF	ACCEPT
EMERG	1	7700	M1: 7700	SIF	REJECT
EMERG	2	7700	M2: 7700	SIF	REJECT
EMERG	3/A	7700	M3/A: 7700	SIF	REJECT
EMERG	C	7700	MC: 7700	SIF	ACCEPT
EMERG	C	7700	MC: 7700	VAR EMERG	REJECT
EMERG	3/A	7700	M3/A: 7700	VAR EMERG	ACCEPT
EMERG	2	7700	M2: 7700	VAR EMERG	ACCEPT
EMERG[1]	1	7700	M1: 7700	VAR EMERG	ACCEPT
I/P	2	7700	M2: 7700	ID OF POS	ACCEPT
I/P	3/A	7700	M3/A: 7700	ID OF POS	ACCEPT

[1]Perform transmitter output power check if emergency mode 1 step produces a flickering **ACCEPT** light.

b. Adjustments. No adjustments can be made.

14. Read Delay and Error Detector

a. Performance Check

(1) Connect RTS oscilloscope **CH 1** probe to test point A10TP6 (fig. 2).

(2) Set **FUNCTION** switch to **SYSTEM**, **MODE** switch to **1**, and **CODE** switches to **7777**.

(3) Press **PUSH TO TEST** switch and turn to **LOCK** position.

(4) Set RTS menus to INITIAL settings and perform a power measurement. Stop measurement after reading has been obtained. **ACCEPT** lamp will glow.

(5) Press RTS oscilloscope **AUTO-SCALE** pushbutton and set **TIME/DIV** switch to **20 µs**. Verify width of pulse on oscilloscope **CH 1** is between 140 and 160 µs.

(6) Disconnect **CH 1** probe from test point A10TP6 (fig. 2) and connect it to test point A11TP3 (fig. 2).

(7) Set **TIME/DIV** switch to **.1 µSEC**. If negative pulse width on **CH 1** is not between 0.34 and 0.36 µs, perform **b** below.

b. Adjustments. Adjust A11R30 (fig. 2) until width of pulse (negative side) on oscilloscope **CH 1** is 0.35 µs (R).

15. Reply Evaluator

a. Performance Check

(1) Set **MODE** switch to **2**.

(2) Install variable attenuator between RTS **MAIN RF I/O** connector and circulator **PORT 1**. Set variable attenuator to minimum setting.

(3) Connect RTS oscilloscope **CH1** probe ground lead (-) to A13TP2 (fig. 2) and probe tip (+) to A12TP2 (fig. 2). Set oscilloscope **CH1 VOLT/DIV** switch for **200 mV**, **COUPLING** to **DC**, and adjust vertical position control to align trace on bottom graticule line.

(4) Perform a power measurement. Stop measurement after reading has been obtained. **ACCEPT** lamp will glow.

(5) Change RTS **MENU 3 M2 CODES** to **7767**. Record oscilloscope voltage indication. Return **CODE** switches to **7777**.

(6) Adjust variable attenuator until **ACCEPT** and **REJECT** indicators glow alternately. Oscilloscope dc voltage will be approximately 70-80 percent of that recorded in (5) above; if not, perform **b** below.

NOTE

The 70-80 percent of the dc voltage recorded in (5) above or the alternating light condition can be held for just a short time.

(7) Adjust variable attenuator until oscilloscope indication is 50 percent of that recorded in (5) above. **ACCEPT** indicator will glow.

(8) Disconnect oscilloscope probe from TI and remove variable attenuator connected between RTS **MAIN RF I/O** and circulator **PORT 1**.

b. Adjustments

(1) Adjust variable attenuator until oscilloscope indication is 70-80 percent of dc voltage recorded in (5) above, and adjust TI test control A12R19 (fig. 2) until **ACCEPT** and **REJECT** indicators glow alternately (R).

(2) Adjust variable attenuator until oscilloscope indication is 50 percent of dc voltage recorded in (5) above. **ACCEPT** lamp will glow.

(3) Repeat steps **a** (4) through (7) above.

16. Transmitter Frequency and Power

a. Performance Check

(1) Set **FUNCTION** switch to **FREQ/POWER**.

(2) Turn power **OFF** and connect jumper between A4TP5 (fig. 2) and A13TP2 (fig. 2). Turn power **ON**.

NOTE

It may be necessary to allow TI to warm-up for several minutes after being turned off.

(3) Connect frequency counter input to **PROBE** connector and observe counter indication. Display will read between 1029.794 and 1030.206 MHz.

(4) Disconnect frequency counter from **PROBE** connector and connect peak power meter.

(5) Observe peak power meter indication and allow reading to stabilize. If peak power meter indication is not between -5 and -7 dBm, perform **b** (1) below.

(6) Set power switch **OFF** and move jumper from A4TP5 (fig. 2) to A4TP4 (fig. 2). Set power switch **ON** again.

(7) Observe peak power meter indication and allow reading to stabilize. If peak power meter does not indicate between -20 and -22 dBm, perform **b** (2) and (3) below.

(8) Set power switch **OFF** and remove jumper from A4TP4 (fig. 2) and A13TP2 (fig. 2). Set power switch **ON** again.

(9) Set **FUNCTION** switch to **SELF TEST** and verify **ACCEPT** indicator is on.

b. Adjustments

(1) Adjust A16A1C2 (fig. 2) until output power is -6 dBm (R).

(2) Turn TI power **OFF**. Disconnect jumper from test point A4TP5 (fig. 2) and connect it to test point A4TP4 (fig. 2). Turn power **ON**.

(3) Adjust A16R6 (fig. 2) until output power is –21 dBm (R).

17. Transmitter Pulse Characteristics and Challenge

a. Performance Check

(1) Connect equipment as shown in figure 1.

(2) Set switches as listed in (a) through (c) below:

(a) **FUNCTION** switch to **SYSTEM**.
(b) **MODE** switch to **1**.
(c) **CODE** switches to **7777**.

(3) Set RTS to INITIAL settings. Select **MENU 16** and set **PULSE#** to **1** and **TO PULSE** to **2.** Perform a time A to B measurement on the RTS (select **SPACING** and press **ENTER** on keypad). If spacing between first and third pulses (second pulse will be suppressed) is not between 2.8 and 3.2 μs, perform **b** (1) below.

(4) Repeat technique of (3) above for setting and indications listed in table 5. If pulse spacing is not within specified tolerance, perform respective adjustment.

(5) Position **ISLS** switch to **ON** and observe spacing between leading edge of first and second pulses. If pulse spacing is not between 1.9 and 2.1 μs, perform **b** (6) below.

Table 5. Transmitter Pulse Characteristics

Test instrument **MODE** switch settings	Radar test set spacing indication (μs)		
	Min	Max	Adjustments
2	4.8	5.2	**b**(2)
3/A	7.8	8.2	**b**(3)
TEST	6.3	6.7	**b**(4)
C	20.8	21.2	**b**(5)

(6) Set **ISLS** switch to **OFF**.

(7) Set RTS **MENU 16 TO PULSE** to **1**. Measure width of first pulse (select **PULSE WIDTH** and press **ENTER** on keypad). Measure width of second pulse (change **MENU 16 PULSE#** to **2** and **TO PULSE** to **2**, then select **WIDTH** and press **ENTER** on keypad). If width of both pulses is not between 0.7 and 0.9 μs perform **b** (7) below.

(8) Set **ISLS** switch to **ON** and verify pulse width of ISLS pulse is between 0.7 and 0.9 μs.

b. Adjustments

(1) Adjust A5R1 (fig. 2) until spacing between first and third pulse is 3 μs (R).

(2) Set **MODE** switch to **2.** Adjust A5R2 (fig. 2) until spacing between first and third pulse is 5 μs (R).

(3) Set **MODE** switch to **3/A**. Adjust A5R3 (fig. 2) until spacing between first and third pulse is 8 μs (R).

(4) Set **MODE** switch to **TEST**. Adjust A5R5 (fig. 2) until spacing between first and third pulse is 6.5 μs (R).

(5) Set **MODE** switch to **C**. Adjust A5R4 (fig. 2) until spacing between first and third pulse is 21 μs (R).

(6) Set **ISLS** switch to **ON**. Adjust A4R22 (fig. 2) until spacing between first and second pulse is 2 μs (R).

(7) Adjust A4R41 (fig. 2) until width of first pulse is 0.8 μs, and for second pulse adjust A4R29 (fig. 2) (R).

18. Mode 4 Decoder Characteristics

a. Performance Check

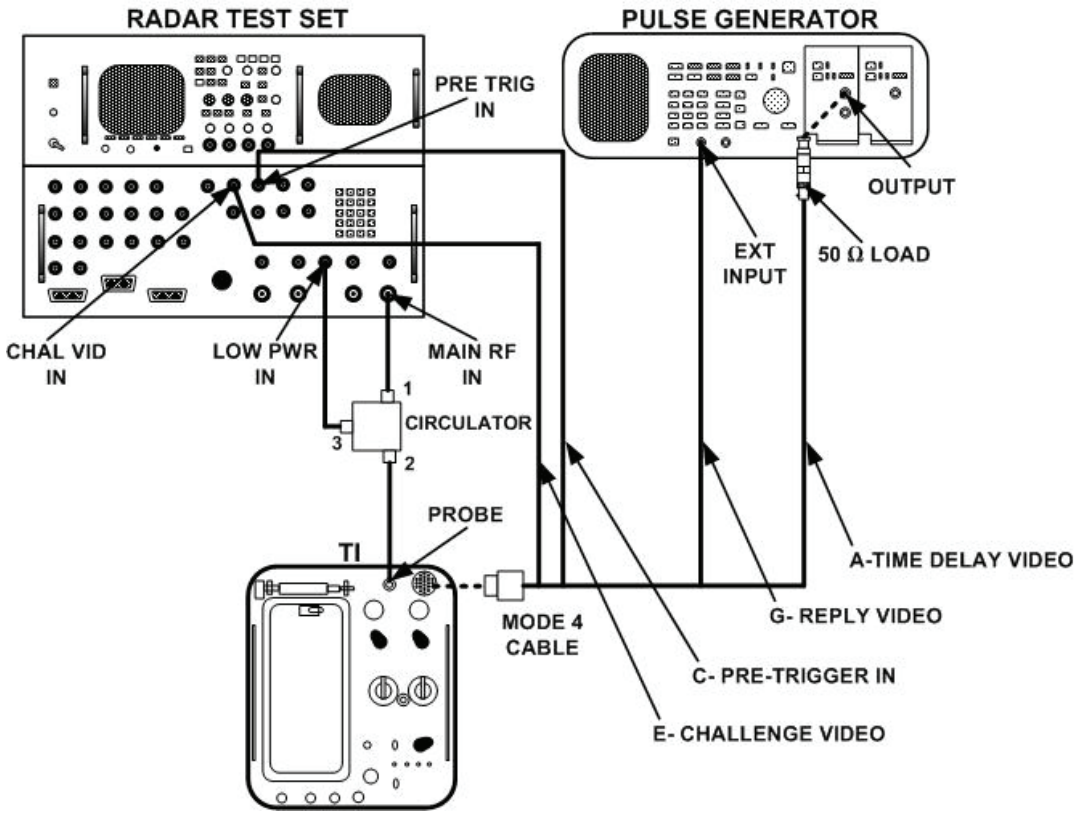
(1) Connect equipment as shown in figure 4.

(2) Set switches as listed in (a) through (c) below:

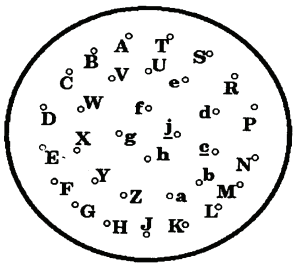
(a) **FUNCTION** switch to **SYSTEM**.
(b) **MODE** switch to **4**.
(c) **ISLS** switch to **OFF**.

(3) Position pulse generator controls as listed in (a) through (i) below:

(a) **VHIGH ---------- 4.000V**.
(b) **VLOW ---------- 0mV**.
(c) **WIDTH ---------- 500.0ns**.
(d) **DELAY ---------- 65.00μs**.
(e) **LEAD** and **TRAIL -- 1.00ns**.
(f) **PERIOD --------- 4.400ms**.
(g) **TRIGGER MODE ---- Single**.
(h) **LEVEL --------- 0.50V**.
(i) **SLOPE --------- Positive**.



Mode 4 Connector Pin Out



Mode 4 Connector/Cable Pin Out

Mode 4 Cable	Mode 4 Connector	
	Signal Pin	Ground Pin
Time Delay Video	A	B
Pre-Trigger In	C	D
Challenge Video	E	F
Reply Video	G	H

Figure 4. Mode 4 decoder – equipment setup.

(4) Set RTS **INTERROGATOR MENUS** as listed in (a) through (g) below:

(a) **Menu 2 – M4** to **WORD C**, all other selections to **OFF**.

(b) **Menu 3 – REPLY SIGNAL** to **MODE 4-3**, **M1 to MC** to **OFF**, **RANGE DELAY** to **3 μs**, **CHAL SOURCE** to **INTERNAL**, **F2** to **OFF**, and **SIF2** to **OFF**.

(c) **Menu 8 – GATING:** to **INTERNAL**, **EXTERNAL:** to **PASS**, **INT GATE: #PASSED:** to **64, and #INHIBITED:** to **0.**

(d) **Menu 10 – MAIN FREQ** to **1090 MHZ**.

(e) **Menu 11 – MODULATION** and **1st REPLY** to **ON**; all other selections to **OFF**.

(f) **Menu 14 – PRF** to **267 PPS**, **O TRIGGER** to **INTERNAL**, **KIT/KIR SELECT** to **KIR**, **SOURCE** to **INT**, and **KIR TRIGGER** to **INT**.

(g) **Menu 16** – **SOURCE** to **LOW PWR** and **RF** to **-6**.

(5) Perform a power measurement on RTS. When measurement is obtained, press the up or down arrow on the keypad to stop measurement.

(6) Press **PUSH TO TEST** switch and turn to **LOCK** position. TI **ACCEPT** lamp will glow.

(7) Connect RTS oscilloscope **CH 1** probe (X10) to A1TP3 (fig. 2). Press **AUTO-SCALE** pushbutton on oscilloscope and adjust **TIME/DIV** control to **100 ns**. If width of each pulse is not between 0.29 and 0.31 μs, perform **b** (2) below.

(8) Connect RTS oscilloscope **CH 2** probe (X10) to A1TP4 (fig. 2). Enable **CH 2** and adjust amplitude as necessary. If width of pulse on **CH2** is not between 0.65 and 0.75 μs, perform **b** (1) below.

(9) Disconnect oscilloscope **CH 2** probe from A1TP4 (fig. 2) and connect to A1TP1 (fig. 2). If width of each pulse on **CH 2** is not between 0.29 and 0.31 μs, perform **b** (3) below.

(10) Observe spacing of first pulse of **CH 1** and **CH 2**. If spacing between leading edge of first pulse on **CH 1** and leading edge of first pulse on **CH 2** is not between 3.59 and 3.61 μs, perform **b**(4) below.

(11) Disconnect **CH 2** probe from A1TP1 (fig. 2) and connect it to A1TP2 (fig. 2). If width of each pulse on **CH 2** is not between 0.29 and 0.31 μs, perform **b** (5) below.

(12) Observe spacing of first pulse of **CH 1** and **CH 2.** If spacing between leading edge of first pulse on **CH 1** and leading edge of first pulse on **CH 2** is not between 1.79 and 1.81 μs, perform **b** (6) below.

(13) Disconnect **CH 2** probe from A1TP2 (fig. 2) and connect it to A1TP5 (fig. 2). If width of positive pulse on **CH 2** is not between 142.5 and 157.5 μs, perform **b** (7) below.

(14) Disconnect **CH 2** probe from A1TP5 (fig. 2) and observe waveform on **CH1**.

(15) On RTS **Menu 11**, decrease **RF** output until displayed reply video just disappears.

(16) Increase **RF** output until reply video re-appears.

(17) Disconnect RTS output from **PROBE** input and connect to peak power meter. On **Menu 11**, set **CW** selection to **ON**. If peak power meter indication is not between -8 and -10 dBm, perform **b** (8) through (12) below and record peak power meter indication.

(18) Disconnect RTS output from peak power meter and reconnect to **PROBE** input. Set **CW** selection to **OFF**.

(19) Increase RTS output level by 3 dBm from value recorded in (17) above.

(20) Press **PUSH TO TEST** switch and turn to **LOCK** position.

b. Adjustments

(1) Adjust A1R17 (fig. 2) until width of pulses is 0.7 μs (R).

(2) Adjust A1R14 (fig. 2) until width of pulses is 0.3 μs (R).

(3) Adjust A1R8 (fig. 2) until width of pulses is 0.3 μs (R).

(4) Adjust A1R1 (fig. 2) until spacing between leading edges of first pulse on **CH 1** and **CH 2** is 3.6 μs (R).

(5) Adjust A1R11 (fig. 2) until width of pulses is 0.3 μs (R).

(6) Adjust A1R2 (fig. 2) until leading edge of first pulse on **CH 1** and leading edge of first pulse on **CH 2** are spaced 1.8 μs (R).

(7) Adjust A1R22 (fig. 2) until width of pulse is 150 μs (R).

(8) Adjust RTS **Menu 11 RF** output to **0** dBm.

(9) Install variable attenuator between **RTS Main RF I/O** and circulator **PORT 1**. Adjust attenuator for **–9 dBm** indication on peak power meter.

(10) Disconnect RTS output from peak power meter and reconnect to **PROBE** input. Set RTS **Menu 11 CW** selection to **OFF**.

(11) Adjust A1R43 (fig. 2) until reply video just appears (R).

(12) Repeat steps **a** (15) through (18).

19. Mode 4 Reply Evaluator

a. Performance Check

NOTE

PUSH TO TEST switch must be pressed and released several times to observe results.

(1) Connect RTS oscilloscope **CH 2** probe to A2TP1 (fig. 2).

(2) Press **PUSH TO TEST** switch and turn to **LOCK** position. If width of pulse on **CH2** is not between 267 and 271 μs, perform **b**(1) below.

(3) Disconnect RTS oscilloscope **CH1** probe from A1TP3 (fig. 2) and connect to A2TP2 (fig. 2).

(4) Press oscilloscope **AUTO-SCALE** pushbutton and set **TIME/DIV** switch to **5 μs**. Position trailing edge of waveform on **CH2** to align with second vertical graticule line.

(5) Press **PUSH TO TEST** switch and turn to **LOCK** position.

NOTE

The next two tests are performed much easier if the oscilloscope **AUTO-STORE** function is used. Press **ERASE** after each measurement to clear screen.

(6) Press **PUSH TO TEST** switch. Pulse will momentarily appear at trailing edge of pulse on **CH 2**. If pulse width is not between 11.8 and 12.2 μs, perform **b** (2) below.

(7) Disconnect oscilloscope **CH 1** probe from A2TP2 (fig. 2) and connect to A2TP3 (fig. 2).

(8) Press **PUSH TO TEST** switch. Negative going pulse will appear on **CH 1** each time **PUSH TO TEST** switch is pressed and **ACCEPT** light will glow.

(9) On RTS **Menu 8** set **RF** selection to **-6**, then step **INT GATE: #INHIBITED:** selection from **1** to **10**. Press TI **PUSH TO TEST** switch for each step and observe that **REJECT** or **ACCEPT** light glows. **ACCEPT** light should glow consistently to 6, become intermittent from 7 through 9 and extinguished upon reaching 10 (solid **REJECT** indication).

(10) Set **INT GATE: #PASSED:** selection to **16** and **#INHIBITED:** to **0**.

(11) Set **MODE 4 DIR/RAD** switch to **DIR.** Press **PUSH TO TEST** switch and observe that **ACCEPT** light glows.

(12) Step **INT GATE: #INHIBITED:** selection to **1** then **2**. Press **PUSH TO TEST** switch for each step and observe that **REJECT** or **ACCEPT** light glows. **REJECT** light should be steady **ON** upon reaching 2.

NOTE

The above tests are similar to consecutive reply tests performed on AN/UPM-98, AN/TPM-25, and AN/APM-270(V)1 radar/ transponder test sets. The TI is tested for a pass rate of 56 correct replies within the 64 pulse recurrence frequency (prf) for radiate mode and 16 for direct.

(13) Set controls as listed in (a) through (d) below:

(a) **FUNCTION** switch to **SELF-TEST**.
(b) **MODE** switch to **1**.
(c) **REFERENCE CODE** switches to **7777**.
(d) **MODE 4** switches to **DOWN** position.

(14) Press **PUSH TO TEST** switch and turn to **LOCK** position. **ACCEPT** lamp with glow.

(15) Set **MODE** switch to **2, 3/A, C,** and **TEST** positions and repeat step (12) above for each setting. The **ACCEPT** lamp will glow in each position.

(16) Disconnect all equipment.

b. Adjustments

(1) Adjust A2R2 (fig. 2) until pulse width on **CH 2** is 269 μs (R).

(2) Adjust A2R7 (fig. 2) until pulse that appears when **PUSH TO TEST** switch is pressed is 12 μs in duration (R).

20. Mode 4 Power Supply Check

NOTE

Do not perform power supply checks if paragraphs **18** and **19** are within tolerance.

a. Performance Check

(1) Set multimeter function for **VDC** and **AUTO-RANGING**.

(2) Connect multimeter negative leads to A13TP2 (fig. 2) and positive lead to A3TP1 (fig. 2).

(3) If multimeter does not indicate between 4.9 and 5.1 V, perform **b** (1) below.

(4) Disconnect equipment.

(5) Set multimeter function for **mA DC** and **AUTO-RANGING**.

(6) Connect multimeter negative lead to A3TP2 (fig. 2) and positive lead with 10 Ω, 1 W resistor to A3TP1 (fig. 2).

(7) If multimeter does not indicate between 380 and 420 ma, perform **b** (2) below.

b. Adjustments

(1) Adjust A3R24 (fig. 2) until multimeter indicates between 4.9 and 5.1 V dc (R).

(2) Adjust A3R3 (fig. 2) until multimeter indicates between 380 and 420 mA (R).

21. Power Supply

NOTE

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

a. Performance Check

(1) Set multimeter function for **VDC** and **AUTO-RANGING**.

(2) Connect multimeter to A14TP3 (fig. 2) and chassis ground. If multimeter does not indicate between 148 to 152 V dc, perform **b** below.

(3) Connect multimeter to A13TP4 (fig. 2) and chassis ground. Multimeter will indicate between 25 and 31 V dc.

(4) Connect multimeter to A13TP3 (fig. 2) and chassis ground. Multimeter will indicate between 11 and 13 V dc.

(5) Connect multimeter to A13TP1 (fig. 2) and chassis ground. Multimeter will indicate between -11 and -13 V dc.

b. Adjustments. Adjust A14R8 (fig. 2) for multimeter indication of +150 V dc.

22. Final Procedure

a. Deenergize and disconnect all equipment. Reinstall metal shield over circuit card assembly and outer case on TI.

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

0800702

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 341126 requirements for calibration procedure TB 9-6625-2163-24.

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: 084593-000