

*TB 9-6625-2197-50

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR TRANSPONDER SET TEST SET AN/APM-424(V)2

Headquarters, Department of the Army, Washington, DC
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REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

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*This bulletin supersedes TB 9-6625-2197-50, dated 21 April 1995.

**SECTION I
IDENTIFICATION AND DESCRIPTION**

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Transponder Set Test Set, AN/APM-424(V)2. TM 11-6625-3090-12&P, TO 33K3-4-2923-1 and NAVAIR 17-20AX-517 were used as the prime data sources 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 6 hours, using the microwave technique and techniques as described in text.

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 applications which pertain to this calibration are in table 1.

Table 1. Calibration Description

Test instrument parameters	Performance specifications	
Transmit pulse width	Modes 1, 2, 3, C Sum	0.8 $\mu\text{s} \pm 0.1 \mu\text{s}$
	Modes 1, 2, 3, C Diff	0.8 $\mu\text{s} \pm 0.1 \mu\text{s}$
	Mode 4 Sum	0.5 $\mu\text{s} \pm 0.1 \mu\text{s}$
	Mode 4 Diff	0.5 $\mu\text{s} \pm 0.1 \mu\text{s}$
Transmit pulse spacing	Mode 1 Sum	3 $\mu\text{s} \pm 0.2 \mu\text{s}$
	Mode 2 Sum	5 $\mu\text{s} \pm 0.2 \mu\text{s}$
	Mode 3 Sum	8 $\mu\text{s} \pm 0.2 \mu\text{s}$
	Mode C Sum	21 $\mu\text{s} \pm 0.2 \mu\text{s}$
	Mode 4 Sum	2 $\mu\text{s} \pm 0.2 \mu\text{s}$ (Burst)
ISLS pulse spacing	Mode 1, Sum to Diff	2 $\mu\text{s} \pm 0.15 \mu\text{s}$
	Mode 2, Sum to Diff	2 $\mu\text{s} \pm 0.15 \mu\text{s}$
	Mode 3, Sum to Diff	2 $\mu\text{s} \pm 0.15 \mu\text{s}$
	Mode C, Sum to Diff	2 $\mu\text{s} \pm 0.15 \mu\text{s}$
Transmitter power output	Mode 4, Sum	4 dBm ± 2 dBm
	Mode 4, Diff	-2 dBm ± 2 dBm
	Droop $\pm 10\%$ of average amplitude	
Transmitter frequency	Modes 1, 2, 3, C, 4 Diff	1030 MHz $\pm 0.02\%$
Receiver sensitivity		-24 dBm ± 2 dBm
Receiver bandwidth		1090 MHz ± 3 MHz

**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 Reference Standards Set NSN 4931-00-621-7878 and limited deployed to Secondary Transfer Calibration Standards Set AN/GSM-287. Alternate items may be used by the calibrating activity. The item 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 four-to-one accuracy will be listed, and 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: Transponder test set kit, Teledyne Electronics, P/N 154397 (NSN 6625-01-118-4440), and battery charger assembly (45413-156721).

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
CIRCULATOR	Insertion Loss: Charted at 1030 and 1090 MHz	(7916840)
FREQUENCY COUNTER	Frequency: 1030 MHz Accuracy: ±0.005 %	Hewlett-Packard, Model 5345A (MIS-28754/1 Type 1) w/converter frequency, plug-in, 5355A (5355A)
MULTIMETER	Range: -12 to +12 V dc Accuracy: ±0.02%	Hewlett-Packard, Model 3458A
POWER METER	Frequency : 1030 MHz Power range: + 6 to - 4 dBm Accuracy: ±0.5 dBm	Wavetek, Model 8502A (8502-16934-17071) w/power detector, Wavetek, Model 16934 (16934)
PULSE GENERATOR	Repetition rate: 10 to 50 kHz Pulse width: 0.1 to 1 µsec Amplitude: 1 to 5 volts	LeCroy Model 9210 (9210) w/ plug-in, Model 9215 (9215) (MIS-45839)
RADAR TEST SET ¹	Frequency Range: 1030 to 1094 MHz. Power output : 0 to - 30 dBm Accuracy: ±0.5 dBm (±1.0 dBm) Oscilloscope display accuracy: ± 3 %	(AN/UPM-155)

¹Limited deployed item.

**SECTION III
CALIBRATION PROCESS**

6. Preliminary Instructions

a. The instruction 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 11-6625-3090-12&P, TO 33DA123-13-1, TO 33D7-29-52-1 and NAVAIR 17-20AX-517.

d. When indications specified in paragraphs 8 through 12 are not within tolerance, perform the power supply check prior to making adjustments. After adjustments are made, repeat paragraphs 8 through 12. Do not perform power supply check if all other parameters are within tolerance.

e. 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.

WARNING

Use extreme caution not to short positive and negative terminals together when handling nickel-cadmium batteries. Shorting may cause batteries to EXPLODE and result in injury to personnel.

a. Install a fully charged battery stick into TI (fig. 1).

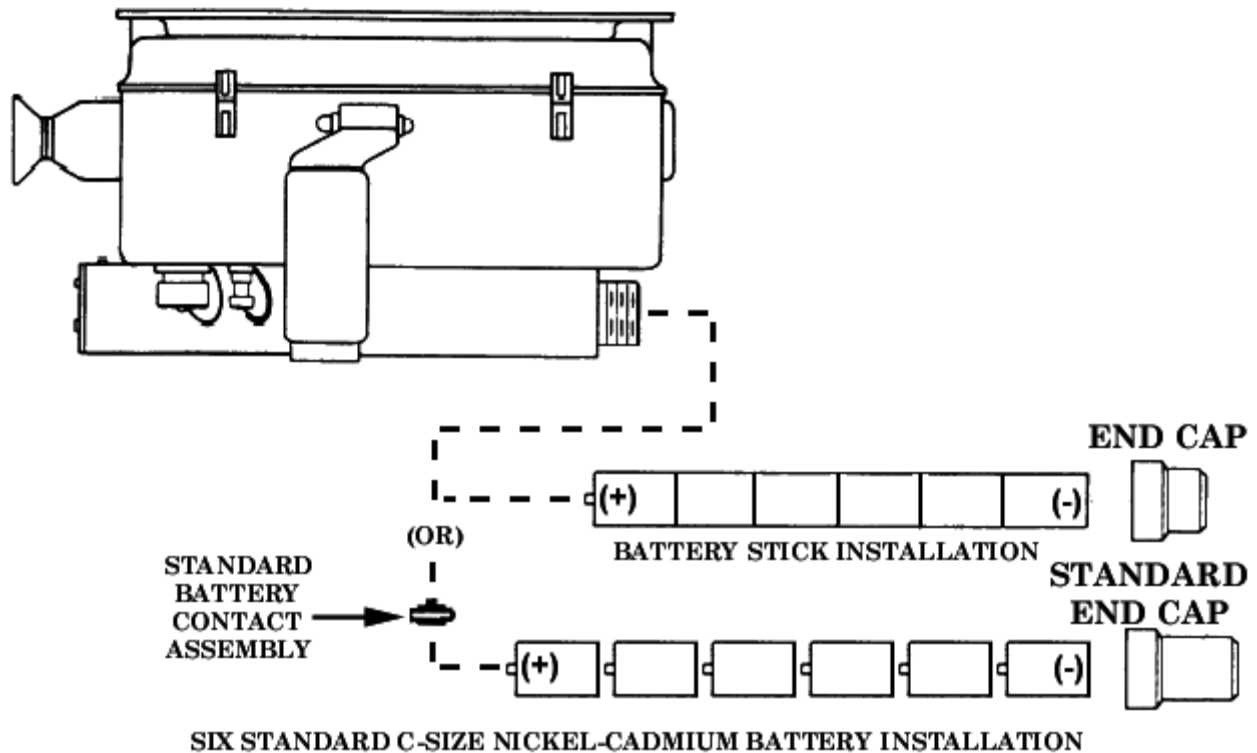


Figure 1. Battery installation.

NOTE

A minimum of two fully charged battery sticks are required for TI calibration.

b. Observe TI display through VIEWFINDER EYEPIECE (fig. 2). Press and release **LAMP TEST** BUTTON **S3** (fig. 2) pushbutton. TI will indicate **8 888.8** in upper half of display and **8 8** separated by the red, green, and yellow indicators in the lower half of display (fig. 3).

NOTE

Flashing decimal points in display, or no display, may indicate that the battery stick requires changing.

c. Press and release **TEST SEQ** (SEQUENCE) BUTTON **S1** (fig. 2) pushbutton. TI will indicate **MODE 1, 2, 3, or C** (fig. 3) and the reject (red) indicator (fig. 3) will be lit in the lower half of display.

d. Press and release **TEST RPT** (REPEAT) BUTTON **S2** (fig. 2) pushbutton and ensure that the display indication repeats.

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e. Repeat technique of (c) above three times and ensure that the TI display will sequence in the order ...2, 3, C, 1, 2, 3.

f. Press and release **LAMP TEST BUTTON S3** (fig. 2) pushbutton to again obtain indication in (b) above. While viewing the display, press and release the **TEST RPT (REPEAT) BUTTON S2** (fig. 2) pushbutton. The TI must indicate Mode 4 (fig. 3), the test code indicator (fig. 2) must indicate 4, and the reject (red) indicator (fig. 3) must be displayed.

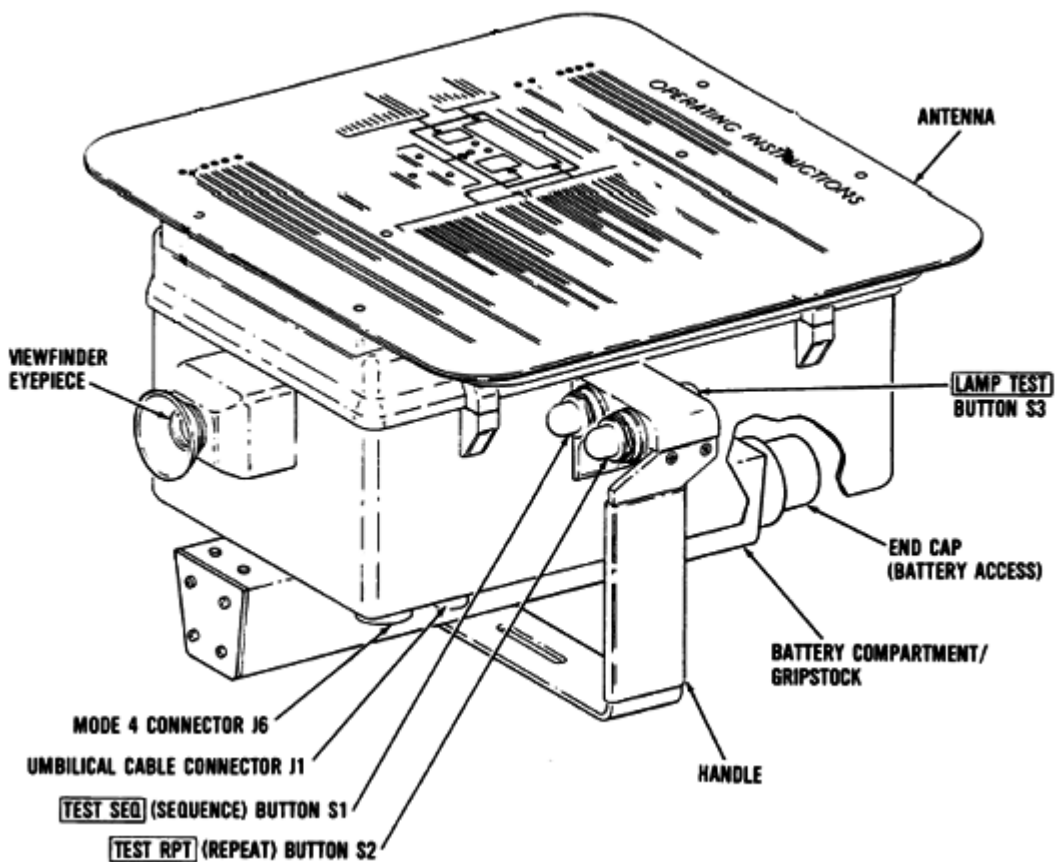


Figure 2. Test set controls and connectors.

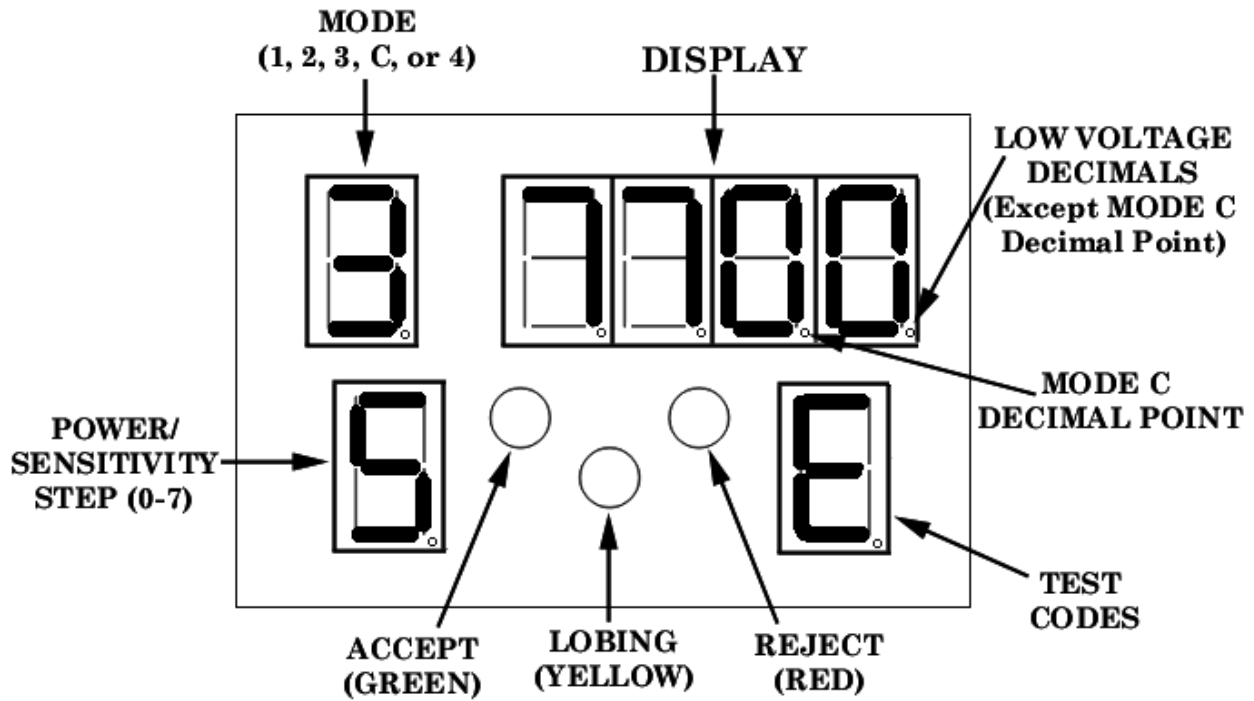


Figure 3. Test set display indicators.

- g. Remove battery stick from TI.

CAUTION

Care must be taken to prevent damage to antenna cables when performing steps below.

NOTE

Disassembly instructions and items in parenthesis below are used in conjunction with test set disassembly blowout (fig. 4).

NOTE

All circuit card assemblies and their components are susceptible to electrostatic discharge/damage when the TI is disassembled. Care must be exercised during handling. Use of precautionary measures such as an electrostatic workstation kit (NSN 4940-01-253-5368) is advised.

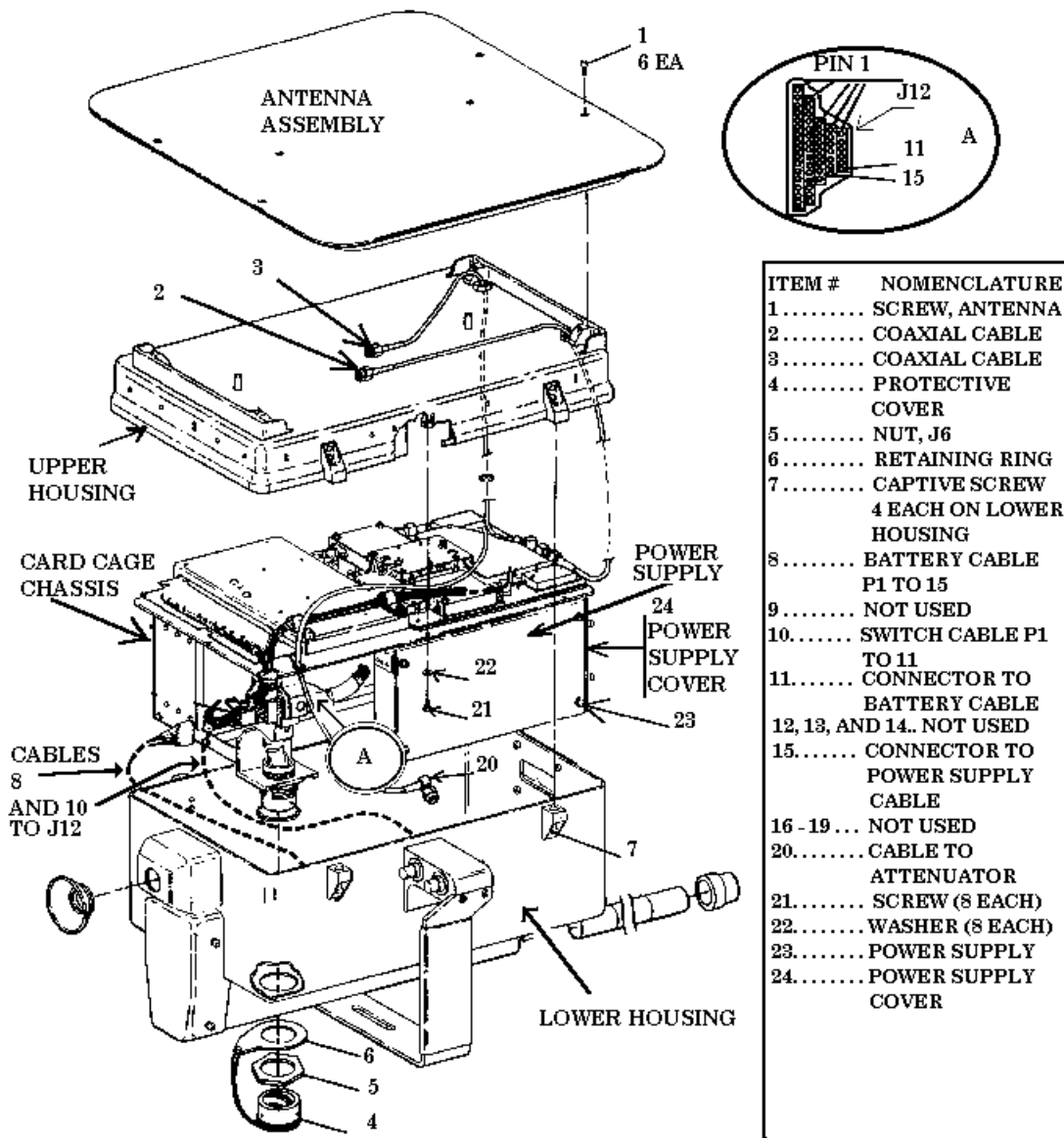


Figure 4. Disassembly blowout.

h. Antenna Removal

- (1) Remove six screws (1) (fig. 4).
- (2) Gently lift antenna and disconnect cables (2) and (3) (fig. 4).

i. Lower Housing Removal

- (1) Turn TI upside down and remove cover (4), nut (5), and retaining ring (6) (fig. 4).
- (2) Loosen four screws (7) (fig. 4) and gently lift and place lower housing beside TI with handle side down.
- (3) Disconnect switch cable P1 (10) (fig. 4) from connector (11) (fig. 4, inset A).

NOTE

Look at connector 11 (fig. 4, inset A) and P1 cable end. Notice the arrangement of pins and guide pins for future reconnections.

- (4) Disconnect battery cable P1 (8) (fig. 4) from connector J12 (15) (fig. 4, inset A).
- (5) Disconnect cable 20 (fig. 4) from attenuator on lower housing.
- (6) Remove lower housing away from card cage chassis and lower housing.

j. Upper Housing Removal

- (1) Place upper housing on bench so that card cage chassis lip is exposed.
- (2) Remove eight screws (21) and washers (22) (fig. 4) located on lip of card cage chassis.

CAUTION

Use extreme care when lifting upper housing away from card cage chassis to avoid damage to coaxial cables (2) and (3) (fig. 4).

- (3) Turn TI on right side and separate card cage chassis and upper housing.

NOTE

Slide cables (2) and (3) (fig. 4) part way through seals while applying a slight pressure.

WARNING

Excess bending of cables (2) and (3) (fig. 4) may cause damage to cables and cause test set malfunction.

- (4) Disconnect cables (2) and (3) (fig. 4) from card cage chassis connectors when sufficient clearance is made.
- (5) Remove upper housing from card cage chassis.

k. Install SMA male to female right angle connectors to (2) and (3) (fig. 4) card cage chassis connectors.

NOTE

Card cage chassis connector (2) (fig. 4) will be referred to as **DIFF** and (3) (fig. 4) will be referred to as **SUM** through the rest of this procedure.

- l.** Install SMA to BNC female connections on **SUM** and **DIFF** outputs.
- m.** Place lower housing beside card cage chassis.
- n.** Connect one end of power supply extender cable (part of transponder test set kit) to lower housing P1 cable (8) (fig. 4) (this cable was disconnected in **g** (4) above) and the other end of power supply extender cable to connector (11) (fig. 4).
- o.** Arrange lower housing for best connection of P1 cable (10) (fig. 4) to connector J12 (15) (fig. 4, inset A) and reconnect cable (20) (fig. 4) to attenuator on lower housing.
- p.** Install fully charged battery stick into TI.
- q.** Place lower housing on handles beside TI for easy access of test pushbuttons.
- r.** Arrange card cage chassis for a convenient view of display and easy access to **SUM** and **DIFF** connections.
- s.** Connect equipment as shown in figure 5, CONNECTION A, and allow sufficient time for equipment warm-up.

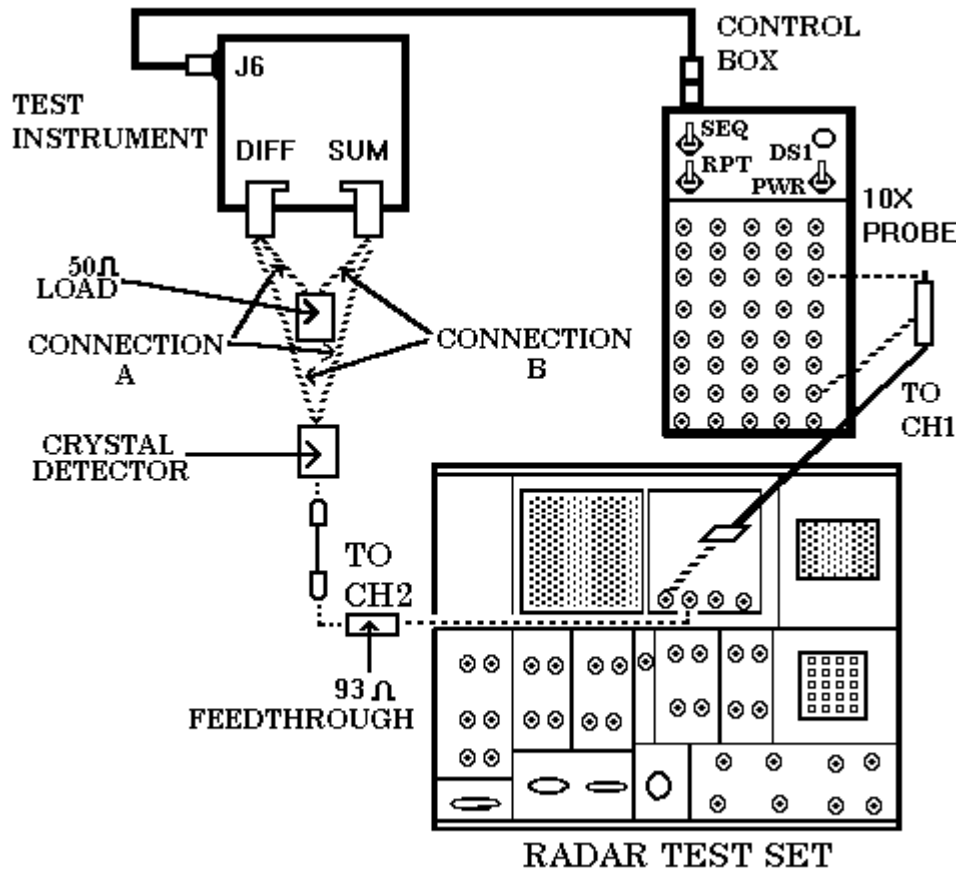


Figure 5. SUM and DIFF pulse measurement - equipment setup.

8. Transmit Pulse Modes Accuracy

a. Performance Check

- (1) Connect control box TJ 15 to oscilloscope **CH 1** using 10X probe.
- (2) Position radar test set oscilloscope controls for the parameters listed in (a) through (e) below:
 - (a) **TRIGGER SOURCE** to 1.
 - (b) Display **CH 2** to **On**.
 - (c) **TIME/DIV** to **500 ns**.
 - (d) **CH1 VOLTS/DIV** to **2.00 V**.

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(e) CH2 VOLTS/DIV to **10 mV** and **Invert** to **On**.

(3) Set control box **PWR** switch to **ON**.

NOTE

Do not set control box **SEQ** and **RPT** switches to **TEST** position at same time. **RPT** will override **SEQ** switch.

NOTE

Figure 5, CONNECTION A, is used to measure SUM pulses; CONNECTION B is used to measure DIFF.

(4) Operation of the control box is described in (a) through (e) below:

(a) **SEQ** switch is momentarily set to **GND** until characters appear on some of the displays, then immediately set switch to **TEST**.

(b) Mode of operation will be seen on the display and will change periodically.

(c) Set **SEQ** switch to **OFF** when desired mode of operation is viewed.

(d) Set **RPT** switch to **GND** until TI display is lit and immediately set switch to **TEST**.

(e) Ensure desired mode of operation is viewed on TI display.

(5) Repeat (3) above to select **MODE 1** operation.

(6) Adjust oscilloscope **TRIGGER Level** and **INTENSITY** controls as necessary to view waveform similar to figure 6, inset A.

(7) Set first pulse leading edge on second vertical graticule line.

NOTE

Pressing **HORIZONTAL** section, **MAIN/DELAYED** pushbutton on oscilloscope will provide selectable menu of left or center time reference.

NOTE

Press oscilloscope **ERASE** pushbutton when necessary throughout this procedure.

(8) Measure SUM pulse width. If pulse width is not between 0.7 and 0.9 μ s, perform **b** (1) below.

(9) Measure SUM pulse spacing. Pulse spacing will be between 2.8 and 3.2 μ s.

(10) Press **Autostore** pushbutton to **STORE**. The two SUM pulses should be stored on screen display.

(11) Set control box **RPT** switch and **PWR** switch to **OFF**.

NOTE

Control box **PWR** switch is set to **OFF** to prevent accidental shorting of components when changing from CONNECTION A to CONNECTION B (fig. 6) and vice versa.

(12) Connect equipment as shown in figure 5, CONNECTION B.

(13) Repeat (2) and (3) above to select **MODE 1** operation.

NOTE

Step (14) below consists of both SUM and DIFF pulses.

(14) Measure DIFF pulse width (second pulse on storage oscilloscope) (figure 6, inset B). If pulse width of second pulse is not between 0.7 and 0.9 μ s, perform **b (2)** below.

(15) Measure pulse spacing of SUM and DIFF pulses. The pulse spacing will be between 1.8 and 2.2 μ s of the first (SUM) and second (DIFF) pulse.

(16) Repeat (3) above to select **MODE 2** operation.

(17) Push **RUN** and **ERASE** pushbuttons on radar test set oscilloscope.

(18) Press **Autostore** pushbutton to **STORE**. One pulse should be stored on screen.

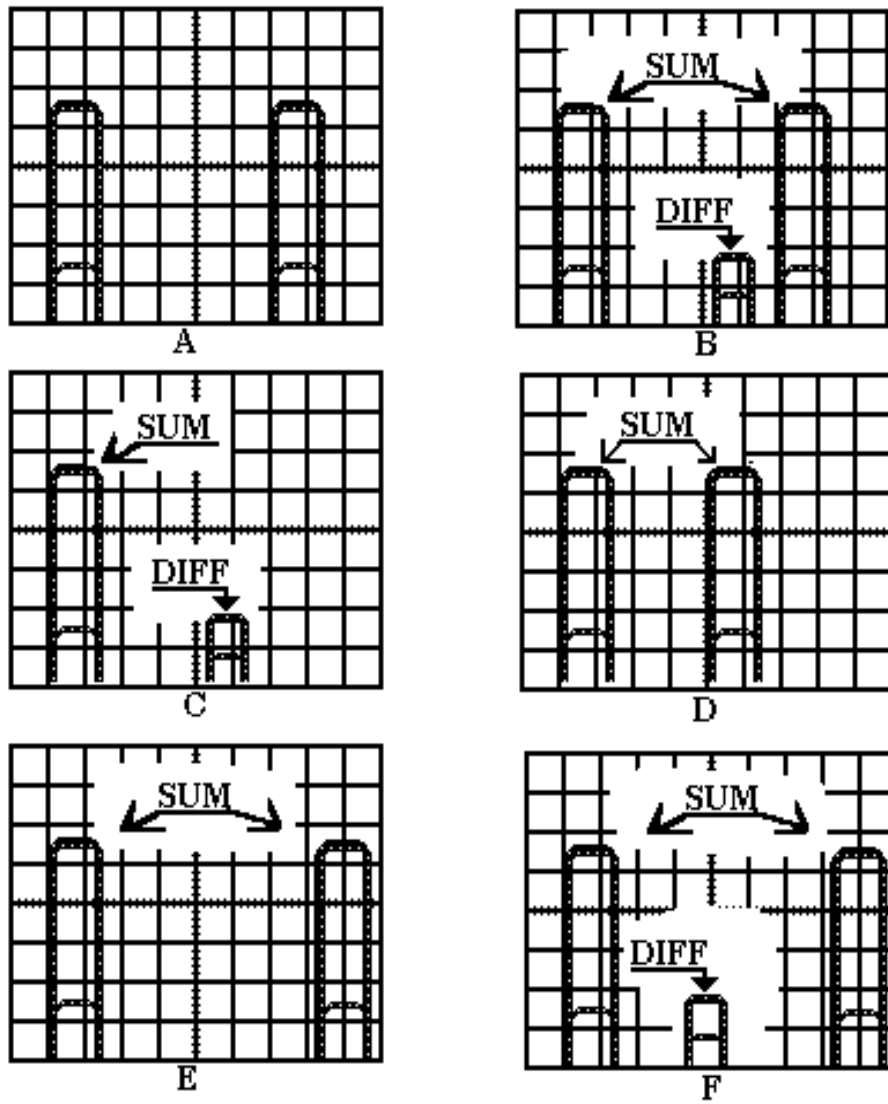


Figure 6. Waveforms.

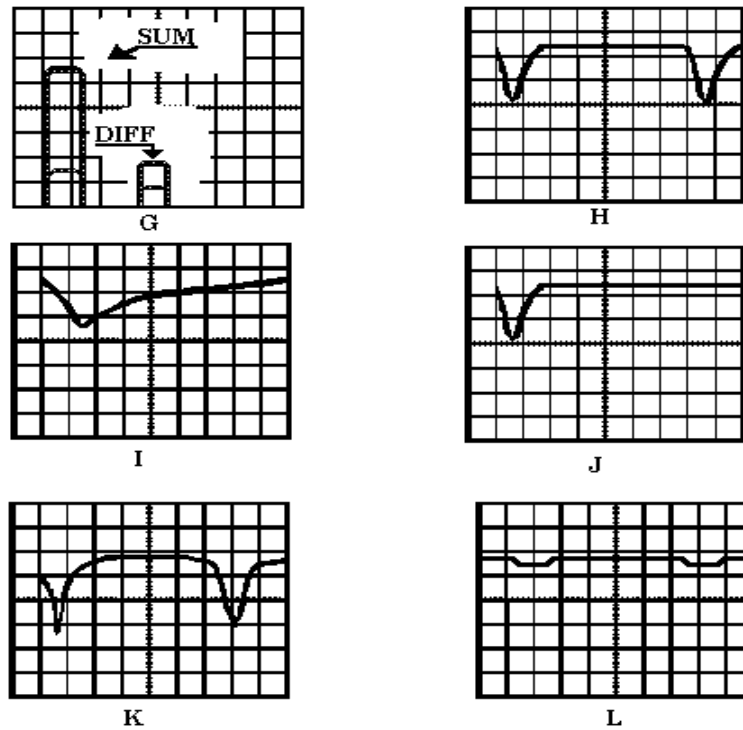


Figure 6. Waveforms - continued.

- (19) Set control box **RPT** switch and **PWR** switch to **OFF**.
- (20) Connect equipment as shown in figure 5, CONNECTION A.
- (21) Repeat (2) and (3) above to select **MODE 2** operation.

NOTE

Step (22) below consists of both SUM and DIFF pulses.

(22) Measure SUM and DIFF pulse widths (fig. 6, inset C). The first pulse must have a pulse width between 0.7 and 0.9 μs ; if not, perform **b** (1) below. The second pulse width will be between 0.7 and 0.9 μs ; if not, perform **b** (2) below.

(23) Measure the pulse spacing between the first and second pulse. Pulse spacing will be between 1.8 and 2.2 μs .

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- (24) Set oscilloscope **TIME/DIV** switch to 1 μ s and press **ERASE** pushbutton.
- (25) Place leading edge of first pulse on second vertical graticule line with oscilloscope controls.
- (26) Measure **MODE 2** (SUM) pulse spacing (fig. 6, inset D). Pulse spacing will be between 4.8 and 5.2 μ s.
- (27) Repeat (3) above to select **MODE 3** operation.
- (28) Press oscilloscope **ERASE** pushbutton and then press **Autostore** pushbutton to **STORE** to establish a new autostore waveform while placing leading edge of first pulse on second vertical graticule line.
- (29) Measure **MODE 3** (SUM) pulse width. Pulse width will be between 0.7 and 0.9 μ s; if not, perform **b** (1) below.
- (30) Measure pulse spacing. **MODE 3** (SUM) pulse spacing will be between 7.8 and 8.2 μ s (fig. 6, inset E).
- (31) Set control box **RPT** switch and **PWR** switch to **OFF**.
- (32) Connect equipment as shown in figure 5, CONNECTION B.
- (33) Repeat (2) and (3) above to select **MODE 3** operation.

NOTE

Step (34) below consists of both SUM and DIFF pulses.

- (34) Measure second pulse width (DIFF). If second pulse width is not between 0.7 and 0.9 μ s, perform **b** (2) below.
- (35) Measure pulse spacing between the first and second pulse (fig. 6, inset F). Pulse spacing will be between 1.8 and 2.2 μ s.
- (36) Repeat (3) above to select **MODE C** operation.
- (37) Press oscilloscope **ERASE** pushbutton and then press **Autostore** pushbutton to **STORE** to establish a new autostore waveform.
- (38) Set control box **RPT** switch and **PWR** switch to **OFF**.
- (39) Connect equipment as shown in figure 5, CONNECTION A.

- (40) Repeat (2) and (3) above to select **MODE C** operation.

NOTE

Step (41) below consists of both SUM and DIFF pulses.

(41) Measure SUM and DIFF pulse widths (fig. 6, inset G). The first pulse must have a pulse width between 0.7 and 0.9 μs ; if not, perform **b** (1) below. The second pulse width will be between 0.7 and 0.9 μs ; if not, perform **b** (2) below.

(42) Measure the pulse spacing between the first and second pulse. Pulse spacing will be between 1.8 and 2.2 μs (fig 6, inset G).

(43) Set oscilloscope **TIME/DIV** switch to **5 μs** and press oscilloscope **ERASE** pushbutton and then press **Autostore** pushbutton to **STORE** to establish a new autostore waveform.

(44) Place leading edge of first pulse on second vertical graticule line.

(45) Measure **MODE C** pulse spacing. Pulse spacing will be between 20.8 and 21.2 μs .

(46) Set control box **RPT** switch to **OFF**.

NOTE

Steps (47) through (55) below utilize a single sweep, triggered by the control box. Because of the "BURST OPERATING MODE" of the TI, one pulse train is sent each time **LAMP TEST** is pressed. TI resets after 2.5 seconds of display time.

(47) Position oscilloscope controls for parameters as listed in (a) through (d) below:

(a) Display to CH 2.

(b) **TRIGGER SOURCE** to 2.

(c) **TIME/DIV** to **500 ns**.

(d) Press **Autostore** pushbutton to **STORE** and press **ERASE** pushbutton.

NOTE

Press and release TI **LAMP TEST** pushbutton to initiate **MODE 4** simulated word.

(48) Press and release **LAMP TEST** pushbutton and adjust oscilloscope **HORIZONTAL** position control for a waveform similar to figure 6, inset E.

(49) Measure **MODE 4** (SUM) pulse width. If pulse width is not between 0.4 and 0.6 μs , perform **b** (3) below.

(50) Measure pulse spacing. Pulse spacing will be between 1.8 and 2.2 μs .

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(51) Set control box **PWR** switch to **OFF**.

(52) Connect TI as shown in figure 5, CONNECTION B.

(53) Press oscilloscope **ERASE** pushbutton then press **Autostore** pushbutton to **STORE**.

(54) Set control box **PWR** switch to **ON** and press **LAMP TEST** pushbutton.

NOTE

Oscilloscope trigger level may need to be readjusted to view the small amplitude waveform.

(55) Measure **MODE 4 (DIFF)** pulse width. If pulse width is not between 0.4 and 0.6 μ s, perform **b (4)** below.

b. Adjustments

(1) Adjust A3R32 (fig. 7) for a SUM pulse width between 0.7 and 0.9 μ s (R).

(2) Adjust A3R34 (fig. 7) for a DIFF pulse width between 0.7 and 0.9 μ s (R).

NOTE

MODES 1, 2, 3, and C have common adjustments A3R32 for SUM pulses and A3R34 for DIFF pulses. (Adjust these resistors for best compromise.)

(3) Adjust A3R33 (fig. 7) for a pulse width between 0.4 and 0.6 μ s (R).

(4) Adjust A3R35 (fig. 7) for a pulse width between 0.4 and 0.6 μ s (R).

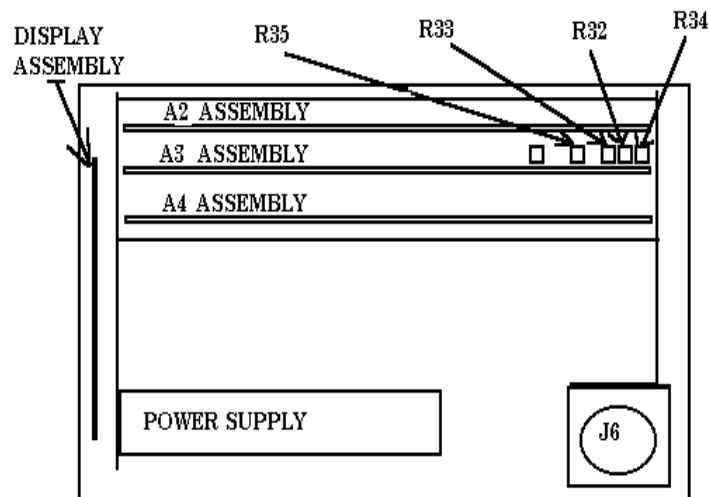


Figure 7. High speed I/O board A3 - adjustment locations.

9. Transmitter Output Power Level Check

a. Performance Check

- (1) Connect equipment as shown in figure 8, CONNECTION A.
- (2) Adjust oscilloscope controls as listed in (a) through (e) below:
 - (a) **TIME/DIV** to **10 μ s**.
 - (b) **TRIGGER MODE** to **AUTO**.
 - (c) Press **MAIN/DELAYED** pushbutton to enable menu **TIME REF** and press soft key to **LFT**.
 - (d) Set **CH 2 INVERT** to **On** and **VOLTS/DIV** to **100 mV/DIV**.
 - (e) Press oscilloscope **ERASE** pushbutton then press **Autostore** pushbutton to **STORE**.
- (3) Set control box **PWR** switch to **ON** and ensure **RPT** and **SEQ** switches are in the **OFF** position.

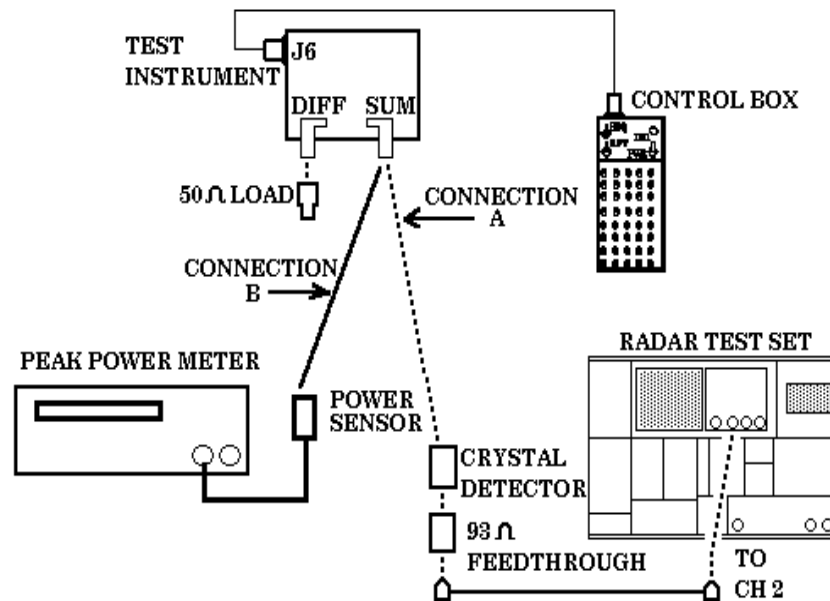


Figure 8. Transmitter power - equipment setup.

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(4) Press and release **LAMP TEST** pushbutton. Amplitude difference between pulses displayed on oscilloscope will not be greater than ± 10 percent of average amplitude.

NOTE

MODE 4 SIMULATED WORD (from the SUM connector) displayed on oscilloscope consist of 37 pulses with number 5 missing.

NOTE

Press oscilloscope **STORAGE ERASE** pushbutton and repeat (4) above several times to ensure maximum pulse amplitude display.

(5) Connect equipment as shown in figure 8, CONNECTION B.

(6) Press TI **LAMP TEST** pushbutton.

(7) Measure peak power from **SUM** connector. Peak power meter will indicate between + 2 and + 6 dBm.

NOTE

Set cursor delay on peak power meter to coincide with the top of one of the pulses. Figure 9 is included as an example of a graphical display from the peak power meter. Pressing graph twice will initiate AUTOSCALING capability of the peak power meter and provide a menu which can then be changed by selecting menu options with the up and down arrow.

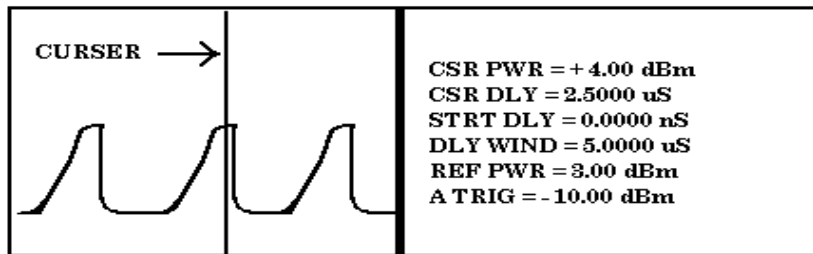


Figure 9. Example of peak power meter display.

NOTE

Pressing TI **LAMP TEST** pushbutton several times will provide viewing of multiple pulses on the peak power graphical display.

(8) Connect equipment as shown in figure 8, CONNECTION B, except reverse SUM and DIFF connections (50 Ω load to SUM and power sensor to DIFF).

NOTE

Only one pulse will be transmitted out of the DIFF connector when TI **LAMP TEST** pushbutton is pressed. Set peak power meter cursor delay to approximately 400 ns, delay window to approximately 1.0000 μs, and set reference power to approximately -4 dBm.

(9) Press TI **LAMP TEST** pushbutton.

(10) Measure peak power from the DIFF connector. Peak power meter reading will be between 0 and - 4 dBm.

b. Adjustments. No adjustments can be made.

10. Transmitter Frequency Accuracy

a. Performance Check

(1) Connect equipment as shown in figure 10.

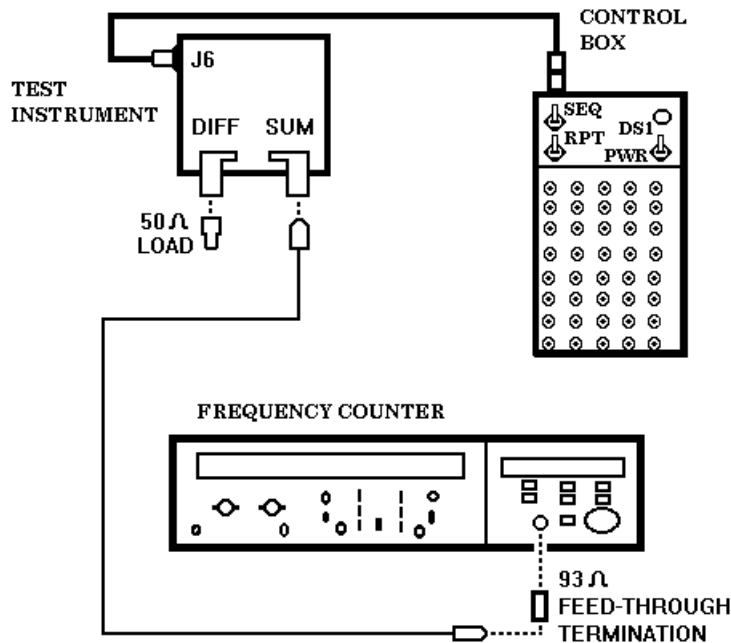


Figure 10. Transmitter frequency accuracy - equipment setup.

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(2) Set control box **PWR** switch to **ON** and set **RPT** and **SEQ** switches to **OFF**.

(3) Position frequency counter controls to measure pulsed RF.

(4) Press **TI LAMP TEST** pushbutton. Frequency counter will indicate between 1029.794 and 1030.206 MHz.

NOTE

Due to changing RF levels, repeat (4) above several times for best results.

b. Adjustments. No adjustments can be made.

11. Receiver Sensitivity

NOTE

Insertion loss of circulator and cable between TI and radar test set at 1090 MHz must be known before the following procedure is performed.

a. Performance Check

(1) Connect equipment as shown in figure 11.

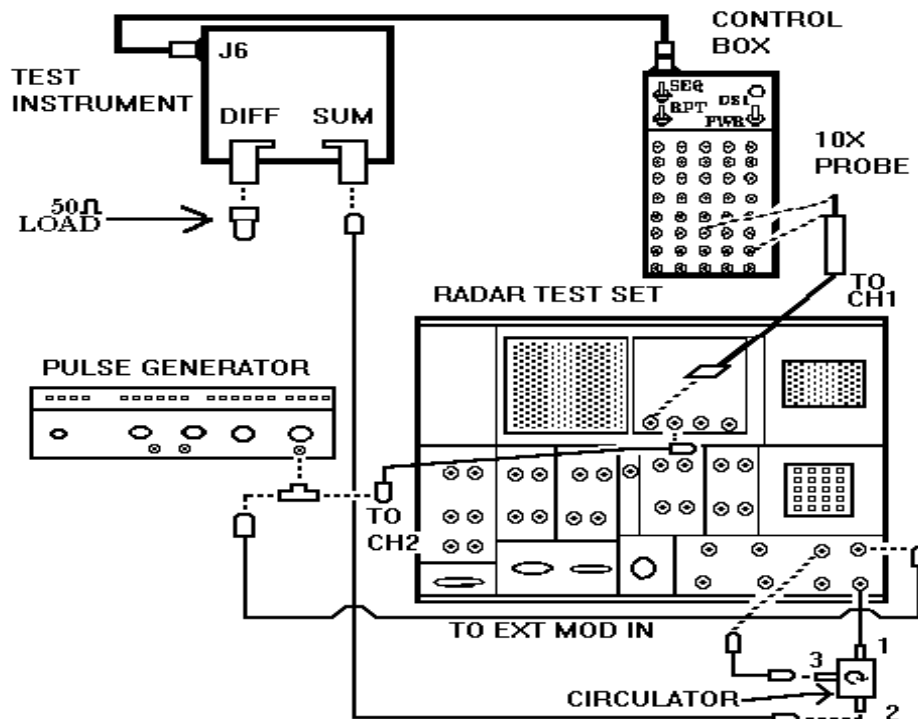


Figure 11. Receiver sensitivity - equipment setup.

- (2) Set radar test set **GENERAL MENUS** menus as listed in (a) through (d) below.

NOTE

All menu choices and selections not listed below are not applicable and may be turned **OFF**. Make the following setup selections then press **FUNC 5** and store front panel menus in any of the locations (1 through 4) for ease of operation. Front panel menu retrieval is accomplished by pressing **FUNC 6** then the location number.

- (a) Menu 10: **MAIN FREQ** to **1090 MHz** .
 - (b) Menu 11: **MODULATION** to **EXT**.
 - (c) Menu 14: **0 TRIGGER** to **INTERNAL**.
 - (d) Menu 16: **SOURCE** to **LOW PWR** and **RF** to **-24**.
- (3) Connect control box TJ 28 connector to radar test set oscilloscope **CH 1**.
- (4) Set radar test set oscilloscope controls for parameters as listed in (a) through (e) below:
- (a) **Autostore** to **RUN**.
 - (b) **TRIGGER SOURCE** to **2**.
 - (c) **TIME/DIV** to **5 μs**.
 - (d) Press **MAIN/DELAYED** pushbutton to enable menu **TIME REF** and press soft key to **LFT**.
 - (e) **VOLTS/DIV** to **1.0 V** and **Invert** to **Off**.
- (5) Position pulse generator controls as listed in (a) through (c) below:
- (a) **0.45 μs** pulse width.
 - (b) **25 kHz** rate.
 - (c) Approximately **5 V** positive output level.
- (6) Set control box **PWR** switch to **ON** and **RPT** switch to **GND**, then **TEST**.

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(7) Adjust oscilloscope main **TRIGGER LEVEL** and **HORIZONTAL** position controls to place positive leading edge of sync pulse from pulse generator (CH2) on second graticule line. If waveform (fig. 6, inset H) is not present, adjust radar test set RF output power level until waveform is just solid.

NOTE

A pulse just solid is characterized by a narrow pulse width (at .5 μ s wide) having a low intensity trailing edge, additionally, as the radar test set RF power is increased from at -28 dBm through -24 dBm (ideal) to near -21 dBm, a noticeable change will occur in the pulse width and negative amplitude to a point little or no additional effect. See figure 12 below for example.

NOTE

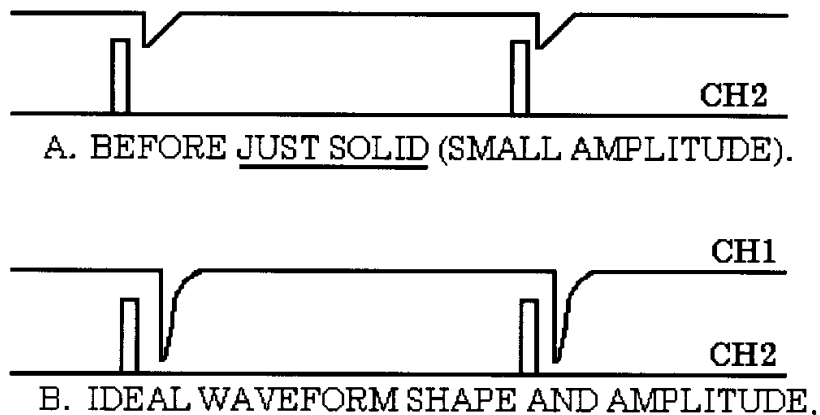


Figure 12. Example of just solid waveform display.

(8) If RF power output level of the radar test set (at the just solid waveform point), including the insertion loss of circulator and cable, is not between -22 and -26 dBm, perform **b** (1) and (2) below. Record actual value.

(9) Move oscilloscope probe from TJ 28 connector and place in TJ 29 connector of control box.

(10) Adjust radar test set power output to -21 dBm (include circulator and cable loss).

(11) Adjust radar test set oscilloscope **TIME/DIV** control to **500 ns**.

(12) If oscilloscope does not display waveform (fig. 6, inset I), adjust radar test set RF power output level until waveform is just solid.

(13) If RF power output level of the radar test set (at the just solid waveform point) including insertion loss of circulator and cable, is not between 2 to 4 dBm greater than (8) above, perform **b** (3) and (4) below.

(14) Remove oscilloscope test probe from TJ 29 of control box and connect to TP3 (fig. 13) of the receiver card.

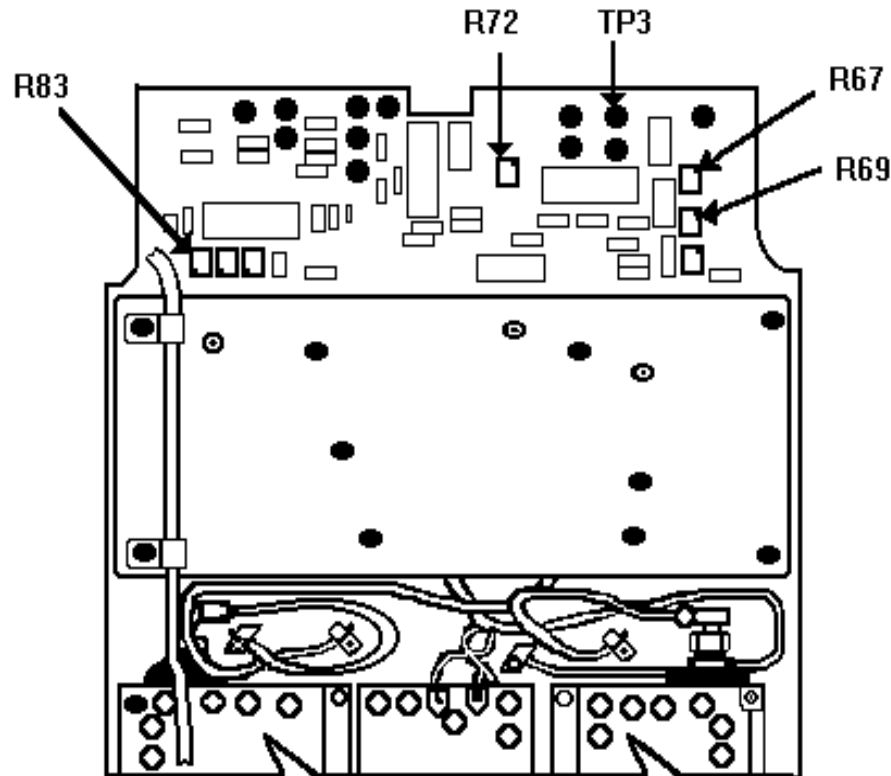


Figure. 13. Receiver card layout.

(14) Adjust radar test set RF output power to -11 dBm (include circulator and cable loss).

(15) If oscilloscope does not display waveform (fig. 6, inset J), adjust radar test set RF power output level until waveform is just solid.

(16) If RF power output level of the radar test set (at the just solid waveform point), including insertion loss of circulator and cable, is not between -9 and -13 dBm, perform **b** (5) and (6) below.

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b. Adjustments

- (1) Adjust radar test set RF power output to include insertion loss of circulator and cable values for a level as close to -24 dBm as possible at TI SUM connector input.
- (2) Adjust R67 (fig. 13) until waveform (fig. 6, inset H) is at the just solid point.
- (3) Adjust radar test set RF power output to include insertion loss of circulator and cable values for a level as close to -21 dBm as possible at TI SUM connector input.
- (4) Adjust R69 (fig. 13) until waveform (fig. 6, inset I) is at the just solid point.
- (5) Adjust radar test set RF power output to include insertion loss of circulator and cable values for a level as close to - 11 dBm as possible at TI SUM connector input.
- (6) Adjust R72 (fig. 13) until waveform (fig. 6, inset J) is at the just solid point.

12. Receiver Bandwidth

a. Performance Check

- (1) Connect equipment as shown in figure 11.
- (2) Position pulse generator controls as listed in (a) through (c) below:
 - (a) 0.45 μ s pulse width.
 - (b) 25 kHz rate.
 - (c) Approximately 5 V positive output level.
- (3) Set radar test set **GENERAL MENUS** menus as listed in (a) through (d) below.

NOTE

All menu choices and selections not listed below are not applicable and may be turned OFF. This check uses the same menu setup as for paragraph 11, Receiver Sensitivity, except RF amplitude. If menus were stored under **FUNC 5** they may be retrieved by pressing **FUNC 6** and the location number.

- (a) Menu 10: **MAIN FREQ** to **1090 MHz** .
- (b) Menu 11: **MODULATION** to **EXT**.
- (c) Menu 14: **0 TRIGGER** to **INTERNAL**.

(d) Menu 16: **SOURCE** to **LOW PWR** and **RF** to a value that will provide approximately -21 dBm input to the TI SUM connector (insertion loss of circulator and cable must be included).

(4) Set radar test set oscilloscope controls for the parameters as listed in (a) through (e) below:

(a) **Autostore** to **RUN**.

(b) **TRIGGER SOURCE** to **2**.

(c) **TIME/DIV** to **5 μs** and press **MAIN/DELAYED** pushbutton for a softkey menu **TIME REF** of **LFT**.

(d) **CH1 VOLTS/DIV** to **1.0 V**.

(e) **CH2 VOLTS/DIV** to **2.0 V**.

(5) Connect oscilloscope **CH1** to TJ 30 on control box.

(6) Set control box **PWR** switch to **ON** and **RPT** switch to **GND**, then **TEST**.

(7) Adjust oscilloscope main **TRIGGER LEVEL** and **HORIZONTAL** position controls to place positive leading edge of sync pulse from pulse generator (CH2) on second graticule line. If waveform (fig. 6, inset K) is not present, adjust radar test set RF output power level (up or down 1 dB) until waveform is correct.

(8) Observe oscilloscope display on **CH 1**. If oscilloscope does not display waveform for **ON FREQ PULSE** (fig. 6, inset K), perform **b** below.

(9) Adjust **MAIN FREQ** (menu 10) to **1091 MHz**. Oscilloscope will display waveform (fig. 6, inset K) with reduced amplitude; if not, perform **b** below.

(10) Adjust **MAIN FREQ** (menu 10) to **1093 MHz**. If oscilloscope does not display **OFF FREQ PULSE** (pulse absent with +5 V level) (fig. 6, inset L), perform **b** below.

(11) Adjust **MAIN FREQ** (menu 10) to **1089 MHz**. Oscilloscope will display waveform (fig. 6, inset K) with reduced amplitude; if not, perform **b** below.

(12) Adjust **MAIN FREQ** (menu 10) to **1087 MHz**. If oscilloscope does not display **OFF FREQ PULSE** (fig. 6, inset L), perform **b** below.

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b. Adjustments

- (1) Adjust radar test set **MAIN FREQ** (menu 10) to **1087 MHz**.
- (2) Adjust R83 (fig. 13) until pulse has just appeared on oscilloscope display (R).

13. Power Supply

NOTE

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

a. Performance Check

- (1) Set control box **PWR** switch to **OFF** and remove battery stick (fig. 1).
- (2) Remove 4 screws (23) (fig. 4) on power supply cover (24) (fig. 4).
- (3) Remove power supply cover.
- (4) Insert battery stick into TI (fig. 1).
- (5) Set control box **PWR** switch to **ON**.
- (6) Set control box **SEQ** switch to **GND**, then to **TEST**.
- (7) Connect digital voltmeter (dc) low (-) probe to control box TJ 35 and high (+) probe to test jacks listed in table 3. If any digital voltmeter reading is not within the specified limits, perform **b** below.

Table 3. Power Supply Voltages

Control box test jack	Voltages (V dc)	Tolerance	
		Min	Max
11	+12	11.75	12.25
12	+5	4.75	5.25
13	-12	-11.5	-12.5

- b. Adjustments.** Connect digital voltmeter to control box TJ 11 and adjust R11 (fig. 14) for a digital voltmeter reading between 11.99 and 12.01 V dc (R).

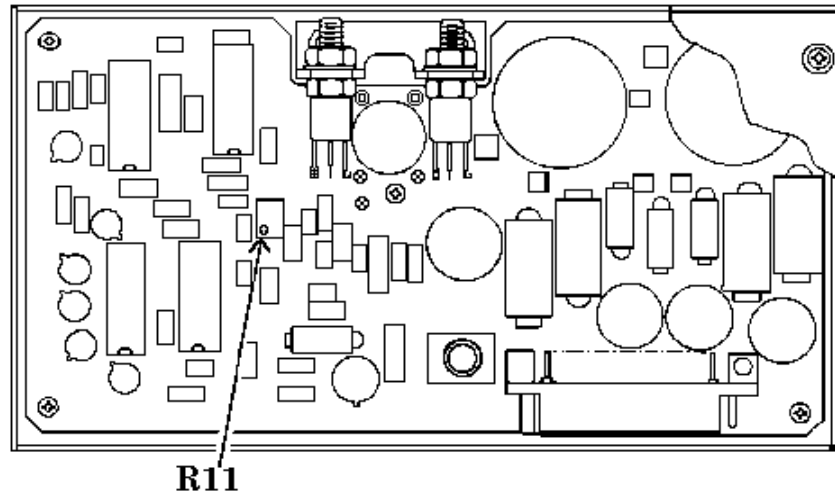


Figure 14. Power supply adjustment location.

14. Final Procedure

- a. Reassemble TI chassis (fig. 4).
 - (1) Deenergize and disconnect all equipment.
 - (2) Remove battery stick from TI.
 - (3) Disconnect cable (20) (fig. 4) from attenuator.
 - (4) Disconnect cable (10) (fig. 4) from connector J12 (11) (fig. 4A).
 - (5) Disconnect power supply extender cable from cable (8) (fig. 4) and connector (15) (fig. 4).
 - (6) Disconnect SMA connectors from card cage chassis, SUM and DIFF outputs.
 - (7) Place upper housing beside card cage chassis and reconnect cables (2) and (3) (fig. 4).
 - (8) Install upper housing into card cage chassis while sliding cables (2) and (3) (fig. 4) through seals to take up slack.
 - (9) Install eight screws and washers (21) and (22) (fig. 4) located on lip of card cage chassis.
 - (10) Place lower housing near card cage chassis and connect cable (20) (fig. 4) to attenuator.

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- (11) Connect P1 cable (8) (fig. 4) to connector J12 (15) (fig. 4).
 - (12) Connect P1 cable (10) (fig. 4) to connector (11) (fig. 4).
 - (13) Gently join lower housing and TI.
 - (14) Install four screws (7) (fig. 4).
 - (15) Turn TI upside down and install retaining ring (6), cover (4), and nut (5) (fig. 4).
 - (16) Place antenna near TI and connect cables (2) and (3) (fig. 4).
 - (17) Gently join antenna and TI.
 - (18) Install six screws (1) (fig. 4).
- b.** Perform an operational check by repeating 7 (a) through (e) above.
 - c.** Annotate and affix DA label/form in accordance with TB 750-25.

By Order of the Secretary of the Army:

Official:



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

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

0334402

Distribution:

To be distributed in accordance with STD IDS No. RLC-1500, 2 January 2003,
Requirements for calibration procedure TB 9-6625-2197-50.

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.

