# TB 9-4935-540-50-4

Change 3

**DEPARTMENT OF THE ARMY, WASHINGTON, DC**

# CALIBRATION PROCEDURE FOR RADAR TARGET SIMULATOR

HEADQUARTERS, DEPARTMENT OF THE ARMY, WASHINGTON, DC
21 August 1979

TB 9-4935-540-50-4, 20 July 1972, is changed as follows:

1. The pages affected by this change, appearing in the following listing, are to be inserted in the manual. New or changed material is indicated by a vertical bar in the margin of the page. Added or extensively revised sections, paragraphs, tables, etc., are indicated by a vertical bar by the title only. Changed or new illustrations are indicated by a letter suffic adjacent to the identification number.

| **Remove pages** | **Insert pages** |
|---|---|
| 15 and 16 | 15 and 16 |

2. This transmittal sheet should be filed in front of the publication for reference purposes.

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**This copy is a reprint which includes current pages from Changes 1 and 2.**

# *TB 9-4935-540-50-4

## DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

# CALIBRATION PROCEDURE FOR RADAR TARGET SIMULATOR

Headquarters, Department of the Army, Washington, DC
20 July 1972

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*This publication supersedes TB 750-92-10/7, 3 July 1967, including all changes.

## CHAPTER 1
## IDENTIFICATION AND DESCRIPTION

**1. Test Instrument Identification.** This bulletin provides instructions for the calibration of radar target simulator 4935-967-9608 at Basic and Improved HAWK sites. Drawing 10045265 was used as the prime data source in compiling these instructions. The radar target simulator will be referred to as "test instrument" throughout this bulletin.

**a. Model Variations**. None.

**b. Time and Technique**. The time required for this calibration is approximately 3 hours, using the microwave technique.

**2. Calibration Data Card (DA Form 2416).** Maintenance forms, records, and reports which are to be used by calibration personnel at all levels are listed in and prescribed by TM 38-750. After each performance check, annotate DA Form 2416 for only those parameters observed to be out-of-tolerance.

# CHAPTER 2
# CALIBRATION AT BASIC HAWK SITES

## SECTION I SPECIFICATIONS AND EQUIPMENT REQUIREMENTS

**3. Calibration Description.** Test instrument parameter and performance specifications which pertain to this calibration are listed in table 1.

Table 1. Calibration Description

| Test Instrument Parameters | Performance Specifications |
|---|---|
| Input voltage[1] | 115 ± 10 V rms, 400 Hz |
| Frequency | Code A, ±125 MHz |
| Power | Not more than 2w |
| Repetition rate:<br>Fully cw<br>Fully ccw | <br>20 ±1 Hz<br>1 ±0.5 Hz |
| Sawtooth amplitude | 47 v peak-to-peak; base reference 2 to 13 V dc |
| Duty cycle | 20 ±5%, 40 ±5%, 60 ±5%, 80 ±5% 100 ±0.5% |
| Noise signal | Code G -10 ± 2 kHz |
| Doppler signal | Code F +3 ±0.5 kHz at 5 ±0.5 V rms |
| OUTPUT NO. 1 and OUTPUT NO. 2 | Difference in output between No. 1 and No. 2 not more than ±1.5 dB |
| Attenuator | At 20 dB, not more than ±0.5 dB |
| Signal to noise mixing:<br>-10 dB position<br>-20 dB position | <br>-10 ± dB below reference voltage<br>-20 ± 2 db below reference voltage |
| Ferrite modulator | Lower sideband at least 12 dB below the upper sideband |
| Power supply regulation<br>105 V rms<br>115 V rms<br>125 V rms | <br>245 to 255 V dc<br>245 to 255 V dc<br>245 to 255 Vdc |

[1]These specifications are for reference only and are not necessarily verified in this procedure.

**4. Equipment Required.** Table 2 identifies the specific equipment used in this calibration procedure. This equipment is issued with secondary transfer calibration standards set 4931-621-7877 and is to be used in performing this procedure. Alternate items may be used by the calibrating activity when the equipment listed in table 2 is not available; however, items selected must be verified to perform satisfactorily prior to use. All applicable equipment items used must bear evidence of current calibration.

Table 2. Minimum Specifications of Equipment Required

| Item | Common Name | Minimum Use Specifications | Manufacturer and Model (Part Number) |
|---|---|---|---|
| A1 | Analyzer, spectrum | Code A ±125 MHz (dwz 10105207) sensitivity-90 db minimum | Polarad, Model SA-84T |
| A2 | Attenuator, variable | 0-20 db at Code A (dwz 10105207) | PRD Electronics, model 159B |
| A3 | Attenuator[1], variable | 0-40 db at Code A | Hewlett-Packard, Model X382-A, 6625-602-2089 |
| A4 | Calorimeter | | PRD Electronics, model X670, 4931-737-6216 (1051-9251) |

See footnote at end of table.

Table 2. Minimum Specifications of Equipment Required - Continued.

| Item | Nomenclature | Minimum use specifications | Calibration equipment and part number |
|---|---|---|---|
| A5 | Capacitance standard, variable | 300-510 uuf | General Radio, model 1422D, 6625-987-9060 (857-9475) |
| A6 | Coupler, directional (3 db) | 3 dB at Code A | Omega, model 318A 4931-683-4592 (8579239) |
| A7 | Coupler, directional (10 db) | 10 dB at Code A | 4931-438-1609 7913359-2-3 |
| A8 | Coupler, directional (20 db) | 20 dB at Code A | PRD 408 S4 5985-813-8826 (7923188) |
| A9 | Frequency/time measuring system | Code F to G | Systron-Donner, model 1037-M2 4931-921-7376 (7910628) |
| A10 | Meter, power amplifier calibrator | | PRD Electronics, model 680R 4931-874-3321 |
| A11 | Oscilloscope | | Tektronix, model RM 33A 4931-299-0826 |
| A11A | Preamplifier plug-in | | Tektronix, model H 6625-738-8065 (10519437) |
| A12 | Phase shifter | 0-360° phase shift at A frequency | Demornary and Bonardi, model DBG-915; RAY341 MO1134 P001 (7922290) |
| A13 | Source, low noise | Code A, ±125 MHz | Raytheon, special RAY 50528-5048 |
| A14 | Voltmeter[2] | 50 V rms to 5.5 V ac ±3% | John Fluke, model 910 AR/AV |
| A15 | Voltmeter[3] | 245-255 V dc ±.66% | John Fluke, model 803 BR/AG |

[1]Two Required.
[2]Voltmeter No. 1.
[3]Voltmeter No. 2.

**5. Accessories Required.** The accessories listed in table 3, issued with secondary transfer calibration standards set 4931-621-7877, are to be used in this calibration procedure. The accessory items listed in table 3 may be substituted by equivalent items unless specifically prohibited.

Table 3. Accessories Required

| Item | Nomenclature | Description and Part Number |
|---|---|---|
| B1 | Adapter[1] | PRD Electronics, model 354C 4931-739-2234 (10519423) |
| B2 | Adapter | BNC jack to UHF plug UG-273/U 5935-149-3534 (10519439) |
| B3 | Adapter, connector | Single banana jack to alligator clip (black) 4931-739-4420 (707560) |
| B4 | Adapter, connector | BNC plug to double banana jack 4935-962-8580 (7909401) |
| B5 | Cable assembly | 8-in. No. 18 (black) single banana plug terminations 6625-764-2937 (7907494) |
| B6 | Cable assembly | 18-in. N plug terminations. RG-9A/U 4931-844-3259 (10519072) |
| B7 | Cable assembly | 48-in., RG-58A/U BNC plug and double banana plug terminations 4931-737-6369 (10519226) |
| B8 | Cable assembly[2] | 72-in., N plug terminations RG-9A/U 4931-846-4787 (10519060) |
| B9 | Cable assembly | BNC plug to alligator clips RG-58A/U 7922273 (RAY 50528-5019) |
| B10 | Cable assembly | Double banana plug to alligator clips 7922272 (RAY 50528-5020) |
| B11 | Resistor, decade | Winslow, model 336 6625-585-4915 (7907234) |
| B12 | Stand, waveguide[2] | PRD Electronics, model 370 4931-739-2218 (10519430) |
| B13 | Tee, hybrid unmatched | Omega, model 628 7922219 (RAY 341 M01128 P001) |
| B14 | Transformer, variable power` | General Radio, model W10MT3A 6120-168-3705 (7910809) |

See footnote at end of table.

Table 3. Accessories Required - Continued.

| Item | Nomenclature | Description and part number |
|---|---|---|
| B15 | Waveguide assembly (X-band) | PRD Electronics 4931-740-6172 (10519542) |
| B16 | Waveguide termination | PRD Electronics, model 116-A 5985-571-7086 (10519373) |
| B17 | Waveguide flexible[1] | Airtron, Inc., model BN-216-2400 4931-842-6039 (10519000) |

[1]Four required.
[2]Two required.

Table 4. Additional Equipment Required

| Item | Nomenclature | Manufacturer And Model No. |
|---|---|---|
| C1 | Cable assembly | 18W1 4935-861-1510 (10044973) |

## SECTION II
## PRELIMINARY OPERATIONS

### 6. Preliminary Instructions

**a.** The instructions outlined in this section are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

**b**. Items of equipment used in this procedure are referenced within the text by common name and item identification number as listed in tables 2 and 3. For the identification of equipment referenced by item numbers prefixed with A, see table 2 and for prefix B see table 3.

**WARNING**

Dangerous voltages exist in this equipment. DEATH OR INJURY on contact may result if personnel fail to observe proper safety precautions. Use extreme care when making connections between the standards and the test instrument.

### 7. Equipment Setup

**a**. Refer to figure 1 for all controls and indicators unless otherwise indicated.

**b**. Connect the equipment as shown in figure 2.

**c**. Set the test instrument power ON OFF switch to OFF.

**d**. Set the variable power transformer Power switch to ON and adjust for 115 vrms.

**e**. Set the test instrument power ON/OFF switch to ON.

**f**. Ascertain that the fan blower motor is operating.

**g**. Set the variable power transformer power switch to OFF.

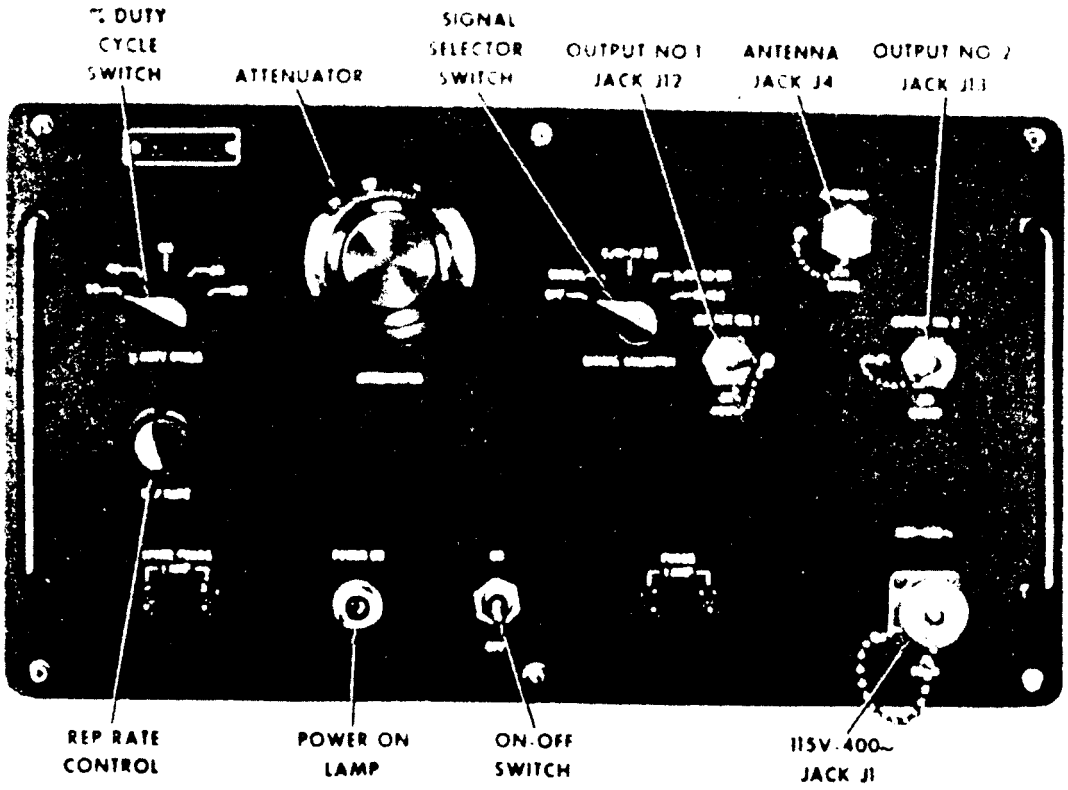


Figure 1. Radar target simulator 4935-967-9608 - front panel.

## SECTION III
## CALIBRATION PROCESS

### NOTE

The following paragraphs are divided into two parts, **a**, performance check and **b**, adjustments. Make adjustments only when the performance check is not within tolerance. If no adjustment is specified and the performance check is not within tolerance, correct the deficiency before continuing with the procedure.

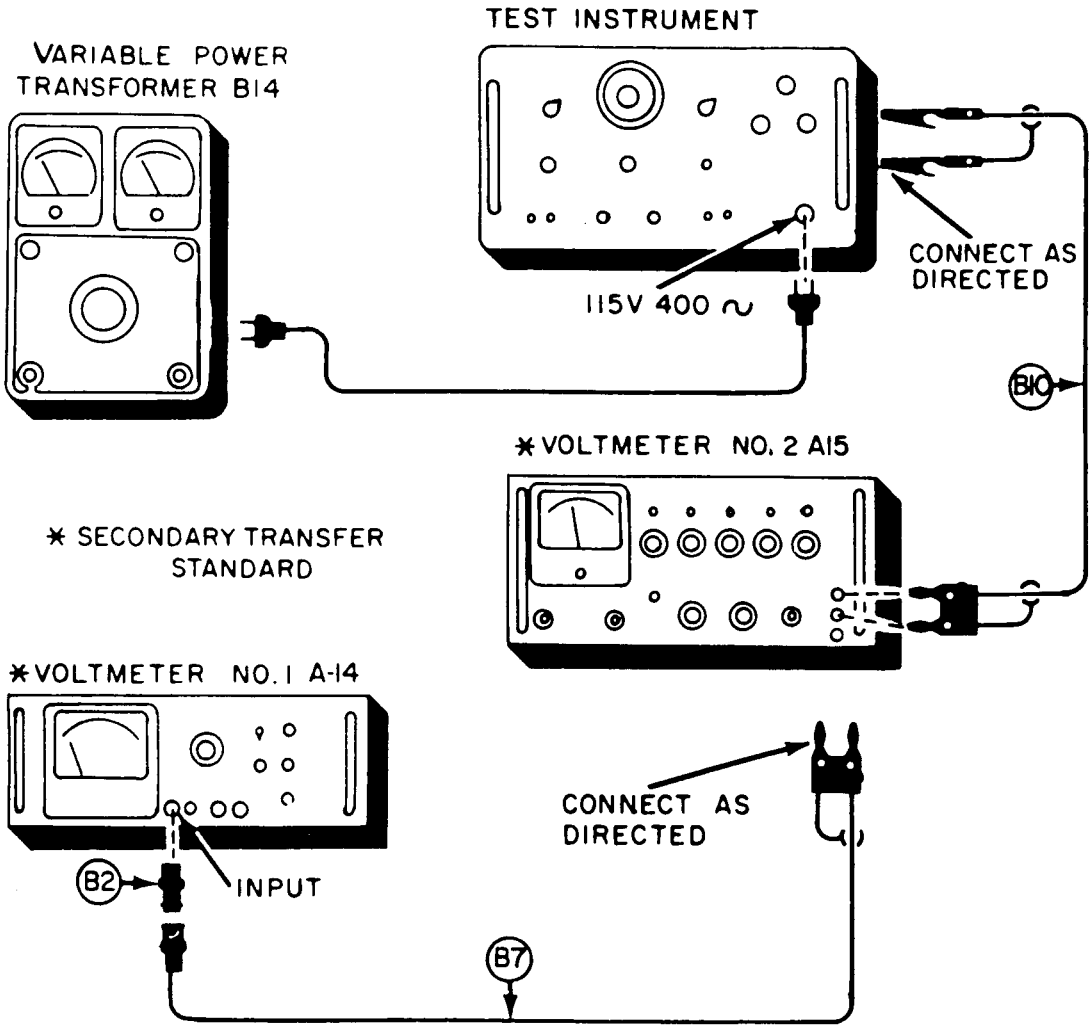


Figure 2. Power supply regulation check - equipment setup.

## 8. Power Supply Regulation

### a. Performance Check

(1) Remove the test instrument from its protective case.

(2) Turn SIGNAL SELECTOR switch to OFF.

(3) Connect cable assembly B10 to the junction of capacitor C75 and pin 6 of XV15 (fig. 3) and ground.

(4) Set variable power transformer on/off switch to on, and allow 15 minutes for the equipment to warm-up and stabilize.

(5) Voltmeter No. 2 should indicate from 245 to 255 vdc. Record the indication.

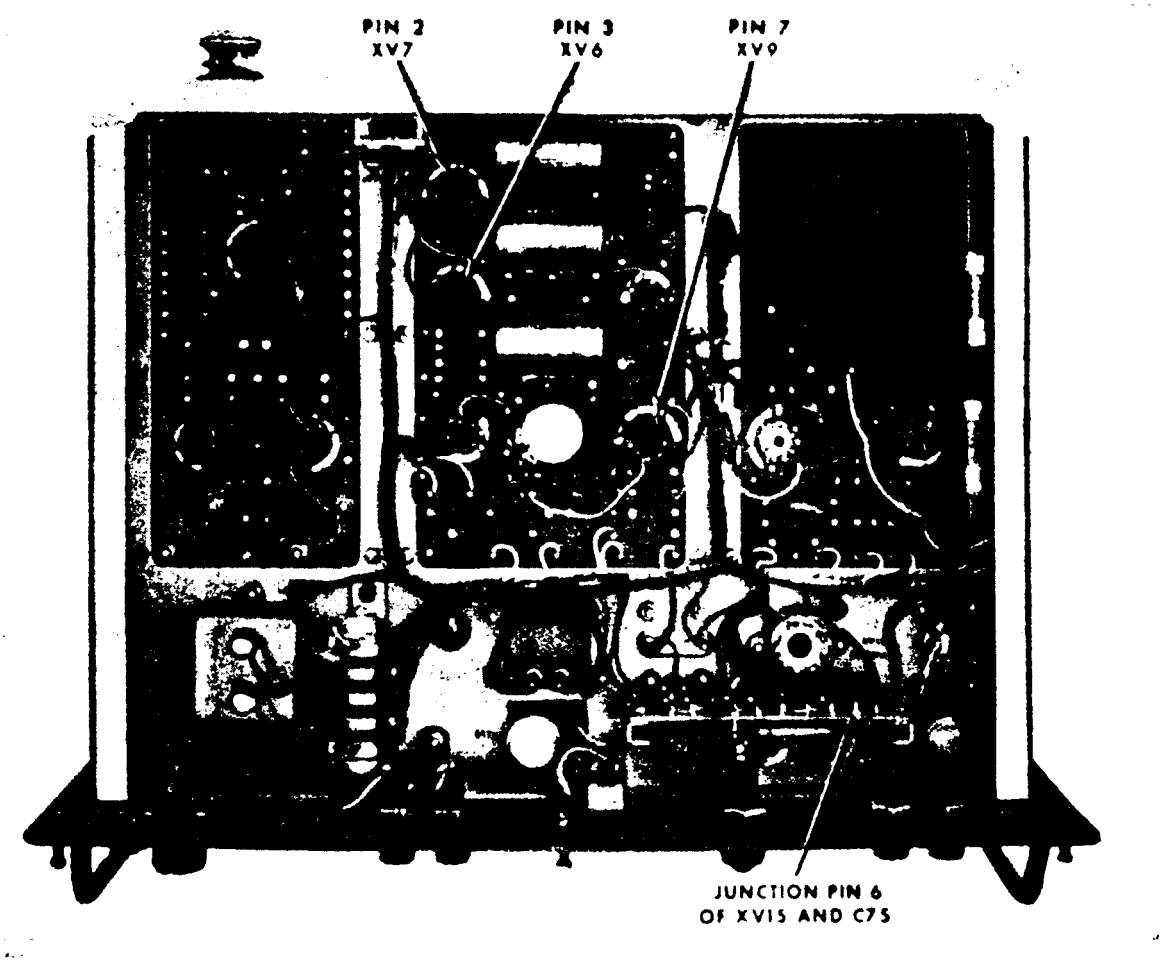


Figure 3. Radar target simulator - bottom view.

(6) Adjust the variable power transformer first for 105 and then for 125 vac. Voltmeter No. 2 should indicate from 245 to 255 vdc and should not vary by more than ±2 percent from the indication recorded in step (5) above.

(7) Adjust the variable power transformer for 115 vac.

**b. Adjustments**

(1) Adjust the variable power transformer for 115 vac.

(2) Adjust R111 (fig. 4) for a 250 vdc indication on Voltmeter No. 2.

(3) Repeat steps **a**(5) through (7) above.

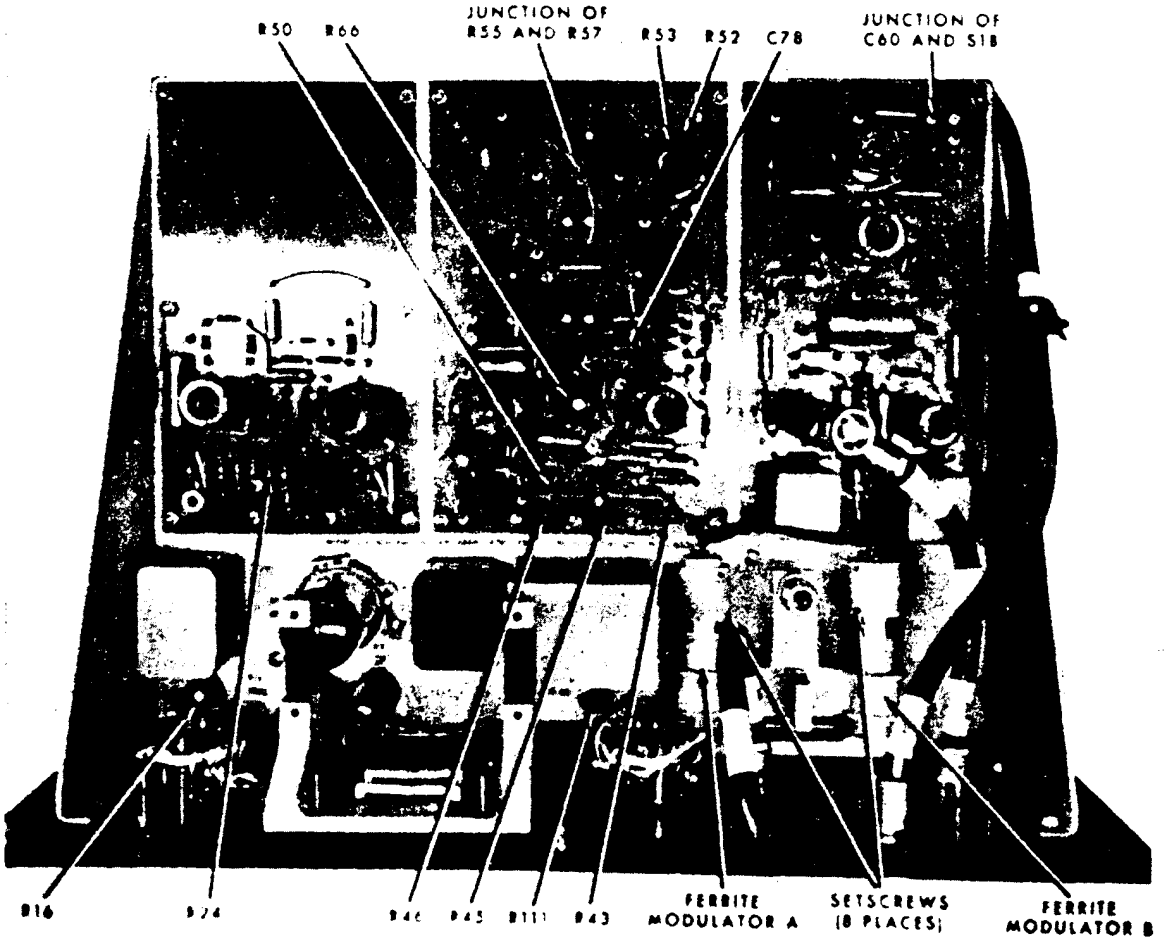


Figure 4. Radar target simulator - top view.

## 9. Power Supply Ripple

### a. Performance Check

(1) Connect cable assembly B7 and adapter B2 to Voltmeter No. 1 and connect it to the double banana jack on Voltmeter No. 2 (fig. 2).

(2) Voltmeter No. 1 should indicate no more than 50 mVrms.

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

## 10. Sawtooth Amplitude

### a. Performance Check

(1) Connect the equipment as shown in figure 5, connection "A".

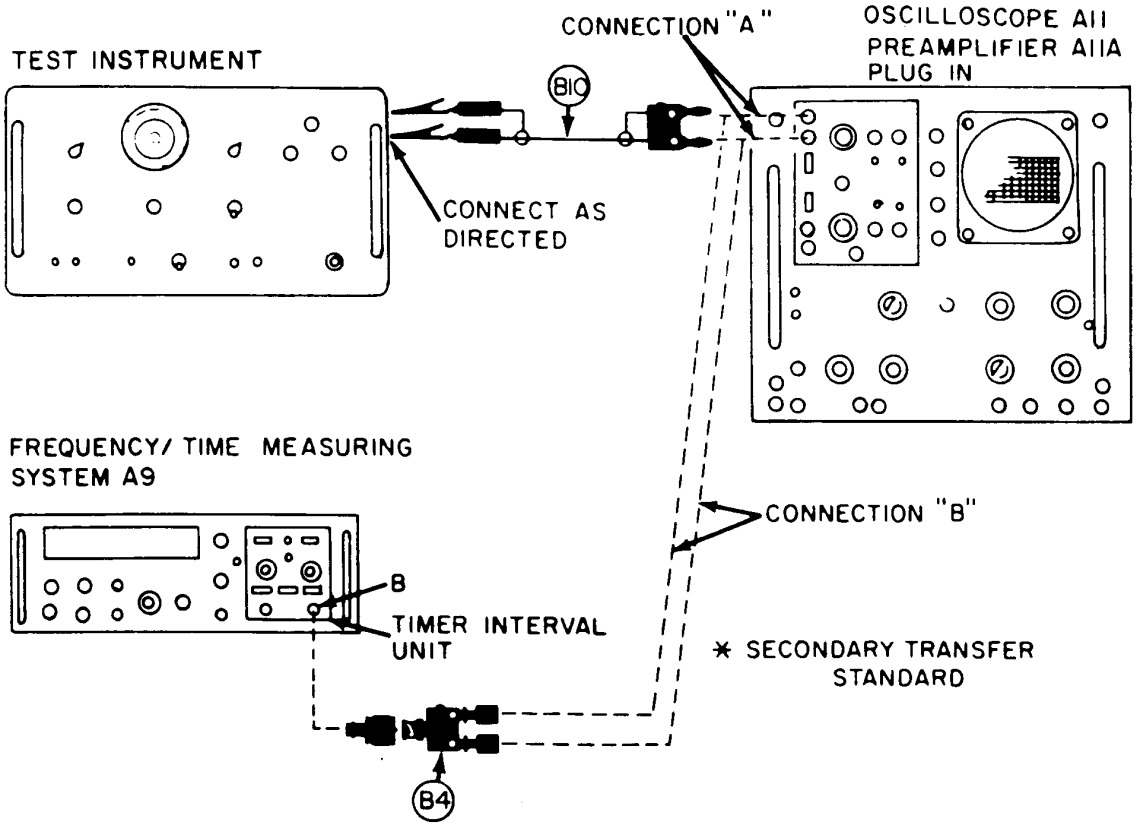


Figure 5. Sawtooth amplitude calibration - equipment setup.

(2) Turn REP RATE control on the test instrument fully clockwise.

(3) Connect cable assembly B10 between INPUT of oscilloscope and pin 2 of XV7 (fig. 3) and ground.

(4) The oscilloscope should indicate between 42 and 52 volts peak-to-peak.

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

**11. Repetition Rate**

**a. Performance Check**

(1) Insure that REP RATE control is turned to fully clockwise position.

(2) Adjust the controls of the oscilloscope until a stable presentation of three sawtooth waveforms is observed. The waveforms should be free of distortion.

(3) Connect the equipment as shown in figure 5, connection "B".

(4) Frequency/time measuring system should indicate from 48,000 to 52,000 usec.

(5) Turn REP RATE control on the test instrument fully counterclockwise. The frequency/time measuring system should indicate from 666,666 to 2,000,000 usec.

**b. Adjustments**

(1) Turn REP RATE control fully clockwise. Replace resistor R53 (fig. 4) with decade resistor B11 and adjust it for an indication of 50,000 usec on the frequency time measuring system.

(2) Replace resistor R53 with a fixed resistor whose resistance is equal to or closest to that which is indicated on the decade resistor.

(3) Turn REP RATE control fully counterclockwise and replace resistor R52 (fig. 4) with the decade resistor and adjust it for and indication of 1,000,000 usec on the frequency/time measuring system. (R52 may not be present in every unit.)

(4) Replace decade resistor R52 with a fixed resistor whose resistance is equal to or closest to that which is indicated on the decade resistor.

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

**12. Doppler Oscillator**

**a. Performance Check**

(1) Connect the input of the frequency/time measuring system to the junction of C60 and switch S1-B (fig. 4) and ground, using cable assembly B9.

(2) Turn SIGNAL SELECTOR switch on the test instrument to SIGNAL.

(3) Using cable assembly B5 and adapter B3 short pin 7 of XV9 (fig. 3) to ground.

(4) The frequency/time measuring system should indicate a frequency code of F + 3 kHz ±50 Hz.

(5) Disconnect cable assembly B9 from the SIGNAL INPUT jack of the frequency/time measuring system, and connect it to the adapter at INPUT of voltmeter No. 1. The voltmeter should indicate between 4.5 to 5.5 vrms. Record the indication.

(6) Turn the SIGNAL SELECTOR switch on the test instrument to S/N-10 B. The voltmeter should indicate 9 to 11 db less than the indication obtained in step (5) above.

(7) Turn the SIGNAL SELECTOR switch on the test instrument to S/N-20 DB. The voltmeter should indicate 19 to 21 db less than the indication obtained in step (5) above.

**b. Adjustments**

(1) Adjust variable resistor R16 (fig. 4) for an indication of frequency code F + 3 kHz on the frequency/time measuring system. Adjust C340 (in Z2) if R16 has insufficient range.

(2) Replace resistor R24 (fig. 4) with the decade resistor, and adjust for indication of 5 vrms on Voltmeter No. 1.

(3) Replace the decade resistor with a resistor of the closest value, and repeat steps **a**(5) through (7) above.

**13. Noise Oscillator Frequency**

**a. Performance Check**

(1) Disconnect cable assembly B9 from Voltmeter No. 1 and connect it to the frequency/time measuring system.

(2) Remove the short from pin 7 of XV9 (fig. 3).

(3) Turn % DUTY CYCLE switch of the test instrument to 100.

(4) Turn SIGNAL SELECTOR switch of the test instrument to NOISE. The frequency/time measuring system should indicate code G minus 10 ± 2 kHz.

**b. Adjustments**

(1) Replace capacitor C78 (fig. 4) with variable capacitance standard A5 and adjust for code G minus 10 indication on the frequency/time measuring system.

(2) Replace the variable capacitance standard with a capacitor of the closest value, determined in step (1) above, and repeat steps **a**(1) through (4) above.

**14. Noise Oscillator Amplitude**

**a. Performance Check**

(1) Disconnect cable assembly B10 from the frequency/time measuring system and connect it to Voltmeter No. 1.

(2) Connect the positive lead of cable assembly B10 to the white lead of one of the ferrite modulators (fig. 4) and the negative lead to the chassis ground.

(3) Turn SIGNAL SELECTOR switch of the test instrument to SIGNAL. The indication should be from 0.2 to 1.2 vrms on Voltmeter No. 1. Record the indication.

(4) Turn SIGNAL SELECTOR switch to NOISE.

(5) Turn REP RATE control fully clockwise. Voltmeter No. 1 should indicate within 1 db of the indication obtained in step (3) above.

(6) Connect to other modulator and repeat steps (3) through (5) above.

**b. Adjustments**. Adjust NOISE GAIN R66 (fig. 4) until the indication on Voltmeter No. 1 is the same as that recorded in step **a**(3) above.

**15. Duty Cycle**

**a. Performance Check**

(1) Connect the equipment as shown in figure 6.

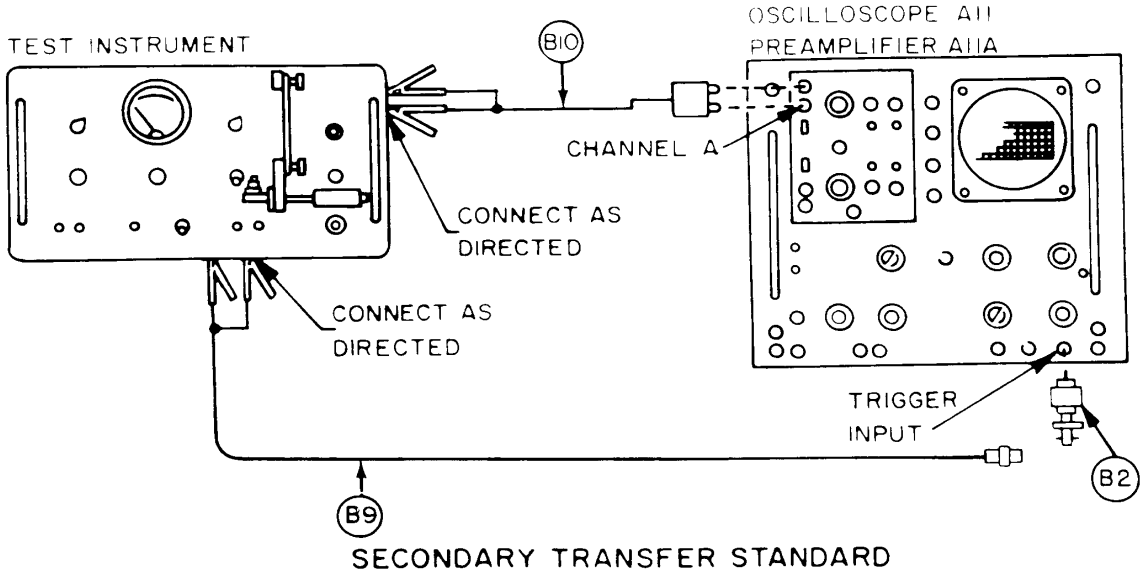


Figure 6. Duty cycle calibration - equipment setup.

(2) Connect cable assembly B10 to the white lead of the ferrite modulators (fig. 4) and ground of the chassis.

**NOTE**

Be careful not to connect the cable to the black lead of the ferrite modulators.

(3) Connect cable assembly B9 pin 3 of XV6 (fig. 3) and ground of the chassis.

(4) Position the oscilloscope controls as indicated in **(a)** through **(e)** below.

(a) TRIGGER MODE switch to AC.

(b) TRIGGER SYNC switch to EXT.

(c) STABILITY control to 0.

(d) TRIGGERING LEVEL control to 0.

(e) TIME CM switch to 5 MILLISEC.

(5) Position the preamplifier controls as indicated in (a) through (c) below:

(a) MODE switch to A ONLY.

(b) CHANNEL A VOLTS CM switch to 0.5.

(c) CHANNEL A VARIABLE control to CALIBRATED.

(6) Turn REP RATE control fully clockwise.

(7) Turn DUTY CYCLE switch to 20. The length of the sweep should be 9.8 to 10.2 cm and the length of the noise pulse should be 1.5 to 2.5 cm.

(8) Turn % DUTY CYCLE switch to 40. The length of the noise pulse should be 3.5 to 4.5 cm.

(9) Turn % DUTY CYCLE switch to 60. The length of the noise pulse should be 5.5 to 6.5 cm.

(10) Turn % DUTY CYCLE switch to 80. The length the noise pulse should be 7.5 to 8.5 cm.

(11) Turn % DUTY CYCLE switch to 100. The length of the noise pulse should be between 9.5 and 10.5 cm.

**b. Adjustments**

(1) Repeat step **a**(11) above.

(2) Replace resistor R50 (fig. 4) with the decade resistor and adjust the decade resistor to obtain a 10-cm length noise pulse on the oscilloscope.

(3) Replace the decade resistor with a fixed resistor whose value is in close proximity with that indicated on the decade resistor.

(4) Repeat steps (2) and (3) above, substituting the values and settings listed in table 5. Replace decade resistor with a fixed resistor whose value is in close proximity with that indicated on the decade resistor.

Table 5. Duty Cycle

| % Duty Cycle Switch Setting | Resistor (Fig. 4) | Noise Pulse Length (Cm) |
|---|---|---|
| 60 | R46 | 6 |
| 40 | R45 | 4 |
| 20 | R43 | 2 |

(5) Repeat steps **a**(1) through (12) above.

## 16. Sideband Modulation

### a. Performance Check

(1) Connect equipment as shown in figure 7.

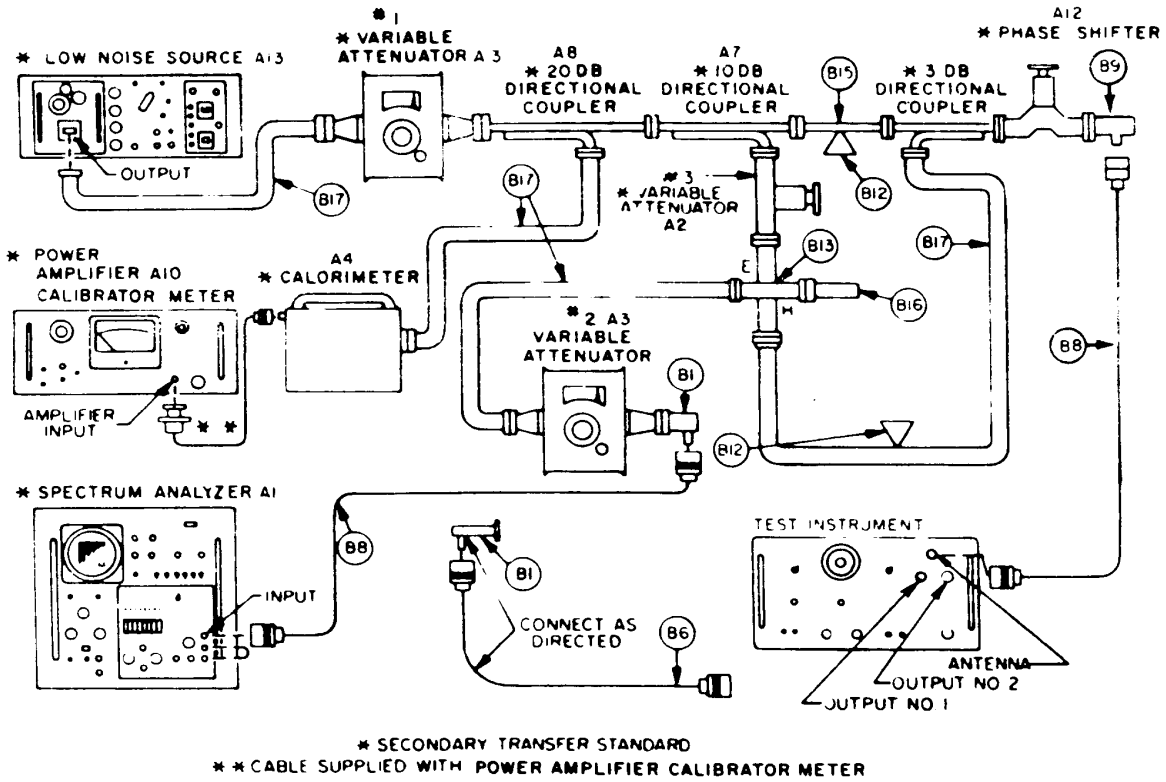


Figure 7. Sideband modulation - equipment setup.

(2) Turn SIGNAL SELECTOR switch on the test instrument to OFF, and the ATTENUATOR control to 0.

(3) Turn variable attenuators nos. 1, 2, and 3 for maximum attenuation.

(4) Turn phase shifter A12 fully counterclockwise.

**CAUTION**

In turning control, be careful not to jam it past stop.

(5) Energize low noise source A13. Turn FUNCTION SELECTOR switch on the low noise source to NOISE.

(6) Adjust no. 1 variable attenuator A3 until calibrator power amplifier meter A10 indicates 2 mw.

(7) Turn no. 2 variable attenuator A3, to 30 db.

(8) Adjust the controls on spectrum analyzer (A1, table 2) for a spectrum presentation output pip ($f_o$).

(9) Adjust no. 2 variable attenuator for 4-cm amplitude on the spectrum analyzer.

(10) Alternately turn no. 3 variable attenuation A2 and the phase shifter until the carrier spike disappears into the baseline noise on the spectrum analyzer.

(11) Adjust no. 2 variable attenuator for a 4-cm amplitude on the spectrum analyzer.

(12) Turn no. 3 variable attenuator and the phase shifter for null on the spectrum analyzer.

(13) Repeat steps (11) and (12) above until no. 2 variable attenuator indicates 0 db and the carrier can be nulled no further.

(14) When no. 2 variable attenuator indicates 0, turn it to 40 db. The presentation on the spectrum analyzer should decrease in amplitude. If the amplitude does not decrease, check for leakage at the flanges and components, then repeat steps (11) through (13) above.

(15) Rotate no. 2 variable attenuator to 12 db.

(16) Turn SIGNAL SELECTOR switch to NOISE.

(17) Adjust VERTICAL GAIN on spectrum analyzer for 4-cm amplitude (upper sideband, fig. 8).

**NOTE**

If spectrum analyzer TEK-R491 is used, LSB and USB indications will be reversed. LSB will be displayed on left side and USB will be displayed on the right side.

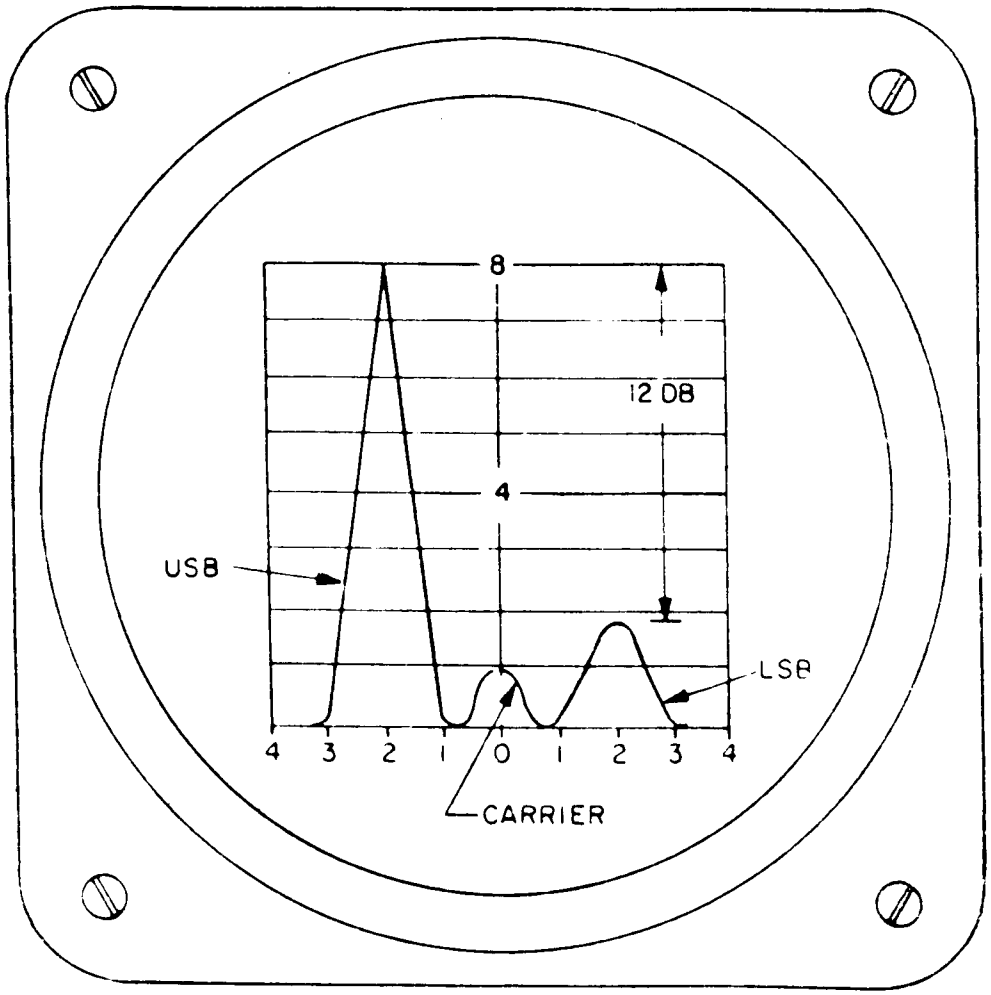


Figure 8. Sideband suppression waveforms.

(18) Maintain the carrier at null and turn no. 2 variable attenuator to 0 db. The suppressed sideband should be less than 4-cm in amplitude, as indicated in figure 8.

**b. Adjustments**

(1) If the carrier cannot be nulled, repeat steps **a**(3) through (13) above.

(2) Loosen three setscrews (fig. 4) on each magnet-retaining ring on either ferrite.

(3) Slide the magnet slightly back and forth along the ferrite container until null is obtained on the spectrum analyzer. When null is obtained, turn no. 2 variable attenuator toward 45 db. The presentation should decrease in amplitude.

(4) Tighten the setscrews. The carrier presentation should remain nulled.

(5) If the lower sideband is not suppressed at least 12 db below the upper sideband, repeat adjustment in steps (1) through (4) above. If the lower sideband is still not sufficiently suppressed, connect the voltmeter to the white lead of ferrite modulator A and then to the white lead of ferrite modulator B. The noise drive signal should be present at both ferrites. To improve suppression of the lower sideband, it may be necessary to degauss the ferrites.

(6) If the upper sideband is suppressed, reverse the white and black leads on either ferrite. Repeat steps **a**(3) through (18) above.

**17. OUTPUT No. 1 and OUTPUT No. 2**

**a. Performance Check**

(1) Disconnect no. 2 variable attenuator from the waveguide assembly.

(2) Connect adapter B1 and cable assembly B6 between no. 2 variable attenuator and OUTPUT No. 1 on the test instrument.

(3) Adjust no. 2 variable attenuator for 4-cm amplitude on the spectrum analyzer. Record the variable attenuator setting.

**NOTE**

No. 1 variable attenuator may be adjusted for good presentation on the spectrum analyzer.

(4) Disconnect the cable assembly from OUTPUT No. 1, and connect it to OUTPUT No. 2 on the test instrument.

(5) Adjust no. 2 variable attenuator to reestablish 4-cm amplitude on the spectrum analyzer. Observe the attenuator setting. The difference in attenuator settings must be within ±1. 5 db of that recorded in step (3) above.

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

**18. Attenuator**

**a. Performance Check**

(1) Disconnect cable P6 from J6 of the test instrument.

(2) Disconnect the cable assembly from OUTPUT No. 2 and connect it to J6 of the test instrument.

(3) Turn the ATTENUATOR control on the test instrument to 20.

(4) Turn no. 2 variable attenuator to 0.

(5) Adjust GAIN control on the spectrum analyzer for a 4-cm amplitude.

**NOTE**

No. 1 variable attenuator may be adjusted for a good presentation on the spectrum analyzer.

(6) Turn the attenuator control on the test instrument to 0.

(7) Turn no. 2 variable attenuator until a 4-cm amplitude is reestablished on the spectrum analyzer. The indication on the variable attenuator should be 19.5 to 20.5 db.

**b. Adjustments**

(1) Turn no. 2 variable attenuator to 20.

(2) Adjust the ATTENUATOR control on the test instrument until a 4-cm amplitude is reestablished on the spectrum analyzer.

(3) Loosen the setscrew on the knob of the attenuator dial on the test instrument. Set the attenuator dial to 0. Tighten the setscrews.

(4) Turn the ATTENUATOR control on the test instrument to 20.

(5) Turn no. 2 variable attenuator toward 0 until a 4-cm amplitude is established on the spectrum analyzer. The indication on the variable attenuator should be 0 db.

**19. Final Procedure**

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

**b**. In accordance with TM 38-750, annotate and affix calibration DA Label 80 (U.S. Army Calibration System). When the test instrument cannot be adjusted to within tolerance, annotate and affix DA Form 2417 (Unserviceable Test Instrument or Standard) (red tag).

## CHAPTER 3
## CALIBRATION AT IMPROVED HAWK SITES

### SECTION I. SPECIFICATIONS AND EQUIPMENT REQUIREMENTS

**20. Calibration Description**. Test instrument parameters and performance specifications which pertain to this calibration are listed in table 6.

**21. Equipment Required.** Table 7 identifies the specific equipment used in this calibration procedure. This equipment is issued with secondary transfer calibration standards set 4931-621-7877 and is to be used in performing)- this procedure. Alternate

items may be used by the calibrating activity when the equipment listed in table 7 is not available; however, items selected must be verified to perform satisfactorily prior to use. All applicable equipment items used must bear evidence of current calibration.

Table 6. Calibration Description

| Test Instrument Parameters | Performance Specifications |
|---|---|
| Note: For frequency codes below, refer to drawing 10105207. | |
| Input voltage | 115 ±10 V rms, 400 Hz |
| Frequency | Code A ±125 MHz |
| Doppler signal | Code F + 3 ± .05 kHz at 5 ±0.5 V rms |
| Ferrite modulator | Lower sideband at least 12 db below the upper sideband |
| DC power supply | 250 V dc ±2%, ripple NMT 50 mV rms |
| Attenuator | ±1.0 dB at 20 db |

**21. Equipment Required.** Table 7 identifies the specific equipment used in this calibration procedure. This equipment is issued with secondary transfer calibration standards set 4931-621-7877 and is to be used in performing)- this procedure. Alternate items may be used by the calibrating activity when the equipment listed in table 7 is not available; however, items selected must be verified to perform satisfactorily prior to use. All applicable equipment items used must bear evidence of current calibration.

Table 7. Minimum Specifications of Equipment Required

| Item | Nomenclature | Minimum use specifications | Calibration equipment and part number |
|---|---|---|---|
| A1 | Ac/dc voltmeter | Capacity: 245 to 255 V dc, .05 to 125 V ac 400 Hz to 10 kHz<br>Accuracy: ±2% | Dana 5600, 7912073-3 |
| A2 | Analyzer[1], spectrum | Code "A" ±125 MHz -90 dBm sensitivity minimum | TEK R491, MIS-10218 |
| A3 | Counter, electrical digital | Code "F" + 3 kHz to code "A" | Systron Donner 1037M, 7910823 |
| A4 | Signal source system | Code "A" ±125 MHz 20 mw output minimum | PRD 7923114 |
| A4A | Power supply | | PRD 816-510 7923105 |
| A4B | RF head assembly | | PRD CX 7006 7923023 |
| A4C | Tunable synchronizer | | LFE 243A 7923102 |
| A5 | Meter SWR | Range: 0-25 dB<br>Accuracy: .05 dB per 10 dB steps | Y10-115E 7910160-3 |

[1]If spectrum analyzer is not available, use oscilloscope RM331 and a plug-in 1L30 located in calibration measure set 7910590.

**22. Accessories Required.** The accessories listed in table 8, issued with secondary transfer calibration standards set 4931-621-7877, are to be used in this calibration procedure. The accessory items listed in table 8 may be substituted by equivalent items unless specifically prohibited.

Table 8. Accessories Required

| Item | Nomenclature | Description And Part Number |
|---|---|---|
| B1 | Adapter[1] connector | UG 57 B/U |
| B2 | Adapter wave-guide to[2] | Code A PRD 354C, 10519423 |
| B3 | Attenuator[1] variable | 0 to 20 db Code a 7923131 |
| B4 | Attenuator video | DC to 1 GHz, HFA 50, 7923143 |
| B5 | Crystal detector | "N" plug to BNC jack, HP423A, 7923182 |

See footnote at end of table.

Table 8. Accessories Required - Continued.

| Item | Nomenclature | Description and part number |
|---|---|---|
| B6 | Coupler, directional[1] | Code A 10 db 40 db isolation PRD 408-54, 7923188 |
| B7 | Coupler, directional | Code A, 10 db PRD 434-1051, 7923158 |
| B8 | Cable assembly,[3] RF | Connectors N-plug, RG-9A/U 10519072 18 in. |
| B9 | Cable assembly, RF | Connectors, UG-88/U BNC plug, 10519141 24 in. |
| B10 | Transformer, variable power | 400 Hz input, 115 vac, 1.5 amp output GR W10MT-3A 7910809 |
| B11 | Magic tee[4] | RAY 341M01128P001 (PRD 481) |
| B12 | Phase shifter[4] | 0 to 360° phase shift at Code A RAY 341M01134P001 (PRD X335) |
| B13 | Cable assembly RF | BNC plug to 2 alligator clips 36 in. long ALCBNC 36, 7909410 |
| B14 | Isolator | 1203B (PRD) 7923167 |
| B15 | Crystal detector | HP423 7910906 or 7923182-2 |
| B16 | Waveguide termination | 7923205-5 |
| B17 | Adapter connector | UG-29/U 10519455 |

[1]Two required.
[2]Five required.
[3]Four required.
[4]Four required.
[5]Items located in calibration measure set 7910590.

## SECTION II
## PRELIMINARY OPERATIONS

### 23. Preliminary Instructions

**a.** The instructions outlined in this section 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 test by common name. For identification of equipment referenced by item prefixed with A, see table 2 and for prefix B, see table 3.

**c**. Refer to figure 1 for all controls and indicators unless otherwise directed.

**WARNING**

Dangerous voltages exist in this equipment. DEATH OR INJURY on contact may result if personnel fail to observe proper safety precautions. Use extreme care when making connections between the standards and the test instrument.

### 24. Equipment Setup

**a**. Connect the equipment as shown in figure 9.

**b**. Connect variable power transformer B10 to a 115 vrms 400 Hz power source and adjust variable power transformer B10 for 115 vrms.

**c**. Set the test instrument power ON/OFF switch to ON.

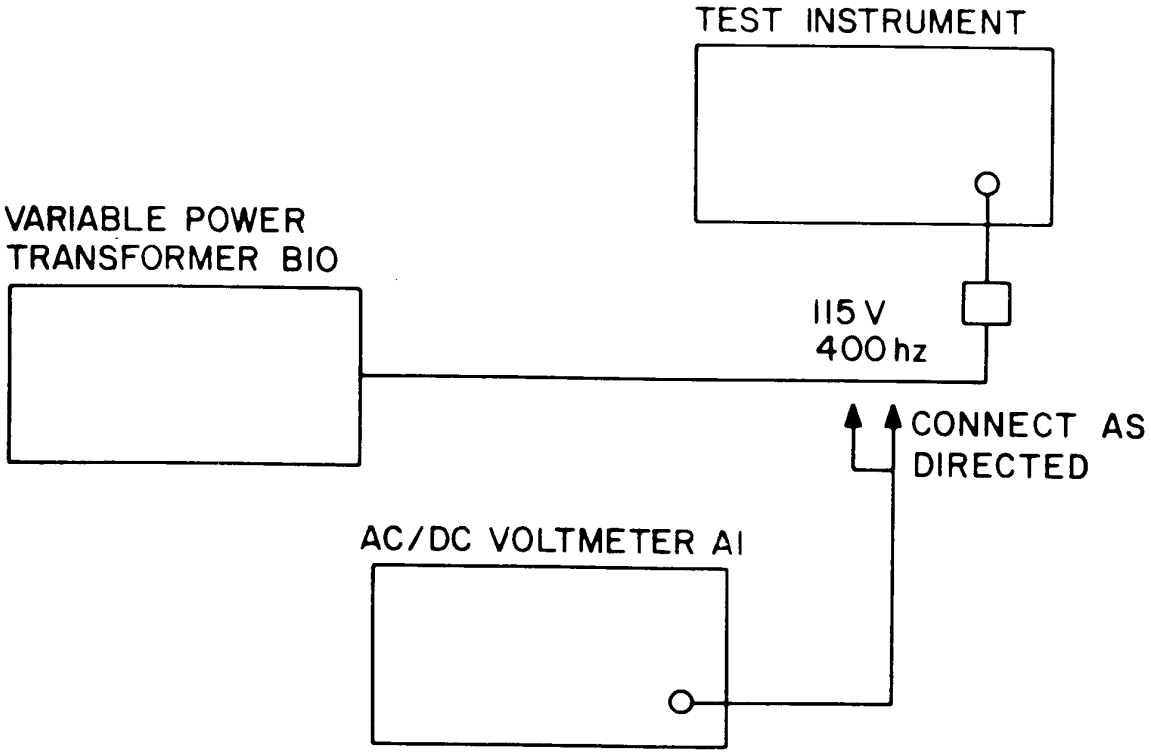


Figure 9. Power supply check - equipment setup.

**d**. Ascertain that the blower motor is operating, as evidenced by audible hum.

**e**. Set the power ON/OFF switch to OFF.

**f**. Adjust variable power transformer for minimum output.

## SECTION III
## CALIBRATION PROCESS

### 25. Power Supply Adjustments

#### a. Performance Check

(1) Remove the test instrument from its protective case.

(2) Turn SIGNAL SELECTOR switch to OFF

(3) Connect the AC/DC Voltmeter A1 leads between XV15-6 (fig. 3) and ground.

(4) Set the AC/DC Voltmeter function switch to DC and the range switch to AUTO.

(5) Adjust the autotransformer for 115 VOLTS output.

(6) Set the test instrument power ON/OFF switch to ON, and allow 15 minutes for the equipment to warm up and stabilize.

(7) The AC/DC Voltmeter A1 should indicate 245 to 255 vdc. Record the indication

(8) Set the AC/DC Voltmeter function switch to AC and observe that the AC/DC Voltmeter indicates 50 mVac maximum.

(9) Set the AC/DC Voltmeter function switch to DC and adjust the variable power transformer first for 105 and then for 125 volts. The indication on the AC/DC Voltmeter should not vary by more than ±2 percent from the indication recorded in step 7 above.

(10) Adjust the variable power transformer for 115 volts.

**b. Adjustments**

(1) Adjust R111 (fig. 4) for 250 volts dc on AC/DC Voltmeter.

(2) Repeat step **a**(9) above.

**26. Signal Oscillator**

**a. Performance Check**

(1) Set the test instrument SIGNAL SELECTOR switch to SIGNAL.

(2) Connect RF cable assembly B13 between the electrical digital counter C INPUT and the junction of C60 and S1-B (fig. 4) on the test instrument with the black clip connected to ground and observe that the electrical digital counter indicates code F +3 kHz ± 50 Hz. (Perform adjustment **b**(1).

(3) Connect the AC/DC Voltmeter test leads between the junction of C60 and S1-B (fig. 4) and ground.

(4) Set the AC/DC Voltmeter function switch to AC and observe that the AC/DC Voltmeter indicates 4.5 to 5.5 vac. (Perform adjustment **b**(2) (3).

**b. Adjustments**

(1) Adjust variable resistor R16 (fig. 4) for an indication of code F + 3 Hz on the electrical digital counter. Adjust C340 (in Z2) if R16 has insufficient range.

(2) Replace resistor R24 (fig. 4) with the decade resistor, and adjust for an indication of 5 volts rms on the AC/DC voltmeter.

(3) Replace the decade resistor with a resistor of the closest value, and repeat steps **a**(1) through (5) above.

## 27. Sideband Modulation

### a. Performance Check

(1) Connect equipment as shown in figure 10.

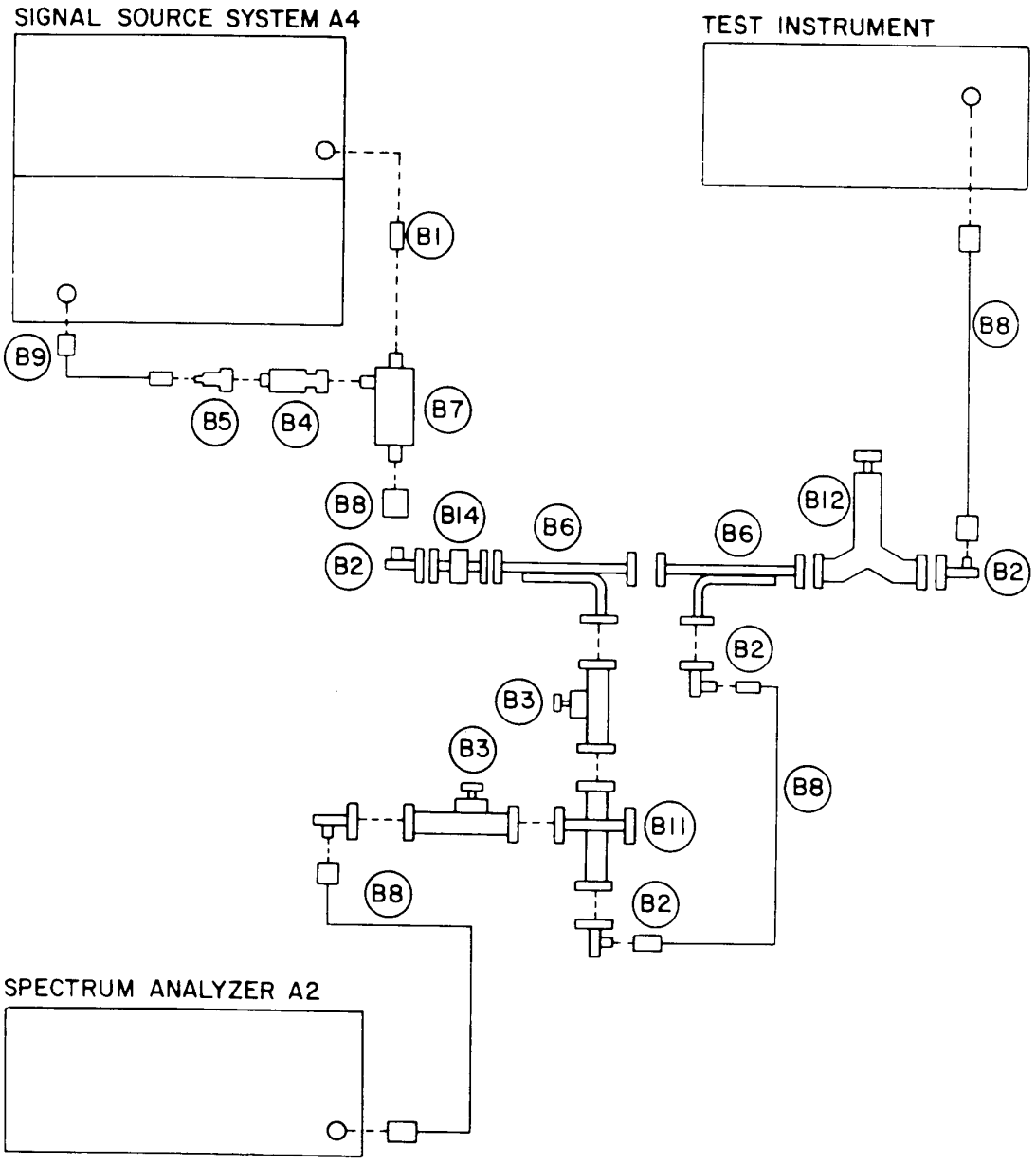


Figure 10. Sideband modulation check - equipment setup.

(2) Turn test instrument SIGNAL SELECTOR switch to SIGNAL, and variable attenuator to 0 db (fig. 1).

(3) Turn all variable attenuators for maximum attenuation.

(4) Turn phase shifter B12 fully counterclockwise.

**CAUTION**

In turning control, be careful not to jam it past the stop.

(5) Energize tithe signal source system (A4) and adjust for code A output.

(6) Adjust the controls on spectrum analyzer A2 for a spectrum presentation output pip ($f_o$).

(7) Maintain signal on spectrum analyzer by adjusting no. 2 variable attenuator.

(8) Turn the phase shifter clockwise until the carrier is nulled.

**NOTE**

Adjust the dispersion control on A2 for 5-10 kHz per division.

(9) Turn No. 1 variable attenuator B3 clockwise and then counterclockwise until the spectrum analyzer displays a sharp carrier null Slowly turn no. 1 attenuator through null, the presentation should increase in amplitude on both sides of null. Then obtain the best carrier null.

(10) Alternately turn no. 1 variable attenuator and the phase shifter until the carrier spike disappears into the baseline noise on the spectrum analyzer. Perform adjustments **b**(1) through **b**(4).

(11) Adjust no. 2 variable attenuator for 3-cm amplitude on the spectrum analyzer.

**NOTE**

If the carrier can not be suppressed, check for leakage at the flanges and components.

(12) The lower sideband shall be greater than 12 db below the upper sideband (fig. 8).

(13) Set the test instrument ON/OFF switch to OFF and disconnect the power cable from the test instrument and variable power transformer B10.

**b. Adjustments**

(1) If the carrier cannot be nulled, repeat steps **a**(1) through (10) above.

(2) Loosen three setscrews (fig. 4) on each magnet retaining ring on ferrite.

(3) Slide the magnet slightly back and forth along the ferrite container until null is obtained on the spectrum analyzer.

(4) Tighten the setscrews. The carrier presentation should remain nulled.

(5) If the lower sideband is not suppressed at least 12 db below the upper sideband, repeat adjustment in steps (1) through (4) above. If the lower sideband is still not sufficiently suppressed, connect the true rms voltmeter to the white lead of ferrite A and then to the white lead of ferrite B. The noise drive signal should be present at both ferrites. To improve suppression of the lower sideband, it may be necessary to degauss the ferrites.

(6) If the upper sideband is suppressed, reverse the white and black leads on either ferrite. Repeat steps **a**(1) through (18) above.

**28. Attenuator**

**a. Performance Check**

(1) At the test instrument, remove P6 from J6.

(2) Connect the equipment as shown in figure 11, connection A.

(3) Establish a reference on the VSWR indicator A5, using variable attenuator B3 and the VSWR indicator controls.

(4) Connect the equipment as shown in figure 11, connection B.

(5) The indication the VSWR indicator decreases not more than 5 db.

(6) Reestablish a reference on the VSWR indicator.

(7) Set the test instrument ATTENUATOR to 20 db.

(8) The indication on the VSWR indicator decreases 19 to 21 db.

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

**29. Final Procedure**

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

**b**. In accordance with TM 38-750, annotate and affix calibration DA Label 80 (U. S. Army Calibration System). When the test instrument cannot be adjusted to within tolerance, annotate and affix DA Form 2417 (Unserviceable Test Instrument or Standard) (red tag).

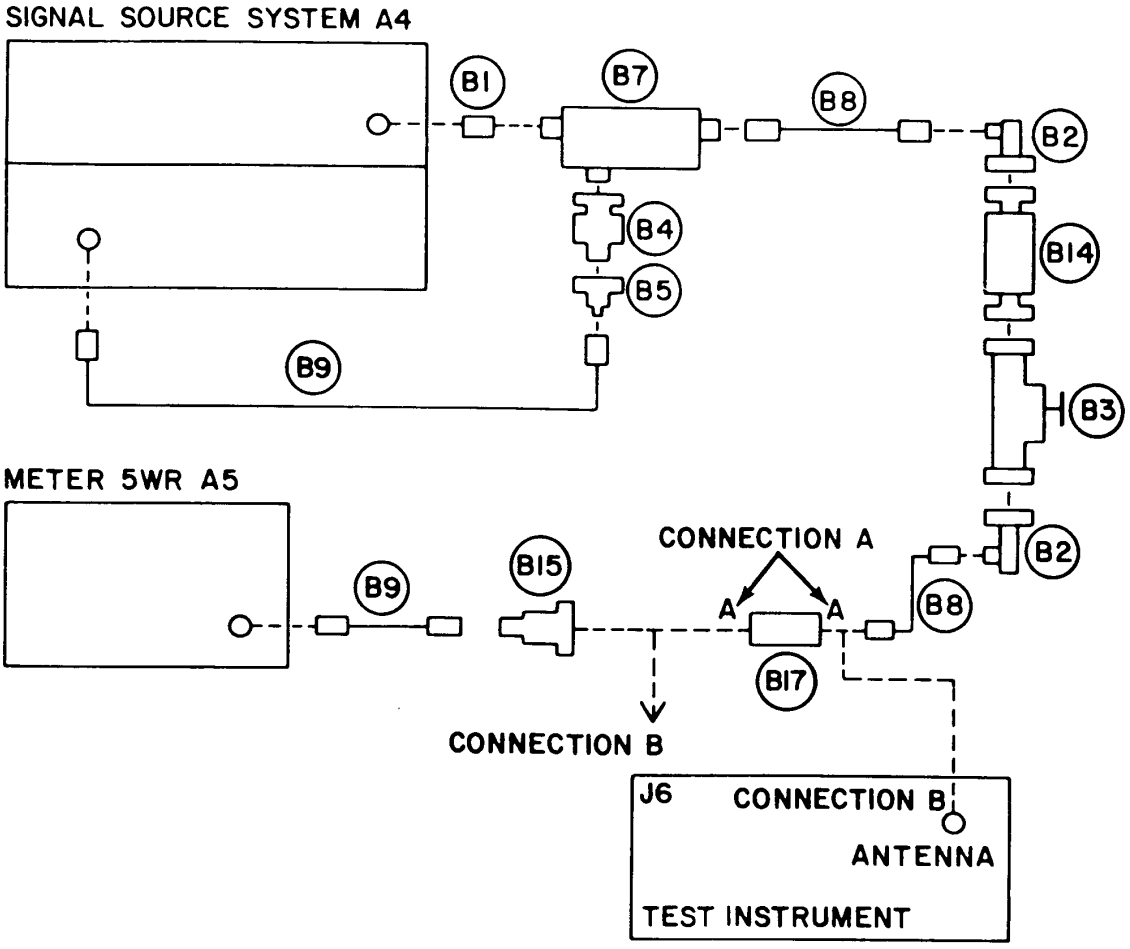


Figure 11. Attenuator check - equipment setup.

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