AIR GROUND RADIO
PRIVATE SYSTEMS
ECHO-FOX UHF RADIO SYSTEM
AUXILIARY EQUIPMENT AND ANTENNA SYSTEMS TESTS

Equipment installed in the auxiliary bay (Fig. 1) is tested at the base station. This equipment includes the following major items; diplexer (duplexer) (Comm. Prod 525-509), Station Guardian (Bendix Model SG-33), RF loopback converter-oscillator (Radio Specialty Model 1156-16-1), data auxiliary set 806A3 (CD-1D053-01), and RF loopback cavity filters. Functional descriptions of these units are included in Section 406-116-101.

This section is reissued to reflect the deletion of wideband service.

Equipment Test Lists are affected.

The performance of this equipment may be monitored by maintaining a record of test results. A sample maintenance log (Fig. 2) is included in this section.

CHART **PAGE**

APPARATUS

1—FM Deviation Meter, w/built-in oscilloscope

1—Transmission Measuring Set J94021A (21A TMS)

1—Power Meter (Jones Micro Match 711N)

1—Volt-Ohm-Milliammeter (VOM) KS-14510

1—Station Guardian Test Set (Dwg FA11035 and CD-EA11035) or (Bendix)

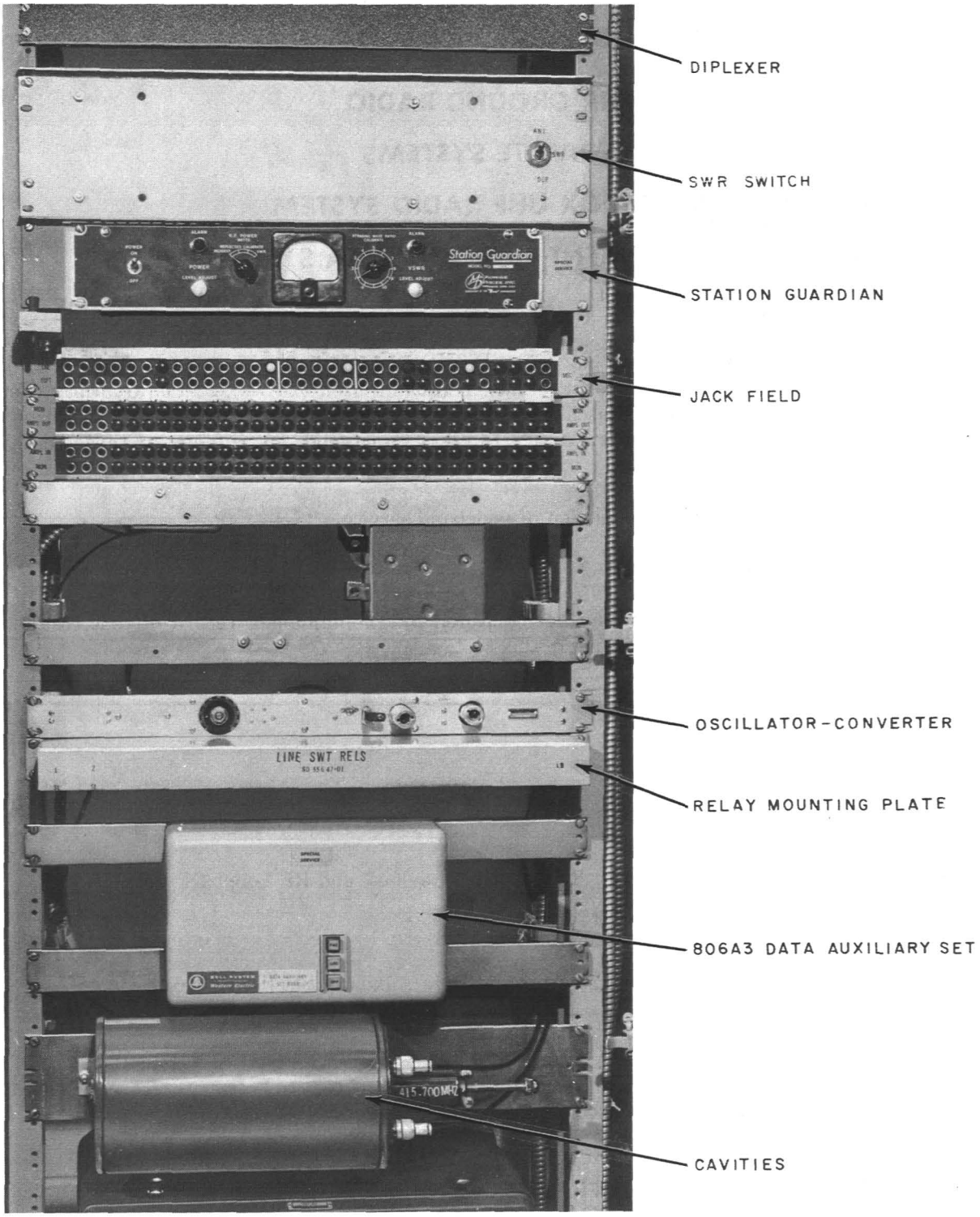


Fig. 1—Auxiliary Bay—Echo-Fox UHF Radio System

MAINTENANCE LOG

EQUIPMENT	INDICATION		TECHNICIAN	DATE
	INITIAL	FINAL		
1. Station Guardian				
a. POWER ALARM (watts)				
b. VSWR ALARM (ratio)				
c. ACCURACY-FS (dc)				
2. Directional Coupler				
a. Duplexer				
(1) FORWARD POWER WATTS				
(2) REVERSE POWER WATTS				
b. Antenna				
(1) FORWARD POWER WATTS				
(2) REVERSE POWER WATTS				
3. Oscillator-Converter				
a. Frequency (MHz)				
b. Conversion Loss (dB)				
c. Variable Pad Loss (dB)				
4. Antenna VSWR				
a. System (ratio)				
b. Loopback-Receive (ratio)				
c. Loopback-Transmit (ratio)				

Remarks: (Description of trouble, test performed, etc)

Fig. 2—Sample Maintenance Log

APPARATUS (Cont):

1—Test Cable Set, Amphenol C133-216

(Dwg FA11035 and CD-EA11035)

1—Test Cord 3P15A

3—Test Cords 1P2A

1—Test Cord 2P13A

1—Terminating Plug, 600-ohm, type 386A

8—Dummy Plugs, type 258

1—Drawing FA40843

1—RF Signal Generator, capable of supplying 406 to 470 MHz

CHART 1

TEST OF STATION GUARDIAN

The Station Guardian (Fig. 3 and 4) monitors RF power output (incident power), reflected power, and voltage standing wave ratio (VSWR). It indicates abnormal changes over preset values of VSWR and incident power. If test requirements are not met, test vacuum tubes and relays.

STEP	PROCEDURE
1	At the base station, obtain a circuit release from the control office.
2	At the auxiliary bay jack field, insert a dummy plug into the TC1 LINE jack.

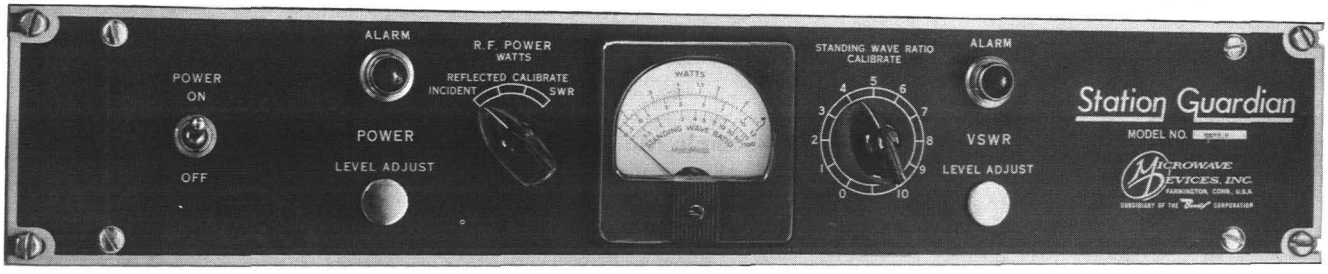
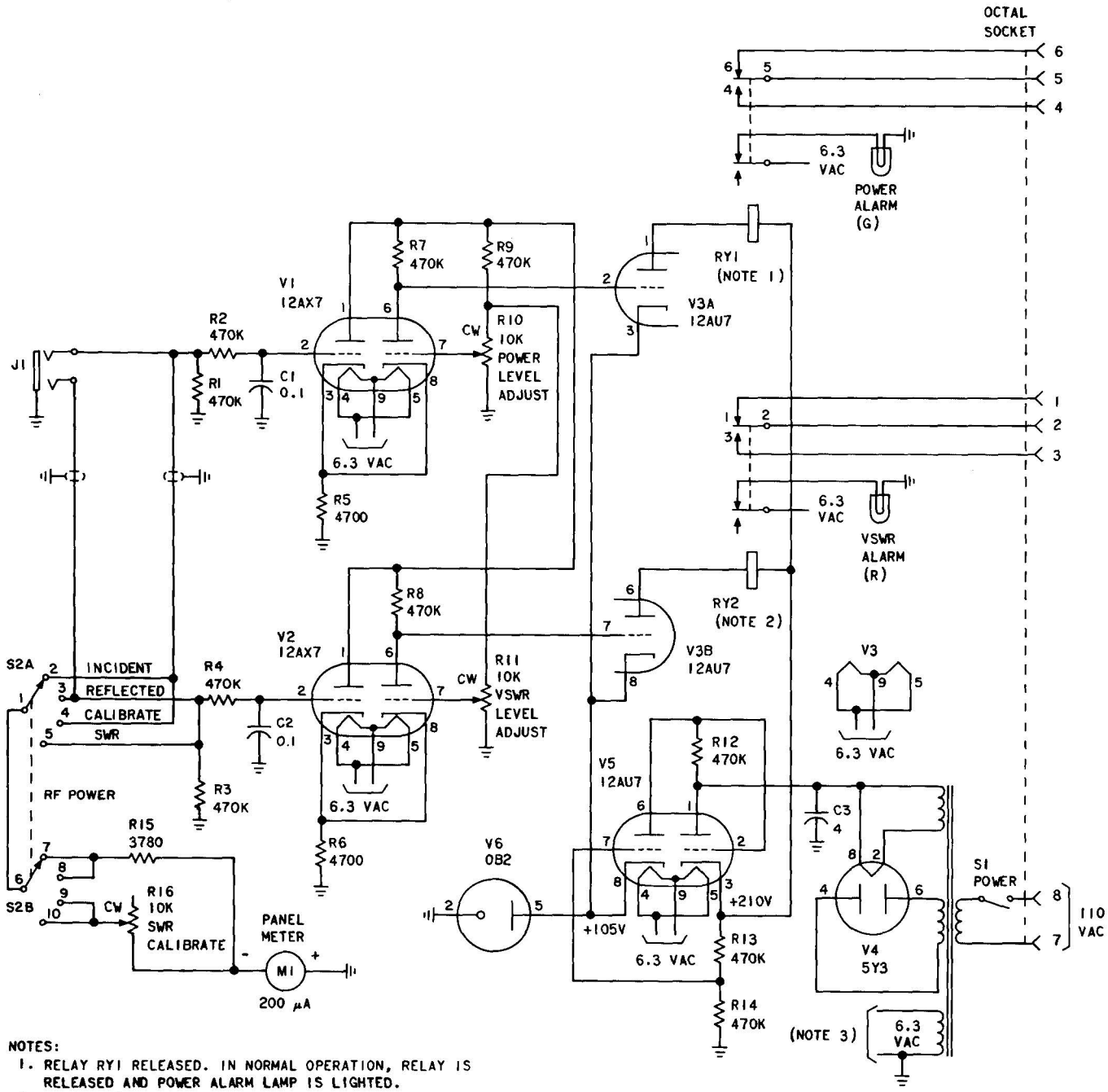


Fig. 3—Station Guardian—Echo-Fox UHF Radio System



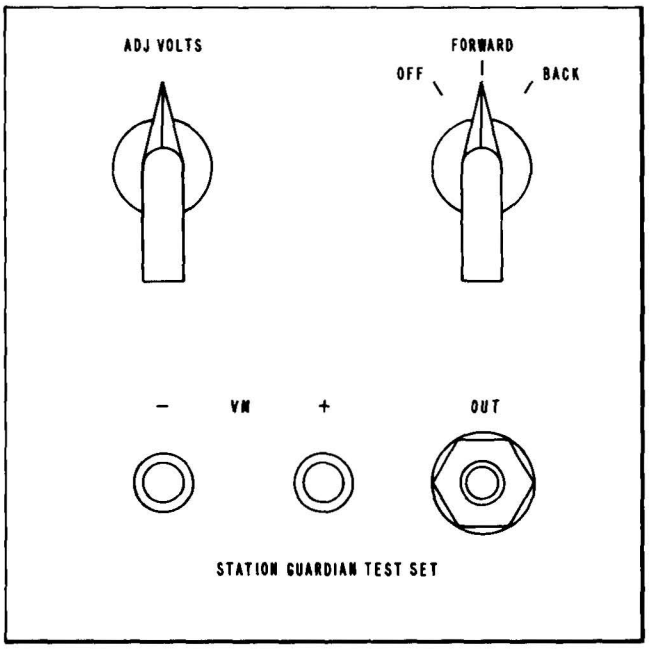
NOTES:

1. RELAY RY1 RELEASED. IN NORMAL OPERATION, RELAY IS RELEASED AND POWER ALARM LAMP IS LIGHTED.
2. RELAY RY2 RELEASED. IN NORMAL OPERATION, RELAY IS OPERATED AND VSWR ALARM LAMP IS EXTINGUISHED.
3. FILAMENT VOLTAGE TO V1, V2, V3, V5, POWER ALARM LAMP, AND VSWR ALARM LAMP.

Fig. 4—Station Guardian—Schematic Diagram—Echo-Fox UHF Radio System

CHART 1 (Cont)

STEP	PROCEDURE
3	At the Station Guardian, set POWER switch to ON; allow a 5-minute warm-up.
	Note: Test the external alarm system if one is connected to the Station Guardian.
4	Prepare the Station Guardian Test Set (SGTS) (Fig. 5) as follows: ADJ VOLTS switch to fully counterclockwise Function switch to OFF
5	At the Station Guardian, disconnect the cord and plug from jack J1; patch J1 with test cord 3P15A to the OUT jack on the SGTS.
6	Prepare the VOM for voltage measurements and connect it to the VM jacks on the SGTS.
7	On the Station Guardian, set the RF POWER selector switch to INCIDENT (Fig. 3).
8	On the SGTS, set the function switch to FORWARD; turn ADJ VOLTS clockwise to obtain full-scale deflection on the panel meter of the Station Guardian.
	Requirement: 1.0 $\pm$0.1 volt on VOM.



FRONT VIEW

Fig. 5—Station Guardian Test Set—Echo-Fox UHF Radio System

CHART 1 (Cont)

STEP	PROCEDURE
9	If the requirement in Step 8 is not met, test R15 and M1 in the Station Guardian.
10	On the Station Guardian, set the selector switch to REFLECTED.
11	On the SGTS, set the function switch to BACK; turn ADJ VOLTS to obtain full-scale deflection on the panel meter of the Station Guardian.
	Requirement: 1.0 $\pm$0.1 volt on VOM.
	Forward Power Alarm Test
12	Prepare the SGTS as follows: Function switch to FORWARD ADJ VOLTS switch to fully counterclockwise
13	On the Station Guardian, set the selector switch to INCIDENT.
14	On the SGTS, turn ADJ VOLTS clockwise to obtain an indication of 2 (200 watts) on the panel meter (0 to 4 scale).
	Requirement: Green POWER ALARM lamp lights.
15	If the requirement of Step 14 is not met, slowly turn POWER LEVEL ADJUST clockwise to light the POWER ALARM lamp.
16	Slowly turn ADJ VOLTS counterclockwise to an indication of 1.25 (125 watts) on the 0 to 4 scale of the panel meter.
	Requirement: POWER ALARM lamp extinguishes at 1.25 $\pm$10%.
17	If the requirement of Step 16 is not met, slowly turn POWER LEVEL ADJUST counterclockwise to extinguish the green POWER ALARM lamp.
18	Repeat Steps 14 and 16 until the requirements are met.
	VSWR Alarm Test
19	On the Station Guardian, set the selector switch to INCIDENT and the STANDING WAVE RATIO CALIBRATE control fully counterclockwise.
20	On the SGTS, set the function switch to FORWARD and turn ADJ VOLTS for a meter indication of 2 (200 watts) on the panel meter.

CHART 1 (Cont)

STEP	PROCEDURE
21	On the Station Guardian, set the selector switch to CALIBRATE and turn the STANDING WAVE RATIO CALIBRATE control to obtain an indication of 100 on the panel meter (1 to 100 scale).
22	Set the selector switch to SWR.
23	On the SGTS, set function switch to REFLECTED; turn ADJ VOLTS fully counterclockwise.
	Requirement: Red VSWR ALARM lamp extinguishes at fully counterclockwise position of ADJ VOLTS control.
24	If the requirement of Step 23 is not met, slowly turn VSWR LEVEL ADJUST on the Station Guardian to extinguish the VSWR ALARM lamp.
25	Slowly turn ADJ VOLTS clockwise for an indication of 1.5 on the panel meter (1 to 100 scale).
	Requirement: Red VSWR ALARM lamp lights at 1.5 on the meter.
26	If the requirement of Step 25 is not met, slowly adjust VSWR LEVEL ADJUST to light the VSWR ALARM lamp.
27	Repeat Steps 23 and 25 until the requirements are met.
	Directional Coupler Test
	Note: If the following test requirements are not met, check the associated connectors and cabling and the crystals in the directional couplers.
28	On the Station Guardian, set the selector switch to INCIDENT.
29	Remove test cord 3P15A from jack J1; reconnect cord and plug from directional couplers.
30	On the dummy load panel, set SWR switch to DUP.
31	Patch the 711N power meter between the load side of the DUP directional coupler and the dummy load [patch (1), Fig. 6]; use a half-wave length of RF cable between the directional coupler and the power meter (RG8U: 5-3/8 inches).
	Note: A half-wave length exhibits identical impedance at either end.
32	On the 711N power meter, set the function switch to FORWARD 300.
33	At the jack field, connect a 1P2A test cord from the TRANS CONT TC1 EQPT jack to the −48V test jack (keying patch).

CHART 1 (Cont)	
STEP	**PROCEDURE**
	Caution: When connecting a keying patch, always connect to the −48V jack last. Disconnect in the reverse order, ie, disconnect from the −48V jack first.
	Requirement 1: Transmitter keyed.
	Requirement 2: Power output indication on panel meter of Station Guardian is within 10 percent of power indicated on the 711N power meter.
34	Disconnect the keying patch.
35	Patch the 711N power meter between the TRANSMITTER side of the DUP directional coupler and the dummy load [patch (2), Fig. 6].
36	At the Station Guardian, set the selector switch to REFLECTED.
37	At the jack field, connect the keying patch.

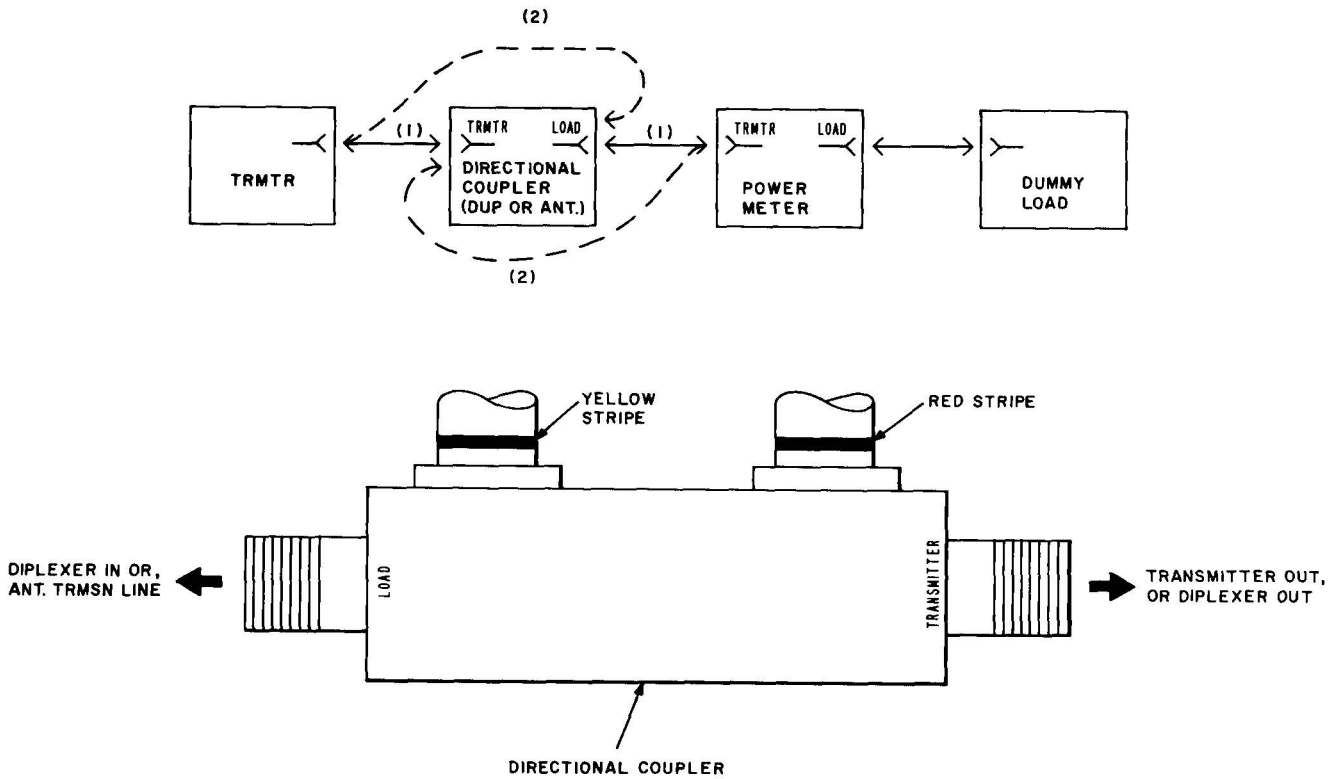


Fig. 6—DUP and ANT Directional Couplers—Test Layout—Echo-Fox UHF Radio System

CHART 1 (Cont)

STEP	PROCEDURE
	Requirement 1: Transmitter keyed.
	Requirement 2: Power output indication on panel meter is within 10 percent of power indicated on the 711N power meter.
38	Disconnect the keying patch.
39	Disconnect the power meter and connect the DUP directional coupler in the normal manner (FA40843).
40	On the dummy load panel, set SWR switch to ANT.
41	Connect the power meter between the load side of the ANT directional coupler [patch (1), Fig. 6] and the dummy load.
42	At the Station Guardian, set the selector switch to INCIDENT.
43	At the jack field, connect the keying patch.
	Requirement 1: Transmitter keyed.
	Requirement 2: Power output indication on panel meter is within 10 percent of power indicated on power meter.
44	Disconnect the keying patch.
45	Patch the power meter between the TRANSMITTER side of the ANT directional coupler and the dummy load [patch (2), Fig. 6].
46	At the Station Guardian, set the selector switch to REFLECTED.
47	Connect the keying patch.
	Requirement 1: Transmitter keyed.
	Requirement 2: Power output indication on panel meter is within 10 percent of power indicated on power meter.
48	Disconnect the keying patch.
49	Connect the ANT directional coupler in the normal manner; disconnect the dummy load and connect the station antenna; remove the dummy plug from the TC1 LINE jack.
50	Restore external alarms and return the circuit to service via the control office.

CHART 2

TEST OF STATION ANTENNAS

The VSWR of each of the three station antennas and RF transmission lines (one system antenna, two RF loopback antennas) is tested using the Station Guardian, the ANT directional coupler, and the dummy load. If the VSWR on any antenna system is out of limits, it will be necessary to isolate the trouble to the antenna or the transmission line, ie, disconnect the transmission line from the antenna and terminate the line with a dummy load.

Note: A unity gain discone antenna measures infinite resistance (dc open) on an ohmmeter. A 10-dB Collinear whip antenna measures zero resistance (dc short) on an ohmmeter. All RF loopback antennas are unity gain, quarter-wave ground plane antennas measuring infinite resistance on an ohmmeter.

STEP	PROCEDURE
1	At the base station, obtain a release from the control office; remove the station from service.
2	At the auxiliary bay jack field, insert a dummy plug in the TRANS CONT TC1 LINE jack.
3	At the radio cabinet, disconnect the RF cable from the TRS bulkhead fitting.
4	At the diplexer, disconnect the ANT directional coupler from the diplexer (ANT port) and connect it to the TRS bulkhead fitting [patch (1), Fig. 7].
5	At the antenna transmission line, disconnect the flexible RF line (Fig. 7) and connect it to the dummy load [patch (2), Fig. 7].
6	On the dummy load panel, set the SWR switch to ANT.

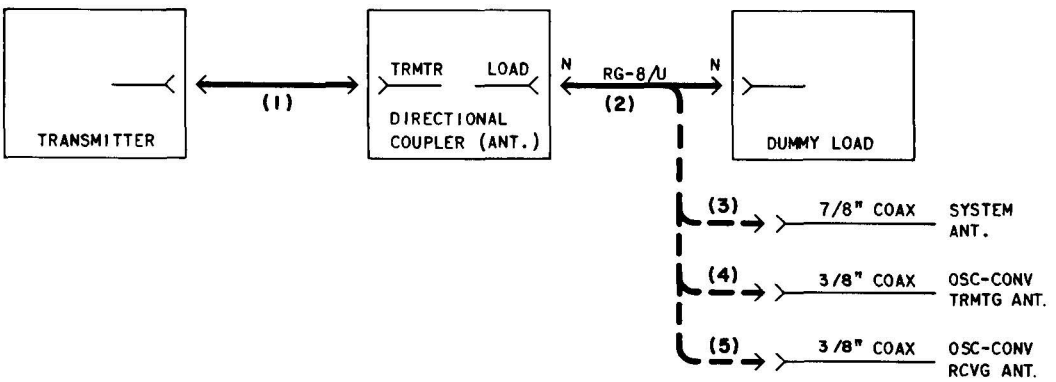
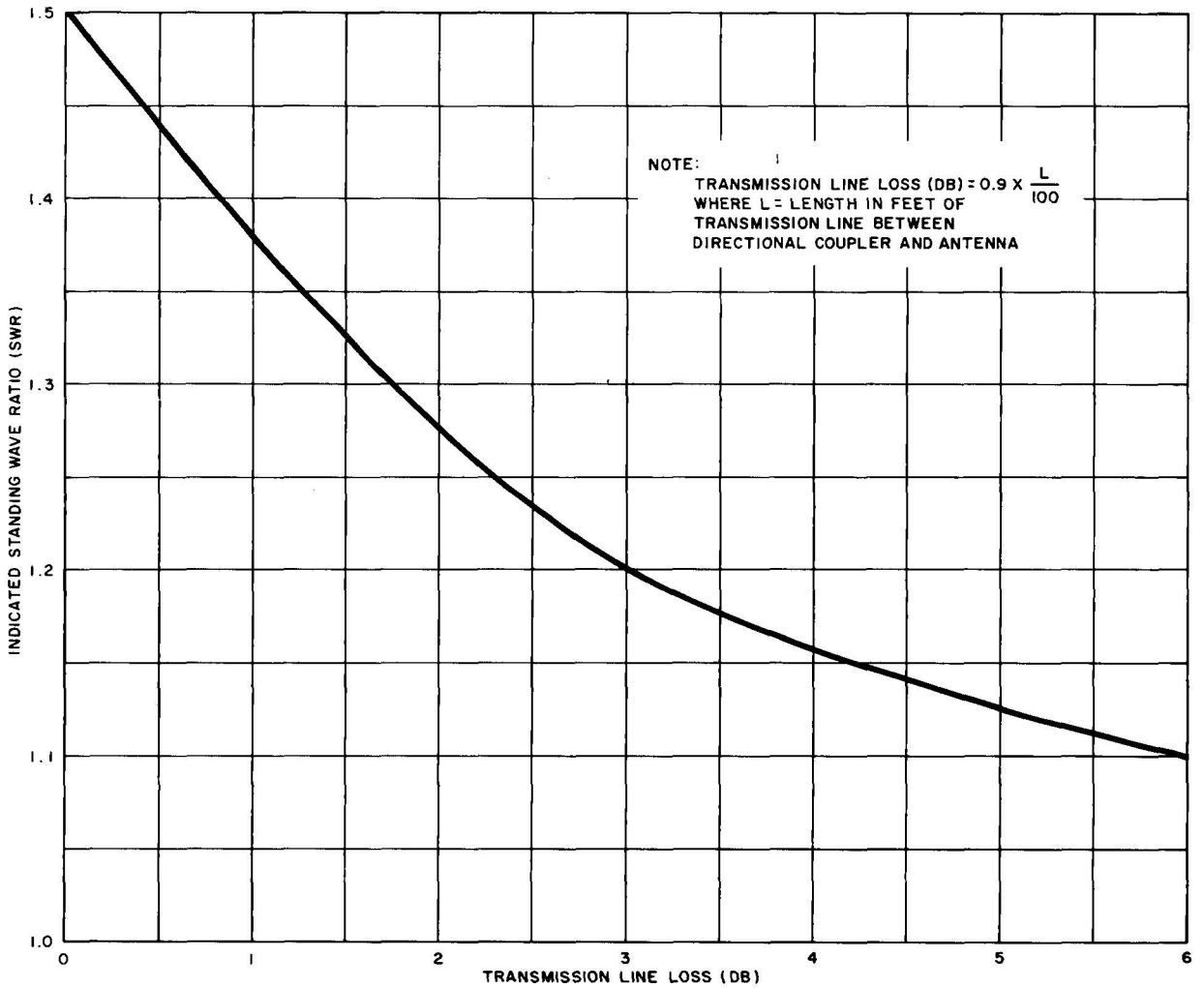


Fig. 7—Station Antennas—Test Layout—Echo-Fox UHF Radio System

CHART 2 (Cont)	
STEP	**PROCEDURE**
7	At the jack field, connect a 1P2A test cord from the TRANS CONT TC1 EQPT jack to the −48V test jack (keying patch).
	Caution: When connecting a keying patch, always connect to the −48V jack last. Disconnect in the reverse order, ie, disconnect from the −48V jack first.
8	On the Station Guardian, set the selector switch to INCIDENT.
	Requirement: Record the power reading on the panel meter (0 to 4 scale).
9	Set the selector switch to CALIBRATE and adjust the CALIBRATE control for an indication of 100 (FS) on the panel meter.
10	Set the selector switch to SWR and record the VSWR reading on the panel meter (1 to 100 scale).
	Requirement: 1 (VSWR 1.0:1.0).
11	At the jack field, disconnect the keying patch.
12	At the dummy load, disconnect the flexible RF line and connect it to the antenna transmission line [patch (3), Fig. 7].
	Note: It may be necessary to use the RF coax test cable when testing the RF loopback antennas.
13	At the jack field, connect the keying patch and record the VSWR indication on the panel meter of the Station Guardian.
	Requirement: 1.5 or less as calculated from Fig. 8.
14	Disconnect the keying patch.
15	Test the RF loopback antennas using Steps 12 to 14 and antennas patches (4) and (5), Fig. 7.
16	Connect the station transmitter, ANT directional coupler, and system transmission line in the normal manner (FA40843).
17	At the jack field, disconnect the dummy plug and return the station to service.



NOTES:

1. FIND THE INDICATED SWR ON THE VERTICAL AXIS. DETERMINE THE TRANSMISSION LINE LOSS ON THE HORIZONTAL AXIS WHICH MEETS THE INDICATED SWR AT A COMMON POINT ON THE CURVED LINE. THIS LINE LOSS SHOULD BE EQUAL TO TWICE THAT LOSS CALCULATED FOR THE INSTALLED ONE-WAY LINE.
2. TRANSMISSION LINE LOSS IS CALCULATED FROM THE ANTENNA DIRECTIONAL COUPLER TO THE ANTENNA; IE, 200 FT OF TRANSMISSION LINE WOULD HAVE 1.8 DB OF LOSS.
3. THIS NOMOGRAPH FOR USE WHEN CALCULATING LOSS IN 7/8 INCH AIR DIELECTRIC LINE AT 400 MHZ.

Fig. 8—Indicated SWR Versus Transmission Line Loss (Ant SWR of 1.5)—Echo-Fox UHF Radio System

CHART 3

ALIGNMENT OF OSCILLATOR-CONVERTER, RF LOOPBACK CAVITIES, AND RF LOOPBACK LOSS

The oscillator-converter (Fig. 9) and the transmission line cavity filters are aligned using the Echo-Fox transmitter and receiver as signal source and monitor respectively. Figure 10 shows signal levels and losses in the RF loopback patch.

STEP	PROCEDURE
	Caution: Sections 406-116-501 and 406-116-505 are prerequisite to this chart.
1	At the base station, obtain a circuit release from the control office and remove the circuit from service.
2	At the auxiliary bay jack field, make the following connections: Dummy plug to TRANS CONT TC1 LINE jack Dummy plug to RC1 LINE jack 600-ohm terminating plug to REC EQPT jack
3	At the receiver meter panel, set RECEIVER meter switch to A (discriminator).
4	At the jack field, connect a 1P2A test cord from the TRANS CONT TC1 EQPT jack to the −48V test jack (keying patch). ***Caution: When connecting a keying patch, always connect to the −48V jack last. Disconnect in the reverse order, ie, disconnect from the −48V jack first.***
5	At the jack field, patch the SG LOOPBACK LINE jack to GRD jack. ***Requirement 1:*** Oscillator-converter operates (loopback lamp lighted). ***Requirement 2:*** RECEIVER meter indicates 0 (zero) discriminator current.
6	At the oscillator-converter (Fig. 9), carefully adjust capacitor C8 to obtain zero current (discriminator zero).
7	At the receiver meter panel, set RECEIVER switch to C (limiter current).
8	At the oscillator-converter, adjust capacitor C5 for maximum limiter current indication on the RECEIVER meter.
9	At the RF loopback cavity filters (input and output), adjust both the transmit and receive cavity adjustments for maximum limiter current indication on the RECEIVER meter.

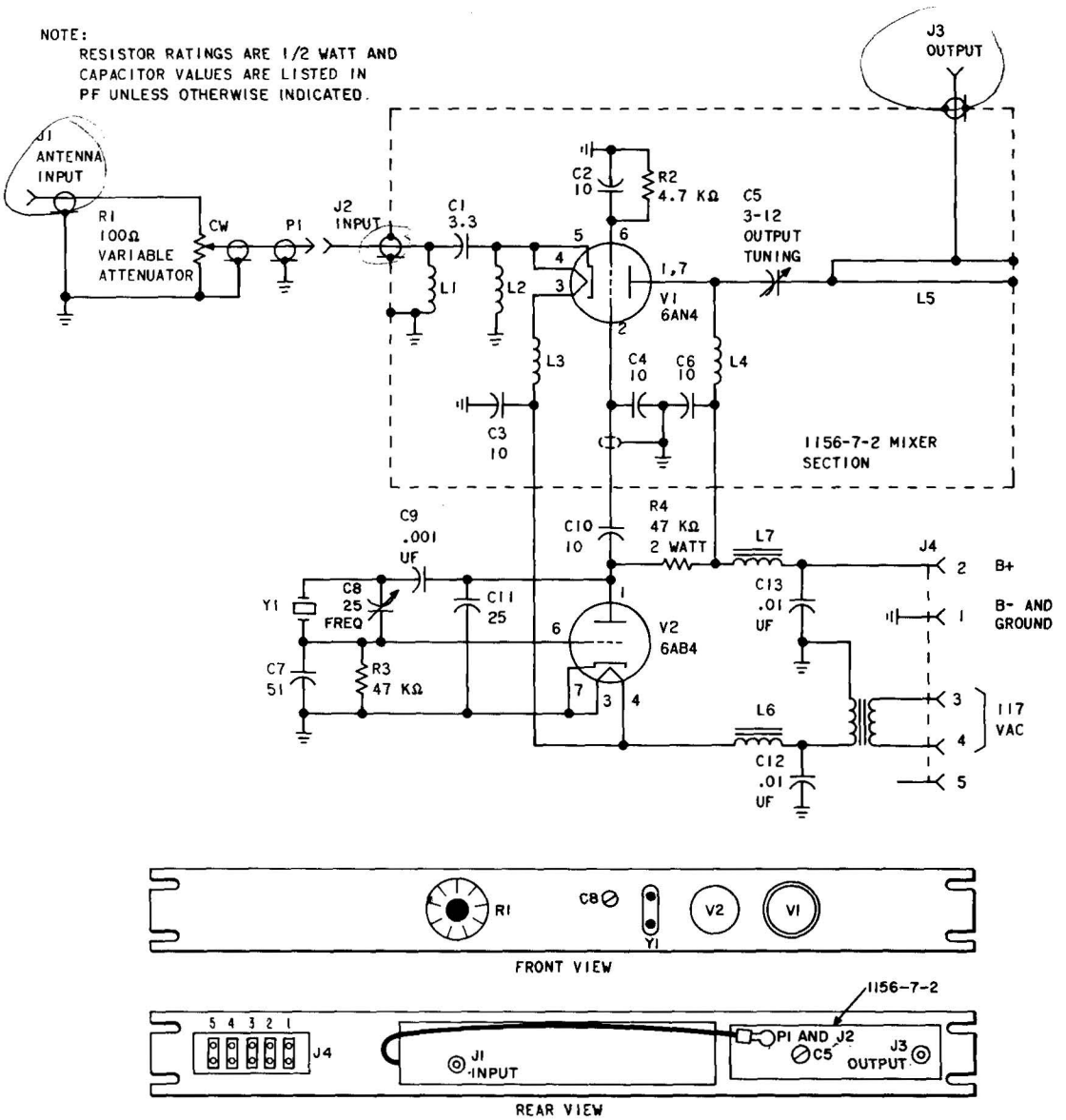
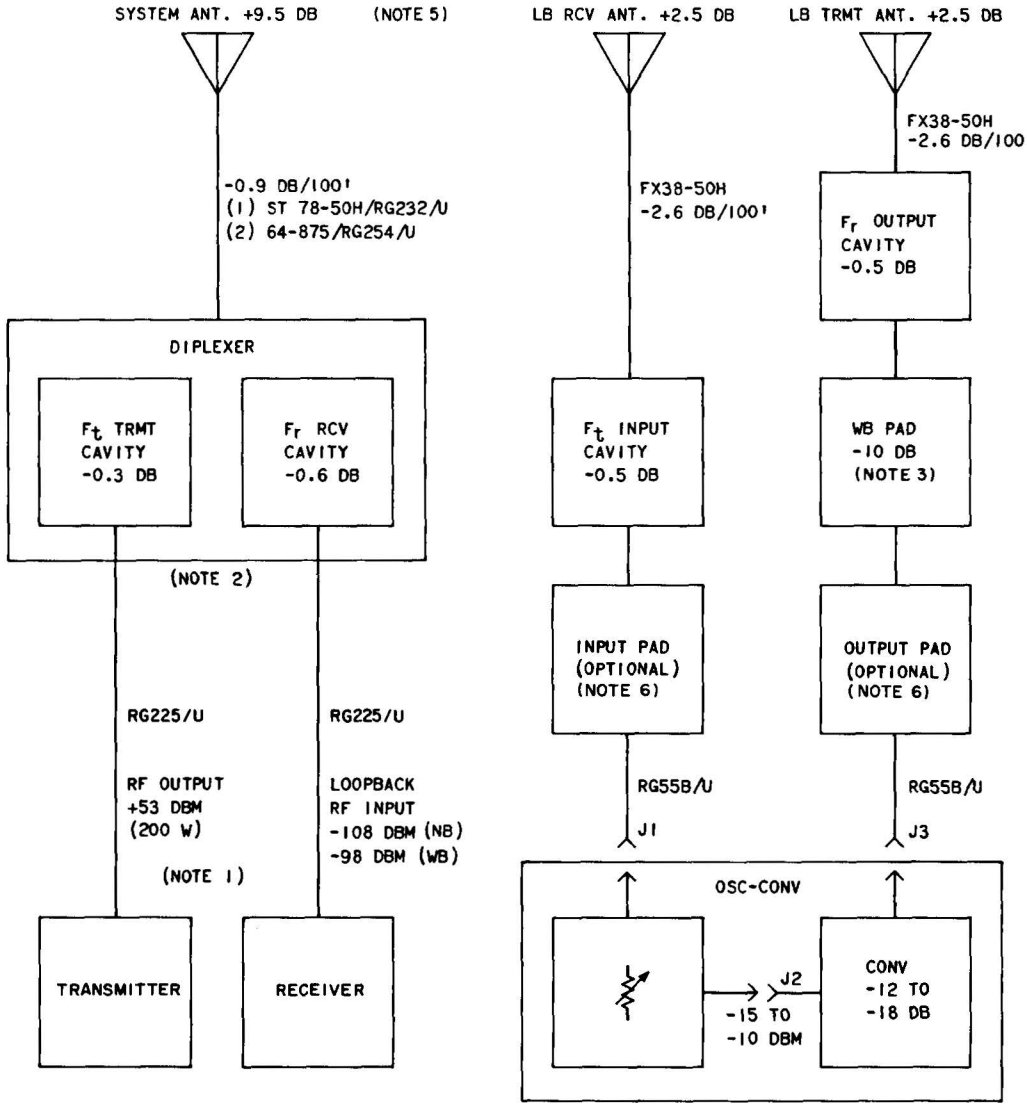


Fig. 9—Oscillator-Converter—Echo-Fox UHF Radio System

CHART 3 (Cont)

STEP	PROCEDURE
10	Remove the transmitter keying patch and the RF loopback activate patch. ***Note:*** Refer to Fig. 10, 11, 12 and FA40843, Fig. 102. The levels shown in Fig. 10 assume that the squelch is set to unmute the receiver at −114 dBm. If the station receiver squelch is set at a lower point, ie,−116 dBm to −118 dBm, a compensating adjustment of R1 must be made in accordance with Chart 5.
11	Set oscillator-converter variable attenuator R1 at midrange. **CALIBRATION OF STATION RECEIVER LIMITER**
12	Make the connections shown in Fig. 11A. Adjust the generator output (at the receiver frequency) for a convenient limiter indication (below saturation). Record the generator output in dBm and the limiter indication in milliamperes on the chart provided in Fig. 12. **Oscillator-Converter Conversion Loss Measurement**
13	Make the connections shown in Fig. 11B. Adjust the generator output (at the transmitter frequency) for a limiter indication equal to that recorded in Step 12. Record the generator output (in dBm) on the chart provided in Fig. 12.
14	Calculate the ***difference*** between the generator output recorded in Step 13 and that recorded in Step 12. The result is the ***conversion loss.*** Record this value (in dBm) on the chart provided in Fig. 12. **RF Loopback Receive Loss Measurement**
15	Make the connections shown in Fig. 11C. Adjust the generator output (at the transmitter frequency) for a limiter indication (in milliamperes) equal to that recorded in Step 12. Record the generator output (in dBm) on the chart provided in Fig. 12.
16	Calculate the ***difference*** between the generator output recorded in Step 15 and that recorded in Step 12. From the result, subtract the conversion loss recorded in Step 14. This result is the ***receive loss.*** Record this loss on the chart provided in Fig. 12.
17	The ***receive loss*** should be 63 dB or the level at J2 should be −10 dBm with the transmitter at full power (+53 dBm). If the ***receive loss*** is less than 63 dB (ie, 60 dB, 55 dB, etc), select and install an ***input*** in-line coaxial pad (Fig. 13) as required. Minimum level at J2 should be no more than −15 dBm. **RF Loopback Transmit Loss Measurement** ***Note:*** This procedure assumes a conversion loss of 18 dB. If the conversion loss is otherwise, the following figures must be adjusted accordingly.



NOTES:

1. SIGNAL LEVELS ARE SHOWN IN DBM.
2. NOMINAL LOSSES (-) AND GAINS (+) ARE SHOWN IN DB.
3. THIS PAD MAY STILL BE INSTALLED IN THOSE STATIONS FORMERLY CAPABLE OF WIDEBAND OPERATION.
4. NOMINAL PATH LOSSES:
   TRANSMITTER TO J1,OSC-CONV: 63 DB.
   J3,OSC-CONV TO RECEIVER: 69 DB.
5. ANTENNA GAINS REFERENCED TO ISOTROPIC ANTENNA.
6. OPTIONAL PADS ARE SELECTED TO DERIVE THE REQUIRED LEVELS WHEN THE VARIABLE PAD (R1) IS AT MIDRANGE.

Fig. 10—RF Loopback Path—Echo-Fox UHF Radio System

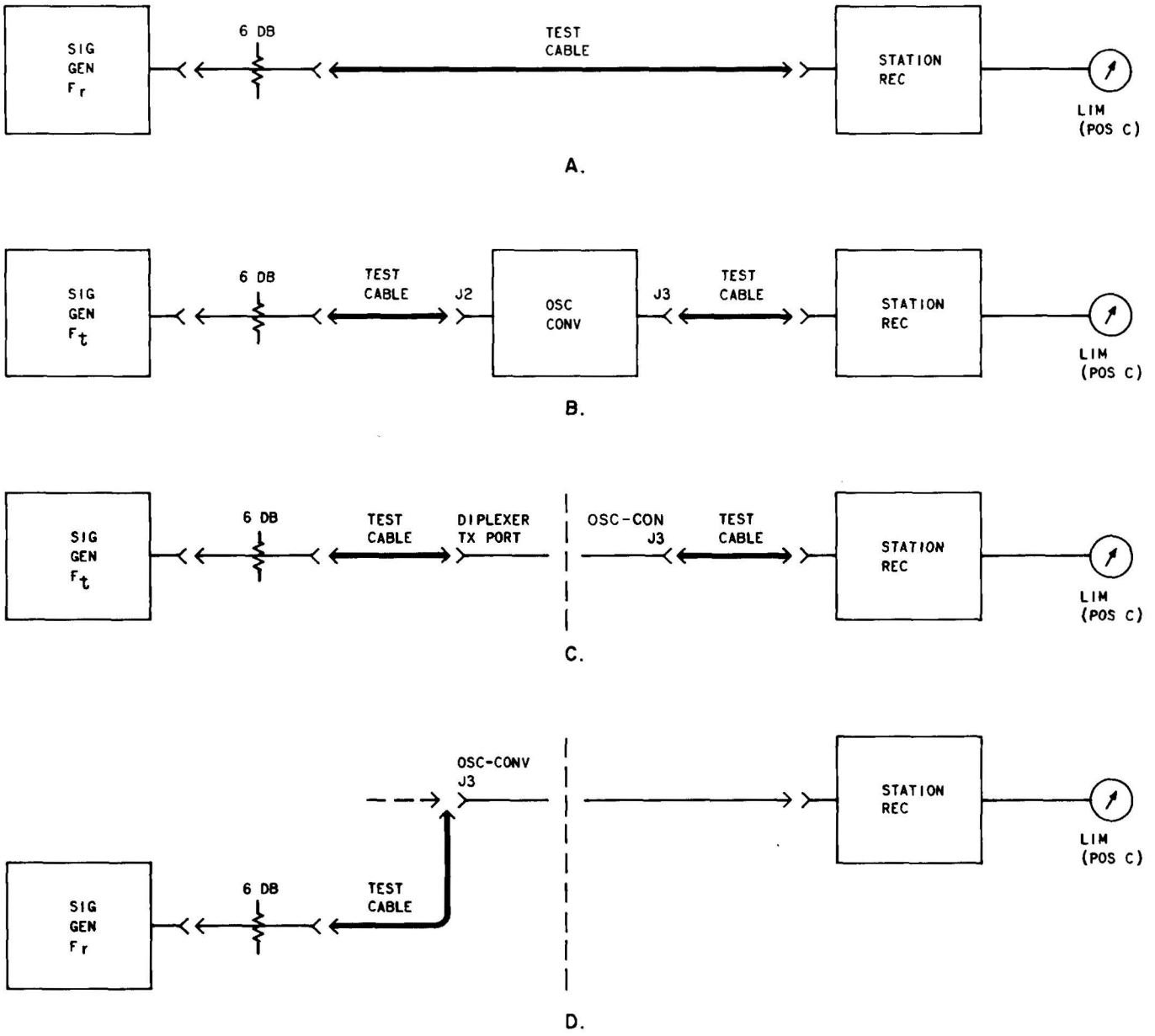


Fig. 11—Measuring Oscillator-Converter Conversion Loss and Overall RF Loopback Loss

CHART 3 (Cont)

STEP	PROCEDURE
18	Make the connections shown in Fig. 11D. Adjust the generator output (on the station receive frequency) for a limiter indication equal to that recorded in Step 12. Record the generator output (in dBm) on the chart provided in Fig. 12.
19	Calculate the ***difference*** between the generator output recorded in Step 18 and that recorded in Step 12. This result is the ***transmit loss.*** Record this result (in dB) on the chart provided in Fig. 12.
20	The ***transmit loss*** should be 80 dB. The level into the receiver should be −108 dB. The level into the receiver should be −108 dBm when the transmitter output power is +53 dBm (200 watts). If the ***transmit loss*** is less than 80 dB (ie, 75 dB, 68 dB, etc), select and install an ***output*** in-line coaxial pad (Fig. 13) as required.
21	Perform Chart 5 and return the system to service.

CHART 3 STEP	CALCULATIONS
12	LIMITER INDICATION (A1) 50 GENERATOR OUTPUT (B1) −112
13	LIMITER INDICATION (A2) 50 EQUALS (A1) ____ GENERATOR OUTPUT (B2) −95
14	GENERATOR OUTPUT (B2) −95 MINUS GENERATOR OUTPUT (B1) −112 EQUALS CONVERSION LOSS (CL) (17)
15	LIMITER INDICATION (A3) 50 EQUALS (A1) ____ GENERATOR OUTPUT (B4) −19DMM
16	GENERATOR OUTPUT (B4) ____ MINUS GENERATOR OUTPUT (B1) ____ EQUALS (B5) ____ RESULT (B5) ____ MINUS CONVERSION LOSS (CL) ____ EQUALS RF LOOPBACK RECEIVE LOSS (RL) ____
17	63 DB MINUS RECEIVE LOSS (RL) ____ EQUALS INPUT PAD VALUE (IP) ____
18	LIMITER INDICATION (A4) ____ EQUALS (A1) ____ GENERATOR OUTPUT (B6) ____
19	GENERATOR OUTPUT (B6) ____ MINUS GENERATOR OUTPUT (B1) ____ EQUALS RF LOOPBACK TRANSMIT LOSS (TL) ____
20	80 DB MINUS TRANSMIT LOSS (TL) ____ EQUALS OUTPUT PAD VALUE (OP) ____

Fig. 12—RF Loopback Loss Calculations—Work Sheet

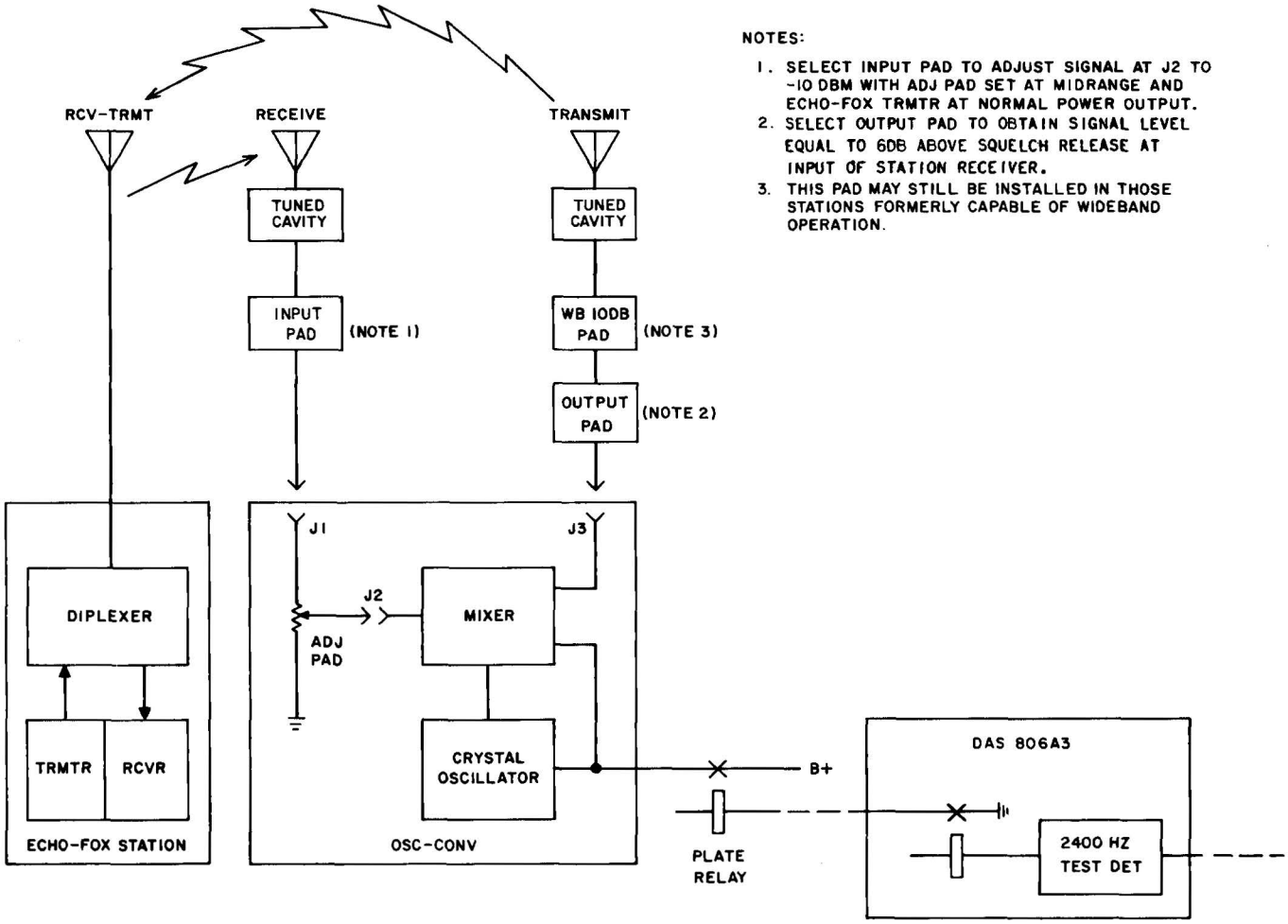


Fig. 13—RF Loopback—Functional Schematic Diagram—Echo-Fox UHF Radio System

CHART 4

ALIGNMENT OF DIPLEXER

The diplexer (Fig. 14) is aligned using the Echo-Fox transmitter and receiver and the oscillator-converter. ***The diplexer is a passive device and normally requires no adjustment after initial alignment. Therefore, alignment should not be necessary unless the operating frequency is changed.***

Note: The diplexer consists of six tuned cavities: one bandpass and one reject cavity in the transmit side; two bandpass and two reject cavities in the receive side.

CHART 4 (Cont)	
STEP	**PROCEDURE**
	Caution: Sections 406-116-502, 406-116-506, and Chart 3 of this section are prerequisites to this chart.
1	At the base station, obtain a circuit release from the control office; remove the circuit from service.
2	At the auxiliary bay jack field, make the following connections: Dummy plug to TRANS CONT TC1 LINE jack 600-ohm terminating plug to REC EQPT jack Dummy plug to RC1 LINE jack
3	At the jack field, connect a 1P2A test cord from the TRANS CONT TC1 EQPT jack to the −48V test jack (keying patch).

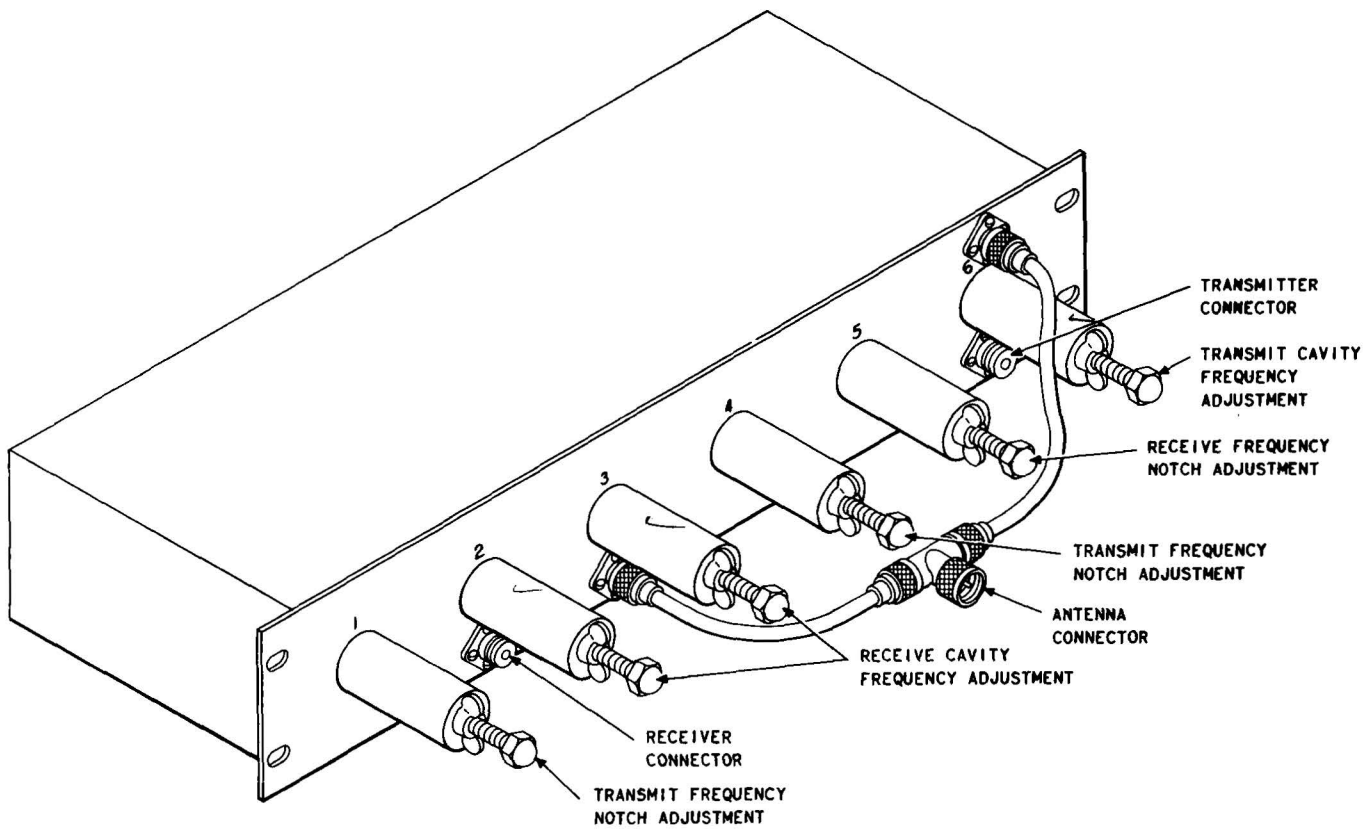


Fig. 14—Diplexer—Echo-Fox UHF Radio System

CHART 4 (Cont)	
STEP	**PROCEDURE**
	Caution: When connecting a keying patch, always connect to the −48V jack last. Disconnect in the reverse order, ie, disconnect from the −48V jack first.
	Requirement: Transmitter keyed.
4	At the receiver meter panel, set RECEIVER meter switch to C (limiter current).
5	At the jack field, patch the SG LOOPBACK LINE jack to GRD jack.
	Requirement 1: : Oscillator-converter operates (loopback lamp lighted).
	Requirement 2: RECEIVER meter indicates limiter current.
6	At the transmitter, adjust the SCREEN control for a transmitter output level that will result in a measurable limiter current.
	Caution: Cavity tuning is very sensitive; the resonant frequency of each tuned cavity changes 2 MHz for each turn of the adjustment screw.
7	At the diplexer (Fig. 11), carefully adjust the ***transmit*** cavity bandpass frequency adjustment (6) for maximum receiver limiter current.
8	Carefully adjust the two ***receive*** cavity bandpass frequency adjustments (2 and 3) for maximum receiver limiter current.
9	Disconnect the keying patch.
	Note: Ensure that the transmitter is returned to normal output power.
10	Make the connections as shown in Fig. 15, patch 1.
11	Ensure that the transmitter remains unkeyed. Insert a dummy plug in the TRANS CONT TC1 LINE jack.
12	Adjust the signal generator (unmodulated and on the station receive frequency) for a readable receiver limiter current indication (approximately midscale).
	Note: Ensure that the receiver limiter is ***not*** saturated.
13	Carefully adjust the diplexer transmit cavity notch (reject) adjustments for ***minimum*** receiver limiter current.
	Note: It is important to ensure that the signal generator remains on the station receiver frequency. Frequently check the receiver discriminator zero throughout this test.
14	Make the patch 2 connections shown in Fig. 15.

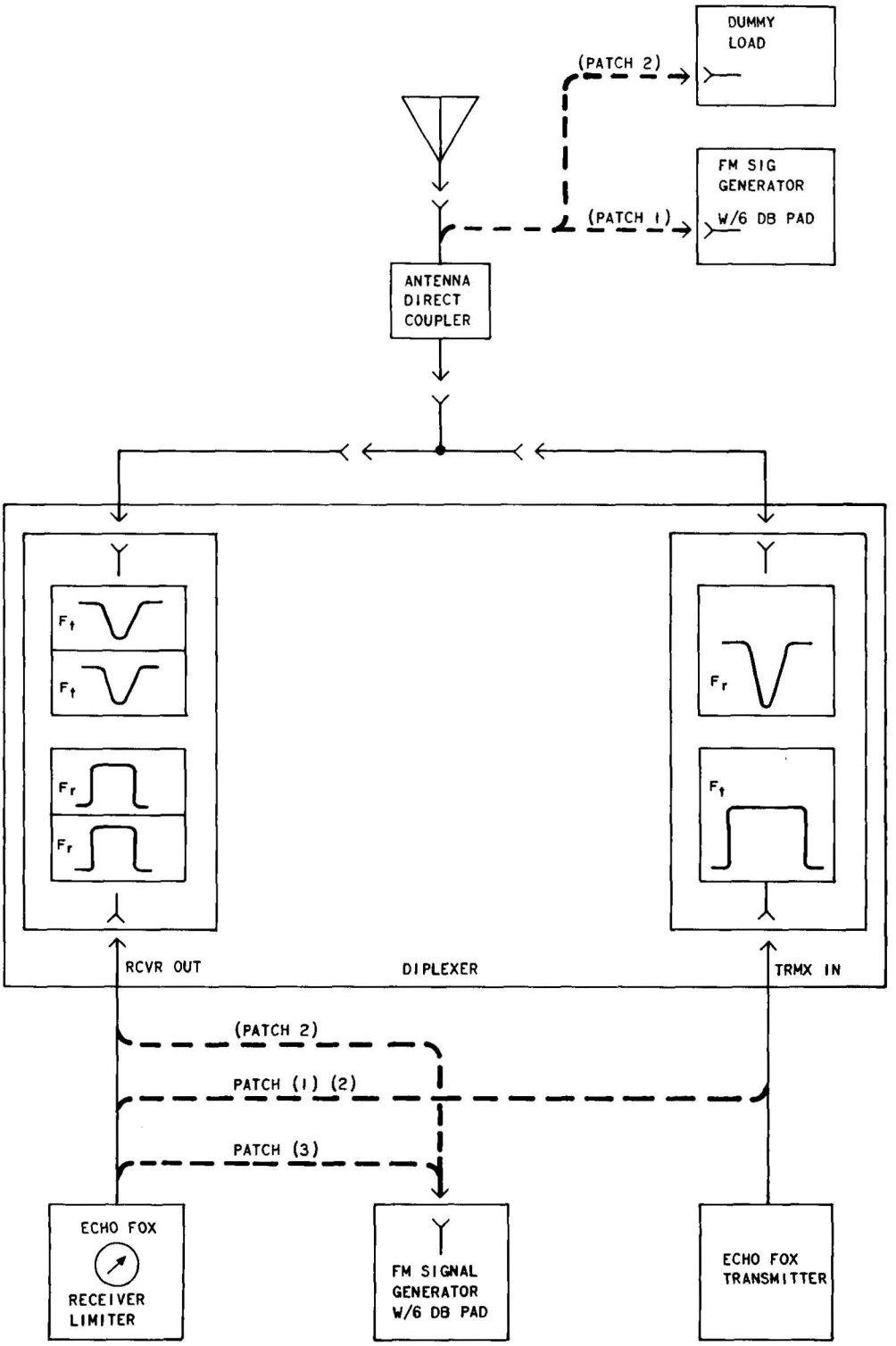


Fig. 15—Diplexer Alignment—Test Layout—Echo-Fox UHF Radio System

CHART 4 (Cont)

STEP	PROCEDURE
15	Adjust the signal generator (unmodulated and on the station receive frequency) for a readable receiver limiter current indication (approximately midscale). Record this indication on the chart provided in Fig. 16. Record the signal generator attenuator setting (in dBm) on the same chart. ***Note:*** Ensure that the receiver limiter is ***not*** saturated.
16	Make the patch 3 connections as shown in Fig. 15.
17	With the signal generator tuned to the station receive frequency (unmodulated), adjust the generator output level to produce the same limiter indication obtained in Step 15. Record the signal generator attenuator setting on the chart provided in Fig. 16. ***Requirement:*** The signal generator attenuator setting in Step 17 minus the attenuator setting recorded in Step 15 should be 50 dBm. This represents the diplexer isolation in dBm at the station receive frequency.
18	Restore all connections to normal.
19	Make the patch 1 connections shown in Fig. 17.
20	At the jack field, connect a 1P2A test cord from the TRANS CONT TC1 EQPT jack to the −48V test jack (keying patch). ***Caution: When connecting a keying patch, connect to the −48V jack last. Disconnect in reverse order, removing the connection from the −48V jack first.*** ***Requirement:*** Transmitter shall be keyed.

DIPLEXER ISOLATION		
RECEIVE	LIMITER (MA)	SIG GEN (DBM)
STEP 15		
STEP 17		
RESULT ISOLATION AT F_r IN DBM		
TRANSMIT	DEVIATION METER READING	SIG GEN (DBM)
STEP 23		
STEP 26		
RESULTANT ISOLATION AT F_t IN DBM		

Fig. 16—Diplexer Isolation Calculations Chart

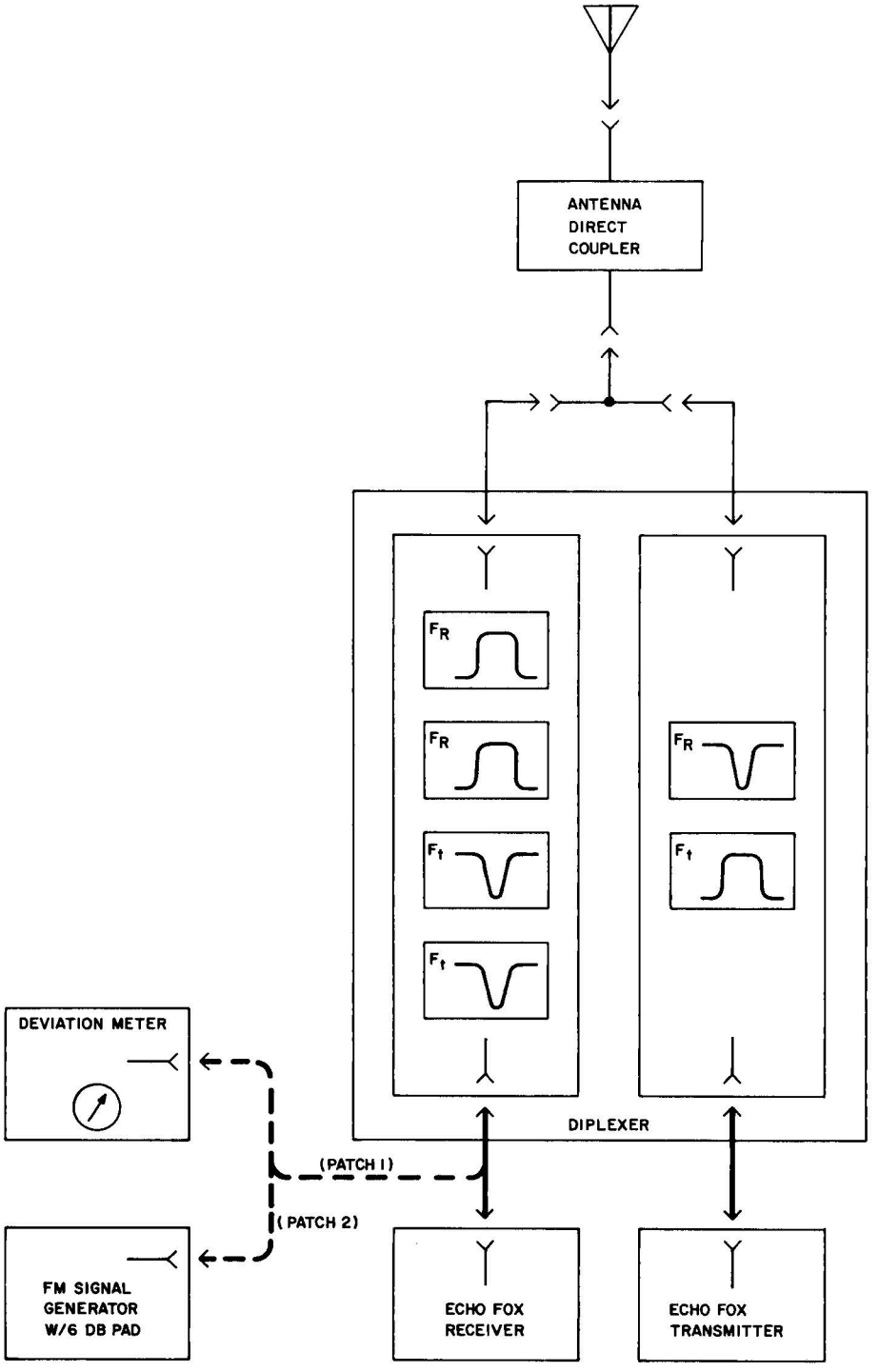


Fig. 17—Diplexer Isolation Tests—Test Layout—Echo-Fox UHF Radio System

CHART 4 (Cont)

STEP	PROCEDURE
21	Tune the deviation meter for a maximum on-scale meter indication at the transmitter frequency. ***Note:*** A high off-scale indication may be indicative of a badly misaligned diplexer. It may be necessary to insert an adjustable pad between the receive output port and the FM deviation meter to obtain an on-scale indication.
22	Carefully adjust the two receive cavity notch (reject) adjustments 1 and 4 to obtain a minimum deviation meter indication.
23	Observe and record the meter indication on the chart provided in Fig. 16.
24	Disconnect the keying patch and restore the connections to normal.
25	Make the patch 2 connections shown in Fig. 17.
26	With the signal generator tuned to the station transmit frequency (unmodulated), adjust the generator output level to obtain the same meter indication as recorded for Step 23. Record the setting of the signal generator attenuator on the chart provided in Fig. 16. ***Requirement:*** The signal generator setting (in dBm) plus the transmitter output (in dBm) is the isolation provided by the diplexer at F_t. The total isolation should be 90 dBm +3 −0 dB. ***Note 1:*** The diplexer isolation is equal to the algebraic difference between the transmitter output and the signal generator setting; ie, if the transmitter output power is +53 dBm (200 watts) and the signal generator setting is −37 dBm, the total isolation is: +53 dBm minus −37 dBm equals total isolation of 90 dB. The nomograph in Fig. 18 provides an aid for converting transmitter output power in watts to dBm. ***Note 2:*** After the diplexer has been placed in operation, a slight adjustment (no greater than 1/4 turn) of the transmit cavity adjustment (Step 6) may be required to bring the diplexer VSWR within limits (1.0:1.0).
27	Remove all test connections and return the system to service.

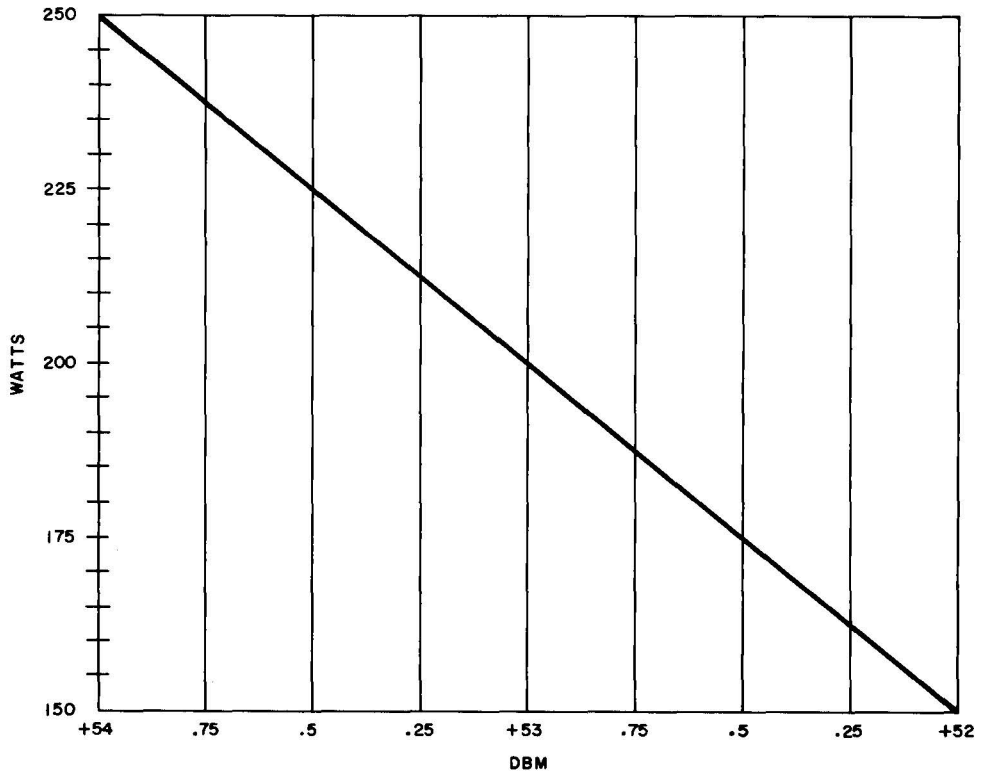
CHART 5

TEST OF RF LOOPBACK OSCILLATOR-CONVERTER AND DATA AUXILIARY SET (DAS) 806A3

The RF loopback oscillator-converter and the DAS 806A3 are tested simultaneously for proper operation. The tests are combined since the oscillator-converter may be controlled locally or remotely through the DAS 806A3 (Fig. 13).

CHART 5 (Cont)

STEP	PROCEDURE



NOTE:
FIND THE INDICATED POWER (IN WATTS) ON THE VERTICAL AXIS. DETERMINE THE POWER (IN DBM) ON THE HORIZONTAL AXIS WHICH MEETS THE INDICATED POWER (IN WATTS) AT A COMMON POINT ON THE DIAGONAL LINE.
EXAMPLE: 200 WATTS = +53 DBM

Fig. 18—Transmitter Power Versus DBM Nomograph

Caution: Sections 406-116-501, 406-116-505, and Chart 3 of this section are prerequisite to this test.

Preparation

1 At the base station, obtain a release from the control office; remove the circuit from service.

2 On the Station Guardian, set selector switch to INCIDENT (Fig. 3).

3 On the dummy load panel, set the SWR switch to DUP (Fig. 1).

4 At the test jack field on the auxiliary bay, make the following connections:

Dummy plug into AUDIO LOOPBACK LN jack

CHART 5 (Cont)	
STEP	**PROCEDURE**
	Dummy plug into AUDIO TRS LN jack Dummy plug into AUDIO REC LN jack.
	Test of Local Control Circuit
5	At DAS 806A3, momentarily depress LOC key. ***Requirement 1:*** LOC lamp lights. ***Requirement 2:*** PLATE RELAY operates. ***Requirement 3:*** RF loopback oscillator-converter to ON (loopback lamp lighted).
6	At the jack field connect a 1P2A test cord from the TRANS CONT TC1 EQPT jack to the −48V test jack (keying patch). ***Caution: When connecting a keying patch, always connect to the −48V jack last. Disconnect in the reverse order, ie, disconnect from the −48V jack first.*** ***Requirement 1:*** Base transmitter is keyed (power output: 200 watts). ***Requirement 2:*** COR lamp on the jack field lights (receiver squelch opens). ***Note:*** If COR lamp is not installed, test for −48 volts at RC1 EQPT (tip) jack.
8	On the power amplifier power supply, adjust the SCREEN control for an indication of 50 watts (6 dB down from 200 watts) on the Station Guardian.
9	Slowly adjust the SCREEN control to decrease and increase RF power; note the points where the COR lamp extinguishes and lights.
10	If necessary, adjust the oscillator-converter variable attenuator (R1) until the COR lamp lights at an indicated power of 50 ±5 watts. ***Requirement:*** Record attenuator setting.
11	Adjust the SCREEN control for normal transmitter power.
12	At the DAS 806A3, momentarily depress the OFF key. ***Requirement 1:*** LOC lamp extinguishes; OFF lamp lights (loopback lamp extinguishes). ***Requirement 2:*** PLATE RELAY releases and the oscillator-converter returns to standby mode. ***Requirement 3:*** COR lamp extinguishes.

CHART 5 (Cont)	
STEP	**PROCEDURE**
	Test of Remote Control Circuit
13	Connect a 2400-Hz tone at −16 dBm from the 21A TMS to the LOOPBACK AUDIO EQPT jack and hold for ten seconds; remove the tone. ***Requirement 1:*** FAC lamp on DAS 806A3 lights. ***Requirement 2:*** PLATE RELAY operates. ***Requirement 3:*** COR lamp lights indicating the oscillator-converter is operating.
14	Repeat Step 13. ***Requirement 1:*** DAS 806A3 releases PLATE RELAY. ***Requirement 2:*** COR and FAC lamps extinguish.
15	Disconnect the keying patch. ***Requirement:*** Radio transmitter switches to idle mode.
16	Remove all test connections and return the circuit to service.