

OVER-THE-HORIZON RADIO SYSTEMS
FARINON TYPE SS2000W-02 OVER-THE-HORIZON RADIO SYSTEM
OVERALL SYSTEM
OPERATION

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The transmitters are frequency diversified and are assigned frequencies separated by at least 40 MHz. Four receivers at a distant station are operated in quadruple diversity. The protection unit combines the receiver output and adds the signals together in proportion to the freedom from noise. The transmitter performance characteristics are shown in Table A. The receiver performance characteristics are shown in Table B.

1. GENERAL

- 1.01 This section provides the procedures for energizing, operating, and removing from service the transmitters and the receivers of the Farinon SS2000W-02 Over-the-Horizon Radio System.
- 1.02 During normal operation, the same baseband information is fed to two FM transmitters.

1.03 When the received signals are equal, the output signal-to-noise ratio will be approximately 6 dB better than that of any single receiver. This improvement decreases to about 4.8 dB if a fade occurs in any one receiver. Should two paths fade simultaneously, the combining amplifiers will still produce a noise advantage of approximately 3 dB.

1.04 For maintenance purposes or emergency operation, the system can be split so that one transmitter and two receivers are carrying regular service while the other transmitter and two receivers are being serviced or are carrying emergency service.

TABLE A
TRANSMITTER PERFORMANCE CHARACTERISTICS

Power Output	2 watts minimum, into 50-ohm load
Frequency Range	1700 to 2300 MHz
Modulator Type	FM
Reference Test Tone Deviation	200 kHz rms (489 kHz modulating frequency at per-channel test tone level)
Frequency Stability	$\pm 0.005\%$ with AFC (10° to 50° C)
Emphasis	Standard 8 dB CCIR (180 channels)
Usable Modulation Baseband	4 to 804 kHz
Pilot Frequency	4 kHz
Pilot Level	16 dB below per-channel test tone level at receiver output
Baseband Impedance	75 ohms unbalanced
Transmit Test Tone Input Level	-38.5 dBm
Power Requirement	52 watts typical 72 watts maximum
Power Sources	105-125/210-250 v, 50-60 Hz ac, single phase
Operating Ambient Temperature Range	-30 to $+55^{\circ}$ C (-22 to $+131^{\circ}$ F)
Mounting	5 mounting spaces (8-3/4") in a standard 19-inch equipment rack
Weight	39 lbs, approximate, depending upon options equipped
External Connections	Female type N connector on rear of transmitter for connection to a transmission line. Baseband connector is BNC female. Other connections are made to terminal points on transmitter frame.

TABLE B
RECEIVER PERFORMANCE CHARACTERISTICS

Frequency Range	1700 to 2300 MHz
Type	Single-conversion Superheterodyne
Noise Figure	9 dB maximum
Mixer	Balanced (twin-diode)
Thermal Noise Characteristics	See Fig. 2
Intermediate Frequency	70 MHz
IF Filter Bandwidth	5 MHz between 3-dB points
De-emphasis	Standard CCIR 8 dB (180 channels)
Usable Baseband	4 to 804 kHz
Spurious Response Rejection	65 dB minimum
Image Response Rejection	64 dB minimum
Baseband Output Impedance	75 ohms unbalanced
Receive Test Tone Output Level	-15 dBm
Power Requirement	9 watts maximum
Power Sources	105-125/210-250v, 50-60 Hz ac, single phase
Mounting	5 mounting spaces (8-3/4") in a standard 19-inch equipment rack
Operating Ambient Temperature Range	-30 to +55° C (-22 to +131° F)
Weight	34 lbs approximate (weight depends upon options equipped)
External Connections	Female type N connector on rear of receiver for connection to a transmission line. Baseband connector is BNC female. Other connections are made to terminal points on transmitter frame.

2. CONNECTIONS, CONTROLS, AND INDICATORS

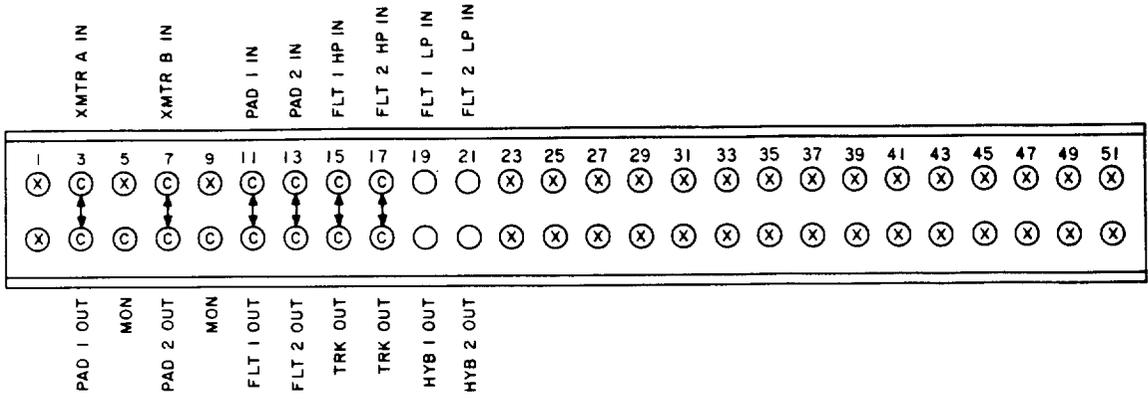
2.01 The transmitter and receiver bays are wired in accordance with Farinon wiring diagram EW-70211-1 and EW-70211-02, respectively. These reflect the wiring of the bays used at the station of interest.

2.02 The transmitters and receivers are self-contained units, each containing its own power supply. Power from the station power source is supplied to these units through dual junction boxes and power connectors.

2.03 High-frequency connections between baseband input and output points and the transmitters and receivers are patched through the respective jackfields. The transmitters, receivers, combiners, pads, and filters have jackfield appearances that are connected through U-links to complete the baseband frequency paths. The jackfields and the destinations of the patches are shown in Fig. 1.

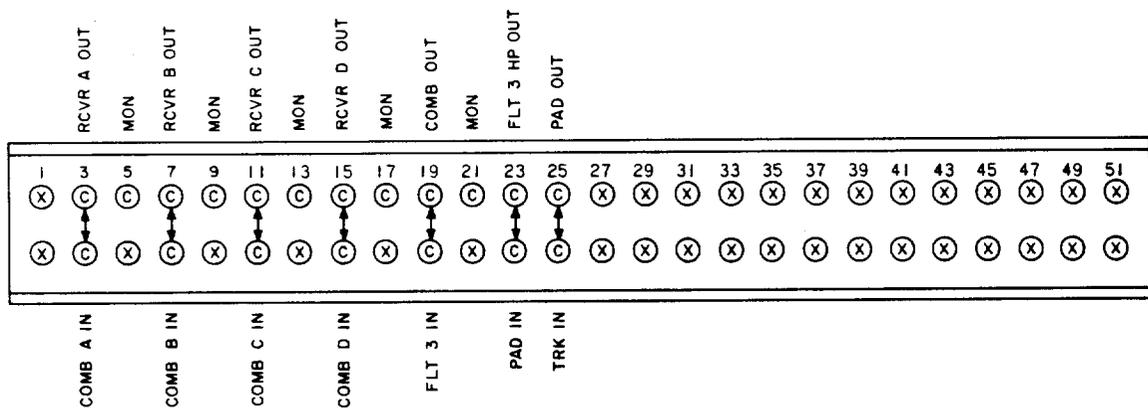
2.04 Alarm outputs from the transmitters and receivers are connected through the respective assembly terminal blocks to the station alarms. In the receiving terminal, the AGC and recorder outputs are also routed through the assembly terminal

SECTION 403-403-301



MA-10153-L1
 JACK MTG
 (20-11137-01 BKTS)

TRANSMITTER JACKFIELD



MA-10153-L1
 JACK MTG
 (20-11137-0R BKTS)

RECEIVER JACKFIELD

JACK LEGEND		
(C)	SINGLE COAXIAL	39-20096-16
(↑)	COAXIAL "U" PLUG	42-20063-28
(X)	PLUG BUTTON (JACK NOT EQ'D)	
(O)	DOUBLE TRS NORMAL THROUGH	39-20096-04

Fig. 1—Jackfield Connections

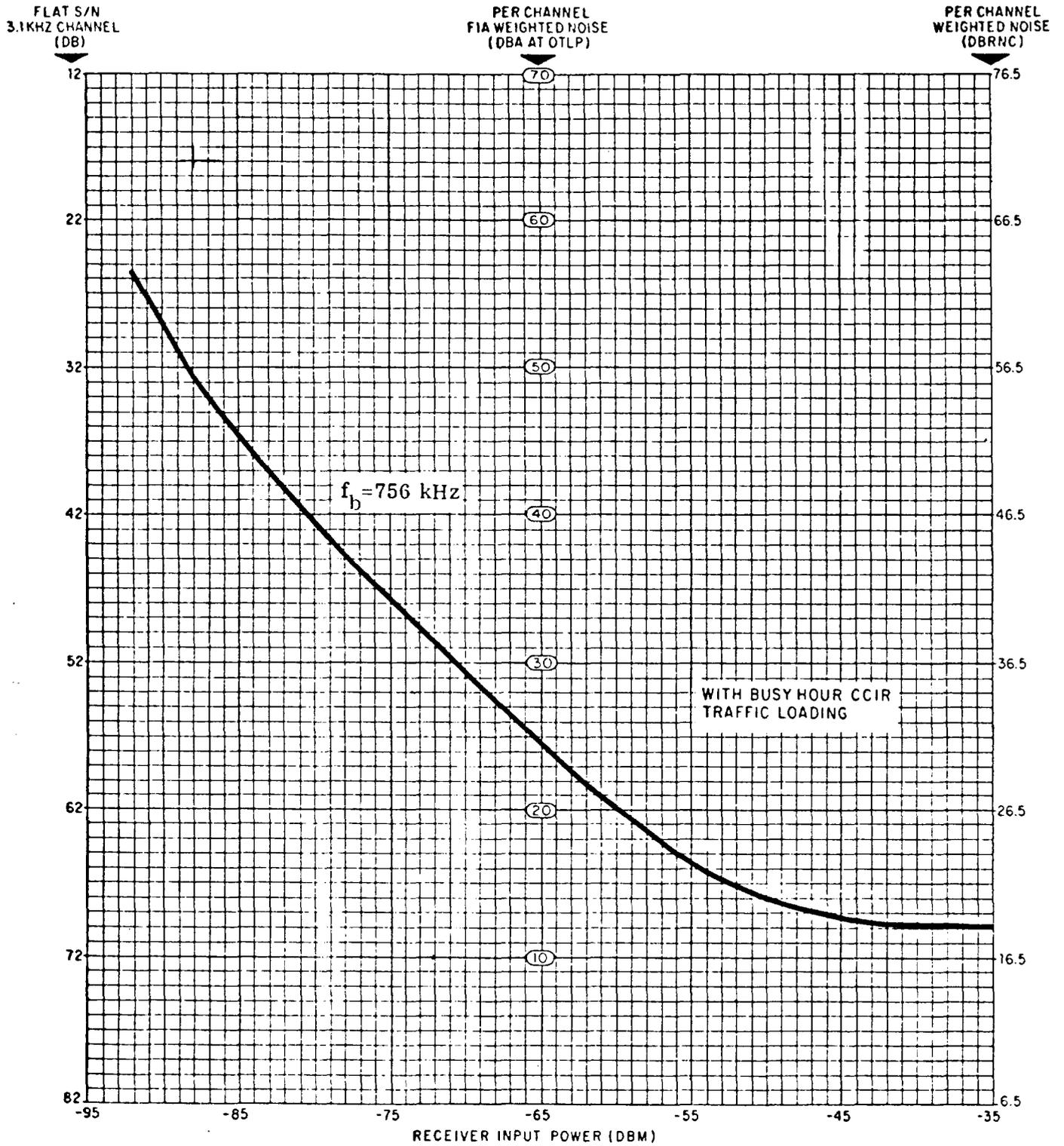


Fig. 2—Typical Performance Characteristics for SS2000W-02-70211 Transmitter-Receiver Connected Back-to-Back and Loaded with 180 Voice Channels

block to the AGC meters and the recorder, if supplied.

Transmitter Controls and Indicators

2.05 The following controls and indicators are used in the transmitter. The location and function of each is listed in Table C.

2.06 The following controls and indicators are used in the receivers and the protection unit. The location and function of each is listed in Table D.

TABLE C
TRANSMITTER CONTROLS AND INDICATORS

ITEM	LOCATION	FUNCTION
Power switch	Transmitter frame	Controls application of power to transmitter
AFC DISABLE switch	AFC Control Unit	Removes output from oscillator-modulator unit when in DISABLE position
Meter selector switch	Small front door	
OFF		Disconnects metering circuit
PWR AMP		Checks power amplifier stage output
DRIVER		Checks driver stage of power amplifier unit
+ VOLTS		Checks + output of power supply
- VOLTS		Checks - output of power supply
VSWR		Checks VSWR
CAL		Indicates forward output so that VSWR indication can be calibrated
PWR OUT		Indicates power output at directional coupler
AFC		Indicates AFC voltage from AFC unit to oscillator-modulator
- EXT		Used to check - voltages at transmitter test points
+ EXT		Used to check + voltages at transmitter test points
VSWR potentiometer	Behind meter	Used to calibrate meter circuit for VSWR measurements
PWR CAL potentiometer	Behind meter	Used to calibrate meter against calorimeter
Meter M1	Small front door	Provides indications for functions selected by selector switch
ALARM lamp	Small front door	When lighted, indicates AFC alarm, pilot alarm, or RF power alarm

TABLE D
RECEIVER AND PROTECTION UNIT CONTROLS AND INDICATORS

ITEM	LOCATION	FUNCTION
Power switch	Receiver frame	Controls application of power to receiver
Selector switch	Small front door	
OFF		Disconnects metering circuit
+ VOLTS		Checks + output of power supply
- VOLTS		Checks - output of power supply
AGC		Checks receiver AGC voltage
EXT		Connects meter to 50 uA EXT TEST jack for receiver test point measurements
ALARM CUTOFF switch	Small front door	Cuts off alarm indications to external alarms
MGC-AGC switch	IF amplifier	Selects manual gain or automatic gain mode of operation
MGC ADJUST potentiometer	IF amplifier	Adjusts manual gain of IF amplifier within range of operation during manual operation
ALARM lamp	Small front door	Indicates failure of control amplifier, high noise, pilot level drop, loss of dc continuity in output circuit, or receiver power supply failure or power switch off.
ALARM CUTOFF lamp	Small front door	Indicates when alarm cutoff switch has been operated
Meter	Small front door	Provides indications for functions selected by selector switch
MAJOR ALARM	Protection unit	Indicates failure of two circuits in combiner
MINOR ALARM	Protection unit	Indicates failure of single channel in combiner

3. OPERATING PROCEDURES

3.01 Four procedures are provided for operating the SS2000W-02 Over-the-Horizon Radio System. These procedures are predicated with the condition that the near and distant stations are using the same equipment.

3.02 Chart 1 provides the initial turnon procedure. The normal operating procedures are presented in Chart 2. Removal from service procedures are presented in Chart 3.

CHART 1

INITIAL TURNON PROCEDURES

It is assumed that the radio system consists of similar equipment at each end of the transmission path and that the antennas at each end are correctly aligned. The initial turnon procedures consist of energizing the transmitters at the local station, the receivers at the distant station, the transmitters at the distant station, and then the receivers at the local station. The checks that should be performed before turning the equipment on for the first time are given in Part A. The normal turnon and subsequent transmitter-receiver voltage checks are provided in Part B.

STEP	PROCEDURE
A. Pre-Initial Turnon Checks	
1	Before making connections between the equipment and the office power mains, check the wiring list of the terminal and make certain that the voltages supplied to the terminal match the terminal requirements.
2	Open the doors on all transmitters and receivers and set the power switches, located on the fuse subassembly on the frame, to the OFF position.
3	Check that the strapping options on all ac power supply units in the transmitters conform to SD-13584 and that those in the receivers conform to SD-11935.
4	Apply power to the connectors on the rack. Using a VOM, verify that the correct input voltage is present on terminals TP1 and TP2 on the fuse assembly of each transmitter and receiver.
<i>Note:</i> Do not turn power switches on the ac power supplies to the ON position.	
B. Transmitter-Receiver Voltage Checks	
5	Connect transmitters to antenna or dummy loads.
<i>Note:</i> The dummy loads are used until the requirement of the appropriate licensing authority are met.	
6	Set the power switch on Transmitter A to the ON position.
7	Set the transmitter meter selector switch to +VOLTS.
<i>Requirement:</i> Meter shall indicate $+28 \pm 0.5$ volts.	
If the requirement is not met, adjust the +28V ADJ control on the transmitter power supply until the requirement is met.	
8	Set the meter selector switch to -VOLTS.

CHART 1 (Cont)

STEP**PROCEDURE**

Requirement: Meter shall indicate approximately 12 (–6 volts).

Note: Check the Factory Test Record for the exact indication expected.

- 9 Set the meter selector switch to PWR OUT.

Requirement: Meter should indicate a nominal RF output of 2 watts.

- 10 Set the meter selector switch to CAL.

Requirement: Meter shall indicate full scale on the VSWR scale.

If the requirement is not met, adjust the VSWR CAL potentiometer on the rear of the meter door until the requirement is met.

- 11 Set the meter selector switch to VSWR.

Requirement: Meter shall indicate 1.5 or less on the VSWR scale.

- 12 Set the power switch on Transmitter B to the ON position.

- 13 Repeat Steps 7 through 11 for Transmitter B.

- 14 At the distant station, check that all receiver ALARM lamps are lighted.

- 15 Set the power switch on Receiver A to the ON position.

Requirement: The ALARM lamp shall extinguish.

If the lamp does not extinguish, one of the monitored functions has failed or no RF signal is being received. See Section 403-403-501.

- 16 Set the receiver meter selector switch to +VOLTS.

Requirement: Meter shall indicate +20 volts.

If the requirement is not met, adjust the +20V ADJ control on the receiver power supply for a correct indication on meter.

- 17 Set the meter selector switch to –VOLTS.

Requirement: Meter shall indicate –20 volts.

If the requirement is not met, adjust the –20V ADJ control on the receiver power supply until the requirement is met.

CHART 1 (Cont)

STEP	PROCEDURE
18	Repeat Steps 15 through 17 for Receiver B.
19	Repeat Steps 15 through 17 for Receiver C.
20	Repeat Steps 15 through 17 for Receiver D.
21	Repeat Part B for the opposite direction of transmission.

CHART 2**NORMAL OPERATING PROCEDURES**

Normal operating procedures for the transmitters and receivers of the SS2000W-02 radio system consists of making certain that no alarms are generated and checking the indications on the front door meters. Should an alarm be generated or a meter indication change, the front door meter indications may be used to aid in localizing the trouble.

STEP	PROCEDURE
1	If not in operation, energize the transmitters and receivers in accordance with Chart 1. <i>Requirement:</i> No alarm lamps shall be lighted.
2	Set the Transmitter A meter selector to +VOLTS. <i>Requirement:</i> The meter shall indicate $+28V \pm 0.5$ volts. If the requirement is not met, adjust the +28V ADJ control until the meter indicates +28 volts.
3	Set the meter selector switch to -VOLTS. <i>Requirement:</i> The meter shall indicate approximately 12 (-6 volts) or as recorded in the Factory Test Records.
4	Set the meter selector switch to PWR OUT. <i>Requirement:</i> The meter shall indicate a nominal 2 watt output.
5	Set the meter selector switch to CAL.

CHART 2 (Cont)

STEP

PROCEDURE

Requirement: The meter shall indicate a full scale VSWR indication.

If the requirement is not met, adjust the VSWR CAL potentiometer until the meter indicates full scale.

6 Set the meter selector switch to VSWR.

Requirement: Meter shall indicate VSWR of 1.5 or less.

7 Set the meter selector switch to DRIVER.

Requirement: Meter indication shall conform to Factory Test Records.

8 Set the meter selector switch to PWR AMP.

Requirement: Meter indication shall conform to Factory Test Records.

9 Repeat Steps 2 through 8 for Transmitter B.

10 Set the meter selector switch of Receiver A to +VOLTS.

Requirement: Meter shall indicate +20 volts.

If the requirement is not met, adjust the +20V ADJ control on the receiver power supply until the meter indicates 20 volts.

11 Set the meter selector switch to –VOLTS.

Requirement: Meter shall indicate –20 volts.

If the requirement is not met, adjust the –20V ADJ control on the receiver power supply until the meter indicates –20 volts.

12 Set the meter selector switch to AGC.

Requirement: Indication shall be within the range indicated in the station log.

Note: The AGC voltage indication is dependent upon the amplitude of the received signal.

13 Repeat Steps 10 through 13 for receivers B, C, and D.

CHART 3
REMOVAL FROM SERVICE

Should an alarm lamp be lighted at the transmitters, receivers, or protection unit, it may be desired to remove the faulty unit from service for testing or repair and still operate the rest of the system. The failure or removal of one channel receiver still provides a noise advantage in the system over that of a single receiver of approximately 4.8 dB. The failure or removal from service of one transmitter or two receivers still provides a noise advantage over that of a single receiver of approximately 3 dB. The procedure also permits the separation of the system into two space diversity systems so that the end-to-end alignment and checks may be performed without completely disrupting service.

STEP	PROCEDURE
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A. Removal of Transmitter From Service

- 1 Set the power switch of Transmitter A or B to the off position.

Requirement: The ALARM lamp on the deactivated transmitter shall light.

- 2 If tests will be performed locally at the transmitter, disconnect the RF output cable at the rear of the transmitter under test and connect a dummy load to the transmitter.

Note: When the transmitter is taken out of service, the ALARM lamps on two receivers at the far end will light, the MAJOR-ALARM lamp on the protection unit will light, and a major alarm will be indicated by the far-end station alarms.

B. Removal of Receiver From Service

- 3 Set the power switch on the receiver to be taken out of service to the OFF position.

Requirement: The ALARM lamp on the receiver taken out of service shall light, the MINOR-ALARM lamp on the protection unit shall light, and a minor station alarm be activated.

Note: Should the A and B receivers, or C and D receivers, be taken out of service simultaneously, the MAJOR-ALARM lamp on the protection unit will light instead of the MINOR-ALARM lamp. The major station alarm will be activated instead of the minor alarm.

- 4 Set the ALARM CUTOFF switch on the receiver taken out of service to the cutoff position.

Requirement: The ALARM CUTOFF lamp on the receiver frame shall light, the ALARM lamp shall extinguish, and the station alarms be disabled.

CHART 3 (Cont)

STEP**PROCEDURE****C. Dual Diversity Arrangement**

Note: This procedure takes half of the equipment out of regular service. The system can be divided into two dual diversity paths. One dual diversity path handles regular service while the other is free for tests or other purposes. The division only affects one direction of transmission.

- 5 At the receiving end, open the protection unit drawer and disconnect the cable from J5 (or J7) on the inside rear panel. Remove the cable from EF OUT on the Channel A and B combining unit.

Caution: *Make certain that the loose cable connectors are not in contact with the circuitry of the combining amplifier cards.*

- 6 At the transmitting end, remove the U-link between XMTR A (or B) IN and the external equipment jack and **immediately** insert a TERM 75 COAX plug into the external equipment jack.

Note: The termination prevents level change in the input to the other transmitter because of the impedance change. The oscillator may now be connected to the XMTR IN jack of the unit being tested.

- 7 At the receiving terminal, connect a selective voltmeter to the TEST jack on the front of the protection unit. Set the selective voltmeter for 75-ohm unbalanced, terminated measurement.

- 8 Connect the cable at the rear of the TEST jack to the TEST jack on the combining amplifier under test.

- 9 Either the A or B (or C or D) combiner path may be muted by removing the appropriate U-link between the RCVR OUT and COMB IN jacks.

- 10 To return the system to regular service, remove the termination at the transmitting end and immediately install the U-link to the external circuit. Reconnect the cable to J5 (or J7) at the receiver protection unit but leave the cable from the rear of the TEST jack on the protection unit connected to the TEST jack on the combining amplifier.

Note: This prevents contact of the cable with components on the combining amplifier cards.