TECHNICAL MANUAL

OPERATOR'S AND ORGANIZATIONAL MAINTENANCE MANUAL

RADIO SET AN/GRC-143
(NSN 5820-00-926-7355)

This copy is a reprint which includes current pages from Changes 1 through 7.

HEADQUARTERS, DEPARTMENT OF THE ARMY
FEBRUARY 1971

WARNING

ELECTROMAGNETIC RADIATION HAZARDS EXIST AT THE WAVEGUIDE OUTPUT FROM THE POWER AMPLIFIER AND WITHIN THE DIRECTIONAL PATTERN OF THE ANTENNA! DO NOT STAND IN THE DIRECT PATH OF THE ANTENNA NOR WORK ON WAVEGUIDES WHILE POWER IS ON!

High frequency electromagnetic radiation can cause fatal burns. It can literally "cook" internal organs and flesh. If you feel the slightest warming effect while near this equipment **MOVE AWAY QUICKLY!**

WARNING

EXTREMELY HIGH VOLTAGE IN EXCESS OF 8,000 VOLTS IS PRESENT IN THE AMPLIFIER, RADIO FREQUENCY AM-6090/GRC-143.
Disconnect power source and discharge capacitors *before* making any connections within the enclosed portion of the cabinet. **DO NOT PLACE HANDS OR TOOLS NEAR TERMINALS CARRYING VOLTAGES ABOVE 500 VOLTS BECAUSE OF THE DANGER OF ARCING.**

Change
No. 7

HEADQUARTERS,
DEPARTMENT OF THE ARMY
Washington, DC, 15 January 1992

Operator's and Organizational Maintenance Manual Radio Set AN/GRC–143 (NSN 5820–00–926–7355) (EIC: HB9)

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Remove pages	*Insert pages*
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3–11 through 3–16	3–11 through 3–16
5–51 and 5–52	5–51 and 5–52
5–69 and 5–70	5–69 and 5–70

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CHANGE
NO. 6

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5-5 through 5-8	5-5 through 5-8
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No. 5

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Operator's and Organizational Maintenance Manual
RADIO SET AN/GRC-143
(NSN 5820-00-926-7355)

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2-45 and 2-46	2-45 and 2-46
B-13 and B-14	B-13 and B-14

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TECHNICAL MANUAL
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OPERATOR'S AND ORGANIZATIONAL MAINTENANCE MANUAL
RADIO SET AN/GRC-143
(NSN 5820-00-926-7355)

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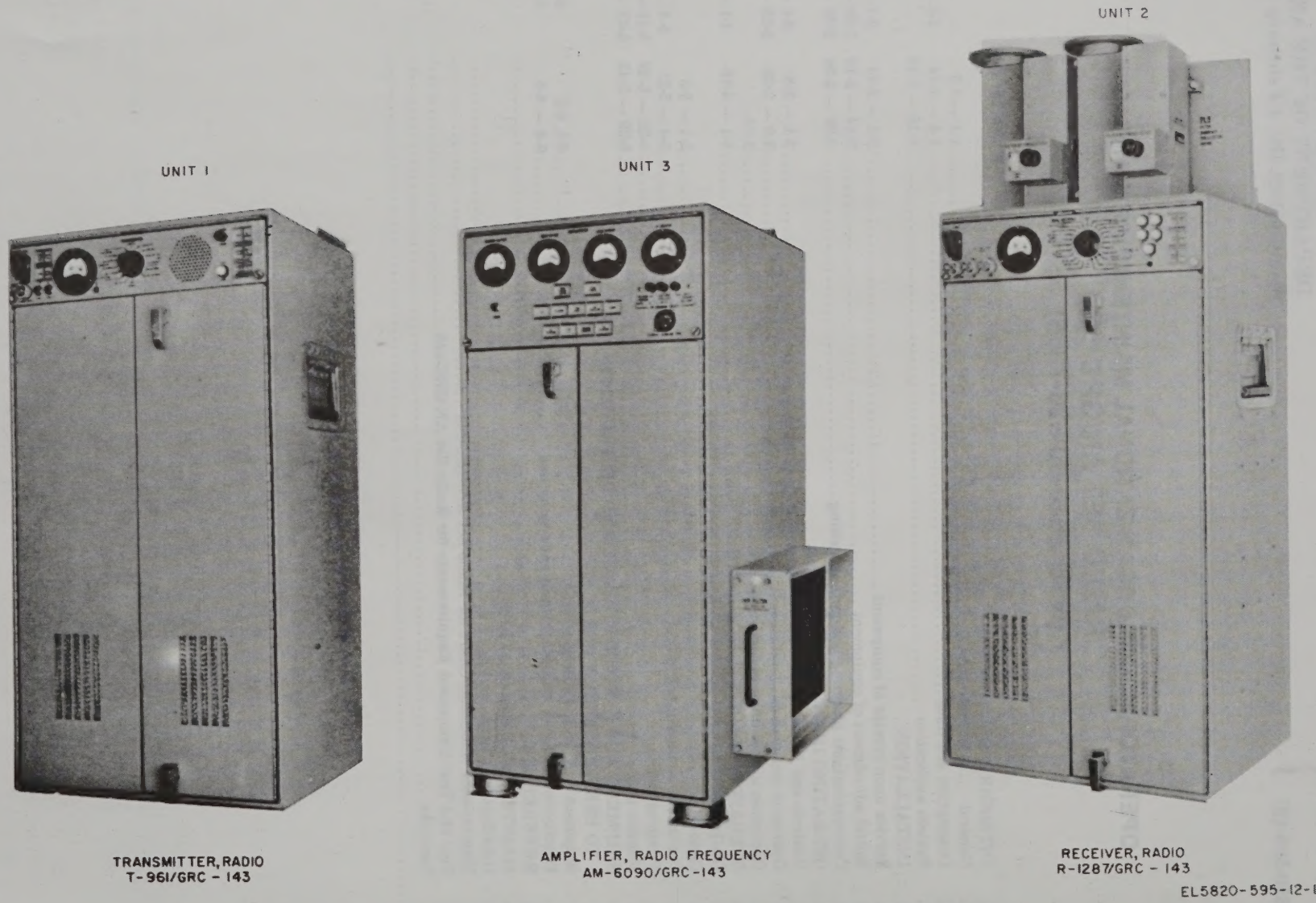


Figure 1-1. Radio Set AN/GRC-143, less minor components, spares, and mode modules.

CHAPTER 1

INTRODUCTION

Section I. INTRODUCTION

1-1. Scope

a. This manual describes Radio Set AN/GRC-143 (fig. 1-1) and covers its installation, operation, and operator's and organizational maintenance. This manual includes instructions for cleaning and inspection of the equipment, and replacement of parts available to the organizational repairman.

b. The maintenance allocation chart (MAC) is also included in this manual.

1-2. Consolidated Index of Army Publications and Blank Forms

Refer to the latest issue of DA Pam 310-1 to determine whether there are new editions, changes or additional publications pertaining to the equipment.

1-2.1. Maintenance Forms, Records, and Reports

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TM 38-750, The Army Maintenance Management System.

b. Report of Packaging and Handling Deficiencies. Fill out and forward SF364 (Report of Discrepancy (ROD)) as prescribed in AR 735-11-2/DLAR 4140.55/NAVMATINST 4355.73A/AFR 400-54/MCO 4430.3F.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33C/AFR 75-18/MCO P4610.19D/DLAR 4500.15.

1-3. Reporting Errors and Recommending Improvements

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to: Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: DRSEL-ME-MP, Fort Monmouth, New Jersey 07703. In either case, a reply will be furnished direct to you.

1-3.1. Reporting Equipment Improvement Recommendations (EIR)

If your Radio Set needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: DRSEL-ME-MP, Fort Monmouth, New Jersey 07703. We'll send you a reply.

1-3.2. Administrative Storage

Administrative Storage of equipment issued to and used by Army activities will have preventive maintenance performed in accordance with the PMCS charts before storing. When removing the equipment from administrative storage the PMCS should be performed to assure operational readiness. Disassembly and repacking of equipment for shipment or limited storage are covered in chapter 6.

Section II. DESCRIPTION AND DATA

1-4. Purpose and Use

a. Radio Set AN/GRC-143 (fig. 1-1) is a general purpose, frequency modulated tactical radio set which provides duplex operation in the 4.4 to 5.0 gigahertz (GHz) frequency range with a continuous wave (cw) power output capability of one kilowatt. The radio set can be used for diffractive and tropospheric scatter modes of propagation at ranges to 100 miles (160.90 kilometers) when used with a suitable antenna, such as Antenna Group AN/TRA-37. Radio Set AN/GRC-143 is compatible with standard pulse code modulated (pcm) multiplex equipment such as TD-352/U and TD-660/U for 12- and 24-voice channel pcm operation. The basic radio set consists of three equipment cabinets; Transmitter, Radio T-961/GRC-143, Receiver, Radio R-1287/GRC-143, and Amplifier, Radio Frequency AM-6090/GRC-143.

b. An order wire circuit, which includes facilities that connect stations of a system on a party line basis, is provided for use by operating and maintenance personnel.

1-5. Technical Characteristics

a. Radio Set AN/GRC-143.

Type .....Modular, solid state (except klystron).
Modes .....(1) 12 channel pcm and order wire.

	(2) 24 channel pcm and order wire.
Output power	Adjustable from 100 watts to 1.0 kilowatt.
Frequency range	4400 to 5000 MHz.
RF channels	6001
RF channel separation	100 kHz.
Transmit/receive separation.	90 MHz, minimum.
Type of modulation	Frequency Modulation (FM)
FM deviation:	
12-channel pcm operation	250 kHz.
24-channel pcm operation	500 kHz.
Antenna requirement	Antenna Group AN/TRA-37.
Transmisssion lines	WR-187 flexible waveguide or equivalent.
Distance Range	Up to 100 miles dependent upon terrain and atmospheric conditions.
Power requirement	115/230 vac, 47 to 63 Hz, power factor 0.84, 5.37 kw.
Temperature limits	0°F to +120°F.
Weight	719 pounds.

b. Transmitter, Radio T-961/GRC-143.

Frequency range	4400 to 5000 MHz.
Power output	150 mw nominal.
Output impedance	50 ohms.
Output connector	Type N.
Local oscillator:	
Type (para 1-5 *e*)	Synthesizer source, crystal controlled.
Synthesizer frequency range.	284.375 to 303.125 MHz.
Frequency multiplication	16
Local oscillator frequency range	4550 to 4850 MHz.
Frequency selection steps	100 kHz.
PCM video input	
Waveform	Composite 12 or 24 channel pcm.
Level	1.0 to 4.0 volts peak-to-peak.
Impedance	50 ohms
Order wire circuits:	
Frequency response	300 to 1700 Hz.
Distortion	5 percent, maximum.
Peak limiting compression:	
at 0 dbm input level	0.4 db maximum.
at +15 dbm input level	10 db ± 3 db.
Order wire input signals	
Recovered order wire	-4 dbm into 600 ohms.
Local handset	0 dbm into 50 ohms.
Receiver (emergency order wire)	-11 dbm into 50 ohms.
Remote telephone set	0 dbm into 600 ohms.
Through path orderwire	-4 dbm into 600 ohms.
Order wire output signals	
Local handset	-18 ±3 dbm at 150 ohms.
Remote telephone set	-14 ±3 dbm at 600 ohms.
Transmitter order wire	0 ± 3 dbm at 600 ohms.
Through path order wire	-4 ± 3 dbm at 600 ohms.
Metering	Integral metering provided for monitoring and adjustment.
Alarm indicators	Seven visual alarms are provided on the transmitter meter panel to monitor the operation of the transmitter circuits. A CNTRL ALARM is also provided on the transmitter meter panel to indicate the operational status of the radio set.
Status indicators	Two status indicators are provided on the transmitter meter panel to indicate presence or absence of test and order wire ring signal in radio set.
Power requirement	115 ± 5 vac, 3 amperes, 275 watts, power factor 0.85, single phase, 47 to 63 Hz.
Temperature limits	0°F to +120°F

c. Receiver, Radio R-1287/GRC-143.

Type	Dual diversity, single conversion superheterodyne.	
Diversity mode	Space diversity.	
Type of combining	IF—predetection with IF squelch and combined signal agc.	
Noise figure (4400 to 5000 MHz)	5.5 db maximum.	
RF input connection	Waveguide flange.	
Sensitivity threshold	*12 channels*	*24 channels*
Operated as single receiver	-100 dbm	-97 dbm
Operated as dual receiver with equal RF inputs.	-103 dbm	-100 dbm
Frequency range	4400 to 5000 MHZ.	
Response to spurious signals	80 db below RF channel response	
Local oscillator:		
Type (para 1-5*e*)	Synthesizer source, crystal controlled.	
Synthesizer frequency range	284.375 to 303.125 MHz	
Frequency multiplication	16 (220 MHz added or subtracted).	
Local oscillator frequency range	4330 to 5070 MHz.	
Adjustment steps	100 kHz.	
Intermediate frequency	70 MHz	
Intermediate frequency bandwidth:		
12-channel operation	750 kHz ± 10 percent at 3 db points.	
24-channel operation	1.5 MHz ± 10 percent at 3 db points.	
Output level	1 volt peak-to-peak.	
Output waveform	12-or 24-channel pcm and order wire.	
Output impedance	50 ohms ± 10 percent	
Metering	Integral metering provided for monitoring and adjustment.	

Alarm indicators ---------- Five visual alarms are provided on the receiver meter panel to monitor the operation of receiver circuits.
Power requirement ---------- 115 ± 5 vac, 2.75 amperes, 295 watts, power factor 0.91, 47 to 63 Hz, single phase.
Temperature limits ---------- 0°F to +120°F.

d. Amplifier, Radio Frequency AM-6090/GRC-143.

Type ---------- 4 cavity, tunable klystron.
Klystron ---------- VA 888D.
Beam focusing ---------- Permanent magnet.
Klystron cooling ---------- Forced air.
High temperature interlock Opens at 260°C.
Input level ---------- 50 mw minimum (zero attenuation).
Input level adjustment ---------- Internal variable attenuator.
Input vswr ---------- Not greater than 2:1.
Input impedance ---------- 50 ohms.
Input connector ---------- Type N.
Frequency range ---------- 4400 to 5000 MHz.
Power output ---------- Adjustable from 100 to 1,000 watts.
Output vsvr ---------- 2:1 maximum.
Output connector ---------- Waveguide flange.
Nominal beam voltage ---------- 7500 volts (adjustable).
Beam current ---------- 0.5 ampere (nominal).
Metered functions ---------- Four meters are provided on power amplifier meter panel to monitor the power amplifier klystron voltages, current, and running time. One meter is provided on the power amplifier meter panel to monitor the power amplifiers input and output signal levels.
Alarm indicators ---------- Eight visual alarms are provided on the power amplifier meter panel to monitor the operation of power amplifier circuits.
Power requirements ---------- 115/230 vac ±10%, power factor 0.82, 4.75 kw (total), line A to neutral 24.5 amperes, line B to neutral 24.0 amperes.
Temperature limits ---------- 0°F to +120°F.

e. Synthesizer, Electrical Frequency. Transmitter, Radio T-961/GRC-143 and Receiver, Radio R-1287/GRC-143 use identical electrical frequency synthesizer (650511). Detailed performance characteristics are listed below.

Type ---------- Modular, solid state, crystal controlled, phase locked.
Frequency range ---------- 284.375 to 303.125 MHz, in 6.250 kHz steps.
Number of frequencies ---------- 3001
Frequency stability ---------- 1×10^{-7} per day or 1×10^{-6} per 30 days.
Power input ---------- 50 watts at 110 volts, 50 to 400 Hz (60 Hz typical), single phase, two wire.
Warmup time ---------- 30 minutes for frequency accuracy of 5 parts in 10^7.
Output power ---------- 20 mw ± 1 db into 50 ohm resistive load.
Output impedance ---------- 59 ohms.
Ouput protection ---------- No damage from open or short circuit.
Spurious am sideband output. 80 db below desired output, minimum.
Harmonic levels:
  Second harmonic ---------- 20 db below desired output, minimum.
  Third harmonic ---------- 30 db below desired output, minimum.
  All others ---------- 40 db below desired output, minimum.
Lamp indications ---------- Power supply and modules
Remote indications ---------- Phase lock, oven, and output level.

1-6. Items Comprising Radio Set AN/GRC-143
(figs. 1-1, 1-2, and 1-18)

a. Items. The items in the chart below make up an operable Radio Set AN/GRC-143, FSN 5820-926-7355. One copy of TM 11-5820-595-12 is packed with each AN/GRC-143.

FSN	Item	Quantity	Height (in.)	Depth (in.)	Width (in.)	Weight (lb)
5820-815-9720	Transmitter, Radio T-961/GRC-143	1	33	14	17	159
5820-935-0169	Receiver, Radio R-1287/GRC-143	1	43 1/2	14	17	178
5820-815-9710	Amplifier, Radio Frequency AM-6090/GRC-143.	1	36	21 1/2	20 1/2	376
5965-892-3850	Handset, H-156/U ----------	1				
5820-136-1243	Indicator, antenna alignment	1				
	Running spares (*b* below).	1 set				
5905-134-9854	24 channel pcm attenuator 1A18.	1*				
5915-134-0740	1.5 MHz if filter 2A25 ----------	2*				
5915-134-0739	680 kHz low pass filter 2A27 ----------	1*				

* Quantities are doubled for a dual radio set.

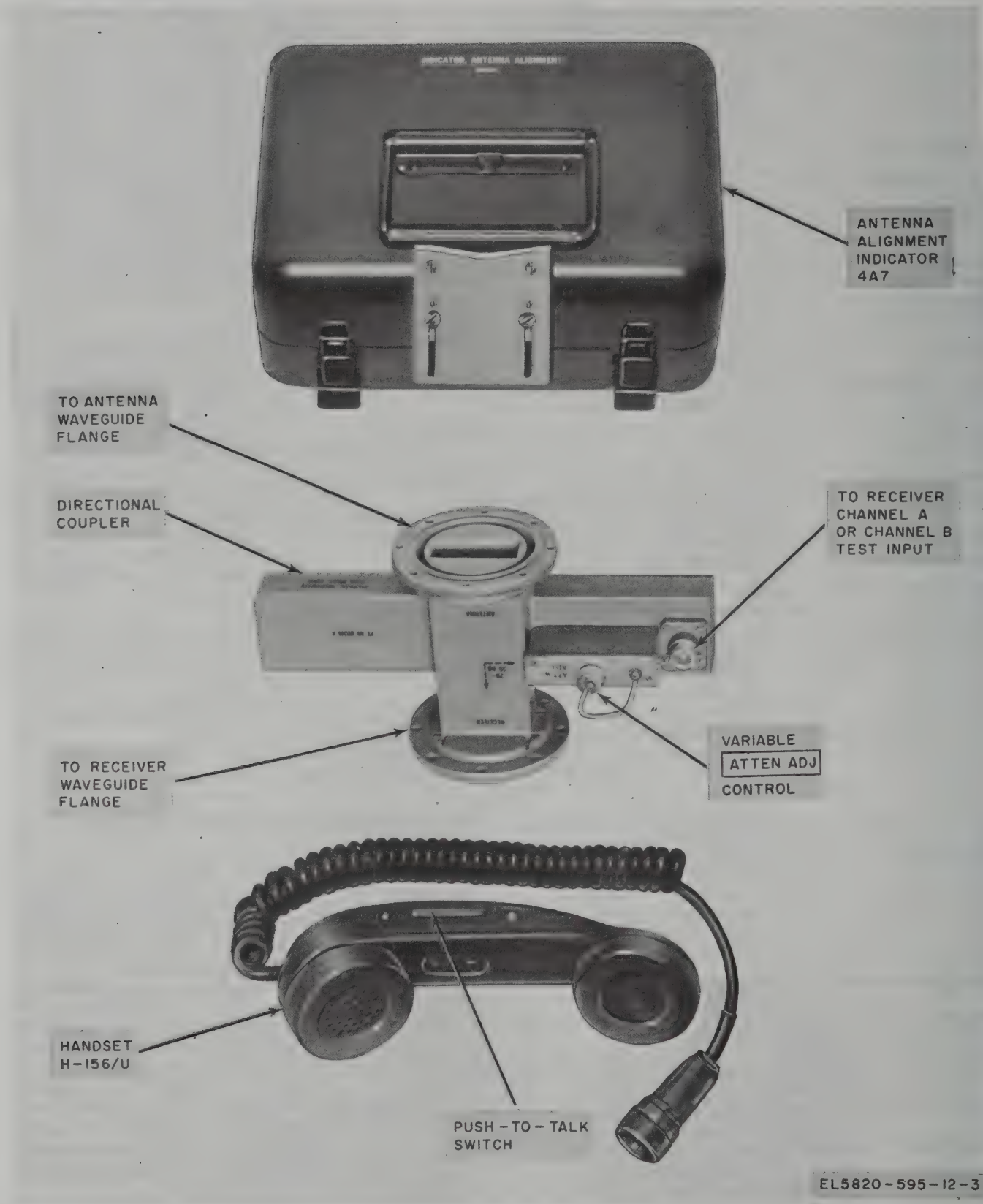


Figure 1-2. Minor components supplied with Radio Set AN/GRC-143.

b. Running Spares (figs. 1–4, 1–10, 1–14, and1–17). Running spares are listed below.

FSN	Item	Quantity
5920–777–6473	Fuse, 3A (FM01–3A)	10
5920–281–0210	Fuse, 4A (F02A250V4AS)	5
5920–877–9934	Fuse, 3A (F02A250V3AS)	10
5920–280–5066	Fuze, SLO BLO 5A	5
5920–850–6091	Fuse, SLO BLO 1A (F02B250V1AS)	5
5920–834–0138	Fuse, SLO BLO 8A	5
5920–199–9498	Fuse, 0.5A (F02B250V1/2A)	2
6240–965–1381	Lamp, incandescent, type 382	4
6240–763–7744	Lamp, incandescent, type 387 Diode, 1N76	10
		1
5961–985–9091	Diode, 1N23WG Crystal detector (653201–1, –2)	1
		2
5961–615–4309	Diode, 1N23WE	1

1–7. Nomenclature and Item Names

Nomenclatured items of Radio Set AN/GRC–143 are referred to by common names throughout this manual and are listed in *a* below. Additional common names and reference designations are given in *b* through *e* below for items that are not nomenclatured.

a. Common Names.

Nomenclature	Common name
Radio Set AN/GRC–143	Radio set.
Transmitter, Radio T–961/RC–143	Transmitter.
Cabinet, Electrical Equipment CY–6512/GRC–143	Transmitter cabinet.
Receiver, Radio R–1287/GRC–143	Receiver.
Cabinet, Electrical Equipment CY–6513/GRC–143	Receiver cainet.
Amplifier, Radio Frequency AM–6090/GRC–143	Power amplifier.
Cabinet, Electrical Equipment CY–6514/GRC–143	Power amplifier cabinet.
Handset, H–156/U	Handset.
Coupler, Directional	Directional coupler.

b. Transmitter Common Names. The chart below lists the common names and reference designations assigned to the transmitter and associated subassemblies.

Nomenclature or item name	Reference designation	Common name
Transmitter, Radio T–961/GRC–143	1	Transmitter
Power supply (650508)	1A1	Power supply
Regulator, voltage 5/6v (650532)	1A1A1 through 1A1A4	5/6v regulator
Regulator, voltage 12v (650531)	1A1A6 through 1A1A9	12v regulator
Regulator, voltage 15/28v (650530)	1A1A10 through 1A1A12	15/28v regulator
Chassis, assembly, power supply (651278).	1A1A13	Power supply chassis
Oscillator, radio frequency, 100 MHz (650509).	1A2	100 MHz RF oscillator
Attenuator Assembly:		
12-channel pcm (650514)	1A3	12-channel pcm attenuator
24-channel pcm (650536)	1A18	24-channel pcm attenuator
Amplifier, aduip frequency radio frequency (650500).	1A4	Af–RF amplifier
Alarm Monitor (650504)	1A5	Alarm monitor
Filter, low pass, 1.3 MHz (650501)	1A6	1.3 MHz low pass filter
Control, electronic frequency (650503)	1A7	Electronic frequency control.
Modulator, radio transmitter (650502)	1A8	Modulator
Mixer stage, frequency transmitter (650507).	1A9	Frequency mixer
Mixer, crystal (650527)	1A9A1	Crystal mixer
Coaxial circulator (651404)	1A9HY1	4. 4–5.0 GHz circulator
Frequency multiplier group, transmitter (650506).	1A10	Frequency multiplier group.
Frequency multiplier, 2d stage, transmitter (650528).	1A10A1	2d frequency multiplier.
Frequency multiplier, 3d stage, transmitter (650529).	1A10A2	3d frequency multiplier.

Nomenclature or item name	Reference designation	Common name
Coaxial circulator (651403)	1A10HY1	2275–2425 MHz circulator
Amplifier-Frequency multiplier, transmitter (650505).	1A11	Amplifier-frequency multiplier.
Modem, digital data (650513)	1A12	Digital data modem
Oscillator, voltage controlled (650580)	1A12A1, 1A12A14	1,608 kHz vco
Regenerator, digital, cable (650539)	1A12A2	Cable digital regenerator.
Control-Comparator, cable (560540)	1A12A3	Cable control comparator.
Processor, digital, cable (650542)	1A12A4	Cable digital processor
Amplifier, audio frequency (650543)	1A12A5	Af amplifier
Alarm-Monitor (650545)	1A12A6	Alarm monitor
Amplifier-Detector radio (650547)	1A12A7	Amplifier-detector
Regenerator, digital, radio (650575)	1A12A8	Radio digital regenerator
Control-Comparator, radio (650576)	1A12A9	Radio control comparator.
Control-Processor (650577)	1A12A10, 1A12A12	Control processor
Decoder, pulse (650578)	1A12A11	Pulse decoder
Processor, digital, radio (650579)	1A12A13	Radio digial processor
Chassis, modem, digital data (651624).	1A12A15	Digital data modem chassis
Order wire (650512)	1A13	Order wire assembly
Daughter board No. 1 assembly (651609).	1A13A1	Board No. 1
Daughter board No. 2 assembly (651510).	1A13A2	Board No. 2
Daughter board No. 3 assembly (651611).	1A13A3	Board No. 3
Daughter board No. 4 assembly (651612).	1A13A4	Board No. 4
Daughter board No. 5 assembly (651613).	1A13A5	Board No. 5
Order wire chassis (651630)	1A13A7	Orderwire chassis
Synthesizer, electrical frequency (650511).	1A14	Frequency synthesizer
Oscillator, radio frequency (650548)	1A14A1	RF oscillator
Converter, frequency, electronic (650551).	1A14A2	Electronic frequency converter.
Detector, audio frequency, phase error (650553).	1A14A3	AF phase error detector
Frequency divider, variable 1 (650549).	1A14A4	Variable frequency divider No. 1.
Frequency divider, variable 2 (650552).	1A14A5	Variable frequency divider No. 2.
Frequency divider, fixed (650550)	1A14A6	Fixed frequency divider
Oscillator, radio frequency standard (651989).	1A14A7	Standard RF oscillator
Dual power supply (651807)	1A14A8	Dual power supply
Chassis, electrical equipment (651941)	1A14A10	Main chassis
Plate assembly (651157)	1A15	Plate assembly
Radio test set	Part of 1A15	Radio test set
Cabinet, Electrical Equipment CY–6512/GRC–143.	1A16	Transmitter cabinet
Attenuator, variable (651390)	1AT3, 1AT4	Variable attenuator
Power divider radio frequency (652120).	1DC1	RF power divider
Coupler, directional (651399)	1DC2	Directional coupler
Coaxial circulator (651402)	1HY1	1137–1213 MHz circulator.
Filter, bandpass, radio frequency (651386).	1FL3	4. 4–5.0 GHz bandpass filter.
Filter, low pass, radio frequency (651438).	1FL4	5.0 GHz low pass filter
Filter, bandpass, radio frequency (651523–2).	1FL5	1137–1213 MHz bandpass filter.
Mixer, crystal (651383)	1Z1	Crystal mixer

c. Receiver Common Names. The chart below lists the common names and reference designations assigned to the receiver and receiver subassemblies. Although many of the parts are not covered in this manual, they are included for information and completeness.

Nomenclature of item name	Reference designation	Common Name
Receiver, Radio R-1287/GRC-143-------	2	Receiver
Amplifier, tunnel diode (651379)	2A1, 2A2	TDA
NOTE **GaAs field-effect transistor (FET) amplifiers may be used in 2A1, 2A2**		
Power supply (650523)----------	2A3	Power supply
Regulator, voltage, 15/28v (650530)-----	2A3A1, 2A3A2, 2A3A4	15/28 v regulator
Regulator, voltage, 12v (650531)--------	2A3A3	12 v regulator
Chassis assembly (651279)----------	2A3A5	Power supply chassis
Amplifier-Mixer (650520)----------	2A4, 2A11	Mixer-preamplifier
Mixer, crystal (651382)----------	2A4Z1, 2A11Z1	Crystal Mixer
Filter, bandpass, 70 MHz (B=750 kHz) (650525).	2A5, 2A10	70 MHz IF filter
Filter, bandpass, 70 MHz (B=1.5 MHz) (650538).	2A25, 2A26	70 MHz IF filter
Mixer, stage, frequency, receiver (650522).	2A6, 2A9	Frequency Mixer
Filter, bandpass, 220 MHz (Bw=11.5) MHz) (650533).	2A6FL1, 2A9FL1	220 MHz bandpass filter
Coaxial circulator (651407)----------	2A6HY1, 2A9HY1	4330-5070 MHz circulator
Mixer, crystal (651424)----------	2A6Z1, 2A9Z1	Crystal mixer
Frequency multiplier group, receiver (650521).	2A7	Frequency multiplier group.
Frequency multiplier, 2d stage, receiver (650534).	2A7A1	2d frequency multiplier
Frequency multiplier, 3d stage, receiver (650535).	2A7A2	3d frequency multiplier
Coaxial circulator (651406)----------	2A7HY1	2275-2425 MHz circulator
Circulator--Coaxial hybrid (652013)----	2A7HY2	4550-4950 MHz power divider
Amplifier-Frequency multiplier (650515).	2A8	Amplifier-multiplier
Amplifier, intermediate frequency, 70 MHz (652590).	2A12, 2A15	IF Amplifier
Frequency multiplier-voltage controlled oscillator, 220 MHz (650524).	2A13, 2A14	220 MHz vco
Oscillator, assembly radio frequency (652605).	2A13Y1, 2A14Y1	110 MHz vco
Amplifier-Frequency multiplier (651501).	2A13A1, 2A14A1	Frequency-multiplier
Unit control, amplifier combiner (dual), unit control (652676).	2A16	Combiner
Demodulator (650518)----------	2A17	Demodulator
Filter, low pass, 260 kHz (650519)------	2A18	260 kHz low pass filter
Filter, low pass, 680 kHz (650537)------	2A27	680 kHz low pass filter
Amplifier, audio frequency-radio frequency (650500).	2A19	Af-RF amplifier
Alarm-Monitor (650504)----------	2A20	Alarm monitor
Synthesizer, electrical frequency-----	2A21	Frequency synthesizer
Cabinet, Electrical Equipment CY-6513/GRC-143	2A22	Receiver cabinet
Plate assembly (651564)----------	2A24	Plate assembly
Filter, bandpass, preselector (651385).	2FL4, 2FL5	Preselector
Filter, bandpass, post selector (651387).	2FL6, 2FL7	Post selector
Filter, bandpass, local oscillator (651388).	2FL8, 2FL9	Local oscillator filter
Filter, bandpass, radio frequency (651523-1).	2FL10	1137-1213 MHz bandpass filter.
Circulator, Coaxial, 440-5000 MHz (652241-1).	2HY1	4.4-5.0 GHz circulator
Circulator, Coaxial, 400-5000 MHz (652241-2).	2HY2	4.4-5.0 GHz circulator
Coaxial circulator (651405)----------	2HY3	1137-1213 MHz circulator.

d. Power Amplifier Common Names. The chart below lists the common names and reference designations assigned to the power amplifier and associated subassemblies.

Nomenclature or item name	Reference designation	Common name
Amplifier, Radio Frequency AM-6090/GRC-143.	3	Power amplifier
Control, regulator, inverter (650572)	3A1	Inverter regulator control
Control, indicator (650573)	3A2, 3A3	Indicator control
Control, alarm, radio frequency mismatch (650564).	3A4	Low RF-mismatch, alarm and control.
Control, time delay (650566)	3A5	Time delay control
Control, beam gate-direct current overload (650565).	3A6	Beam gate-dc overload control
Power supply control (650569)	3A7	Power supply control
Inverter (650574)	3A8	Inverter
Cabinet, Electrical Equipment CY-6514/GRC-143.	3A9	Power amplifier cabinet
Power supply (650568)	3A9A1	HV power supply

e. Minor Components Common Names. The chart below lists the common names and reference designations assigned to the minor components of the radio set.

Nomenclature or item name	Reference designation	Common name
Handset H-156/U (SC-D-76454)	4A4	Handset
Coupler, directional	4A5, 4A6	Directional coupler
Indicator, antenna alignment assembly (650526).	4A7	Antenna alignment indicator.

1-8. Description of Radio Set AN/GRC-143

Major components (fig. 1-1) of the radio set consists of the transmitter, receiver, and power amplifier which are each inclosed in radio frequency interference (rfi) equipment cabinets. These equipments provide the major functions of the radio set and a detailed description of each is provided in paragraphs 1-9 through 1-11. Minor components (fig. 1-2) consist of a handset and antenna alignment indicator. The minor components supplement the functions of the major components and are described in paragraph 1-12. Remaining equipment items are spares and mode modules (figs. 1-16, 1-17, and 1-18). These items include lamps, diodes, and 24-channel mode modules. The spares and mode modules provide operational and maintenance backup for normal equipment operation and are described in paragraph 1-13.

1-9. Description of Transmitter, Radio T-961/GRC-143

The transmitter (fig. 1-3) is housed in a shielded rfi aluminum cabinet. When installed, the transmitter is rigidly secured to a mounting surface by means of four bolts at the bottom and two bolts at the upper rear of the transmitter cabinet. Forced air circulation is maintained by a cooling fan mounted at the top rear of the transmitter cabinet. The fan exhaust port is covered by a rfi shielded air filter.

a. Recessed handles are provided at each side of the transmitter cabinet to permit lifting during installation or removal. Latch handles mounted at the top and bottom of the right door provide access to the interior of the transmitter cabinet. The lower portion of each door includes an intake air filter.

b. A comparment (figs. 1-3 and 1-4) with a hinged cover marked SPECIAL TOOLS AND SPARE FUSES is mounted on the inside of the left front cabinet door. The compartment cover is secured by two captive screws mounted along the upper edge of the cover. The compartment contains spare fuses, a connector wrench, card extractor, and a test lead for patching the panel mounted meter to various module test points. A flip-chart is mounted on the inside of the right cabinet door. The flip-chart provides condensed operating instructions, and identifies the location of assemblies and cables within the transmitter cabinet.

c. All transmitter input and output connections are made through connectors mounted on top of the transmitter cabinet (fig. 2-16).

d. The transmitter meter panel (fig. 1-3) is mounted at the upper front portion of the transmitter cabinet. This panel is hinged to allow ac-

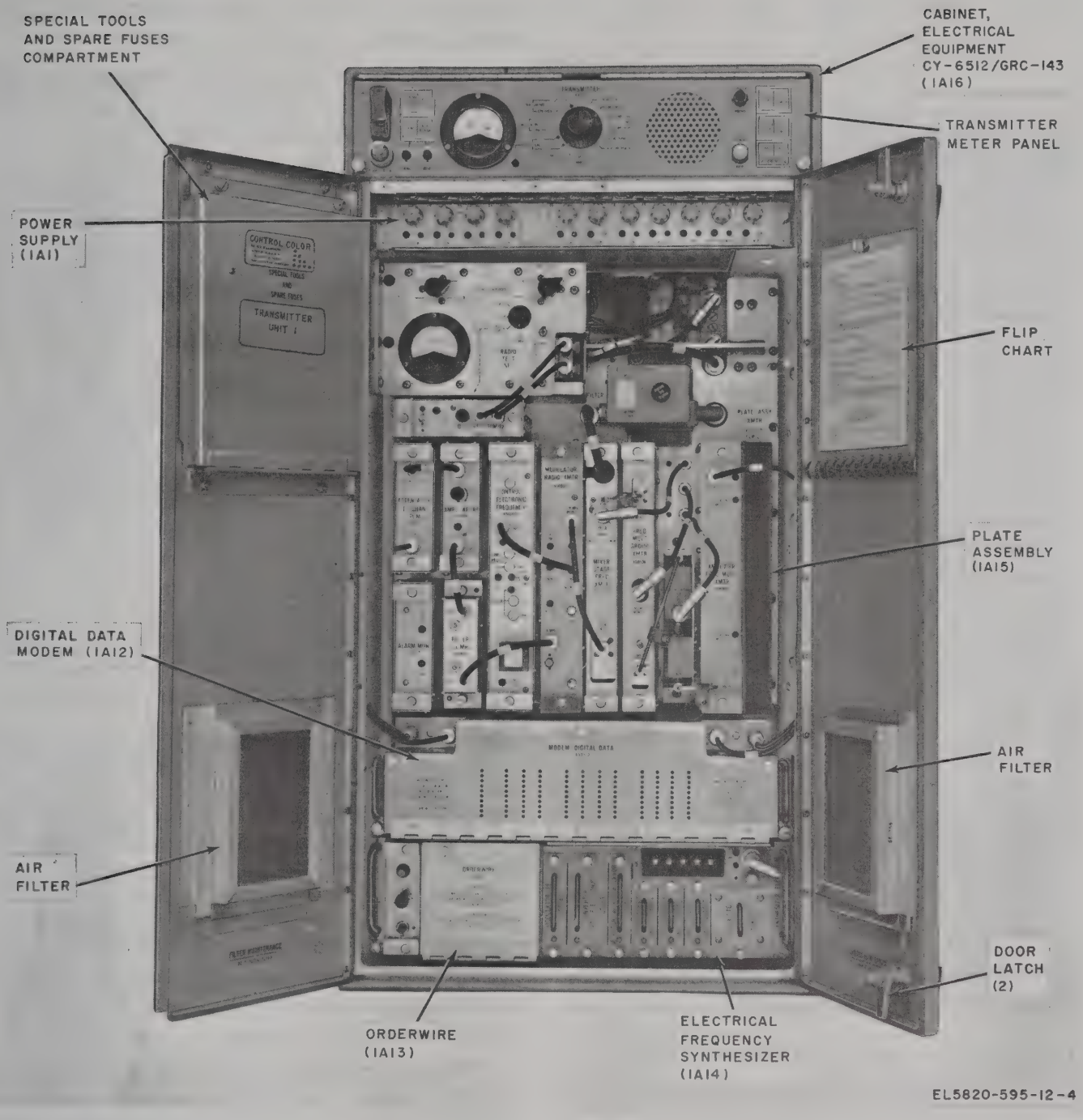


Figure 1–3. Transmitter, Radio T–961/GRC–143.

cess to the panel wiring and voltage regulator modules of power supply 1A1. The transmitter meter panel contains pushbuttons, switches, status indicator lamps, alarm indicator lamps, a meter and meter selector switch that permits control and monitoring of transmitter operation.

e. Power supply 1A1 (figs. 1–3 and 1–5) extends across the full width of the transmitter cabinet and contains 11 plug-in type voltage regulator modules which insert into the plug-in power supply chassis. Each module has an associated indicator light, fuse, and test jack mounted on the lower portion of the power supply chassis.

f. Plate assembly 1A15 (figs. 1–3 and 1–6) includes a radio test set and provides a mounting and interconnection facility for the various plug-in modules. Each module is secured to the plate assembly by two captive screws. Electrical connections for control and power are made through mating connectors mounted on the rear of the module and front of the plate assembly. Guide pins are provided at the rear of each module to

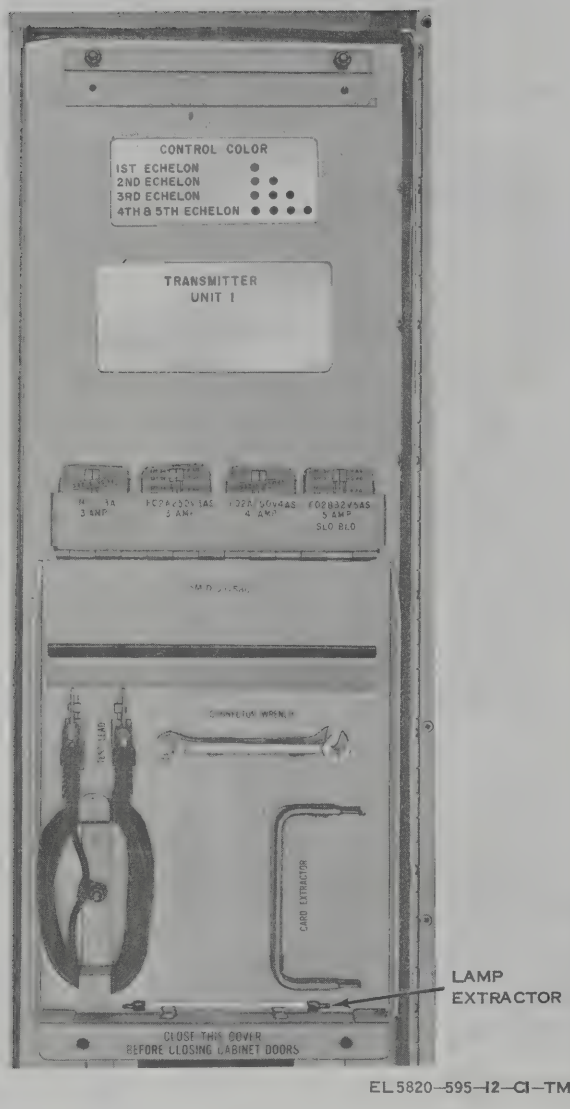


Figure 1-4. Transmitter, Radio T-961/GRC-143, special tools, and spare fuses compartment.

prevent module insertion into an incorrect position on the plate assembly. All operator and organizational maintenance controls and test points are accessible from the front of the transmitter cabinet.

g. Digital data modem 1A12 (figs. 1-3 and 1-7) is an inclosed plug-in chassis assembly which is secured to transmitter cabinet 1A16 by two captive screws. A hinged front cover permits access to plug-in card assemblies, and related switches, test jacks, and test lamps. Keying slots on the connector end of each plug-in card assembly prevents insertion of a card at the wrong location or with the wrong orientation.

h. Order wire assembly 1A13 (figs. 1-3 and 1-8) is an inclosed plug-in chassis assembly. This assembly and frequency synthesizer 1A14 are bolted together; the composite assembly is secured to the transmitter cabinet by two captive screws. Two test switches and an indicator lamp are located on the left front panel of the order wire assembly. Keying slots at the connector end on each of five plug-in card assemblies prevent insertion in the wrong location or with the wrong orientation.

i. Frequency synthesizer 1A14 (figs. 1-3 and 1-8) is an inclosed plug-in chassis assembly which is secured to the order wire assembly as described in *h* above. Frequency synthesizer 1A14 consists of a main chassis, seven plug-in card assemblies, and a dual power supply which is mounted on the rear of the main chassis. Each plug-in card assembly is held in place by means of captive thumbscrews. Power and remote indication connections are made at the rear of the main chassis. Connection to the RF output is made direct to the main chassis front panel.

1-10. Description of Receiver, Radio R-1287/GRC-143

Components of the receiver (fig. 1-9) are housed in an rfi shielded aluminum cabinet. When installed, the receiver is rigidly secured to a mounting surface by means of four bolts at the bottom, and two bolts at the upper rear of the receiver cabinet. Forced air circulation is maintained by a cooling fan mounted at the top rear of the cabinet. The fan exhaust port is covered by an rfi shielded air filter.

a. Recessed handles are provided at each side of the receiver cabinet to permit lifting the cabinet during installation and removal. Latch handles mounted on the top and bottom of the right-hand door provide access to the receiver cabinet interior. The lower portion of each door includes an intake air filter.

b. A compartment (figs. 1-9 and 1-10) with a hinged cover marked SPECIAL TOOLS AND SPARE FUSES is mounted on the inside of the left front cabinet door. The compartment cover is secured by two captive thumbscrews mounted along the upper edge of the cover. The compartment contains spare fuses, three connector wrenches, an alignment tool, and a test lead for patching the panel mounted meter to module test

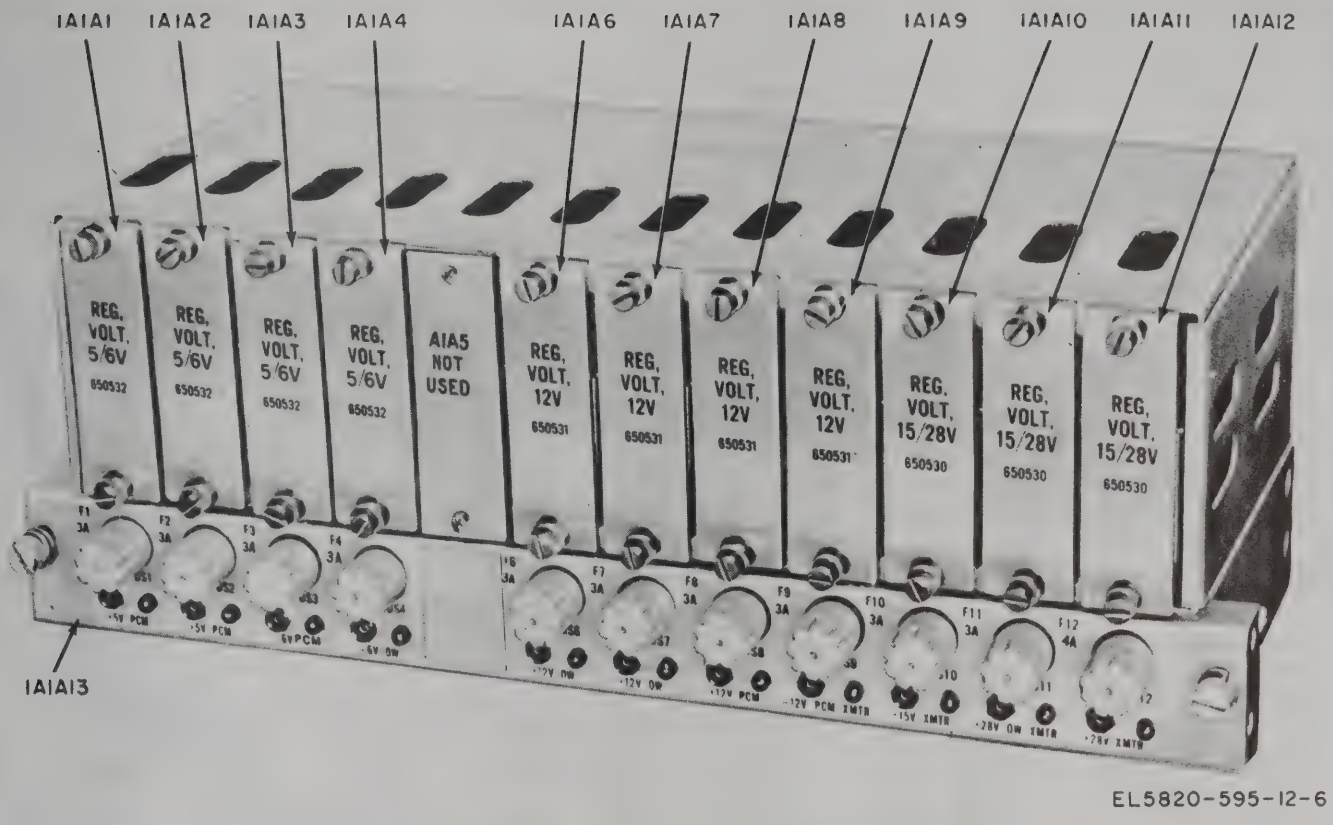


Figure 1-5. Transmitter power supply 1A1.

points. A flip-chart is mounted on the inside of the right cabinet door. The flip-chart provides condensed operating instructions, and identifies the location of assemblies and cables within the receiver cabinet. The lower portion of each cabinet door has a mounted intake air filter.

c. All receiver input and output connections are made at the top of the receiver cabinet (fig. 2-17).

d. The receiver meter panel (fig. 1-9) is mounted at the upper front portion of the receiver cabinet and is hinged to allow access to the panel wiring, TDA 2A1 and 2A2, and power supply 2A3. Mounted on this panel are pushbutton switches, status indicator lamps, alarm indicator lamps, and metering of selected functions that permit control and monitoring of receiver operation.

e. TDA 2A1 and 2A2 are mounted in the upper left portion of the receiver cabinet directly under preselectors 2FL4 and 2FL5 as shown in figure 1-9.

NOTE

The tunnel diode amplifiers in some radios have been replaced by GaAs field effect transistor (FET) amplifiers; radios using the FET amplifiers will be labeled on the front of the electrical equipment cabinet 2A22. The letters "TDA" will cover both types of amplifiers and the operating characteristics are similar except where indicated.

f. Power supply 2A3 (figs. 1-9 and 1-11) is mounted in the upper right corner of the receiver cabinet and contains four plug-in type voltage regulator modules. Each module has an associated indicator lamp, fuse, and voltage measurement test jack mounted on the lower portion of the power supply chassis.

g. A filter mounting plate (fig. 1-9) provides the mounting facility for post selectors, local oscillator filters, and impedence matching circulators.

h. Plate assembly 2A24 (figs. 1-9 and 1-12) provides a mounting and interconnection facility for plug-in modules. Each module is secured to the plate assembly by two captive screws. Electrical connections for control and power are completed through mating connectors at the rear of each module and the plate assembly. Guide pins are provided at the rear of each module to prevent incorrect module insertion into a plate assembly connector. All operator and organizational maintenance controls and test points are accessible from the front of the receiver cabinet.

i. Frequency synthesizer 2A21 (figs. 1-9 and 1-13) is identical to frequency synthesizer 1A14 used in the transmitter cabinet, except that an additional handle and captive mounting screw are used on the left side of the frequency synthesizer in the receiver cabinet.

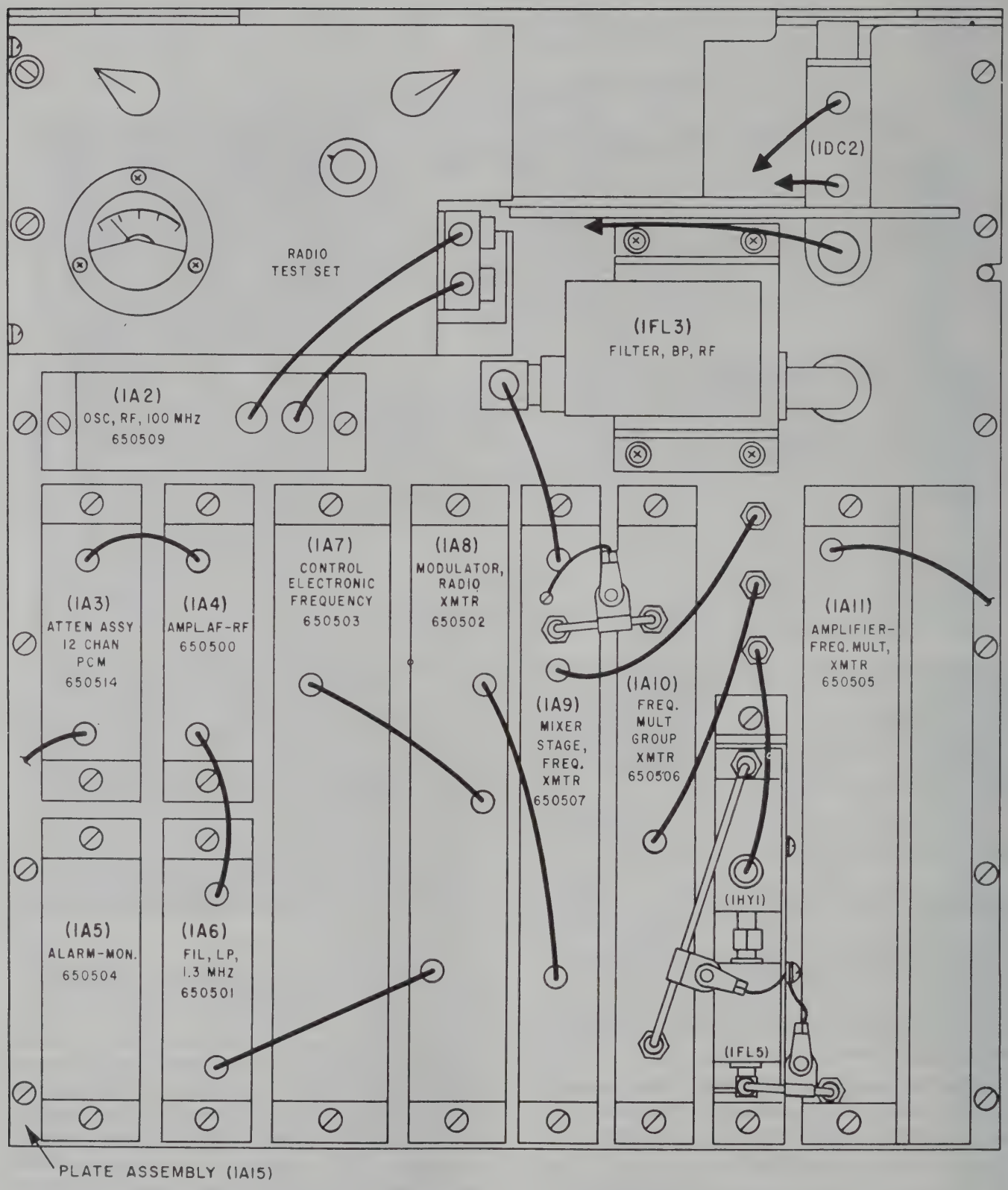


Figure 1-6. Transmitter plate assembly 1A15, module locations.

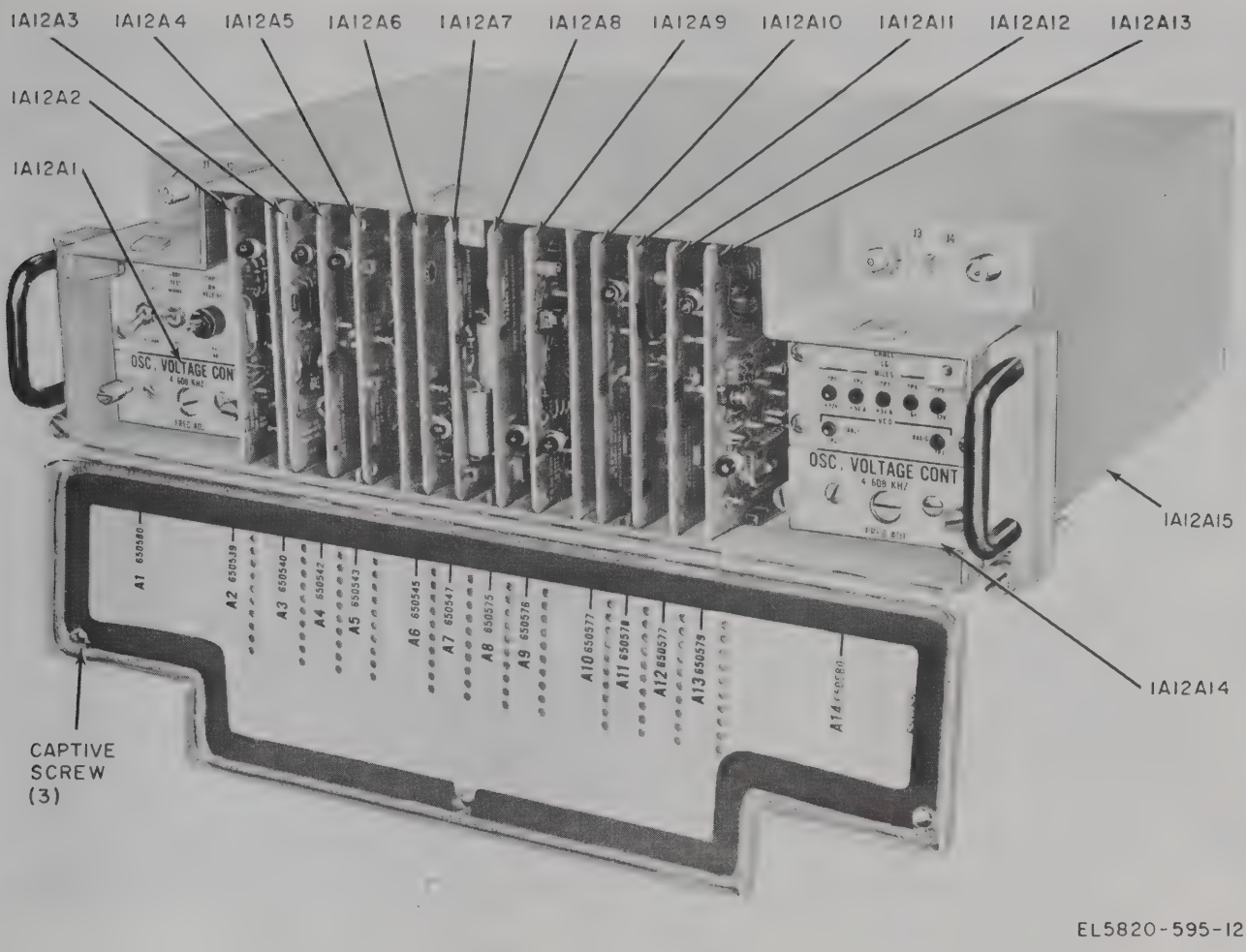


Figure 1–7. Transmitter digital data modem 1A12.

1–11. Description of Amplifier, Radio Frequency AM–6090/GRC–143

The power amplifier (fig. 1–14) is housed in a rfi shielded aluminum cabinet. When installed, the power amplifier is rigidly secured to a mounting surface by means of sixteen bolts at the bottom and eight bolts at the upper rear of the cabinet. The power amplifier is protected against shock and vibration by four supporting shockmounts at the bottom and two supporting shockmounts at the upper rear of the cabinet. Forced air circulation is maintained by four intake cooling fans, mounted on the lower right side, and a main blower exhause fan, mounted at the top rear of the cabinet. Dust entry is prevented by an air filter covering the intake cooling fans.

a. Latch handles are mounted at the top and bottom of the left cabinet door to provide access to the interior of the power amplifier cabinet. A flip-chart containing condensed operating instructions and location of assemblies and cables within the power amplifier, is mounted on the inside of the left cabinet door. A grounding rod, card extractor, and two power amplifier spare fuses are mounted on the inside of the right cabinet door.

b. All power amplifier input and output connections are made through connectors mounted on top of the power amplifier cabinet (fig. 2–18).

c. The power amplifier meter panel (fig. 1–14) is mounted on the upper front portion of the power amplifier cabinet. The panel is hinged to allow access to back wiring and to assemblies in the upper portion of the power amplifier cabinet. Mounted on the panel are pushbutton switches, status indicator lamps, alarm indicator lamps, and meters that permit control and monitoring of the power amplifier status.

d. HV power supply 3A9A1 (fig. 1–15) extends across the full width of the power amplifier cabinet and contains the major items of the HV power supply. Personnel are protected from ex-

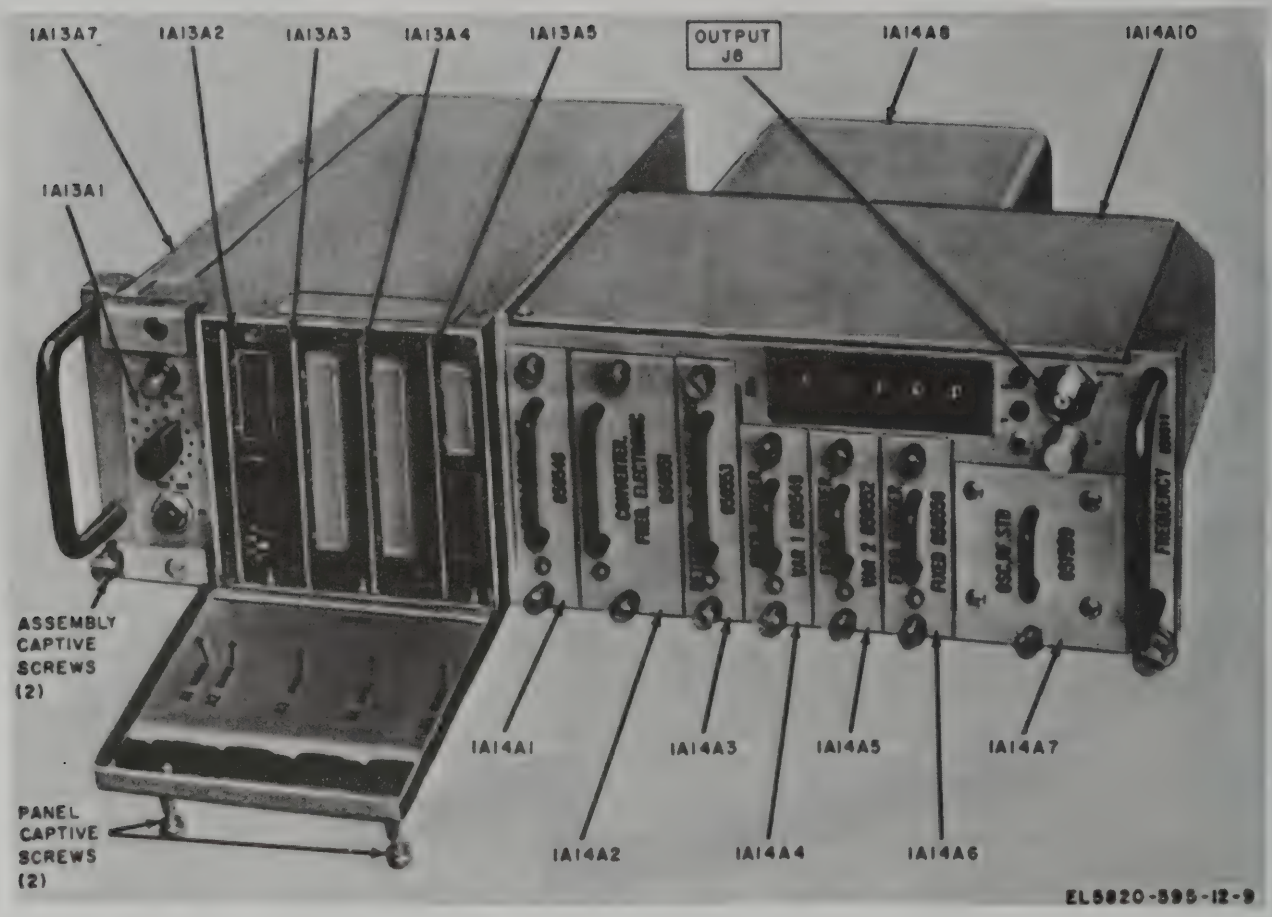


Figure 1–8. Transmitter 1A13, and electrical frequency synthesizer 1A14.

posed high voltage terminals by an interlock panel (fig. 1–14) which covers the lower portion of the power amplifier cabinet. Access to five circuit breakers, which control primary power to the amplifier, is provided by cutouts in the interlock panel.

e. Seven plug-in card assemblies (fig. 1–15) are mounted above the HV power supply. A five position module inclosure (fig. 1–14) is mounted on the left side of the cabinet and contains plug-in card assemblies 3A1 through 3A5. A two position module enclosure is mounted on the right side of the cabinet and contains plug-in card assemblies 3A6 and 3A7. A high voltage interlock door is positioned between the two module inclosures. The door is hinged to allow access to klystron filament leads and is secured in place by a captive thumbscrew.

f. The klystron assembly (fig. 1–14) is mounted above the plug-in card assemblies and provides the high RF power output of the power amplifier. The klystron cavity tuning controls (four) are mounted on the klystron assembly. The klystron filament and high voltage connections are completed through two color coded plugs and color matched receptacles mounted behind the high voltage interlock door.

1–12. Description of Minor Components

Minor components (fig. 1–2) supplied with the radio set supplement the functions provided by the three major equipment cabinets and are described below.

a. Handset H–156/U (4A4). Handset H–156/U (4A4) (fig. 1–2) is a lightweight telephone handset equipped with a PUSH-TO-TALK switch, and is used as the local handset for order wire communication. The handset cord terminates in a multiple pin connector which attaches to HANDSET INTERCONNECT jack J5 (fig. 2–16) on top of the transmitter cabinet. Order wire signaling is provided by a RING pushbutton and lamp indicator mounted on the transmitter meter panel.

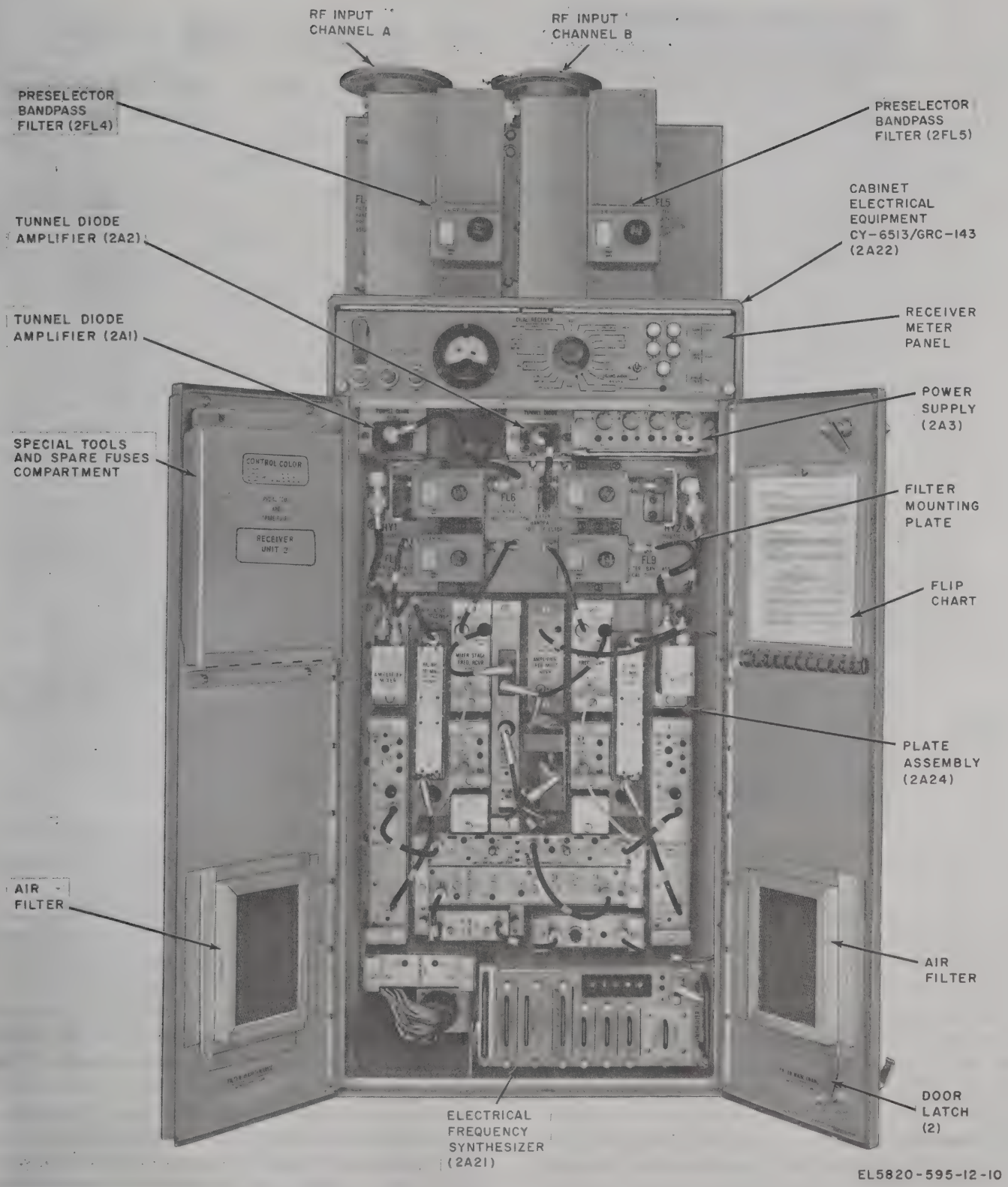


Figure 1–9. Receiver, Radio R–1287/GRC–143.

b. Directional Couplers 4A5 and 4A6. Directional couplers 4A5 and 4A6 (fig. 1–2), used with but not part of the radio set, couples a radio test signal into either or both receiver input channels. A directional coupler is externally connected between the receiving antenna waveguide, and a preselector bandpass filter of each RF input channel of the dual diversity receiver. Each directional coupler contains a slotted adjustment shaft that is protected by a threaded, captive

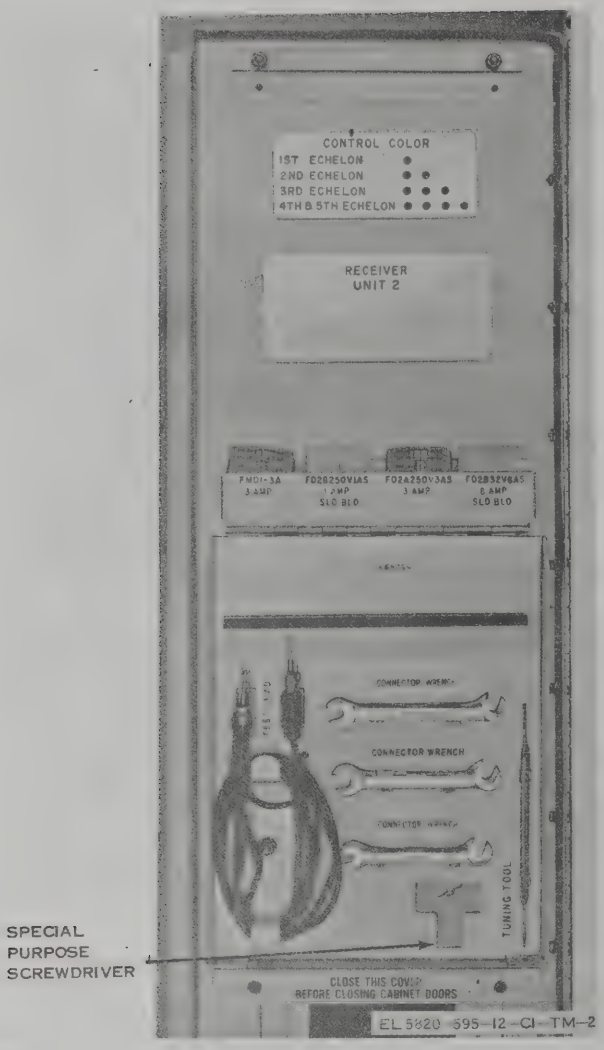


Figure 1–10. Receiver, Radio R–1287/GRC–143, special tools and spare fuses compartment.

cover which is secured by a flexible wire. The receiver flange and antenna flange interface with waveguide fittings.

c. Antenna Alignment Indicator 4A7. Antenna alignment indicator 4A7 (fig. 1–2) consists of two panel mounted meters, a switch, two capacitors, and a captivated interconnection cable terminated in an eight-pin connector. These items are mounted in a portable, hinged, case equipped with two cover latches. A carrying handle and a sliding bracket is provided for attaching the unit to the AN/TRA–37 mast. When not in use, the 25-foot interconnection cable is stored in the case cover. The antenna alignment indicator is used for receiver antenna orientation in azimuth and elevation. The antenna alignment indicator also contains phone circuitry and 10 feet of twisted pair field wire for connection to Telephone Set TA–312/PT to permit maintenance communication.

1–13. Description of Spares and Mode Modules

Spare modules, diodes, lamps, subassemblies, and 24-channel mode modules are supplied as part of or used with the radio set. The spares and mode modules are stored in six metal drawer assemblies (figs. 1–16, 1–17, and 1–18) and provide operational and maintenance backup for normal equipment operation.

1–14. Additional Equipment Required

The following equipments (or suitable equivalents) are not supplied as part of the radio set but are needed for use with the radio set.

a. Antenna Group AN/TRA–37. Antenna Group AN/TRA–37 includes two antennas, two mast assemblies, installation tools, and erection equipment required for installation (TM 11–5985–324–15). It provides dual (space) diversity reception utilizing one transmit/receive antenna, and one receive only antenna. An orthogonally polarized feedhorn permits simultaneous transmission and reception through a single antenna. A separate antenna group is required for each radio set used at a single location.

b. Equipment Shelter. Equipment shelter S–336/TRC–112 houses a single radio set; Equipment Shelter S( ) TRC–121 houses two radio sets. Each shelter provides environmental protection for communications equipment and operating personnel.

c. Converter, Telegraph-Telephone CV–425/U. This shelter mounted item transforms 20-Hz ring signals from the remote Telephone Set TA–312/PT to a 1600-Hz ring signal compatable with in-band ring signals used in the radio set order wire circuits. The telephone converter processes transmit and receive ring signals.

d. Waveguide Switch SC–C–602499. A shelter mounted waveguide switch is required to manually operate and transfer the 1-kw output of the power amplifier to either the transmitting antenna waveguide or a dummy load. Waveguide switch SC–C–602499 operates in the 4400-to 5000-MHz frequency range without tuning, and is provided with limit switches which serve two purposes. One purpose is to disable the transmitter output drive when the waveguide switch is being operated (this prevents damage to the switch and power amplifier). The other purpose is to indicate the waveguide switch position by means of shelter mounted indicator lamps.

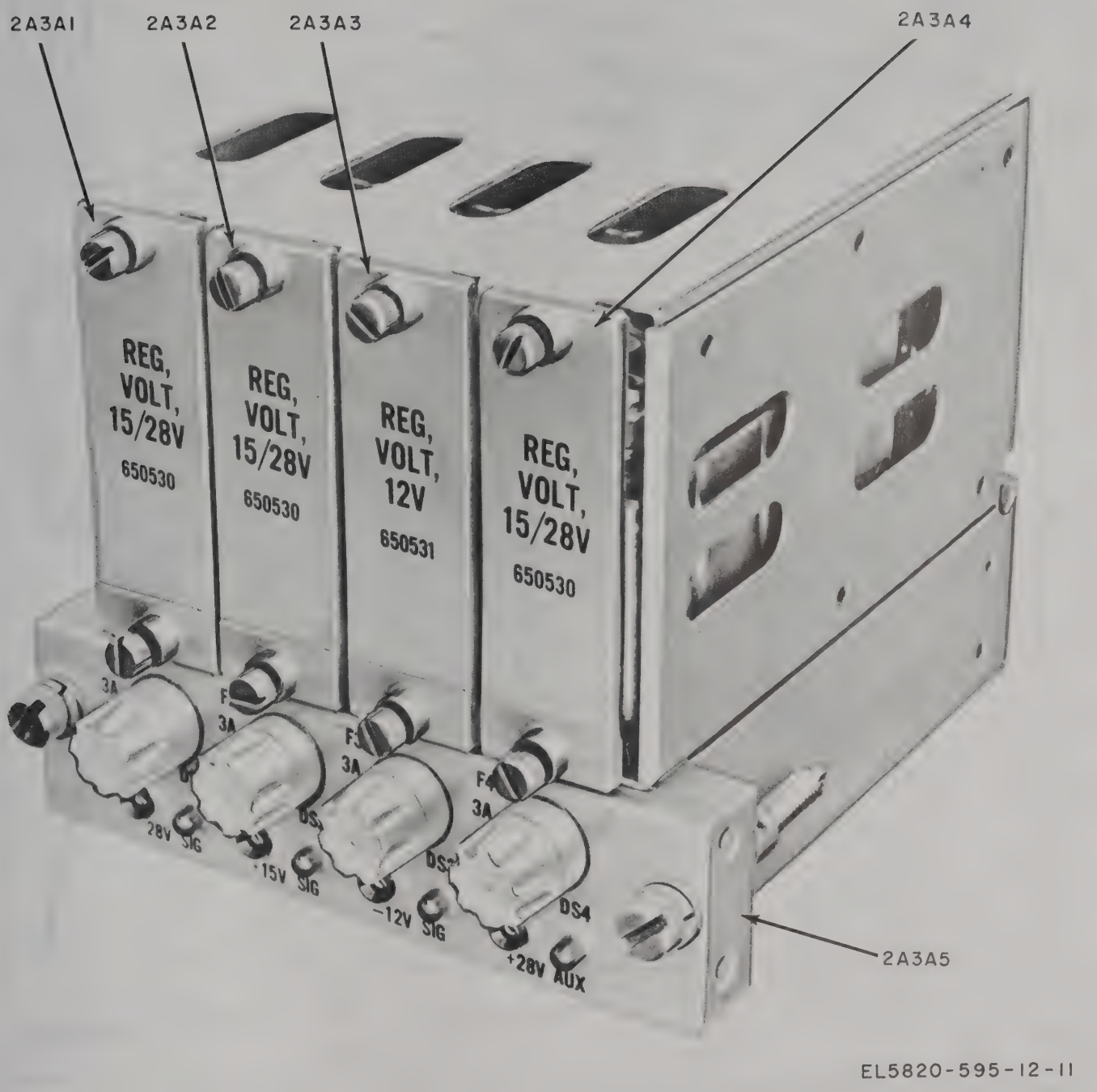
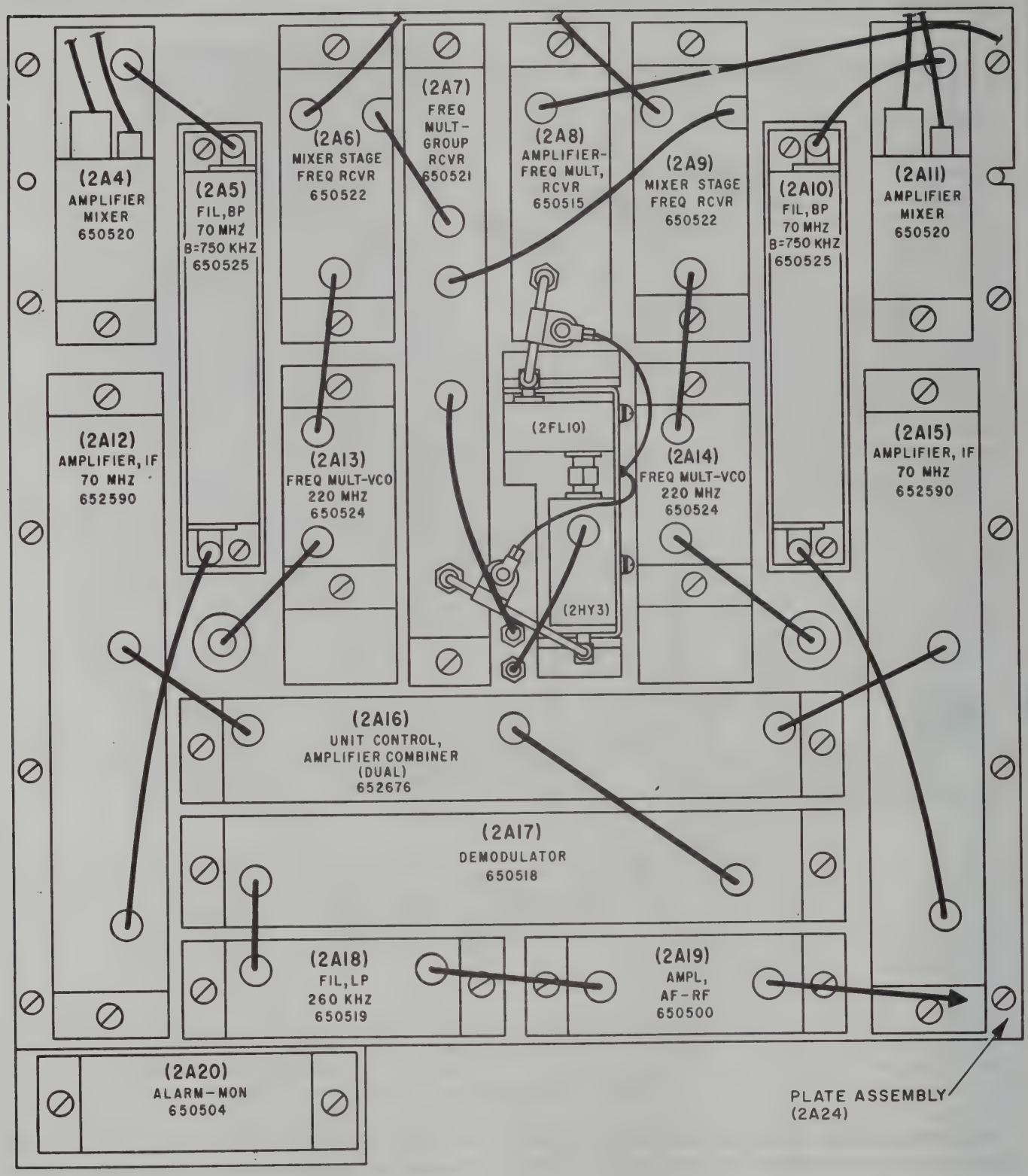


Figure 1–11. Receiver power supply 2A3.

e. Dummy Load FSN 5985–624–6822. The dummy load is a conventional forced air-cooled termination, capable of dissipating 2.0 kw cw power in the 4400-to 5000-MHz frequency range. This item is shelter mounted and is used to dissipate the output power from the power amplifier during testing and tuning.

f. Remote Telephone Set TA–312/PT. The remote telephone is a field unit linked to the radio by telephone landlines, permitting communication with any order wire station in the communications network on a party line basis. It also provides a remote alarm indication by ringing when the summary alarm is activated.

g. Multiplexing Equipment. Multiplexing equipment such as Multiplexer TD–352/U and Multiplexer TD–204/U is used to provide the multiplexed 12-or 24-channel pcm inputs to the radio set. Multiplexer TD–204/U operates as a pcm cable combiner to control the 12-channel pcm input from Multiplexer TD–352/U. For 24-channel pcm operation, Multiplexer TD–204/U



NOTE:
REFERENCE DESIGNATIONS (2A4), (2A5) ETC.
ARE NOT MARKED ON MODULES.

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Figure 1-12. Receiver plate assembly 2A24, module locations.

controls and interleaves the 12 channel pcm inputs (one 12-channel pcm input from each Multiplexer TD-352/U) from two Multiplexer TD-352/U's. Multiplexer TD-204/U can also provide duplex interfacing, via cable, between the radio set and Multiplexer TD-352/U equipment.

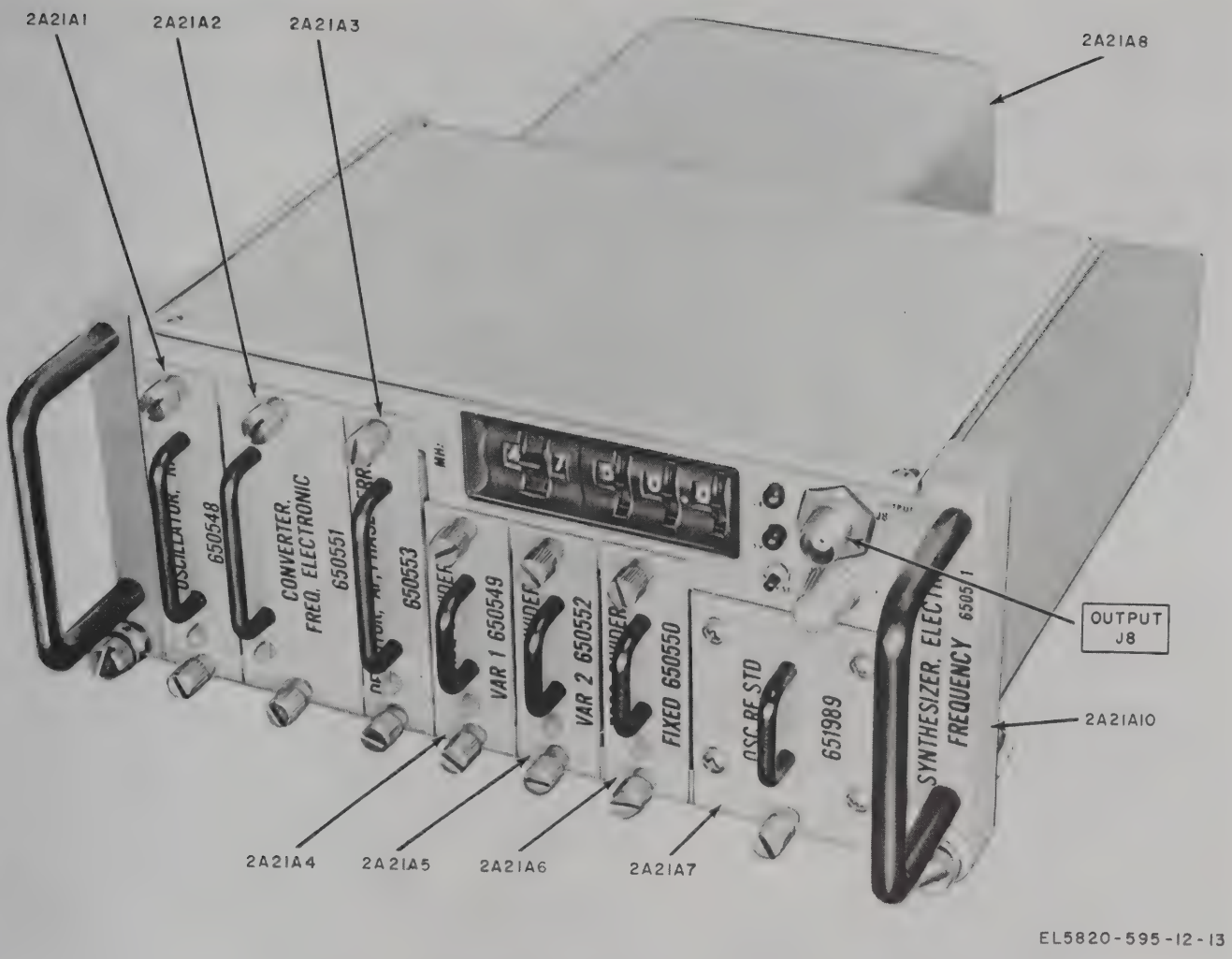


Figure 1–13. Receiver electrical frequency synthesizer 2A21.

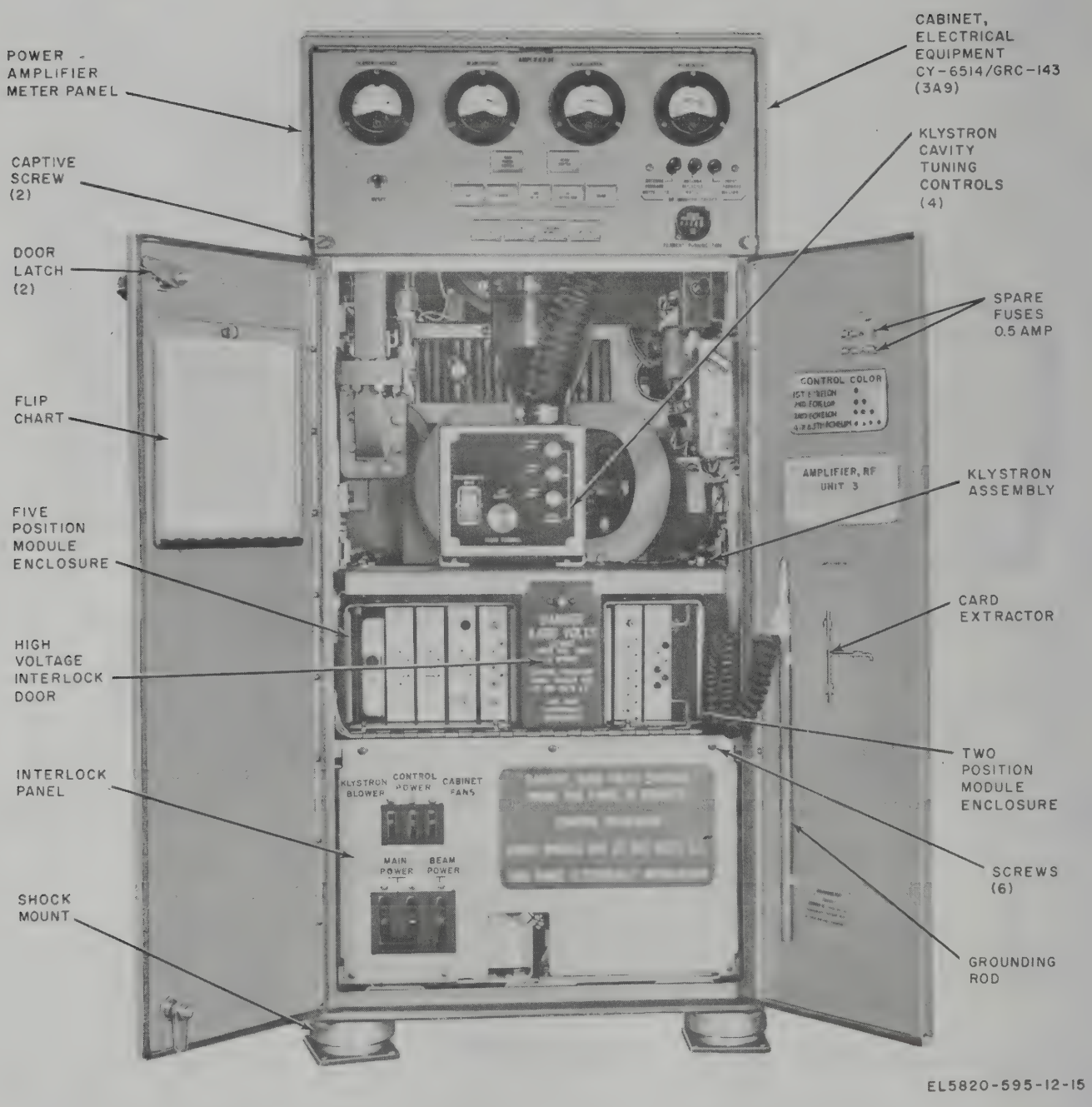
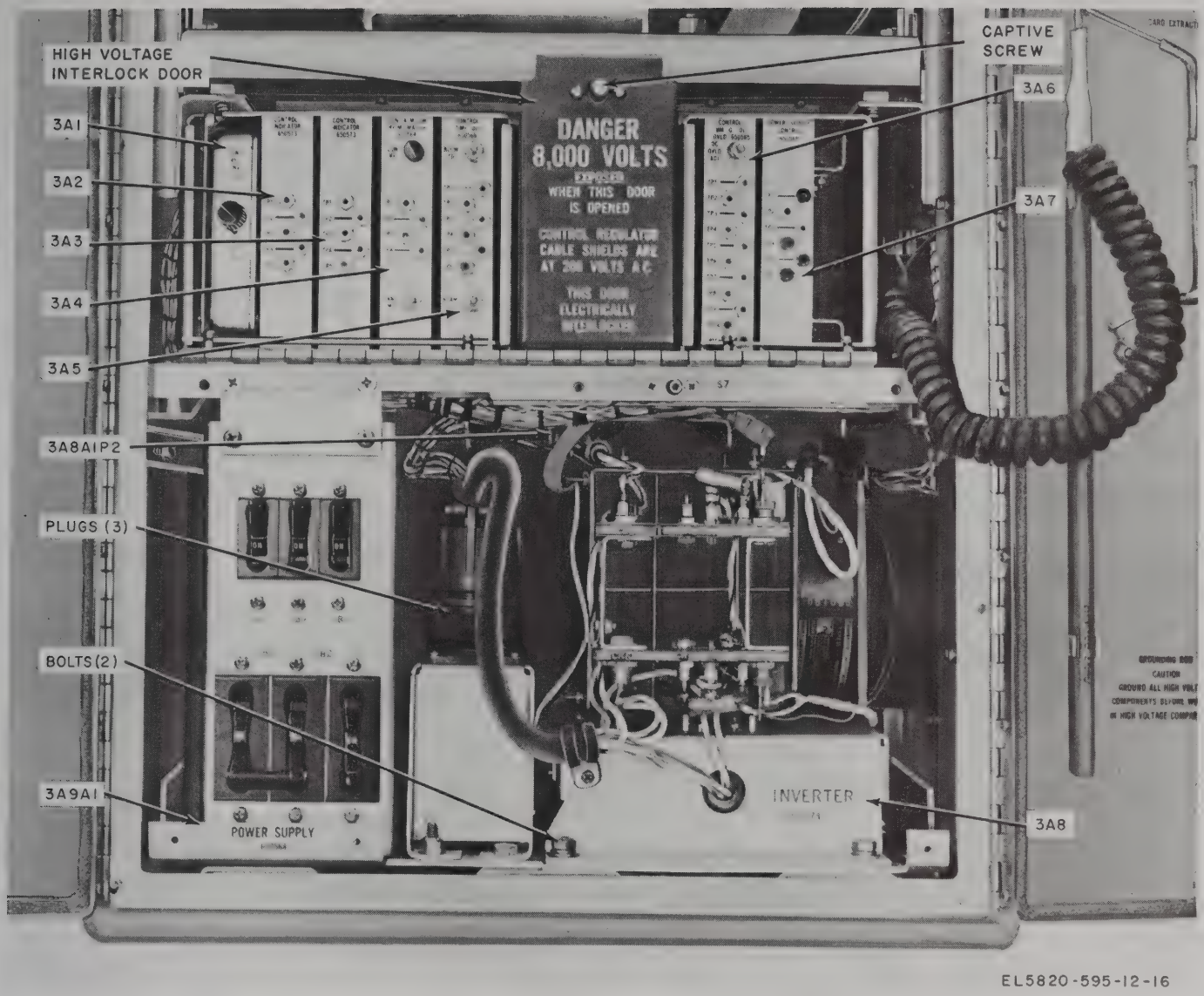


Figure 1-14. Amplifier, Radio Frequency AM-6090/GRC-143.



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Figure 1–15. Power amplifier high voltage power supply 3A9A1.

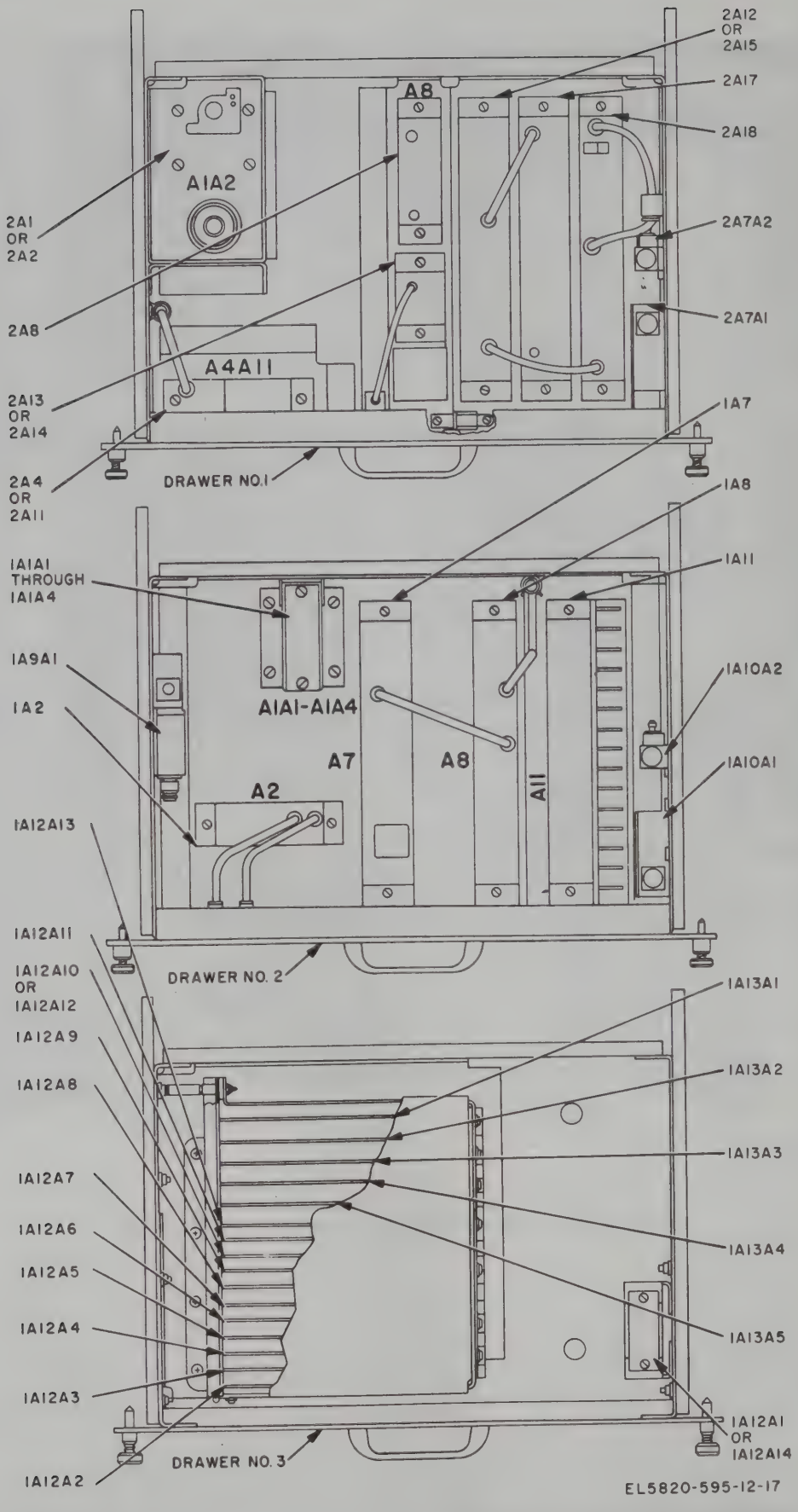


Figure 1–16. Spares stored in drawer No. 1 assembly through drawer No. 3 assembly.

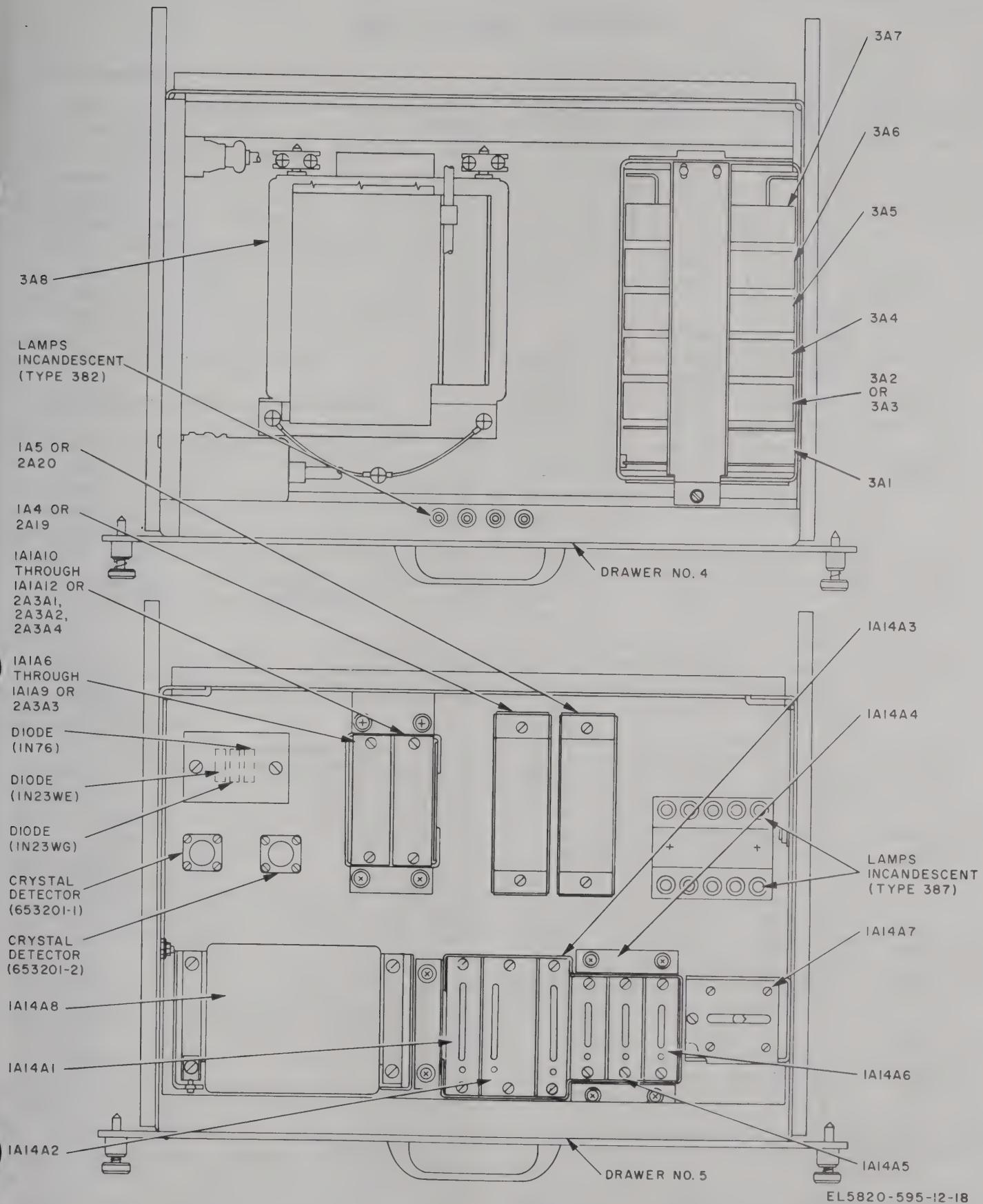


Figure 1–17. Spares stored in drawer No. 4 assembly and drawer No. 5 assembly.

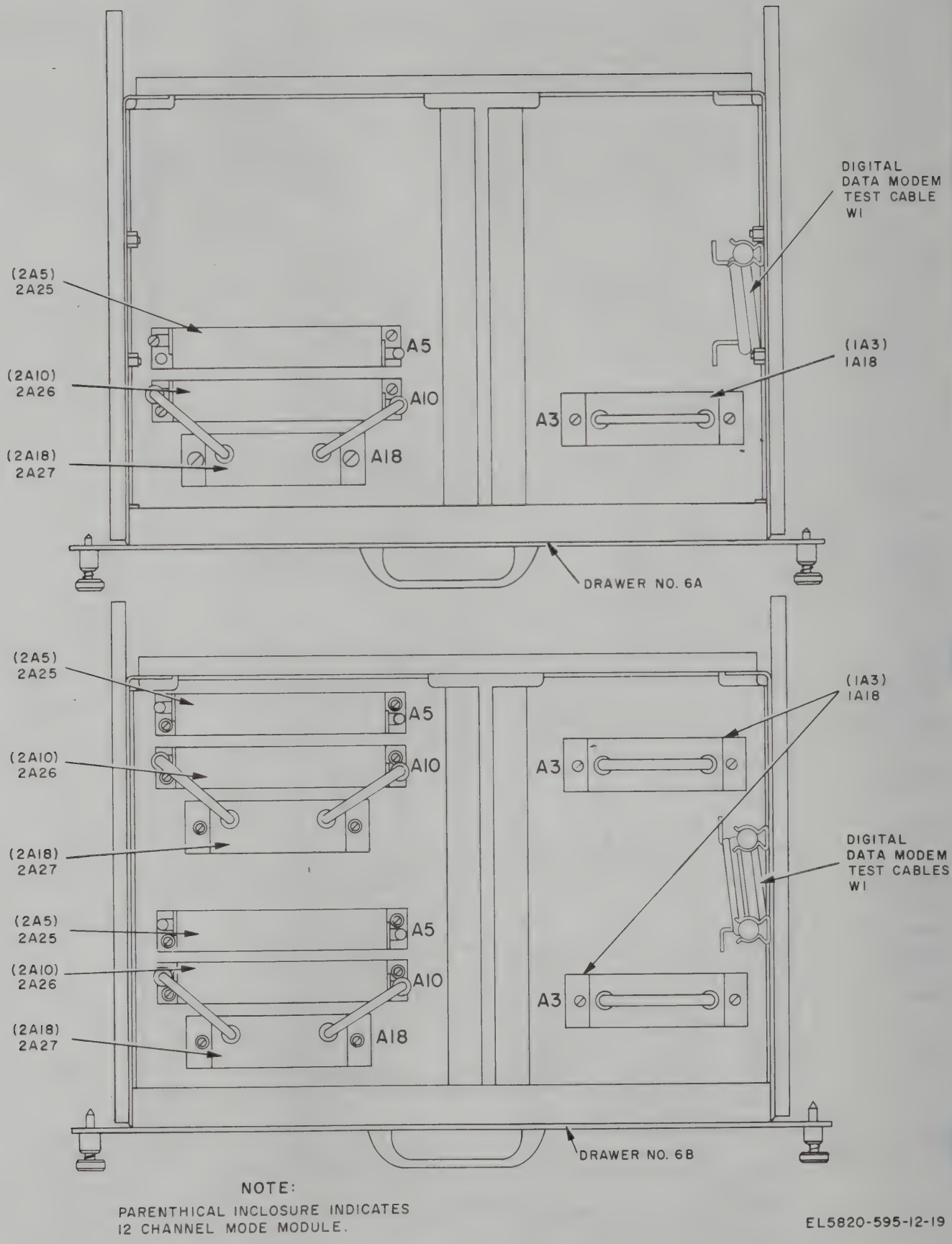


Figure 1-18. Mode modules stored in drawer No. 6A assembly and drawer No. 6B assembly.

Section III. SYSTEM APPLICATION

1-15. General

The radio set can be used in two basic configurations; single stack AN/TRC-112 and double stack AN/TRC-121 to provide diffractive and tropospheric scatter pcm cable terminal operation. One radio set is provided for single stack pcm cable terminal operation and is housed in an equipment shelter such as S-336/TRC-112. Two radio sets are provided for double stack pcm cable terminal operation and are housed in an equipment shelter such as S-( )/TRC-121. Operational procedures of the radio set in either of the two configurations is identical.

1-16. PCM Cable Terminal Operation

The radio set is primarily intended to be used for single or dual pcm cable terminal operation. When used for pcm cable terminal operation, the radio set can provide duplex 12-or 24-channel pcm and single channel order wire communications over distances of 100 miles. A typical two station tropospheric scatter communication link is shown in figure 1-19 and described in *a* through *c* below.

a. Station A to Station B Transmission. A dual diversity radio link can be established by providing one pcm cable terminal at station A and one at station B.

(1) At station A, 12 telephone channels are applied to Multiplexer TD-352/U. Multiplexer TD-352/U converts the voice signals on each of the 12 telephone channels into a single composite pcm signal for transmission to Multiplexer TD-204/U.

(2) For 24-channel operation, Multiplexer TD-204/U interleaves the composite pcm signal from one Multiplexer TD-352/U with the composite pcm signal from the second Multiplexer TD-352/U to form a single composite 24-channel pcm signal for transmission, via cable, to the transmitter. For 12 channel operation, only one Multiplexer TD-352/U is required and Multiplexer TD-204/U transmits the composite 12-channel pcm signal, via cable, to the transmitter.

(3) At station A, the composite 12-or 24-channel pcm signal FROM CABLE frequency modulates the transmitter carrier signal. The low level transmitter output is applied to the power amplifier where it is amplified to a 1.0-kilowatt power level and waveguide coupled to a transmit antenna where it is radiated to station B.

(4) At station B, the receiving antennas are physically separated to provide space diversity improvement and the two received signals are waveguide coupled to the dual diversity receiver. The dual diversity receiver combines, then demodulates the two received signals and the demodulated output is applied to the transmitter. The transmitter sends the composite 12-or 24-channel pcm signal, via cable, to Multiplexer TD-204/U.

(5) For 24-channel operation, Multiplexer TD-204/U separates the composite 24-channel pcm signal into the original two 12-channel pcm signals and forwards the two composite 12-channel pcm signals to their respective Multiplexer TD-352/U. For 12-channel operation, Multiplexer TD-204/U forwards the composite 12-channel pcm signal to the appropriate Multiplexer TD-352/U.

(6) At station B, Multiplexer(s) TD-352/U demultiplexes the composite 12-channel pcm signal into 12 separate voice signals and applies them to the remote telephone equipment.

b. Station B to Station A Transmission. Except for transmit and receive frequencies, the transmission from station B to station A is identical with that described in *a* above.

c. Orderwire Facilities. The radio set order wire channel provides duplex single channel orderwire communications, on a party line basis, between station A and station B. *For example,* assume that the radio operator at station A originates an order wire call over the local handset (Handset H-156/U). The order wire call will be routed via the transmitter orderwire circuits to the following places:

(1) To the TD-204/U multiplex operator by superimposing the order wire signal on the composite 12-or 24-channel pcm signal TO CABLE.

(2) To the remote orderwire TA-312/PT telephone set via Converter, Telegraph-Telephone Signal CV-425/U.

(3) To station B by superimposing the orderwire signal on the composite 12-or 24-channel pcm signal to be transmitted.

Order wire calls can also be originated at station B and are routed in the same manner as at station A. (See above description.)

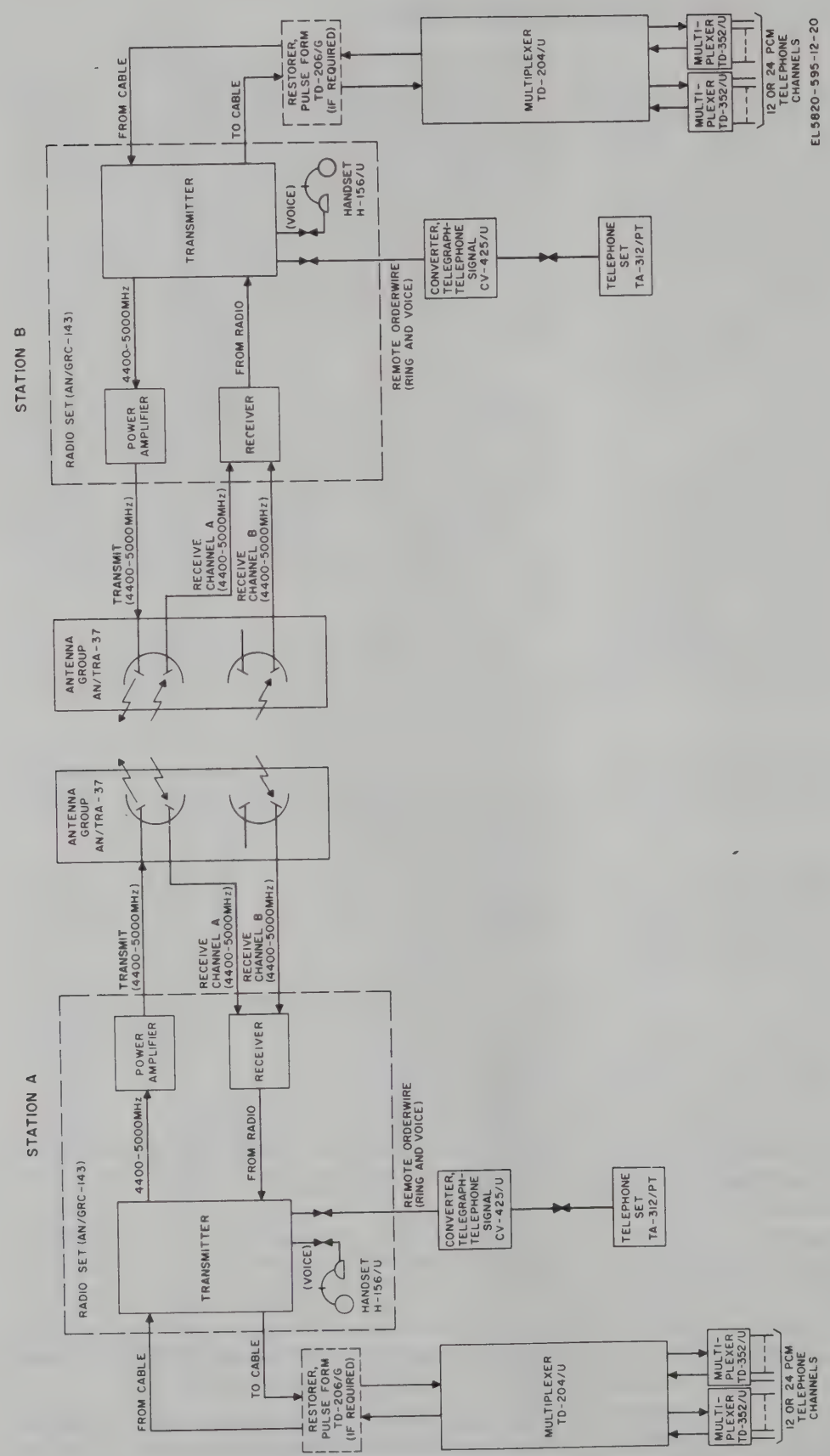


Figure 1–19. Typical two station, tropospheric scatter, communications link.

CHAPTER 2

INSTALLATION

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

2-1. Unpacking

a. Packaging Data. When packed for shipment for depot application, the components of the radio set are placed in three wooden boxes and seven cartons. The transmitter and receiver are attached to the shipping boxes (fig. 2-1) by means of four 5/16-inch bolts passed through the normal mounting holes at the bottom of the transmitter and receiver cabinets. The power amplifier is held in place by recessed rubberized hair pads at the top and bottom of the shipping box (fig. 2-2). Cushioning material is provided to minimize shock during transport. The six drawer assemblies (figs. 1-16, 1-17, and 1-18), and minor components are individually packaged in cartons. A typical drawer assembly packaging arrangement is shown in figure 2-3. The minor components are placed in a separate carton with rubberized hair pads used for cushioning. Dimensions, volume, weight, and contents of each box are listed below.

Package	Approximate dimensions (in.)			Approximate volume (cu ft)	Approximate shipping weight (lb)	Contents of box
	Height	Width	Depth			
Box 1 of 3	42	29	25	17	220	Transmitter
Box 2 of 3	53	29	25	22.2	260	Receiver
Box 3 of 3	48	41	42	47.7	449	Power amplifier
Carton 1 of 7	14	24	24	4.6	35	Drawer No. 1 assembly with spares
Carton 2 of 7	14	24	24	4.6	34	Drawer No. 2 assembly with spares
Carton 3 of 7	14	24	24	4.6	32	Drawer No. 3 assembly with spares
Carton 4 of 7	14	24	24	4.6	48	Drawer No. 4 assembly with spares
Carton 5 of 7	14	24	24	4.6	33	Drawer No. 5 assembly with spares
Carton 6 of 7	14	24	24	4.6	27	Drawer No. 6A assembly with mode modules (single stack set) or
7	14	24	24	4.6	28	Drawer No. 6B assembly with mode modules (double stack set).
Carton 7 of 7	14	24	24	4.6	21	Minor components

b. Unpacking Transmitter. Move the packing box (fig. 2-1) as close to the desired operating location as possible, and unpack the transmitter as outlined below.

CAUTION

Do not attempt to pry off the top or sides of the box without removing the nails as the transmitter can be accidentally damaged.

(1) Remove the nails from the top and sides of the box with a nailpuller.

(2) Remove the loosened top and sides of the box.

(3) Cut and remove protective plastic bag covering the transmitter.

(4) Lift and turn the two front door latche handles and open the two cabinet doors.

(5) On frequency synthesizer 1A14 (fig. 1-3) disconnect the coaxial cable from OUTPUT J8 connector (fig. 1-8).

(6) Alternately loosen the two assembly captive screws (fig. 1-8) securing the order wire-frequency synthesizer assembly (1A13 and 1A14) in place and withdraw the composite assembly from the transmitter cabinet by means of the two attached handles. Place the order wire-frequency synthesizer assembly aside while the transmitter cabinet is being unbolted from the skid.

(7) Remove the retaining hardware securing the transmitter cabinet to the skid using openend wrenches. One bolt with washers and

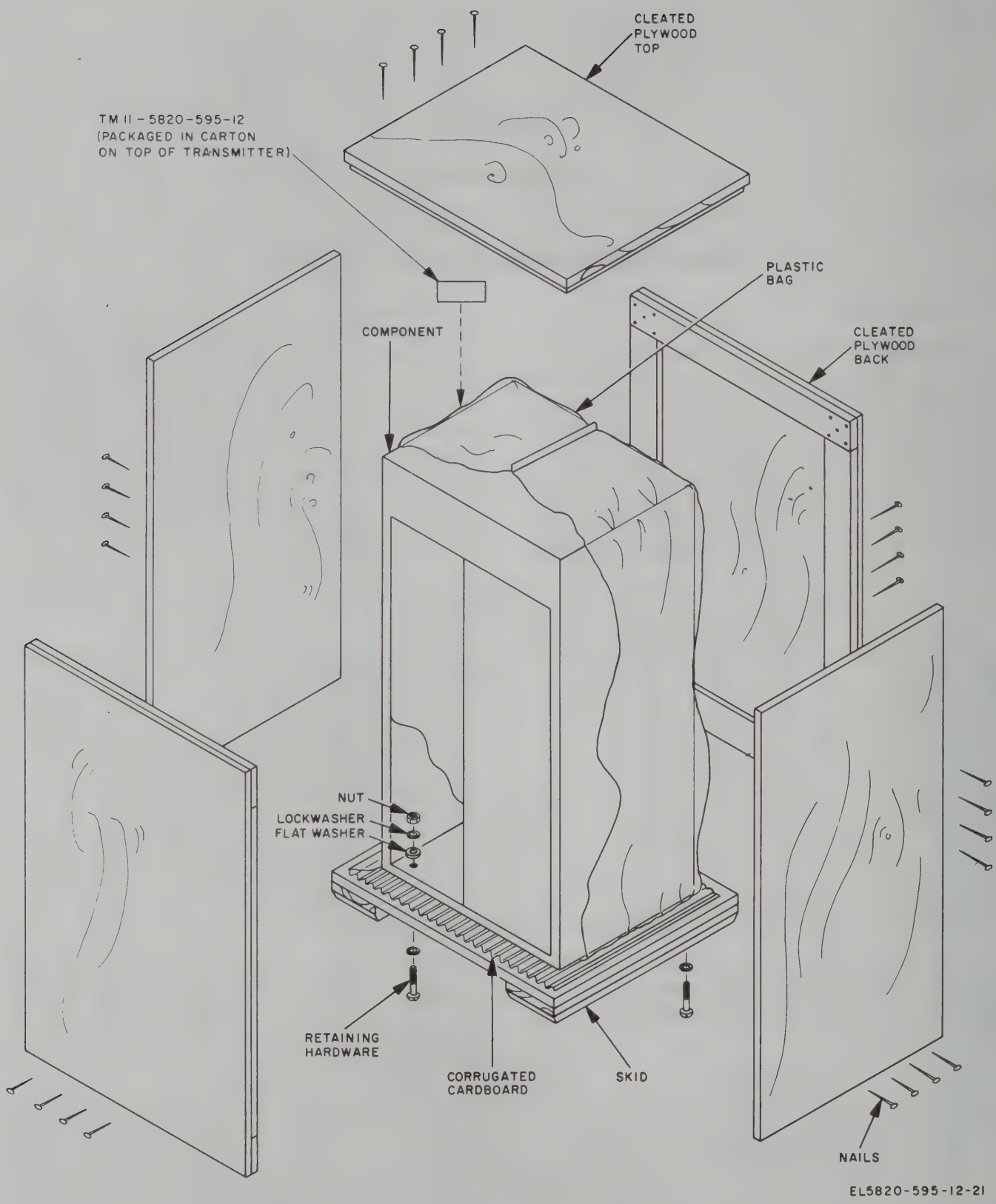


Figure 2-1. Typical transmitter and receiver packing.

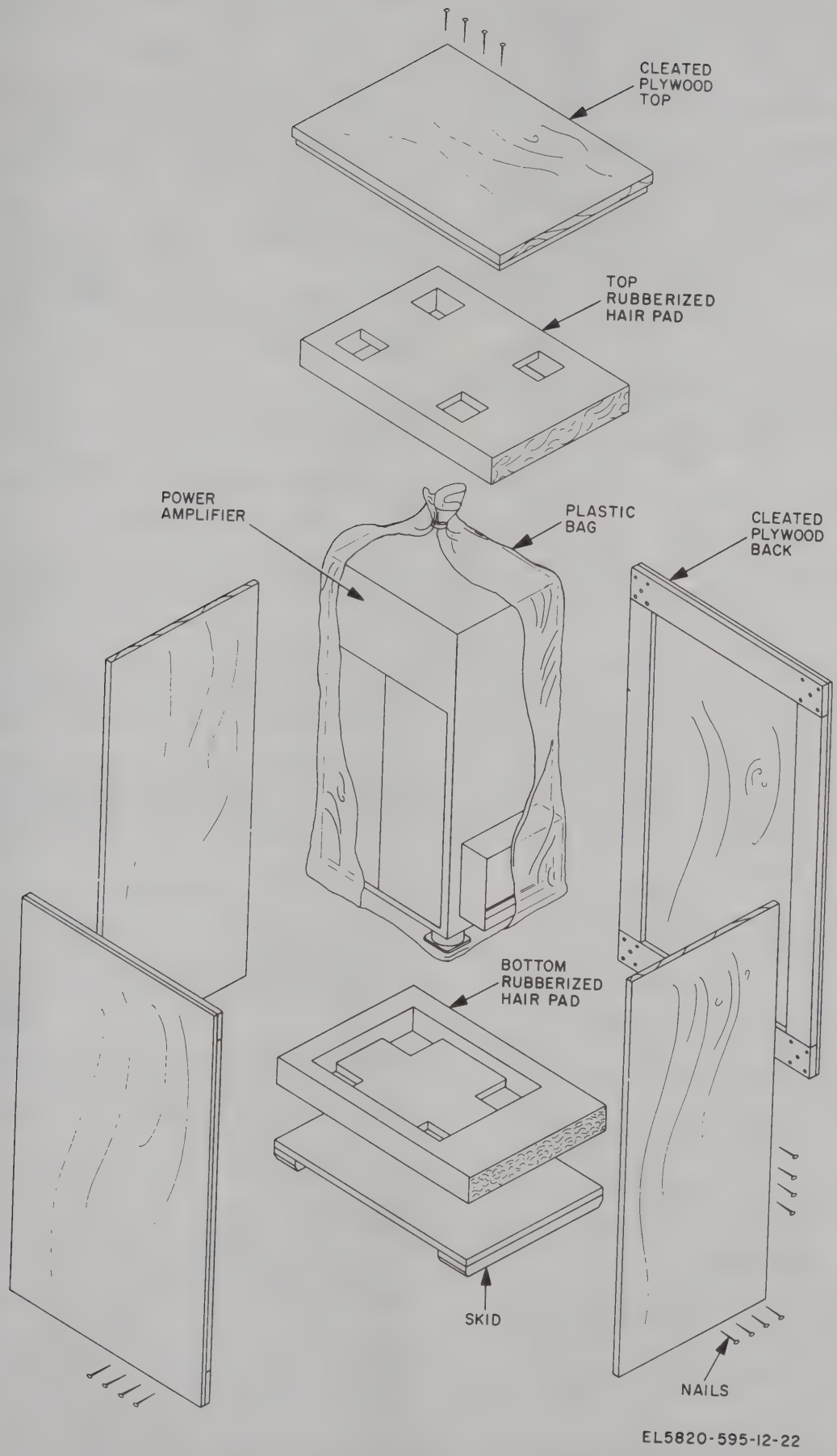


Figure 2–2. Typical power amplifier packing.

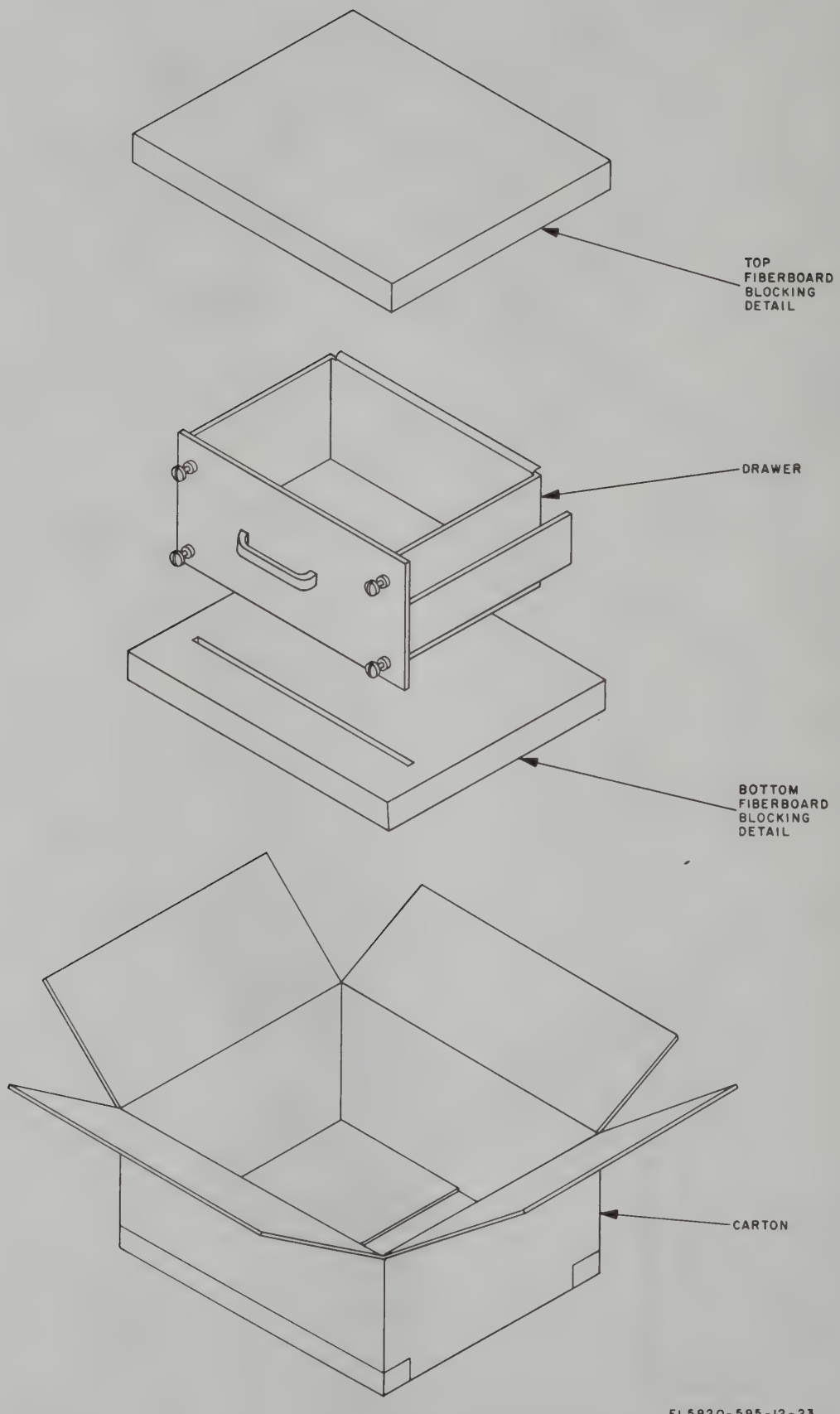


Figure 2-3. Typical spares drawer and mode module drawer assemblies and minor components packing.

nut are located at each corner of the cabinet floor.

NOTE

Boltheads are recessed into the underside of the skid (fig. 2–1), and are made accessible by tilting or propping the skid with the mounted transmitter.

(8) Make certain that the four nuts, flat washers, and lockwashers are removed from inside the transmitter cabinet.

(9) Replace the order wire-frequency synthesizer assembly (fig. 1–3) removed in step (6) above, and tighten the two assembly captive screws (fig. 1–8).

(10) Connect the coaxial cable disconnect in step (5) above to OUTPUT J8 connector (fig. 1–8).

(11) Close and latch the two front doors.

WARNING

The transmitter weighs approximately 159 pounds. Use at least two men to move the unpacked cabinet.

(12) Using the two recessed handles provided on the side of the transmitter cabinet, lift and carry the transmitter to its place of installation.

c. Unpacking Receiver. Move the packing box (fig. 2–1) as close to the desired operating location as possible, and unpack the receiver as outlined below.

CAUTION

Do not attempt to pry off the top or sides of the box without removing the nails as the receiver can be accidentally damaged.

(1) Remove the nails from the top and sides of the box with a nailpuller.

(2) Remove the loosened top and sides of the box.

(3) Cut and remove protective plastic bag covering the receiver.

(4) Lift and turn the two front door latch handles and open the two cabinet doors.

(5) On frequency synthesizer 2A21 (fig. 1–9), disconnect the coaxial cable from OUTPUT J8 connector (fig. 1–13).

(6) Alternately loosen the two assembly captive screws (fig. 1–13) holding frequency synthesizer 2A21 in place and withdraw the assembly from the receiver cabinet by means of the two attached handles. Place the frequency synthesizer aside while the receiver cabinet is being unbolted.

NOTE

Boltheads are recessed into the underside of the skid (fig. 2–1) and are made accessible by tilting or propping the skid with the mounted receiver.

(7) Remove the retaining hardware securing the receiver cabinet to the skid using open end wrenches. One bolt with washers and nut are located at each corner of the cabinet floor.

(8) Make certain that the four nuts, flat washers, and lockwashers are removed from inside the receiver cabinet.

(9) Replace frequency synthesizer 2A21 (fig. 1–9) removed in step (6) above, and tighten the two assembly captive screws (fig. 1–13).

(10) Connect the coaxial cable disconnected in step (5) above to OUTPUT J8 connector (fig. 1–13).

(11) Close and latch the two front doors.

WARNING

The receiver weighs approximately 178 pounds. Use at least two men to move the unpacked cabinet.

(12) Using the two recessed handles provided on the sides of receiver cabinet, lift and carry the receiver to its place of installation.

d. Unpacking Power Amplifier. Move the packing box (fig. 2–2) as close to the desired operation position as possible, and unpack the power amplifier as outlined below.

CAUTION

Do not attempt to pry off the top or sides of the box without removing the nails as the power amplifier can be accidentally damaged.

(1) Remove the nails from the top and sides of the box with a nailpuller.

(2) Remove the loosened top and sides of the box.

(3) Remove rubberized hair pad from the top of the cabinet.

(4) Cut and fold back the protective plastic bag covering the power amplifier.

WARNING

The power amplifier weighs approximately 376 pounds. DO NOT attempt to lift or carry this cabinet without mechanical assistance such as a hoist or forklift truck.

(5) Using a hoist or other suitable lifting device, carefully lift the power amplifier and remove the bottom rubberized hair pad and skid.

(6) Using a hoist or other suitable lifting device, lift and carry the power amplifier to its place of installation.

e. Unpacking Minor Components, Spares and Mode Module Drawer Assemblies. Unpack minor components, and spares and mode module drawer assemblies (fig. 2–3) as outlined below.

(1) Unseal and carefully open and fold back the lids of the cardboard carton.

(2) Remove top fiberboard blocking detail from carton.

(3) Carefully lift and remove contents from carton.

(4) Repeat steps (1) through (3) above for each of the remaining cartons.

2–2. Checking Unpacked Equipment

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on DD Form 6 (para 1–3*b*).

b. See that the equipment is complete as listed on the packing slip. If a packing slip is not available, check the equipment against the list of items comprising a radio set (para 1–6) or packaging data (para 2–1). Drawer assembly contents are shown in figures 1–16, 1–17 and 1–18. The packaging data covers the components that are only shipped to a depot under Contract DAAB05–68–C–0001. Report all discrepancies in accordance with paragraph 1–3*c*. Shortage of a minor assembly or part that does not affect proper function of the equipment should not prevent use of the equipment.

c. If the equipment has been used or reconditioned, see whether it has been changed by a modification work order (MWO). If the equipment has been modified, the MWO number will appear on the front panel near the nomenclature plate. Check to see whether the MOW number (if any) and appropriate notations concerning the modification have been entered in the equipment manual.

NOTE

Current MWO's applicable to the equipment are listed in DA Pam 310–7.

2–3. Siting

When locating the radio set, consider the following:

a. Locate all station facilities in such a manner that no person is exposed to the hazardous electromagnetic radiation which exists directly forward of the antenna, while the station is in operation. If transmission in more than one direction is required, increase the hazard area accordingly.

b. Avoid use of equipment near or under power lines, telegraph or telephone lines, or near radar or field hospital sites which can interfere with receiver operation.

c. Avoid operating the radio set in a tightly inclosed, restricted space without adequate ventilation.

2–4. Shelter Requirements

One radio set can be installed in Shelter S–336/TRC–112 and two radio sets can be installed in Shelter S– ( )/TRC–121.

a. The shelter used for installation should afford environmental protection and include provisions for ventilation, heating, and air circulation or cooling. It should include a power distribution system to supply power for general lighting, utility outlets, and equipment requirements; and provide properly fitted spaces to store the slide mounted spares and mode module drawer assemblies. The shelter should include adequate space for installation, operation, and maintenance of the radio set and interconnection facilities to any other equipment installed in the same shelter. The space requirements indicated below are sufficient for all components of the radio set, such as waveguides, waveguide switch and others.

b. A typical floor plan is shown in figure 2–4, requiring a floor space approximately 6 feet by 6 feet. The power amplifier is supported on the floor by four shockmounts, and attached to the bulkhead bearing plate by two shockmounts at the rear of the cabinet. The transmitter and receiver can be supported on bases running the length of the shelter. These bases elevate the cabinet level. I bases are not provided in the mit installation of the spares drawers below the cabinet level. If bases are not provided in the shelter, spares drawers can be mounted in a storage rack or cabinet. The suggested space includes sufficient area for the equipment, including extensions such as doors; and adequate aisle space between the equipment and the nearest obstructions to permit access for replacement of removable assemblies during installation or maintenance. Although the aisle space indicated in figure 2–4 can be reduced if absolutely necessary, allow sufficient space to service removable assemblies after initial installation. Ceiling height should be approximately 6 feet to allow person-

nel access to the equipment. This height also provides sufficient clearance above the equipment cabinets for waveguide routing.

2–5. Tools and Materials Required for Installation

a. Tools Required. A Tool Kit, Electronic Equipment, TK–100/G is required for installation of the radio set. No special tools are required.

b. Materials Required. Materials listed in the chart below are required for installation of each radio set but are not supplied. The interconnection cables must be fabricated to the specific length required for eaph shelter application using the connectors listed in paragraph 2–11. Refer to paragraph 2–12 for specific information on wire size, type, and pin connections when fabricating interconnecting cables.

Materials required

1 set of interconnection cables fabricated to the specific length required for shelter type.

1 set of mounting hardware for transmitter cabinet consisting of: six hexagon head 5/16–24 bolts, six flat washers, and six lockwashers.

1 set of mounting hardware for receiver cabinet (same as transmitter).

1 set of mounting hardware for power amplifier cabinet consisting of: 24 hexagon head 1/4–20 bolts and 24 lockwashers.

2–6. Preparation for Installation

a. General. The equipment should be located in accordance with the specific installation instructions for the shelter in which it is to be used. Paragraphs 2–7, 2–8, and 2–9 provide specific instructions for installation of the transmitter, receiver, and power amplifier cabinets. Figures 2–5 and 2–6 show the location of the mounting holes for each cabinet. Prior to starting installation of the power amplifier, determine whether a loading ramp is required to clear the shelter sill. This ramp will be required to transport the unpacked power amplifier into the shelter if the door sill is not flush with the floor.

b. Mounting Holes. At selected equipment locations, drill mounting holes in positions and to dimensions shown in figures 2–5 and 2–6.

2–7. Installation of Transmitter

Install the transmitter by following the procedure outlined below.

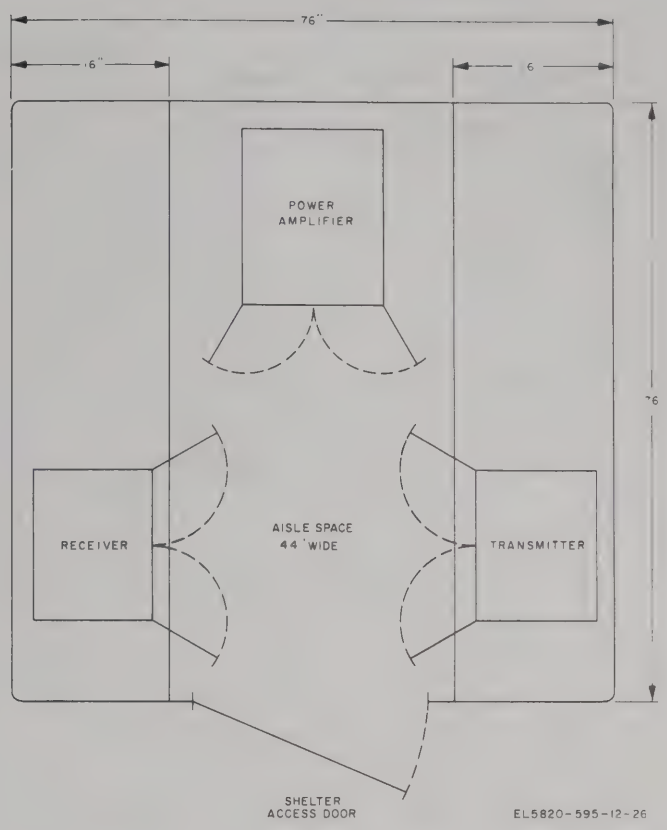


Figure 2–4. Typical floor plan for radio set installation.

WARNING

The transmitter weighs approximately 159 pounds. Use at least two men when lifting the cabinet.

a. Using the two recessed cabinet handles lift the transmitter to the mounting surface location and position in accordance with the base and wall mounting holes.

b. Lift and turn the two front door latch handles and open the two cabinet doors.

c. On frequency systhesizer 1A14 (fig. 1–3), disconnect the coaxial cable from OUTPUT J8 connector (fig. 1–8).

d. Release the two assembly captive screws (fig. 1–8) holding the order wire-frequency synthesizer assembly (1A13 and 1A14) in place, and withdraw the composite assembly from the transmitter cabinet using the two attached handles. Set the order wire-frequency synthesizer assembly aside until cabinet installation is completed.

e. Alternately loosen the two meter panel captive screws (fig. 2–7) securing the transmitter meter panel to the cabinet. Swing the transmitter meter panel upward on its hinge and lock it in the open position (fig. 2–7). The panel locking latch is mounted in the center of the transmitter

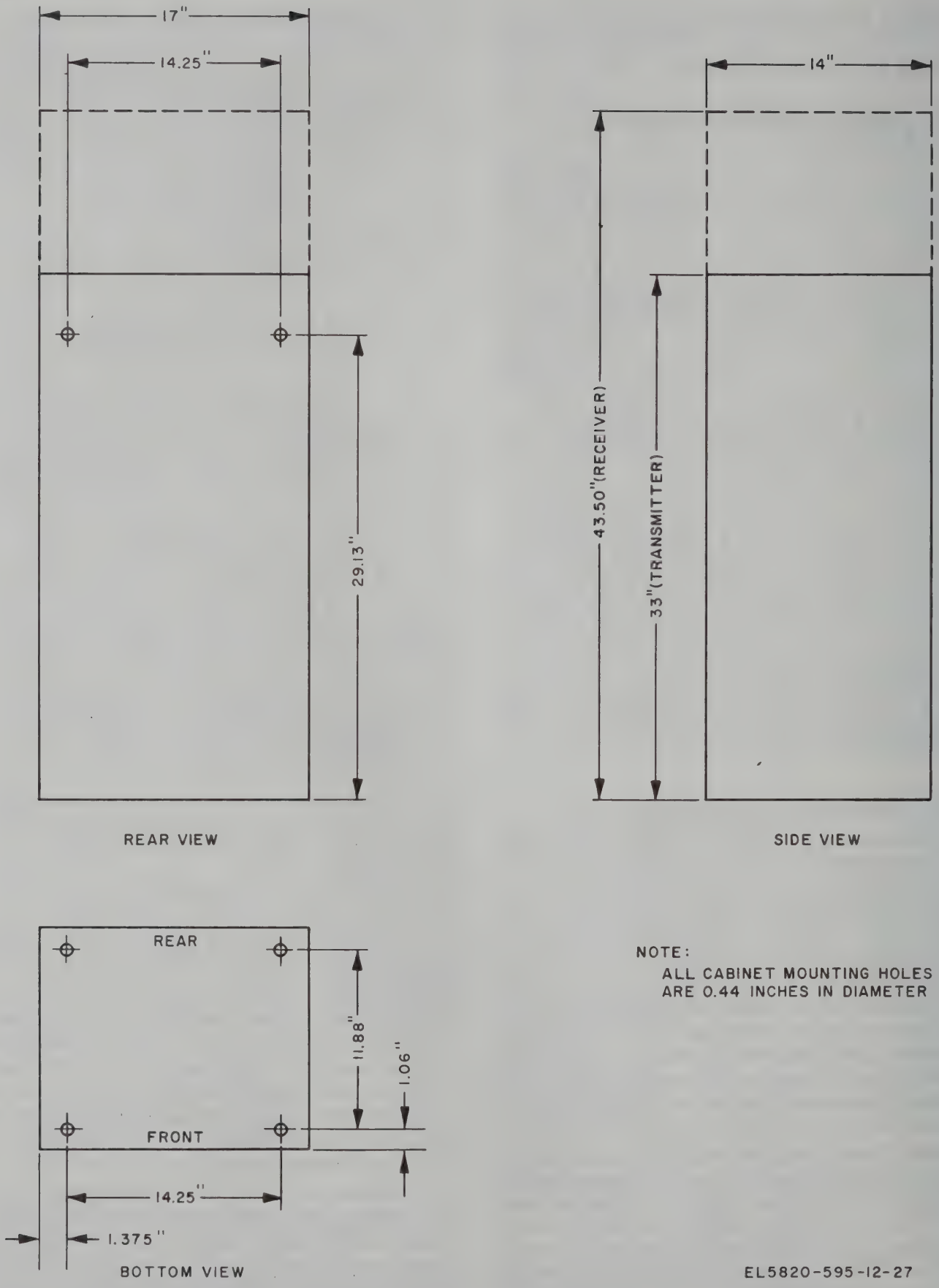


Figure 2-5. Cabinet mounting dimensions for transmitter and receiver.

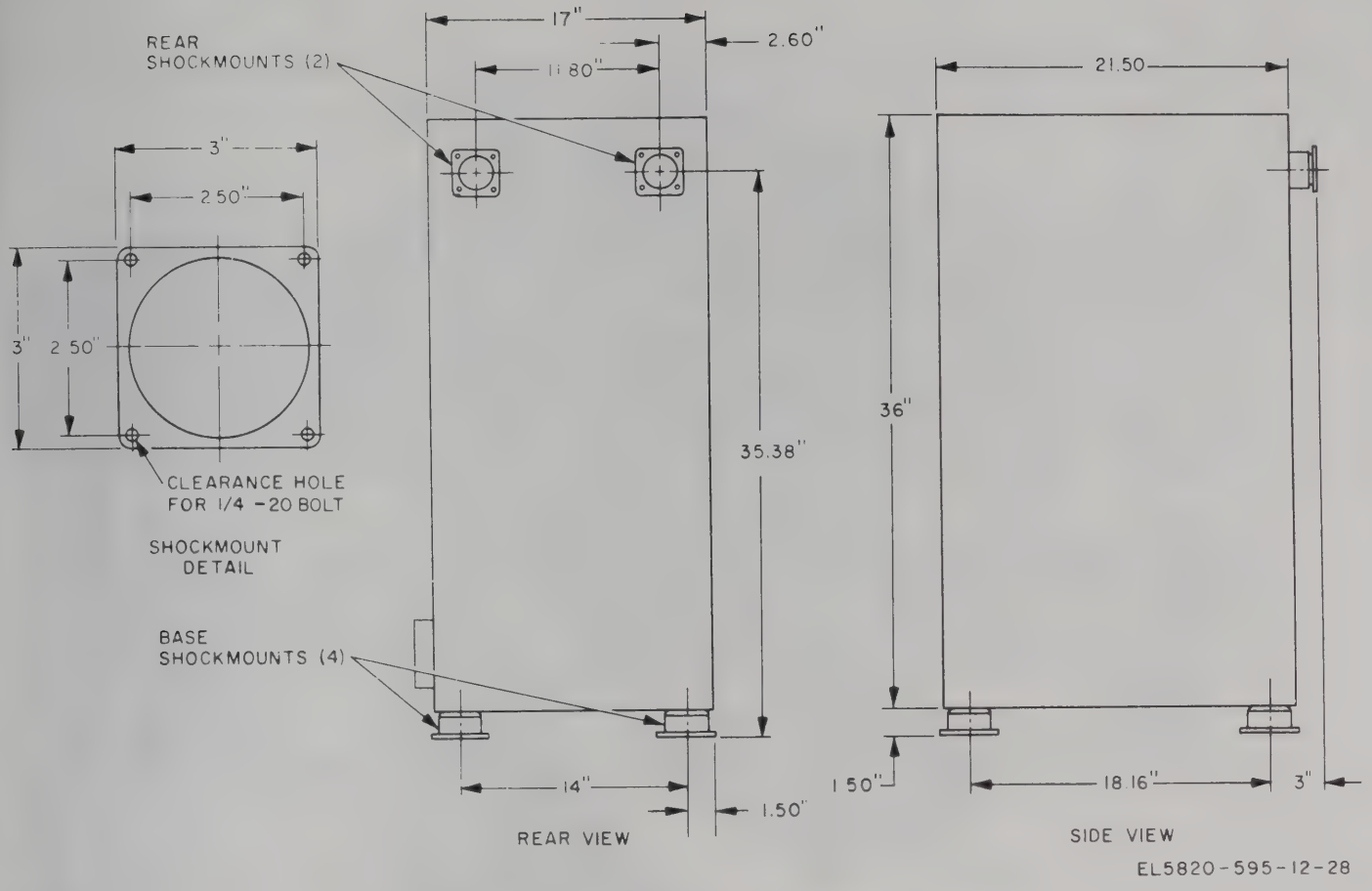


Figure 2-6. Cabinet mounting dimensions for power amplifier.

meter panel between the two hinges, and is operated by turning the latch around its pivot (fig. 2-8).

CAUTION

Exercise care in removal of power supply 1A1 to avoid damaging the meter panel cables shown in figure 2-7.

f. Alternately loosen the two power supply assembly captive screws (fig. 2-7) securing the power supply to the transmitter cabinet and carefully withdraw power supply 1A1 from the cabinet as shown in figure 2-7. Set the power supply aside until cabinet installation is completed.

g. Remove and discard the nuts and bolts securing the mounting hole washers (fig. 2-8) and align the cabinet with the shelter mounting holes. Use two of the 5/16-24 mounting bolts and mounting hole washers, to attach the cabinet to the shelter wall. The four remaining bolts are attached at the bottom of the cabinet. Use a 1/2-inch openend or box wrench to tighten all mounting bolts.

h. Replace power supply 1A1 removed in step *f* above and tighten the two power supply assembly captive screws.

i. Unlatch the panel locking latch, lower the transmitter meter panel, and secure it with the two meter panel captive screws.

j. Replace the order wire-frequency synthesizer assembly (1A13 and 1A14) removed in step *d* above and tighten the two assembly captive screws.

k. Connect the coaxial cable disconnected in step *c* above to OUTPUT connector J8 (fig. 1-8).

l. Close and latch both front doors.

2-8. Installation of Receiver

Install the receiver by following the procedure outlined below.

WARNING

The receiver weighs approximately 178 pounds. Use at least two men to lift the cabinet.

a. Using the two recessed cabinet handles lift the receiver to the mounting surface location and position in accordance with the base and wall mounting holes.

b. Lift and turn the two front door latch handles and open the two cabinet doors.

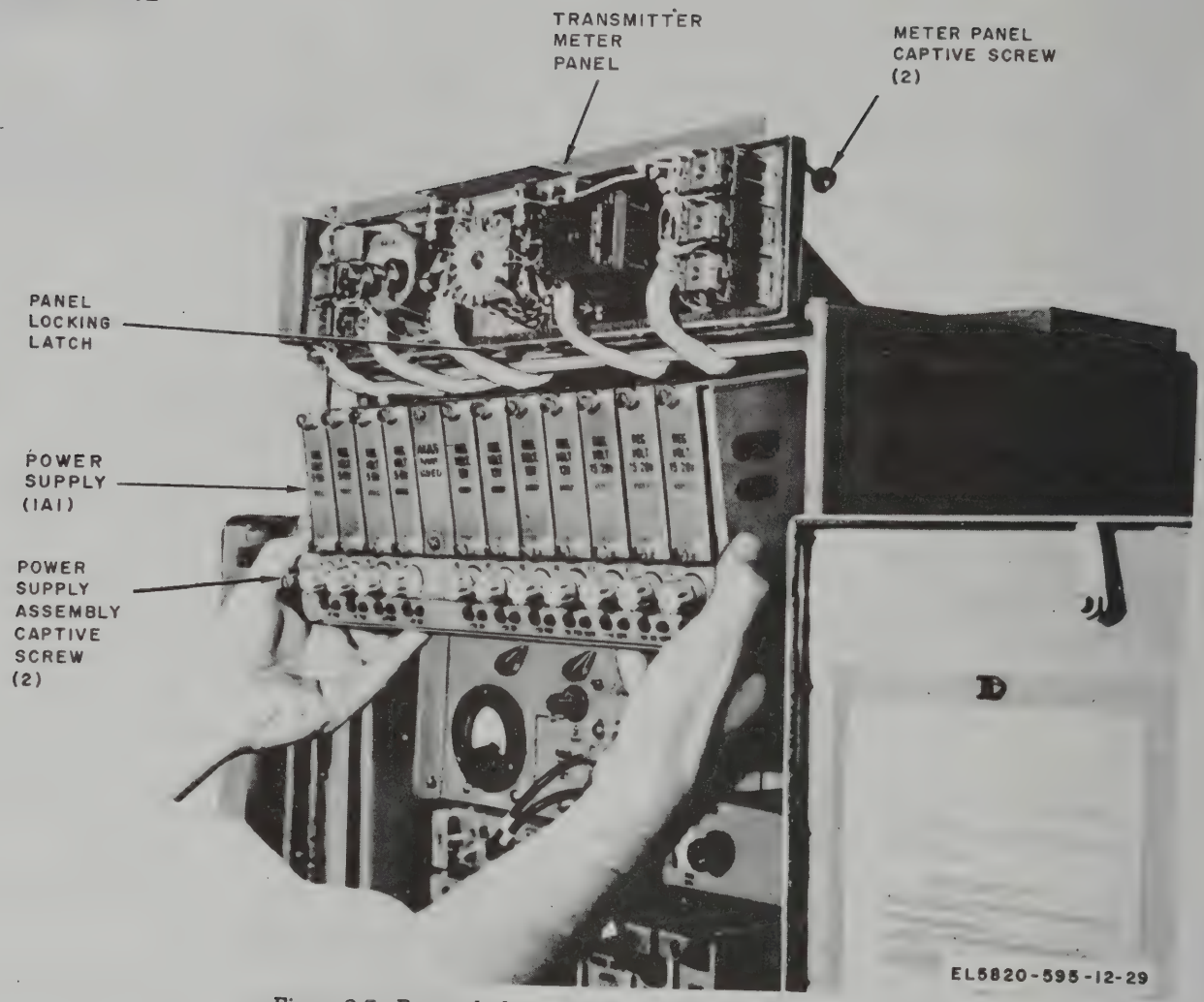


Figure 2-7. Removal of transmitter power supply

c. On frequency synthesizer 2A21 (fig. 1-9), disconnect the coaxial cable from OUTPUT connector J8 (fig. 1-13).

d. Release the two assembly captive screws holding the frequency synthesizer (fig. 1-13) in place, and withdraw the frequency synthesizer from the cabinet by the two attached handles. Set the frequency synthesizer aside until cabinet installation has been completed.

e. Alternately loosen the two metal panel captive screws (fig. 2-9). Swing the receiver meter panel upward on its hinges and, using the panel locking latch, lock the receiver meter panel in the open position by swinging the panel locking latch around on its pivot.

f. To gain access to the two mounting holes in rear of the receiver cabinet, alternately loosen the two power supply assembly captive screws (fig. 2-9) and withdraw the power supply 2A3 from the cabinet.

g. Remove TDA 2A1 as described in paragraph 5-31d.

NOTE

The tunnel diode amplifiers in some radios have been replaced by GaAs field effect transistor (FET) amplifiers. Removal and replacement is identical.

h. Remove and discard the nuts and bolts securing the mounting hole washers and (fig. 2-9) align the cabinet with the shelter mounting holes. Use two sets of the 5/16-24 mounting bolts mounting hole washers, flat washers, and lockwashers to attach the cabinet to the shelter. The four remaining sets of bolts, flat washers, and lockwashers are attached at the bottom of the cabinet. Use a 1/2-inch openend or box wrench to tighten all mounting bolts.

i. Replace power supply 2A3 removed in step f above, and tighten the two power supply assembly captive screws.

j. Replace TDA 2A1 and cable connections removed in step g using the procedure given in paragraph 5-31d.

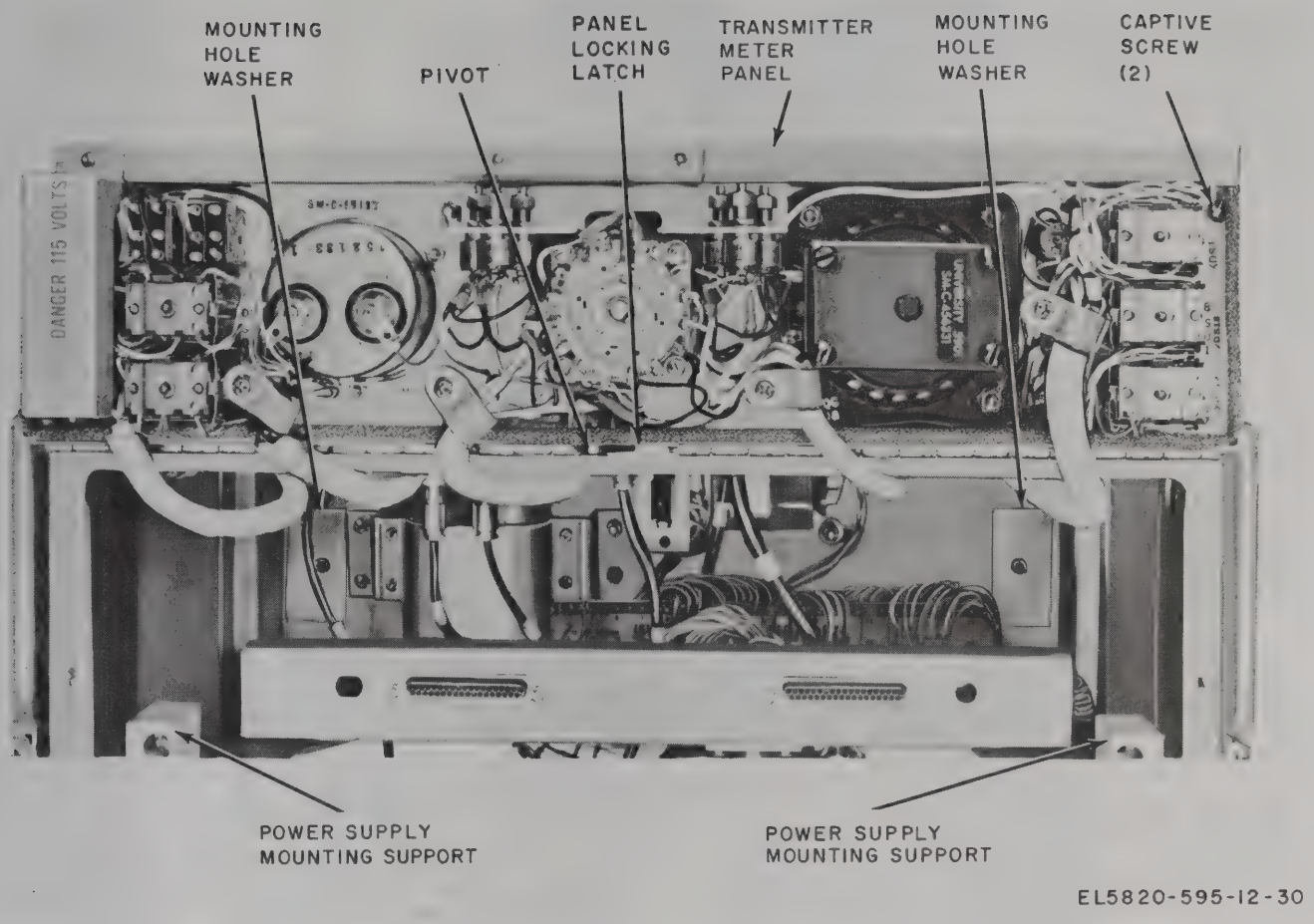


Figure 2–8. Location of transmitter cabinet rear mounting holes.

k. Unlatch the panel locking latch, lower the receiver meter panel, and secure it with the two meter panel captive screws.

l. Replace frequency synthesizer 2A21 removed in step *d* above and tighten the two assembly captive screws.

m. Connect the coaxial cable disconnected in step *c* above to OUTPUT connector J8 (fig. 1–13).

n. Close and latch both cabinet doors.

2–9. Installation of Power Amplifier

WARNING

The power amplifier weighs 376 pounds. DO NOT attempt to lift or carry it without mechanical assistance such as a forklift truck or hoist. Four men should be available to support the power amplifier during loading or unloading. Failure to observe this warning can result in serious personal injury and damage to the equipment.

Install the power amplifier by following the procedure outlined below.

CAUTION

Exercise extreme care to avoid scratching or damaging the power amplifier cabinet during initial positioning into the shelter.

a. Using a padded forklift truck for transport, and with the front of the cabinet facing the forklift truck operator, move power amplifier to desired location.

b. Final alignment of the shockmounts with the base and wall mounting holes can be completed by two men sliding the power amplifier cabinet for final positioning.

c. Secure the two shockmounts at the upper rear of the power amplifier cabinet to the shelter using eight sets hexagon head 1/4–20 bolts and lockwashers. Use an openend wrench to tighten the bolts.

d. Secure the four shockmounts at the bottom of the cabinet to the shelter using sixteen sets of

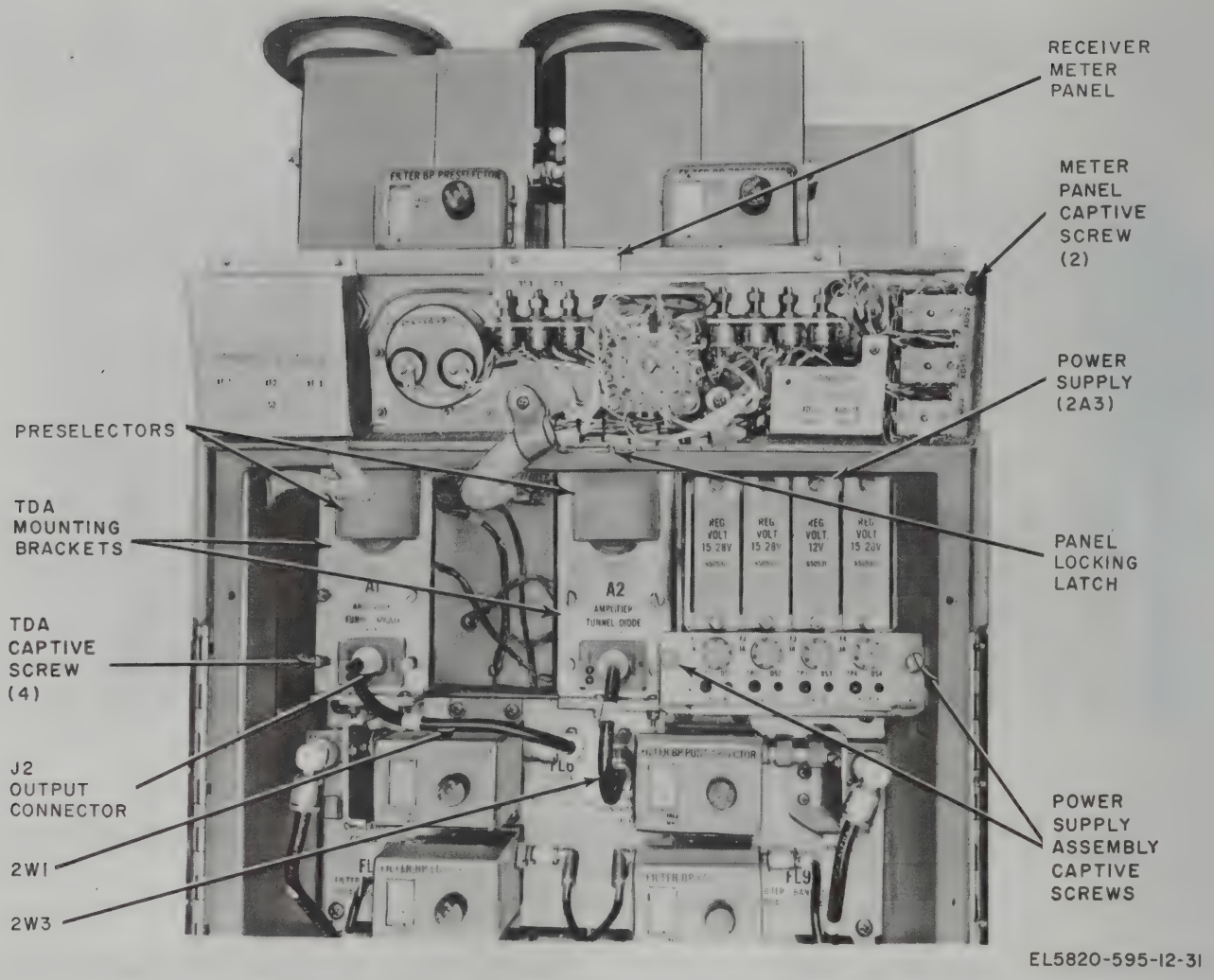


Figure 2–9. Removal of receiver power supply 2A3.

hexagon head 1/4–20 bolts and lockwashers in a manner similiar to step *c* above.

2–10. Location of Modules, Fuses, and Lamps

The radio set is shipped with all modules, fuses, and lamps installed and ready for 12-channel operation. Insure that all components are properly installed by following the procedures outlined below.

a. Transmitter Module Interconnections. Check transmitter module interconnections (fig. 2–10) and refer to the table provided below. The table lists module cables associated with the transmitter. All module cables are captivated (clamped or hard-wired) to components of the transmitter. Three types of captivated cables are listed; cables clamped to transmitter cabinet 1A16, cables clamped to plate assembly 1A15, and cables clamped or hard-wired to certain modules. The table includes the cable markings and the module and/or assembly connectors associated with each cable.

Cable marking	Cabinet 1A16 captivated cables	Plate assembly 1A15 captivated cables	Module captivated cables	From--	To--
W1	--------	--------	1A2W1	1A2	1Z1J4
W1			1A3W1	1A3	1A4J1
W1			1A6W1	1A6	1A4J2
W1			1A8W1	1A8	1A9A1J1
W1			1A9W1[a]	1A9J1	1A10A2J2
W1	1A16W1	--------	--------	1A12J1	1A16J2

See footnotes at end of table.

Cable marking	Cabinet 1A16 captivated cables	Plate assembly 1A15 captivated cables	Module captivated cables	From	To
W2			1A2W2	1A2	1Z1J3
W2			1A6W2	1A6	1A8J1
W2			1A8W2	1A8	1A7J1
W2	1A16W2	--------	--------	1A12J4	1A16J3
W3			1A9W3	1A9	1FL3J1
W3	1A16W3	--------	--------	1A12J2	1A3J1
W4	1A16W4	--------	--------	1A12J3	1A13P1
W5	1A16W5[d]	--------	--------	1A13[b]	1A16J6
W6	1A16W6			1A14J8	1A11J1
W7		1W7[c]		1A11J7	1FL5J1
W8		1A15W8		1HY1J3	1A15E4
W9		1W9[c]		1HY1J2	1A10A1J1
W10		1A15W10		1A10HY1J3	1A15E5
W11		1A15W11		1A9HY1J4	1A15E6
W12		1A15W12		1DC2J4	1A15E7
W13		1A15W13		1DC2J5	1A15E8
W14		1A15W14		1DC2J3	1Z1J2
W15	1A16W15[d]	--------	--------	1DC2J2	1A16J8
W16	1A16W16[d]			1AT3J2	1A16J9
W17	1A16W17[d]	--------	--------	1AT4J2	1A16J10

[a] 1A9W1 is a rigid coaxial cable captivated by means of a cable clamp and a flexible steel cable which is fastened to module 1A9.
[b] Associated connector XA13 is part of transmitter cabinet 1A16.
[c] 1W7 and 1W9 are rigid coaxial cables which are fastened to plate assembly 1A15 by means of cable clamps and flexible steel cables.
[d] Cables 1A16W15, 1A16W16, and 1A16W17 are located in the rear of transmitter cabinet 1A16, and are not shown in figure 2-10.

b. Receiver Module Interconnections. Check receiver module interconnections (fig. 2-11); and refer to the table provided below. The table lists all removable and nonremovable module cables associated with the receiver. Removable (noncaptivated) cables are used for interconnection between certain modules and may be disconnected and removed from the equipment. Three types of captivated cables are listed; cables clamped to receiver cabinet 2A22, cables clamped to plate assembly 2A24, and cables clamped or hard-wired to certain modules. The table includes the cable markings and the modules or assembly connectors associated with each cable.

Cable marking	Cabinet 2A22 captivated cables	Plate assembly 2A24 captivated cables	Module captivated cables	Non-captivated cables	From—	To—
W1	------	----------	----------	2W1	2A1J2	2FL6J2
W1	------	----------	2A4W1	----------	2A4	2A5J1
W1	------	----------	2A6W1	----------	2A6	2A7HY2J2
W1	------	----------	2A9W1	----------	2A9	2A7HY2J3
W1	------	----------	2A11W1	----------	2A11	2A10J1
W1	------	----------	2A12W1	----------	2A12	2A5J2
W1	------	----------	2A15W1	----------	2A15	2A10J2
W1	------	----------	2A16W1	----------	2A16	2A17J1
W1	------	----------	2A18W1	----------	2A18	2A17J6
W2	------	----------	----------	2W2	2HY1J2	2A4J1
W2	------	----------	2A12W2	----------	2A12	2A16J1
W2	------	----------	2A13W2	----------	2A13	2A6FL1J1
W2	------	----------	2A14W2	----------	2A14	2A9FL1J1
W2	------	----------	2A15W2	----------	2A15	2A16J4
W2	------	----------	2A18W2	----------	2A18	2A19J1
W3	------	----------	----------	2W3	2A2J2	2FL7J1
W4	------	----------	----------	2W4	2HY2J2	2A11J1
W5	2A22W5	----------	----------	----------	2A21J8	2A8J1
W6	------	2W6[a]	----------	----------	2A8J5	2FL10J1
W7	------	2A24W7	----------	----------	2HY3J3	2A22J1-M
W8	------	2A24W8	----------	----------	2A7HY1J3	2A22J1-N
W9	------	2W9[a]	----------	----------	2HY3J2	2A7A1J1
W10	------	2A24W10	----------	----------	2A13J3	2A20[b]
W11	------	----------	----------	2W11	2A6HY1J2	2FL8J2
W12	------	----------	----------	2W12	2A4J2	2FL8J1
W13	------	2A24W13	----------	----------	2A14J3	2A20[b]
W14	------	----------	----------	2W14	2A9HY1J2	2FL9J1
W15	------	----------	----------	2W15	2A11J2	2FL9J2
W16	2A22W16	----------	----------	----------	2A19J2	2A22J4

[a] 2W6 and 2W9 are rigid coaxial cables which are fastened to plate assembly 2A24 by means of cable clamps and flexible steel cables.
[b] Associated connector XA20 is part of cabinet 2A22.

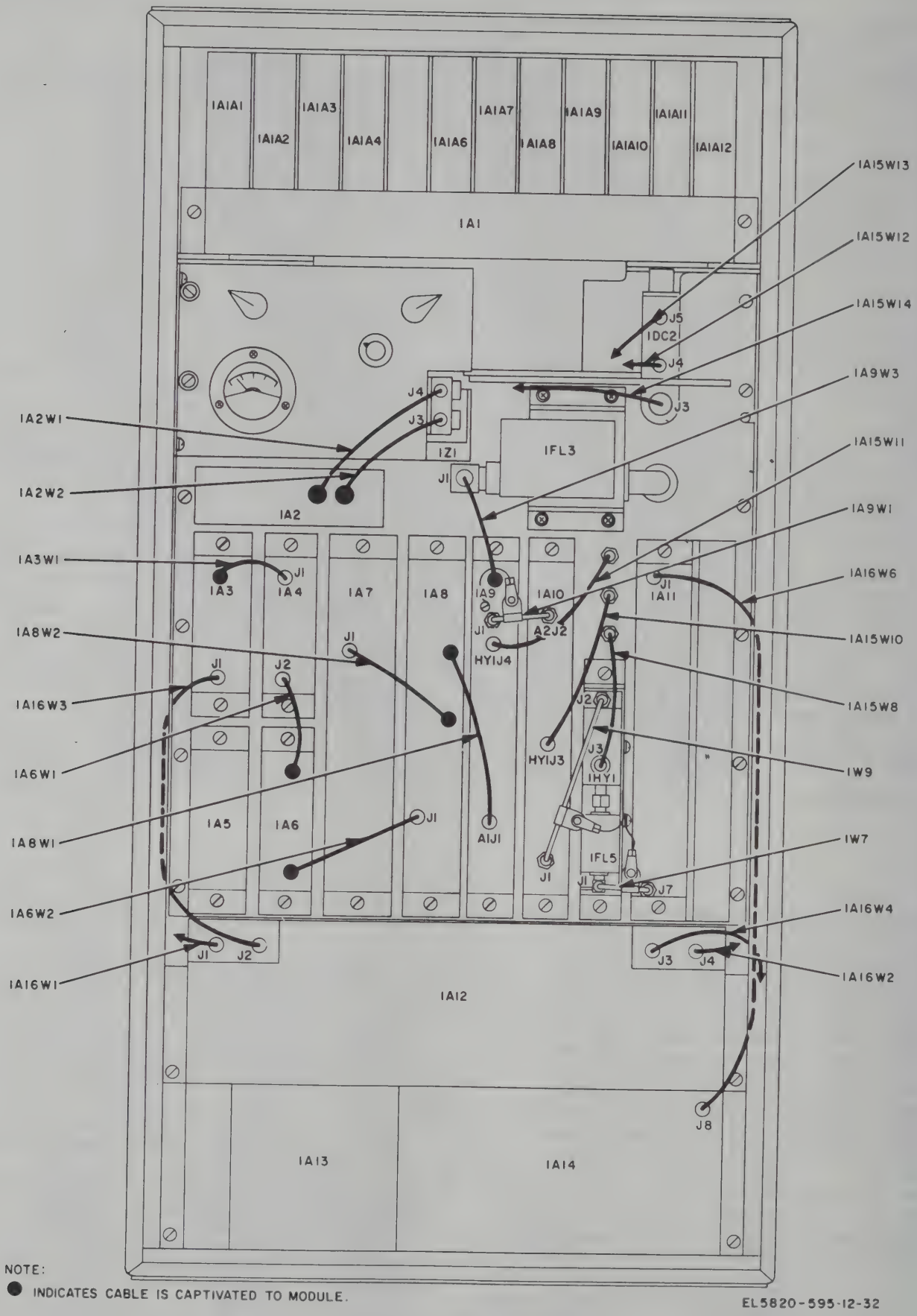


Figure 2–10. Transmitter module interconnection cables.

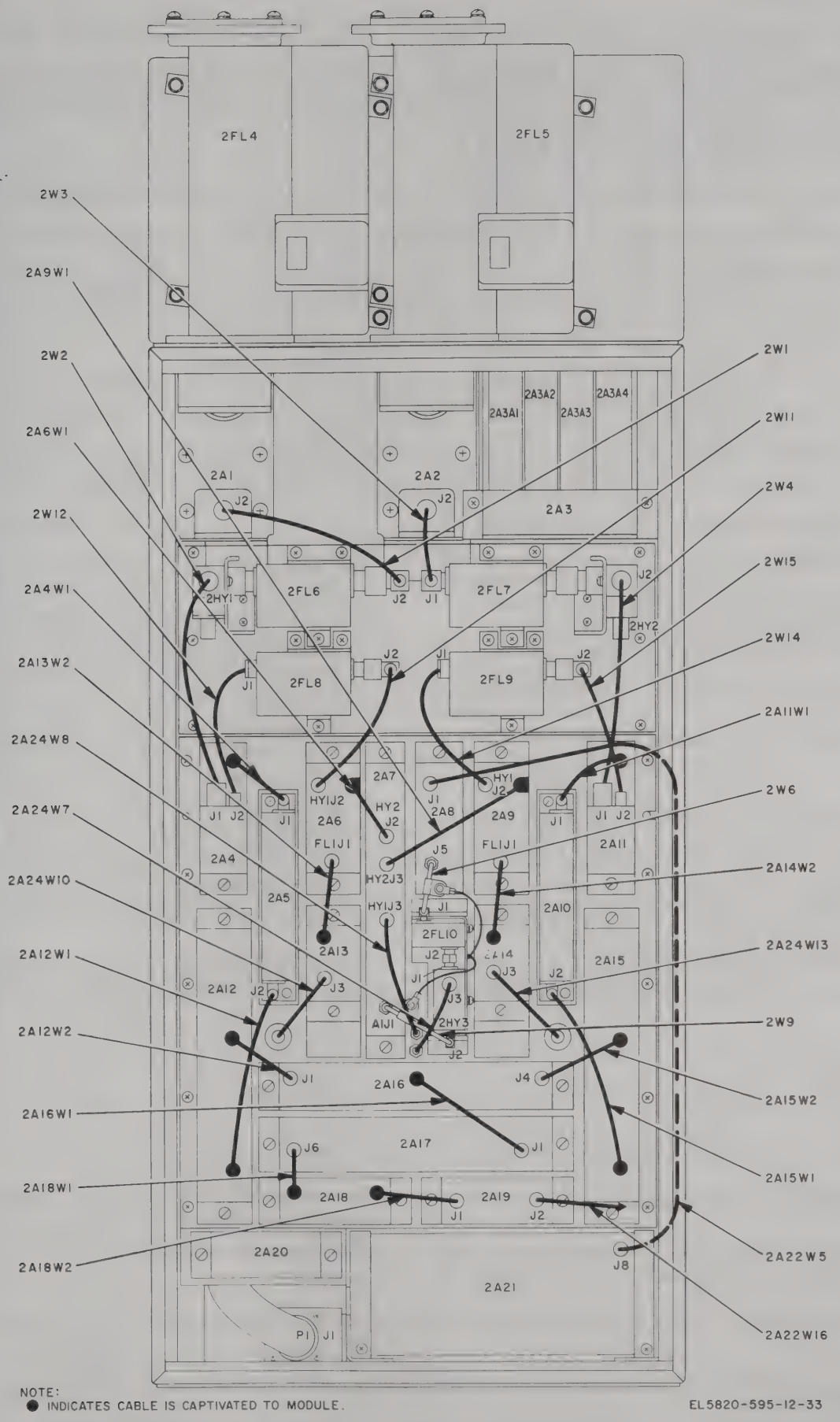


Figure 2–11. Receiver module interconnection cables.

c. Fuses and Lamps. The radio set is shipped with all fuses and indicator lamps installed. Be sure that the proper fuses and lamps are installed in appropriate holders of all components associated with the radio set. The following table provides symbols for the fuses and lamps, fuse ratings, and indicator lamp types. Fuse and lamp locations are shown in figures 2–12 through 2–15.

Component	Fuse or lamp symbol	Fuse rating (amp)	Lamp type	Reference (fig. No.)
Transmitter				
Meter panel (p/o cabinet 1A16)	1A16F1	5A slo-blo		2–12
	1A16DS1 through 1A16DS21		MS18209–387	2–12
Power supply 1A1	1A1A13F1 through 1A1A13F4	F02A250V3AS		2–12
	1A1A13F6 through 1A1A13F11	F02A250V3AS		
	1A1A13F12	F02A250V4AS		2–12
	1A1A13DS1 through 1A1A13DS4 and 1A1A13DS6 through 1A1A13DS12		MS24367–683	2–12
Frequency synthesizer 1A14	1A14F1	FM01–3A		2–12
	1A14DS1, 1A14A1DS1, 1A14A2DS1, and 1A14A3DS1		62	2–12
			MS24367–683	2–12
	1A14DS2, 1A14A4DS1, 1A14A5DS1, and 1A14A6DS1.			
Orderwire assembly 1A13	1A13A1S2DS1 (MODULE TEST pushbutton switch indicator lamp).		382	2–12
100 MHz oscillator 1A2	1A2DS1		MS24367–683	2–12
Digital data modem 1A12	1A12A2DS1, 1A12A3DS1, 1A12A4DS1, 1A12A6DS1, 1A12A8DS1, 1A12A9DS1 1A12A10DS1, 1A12A12DS1, 1A12A13DS1, and 1A12A15A2DS1 through 1A12A15A2DS4.		CM8–1062	2–13
Receiver				
Meter panel (p/o cabinet 2A22).	2A22F1	8A slo-blo		2–14
	2A22F2 and F3	1A slo-blo		
	2A22DS1 through 2A22DS17		MS18209–387	2–14
Power supply 2A3	2A3A5F1 through 2A3A5F4	F02A250V3AS		2–14
	2A3A5DS1 through 2A3A5DS4.		MS24367–683	2–14
Frequency synthesizer 2A21	2A21F1	FM01–3A		2–14
	2A21DS1, 2A21A1DS1, 2A21A2DS1, and 2A1A3DS1		62	2–14
	2A21DS2, 2A21A4DS1, 2A21A5DS1, and 2A21A6DS1.		MS24367–683	2–14
Power amplifier				
Cabinet (3A9)	3A9A23F1	1/2		2–15
Meter panel (p/o cabinet 3A9).	3A9DS1 through 3A9DS44		382	2–15

2–11. Interface Cable Connectors

Interface cable connectors are mounted on each cabinet as shown in figures 2–16 through 2–18. The following table lists the name and designation of all cabinet mounted connectors, and the plug designation and part number of each mating connector.

Connector name	Connector designation	Plug designation	Plug nomenclature or part No.
Transmitter (fig. 2–16)			
FROM CABLE	1A16J2	4A1P2	SM–B–652971
TO CABLE	1A16J3	4A1P3	SM–B–652972
EQUIPMENT INTERCONNECT	1A16J4	4A1P6	MS–3116F16–26S
HANDSET INTERCONNECT	1A16J5	4A1P1	SC–D–22580

Connector name	Connector designation	Plug designation	Plug nomenclature or part No.
TRAFFIC INPUT (RECEIVER)	1A16J6	4A1P7	SM–B–652910
AC POWER INPUT	1A16J7	4A1P4	MS–3116F12–3S
RF OUTPUT	1A16J8	4A1P5	SM–B–652957
TEST OUTPUT (RECEIVER CHAN A)	1A16J9	4A1P8	SM–B–652957
TEST OUTPUT (RECEIVER CHAN B)	1A16J10	4A1P9	SM–B–652957
Receiver (fig. 2–17)			
EQUIPMENT INTERCONNECT	2A22J2	4A1P11	MS–3116F12–10P
ANTENNA ALIGNMENT INDICATOR	2A22J3	4A2P13	MS–3116F12–8P
TRAFFIC OUTPUT	2A22J4	4A2P10	SM–B–652910
AC POWER INPUT	2A22J5	4A2P12	MS–3116F12–3S
Power Amplifier (fig. 2–18)			
AC POWER INPUT	3A9A8J1	4A3P17	MS–3106E24–10S
INTERLOCK	3A9J2	4A3P16	MS–3116F10–6P
RF INPUT	3A9J3	4A3P15	SM–B–652957
EQUIPMENT INTERCONNECT	3A9J4	4A3P14	MS–3116F12–10S
Chan A directional coupler	P/O 4A5	4A5P19	SM–B–652957
Chan B directional coupler	P/O 4A6	4A6P18	SM–B–652957

2–12. Interconnection Cables

Interconnection cables (fig. 2–19) are not supplied with the radio set and must be fabricated to the required length using the materials listed in paragraph 2–5*c* and the connectors listed in paragraph 2–11. Figure 2–19 shows all interconnecting cables between a radio set and its ancillary equipment. Typical shelter mounted items and associated connectors not supplied with the radio set are listed in *a* below. Wiring information for all radio set interconnecting cables is provided in *b* below. For additional information, refer to the appropriate technical manual covering equipment Shelter S–336/TRC–112 (DTM 11–5820–556–15) or S–( )/TRC–121 (DTM 11–5820–602–15).

a. Shelter Mounted Components. The following items (and associated connectors) are shelter mounted for use, but not supplied, with the radio set:

(1) PCM Cable CX–4245/G.
(2) Primary power source and distribution.
(3) Shelter mounted alarm indicators.
(4) Telephone Set TA–312/PT.
(5) Converter, Telephone-Telegraph CV–425/U.
(6) Waveguide switch and dummy load.
(7) Alarm disable switch.
(8) Preheater.
(9) All shelter interconnection cables.

b. Interconnections. All wired interface connections for the transmitter cabinet 1A16, receiver cabinet 2A22, and power amplifier cabinet 3A9 are listed in the following table. All cabinet connectors are mounted on top of the equipment cabinets as shown in figures 2–16 through 2–18.

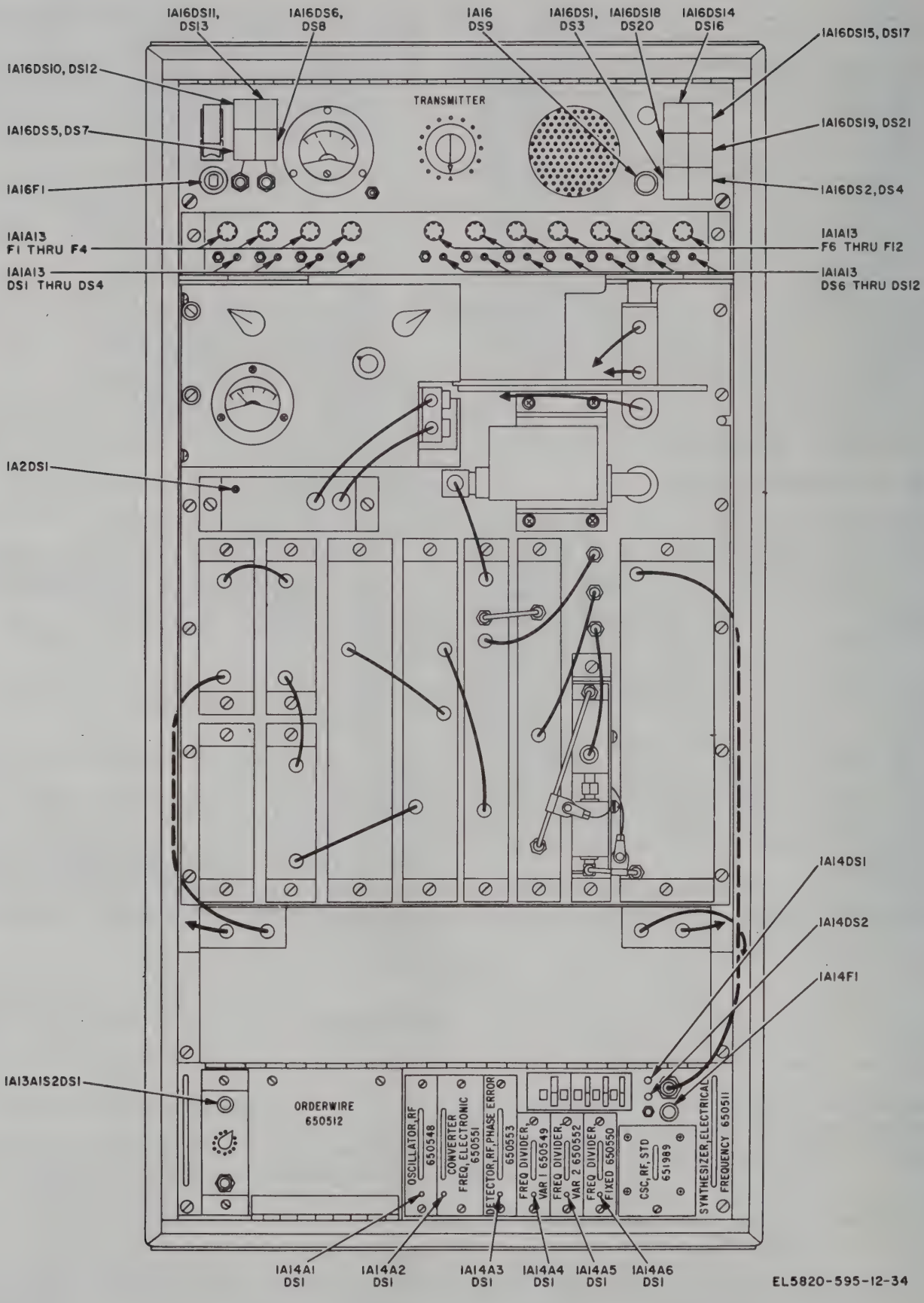


Figure 2–12. Transmitter fuse and indicator lamp locations.

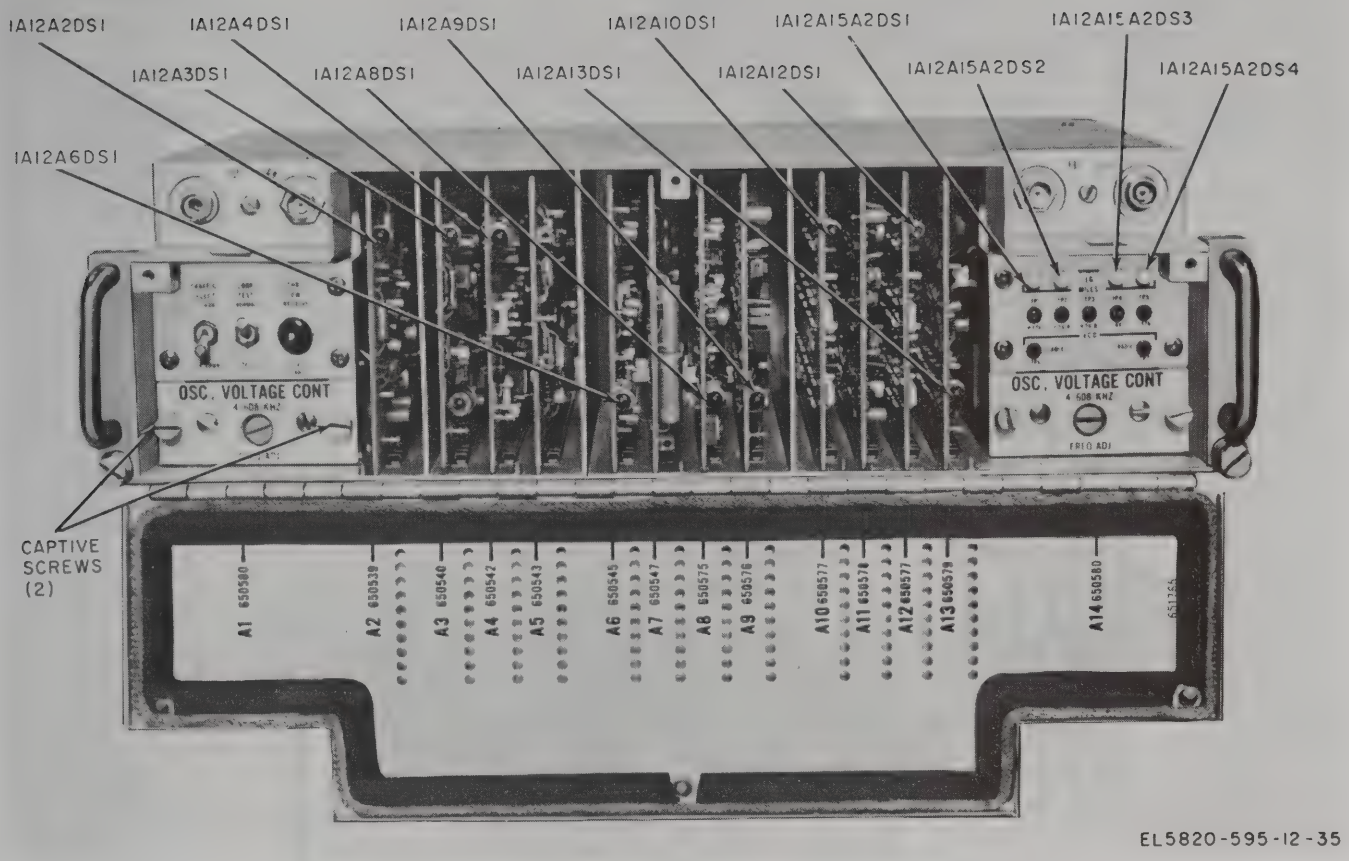


Figure 2–13. Transmitter digital data modem 1A12, indicator lamp locations.

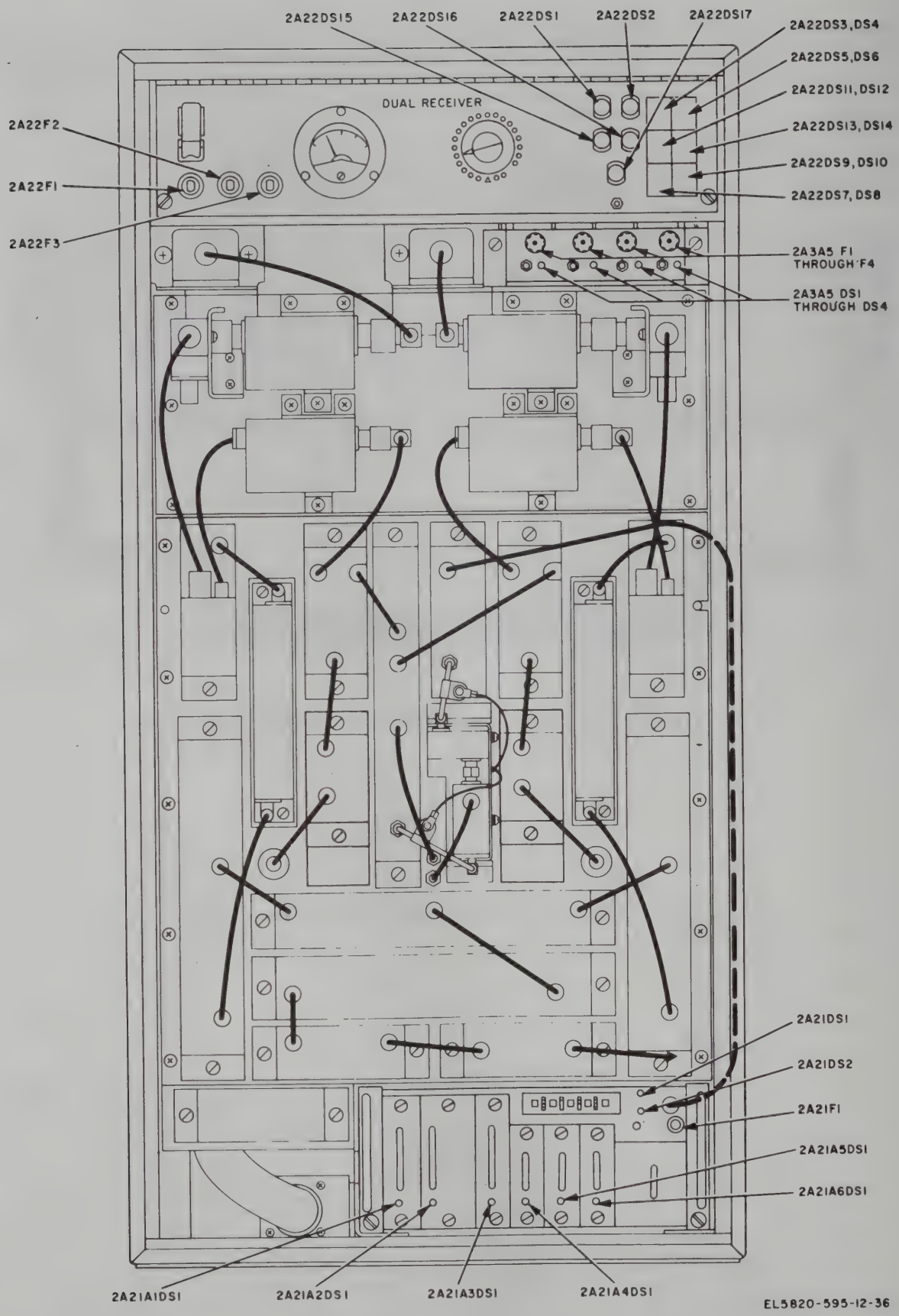


Figure 2-14. Receiver fuse and indicator lamp locations.

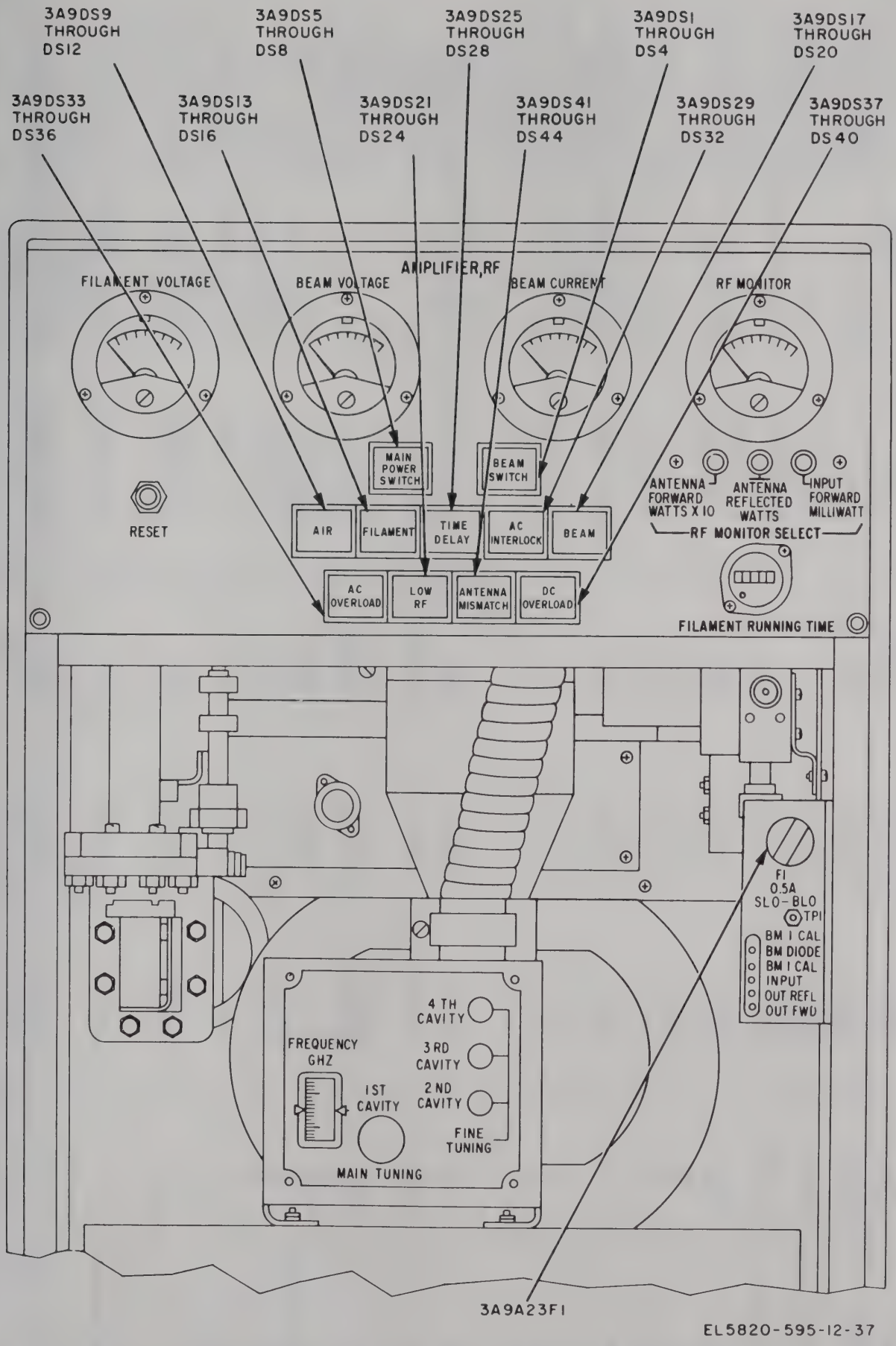


Figure 2–15. Power amplifier fuse and indicator lamp locations.

Wire		From—		To—			Function
			Interconn.		Via interconn.		
Category	AWG size, or type wire	Cabinet connector	Plug Pin	Cabinet connector	Plug Pin	Ancillary equipment	
Shielded	20 shield	1A16J5	4A1P1 A	NA	----------	Handset 4A4[a]	Handset receive.
		1A16J5	4A1P1 B				Receive return.
Shielded	20 shield	1A16J5	4A1P1 C				Handset transmit.
		1A16J5	4A1P1 E				Transmit return.
Coax.	RG-223/U	1A16J2	4A1P2	NA	Not supplied	CX-4245/G cable	FROM CABLE signal.
Coax.	RG-223/U	1A16J3	4A1P3	NA	Not supplied	CX-4245/G cable	TO CABLE signal.
Single	16	1A16J7	4A1P4 A	NA	Not supplied	Power source	115 vac.
Single	16	1A16J7	4A1P4 B	NA			Ground.
Single	16	1A16J7	4A1P4 C	NA	----------	----------	115 vac neutral.
Coax.	RG-214/U	1A16J8	4A1P5	3A9J3	4A3P15	NA	Transmitter RF OUTPUT.
Single	20	1A16J4	4A1P6 F	NA	Not supplied	Traffic indicators (shelter mounted).	28 volts for shelter mounted traffic indicators. (Indicators returned through P6 pins M, N, P, R).
Single	20	1A16J4	4A1P6 G	NA	----------	----------	28 volt return (not used).
Single	20	1A16J4	4A1P6 H	2A22J2	4A2P11 B	NA	Receiver summary alarm.
Single	20	1A16J4	4A1P 6 J	2A22J2	4A2P11 A	NA	Alarm return.
Single	20	1A16J4	4A1P6 K	3A9J4	4A3P14 A	NA	Power amplifier summary alarm.
Single	20	1A16J4	4A1P6 L	3A9J4	4A3P14 B	NA	Alarm return.
Shielded, twisted pr.	20	1A16J4	4A1P6 M	NA	Not supplied	Alarm indicator (shelter mounted).	Cable-to-radio alarm.
	20	1A6J4	4A1P6 N	NA	Not supplied	Traffic indicator (shelter mounted).	Cable-to-radio normal.
	shield	1A16J4	4A1P6 Y	NA	Not supplied	----------	Shield for twisted pair wires at P6-M and P6-N.
Shielded, twisted pr.	20	1A16J4	4A1P6 P	NA	Not supplied	Alarm indicator (shelter mounted).	Radio-to-cable alarm.
	20	1A16J4	4A1P6 R	NA	Not supplied	Traffic indicator (shelter mounted).	Radio-to-cable normal.
	shield	1A16J4	4A1P6 Y	NA	Not supplied	----------	Shield for twisted pair wires at P6-P and P6-R.

Wire		From		To			Ancillary
			Interconn.		Via interconn.		
Category	AWG size, or type wire	Cabinet connector	Plug Pin	Cabinet connector	Plug Pin	Ancillary equipment	
Shielded, twisted	20	1A16J4	4A1P6 S	NA	Not supplied	Remote Telephone Set TA–312/PT via Telephone-Telegraph Converter CV–425/U.	Two-wire order wire.
	20	1A16J4	4A1P6 T	NA	Not supplied	Same as above.	Same as above.
	shield	1A16J4	4A1P6 Z	NA	Not supplied	----------	Shield for twisted pair wires at P6–S and P6–T.
Single	20	1A16J4	4A1P6 U	NA	Not supplied	Waveguide switch[b]	RF interlock.
Single	20	1A16J4	4A1P6 V	NA	Not supplied	Same	Same.
Shielded, twisted pr.	20	1A16J4	4A1P6 W	NA	4A2P11 C	NA	AGC.
	20	1A16J4	4A1P6 X	2A22J2	4A2P11 K	NA	AGC reference.
	shield	1A16J4	A1P6 Y			NA	Shield for twisted pair wires at 4A1P6–W and 4A1P6–X.
Single	20	1A16J4	4A1P6 a	NA	Not supplied	Alarm disable switch (shelter mounted)	Disables audible alarm during equipment turn-on.
Single	20	1A16J4	4A1P6 c	NA	Not supplied	Same	Same
Single	16	2A22J5	4A2P12 A	NA	Not supplied	Power source	115 vac.
Single	16	2A22J5	4A2P12 B	NA	----------	Power source	Ground.
Single	16	2A22J5	4A2P12 C	NA	----------	Power source	Neutral.
Shielded twisted pr.	20	2A22J3	4A2P13A	NA	J1(S) A Not supplied	Antenna alignment indicator 4A7[c].	Chan A reerence.
	20	2A22J3	4A2P13 B	NA	J1(S) B Not supplied	Same	Chan A.
	shield	2A22J3	4A2P13 C	NA	J1(S) C Not supplied	Same	Ground.
Shielded twisted pr.	20	2A22J3	4A2P13 D	NA	J1(S) D Not supplied	Same	Chan B.
	20	2A22J3	4A2P13 E	NA	J2(S) E Not supplied	Same	Chan B reference.
	shield	2A22J3	4A2P13 C	NA	J1(S) C Not supplied	Same	Ground.
Shielded twisted pr.	20	Telephone converter –5	NA	NA	J1(S) F Not supplied	Antenna alignment indicator	Two-wire order wire.

Wire		From—		To—			Function
			Interconn.		Via interconn.		
Category	AWG size, or type wire	Cabinet connector	Plug Pin	Cabinet connector	Plug Pin	Ancillary equipment	
	20	Telephone converter –6[d]	NA	NA	J1(S) G Not supplied	Field phone	Two-wire order wire.
Single	20	3A9J4	4A3P14D	NA	Not supplied	High temperature indicator (shelter mounted)[e]	High temperature alarm.
Single	20	3A9J4	4A3P14 E	NA		Same	Same
Single	18	3A9J2	4A3P16 A	NA	Not supplied	Preheater (shelter mounted)[f]	Interlock to coil of preheater control elay.
Single	18	3A9J2	4A3P16 C	NA	Same		Same.
Single	20	3A9J2	4A3P16 B	3A9J2	4A3P16 E	NA	Interlock.
Single	10	3A9A8J1	4A3P17 A	NA	Not supplied	Power source	230 vac.
Single	10	3A9A8J1	4A3P17 B	NA	----------	Power source	Neutral.
Single	10	3A9A8J1	4A3P17 C	NA		Power source	230 vac.
Single	10	3A9A8J1	4A3P17 F	NA		Power source	Ground.
Single	10	1A16E2				Ground system	Ground.
Single	10	2A22E2				Ground system	Ground.
Single	10	3A9E1	----------	----------	----------	Ground system	Ground.
Coax.	RG–58/U	1A16J6	4A1P7	2A22J4	4A2P10	NA	Traffic.
Coax.	RG–214/U	1A16J9	4A1P8	NA	4A2P19	Directional coupler 4A5.	Test output.
Coax.	RG–214/U	1A16J10	4A1P9	NA	4A2P18	Directional coupler 4A6.	Test output.

[a] Handset 4A4 can be directly connected to 1A16J5, or remoted through connector 4A1P1. Remote cable termination is not supplied, but connector 4A1P1 is supplied.

[b] Waveguide switch requires limit switches for RF interlock. These limit switches provide open contacts to 4A1P6 pins U and V when waveguide switch is in either the antenna or dummy load position, and closed contacts to 4A1P6 pins U and V during travel from one waveguide switch position to the other. The limit switches should also provide contacts to light the appropriate position indicator lamp in the shelter.

[c] Antenna alignment indicator 4A7 is normally connected through shelter RF entry panel connector J1(S). Connector J1(S) is not supplied.

[d] It is recommended that a selector switch (not supplied) be used at telephone converter terminals 5 and 6. The selector switch would connect either the antenna alignment indicator field phone or the remote phone to the telephone converter. The use of a selector switch will avoid connecting both the field phone and remote phone to the telephone converter. The use of a selector switch will avoid connecting both the field phone and remote phone at the same time, thus avoiding an improper order wire termination.

[e] Connector 4A3P14 pins D and E are closed by a shorting switch when power amplifier cabinet temperature rating is exceeded.

[f] Shelter mounted preheater supplies warm air to the power amplifier intake filter when ambient temperature is below 0°F. Connector 4A13P16 pins B and E provide an interlock. When beam voltage is applied to the power amplifier, the interlock removes power from the preheater. When beam voltage is removed from the power amplifier, the interlock provides power to the preheater.

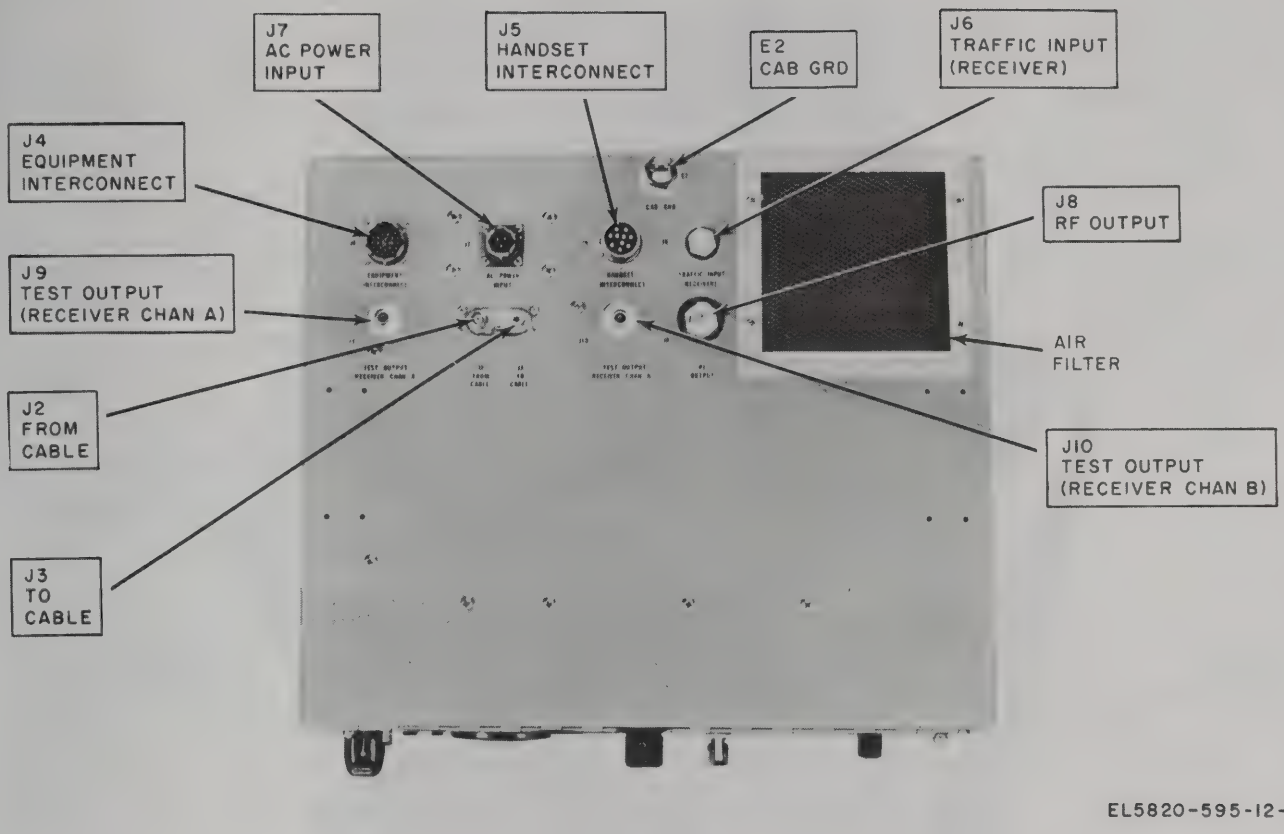


Figure 2–16. Transmitter, cabinet mounted interface connectors.

2–13. Waveguide Connections

Interconnecting waveguide sections, waveguide switch, and dummy load are not supplied with the radio set but constitute a part of the shelter equipment. The following table lists the waveguide connections which must be completed during installation of each radio set into a shelter:

WARNING

Check waveguide connections for completeness before applying power to power amplifier.

Waveguide Connection	Location	Flange type
Power amplifier RF OUTPUT.	3A9	UG–406/U
Preselector 2FL4	2A22	UG–406B/U
Preselector 2FL5	2A22	UG–406B/U
Chan A Directional coupler 4A5[a]:		
a. Antenna	----	UG–406B/U
b. Receiver	----	UG–407/U
Chan B directional coupler 4A6[a]:		
a. Antenna	----	UG–406B/U
b. Receiver	----	UG–407/U

[a] Channel A and channel B directional couplers are installed in the shelter waveguide run between the receiving antennas and receiver cabinet 2A22. The waveguide switch and dummy load are interconnected in the shelter waveguide run between the power amplifier and the antenna connection at the RF entry panel of the equipment shelter.

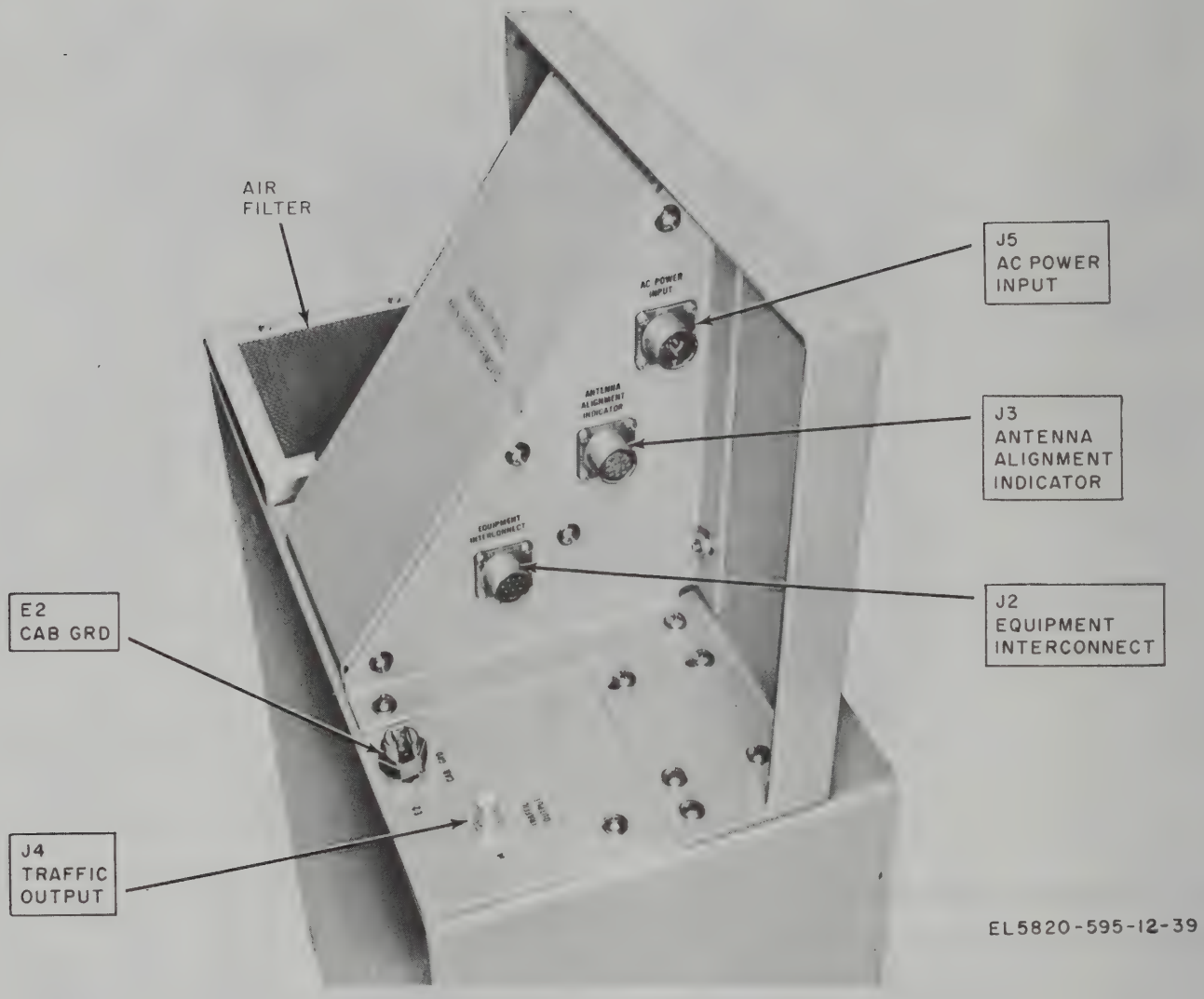


Figure 2-17. Receiver, cabinet mounted interface connectors.

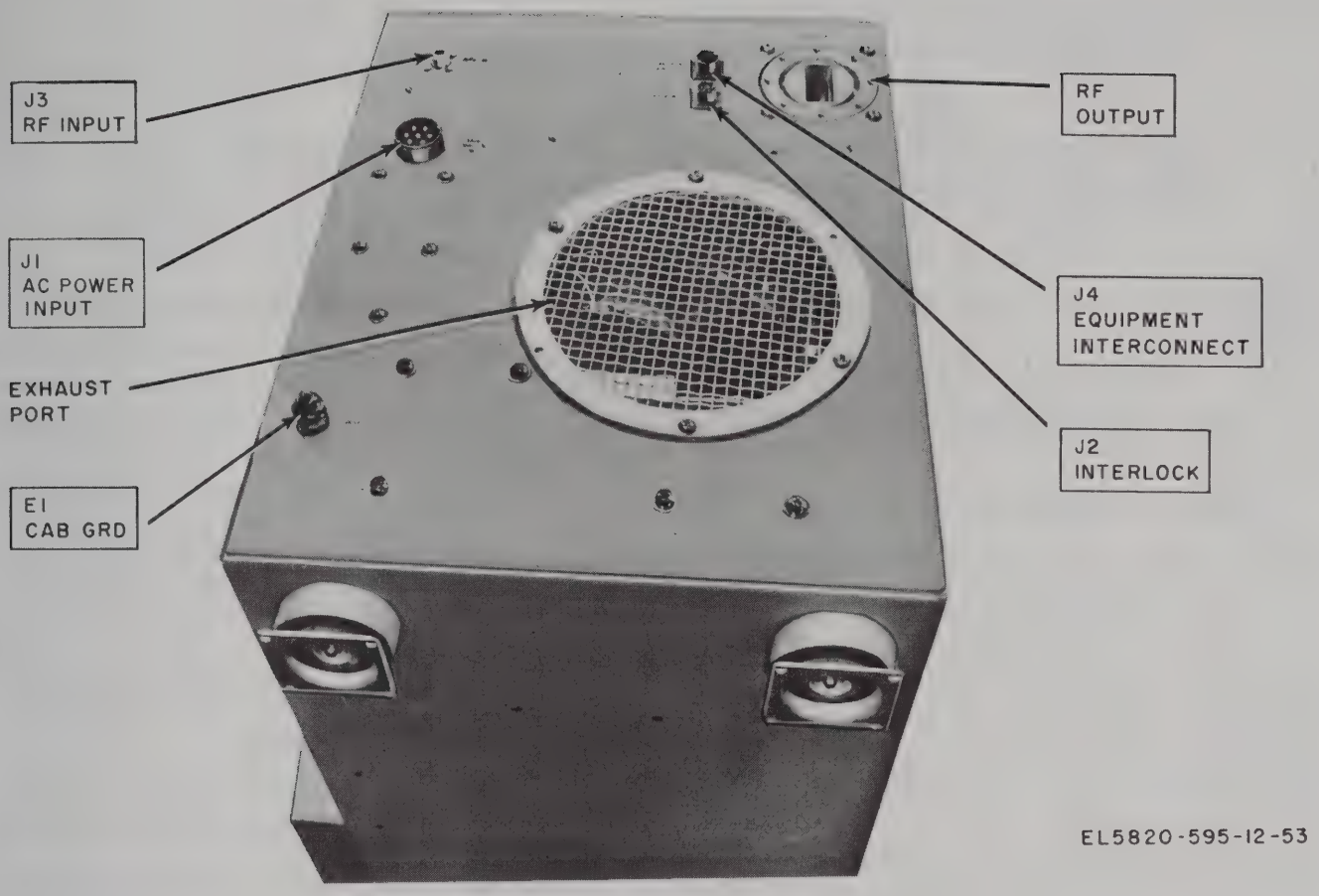


Figure 2–18. Power amplifier, cabinet mounted interface connectors.

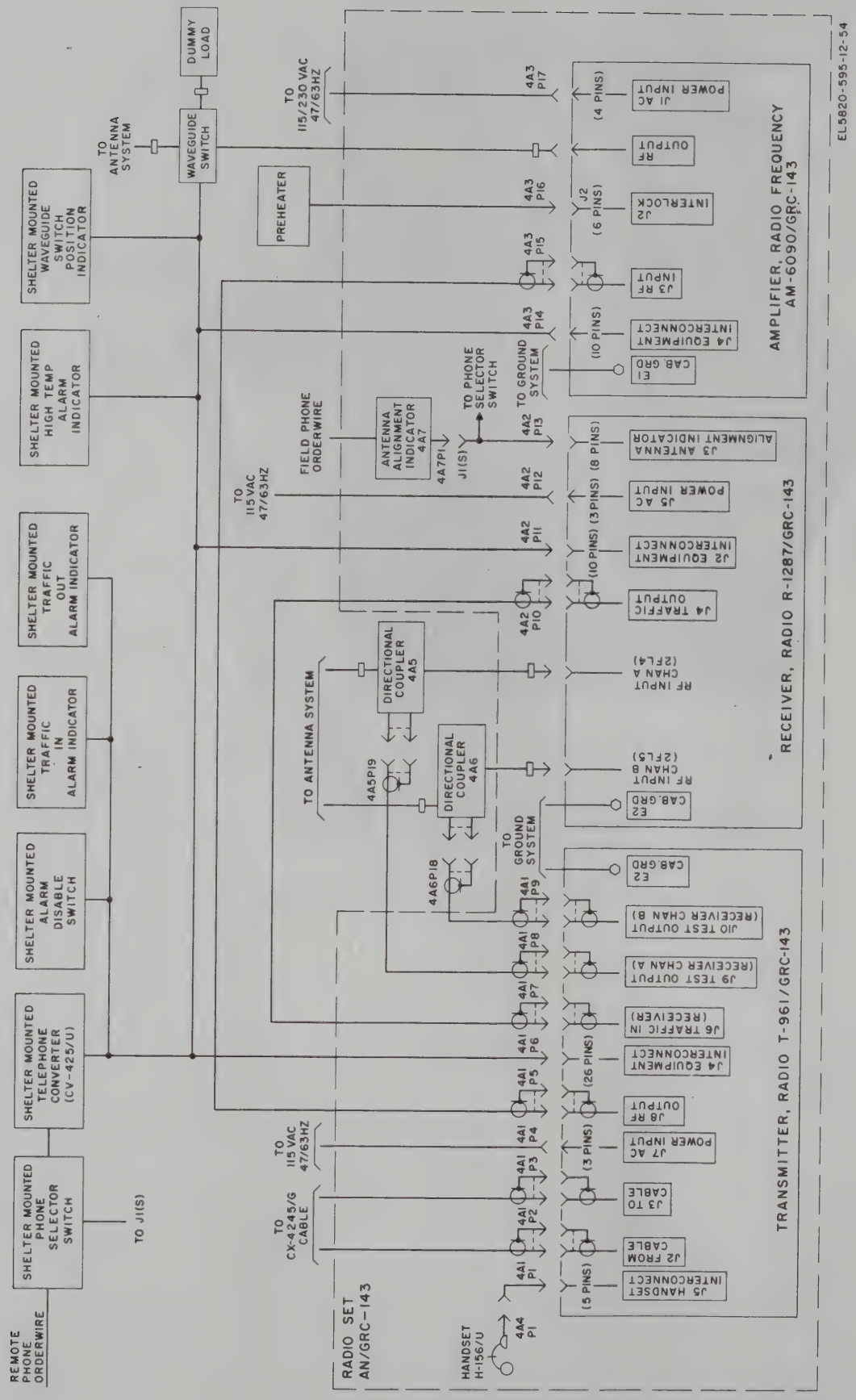


Figure 2–19. Radio set interconnection cabling.

Section II. INITIAL ADJUSTMENTS OF EQUIPMENT

CAUTION

All interconnection cables must be connected before application of primary ac power to the radio set. DO NOT connect or disconnect power, control cables, or modules while primary ac power is applied to the radio set.

NOTE

Except for paragraph 2-14*g*, the initial adjustments contained in paragraph 2-14 must be performed by organizational, or higher, maintenance personnel. The adjustmens must be performed when the equipment shelter containing the AN/GRC-143 is initially delivered to the field or is subsequently relocated.

2-14. Extent of Initial Adjustments

Before the radio set can be used for routine operation as described in chapter 3, the procedures listed in *a* through *k* below must be performed.

a. Determine 12 or 24 channel mode selection (para 2-15) and frequency selection (para 3-10).

b. Preliminary starting procedure (para 3-11).

c. Starting procedure (para 3-12.)

d. Cable length adjustment (para 2-16).

e. Transmitter orderwire level adjustment (para 5-35).

f. Transmitter traffic level adjustment (para 4-16).

NOTE

Step *g* must be performed by direct support (or higher) maintenance personnel.

g. Calibration of Transmitter Radio Test Set (TM 11-5820-595-35).

h. Initial receiver traffic level adjustment (para 2-18).

i. Radio set loop back test (para 5-28).

j. Power amplifier tuning procedure (para 3-13).

k. Establishing initial communications (para 2-17).

2-15. 12 or 24-Channel Mode Selection

The radio set is shipped with the 12-channel mode modules installed. When 24-channel pcm operation is required, interchange the 12-and 24-channel mode modules listed in the chart below. Refer to paragraphs 5-30 and 5-31 for module replacement instructions. For single stack radio sets, the 24-channel mode module drawer No. 6A (fig. 1-18). For double stack radio sets, the 24-channel mode modules are stored in mode module drawer No. 6B (fig. 1-18). The mode modules not being used can be stored in the appropraite mode module drawer (No. 6A or No. 6B).

Mode module identification	12-channel mode	24-channel mode
Fig. No.	Module	Module
2-10	12-channel pcm attenuator 1A3	24-channel pcm attenuator 1A18
2-11	750 kHz IF filter 2A5	1.5 MHz IF filter 2A25
2-11	750 kHz IF filter 2A10	1.5MHz IF filter 2A26
2-11	260 kHz low pass filter 2A18	680 kHz low pass filter 2A7

2-16. Cable Length Adjustments

During initial installation of the radio set in the field, or after the radio set has been relocated in the field, the digital data modem cable length adjustments must be made to equalize for the length of PCM Cable CX-4245/G used between Multiplexer TD-240/U and the radio set. If distance between the Multiplexer TD-204/U and the radio set is more than 1-mile away but not greater than 2-miles, a Pulse Form Restorer TD-206/G must be inserted between the radio set and Multiplexer TD-204/U and the digital data modem cable length adjustment must be made to equalize for the length of PCM Cable CX-4245/G between the radio set and Pulse Form Restorer TD-206/G. To equalize for the length of PCM Cable CX-4245/G being used between the radio set and Multiplexer TD-204/U or pulse Form Restorer TD-206/G; perform steps *a* through *n* below.

a. Determine whether a Pulse Form Restorer TD-206/G is used between the radio set and Multiplexer TD-204/U. Consult your communications officer for this information.

b. If a Pulse Form Restorer TD-206/G is not being used proceed to step *e* below.

c. Notify the TD-204/U multiplex operator, via order wire (para 3-17), that he must equalize for the length of PCM Cable CX-4245/G between his site and Pulse Form Restorer TD-206/G.

d. Determine the actal length of PCM Cable CX-4245/G between the radio set and Pulse Form Restorer TD-206/G and proceed to step *g* below.

e. Notify the TD-204/U multiplex operator, via order wire (para 3-17), to set his cable equalization network for one mile of PCM Cable CX-4245/G.

f. Determine the actual length of PCM Cable CX-4245/G between the radio set and Multiplexer TD-204/U and proceed to step *g* below.

g. Round off the cable length determined in step *d* or *f* above to the nearest 1/4-mile interval. That is 1/4 mile, 1/2 mile, 3/4 mile, or 1 mile. Record the cable length.

h. Loosen the three captive screws (fig. 1-7) securing the hinged cover of digital data modem 1A12 in place and lower the hinged cover.

i. Using the card extractor as shown in figure 5-6, remove plug-in card assemblies 1A12A2 and 1A12A13 (fig. 1-7) from the digital data modem.

j. Observe the position of jumper plug P2 (fig. 2-20) on plug-in card assemblies 1A12A2 and 1A12A13. If the position of jumper plug P2 does not correspond to the cable length recorded in step *g* above, carefully remove the jumper plug from each plug-in card assembly and reconnect it to the cable length position determined in *g* above.

k. One at a time, insert plug-in card assemblies 1A12A2 and 1A12A13 into their correct card position in digital data modem 1A12 being sure that the plug-in card assemblies are inserted into their upper and lower card guide rails. Check that plug-in card assemblies 1A12A2 and 1A12A13 are firmly seated in their card positions.

l. Observe that the CABLE LG (MILES) indicator lamp (fig. 2-13) corresponding to the cable length determined in step *g* above is lighted. If the incorrect CABLE LG (MILES) indicator lamp is lighted, then the incorrect cable length was determined in step *g* above, or jumper plug P2 was incorrectly positioned on either or both of the plug-in card assemblies (1A12A2 or 1A12A13).

m. If none of the CABLE LG (MILES) indicator lamps are lighted, corrective measures (para 5-24) are required.

n. Close the hinged cover of digital data modem 1A12 (fig. 2-13) and finger tighten the three captive screws which hold the hinged cover in place.

2-17. Establishing Initial Communications

WARNING
ELECTROMAGNETIC
RADIATION
ELECTROMAGNETIC RADIATION HAZARDS EXIST AT THE POWER AMPLIFIER WAVEGUIDE OUTPUT AND WITHIN THE DIRECTIONAL PATH OF THE ANTENNA! DO NOT PLACE THE SHELTER MOUNTED WAVEGUIDE SWITCH IN THE ANTENNA POSITION UNTIL YOU ARE SURE THAT THE ANTENNA IS CORRECTLY POSITIONED AND THAT ITS RADIATION PATH IS CLEAR.

After the radio set has been started (para 3-12) and the power amplifier tuned (para 3-13), communications must be established with the distant radio set. Initially the antennas at both radio sites must be roughly aligned in azimuth and elevation to make the troposheric hop between the two radio sites. Then the power amplifier's output must be switched (using the shelter mounted waveguide switch) from the dummy load position to the antenna position. Next, the antenna alignment indicator (4A7) should be used to optimize antenna orientation (para 3-18). After antenna alignment is completed, each radio set operator must notify his cable site operator (Multiplexer TD-204/U operator), via order wire (para 3-17), that he is ready to begin handling traffic.

2-18. Initial Receiver Traffic Level Adjustment

The initial receiver traffic level adjustment must be performed during the initial installation of the radio set in the field or whenever the radio set is relocated, thus maintaining the traffic level output of the receiver at the required traffic level. Perform steps *a* through *g* below to set the receiver traffic level.

a. Record the transmitter and receiver operating frequencies.

b. Use the radio test set (para 5-25) to loop the radio test set's output back to the receiver.

c. On the transmitter (fig. 3-3), set the RCVR CHAN A and RCVR CHAN B switches to T.

d. On the receiver (fig. 3-6), set the receiver meter selector switch to TRAFFIC.

e. While observing the receiver meter (fig. 3-6), set the TRAFFIC LEVEL ADJ control (fig 3-9) on AF-RF amplifier 2A19 for a receiver meter indication of 100. If a receiver meter indication of 100 ± 10 cannot be obtained, refer to the receiver troubleshooting chart (para 5-24*b*) for checks and corrective measures.

f. On the transmitter (fig. 3-3), set the ON-OFF switch on 100-MHz RF oscillator 1A2 to OFF.

g. Return the transmitter and receiver control settings to the settings recorded in *a* above.

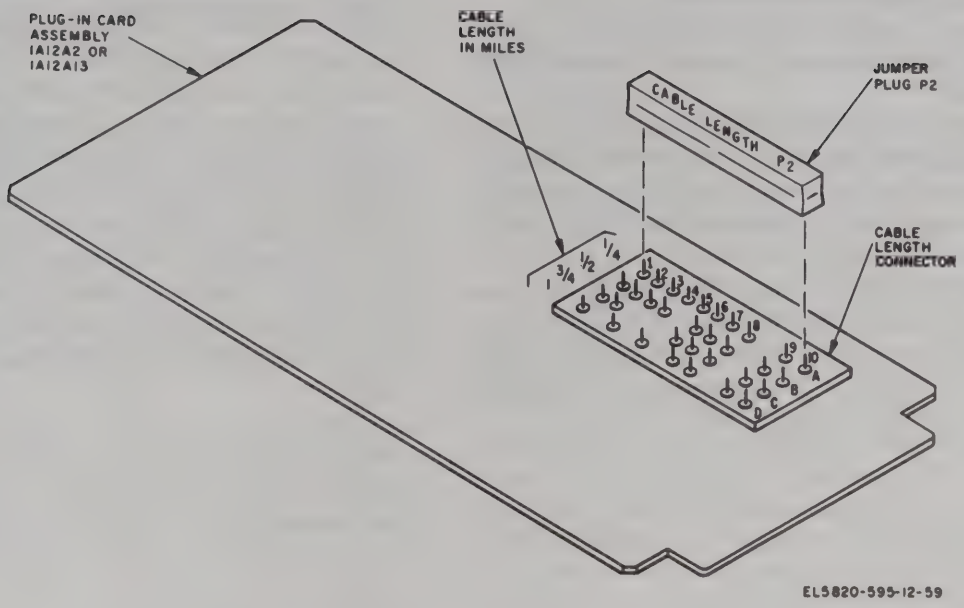


Figure 2-20. Cable length adjustment.

2-19. Radio Test Set Initial Adjustment. Deleted.

Section III. COMMUNICATIONS PLANNING AND ANTENNA SITING

2-20. General

a. Scope. The information in this section covers communications planning and antenna siting procedures for Antenna Group AN/TRA-37 as used with Radio Set AN/GRC-143 for the purpose of planning and siting a tropospheric scatter radio system. In the carrier frequency range of the AN/GRC-143, tropospheric scatter system permits communication between sites when a direct line-of-sight path between antennas is obstructed by hilly or mountainous terrain or by the curvature of the earth.

b. Basic Principles of Tropospheric Scatter Propagation. The radio site transmitting antenna radiates a narrow beam of microwave energy directed toward the horizon, through the troposphere. The troposphere is that portion of the earth to heights of about 11 kilometers (approximately 6.8 miles). The narrow viewing angle, antenna beamwidth, of the receiving antenna is also directed toward the horizon. Communication is effected by means of the common scatter volume in the troposphere as seen by both antennas. This volume is formed by the intersecting transmit and receive antenna beam paths. The transmit antenna transmits energy into this common volume and the receiving antenna derives energy from it. Further information is contained in TM 11-666 and TM 11-673.

2-21. Requirements for Communications Planning and Antenna Siting Procedures

Complete planning and antenna siting procedures includes coverge of the following subjects in the order listed.

a. Site considerations (para 2-22).
b. Performance prediction (para 2-23).
c. Antenna placement and assembly (para 2-35).
d. Antenna orientation (para 2-36).

2-22. Antenna Site Considerations

a. Distance Between Sites. A typical distance between sites is 100 miles. The accuracy of performance predictions for distances over 100 miles decreases with increased distances.

b. Accessibility. The proposed site must be accessible from the air or road so that the equipment can be moved in and out with minimum difficulty. Accessibility of fuel, water, and food must be considered and

coordinated with support organizations. Topographical maps and field surveys will aid in determining if the area is accessible.

c. Terrain.

(1) Avoid locations near powerlines or electrical noise sources.

(2) Antenna elevation angles (para 2-27) depend on the height of obstructions that must be cleared by the antenna beam path and will be less than 2 degrees. The smaller the antenna elevation angle, the more preferable the condition.

(3) Avoid a location that will result in vegetation in the beam path of the antenna (para 2-31).

(4) Locate the antenna on hardpacked or rocky ground. The ground must be suitable for accepting the emplacement of ground anchors.

2-23. Performance Prediction

Prior to movement and placement of the equipment, a performance prediction of the proposed siting should be made. The performance prediction in this text accounts for all losses and gains normally associated with a troposcatter system. A performance prediction requires that the following steps be taken in the order listed:

a. Determine the K factor (para 2-24).

b. Select the topographical maps (para 2-25).

c. Plot the profile chart (para 2-26).

d. Determine the antenna elevation angles (para 2-27).

e. Determine the scatter angle (effective angular distance) ⊖ (para 2-28).

f. Determine the performance margin (para 2-29).

2-24. K Factor

a. General. The factor K expresses the bending of transmitted waves in the toposphere due to surface refractivity. By definition, K is a ratio of the effective radius of the earth with respect to the actual radius of the earth. The effective radius of the earth is a function of the surface refractivity at a specific geographic location. Surface refractivity depends on the terrain and also varies with the time of the year.

b. K Factor Selection. Select a K factor that most closely relates to the description of the terrain given. If justified, it may be a value in between those listed; *for example:* 1.1 if the terrain were approximately 25% smooth land and 75% water.

	Worst medium	*Annual medium*
(1) Over sea	K=1.20	1.90
(2) One sea, one land horizon	K=1.10	1.80
(3) Over land	K=0.95	1.33
(4) High altitude (scatter volume 400m) path	K=0.60	1.00
(5) Over land path 55 latitude	K=0.75	1.33
(6) Over sea path 55 latitude	K=1.90	1.20

c. Example of K Factor Selection. As an example, even though some of the elevations in figure 2-21 extend upward of 750 feet, this terrain would be evaluated as "over smooth land" and a K factor of 1.33 would be selected.

2-25. Selection of Topographical Maps

a. Topographical maps are required to determine the types of information listed below. Pertinent information concerning map reading is covered in FM 21-26.

(1) Establish geographic locations of sites.

(2) Determine distances between sites and between sites and terrain elevations.

(3) Determine terrain elevations that may possibly be antenna beam path obstacles.

(4) Determine elevation of antenna sites.

(5) Convert magnetic azimuth of beam paths of antennas with respect to true north or grid north azimuths.

b. Site locations and distance between sites can be determined on a 1:250,000 scale map. The other information should be taken from 1:50,000 scale maps, if such maps are available.

c. During the siting process, it may be necessary to convert distances from one unit of measurement to another unit. For instance, all graphs used in this section for predicting path performance use statute miles for distances and feet for heights, while many topographical maps use kilometers and meters respectively. The following chart aids in the conversion process. To use the chart, first locate the unit of measurement needed to the left *To obtain* column, follow the line horizontally to the vertical column headed by the unit of measurement to be converted. Multiply the unit to be converted by the figure in the square common to both units. *For example:* convert 100 kilometers to statute miles. Locate statute miles in the *To obtain* column. Follow the horizontal line to the right until the *Kilometers by* column is located. Multiply 100 kilometers by 0.6214. The answer is 62.14 statute miles.

To obtain	Multiply number of: Feet by	Yards by	Meters by	Kilometers by	Statute miles by	Nautical miles by
Feet	1	3	3.281	3,281	5,280	6,080.27
Yards	0.3333	1	1.094	1,094	1,760	2,027
Meters	0.3048	0.9144	1	1,000	1,609	1,853
Kilometers	3.048×10^{-4}	9.144×10^{-4}	0.001	1	1.609	1.853
Statute miles	1.894×10^{-4}	5.682×10^{-4}	6.214×10^{-4}	0.6214	1	1.1516
Nautical miles	1.645×10^{-4}	4.934×10^{-4}	5.396×10^{-4}	0.5396	0.8684	1

2-26. Plot Profile Chart

a. General. The main purpose of a profile chart is to identify the true obstacles of the beam paths of the antennas. The true obstacles determine the elevation angles of the antennas. In figure 2-21, the beam paths of the antennas are those lines that intersect to form the scatter angle (effective angular distance)⊖. The true obstacles, for the conditions expressed in figure 2-21, are those points identified by h_{ot} and h_{or}. Use the profile chart with K factor closest to the K factor selected in paragraph 2-24. Although, antenna elevation angles are shown as positive angles with respect to the earth tangent (fig. 2-21), the angles can be negative with respect to earth tangent as shown in figure 2-22. A negative angle occurs when a site, due to the height of its location, requires that the antenna beam path be directed to a level below the earth tangent. Earth tangent is a line that is perpendicular to a plumbline at the site location.

b. Procedure.

(1) On a topographical map (para 2-25), locate the proposed antenna sites and connect the two site points with a straight line as shown in figure 2-23. Determine the distance in miles between the sites. Identify one site as A and the other as B.

(2) On the profile chart, insert the applicable set of distance values into the DISTANCE IN MILES blocks and ELEVATION IN FEET blocks.

(3) On the topographical map, determine and mark the midpoint between the two sites. On the profile chart, identify and mark the midpoint of the DISTANCE IN MILES scale.

(4) Measure the distance in miles between the midpoint and site A on the topographical map. On the profile chart DISTANCE IN MILES scale, measure off the same distance from the midpoint and identify that point as site A. Repeat the same procedure for site B.

(5) On the topographical map, determine the elevation in feet of site A by use of the contour line values. Add 15 feet to this value (antenna height) and plot that point on the profile chart ELEVATION IN FEET scale over the location of site A. Repeat the same procedure for site B.

(6) On the topographical map, starting at site A or B, determine the next elevation change (feet) by use of the contour lines that intersect the straight line between site A and B. Determine the distance (miles) between the elevation and site A or B. Plot the same point with respect to elevation and distance on profile chart. Do the same with all high and low points on the topographical map. Connect all points on the profile chart to form a curve (fig. 2-21).

(7) On the profile chart, draw a straight line from the point of a site A toward the center of the paper so that the line is tangent to the highest obstacle without intersecting any other obstacle.

(8) As identified in figure 2-21, at site A, determine the values of h_t and h_{ot} in feet and D_t in miles. At site B, determine the values of h_r, h_{or}, and D_r. Also note that D equals miles between sites A and B.

2-27. Determination of Antenna Elevation Angles

Using the values determined in paragraph 2-26*b (8)*, compute antenna evaluation angles as follows. K is the value selected in paragraph 2-24.

a. Angle ψ r (fig. 2-21).

(1) Substitute the known values in the following equation to determine the numerical value of $\frac{H_r}{K}$.

$$\frac{h_{or} - h_r}{K} = \frac{H_r}{K}$$

(2) Divide D_r by K to determine the numerical value of $\frac{D_r}{K}$.

(3) Using the chart (fig. 2-24(1) or (2)), determine the angle at which the horizontal value of $\frac{D_r}{K}$ intersects the vertical value of $\frac{H_r}{K}$

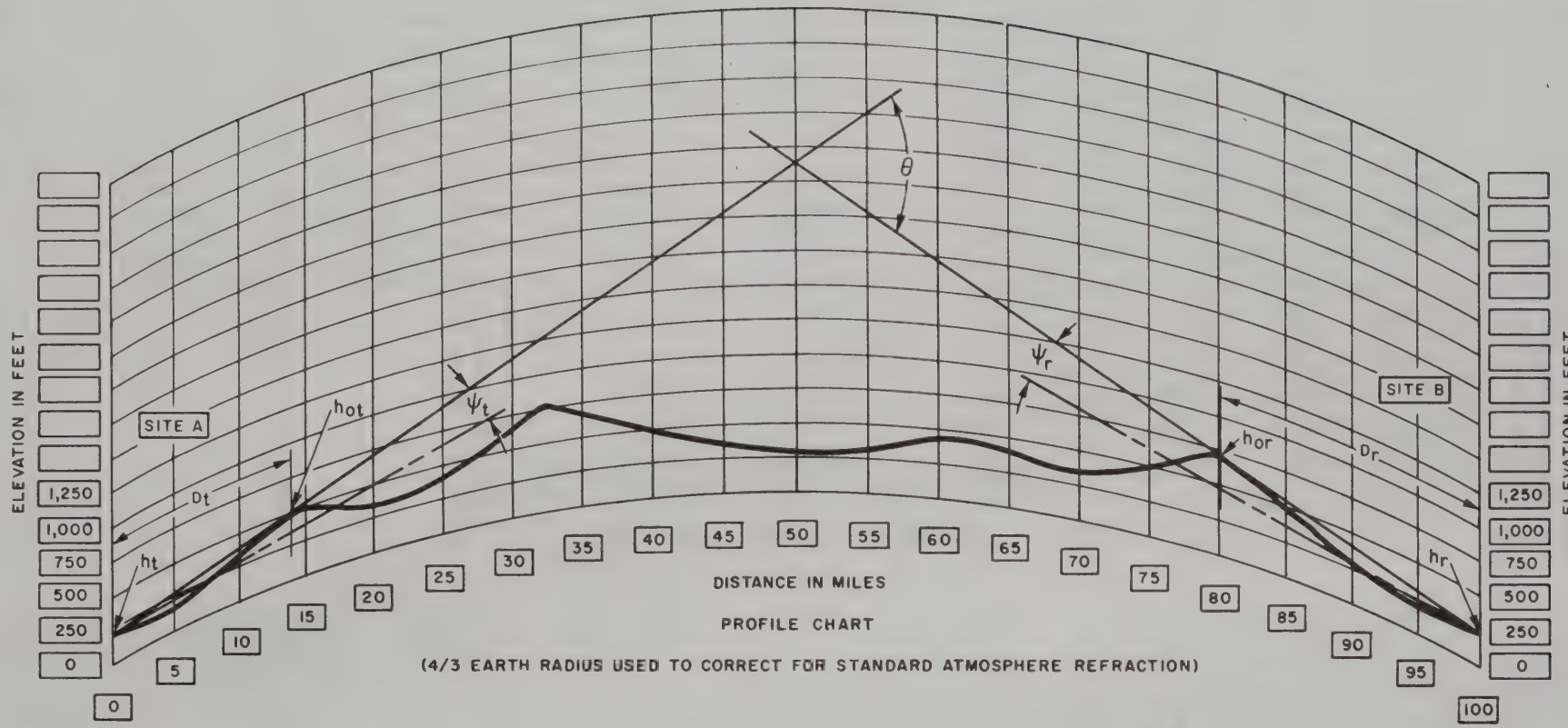
This angle is ψ r in degrees.

b. Angle ψ t (fig. 2-21).

(1) Substitute known values in the following equation to determine the numerical vaue $\frac{H_t}{K}$.

$$\frac{h_{ot} - h_t}{K} = \frac{H_t}{K}$$

(2) Divide D_t by K to determine the numerical value of $\frac{D_t}{K}$.



SITE A

h_t = ELEVATION OF TRANSMIT ANTENNA IN FEET (INCLUDES HEIGHT OF ANTENNA DISH CENTER)

h_{ot} = ELEVATION OF OBSTACLE IN FEET

D_t = DISTANCE FROM TRANSMIT ANTENNA TO OBSTACLE IN MILES

ψ_t = ELEVATION ANGLE OF TRANSMIT ANTENNA RELATIVE TO SITE EARTH TANGENT

$H_t = h_{ot} - h_t$

SITE B

h_r = ELEVATION OF RECEIVE ANTENNA IN FEET (INCLUDES HEIGHT OF ANTENNA DISH CENTER)

h_{or} = ELEVATION OF OBSTACLE IN FEET

D_r = DISTANCE FROM TRANSMIT ANTENNA TO OBSTACLE IN MILES

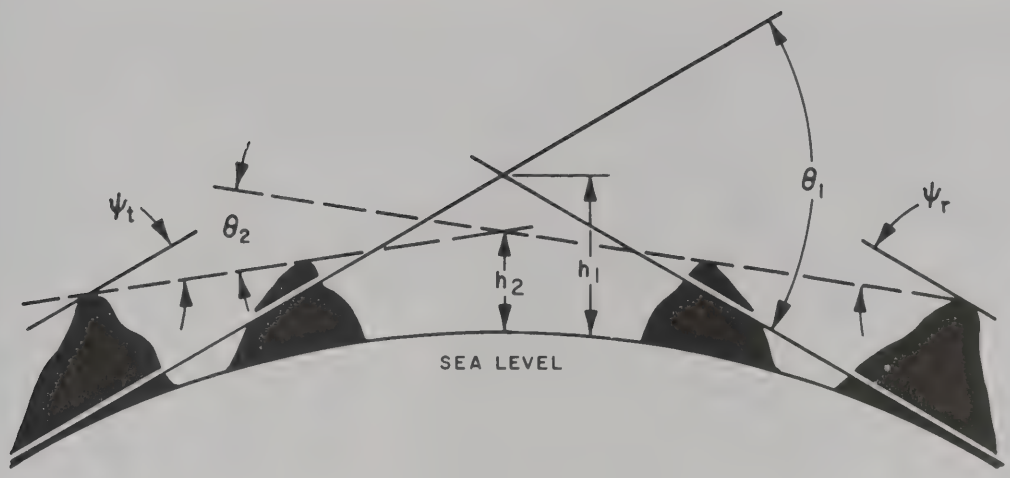
ψr = ELEVATION ANGLE OF RECEIVE ANTENNA RELATIVE TO SITE EARTH TANGENT

$H_r = h_{or} - h_r$

θ = EFFECTIVE ANGULAR DISTANCE

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Figure 2–21. Typical tropospheric scatter circuit profile.



ψ_t = ELEVATION ANGLE AT TRANSMIT SITE (NOTE)

ψ_r = ELEVATION ANGLE AT RECEIVE SITE (NOTE)

θ_1 = SCATTER ANGLE WITH SMOOTH EARTH

θ_2 = SCATTER ANGLE WITH RAISED SITE ELEVATIONS

h_1 = HEIGHT OF SCATTER VOLUME WITH SMOOTH EARTH

h_2 = HEIGHT OF SCATTER VOLUME WITH NEGATIVE ELEVATION ANGLES

NOTE:
NEGATIVE ELEVATION ANGLES RELATIVE TO SITE EARTH TANGENT.

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Figure 2–22. Negative antenna elevation angles.

(3) Using the chart (fig. 2–24(1) or (2)), determine the angle at which the horizontal value of D_t intersects the vertical value of H_t.

$\frac{}{K}$ $\frac{}{K}$

This angle is ψ t in degrees.

2–28. Determination of Scatter Angle (Effective Angular Distance)

Scatter angle (effective angular distance) θ represents the angle of intersection of the antenna beam paths (fig. 2–21) as influenced by the terrain, distance, and surface refractivity. The value of θ in figure 2–21 is not one that can be measured with a protractor.

a. Determine a numerical value for D. D equals

$\frac{}{K}$

mileage distance between sites A and B, and K equals the value selected in paragraph 2–24.

b. Using the chart (fig. 2–25), select the horizontal value of the distance angle D at a point

$\frac{}{a}$

where D (*a* above) intersects the diagonal line

$\frac{}{K}$

on the chart.

c. Using the angles ψ t and ψ r (para 2–27) and the distance angle D (*b* above), Solve for

$\frac{}{a}$

the value of the scatter angle (effective angular distance) θ in the equation below.

$$\theta \text{ (degrees)} = \frac{D}{a} + \psi r + \psi t$$

If ψ t or ψ r is a negative angle, the sign preceding it in the equation will become negative (subtract instead of add).

2–29. Determination of Performance Margin

a. General. Performance margin for a particular communication path is measured in terms of available carrier-to-noise ratio (CNR) level in db relative to a minimum acceptable CNR level. The minimum acceptable CNR level is predetermined and is based on the performance characteristics

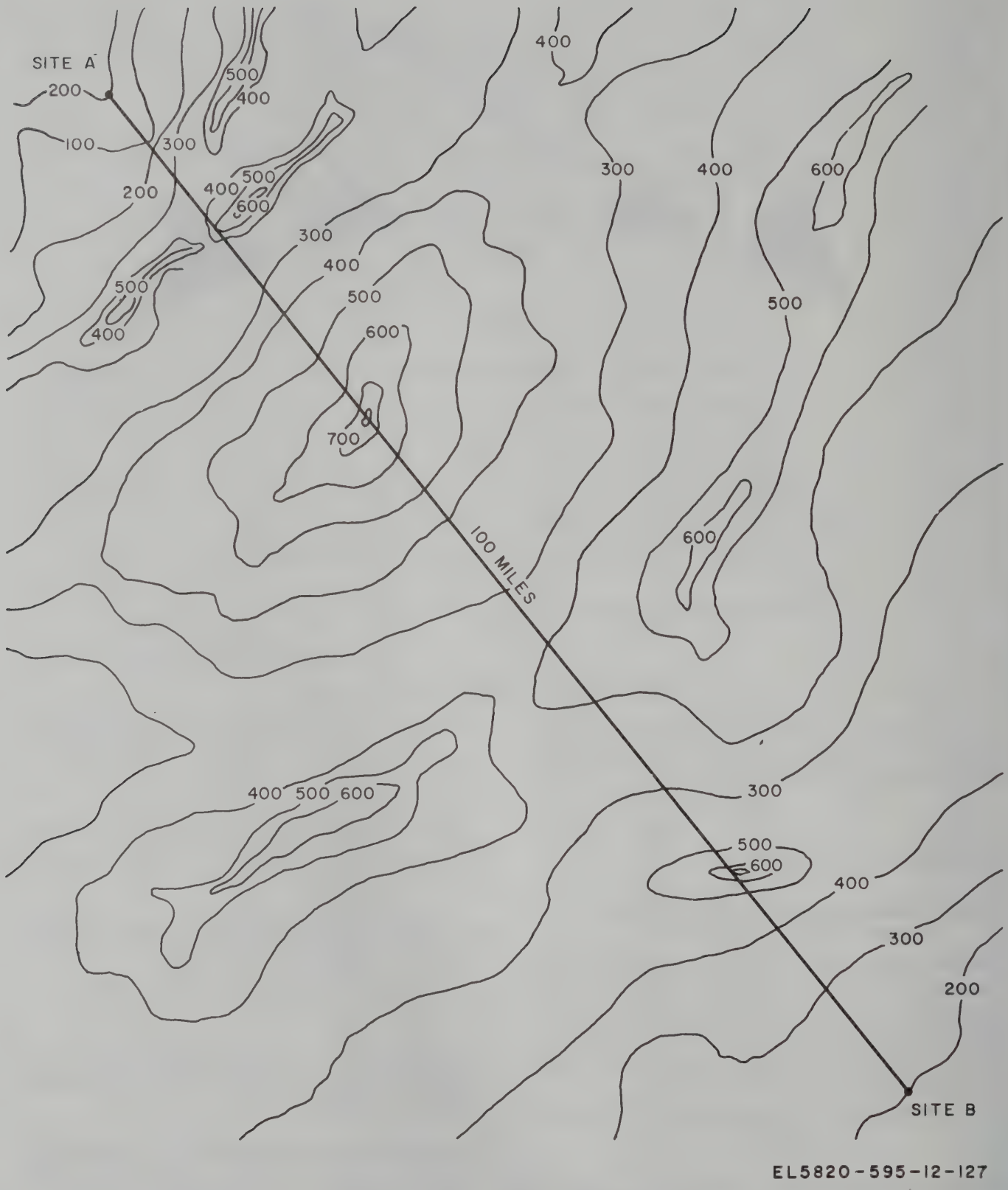
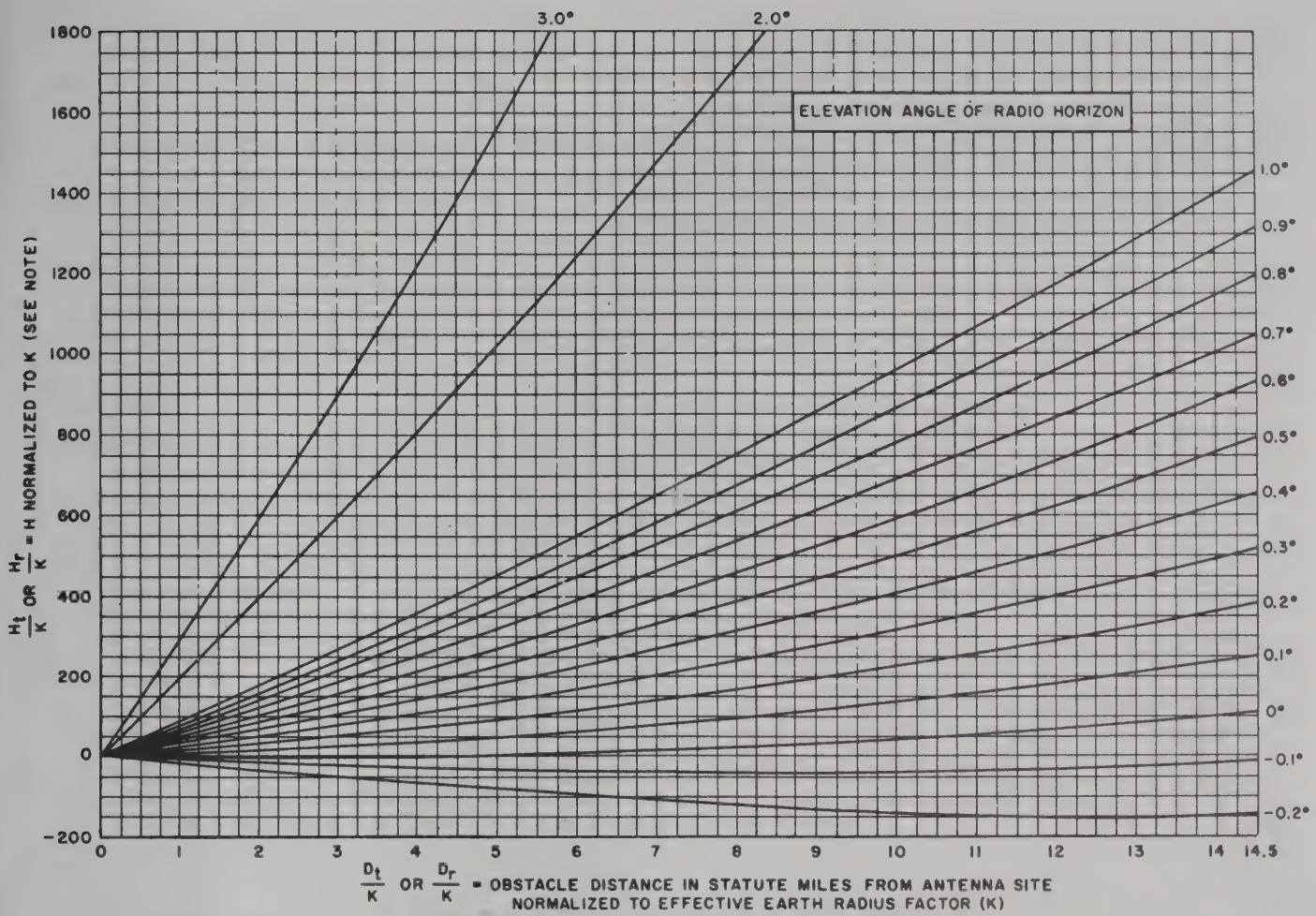


Figure 2-23. Part of typical topographical map.

of the radio equipment. Minimum requirements for the various types of information that is converted for transmission, as shown in the left-hand columns of figure 2-26 chart, is designated as zero (0). Zero or positive values (above zero) indicate acceptable standards. Negative values (below zero) indicate unacceptable standards.



DEGREES	MILLIRADIANS
.1	1.75
.2	3.5
.3	5.25
.4	7.0
.5	8.75
.6	10.5
.7	12.25
.8	14.0
.9	15.75
1.0	17.5

NOTE:
H_t OR H_r (IN FEET) = (ELEVATION OF POINT AT DISTANCE D_t OR D_r) − (ELEVATION AT ANTENNA SITE).

EL5820-595-12-110 (1)

Figure 2-24 (1). Horizon angle determination curves (part 1 of 2).

b. Procedure for Performance Margin Calculation. Locate the value of scatter angle (effective angular distance) θ (para 2-28) on the lower horizontal scale of figure 2-26. Determine where the θ value intersects with one of the D curves that represents the distance between sites A and B. The intersection could be at a point, if applicable, between two of the curves shown. The performance margin in db is read directly from the left-hand columns of figure 2-26 that corresponds to the intersection of θ value and the distance curve.

c. Interpretation of Performance Margin Calculation.

(1) *Example.* Assume that an effective angular distance of 1.0 degrees (para 2-28) has been predicted for a specific scatter path between sites A and B that are 100 miles distant. Applying this information to figure 2-26, the following is determined:

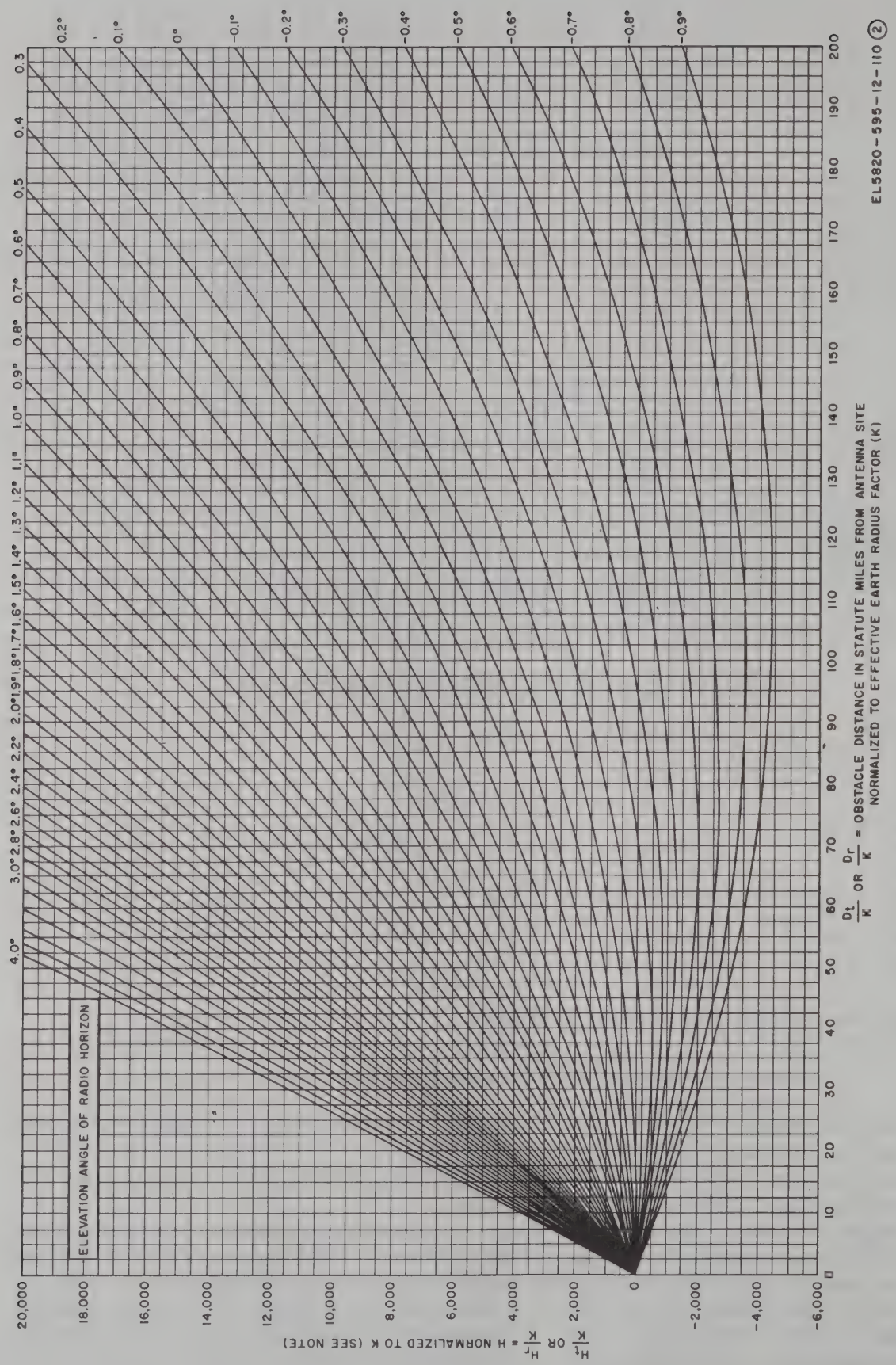


Figure 2-24 (2). Horizon angle determination curves (part 2 of 2).

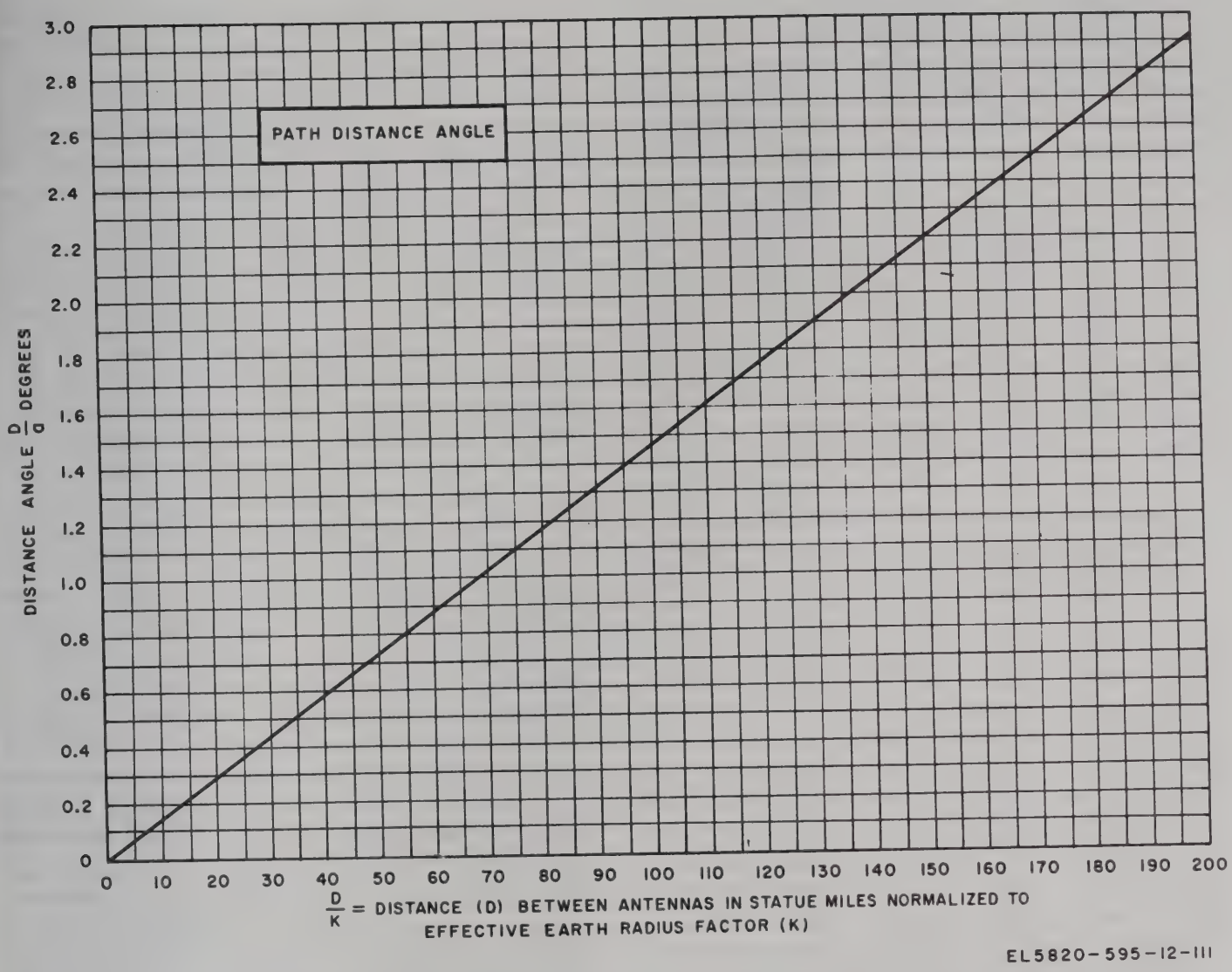


Figure 2–25. Distance angle as a function of normalized distance $\frac{D}{K}$.

Converted transmission information
Data (1 x 10^{-5} error rate)
24 channels ----------–1.3 db
12 channels ----------+1.7 db
Voice, tty, fasimilie (1 x 10^{-4} error rate)
24 channels ----------+13.7 db
12 channels ----------+16.7 db

(2) *Comments.*

(*a*) The scatter path cannot provide minimum acceptable performance (para 2–30*b*) for 24 channels of data information.

(*b*) The scatter path can provide minimum acceptable performance for 12 channels of data and 24 and 12 channels of voice, tyletypewriter or facsimilie information.

(*c*) Other considerations required.

1. Effect of field vegetation (para 2–31).

2. Effect of rainfall (para 2–32).

3. Effect of transmitted power reduction (para 2–33).

4. Alternatives for negative performance margin (para 2–34).

2–30. Minimum Performance Standards

a. Criteria for Performance Standards. In a pcm system, the acceptance criteria is based on an error rate and propagation reliability of the received transmitter signal.

(1) *Error rate.* Error rate indicates the quantity of bits of the transmitted signal that will appear at the receiving terminal as error bits. If the error rate is 1×10^{-5}, it indicates that not more than one bit out of every 100,000 transmitted will be in error when received. For an error rate of 1×10^{-2}, not more than one bit out of every 100 transmitted will be in error when received. Error rate increases with increasing

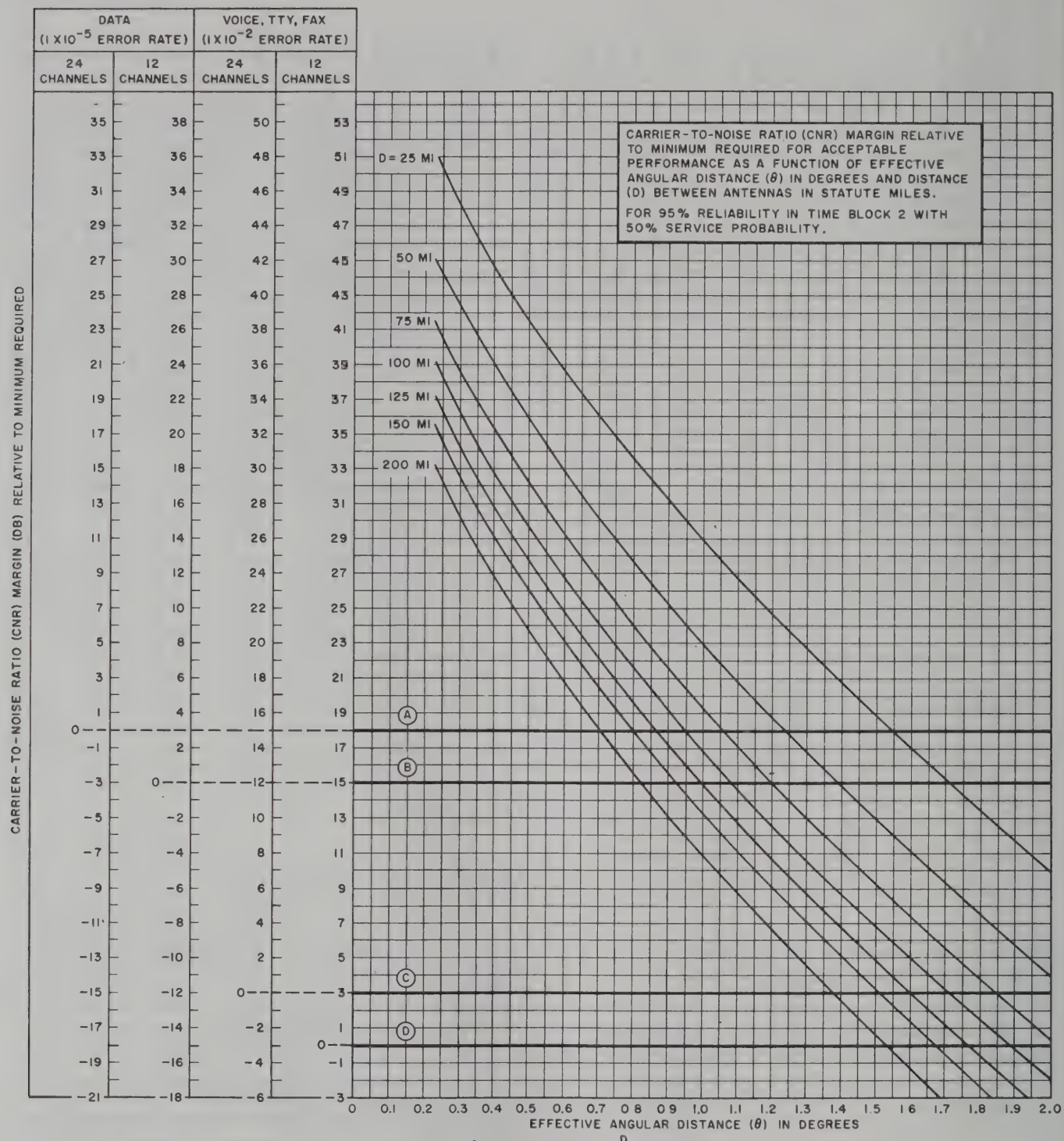


Figure 2–26. Relative CNR as a function of effective angular distance.

path length, increasing number of pcm channels, and increased multipath propagation.

(2) *Propagation reliability.* Propagation reliability concerns two factors: percentage of reliability and percentage of service probability.

(*a*) *Percentage of reliability.* Percentage of reliability indicates that a given error rate is not exceeded for a specified percentage of the year. The chart information, figure 2–26, is based on specific time block 2 as defined by Note 101

of National Bureau of Standards. Time block 2 represents the time period of the year which provides the worst troposcatter propagation conditions. This condition exists during the afternoon hours of the six coldest months of the year. For other periods of the year the performance margin can increase as much as 20 db.

(*b*) *Percentage of service probability.* Percentage of service probability is a confidence factor expressing the probability of achieving the percentage of reliability.

b. Minimum Acceptable Performance Standards. For either the 12- or 24-channel pcm input to Radio Set AN/GRC–143, minimum acceptable performance is determined by the type of information to be transmitted.

(1) *Data.* Minimum acceptable performance standards is established at an error rate of 1×10^{-5}, not to be exceeded for 95 percent of time block 2, as defined by Note 101 of National Bureau of Standards, with a service probability of 50%.

(2) *Voice, teletypewriter, or facsimilie.* Minimum acceptable performance standards is eatablished at an error rate of 1×10^{-2}, not to be exceeded for 95% of time block 2, as defined by Note 101 of National Bureau of Standards, with a service probability of 50%.

c. Effect of Operation with Negative Performance Margin. Assume that a proposed siting results in a predicted performance margin calculation (para 2–29*b*) where the 24-channel CNR margin is –5 db for data or voice, teletypewriter, and facsimilie. Using the chart in figure 2–27, it can be seen that the percentage of reliability is 80% for an error rate of 1×10^{-5} or 1×10^{-2}. The 80% reliability indicates a degraded performance as compared to the established minimum performance standards (*b* above). At a given time, the lower percentage of reliability could be tolerated, depending on the requirements of a situation.

2–31. Effect of Field Vegetation

a. Field vegetation, directly in the path of an antenna beam can cause considerable signal loss. The degree of loss depends on the density and depth of the vegetation, and the proximity of the vegetation to the antenna.

b. Figure 2–28 shows the relationship of expected additional CNR margin loss with respect to the depth of the dense vegetation that exists within the line of the antenna beam path. For the first 100 feet adjacent to the antenna, in the beam path, the beam dimension is considered to be equal to the diameter of the antenna (10 feet), and the loss in db will be as shown on the chart. Although the chart losses are not accurately applicable to distances beyond 100 feet, dense vegetation beyond that distance will cause significant signal loss.

c. As an example, assume that for a predicted path, a group of trees, closely spaced and heavily foliaged, has a depth, with respect to the direction of the antenna beam path, of 75 feet. Also assume that the trees nearest the antenna are at a distance of 15 feet. In accordance with figure 2–28, the 75 feet depth of dense foliage would cause an additional reduction of CNR margin calculated in paragraph 2–29*b* by 10.2 db for this specific case.

d. Considering the extent of signal loss due to dense vegetation, it would be preferable to exclude a loss of that type when selecting antenna sites.

2–32. Effect of Rainfall

Attenuation caused by rainfall is a function of frequency, distance through rain, and rainfall rate. Rainfall rates vary considerably throughout the world and, at a given location, also vary with time. In general, at 95% reliability, the proper K factor for the area accounts for the occasional peak attenuations caused by high rainfall rates. However, if higher levels of tropospheric scatter circuit reliability predictions are desired (greater than minimum requirements for 95% reliability), additional CNR margins must be allowed for rain attenuation. For example, a 100 mile path at 5,000 MHz would require the following additional margins if a 99.9% reliability level were being calculated:

Temperate climate 2.7 db
Tropical climate 9.0 db

That is, rain attenuation over a 100 mile path at 5,000 MHz reaches the values listed above for less than 0.1 percent of the year for the area described.

2–33. Effect of Transmitted Power Reduction

If the performance margin obtained in paragraph 2–29*b* is positive, it may be desirable to reduce the transmitted power (para 3–24) to lower interference with other communications circuits in the area and to prevent overloading the AN/GRC–143 receivers. It is desirable to maintain a dual receiver AGC meter reading no greater than

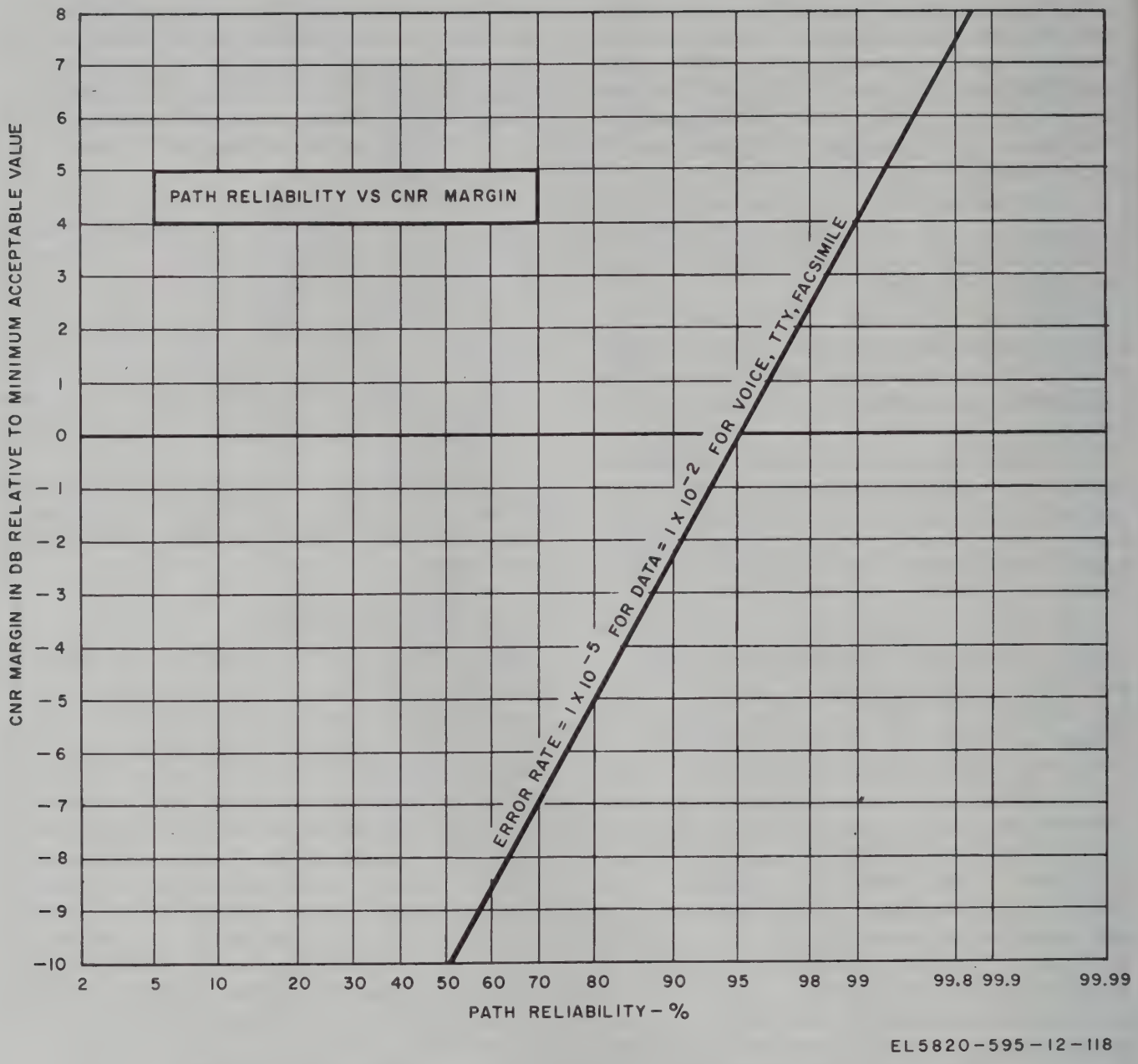


Figure 2–27. Performance margin as a function of path reliability and bit error rate.

120, which corresponds to a CNR of approximately 60 db. However, a reduction of transmitted power to below 500 watts will cause a power amplifier alarm condition, which should be avoided. Transmitted power below 1 kw, however, causes a reduction in performance margin in accordance with figure 2–29. The adjusted performance margin can be calculated as follows:

Performance margin (adjusted) = Performance margin (para 2–29*b*) − Reduction of CNR margin (fig. 2–29).

2–34. Alternatives if Predicted Performance Margin is Negative

When the calculation in paragraph 2–29*b* results in negative performance margin such as the sample value obtained for 24 channel date in paragraph 2–30*c*, then the communication path will provide performance below minimum acceptable standards. For this condition, several alternatives may be taken.

a. Relocation of Terminals. It may be possible to relocate the antenna sites within the same general localities for the purpose of reducing the antenna elevation angles. This would result in a reduced effective angular distance Θ (para 2–28)

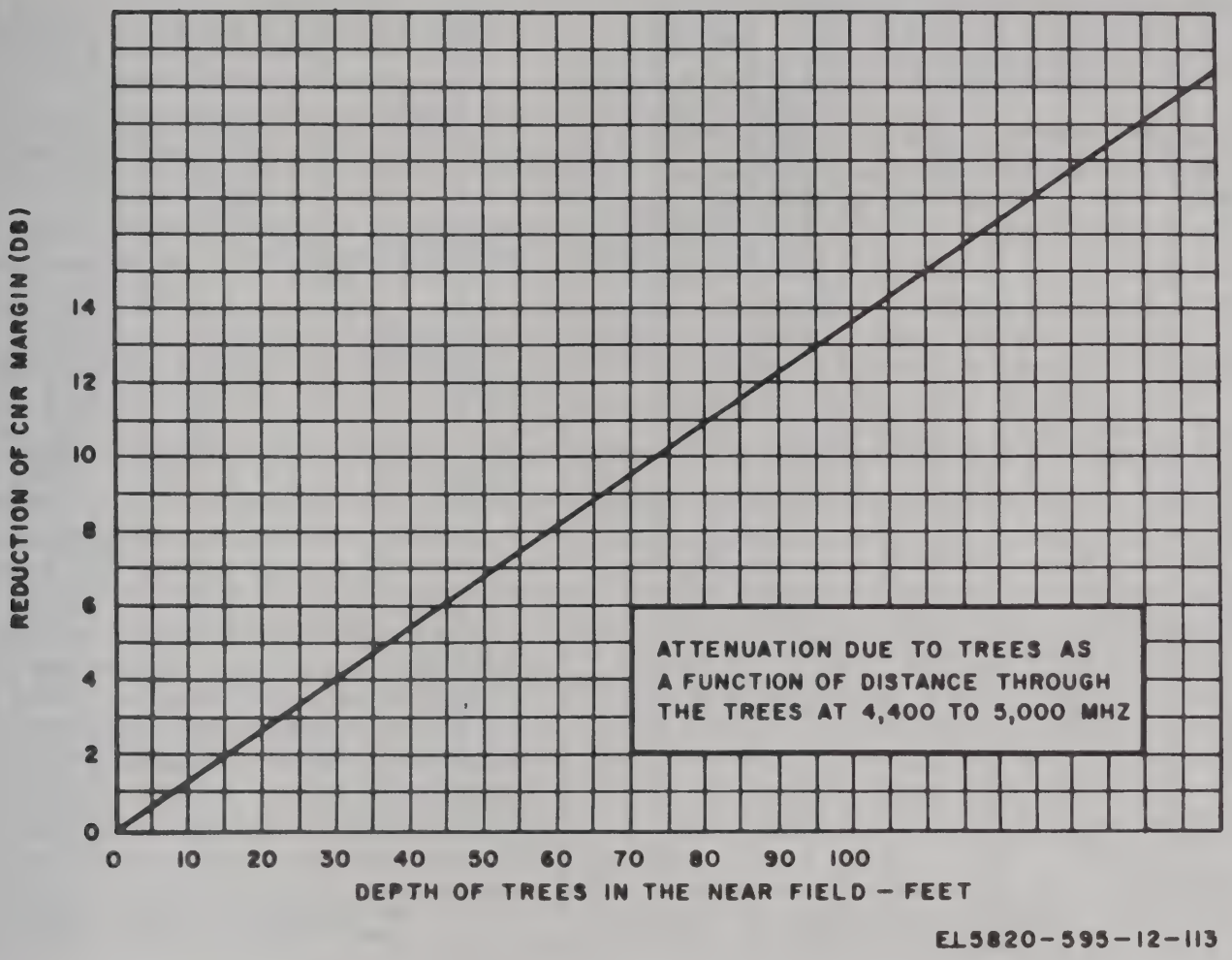


Figure 2-28. Reduction of performance margin as a function of depth of trees.

and in turn increase the CNR margin value (fig. 2-26).

b. Other Types of Propagation.

(1) When horizons are extremely elevated, the mountainous terrain normally associated with these conditions offers a possibility of using obstacle gain of knife edge diffraction paths. A path profile made from the topographical maps should indicate if a common horizon does exist. If such a condition is available, the resultant loss is normally less than an equivalent length troposcatter circuit.

(2) Another possibility is the use of a mountainside as a passive reflector. Visual checks or investigation of topographical maps indicates if reflection is possible.

c. 24- to 12-Channel Operation. If switching from 24- to 12-channel operation can be tolerated, a 3-db CNR margin increase is gained.

d. Operation Below Minimum Acceptable Standards. Operation below minimum acceptable standards can be an alternative if the requirements of a situtation can justify a lesser degree of communication reliability (para 2-30*b*).

2-35. Antenna Placement and Assembly

When the performance prediction has been made and approved, the antenna placement can be made. Antenna placement and assembly procedures for Antenna Group AN/TRA-37 are covered in TM 11-5985-324-15. Antenna placement location should be made in accordance with geographical coordinates and general directions determined in accordance with paragraph 2-26*b*.

2-36. Antenna Orientation

Prior to antenna orientation, it is required that all antenna associated equipment is installed and prepared for operation.

a. Coarse Orientation. Using the procedures in TM 11-5985-324-15, adjust each antenna elevation control to orient the antennas to the elevation angles determined in paragraph 2-27. Using

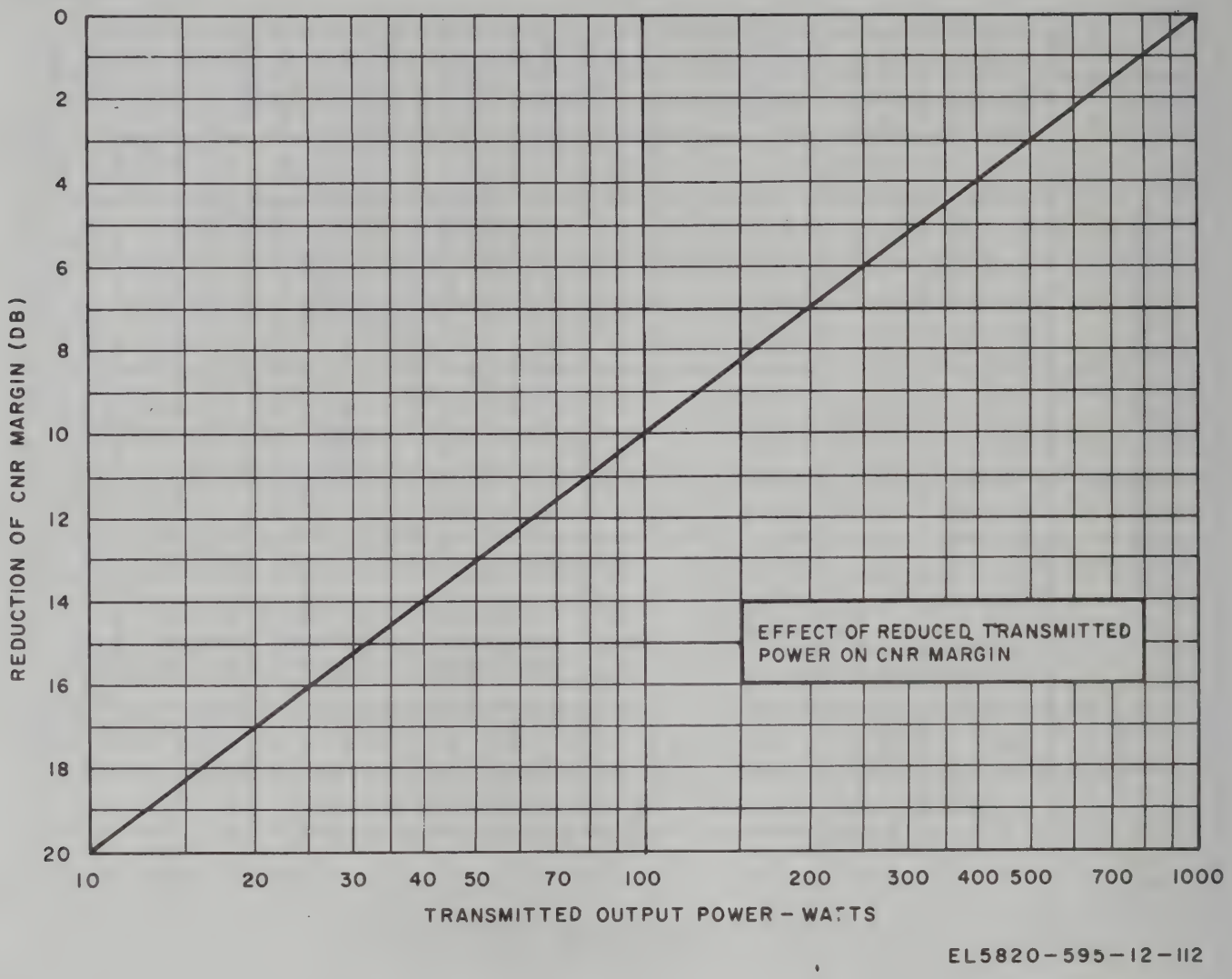


Figure 2-29. Effect of reduced transmitted power on CNR margin.

the topographical maps (para 2-23), determine the desired azimuth bearing of the antenna and adjust each antenna azimuth control to orient the antennas to the required setting. Make certain that the topographical map declination diagram as concerns true north, grid north, and magnetic north, is taken into account when adjusting the antennas for azimuth setting.

b. Fine Orientation. Coarse antenna orientation should position the antennas so that order wire communications (para 3-17) can be established between the radio equipment sites. It is assumed hat operating frequencies have been predetermined (para 3-10).

(1) Apply the starting procedures (para 3-12) and power amplifier tuning procedures (para 3-13).

(2) Perform steps *a* through *h* of paragraph 3-18.

(3) At one equipment site, while observing the CHANNEL A meter on the antenna alignment indicator, slowly adjust the antenna azimuth control in one direction until a maximum meter indication is obtained. If the meter indication decreases or remains at zero, adjust the azimuth control in the opposite direction until a maximum meter indication is obtained.

(4) Slowly adjust the antenna elevation control for a maximum meter indication.

(5) Repeat the azimuth and elevation control adjustments for a maximum average antenna alignment indicator meter indication and record actual meter indication.

NOTE

It is important to maintain voice communication during fine orientation.

(6) Notify the distant site to adjust their antenna azimuth one or two degrees to either side of their original setting.

(7) Repeat step (3) above at the local antenna site for maximum average meter indication and record the actual meter indication.

(8) Notify the distant site to adjust their antenna azimuth one or two degrees to the opposite side of their original setting.

(9) Repeat step (3) above at the local site for maximum average meter indication and record actual meter indication.

(10) Compare the average maximum meter indications recorded in steps (5), (7), and (9) above and determine if there is an increasing or decreasing trend to either side of the original azimuth setting of the distant site. If the trend is decreasing to both sides of their original azimuth setting, then the optimum azimuth adjustment for the distant antenna is near their original setting. If there is an increasing trend to either side of their original azimuth setting, then advise the distant site to continue to adjust their azimuth in discrete one-degree steps in the direction of increasing average maximum meter indication. Adjust the azimuth of the local antenna for maximum meter indication. Repeat this procedure as often as necessary to insure that the antenna at the distant site is properly oriented in azimuth. This also automatically orients the local antenna to the optimum azimuth setting.

(11) Notify the distant site and have them adjust their antenna elevation angle for maximum antenna alignment indicator meter indication at the distant site.

(12) Adjust the elevation of the local antenna for maximum antenna alignment indicator meter indication at the local site. This should provide for near optimum antenna alignment at both distant and local sites. Further minute azimuth and elevation adjustments at both sites should be made to obtain optimum results.

(13) Position the antenna alignment indicator on the second antenna.

(14) Preset the second antenna azimuth and elevation controls at both local and distant sites to the optimum settings of the first antenna at their respective sites. This should provide for near optimum settings of the second antenna.

(15) Observing the antenna alignment indicator CHANNEL B meter indication, optimize the azimuth and elevation settings of the second antenna at both local and distant sites. The maximum average meter indication obtained at both sites for both antennas should be nearly the same. Record the actual meter indications.

(16) Perform steps *i* through *o* of paragraph 3–18.

(17) The site is now ready for initial AN/GRC–143 adjustments (para 2–14).

CHAPTER 3

OPERATING INSTRUCTIONS

Section I. CONTROLS AND INDICATORS

3-1. General

This section describes all radio set front panel controls, indicators, fuses, circuit breakers and test points. Internally located controls and test points are covered in the Direct Support, General Support, and Depot Maintenance Manual, TM 11-5820-595-35.

3-2. Damage From Improper Settings

The following precaution must be observed when setting the power amplifier controls: Do not set the MAIN POWER circuit breaker (fig. 3-11) on the power amplifier circuit breaker panel to OFF until the power amplifier fans and blower have stopped running. The power amplifier fans and blower will stop running 3 to 4 minutes after the MAIN POWER SWITCH (fig. 3-10) on the power amplifier meter panel has been deactivated (MAIN POWER SWITCH lighted white when deactivated).

3-3. Transmitter Controls and Indicators

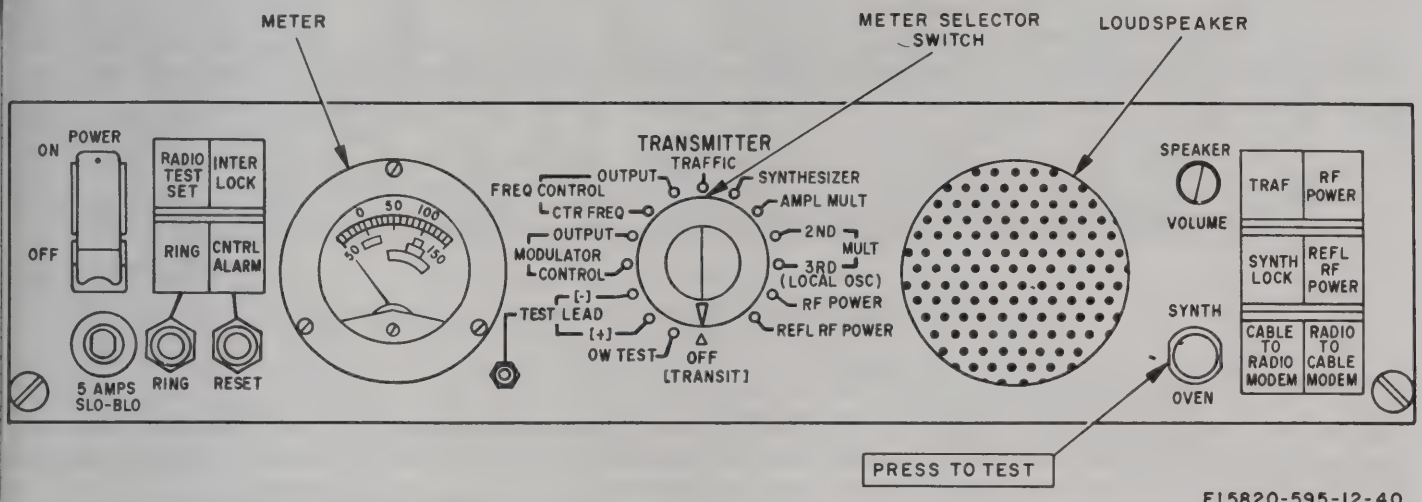
a. Transmitter-Meter Panel (fig. 3-1).

Control, indicator, or test jack	Function
POWER ON-OFF switch (red).	Turns transmitter on and off.
5 AMPS SLO-BLO fuse and neon indicator	Fuse protects primary power circuit. Neon indicator lights when fuse has blown.
RADIO TEST SET indicator	Green light indicates radio test set is off. Red light indicates radio test set is on and supplying a test signal to receiver.
INTERLOCK INDICATOR	Green light indicates shelter mounted waveguide switch is locked into antenna or dummy load position. Red light indicates waveguide switch is between positions.
RING indicator	Green light indicates normal operation; amber light indicates RING pushbutton on the transmitter meter panel has been pressed, or order wire signaling tone is being received.
CNTRL ALARM indicator	Green light indicates normal radio set operation. Red light indicates traffic or equipment failure in the transmitter, digital data modem, receiver, or power amplifier.
RING pushbutton switch (black, momentary)	Orginates 1600 Hz order wire signaling tone.
RESET pushbutton switch (black, momentary open)	When pressed, silences audible alarm.
Meter	Provides indication of function selected by meter selector switch. Contains four color coded bands (black, 80 to 120; blue, -20 to +20; orange, 90 to 110; and yellow 30 to greater than 150 that correspond to color dots on the meter selector switch. Numbers refer to meter indications.
Meter selector switch (black)	Connects meter to any one of 14 metering circuits.

Sw pos.	*Meter band*	*Causes meter to indicate*
OFF (TRANSIT)	None	Zero; shorts meter terminals during transit.

Control, indicator, or test jack	Function		
	Sw pos.	*Meter band*	*Causes meter to indicate*
	OW TEST	Orange	Order wire signal level at attenuator assembly 1A3.
	TEST LEAD(+)	Black	Dc voltage level applied to TEST LEAD jack.
	TEST LEAD (-)	Black	Same as above.
	MODULATOR CONTROL.	Black	Frequency control output level in modulator 1A8.
	MODULATOR OUTPUT	Black	Carrier level of modulator 1A8.
	FREQ CONTROL CTR FREQ.	Blue	Frequency correction input to modulator 1A8.
	FREQ CONTROL OUTPUT.	Black	Limiter level of electronic frequency control 1A7.
	TRAFFIC	Orange	Input signal level applied to modulator 1A8.
	SYNTHESIZER	Yellow	Ouput level of frequency synthesizer 1A14.
	AMPL-MULT	Yellow	Output level of amplifier-frequency multiplier 1A11.
	2ND MULT	Yellow	Output level of 2nd frequency multiplier 1A10A1.
	3RD MULT (LOCAL OSC).	Yellow	Local oscillator level at frequency mixer 1A9.
	RF POWER	Yellow	Transmitter output level.
	REFL RF POWER	None	Reflected RF power level.
TEST LEAD jack (black)	Provides test access to panel meter through meter selector switch. Patches with any black or green test jack.		
Loudpeaker	Monitors order wire traffic, order wire signaling tone, and provides audible alarm tones.		
SPEAKER VOLUME control (black)	Controls order wire loudspeaker volume. Does not control alarm or ringing signal volume.		
SYNTH OVEN indicator with PRESS TO TEST pushbutton switch.	White light indicates correct oven temperature. Lamp not lighted until oven temperature has stabilized. The indicator lamp can be checked by PRESS TO TEST function.		
TRAF indicator	Green light indicates normal traffic operation. Red light indicates loss of traffic input to modulator 1A8.		
RF POWER indicator	Green light indicates forward RF power from transmitter is normal. Red light indicates RF power from transmitter is below normal.		
SYNTH LOCK indicator	Green light indicates frequency synthesizer 1A14 operation is normal. Red light indicates 1.5625 kHz signals from variable frequency divider No. 2 1A14A5 and standard RF oscillator 1A14A7 are not phase locked.		

Control, indicator, or test jack	Function
REFL RF POWER indicator	Green light indicates normal operation. Red light indicates high transmitter output vswr.
CABLE TO RADIO MODEM indicator	Green light indicates normal operation. Red light indicates failure in cable-to-radio path of digital data modem 1A12.
RADIO TO CABLE MODEM indicator	Green light indicates normal operation. Red light indicates failure in radio-to-cable path of digital data modem 1A12.

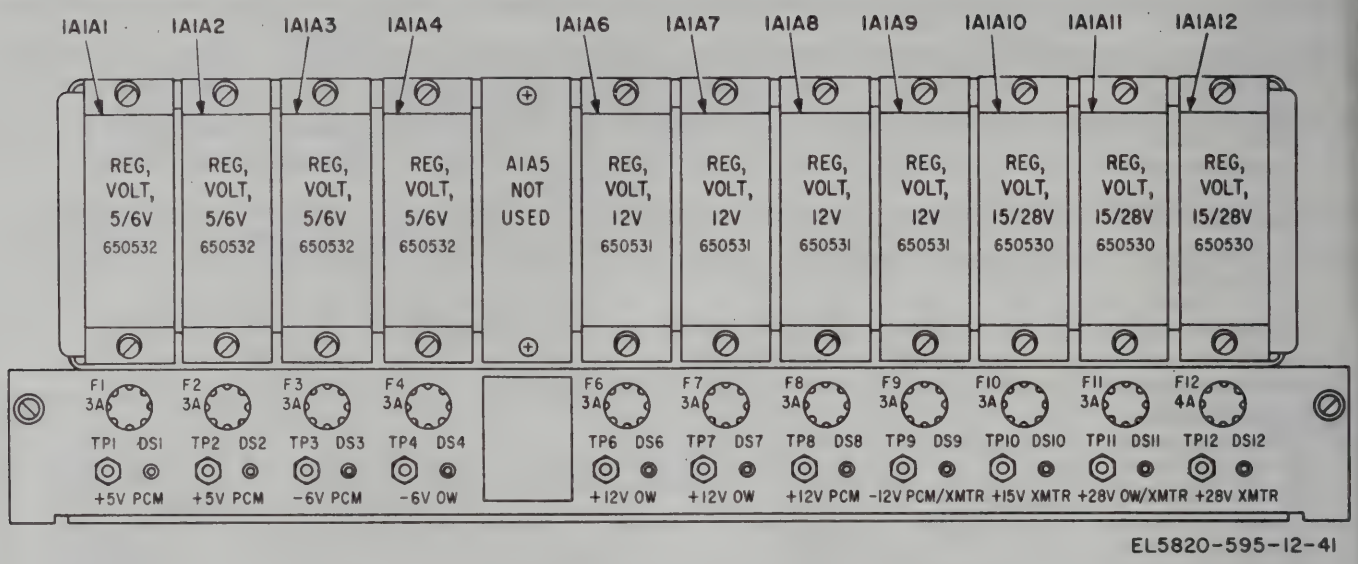


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Figure 3–1. Transmitter meter panel, controls and indicators.

b. Power Supply 1A1 (fig. 3–2).

Control, indicator, or test jack	Function
DS1 through DS4 and DS6 through DS12 indications	Green light indicates normal operation of voltage regulator modules. When indicator is extinguished it indicates associated voltage regulator module is inoperative, or indicator lamp is defective.
F1 3A fuse	Protects 11.0 volts ac circuit of 5/6 v regulator 1A1A1
F2 3A fuse	Protects 11.0 volts ac circuit of 5/6 v regulator 1A1A2
F3 3A fuse	Protects 8.5 volts ac circuit of 5/6 v regulator 1A1A3
F4 3A fuse	Protects 8.5 volts ac circuit of 5/6 v regulator 1A1A4
F6 3A fuse	Protects 13.5 volts ac circuit of 12 v regulator 1A1A6
F7 3A fuse	Protects 15.0 volts ac circuit of 12 v regulator 1A1A7
F8 3A fuse	Protects 16.5 volts ac circuit of 12 v regulator 1A1A8
F9 3A fuse	Protects 15.0 volts ac circuit of 12 v regulator 1A1A9
F10 3A fuse	Protects 16.0 volts ac circuit of 15/28 v regulator 1A1A10
F11 3A fuse	Protects 27.5 volts ac circuit of 15/28 v regulator 1A1A11
F12 4A fuse	Protects 30.0 volts ac circuit of 15/28 v regulator 1A1A12
TP1 +5V PCM test jack (black)	Provides test access to dc output of 5/6 v regulator 1A1A1
TP2 +5V PCM test jack (black)	Provides test access to dc output of 5/6 v regulator 1A1A2
TP3 –6V PCM test jack (black)	Provides test access to dc output of 5/6 v regulator 1A1A3
TP4 –6V OW test jack (black)	Provides test access to dc output of 5/6 v regulator 1A1A4
TP6 +12 V OW test jack (black)	Provides test access to dc output of 12 v regulator 1A1A6
TP7 +12 V OW test jack (black)	Provides test access to dc output of 12 v regulator 1A1A7
TP8 +12V PCM test jack (black)	Provides test access to dc output of 12 v regulator 1A1A8
TP9 –12V PCM/XTMR test jack (black)	Provides test access to dc output of 12 v regulator 1A1A9
TP10 +15V XMTR test jack (black)	Provides test access to dc output of 15/28 v regulator 1A1A10.
TP11 +28V OW/XMTR test jack (black)	Provides test access to dc output of 15/28 v regulator 1A1A11.
TP12 +28V XMTR test jack (black)	Provides test access to dc output of 15/28 v regulator 1A1A12.



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Figure 3-2. Transmitter power supply 1A1, controls and indicators.

c. 100 MHz Oscillator 1A2 (fig. 3-3).

Control, indicator, or test jack	Function
ON-OFF switch (toggle)	*Switch pos.* — *Action* ON — Turns 100 MHz oscillator 1A2 on and causes RADIO TEST SET indicator on transmitter meter panel to light red. OFF — Turns 100 MHz oscillator 1A2 off and causes RADIO TEST SET indicator on transmitter meter panel to light green.
Indicator	When lighted indicates +15 vdc is applied to 100 MHz oscillator 1A2.
LEVEL ADJ control (black)	Sets output level of 100 MHz oscillator 1A2.
TP1 + 15V test jack (black)	Monitors +15 vdc applied to module.

d. AF-RF Amplifier 1A4 (fig. 3-3).

Control, indicator, or test jack	Function
TRAFFIC LEVEL ADJ control (black)	Sets level of pcm signal applied to modulator 1A8, via 1.3-MHz low pass filter 1A6.
TP1 +15V test jack (black)	Monitors +15 vdc applied to module.

e. Alarm Monitor 1A5 (fig. 3-3).

Control, indicator, or test jack	Function
TP1 +28V test jack (black)	Monitors +28 vdc applied to module.
TP2 -12V test jack (black)	Monitors -12 vdc applied to module.

f. 1.3-MHz Low Pass Filter 1A6 (fig. 3-3).

Control, indicator, or test jack	Function
INPUT filter tuning control (red)	Tunes input to 1.3-MHz low pass filter 1A6.
OUTPUT filter tuning control (red)	Tunes output of 1.3-MHz low pass filter 1A6.

g. Electronic Frequency Control 1A7 (fig. 3-3).

Control, indicator, or test jack	Function
LIM LEVEL-1ST control (red)	Tunes first limiter stage.
LIM LEVEL-2ND control (red)	Tunes second limiter stage.

Control, indicator, or test jack	Function
DISCR PRIM control (red)	Tunes primary winding of discriminator transformer.
DISCR SEC control (red)	Tunes secondary winding of discriminator transformer to crossover frequency.
TP1 SYNC test jack (red)	*a.* Provides synchronizing output for test purposes. *b.* Monitors output of switching oscillator.
TP2 2ND LIM LEVEL test jack (red)	Monitors rectified limiter output level.
TP3 AMPL test jack (red)	Monitors afc correction signal applied to afc phase detector
TP4 DISCR test jack (red)	Monitors discriminator output level.
TP5 +15V test jack (black)	Monitors +15 vdc power source.

h. Modulator 1A8 (fig. 3–3).

Control, indicator, or test jack	Function
S1 switch (blue)	Interrupts connection to electronic frequency control 1A7.
C15 control (blue)	Tunes 150 MHz oscillator.
R2 control (red)	Sets deviation sensitivity.
TP1 +15V test jack (black)	Monitors +15 vdc power source.
TP2 +28V test jack (black)	Monitors +28 vdc power source.
TP3 CONTROL LEVEL test jack (red)	Monitors rectified control level output.
TP4 OUTPUT LEVEL test jack (red)	Monitors rectified 150 MHz output.

i. Frequency Mixer 1A9 (fig. 3–3).

Control, indicator, or test jack	Function
C1 (red)	Tunes input circuit of crystal mixer 1A9A1.

j. Amplifier-Frequency Multiplier 1A11 (fig. 3–3).

Control, indicator, or test jack	Function
TP1 +28V test jack (black)	Monitors +28 vdc power source.
TP2 LOW PWR AMPL LEVEL test jack (red)	Monitors rectified 284.375–303. 125-MHz signal from low level amplifier.
TP3 HIGH PWR AMPL LEVEL test jack (red)	Monitors rectified 234.375–303. 125-MHz signal from high level amplifier.

k. 4.4–0-GHz Bandpass Filter 1FL3 (fig. 3–3).

Control, indicator, or test jack	Function
PUSH TO TURN knob (black)	Tunes 4.4–5.0-GHz bandpass filter to transmitter operating frequency.
FREQ MHZ dial indicator	Indicates selected transmitter frequency.

l. Radio Test Set p/o 1A15 (fig. 3–3).

Control, indicator, or test jack	Function
Meter	Monitors circuit selected by meter switch and indicates 12-or 24-channel mode calibrate level.
Meter switch (black)	Meter switch connects meter to any one of four circuits.

Sw pos	*Meter band*	*Causes meter to read*
OFF (TRANSIT)	None	No deflection; shorts meter terminals when equipment is in transit.

Control, indicator, or test jack	Function		
	Sw pos	*Meter band*	*Causes meter to read*
	OSC LEVEL	Black	Output level of 100-MHz oscillator 1A2.
	CR1	Yellow	Crystal current of diode CR1 in crystal mixer 1Z1.
	CR2	Yellow	Crystal current of diode CR2 in crystal mixer 1Z1.
RCVR CHAN A selector switch (black) (rotary)	Switch selects any one of four output levels to receiver channel A.		
	Sw pos		*Output level selected*
	T +30		30 db above threshold.
	T +20		20 db above threshold.
	T		Receiver threshold level (–100 db for 12 channel operation, –97 db for 24-channel operation.
	T–8		8 db below threshold.
RCVR CHAN B selector switch (black) (rotary)	Switch selects any one of four output levels to receiver channel B.		
	Sw pos		*Output level selected*
	T +30		30 db above threshold.
	T +20		20 db above threshold.
	T		Receiver threshold level (–100 db for 12 channel operation, –97 db for 24-channel operation.
	T–8		8 db below threshold.

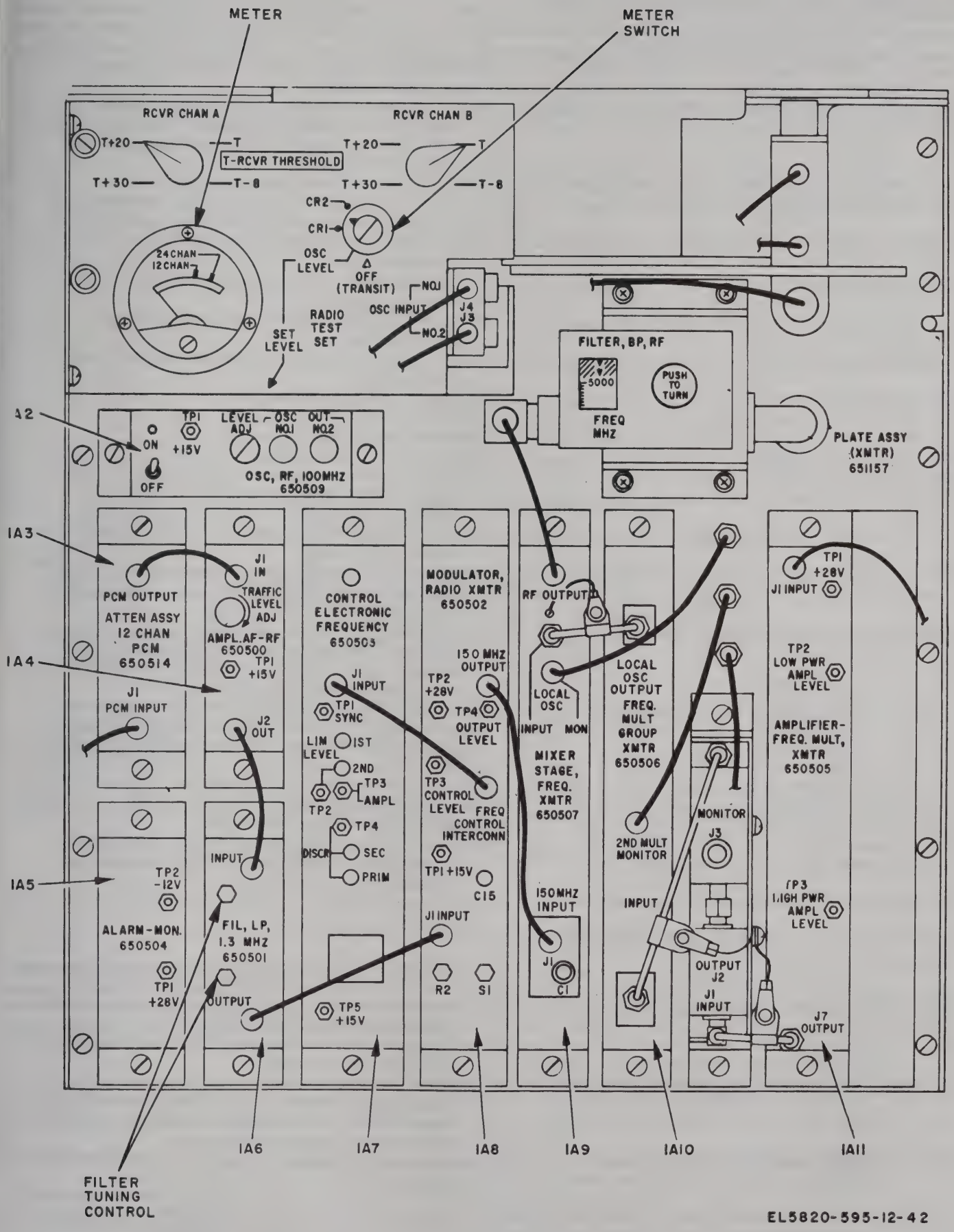


Figure 3–3. Transmitter plate assembly 1A15, module controls and indicators.

m. Digital Data Modem 1A12 (fig. 3-4).

Control, indicator, or test jack	Function
TRAFFIC SELECT 12 CHAN/24 CHAN switch	Modifies digital data modem timing for 12-channel or 24-channel operation.
CABLE LOOP TEST NORMAL/TEST switch (toggle)	In TEST position, FROM CABLE traffic is looped and returned as TO CABLE test traffic. The switch is placed in the NORMAL position for all radio set operation except troubleshooting.
THRU OW RECEIVE LEVEL ADJ control (green)	Adjusts CABLE FROM incoming order wire level.
4,608 KHZ FREQ ADJ control (red)	Provides a frequency correction range to compensate for aging effects of 4,608 kHz vco 1A12A1 and 1A12A14.
CABLE LG (MILES) indicator group 1/4 mile indicator	White light indicates equalization provided for 1/4-mile cable length.
1/2-mile indicator	White light indicates equalization provided for 1/2-mile cable length.
3/4-mile indicator	White light indicates equalization provided for 3/4-mile cable length.
1-MI indicator	White light indicates equalization provided for 1-mile cable length.
TP1 +12V test jack (black)	Monitors +12 vdc power source.
TP2 +5V (A) test jack (black)	Monitors +5 vdc power source A.
TP3 +5V (B) test jack (black)	Monitors +5 vdc power source B.
TP4 -6V test jack (black)	Monitors -6 vdc power source.
TP5 -12V test jack (black)	Monitors -12 vdc power source.
TP6 VCO CABLE test jack (green)	Monitors voltage input to 4.608 kHz vco 1A12A1 in terms of a dc voltage.
TP7 VCO RADIO test jack (green)	Monitors voltage input to 4,608 kHz vco 1A12A14 in terms of a dc voltage.
Failure indicator lamp 1A12A2DS1, 1A12A3DS1, and 1A12A4DS1.	Green light indicates no failure detected. Extinguished lamp indicates failure detected in cable-to-radio path of digital data modem 1A12.
NORMAL/TEST switch 1A12A6S1 (rotary)	In NORMAL position, the agc signal from the receiver is applied to the radio digital regenerator. In TEST position, the agc signal from the receiver is inhibited and a fixed agc voltage is supplied.
NORMAL/TEST indicator lamp 1A12A6DS1	Red light indicates NORMAL/TEST switch 1A12A6S1 is in the TEST position. Extinguished light indicates NORMAL/TEST switch 1A12A6S1 is in the NORMAL position.
Test jack, 1A12A5TP1, upper (green)	Monitors received order wire signal.
Test jack, 1A12A5TP2, lower, (green)	Monitors transmit order wire signal.
Test jack 1A12A7TP1, (green)	Monitors recovered order wire signal.
Failure indicator lamp 1A12A8DS1, 1A12A9DS1, 1A12A10DS1, 1A12A12DS1, 1A12A13DS1.	Green light indicates no failure detected. Extinguished lamp indicates failure detected in radio-to-cable path of digital data modem 1A12.

n. Order Wire Assembly 1A13 (fig. 3-5).

Control, indicator, or test jack	Function
TEST TONE pushbutton switch (black) (monentary)	*a.* When switch is not pressed it connects output of a 1.1 kHz oscillator (1A13A2) to audible alarm circuit. *b.* When pressed, switch routes a 1.1 kHz test tone to all order wire circuits.
MODULE TEST indicator lamp/pushbutton switch	Red light indicates a defective circuit has been selected for test by the MODULE TEST selector switch. Lamp condition can be checked by pressing the button lens to operate the pushbutton switch.
MODULE TEST selector switch (black) (rotary)	Selects one of 12 items to be tested in order wire assembly 1A13. *Sw pos* — *Item under test and location* 1 — 4-kHz monitor, 4-kHz oscillator, and MODULE TEST indicator lamp on board No. 1 1A13A1.

Control, indicator, or test jack	Function
	Sw pos — *Item under test and location*
	2 — Amplifier A5 on board No. 5 1A13A5.
	3 — Amplifier A2 on board No. 3 1A13A3.
	4 — Amplifier A1 on board No. 3, 1A13A3.
	5 — Amplifier A1 on board No. 4, 1A13A4.
	6 — Amplifier A4 on board No. 5, 1A13A5.
	7 — Amplifier A2 on board No. 4, 1A13A4.
	8 — Peak limiters (A2 and A3) on board No. 5, 1A13A5.
	9 — Speaker-amplifier A2 on board No. A2, 1A13A2.
	10 — 1.6-kHz oscillator on board No. 5, 1A13A5.
	11 — 1.1-kHz oscillator on board No. 2, 1A13A2.
	12 — Central alarm monitor on board No. 2, 1A13A2.

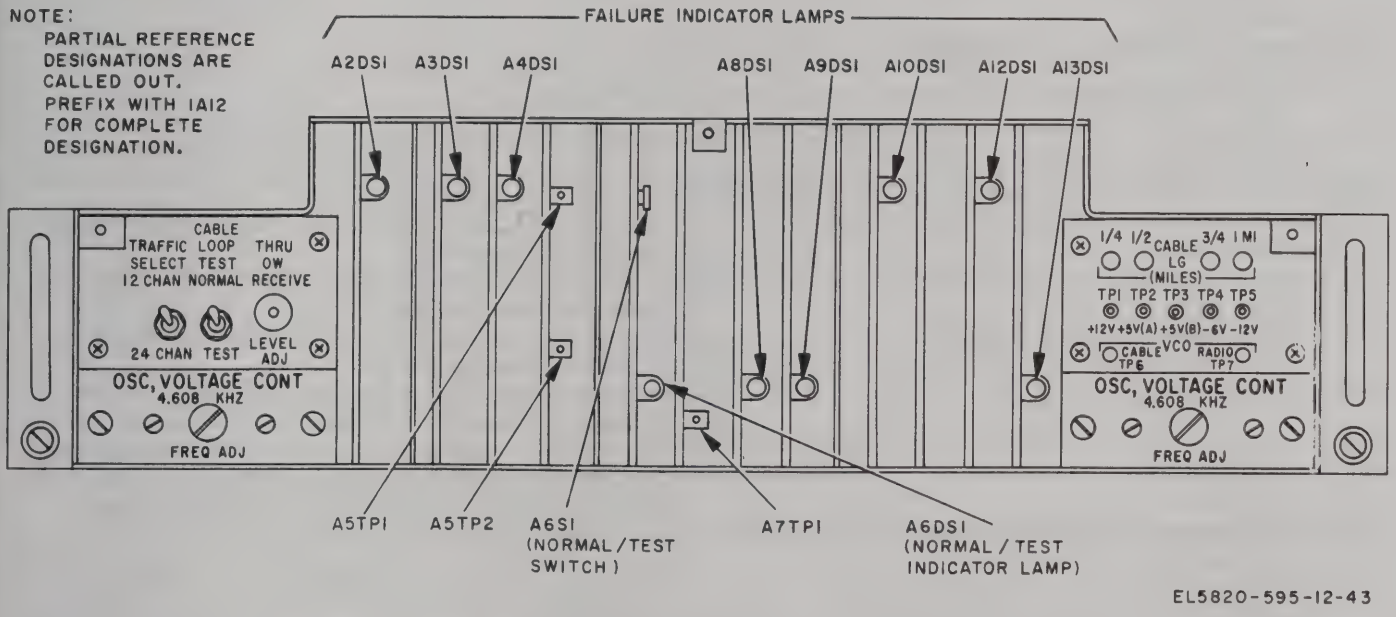


Figure 3–4. Transmitter digital data modem 1A12, controls and indicators.

o. *Frequency synthesizer 1A14* (fig. 3–5).

Control, indicator, or test jack	Function
Thumbwheel switches (4) (black)	Starting from the left; each thumbwheel switch selects and indicates the transmitter operating frequency in 100, 10, 1.0, and 0.1 MHz increments.
TEST pushbutton switch (black) momentary	Lights module fault indicator lamps when pressed.
F1 fuse	Protects primary power circuit of dual power supply 1A14A8.
28V indicator lamp	Green light indicates +28 vdc is available. Extinguished light indicates faulty lamp on dual power supply 1A14A8 is inoperative.
5V indicator lamp	Green light indicates +5 vdc is available. Extinguished light indicates faulty lamp or dual power supply 1A14A8 is inoperative.
Module fault indicator lamps (6)	Lights red to indicate a module malfunction.

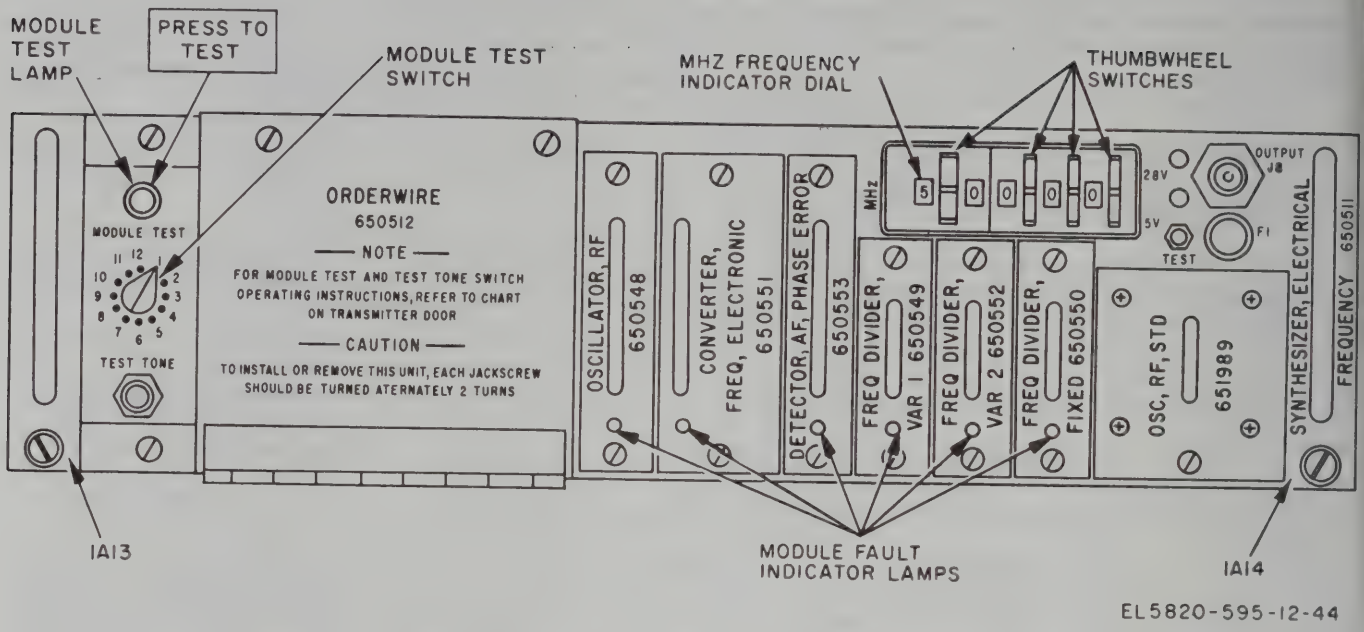


Figure 3–5. Transmitter order wire assembly 1A13 and frequency synthesizer 1A14 controls and indicators.

3–4. Receiver Controls and Indicators

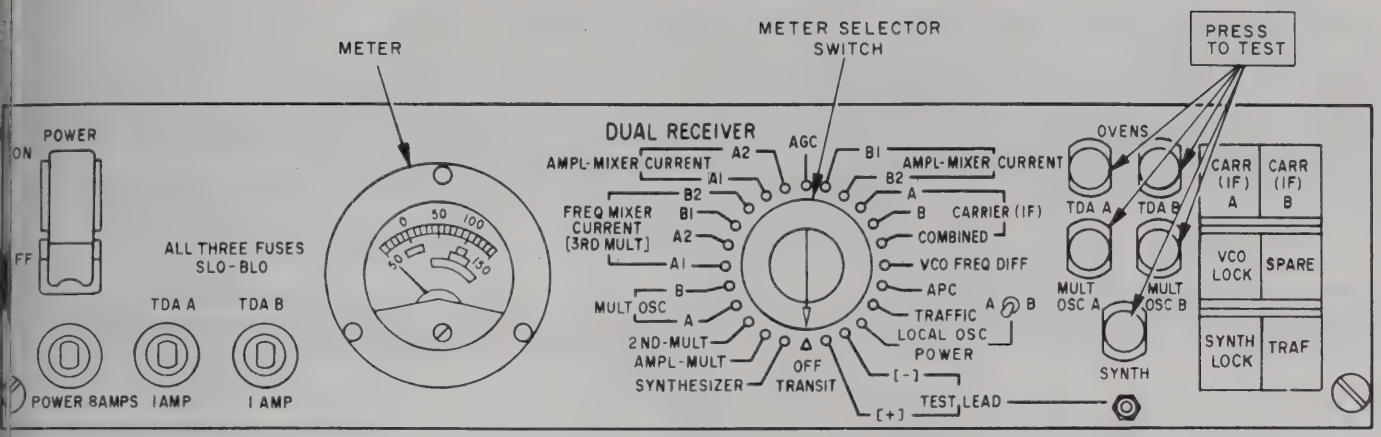
a. Receiver Meter Panel (fig. 3–6).

Control, indicator, or test jack	Function
POWER ON–OFF switch (red) (toggle)	Turns receiver on and off.
ALL THREE FUSES SLO-BLO POWER 8 AMPS fuse and neon indicator.	Fuse protects primary power circuit. Neon indicator lights when fuse has blown.
TDA A 1 AMP fuse and neon indicator	Protects primary power circuit of TDS 2A1. Neon indicator lights when fuse has blown.
TDA B 1 AMP fuse and neon indicator	Protects primary power circuit of TDS 2A2. Neon indicator lights when fuse has blown.
Meter	Provides indication of function selected by meter switch. Contains four color coded bands (black, 80 to 120; blue, –20 to +20; orange, 90 to 100; and yellow, 30 to greater than 150) that correspond to color dots on the meter selector switch. Numbers refer to meter indications.
Meter selector switch (black) (rotary)	Connects meter to any one of 24 circuits.

Sw pos	*Meter band*	*Causes meter to indicate*
OFF (TRANSIT)	None	Zero; shorts meter terminals during transit.
SYNTHESIZER	Yellow	Output level from frequency synthesizer 2A21.
AMPL-MULT	Yellow	Output level from amplifier-multiplier 2A8.
2ND MULT	Yellow	2275–2435–MHz signal level from 2nd frequency multiplier 2A7A1.
MULT OSC A	Black	Level of 220-MHz signal from 220 MHz vco 2A13.
MULT OSC B	Black	Level of 220-MHz signal from 220 MHz vco 2A14.

Control, indicator, or test jack	Function		
	Sw pos	*Meter band*	*Causes meter to indicate*
FREQ MIXER CURRENT (3RD MULT) A1.		Yellow	Channel A crystal mixer current at 2A6Z1CR1.
FREQ MIXER CURRENT (3RD MULT) A2.		Yellow	Channel A crystal mixer current at 2A6Z1CR2.
FREQ MIXER CURRENT (3RD MULT) B1.		Yellow	Channel B crystal mixer current at 2A9Z1CR1.
FREQ MIXER CURRENT (3RD MULT) B2.		Yellow	Channel B crystal mixer current at 2A9Z1CR2.
AMPL-MIXER CURRENT A1.		Yellow	Crystal mixer current at 2A4Z1CR1.
AMPL-MIXER CURRENT A2.		Yellow	Crystal mixer current at 2A4Z1CR2.
AGC		None	Agc level at IF amplifier 2A12.
AMPL-MIXER CURRENT B1.		Yellow	Crystal mixer current at 2A11Z1CR1.
AMPL-MIXER CURRENT B2.		Yellow	Crystal mixer current at 2A11Z1CR2.
CARRIER (IF) A.		None	Carrier level at IF amplifier 2A12.
CARRIER (IF) B.		None	Carrier level at IF amplifier 2A15.
CARRRIER (IF) COMBINED.		None	Combined IF carrier level at combiner 2A16.
VCO FREQ DIFF		Blue	Relative frequency difference between 220 MHz vco's 2A13 and 2A14.
APC		Blue	APC output from combiner 2A16.
TRAFFIC		Orange	Traffic level from AF–RF amplifier, 2A19.
LOCAL OSC POWER.		Yellow	Local oscillator power level at mixer preamplifier A (2A4) or B (2A11) depending on position of LOCAL OSC POWER selector switch.
TEST LEAD (–)		Black	Dc voltage level applied to TEST LEAD jack.
TEST LEAD (+)		Black	Same as above.

Control, Indicator, or test jack	Function
LOCAL OSC POWER, A-B selector switch (toggle)--------	*Switch pos.* / *Action* A---------- In position A selects measurement of local oscillator power at mixer preamplifier 2A4. B---------- In position B selects measurement of local oscillator power at mixer preamplifier 2A11. *Note.* Meter selector must be in the LOCAL OSC POWER position when making these measurements.
TEST LEAD jack (black)----------	Provides test access to panel meter through meter switch. Patches with any black test jack. Meter selector switch must be set to the appropriate TEST LEAD (-) or (+) position when making these measurements.
OVENS indicator group TDA A indicator with PRESS TO TEST pushbutton switch. **NOTE FOR TDA A&B:** The OVENS indicators will not light when the receiver is equipped with a GaAs FET amplifier. Check the front panel of the electrical equipment cabinet for a label.	Lights white when TDA 2A1 oven power is applied. PRESS TO TEST switch lights indicator lamp
TDA B indicator with the PRESS TO TEST pushbutton switch.	Lights white when TDA 2A2 oven power is applied. PRESS TO TEST switch lights indicator lamp.
MULT OSC A indicator with PRESS TO TEST pushbutton switch.	Indicator not lighted during oven warmup. White light indicates oven temperature of 220 MHz vco 2A13 has stabilized. PRESS TO TEST switch lights indicator lamp.
MULT OSC B indicator with PRESS TO TEST pushbutton switch.	Indicator not lighted during oven warmup. White light indicates oven temperature of 220 MHz vco 2A14 has stabilized. PRESS TO TEST switch lights indicator lamp.
SYNTH indicator with PRESS TO TEST pushbutton switch.	Indicator not lighted during oven warmup. White light indicates oven temperature of frequency synthesizer 2A21 has stabilized. PRESS TO TEST switch lights indicator lamp.
CARR (IF) A indicator----------	Green light indicates normal channel A carrier IF level at combiner 2A16; Red light indicates carrier IF failure.
CARR (IF) B indicator----------	Green light indicates normal channel A carrier IF level at combiner 2A16; Red light indicates carrier IF failure.
SYNTH LOCK indicator----------	Normal green indication turns red when phase lock alarm signal is generated within frequency synthesizer 2A21.
TRAF indicator----------	Normal green indication turns red when traffic failure is detected at output of AF-RF amplifier 2A19.
SPARE indicator----------	Normally lighted green. This indicator permits expansion of receiver functions and does not indicate an active function in the receiver.
VCO LOCK indicator----------	Normal green indication turns red when 220 MHz vco's 2A13 and 2A14 are not phase locked.



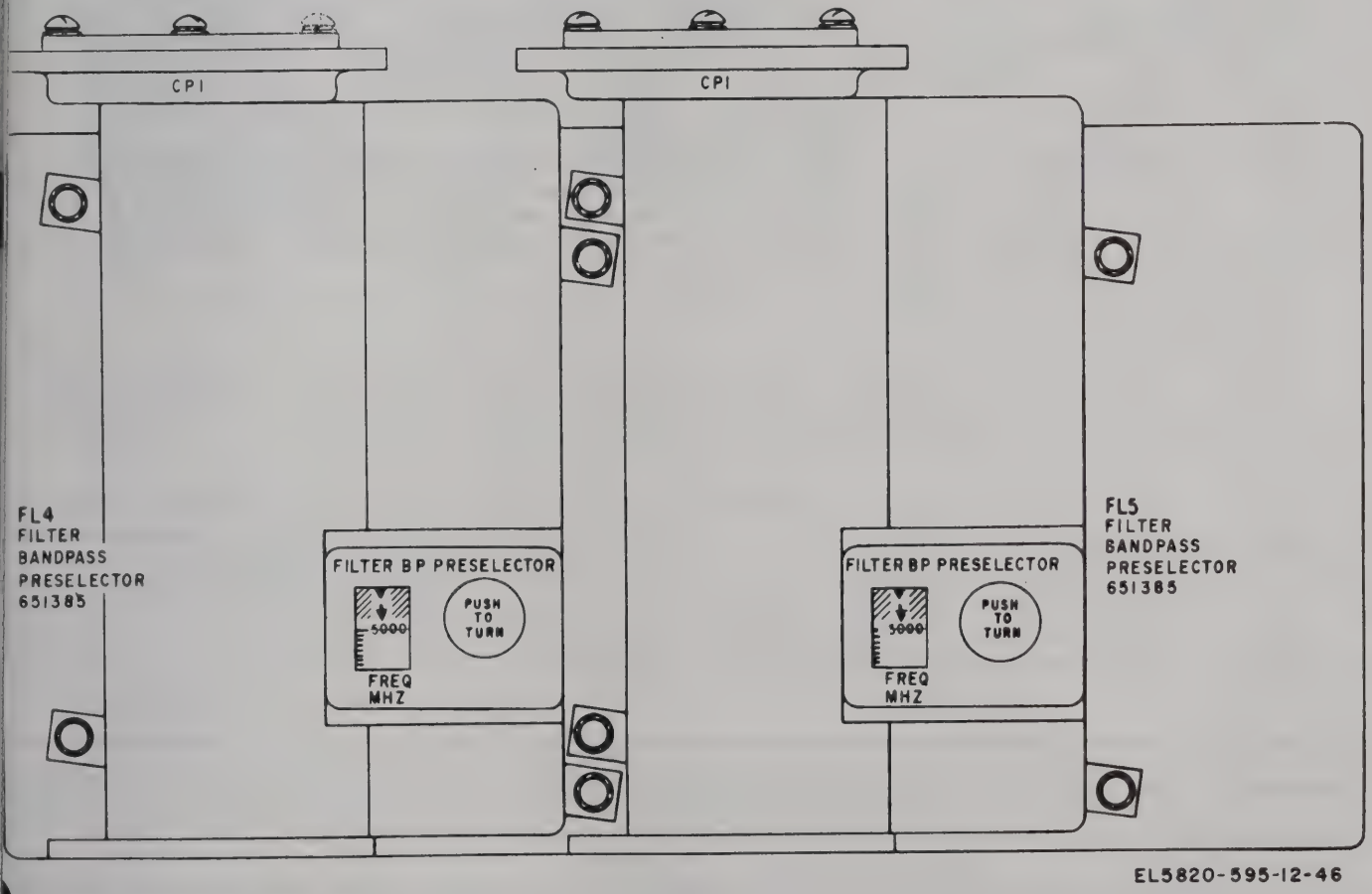
NOTE:
The OVENS indicator will not light when the receiver is equipped with a GaAs FET amplifier. Check the front panel of the electrical equipment cabinet for a label.

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Figure 3-6. Receiver meter panel, controls and indicators.

b. Preselectors 2FL4 (Channel A) and 2FL5 (Channel B) (fig. 3-7).

Control, indicator, or test jack	Function
PUSH TO TURN knob (black)	Tunes preselector to receiver operating frequency.
FREQ MHZ dial	Indicates selected receiver frequency.



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Figure 3-7. Receiver preselectors 2FL4 and 2FL5, controls and indicators.

c. TDA 2A1 (Channel A) and 2A2 (Channel B) (fig. 3-8).

Control, indicator, or test jack	Function
BIAS test Jacks (two) (black)	Monitors TDA bias.

NOTE: Bias jacks are not on units containing GaAs FET amplifiers. Check front panel for a label.

d. Post Selectors 2FL6 (Channel A) and 2FL7 (Channel B) (fig. 3-8).

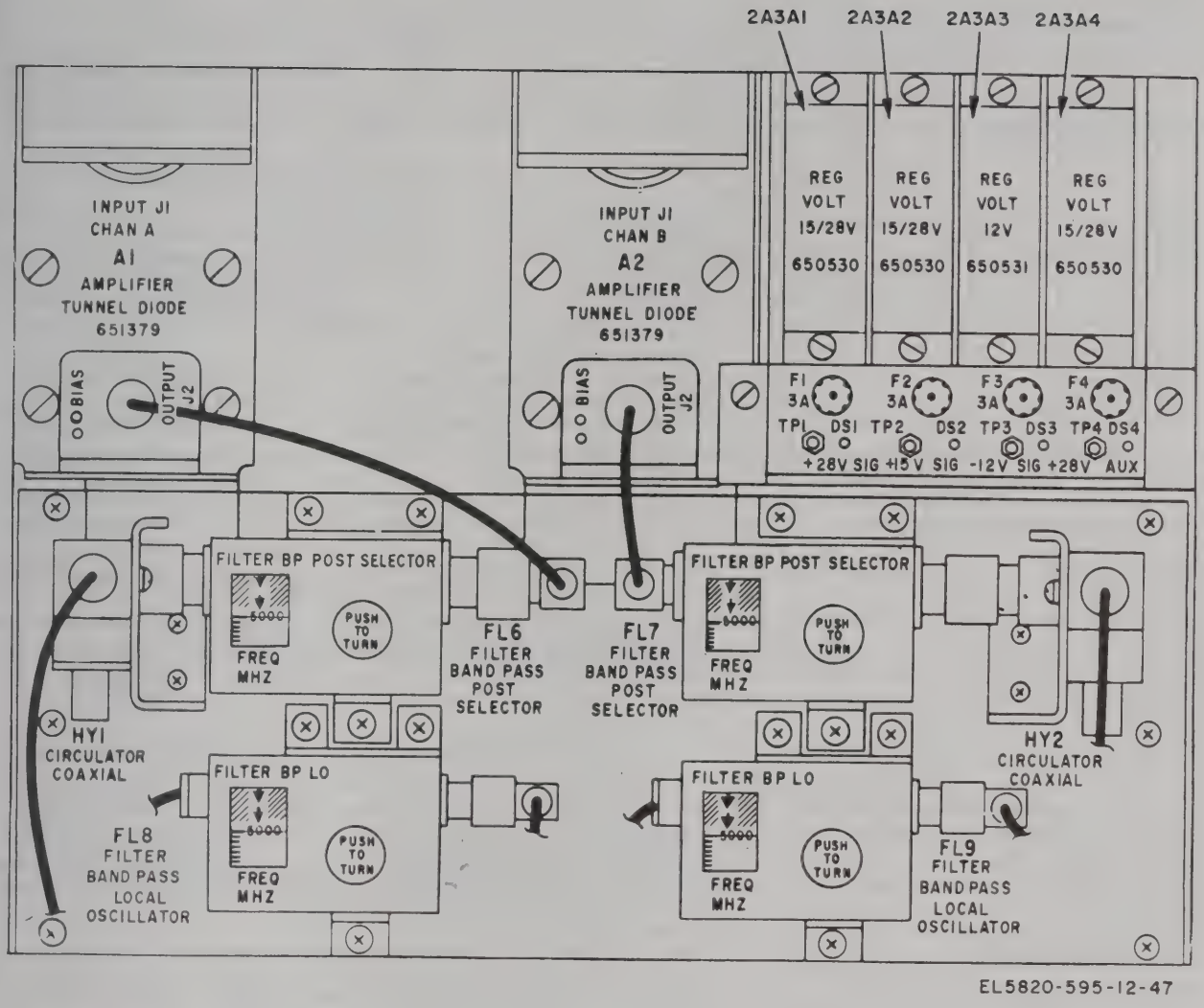
Control, indicator, or test jack	Function
PUSH TO TURN knob (black)	Tunes post selector to receiver operating frequency.
FREQ MHZ dial	Indicates selected receiver frequency.

e. Local Oscillator Filters 2FL8 (Channel A), and 2FL9 (Channel B) (fig. 3-8).

Control, indicator, or test jack	Function
PUSH TO TURN knob (black)	Turns local oscillator filters to receiver operating frequency.
FREQ MHZ dial	Indicates selected receiver frequency.

f. Power Supply 2A3 (fig. 3-8).

Control, indicator, or test jack	Function
DS1 through DS4 indicator	Green light indicates normal operation of voltage regulator modules 2A3A1 through 2A3A4, respectively. Extinguished light indicates associated voltage regulator module is inoperative, or indicator lamp is defective.
F1 3A fuse	Protects 29.0 volts ac circuit of 15/28 v regulator 2A3A1.
F2 3A fuse	Protects 19.0 volts ac circuit of 15/28 v regulator 2A3A2.
F3 3A fuse	Protects 18.0 volts ac circuit of 12v regulator 2A3A3.
F4 3A fuse	Protects 30.0 volts ac circuit of 15/28 v regulator 2A3A4.
TP1 +28V SIG test jack (black)	Provides test access to dc output of 15/28v regulator 2A3A1.
TP2 +15V SIG test jack (black)	Provides test access to dc output of 15/28v regulator 2A3A2.
TP3 -12V SIG test jack (black)	Provides test access to dc output of 12v regulator 2A3A3.
TP4 +28V AUX test jack (black)	Provides test access to dc output of 5/28v regulator 2A3A4.



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NOTE: TDA1 and TDA2 have been replaced in certain radios by GaAs FET Amplifiers.

Figure 3-8. Receiver TDA 2A1 and TD 2A2, power supply 2A3, post selectors 2FL6 and 2FL7, local oscillator filters 2FL8 and 2FL9, controls and indicators.

g. Mixer Preamplifier 2A4 (Channel A) and 2A11 (Channel B) (fig. 3-9).

Control, indicator, or test jack	Function
TP1 IF MON test jack (red)	Monitors rectified 70-MHz output.
TP2 +15V test jack (black)	Monitors +15 vdc power source.

h. Amplifier-Multiplier 2A8 (fig. 3-9).

Control, indicator, or test jack	Function
TP1 +28V test jack (black)	Monitors +28 vdc power source.
TP2 AMPL LEVEL test jack (red)	Monitors amplifier level applied to frequency multiplier group 2A7.

i. IF Amplifier 2A12 (Channel A) and 2A15 (Channel B) (fig. 3-9).

Control, indicator, or test jack	Function
AGC GAIN control (green)	Adjust agc gain of IF amplifier.
BUS TP 2 test jack (red)	Monitors agc voltage.
ALM SET control (green)	Not used.
AGC DET TP1 test jack (green)	Monitors agc detector voltage.
AGC SEL switch (black) (rotary)	Selects one of three agc configurations.

Control, indicator, or test jack	Function	
	Sw pos	*Selected function*
	Test	Disables agc to provide full IF gain.
	DIV ON	Connects agc amplifier to remote detector in combiner 2A16.
	DIV OFF	Connects internal IF amplifier. Used in conjunction with antenna alignment indicator 4A7 for antenna positioning.
+15V TP3 test jack (black)	Monitors +vdc power source.	
IF GAIN control (green)	Adjusts level of 70 MHz IF input signal.	
METER ZERO control (red)	Sets meter on receiver meter panel to electrical zero with AGC SEL switch in TEST position.	

i. Freq. Mult.-VCO, 220 MHz 2A13 (Channel A) and 2A14 (Channel B) (fig. 3-9).

Control, indicator, or test jack	Function
TP1 +28V test jack (black)	Monitors +28 vdc power source
TP2 CR1 test jack (black)	Monitors 220 MHz output of 220 MHz vco 2A13 or 2A14.
FREQ ADJ control	Frequency correction adjustment for 110 MHz vco 2A13Y1 or 2A14Y1.

k. Combiner 2A16 (fig. 3-9).

Control, indicator, or test jack	Function
SQUELCH ON-OFF switch (channel A) (toggle)	Turns receiver channel A squelch circuit on or off.
SQUELCH ADJ control (channel A) (green)	Sets channel A squelch threshold level.
TP1 test jack (green)	Monitors channel A squelch level.
APC ON-OFF switch (channel A) (toggle)	Connects or disconnects apc output to 220 MHz vco 2A13.
APC ADJ control (channel A) (green)	Monitors apc output level to 220 MHz vco 2A13.
TP2 test jack (green)	Monitors channel A APC level.
AGC, AUTO-MAN switch (toggle)	Selects automatic or manual gain control for IF amplifier 2A12 and 2A15.
MAN, AGC ADJ control (green)	Manual gain control for IF amplifiers 2A12 and 2A15.
AUTO, AGC ADJ control (green)	Sets combined IF output level applied to demodulator 2A17.
ALM ADJ control (green)	Sets combined IF carrier alarm threshold level.
TP6 −12V test jack (black)	Monitors −12 vdc power source.
TP4 +15V Test jack (black)	Monitors +15 vdc power source.
SQUELCH ON-OFF switch (channel B) (toggle)	Turns receiver channel B squelch circuit on or off.
SQUELCH ADJ control (channel B) (green)	Sets channel B squelch threshold level.
TP3 test jack (green)	Monitors channel B squelch level.
APC ON-OFF switch (channel B) (toggle)	Connects or disconnects apc output to 220 MHz vco 2A14.
APC ADJ control (channel B) (green)	Sets channel B apc output level.
TP5 test jack (green)	Monitors channel B APV level.

l. Demodulator 2A17 (fig. 3-9).

Control, indicator, or test jack	Function
DISCR SEC control (red)	Sets crossover frequency of demodulator discriminator transformer.
TP7 +15V test jack (black)	Monitors +15 vdc power source.
TP4 DISCR test jack (red)	Monitors discriminator output level.
DISCR PRIM control (red)	Tunes primary winding of demodulator discriminator transformer.
TP3 LIM LEVEL test jack (red)	Monitors limiter output level.
4TH LIM TUNING control (red)	Tunes 4th limiter stage.
3RD LIM TUNING control (red)	Tunes 3rd limiter stage.
2ND LIM TUNING control (red)	Tunes 2nd limiter stage.
1ST LIM TUNING control (red)	Tunes 1st limiter stage.
TP2 INPUT LEVEL test jack (red)	Monitors 70-MHz IF input level to demodulator 2A17.

m. 260 kHz Low Pass Filter 2A18 (fig. 3-9).

Control, indicator, or test jack	Function
INPUT filter tuning control (red)	Tunes input of 260-kHz low pass filter.
OUTPUT filter tuning control (red)	Tunes output circuit of 260 kHz low pass filter.

n. AF-RF Amplifier 2A19 (fig. 3-9).

Control, indicator, or test jack	Function
TRAFFIC LEVEL ADJ control (black)	Sets traffic signal level out of AF-RF amplifier 2A19.
TP1 +15V test jack (black)	Monitors +15 vdc power source.

o. Alarm Monitor 2A20 (fig. 3-9).

Control, indicator, or test jack	Function
TP1 +28V test jack (black)	Monitors +28 vdc power source.
TP2 -12V test jack (black)	Monitors -12 vdc power source.

p. Frequency Synthesizer 2A21 (fig. 3-9).

Control, indicator, or test jack	Function
Thumbwheel switches (4) (black)	Starting from the left; each thumbwheel switch selects and indicates the receiver operating frequency in 100, 10, 1.0, and 0.1 MHz increments.
TEST pushbutton switch (black) (momentary)	Lights module fault indicator lamps when pressed.
F1 fuse	Protects primary power circuit.
28V indicator lamp	Lights green when +28 vdc is available.
5V indicator lamp	Lights green when +5 vdc is available.
Module fault indicators (6)	Lights red when a module fault malfunctions.

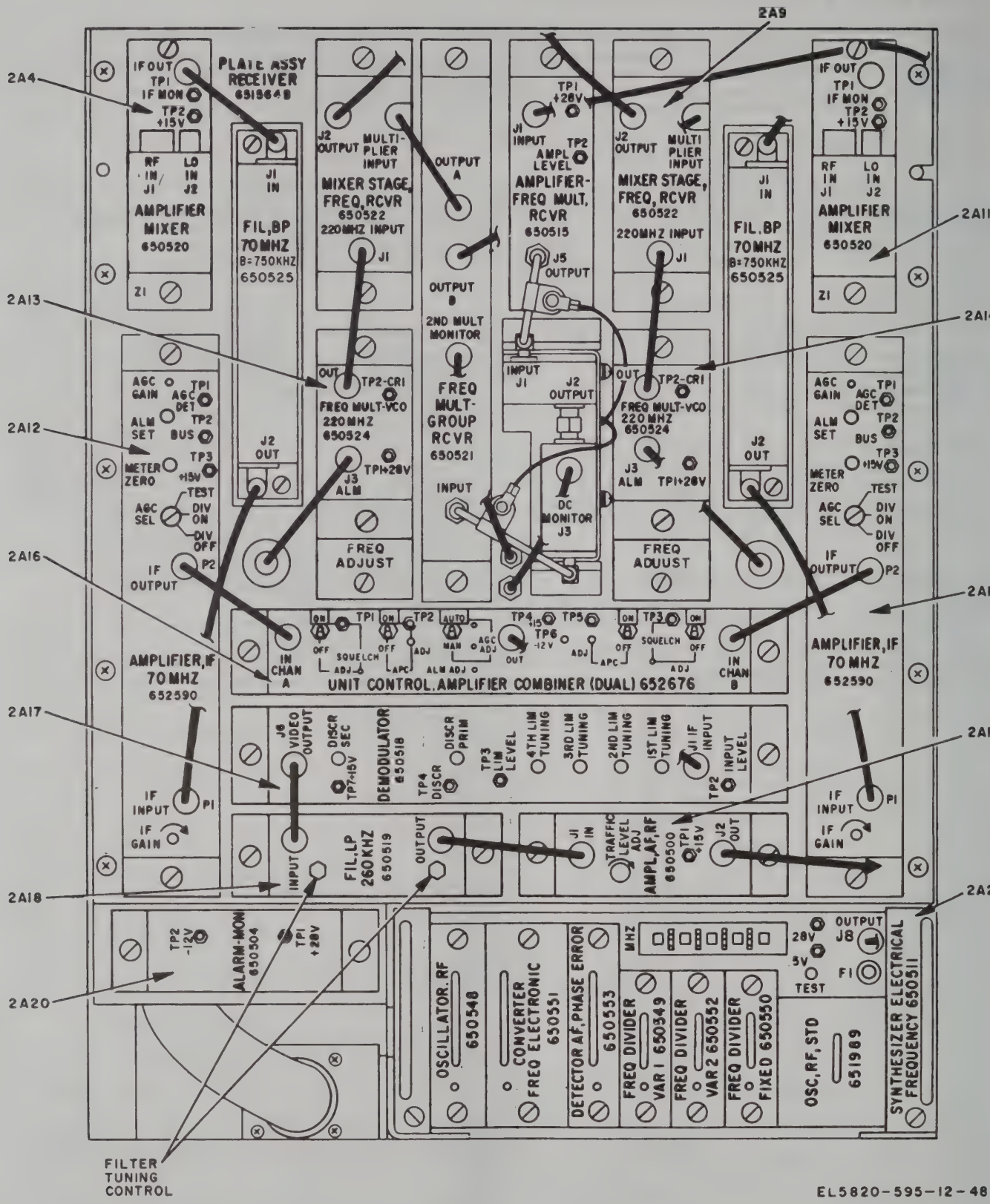


Figure 3-9. Receiver plate assembly 2A24 and frequency synthesizer 2A21, module controls and indicators.

3-5. Power Amplifier, Controls and Indicators

a. Power Amplifier Meter Panel (fig. 3-10).

Control, indicator, or test jack	Function
FILAMENT VOLTAGE meter	Indicates klystron filament voltage in ac volts. Green band (5.9 to 7.0) indicates acceptable limits for klystron filament voltage.
BEAM VOLTAGE meter	Indicates klystron beam voltage in kilovolts. Green band (5.0 to 8.3) indicates acceptable limits for klystron beam voltage.
BEAM CURRENT meter	Indicates klystron beam current in amperes. Green band (0.3 to 0.6) indicates acceptable limits for klystron beam current.
RF MONITOR meter	Indicates power level of function selected by RF MONITOR SELECT switch. The three color coded bands (Yellow, 30 to 50; blue, 0 to 90; and green, 50 to 120) correspond to color of associated RF MONITOR SELECT pushbutton.
RF MONITOR SELECT pushbuttons	Connects RF MONITOR meter to any one of three circuits. *Pushbutton* / *Meter band* / *Causes meter to indicate* ANTENNA FORWARD WATTS X 10 — Green — Output power in tenths of actual watts. Multiply meter indication by 10 to obtain actual output power in watts. ANTENNA REFLECTED WATTS. — Blue — Reflected power in watts. INPUT FORWARD MILLIWATT. — Yellow — Klystron drive power in milliwatts.
FILAMENT RUNNING TIME indicator	Counter indicates klystron filament running time in hours and tenths, with a maximum reading of 9999.9 hours. *Note.* Small operture below hundreds digit will alternately show black and white color while indicator is operating.
RESET pushbutton switch (black)	Resets control circuits and indicators after a dc overload or antenna mismatch failure has shutdown high voltage power supply.
MAIN POWER SWITCH (press on-off pushbutton) and indicator.	*a.* Controls primary ac power providing: (1) Klystron filament power. (2) DC power to BEAM SWITCH indicator and time delay control 3A5. *b.* MAIN POWER SWITCH indicator light is white when power is available, and changes to green when pushbutton switch is operated.
BEAM SWITCH (press on-off pushbutton) and indicator.	Controls dc power to beam gate – dc overload control 3A6. Indicator light is red when pushbutton switch is off, and green when pushbutton switch is on.
[illegible] indicator	Green light indicates status of the following items. *a.* CABINET FANS circuit breaker CB5 is closed. *b.* Dummy load interlock is closed. *c.* Klystron temperature is normal. Red light indicates interlocks are open or klystron temperature exceeds 260°C.
FILAMENT indicator	Green light indicates klystron filament current is normal, red light indicates low or no filament current flow.
TIME DELAY indicator	Amber light displayed during beam turn-on or blower shutdown timing period, lights green when beam turn-on timing period has been completed.
AC INTERLOCK indicator	Green light indicates normal operation, red light indicates high voltage interlock door (fig. 1-14) is open, interlock panel is removed, or cabinet fan assembly is removed.

Control, indicator, or test jack	Function
BEAM indicator	Green light indicates klystron beam voltage is on, red light indicates beam voltage is off.
AC OVERLOAD indicator	Green lights indicates normal operation with MAIN POWER circuit breaker CB1 set to ON. Red light indicates MAIN POWER circuit breaker CB1 has been tripped (set to OFF).
LOW RF indicator	Green light indicates RF power output is 500 watts (minimum). Red light indicates RF power output is below 500 watts.
ANTENNA MISMATCH indicator	Green light indicates reflected power is less than 100 watts. Red light indicates reflected power is greater than 100 watts.
DC OVERLOAD indicator	Green light indicates Klystron beam current is less than 0.55 amperes; red light indicates beam current overload circuit has been tripped.

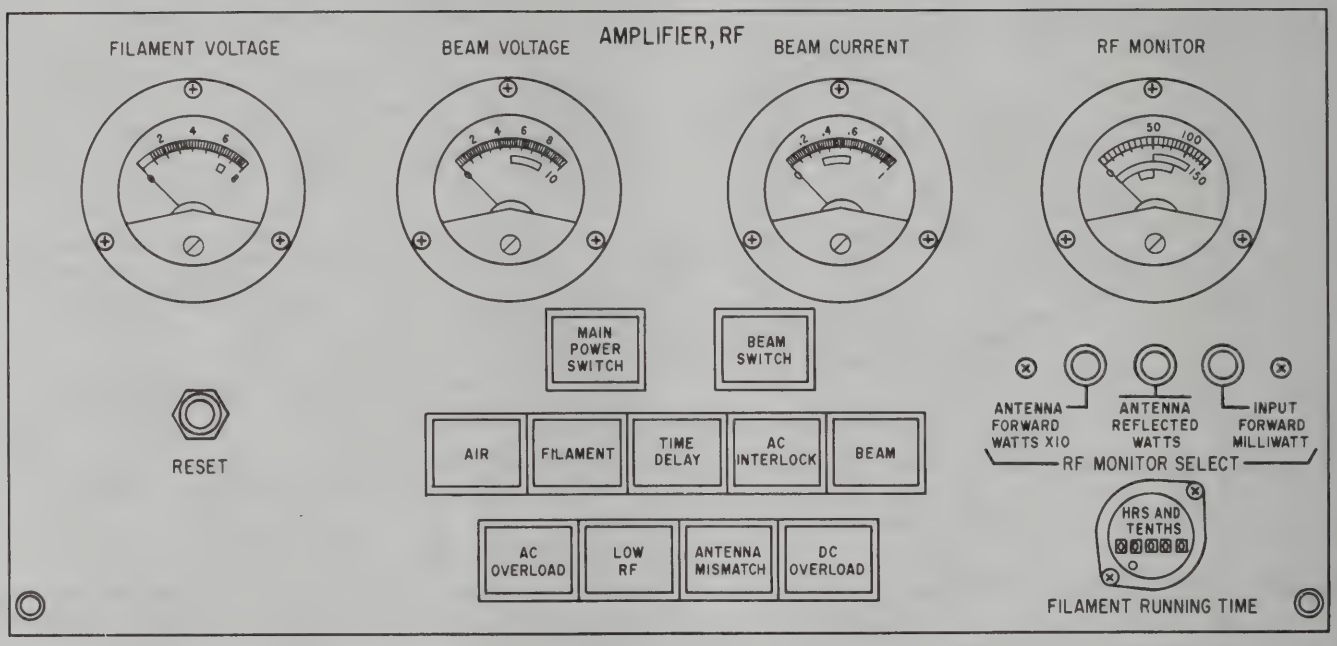


Figure 3-10. Power amplifier meter panel, controls and indicators.

b. Circuit Breaker Panel P/O 3A9 (fig. 3-11).

Control, indicator, or test jack	Function
KLYSTRON BLOWER circuit breaker (black)	Protects main blower 3A9B1B1 against overload.
CONTROL POWER circuit breaker (black)	Protects primary power circuit of low power transformer 3A9T1.
CABINET FANS circuit breaker (black)	Protects blower motors 3A9A26B2 through 3A9A26B5 of cabinet fans against current overlaod. Auxiliary contacts form interlock circuit for AIR indicator.
MAIN POWER circuit breaker (dual section breaker) (black).	Serves as a main breaker to protect all 115/230 vac primary power circuits within the power amplifier cabinet.
BEAM POWER circuit breaker (black)	Protects inverter 3A8 against ac overload. Auxiliary contacts on circuit breaker interrupt -7.5 vdc to beam gate dc overload control 3A6, and indicator control 3A3.

c. Inverter Regulator Control 3A1 (fig. 3-11).

Control, indicator, or test jack	Function
BEAM VOLT ADJ control (black)	Sets beam voltage level applied to klystron tube 3A9V1.

d. Indicator Control 3A2 (fig. 3–11).

Control, indicator, or test jack	Function
TP1 test jack (white)	Monitors output state of beam shutdown circuit.
TP2 test jack (white)	Monitors output state of low rf circuit.
TP3 test jack (white)	Monitors output of filament sensing and beam time delay control circuit.
TP4 test jack (white)	Monitors operational state of air protection circuits.
TP5 test jack (white)	Not used.

e. Indicator Control 3A3 (fig. 3–11).

Control, indicator, or test jack	Function
TP1 test jack (white)	Monitors operational state of ac overload voltage.
TP2 test jack (white)	Monitors operational state of beam time delay control circuit.
TP3 test jack (white)	Monitors output state of antenna mismatch control circuit.
TP4 test jack (white)	Monitors operational state of ac interlock protection circuits.
TP5 test jack (white)	Monitors operational state of dc overload protection circuits.

f. Low RF–Mismatch Alarm and Control 3A4 (fig. 3–11).

Control, indicator, or test jack	Function
LOW RF control (black)	Sets low RF alarm level.
ANT MIS control (blue)	Sets level at which antenna mismatch alarm circuit will trigger.
TP1 test jack (white)	Monitors applied low RF input level.
TP2 test jack (white)	Monitors operational state of beam gate control circuit.
TP3 test jack (white)	Monitors –7.5 vdc through off contacts of BEAM SWITCH.
TP4 test jack (white)	Monitors detected antenna mismatch input level from directional coupler 3A9DC2.

g. Time Delay Control 3A5 (fig. 3–11).

Control, indicator, or test jack	Function
BLOW TD control (green)	Sets rc time constant of blower shutdown control circuit.
TP1 test jack (yellow)	Monitors timing waveform of blower time delay control circuit.
TP2 and TP3 test jacks (white)	Monitors ac output of klystron filament current sensing transformer 3A9A8T4.
TP4 test jack (yellow)	Monitors operational state of Klystron filament control circuit.
TP5 test jack (orange)	Monitors operational state of beam time delay control circuit.
TP6 test jack (orange)	Monitors beam time delay indicator level.
BEAM TD control (green)	Sets rc time constant of beam turn-on control circuit.

h. Beam Gate – DC Overload Control 3A6 (fig. 3–11).

Control, indicator, or test jack	Function
DC OVLD ADJ control (blue)	Sets dc overload alarm threshold.
TP1 test jack (white)	Monitors operational state of BEAM SWITCH.
TP2 test jack (white)	Monitors operational state of time delay contol circuit.
TP3 test jack (white)	Monitors operational state of RF mismatch control circuit.
TP4 test jack (white)	Monitors –7.5 vdc output of power supply control 3A7.
TP5 test jack (white)	Monitors operational state of air protection circuit.
TP6 test jack (white)	Monitors operational state of ac interlock protection circuits.
TP7 test jack (white)	Monitors operational state of ac interlock protection circuits.

Control, indicator, or test jack	Function
TP8 test jack (white)	Monitors operatonal state of dc overload protection circuit.
TP9 test jack (white)	Monitors applied DC OVERLOAD level.
TP10 test jack (orange)	Monitors output of beam gate control circuit.
TP11 test jack (orange)	Monitors dc overload indicator level.

i. Power Supply Control 3A7 (fig. 3-11).

Control, indicator, or test jack	Function
TP1 test jack (black)	Provides access to chassis ground for test meter measurement.
TP2 and TP3 test jacks (white)	Monitors 28.5 vac power source.
TP4 test jack (blue)	Monitors rectified but unfiltered -12 vdc output.
TP5 test jack (red)	Monitors shunt regulated +7.5 vdc output.
TP6 test jack (blue)	Monitors shunt regulated -7.5 vdc output.

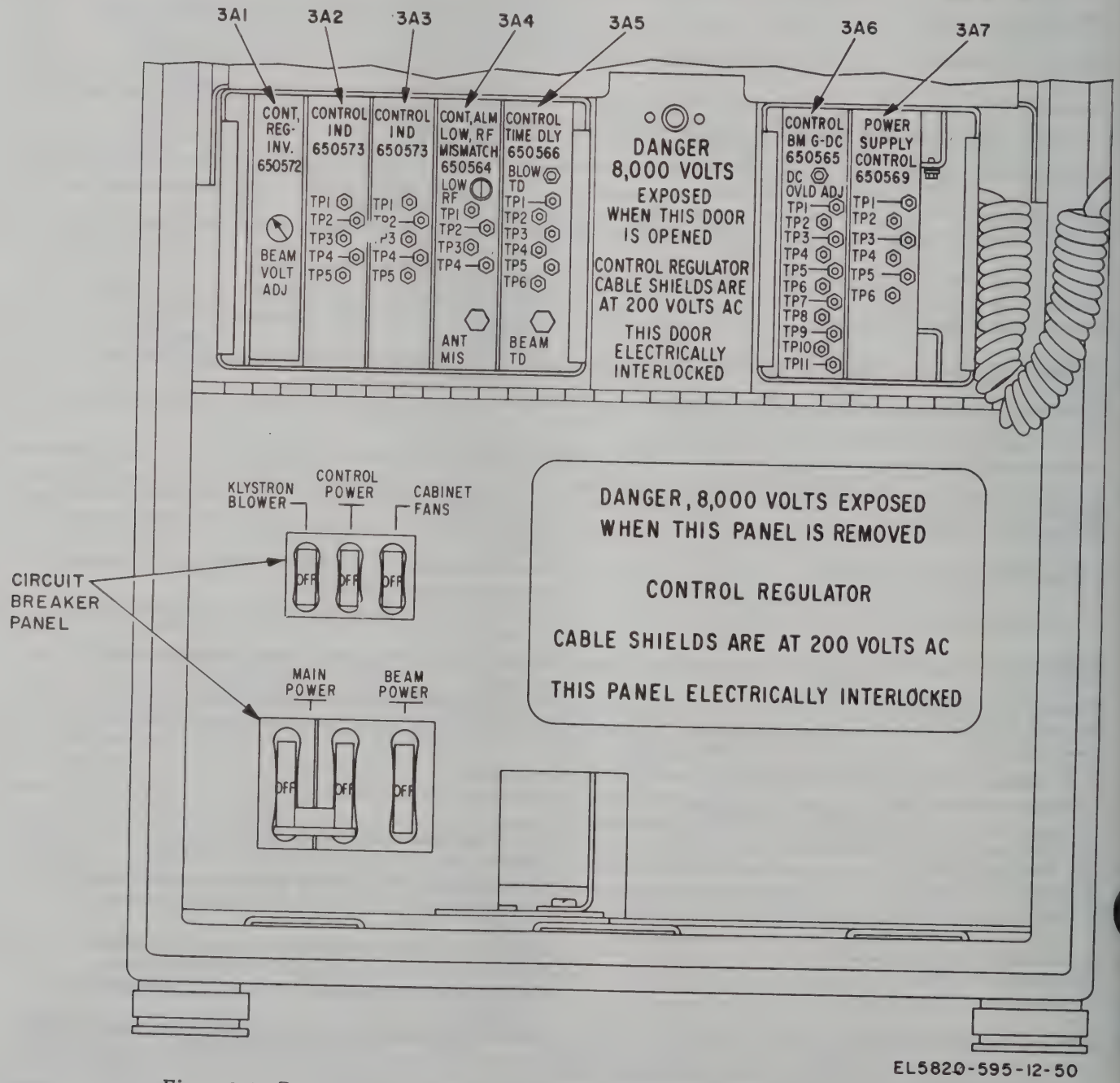


Figure 3-11. Power amplifier modules and circuit breaker panel, controls and indicators.

j. Klystron Compartment (fig. 3–12).

Control, indicator, or test jack	Function
FREQUENCY GHZ dial	Indicates klystron operating frequency set by operating 1ST CAVITY/MAIN TUNING control.
1ST CAVITY/MAIN TUNING control (black)	Tunes first cavity of klystron while setting FREQUENCY GHZ dial.
2ND CAVITY/FINE TUNING control (black)	Tunes second cavity of klystron.
3RD CAVITY/FINE TUNING control (black)	Tunes third cavity of klystron.
4TH CAVITY/FINE TUNING control (black)	Tunes fourth cavity of klystron.
AT1 attenuator control (black)	Sets rf input level from transmitter.
F1, 0.5A SLO-BLO fuse with neon indicator	Protects primary circuit of –12 vdc power supply; neon indicator lights when fuse has blown.
TP1 BM I CAL test jack (blue)	Provides test access for monitoring BEAM CURRENT metering circuit.

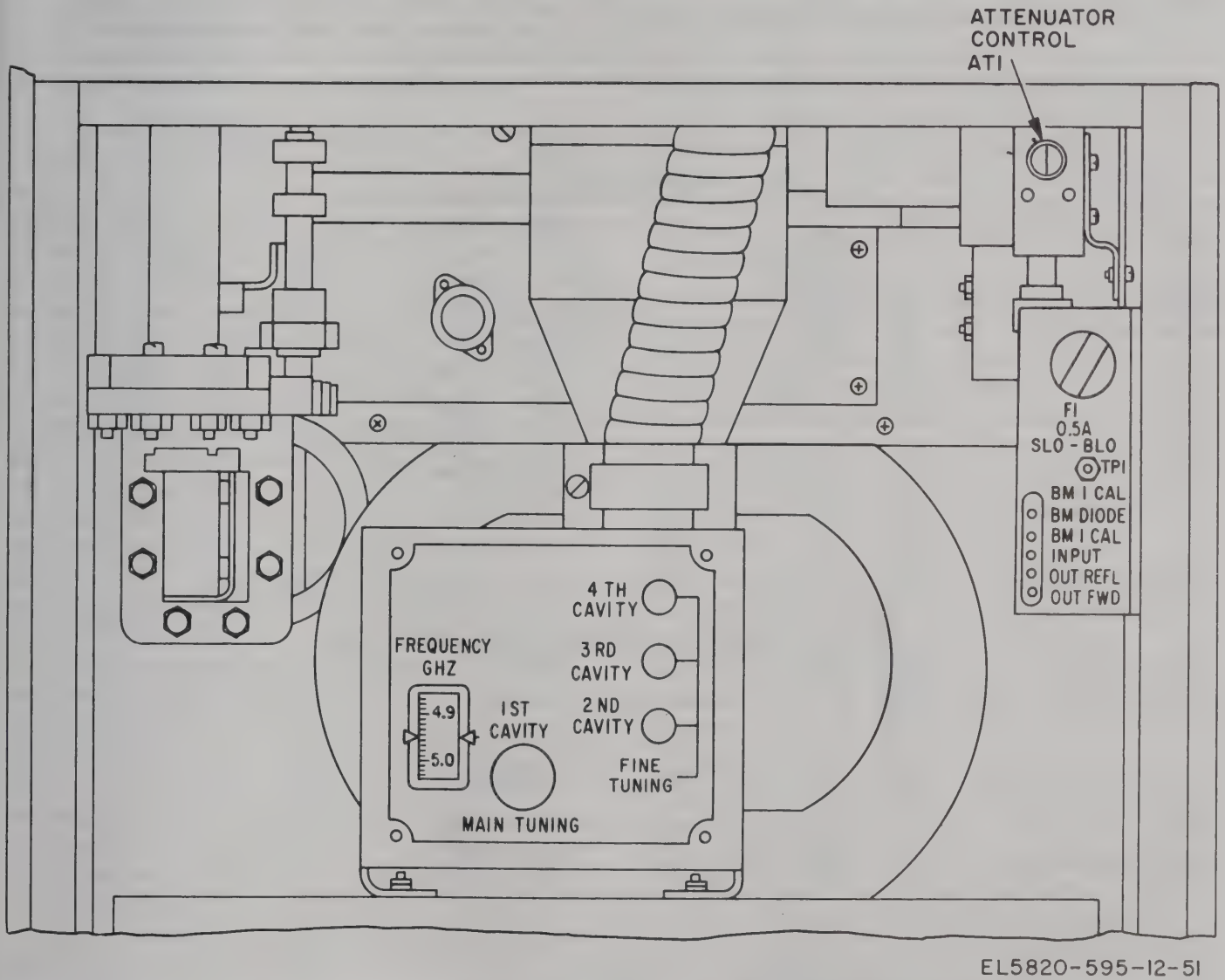


Figure 3–12. Power amplifier klystron compartment, controls and indicators.

3–6. Antenna Alignment Indicator 4A7, Controls and Indicators

Control, indicator, or test jack	Function
CHANNEL A meter	Indicates relative signal strength of received channel A input when IF amplifier 2A12 AGC SEL switch is in DIV OFF position.

Control, indicator, or test jack	Function
CHANNEL B meter	Indicates relative signal strength of received channel B input when IF amplifier 2A15 AGC SEL switch is in DIV OFF position.
ON–OFF (TRANSIT) switch (toggle)	When switch is ON, meters are connected for external current measurement; when switch is OFF meter terminals are short circuited to protect meters during transit.
FIELD TELEPHONE binding post	Provide connections for field telephone (order wire circuit) communications during orientation of antennas.

3–7. Directional Couplers 4A5 and 4A6, Controls and Indicators

Control, indicator, or test jack	Function
ATTEN ADJ control	Sets attenuation level of test signal injected into receiver input port. Control is adjustable from –20 db (minimum attenuation) o –40 db (maxitmum attenuation).

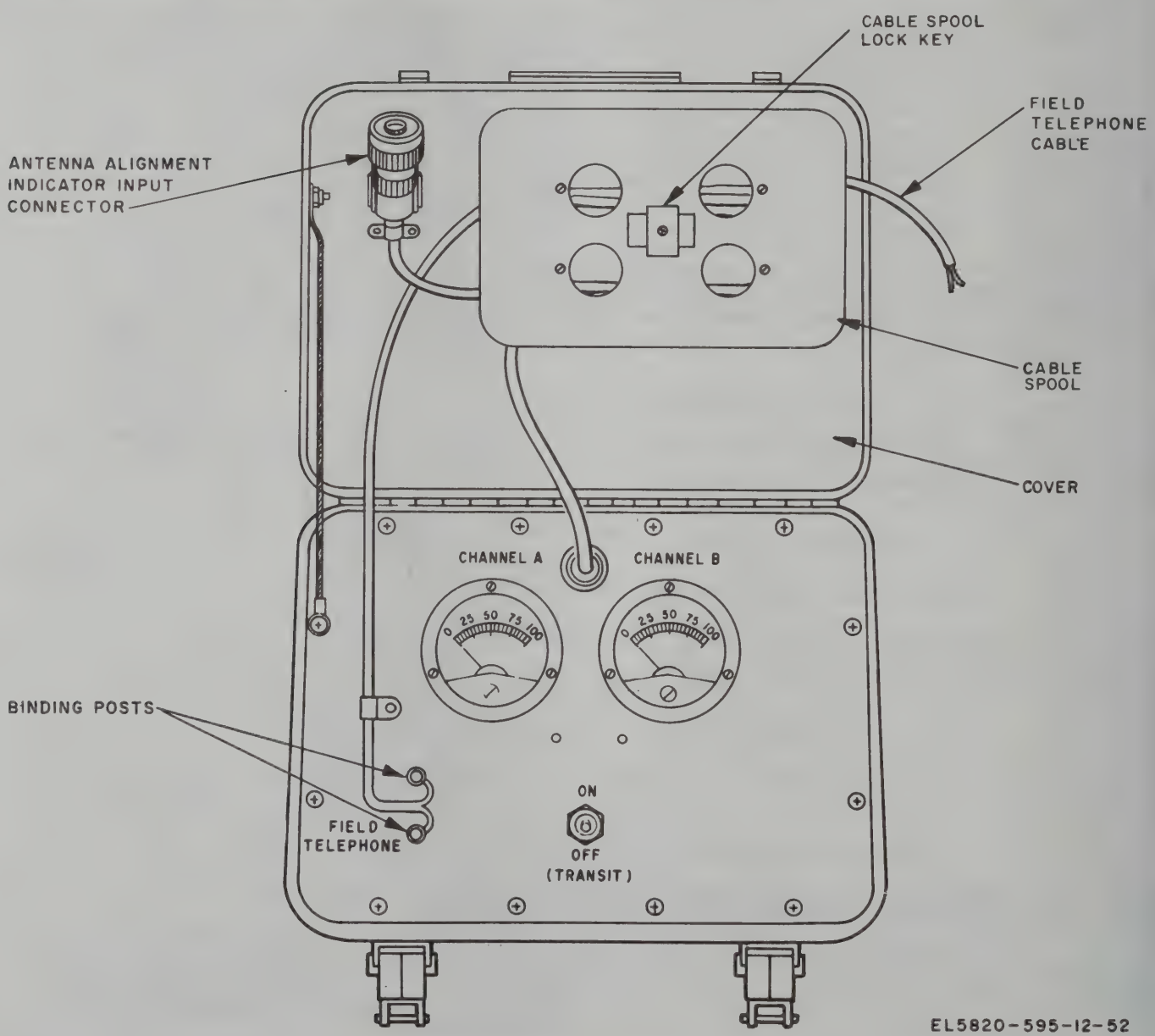


Figure 3–18. Antenna alignment indicator 4A7, controls and indicators.

3-8. Handset 4A4, Controls and Indicators

Control, indicator, or test jack	Function
Push to talk switch (pushbutton)	When depressed, this switch routes microphone output to handset cord for transmission. When switch is not depressed, voice signals transmitted to handset are routed to speaker.

Section II. OPERATION UNDER USUAL CONDITIONS

3-9. Operating Procedures

CAUTION

Operating personnel must observe the power amplifier fans and blower shutdown operating precautions covered in paragraph 3-19*a* when turning off the power amplifier input line power.

a. General. This section contains the operating procedures required to prepare and operate the radio set under usual conditions. Included are starting, tuning, and stopping procedures supplemented by 12- or 24-channel mode selection, frequency separation and the establishment of communications considerations. It should be noted that the radio set is shipped ready for 12-channel pcm operation. The exchange of modules to 24-channel pcm operation is normally implemented only as directed by the tactical situation and/or the communications officer. The operating procedures in the sequence that they should be performed are listed in *b* below. Operating personnel must become throughly familiar with all procedures contained in this section to prevent unnecessary delays in maintaining communications and to readily recognize and accurately report all radio set troubles that can cause communications difficulties.

b. Preparation and Operation of the Radio Set. To prepare and operate the radio set perform the procedures listed in (1) through (7) below. To restart the radio set after a shutdown for operational reasons (except shutdowns due to equipment malfunctions) perform the restarting procedures given in paragraph 3-14.

(1) Determine 12- or 24-channel mode selection (para 2-15).

(2) Determine carrier frequency separation (para 3-10).

(3) Preliminary starting procedure (para 3-11).

(4) Starting procedure (para 3-12).

(5) Power amplifier tuning procedure (para 3-13).

(6) Establishing communications (para 3-15).

(7) Stopping procedure (para 3-23).

3-10. Carrier Frequency Separation

Prior to starting the radio set, a frequency plan must be established between the radio set operators of a common radio link. When establishing the frequency plan the restrictions listed in *a* through *c* below must be taken into consideration. For information on frequency planning, refer to the system manual or consult the communications officer.

a. Single Stack Radio Sets. When operating a radio set in the single stack configuration, the transmit and receive frequencies must be separated by 90 MHz minimum. In addition, the transmitter operating frequency cannot be within 5 MHz of the receiver image frequency. For any given operating frequency, the receiver image frequency can be determined by using the formula given below.

Receiver image frequency = Received frequency − 140 MHz (when the received frequency is between 4400 and 4699.9 MHz).

Receiver image frequency = Received frequency + 140 MHz (when the received frequency is between 4700 and 5000 MHz).

b. Double Stack Radio Sets. When operating a radio set in the double stack configuration, the following restriction must be made in addition to the restrictions given in *a* above. That is, the transmit frequency of one radio set and the receive frequency of the second radio set must be separated by 40 MHz (minimum). *For example*; if the transmit frequency of one radio set is 4700 MHz, the receive frequency of the second radio set cannot be between 4660 and 4740 MHz. Similarly, the transmit frequency of the second radio set cannot be operated within 40 MHz (minimum) of the first radio set.

c. Interference From Other Radio Sets. When two or more radio terminals are operated within

50 miles of each other, the minimum carrier frequency separation between the transmitter of one communications terminal and the receiver of a different communications link shall be in accordance with the following chart.

Site separation	Frequency separation
Up to 2 miles	40 MHz minimum.
2 to 5 miles	32 MHz minimum.
5 to 10 miles	24 MHz minimum.
10 to 20 miles	21MHz minimum.
20 to 40 miles	17.5 MHz minimum.
40 to 50 miles	13 MHz minimum.
50 miles and greater	No separation required.

3-11. Preliminary Starting Procedure

Perform the preliminary starting procedures in *a* through *c* below before starting the equipment (para 3-12).

a. Transmitter. Lift and turn the two transmitter cabinet door latches and open cabinet doors. Preset transmitter controls as given in the following chart:

Location of item	Control	Set to—
Meter panel	POWER ON-OFF switch	OFF.
	Meter selector switch	OFF (TRANSIT).
Radio test set (p/o 1A15)	RCVR CHAN A selector switch	T-8.
	RCVR CHAN B selector switch	T-8.
100 MHz oscillator 1A2	ON-OFF switch	OFF.
4.4-5.0 GHz bandpass filter	PUSH TO TURN knob	Required transmitter output frequency.
Digital data modem 1A12	TRAFFIC SELECT 12 CHAN/24 CHAN switch.	12-or 24-channel position as required.
	CABLE LOOP TEST NORMAL/TEST switch.	NORMAL.
Order wire assembly 1A13	MODULE TEST switch	Switch position 1.
Frequency synthesizer 1A14	Thumbwheel switches (4)	Required transmitter output frequency.

b. Receiver. Lift and turn the two receiver cabinet door latches (fig. 1-9) and open cabinet doors. Preset the receiver controls as given in the following chart:

Location of item	Control	Set to—
Meter panel (p/o 2A22)	POWER ON-OFF switch	OFF.
	Meter selector switch	OFF (TRANSIT).
Preselector 2FL4	PUSH TO TURN knob	Required receiver frequency.
Preselector 2FL5	PUSH TO TURN knob	Required receiver frequency.
Post selector 2FL6	PUSH TO TURN knob	Rquired receiver frequency.
Post selector 2FL7	PUSH TO TURN knob	Required receiver frequency.
Local oscillator filter 2FL8	PUSH TO TURN knob	Required receiver frequency.
Local oscillator filter 2FL9	PUSH TO TURN knob	Required receiver frequency.
IF Amplifier 2A12	AGC SEL switch	DIV ON.
IF Amplifier 2A15	AGC SEL switch	DIV ON.
Combiner 2A16	Both SQUELCH ON-OFF switches	ON.
	Both APC ON-OFF switches	ON.
	AGC AUTO/MAN switch	AUTO
Frequency synthesizer 2A21	Thumbwheel switches (4)	Required receiver frequency.

c. Power Amplifier. Lift and turn the two power amplifier cabinet door latches and open cabinet doors. Set the shelter mounted waveguide switch to dummy load and preset the power amplifier controls as given in the following chart:

Location of item	Control	Set to—
Circuit breaker panel (fig. 3-11)	All circuit breakers	OFF.
Meter panel (p/o 3A9)	RF MONITOR SELECT pushbuttons	Press the INPUT FORWARD MILLIWATT pushbutton.
Klystron tuning panel	1ST CAVITY/MAIN TUNING control.	Required transmitter output frequency.
Inverter regulator control 3A1	BEAM VOLT ADJ knob	Fully counterclockwise.
Right side of klystron compartment (fig. 3-12).	Attenuator control AT1	Fully counterclockwise.

3-12. Starting Procedure

After the preliminary starting procedure (para 3-11) has been completed, perform steps *a* and *b* below to start the radio set. During the starting procedure alarm indications will be generated as a result of applying power to the equipment. All alarm indications are to be ignored until specifically checked as directed in a procedural step. If an abnormal indication is obtained in a procedural step; DO NOT continue to the next step! Refer to the preventive maintenance checks and services chart (para 4-5) for corrective measures. If the abnormal condition cannot be corrected, notify higher category of maintenance.

NOTE

Audible alarms will be generated during the starting procedure. To silence the audible alarm, press the RESET pushbutton (fig. 3-1) on the transmitter meter panel each time the audible alarm is heard.

a. On the transmitter meter panel (fig. 3-1), set the POWER ON/OFF switch to ON, then make the following checks:

(1) Check that the 5 AMPS SLO-BLO fuse indicator (fig. 3-1) on the transmitter meter panel is not lighted.

(2) Check that all power supply indicator lamps, DS1 through DS4 and DS6 through DS12, (fig. 3-2) are lighted green.

(3) Check that the 5V and 28V indicator lamps (fig. 3-5) on frequency synthesizer 1A14 are lighted green.

b. On the receiver meter panel (fig. 3-6), set the POWER ON-OFF switch to ON, then make the following checks:

(1) Check that the POWER 8 AMPS, TDA A 1 AMP, and TDA B 1 AMP fuse indicators (fig. 3-6) are not lighted.

(2) Check that all power supply indicator lamps, DS1 through DS4, (fig. 3-8) are lighted green.

(3) Check that the 5V and 28V indicator lamps (fig. 3-9) on frequency synthesizer 2A21 are lighted green.

3-13. Power Amplifier Tuning Procedure

CAUTION

When outside temperatures are below zero degrees Farenheit (—18 degrees Centigrade), the shelter amplifier circular heater must be turned on to preheat the amplifier before the beam voltage is used. The beam voltage must not be turned on until the circular heater thermostat has turned off the circular heater. Power unit overload will result if both the circular heater and beam voltage are on at the same time.

a. Check that the shelter mounted waveguide switch is set to the dummy load position and set the power amplifier FINE TUNING controls to the following positions:

(1) 2ND CAVITY to fully counterclockwise.

(2) 3RD CAVITY to fully clockwise.

(3) 4TH CAVITY to approximately center.

b. Check that 3A1 BEAM VOLT ADJ control (fig. 3-11) is turned fully counterclockwise.

c. On the power amplifier circuit breaker panel (fig. 3-11) set the MAIN POWER, KLYSTRON BLOWER, CONTROL POWER, and CABINET FANS circuit breakers to ON. The BEAM POWER circuit breaker remains OFF.

d. On the power amplifier meter panel (fig. 3-10), if not lighted green, press the MAIN POWER SWITCH to light green. If not lighted red, press the BEAM SWITCH to light red.

e. Press the INPUT FORWARD MILLIWATT pushbutton (fig. 3-10) and set attenuator control AT1 (fig. 3-12) for a RF MONITOR meter indication of 30.

f. If the outside temperature is less than zero degrees Fahrenheit (-18 degrees Centigrade) wait 5 minutes before proceeding with the tuning procedure. If the klystron was in storage prior to use wait 15 minutes.

g. After the TIME DELAY indicator (fig. 3-10) on the power amplifier meter panel lights green (approximately 4 minutes after the MAIN POWER SWITCH lights green), set the circuit breaker panel BEAM POWER circuit breaker (fig. 3-11) to ON.

CAUTION

Perform the following step so that no time is lost between activating the BEAM SWITCH and adjusting the BEAM VOLT ADJ control.

h. Press the power amplifier meter panel BEAM SWITCH to light green and adjust the 3A1 BEAM VOLT ADJ control for an indication of 2.0 on the BEAM VOLTAGE meter. Wait 5 minutes before proceeding.

CAUTION

Use the ANTENNA REFLECTED WATTS pushbutton (fig. 3-10) on the power amplifier meter panel at frequent intervals during the tuning procedure. With the ANTENNA REFLECTED WATTS pushbutton pressed, the RF MONITOR meter indication should not exceed 100.

i. On inverter regulator control 3A1 (fig. 3-11), slowly adjust the BEAM VOLT ADJ control for a BEAM VOLTAGE (fig. 3-10) meter indication of 7.5.

If any instability of the BEAM CURRENT or BEAM VOLTAGE meter is noticed, reduce the BEAM VOLT ADJ to a level just below the point of instability and allow approximately five minutes warmup. Repeat until a stable 7.5 kv beam voltage is established.

j. On the power amplifier meter panel (fig. 3-10), press the ANTENNA FORWARD WATTS X 10 pushbutton.

k. Slowly turn 1ST CAVITY/MAIN TUNING control (fig. 3-12) for a peak RF MONITOR meter indication.

l. Preset the 4TH CAVITY/FINE TUNING control fully counterclockwise, then slowly turn it clockwise and tune for a peak RF MONITOR meter indication.

m. Deleted.

n. Turn 2ND CAVITY/FINE TUNING control and tune for a maximum RF MONITOR meter indication.

o. Slowly turn 3RD CAVITY/MAIN TUNING control counterclockwise and tune for a peak RF MONITOR meter indication.

p. Press the INPUT FORWARD MILLIWATT pushbutton (fig. 3-10), and set attenuator control AT1 (fig. 3-12) for a RF MONITOR meter indication of 40.

q. Press the ANTENNA FORWARD WATTS X 10 pushbutton (fig. 3-10) on the power amplifier meter panel.

CAUTION

Do not permit BEAM VOLTAGE meter indication to exceed 8.2 during BEAM VOLT ADJ in step *r* below.

r. Set BEAM VOLT ADJ control (fig. 3-11) on inverter regulator control 3A1 for a RF MONITOR meter indication of 100. If RF MONITOR meter indication of 100 cannot be obtained, readjust the 1ST CAVITY, 2ND CAVITY, 4TH CAVITY and 3RD CAVITY tuning controls for a peak RF MONITOR meter reading. If a RF MONITOR meter indication of 100 still cannot be obtained, notify higher category of maintenance.

s. Press the INPUT FORWARD MILLIWATT pushbutton (fig. 3-10), and check that RF MONITOR meter indication is not greater than 50.

t. Press the ANTENNA REFLECTED WATTS pushbutton (fig. 3-10), and check that the RF MONITOR meter indication is less than 100.

u. Close and latch the two power amplifier cabinet doors.

3-14. Restarts

WARNING

ELECTROMAGNETIC RADIATION

ELECTROMAGNETIC RADIATION HAZARDS EXIST AT THE POWER AMPLIFIER WAVEGUIDE OUTPUT AND WITHIN THE DIRECTIONAL PATH OF THE ANTENNA! DO NOT START THE POWER AMPLIFIER UNTIL YOU ARE SURE THAT THE ANTENNA IS CORRECTLY POSITIONED AND THAT ITS RADIATION PATH IS CLEAR.

To start the radio set after a routine shutdown period, one during which the operating frequency requires no change, perform steps *a* through *g* below. If trouble is encountered in starting or operating the radio set, refer to paragraph 3-9*b* and perform all of the procedures listed.

a. On the transmitter and receiver meter panels (figs. 3-1 and 3-6), set the POWER ON-OFF switches to ON.

b. On the power amplifier inverter regulator control 3A1, set the BEAM VOLT ADJ control fully counterclockwise.

c. On the power amplifier circuit breaker panel (fig. 3–11), set the following circuit breakers to ON: MAIN POWER, KLYSTRON BLOWER, CONTROL POWER, and CABINET FANS.

d. Check that MAIN POWER SWITCH (fig. 3–10) on power amplifier meter panel is lighted green. If it is not; press the MAIN POWER SWITCH, it shall light green. Approximately four minutes after the MAIN POWER SWITCH lights green, the TIME DELAY indicator will light green.

e. After the TIME DELAY indicator (fig. 3–10) on the power amplifier meter panel lights green, set the BEAM POWER circuit breaker (fig. 3–11) to ON.

f. Check that the BEAM SWITCH (fig. 3–10) on the power amplifier meter panel is lighted green. If it is not; press the BEAM SWITCH, it shall light green.

g. On inverter regulator control 3A1 (fig. 3–11), slowly adjust the BEAM VOLT ADJ control for a BEAM VOLTAGE (fig. 3–10) meter indication of 7.5. If any instability of the BEAM CURRENT or BEAM VOLTAGE meter is noticed, reduce the BEAM VOLT ADJ to a level just below the point of instability and allow approximately five minutes warmup. Repeat until a stable 7.5 kv beam voltage is established.

3–15. Establishing Communications

WARNING
ELECTROMAGNETIC
RADIATION
ELECTROMAGNETIC RADIATION HAZARDS EXIST AT THE POWER AMPLIFIER WAVEGUIDE OUTPUT AND WITHIN THE DIRECTIONAL PATH OF THE ANTENNA! DO NOT PLACE THE SHELTER MOUNTED WAVEGUIDE SWITCH IN THE ANTENNA POSITION UNTIL YOU ARE SURE THAT THE ANTENNA IS CORRECTLY POSITIONED AND THAT ITS RADIATION PATH IS CLEAR.

a. Make certain the power amplifier is tuned (para 3–13), then place the shelter mounted waveguide switch in the antenna position.

b. Contact the distant radio set operator, via order wire (para 3–17), and notify him that you are ready to begin traffic transmission.

c. Contact your cable site operator (Multiplexer TD–204/U operator), via order wire (para 3–17), and notify him that you are ready to begin handling traffic.

d. Perform the operational checks (para 4–8) to determine whether the radio set is operating properly.

NOTE

When communications must be stopped for any reason, be sure to notify the distant radio set operator and your cable site operator, via order wire (para 3–17), before turning off the radio set. NEVER turn off your radio set without first notifying all cognizant personnel. Contact will be completely lost with the radio set off.

3–16. Changing Frequency

Refer to the frequency limitations imposed in paragraph 3–10 before attempting to retune the radio set to a new carrier frequency. The transmitter and power amplifier must be tuned to the same frequency, and the receiver must be tuned to a different frequency within the operational band of 4.4 to 5.0 GHz. The following procedures assumes that the radio set is in an operational status prior to the carrier frequency change.

NOTE

Certain alarm indications will be generated when changing frequency. These alarm conditions are to be ignored unless otherwise stated in text. The audible alarm can be silenced by pressing the RESET pushbutton (fig. 3–1) on the transmitter meter panel each time the audible alarm is heard.

a. Receiver. This procedure can be omitted if only a transmitter carrier frequency change is required.

(1) Set the four thumbwheel switches on frequency synthesizer 2A21 (fig. 3–9) for a frequency indicator dial readout equal to the required receiver frequency.

(2) Set preselectors 2FL4 and 2FL5 (fig. 3–7) to required receiver frequency by operating the PUSH TO TURN knobs and observing the readout on the FREQ MHz dial.

(3) Set post selectors 2FL6 and 2FL7 (fig. 3–8) to required receiver frequency by operating the PUSH TO TURN knobs and observing the readout on the FREQ MHz dial.

(4) Set local oscillator filters 2FL8 and 2FL9 (fig. 3–8) to required receiver frequency by operating the PUSH TO TURN knobs and observing the readout on the FREQ MHz dial.

b. Transmitter. Perform procedure given below, and then power amplifier procedure given in *c* below, when a transmitter carrier frequency change is required.

(1) Set the four thumbwheel switches on frequency synthesizer 1A14 (fig. 3–5) for a frequency indicator dial readout corresponding to the required transmitter frequency.

(2) Set 4.4 to 5.0 GHz bandpass filter 1FL3 (fig. 3–3) to the required transmitter frequency by operating the PUSH TO TURN knob and observing the reading on the FREQ MHz dial. The RF POWER indicator (fig. 3–1) on transmitter meter panel will light green.

c. Power Amplifier. The power amplifier tuning procedure (para 3–13) must be performed each time the transmitter frequency is changed.

3–17. Use of Orderwire Facilities

All order wire stations in the communications network can signal and communicate with all other orderwire stations on a party line basis. Since all stations receive an identical orderwire RING signal, it may be desirable to prearrange an addressee code to identify the station being called. Each station can be identified by combinations of long and short ring signals as required. The local handset (fig. 1–2) must be connected to the J3 HANDSET INTERCONNECT connector at the top of the transmitter cabinet.

a. Originating a Local Order Wire Call.

(1) Lift handset from its shelter mounted cradle.

(2) Press the RING pushbutton (fig. 3–1) on the transmitter meter panel. The RING indicator directly above the pushbutton will change from green to amber color and a 1.6-kHz tone signal will be heard over the speaker mounted on the transmitter meter panel.

(3) When the distant station answers, a voice response will be heard in the local handset and over the speaker. Adjust the SPEAKER VOLUME control (fig. 3–1) on the transmitter meter panel to a comfortable listening level.

(4) Operate the push-to-talk switch on the local handset (fig. 1–2) while speaking, and talk in a normal conversational tone directly into the handset mouthpiece.

(5) Release the push-to-talk switch on the handset to listen to the other orderwire station.

(6) At the completion of the call, replace handset in its cradle.

NOTE

An order wire call can also be originated from remote telephone TA–312/PT (not included with radio set) by turning the ring crank for signaling.

b. Receiving an Order Wire Call.

(1) When an orderwire ring signal is received, the RING indicator (fig. 3–1) on the transmitter meter panel will change color from green to amber, and a 1.6-kHz tone will be heard over the speaker.

NOTE

The visual indication at the RING indicator and the audible 1.6-kHz tone from the speaker will not be influenced by the setting of the SPEAKER VOLUME control.

(2) Lift the handset (fig. 1–2) from its shelter mounted cradle and while operating push-to-talk switch on the handset, reply to the calling station by speaking in a normal conversational level directly into the handset mouthpiece.

(3) Release push-to-talk switch at the end of each transmission and adjust the SPEAKER VOLUME control (fig. 3–1) to a comfortable listening level while the caller is speaking.

(4) At the completion of the call, replace the handset in its cradle.

(5) Orderwire converstaions between any other stations will be heard over the speaker due to the party line concept. These conversations can be silenced by turning the SPEAKER VOLUME control (fig. 3–1) fully counterclockwise.

3–18. Use of Antenna Alignment Indicator 4A7

When used with the receiver, the two meters in antenna alignment indicator 4A7 monitor the signal strengths of either or both of the diversity receiver channels. When antenna orientation adjustments are required during the installation phase, or the antennas must be redirected to an alternate station on a different azimuth bearing, follow the procedures outlined below. It is assumed that the starting procedure (para 3–12) has been completed, the power amplifier tuned (para 3–13), and the remote radio station is transmitting.

a. Position the antenna alignment indicator where it will be used as an indicator while orienting the antennas.

b. Remove the cabling from the antenna alignment indicator (fig. 3–13) by turning the cable spool lock key a 1/4 turn and removing the cable spool from the cover. Unwind as much cabling from the cable spool as will be required for connections.

c. Connect the antenna alignment indicator input connector (fig. 3–13) to the shelter external entry connector for the antenna alignment indicator.

d. Connect the open ends of the field telephone cable (fig. 3–13) to Telephone Set TA–312/PT.

e. Utilize the mast bracket on the receiver channel A antenna (the antenna that has two waveguides connected to it), and hang the antenna alignment indicator at the joint of the first and second mast section of that antenna.

f. Set the shelter phone selector switch to the antenna alignment indicator position.

g. Set the ON–OFF (TRANSIT) switch on antenna alignment indicator to ON.

h. Set the receiver AGC SEL switches (fig. 3–9) on 70-MHz IF amplifiers 2A12 and 2A15 to DIV OFF.

i. Perform the procedures in paragraph 2–36 *b*(3) through (16).

j. Set the ON–OFF (TRANSIT) switch on antenna alignment indicator (fig. 3–13) to OFF.

k. Disconnect the antenna alignment indicator input connector from the shelter external entry connector and wind the cable back onto the cable spool.

l. Disconnect the open ends of the field telephone cable from Telephone Set TA–312/PT and wind the cable back onto the cable spool.

m. Insert the cable spool into the antenna alignment indicator cover and turn the cable spool lock key 1/4 turn to secure the cable spool.

n. Set the shelter phone selector switch to the TA–312/PT phone position.

o. Set the receiver AGC SEL switches (fig. 3–9) on 70-MHz IF amplifiers 2A12 and 2A15 to DIV ON.

3–19. Operating Precautions

a. Power Amplifier Fans and Blower Shutdown. The power amplifier fans and blower will continue to operate for 3.0 to 4.0 minutes after the MAIN POWER SWITCH (fig. 3–10) is deactivated (MAIN POWER SWITCH lighted white when deactivated). Never set the MAIN POWER circuit breaker (fig. 3–11) to OFF during this blower shutdown period. Failure to heed this caution may cause damage to the power amplifier.

b. Handset Techniques. Use of the H–156/U requires that the mouthpiece of the handset be held close to the operator's lips and normal conversational speech level be used while pressing the handset push-to-talk switch.

c. Cabinet Doors. Keep cabinet doors closed during normal operation. Open the cabinet doors only when required to perform maintenace functions.

3–20. Recognition and Identification of Jamming

It is possible that under real or simulated tactical conditions the receiver may be jammed by the enemy. Enemy jamming can be accomplished by transmitting a strong signal at the same frequency as that of the receiving AN/GRC–143, making it difficult or impossible for intelligible signal reception. Unusual noises or strong interference heard on the receiver may be enemy jamming, signals from a friendly station, noise from a local source, or the receiver may be defective. To determine whether or not the interference is originating in the receiver, retune both preselector filters (2FL4 and 2FL5) to the furthest frequency away from the receiver carrier frequency. If the interference continues at approximately the same level, the receiver is defective. If the interference level decreases, an external signal is present. Retune both filters to the original receiver frequency when this check has been completed. Enemy jamming signals may be typed as continuous wave, pulsed carrier, or modulated jamming.

a. Continuous-Wave Jamming. Continuous-wave jamming can be detected by steady high readings when the meter on the receiver meter panel is in the AGC position, and squeals or distorted orderwire signals are received from the distant radio station.

b. Pulsed Carrier. When the receiver is being jammed by carrier being periodically turned on and off in a telegraphic manner, a continuous buzz will be heard over the order wire circuit at an audio frequency equal to the pulse repetition rate of the jamming signal.

c. Modulated Jamming. Jamming signals can be modulated in amplitude, frequency, or by stepped tones. In addition to the high signal strength indications described in *a* above, modulated jamming can cause severe amplitude of frequency distortion of the order wire signals from the distant radio station.

3–21. Antijamming

Two or more alternate frequencies and call signs should be prearranged between the radio stations in the event that future jamming completely disrupts order wire communication between the two radio stations. When it is known that a receiver is being jammed, the operator will notify the superior officer immediately and continue to operate the equipment. To provide maximum intelligibility of jammed signals, follow the operational procedures below.

NOTE

Even though the received order wire signal from the distant station is completely jammed, one-way order wire transmission may still be effective if the distant station receiver is not being simultaneously jammed. This characteristic may be used to advantage in coordinating frequency changes, station relocation, or other countermeasures.

a. Originate an order wire call (para 3–17) to the distant radio station and request that the operator provide a slow count of numbers or a test tone on the order wire circuit.

b. While listening to the distant station order wire signal, slowly reposition each of the receiving antennas in azimuth and elevation. If the jamming station is not on a direct plane between the two radio stations, some separation of the desired signal and the jamming signal can be effected.

c. While listening to the distant station order wire signal, detune both receiver channels by operating the PUSH TO TURN knobs of the preselector and post selector filters to a slightly different carrier frequency. Adjustment of one or more of these filters may provide some additional separation between the order wire signal and the jamming signal.

NOTE

This step will be ineffective if the jamming station frequency is equal to, or close to the required receiver frequency.

d. If the above steps do not provide sufficient signal separation for operation, change to a prearranged alternate frequency and alternate call sign.

NOTE

In cases where extremely severe jamming is experienced, relocate the jammed station behind an obstruction such as a hill which shadows the jamming station but provides a clear path to the desired radio station. If a suitable obstruction is not available, select a new site which requires a significant change of antenna azimuth or elevation settings. This type of relocation takes advantage of the relatively narrow beamwidth of the antenna to reject the jamming station signals, yet permits normal communication with the desired station.

3-22. Standby Operation

When radio communications is not required, the radio set can be placed in the standby condition by pressing the BEAM SWITCH (fig. 3-10) on the power amplifier meter panel. The BEAM SWITCH indicator shall light red. To return to normal operation, press the BEAM SWITCH again, it shall light green.

3-23. Stopping Procedure

To turn off the radio set, proceed as follows:

a. Set the POWER ON-OFF switch (fig. 3-1) on the transmitter meter panel to OFF.

b. Set the POWER ON-OFF switch (fig. 3-6) on the receiver meter panel to OFF.

CAUTION

NEVER set the MAIN POWER, KLYSTRON BLOWER, or CABINET FANS circuit breakers on the power amplifier circuit breaker panel (fig. 3-11) to OFF while the cabinet fans and blower are operating. The cabinet fans and blower will continue to run for approximately 4 minutes after the MAIN POWER SWITCH (*c* below) has been deactivated (lighted white when deactivated).

c. Press the BEAM SWITCH and MAIN POWER SWITCH on the power amplifier meter panel (fig. 3-10).

d. When the cabinet fans and blower stop operating, set the five circuit breakers (fig. 3-11) on the power amplifier circuit breaker panel to OFF.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

3-24. Operation at Reduced Power Output

The radio set can be operated at reduced power outputs, down to 100 watts, by tuning the power amplifier for a 1.0-kilowatt output as described in paragraph 3-13 and then decreasing the power amplifier's output power as described below.

NOTE

The LOW RF alarm indicator (fig. 3-10) on the power amplifier meter panel will light red when the power amplifier's power level drops below 500 watts.

NOTE

Operation of the power amplifier at power output levels below 500 watts will cause the CNTRL ALARM indicator (fig. 3-1) on the transmitter meter panel to light red and audible alarm to sound. The audible alarm can be silenced by pressing the RESET pushbutton (fig. 3-1) on the transmitter meter panel each time the audible alarm is heard. If the audible alarm continues to sound or sounds after the following procedure is completed, it indicates a trouble exists in the equipment.

a. Press the ANTENNA FORWARD WATTS X 10 pushbutton (fig. 3-10) on the power amplifier meter panel.

b. Slowly decrease the power amplifier output power to 100 watts, as indicated by a RF MONITOR meter indication of 10, by slowly turning the BEAM VOLT ADJ control (fig. 3-11) on inverter regulator control 3A1 and counterclockwise.

CHAPTER 4

OPERATOR'S MAINTENANCE INSTRUCTIONS

4–1. Scope of Maintenance

The maintenance duties assigned to the operator of Radio Set AN/GRC–143 are listed below with a reference to the paragraphs covering the specific maintenance function. The duties assigned to the operator do not require any special tools or test equipment other than those issued with the radio set.

a. Operator/crew preventive maintenance checks and services (para 4—5).

b. Deleted.

c. Cleaning (para 4–7).

d. Operational checks (para 4–8).

(1) Status and alarm indicator checks (para 4–9).

(2) Metering checks (para 4–10).

(3) Order wire checks (para 4–11).

e. Operation of fans and blowers (para 4–12).

f. Operator's troubleshooting (para 4–13).

g. Fuse replacement (para 4–14).

h. Air filter removal and replacement (para 4–15).

i. Transmitter traffic level adjustment (para 4–16).

j. Receiver traffic level adjustment (para 4–17).

k. Power amplifier low RF alarm adjustment (para 4–18).

4–2. Tools and Materials Required for Maintenance

The tools and materials required for operator's maintenance are listed below.

a. Tools. No special tools are required.

b. Materials.

(1) Cleaning compound (trichlorotrifluoroethane). NSN 6850-00-105-3084.

(2) Cleaning cloth.

(3) Detergent.

(4) Fine bristle brush.

4–3. Preventive Maintenance

a. General. Operator/crew preventive maintenance is the systematic care, servicing and inspection of equipment to prevent the occurrence of trouble, to reduce downtime, and to maintain equipment in serviceable condition. To be sure that your Radio Set is always ready for your mission, you must do scheduled preventive maintenance checks and services (PMCS).

(1) BEFORE OPERATION, perform your B PMCS to be sure that your equipment is ready to go.

(2) DURING OPERATION, perform your D PMCS. This should help you to spot small troubles before they become big problems.

(3) WEEKLY AND MONTHLY PMCS are important checks to keep serious problems from suddenly happening. Perform WEEKLY as well as BEFORE OPERATION PMCS if:

(a) You are the assigned operator and have not operated the item since the last WEEKLY.

(b) You are operating the item for the first time.

(4) When an item of equipment is reinstalled after removal, for any reason, perform the necessary B PMCS to be sure the item meets the readiness reporting criteria.

(5) Use the ITEM NO. column in the PMCS table to get the number to be used in the TM ITEM NO. column on DA Form 2404 (Equipment Inspection and Maintenance Worksheet) when you fill out the form.

b. Special Instructions. Routine checks like CLEANING, PRESERVATION, DUSTING, WASHING, CHECKING FOR FRAYED CABLES, STOWING ITEMS NOT IN USE, COVERING UNUSED RECEPTACLES, CHECKING FOR LOOSE NUTS AND BOLTS, AND CHECKING FOR COMPLETENESS are not listed as PMCS checks. They are things that you should do any time you see they must be done. If you find a routine check like one of those listed in your PMCS, it is because other operators reported problems with this item.

NOTE

When you are doing any PMCS or routine checks, keep in mind the warnings and cautions.

WARNINGS

- Never operate the generator or shelter until it has been properly grounded. Electrical defects in the load lines or equipment can cause death by electrocution when contact is made with an ungrounded system.

- Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Prolonged breathing of vapor should be avoided. The solvent should not be used near heat or open flame; the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, prolonged contact with skin should be avoided. When necessary, use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a physician immediately.
- Compressed air is dangerous and can cause serious bodily harm if protective means or methods are not observed to prevent a chip or particle (of whatever size) from being blown into the eyes or unbroken skin of the operator or other personnel. Goggles must be worn at all times while cleaning with compressed air. Compressed air shall not be used for cleaning purposes except where reduced to less than 29 pounds per square inch gage (psig) and then only with effective chip guarding and personnel protective equipment. Do not use compressed air to dry parts when trichlorotrifluoroethane has been used.

NOTES

The PROCEDURES column in your PMCS charts instruct how to perform the required checks and services. Carefully follow these instructions and, if tools are needed or the chart so instructs, get organizational maintenance to do the necessary work.

If your equipment must be in operation all the time, check those items that can be checked and serviced without disturbing operation. Make the complete checks and services when the equipment can be shut down.

c. Deficiencies that cannot be corrected must be reported to higher category maintenance personnel. Records and reports of preventive maintenance must be made in accordance with procedures given in TM 38-750.

4–4. Operator/Crew Preventive Maintenance Checks and Services (Paragraph 4–5)

Perform weekly as well as before operation PMCS if:

a. You are the assigned operator and have not operated the item since the last weekly.

b. You are operating the item for the first time.

NOTE

The checks in the interval column are to be performed in the order listed.

4–5. Operator/Crew Preventive Maintenance Checks and Services Chart - continued

B — Before D — During W — Weekly M — Monthly

Item No.	Interval B	Interval D	Interval W	Interval M	Item to be Inspected	Procedures — Check for and have repaired or adjusted as necessary	Equipment is Not Ready/Available If:
1	•				Mission Essential Equipment	Check for completeness and satisfactory condition of the equipment. Report missing items.	Available equipment is insufficient to support the combat mission.
						TRANSMITTER	
2	*				Indicator Lights	Check the following indicator lights: a. 5 AMPS SLO-BLO - not lighted. b. SYNTH OVEN - not lighted until oven up to temperature. c. Power Supply - lighted green (11 each). d. 100 MHz Oscillator Power - not lighted.	Indicator lights are inoperable and the replacement light does not work.

*Do this check before each deployment to a mission location. This will permit any existing problems to be corrected before the mission starts. The check does not need to be done again until redeployment.

4–5. Operator/Crew Preventive Maintenance Checks and Services Chart — continued

B — Before D — During W — Weekly M — Monthly

Item No.	Interval B	Interval D	Interval W	Interval M	Item to be Inspected	Procedures — Check for and have repaired or adjusted as necessary	Equipment is Not Ready/Available If:
						e. Freq. synthesizer power - lighted green. f. Freq. synthesizer module fault - not lighted (6 each). g. Digital data modem failure - lighted green (8 each).	
3	*				Radio Test Set	Perform the transmitter radio test set check during the first radio set shutdown period.	Transmitter does not operate properly.
4		•		•	Order Wire Check	a. When not interfering with radio operation, originate a call to the operator at the cable and radio ends of the communications link. b. Monthly check only — perform the order wire check as described in paragraph 4-11.	Unable to communicate.
5	•				Status and Alarm Indicator Checks	Perform the transmitter status and alarm indicator checks as described in paragraph 4-9a.	Status and alarm indicator checks do not operate properly.
6	•				Metering Checks	Perform the transmitter metering checks as described in paragraph 4-10a and record results.	Any meter indication not within limits.
						RECEIVER	
7	*				Indicator Lights	Check the following indicator lights: a. POWER 8 AMPS, TDAA-1 AMP and TDA B-1 AMP - not lighted. b. Power supply - lighted green. c. Freq. synthesizer power - lighted green. d. MULT OSC. A, MULT OSC. B and SYNTH OVEN - not lighted until oven up to temperature. e. Freq. synthesizer module fault - not lighted (6 each).	Indicator lights are inoperable and the replacement light does not work.
8	•				Status and Alarm Indicator Checks	Perform the receiver status and alarm indicator checks as described in paragraph 4-9b.	Status and alarm indicator checks do not operate properly.
9	•				Metering Checks	Perform the receiver metering checks as described in paragraph 4-10b. and record results.	Any meter indication not within limits.

*Do this check before each deployment to a mission location. This will permit any existing problems to be corrected before the mission starts. The check does not need to be done again until redeployment.

4–5. Operator/Crew Preventive Maintenance Checks and Services Chart – continued

B — Before D — During W — Weekly M — Monthly

Item No.	Interval B	Interval D	Interval W	Interval M	Item to be Inspected	Procedures — Check for and have repaired or adjusted as necessary	Equipment is Not Ready/Available If:
						AMPLIFIER	
10	*				Indicator Lights	Check the following indicator light: F1 fuse indicator - not lighted.	
11	•				Status and Alarm Indicator Checks	Perform the power amplifier status and alarm indicator checks as described in paragraph 4-9c.	
12	•				Metering Checks	Perform the power amplifier metering checks as described in paragraph 4-10c. and record results.	Any meter indication not within limits.
13			•		Air Filters (7 each)	Remove air filters as described in paragraph 4-15 and clean in a solution of detergent and water. Dry and reinstall.	
14			•		Fans and blowers	Check operation of all fans and blowers.	Cooling fan or blower inoperative.

*Do this check before each deployment to a mission location. This will permit any existing problems to be corrected before the mission starts. The check does not need to be done again until redeployment.

4-6. Deleted.

4–7. Cleaning

a. Equipment Exterior. Inspect the exteriors of the receiver, transmitter, and power amplifier cabinets. The exteriors must be kept free of dust, dirt, grease and fungus.

(1) Remove dust and loose dirt with a clean, soft cloth.

WARNING

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Prolonged breathing of vapor should be avoided. The solvent should not be used near heat or open flame; the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, prolonged contact with skin should be avoided. When necessary, use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a physician immediately.

(2) Remove grease, fungus, and ground-in dirt from the cabinets; use a cloth dampened (not wet) with trichloroethane.

(3) Remove dust or dirt from exterior plugs and jacks (figs. 2–16 through 2–18) with a bristle brush.

CAUTION

Do not press on meter faces (glass) when cleaning; the meters may be damaged.

(4) Clean the meter panels, meters, and control knobs. Use a soft, clean cloth. If difficulty in removing dirt occurs, dampen the cloth

with water; mild soap may be used to make the cleaning more effective.

b. Air Filters. To clean air filters, proceed as follows:

(1) Remove the air filter as described in paragraph 4-15.

(2) Clean the dirty air filter in a solution of water and detergent.

(3) Air the filter or if compressed air is available, dry the filter by blowing air (not exceeding 30 psi) through the filter.

NOTE

Perform steps (4) and (5) below on the power amplifier filter only.

(4) Coat the cleaned power amplifier filter with viscous impingement oil, NSN 8040-00-140-6988 and allow to drain before reuse.

(5) Wipe off excess oil from filter frame.

(6) Replace the air filter as described in paragraph 4-15.

4–8. Operational Checks

The operational checks provide the operator with a detailed check of the radio set's operating capability and tells the operator what to do if an abnormal condition is detected while the radio set is operating. The operational checks consist of the status and alarm indicator checks (para 4—9); the metering checks (para 4—10); and the order wire checks (para 4—11) and appear in the sequence that they should be performed. The status and alarm indicator checks determine whether the radio set is handling traffic satisfactorily, and the metering checks are used to verify the findings of the status and alarm indicator checks. The metering checks are also used to detect deteriorating components or modules in the radio set to prevent loss of radio communications. The order wire checks are used to determine whether the order wire channel is operating satisfactorily.

4–9. Status and Alarm Indicator Checks

The status and alarm indicator checks are performed daily by the operator to determine the operational status of the transmitter, receiver, and power amplifier. The status and alarm indicator checks are divided into three sections (*a* through *c* below); one for each major equipment cabinet in the radio set. Each section contains a chart that lists the status and alarm indicators on the equipment meter panel, the two possible colors the indicator can be lighted, and tells the operator what action is required if an abnormal indication is obtained. The status and alarm indicator checks should be performed in the sequence given. If more than one indicator is lighted red, refer to the operator action required for the first abnormal indication as it appears in the chart. If the operator action fails to remedy the trouble, or if a status or alarm indicator is extinguished (not lighted), a lamp failure is indicated. Notify higher category of maintenance.

a. Transmitter (fig. 3-1).

Indicator	Color lighted	Remarks	Operator action
RADIO TEST SET	Green	Normal indication	None.
	Red	Indicates that 100-MHz oscillator 1A2 is ON.	Set ON-OFF switch (fig. 3-3) on 100-MHz oscillator 1A2 to OFF.
INTERLOCK	Green	Normal indication	None.
	Red	Indicates that shelter mounted waveguide switch is between positions of dummy load and antenna.	*Warning:* DO NOT touch the waveguide switch until you are sure that no one is working on the waveguides, or is in the directional path of the antennas. Set the shelter mounted waveguide switch to ANTENNA. If the INTERLOCK indicator is still lighted red, check the RF POWER indicator on the transmitter meter panel. If RF POWER indicator is also lighted red, an operational fault has interrupted radio communications, notify higher category maintenance for repair. If RF POWER indicator is not lighted red, an alarm circuitry failure has occurred but radio set is operational, notify higher category of maintenance but do not interrupt radio set operation to remedy trouble.
RING	Green or amber	Lights amber when an order wire ring signal is present.	If indicator remains green or amber regardless of the order wire's status, a failure is indicated but radio communications has not been affected, notify higher category of maintenance.
CNTRL ALARM	Green	Normal indication	None.
	Red	Indicates that a functional alarm has been detected in the transmitter, receiver, or power amplifier.	Check all meter panel alarm indicators on the radio set. If any other alarm indicator is lighted red, check the operator action required for that condition. If the CNTRL ALARM indicator is the only red alarm indicator, contact the Multiplexer TD-204/U operator and distant radio set operator via order wire (para 3-17) and find out if traffic is being properly routed in both directions. If traffic is not being satisfactorily

Indicator	Color lighted	Remarks	Operator action
			routed, an operational failure is indicated, notify higher category of maintenance. If traffic is being routed satisfactorily, an alarm circuitry failure is indicated, notify higher category of maintenance, but do not interrupt radio set operation to remedy trouble.
TRAF	Green	Normal indication	None.
	Red	Indicates absence of pcm traffic from Multiplexer TD–204/U.	Check the CABLE TO RADIO MODEM indicator on the transmitter meter panel. If this indicator is lighted red, refer to the operator action required for that alarm indication.
			Check shelter mounted TRAFFIC IN indicator. If this indicator is lighted red, contact Multiplexer TD–204/U operator via order wire (para 3–17) and tell him that you are not receiving traffic.
			Perform the transmitter traffic level adjustment (para 4–16).
SYNTH LOCK	Green	Normal indication	None.
	Red	Indicates that an error has been detected in the frequency synthesizer's output.	Notify higher category maintenance. Radio communications may not be lost, but will be lost if corrective action is not taken.
RF POWER	Green	Normal indication	None.
	Red	Indicates loss of transmitter's RF carrier output.	Check the LOW RF indicator on the power amplifier meter panel amplifier meter panel (fig. 3–10).
			If LOW RF indicator is lighted red, an operational failure is indicated. Notify higher category of maintenance. If LOW RF indicator is lighted green, an alarm circuitry failure is indicated. Notify higher category maintenance but do not interrupt radio set operation to remedy trouble.
REFL RF POWER	Green	Normal indication	None.
	Red	Indicates that a mismatch exists between the transmitter's output and the power amplifier's input.	Retune power amplifier (para 3–13), then check LOW RF indicator (fig. 3–10) on power amplifier meter panel. If LOW RF indicator is lighted red, an operational failure is indicated. Notify higher category

Indicator	Color lighted	Remarks	Operator action
			of maintenance. If LOW RF indicator is lighted green, radio communication has not been interrupted. Notify higher category of maintenance.
CABLE TO RADIO MODEM	Green	Normal indication	None.
	Red	Indicates that a pcm fault exists in the digital data modem.	An operational failure is indicated. Check all digital data modem 1A12 failure indicator lamps (fig. 3–4) and notify higher category of maintenance.
RADIO TO CABLE MODEM	Green	Normal indication	None.
	Red	Indicates that a pcm fault exists in the digital data modem.	Check shelter mounted TRAFFIC OUT indicator. If this indicator is lighted red, an operational failure is indicated. Check all digital data modem 1A12 failure indicator lamps (fig. 3–4) and notify higher category of maintenance. If shelter mounted TRAFFIC OUT indicator is lighted green, contact Multiplexer TD–204/U operator (para 3–17) and ask if traffic is being received. If it is not, an operational failure is indicated. Notify higher category of maintenance. If the Multiplexer TD–204/U operator is receiving traffic, the radio set is operational but may have an intermittent or marginal operational capability. Notify higher category maintenance.

b. Receiver (fig. 3–6).

Indicator	Color lighted	Remarks	Operator action
CARR (IF) A	Green	Normal indication	None.
	Red	Indicates loss of receiver channel A input or that receiver channel A is squelched.	If indicator lights red intermittently, set receiver meter selector switch to CARRIER (IF) A and observe the receiver meter indication (fig. 3–6). If meter indication fluctuates between 10 and 100, check shelter mounted TRAFFIC OUT indicator. If this indicator is lighted green, disregard red CARR (IF) A indicator. If this indicator is lighted red,

Indicator	Color lighted	Remarks	Operator action
			or if CARR (IF) A indicator remains lighted red, an operational failure is indicated. Notify higher category of maintenance.
CARR (IF) B	Green	Normal indication	None.
	Red	Indicates loss of receiver channel B input or that receiver channel B is squelched.	Same as CARR (IF) A above. However, if both indicators are lighting red simultaneously, an operatonal failure is indicated. Notify higher category of maintenance.
VCO LOCK	Green	Normal indication	None.
	Red	Indicates fault in APC circuit, or loss of local oscillator signal.	If any other alarm indicator on the receiver meter panel is lighted red, an operational failure is indicated. Notify higher category of maintenance. Set receiver meter selector switch to VCO FREQ DIFF. If meter indication is not in blue band, an operational failure is indicated. Notify higher category of maintenance. If meter indication is within blue band, an alarm circuitry failure is indicated. Notify higher category of maintenance, but do not interrupt radio set operation to remedy trouble.
SPARE	Green	Normal indication	No action is required. This indicator is not connected to an operational circuit in the receiver but is provided for future expansion possibilities.
SYNTH LOCK	Green	Normal indication	None.
	Red	Indicates that an error has been detected in the frequency synthesizer's output.	Notify higher category of maintenance. Radio communication may not be lost, but will be lost if corrective action is not taken.
TRAF	Green	Normal indication	None.
	Red	Indicates absence of pcm traffic from distant radio set.	Check shelter mounted TRAFFIC OUT indicator. If this indicator is lighted green, perform the receiver traffic level adjustment (para 4–17). If TRAFFIC OUT indicator is lighted red, notify the distant radio set operator (para 3–17) that traffic is not being received. If traffic output from distant radio set is normal,

Indicator	Color lighted	Remarks	Operator action
			an operational failure is indicated. Notify higher category of maintenance.

c. Power Amplifier (fig. 3–10).

Indicator	Color lighted	Remarks	Operator action
MAIN POWER SWITCH	Green	Normal indication	None.
	White	Indicates that MAIN POWER SWITCH is deactiviated (off).	*Warning:* DO NOT press the MAIN POWER SWITCH until checking that no one is working on the waveguides, or is in the directional path of the antenna. Press the MAIN POWER SWITCH. If it does not light green, an operational failure is indicated. Notify higher category of maintenance.
	Extinguished	Indicates absences of primary power to the MAIN POWER SWITCH.	*Warning*: Check that no one is working on the waveguides, or is in the directional path of the antenna before performing any action. If all power amplifier meter panel indicators are lighted except the MAIN POWER SWITCH and BEAM SWITCH; set the MAIN POWER circuit breaker (fig. 3–11) to OFF and replace fuse F1 (fig. 3–12). If the MAIN POWER circuit breaker (fig. 3–11) is tripped (OFF), set it to ON and restart (para 3–14) the power amplifier. If MAIN POWER circuit breaker trips after being set to ON, an operational failure is indicated. Notify higher category of maintenance. If all power amplifier meter panel indicators are lighted green except MAIN POWER SWITCH a lamp failure is indicated. Notify higher category of maintenance but do not interrupt radio set operation to remedy trouble.
BEAM SWITCH	Green	Normal indication.	None.
	Red	Indicates that BEAM SWITCH is deactivated (off).	*Warning*: DO NOT press the BEAM SWITCH until you are sure

Indicator	Color lighted	Remarks	Operator action
			that no one is working on the waveguides, or is in the directional path of the antenna. Press the BEAM SWITCH; if it does not light green, an operational failure is indicated. Notify higher category of maintenance.
AIR	Green	Normal indication	None.
	Red	Indicates that klystron temperature is too high or air interlocks are open.	Check that CABINET FANS circuit breaker (fig. 3–11) is set to ON. If it is not, set it to ON. If CABINET FANS circuit breaker trips (OFF) after being reset to ON, an operational failure is indicated. Notify higher category of maintenance. If any other alarm indicator on the power amplifier meter panel is lighted red, an operational failure is indicated. Notify higher category of maintenance. If AIR indicator is the only red alarm indicator, check that all fans and blower are operating. If all fans and blower are operating, an alarm failure is indicated. Notify higher category of maintenance but do not interrupt radio set operation to remedy trouble.
FILAMENT	Green	Normal indication.	None.
	Red	Indicates loss of klystron filament voltage.	Check that FILAMENT VOLTAGE meter indication is in green band. If it is not, an operational failure is indicated. Notify higher category of maintenance. If any other indicator on the power amplifier meter panel is lighted red, an operational failure is indicated. Notify higher category of maintenance. If the FILAMENT indicator is the only red indicator, an alarm circuitry failure is indicated. Notify higher category of maintenance but do not interrupt radio set operation to remedy trouble.
TIME DELAY	Green	Normal indication.	None.
	Amber	Indicates that time delay is in progress.	If TIME DELAY indicator remains lighted amber after 4 minutes has

Indicator	Color lighted	Remarks	Operator action
			elapsed, an operational failure is indicated. Notify higher category of maintenance.
AC INTERLOCK	Green	Normal indication.	None.
	Red	Indicates that high voltage interlock door (fig. 1–14) is not closed.	Set BEAM POWER circuit breaker (fig. 3–11) to OFF and then close high voltage interlock door (fig. 1–4) and tighten the captive thumbscrew. Set BEAM POWER circuit breaker to ON. If AC INTERLOCK indicator is still lighted red, an operational failure is indicated. Notify higher category of maintenance.
BEAM	Green	Normal indication.	None.
	Red	Indicates loss of primary power to high voltage power supply.	*Warning*: Be sure that no one is working on the waveguides, or is in the directional path of the antenna before taking any action. Check that all other alarm indicators on the power amplifier meter panel are lighted green. If they are not, refer to the operator action required for the other red alarm indicators. If all other alarm indicators are lighted green, check that BEAM VOLTAGE meter indication is in green band. If it is not, an operational failure is indicated. Notify higher category maintenance. If BEAM VOLTAGE meter indication is in the green band, an alarm circuitry failure is indicated. Notify higher category of maintenance but do not interrupt radio set operation to remedy trouble.
AC OVERLOAD	Green	Normal indication.	None.
	Red	Indicates loss of primary power to high voltage power supply.	Check that BEAM POWER circuit breaker (fig. 3–11) is set to ON. If it is not, set it to ON. If BEAM POWER circuit breaker trips (OFF) after being set to ON, an operational failure is indicated. Notify higher category of maintenance. If any other alarm indicator on the power amplifier meter panel is lighted red, an operational failure is indi-

Indicator	Color lighted	Remarks	Operator action
			cated. Notify higher category of maintenance. If AC OVERLOAD indicator is the only indicator lighted red, an alarm circuitry failure is indicated. Notify higher category of maintenance but do not interrupt radio set operation to remedy trouble.
LOW RF	Green	Normal indication.	None.
	Red	Indicates that power amplifier output is below 500 watts.	If any other alarm indicator on the power amplifier meter panel is lighted red, refer to the operator action required for those alarm indications. Press the ANTENNA FORWARD WATTS X10 pushbutton (fig. 2–10) on the power amplifier meter panel. If RF MONITOR meter indication is less than 50, perform the power amplifier tuning procedure (para 3–13). If RF MONITOR meter indication is greater than 50, perform the power amplifier low RF alarm adjustment (para 4–18).
ANTENNA MISMATCH	Green	Normal indication.	None.
	Red	Indicates that a mismatch exists between the power amplifier output and the antenna.	Press the RESET pushbutton (fig. 3–10) on the power amplifier meter panel. If the ANTENNA MISMATCH indicator does not light green, an operational failure is indicated. Notify higher category of maintenance.
DC OVERLOAD	Green	Normal indication.	None.
	Red	Indicates loss of dc control power.	Check that all circuit breakers (fig. 3–11) on the power amplifier circuit breaker panel is set to ON. If any circuit breaker is not set to ON, set it to ON. If any circuit breaker trips (OFF) after being set to ON, an operational failure is indicated. Notify higher category maintenance. Press the RESET pushbutton (fig. 3–10) on the power amplifier meter panel. If DC OVERLOAD indicator is still lighted red, an operational failure is indicated. Notify higher category of maintenance.

4-10. Metering Checks

The metering checks are performed daily by the operator to verify the findings of the status and alarm indicator checks (para 4-9) and to locate deteriorating components or modules in the radio set before radio communication is lost. A daily record of the meter indications (actual scale values) must be kept by the operator to help locate deteriorating components or modules. The metering checks and required indications are in *a* through *c* below. If any meter indication is not within the range or color band specified in the chart, notify the organizational maintenance man.

a. Transmitter Metering Checks (fig. 3-1). The transmitter meter checks are performed using the meter and meter selector switch on the transmitter meter panel. The chart below lists the metering positions to be checked and the required meter indications. Record the actual meter indication obtained for each meter position checked.

Meter selector switch position	Color band	Meter indication
MODULATOR CONTROL	Black	80 to 120
MODULATOR OUTPUT	Black	80 to 120
FREQ CONTROL CTR FREQ.	Blue	-20 to +20
FREQ CONTROL OUTPUT.	Black	80 to 120
TRAFFIC[a]	Orange	90 to 110
SYNTHESIZER	Yellow	30 to full scale
AMPL-MULT	Yellow	30 to full scale
2ND MULT	Yellow	30 to full scale
3RD MULT (LOCAL OSC).	Yellow	30 to full scale
RF POWER	Yellow	30 to full scale
REFL RF POWER	None	0 to 20

[a] If this meter indication is out of its color band; perform the transmitter traffic level adjustment (para 4-16).

b. Receiver Metering Checks (fig. 3-6). The receiver meter checks are performed using the meter and meter selector switch on the receiver meter panel. The chart below lists the metering positions to be checked and the required meter indications. Record the actual meter indications for each meter position checked.

Meter selector switch position	Color band	Meter indication
SYNTHESIZER	Yellow	30 to full scale
AMPL-MULT	Yellow	30 to full scale
2ND MULT	Yellow	30 to full scale
MULT OSC A	Black	80 to 120
MULT OSC B	Black	80 to 120
FREQ MIXER CURRENT (3RD MULT) A1.	Yellow	30 to full scale
FREQ MIXER CURRENT (3RD MULT) A2.	Yellow	30 to full scale
FREQ MIXER CURRENT (3RD MULT) B1.	Yellow	30 to full scale
FREQ MIXER CURRENT (3RD MULT) B2.	Yellow	30 to full scale
AMPL-MIXER CURRENT A1.	Yellow	30 to full scale
AMPL-MIXER CURRENT A2.	Yellow	30 to full scale
AGC[a]	None	0 to full scale
AMPL-MIXER CURRENT B1.	Yellow	30 to full scale
AMPL-MIXER CURRENT B2.	Yellow	30 to full scale
CARRIER (IF) A[a]	None	0 to full scale
CARRIER (IF) B[a]	None	0 to full scale
CARRIER (IF) COMBINED.	None	90 to 110
VCO FREQ DIFF	Blue	-20 to +20
APC	Blue	-20 to +20
TRAFFIC[b]	Orange	90 to 110
LOCAL OSC POWER[c], A and B.	Yellow	30 to full scale

[a] This meter indication will vary as the received RF signal level varies. If meter indication does not vary and is approximately 10 or 100 notify higher category of maintenance.

[b] If this meter indication is out of its color band; perform the receiver traffic level adjustment (para 4-17).

[c] This meter indication is obtained with associated A/B switch in each of its positions. If either meter indication is out of its color band; notify higher category of maintenance.

c. Power Amplifier Metering Checks (fig. 3-10). The power amplifier meter checks are performed using the meters mounted on the power amplifier meter panel. The following chart lists the metering checks to be made by the operator, and the required meter indications. Separate meter indications are given for the RF MONITOR meter, each one corresponding to the active (depressed) RF MONITOR SELECT pushbutton being used. Record the actual meter indication obtained for each of the metering checks made.

Meter	Color band	Meter indication
FILAMENT VOLTAGE	Green	5.9 to 7.0
BEAM VOLTAGE	Green	5.0 to 8.3
BEAM CURRENT	Green	0.3 to 0.55
RF MONITOR with the following RF MONITOR SELECT pushbutton depressed.		

Meter	Color band	Meter indication
ANTENNA FORWARD WATTS X 10	Green	50 to 120
ANTENNA REFLECTED WATTS	Blue	0 to 100
INPUT FORWARD MILLI-WATT[a]	Yellow	30 to 50

a If this meter indication is not in its color band; adjust attenuator control 3A9AT1 (fig. 3—12) for a RF MONITOR meter indication of 50. If a RF MONITOR meter indication of 50 cannot be obtained, notify higher category of maintenance.

4–11. Order Wire Checks

The order wire checks are part of the weekly preventive maintenance checks and services (para 4–6), and must be performed weekly. The order wire checks are contained in the chart below, and the chart specifies the MODULE TEST switch position for each check, and lists the lamp indications and loudspeaker tone output that should be obtained for that check. If the proper lamp indications and loudspeaker tone is obtained for each check, the order wire is assumed to be operating properly. If the required lamp indications and loudspeaker tone is not obtained for any check, notify higher category of maintenance for repair or replacement. The CNTRL ALARM indicator and loudspeaker are located on the transmitter meter panel (fig. 3–1). The MODULE TEST switch and MODULE TEST lamp are located on the order wire assembly (fig. 3–5).

MODULE TEST switch position	MODULE TEST lamp indication	CNTRL ALARM lamp indication	Loudspeaker tone output
1	OFF	Green	None
1 (press MODULE TEST lamp).	On	Green	None
2	Off	Green	4 kHz
3	Off	Green	4 kHz
4	Off[a]	Green	4 kHz
5	Off[a]	Green	4 kHz
6	Off	Green	4 kHz
7	Off	Green	4 kHz
8	Off	Green	4 kHz
9	Off	Green	4 kHz
10	Off	Green	1.6 kHz
11	Off	Green	1.1 kHz
12	Off	Red	Alternating 1.1 and 1.6 kHz tone[b].
12 (momentarily press RESET pushbutton switch) (fig. 3–1)	On	Red	None
Return to 1[c]	Off	Green	None

a The MODULE TEST lamp will be lighted if the Multiplexer TD—204/U is not turned on and operating properly. Always contact the Multiplexer TD-204/U operator, via order wire (para 3—17), and ask him to check his Multiplexer TD—204/U before assuming that this check has failed.
b The shelter mounted audible alarm disable switch must not be disabling the loudspeaker output during this check.
c The MODULE TEST switch must be left in this position during normal radio set operation.

4–12. Operation of Fans and Blowers

The operator must check the operation of fans and blowers in each of the equipment cabinets on a weekly basis as part of his regular duties. If any fan or blower is not operating, is noisy, or seems to be scraping, notify higher category of maintenance for repair or replacement. To perform the fans and blowers check, proceed as follows:

a. Place a hand over the air filter (fig. 2–16) on top of the receiver cabinet and check that air is being blown out of the air filter.

b. Place a hand over the air filter (fig. 2–17) on top of the receiver cabinet and check that air is being blown out of the air filter.

c. Remove the air filter (fig. 1–1) on the lower right side of the power amplifier cabinet (para 4–15*c*).

d. With the power amplifier air filter removed, check that the four cabinet fans are operating.

e. Replace the power amplifier air filter (para 4–15*c*).

f. Place a hand over the power amplifier exhaust port (fig. 2–18) on top of the power amplifier cabinet and check that air is being blown out the exhaust port.

4–13. Troubleshooting

a. General. Operator troubleshooting is based on the preventive maintenance checks and services (paras 4-3, 4-4 and 4-5). To troubleshoot the radio set, perform the daily preventive maintenance checks and services (para 4-5) starting with sequence No. 2, and continue until an ab-

normal indication or result is observed. Checks and corrective measures for operational trouble symptoms, within the scope of the operator, are listed in the troubleshooting chart (*b* below). Other operational symptoms or faulty meter indications are covered in paragraphs 4-9, 4-10 and 4-11 and will require higher category of maintenance for repair or replacement.

b. Troubleshooting Chart.

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
1	5 AMPS SLO-BLO fuse indicator on transmitter meter panel is lighted.	5 AMPS SLO-BLO fuse defective	Replace 5 AMPS SLO-BLO fuse (para 4–14*a*).
2	Any transmitter power supply 1A1 indicator not lighted.	Associated transmitter power supply 1A1 fuse defective.	Replace transmitter power supply 1A1 fuse (para 4–14*a*) located directly above extinguished transmitter power supply 1A1 indicator.
3	5V and 28V indicators on transmitter frequency synthesizer 1A14 not lighted.	Transmitter frequency synthesizer 1A14 fuse F1 defective.	Replace transmitter frequency synthesizer 1A14 fuse F1 (para 4–14*b*).
4	POWER 8 AMPS fuse indicator on receiver meter panel is lighted.	POWER 8 AMPS fuse defective	Replace POWER 8 AMPS fuse (para 4–14*a*).
5	TDA A 1 AMP fuse indicator on receiver meter panel is lighted.	TDA A 1 AMP fuse defective	Replace TDA A 1 AMP fuse (para 4–14*a*).
6	TDA B 1 AMP fuse indicator on receiver meter panel is lighted.	TDA B 1 AMP fuse defective	Replace TDA B 1 AMP fuse (para 4–14*a*).
7	Any receiver power supply 2A3 indicator not lighted.	Associated receiver power supply 2A3 fuse defective.	Replace receiver power supply 2A3 fuse (para 4–14*a*) located directly above extinguished receiver power supply 2A3 indicator.
8	5V and 28V indicators on receiver frequency synthesizer 2A21 not lighted.	Receiver frequency synthesizer 2A21 fuse F1 defective.	Replace receiver frequency synthesizer 2A21 fuse F1 (para 4–14*b*).
9	Power amplifier F1 fuse indicator is lighted.	Power amplifier fuse F1 defective	Replace power amplifier fuse F1 (para 4–14*c*).

4–14. Fuse Replacement

CAUTION

If replacement fuse burns out, do not insert another fuse, notify higher category of maintenance. Never replace a burned out fuse with one of a higher current rating.

Radio set fuse locations are shown in figures 2–12 through 2–15 and are identified by reference designation callouts containing the letter F. When a defective fuse is located during the preventive maintenance checks and services (para 4–5), replace the defective fuse using the appropriate procedure given in *a* through *c* below.

a. Transmitter/Receiver Meter Panel and Power Supply (1A1 or 2A3) Fuses. All meter panel fuse caps are equipped with a neon indicator which glows when the fuse has burned out. When a power supply (1A1 or 2A3) fuse burns out, the indicator lamp located below the associated fuse will go out. To replace a defective meter panel or power supply fuse, proceed as follows:

(1) Set the receiver or transmitter POWER ON–OFF switch on the meter panel to OFF.

(2) Release the fuse cap by rotating it 1/4 turn counterclockwise.

(3) Extract the fuse cap with the fuse intact from the fuse holder.

(4) Pull the fuse out of the fuse cap and select a new fuse of the correct type and value (para 2–10).

CAUTION

Do not force fuse cap into fuse holder.

(5) Insert selected fuse into the fuse cap and insert the fuse cap into the fuse holder.

(6) Lock fuse cap in position by turning it 1/4 turn clockwise while gently pressing on the fuse cap.

(7) Set the POWER ON–OFF switch on the meter panel to ON.

b. Frequency Synthesizer 1A14 or 2A21 Fuses. When the frequency synthesizer fuse F1 burns out, both the 5V and 28V indicators (fig. 3–5) will be extinguished. To replace a defective frequency synthesizer 1A14 or 2A21 fuse, proceed as follows:

(1) Set the POWER ON–OFF switch on the meter panel to OFF.

(2) Rotate the fuse cap counterclockwise until it is free of the fuse holder.

(3) Pull the fuse cap with the fuse intact from the fuse holder.

(4) Pull the fuse out of the fuse cap and select a new fuse of the correct type and value (para 2–10).

CAUTION

Do not force fuse cap into fuse holder.

(5) Insert selected fuse into the fuse cap and insert the fuse cap into the fuse holder.

(6) Lock fuse cap in position by turning it clockwise until fingertight.

(7) Set the POWER ON–OFF switch on the meter panel to ON.

c. Power Amplifier Fuse. When the power amplifier fuse is burned out, the neon indicator in the fuse cap will glow. To replace a defective power amplifier fuse, proceed as follows:

(1) Turn off the power amplifier as described in paragraph 3–23.

(2) Repeat steps (2) through (6) of *a* above.

(3) Repeat steps *b* through *e* of paragraph 3–14 to restart the power amplifier.

4–15. Air Filter Removal and Replacement

The transmitter and receiver are each equipped with three air filters. One air filter is located inside each of the cabinet doors (figs. 1–3 and 1–9), and the third air filter is mounted on the top of each cabinet (figs. 2–16 and 2–17). The power amplifier is equipped with a single air filter mounted on the lower right side of the cabinet (fig. 1–1). To remove and replace any of the air filters, perform the appropriate procedure given in *a* through *c* below.

a. Transmitter and Receiver Door Mounted Air Filters. To remove and replace a door mounted air filter, proceed as follows:

(1) Lift and turn the two cabinet door latches and open the two cabinet doors.

(2) Slide the air filter upward and remove it from its retaining frame.

(3) Slide the cleaned (para 4–7) or replacement air filter downward into its retaining frame.

NOTE

Cabinet doors will not latch unless air filters are properlyseated.

(4) Close and latch the two cabinet doors.

b. Transmitter and Receiver Cabinet Mounted Air Filter. To remove and replace the top mounted air filter, proceed as follows:

(1) Set the POWER ON–OFF switch on the meter panel to OFF.

(2) Unscrew and remove the four screws securing the air filter to the top of the cabinet.

(3) Remove the air filter.

(4) Place the cleaned (para 4–7) or replacement air filter on top of cabinet and align the four screws holes.

(5) Insert the four screws removed in step (2) above, and tighten them.

(6) Set the POWER ON–OFF switch on the meter panel to ON.

c. Power Amplifier Cabinet Mounted Air Filter. To remove and replace the power amplifier cabinet mounted air filter, proceed as follows:

(1) Loosen the four captive screws securing the air filter to its filter frame.

(2) Pull air filter forward out of the filter frame.

(3) Insert the cleaned (para 4–7) or replacement air filter into the filter frame being sure that the arrow marked on the rear of the air filter frame is pointing toward the power amplifier cabinet.

(4) Tighten the four captive screws on the air filter to secure the air filter to its filter frame.

4–16. Transmitter Traffic Level Adjustment

The transmitter traffic level adjustment should be performed as required during the operational checks (para 4–8) to maintain the pcm traffic level. To perform the transmitter traffic level adjustment, proceed as follows:

a. Set the meter selector switch (fig. 3–1) on the transmitter meter panel to TRAFFIC.

b. Adjust the TRAFFIC LEVEL ADJ control (fig. 3–3) on AF–RF amplifier 1A4 for a transmitter meter indication (fig. 3–1) of 100.

c. If a meter indication of 100 cannot be obtained, contact the Multiplexer TD–204/U operator at the cable end of the communication link, via order wire (para 3–17), and request that he check his traffic output. If the traffic output from Multiplexer TD–204/U is correct, notify higher category of maintenance for further troubleshooting.

4-17. Receiver Traffic Level Adjustment

The receiver traffic level adjustment should be performed as required during the operational checks (para 4-8) to maintain the pcm traffic level. To perform the receiver traffic level adjustment, proceed as follows:

a. Set the meter selector switch (fig. 3-6) on the receiver meter panel to TRAFFIC.

b. Adjust the TRAFFIC LEVEL ADJ control (fig. 3-9) on AF-RF amplifier 2A19 for a receiver meter indication (fig. 3-6) of 100.

c. If a meter indication of 100 cannot be obtained, contact the radio operator at the radio end of the communication link, via order wire (para 3-17), and request that he check his traffic output. If the traffic output from the radio end of the communication link is correct, contact the multiplexer TD-204/U operator at the cable end of the communication link and request that he check his traffic input. If traffic is being received satisfactorily at the cable end of the communications link, contact higher category of maintenance and notify him that the TRAFFIC meter indication cannot be adjusted for a meter indication of 100, but that traffic is being satisfactorily received at the cable site. If traffic is not being received satsifactorily at the cable end of the communications link, contact higher category of maintenance and notify him that radio communication has been lost in the receiver path of the communications link.

4-18. Power Amplifier Low RF Alarm Adjustment

NOTE

Never perform the power amplifier low RF alarm adjustment while the radio set is handling traffic, wait until radio communications can be interrupted.

The power amplifier low RF alarm adjustment is checked by the operator during the PMCS status and alarm indicator checks (para. 4-9c). To perform the power amplifier low RF alarm adjustment, proceed as follows:

a. Press the ANTENNA FORWARD WATTS X 10 pushbutton (fig. 3-10) on the power amplifier meter panel and observe the RF MONITOR meter indication during the following steps.

b. Set the BEAM VOLT ADJ control (fig. 3-11) on inverter regulator control 3A1 for a RF MONITOR meter indication of 50.

NOTE

If the LOW RF alarm indicator (fig. 3-10) is lighted red at the start of this adjustment, turn LOW RF control (fig. 3-11) clockwise until the indicator turns green and proceed to step *c* below.

c. Slowly turn the LOW RF control (fig. 3-11) on low RF-mismatch, alarm and control module 3A4 counterclockwise until the LOW RF alarm indicator (fig. 3-10) on the power amplifier meter panel lights red.

d. Slowly increase RF output power, by turning the BEAM VOLT ADJ control (fig. 3-11) clockwise, until the LOW RF alarm indicator (fig. 3-1) lights green. The RF MONITOR meter indication shall be between 50 and 80.

e. If LOW RF alarm trip point cannot be set between 50 and 80, notify higher category maintenance.

f. Set BEAM VOLT ADJ control (fig. 3-11) on inverter regulator control 3A1 for a RF MONITOR meter indication of 100.

CHAPTER 5

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. GENERAL

5-1. Scope of Maintenance

a. This chapter contains instructions covering organizational maintenance of the radio set. It includes general system analysis and instructions for performing preventive and periodic maintenance services, troubleshooting, and repair functions to be accomplished by the organizational repairman.

b. Organizational maintenance of the radio set includes–

(1) Organizational preventive maintenance (para 5-4).

(2) Organizational preventive maintenance checks and services chart (para 5-5).

(3) Para (3) deleted.

(4) Lubrication (para 5-9).

(5) Checks and adjustments (paras 5-10 through 5-21).

(6) Troubleshooting (paras 5-22 through 5-24).

(7) Tests (paras 5-25 through 5-28).

(8) Module replacement techniques (para 5-29).

(9) Removal and replacement of transmitter modules (para 5-30).

(10) Removal and replacement of receiver modules (para 5-31).

(11) Removal and replacement of power amplifier modules (para 5-32).

(12) Removal and replacement of diodes (para 5-33).

(13) Removal and replacement of lamps (para 5-34).

(14) Adjustment and alignment procedures (paras 5-35 through 5-42).

(15) Touchup painting instructions (para 5-43).

5-2. Tools, Materials, and Test Equipment Required

The tools, materials, and test equipment required for organizational maintenance are listed below.

a. Tools.

(1) Screwdriver, flat tip (NSN 5120-00-596-1185).

(2) Screwdriver, cross tip (NSN 5120-00-234-8912).

(3) Card extractor (figs. 1-4 and 1-14).

(4) Tuning tool (fig. 1-10).

(5) Discharge arm (grounding rod) (fig. 1-14).

(6) Wrenches, openend (figs. 1-4 and 1-10).

(7) Pliers, round needle nose (NSN 5120-00-540-6973).

(8) Tool Kit, Electronic Equipment TK-101/G (NSN 5180-00-064-5178).

(9) Lamp extractor (fig. 1-4).

(10) Special purpose screwdriver (fig. 1-10).

b. Materials.

(1) Cleaning compound (trichlorotrifluoroethane).

(2) Cleaning cloth.

(3) Lubricating grease, lubri-plate (or equivalent), and Dow Corning Fluid 550 (or equivalent).

(4) Sandpaper No. 000.

c. Test Equipment. Multimeter AN/URM-105.

5-3. Block Diagram Functioning of Radio Set AN/GRC-143

a. Functionally, the radio set can be divided into three major components: a transmitter that

contains all the circuits necessary to generate a low level fm carrier signal containing the pcm/order wire signal; a radio frequency power amplifier that contains all of the circuits necessary to boost the low level transmitter output to a high level (1.0 kilowatt nominal) RF signal suitable for transmission through a tropospheric medium; and a receiver that contains all the circuits necessary to amplify and demodulate the fm carrier signal. A functional block diagram of the radio set is shown in figure 5-1.

b. The transmitter accepts an externally multiplexed pcm signal from Multiplexer TD-204/U. This signal consists of 12 or 24 individual telephone channels that have been converted to a pcm form and time division multiplexed (interleaved) to form a single signal. The pcm signal is routed via CX-4245/G cable to the transmitter, and is called the FROM CABLE input. The FROM CABLE input is applied to cable-to-radio circuits in digital data modem 1A12 where the pcm signal is reshaped, retimed, and applied to the modulator circuits. The modulator circuits basically consist of a voltage controlled 150 MHz oscillator (the output of the modulator circuits with no input is 150 MHz). The pcm signal offsets the voltage controlled 150-MHz oscillator and causes its output to vary in frequency directly proportional to the pcm intelligence. The frequency modulated 150 MHz signal is then applied to frequency mixer 1A9. A highly stable 4.55- to 4.85GHz carrier signal, generated in the local oscillcator circuits, is also applied to frequency mixer 1A9. The output of the local oscillator circuit can be selected in 100-kHz increments between 4.55 and 4.85 GHz and provides 6001 different frequencies. The 4.55 to 4.85 GHz carrier signal is mixed with the frequency modulated 150 MHz signal to produce a low level 4.4- to 5.0-GHz signal. The 4.4- to 5.0-GHz signal from frequency mixer 1A9 is applied to the RF output circuits where it is routed to the power amplifier. A small portion of the transmitter output is also applied to the radio test set for maintenance purposes (*f* below).

c. The power amplifier receives the low level transmitter output and amplifies the 4.4- to 5.0-GHz signal to a level (1.0 kilowatt) suitable for transmission in a tropospheric medium. The low level transmitter output is applied through the RF input circuits to a klystron. A high voltage power supply generates the high voltage (7.5 kilovolts nominal) required to drive the klystron and a high voltage power supply control circuit is used to protect the power amplifier circuits in the event of an overload. The klystron amplifies the 4.4- to 5.0-GHz signal to 1.0 kilowatt (nominal) and its output is coupled to the transmit antenna via the RF output circuits, waveguide switch, and antenna waveguide.

d. The receiver contains the circuits necessary to amplify the extremely low level (down to .01 picowatt) 4.4- to 5.0-GHz signal from the receive antennas. The receiver is basically a superhetrodyne that uses two (dual) input channels (A and B) to amplify the two separate input signals from the two physically separated receive antennas. The information contained in each of the two separate input signals is identical since transmission is via a single antenna at the distant radio set. However, the two input signals will vary in level due to the different tropospheric paths they travel. Use of a dual channel superhetrodyne receiver takes advantage of space diversity reception and dual channel combining to improve the receiver's overall reliability and noise figure. The channel A input signal is applied through the channel A directional coupler to the channel A RF input circuits. The channel A RF input circuits pass and amplify the rf input signal and the output is applied to mixer-preamplifier 2A4. A highly stable 4.55- to 4.85-GHz carrier signal is generated in the receiver local oscillator circuits which are similar to the transmitter local oscillator circuits, except the receiver provides two identical outputs. Local oscillator output channel A is applied to the local oscillator mixer circuits where the 4.55- to 4.85-GHz signal is mixed with a 220-MHz signal to produce the 4.33- to 5.07-GHz channel A local oscillator signal which is separated by 70 MHz from the RF input signal. Mixer-preamplifier 2A4 mixes the 4.33- to 5.07-GHz local oscillator signal and RF signal and the resultant 70-MHz signal is amplified and applied to the IF amplifier circuits. The 70-MHz signal is amplified in the IF amplifier circuits and applied to combiner 2A16. A small portion of the 70-MHz signal is detected and coupled to the antenna alignment indicator (*g* below). Processing of the channel B input signal is the same as channel A. Combiner 2A16 compares the phase of channel A and channel B 70-MHz signals and produces two PAC (automatic phase control) voltages that control the output frequency of 220 MHz vco 2A13 and 2A14. This compensates for phase variations in the channel A and channel B 70-MHz signals. Combiner 2A16 also combines the two 70-MHz signals and the combined output is applied to the demodulator and amplifier circuits. The demodulator senses

Figure 5-1. Block diagram functioning of radio set AN/GRC-143.
(Located in back of manual)

the frequency modulated pcm signal and discards the 70-MHz carrier signal. The demodulated pcm signal is then amplified and routed to the radio-to-cable circuits in transmitter digital data modem 1A12. The radio-to-cable circuits reshape and retime the pcm signal from the receiver and routes the pcm signal via CX–4245/G cable to Multiplexer TD–204/U as the TO CABLE signal.

e. The order wire circuits are contained in the transmitter and permit single channel voice communications on a party line bases. The order wire circuits route voice signals originated at the local handset, remote telephone, Multiplexer TD–204/U, or distant radio set to the three remaining locations. That is, an order wire call originated at the local handset will be routed to—the remote telephone via the order wire circuits; Multiplexer TD–204/U, via the order wire circuits and radio-to-cable circuits where the order wire signal is superimposed on the pcm signal and routed via CX–4245/G cable to Multiplexer TD–204/U as the TO CABLE signal; and to the distant radio set via the modulator circuits where the orderwire signal is superimposed on the pcm signal and subsequently processed as explained in *b* above.

f. A radio test set is provided in the transmitter for maintenance purposes. Use of the radio test set is controlled by the ON–OFF switch (fig. 3–3) on 100-MHz oscillator 1A2. When the 100-MHz oscillator is turned on, its output is mixed with the transmitter output (*b* above) to produce a test signal that is separated by 100 MHz from the transmitter output frequency. This test signal is applied to a power divider in the radio test set, where the test signal is split to produce two identical outputs. The two test signals are applied to each receiver channel via their respective directional coupler. Use of the radio test set permits the repairman to loop the FROM CABLE pcm signal through the receiver back to Multiplexer TD–204/U as the TO CABLE pcm signal.

g. The antenna alignment indicator uses the detected 70 MHz signals from the channel A and B IF amplifiers (*e* above) to align the receive antennas in azimuth and elevation. The antenna alignment indicator contains two meters that indicate the relative signal strength of the detected channel A and channel B 70-MHz signals. As the antennas are positioned in azimuth and elevation, the antenna alignment indicator meters will vary in accordance with the level of the received signals. With the maximum reading obtained on each antenna alignment indicator meter, the best antenna orientation is assured.

Section II. PREVENTIVE MAINTENANCE

5–4. Organizational Preventive Maintenance Checks and Services

Organizational preventive maintenance procedures are designed to help maintain equipment in serviceable condition. They include items to be checked and how to check them. These checks and services, described in paragraph 5–5, outline inspections that are to be made at specific monthly (M), and quarterly (Q), intervals.

5–5. Organizational Preventive Maintenance Checks and Services Chart

M — Monthly Q — Quarterly

Item No.	Interval M	Interval Q	Item to be Inspected	Procedures
				TRANSMITTER
1	•		Metering Checks	Check the Operator/Crew metering check record for a module or component deterioration trend.
2	•		Order Wire Checks	Perform the transmitter orderwire checks.

5-5. Organizational Preventive Maintenance Checks and Services Chart — Continued.

M — Monthly Q — Quarterly

Item No.	Interval M	Interval Q	Item to be Inspected	Procedures
3	•		Metering Checks	Check the Operator/Crew metering check record for a module or component deterioration trend.
4	•		IF Gain and AGC Checks and Adjustments	Perform the receiver IF gain and AGC checks and adjustments during the first radio set shutdown period.
5	•		Metering Checks	Check the Operator/Crew metering check record for a component or assembly deterioration trend.
6		•	Equipment Lubrication	Lubricate the door handles on the receiver, transmitter and power amplifier cabinets with low corning fluid 550 or equivalent. Lubricate module captive screws when it is noticed that they are difficult to turn. Use lubri-plate or equivalent.

Paragraph 5—6 deleted.

Paragraph 5—7 deleted.

Paragraph 5—8 deleted.

5-9. Lubrication

Lubrication of the radio set is not required at regular intervals, but rather on an as required basis. (*a* and *b* below provide the procedures for lubricating those parts of the radio set which require lubrication, *c* below provides a list of the parts which have been lubricated by the manufacturer, but do not require further lubrication.)

a. Lubricant has been applied to module captive screws to permit smooth engagement of the screw threads into retaining nuts. When the operator notices that the captive screws are beginning to become difficult to turn, a grease type lubricant (lubri-plate or equivalent) should be applied lightly to the threaded portion of the screw (fig. 5-2) to prevent binding of the screw in the retaining nut.

b. Lubricant has been applied to all the moving parts of the door handle on the receiver, transmitter, and power amplifier, to permit smooth operation of the door handles. When the operator notices that the door handles are becoming hard to operate, a silicone based lubricant (Dow Corning Fluid 550 or equivalent) should be applied to the door handles as shown in figure 5-3, to permit smooth operation of the door handles.

c. The following parts have been lubricated by the manufacturer and require no further lubrication:

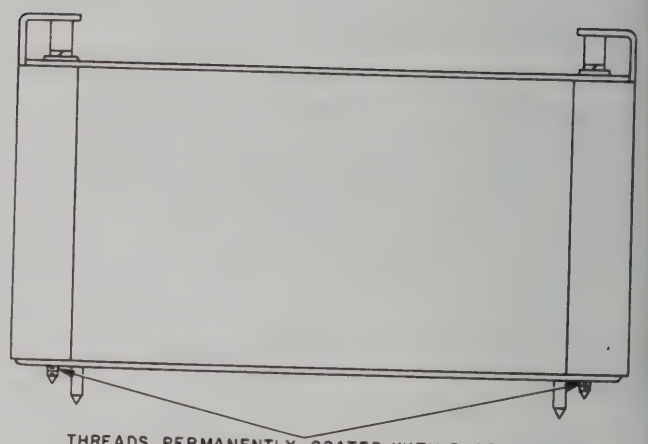


Figure 5-2. Lubrication of module captive screws, typical.

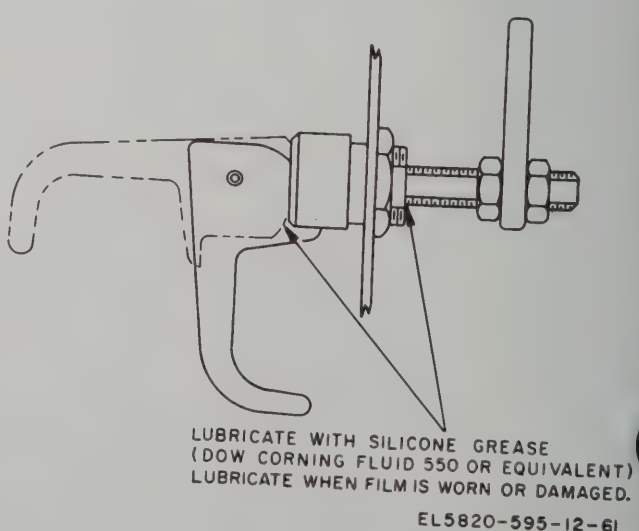


Figure 5-3. Lubrication of cabinet door handles, typical.

Part	Lubricant	Remarks
	POWER AMPLIFIER	
Fan bearings	Unitemp 500 grease, Texaco	Sealed bearings lubricated for life during manufacture.
Blower bearings	Military lubricant: Known commercially as Beacon 325 per Mil–G–3278A, manufactured by Esso Standard Oil Co.	Not accessible for lubrication. Bearings are replaced each time the blower is disassembled for repair.
	RECEIVER	
Fan bearings	Same as power amplifier fan bearings.	Same as power amplifier fan bearings.
	TRANSMITTER	
Fan bearings	Same as power amplifier fan bearings.	Same as power amplifier fan bearings.

5–10. Transmitter Power Supply Voltage

Transmitter power supply voltage checks are performed monthly by the organizational repairman as part of preventive maintenance, and when specified in the troubleshooting chart (para 5–24*a*) to localize a trouble in the power supply. Use the chart and procedure given below to perform the transmitter power supply voltage checks.

a. Turn the meter selector switch (fig. 3–1) on the transmitter meter panel to the first position (TEST LEAD (+)) shown in the chart.

b. Remove the test lead (fig. 1–4) from the clip mounts in the SPECIAL TOOLS AND SPARE FUSES compartment.

c. Connect one test lead probe to the TEST LEAD jack (fig. 3–1) on the transmitter meter panel.

d. Connect, in turn, the free test lead probe to each of the test points, TP( ), of the power supply 1A1 (fig. 3–2), as listed in the chart below. Note that the meter selector switch position is changed for TP3, TP4, and TP9.

e. The meter indication shall be in the black band (100 ± 20). If the meter indication is not in the black band, refer to the troubleshooting chart (para 5–24 *a*) for corrective measures.

Meter selector switch position	Connect free test lead probe to—	Meter indication
TEST LEAD (+)	TP1	Meter indication shall be in black band (100 ± 20) for each TP check.
	TP2	
	TP6	
	TP7	
	TP8	
	TP10	
	TP11	
	TP12	
TEST LEAD (–)	TP3	
	TP4	
	TP9	

5–11. Transmitter Module Test Point Checks

The transmitter module test point checks are performed monthly by the organizational repairman as part of preventive maintenance, and when specified in the troubleshooting chart (para 5–24 *a*) to localize a trouble in the transmitter. Use the procedure and chart given below to perform the transmitter module test point checks.

a. Turn the meter selector switch (fig. 3–1) on the transmitter meter panel to the first position (TEST LEAD (+) shown in the chart.

b. Remove the test lead (fig. 1–4) from the clip mounts in the SPECIAL TOOLS AND SPARE FUSES compartment.

c. Connect one test lead probe to the TEST LEAD jack (fig. 3–1) on the transmitter meter panel.

d. Connect, in turn, the free test lead probe to each of the module test points, TP( ), of the various modules (fig. 3–3) as listed in the chart below. Note the change of meter selectors switch position for some test points.

e. The meter indication shall be in the black band (100 ± 20). If the meter indication is not in the black band, refer to the troubleshooting chart (para 5–24 *a*) for corrective measures.

Meter selector switch position	Connect free test lead probe to-	Meter indication
TEST LEAD (+)	TP1 on AF-RF amplifier 1A4. TP1 on alarm monitor 1A5. TP5 on electronic frequency control 1A7. TP1 and TP2 on modulator 1A8. TP1 on amplifier-frequency multiplier 1A11. TP1, TP2, TP3, TP6 and TP7 on digital data modem 1A12.	Meter indication shall be in black band (100 ± 20) for each module TP check.
TEST LEAD (-)	TP2 on alarm monitor 1A5 TP4 and TP5 on digital data modem 1A12.	Same as above.

5-12. Transmitter Order Wire Checks

The transmitter order wire checks are performed monthly by the organizational repairman as part of preventive maintenance, and when specified in the troubleshooting chart (para 5-24*a*) to localize a trouble in the order wire channel. Use the procedure given below to perform the transmitter order wire checks.

a. Contact the local Multiplexer TD-204/U operator (para 3-17), and request that he set the TONE/OFF switch on Multiplexer TD-204/U to TONE.

b. Turn the meter selector switch (fig. 3-1) on the transmitter meter panel to OW TEST.

c. The meter indication (fig. 3-1) shall be 100 ± 20. If the meter indication is not 100 ± 20, perform the transmitter order wire level adjustment (para 5-35).

d. Notify TD-204/U operator to set TO-204/U TONE/OFF switch to OFF.

5-13. Transmitter Alarm Circuitry Checks

The transmitter alarm circuitry checks are performed monthly by the organizational repairman as part of preventive maintenance. These checks must be performed when radio communication is not required and should be scheduled during a radio set shutdown period.

a. Traffic Alarm Check. Perform the traffic alarm circuit check as follows:

(1) Disconnect coaxial cable 1A16W3 (fig. 2-10) from the J1 connector on attenuator assembly 1A3.

(2) The TRAF alarm indicator (fig. 3-1) on the transmitter meter panel shall light red. If it does not, replace alarm monitor 1A5 (para 5-30) and repeat check.

(3) Connect coaxial cable 1A16W3 (fig. 2-10) to the J1 connector on attenuator assembly 1A3.

(4) The TRAF alarm indicator (fig. 3-1) shall light green.

b. Frequency Synthesizer Alarm Check. Perform the frequency synthesizer alarm circuit check as follows:

(1) Record the frequency setting of the four thumbwheel switches (fig. 3-5) on the frequency synthesizer 1A14 and set the thumbwheel switches for a frequency readout of 5090.0 MHz.

NOTE

The RF POWER alarm indicator (fig. 3-1) on the transmitter meter panel may light red during this check.

(2) The SYNTH LOCK alarm indicator (fig. 3-1) shall light red. If it does not, replace alarm monitor 1A5 (para 5-30) and repeat check.

(3) Reset the four thumbwheel switches on frequency synthesizer 1A14 to the original frequency setting ((1) above).

(4) The SYNTH LOCK alarm indicator (fig. 3-1) shall light green.

c. Low RF Alarm Check. Perform the RF power alarm circuit check as follows:

(1) Disconnect coaxial cable 1A16W6 from connector J1 (fig. 2-10) on amplifier-frequency multiplier 1A11.

(2) The RF POWER alarm indicator (fig. 3-1) shall light red. If it does not, replace alarm monitor 1A5 (para 5-30) and repeat check.

(3) Reconnect coaxial cable 1A16W6 to connector J1 (fig. 2-10) on amplifier-frequency multiplier 1A11.

(4) The RF POWER alarm indicator (fig. 3-1) shall light green.

d. Reflected RF Power Alarm Check. Perform the reflected RF power alarm circuit check as follows:

(1) Disconnect cable from RF OUTPUT connector J8 (fig. 2-16) on top of the transmitter cabinet.

(2) The REFL RF POWER alarm indicator (fig. 3-1) on the transmitter meter panel shall light red. If it does not, replace alarm monitor 1A5 (para 5-30) and repeat check. If check still

fails replace diode 1DC2CR2 (para 5–33) and repeat check.

(3) Connect plug 4A1P5 to RF OUTPUT connector J8 (fig. 2–19) on top of the transmitter cabinet.

(4) The REFL RF POWER alarm indicator (fig. 3–1) shall light green.

5–14. Transmitter Radio Test Set Check

The transmitter radio test set check is performed before each deployment and re-deployment as part of preventive maintenance. This check must be performed when radio communication is not required and should be scheduled during a radio set shutdown period. Follow the procedural steps below.

NOTE

Disregard all radio set alarm indications during performance of the transmitter radio test set check.

a. Set the ON–OFF switch (fig. 3–3) on 100-MHz oscillator 1A2 to ON. The RADIO TEST SET indicator (fig. 3–1) on the transmitter meter panel will light red.

b. Turn the radio test set meter switch (fig. 3–3) to OSC LEVEL and adjust the LEVEL ADJ control on 100 MHz oscillator 1A2 for a 12 CHAN or 24 CHAN (determined by operating mode) meter indication on the radio test set meter. If the meter indication cannot be obtained by adjustment, replace 100-MHz oscillator 1A2 (para 5–30) and repeat check.

c. Turn the radio test set meter switch to CR1. The radio test set meter indication shall be in or to the right of the yellow band. If it is not, replace mixer diode 1Z1CR1 (para 5–33) and repeat check.

d. Turn the radio test set meter switch to CR2. The radio test set meter indication shall be in or to the right of the yellow band. If it is not, replace diode 1Z1CR2 (para 5–33) and repeat check.

e. Set the ON–OFF switch on 100-MHz oscillator to OFF. The RADIO TEST SET indicator (fig. 3–1) shall light green.

5–15. Receiver Power Supply Voltage Checks

The receiver power supply voltage checks are performed monthly by the organizational repairman as part of preventive maintenance, and when specified on the troubleshooting chart (para 5–24*b*) to localize a trouble in the power supply. Use the procedure and chart given below to perform the receiver power supply voltage checks.

a. Turn the meter selector switch (fig. 3–6) on the receiver meter panel to the first position (TEST LEAD (+)) shown in the chart.

b. Remove the test lead (fig. 1–10) from the clip mounts in the SPECIAL TOOLS AND SPARE FUSES compartment.

c. Connect one test lead probe to the TEST LEAD jack (fig. 3–6) on the receiver meter panel.

d. Connect, in turn, the free test lead probe to each of the test points, (TP( ), of power supply 2A3 (fig. 3–8) as listed in the chart below. Note that the meter selector switch position is changed for TP3.

e. The meter indication shall be in the black band (100 ± 20). If the meter indication is not in the black band, refer to the troubleshooting chart (para 5–24*b*) for corrective measures.

Meter selector switch position	Connect free test probe to	Meter indication
TEST LEAD (+) --	TP1 TP2 TP4	Meter indication shall be in black band (100 ± 20) for each TP check.
TEST LEAD (–) --	TP3	

5–16. Receiver Module Test Point Checks

The receiver module test point checks are performed monthly by the organizational repairman as part of preventive maintenance, and when specified in the troubleshooting chart (para 5–24*b*) to localize a trouble in the receiver. Use the procedure and chart given below to perform the receiver module test point checks:

a. Turn the meter selector switch (fig. 3–6) on the receiver meter panel to the first position (TEST LEAD (+)) shown in the chart.

b. Remove the test lead (fig. 1–10) from the clip mounts in the SPECIAL TOOLS AND SPARE FUSES compartment.

c. Connect one test lead probe to the TEST LEAD jack (fig. 3–6) on the receiver meter panel.

d. Connect, in turn, the free test lead probe to each of the module test point (figs. 3–8 and 3–9) as listed in the chart below. Note that the meter selector switch position is changed for some test points.

e. The meter indication shall be in the black band (100 ± 20). If the meter indication is not in the black band, refer to the troubleshooting chart (para 5–24*b*) for corrective measures.

Meter selector switch position	Connect free test probe to—	Meter indication
TEST LEAD (+)	BIAS (upper and lower TP) on TDA2A1. BIAS (upper and lower TP) on TDA 2A2. TP2 on mixer-preamplifier 2A4. TP1 on amplifier-multiplier 2A8. TP2 on mixer-preamplifier 2A11. TP3 on if amplifier 2A12. TP1 and TP2 on 220 MHz vco 2A13. TP1 and TP2 on 220 MHz vco 2A14. TP3 on if amplifier 2A15. TP4 on combiner 2A16. TP7 on demodulator 2A17. TP1 on AF–RF amplifier 2A19. TP1 on alarm monitor 2A20.	Meter indication shall be in black band (100 ± 20) for each module TP check.
TEST LEAD (–)	TP6 on combiner 2A16. TP2 on alarm monitor 2A20.	

5–17. Receiver Alarm Circuit Checks

Receiver alarm circuit checks are performed monthly by the organizational repairman as part of preventive maintenance. These checks must be performed when radio communication is not required, and should be scheduled during a radio set shutdown period.

a. Traffic Alarm Check. Perform the traffic alarm circuit check as follows:

NOTE

Disregard all radio set alarm indications during performance of this check.

(1) Disconnect coaxial cable 2A18W1 from connector J6 (fig. 2–11) on demodulator 2A17.

(2) The TRAF alarm indicator (fig. 3–6) on the receiver meter panel shall light red. If it does not, replace alarm monitor 2A20 (para 5–31) and repeat indicator check.

(3) Connect coaxial cable 2A18W1 to connector J6 (fig. 2–11) on demodulator 2A17.

(4) The TRAF alarm indicator (fig. 3–6) shall light green.

b. VCO Lock Alarm Check. Perform the vco lock alarm circuit check as follows:

NOTE

Disregard all radio set alarm indications during performance of this check.

(1) Set both APC ON/OFF switches (fig. 3–9) on combiner 2A16 to OFF.

(2) Turn meter selector switch (fig. 3–6) on receiver meter panel to VCO FREQ DIFF.

(3) Use a screwdriver to remove the green cap and to turn the FREQ ADJUST control (fig. 3–9) on 220 MHz vco 2A14 for a receiver panel meter indication of 50. If this indication cannot be obtained, adjust the FREQ ADJUST control on 220 MHz vco 2A13. If a meter indication of 50 cannot be obtained, using either FREQ ADJUST control, replace the 220 MHz vco's (2A13 and 2A14) one at a time (para 5–31) and repeat check.

(4) The VCO LOCK alarm indicator (fig. 3–6) on the receiver meter panel will light red approximately 5 seconds after step (3) above has been performed. If it does not light red, replace alarm monitor 2A20 (para 5–31) and repeat check.

(5) Turn the FREQ ADJUST control (fig. 3–9) on 220 MHz vco 2A14 and on 220 MHz vco 2A13 to obtain a minimum meter indication. Replace green cap removed in step (3) above.

c. Frequency Synthesizer Alarm Check. Perform the frequency synthesizer alarm circuit check as follows:

NOTE

Disregard all radio set alarm indications during performance of this check.

(1) Record the frequency setting of the four thumbwheel switches (fig. 3–5) on frequency synthesizer 2A21 and set the thumbwheel switches for a frequency readout of 5090.0 MHz.

(2) The SYNTH LOCK alarm indicator (fig. 3–9) on the receiver meter panel shall light red. If it does not, replace alarm monitor 2A20 (para 5–31) and repeat check.

(3) Reset the four thumbwheel switches on frequency synthesizer 2A21 to the original frequency setting (step (1) above).

(4) The SYNTH LOCK alarm indication (fig. 3–9) on the receiver meter panel shall light green.

5–18. Receiver IF Gain and AGC Checks and Adjustments

The receiver IF gain and agc checks and adjustments are performed monthly by the organizational repairman as part of preventive maintenance. The receiver IF gain and agc checks and adjustments must be performed when radio communication is not required, and should be scheduled during a radio set shutdown period. Perform the IF gain and agc checks and adjustments as follows:

NOTE

Disregard all radio set alarm indications which may occur during performance of these procedures.

a. Initial Equipment Setup.

(1) Record the receiver and transmitter operating frequencies.

(2) Apply the radio test set information and procedures covered in paragraph 5–25.

(3) On the receiver, set both SQUELCH ON/OFF switches (fig. 3–9) On combiner 2A16 to OFF.

(4) On the transmitter, set the RCVR CHAN A and RCVR CHAN B switches (fig. 3–3) on the radio test set to T.

(5) On the receiver, set the AGC SEL switches (fig. 3–9) on IF amplifiers 2A12 and 2A15 to TEST.

(6) On the receiver, set the receiver meter selector switch (fig. 3–6) on the receiver meter panel to CARRIER (IF) COMBINED.

b. IF Gain Check.

(1) Disconnect coaxial cable 2A15W1 from connector J2 (fig. 2–11) on 70 MHz IF filter 2A10.

(2) Receiver meter indication (fig. 3–6) shall be 100 ± 5. If it is not, perform the IF gain adjustment (para 5–36).

(3) Connect coaxial cable 2A15W1 to connector J2 (fig. 2–11) on 70 MHz IF filter 2A10, and disconnect coaxial cable 2A12W1 from connector J2 on 70 MHz IF filter 2A5.

(4) Receiver meter indication (fig. 3–6) shall be 100 ± 5. If it is not, perform the IF gain adjustment (para 5–36).

(5) Connect coaxial cable 2A12W1 to connector J2 (fig. 2–11) on 70 MHz IF filter 2A5.

c. AGC Check and Adjustment.

(1) On the receiver, set the AGC SEL switches (fig. 3–9) on IF amplifiers 2A12 and 2A15 to DIV ON.

(2) On the transmitter, set the RCVR CHAN A and RCVR CHAN B switches (fig. 3–3) on the radio test set to T +30.

(3) On the receiver, set the AUTO/MAN switch (fig. 3–9) on combiner 2A16 to MAN.

(4) Disconnect coaxial cable 2A15W1 from connector J2 (fig. 2–11) on 70-MHz IF filter 2A10.

(5) On the receiver, remove the green cap cover from the MAN AGC ADJ potentiometer (fig. 3–9) on combiner 2A16 and, using the tuning tool, adjust the potentiometer for a receiver meter (fig. 3–6) indication of 60 ± 10. If difficulty is encountered in obtaining the indication, perform the agc adjustment (para 5–36).

(6) Connect coaxial cable 2A15W1 to connector J2 (fig. 2–11) on 70-MHz IF filter 2A10, and disconnect coaxial cable 2A12W1 from connector J2 on 70-MHz IF filter 2A5.

(7) Receiver meter indication (fig. 3–6) shall be within ± 10 of meter indication obtained in step (5) above. If it is not, perform the agc adjustment (para 5–36). Replace the green cap removed in step (5) above.

(8) Connect coaxial cable 2A12W1 to connector J2 (fig. 2–11) on 70-MHz IF filter 2A5.

(9) On the transmitter, set the RCVR CHAN A and RCVR CHAN B switches (fig. 3–3) on the radio test set to T +20 and repeat steps (4) through (8) above and then proceed to step (10) below.

(10) On the receiver, set both SQUELCH ON/OFF switches (fig. 3–9) on combiner 2A16 to ON.

(11) On the receiver, set the AUTO/MAN switch (fig. 3–9) on combiner 2A16 to AUTO.

(12) On the transmitter, set the RCVR CHAN A and RCVR CHAN B switches (fig. 3–3) to T +30.

(13) The receiver meter indication shall be 100 ± 5. If it is not, perform the agc adjustment (para 5–36).

(14) On the transmitter, set the ON–OFF switch on 100-MHz oscillator 1A2 to OFF.

(15) Return transmitter and receiver frequency control settings to the original operating frequency settings (*a*(1) above).

5–19. Receiver Squelch and Carrier Alarm Checks

The receiver squelch and carrier alarm checks are performed monthly by the organizational repair-

man as part of preventive maintenance. These checks must be performed when radiocommunication is not required, and should be scheduled during a radio set shutdown period. To perform the squelch and carrier alarm checks, proceed as follows:

NOTE

Disregard all radio set alarm indications during performance of this procedure.

a. Initial Equipment Setup.

(1) Record the receiver and transmitter operating frequencies.

(2) Apply the radio test set information and procedures covered in paragraph 5-25.

(3) On the transmitter, set the RCVR CHAN A and RCVR CHAN B switches (fig. 3-3) on the radio test set to T.

(4) On the receiver, check that the CARR (IF) A and CARR (IF) B, indicators (fig. 3-6) on the receiver meter panel are lighted green. If either indicator is not lighted green, refer to the troubleshooting chart (para 5-24*b*) for corrective measures.

b. Squelch and Carrier Alarm Check.

(1) On the transmitter, set the RCVR CHAN A switch (fig. 3-3) on the radio test set to T-8.

(2) On the receiver, the CARR (IF) A alarm indicator (fig. 3-6) shall light red after approximately 5 seconds. If it does not, perform all of the combiner 2A16 adjustments listed in the chart for replacement of a combiner (para 5-29d).

(3) On the transmitter, t the RCVR CHAN A switch (fig. 3-3) on the radio test set to T and set the RCVR CHAN B switch to T-8.

(4) On the receiver, the CARR (IF) A alarm indicator shall light green and the CARR (IF) B alarm indicator shall light red after approximately 5 seconds. If they do not, perform all of the combiner 2A16 adjustments listed in the chart for replacement of a combiner (para 5-29*d*).

(5) On the transmitter, set the RCVR CHAN B switch (fig. 3-3) on the radio test set to T.

(6) On the receiver, the CARR (IF) B alarm indicator shall light green. If it does not, refer to the troubleshooting chart (para 5-24*b*) for corrective measures.

(7) On the transmitter, set the ON-OFF switch (fig. 3-3) on 100-MHz oscillator 1A2 to OFF.

(8) Return the transmitter and receiver control settings to the original operating frequency settings (*a* (1) above).

5-20. Power Amplifier Power Supply Voltage Checks

Power amplifier power supply voltage checks are performed monthly by the organizational repairman as part of preventive maintenance, and when specified in the troubleshooting chart (para 5-24*c*) to localize a trouble in the power supply control 3A7. Use the procedures and chart given below to perform the power amplifier power supply voltage checks.

a. Set the selector switch on Multimeter AN/URM-105 (multimeter) to the voltage range indicated in the chart.

b. Connect, in turn, each multimeter lead to the test points, TP( ), indicated in the chart.

c. Observe that multimeter indication is within limits specified in the chart. If multimeter indication is not within limits, replace power supply control 3A7 (para 5-32) and repeat voltage checks.

Selector switch position	Connect (-) multimeter lead to	Connect (+) multimeter lead to	Multimeter indication shall be
AC VOLTS 100	TP2 on 3A7	TP3 on 3A7	28 ±6.0
DC VOLTS 10	TP6 on 3A7	TP1 on 3A7	-7.5 ±2.0
DC VOLTS 100	TP4 on 3A7	TP1 on 3A7	-12 ±4.0
DC VOLTS 10	TP1 on 3A7	TP5 on 3A7	+7.5 ±2.0

5-21. Power Amplifier Module Test Point Checks

Power amplifier module testpoint checks are performed monthly by the organizational repairman as part of preventive maintenance, and when specified in the troubleshooting chart (para 5-24*c*) to localize a trouble in the power amplifier. Use the procedures and chart given below to perform the power amplifier module test point checks.

a. Set the selector switch on Multimeter AN/URM-105 (multimeter) to the voltage range indicated in the chart.

b. Connect, in turn, each multimeter lead to the test points TP( ), indicated in the chart.

c. Observe that multimeter indication is within limits specified in the chart. If multimeter indication is not within limits, refer to the troubleshooting chart (para 5–24*c*) for corrective measures.

Selector switch position	Connect (–) multimeter lead to	Connect (+) multimeter lead to	Multimeter indication shall be
DC VOLTS 10	TP1 on 3A2	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP2 on 3A2	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 100	TP3 on 3A2	TP1 on 3A7	–12 ±3.0
DC VOLTS 10	TP4 on 3A2	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP1 on 3A3	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP2 on 3A3	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP3 on 3A3	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP4 on 3A3	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP5 on 3A3	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP1 on 3A4	TP1 on 3A7	–1.5 ±0.5
DC VOLTS 1	TP4 on 3A4	TP1 on 3A7	–0.2 ±0.1
DC VOLTS 10	TP1 on 3A5	TP1 on 3A7	–7.5 ±3.0
AC VOLTS 10	TP2 on 3A5	TP3 on 3A5	5.0 ±3.0
DC VOLTS 10	TP4 on 3A5	TP1 on 3A7	–12 ±3.0
DC VOLTS 10	TP5 on 3A5	TP1 on 3A7	–12 ±4.0
DC VOLTS 10	TP6 on 3A5	TP1 on 3A7	–12 ±4.0
D CVOLTS 10	TP1 on 3A6	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP2 on 3A6	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP3 on 3A6	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP4 on 3A6	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP5 on 3A6	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP6 on 3A6	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP7 on 3A6	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP8 on 3A6	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP1 on 3A7	TP9 on 3A6	+2.0 ±1.0
DC VOLTS 10	TP10 on 3A6	TP1 on 3A7	–7.5 ±3.0
DC VOLTS 10	TP11 on 3A6	TP1 on 3A7	–7.5 ±3.0

Section III. TROUBLESHOOTING

5–22. General Information

When trouble is encountered during normal radio set operation, or during performance of the preventive maintenance checks and services, determine whether the trouble has interrupted radio communications before performing any troubleshooting procedure or remedial action that will interrupt radio communications. If communications exist, it is not necessary to interrupt the communications to remedy a trouble unless failure to take immediate corrective action will result in damage to the equipment. The organizational repairman can determine whether radio communication has been lost or seriously affected by use of the order wire channel (para 3–17). If radio communication has been interrupted, refer to paragraph 5–23 for troubleshooting procedures.

5–23. Troubleshooting Techniques

Troubleshooting of the radio set is based on the operational checks, (para 4–8) and the transmitter, receiver, and power amplifier checks contained in the monthly preventive maintenance checks and services chart (para 5–6). To troubleshoot the equipment, perform all of the functions in the operational checks (para 4–8) and continuing with the equipment checks that start with item number 7 in the monthly preventive maintenance checks and services chart (para 5–6). Proceed through the items until an abnormal condition or result is observed. When an abnormal condition or result is observed, refer to the troubleshooting chart (para 5–24). Paragraphs 5–25 through 5–28 contain additional information and step-by-step instructions for performing equipment tests to be used during the troubleshooting procedures to aid in localizing a trouble.

5–24. Troubleshooting Charts

Three troubleshooting charts; transmitter, receiver, and power amplifier, are provided for localizing troubles in the radio set. When trouble is encountered during normal radio set operation or

during the procedures described in paragraph 5–23, note the abnormal indication and refer to the appropriate troubleshooting chart. Read down the *Trouble symptom* column to locate the abormal indication and then perform the cherks and corrective measures indicated in the sequence listed. If the checks and corrective measure indicated do not correct the trouble, notify higher category of maintenance.

a. Transmitter Troubleshooting Chart.

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
	Note. Any of the following alarm conditions will cause the CNTRL ALARM indicator on the transmitter meter panel to light red and the audible alarm to sound. Press the RESET pushbutton on the transmitter meter panel to silence the audible alarm; the CNTRL ALARM indicator will light green when the trouble is remedied.		
1	All status and alarm indicators on transmitter meter panel not lighted.	Loss of primary power, or 15/28V regulator 1A1A11 defective.	Perform the following checks: *a.* Check the 5 AMPS SLO-BLO fuse indicator on transmitter meter panel. If indicator is lighted, refer to item number 3 in this chart. *b.* Check that POWER ON–OFF switch on transmitter meter panel is set to ON. If it is not, set it to ON. *c.* Check that primary power is applied to transmitter cabinet and J7 AC POWER INPUT connection on top of transmitter cabinet is securely tightened. *d.* Check indicator lamp 1A1A13DS11 on power supply 1A1. If indicator lamp is extinguished, refer to item 4 in this chart.
2	Any of the following status or alarm indicators on the transmitter meter panel lighted red:	Loss of dc power	Check all indicator lamps (1A1A13DS1 through 1A1A13DS12) on power supply 1A1. If any indicator lamp is not lighted, refer to item number 4 in this chart.
	a. RADIO TEST SET	*a.* ON–OFF switch on 100-MHz RF oscillator 1A2 in ON position.	*a.* Set ON–OFF switch on 100-MHz RF oscillator 1A2 to OFF if radio test set is not being used.
	b. CNTRL ALARM	*b.* Any alarm indicator on transmitter, receiver, or power amplifier is lighted red, causing the CNTRL ALARM indicator to light red. If no other alarm indicator is lighted red, trouble is transmitter alarm monitor 1A5, receiver alarm monitor 2A20, power amplifier low RF-mismatch alarm and control 3A4, or order wire board No. 2 (1A13A2) defective.	*b.* Check alarm indicators (para 4–9) on transmitter, receiver, and power amplifier. Troubleshoot on basis of these alarms. If the CNTRL ALARM indicator is the only alarm indicator on the three units that is lighted red, replace the follow-ind modules one at a time using the substitution method (para 5–29*b*): Transmitter alarm monitor 1A5, receiver alarm monitor 2A20, power amplifier low RF-mismatch alarm monitor 3A4. If CNTRL ALARM indicator is still lighted red, replace order wire board No. 2 (1A13A2) (para 5–29*b*).
	c. TRAF	*c.* Loss of pcm traffic from cable system. Defective module in digital data modem 1A12. AF–RF amplifier 1A4, modulator 1A8, alarm monitor 1A5, attenuator assembly 1A3, or 1.3 MHz low pass filter 1A6 defective.	*c.* Perform the following checks: (1) Check the external TRAFFIC IN alarm indicator. If the alarm indicator is lighted red, trouble is loss of pcm from cable system. Notify Multiplexer TD–204/U operator (para 3–17).

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			(2) Check CABLE TO RADIO MODEM alarm indicator on transmitter meter panel. If this indicator is lighted red, refer to item number 9 in this chart. (3) Turn transmitter meter selector switch to TRAFFIC. (4) If meter indication is not 90 to 110, adjust TRAFFIC LEVEL ADJ control on AF–RF amplifier 1A4 to obtain a meter indication of 100. (5) If a meter indication of 100 cannot be obtained by adjusting the TRAFFIC LEVEL ADJ control, replace the following modules one at a time (para 5–29*b*): AF–RF amplifier 1A4, alarm monitor 1A5, modulator 1A8, attenuator assembly 1A3, and 1.3 MHz low pass filter 1A6. (6) If trouble not remedied, perform the cable loop back test (para 5–26).
	d. RF POWER	*d.* Transmitter requires returning, directional coupler diode 1DC2–CR1, crystal mixer 1A9A1, modulator 1A8, electronic frequency control 1A7, 3rd frequency multiplier 1A10A2, 2nd frequency multiplier 1A10A1, amplifier-frequency multiplier 1A11, frequency synthesizer 1A14, or alarm monitor 1A5 defective.	*d.* Perform the following checks: (1) Check that 4.4–5.0 GHz bandpass filter 1FL3 and frequency synthesizer 1A14 controls are set to the desired frequency. (2) Turn transmitter meter selector switch to RF POWER. If meter indication is not within yellow band (or marginal) proceed to next step. If meter indication is within yellow band, replace alarm monitor 1A5 (para 5–30) during first period that the radio set can be shutdown. (3) If the RF POWER meter indication is zero, check RF MONITOR meter indication with INPUT FORWARD MILLIWATT pushbutton depressed, on power amplifier meter panel. If meter indication is in yellow band, or if attenuator control 3A9AT1 can be adjusted for a RF MONITOR meter indication in yellow band, replace directional coupler diode 1DC2CR1 (para 5–33). (4) Turn transmitter meter selector switch to 3RD MULT. (LOCAL OSC).

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			If meter indication is within yellow band, proceed to next step. If meter indication is not within yellow band, perform steps (7) through (9) below. (5) Turn transmitter meter selector switch to MODULATOR OUTPUT. If meter indication is within black band, proceed to next step. If meter indication is not within blank band, replace modulator 1A8 (para 5–29). (6) Turn transmitter meter selector switch to FREQ CONTROL CTR FREQ. If meter indication is in blue band, replace crystal mixer 1A9A1 (para 5–30). If meter indication is not in blue band, replace modulator 1A8 and electronic frequency control 1A7, one at a time (para 5–29). (7) Turn transmitter meter selector switch to 2ND MULT. If meter indication is not within yellow band, proceed to next step. If meter indication is within yellow band, replace 3rd frequency multiplier 1A-10A2 (para 5–30). (8) Turn transmitter meter selector switch to AMPL-MULT. If meter indication is not within yellow band, proceed to next step. If meter indication is within yellow band, replace 2nd frequency multiplier 1A10A1 (para 5–30). (9) Turn transmitter meter selector switch to SYNTHESIZER. If meter indication is within black band, replace amplifier-frequency multiplier 1A11 (para 5–30). If meter indication is not within black band, check frequency synthesizer 1A14 module fault indicators and troubleshoot using item 7 in this chart.
e.	SYNTH LOCK ----------	*e.* One of frequency synthesizer 1A14 modules is defective, or alarm monitor 1A5 defective.	*e.* Perform the frequency synthesizer module fault indicaton checks (item number 7). If trouble is not remedied, contact the distant radio site (para 3–17) and check if traffic is received satisfactorily. If not, replace each of frequency synthesizer 1A14 modules (para 5–30), one at a

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			time, until trouble is resolved. If traffic is received satisfactorily, replace alarm monitor 1A5 (para 5–30) during first radio set shutdown period.
	f. REFL RF POWER	*f.* Mismatch between transmitter and power amplifier, alarm monitor 1A5 defective, or power amplifier requires retuning.	*f.* Perform the following checks: (1) Check transmitter meter selector switch to REFL RF POWER. If meter indication is not 0–20, proceed to next step. If meter indication is 0–20, replace alarm monitor 1A5 (para 5–30) during the first radio set shutdown period. (2) Adjust the 1ST CAVITY MAIN TUNING control on power amplifier for a minimum REFL RF POWER meter indication on the transmitter meter panel. *Note.* The 2nd, 3rd, and 4th CAVITY TUNING controls on the power amplifier must be adjusted (para. 3–13) to restore output power. (3) Check all power amplifier alarm indicators (para 4–9).
	g. RADIO TO CABLE MODEM.	*g.* Digital data modem 1A12 faulty	*g.* Perform the following checks: (1) Check digital data modem 1A12 failure indicator lamps (fig. 3–4). If any failure indicator lamp is not lighted, refer to item number 10 in this chart. (2) Contact Multiplexer TD–204/U operator (para 3–17) and check if traffic is received satisfactorily. If not, perform the radio set loop back test (para 5–28) to isolate the trouble to the receiver, transmitter, or incoming signal. (3) If Multiplexer TD–204/U operator is receiving traffic satisfactorily, replace alarm monitor 1A12A6 (para 5–30) during the first radio set shutdown period.
	h. CABLE TO RADIO MODEM.	*h.* Digital data modem 1A12 faulty	*h.* Perform the following checks: (1) Check digital data modem 1A12 failure indicator lamps (fig. 3–4). If any failure indicator lamp is not lighted, refer to item number 9 in this chart. (2) Contact distant radio site (para 3–17), and check if traffic is received satisfactorily. If not, replace each of the digital data modem modules (para 5–30), one at a time, until the trouble is resolved. If trouble is not remedied,

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			perform the loop back test (para 5–26). (3) If the distant radio site is receiving traffic satisfactorily, replace alarm monitor 1A12A6 (para 5–30) during the first radio set shutdown period.
	i. CABLE TO RADIO MODEM and TRAF.	*i.* Any one of the following digital data modem 1A12 modules (A1 through A4) defective.	*i.* Refer to item number 9 in this chart.
	j. INTERLOCK and RF POWER.	*j.* Waveguide switch is between positions.	*j.* Place waveguide switch in required position.
	k. SYNTH LOCK and RF POWER.	*k.* Any frequency synthesizer 1A14 module defective.	*k.* Refer to item number 7 in this chart.
3	5 AMPS SLO-BLO fuse indicator lights.	5 AMPS SLO-BLO fuse defective	Replace 5 AMPS SLO-BLO fuse (para 4–14). If replacement fuse blows, notify higher category of maintenance.
4	Any power supply 1A1 indicator (1A1A13DS1 through 1A1A13DS12 not lighted.	Indicator lamp (1A1A13DS1 through 1A1A13DS12) defective, or voltage regulator (1A1A1 through 1A1A12) defective.	Perform the transmitter power supply voltage checks (para 5–10). If any step of the power supply voltage checks fails, refer to item 11 in this chart. If all of the power supply voltage checks are within tolerance, replace extinguished indicator lamp (para 5–34).
5	*a.* 28V indicator on frequency synthesizer 1A14 not lighted.	*a.* Lamp 1A14DS1 defective, or dual power supply 1A14A8 defective.	*a.* Perform the following checks: (1) Replace lamp 1A14DS1 (para 5–34). (2) If replacement lamp does not light, replace dual power supply 1A14A8 (para 5–30).
	b. 5V indicator on frequency synthesizer 1A14 not lighted.	*b.* Lamp 1A14DS2 defective, or dual power supply 1A14A8 defective.	*b.* Perform the following checks: (1) Replace 5V indicator lamp 1A14DS2 (para 5–34). (2) If replacement lamp does not light, replace dual power supply 1A14A8 (para 5–30).
	c. 28V and 5V indicators on frequency synthesizer 1A14 not lighted.	*c.* Fuse 1A14F1 or dual power supply 1A14A8 defective.	*c.* Perform the following checks: (1) Replace fuse 1A14F1 (para 4–14). (2) If 28V and 5V indicators still not lighted, replace dual power supply 1A14A8 (para 5–30).
6	SYNTH OVEN indicator not lighted.	SYNTH OVEN indicator lamp defective or standard RF oscillator 1A14A7 defective.	Perform the following checks: *a.* Press the SYNTH OVEN indicator, it should light white. If it does not, replace the indicator lamp (para 5–34). *b.* Replace standard rf oscillator 1A14A7 (para 5–29).
7	Any of the following frequency synthesizer 1A14 module fault indicators lights.		
	a. Any module fault indicators lights.	*a.* Frequency synthesizer 1A14 module (A1 through A6) on which fault indicator is lighted is defective.	*a.* Replace frequency synthesizer module containing lighted module fault indicator (para 5–29).

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
	b. Frequency synthesizer 1A14 module fault indicators A2DS1 and A6DS1 light.	*b.* Standard RF oscillator 1A14A7 defective.	*b.* Replace standard RF oscillator 1A14A7 (para 5–30).
	c. Frequency synthesizer 1A14 module fault indicators A3DS1 and A6DS1 light.	*c.* Fixed frequency divider 1A14A6 defective.	*c.* Replace fixed frequency divider module 1A14A6 (para 5–30).
	d. Frequency synthesizer 1A14 module fault indicators A1DS1, A2DS1, A4DS1, and A5DS1 light.	*d.* RF oscillator 1A14A1 defective	*d.* Replace RF oscillator module 1A14A1 (para 5–30).
	e. Frequency synthesizer 1A14 module fault indicators A2DS1, A4DS1, and A5DS1 lighted.	*e.* Electronic frequency converter 1A14A2 defective.	*e.* Replace electronic frequency converter 1A14A2 (para 5–30).
8	*a.* Any of the following digital data modem 1A12 failure indicator lamps not lighted and the CABLE TO RADIO MODEM alarm indicator on transmitter meter panel is lighted green: A2DS1 through A4DS1.	*a.* Loss of traffic from Multiplexer TD–204/U, CABLE LOOP TEST/NORMAL switch in TEST position, or module failure indicator lamp burned out.	*a.* Perform the following checks: (1) Check that CABLE LOOP TEST/NORMAL switch on digital data modem 1A12 is set to NORMAL. If not, set it to NORMAL. (2) Check external TRAFFIC IN alarm indicator lamp. If it is lighted red, notify Multiplexer TD–204/U operator traffic is not being received. (3) Replace extinguished module failure indicator lamp (para 5–34).
	b. Any of the following digital data modem 1A12 failure indicator lamps not lighted and the RADIO TO CABLE MODEM alarm indicator on transmitter meter panel is lighted green: A8DS1, A9DS1, A10DS1, A12DS1, or A13DS1.	*b.* Loss of traffic from distant radio set, receiver defective, or module failure indicator lamp burned out.	*b.* Perform the following checks: (1) Check receiver status and alarm indicators (para 4–9). If any indicator is not lighted green, refer to receiver troubleshooting chart (para 5–24*b*). (3) Contact Multiplexer TD–204/U operator (para 3–17) and check if traffic is received satisfactorily. If not, perform the radio set loop back test (para 5–26). If no fault is found, contact distant radio site (para 3–17) and tell him to check out his end of the communications link. (4) Replace extinguished module failure indicator lamp (para 5–34) if radio communication is satisfactory.
9	Any of the following digital modem 1A12 failure indicator lamps not lighted and CABLE TO RADIO MODEM indicator on transmitter meter panel lighted red.		
	a. Cable digital regenerator 1A12A2 failure indicator lamp not lighted.	*a.* FROM CABLE traffic failure, or cable digital regenerator 1A12A2 defective.	*a.* Perform the following checks: (1) Check CABLE LG (Miles) indicators. If correct

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			CABLE LG (Miles) indicator lamp is not lighted, perform cable length adjustment (para 2-16). (2) Replace cable digital regenerator 1A12A2 (para 5-29). If failure indicator lamp still not lighted, a FROM CABLE traffic failure is indicated. Notify Multiplexer TD-204/U operator (para 3-17).
	b. Cable control comparator 1A12A3 module failure indicator lamp not lighted.	*b.* Cable control comparator 1A12A3, 4,608 kHz vco 1A12A1, or cable digital regenerator 1A12A2 defective.	*b.* Replace cable control comparator 1A12A3 (para 5-29). If failure indicator lamp still not lighted, replace 4,608 kHz vco 1A12A1 (para 5-29). If failure indicator lamp still not lighted, perform checks and corrective measures listed for *a* above.
	c. Cable digital processor 1A12A4 module failure indicator lamp not lighted.	*c.* Cable digital processor 1A12A4, cable control comparator 1A12A3, 4,608 kHz vco 1A12A1 or cable digital regenerator 1A12A2 defective.	*c.* Replace cable digital processor 1A12A4 (para 5-29). If failure indicator lamp still not lighted, replace cable control comparator 1A12A3, and voltage control oscillator 1A12A1, one at a time (para 5-29). If failure indicator lamp is still not lighted, perform checks and corrective measures listed for 9*a* above.
10	Any one of the following digital data modem 1A12 failure indicator lamps not lighted and RADIO TO CABLE MODEM indicator on transmitter meter panel, lighted red:		
	a. Radio digital regenerator 1A12A8 module failure indicator lamp not lighted.	*a.* Radio digital regenerator 1A12A8 defective.	*a.* Replace radio digital regenerator 1A12A8 (para 5-29). If trouble not remedied, perform receiver status and alarm indicator checks (para 4-9).
	b. Radio control comparator 1A12A9 failure indicator lamp not lighted.	*b.* Radio control comparator 1A12A9, 4,608 kHz vco 1A12A14, or radio digital regenerator 1A12A8 defective.	*b.* Replace radio control comparator 1A12A9 (para 5-29). If failure indicator lamp still not lighted, replace 4,608 kHz vco 1A12A14 (para 5-29). If failure indicator lamp still not lighted, perform checks and corrective measures listed for *a* above.
	c. Control processor 1A12A10 failure indicator lamp not lighted.	*c.* Control processor 1A12A10, pulse decoder 1A12A11, radio control comparator 1A12A9, 4,608 kHz vco 1A12A14, or radio digital regenerator 1A12A8 defective.	*c.* Replace control processor 1A12A10 (para 5-29). If failure indicator lamp still not lighted, replace pulse decoder 1A12A11 (para 5-29). If failure indicator lamp still does not light, perform checks and corrective measures listed for *b* above.
	d. Control processor 1A12A12 failure indicator lamp not lighted.	*d.* Control processor 1A12A12, pulse decoder 1A12A11, radio control comparator 1A12A9, 4,608 kHz vco 1A12A14, or radio digital regenerator 1A12A8 defective.	*d.* Replace control processor 1A12A12 (para 5-29). If failure indicator lamp still not lighted, replace pulse decoder 1A12A11 (para 5-29). If failure indicator lamp still not lighted, perform checks

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			and corrective measures listed for *b* above.
	e. Radio digital processor 1A12A13 failure indicator lamp not lighted.	*e.* Radio digital processor 1A12A13, control processor 1A12A10 or 1A12A12, pulse decoder 1A12A11, radio control comparator 1A12A9, 4,608 kHz vco 1A12A14, or radio digital regenerator 1A12A8 defective.	*e.* Replace radio digital processor 1A12A13 (para 5–29). If failure indicator lamp still not lighted, replace the following modules, one at a time (para 5–29): Pulse decoder 1A12A11, control processor 1A12A10, radio control comparator 1A12A9, voltage control oscillator 1A12A14, and radio digital regenerator 1A12A8.
11	Out of color band meter indication obtained when monitoring any of the following power supply 1A1 test points (para 5–10):		
	a. TP1	*a.* Digital data modem 1A12 not plugged in, or 5/6V regulator 1A1A1 defective.	*a.* Perform the following checks: (1) Check that digital data modem 1A12 is firmly seated and replace fuse 1A1A13F1 (para 4–14) if required. (2) Replace 5/6V regulator 1A1A1 (para 5–30) and check fuse F1.
	b. TP2	*b.* Digital data modem 1A12 not plugged in, or 5/6V regulator 1A1A2 defective.	*b.* Perform the following checks: (1) Check that digital data modem 1A12 is firmly seated and replace fuse 1A1A13F2 (para 4–14) if required. (2) Replace 5/6V regulator 1A1A2 (para 5–30) and check fuse 1A1A13F2.
	c. TP3	*c.* Digital data modem 1A12 not plugged in, or 5/6V regulator 1A1A3 defective.	*c.* Perform the following checks: (1) Check that digital data modem 1A12 is firmly seated and replace fuse 1A1A13F3 (para 4–14) if required. (2) Replace 5/6V regulator 1A1A3 (para 5–30) and check fuse 1A1A13F3.
	d. TP4	*d.* Orderwire 1A13 not plugged in, or 5/6V regulator 1A1A4 defective.	*d.* Perform the following checks: (1) Check that order wire 1A13 is firmly seated and replace fuse 1A1A13F4 (para 4–14) if required. (2) Replace 5/6V regulator 1A1A4 (para 5–30) and check fuse 1A1A13F4.
	e. TP6	*e.* Order wire 1A13 not plugged in, or 12V regulator 1A1A6 defective.	*e.* Perform the following checks: (1) Check that order wire 1A13 is firmly seated and replace fuse 1A1A13F6 (para 4–14) if required. (2) Replace 12V regulator 1A1A6 (para 5–30) and check fuse 1A1A13F6.
	f. TP7	*f.* Order wire 1A13 not plugged in, or 12V regulator 1A1A7 defective.	*f.* Perform the following checks: (1) Check that order wire 1A13 is firmly seated and replace fuse 1A1A13F7 (para 4–14) if required.

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			(2) Replace 12V regulator 1A1A7 (para 5–30) and check fuse 1A1A13F7.
	g. TP8	*g.* Digital data modem 1A12 not plugged in, or 12V regulator 1A1A8 defective.	*g.* Perform the following checks: (1) Check that digital data modem 1A12 is firmly seated and replace fuse 1A1A13F8 (para 4–14) if required. (2) Replace 12V regulator 1A1A8 (para 5–30) and check fuse 1A1A13F8.
	h. TP9	*h.* Digital data modem 1A12 or alarm monitor 1A5 not plugged in, or 12V regulator 1A1A9 defective.	*h.* Perform the following checks: (1) Check that the digital data modem 1A12 and alarm monitor 1A5 are firmly seated and replace fuse 1A1A13F9 (para 4–14) if required. (2) Replace 12V regulator 1A1A9 (para 5–30) and check fuse 1A1A13F9.
	i. TP10	*i.* Transmitter modules 1A2, 1A4, 1A7, and 1A8 not plugged in; or 15/28V regulator 1A1A10 defective.	*i.* Perform the following checks: (1) Check that transmitter modules 1A2, 1A4, 1A7, and 1A8 are firmly seated and replace fuse 1A1A13F10 (para 4–14) if required. (2) Replace 15/28V regulator 1A1A10 (para 5–30) and check fuse 1A1A13F10.
	j. TP11	*j.* Transmitter modules 1A5, 1A8, and 1A13 not plugged in; or 15/28V regulator 1A1A11 defective.	*j.* Perform the following checks: (1) Check that transmitter modules 1A5, 1A8, and 1A13 are firmly seated and replace fuse 1A1A13F11 (para 4–14) if required. (2) Replace 15/28V regulator 1A1A11 (para 5–30) and check fuse 1A1A13F11.
	k. TP12	*k.* Amplifier-frequency multiplier 1A11 not plugged in; or 15/28V regulator 1A1A12 defective.	*k.* Perform the following checks: (1) Check that amplifier-frequency multiplier 1A11 is firmly seated and replace fuse 1A1A13F12 (para 4–14) if required. (2) Replace 15/28V regulator 1A1A12 (para 5–30) and check fuse 1A1A13F12.
12	Out of color band meter indication obtained when monitoring the test points on any of the transmitter modules (para 5–11).	Voltage regulator associated with module test point defective.	Perform transmitter power supply voltage checks (para 5–10). If trouble is not remedied, replace module (para 5–31) on which out of color band meter indication was obtained.
13	Any one of the following order wire 1A13 module test switch positions checks fail (para 5–12). MODULE TEST *switch position*	*Note.* Check that all external equipment such as, local hand-set, remote phone, and thru order wire patching, are connected or terminated properly before replacing an order wire module.	
	a. 1 (with module test lamp depressed).	*a.* Board No. 1 (1A13A1) defective.	*a.* Replace board No. 1 (1A13A1) (para 5–30).
	b. 2, 6, 8, or 10	*b.* Board No. 5 (1A13A5) defective.	*b.* Replace board No. 5 (1A13A5) (para 5–30).

Item No	Trouble symptom	Probable trouble	Checks and corrective measures
	c. 3 or 4	*c.* Board No. 3 (1A13A3) defective.	*c.* Replace board No. 3 (1A13A3) (para 5–30).
	d. 5 or 7	*d.* Board No. 4 (1A13A4) defective.	*d.* Replace board No. 4 (1A13A4) (para 5–30).
	e. 9, 11, or 12	*e.* Board No. 2 (1A13A2) defective.	*e.* Replace board No. 2 (1A13A2) (para 5–30).
14	Out of color band meter indication obtained with meter selector switch in any of the following meter positions (para 4–10*a*).		
	a. OW TEST	*a.* Digital data modem 1A12 requires adjustment, one of digital data modem 1A12 or orderwire assembly 1A13 modules is defective or 12-channel pcm attenuator 1A3 defective.	*a.* Perform the following checks: (1) Perform the transmitter order wire level adjustment (para 5–35). Perform the order wire checks (para 4–11). (2) Replace attenuator assembly 1A3 (para 5–30).
	b. MODULATOR CONTROL.	*b.* Modulator 1A8 defective	*b.* Replace modulator 1A8 (para 5–30).
	c. MODULATOR OUTPUT.	*c.* Modulator 1A8 defective	*c.* Same as *b* above.
	d. FREQ CONTROL CTR FREQ.	*d.* Electronic frequency control 1A7, or modulator 1A8 defective.	*d.* Replace electronic frequency control 1A7 (para 5–29). If meter indication is still not in blue band, replace modulator 1A8 (para 5–29).
	e. FREQ CONTROL OUTPUT.	*e.* Modulator 1A8, or electronic frequency control 1A7 defective.	*e.* Same as *d* above.
	f. TRAFFIC	*f.* Loss of pcm traffic from Multiplexer TD–204/U, digital data modem 1A12, AF–RF amplifier 1A4, modulator 1A8, alarm monitor 1A5, 12 channel pcm attenuator 1A3, or 1.3 MHz low pass filter 1A6 defective.	*f.* Perform the following checks: (1) If shelter TRAFFIC IN alarm indicator is lighted red, trouble is loss of pcm traffic from Multiplexer TD–204/U. Notify Multiplexer TD–204/U operator (para 3–17). (2) Check CABLE TO RADIO MODEM indicator on transmitter meter panel. If it is lighted red, refer to item number 9 in this chart. (3) Adjust the TRAFFIC LEVEL ADJ control on amplifier 1A4 for a meter indication of 100. If a meter indication of 100 cannot be obtained using the TRAFFIC LEVEL ADJ control, replace AF–RF amplifier 1A4 (para 5–30). If meter indication still is not 100, replace modulator 1A8, alarm monitor 1A5, attenuator assembly 1A3, and low pass filter 1A6, one at a time (para 5–29).
	g. SYNTHESIZER	*g.* One of the frequency synthesizer 1A14 modules is defective.	*g.* Turn transmitter meter selector switch to RF POWER. If meter indication is not in yellow band

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			refer to item number 7 in this chart. If meter indication is in yellow band, notify higher category of maintenance.
	h. AMPL MULT	*h.* Amplifier-frequency multiplier 1A11, frequency synthesizer 1A14, or diode 1HY1CR1 defective.	*h.* Perform the following checks: (1) Turn transmitter meter selector switch to RF POWER. If meter indication is not in yellow band proceed to the next step. If meter indication is in yellow band, replace diode 1HY1CR1 (para 5–33) during first radio set shutdown period. (2) Turn transmitter meter selector switch to SYNTHESIZER. If meter indication is within yellow band, replace amplifier-frequency multiplier 1A11 (para 5–30). If meter indication is not within yellow band refer to item number 7 in this chart.
	i. 2ND MULT	*i.* 2ND frequency multiplier 1A10A1, amplifier-frequency multiplier 1A11, frequency synthesizer 1A14, or diode 1A10HY1CR1 defective.	*i.* Perform the following checks: (1) Turn transmitter meter selector switch to RF POWER. If meter indication is not in yellow band, proceed to the next step. If meter indication is in yellow band, replace diode 1A10HY1CR1 (para 5–33) during first radio set shutdown period. (2) Turn transmitter meter selector switch to AMPL MULT. If meter indication is not in yellow band, proceed to next step. If meter indication is in yellow band, replace 2nd frequency multiplier 1A-10A1 (para 5–30). (3) Turn transmitter meter selector switch to SYNTHESIZER. If meter indication is in yellow band, replace amplifier-frequency multiplier 1A11 (para 5–30). If meter indication is not in yellow band, check frequency synthesizer 1A14 module fault indicators (item number 7).
	j. 3RD MULT (LOCAL OSC).	*j.* 3rd frequency multiplier 1A10A2, 2nd frequency multiplier 1A10A1, amplifier-frequency multiplier 1A11, frequency synthesizer 1A14, or diode 1A9HY1CR1 defective.	*j.* Perform the following checks: (1) Turn transmitter meter selector switch to RF POWER. If meter indication is not in yellow band, proceed to next step. If meter indication is in yellow band, replace diode 1A9HY1CR1 (para 5–33)

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			during first radio set shutdown period. (2) Turn transmitter meter selector switch to 2ND MULT. If meter indication is not in yellow band, refer to *i* above. If meter indication is in yellow band, replace 3rd frequency multiplier 1A10A2 (para 5-30).
	k. RF POWER	*k.* Same as item number 2*d* in this chart.	*k.* Refer to item number 2*d* in this chart.
	l. REFL RF POWER	*l.* Same as item number 2*f* in this chart.	*l.* Refer to item number 2*f* in this chart.

b. Receiver Troubleshooting Chart.

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
	Note. Any of the following conditions will cause the CNTRL ALARM indicator on the transmitter meter panel to light red and the audible alarm to sound. Press the RESET pushbutton on the transmitter meter panel to silence the audible alarm; the CNTRL ALARM indicator will light green when the trouble is remedied.		
1	All alarm indicators on the receiver meter panel not lighted.	Loss of primary power, or 15/28v regulator 2A3A4 defective.	Perform the following checks: *a.* Check the POWER 8 AMPS fuse indicator on the receiver meter panel. If indicator is lighted, refer to item 3 in this chart. *b.* Check that POWER ON-OFF switch on receiver meter panel is set to ON. If it is not, set it to ON. *c.* Check that primary power is applied to the receiver cabinet and that AC POWER INPUT connection on top of receiver cabinet is securely tightened. *d.* Check indicator lamp 2A3A5DS4 on power supply 2A3. If extinguished, refer to item number 6 in this chart.
2	Any of the following alarm indicators on the receiver meter panel lighted red:	Loss of dc power	Check all indicator lamps (2A3A5DS1 through 2A3A5DS4) on power supply 2A3. If any indicator lamp is not lighted, refer to item number 6 in this chart.
	a. CARR (IF) A and CARR (IF) B.	*a.* Frequency synthesizer controls not set to proper operating frequency. Any of the following modules defective: 15/28V regulator 2A3A1, 15/28V regulator 2A3A2, 12V regulator 2A3A3, frequency synthesizer 2A21, amplifier-multiplier 2A8, 2nd frequency multiplier 2A7A1, 3rd frequency multiplier 2A7A2, or combiner 2A16.	*a.* Perform the following checks: (1) Check that frequency synthesizer thumbwheel switches (4) are set to the correct operating frequency. (2) Perform the power supply voltage checks (para 5-15). If any step of the power supply voltage checks fails, refer to item No. 10 in this chart. (3) Turn receiver meter selector switch to LOCAL OSC POWER, A and B. If both meter indications are in the

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			yellow band, proceed to step (4) below. If both meter indications are not in the yellow band, turn meter selector switch to 2ND MULT. If this meter indication is in yellow band, replace 3rd frequency multiplier 2A7A2 (para 5–31). If this meter indication is not in the yellow band, refer to item No. 12*c* in this chart. (4) Use the radio set loop back test (para 5–28) to troubleshoot the receiver. If no abnormal indications are observed during application of the radio set loop back test, trouble is loss of receiver inputs. Notify higher category of maintenance.
	b. CARR (IF) A or CARR (IF) B.	*b.* Frequency controls for alarmed channel not set to proper operating frequency. Either receiver channel being squelched due to poor trophospheric reception. Any of the following modules defective: TDA 2A1, TDA 2A2, mixer-preamplifier 2A4 or 2A11, frequency mixer 2A6 or 2A9, 220 MHz vco 2A13 or 2A14, 70 MHz if filter 2A5 or 2A10, combiner 2A16, or alarm monitor 2A20.	*b.* If CARR (IF) A is lighted red, perform steps (1) through (4) below. If CARR (IF) B is lighted red, perform steps (5) through (8) below. (1) Check that preselector 2FL4, post selector 2FL6, and local oscillator 2FL8 are set to the same frequency as frequency synthesizer 2A21. (2) Turn receiver meter selector switch to LOCAL OSC POWER, A. If this meter indication is not in the yellow band, refer to item No. 12*q* in this chart. (3) Set both SQUELCH ON–OFF switches on combiner 2A16 to OFF, wait approximately 1 minute, and observe the CARR (IF) A alarm indicator. If the CARR (IF) A alarm indicator lights green, even for a moment, probable trouble is receiver channel A is being squelched due to poor tropospheric conditions. Set both SQUELCH ON–OFF switches on combiner 2A16 to ON. Wait until radio communications is not vital and use the radio set loop back test (para 5–28) to check the receiver. (4) Wait until radio communications can be interrupted and then replace the following modules (para 5–31) one at a time: TDA 2A1,

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			mixer-preamplifier 2A4, 70 MHz if filter 2A5, if amplifier 2A12, combiner 2A16, and alarm monitor 2A20. (5) Check that preselector 2FL5, post selector 2FL7, and local oscillator filter 2FL9 are set to the same frequency as frequency synthesizer 2A21. (6) Turn receiver meter selector switch to LOCAL OSC POWER, B. If this meter indication is not in the yellow band, refer to item No. 12*r* in this chart. (7) Set both SQUELCH ON–OFF switches on combiner 2A16 to OFF, wait approximately 1 minute, and observe the CARR (IF) B alarm indicator. If the CARR (IF) B alarm indicator lights green, even for a moment, probable trouble is receiver channel B is being squelched due to poor tropospheric conditions. Set both SQUELCH ON–OFF switches on combiner 2A16 to ON. Wait until radio communications is not vital and use the radio set loop back test (para 5–28) to check the receiver. (8) Wait until radio communications can be interrupted and then replace the following modules (para 5–31) one at a time: TDA 2A2, mixer-preamplifier 2A11, 70-MHz IF filter 2A10, IF amplifier 2A15, combiner 2A16, and alarm monitor 2A20.
	c. VCO LOCK	*c.* 220 MHz vco 2A13 or 2A14, combiner 2A16, or alarm monitor 2A20 defective.	*c.* Perform the following checks: (1) Turn receiver meter selector switch to VCO FREQ DIFF. If meter indication is from 0 to 10 proceed to next step. If meter indication is not 0 to 10, replace alarm monitor 2A20 (para 5–31) during first radio set shutdown period. (2) Set both APC ON–OFF switches on combiner 2A16 to OFF. Adjust the FREQ ADJUST controls on 220 MHz vco 2A13 and 2A14 and observe that the meter indication varies as the

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			FREQ ADJUST control is varied. Set the FREQ ADJUST control on 220 MHz vco 2A14 for a minimum receiver meter indication. (4) If the FREQ ADJUST control on either 220 MHz vco 2A13 or 2A14 fails to vary the meter indication, replace that faulty module (para 5–31). (5) Set the APC ON–OFF switches on combiner 2A16 to ON. Turn receiver meter selector switch to TEST LEAD (+). (6) Using the test lead, connect one test lead probe to the TEST LEAD jack on the receiver meter panel. Connect other test lead probe to TP2 on combiner 2A16. Turn the FREQ ADJUST control on 220 MHz vco 2A13 clockwise and then counterclockwise. The meter indication should vary above and below meter-zero. Set the FREQ ADJUST control on 220 MHz vco 2A13 for a minimum meter indication. (7) Move the test lead probe from TP2 to TP5 on combiner 2A16 and repeat step (6) using the FREQ ADJUST control on 220 MHz vco 2A14. (8) If the FREQ ADJUST control on either 220 MHz vco 2A13 or 2A14 fails to vary the meter indication above and below zero, replace combiner 2A16 (para 5–31) and perform the combiner adjustments (para 5–41). (9) Turn receiver meter selector switch to APC and disconnect the test lead. (10) Check that a meter indication above and below meter zero can be obtained by varying the FREQ ADJUST control on 220 MHz vco 2A13 then set the control for a zero meter indication.
	d. SYNTH LOCK	*d.* One of frequency synthesizer 2A21 modules defective or alarm monitor 2A20 defective.	*d.* Perform the following checks: (1) Check the frequency synthesizer module fault indicator lamps. If any in-

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			dicator is lighted, refer to number 9 in this chart. (2) Contact Multiplexer TD-204/U operator (para 3-17) and check if traffic is received satisfactorily. If not, replace each of the frequency synthesizer modules (2A21A1 through 2A21A7) one at a time (para 5-31) until trouble is remedied. (3) If Multiplexer TD-204/U operator is receiving traffic satisfactorily and SYNTH LOCK indicator is still lighted red, replace alarm monitor 2A20 (para 5-31) during first radio set shutdown period.
	e. TRAF	*e.* Loss of pcm traffic from distant radio set. AF-RF amplifier 2A19, demodulator 2A17, alarm monitor 2A20, or 260 kHz low pass filter 2A18 defective.	*e.* Perform the following checks: (1) Check CARR (IF) A and CARR (IF) B alarm indicators on receiver meter panel. If these indicators are lighted red, refer to *a* above. (2) Set receiver meter selector switch to TRAFFIC. If meter indication is less than 100, adjust the LEVEL ADJ control on AF-RF amplifier 2A19 for a meter indication of 100. (3) Contact Multiplexer TD-204/U operator (para 3-17) and check if traffic is received satisfactorily. (4) If traffic is not received satisfactorily, proceed to step (5) below. If traffic is received satisfactorily, replace alarm monitor 2A20 (para 5-31) during first radio set shutdown period. (5) Contact distant radio site (para 3-17) and check if traffic is transmitted properly. (6) If it is, replace AF-RF amplifier 2A19, demodulator 2A17, and 260 kHz low pass filter 2A18 one at a time (para 5-31) until trouble is remedied.
	f. CARR (IF) A or CARR (IF) B and VCO LOCK.	*f.* Channel A or B failure	*f.* Refer to *b* above.
	g. SYNTH LOCK and any other alarm indicators.	*g.* One or more frequency synthesizer 2A21 modules is defective.	*g.* Refer to item number 9 in this chart.
3	POWER 8 AMPS fuse indicator lights.	POWER 8 AMPS fuse defective	Replace POWER 8 AMPS fuse (para 4-14).
4	TDA A 1 AMP fuse indicator lights.	TDA A1 AMP fuse or TDA 2A1 defective.	Replace TDA A1 AMP fuse (para 4-14). If replacement fuse blows, replace TDA 2A1 (para 5-31).
5	TDA B1 AMP fuse indicator lights.	TDA B1 AMP fuse or TDA 2A2 defective.	Replace TDA B 1 AMP fuse (para

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			4–14). If replacement fuse blows, replace TDA 2A2 (para 5–31).
6	Any power supply 2A3 indicator (2A3A5DS1 through 2A3A5DS4) not lighted.	Indicator lamp (2A3A5DS1 through 2A3A5DS4) or 15/28v regulator (2A3A1 through 2A3A4) defective.	Perform receiver power supply voltage checks (para 5–15). If any step of power supply voltage checks fails, refer to item number 10 in this chart. If all of the power supply voltage checks are within tolerance, replace extinguished indicator lamp (para 5–34).
7	*a.* 28V indicator on frequency synthesizer 2A21 not lighted.	*a.* Lamp 2A21DS1 defective or dual power supply 2A21A8 defective.	*a.* Perform the following checks: (1) Replace 28V indicator lamp 2A21DS1 (para 5–34). (2) If replacement lamp does not light, replace dual power supply 2A21A8 (para 5–31).
	b. 5V indicator on frequency synthesizer 2A21 not lighted.	*b.* Lamp 2A21DS2 defective or dual power supply 2A21A8 defective.	*b.* Perform the following checks: (1) Replace 5V indicator lamp 2A21DS2 (para 5–34). (2) If replacement lamp does not light, replace dual power supply 2A21A8 (para 5–31).
	c. 28V and 5V indicators on frequency synthesizer 2A21 not lighted.	*c.* Fuse 2A21F1 or dual power supply 2A21A8 defective.	*c.* Perform the following checks: (1) Replace fuse 2A21F1 (para 4–14). (2) If 28V and 5V indicators still not lighted, replace dual power supply 2A21A8 (para 5–31).
8	Any of the following OVEN indicators not lighted:		
	a. MULT OSC A	*a.* MULT OSC A OVEN indicator lamp or 220 MHz vco 2A13 defective.	*a.* Perform the following checks: (1) Press the MULT OSC A OVEN indicator. If it does not light, replace the indicator lamp (para 5–34). (2) If replacement lamp does not light, replace 220 MHz vco 2A13 (para 5–31).
	b. MULT OSC B	*b.* MULT OSC B OVEN indicator lamp or 220 MHz vco 2A14 defective.	*b.* Perform the following checks: (1) Press the MULT OSC B OVEN indicator. If it does not light, replace the indicator lamp (para 5–34). (2) If replacement lamp does not light, replace 220 MHz vco 2A14 (para 5–31).
	c. SYNTH	*c.* SYNTH OVEN indicator lamp or standard RF oscillator 2A21A7 defective.	*c.* Perform the following checks: (1) Press the SYNTH OVEN indicator. If it does not light, replace the indicator lamp (para 5–34). (2) If the SYNTH OVEN indicator does not light after lamp replacement, replace standard RF oscillator 2A21A7 (para 5–31).
9	Any of the following frequency synthesizer 2A21		

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
	module fault indicator lamps light.		
	a. Any module fault indicator lights.	*a.* Frequency synthesizer 2A21 module (A1 through A6) on which module fault indicator is lighted is defective.	*a.* Replace frequency synthesizer module containing lighted module fault indicator (para 5-31).
	b. Frequency synthesizer module fault indicators 2A217A2DS1 and A6DS1 light.	*b.* Standard RF oscillator 2A21A7 defective.	*b.* Replace standard RF oscillator 2A21A7 (para 5-31).
	c. Frequency synthesizer module fault indicators 2A217A3DS1 and 2A217A6DS1 light.	*c.* Fixed frequency divider 2A21A6 defective.	*c.* Replace fixed frequency divider 2A21A6 (para 5-31).
	d. Frequency synthesizer module fault indicators 2A217A2DS1 and A5DS1 light.	*d.* RF voltage controlled oscillator 2A21A1 defective.	*d.* Replace RF voltage controlled oscillator 2A21A1 (para 5-31).
	e. Frequency synthesizer module fault indicators 2A217A2DS1, 2A217-A4DS1, 2A217A5DS1 light.	*e.* Electronic frequency converter 2A21A2 defective.	*e.* Replace electronic frequency converter 2A21A2 (para 5-31).
10	Out of color band meter indication obtained when monitoring any of the following power supply 2A3 test points (para 5-15):		
	a. TP1	*a.* Amplifier-multiplier 2A8, 220 MHz vco 2A13 or 2A14 not plugged in; or 15/28V regulator 2A3A1 defective.	*a.* Perform the following checks: (1) Check that amplifier-multiplier 2A8, 220 MHz vco 2A13, and 220 MHz vco 2A14 are firmly seated and replace fuse 2A3A5F1 (para 4-14) if required. (2) Replace 15/28V regulator 2A3A1 (para 5-31) and check fuse 2A3A5F1.
	b. TP2	*b.* Receiver module 2A1, 2A2, 2A4, 2A11, 2A12, 2A15, 2A16, 2A17, or 2A19 not plugged in; or 15/28V regulator 2A3A2 defective.	*b.* Perform the following checks: (1) Check that receiver modules 2A1, 2A2, 2A4, 2A11, 2A12, 2A15, 2A16, 2A17, and 2A19 are firmly seated and replace fuse 2A3A5F2 (para 4-14) if required. (2) Replace 15/28V regulator 2A3A2 (para 5-31) and check fuse 2A3A5F2.
	c. TP3	*c.* Receiver module 2A13, 2A14, 2A16, or 2A20 not plugged in; or 12V regulator 2A3A3 defective.	*c.* Perform the following checks: (1) Check that receiver modules 2A13, 2A14, 2A16, and 2A20 are firmly seated and replace fuse 2A3A5F3 (para 4-14) if required. (2) Replace 12V regulator 2A3A3 (para 5-31) and check fuse 2A3A5F3.
	d. TP4	*d.* Receiver module 2A13, 2A14, or 2A20 not plugged in; or 15/28V regulator 2A3A4 defective.	*d.* Perform the following checks: (1) Check that receiver modules 2A13, 2A14, and 2A20 are firmly seated and replace fuse 2A3A5F4 (para 4-14) if required.

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			(2) Replace 15/28V regulator 2A3A4 (para 5–31) and check fuse 2A3A5F4.
11	Out of color band meter indication obtained when monitoring the test points on any of the receiver modules (para 5–16).	Voltage regulator associated with module test point defective.	Perform receiver power supply voltage checks (para 5–15). If trouble not remedied, replace module (para 5–31) on which out of color band meter indication was obtained.
12	Out of color band meter indication obtained with meter selector switch in any of the following positions (para 4–10*b*).		
	a. SYNTHESIZER	*a.* One or more of frequency synthesizer 2A21 modules defective.	*a.* Turn receiver meter selector switch to LOCAL OSC POWER, A and B. If meter indications are not in yellow band, check the module fault indicator lamps on frequency synthesizer 2A21, and refer to item number 9 in this chart. If meter indications are within yellow band, notify higher category of maintenance.
	b. AMPL-MULT	*b.* Diode 2HY3CR1, amplifier multiplier 2A8, or frequency synthesizer 2A21 defective.	*b.* Perform the following checks: (1) Turn receiver meter selector switch to LOCAL OSC POWER, A and B. If meter indications are not in yellow band, proceed to the next step. If meter indications are in yellow band, replace diode 2HY3CR1 (para 5–33) during first radio set shutdown period. (2) Turn receiver meter selector switch to SYNTHESIZER. If meter indication is not in yellow band, refer to item number 9 in this chart. If meter indication is in yellow band, replace amplifier multiplier 2A8 (para 5–31).
	c. 2ND MULT	*c.* Diode 2HY1CR1, 2nd frequency multiplier 2A7A1, amplifier-multiplier 2A8, or frequency synthesizer 2A21 defective.	*c.* Perform the following checks: (1) Turn receiver meter selector switch to LOCAL OSC POWER, A and B. If meter indications are not in yellow band, proceed to the next step. If meter indication is in yellow band, replace diode 2HY1CR1 (para 5–33) during first radio set shutdown period. (2) Turn receiver meter selector switch to AMPL-MULT. If meter indication is not in yellow band, refer to *b* above. If meter indication is in yellow band, replace 2nd frequency multiplier 2A7A1 (para 5–31).

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
	d. MULT OSC A	*d.* 220 MHz vco 2A13 defective	*d.* Turn receiver meter selector switch to LOCAL OSC POWER, A. If meter indication is not in yellow band, replace 220 MHz vco 2A13 (para 5-31). If meter indication is in yellow band, notify higher category of maintenance.
	e. MULT OSC B	*e.* 220 MHz vco 2A14 defective	*e.* Turn receiver meter selector switch to LOCAL OSC POWER, B. If meter indication is not in yellow band, replace 220 MHz vco 2A14 (para 5-31). If meter indication is in yellow band, notify higher category of maintenance.
	f. FREQ MIXER CURRENT (3RD MULT) A1 or A2.	*f.* Frequency mixer diodes 2A6Z1CR1 and 2A6Z1CR2 frequency mixer 2A6, 3rd frequency multiplier 2A7A2, 2nd frequency multiplier 2A7A1, amplifier-multiplier 2A8, or frequency synthesizer 2A21 defective.	*f.* Perform the following checks: (1) Turn receiver meter selector switch to LOCAL OSC POWER, A. If meter indication is not in yellow band, proceed to the next step. If meter indication is in yellow band, notify higher category maintenance. (2) Turn receiver meter selector switch to 2ND MULT. If meter indication is within yellow band, proceed to next step. If meter indication is not within yellow band, refer to *c* above. (3) Turn receiver meter selector switch to FREQ MIXER CURRENT (3RD MULT) B1 and B2. If both meter indications are above 50, replace frequency mixer diodes 2A6Z1CR1 and 2A6Z1CR2 (para 5-33). If both meter indications are still above 50, replace frequency mixer 2A6 (para 5-31). If both meter indications are not above 50, replace 3rd frequency multiplier 2A7A2 (para 5-31).
	g. FREQ MIXER CURRENT (3RD MULT) B1 or B2.	*g.* Frequency mixer diodes 2A9Z1CR1 and 2A9Z1CR2, frequency mixer 2A9, 3rd frequency multiplier 2A7A2, 2nd frequency multiplier 2A7A1, amplifier-multiplier 2A8, or frequency synthesizer 2A21 defective.	*g.* Perform the following checks: (1) Turn receiver meter selector switch to LOCAL OSC POWER B. If meter indication is not in yellow band, proceed to next step. If meter indication is in yellow band, notify higher category of maintenance. (2) Turn receiver meter selector switch to 2ND MULT. If meter indication is within yellow band, proceed to the next step. If meter indication is not in yellow

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			band, refer to *c* above. (3) Turn receiver meter selector switch to FREQ MIXER CURRENT (3RD MULT) A1 and A2. If both meter indications are above 50, replace frequency mixer diodes 2A9Z1CR1 and 2A9Z1CR2 (para 5-22). If both meter indications are still above 50, replace frequency mixer 2A9 (para 5-33). If both meter indications are not above 50, replace 3rd frequency multiplier 2A7A2 (para 5-31).
h.	AMPL-MIXER CURRENT A1 or A2.	*h.* Mixer-preamplifier 2A4, 220 MHz vco 2A13, 3rd frequency multiplier 2A7A2, 2nd frequency multiplier 2A7A1, amplifier-multiplier 2A8, or frequency synthesizer 2A21 defective.	*h.* If both meter indications are out of the yellow band, refer to *d* and *f* above. If only one of the meter indications is out of the yellow band, replace mixer-preamplifier 2A4 (para 5-31).
i.	AMPL-MIXER CURRENT B1 or B2.	*i.* Mixer-preamplifier 2A11, 220 MHz vco 2A14, 3rd frequency multiplier 2A7A2, 2nd frequency multiplier 2A7A1, amplifier-multiplier 2A8, or frequency synthesizer 2A21 defective.	*i.* If both meter indications are out of the yellow band, refer to *e* and *g* above, this chart. If only one of the meter indications is out of the yellow band, replace mixer-preamplifier 2A11 (para 5-31).
j.	AGC meter indication exceeds 150.	*j.* Combiner 2A16, IF amplifier 2A12, or IF amplifier 2A15 defective.	*j.* Perform the following checks: (1) Turn receiver meter selector switch to CARR (IF) A, CARR (IF) B, and CARR (IF) COMBINED. If all meter indication is zero, replace combiner 2A16 (para 5-31). If all meter indications are not zero, and the CARR (IF) COMBINED meter indication is 90 to 110, perform the adjustments given in paragraphs 5-36 through 5-39 during first radio set shutdown period. (2) If the AGC meter indication still exceeds 150 and the CARR (IF) A, CARR (IF) B, and CARR (IF) COMBINED meter indications are zero, replace if amplifier 2A12 (para 5-31). If trouble is still encountered, replace if amplifier 2A15 (para 5-31).
k.	CARRIER (IF) A meter indication does not vary and is less than 10 or exceeds 150 divisions.	*k.* Same as item number 2*b* in this chart.	*k.* Refer to item number 2*b* in this chart.
l.	CARRIER (IF) B meter indication does not vary and is less than 10 or exceeds 150 divisions.	*l.* Same as item number 2*b* in this chart.	*l.* Refer to item number 2*b* in this chart.

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
	m. CARRIER (IF) COMBINED meter indication is less than 50 or exceeds 150 divisions.	*m.* Same as item number 2*b* in this chart.	*m.* Refer to item number 2*b* in this chart.
	n. VCO FREQ DIFF	*n.* 220 MHz vco 2A13 and/or 2A14 require adjusting or defective.	*n.* Refer to item number 2*c* in this chart.
	o. APC	*o.* 220 MHz vco 2A13 and/or 2A14 require adjusting, or combiner 2A16 defective.	*o.* Perform the vco frequency adjustment (para 5–40). If APC meter indication still not within blue band, replace combiner 2A16 (para 5–31).
	p. TRAFFIC	*p.* TRAFFIC LEVEL ADJ control on AF–RF amplifier 2A19 needs adjusting, AF–RF amplifier 2A19, 260 kHz low pass filter 2A18, alarm monitor 2A20, or demodulator 2A17 defective.	*p.* Refer to item number 2*e* in this chart.
	q. LOCAL OSC POWER, A	*q.* Same as *h* above	*q.* Refer to item *h* above.
	r. LOCAL OSC POWER, B	*r.* Same as item *i* above	*r.* Refer to *i* above.

c. Power Amplifier Troubleshooting Chart.

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
1	Indicating fuse (F1 0.5A SLO-BLO) 3A9A23F1 lighted.	Fuse 3A9A23F1 burned out	Replace fuse 3A9A23F1 (para 4–14).
2	All of the alarm indicators on the power amplifier meter panel extinguished; except MAIN POWER SWITCH, and BEAM SWITCH.	Power supply control 3A7 or time delay control 3A5 defective.	Replace power supply control 3A7 and time delay control 3A5 (para 5–32) one at a time and recheck power amplifier alarm indicators.
3	Any of the following indicators are not lighted: FILAMENT, LOW RF, AIR, BEAM.	Indicator lamp or indicator control 3A2 defective.	Check indicator lamp. *a.* If lamp is defective, replace lamp (para 5–34). *b.* If lamp not defective, replace indicator control 3A2 (para 5–32) during first radio set shutdown period.
4	Any of the following indicators not lighted: TIME DELAY, ANTENNA MISMATCH, DC OVERLOAD, AC OVERLOAD, AC INTERLOCK.	Indicator lamp or indicator control 3A3 defective.	Check indicator lamp. *a.* If lamp defective, replace lamp (para 5–34). *b.* If lamp not defective, replace indicator control 3A3 (para 5–32) during first radio set shutdown period.
5	TIME DELAY indicator lighted amber after 3 minute time delay has elapsed (all other indicators lighted green).	Indicator control 3A3 or time delay control 3A5 defective.	Perform the following checks: *a.* Set multimeter AN/URM–105 to measure a negative voltage (–7.5 volts approx.). *b.* Connect positive lead of multimeter to TP1 on power supply control 3A7 and negative lead to TP2 on indicator control 3A3. *c.* If meter indication is –5 to –8.25 volts, replace indicator control 3A3 (para 5–35) during first radio set shutdown period. *d.* If meter indication is approximately 0 volts, replace time delay control 3A5 (para 5–32)

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			during first radio set shutdown period.
6	AIR indicator lighted red (all other indicators lighted green).	Indicator control 3A2 defective.	Replace indicator control 3A2 (para 5–32) during first radio set shutdown period.
7	FILAMENT indicator lighted red (all other indicators lighted green).	Indicator control 3A2 or time delay control 3A5 defective.	Perform the following checks: *a.* Set multimeter AN/URM–105 to measure a negative voltage (–7.5 volts approx.). *b.* Connect positive lead of multimeter to TP1 on power supply control 3A7 and negative lead to TP3 on indicator control 3A2. *c.* If meter indication is –5 to –8.25 volts, replace indicator control 3A2 (para 5–32) during first radio set shutdown period. *d.* If meter indication is approximately 0 volt, replace time delay control 3A5 (para 5–32) during first radio set shutdown period.
8	BEAM indicator lighted red (all other indicators lighted green).	Indicator control 3A2 defective.	Replace indicator control 3A2 (para 5–32) during first radio set shutdown period.
9	DC OVERLOAD lighted red (all other indicators lighted green).	Indicator control 3A3 or beam gate-dc overload control 3A6 defective.	Perform the following checks: *a.* Observe BEAM VOLTAGE meter on front panel of power amplifier. *b.* If meter indication is in green band proceed to step *c.* If meter indication is above green band, turn off power amplifier by pressing MAIN POWER SWITCH and notify higher category of maintenance. *c.* Set multimeter AN/URM–105 to measure a negative voltage (–7.5 volts approximately). *d.* Connect positive meter lead to TP1 on power supply control 3A7 and negative meter lead to TP5 on indicator control 3A3. *e.* If meter indication is –5 to –8.25 volts, replace indicator control 3A3 (para 5–32) during first radio set shutdown period. *f.* If meter indication is 0 volts (approximate), replace beam gate dc-overload control 3A6 (para 5–32) during first radio set shutdown period.
10	AC INTERLOCK indicator lighted red (all other indicators lighted green).	Indicator control 3A3 or beam gate-dc overload control 3A6 defective.	Perform the following checks: *a.* Set multimeter AN/URM–105 to measure a negative voltage (–7.5 volts approximately). *b.* Connect positive meter lead TP1 on power supply control 3A7 and negative meter lead to TP1 on indicator control 3A3. *c.* If meter indication is –7.5 volts (approx), replace indicator con-

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			trol 3A3 during first radio set shutdown period. Warning: Extremely high voltage in excess of 8,000 volts is present in the power amplifier. Set MAIN POWER circuit breaker (fig. 3–11) to OFF before checking cabinet interlocks. *d.* If meter indication is 0 volt, replace beam gate-dc overload control 3A6 (para 5–32) and check that high voltage interlock door (fig. 1–14) and interlock panel is secure.
11	AC OVERLOAD indicator lighted red (all other indicators lighted green).	Indicator control 3A3 defective.	Replace indicator control 3A3 (para 5–32) during first radio set shutdown period.
12	ANTENNA MISMATCH indicator lighted red (all other indicators lighted green).	Indicator control 3A3, low RF-mismatch, alarm and control 3A4, or beam gate-dc overload control 3A6 defective.	Perform the following checks: *a.* Press ANTENNA REFLECTED WATTS pushbutton on power amplifier meter panel and observe RF MONITOR meter. *b.* If meter indication is in blue band, proceed to step *c* below. If meter indication is above blue band, replace beam gate-dc overload control 3A6 (para 5–32) during first radio set shutdown period. *c.* Set multimeter AN/URM–105 to measure a negative voltage (–7.5 volts approx). *d.* Connect positive meter lead on TP1 on power supply control 3A7 and negative meter to TP3 on indicator control 3A3. *e.* If meter indication is –5 to –8.5 volts, replace indicator control 3A3 (para 5–32) during first radio set shutdown period. *f.* If meter indication is 0 volts (approx), replace low RF-mismatch alarm and control 3A4 (para 5–32) during first radio set shutdown period.
13	LOW RF indicator lighted red (all other indicators lighted green).	Loss of beam voltage, loss of RF input power; power amplifier not tuned properly; crystal detector 3A9XCR15, low RF-mismatch, inverter regulator control 3A1, beam gate-dc overload control 3A6, inverter 3A8, alarm control 3A4, or indicator control 3A2 defective.	Perform the following checks: *a.* Press ANTENNA FORWARD WATTS X10 pushbutton on power amplifier meter panel. If RF MONITOR meter indication is in the green band, proceed to step *d* below. If meter does not indicate in the green band, proceed to step *b* below. *b.* Observe BEAM VOLTAGE meter on power amplifier meter panel. If meter indication is in the green band, proceed to step *c* below. If meter indication is not in green band, proceed to step *g* below. *c.* Press INPUT FORWARD MILLIWATT pushbutton on power amplifier meter panel and observe RF MONITOR

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			meter. If meter indication is in the yellow band, proceed to step *d* below. If meter indication is not in yellow band, adjust attenuator control AT1 (fig. 3–12) for meter indication of 40. If attenuator control AT1 cannot be adjusted for an RF MONITOR meter indication of 40, perform transmitter troubleshooting (para 5–24*a*).
			d. Set multimeter AN/URM–105 to measure a negative voltage (–1.0 to –1.5 volt). Connect positive lead of multimeter to TP1 on power supply control 3A7 and negative lead to TP1 on low RF-mismatch, alarm control 3A4. If meter indication is –1.0 to –1.5 volt, proceed to step *e* below. If meter indication is not –1.0 to –1.5 volt, replace crystal detector 3A9CR15 (para 5–33) during first radio set shutdown period.
			e. Set multimeter to measure a negative voltage (–7.5 volts approx). Connect negative multimeter lead to TP2 on indicator control 3A2. If meter indication is –5 volts to –8.25 volts, replace indicator control 3A2 (para 5–32) during first radio set shutdown period. If meter indication is not –5 to –8.25 volts, proceed to step *f* below.
			f. Perform low RF alarm adjustment (para 4–18). If trouble is encountered during adjustment procedures, replace low RF-mismatch, alarm and control 3A4 (para 5–32) and perform low RF alarm adjustment (para 4–18) during first radio set shutdown period.
			g. Set the BEAM VOLT ADJ control on inverter regulator control 3A1 for BEAM VOLTAGE meter indication in green band. If meter indication is in green band and LOW RF indicator is lighted red, proceed to step *h* below. If unable to adjust for BEAM VOLTAGE meter indication in green band, proceed to step *i* below.
			h. Perform power amplifier tuning procedure (para 3–13). If trouble is encountered during these procedures, notify higher category of maintenance.
			i. Set multimeter AN/URM–105 to measure a negative voltage

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			(–12 volts approx). Connect positive meter lead to TP1 on power supply control 3A7 and negative meter lead to TP10 on beam gate-dc overload control 3A6. If meter indication is approximately –12 volts, replace module 3A6 (para 5–32) and readjust beam voltage. If meter indication is approximately 0 volt, proceed to step *j* below. *j*. Replace inverter regulator control 3A1 (para 5–32). Adjust the BEAM VOLT ADJ control on inverter regulator control 3A1 for BEAM VOLTAGE meter indication in green band. If unable to adjust for BEAM VOLTAGE meter indication in green band, proceed to step *k* below. *k*. Replace inverter 3A8 (para 5–32) and readjust beam voltage. If unable to adjust for BEAM VOLTAGE meter indication in green band, notify higher category of maintenance.
14	AIR, FILAMENT, and LOW RF indicators lighted red (all other indicators lighted green).	Beam gate-dc overload control 3A6 not detecting air alarm.	Replace beam gate-dc overload control 3A6 (para 5–32) and refer to corrective measures provided in item number 18.
15	AC OVERLOAD and LOW RF indicators lighted red (all other indicators lighted green).	Beam gate-dc overload control 3A6 not detecting AC overload condition.	Replace beam gate-dc overload control 3A6 (para 5–32) and refer to corrective measures provided in item number 19.
16	BEAM and LOW RF indicators are lighted red (all other indicators lighted green).	Beam gate-dc overload control 3A6 defective.	Replace beam gate-dc overload control 3A6 (para 5–32).
17	AIR, BEAM FILAMENT and LOW RF indicators are lighted red (all other indicators lighted green).	Air filter clogged, fans and/or blowers not operating, or cabinet INTERLOCK connector is not securely tightened.	Perform the following checks: *a*. Check that air filter is not clogged or excessively dirty. Clean or replace filter if required (para 4–15). *b*. Check that all fans and blowers are operating (para 4–12). *c*. Check that INTERLOCK connector on top of power amplifier cabinet (external preheater connection) is securely tightened. *d*. Depress RESET pushbutton on power amplifier meter panel. AIR, BEAM, and LOW RF alarm indicators should light green. *e*. If the alarm indicators do not light green after approximately 4 minutes, notify higher category of maintenance.
18	FILAMENT, BEAM, and LOW RF indications lighted red (all other indicators lighted green).	Filament leads not connected, defect in filament supply circuit, or time delay control 3A5 defective.	Perform the following checks: *a*. Observe FILAMENT VOLTAGE meter on power amplifier meter panel. If meter indication is in green band, replace time delay

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			control 3A5 (para 5–32). If meter indication is not in green band, proceed to step *b* below. *b.* Check that the white and yellow klystron filament leads (fig. 5–12) are connected to klystron. If filament leads are connected, notify higher category maintenance.
19	DC OVERLOAD, BEAM, and LOW RF indicators red (all other indicators lighted green).	Beam voltage set too high, inverter regulator control 3A1 or beam gate-dc overload control 3A6 defective.	Perform the following checks: *a.* Lower the beam voltage by turning the BEAM VOLT ADJ control on inverter regulator control 3A1, fully counterclockwise and then readjust for BEAM VOLTAGE meter indication of 7.5. If unable to adjust beam voltage replace inverter regulator control 3A1 (para 5–32) and readjust beam voltage. *b.* Press RESET pushbutton on power amplifier meter panel. *c.* DC OVERLOAD and BEAM indicators should light green. *d.* If DC OVERLOAD and BEAM indicators do not light green replace beam gate-dc overload control 3A6 (para 5–32).
20	AC INTERLOCK, BEAM, and LOW RF indicators red (all other indicators lighted green).	Interlock panel or high voltage interlock door open.	Perform the following checks: *a.* Check that interlock panel (fig. 1–14) is installed and securely tightened. *b.* Check that high voltage interlock door (fig. 1–14) is closed and securely tightened.
21	AC OVERLOAD, BEAM, and LOW RF lighted red (all other indicators lighted green).	Inverter 3A8 defective.	Replace inverter 3A8 (para. 5–32). If AC OVERLOAD, BEAM, and LOW RF indicators do not light green after pressing RESET pushbutton on meter panel, notify higher category of maintenance.
22	ANTENNA MISMATCH, BEAM, and LOW RF indicators lighted red (all other indicators lighted green).	Antenna waveguide system, low RF-mismatch, alarm control 3A4, or crystal detector 3A9CR16 defective.	Press ANTENNA REFLECTED WATTS pushbutton on power amplifier meter panel. Depress RESET pushbutton and observe RF MONITOR meter. If meter indication is in blue band (less than 90 watts), replace low RF-mismatch, alarm control 3A4 (para 5–32). If meter indication is greater than 90, a defect exists in the antenna system, notify higher category maintenance. If ANTENNA REFLECTED WATTS meter indication is zero, replace crystal detector 3A9CR16 (para 5–33) during first radio set shutdown period.
23	Abnormal meter indications: *a.* FILAMENT VOLTAGE	*a.* Filament leads disconnected or air alarm condition.	*a.* Perform the following checks: (1) Press ANTENNA FORWARD WATTS X10

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			pushbutton and observe RF MONITOR meter. (2) If meter does not indicate in green band, proceed to the next step. If meter indication is in green band, notify higher category of maintenance. (3) Check AIR indication. If lighted red, refer to item number 18 in this chart. Warning: Extremely high voltage in excess of 8,000 volts is present in power amplifier. Never attempt repairs while MAIN POWER SWITCH is lighted green. (4) Press MAIN POWER SWITCH on power amplifier meter panel, the MAIN POWER SWITCH shall light white. Check that yellow and white klystron filament leads (fig. 5-12) are connected to klystron. Connect filament leads if disconnected.
	b. BEAM VOLTAGE	*b.* Beam gate-dc overload 3A6, inverter regulator control 3A1, or inverter 3A8, defective.	*b.* Perform the following checks: (1) Press ANTENNA FORWARD WATTS X10 pushbutton and observe RF MONITOR meter. (2) If meter indication is in green band, notify higher category of maintenance. (3) If meter indication is not in green band, check alarm indicators and perform troubleshooting based on red alarm indicators (item numbers 2 through 23).
	c. BEAM CURRENT	*c.* Beam gate-dc overload control 3A6, inverter regulator control 3A1, or inverter 3A8 defective.	*c.* Perform the following checks: (1) Press ANTENNA FORWARD WATTS X10 pushbutton and observe RF MONITOR meter. (2) If meter indication is in green band, notify higher category of maintenance. (3) If meter indication is not in green band, check alarm indicators and perform troubleshooting based on red alarm indicators (item numbers 2 through 23).
	d. RF MONITOR: (1) INPUT FORWARD MILLI WATT position.	(1) Attenuator control AT1 requires adjusting, klystron requires tuning, or crystal detector 3A9CR13 defective.	(1) Perform the following checks: (*a*) Press ANTENNA FORWARD WATTS X10 pushbutton and observe RF MONITOR meter. (*b*) If meter indication is in green band, replace crystal detector 3A9CR13 (para 5-

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
			33) during first radio set shutdown period. (*c*) If meter indication is not in green band, press INPUT FORWARD MILLIWATT pushbutton and adjust attenuator control AT1 for a RF MONITOR meter indication of 50. (*d*) If attenuator control AT1 cannot be adjusted for RF MONITOR meter indication in yellow band, check RF POWER meter indication on transmitter meter panel. (*e*) If RF POWER meter indication is not in yellow band, perform transmitter troubleshooting (para 5–24*a*). (*f*) If RF POWER meter indication is in yellow band, perform power amplifier tuning procedure (para 3–13).
	(2) ANTENNA REFLECTED WATTS position.	(2) Antenna waveguide system defective.	(2) Notify higher catory of maintenance.
	(3) ANTENNA FORWARD WATTS X10 position.	(3) Low RF input power, or defective module.	(3) Perform the following checks: (*a*) Press INPUT FORWARD MILLIWATT pushbutton and observe RF MONITOR meter. (*b*) If meter indication is not in yellow band, perform item number 23*d*(1). (*c*) If meter indication is in yellow band, check alarm indicators and perform troubleshooting based on red alarm indicators (item numbers 2 through 23). (*d*) If ANTENNA FORWARD WATTS X10 meter indication is zero and no alarm indicators on power amplifier meter panel is lighted red, replace crystal detector 3A9CR17 (para 5–33) during first radio set shutdown period.

5–25. Use of the Radio Test Set

The radio test set, built-in-test-equipment (fig. 3–3), provides two separate test signals (one for each receiver channel) which can be used to loop the transmitter output back to the dual receiver inputs (fig. 5–1). The two test signals are ob-

tained by mixing a portion of the transmitter output with the output of 100-MHz RF oscillator 1A2. This arrangement provides two test signals which have the same characteristics as the transmitter output signal but which is separated by 100 MHz. The radio test set is used to perform most of the receiver adjustments and alignments (paras 5–36 through 5–41) and can be used to check out the cable equipment and radio set (except power amplifier) at either end of the communications link. The radio test set is also used during troubleshooting (para 5–24) as an aid in locating or isolating faults in the radio set. The distant radio set operator should be intructed to discontinue transmission during use of the radio test set. Modulated signals maybe transmitter during use of the radio test set providing the carrier signal can be 4800 MHz. Application of the radio test set requires that the transmitter frequency be set to 4800 MHz and the receiver frequency be set to 4700 MHz. To use the radio test set to align, test, or troubleshoot the radio set, proceed as follows:

a. Set the transmitter operating frequency to 4800 MHz as follows:

(1) Set the four thumbwheel switches (fig. 3–5) on frequency synthesizer 1A14 to 4800.0 MHz.

(2) Set the PUSH TO TURN knob on 4.4 to 5.0 GHz bandpass filter 1FL3 for a FREQ MHZ dial readout of 4800.

b. Set the receiver operating frequency to 4700 MHz as follows:

(1) Set the PUSH TO TURN knobs on preselectors 2FL4 and 2FL5 (fig. 3–7) for a FREQ MHZ dial readout of 4700.

(2) Set the PUSH TO TURN knobs on post selectors 2FL6 and 2FL7 (fig. 3–8) for a FREQ MHZ dial readout of 4700.

(3) Set the PUSH TO TURN knobs on local oscillator filters 2FL8 and 2FL9 (fig. 3–8) for a FREQ MHZ dial readout of 4700.

(4) Set the four thumbwheel switches (fig. 3–5) on frequency synthesizer 2A21 to 4700.0 MHz.

c. Set ON/OFF switch on 100 MHz oscillator 1A2 to ON. Turn the radio test set meter switch (fig. 3–3) to CR1. Radio test set meter indication (fig. 3–3) shall be in or to the right of the yellow band. If it is not, perform the radio test set checks (para 5–14) before proceding with this procedure.

d. Turn the radio test set meter switch to CR2. Radio test set meter indication shall be in or to the right of the yellow band. If it is not, perform the radio test set checks (para 5–14) before proceding with this procedure.

e. Turn the radio test meter switch to OSC LEVEL and adjust the LEVEL ADJ control (fig. 3–3) on 100 MHz RF oscillator 1A2 for a 12 CHAN or 24 CHAN radio test set meter indication as follows: If 12 channel operation is being used, set the LEVEL ADJ control for a 12 CHAN radio test set meter indication. If 24 channel operation is being used, set the LEVEL ADJ control for a 24 CHAN radio test set meter indication.

f. Set the RCVR CHAN A and RCVR CHAN B switches (fig. 3–3) on the radio test set to the position specified in the test or alignment procedure.

5–26. Cable Loop Back Test

The cable loop back test permits the Multiplexer TD–204/U operator to checkout the cable system. The test routes the FROM CABLE input (fig. 5–1) to digital data modem 1A12 back to the TO CABLE output of digital data modem 1A12, bypassing the digital data modem circuits. The cable loop back test will interrupt radio communications and the test should only be performed when requested by Multiplexer TD–204/U operator. When requested by the Multiplexer TD–204/U operator, perform the cable loop back test as follows:

a. Ask the Multiplexer TD–204/U operator (para 3–17) how long it will take to check out the cable system. Record the time.

b. Notify the distant radio set operator (para 3–17) that radio communications will be interrupted for the length of time recorded in step *a* above.

c. Set the CABLE LOOP TEST NORMAL/TEST switch (fig. 3–4) on digital data modem 1A12 to TEST.

d. After the time recorded in step *a* above has elapsed, set the CABLE LOOP TEST NORMAL/TEST switch on digital data modem 1A12 back to NORMAL.

e. Check with the Multiplexer TD–204/U operator (para 3–17) to determine whether a fault exists in the cable system.

5–27. Digital Data Modem Loop Back Test

The digital data modem loop back test is used to checkout the cable-to-radio and radio-to-cable circuits (fig. 5–1) in digital data modem 1A12.

The test routes the cable-to-radio outputs of digital data modem 1A12 back to the radio-to-cable input of digital data modem 1A12, thus forming a communications loop with Multiplexer TD-204/U. Performing this test will interrupt radio communications and the test should only be performed when normal troubleshooting techniques (para 5-24*a*) fail to localize a trouble. Use the procedure given below to perform the digital data modem loop back test.

a. Notify the Multiplexer TD-204/U operator and distant radio set operator (para 3-17) that a digital data modem loop back test is to be performed and that radio communications will be temporarily interrupted.

b. Ask the Multiplexer TD-204/U operator to continue normal pcm traffic transmission and to check that traffic is being received satisfactorily.

c. Remove the digital data modem test cable W1 (fig. 1-18) from mode module drawer No. 6A or 6B.

d. Disconnect coaxial cables 1A16W3 and 1A16W4 (fig. 2-10) from connectors J2 and J3 on digital data modem 1A12 and connect the digital data modem test cable between connectors J2 and J3.

e. Set the NORMAL/TEST switch (fig. 3-4) on 1A12A6 to TEST.

f. Check that the shelter mounted TRAFFIC IN indicator is lighted green. If it is, proceed to step *g* below. If it is not, remove the digital data modem test cable, reconnect coaxial cables 1A16W3 and 1A16W4 to connectors J2 and J3 (step *d* above), and notify the Multiplexer TD-204/U operator (para 3-17) that a trouble exists in the cable system. Ask the Multiplexer TD-204/U operator to checkout the cable system. If the Multiplexer TD-204/U operator reports that the cable system is operating properly, replace alarm monitor 1A12A6 (para 5-30) and repeat the digital data modem loop back test. If the shelter mounted TRAFFIC IN indicator is still lighted red, notify higher category maintenance for further troubleshooting.

g. Check that all failure indicator lamps on digital data modem 1A12 are lighted green. If any failure indicator lamp is not lighted, refer to the troubleshooting chart (para 5-24*a*) for corrective measures.

h. Check that the shelter mounted TRAFFIC OUT indicator is lighted green. If it is, proceed to *i* below. If it is not, higher category maintenance is required for further troubleshooting.

i. Remove the digital data modem test cable and reconnect coaxial cables 1A16W3 and 1A16W4 to J2 and J3 on digital data modem 1A12 (step *d* above).

j. Set the NORMAL/TEST switch (fig. 3-4) on 1A12A6 to NORMAL.

k. Notify the Multiplexer TD-204/U operator and distant radio set operator (para 3-17) that testing has been completed, and that normal radio communications will be resumed.

5-28. Radio Set Loop Back Test

The radio set loop back test is used to checkout the transmitter and receiver. This test routes signals as described in paragraph 5-25. Performing the radio set loop back test will interrupt radio communications and the test should only be performed during initial equipment adjustments para 3-22) or when specified in the troubleshooting chart (para 5-24). Use the procedure given below to perform the radio set loop back test.

a. Place the radio set in the standby mode para 3-22) and notify the distant radio set operator (para 3-17) to do the same.

b. Record the transmitter and receiver operating frequencies and set the transmitter and receiver controls to the frequencies indicated in paragraph 5-25*a* and *b*.

c. Check that pcm traffic is being transmitted by Multiplexer TD-204/U (para 3-17).

d. Set the ON/OFF switch (fig. 3-3) on 100 MHz RF oscillator 1A2 to ON.

e. Set the RCVR CHAN A and RCVR CHAN B switches (fig. 3-3) on the transmitter radio test set to T.

f. Turn the radio test set meter selector switch to OSC LEVEL (fig. 3-3) and set the LEVEL ADJ control (fig. 3-3) on 100 MHz RF oscillator 1A2 for a 12 CHAN or 24 CHAN radio test set meter indication depending on the number of channels being used.

g. Perform the transmitter and receiver checks given in the monthly preventive maintenance checks and services chart (para 5-6) and troubleshoot the radio set (para 5-24) if any of the operational checks fail.

h. After application of the radio test set is completed, set the ON-OFF switch (fig. 3-3) on 100 MHz rf oscillator 1A2 to OFF.

i. Return the transmitter and receiver control settings to the frequency settings recorded in step *b* above.

j. Return the radio set to normal operation (para 3-22) and then notify the distant radio set operator (para 3-17) to resume normal operation.

Section IV. REPAIRS AND ADJUSTMENTS

5-29. Module Replacement Techniques

NOTE

Modules that are adjusted or aligned after replacement should have the adjustment or alignment retouched after approximately 4 hours of operational use to compensate for any drift.

a. General. Replacement of certain modules in the receiver and power amplifier require that the replacement module be adjusted and/or aligned after it is inserted in the unit. A chart is provided in *d* below which lists the modules which require adjustments and/or alignment when they are replaced.

b. Module Substitution. Replace a suspected faulty module when directed in the troubleshooting chart (para 5-24), with a spare module of the same type. Use the procedures given in paragraph 5-30 through 5-32 to replace the module. With the substitute (spare) module in the unit, apply power and check to determine whether the original trouble has been remedied. If the trouble is not remedied, remove the substituted (spare) module and replace the original module. Continue to troubleshoot the unit using the procedures given in the troubleshooting chart (para 5-24).

c. Module Spares. The spares drawers (figs. 1-16, through 1-18) contain most of the modules replaceable by the organizational repairman.

d. Adjustment and/or Alignments Required With Module Replacement.

Unit	Module replaced	Action required	References
Receiver	Combiner 2A16	IF gain and agc alignment, squelch adjustment, apc alignment, and combined alarm adjust.	Paras 5-36 through 5-39.
Receiver	220 MHz vco 2A13 and 2A14	VCO frequency adjust	Para 5-40.
Receiver	Demodulator 2A17	Traffic level adjust	Para 4-17.
Receiver	AF-RF amplifier 2A19	Traffic level adjust	Para 4-17.
Receiver	TDA 2A1 or 2A2	IF gain adjustment	Para 5-36*a*.
Receiver	Mixer preamplifier 2A4 or 2A211	IF gain adjustment	Para 5-36*a*.
Receiver	IF amplifier 2A12 or 2A15	IF gain and agc alignment, and combined alarm adjust.	Paras 5-36 and 5-39.
Power amplifier	Low rf-mismatch, alarm and control 3A4.	Low RF alarm adjustment	Para 4-18.

5-30. Removal and Replacement of Transmitter Modules

CAUTION

Always set the POWER ON-OFF switch (fig. 3-1) on the transmitter meter panel to OFF before attempting to remove or replace any module in the transmitter.

a. General. Most of the modules in the transmitter are easily removed and replaced. However, removal or replacement of any module in the transmitter requires that the organizational repairman read the module replacement techniques outlined in paragraph 5-29 before attempting to remove or replace a module. To remove or replace any module in the transmitter, refer to the replacement given in *b* through *i* below.

b. General Module Replacement. Use the procedure given below to replace transmitter modules 1A2 through 1A8 (fig. 2-10).

(1) Set the POWER ON-OFF switch (fig. 3-1) on the transmitter meter panel to OFF.

NOTE

Do not attempt to disconnect captivated connections of cables (fig. 2-10).

(2) Disconnect all non-captivated connections of cables attached to modules to be removed.

(3) Use the special purpose screwdriver (fig. 1-10) to alternately loosen the two captive screws securing the module to the plate assembly and remove module by firmly pulling it away from the transmitter.

(4) Align guide pins on rear of replacement module with the alignment holes in the plate assembly and carefully insert the module into position and firmly press it into operating position.

CAUTION

Tighten captive screws only until screw head is flush with screw guard.

(5) Alternately tighten the two captive screws loosened in step (3) above.

(6) Connect any coaxial cables disconnected in step (2) above.

(7) Set the POWER ON-OFF switch (fig. 3-1) to ON.

c. Replacement of Modules with Rigid Coaxial Cables (1A9 through 1A11). Use the procedure given below to replace any module with rigid coaxial cable(s) connected to the module (fig. 2-10).

(1) Set the POWER ON-OFF switch (fig. 3-1) on the transmitter meter panel to OFF.

NOTE

Do not attempt to disconnect captivated connections of cables (fig. 2-10).

(2) Disconnect all non-captivated connections of cables attached to module to be removed.

(3) Use the special purpose screwdriver (fig. 1-10) to alternately loosen the two captive screws securing the module to be removed until the module is loosely held to the plate assembly by the captive screws.

(4) Alternately loosen the two captive screws, securing module at the opposite end of rigid coaxial cable, until that module is loosely held to the plate assembly by its captive screws.

CAUTION

Bending a rigid coaxial cable, no matter how slight, can possibly impair its useful function.

(5) Use the openend wrench (fig. 1-4) to loosen the hexnut on one end of the rigid coaxial cable.

(6) Hold the rigid coaxial cable firmly in to loosen the hex nut on opposite end of the place with one hand and use the openend wrench rigid coaxial cable.

(7) Carefully remove the rigid coaxial cable by pulling it away from its mating connectors simultaneously.

(8) Loosen the two captive screws securing the module to be removed to the plate assembly and remove the module.

(9) Align guide pins on rear of replace-module with the alignment holes in the plate assembly and carefully insert the module into its position on the plate assembly and firmly press it into operating position.

(10) Tighten the two captive screws on the replacement module two or three turns each.

(11) Simultaneously mate the center conductors on the rigid coaxial cable with the mating connectors on the modules ((7) above) and press it into position. Hold the rigid coaxial cable with one hand and tighten the hex nut at one end of the rigid coaxial cable to its mating connector using the open end wrench ((5) above).

(12) Continue to hold the rigid coaxial cable firmly and tighten the hex nut at the opposite end of the rigid coaxial cable with the open end wrench.

(13) Connect all flexible coaxial cables disconnected in (2) above.

CAUTION

Tighten captive screws until screw head is flush with screw guard.

(14) Alternately tighten the two module captive screws loosened in (3) above.

(15) Alternately tighten the two captive screws loosened in (4) above.

(16) Set the POWER ON-OFF switch (fig. 3-1) to ON.

d. Replacement of Modules in Power Supply 1A1. Use the procedures given below to replace any module in power supply 1A1 (fig. 1-5).

(1) Set the POWER ON-OFF switch (fig. 3-1) on the transmitter meter panel to OFF.

(2) Release the two meter panel captive screws securing transmitter meter panel to the cabinet (fig. 2-7). Swing the transmitter meter panel upward and lock in open position.

(3) Alternately loosen the two captive screws securing the module to be replaced.

(4) Use the captive screws on the module to pull the module out of the power supply inclosure.

(5) Insert replacement module into power supply inclosure being sure that upper and lower sections of replacement module is inserted into the upper and lower guide rails of power supply inclosure.

(6) Alternately tighten the two module captive screws loosened in (3) above.

(7) Unlock and lower transmitter meter panel. Tighten the two meter panel captive screws loosened in (2) above.

(8) Set the POWER ON-OFF switch (fig. 3-1) to ON.

e. Replacement of Crystal Mixer 1A9A1. Use the procedure given below to replace crystal mixer 1A9A1 (fig. 5-4).

(1) Set POWER ON-OFF switch (fig. 3-1) on the transmitter meter panel to OFF.

(2) Remove frequency mixer 1A9 (para 5-30*c*) from the transmitter.

(3) Loosen the two module securing screws securing crystal mixer 1A9A1 to frequency mixer 1A9 enclosure (fig. 5-4).

(4) Unscrew the knurled connector between 4.4- to 5.0-GHz circulator 1A9HY1 and crystal mixer 1A9A1 by rotating the knurled connector in the direction of the arrow shown in figure 5-4.

(5) Slide crystal mixer 1A9A1 away from 4.4- to 5.0-GHz circulator 1A9HY1 until it is free of the knurled connector and then remove crystal mixer 1A9A1 from frequency mixer 1A9 inclosure.

(6) Insert replacement crystal mixer 1A9A1 into frequency mixer 1A9 inclosure and slide it

oward 4.4- to 5.0-GHz circulator 1AHY1 until heir mating connectors meet.

(7) Secure crystal mixer 1A9A1 to 4.4- to .0-GHz circulator 1A9HY1 by rotating the knurled connector (fig. 5–4) in a direction opposite that shown by the arrow.

(8) Tighten the two module screws securing crews loosened in (3) above.

(9) Reinstall frequency mixer 1A9 in transmitter (para 5–30*c*).

(10) Set POWER ON–OFF switch (fig. 3–1) to ON.

f. Replacement of 2d or 3d Frequency Multiplier 1A10A1 or 1A10A2. The removal or replacement of the 2d or 3d frequency multiplier (1A10A1 or 1A10A2) from frequency multiplier group 1A10 is identical. Use the procedure given below to replace 2d or 3d frequency multiplier 1A10A1 or 1A10A2 (fig. 5–5).

(1) Set POWER ON–OFF switch (fig. 3–1) on the transmitter meter panel to OFF.

(2) Remove frequency multiplier group 1A10 (para 5–30*c*) from the transmitter.

(3) Loosen the two module securing screws securing the 2d or 3d frequency multiplier (1A10A1 or 1A10A2) to frequency multiplier group 1A10 inclosure (fig. 5–5).

(4) Unscrew the knurled connector between 2275–2425 MHz circulator 1A10HY1 and 2d or 3d frequency multiplier by rotating it in the direction of the arrow shown in figure 5–5.

(5) Slide 2d or 3d frequency multiplier 1A10A1 or 1A10A2 away from 2275–2425 MHz circulator 1A10HY1 until it is free of the knurled connector and then remove 2d or 3d frequency multiplier 1A10A1 or 1A10A2.

(6) Insert replacement 2d or 3d frequency multiplier 1A10A1 or 1A10A2 into frequency

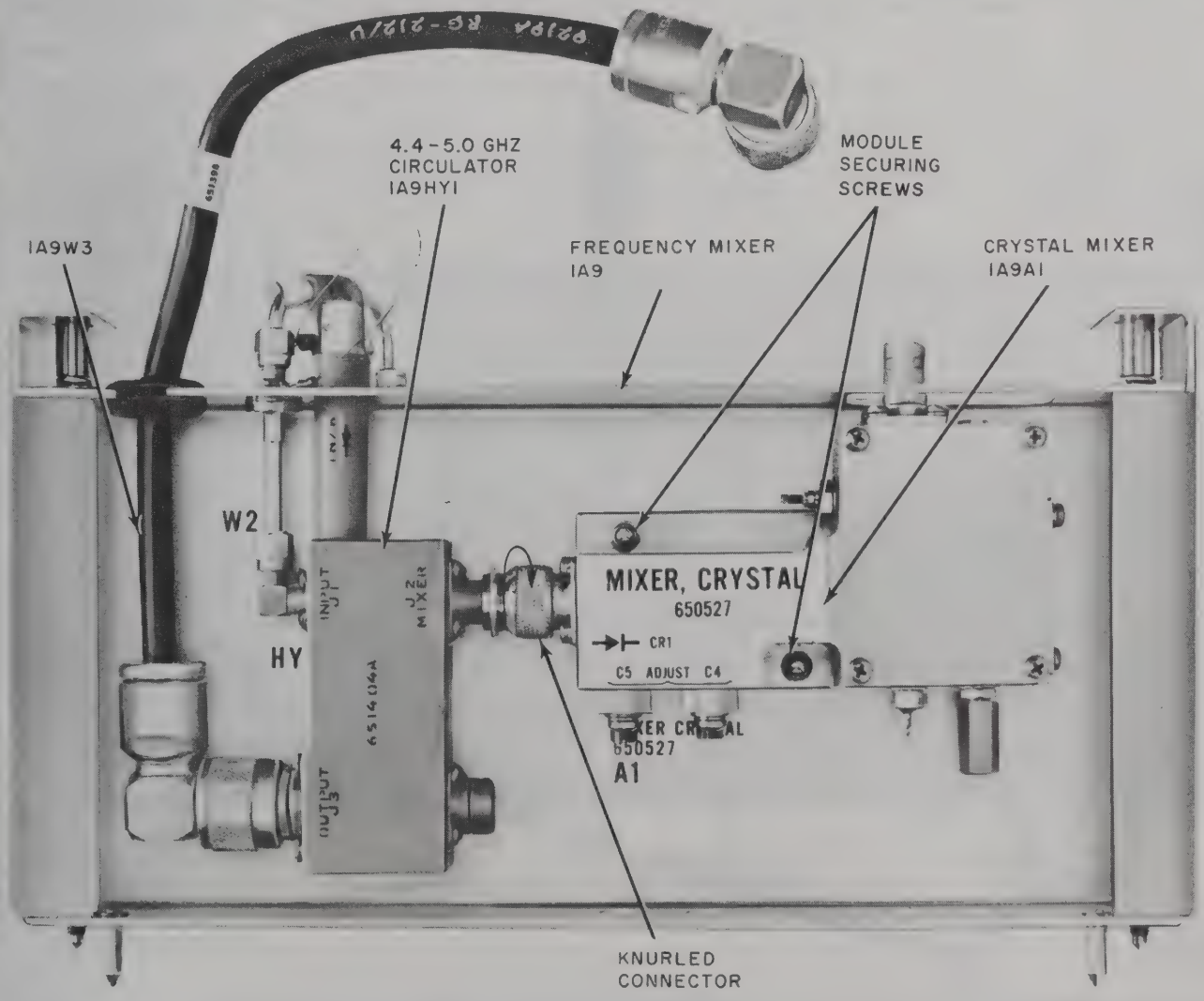


Figure 5–4. Replacement of crystal mixer 1A9A1, parts location.

multiplier group 1A10 inclosure and slide it toward 2275–2425 MHz circulator 1A10HY1 until their mating connectors meet.

(7) Connect and tighten the knurled connector on 2d or 3d frequency multiplier 1A10A1 or 1A10A2 to its mating connector on 2275–2425 MHz circulator 1A10HY1.

(8) Tighten the two module securing screws loosened in (3) above.

(9) Reinstall frequency multiplier group 1A10 in transmitter (para 5–30*c*).

(10) Set POWER ON–OFF switch (fig. 3–1) to ON.

g. Replacement of Modules in Digital Data Modem 1A12. Use the procedure given below to replace any module in digital data modem 1A12 (fig. 1–7). Use steps (1), (2), (3), (4), (8) and (9) to replace module 1A12A1 or 1A12A14. Use steps (1), (2), and (5) through (9) to replace module 1A12A2 through 1A12A13.

(1) Set the POWER ON–OFF switch (fig. 3–1) on transmitter meter panel to OFF.

(2) Loosen the three captive screws securing the hinged cover (fig. 1–7) to the digital data modem chassis 1A12A15 and lower the hinged cover.

(3) Alternately loosen the two captive screws (fig. 2–13) securing module 1A12A1 or 1A12A14 to digital data modem chassis 1A12A15 and pull the module out of the chassis using the two module captive screws as hand grips.

(4) Insert replacement module 1A12A1 or 1A12A14 into its position in the digital data modem chassis and alternately tighten the two captive screws loosened in (3) above.

(5) Use the card extractor (fig. 1–4) to remove a plug-in card assembly, 1A12A2 through 1A12A13 (fig. 1–7). Insert the card extractor (fig. 5–6) into the two holes on front of the plug-in card assembly and pull the plug-in card assembly out of the digital data modem chassis.

(6) Insert replacement plug-in card assembly, 1A12A2 through 1A12A13, into its position in the digital data modem chassis being sure that

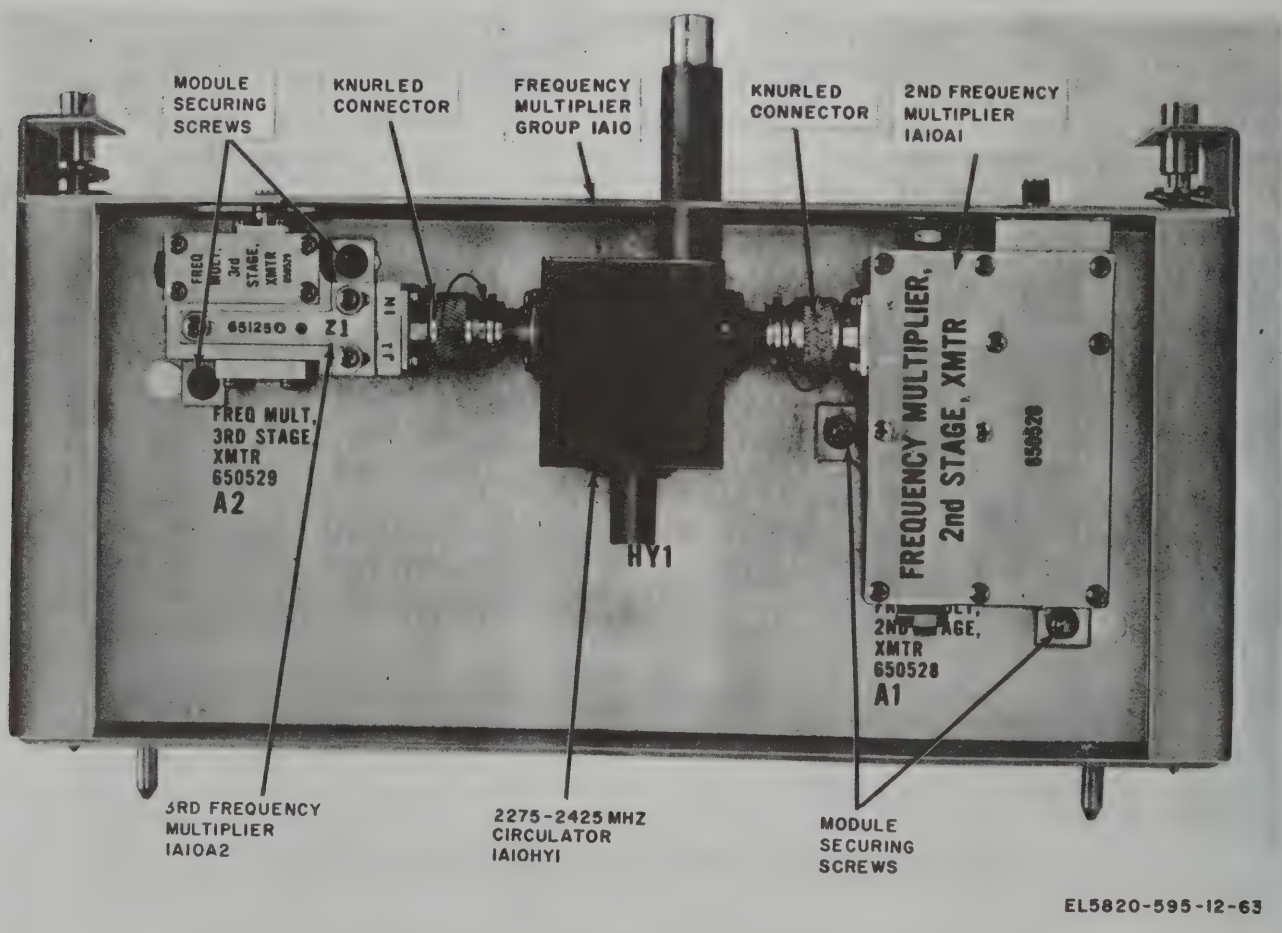


Figure 5–5. Replacement of 2d or 3d frequency multiplier 1A10A1 or 1A10A2, parts location.

the upper and lower part of the plug-in card is inserted into upper and lower guide rails of digital data modem inclosure.

(7) Firmly press the plug-in card assembly into digital data modem chassis until its outer edge is flush with outer edge of other plug-in card assemblies.

(8) Close the hinged cover of digital data modem 1A12 and secure it in place by tightening the three captive screws loosened in (2) above.

(9) Set POWER ON–OFF switch (fig. 3–1) to ON.

h. Replacement of Modules in Order Wire Assembly 1A13. Use the procedures below to replace any module (fig. 1–8) in order wire assembly 1A13. Use steps (1), (2), (3), and (9) to replace module 1A13A1. Use steps (1), and (4) through (9) to replace modules 1A13A2 through 1A13A5.

(1) Set the POWER ON–OFF switch (fig. 3–1) on transmitter meter panel to OFF.

(2) Alternately loosen the two captive screws (fig. 1–8) securing module 1A13A1 to orderwire chassis 1A13A7 and pull the module out of the chassis using the two module captive screws as hand grips.

(3) Insert module 1A13A1 into its position in the order wire chassis and alternately tighten the two module securing screws loosened in (2) above.

(4) Loosen the two panel captive screws (fig. 1–8) securing the hinged cover to the order wire chassis and lower the hinged cover.

(5) Use the card extractor (fig. 1–4) to remove the plug-in card assembly 1A13A2 through 1A13A5 (fig. 1–8). Insert the card extractor into the two holes in front of the plug-in card assembly, in the same manner as shown in figure 5–6, and pull the plug-in card assembly out of the order wire chassis.

(6) Insert replacement plug-in card assembly, 1A13A3 through 1A13A5, into its position in the order wire chassis being sure that the upper and lower portions of the plug-in card is inserted into upper and lower guide rails of order wire chassis.

(7) Push the plug-in card assembly into orderwire chassis until its outer edge is flush

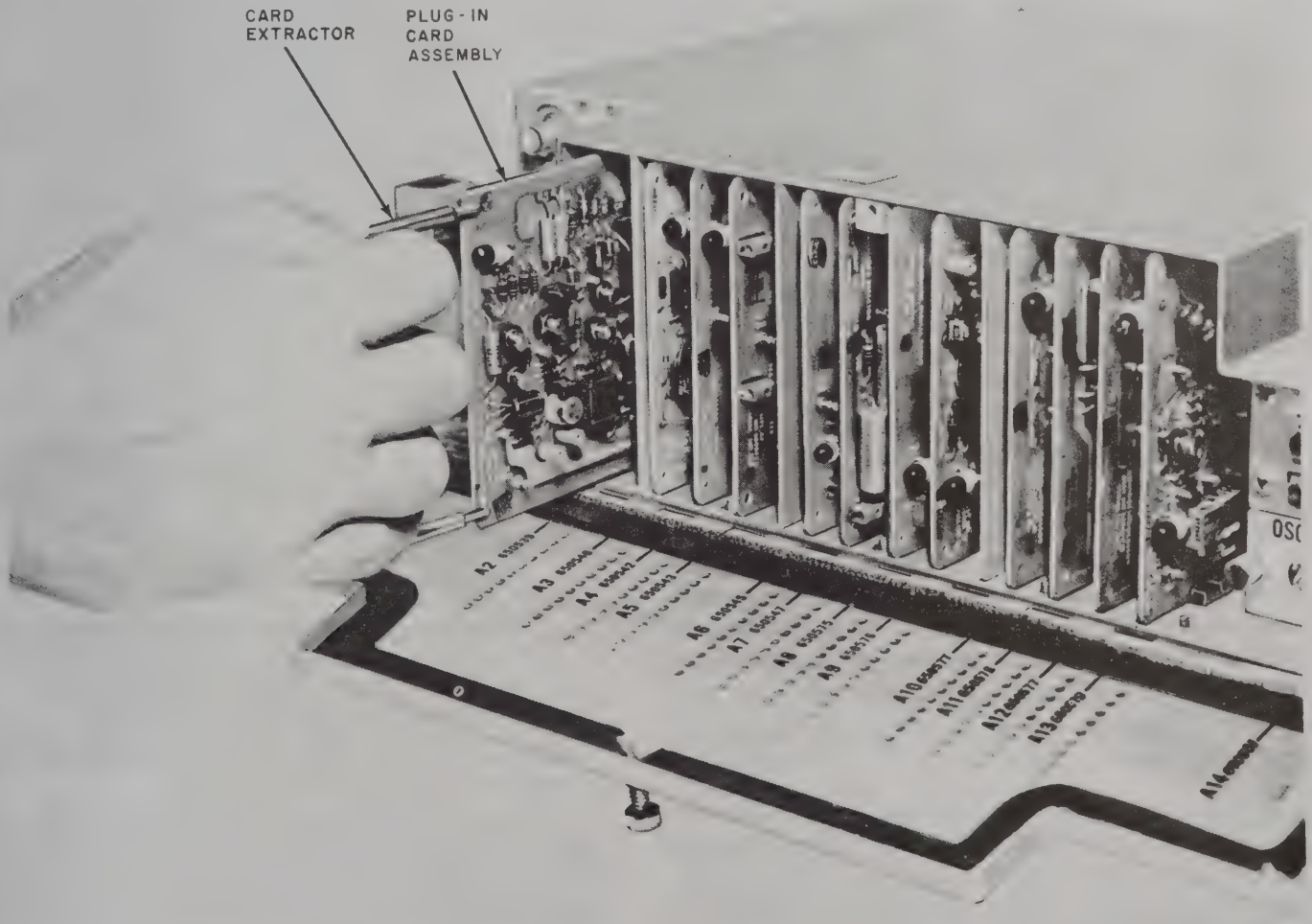


Figure 5–6. Replacement of digital data modem 1A12 plug-in cards, typical.

with outer edge of the other plug-in card assemblies.

(8) Close the hinged cover to order wire assembly 1A13 and secure it in place by tightening the two panel captive screws loosenedin (4) above.

(9) Set POWER ON-OFF switch (fig. 3-1) to ON.

i. Replacement of Modules in Frequency Synthesizer 1A14. Use the procedures given below to replace any module (fig. 1-8) in frequency synthesizer 1A14. User steps (1), (2), (3) and (11) to replace modules 1A14A1 through 1A14A7. Use steps (1) and (4) through (11) to replace module 1A14A8.

(1) Set the POWER ON-OFF switch (fig. 3-1) on transmitter meter panel to OFF.

(2) Alternately loosen the two captive screws (fig. 1-8) securing the selected modules, 1A14A1 through 1A14A7, to frequency synthesizer chassis 1A14A1 and pull the module out of the chassis using the attached handle. Note that 1A14A7 has only a single captive screw.

(3) Insert replacement module 1A14A1 through 1A14A7 into its position in the frequency synthesizer chassis and tighten the two captive screws loosened in (2) above.

(4) On frequency synthesizer 1A14, disconnect the coaxial cable from OUTPUT J8 connector (fig.1-8).

(5) Release the two assembly captive mounting screws holding the order wire frequency synthesizer assembly (1A13 and 1A14) in place and withdraw the composite assembly from the transmitter cabinet by means of the two attached handles.

(6) Loosen the six captive screws (fig 5-7) securing module 1A14A8 to rear of frequency synthesizer chassis 1A14A10 and pull the module from the chassis.

(7) Align guide pins (fig. 5-7) on rear of frequency synthesizer chassis with the alignment holes on rear of replacement module 1A14A8 and carefully slide and firmly press the module into position.

(8) Tighten the six captive screws loosened in (6) above.

(9) Replace the order wire frequency synthesizer assembly (1A13 and1A14) removed in (5) above, and before tightening the two assembly captive mounting screws connect coaxial cable output J8 connector disconnected in (4) above.

(10) Tighten the captive screws and set POWER ON-OFF switch (fig. 3-1) to ON.

5-31. Removal and Replacement of Receiver Modules

CAUTION

Always set the POWER ON-OFF switch (fig. 3-6) on the receiver meter panel to OFF before attempting to remove or replace any module in the receiver.

a. General. Removal or replacement of any module in the receiver requires that the organizational repairman read the module replacement techniques outlined in paragraph 5-29 before attempting to remove or replace a module. Special attention should be given to alignment or adjustment requirements when specific modules are replaced. To remove or replace any module in the receiver, follow the replacement procedures in b through g below.

b. General Module Replacement. Use the procedure given in paragraph 5-30b to replace any of the following receiver modules (fig. 2-11): 2A4 through 2A6, and 2A9 through 2A20. The following exceptions apply: Set the POWER ON-OFF switch (fig. 3-6) on the receiver meter panel to OFF before starting the removal procedure. When removing module 2A13, use the openend wrench (fig. 1-10) to remove coaxial cable 2A24W10. When removing module 2A14, use the openend wrench (fig. 1-10) to remove coaxial cable 2A24W13. Set the POWER ON-OFF switch (fig. 3-6) on the receiver meter panel to ON when the replacement procedure has been completed.

c. Replacement of Modules with Rigid Coaxial Cables (2A7 and 2A8). Use the procedure given in paragraph 5-30c (steps (2) through (14)) to replace receiver module 2A7 or 2A8 (fig. 2-11). The following exceptions apply: Set the POWER ON-OFF switch (fig. 3-6) on the receiver meter panel to OFF before starting the removal procedure. Set the POWER ON-OFF switch (fig. 3-6) to ON when the replacement procedure has been completed.

d. Replacement of TDA 2A1 or TDA 2A2. Use the following procedures to replace TDA 2A1 or TDA 2A2 (fig. 1-9).

NOTE

The tunnel diode amplifiers in some radios have been replaced by GaAs field effect transistor (FET) amplifiers. Removal and replacement is identical.

(1) Set the POWER ON-OFF switch (fig. 3-6) on the receiver meter panel to OFF.

(2) Alternately loosen the two captive screws (fig. 2-9) securing the hinged receiver meter panel in place, then raise and lock the hinged receiver meter panel in the upright position using the panel locking latch.

(3) Disconnect coaxial cable 2W1 or 2W3 (fig. 2-11) from the TDA J2 OUTPUT connec-

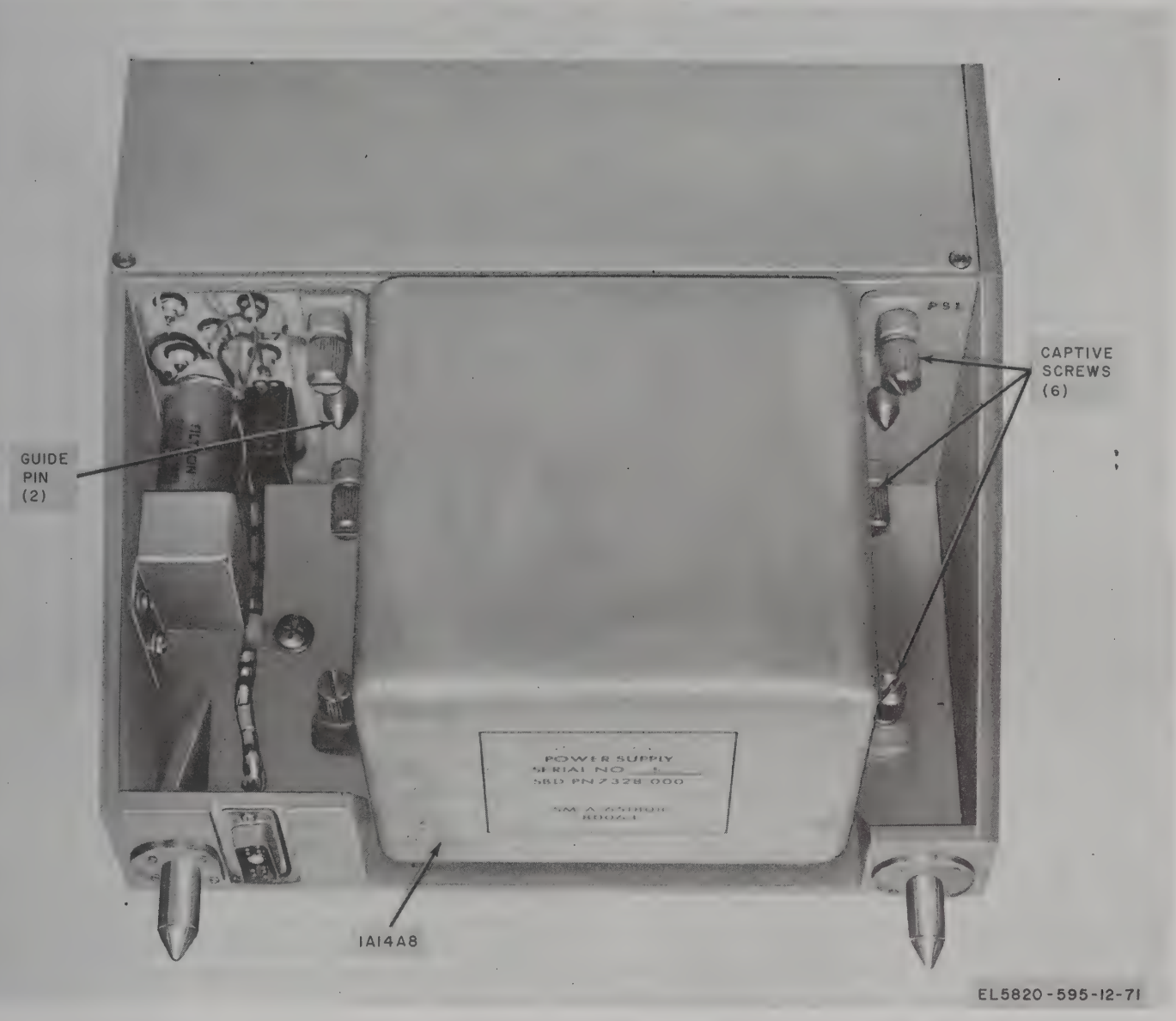


Figure 5-7. Frequency synthesizor 1A14 or 2A21, rear view, parts location.

tor by rotating the knurled connector on the coaxial cable in a counterclockwise direction.

(4) Disconnect the power cable connected to J3 at the rear of the TDA by rotating it 1/2-turn clockwise (viewed from front of cabinet) and pulling it off of J3. J3 location is shown in rear view of TDA in figure 5–17.

(5) Loosen the four TDA captive screws securing the TDA to the TDA mounting bracket (fig. 2–9).

(6) Disconnect the INPUT J1 connector (fig. 5–17) by turning the knurled portion of the connector in a clockwise direction until the INPUT J1 connector is free from the preselector.

(7) To remove TDA 2A1, slide it toward the back of the cabinet and rotate it clockwise in a horizontal plane around the TDA mounting bracket until, with the rear side of the TDA facing forward, it can be pulled forward between the TDA mounting brackets and removed from the receiver cabinet.

(8) To remove TDA 2A2, slide it toward the back of the cabinet and rotate it counterclockwise in a horizontal plane around the TDA mounting bracket until, with the rear side of the TDA facing forward, it can be pulled forward between the TDA mounting brackets and removed from the receiver cabinet.

(9) To replace TDA 2A1, position the front of the TDA toward the back of the receiver cabinet and insert the TDA between the TDA mounting brackets and rotate it counterclockwise in a horizontal plane around the mounting bracket until it can be maneuvered into its mounting bracket.

(10) To replace TDA 2A2, position the front of the TDA toward the back of the receiver cabinet and insert the TDA between the TDA mounting brackets and rotate it clockwise in a horizontal plane around the mounting bracket until it can be manuevered into its mounting bracket.

(11) Turn the four captive screws on the TDA mounting bracket until the TDA is loosely held in position by the four captive screws.

(12) Connect and finger tighten the INPUT J1 connector on the TDA to the preselector connector by rotating the knurled connector portion of INPUT J1 connector in a counterclockwise direction.

(13) Tighten the four captive screws on the TDA mounting bracket.

(14) Connect coaxial cable 2W1 or 2W3 to the OUTPUT J2 connector on the TDA disconnected in (3) above.

(15) Connect the power cable removed in (4) above to the J2 connector on the rear of the TDA by pushing it in and rotating it 1/2 turn counterclockwise viewed from front of cabinet.

(16) Unlock and lower the hinged receiver meter panel and secure it in position by tightening the two captive screws loosened in (2) above.

(17) Set the POWER ON–OFF switch (fig. 3–6) to ON.

e. Replacement of Modules in Power Supply 2A3. Use the procedure given in paragraph 5–30*d* to replace any of the modules (2A3A1 through 2A3A4) in power supply 2A3 (fig. 1–11). The raised receiver meter panel is shown in figure 2–9. The following exceptions apply: Set the POWER ON–OFF switch (fig. 3–6) on the receiver meter panel to OFF before starting the removal procedure. Set the POWER ON–OFF switch (fig. 3–6) to ON when the replacement procedure has been completed.

f. Replacement of 2d or 3d Frequency Multiplier 2A7A1 or 2A7A2. Use the procedure given below to replace the 2d or 3d frequency multiplier (2A7A1 or 2A7A2) in frequency multiplier group 2A7 (fig. 5–8).

(1) Set POWER ON–OFF switch (fig. 3–6) on the receiver meter panel to OFF.

(2) Remove frequency multiplier group 2A7 (para 5–31*c*) from the receiver.

(3) Loosen the two module securing screws securing the 2d or 3d frequency multiplier (2A-7A1 or 2A7A2) to frequency multiplier group 2A7 inclosure (fig. 5–8). The screwheads are accessible from the rear of the module enclosure.

(4) To replace 3d frequency multiplier 2A-7A2, loosen the two screws securing 4.55- to 4.85-GHz power divider 2A7HY2 to frequency multiplier group 2A7 inclosure. The screwheads are accessible from the rear of the module inclosure.

(5) Unscrew the knurled connector between 2275–2425 MHz circulator 2A7HY1 and 3d frequency multiplier by rotating the knurled connector in the direction of the arrow shown in figure 5–8.

(6) To remove 2d frequency multiplier 2A-7A1, slide it away from 2275–2425 MHz circulator 2A7HY1 and remove it from the module inclosure.

(7) To remove 3d frequency multiplier 2A-7A2, loosen the two screws securing 4.55- to 85-GHz circulator 2A7HY2 to the frequency multiplier group 2A7 inclosure. The screwheads are accessible from the rear of module inclosure. Disconnect the hex nut between 3d frequency multiplier 2A7A2 and 4.55- to 4.85-GHz power divider 2A7HY2 using an openend wrench (fig. 1–10), then slide 3d frequency multiplier 2A7A2 away from 2275–2425 MHz circulator 2A7HY1 and remove it from the module inclosure.

(8) Insert the replacement 2d or 3d frequency multiplier 2A7A1 or 2A7A2 into the frequency multiplier group 2A7 inclosure and slide it toward 2275–2425 MHz circulator 2AHY1 until the mating connectors meet.

(9) Connect and tighten the knurled connector on 2d or 3d frequency multiplier 2A7A1 or 2A7A2 to its mating connector on 2275–2425 MHz circulator 2A7HY1.

(10) When replacing 3d frequency multiplier 2A7A2, connect and tighten the hex nut loosened in (7) above to its mating connector on 3d frequency multiplier 2A7A2, then tighten the two 2A7HY2 screws loosened in (7) above.

(11) Tighten the two 2A7A2 or 2A7A1 module securing screws loosened in (3) above.

(12) Reinstall frequency multiplier group 2A7 in the receiver (para 5–35*c*).

(13) Set POWER ON–OFF switch (fig. 3–6) to ON.

g. Replacement of Modules in Frequency Synthesizer 2A21. Frequency synthesizer 2A21 is mechanically the same as frequency synthesizer 1A-14. Use the procedures given in paragraph 5–30*i*, steps (2) through (10), to replace any of the modules (2A21A1 through 2A21A8) in frequency synthesizer 2A21 (fig. 1–13). The following exceptions apply: Set the POWER ON–OFF switch (fig. 3–6) on the receiver meter panel to OFF before starting the removal procedure. Set

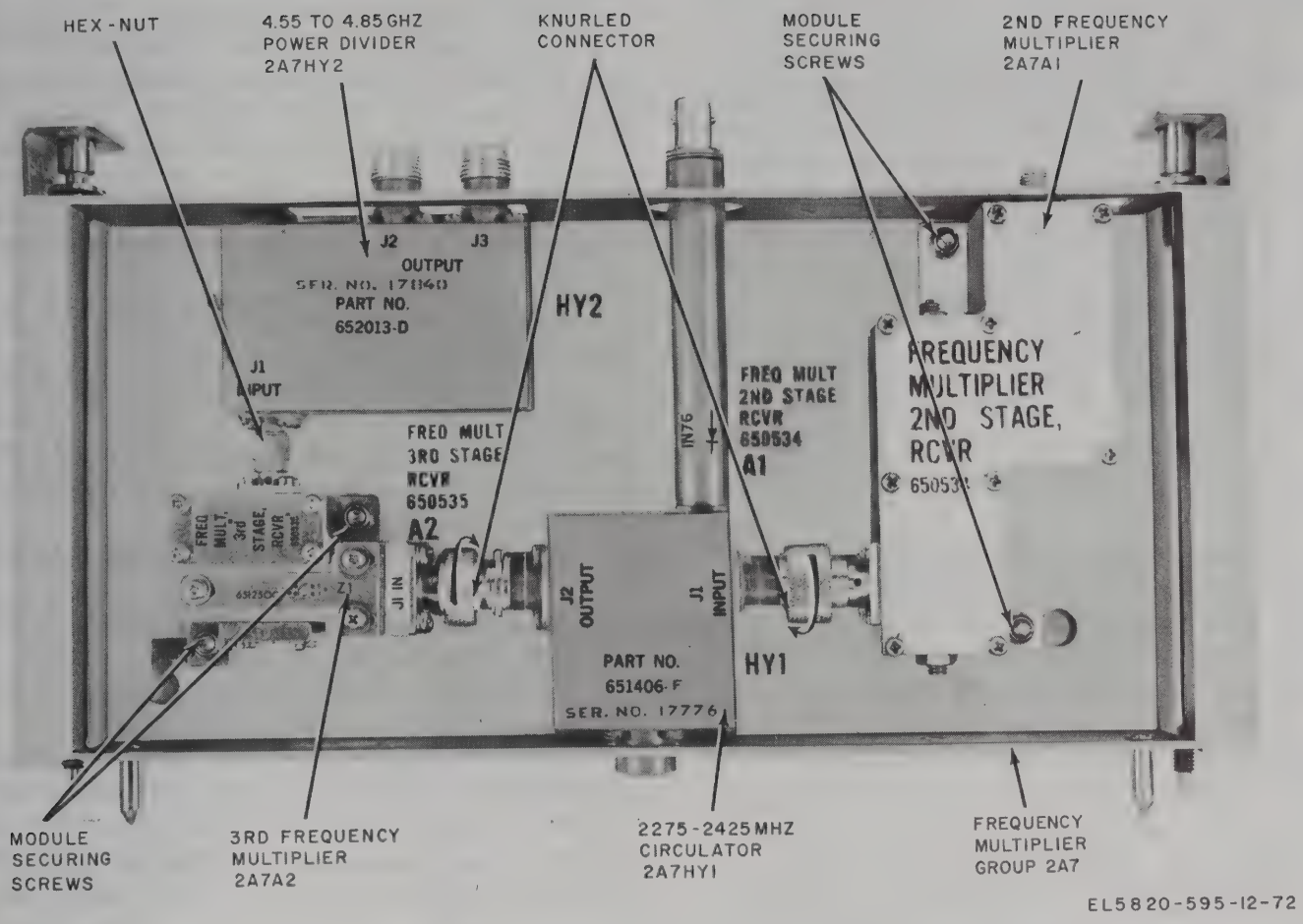


Figure 5–8. Replacement of 2d or 3d frequency multiplier 2A7A1 or 2A7A2, parts location.

the POWER ON–OFF switch (fig. 3–6) to ON when the replacement procedure has been completed.

5–32. Removal and Replacement of Power Amplifier Modules

WARNING

Always deactivate the MAIN POWER SWITCH (lighted white when deactivated) on the power amplifier meter panel (fig. 3–10) before attempting to remove or replace modules 3A1 through 3A7 in the power amplifier. Failure to heed this warning may result in death or serious injury.

WARNING

Always shutdown the power amplifier (para 3–23) before attempting to remove inverter module 3A8. Failure to heed this warning may result in death or serious injury.

a. General. Removal or replacement of any module in the power amplifier requires that the organizational repairman read the module replacement techniques outlined in paragraph 5–29 before attempting to remove or replace a module. To remove or replace any module in the power amplifier, follow to the replacement procedures in *b* and *c* below.

b. Replacement of Power Amplifier Modules 3A1 through 3A7. Use the procedures given below to remove or replace power amplifier modules 3A1 through 3A7 (fig. 1–15).

(1) Press the BEAM SWITCH and MAIN POWER SWITCH (fig. 3–10) on the power amplifier meter panel. The MAIN POWER SWITCH shall light white and the BEAM SWITCH shall be extinguished.

(2) Loosen the captive screw on the high voltage interlock door (fig. 1–15) and lower the door.

(3) Remove the card extractor from the power amplifier cabinet door (fig. 1–14). Insert the card extractor (fig. 1–14) behind the top of

the module front panel (fig. 5–9) to free the module about 1 inch from its operating position.

(4) Use fingers to pull the module completely out of the power amplifier cabinet.

(5) Insert replacement module into its position being sure that the upper and lower portions of the module are inserted into the upper and lower guide rails of the module inclosure, then push the module in until the front panel of the module is flush with the front panel of the other power amplifier modules.

(6) Close the high voltage interlock door (fig. 1–15) and secure it in position by tightening the captive screw loosened in (2) above.

(7) Press the MAIN POWER SWITCH (fig. 3–10) on the power amplifier meter panel, it shall light green.

(8) Wait until the TIME DELAY indicator (fig. 3–10) on the power amplifier meter panel lights green (approximately 3.5 minutes after MAIN POWER SWITCH is pressed), then press the BEAM SWITCH, it shall light green.

c. Replacement of Inverter Module 3A8. Use the procedures given below to replace inverter module 3A8 (fig. 1–15).

WARNING

Extremely high voltages exist in the power amplifier, be sure to shutdown the power amplifier (para 3–23) and use the grounding rod (fig. 1–14) to short out all exposed components before attempting to remove inverter module 3A8.

(1) Shutdown the power amplifier using the procedures given in paragraph 3–23.

(2) Remove the six screws (fig. 1–14) securing the power amplifier interlock panel to the power amplifier.

(3) Remove the grounding rod from its holder (fig. 1–14) and short out all exposed components on inverter module 3A8 (fig. 1–15).

(4) Remove the two bolts (fig. 1–15) securing the front of inverter module 3A8 to the bottom of the power amplifier cabinet.

(5) Disconnect the three plugs on the left side of inverter module 3A8 by unscrewing the knurled connector on each plug.

(6) Partially slide inverter module 3A8 out of the power amplifier cabinet until plug 3A8A-1P2 (fig. 1–15) is taut, then disconnect plug 3A8A1P2 by a half-turn of the twist-lock connector.

(7) Remove inverter module 3A8 from the power amplifier cabinet.

(8) Align the guide pins on the rear of the replacement inverter module 3A8 with the alignment holes on power supply assembly 3A9A1 and then slide inverter module 3A8 into position in the power amplifier.

(9) Connect plug 3A8A1P2 removed in (6) above.

(10) Connect the three plugs removed in (5) above to their mating connectors.

(11) Replace the two bolts removed in (4) above.

(12) Position the interlock panel as shown in figure 1–14 and then replace and tighten the six screws removed in (2) above.

(13) Start the power amplifier as described in paragraph 3–14.

5–33. Removal and Replacement of Diodes

a. General. Replaceable RF detector diodes are used in the transmitter (fig. 5–10), receiver (fig. 5–11), and power amplifier (fig. 5–12). To replace an RF detector diode, locate the RF detector diode type in the following chart and perform the applicable replacement procedure given in *b* through *f* below.

NOTE

Do not turn off the equipment to replace the RF detector diodes unless it is specifically stated in the procedure.

Unit	Diode reference designation	Diode type	Replacement paragraph
Transmitter Unit 1 (fig. 5–10)	1HY1CR1	1N76	5–33*d*
	1A10HY1CR1	1N76	5–33*d*
	1A9HY1CR1	1N76	5–33*d*
	1DC2CR1	1N23WE (reversed)	5–33*b*
	1DC2CR2	1N23WE (reversed)	5–33*b*
	1Z1CR1	1N23WE	5–33*c*
	1Z1CR2	1N23WE	5–33*c*
Receiver Unit 2 (fig. 5–11)	2HY3CR1	1N76	5–33*d*
	2A7HY1CR1	1N76	5–33*d*
	2A6Z1CR1	1N23WG	5–33*e*
	2A6Z1CR2	1N23WG	5–33*e*

Unit	Diode reference designation	Diode type	Replacement paragraph
Receiver Unit 2 (fig. 5–11)	2A9Z1CR1	1N23WG	5–33*e*
	2A9Z1CR2	1N23WG	5–33*e*
Power Ampl. Unit 3 (fig. 5–12)	3A9CR13	653201–2	5–33*f*
			5–33*f*
	3A9CR15	653201–1	5–33*f*
	3A9CR16	653201–1	5–33*f*
	3A9CR17	653201–1	5–33*f*

b. Replacement of Transmitter Directional Coupler Diodes (Type 1N23WE). Use the procedures given below to replace directional coupler diodes 1DC2CR1 or 1DC2CR2 (fig. 5–10).

(1) Use round needle nose pliers to rotate the knurled portion of the male BNC connector on coaxial cable 1A15W12 or 1A15W13 (fig. 5–13) in a counterclockwise direction until the mating female BNC connector on directional coupler 1DC2 is loosened.

(2) Disconnect coaxial cable 1A15W12 or 1A15W13 male BNC connector from the female BNC connector.

(3) Unscrew and remove the female BNC connector from directional coupler 1DC2. The end of the diode's base (1DC2CR1 or 1DC2CR2) should be visible in the diode cavity.

(4) Use round needle nose pliers to grasp the diode base and pull the diode out of the diode cavity.

(5) Note the polarity of the diode (fig. 5–13) and then pull the diode out of the diode base.

(6) Insert replacement diode into diode base being sure to observe correct reversed diode polarity (fig. 5–13).

(7) Use round needle nose pliers to gently grasp the diode base and insert the diode into the diode cavity (fig. 5–13).

(8) Connect the female BNC connector to the diode cavity and rotate it in a clockwise direction until it is securely tightened (finger tight).

(9) Connect coaxial cable 1A15W12 or 1A-15W13 male BNC connector to the female BNC connector on directional coupler 1DC2.

c. Replacement of Transmitter Mixer Diodes (Type 1N23WE). Use the procedures given below to replace mixer diodes 1Z1CR1 or 1Z1CR2.

(1) Unscrew and remove the knurled cap (fig. 5–10) from crystal mixer 1Z1.

NOTE

Be sure that rubber washer on knurled cap is not lost or misplaced during replacement procedure.

(2) Use fingernails or round needle nose pliers to grasp the diode base and pull diode out of crystal mixer diode cavity. The diode base, diode, and diode cavity are similar to those shown in figure 5–13.

(3) Note the polarity of the diode (fig. 5–13) and then pull the diode out of the diode base.

(4) Insert replacement diode into diode base being sure to observe that diode is inserted for normal diode configuration (fig. 5–13).

(5) Insert replacement diode into crystal mixer diode cavity and connect and finger tighten the knurled cap removed in (1) above.

d. Replacement of Transmitter or Receiver Circulator Diodes (Type 1N76). Use the procedure given below to replace transmitter circulator diodes 1HY1CR1, 1A9HY1CR1, or 1A10HY1-CR1 or receiver circulator diodes 2HY3CR1 or 2A7HY1CR1.

(1) Use round needle nose pliers to rotate the knurled portion of the male BNC connector (fig. 5–14) in a counterclockwise direction until the mating female BNC connector on the circulator barrel is loosened.

(2) Disconnect the coaxial cable male BNC connector connected to the female BNC connector on the circulator barrel.

(3) Unscrew and remove the female BNC connector from the circulator barrel. The entire diode holder assembly will be removed with the female BNC connector.

(4) Being careful not to distort the spring, remove the diode (type 1N76) from its retaining ring.

(5) Insert replacement diode into its retaining ring observing diode polarity shown in figure 5–14.

(6) Insert diode holder into barrel of circulator and rotate female BNC connector clockwise until it is securely finger tightened.

(7) Connect the coaxial cable male BNC connector removed in (2) above.

e. Replacement of Receiver Mixer Diodes (Type 1N23WG). Use the procedures given be-

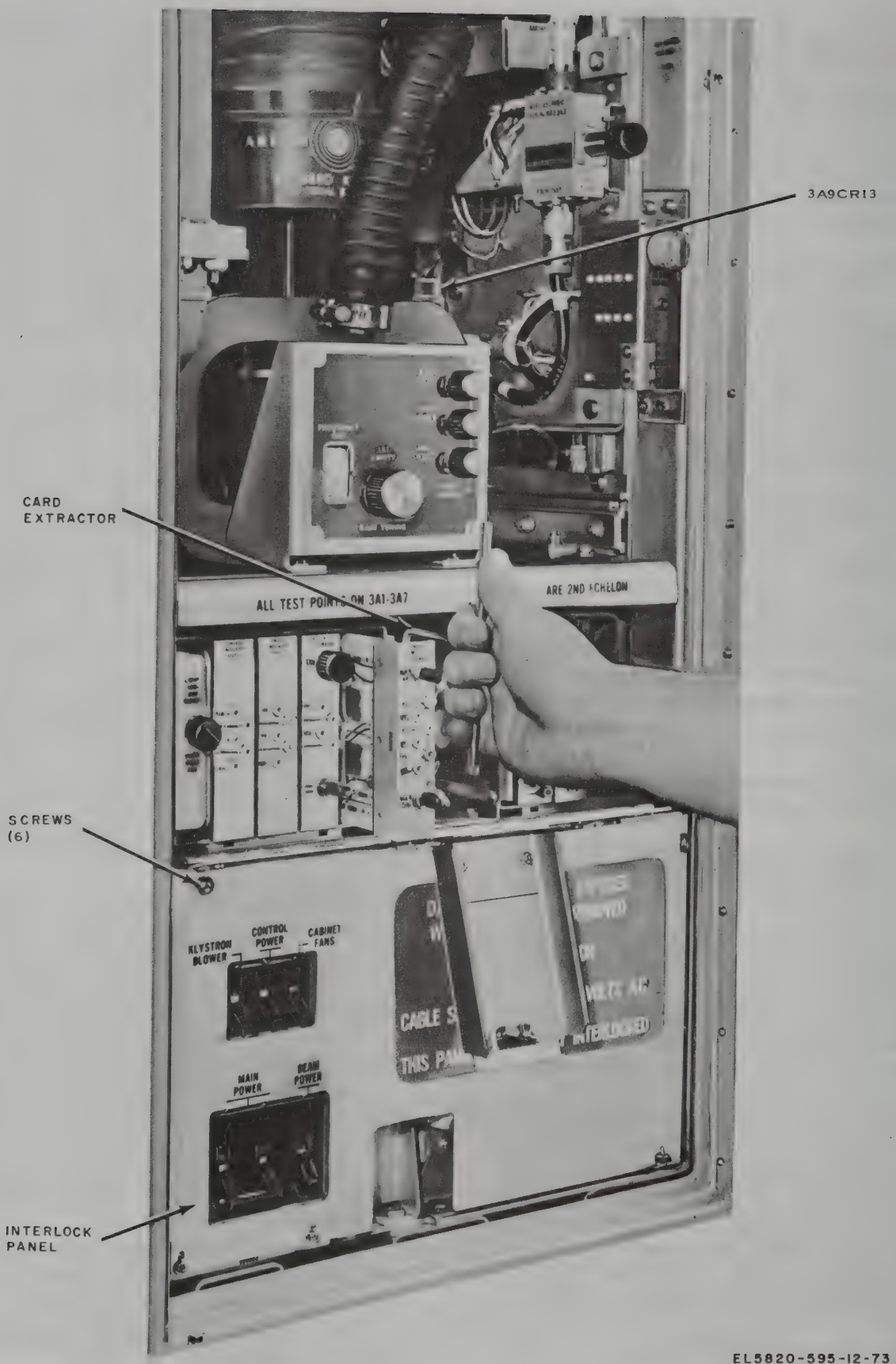


Figure 5–9. Replacement of power amplifier modules 3A1 through 3A7, typical.

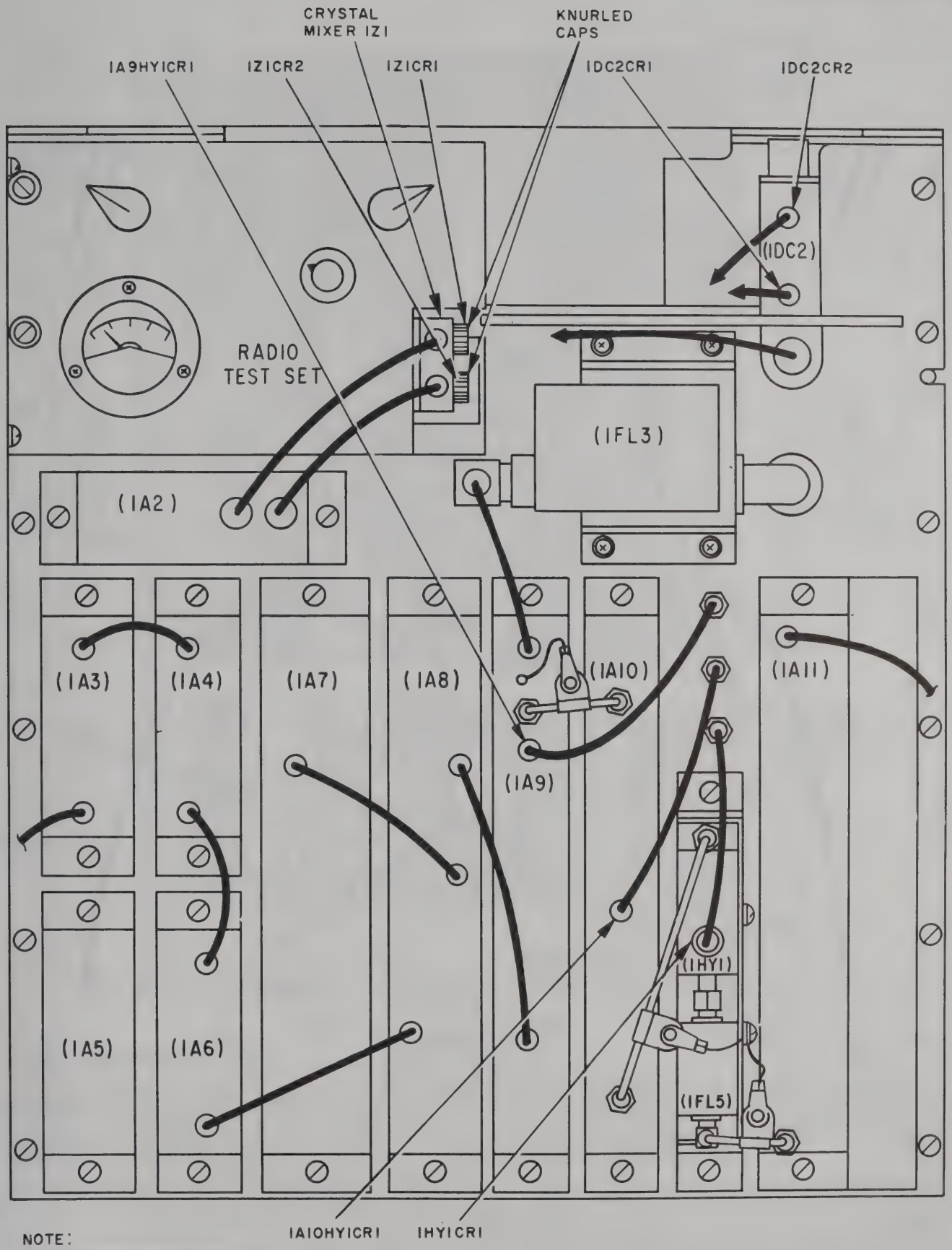
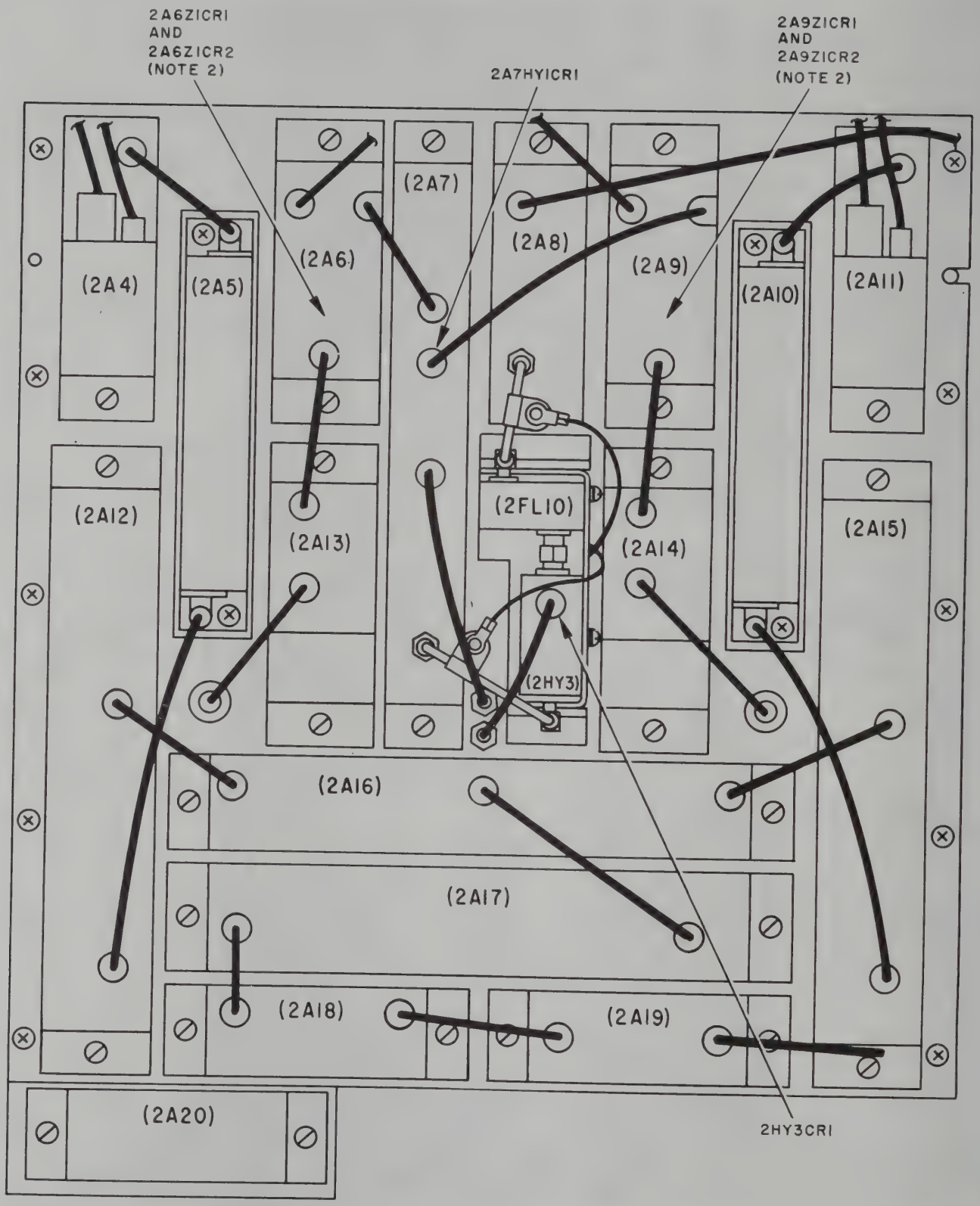


Figure 5–10. Transmitter RF detector diodes, parts location.



NOTES:
1. REFERENCE DESIGNATIONS (2A4), (2A5) ETC. ARE NOT MARKED ON MODULES.
2. THE DIODES IN 2A6 AND 2A9 ARE LOCATED ON THE BACK OF THE MODULE.

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Figure 5-11. Receiver RF detector diodes, parts location.

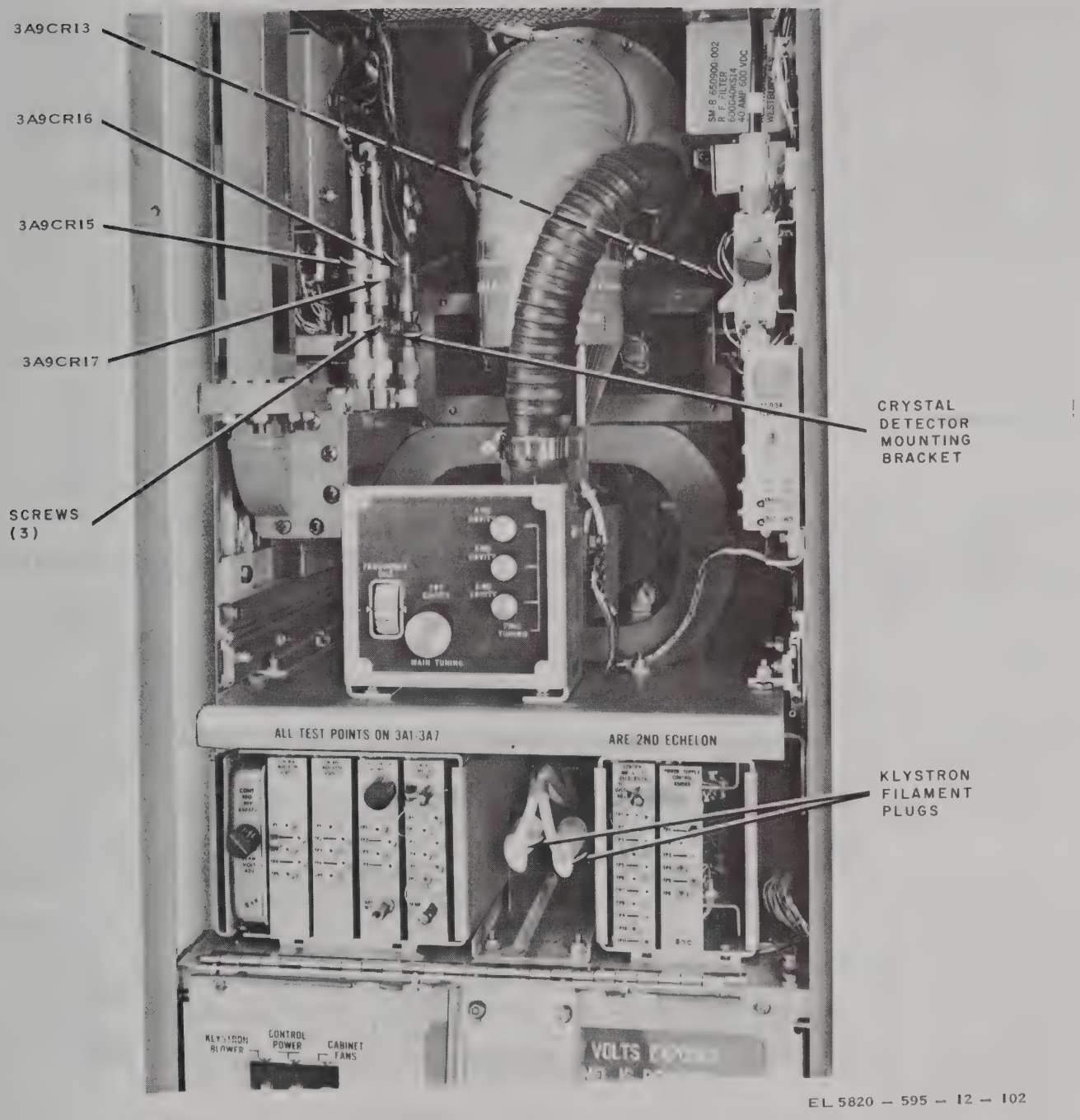


Figure 5–12. Power amplifier crystal detectors, parts location.

low to replace receiver mixer diodes 2A6Z1CR1 and 2A6Z1CR2, or 2A9Z1CR1 and 2A9Z1CR2. The diodes are replaced as parts (unmatched).

(1) Remove frequency mixer 2A6 or 2A9 (para 5–31*b*) from the receiver using the procedures given in paragraph 5–31*b*.

(2) Use a screwdriver to remove the two diode cover screws (CR1 FWD and CR2 FWD) on the back of module 2A6 or 2A9 (fig. 5–15).

NOTE

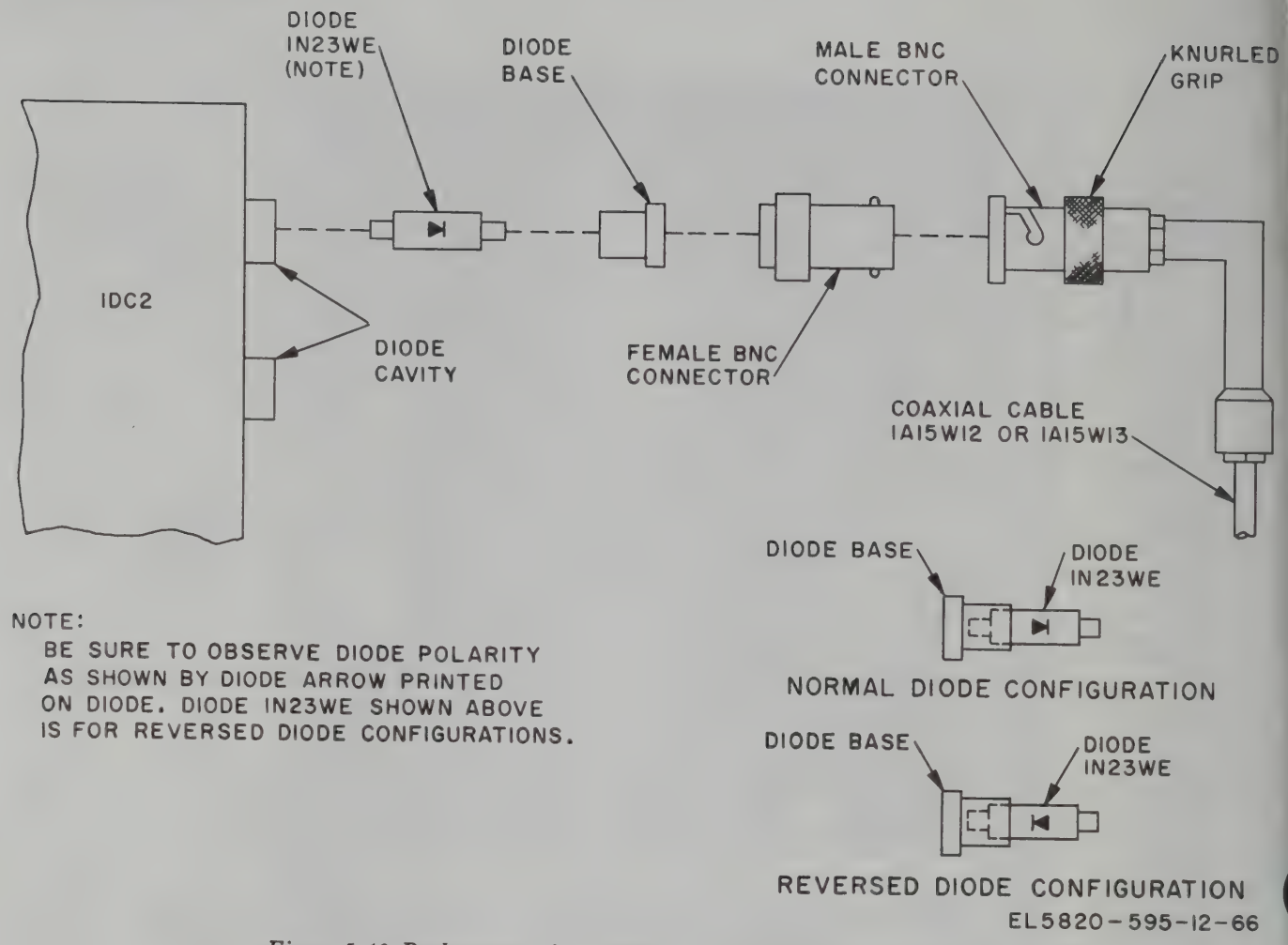
Be sure that rubber washer (fig. 5–15) positioned on inside of each diode cover screw is not lost or misplaced during replacement procedure.

(3) Use finger nails or round needle nose pliers to grasp the diode's base and pull diode out of frequency mixer diode cavity.

(4) Repeat (3) above for remaining diode.

(5) Note the polarity of the diodes (fig. 5–15) and then pull the diodes out of diode base.

(6) Insert replacement diodes into diode



NOTE:
BE SURE TO OBSERVE DIODE POLARITY AS SHOWN BY DIODE ARROW PRINTED ON DIODE. DIODE IN23WE SHOWN ABOVE IS FOR REVERSED DIODE CONFIGURATIONS.

Figure 5-13. Replacement of transmitter directional coupler diodes, typical.

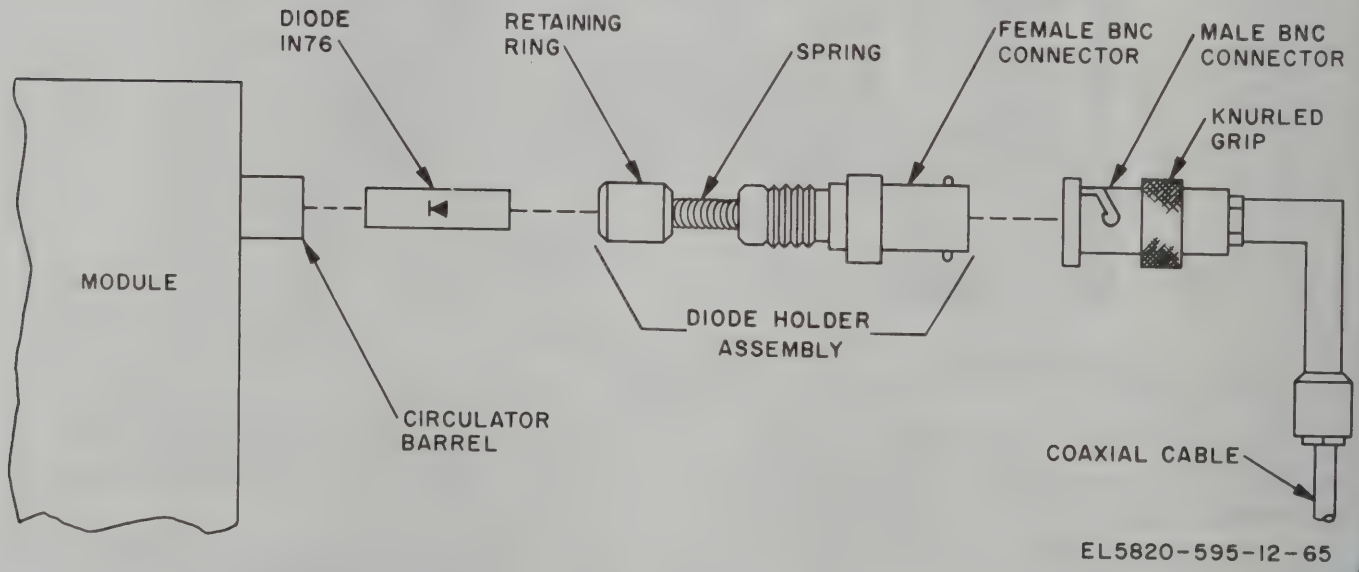


Figure 5-14. Replacement of transmitter or receiver circulator diodes, typical.

base being sure to observe correct diode polarity (fig. 5-15).

(7) Insert the two replacement diodes in the two frequency mixer diode cavities.

(8) Use a screwdriver to replace and tighten the two diode cover screws removed in (2) above.

(9) Reinstall frequency mixer 2A6 or 2A9 using the procedures given in paragraph 5-31*b*.

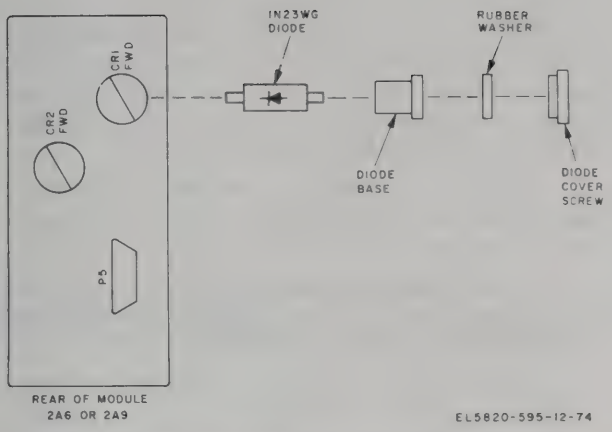


Figure 5–15. Replacement of receiver mixer diodes.

f. Replacement of Power Amplifier Crystal Detectors (Type 653201–1 or 653201–2). Use the procedures given below to replace any of the following power amplifier crystal detectors: 3A9CR13, 3A9CR15, 3A9CR16, or 3A9CR17 (fig. 5–12).

WARNING

Always deactivate the MAIN POWER SWITCH (MAIN POWER SWITCH lighted white when deactivated) on the power amplifier meter panel (fig. 3–10) before attempting to remove or replace a crystal detector in the power amplifier.

(1) Press the BEAM SWITCH and MAIN POWER SWITCH (fig. 3–10) on the power amplifier meter panel. The MAIN POWER SWITCH shall light white and the BEAM SWITCH shall be extinguished.

(2) Loosen the two captive screws securing the power amplifier meter panel (fig. 1–14) in place and raise and lock the power amplifier meter panel in the upright position using the panel locking latch.

(3) Identify the location of crystal detector (figs. 5–9 and 5–12) and remove the coaxial cable connected to the top of the crystal detector (fig. 5–18).

(4) Loosen the knurled connector on the crystal detector by rotating it in a counterclockwise direction and remove crystal detector from mating type N connector.

(5) Replace the crystal detector with a spare crystal detector of the same type. Crystal detectors 3A9CR15 through 3A9CR17 are type 653201–1 as indicated on the body of the crystal detector. Crystal detector 3A9CR13 is a type 653201–2 as indicated on the body of the crystal detector.

(6) Tighten knurled connector portion of the replacement crystal detector to the mating type N connector by turning it clockwise.

(7) Connect coaxial cable removed in (3) above to the BNC connector end of the crystal detector.

(8) Unlock the panel locking latch, lower power amplifier meter panel, and secure it by tightening the two captive screws.

(9) Press the MAIN POWER SWITCH on the power amplifier meter panel and observe that it lights green.

(10) Approximately 3.5 minutes after the MAIN POWER SWITCH is pressed, the TIME DELAY indicator on the power amplifier meter panel lights green. Wait until the TIME DELAY indicator lights green, then press the BEAM SWITCH and observe that it lights green.

5–34. Removal and Replacement of Lamps

a. General. To replace a lamp in any unit of the radio set, perform the applicable replacement procedure given in *b* through *e* below. Lamp identification by reference designation is covered in figures 2–12 through 2–15. Lamp types for various lamp locations are identified in paragraph 2–10c. Lamp replacement detail is shown in figure 5–16.1.

b. Replacement of Status and Alarm Indicator Lamps. Use the procedure given below to replace a lamp in any of the status or alarm indicator assemblies mounted on the transmitter, receiver, or power amplifier meter panels.

NOTE

Do not attempt to replace a lamp installed in the power amplifier MAIN POWER SWITCH or BEAM SWITCH indicator assemblies while the radio set is operating and handling traffic. Accidental operation of either switch during lamp replacement will interrupt radio communications. Wait until the radio set is shutdown or in the standby mode to replace these lamps. All other lamps can be replaced during communications, if required.

(1) Using your fingernails, grasp the slots at both sides of the cover (fig. 5–16) and pull the cover out until firm resistance is met.

(2) Rotate the cover 90 degrees counterclockwise and lightly press the cover to release the entire assembly (fig. 5–16).

(3) Press lamp cap with thumb to release cap and then use fingernails to remove burned out lamp.

(4) Press the replacement lamp into the indicator assembly.

(5) Seat the indicator assembly into its holder (fig. 5–16) and then firmly press the cover while rotating it 90 degrees clockwise. Continue to press the cover until the assembly locks in place.

c. Replacement of Oven Indicator Lamps. Use the procedures given below to replace a lamp in any of the oven indicator assemblies mounted on the transmitter or receiver meter panels.

(1) Unscrew the oven indicator lens cover.

(2) Use fingernails to grasp the base of the lamp and pull it out of the oven indicator lens cover.

(3) Insert replacement lamp into oven indicator lens cover and then screw oven indicator lens cover into oven indicator assembly.

(4) Check replacement lamp by pressing on the oven indicator lens cover. The lamp should light.

d. Replacement of Power Supply and Module Fault Indicator Lamps. Use the procedures given below to replace a lamp in power supply 1A1, power supply 2A3, 100-MHz oscillator 1A2, frequency synthesizer 1A14, frequency synthesizer 2A21, or digital data modem 1A12.

(1) Use fingernails to remove the colored plastic lens cap. Pull plastic lens cap off using a rocking motion.

(2) Use lamp extractor (fig. 1-4) to pull lamp out of the holder. Do not turn or twist lamp while pulling it out.

(3) Trim lamp wires on replacement lamp to same length as burned out lamp.

(4) Carefully insert replacement lamp into its holder using care not to twist or bend lamp leads.

(5) Replace plastic lens cap removed in (1) above and press it firmly into place.

e. Replacement of Order Wire MODULE TEST Indicator Lamp. Use procedures given in paragraph 5–34*c* to replace the order wire 1A13 MODULE TEST indicator lamp.

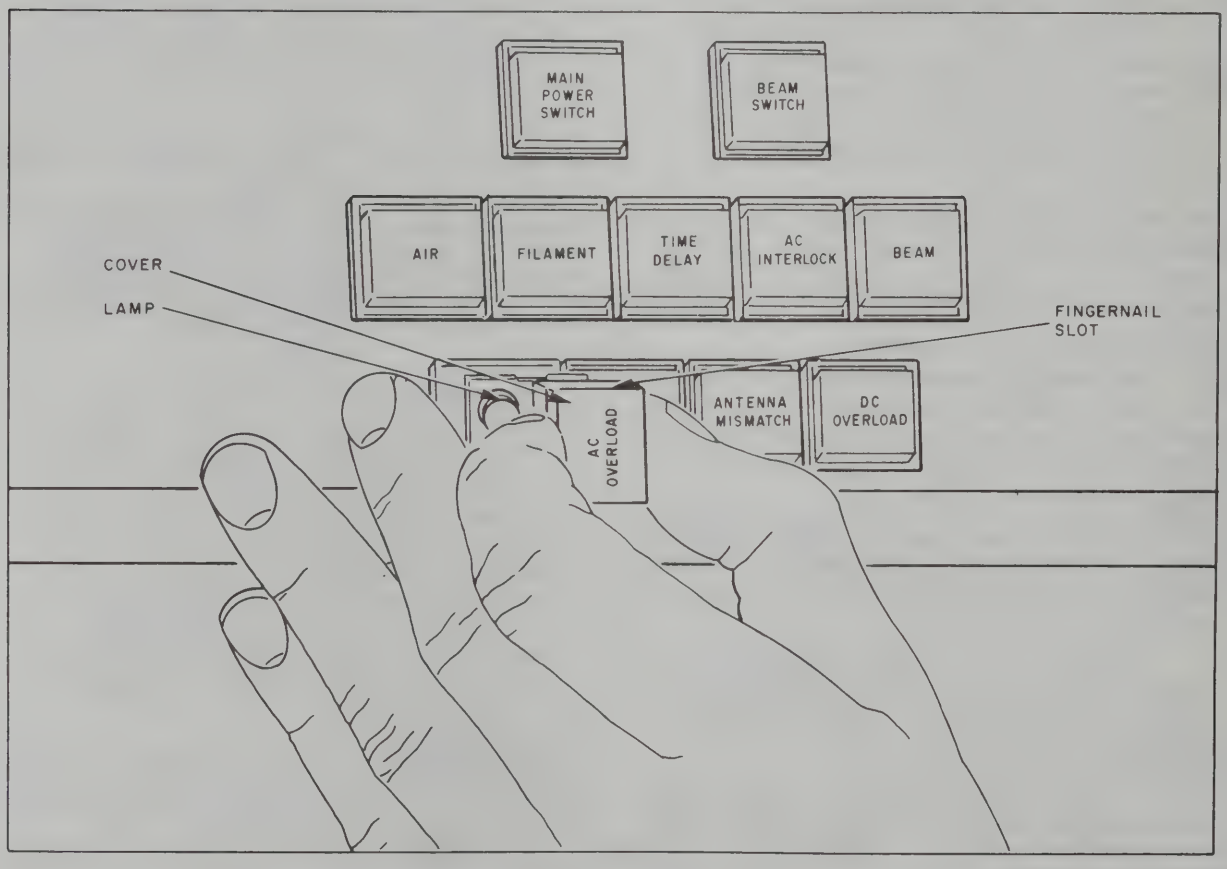
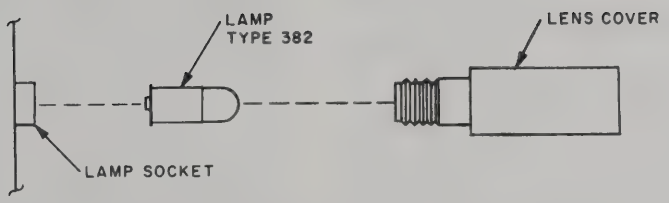
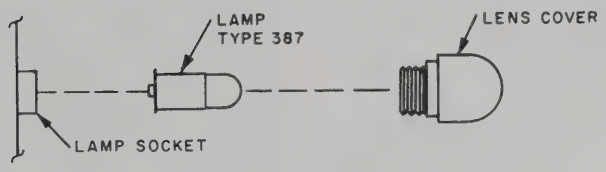


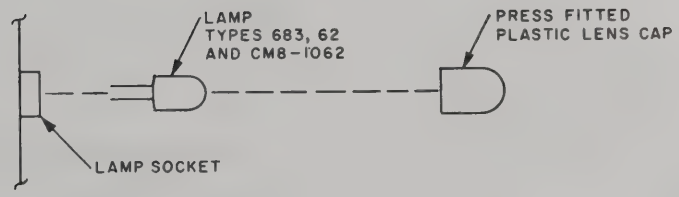
Figure 5–16. Replacement of status and alarm indicator lamps.



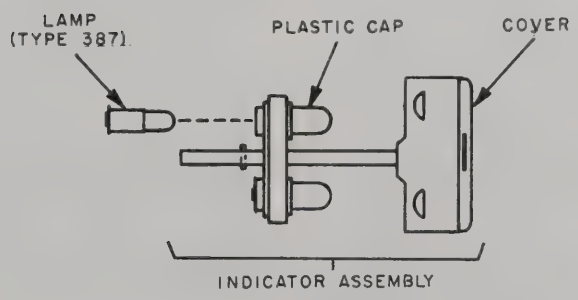
A. ORDERWIRE INDICATOR LAMP



B. OVEN INDICATOR LAMP



C. MODE, POWER SUPPLY AND FAULT INDICATOR LAMPS



D. STATUS AND ALARM INDICATOR LAMPS

EL5820-595-12-TM-CI-3

Figure 5-16.1. Oven, order wire, fault indicator, and status and alarm indicator lamps, replacement detail.

5-35. Transmitter Order Wire Level Adjustment

The transmitter orderwire level adjustment (*a* through *d* below) sets the input orderwire level from Multiplexer TD-204/U to the proper level and is used to compensate for the length of CX-4245/G cable between Multiplexer TD-204/U and the radio set. The transmitter order wire level adjustment will not interrupt pcm traffic and is performed during initial equipment adjustments (para 2-14), and when specified in the troubleshooting chart (para 5-24).

a. Notify Multiplexer TD-204/U operator at the cable end of your communications link via order wire (para 3-17) to set the TONE-OFF switch on Multiplexer TD-204/U to TONE.

b. Turn the meter selector switch (fig. 3-1) on the transmitter meter panel to OW TEST.

c. Using a screwdriver adjust the THRU OW RECEIVE LEVEL ADJ control (fig. 3-4) on digital data modem 1A12 for a transmitter meter indication (fig. 3-1) of 100. If a meter indication of 100 cannot be obtained, notify higher category maintenance.

d. Notify Multiplexer TD-204/U operator at the cable end of your communications link via order wire (para 3-17) to set the TONE-OFF switch on Multiplexer TS-204/U to OFF.

5-36. Receiver IF Gain and AGC Alignment

The receiver IF gain and agc alignment procedures given below will interrupt normal radio communications and should be performed only when specified in the troubleshooting chart (para 5-24) or in paragraph 5-29d.

a. IF Gain.

(1) Record the transmitter and receiver operating frequencies.

(2) Apply the radio test set information and procedures covered in paragraph 5-25.

(3) Turn RCVR CHAN A and RCVR CHAN B switches (fig. 3-3) on radio test set to T.

(4) Set both SQUELCH ON-OFF switches (fig. 3-9) on receiver combiner 2A16 to OFF.

(5) Turn AGC SEL switch (fig. 3-9) on IF amplifier 2A12 and 2A15 to TEST.

(6) Disconnect coaxial cable 2A15W1 (fig. 2-11) from J2 connector on 70 MHz IF filter 2A10.

(7) Set receiver meter panel meter selector switch (fig. 3-6) to CARRIER (IF) COMBINED.

(8) Remove the green cap from the receiver IF GAIN control (fig. 3-9) on IF amplifier 2A12 and use the tuning tool (fig. 1-10) to adjust the IF GAIN control for a receiver meter panel meter indication (fig. 3-6) of 100.

(9) If a receiver meter indication of 100 cannot be obtained, replace IF amplifier 2A12 (para 5-31) and repeat steps (6) through (8) above.

(10) Replace the green cap removed in step (8) above.

(11) Connect coaxial cable 2A15W1 (fig. 2-11) J2 connector on 70-MHz IF filter 2A10 and disconnect coaxial cable 2A12W1 from J2 connector on 70-MHz IF filter 2A5.

(12) Remove the green cap from the receiver IF GAIN control (fig. 3-9) on IF amplifier 2A-15 and use the tuning tool (fig. 1-10) to adjust the IF GAIN control for a receiver meter panel indication (fig. 3-9) of 100.

(13) If a receiver meter indication of 100 cannot be obtained, replace IF amplifier 2A15 (para 5-31) and repeat (11) and (12) above.

(14) Replace the green cap removed in (12) above.

(15) Connect coaxial cable 2A12W1 (fig. 2-11) to J2 connector.

(16) The receiver meter indication should be approximately full scale (130 or greater).

(17) Set the AGC SEL switch (fig. 3-9) on IF amplifier 2A12 and 2A15 to DIV ON.

NOTE

If agc alignment is to be performed, proceed to *b* (1) below.

(18) Proceed to *b*(18) below to restore radio set to normal operation.

b. AGC Alignment.

(1) Remove the green cap from the receiver AGC GAIN control (fig. 3-9) on IF amplifiers 2A12 and 2A15 and turn the AGC GAIN control on both IF amplifiers fully clockwise.

(2) Turn the transmitter RCVR CHAN A and RCVR CHAN B switches (fig. 3-3) on the radio test set to T+30.

(3) Disconnect coaxial cable 2A15W1 (fig. 2-11) from its J2 connector on 70-MHz IF filter 2A10.

(4) Set the AGC AUTO/MAN switch (fig. 3-9) on combiner 2A16 to MAN.

(5) Remove the green cap from the MAN AGC ADJ control (fig. 3-9) on combiner 2A16 and adjust the MAN AGC ADJ control for a receiver meter indication of 60 ± 10. Record

actual meter indication. Meter selector switch is in CARRIER (IF) COMBINED position.

(6) Connect coaxial cable 2A15W1 (fig. 2-11) to J2 connector on 70-MHz IF filter 2A10 and disconnect coaxial cable 2A12W1 from J2 connector on 70-MHz IF filter 2A5.

(7) Observe the receiver meter panel meter indication (fig. 3-6). If meter indication is higher than meter indication recorded in (5) above, proceed to (10) below. If meter indication is lower, continue to (8) below.

(8) Turn the AGC GAIN control fig. 3-9) on IF amplifier 2A15 counterclockwise until the receiver meter indication is the same as the meter indication recorded in (5) above.

(9) Replace the two green caps removed in (5) above. Connect coaxial cable 2A12W1 to J2 connector on 70-MHz IF filter 2A5 and proceed to (15) below.

(10) Readjust the MAN AGC ADJ control (fig. 3-9) on combiner 2A16 for a receiver meter panel meter indication of 60 ± 10. Record the actual meter indication.

(11) Connect coaxial cable 2A12W1 (fig. 2-11) to J2 connector on 70-MHz IF filter 2A5 and disconnect coaxial cable 2A15W1 from J2 connector on 70-MHz IF filter 2A10.

(12) Observe the receiver meter indication (fig. 3-6). If meter indication is lower than the meter indication recorded in (10) above, proceed to (13) below. If higher, return to step (5) above. If repeated attempts (two or three attempts) fail to correct agc alignment, replace IF amplifiers 2A12 and 2A15 one at a time (para 5-31) and repeat the entire IF gain and agc alignment procedure after replacement of each IF amplifier.

(13) Turn the AGC GAIN control (fig. 3-9) on IF amplifier 2A12 counterclockwise until receiver meter indication (fig. 3-6) is the same as meter indication recorded in (10) above.

(14) Replace the two green caps removed in (1) above, and then connect coaxial cable 2A15W1 (fig. 2-11) to J2 connector on 70-MHz IF filter 2A10.

(15) Set the AGC AUTO/MAN switch (fig. 3-9) on combiner 2A16 to AUTO.

(16) Remove the green cap from the AUTO AGC ADJ control (fig. 3-9) on combiner 2A16 and adjust the AUTO AGC ADJ control for a receiver meter indication (fig. 3-6) of 100.

(17) Replace the green cap removed in (16) above.

(18) Set both SQUELCH ON-OFF switches on combiner 2A16 to ON.

(19) Set the ON-OFF switch (fig. 3-3) on 100-MHz oscillator 1A2 to OFF.

(20) Reset the transmitter and receiver controls to the original operating frequencies recorded in *a* (1) above.

5-37. Receiver Squelch Adjustment

The receiver squelch adjustment procedure given below will interrupt normal radio communications and should be performed only when specified in the troubleshooting chart (para 5-24) or in paragraph 5-29*d*.

a. Record the transmitter and receiver operating frequencies.

b. Apply the radio test set information and procedures covered in paragraph 5-25.

c. Turn RCVR CHAN A and RCVR CHAN B switches (fig. 3-3) on radio test set to T.

d. Check that both SQUELCH ON-OFF switches (fig. 3-9) on combiner 2A16 are set to ON. If they are not, set them to ON.

e. Turn the receiver meter selector switch (fig. 3-6) on the receiver meter panel to TEST LEAD (+).

f. Remove the test lead (fig. 1-10) from the SPECIAL TOOLS AND SPARE FUSES compartment. Connect one test lead probe to the TEST LEAD jack (fig. 3-6) on the receiver meter panel and connect the remaining test lead probe to TP1 (fig. 3-9) on combiner 2A16.

g. The receiver meter indication (fig. 3-6) shall be 100 ±30. If it is not, proceed to paragraph 5-39. When completed, return to paragraph 5-37*g*. If still not 100 ±30, replace combiner 2A16 (para 5-31) and perform all of the adjustments specified in paragraph 5-29*d*.

h. Turn the RCVR CHAN A switch (fig. 3-3) on radio test set to T-8.

i. Remove the green cap from the SQUELCH ADJ control (fig. 3-9) on the left side of combiner 2A16 and, using the tuning tool, turn the SQUELCH ADJ control clockwise until the receiver meter indication (fig. 3-6) drops below 50.

j. Replace the green cap removed in *j* above.

k. Remove test lead probe from TP1 (combiner 2A16) and connect it to TP3 (combiner 2A16).

l. Turn the RCVR CHAN A switch (fig. 3-3) on radio test set to T and turn the RCVR CHAN B switch to T-8.

m. Remove the green cap from the SQUELCH ADJ control (fig. 3-9) on the right side of combiner 2A16 and, using the tuning tool, turn the SQUELCH ADJ control clockwise until the receiver meter indication (fig. 3-6) drops below 50.

n. Replace the green cap removed in *m* above.

o. Turn the RCVR CHAN B switch (fig. 3–3) on the radio test set to T. Note that both the CARR (IF) A and CARR (IF) B alarm indicators (fig. 3–6) on the receiver meter panel are lighted green. If either or both of the alarm indicators are not lighted green, refer to the troubleshooting chart (para 5–24*b*) for corrective measures.

p. Set the ON–OFF switch (fig. 3–3) on 100-MHz oscillator 1A2 to OFF.

q. Remove the test lead and reinstall it in the SPECIAL TOOLS AND SPARE FUSES compartment (fig. 1–10).

r. Reset the transmitter and receiver controls to the original operating frequencies recorded in *a* above.

5–38. Receiver APC Alignment

The receiver apc alignment procedure given below will interrupt normal radio communications and should be performed only when specified in the troubleshooting chart (para 5–24) or in paragraph 5–29*d*.

a. Record the transmitter and receiver operating frequencies.

b. Apply the radio test set information and procedures covered in paragraph 5–25.

c. Turn RCVR CHAN A and RCVR CHAN B switches (fig. 3–3) on radio test set to T+30.

d. Disconnect coaxial cable 2A15W1 (fig. 2–11) from J2 connector on 70-MHz IF filter 2A10.

e. Turn receiver meter selector switch (fig. 3–6) on receiver meter panel to CARRIER (IF) COMBINED. Receiver meter indication should be approximately 100 ± 10. If it is not, perform the receiver IF gain adjustment (para 5–36*a*) before proceeding with this procedure.

f. Check that both SQUELCH ON–OFF switches and both APC ON–OFF switches (fig. 3–9) on combiner 2A16 are set to ON. If they are not, set them to ON.

g. Set the RCVR CHAN A and RCVR CHAN B switches (fig. 3–3) on the radio test set to T.

h. Turn the receiver meter selector switch (fig. 3–6) to TEST LEAD (–).

i. Remove the test lead probes (fig. 1–10) from the SPECIAL TOOLS AND SPARE FUSES compartment. Connect one test lead probe to TP2 (fig. 3–9) on combiner 2A16. Connect the remaining test lead probe to the TEST LEAD jack (fig. 3–6) on the receiver meter panel.

j. Remove the green cap from the APC ADJ control (fig. 3–9) on the left side of combiner 2A16 and check that the receiver meter indication (fig. 3–6) varies above and below meter zero as the APC ADJ control, using a tuning tool, is turned in both directions. Adjust the APC ADJ control for a zero receiver meter indication.

k. Replace the green cap removed in step *j* above.

l. Connect coaxial cable 2A15W1 (fig. 2–11) to J2 connector on 70-MHz IF filter 2A10 and disconnect coaxial cable 2A12W1 from J2 connector on 70-MHz IF filter 2A5.

m. Remove the test lead probe connected to TP2 (fig. 3–9) on combiner 2A16 and connect it to TP5 on combiner 2A16.

n. Remove the green cap from the APC ADJ control (fig. 3–9) on the right side of combiner 2A16 and check that the receiver meter indication (fig. 3–6) varies above and below meter zero as the APC ADJ control is turned in both directions. Adjust the APC ADJ control for a zero receiver meter indication.

o. Replace the green cap removed in *n* above.

p. Connect coaxial cable 2A12W1 (fig. 2–11) to J2 connector on 70-MHz IF filter 2A5.

q. Disconnect the test lead and reinstall it in the SPECIAL TOOLS AND SPARE FUSES compartment (fig. 1–10).

r. Set the ON–OFF switch (fig. 3–3) on 100-MHz oscillator 1A2 to OFF.

s. Reset the transmitter and receiver controls to the original operating frequencies recorded in *a* above.

5–39. Receiver Combined Alarm Adjustment

The receiver combined alarm adjustment procedure given below will interrupt radio communications and should be performed only when specified in the troubleshooting chart (para 5–24) or in paragraph 5–29*d*.

a. Record the transmitter and receiver operating frequencies.

b. Apply the radio test set information and procedures covered in paragraph 5–25.

c. Turn RCVR CHAN A and RCVR CHAN B switches (fig. 3–3) on radio test set to T–8.

d. Turn the receiver meter selector switch (fig. 3–6) to TEST LEAD (+).

e. Remove the test lead (fig. 1–10) from the SPECIAL TOOLS AND SPARE FUSES compartment. Connect one test lead probe to the TEST LEAD jack (fig. 3–6) on the receiver meter panel. Connect the remaining test lead probe to TP1 (fig. 3–9) on combiner 2A16.

f. Remove the green cap from the ALARM ADJ control (fig. 3–9) on combiner 2A16 and, using

the tuning tool, turn the ALARM ADJ control fully clockwise.

g. Receiver meter indication (fig. 3-6) shall be 100 ±30. If it is not replace combiner 2A16 (para 5-31) and perform all of the adjustments specified in paragraph 5-29*d*, before proceeding with this procedure.

h. Using the tuning tool, turn the ALARM ADJ control on combiner 2A16 counterclockwise until the receiver meter indication (fig. 3-6) decreases 3 meter divisions.

i. Turn the LEVEL ADJ control (fig. 3-3) on 100-MHz oscillator 1A2 slowly counterclockwise and observe that the receiver meter indication (fig. 3-6) begins to slowly decrease.

j. If the receiver meter indication does not begin to decrease, using the tuning tool, turn the ALARM ADJ control (fig. 3-9) on combiner 2A16 slowly counterclockwise until the receiver meter indication (fig. 3-6) does decrease.

k. Remove the test lead and reinstall it in the SPECIAL TOOLS AND SPARE FUSES compartment (fig. 1-10).

l. Replace green cap removed in *f* above.

m. Set the ON-OFF switch (fig. 3-3) on 100-MHz oscillator 1A2 to OFF.

n. Reset the transmitter and receiver controls to the original frequencies recorded in *a* above.

5-40. Receiver VCO Frequency Adjustment

The receiver vco frequency adjustment procedure given below will not interrupt radio communications and should be performed when specified in the troubleshooting chart (para 5-24) and in paragraph 5-29*d*.

NOTE

When performing the vco frequency adjustment on a replacement 220 MHz vco (2A13 or 2A14), allow the 220 MHz vco to warm up for 30 minutes before performing the vco frequency adjustment procedure given below.

a. Turn receiver meter selector switch (fig. 3-6) on the receiver meter panel to VCO FREQ DIFF.

b. Set both APC ON-OFF switches (fig. 3-9) on combiner 2A16 to OFF.

c. Remove the green cap from the FREQ ADJUST control (fig. 3-9) on 220 MHz vco 2A13 and, using the tuning tool, adjust the FREQ ADJUST control on 220 MHz vco 2A13 for a minimum receiver meter indication (fig. 3-6).

d. Turn the receiver meter selector switch (fig. 3-6) to APC.

e. Set both APC ON-OFF switches (fig. 3-9) on combiner 2A16 to ON.

f. Check that the receiver meter indication (fig. 3-6) varies above and below meter zero as the FREQ ADJUST control (fig. 3-9) on 220 MHz vco 2A13, using the tuning tool, is turned slowly clockwise and counterclockwise.

g. Using the tuning tools, adjust the FREQ ADJUST control (fig. 3-9) on 220 MHz vco 2A13 for a zero receiver meter indication (fig. 3-6).

h. Replace the green cap removed in *c* above.

5-41. Receiver Combiner 2A16 Adjustments

The receiver combiner adjustment procedures given below are used to partially align combiner 2A16 while the radio set is operating and handling traffic. The receiver combiner adjustment does not completely align the combiner (2A16) and the organizational repairman must perform all of the adjustments specified in paragraph 5-29d at the first available time that radio communications can be interrupted. Perform the receiver combiner adjustments given below only when specified in the troubleshooting chart (para 5-24).

a. Turn receiver meter selector switch (fig. 3-6) on receiver meter panel to CARRIER (IF) COMBINED.

b. Set both SQUELCH ON-OFF switches (fig. 3-9) on combiner 2A16 to OFF.

c. Remove the green cap from the AUTO AGC ADJ control (fig. 3-9) on combiner 2A16 and, using the tuning tool, adjust the control for a receiver meter indication of 100.

d. Disconnect coaxial cable 2A15W1 (fig. 2-11) from J2 connector on 70-MHz IF filter 2A10.

e. Turn the receiver meter selector switch (fig. 3-6) to TEST LEAD (-).

f. Remove the two test lead probes (fig. 1-10) from the SPECIAL TOOLS AND SPARE FUSES compartment. Connect one test lead probe to the TEST LEAD jack (fig. 3-6) on the receiver meter panel. Connect the remaining test lead probe to TP2 (fig. 3-9) on combiner 2A16.

g. Remove the green cap from the APC ADJ control (fig. 3-9) on the left side of combiner 2A16 and, using the tuning tool, adjust the APC ADJ control for a minimum receiver meter indication (fig. 3-6).

h. Connect coaxial cable 2A15W1 (fig. 2-11) to J2 connector on 70-MHz IF filter 2A10 and disconnect coaxial cable 2A12W1 from J2 connector on 70-MHz IF filter 2A5.

i. Remove the test lead probe from TP2 (fig. 3–9) on combiner 2A16 and connect it to TP5 on combiner 2A16.

j. Remove the green cap from the APC ADJ control (fig. 3–9) on the right side of combiner 2A16 and, using the tuning tool, adjust the APC ADJ control for a minimum receiver meter indication (fig. 3–6).

k. Connect coaxial cable 2A12W1 (fig. 2–11) to J2 connector on 70-MHz IF filter 2A5.

l. Replace the three green caps removed in *c*, *g*, and *j* above.

m. Remove the test lead and reinstall it in the SPECIAL TOOLS AND SPARE FUSES compartment (fig. 1–10).

NOTE

Leave the SQUELCH ON–OFF switches (fig. 3–9) on combiner 2A16 in the OFF position until all of the combiner adjustments specified in paragraph 5–29*d* can be performed.

5–42. Power Amplifier Beam and Blower Time-Delay Adjustments

The power amplifier beam and blower time-delay adjustments procedures given below will interrupt normal radio communications and should be performed only when specified in the troubleshooting chart (para 5–24).

NOTE

The power amplifier must be shutdown at the beginning of the beam time-delay adjustment. Use the stopping procedures given in paragraph 3–23 to shut down the power amplifier if it is turned on.

a. Beam Time-Delay Adjustment.

(1) Set all circuit breakers (fig. 3–11) on the power amplifier circuit breaker panel to ON.

(2) Press the MAIN POWER SWITCH (fig. 3–10) on the power amplifier meter panel, it shall light green.

(3) Record the time between pressing the MAIN POWER SWITCH and the TIME DELAY indicator (fig. 3–10) on the power amplifier meter panel lighting green.

(4) The beam time delay interval shall be 3.5 ±0.5 minutes. If its not perform steps (5) through (7) below to set the time delay interval between 3.0 and 4.0 minutes.

(5) To increase the beam time-delay interval, use a screwdriver, turn the BEAM TD control (fig. 3–11) on time-delay control 3A5 in a clockwise direction 1/8th of a turn. To decrease the beam time-delay interval, turn the BEAM TD control in a counterclockwise direction 1/8th of a turn.

(6) Press the MAIN POWER SWITCH (fig. 3–11) on the power amplifier meter panel, it shall light white.

(7) Press the MAIN POWER SWITCH on the power amplifier meter panel again, it shall light green. Record the time between pressing the MAIN POWER SWITCH and the TIME DELAY indicator on the power amplifier meter panel lighting green. The beam time delay interval shall be 3.5 ±0.5 minutes.

(8) Repeat (5) through (7) above until the beam time-delay interval is between 3.0 and 4.0 minutes. If repeated attempts to set the time-delay interval do not result in improved time-delay readings, replace time-delay control 3A5 and repeat the entire procedure.

b. Blower Time-Delay Adjustment.

NOTE

The power amplifier must be turned on at the start of this procedure. If the power amplifier is not turned on, use the starting procedure given in paragraph 3–14 to start the power amplifier.

(1) Press the MAIN POWER SWITCH (fig. 3–10) on the power amplifier meter panel and record the time between pressing the MAIN POWER SWITCH and all of the power amplifier fans and blower shutting off.

(2) The blower time-delay interval shall be 3.5 ±0.5 minutes. If it is not perform (3) through (5) below to set the blower time-delay interval between 3.0 and 4.0 minutes.

(3) To increase the blower time-delay interval, use a screwdriver to turn the BLOW TD control (fig. 3–11) on time-delay control 3A5 in a clockwise direction 1/8th of a turn. To decrease the blower time-delay interval, turn the BLOW TD control in a counterclockwise direction 1/8th of a turn.

(4) Press the MAIN POWER SWITCH (fig. 3–10) on the power amplifier meter panel.

(5) Press the MAIN POWER SWITCH on the power amplifier meter panel again, it shall light white. Record the time between pressing the MAIN POWER SWITCH and all of the power amplifier fans and blowers shutting off. The blower time-delay interval shall be 3.5 ±0.5 minutes.

(6) Repeat (3) through (5) above until the blower time-delay interval is between 3.0 and 4.0 minutes. If repeated attempts to set the blower

time-delay interval do not result in improved time-delay readings, replace time-delay control 3A5 and repeat entire procedure.

5-43. Touchup Painting Instructions

Remove rust and corrosion from metal surfaces by lightly sanding them with sandpaper. Brush two coats of paint on bare metal to protect it from further corrosion. Refer to the applicable cleaning and refinishing practices specified in TB 746-10.

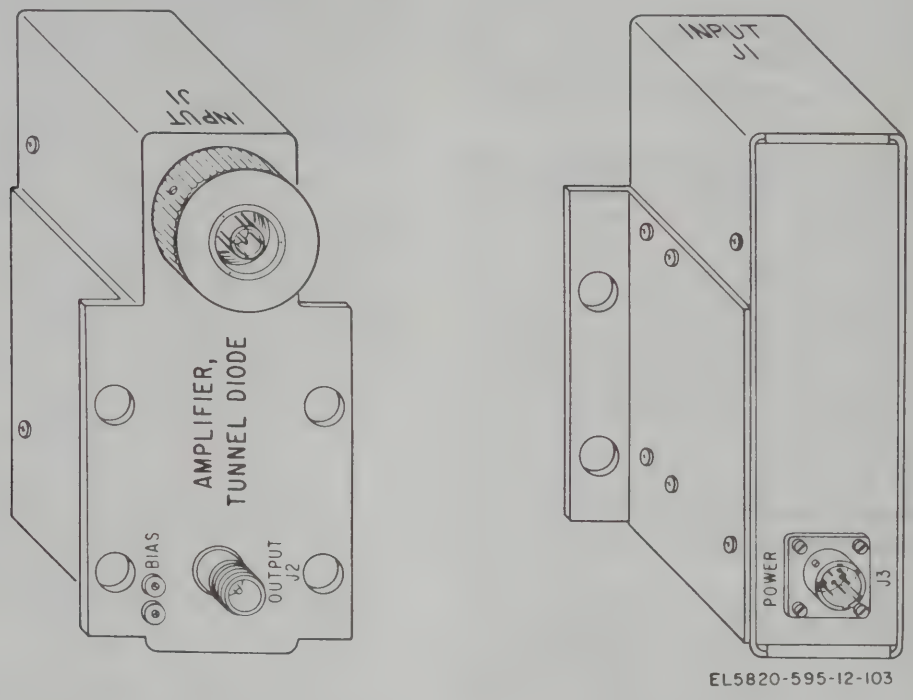


Figure 5-17. Tunnel diode Amplifier TDA2A1 or TDA2A2, rear and front view.

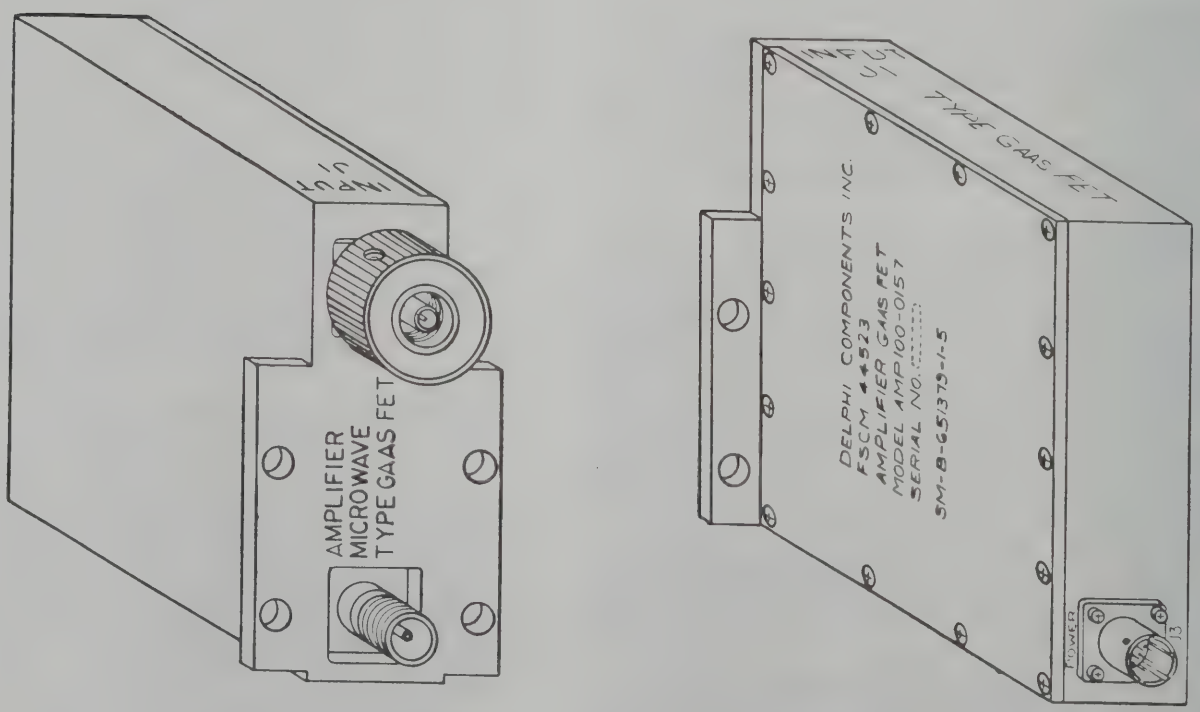


Figure 5-17a. GaAs FET Amplifier TDA2A1 or TDA2A2, used in some radios in place of Tunnel Diode Amplifiers, rear and front view.

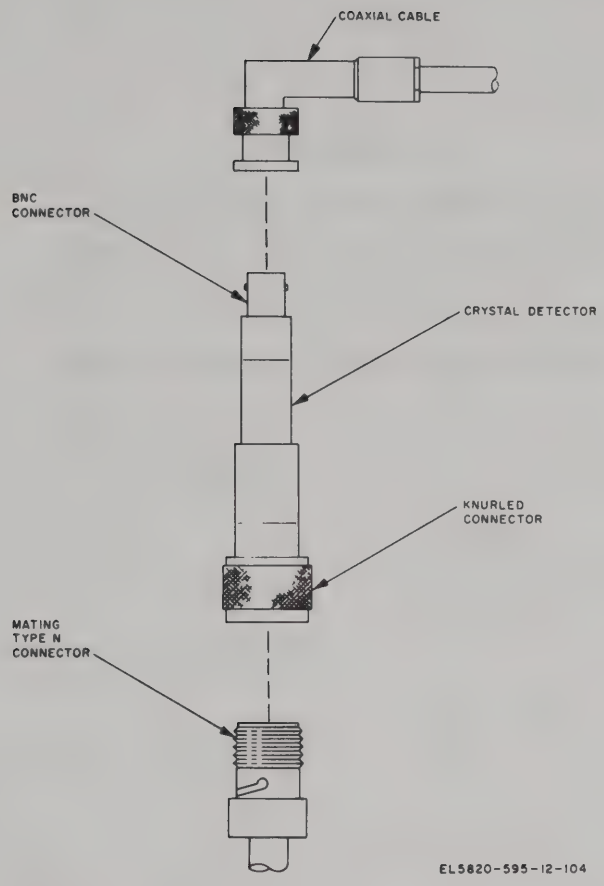


Figure 5-18. Replacement of power amplifier crystal detector, typical.

CHAPTER 6

SHIPMENT AND LIMITED STORAGE AND DESTRUCTION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

6-1. Disassembly of Equipment

The following instructions are recommended as a guide for preparing the radio set for shipment or limited storage:

a. Disconnection of External Cables.

(1) Remove power from the radio set (para 3-23).

(2) Disconnect all waveguide sections and directional couplers from the receiver and power amplifier (para 2-13).

(3) Disconnect all interface connectors and interconnection cables from the top of the equipment cabinets (para 2-12).

b. Removal of Transmitter.

(1) Open the cabinet doors and release the two captive screws securing the transmitter meter panel to the transmitter cabinet.

(2) Swing the transmitter meter panel upward and lock in the open position (fig. 2-7).

CAUTION

Exercise care in removal of power supply 1A1 to avoid damaging meter panel cables.

(3) Release the captive screws from the power supply mounting supports and carefully withdraw the assembly from the cabinet.

(4) Remove the two rear cabinet mounting bolts (fig. 2-8) using an openend, box, or socket wrench.

(5) Replace power supply 1A1 removed in step (3) above, tighten the two captive screws, and secure the transmitter meter panel.

(6) Disconnect coaxial cable 1A16W6 (fig. 2-10) from the OUTPUT J8 connector on frequency synthesizer 1A14.

(7) To gain access to the four mounting bolts at the bottom of the cabinet, release the two captive screws holding the order wire-frequency synthesizer assembly (1A13 and 1A14) in place, and withdraw the composite assembly from the transmitter cabinet by the two attached handles.

(8) Remove the four bottom cabinet mounting bolts.

(9) Replace order wire-frequency synthesizer assembly removed in step (7) above. Connect coaxial cable 1A16W6, tighten the two captive mounting screws, and close cabinet doors.

WARNING

The transmitter weighs approximately 160 pounds, use at least two men when lifting the cabinet.

(10) Lift the transmitter by the recessed handles and move it to the packing area.

c. Removal of Receiver.

(1) Open the cabinet doors and release the two captive screws securing the receiver meter panel to the receiver cabinet.

(2) Swing the receiver meter panel upward and lock in the open position (fig. 2-9).

(3) To gain access to the two mounting holes at the rear of the receiver cabinet, release the two captive screws holding power supply 2A3 in place, and carefully withdraw the assembly from the cabinet.

(4) Remove TDA 2A1 (para 5-31).

(5) Remove the two cabinet mounting bolts located in rear of cabinet (same as transmitter, fig. 2-8), using an openend, box, or socket wrench.

(6) Replace TDA 2A1 removed in step (4) above and power supply 2A3 removed in step (3) above.

(7) Tighten the captive screws and secure the receiver meter panel.

(8) Disconnect coaxial cable 2A22W5 (fig. 2-11) from OUTPUT J8 connector on frequency synthesizer 2A21.

(9) To gain access to the four mounting bolts at the bottom of the receiver cabinet, re-

lease the two captive screws holding frequency synthesizer 2A21 in place, and withdraw the assembly from the cabinet by the two attached handles.

(10) Remove the four bottom cabinet mounting bolts.

(11) Replace frequency synthesizer 2A21 removed in step (9) above. Connect coaxial cable 2A22W5, tighten the two captive mounting screws, and close cabinet doors.

WARNING

The receiver weighs approximately 195 pounds, use at least two men when lifting the cabinet.

(12) Lift the receiver by the recessed handles and move it to the packing area.

d. Removal of Power Amplifier.

(1) Remove the eight cabinet mounting bolts securing the rear shock mounts (fig. 2–6) to the shelter bulkhead using an open end, box, or socket wrench.

(2) In a similar manner, remove the 16 cabinet mounting bolts securing the base shock mounts (fig. 2–6) to the shelter floor.

WARNING

The power amplifier cabinet weighs 369 pounds. Do not attempt to lift or carry this cabinet without mechanical assistance such as a hoist or other suitable means. At least four men should be available during the moving operation. Failure to observe this warning can result in serious personal injury and damage to the equipment.

(3) Using the bottom and rear shock mounts as handles and mechanical assistance, lift and remove the power amplifier from the shelter to the packing area.

6–2. Repacking for Shipment or Limited Storage

The procedures for repacking depend on the material available and the conditions under which the equipment is to be shipped or stored. Adopt the procedures outlined below whenever possible. The information concerning the original packaging (para 2–1) may also be helpful.

a. Material Requirements. The following materials are required for packaging the radio set. For stock numbers of materials, consult SB 38–100.

Material	Quantity
Fiberbound hairflex, 2 inch thick.	100 sq ft
Filler material	40 lb
Corrugated cardboard	400 sq ft
Adhesive tape	200 ft
Waterproof paper	500 sq ft
Waterproof tape	150 ft
Cotton twine	50 ft

b. Packaging. Package the items of the radio set as outlined below.

(1) *Receiver and transmitter cabinets.* Cushion the receiver and transmitter cabinets on all surfaces with pads of filler material. Wrap the cushioned cabinet with corrugated cardboard. Secure the corrugated cardboard in place with adhesive tape.

(2) *Power amplifier cabinet.* Cushion the sides of the power amplifier with a layer of fiberbound hairflex and pads of filler material. Use at least two layers of fiberbound hairflex and pads of filler material on the top and bottom of the cabinet. Wrap the cushioned cabinet with corrugated cardboard and secure in place with adhesive tape.

(3) *Miscellaneous components.* Wind cables into coils of convenient dimensions and tie with cotton twine. Pack miscellaneous parts within a wrap of corrugated cardboard. Use filler material to cushion each item as required. Consolidate the miscellaneous parts with corrugated cardboard and secure with adhesive tape.

(4) *Spares drawers.* Cushion each drawer on all surfaces with pads of filler material and wrap with corrugated cardboard. Secure with adhesive tape.

c. Packing. Wrap each cabinet, drawer, and the minor components with waterproof paper. Secure the waterproof paper with waterproof tape. Pack each major cabinet (receiver, transmitter, and power amplifier) into a separate, nailed wooden box. Pack spare drawers and minor components into nailed wooden boxes or strong cardboard cartons.

Section II. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

6–3. Destruction of Army Materiel to Prevent Enemy Use

Follow procedures for the destruction of Army materiel to prevent enemy use as contained in TM 750-244-2.

APPENDIX A

REFERENCES

DA Pam 310-1	Consolidated Index of Army Publications and Blank Forms.
SB 38-100	Preservation, Packaging and Packing Materials, Supplies, and Equipment Used by the Army.
TM 11-5805-201-12	Operator's and Organizational Maintenance Manual: Telephone Set, TA-312/PT (NSN 5805-00-543-0012).
TM 11-5805-367-12	Operator's and Organizational Maintenance Manual: Multiplexers TD-202/U, TD-203/U, TD-204/U, TD-352/U, and TD-353/U, Restorer, Pulse Form TD-206/G, and Converter, Telephone Signal CB-1548/G.
TM 11-5965-224-14P	Operator's, Organizational, DS and GS Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools): Handsets H-60/PT (NSN 5905-00-669-9145) and H-165/U (5965-00-543-1837).
TM 11-5985-324-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual for Antenna Group AN/TRA-37 and Transit Frames, Antenna MT-3894/TRC and MT-3895/TRC.
TM 11-6625-203-12	Operator's and Organizational Maintenance Manual: Multimeter AN/URM-105 and AN/URM-105C (Including Multimeter ME-77/U and ME-77C/U).
TM 11-6625-498-12	Operator's and Organizational Maintenance Manual Test Set, Radio Frequency Power AN/USM-161.
TM 11-6625-214-10	Operator's Manual Signal Generator AN/URM-52 and AR/URM-52A.
TM 38-750	The Army Maintenance Management System (TAMMS).
TM 740-90-1	Administrative Storage of Equipment.
TM 750-244-2	Procedures for Destruction of Electronic Materiel to Prevent Enemy Use (Electronics Command).

APPENDIX B
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

B-1. General

This appendix provides a summary of the maintenance operations for AN/GRC-143. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

B-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to the specified paramters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard or known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment or system.

h. Replace. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipments/components.

B-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "worktime" figures will be shown for each category. The number of task-hours specified by the "worktime" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C – Operator/Crew
O – Organizational
F – Direct Support
H – General Support
D – Depot

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks. Column 6 contains an alphabetic code which leads to the remark in section IV, Remarks, which is pertinent to the item opposite the particular code.

B-4. Tool and Test Equipment Requirements (sec III)

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment.

e. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

B-5. Remarks (sec IV)

a. Reference Code. This code refers to the appropriate item in section II, column 6.

b. Remarks. This column provides the required explanatory information necessary to clarify items appearing in section II.

(Next printed page is B-3.)

SECTION II MAINTENANCE ALLOCATION CHART FOR

RADIO SET AN/GRC-143

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT.	(6) REMARKS
00	RADIO SET AN/GRC-143	Inspect	0.5						A
		Inspect		1.0					B
		Inspect			1.2				C
		Inspect					2.0		
		Test	0.5						D
		Test		0.6				1	E
		Test			1.2			20 thru 26	F
		Test					1.5	22, 25, 27, 28	
		Service	1.2						C
		Service		0.8					B
		Service			1.2				C
		Service					2.0		
		Adjust		0.5					H
		Adjust			1.4				I
		Adjust					2.0		
		Align	0.8						
		Align			2.0			20 thru 26, 29	I
		Calibrate			2.5			20 thru 26, 29	J
		Repair	0.4						K
		Repair		0.5				2 thru 6	L
		Repair			2.3			4 thru 19	R
		Repair					15	15 thru 19	S
		Overhaul					65	15 thru 19	
		Rebuild					140	15 thru 19	
01	TRANSMITTER, RADIO T-961/GRC-143	Inspect	0.2						A
		Inspect		0.3					B
		Inspect			0.4				C
		Inspect					1.0		
		Test		0.4					O
		Test			1.0			20, 21, 22, 24, 25, 26	
		Test					1.0	22, 28	
		Service	0.4						G
		Service		0.3					B
		Service			0.4				C
		Service					1.0		
		Adjust		0.2					H
		Adjust			0.5				I
		Adjust					1.0		
		Align		0.3					P
		Align			0.8			20 thru 25	
		Calibrate			0.8			20 thru 26	Q
		Repair	0.4						K
		Repair		0.5				2 thru 6	L
		Repair			2.5			4 thru 10, 13 thru 19	M
		Repair					10	18, 19	
		Overhaul					20	18, 19	
		Rebuild					50	18, 19	
0101	POWER SUPPLY 1A1 (650508)	Test	0.1						D
		Test		0.4					R
		Test			1.0			21	S
		Test					0.5	28	
		Replace			0.5				T
		Repair	0.1						U
		Repair		0.2					T
		Repair			1.5			18, 19	
		Repair					1.5	18, 19	
		Overhaul					3.0	18, 19	
		Rebuild					5.0	18, 19	

SECTION II MAINTENANCE ALLOCATION CHART
FOR

RADIO SET AN/GRC-143

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT.	(6) REMARKS
010101 thru 010104	REGULATOR, VOLTAGE 5/6 VDC 1A1A1 THRU 1A1A4 (650532)	Test		0.4					R
		Test					0.5	28	
		Replace		0.2					
		Repair					1.5	18, 19	
010105 thru 010108	REGULATOR, VOLTAGE 12 VDC 1A1A6 THRU 1A1A9 (650531)	Test		0.4					R
		Test					0.5	28	
		Replace		0.2					
		Repair					1.5	18, 19	
010109 thru 010111	REGULATOR, VOLTAGE 15/28 VDC 1A1A10 THRU 1A1A12 (650530)	Test		0.4					
		Test					0.5	28	
		Replace		0.2					
		Repair					1.5	18, 19	
010112	POWER SUPPLY CHASSIS 1A1A13 (651278)	Test			1.0			21	W
		Replace			0.4				
		Repair			1.5			18, 19	X
		Repair					1.5	18, 19	
		Repair		0.1				3	BM
0102	OSCILLATOR, RF 100 MHZ 1A2 (650509)	Test		0.4					R
		Test					0.5	28	
		Replace		0.2					
		Repair					1.5	18, 19	
		Repair		0.1				3	BM
0103	ATTENUATOR ASSEMBLY, 12 CHAN. PCM 1A3 (650514)	Test		0.4					R
		Test					0.5	28	
		Replace		0.2					
		Repair					1.5	18, 19	
0104	AMPLIFIER, AF-RF 1A4 (650500)	Test		0.4					R
		Test					0.5	28	
		Replace		0.2					
		Repair					1.5	18, 19	
		Repair		0.1				3	BM
0105	ALARM MONITOR 1A5 (650504)	Test		0.4					R
		Test					0.5	28	
		Replace		0.2					
		Repair					1.5	18, 19	
0106	FILTERS, LOW PASS 1.3 MHZ 1A6 (650501)	Test		0.4					R
		Test					0.5	28	
		Replace		0.2					
		Repair					1.5	18, 19	
		Repair		0.1				3	BM
0107	CONTROL, ELECTRONIC FREQUENCY 1A7 (650503)	Test		0.4					R
		Test					0.5	28	
		Replace		0.2					
		Repair					1.5	18, 19	
0108	MODULATOR, RADIO TRANSMITTER 1A8 (650502)	Test		0.4					R
		Test					0.5	22, 28	
		Replace		0.2					
		Repair					1.5	18, 19	
0109	MIXER STAGE, FREQ. TRANSMITTER 1A9 (650507)	Test		0.5					Y
		Test			0.4			21	Z
		Test					0.6	22, 28	
		Replace		0.2					
		Repair		0.6					AA
		Repair			0.5			4, 5, 6	AB
		Repair					1.5	18, 19	
010901	MIXER STAGE CRYSTAL 1A9A1 (650527)	Test		0.2					AC
		Test					0.5	22, 28	
		Replace		0.4					
		Repair					1.5	18, 19	

SECTION II MAINTENANCE ALLOCATION CHART FOR

RADIO SET AN/GRC-143

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT.	(6) REMARKS
0110	FREQUENCY MULTIPLIER GROUP, XMTR 1A10 (650506)	Test		0.5					AE
		Test			0.4			21	Z
		Test					0.6	22, 28	
		Replace		0.2					
		Repair		0.6					AF
		Repair			0.5			4, 5, 6	AB
		Repair					1.5	18, 19	
011001	FREQUENCY MULTIPLIER, XMTR, (2ND STAGE) 1A10A1 (650528)	Test		0.5				21	AC
		Test					0.3	22, 28	
		Replace		0.2					
		Repair					1.5	18, 19	
011002	FREQUENCY MULTIPLIER, XMTR, (3RD STAGE) 1A10A2 (650529)	Test		0.5					
		Test					0.3	22, 28	
		Replace		0.2					
		Repair					1.5	18, 19	
0111	AMPLIFIER-FREQ. MULTIPLIER XMTR 1A11	Test		0.4					R
		Test					0.5	22, 28	
		Replace		0.2					
		Repair					1.5	18, 19	
0112	MODEM, DIGITAL DATA 1A12 (650513)	Test		0.4					AG
		Test			1.0			1	AH
		Test					1.5	28	
		Replace			1.0				
		Repair		0.1					AI
		Repair			1.0			4	AJ
		Repair					1.5	18, 19	
		Overhaul					10	18, 19	
		Rebuild					15	18, 19	
011201	REGENERATOR, DIGITAL CABLE 1A12A2 (650539)	Test		0.4					AG
		Test					0.8	28	
		Replace		0.1					
		Repair		0.1					AL
		Repair					1.5	18, 19	
011202	CONTROL COMPARATOR CABLE 1A12A3 (650540)	Test		0.4					AG
		Test					0.8	28	
		Replace		0.1					
		Repair		0.1					AL
		Repair					1.5	18, 19	
011203	PROCESSOR, DIGITAL CABLE 1A12A4 (650542)	Test		0.4					AG
		Test					0.8	28	
		Replace		0.1					
		Repair		0.1					AL
		Repair					1.5	18, 19	
011204	AMPLIFIER, RADIO FREQUENCY 1A12A5 (650543)	Test		0.4					AK
		Test					0.8	28	
		Replace		0.1					
		Repair					1.5	18, 19	
011205	ALARM MONITOR 1A12A6 (650545)	Test		0.4					AG
		Test					0.8	28	
		Replace		0.1					
		Repair		0.1					AL
		Repair					1.5	18, 19	
011206	AMPLIFIER DETECTOR RADIO 1A12A7 (650547)	Test		0.4					AK
		Test					0.8	28	
		Replace		0.1					
		Repair					1.5	18, 19	
011207	REGENERATOR, DIGITAL RADIO 1A12A8 (650575)	Test		0.4					AG
		Test					0.8	28	
		Replace		0.1					
		Repair		0.1					AL
		Repair					1.5	18, 19	

SECTION II MAINTENANCE ALLOCATION CHART FOR

RADIO SET AN/GRC-143

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT.	(6) REMARKS
011208	CONTROL COMPARATOR, RADIO 1A12A9 (650576)	Test		0.4					AG
		Test					0.8	28	
		Replace		0.1					
		Repair		0.1					AL
		Repair					1.5	18, 19	
011209	CONTROL PROCESSOR 1A12A10 (650577)	Test		0.4					AG
		Test					1.0	28	
		Replace		0.1					
		Repair		0.1					AL
		Repair					2.0	18, 19	
011210	DECODER, PULSE 1A12A11 (650578)	Test		0.4					AK
		Test					0.8	28	
		Replace		0.1					
		Repair					1.5	18, 19	
011211	CONTROL PROCESSOR 1A12A12 (650577)	Test		0.4					AG
		Test					1.0	28	
		Replace		0.1					
		Repair		0.1					AL
		Repair					2.0	18, 19	
011212	PROCESSOR DIGITAL RADIO 1A12A13 (650579)	Test		0.4					AG
		Test					1.0	28	
		Replace		0.1					
		Repair		0.1					AL
		Repair					1.5	18, 19	
011213	CHASSIS, MODEM DIGITAL DATA 1A12A15 (651624)	Test		0.1					AM
		Test			1.0			21	AH
		Test					1.0	21	
		Replace			1.0				
		Repair		0.1					AL
		Repair			1.0			18, 19	AJ
		Repair					1.5	18, 19	
		Overhaul					10	18, 19	
		Rebuild					15	18, 19	
0113	ORDER WIRE 1A13 (650512)	Test		0.4					AN
		Test			1.0			21	AO
		Test					2.0	28	
		Replace			0.2				
		Repair		0.2					AP
		Repair			1.2			18, 19	AQ
		Repair					1.5	18, 19	
		Overhaul					10	18, 19	
		Rebuild					15	18, 19	
011301	DAUGHTER BOARD NO. 1 1A13A1 (651609)	Test		0.4					R
		Test					0.8	28	
		Replace		0.1					
		Repair		0.1					AR
		Repair					1.2	18, 19	
011302	DAUGHTER BOARD NO. 2 1A13A2 (651610)	Test		0.4					R
		Test					0.8	28	
		Replace		0.1					
		Repair					1.2	18, 19	
011303	DAUGHTER BOARD NO. 3 1A13A3 (651611)	Test		0.4					R
		Test					0.8	28	
		Replace		0.1					
		Repair					1.2	18, 19	
011304	DAUGHTER BOARD NO. 4 1A13A4 (651612)	Test		0.4					R
		Test					0.8	28	
		Replace		0.1					
		Repair					1.2	18, 19	
011305	DAUGHTER BOARD NO. 5 1A13A5 (651613)	Test		0.4					R
		Test					0.8	28	
		Replace		0.1					
		Repair					1.2	18, 19	

SECTION II MAINTENANCE ALLOCATION CHART FOR

RADIO SET AN/GRC-143

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT.	(6) REMARKS
011306	ORDERWIRE, CHASSIS 1A13A7 (651630)	Test			1.0			21	AO
		Test					1.2	28	
		Replace			0.2				
		Repair			1.2			18, 19	AQ
		Overhaul					10	18, 19	
		Rebuild					15	18, 19	
0114	SYNTHESIZER, ELECTRICAL FREQUENCY 1A14 (650511)	Test		0.1					D
		Test		0.4					R
		Test			2.0			21	AO
		Test					1.5	22, 28	
		Replace			0.2				
		Repair	0.1						T
		Repair		0.8				18, 19	AS
		Repair			0.8				AQ
		Repair					2.0	18, 19	
011401	OSCILLATOR, RF 1A14A1 (650548)	Test		0.4					R
		Test					1.0	22, 28	
		Replace		0.1					
		Repair		0.1					AL
		Repair					1.5	18, 19	
011402	CONNECTOR FREQUENCY ELECTRONIC 1A14A2 (650551)	Test		0.4					R
		Test					1.0	28	
		Replace		0.1					
		Repair		0.1					AL
		Repair					1.5	18, 19	
011403	DETECTOR, AF, PHASE ERROR 1A14A3 (650553)	Test		0.4					R
		Test					1.0	28	
		Replace		0.1					
		Repair		0.1					AL
		Repair					1.5	18, 19	
011404	FREQUENCY DIVIDER, VAR. NO. 1 1A14A4 (650549)	Test		0.4					R
		Test					1.0	28	
		Replace		0.1					
		Repair		0.1					AL
		Repair					1.5	18, 19	
011405	FREQUENCY DIVIDER, VAR. NO. 2 1A14A5	Test		0.4					R
		Test					1.0	28	
		Replace		0.1					
		Repair		0.1					AL
		Repair					1.5	18, 19	
011406	FREQUENCY DIVIDER FIXED 1A14A6 (650550)	Test		0.4					R
		Test					1.0	28	
		Replace		0.1					
		Repair		0.1					AL
		Repair					1.5	18, 19	
011407	FREQUENCY SYNTHESIZER CHASSIS 1A14A10 (INCLUDES 1A14A9)	Test			1.5			21	AO
011408		Test					1.5	21	
		Replace			0.8				
		Repair			0.8			18, 19	AQ
		Repair					2.0	18, 19	
0115	PLATE ASSEMBLY 1A15 (651157)	Test			1.2			21	W
		Test					0.8	28	
		Replace			1.0				
		Repair			1.2			7 thru 10, 18,19	
		Repair					2.0	18, 19	
011501	RADIO TEST SET P/O 1A15	Test			1.2			21	AT
		Test					1.5	21	
		Calibrate			0.5			27, 24, 8	
		Repair			1.0			18, 19	AU
		Repair					1.2	18, 19	

SECTION II MAINTENANCE ALLOCATION CHART FOR

RADIO SET AN/GRC-143

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT.	(6) REMARKS
0116	CABINET, ELECTRICAL EQUIPMENT 1A16 (651153)	Test		0.2					
		Test			0.4			21, 28	AV
		Replace			1.2				
		Repair			2.5			18, 19 7 thru 10	
		Overhaul					3	18, 19	
		Rebuild					5	18, 19	
0117	ATTENUATOR ASSEMBLY, 24 CHAN. PCM 1A18 (650536)	Test		0.1					R
		Test					0.8	28	
		Replace		0.2					
		Repair					0.6	18, 19	
02	RADIO RECEIVER, R-1287/GRC-143	Inspect	0.2						A
		Inspect		0.3					B
		Inspect			0.4				C
		Inspect					1.0		
		Test	0.1						D
		Test		0.4					O
		Test			1.0			20, 22, 23	F
		Test					1.0	28	
		Service	0.4						G
		Service		0.3					B
		Service			0.4				C
		Service					1.0		
		Adjust		0.2					H
		Adjust			0.5				AX
		Adjust					1.0		
		Align		0.3				4	P
		Align			0.8			1, 4	
		Repair	0.4						K
		Repair		0.5				2 thru 6	L
		Repair			2.5			4 thru 10, 13	M
		Repair					1.0	18, 19	
		Overhaul					20	18, 19	
		Rebuild					50	18, 19	
0201	POWER SUPPLY 2A3 (650523)	Test	0.1						D
		Test		0.4					R
		Test			1.2			21	AY
		Test					1.5	28	
		Replace			0.8				
		Repair	0.1						T
		Repair		0.4					AC
		Repair			1.5			4, 18, 19	BA
		Repair					2.0	18, 19	
020101, 020102, &020103	REGULATOR, VOLTAGE (15/28 VDC) 2A3A1, 2A3A2, & 2A3A4 (650530)	Test		0.4					R
		Test					0.6	28	
		Replace		0.2					
		Repair					1.0	18, 19	
020104	REGULATOR, VOLTAGE (12 VDC) 2A3A3 (650531)	Test		0.4					R
		Test					0.6	28	
		Replace		0.2					
		Repair					1.0	18, 19	
020105	POWER SUPPLY CHASSIS 2A3A5 (651279)	Test	0.1						D
		Test		0.1					AM
		Test			1.2			21	S
		Test					1.0		
		Replace			0.5				
		Repair	0.2						S
		Repair		0.2					AL
		Repair			1.5			4, 18, 19	V
		Overhaul					3.0	18, 19	
		Rebuild					5.0	18, 19	

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RADIO SET AN/GRC-143

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT.	(6) REMARKS
0202 & 0209	AMPLIFIER, MIXER 2A4, 2A11 (650520)	Test		0.4					R
		Test					1.2	28	
		Replace		0.1					
		Repair					1.0	18, 19	
0203 & 0208	FILTER, BANDPASS, 70 MHZ 2A5, 2A10 (650525)	Test		0.4					R
		Test					1.0	28	
		Replace		0.1					
		Repair					1.0	18, 19	
0204	MIXER STAGE, FREQ. RCVR. 2A6 (650522)	Test		0.4					O
		Test					1.2	22, 28	
		Replace		0.1					
		Repair		0.5					
		Repair					1.5	18, 19	
		Repair		0.1				3	BM
0205	FREQUENCY MULTIPLIER GROUP; RCVR. 2A7 (650521)	Test		0.4					O
		Test			0.6			21	Z
		Test					1.5	22, 28	
		Replace			0.6				
		Repair		0.8					AF
		Repair			0.5			4, 5, 6	AB
		Repair					1.2	18, 19	
020501	FREQUENCY MULTIPLIER, RCVR. (2ND STAGE) 2A7A1 (650534)	Test		0.4				1	AC
		Test					0.8	22, 28	
		Replace		0.2					
		Repair					1.2	18, 19	
020502	FREQUENCY MULTIPLIER, RCVR. (3RD STAGE) 2A7A2 (650535)	Test		0.4				1	AC
		Test					1.2	22, 28	
		Replace		0.2					
		Repair					1.2	18, 19	
0206	AMPLIFIER-FREQ. MULTIPLIER RCVR. 2A8 (650515)	Test		0.4					R
		Test					1.2	22, 28	
		Replace		0.2					
		Repair					1.5	18, 19	
0207	MIXER STAGE, FREQ. RCVR. 2A9 (650522)	Test		0.4					O
		Test					1.2	22, 28	
		Replace	0.1						
		Repair	0.5						BB
		Repair					1.5	18, 19	
0210 & 0213	AMPLIFIER, I.F. (70 MHZ) 2A12 & 2A15 (652590)	Test		0.4					R
		Test					1.0	28	
		Replace		0.2					
		Repair					1.5	18, 19	
		Repair		0.1				3	BM
0211	FREQUENCY MULTIPLIER OSCILLATOR (200 MHZ) 2A13 (65052A)	Test		0.4					R
		Test					1.2	22, 28	
		Replace		0.2					
		Repair					1.5	18, 19	
021101	AMPLIFIER FREQUENCY MULTIPLIER 2A13A1 (P/O VCO 220 MHZ) (65052A)	Test					1.2	22, 28	
		Replace					0.2		
		Repair					1.5	18, 19	
0212	FREQUENCY MULTIPLIER OSCILLATOR (200 MHZ) 2A14 (650524)	Test		0.4					R
		Test					1.2	22, 28	
		Replace		0.2					
		Repair					1.5	18, 19	
021201	AMPLIFIER FREQUENCY MULTIPLIER (P/O VCO 220 MHZ) 2A14A1 (65052A)	Test					1.2	22, 28	
		Replace					0.2		
		Repair					1.5	18, 19	

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(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT.	(6) REMARKS
0214	UNIT CONTROL, AMPL. COMBINER (DUAL) 2A16 (652676)	Test		0.4					R
		Test					1.0	28	
		Replace		0.2					
		Repair					1.5	18, 19	
0215	DEMODULATOR 2A17 (650518)	Test		0.4					R
		Test					1.0	28	
		Replace		0.2					
		Repair					1.5	18, 19	
0216	FILTER, LOW PASS (260 KHZ) 2A18 (650519)	Test		0.4					R
		Test					0.8	28	
		Replace		0.2					
		Repair					1.0	18, 19	
0217	AMPLIFIER AF-RF 2A19 (650500)	Test		0.4					R
		Test					1.0	28	
		Replace		0.2					
		Repair					1.2	18, 19	
0218	ALARM MONITOR 2A20 (650504)	Test		0.4					R
		Test					1.0	28	
		Replace		0.2					
		Repair					1.2	18, 19	
0219	SYNTHESIZER, ELECTRICAL FREQUENCY	Test		0.4					R
		Test			1.0			21	AO
		Test					2.5	22, 28	
		Replace			0.5				
		Repair	0.1						T
		Repair		0.3					AS
		Repair			1.5			18, 19	AQ
		Repair					1.5	18, 19	
021901	OSCILLATOR, R.F. 2A21A1 (650548)	Test		0.4					R
		Test					1.2	22, 28	
		Replace		0.2					
		Repair		0.1					AL
		Repair					1.5	18, 19	
021902	CONVERTER, FREQ. ELECTRONIC 2A21A2 (650551)	Test		0.4					R
		Test					1.0	28	
		Replace		0.2					
		Repair		0.1					AL
		Repair					1.5	18, 19	
021903	DETECTOR, AF PHASE ERROR 2A21A3 (650553)	Test		0.4					R
		Test					1.0	28	
		Replace		0.2					
		Repair		0.1					AL
		Repair					1.5	18, 19	
021904	FREQUENCY DIVIDER VAR. NO. 1 2A21A4 (650554)	Test		0.4					R
		Test					1.0	28	
		Replace		0.2					
		Repair		0.1					AL
		Repair					1.5	18, 19	
021905	FREQUENCY DIVIDER VAR. NO. 2 2A21A5 (650552)	Test		0.4					R
		Test					1.0	28	
		Replace		0.2					
		Repair		0.1					AL
		Repair					1.5	18, 19	
021906	FREQUENCY DIVIDER FIXED NO. 3 2A21A6 (650550)	Test		0.4					R
		Test					1.0	28	
		Replace		0.2					
		Repair		0.1					AL
		Repair					1.5	18, 19	

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(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT.	(6) REMARKS
021907 & 021908	FREQUENCY SYNTHESIZER CHASSIS 2A21A10 (INCLUDES 2A21A9)	Test			1.0			21	AO
		Test					1.0	28	
		Replace			1.5				
		Repair			1.5			18, 19	AQ
		Repair					1.5	18, 19	
0220	CABINET, ELECTRICAL EQUIPMENT 2A22 (651154)	Test			2.5			21	AV
		Replace			2.5				
		Repair			3.0			7 thru 10, 13, 14, 18	W
		Repair					4.0	18, 19	
		Repair		0.1				3	BM
0221	PLATE ASSEMBLY 2A24 (651564)	Test			2.0			21	W
		Replace			1.5				
		Repair			3.0			7 thru 10, 13, 14	X
		Repair					3.0	28	
0222 & 0223	FILTER BANDPASS (70 MHZ, BW- 1.5 MHZ) 2A25, 2A26 (650538)	Test		0.4					R
		Test					0.8	28	
		Replace		0.2					
		Repair					1.0	18, 19	
0224	FILTER LOW PASS (680 KHZ) 2A27 (650537)	Test		0.4					R
		Test					0.8	28	
		Replace		0.2					
		Repair					1.0	18, 19	
03	AMPLIFIER, R.F., AM-6090/GRC-143 (650457)	Inspect	0.2						A
		Inspect		0.3					B
		Inspect			1.0				
		Test	0.1						D
		Test		0.4				1	O
		Test			1.2			21, 22	
		Test					1.5	22, 27	
		Service	0.4						G
		Service		0.3					B
		Service			0.4				
		Adjust		0.2				4	
		Adjust			0.5			19, 22, 27	
		Calibrate			1.0			19,22, 27	Q
		Replace			1.5				
		Repair	0.4						K
		Repair		0.5				2, 3	BC
		Repair				2.0		11, 12, 13, 18	BD
		Repair					10	18, 19	
		Overhaul					25	18, 19	
		Rebuild					40	18, 19	
0301	CONTROL REGULATOR-INVERTER 3A1 (650572)	Test		0.4					R
		Test					1.0	28	
		Replace		0.2					
		Repair					1.2	18, 19	
0302 & 0303	CONTROL INDICATOR 3A2 & 3A3 (650573)	Test		0.4					R
		Test					1.0	28	
		Replace		0.2					
		Repair					1.2	18, 19	
0304	CONTROL, ALARM, LOW R.F.-MISMATCH 3A4 (650564)	Test		0.4				1	R
		Test					1.0	28	
		Replace		0.2					
		Repair					1.2	18, 19	

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RADIO SET AN/GRC-143

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT.	(6) REMARKS
0305	CONTROL, TIME DELAY 3A5 (650566)	Test		0.4				1	R
		Test					1.0	28	
		Replace		0.2					
		Repair					1.2	18, 19	
0306	CONTROL, BEAM GATE-D.C. OVERLOAD 3A6 (650565)	Test		0.4				1	R
		Test					1.0	28	
		Replace		0.2					
		Repair					1.2	18, 19	
0307	POWER SUPPLY, CONTROL 3A7 (650569)	Test		0.4				1	R
		Test					1.0	28	
		Replace		0.2					
		Repair					1.2	18, 19	
0308	INVERTER 3A8 (650574)	Test		0.4					R
		Test					1.0	28	
		Replace		0.2					
		Repair					1.2	18, 19	
0309	CABINET, ELECTRICAL EQUIPMENT	Inspect		0.1					
		Test		0.5					AD
		Test			1.2			21	BF
		Test					1.0	28	
		Adjust			0.8			19, 22, 28	
		Calibrate			1.0			19, 22, 28	Q
		Replace			2.0				
		Repair		0.5					BG
		Repair			2.5			11, 12, 13, 18	BH
		Overhaul					8.0	18, 19	
		Rebuild					15.0	18, 19	
030901	POWER SUPPLY ASSEMBLY 3A9A1 (650568)	Test			1.5			21	BI
		Test					1.0	28	
		Replace			0.5			18, 19	
		Repair			0.5			18, 19	
		Repair					1.5	18, 19	
030902	AMPLIFIER SUBASSEMBLY 3A9A33 (653434)	Test			1.0			21	AC
		Test					1.0	28	
		Replace			1.5			18, 19	
		Repair					1.5	18, 19	
04	ANTENNA ALIGNMENT INDICATOR 4A7 (650526)	Test			1.2			21	AT
		Calibrate			0.5			19, 25	BJ
		Repair			6.5			19	
05	HANDSET H-156/U (4A4)	Test	0.2						BL
		Test			1.0			21	
		Replace		0.2					AT
		Repair			1.2			19	
		Overhaul				3.0		18, 19, 21	
		Rebuild					5.0	18, 19, 21	

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS FOR

RADIO SET AN/GRC-143

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	O	MULTIMETER AN/URM-105	6625-00-581-2036	
2	O	PLIERS, ROUNDNOSE	5120-00-293-3481	
3	O	TOOL KIT, ELECTRONIC EQUIPMENT TK-101/G	5180-00-064-5178	
4	O,F,D	SCREWDRIVERS, FLAT TIP	5120-00-596-1185	
5	O,F,D	SCREWDRIVERS, CROSS TIP	5120-00-234-8913	
6	O,F,D	SCREWDRIVER, CROSS TIP	5120-00-234-8912	
7	F,D	EXTRACTION TOOL, MS24256 R20	5120-00-079-4601	
8	F,D	INSERTION TOOL, MS24256 A20	5120-00-079-4598	
9	F,D	EXTRACTION TOOL, MS18278 SIZE 20	5120-00-230-3770	
10	F,D	EXTRACTION CET-C6B	5120-00-963-7661	
11	F,D	EXTRACTION TOOL, MS24256 R12	5120-00-079-9461	
12	F,D	INSERTION TOOL, MS24256 A12	5120-00-079-4600	
13	F,D	CRIMPING TOOL, MS3191-3 W/HEAD ASSEMBLY W1	5120-00-856-3732	
14	F,D	CRIMPING TOOL, MS3191-4 W/HEAD ASSEMBLY W25	5120-00-230-3771	
15	F,D	SOCKET, WRENCH, DHEX 12 PT. ¼ INCH	5120-00-235-5869	
16	F,D	HAND RATCHET, SOCKET WRENCH, T SLIDING	5120-00-221-7966	
17	F,D	ATTACHMENT, BAR EXTENSION SOLID	5120-00-243-7325	
18	F,D	TOOL KIT, ELECTRONIC EQUIPMENT TK-100/G	5180-00-605-0079	
19	F,D	TOOL KIT, ELECTRONIC EQUIPMENT TK-105/G	5180-00-610-8177	
20	F,D	COUNTER ELECTRONIC, DIGITAL READOUT AN/USM-207	6625-00-911-6368	
21	F,D	MULTIMETER TS-352/B	6625-00-242-5023	
22	F,D	TEST SET, RADIO FREQUENCY POWER AN/USM-161	6625-00-892-5541	
23	F,D	OSCILLOSCOPE AN/USM-281	6625-00-053-3112	
24	F,D	SIGNAL GENERATOR AN/URM-52B	6625-00-965-1501	
25	F,D	TEST SET, ELECTRICAL METER TS-656/U	6625-00-806-4485	
26	F,D	FACILITIES KIT, METER CALIBRATION MK-1207/GRC	6625-00-133-7863	
27	D	KLYSTRON TESTER SOLITRON, MODEL G601		
*28	D	RADIO TEST SET AN/GRM-100 ITTDCD P/N 11612		
29	F	VOLTMETER, ELECTRONIC ME-202B/U	6625-00-972-4046	

* THIS ITEM WILL BE LOCATED AT TOBYHANNA ARMY DEPOT (PRIME DEPOT FOR RADIO SET AN/GRC-143) AND AT ONE OTHER DEPOT TO BE SELECTED AT A LATER DATE. THIS ITEM CONSISTS OF THE FOLLOWING COMPONENTS:

R. F. AMPLIFIER TEST BAY P/N 11613

DDM/ADX TEST BAY P/N 11631

FREQUENCY SYNTHESIZER TEST BAY P/N 11654

FREQUENCY MULTIPLIER TEST BAY P/N 11662

RADIO TEST BAY 1 P/N 11679

RADIO TEST BAY 2 P/N 11703

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS FOR

RADIO SET AN/GRC-143

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
		THE FOLLOWING TEST EQUIPMENT IS ALSO PART OF THE AN/GRM-100. THIS TEST EQUIPMENT WILL BE RACKED AND PROVIDED WITH THE AN/GRM-100 AS A FUNCTIONAL UNIT TO TWO DEPOTS: WAVE ANALYZER HP 302AR (3 ea) DISTORTION ANALYZER HP 331A (2 ea) TEST OSCILLATOR HP 651B (4 ea) SPECTRUM ANALYZER, DISPLAY SECTION HP 141T (4 ea) SPECTRUM ANALYZER, IF SECTION HP 8552A (4 ea) SPECTRUM ANALYZER, RF SECTION HP 8555A (4 ea) ELECTRONIC COUNTER HP 5245L (5 ea) PRESCALER PLUG-IN HP 5252A (1 ea) FREQUENCY CONVERTER, PLUG-IN HP 5254C (2 ea) NOISE FIGURE METER HP 342AR (1 ea) MICROWAVE POWER METER HP 432A (5 ea) COAX THERMISTOR MOUNT HP 478A (5 ea) MICROWAVE AMPLIFIER HP 493A (2 ea) PRESELECTOR HP 8445A OPTION 20 (1 ea) AMPLIFIER HP 1806A (1 ea) VHF OSCILLATOR HP 3200B (2 ea) COAX ADAPTER KIT HP 00515A (1 ea) SWEEP OSCILLATOR HP 8620B (2 ea) SWEEP OSCILLATOR HP 86241A (1 ea) R.F. SOURCE MODULE HP 86341B (1 ea) R.F. DROWER HP 8621A (1 ea) REACTANCE METER HP 250B (1 ea) D.C. CURRENT PROBE TEKTRONIX P6042 (1 ea) MICROWATT METER BOONTON 42A (1 ea) DETECTOR MOUNT BOONTON 41-4A (1 ea) WAVEGUIDE NOISE SOURCE MICROWAVE SEMICONDUCTOR MC 5112P (1 ea) ADAPTER MICROWAVE SEMICONDUCTOR MC 601 (1 ea) NOISE GENERATOR GENERAL RADIO 1390B 480-P412 (1 ea) ATTENUATOR, FIXED, 10db PRD 130C (1 ea) ATTENUATOR, STEP, 0-69db NARDA (3 ea) PHASE METER DRANETZ 301R (1 ea) TRUE RMS AUG PEAK ELECTRONIC VOLTMETER BALLENTINE 321-S2 (1 ea) LOGAFIER KAY 1025B (1 ea) MEGASWITCH KAY 255E (75R IMPEADANCE) (1 ea) PULSE TYPE MARKER PLUG-IN KAY PM 7670 (1 ea)		

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS FOR

RADIO SET AN/GRC-143

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
		SWEEP GENERATOR KAY 8323A (75 OHM OUTPUT) (2 ea)		
		SWEEP GENERATOR KAY 159C (75 OHM OUTPUT) (1 ea)		
		SELECTIVE VOLTMETER SIERRA 128A (3 ea)		
		VOLTMETER DIGITAL ELDORADO 1810A (1 ea)		
		DC AMMETER WENTON 931 (1 ea)		
		SWEEPER MAIN FRAM DRUSE 5000A-M11 (1 ea)		
		SWEEPER PLUG-IN KRUSE 5008-13 (1 ea)		
		MEASURING SET, STANDING WAVE RATIO AN/USM-37E (1 ea)	6625-00-197-6910	
		OSCILLOSCOPE AN/USM-281 (6 ea)	6625-00-053-3112	
		OSCILLATOR, AUDIO TS-421/U (1 ea)	6625-00-669-0228	
		GENERATOR, SIGNAL HP 606A (1 ea)	6625-00-865-8353	
		GENERATOR, SIGNAL HP 618CR (2 ea)		
		COUNTER, PLUG-IN HP 5255A (2 ea)		
		VOLTMETER, TRUE RMS HP 3400A (3 ea)		
		MULTIMETER ME-26/U (4 ea)	6625-00-902-7140	
		SIGNAL GENERATOR AUDIO HP 200CD (1 ea)		
		SIGNAL GENERATOR, AUDIO HP 201C (1 ea)		
		TRANSMISSION MEASURING SET DAVEN 12BR (3 ea)		
		MULTIMETER SIMPSON 270	6625-00-242-5023	
		VOLTMETER, ELECTRONIC BOONTON 91H (2 ea)	6625-00-973-3986	
		VOLTMETER, DIGITAL NON-LINEAR SYSTEMS LX-2 (5 ea)		
		DEVIATION METER MARCONI TF-791D (1 ea)		

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A	CHECK TO ASSURE ALL INTERCONNECTIONS ARE MADE.
B	INTERNAL BUT EXTERNAL OF MODULES.
C	ALL INTERNAL WITH EXCEPTION OF MODULE INTERIOR.
D	TO LOCATE FAULTY FUSES.
E	ISOLATE DEFECTIVE ASSEMBLIES, 12/24 CHANNEL COMPONENTS, MODULES AND/OR DIODES USING BUILT-IN TEST EQUIPMENT (BITE).
F	ISOLATE DEFECTIVE WIRING, COMPONENTS, PIECE PARTS AND PASSIVE ELEMENTS MOUNTED ON THE EQUIPMENT CABINETS.
G	AIR FILTERS.
H	12/24 CHANNEL.
I	THOSE REQUIRED WHEN REPLACING TRANSMITTER, RECEIVER, AND POWER AMPLIFIER COMPONENTS OF RADIO SET ARE REPLACED IN THE SHELTER.
J	REQUIRED PERIODICALLY FOR BUILT-IN-TEST EQUIPMENT, AND WHEN COMPONENTS OF RADIO SET ARE REPLACED IN THE SHELTER.
K	BY REPLACEMENT OF DEFECTIVE FUSES AND AIR FILTERS.
L	REPLACE DEFECTIVE INDICATOR LAMPS, LEASES, KNOBS, RIGID CABLE ASSEMBLIES, MODULES, SUBASSEMBLIES, AND/OR DIODES, 12/24 CHANNEL COMPONENTS. RETURN MODULES AND SUBASSEMBLIES TO DEPOT FOR REPAIR.
M	REPLACE DEFECTIVE COMPONENTS, RF CABLE ASSEMBLIES (NON-CAPTIVE), PIECE PARTS AND PASSIVE MODULES, FILTERS AND COUPLERS MOUNTED ON THE EQUIPMENT CABINETS.
N	REPAIR MODULES, SUBASSEMBLIES. REPAIR OF WAVEGUIDE ASSEMBLIES TO BE DETERMINED BY DEPOT.
O	LOCATE DEFECTIVE MODULES, SUBASSEMBLIES, AND/OR DIODES USING BITE.
P	AS REQUIRED AFTER MODULE REPLACEMENT OR 12/24 CHANNEL CHANGE.
Q	CALIBRATE THE BUILT-IN TEST EQUIPMENT.
R	LOCATE FAULTY MODULES.
S	LOCATE DEFECTIVE WIRING, COMPONENTS, PIECE PARTS MOUNTED ON THE CHASSIS.
T	REPLACE DEFECTIVE FUSES.
U	REPLACE DEFECTIVE MODULES.
V	REPLACE DEFECTIVE WIRING, COMPONENTS, AND PIECE PARTS.
W	ISOLATE TO DEFECTIVE WIRING, CONNECTOR, AND PIECE PARTS.
X	REPLACE DEFECTIVE WIRING, CONNECTORS AND PIECE PARTS.
Y	LOCATE FAULTY MODULE A1 AND/OR DIODE.
Z	LOCATE FAULTY CIRCULATOR.
AA	BY REPLACEMENT OF A1, DIODE, AND W1.
AB	REPLACE FAULTY CIRCULATOR AND RETURN TO DEPOT.
AC	LOCATE FAULTY UNIT.

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
AD	LOCATE FAULTY DIODE.
AE	LOCATE FAULTY MODULE A1 AND A2 AND/OR DIODE.
AF	BY REPLACEMENT OF A1 AND A2 AND HY1CR1.
AG	LOCATE FAULTY CARD AND LAMPS.
AH	ISOLATE TO DEFECTIVE MODEM FRAME OR WRAP AROUND.
AI	REPLACE DEFECTIVE CARD OR LAMP AND RETURN CARD TO DEPOT FOR REPAIR.
AJ	REPLACE DEFECTIVE FRAME AND WRAP AROUND AND RETURN TO DEPOT FOR REPAIR, LESS MODULES.
AK	LOCATE FAULTY CARD.
AL	BY REPLACEMENT OF LAMP.
AM	LOCATE FAULTY LAMPS.
AN	LOCATE FAULTY MODULES, LAMPS AND KNOBS.
AO	ISOLATE TO FAULTY CHASSIS.
AP	REPLACE FAULTY MODULES, LAMPS AND KNOBS, AND RETURN MODULES TO DEPOT FOR REPAIR.
AQ	REPLACE FAULTY CHASSIS AND RETURN CHASSIS TO DEPOT FOR REPAIR, LESS MODULES.
AR	BY REPLACEMENT OF LAMP AND KNOBS.
AS	REPLACE FAULTY MODULES AND LAMPS, RETURN MODULES TO DEPOT FOR REPAIR.
AT	LOCATE FAULTY COMPONENTS.
AU	REPLACE FAULTY COMPONENTS.
AV	ISOLATE TO DEFECTIVE WIRING, CONNECTORS, AND PIECE PARTS MOUNTED ON THE CABINET.
AW	REPLACE DEFECTIVE WIRING, CONNECTORS, AND PIECE PARTS MOUNTED ON CABINET.
AX	THOSE REQUIRED WHEN REPLACING RECEIVER COMPONENTS IN THE SHELTER.
AY	ISOLATE TO DEFECTIVE CHASSIS OR PIECE PART ON MODULE.
AZ	REPLACE DEFECTIVE PLUCK-CUT MODULES AND LAMPS.
BA	REPLACE DEFECTIVE COMPONENTS ON CHASSIS.
BB	BY REPLACEMENT OF DIODES Z1CR1 AND Z1CR2.
BC	REPLACE DEFECTIVE MODULES, KNOBS, INDICATOR LAMPS, AND DIODES.
BD	REPLACE DEFECTIVE KLYSTRON TUBE, RF CABLE ASSEMBLIES, COMPONENTS, AND PIECE PARTS MOUNTED ON THE EQUIPMENT FRAME, 3A9A1 AND 3A9A33.
BE	TEST KLYSTRON FOR GAS.
BF	ISOLATE TO DEFECTIVE WIRING, CONNECTORS, AND PIECE PARTS MOUNTED ON THE CABINET, 3A9A1 AND 3A9A33.
BG	BY REPLACEMENT OF DIODES.
BH	REPLACE DEFECTIVE WIRING, CONNECTORS AND PIECE PARTS MOUNTED ON THE CABINET, CR14, 3A9A1 AND 3A9A33.

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
BI	LOCATE FAULTY UNIT OR SUBASSEMBLY.
BJ	PERIODIC CALIBRATION REQUIRED.
BK	BY REPLACEMENT OF PIECE PARTS.
BL	OPERATIONAL TESTS ONLY.
BM	BY REPLACEMENT OF KNOBS, LAMPS, FUSES, ETC.

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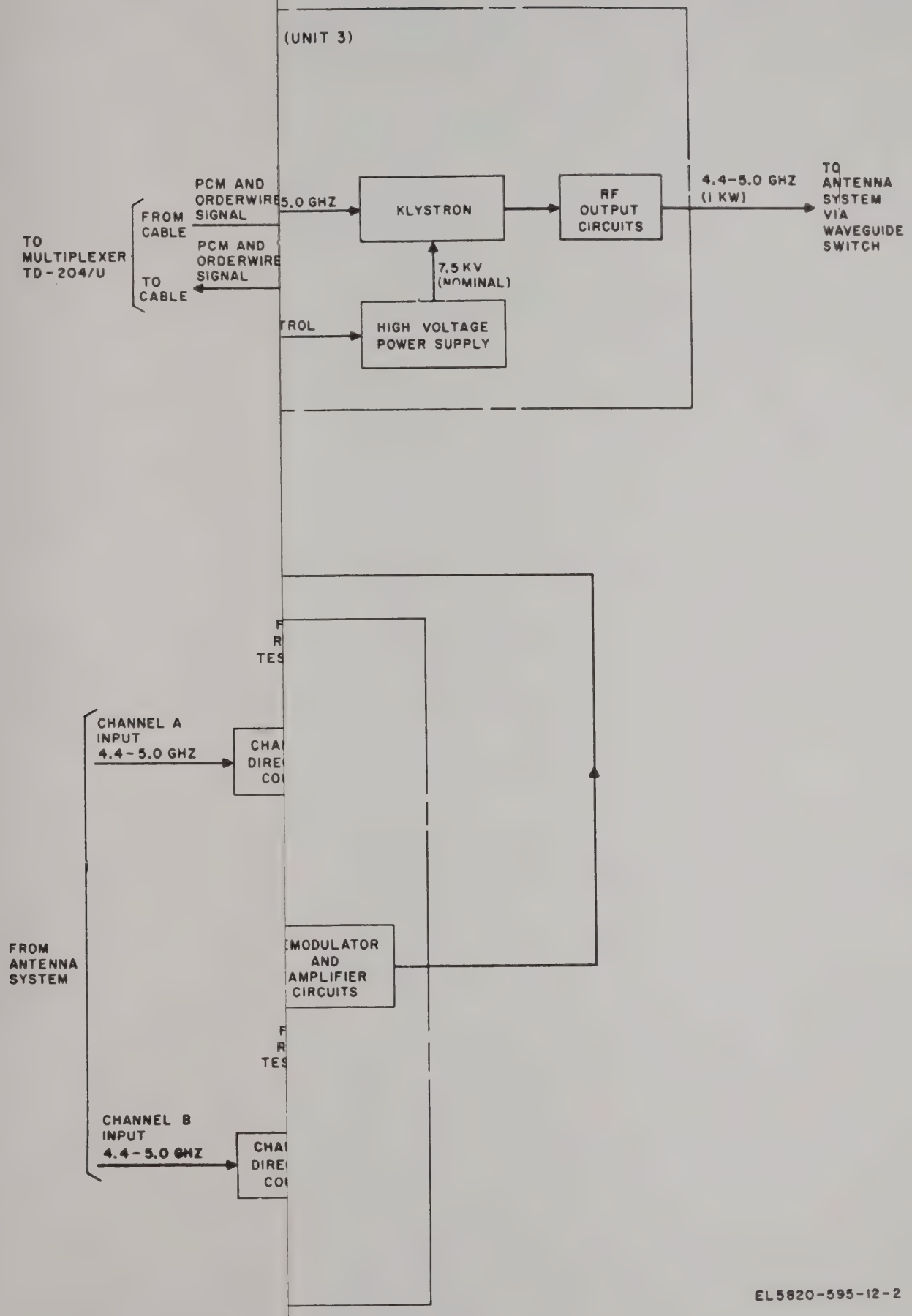
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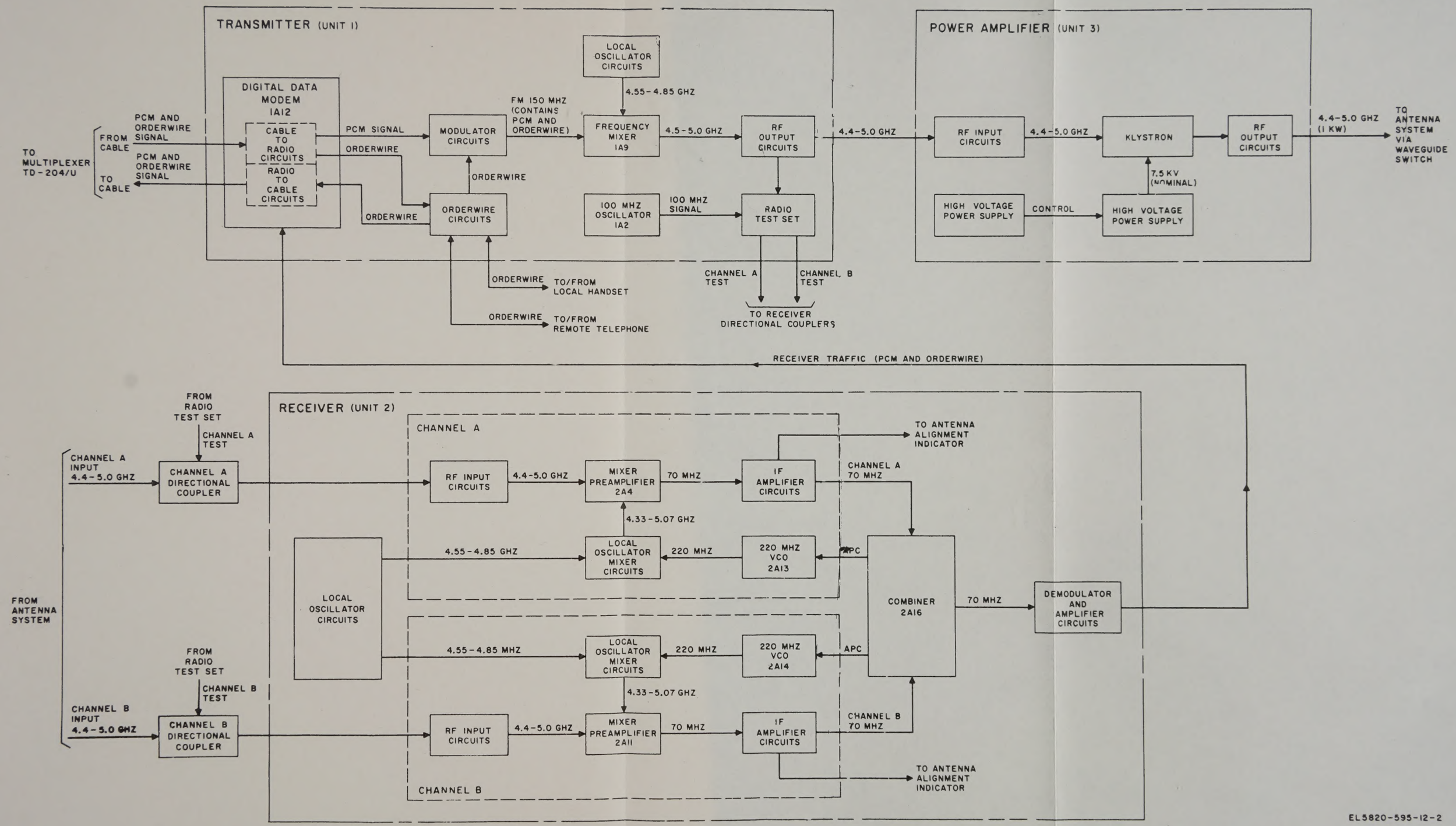


Figure 5-1. Block diagram functioning of radio set AN/GRC-143.

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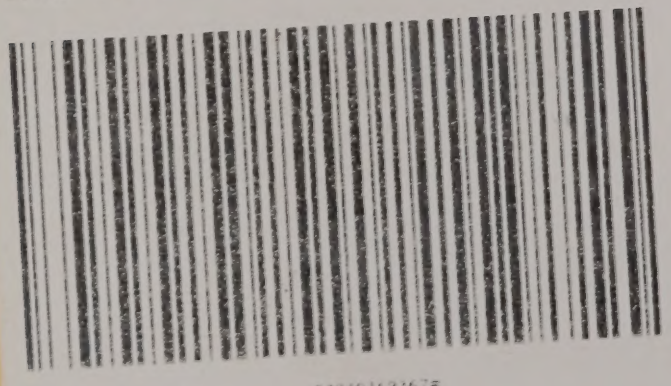
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