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TECHNICAL MANUAL

for

**RADIO TRANSMITTING SET
AN / FRT-24A**

DEPARTMENT OF THE NAVY

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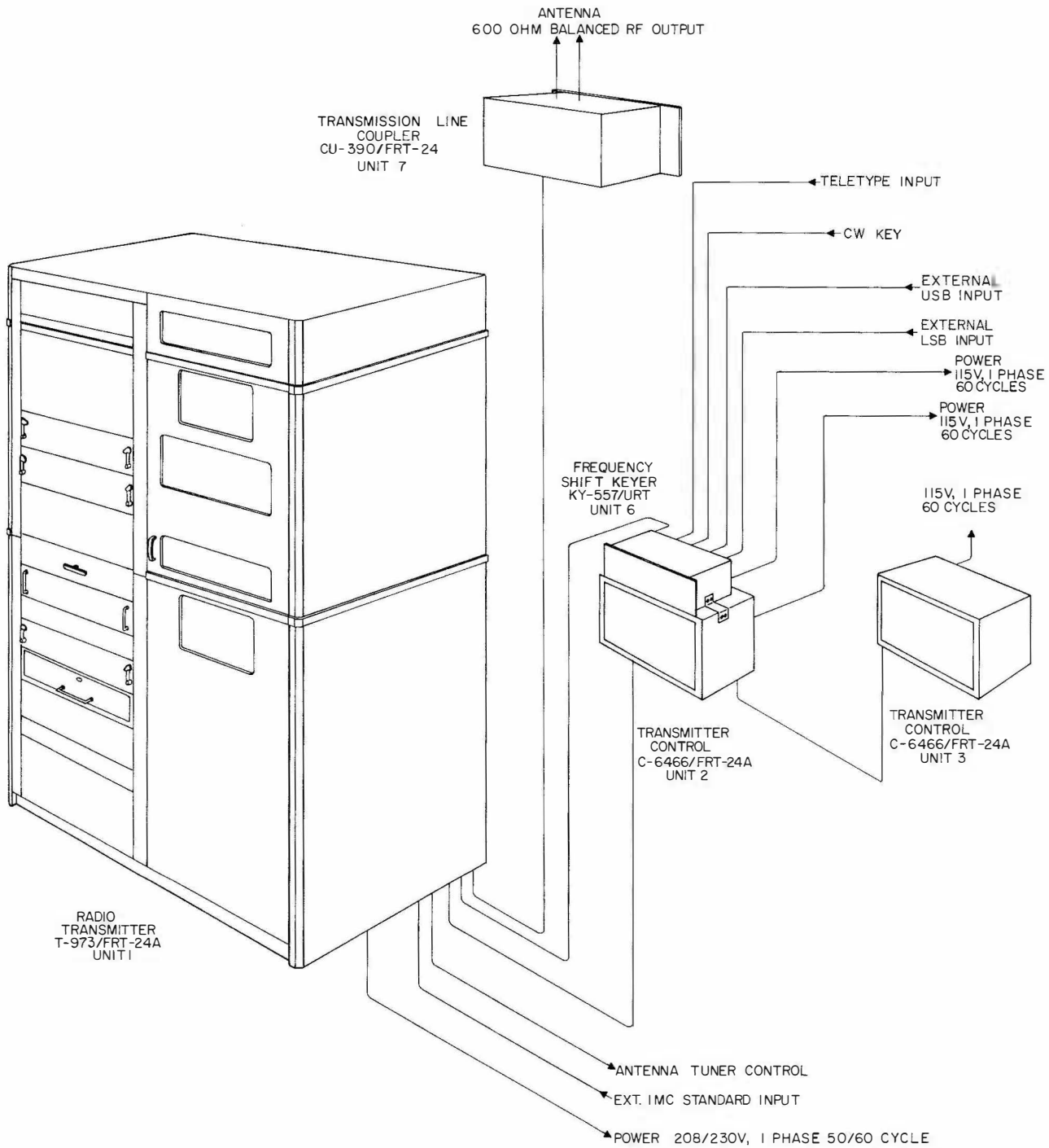


Figure 1-1. Radio Transmitting Set, AN/FRT-24A, Relationship of Units

SECTION I

GENERAL INFORMATION

1-1. SCOPE.

This Technical Manual is in effect upon receipt. Extracts from this publication may be made to facilitate the preparation of other Department of Defense publications.

1-2. GENERAL DESCRIPTION.

Radio Transmitting Set AN/FRT-24A (see figure 1-1) is a modification of Radio Transmitting Set AN/FRT-24 for single sideband operation. Radio Transmitting Set AN/FRT-24A (hereinafter called radio set) provides emission in the 2- to 30-MC frequency range tunable in 100-cycle steps for the following modes: A1 (continuous wave telegraphy), A3a (compatible AM telephony), A3b (two independent sidebands), A3j (single sideband suppressed carrier, selectable upper and lower sideband), and F1 (frequency shift keying). The radio set has independent sideband control and selectable carrier suppression which allow combinations of sideband transmission with a modulation passband of 300 to 3400 CPS. The radio set provides 1-kilowatt average output power in type A1 emission, 1-kilowatt peak-envelope-power (PEP) in types A3b, A3j, and F1 emission, and a 400-watt nominal carrier power in type A3a emission. The radio set is designed for remote automatic operation with manual overrides for local-manual or manual-automatic operation. Forced air cooling maintains normal operating temperatures. The 50-ohm transmitter output impedance of the radio set may be matched to a 300- to 600-ohm balanced antenna system by Transmission Line Coupler CU-390/FRT-24.

1-3. DESCRIPTION OF UNITS.

a. RADIO TRANSMITTER T-973/FRT-24A. Radio Transmitter T-973/FRT-24A (hereinafter called transmitter) is a single sideband transmitter which operates from a 208/230-volt, single-phase, 50/60-CPS power source. It has an average output power of 1000 watts in type A1 emission, 1000-watt peak-envelope-power (PEP) in types A3b, A3j, and F1 emission, and a 400-watt nominal carrier power in type A3a emission. The 2-to-30 MC frequency range of the transmitter is covered in eight bands. The transmitter is contained within two frame-type cabinets, which are bolted together. The dimensions of the combined cabinets are given in table 1-1. A description of each assembly in the transmitter is given in paragraphs 1-3a (1) through 1-3a (13).

ORIGINAL

(1) RF ASSEMBLY. — The RF assembly, located in the upper right-hand section of the transmitter, rests on telescoping roller slides. It is self-contained, consisting of a driver, an RF power amplifier, an RF bias supply, and an autotune system. The high voltage input enters the assembly through a plug located on the upper rear panel of the assembly and the low-voltage input, and control-circuit wiring enters through connectors located on the bottom of the assembly. The RF output wiring is mounted on the rear.

(2) LOW-VOLTAGE POWER SUPPLY. — The low-voltage power supply (hereinafter called LV supply) furnishes 600 VDC for the driver plate in the RF assembly. Connections are made to the RF assembly from a screw-type terminal strip mounted on the LV supply. The LV supply is located in the center of the right-hand cabinet and is bolted to a channel.

(3) HIGH-VOLTAGE POWER SUPPLY. — The high-voltage power supply (hereinafter called HV supply) furnishes 3000 VDC for the power amplifier plate in the RF assembly, and 630 VDC through dropping resistors located in the filter assembly and through zener diodes located in the RF assembly. The HV supply consists of three assemblies: a plate transformer, located below the LV supply, a rectifier assembly located above the LV supply and behind the power control assembly, and a filter assembly chassis, located behind the rectifier assembly. The plate transformer rests on channels in the cabinet framework. The rectifier assembly and filter assembly are bolted to channels in their section of the cabinet.

(4) POWER CONTROL ASSEMBLY. — The power control assembly (hereinafter called power control) controls the application of AC power to all power supplies. It also contains the local-remote and emission selector switches. All connections from the power control are made with plug-in connectors. The power control is located in front of the LV and HV supplies and above the blower assembly.

(5) DIAL CONTROL ASSEMBLY. — The dial control assembly (hereinafter called dial control) contains relays which control the autotune system, actuate the emission selector, and turn the transmitter on or off, according to pulse information from Transmitter Control C-6466/FRT-24A. The dial control is located in the left-hand cabinet, above and behind Audio Frequency Amplifier AM-4246/FRT-24A.

(6) SERVICE POWER SUPPLY. - The service power supply (hereinafter called service supply) distributes AC power to Power Supplies PP-4243/FRT-24A and PP-4242/FRT-24A. It also supplies 115 volts, 50-60 CPS, to an auxiliary outlet. The service supply is located in the left-hand cabinet behind Power Supply PP-4242/FRT-24A.

(7) PATCH PANEL ASSEMBLY. - The patch panel assembly (hereinafter called patch panel) connects Amplitude-Single Side-Band Converter CV-1846/FRT-24A to the RF assembly. It also provides a 50-ohm load for the converter and provides samples of the 2- to 30-MC and 1-MC outputs. It is located near the center of the left-hand cabinet, above Power Supply PP-4242/FRT-24A.

(8) ELECTRICAL FREQUENCY SYNTHESIZER O-1251/FRT-24A. - Electrical Frequency Synthesizer O-1251/FRT-24A (hereinafter called synthesizer) is an automatically tuned synthesizer which provides 10 preset output frequencies or one variable output frequency in the 17.75- to 35.60-MC range tunable in 100-cycle steps. The synthesizer obtains its stability (1 part in 10^8 per day) from a 1-MC crystal-controlled oscillator in Audio Frequency Amplifier AM-4246/FRT-24A. The synthesizer and its analog memory, which provides the 10 preset channels, is mounted in a tiltslide assembly in the left-hand cabinet relay rack, below Power Supply PP-4242/FRT-24A.

(9) POWER SUPPLY PP-4242/FRT-24A. Power Supply PP-4242/FRT-24A (hereinafter called synthesizer power supply) furnishes +180 VDC regulated, +28 VDC regulated, -24 VDC regulated, +12 VDC regulated, -12 VDC regulated, 28 VDC unregulated, 6.3 VDC filament voltage, and 115 VAC to the synthesizer. It is mounted in the left-hand cabinet relay rack, above the synthesizer.

(10) AUDIO FREQUENCY AMPLIFIER AM-4246/FRT-24A. - Audio Frequency Amplifier AM-4246/FRT-24A (hereinafter called amplifier) provides two independent audio channels which are fed to Amplitude-Single Side-Band Converter CV-1846/FRT-24A. Each channel can be supplied by an audio line or a microphone. The amplifier contains a phase detector circuit which can compare its internal 1-MC reference signal with an external 1-MC or 5-MC standard frequency. The amplifier is mounted in a tiltslide assembly in the left-hand cabinet relay rack, above Amplitude-Single Side-Band Converter CV-1846/FRT-24A.

(11) AMPLITUDE-SINGLE SIDE-BAND CONVERTER CV-1846/FRT-24A. - Amplitude-Single Side-Band Converter CV-1846/FRT-24A

(hereinafter called converter) is a single side-band converter which translates the two audio signals from the amplifier to RF signals in the 2- to 30-MC frequency range. The converter also receives a 17.75- to 35.60-MC RF carrier input, a 1750-KC IF input, and a 100-KC reference input from the synthesizer. It is tuned automatically with a mechanical override for manual tuning. The converter provides type A1, A3a, A3b, A3j, or F1 emission which is fed through the patch panel to the RF assembly. The converter is mounted in a tilt-slide assembly in the left-hand cabinet relay rack below the amplifier.

(12) POWER SUPPLY PP-4243/FRT-24A. - Power Supply PP-4243/FRT-24A (hereinafter called exciter power supply) furnishes +185 VDC unregulated, -30 VDC unregulated, -12 VDC unregulated, -10 VDC unregulated, and 115 VAC to the amplifier and converter. It is mounted in the left-hand cabinet relay rack below the synthesizer.

(13) CABINET ACCESSORIES. - Cabinet accessories include all parts that are attached to the transmitter frame, such as meters and interlock switches. Also included is the blower assembly, located in the bottom section of the right-hand cabinet, under the power control assembly.

b. TRANSMITTER CONTROL C-6466/FRT-24A. - Transmitter Control C-6466/FRT-24A (hereinafter called transmitter control) is a remote control for Radio Transmitter T-973/FRT-24A. Two identical control units are provided with the radio set. Their dimensions are given in table 1-1.

c. FREQUENCY SHIFT KEYS KY-557/URT. - Frequency Shift Keyer KY-557/URT (hereinafter called keyer) is a frequency shift keying unit that provides upper and lower side-band audio and FSK signals to the amplifier. The keyer receives upper and lower sideband audio from external phone lines, lower sideband audio from the transmitter control contact closures from a CW key line, and teletype data from a 20-MA or 60-MA teletypewriter key loop. The keyer provides two FSK outputs, one with a center frequency of 2000 CPS and the other with a center frequency of 2550 CPS. It also provides a 1-KC tone output upon closure of a CW key line. The output of the keyer is monitored on two front panel monitor meters. The dimensions of the keyer are given in table 1-1.

d. TRANSMISSION LINE COUPLER CU-390/FRT-24. - Transmission Line Coupler CU-390/FRT-24 (hereinafter called transmission line coupler) matches the 50-ohm unbalanced output of the transmitter to a 300- to 600-ohm balanced

antenna within the 2- to 30-MC frequency range. It is contained in a weatherproof aluminum case whose dimensions are given in table 1-1.

1-4. REFERENCE DATA.

a. FREQUENCY RANGE. - 2 to 30 MC.

b. TUNING BANDS.

BAND	RANGE (MC)
1	2 to 3
2	3 to 4
3	4 to 6
4	6 to 8
5	8 to 12
6	12 to 16
7	16 to 24
8	24 to 30

c. NUMBER OF CHANNELS. - 10.

d. TYPE OF FREQUENCY CONTROL. - Synthesized.

e. STABILITY. - 1 part in 10^8 per day.

f. TYPE OF EMISSION AND MODULATION CAPABILITY.

(1) A1 (telegraph without use of modulating audio frequency; CW).

(2) A3a (compatible AM telephony; upper sideband with carrier).

(3) A3b (two independent sidebands).

(4) A3j (single sideband suppressed carrier; selectable upper and lower sideband).

(5) F1 (frequency shift keying).

g. KEYING SPEED. - 50 words per minute.

h. TRANSMITTER OUTPUT POWER.

(1) A1: 1000 watts average into 50 ohms with maximum SWR of 3 to 1.

(2) A3a: 400 watts nominal carrier power into 50 ohms with maximum SWR of 3 to 1.

(3) A3b, A3j, and F1: 1000 watts peak-envelope-power (PEP) into 50 ohms with maximum SWR of 3 to 1.

ORIGINAL

i. PERCENT MODULATION. - 100%.

j. INTERMODULATION DISTORTION. - Third order intermodulation products attenuated 43 DB below one tone of two-tone test at 100 watts PEP for frequency range of 2 to 24 MC and attenuated 40 DB below one tone of two-tone test at 1000 watts PEP for frequency range of 24 to 30 MC.

k. CARRIER SUPPRESSION. - Adjustable from 0 DB to 50 DB below a 1000-cycle modulated single sideband output signal at 1000 watts.

l. UNWANTED SIDEBAND. - Suppressed 50 DB at 1000 watts PEP.

m. SPURIOUS EMISSION. - 50 DB below 1000 watts average power with singletone input.

n. HARMONIC RADIATION. - 50 DB below 1000 watts PEP with two-tone single sideband input.

o. OUTPUT SIGNAL-TO-HUM RATIO. - 50 DB below 1000 watts PEP.

p. NOISE.

(1) "Key down" with no input signal: 50 DB below 1000 watts PEP.

(2) "Key up" with no input signal: below -90 DB.

q. POWER OUTPUT DIVISION. - $\pm 5\%$ when operating with type A3b emission with equal power input to each sideband.

r. POWER AMPLIFIER BANDWIDTH. - 7 KC.

s. OUTPUT IMPEDANCE.

(1) Transmitter output impedance: 50 ohms unbalanced.

(2) Transmission line coupler output impedance: 300 to 600 ohms balanced.

t. DUTY CYCLE. - Continuous at full output throughout environmental range.

u. TRANSMITTER COOLING. - Forced air.

v. TRANSMITTER POWER FACTOR. - 0.92.

w. POWER SOURCE REQUIREMENTS.

Note

Radio Transmitter T-973/FRT-24A is initially wired for 208 VAC, 60 cycle, single phase operation. For 230 VAC operation refer to paragraph 2-2.

- (1) Voltage: 208/230 volts $\pm 10\%$.
- (2) Frequency: 50/60 CPS $\pm 5\%$.
- (3) Phase: one
- (4) Consumption:
 - (a) Standby: 1000 watts.
 - (b) Carrier on, CW: 4180 watts.
 - (c) Carrier on, SSB: 3560 watts.
 - (d) Carrier on, FSK: 3560 watts.

x. HEAT DISSIPATION. — 3180 watts maximum.

y. AMBIENT ENVIRONMENT.

- (1) Temperature: 0°C to $+50^{\circ}\text{C}$ ($+32^{\circ}\text{F}$ to $+122^{\circ}\text{F}$).
- (2) Humidity: 0% to 95% RH.
- (3) Elevation above sea level: 10,000 feet maximum.

1-5. EQUIPMENT SUPPLIED.

Equipment supplied with the radio set is listed in table 1-1. The list includes units, technical manuals, and accessories.

1-6. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED.

Equipment and publications required but not supplied with the radio set are listed in table 1-2. The list includes accessories, test equipment, and technical manuals.

1-7. FACTORY OR FIELD CHANGES.

No factory or field changes have been made to Radio Transmitting Set AN/ FRT-24A.

1-8. EQUIPMENT DIFFERENCES.

Radio Transmitting Set AN/FRT-24A is a modification of Radio Transmitting Set AN/FRT-24 for single sideband operation. The basic equipment differences between them are listed in table 1-3.

1-9. PREPARATION FOR RESHIPMENT.

If the original shipping crates are not available, the equipment should be packaged in shipping crates which conform to the dimensions of the equipment listed in table 1-1. Refer to Section 2 for guidance in repacking. If the equipment is packaged for overseas shipment, an outer barrier and dessicant bags must be included. Make certain that the entire radio set is protected against the elements. If it will be stored domestically, no outer barrier or dessicant bags are required. Before packaging, proceed as follows:

a. Remove the six tubes mentioned in paragraph 2-1b(3) and carefully pack them, with sufficient padding, in a separate carton. Remove B+ interlock pin, wrap in protective wadding, and secure to B+ interlock mounting bracket.

b. Check that all tubes, assemblies, sub-assemblies, and fuses are installed in the radio set and are properly seated in their sockets. Secure all doors, drawers, and latches.

c. Using two-by-four lumber, brace the chassis or assemblies that may be shaken in transit.

d. Construct a platform (skid) of sufficient strength to support the radio set. Use the platform as the base and build the crate around it.

e. Wrap technical manuals in a separate package and label package "TECHNICAL MANUALS INSIDE". Prepare a separate package of mounting hardware. Place the technical manual and hardware packages in one carton and label accordingly.

f. Include packing slip in shipping case listing all items packaged in each case.

Note

Stencil sufficient cautions on the crates that will make the carrier aware of the fragile nature of the equipment.

TABLE 1-1. EQUIPMENT SUPPLIED

QTY PER EQUIP	NOMENCLATURE		UNIT NO.	OVERALL DIMENSIONS (IN)			VOLUME (CU FT)	WEIGHT (LB)
	NAME	DESIGNATION		HEIGHT	WIDTH	DEPTH		
	Transmitting Set, Radio	AN/FRT-24A		-	-	-	-	-
1	Transmitter, Radio	T-973/FRT-24A	1	83	46.875	31.75	71.20	1500
2	Control, Transmitter	C-6466/FRT-24A	2, 3	10.875	21.125	11	1.46	50
1	Keyer, Frequency Shift	KY-557/URT	6	8	21	14	1.36	12.5
1	Coupler, Transmission Line	CU-390/FRT-24	7	20.125	23	20.25	5.75	90
2	Technical Manual for Radio Transmitting Set AN/FRT-24A	NAVSHIPS 0967 009 2010 thru 0907 009 2040	-	11.5	9.5	-	-	-
1	Maintenance Standards Book for Radio Trans- mitting Set AN/FRT-24A	NAVSHIPS 0967 009 2060	-	11.5	9.5	-	-	-
1	Synthesizer Frequency Calibration Book for Ra- dio Transmitting Sets AN/FRT-24A, AN/URT- 22 (XN-1), AN/URT-25 (XN-1)		-	9	12.75	-	-	-
1	Operating Instruction Chart for Radio Trans- mitting Set AN/FRT-24A	NAVSHIPS 0967 009 2050	-	11	8.5	-	-	-

* Includes mounting material

TABLE 1-2. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED

QTY PER EQUIP	NOMENCLATURE		REQUIRED USE	RADIO TRANSMITTING SET AN/FRT-24A EQUIPMENT CHARACTERISTICS
	NAME	DESIGNATION		
1	Telegraph Key		CW operation.	Keying speed: 50 words per minute.
1	Handset	H-169/U	Radio telephone operation.	Audio frequency response: 300 to 3400 CPS.
1	Headset	CW49507	Audio Monitoring.	
1	Electronics Installation and Maintenance Book	NAVSHIPS 900,000		
1	Handbook for Electronic Circuits	NAVSHIPS 900,000.102		
1	Handbook of Test Methods and Practices	NAVSHIPS 91828		
1	Electrical Dummy Load	DA-242/U	Dummy antenna for tuning, adjustments, and trouble shooting.	Power: Up to 1000 watts PEP; Impedance: 50 ohms, Frequency: 2 to 30 MC.
1	Instruction Book for Electrical Dummy Load DA-242/U			
1	Electronic Multimeter (VTVM)	AN/USM-116	Vacuum-tube voltmeter for trouble-shooting and maintenance procedures.	Voltages: 0 to 1000 VDC; Impedance 10 MEGO; Frequency: DC to 700 MC.
1	Instruction Book for Electronic Multimeter AN/USM-116	NAVSHIPS 93808		
1	RF Voltmeter (RF VTVM)	CCVO-91CA	RF vacuum tube voltmeter for trouble-shooting and maintenance procedures.	Voltages: 0.2 VRMS to 3 VRMS; Impedance: 10 MEGO; Frequencies: 100 KC to 50 MC.
1	Instruction Book for RF Voltmeter CCVO-91CA			
1	Multimeter (VOM)	AN/PSM-4	Volt-ohm meter for trouble-shooting and maintenance procedures.	Voltages: 6.3 VAC to 230 VAC, 6.3 VDC to 680 VDC.
1	Instruction Book for Multimeter AN/PSM-4			

TABLE 1-2. (Continued)

QTY PER EQUIP	NOMENCLATURE		REQUIRED USE	RADIO TRANSMITTING SET AN/FRT-24A EQUIPMENT CHARACTERISTICS
	NAME	DESIGNATION		
1	Heterodyne Frequency Meter	AN/URM-29	Precision frequency measurement for maintenance and alignment.	Frequencies: 250 KC to 18 MC.
1	Instruction Book for Heterodyne Frequency Meter AN/USM-29			
1	Oscilloscope	AN/USM-105A	Peak voltage measurements and waveform for analysis for maintenance and alignment.	Voltage calibration: 5% or better. Sweep speed: 1 USEC/CM or faster. Response: more than 30 MC.
1	Instruction Book for Oscilloscope AN/USM-105A	NAVSHIPS 93482A		
1	Electronic Counter with Converter	CAQI-524D with CAQI-525A	Precision frequency measurement for maintenance and alignment.	300-KC to 30 MC; accurate ± 1 count to 34 MC.
1	Instruction Book for Electronic Counter with Converter CAQI-524D/CAQI-525A			
1	Radio Test Set	AN/URM-134	Comprehensive spectrum analyzer for single sideband maintenance and adjustment procedure.	Frequencies: 2 MC to 30 MC.
1	Instruction Book for Radio Test Set AN/URM-134			
1	Audio Oscillator	TS-382A/U	Two-tone modulation test and audio filter bandpass measuring for maintenance and trouble shooting.	300 to 3000 CPS +8 DBM
1	Handbook Operation and Service Instructions for Audio Oscillator TS-382A/U	T.O. 16-35TS382-2		

TABLE 1-2. (Continued)

QTY PER EQUIP	NOMENCLATURE		REQUIRED USE	RADIO TRANSMITTING SET AN/FRT-24A EQUIPMENT CHARACTERISTICS
	NAME	DESIGNATION		
1	RF Signal Generator	AN/URM-25F	Signal substitution for trouble shooting and maintenance.	Frequencies: 1.860 MC to 50 MC. Voltages: 5 MVRMS to 1 VRMS.
1	Instruction Book for RF Signal Generator	NAVSHIPS 91283		
1	RF "Tee" Connector	UG-274A/U	Signal and load connection for trouble shooting and maintenance.	
1	50-ohm Dummy Load	XFR 4700-51	Dummy load for low-power RF outputs.	50-ohm impedance, 2 to 34 MC, 2 watts.
1	Adapter	UG-914/U	Test set-up adapter for trouble shooting and maintenance.	
1	Adapter	UG-491/U	Test set-up adapter for trouble shooting and maintenance.	
1	10-DB, 50-ohm Attenuator		Signal attenuator for trouble shooting and maintenance.	
1	Electron Tube Tester	TV-7D/U	Tube testing for trouble shooting and maintenance.	
1	Instruction Book for Electron Tube Tester TV-7D/U			
1	Transistor Test Set	TS-1100A/U	Transistor testing for trouble shooting and maintenance.	
1	Instruction Book for Transistor Test Set TS-1100A/U			
1	Frequency Standard	AN/URQ-9	External reference for trouble shooting and maintenance.	Frequency: 1-MC or 5-MC Level: 0.1 VRMS to 3 VRMS Stability: 1 part in 10^8 per day.
1	Instruction Book for Frequency Standard AN/URQ-9			

TABLE 1-3. EQUIPMENT DIFFERENCES

ITEM	AN/FRT-24	AN/FRT-24A
Emission	A1, A3	A1, A3a, A3b, A3j, and F1
Frequency Control	Crystal or stabilized oscillator	Automatically tuned synthesizer.
Preset Channels RF Assembly	Nine 1. Contains nine crystals; one for each channel. 2. Contains keyer assembly.	Ten 1. Does not contain crystals. Preset channels selected from synthesizer. 2. Does not contain keyer assembly.
Power Supply	Contains Power Supply PP-454/FRT-5.	Contains Power Supply PP-4243/FRT-24A.
Frequency Control	Contains RF Oscillator O-243/FRT-24.	Contains Electrical Frequency Synthesizer O-1251/FRT-24A.
Transmitter Control	Contains Transmitter Control C-1362/FRT-24.	Contains Transmitter C-6466/FRT-24A.
Reference Oscillator	In RF Oscillator O-243/FRT-24.	In Audio Frequency Amplifier AM-4246/FRT-24A.
Phase Detector	None	Phase detector contained in Audio Frequency Amplifier AM-4246/FRT-24A.
Power Change Assembly	Yes	None
Modulator	Audio chassis and modulation transformer and filter chassis	Amplitude-Single Side-Band Converter CV-1846/FRT-24A.
Keyer	Step up transmitter for phone and CW operation, part of RF assembly	None
FSK Unit	None	Frequency Shift Keyer KY-557/URT selects sidebands remotely for transmission.
Telephone Set	TA-267/U	H-169/U (Handset)



SECTION 2
INSTALLATION

2-1. UNPACKING AND HANDLING.

The radio set is shipped in two wooden crates and four corrugated cartons. The complete transmitter, except for six tubes, is packed in one crate and the transmission line coupler is packed in another crate. The keyer, the two transmitter control units, and the tubes are each packed in separate corrugated cartons.

a. TRANSMITTER. — Unpack the transmitter as follows:

(1) Place transmitter crate near location in which it is to be installed (refer to paragraph 2-3).

CAUTION

Prying off sides may result in damage. Use care.

(2) Remove nails from top, sides and ends of crate using a nail puller. Do not remove platform the transmitter rests on.

(3) If the transmitter has been packed for overseas shipment, slit waterproof barrier.

(4) Remove the four wooden cross-member stops from bottom platform.

CAUTION

Do not attempt to lift transmitter with hoist. Transmitter weighs nearly 2000 pounds.

(5) Place a forklift (with capacity of 1 ton or more) in front of transmitter. Adjust height to level of transmitter base.

WARNING

Use as much manpower as necessary (minimum 5 men) when performing the following steps.

(6) Use greased steel plates, slip plates under unit, then slide unit onto forklift, lower forks, and slide unit onto the floor. Steel plates should be at least 1/8-inch cold rolled steel and should be long enough both to fit under the unit and also to cover the forks.

An alternate means of removing the transmitter from the skid is to utilize a hoist and webbing. Pass two web straps (rated at 2000

pounds each) under the unit from front to rear. Route both straps to a hoisting ring approximately twelve inches above the unit. Rig another strap horizontally around the unit, over the two hoisting straps, not more than eighteen inches from the top and remove slack. Then hoist the unit from the skid and set in place.

CAUTION

Horizontal strap is necessary to prevent unit from tipping, as the unit is top heavy.

(7) Move transmitter into installation position, (refer to paragraphs 2-2, 2-3, and 2-4) lower forklift, and carefully walk transmitter off forklift.

(8) Remove side panels and right-rear panel of transmitter and carefully remove seven wooden blocking supports from inside transmitter.

(9) Remove all padding and bonding tape used to protect transmitter from damage during shipment. In cases of overseas shipment, remove bags of dessicant.

(10) Open door on right side of transmitter, turn LATCH RF UNIT OPEN-LOCK switch to OPEN and pull out RF assembly (see figure 2-8).

(11) To prevent damage, the high voltage interlock pin (P106, J106) located in the rear of the RF assembly, is not shipped assembled in its bracket. Remove high voltage interlock pin (wrapped in cellulose wadding) from high voltage interlock mounting bracket.

(12) Remove two nuts and star washer from rear of high voltage interlock pin, insert pin in its mounting board and secure with one nut.

(13) Place high voltage terminal lug over rear of high voltage interlock pin and secure with star washer and nut.

CAUTION

Check alignment of high voltage interlock pin before pushing RF assembly completely into cabinet.

(14) Inspect transmitter (see paragraph 2-7a).

(15) Replace right-rear panel of transmitter.

b. TUBES. — Unpack the tubes as follows:

- (1) Open top of corrugated carton.
- (2) If tubes have been packed for overseas shipment, slit waterproof barrier.
- (3) Remove cushioning from top of tubes and carefully remove tubes. The carton contains six tubes; one PL264, one PL177, two 4B32's, and two 3B28's.
- (4) Remove tubes from cellulose wadding and inspect for damage.
- (5) Open door on right side of transmitter, turn LATCH RF UNIT OPEN-LOCK switch to OPEN, and pull out RF assembly (see figure 2-8).
- (6) Open left side-panel of RF assembly and carefully insert tubes as follows:
 - (a) Remove four acorn nuts securing gray air director around socket marked V115. Lift out air director.

CAUTION

Be careful when inserting type PL264 tube in socket to avoid damage to the finger-like contacts. Do not place capacitor C249 electrode under strap. Strap lead must be located away from C249.

- (b) Remove strap from around tube and insert PL264 tube in socket. Place air director over tube and secure with four acorn nuts. Place strap over tube and insert the tube plate lead between strap and tube. Tighten strap.
- (c) PL177 tube in socket marked V114. Connect plate cap and tighten plate cap screw.
- (d) 4B32 tubes in HV supply rectifier assembly and connect plate caps (see figure 2-11).
- (e) 3B28 tubes in LV supply and connect plate caps (see figure 2-11).
- (7) Turn LATCH RF UNIT OPEN-LOCK switch to OPEN, push in RF assembly and turn switch to LOCK. Pull on RF assembly to make certain unit is secure.

c. TRANSMITTER CONTROL AND KEYS. — The radio set has two transmitter control units, one is to be located in the same area as the keyer. Unpack the transmitter control units and keyer as follows:

- (1) Open top of corrugated cartons.
- (2) If equipment has been packed for overseas shipment, slit waterproof barrier.

- (3) Remove cushioning from top and sides of equipment and carefully lift equipment out of cartons. In cases of overseas shipment remove bags of dessicant.

- (4) Inspect units (see paragraph 2-7a).

d. TRANSMISSION LINE COUPLER. — Unpack the transmission line coupler as follows:

- (1) Place crate near location in which it is to be installed.

CAUTION

Prying off sides may result in damage. Use care.

- (2) Remove nails from top, sides and ends of crate using nail puller.

- (3) If transmission line coupler has been packed for overseas shipment, slit waterproof barrier.

- (4) Remove transmission line coupler from crate and visually inspect for damage. In cases of overseas shipment, remove bags of dessicant.

2-2. POWER REQUIREMENTS. — The radio set requires the following power:

a. TRANSMITTER.

Note

The transmitter is initially wired for 208-VAC, 60-CPS, single-phase primary power. Refer to table 2-1 and figure 2-6 for transformer tap connections when primary power is other than 208 VAC. When primary power frequency is 50 CPS connect capacitor 1A10C404, located on HV supply filter in parallel with capacitor 1A10C401.

The transmitter requires 208- to 230-VAC $\pm 10\%$, 50- to 60-CPS, single-phase primary voltage (see figure 5-164). In the standby condition (filaments on) the transmitter consumes approximately 1000 watts. When the transmitter is on in the carrier CW, carrier phase (unmodulated), SSB carrier phone (100% modulated) or FSK modes, it consumes 4180 watts, 4180 watts, 3560 watts, and 4180 watts respectively.

b. TRANSMITTER CONTROLS. — Each transmitter control requires 115-VAC $\pm 10\%$, 50- to 60-CPS, single-phase primary voltage with 0.5 ampere drawn at 115 VAC (see figure 5-165).

TABLE 2-1. TRANSFORMER VOLTAGE CONNECTIONS

ASSEMBLY	TRANSFORMER REF DESIG	FOR PRIMARY VOLTAGE (AC)	USE TERMINALS
Amplifier 1A2	1A2A1A8T3	208	2 and 3
		230	1 and 3
Power Control 1A9	1A9T501 and 1A9T502	200	1 and 4
		210	1 and 5
		220	1 and 6
		230	1 and 7
		240	1 and 8
HV Supply 1A10 (See figure 2-6 for transformer con- figuration and ter- minal locations)	1A10T401	250	1 and 9
		198	2 and 3
		208	2 and 4
		217	2 and 5
		226	2 and 6
Service Supply 1A12	1A12T701	220	1 and 3
		230	1 and 4
		240	1 and 5
		250	1 and 6
		200	1 and 4
		210	1 and 5
		220	1 and 6
		230	1 and 7
		240	1 and 8
		250	1 and 9

c. **KEYER.** - The keyer requires a 115-VAC $\pm 10\%$, 50- to 60-CPS, single-phase primary voltage with 0.06 ampere drawn at 115 VAC (see figure 5-166).

2-3. **SITE SELECTION.**

The radio set site should be located to permit connections to the electrical power, ground, remote transmitter control equipment, and an antenna system. The conditions listed below should be provided. (See figures 2-2 through 2-5 for the dimensional requirements of the radio set.)

a. The transmitter must be deck mounted, so make certain that the deck construction will not be strained by the added weight of the transmitter.

b. Provide adequate ventilation and a supply of clean fresh air for efficient blower operation.

c. Provide sufficient space around the transmitter for servicing.

d. Locate the transmitter control units wherever convenient, but the distance to the transmitter must not be so great that the audio line has a loss of more than 25 DB or that the keyline loop resistance exceeds 1000 ohms. The keyer is normally located on top of one transmitter control unit, so the same site selection criteria apply.

e. The connecting cables to the transmitter control units must not be near high-current-carrying power lines.

f. Locate the transmission line coupler near the transmitter or the antenna, depending upon the installation.

2-4. INSTALLATION REQUIREMENTS.

a. PREPARATION FOR INSTALLATION. Before starting to install the radio set, refer to the latest Bureau of Ships installation plans. Methods of installation vary between stations, depending upon the station location. If the transmitter is received disassembled, do not assemble it until the transmitter cabinet is installed in place. Follow the requirements in paragraphs 2-5 and 2-6.

b. INSTALLATION. - Refer to figures 1-1 and 2-1 for a typical installation, and to figures 2-2 through 2-5 for dimensional outline

drawings. Conduit and wire for interconnecting the transmitter and its control units are not supplied with the equipment, run the conduit and wires in a trench. Refer to paragraph 2-5 and figure 5-162 for electrical interconnections to the transmitter cabinet.

Note

All external connections to transmitter are brought through the bottom of cabinet to terminal boards.

2-5. CABLE ASSEMBLIES.

a. WIRE SIZES. - Wire sizes for external connections in the radio set are listed in table 2-2.

TABLE 2-2. WIRE SIZES

CONNECTION	RECOMMENDED WIRE(S) *	NAVY TYPE DESIGNATION
Primary power source to terminal board 1A13TB651 on transmitter cabinet.	MW-C10(37)U-(9) MW-C10(37)U-(0)	
Remote keyline switch to terminal board 3TB903 on Transmitter Control C-6466/FRT-24A(Unit 3).	MW-C22(7)U-(4) MW-C22(7)U-(6)	
Terminal board 2TB901 on Transmitter Control C-6466/FRT-24A(Unit 2) to terminal board 3TB901 on Transmitter Control C-6466/FRT-24A(Unit 3).	MW-C22(7)U-(0) MW-C22(7)U-(6) MW-C22(7)U-(8) MW-C22(7)U-(91) MW-C22(7)U-(92) MW-C22(7)U-(95)	
Terminal board 2TB903 on Transmitter Control C-6466/FRT-24A(Unit 2) to terminal board 3TB903 on Transmitter C-6466/FRT-24A (Unit 3).	MW-C22(7)U-(1) MW-C22(7)U-(2) MW-C22(7)U-(4) MW-C22(7)U-(6)	
Terminal board 2TB901 on Transmitter Control C-6466/FRT-24A (Unit 2) to terminal board 6TB2 on Frequency Shift Keyer KY-557/URT (Unit 6).	MW-C22(7)SJ-(4) MW-C22(7)SJ-(5)	
Terminal board 6TB2 on Frequency Shift Keyer KY-557/URT (Unit 6) to terminal board 2TB903 on Transmitter Control C-6466/FRT-24A.	MW-C22(7)U-(1) MW-C22(7)U-(2)	

TABLE 2-2. (Continued)

CONNECTION	RECOMMENDED WIRE(S)*	NAVY TYPE DESIGNATION
Terminal board 2TB901 on Transmitter Control C-6466/FRT-24A (Unit 2) to terminal board 1A13TB603 on transmitter cabinet.	MW-C22(7)U-(6) MW-C22(7)U-(8) MW-C22(7)U-(9) MW-C22(7)U-(91) MW-C22(7)U-(92) MW-C22(7)U-(95)	
Terminal board 6TB1 on Frequency Shift Keyer KY-557/URT (Unit 6) to terminal board 1A13TB603 on transmitter cabinet.	MW-C22(7)SJ-(2) MW-C22(7)SJ-(3) MW-C22(7)SJ-(5) MW-C22(7)SJ-(7)	
Jack 1A13J616 on transmitter cabinet to jack 7J2001 on Transmission Line Coupler CU-390/FRT-24A(Unit 7).	RG-17A/U	
External reference source to jack 1A13J615 on transmitter cabinet.	RG-58A/U	
Antenna tuner control to terminal board 1A13TB603 on transmitter cabinet.	MW-C22(7)U-(2) MW-C22(7)U-(3) MW-C22(7)U-(4) MW-C22(7)U-(5)	
Remote terminal equipment to terminal board 6TB1 on Frequency Shift Keyer KY-557/URT (Unit 6).	MW-C22(7)SJ-(1) MW-C22(7)SJ-(4) MW-C22(7)SJ-(9) MW-C22(7)SJ-(0)	
TTY to terminal board 6TB2 on Frequency Shift Keyer KY-557/URT (Unit 6).	Multiconductor 2 wire AWG No. 20	

* MW - Type of wire (7) - Stranding
 C - Conductor material SJ - Construction
 22 - Conductor size (1) - Color Code
 Wire and Cable, Hookup, Electrical Insulated per MIL-W-76B

b. INSTALLATION OF CABLES. - Before installing the necessary cabling, refer to the latest Bureau of Ships installation plans.

(1) EXTERNAL CABLING AND CONNECTORS. - No external cabling or connectors are supplied. Refer to figure 5-162 for type of connectors required.

(2) CARE OF CABLES. - Run the cables so they will be protected from damage, being careful that they are never pressed against sharp edges and never subjected to excessive pressure or bends. Each cable should be mechanically supported at frequent points throughout its length.

c. EXTERNAL CONNECTIONS. - Refer to figure 2-1 for typical cable connections.

(1) PRIMARY POWER
CONNECTIONS.

Note

The transmitter is initially wired for 208-VAC, 60-CPS, single-phase primary power. Refer to table 2-1 and to figure 2-6 for transformer tap connections when primary power is other than 208 VAC. When primary power frequency is 50 CPS, connect capacitor 1A10C404, located on HV supply filter in parallel with capacitor 1A10C401.

Connect a 208/230-VAC 50/60-CPS line from the station distribution panel to terminal board 1A13TB651, which is mounted on the cabinet frame (see figure 5-162). This cable extends 3 feet into the transmitter cabinet. Connect the line cord of the keyer and transmitter control units to a 115-VAC, 60-CPS, single-phase primary power source.

(2) INPUT, OUTPUT, AND CONTROL CONNECTIONS. - The input, output, and control connections to the radio set must be fabricated from parts not supplied with the radio set. Refer to figure 5-162 for electrical interconnections and cable characteristics.

(3) GROUND CONNECTIONS. - Connect transmitter cabinet to a good ground system in the vicinity of the transmitter. These metal ground areas should be well-bonded together. Connect the base of the transmitter to as many places as is practicable, using wide copper straps bonded to the station ground system or other suitable ground. Do not use flexible copper braid.

2-6. INSTALLATION OF ASSEMBLIES REMOVED BEFORE SHIPMENT. - If the transmitter is shipped with each assembly in a separate box, assemble as described in the following paragraphs. However, if the transmitter is received completely assembled, continue to paragraph 2-7. Inspect all assemblies before installation as described in paragraph 2-7a.

a. RF ASSEMBLY. - Mount the RF assembly in the telescoping slide assembly of the right-hand relay rack of the transmitter cabinet as follows:

- (1) Pull out telescoping slides.

CAUTION

Three or four persons are required to lift RF assembly.

- (2) Lift RF assembly and insert into place on telescoping slides. The telescoping slides should fit into the channel on each side of the RF assembly. Before moving RF assembly into transmitter cabinet, hold LATCH RF UNIT OPEN-LOCK switch in OPEN and push RF assembly back and into transmitter cabinet.

- (3) Insert six flathead machine screws (supplied) through holes in top, front of RF assembly and through to each telescoping slide, then tighten screws.

- (4) Turn LATCH RF UNIT OPEN-LOCK switch to OPEN and pull out RF assembly until it locks in position.

- (5) Open left side-panel of RF assembly and install tubes removed for shipment. Installation procedures are described in paragraph 2-1b.

- (6) Engage connectors on rear of RF assembly. Refer to figure 5-163 for RF assembly connections.

- (7) Turn LATCH RF UNIT OPEN-LOCK switch to OPEN and push RF assembly into transmitter cabinet.

- (8) Check operations of RF assembly telescoping slide assembly. Check for abnormal interference or operation of cable return springs, making sure that cables are not pinched at any time.

b. HV SUPPLY. - The HV supply consists of a plate transformer, a filter assembly, and a rectifier assembly. Each assembly is mounted separately. See figures 2-9, and 2-11 for their locations. To install these assemblies follow the directions outlined below.

- (1) PLATE TRANSFORMER. - Mount the HV supply plate transformer in the lower rear section of the right-hand relay rack of the transmitter cabinet as follows:

CAUTION

Two or three persons are required to mount plate transformer.

- (a) Place plate transformer on angle brackets (see figures 2-9 and 2-11) with terminals 7, 8, and 9 facing the right side panel.

- (b) Secure plate transformer with four bolts, lockwashers and nuts supplied.

- (c) Refer to figure 5-163 for plate transformer interconnections.

- (2) FILTER ASSEMBLY. - Mount the HV supply filter assembly in the rear of the right-hand relay rack of the transmitter cabinet as follows:

- (a) Place assembly on angle bracket, beneath the RF assembly, with choke coils toward the rear (see figure 2-11).

- (b) Position assembly so that holes in angle brackets register with holes in bottom of assembly.

(c) Secure assembly with four phillips head machine screws, lockwashers, and nuts supplied.

(d) Refer to figure 5-163 for filter assembly interconnections.

(3) RECTIFIER ASSEMBLY. - Mount the HV supply rectifier assembly directly in front of the filter assembly.

(a) Place assembly on angle bracket, in front of filter assembly, with tubes toward front (see figure 2-11).

(b) Position assembly so that holes in angle brackets register with holes in bottom of assembly.

(c) Secure assembly with two phillips head machine screws, lockwashers, and nuts supplied.

(d) Refer to figure 5-163 for rectifier assembly interconnections.

c. LV SUPPLY. - Mount the LV supply in the right-hand relay rack of the transmitter cabinet directly above the HV supply plate transformer as follows:

(1) Place assembly on angle brackets above HV supply plate transformer with tubes toward the front (see figure 2-11).

(2) Position assembly so that holes in angle bracket register with holes in bottom of assembly.

(3) Secure assembly with four phillips head machine screws, lockwashers, and nuts supplied.

(4) Refer to figure 5-163 for LV supply assembly interconnections.

d. BLOWER. - The blower is already installed in the lower right-hand relay rack. Refer to figure 5-163 for blower interconnections.

e. POWER CONTROL. - The power control is already installed in the right-hand rack. Refer to figure 5-163 for power control interconnections.

f. DIAL CONTROL. - Mount the dial control in the rear of the left-hand relay rack of the transmitter cabinet above the amplifier as follows:

(1) Place dial control on angle brackets with relays toward the front (see figure 2-10).

(2) Position dial control so that holes in angle brackets register with holes in bottom of assembly.

(3) Secure dial control with four phillips head machine screws, lockwashers, and nuts supplied.

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(4) Refer to figure 5-163 for dial control interconnections.

g. SERVICE SUPPLY. - Mount the service supply in the rear of left-hand relay rack of the transmitter cabinet as follows:

(1) Position service supply so that holes in rear upright corner supports of the cabinet register with holes in supply (see figure 2-10).

(2) Secure supply with four phillips head machine screws, star lockwashers, and nuts supplied.

(3) Refer to figure 5-163 for service supply interconnections.

h. POWER SUPPLY PP-4243/FRT-24A. Mount the exciter power supply in the bottom of the left-hand relay rack of the transmitter cabinet as follows:

(1) Slide exciter power supply into transmitter cabinets slide assembly (see figure 2-11).

(2) Secure front panel of exciter power supply to slide assembly with four phillips head machine screws, flat washers, and lockwashers supplied.

(3) Refer to figure 5-163 for exciter power supply interconnections.

i. ELECTRICAL FREQUENCY SYNTHESIZER. O-1251/FRT-24A. - Mount the synthesizer in the bottom of the slide assembly in left-hand relay rack of the transmitter cabinet as follows:

(1) Place synthesizer on workbench and solidly secure case.

CAUTION

Do not allow analog memory section of synthesizer (hinged portion) to swing loose during installation. Tighten screws in rear.

(2) Press PUSH TO UNLOCK button on each handle and carefully slide synthesizer out of case until it locks in position.

(3) Pull tilt latch on each side of front panel and swing synthesizer to vertical position for access to rear panel.

(4) Disconnect all power and RF connectors from rear panel jacks and tag for identification.

(5) Remove cable clamp and spring retractor from rear panel.

(6) Pull tilt latch on each side of front panel and swing synthesizer so that front panel faces up.

Note

Do not lose teflon washers when performing next step.

(7) Remove pivot screw on slide at each side of synthesizer and carefully lift synthesizer, separating it from tilt-slide assembly. Set synthesizer aside on workbench.

(8) Push the rectangular locking bar on the outside of each slide and push in slides.

(9) Turn "Tee" handle on transmitter slide assembly and pull out slide assembly.

(10) Place case in slide assembly as shown in figure 2-10.

(11) Place one each thin rectangular spacer (supplied) in each corner between the front of the four case mounting rails and the transmitter slide assembly and secure each with two screws supplied. Insert screws from inside of transmitter slide assembly.

(12) Place one each thick rectangular spacer (supplied) in each corner between the rear of the four case mounting rails and the transmitter slide assembly and secure with two screws (supplied).

(13) Push transmitter slide assembly back into transmitter cabinet and turn "TEE" handle.

(14) Pull out case tilt-slides until they lock in position.

(15) Hold synthesizer in vertical position, front panel up, and place on tilt-slide assembly.

(16) Place each of two teflon washers between tilt-slide assembly pivot-screw hole and synthesizer. Then place pivot screw in each side of tilt-slide assembly and tighten. If pivot screw does not go in all the way, shift synthesizer slightly and then tighten screw.

(17) Pull tilt latch on each side of front panel and swing synthesizer so that front panel faces down.

(18) Connect power and RF connectors to rear panel jacks and secure cable clamp and spring retractor.

(19) Pull tilt latch on each side of front panel and swing synthesizer to horizontal position.

(20) Press PUSH TO RETRACT button on each handle and carefully slide synthesizer in case.

(21) Check operation of synthesizer in tilt-slide assembly by placing it on each of its positions. Check for abnormal interference or operation of cable retractor, making certain that cables are not pinched at any time. Check that synthesizer locks in the extended position of tilt-slide assembly.

(22) Refer to figure 5-163 for synthesizer interconnections.

j. POWER SUPPLY PP-4242/FRT-24A. Mount the synthesizer power supply in the bottom of the left-hand relay rack of the transmitter cabinet as follows:

(1) Slide synthesizer power supply into transmitter cabinet slide assembly (see figure 2-11). Make certain the guide pins on the rear panel mate with the guide pin receptacles in the slide assembly.

(2) Secure front panel of synthesizer power supply to slide assembly with four screws and lockwashers supplied.

(3) Refer to figure 5-163 for synthesizer power supply interconnections.

k. AMPLITUDE-SINGLE SIDE-BAND CONVERTER CV-1846/FRT-24A. - Mount the converter in the top of the left-hand relay rack of the transmitter cabinet as follows:

(1) Procedures for removing the converter from its case are similar to the steps outlined in paragraphs 2-6i(1) through 2-6i(8).

(2) After removal place case in relay rack above patch panel as shown in figure 2-10.

(3) From the inside of the case insert four flat-head screws and washers (supplied) through the holes containing sleeve spacers and tighten screws into tapped holes in vertical support brackets of transmitter cabinet.

(4) Refer to paragraphs 2-6i(14) through 2-6i(21) to replace converter in case.

(5) Refer to figure 5-163 for converter interconnections.

l. AUDIO FREQUENCY AMPLIFIER AM-4246/FRT-24A. - Mount the amplifier in the top of the left-hand relay rack of the transmitter cabinet as follows:

(1) Procedures for removing the amplifier from its case are similar to the steps outlined in paragraphs 2-6i(1) through 2-6i(8).

(2) After removal, place case in relay rack, above converter, as shown in figure 2-10.

(3) Follow the procedure outlined in paragraph 2-6k(3) for securing amplifier.

(4) Refer to paragraphs 2-6i(14) through 2-6i(21) to replace amplifier in case.

(5) Refer to figure 5-163 for amplifier interconnections.

m. PATCH PANEL. The patch panel is already installed. Refer to figure 5-163 for patch panel interconnections.

2-7. INSPECTION AND ADJUSTMENT.

a. INSPECTION. - Inspect the equipment for possible damage or disarrangement during shipping. Check to see that screws and nuts are tight and that nuts, washers, bits of solder, or other foreign particles have not become lodged where they might cause a short circuit. Make a careful search for broken wires and loose connections. Operate all mechanical controls in each position or through their full range of travel to select any bent shafts or other abnormal indications.

b. PRELIMINARY CHECKS AND CONTROL SETTINGS. - Before applying primary power to the equipment, check that all interconnections have been made in accordance with figure 5-163 and that all doors and interlock switches are closed and equipment is properly grounded. Set controls as indicated in table 2-3.

WARNING

Voltages as high as 3000 volts exist in the radio set. Observe safety regulations at all times.

c. TRANSMITTER CHECK. - Energize transmitter as follows:

CAUTION

Before energizing transmitter for first time, make sure that power line and antenna are properly connected, and equipment is properly grounded.

(1) FILAMENT, TIME DELAY AND BLOWER CHECK. - To check the filaments, time delay and blower circuits, proceed as follows:

(a) Set PRIMARY CIRCUIT BREAKER to ON.

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(b) Pull out FILAMENT switch. This turns on FILAMENT lamp and all rectifier and tube filaments, and the blower starts. PRIMARY VOLTAGE meter should indicate amplitude of primary voltage.

(c) Pull out PLATE switch. After a delay of 4-1/2 minutes, PLATE lamp should light.

(d) If this delay is more, or less, than 4-1/2 minutes $\pm 1/2$ minute, adjust TIME DELAY as described in section 5.

(2) RF ASSEMBLY CHECK. - Check the RF assembly as follows:

(a) Turn LV-TUNE-OPERATE switch to TUNE position. Listen for closing contacts of high-voltage plate relay.

(b) Check PLATE VOLTAGE and PA FIL VX10 meter readings against readings given in table 3-11.

(c) Turn LV-TUNE OPERATE switch to LV.

(3) AUTOTUNE SYNCHRONIZATION CHECK. - Check autotune synchronization as follows:

(a) Turn CHANNELSELECTOR switch on RF assembly to channel 1 position.

(b) Loosen locking keys on all autotune control knobs.

(c) Set autotune controls to center of mechanical range and secure locking keys.

(d) Record position of each autotune control.

(e) Turn CHANNELSELECTOR switch to channel 2.

(f) Wait until autotune stops turning then turn CHANNEL SELECTOR switch back to channel 1 and note position of autotune control knobs. A deviation of ± 2 divisions from those recorded in step (d) is permissible. If a reading(s) is incorrect, refer to Section 4 for trouble shooting and to Section 5 for maintenance.

(4) SYNTHESIZER POWERSUPPLY CHECK. - Check synthesizer power supply as follows:

(a) Set ON-OFF switch to ON position; POWER and FIL lamps should light.

TABLE 2-3. PRELIMINARY CONTROL SETTINGS

UNIT	CONTROL	POSITION
Power Control	PRIMARY CIRCUIT BREAKER PLATE switch FILAMENT switch LOCAL-REMOTE switch SSB-CW-AM LOCAL switch	OFF Push to off Push to off LOCAL CW
RF Assembly	CHANNEL SELECTOR switch BAND SWITCH LV-TUNE-OPERATE switch TEST KEY switch EXCITER TUNING control DRIVER PLATE TUNING control P.A. PLATE TUNING control P.A. LOADING control LOADING COIL SWITCH Multimeter switch POWER FORWARD-REVERSE switch APC switch PPC control	1 1 LV Neutral (center) 50 50 50 50 1 DR PLATE MA x 100 FORWARD OFF Fully Counterclock- wise
Synthesizer Power Supply	ON-OFF switch	OFF
Synthesizer	Band switch MANUAL SETTING digital switches SERVO MODE switch TEST METER switch MOTOR DRIVE ON switch	A 25.8500 AUTO REF MONITOR OFF
Exciter Power Supply	ON-OFF switch 115V - 230V (rear)	OFF 230V
Converter	BAND SWITCH RF GAIN control SSB CARRIER INSERT control METER switch	2-4 Fully counterclock- wise but not in PRESET SUPPR CARRIER +180V
Amplifier	LSB LINE LEVEL control USB LINE LEVEL control MIKE LEVEL control REF SEL switch	Counterclockwise Counterclockwise Counterclockwise INT REF ONLY
Transmitter Control	ON-OFF, switch INPUT-OUTPUT switch AUDIO GAIN control	OFF OUTPUT Counterclockwise
Keyer	ON-OFF switch KEYLINE INVERTER switch(rear) SENSE INVERTER switch (rear) MODE switch TEST switch TONE SUPPR FUNCTION, LSB FUNCTION, USB	OFF NORM NORM OFF LINE OFF OFF OFF

TABLE 2-3. (Continued)

UNIT	CONTROL	POSITION
Patch Panel	Connect patch cable between EXCITER OUTPUT jack and PA 1st AMPL INPUT jack	

(b) Observe front-panel blown fuse indicators. If a blown fuse indicator is lighted, check applicable fuse, refer to paragraph 3-6d(2) and table 3-17.

(c) Using Electronic Multimeter AN/USM-116, measure voltages at front-panel test points (refer to paragraph 4-10b). If test results are unsatisfactory, refer to Section 4 for trouble shooting and Section 5 for maintenance.

(5) SYNTHESIZER CHECK. — Check the synthesizer as follows:

(a) Start synthesizer as described in paragraph 3-3c(1) but leave LV-TUNE-OPERATE switch in LV position.

(b) Program synthesizer analog memory as described in paragraph 3-3b(1).

(c) Tune synthesizer manually as described in paragraphs 3-5a(2) through 3-5a(13).

(d) Turn synthesizer TEST METER switch to each position and check readings with those in table 3-12. If readings are incorrect refer to Section 4 for trouble shooting and Section 5 for maintenance.

(e) Turn SERVO MODE switch to AUTOTUNE.

(f) Turn MOTOR DRIVE ON switch to ON.

(g) Turn CHANNEL SELECTOR switch on RF assembly to an operating channel.

(h) Turn synthesizer TEST METER switch to each position and check readings with those in table 3-12.

(6) EXCITER POWER SUPPLY CHECK. — Check exciter power supply as follows:

(a) Set ON-OFF switch to ON position; POWER lamp should light.

(b) Turn voltage selector switch to each position and check readings with those in table 3-15. If readings are incorrect refer to Section 4 for trouble shooting and Section 5 for maintenance.

(7) AMPLIFIER CHECK. — Check the amplifier as follows:

(a) Turn SSB-CW-AM LOCAL switch to SSB.

(b) Connect Handset H-169/U to front-panel MIKE jack.

(c) Turn LSB and USB selector switches to MIKE positions.

(d) Operate press-to-talk switch on handset and speak into transmitter. While speaking, turn MIKE LEVEL control for approximately a red line reading on LSB LEVEL and USB LEVEL meters.

(e) Turn REF SEL switch to each position and check readings with those in table 3-13. If test results are unsatisfactory, refer to Section 4 for trouble shooting and Section 5 for maintenance.

(8) CONVERTER CHECK. — Check the converter as follows:

(a) Start converter as described in paragraph 3-3c(1) but leave LV-TUNE-OPERATE switch in LV position.

(b) Turn converter METER SWITCH to each position and check readings with those in table 3-14. If readings are incorrect refer to Section 4 for trouble shooting and Section 5 for maintenance.

(c) Tune converter automatically as described in paragraph 3-3c(5).

(d) Turn converter METER SWITCH to each position and check readings with those in table 3-14. If readings are incorrect refer to Section 4 for trouble shooting and Section 5 for maintenance.

(9) TRANSMITTER OPERATIONAL CHECK. — Place transmitter in full operation as described in paragraphs 3-3b(2) through 3-3b(2)(a) and table 3-4.

d. TRANSMITTER CONTROL CHECK.- The checks for remote operation are the same as for local operation, except that the LOCAL-REMOTE switch is placed in REMOTE position after completing the tests for local operation. The following checks are necessary:

(1) GENERAL. - Make sure that transmitter control units and keyer are properly connected (see figure 5-166).

(2) CONTROL CHECK. - Check transmitter control units as follows:

(a) Set ON-OFF switch to ON; POWER lamp should light.

(b) Dial any number on EMIS-SION AND CHANNEL SELECTOR dial. Transmitter should set up for single sideband operation (A7 MODE lamp on amplifier should light) and automatically tune to channel dialed (applicable CHANNEL MEGACYCLES lamp on synthesizer should light). Filaments in RF assembly should energize and HV and LV supplies should energize. The CHANNEL meter should indicate channel dialed and A7-SSB lamp should light.

(c) Dial 2. Transmitter should set up on second channel, CHANNEL meter should indicate 2 and A7-SSB lamp should light.

(d) Dial A1. Transmitter should remain on channel 2, A7 MODE lamp on amplifier

should go out and A1 MODE lamp should light, A7-SSB lamp on transmitter control should go out and A1-CW lamp should light.

(e) Dial A3. Transmitter should remain on channel 2, A1 MODE lamp on amplifier should go out and A3 MODE lamp should light, A1-CW lamp on transmitter control should go out and A3-AM lamp should light.

(f) Dial 3. Transmitter should set up on third channel, CHANNEL meter should indicate 3, A3-AM lamp should go out and A7-SSB lamp should light. A3 MODE lamp on amplifier should go out and A7 MODE lamp should light.

(g) Dial A9 High voltage to transmitter should turn off and place transmitter in standby.

(h) Dial A0. Filaments in RF assembly should turn off and disable transmitter.

2-8. INTERFERENCE REDUCTION. - To reduce interference, the assemblies containing radio frequencies are shielded. If trouble shooting or maintenance requires the removal of the shields, they should be replaced properly after maintenance is completed. Failure to do this will result in RF leaks, which can cause harmonic interference.

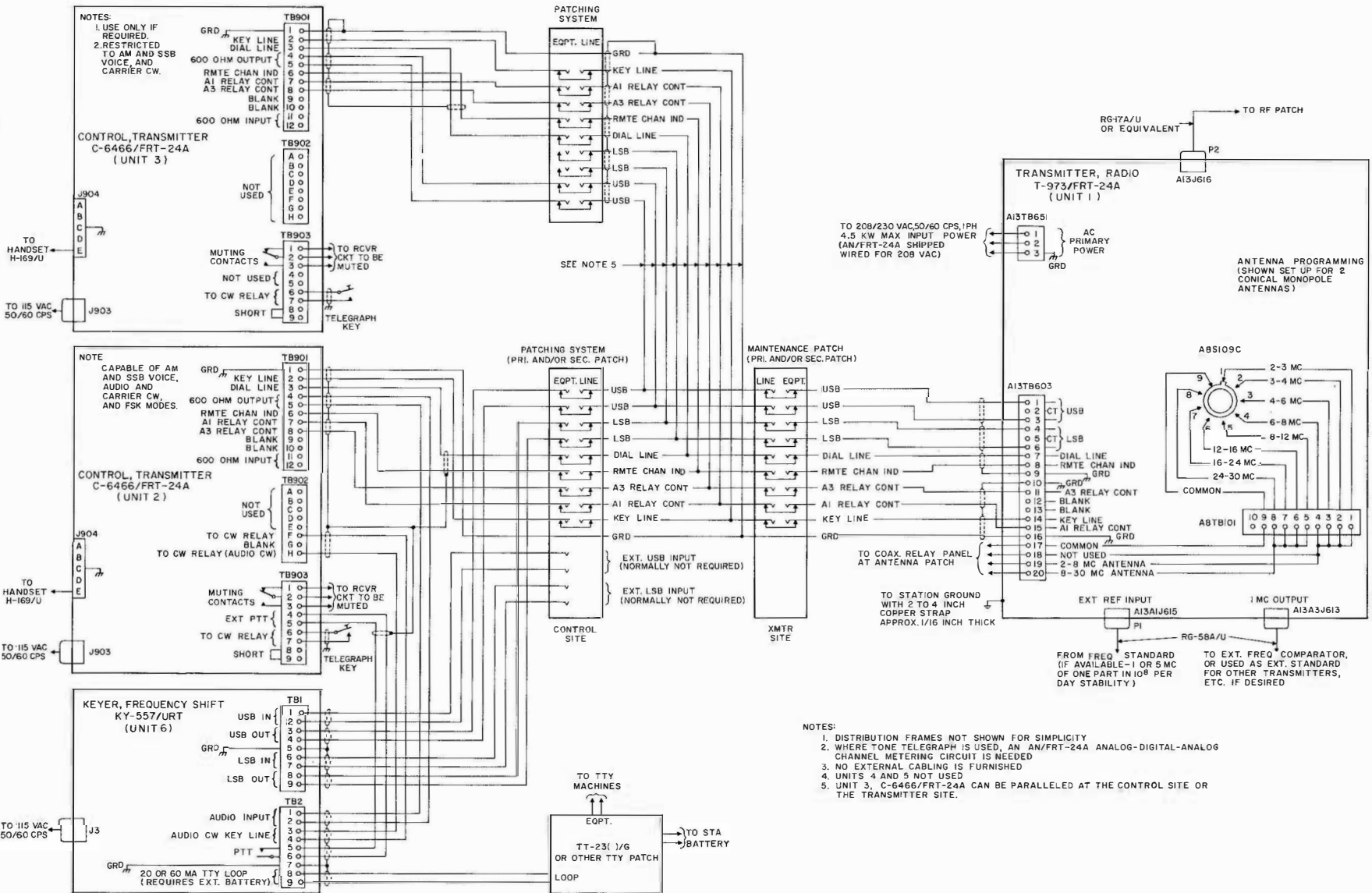
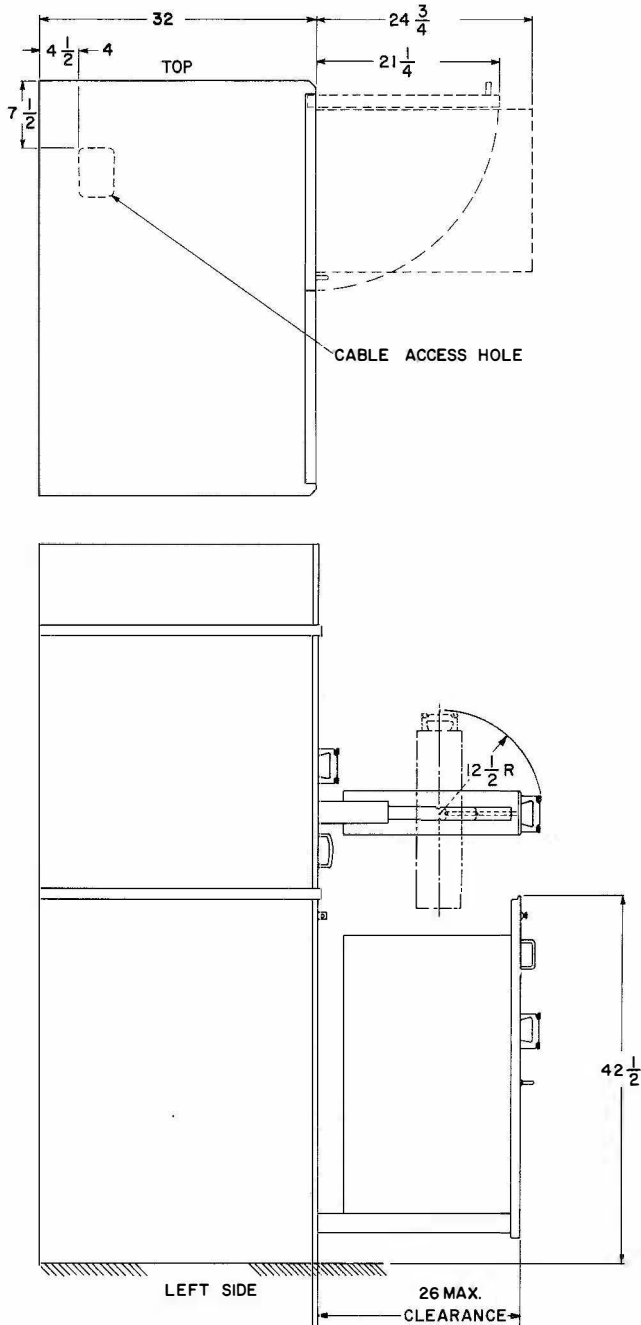


Figure 2-1. Radio Transmitting Set AN/FRT-24A, Typical Installation Drawing



NOTES:

1. ALL DIMENSIONS IN INCHES.
2. HEAT DISSIPATION 3180 WATTS MAX.
3. AMBIENT TEMPERATURE DESIGN 0°C TO +50°C.
4. AMBIENT HUMIDITY DESIGN 0% TO 95% RH.
5. ASSEMBLY DESCRIPTION
 - IA1 - CONTROL, DIAL
 - IA2 - AMPLIFIER, AUDIO FREQUENCY (AM-4246/FRT-24A)
 - IA3 - CONVERTER, AMPLITUDE SSB (CV-1846/FRT-24A)
 - IA4 - POWER SUPPLY (PP-4242/FRT-24A)
 - IA5/IA6 - SYNTHESIZER (MEMORY) ELECTRICAL FREQ (O-1251/FRT-24A)
 - IA7 - POWER SUPPLY (PP-4243/FRT-24A)
 - IA8 - AMPLIFIER, RF
 - IA9 - CONTROL, POWER
 - IA10 - POWER SUPPLY, H V
 - IA11 - POWER SUPPLY, L V
 - IA12 - POWER SUPPLY, SERVICE
 - IA13 - CABINET, ELECTRICAL EQUIPMENT

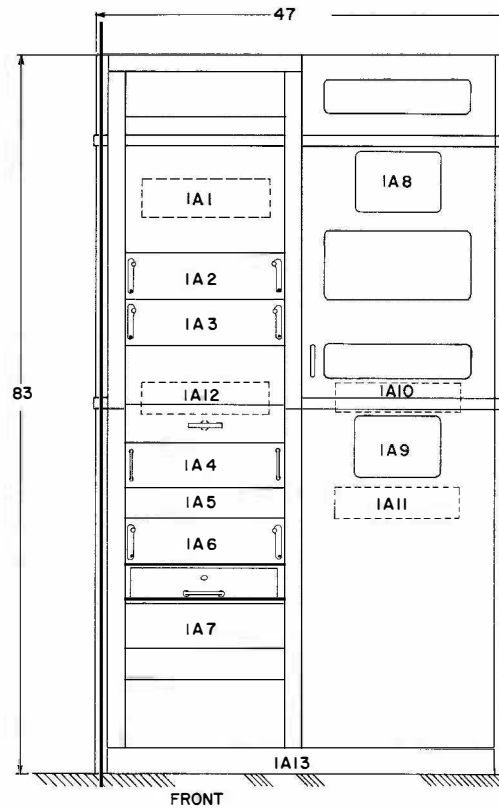
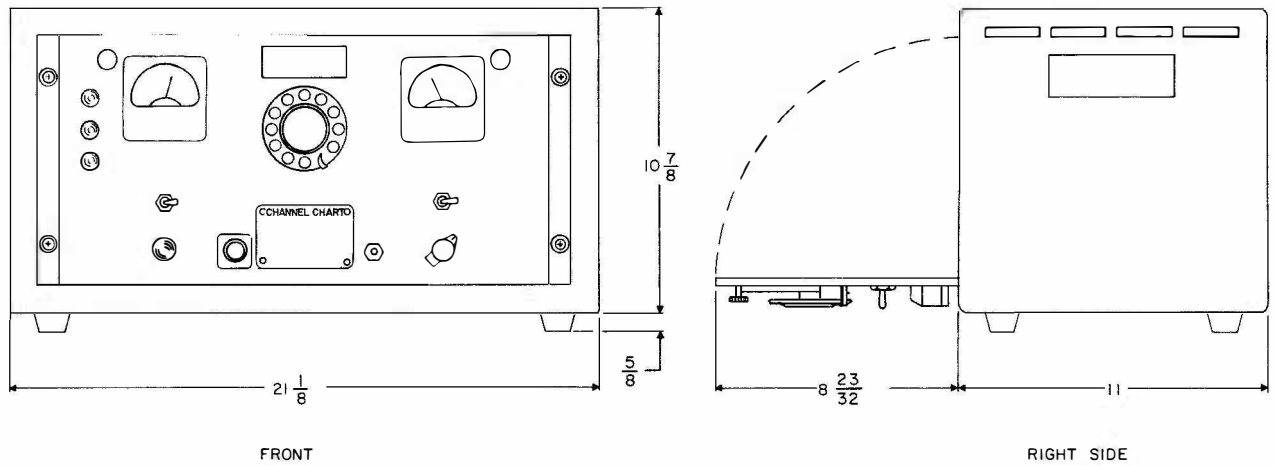
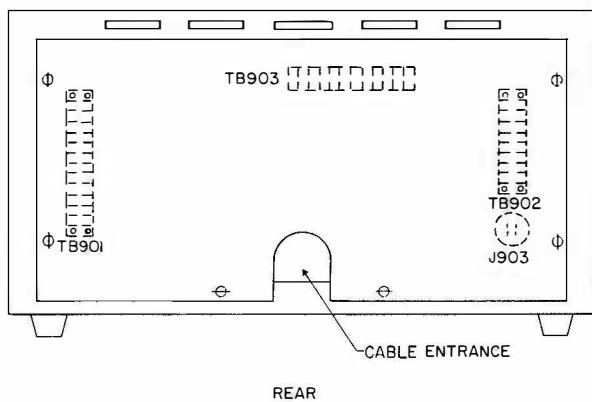


Figure 2-2. Radio Transmitter T-973/FRT-24A, Outline Drawing



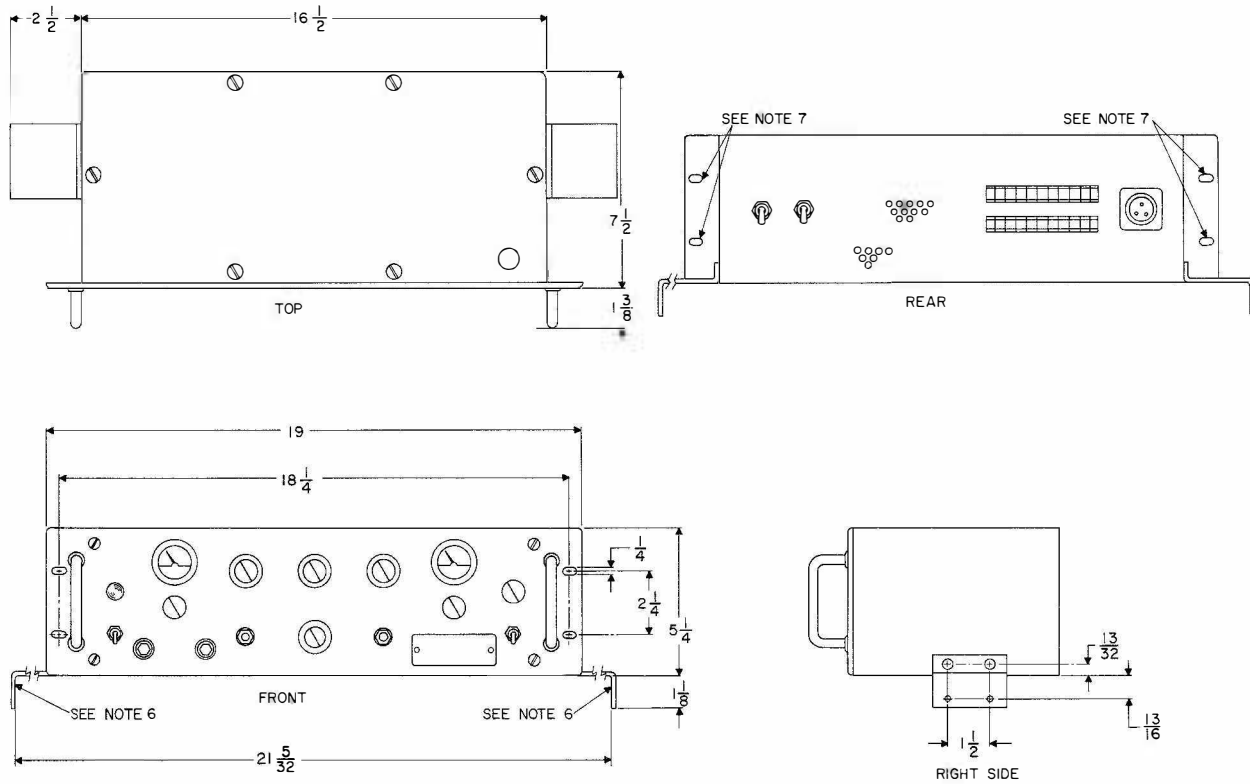
NOTES:

1. ALL DIMENSIONS IN INCHES.
2. HEAT DISSIPATION 46 WATTS.
3. AMBIENT TEMPERATURE DESIGN 0°C TO +50°C.
4. AMBIENT HUMIDITY DESIGN 0% TO 95% RH.
5. ALLOW 4 INCH CLEARANCE AROUND UNIT IN ALL DIRECTIONS FOR MOVEMENT.
6. DASHED LINES DEPICT COMPONENTS BENEATH REAR COVER.



156-007914

Figure 2-3. Transmitter Control C-6466/FRT-24A, Outline Drawing



NOTES:

1. ALL DIMENSIONS IN INCHES.
2. HEAT DISSIPATION 8 WATTS.
3. AMBIENT TEMPERATURE DESIGN 0°C TO $+50^{\circ}\text{C}$.
4. AMBIENT HUMIDITY DESIGN 0% TO 95% RH.
5. ALLOW SUFFICIENT CLEARANCE AT REAR OF UNIT FOR CABLE CONNECTIONS AND SWITCH OPERATION.
6. BRACKETS USED WHEN MOUNTING KEYS ON TOP OF TRANSMITTER CONTROL C-6466/FRT-24A.
7. MOUNTING HOLES FOR STANDARD 19 INCH RACK INSTALLATION.

Figure 2-4. Frequency Shift Keyer KY-557/URT, Outline Drawing

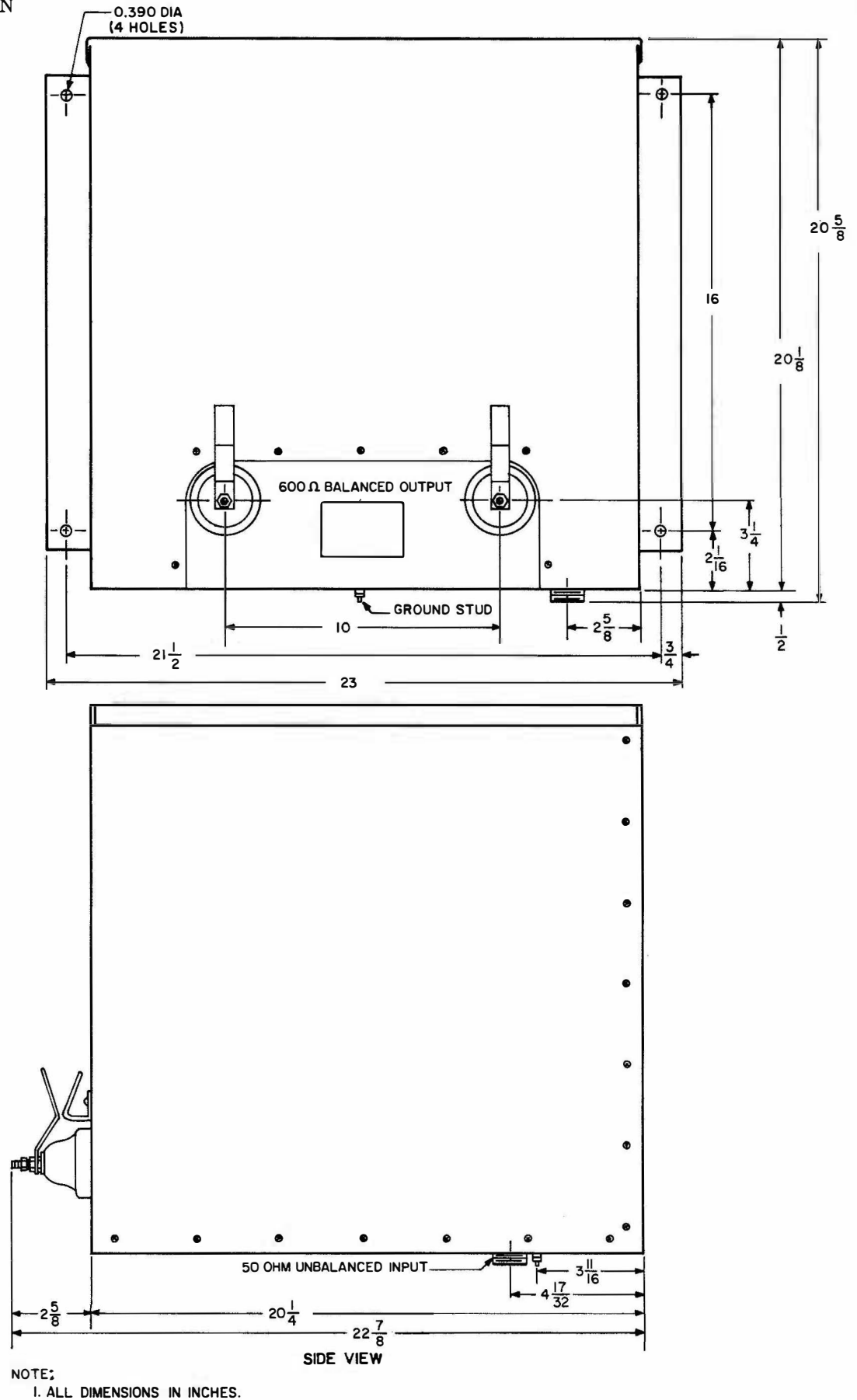
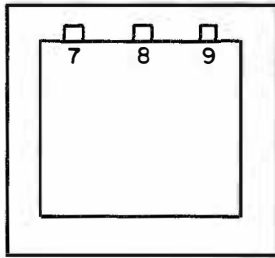
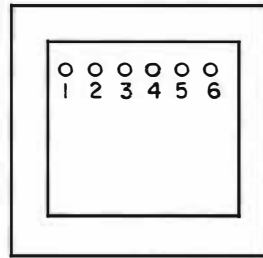


Figure 2-5. Transmission Line Coupler CU-390/FRT-24, Outline Drawing



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NOTE:

CONFIGURATION AND TERMINAL VOLTAGES FOR
TYPE CSTC 14947 TRANSFORMER, AND AC
TRANSFORMER CORP. PART NO. 1382 TRANS-
FORMER.

TERM	VOLTS AC
1-3	220
1-4	230
1-5	240
1-6	250
7-8	3600
8-9	3600
7-9	7200
2-3	198
2-4	208
2-5	217
2-6	226

NOTE:

CONFIGURATION AND TERMINAL VOLTAGES FOR
ELECTRO ENGINEERING WORKS TRANSFORMER
E95726720385009.

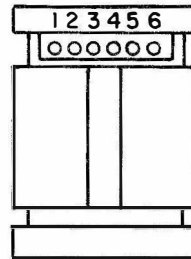
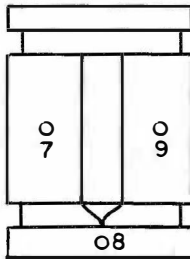


Figure 2-6. Plate Transformer, Terminal Locations

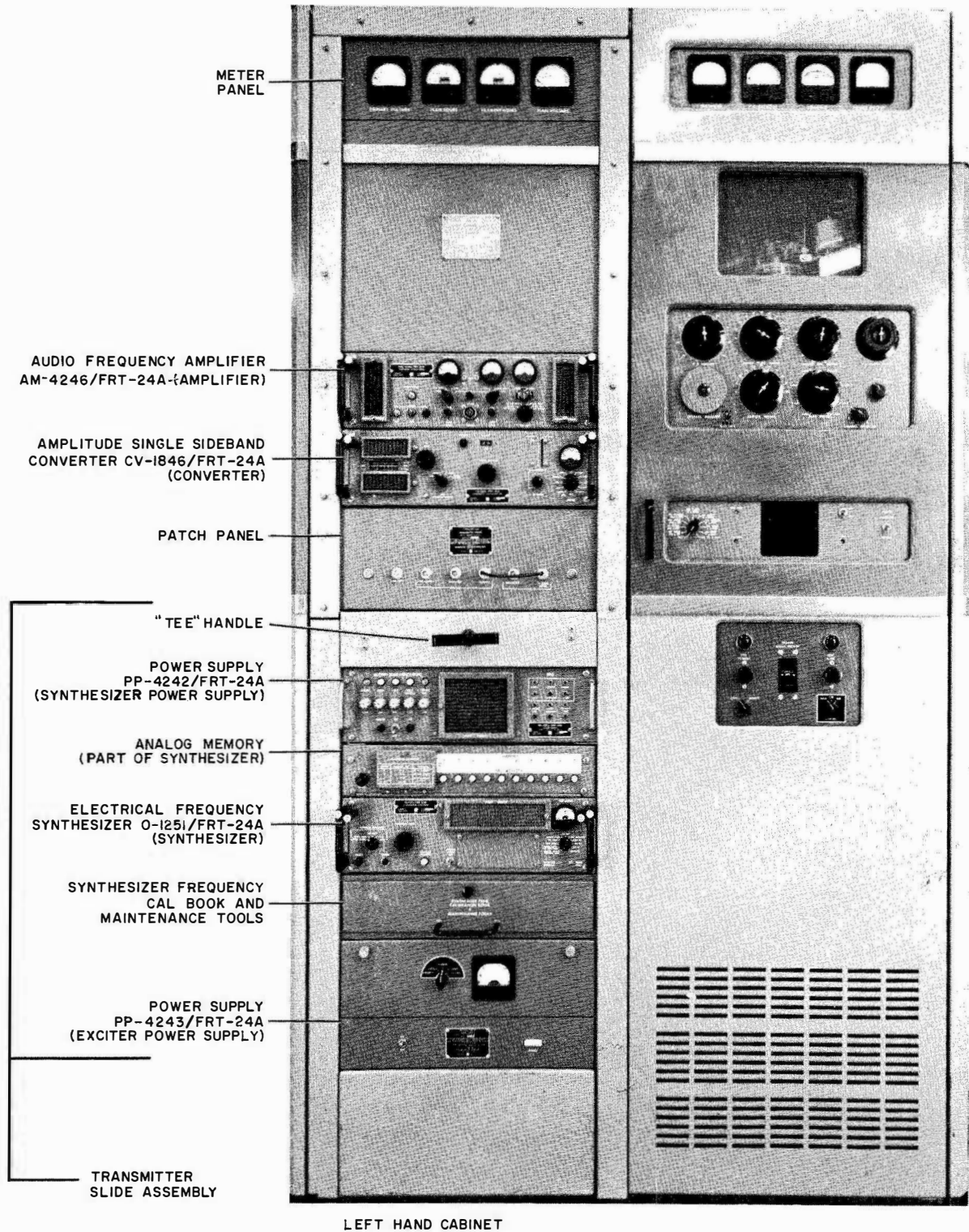


Figure 2-7. Radio Transmitter T-973/FRT-24A, Left-Hand Cabinet

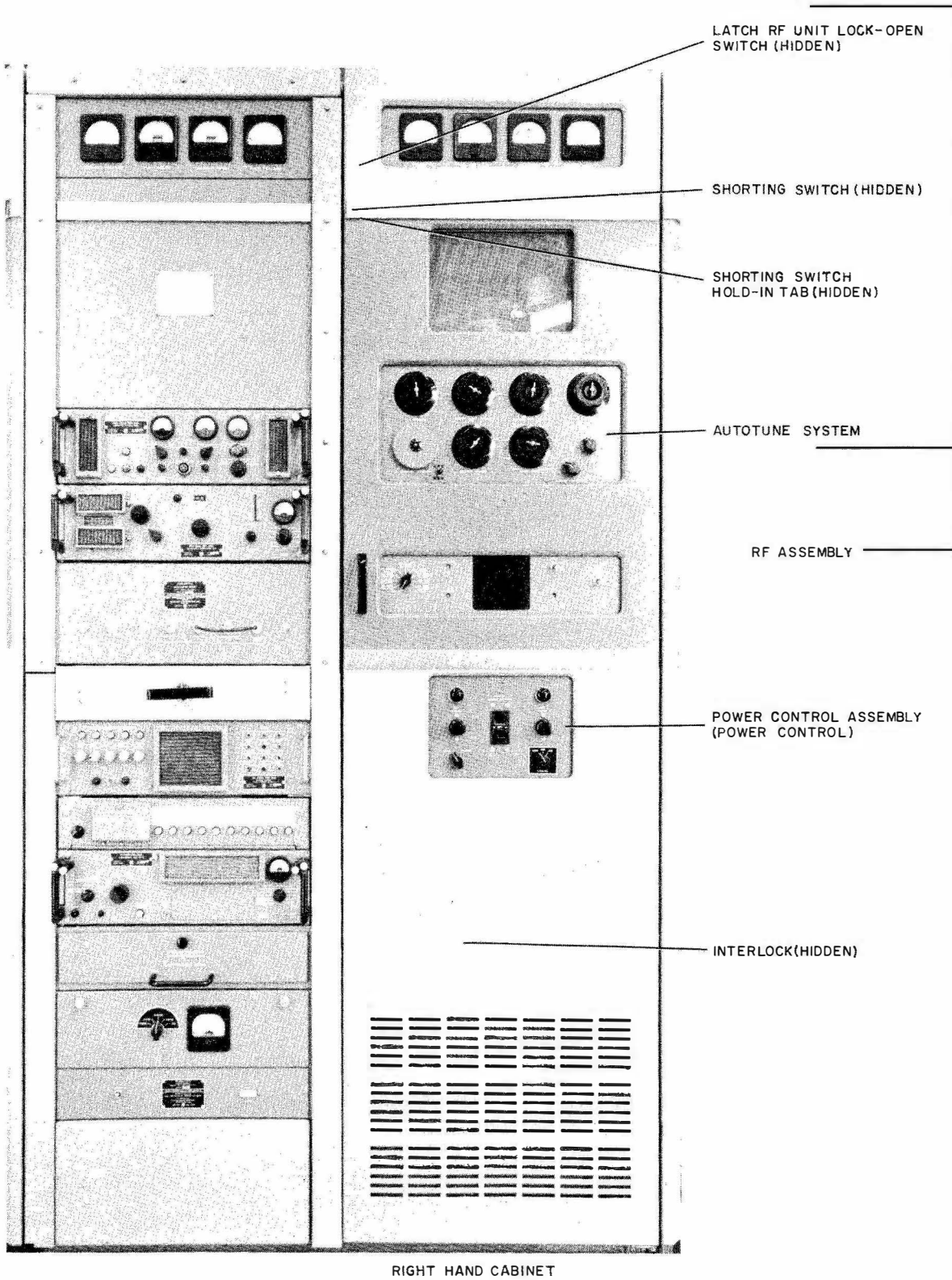


Figure 2-8. Radio Transmitter T-973/FRT-24A, Right-Hand Cabinet

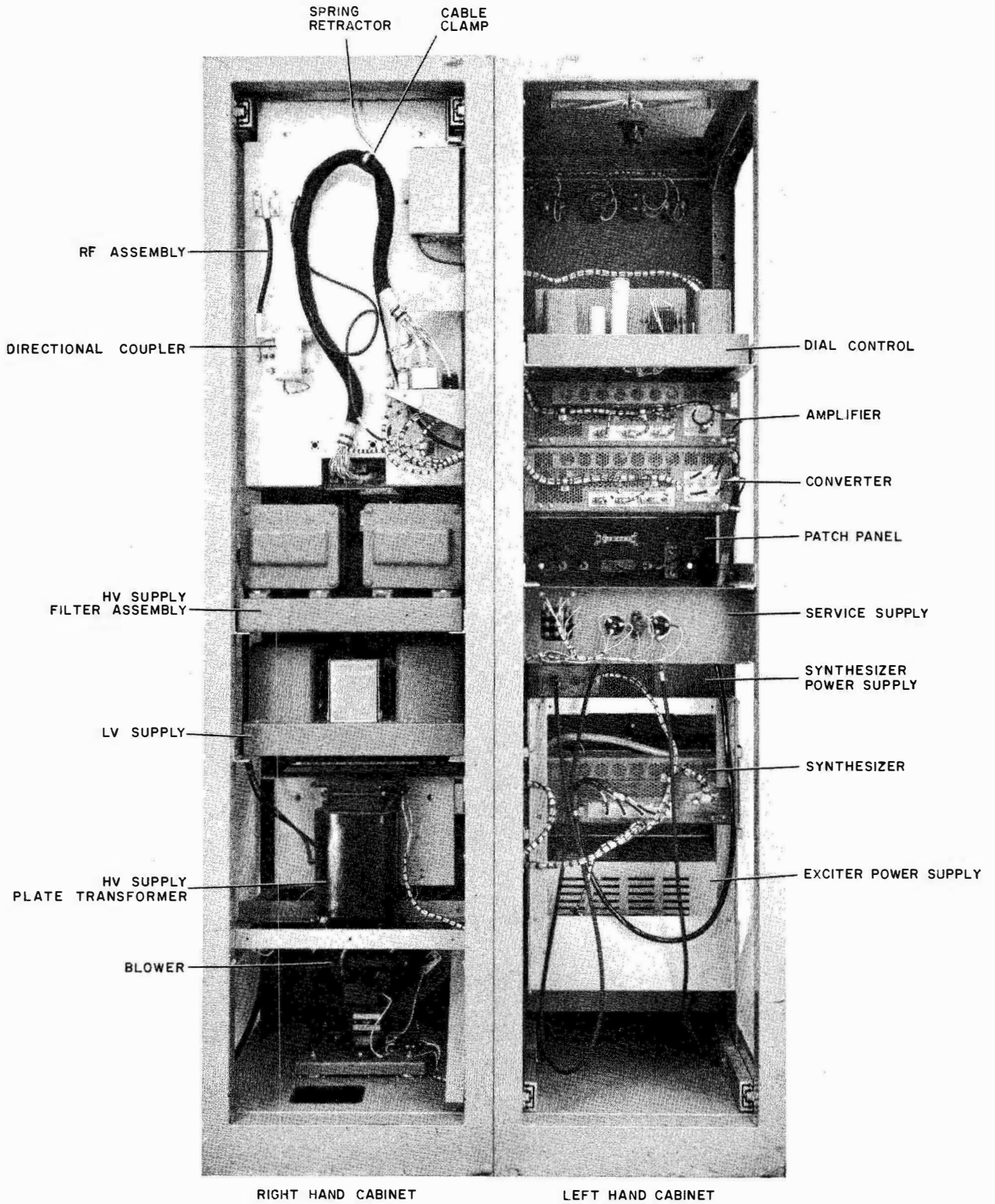


Figure 2-9. Radio Transmitter T-973/FRT-24A, Rear Panels Removed

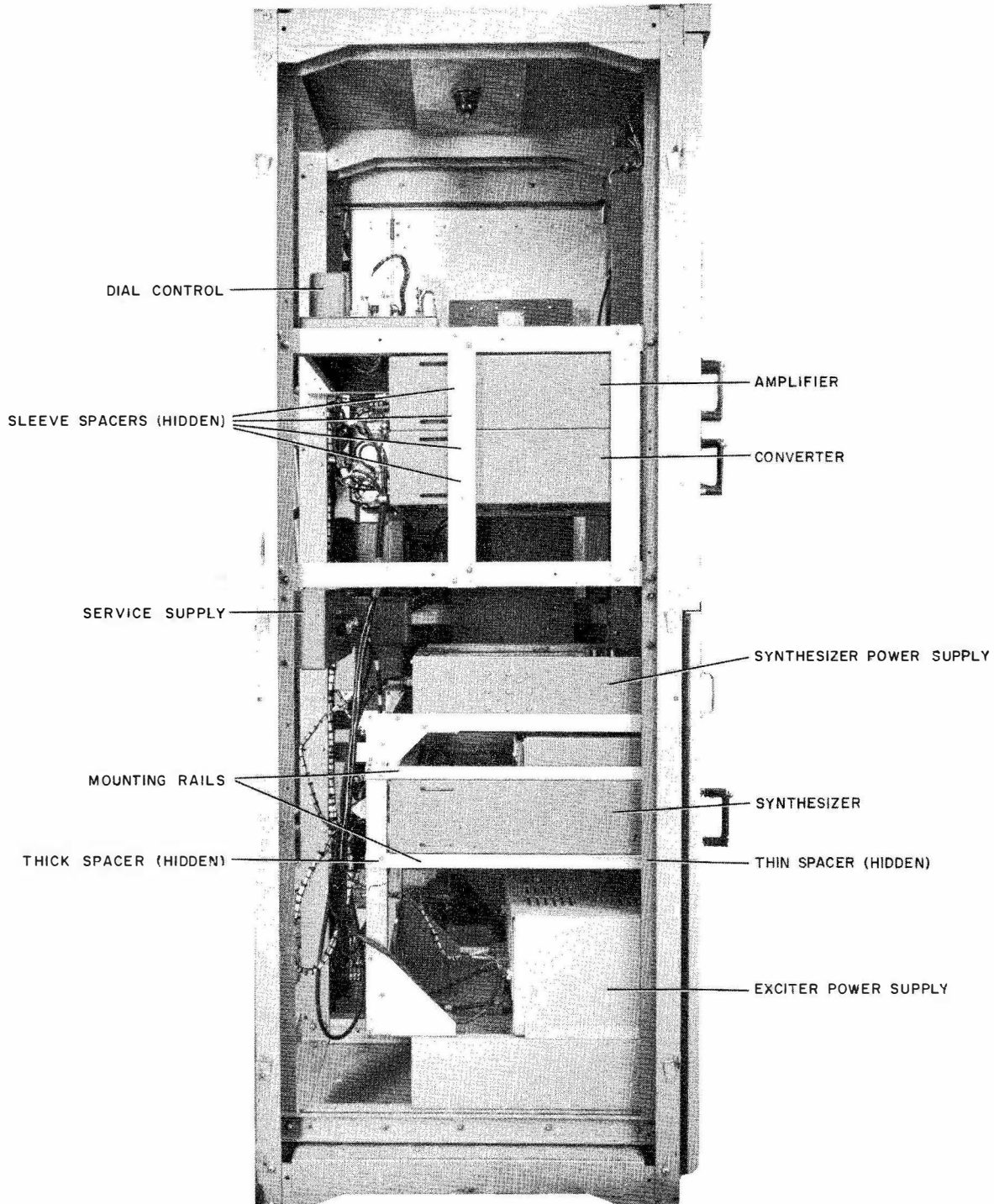


Figure 2-10. Radio Transmitter T-973/FRT-24A, Side View of Left-Hand Cabinet, Side Panel Removed

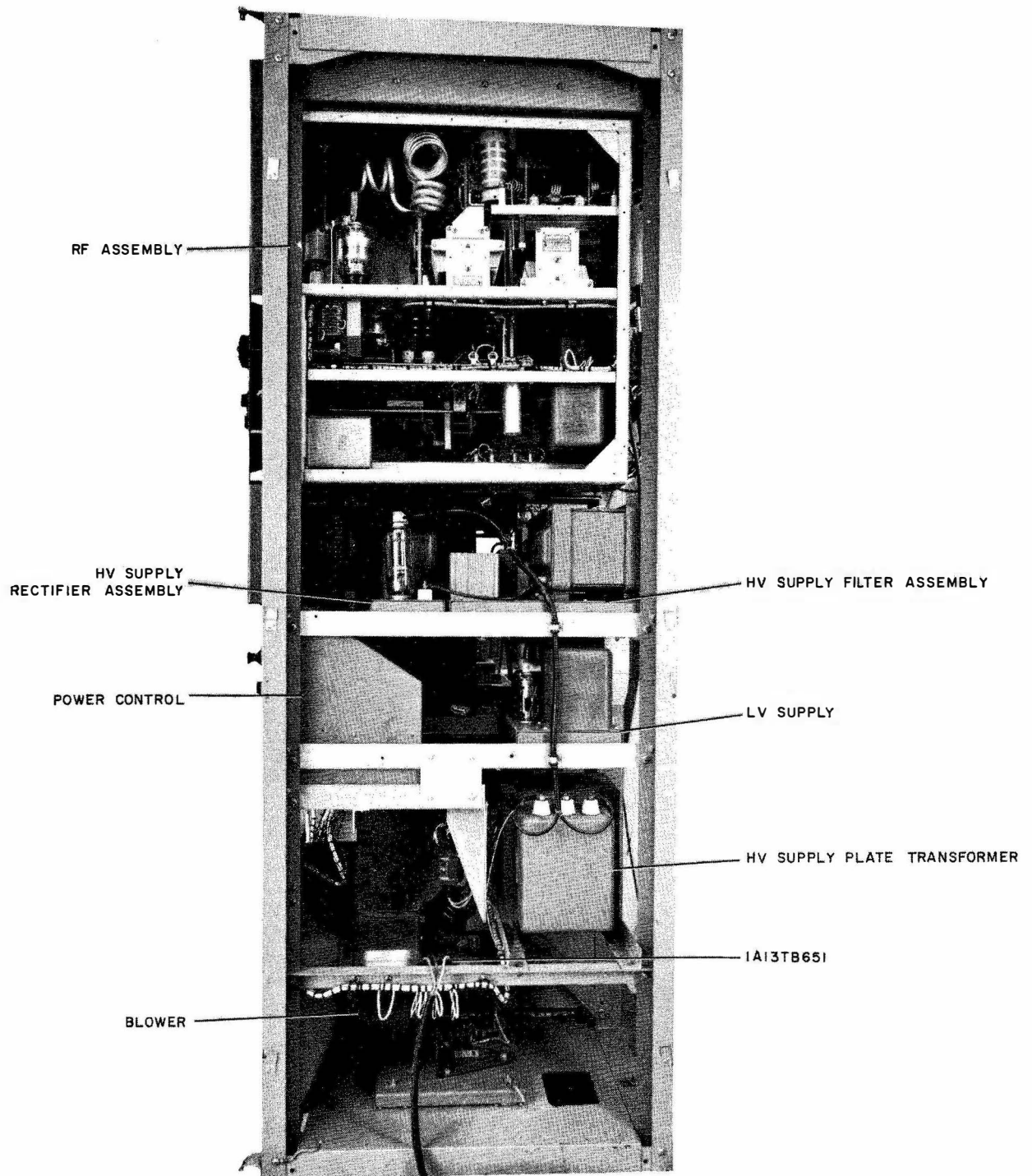


Figure 2-11. Radio Transmitter T-973/FRT-24A, Side View of Right-Hand Cabinet, Side Panel Removed



SECTION 3
OPERATION

3-1. FUNCTIONAL OPERATION.

a. GENERAL. - Radio Transmitting Set AN/FRT-24A (radio set) includes the following major units:

(1) Radio Transmitter T-973/FRT-24A (transmitter) which is composed of the following assemblies (see figure 3-1):

- (a) RF Assembly
- (b) LV Supply
- (c) HV Supply
- (d) Power Control
- (e) Dial Control
- (f) Service Supply
- (g) Patch Panel

(h) Electrical Frequency Synthesizer O-1251/FRT-24A (synthesizer).

(i) Power Supply PP-4242/FRT-24A (synthesizer power supply).

Note

Amplifier and converter together form an exciter for the transmitter.

(j) Audio Frequency Amplifier AM-4246/FRT-24A (amplifier)

(k) Amplitude Single-Sideband Converter CV-1846/FRT-24A (converter).

(l) Power Supply PP-4243/FRT-24A (exciter power supply) furnishes power to amplifier and converter.

(m) Cabinet Accessories

(2) Transmitter Control C-6466/FRT-24A (transmitter control); two supplied.

(3) Frequency Shift Keyer KY-557/URT (keyer).

(4) Transmission Line Coupler CU-390/FRT-24 (transmission line coupler).

The radio set is a general purpose, quick shift, remotely controlled, single sideband radio

transmitter for operation over the 2- to 30-MC frequency range. The radio set provides an average output power of 1000 watts for type A1 emission, 1000-watt peak-envelope-power (PEP) for types A3b, A3j, and F1 emission, and 400-watt nominal carrier power for type A3a emission. The transmitter is tuned to any one of ten preset channels by a motor driven autotune system. A ten-preset-channel synthesizer furnishes the converter with RF required for the excitation of the RF assembly in the transmitter. The transmitter can be operated locally using front-panel controls or remotely using a telephone type dial on either transmitter control.

b. DEFINITION OF METHODS OF OPERATION. - To understand the operational characteristics of the radio set, a definition of each of the four modes of operation is given below. Refer to table 3-1 for function of controls or indicators.

(1) LOCAL AUTOMATIC. - In local automatic operation, the operator selects the channel frequency and type of emission using the CHANNEL SELECTOR switch on the RF assembly, the LSB and USB selector switches on the amplifier and the SSB-CW-AM LOCAL switch on the power control assembly. The RF assembly, synthesizer, and converter automatically tune to the channel frequency selected by the CHANNEL SELECTOR switch. Initially, the synthesizer must be programmed to the desired channel frequency, and the autotune system of the RF assembly must be set up to tune the RF assembly to the operating frequency. The synthesizer can be programmed (by inserting shorting plugs in the synthesizer analog memory) for up to ten preset channel frequencies. To provide proper amplification of the ten preset channel frequencies, the RF assembly must be tuned to the proper frequency by setting up the autotune system to the operating frequency on each channel. Once the autotune system is set to the channel frequencies programmed in the synthesizer analog memory, all that is required to tune the transmitter to the operating frequency is to set the CHANNEL SELECTOR switch on the RF assembly to the proper channel number. When a channel is selected, the autotune system cycles and tunes the RF assembly to the channel frequency. Servo motors in the synthesizer and converter tune these units to the channel frequency programmed in the synthesizer analog memory. After the automatic tuning sequence, the RF assembly,

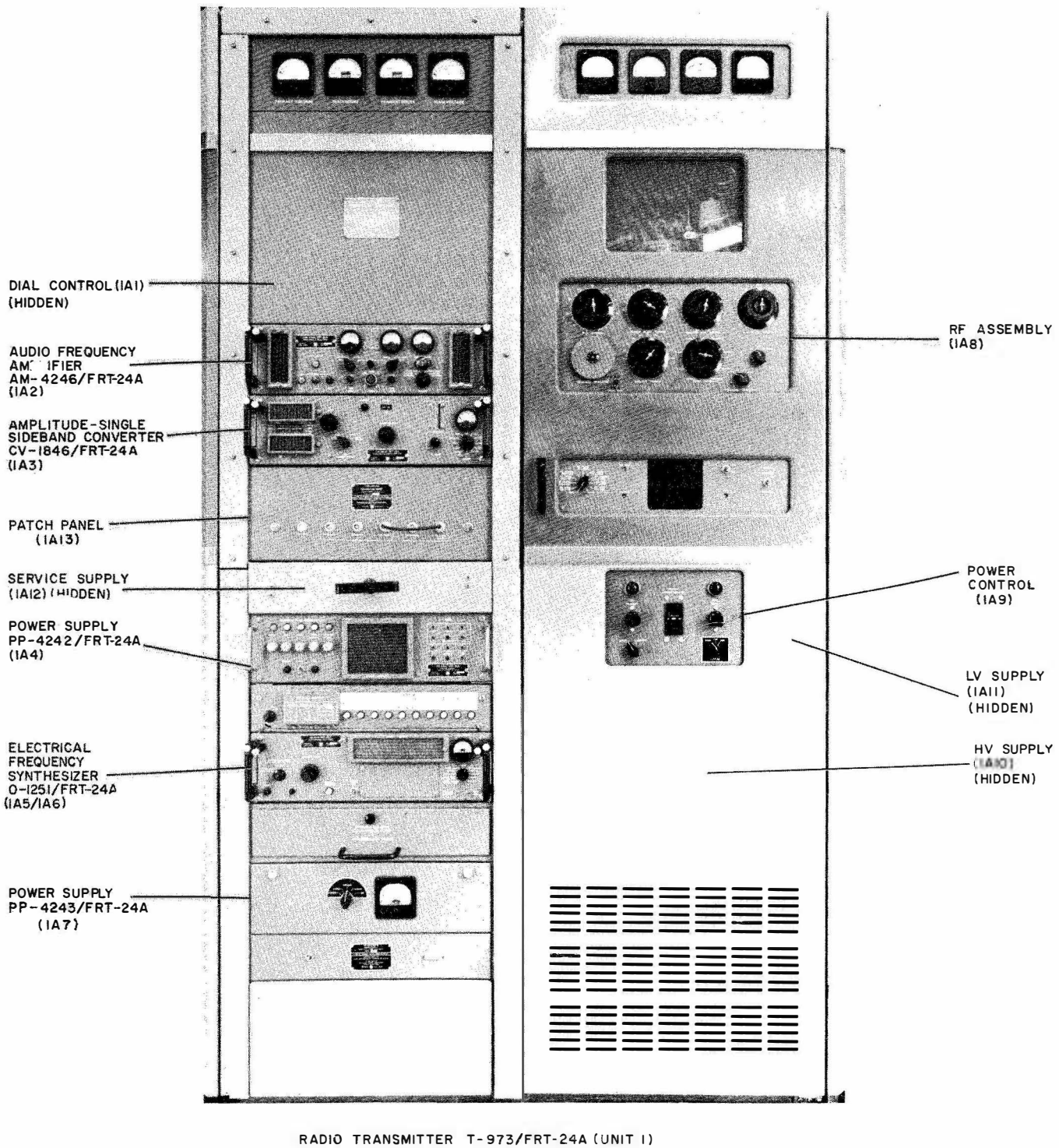


Figure 3-1. Radio Transmitting Set AN/FRT-24A, Major Units (Sheet 1 of 2)

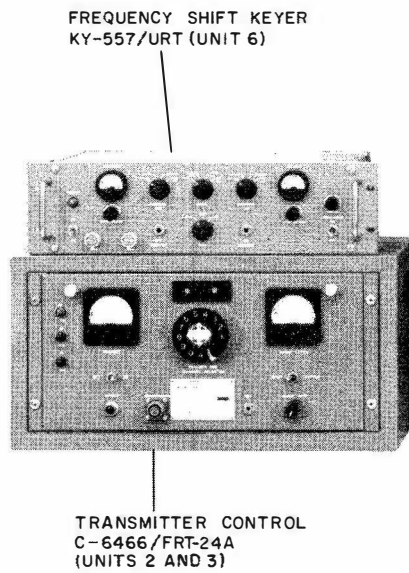
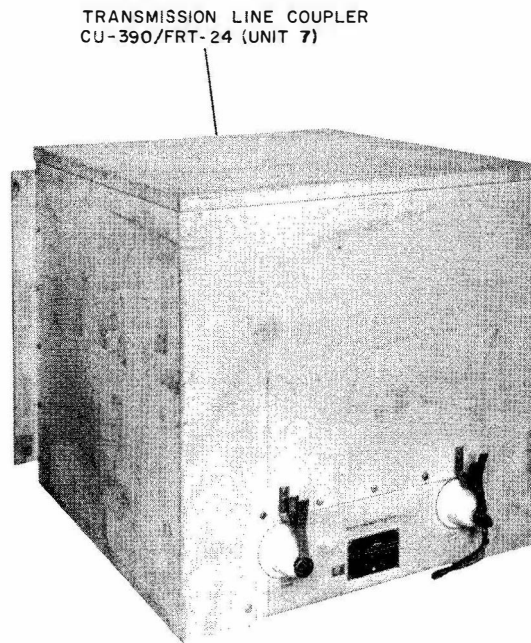


Figure 3-1. Radio Transmitting Set AN/FRT-24A, Major Units (Sheet 2 of 2)

synthesizer, and converter are tuned to the operating channel frequency. In this mode of operation, the type of emission is selected by the SSB-CW-AM LOCAL switch on the power control and the LSB and USB selector switches on the amplifier.

(2) **REMOTE AUTOMATIC.** — In remote automatic operation, the operator uses the transmitter control and keyer units. As mentioned in the local automatic mode of operation, the synthesizer must be programmed and the autotune system set up to the preset operating channel frequencies. However, before the transmitter can be operated remotely, the LOCAL-REMOTE switch on the power control must be in the REMOTE position. To operate the transmitter remotely, the operator need only dial the desired channel and mode of emission on the transmitter control. Upon dialing, the transmitter automatically cycles to the selected channel and sets up for the selected mode of emission. In addition to dialing, the controls on the keyer must be set to the type of emission selected. If the frequency of a preset channel must be changed, and the original preset channel frequency retained in the synthesizer analog memory, the synthesizer must be tuned to the operating frequency with the MANUAL SETTING digital switches. Once the frequency of a channel is changed, the autotune system must be reset to the changed channel frequency. To return to the original preset frequency on the changed channel, the autotune system must be reset again.

(3) **LOCAL SEMI-AUTOMATIC.** — In local semi-automatic operation, the transmitter is operated as in local automatic operation, but one or more of the preset channel frequencies is replaced by the frequency selected with the MANUAL SETTING digital switches on the synthesizer analog memory section. Every time a new frequency is selected by the digital switches,

the autotune system must be reset so that the RF assembly is properly tuned. This mode of operation is referred to as local semi-automatic, because the operating frequency must be set manually, although the synthesizer and converter tune automatically. When returning the semi-automatic channel to the preset channel frequency, the autotune must be reset to the preset frequency.

(4) **LOCAL MANUAL.** — In local manual operation, mechanical overrides on the synthesizer and converter tuning controls are used in place of the servo motors. This is an emergency method of tuning the transmitter. When operating local manual, the synthesizer operating frequency is set by the MANUAL SETTING digital switches and the synthesizer is tuned manually with its MANUAL TUNE control. The converter is also tuned manually with its RF TUNE control. If the frequency of the manually tuned channel is different from that set up for the same channel in the autotune system, the RF assembly must be tuned to the manual channel frequency. Every time a channel frequency is changed, the autotune system must be reset to the original frequency.

3-2. PREPARATION FOR USE.

There are no special procedures to be performed before operating the radio set.

3-3. OPERATING PROCEDURES.

a. **DESCRIPTION OF CONTROLS.** — The controls and indicators used during normal operation of the radio set and the function of each are listed in table 3-1. Refer to figures 3-2 through 3-10 for the physical location of each control or indicator.

TABLE 3-1. OPERATOR'S CONTROLS AND INDICATORS

CONTROL OR INDICATOR	POSITION	FUNCTION
POWER CONTROL (Figure 3-2)		
PRIMARY CIRCUIT BREAKER		Protects transmitter from 208/230-volt primary power overloads and controls application of 208/230-volt, 50/60-cycle power to entire transmitter.
FILAMENT switch		Controls application of power to RF assembly filaments.
	Pulling control	Energizes filaments.
	Pushing control	Deenergizes filaments.

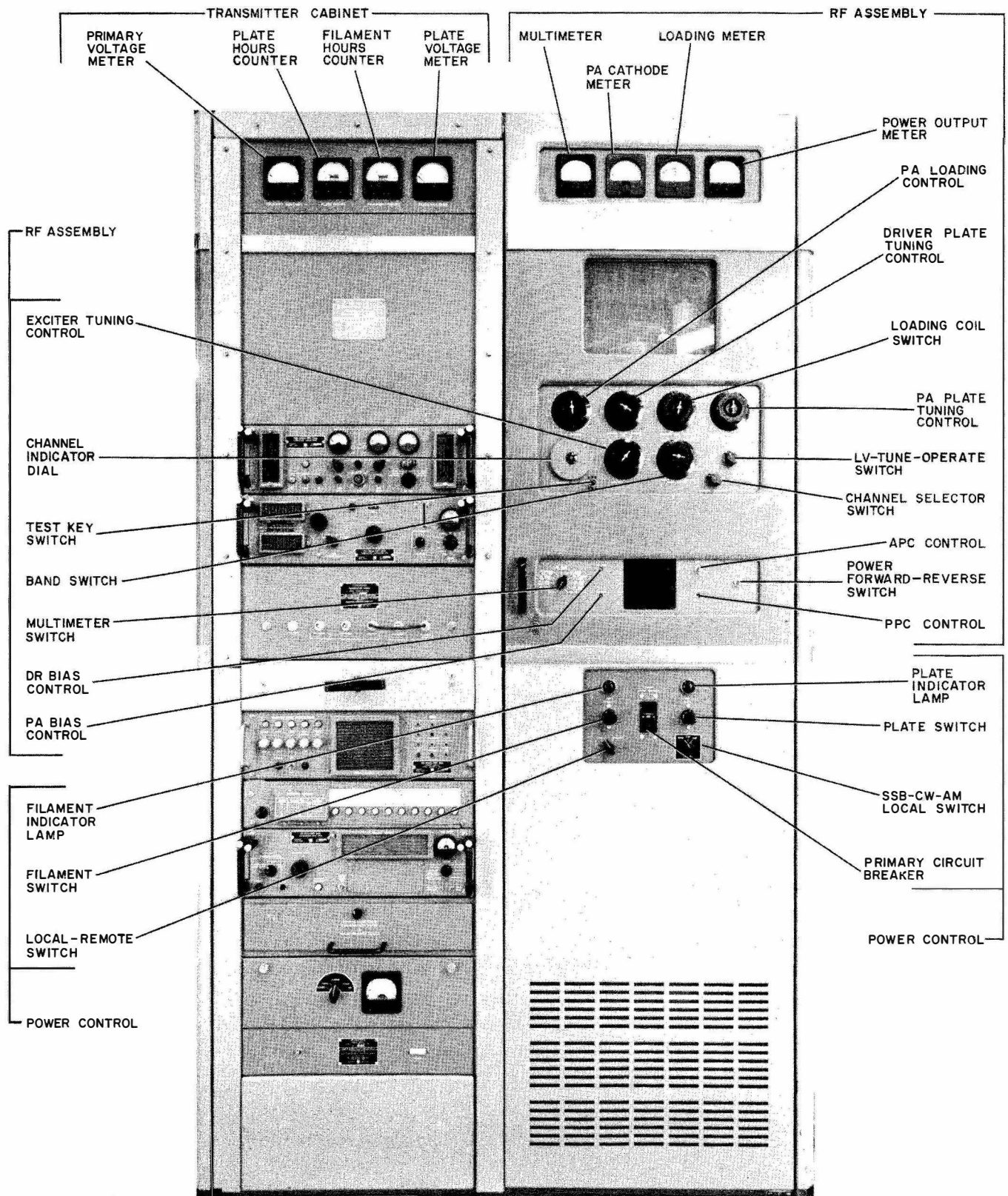


Figure 3-2. Radio Transmitter T-973/FRT-24A, Operating Control and Indicator Locations

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
POWER CONTROL (Figure 3-2) (Cont.)		
<p>FILAMENT lamp</p> <p>PLATE switch</p> <p>PLATE lamp</p> <p>LOCAL-REMOTE switch</p> <p>(Normal position)</p> <p>SSB-CW-AM LOCAL switch</p> <p>(Normal position)</p>	<p>Pulling control</p> <p>Pushing control</p> <p>LOCAL</p> <p>REMOTE</p> <p>SSB</p> <p>CW</p> <p>AM</p>	<p>Lights when RF assembly filaments are energized.</p> <p>Controls application of power to high-voltage and low-voltage plate transformers.</p> <p>Energizes transformers.</p> <p>Deenergizes transformers.</p> <p>Lights when high-voltage and low-voltage transformers are energized.</p> <p>Transfers control functions between local controls (for local operation) and controls on transmitter control units (for remote operation).</p> <p>Transmitter operates with local controls.</p> <p>Transmitter operates with remote controls.</p> <p>Selects type of emissions.</p> <p>Transmitter operates in single sideband mode.</p> <p>Transmitter operates in continuous wave mode.</p> <p>Transmitter operates in compatible amplitude modulated continuous wave mode.</p>
RF ASSEMBLY (Figure 3-2)		
<p>LV-TUNE-OPERATE switch</p> <p>(Normal position)</p>	<p>LV</p> <p>TUNE</p> <p>OPERATE</p>	<p>Energizes RF assembly in selected steps.</p> <p>Deenergizes HV supply and leaves LV supply energized.</p> <p>Applies plate and screen voltage to power amplifier in RF assembly.</p> <p>Applies full operating voltage to all circuits in RF assembly.</p>

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
RF ASSEMBLY (Figure 3-2) (Cont.)		
BAND SWITCH	<p>1</p> <p>2</p> <p>3</p> <p>4</p> <p>5</p> <p>6</p> <p>7</p> <p>8</p>	<p>Selects frequency band on which transmitter operates.</p> <p>Transmitter operates in 2-to 3-MC frequency range.</p> <p>Transmitter operates in 3-to 4-MC frequency range.</p> <p>Transmitter operates in 4-to 6-MC frequency range.</p> <p>Transmitter operates in 6-to 8-MC frequency range.</p> <p>Transmitter operates in 8-to 12-MC frequency range.</p> <p>Transmitter operates in 12-to 16-MC frequency range.</p> <p>Transmitter operates in 16-to 24-MC frequency range.</p> <p>Transmitter operates in 24-to 30-MC frequency range.</p>
LOADING COIL SWITCH	<p>Clockwise</p> <p>Counterclockwise</p>	<p>Adjusts P. A. loading circuit to antenna loading circuit in steps. (Set to a number corresponding to, or close to, setting of BANDSWITCH.)</p> <p>Increases loading.</p> <p>Decreases loading.</p>
TEST KEY switch (Normally centered)	<p>Up</p> <p>Center</p> <p>Down</p>	<p>Keys transmitter locally for alignment.</p> <p>Keyed continuously.</p> <p>Key open.</p> <p>Keyed momentarily.</p>
EXCITER TUNING control		<p>Tunes plate tank circuit of first amplifier stage.</p>
DRIVER PLATE TUNING control		<p>Tunes plate tank circuit of driver stage.</p>
P. A. PLATE TUNING control		<p>Tunes plate tank circuit of power amplifier stage.</p>
P. A. LOADING control		<p>Tunes output circuit and provides fine adjustment of loading after LOADING COIL SWITCH has been set to number corresponding to, or close to, setting of BANDSWITCH.</p>

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
RF ASSEMBLY (Figure 3-2) (Cont.)		
CHANNEL SELECTOR switch		Starts autotune and selects a channel (1 through 10) on which an operating frequency can be set up when in LOCAL position.
CHANNEL INDICATOR dial		Indicates channel to which autotune and transmitter is tuned.
MULTIMETER		Indicates operating parameters of various sections of RF assembly as selected by multimeter switch.
Multimeter switch		Selects parameters to be monitored on MULTIMETER.
	OFF	MULTIMETER is not operative.
	DR GRID MA X 20	Driver grid current is monitored on MULTIMETER; reading should be multiplied by 20 for true value.
	DR PLATE MA X 100	Driver plate current is monitored on MULTIMETER; reading should be multiplied by 100 for true value.
	PA GRID MA X 20	Power amplifier grid current is monitored on MULTIMETER; reading should be multiplied by 20 for true value.
	PA SCREEN MA X 100	Power amplifier screen grid current is monitored on MULTIMETER; reading should be multiplied by 100 for true value.
	DR PLATE V X 100	Driver plate voltage is monitored on MULTIMETER; reading should be multiplied by 100 for true value.
	1st AMPL V X 1000	1st amplifier plate voltage is monitored on MULTIMETER; reading should be multiplied by 1000 for true value.

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
RF ASSEMBLY (Figure 3-2) (Cont.)		
Multimeter switch (cont.) P. A. CATHODE meter LOADING meter POWER OUTPUT meter POWER FORWARD-REVERSE switch (Normal position) APC ON-OFF switch	PA SCREEN V X 1000	Power amplifier screen grid voltage is monitored on MULTIMETER; reading should be multiplied by 1000 for true value.
	DR BIAS V X 200	Driver bias voltage is monitored on MULTIMETER; reading should be multiplied by 200 for true value.
	PA BIAS V X 200	Power amplifier bias voltage is monitored on MULTIMETER; reading should be multiplied by 200 for true value.
	PA FIL V X 10	Power amplifier filament voltage is monitored on MULTIMETER; reading should be multiplied by 10 for true value.
		Indicates power amplifier cathode current.
		Indicates optimum loading of power amplifier stage.
		Indicates forward and reverse output power of power amplifier as selected by POWER FORWARD-REVERSE switch.
		Selects forward or reverse power in output line to be monitored on POWER OUTPUT meter.
	FORWARD	Forward output power is monitored on POWER OUTPUT meter.
	REVERSE	Reverse (reflected) power is monitored on POWER OUTPUT meter.
ON	Sets limit to average power output.	
OFF	Average power control out of circuit.	

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
RF ASSEMBLY (Figure 3-2) (Cont.)		
PPC control DR BIAS control PA BIAS control		Adjusts level of peak power output. Adjusts bias voltage of driver stage. Adjusts bias voltage of power amplifier stage.
TRANSMITTER CABINET (Figure 3-2)		
PRIMARY VOLTAGE meter PLATE HOURS counter FILAMENT HOURS counter PLATE VOLTAGE meter		Indicates primary voltage that is applied to transmitter. Indicates total number of hours power amplifier has operated. Indicates total number of hours filament power has been applied to filaments of power amplifier. Indicates plate voltage of power amplifier.
PATCH PANEL (Figure 3-3)		
1MC OUT jack EXCITER OUTPUT jack EXCITER MONITOR jack EXCITER 50 Ω LOAD jack PA 1st AMPL INPUT jack.		Furnishes 1-MC output frequency for monitoring purposes. Furnishes 2- to 30-MC output frequency of converter. During normal operation a patch cable is connected between EXCITER OUTPUT jack and PA 1st AMPL INPUT jack. Furnishes 2- to 30-MC output frequency of converter for monitoring purposes. Provides a 50-ohm dummy load termination for converter output when patch cable is connected between EXCITER OUTPUT jack and EXCITER 50 Ω LOAD jack. Normally used during maintenance. Provides input connection of converter output. During normal operation a patch cable is connected between EXCITER OUTPUT jack and PA 1st AMPL INPUT jack.

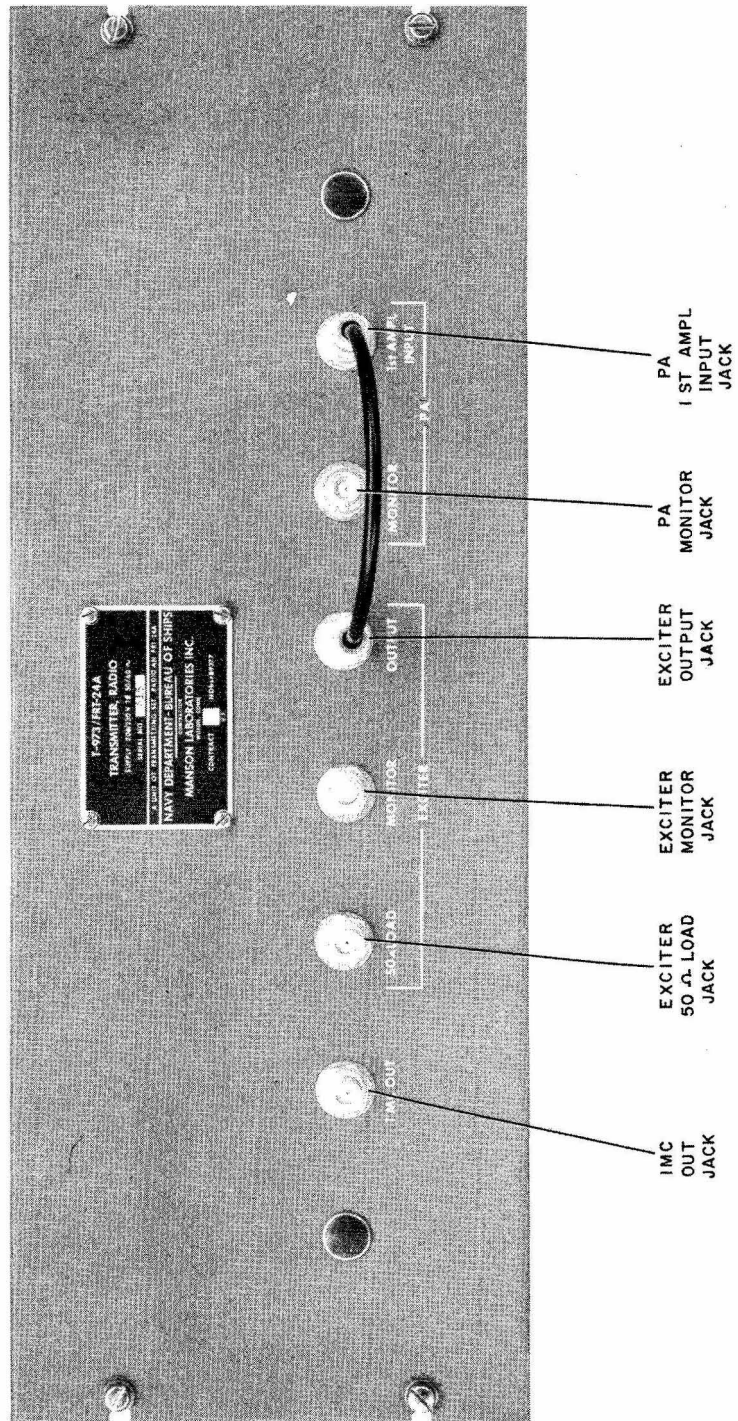


Figure 3-3. Patch Panel, Jack Locations

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
PATCH PANEL (Figure 3-3) (Cont.)		
PA MONITOR jack		Furnishes 2-to 30-MC output frequency of RF assembly for monitoring purposes.
SYNTHESIZER POWER SUPPLY (Figure 3-4)		
<p>ON-OFF switch</p> <p>POWER lamp</p> <p>FIL lamp</p> <p>BLOWN FUSE INDICATION</p> <p> +180V lamp</p> <p> +28V lamp</p> <p> -12V lamp</p> <p> +28V UNREG lamp</p> <p> 115 VAC SEC lamp</p> <p>REG</p> <p> +28V test point</p> <p> +180V test point</p> <p> -24V test point</p>		<p>Controls application of primary power to synthesizer power supply .</p> <p>Lights when primary power is applied to synthesizer power supply.</p> <p>Lights when primary power is applied to synthesizer power supply indicating application of DC filament voltage to synthesizer.</p> <p>Lights when associated fuse is blown.</p> <p>Lights when associated fuse is blown.</p> <p>Lights when associated fuse is blown.</p> <p>Lights when associated fuse is blown.</p> <p>Lights when associated fuse is blown.</p> <p>Furnishes regulated +28 volts DC output for test measurements. Measured to REG GROUND test point.</p> <p>Furnishes regulated +180 volts DC output for test measurements. Measured to REG GROUND test point.</p> <p>Furnishes regulated -24 volts DC output for test measurements. Measured to REG GROUND test point.</p>

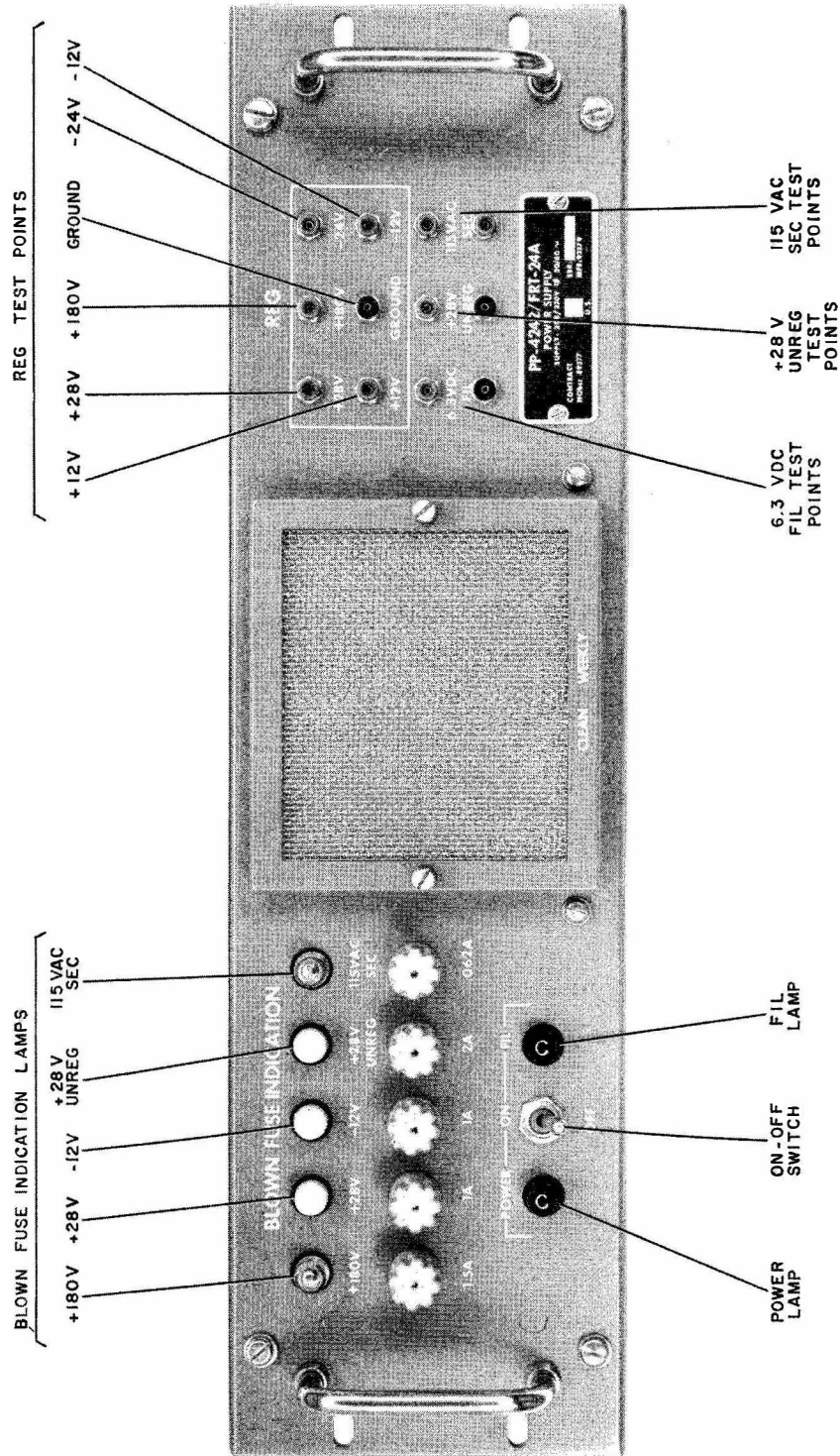


Figure 3-4. Synthesizer Power Supply, Operating Control and Indicator Locations

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
SYNTHESIZER POWER SUPPLY (Figure 3-4) (Cont.)		
<p>REG (cont.)</p> <p>+12V test point</p> <p>-12V test point</p> <p>GROUND test point</p> <p>6.3VDC FIL test points</p> <p>+28V UNREG test points</p> <p>115 VAC SEC test points</p>		<p>Furnishes regulated +12 volts DC output for test measurements. Measured to REG GROUND test point.</p> <p>Furnishes regulated -12 volts DC output for test measurements. Measured to REG GROUND test point.</p> <p>Provides ground connection for all regulated voltage test points.</p> <p>Furnishes 6.3 volts DC filament output for test measurements.</p> <p>Furnishes unregulated +28 volts DC output for test measurements.</p> <p>Furnishes 115 volts AC output for test measurements.</p>
SYNTHESIZER (Figure 3-5)		
<p>BAND switch</p>	<p>A</p> <p>B</p> <p>C</p> <p>D</p>	<p>Selects one of four bands of operation for converter in semi-automatic and local manual modes of operation.</p> <p>Provides converter with a frequency range of 19.6 to 35.6 MC to cover 2- to 4-MC band.</p> <p>Provides converter with a frequency range of 17.8 to 33.8 MC to cover 4- to 8-MC band.</p> <p>Provides converter with a frequency range of 19.5 to 35.5 MC to cover 8- to 16-MC band.</p> <p>Provides converter with a frequency range of 17.75 to 33.75 MC to cover 16-to 32-MC band.</p>

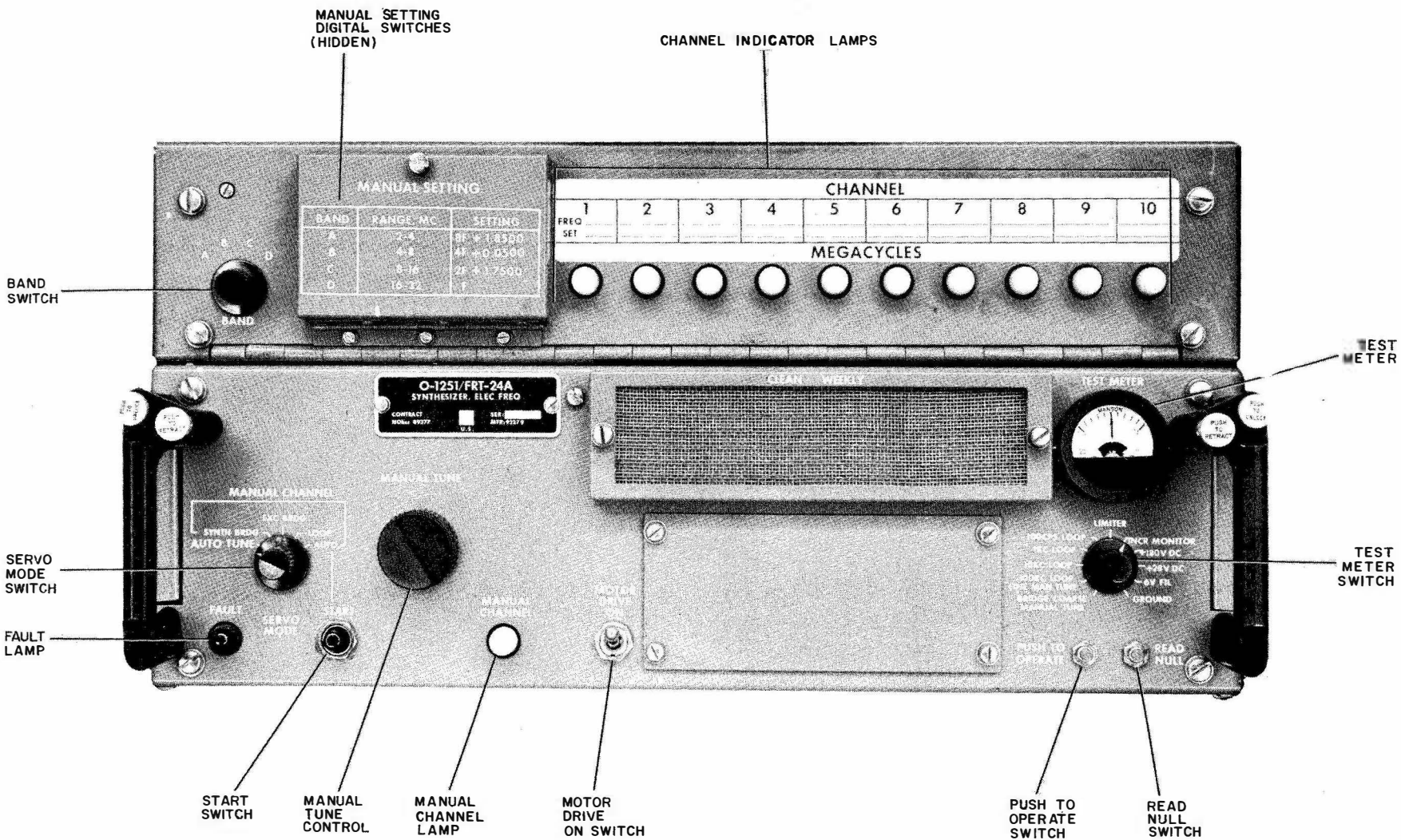


Figure 3-5. Synthesizer, Operating Control and Indicator Locations

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
SYNTHESIZER (Figure 3-5) (Cont.)		
MANUAL SETTING digital	10-MC digital switch	Selects synthesizer operating frequency (determined from the Synthesizer Frequency Calibration book) in semi-automatic and manual mode of operation.
	1-MC digital switch	Selects first significant digit of synthesizer frequency corresponding to 10-MC position.
	100-KC digital switch	Selects second significant digit of synthesizer frequency corresponding to 1-MC position.
	10-KC digital switch	Selects third significant digit of synthesizer frequency corresponding to 100-KC position.
	1-KC digital switch	Selects fourth significant digit of synthesizer frequency corresponding to 10-KC position.
	100-CPS digital switch	Selects fifth significant digit of synthesizer frequency corresponding to 1-KC position.
CHANNEL INDICATOR lamps (1 through 10)		Selects last digit of synthesizer frequency corresponding to 100-CPS position.
SERVO MODE switch		Indicates which channel is in use during operation
(Normal position)	AUTO TUNE	Selects operating mode of synthesizer.
	MANUAL CHANNEL SYNTH BRDG	Allows automatic synthesizer and converter tuning of any one of the ten preset channels in local or remote automatic modes of operation.
	MANUAL CHANNEL EXC BRDG	Allows tuning of synthesizer bridge circuit during local manual operation.
	MANUAL CHANNEL LOOP	Allows tuning of converter after synthesizer bridge has been tuned during local manual operation.
	MANUAL CHANNEL AUTO	Allows zeroing of main loop discriminator during local manual operation.
		Allows tuning of synthesizer and converter during semi-automatic operation when START switch is pressed.

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
SYNTHESIZER (Figure 3-5) (Cont.)		
<p>TEST METER</p> <p>Test Meter switch</p> <p>(Normal position)</p>	<p>BRIDGE COARSE MANUAL TUNE</p> <p>100KC LOOP FINE MAN. TUNE</p> <p>10KC LOOP</p> <p>1KC LOOP</p> <p>100CPS LOOP</p> <p>LIMITER</p> <p>INCR MONITOR</p> <p>+180V DC</p> <p>+28V DC</p> <p>6V FIL</p>	<p>Indicates operating parameters of various sections of synthesizer selected by TEST METER switch.</p> <p>Selects parameters to be monitored on TEST METER.</p> <p>Synthesizer bridge output is monitored on TEST METER during manual tuning when SERVO MODE switch is in MANUAL CHANNEL SYNTH BRDG or MANUAL CHANNEL EXC BRDG position.</p> <p>100-KC loop discriminator output is monitored on TEST METER when SERVO MODE switch is in MANUAL CHANNEL LOOP position and PUSH TO OPERATE switch is depressed.</p> <p>10-KC loop is monitored on TEST METER. Meter pointer cycles when loop breaks lock.</p> <p>1-KC loop is monitored on TEST METER. Meter pointer cycles when loop breaks lock.</p> <p>100-CPS loop is monitored on TEST METER. Meter pointer cycles when loop breaks lock.</p> <p>Main loop limiter output is monitored on TEST METER.</p> <p>10-KC, 1-KC, and 100-cycle loops are monitored simultaneously on TEST METER. Meter pointer cycles when any loop breaks lock.</p> <p>+180-volt output of synthesizer power supply is monitored on TEST METER. A reading from +2.5 to 3.5 is noted.</p> <p>+28-volt output of synthesizer power supply is monitored on TEST METER. A reading from +2.5 to 3.5 is noted.</p> <p>6-volt DC output of synthesizer power supply is monitored on TEST METER. A reading from +2.5 to 3.5 is noted.</p>

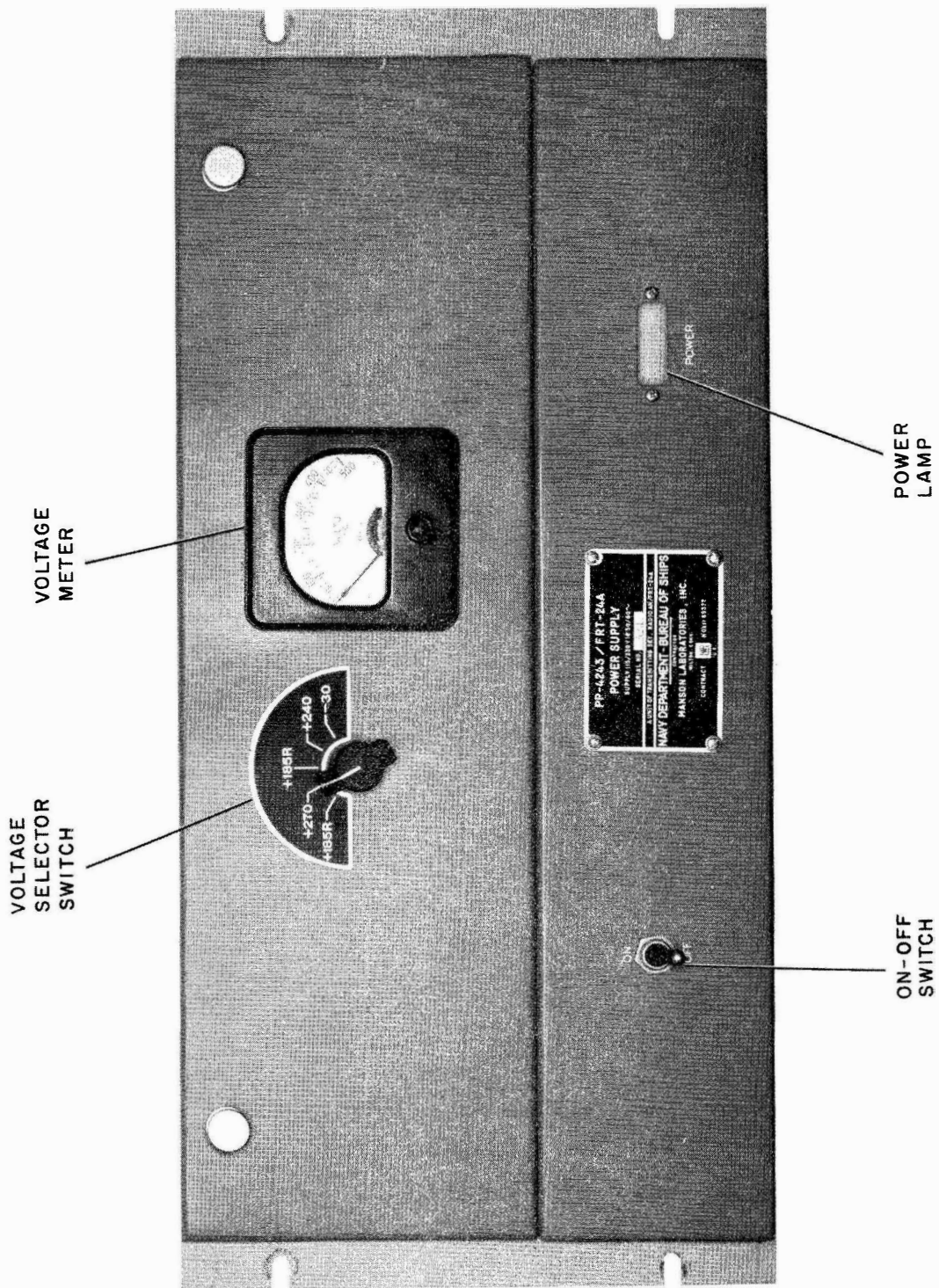


Figure 3-6. Exciter Power Supply, Operating Control and Indicator Locations

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
EXCITER POWER SUPPLY (Figure 3-6) (Cont.)		
Voltage selector switch	+185R	Selects one of five operating voltages to be monitored on voltage meter.
	+270	+185 VDC regulated is monitored on voltage meter.
	+270	+270 VDC is monitored on voltage meter.
	+185R	+185 VDC regulated is monitored on voltage meter.
	+240	+240 VDC is monitored on voltage meter.
	-30	-30 VDC is monitored on voltage meter.
AMPLIFIER (Figure 3-7)		
OVEN CYCLE lamp		Lights while 1-MC frequency standard crystal oven is being heated and extinguishes when proper oven temperature is reached. Cycles "on" and "off" during normal operation.
LSB LINE LEVEL control		Provides variable attenuation of lower sideband phone line level from external terminal during local automatic, local semi-automatic and local manual operation.
LSB LEVEL meter		Indicates lower sideband audio output level.
LSB selector switch		Selects lower sideband operating mode of amplifier section.
	OFF	No lower sideband audio output.
	LINE AMPL	Selects phone line input, from terminal to modulate lower sideband signal. Audio input is compressed and amplified.
(Normal position)	LINE	Selects phone line input from terminal to modulate lower sideband signal. Audio input is applied directly through unit without amplification or compression.

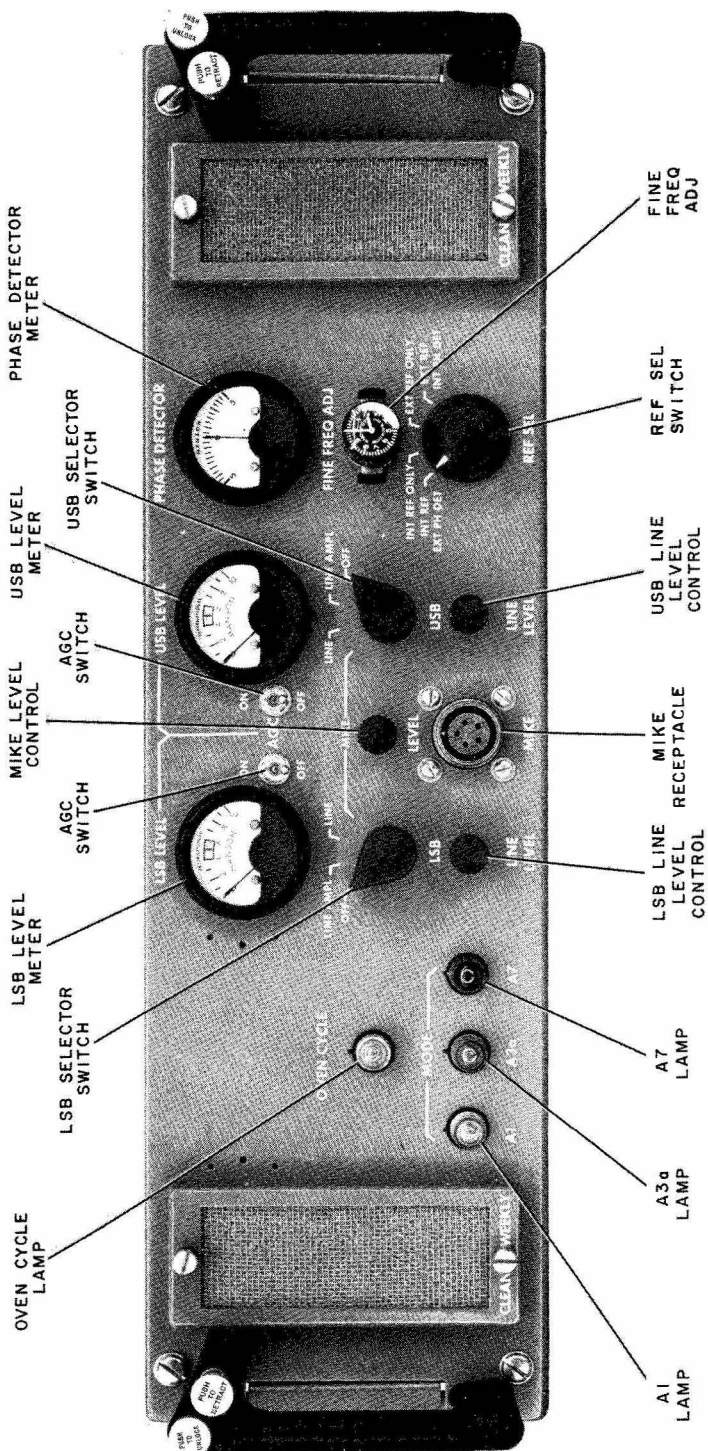


Figure 3-7. Amplifier, Operating Control and Indicator Locations

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
AMPLIFIER (Figure 3-7) (Cont.)		
A1 MODE lamp		Lights when A1 is dialed on EMISSION AND CHANNEL SELECTOR dial on transmitter control or when A1 is switched on by means of the SSB-CW-AM LOCAL switch located on the power control unit; light stays on indicating transmitter is set up for type A1 (CW) emission.
A3a MODE lamp		Lights when A3 is dialed on EMISSION AND CHANNEL SELECTOR dial on transmitter control or when A3 is switched on by means of the SSB-CW-AM LOCAL switch located on the power control unit; light stays on indicating transmitter is set up for type A3a (compatible AM) emission.
A7 MODE lamp		Lights when any channel is dialed on EMISSION AND CHANNEL SELECTOR dial on transmitter control or when A7 is switched on by means of the SSB-CW-AM LOCAL switch located on the power control unit; light stays on indicating transmitter is set up for types A3b (two independent sidebands), A3j (single sideband suppressed carrier) or F1 (FSK) emission.
PHASE DETECTOR meter		Indicates relative phase error between internal frequency standard and external reference frequencies as selected by REF SEL switch.
REF SEL switch		Selects internal frequency standard or external reference frequency for 1-MC reference to synthesizer and converter. Also selects signal to be compared on PHASE DETECTOR meter.

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
AMPLIFIER (Figure 3-7) (Cont.)		
<p>REF SEL switch (cont.)</p> <p>(Normal position)</p> <p>FINE FREQ ADJ control</p> <p>MIKE receptacle</p>	<p>INT REF EXT PH DET</p> <p>INT REF ONLY</p> <p>EXT REF ONLY</p> <p>EXT REF INT PH DET</p>	<p>Selects internal frequency standard for 1-MC reference to synthesizer and converter. PHASE DETECTOR meter indicates phase error of external reference frequency compared to internal frequency standard.</p> <p>Selects internal frequency standard for 1-MC reference to synthesizer and converter. No phase comparison.</p> <p>Selects external reference frequency for 1-MC reference to synthesizer and converter. No phase comparison.</p> <p>Selects external reference frequency for 1-MC reference to synthesizer and converter. PHASE DETECTOR meter indicates phase error of internal frequency standard compared to external reference frequency.</p> <p style="text-align: center;">Note</p> <p style="text-align: center;">Maintenance adjustment only. Proper authorization required for adjustment.</p> <p>Provides fine frequency adjustment of internal 1-MC frequency standard.</p> <p>Provides connection for type H-169/U handset for transmission of speech.</p>
CONVERTER (Figure 3-8)		
<p>POWER LAMP</p> <p>BAND SWITCH</p> <p>BAND MC counter</p> <p>RF TUNE control</p>		<p>Lights when +185 VDC from exciter power supply is applied to converter.</p> <p>Selects desired frequency band. May be set manually or automatically.</p> <p>Indicates operating band of frequencies selected by BAND SWITCH.</p> <p>Tunes converter to desired operating frequency. May be tuned manually or automatically, as selected by RF TUNE control.</p>

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
CONVERTER (Figure 3-8) (Cont.)		
<p>Frequency dial</p> <p>RF GAIN control</p> <p>(Normal position)</p> <p>SSB CARRIER INSERT switch</p> <p>(Normal position)</p> <p>PRESET CHANNEL-RF GAIN potentiometers</p>	<p>PRESET (Full CCW)</p> <p>Clockwise</p>	<p>Indicates approximate transmitter operating frequency, as selected by RF TUNE control.</p> <p>Allows adjustment of converter gain to be controlled manually and in PRESET, automatically.</p> <p>RF drive level is determined by applicable PRESET CHANNEL-RF GAIN potentiometer which is selected automatically when a frequency channel is changed.</p> <p>RF drive level is adjusted manually by rotating control clockwise for desired amount of drive (PRESET CHANNEL-RF GAIN potentiometers are disabled).</p>
		<p>Allows predetermined 1750-KC carrier levels to be inserted for reduced carrier operation.</p>
	<p>0 DB</p>	<p>Inserts predetermined carrier level of 0 DB with respect to 1 KW PEP.</p>
	<p>-10 DB</p>	<p>Inserts a predetermined carrier level of -10 DB with respect to 1 KW PEP.</p>
	<p>-20 DB</p>	<p>Inserts a predetermined carrier level of -20 DB with respect to 1 KW PEP. Some carrier is inserted into the SSB transmission to overcome poor reception due to noise.</p>
	<p>SUPPR CARRIER</p>	<p>Carrier level is suppressed 60 DB.</p>
	<p>CHANNEL</p>	<p>Provides preset gain adjustment of channel 1 through 10 of converter.</p>
	<p>1</p>	<p>Provides RF gain adjustment for operation on channel 1; must be adjusted whenever channel frequency is changed.</p>

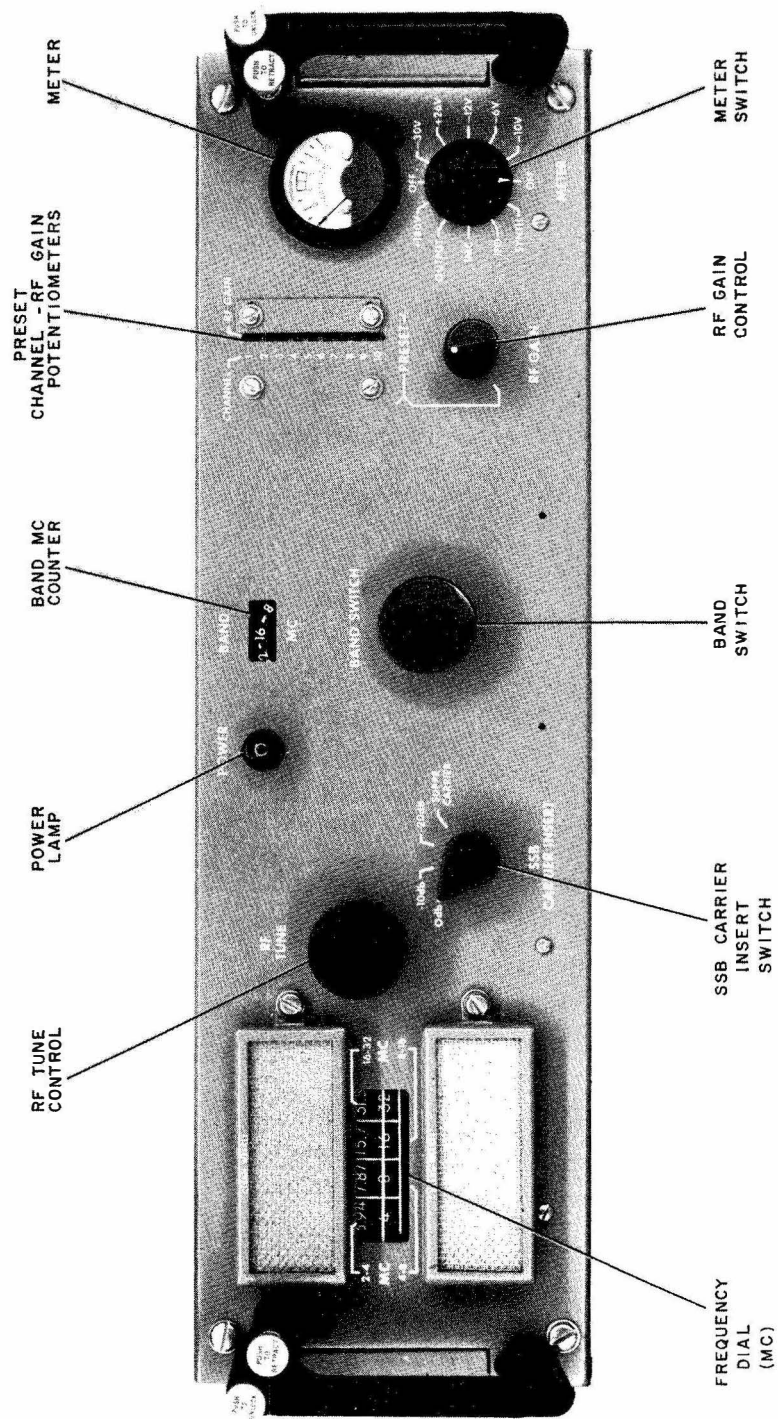


Figure 3-8. Converter, Operating Control and Indicator Locations

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
CONVERTER (Figure 3-8) (Cont.)		
PRESET CHANNEL-RF GAIN potentiometers (cont.)	2	Provides RF gain adjustment for operation on channel 2; must be adjusted whenever channel frequency is changed.
	3	Provides RF gain adjustment for operation on channel 3; must be adjusted whenever channel frequency is changed.
	4	Provides RF gain adjustment for operation on channel 4; must be adjusted whenever channel frequency is changed.
	5	Provides RF gain adjustment for operation on channel 5; must be adjusted whenever channel frequency is changed.
	6	Provides RF gain adjustment for operation on channel 6; must be adjusted whenever channel frequency is changed.
	7	Provides RF gain adjustment for operation on channel 7; must be adjusted whenever channel frequency is changed.
	8	Provides RF gain adjustment for operation on channel 8; must be adjusted whenever channel frequency is changed.
	9	Provides RF gain adjustment for operation on channel 9; must be adjusted whenever channel frequency is changed.
	10	Provides RF gain adjustment for operation on channel 10; must be adjusted whenever channel frequency is changed.
	METER	
METER switch		Selects parameters to be monitored on METER.
	OFF	METER is not operative.

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
CONVERTER (Figure 3-8) (Cont.)		
METER switch (cont.)	-30V	-30-volt input from exciter power supply is monitored on METER.*
	+26V	+26-volt input from amplifier is monitored on METER.*
	-12V	-12-volt input from exciter power supply is monitored on METER.*
	-6V	-6-volt in converter is monitored on METER.*
	-10V	-10-volt in converter is monitored on METER.*
	OFF	METER is not operative.
	SYNTH	Synthesizer input to converter is monitored on METER.*
	IFO	Intermediate frequency oscillator output is monitored on METER.*
	1MC	1-MC input from amplifier is monitored on METER.*
	OUTPUT	RF output is monitored on METER.*
+180V	+185-volt input from exciter power supply is monitored on METER (Zener diode drops voltage to +180 VDC).*	
*Proper operating level will occur in yellow area on METER.		
TRANSMITTER CONTROL (Figure 3-9)		
ON-OFF switch		Controls application of primary power to transmitter control.
POWER lamp		Lights when primary power is applied to transmitter control.
AUDIO LEVEL meter		Indicates level of audio signal selected by INPUT-OUTPUT switch.
INPUT-OUTPUT switch		Selects signal to be monitored on AUDIO LEVEL meter.

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
TRANSMITTER CONTROL (Figure 3-9) (Cont.)		
INPUT-OUTPUT switch (cont.) (Normal Position) AUDIO GAIN control CHANNEL meter EMISSION AND CHANNEL SELECTOR dial	INPUT	Audio input to transmitter control is monitored on AUDIO LEVEL meter.
	OUTPUT	Audio output of transmitter control is monitored on AUDIO LEVEL meter.
	Adjusts audio output level of transmitter control.	
	Indicates dialed channel when transmitter is operationally ready. OFF indicates transmitter is either secured or in standby.	
	Selects type of emission (CW, compatible AM, or SSB) and channel for transmitter when operating transmitter remotely. Also places transmitter in standby and turns it on and off.	
	Dial 1 through 0	Transmitter tunes to dialed channel frequency in the SSB mode of emission. CHANNEL meter indicates dialed channel when transmitter is operationally ready. Approximately 15 to 20 seconds is required for the transmitter to tune to a new channel frequency. Approximately 3 to 5 minutes is required for the transmitter to warm up and tune to a channel frequency from the transmitter off mode (filament and high voltage off).
	Dial A1*	CW type emission is selected.
	Dial A3*	Compatible AM type emission is selected.
	Dial A7*	SSB, ISB, and FSK type emission is selected.
	Dial A9	Transmitter is placed in standby (filaments on and high voltage off).
Dial A0	Transmitter is secured (filaments and high voltage off).	

* If the transmitter is in standby on the desired channel, it can be placed in operational readiness in a few seconds by dialing the type of emission.

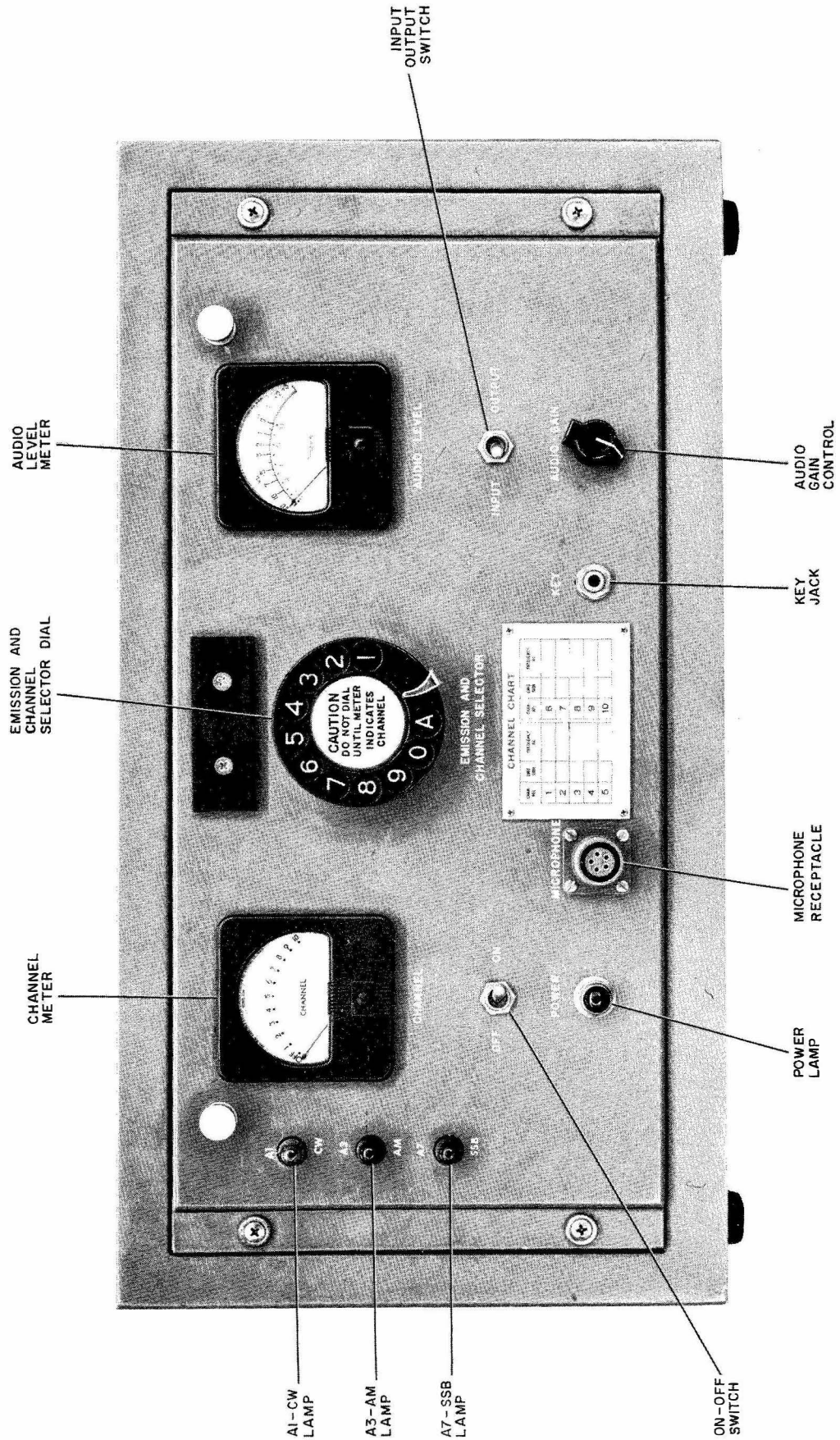


Figure 3-9. Transmitter Control, Operating Control and Indicator Locations

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
TRANSMITTER CONTROL (Figure 3-9) (Cont.)		
<p>A1-CW lamp</p> <p>A3-AM lamp</p> <p>A7-SSB lamp</p> <p>MICROPHONE receptacle</p> <p>KEY jack</p>		<p>Lights when A1 is dialed on EMISSION AND CHANNEL SELECTOR dial or when A1 is switched on by means of the SSB-CW-AM LOCAL switch located on the power control unit; light stays on indicating transmitter is set up for type A1 emission.</p> <p>Lights when A3 is dialed on EMISSION AND CHANNEL SELECTOR dial or when A3 is switched on by means of the SSB-CW-AM LOCAL switch located on the power control unit; light stays on indicating transmitter is set up for type A3a emission.</p> <p>Lights when any channel is dialed on EMISSION AND CHANNEL SELECTOR dial or when A7 is switched on by means of the SSB-CW-AM LOCAL switch located on the power control unit; light stays on indicating transmitter is set up for type A3b, A3j, or F1 emission.</p> <p>Provides connection for H-169/U handset.</p> <p>Provides connection for telegraph key.</p>
KEYER (Figure 3-10)		
<p>ON-OFF switch</p> <p>POWER lamp</p> <p>LSB LEVEL meter</p> <p>FUNCTION LSB selector</p>	<p>OFF</p>	<p>Controls application of primary power to keyer.</p> <p>Lights when primary power is applied to keyer.</p> <p>Indicates lower sideband audio output level of keyer. Level is adjustable with LSB LEVEL ADJUST.</p> <p>Selects lower sideband operating mode of keyer.</p> <p>No lower sideband output from keyer.</p>

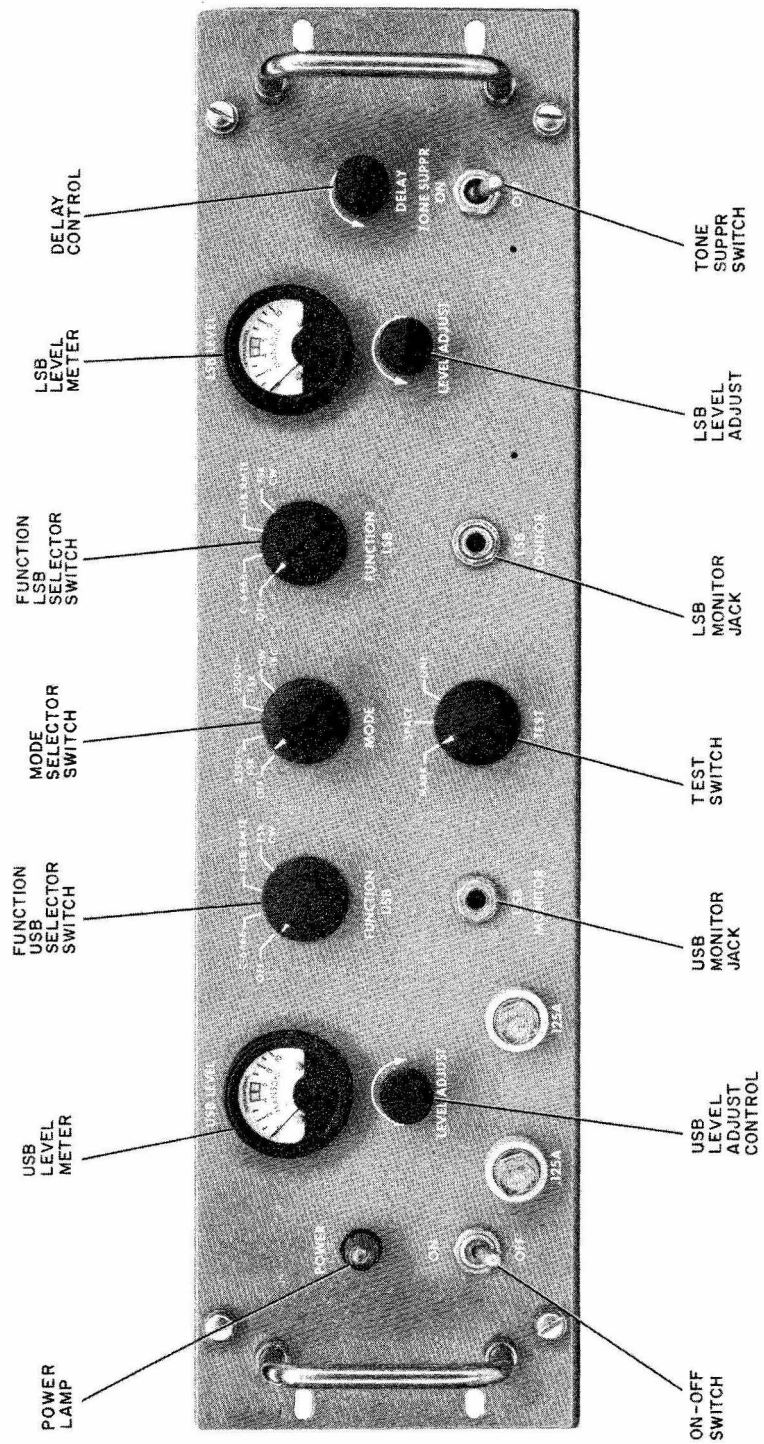


Figure 3-10. Keyer, Operating Control and Indicator Locations

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
KEYER (Figure 3-10)		
FUNCTION LSB selector (cont.)	C-6466	Selects direct line audio input from transmitter control to modulate lower sideband signal.
	LSB RMTE	Selects remote phone line input to modulate lower sideband signal.
	FSK CW	Selects frequency shift keyed 2000 CPS or frequency shift keyed 2550 CPS when MODE switch is in 2000~ FSK or 2550~ FSK position and TEST switch is in LINE position. When MODE switch is in CW 1KC position and TEST switch is in LINE position, keyer provides continuous 1-KC tone that is keyed by telegraph key at the transmitter control unit or an interrupted 1-KC tone keyed by the teletype data.
LSB LEVEL ADJUST		Adjusts lower sideband output level.
LSB MONITOR jack		Provides means of monitoring lower sideband output of keyer with headset.
USB LEVEL meter		Indicates upper sideband audio output level of keyer. Level is adjustable with USB LEVEL ADJUST.
FUNCTION USB selector switch	OFF	Selects upper sideband operating mode of keyer. No upper sideband output from keyer.
	C-6466	Selects direct line audio input from transmitter control to modulate upper sideband signal.
	USB RMTE	Selects remote phone line input to modulate upper sideband signal.

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
KEYER (Figure 3-10) (Cont.)		
<p>FUNCTION USB selector switch (cont.)</p> <p>USB LEVEL ADJUST</p> <p>USB MONITOR jack</p> <p>MODE selector switch</p> <p>TEST switch</p> <p>(Normal position)</p>	FSK CW	<p>Selects frequency shift keyed 2000 CPS or frequency shift keyed 2550 CPS when MODE switch is in 2000~ FSK or 2550~ FSK position and TEST switch is in LINE position. When MODE switch is in CW 1-KC position and TEST switch is in LINE position, keyer provides continuous 1-KC tone that is keyed by telegraph key at the transmitter control unit or an interrupted 1-KC keyed by the teletype data.</p> <p>Adjusts upper sideband output level.</p> <p>Provides means of monitoring upper sideband output of keyer with headset.</p> <p>Selects frequency shift keying signal center frequency.</p>
	OFF	<p>No frequency shift keyed output signal.</p>
	2550~ FSK	<p>Provides frequency shift keyed output with center frequency of 2550 CPS when FUNCTION USB or FUNCTION LSB selector switch is in FSK CW position.</p>
	2000~ FSK	<p>Provides frequency shift keyed output with center frequency of 2000 CPS when FUNCTION USB or FUNCTION LSB selector switch is in FSK CW position.</p>
	CW 1KC	<p>Provides continuous 1-KC tone output when FUNCTION USB or FUNCTION LSB selector switch is in FSK CW position.</p>
	LINE	<p>Selects actual or simulated teletypewriter data to produce frequency shift keyed output.</p>
	LINE	<p>Provides frequency shift keyed output produced by actual teletypewriter data from the 20/60 MA key loop.</p>

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
KEYER (Figure 3-10) (Cont.)		
TEST switch (cont.)	MARK	<p>Provides simulated "mark" output frequency. When MODE switch is in 2550~FSK position and SENSE INVERTER switch is in NORM position "mark" frequency is 2975 CPS. When SENSE INVERTER switch is thrown to INV position, "mark" frequency is 2125 CPS. When MODE switch is in 2000~FSK position and SENSE INVERTER switch is in NORM position, "mark" frequency is 2425 CPS. When SENSE INVERTER switch is thrown to INV position, "mark" frequency is 1575 CPS.</p>
	SPACE	<p>Provides simulated "space" output frequency. When MODE switch is in 2550~FSK position and SENSE INVERTER switch is in NORM position, "space" frequency is 2125 CPS. When SENSE INVERTER switch is thrown to INV position, "space" frequency is 2975 CPS. When MODE switch is in 2000~FSK position and SENSE INVERTER switch is in NORM position, "space" frequency is 1575 CPS. When SENSE INVERTER switch is thrown to INV position, "space" frequency is 2425 CPS.</p>
	ON	<p>Provides tone suppression of keyer output at end of teletypewriter message.</p>
	OFF	<p>Discontinues "mark" or "space" output frequency (depending upon position of SENSE INVERTER switch) after completion of teletypewriter message.</p> <p>No suppression of continuous "mark" or "space" frequency after completion</p>
TONE SUPPR switch (Normal position)		

TABLE 3-1. (Continued)

CONTROL OR INDICATOR	POSITION	FUNCTION
KEYER (Figure 3-10) (Cont.)		
TONE SUPPR switch (cont.)		of teletypewriter message. The keyer will provide a continuous "mark" or "space" output frequency (depending upon position of SENSE INVERTER switch) until teletypewriter begins another message.
DELAY control		Provides from 0 to 10 seconds delay before termination of keyer output frequency after completion of teletypewriter message. TONE SUPPR switch must be in ON position for DELAY control to be effective.
SENSE INVERTER switch (on rear panel) (Normal position)	NORM	Changes frequency of "mark" and "space" output. Provides "mark" output frequency (2975 CPS or 2425 CPS) with "mark" input message from teletypewriter.
	INV	Provides "space" output frequency (2125 CPS or 1575 CPS) with "mark" input message from teletypewriter.
KEYLINE INVERTER switch (on rear panel) (Normal position)	NORM	Changes polarity of input signal from teletypewriter. Provides normal operation of keyer when polarity of teletypewriter input signal is correct.
	INV	Provides normal operation of keyer when polarity of teletypewriter input signal is reversed. Keyer will not operate with reversed input polarity.

b. BEFORE OPERATION.

CAUTION

Before operating the radio set, make sure all interconnections have been made in accordance with Section 2 (Installation).

(1) PROGRAMMING PRESET CHANNELS. — Before operating the radio set for the first time or whenever changing a channel frequency, program the synthesizer to ten preset operating frequencies (channels 1 through 10). The synthesizer frequency may be determined from the Synthesizer Frequency Calibration manual supplied with the equipment, or by performing the procedure which follows. The Synthesizer Frequency Calibration manual lists the synthesizer setting for frequencies between 2-MC and 34-MC in 100-cycle steps. If an operating frequency is chosen with less than 100-cycle steps, the following procedure must be performed for the correct synthesizer setting. If the synthesizer has been programmed previously, start the equipment as described in paragraph 3-3c(1). To preset the channel operating frequencies, proceed as follows:

Notes

1. Select frequency range in accordance with frequency range of available antenna.
2. The frequency setting of the synthesizer is not necessarily the output frequency of the synthesizer.

(a) Select and record ten antenna frequencies from 2 to 30 MC.

(b) Determine operating frequencies of synthesizer for antenna frequencies selected as follows:

$$\text{SETTING} = N (f_{\text{ant}} + f_{\text{off}}) - 1.75 \text{ MC.}$$

Where: SETTING is synthesizer output frequency minus 1.75 MC. N is band divider: band divider for band A (2-4 MC) is 8, for band B (4-8 MC) is 4, for band C (8-16 MC) is 2, and for band D (16-30 MC) is 1.

f_{ant} is antenna operating frequency.

f_{off} is offset frequency of converter; for bands A and B, it is 0.450 MC, and for bands C and D, it is 1.75 MC.

Example: For antenna frequency of 6 MC

$$\begin{aligned} \text{SETTING} &= N (f_{\text{ant}} + f_{\text{off}}) - 1.75 \text{ MC} \\ &= 4 (6 \times 10^6 + 0.450 \times 10^6) - 1.75 \times 10^6 \\ &= 4 (6.450 \times 10^6) - 1.75 \times 10^6 \\ &= 25.80 \times 10^6 - 1.75 \times 10^6 \\ &= 24.05 \times 10^6 \\ &= 24.05 \text{ MC} \end{aligned}$$

(c) Pull synthesizer out of transmitter cabinet until it locks in extended position.

(d) Remove all shorting plugs from analog memory section (top of synthesizer).

(e) Insert shorting plug in BAND hole of CH → 1 corresponding to N used in determining channel 1 preset frequency.

(f) Insert shorting plug in 10-MC hole of CH → 1 corresponding to 10-MC digit determined for channel 1 preset frequency.

(g) Insert shorting plug in 1-MC hole of CH → 1 corresponding to 1-MC digit determined for channel 1 preset frequency.

(h) Insert shorting plug in 100-KC hole of CH → 1 corresponding to 100-KC digit determined for channel 1 preset frequency.

(i) Insert shorting plug in 10-KC hole of CH → 1 corresponding to 10-KC digit determined for channel 1 preset frequency.

(j) Insert shorting plug in 1-KC hole of CH → 1 corresponding to 1-KC digit determined for channel 1 preset frequency.

(k) Insert shorting plug in 100~ hole of CH → 1 corresponding to 100-cycle digit determined for channel 1 preset frequency.

(l) Repeat steps (e) through (k) for channels 2 through 10.

(m) Record preset frequencies on front panel of synthesizer above corresponding CHANNEL INDICATOR lamps.

(n) Push synthesizer into transmitter and secure in place.

(o) Record type of emission and output power that will be used on each preset channel above corresponding CHANNEL INDICATOR lamps.

(2) SETTING AUTOTUNE SYSTEM. —

Set the autotune system only if the synthesizer channels are preset to a different operating frequency or if the autotune system controls have been moved. Set controls as indicated in table 2-3.

Note

Make sure EXCITER OUTPUT jack is connected to 1st AMPL INPUT jack on patch panel and that transmitter is terminated in a dummy load.

(a) Turn LOCAL-REMOTE switch to LOCAL.

(b) Throw PRIMARY CIRCUIT BREAKER, located on power control assembly to ON.

(c) Turn SSB-CW-AM LOCAL switch to SSB.

Note

Make certain TEST KEY switch is in center position; APC ON-OFF switch is OFF; and POWER FORWARD — REVERSE switch is in FORWARD. REF SEL switch on the amplifier should be in INT REF ONLY.

(d) Pull out FILAMENT switch.

(e) Throw power switch, located on synthesizer and exciter power supplies, to ON and check voltages.

(f) Allow equipment to warm up for at least five minutes.

Note

Make certain locking screws on all autotune system controls, located on RF assembly, are secure.

(g) Turn SERVO MODE switch to AUTO TUNE.

(h) Throw MOTOR DRIVE switch, located on synthesizer, to ON.

(i) Press START switch momentarily. Allow autotune system to cycle.

(j) Turn RF GAIN control, located on converter, fully counterclockwise but not to PRESET.

(k) Turn SSB CARRIER INSERT control to 0 DB.

(l) Turn CHANNEL SELECTOR switch, located on RF assembly, to reprogrammed synthesizer channel and allow autotune system to cycle.

(m) After autotune system has cycled, loosen all locking screws on autotune knobs.

ORIGINAL

(n) Turn autotune system controls to positions indicated in table 3-2 for approximate settings corresponding to reprogrammed channel frequency of synthesizer.

(o) Turn LV-TUNE-OPERATE switch to LV.

(p) Pull out PLATE switch, located on power control assembly.

(q) Throw TEST KEY switch, located on RF assembly, to up (locked position). Connect patch cord to PA 1st AMPL INPUT jack on patch panel.

(r) Turn MULTIMETER switch, located on RF assembly, to DRIVER PLATE MA X100. Adjust DRIVER BIAS for 50 MA.

(s) Turn METER SWITCH, located on converter, to OUTPUT and adjust RF GAIN control for two divisions on METER and adjust EXCITER TUNING control for peak reading on MULTIMETER.

(t) Adjust DRIVER PLATE TUNING control for dip on MULTIMETER.

(u) Turn LV-TUNE OPERATE switch to OPERATE and adjust PA BIAS for a nominal reading on PA CATHODE meter.

(v) Turn LV-TUNE-OPERATE switch to TUNE and readjust RF EXCITER DRIVE for 200 watts out of PA and a 400-MA reading on the PA CATHODE meter.

(w) Adjust P.A. PLATE TUNING control for dip on PA CATHODE meter.

(x) Adjust P.A. LOADING control for green area indication on LOADING meter. Readjust P.A. PLATE TUNING control to maintain resonance in power amplifier plate circuit. (Resonance is indicated by a minimum dip in reading on P.A. CATHODE meter.) Check that LOADING meter pointer is approximately 1/4 inch to the right of the green area. Reduce RF GAIN control to zero output.

(y) Turn LV-TUNE-OPERATE switch to OPERATE.

(z) Alternately adjust PA LOADING control and PA PLATE TUNING control to keep LOADING meter in green area and PA CATHODE meter dipped. Adjust RF GAIN control for 1 KW on POWER OUTPUT meter. PA CATHODE meter should read 750 MA nominal.

(aa) Compare all meter readings with those in table 3-11 (type A1 emission). If they do not agree, repeat steps (1) through (z).

TABLE 3-2. AUTOTUNE TUNING CHART

FREQ (MC)	BAND SWITCH	APPROX POSITION OF CONTROLS					APPROX METER READINGS				
		P.A. LOAD- ING	DRIVER PLATE	LOADING COIL SWITCH	P.A. PLATE	EXCITER TUNING	MULTI METER*	PLATE VOLT- AGE	P.A. CATHODE (NOMINAL)	LOAD- ING	POWER OUTPUT (KW PEP)
2	1	44	4	1	32	12	50-60	3000	750 MA	Green	1
3	1	80	70	1	75	64	50-60	3000	750 MA	Green	1
3	2	50	14	2	30	42	50-60	3000	750 MA	Green	1
4	2	77	60	2	62	92	50-60	3000	750 MA	Green	1
4	3	61	26	3	45	54	50-60	3000	750 MA	Green	1
6	3	92	76	3	78	88	50-60	3000	750 MA	Green	1
6	4	79	54	4	65	24	50-60	3000	750 MA	Green	1
8	4	93	80	4	82	66	50-60	3000	750 MA	Green	1
8	5	55	38	5	65	38	50-60	3000	750 MA	Green	1
12	5	90	80	5	90	86	50-60	3000	750 MA	Green	1
12	6	67	40	6	71	40	50-60	3000	750 MA	Green	1
16	6	90	72	6	86	76	50-60	3000	750 MA	Green	1
16	7	42	28	6	48	34	50-60	3000	750 MA	Green	1
24	7	74	78	9	83	88	50-60	3000	750 MA	Green	1
24	8	61	54	9	68	38	50-60	3000	750 MA	Green	1
30	8	79	82	10	81	64	50-60	3000	750 MA	Green	1

* Multimeter switch on RF assembly in DR. PLATE MA X 100 position.

(ab) After all tuning controls of auto-tune system have been properly adjusted, tighten locking screws and record all control settings on a sheet of paper.

(ac) Turn RF GAIN control, located on converter, to zero output.

(ad) Remove cable to 1st AMPL INPUT jack located on patch panel, and connect it to 50-OHM LOAD jack.

(ae) Turn RF GAIN control, located on converter, to PRESET and adjust Preset Potentiometer for Channel 1 to zero output.

(af) Disconnect cable to 50 OHM LOAD jack, located on patch panel and connect it to 1st AMPL INPUT jack, located on patch panel.

(ag) Adjust CHANNEL 1 Preset Potentiometer located on converter for desired output power on POWER OUTPUT meter, located on RF assembly.

(ah) Turn CHANNEL SELECTOR switch located on RF assembly, to 2. After auto-tune system has cycled, set CHANNEL SELECTOR switch to channel 1. Autotune system controls should return to positions recorded in step (ab). If controls do not return to correct positions, repeat steps (a) through (ag).

(ai) Repeat steps (1) through (ah) for preset channels 2 through 10.

(aj) Slide PRESET CHANNEL-RF GAIN cover to left and tighten the two screws.

(ak) Turn RF GAIN control, located on converter, for 1 KW on RF assembly POWER OUTPUT meter.

(al) Throw APC ON-OFF switch on RF assembly to ON.

c. SEQUENCE OF OPERATION. — To operate the radio set, proceed as follows:

(1) STARTING LOCALLY. To start the radio set locally, set controls as indicated in table 3-3.

Note

If preset operating frequencies must be changed, refer to paragraphs 3-3b(1) and 3-3b(2).

(2) STARTING REMOTELY. — To start the radio set remotely, set controls as indicated in table 3-3 and proceed as follows:

(a) Turn LOCAL—REMOTE switch, located on power control assembly, to REMOTE.

(b) Throw ON-OFF switch, located on transmitter control, to ON.

(c) The radio set can now be started, with telephone-type dial switch on transmitter control. Dialing desired channel number starts radio set automatically.

(3) OPERATING LOCAL—AUTOMATIC. — To operate the radio set local-automatic, proceed as follows:

(a) Turn LOCAL—REMOTE switch, located on power control assembly, to LOCAL.

(b) Turn CHANNEL SELECTOR switch, located on RF assembly, to desired channel.

(c) Refer to tables 3-4 through 3-6 for desired type of emission and perform steps as indicated.

(4) OPERATING REMOTE-AUTOMATIC. — To operate the radio set remote-automatic, proceed as follows:

CAUTION

Perform following steps only when radio set has been properly tuned and adjusted as described in paragraphs 3-3b(1) and 3-3b(2).

(a) Turn LOCAL—REMOTE switch, located on power control, to REMOTE.

(b) Refer to tables 3-7 through 3-10 for desired type of emission and perform steps as indicated.

(5) OPERATING LOCAL-SEMI-AUTOMATIC.

Note

Only use this type of operation when an operating frequency other than a preset channel frequency is desired.

To operate the radio set local-semi-automatic, proceed as follows:

(a) Turn LOCAL-REMOTE switch, located on power control, to LOCAL.

(b) Turn CHANNEL SELECTOR switch, located on RF assembly, to channel with frequency that is seldom used.

(c) Turn SERVO MODE selector switch, located on synthesizer, to MANUAL AUTO.

(d) Throw MOTOR DRIVE switch to ON.

(e) Determine operating frequency of synthesizer as indicated below.

BAND	RANGE (MC)	SETTING
A	2-4	8F + 1.8500
B	4-8	4F + 0.0500
C	8-16	2F + 1.7500
D	16-32	F

(f) Set frequency, determined above, on MANUAL SETTING digital switch.

(g) Turn BAND switch, located on synthesizer, to band selected in step (e).

(h) Energize transmitter as described in paragraphs 3-3b(2)(a) through 3-3b(2)(f).

(i) Momentarily press START switch located on synthesizer.

(j) Turn RF GAIN control, located on converter, counterclockwise but not to PRESET.

(k) Turn SSB CARRIER INSERT control to SUPPR CARRIER.

(l) Set autotune system controls, located on RF assembly, as described in paragraph 3-3b(2)(n) through 3-3b(2)(ab).

(m) Refer to tables 3-4 through 3-6 for desired type of emission and perform steps as indicated.

(6) STOPPING LOCALLY. — To shut down the radio set locally, push in the FILAMENT switch, located on the power control. The plate and filament hold circuits will be open and the transmitter will not operate until the starting procedure described in paragraph 3-3b(1) is performed.

(7) STOPPING REMOTELY. — To turn off the plate power supplied and put the transmitter on standby, dial A9 on the EMISSION AND CHANNEL SELECTOR dial switch, located on the transmitter control. To turn off all power supplies, dial A0. To turn off the transmitter control, throw its ON-OFF switch to OFF. To turn off the keyer, throw its ON-OFF switch to OFF.

d. INDICATOR PRESENTATIONS. — Typical meter readings for the various modes of emission are given in tables 3-11 through 3-15. Under normal operation the OVEN CYCLE indicator lamp on the amplifier will cycle "on" and "off" at regular rate.

3-4. SUMMARY OF OPERATING PROCEDURES.

A summary of operating procedures for the radio set is given in table 3-16. There is also an equipment check-out procedure in the rear of the manual for quickly and effectively checking out the transmitter.

TABLE 3-3. STARTING CONTROL SETTINGS FOR A PRE-TUNED TRANSMITTER

CONTROL NAME	LOCATION	POSITION
LOCAL-REMOTE switch	Power Control	LOCAL
PRIMARY CIRCUIT BREAKER	Power Control	ON
SSB-CW-AM LOCAL switch	Power Control	Desired emission
FILAMENT switch	Power Control	Pulled Out
ON-OFF switch	Synthesizer Power Supply	ON
ON-OFF Switch	Exciter Power Supply	ON
SERVO MODE switch	Synthesizer	AUTOTUNE
MOTOR DRIVE ON switch	Synthesizer	ON
RF GAIN control	Converter	PRESET
SSB CARRIER INSERT switch	Converter	SUPPR CARRIER
LV-TUNE-OPERATE switch	RF Assembly	OPERATE
PLATE switch	Power Control	Pulled out
LSB selector switch	Amplifier	LINE
USB selector switch	Amplifier	LINE
REF SEL switch	Amplifier	INT REF ONLY
POWER FORWARD-REVERSE switch	RF Assembly	FORWARD

TABLE 3-4. COMPATIBLE AM, LOCAL-AUTOMATIC OPERATION CONTROL SETTINGS

DIRECTION TO OPERATOR	LOCATED ON FRONT PANEL OF
1. Turn SSB-CW-AM LOCAL switch to AM.	Power Control
2. Turn USB selector switch to MIKE.	Amplifier
3. Connect Handset H-169/U to MIKE receptacle. Press press-to-talk switch and talk at normal level into handset transmitter while adjusting MIKE LEVEL control for red line PEAK readings on USB LEVEL meter.	Amplifier
4. To transmit phone-line information, set applicable sideband selector switch to LINE AMPL or LINE position and other sideband selector switch to OFF.	Amplifier

TABLE 3-5. INDEPENDENT SIDEBAND, LOCAL-AUTOMATIC OPERATION,
CONTROL SETTINGS

DIRECTION TO OPERATOR	LOCATED ON FRONT PANEL OF
1. Turn SSB-CW-AM LOCAL switch to SSB.	Power Control
2. Turn USB selector switch to MIKE.	Amplifier
3. Turn LSB selector switch to MIKE.	Amplifier
4. Connect Handset H-169/U to MIKE receptacle. Press press-to-talk switch and talk at normal level into handset transmitter while adjusting MIKE LEVEL control for red line PEAK readings on LSB LEVEL AND USB LEVEL meters.	Amplifier
5. To transmit phone-line information set LSB and USB selector switches to LINE AMPL or LINE position as desired.	Amplifier

TABLE 3-6. SINGLE SIDEBAND, LOCAL-AUTOMATIC OPERATION,
CONTROL SETTINGS

DIRECTION TO OPERATOR	LOCATED ON FRONT PANEL OF
1. Turn SSB-CW-AM LOCAL switch to SSB.	Power Control
2. Turn USB or LSB selector switch (depending upon sideband selected) to MIKE and other sideband switch to OFF.	Amplifier
3. Connect Handset H-169/U to MIKE receptacle. Press press-to-talk switch and talk at normal level into handset transmitter while adjusting MIKE LEVEL control for red line PEAK readings on USB LEVEL or LSB LEVEL meter.	Amplifier
4. To transmit phone-line information, set applicable sideband selector switch to LINE AMPL or LINE position and other sideband selector switch to OFF.	Amplifier

TABLE 3-7. CONTINUOUS WAVE, REMOTE-AUTOMATIC OPERATION,
CONTROL SETTINGS

DIRECTION TO OPERATOR	LOCATED ON FRONT PANEL OF
1. Connect telegraph key to KEY jack.	Transmitter Control
2. Throw ON-OFF switch to ON.	Keyer
3. Throw TONE SUPPR switch to ON.	Keyer
4. Turn TEST switch to LINE.	Keyer
5. Dial desired channel number on EMISSION AND CHANNEL SELECTOR dial switch. When transmitter is set up on selected channel, channel number appears on CHANNEL meter.	Transmitter Control
6. Dial A1 on EMISSION AND CHANNEL SELECTOR dial switch.	Transmitter Control
7. For CW-operation, key the transmitter with telegraph key.	Transmitter Control

TABLE 3-8. COMPATIBLE AM, REMOTE-AUTOMATIC OPERATION, CONTROL SETTINGS

DIRECTION TO OPERATOR	LOCATED ON FRONT PANEL OF
1. Connect handset H-169/U to MICROPHONE receptacle.	Transmitter Control
2. Throw ON-OFF switch to ON.	Keyer
3. Throw TONE SUPPR switch to ON.	Keyer
4. Adjust applicable LEVEL ADJUST control so that the pointer on corresponding level meter is in center of yellow area.	Keyer
5. Turn TEST switch to LINE.	Keyer
6. Throw SENSE INVERTER and KEYLINE INVERTER switches (rear panel) to NORM or to INV position for inverted operation.	Keyer
7. Dial desired channel number on EMISSION AND CHANNEL SELECTOR dial switch. When transmitter is set up on selected channel, channel number appears on CHANNEL meter.	Transmitter Control
8. Dial A3 on EMISSION AND CHANNEL SELECTOR dial switch.	Transmitter Control
9. For phone operation press the press-to-talk switch on the handset.	Transmitter Control
10. Adjust AUDIO GAIN control to nominal level on AUDIO LEVEL meter.	Transmitter Control

TABLE 3-9. INDEPENDENT SIDEBAND, AND SINGLE SIDEBAND, REMOTE-AUTOMATIC OPERATION, CONTROL SETTINGS

DIRECTION TO OPERATOR	LOCATED ON FRONT PANEL OF
1. Connect handset H-169/U to MICROPHONE receptacle.	Transmitter Control
2. Throw ON-OFF switch to ON.	Keyer
3. Throw TONE SUPPR switch to ON.	Keyer
4. Turn MODE switch to desired mode of operation.	Keyer
5. Turn FUNCTION USB or FUNCTION LSB switch to desired position.	Keyer
6. Adjust applicable LEVEL ADJUST control so that the pointer on corresponding level meter is in center of yellow area.	Keyer
7. Turn TEST switch to LINE.	Keyer
8. Throw SENSE INVERTER and KEYLINE INVERTER switches (rear panel) to NORM or to INV position for inverted operation.	Keyer
9. Dial desired channel number on EMISSION AND CHANNEL SELECTOR dial switch. When transmitter is set up on selected channel, channel number appears on CHANNEL meter.	Transmitter Control
10. Dial A7 on EMISSION AND CHANNEL SELECTOR dial switch.	Transmitter Control
11. For phone operation press the press-to-talk switch on the handset.	Transmitter Control
12. Adjust AUDIO GAIN control to nominal level on AUDIO LEVEL meter.	Transmitter Control

TABLE 3-10. FREQUENCY SHIFT KEYING, REMOTE-AUTOMATIC OPERATION, CONTROL SETTINGS

DIRECTION TO OPERATOR	LOCATED ON FRONT PANEL OF
1. Throw ON-OFF switch to ON.	Keyer
2. Throw TONE SUPPR switch to ON.	Keyer
3. Turn MODE switch to desired mode of operation.	Keyer
4. Turn FUNCTION USB or FUNCTION LSB switch to desired position.	Keyer
5. Adjust applicable LEVEL ADJUST control so that the pointer on corresponding level meter is in center of yellow area.	Keyer
6. Turn TEST switch to LINE.	Keyer
7. Throw SENSE INVERTER and KEYLINE INVERTER switches (rear panel) to NORM or to INV position for inverted operation.	Keyer
8. Dial desired channel number on EMISSION AND CHANNEL SELECTOR dial switch. When transmitter is set up on selected channel, channel number appears on CHANNEL meter.	Transmitter Control
9. Dial A7 on EMISSION AND CHANNEL SELECTOR dial switch.	Transmitter Control

TABLE 3-11. RF ASSEMBLY AND TRANSMITTER CABINET, TYPICAL METER READINGS

METER	SWITCH AND POSITION	MODE/READING				
		CW (A1)	Compatible AM (A3a)	ISB (A3b)	SSB (A3j)	FSK (F1)
PRIMARY VOLTAGE		208/230	208/230	208/230	208/230	208/230
PLATE VOLTAGE		3000	3000	3000	3000	3000
MULTIMETER	MULTIMETER switch					
	OFF	0	0	0	0	0
	DR GRID MAx20	0	0	0	0	0
	DR PLATE MAx100	0.55	0.55	0.55	0.55	0.55
	PA GRID MAx 20	0	0	0	0	0
	PA SCREEN MAx100	0.22	0.22	0.22	0.22	0.22

TABLE 3-11. (Continued)

METER	SWITCH AND POSITION	MODE/READING					
		CW (A1)	Compatible AM (A3a)	ISB (A3b)	SSB (A3j)	FSK (F1)	
MULTIMETER (Cont.)	DR PLATE \times 100	0.6	0.6	0.6	0.6	0.6	
	1st AMPL V_{\times} 100	0.3	0.3	0.3	0.3	0.3	
	PA SCREEN V_{\times} 1000	0.63	0.63	0.63	0.63	0.63	
	DR BIAS V_{\times} 200 (NOMINAL)	0.2	0.2	0.2	0.2	0.2	
	PA BIAS V_{\times} 200 (NOMINAL)	0.4	0.4	0.4	0.4	0.4	
	PA FIL/ V_{\times} 10	0.6	0.6	0.6	0.6	0.6	
P.A. CATHODE (NOMINAL)		750	500	750	750	750	
LOADING		GREEN AREA					
POWER OUTPUT	POWER FORWARD-REVERSE switch						
	FORWARD						Desired output
	REVERSE						Approx. zero

TABLE 3-12. SYNTHESIZER TYPICAL METER READINGS

METER SELECTOR SWITCH POSITIONS	METER READINGS
BRIDGE COURSE MANUAL TUNE	0
100 KC LOOP FINE MAN. TUNE	0
10 KC LOOP	0
1 KC LOOP	0
100 CPS LOOP	0
LIMITER	(-) Direction
INCR MONITOR	0
+180V DC	+2.5 to +3.5
+28V DC	+2.5 to +3.5
6 V FIL	+2.5 to +3.5
GROUND	0

TABLE 3-13. AMPLIFIER TYPICAL METER READINGS

METER SELECTOR SWITCH POSITIONS	METER READINGS
LSB LEVEL METER (WITH TONE APPLIED)	
OFF	None
LINE AMPL	Red line ± yellow area
LINE	Red line ± yellow area
MIKE	Red line ± yellow area
USB LEVEL METER (WITH TONE APPLIED)	
OFF	None
LINE AMPL	Red line ± yellow area
LINE	Red line ± yellow area
MIKE	Red line ± yellow area
PHASE DETECTOR METER (WITH EXTERNAL STANDARD APPLIED)	
INT REF EXT PH DET	Needle cycles (speed of cycle depends on frequency difference)
INT REF ONLY	None
EXT REF ONLY	None
EXT REF INT PH DET	Needle cycles (speed of cycling depends on frequency difference)

TABLE 3-14. CONVERTER TYPICAL METER READINGS

METER SELECTOR SWITCH POSITIONS	METER READINGS
OFF	None
SYNTH	Approximately 2-8
IFO	Red line ± yellow area
1MC	Red line ± yellow area
OUTPUT	Variable, approximately 3-4
+180V	Red line ± yellow area
OFF	None
-30V	Red line ± yellow area
+26V	Red line ± yellow area
-12V	Red line ± yellow area
-6V	Red line ± yellow area
-10V	Red line ± yellow area

TABLE 3-15. EXCITER POWER SUPPLY, TYPICAL METER READINGS

VOLTAGE SELECTOR SWITCH POSITIONS	VOLTAGE METER READING
+185R	+185
+270	+270
+185R	+185
+240	+240
-30	-30

TABLE 3-16. SUMMARY OF OPERATING PROCEDURES

STEP	PROCEDURE
	<p>Note</p> <p>To change preset operating frequencies, refer to paragraphs 3-3b(1) and 3-3b(2).</p>
STARTING LOCALLY	
1.	Turn LOCAL-REMOTE switch on power control to LOCAL.
2.	Throw PRIMARY CIRCUIT BREAKER on power control to ON.
3.	Turn SSB-CW-AM LOCAL switch on power control to desired emission.
4.	Turn SERVO MODE switch on synthesizer to AUTO TUNE.
5.	Turn RF GAIN control on converter to PRESET.
6.	Turn SSB CARRIER INSERT switch on converter to SUPFR CARRIER position.
7.	Turn LV-TUNE-OPERATE switch on RF assembly to OPERATE.
8.	Turn REF SEL switch on amplifier to INT REF ONLY.
9.	Pull out FILAMENT switch on power control.
10.	Throw ON-OFF switch on synthesizer and exciter power supplies to ON.
11.	Allow equipment to warm up for at least 5 minutes.
12.	Throw MOTOR DRIVE ON switch on synthesizer to ON.
13.	Momentarily press START switch on synthesizer.
14.	Pull out PLATE switch on power control.
15.	Turn LSB selector switch on amplifier to LINE AMPL.
16.	Turn USB selector switch on amplifier to LINE AMPL.

TABLE 3-16. (Continued)

STEP	PROCEDURE
STARTING REMOTELY	
17.	Perform steps 1 through 16.
18.	Turn LOCAL-REMOTE switch on power control assembly to REMOTE.
19.	Throw ON-OFF switches on transmitter control and keyer to ON.
20.	Dial desired channel number on EMISSION AND CHANNEL SELECTOR dial switch on transmitter control.
OPERATING LOCAL-AUTOMATIC	
21.	Perform steps 1 through 16.
22.	Turn CHANNEL SELECTOR switch on RF assembly to desired channel.
23.	Refer to tables 3-4 through 3-6 for desired type of emission and perform steps as indicated.
OPERATING REMOTE-AUTOMATIC	
24.	Perform steps 17 through 20.
25.	Refer to tables 3-6 through 3-10 for desired type of emission and perform steps as indicated.
OPERATING LOCAL-SEMI-AUTOMATIC	
26.	Perform steps 1 through 16.
27.	Turn CHANNEL SELECTOR switch on RF assembly to channel with frequency that is seldom used.
28.	Turn SERVO MODE switch on synthesizer to MANUAL CHANNEL AUTO.
29.	Determine operating frequency of synthesizer as described in paragraphs 3-3c(5)(e).
30.	Set frequency determined in step 29 on MANUAL SETTING digital switch on synthesizer.
31.	Turn BAND switch on synthesizer to band selected in step 29.
32.	Throw MOTOR DRIVE ON switch on synthesizer to ON.
33.	Momentarily press START switch on synthesizer.
34.	Turn RF GAIN control on converter counterclockwise but not to PRESET position.
35.	Turn SSB CARRIER INSERT control to SUPPR CARRIER.
36.	Set autotune system controls on RF assembly as described in paragraphs 3-3b(2)(n) through 3-3b(2)(ab).
37.	Refer to tables 3-4 through 3-6 for desired type of emission and perform steps as indicated.
STOPPING LOCALLY	
38.	Push in FILAMENT switch on power control.
STOPPING REMOTELY	
39.	Dial A9 EMISSION AND CHANNEL SELECTOR dial switch on transmitter control for standby.
40.	Dial A0 on EMISSION AND CHANNEL SELECTOR dial switch on transmitter control to secure transmitter.
41.	Throw ON-OFF switch on transmitter control to OFF.
42.	Throw ON-OFF switch on keyer to OFF.

3-5. EMERGENCY OPERATION.

In an emergency, the radio set can be manually tuned. Also, an external 5-MC or 1-MC reference signal can be used if the internal 1-MC frequency standard fails.

a. MANUAL TUNING. — Tune the transmitter manually, as follows:

- (1) Start radio set as described in paragraph 3-3c(1).
- (2) Throw MOTOR DRIVE ON switch, located on synthesizer, to OFF.
- (3) Turn SERVOMODE switch to MANUAL CHANNEL SYNTH BRDG.
- (4) Determine operating frequency of synthesizer as indicated below.

BAND	RANGE (MC)	SETTING
A	2-4	8F + 1.8500
B	4-8	4F + 0.0500
C	8-16	2F + 1.7500
D	16-32	F

- (5) Set frequency, determined above, on MANUAL SETTING digital switches.
- (6) Turn BAND switch, located on synthesizer, to band selected in step (4).
- (7) Turn TEST METER switch to BRIDGE COARSE MANUAL TUNE.
- (8) Press and hold READ NULL switch and adjust MANUAL TUNE control on TEST METER. Release NULL switch.

Note

A null is indicated by minimum TEST METER indication in either direction. When this is reached, further adjustment of MANUAL TUNE control, in either direction, sharply increases the meter indication.

- (9) Turn test meter switch to 100 KC LOOP FINE MAN. TUNE.
- (10) Turn SERVOMODE switch to MANUAL CHANNEL LOOP.
- (11) Press and hold PUSH TO OPERATE switch and adjust MANUAL TUNE control for null on TEST METER. Release PUSH TO OPERATE switch.
- (12) Press and hold READ NULL switch and repeat step (8). Release READ NULL switch.

(13) Turn test meter switch to LIMITER. The TEST METER should give a negative (-) reading indicating that all loops are locked. If reading is positive (+), repeat steps (7) through (13).

(14) Connect patch cable between EXCITER OUTPUT jack and EXCITER 50ΩLOAD jack on patch panel.

(15) Turn BAND SWITCH, located on converter, to center of frequency band on BAND MC counter.

(16) Turn RF TUNE control for operating frequency on frequency dial.

(17) Turn METER switch to OUTPUT and press the press-to-talk switch on handset.

(18) Adjust RF TUNE control for maximum reading on TEST METER.

(19) Disconnect patch cable from EXCITER LOAD jack on patch panel and connect to PA. 1st AMPL INPUT jack.

(20) Set autotune system controls, located on RF assembly, to operating frequency as described in paragraphs 3-3b(2)(n) through 3-3b(2)(ab).

(21) Refer to tables 3-4 through 3-6 for desired type of emission and perform steps as indicated.

b. LOCAL OPERATION. — This procedure covers operation of the transmitter from a local position when the automatic tuning controls are not in service, or when the transmitter control unit is not in service, or when both functions are not in service.

(1) When the transmitter control unit is out of service or when the transmitter control cables are damaged, turn the primary power off and remove all connections from terminal board 1A13A1TB603.

(2) Follow procedure as described in paragraph 3-3a(3), OPERATING LOCAL-AUTOMATIC or paragraph 3-3a(5), OPERATING LOCAL-SEMIAUTOMATIC.

(3) When the automatic tuning controls are out of service, follow procedure as described in paragraph 3-5a, MANUAL TUNING.

c. SUBSTITUTION OF EXTERNAL REFERENCE SIGNAL. — To substitute an external reference signal for the internal frequency standard, proceed as follows:

(1) Connect an external 1-MC or 5-MC reference signal (with a stability equal to or better than 1 part in 10⁸ per day) to J615, located next to the RF output jack in the bottom of the right-hand cabinet.

(2) Turn REF SEL switch, located on amplifier, to EXT REF ONLY.

(3) Proceed with normal operation and notify maintenance personnel.

3-6. OPERATOR'S MAINTENANCE.

a. GENERAL. — Electronic technicians are responsible for monitoring and repairing the radio set; however, to reduce the technician workload, routine preventive and corrective maintenance items which do not require elaborate test equipment are normally assigned to the operator. To meet this responsibility, complete familiarity with the equipment and its functional sections is mandatory. In this way, the troubles can be isolated, located, and corrected before they become serious. Under normal operation, however, all repairs and adjustments should be made only by the technician.

b. OPERATING CHECKS AND ADJUSTMENTS. — Make the following checks and adjustments before and during operation.

(1) GENERAL CHECKS. — Before operating the equipment after repairs have been made, check that the equipment is properly grounded and that all tubes, fuses, and indicator lamps are inserted in their proper receptacles. Check equipment power controls for work tags. If work tags are attached, do not operate equipment until they are removed by maintenance personnel and equipment is said to be operational. During operation, check meter readings on equipment against readings given in tables 3-11 through 3-15. Check blown fuse indicators for blown fuses. Check that applicable indicator lamps are lighted and that OVEN CYCLE indicator lamp on the converter cycles on and off.

(2) INTERNAL FREQUENCY STANDARD CHECK. — To monitor and adjust the internal frequency standard, using an external high-stability (with stability equal to or greater than 1 part in 10^8 per day) 1-MC or 5-MC reference signal, proceed as follows:

(a) Energize radio set as described in paragraph 3-3c(1) and allow to warm up for approximately 1 hour.

(b) Connect an external 1-MC or 5-MC reference signal (with stability equal to or greater than 1 part in 10^8 per day) to jack J615 located next to the RF output jack in the bottom of the right-hand cabinet.

(c) Turn REF SEL switch, located on amplifier, to REF EXT PH DET. When the internal and external reference signals are in phase, the PHASE DETECTOR meter reading is zero. Any phase or frequency difference between the two reference signals causes the PHASE DETECTOR meter pointer to cycle from left to right as signals go in and out of phase. One full cycle of the needle is from center scale to maximum right, back to center scale, to maximum left, and return to center scale. Timing the cycles of the pointer provides the following information

regarding the difference between the internal and external reference signals:

1 cycle per second = frequency difference of 1 part in 10^6

1 cycle per 10 seconds = frequency difference of 1 part in 10^7

1 cycle per 100 seconds = frequency difference of 1 part in 10^8

Note

Proper authorization is required for step (d). Maintenance adjustment only.

(d) If the frequency of internal 1-MC reference signal requires adjustment, release the locking mechanism on the FINE FREQ ADJ control and rotate the control for minimum cycling of PHASE DETECTOR meter pointer.

(e) Turn REF SEL switch back to INT REF ONLY and disconnect external reference signal.

c. PREVENTIVE MAINTENANCE. — Refer to Maintenance Standards Book NAVSHIPS 0967 009 2060, Radio Transmitting Set AN/FRT-24A, for routine preventive maintenance checks that should be performed by the operator before, during, and after operation.

d. EMERGENCY MAINTENANCE. — Sometimes the equipment may fail when technician services are not available. If the radio set must be kept in service, the operator must locate the source of the trouble, determine its nature, and make the necessary repairs. The following paragraphs provide a general discussion of troubleshooting the radio set to determine which unit or assembly is defective.

(1) TROUBLE ISOLATION. — The radio set consists of several interconnected units and assemblies, each of which performs a specific function. A component failure in one of these units usually will affect another which in turn will affect others. Depending upon the function of the defective component, the result may range in seriousness from reduced frequency stability or reduced transmitter power output to a complete breakdown of the equipment. A haphazard search for the defective part may only locate it accidentally. A more efficient approach is to locate the unit in which the trouble has occurred, and isolate it to the defective assembly or stage(s). The repair can be greatly simplified by adhering to these procedures and making the following checks:

(a) Obtain information from previous operator and review radio set history in log book. Then verify reported abnormal operation.

(b) Check position of all controls to make sure they have not been accidentally moved from the normal position.

(c) Check all meter readings and make monitor adjustments of tuning controls to verify proper tuning.

(d) If the radio set is apparently dead, check input power and any external equipment. Note whether any other equipment connected to the same power line is affected.

(e) Check all fuses to determine the power circuit affected by the trouble. Never replace a fuse before examining the circuit to make sure the defect is not permanent.

(f) Make sure all connections between units, to antenna, and to external or remote control equipment, are properly made.

(g) Inspect all tubes and plug-in electronic assemblies or subassemblies, noting whether they are properly seated in their sockets.

(h) Inspect all terminal boards on racks and on each unit or assembly for broken or loose connections.

(i) Visually inspect for flashover of rectifier tubes. Abnormal color may be indicative of improper operation.

(2) OPERATOR'S FUSE FAILURE GUIDE. — A guide to help the operator determine the defective fuse(s) is contained in table 3-17.

(3) FUSE REPLACEMENT AND RESETTING OF CIRCUIT BREAKER. — The power control contains all fuses for the transmitter. Fuses for the synthesizer are located on the synthesizer power supply. Fuses for the amplifier and converter are located on their rear panels and on the exciter power supply. The primary power circuit breaker, which is in series with the 208/230-volt power-line input, will not open unless a short occurs in an unfused portion of the autotransformer circuit. Each circuit fed by the autotransformer is fused, as well as the power control circuits.

WARNING

Do not make any repairs on an energized radio set. Before repair, throw PRIMARY CIRCUIT BREAKER to OFF.

CAUTION

Never replace a fuse with one of higher rating unless continued operation of equipment is more important than probable damage. If a fuse burns out immediately after replacement, do not replace it a second time until cause of trouble has been corrected. If a circuit breaker trips after resetting, do not reset a second time until cause of trouble has been corrected.

All fuses in the transmitter are the slow-blow type except the LOW VOLTAGE PLATE, AUTOTUNE MOTOR, and CONTROL CIRCUIT NO. 1 fuses; do not replace these three fuses with the slow-blow type.

If the transmitter fails, the trouble may be caused by a blown fuse; open the right-hand door and observe the blown-fuse indicators on the power control assembly. A lighted lamp indicates that the associated fuse is open. Refer to table 3-17 for symptoms of fuse failure, and to table 3-18 for fuse locations.

(4) ELECTRON TUBE MAINTENANCE. — For satisfactory tube operation and normal tube life, the filament voltage must be within five percent of the rated value. Permitting the tubes to draw current longer than a few seconds while the stage is out of resonance shortens the tube's life.

The rectifier tubes, type 3B28, used in LV supply 1A11, and the rectifier tubes, type 4B32, used in HV supply 1A10 are xenon-filled. These tubes have the same current and voltage ratings as tube types 866/866A and 872/872A, and are directly interchangeable. However, tube types 3B28 and 4B32 will withstand ambient temperature changes better than types 866/866A and 872/872A and should not be interchanged except in an emergency.

(5) DEFECTIVE TUBE INDICATIONS.— Several types of electron-tube failures are evident to a careful observer; however, many other defective-tube failures can be identified only after tubes are tested and checked. Refer to Handbook of Test Methods and Practices (NAVSHIPS 91828A) and Electronic Equipment Application Guide (NAVSHIPS 91727). If the test equipment is not on hand, the investigation must be visual.

(a) Always replace tubes which indicate arcing across electrodes.

(b) A tube with warped or sagging electrodes may give an erratic indication on the respective monitor meter when the tube is tapped sharply. Replace such a tube as soon as possible.

(6) DEFECTIVE TUBE INSPECTION
AND REPLACEMENT.

WARNING

Allow tubes to cool before handling. If immediate replacement is required, use asbestos gloves or tube puller, and handle carefully.

If it is necessary to examine tubes while equipment is energized, open the transmitter doors, manually lock the interlock switches, and pull out the PLATE and FILAMENT switches. Do not handle exposed high-voltage contacts (terminal boards, plate caps, etc.) when the interlock switches are locked.

WARNING

Dangerously high voltage exists. Before replacing a tube, push in PLATE and FILAMENT switches and discharge all exposed components using a grounding stick.

Before replacing an electron tube, note the proper location from table 3-19. When removing octal type electron tubes, use a gentle rocking motion. When inserting the replacement tube into the socket, align the tube guide and socket slot; use a steady pressure and push straight downward until the tube is seated properly. Do not force; otherwise, the socket terminal clamp and wiring may be damaged. Use the same procedure when removing any four- or five-pin electron tube.

When removing the 3B28 or 4B32 tubes, or similarly constructed tubes, grasp the tube firmly and rotate counterclockwise until the tube guide pin is in line with the socket slot. Then lift the tube out of the socket. When inserting a new tube into this type of socket, align the guide pin with the socket slot, push the tube straight down, and rotate clockwise until the guide pin is stopped.

(7) DEFECTIVE PLUG-IN ELECTRONIC ASSEMBLY INDICATION AND REPLACEMENT. — Sometimes a trouble appears in a plug-in electronic assembly, and the radio set may be returned to normal operation by replacing the defective electronic assembly. Complete familiarity with the functional operation of each plug-in electronic assembly is necessary so that the defective assembly can be readily isolated and replaced. The replaceable plug-in electronic assemblies are listed in table 3-20 and are located in figures 3-11 through 3-15. Be extremely careful when replacing an electronic assembly so that the connectors or pins are not damaged in the process. For access to the plug-in electronic assemblies, pull the suspected unit out until it locks in position, remove the top cover and ease the assembly out of its socket.

CAUTION

Do not allow hinged memory section of synthesizer to drop in place. Lower gently to avoid damage to components.

TABLE 3-17. OPERATOR'S FUSE FAILURE GUIDE

SYMPTOM	FUSE (fuse indicator light glows when fuse is blown)
POWER CONTROL (Fuses on front panel, figure 5-133)	
CONTROL CIRCUIT NO. 3 lamp I503 lights. POWER AMPL FIL. lamp I504 lights. EXCITER FIL. lamp I505 lights. BIAS lamp I506 lights. AUTOTUNE MOTOR lamp I507 lights. D.C. RELAY SUPPLY lamp I508 lights. SPARE NO. 1 lamp I509. SERVICE POWER SUPPLY lamp I510 lights. BLOWER lamp I511 lights. SPARE NO. 2 lamp I512. SPARE NO. 3 lamp I513. H.V. RECT. FIL. lamp I514 lamp I514 lights. L.V. PLATE lamp I515 lights. L.V. RECT. FIL. lamp I516 lights. CONTROL CIRCUIT NO. 1 lamp I517 lights. CONTROL CIRCUIT NO. 2 lamp I518 lights.	F503 F504 F505 F506 F507 F508 F509 (Spare) F510 F511 F512 (Spare) F513 (Spare) F514 F515 F516 F517 F518

TABLE 3-17. (Continued)

SYMPTOM	FUSE (Fuse indicator light glows when fuse is blown)
TRANSMITTER CONTROL (Fuse behind front panel, figure 5-148)	
Indicator lamp I901 lights.	F901
KEYER (Fuses on front panel, figure 5-150)	
Indicator lamp F1 lights.	F1
Indicator lamp F2 lights.	F2
EXCITER POWER SUPPLY (Fuses on rear panel, figure 5-122)	
Rectifiers V1001 and V1002 do not light.	F1001 effective on 115 and 230 volts, AC.
Rectifier V1004 does not light.	F1002 effective on 115 and 230 volts, AC.
Rectifiers V1001 and V1002 do not light.	F1003--effective on 230 volts AC only.
Rectifier V1004 does not light.	F1004--effective on 230 volts AC only.
SYNTHESIZER POWER SUPPLY (Fuses on front panel, figure 5-70)	
POWER lamp does not light.	F1 or F2 (rear panel, figure 5-77)
115 VAC SEC lamp lights.	F3
+28V UNREG lamp lights.	F4
-12V lamp lights.	F5
+28V lamp lights.	F6
+180V lamp lights.	F7
FIL lamp does not light.	F8 (Refer to figure 5-71)
CONVERTER (Fuses on rear panel, figure 5-69)	
Blower stops operating.	F1 or F2
AMPLIFIER (Fuses on rear panel, figure 5-51)	
Blower stops operating.	F1 or F2
LSB LEVEL and USB LEVEL meters do not operate, but blower operates.	F3
OVEN CYCLE lamp does not light (stops cycling, remains out).	F4 or F5

TABLE 3-18. FUSE LOCATION

REF DESIG	PROTECTS	AMPS	VOLTS
AMPLIFIER (Fuses on rear panel, figure 5-51)			
1A2A1F1	115-VAC input	1	125
1A2A1F2	115-VAC input	1	125
1A2A1F3	230-VAC input	1/2	250
1A2A1F4	230-VAC input	1/4	250
1A2A1F5	230-VAC input	1/4	250

TABLE 3-18. (Continued)

REF DESIG	PROTECTS	AMPS	VOLTS
CONVERTER (Fuses on rear panel, figure 5-69)			
1A3A1F1	115-VAC input	1	125
1A3A1F1	115-VAC input	1	125
SYNTHESIZER POWER SUPPLY (Fuses on front and rear panels, figures 5-70 and 5-77)			
1A4F1	115-VAC input	2	250
1A4F2	115-VAC input	2	250
1A4F3	115-VAC secondary output	1/10	250
1A4F4	+28 VDC unregulated output	2	250
1A4F5	-12 VDC regulated output	1	250
1A4F6	+28 VDC regulated output	1	250
1A4F7	+180 VDC regulated output	1-1/2	250
EXCITER POWER SUPPLY (Fuses on rear panel, figure 5-122)			
1A7F1001	AC input	3	250
1A7F1002	AC input	2	250
1A7F1003	230 VAC input	1-1/2	250
1A7F1004	230 VAC input	1	250
POWER CONTROL (Fuses on front panel, figure 5-132)			
1A9F503	Power distribution to control circuits.	1	125
1A9F504	RF assembly power amplifier filament.	1	125
1A9F505	RF assembly amplifier and drive.	1	125
1A9F506	RF assembly bias rectifiers.	1	125
1A9F507	RF assembly autotune system motor.	3	250
1A9F508	Dial control DC relay supply.	1	125
1A9F509	Spare.	1	250
1A9F510	Spare.	3	250
1A9F511	Blower 1A13B641.	3	250

TABLE 3-18. (Continued)

REF DESIG	PROTECTS	AMPS	VOLTS
POWER CONTROL (Fuses on front panel, figure 5-132) (Continued)			
1A9F512	Spare.	2	125
1A9F513	Spare.	1	125
1A9F514	HV supply.	1	125
1A9F515	LV supply.	6	250
1A9F516	LV supply rectifier filament.	1/4	250
1A9F517	Power distribution to control circuits.	2	125
1A9F518	Power distribution to control circuits.	1	125
TRANSMITTER CONTROL (Fuses behind) front panel, figure 5-148)			
2F901	115-VAC line.	1/2	125
3F901	115-VAC line.	1/2	125
KEYER (Fuses on front) panel, figure 5-150)			
6F1	115-VAC input	1/8	250
6F2	115-VAC input	1/8	250

TABLE 3-19. REPLACEMENT OF ELECTRON TUBES

REF DESIG	TUBE TYPE NO.	REFER TO FIGURE NO.	FUNCTION
AMPLIFIER			
1A2A1A7V1	5654/6AK5	5-42	1-MC amplifier
1A2A1A7V2	5654/6AK5	5-42	Phase inverter
1A2A1A7V3	5654/6AK5	5-42	Phase detector driver
1A2A1A7V4	5654/6AK5	5-42	1-MC amplifier
1A2A1A7V5	5654/6AK5	5-42	1-MC amplifier
1A2A1A8V1	6AH6	5-47	1-MC oscillator
CONVERTER			
1A3A1A3V1	5654/6AK5	5-58	Buffer
1A3A1A3V2	5670/2C51	5-58	Single sideband combiner

TABLE 3-19. (Continued)

REF DESIG	TUBE TYPE NO.	REFER TO FIGURE NO.	FUNCTION
CONVERTER (Continued)			
1A3A1A3V3	5654/6AK5	5-58	Buffer
1A3A1A4V1	5670/2C51	5-60	450-KC sideband mixer
1A3A1A4V2	5654/6AK5	5-60	450-KC double sideband amplifier
1A3A1A4V3	6EH7	5-60	1750-KC carrier gate
1A3A1A4V4	5725/6AS6	5-60	1st 1750-KC double side amplifier
1A3A1A4V5	5654/6AK5	5-60	2nd 1750-KC double sideband amplifier
1A3A1A5V1	6EH7	5-65	1st RF amplifier
1A3A1A5V2	6EH7	5-65	2nd RF amplifier
1A3A1A5V3	6EH7	5-65	3rd RF amplifier
1A3A1A5V4	8233	5-65	Power amplifier
SYNTHESIZER			
1A6A1A4V1	5702	5-90	Driver
1A6A1A4V2	5702	5-90	X5 multiplier
1A6A1A4V3	5702	5-90	Amplifier
1A6A1A4V4	5702	5-90	Driver
1A6A1A4V5	5702	5-90	Amplifier
1A6A1A4V6	5702	5-90	X10 multiplier
1A6A1A4V7	5703	5-91	10-KC loop VFO
1A6A1A4V8	5702	5-91	X2 multiplier
1A6A1A4V9	5703	5-91	1-KC loop VFO
1A6A1A4V10	5702	5-91	Amplifier
1A6A1A4V11	5702	5-90	1st IF amplifier
1A6A1A4V12	5702	5-90	2nd IF amplifier
1A6A1A4V13	6021	5-91	100-cycle loop VFO and cathode follower
1A6A1A4V14	5702	5-91	X5 multiplier

TABLE 3-19. (Continued)

REF DESIG	TUBE TYPE NO.	REFER TO FIGURE NO.	FUNCTION
SYNTHESIZER (Continued)			
1A6A1A4V15	5702	5-91	Limiter
1A6A1A4V16	5702	5-91	Driver
1A6A1A5V1	5702	5-96	Driver
1A6A1A5V2	5702	5-96	X5 multiplier
1A6A1A5V3	5702	5-96	Amplifier
1A6A1A5V4	6021	5-97	100-cycle loop sweep multivibrator
1A6A1A5V5	6021	5-97	1-KC loop sweep multivibrator
1A6A1A5V6	6021	5-97	10-KC loop sweep multivibrator
1A6A1A6V1	5702	5-99	Reactance tube
1A6A1A6V2	5703	5-99	Main loop VFO
1A6A1A6V3	5702	5-99	Buffer amplifier
1A6A1A8V1	6C4	5-101	Cathode follower
1A6A1A12V401	6AK5	5-113	X7 multiplier
1A6A1A12V402	6AK5	5-113	Amplifier
1A6A1A12V403	6AK5	5-113	Amplifier
EXCITER POWER SUPPLY			
1A7V1001	5R4GYW	5-120	Rectifier
1A7V1002	5R4GYW	5-120	Rectifier
1A7V1004	5R4GYW	5-120	Rectifier
RF ASSEMBLY			
1A8V108	OA2	5-127	Exciter regulator ref- erence tube
1A8V109	OA2	5-127	Exciter regulator ref- erence tube
1A8V110	5763	5-127	Exciter voltage regulator tube

TABLE 3-19. (Continued)

REF DESIG	TUBE TYPE NO.	REFER TO FIGURE NO.	FUNCTION
RF ASSEMBLY (Continued)			
1A8V111	5763	5-127	Exciter voltage regulator tube
1A8V112	5763	5-127	Exciter voltage regulator tube
1A8V113	5Y3WGTA	5-127	Power-amplifier bias rectifier
1A8V114	PL177	5-127	RF Driver
1A8V115	PL264	5-125	Power amplifier
1A8V116	6GK6	5-127	RF Amplifier
HF SUPPLY			
1A10V401	4B32	5-135	High voltage rectifier
1A10V402	4B32	5-135	High voltage rectifier
LV SUPPLY			
1A11V301	3B28	5-138	High voltage rectifier
1A11V302	3B28	5-138	High voltage rectifier
TRANSMITTER CONTROL			
V901	12AT7WA	5-148	Input audio amplifier
V902	12AT7WA	5-148	Compressor tube
V903	12AT7WA	5-148	Output audio amplifier
V904	12AT7WA	5-148	Compressor rectifier
V905	12AT7WA	5-148	Meter amplifier
V906	5Y3WGTA	5-148	Rectifier

TABLE 3-20. REPLACEABLE PLUG-IN ELECTRONIC ASSEMBLIES

REF DESIG	NAME	FUNCTION
AMPLIFIER (Figure 3-11)		
1A2A1A1	AGC and audio amplifier	Amplifies lower sideband audio input signal. AGC controlled by front panel AGC switch.
1A2A1A2	Audio voltmeter	Rectifies lower sideband audio signal for monitoring on front panel LSB LEVEL meter.
1A2A1A3	CW assembly	Provides ground gate to converter for carrier on-off keying. Also supplies grid blocking voltage to RF assembly.
1A2A1A4	AGC and audio amplifier	Amplifies upper sideband audio input signal. AGC controlled by front panel AGC switch.
1A2A1A5	Audio voltmeter	Rectifies upper sideband audio signal for monitoring on front panel USB LEVEL meter.
1A2A1A6	Voltage regulator	Provides regulated +26 VDC to assemblies and relays in amplifier.
1A2A1A7A2	Squelch and emitter follower	Amplifies external reference signal. If external reference signal is less than 0.3 VRMS the squelched circuit discontinues output from 1A2A1A7A2.
1A2A1A7A2	1-MC oscillator	Provides 1-MC output phase locked to the external reference signal.
1A2A1A7A3	Phase detector	Compares external reference signal with internal reference signal. Any phase or frequency difference is monitored on front panel PHASE DETECTOR meter.
CONVERTER (Figure 3-12)		
1A3A1A2	Binary divider	Divides synthesizer input frequency by 8, 4, and 2 for bands 2-4, 4-8, and 8-16, respectively.
1A3A1A3Z1	Balanced modulator	Combines lower sideband audio with 1.75-MC subcarrier to provide upper sideband.
1A3A1A3Z2	Balanced modulator	Combines upper sideband audio with 1.75-MC subcarrier to provide upper sideband.
1A3A1A4A1	1300-KC generator	Generates a 1300-KC signal that is mixed with 1.75 MC to produce a 450-KC subcarrier signal for operation on the two low frequency bands (2 to 8 MC).
1A3A1A4A2	300-KC generator	Generates a 300-KC signal that is mixed with 1 MC in 1300-KC generator 1A3A1A4A1 to produce 1300 KC.

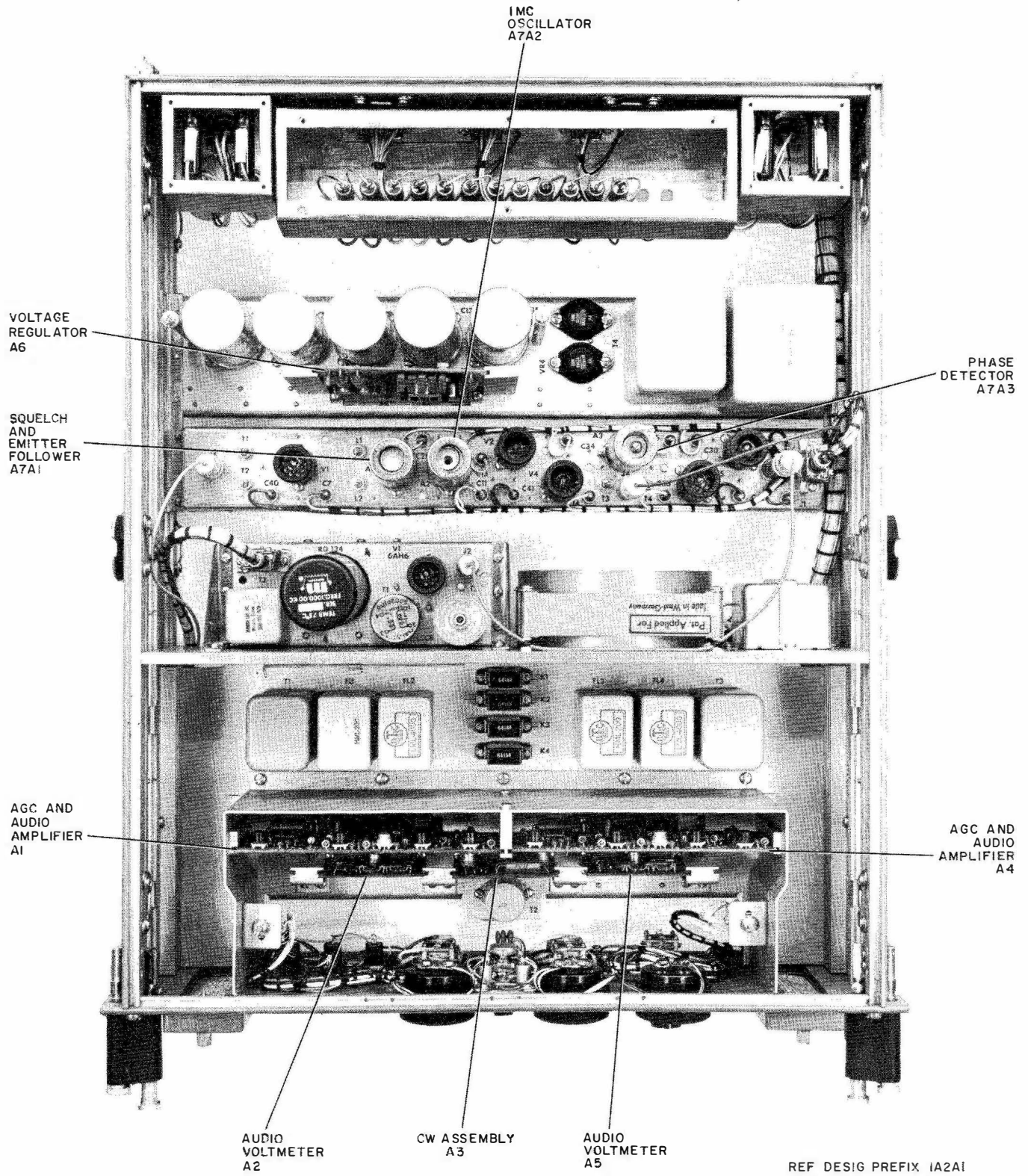
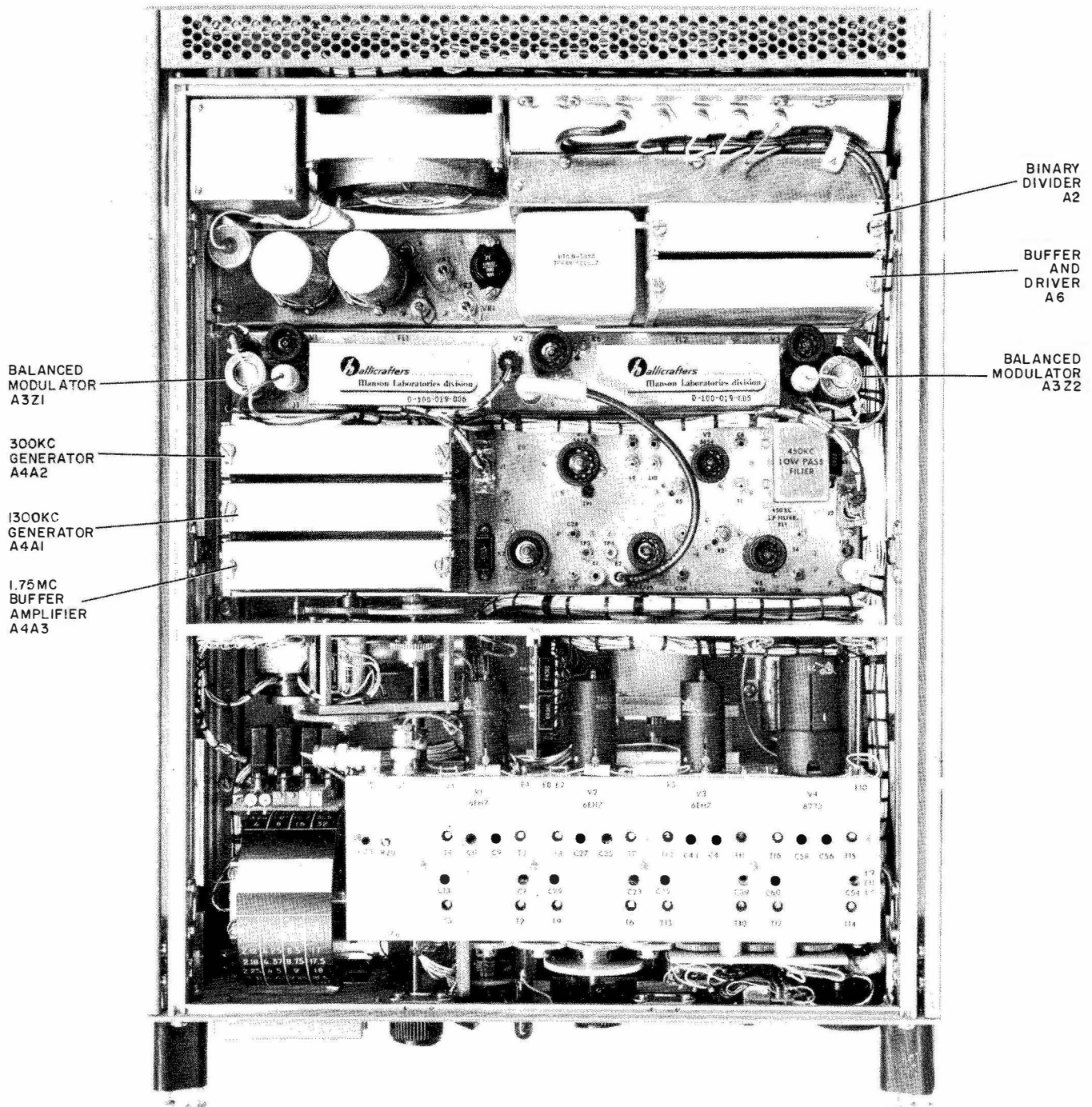


Figure 3-11. Amplifier, Location of Plug-in Electronic Assemblies



REF DESIG PREFIX IA3AI

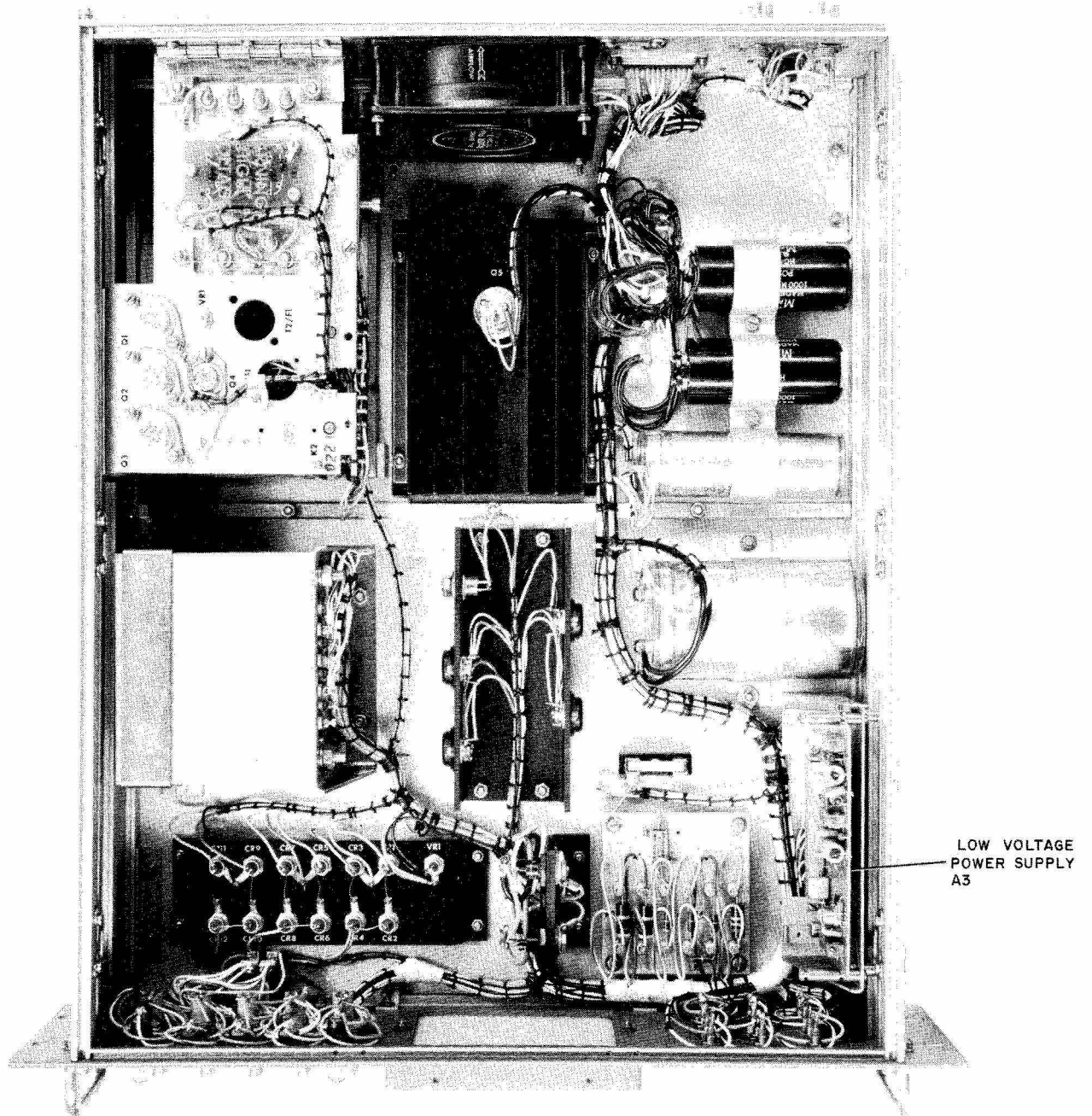
Figure 3-12. Converter, Location of Plug-in Electronic Assemblies

TABLE 3-20. (Continued)

REF DESIG	NAME	FUNCTION
CONVERTER (Figure 3-12) (Cont.)		
1A3A1A4A3	1.75-MC buffer amplifier	Isolates 1.75-MC input from circuits in IF assembly.
1A3A1A6	Buffer and driver	Amplifies output frequency of binary divider 1A3A1A2.
SYNTHESIZER POWER SUPPLY (Figure 3-13)		
1A4A3	Low voltage power supply	Provides regulated outputs of +12 VDC, +28 VDC, -12 VDC and 6.3 VDC to synthesizer.
SYNTHESIZER (Figure 3-14)		
1A6A1A3A1	Programmer trigger	Converts start pulse from RF assembly to trigger for starting programmer timer 1A6A1A3A2. Also recycles programmer when power returns after line power failure.
1A6A1A3A2	Programmer timer	Provides three-slot time sequence which controls sequence of operation for automatically tuning synthesizer and converter.
1A6A1A3A3	Programmer coder	Utilizes timing pulses from programmer timer 1A6A1A3A2 to operate relays that control of automatically tuning synthesizer and converter.
1A6A1A8A3	10 to 1 locked divider	Divides 1-MC reference signal to 100 KC having stability of reference signal.
1A6A1A8A4	100-KC amplifier	Amplifies 100-KC output of 10 to 1 locked divider 1A6A1A8A3.
1A6A1A8A5	X4 multiplier	Multiplies 100-KC output of 10 to 1 locked divider to 400 KC.
1A6A1A9A1	Servo amplifier differential chopper and preamplifier	Compares analog output voltage of memory section with output of motor driven potentiometer 1A6A1A7R1. Produces servo motor driving signal when the two inputs are unequal. Part of a closed loop servo circuit as loop error decreases output decreases.
1A6A1A9A2	Servo amplifier driver and null detector	Converts output of servo amplifier differential chopper and preamplifier 1A6A1A9A1 to trigger pulses that fire silicon control rectifier to obtain proper direction of rotation of servo motor.
1A6A1A10A1	4 to 1 locked divider	Divides 1.964 to 2.000-MC output of 100-CPS loop to 0.491 to 0.500 MC which is applied to third mixer 1A6A1A10A2.

TABLE 3-20. (Continued)

REF DESIG	NAME	FUNCTION
SYNTHESIZER (Figure 3-14) (Cont.)		
1A6A1A10A2	Third mixer	Mixes 0.491- to 0.500-MC output of 4 to 1 locked divider 1A6A1A10A1 with 3.21- to 3.3-MC output of 1-KC loop to produce 3.701- to 3.8-MC which is applied to 5 to 1 locked divider 1A6A1A10A3.
1A6A1A10A3	5 to 1 locked divider	Divides 3.701- to 3.8-MC output of third mixer 1A6A1A10A2 to 0.7402- to 0.7600-MC which is applied to fourth mixer 1A6A1A10A4.
1A6A1A10A4	Fourth mixer	Mixes 0.7402- to 0.7600-MC output of 5 to 1 locked divider 1A6A1A10A3 with 7.06- to 7.24-MC output of 10 KC loop to produce 7.8002- to 8.00 - MC which is applied to 2 to 1 locked divider 1A6A1A10A5.
1A6A1A10A5	2 to 1 locked divider	Divides 7.8002- to 8.000-MC output of fourth mixer 1A6A1A10A4 to 3.9001 to 4.000 MC which is applied to second mixer on front IF 1A6A1A4.
1A6A1A12A1	4 to 1 locked divider	Divides 1-MC reference signal to 0.250 MC which is applied to X7 multiplier 1A6A1A12V401 to produce a 1.75 MC signal.
KEYER (Figure 3-15)		
6A1	Power supply	Provides DC operating voltage to keyer.
6A2	Key gate and 1-KC oscillator	Generates "mark" and "space" keying signals (in response to TTY information) of 0 to -5 VDC which are applied to trigger and binary gate 6A5 and audio output and suppression gate 6A7. Also generates MCW that is applied to 6A7.
6A3	23.8-KC and 17-KC crystal oscillators	Generates output frequencies of 23.8-KC and 17-KC which are applied to trigger and binary gate 6A5.
6A4	19.4-KC and 12.6-KC crystal oscillators	Generates output frequencies of 19.4-KC and 12.6 KC which are applied to trigger and binary gate 6A5.
6A5	Trigger and binary gate	Converts "mark" and "space" signals from key gate and 1-KC oscillator 6A1A2 to frequency shift keying output frequencies with a center frequency of 15.8-KC or 20.4-KC depending upon position of front panel MODE switch 6S2.
6A6	Divider	Divides output of trigger and binary gate 6A1A5 to produce center frequency of 2000 CPS and 2550 CPS which is applied to audio output and suppression gate 6A7.



REF DESIG PREFIX IA4

Figure 3-13. Synthesizer Power Supply, Location of Plug-in Electronic Assembly

TABLE 3-20. (Continued)

REF DESIG	NAME	FUNCTION
KEYER (Figure 3-15) (Cont.)		
6A7	Output and suppression gate.	Discontinues keyer output at end of teletype-writer message.
6A8	Audio metering	Rectifies audio output of keyer for monitoring on front panel LSB LEVEL and USB LEVEL meters.

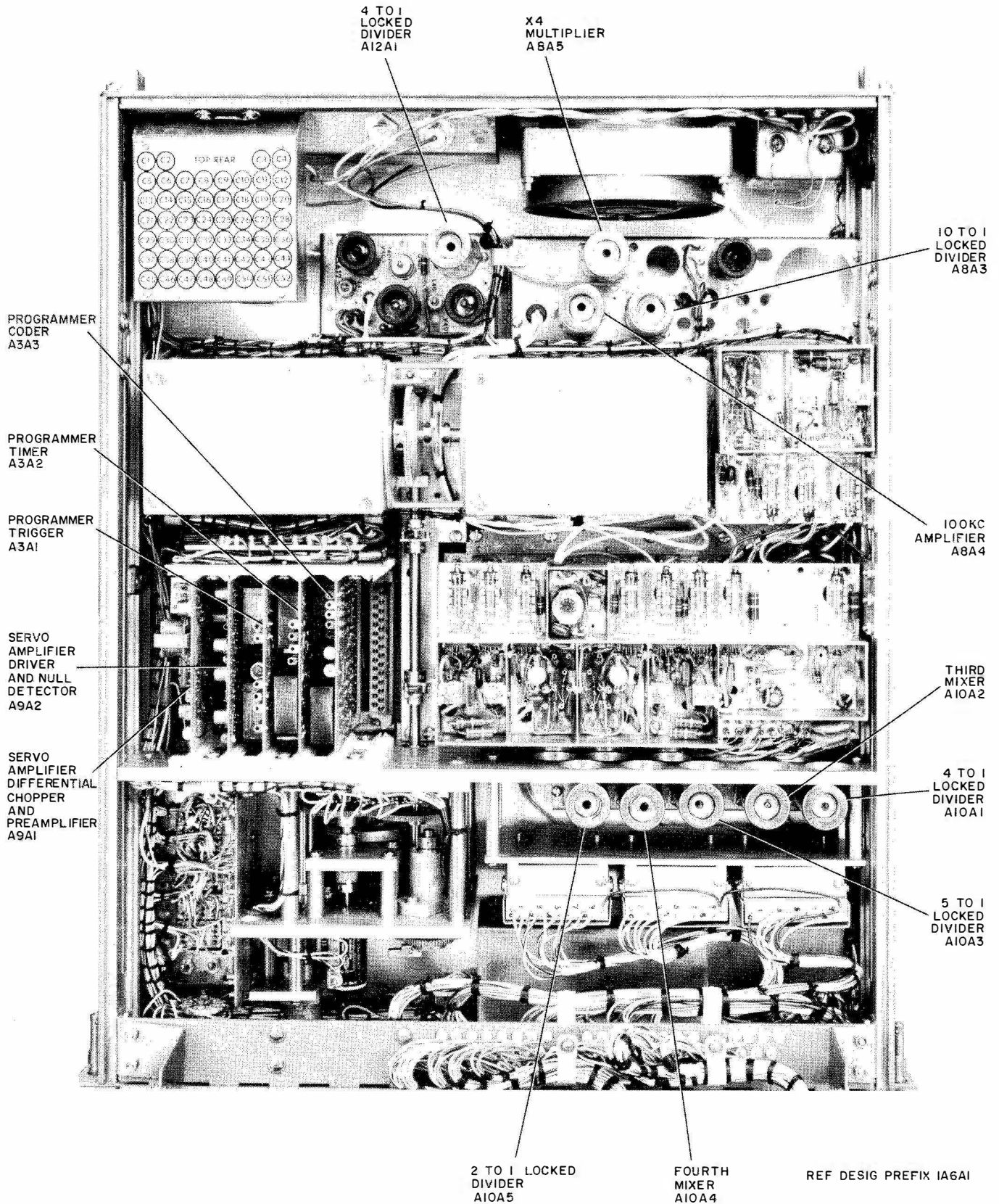


Figure 3-14. Synthesizer, Location of Plug-in Electronic Assemblies

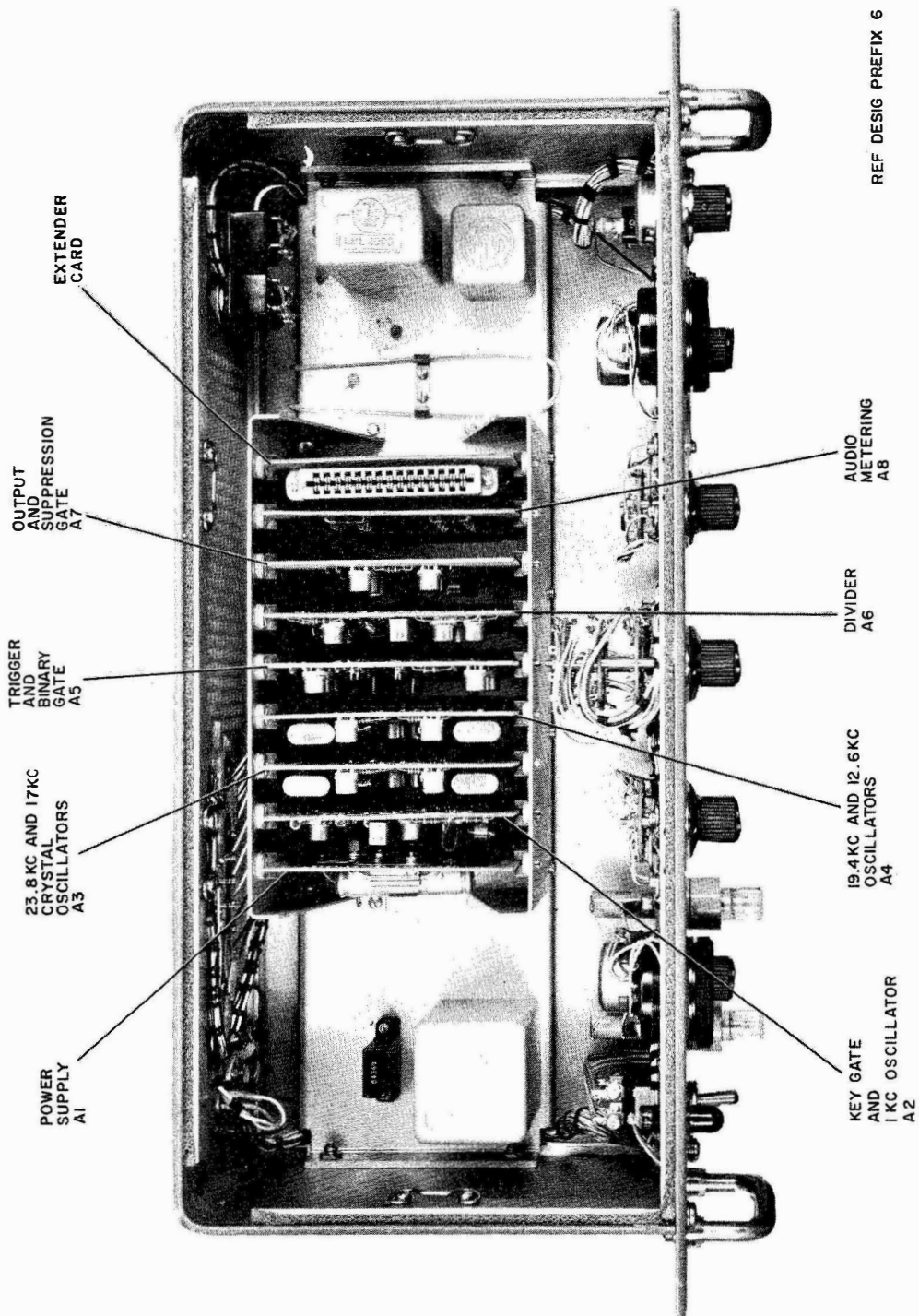


Figure 3-15. Keyer, Location of Plug-in Electronic Assemblies

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