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DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR AND ORGANIZATIONAL MAINTENANCE MANUAL

RADIO TRANSMITTING SET AN/FRT-52

HEADQUARTERS, DEPARTMENT OF THE ARMY
16 JANUARY 1962

Technical Manual
No. 11-5820-475-12

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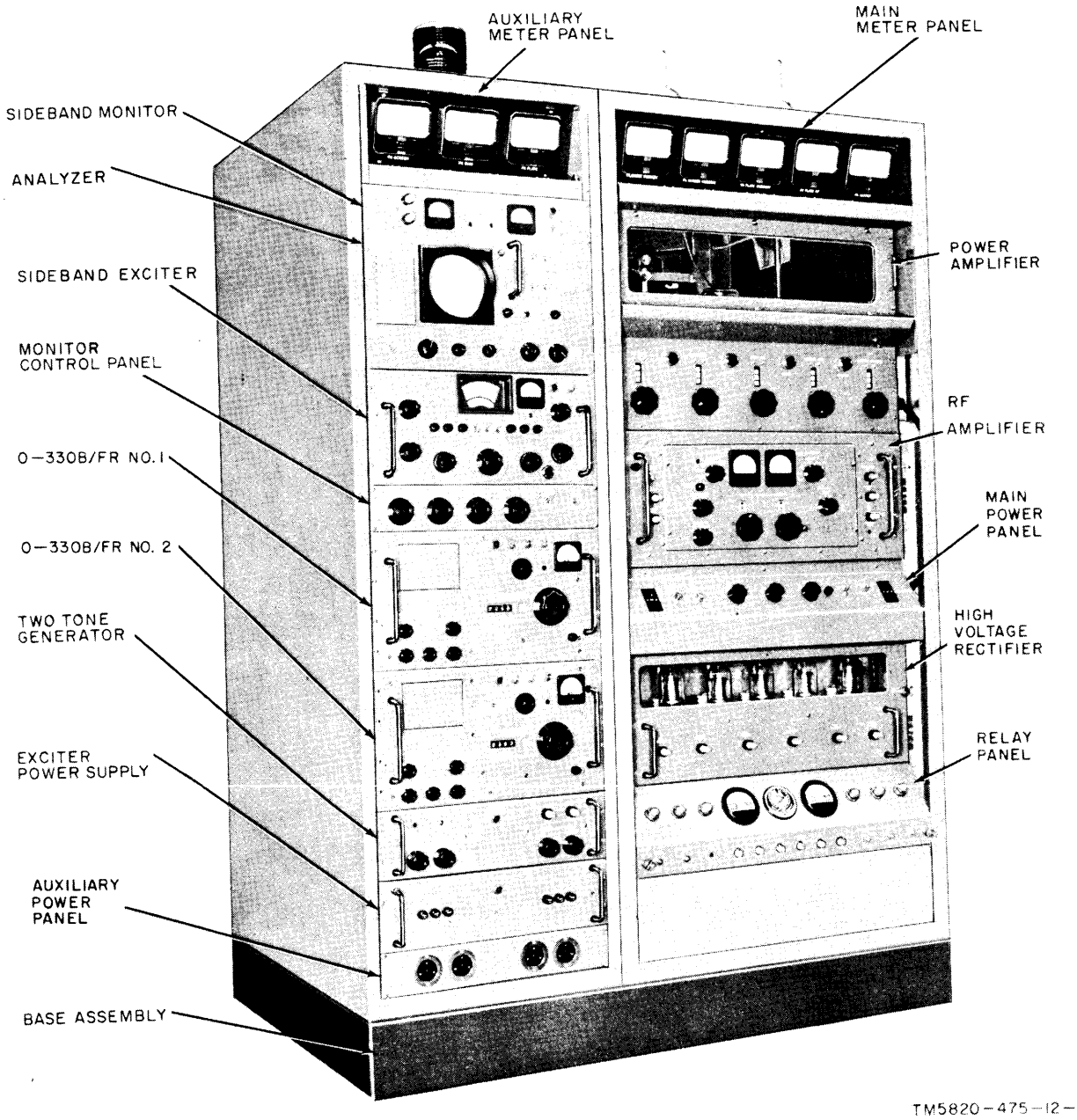


Figure 1. Radio Transmitting Set AN/FRT-52 (less manuals and running spares), front view.

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

This manual describes Radio Transmitting Set AN/FRT-52 (fig. 1) and covers its operation, operator's maintenance, and second echelon maintenance. It includes preoperational and operational procedures, and replacement of parts available to first and second echelon maintenance personnel.

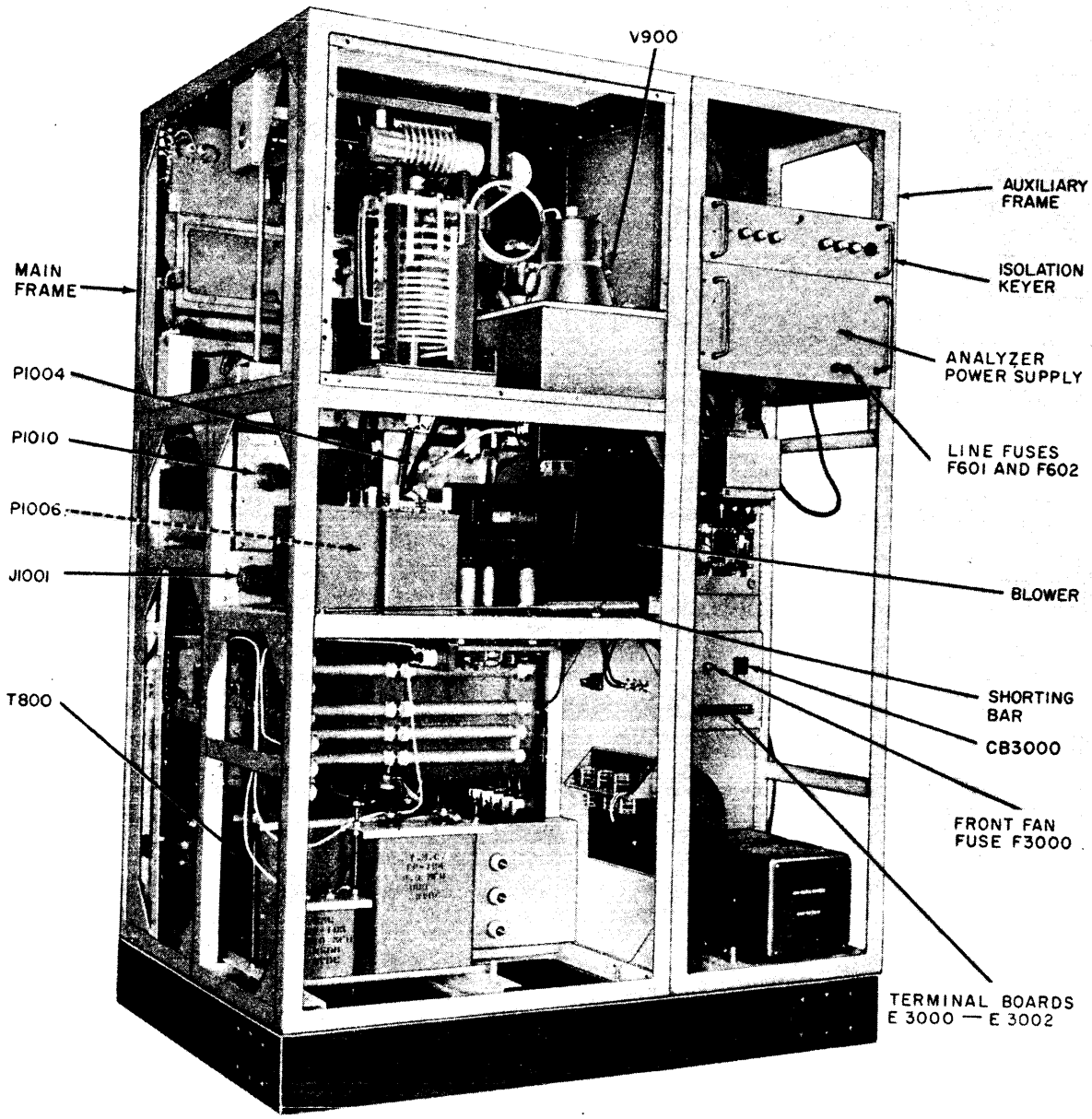


Figure 2. Radio Transmitting Set AN/FRT-52, rear view.

2. Forms and Records

a. Unsatisfactory Equipment Reports. Fill out and forward DA Form 468, Unsatisfactory Equipment Report, as prescribed in AR 700-38.

b. Report of Damaged or Improper Shipment. Fill out and forward DD Form 6, Report of Damaged or Improper Shipment, as prescribed in AR 700-58 (Army).

c. Preventive Maintenance Forms. Prepare DA Form 11-238 (fig. 32 and 33), Maintenance Check List for Signal Equipment (Sound Equipment, Radio, Direction Finding, Radar, Carrier, Radiosonde and Television), in accordance with instructions on the form.

d. Parts List Form. Fill out and forward DA Form 2028, Recommended changes to DA Technical Manual Parts Lists or Supply Manual 7, 8, or 9, directly to the Commanding Officer, U. S. Army Signal Materiel Support Agency, Fort Monmouth, N. J., to recommend changes in, or to comment on, Basic Issue Items Lists or Repair Parts and Special Tools Lists.

e. Comments on Manual. Forward all other comments on this publication directly to the Commanding Officer, U. S. Army Signal Materiel Support Agency, ATTN: SIGMS-PA2d, Fort Monmouth, N. J.

f. Index of Equipment Publications. Refer to DA Pamphlet 310-4 to determine what changes to or revisions of this publication are current.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Purpose. Radio Transmitting Set AN/FRT-52 is a radio transmitter that provides multichannel long range communication using single-sideband (ssb), double-sideband (dsb), independent-sideband (isb), continuous-wave (cw), or amplitude modulation (am.) operation within the frequency range of 2 to 28 megacycles (mc).

b. Use. Radio Transmitting Set AN/FRT-52 is capable of transmitting four 3-kilocycle channels of intelligence in a multiplexed communication system. When the AN/FRT-52 is used as a cw or am. transmitter, the average output power is 5,000 watts; when it is used as a sideband transmitter, the peak envelope power (pep) output is 10,000 watts.

c. Use in Communications System. Figure 3 illustrates a typical communications system using the AN/FRT-52 as the radio link. System signal paths are explained in (1) through (5) below.

(1) *Teletypewriter signal input.* Direct-current (dc) signals from two teletypewriter keyboards or distributor units are applied to a frequency shift tone keyer. The two-channel output of the tone keyer is applied to multiplexer No. 1. The output frequencies of the multiplexer are applied to the sideband generator section of the AN/FRT-52.

(2) *Telephone input.* Voice signals from two telephone sets are applied to multiplexer No. 2. The frequency-multiplexer output from this multiplexer is also applied to the sideband generator section of the AN/FRT-52.

(3) *AN/FRT-52.* The multiplexed voice and teletypewriter signals are converted by the AN/FRT-52 into sideband energy. The output is raised to the required level and applied to a transmitting antenna for transmission to a distant receiver.

(4) *Receiving system.* The rf signals received at the receiving station are applied through a receiver to a converter. The converter separates the upper and lower sidebands and applies the energy within these sidebands to demultiplexers No. 1 and No. 2. The teletypewriter intelligence is separated into two channels by the demultiplexer and

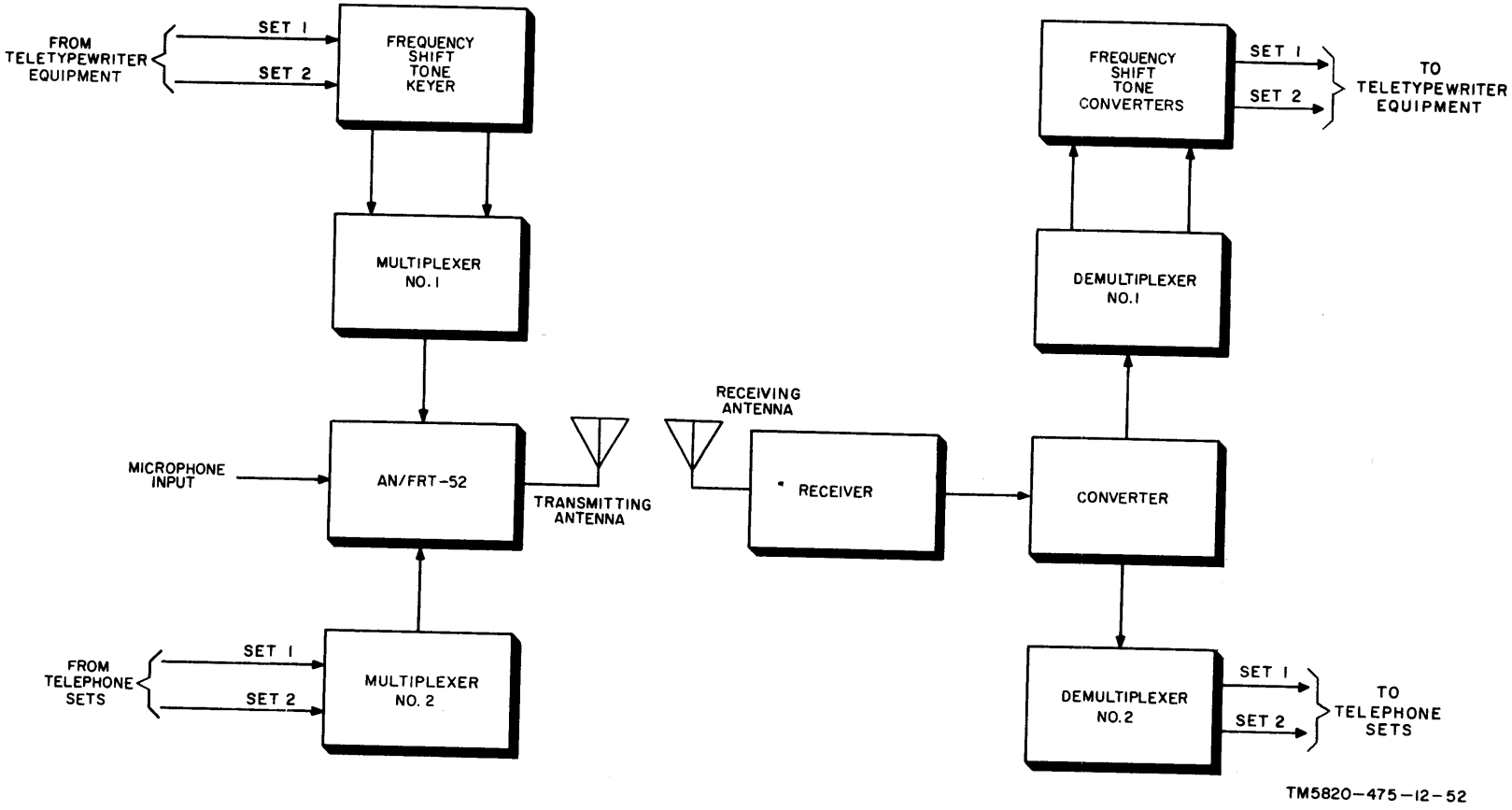


Figure 3. Radio Transmitting Set AN/FRT-52, system application.

routed to teletypewriter equipment through a frequency shift tone converter. The voice energy is separated into two voice channels by demultiplexer No. 2 and applied to telephone equipment.

(5) *Microphone input.* This facility permits voice input signals to be applied directly to the AN/FRT-52. When microphone is used, its output modulates either the *entire* upper or lower sideband, which thereby limits intelligence from external signal generating equipment to one sideband only.

4. Technical Characteristics

a. Radio Transmitting Set AN/FRT-52.

Frequency range	2 mc to 28 mc.
Output power:	
Ssb, dsb, and isb	10,000-watt pep.
Cw and am.	5,000 watts.
Operating modes	Ssb, dsb, isb, cw, and am.
Output impedance:	
Balanced	600 ohms.
Unbalanced	72 ohms.
Harmonic suppression:	
Third order harmonics	35 db down from pep.
Fifth order harmonics	45 db down from pep.
Carrier insertion	Variable to 45 db below pep.
Audio input	-20 db to +10 db, adjustable for full rf output.
Audio response	Flat within ±1.5 db, 350 to 7,500 cps.
Primary power requirements	230 volts ac, 50/60 cps, 3-phase, 13,000 watts.
Safety features	Mechanical and electrical interlocks.
Cooling	Forced-air cooling
Operating temperature and humidity range	0° C (32° F) to 50° C (112° F), 90 percent humidity.

b. Sideband Monitor.

Number of tubes	4.
Input impedance	1,000 ohms.
Sensitivity	8-mv input provides full-scale deflection.
Input frequency	250 kc ± 7.5.

c. Spectrum Analyzer.

Number of tubes	23.
Number of transistors	4.
Input center frequency	500 kc.
Bandpass region frequency (after input mixer)	450 kc to 550 kc.
Bandpass region response	Flat within 0.5 db.
Image rejection	130 to 1 at 500 kc.
Input attenuation	0 db to 65 db in 5-db steps.
Input impedance	50 ohms.
Direct sensitivity	200 uv at 500 kc ±50 for full-scale linear deflection.
Conversion sensitivity	3-uv input for full-scale log. deflection with variable master oscillator input of 0.1 volt.
Input mixer range	1,000 mc maximum.
Scan rate:	
0.1 to 30 cps	Continuously variable.
150 and 300 cps	0.1 cps.
3.5, 7, and 14 kc	1 cps.
Resolution:	
100-kc sweep width	3 kc.
1,500-cps sweep width	10 cps.
Auxiliary outputs	Vertical and horizontal frequency.
Power requirements	115/230 volts, 50/60 cps, 180 watts with external line regulator.
Amplitude scales	Linear and log.
Sweep width (AFC switch in on position):	
SWEEPWIDTH SELECTOR switch:	
VAR	0 kc to 2 kc variable.
150~	150 cps.
500~	500 cps.
Sweep width (AFC switch in AFC OFF position):	
SWEEPWIDTH SELECTOR switch:	
VAR	0 kc to 100 kc variable.
3.5KC	3.5 kc.
7KC	7 kc.
14KC	14 kc.

d. Sideband Exciter Assembly.

Number of tubes	23.
Frequency range	2 mc to 32 mc.
Operating modes	Ssb, dsb, isb, cw, and am.
Crystal oven operating temperatures:	
250-kc oscillator	75° C (167° F).
Medium- and high-frequency oscillator	70° C (158° F).
Stability	One pulse per minute per 24-hour period.
Variable master oscillator:	
Input frequency	2 mc to 4 mc.
Input impedance	72 ohms.
Input voltage	1.5 volts rms.
Output power	0- to 1-watt pep.
Output impedance	72 ohms.
Carrier suppression	At least 55 db below pep output.
Spurious output	At least 60 db below pep output.
Distortion products (two-tone test)	Third order distortion at least 45 db below either tone at full pep output.
Harmonic radiation:	
Second harmonic	At least 45 db below pep output.
All other harmonics	At least 50 db below pep output.

Suppressed sideband rejection	At least 60 db below pep output (for 500-cps tone).
Audio input:	
600-ohm balanced or unbalanced	Two independent channels, -20 db for full rf output.
High-impedance crystal or dynamic microphone	500,000 ohms, -50 db for full rf output.
Audio response per sideband	Within 3 db from 350 to 7,500 cps.
Frequency control	Crystal or external vmo (O-330B/FR No. 1).
Frequency determining elements	One 250-kc crystal and 10 high-frequency crystals.
Tuning controls	Directly calibrated in frequency.
Carrier insertion	Continuously adjustable from 60 db below pep.
Power requirements	115/230 volts, 50/60 cps, single phase, 140 watts.

e. Oscillator, Radio Frequency O-330B/FR.

(1) *General.*

Number of tubes	14.
Power requirements	115/230 volts, 50/60 cps, single phase, 250 watts.

(2) *High-frequency oscillator section.*

Frequency range	2 mc to 64 mc (crystal-controlled or continuously variable).
Output impedance	75 ohms.
Output level:	
2 to 4 mc	2 watts.
4 to 64 mc	0.5 watt.
Crystal frequencies	2 mc to 4 mc.
Output voltage waveform	Sinusoidal.
Frequency stability:	
Temperature changes	Less than 20 cps per megacycle change for 0° C (32° F) to 50° C (122° F) temperature change.
Line voltage changes	Maximum change of 10 cps per megacycle for 10-percent change in line voltage.
Humidity changes	No appreciable change for humidities up to 95 percent.
Calibration	Direct-reading calibration in cps between 2 mc and 4 mc. (Checked against 100-kc oscillator at 50-kc checkpoints.)
Dial accuracy	20 cps per megacycle.

(3) *Intermediate frequency oscillator section.*

Frequency range	3.2 mc to 3.9 mc (crystal-controlled oscillator).
Output level	2 volts across 75 ohms.

(4) *Beat Frequency oscillator section.*

Frequency range	300 kc to 1,000 kc (crystal-controlled).
Output level	6 volts across 1,000 ohms.

f. Two-Tone Generator.

(1) *General.*

Number of tubes	7.
Power requirements	115/230 volts, 50/60 cps, 35 watts.

(2) *Audiofrequency oscillator section.*

Output frequencies	935 cps and 2,805 cps.
Output distortion:	
Harmonic	At least 65 db down.
Intermodulation	At least 55 db down.
Output impedance:	
Balanced	50 ohms.
Unbalanced	600 ohms.
Output level	0 to 0.5 volt, continuously variable.

(3) *Radiofrequency oscillator section.*

Output frequencies	1,999 kc and 2,001 kc, crystal-controlled.
Distortion	At least 65 db down.
Output impedance	70 ohms, unbalanced.
Output level	1 volt.

g. Isolation Keyer.

Number of tubes	2.
Keying sources	Teletypewriter or telegraph key.
Keying modes	50 volts, 100 volts or 60-ma neutral pulse or 20-ma polar pulse.
Key line input impedance:	
50-volt neutral pulse	50,000 ohms.
100-volt neutral pulse	100,000 ohms.
60-milliampere neutral pulse	100 ohms.
20-milliampere polar pulse	300 ohms.
Output keying voltage:	
Teletypewriter	0 to 30 volts.
Telegraph key (cw)	Carrier on and off keying.
Keying speed	120 words per minute, maximum.
Power requirements	115/230 volts, 50/60 cps, 20 watts.

h. Rf Amplifier.

Number of tubes	7.
Frequency range	2 mc to 32 mc.
Output power	1,000 watts pep.
Output impedance	50 to 70 ohms.
Signal input requirements	3 mw for full output.
Signal to distortion ratio	At least 35 db down.
Harmonic suppression	At least 55 db down.
Cooling	Forced-air cooling.
Power requirements	230 volts, 50/60 cps, 3 phase, 3,300 watts.

i. Power Amplifier.

Number of tubes	1.
Frequency range	2 mc to 28 mc.
Output power:	
Ssb, dsb, and isb	10,000-watt pep.
Am. and cw	5,000 watts (average).
Output impedance:	
Balanced	600 ohms.
Unbalanced	72 ohms.
Harmonic suppression:	
Third order harmonics	35 db down from pep.
Fifth order harmonics	45 db down from pep.

Signal to distortion ratio ---------- At least 35 db below pep output.
Cooling ---------- Forced-air cooling.
Power requirem nts-- 230 volts ac, 3 phase, 15 kw.

j. High Voltage Rectifier.

Number of tubes ----- 6.
Output voltage ------- 7,500 volts dc.
Power r quirements-- 230 volts, 50/60 cps, 3 phase, 1,500 watts.

k. Relay Panel.

Number of relays ---- 9.
Power requirements-- 230 volts, 50/60 cps, 3 phase, 10 watts.

5. Common Names

The following chart lists the common names and commercial designations of the components of the AN/FRT-52.

Note: Oscillators, Radio Frequency O-330B/FR (No. 1 and No. 2) are commercially designated as VOX-5.

Common name	Commercial designation
Sideband exciter assembly	SBE-3
Sideband exciter	AO-101
Exciter power supply	A-1397
Two-tone generator	TTG-2
Monitor control panel	MCP-2
Spectrum analyzer	FSA-2
Analyzer	SA-2
Analyzer power supply	PS-2
Auxiliary power panel	APP-1
Equipment cabinet	AX-262
Rf amplifier	RFC-1 and AX-104
Relay panel	AX-139
Auxiliary frame	AX-180
Main power supply	AX-138
Sideband monitor	SLM-2
High voltage rectifier	AX-103
Main power panel	AX-113
Auxiliary meter panel	AX-107
Main meter panel	AX-173
Main frame	AX-186
Power amplifier	AX-236
Isolation keyer	AK-100

6. Components of AN/FRT-52

a. Components (fig. 1 and 2). The major components of the AN/FRT-52 are listed in the following chart:

Quantity	Item	Height (in.)	Depth (in.)	Width (in.)	Unit Weight (lb)
1	Auxiliary frame (AX-180)	72	38	21	366
1	Sideband monitor (SLM-2)	3-1/2	8	19	8.5
1	Spectrum analyzer (FSA-2) consisting of:	10-1/2	21-7/8	19	31
	Analyzer (SA-2)	8-3/4	14-5/8	19	28
	Analyzer power supply (PS-2)				
1	Sideband exciter assembly (SBE-3) consisting of:	8-3/4	15	19	41
	Sideband exciter (AO-101)	5-1/4	15	19	38
	Exciter power supply (A-1397)	3-1/2	5-3/4	19	4
1	Monitor control panel (MCP-2)	10-1/2	16	19	75
2	Oscillator, Radio Frequency O-330B/FR	3-1/2	15	19	19
1	Two-tone generator (TTG-2)	3-1/2	5-1/2	19	2.5
1	Auxiliary power panel (APP-1)	5-1/4	15	19	28
1	Isolation keyer (AK-100)	72	38	33	500
1	Main frame (AX-186)	11-3/4	18	28-3/4	100
1	Rf amplifier (RFC-1 and AX-104)	10-3/4	15	28-3/4	80
1	High voltage rectifier (AX-103)	10	3	28-3/4	20
1	Relay panel (AX-139)	7	38	54	152
1	Base assembly (MS-1458-1 and MS-2175)				
1 set	Running spares (*b* below)				

b. Running Spares (fig. 4). The following running spares are supplied as part of the AN/FRT-52:

(1) *Tubes.*

Tube type	Item No. (fig. 4)	Quantity		Component used in	Reference designation
		In use	Running spares		
OA2	8	8	3	Sideband exciter assembly	V106, V121, and V402
				O-330B/FR	V102
				Rf amplifier	V2002 and V2003
				Analyzer	V18
OB2	8	1	1	Sideband monitor	V403
5ADP7	1	1	1	Analyzer	V12

Tube type	Item No. (fig. 4)	Quantity		Component used in	Reference designation
		In use	Running spares		
5V4G	9	3	2	O-330B/FR	V101
				Analyzer power supply	V101
5R4	11	2	1	Exciter power supply	V401
				Rf amplifier	V2000
6AB4	23	6	3	Sideband exciter	V101, V124, V125, and V127
				O-330B/FR	V301
6AS7G	12	1	1	Analyzer power supply	V102
6AH6	23	4	2	Sideband exciter	V114, V118, and V125
				Analyzer	V4
6AL5	29	1	1	Sideband exciter	V111
6AU6	23	2	1	Analyzer	V9 and V13
6J6	23	1	1	Analyzer	V1
6AQ5	7	12	4	O-330B/FR	V105, V203, V204, V205, V206, and V207
6BE6	23	3	2	O-330B/FR	V103
				Analyzer	V3
6BH6	23	2	1	Analyzer	V5 and V15
6C4	23	2	1	O-330B/FR	V202
6CL6	5	3	2	Sideband exciter	V116 and V119
				Rf amplifier	V201
6U8A	27	7	3	Sideband exciter	V110 and V117
				Analyzer	V7, V8, and V20
				Sideband monitor	V400 and V401
6X4	7	3	2	Rf amplifier	V2001
				Two-tone generator	V506
				Sideband monitor	V402
4XC5000A	2	1	1	Power amplifier	V900
12AL5	29	1	1	Analyzer	V6
12AT7	27	7	3	Sideband exciter	V113, V122, and V123
				Analyzer	V2
				Two-tone generator	V500 and V501
				Isolation keyer	V4001
12AU7	27	18	4	Sideband exciter	V105, V112, and V115
				O-330B/FR	V104, V201, and V302
				Analyzer	V10, V11, V14, and V16
				Two-tone generator	V502-V505
				Isolation keyer	V4002
12AX7	27	1	1	Analyzer power supply	V103
TV-100	4	1	1	Rf amplifier	V203
872A	6	6	3	High voltage rectifier	V600-V605
5651	23	2	1	Spectrum analyzer	V17 and V104
6146	3	2	1	Sideband exciter	V120
				Rf amplifier	V202

(2) *Diodes.*

Diode type	Item No. (fig. 4)	Quantity		Component used in	Reference designation
		In use	Running spares		
1N67	16	6	3	Sideband exciter	CR107 and CR108
				Rf amplifier	CR201 and CR202
				Sideband monitor	CR400 and CR401
1N34	16	8	3	O-330B/FR	CR101, CR102, CR201, and CR202
1N303	17	10	4	Sideband exciter	CR111-CR114
				Rf amplifier	CR203, CR204, and CR205
				Isolation keyer	CR4003
				Power amplifier	CR900 and CR901
RX-104	18	2	1	Isolation keyer	CR4001 and CR4002
CR2021	13	1	1	Analyzer	CR1
CR2005	14	2	1	Analyzer power supply	CR601 and CR602
DD-100	15	2	1	Sideband exciter	CR115 and CR116

(3) *Lamps.*

Lamp type	Item No. (fig. 4)	Quantity		Component used in	Reference designation
		In use	Running spares		
47	21	2	1	Two-tone generator	I502
				Sideband exciter	I103
NE51	21	10	4	Sideband exciter	I101 and I102
				O-330B/FR	I301, I303, and I304
				Rf amplifier	I2000
				Main power panel	I1004
44	21	4	2	O-330B/FR	I401
				Isolation keyer	I4001
				Sideband monitor	I400
44(AF)	19	1	1	Exciter power supply	I401
3S6	20	2	1	Two-tone generator	I500 and I501
NE-17	24	6	3	Relay panel	I700-I705
10S6	25	4	2	Main frame	I1000-I1003
BI-106-1	26	1	1	Auxiliary frame	I3000
BI-106-2	28	1	1	Main frame	I1007
BI-107	10	3	2	Main frame	I1005 and I1006
				Auxiliary frame	I3001
328	22	5	2	Spectrum analyzer	I1-15

(4) *Fuses.*

Fuse type	Item No. (fig. 4)	Quantity		Component used in	Reference designation
		In use	Running spares		
AGC 1/8	30	1	12	Two-tone generator	F501
AGC 2	30	6	36	Analyzer power supply	F601 and F602
				O-330B/FR	F703
				Two-tone generator	F500
				Sideband monitor	F400
AGC 3	30	2	12	O-330B/FR	F101
MDL 1/16	31	3	18	Sideband monitor	F401
				Isolation keyer	F4002 and F4003
MDL 1/8	31	1	12	Rf amplifier	F2001
MDL 1/4	31	2	24	Rf amplifier	F2000
				Exciter power supply	F403
MDL 1	31	7	42	High voltage rectifier	F600-F605
				Relay panel	F704
MDL 2	31	3	36	Rf amplifier	F2002 and F2003
				Exciter power supply	F401
MDL 3	31	2	18	Rf amplifier	F2004
				Exciter power supply	F402
MDL 5	31	3	12	Relay panel	F703 and F705
				Auxiliary frame	F3000
MDL 10	31	3	18	Relay panel	F700-F702

7. Additional Equipment Required

The following equipment is not supplied as part of the AN/FRT-52 but is required for operation:

a. High-impedance (500,000 ohms) microphone is required for voice modulation of the sideband exciter.

b. A standard telegraph key is required for cw operation.

c. A standard headset (high impedance), such as Headset HS-30-U, is required for operation of the O-330B/FR.

d. When unbalanced antenna connections are required, the use of an adaptable coaxial connector is necessary.

e. Two 0-5 rf ammeters with internal thermocouples (manufacturer's part No. MR-139), for output monitoring of balanced output.

8. Radio Transmitting Set AN/FRT-52 (fig. 1 and 2)

a. General. The AN/FRT-52 consists of a main frame and an auxiliary frame bolted

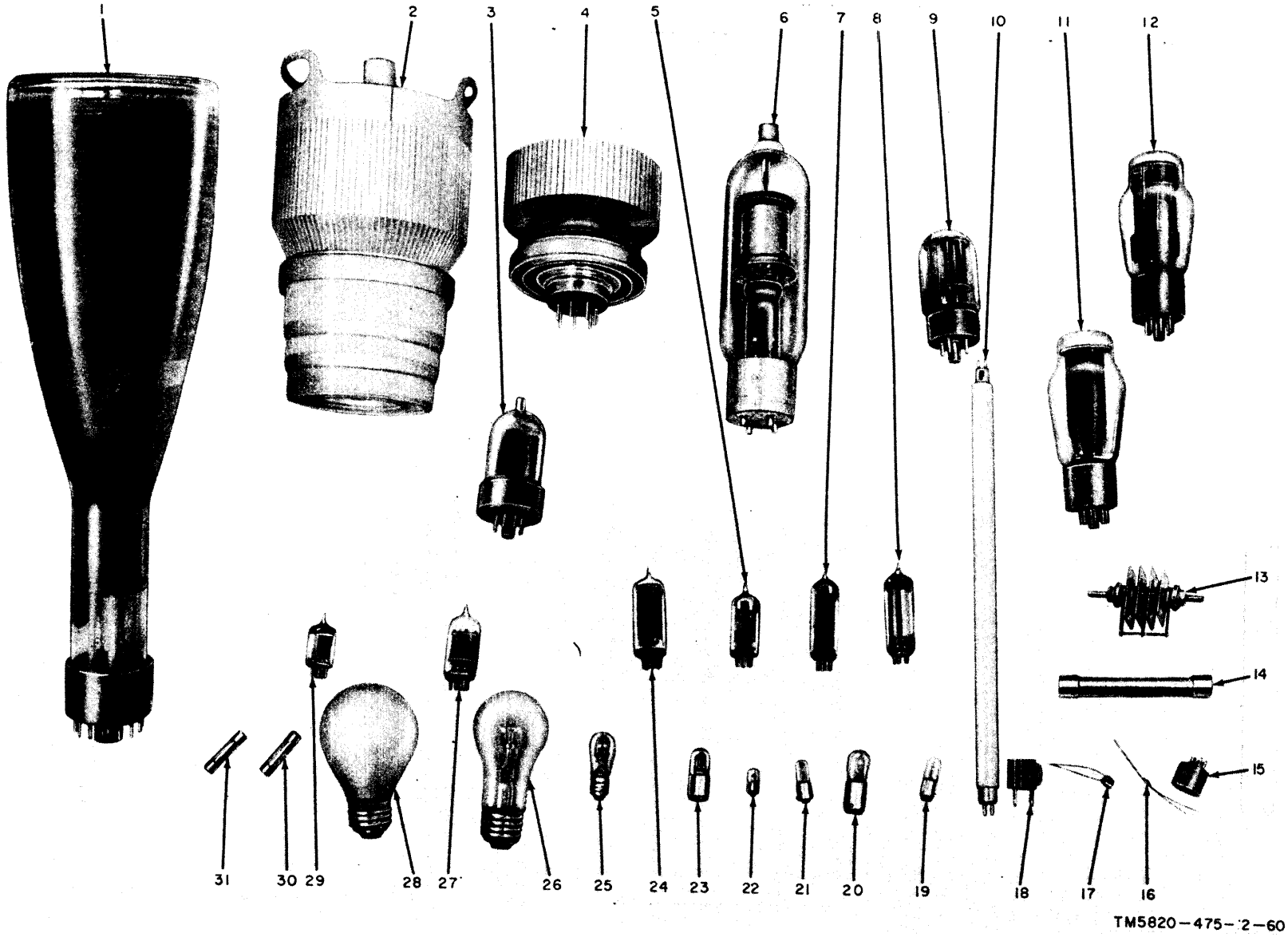


Figure 4. AN/FRT-52, running spares.

together and to a base assembly that is bolted to the floor. The two frames house all the components of the AN/FRT-52 and are equipped with front doors for protection of the components when not in use. Primary power connections are made through the base assembly. Two antenna bowl insulators, and rf ammeters, used for balanced antenna operation, are provided at the top of the main frame. If unbalanced antenna operation is required, a connector must be mounted in the hole located in the side of the main frame.

b. Auxiliary Frame. The auxiliary frame houses the components which form the exciter portion of the AN/FRT-52 and those components used for testing and extending the facilities of the AN/FRT-52. The frame is divided into a front and a rear section by a partition which supports supplementary parts such as main contactors, terminal boards, and miscellaneous parts for the control of the AN/FRT-52 and for interconnecting the auxiliary frame and the main frame. Paragraphs 9 through 17 describe the components contained in the auxiliary frame.

c. Main Frame. The main frame houses the components which contain the output stages of the AN/FRT-52 and their necessary power supplies. A portion of the main frame is divided into a front and a rear section by a partition. The front section contains the removable components; the rear section contains parts associated with the main power supply and a blower assembly for power amplifier tube V900. Paragraphs 18 through 23 describe the components contained in the main frame.

9. Auxiliary Meter Panel
(fig. 1)

The auxiliary meter panel is factory mounted at the top of the auxiliary frame and contains three meters. The meters monitor the power amplifier screen grid voltage, plate voltage, and grid bias.

10. Sideband Monitor
(fig. 1)

The sideband monitor, rack mounted directly below the auxiliary meter panel, monitors the upper and lower sideband outputs of the sideband exciter (para 12). All operating controls, indicators, and fuses are mounted on the front panel. Two screwdriver adjustments are accessible through holes in the front panel. A polarized power connector is mounted on the rear of the chassis.

11. Spectrum Analyzer

a. Analyzer (fig. 1). The analyzer is slide mounted below the sideband monitor. The analyzer is an automatic scanning superheterodyne receiver that displays a complete band of radiofrequency (rf) signals and their harmonics. All operating controls and indicators and signal input connections are mounted on the front panel. Six of the operating controls are mounted behind a door on the left side of the front panel. Controls used for alignment and calibration are mounted on the chassis. A celluloid shield placed over the cathode-ray tube (crt) is calibrated linearly from 0 to 1 and logarithmically from 0 decibel (db) to 40 db for signal level measurements. Direct-current operating voltages are supplied to the analyzer from the analyzer power supply through connectors on the rear of the chassis.

b. Analyzer Power Supply (fig. 2). The analyzer power supply is rack-mounted in the rear section of the auxiliary frame. Two fuses are mounted on the front panel; a 270-volt test jack, a VOLTAGE REGULATOR ADJUST control, a two-prong alternating-current (ac) input connector, and a multipin dc output connector are mounted on the rear panel. The ac voltage is applied to the analyzer power supply from a constant voltage transformer at the bottom rear section of the auxiliary frame. The multipin connector supplies dc operating voltages to the analyzer through an interconnecting cable.

12. Sideband Exciter Assembly
(fig. 1)

a. Sideband Exciter. The sideband exciter is slide mounted below the analyzer (fig. 1) and is the excitation portion of the AN/FRT-52. The sideband exciter supplies

the necessary drive signal for the rf amplifier. All operating controls and indicators are mounted on the front panel of the sideband exciter. Controls on the top, bottom, and rear of the chassis are for higher echelon maintenance. Two crystal ovens are contained on the chassis. The crystal oven on the top of the chassis near the rear contains 250-kilocycle (kc) crystals. A two-section crystal oven on the left side of the chassis contains facilities for holding 8 high-frequency crystals in a lower section (accessible from the bottom of the chassis) and has facilities for 10 medium-frequency crystals in the upper section. The medium-frequency crystals are not supplied with the AN/FRT-52. Input and output signal connections are made through a terminal board and six coaxial connectors on the rear panel. Dc voltage, from the exciter power supply, is applied through an interconnecting cable and a multipin connector. A three-pin MIKE receptacle, on the front panel, permits external excitation from a microphone.

b. Exciter Power Supply. The exciter power supply is rack mounted near the bottom of the auxiliary frame. Six fuses and one indicator lamp are mounted on the front panel. The three fuses mounted to the left of the front panel are spares. Input and output power receptacles are mounted on the rear panel. Ac voltage is applied to the chassis from the primary power source through an eight-outlet terminal strip and an ac power cable. Ac and dc output voltages are applied to the sideband exciter through an interconnecting cable.

13. Monitor Control Panel (fig. 1)

The monitor control panel is rack mounted below the sideband exciter. All controls are mounted on the front panel. The monitor control panel controls the application of audio, rf, and keying signals to various test and operational components of the AN/FRT-52. Two terminal boards and three coaxial switches are mounted on the rear of the front panel.

14. Oscillator, Radio Frequency O-330B/FR (fig. 1)

Two O-330B/FR's are slide mounted below the monitor control panel. The O-330B/FR No. 1 supplies an rf output to the sideband exciter through the monitor control panel. The O-330B/FR No. 2 supplies an rf signal directly to the analyzer for testing purposes. Each O-330B/FR contains a variable master oscillator (vmo) chassis. Operating controls are on the front panel and on a subpanel accessible through a door on the upper left side of the front panel. Installation and preoperational controls, signal and power connectors, and fuses are located at the rear of the chassis.

15. Two-Tone Generator (fig. 1)

The two-tone generator is slide mounted below the O-330B/FR No. 2. This component provides one or two audio tones and one or two rf signals. The audio tones are applied to the sideband exciter through the monitor control panel; the rf signals are applied to the analyzer through the monitor control panel. Ac power is applied to the two-tone generator through a connector at the rear of the chassis. All operating controls and indicators are mounted on the front panel. Alignment and adjustment controls are mounted on the top of the chassis. Power supply components and two audio filters are mounted on the rear of the chassis. The top of the component is protected with a perforated cover plate.

16. Auxiliary Power Panel (fig. 1)

The auxiliary power panel is rack mounted at the bottom of the auxiliary frame and contains four polarized ac receptacles on the front panel. A fifth receptacle is mounted at the rear of the panel. Ac voltage is applied to the auxiliary power panel through a terminal board at the rear of the panel from an external power source.

17. Isolation Keyer
(fig. 2)

The isolation keyer is rack mounted at the rear of the auxiliary frame. This component provides facilities for keying the AN/FRT-52 from an external telegraph key or teletypewriter equipment. The front panel contains six fuses, one indicator lamp, and two switches. Two controls are accessible through two normally capped holes in the front panel.

18. Main Meter Panel
(fig. 1)

The main meter panel is rack mounted at the top of the main frame and contains five meters. The meters monitor the power amplifier filament voltage, screen grid current, plate current, rf plate voltage, and power output of the power amplifier.

19. Power Amplifier
(fig. 1 and 2)

The power amplifier is factory mounted to the main frame below the main meter panel. The power amplifier provides the power amplification necessary for long range transmission. A blower motor, which provides forced-air cooling of the power amplifier tube is mounted to the main frame directly below the power amplifier tube. The front panel contains a plexiglass window, four indicator lamps, five tuning and loading controls, and their associated indicator dials.

20. Rf Amplifier
(fig. 1)

The rf amplifier is slide mounted below the power amplifier and is the intermediate power amplifier between the sideband exciter and the power amplifier. The rf amplifier chassis consists of two sections. An outer section contains all power supply parts; the inner section contains all amplifier parts. Forced-air cooling of the rf amplifier tube is provided by a blower motor. The operating controls and indicators for the rf amplifier are mounted on the front panel. Ac and dc power is applied through connectors on the rear apron of the power supply section; rf signals are routed through connectors on the rear apron of the amplifier section.

21. Main Power Panel
(fig. 1)

The main power panel is factory mounted to the main frame, below the rf amplifier. The main power panel controls the application of plate, screen grid, and filament voltages to the power amplifier and monitors all interlock circuits contained on the main frame. The panel also controls the application of primary ac power to the auxiliary and main frames. All the main power panel controls and indicators required to perform the above functions are contained on the front panel. All associated circuit parts are mounted on the main frame.

22. High Voltage Rectifier
(fig. 1)

The high voltage rectifier, rack mounted below the power panel, supplies the high voltage required by the power amplifier. Six fuses are mounted on the lower section of the front panel; the upper portion of the front panel consists of a plexiglass window for observation of the high voltage rectifier tubes. All interconnecting wiring is located on the bottom of the chassis. A cover plate secured to the bottom of the chassis prevents accidental contact with the high voltage transformers and tube sockets. Seven connectors on the rear of the chassis provide connections for ac input voltages and dc output voltages.

23. Relay Panel
(fig. 1)

The relay panel is rack mounted at the bottom of the main frame. The panel contains nine relays and their associated parts to protect various circuits of the AN/FRT-52 against overloads. The relays also connect various voltages to other components of the AN/FRT-52.

CHAPTER 2

INSTALLATION AND OPERATION INSTRUCTIONS

Section I. INSTALLATION

Notes:

1. The procedures described in this section are performed by the equipment installer.
2. The following procedures, together with the installation literature supplied by the manufacturer with the equipment, provide complete installation information.
3. The tuning chart supplied with the equipment indicates readings with the AN/FRT-52 connected to a dummy load. Equipment installers should correct the tuning chart to reflect actual field conditions.

24. General

Upon completion of the installation procedures covered in the manufacturer's literature, perform the following procedures in the sequence listed below.

a. Check to see that all components are in their proper locations (fig. 1 and 2).

b. Check to see that all tubes, fuses, and crystals are correctly installed in their proper locations (para 25 through 27).

c. See that all intercomponent connections are correct (para 28).

d. Calibrate the O-330B/FR's No. 1 and No. 2 (para 31).

e. Connect external equipment to the appropriate terminals of terminal boards E3000, E3001, and E3002 of the auxiliary frame (para 30).

f. Connect the two-tone generator for balanced or unbalanced operation as required (para 28*e*).

g. Connect the antenna to the antenna connections (para 29).

h. Perform the preliminary starting procedures (para 46).

i. Perform the starting procedures (para 47).

j. Perform the procedures for tuning to the carrier frequency (para 48).

k. Adjust the AN/FRT-52 for the desired type of operation (para 50 through 54).

25. Tube Location

a. General. Check the tubes in the components of the AN/FRT-52 for correct location and proper seating in their tube sockets. The following chart indicates the general location, type of component mounting, and figure references for the applicable components of the AN/FRT-52. Supplementary information for tube location is given in *b* below. Component removal procedures are covered in paragraph 72.

Component	Location	Component mounting	Figure reference
Sideband monitor	Auxiliary frame	Rack	34
Analyzer	Auxiliary frame	Slide	35
Analyzer power supply	Auxiliary frame, rear	Rack	36
Sideband exciter	Auxiliary frame	Slide/tilt[a]	37
Exciter power supply	Auxiliary frame	Rack	38
Oscillator, Radio Frequency O-330B/FR (see *b* below)	Auxiliary frame	Slide	39-41
Two-tone generator	Auxiliary frame	Slide	42
Isolation keyer	Auxiliary frame, rear	Rack	43
Power amplifier[b]	Main frame	Part of frame	2
Rf amplifier	Main frame	Slide-lock[c]	44
High voltage rectifier[b]	Main frame	Part of frame	45

[a] Component chassis may be tilted for convenience of maintenance
[b] Tubes may be observed through the front plexiglass panels.
[c] Depress LOCK controls on front panel for slide action.

b. Oscillator, Radio Frequency O-330B/FR. To check the location of tubes in either O-330B/FR, proceed as follows:

(1) Remove eight mounting screws from the front panel of the O-330B/FR and slide the component out of the auxiliary frame.

(2) Remove the tube shields from the two tubes at the rear of the O-330B/FR and check them against those shown in figure 39.

(3) Remove the meshed cover plate over the power supply chassis to expose the tubes. Check the tube locations against those shown in figure 40.

(4) To check the tubes in the rf multiplier chassis (fig. 41), remove the power supply chassis as follows:

(a) Disconnect plug P301 from jack J101 (fig. 39).

(b) Disconnect plug P101 from jack J201.

(c) Disconnect plug P102 from jack J203.

(d) Turn the four Dzus fasteners (two on the front panel and two under the rear of the power supply chassis).

(e) Remove the power supply chassis from the O-330B/FR by sliding the chassis to the rear.

(f) Remove the tube shields from the tubes in the rf multiplier chassis and check the tube locations against those shown in figure 41.

(g) Replace the tube shields on the rf multiplier chassis and reinstall the power supply chassis; reconnect the interchassis cables as shown in figure 39.

(5) Slide the O-330B/FR into the auxiliary frame and secure it with the eight mounting screws.

26. Fuse Location

Be sure that the fuses of the proper value are contained in the fuseholders of all the components of the AN/FRT-52. The following chart shows the value of each fuse and indicates its location:

Component	Fuse and reference symbol	Rating (amp)
Auxiliary frame (rear) (fig. 2)	Front fan F3000	5
Sideband monitor (fig. 12)	MAIN F400	2
	B+ F401	1/16
Analyzer power supply (fig. 2)	Line F601	2
	Line F602	2
Exciter power supply (fig. 17)	OVEN F401	2
	MAIN F402	3
	B+ F403	0.25
O-330B/FR (fig. 20)	OVENS F101	3
	POWER F102	2
Two-tone generator (fig. 21)	MAIN F500	2
	B+ F501	0.125
Isolation keyer (fig. 22)	MAIN F4001	1
	B_1+ F4002	1/16
	B_2+ F4003	1/16
Rf amplifier (fig. 24)	B+ F2000	0.25
	IPA BIAS F2001	0.125
	IPA FIL F2002	2
	IPA BLOWER F2003	2
	LV F2004	3
High voltage rectifier (fig. 45)	HV FILAMENT F600	1
	HV FILAMENT F601	1
	HV FILAMENT F602	1
	HV FILAMENT F603	1
	HV FILAMENT F604	1
	HV FILAMENT F605	1
Relay panel (fig. 26)	MAIN BLOWER PH1 F700	10
	MAIN BLOWER PH2 F701	10
	MAIN BLOWER PH3 F702	10
	REAR FAN F703	5
	TIMER F704	1
	PA FIL F705	5

27. Crystal Location

Crystals are used in the high-frequency section of the sideband exciter crystal oven (*a* below), and on the O-330B/FR power supply and rf multiplier chassis (*b* below).

a. Sideband Exciter Crystal Location.

(1) Remove the screws from the front panel of the sideband exciter and slide the component from the auxiliary frame.

(2) Remove the screws from the cover plate that covers the crystal sockets.

(3) Remove the cover plate and the filler material.
(4) Check to see that the proper crystals are contained in their appropriate sockets in accordance with the following chart:

Crystal frequency (mc)	Reference symbol
8	Y101
10	Y102
12	Y103
14	Y104
18	Y105
11	Y106
13	Y107
17	Y108

b. O-330B/FR Crystal Location (fig. 40 and 41).
(1) Remove the screws from the front panel of the O-330B/FR and slide the component from the auxiliary frame.
(2) Check to see that the proper crystals are contained in the sockets labeled Y101 and Y102 on the power supply chassis.
(3) To expose the crystals in the rf multiplier chassis, perform the procedures given in paragraph 25*b*(4)(*a*) through (*e*); check the crystals in the sockets labeled Y201 through Y204 for proper location and seating and replace the power supply chassis and O-330B/FR in the auxiliary frame.

Note: The use of the O-330B/FR as part of the AN/FRT-52 is limited to the vmo function. None of the crystals listed in (2) or (3) above is required for the operations detailed in this manual.

28. Checking Connections

a. Auxiliary Frame Connections. Check the auxiliary frame connections in accordance with the data shown in figure 48. The following chart lists the cables connected by the installer and the components and jacks to which they are connected:

Cable No.	Wire	Connects	
		From	To
CA-427	45	Sideband exciter (J111 USB OUT)	Sideband monitor (J401 USB INPUT)[a]
CA-427	46	Sideband exciter (J112 LSB OUT)	Sideband monitor (J400 LSB INPUT)[a]
CA-427	1 and 8[b]	Analyzer (VFO INPUT)	0-330B/FR No. 2 (J208)
CA-427	2	Analyzer (SIGNAL INPUT)	Monitor control panel (S302-R)
CA-427	5	Sideband exciter (J103 RF OUT)	Auxiliary frame (J3001 EXCITER OUTPUT)[a]
CA-427	64	Sideband exciter (ALDC IN)	Auxiliary frame (J3017 ALDC)[a]
CA-427	3	Sideband exciter (J102 RF MON)	Monitor control panel (S302-K)[a]
CA-427	4	Sideband exciter (J104 VMO IN)	Monitor control panel (S304-N)[a]
CA-427	14	Sideband exciter (E101-1)	Auxiliary frame (E3000-14)[a]
CA-427	15	Sideband exciter (E101-2)	Auxiliary frame (E3002-23)[a]
CA-427	16	Sideband exciter (D101-3)	Auxiliary frame (E3002-24)[a]
CA-427	17	Sideband exciter (E101-4)	Auxiliary frame (E3002-25)[a]
CA-427	18[c]	Sideband exciter (E101-6)	Monitor control panel (E300-5)[a]
CA-427	43	Sideband exciter (E101-7)	Auxiliary frame (E3002-29)[a]
CA-427	19	Sideband exciter (E101-8)	Monitor control panel (E300-4)[a]
CA-427	20[d]	Sideband exciter (E101-10)	Monitor control panel (E300-12)[a]
CA-427	44	Sideband exciter (E101-11)	Auxiliary frame (E3002-33)[a]
CA-427	21	Sideband exciter (E101-12)	Monitor control panel (E300-11)[a]
CA-427	22	Sideband exciter (E101-13)	Auxiliary frame (E3002-26)[a]
CA-427	23	Sideband exciter (E101-14)	Auxiliary frame (E3001-20)[a]
CA-427	29[e]	Two-tone generator (E500-3)	Monitor control panel (E300-1)[a]
CA-427	Blk	Two-tone generator (E500-2)	Monitor control panel (E300-3)[a]
CA-427	13	Two-tone generator (J501 RF OUT)	Monitor control panel (S302-J)[a]
CA-427	6	0-330B/FR No. 1 (J208)	Monitor control panel (S303-P)[a]
CA-346	---	Sideband exciter (J109)	Exciter power supply (J402)
CA-432	---	Analyzer	Analyzer power supply

[a] These connections have been made by the manufacturer.
[b] Wires 1 and 8 are connected together through a line plug and jack assembly.
[c] Shield is connected to E300-5 on the monitor control panel.
[d] Shield is connected to E300-9 on the monitor control panel.
[e] Shield is connected to E300-9 on th monitor control pan l.

b. Auxiliary Frame to Main Frame Connections. Check the connections between the auxiliary frame and the main frame in accordance with the data shown in figure 5. The following chart lists the cables connected by the installer and the jacks to which they are connected:

Cabl	Connects	
	From[a] auxiliary frame	To main frame
W3000	P3005	J1005
W3000	P3006	J1006
W3000	P3007	J1007
W3000	P3049	J1008
W3000	P3000	J1000
Armored cable (bx)	Constant voltage transformer	Terminai box

[a]These connections have been made by the manufacturer.

c. Main Frame Connections.

(1) *Relay panel and rf amplifier.* Check the connections to the relay panel and the rf amplifier in accordance with the data shown in figure 6. The following chart lists the cables connected by the installer and the components and jacks to which they are connected:

Cable No.	Connects	
	From[a] main frame	To
W1002	P1002	Rf amplifier (J201)
W1003	J1003	Rf amplifier (J203)
W1001	J1001 (power amplifier)	Rf amplifier (J2002)
	J1008	Rf amplifier (E201-2)
CA-425	P1001	Relay panel (J701)
CA-425	P1000	Relay panel (J700)

[a]These connections have been made by the manufacturer.

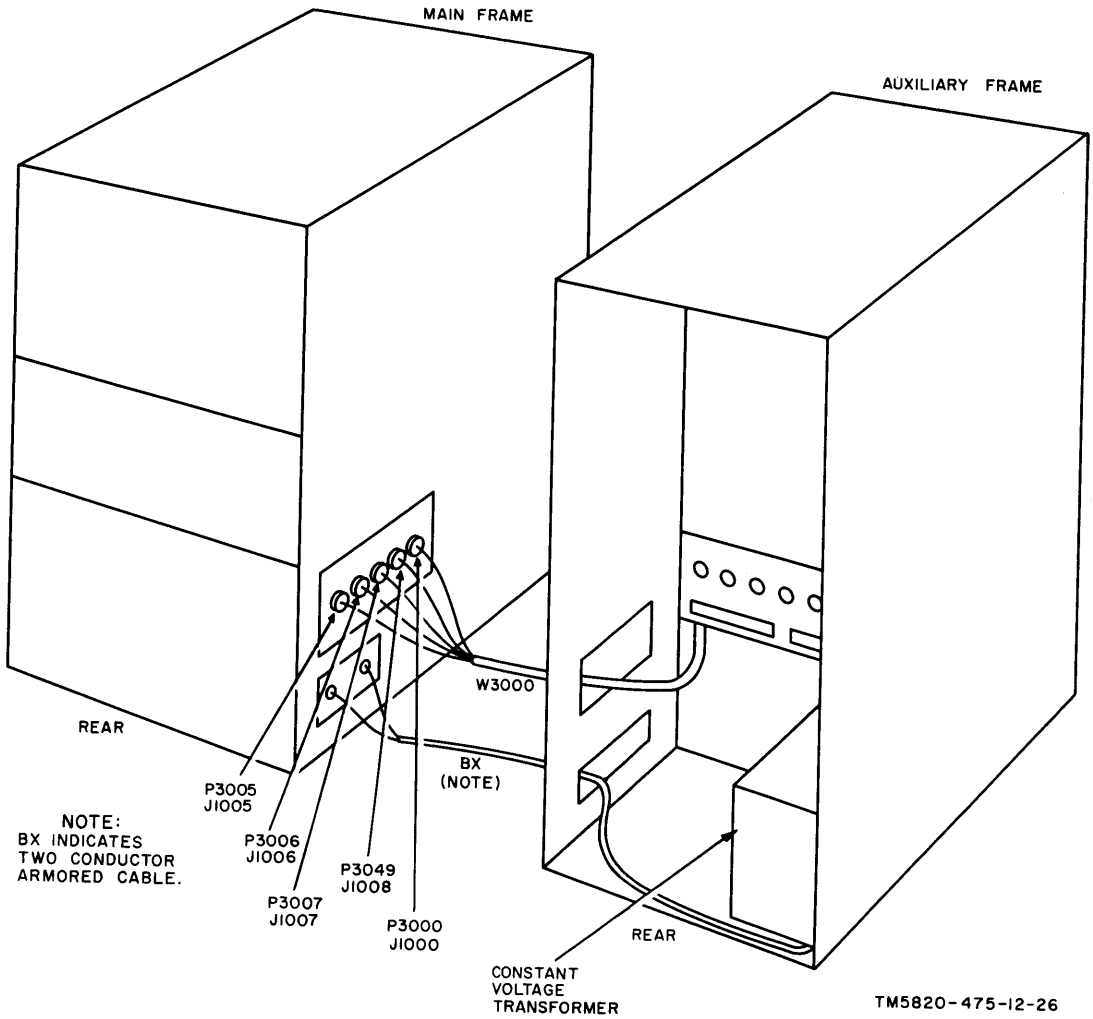


Figure 5. Interframe connections.

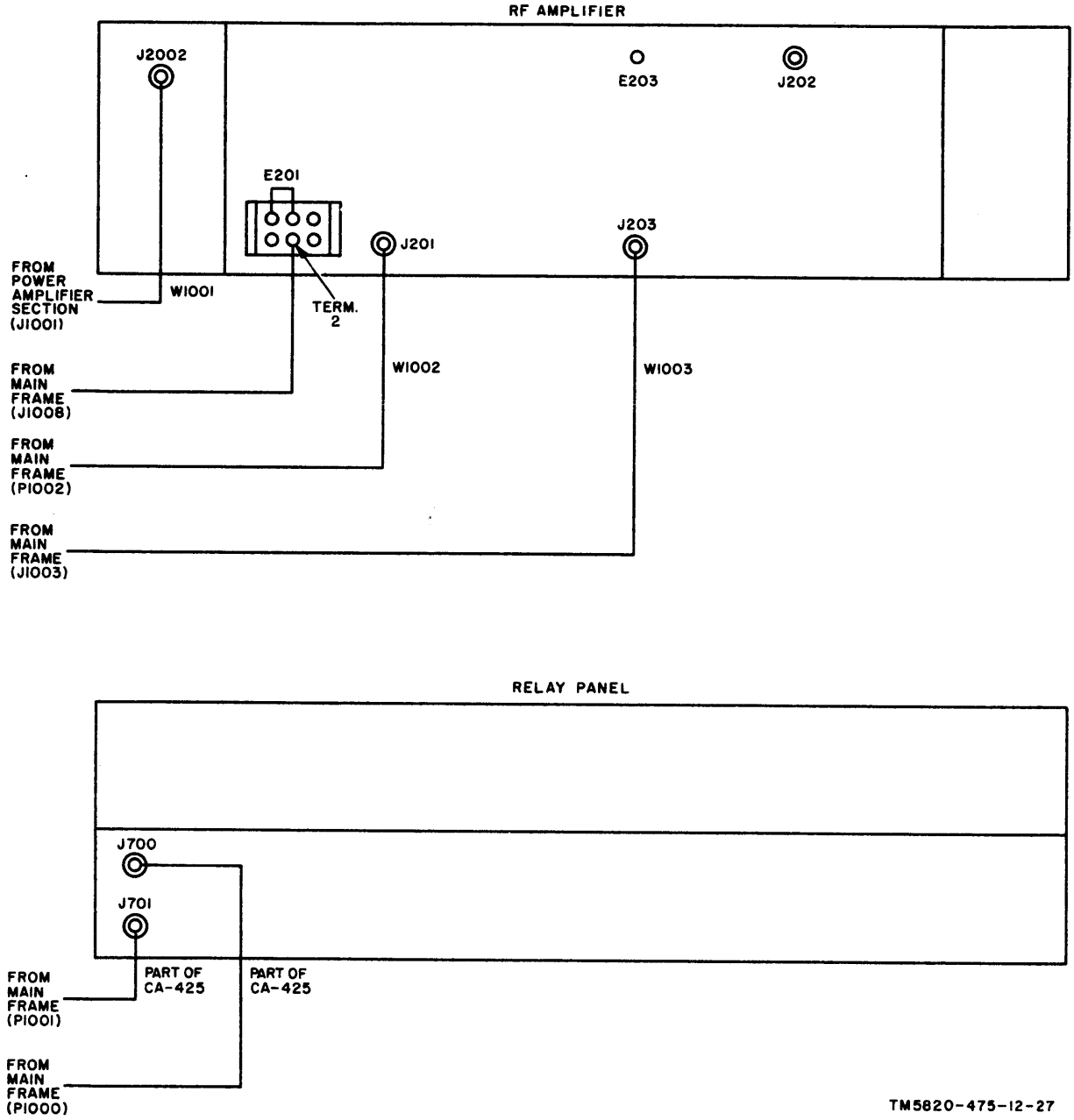


Figure 6. Rf amplifier and relay panel connections.

(2) *High voltage transformer T800.* Check the connections to high voltage transformer T800 in accordance with the data shown in figure 7. This figure shows all connections made by the installer; terminations of cables and wires not shown have been made by the manufacturer. Figure 2 shows the location of this transformer in the main frame.

d. Primary Power Conversion Connections. The AN/FRT-52 is operated from a primary source of 230-volt, 60-cps, 3-phase power. Components mounted in the auxiliary frame are wired for 115-volt, single-phase operation but can be operated individually from a 230-volt source. The wiring information for converting these components from 115-volt to 230-volt operation is shown in figures 8, 9, and 10.

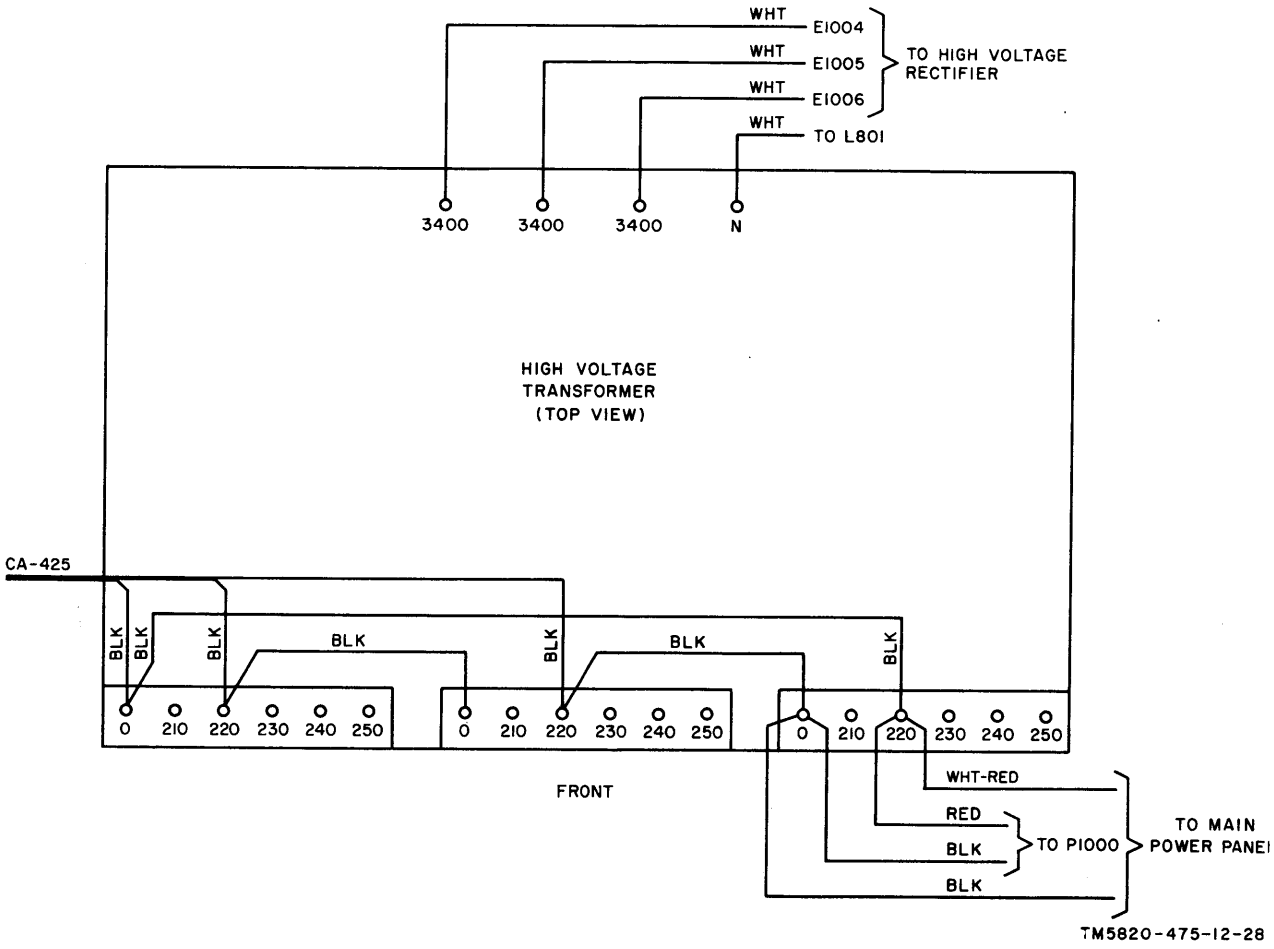


Figure 7. High voltage transformer (T800) connections.

Note: For 230-volt operation, the converted component fuse values must be adjusted to protect the equipment. Reduce the current ratings of the affected fuses to half of that shown on the panel marking.

e. Two-Tone Generator Output Connections. AUDIO OUT terminal board E500, at the rear of the two-tone generator can be connected for balanced or unbalanced operation. For balanced operation, the output is taken between terminals 1 and 3, with terminal 3 ungrounded. For unbalanced operation, terminal 3 is grounded.

f. Connections for Cw Operation. Perform the following procedure to adapt the AN/FRT-52 for cw operation.

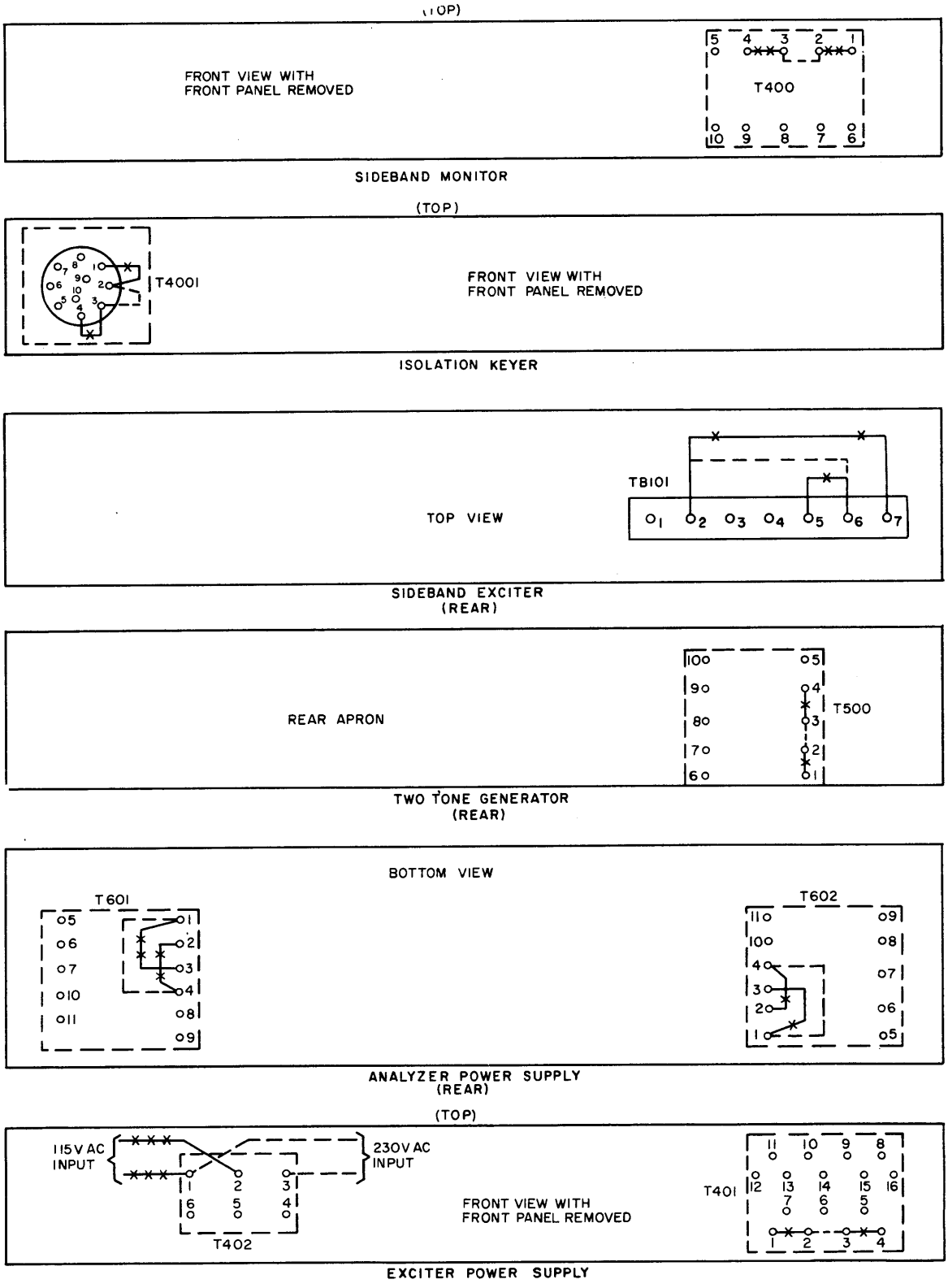
(1) Remove the jumper connected between terminals 23 and 24 of terminal board E3002 (fig. 2 and 48) and connect a telegraph key between these terminals.

Note: For operation from electronic keying or dc pulse generating equipment, remove the jumpers between terminals 5 and 6 of terminal board E3000 and connect the input signal.

(2) Remove the jumper connected between terminals 2 and 3 of terminal board E101 on the rear of the sideband exciter (fig. 48).

29. Antenna Connection

a. General. Connections for balanced and unbalanced antenna operation are made on a terminal board located at the top of the power amplifier. This terminal board (fig. 11) is accessible by removal of the upper panel (containing the plexiglass window) from the main frame.



NOTE:
FOR 115 V AC OPERATION, CONNECT LEADS MARKED ~~×××~~. FOR 230 V AC OPERATION, CONNECT LEADS MARKED – – –.

TM5820-475-12-55

Figure 8. Primary power conversion connections, 115 volts and 230 volts, part of auxiliary frame components.

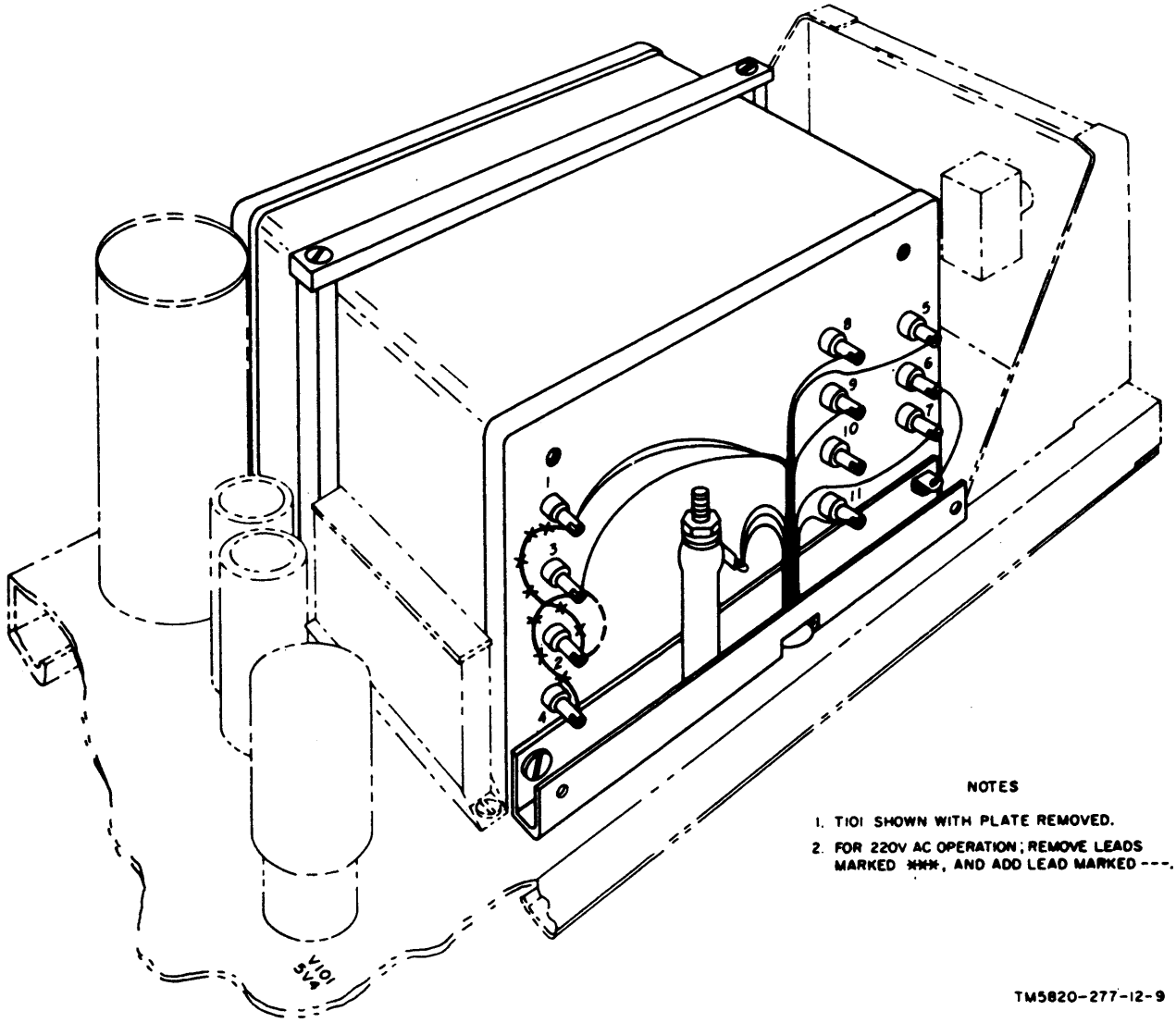


Figure 9. O-330B/FR, primary power conversion connections, power supply transformer.

b. Balanced Operation. For operation with a balanced antenna, connect a strap between E900 and E901 (A, fig. 11).

Note: Check that an rf ammeter (0-5 amperes) is connect d in series between each bowl insulator, on top of the main frame, and the antenna leads.

c. Unbalanced Operation. For operation with an unbalanced antenna, proceed as follows:

(1) Mount a coaxial connector on the coaxial connector bracket at the top of the right side of the main frame (fig. 30).
(2) Connect the wire attached to thermocouple TC900 to the coaxial connector.
(3) Connect one strap between E900 and E902 (B, fig. 11).
(4) Connect a second strap across E901, E903, and E904.

30. Signal Input Connections (fig. 48)

The following signal input connections are made to terminal boards E3000 through E3002 as applicable to the mode of operation.

Terminal No.	Function
1 through 4, 36	Not used.
5-6	Connect to a source of voltage or current keying signals for cw operation. Jumper installed for other modes of operation.
7, 22, 31, 35	Connect to station ground.
8-14	If desirable, connect interlock circuit of other station equipment to appropriate terminals. Remove jumpers for use.
15-20	Not applicable in the AN/FRT-52 (for use with a frequency shift keyer component).
21	Connect remote push-to-talk circuit for keying AN/FRT-52 during am. operation if required.
23-24	Connect to a telegraph key for cw operation. Jumper installed for other modes of operation.
25	Provides facilities for keying an additional transmitter. Ground potential is present at this terminal when the AN/FRT-52 is keyed. Connect keying circuit of the additional transmitter.
26-27	Connect audio output of station radio receiver for squelch circuit operation during am. operation using a local microphone.
28-30	Connect audio input signals (voice or teletypewriter) for channel 1 input. For balanced line operation, connect between terminals 28 and 30. For unbalanced line operation, connect between terminals 29 and either 28 or 30.
32-34	Connect audio input signals (voice or teletypewriter) for channel 2 input. For balanced line operation, connect between terminals 32 and 34. For unbalanced line operation, connect between terminals 33 and either 32 or 34.

31. Calibration of O-330B/FR's No. 1 and No. 2

a. General. The high-frequency output of the O-330B/FR vmo can be adjusted to any frequency between 2 and 4 mc. The CALIBRATE control is used when changing frequencies. Performance of the calibration procedures (*b* below) results in an adjustment that sets the CALIBRATE control closest to its correct mean position.

Caution: **The O-330B/FR requires a warmup period of at least 48 hours. Before applying ac power to the O-330B/FR, check to see that the front panel controls of the AN/FRT-52 are set properly as indicated in paragraph 46c.**

b. Calibration Procedures. Perform the following procedures on the O-330B/FR's No. 1 *and* No. 2:

(1) Set circuit breaker CB3000 (rear of auxiliary frame) to the *on* position.

(2) Set the O-330B/FR POWER switch to the ON position and allow for the necessary warmup period.

(3) Place the BEAT and HFO switches to the ON position.

(4) Plug the headset into the PHONES jack.

(5) Turn the BAND-MCS switch to the 2-4 position.

(6) Turn the XTAL switch to the VMO position.

(7) Turn the MASTER OSCILLATOR FREQUENCY control until a reading of 2,000 kc is obtained on the associated dials; note whether the direction of approach to this frequency is from a higher reading to a lower reading or from a lower reading to a higher reading.

(8) Loosen the CALIBRATE LOCK knob behind the CALIBRATE control. Vary the CALIBRATE control until a zero beat is indicated by the headset and the ZERO BEAT panel indicator. (The ZERO BEAT lamp is normally lighted. As zero beat is approached, it will blink on and off erratically. At the zero beat, the lamp will be out.)

(9) Turn the MASTER OSCILLATOR FREQUENCY knob until a reading of 4,000 kc is obtained; approach this frequency in the same direction as the 2,000-kc frequency was approached. (For example, if in (7) above, 2,000 kc was approached from a higher frequency, turn the knob until a reading *over* 4,000 kc is obtained; then set to 4,000 kc.)

(10) Remove the front panel cap that covers trimmer C303 and adjust trimmer C303 with a screwdriver until a zero beat indication is indicated by both the headset and the ZERO beat indicator.

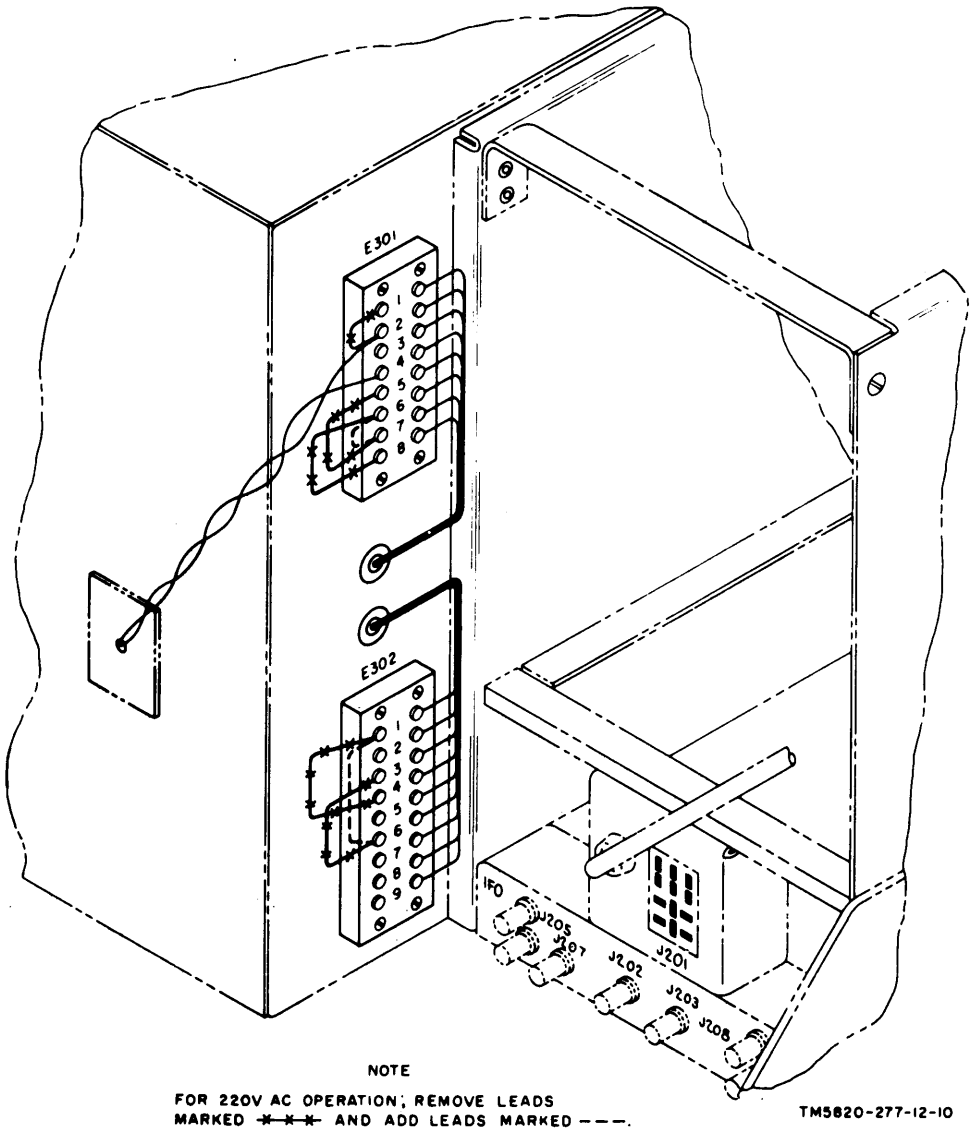


Figure 10. O-330B/FR, oven terminal boards, primary power conversion connections.

(11) Repeat the procedure given in (7), (8), (9), and (10) above until adjustments of the CALIBRATE control and trimmer C303 produce zero beat at both 2,000 and 4,000 kc. Tighten the CALIBRATE LOCK knob and check to see that the adjustment has not been disturbed.

(12) Replace the C303 trimmer cover.

(13) Turn the BEAT and HFO switches off.

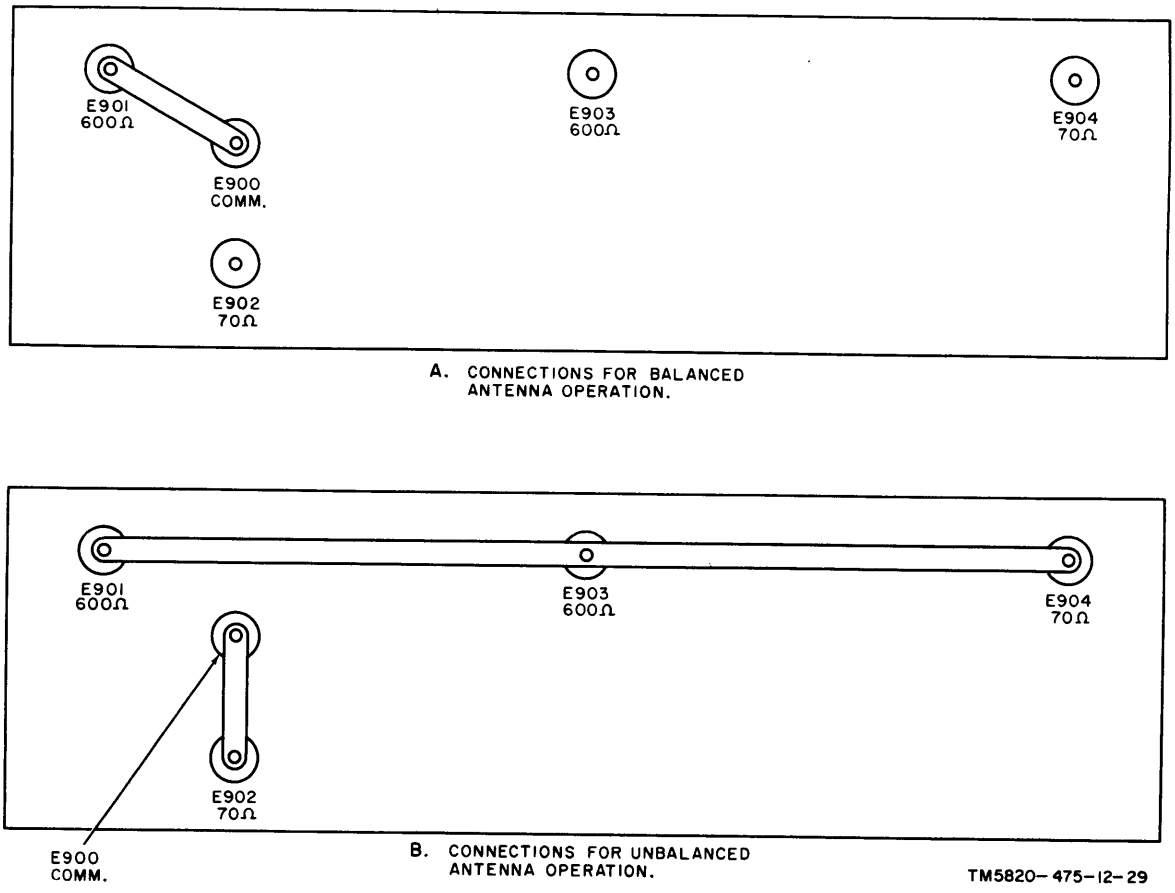


Figure 11. Connections for balanced and unbalanced antenna operation.

Section II. CONTROLS AND INDICATORS

Notes:

1. The OPERATE-TUNE switch on the main power panel must be in the TUNE position wh n the rf amplifier are tuned. Use the OPERATE position when loading the components.
2. A 48-hour warmup period is required for stabilization of Oscillator, Radio Frequency O-330B/FR.
3. The controls and indicators covered in this section are applicable for installation, operation, and organizational maintenance.

32. Auxiliary Meter Panel

Indicator	Function
PA SCREEN	Indicates amplitude of dc screen grid voltage applied to power amplifier stage.
PA BIAS	Indicates amplitude of bias voltage applied to power ampliifi r stage.
PA PLATE	Indicates amplitude of dc plate voltage applied to power amplifier stage.

33. Sideband M nitor

a Front Panel Controls and Indicators (fig. 12).

Control or indicator	Function
LSB LEVEL meter	Indicates the level of the lower sideband signal in db.
USB LEVEL meter	Indicates the level of the upper sideband signal in db.
MAIN POWER lamp	When lighted, indicates that ac voltage is applied to sideband monitor.
MAIN POWER switch	Applies ac voltage to sideband monitor.
CALIBRATE LSB control	Varies the level of the lower sideband signal applied to the LSB LEVEL meter.
CALIBRATE USB control	Varies the level of the upper sideband signal applied to the USB LEVEL meter.
B+ indicator	When lighted, indicates a blown B+ fuse.
MAIN indicator	When lighted, indicates a blown MAIN fuse.

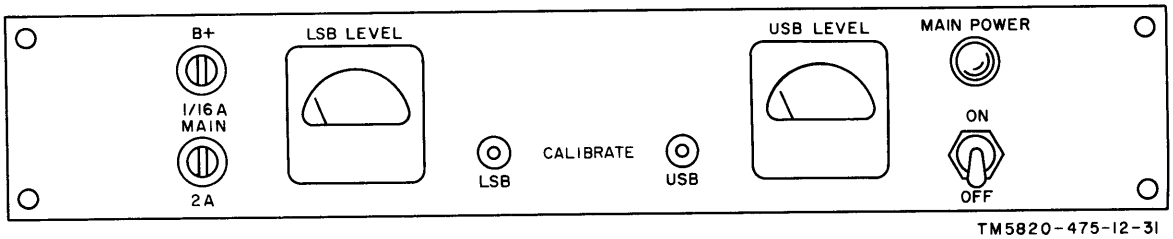


Figure 12. Sideband monitor, front panel.

b. Rear Panel Jacks (fig. 13).

Jack	Function
USB INPUT jack	Receives upper sideband signal from sideband exciter.
LSB INPUT jack	Receives lower sideband signal from sideband exciter.

34. Analyzer

a. Subpanel Controls (fig. 14).

Control or jack	Function
H POS control	Positions the baseline trace along the horizontal axis.
V POS control	Positions the baseline trace along the vertical axis.
SWEEP WIDTH control	Varies the bandwidth of the displayed signal between 0 and 100 kc when SWEEPWIDTH SELECTOR switch is in VAR position.
IF. BANDWIDTH control	Controls the if. bandwidth of the analyzer.
VIDEO FILTER switch (3-position toggle switch)	Varies video bandwidth for suppression of unwanted noise, hum, and interference. Reduces bandwidth in three steps: OFF, HI, or LO.
SWEEP RATE control	Adjusts sweep rate between 0.1 and 30 cps when SWEEPWIDTH SELECTOR switch is in VAR position.

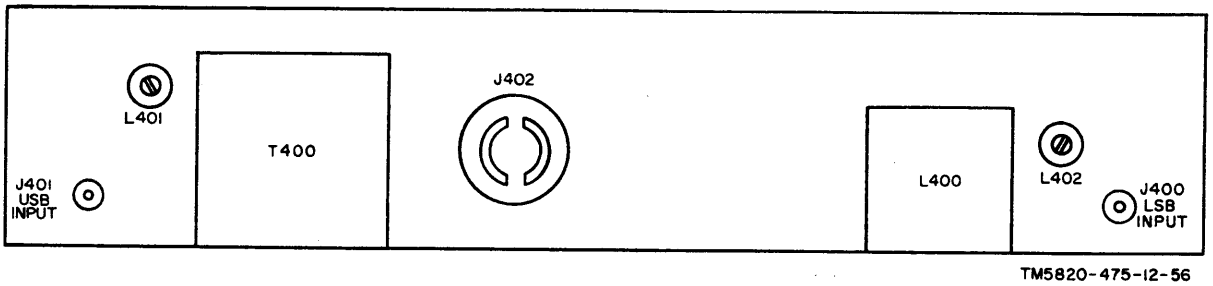


Figure 13. Sideband monitor, rear panel.

b. *Front Panel Controls, Indicators, and Jacks* (fig. 14).

Control, indicator, or jack	Function
Power lamp	When lighted, indicates that ac voltage is applied to the spectrum analyzer.
INPUT ATTENUATOR switches (6)	Attenuates the input signal in steps of 5 db from 0 to 65 db.
SIGNAL INPUT jack	Receives input signals to be analyzed.
5KC MARKER switch	Causes the marker pips to appear on the baseline trace at 5-kc intervals.
POWER OFF-ILLUMINATION control	Applies power to the spectrum analyzer and controls the brilliance of the edge lights on the crt.
FAST SWEEP switch (pushbutton switch)	Rapidly increases the sweep rate from 0.1 to 1 cps when the SWEEPWIDTH SELECTOR switch is s t in the 150~ or 500~ position.
CAL OSC LEVEL-OFF control	Provides a 500-kc test signal and controls the level of this test signal.
EXT MOD jack	Provides for marker input signal.
IF ATTEN switch	*Sw pos* / *Action* ODB — Full-scale display on crt indicates a 40-db input signal. 2ODB — Full-scale display on crt indicates a 60-db input signal.
Crt indicator	Supplies visual indication of input signals s lected by associated controls.
SWEEPWIDTH SELECTOR switch (6-position rotary switch).	Sets the sweep width to one of five widths or a variable width. When the switch is in the 150~ or 500~ position, the bandwidth is reduced; wh n it is in the 3.5KC, 7KC, or 14KC position, th bandwidth is further reduced. *Sw pos* / *Action* 150~and 500~. — Sweep rate set at 0.1 cps. 3.5KC, 7KC, and 14KC. — Sweep rate set at 1 cps. VAR — Sweep rate varied by SWEEP RATE control between 0.1 and 30 cps.
BRILLIANCE control	Varies crt intensity.
FOCUS control	Varies crt focus.
AMPLITUDE SCALE switch	Adjusts the amplitude of the signal so that the signal amplitude may be read on the LOG DB or LIN scale on the crt scale.
CENTER FREQ control	Centers the display on the crt.
AFC OFF control	When control is rotated clockwise, the normal 100-kc maximum sweep width is reduced to 2 kc.
GAIN control	Controls the amplitude of the display on the crt.
VFO INPUT jack	Provides for signal input from an ext rnal oscillator for us with a t st signal to produce th required if.

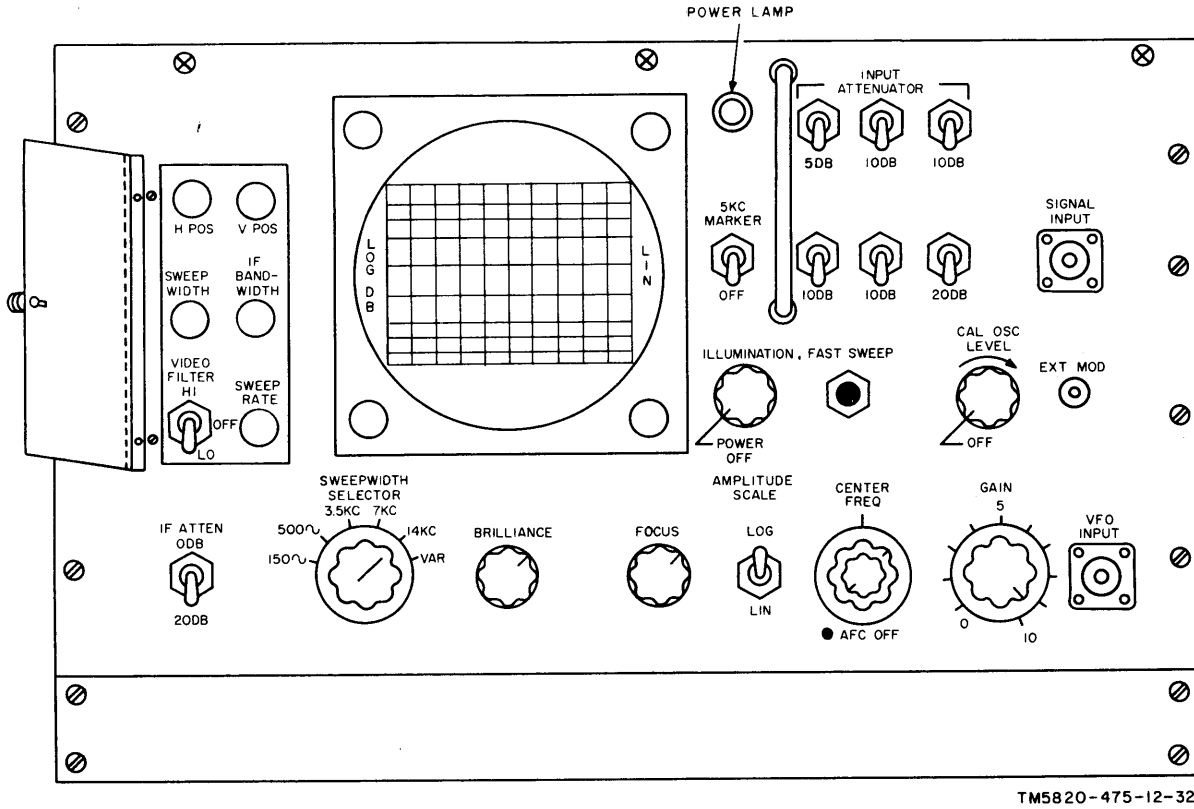


Figure 14. Analyzer, front panel.

c. *Rear Panel Control and Jacks* (fig. 15).

Control or jack	Function
SIGNAL INPUT jack	Receives input signals to be analyzed.
VFO INPUT jack	Provides for signal input from an external oscillator for use with a test signal to produce the required if. frequency.
EXT LINE SIZE control	Used in conjunction with external line recorder.
HOR. OUT jack	Provides horizontal output signal for external use.
VERT. OUT jack	Provides vertical output signal for external use.

35. Sideband Exciter Assembly

a. *Sideband Exciter* (fig. 16).

Control, indicator, or jack	Function	
MF XTAL SW switch (11-position rotary switch)	*Sw pos*	*Action*
	1-10	Connects corresponding internal crystal (when supplied) in oscillator circuit within 2- to 4-mc mf range and simultaneously disables vmo input signal.
	VMO	Permits injection of vmo signal from O-330B/FR and disables local crystal oscillator circuit.

Control, indicator, or jack	Function
Tuning dial	Two-section dial. Upper hf multiscale section indicates setting of OUTPUT TUNING control; lower mf single-scale section indicates setting of MF TUNING control.
Meter	Measures signal level as selected by METER SW switch.
EXCITER lamp	When lighted, indicates that plate power is applied to rf output tubes.
OVEN lamp	When lighted, indicates that ac power is applied to crystal heaters.
LBS switch	*Sw pos* / *Action* OFF — Grounds input to lower sideband channel. CH 2 — Connects channel 2 input to lower sideband channel. CH 1 — Connects channel 1 input to lower sideband channel. MIKE — Connects amplified microphone signal to lower sideband channel.
LSB GAIN control	Controls amplitude of lower sideband audio signal.
VOX GAIN control	Sets gain of voice-operated transmitter control circuit.
XMTR switch	Not functional in AN/FRT-52.
EXCITER switch	In ON position, bypasses voice-operated and squelch control relay circuits, applying plate power to the rf output tubes. When switch is in STANDBY position, plate supply voltages to the rf output stages can be applied only through voice-operated and squelch control relay circuits.
POWER switch	In ON position, applies primary power to exciter power supply.
SQUELCH GAIN control	Controls gain of squelch amplifier.
USB GAIN control	Controls amplitude of upper sideband audio signal.
USB switch	*Sw pos* / *Action* MIKE — Connects amplified microphone signal to upper sideband channel. CH 1 — Connects channel 1 input to upper sideband channel. CH 2 — Connects channel 2 input to upper sideband channel. OFF — Grounds input to upper sideband channel.
CAL control	Meter zero adjustment.
METER SW switch	Connects meter to any one of 5 circuits. *Sw pos* / *Causes meter to indicate* CAL — Zero (for calibration purposes). LSB — Relative value of lower sideband signal. USB — Relative value of upper sideband signal. MF — Relative value of mf signal. RF — Relative value of rf output signal.
BAND MCS indicator	Indicates range setting of BAND MCS switch and displays multiplying factor (N) for vmo frequency determination.
BAND MCS switch	Selects 16 hf ranges, as displayed on BAND MCS indicator.
CARRIER INSERT control	Controls degree of carrier insertion.
OUTPUT TUNING switch	Selects frequency range of rf output circuits.
OUTPUT TUNING control	Fine tunes the tuned circuit selected by the OUTPUT TUNING switch.
MF TUNING control	Fine tunes the rf output of the mf section.
OUTPUT control	Controls rf output level of the sideband exciter.
MIKE jack (3-contact receptacle)	Provides connection for external microphone.

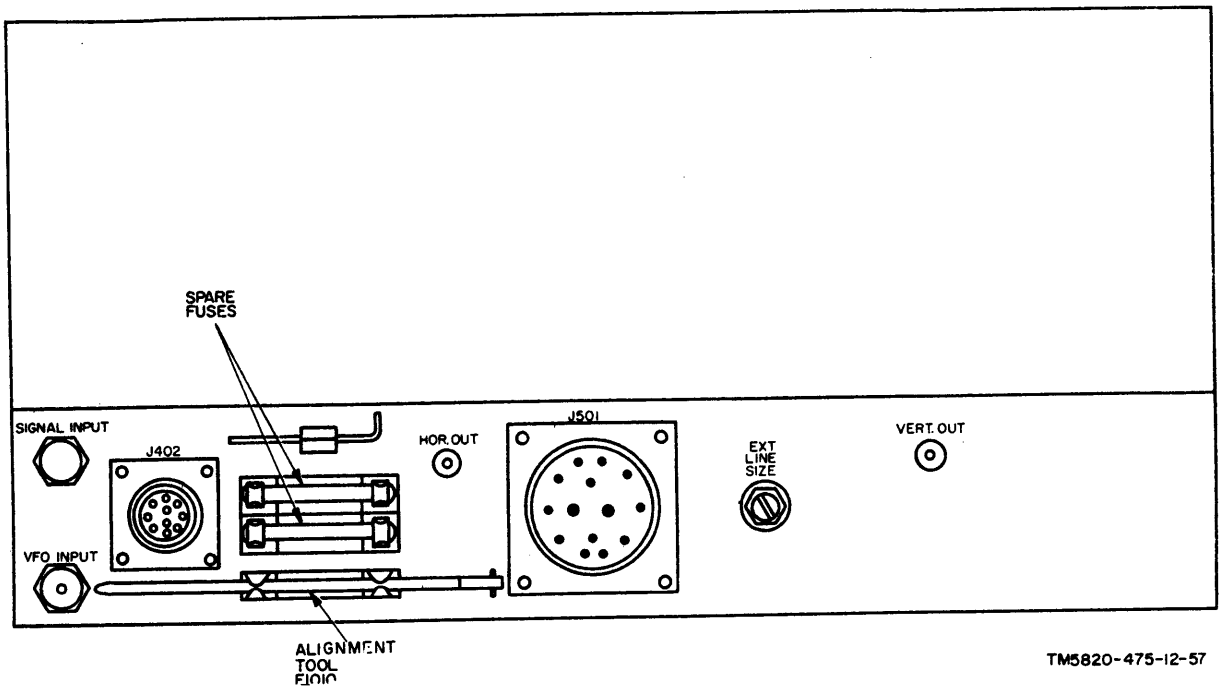


Figure 15. Analyzer, rear panel.

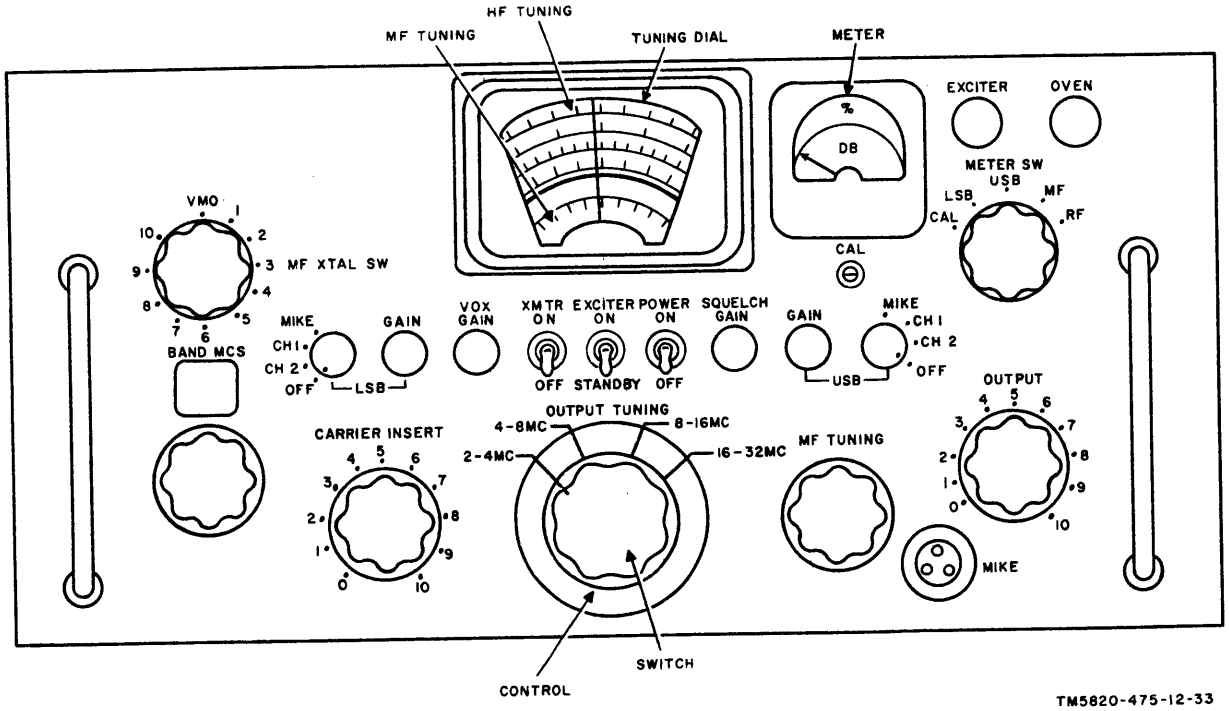


Figure 16. Sideband exciter, front panel.

b. Exciter Power Supply. A single indicator lamp is mounted on the exciter power supply front panel (fig. 17). The lamp lights when the sideband exciter POWER switch is in the ON position, indicating that power is applied to the sideband exciter assembly.

36. Monitor Control Panel
(fig. 18)

Control	Function
SBE VMO INPUT switch	*Sw pos* — *Function* VOX — Connects O-330B/FR No. 1 output to the sideband exciter when VOX RF OUTPUT switch is in SBE position. OFF — Connects input to sideband exciter to an open connection, not used for the application. XFK and EXT — Not used for this application. EXT — Connects O-330B/FR No. 1 output to auxiliary frame EXT VOX OUTPUT connector. SBE — Connects O-330B/FR No. 1 output to the sideband exciter through SBE VMO INPUT switch. FSA and XFK. — Not used for this application.
VOX RF OUTPUT switch	
ANALYZER MONITOR switch	Connects rf signals to the spectrum analyzer for monitoring purposes.
MODE switch SBE section	TEST — Connects output of two-tone generator. SBE — Connects output of sideband exciter. IPA — Connects output of rf amplifier. PA — Connects output of power amplifier. SSB — Connects sideband exciter for normal sideband operation. Disconnects isolation keyer. CW — Connects sideband exciter so as to be controlled by an external telegraph key through the isolation keyer.
XFK section	Not used for this application.
CHANNEL 1 switch	In the TONE INPUT position, applies the audio output of the two-tone generator to the channel 1 input of the sideband exciter. In the LINE 1 INPUT position, applies the line 1 input to the AN/FRT-52 to the channel 1 input of the sideband exciter.
CHANNEL 2 switch	In the TONE INPUT position, applies the audio output of the two-tone generator to the channel 2 input of the sideband exciter. In the LINE 2 INPUT position, applies the line 2 input to the AN/FRT-52 to the channel 2 input of the sideband exciter.

37. Oscillator, Radio Frequency O-330B/FR

a. Subpanel Controls and Jacks (fig. 19).

Control or jack	Function
POWER switch	Turns variable frequency oscillator on and off.
HFO switch	Applies 300 volts dc plate voltage to hfo section.
IFO swtich	Applies 150 volts dc plate voltage to ifo section.
BFO switch	Applies 150 volts dc plate voltage to bfo section.
BEAT switch	Applies 150 volts dc plate voltage to 100-kc oscillator section.
METER switch	Connects meter to output of either hfo, ifo, bfo, or vmo section.
PHONES jack	With a headset, provides audible indication of zero beat during calibration.

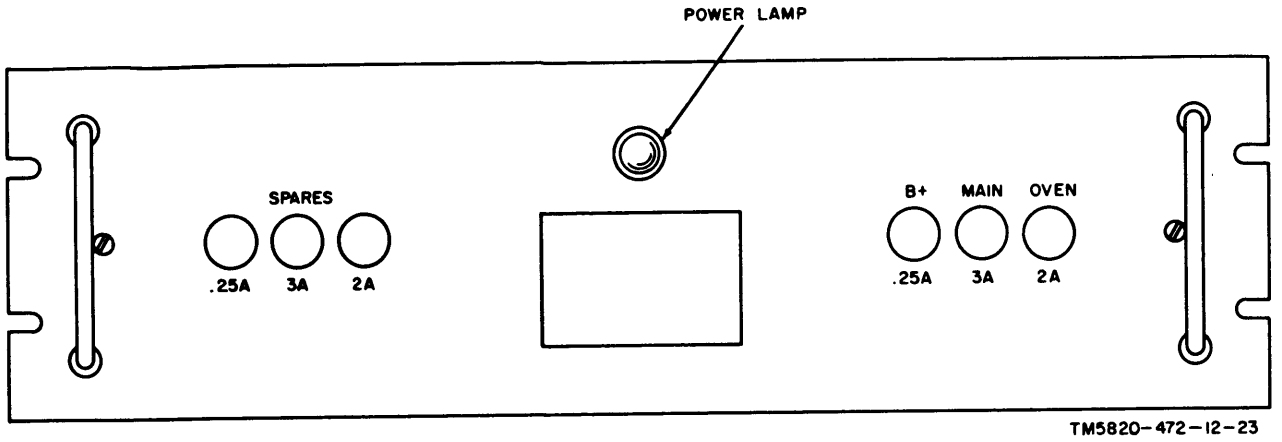


Figure 17. Exciter power supply, front panel.

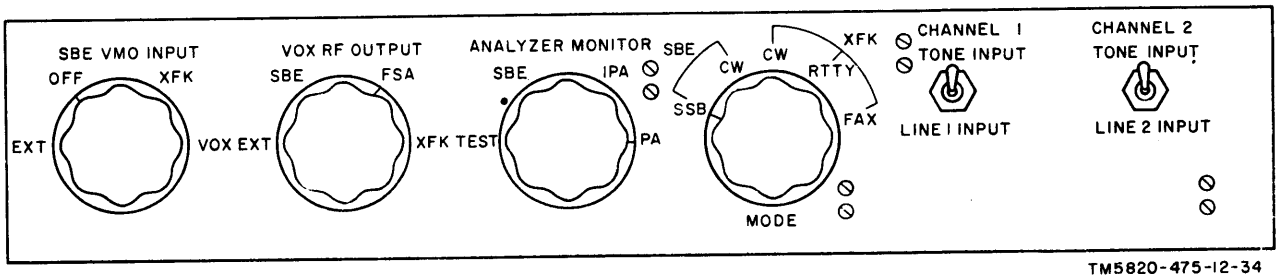


Figure 18. Monitor control panel, front panel.

b. *Front Panel Controls and Indicators* (fig. 19).

Control or indicator	Function
HFO TUNING control	Tunes multiplier section of hfo.
HFO OUTPUT control	Adjusts rf output voltage of hfo section.
BAND-MCS switch	Selects frequency range of hfo section output.
XTAL FREQ control	Trims the hfo section crystals to exact frequency.
XTAL switch	Selects vmo operation or one of three crystal-controlled frequencies.
CALIBRATE control	Calibrates frequency of vmo at calibration checkpoints.
CALIBRATE LOCK control	Locks CALIBRATE control.
Trimmer C303	Balances CALIBRATE control adjustment.
MASTER OSCILLATOR FREQUENCY control	Controls output frequency of vmo section.
MASTER OSCILLATOR FREQUENCY dials	Indicate vmo output frequency.
LOCK control	Locks MASTER OSCILLATOR FREQUENCY control.
MAIN POWER lamp	When lighted, indicates power applied to O-330B/FR.
INNER OVEN lamp	When lighted, indicates power is applied to inner crystal oven.
OUTER OVEN lamp	When lighted, indicates power is applied to outer crystal oven.
ZERO BEAT lamp	Provides visual indication of zero beat during calibration.
Meter	Indicates rf output voltage from circuit selected by METER switch.

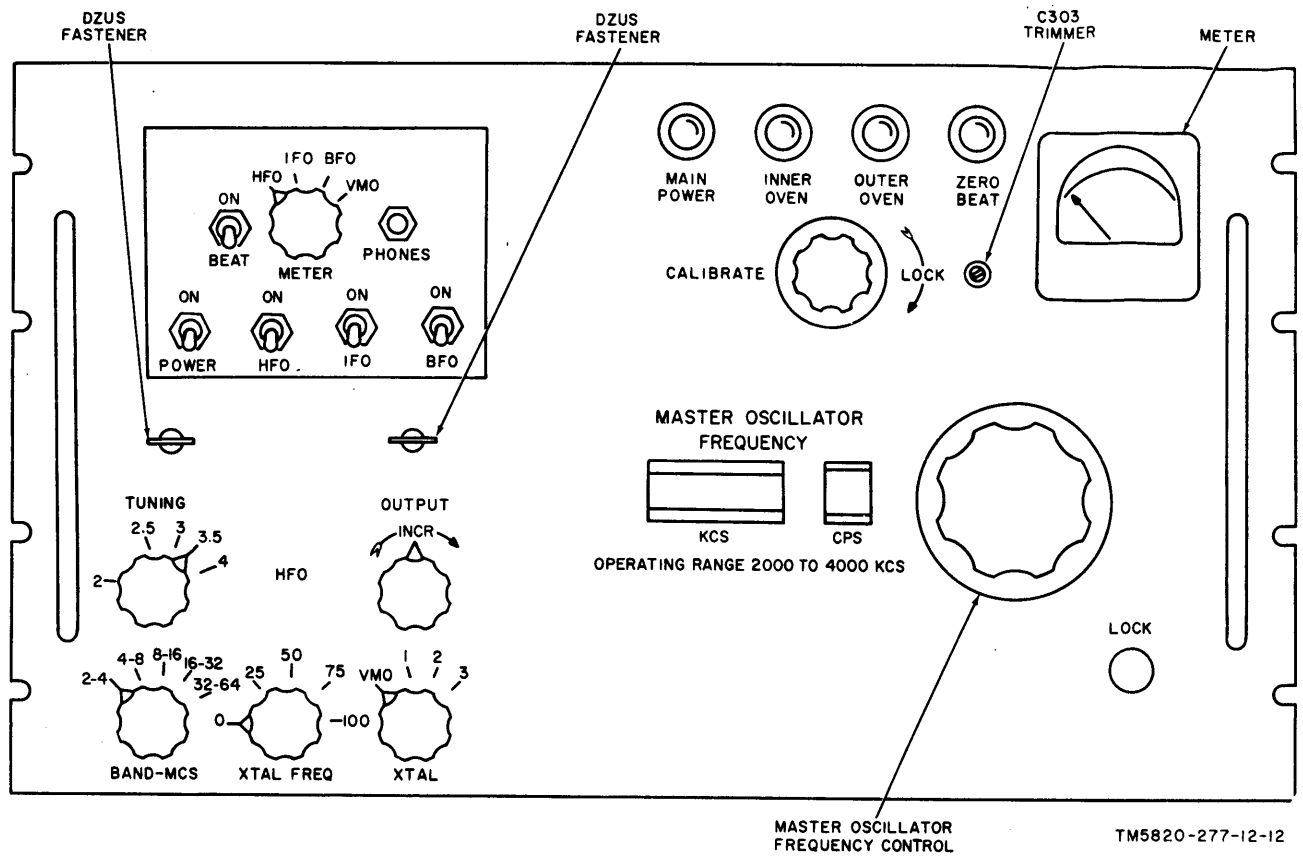


Figure 19. O-330B/FR, front panel

c. Rear Panel Controls and Jacks (fig. 20).

Control and jack	Function
Y101-Y102 switch	Selects crystal in the bfo section.
BFO-J102, J103, J104 jacks	Provide bfo outputs.
IFO-J205, J206, J207 jacks	Provide ifo outputs.
HFO-J208, J209, J210 jacks	Provide hfo outputs.
R116 control	Adjusts level of bfo output.
J106 jack	With a headset, provides audible indication of zero beat during calibration.

38. Two-Tone Generator (fig. 21).

Control or indicator	Function
AUDIO OUTPUT control	Adjusts the output level of the audio tones.
AUDIO TONE SELECTOR switch	*Sw pos* — *Action* OFF — Disconnects plate voltage from the tone 1 and tone 2 audio amplifiers. TONE 1 — Connects plate voltage to the tone 1 audio amplifier only. TONE 2 — Connects plate voltage to the tone 2 audio amplifier only. TWO TONE — Connects plate voltage to the tone 1 and tone 2 audio amplifiers.

Control or indicator	Function	
	Sw pos	*Action*
RF TONE SELECTOR switch	OFF	Disconnects plate voltage from the tone 1 and tone 2 rf oscillators.
	TONE 1	Connects plate voltage to the tone 1 rf oscillator only.
	TONE 2	Connects plate voltage to the tone 2 rf oscillator only.
	TWO TONE	Connects plate voltage to the tone 1 and tone 2 rf oscillators.
POWER switch	Applies power to the two tone generator.	
MAIN POWER lamp	When lighted, indicated that power is applied to the two tone generator.	
MAIN indicator	When lighted, indicates a blown MAIN fuse.	
B+ indicator	When lighted, indicates a blown B+ fuse.	

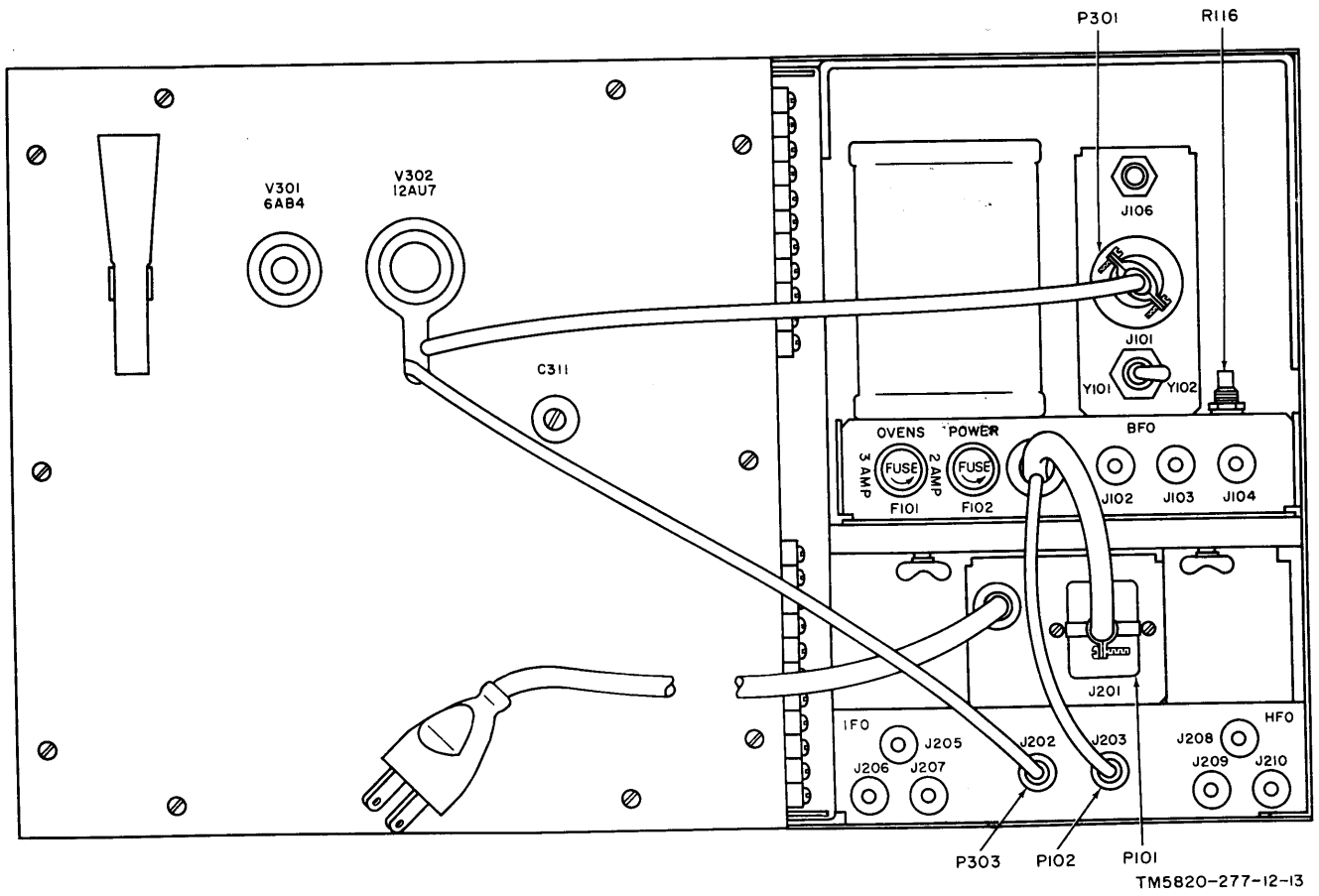


Figure 20. O-330B/FR, rear panel.

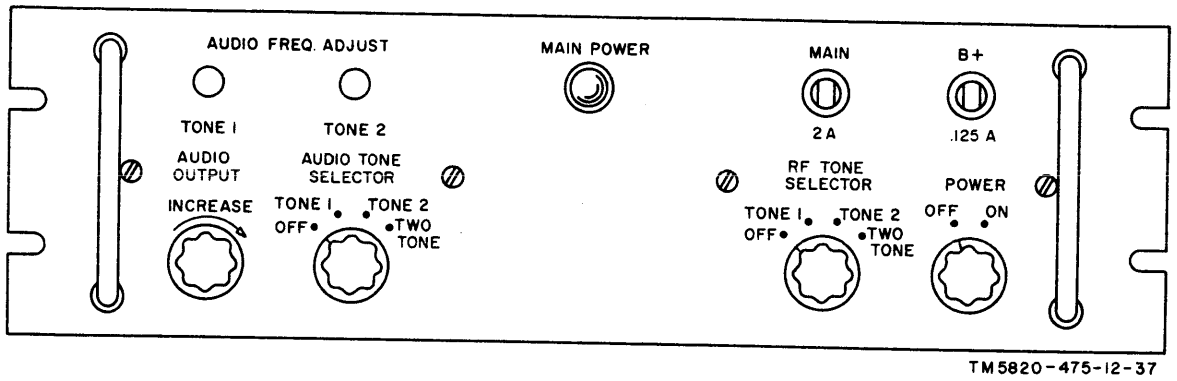


Figure 21. Two-tone generator, front panel.

39. Isolation Keyer (fig. 22).

Control or indicator	Function
POWER switch	Connects power to the isolation keyer.
POWER lamp	When lighted, indicates application of power.
KEYING MODE switch	Selects and connects circuits for desired operation.
	Sw pos — *Function*
	50V — 50-volt neutral pulse.
	100V — 100-volt neutral pulse.
	60MA — 60-ma neutral pulse.
	20MA — 20-ma polar pulse.
MAIN indicator	When lighted, indicates a blown MAIN fuse.
B_1+ indicator	When lighted, indicates a blown B_1 + fuse.
B_2+ indicator	When lighted, indicates a blown B_2 + fuse.

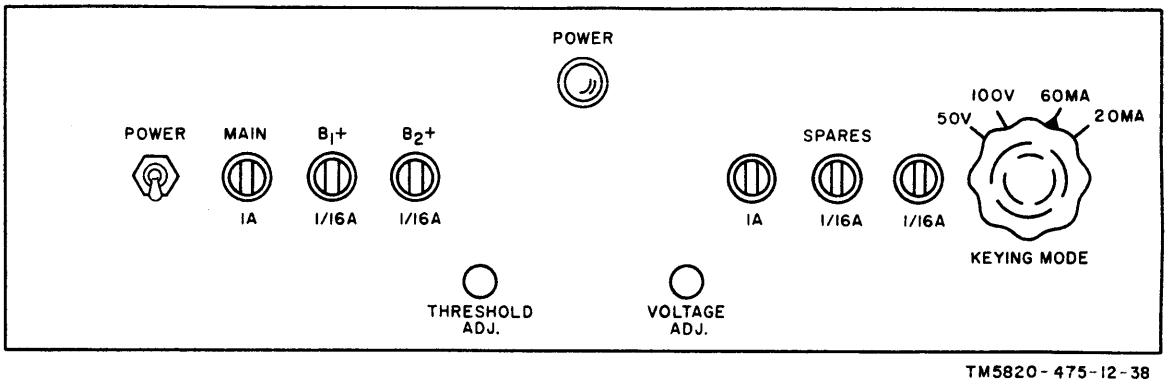


Figure 22. Isolation keyer, front panel.

40. Main Met r Panel

Indicator	Function
FILAMENT PRIMARY meter	Indicates the voltage applied to the filament transformer in the power amplifier.
PA SCREEN CURRENT meter	Indicates the screen grid current of the power amplifier.
PA PLATE CURRENT meter	Indicates the plate current of the power amplifier.
PA PLATE RF meter	Indicates the rf output voltage of the power amplifier.
PA OUTPUT meter	Indicates the output current of the power amplifier.

41. Power Amplifier
(fig. 23)

Control or indicator	Function
PA TUNE control	Tunes the output of the power amplifier stage to the desired frequency.
PA TUNE dial	Indicates setting of PA TUNE control.
PA LOAD control	Varies the power output of the power amplifier stage.
PA LOAD dial	Indicates setting of PA LOAD control.
BAND SW switch	Sets the frequency range of the power amplifier stage in accordance with the operating frequency.
BAND SW dial	Indicates setting of BAND SW switch.
OUTPUT BAL control	Operates with the OUTPUT LOADING control to match the impedance of the power amplifier stage output circuit to the impedance of the antenna.
OUTPUT BAL dial	Indicates setting of OUTPUT BAL control.
OUTPUT LOADING control	Operates with the OUTPUT BAL control to match the impedance of the power amplifier stage output circuit to the impedance of the antenna.
OUTPUT LOADING dial	Indicates setting of OUTPUT LOADING control.
AC POWER lamp	When lighted, indicates that power is applied to the main power supply.
TUNE lamp	When lighted, indicates that the OPERATE-TUNE switch, on the main power panel, is in the TUNE position.
OPERATE lamp	When lighted, indicates that the OPERATE-TUNE switch on main power panel is in the OPERATE position.
PLATE ON lamp	When lighted, indicates that ac voltage is applied to the high voltage rectifier.
Light switch	Connects power to a lamp within the power amplifier for visual observation of amplifier circuit components.

42. Rf Amplifier
(fig. 24)

Note: When lighted, fuse indicators indicate a blown fuse.

Control or indicator	Function
DRAWER INTERLOCK lamp	When lighted, indicates that the chassis interlock is open.
MULTI METER meter	Indicates rf voltage, dc voltage, or dc current as selected by the MULTI METER switch.
IPA PLATE CURRENT meter	Indicates plate current of rf amplifier (intermediate power amplifier) (ipa) stage.
MULTI METER switch (8-position rotary switch)	Connects MULTI METER to any one of six circuits.

Control or indicator	Function
	Sw pos — *Causes meter to indicate* DC: IPA ISG — Dc screen of current of ipa tube. IPA EP — Dc plate voltage of ipa tube. IPA ESG — Dc screen grid voltage of ipa tube. IPA BIAS — Dc control grid voltage of ipa tube. RF: 1ST AMPL EP — Rf plate voltage of first amplifier tube. IPA EG — Rf control grid voltage of ipa tube.
1ST AMPL TUNING control	Provides fine tuning for the driver and ipa stages.
IPA GRID TUNING control	Tunes driver stage output circuit for operating frequency.
IPA BAND switch (8-position rotary switch)	Sets the frequency range of the rf amplifier output circuit for the operating frequency.
IPA LOADING switch(3-position rotary switch)	Operates with IPA LOADING control to match the rf amplifier output impedance to the antenna impedance. Operative only when IPA BAND switch is in 2-2.5 or 2.5-3 position.
DRIVER BAND switch (5-position rotary switch)	Adjusts the frequency range of the rf amplifier input circuit for the operating frequency.
IPA TUNING control	Tunes output circuit of rf amplifier for operating frequency.
IPA TUNING dial	Indicates setting of IPA TUNING control.
IPA LOADING control	Operates with IPA LOADING switch to match the rf amplifier output impedance to the antenna impedance.
IPA LOADING dial	Indicates setting of IPA LOADING control.
NEUT. control	Adjusts negative feedback neutralizing voltage applied to the control grid of the ipa tube.
IPA BIAS ADJ control	Sets bias level of ipa tube.
LOCK control	Allows for removal of rf amplifier from cabinet.

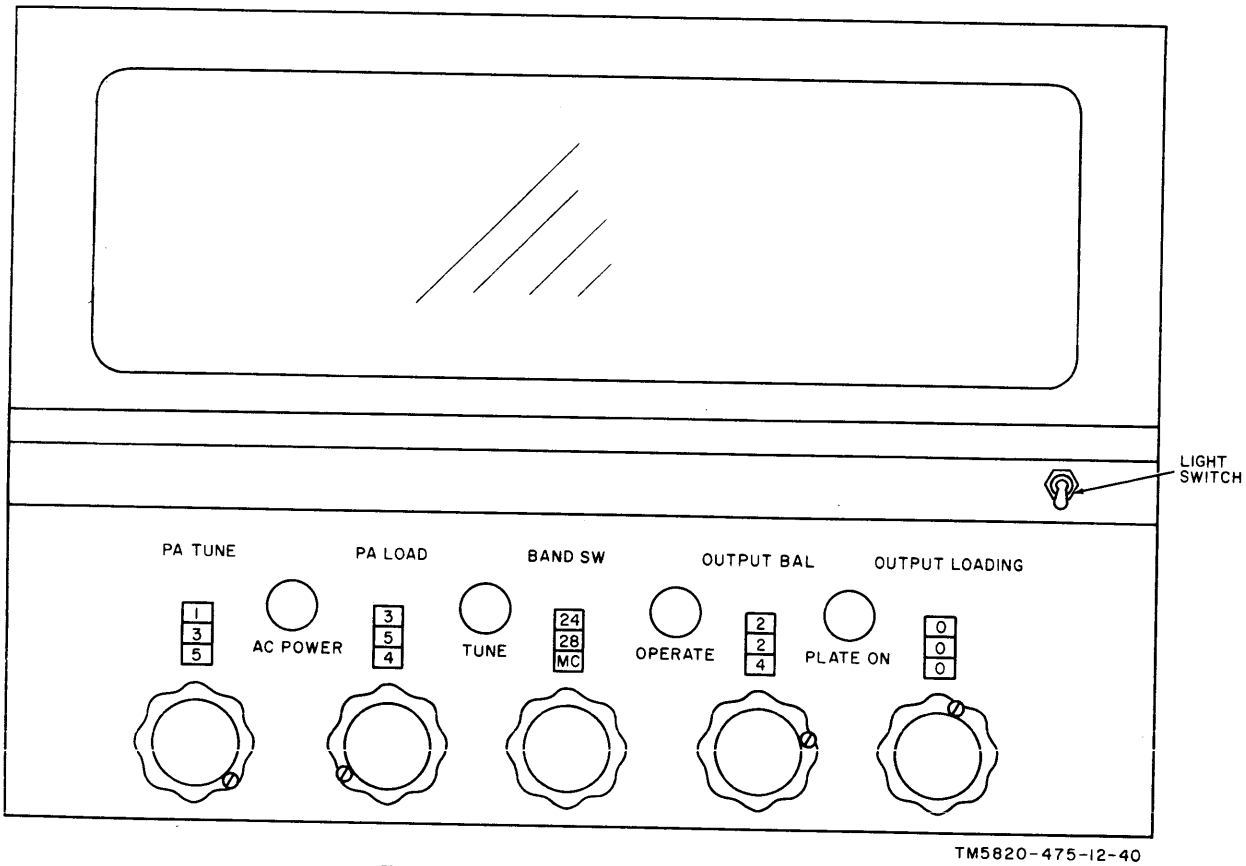


Figure 23. Power amplifier, front panel.

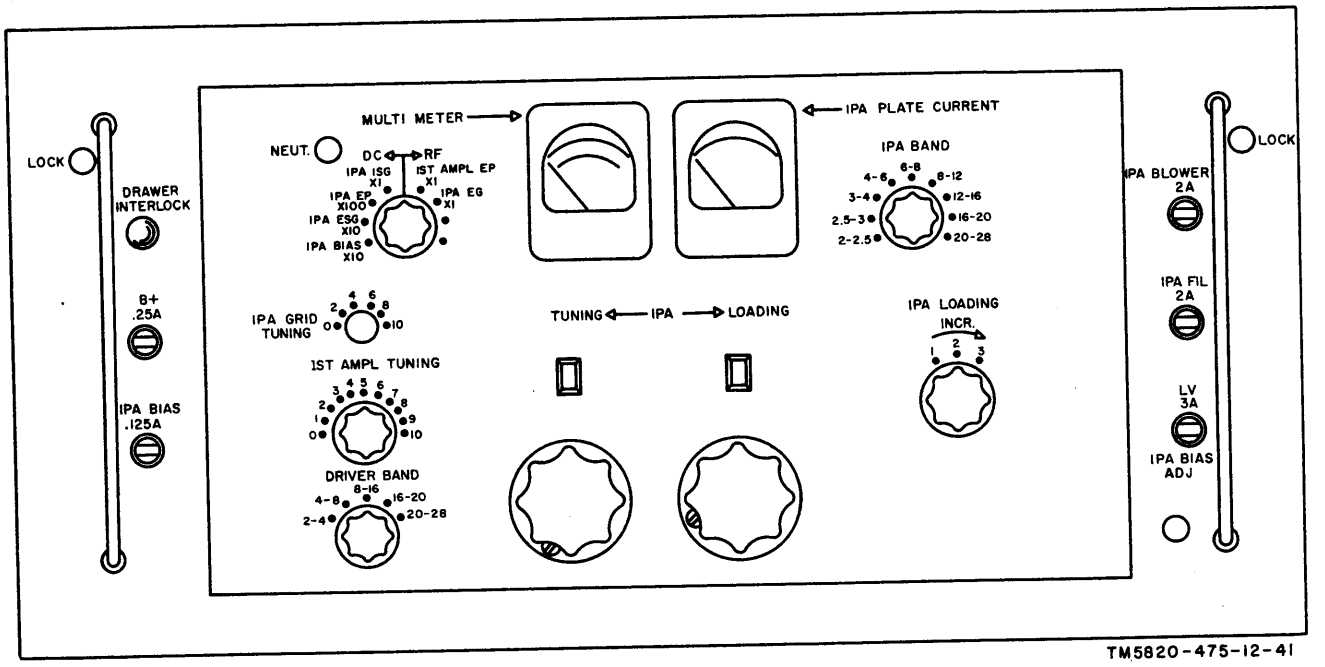


Figure 24. Rf amplifier, front panel.

43. Main Power Panel (fig. 25)

Control or indicator	Function
MAIN POWER circuit breaker	Applies power to the circuits in the main frame.
OVERLOAD RESET switch	Resets relays in the relay panel after an overload condition occurs.
INTERLOCK INDICATOR lamp	When lighted, indicates that the interlock circuit selected by the INTERLOCK switch is closed.
INTERLOCK switch (12-position rotary switch)	*Sw pos* — *INDICATOR lamp indicates* NORMAL — Interlocks associated with rf amplifier are closed. BAND SW — IPA BAND switch of rf amplifier is properly set in a detent. IPA AIR SW — Blower motor in the rf amplifier is operating normally. EXTERNAL — External jumper is connected betwe n terminals 8 and 10 of terminal board E3000. REAR DOOR — Rear door is closed. PA AIR SW — Blower motor associated with the power amplifier is operating normally. PA DECK — Shield on power amplifier is in position. PA BAND SW — Power amplifier BAND SW is properly set in a detent. RIGHT SIDE — Right side panel is in position. HV DECK — High voltage rectifier is secured in position. RELAY DECK — Relay panel is secured in position. TIMER — Timer circuit is operating normally.
FIL ADJUST switch (7-position rotary switch)	Selects the filament voltage for the power amplifier stage.
ALDC switch	Connects ALDC voltage to the rf amplifier.
ALDC ADJ control	Varies ALDC voltage applied to the rf amplifier.

Control or indicator	Function
FIL ADJUST switch (7-position rotary switch)	Selects the filament voltage for the power amplifier stage.
ALDC switch	Connects ALDC voltage to the rf amplifier.
ALDC ADJ control	Varies ALDC voltage applied to the rf amplifier.
OPERATE-TUNE switch	*Sw pos* / *Function* OPERATE: Connects high voltage to pa and ipa screen grids. TUNE: Connects reduced high voltage to pa and ipa screen grids.
PA SCREEN switch	Applies voltage to the screen grid of the power amplifier stage.
HIGH VOLTAGE circuit breaker	Applies high ac voltage to high voltage rectifier.

44. Relay Panel (fig. 26)

Note: When lighted, fuse indicators indicate a blown fuse.

Control or indicator	Function
PA BIAS lamp	When lighted, indicates that no bias voltage is applied to the power amplifier stage.
PA PLATE OVLD lamp	When lighted, indicates that an overload condition exists in the power amplifier stage plate circuit.
PA SCREEN OVLD lamp	When lighted, indicates that an overload condition exists in the power amplifier stage screen grid circuit.
FILAMENT TIME meter	Indicates operating time of the power amplifier filament circuit.
TIME DELAY timer	High voltage time delay.
PLATE TIME meter	Indicates operating time of the high voltage rectifier.
IPA SCREEN OVLD lamp	When lighted, indicates that an overload condition exists in the ipa screen grid circuit.
IPA PLATE OVLD lamp	When lighted, indicates that an overload condition exists in the ipa plate circuit.
IPA BIAS lamp	When lighted, indicates that no bias voltage is applied to the ipa stage.
ALARM switch	When ON, energizes an audible alarm until the MAIN POWER circuit breaker is closed and the associated time delay relay is energized.

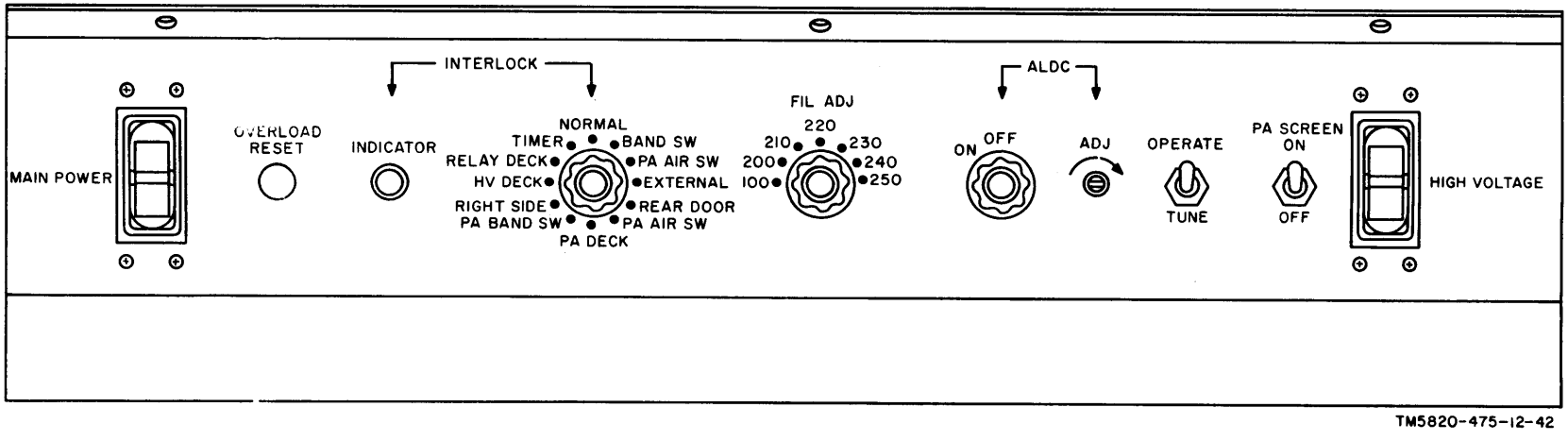


Figure 25. Main power panel, front panel.

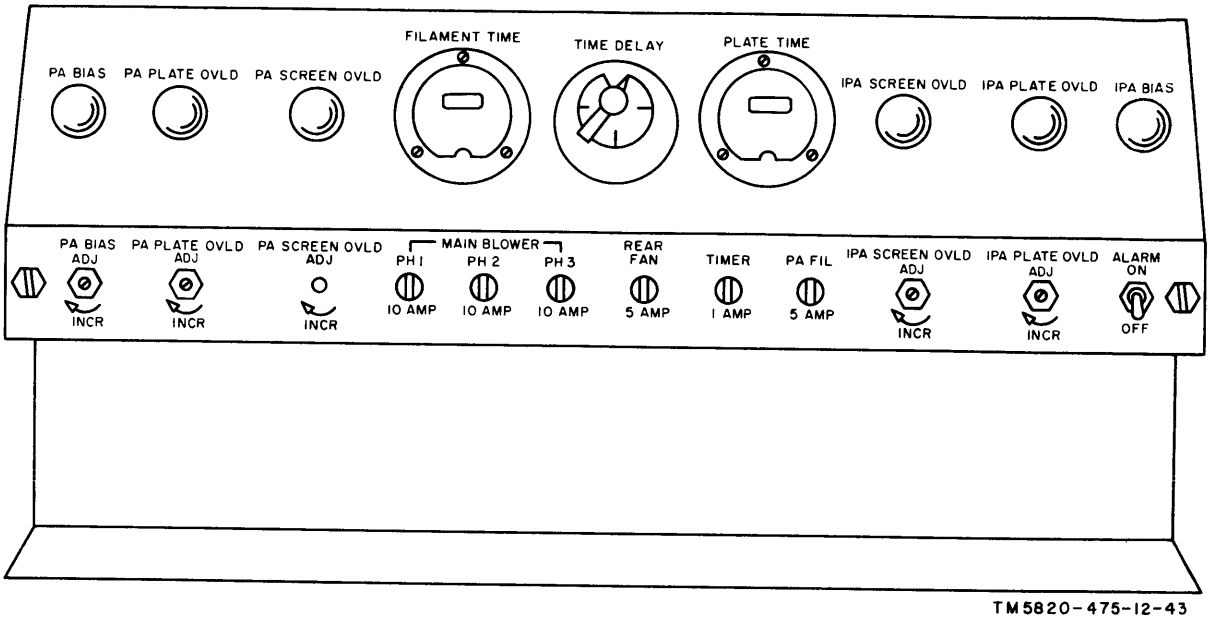


Figure 26. Relay panel, front panel.

Section III. OPERATION UNDER USUAL CONDITIONS

45. General

Radio Transmitting Set AN/FRT-52 can transmit ssb, isb, dsb, am., or cw signals. Upon receipt of information covering the operational mode, frequency, and output power, place the AN/FRT-52 into operation following the applicable procedures in *a* through *g* below. Stopping procedures are covered in paragraph 56.

a. Determine the variable master oscillator frequency (para 46*a*).

b. Set the front panel controls for starting (para 46*c*).

c. Apply power to the components of the AN/FRT-52 and check for normal indications (para 47).

d. Tune the AN/FRT-52 for the proper output frequency (para 50).

e. Tune the AN/FRT-52 for the maximum output power (para 50 and 51).

f. Tune the AN/FRT-52 for the detailed mode of operation (para 52 through 56).

g. Check the AN/FRT-52 output for distortion (para 57*d*).

46. Preliminary Starting Proc dure

a. Determination of Variable Master Oscillator Frequency. The medium-frequency section of the sideband exciter receives its excitation from O-330B/FR No. 1. Before operating the AN/FRT-52 within its range of 2 to 28 mc, determine the input frequency ((1) below) required from O-330B/FR No. 1 and set the controls on the sideband exciter as specified below.

(1) *Operation between 2 mc and 4.25 mc.* To operate the AN/FRT-52 between 2 and 4.25 mc, set the BAND MCS and OUTPUT TUNING switches on the sideband exciter to the positions shown in the chart. To determine the frequency setting of the O-330B/FR (vmo input signal) add, or subtract, 0.25 mc from the desired transmitter output frequency as indicated in the chart. For example, assume that an output frequency of 4.1 mc is desired:

Desired transmitter output frequency:	4.1 mc
Sideband exciter BAND MCS switch setting:	2-4.25
Sideband exciter OUTPUT TUNING switch setting:	4-8MC

O-330B/FR MASTER OSCILLATOR FREQUENCY dial setting: 3.85 mc (4.1 mc - 0.25 mc)

For other frequencies in the 2- to 4.25-mc range, use the chart below:

Desired transmitter output frequency range (mc)	BAND MCS switch setting	OUTPUT TUNING switch	Vmo frequency
2 to 3.73	2-4.25	2-4MC	F_{output} +0.25
3.73 to 4.00	2-4.25	2-4MC	F_{output} -0.25
4.00 to 4.25	2-4.25	4-8MC	F_{output} -0.25

(2) *Operation between 4.25 mc and 32.25 mc.*

(a) Set the BAND MCS and OUTPUT TUNING switches to the range into which the operating frequency falls. (See chart in (3) below.)

(b) Note the multiplying factor N which appears under the frequency range markings on the BAND MCS dial.

(c) To determine the frequency settings of the O-330B/FR (vmo signal input), use the formula:

$$F_{vmo} = \left[(2 \times N) - f_{output}\right] + 0.25$$

Examples:

1. Assume that an output frequency of 10.5 mc is desired.

Sideband exciter BAND MCS switch setting: 10.25-12.25[1]

Sideband exciter OUTPUT TUNING switch setting: 8-16MC

O-330B/FR MASTER OSCILLATOR FREQUENCY dial setting:

$$F_{vmo} = [(2 \times 7) - 10.5] + 0.25$$
$$= [14 - 10.5] + 0.25$$
$$= 3.5 + 0.25$$
$$= 3.75 \text{ mc}$$

2. Assume that an output frequency of 26.8 mc is desired:

Sideband exciter BAND MCS switch setting: 26.25-28.25[1]

Sideband exciter OUTPUT TUNING switch setting: 16.32MC

O-330B/FR MASTER OSCILLATOR FREQUENCY dial setting:

$$F_{vmo} = [(2 \times 15) - 26.8] + 0.25$$
$$= [30 - 26.8] + 0.25$$
$$= 3.2 + .25$$
$$= 3.45 \text{ mc}$$

(3) *Sideband exciter switch settings.* The range settings of the BAND MCS switch, the corresponding multiplying factors (N), and the associated settings of the OUTPUT TUNING switch are listed below:

BAND MCS switch setting	Vmo multiplying factor	OUTPUT TUNING switch setting
2-4	0	(See chart in (1) above)
4.25-6.25	4	4-8MC
6.25-8.25	5	4-8MC (for frequencies from 6.25 to 8.00 mc) 8-16MC (for frequencies from 8.00 to 8.25 mc)
8.25-10.25	6	8-16MC
10.25-12.25	7	8-16MC
12.25-14.25	8	8-16MC
14.25-16.25	9	8-16MC (for frequencies from 14.25 to 16.00 mc) 16-32MC (for frequencies from 16.00 to 16.25 mc)
16.25-18.25	10	16-32MC
18.25-20.25	11	16-32MC
20.25-22.25	12	16-32MC
22.25-24.25	13	16-32MC
24.25-26.25	14	16-32MC
26.25-28.25	15	16-32MC
28.25-30.25	16	16-32MC
30.25-32.25	17	16-32MC

[1] Th multiplying factor 7 will appear under the frequency range markings on the BAND MCS dial.

[1] The multiplying factor 15 will appear und r the frequency range markings on the BAND MCS dial.

b. Determination of Medium-Frequency Crystal Frequency.

Note: Crystals Y111 through Y120 are *not* supplied as part of the AN/FRT-52. The O-330B/FR normally supplies the excitation signal to the medium-frequency section of the sideband exciter. The procedures given in (1) through (3) below should be used *only* when crystals rather than the vmo signal from the O-330B/FR are used for excitation.

(1) *General.* The crystal to be used is selected by the MF XTAL SW switch (positions 1 through 10). When a crystal position is selected, the vmo input signal is automatically grounded and the output of the selected crystal is applied to the medium-frequency section of the sideband exciter.

(2) *Medium-frequency crystal operation between 2 and 4.25 mc.* To determine the crystal frequency for operation between 2 and 4.25 mc, set the BAND MCS and OUTPUT TUNING switches on the sideband exciter to the positions shown in the chart supplied with the equipment. Set the MF XTAL SW switch to the desired crystal position. To determine the crystal frequency required, add, or subtract 0.25 mc from the desired transmitter output frequency as indicated in the chart. For example: assume that an output frequency of 4.1 mc is desired:

Desired transmitter output frequency:	4.1 mc
Sideband exciter BAND MCS switch setting:	2-4.25
Sideband exciter OUTPUT TUNING switch setting:	4-8MC
Crystal frequency required:	3.85 mc (4.1 - 0.25)

For other frequencies in the 2- to 4.25-mc range, use the chart below:

Output frequency range (mc)	BAND MCS switch setting	OUTPUT TUNING switch	Crystal frequency
2 to 3.73	2-4.25	2-4MC	$F_{output} + 0.25$
3.73 to 4.00	2-4.25	2-4MC	$F_{output} - 0.25$
4.00 to 4.25	2-4.25	4-8MC	$F_{output} - 0.25$

(3) *Medium-frequency crystal operation between 4.25 and 32.25 mc.*

(a) Set the BAND MCS and OUTPUT TUNING switches to the range into which the desired output frequency falls. (See chart in (4) below.)

(b) Note the multiplying factor N which appears under the frequency range markings on the BAND MCS dial.

(c) Set the MF XTAL SW switch to the desired crystal position.

(d) To determine the crystal frequency to use for a desired output frequency, use the formula:

$$F_{crystal:} = \left[(2 \times N) - f_{output}\right] + 0.25$$

Example: Assume that an output frequency of 26.8 mc is desired:

Sideband exciter switch settings:

BAND MCS:	26.25-28.25[1]
OUTPUT TUNING:	16-32MC
MF XTAL SW:	Desired crystal position.

Crystal frequency required:

$$F_{crystal:} = [(2 \times 15) - 26.8] + 0.25$$
$$= [30 - 26.8] + 0.25$$
$$= 3.2 + 0.25$$
$$= 3.45 \text{ mc}$$

(4) *Medium-frequency crystal chart.* When crystals are used to generate the medium frequencies, a chart, supplied with the crystals, lists the assigned output frequencies and the required positions of the MF

[1] The multiplying factor 15 will appear under th frequency rang markings on the BAND MCS dial.

XTAL SW and BAND MCS switches. The chart may appear as follows:

Output frequency (mc)	MF XTAL SW switch position	BAND MCS switch setting	Crystal frequency (mc)
3.5	1	2-4.25	3.75
5.25	2	4.25-6.25	3.0
7.0	3	6.25-8.25	3.25
11.75	4	10.25-12.25	2.50
15.1	5	14.25-16.25	3.15
19.5	6	18.25-20.25	2.75
22.0	7	20.25-22.25	2.25
23.2	8	22.25-24.25	3.05
26.8	9	26.25-28.25	3.45
30.25	10	28.25-30.25	2.0

c. Preliminary Control Settings. Before starting the AN/FRT-52, set the front panel controls as follows:

***Caution:* Do not disturb the settings of the POWER and HFO switches on either O-330B/FR. These switches are normally left in their ON positions to permit the O-330B/FR to remain powered. This arrangement insures that optimum frequency stability is obtained from the O-330B/FR. For the initial tuning adjustment of the O-330B/FR, refer to paragraph 31.**

Component	Control	Position
Sideband exciter	POWER switch	OFF
	XMTR switch	OFF
	EXCITER switch	ON
	VOX GAIN control	Fully counterclockwise
	SQUELCH GAIN control	Fully counterclockwise
	LSB switch	OFF
	LSB GAIN control	Fully counterclockwise
	USB switch	OFF
	USB GAIN control	Fully counterclockwise
	MF XTAL SW switch	VMO
	OUTPUT control	Midposition
Sideband monitor	MAIN POWER switch	OFF
Analyzer	ILLUMINATION control	Fully counterclockwise
Monitor control panel	CHANNEL 1 switch	LINE 1 INPUT
	CHANNEL 2 switch	LINE 2 INPUT
	SBE VMO INPUT switch	VOX
	VOX RF OUTPUT switch	SBE
	ANALYZER MONITOR switch	PA
	MODE switch	SBE SSB
Two-tone generator	POWER switch	OFF
	RF TONE SELECTOR switch	OFF
	AUDIO TONE SELECTOR switch	TWO TONE
Isolation keyer	POWER switch	Down
Main power panel	MAIN POWER circuit breaker	OFF
	OPERATE-TUNE switch	TUNE
	PA SCREEN switch	OFF
	HIGH VOLTAGE circuit breaker	OFF
	ALDC switch	OFF (clockwise)
	FIL ADJ switch	Set for 230-volt reading on FILAMENT PRIMARY meter (main meter panel).

47. Starting Procedures

If an abnormal indication is obtained during the starting procedure, refer to the operational checklist (para 63) or the equipment performance checklist (para 70) for possible corrective measures. Perform the procedure given in paragraphs 24 through 29 and paragraph 46 before proceeding.

a. The following chart lists indications that are observed before the AN/FRT-52 is started.

Component	Control or indicator	Indication
Auxiliary panel	CB3000	In the on position. Blower motor operating.
0-330B/FR's NO. 1 and NO. 2	POWER switch	ON position.
	HFO switch	In OFF position.
	MAIN POWER lamp	Lighted.
	INNER OVEN lamp	Cycling on and off.
	OUTER OVEN lamp	Cycling on and off.

b. The following chart indicates the starting procedures for the AN/FRT-52.

Component	Control or indicator	Indication or action
Sideband monitor	ON-OFF switch	ON.
	MAIN POWER lamp	Lighted.

Component	Control or indi ator	Indication or action
Analyzer	ILLUMINATION control	Fully clockwise; power lamp lighted, edge lights lighted.
Two-tone generator	POWER switch	ON.
	MAIN POWER lamp	Lighted.
O-330B/FR's No. 1 and No. 2	HFO switch	ON.
Sideband exciter	POWER switch	ON. (See not 1.)
	OVEN lamp	Lighted.
	EXCITER lamp	Lighted after delay.
Isolation keyer	POWER switch	In the off position.
Main power panel	MAIN POWER circuit breaker	ON. (See note 2.)
Power amplifier	LIGHT switch	In the ON position, inner lamp lights.

Notes:
1. Exciter power supply power lamp lights when sideband exciter POWER switch is in the ON position.
2. When the main power panel MAIN POWER circuit breaker is in the ON position, the power amplifier AC POWER and TUNE lamps light, the main power panel INTERLOCK INDICATOR lamp lights, blower motors in the main power supply section in the auxiliary frame and in the rf amplifier operate, and the meter panel fluorescent lamps light.

c. Check the interlock circuits of the AN/FRT-52 by rotating the INTERLOCK switch on the main power panel through all of its positions. The associated INTERLOCK INDICATOR lamp should remain lighted for all positions of the switch.

48. Tuning AN/FRT-52 on Carrier

a. General.

(1) Before the AN/FRT-52 can be tuned for a specific type of operation (para 50 through 54), the sideband exciter must be tuned to the carrier frequency supplied by the vmo section of the O-330B/FR No. 1. This procedure must also be performed when suppressed carrier operation is desired. The sideband exciter is tuned to the carrier frequency; then one or both sidebands are generated by proper application of the modulating signals as required by the particular mode of operation. For cw operation, the sideband exciter is tuned to the carrier frequency and the first rf amplifier is keyed by an externally connected telegraph key to produce cw signals.

(2) The following tuneup procedures are based on transmission of a 26.8-mc output frequency. Procedures for the determination of the required vmo frequency and the settings of the sideband exciter controls for generation of this or any other carrier frequency are covered in paragraph 46.

b. Tuning O-330B/FR No. 1 on Carrier. Tune the O-330B/FR No. 1 to the calculated vmo frequency (3.45 mc for this example as shown in paragraph 46*a*(2)) by following the procedures below.

(1) Set the BEAT switch to ON.

(2) Plug the headset into the PHONES jack.

(3) Set the BAND-MCS switch to the 2-4 MC position.

(4) Set the XTAL switch to the VMO position.

(5) Tune the MASTER OSCILLATOR FREQUENCY control to the checkout frequency (listed below) closest to the desired frequency dial reading (3,450,000 for this example). Note the direction of rotation used in approaching the checkout frequency. In the list of checkout frequencies below, the two left-hand digits of the dial reading are omitted. The last 5 digits listed hold true for any frequency from 2.0 to 4.0 mc.

-,-00,000	-,-50,000
-,-05,000	-,-55,000
-,-10,000	-,-60,000
-,-12,500	-,-66,667
-,-20,000	-,-71,428
-,-25,000	-,-75,000
-,-28,571	-,-80,000
-,-30,000	-,-83,333
-,-33,333	-,-85,714
-,-40,000	-,-90,000
-,-45,000	-,-95,000

(6) Vary the CALIBRATE control for a zero beat. (At exactly zero beat, the ZERO BEAT indicator lamp should go out; near zero beat, it will flicker on and off.) At some checkout frequencies, zero beat indication will be obtained only from the headset and not from the ZERO BEAT lamp.

(7) When the CALIBRATE control is set ((6) above), use the CALIBRATE LOCK control to lock it in place.

(8) Tune the MASTER OSCILLATOR FREQUENCY control to the desired dial reading.

Note: For accurate calibration and resettability, rotate the MASTER OSCILLATOR FREQUENCY control in the same direction as instructed in (5) above to prevent any error due to backlash in the gears.

(9) Set the BEAT switch to the off (down) position.

(10) Turn the METER switch to the HFO position.

(11) Set the HFO TUNING control to the position numerically closest to the MASTER OSCILLATOR FREQUENCY dial reading.

(12) Vary the HFO OUTPUT control to obtain a one-quarter scale (approximately) reading on the meter.

(13) Adjust the HFO TUNING control for the highest meter reading obtainable.

(14) Adjust the HFO OUTPUT control until the required rf output level for the sideband exciter is indicated on the meter.

c. Tuning Sideband Exciter on Carrier (fig. 16). Tune the sideband exciter to the carrier frequency as follows:

(1) Rotate the BAND MCS switch until the associated BAND MCS indicator is set at the proper position (26.25-28.25 for this example).

(2) Rotate the CARRIER INSERT control to the 10 position.

(3) Set the METER SW switch to the MF position.

(4) Set the OUTPUT TUNING switch to the proper position (16-32MC for this example).

(5) Rotate the OUTPUT TUNING control for a setting on the high frequency (hf) portion of the tuning dial which is slightly lower than the selected carrier frequency (slightly less than 26.8 mc for this example).

(6) Rotate the MF TUNING control until a maximum indication is obtained on the meter. If necessary, decrease the setting of the CARRIER INSERT control to avoid an off-scale meter reading.

Note: The mf portion of the tuning dial should now correspond with the vmo frequency supplied by O-330B/FR No. 1 (3.45 mc for this example).

(7) Set the METER SW switch to the RF position.

(8) Increase the frequency setting of OUTPUT TUNING control to the first peak reading obtained on the meter.

d. Tuning Rf Amplifier and Power Amplifier on Carrier. Tune the rf amplifier and power amplifier to the carrier frequency as follows:

***Caution:* When tuning and loading the rf amplifier and power amplifier, do not exceed the following meter indications:**

Meter	Limits
Main meter panel:	
PA PLATE CURRENT (fig. 1)	
At start of loading	0.75 amp
At end of loading	1.5 amp
PA SCREEN CURRENT	25 ma
Rf amplifier:	
IPA PLATE CURRENT (fig. 24)	400 ma
MULTIMETER (with MULTIMETER switch in DC IPA ISG position)	15 ma

(1) Set the controls on the rf amplifier and power amplifier in accordance with the tuning chart supplied with the equipment.

Note: The tuning chart supplied with th equipment indicates readings with the AN/FRT-52 connected to a dummy load. Equipment installers should correct the tuning charts to reflect actual field conditions.

(2) Set the rf amplifier MULTIMETER switch (fig. 24) to the RF 1ST AMPL EP position.

(3) Slowly rotate 1ST AMPL TUNING control about its preset position until a peak is obtained on the multimeter.

Note: If the peak is off-scale, rotate th OUTPUT control on the sideband exciter (fig. 16) counterclockwise. If the peak is on th low end of th scal , rotate th OUTPUT control clockwise.

(4) Set the rf amplifier MULTIMETER SWITCH (fig. 24) to the RF IPA EG position.

(5) Slowly rotate the IPA GRID TUNING control about its preset position until a peak is obtained on the MULTIMETER.

(6) Rotate the sideband exciter OUTPUT control (fig. 16) fully counterclockwise.

(7) Depress the main power panel OVERLOAD RESET switch (fig. 25).

(8) Set the HIGH-VOLTAGE circuit breaker to the ON position. The power amplifier PLATE ON lamp (fig. 23) should light. The indicator on the top of the auxiliary frame (fig. 1) should glow dimly at first and should brighten after 1 or 2 seconds.

(9) Rotate the sideband exciter OUTPUT control (fig. 16) until some increase is observed on the rf amplifier IPA PLATE CURRENT meter (fig. 24).

(10) Rotate the IPA TUNING control until a dip is obtained on the IPA PLATE CURRENT meter.

(11) Rotate the sideband exciter OUTPUT control (fig. 16) fully counterclockwise.

Caution: **Before proceeding, make sure the main power panel OPERATE-TUNE switch (fig. 25) is in the TUNE position.**

(12) Set the PA SCREEN switch to the ON position.

(13) Rotate the sideband exciter OUTPUT control (fig. 16) until an increase is obtained on the main meter panel PA PLATE CURRENT meter.

(14) Slowly rotate the PA TUNE control about its preset position until a dip is obtained on the PA PLATE CURRENT meter.

(15) Rotate the sideband exciter OUTPUT control (fig. 16) fully counterclockwise.

(16) Set the main power panel OPERATE-TUNE switch (fig. 25) to the OPERATE position.

(17) Repeat the procedures given in (2), (3), (4), (5), and (10) above.

(18) Rotate the rf amplifier IPA LOADING control (fig. 24) clockwise in small increments. After each setting, set the IPA LOADING switch for maximum indication on the IPA PLATE CURRENT meter and rotate the IPA TUNING control until a dip is obtained on the IPA PLATE CURRENT meter.

(19) Rotate the power amplifier PA LOAD control (fig. 23) so that the AN/FRT-52 is slightly underloaded.

Note: The AN/FRT-52 is underloaded if the indication on the main meter panel PA SCREEN CURRENT meter is high and the indication on the PA PLATE CURRENT meter is low, as compared with those values listed in the tuning chart supplied supplied with the equipment.

(20) Rotate the power amplifier PA TUNE control (fig. 23) until a dip is obtained on the main meter panel PA PLATE CURRENT meter.

(21) Rotate the power amplifier PA LOAD and OUTPUT LOADING controls (fig. 23) until a small increase is obtained on the main meter panel PA OUTPUT meter.

(22) Slowly rotate the power amplifier PA TUNE control (fig. 23) until a dip is obtained on the main meter panel PA PLATE CURRENT meter.

(23) Slowly rotate the rf amplifier IPA LOADING control (fig. 24) until an increase is obtained on the main meter panel PA OUTPUT meter.

(24) Slowly rotate the rf amplifier IPA TUNING control (fig. 24) until a dip is obtained on the IPA PLATE CURRENT meter.

(25) Repeat procedures (21) through (24) above until maximum indication is obtained on the PA OUTPUT meter and minimum indications are obtained on the IPA PLATE CURRENT, PA PLATE CURRENT, and PA SCREEN CURRENT meters.

49. Output Power Computation

The average power output measure in kilowatts (kw) is calculated with the formula $P_{av} = I^2R$. I is the PA OUTPUT meter indication; R is the antenna impedance in kilohms. The peak envelope power (pep) output is twice the average power output (PEP = $2P_{av}$). For a balanced antenna (example 1) R = 0.6, for an unbalanced antenna (example 2) R = 0.072. The following examples assume that the PA OUTPUT meter indicated 3 amperes and 8.4 amperes respectively.

Examples:

1. $P_{av} = I^2R$ Pep = $2P_{av}$
   $= 3^2$ (0.6) $= 2$ (5.4)
   $= 9$ (0.6) $= 10.8$ kw
   $= 5.4$ kw

2. $P_{av} = I^2R$ Pep = $2P_{av}$
   $= 8.4^2$ (0.072) $= 2$ (5.08)
   $= 70.56$ (0.072) $= 10.16$ kw
   $= 5.08$ kw

50. Single-Sideband Operation

a. General. To tune the AN/FRT-52, proceed as follows:

(1) Tune to carrier frequency (para 48).
(2) Apply two-tone test signal from the two-tone generator to the sideband exciter (*b*(2) through (9) below).
(3) Adjust for the proper output signal from the rf amplifier (*b*(10) below).
(4) Check the amount of sideband distortion (*b*(11) through (15) below).
(5) Tune for maximum power output with minimum distortion (*b*(16) through (20) below).
(6) Substitute the actual modulating signal for the two-tone test signal and adjust the degree of carrier of insertion desired (*b*(21) through (23) below).
(7) Recheck for proper output and adjust the monitor controls (*b*(24) through (27) below).

Note: In the following procedures, it is assumed that the lower sideband is being used and that the modulating signal is applied to terminal board E3000 LINE 1 input terminals of the auxiliary frame. To operate with a modulating signal applied to the LINE 2 input terminals or from a microphone, substitute the monitor control panel CHANNEL 2 switch and the CH 2 or MIKE setting, respectively, of the sideband exciter LSB switch in place of the CHANNEL 1 switch and CH 1 setting specified. For upper sideband use, operate the USB switch and USB GAIN control on the sideband exciter instead of the corresponding LSB controls specified.

b. Tuning Procedure for Single-Sideband Operation. To tune the AN/FRT-52 for single-sideband operation, proceed as follows:

(1) Tune the AN/FRT-52 on the carrier as described in paragraph 48.
(2) Set the sideband exciter LSB switch (fig. 16) to the CH 1 position.
(3) Set the USB switch to the OFF position.
(4) Set the LSB GAIN control to mid-position.
(5) Rotate the CARRIER INSERT control to the 0 position.
(6) Set the monitor control panel CHANNEL 1 switch (fig. 18) to the TONE INPUT position.
(7) Set the two-tone generator AUDIO OUTPUT control (fig. 21) to mid-position.
(8) Set the sideband exciter METER SW switch (fig. 16) to the LSB position.
(9) Adjust the sideband exciter OUTPUT control (fig. 16) and/or the the two-tone generator AUDIO OUTPUT control (fig. 21) for a reading of -6 db on the sideband exciter meter.

Caution: **When the sideband exciter METER SW switch is placed in the USB, LSB, or RF position, meter peaks should never exceed 100, because intermodulation distortion may become excessive beyond this point.**

(10) Set the sideband exciter METER

SW switch (fig. 16) in the RF position and adjust the OUTPUT control for an 8 ampere reading on the main meter panel PA OUTPUT for unbalanced output or for 2.9 amperes on the antenna RF meter ammeters (on top of main frame) for balanced output.

(11) Set up the analyzer (fig. 14) as described in paragraph 55*b*(1) through (17) with the monitor control panel (fig. 18) ANALYZER MONITOR switch ((12) para 62*b*) set to the PA position.

(12) Set the analyzer IF ATTEN switch (fig. 14) to the 20DB position.

(13) Set the SWEEPWIDTH SELECTOR switch to the 7KC position.

(14) Set the INPUT ATTENUATOR, GAIN, and CENTER FREQ controls to center the display on the crt.

(15) Determine the distortion as described in paragraph 55*d*.

Note: During the following procedure, the AN/FRT-52 is tuned for maximum power output while maintaining third harmonic distortion at least 35 db down.

(16) Repeat the procedures given in paragraph 48*d*(2) through (24).

Note: When returning the AN/FRT-52, the controls should require only slight adjustment. It may be necessary to compromise between optimum tuning and distortion; unloading the rf amplifier may decrease the distortion appreciably, and a slight detuning of the power amplifier may decrease distortion without greatly affecting the power output. The sideband exciter output should be kept as low as possible.

(17) Set the main power panel ALDC ADJ control (fig. 25) fully counterclockwise and set the ALDC switch to ON.

(18) Slowly rotate the ALDC ADJ control until the indication on the main meter panel PA OUTPUT meter just begins to drop.

(19) Note the position of the sideband exciter OUTPUT control (fig. 16) and slowly rotate this control clockwise. If the indication on the main meter panel PA OUTPUT meter remains constant, the ALDC circuit is effective.

Note: If the meter indication incr ases, rep at the procedures given in (18) and (19) above, until the meter indication remains constant as the OUTPUT control is rotated clockwise.

(20) Return the sideband exciter OUTPUT control (fig. 16) to its original position.

(21) Set the monitor control panel CHANNEL 1 switch (fig. 18) to the LINE 1 INPUT position.

(22) Set the sideband exciter METER SW switch (fig. 16) to the RF position.

(23) Simultaneously adjust the OUTPUT and CARRIER INSERT controls for the desired degree of carrier insertion.

Note: For suppressed carrier operation, leave the CARRIER INSERT control in the 0 position. For 10-percent carrier injection (carrier down 20 db from full power), first set the OUTPUT control so that the meter reads 90 on audio peaks with the CARRIER INSERT control set in the 0 position; then, rotate the CARRIER INSERT control clockwise until the meter rises from 90 to 100 on audio peaks.

(24) Recheck the power output (para 49) and third harmonic distortion (para 55*d*) and readjust the tuning controls if necessary.

(25) Set the sideband exciter METER SW switch (fig. 16) to the LSB position.

(26) Adjust the sideband monitor CALIBRATE LSB control (fig. 12) until the indication on the LSB LEVEL meter agrees with the reading on the sideband exciter meter (fig. 16).

(27) Set the sideband exciter METER SW switch to the RF position.

51. Independent-Sideband Operation

a. General. Isb operation is essentially the same as single-sideband operation (para 50), except that both sidebands contain intelligence. Each sideband must be tuned, independent of the other, for minimum distortion and maximum power output.

Note: In the procedure detailed below, it is assumed that the channel 1 input is applied to the upper sideband and the channel 2 input is applied to the lower sideband. If it is desired to switch the channel inputs or if a microphone input is to be used as one of the modulating signals, use the corresponding CH 1, CH 2, or MIKE settings of the sideband exciter LSB and USB switches (fig. 16).

b. Tuning Procedure for Independent-Sideband Operation. To tune the AN/FRT-52 for isb operation, proceed as follows:

(1) Tune the AN/FRT-52 on the carrier as described in paragraph 48.
(2) Set the sideband exciter LSB switch to CH 1 and the LSB GAIN control to approximately one-quarter position (fig. 16).
(3) Rotate the CARRIER INSERT control to the 0 position.
(4) Set the USB switch to OFF and the USB GAIN control to one-quarter scale.
(5) Set the METER SW switch to the LSB position.
(6) Set the monitor control panel CHANNEL 1 and CHANNEL 2 switches (fig. 18) to the TONE INPUT positions.
(7) Set the two-tone generator AUDIO OUTPUT control (fig. 21) to mid-position.
(8) Adjust the LSB GAIN control for a -9 db meter reading on the sideband exciter (fig. 16).
(9) Set the LSB switch to the OFF position and set the USB switch to the CH 2 position.
(10) Set the METER SW switch to the USB position.
(11) Adjust the USB GAIN control for a -9 db reading on the meter.
(12) Set the METER SW switch to the RF position and adjust the OUTPUT control for an 8 ampere reading on the main meter panel PA OUTPUT meter for unbalanced output or for 2.9 amperes on the antenna rf ammeters (on top of main frame) for balanced output.

Note: In the following steps, the upper-sideband output is checked for distortion and the AN/FRT-52 is tuned. The lower sideband is then checked for distortion. No retuning should be necessary.

(13) Perform the procedures given in paragraph 50*b*(11) through (15).
(14) Perform the procedures given in paragraph 48*d*(2) through (24).
(15) Set the sideband exciter USB switch (fig. 16) to the OFF position.
(16) Set the LSB switch to the CH 1 position.
(17) Perform the procedures given in paragraph 50*b*(11) through (15).
(18) Perform the procedures given in paragraph 48*d*(2) through (24).
(19) Set the sideband exciter USB switch to the CH 2 position.
(20) Set the ALDC ADJ control on the main power panel (fig. 25) fully counterclockwise and set the ALDC switch to on.
(21) Slowly rotate the ALDC ADJ control until the indication on the main meter panel PA OUTPUT meter just begins to drop.
(22) Note the position of the sideband exciter OUTPUT control (fig. 16) and slowly rotate this control clockwise. If the indication on the main meter panel PA OUTPUT meter remains constant, the ALDC circuit is effective.

Note: If the meter indication increases, repeat the procedures given in (21) and (22) above until the meter indication remains constant as the OUTPUT control is rotated clockwise.

(23) Return the sideband exciter OUTPUT control (fig. 16) to its original position.
(24) Set the monitor control panel CHANNEL 1 and CHANNEL 2 switches (fig. 18) to the LINE 1 INPUT and LINE 2 INPUT positions, respectively.
(25) Set the sideband exciter METER SW switch (fig. 16) to the RF position.
(26) Simultaneously adjust the OUTPUT and CARRIER INSERT controls for the desired degree of carrier insertion.

Note: For suppressed carrier operation, leave the CARRIER INSERT control in the 0 position. For 10-percent carrier injection (carrier down 20 db from full power), first set the OUTPUT control so that the meter

reads 90 on audio p aks with the CARRIER INSERT control set in the 0 position, and then rotat the CARRIER INSERT control clockwise until th met r reading rises from 90 to 100 on audio peaks.

(27) Recheck the power output (para 49) and the harmonic distortion (para 55*d*) and readjust the tuning controls if necessary.

(28) Set the sideband exciter METER SW switch (fig. 16) to the LSB position.

(29) Adjust the sideband monitor CALIBRATE LSB control (fig. 12) so that the indication on the LSB LEVEL meter agrees with the reading on the sideband exciter meter (fig. 16).

(30) Set the sideband exciter METER SW switch to the USB position.

(31) Adjust the sideband monitor CALIBRATE USB control (fig. 12) so that the reading on the USB LEVEL meter agrees with the reading on the sideband exciter meter (fig. 16).

(32) Set the sideband exciter METER SW switch to the RF position.

52. Double-Sideband Operation

a. Double-sideband operation is identical with independent-sideband operation (para 51), except that only one modulating signal is received by the AN/FRT-52. This modulating signal is applied to both the upper and lower sidebands. Assuming that the modulating signal is received at the channel 1 input of the AN/FRT-52, double-sideband operation is identical with independent-sideband operation (para 51) with the following exceptions:

(1) Only the CHANNEL 1 switch need be operated during the procedures given in paragraph 51*b*(6) and (24).

(2) The USB switch is set to the CH 1 position when performing the procedures given in paragraph 51*b*(9) and (19).

b. If the modulating signal is received at the channel 2 input of the AN/FRT-52, perform the procedure in paragraph 51 with the following exceptions:

(1) Only the CHANNEL 2 switch need be operated during the procedures given in 51*b*(6) and (24).

(2) Set the LSB switch to the CH 2 position when performing the procedures given in 51*b*(2) and (16).

53. Am. Operation

Am. operation is identical with double-sideband operation (para 52), except that the carrier insertion level is adjusted for 50 percent. This is done by adjusting the sideband exciter LSB GAIN and USB GAIN controls (fig. 16) for a meter reading of 50 percent on audio peaks, and then rotating the CARRIER INSERT control clockwise from 0 until the meter indication rises from 50 to 100.

54. Cw Operation

Cw operation is accomplished by tuning the AN/FRT-52 to the carrier frequency (para 48) and then keying the carrier with an externally connected telegraph key. To prepare the AN/FRT-52 for cw operation, proceed as follows:

a. Tune the AN/FRT-52 to carrier frequency as described in paragraph 48.

b. Adapt the AN/FRT-52 for cw operation (para 28*f*).

c. Set the monitor control panel MODE switch (fig. 18) to the SBE CW position.

d. Set the isolation keyer KEYING MODE switch (fig. 22) to the 60 MA position.

e. Set the sideband exciter LSB and USB switches (fig. 16) to the OFF positions.

f. Set the METER SW switch to the RF position.

g. Depress the telegraph key and adjust the OUTPUT control for an 8-ampere indication on the main meter panel PA OUTPUT meter for unbalanced or for 2.9 amperes on the antenna rf ammeters (on top of main frame) for balanced output.

55. Operating the Analyzer

a. General. Operation of the analyzer can be divided into three categories: general or search operation (*b* below), narrow band or detailed analysis (*c* below), and distortion measurements (*d* below). Typical signals displayed on the analyzer crt are described in *e* below.

b. General or Search Operation. When it is desired to determine the frequency of the modulating signals or of the harmonics, search operation is used. Search operation can also be used to see the entire transmitting spectrum. During this operation, O-330B/FR No. 2 is adjusted until the desired signal is centered on the crt. To set the analyzer for search operation, proceed as follows:

(1) Set the CENTER FREQ control (fig. 14) to the vertical marker.
(2) Rotate the SWEEP WIDTH control fully clockwise.
(3) Rotate the IF BANDWIDTH control fully clockwise.

Note: If the SWEEP WIDTH and IF BANDWIDTH controls are set fully counterclockwise, the centered signal will appear as an elevated baseline or pip with hum superimposed.

(4) Set the BRILLIANCE control for the desired brilliance.
(5) Set the SWEEPWIDTH SELECTOR switch to the VAR position.
(6) Set the FOCUS control for a sharp trace.
(7) Set the AMPLITUDE SCALE switch to the LIN position.
(8) Rotate the GAIN control midway between 5 and 10.
(9) Set the VIDEO FILTER switch to the OFF position.
(10) Set the AFC OFF switch to the off position.
(11) Set all the INPUT ATTENUATOR switches up.
(12) Set the monitor control panel ANALYZER MONITOR switch (fig. 18) to the desired position.
(13) Set the O-330B/FR No. 2 BAND-MCS switch (fig. 19) to the position which includes the carrier frequency.
(14) Set the XTAL switch on O-330B/FR No. 2 to the VMO position.
(15) Set the MASTER OSCILLATOR FREQUENCY control on O-330B/FR No. 2 to the position *corresponding* to the carrier frequency. A series of pips should appear on the crt.

(a) The MASTER OSCILLATOR FREQUENCY control (f_X) in kilocycles can be determined by use of the formula

$$f_X = \frac{f_O + 500}{N}$$

F_O is the output carrier frequency in kilocycles and N is determined by the BAND-MCS switch position as indicated in *(b)* below. The following example indicates the MASTER OSCILLATOR FREQUENCY control setting when the output frequency is 26.8 mc.

$$f_X = \frac{f_O + 500}{N}$$

$$= \frac{26,800 + 500}{8}$$

$$= \frac{27,300}{8}$$

$$= 3,412.50$$

(b) The value of N is determined by the chart below.

BAND-MCS switch position	N
2-4	1
4-8	2
8-16	4
16-32	8
32-64	16

(16) Adjust the analyzer H POS and V POS controls (fig. 14) so that the carrier frequency is horizontally centered and the baseline is vertically positioned on the 0 line.

Note: If the carrier is suppressed, no carrier frequency pip will be indicated. In this case, adjust the H POS control so that the first upper and lower sideband pips are equally spaced on either side of the vertical 0 line.

(17) Slowly adjust the O-330B/FR No. 1 MASTER OSCILLATOR FREQUENCY control (fig. 19) until the center on one sideband or harmonic pip lies under the vertical 0 line.
(18) Determine the frequency of the

sideband or harmonic pip (f_S), with the formula $f_S = Nf_X - 500$. F_S is the displayed signal frequency in kilocycles, f_X is the MASTER OSCILLATOR FREQUENCY control setting, and N is determined as in (15) above. The following example indicates the displayed signal frequency if the MASTER OSCILLATOR FREQUENCY control dial setting is 3425.0.

$$f_S = Nf_X - 500$$
$$= [8\ (3425)] - 500$$
$$= 27,400 - 500$$
$$= 26,900$$

c. Narrow-Band or Detailed Signal Analysis. When signals on a carrier and/or its sidebands are so closely spaced in frequency that their corresponding deflections tend to merge into each other, narrow-band operation is used. Essentially, in this operation, the pattern on the crt is spread out so that the signals may be examined. Three methods can be used to spread the band ((1), (2), and (3), below).

(1) *Spreading band by use of IF BANDWIDTH control.* To spread the band by use of the IF BANDWIDTH control, proceed as follows:

(a) Center the band on the crt as described in *b* above.

(b) Rotate the SWEEP WIDTH control counterclockwise.

(c) If necessary, use the CENTER FREQ control to center the band.

(d) Adjust the IF BANDWIDTH control for optimum resolution.

Note: Rotation of the IF BANDWIDTH control may result in increased or decreased pip height (fig. 27). Pip amplitude may be returned to suitable level by adjusting the GAIN control. When the IF BANDWIDTH control is turned counterclockwise after optimum resolution is reached, the resolving power will decrease and the sensitivity will be greatly reduced (D, fig. 27). Maximum resolution can be recognized by the presence of ringing on one side of the pip (C, fig. 27). Ringing can be seen more easily with the VIDEO FILTER control in the OFF position. Figure 27 (A through D) indicates progressive variations in pip width effected by counterclockwise rotation of the IF BANDWIDTH control.

(e) If necessary, the signals can be further separated by setting the SWEEP RATE control to a lower setting and readjusting the SWEEP WIDTH and IF BANDWIDTH controls. If further separation is required, refer to (2) below.

(2) *Spreading band by use of AFC OFF control.* To spread the band by use of the AFC OFF control, proceed as follows:

(a) Center the band on the crt as described in *b* above.

(b) Set the AFC OFF control on.

(c) If necessary, use the AFC OFF and CENTER FREQ controls to recenter the band.

(d) Set the SWEEP RATE control to a rate less than 5 cps, depending on the nature of the signals and the desired frequency separation.

Note: With the controls set as described above, each vertical division on the crt equals 200 cps.

(e) Set the IF BANDWIDTH control for optimum resolution ((*d*)(1) above).

(3) *Spreading band by use of SWEEP WIDTH SELECTOR switch.* The simplest way to to spread the band is to reduce the sweep by using the SWEEP WIDTH SELECTOR switch. When this switch is used, the if. bandwidth, sweep width, and video filtering is automatically set for optimum resolution.

d. Distortion Measurements. When tuning the AN/FRT-52 for ssb, dsb, isb, or am. operation, distortion and power output measurements are important considerations. The distortion measurements are basically a comparison of amplitude between a reference signal, such as the carrier or a harmonic, and any other signal present.

(1) During the tuning procedures for the AN/FRT-52, the carrier is modulated by two tones: 935 cps

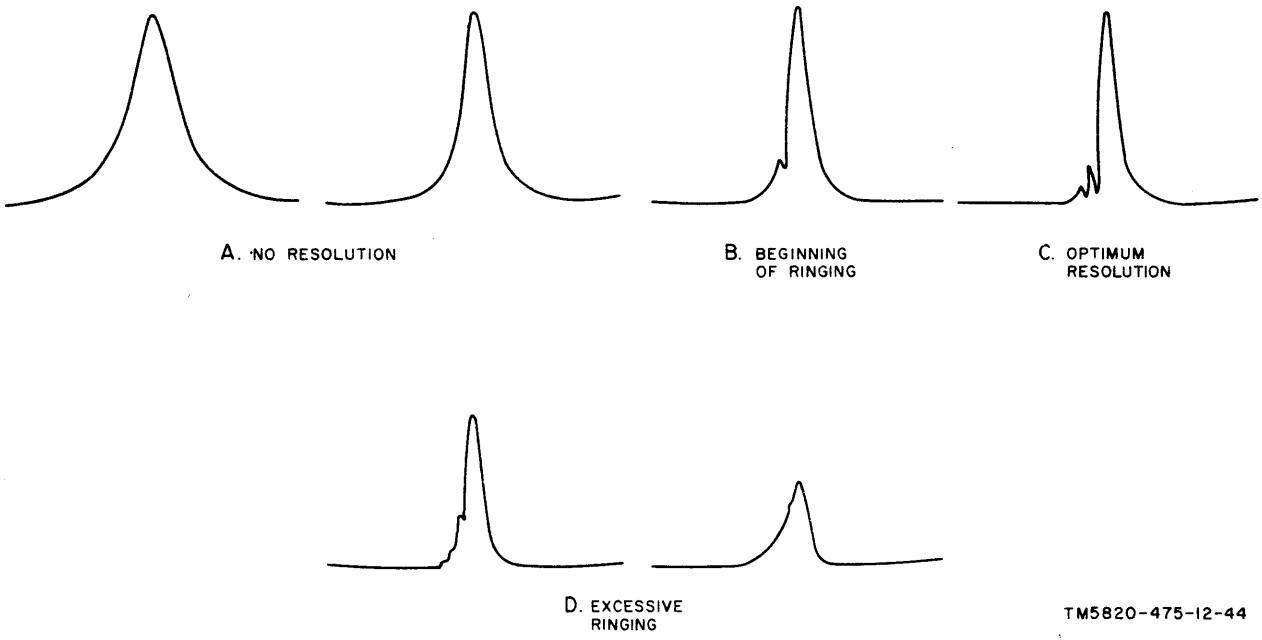


Figure 27. Analyzer displays, effect of IF BANDWIDTH control on resolution.

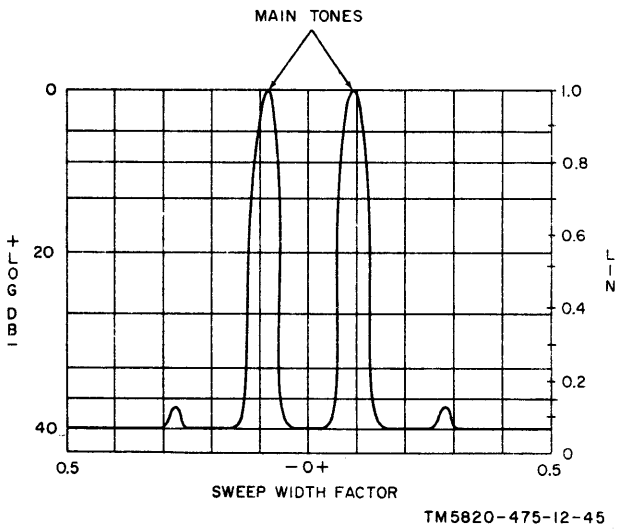


Figure 28. Analyzer, typical two-tone distortion test display.

and 2,805 cps. The levels of the tones are adjusted for full scale deflection on the crt. This full scale deflection is considered as the 0-db reference level. Major inband intermodulation components displayed may be measured in reference to the 0-db level over a 40-db range. To examine distortion products from 40 to 60 db *below* the reference level, set the IF ATTEN switch to 0 DB position. This position of the IF ATTEN switch causes the upper portion of the display to be deflected off the crt and the -20- to -60-db portion of the signal is displayed.

(2) In the two-tone test, the odd order distortion components are distributed symmetrically on either side of the main output signals and are located at separations equal to the frequency difference between the two tones. The distortion may be readily read as db down from the reference levels. When using 935- and 2,805-cycle tones, the odd order distortion terms are 38 db down, and the carrier is suppressed more than 40 db because there is no deflection at the vertical 0 line on the calibrated scale. Refer to figure 28.

e. Interpretation of Analyzer Displays (fig. 29). The following paragraphs describe certain common waveforms which may be displayed on the analyzer.

(1) A constant carrier (A and B, fig. 29) appears as a deflection of fixed height.

(2) An amplitude-modulated carrier (C and D, fig. 29) appears as a deflection of variable height. Nonconstant tone modulation of low frequency produces a series of pips that vary in height; the number of pips is determined by the modulation frequency. The nature of the presentation depends on the scanning width. As the modulation frequency increases, the pips move toward the outer edges of the crt, and the sidebands tend to become visible. When the modulation frequency is increased, it becomes possible to separate the sidebands by reducing the the sweep width. The IF BANDWIDTH control will enable further separation. The higher the modulation frequency, the farther away these sidebands will move from the carrier signal. Because of possible nonlinear amplification of the analyzer or nonuniform generator output, or both, over a wide band, the sidebands may appear unequal in height even though they are of equal strength. Their relative heights may vary as the generator is tuned and as the deflection moves from one end of the screen to the other.

(3) Single-sideband modulation appears as two carriers of slightly different frequency ((7) below).

(4) A carrier frequency modulated at a low rate appears to wobble sideways.

(5) Cw operation appears as a pulsing carrier signal at the rate of keying. for rapidly keyed signals, the vertical deflection and the baseline trace are seen simultaneously.

(6) An mcw signal appears as a cw signal of periodic varying height. If the modulation rate is high, sidebands will appear as explained in (2) above.

(7) Two signals which are so close in frequency as to cause aural interference or beats may appear on the screen as a single deflection, varying in height as with a modulated signal (E, fig. 29). As the frequency separation is increased, the deflection appears as if modulated on one side only. Further increase of frequency will cause a break in the apex of the deflection (F, fig. 29). If the sweep width is reduced, the respective deflection will gradually separate. Further separation is effected in accordance with the procedure given in *c* above.

(8) Transient disturbances appear as signals on the sweep axis. Transient disturbances are classified as periodic or aperiodic transients.

(a) Periodic transients, such as those produced by motors, vibrators, and buzzers, appear as signals moving along the frequency sweep baseline to the right or left. Thus, an accelerating engine will produce a set of deflections which may move first in one direction, slow down, stop, and then move in an opposite direction. If the transient disturbance is synchronized with the 60-cycle line, the noise appears as a fixed signal which does not move on the screen when the noise source is varied but only varies in height. Such deflections may appear as amplitude-modulated signals or as a steady carrier.

(b) Aperiodic transients, such as static, appear as irregular deflections and flash along the whole frequency sweep axis.

(9) Image signals can be distinguished from normal signals by their movement in an opposite direction with respect to normal signals on the screen when the external oscillator is being tuned.

(10) Harmonics, produced by the beat of every strong signal with harmonics of the analyzer oscillator, can be distinguished from other signals because they move on the screen more rapidly when tuning than the normal signals (twice as fast for second harmonics). Generally, a

reduction of gain and/or a reduction in generator output will eliminate this type of spurious signal.

(11) Diathermy or other apparatus that uses an unfiltered or ac power supply will produce a periodic-type disturbance which will cause a deflection to appear on certain portions of the screen and disappear on other portions. This is due to the fact that such equipment emits a pulsating signal synchronized with the ac power line. To examine signals which are synchronized to the ac line frequency, adjust the SWEEP RATE control for the best presentation across the entire screen.

(12) Excessive signal level causes the deflection to break up into a series of parallel deflections somewhat similar to sidebands. Attenuation of the input signal level will remedy this situation.

56. Stopping Procedure

The AN/FRT-52 may be placed in standby operation or completely turned off. For standby operation, or when the off-time of the transmitter will not exceed 48 hours, the O-330B/FR is left on to maintain maximum oscillator stability. Normal stopping procedure takes at least 5 minutes. Emergency stopping procedure may be accomplished by removing the primary source of power with a switch external to the equipment.

a. Standby. To place the AN/FRT-52 in the standby operation, set the controls in the following chart to the positions indicated.

Note: When shutdown time will not exceed 5 minutes and equipment is operating normally, operate only the HIGH VOLTAGE circuit breaker as indicated below.

Component	Controll	Position
Main power panel	HIGH VOLTAGE circuit breaker	Off position
	PA SCREEN switch	OFF
	MAIN POWER circuit breaker	Off
Sideband exciter	EXCITER switch	STANDBY
	POWER switch	OFF
Sideband monitor	MAIN POWER switch	OFF
Analyzer	ILLUMINATION control	Counterclockwise
Two-tone generator	POWER switch	OFF
Isolation keyer	POWER switch	OFF

b. Stopping. If the transmitter off-time is expected to exceed 48 hours, stop the AN/FRT-52 by performing the procedures indicated in *a* above and set the controls to the positions indicated in the chart below.

Component	Control	Position
O-330B/FR's No. 1 and No. 2	POWER switch	OFF
Auxiliary frame (rear)	Circuit breaker CB3000	Off

Note: All equipment in the auxiliary frame may be simultaneously deenergized by setting circuit breaker CB3000 to the OFF position.

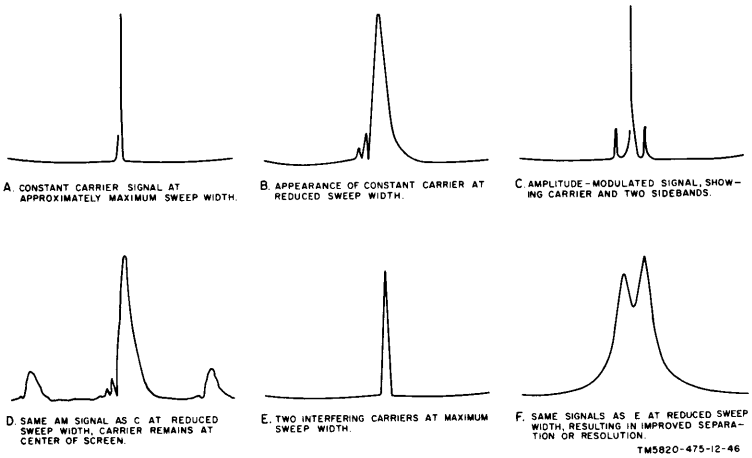


Figure 29. Typical analyzer waveshape displays.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

57. General

If the power amplifier fails to function properly, it is possible to operate the AN/FRT-52 at reduced output power as a 1-kilowatt (kw) transmitter. To do this, the output of the rf amplifier is wired directly to the transmitting antenna rather than to the power amplifier. The following paragraphs describe the procedures for connecting and tuning the AN/FRT-52 for 1-kw operation.

58. Connections for 1-Kw Operation

To connect the AN/FRT-52 for 1-kw operation, proceed as follows:

a. Set the main power panel MAIN POWER circuit breaker to the off position.

***Warning:* Before proceeding, make certain that the rf and power amplifiers and all capacitors in the power amplifier are deenergized.**

b. Remove the nut that secures one end on the connecting strap to capacitor C928 (fig. 30).

c. Remove the screw that holds the other end of the connecting strap to capacitor C911. Remove the connecting strap.

d. Remove plug P1009, normally connected to jack J901 (fig. 31), and connect it to the bottom of feedthrough connector CP901 (fig. 30 and 31).

e. Connect the connector end of cable assembly CA-582 (fig. 31) to the upper end of CP901.

f. Connect the braided and coaxial leads, on the other side of cable assembly CA-582, to terminals A and B, respectively, of the capacitor mounting board (fig. 31).

59. Tuning for 1-Kw Operation

a. General. Tuning the AN/FRT-52 for 1-kw operation is essentially the same as tuning it for 10-kw operation. The following subparagraphs give the procedures for tuning the AN/FRT-52 for carrier frequency for 1-kw operation (*b* below) and then adjusting it for the desired mode of operation (*c* through *g* below).

b. Tuning on Carrier.

(1) Perform the procedures given in paragraphs 48*a*, *b*, and *c*.

(2) Set the controls on the rf amplifier in accordance with the tuning chart supplied with the equipment.

Note: The tuning chart supplied with the equipment indicates readings with the AN/FRT-52 connected to a dummy load. Equipment installers should correct the tuning chart to reflect actual field conditions.

(3) Set the rf amplifier MULTI METER switch (fig. 24) to the RF 1ST AMPL EP position.

(4) Slowly rotate the 1ST AMPL TUNING control about its preset position until a peak is obtained on the MULTI METER.

Note: If the peak is off-scale, rotate the OUTPUT control on the sideband exciter (fig. 16) counterclockwise. If the peak is on the low end of the scale, rotate the OUTPUT control clockwise.

(5) Set the rf amplifier MULTI METER switch (fig. 24) to the RF IPA EG position.

(6) Slowly rotate the IPA GRID TUNING control about its preset position until a peak is obtained on the MULTI METER.

(7) Rotate the sideband exciter OUTPUT control (fig. 16) fully counterclockwise.

(8) Depress the main power panel OVERLOAD RESET switch (fig. 25).

(9) Set the HIGH VOLTAGE circuit breaker to the ON position. The power amplifier PLATE ON lamp (fig. 23) should light. The indicator on top of the auxiliary frame should glow dimly at first and should brighten after 1 or 2 seconds.

(10) Rotate the sideband exciter OUTPUT control (fig. 16) until some increase is observed on the rf amplifier IPA PLATE CURRENT meter (fig. 24).

(11) Rotate the IPA TUNING control

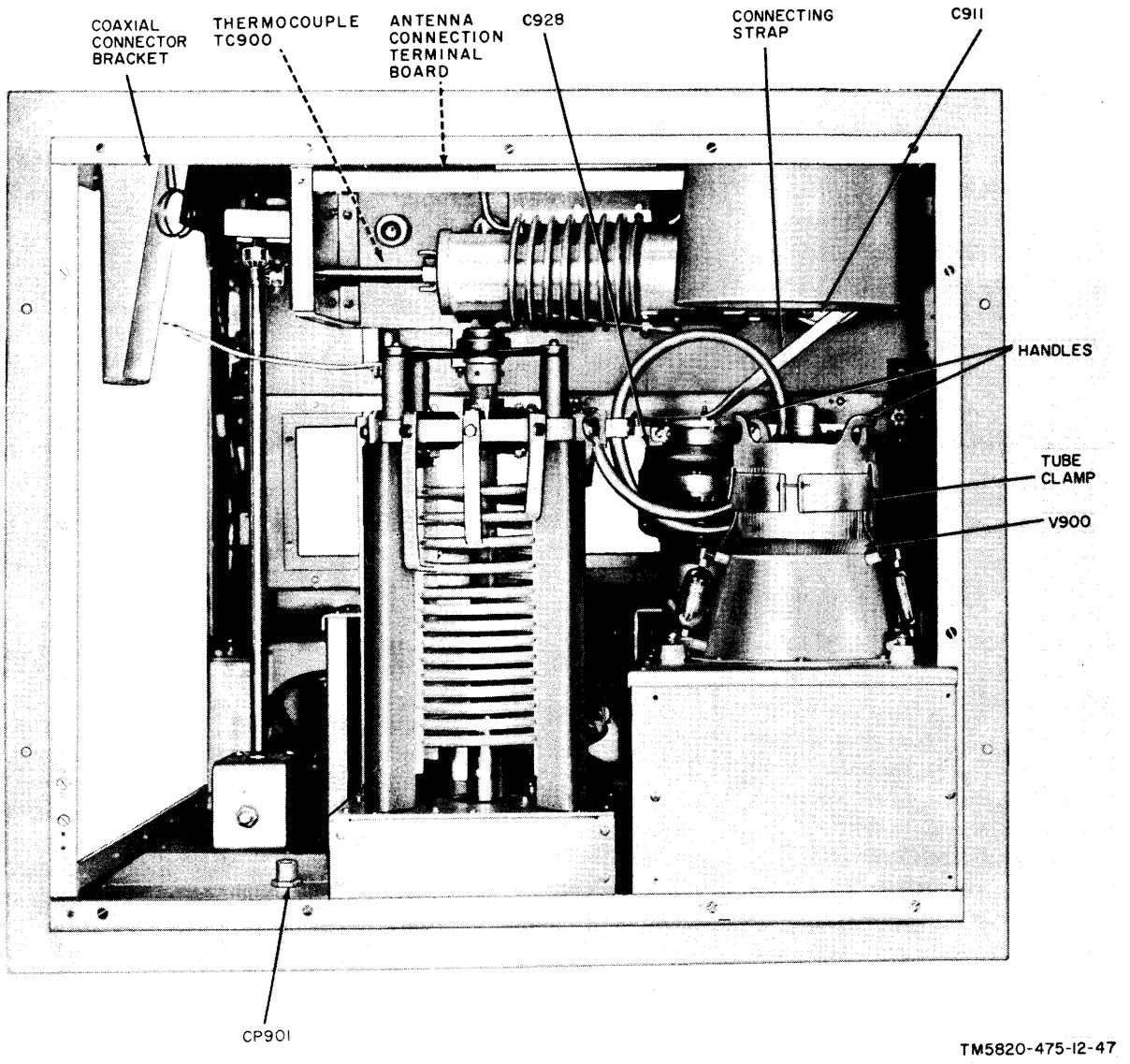


Figure 30. Main frame, upper rear view.

until a dip is obtained on the IPA PLATE CURRENT meter.

(12) Rotate the sideband exciter OUTPUT control (fig. 16) fully counterclockwise.

(13) Set the main power panel OPERATE-TUNE switch (fig. 25) to the OPERATE position.

(14) Repeat the procedures given in (3), (4), (5), (6), and (10) above.

(15) Rotate the rf amplifier IPA LOADING control (fig. 24) clockwise in small increments. After each setting, set the IPA LOADING switch for maximum indication on the IPA PLATE CURRENT meter and rotate the IPA TUNING control until a dip is obtained on the IPA PLATE CURRENT meter.

(16) Rotate the power amplifier OUTPUT LOADING control (fig. 23) until a small increase is obtained on the main meter panel PA OUTPUT meter.

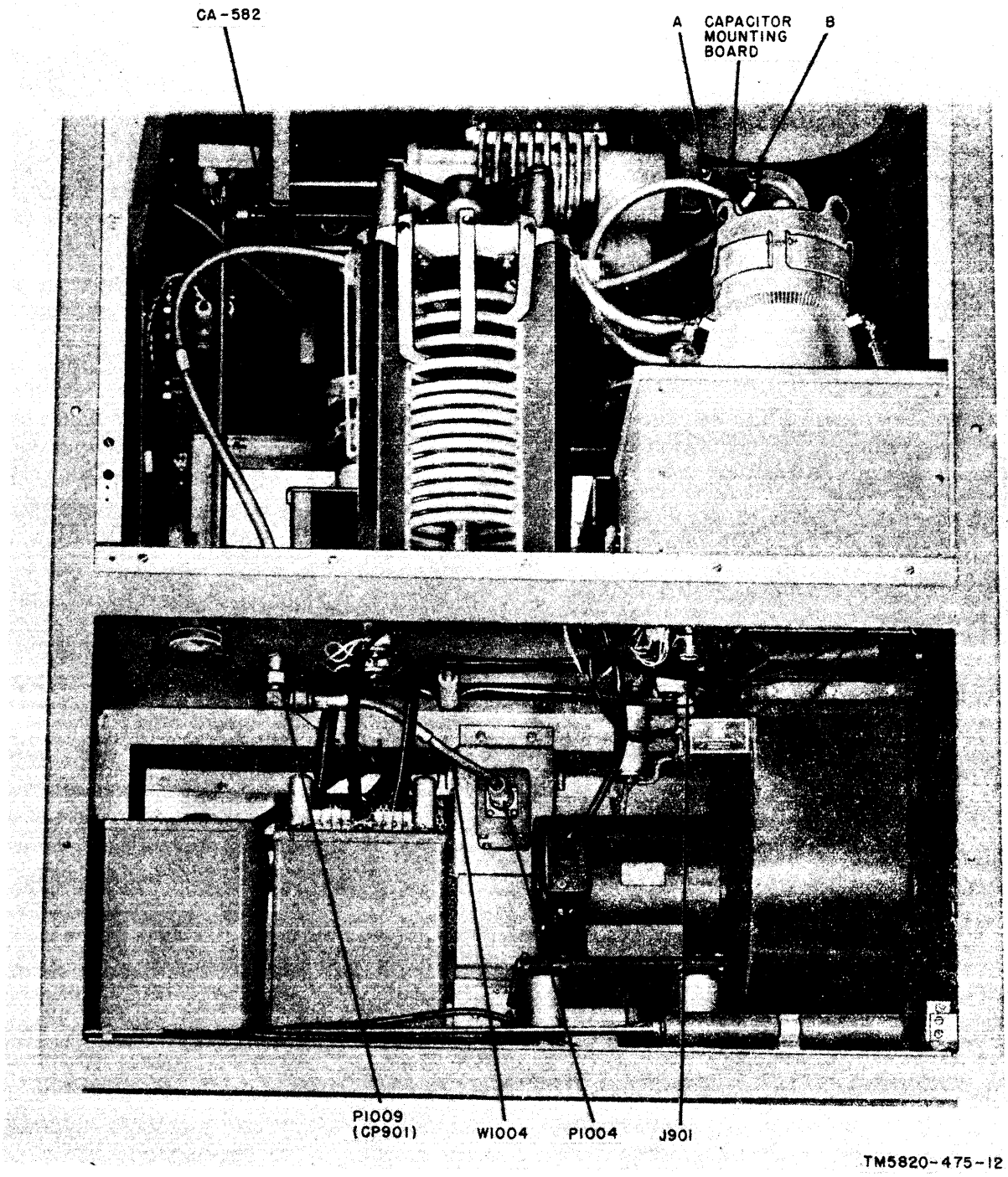


Figure 31. AN/FRT-52 connected for emergency operation.

(17) Slowly rotate the rf amplifier IPA TUNING control (fig. 24) until a dip is obtained on the IPA PLATE CURRENT meter.

(18) Slowly rotate the IPA LOADING control until an increase is obtained in the main meter panel PA OUTPUT meter.

(19) Slowly rotate the rf amplifier IPA TUNING control (fig. 24) until a dip is obtained on the IPA PLATE CURRENT meter.

Note: Repeat the procedures given in (16), (17), (18), and (19) until a maximum indication is obtained on the IPA PLATE CURRENT meter.

c. Single-Sideband Operation. Tuning procedures for single-sideband operation are identical with the procedures contained in paragraph 50*b*, except for the procedures given in (16). Perform (2) through (19) in *b* above. The procedures given in *b*(2) through (19) replaces those in paragraph 50*b*(16).

d. Independent-Sideband Operation. Tuning procedures for independent-sideband operation are identical with the procedures contained in paragraph 51*b*, except for (14) and (18). Instead of performing procedures (2) through (24) of paragraph 48*d* as indicated in 58*b*(14) and (18), perform the procedures given in *b*(2) through (19) above.

e. Double-Sideband Operation.

(1) Double-sideband operation is identical with independent sideband operation (para 51), except that only one modulating signal is received by the AN/FRT-52. If the modulating signal is received at the channel 1 input to the AN/FRT-52, perform the procedures given in paragraph 51*b* with the following exceptions:

(a) In procedures (6) and (24), only the CHANNEL 1 switch need be operated.

(b) In procedures (9) and (19), the USB switch is set to the CH 1 position.

(c) In procedures (14) and (18), instead of performing the procedures given in 48*d*(2) through (24), perform procedures *b*(2) through (19) above.

(2) If the modulating signal is received at the channel 2 input to the AN/FRT-52, perform the procedures in paragraph 51*b* with the following exceptions:

(a) In procedures (6) and (24), only the CHANNEL 2 switch need be operated.

(b) In procedures (2) and (16), set the LSB switch to the CH 2 position.

(c) In procedures (14) and (18), instead of performing the procedures given in 48*d*(1) through (24), perform procedures *b* (2) through (19) above.

f. Am. Operation. Am. operation is identical with double-sideband operation (e above) except that the carrier insertion level is adjusted for 50 percent. This is done by adjusting the sideband exciter LSB GAIN and USB GAIN controls (fig. 16) for a meter reading of 50 percent on audio peaks and then rotating the CARRIER INSERT control clockwise from 0 until the meter indication rises from 50 to 100.

g. Cw Operation. Cw operation is accomplished by tuning the AN/FRT-52 on carrier (para 48) and then keying the carrier with an externally connected telegraph key. To prepare the AN/FRT-52 for cw operation, proceed as follows:

(1) Tune the AN/FRT-52 on the carrier as described in paragraphs 48*a*, *b*, and *c* and perform the procedures given in *b*(2) through (19) above.

(2) Connect a telegraph key to the AN/FRT-52 (para 28*f*).

(3) Set the monitor control panel MODE switch (fig. 18) to SBE CW operation.

(4) Set the isolation keyer KEYING MODE switch (fig. 22) to the 60 MA position.

(5) Set the sideband exciter LSB and USB switches (fig. 16) to the OFF position.

(6) Set the METER SW switch to the RF position.

(7) With the telegraph key depressed, adjust the sideband exciter OUTPUT control to 7 for the correct rf output to drive the 1-kw portion of the AN/FRT-52.

CHAPTER 3
MAINTENANCE INSTRUCTIONS

Section I. OPERATOR'S MAINTENANCE

60. Scope of Operator's Maintenance

The following is a list of maintenance duties normally performed by the operator of the AN/FRT-52. The procedures do not require special tools or test equipment.

a. Preventive maintenance (para 61).
b. Visual inspection (para 62).
c. Operational checks (para 63).
d. Replacement of fuses (para 64).
e. Replacement of indicator lamps (para 64).
f. Checking cable connections (para 28 and 30).

61. Operator's Preventive Maintenance

a. DA Form 11-238. DA Form 11-238 (fig. 32 and 33) is a preventive maintenance checklist to be used by the operator and unit repairman. Items 1 through 12 are performed by the operator, and items 13 through 25 are performed by the unit repairman. Items not applicable to the AN/FRT-52 are lined out in the figures. References to the ITEM block in the figures are to paragraphs that contain additional maintenance information pertinent to the particular item. Instructions appear on the form.

b. Items. The information shown in this subparagraph is supplementary to DA Form 11-238. The item numbers correspond to the ITEM numbers on the form.

Item	Maintenance procedure
2	Use a clean cloth to remove dust, dirt, moisture, and grease from the microphone, headset, and front panel controls. If necessary, wet the cloth with Cleaning Compound (FSN 7930-395-9542); clean the parts and wipe them with a clean dry cloth.
3	All controls should work smoothly and control knobs should be tight on the shaft. Tighten all loose knobs and be sure that knobs do not rub against the front panel.
4	Check all meter readings against those listed in the tuning chart supplied with the equipment. Report any great discrepancies to the proper personnel.
5	Make sure all panels and doors are secured properly. Tighten any doors or panels that are loose.
6	Remove rust from units and touch up bare spots with paint.
7	Repair any cuts in the insulation by covering them with rubber tape and then with friction tape. Report the condition of any cables or cords that are beyond repair to the unit repairman.
11	Clean the windows of the power amplifier and high voltage rectifier with a clean dry cloth. If necessary, wet the cloth with soap and water, clean the windows, and thoroughly dry them with a clean dry cloth.

Warning: **Cleaning compound is flammable and its fumes are toxic. Do not use near a flame; provide adequate ventilation.**

62. Visual Inspection

a. When the equipment fails to perform properly, turn off the power and check for the conditions listed below. *Do not check any items with the power on.*

(1) Wrong settings of switches and controls. (Refer to the tuning chart supplied with the equipment.)
(2) Cables or antenna lead-in wire poorly connected (para 28).
(3) Disconnected cables or plugs.
(4) Interlock switches not closed properly.
(5) Burned out fuses (usually indicates some other fault).

b. If the above checks do not locate the trouble, proceed to the operational checklist (para 63).

63. Operational Checklist

a. General. The operational checklist will help the operator to locate the trouble quickly. The corrective measures are used to repair the trouble. If the corrective measures listed do not restore normal equipment performance, troubleshooting is

ADDITIONAL ITEMS FOR 2D AND 3D ECHELON INSPECTI NS	CONDITION
26. ~~INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.~~	
27. CHECK FOR NORMAL OPERATION.	✓
28. ~~BEFORE SHIPPING OR STORING, REMOVE BATTERIES~~	

IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING THE INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

ITEM 7. CABLE CA-427 DAMAGED, REPORTED TO THIRD ECHELON FOR REPLACEMENT.

FOLD

MAINTENANCE CHECK LIST FOR SIGNAL EQUIPMENT
SOUND EQUIPMENT, RADIO, DIRECTION FINDING RADAR, CARRIER, RADIOSONDE AND TELEVISION

(AR 750-625)

EQUIPMENT NOMENCLATURE: RADIO TRANSMITTING SET AN/FRT-52

EQUIPMENT SERIAL NUMBER: 00

INSTRUCTIONS

This form may be used for a period of one month by using the correct dates and weeks of the month. It is to be used as a Preventive Maintenance check list for Signal equipment in actual use, or for a check on equipment prior to issue.

1. For detailed Preventive Maintenance instructions see:
   a. The Technical Manual *(in TM 11 series)* for the equipment. *(See DA Pamphlet Number 310-4)*
   b. The Supply Bulletin *(SB 11-100 series)* for the equipment. *(See DA Pamphlet Number 310-4)*
   c. The Department of the Army Lubrication Order. *(See DA Pamphlet Number 310-4)*

2. The following action will be taken by either the Communications Officer/ Chief for 1st echelon, or the Inspector for higher echelon:
   a. Enter Equipment Nomenclature and Serial Number.
   b. Strike out items that do not apply to the equipment.

3. Operator/Inspector will enter in the columns entitled CONDITION, on the proper line, a notation regarding the condition, using symbols specified under LEGEND.

4. After operator completes each daily inspection he will initial over the appropriate dates under "Daily Condition for Month", then return form to his supervisor.

TYPE OF INSPECTION: PREVENTIVE MAINTENANCE

OPERATOR	2/3 ECHELON	DATE	SIGNATURE
✓		12 JAN 62	D. Jones
	✓	16 JAN 62	H. Smith

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DA FORM 1 MAY 57 11-238

REPLACES DA FORMS 11-238, 1 NOV 55; 11-239, 11-244, 11-245, 11-248, 11-249, 11-250, AND 11-251; WHICH ARE OBSOLETE.

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Figure 32. DA Form 11-238, pages 1 and 4.

LEGEND for marking conditions:
Satisfactory, ✓.
Adjustment, Repair or Replacement required, X.
Defect corrected, (X).

DAILY CONDITION FOR MONTH OF

NO.	DAILY ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	2D 3D ECHELON
		17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
1.	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT. *(Transmitter, receiver, carrying cases, wire, cables, microphones, tubes, spare parts, technical manuals).*	✓	✓	✓	✓													✓
2.	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONES, HEADSETS, KEYS, JACKS, PLUGS, COMPONENT PANELS.	✓	✓	✓	✓													✓
3.	INSPECT CONTROLS FOR NORMAL OPERATION. TAP CONTROLS LIGHTLY FOR EVIDENCE OF CUT-OUT FROM LOOSE CONTACTS.	✓	✓	✓	✓													✓
4.	CHECK FOR NORMAL OPERATION OF EQUIPMENT. BE ALERT FOR UNUSUAL OPERATION OR CONDITION.	✓	✓	✓	✓													✓

WEEKLY	CONDITION EACH WEEK 1ST	2D	3D	4TH	5TH	2D 3D ECH
5. CLEAN AND TIGHTEN EXTERIORS OF CASES, RACKS, MOUNTS, TRANSMISSION LINES.	✓					✓
6. INSPECT CASES, MOUNTS, ANTENNA TOWERS AND EXPOSED METAL SURFACES FOR RUST, CORROSION.	✓					✓
7. INSPECT CORDS, CABLE, WIRE, SHOCK MOUNTS FOR CUTS, KINKS, BREAKS, FRAYING, UNDUE STRAIN.	X					(X)
8. ~~CHECK ANTENNA GUY WIRES FOR PROPER TENSION OR DAMAGE.~~						
9. ~~INSPECT CANVAS AND LEATHER ITEMS FOR MILDEW, TEARS, FRAYING.~~						
10. INSPECT ACCESSIBLE ITEMS FOR LOOSENESS: SWITCHES, KNOBS, JACKS, CONNECTORS, RELAYS, TRANSFORMERS, MOTORS, PILOT LIGHTS, BLOWERS, ETC.	✓					✓
11. CLEAN AND/OR INSPECT AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS.	✓					✓
12. ~~INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, SPECIFIC GRAVITY, DAMAGED CASES. INSPECT DRY BATTERIES FOR LEAKAGE.~~						

ADDITIONAL ITEMS FOR 2D AND 3D ECHELON INSPECTIONS	CONDITION
13. ~~INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHER PROOFING, TEARS, FRAYING.~~	
14. ~~CHECK TERMINAL BOX COVERS FOR CRACKS, DIRT, LEAKS, DAMAGED GASKETS, GREASE.~~	

ADDITIONAL ITEMS FOR 2D AND 3D ECHELON INSPECTIONS	CONDITION
15. INSPECT SEATING OF READILY ACCESSIBLE PLUCK-OUT ITEMS: TUBES, LAMPS, FUSES, CRYSTALS, CONNECTORS, VIBRATORS, PLUG-IN COILS.	✓
16. INSPECT RELAYS AND CIRCUIT BREAKERS FOR LOOSE MOUNTINGS, BAD CONTACTS, MIS-ALINEMENT OF CONTACTS AND SPRINGS, PROPER SPRING TENSION.	✓
17. INSPECT VARIABLE CAPACITORS FOR DIRT, MIS-ALINEMENT OF PLATES, LOOSE MOUNTINGS, MOISTURE.	✓
18. INSPECT RESISTORS, BUSHINGS AND INSULATORS FOR CRACKS, CHIPPING, BLISTERING, MOISTURE, DISCOLORATION.	✓
19. CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE.	✓
20. INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS.	✓
21. INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR DIRT, CORROSION, LOOSE CONTACTS.	✓
22. INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS AND RHEOSTATS FOR OVERHEATING AND OIL LEAKAGE.	✓
23. INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS FOR BRUSH WEAR, SPRING TENSION, ARCING AND FITTING OF COMMUTATOR.	✓
24. INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.	✓
25. ~~INSPECT WATERPROOF GASKETS FOR LEAKS, WORN OR LOOSE PARTS.~~	

CONTINUED ON PAGE 4

2

3

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Figure 33. DA Form 11–238, pages 2 and 3.

required by the unit repairman. Note on the repair tag what corrective measures were taken and how the equipment performed at the time of failure.

b. Procedure. Perform the procedures given in *c* below. Observe the equipment operation and perform the necessary corrective measures.

Note: Befor proceeding, be sure that an ant nna or dummy load is connected to th output terminals of the AN/FRT-52.

c. Checklist.

Action	Normal indication	Corrective measure
1. Set auxiliary frame circuit breaker CB3000 (fig. 2) to the on position.	The auxiliary frame blower motor starts.	Check the power input connections (para 28). Check front fan fuse F3000 (fig. 2).
2. Set the MAIN POWER switch on sideband monitor to the ON position (fig. 31).	The associated MAIN POWER lamp lights.	Check the MAIN 2A fuse (fig. 12). Check the MAIN POWER lamp.
3. Rotate the ILLUMINATION control on the analyzer fully clockwise.	The power lamp and the panel lamps on the analyzer light.	If none of the lamps light, check the two 2 amp fuses on the analyzer power supply (fig. 2). If only one lamp does not light, check that lamp.
4. Set the POWER switch ón the two-tone gen rator to the ON position.	The MAIN POWER lamp on the two-tone generator lights.	Check the MAIN 2A fuse. Check the MAIN POWER lamp.
5. Set the POWER switch on O-330B/FR's No. 1 and No. 2 to the ON position.	The MAIN POWER lamp on each O-330B/FR lights. OUTER OVEN and INNER OVEN lamps light.	Check the POWER fuse on the rear apron (fig. 39). Check the MAIN POWER lamp. Check the OVENS fuse on the rear apron (fig. 39). Check the lamps.
6. Determine the vmo frequency required for the desired operating frequency (para 46) and then tune O-330B/FR No. 1 to this frequency.	The required rf output is produced as indicated by the front panel meter.	Higher echelon repair required.
7. Tune O-330B/FR No. 2 for the desired carrier frequency as described in 55*b*(13), (14) and (15).	The required rf output is produced as indicated by the front panel meter.	Higher echelon repair required.
8. Adjust the analyzer controls as described in 55*b*(1) through (11).	A sharp bright trace appears on the crt.	Higher echelon repair required.
9. Set the POWER switch on the sideband exciter to the ON position.	The power lamp on the exciter power supply lights. The OVEN lamp on the sideband exciter lights.	Check the exciter power supply MAIN fuse. Check the power lamp. Check the OVEN fuse on the exciter power supply. Check the OVEN lamp.
10. S t the EXCITER switch on the sideband exciter to the ON position.	The EXCITER lamp on the sideband exciter lights.	Check the EXCITER lamp. Check the B+ fuse on the exciter power supply.
11. Tune the sideband exciter on carrier (para 48*c*).	The required rf output is produced as indicated by the OUTPUT meter.	Higher echelon repair required.
12. Set the MAIN POWER circuit breaker on the main power panel to the on position.	The AC POWER lamp on the power amplifier lights. The TUNE lamp on the power amplifier lights. The INTERLOCK INDICATOR lamp on the main power panel lights for any position of the INTERLOCK switch except the TIMER and NORMAL positions. The blower motor on the rf amplifier starts. All tubes in the high voltage r ctifier light.	Check the MAIN BLOWER PH1 and PH2 fuses on the relay panel. Check the AC POWER lamp. Make certain that the OPERATE-TUNE switch on the main power panel is in the TUNE position. Check the MAIN BLOWER PH1 fuse on the relay panel. Check the TUNE lamp. Check all interlocks in the main frame (para 47*c*). Check the INTERLOCK INDICATOR lamp. Check the IPA BLOWER fuse. Check the associated fuse.

Action	Normal indication	Corrective measure
	Neither the IPA BIAS nor the PA BIAS lamps on the relay panel light.	Higher echelon repair required.
	The PA BIAS meter on the auxiliary meter panel indicates 230 volts.	Higher echelon repair required.
	The FILAMENT PRIMARY meter on the main meter panel indicates 230 volts.	Higher echelon repair required.
	The DRAWER INTERLOCK lamp on the rf amplifier should not light.	Tighten the rf amplifier in the main frame.
	The fluorescent light in auxiliary meter panel lights.	Higher echelon repair required.
	The fluorescent lights in main meter panel light.	Check the PA FIL fuse on the relay panel. Check the MAIN BLOWER PH1 fuse on the relay panel.
	The fan motor at the rear of the auxiliary frame starts.	Check the REAR FAN fuse on the relay panel.
	The blower motor in the main frame starts.	Check the three MAIN BLOWER fuses on the relay panel.
	The FILAMENT TIME timer on the relay panel registers elapsed time.	Check the PA FIL fuse.
13. Tune the rf amplifier to carrier frequency in accordance with procedures in 48*d*(1) through (6).	The required rf output is produced as indicated on the MULTI METER.	Check the B+ fuse on the rf amplifier. Check the IPA FIL fuse on the rf amplifier. Check the IPA BIAS fuse on the rf amplifier.
14. Set the HIGH VOLTAGE circuit breaker on the main power panel to the on position.	After 5 seconds: PLATE ON lamp on the power amplifier lights. The red light on top of the auxiliary frame glows dimly for 5 seconds and then glows with full brightness. All tubes in the high voltage rectifier have a dull purple glow for 5 seconds and then glow bright purple. The PLATE TIME timer on the relay panel indicates elapsed time.	Check the timer fuse on the relay panel. Check the PLATE ON lamp. Check the red light. Check the associated fuse. Higher echelon repair required.
15. Start tuning the power amplifier on carrier in accordance with procedures in 48*d*(9) through (15).	The correct rf output is produced as indicated on the front panel meters.	Higher echelon repair required.
16. Set the OPERATE-TUNE switch on the main power panel to the OPERATE position.	The OPERATE lamp on the power amplifier lights.	Check the OPERATE lamp.
17. Continue tuning the rf amplifier and the power amplifier in accordance with procedures in 48*d*(17) through (24). *Note:* For cw operation, perform steps 18 through 24 below. For any other mode of operation, proceed to step 25 below.	The correct rf output is produced as indicated on the front panel meters.	Higher echelon repair required.
18. Set the POWER switch on the isolation keyer to the on (up) position.	The associated POWER lamp lights.	Check the MAIN fuse. Check the POWER lamp.
19. Set the KEYING MODE switch on the isolation keyer to the 60 MA position.		
20. Set the POWER switch on the sideband exciter to the OFF position.		
21. Remove the jumper from between terminals 23 and 24 of terminal board E3002 (fig. 48) and connect an external telegraph key between these two terminals.		
22. Set the MODE switch on the monitor control panel to the SBE CW position.	The PA OUTPUT meter does not indicate any output current.	Higher echelon repair required.

Action	Normal indication	Corrective measure
23. Set the POWER switch on the sideband exciter to the ON position. 24. Close the telegraph key. 25. Operate the AN/FRT-52 for the desired mode of operation (para 50 through 53).	The corrent rf output is produced as indicated on the front panel meters. The correct rf output is produced as indicated on the front panel meters. One or both meters on the sideband monitor indicate the level of the sidebands.	Check the B_1+ and B_2+ fuses on the isolation keyer (fig. 22). Higher echelon repair required. Check the B+ fuse on the sideband monitor (fig. 12).

64. R placement of Lamps and Fuses

Three types of lamps are contained in the AN/FRT-52. The lamps mounted in the power amplifier and the relay panel are screwbase 115-volt lamps. Other indicator lamps in the AN/FRT-52 are bayonet base 6-volt lamps. Lamps used for illumination are standard incandescent and fluorescent lamps. No special instructions are required for replacement of the lamps. All fuses in the AN/FRT-52 are cartridge-type fuses and require no special replacement instructions.

Section II. SECOND ECHELON MAINTENANCE

65. Scope of Second Echelon Maintenance

The following is a list of maintenance duties normally performed at second echelon by the organizational repairman of the AN/FRT-52. The tools, materials, and test equipment required for the performance of these duties are listed in paragraph 66.

a. Preventive maintenance (para 67).
b. Lubrication (para 68).
c. Visual inspection (para 69).
d. Troubleshooting (para 70).
e. Tube testing (para 71).
f. Replacement of components (para 72).
g. Replacement of defective tubes (para 71) and crystals.

66. Tools, Materials, and Test Equipment R quired

The tools, materials, and test equipment required for second echelon maintenance are listed below:

a. Tools. Tool Kit TK-87/U contains all tools required for second echelon maintenance.

b. Materials.
(1) Cleaning compound.
(2) Cleaning cloth.
(3) Lubricating Oil, General Purpose, Preservative (PL-Special).
(4) Fine sandpaper.

c. Test Equipment.
(1) Multimeter TS-352/U.
(2) Electron Tube Test Set TV-7/U.
(3) Headset HS-33A.

67. Second Echelon Preventive Maintenance

a. DA Form 11-238. Items 13 through 25 of DA Form 11-238 (fig. 32 and 33) are preventive maintenance checks to be performed by the unit repairman. Items not applicable to the equipment are lined out in the figures. Additional preventive maintenance information concerning items 2 through 7, and 11 on DA Form 11-238 will be found in paragraph 61. Instructions appear on the form.

b. Items. The information shown in this subparagraph is supplementary to DA Form 11-238. The item numbers correspond to the ITEM numbers on the form.

***Warning:* Obtain permission to disconnect all power before performing the following operations. When power to the equipment is disconnected, some capacitors still may retain voltage of dangerous potential. Before touching exposed electrical parts, short-circuit the part to ground with the shorting bar supplied with the equipment (fig. 2). When maintenance is completed, reconnect the power, and check for satisfactory operation.**

Item	Maintenance procedure
15	Make certain that all crystals in the sideband xciter are properly seated.
16	Check the circuit breakers at the rear of the auxiliary frame for excessive pitting.
19	Make certain that all switch and control extensions on the power amplifier are tight.
20	Check the terminal board connections at the rear of the units in the auxiliary frame.

68. Lubrication

Lubrication instructions for the unit repairman consists of lubricating cabinet door hinges and latches and component slide mechanisms (fig. 46). Contacting surfaces of the door and slide mechanisms must be cleaned and lightly lubricated with oil (PL-Special) at periodic intervals.

69. Visual Inspection

Before operating the equipment, inspect it for the following defects:

a. Improper seating of pluckout units.

b. Loose or broken connections on terminal boards.

c. Loose or damaged interconnecting cables.

d. Discolored, loose, or broken glass resistors, insulators, and vacuum capacitors.

e. Damaged glass or bent pointers in the front panel meters.

70. Equipment Performance Ch cklist

a. General. The equipment performance checklist is a procedure used to systematically check equipment performance. All corrective measures which the unit repairman can perform are given in the *Corrective measures* column. When using the checklist after initial installation, start at the beginning and follow each step in order; thereafter, perform the starting procedures (para 47) and begin with step No. 11. If the indicated corrective measures do not fix the equipment, trouble-shooting is required by higher echelon. Note the equipment performance on the repair tag and what corrective measures were taken.

b. Procedure. Operate the equipment as indicated in the following checklist.

***Caution:* Before proceeding, be sure that all controls are in the positions indicated in the tuning chart supplied with the equipment and that all power switches are in their off position.**

	Step	Item or component	Action	Normal indication	Corrective measures
PREP	1	Antenna	Connect antenna or dummy load to antenna terminals of AN/FRT-52 (para 29).		
	2	Interlocks	Make certain that all doors, covers, and components are properly secured.		
	3	All components	Set all controls in accordance with the instructions given in paragraph 46.		
START	4	Auxiliary frame	Set circuit breaker CB3000 (fig. 2) to the on position.	The auxiliary frame blower motor starts.	Make certain that plug P3008 (located below the blower motor) is properly seated. Check the capacitor mounted below the blower motor.
	5	Sideband monitor	Set the MAIN POWER switch to the ON position.	The associated MAIN POWER lamp lights.	Make certain that the associated power cord is connected to the power strip.
	6	Spectrum	Rotate the ILLUMINATION control on the analyzer fully clockwise.	The power lamp and panel lamps light.	Make certain that the power cord is connected to the power strip and cable CA-432 between the analyzer and the analyzer power supply (para 28 and fig. 48) is properly connected.

	Step	Item or compon nt	Action	Normal indication	Corrective measures
START	7	Two-tone g nerator	Set the POWER switch to th ON position.	The MAIN POWER lamp lights.	Make certain that the power cord is connected to the power strip.
	8	O-330B/FR's No. 1 and No. 2	Set the POWER switch on each unit to the ON position.	The associated MAIN POWER lamp lights. OUTER OVEN and INNER oven lamps light.	Make certain that the power cord is connected to the power strip.
	9	Sideband exciter assembly	Set the POWER switch to the ON position.	The power lamp on the exciter power supply lights.	Make certain that the power cord on the analyzer is connected to the power strip and that cable CA-346 (between the sideband exciter and exciter power supply (para 28 and fig. 48)) is properly connected.
	10	Sideband exciter	Set the EXCITER switch to the ON position.	The EXCITER lamp on the sideband exciter lights.	Check tubes V401 and V402 in the exciter power supply (fig. 38).
EQUIPMENT PERFORMANCE	11	O-330B/FR's No. 1 and No. 2	Turn BEAT switch to ON position. Turn HFO switch to ON position. Turn XTAL switch to VMO. Tune MASTER OSCILLATOR FREQUENCY dial through entire frequency range.	Headset indicates zero beat at many intervals throughout frequency range. ZERO BEAT pilot lamp lights except at many of the zero-beat intervals.	Check headset. Check tubes V301, V302, V103, and V104 (fig. 39 and 40). Check ZERO BEAT pilot lamp.
			Turn MASTER OSCILLATOR FREQUENCY dial to 2,000 KCS (000) CPS reading. Adjust CALIBRATE control.	Headset, and possibly ZERO BEAT pilot lamp, indicates zero beat when proper calibration is reached.	
			Turn MASTER OSCILLATOR FREQUENCY dial to 2,500 KCS, 3,000 KCS, 3,500 KCS, and then to 4,000 KCS. Adjust CALIBRATE control at each frequency setting listed above, but do *not* make more than 2 complete revolutions of the CALIBRATE control from its position at 2,000 KCS to effect calibration at any dial frequency.	Headset, and possibly ZERO BEAT pilot lamp, indicates zero beat within the limits of adjustment of the CALIBRATE control.	
	12	O-330B/FR No. 1	Determine the vmo frequency required for the desired operating frequency (para 46) and then tune O-330B/FR No. 1 to this frequency (para 48*b*).	The required rf output is produced as indicated by the front panel meter.	Check tubes V101, V102, V202 through V207, V301, and V302 (fig. 39-41).
	13	O-330B/FR No. 2	Tune for the desired carrier frequency as described in paragraph 55*b* (13), (14), and (15).	The required rf output is produced as indicated by the front panel meter.	Check tubes V101, V102, V202 through V207, V301, and V302 (fig. 39-41).
	14	Analyzer	Set the CENTER FREQ control to the vertical marker. Rotate the SWEEP WIDTH control fully clockwise. Rotate the IF BANDWIDTH control fully clockwise.		

	Step	Item or compon nt	Acti n	Normal indi ation	Corrective measures
EQUIPMENT PERFORMANCE	15	Spectrum analyzer	Rotate the CAL OSC LEVEL switch fully clockwise. Set the 5 KC MARKER switch to the on (up) position. Rotate the BRILLIANCE control for the desired brightness.	A horizontal trace with a calibration pip and marker pips superimposed should appear on the crt.	If neither the horizontal nor the pips are seen, check tubes V101 through V104 in the analyzer power supply (fig. 36). If only the horizontal trace is seen, check tubes V1, V2, V3, V7 through V11, and V20 in the analyzer (fig. 35). Check the continuity of cords 1 and 8 of cable CA-427 (para 28 and fig. 48). If only the trace and the calibration pips are seen, check tube V4 in the analyzer. If only a dot at the center of the crt is seen, check tubes V13, V14, V15, and V17 in the analyzer (fig. 35).
	16	Analyzer	Set the SWEEP WIDTH control to the 100 KC position. Rotate the AFC OFF control clockwise.	No marker pips should be visible; the width of the calibration pip should be expanded.	Check tubes V5, V6, and V18 (fig. 35).
	17	Analyzer	Adjust the FOCUS control for the desired focus.	A sharp trace should appear on the crt.	
	18	Sideband exciter assembly	Set the METER SW switch to the CAL position. Adjust the CAL control for zero reading on the meter.	The meter can be zeroed.	Check tube V112 (fig. 37).
	19	Sideband exciter	Rotate the CARRIER INSERT control to the 10 position. Set the METER SW switch to the MF position. Rotate the MF TUNING control for a maximum reading on the meter.	Maximum meter reading is obtained when the MF TUNING dial indication corresponds with the vmo frequency of O-330B/FR No. 1 (steps 12 and 13 above).	Check tubes V105, V113, V114, V115, and V126 (fig. 37). Check wires 4 and 6 of cable CA-427 (para 28 and fig. 45).
	20	Sideband exciter	Set the METER SW switch to the RF position. Increase frequency setting of the OUTPUT TUNING control until the first peak reading is obtained on the meter.	Maximum meter reading is obtained when the OUTPUT TUNING control is set at the desired carrier frequency.	Check tubes V116 through V120 (fig. 37).
	21	Sideband exciter	Set the LSB switch to the CH 1 position. Set the LSB GAIN control to midposition. Set the METER SW switch to the LSB position.	The front panel meter indicates the audio level.	Check tube V123 (fig. 37).

	Step	Item or component	A tion	Normal indicati n	Correctiv measures
EQUIPMENT PERFORMANCE	22	Sideband exciter	Set the LSB switch to the OFF position and set the USB switch to the CH 1 position. Set the USB GAIN control to midposition. Set the METER SW switch to the USB position.	The front panel meter indicates the audio level.	Check tube V122 (fig. 37).
	23	Sideband exciter	Rotate the CARRIER INSERT control fully counterclockwise and adjust the USB GAIN control for maximum meter readings of 100. Set the METER SW switch to the RF position and adjust the OUTPUT control for the desired rf level.	The front panel meter indicates the desired rf level.	Check tubes V123 and V125 (fig. 37).
	24	Sid band monitor	Adjust the CALIBRATE USB control for a db reading on the USB LEVEL meter equal to the db reading on the sideband exciter meter.	The db readings on both meters are the same.	Check tubes V401 and V402 (fig. 34). Check the continuity of wire 45 (para 28 and fig. 48).
	25	Sid band exciter	Set the USB switch to the OFF position and set the LSB switch to the CH 1 position. Set the METER SW switch to the LSB position and adjust the LSB GAIN control for maximum meter readings of 100. Set the METER SW switch to the RF position and adjust the OUTPUT control for the desired rf level.	The front panel meter indicates the desired rf level.	Check tubes V122 and V125 (fig. 37).
	26	Sideband monitor	Adjust the CALIBRATE LSB control for a db reading on the LSB LEVEL meter equal to the db reading on the sideband exciter meter.	The db readings on both meters are the same.	Check tube V400 (fig. 34). Check the continuity of wire 46 (para 28 and fig. 48).
	27	Sideband exciter	Set the LSB switch to the MIKE position and speak into the microphone.	The front panel meter indication fluctuates.	Check tubes V101 and V121 (fig. 37).
	28	Sideband exciter	Adjust the LSB GAIN control for maximum meter readings of 100. Set the METER SW switch to the RF position and adjust the OUTPUT control for the desired rf level. Set the EXCITER switch to the STANDBY position.	The EXCITER lamp goes out.	
	29	Sideband exciter	Speak into the microphone and adjust the VOX GAIN control until the EXCITER lamp lights.	The EXCITER lamp lights as long as the microphone is spoken into.	Check tubes V110, V111, and V127 (fig. 37).
	30	Sideband exciter	With the microphone connected but with no direct speech input, increase the room background nois .	The EXCITER lamp lights as a result of the increase in background noise.	If necessary, increase the setting of the VOX GAIN control.
	31	Sideband xciter	Apply a 0.5- to 1.0-volt audio signal to the squelch input of the AN/FRT-52 (between terminal 20 of	The EXCITER lamp goes out.	Check tubes V110 and V111 (fig. 37).

	Step	Item or compon nt	Action	Normal indication	Corrective measures
EQUIPMENT PERFORMANCE			E3001 and terminal 26 of E3002 (fig. 48)). Increase the setting of the SQUELCH GAIN control *Note:* Use audio output of station receiver.		
	32	Main power panel	Set the MAIN POWER circuit breaker to the on position.	The power amplifier AC POWER lamp lights.	Check the MAIN BLOWER PH 1 fuse on the relay panel.
				The power amplifier TUNE lamp lights.	
				The INTERLOCK INDICATOR lamp lights for every position of the INTERLOCK switch except the TIMER and NORMAL positions.	
				Neither the IPA BIAS nor PA BIAS LAMPS on relay panel light.	If either lamp lights, check the following items on the rf amplifier: tub s V2001, V2002, and V2003, IPA BIAS fuse, and the LV fuse (fig. 44).
				The blower motor in the rf amplifier starts.	Check the IPA BLOWER fuse on the rf amplifer.
				All tubes in high voltage rectifier light.	Check the unlighted tub s.
				The DRAWER INTERLOCK on the rf amplifier does not light.	
				The PA BIAS meter on auxiliary frame meter panel should indicate 230 volts.	
				The blower motor in the main frame starts.	Check the three MAIN BLOWER fuses on relay panel. Higher echelon repair required.
				The fluorescent lamps in main frame meter panel light.	Check the fluorescent lamp.
					Check the associated lamp starter.
				The fluorescent lamp in auxiliary frame meter panel lights.	Check the fluorescent lamp.
				The fan motor at the rear of the auxiliary frame starts.	Check the starter.
				The FILAMENT TIME timer relay panel registers elapsed time.	
				The FILAMENT PRIMARY meter on main frame meter panel indicates 230 volts.	Adjust the FIL ADJ control on main power panel.
	33	Rf amplifier	Set the MULTI METER to the DC IPA BIAS X10 position.	The MULTI METER indicates 100 volts.	Check the IPA BIAS and LV fuses.
					Check tubes V2001, V2002, and V2003 (fig. 44).
	34	Rf amplifier	Set the MULTI METER switch to the RF 1ST AMPL EP X1 position and slowly rotate the 1ST AMPL TUNING control until a peak is obtained on the MULTI METER.	A peak is obtained on the MULTI METER.	Check the B+ and LV fuses.
					Check tube V2000 (fig. 44).
					Check tube V201 (fig. 44).

EQUIPMENT PERFORMANCE

Step	Item or compon nt	Acti n	Normal indication	Corrective measures
35	Rf amplifier	Set the MULTI METER switch to the RF IPA EG X1 position and rotate the IPA GRID TUNING control until a peak is obtained on the MULTI METER.	A peak is obtained on the MULTI METER.	Check tube V202 (fig. 44).
36	Main power panel	Set the HIGH VOLTAGE circuit breaker to the ON position.	After 5 seconds, the PLATE ON lamp on power amplifier lights. The red light on top of the auxiliary frame glows dimly for 5 seconds and then glows with full brightness. All tubes in high voltage rectifier glow dull purple for 5 seconds and then glow bright purple. After 5 seconds, the PLATE TIME timer on relay panel indicates elapsed time. The PA PLATE meter on meter panel indicates plate voltage.	Check the associated tube (fig. 45).
37	Rf amplifier	Rotate the IPA TUNING control until a dip is obtained on the IPA PLATE CURRENT meter.	A dip is obtained.	Check tube V203, (fig. 44). Check tubes V600 through V605 in high voltage rectifier (fig. 45).
38	Sideband exciter	Rotate the OUTPUT control fully counterclockwise.		
39	Main power panel	Set the PA SCREEN switch the ON position.	The PA SCREEN meter on auxiliary frame meter panel indicates 200 volts.	
40	Rf amplifier	Set the MULTI METER switch to the DC IPA ESG X10 position.	The MULTI METER indi-indicates 200 volts.	
41	Sideband exciter	Rotate the OUTPUT control until an increase is obtained on the PA PLATE CURRENT meter on meter panel.	The indication on the PA PLATE CURRENT meter increases.	
42	Power amplifier	Rotate the PA TUNE control until a dip is obtained on the PA PLATE CURRENT meter on main frame meter panel.	A dip is obtained on the PA PLATE CURRENT meter.	Check tube V900 (fig. 30).
43	Sideband exciter	Rotate the OUTPUT control fully counterclockwise.		
44	Main power panel	Set the OPERATE-TUNE switch to the OPERATE position.	The OPERATE lamp on power amplifier lights. The PA SCREEN meter in main frame panel indicates 400 volts.	
45	Rf amplifier	Set the MULTI METER switch to the DC IPA ESG X10 position.	The MULTI METER indicates 400 volts.	
46	Rf amplifier and power amplifier	Continue tuning the rf amplifier and power amplifier in accordance with paragraph 48*d* (17) through (24). *Note:* For cw operation, perform steps 47 through 53 below. For any other type of op ration, perform steps 54 through 62 below.	The proper rf output is produced as indicated by the front panel meters.	
47	Isolation keyer	Set the POWER switch to the ON (up) position.	The POWER lamp lights.	Mak certain the power cord is connected to th power strip.

	Step	Item or component	Action	Normal indication	Corrective measures
EQUIPMENT PERFORMANCE	48	Isolation keyer	Set the KEYING MODE switch to the 60 MA position.		
	49	Sideband exciter	Set the POWER switch to the OFF position.		
	50	Terminal board E3002 on the auxiliary frame	Remove the jumpers from between terminals 23 and 24 and connect the external telegraph key between these two terminals.		
	51	Sideband exciter	Set the POWER switch to the ON position.		
	52	Monitor control panel	Set the MODE switch to the SBE CW position.		
	53	Telegraph key	Close the telegraph key.	The correct rf output is produced as indicated by the front panel meters.	Check tubes V4001 and V4002 in isolation keyer (fig. 43). Check wires 6, 7, 9, 10, 11, and 12 of cabl CA-495 (fig. 48). Check wire 16 of cabl CA-427 (fig. 48).
	54	Two-tone generator	Set the RF TONE SELECTOR switch to the TWO TONE position.		
	55	Spectrum analyzer	Set the following switches to the indicated positions: CAL OSC LEVEL OFF 5 KC MARKER OFF IF ATTEN 20DB INPUT ATTENUATOR up GAIN 10 SWEEPWIDTH SELECTOR VAR Set the SWEEP RATE and IF BANDWIDTH control for optimum resolution.		
	56	Monitor control panel	Set the ANALYZER MONITOR switch to the TEST position.		
	57	O-330B/FR No. 2	Tune for a carrier frequency of 2.5 mc as described in paragraph 55*b*(13), (14), and (15). Slowly rotate the MASTER OSCILLATOR FREQUENCY control until two pips appear in the center of the crt on the spectrum analyzer.	Two pips are centered on the crt.	Check tn MAIN and B+ fuses on the two-tone generator. Check tubes V504, V505, and V506 in the two-tone g nerator (fig. 42). Check wires 2 and 13 of cable CA-427 (fig. 48).
	58	Spectrum analyzer	Check the distortion of the display on the crt (para 55).	The distortion products should be at least 60 db down.	
	59	AN/FRT-52	Set the AN/FRT-52 for single-sideband operation in accordance with paragraph 50 except that the monitor control panel ANALYZER MONITOR switch should be in the SBE position.	Two pips and their distortion products are centered on the spectrum analyzer crt. The distortion products are at least 35 db down.	If no pips are visible on the crt, check wires 2 and 3 of cable CA-427 (fig. 48). Check tube V506 in the two-tone generator (fig. 42). If only on pip and its distortion products are visible, check tubes V500 through V503 in the two-tone generator (fig. 42).

	Step	Item or component	Action	Normal indication	Corrective measures
EQUIPMENT PERFORMANCE	60	Monitor control panel	Set the ANALYZER MONITOR switch to the IPA position.	Two pips and their distortion products are centered on the spectrum analyzer crt. The distortion products are at least 35 db down.	If the distortion products ar excessiv , set the ALDC switch on main power panel to the ON position. If the distortion is still excessive, ch ck wire 64 of cable CA-427 (fig. 48). Check cable W3000 (fig. 5). If no pips are visible on the crt, check wire 9 of cable CA-427 (fig. 48). If the distortion products are excessive. disconnect the cable from the ALDC jack at the rear of the auxiliary frame and set the ALDC switch on main power panel to the ON position. Retune the rf amplifier to decrease the distortion.
	61	Monitor control panel	Set the ANALYZER MONITOR switch to the PA position.	Two pips and their distortion products are centered on the spectrum analyzer crt. The distortion products are at least 35 db down.	If no pips are visible on the crt, check wire 10 of cable CA-427 (fig. 48). Check cable W3000 (fig. 5). If the distortion products are excessive, retune power amplifier.
	62	AN/FRT-52	Operate the AN/FRT-52 for independent or double sideband operation or am. operation in accordance with paragraph 51, 52, or 53, respectively.	The correct rf output is produced as indicated by the front panel meters.	

71. Tube T sting

When trouble occurs, check for loose components, parts, and connections before removing any tubes. Try to isolate the trouble to a component or stage. If tube failure is suspected, use the applicable procedure (*a* or *b* below) to check the tubes. Procedures for gaining access to all tubes, except V203 in the rf amplifier and V900 in the power amplifier, are given in paragraphs 25 and 72. Porcedures for removing tubes V203 and V900 are given in *b* and *c* below. Figures 34 through 45 indicate tube location in components of the AN/FRT-52.

Caution: **Do not rock or rotate a tube when removing it from a socket; pull it straight out with a tube puller.**

a. Use of Tube Tester. Electron Tube Test Set TV-7/U can test all tubes in the AN/FRT-52, except tubes V203 in the rf amplifier and V900 in the power amplifier which must be checked by substitution (*b* below). Remove and test one tube at a time. Discard a tube only if its defect is obvious or if the tube tester shows it to be defective. Do not discard a tube that tests at or near its minimum test limit on the tube tester. Put back the original tube or insert a new one if required, before testing the next one.

b. Tube Substitution Method. Replace a suspected tube with a new tube. If the equipment remains inoperative, remove the new tube and put back the original tube. Repeat this procedure with each suspected tube until the defective tube is located.

c. *Replacing Tube V203* (fig. 44).

(1) Slide the rf amplifier out of the main frame (para 72*b*(1) and (2)).
(2) Loosen the tube clamp screw on V203.
(3) Lift the tube clamp over the top of the tube.
(4) Gently rock the tube sidewards while pulling upward.
(5) Set the replacement tube in position in the tube socket and firmly press down until the tube seats.
(6) Place the tube clamp over the tube.
(7) Tighten the tube clamp screw.

d. *Replacing Tube V900* (fig. 30).

Warning: **Before proceeding, ground the outside of the tube with the shorting bar (fig. 2) and allow sufficient time for the tube to cool.**

(1) Remove the two screws that secure the tube clamp together.
(2) Grasp the handles of the tube and rotate the tube one-quarter turn counterclockwise.
(3) Remove the tube from the tube socket.
(4) Position the replacement tube in the tube socket.
(5) Depress the tube and rotate it one-quarter turn clockwise.
(6) Secure the tube clamp around the tube; use the two screws and nuts.

72. Replacement of Components

The removable components of the AN/FRT-52 are either slide mounted or panel mounted. The following paragraphs contain procedures for removing these components.

a. *Rack-Mounted Components.* To replace all rack-mounted components, proceed as follows:

(1) Remove the screws that secure the component to the frame.
(2) Slide the component far enough out of the rack so that the cable connections at the rear are accessible.
(3) Tag and disconnect all cables and/or wires connected to jacks and terminal strips at the rear of the component.
(4) Remove the component.
(5) Set the replacement component in position in the frame.
(6) Connect all cables and/or wires.
(7) Push the component into the frame; be sure that the cables do not kink of bind.
(8) Secure the component to the frame.

b. *Slide-Mounted Components* (A, fig. 46). To replace all slide-mounted components proceed as follows:

Warning: **Two men should be used when replacing heavier components such as the rf amplifier and O-330B/FR.**

(1) Remove the screws that secure the component to the frame.
(2) Pull the component out of the frame until the release buttons engage the holes in the tracks.
(3) Tag and disconnect all cables and/or wires connected to jacks or terminal strips at the rear of the component.
(4) Depress the release buttons and slide the component off the tracks.
(5) Set the replacement components in position on the tracks.

Note: It may be necessary to hold th tracks in the extended position while positioning the component.

(6) Slide the component onto the tracks until the release buttons catch.
(7) Depress the release buttons and push the component into the frame until the release buttons engage the holes in the tracks.
(8) Connect all cables and/or wires.
(9) Depress the release buttons and push the component into the frame; be sure that the cables do not kink or bind.
(10) Secure the component to the frame.

c. *Tilting Slide-Mounted Components* (B, fig. 46). During initial checks or maintenance, it may be desirable to tilt the component to reach the top or bottom of the chassis. To tilt a component, proceed as follows:

(1) Remove the screws that secure the component to the frame.
(2) Pull the component out of the frame until the release buttons engage the holes in the tracks.

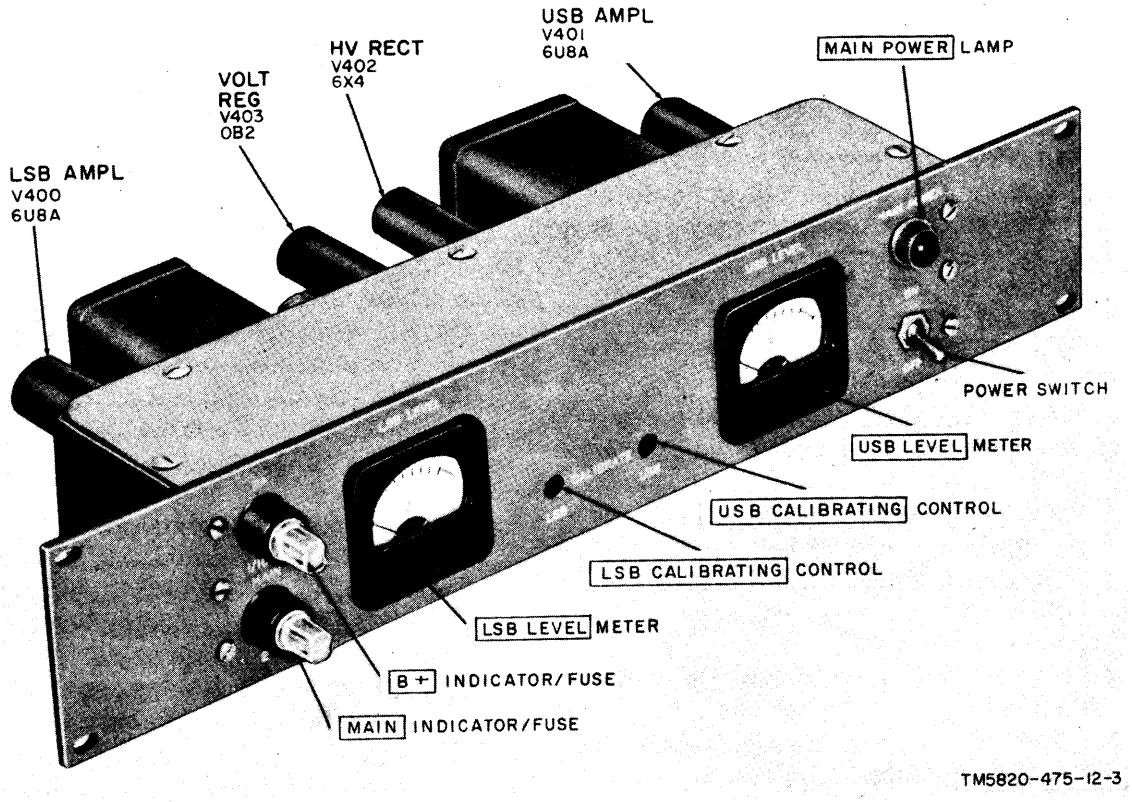


Figure 34. Sideband monitor, tube location.

(3) Pull out the tilt lever and tilt the component to the desired position.
(4) Pull out the tilt lever and return the component to the horizontal position.
(5) Depress the release buttons and slide the component into the frame; be sure that the cables do not kink or bind.
(6) Secure the component to the frame.

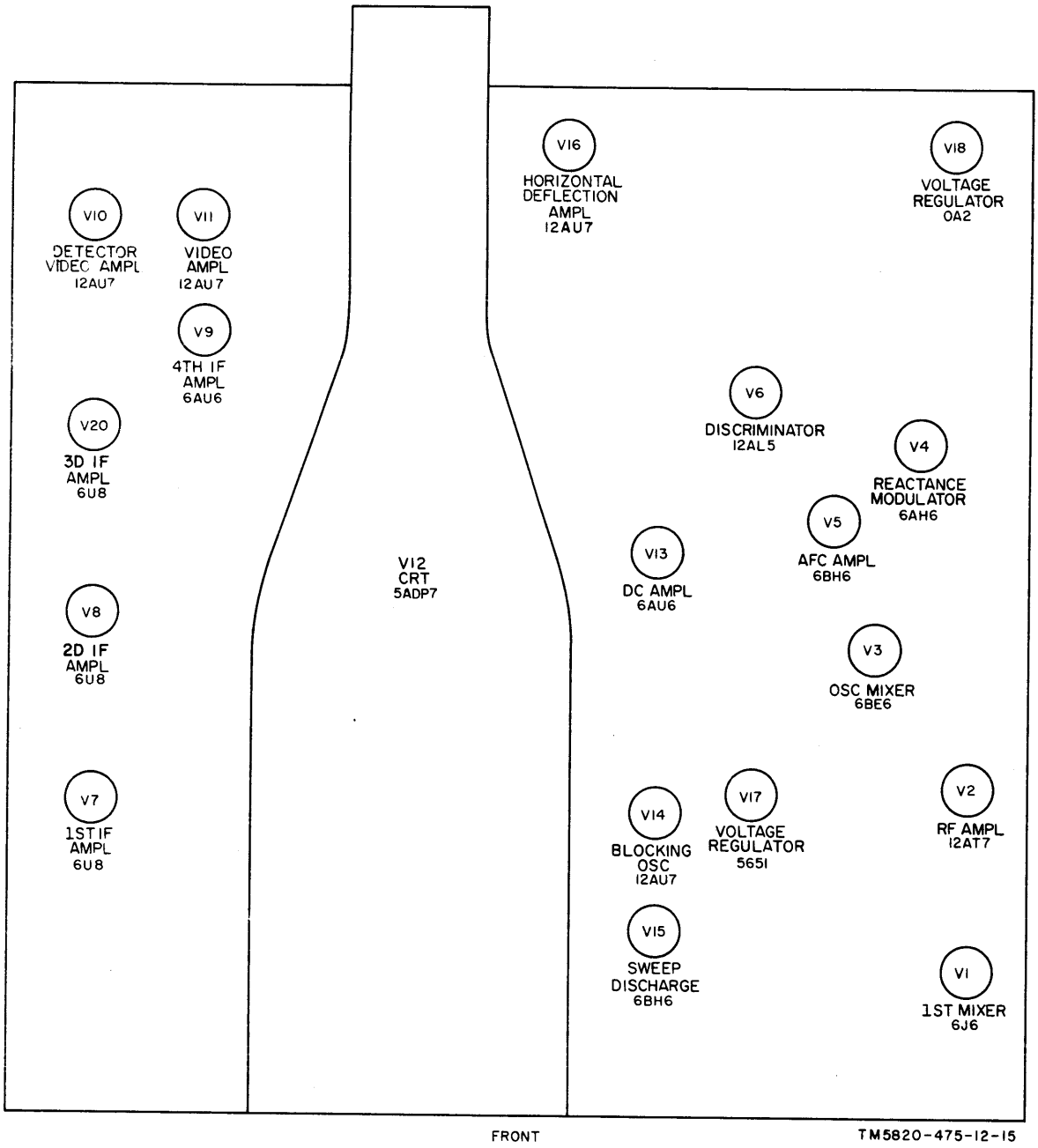


Figure 35. Analyzer, tube location.

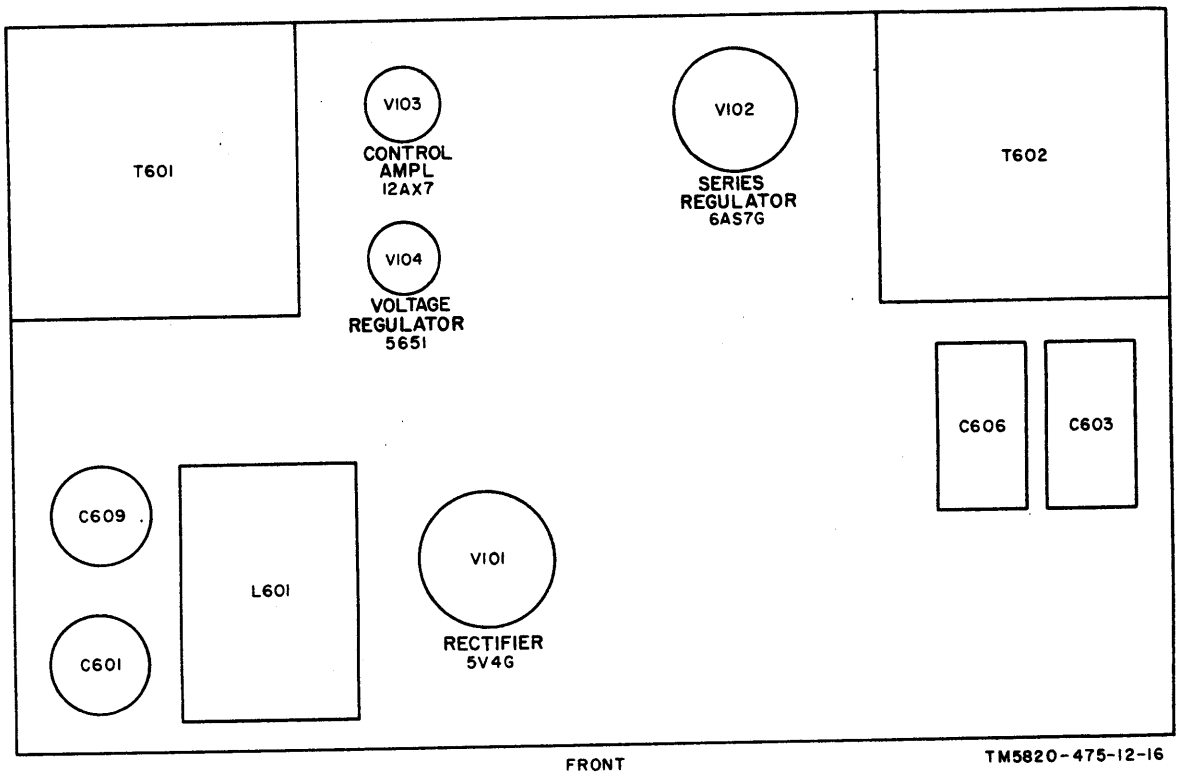


Figure 36. Analyzer power supply, tube location.

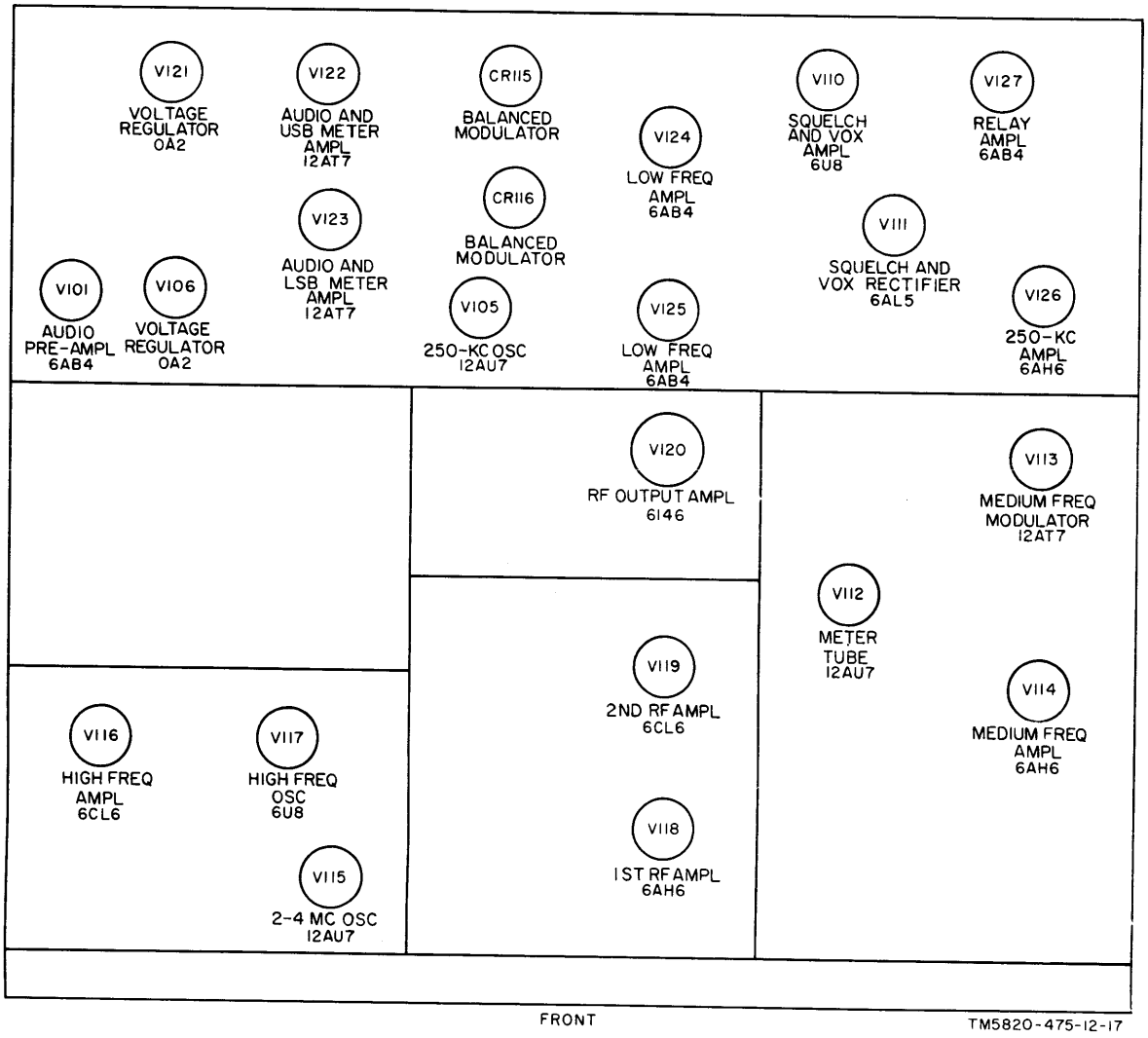


Figure 37. Sideband exciter, tube location.

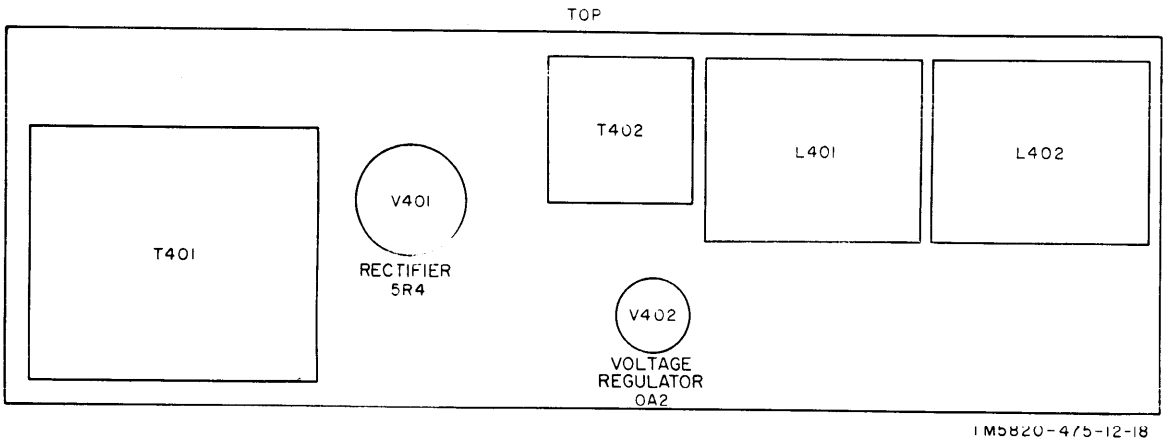


Figure 38. Exciter power supply, tube location.

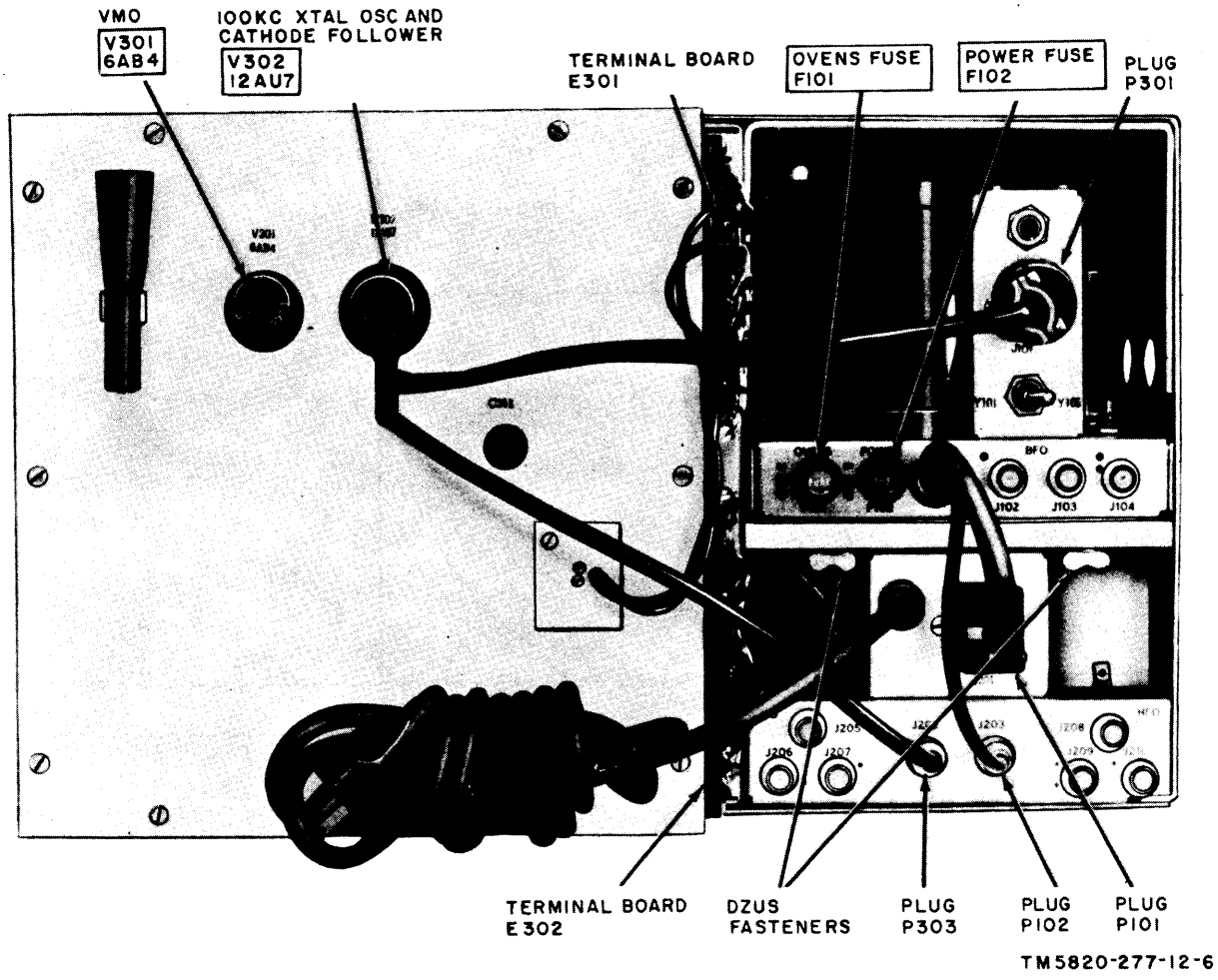


Figure 39. Oscillator, Radio Frequency O-330B/FR, tube location, rear view.

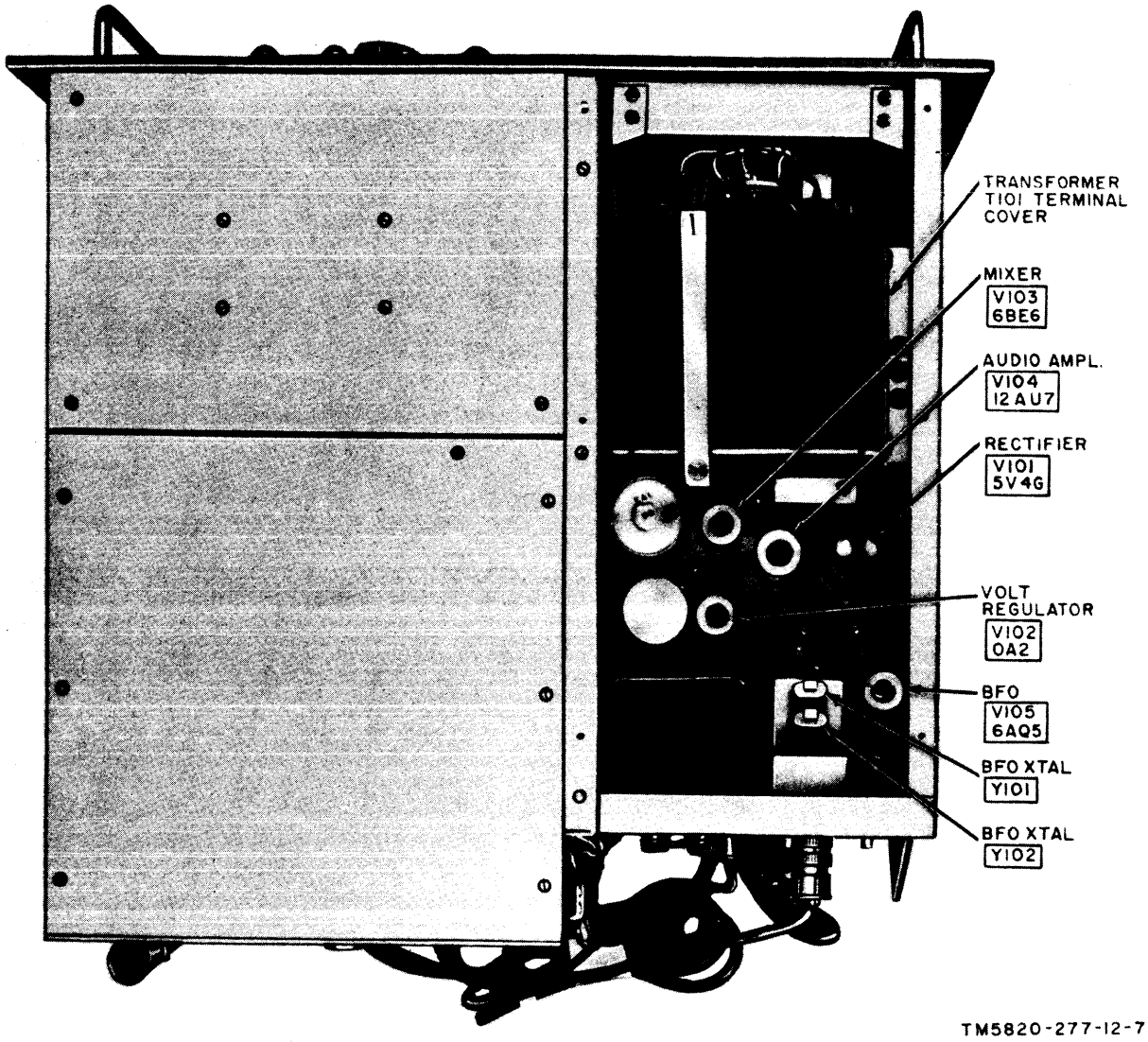


Figure 40. Oscillator, Radio Frequnecy O-330B'FR, tube location, top view.

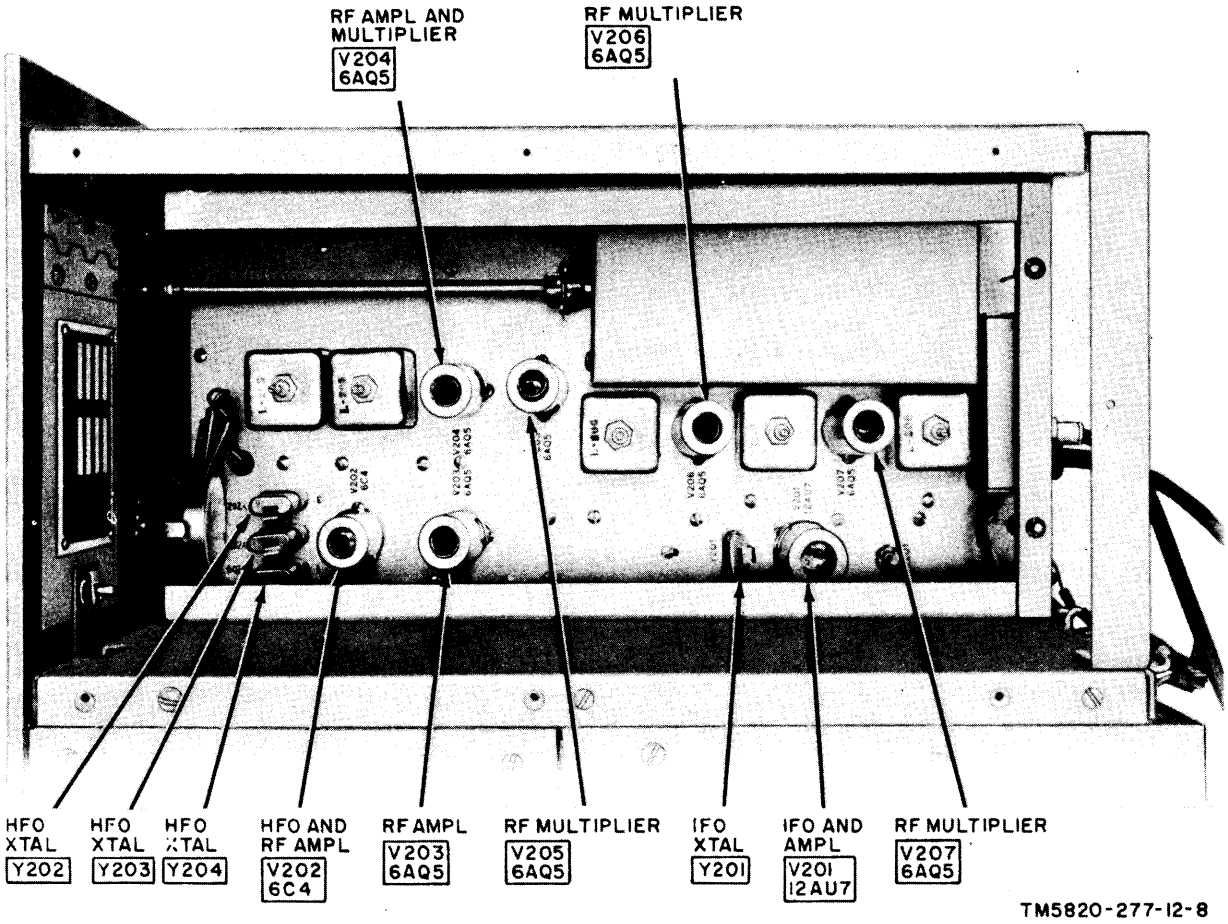


Figure 41. Oscillator, Radio Frequency O-330B/FR, tube location, rf multiplier chassis.

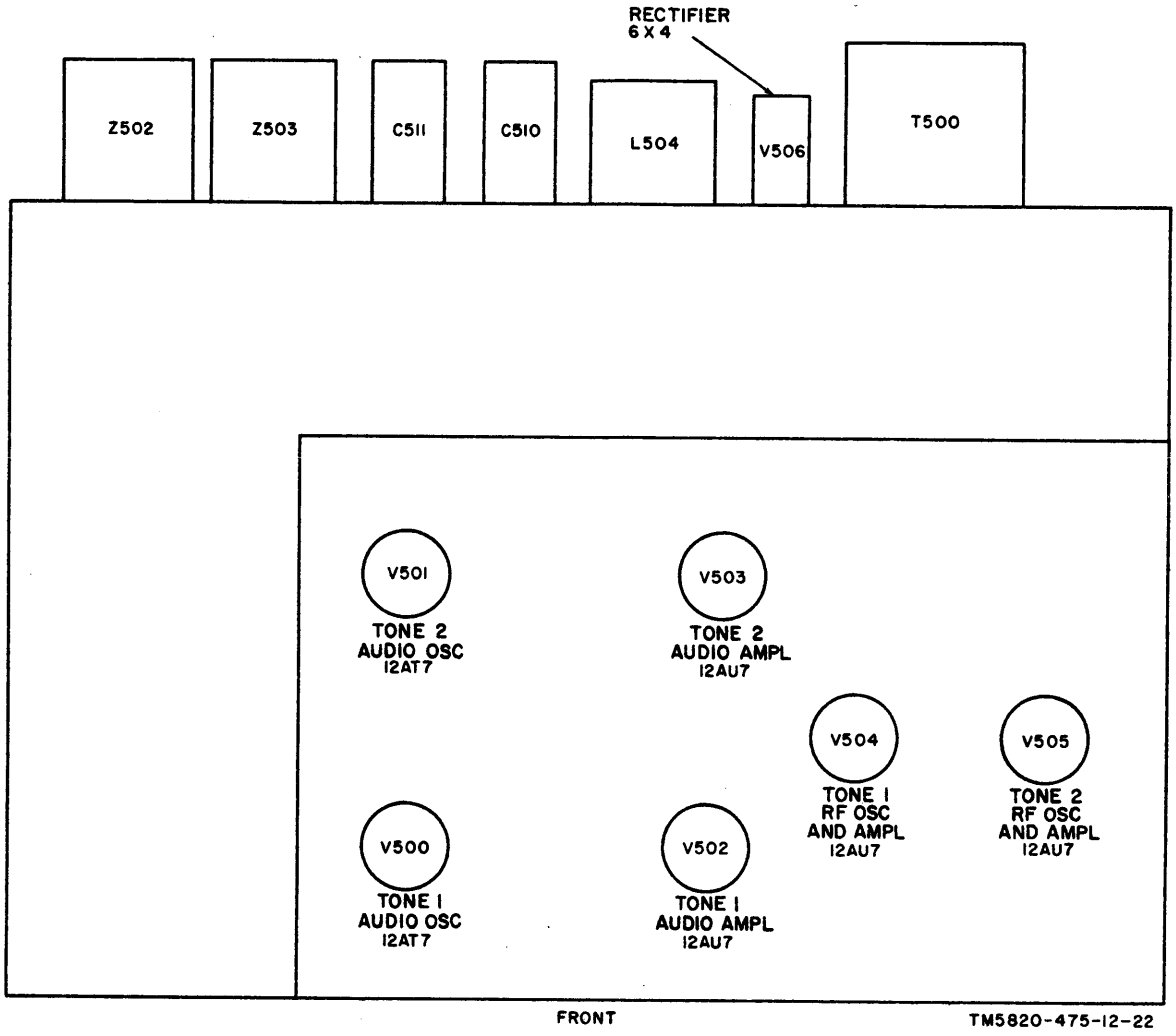


Figure 42. Two-tone generator, tube location.

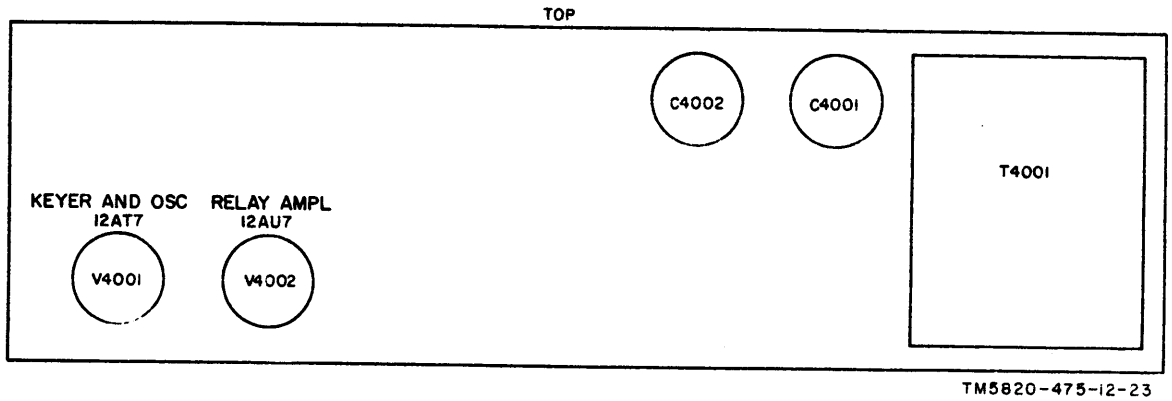


Figure 43. Isolation keyer, tube location.

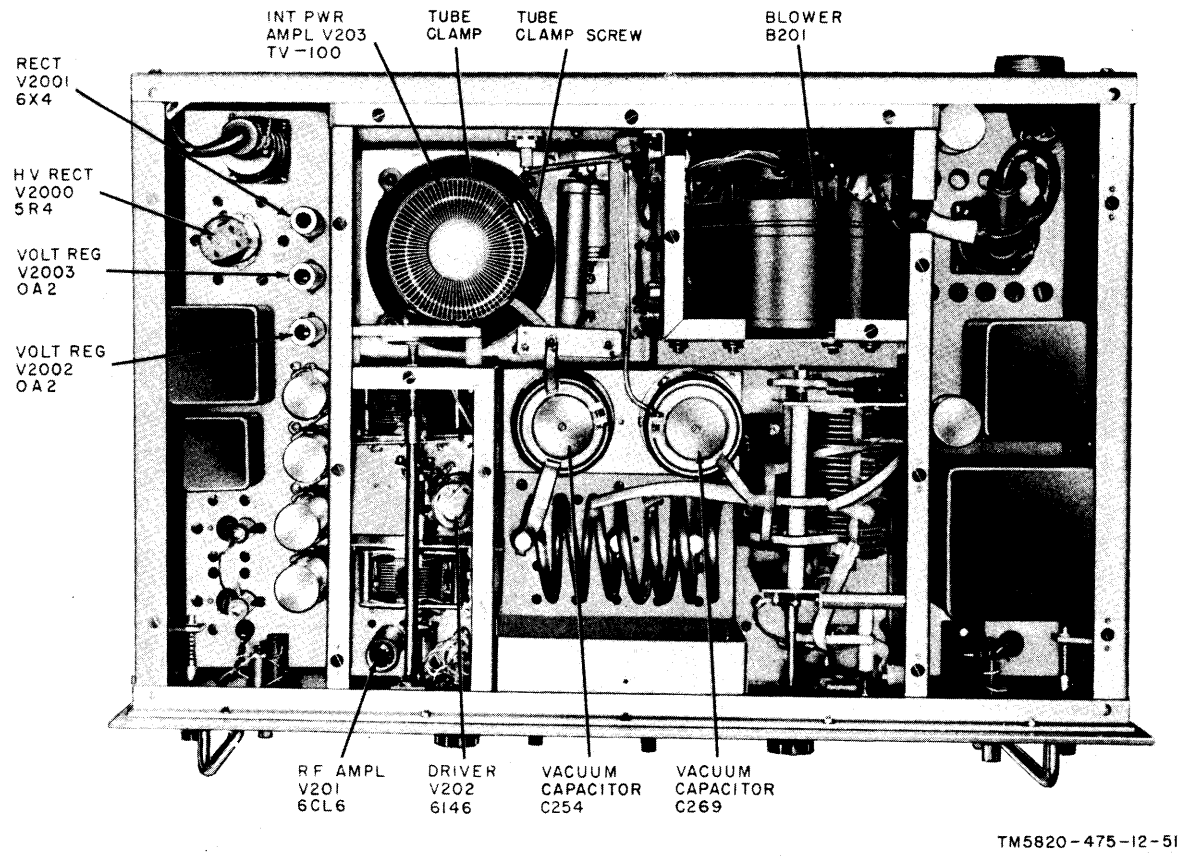


Figure 44. Rf amplifier, tube location.

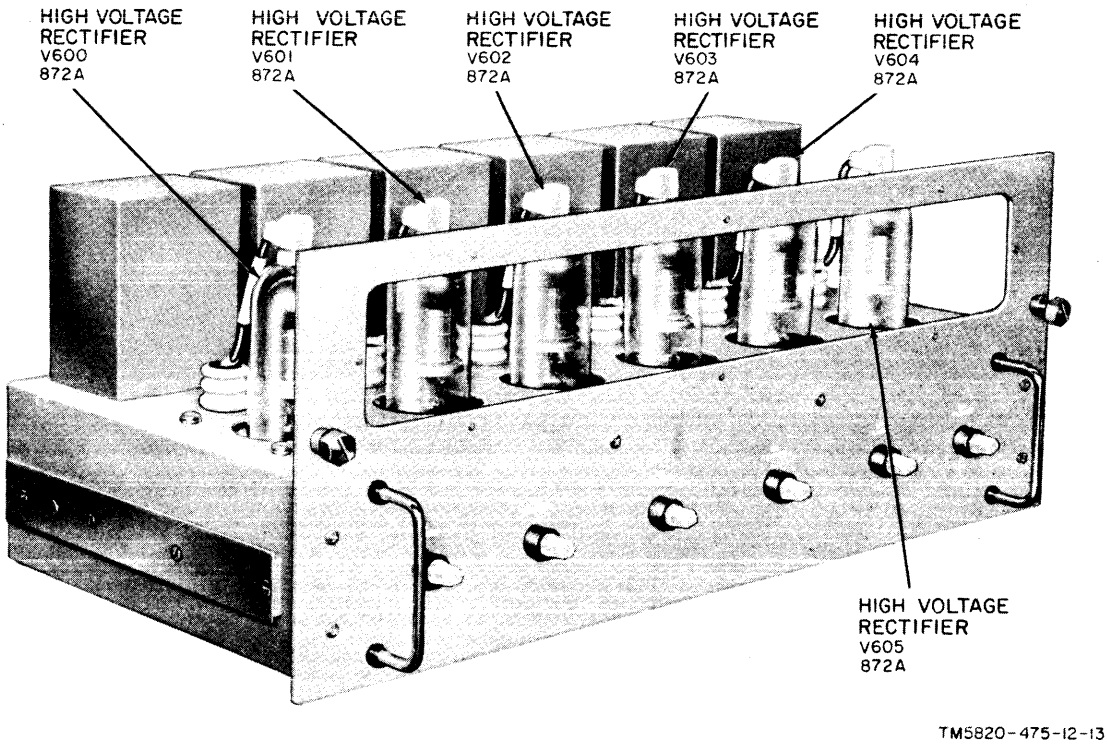
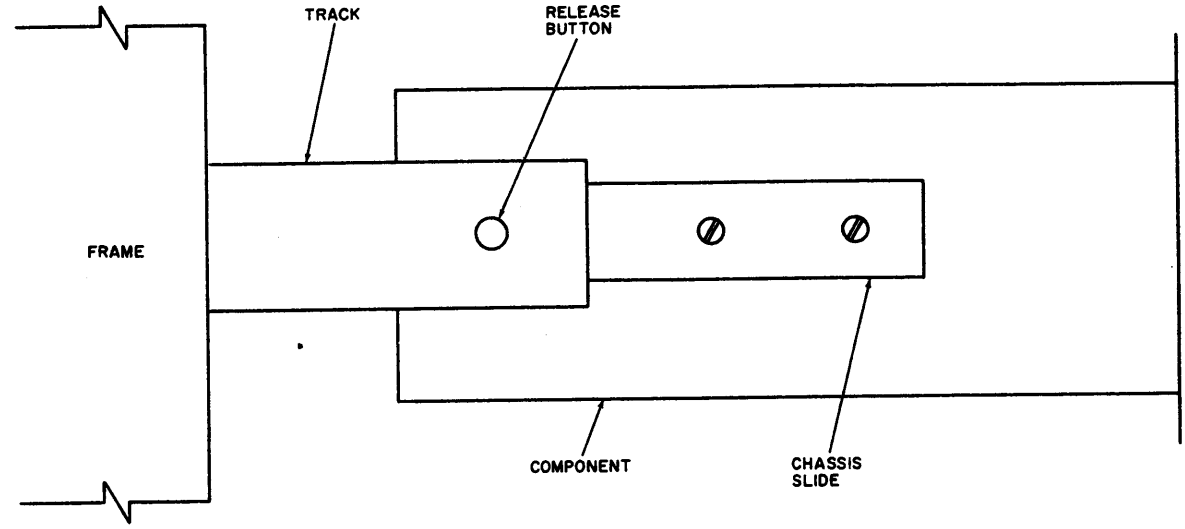
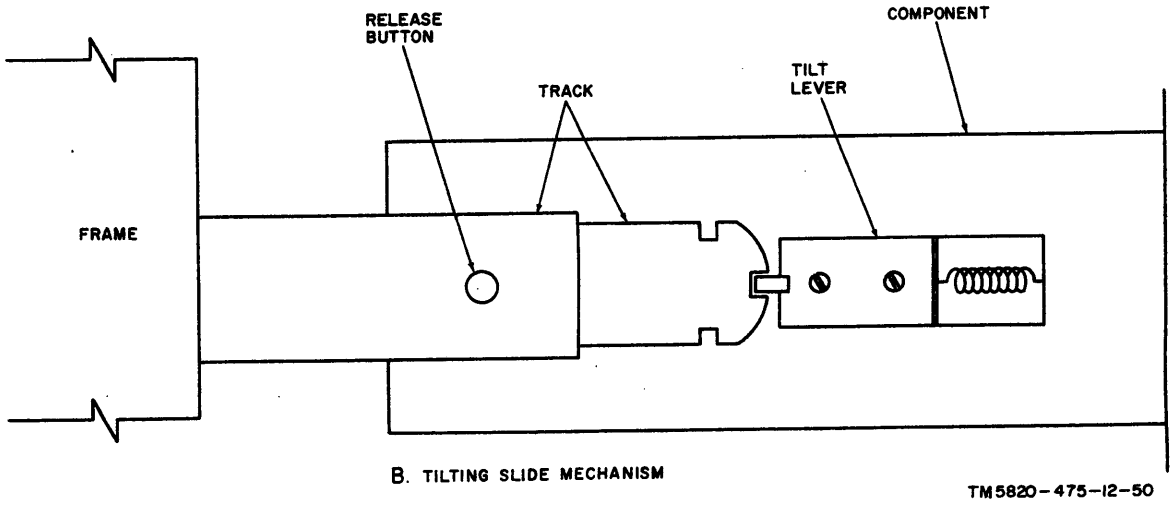


Figure 45. High voltage rectifier, tube location.



A. NON-TILTING SLIDE MECHANISM



B. TILTING SLIDE MECHANISM

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Figure 46. Slide details.

CHAPTER 4
THEORY

73. Signal Flow
(fig. 47)

a. Four different types of input signals can be processed and transmitted by the AN/FRT-52; a microphone input from an external microphone, audio signals from an external telephone set (line 2 audio), cw keying signals from an external telegraph key, and frequency shifted signals from external teletypewriter equipment through frequency shift tone keyers (line 1 audio). Frequency shift tone keyers convert the dc output of the teletypewriter equipment to frequency shifted signals. These frequency shifted signals appear at the input to the AN/FRT-52 as normal audio signals.

b. All of the input signals are routed to the sideband exciter assembly as follows:

(1) The external microphone is connected directly to the sideband exciter assembly, the frequency shifted and telephone signals are applied to the channel 1 and channel 2 inputs of the sideband exciter assembly through line 1 and line 2 audio inputs, respectively, of the AN/FRT-52, and the monitor control panel.

(2) Keying signals are routed from the external telegraph key to the isolation keyer through the monitor control panel.

(3) The keyed signals from the isolation keyer are applied through the monitor control panel to the key line input terminals of the sideband exciter assembly.

c. The sideband exciter assembly sets the mode of operation of the AN/FRT-52 and also controls the degree of carrier insertion. For ssb operation, one of three audio signals is used to modulate the carrier; one sideband (and the carrier, if desired) is then suppressed by the sideband exciter assembly. Dsb operation is identical with single sideband operation, except that both sidebands containing the same intelligence are transmitted. Conventional am. operation is identical with dsb operation, except that the carrier is not suppressed. For isb operation, any two of three audio inputs are used to modulate the carrier; one audio signal is placed on the upper sideband while the second audio signal is placed on the lower sideband. For cw operation, the keyed signals applied to the sideband exciter assembly from the isolation keyer controls the operation of the sideband exciter assembly. When the external telegraph key is open, the sideband exciter assembly is disabled. When the telegraph key is closed, the sideband exciter assembly operates normally.

d. The correct carrier frequency of the sideband exciter assembly is generated by heterodyning a highly stable signal from the O-330B/FR No. 1 with a carrier signal generated within the sideband exciter assembly. The signal from the O-330B/FR No. 1 is applied to the sideband exciter assembly through the monitor control panel.

e. The output level of the sideband exciter assembly is amplified by the rf amplifier and the power amplifier. The rf amplifier and power amplifier raise the rf signal level to 10 kilowatts.

74. Test and Monitoring Facilities
(fig. 47)

a. Two units are used for monitoring the signal at various stages in the path of transmission. The sideband monitor measures the upper and lower sideband levels of the sideband exciter assembly output. The spectrum analyzer displays the carrier (if it is not suppressed), the transmitted sidebands, and the associated distortion products of the signal applied to it. The outputs of the sideband exciter assembly (rf monitor), the rf amplifier (ipa monitor), and the power amplifier

(pa monitor) are applied to a selector switch in the monitor control panel. The selected signal is applied to the spectrum analyzer. An external signal from O-330B/FR No. 2 (vmo output) is used in conjunction with the spectrum analyzer to provide the proper operating frequency.

b. In addition to checking the signal at one of three points in the transmission path, it is also possible to check the internal distortion of the spectrum analyzer or of the AN/FRT-52 transmitting circuits proper (*c* below). To check the internal distortion of the spectrum analyzer, an rf test signal from the two-tone generator is routed to the spectrum analyzer through the monitor control panel. The signal is then displayed and the distortion products measured.

c. To measure the distortion products of the AN/FRT-52, a two-tone test is used. In this test, a two-tone audio signal from the two-tone generator is simultaneously applied to the channel 1 and channel 2 inputs of the sideband exciter assembly instead of the external modulating signals. By monitoring the output of the sideband exciter assembly, the rf amplifier, and the power amplifier, the distortion products at different stages in the path of transmission can be determined.

75. B+ Distributi n
(fig. 47)

B+ for the operation of the rf amplifier and power amplifier is generated by the high voltage rectifier. The 220-volt, three-phase input from an external power source is simultaneously applied to the main power panel and relay panel. When all relays in the relay panel are properly set (indicating no overloads and proper circuit conditions), an *enable* signal is applied to the power control circuits. The enable signal energizes the power control circuits, which in turn, apply the 220-volt, three-phase input voltage to the high voltage rectifier. The output of this unit (7,500 volts dc) is applied directly to the power amplifier. This voltage is also applied directly to the power amplifier. This voltage is also applied to voltage divider circuits which provide voltages of 3,000 volts, 1,200 volts, and 600 volts. The 3,000 volts is applied to the rf amplifier and either 600 volts or 1,200 volts is applied to the power amplifier through the relay panel.

CHAPTER 5
DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

76. Authority for Demolition

The demolition procedures given in paragraph 78 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon the order of the commander.

77. Destruction Plan

If a destruction plan is not provided by higher authority, one should be prepared by the using organization. Personnel should be assigned specific destruction tasks, but all personnel in the using organzation should be familiar with all aspects of the complete destruction plan. The plan must be adequate and easily carried out in the field and must provide for as complete destruction as available time, equipment, and personnel will permit. Because the time required for complete destruction may not always be available, the destruction plan must establish priorities so that essential parts of the equipment will be destroyed in the order of their importance. Systematic destruction of the same important units of equipment of a given type will prevent the enemy from learning the important features of the equipment or assembling a complete equipment by cannibalization of partially destroyed equipments. Completely destroy identical components of similar equipments in the area (AN/FRT-52, AN/FRT-53, AN/FRT-54) in preference to *partial* destruction of all components. The method of destruction (para 78) to be used depends on time available.

78. Methods of Destruction

The information which follows is for guidance only. Some of the procedures outlined require the use of explosives and incendiary grenades which normally may not be authorized items for the AN/FRT-52. The issue of these and related materiels, and the conditions under which destruction will be effected, are command decisions in each case, according to the tactical situation.

Method	Requirement
Mechanical.....	Axe, pick, mattock, sledge, crowbar, or similar implement.
Burning.....	Gasoline, oil, incendiary grenades, or other flammables.
Demolition.....	Suitable explosives or ammunition.

Before performing destruction by any of the following methods, mechanically smash all front panel meters and indicators.

a. Demolition. Plan for simultaneous detonation, and prepare charges of explosive, TNT. Use 1-pound blocks or equivalent, together with the necessary detonating cord to make up each charge, as indicated below:

Charge	Location of charge
1 pound.....	Open cover of rf amplifier and place the charge next to the tuning mechanism.
1 pound.....	Place charge on right side of O-330B/FR (above the variable master oscillator oven).
1 pound.....	Place 1-pound charges within each of the remaining components.

Connect these charges for simultaneous detonation with detonating cord. Provide for dual priming to minimize the possibility of a misfire. For priming, either a nonelectric blasting cap crimped to at least 5 feet of safety fuse, or an electric blasting cap and firing wire may be used. (The safety fuse burns at the rate of 1 foot in 30 to 45 seconds; test before using.) Safety fuse, which contains black powder, and nonelectric blasting caps must be protected from moisture at all times. The safety fuse is ignited by a fuse light or match before personnel take cover. The electric blasting cap requires a blasting machine or equivalent source of electricity and is fired after personnel take cover.

Caution: **Keep the blasting caps, detonating cord, and safety fuse separated from the charges until required for use.**

Notes:

1. For the successful execution of methods of destruction involving the use of demolition materials, all personnel concerned will be thoroughly familiar with the pertinent provisions of FM 5-25. Training and careful planning are essential. The danger area is approximately 300 yards.
2. Elapsed time: about 10 minutes.
3. If time and means are not available to carry out the above demolition procedure place a hand grenade in the equipment rack through the access door on the front of the high voltage power supply chassis. Smash items not demolished by the grenade, as time permits.

b. Burning. See that instruction manuals and the equipment tuning chart are burned, regardless of other methods of destruction used for other units of the equipment.

(1) Pile wood, rags, and sections of the cable system, on and under the materiel.

(2) Pour gasoline and oil in and over all units of the AN/FRT-52. From a safe distance, ignite the materiel with an incendiary grenade, flame thrower, or use some other suitable means.

Caution: **Be careful when igniting with gasoline; it is highly flammable and its vapors are explosive. Carelessness may result in painful burns.**

Note: Elapsed time: about 5 minutes.

c. Disposal. Burn or scatter the destroyed parts in slit trenches, foxholes, or other holes, or throw them into streams.

APPENDIX I

REFERENCES

Following is a list of references applicable and available to the operator and second echelon maintenance personnel of the AN/FRT-52.

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
FM 5-25	Explosives and Demolitions.
TB SIG 225	Radioactive Electron Tube Handling.
TM 11-5527	Multimeters TS-352/U, TS-352A/U, and TS-352B/U.
TM 11-5820-277-12	Operator and Organizational Maintenance Manual: Oscillators, Radio Frequency O-330A/FR and O-330B/FR.
TM 11-6625-274-12	Operator's and Organizational Maintenance Manual: Test Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U and TV-7D/U.

APPENDIX II
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

1. General

a. This appendix assigns maintenance functions to be performed on components, assemblies, and subassemblies by the lowest appropriate maintenance echelon.

b. Columns in the maintenance allocation chart are as follows:

(1) *Part or component.* This column shows only the nomenclature or standard item name. Additional descriptive data are included only where clarification is necessary to identify the component. Components, assemblies, and subassemblies are listed in top-down order. That is, the assemblies which are part of a component are listed immediately below that component, and the subassemblies which are part of an assembly are listed immediately below that assembly. Each generation breakdown (components, assemblies, or subassemblies) is listed in disassembly order or alphabetical order.

(2) *Maintenance function.* This column indicates the various maintenance functions allocated to the echelons.

(a) *Service.* To clean, to preserve, and to replenish lubricants.

(b) *Adjust.* To regulate periodically to prevent malfunction.

(c) *Inspect.* To verify serviceability and to detect incipient electrical or mechanical failure, by scrutiny.

(d) *Test.* To verify serviceability and to detect incipient electrical or mechanical failure, by use of special equipment such as gages, meters, etc.

(e) *Replace.* To substitute serviceable components, assemblies, or subassemblies, for unserviceable components, assemblies, or subassemblies.

(f) *Repair.* To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This function includes, but is not limited to, welding, grinding, riveting, straightening, and replacement of parts other than the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

(g) *Align.* To adjust two or more components of an electrical system so that their functions are properly synchronized.

(h) *Overhaul.* To restore an item to *completely serviceable* condition as prescribed by serviceability standards developed and published by heads of technical services. This is accomplished through employment of the technique of "Inspect and Repair Only as Necessary" (IROAN). Maximum utilization of diagnostic and test equipment is combined with minimum disassembly of the item during the overhaul process.

(i) *Rebuild.* To restore an item to a standard as near as possible to original or new condition in appearance, performance, and life expectancy. This is accomplished through the maintenance technique of complete disassembly of the item, inspection of all parts or components, repair or replacement of worn or unserviceable elements, using original manufacturing tolerances and/or specifications and subsequent reassembly of the item.

(3) *1st, 2d, 3d, 4th, 5th echelon.* The symbol X indicates the echelon responsible for performing that particular maintenance operation, but does not necessarily indicate that repair parts will be stocked at that level. Echelons higher than the echelon marked by X are authorized to perform the indicated operation.

(4) *Tools required.* This column indicates codes assigned to each individual tool equipment, test equipment, and maintenance equipment referenced. The grouping of the codes in this column of the maintenance allocation chart indicates the tool, test, and maintenance equipment required to perform the maintenance function.

(5) *Remarks.* Entries in this column will be utilized when necessary to clarify any of the data cited in the preceding columns.

c. Columns in the allocation of tools for maintenance functions chart are as follows:

(1) *Tools required for maintenance functions.* The column lists tools, test, and maintenance equipment required to perform the maintenance functions.

(2) *1st, 2d, 3d, 4th, 5th echelon.* The dagger (†) symbol indicates the echelons normally allocated the facility.

(3) *Tool code.* This column lists the tool code assigned.

2. Maintenance by Using Organizations

When this equipment is used by signal service organizations organic to theater headquarters or communications zones to provide theater communications, those maintenance functions allocated up to and including fourth echelon are authorized to the organization operating this equipment.

Section II. MAINTENANCE ALLOCATION CHART

PART OR COMPONENT	MAINTENANCE FUNCTION	1ST ECH	2D ECH	3D ECH	4TH ECH	5TH ECH	TOOLS REQUIRED	REMARKS
TRANSMITTING SET, RADIO GPT-10K-T5 (AN/FRT-52)	service adjust inspect test replace repair align rebuild		X X X X X	 X	 X	 X	None 2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16, 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 17, 18	Preventive maintenanc
AUXILIARY PANEL APP-1	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4–10, 12, 13, 14, 16, 17, 18	
CABINET, ELECTRICAL EQUIPMENT X-262	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
ANTENNA TUNER, POWER AMPLIFIER AT-100	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
AUXILIARY FRAME AX-180	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
AUXILIARY FRAME AX-181	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
AUXILIARY FRAME AX-264	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18	
BANDSWITCH ASSEMBLY AS-119	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
CABINET AND ENCLOSURES AX-227	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
CHASSIS ASSEMBLY AX-104	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
DRIVER, R. F. AMPLIFIER RFC-1	r place r pair r build		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	

HIGH VOLTAGE RECTIFIER AX-103	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
MAIN FRAME AX-182	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
MAIN FRAME, ASSEMBLY AX-186	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
MAIN POWER PANEL AX-113	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
MAIN POWER SUPPLY AX-138	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
METER BOX ASSEMBLY AX-173	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
METER BOX, AUXILIARY FRAME AX-107	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
MONITOR CONTROL PANEL SIM-2	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
POWER AMPLIFIER SECTION AX-236	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 17, 18	
RELAY PANEL AX-139	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
CABLE ASSEMBLY GROUP	replace		X					
EXCITER, SINGLE SIDEBAND SBE-3	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
OSCILLATOR, RADIO FREQUENCY AO-101	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
POWER SUPPLY A-1397	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
MONITOR CONTROL PANEL MCP-2	replace repair rebuild		X	X		X	2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
OSCILLATOR, RADIO FREQUENCY O-330/FR, O-330A/FR, and O-330B/FR	replace repair rebuild		X	X		X		Separate MAC TM 11-5820-277-20

PART OR COMPONENT	MAINTENANCE FUNCTION	1ST ECH	2D ECH	3D ECH	4TH ECH	5TH ECH	TOOLS REQUIRED	REMARKS
SPECTRUM ANALYZER FSA-2	r place		X					
	repair			X			2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16	
	rebuild					X	1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
POWER SUPPLY PS-2	replace		X					
	repair			X			2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16	
	rebuild					X	1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
SPECTRUM SA-2	replace		X					
	repair			X			2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16	
	rebuild					X	1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	
TEST GENERATOR TTG-2	replace		X					
	repair			X			2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16	
	rebuild					X	1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18	

Section III. ALLOCATION OF TOOLS FOR MAINTENANCE FUNCTIONS

TOOLS REQUIRED FOR MAINTENANCE FUNCTIONS	1ST ECH	2D ECH	3D ECH	4TH ECH	5TH ECH	TOOL CODE	REMARKS
Analyzer, Spectrum TS-723/U	-----	-----		†	†	1	MAC[a]
Audio Oscillator TS-382/U	-----	-----	†	†	†	2	
Frequency Meter AN/URM-32	-----	-----	†			3	
Frequency Meter AN/URM-79	-----	-----		†	†	4	
Frequency Meter AN/URM-80	-----	-----		†	†	5	
Frequency Meter AN/USM-26	-----	-----		†	†	6	
Headset HS-33A[a]	-----	-----	†	†	†	7	
Multimeter TS-352/U	-----	-----	†	†	†	8	
Multimeter, Meter ME-26/U	-----	-----	†	†	†	9	
Oscilloscope OS-8/U	-----	-----	†	†	†	10	
Power Supply PP-1243/U	-----	-----	†			11	
RF Signal Generator AN/URM-25	-----	-----	†	†	†	12	
Square Wave Generator SG-299/U	-----	-----	†	†	†	13	
Test Set, Electron Tube TV-2/U	-----	-----			†	14	
Test Set, Electron Tube TV-7/U	-----	-----	†	†		15	
Tool Kit TK-87/U	-----	-----	†	†	†	16	
Tool Kit TK-88/U	-----	-----		†	†	17	
Voltmeter, Meter ME-30/U	-----	-----		†	†	18	

[a] To be provided as shop support.

INDEX

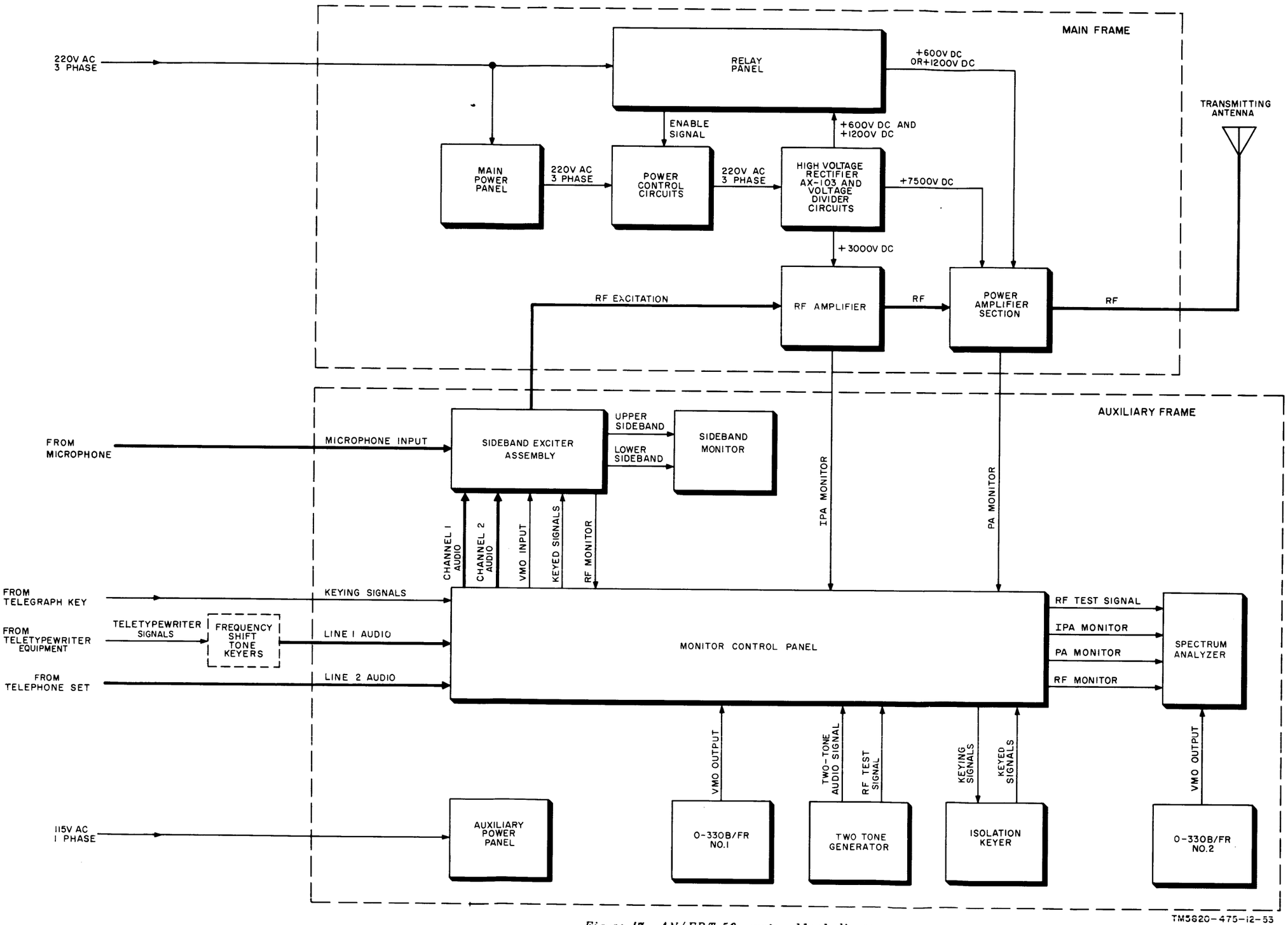
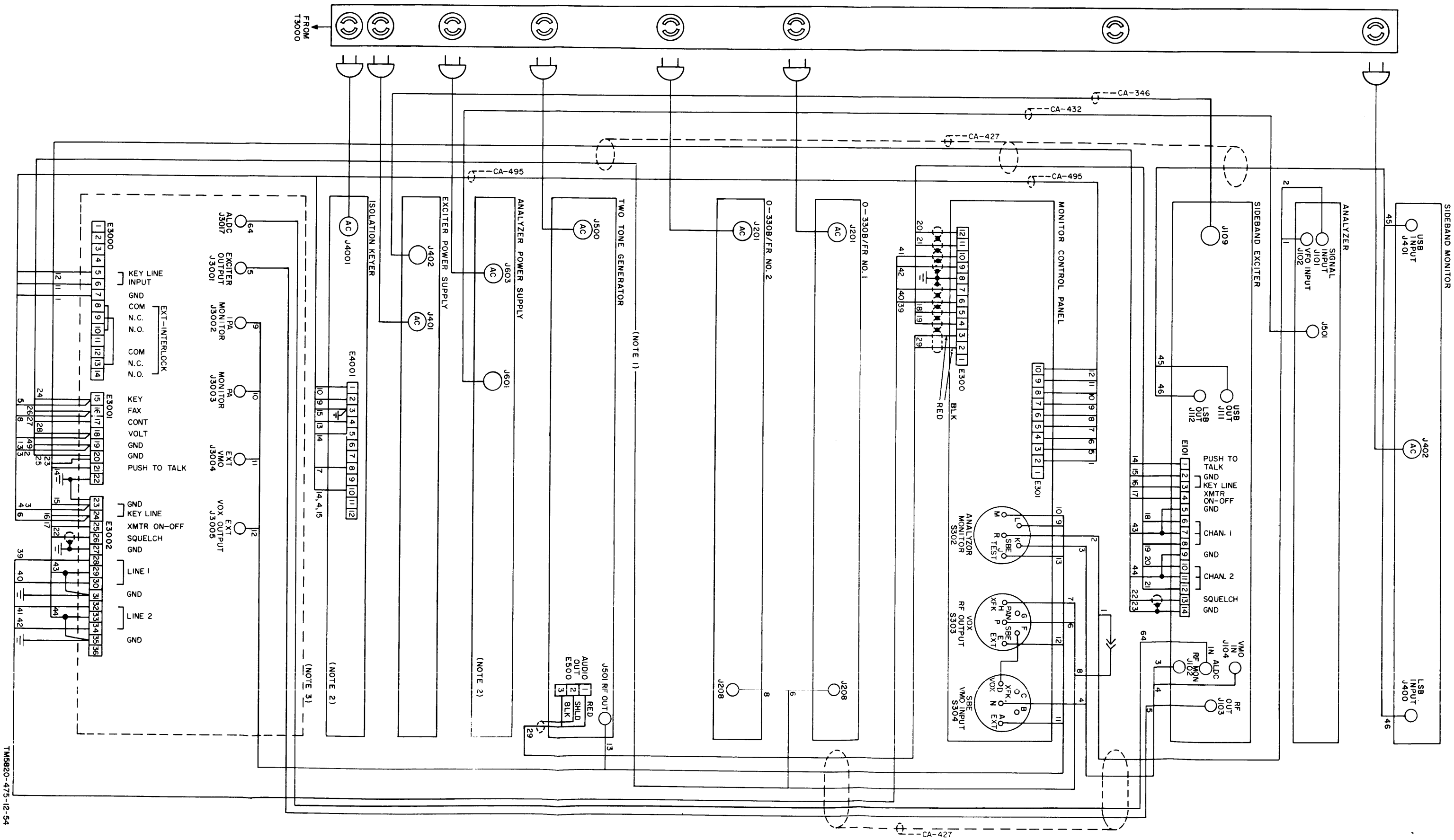


Figure 47. AN/FRT-52, system block diagram.

Figure 48. Auxiliary frame connection diagram.



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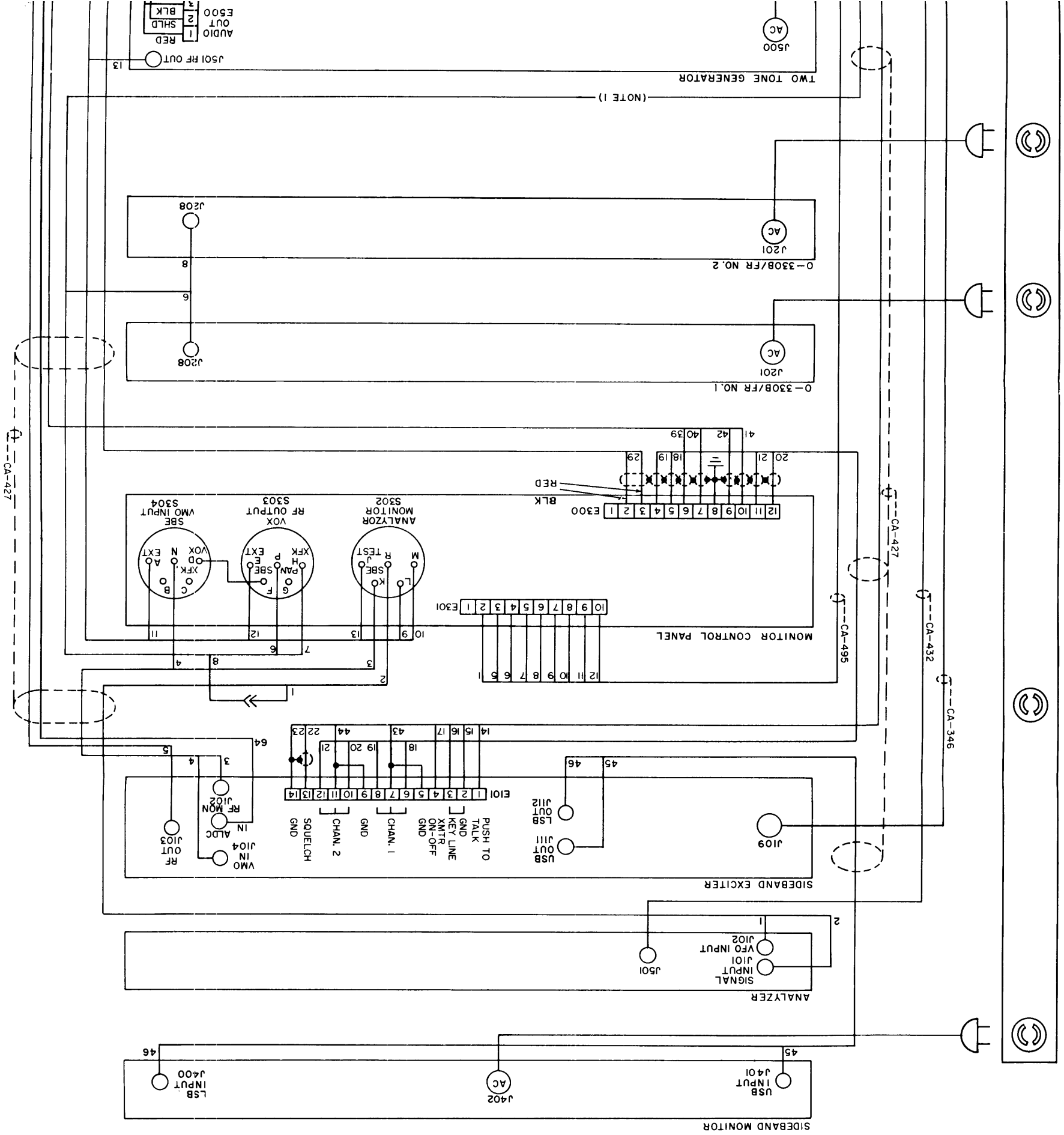

Figure 48. Auxiliary frame connection diagram.

NOTES:

1. WIRES 7,24,25,26,27,28, AND 49 ARE NOT USED BUT ARE PART OF CABLE CA-427 AND ARE TAPED AND LACED TO THE CABLE.
2. THESE UNITS ARE MOUNTED AT THE REAR OF THE AUXILIARY FRAME.
3. THIS PANEL IS LOCATED AT THE REAR OF THE AUXILIARY FRAME.
4. LIKE NUMBERS IDENTIFY EACH END OF THE SAME WIRE WITHIN A CABLE.

NOTES:

1. WIRES 7,24,25,26,27,28, AND 49 ARE NOT USED BUT ARE PART OF CABLE CA-427 AND ARE

By Order of Secretary of the Army:

G. H. DECKER,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

DASA (6)
USASA (2)
CNGB (1)
Tech Stf, DA (1) except
CSigO (18)
Tech Stf Bd (1)
USCONARC (5)
USAARTYBD (1)
USAARMBD (2)
USAIB (1)
USARADBD (2)
USAAVNBD (1)
USABELCTBD (1)
USAATBD (1)
ARADCOM (2)
ARADCOM Rgn (2)
OS Maj Comd (3)
OS Base Comd (2)
LOGCOMD (2)
MDW (1)
Armies (2)
Corps (2)
Instl (2)
Ft Monmouth (63)
USATC AD (2)
USATC Armor (2)
USATC Engr (2)
USATC Inf (2)
USATC FA (2)
USAOMC (3)
Svc College (2)
Br Svc Sch (2)
GENDEP (2) except
Atlanta GENDEP (None)
Sig Sec, GENDEP (5)
Sig Dep (12)
WRAMC (1)
USA Trans Tml Comd (1)
Army Tml (1)
POE (1)
OSA (1)
USAEPG (2)
AFIP (1)
AMS (1)
Army Pictorial Cen (2)
EMC (1)
Yuma Test Sta (2)
USACA (3)
USASSA (20)
USASSAMRO (1)
USASEA (1)
USA Carib Sig Agcy (1)
USA Sig Msl Spt Agcy (13)
Sig Fld Maint Shops (3)
USA Corps (3)
AFSSC (1)
JBUSMC (2)
Units org under fol TOE:
2 copies each UNOINDC:
11-7
11-16
11-57
11-98
11-117
11-155
11-157
11-500 (AA-AE) (4)
11-557
11-587
11-592
11-597

NG: None.
USAR: None.
For explanation of abbreviations used, see AR 320-50.