OPERATOR'S MANUAL

for

SYNTHESIZED GPT-40K TRANSMITTER

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, CANADA

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NOTICE

THE TECHNICAL MATERIEL CORPORATION
COMMUNICATIONS ENGINEERS
700 FENIMORE ROAD MAMARONECK, N. Y.

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The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment (except electron tubes*, fuses, lamps, batteries and articles made of glass or other fragile or other expendable materials) purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purposes for which the same is designed, for a period of one year from the date of delivery F.O.B. factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

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4. That any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

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Should it be necessary to return equipment or material for repair or replacement, whether within warranty or otherwise, a return authorization must be obtained from TMC prior to shipment. The request for return authorization should include the following information:

1. Model Number of Equipment.
2. Serial Number of Equipment.
3. TMC Part Number.
4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

PROCEDURE FOR ORDERING REPLACEMENT PARTS

When ordering replacement parts, the following information must be included in the order as applicable:

1. Quantity Required.
2. TMC Part Number.
3. Equipment in which used by TMC or Military Model Number.
4. Brief Description of the Item.
5. The *Crystal Frequency* if the order includes crystals.

PROCEDURE IN THE EVENT OF DAMAGE INCURRED IN SHIPMENT

TMC's Warranty specifically excludes damage incurred in shipment to or from the factory. In the event equipment is received in damaged condition, the carrier should be notified immediately. Claims for such damage should be filed with the carrier involved and not with TMC.

All correspondence pertaining to Warranty Claims, return, repair, or replacement and all material or equipment returned for repair or replacement, within Warranty or otherwise, should be addressed as follows:

THE TECHNICAL MATERIEL CORPORATION
Engineering Services Department
700 Fenimore Road
Mamaroneck, New York

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By

TABLE OF CONTENTS

Paragraph		Page
	SECTION 1 — GENERAL INFORMATION	
1-1	Purpose of Equipment	1-1
1-2	Block Diagram Analysis	1-1
	SECTION 2 — OPERATING CONTROLS	
	SECTION 3 — OPERATING PROCEDURES	
3-1	Introduction	3-1
3-2	Preliminary Procedure	3-1
3-3	Starting Procedure	3-1
3-4	Considerations in Tuning Transmitter	3-2
3-5	Exciter Tune-up on Carrier	3-3
3-6	Tune-up of 1-kw IPA, 10-kw PA, and 40-kw PA on Carrier	3-4
3-7	Set-up of Tone Intelligence Unit TIS	3-11
3-8	Single Sideband Operation	3-12
3-9	Double Sideband Operation	3-13
3-10	Independent Sideband Operation	3-13
3-11	CW Operation	3-14
3-12	Emergency Operation	3-14
3-13	10-KW Emergency Operation	3-14
3-14	1-KW Emergency Operation	3-15
3-15	Stopping Procedures	3-15
3-16	Operator's Maintenance	3-16
	SECTION 4 — SUPPLEMENTARY DATA	
4-1	Introduction	4-1
4-2	Calculation of Maximum Antenna Current	4-1
4-3	Two-tone Testing	4-1

LIST OF ILLUSTRATIONS

Figure		Page
	SECTION 1 — GENERAL INFORMATION	
1-1	GPT-40K Transmitter, Front View	1-0
1-2	Transmitter Block Diagram	1-3/1-4
	SECTION 2 — OPERATING CONTROLS	
2-1	Synthesized Exciter, Operating Controls and Indicators	2-13/2-14
2-2	Main Frame, Operating Controls and Indicators	2-15/2-16
2-3	PA Frame, Operating Controls and Indicators	2-17/2-18
2-4	PS Frame, Operating Controls and Indicators	2-19/2-20
	SECTION 4 — SUPPLEMENTARY DATA	
4-1	Odd Order Distortion Product Distribution	4-2
4-2	Two-tone Spectrum Analyzer Patterns (Example 1)	4-3
4-3	Transmitter Output Patterns (Example 2)	4-5
4-4	Two-tone Oscilloscope Pattern	4-6

LIST OF TABLES

Table		Page
	SECTION 2 — OPERATING CONTROLS	
2-1	Auxiliary Frame, Operating Controls and Indicators	2-1
2-2	Main Frame, Operating Controls and Indicators	2-4
2-3	PA Frame, Operating Controls and Indicators	2-8
2-4	PS Frame, Operating Controls and Indicators	2-10
	SECTION 3 — OPERATING PROCEDURES	
3-1	Transmitter Tuning Chart, Balanced Operation	3-6
3-2	Transmitter Tuning Chart, Unbalanced Operation	3-7
3-3	Auxiliary and Main Frame, Fuse Locations and Functions .	3-16
3-4	PA and PS Frames, Fuse Locations and Functions .	3-17/3-18

FOREWORD

This manual presents complete procedures for operating the synthesized GPT-40K transmitter. For system data and maintenance instructions for the four frames of the transmitter, refer to the following TMC publications:

ITEM	PUBLICATION
Overall System Description of Synthesized Transmitter	Synthesized GPT-40K Transmitter, System Description
Maintenance of Synthesized Exciter	Technical Manual for Synthesized Exciter
Maintenance of Main Frame	Maintenance Manual for GPT-10K Transmitter
Maintenance of PA and PS Frames	Maintenance Manual for GPT-40K Transmitter

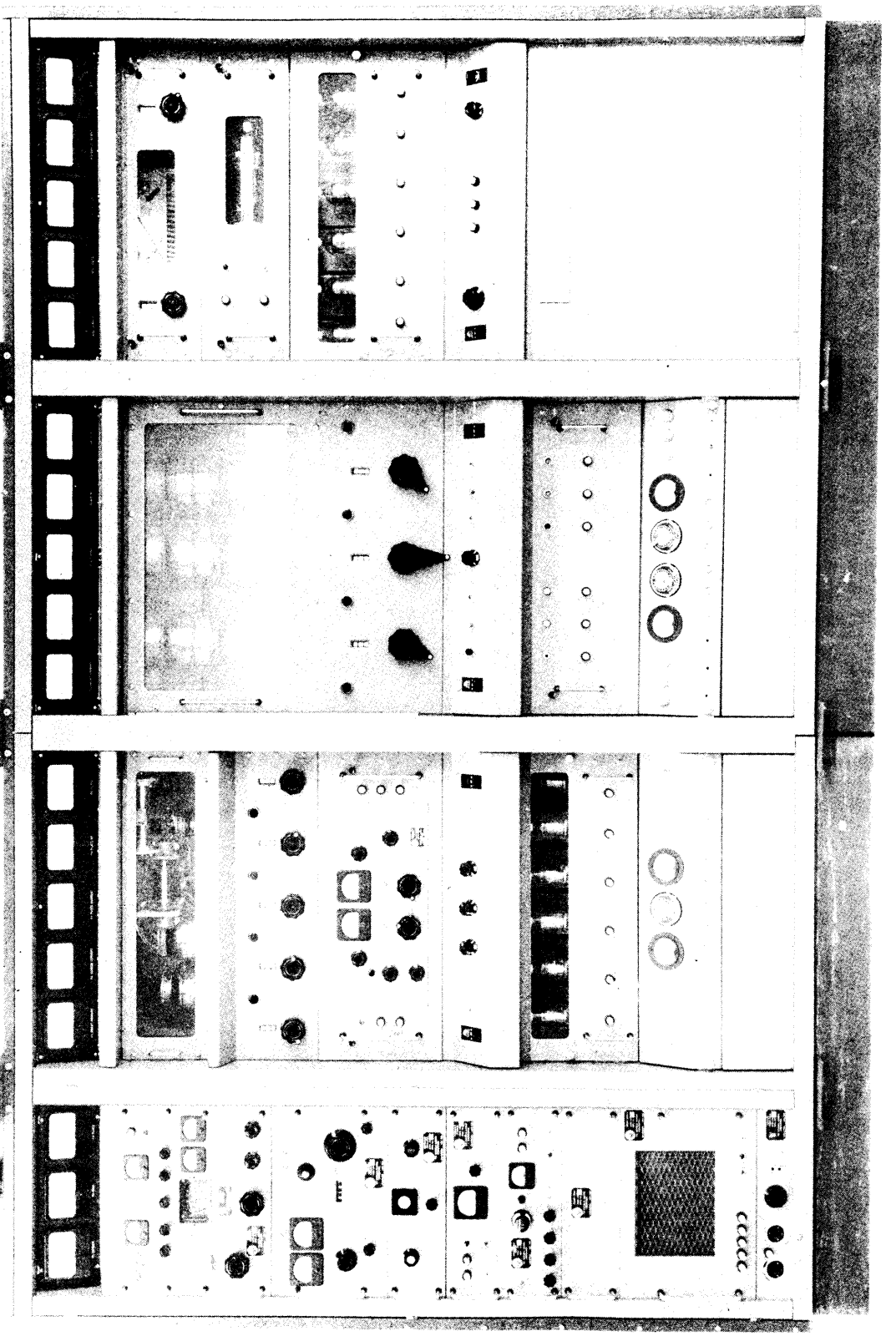


Figure 1-1. GPT-40K Transmitter, Front View

SECTION 1
GENERAL INFORMATION

1-1. PURPOSE OF EQUIPMENT.

The GPT-40K Synthesized Transmitter (figure 1-1) is a conservatively-rated general purpose transmitter that delivers 40,000 watts PEP (peak envelope power), throughout the 2- to 28-mc range. The transmitter provides several types of operating modes:

(1) SSB (single sideband) with suppressed or any degree of carrier.

(2) DSB (double sideband) with suppressed or any degree of carrier. (This mode includes AME (AM equivalent) operation.)

(3) ISB (independent sideband with separate intelligence on each sideband) with suppressed or any degree of carrier.

(4) FSK (frequency-shift telegraphy).

(5) CW (carrier wave) keying.

(6) FAX (facsimile).

1-2. BLOCK DIAGRAM ANALYSIS. (See figure 1-2.)

a. GENERAL. - The synthesized transmitter consists of a synthesized exciter, a 1-kw IPA (intermediate power amplifier), a 10-kw PA (power amplifier), a 40-kw PA, and associated power supply and power control circuits. The transmitter delivers 40,000 watts PEP throughout its operating range. The exciter generates 1 watt (PEP) rf in the range of 1.75 to 33.75 mc, with the signal frequency-locked to an accuracy of 1 part in 10^8 (10^9 when using CSS-2) when operating at any 100-cycle increment within this range. The 1-kw IPA, 10-kw PA, and 40-kw PA stages are tuned to the 2- to 28-mc range, limiting the transmitter output frequencies to this range.

The exciter circuits provide a large variety of operating modes and types of sideband intelligence. The circuits can be set up for single sideband, double sideband, independent sideband or keyed CW. Operating with appropriate terminal equipment, either or both sidebands may carry FSK, FAX, or audio line intelligence.

b. EXCITER. - The exciter consists of Sideband Generator SBG in combination with Tone Intelligence Unit TIS. All exciter circuits are located in the auxiliary frame.

(1) Primary Standard CSS. - The CSS generates the 1-mc signal that is the heart of the sideband generator. The CSS-1B provides 1-mc with a frequency stability of 1 part in 10^8 per day; the CSS-2 provides increased stability of 1 part in 10^9 per day. In either case, the 1-mc signal is applied to frequency amplifier CHG.

The CHG also contains a 1-mc oscillator with frequency stability of one part in 10^6 that is included only for emergency use. During normal operation, the 1-mc standard signal from the CSS is amplified, then routed through a switch in the CHG to Divider Chain CHL.

(2) Divider Chain CHL. - In the CHL, the standard 1-mc signal is divided to provide outputs at 500 kc, 10 kc, 1 kc, and 100 cps. These signals, locked to the standard, are applied to Controlled Oscillator CLL.

(3) Controlled Oscillator CLL. - Equipped with three frequency synthesizer loops, the CLL uses the four outputs of the CHL to produce a synthesized output that is variable from 510.0 to 519.9 kc in 100-cycle increments. Each of the 100 discrete synthesized frequencies provided by the CLL is frequency-locked to the 1-mc standard to maintain frequency stability. The 510.0- to 519.9 kc output of the CLL is applied to Controlled Master Oscillator CMO.

(4) Controlled Master Oscillator CMO. - The CMO receives the selected 510.0- to 519.9-kc output of the CLL and the 10-kc output of the CHL. The CMO contains a precision-designed variable frequency oscillator (VFO) which is operable through the 1.75- to 3.75-mc range. With the CMO CAL/OPERATE switch at CAL, 100 kc crystal oscillator in the CMO is used to calibrate the VFO at any desired 100 kc check point in the 1.75- to 3.75-mc range. After calibration, the CAL/OPERATE switch is set at OPERATE. This causes the selected 510.0 to 519.9 kc input signal and the 10 kc input signal to synthesize the VFO at the selected 100 cycle increment within the 1.75 to 3.75 mc selected range.

(5) Tone Intelligence Unit TIS. - The TIS controls the passage of audio channels 1 and 2 to Sideband Exciter CBE. The TIS passes audio line 1 and/or 2 to the audio channel inputs of the CBE, depending on the position of the TIS front panel EXCITER switches. When connected to the appropriate terminal equipment, the TIS converts pulsed FSK signals into frequency-shifted audio mark and space tones, or varying dc FAX input signals to varying audio frequency signals. When CW keying signals are applied, the TIS provides keyed 1000-cycle tones for keyed carrier operation.

(6) Sideband Exciter CBE. - The CBE receives the selected audio input channels from the TIS and a 250-kc frequency-locked subcarrier from Frequency Amplifier CHG. Depending on the setting of the CBE front panel controls, it generates either or both sideband signals with varying degrees of carrier insertion, from -55 DB to 0 DB, at a nominal frequency of 250 kc. The signal may be single sideband, double sideband, or independent sideband

transmission. The sideband signals are routed to the CHG.

(7) Frequency Amplifier CHG. - The CHG frequency-translates the 2- to 4-mc synthesized input from the CMO with the sideband intelligence received from the CBE, providing a sideband output in the range of 1.75 to 33.75 mc, synthesized in 100-cycle steps. This rf output signal, conservatively rated at 1 watt PEP is applied to rf amplifier RFC in the main frame.

(8) Power Supplies. - Power Supply CPP-5 provides all the necessary ac and dc power required by the CHG. Power Supply CPP-2 provides ac and dc power for the CHL, the CMO, and the CLL. The remaining exciter units contain their own power supplies. Primary power is supplied to the exciter units by an autotransformer in the auxiliary frame.

(9) Standing Wave Control Unit SWCU. - The SWCU, rack-mounted at the rear of the auxiliary frame, contains an SWR overload relay, a dc amplifier and a power supply. The SWCU monitors VSWR at the output of the 10-kw PA in the main frame. When excessive VSWR is detected, the overload relay automatically removes high voltage from the transmitter.

c. MAIN FRAME CIRCUITS. - The main frame circuits raise the 1-watt (PEP) rf output signal from the exciter to a level sufficiently high (up to 10-kw PEP) to drive the 40-kw PA. These circuits include the 10-kw high voltage power supply, power controls, and protective relays.

(1) RF Amplifier RFC (1KW IPA). - The RFC consists of two voltage amplifier stages operating class A and a 1-kw IPA that operates class AB1. The linear stages of the RFC raise the nominal 1-watt (PEP) rf output of the exciter to 1-kw (PEP). This signal is applied to the 10-kw PA.

(2) 10-kw PA. - This section contains the 10-kw power amplifier, a linear power amplifier that operates class AB1 to raise the rf level to as high as 10-kw PEP. A sample of 10-kw PA output is routed to the auxiliary power panel where it may be conveniently monitored.

A portion of the 10-kw PA rf output is rectified to obtain a control voltage that is applied to an ALDC (automatic load and drive control) circuit. When the front panel ALDC switch is set at ADJ, the ALDC control voltage is applied to frequency amplifier CHG in the exciter. The ALDC control voltage limits high drive peaks which can be developed during multiple signal transmission and subsequently suppresses unwanted transmission products. The ALDC circuit is functionally similar to an AGC circuit in a receiver.

(3) Main Power Supply, 10-kw High Voltage Rectifier, and Main Power Panel. - The 10-kw high voltage rectifier functions together with the main power panel and main power supply to produce the high dc voltages required by the 1-kw IPA and 10-kw PA.

(4) Main Frame Relay Panel. - The main frame relay panel contains protective circuits that automatically cut off high voltages to the 1-kw IPA and 10-kw PA when preset overload levels are exceeded in these stages. The protective circuits sample the 1-kw IPA and 10-kw PA plate and screen currents, bias supply voltages, and the current in a voltage regulating diode assembly in the main power supply. When any of these currents is excessive, or if a dc voltage is low, the associated protective relay operates and removes high voltage.

d. PA AND PS FRAME CIRCUITS. - The PA and PS frame circuits raise the rf output power of the 10-kw PA to 40-kw PEP. These circuits include the 40-kw high voltage power supply, power controls and protective relays.

High voltage for the 40-kw PA is supplied by the 40-kw high voltage rectifier. The B+ and B- outputs of the 40-kw high voltage rectifier are also connected across circuits in the crowbar drawer. The crowbar drawer, a protective device for the 40-kw PA, detects surges in PA grid current. If a sharp rise in grid current occurs (as a result of arcing), the crowbar drawer shorts B+ of the 40-kw high voltage rectifier to B-, causing MAIN POWER breaker CB8101 to trip. This action removes power from the 4-kw high voltage rectifier.

The 40-kw PA receives a +600-volt regulated bias voltage from the bias supply via the PA frame relay panel. The bias supply contains an unregulated +350-volt supply and electronic circuits associated with the SWR (standing wave ratio) and retune protective circuits. A dc voltage proportional to the rf plate voltage in the 40-kw PA is applied to the retune circuit. A dc voltage proportional to the VSWR of the unbalanced output line is supplied from directional coupler DC7302 to the SWR circuits in the bias supply.

Protective relay circuits are used to remove high voltage from the 40-kw PA when a malfunction occurs in an associated circuit. These protective circuits, contained in the PA frame relay panel, sample bias (+600-volts), VSWR, retune signals, final filament and crowbar filament voltages, and plate and grid currents. If one of these currents is excessive, if a dc voltage is low, or if 40-kw PA is mistuned, an associated relay operates and removes power from the 40-kw high voltage rectifier.

Transformer T8104 is an autotransformer that receives 220-volt 3-phase power from the PA control panel and supplies 230-volts ac (single phase) to the primary windings of filament transformers in the bias supply, crowbar drawer, and the 40-kw PA. The autotransformer also supplies 3-phase 230 volts ac to the filament transformers in the 40-kw high voltage rectifier. The 3-phase 200 volts ac from the power supply control panel is used for operation of the blowers in the PA frame.

The transmitter also contains an interlock circuit that is provided for personnel and equipment safety. Whenever one of these interlocks opens, high voltage circuits are disabled. Interlock circuits are provided for drawers in which voltages greater than 500 volts are present. Important cooling air ducts are also interlocked.

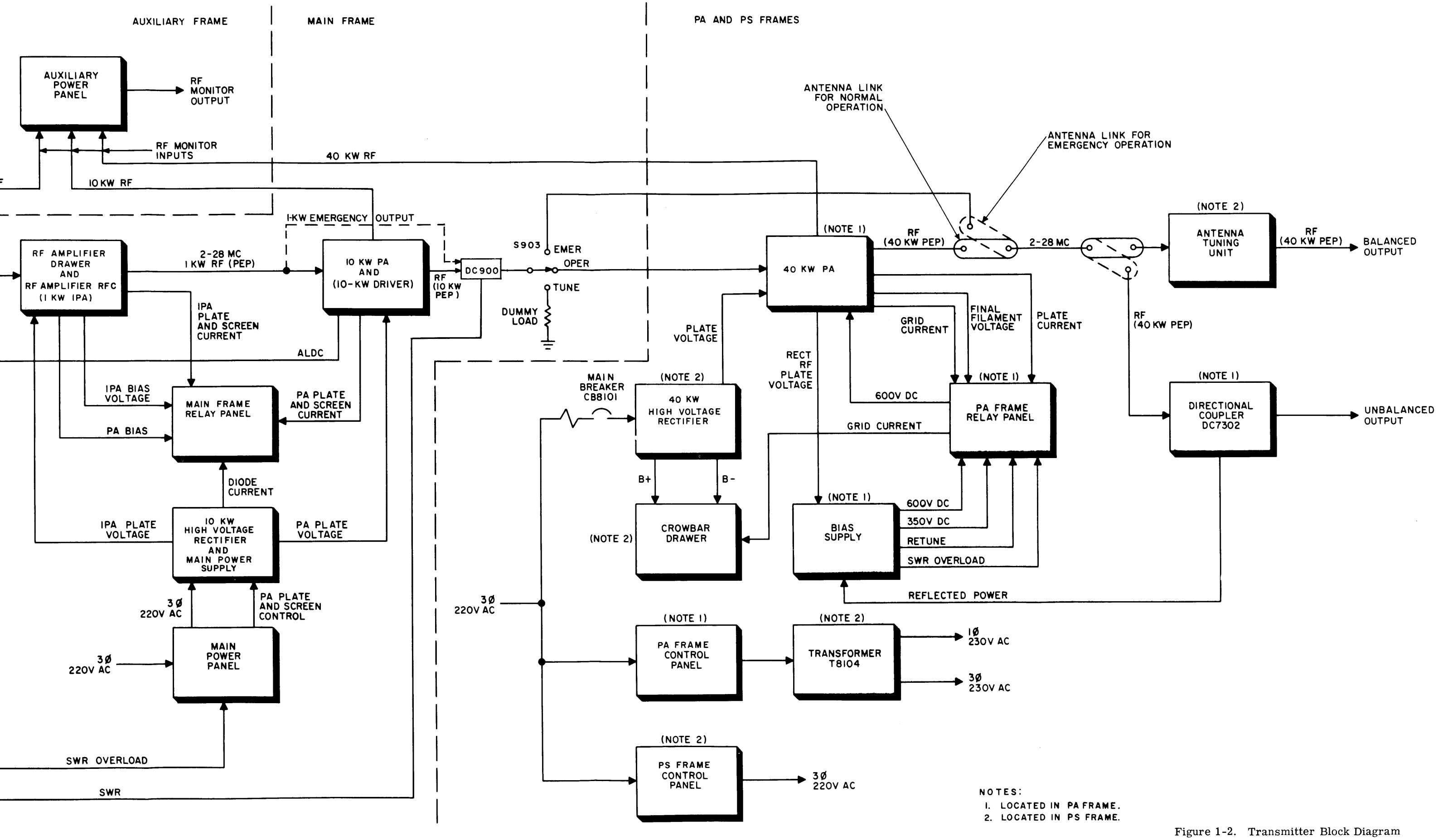
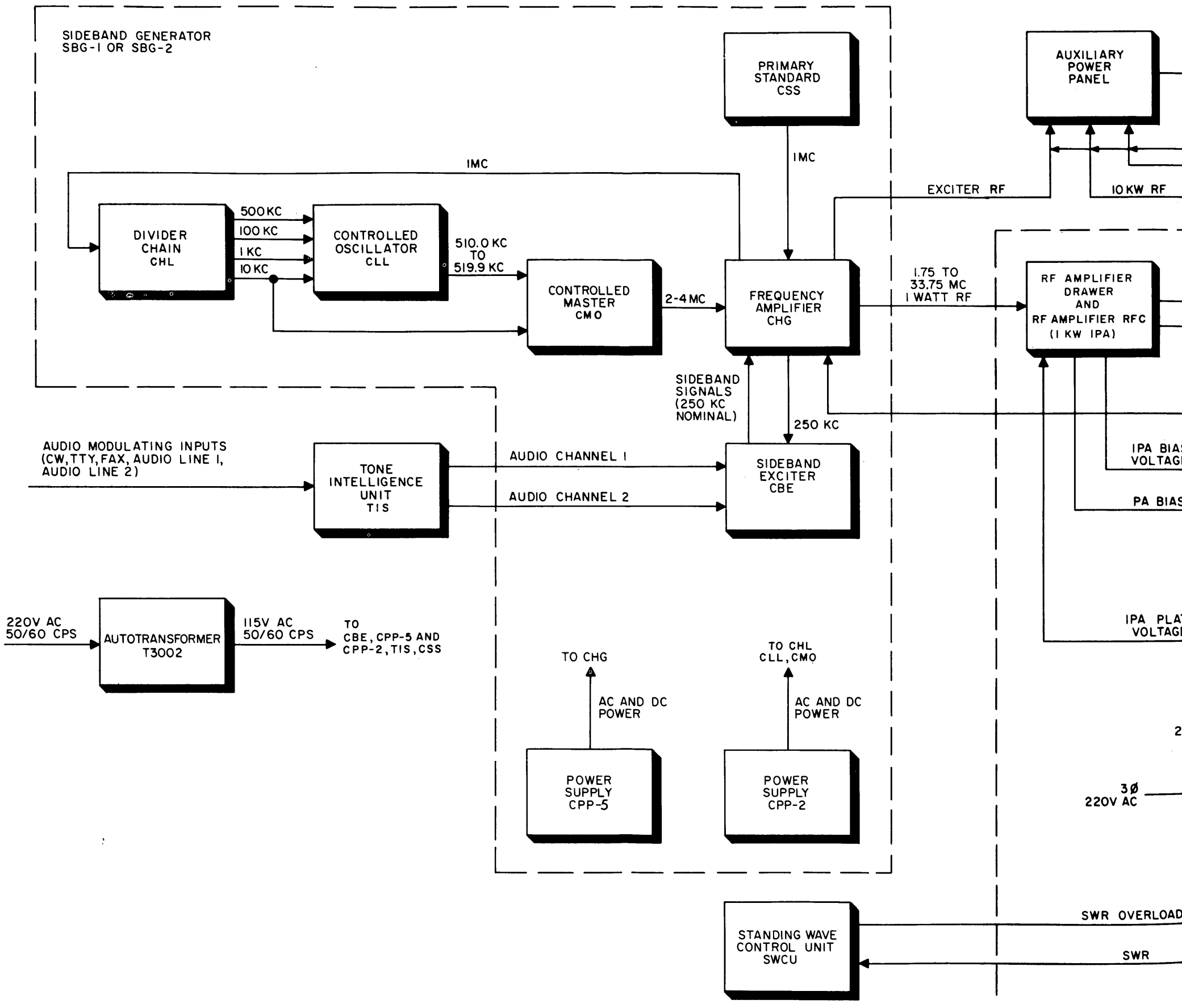


Figure 1-2. Transmitter Block Diagram


SIDEBAND GENERATOR
SBG-1 OR SBG-2
PRIMARY STANDARD CSS
AUXILIARY POWER PANEL
1MC
1MC
EXCITER RF
10 KW RF
DIVIDER CHAIN CHL
500 KC
100 KC
1 KC
10 KC
CONTROLLED OSCILLATOR CLL
510.0 KC TO 519.9 KC
CONTROLLED MASTER CMO
2-4 MC
FREQUENCY AMPLIFIER CHG
1.75 TO 33.75 MC 1 WATT RF
RF AMPLIFIER DRAWER AND RF AMPLIFIER RFC (1 KW IPA)
SIDEBAND SIGNALS (250 KC NOMINAL)
250 KC
IPA BIAS VOLTAGE
PA BIAS
AUDIO MODULATING INPUTS (CW, TTY, FAX, AUDIO LINE 1, AUDIO LINE 2)
TONE INTELLIGENCE UNIT TIS
AUDIO CHANNEL 1
AUDIO CHANNEL 2
SIDEBAND EXCITER CBE
IPA PLATE VOLTAGE
220V AC 50/60 CPS
AUTOTRANSFORMER T3002
115V AC 50/60 CPS
TO CBE, CPP-5 AND CPP-2, TIS, CSS
TO CHG
AC AND DC POWER
TO CHL CLL, CMO
AC AND DC POWER
POWER SUPPLY CPP-5
POWER SUPPLY CPP-2
3Ø 220V AC
STANDING WAVE CONTROL UNIT SWCU
SWR OVERLOAD
SWR

SECTION 2
OPERATING CONTROLS

Tables 2-1 through 2-4 present component designations and functions of front panel controls and indicators of the four transmitter frames. See figures 2-1 through 2-4 for the location of controls and indicators. Controls and indicators on the auxiliary frame are numbered between 0 and 100, those on the main frame are numbered between 101 and 200, and those on the PA and PS frames are numbered between 201 and 300.

TABLE 2-1. AUXILIARY FRAME OPERATING CONTROLS AND INDICATORS

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
1	PA SCREEN meter	Indicates amplitude of 10-kw PA screen grid voltage.
2	PA BIAS meter	Indicates amplitude of 10-kw PA bias voltage.
3	PA PLATE meter	Indicates amplitude of 10-kw PA plate (dc) voltage.
4	LSB meter	Indicates peak amplitude of lower sideband signal.
5	USB meter	Indicates peak amplitude of upper sideband signal.
6	LSB selector switch	Selects audio channel to be applied to lower sideband.
7	LSB GAIN control	Sets level of lower sideband audio signal.
8	CARRIER LEVEL control	Sets degree of carrier insertion.
9	USB GAIN control	Sets level of upper sideband audio signal.
10	USB selector switch	Selects audio channel to be applied to upper sideband.
11	POWER lamp	When lit, indicates that ac power is applied to CBE.
12	ON-OFF switch	In ON position, applies ac power to CBE.
13	OVEN lamp	When lit, indicates that power is applied to oven of CHG. After warm-up period, it cycles on and off.
14	POWER switch	In STANDBY position, applies power to oven circuit. In ON position, applies full ac and dc power to CHG through B+ switch.
15	STANDBY lamp	When lit, indicates that CHG is in standby.
16	B+ switch	In ON position, applies B+ to portion of CHG.
17	SYNC lamp	When lit, indicates high frequency lock-on in CHG.
18	MCS tuning dial	Indicates rf output frequency of CHG.
19	MF TUNING meter	Indicates relative amplitude of mid-frequency signal tuned by MF TUNING control.
20	OUTPUT meter	Indicates amplitude of rf output of CHG. At full deflection, indicates output of 1 watt PEP.

TABLE 2-1. AUXILIARY FRAME OPERATING CONTROLS AND INDICATORS (CONT)

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
21	MCS band switch dial	Indicates frequency range, dial designation, and dial numeric of selected rf band.
22	BAND switch	Selects rf operating band of CHG.
23	OUTPUT TUNING control	Tunes output stages of CHG.
24	MF TUNING control	Tunes mid-frequency circuits of CHG.
25	OUTPUT control	Controls amplitude of CHG rf output signal.
26	SYNC IND lamp	When lit, indicates that low frequency loop of sideband generator is frequency-locked.
27	OVEN lamp	When lit, indicates that power is applied to oven of CMO. After warm-up period, it cycles on and off.
28	CAL BEAT lamp	Used to indicate zero beat during calibration of master oscillator.
29	OPERATE-CAL switch	In OPERATE position, applies power to master oscillator and disables crystal oscillator used for calibration. In CAL position, also applies power to crystal oscillator for calibration purposes.
30	TUNE FOR MAX meter	Indicates relative amplitude of mid-frequency signal.
31	ADJ FOR ZERO meter	Indicates relative amplitude and direction of correction voltage generated during low frequency lock-on operation.
32a	LOCK knob	In clockwise position, locks red calibrate control.
32b	Calibrate control	Varies frequency of master oscillator in small increments.
33	TUNING KCS control	Tunes mid-frequency circuit in CMO.
34	MASTER OSCILLATOR FREQUENCY counter dials	Indicates frequency of master oscillator.
35	MASTER OSCILLATOR FREQUENCY control	Varies frequency of master oscillator.
36	OUTPUT control	Controls amplitude of rf mid-frequency signal generated by CMO.
37	LOCK knob	Locks MASTER OSCILLATOR FREQUENCY control when turned clockwise.
38	KILOCYCLES switch	Sets kilocycles (third) digit of output frequency generated by CLL.
39	SYNC oscilloscope	In positions L-1, L-2, and L-3, presents visual display (stationary rectangle) to indicate operational status of three synthesizer loops.
40	SYNC switch	Selects synthesizer loop for visual display on SYNC oscilloscope.

TABLE 2-1. AUXILIARY FRAME OPERATING CONTROLS AND INDICATORS (CONT)

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
41	HUNDREDS OF CYCLES switch	Selects hundreds of cycles (fourth) digit of output frequency generated by CLL.
42	POWER lamp	When lit, indicates that ac and dc power are applied to CSS.
43	PHASE COMPARATOR meter	When external 1-mc signal is applied to PRI STD IN jack, indicates frequency difference between external signal and 1-mc standard. Frequency of meter pointer movement represents difference in frequency.
44	SENSITIVITY control	Controls amplitude of swing on PHASE COMPARATOR meter when frequency comparison is being made.
45	ON-STANDBY switch	In ON position, applies all ac and dc voltages to CSS. In STANDBY position, applies power only to oven circuits.
46	1 MC MONITOR connector	Provides sample of 1-mc primary standard signal.
47	STANDBY lamp	When lit, indicates that CSS is in standby condition.
48	PRI STD IN connector	Provides means for applying external 1-mc signal for frequency comparison.
49	OVEN lamp	When lit, indicates that power is applied to oven of TIS. After warm-up period, it cycles on and off.
50	SHIFT CPS control	Sets the total amount of frequency shift when TIS is set up for FSK operation.
51	LEVEL ADJ control	Controls amplitude of audio output signal of TIS.
52	OUTPUT LEVEL meter	Indicates amplitude of audio output signal of TIS.
53	FUNCTION switch	Sets up TIS for FSK, FAX, or CW operation.
54	CENTER FREQ CPS switch	Determines center frequency when operating FSK or FAX.
55	TEST switch	Simulates mark or space condition in MARK or SPACE position, respectively. Bypassed in LINE position.
56	KEY MODE switch	Matches keying input impedance for voltage or current keying.
57	EXCITER CH 1 switch	In LINE position, connects audio line 1 input to TIS to channel 1 audio output of TIS. In FSK-FAX-CW position, connects FSK, FAX, or CW output of TIS (as selected by FUNCTION switch) to channel 1 audio output of TIS.
58	EXCITER CH 2 switch	Same as EXCITER CH 1 switch, but applies to channel 2 audio output of TIS.
59	B+ lamp	When lit, indicates that B+ is applied to TIS.
60	B+ switch	In B+ position, applies all ac and dc voltages to TIS; in STANDBY position, applies power to oven only.

TABLE 2-1. AUXILIARY FRAME OPERATING CONTROLS AND INDICATORS (CONT)

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
61	STANDBY lamp	When lit, indicates that CPP-2 is in standby; i.e., it is applying oven power to CMO and CLL.
62	POWER lamp	When lit, indicates that CPP-2 is applying ac and dc power to CHL, CLL, and CMO.
63	POWER-STANDBY switch	In POWER position, applies all ac and dc voltages to CHL, CLL, and CMO. In STANDBY position, applies oven power to CMO and CLL.
64	MONITOR switch	In EXCITER position, connects rf output sample from CGH to MONITOR OUTPUT connector. In PA or IPA position, connects rf output sample from 40-kw PA or 10-kw PA, respectively to MONITOR OUTPUT connector.
65	MONITOR OUTPUT connector	Provides sample of rf output from CHG (exciter), 40-kw PA, or 10-kw PA, as determined by setting of MONITOR switch.
66	CHANNEL 1 AUDIO INPUT jack	Receives external autio input. Audio applied to this jack is connected by auxiliary frame wiring to line 1 input of TIS.

TABLE 2-2. MAIN FRAME OPERATING CONTROLS AND INDICATORS

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
101	FILAMENT PRIMARY meter	Indicates primary voltage applied to filament transformer of 10-kw PA.
102	PA SCREEN CURRENT meter	Indicates screen current of 10-kw power amplifier tube.
103	PA PLATE CURRENT meter	Indicates plate current of 10-kw power amplifier tube.
104	PA PLATE RF meter	Indicates rf output voltage of 10-kw PA.
105	PA OUTPUT meter	Normally indicates 10-kw PA output power in kilowatts PEP (upper scale). When operating into unbalanced antenna, and with SWR switch (138) set to SWR, indicates VSWR on lower scale.
106	AC POWER lamp	When lit, indicates that power is applied to main power supply.
107	TUNE lamp	When lit, indicates that TUNE-OPERATE switch (139) on main power panel is in TUNE position.
108	OPERATE lamp	When lit, indicates that TUNE-OPERATE switch (139) on main power panel is in OPERATE position.
109	PLATE ON lamp	When lit, indicates that ac voltage is applied to 10-kw high voltage rectifier.
110	PA TUNE dial	Indicates setting of PA TUNE control (115).

TABLE 2-2. MAIN FRAME OPERATING CONTROLS AND INDICATORS (CONT)

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
111	PA LOAD dial	Indicates setting of PA LOAD control (116).
112	BAND SW dial	Indicates setting of BAND SW switch (117).
113	OUTPUT BAL dial	Indicates setting of OUTPUT BAL control (118).
114	OUTPUT LOADING dial	Indicates setting of OUTPUT LOADING control (119).
115	PA TUNE control	Tunes output of 10-kw PA to desired frequency.
116	PA LOAD control	Matches output impedance of 10-kw PA to load, antenna, or 40-kw PA input.
117	BAND SW switch	Sets operating frequency range of 10-kw PA.
118	OUTPUT BAL control	Operates in conjunction with OUTPUT LOADING control (119) to match impedance of 10-kw PA to antenna impedance.
119	OUTPUT LOADING control	Control Position — Function TUNE — Connects 10-kw PA output to dummy load. OPER — Connects 10-kw PA output to input of 40-kw PA. EMER — Connects 10-kw PA output to antenna circuits.
120	MULTIMETER	Indicates rf voltage, dc voltage, or dc current as selected by MULTIMETER switch (122).
121	IPA PLATE CURRENT meter	Indicates plate current of 1-kw IPA.
122	MULTIMETER switch	8-position rotary switch: Position — Measures DC IPA BIAS — Bias on 1-kw IPA. DC IPA ESG — Screen voltage of 1-kw IPA. DC IPA EP — Plate voltage of 1-kw IPA. DC IPA ISG — Screen current of 1-kw IPA. RF 1ST AMPL EP — Rf voltage at plate of first rf amplifier in 1-kw IPA. RF IPA EG — Rf voltage at grid of 1-kw IPA. RF IPA EP — Rf voltage at plate of 1-kw IPA. RF PA EG — Rf voltage at input to 10-kw PA.

TABLE 2-2. MAIN FRAME OPERATING CONTROLS AND INDICATORS (CONT)

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
123	IPA GRID TUNING control	Tunes rf input circuit of 1-kw IPA.
124	1ST AMPL TUNING control	Tunes rf output circuit of first rf amplifier in 1-kw IPA.
125	DRIVER BAND switch	Sets operating frequency range of first two rf amplifiers in 1-kw IPA.
126	IPA BAND switch	Sets operating frequency range of 1-kw IPA.
127	IPA LOADING switch	Operates in conjunction with IPA LOADING control (130) to vary impedance at output of 1-kw IPA.
128	IPA TUNING control	Tunes output circuit of 1-kw IPA.
129	IPA TUNING dial	Indicates setting of IPA TUNING control (128).
130	IPA LOADING control	Operates in conjunction with IPA LOADING switch (127) to vary impedance at output of 1-kw IPA.
131	IPA LOADING dial	Indicates setting of IPA LOADING control (130).
132	MAIN POWER circuit breaker	In ON position, applies primary power to main frame circuits.
133	OVERLOAD RESET push-button	When depressed after an overload occurs, resets relays in relay panel.
134	INTERLOCK INDICATOR lamp	When lit, indicates interlock circuit selected by INTERLOCK switch (135) is closed.
135	INTERLOCK switch	Selects interlock switch circuit to be checked by INTERLOCK INDICATOR lamp (134) as follows:

Position	Circuit or Condition Checked
NORMAL	Closure of all main frame interlocks.
BAND SW	In-detent status of IPA BAND switch (126).
IPA AIR SW	Normal operation of blower in 1-kw IPA.
EXTERNAL	Continuity of external interlock (terminals 8 and 10 of E3000 in auxiliary frame).
REAR DOOR	Closure of rear door.
PA AIR SW	Normal operation of blower in 10-kw PA.
PA DECK	Closure of door on power amplifier section.
PA BAND SW	In-detent status of BAND SW switch (117).
RIGHT SIDE	Closure of right side panel.
HV DECK	Closure of high voltage rectifier in main frame.

TABLE 2-2. MAIN FRAME OPERATING CONTROLS AND INDICATORS (CONT)

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
135 (cont)		Position — Circuit or Condition Checked RELAY DECK — Closure of relay panel in main frame. TIMER — Activation of timer after time interval elapses.
136	FIL ADJ switch	Sets ac input voltage at primary of 10-kw filament transformer.
137	ALDC switch and control	Switch connects ALDC circuit in system. Control sets ALDC voltage level.
138	SWR switch	In SWR position, permits direct reading of VSWR during unbalanced operation.
139	TUNE-OPERATE switch	In TUNE position, causes reduced dc voltage to be applied to screen grids of 1-kw and 10-kw power amplifier tubes. In OPERATE position, it causes full screen voltage to be applied to tubes.
140	PA SCREEN switch	In ON position, applies screen voltage to 10-kw PA.
141	HIGH VOLTAGE circuit breaker	In ON position, turns on 10-kw high voltage rectifier, applying high voltage dc to 10-kw power amplifier plate circuit.
142	FILAMENT TIME meter	Indicates total operating time of filament circuit of 10-kw PA.
143	TIME DELAY timer	Delays application of high ac voltage to high voltage rectifier so filaments may heat.
144	PLATE TIME meter	Indicates total operating time of high voltage rectifier.
145	PA BIAS lamp	When lit, indicates that no bias voltage is applied to 10-kw PA.
146	PA PLATE OVLD lamp	When lit, indicates that overload occurred in plate circuit of 10-kw PA.
147	PA SCREEN OVLD lamp	When lit, indicates that overload has occurred in screen circuit of 10-kw PA.
148	IPA SCREEN OVLD lamp	When lit, indicates that overload has occurred in screen circuit of 1-kw IPA.
149	IPA PLATE OVLD lamp	When lit, indicates that overload has occurred in plate circuit of 1-kw IPA.
150	SWR OVLD lamp	When lit, indicates that overload has occurred as a result of excessive VSWR.
151	PA BIAS ADJ control	Sets amplitude of bias voltage applied to 10-kw power amplifier tube.
152	PA PLATE OVLD ADJ control	Controls dc level at which 10-kw PA plate overload relay is energized.

TABLE 2-2. MAIN FRAME OPERATING CONTROLS AND INDICATORS (CONT)

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
153	PA SCREEN OVLD ADJ control	Controls dc level at which 10-kw PA screen overload relay is energized.
154	IPA SCREEN OVLD ADJ control	Controls dc level at which 1-kw IPA screen overload relay is energized.
155	IPA PLATE OVLD ADJ control	Controls dc level at which 1-kw IPA plate overload relay is energized.
156	ALARM switch	When set at ON position, energizes an audible alarm until high voltage is applied to the 10-kw PA.
157	DRAWER INTERLOCK lamp	When lit, indicates that rf amplifier drawer interlock is open.
158	IPA BIAS ADJ control	Adjusts amplitude of bias voltage applied 1-kw IPA.

TABLE 2-3. POWER AMPLIFIER FRAME CONTROLS AND INDICATORS

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
201	FILAMENT PRIMARY meter.	Indicates ac voltage applied to filament transformer
202	DRIVE meter	Indicates rf input applied to 40-kw PA.
203	PLATE CURRENT meter	Indicates dc plate current of 40-kw PA.
204	PLATE RF meter	Indicates rf output voltage of 40-kw PA.
205	OUTPUT meter	Indicates rf output current of 40-kw PA during unbalanced output operation.
206	AC POWER lamp	When lit, indicates that MAIN POWER circuit breaker (219) is on.
207	TUNE lamp	When lit, indicates that OUTPUT LOADING switch (119) on 10-kw PA is set at TUNE.
208	OPERATE lamp	When lit, indicates that OUTPUT LOADING switch (119) is set at OPERATE.
209	PLATE ON lamp	When lit, indicates that full ac voltage is applied to 40-kw high voltage rectifier.
210	TUNE control	Tunes output of 40-kw PA to desired frequency.
211	BAND SW switch	Sets operating frequency range of 40-kw PA.
212	LOAD control	Varies output impedance of 40-kw PA.
213	BANDSWITCH RELEASE switch	When depressed, permits BAND SW switch (211) to be turned. When released, BAND SW is locked in position.
214	OVERLOAD RESET switch pushbutton	When depressed after an overload occurs, resets relays in PA frame relay panel.

TABLE 2-3. POWER AMPLIFIER FRAME CONTROLS AND INDICATORS (CONT)

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
215	INTERLOCK INDICATOR lamp	When lit, indicates that interlock circuit selected by INTERLOCK switch is closed.
216	HV BREAKER INDICATOR lamp	When lit, indicates that main breaker CB8101 is closed.
217	HV BREAKER RESET switch	When depressed, actuates breaker motor B8101, closing main breaker CB8101.
218	PA LIGHT switch	When set at ON, turns on light in 40-kw PA.
219	MAIN POWER circuit breaker	Applies ac power to PA frame and PS frame.
220	HIGH VOLTAGE circuit	Causes ac voltage to be applied to 40-kw high voltage relay.
221	INTERLOCK switch	Selects interlock switch circuit to be checked by INTERLOCK INDICATOR lamp (215) as follows: Position — Circuit or Condition Checked EXTERNAL — OUTPUT LOADING switch (119) is set at OPERATE. HV DECK door and REAR DOOR in position on 10K main frame. PA DECK — Shield on 40-kw PA is in position. BIAS DRAWER — Bias supply drawer secured. REAR DOOR (PA FRAME) — Rear door on PA frame secured. AIR SW — Main PA blower operating. BAND SW — BAND SW (211) properly set in detent. HV RECT — 40-kw high voltage rectifier secured. CROWBAR — Crowbar drawer secured. ANT. TUNING — BAND MCS switch (249) properly set in detent. REAR DOOR (PS FRAME) — Rear door on PS frame secured. TIMER — Contacts on TIME DELAY timer (232) closed. Front bottom shield on PS frame in position.
222	BIAS ADJ control	Adjusts output of 600-volt regulated power supply in bias supply.
232	SWR OVLD ADJ control	Sets operating point of SWR OVLD relay on PA frame relay panel.
224	RETUNE OVLD ADJ control	Sets operating point of RETUNE OVLD relay on PA frame relay panel.
225	AC POWER lamp	When lit, indicates that ac power applied to bias supply drawer.

TABLE 2-3. POWER AMPLIFIER FRAME CONTROLS AND INDICATORS (CONT)

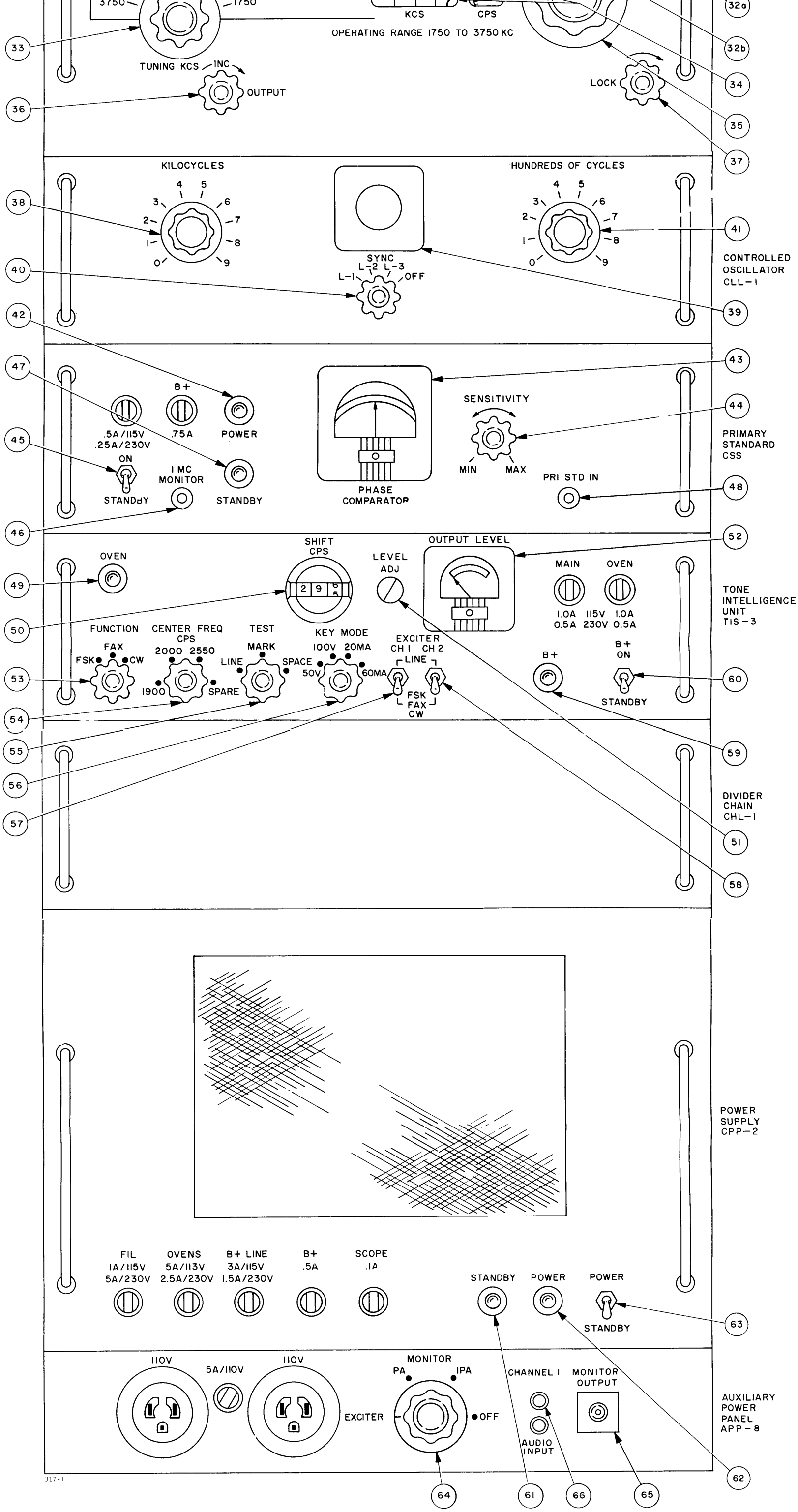
NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
226	BIAS lamp	When lit, indicates +600 volts dc present in bias supply drawer.
227	LV lamp	When lit, indicates that 350 volts dc is present in bias supply drawer.
228	BIAS lamp	When lit, indicates that bias voltage applied to 40-kw PA.
229	PLATE OVLD lamp	When lit, indicates that overload has occurred in plate circuit of 40-kw PA.
230	GRID OVLD lamp	When lit, indicates that overload has occurred in grid circuit of 40-kw PA.
231	FILAMENT TIME meter	Indicates operating time of 40-kw PA filament circuit.
232	TIME DELAY meter	Prevents application of high voltage to 40-kw PA before preset time interval has expired.
233	BLOWER DELAY timer	Allows blower to operate for 5 minutes after the 40-kw PA MAIN POWER breaker is set at OFF.
234	PLATE TIME meter	Indicates operating time of 40-kw PA plate circuit.
235	RETUNE lamp	When lit, indicates that level of PA rf plate voltage is too low with respect to level of dc plate current in 40-kw PA.
236	SWR lamp	When lit, indicates excessive VSWR in unbalanced antenna transmission line.
237	FINAL FILAMENT lamp	When lit, indicates defect in 40-kw PA filament circuit.
238	BIAS RELAY ADJ control	Sets operating point of BIAS relay in PA frame relay panel.

TABLE 2-4. POWER SUPPLY FRAME CONTROLS AND INDICATORS

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
239	PLATE OVLD ADJ control	Sets operating point of PLATE OVLD relay in PA frame relay panel.
240	GRID OVLD ADJ control	Sets operating point of GRID OVLD relay in PA frame relay panel.
241	TUBE PROTECT ADJ control	Sets operating point of TUBE PROTECT relay in PA frame relay panel.
242	DRIVER INTERLOCKS IND lamp	When lit, indicates high voltage is not applied to 10-kw PA.

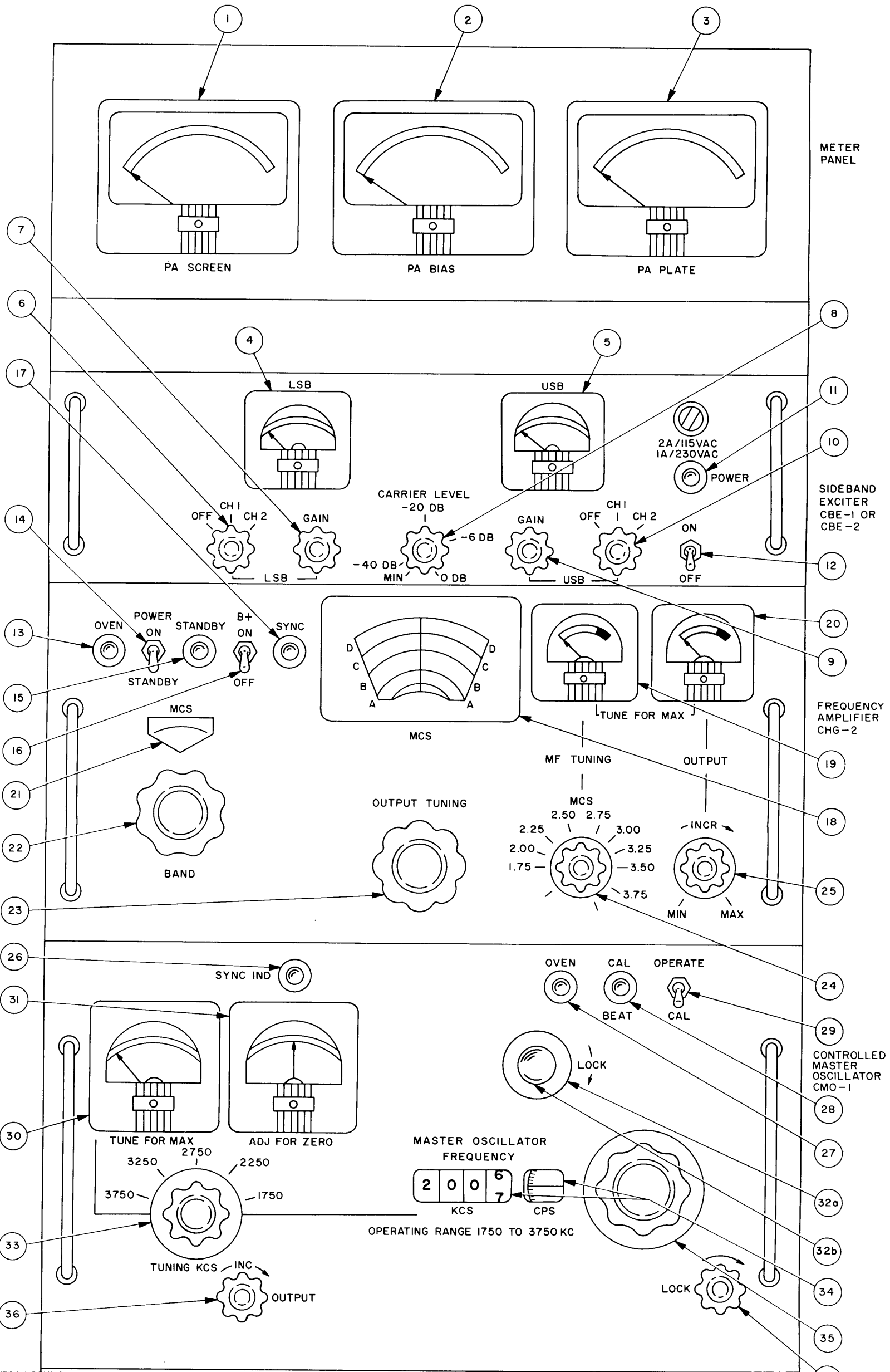
TABLE 2-4. POWER SUPPLY FRAME CONTROLS AND INDICATORS (CONT)

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
243	DRIVER INTERLOCKS switch	In ON position, permits high voltage to be applied to 10-kw PA.
	NOTE After the main frame is powered and high voltage applied to 10-kw PA, DRIVER INTERLOCKS switch should be set at OFF position to insure full interlock protection.	
244	GRID CURRENT meter	Indicates grid current of 40-kw PA tube.
245	GRID VOLTS meter	Indicates bias voltage applied to 40-kw PA.
246	PLATE VOLTS meter	Indicates dc plate voltage of 40-kw PA.
247	CROWBAR FILAMENT meter	Indicates ac voltage applied to filament or reservoir of thyratron in crowbar drawer. (Refer to control 252.)
248	SWR meter	Indicates VSWR of unbalanced antenna transmission line.
249	BAND MCS switch	Sets frequency range of antenna tuning unit.
250	BALANCE control	Balances impedances of two legs of antenna tuning unit.
251	RESERVOIR ADJ control	Adjusts ac voltage applied to reservoir filament of thyratron in crowbar drawer.
252	RESERVOIR-FILAMENT switch	In RESERVOIR position, applies reservoir voltage of thyratron to CROWBAR FILAMENT meter (247). In FILAMENT position, applies filament voltage of thyratron to CROWBAR FILAMENT meter (247).
253	BLOWER circuit breaker	Applies power to main blower in 40-kw PA.
254	FIL ADJ selector switch	Selects proper primary voltage for application to 40-kw PA filament transformer, 40-kw high voltage rectifier, crowbar drawer, and bias supply.
255	CAL-SWR switch	In CAL position, permits calibration of SWR meter circuit. In SWR position, permits SWR meter (248) to measure VSWR.
256	CAL control	Calibrates SWR meter (248).
257	FINAL FIL circuit breaker	Applies ac power to filament circuit of 40-kw PA.



NOTE:
UNIT CPP-5 IS MOUNTED ON REAR OF THE EXCITER FRAME.

Figure 2-1. Synthesized Exciter, Operating Controls and Indicators


1
2
3
METER PANEL
PA SCREEN
PA BIAS
PA PLATE
7
6
8
4
5
17
LSB
USB
11
2A/115VAC
1A/230VAC
10
POWER
SIDEBAND EXCITER CBE-1 OR CBE-2
CARRIER LEVEL
-20 DB
-6 DB
-40 DB
MIN
0 DB
OFF
CH 1
CH 2
GAIN
14
LSB
GAIN
OFF
CH 1
CH 2
ON
12
OFF
USB
13
OVEN
POWER ON
STANDBY
B+ ON
SYNC
20
9
15
STANDBY
OFF
MCS
D
C
B
A
TUNE FOR MAX
FREQUENCY AMPLIFIER CHG-2
16
MCS
MF TUNING
OUTPUT
19
21
OUTPUT TUNING
MCS
2.50
2.75
2.25
3.00
2.00
3.25
1.75
3.50
3.75
INCR
18
22
BAND
25
MIN
MAX
23
24
26
SYNC IND
OVEN
CAL
OPERATE
29
31
BEAT
CAL
CONTROLLED MASTER OSCILLATOR CMO-1
LOCK
28
TUNE FOR MAX
ADJ FOR ZERO
30
MASTER OSCILLATOR FREQUENCY
2 0 0 6 7
KCS
CPS
27
2750
3250
2250
3750
1750
OPERATING RANGE 1750 TO 3750 KC
32a
32b
33
TUNING KCS
INC
LOCK
34
OUTPUT
36
35

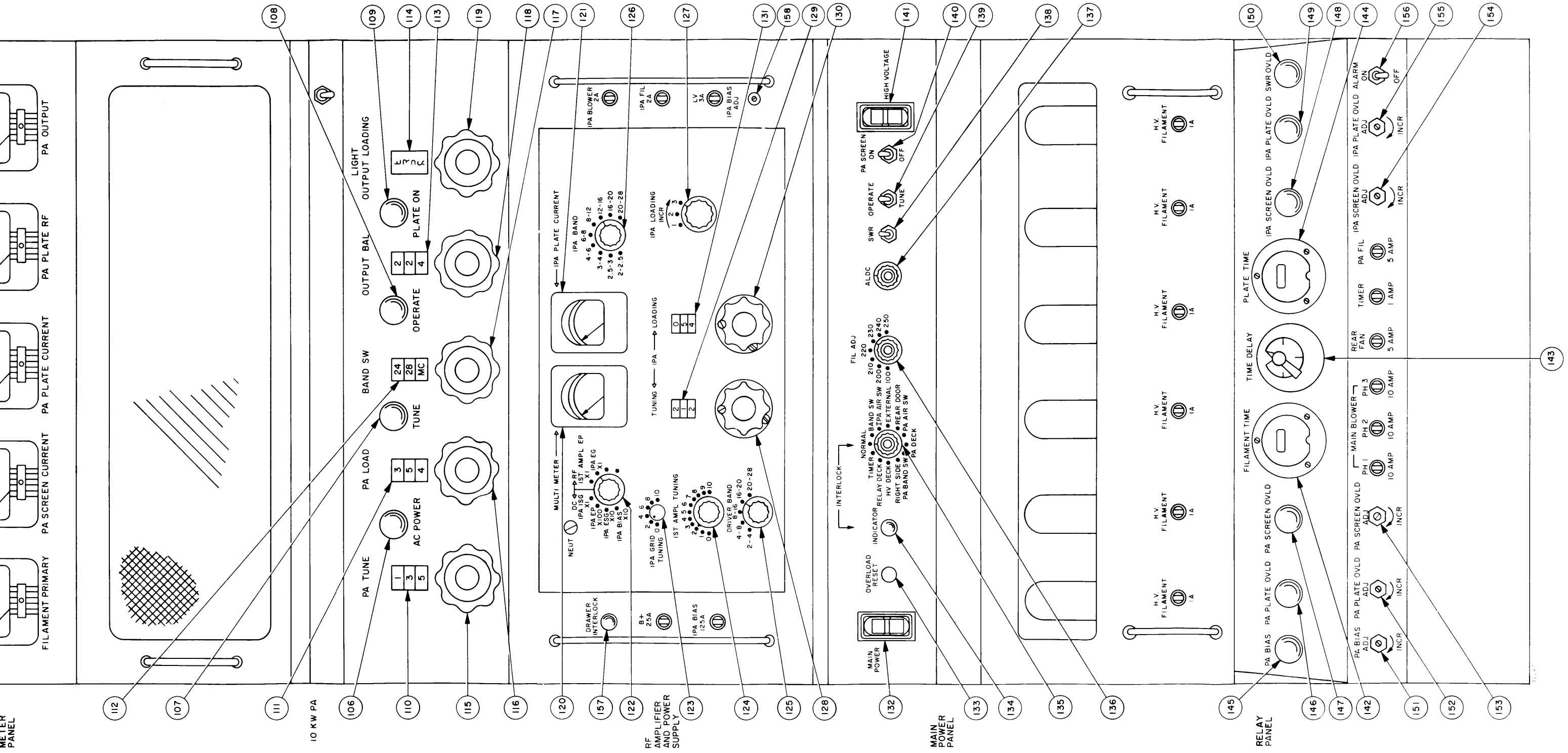
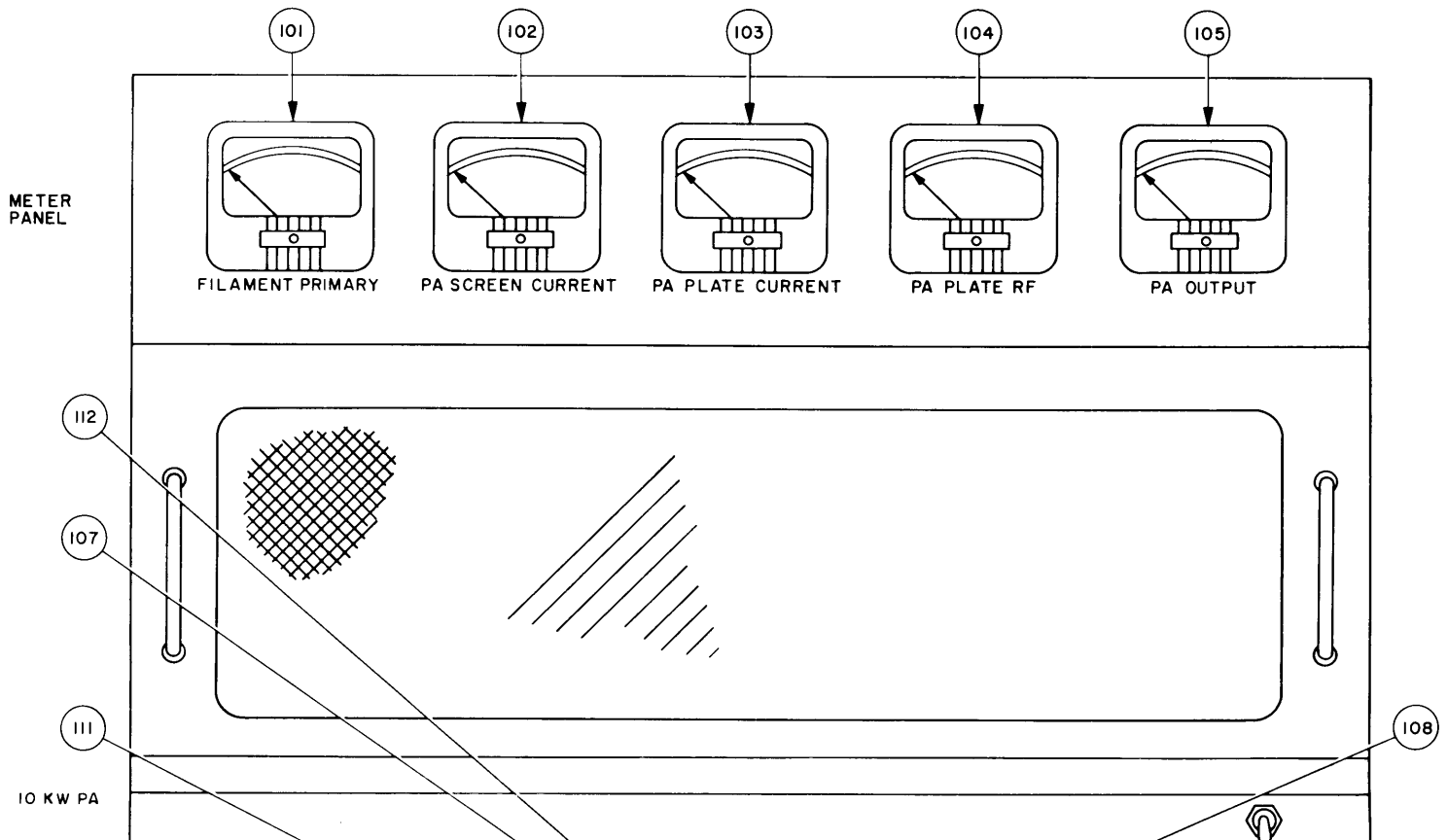
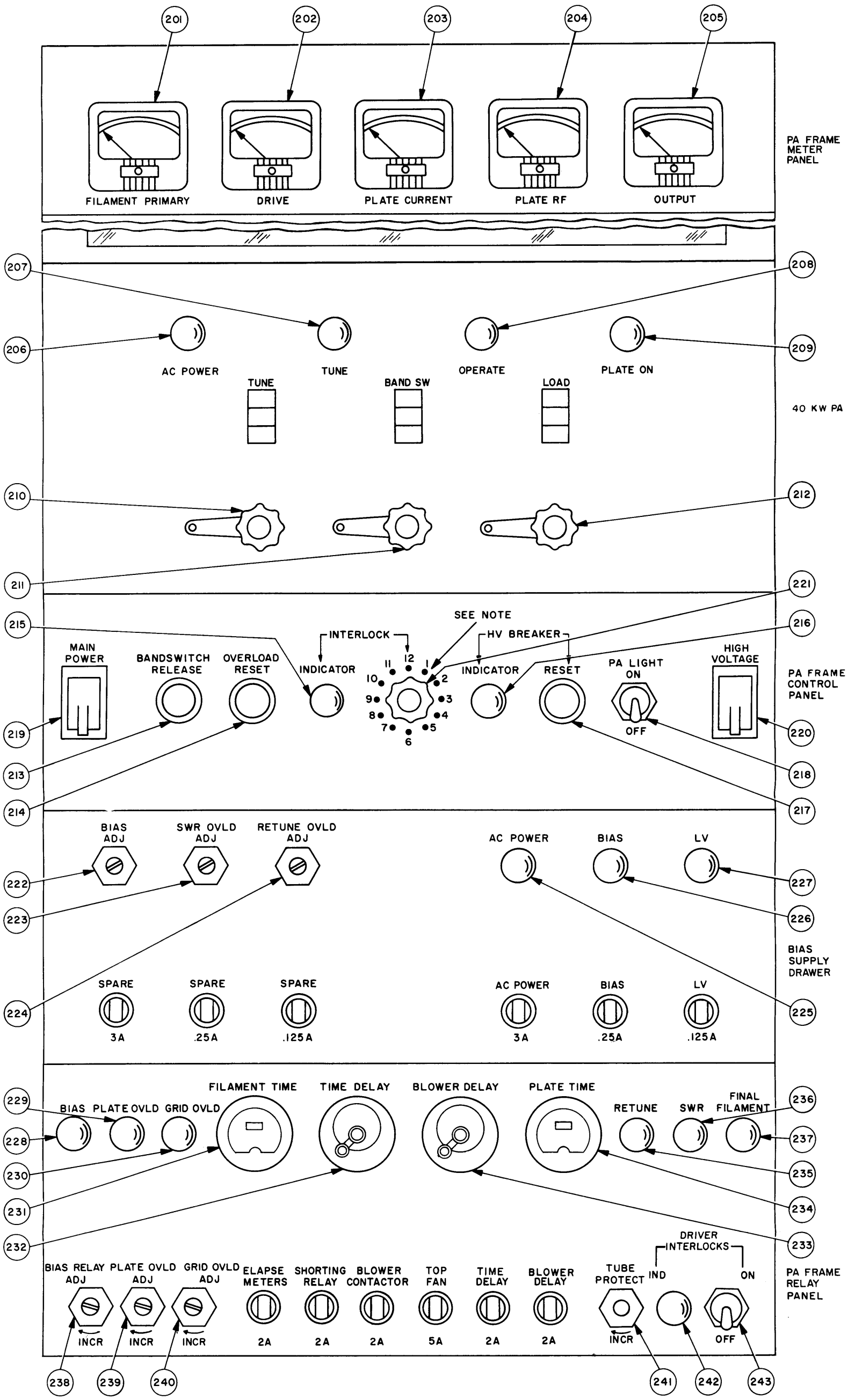


Figure 2-2. Main Frame, Operating Controls and Indicators


101
102
103
104
105
METER PANEL
FILAMENT PRIMARY
PA SCREEN CURRENT
PA PLATE CURRENT
PA PLATE RF
PA OUTPUT
112
107
111
108
10 KW PA



NOTE:

INTERLOCK SWITCH			
1	PA DECK	7	HV RECT
2	BIAS DRAWER	8	CROWBAR
3	RELAY PANEL	9	ANT. TUNER
4	REAR DOOR (PA FRAME)	10	REAR DOOR (PS FRAME)
5	AIR SW	11	TIMER
6	BAND SW	12	EXTERNAL

320-1

Figure 2-3. PA Frame, Operating Controls and Indicators

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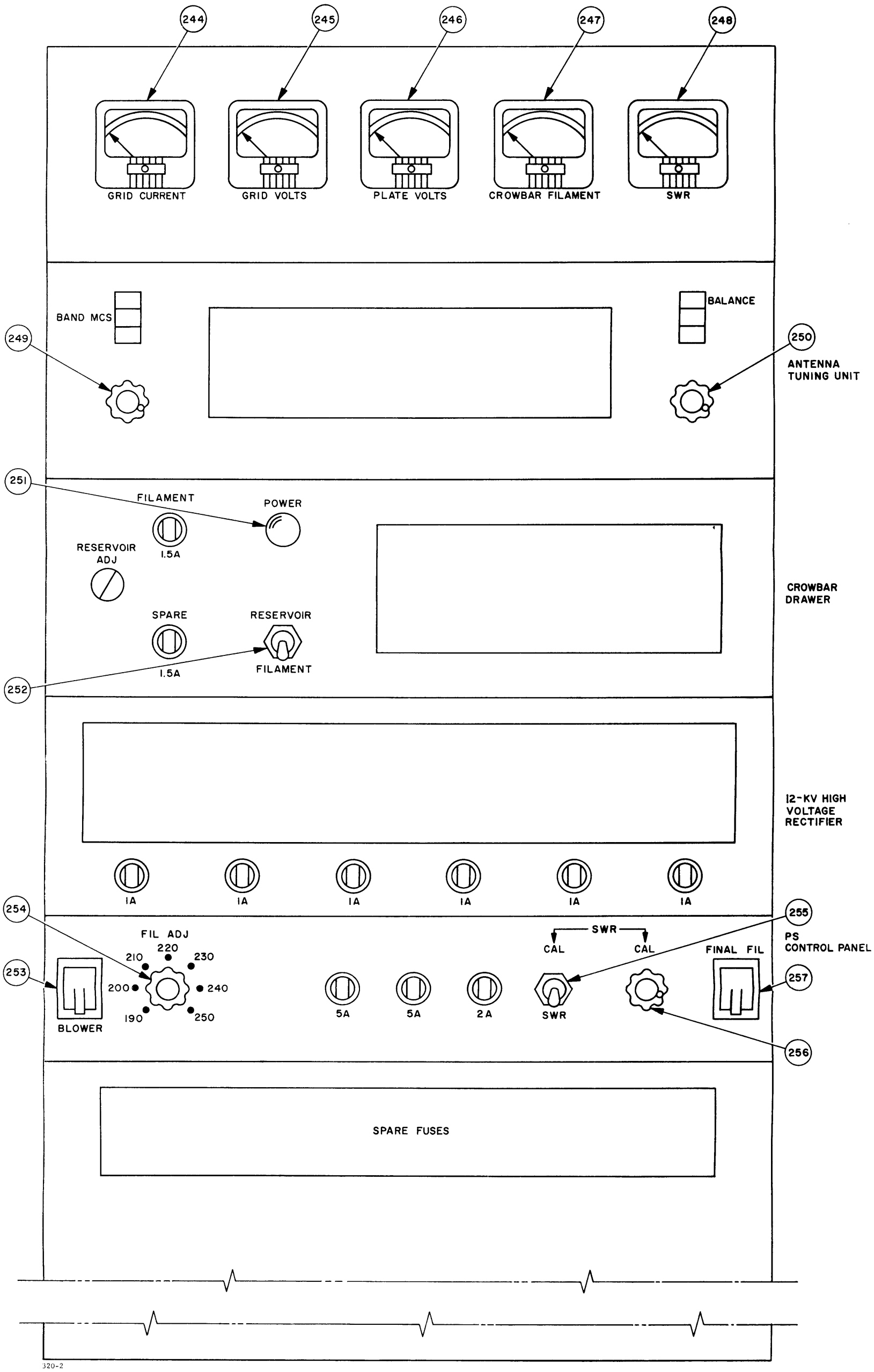

Figure 2-4. PS Frame, Operating Controls and Indicators

0106403 20

SECTION 3
OPERATING PROCEDURES

3-1. INTRODUCTION.

This section presents operating procedures, both normal and emergency, for the synthesized transmitter. The following paragraphs describe the starting procedures, tune-up of exciter on carrier, tune-up of 1-kw IPA and 10-kw PA on carrier, tune-up of 40-kw PA on carrier, operation of the tone intelligence unit TIS for different modes of operation, single sideband operation, double sideband operation, independent sideband operation, and CW (telegraphy) operation, and emergency operating procedures and techniques. The contents of this section are limited to operating procedures; supplementary operating information such as general tuning techniques, distortion measurements, and power output measurements for multi-tone modulation are described in section 4. All referenced controls and indicators are shown in figures 2-1 thru 2-4, and functionally described in tables 2-1 thru 2-4.

3-2. PRELIMINARY PROCEDURE.

Before applying power to any section of the transmitter, make sure the following inputs are connected to the auxiliary frame (as required for the modes of operation to be used):

INPUT	CONNECTION
FAX	E3000, terminals 3 (hot) and 4 (gnd)
FSK	E3002, terminals 15(-) and 16(+)
Audio line 1	E3002, terminals 20, 21 (gnd), and 22
Audio line 2	E3002, terminals 24, 25 (gnd), and 26
CW keying	E3002, terminals 15(-) and 16(+)

Also make sure the antenna is properly connected. Connections for balanced and unbalanced operation are made on a terminal board located inside the top front of the PA frame. For unbalanced operation, the rf output of the transmitter is detained at a coaxial connector that is located at the top of the PA frame. For balanced output operation, the antenna transmission lines are connected to the threaded metal rods in the porcelain bowl insulators on the roof of the PS frame through individual rf ammeters (0 to 10 amperes). The ammeters are available from TMC as model TMA-40K or may be supplied by the customer.

3-3. STARTING PROCEDURE.

a. APPLYING STANDBY POWER TO EXCITER. - The temperature-controlled oven circuits should be energized for at least 24 hours before the exciter is operated to assure optimum frequency stability. If the transmitter is to be operated on a fairly constant basis, its exciter should be left in standby during idle periods. Proceed as follows:

(1) Set the switches listed below at the positions shown:

UNIT	SWITCH	POSITION
CBE	ON-OFF (12)	OFF
CHG	POWER (14)	STANDBY
	B+ (16)	OFF
CLL	SYNC (40)	OFF
CSS	ON-STANDBY (45)	STANDBY
TIS	B+ (60)	STANDBY
CPP-2	POWER-STANDBY (63)	STANDBY

(2) Set the AUXILIARY FRAME MAIN POWER circuit breaker, on the inner rear partition of the auxiliary frame at its ON position. Set SWCU front panel 2:1/3:1 switch at 3:1. The following actions should occur:

(a) Top front fan in auxiliary frame rotates.

(b) STANDBY lamp (61) on CPP-2 lights.

(c) STANDBY lamp (47) on CSS lights.

(d) STANDBY lamp (15) on CHG lights.

(e) Power lamp on CPP-5 (rear of auxiliary frame) lights.

(f) When OVEN lamps on CHG (13), CMO (27), and TIS (49) start cycling on and off, these oven circuits have come up to temperature. However, the CSS must be in standby for 24 hours before operating the transmitter to insure that frequency stability is maintained.

b. APPLYING B+ TO EXCITER. - Apply plate power to exciter as shown below.

UNIT	CONTROL	POSITION	ACTION
CBE	ON-OFF (12)	ON	POWER lamp (11) lights.
	LSB (6)	OFF	
	USB (10)	OFF	
	LSB GAIN (7)	Max ccw	
	USB GAIN (9)	Max ccw	
	CARRIER LEVEL (8)	0 DB (max cw)	
CHG	POWER (14)	ON	STANDBY lamp (15) goes off.
CSS	ON-STANDBY (45)	ON	STANDBY lamp (47) goes off. POWER lamp (42) lights.
TIS	B+ (60)	ON	B+ lamp (59) lights.
CPP-2	POWER-STANDBY (63)	POWER	STANDBY lamp (61) goes off. POWER lamp (62) lights. After 60 seconds, dc power is applied to CHL, CMO, and CLL.

3-4. CONSIDERATIONS IN TUNING TRANSMITTER.

a. GENERAL. - Before the transmitter is tuned for any other mode of operation, it should be initially tuned and loaded on carrier. This procedure should be followed even if suppressed carrier operation is desired. After the transmitter is tuned on carrier, either or both sidebands are generated by applying the proper modulating signals (FAX, FSK, audio line, CW) required by the particular mode of operation. The carrier level may then be re-inserted or suppressed, as desired.

b. CARRIER FREQUENCY VS ASSIGNED FREQUENCY. - A brief description of "carrier" versus "assigned" frequency is presented at this point since these may be significantly different when operating in certain modes and will affect the choice of frequency to be synthesized in the exciter.

"Carrier" frequency is the frequency of the unmodulated carrier wave, if sinusoidal, or the center frequency of the unmodulated carrier when a recurring series of pulses are used. The "assigned" frequency is a reference frequency to, or reserving a given portion of the rf spectrum. Most government agencies define the "assigned" frequency as the "center of a frequency band assigned to a station". The "assigned" frequency and the "carrier" frequency may or may not be the same. In practice, the assigned frequency is frequently suffixed by the carrier frequency in parenthesis for clarification.

EXAMPLE 1

For upper sideband transmission, with carrier completely suppressed and with total audio bandpass extending to 3000 cycles, the assigned frequency is 1500 cycles above the non-existent carrier frequency.

EXAMPLE 2

For independent sideband transmission, with audio intelligence covering 350 to 7500 cycles per sideband, with or without carrier suppression, the assigned frequency and the carrier frequency are one and the same, since both occupy the center of the transmitted spectrum.

c. DETERMINATION OF PROPER SYNTHESIZED FREQUENCY.

(1) Dry Contact Keying. - When dry contact keying is used for nominal carrier on-off cw transmission, carrier frequency and assigned frequency are the same. Tune up on carrier as described in paragraph 3-5.

(2) Double or Independent Sideband Operation. - For either DSB or ISB, carrier and assigned frequency are the same, regardless of the type of modulation. Tune up on carrier as described in paragraph 3-5.

(3) CW Tone Keying. - When the transmitter is keyed through the TIS, the TIS delivers a keyed 1-kc tone to the selected input channel of the CBE. If the exciter is initially tuned to the desired output frequency in normal fashion, injection of the keyed tone will cause the output frequency to be in error by 1-kc; i.e., the assigned frequency and carrier frequency will be 1-kc apart. To compensate for this effect, the carrier frequency must be offset by 1-kc. This places the final keyed rf output signal on the desired frequency.

Modify the tune-up procedure in paragraph 3-5 as follows:

After the dial numeric is subtracted from the desired output frequency, reduce the resulting figure

by 1-kc, then follow the normal procedure outlined in paragraph 3-5. Thus, if a keyed output frequency of 15.5 mc is desired, set BAND switch (22) on the CHG to 11.75 - 15.75. Note that the dial numeric for that band is 12.

Output frequency	=	15.5 mc
- Dial numeric	=	12.0 mc
Difference		3.5 mc
Now subtract 1 kc		.001 mc
Result		3.499 mc

If the mid-frequency circuits are now tuned to 3.449 mc, the keyed transmitter output will be 15.5 mc.

(4) FAX Operation. - The international standard "center" frequency for facsimile transmission is 1900 cps. When the transmitter is to be used only for FAX transmission on one sideband, the TIS will deliver a 1900 cycle center frequency to the selected channel. The instantaneous output frequency will shift about this point, so that the assigned frequency and carrier frequency will be 1900 cycles apart. To compensate for this effect, the carrier frequency must be offset by 1900 cycles. When operating in this mode, upper sideband, modify the normal carrier tune-up procedure described in paragraph 3-5 by reducing the difference between the output frequency and the dial numeric by an additional 1900 cycles. (For nominal output frequency of 15.5 mc, the mid-frequency becomes 3.4981 mc.) For LSB increase difference by 1900 cps. (For nominal output frequency of 15.5 mc, the mf becomes 3.5019 mc.)

(5) FSK Operation. - The international standard "center" frequency for frequency shift teletype signals is 2550 cycles. The TIS provides a choice of a 2000 or 2550 cycle center frequency for FSK. The mark and space frequencies will shift about the center frequency selected, so that the assigned frequency and carrier frequency will be separated by an amount equal to the selected center frequency. The 2000-cycle center frequency should be used with the synthesized exciter since the system is not capable of precision frequency control in less than 100-cycle increments. (The 2550-cycle center frequency may cause off-frequency violation if the circuit is not cleared for SSB.) When operating in this mode, upper sideband, modify the normal carrier tune-up procedure described in paragraph 3-5 by reducing the difference between the output frequency and the dial numeric by an additional 2000 cycles. (For a nominal output frequency of 15.5 mc, the mid-frequency becomes 3.498 mc.) When operating in FSK mode, lower sideband, modify the normal carrier tune-up procedure described in paragraph 3-5 by increasing the difference between the output frequency and the dial numeric by 2000 cycles. (For a nominal output frequency of 15.5 mc, the mid frequency becomes 5.002 mc.)

3-5. EXCITER TUNE-UP ON CARRIER.

NOTE

For purposes of illustration, the following tune-up is made at a carrier frequency of 11.0015 mc.

a. At the CHG, proceed as follows:

(1) Set BAND switch (22) to the band which includes the desired frequency. The frequency range, frequency band, and dial numeric will appear in MCS window (21). (The dial numeric, the bottom number in the MCS window (21), is used to quickly determine the mid-frequency.

EXAMPLE 1

For 11.0015 mc, BAND switch (22) is set to 9.75-11.75 mc, band C, with dial numeric 8 displayed in window.

(2) Subtract dial numeric from desired output frequency. This is mid-frequency which is used to set up several of the exciter units. Note this mid-frequency figure.

EXAMPLE 2

For 11.0015 mc carrier, mid-frequency is 11.0015 - 8 = 3.0015 mc.

(3) Set MF TUNING control (24) to mid-frequency calculated in (2) above.

(4) Rotate OUTPUT control (25) to MIN (fully ccw) position.

b. At the CLL:

(1) Rotate SYNC switch (40) through positions L-1, L-2, and L-3. Check that a stationary rectangle appears on SYNC monitor scope (39) in each position. Return SYNC switch (40) to OFF position.

(2) Set KILOCYCLES switch (38) and HUNDREDS OF CYCLES switch (41) to the positions corresponding to the 4th and 5th digits, respectively, of the mid-frequency calculated in a(2) above.

EXAMPLE

For mid-frequency of 3.0015 mc (3001.5 kc), set KILOCYCLES switch (38) to 1 and HUNDREDS OF CYCLES switch (41) to 5.

c. At the CMO:

(1) Set OPERATE-CAL switch (29) to CAL position.

(2) Unlock MASTER OSCILLATOR FREQUENCY control (35) by rotating LOCK knob (37) counterclockwise.

(3) Rotate MASTER OSCILLATOR FREQUENCY control (35) to closest 100-kc checkpoint lower than the calculated mid-frequency. Approach this setting from a lower frequency.

EXAMPLE 1

The closest lower 100-kc checkpoint to mid-frequency 3.0015 mc (3001.5 kc) is 3050.000 kc. For this example, rotate counter control (35) to a counter reading lower than 3050.000 kc, then increase the counter readings to precisely 3050.000 (3050 on KCS counter and 000 on CPS counter (34)).

CAUTION

Rotating MASTER OSCILLATOR FREQUENCY control (35) past either of its marked frequency limits (1750 and 3750 kc) may upset resettability of counter.

(4) Unlock red calibration control (32b) with outer black LOCK knob (32a), then adjust red knob for zero-beat indication on CAL BEAT indicator (28). Lock red calibration control in place.

(5) Carefully rotate MASTER OSCILLATOR FREQUENCY control (35) until the precise calculated mid-frequency appears on counter dials (34). Lock the counter control (35) in place with LOCK knob (37).

EXAMPLE 2

For mid-frequency of 3.0015 mc, adjust counter control (35) until KCS counter indicates 3001 and CPS counter indicates 500.

(6) Rotate OUTPUT control (36) to mid-position.

(7) Adjust TUNING KCS control (33) for maximum indication on TUNE FOR MAX meter (30). This peak should occur with control (33) set at calculated mid-frequency.

(8) Reset OUTPUT control (36) so that TUNE FOR MAX meter indication is mid-scale.

(9) Set OPERATE-CAL switch (29) at OPERATE position. The SYNC IND lamp (26) should glow and the ADJ FOR ZERO meter (31) should read in center of green band. If necessary, unlock MASTER OSCILLATOR control (35) and readjust for a center reading. Be sure to lock control after readjustment.

d. At the CHG:

(1) Set B+ switch (16) at ON. SYNC indicator (17) should glow to indicate high-frequency oscillator lock-in.

(2) Advance OUTPUT control (25) to its mid-position.

(3) Adjust MF TUNING control (24) for maximum indication on MF TUNING meter (19). If the meter reads in the red portion of the scale, reduce the setting of OUTPUT control (36) on the CMO.

(4) Rotate OUTPUT TUNING control (23) for maximum reading on OUTPUT meter (20). Reduce the setting of OUTPUT control (25) if OUTPUT meter reading tends to move off scale.

CAUTION

Be sure that the peak reading obtained on MF TUNING meter (19) is obtained with MF TUNING control set at calculated mid-frequency. It is possible to obtain a false peak by tuning to a harmonic or mixing product. As a simple check, rotate CARRIER LEVEL control (8) on CBE to its MIN position. The readings on both the MF TUNING METER (19) and OUTPUT meter (20) should return to zero if MF TUNING control is properly set. Return CARRIER LEVEL control (8) on CBE to full on (0 DB) position.

(5) This completes tuning of exciter to carrier frequency. Return OUTPUT control (25) to minimum setting.

NOTE

At full scale, OUTPUT meter (20) indicates 1 watt PEP.

3-6. TUNE-UP OF 1-KW IPA, 10-KW PA, AND 40-KW PA ON CARRIER.

a PRELIMINARY PROCEDURE.

(1) Before applying power to the main frame, PA frame, and PS frame, set up the tuning controls on these units for the selected carrier frequency in accordance with the appropriate factory tuning chart prepared for your transmitter. In the absence of such charts (one for unbalanced and other for balanced output operation), set up the controls in accordance with the sample tuning charts shown in tables 3-1 and 3-2. These charts were prepared from a typical transmitter at the factory, with the transmitter operating into a dummy load. If control settings are set up as shown, the charts should provide a good starting point for tuning the transmitter. When the transmitter is tuned using an antenna, the tuning will change somewhat. If necessary, modify the tuning charts so that they reflect actual field conditions. Preset the following controls on the transmitter:

UNIT	CONTROL
10-kw PA	PA TUNE (115)
	PA LOAD (116)
	BAND SW (117)
	OUTPUT BAL (118)
	OUTPUT LOADING (119) TO TUNE
RF Amplifier RFC (1-kw IPA)	IPA GRID TUNING (123)
	1ST AMPL TUNING (124)
	DRIVER BAND (125)
	IPA BAND (126)
	IPA LOADING (127)
	IPA TUNING (128)
	IPA LOADING (130)
40-kw PA	TUNE (210)
	BAND SW (211)
	LOAD (212)
Antenna Tuning Unit (Balanced operation only)	BAND MCS (249)
	BALANCE (250)

(2) On the main power panel (main frame), set controls as follows:

CONTROL	POSITION
PA SCREEN (140)	OFF
TUNE-OPERATE (139)	TUNE
HIGH VOLTAGE (141)	OFF
ALDC (137)	OFF
INTERLOCK (135)	NORMAL

(3) Set TIME DELAY control (143) at 5 minutes.

(4) Set MAIN POWER circuit breaker (132) at ON:

(a) Main frame blowers should start up.

CAUTION

It is possible for a three phase blower to run backward, diminishing the flow of cooling air. To check rotation of main frame 10K PA blower, allow blower to run for a few seconds, then set MAIN POWER circuit breaker at OFF. As blower slows, observe rotor blade to make sure it is turning in direction indicated by arrow stenciled on blower case. Reversing any pair of three-phase power inputs at rear of PA frame will correct blower rotation.

(b) TUNE lamp (107) should light.

(c) PA BIAS lamp (145) should light, then go off when rf amplifier drawer warms up.

(d) Adjust PA BIAS ADJ (151) on main frame relay panel so that PA BIAS meter (2) reads 300 volts.

(e) Set MULTIMETER switch (122) at DC IPA BIAS.

(f) Adjust IPA BIAS ADJ control (158) so that MULTIMETER (120) indicates -100 volts.

(g) FILAMENT PRIMARY meter (101) should read 230 volts ac. If necessary, rotate FIL ADJ switch (136) on main power panel for proper meter reading.

(h) At expiration of 5-minute preset time delay period, INTERLOCK INDICATOR (134) lamp on main power panel should glow.

NOTE

If INTERLOCK INDICATOR lamp (134) does not light, rotate INTERLOCK switch (135) clockwise from its NORMAL position. At first position that INTERLOCK INDICATOR (134) goes out, note switch designation and check interlock at that location. When open interlock has been closed, return INTERLOCK switch to NORMAL position. When NORMAL position of switch lights INTERLOCK INDICATOR, proceed to next step.

(5) Set TIME DELAY control (232) at 5 minutes, then set MAIN POWER circuit breaker (219) on PA frame control panel at ON:

(a) AC POWER lamp (206) and TUNE lamp (207) on 40-kw PA should light.

(b) The top fan in the PA frame should rotate.

(c) The AC POWER lamp (225) on the bias supply drawer should light. (After a short delay, the BIAS and LV lamps (226 and 227, respectively) should also light.)

(d) The filaments of the rectifiers in the 40-kw high voltage rectifier should glow.

TABLE 3-1. TRANSMITTER TUNING CHART, BALANCED OPERATION

SBG-1			10K (IPA) STAGE							40K (PA) STAGE											
FREQ. MC	SBG-1 BAND	CMD	BAND	PTE OSC SETTING	TUNE	LOAD	PLATE CURRENT	OUTPUT BALANCE	10KW LOAD CURRENT	FINAL BAND	TUNE	LOADING	DC PLATE CURRENT	PLATE RF	DC GRID CURRENT	40KW LOAD CURRENT	40KW S/D DB	20KW LOAD CURRENT	20KW S/D DB	RF DRIVE VOLTS	BALANCE	ANTENNA BAND
2	0	2000	2-3	2500	545	660	.85	513	3.1	2-3	518	519	5.0	7.4	30	20	36	10	41	.50	-	-
3	0	3000	2-3	3500	268	278	.85	432	3.6	2-3	284	505	4.8	7.5	30	20	36	10	41	.45	-	-
3	0	3000	3-4	3500	306	438	.82	432	3.8	3-4	283	378	4.7	7.0	20	20	36	10	41	.45	-	-
4	2	2000	3-4	2250	200	229	.88	385	3.9	3-4	221	382	4.7	6.6	20	20	36	10	41	.43	-	-
4	2	2000	4-6	2250	291	449	.88	385	3.7	4-5	245	457	4.7	6.8	20	20	36	10	41	.43	-	-
5	2	3000	4-6	2750	203	367	.72	385	3.8	4-5	211	345	4.6	6.5	20	20	36	10	41	.44	-	-
5	2	3000	4-6	2750	203	367	.70	385	3.8	5-7	269	427	4.7	6.6	20	20	36	10	41	.44	-	-
6	4	2000	4-6	3250	162	187	.80	368	3.4	5-7	237	318	4.8	6.2	20	20	36	10	41	.42	-	-
6	4	2000	6-8	3250	218	346	.80	368	3.6	5-7	237	318	4.8	6.2	20	20	36	10	41	.42	-	-
7	4	3000	6-8	3750	178	260	.75	359	3.0	5-7	210	271	4.8	7.2	30	20	35	10	40	.43	-	-
7	4	3000	6-8	3750	178	260	.75	357	3.0	7-13	277	372	4.8	7.2	30	20	35	10	40	.40	-	-
8	6	2000	6-8	2125	150	212	.75	345	2.6	7-13	246	321	4.6	7.5	30	20	35	10	40	.41	-	-
8	6	2000	8-11	2125	211	319	.80	345	2.6	7-13	246	321	4.6	7.5	30	20	35	10	40	.41	-	-
13	10	3000	11-15	3375	145	229	.80	331	3.2	7-13	167	195	4.6	5.7	30	20	36	10	41	.43	-	-
13	10	3000	11-15	3375	145	229	.80	331	3.2	13-18	228	259	4.4	6.0	30	20	36	10	41	.43	-	-
18	16	2000	15-19	2312.5	130	150	.85	300	3.4	13-18	157	203	4.8	5.0	20	20	36	10	41	.51	-	-
18	16	2000	15-19	2312.5	130	150	.80	300	3.4	18-24	222	227	4.4	5.2	20	20	35	10	40	.45	-	-
24	22	2000	19-24	3062.5	116	097	.85	328	2.8	18-24	144	188	4.0	4.5	30	20	35	10	40	.40	-	-
24	22	2000	24-28	3062.5	191	150	.90	330	2.4	24-28	218	207	4.3	4.5	30	20	35	10	40	.41	-	-
28	26	2000	24-28	3562.5	169	093	.90	305	2.8	24-28	199	184	4.5	4.0	30	20	35	10	40	.41	-	-

TEST 40K LOAD

CONDITIONS:

600Ω BALANCED

50Ω UNBALANCED

REMARKS: _____

DATE _____

MFG NO. _____

SERIAL NO. _____

TESTED BY _____

APPROVED BY _____

MODEL GPT-40K

THE TECHNICAL MATERIEL CORP.
MAMARONECK NEW YORK

TUNING CHART 2-28MC SYNTHESIZED

TABLE 3-2. TRANSMITTER TUNING CHART, UNBALANCED OPERATION

SBG-1			10K (IPA) STAGE							40K (PA) STAGE												
FREQ MC	SBG-1 BAND	CMD	BAND	PTE OSC SETTING	TUNE	LOAD	PLATE CURRENT	OUTPUT BALANCE	10KW LOAD CURRENT	FINAL BAND	TUNE	LOADING	DC PLATE CURRENT	PLATE RF	DC GRID CURRENT	40KW LOAD CURRENT	40KW S/D DB	20KW LOAD CURRENT	20KW S/D DB	RF DRIVE VOLTS	BALANCE	ANTENNA BAND
2	0	2000	2-3	2500	543	660	.79	513	2.0	2-3	523	484	3.4	8.0	40	5.8	36	4.1	41	.45	576	2-12
3	0	3000	2-3	3500	257	447	.65	435	2.1	2-3	276	437	3.5	6.5	10	5.8	37	4.1	42	.37	226	2-12
3	0	3000	3-4	3500	303	527	.65	435	2.7	3-4	290	429	3.8	7.0	20	5.8	37	4.1	42	.38	226	2-12
4	2	2000	3-4	2250	195	309	.62	377	2.1	3-4	225	393	3.6	6.2	10	5.8	36	4.1	41	.35	143	2-12
4	2	2000	4-6	2250	288	440	.75	377	2.3	4-5	245	411	3.8	5.3	10	5.8	36	4.1	41	.34	143	2-12
5	2	3000	4-6	2750	207	287	.65	369	1.4	4-5	206	324	3.2	5.8	0	5.7	35	4.0	40	.30	077	2-12
5	2	3000	4-6	2750	207	287	.62	369	1.3	5-7	261	436	3.1	5.5	0	5.7	36	4.0	41	.28	077	2-12
6	4	2000	4-6	3250	161	210	.60	373	1.2	5-7	220	365	3.0	5.0	0	5.2	35	3.7	40	.27	069	2-12
6	4	2000	6-8	3250	223	268	.63	373	1.2	5-7	220	365	3.0	5.0	0	5.2	35	3.7	40	.27	069	2-12
7	4	3000	6-8	3750	180	209	.66	356	1.3	5-7	186	289	3.4	4.5	0	5.5	35	3.9	40	.27	050	2-12
7	4	3000	6-8	3750	180	209	.66	356	1.3	7-13	262	425	3.4	5.6	0	5.5	35	3.9	40	.31	050	2-12
8	6	2000	6-8	2125	152	148	.75	342	1.3	7-13	236	337	3.7	4.3	0	5.5	35	3.9	40	.27	033	2-12
8	6	2000	8-11	2125	212	320	.70	342	1.1	7-13	236	337	3.6	4.2	0	5.5	35	3.9	40	.25	033	2-12
13	10	3000	11-15	3375	146	188	.95	342	3.0	7-13	005	208	5.4	2.5	0	5.8	35	4.1	40	.30	035	12-20
13	10	3000	11-15	3375	146	188	.70	342	1.7	13-18	220	270	3.6	4.6	0	5.8	37	4.1	42	.29	035	12-20
18	16	2000	15-19	2312.5	130	150	.75	330	1.3	13-18	071	205	3.4	4.0	0	6.2	36	4.3	41	.27	003	12-20
18	16	2000	15-19	2312.5	130	150	.78	330	1.3	18-24	218	230	3.3	4.5	0	6.2	36	4.3	41	.29	003	12-20
24	22	2000	19-24	3062.5	125	084	.80	329	1.6	18-24	136	181	3.6	4.2	10	5.8	36	4.1	41	.30	002	20-28
24	22	2000	24-28	3062.5	192	148	.90	329	1.4	24-28	210	209	3.4	6.5	30	5.8	36	4.1	41	.38	002	20-28
28	26	2000	24-28	3562.5	169	095	.85	325	2.2	24-28	121	191	3.4	5.0	30	6.4	35	4.5	40	.40	002	20-28

TEST 40K LOAD

CONDITIONS:

600Ω BALANCED

50Ω UNBALANCED

REMARKS: _____

DATE _____ MODEL _____

MFG NO. _____

SERIAL NO _____

TESTED BY _____

APPROVED BY _____

THE TECHNICAL MATERIEL CORP.
MAMARONECK NEW YORK

TUNING CHART 2-28MC SYNTHESIZED

(e) POWER lamp (251) on the crowbar drawer should light and CROWBAR FILAMENT meter (247) should indicate crowbar filament voltage after setting the RESERVOIR-FILAMENT switch (252) at FILAMENT.

(f) DRIVER INTERLOCKS IND lamp (242) on PA frame should light.

(6) Set BLOWER circuit breaker (253) at ON position. The main blower in the PA frame should rotate.

CAUTION

It is possible for a three-phase blower to run backward, diminishing the flow of cooling air. To check rotation of PA frame main blower, allow blower to run for a few seconds, then set BLOWER circuit breaker at OFF. Observe main blower motor shaft (protruding through case of main blower motor) to make sure it is turning in direction indicated by arrow stenciled on blower case. Reversing any pair of three-phase power inputs at rear of PA frame will correct blower rotation.

(7) Set FINAL FIL circuit breaker (257) at ON position:

(a) FILAMENT TIME meter (231) should start registering elapsed time.

(b) FILAMENT PRIMARY meter (201) should read 230 volts. If necessary, adjust FIL ADJ (254) until this reading is obtained.

b. TUNE-UP OF 1-KW IPA AND 10-KW PA ON CARRIER.

CAUTION

When tuning and loading the 1-kw IPA and 10-kw PA, do not exceed the following meter indications:

PA PLATE CURRENT (103):	
At start of loading	1 amp
At end of loading	1.75 amp
PA SCREEN CURRENT (102):	50 ma
PA PLATE RF (104):	6 kv
IPA PLATE CURRENT (121):	400 ma
IPA screen current (as read on MULTIMETER (120) with MULTIMETER switch (122) set to DC IPA ISG):	25 ma

(1) Set MULTIMETER switch (122) at RF 1ST AMPL EP position.

(2) Apply rf drive from exciter by slowly advancing OUTPUT control (25) on CHG until indication is observed on MULTIMETER (120).

(3) Carefully adjust 1ST AMPL TUNING control (123) until peak is obtained on MULTIMETER (120). Adjust OUTPUT control (25) as necessary to keep meter reading on scale.

(4) Set MULTIMETER switch (122) at RF IPA EG position.

(5) Adjust IPA GRID TUNING control (123) for maximum reading on MULTIMETER (120).

(6) Readjust 1ST AMPL TUNING control (123), if necessary, to peak reading on MULTIMETER (120).

(7) Reduce rf drive to minimum with OUTPUT control (25) on CHG.

NOTE

If the transmitter has been idle for a long period of time, as after shipment, allow a half hour warm-up period at this point so that the mercury in rectifier tubes will be vaporized before high voltage is applied.

(8) Depress OVERLOAD RESET pushbutton (133).

(9) Set HIGH VOLTAGE circuit breaker (141) at ON position. PLATE ON lamp (109) on power amplifier should light and red indicator on roof of auxiliary frame should glow dimly at first and should brighten after 5 seconds. The mercury vapor rectifier tubes in the high voltage rectifier deck should glow brightly. PA PLATE meter (3) should indicate plate voltage (7.5 kv). DRIVER INTERLOCKS IND lamp (242) on PA frame should go out. PA PLATE CURRENT METER (103) and IPA PLATE CURRENT METER (121) should indicate zero current.

(10) Carefully advance OUTPUT control (25) on CHG until increase is noted on IPA PLATE CURRENT meter (121).

(11) Rotate IPA TUNING control (128) until dip is obtained on IPA PLATE CURRENT meter (121).

(12) Carefully advance OUTPUT control (25) until some slight reading is obtained on PA PLATE CURRENT meter (103).

(13) Adjust PA TUNE control (115) until a dip is obtained on PA PLATE CURRENT meter (102). The indication on the PA PLATE RF meter (104) should simultaneously maximize at this tuning point.

(14) Reduce rf drive to minimum with OUTPUT control (25).

(15) Set PA SCREEN switch (140) at ON.

NOTE

To prevent energizing PA screen overload circuit in main frame, be careful not to turn on PA SCREEN switch when TUNE-OPERATE switch is set to OPERATE. The proper sequence for applying full screen voltage is as follows:

TUNE-OPERATE switch (139) at TUNE

HIGH VOLTAGE circuit breaker (141) at ON

PA SCREEN switch (140) at ON

TUNE-OPERATE switch (139) at OPERATE

NOTE

If any overload relay becomes energized, high voltage is automatically turned off. If this occurs, reduce rf drive to minimum, set TUNE-OPERATE switch (139) at TUNE and PA SCREEN switch (140) at OFF and momentarily depress OVERLOAD RESET button. High voltage will be reapplied. Retune high voltage circuits, starting with step (8) above.

(16) Set TUNE-OPERATE switch (139) at OPERATE position. Adjust PA BIAS ADJ (151) for reading of .5 amps on PA PLATE CURRENT meter (103). Adjust IPA BIAS ADJ (158) for reading of 200 ma on IPA PLATE CURRENT meter (121).

(17) Retune 1-kw IPA circuits as described in steps (1) through (7) and (10) and (11) above.

(18) Alternately load 1-kw IPA with IPA LOADING controls (130 and 127) to give an increased reading on IPA PLATE CURRENT meter (121), and tune 1-kw IPA with IPA TUNING control (128) for a dip on IPA PLATE CURRENT meter. Continue to load and tune IPA, loading in small increments, until IPA PLATE CURRENT meter reads approximately 300 ma. Set MULTIMETER switch (122) to IPA ISG position and check that IPA screen current is approximately 15 ma as displayed on MULTIMETER (120). If IPA screen current is above 15 ma, increase IPA plate loading and retune until proper screen current is obtained.

CAUTION

During IPA loading phase, be careful to limit drive to keep reading on PA PLATE CURRENT meter (103) at a reasonable level (below one amp.).

(19) Alternately load the 10-kw PA with PA LOAD control (116) to give an increased reading on PA PLATE CURRENT meter (103), and tune PA with PA TUNE control (115) for a dip on PA PLATE CURRENT meter. Continue to load and tune 10-kw PA, loading in small increments, until approximately 1.5 amperes is obtained on PA PLATE CURRENT meter (103) and 2 to 5 kv rf obtained on PA PLATE RF meter (104). Check that the reading on PA SCREEN CURRENT meter (102) is below 50-ma. If PA screen current is excessive, increase the PA plate loading and retune proper screen current is obtained.

(20) Reduce rf drive to minimum with OUTPUT control (25) on CHG.

(21) Set HIGH VOLTAGE circuit breaker (141) to OFF position. DRIVER INTERLOCKS IND lamp (242) should light.

NOTE

If the transmitter is connected for balanced operation, proceed to step c below. For unbalanced output operation, proceed to step d below.

c. TUNE-UP OF 40-KW PA - BALANCED OUTPUT OPERATION.

CAUTION

When tuning and loading 40-kw PA, do not exceed the following meter indications.

PLATE CURRENT (203):	
At starting of loading	2 amperes
At end of loading	6 amperes
PLATE RF (204):	8 kv
GRID CURRENT (244):	200 ma

(1) Set OUTPUT LOADING control (119) at OPER. TUNE lamp (207) should go out and OPERATE lamp (208) should light.

(2) Set DRIVER INTERLOCKS switch (243) at ON position.

(3) Depress OVERLOAD RESET switch (214) and HV BREAKER RESET switch (217). None of the lamps (except DRIVER INTERLOCK IND lamp) on the PA frame relay panel should be on.

(4) Rotate INTERLOCK switch (221) clockwise through its 12 positions. INTERLOCK INDICATOR lamp (215) should light at each position. (When the switch is set to TIMER, the preset time delay interval must first expire before the lamp will light.)

NOTE

If lamp fails to light in any position, check the drawer, door, or panel that corresponds to first switch position at which INTERLOCK INDICATOR lamp (215) fails to light. Correct open interlock condition before proceeding to next step.

NOTE

If the transmitter has been idle for a long period of time (as after shipment), allow half hour warm-up period at this point so mercury in rectifier tubes will be vaporized before high voltage is applied.

(5) Adjust BIAS ADJ (222) on PA frame for an indication of 550 volts on GRID VOLTS meter (245). Set HIGH VOLTAGE circuit breaker (220) at ON. PLATE ON lamp (209) on the 40-kw PA and the red lamp inside the 40-kw PA section should glow after approximately 5 seconds. HV BREAKER INDICATOR lamp (216) should light. The mercury vapor tubes in the 40-kw high voltage rectifier should glow. Adjust BIAS ADJ (222) on PA frame for an indication of 1.8 amperes on PLATE CURRENT meter (203).

(6) Set HIGH VOLTAGE circuit breaker (141) on main frame at ON.

(7) When DRIVER INTERLOCKS IND lamp (242) goes out, set DRIVER INTERLOCKS switch (243) at OFF position.

(8) Carefully turn OUTPUT control (25) on CHG clockwise until an increase is indicated on PLATE CURRENT meter (203).

(9) Adjust TUNE control (210) for dip on PLATE CURRENT meter (203).

(10) Turn OUTPUT control (25) clockwise until PA PLATE CURRENT meter (103) reads approximately 2 amperes.

(11) Adjust BALANCE control (250) until both rf meters connected to the antenna terminals on the roof of the PS frame indicate equal current.

(12) Adjust TUNE control (210) for dip on PLATE CURRENT meter (203).

(13) Hold SWR switch (138) on main frame in SWR position. Rotate OUTPUT BAL control (118) on main frame for a dip in VSWR on PA OUTPUT meter (105). If VSWR is considerably below 2:1, set SWCU front panel 2:1/3:1 switch of 2:1.

(14) Adjust PA TUNE control (115) on main frame for dip on PA PLATE CURRENT meter (103).

(15) Adjust IPA TUNING control (128) for dip on IPA PLATE CURRENT meter (121).

(16) Adjust LOAD control (212) for increased reading on external rf meters (5.7 amps maximum).

(17) Adjust TUNE control (210) for dip in PLATE CURRENT meter (203).

(18) Repeat steps (16) and (17), increasing the rf output in small increments until the external rf meters read approximately 5.7 amperes.

(19) Adjust PA TUNE control (115) for dip on PLATE CURRENT meter (103).

(20) Adjust IPA TUNING control (128) for dip on IPA PLATE CURRENT meter (121).

(21) If necessary, repeat steps (16) through (20) until the external meter readings are 5.7 amperes. When 5.7 amps antenna current is obtained, note the reading on PLATE RF meter (204). This reading will be used in setting up the transmitter for full PEP after modulation is applied.

NOTE

At conclusion of tuning procedure, meter readings on the PA frame and PS frame should agree approximately with the following values:

DRIVE (202):	300-600 volts
PLATE CURRENT (203):	4-5 amps
PLATE RF (204):	5.0 - 8.0 kv
GRID CURRENT (244):	0-125 ma
PLATE VOLTS (246):	11 kv
GRID VOLTS (245):	450-550 volts

d. TUNE-UP OF 40-KW PA. - UNBALANCED OUTPUT OPERATION.

CAUTION

When tuning and loading the 40-kw PA, do not exceed the following meter indications:

PLATE CURRENT (203):	
At start of loading	2 amperes
At end of loading	6 amperes
PLATE RF (204):	8 kv
GRID CURRENT (244):	200 ma

(1) Set OUTPUT LOADING control (119) at OPER. TUNE lamp (207) should go out and OPERATE lamp (208) should light.

(2) Set DRIVER INTERLOCKS switch (243) at ON position.

(3) Depress OVERLOAD RESET switch (214) and HV BREAKER RESET switch (217). None of the lamps on the PA frame relay panel (except DRIVER INTERLOCKS IND light) should be on.

(4) Rotate INTERLOCK switch (221) clockwise through its 12 positions. INTERLOCK INDICATOR lamp (215) should light at each position. (When the switch is set at TIMER, the preset time delay interval must first expire before the lamp will light.)

NOTE

If the lamp fails to light in any position, check the drawer, door, or panel that corresponds to the first switch position at which INTERLOCK INDICATOR lamp (215) fails to light. Correct open interlock condition before proceeding to the next step.

NOTE

If the transmitter has been idle for a long period of time (as after shipment), allow half hour warm-up period at this point so mercury in rectifier tubes will be vaporized before high voltage is applied.

(5) Adjust BIAS ADJ (222) on PA frame for an indication of 550 volts on GRID VOLTS meter (245). Set HIGH VOLTAGE circuit breaker (220) at ON. PLATE ON lamp (209) on the 40-kw PA and the red lamp inside the 40-kw PA section should glow after approximately 5 seconds. The mercury vapor tubes in the 40-kw high voltage rectifier should glow. Adjust BIAS ADJ (222) on PA frame for an indication of 1.8 amperes on PLATE CURRENT meter (203).

(6) Set HIGH VOLTAGE circuit breaker (141) on main frame at ON.

(7) When DRIVER INTERLOCKS IND lamp (242) goes out, set DRIVER INTERLOCKS switch (243) at OFF position.

(8) Carefully turn OUTPUT control (25) on CHG clockwise until an increase is indicated on PLATE CURRENT meter (203).

(9) Adjust TUNE control (210) for a dip on PLATE CURRENT meter (203).

(10) Turn OUTPUT control (25) clockwise until PA PLATE CURRENT meter (103) reads approximately 2 amperes.

(11) Adjust PA TUNE control (115) for dip on PA PLATE CURRENT meter (103).

(12) Hold SWR toggle switch (138) on main frame in SWR position. Rotate OUTPUT BAL control (118) on main frame for a dip on PA OUTPUT meter (105). If VSWR is considerably below 2:1, set SWCU front panel 2:1/3:1 switch of 2:1.

(13) Adjust IPA TUNING control (128) for dip on IPA PLATE CURRENT meter (121).

(14) Adjust LOAD control (212) for rise on OUTPUT meter (205) reading.

(15) Adjust TUNE control (210) for dip on PLATE CURRENT meter (203).

(16) Repeat steps (14) and (15) until reading on OUTPUT meter (205) is either 16.6 kw (72 ohm load) or 20 kw (50 ohm load).

(17) Adjust PA TUNE control (115) for dip on PA PLATE CURRENT meter (103).

(18) Adjust IPA TUNING control (128) for dip on IPA PLATE CURRENT meter (121).

(19) Hold the CAL-SWR switch (255) in the CAL position and adjust SWR CAL control (256) until the pointer on SWR meter (248) is aligned with the CAL mark, then release the switch.

(20) Repeat steps (14) through (18) until full rated (see NOTE below) is obtained on OUTPUT meter. Note the corresponding reading on PLATE RF meter (204). This reading will be used in setting up the transmitter for full PEP after modulation is applied.

NOTE

At conclusion of tuning procedure, the meter readings on the PA and PS frames should agree approximately with the following values:

DRIVE (202)	300-600 volts
PLATE CURRENT (203)	4-5 amperes
PLATE RF (204)	5-8 kv
OUTPUT (205)	16.6 kw (72 ohm load) or 20 kw (50 ohm load)
GRID CURRENT (244)	0-125 ma
GRID VOLTS (245)	450-550 volts
SWR (248)	Less than 2.5

e. FINAL CARRIER TUNE-UP CHECK. - Recheck settings of TUNE control (210) and PA TUNE control (115) to make sure that interaction has not affected tuning. If necessary, touch up control settings. This completes tune-up of transmitter on carrier. Reduce rf drive to minimum with OUTPUT control (25) on CHG.

NOTE

Two-tone distortion testing is described in section 4.

3-7. SET-UP OF TONE INTELLIGENE UNIT TIS.

NOTE

See paragraph 3-4c for discussion of offset carrier frequency operation when using the TIS for keying or facsimile transmitter operation only.

All modulating inputs to the transmitter are applied through the TIS. The following paragraphs describe the procedures required to set up the TIS after the transmitter is tuned on carrier.

a. AUDIO LINE MODULATION. - When audio line intelligence is connected to the audio line 1 and/or audio line 2 inputs of the transmitter, the TIS audio tone circuits are not required. To modulate the transmitter directly from audio lines, proceed as follows:

(1) For single or double sideband transmission, determine in which audio line the modulating intelligence is located. If it is contained in audio line 1, set EXCITER CH 1 switch (57) on the TIS at LINE position. If in audio line 2, set EXCITER CH 2 switch (58) at LINE.

(2) For independent sideband transmission, when two audio line inputs are to be used for separate sideband transmissions, set both EXCITER switches (57 and 58) at LINE.

b. FSK OPERATION. - For FSK operation from teletype signals delivered by associated teletype equipment, proceed as follows:

(1) Make sure that teletype equipment is supplying FSK signals to auxiliary frame.

(2) Set FUNCTION switch (53) at FSK.

(3) Set TEST switch (55) at LINE.

(4) Set CENTER FREQ CPS switch (54) at 2000 or 2550, depending on the center frequency desired.

(5) Adjust SHIFT CPS control (50) until desired total frequency shift appears on counter.

(6) Set KEY MODE switch (56) at position that matches the mode of teletype signal input (voltage or current, and level).

(7) Place the FSK audio output of the TIS in the desired audio channel by positioning EXCITER CH 1 or EXCITER CH 2 switch (as applicable) at FSK-FAX-CW.

(8) Adjust LEVEL ADJ control (51) for a mid-range reading on OUTPUT LEVEL meter (52).

c. FAX OPERATION. - For FAX operation from varying dc FAX signals from associated facsimile equipment, proceed as follows:

(1) Make sure that facsimile equipment is supplying FAX signals to the auxiliary frame.

(2) Set FUNCTION switch (53) to FAX.

(3) Set CENTER FREQ CPS switch (54) to 1900.

(4) Place the FAX audio output of the TIS in the desired audio channel by positioning EXCITER CH 1 or EXCITER CH 2 switch (as applicable) to FSK-FAX-CW.

(5) Adjust LEVEL ADJ control (51) for a mid-range reading on OUTPUT LEVEL meter (52).

d. CW KEYING. - (TELEGRAPH.) For cw modulation from voltage or current keying CW signals delivered externally, proceed as follows:

(1) Set FUNCTION switch (53) to CW position.

(2) Set TEST switch (55) to LINE.

(3) Set KEY MODE switch (56) at position which matches mode of CW input signal.

(4) Make sure that CW signals are being supplied to the auxiliary frame by keyer.

(5) Place the CW audio output signals of the TIS in the desired audio channel by setting EXCITER CH 1 or EXCITER CH 2 switch (57 or 58) to FSK-FAX-CW position.

(6) Adjust LEVEL ADJ control (51) for mid-range reading on OUTPUT LEVEL meter (52).

e. CARRIER ON-OFF CW KEYING. - When "dry" (contact) CW keying is to be used, the TIS is not used. To operate the transmitter in this mode, proceed as follows:

(1) Remove jumper that connects terminals 17 and 18 on terminal board E3002 on the rear of the auxiliary frame. Connect handkey across these terminals.

(2) With handkey maintained in depressed (closed position), tune transmitter on carrier (paragraphs 3-5 and 3-6).

(3) Set CARRIER LEVEL control (8) on CBE at 0 DB.

(4) Set LSB and USB selector switches (6 and 10, respectively) at their OFF positions.

(5) Key carrier by operating handkey.

3-8. SINGLE SIDEBAND OPERATION.

a. Tune up the transmitter on carrier as described in paragraphs 3-5 and 3-6. If operating FSK or FAX, using the TIS, be sure to offset carrier as required to maintain proper assigned frequency. (See paragraph 3-4c.)

b. Set up the TIS for the desired type of operation as described in paragraph 3-7.

c. Rotate CARRIER LEVEL control (8) on CBE to MIN (fully ccw) position.

d. To place the selected audio intelligence from the TIS into the lower sideband of the transmitter output, set LSB selector switch (6) on CBE at either CH 1 or CH 2, as applicable. For upper sideband operation, set the USB selector switch at the applicable audio channel. Set unused sideband selector switch (LSB or USB) at OFF position.

NOTE

The audio channel inputs to the CBE correspond to the channel outputs previously set up at the TIS.

e. For FAX, FSK, or CW transmission, adjust GAIN control (7 or 9) of selected sideband (with input applied to transmitter) so that corresponding sideband meter (4 or 5) reads -3 db. For voice transmission on audio line input, adjust applicable GAIN control for reading of -6 db.

f. For suppressed carrier operation, leave CARRIER LEVEL control (8) in MIN (off) position. For -10 db or -20 db carrier insertion, rotate CARRIER LEVEL control (8) to -10 or -20 db, respectively.

g. With modulating inputs set up, carefully turn up rf drive with OUTPUT control (25) on CHG until reading on PLATE RF meter (204) indicates the same voltage as when tuned on carrier only. (See paragraphs 3-6d for unbalanced output operation, or paragraph 3-6c for balanced operation.) When transmitter output is brought up to this point, output level is approximately 40-kw PEP.

NOTE

When multiple tone transmission is employed, some reduction in antenna current will be noticed, as compared with the value obtained with pure carrier power output. This is normal and results because of instantaneous addition and cancellation of tones. Do not increase drive above the previously observed rf plate voltage -- such action may produce excessive distortion.

h. Set up the automatic load and drive control (ALDC) circuit as follows:

(1) Set ALDC switch (137) at ON. Advance this control until reading on OUTPUT meter (205) just begins to drop.

(2) Increase rf drive until reading on PLATE RF meter (204) is the same as in step g.

3-9. DOUBLE SIDEBAND OPERATION.

a. Tune up transmitter on carrier as described in paragraphs 3-5 and 3-6.

b. Set up TIS for desired type of modulation as described in paragraph 3-7.

c. Rotate CARRIER LEVEL control (8) on CBE to MIN (full ccw) position.

d. Set USB selector switch (10) at CH 1 or CH 2 position, depending on which is receiving the desired audio input. Set USB GAIN control (9) at quarter scale.

e. Set LSB selector switch (6) at OFF and LSB GAIN control (7) at quarter scale.

f. If suppressed carrier operation is to be used, adjust USB GAIN control (9) until USB meter (5) reads 50% on audio peaks. For 10-percent carrier injection (carrier down 20 db from full power) adjust USB GAIN control for reading of 45% on audio peaks.

g. Set USB switch (10) at OFF position and LSB switch (6) at desired audio channel (CH 1 or CH 2 position).

h. If suppressed carrier operation is to be used, adjust LSB GAIN control (7) until LSB meter (4) reads 50% on audio peaks. For 10-percent carrier injection, adjust LSB GAIN control for reading of 45% on audio peaks.

i. Return USB switch to setting chosen in step d.

j. Compare readings on both meters. If unequal, adjust associated GAIN controls slightly to equalize.

k. For suppressed carrier operation, leave CARRIER LEVEL control (8) in MIN (fully ccw) position. For 10-percent carrier injection, rotate CARRIER LEVEL control to -20 DB.

l. Apply drive to transmitter and adjust ALDC circuit (if desired) as described in paragraph 3-8, g and h.

3-10. INDEPENDENT SIDEBAND OPERATION.

a. Tune up the transmitter on carrier as described in paragraphs 3-5 and 3-6.

b. Set up the TIS for the desired types of modulation as described in paragraph 3-7.

c. Rotate CARRIER LEVEL control (8) to MIN position.

d. Set USB selector switch (10) at CH 1 or CH 2 position, depending on which audio channel is to be placed in the upper sideband. Set USB GAIN control (9) at quarter scale.

e. Set LSB selector switch (6) to OFF and LSB GAIN control (7) at quarter scale.

f. If suppressed carrier operation is to be used, adjust USB GAIN control (9) until USB meter (5) reads 50% on audio peaks. For 10-percent carrier injection, adjust USB GAIN control for reading of 45% on audio peaks.

g. Set USB switch (10) at OFF position and LSB switch (6) at other channel; i.e., if the USB switch was set at CH 1 in step d, set the LSB switch at CH 2.

h. For suppressed carrier operation, adjust LSB GAIN control (7) until LSB meter (4) reads 50% on audio peaks. For 10-percent carrier injection, adjust LSB GAIN control for reading of 45% on audio peaks.

i. Return USB switch (10) to same setting used in step d.

j. Compare readings on both meters, if unequal, adjust associated GAIN controls slightly to equalize.

k. For suppressed carrier operation, leave CARRIER LEVEL control (8) in MIN position. For 10-percent injection, rotate CARRIER LEVEL control to -20 DB.

l. Apply drive to transmitter and adjust ALDC circuit (if desired) as described in paragraph 3-8, g and h.

3-11. CW OPERATION.

a. Tune up the transmitter on carrier as described in paragraphs 3-5 and 3-6. If TIS is to be used for keying, offset carrier by 1 kc to maintain proper assigned frequency.

b. Set up the TIS for CW operation as described in paragraph 3-7d.

c. Rotate CARRIER LEVEL control (8) to MIN position.

d. Insert CW signals into either sideband by setting the LSB or USB selector switch (6 or 10, respectively) at the channel that is receiving the keying signals from the TIS. Set the other sideband switch at OFF.

e. With tone applied, adjust the appropriate GAIN control (7 or 9) for a reading of -3 DB on the appropriate meter (4 or 5).

f. Apply drive to transmitter as described in paragraph 3-8g.

3-12. EMERGENCY OPERATION.

If the 40-kw PA fails to function properly, it is possible to operate the transmitter at 10-kw PEP, using the 10-kw PA as an emergency power amplifier and bypassing the 40-kw PA stage. It is also possible to bypass both the 10-kw PA and 40-kw PA stages, and operate at 1-kw PEP from the 1-kw IPA. The transmitter may be set up for either emergency output by making appropriate connections as shown on decals permanently affixed to the inner side walls of the associated transmitter stages.

3-13. 10-KW EMERGENCY OPERATION.

a. CONNECTIONS.

(1) Set MAIN POWER circuit breakers (132 and 219) on the main frame and PA frame, respectively, at OFF.

(2) Set OUTPUT LOADING control (119) at EMER position.

WARNING

Before proceeding, make sure that all capacitors in the 40-kw PA section are discharged.

(3) For emergency balanced output, make connections as shown in applicable portion of PA frame decal.

(a) Remove balance strap from its normal position between the connector nut on the vacuum capacitor stand and the antenna tuning unit connector on the side wall of the PA section.

(b) Connect one shorting strap between the EMER and BAL OUTPUT terminals on the PA frame antenna terminal board.

(c) Connect a second shorting strap between the GRD 2 and DC7302 terminals on the PA frame antenna terminal board.

(4) For emergency unbalanced output operation, make appropriate connections as shown on PA frame decal:

(a) Connect the balance strap between the connector nut on the vacuum capacitor stand and the antenna tuning unit connector on the side wall of the PA section.

(b) Connect one shorting strap between the EMER and DC7302 terminals on the antenna terminal board.

(c) Connect a second shorting strap between the BAL OUTPUT and GRD 1 terminals on the antenna terminal board.

b. TUNING TRANSMITTER ON CARRIER.

(1) Tune up the exciter on carrier as described in paragraph 3-5.

(2) Perform preliminary procedure described in paragraph 3-6a, (1) through (4), but leave OUTPUT LOADING control in EMER position.

(3) Tune and load 1-kw IPA and 10-kw PA on carrier as described in paragraphs 3-6b.

(4) If the transmitter is connected for emergency unbalanced output, leave BALANCE control (250) at the tuning chart position. For emergency operation, maximum permissible output, as indicated by PA OUTPUT meter (105) is 10 kilowatts PEP. (This corresponds to 8.4 amperes into a 70-ohm load or 10 amperes into a 50-ohm load, for an average power of 5 kilowatts.

NOTE

To measure VSWR on the transmission line, hold SWR switch in SWR position and read VSWR on lower scale of PA OUTPUT meter (105).

(5) If the transmitter is set up for emergency balanced output, adjust BALANCE control (250) until both external rf meters connected to the antenna terminals on the roof of the PS frame indicate equal currents. For a 600-ohm antenna, maximum current in each leg is 2.9 amps (5 kilowatts average).

c. SET UP OF TONE INTELLIGENCE UNIT TIS. - Set up the TIS as described in paragraph 3-7.

d. SSB, DSB, ISB, and CW OPERATION. - Perform the applicable procedures described in paragraphs 3-8 through 3-11. When applying drive to the transmitter, be careful to limit peak envelope power, as indicated on PA OUTPUT meter (105) to 10 kilowatts.

3-14. 1-KW EMERGENCY OPERATION.

a. CONNECTIONS.

(1) Set MAIN POWER circuit breakers (132 and 219) on the main frame and PA frame, respectively, at OFF.

WARNING

Before proceeding, make sure that all capacitors in the main frame PA section are discharged.

(2) Disconnect and remove lead from coupling capacitor C949 to input of directional coupler DC900.

(3) Connect cable W901 (loose item) between P902 and input of directional coupler DC900.

(4) Connect plug P1009 on cable W1004 (from 1-kw IPA) to P902 through feed through connector CP900.

(5) Set OUTPUT LOADING control (119) at EMER.

b. TUNING. - Tune the rf and 1-kw IPA circuits on carrier as follows:

(1) Tune up the exciter on carrier as described in paragraph 3-5.

(2) Perform procedures described in paragraph 3-6, a(1) through a(4) and b(1) through b(11).

(3) Set TUNE-OPERATE switch (139) at OPERATE position. Adjust IPA BIAS ADJ (158) for a reading of 200 ma on IPA PLATE CURRENT meter (121).

(4) Return rf amplifier and 1-kw IPA circuits as described in paragraph 3-6, b(1) through b(7) and b(11).

c. LOADING. - Load the 1-kw IPA as described in paragraph 3-6b(18), until the IPA PLATE CURRENT meter reads approximately 300 ma.

d. UNBALANCED OUTPUT TERMINATION.

(1) If the transmitter is connected for unbalanced output, setting of BALANCE control (250) is of no importance.

(2) For emergency operation, maximum permissable output is 1-kw PEP. For a 50-ohm antenna, this corresponds to approximately 3.1 kw as indicated on OUTPUT meter (205). For a 70-ohm antenna, it is approximately 2.6 kw.

e. BALANCED OUTPUT TERMINATION.

(1) Adjust BALANCE control (250) until the two external antenna current meters on the roof of the PS frame indicate equal currents.

(2) For balanced 600-ohm output, maximum antenna current in each leg is .91 amperes.

f. SET UP OF TONE INTELLIGENCE UNIT TIS.- Set up the TIS as described in paragraph 3-7.

g. SSB, DSB, ISB, AND CW OPERATION. - Perform the procedures described in paragraphs 3-8 through 3-11. When applying drive to the transmitter, be careful to limit peak envelope power to 1 kilowatt.

3-15. STOPPING PROCEDURES.

a. STANDBY. - When the GPT-40K is to be turned off for a limited interval of time, the temperature control oven circuits in the exciter should be left on to maintain maximum frequency stability. To place the transmitter in standby, proceed as follows:

UNIT	CONTROL	POSITION	ACTION
PA frame control panel	HIGH VOLTAGE (220) MAIN POWER (219)	OFF OFF	All indicators on PA and PS frames go off and meters drop to zero.
PS frame control panel	BLOWER (253) FINAL FIL (257)	OFF OFF	
Main frame control panel	PA SCREEN (140) TUNE-OPERATE (139) HIGH VOLTAGE (141) MAIN POWER (132)	OFF TUNE OFF OFF	All indicators on main frame go off and all meters on auxiliary frame meter panel drop to zero.
CPP-2	POWER-STANDBY	STANDBY	POWER lamp (62) goes off STANDBY lamp (61) lights
TIS	B+ (60)	STANDBY	B+ lamp (59) goes off
CSS	ON-STANDBY (45)	STANDBY	POWER lamp (42) goes off STANDBY lamp (47) lights
CHG	POWER (14)	STANDBY	STANDBY lamp (15) lights
CBE	ON-OFF (12)	OFF	POWER lamp (11) goes off

b. COMPLETE STOPPING. - If the transmitter is in standby, simply set MAIN POWER AUXILIARY FRAME circuit breaker on rear of auxiliary frame to OFF. For complete stopping from full on condition, proceed as follows:

UNIT	CONTROL	POSITION
PA Frame Control	HIGH VOLTAGE (220)	OFF
	MAIN POWER (219)	OFF
PS Frame Control Panel	BLOWER (253)	OFF
	FINAL FIL (257)	OFF
Main Power Panel	PA SCREEN (140)	TUNE
	TUNE-OPERATE (139)	OFF
	HIGH VOLTAGE (141)	OFF
	MAIN POWER (132)	OFF
Auxiliary Frame	MAIN POWER AUXILIARY FRAME	OFF

c. EMERGENCY STOPPING. - For quick stopping during an emergency, set the following circuit breakers at OFF:

MAIN POWER (219)

MAIN POWER (132)

BLOWER (253)

MAIN POWER AUXILIARY FRAME

NOTE

Every attempt should be made to maintain power to the exciter at all times. Indiscriminate interruption of power will result in loss of frequency stability and may require resetting of the 1-mc frequency standard in primary standard CSS.

3-16. OPERATOR'S MAINTENANCE.

a. GENERAL. - The operator should observe that transmitter controls, indicator lamps, and meters are functioning properly. During daily operation, all electrical quantities measurable with built-in meters should be observed and compared with established standards. Noticable irregularities should be immediately referred to maintenance personnel.

b. REPLACEMENT OF FUSES. - Tables 3-3 and 3-4 list all fuses in the transmitter, their panel designations, types, and indicate their functions.

CAUTION

Never replace a fuse with one of higher rating. If a fuse burns out immediately after replacement, do not replace it a second time until the trouble has been located and corrected.

TABLE 3-3. AUXILIARY AND MAIN FRAMES, FUSE LOCATIONS AND FUNCTIONS

LOCATION	PANEL DESIGNATION	TYPE	CIRCUIT PROTECTED	REFERENCE DESIGNATION
10-kw high voltage rectifier	H.V. FILAMENT	MDL 1	Filaments V600 through V605	F600 through F605
Relay panel	MAIN BLOWER	MDL 10	Main blower B800	F700 through F702
Relay panel	REAR FAN	MDL 5	Rear fan B3001	F703
Relay panel	PA FIL	MDL 5	Filaments of PA V900	F705
Relay panel	TIMER	MDL 1	Timer M701	F704
Rf amplifier drawer	B+	MDL 1/4	Plate circuits of V201 and V202 in RFC	F2000
Rf amplifier drawer	IPA BIAS	MDL 1/8	Bias circuit of PA V900	P2001
Rf amplifier drawer	IPA BLOWER	MDL 2	Blower B201	F2002
Rf amplifier drawer	IPA FIL	MDL 2	Filament of IPA V203	F2003
Rf amplifier drawer	LV	MDL 1.5	Rf amplifier driver	F2004
Auxiliary frame (rear)	FRONT FAN	MDL 5	Front fan B3000	F3000
SWCU-1	OVLD LIGHT	MDL 1	Lamp I705	F101
SWCU-1	B+	MDL 1/8	SWCU-1 power supply	F102
SWCU-1	AC	MDL 1	SWCU-1 transformer T101	F103

TABLE 3-4. PA AND PS FRAMES, FUSE LOCATIONS AND FUNCTIONS

LOCATION	PANEL DESIGNATION	TYPE	CIRCUIT PROTECTED	REFERENCE DESIGNATION
Bias supply	LV	AGC 1/8	Low voltage power supply	F7501
	BIAS	MDL-1/2	600-volt power supply	F7502
	AC POWER	MDL-3	Transformer T7501	F7503
Relay panel	TOP FAN	MDL-5	Top fan B7301	F7601
	BLOWER	MDL-2	Blower delay meter	F7602
	ELAPSE METERS	MDL-2	Filament time meter	F7603
	TIME DELAY	MDL-2	Time delay and plate time meters	F7604
	SHORTING RELAY	MDL-2	Time delay relay	F7605
	BLOWER CONTACTOR	MDL-2	Blower relay K7101	F7606
PS frame	TOP FAN	MDL-3	Top fan B8102	F8101
40-kw high voltage power supply	H.V. FILAMENT	MDL-1	Filament transformers T8401 thru T8406	F8401 thru F8406
PS frame control panel	INTERLOCK	MDL-5	Contactors K8101 and K8102	F8501
	BREAKER MOTOR	MDL-5	Breaker motor B8101	F8502
	LIGHTS	MDL-2	Antenna tuning unit light circuit	F8503

SECTION 4
SUPPLEMENTARY DATA

4-1. INTRODUCTION.

This section contains supplementary information useful to the operator of the GPT-40K transmitter. Paragraph 4-2 relates maximum antenna current to peak envelope power so that the operator can compute maximum current levels for his specific application. Paragraph 4-3 describes two-tone test procedures, as used to set up full PEP and checking distortion.

4-2. CALCULATION OF MAXIMUM ANTENNA CURRENT.

a. GENERAL. - When tuning the GPT-40K transmitter, care must be taken not to exceed specified power ratings. This paragraph indicates how maximum antenna current can be approximately calculated for different antenna impedances under carrier or multi-signal transmission. A practical method of setting up the transmitter for maximum PEP and minimum distortion with any complex type of sideband information is included in paragraph 4-3.

b. CARRIER TRANSMISSION. - The GPT-40K is rated at 40,000 watts PEP, 20,000 watts average (CW or FSK). When tuning the transmitter to full PEP, always calculate maximum antenna current in terms of average power.

Thus, $P_{average} = 20,000 \text{ watts} = \frac{2}{1\ R}$

or $I_{max} = \sqrt{\frac{20,000}{R}}$

where Imax = maximum antenna current

R = antenna impedance

For unbalanced 70-ohm output,

$$I_{max} = \sqrt{\frac{20,000}{70}} = 16.6 \text{ amperes}$$

For unbalanced 50-ohm output,

$$I_{max} = \sqrt{\frac{20,000}{50}} = 20 \text{ amperes}$$

When operating balanced 600-ohm output,

$$I_{max} = \sqrt{\frac{20,000}{600}} = 5.8 \text{ amperes}$$

c. MULTI-TONE TRANSMISSION. - When two or more tones are used to modulate a sideband,

$$P_{average} = \frac{PEP}{N}$$

where PEP = Peak Envelope Power

N = Number of Tones

(1) For two-tone operation,

$$P_{average} = \frac{40,000}{2} = 20,000 \text{ watts}$$

Thus, maximum antenna current on two-tone transmissions can be calculated as for carrier transmission (b, above).

(2) Now assume that four tones are used:

$$P_{average} = \frac{PEP}{4} = 10,000 \text{ watts}$$

For unbalanced 70-ohm output,

$$I_{max} = \sqrt{\frac{10,000}{70}} = \sqrt{142.8} = 11.8 \text{ amperes}$$

For unbalanced 50-ohm output,

$$I_{max} = \sqrt{\frac{10,000}{50}} = \sqrt{200} = 14 \text{ amperes (approx)}$$

For balanced 600-ohm output,

$$I_{max} = \sqrt{\frac{10,000}{600}} = \sqrt{16.6} = 4 \text{ amperes (approx)}$$

Thus, as more tones are added, antenna current is reduced for any given PEP rating. In practice, rf excitation must be reduced to prevent exceeding the PEP as more tones are added. Failure to reduce excitation will result in excessive distortion and may damage equipment.

4-3. TWO-TONE TESTING.

a. GENERAL. - The operating procedures presented in section 3 can be used to quickly bring the GPT-40K to full rated output in the field. This paragraph describes an alternate method of obtaining full rated power, using two-tone testing techniques, and indicates how signal-to-distortion ratio can be measured at rated output. An rf spectrum analyzer and a two-tone generator (such as a TMC Model PTE-3, or equivalent) must be used to measure

signal-to-distortion ratio. In the absence of a spectrum analyzer, rough distortion checks can be made with a good oscilloscope.

If the output signal of a linear amplifier is a replica of the exciting signal, there are no distortion products.

However; when a multiple signal source (such as multiple tones or a voice signal) is applied, an inherent mixing action occurs, producing distortion. Such distortion products are the sum and difference combinations of the original frequencies. The degree of such intermodulation distortion caused by any nonlinearity can be measured by the two-tone test. In this test, two known radio frequencies of equal amplitude are applied to the amplifier and the output signal is examined for spurious products. These products fall in the fundamental signal region and in the harmonic regions. The tuned circuits of the amplifier filter out the spurious signals falling in the harmonic regions. Such signals are called even order products. However, the odd-order products (such as third order and fifth order) fall close to the fundamental output frequency of the amplifier. The third-order product frequencies are $2f_1 - f_2$ and $2f_2 - f_1$ where f_1 and f_2 represent any two radio frequencies present in the desired transmission. The fifth-order product frequencies are $3f_1 - 2f_2$ and $3f_2 - 2f_1$. These are shown in figure 4-1. For illustrative purposes, figure 4-1 shows the basic tones and third and fifth order distortion products when a 2-mc carrier is modulated by two audio tones of 935 cps and 2805 cps. Note that the frequency spacing of the distortion products is always equal to the frequency difference between the two original tones, or legitimate sideband frequencies. When a linear amplifier is heavily overloaded, such spurious frequencies can extend beyond the original channel, causing adjacent channel interference.

Using a two-tone test, the distortion (called signal-to-distortion ratio) is defined as the ratio of the amplitude of one test tone to the amplitude of the odd-order products and is expressed in db. Generally, odd-order products such as the fifth, seventh, and so forth, are negligible in amplitude in comparison to the third-order product. In the GPT-40K, the signal-to-distortion ratio for a two-tone input at full rated output is specified as 35 db minimum.

EXAMPLE 1

Figure 4-2 shows output waveforms observed on the spectrum analyzer of the PTE-3 with two-tone input applied to the transmitter and the transmitter tuned and loaded to 40-kw PEP, operating single sideband, upper carrier. In each case, the bandwidth displayed is 10-kc. In pattern A, the carrier (almost fully suppressed) is centered on the display. The two test tones appear 935 cps and 2805 cps above the carrier. The third order modulation product

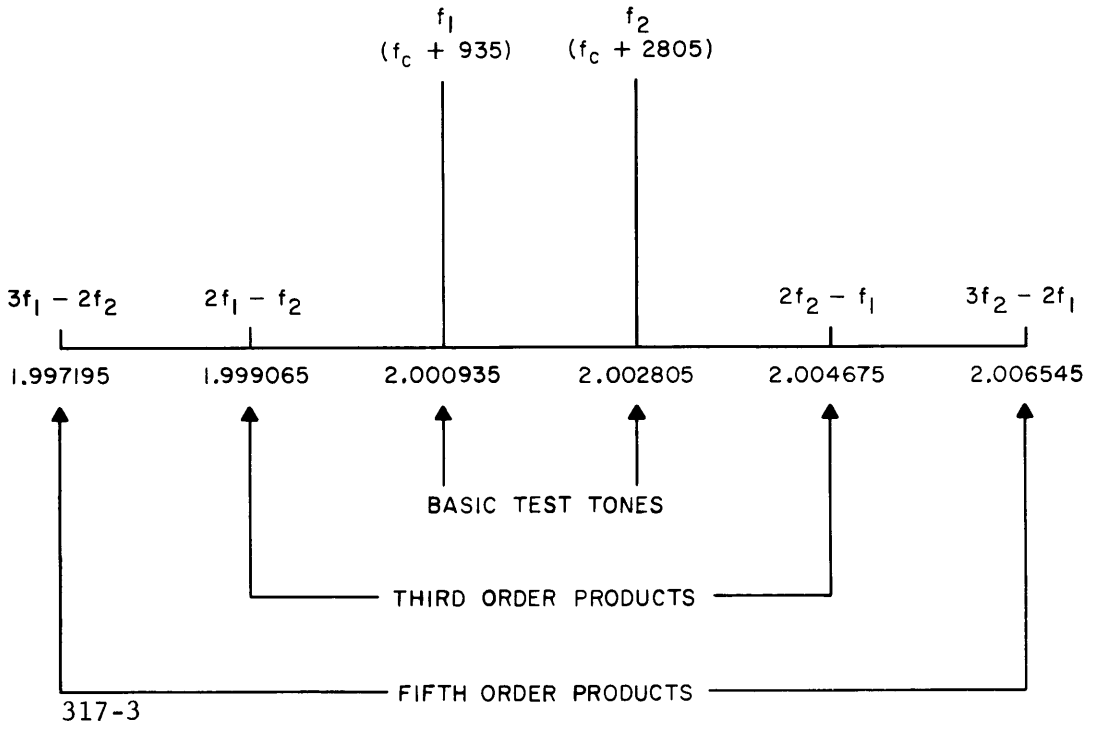

Figure 4-1. Odd Order Distortion Product Distribution

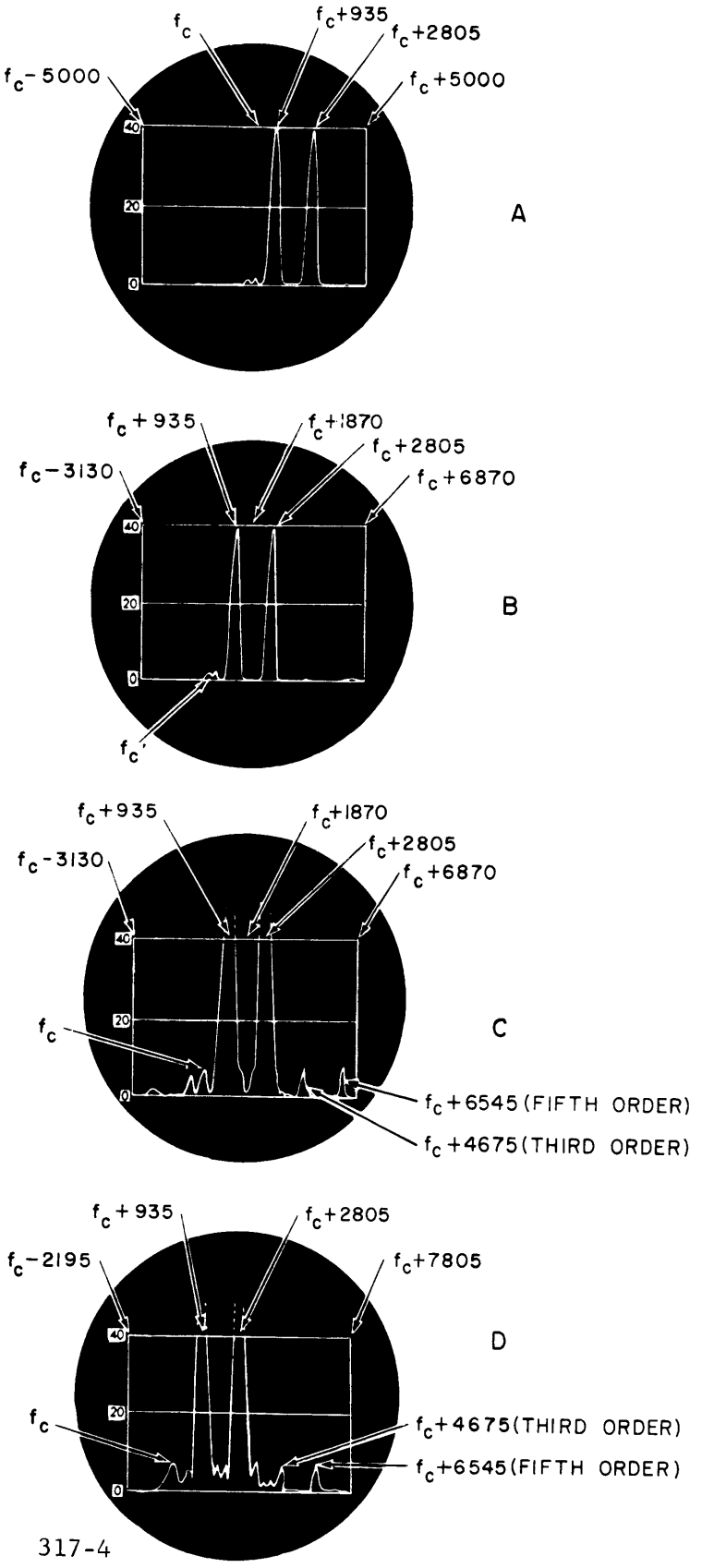

Figure 4-2. Two-Tone Spectrum Analyzer Patterns (Example 1)

is too small to be discerned. The fifth-order harmonic is not included in the displayed passband. In pattern B, the tones are centered within the 10-kc passband so that both third and fifth order harmonics fall within the display passband. Again the distortion products are not discernible. In pattern C, the vertical scale attenuation of the spectrum analyzer oscilloscope is reduced, so that the two tone peaks rise 20 db. The third and fifth order modulation products can now be seen. They are well below 40 db. In pattern D, the display is centered at the second tone to permit better viewing of the fifth order distortion product.

EXAMPLE 2

Figure 4-3 illustrates the appearance of transmitter output waveforms under varying conditions. In pattern A, a two-tone input signal is applied to an improperly tuned transmitter and the output is monitored on a spectrum analyzer. The fundamental tones, situated 1-kc on each side of the zero reference, are at a power level of zero db. The third and fifth odd order products are shown for each sideband. The third order product is down 15 db; the fifth order product is down 25 db. This distortion level is a result of improper tuning. The transmitter should be retuned until the signal-to-distortion ratio is at least 35 db.

In pattern B, a 16-channel teletype signal is modulating the A1 slot of a transmitter.

The input level shown is approximately zero db. Note that, because of intermodulation distortion effects, much of the modulating information extends into adjacent frequency slots. This represents a case of extreme distortion. If additional voice slots were used under these conditions, they would be highly distorted.

Pattern C shows the effect of reducing the power level of the composite tones 15 db. Some improvement is noted; however, a high degree of distortion is still present and appears in adjacent slots as noise. The carrier appears in this pattern, approximately 17 db down.

Pattern D shows the insertion of two-tones in the upper sideband of a properly tuned transmitter. With the fundamental tone level at zero db, the third and fifth order products are at least 35 db down. With the transmitter tuned in this fashion, intermodulation between slots is reduced to a minimum.

Pattern E shows the result of proper operation. With the composite tones in the A1 slot 15 db down from the zero reference, the distortion in adjacent sideband slots is well below 35 db. The carrier, set 20 db down, is at normal operating amplitude.

Pattern F, taken with a sweep width of 10-kc on the spectrum analyzer, shows portions of all four sideband slots. The composite tones are shown in the A1 slot and line-up tones are shown in the voice slots. The line-up tones are adjusted for zero db level, the composite tones are 15 db down, and the carrier is 20 db down. This pattern represents clean transmission for all four sideband slots, since distortion is at least 35 db down.

Pattern G, taken during a period of normal transmission, shows the A1 and B1 sideband slots of a properly tuned transmitter. The B1 slot is modulated with voice signals, while composite tones are transmitted in the A1 slot. Noise level in the outer slots is at least 35 db down, indicating normal tuning and normal input levels.

b. TWO-TONE TESTING WITH SPECTRUM ANALYZER. If a PTE-3 or equivalent is available for test, proceed as follows:

(1) Connect the two-tone audio output of the two-tone generator to audio line 1 or audio line 2 input on terminal board E3002 at rear of auxiliary frame.

(2) Tune transmitter to carrier as described in paragraphs 3-5 and 3-6.

(3) Set appropriate EXCITER switch (57 or 58) at CH 1 or CH 2 position (as determined by connection made in (1) above).

(4) Set MONITOR switch (64) on the APP at PA position and connect the rf input cable on the spectrum analyzer to MONITOR OUTPUT jack (65).

(5) With transmitter operating at 40-kw, as indicated by reading on OUTPUT meter (205), check the amplitude of odd order distortion displayed on spectrum analyzer. All odd order distortion should be at least 35 db down from basic test frequencies. If necessary, make slight adjustments in tuning and loading of the 10-kw PA and 40-kw PA to decrease distortion. When satisfactory output is obtained, carefully note maximum amplitude of basic tones on face of the analyzer.

NOTE

For complete operating information on the TMC Model PTE-3, refer to the TMC technical manual for the PTE-3.

(6) Reduce drive to minimum.

(7) Apply mal signal input to transmitter and carefully increase drive until the same amount of maximum deflection is obtained on spectrum analyzer as noted in step (5). This corresponds to full PEP and insures that distortion levels are not exceeded.

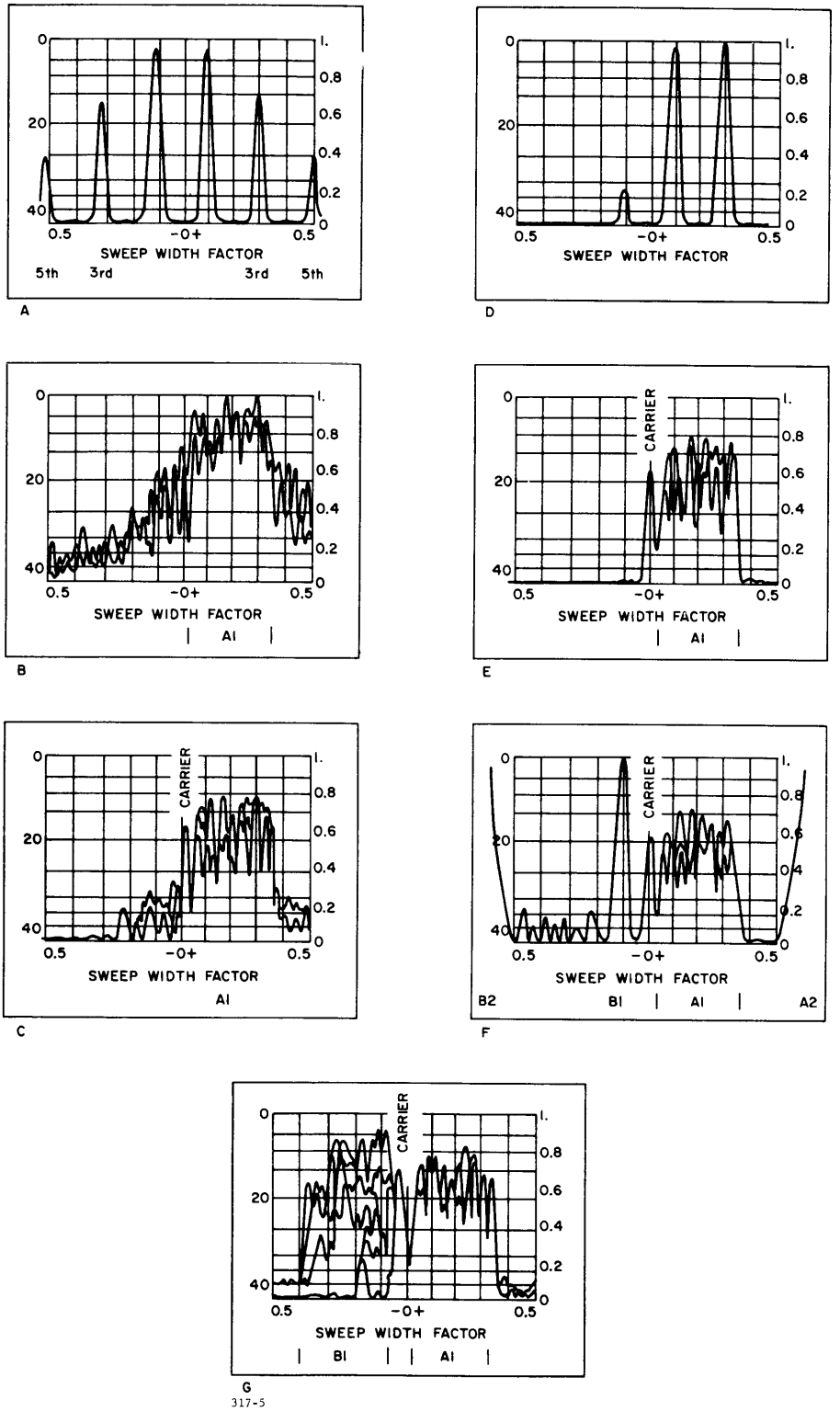

Figure 4-3. Transmitter Output Patterns (Example 2)

c. TWO-TONE TESTING WITH OSCILLOSCOPE. - If only a two-tone generator and oscilliscope is available for test, proceed as follows:

(1) Perform steps (1) through (3) of b above.

(2) Set MONITOR switch (64) on the APP-3 to PA position and connect an rf cable between the MONITOR OUTPUT jack on the APP and the vertical input to the oscilloscope.

(3) With the transmitter set up for full rated output, as indicated by reading on OUTPUT meter (205), note the waveform obtained on the oscilloscope. The outline of the two-tone pattern should look like the solid line of figure 4-4. The dashed lines represent distortion. The peaks should not be rounded or flattened - such distortion is caused by too much drive or too little loading. If necessary, adjust tuning and loading of the 10-kw PA and 40-kw PA until the ideal pattern is obtained with full power output. When satisfactory output is obtained, carefully note maximum amplitude of pattern on oscilloscope screen.

(4) Reduce drive to minimum.

(5) Apply normal signal input to transmitter and carefully increase drive until the same amount of maximum deflection is obtained on oscilloscope screen as noted in step (3) above. This corresponds to full PEP and insures that distortion is at reasonable level.

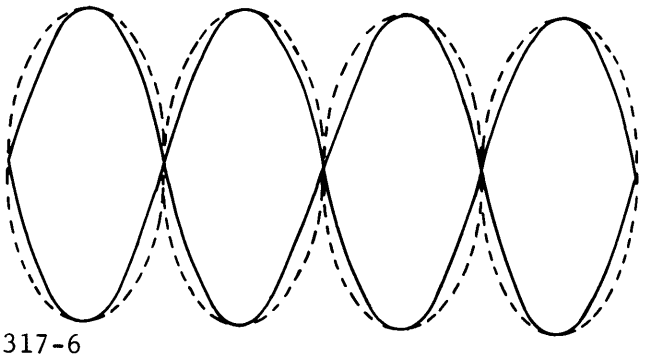

Figure 4-4. Two-Tone Oscilloscope Pattern