OPERATING INSTRUCTIONS

For

GENERAL PURPOSE TRANSMITTER

MODEL GPT–10KSA8

WORLD WIDE SUPPLIERS OF ELECTRONIC COMMUNICATIONS EQUIPMENT

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.

Warranty

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.

TMC will replace or repair any such defective items, F.O.B. factory, which may fail within the stated warranty period, PROVIDED:

1. That any claim of defect under this warranty is made within sixty (60) days after discovery thereof and that inspection by TMC, if required, indicates the validity of such claim to TMC's satisfaction.
2. That the defect is not the result of damage incurred in shipment from or to the factory.
3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.
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.

Electron tubes*furnished by TMC, but manufactured by others, bear only the warranty given by such other manufacturers. Electron tube warranty claims should be made directly to the manufacturer of such tubes.

TMC's obligation under this warranty is limited to the repair or replacement of defective parts with the exceptions noted above.

At TMC's option any defective part or equipment which fails within the warranty period shall be returned to TMC's factory for inspection, properly packed with shipping charges prepaid. No parts or equipment shall be returned to TMC, unless a return authorization is issued by TMC.

No warranties, express or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by TMC and the foregoing warranty shall constitute the Buyers sole right and remedy. In no event does TMC assume any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of TMC Products, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

*Electron tubes also include semi-conductor devices.

PROCEDURE FOR RETURN OF MATERIAL OR EQUIPMENT

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

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

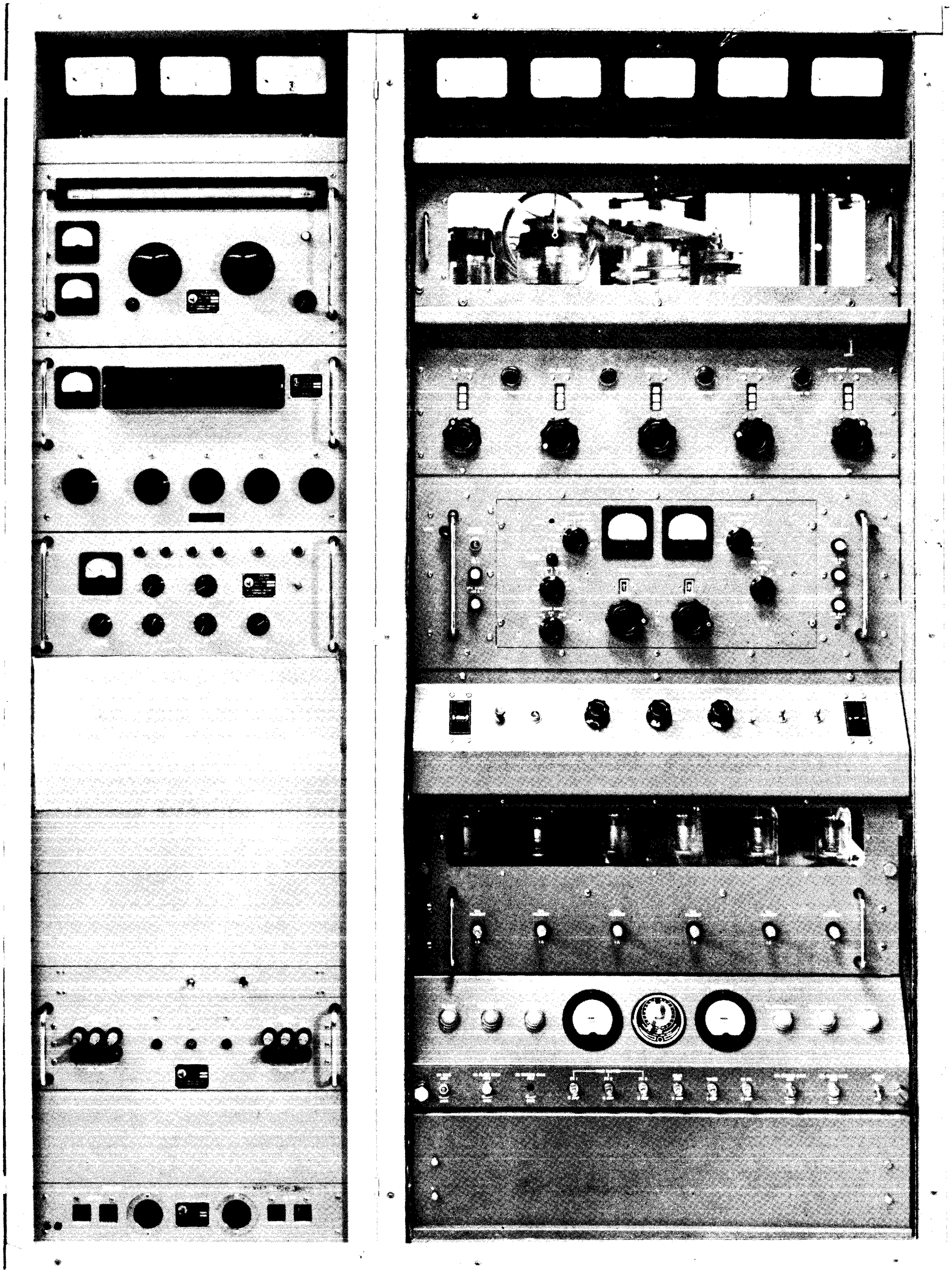

Figure 1-1. Overall View of Synthesized GPT-10KSA8 Transmitter

SECTION 1
GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION

General Purpose Transmitter Model GPT-10K (hereafter called the Transmitter, the 10K, or the GPT) is a synthesized four-channel independent sideband transmitter capable of 10 kilowatts PEP output over the range 2- to 28 MHz, in the following emission modes: CW, SSB, 2-channel ISB, 4-channel ISB, CW, AM, and AME. Full, reduced, or suppressed carrier may be employed, as applicable to the particular mode.

The major components comprising the EXCITER SECTION are listed in table 1-1. See figure 1-1 for equipment used and paragraph 1-3 for component description.

TABLE 1-1

EXCITER SECTION MAJOR COMPONENTS
SIDEBAND EXCITER, MODEL CMR-1
CONTROL SYNTHESIZER, MODEL HFS-2
RF TRANSLATOR, MODEL CHG-3
POWER SUPPLY, MODEL HFP-1

1-2. DESCRIPTION OF EQUIPMENT.

The following paragraphs briefly describe each sub-section or modular unit of the 10K. For more detailed information about a particular unit, refer to the modular manual for that unit.

a. GENERAL. As shown in figure 1-1, the transmitter consists of an auxiliary frame and a main frame that are bolted together and to a common base assembly. The two frames house all the components of the transmitter and are equipped with protective doors. Primary power connections are made through the base assembly. Two antenna bowl assemblies, used for balanced output operation, are provided at the top of the main frame. For unbalanced output operation, a connector must be mated to the directional coupler output flange located in the side of the main frame.

b. AUXILIARY FRAME. The auxiliary frame houses the exciter components of the transmitter. The frame is divided into a front and rear section by a partition which supports miscellaneous controls, connectors, and terminal boards. All major exciter units are mounted at the front of the auxiliary frame. The exciter units are slide-mounted and can be partially withdrawn from the cabinet and tilted to expose the top or bottom surface of each chassis. Thus, adjustments and maintenance procedures may be conveniently performed with full power applied. An AUXILIARY FRAME MAIN POWER circuit breaker, located on the rear of the inner partition, controls the application of primary power to the auxiliary frame. When it is turned on, a-c power is applied to an auto-transformer bolted to the rear base of the auxiliary frame. The transformer delivers 115 volts ac to a strip positioned vertically within the auxiliary frame; the a-c power cords of the exciter units are plugged into this strip. A fan at the upper front portion of the auxiliary frame provides forced-air cooling of the exciter components. A red lamp on the roof of the auxiliary frame lights when high voltage is applied to the transmitter.

c. AUXILIARY METER PANEL. The auxiliary meter panel, mounted at the top of the auxiliary frame, contains three meters. These monitor the power-amplifier screen grid voltage, grid bias voltage, and plate voltage.

d. SIDEBAND GENERATOR SBG. The SBG is a solid-state exciter system capable of producing a four-channel independent sideband signal over the entire frequency range of the GPT, tuning this range in 100-Hz increments. The SBG includes four modular exciter units:

(1) RF TRANSLATOR CHG-3. - RF Translator CHG contains the final r-f amplification stages and final frequency translating stage of the exciter. The CHG

contains a high frequency oscillator (HFO) that may be controlled by a d-c correction voltage supplied by Control Synthesizer HFS. This correction voltage is used to maintain a high degree of stability in the HFO signals.

(2) CONTROL SYNTHESIZER HFS-2. - Control Synthesizer HFS contains a stable 1-mc oscillator that is the frequency reference for the synthesized exciter. The HFS accepts a sample of the HFO signal (from the r-f translator), compares it with an internally synthesized signal, and generates a control voltage that can stabilize the CHG HFO to 1 part in 10^8. The HFS-2 is tuned by five switches; these switches may be either locally or remotely controlled.

(3) SIDEBAND EXCITER CMR. - Sideband Exciter CMR utilizes audio frequency input signals to produce a maximum of four sideband channels centered about a carrier frequency of 1.75 megacycles. Carrier may be suppressed or may be reinserted by a front panel control. The composite sideband channel output signal is applied to the r-f translator.

(4) CONTROL PANEL ASSEMBLY AX-560. - Control Panel Assembly AX560 contains a switch and a test key. Operating the switch energizes Power Supply HFP. Operating the test key controls the RF amplifier stage of the CHG-3.

(5) POWER SUPPLY HFP-1. - Power Supply HFP provides the plate, bias, and filament voltages for the CHG and HFS units, and routes 115 volts ac to the CMR unit. The HFP requires 115 volts, 50 to 60 cycles, single-phase power for operation, and is activated by switch on the control panel assembly.

h. STANDING WAVE CONTROL UNIT SWCU. The SWCU, mounted topmost in the auxiliary frame, contains an SWR overload relay, a d-c amplifier, and a power supply. During unbalanced output operation, this unit monitors SWR on the transmission line. When excessive SWR is detected, the overload relay automatically removes high voltage from the transmitter.

i. AUXILIARY POWER PANEL APP. - The APP, mounted at the bottom of the auxiliary frame, contains two a-c receptacles, a coaxial MONITOR switch, and a coaxial OUTPUT jack. RF output samples of the exciter circuits, the 1-kw IPA, and the 10-kw PA are wired to the switch. The selected RF sample may be conveniently monitored by means of a spectrum analyzer at the OUTPUT jack on the APP front panel.

j. CENTER PANEL. The Center Panel is located at the rear center of the auxiliary frame; it is a convenient central tie-point for all input and keying lines to the GPT.

k. MAIN FRAME. The main frame houses a two-stage r-f voltage amplifier, a 1-kw IPA (Intermediate Power Amplifier), the 10-kw PA, a relay panel, and associated power supply and power circuits. The r-f components are distributed through the upper portion of the frame; heavy power supply components are bolted to the base channels of the frame.

l. MAIN METER PANEL. The main meter panel, mounted at the top of the main frame, contains five meters. These monitor the 10-kw PA filament voltage, screen grid current, plate current, r-f plate voltage and r-f power output or unbalanced transmission line SWR.

m. POWER AMPLIFIER SECTION. The 10-kw PA is mounted below the main meter panel: it contains the power-amplifier tube and its associated tuned circuits. A blower, which provides forced-air cooling of the power-amplifier tube, is mounted directly under the power-amplifier tube. The front panel of the power amplifier contains a plexiglass window, the power amplifier tuning and loading controls and their associated counter-type dials, and indicator lamps.

n. RF AMPLIFIER RFC. AND POWER SUPPLY. The r-f amplifier and power supply is mounted below the 10-kw PA. This unit serves as the r-f voltage amplifier and 1-kw IPA between the exciter and the 10-kw PA. The inner section of the unit contains all r-f amplifier parts; the outer section houses the power supply components. The 1-kw IPA tube is air-cooled by a blower contained in the r-f section. The front panel of the inner r-f section contains tuning and loading controls for the 1-kw IPA, bandswitches to cover the 2- to 28-mc r-f range, and a monitoring meter and associated meter switch. All major d-c and r-f voltages in the r-f amplifier may be conveniently monitored with this arrangement.

o. MAIN POWER PANEL. The main power panel controls the application of plate, screen grid, and filament voltages to the 10-kw PA and monitors all interlock circuits contained in the main frame. Other front-panel controls include a reset pushbutton associated with the protective relays in the main frame, and an automatic load and drive control switch and level adjustment.

p. 10-KW HIGH-VOLTAGE RECTIFIER HVRC. The 10-kw high-voltage rectifier, mounted below the power panel, contains the solid-state high-voltage rectifiers. Operating as the high-voltage rectifier deck associated with the main power supply, this unit produces 7500 volts d-c for the plate of the 10-kw PA tube. Heavy insulated button connectors at the rear of the unit provide connection for the 3-phase input voltage and the d-c output voltage.

q. 10-KW RELAY PANEL. The 10-kw relay panel, mounted at the bottom of the main frame, contains nine relays that protect the transmitter circuits against overlaods. The relays and their associated terminal boards are mounted under a front panel cover plate for quick accessibility. The upper portion of the relay panel contains filament and plate time meters, an automatic reset timer, and overload indicator lamps. All IPA and PA overload adjustments are also brought out on the relay panel for ease of adjustment.

1-3. TECHNICAL SPECIFICATIONS.

Frequency Range:	2-28 mc (bandswitched).
Output Power:	10,000 watts PEP, 5,000 watts average. 3rd order distortion products down at least 35 db from either tone of a standard 2-tone test at full PEP.

1-3. TECHNICAL SPECIFICATIONS (CONT.)

Operating Modes:	SSB, 2- or 4-channel ISB, CW, and AME.
Frequency Stability:	1 part in 10^8 per day at any 100-cycle increment from 2- to 28-mc.
Carrier Insertion:	-55 db, -30db, -20db, -6db, -3db, full; switch selectable from exciter front panel.
Harmonic Suppression:	Second harmonic at least 50 db down from PEP; third harmonic at least 65 db down from PEP.
Environment:	Between 0°C (32°F) and 50°C (122°F) for humidity as high as 90%.
Output Impedance:	50 or 70 ohms unbalanced; 600 ohms balanced. Pi-L network will match load with VSWR of 2:1 maximum.
Audio Inputs to SBG:	Four independent 600-ohm channels, balanced or unbalanced.
Input Dynamic Range:	-20dbm to +5dbm.
Audio Response per channel:	350- to 3040-Hz each.
Power Consumption:	220 volts 3-phase, 60 cps, 50 amps per leg.

SECTION 2
INSTALLATION

2-1. GENERAL.

This section shall deal mainly with choice of operating site and general installation of modular units. For detailed installation instructions, refer to the Installation Instructions for General Purpose Transmitter Model GPT-10K (TMC issue number IN294).

2-2. INSTALLATION

a. OPERATING SITE. Choice of operating site is of prime consequence in assuring reliable communications and transmitter operation.

Physically, the site must accomodate both volume and weight of the 10K. There should be adequate space provided around the transmitter to allow easy access to the GPT's interior by maintenance personnel. Remember to allow enough space to permit all doors to be opened easily. It is also particularly important that all air ducts, vents, filters, or grilles have adequate surrounding air space to permit unimpeded airflow. If operating and/or maintenance personnel are to be billeted at the transmitter site, or will be working there for extended periods, their quarters and/or working areas should not be located so near the GPT that a safety hazard could develop in course of time, or that personnel fatigue could result from the operating "rush" of the GPT's blowers: extended exposure to white noise could have deleterious psychological and physiological effects upon key personnel.

Electrically, the site must satisfy all primary power requirements of the GPT. Adequate 3-phase AC voltage and current regulation is essential for reliable, positive relay operation. The transmitter in general, and particularly high-impedance and/or unshielded lines, as well as all audio input lines, must be kept as far as possible from all potential sources of electrical noise, to avoid false keying of VOX circuitry, and worse, transmission of undesired noise. Especially to be avoided are such sources as: Motors (particularly DC motors), high-voltage arcs (such as are found in neon signs, oil burners, or automotive ignition systems) make-and-break devices (thermostats, flashers, etc.), sources of RF, especially near the GPT's low-level circuits (diathermy equipment, TV receivers, etc.). The operating site should not be so far removed from the antenna site as to necessitate an extremely long antenna lead-in, particularly in those configurations using coaxial cable, with its relatively high inherent attenuation.

b. MODULAR UNIT INSTALLATION. Auxiliary frame units CHG, CMR, HFS, HFP, and main frame units HVRC (High Voltage Rectifier) and AX104 (IPA Drawer) are slide-mounted for ease in installation/removal and servicing access. These units have the equipment portion of their slides already mounted on their sides. To install the slide-mounted units, proceed as follows:

(1) Mount cable retractors, if used, in rear of compartment (TMC recommends use of cable retractors to prevent cable snags and possible attendant damage to both cables and equipment).

(2) Pull center section of compartment track out until it locks in extended position.

(3) Position slide mechanism of unit in tracks, and ease forward into housing until lock buttons engage hole in track.

(4) After making necessary electrical and cable connections to unit, depress forward lock buttons and slide completely into compartment. (refer to exciter interconnect wiring diagram).

(5) Secure front panel of unit to housing with screws.

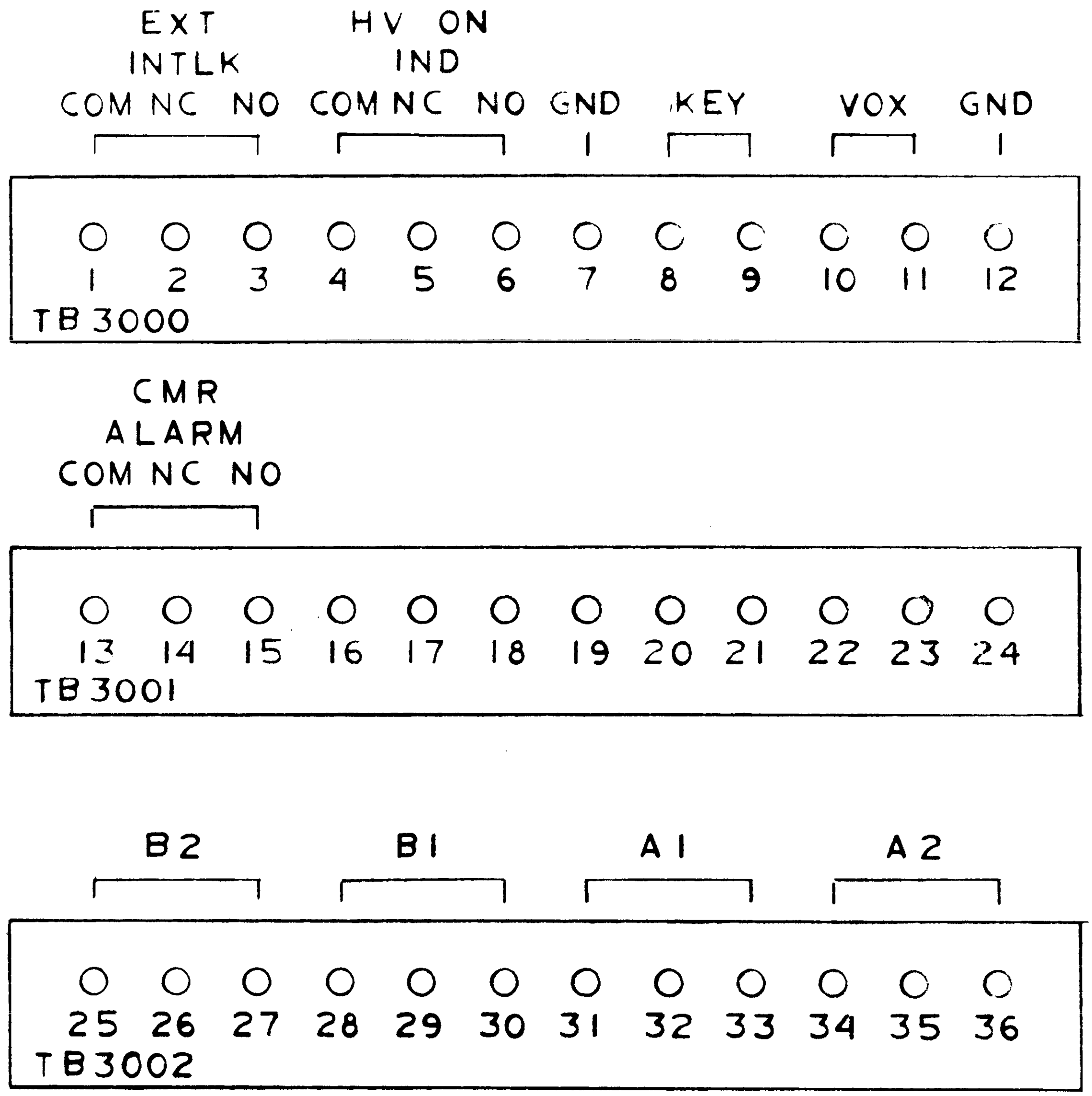

Figure 2-1. Signal Input Distribution Panel (Rear Auxiliary Frame)

SECTION 3
OPERATOR'S SECTION

3-1. SCOPE

This section gives detailed operating instructions for the SBG exciter portion of the 10K, and for the transmitter as a system.

3-2. GENERAL

The operator should become thoroughly familiar with the location and function of each major control of the 10K. Bear in mind that, despite the extensive interlock system designed into the transmitter, a single incorrect control setting might still dangerously overload certain components, inviting early failure and consequently transmitter "down time", not to mention improper and illegal emission.

A definite operating sequence (as outlined by operating instructions) should be strictly followed; the operator should establish a procedural pattern, thus ensuring consistent operation.

Before applying power to the transmitter, check that the following inputs are connected: (as required for the modes of operation to be used). Refer to figure 2-1.

Also check that antenna connections are properly made for the particular antenna to be used. Connections for balanced and unbalanced operation are made on a terminal board located at the top of the power amplifier. For unbalanced operation, the RF output of the transmitter is routed to the external antenna through a coaxial connector which is customer-installed on the coaxial connector bracket at the upper right side of the transmitter. For operation with a balanced antenna, the antenna leads are connected to the bowl insulators on the roof of the main frame through individual RF ammeters (0 to 5 amperes). The ammeters are available from TMC as Model TMA-10K, or may be supplied by the customer.

3-3. STARTING PROCEDURE

a. APPLYING POWER TO EXCITER. - The temperature-controlled oven circuits which contribute to the high degree of frequency stability in the synthesized exciter should be energized for at least thirty minutes before the exciter is operated. 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 to the positions shown:

UNIT	SWITCH	POSITION
AX560	STANDBY/OPERATE	OPERATE
CMR-1	ON	ON
HFP	ON/OFF (Rear)	ON

(2) Set the AUXILIARY FRAME MAIN POWER circuit breaker (on the inner rear partition of the auxiliary frame) to its ON position. The following actions should occur:

(a) Top fan in the auxiliary frame comes on.
(b) Dial lamp on CHG-3 lights.
(c) Power lamp on CMR-1 lights.
(d) Digital Frequency Display window lights on HFS-2.
(e) Standby lamp on HFP-1 Lights (after approx. 60 sec. standby goes out and operate lamp comes on).

3-4. CONSIDERATIONS IN TUNING TRANSMITTER

a. GENERAL. - Before the transmitter is tuned for any specified 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 to carrier, either or both sidebands are generated by applying the proper modulating signals required by the particular mode of operation. The carrier level may then be re-inserted or bypassed, as desired.

b. CARRIER FREQUENCY VERSES 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 may be defined as that position in the rf spectrum reserved for the "carrier" whether the carrier is present or not. The "assigned" frequency is a reference frequency designed to identify or reserve 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 an 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 an independent sideband (ISB) 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 both occupy the center of the transmitted spectrum.

c. DETERMINATION OF PROPER SYNTHESIZED FREQUENCY.

(1) Dry Keying. When dry keying is used for nominal carrier on-off cw transmission, carrier frequency and assigned frequency are the same.

(2) Double or Independent Sideband Operation. For either DSB or ISB, carrier and assigned frequency are the same, regardless of the type of modulation.

3-5. SBG OPERATION

a. The SBG-3 exciter system (hereafter referred to as SBG or exciter) consists of 3 major units. The actual signal to be eventually transmitted is generated in the CMR; it is in this unit that the degree of carrier suppression and mode of transmissions are selected. Channel power allocations (so-called

"Channel Priorities") are also selected in the CMR. Output of a carrier frequency of 1.75 MHz is fed from the CMR to the CHG. The CHG mixes the 1.75 MHz intelligence with variable-frequency RF to produce intelligence at the desired output frequency. Output frequency is selected at the CHG, and is directly displayed in the digital frequency display window of the synthesizer, HFS-2. Drive to the IPA-PA sections of the transmitter is controlled at the exciter.

The following paragraphs provide detailed operating procedures for the CMR-CHG-HFS combination. Before operating these units be sure that all primary power and interface connections to the transmitter have been made.

3-6 SBG OPERATING PROCEDURE.

This sub-section enables the operator to produce a usuable signal of the desired frequency and emission mode from the SBG.

a. FULL-CARRIER (TUNE-UP) OPERATION. - This provides a steady, unmodulated carrier of continuously-variable amplitude at the desired operating frequency for use during system tune-up. To produce this "key down" condition, follow the outlined tune-up procedure. Refer to figure 3-3 and table 3-3 for controls and indicator functions.

CAUTION

INITIAL EXCITER TUNING MUST BE PERFORMED WITH TRANSMITTER HIGH VOLTAGE BREAKER OFF.

STEP	OPERATION	NORMAL INDICATION
1	Place TEST-KEY to the uppermost Position (33)	Uppermost position will cause test-key to lock and remain up.
2	Place CHANNEL PRIORITY (All four controls) to "0" (26) (27) (28) (29). CARRIER SUPPRESION switch to "0".	NONE

STEP	OPERATION	NORMAL INDICATION
3	Rotate BAND control (9) to the desired output frequency band.	Illuminated RF band dial on CHG (7) displays the output frequency band selected.
4	Rotate the frequency knobs 1MC, 100KC, 10KC, 1KC; .1KC (12) (13) (15) (16) (17) as required to produce digital readout on the display window of the desired output frequency.	Digital display (14) will indicate desired output frequency.
5	Rotate TUNE control (5) to the desired output frequency indicated by pointer on the RF BAND dial (7).	SYNC IND (8) will light.
6	Adjust RF GAIN control (10) for an indication approx. "2" on RF LEVEL METER (6).	RF LEVEL meter indicates approx. 2 (For indications lower than 2 refer to CHG-3 modular manual).
7	Rotate RF GAIN control maximum counterclockwise. (10).	Output level reduces to zero.

NOTE

THE PROCEEDING COMPLETES THE EXCITER CARRIER TUNING PROCEDURE.

NOTE

Once having tuned the GPT on a carrier, reduce RF OUTPUT of the CHG to minimum (RF OUTPUT control full CCW.) At this point, a fairly accurate estimate must be made of the total number of modulating tones to be contained in the entire transmitted spectrum. RF OUTPUT must then be increased no further than the point which average power is such

NOTE (CONT.)

as to produce 10,000 watts PEP, <u>when under modulation by the estimated total number of tones</u>. See Section 4 (Supplementary Data) for information on PEP determination.

In view of the preceding note, the following operational procedures will omit direct mention of RF GAIN control settings. However, this control must be adjusted for each mode of operation, in accordance with the note.

CW Operation. Simply set the SBG as previously described for Full Carrier tune-up, with the following exception: Place TEST-KEY (33) to Neutral or center position. SBG may now be keyed via the transmitter's Center Panel KEY connections, and/or from the <u>TEST-KEY</u> on transmitter Auxiliary frame.

3-7. TUNE-UP 1-KW IPA AND 10-KW PA ON CARRIER

A. TUNING.

(1) Before applying power to the IPA and PA in the main 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 another for balanced output operation), set up the controls in accordance with the sample tuning chart shown in table 3-2 (refer to controls and indicators Figure 3-1 for location of controls).

The chart has been prepared from a typical transmitter at the factory, with the transmitter operating into a 50 ohm dummy load. If control settings are set up as shown, the chart should provide a good starting point for tuning the transmitter. When the transmitter is loaded into an antenna, the tuning will change somewhat. If necessary, modify the tuning chart so that it reflects actual field conditions.

Preset the following controls on transmitter:

UNIT	CONTROL
PA Section	PA TUNE (115) PA LOAD (116) BAND SW (117) OUTPUT BAL (118) OUTPUT LOADING (119)
RF Amplifier RFC-1	IPA GRID TUNING (123) 1ST AMPL TUNING (124) DRIVER BAND (125) IPA BAND (126) IPA LOADING SWITCH (127) IPA TUNING (128) IPA LOADING (130)

(2) On the MAIN POWER PANEL, 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) to 5 minutes.

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

(a) Main frame blowers should start up.

(b) TUNE lamp (107) should light.

(c) PA BIAS lamp (145) should light, then go off as RF amplifier power supply comes on.

(d) PA BIAS meter (2) should read 300 volts.

NOTE

If PA BIAS reading is incorrect, adjust PA BIAS ADJ control (151) on relay control panel.

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

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

NOTE

If INTERLOCK INDICATOR lamp (134) does not come on, rotate INTERLOCK switch (135) (clockwise from its NORMAL position. At first position that INTERLOCK INDICATOR (134) goes off, 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 turns on INTERLOCK INDICATOR, proceed to next step.

(5) Tune the IPA and PA circuits as follows:

CAUTION

When tuning and loading the IPA and PA, do not exceed the following meter indications:

PA PLATE CURRENT (103): At start of loading At end of loading	0.5 to 1 amp 1.5 to 1.75 amp
PA SCREEN CURRENT (102): PA PLATE RF (104): IPA PLATE CURRENT (121).	25 to 50 ma 6 kv 400 ma
IPA SCREEN CURRENT (as read on MULTIMETER (120) with MULTIMETER switch (122) set to DC IPA ISG).	25 ma

(a) Set MULTIMETER switch (122) to RF 1ST AMPL EP position.
(b) Apply RF drive from exciter by slowly advancing RF GAIN control (10) on CHG until some indication is produced. on MULTIMETER (120).
(c) Carefully adjust 1ST AMPL TUNING control (123) until peak is obtained on MULTIMETER (120). Adjust RF GAIN control (10) as necessary to keep meter reading on scale.
(d) Set MULTIMETER switch (122) to RF IPA EG position.
(e) Adjust IPA GRID TUNING control (123) for maximum reading on MULTIMETER (120).
(f) Readjust 1ST AMPL TUNING control (123), if necessary, to peak reading on MULTIMETER (120).
(g) Reduce RF drive to minimum with RF GAIN control 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.

(h) Depress OVERLOAD RESET pushbutton (133).
(i) Set HIGH VOLTAGE circuit breaker (141) to 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 20 seconds. PA PLATE meter (3) should indicate plate voltage. (7500 VDC, ± 10%).
(j) Carefully advance RF GAIN control on CHG until some increase is noted on IPA PLATE CURRENT meter (121).
(k) Rotate IPA TUNING control (128) until a dip is obtained on IPA PLATE CURRENT meter (121).
(l) Carefully advance RF GAIN control until some slight reading is obtained on PA PLATE CURRENT meter (103).
(m) Adjust PA TUNE control (115) until a dip is obtained on PA PLATE CURRENT meter (103). The indication on the PA PLATE RF meter (104) should simultaneously maximize at this tuning point.
(n) Reduce RF drive to minimum with RF GAIN control.
(o) Set PA SCREEN switch (140) to ON.

NOTE

To prevent energizing PA screen overload circuit, 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) to TUNE
HIGH VOLTAGE circuit breaker (141) to ON

PA SCREEN SWITCH (140) to ON
TUNE-OPERATE switch (139) to OPERATE

NOTE

If any overload relay becomes energized, high voltage is automatically turned OFF. If this occurs, reduce RF drive to minimum, press reset button (133).

(p) The PA PLATE CURRENT meter (103) should read approximately .5 Amperes and the IPA PLATE CURRENT meter (121) should read approximately 200 ma. These are the static values of plate current.

NOTE

If necessary, adjust PA BIAS ADJ control (151) on relay panel and/or IPA BIAS ADJ control on Power Supply AX-104 as required, to obtain proper readings.

(q) Retune RF amplifier and IPA circuits as described in steps (a) through (g) and (k) and (m) above. This completes tuning portion of operating procedure.

B. LOADING

(1) Alternately load the IPA with IPA LOADING control (130) as indicated by increased reading on IPA PLATE CURRENT meter (121), and tune the IPA with IPA TUNING control (128) as indicated by dip on IPA PLATE CURRENT meter. Continue to load and tune IPA, loading in small increments, until the IPA PLATE CURRENT meter reads approximately 300 ma. Set MULTIMETER switch (122) to IPA ISG position and check that IPA screen current does not exceed 25 ma (as displayed on MULTIMETER 120). If IPA screen current is excessive, increase the IPA plate loading (counterclockwise rotation) and retune until proper screen current is obtained.

CAUTION

During this IPA loading phase, be careful to limit drive to keep reading on PA PLATE CURRENT meter (103) at reasonable level (within previously specified limits).

(2) Alternately load the PA with PA LOAD control (116) as indicated by increased reading on PA PLATE CURRENT meter (103), and tune the PA with PA TUNE control (115) as indicated by dip on PA PLATE CURRENT meter. Continue to load and tune the PA, loading in small increments, until approximately 1.5 amperes is obtained on PA PLATE CURRENT meter (103) and 2 to 5 KV RF is obtained on PA PLATE RF meter (104). Check that the reading on PA SCREEN CURRENT meter (102) is within 35-ma limit. If PA screen current is excessive, increase the PA plate loading (clockwise rotation of loading control (116)) and retune until proper screen current is obtained.

NOTE

The OUTPUT LOADING control (119) may generally be left at its tuning chart position Vary this control in conjunction with PA LOAD control (116) when necessary to obtain rated output.

C. UNBALANCED OUTPUT TERMINATION.

(1) If the GPT-10K is connected for unbalanced output (50 ohms), leave the OUTPUT BAL control (118) at the tuning chart position.

(2) Maximum permissible output, is 10 kilowatts PEP. (This corresponds to 5 kw as read on PA output meter (for two-tones only).

NOTE

When full rated output is obtained, note the corresponding reading on PA PLATE RF meter (104). This reading will be used in setting up the transmitter for full PEP after modulation is applied.

(3) To measure SWR on the transmission line, set SWR switch (138) to SWR position and read SWR on the lower scale of PA OUTPUT meter (105).

D. BALANCE OUTPUT TERMINATION

(1) Adjust OUTPUT BAL control (118) either clockwise or counterclockwise until a point is reached where the two external antenna current meters move in opposite directions, then refine setting until both meter readings are exactly the same.

(2) For a balanced 600-ohm antenna, such as a rhombic, maximum permissible antenna current in each leg is 2.9 amps (5 kilowatts average).

E. FINAL CARRIER TUNE-UP CHECK

(1) Recheck setting of IPA TUNING control (128) to insure that output tuning has not affected IPA. If necessary, touch up settings of IPA controls.

(2) Recheck setting of PA TUNING control (115). If necessary, touch up settings of PA controls.

(3) This completes tune-up of transmitter on carrier. Reduce RF drive to minimum with RF GAIN control on CHG.

NOTE

Tables 3-1 and 3-3 indicate the component designations and functions of the front panel controls and indicators of the auxiliary frame and main frame of the GPT-10K transmitter. See figure 3-1 and 3-3 for the location of each control and indicator. For purposes of the simplification, controls and indicators on the auxiliary frame are numbered between 1 and 46; those on the main frame are numbered between 101 and 200.

TABLE 3-1 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 amplifier.
102	PA SCREEN CURRENT meter	Indicates screen current of 10-kw amplifier.
103	PA PLATE CURRENT meter	Indicates plate current of 10-kw amplifier.
104	PA PLATE RF meter	Indicates rf output voltage of 10-kw amplifier.
105	PA OUTPUT meter	Normally indicates transmitter output power in kilowatts PEP (upper scale). When operating into unbalanced antenna, and with SWR switch (138) set to SWR, indicates SWR 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 high voltage rectifier.

TABLE 3-1 MAIN FRAME OPERATING CONTROLS AND INDICATORS (CONT)

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
110	PA TUNE dial	Indicates setting of PA TUNE control (115).
110	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 amplifier to desired frequency.
116	PA LOAD control	Varies power output of 10-kw amplifier.
117	BAND SW switch	Sets operating frequency range of 10-kw amplifier.
118	OUTPUT BAL control	Operates in conjunction with OUTPUT LOADING control (119) to match impedance of 10-kw amplifier to antenna impedance.
119	OUTPUT LOADING control	Operates in conjunction with OUTPUT BAL control (118) to match impedance of 10-kw amplifier to antenna impedance.
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 amplifier
122	MULTIMETER switch	8-position rotary switch: Position — Measures DC IPA BIAS — Bias on 1-kw amplifier DC IPA ESG — Screen voltage of 1-kw amplifier DC IPA EP — Plate voltage of 1-kw amplifier DC IPA ISG — Screen current of 1-kw amplifier RF 1ST AMPL EP — Rf voltage at plate of first rf amplifier RF IPA EG — Rf voltage at grid of 1-kw amplifier RF IPA EP — Rf voltage at plate of 1-kw amplifier RF PA EG — Rf voltage at input to 10-kw amplifier

TABLE 3-1 MAIN FRAME OPERATING CONTROLS AND INDICATORS (CONT)

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
123	IPA GRID TUNING control	Tunes rf input circuit of 1-kw amplifier.
124	1ST AMPL TUNEING control	Tunes rf output circuit of first rf amplifier.
125	DRIVER BAND switch	Sets operating frequency range of first two rf amplifiers.
126	IPA BAND switch	Sets operating frequency range of 1-kw amplifier.
127	IPA LOADING switch	Operates in conjunction with IPA LOADING control (130) to vary impedance at output of 1-kw amplifier.
128	IPA TUNING control	Tunes output circuit of 1-kw amplifier.
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 amplifier.
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 pushbutton	When depressed, resets relays in relay panel after an overload occurs.
134	INTERLOCK INDICATOR lamp	When lit, indicates that 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 at 1-kw amplifier. EXTERNAL — Continuity at external interlock (terminals 8 and 10 of E3000 in auxiliary frame) REAR DOOR — Closure of rear door

TABLE 3-1 MAIN FRAME OPERATING CONTROLS AND INDICATORS (CONT)

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
135 (cont)		**Position** — **Circuit or Condition Checked** PA AIR SW — Normal operation of blower at 10-kw amplifier PA DECK — Closure of shield 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 RELAY DECK — Closure of relay panel in main frame TIMER — Activiatio 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 rf level at which ALDC circuit becomes operative.
138	SWR switch	In SWR position, permits direct reading of SWR 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 amplifiers. In OPERATE position, it causes full screen voltage to be applied to amplifiers.
140	PA SCREEN switch	In ON position, applies screen voltage to 10-kw amplifier.
141	HIGH VOLTAGE circuit breaker	In ON position, turns on high voltage rectifier, applying high voltage dc to 10-kw amplifier plate circuit.
142	FILAMENT TIME meter	Indicates total operating time of filament circuit of 10-kw amplifier.
143	TIME DELAY timer	Delays application of high ac voltage to high voltage rectifier so that filaments may heat.

TABLE 3-1 MAIN FRAME OPERATING CONTROLS AND INDICATORS (CONT)

NUMERICAL DESIGNATION	PANEL DESIGNATION	FUNCTION
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 power amplifier.
146	PA PLATE OVLD lamp	When lit, indicates that overload occurred in plate circuit of 10-kw amplifier.
147	PA SCREEN OVLD lamp	When lit, indicates that overload has occurred in screen circuit of 10-kw amplifier.
148	IPA SCREEN OVLD lamp	When lit, indicates that overload has occurred in screen circuit of 1-kw amplifier.
149	IPA PLATE OVLD lamp	When lit, indicates that overload has occurred in plate circuit of 1-kw amplifier.
150	SWR OVLD lamp	When lit, indicates that overload has occurred as a result of excessive SWR.
151	PA BIAS ADJ control	Sets amplitude of bias voltage applied to 10-kw amplifier.
152	PA PLATE OVLD ADJ control	Controls dc level at which 10-kw amplifier plate overload relay is energized.
153	PA SCREEN OVLD ADJ control	Controls dc level at which 10-kw amplifier screen overload relay is energized.
154	IPA SCREEN OVLD ADJ control	Controls dc level at which 1-kw amplifier screen overload relay is energized.
155	IPA PLATE OVLD ADJ control	Controls dc level at which 1-kw amplifier plate overload relay is energized.
156	ALARM switch	When set to ON position, energizes an audible alarm until high voltage is applied to the 10-kw amplifier.
157	DRAWER INTERLOCK lamp	When lit, indicates that rf amplifier drawer interlock is open.

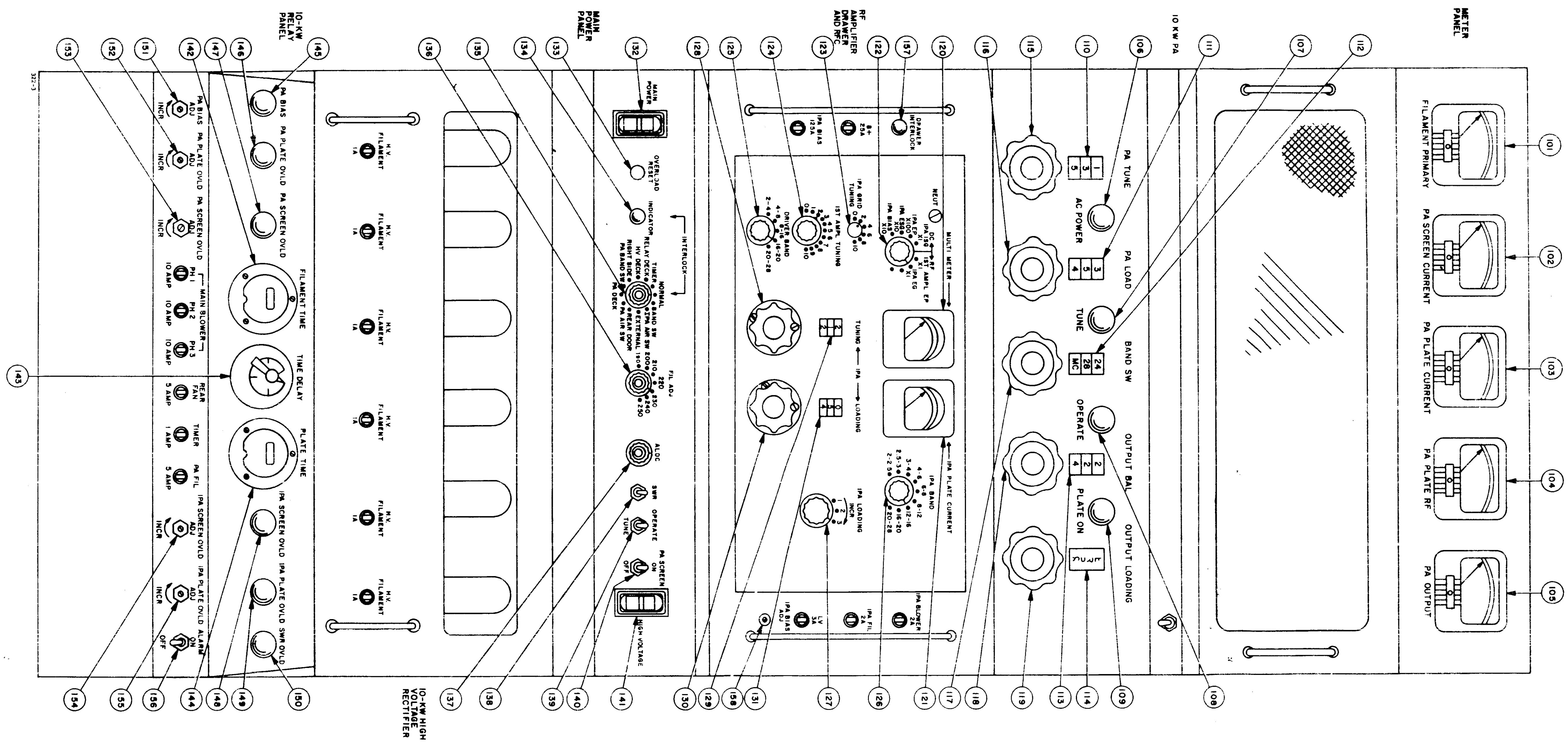

Figure 3-1 Main Frame, Operating Controls and Indicators

TABLE 3-2. TRANSMITTER TUNING CHART (TYPICAL), UNBALANCED OPERATION

SBG	IPA STAGE								PA STAGE					TEST RESULTS			
FREQ MC	IPA BAND	DRIVER BAND	1ST AMP TUNING	IPA GRID TUNING	IPA TUNING	IPA LOADING	IPA LOAD POS	IPA PLATE CURRENT	FINAL BAND	PA TUNE	PA LOADING	OUTPUT BAL	OUTPUT LOADING	PA OUTPUT KW(PEP)	DC PLATE CURRENT	DC SCREEN CURRENT	PA PLATE RF
2	2-2.5	2-4	0	0	012	125	1	400	2-3	551	361	300	900	10	1.3	30	2.0
2.5	2-2.5	2-4	3	5	053	100	2	390	2-3	316	404	300	900	10	1.3	34	2.2
2.5	2.5-3	2-4	3	5	036	065	2	390	2-3	313	404	300	900	10	1.3	30	2.2
3	2.5-3	2-4	5	6	062	100	2	325	3-4	278	608	300	800	10	1.4	25	2.5
3	3-4	2-4	5	6	053	063	2	330	3-4	282	633	300	800	10	1.4	28	2.5
4	4-6	2-4	4	9	073	070	2	320	4-6	276	669	300	800	10	1.2	26	2.7
4	4-6	4-8	0	0	074	070	2	330	4-6	280	669	300	800	10	1.2	30	3.4
6	4-6	4-8	5	7	097	051	3	235	4-6	179	120	300	800	10	1.3	16	3.6
6	6-8	4-8	5	7	075	000	3	310	6-8	243	208	300	800	10	1.2	20	4.2
8	6-8	4-8	9	9	092	052	3	250	6-8	173	074	300	800	10	1.1	22	5.0
8	8-12	8-16	0	0	076	004	3	320	8-11	251	132	300	800	10	1.2	24	5.1
11	8-12	8-16	4	6	093	061	3	290	8-11	163	057	003	700	10	1.4	22	5.7
11	8-12	8-16	4	6	093	061	3	290	11-15	209	091	003	700	10	1.4	24	5.6
12	8-12	8-16	5	6	098	050	3	250	11-15	188	073	003	600	10	1.3	16	5.0
12	12-16	8-16	5	6	087	005	3	260	11-15	188	073	003	600	10	1.3	16	5.0
15	12-16	8-16	7	8	097	040	3	250	11-15	149	029	003	500	10	1.2	11	4.1
15	12-16	8-16	7	8	097	040	3	250	15-19	197	061	003	500	10	1.1	12	4.4
16	12-16	8-16	9	9	105	036	3	240	15-19	185	048	003	500	10	1.2	12	4.0
16	16-20	16-20	5	6	086	034	3	300	15-19	185	048	003	500	10	1.1	12	4.0
19	16-20	16-20	7	8	094	014	3	300	15-19	144	029	003	500	10	1.3	16	5.2
19	16-20	16-20	7	8	094	014	3	300	19-24	183	059	003	500	10	1.3	18	5.4
20	16-20	16-20	8	8	096	034	3	320	19-24	162	069	003	200	10	1.2	14	5.0
20	20-28	20-28	4	6	089	008	3	360	19-24	162	069	003	200	10	1.2	14	5.0
24	20-28	20-28	6	7	092	023	3	290	19-24	124	038	003	200	10	1.1	10	4.3
24	20-28	20-28	6	7	092	023	3	300	24-28	195	099	003	200	10	1.0	12	5.1
28	20-28	20-28	9	9	099	053	3	285	24-28	156	085	003	200	10	1.0	20	6.3

TEST CONDITIONS:

50 OHMS

MODEL: GPT( )10K

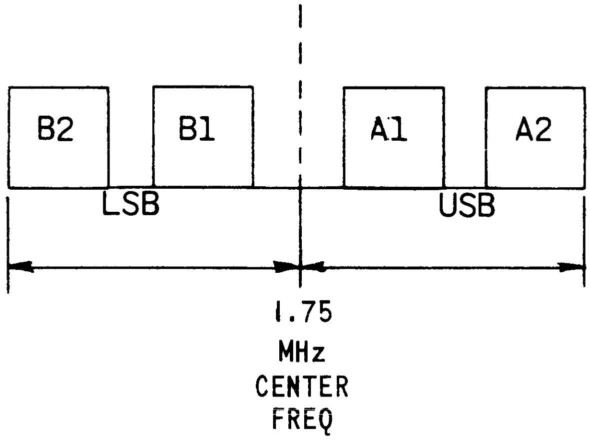

Figure 3-2. Four-channel ISB spectrum centered at 1.75 MHz.

Notice the channel labelling; this corresponds to the labelling on the CMR's CHANNEL PRIORITY controls. Each CHANNEL PRIORITY control adjusts power level of its associated channel, and is calibrated in percent of total available power. Thus, if it is desired to allocate, for example, 50 percent of total transmitter power to channel A1, and 25 percent to A2, then the total of channels B1 and B2 settings must not exceed 25 percent, or the remaining "unused" power (assuming full suppression).

Note that both inboard channels (A1 and B1) are the "normal" upper sideband and lower sideband, respectively, of the 1.75 MHz center frequency. Outboard channels A2 and B2 are the multiplexed channels.

The following paragraphs describe SBG operation for the various modulated modes: Full carrier suppression is assumed; partial carrier operation will be discussed subsequently.

NOTE

ALL MODULATING CONTROL ADJUSTMENTS ARE PERFORMED ON THE SIDEBAND EXCITER, CMR-1. THE DESIRED OUTPUT FREQUENCY, ALTHOUGH NOT MENTIONED IN THE FOLLOWING PROCEDURES, MUST BE SETUP AND ADJUSTED IN ACCORDANCE WITH PARAGRAPHS 3-6.

3-8. UPPER SIDEBAND CHANNEL A1 TRANSMISSION

Set SBG controls as follows:

Control	Position
Power Switch (24)	ON
CARRIER SUPPRESSION (25)	FULL
CHANNEL PRIORITY:	as follows:
A1 (26)	100
A2 (27)	0
B1 (28)	0
B2 (29)	0
METER FUNCTION	A1

Set CHG and Synthesizer, HFS-2 as described under Full Carrier tune-up operation (paragraph 3-6).

Apply audio input to channel A1 (terminals 34 and 36 of TB-3002). A1 channel activity indicator should illuminate, and INPUT LEVEL (dbm) meter should indicate presence of audio.

3-9. LOWER SIDEBAND CHANNEL B1 TRANSMISSION

Set as for USB, with the following exceptions:

CHANNEL PRIORITY:

A1 (26)	0
A2 (27)	0
B1 (28)	100
B2 (29)	0
METER FUNCTION	B1

Set CHG and synthesizer, HFS as described under Full Carrier tune-up operation. (paragraph 3-6). Apply audio input to channel B1 (terminals 28 and 30 of TB3002). CHANNEL ACTIVITY indicator B1 should illuminate, and INPUT LEVEL (dbm) meter should indicate variations in average incoming audio level.

3-10. INDEPENDENT SIDEBAND CHANNELS A1 AND B1 TRANSMISSION

For two-channel ISB (inboard channels used, to conserve spectrum space), Set the SBG as follows:

Control	Position
power switch (24)	ON
CARRIER SUPPRESSION (25)	FULL
CHANNEL PRIORITY:	as follows:
A1 (26	50
A2 (27).	0
B1 (28).	50
B2 (29).	0
METER FUNCTION (30)	A1 or B1, as necessary or desired.

Set CHG and synthesizer, HFS-2 as described under Full Carrier tune-up operation (paragraph 3-6).

Apply audio (terminals 28 and 30 (CH-B1), 31 and 33 (CH-A1) of TB-3002) to A1 and B1 inputs: CHANNEL ACTIVITY indicators A1 and B1 should illuminate, and INPUT LEVEL (dbm) meter should vary with average audio input level.

a. The above operating procedure assigned equal priorities (power allocations) to each channel. However, it is sometimes desirable to assign different power levels to each sideband channel, particularly when the most important (or highest-priority) channel carries complex modulation (eg. - 16-tone VFTG), resulting in a low average power, compared to a lower-priority channel, carrying, say, relatively simple modulation, and enjoying a higher average power. The situation created, therefore, is precisely the opposite of that which is desired: the high priority channel carries less average power than the lower-priority channel.

b. To correct this situation, power may be reapportioned according to channel priority and/or complexity of modulation. CHANNEL PRIORITY controls are merely adjusted to establish proper priority and/or power allocations. Thus, instead of setting both A1 and B1 CHANNEL PRIORITY controls to 50, it may be necessary or desirable to use a ratio other than 50-50 (1:1). Simply set the CHANNEL PRIORITY controls to obtain desired priority or power-per-channel: this will necessitate a determination of relative peak-to-average ratios between channels; if one channel, for example, has a peak-to-average ratio of 4 to 1 and the other channel has a peak-to-average ratio of 3 to 1, the relative ratio between channels is 4 to 3. CHANNEL PRIORITY controls are then set inversely to the between-channel ratio. Thus, in the case of a 4:3 between-channel ratio, the controls are adjusted to produce an inverse, or 3:4 power allocation ratio. This will restore power balance between channels. Once having achieved a 1:1 power ratio between channels, the operator may then proceed to establish any desired ratio: a 1:1 ratio provides a convenient starting point, and allows the operator to visualize the power ratio between channels.

3-11. INDEPENDENT SIDEBAND TRANSMISSIONS CHANNELS A1, A2, B1, B2.

For four-channel ISB, set the SBG as follows:

Control	Position
power switch (24).	ON
CARRIER SUPPRESSION (db) 25)	FULL
CHANNEL PRIORITY:	as follows:
A1 (26).	.25
A2 (27).	.25
B1 (28).	.25
B2 (29).	.25
METER FUNCTION (30)	A1, A2, B1, B2 as necessary or desired

Set CHG and synthesizer, HFS-2 as described under Full Carrier tune-up operation (paragraph 3-6).

Apply audio to A1, A2, B1, and B2 channel inputs. All CHANNEL ACTIVITY indicators should illuminate, if all channels are simultaneously active; only active channels will cause their respective CHANNEL ACTIVITY indicators to illuminate. INPUT LEVEL (dbm) meter will indicate variations in average level of the channel to which it is switched.

Channel priorities for four-channel ISB operation may be assigned in similar manner to two-channel priority assignments. However, note that initial power balance becomes a two-step operation: I. By the method previously described, balance A1 and A2; similarly, balance B1 and B2, 2. Then, balance both LSB channels ("B" channels) against both USB channels ("A" channels); when balancing, take care not to disturb the ratio already established between inboard and outboard channels of a given sideband (step 1 above).

3-12. TONE FSK, TONE FAX, TONE CW.

When used with a Tone Intelligence System, such as the TMC Model TIS, the SBG is capable of generating RF tones keyed and/or varied in frequency in accordance with the particular desired tone emission mode.

The following paragraphs give operating instruction for full-and partial-carrier modes. These modes include AM, AME, and all previous sideband modes, when operating procedure is properly modified as explained below.

3-13. AM OPERATION.

To place the SBG in AM operation, set controls as for two-channel ISB, with the following exceptions:

Unit	Control	Position
CMR	CARRIER SUPPRESSION (db)	3
CMR	CHANNEL PRIORITY:	as follows:
	A1	25
	A2	0
	B1	25
	B2	0

Other control settings and operating procedures remain unchanged, with the exception that identical audio is fed to both A1 and B1.

3-14. AME OPERATION.

AM Equivalent, or AME, consists of a single sideband plus a -6db carrier. It is indistinguishable to the ear from conventional AM, but uses only half the spectrum space, and enjoys a 6db sideband power advantage over AM (3db of this advantage results from elimination of one sideband, and 3db is the result of carrier reduction of 3db from the -3db conventional AM carrier); this results in a Total Intelligence Power (so-called "talk power") advantage of 3db, for the AME mode.

AME operation with the SBG is accomplished as follows: First, determine which sideband is to be transmitted; then, simply set the SBG as for SSB transmission of the desired sideband, with the following exceptions:

Unit	Control	Position
CMR	CARRIER SUPPRESSION (db)	6
CMR	CHANNEL PRIORITY	either A1 or B1, depending on desired sideband: 50.

Proceed as for single-sideband, suppressed-carrier operation: all further control settings and procedures are identical to those for SSB.

3-15. PARTIAL CARRIER OPERATION.

In those communciations circuits that utilize Automatic Frequency Control (AFC) to maintain proper receiver tuning, it is usually necessary to insert a reduced or partially-suppressed pilot carrier at the transmitter, to provide a lock point for the receiver's AFC circuitry. Also, certain types of AGC circuits intended for use in multi-channel applications make use of re-inserted pilot carrier, for proper operation.

The SBG may be operated in any of the single- or multi-channel modes previously described (for which full suppression was assumed), using reduced or only partially suppressed carrier. Reduced carrier is defined as a carrier greater than 6db but less than 26db below full CW carrier; a carrier greater than 26db below a full CW carrier is defined as a Suppressed Carrier. The term "partially-supressed carrier" is peculiar to this text, and is defined as a carrier greater than 26db below full CW carrier, but less than the greatest suppression of which the system is capable (in this case, 55db). Full carrier is defined as a carrier 6 db or less below full CW carrier.

To operate the SBG with reduced- or partially-suppressed carrier, simply set the controls for the particular emission mode desired, as if the carrier were fully suppressed, with the following exception:

Unit	Control	Position
CMR	CARRIER SUPPRESSION (db)	either 20 or 30, as necessary or desired (20 position inserts a -20db carrier; 30 inserts a carrier -30db from full CW).

Theoretically, the partial reinsertion of a carrier would require a slight reduction in CHANNEL PRIORITY controls, since a certain amount of total available power is being used to generate the pilot carrier, and cannot, therefore, be called upon to produce sideband intelligence without overdriving the system. However, when calculated in terms of percentage of total available power, a -20db (worst-case) carrier amounts to only one percent of total power; this is negligible, for all practical purposes, and is well beyond the readability and resettability limits of the CHANNEL PRIORITY controls and their resepective calibrations.

TABLE 3-3. AUXILIARY FRAME OPERATING CONTROLS AND INDICATORS

Modular Unit	Item No. (Fig. 3-3)	Panel Designation	FUNCTION
Auxiliary Frame	1	PA SCREEN METER	Indicates amplitude of PA screen grid Voltage.
	2	PA BIAS METER	Indicates amplitude of PA bias Voltage.
	3	PA PLATE METER	Indicates amplitude of PA plate (dc) voltage.
CHG-3	4	SYNCHRONIZE METER	Indicates amount and polarity of DC Voltage.
	5	TUNE control	Moves pointer to appropriate frequency along dial of selected band. (TUNE control is fitted with a LOCK).
	6	RF LEVEL meter	Indicates level of RF output signal.
	7	MEGACYCLES dial	Displays illuminated RF band dial selected by operating BAND control (9).
	8	SYNC IND	Lights to indicate system is synchronized.
	9	BAND switch	Rotates MEGACYCLES dial, (7) and switches in desired RF band.
	10	RF GAIN control	Controls amplitude of RF output signal.
HFS-2	11	1 MC COMPARATOR meter M3001	Indicates frequency error in internal 1-mc standard.
	12	100 KC switch S3401	Tunes the synthesizer in 100-kc steps.
	13	1 MC switch S3501	Tunes the synthesizer in 1-mc steps between 2 and 32-mc.
	14	Digital display indicators DS3001, 2 and 4 thru 7.	Indicates the frequency.

TABLE 3-3. AUXILIARY FRAME OPERATING CONTROLS AND INDICATORS

Modular Unit	Item No. (Fig. 3-3)	Panel Designation	FUNCTION
HFS-2	15	10KC switch S3301	Tunes the synthesizer in 10-kc steps.
	16	1 KC switch S3201	Tunes the synthesizer in 1000-cycle steps.
	17	.1 KC switch S3101	Tunes the synthesizer in 100-cycle steps.
CMR-1	18 thru 21	CHANNEL ACTIVITY lamps (one for each channel)	Lights to indicate that corresponding channel is active (channel audio input level is -26dbm or higher)
	22	STANDBY lamp	Lights when all channels are inactive (no audio input)
	23	POWER lamp	Lights to indicate unit is in operation.
	24	On switch	When at ON position, energizes the unit.
	25	CARRIER SUPPRESSION (db) switch	Reinserts carrier at indicated levels below full power output.
	26 thru 29	CHANNEL PRIORITY controls (one for each channel)	Controls apportionment of output power each channel (graduated in percentages).
	30	METER FUNCTION switch	Selects channel input signal for monitoring by INPUT LEVEL meter.
	31	INPUT LEVEL (dbm)	Indicates power input level (to each channel) between -20 dbm and +3dbm, as selected by METER FUNCTION switch.
AX560	32	OPERATE/STANDBY	Provides standby/operate power control for an associated transmitter system.

TABLE 3-3. AUXILIARY FRAME OPERATING CONTROLS AND INDICATORS

Modular Unit	Item No. (Fig. 3-3)	Panel Designation	FUNCTION
AX560A (CONT.)	33	TEST KEY	Provides a test key function for associated transmitter system.
	34	TIME DELAY lamp	Indicates HFP is going through time delay stage between standby and operate conditions.
	35	STANDBY lamp	Indicates HFP is in standby condition (i.e. HFP is sending power to oscilator ovens and frequency standard in system units).
	36	OPERATE lamp	Indicates HFP is in operation (sending power to all units of the system).
		MAIN POWER switch	Indicates HFP is in operate condition (sending power to all units of the system).
APP-10A	37	MONITOR OUTPUT	R-f output jack, used in conjunction with associated MONITOR selector switch (38).
	38	MONITOR	Four-position rotary selector switch; selects designated signals to be applied to MONITOR OUTPUT jack (37) for test monitoring.
	39 & 40	Circuit breakers (2)	Used to control application of line voltage to associted AUXILIARY POWER outlet.
	41	AUXILIARY POWER	Convenience line voltage receptacle.
	42	Same as item 41	
	43 & 44	Same as item 39 & 40	
	45 & 46	AUDIO INPUT	Front panel audio input test signal jacks.

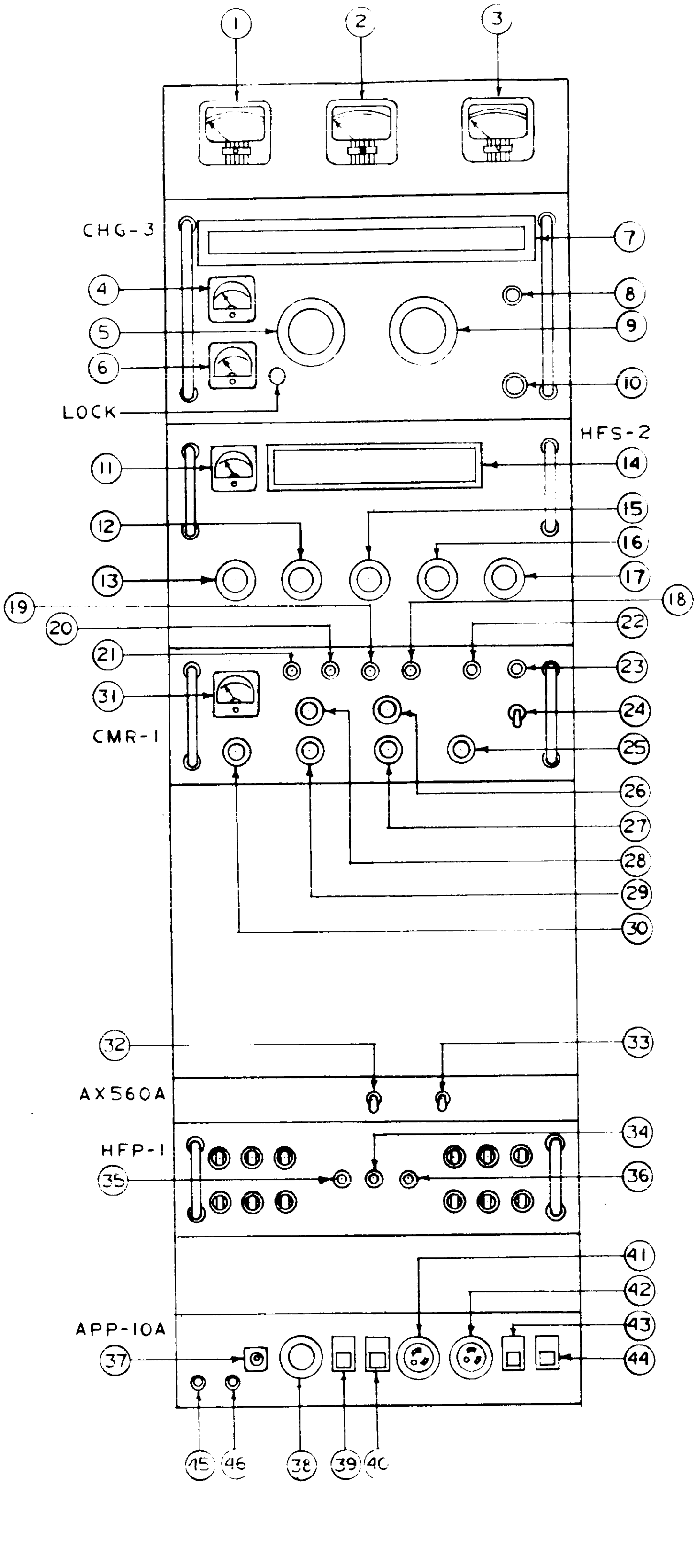

Figure 3-3. Auxiliary Frame Operating Controls and Indicators

SECTION 4
SUPPLEMENTARY DATA

4-1. INTRODUCTION.

This section contains supplementary information useful to the operator of the GPT-10K 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-10K 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-10K is rated at 10, 000 watts PEP, 5, 000 watts average (CW or FSK). When tuning the transmitter to full PEP, always calculate maximum antenna current in terms of average power.

Thus,

$$P_{average} = 5,000 \text{ watts} = I^2R$$

or

$$I_{max} = \sqrt{\frac{5000}{R}}$$

where

I_{max} = maximum antenna current

R = antenna impedance

For an unbalanced 70-ohm antenna,

$$I_{max} = \sqrt{\frac{5000}{70}} = 8.4 \text{ amperes}$$

For an unbalanced 50-ohm antenna,

$$I_{max} = \sqrt{\frac{5000}{50}} = 10 \text{ amperes}$$

When operating into a balanced 600-ohm antenna,

$$I_{max} = \sqrt{\frac{5000}{600}} = 2.9 \text{ amperes}$$

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,

$$P_{average} = \frac{10,000}{2} = 5,000 \text{ watts}$$

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:

$$P_{average} = \frac{PEP}{4} = 2,500 \text{ watts}$$

For an unbalanced 70-ohm antenna,

$$I_{max} = \sqrt{\frac{2500}{70}} = \sqrt{35.7} = 5.9 \text{ amperes}$$

For an unbalanced 50-ohm antenna,

$$I_{max} = \sqrt{\frac{2500}{50}} = \sqrt{50} = 7 \text{ amperes (approx)}$$

For a balanced 600-ohm antenna,

$$I_{max} = \sqrt{\frac{2500}{600}} = \sqrt{4.17} = 2 \text{ amperes (approx)}$$

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-10K 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 will be 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 is produced by the sum and difference combinations of the original radio frequencies. The degree of such intermodulation distortion caused by any non-linearity 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 badly 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-10K, the signal-to-distortion ratio for a two-tone input at full rated output is specified as 35 db minimum.

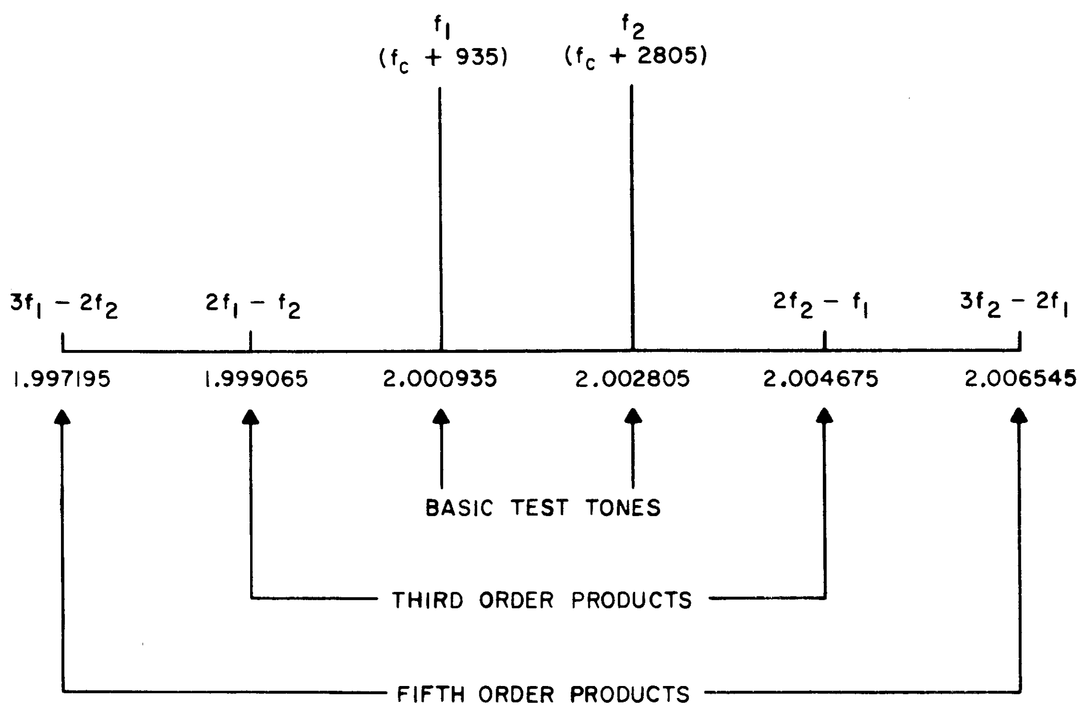

Figure 4-1. Odd Order Distortion Product Distribution

EXAMPLE 1

Figure 4-2 shows actual output waveforms observed on the spectrum analyzer of the PTE-3 with two-tone input applied and the GPT-10K tuned and loaded to rated capacity, 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 3805 cps above the carrier. The third order modulation product is too small to be discerned, while 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 displayed 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. However, they are obviously 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

The output waveforms shown in figure 4-3 were taken from another transmitter 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. In this pattern, 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 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 represents improper tuning since the signal-to-distortion ratio should be down at least 35 db.

In pattern B, a 16-channel teletype signal is modulating the A1 slot of a transmitter such as that depicted in pattern A. 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 and beyond use.

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 for 20 db down, is in normal operating amplitude. To reduce carrier noise on the circuit, the carrier should be as low as possible consistent with circuit reliability.

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) to CH 1 or CH 2 position (as determined by connection made in (1) above).

(4) Set MONITOR switch (64) on the APP-3 to PA position and connect the rf input cable on the spectrum analyzer to MONITOR OUTPUT jack (65).

(5) With transmitter set up for full rated output, as indicated by reading on PA OUTPUT meter (105), 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 1-kw and 10-kw amplifiers 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 corresponding TMC manual on that unit.

(6) Reduce drive to minimum.

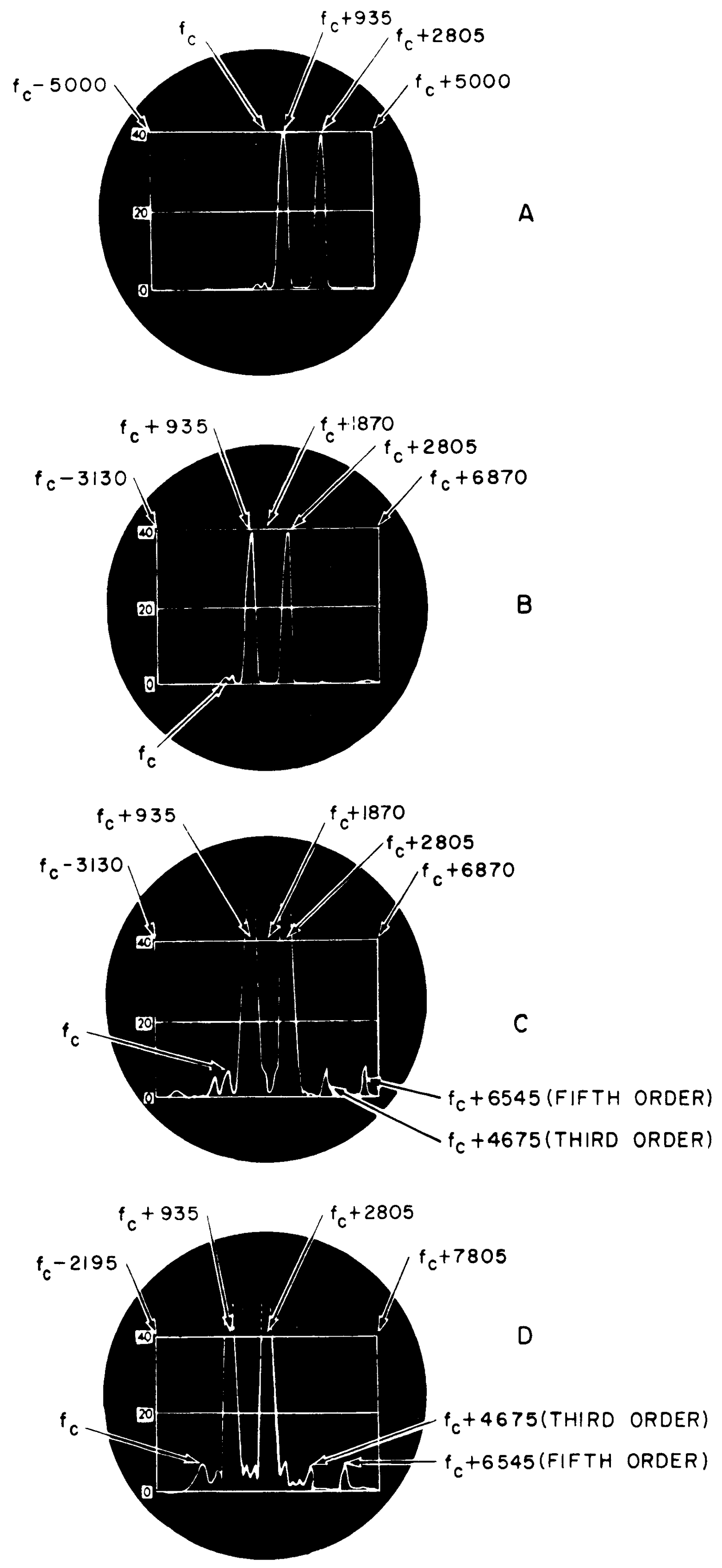

Figure 4-2. Two-Tone Spectrum Analyzer Patterns (Example 1)

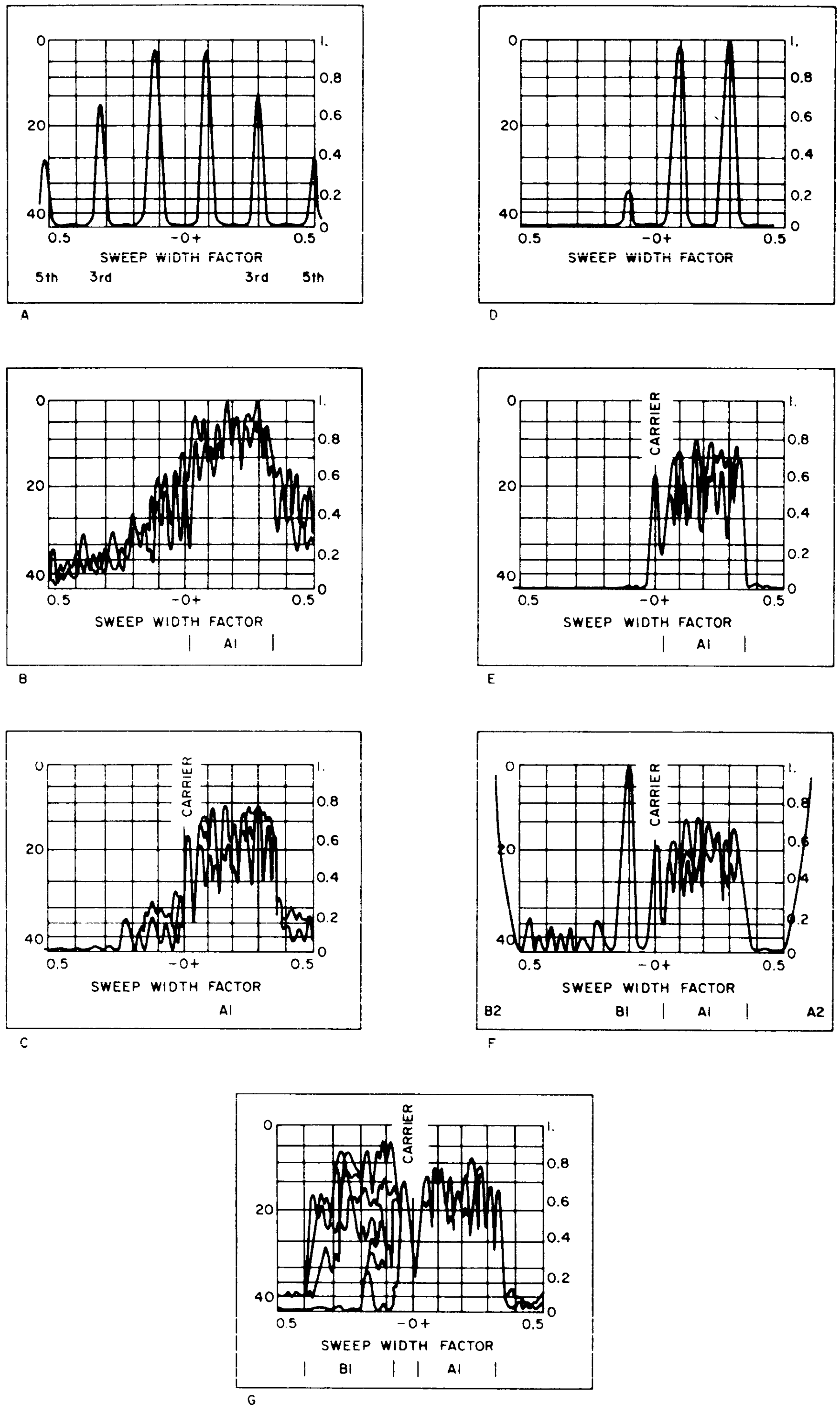

Figure 4-3. Transmitter Output Patterns (Example 2)

(7) Apply normal 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 insure that distortion levels are not exceeded.

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

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

(2) Set MONITOR switch (64) on the APP-10 to PA position and connect an rf cable between the MONITOR OUTPUT jack on the APP-10 and the vertical input to the oscilloscope.

(3) With the transmitter set up for full rated output, as indicated by reading on PA OUTPUT meter (105), 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 1-kw and 10-kw amplifiers 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.

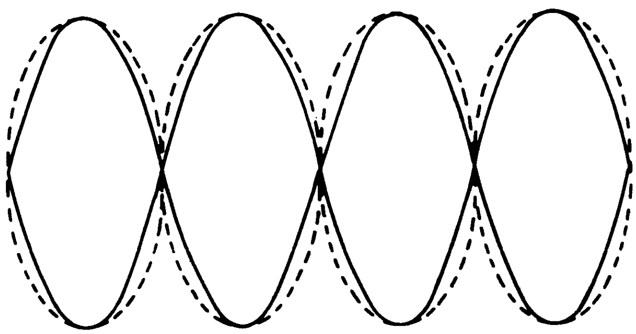

Figure 4-4. Two-tone Oscilloscope Pattern