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TECHNICAL MANUAL
for
GENERAL PURPOSE
RADIO TRANSMITTER
MODEL SBT-350V(A)



TMC (CANADA) LIMITED
Ottawa, Ontario

★

PRELIMINARY MANUAL
FOR

TECHNICAL MANUAL

for

GENERAL PURPOSE

RADIO TRANSMITTER

MODEL SBT-350V(A).

TMC (Canada) LTD.
OTTAWA ONTARIO

FOREWORD

TMC's General Purpose Transmitter, Model SBT-350V(A) consists of three major components as follows:

SWR-1K Standing Wave Ratio Indicator
PAL-350 Linear Power Amplifier
SBE-8 Transmitting Mode Selector

These three basic units are also included in various TMC transmitter systems as well as in the SBT-350V(A). To satisfy this condition most practically, individual manuals on each unit are written, then combined, as required, to cover any of the SBT-350'S multi-model transmitters. The SBT-350V(A) manual is made up of individual manuals as described below:

<u>PART</u>	<u>TITLE</u>
I	TECHNICAL MANUAL FOR GENERAL PURPOSE RADIO TRANSMITTER MODEL SBT-350V(A) SYSTEM.
II	TECHNICAL MANUAL FOR STANDING WAVE RATIO INDICATOR MODEL SWR-1K.
III	TECHNICAL MANUAL FOR LINEAR POWER AMPLIFIER MODEL PAL-350.
IV	TECHNICAL MANUAL FOR TRANSMITTING MODE SELECTOR MODEL SBE-8.
V	NOT USED.
VI	APPENDIX-RACK WIRING.

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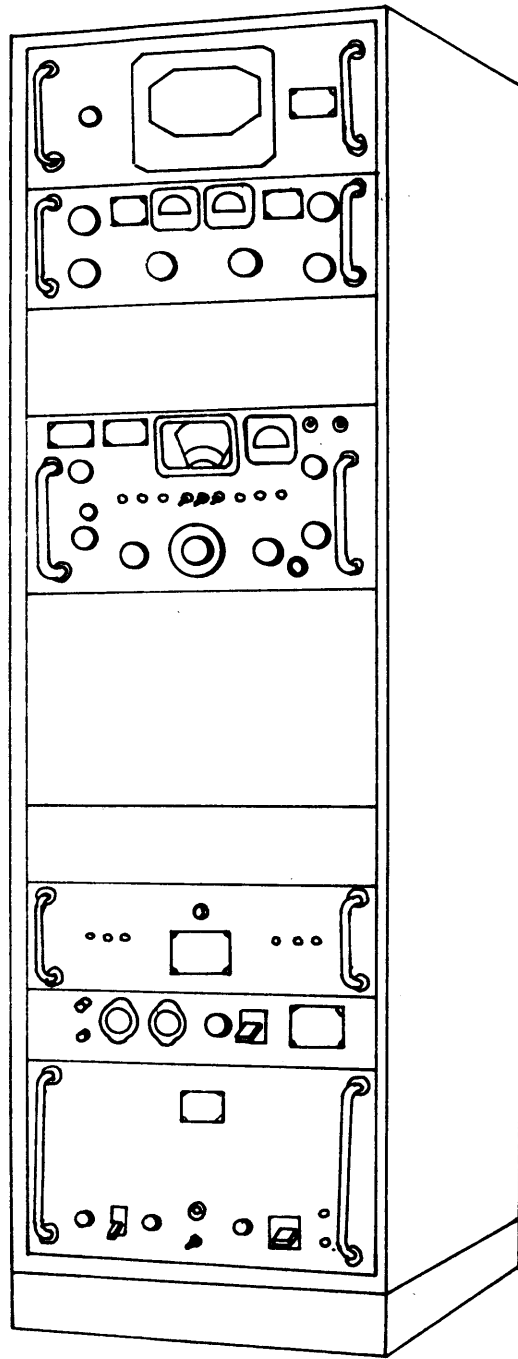


FIGURE I-1-1. FRONT ANGLE VIEW, SBT 350 (A)
GENERAL PURPOSE TRANSMITTER

SECTION 1.

GENERAL DESCRIPTION

1-1-1. PHYSICAL DESCRIPTION

The Technical Materiel Corporation Model SBT-350V(A) General Purpose Transmitter, shown in figure 1-1-1, is contained in a single rack. Two types are available, varying only in rack installation and overall height as follows:

<u>Type</u>	<u>Overall Height</u>
SBT-350V(A)-B (Base Mounted)	62 1/2 inches
SBT-350V(A)-S (Shock Mounted)	61 1/2 inches

The base mounted model (shown in figure 1-1-1) comes equipped with its own removeable mounting base (3 1/4 inches high). The shock mounted model is the same as the base mounted model with a set of 4 shock mounts replacing the mounting base at the bottom and 2 shock mounts installed at the top of the rear rack wall. Both models measure 20 5/8 inches wide X 24 1/2 inches deep. The components are removable and are mounted on drawer slides. The SBT-350V(A) contains its own forced-air cooling system, consisting of two intake blowers and an air filter on the rear rack door, a blower for the power amplifier tubes in the PAL-350, and a filtered air exhaust at the top of the rack. The transmitter is manufactured in accordance with MIL/SEL specifications wherever practicable. All parts meet or exceed the highest quality standards.

1-1-2. FUNCTIONAL DESCRIPTION

a. Overall Function. - The SBT-350V(A) is a general purpose transmitter with a conservatively rated output of 350 watts PEP (Peak Envelope Power) and a frequency range of 2 to 32 megacycles. By selection made at its front panel controls, it transmits in the following modes:

SSB (single sideband with voice or audio signal input and fully suppressed or partial carrier).

ISB (independent sidebands with voice or audio signal input and fully suppressed or partial carrier).

AM (equivalent amplitude modulation with voice or audio signal input).

CW telegraphy (keying of carrier).

b. Component Functions. - Referring to the components shown in figure 1-1-1 and in the order in which they appear from top to bottom, the functions are described in the following paragraphs.

- (1) Model SWR-1K Standing Wave Indicator provides accurate indication of the voltage standing wave ratio in the antenna system and simultaneously provides indications of forward and reflected power.
- (2) Model RFA-1 is the amplifier in the PAL-350 Linear Power Amplifier. This unit amplifies the output of the SBE-8 exciter up to 350 watts (PEP).
- (3) Model SBE-8 Transmitting Mode Selector is the exciter unit in the transmitter. From two audio input channels or a microphone input it translates intelligence into single, double or independent sidebands with suppressed carrier or any degree of carrier.

It also generates equivalent AM and CW signals.

- (4) The SBE-8 Power Supply provides power to the SBE-8 exciter.
- (5) Model APP-5 Auxiliary Power Panel is a standard unit for the SBT-350 series of transmitters. It distributes line voltage to the individual components and rack blowers. In addition, it contains wiring connections and terminal blocks on the rear of the unit for connection of a variety of equipment external to the SBT-350V(A).
- (6) Model PSP-350 is the power supply for the PAL-350 system. It has a sequential relay system which controls the sequence of voltages applied to the RFA-1 amplifier as the transmitter is turned on to protect the power amplifier tubes. A safety interlock system turns off the power if the doors or covers are opened around the high voltage areas of the transmitter or if an overload condition develops.

c. Additional Functions. - An additional capability of the SBT-350V(A) is found in its individual modular units - PAL-350 and SBE-8. These units may be used by themselves, without removing them from the rack. Their many capabilities are described in their individual manuals.

1-1-3. REFERENCE DATA

The SBT-350V(A) Transmitter weighs approximately 515 pounds; crated for shipping, divided into 4 crates, it weighs 985 pounds. Electrical characteristics are given in table 1-1-1.

TABLE 1-1-1. ELECTRICAL CHARACTERISTICS, SBT-350V(A).

Output power	350 watts PEP for SSB, ISB and AM. 175 watts average for CW.
Frequency range	2 to 32 megahertz.
Modes of operation	CW, SSB, ISB and equivalent AM. (sideband modes with suppressed carrier or any degree of carrier).
Output impedance	Will match any unbalanced load from 70 to 150 ohms at ± 20 degrees in the range of 2 to 4 megahertz and any unbalanced load from 50 to 600 ohms at ± 45 degrees in the range of 4 to 32 megahertz.
Frequency stability	SBE- 1 part in 10^6 per day. (crystal controlled)
Tuning	All tuning and bandswitching controls on the front panel.
Signal/distortion ratio	Distortion at least 40db below either tone of a standard two tone test.
Unwanted sideband rejection	A 500 cycle single tone in the unwanted sideband, 60db down from full PEP in the desired sideband.
Carrier insertion	-55db to full output.
Spurious signals	50db down from full PEP output.
Harmonic suppression	Second - at least 45db below PEP output. Third - at least 55db below PEP output.

TABLE 1-1-1 (Cont'd)

Audio input	1 - 500K ohms for high impedance crystal or dynamic mike. - 50dbm input will provide full rf output. 2 - Two independent 600 ohm channels, balanced or unbalanced.
Audio response	Flat within ± 1.5 db from 250 to 3500 cps.
VOX operation	Voice control with anti-trip features- (adjustable gain and squelch).
Noise level	60db down from PEP output.
Safety features	1- ALDC (automatic load and drive control) 2- Full interlock protection. 3- Full overload and fuse protection.
Primary power input	115/230 vac, 50/60 cps, single phase.
Power consumption	watts average.
Cooling system	Filtered forced-air blower system.
Enviromental	Designed to operate in any ambient temperature between 0 and 50°C and for any value of humidity up to 90%.

SECTION 2.
INSTALLATION

1-2-1. INTRODUCTION

Each SBT-350V(A) transmitter has been tested and calibrated as a complete system before shipment. Upon shipment it is disassembled and packed into crates. It is only necessary to unpack and reassemble the equipment as outlined in the following paragraphs. Recalibration of the individual rack mounted units is not necessary.

1-2-2. INITIAL INSPECTION

The complete SBT-350V(A) will arrive in 4 crates containing components as listed in table VI-D in Part VI of the manual (Appendix-Rack and Accessories). Inspect each crate and its contents immediately for possible damage. Unpack the equipment carefully. Inspect all packing material for parts which may have been shipped as "loose items". Although the carrier is liable for any damage in the equipment, Technical Materiel Corporation will assist in describing and providing for repair or replacement of damaged items. The equipment is shipped with all tubes and plug-in components installed, check that all such components are properly seated in their sockets.

1-2-3. RACK INSTALLATION

- a. Location. - Adequate ventilation must be provided; operation of the transmitter in a poorly ventilated room will cause the surrounding temperature to become unduly high.

The room (or van), in which the SBT-350V(A) is located, should have a ceiling height of at least 8 feet. A clearance of about 2 feet at the rear of the rack is needed for opening the door. In selecting the transmitter location, refer to the Appendix (Part VI) for reference drawings of rack dimensions. The rack should be located as close to the antenna as possible to maintain the shortest transmission lines between transmitter and antenna (see paragraph 1-2-7-1, antenna connection).

- b. Installation. - The four threaded holes on the top side of the rack and the four eyebolts included in the shipment are for lifting the rack with a crane hoist. The base-mounted rack is bolted to its own base. In the shock-mounted model, the four threaded holes in the two channels in the bottom of the rack are for the four shock mounts at the bottom. The two holes in the rear rack wall near the top edge are for two shock mounts. To install the shock-mounted model, use the base shock-mount pattern in figure VI-1 (Appendix) for drilling in the floor or mounting base. Hoist the completely assembled transmitter and place it upon the four base mounts and allow the transmitter to settle with its own weight. Install the two top shock mounts, using the two top holes in the rack as a template for drilling holes in the structure.

1-2-4. 230V LINE VOLTAGE MODIFICATION

- a. General. - The SBT-350V(A) is factory wired for 115vac 50/60 cycle, single phase line voltage unless specified otherwise on order. If the line voltage is 230vac 50/60 cycle, single phase, refer to paragraphs 1-2-4b through 1-2-4f for modification of the SBT-350V(A) wired for 115vac.
- b. PAL-350. - Relocate wiring connections at T210 transformer in RFA-1 Amplifier and at CB101 MAIN LINE circuit breaker, R104 resistor, and T101 and T102 transformers in the PSP-350 Power Supply as shown on overall schematics in Part III (PAL-350 manual). Replace the 1 amp fuse (F201) cartridge with a 1/2 amp fuse cartridge (TMC part number FU-100-.5) in the RFA-1. Replace the 1 amp L.V. Supply fuse (F101) cartridge with a 1/2 amp fuse cartridge (TMC part number FU-102-.5) in the PSP-350.
- c. SBE-8. - Relocate the wiring jumpers at T401 and T402 transformers in the SBE Power Supply unit and at TB101 oven heater circuit terminal block in the SBE exciter unit as shown in the overall schematics in Part IV (SBE-8 manual). Replace the 3 amp MAIN fuse (F402) cartridge with a 1/2 amp fuse cartridge (TMC part number FU-102-1.5). Replace the 2 amp OVEN fuse (F401) cartridge with a 1 amp fuse cartridge (TMC part number FU-102-1).
- d. APP-5. - Change bus straps at CB501 as shown in figure 1-2-1.
- e. Rack Blowers. - Relocate the wiring jumpers at E701 blower terminal block located on the rack door as shown in figure 1-2-2.

1-2-5. ASSEMBLY OF TRANSMITTER

Refer to table VI-D (Shipping List for SBT-350V(A)) for parts and their functions. Install components as shown in figure 1-1-1 and make cable connections as shown in figure VI-2 and VI-3 in Part VI (Appendix) of this manual. In some cases some of the smaller parts may be partially assembled before shipment. All components are slide-mounted except the SBE-8 Power Supply, the SWR-1K Standing Wave Ratio Indicator and the APP-5 Auxiliary Power Panel. Follow this general procedure for installing the slide-mounted units (see figure 1-2-3).

- a. Set the component in position on the tracks.
- b. Slide the component on the tracks until the release button catches.
- c. Press the release buttons and push the component into the rack until the release buttons engage in the holes in the equipment.
- d. When all the components have been installed and cabled; press the release buttons and push the component into the rack. To prevent the cables from the SBE-8 unit from snagging, utilize the reel-mounted spring located inside the rack (see figure VI-2).

1-2-6. INITIAL ADJUSTMENTS

The SBT-350V(A) has been factory tested and adjusted before disassembly for crating. No initial adjustments of chassis mounted variable components are necessary before operation.

1-2-7. CONNECTION OF EXTERNAL EQUIPMENT

- a. Introduction. - The APP-5 Auxillary Power Panel is a standard modular unit present in all of the SBT-350 series of transmitters. Besides functioning as a distributor for line voltage, it contains wiring for connections to many variations of equipment external to the SBT-350 and remote control features. Except for the antenna and mike connections, all external connections are made at two terminal blocks, E501 and E502, located at the rear of the APP-5. Wires may be brought into the transmitter through one of the four holes (with cover plates) near the bottom of the rack. Figure 1-2-4 and the following paragraphs illustrate the possible external connections to the SBT-350V(A). Schematic diagrams in Part VI of this manual and Section 7 of individual component manuals may be referred to for tracing wiring.
- b. Remote Transmitter Plate Relay. - Terminals 1 and 2 of E501 are provided for attachment to the coil of a relay supplying plate voltage to an additional stage of rf amplification external to the SBT-350V(A). This enables control of the entire transmitter at the SBE-8 panel by means of the XMTR OFF/ON switch. Such a relay is sometimes employed in larger transmitter systems of which the SBT-350V(A) is a sub-assembly.
- c. Regulated 115VAC. - Terminals 3 and 4 are available for an extension source of the regulated 115vac used in the PAL-350 power supply sequential relay system.

This 115 vac becomes available after the sequential relays have acted to turn the transmitter on. It may be used to energize an antenna relay in cases where a common antenna is used for both transmitter and receiver.

- d. External Interlocks. - Terminals 5, 6, 7 and 8 are provided for the connection of additional safety interlocks external to the SBT-350V(A) transmitter. Such additional interlocks will be in series with the SBT-350V(A) interlocks and form another link in the interlock circuit. When these terminals are not used in this way, the jumpers remain in place.
- e. Push-To-Talk System. - Terminals 9 and 10 are provided for a push-to-talk button attachment. A push-to-talk system may be used in lieu of or along with the voice-operated (VOX) circuit available in the SBE-8 unit.
- f. Receiver Squelch. - Terminals 11 and 12 are provided for attachment to the receiver audio output, if receiver "squelch" is desired when using VOX (voice operated) feature in the SBE-8 unit. Receiver squelch is used to prevent sound from a nearby receiver from automatically actuating the VOX circuit.
- g. Audio Input-Channels 1 and 2. - Terminals 13 through 20 are provided for the attachment of two separate sources (or channels) of intelligence in the form of 600 ohm audio. Figure 1-2-4 illustrates connections for either balanced or unbalanced inputs.

- h. Key Line. - Terminals 21 and 22 are provided for the attachment of a hand keying device for CW mode of transmission. Operating the key grounds the cathode circuit of V118 1st rf amplifier in the SBE-8 unit enabling it to operate. Leave the jumper wire in place when the keyer is not installed. For hand keyed CW transmission, single sideband mode, see paragraph 1-2-7j.
- i. Reserved Terminals. - Terminals 23, 24 and 25 are present in all standard APP-5 Auxillary Power Panels for connection to a receiver for purposes of receiver muting in a receiver/transmitter system in some versions of the SBT-350. The SBT-350V(A) is not wired for this feature and these terminals are not used.
- j. Antenna. - The SBT-350V(A) Transmitter is supplied with an SWR-1K Standing Wave Ratio Indicator adjusted for either a 50 ohm or 70 ohm load as indicated on the customer's order. When not specified, the SWR-1K arrives adjusted for a 50 ohm load. The nameplate on the SWR-1K control panel indicates SWR-1K (50) or SWR-1K (70). Adjustment from one load to the other may be made by means of two trimming capacitors (Null and Equalizer) as described in Part II (SWR-1K Manual). Connection of the SBT-350V(A) to the antenna is made at J305 ANTENNA jack on the rear of the SWR-1K chassis. TMC part number PL-149 is a QDS series rf plug supplied with the shipment to mate with J305. It will accommodate either an RG-8/U or an RG-11/U coaxial cable for a 50 ohm or 70 ohm load, respectively.

Keep the cable as short as possible to minimize power loss. Four knock-out holes are supplied in the top of the rack for cable exit.

- k. Mike. - The MIKE jack on the SBE-8 control panel is a 500K ohm input for a crystal or dynamic high impedance microphone. See table VI-D Shipping List in Appendix for mating plug supplied in the shipment.
- l. Line Voltage. - Connect the 115 or 230 vac 50/60 cycle, single phase line voltage source at J701 receptacle located at the bottom of the rack on the back wall. See table VI-D Shipping List in appendix for mating plug supplied in the shipment.

1-2-8. CRYSTAL INSTALLATION

- a. General. - The SBT-350V(A) requires crystals in the SBE-8 mf stage for carrier generation and selection. Unless specified on the customer's order, mf stage crystals are not included in the shipment. Ten crystal sockets are located in a small enclosure mounted on the top of the SBE-8 exciter chassis. The sockets are numbered 1 through 10 and are selectable by the SBE-8 MF XTAL SW with positions 1 through 10 on the front panel.
- b. Crystal Selection VS Carrier. - Type CR-27/U quartz crystals, with parallel resonance frequencies in the 2-4 megahertz range and housed in HC-6/U holders are required for the 2-32 megahertz carrier generation. Each crystal, used in conjunction with the SBE-8 BAND-MCS selector switch, yields approximately 15 carrier frequencies.

Crystal frequencies are calculated by the following formulae:

$$f_{xtl} = f_o + .270 \text{ (when } f_o \text{ is 2 to 4.27MHz)}$$

$$f_{xtl} = 2N - f_o + .270 \text{ (when } f_o \text{ is 4.27 to 32.27MHz)}$$

where f_o = carrier frequency (in MHz)

N = N value from table 1-2-1

f_{xtl} = crystal frequency (in MHz)

Example: A carrier frequency of 10MHz is required, Referring to the table 1-2-1, $N=6$, and the crystal frequency is:

$$f_{xtl} = 2N - f_o + .270$$

$$f_{xtl} = 12 - 10 + .270 = 2.27\text{MHz}$$

Since $f_o = f_{xtl} - .270$ (when $f_o = 2-4.27\text{MHz}$) and

$f_o = 2N - f_{xtl} + .270$ (when $f_o = 4.27- 32.27\text{MHz}$), additional

carrier frequencies are available from the 2.27MHz crystal:

$$f_o = f_{xtl} - .270$$

$$f_o = 2.27 - .270 = 2\text{MHz}$$

$$f_o = 2N - f_{xtl} + .270$$

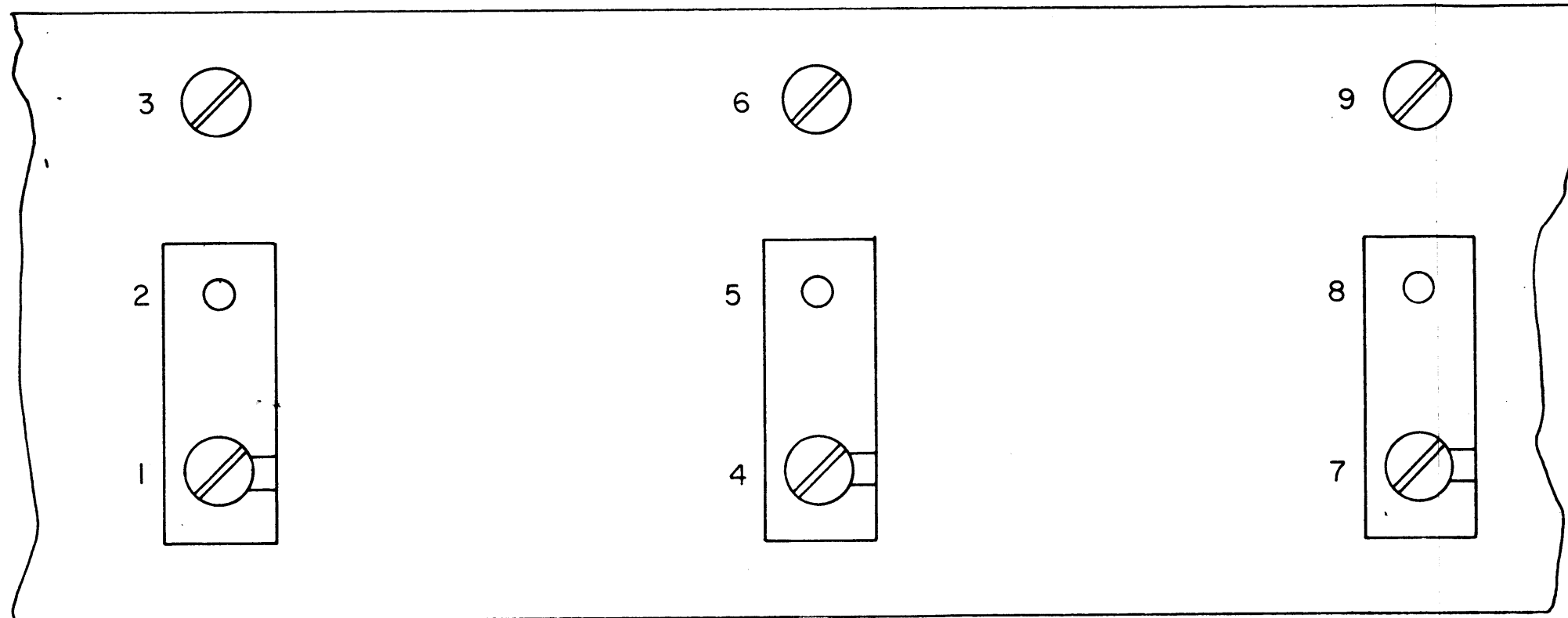
$$f_o = 8 - 2.27 + .270 = 6\text{MHz}$$

$$f_o = 2N - f_{xtl} + .270$$

$$f_o = 10 - 2.27 + .270 = 8\text{MHz etc.}$$

TABLE 1-2-1. N VALUES

f _o IN RANGE: -	N	f _o IN RANGE: -	N
2.0 - 4.27	0	18.27 - 20.27	11
4.27 - 6.27	4	20.27 - 24.27	12
6.27 - 8.27	5	22.27 - 24.27	13
8.27 - 10.27	6	24.27 - 26.27	14
10.27 - 12.27	7	26.27 - 28.27	15
12.27 - 14.27	8	28.27 - 30.27	16
14.27 - 16.27	9	30.27 - 32.27	17
16.27 - 18.27	10		



APP-5 BUSS STRAP ARRANGEMENT

NOTES:

1. FOR 115 VAC OPERATION ,CONNECT TERMINALS 1 & 2 ,4 & 5,7 & 8.

2. FOR 230 VAC OPERATION ,CONNECT TERMINALS 2 & 3,5 & 6,8 & 9.

Figure I-2-1. 230 V LINE VOLTAGE MODIFICATION DIAGRAM, APP-5

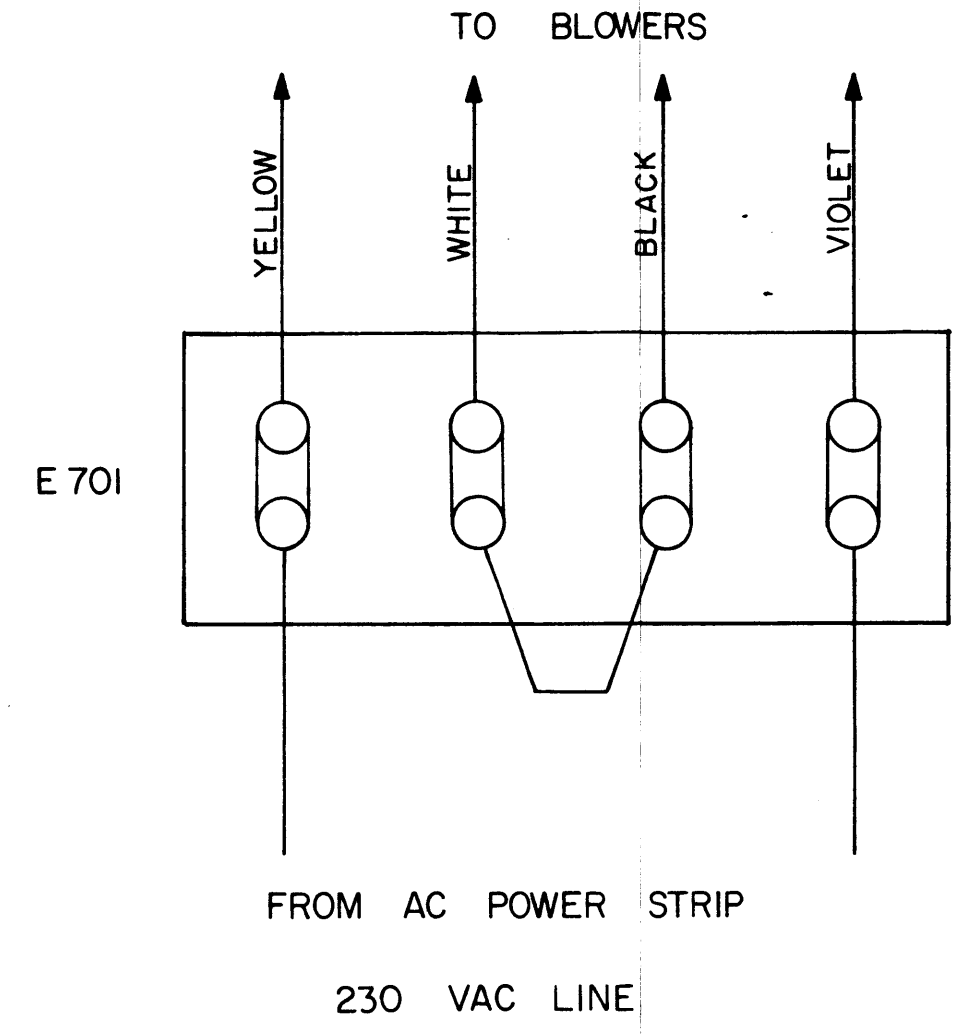
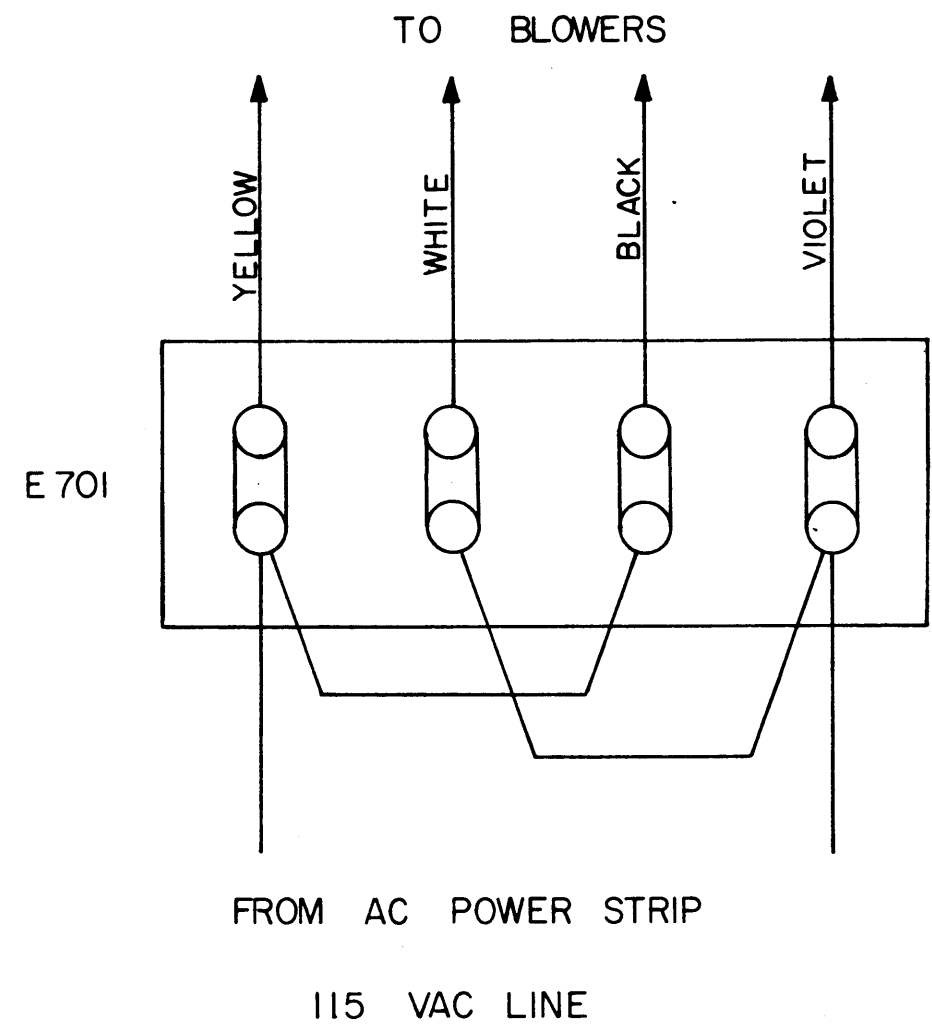
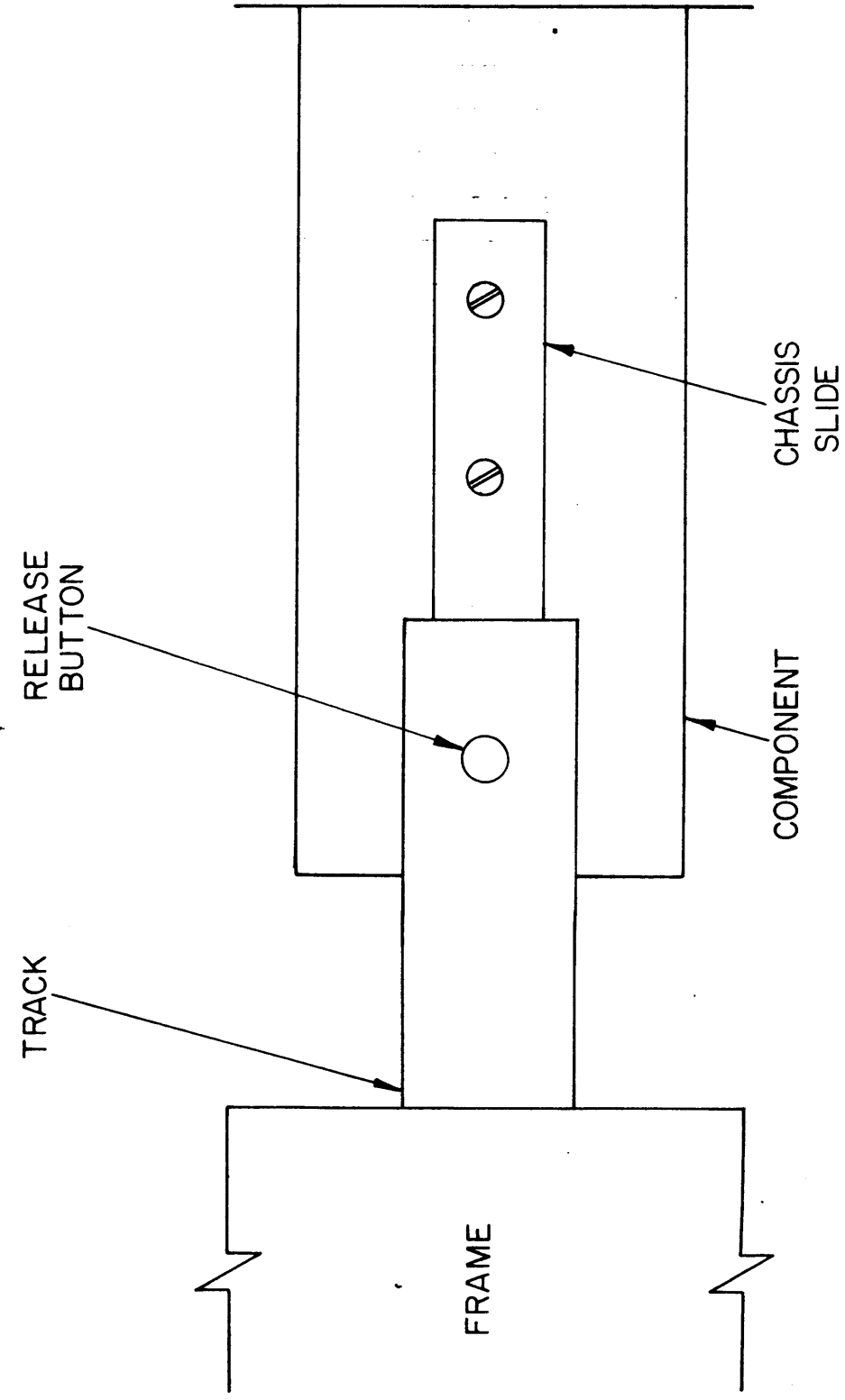
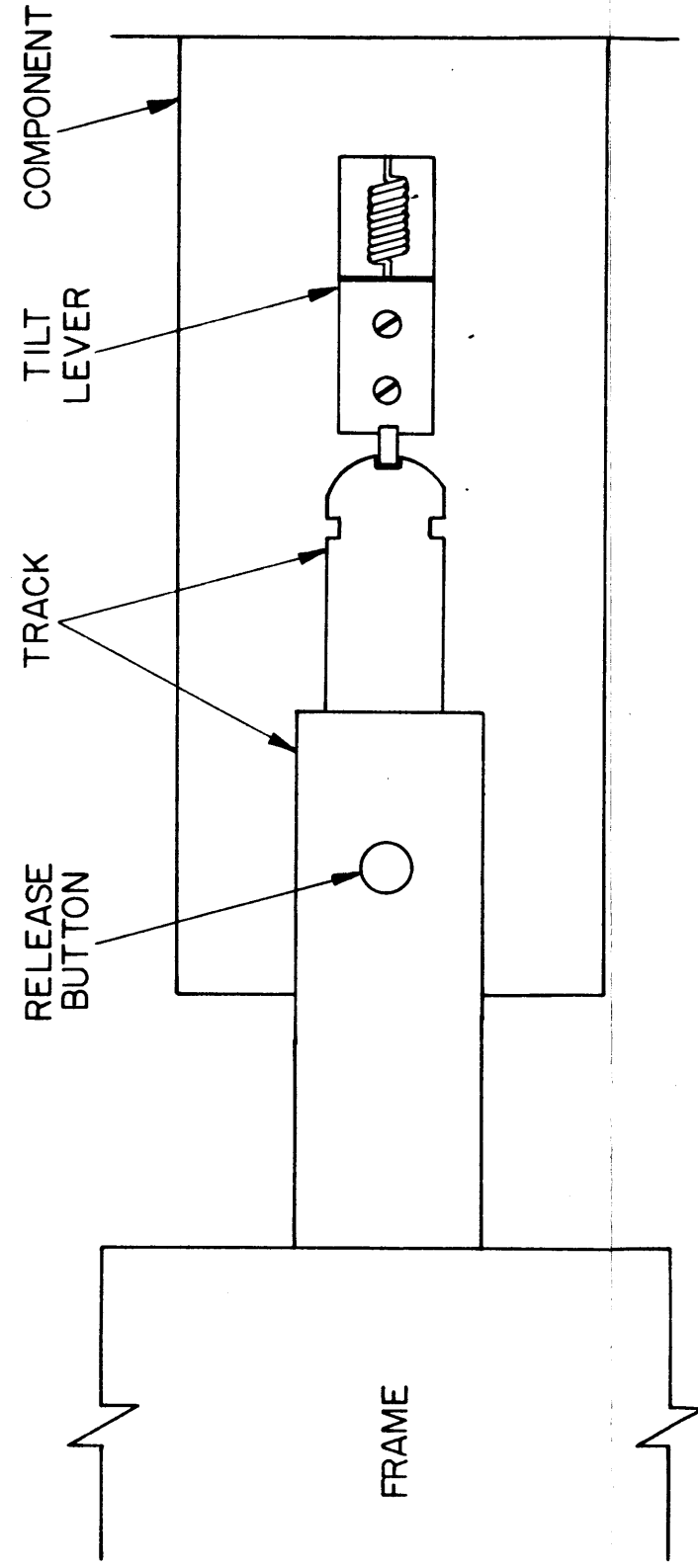


FIGURE I-2-2 JUMPER ARRANGEMENTS, RACK BLOWER TERMINAL BLOCK, 115- AND 230-VAC LINES, SBT-350



"A" NON-TILTING SLIDE MECHANISM



"B" TILTING SLIDE MECHANISM

FIGURE 1-2-3

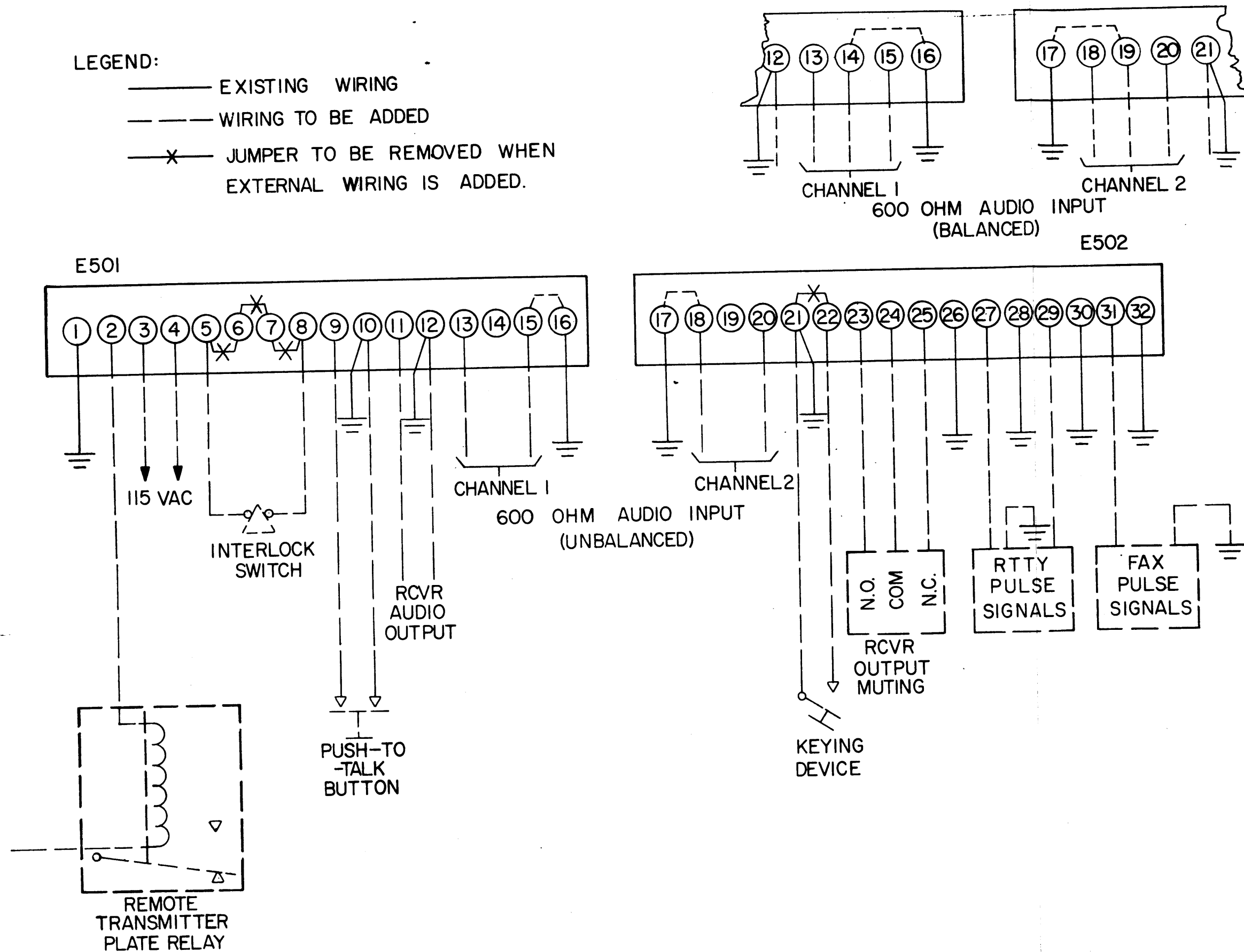


Figure I-2-4. CONNECTION DIAGRAM, EXTERNAL EQUIPMENT TO SBT-350 V(A)

SECTION 3
OPERATOR'S SECTION

1-3-1. PRELIMINARY INSTRUCTIONS

- a. General. - Before proceeding to "turn on", tune or operate the SBT-350V(A) transmitter, certain preliminary considerations should be taken to protect the equipment and personnel and to save time in tuning.

The considerations are:

- (1) - Functions of panel controls.
 - (2) - Power amplifier tube protection.
 - (3) - Warm-up time for crystal ovens.
 - (4) - Mode of transmission.
 - (5) - Carrier frequencies available.
 - (6) - Shut-down procedure.
- b. Functions of Panel Controls. - Figure 1-3-1 shows the SBT-350V(A) panel controls. Refer to section 3 of Part II (individual component manual) for functions of panel controls and indicators.
- c. Power Amplifier Tube Protection. - The two power amplifier (PA) tubes located in the RFA-1 Amplifier unit should not be powered up and down rapidly or inadvertently. This may result in too-rapid heat changes in the tubes with shortened tube-life as a result. A systematic procedure of "power on" adjustments, tuning, operating and shut-down procedure should be adhered to in that sequence.

d. Warm-Up Time for Crvstal Ovens. - Frequency determining crystals and components for the SBT-350V(A) are located in ovens in the SBE-8 unit. After tune-up, the transmitted frequency will remain within rated stability only if the oven temperatures have stabilized. The necessary warm-up time for the SBE-8 ovens is one (1) hour. If, after operating the transmitter, it is intended to use it again soon, a repitition of the warm-up procedure may be eliminated by leaving certain switches on, as described in "shut-down procedure" (paragraph 1-3-4).

e. Modes of Transmission. - There are four general modes of transmission available. These are: -

- (1) CW telegraphy (keyed carrier).
- (2) SSB (single sideband with voice or audio signal input and suppressed or partial carrier).
- (3) ISB (Independent sidebands with voice and/or audio signal inputs and suppressed or partial carrier).
- (4) AM (equivalent) (both sidebands and full carrier with voice or audio signal input).

The operator should inspect the connection points outlined in paragraphs 1-2-7b through 1-2-7n to establish that appropriate external equipment is attached to the SBT-350V(A) for the particular mode of transmission desired. It will be noted that several auxiliary features may be had, according to connections made at E501 and E502 terminals (i.e. "push to talk", receiver squelch, remote transmitter plate relay, or a common antenna used for transmitter and receiver).

Such connections should be noted by the operator for their possible effect on operating procedure as outlined in paragraphs 1-3-3a through 1-3-3j.

- f. Carrier Frequencies Available. - Carrier frequencies available in the SBT-350V(A) depend upon crystals installed in the SBE-8 exciter unit MF stage. The operator should note the number and frequency of crystals installed to determine what carrier frequencies are available. The crystal sockets are located in a small enclosure on the top to the SBE-8 exciter chassis and are numbered 1 through 10. The crystals are selectable by the SBE-8 MF XTAL SW with the corresponding positions numbered 1 through 10. For each crystal installed, there are several carrier frequencies available, calculated by the following formulae:

$$f_c = f_{xtal} - .270 \text{ (when } f_c \text{ is 2 to 4.27MHz)}$$

$$f_c = 2N - f_{xtal} + .270 \text{ (when } f_c \text{ is 4.27 to 32.27MHz)}$$

where f_c = carrier frequency (in MHz)

N = SBE-8 BAND MCS dial setting
(bottom figure under range in which
 f_c falls)

$$f_{xtal} = \text{SBE-8 MF stage crystal frequency (in MHz)}$$

To determine how many carrier frequencies are available, calculate each crystal f_{xtal} with each N value in each of the 16 settings of the BAND MCS dial. (f_c must fall within the printed range appearing above N). It is suggested that the operator then make a list of available carrier frequencies and their corresponding MF XTAL SW switch and BAND MCS dial positions and MF crystal frequency for reference when tuning the transmitter.

EXAMPLE: One 3MHz crystal is installed in socket number 1. By turning the BAND MCS dial to the first position (2.0 - 4.27 range), it is seen that N=0. In this position, for a carrier between 2 and 4.27MHz:

$$f_c = f_{xtal} - .270$$

$$f_c = 2.730\text{MHz}$$

In the next BAND MCS dial position (4.27 - 6.27) N=4 and the carrier is:

$$f_c = 2N - f_{xtal} + .270$$

$$f_c = 8 - 3 + .270 = 5.27\text{MHz}$$

In like manner, the remaining 13 positions of the BAND MCS dial will yield carrier frequencies increasing in 2MHz increments from 5.27MHz (i.e. 7.27, 9.27 etc).

The operator's chart will appear as follows:

CARRIER FREQUENCY (in MHz)	MF XTAL SW switch position	BAND MCS dial position	MF crystal freq. (in MHz)
2.73	1	2.0 - 4.27	3
5.27	1	4.27 - 6.27	3
7.27	1	6.27 - 8.27	3
9.27	1	8.27 - 10.27	3
etc.			

1-3-2. TUNING PROCEDURE

- a. Tuning Tables. - Table 1-3-1 outlines the procedure for tuning the transmitter for the carrier frequency. In all modes of transmission, the carrier is tuned up first, even though it may be suppressed in transmission, as in some of the sideband modes. Tables 1-3-2 through 1-3-5 include additional steps for tuning CW, SSB, ISB and AM modes.
- b. General Notes on Tuning. -

(1) For a brief review of theory, the operator may refer to paragraph 1-4-2 which outlines the functions of the major components in the various modes of transmission.

(2) When tuning the SBE-8, avoid exceeding the 100% marking on the SBE-8 meter, whether sending one sideband, both sidebands or sideband and carrier. Considerable distortion from intermodulation may result otherwise. VOX (voice actuated) operation of the transmitter is not effective in such modes where more than 30% carrier is transmitted.

TABLE 1-3-1. TUNE-UP OF CARRIER, SBT-350V(A).

STEP	CONTROL NUMBER (see Fig.1-3-1.)	OPERATION	PURPOSE
1	1, 24, 49, 52, 54, 69	Place all power switches in OFF or STANDBY positions.	Disconnects all line voltage inputs.
2	69, 68	Set MAIN POWER switch (69) to ON. MAIN POWER light (68) will ignite and rack blowers will start.	Connects transmitter to line voltage.
3	24, 12, 15, 60	Set POWER switch (24) to ON. Main tuning dial (12) will light up and OVEN light (15) and light (60) will ignite.	Supplies voltages to SBE-8 filaments and oven heater elements. Supplies plate voltages to all but RF amplifier stage.
4		Wait one (1) hour for oven temperatures to stabilize before proceeding with step 5.	Allows oven temperatures to stabilize critical frequency determining elements in transmitter.
5	19, 27, 20, 26, 33, 21, 25	Set LSB and USB switches (19) and (27) to OFF. Turn LSB and USB GAIN knobs (20 and 26) to their extreme counter-clockwise positions. Set OUTPUT knob (33) at position 5. Turn VOX GAIN knob (25) to their extreme counter-clockwise positions.	Disconnects audio input at SBE-8. Sets output level at mid-position in preparation for tuning. Disables VOX (voice-operating) circuit and receiver squelch input.

TABLE 1-3-1. TUNE-UP OF CARRIER, SBT-350V(A) (Cont'd).

STEP	CONTROL NUMBER (See Fig.1-3-1.)	OPERATION	PURPOSE
6	23,14	Set EXCITER switch (23) to ON. EXCITER lamp (14) will light.	Feeds plate voltage to SBE-8 output stage.
7	18,17,11	Determine carrier frequency (f_c) (see paragraph 1-3-1f). Refer to chart for appropriate MF XTAL SW and BAND MCS dial settings. Turn BAND MCS knob (18) to bring chart reading on BAND MCS dial (17). Set MF XTAL SW knob (11) to position indicated on chart.	Selects proper injection frequencies for MF and HF stages in SBE-8.
8	31,12	Turn MF TUNING knob (31) to bring MF crystal frequency reading on lower movable dial on main tuning dial (12).	Coarse-tunes MF stage in SBE-8.
9	29	Set OUTPUT TUNING center knob (29) to appropriate range reading for f_c .	Coarse-tunes HF stage in SBE-8.
10	16	Set METER SW knob (16) to MF.	Connects meter (13) to monitor output of MF stage.

TABLE 1-3-1. TUNE-UP OF CARRIER, SBT-350V(A) (Cont'd).

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
11	30, 12, 31, 13, 28	Adjust OUTPUT TUNING disc (30) to bring a reading on the upper section of dial (12) which is slightly lower than f_c . Then adjust MF TUNING knob (31) to obtain maximum reading on meter (13). If necessary, decrease the setting of CARRIER INSERT knob (28) to avoid an off-scale meter (13) reading. Lock MF TUNING knob (31) with outer disc. <u>NOTE:</u> Reading on lower section of dial (12) should now correspond with chart indication for MF crystal.	Fine-tunes MF stage in SBE-8.
12	16	Set METER SW knob (16) to MF.	Connects meter (13) to monitor output of HF stage.
13	30, 12, 13	With OUTPUT TUNING disc (30), increase the frequency reading on the upper section of dial (12) to the first peak reading on meter (13).	Fine-tunes HF stage in SBE-8.
14	33	Set OUTPUT knob (33) at 0. Lock movement with outer LOCK disc.	Turns SBE-8 output level down to minimum to check static voltage values in PAL-350.

TABLE 1-3-1. TUNE-UP OF CARRIER, SBT-350V(A) (Cont'd).

STEP	CONTROL NUMBER (See Fig. 1-3-1).	OPERATION	PURPOSE
15	4, 9	Set DRIVER BAND knob (4) and PA BAND knob (9) to appropriate ranges for f_c .	Selects band-pass circuits in driver and PA stages in PAI-350.
16	54, 53, 10, 6	Set MAIN LINE circuit breaker (54) to ON. MAIN LINE lamp (53) will light and blower in RFA-1 amplifier will start. Set MULTIMETER switch (10) to FILL 0-10V and observe MULTIMETER (6). Needle should coincide with FILL ADJ mark on dial.	Connects line voltage to PAI-350. Turns on filament supply and PA bias supply. Checks for proper voltage to PA tube.
17	52, 48, 51	Set TRANSMITTER PLATES switch (52) to ON. H.V. LINE OVERLOAD (BREAKER OFF) lamp (48) will light. After a 60 second interval, TRANSMITTER PLATES lamp (51) will light.	Sends plate and bias voltage to 1st amplifier and driver stages.
18	49, 48, 50, 5	Set H.V. LINE circuit breaker (49) to ON. OVERLOAD (BREAKER OFF) lamp (48) will go out and H.V. LINE lamp (50) will go on. PA PLATE meter (5) should read about 160 ma.	Sends plate voltage to PA stage.
19	10, 6, 51, 49	Set MULTIMETER switch (10) to H.V. 0-5K.V. MULTIMETER (6) should read 2000V. Then set TRANSMITTER PLATES switch (51) to STANDBY and H.V. LINE circuit breaker (49) to OFF.	Checks PA stage plate voltage. Turns off plate and bias voltages.

TABLE 1-3-1. TUNE-UP OF CARRIER, SBT-350V(A) (Cont'd).

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
20	7,8,3,10	Set PA TUNING and PA LOADING knobs (7 and 8) to 0. Set DRIVER TUNING knob (3) to position indicated for f_c in table 1-3-11. Set MULTIMETER switch (10) to DR 0-50v.	Coarse-tunes 1st amplifier and driver stages of PAL-350. Connects MULTIMETER to driver stage output.
21	33,52,51,3,6	Set OUTPUT knob (33) to 1. Set TRANSMITTER PLATES switch (52) to ON. After TRANSMITTER PLATES lamp (51) lights, readjust DRIVER TUNING knob (3) to obtain a peak reading on MULTIMETER (6). Keep peak below "3" (30v) by operation of OUTPUT knob (33).	Turns on plate and bias supply for 1st amplifier and driver stages. Turns up SBE-8 exciter output to a low level and fine-tunes 1st amplifier and driver stages in PAL-350.
22	33,10,49,50,5	Set OUTPUT knob (33) to 0. Leave MULTIMETER switch (10) set at RF DR 0-50v. Set H.V. LINE circuit breaker (49) to ON. H.V. LINE lamp (50) will light. Then slowly increase setting on OUTPUT knob (33) and observe PA PLATE meter (5). Increase OUTPUT knob setting until meter indicates current of 200ma.	Applies plate voltage to PA stage and adjusts input level to proper starting point for subsequent tuning.

TABLE 1-3-1. TUNE-UP OF CARRIER, SBT-350V(A) (Cont'd).

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
23	7,6,8,10,5	Adjust PA TUNING knob (7) to obtain a dip on MULTIMETER (6). Then adjust PA LOADING knob (8) to increase reading on MULTIMETER (6). Adjust OUTPUT knob (33) to obtain "3" (30v) on MULTIMETER. Readjust PA TUNING knob (7) to obtain another dip and then readjust PA LOADING knob (8) to obtain an increase. Readjust OUTPUT knob (33) to obtain a lower reading on MULTIMETER than that in the last OUTPUT knob adjustment. Repeat this loading procedure until approximately the values listed below are reached.	To obtain fine tuning of PA TUNING and PA LOADING circuits.

MULTIMETER	MULTIMETER
switch (10)	meter (6)
<u>position</u>	<u>reading</u>

RF DR 0-50v ----- 18v (maximum)
 ISG-20, + 30ma----- -5ma *
 RF PL 0-2.5Kv----- 500v *
 RF OUT 0-500v----- 70v

PA PLATE meter (5) 270ma *

* During the entire loading procedure, use OUTPUT knob (33) to prevent the following readings from exceeding the following maximum values at any time:

TABLE 1-3-1. TUNE-UP OF CARRIER, SBT-350V(A) (Cont'd).

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
23 (Cont'd)		<p>MULTIMETER switch (10) position</p> <p>MULTIMETER meter (6) <u>maximum reading</u></p> <p>ISG-20, + 30ma 20ma RF PL 0-2.5Kv 800v</p> <p>PA PLATE meter (5) 300ma maximum</p>	
24	33	Turn OUTPUT knob (33) fully counter-clockwise.	Turns PAL-350 output down to minimum to protect SWR-1K unit in next step.
25	1,33,2,7,8	Set OFF/x10/x1 knob (1) to x1 and slowly increase OUTPUT knob (33) setting until needles on meter (2) give good indication of a low VSWR (2:1 maximum) on SBE'S low drive. If necessary, retouch PA TUNING and PA LOADING knob (7 and 8) to bring VSWR down.	Selects 100 watt range indication for output power meter (2) for final tuning adjustments in order to protect SWR-1K circuitry.
26	1,33,2	When a satisfactory VSWR is reached in step 25, set OFF/x10/x1 knob (1) to x10 position and slowly increase OUTPUT knob (33) setting to bring desired level of output on power meter (2). * Check that VSWR still indicates a satisfactory ratio and retouch PA TUNING and PA LOADING knobs (7 and 8), if satisfactory.	Selects 1000 watt range indication for output power meter (2). Final power level adjustment made. * Output power is read by subtracting WATTS REFLECTED from FORWARD WATTS.

TABLE 1-3-1. TUNE-UP OF CARRIER, SBT-350V(A) (Cont'd).

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
27	33,1	Lock OUTPUT knob (33) with LOCK disc. Set OFF/x10/x1 knob (1) to OFF.	Disconnects power meter (2) from circuit to prevent meter damage due to surges in transmitter output power.

TABLE 1-3-2. TUNING PROCEDURE FOR CW TRANSMISSION SBT-350V(A).

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
1		Tune up carrier as described in table 1-3-1. Keyer must be shorted during tuning procedure.	Tunes for carrier to be sent.
2		Remove short from keyer.	Puts keyer between SBE-8 1st RF amplifier tube cathode and ground.

TABLE 1-3-3. TUNING PROCEDURE FOR SSB TRANSMISSION, SBT-350V(A).

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
1		Tune up carrier as described in table 1-3-1. Leave short across keyer.	
2	33, 52, 51	Turn OUTPUT knob (33) down to "0". Set TRANSMITTER PLATES switch (52) to STANDBY REMOTE. TRANSMITTER PLATES light (51) will go out.	Sets SBE-8 output level to zero. Removes power voltages from PAL-350.
<p><u>NOTE:</u> The following procedure is for transmitting audio channel 1 information on the lower sideband. To transmit channel 2 or MIKE information on lower sideband, use 2 or MIKE settings on LSB switch (19) rather than CH 1 setting. To use the upper sideband rather than the lower sideband, use USB switch (27) and USB GAIN control (26) rather than LSB switch (19) and LSB GAIN control (20).</p>			
3	27, 19, 20	Set USB knob (27) to OFF. Set LSB knob (19) to CH 1. Turn LSB GAIN knob (20) to mid-position.	Adjusts level of audio input for lower sideband.
4	28	Set CARRIER INSERT knob (28) to "0".	Turns down carrier level for subsequent adjustments.

TABLE 1-3-3. TUNING PROCEDURE FOR SSB TRANSMISSION, SBT-350V(A). (Cont'd)

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
5	16,33,13,20	Set METER SW knob (16) to RF. Turn up OUTPUT knob (33) to obtain useable reading on meter (13). Adjust LSB GAIN knob (20) until meter (13) indicates a maximum of 100% on audio peaks.	Connects meter (13) to read LSB rf output level in SBE-8. Adjusts LSB level to a reference point.
6	28,33	Adjust CARRIER INSERT knob (28) and OUTPUT knob (33) for desired degree of carrier insertion. * Then lock CARRIER INSERT knob (28) with LOCK disc.	Adjusts degree of carrier insertion.
*NOTE: For fully suppressed carrier operation, leave CARRIER INSERT knob (28) at "0". For any degree of carrier insertion, use the OUTPUT knob (33) to reduce audio peaks on meter (13) by an amount on the "% scale equal to the carrier insertion desired; then return the reading up to "100%" with the CARRIER INSERT knob (28).			
EXAMPLE: For 10% carrier injection (carrier down 20-db from full power), set OUTPUT knob (33) so that meter (13) reads "90%" on audio peaks with CARRIER INSERT knob (28) set at "0"; then rotate CARRIER INSERT knob (28) clockwise until meter (13) reading rises from "90%" to "100%" on audio peaks.			

TABLE 1-3-3. TUNING PROCEDURE FOR SSB TRANSMISSION, SBT-350V(A). (Cont'd).

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
7	23,14,21	If MIKE input is used and VOX (voice operated transmission) control is desired, # set exciter switch (23) to STANDBY. Then, speaking into mike and observing EXCITER lamp (14) adjust VOX GAIN knob (21) so that reasonably strong speech lights EXCITER lamp (14).	Sets up voice actuated control of transmitter. * VOX control is effective when carrier is suppressed to below 10db down from PEP.
8	25,14	If VOX control is employed and if it is also planned to use the receiver squelch feature adjust SQUELCH GAIN knob (25) so that extraneous noises reaching the mike from the receiver do not light the EXCITER lamp (14).	Set up receiver SQUELCH feature to be used with VOX control.
9	33,52,51	Return OUTPUT knob (33) to "0". Then set TRANSMITTER PLATES switch (52) to ON. TRANSMITTER PLATES light (51) will go on after 60 seconds.	Turns SBE-8 output down to zero. Connects power voltages to PAL-350.
10	16,1,33,2,13	With METER SW (16) set RF and OFF/x10/x1 switch (1) to x10 position, slowly increase OUTPUT knob (33) setting to bring desired output level to power meter (2). Do not allow reading on meter (13) to exceed "100%" or reading on meter (2) to exceed 350 watts output power.	Switches in meter to read SBE-8 output and transmitter power output. Adjusts total power output level of sideband and carrier. Checks output levels to prevent distortion in SBE-8 amplifiers and over-driving of PAL-350 PA tubes.

TABLE 1-3-3. TUNING PROCEDURE FOR SSB TRANSMISSION, SBT-350V(A). (Cont'd)

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
11	33,1	Lock OUTPUT knob (33) with LOCK disc. Set OFF/x10/x1 switch (1) to OFF.	Disconnects power meter (2) from circuit to prevent damage due to surges in transmitter output power.

TABLE 1-3-4. TUNING PROCEDURE FOR ISB TRANSMISSION, SBT-350V(A).

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
1		Tune up carrier as described in table 1-3-1. Leave short across keyer.	Tunes rf section for carrier.
2	33,52,51	Turn OUTPUT knob (33) down to "0". Set TRANSMITTER PLATES switch (52) to STANDBY REMOTE. TRANSMITTER PLATES light (51) will go out.	Sets SBE-8 output level to zero. Removes power voltages from PAL-350.

NOTE: The following procedure is for transmitting audio channel 1 information on the lower sideband and audio channel 2 on the upper sideband. To switch channel inputs or to use the MIKE input as one of the signals, use the corresponding CH 1, CH 2 or MIKE settings of the LSB and USB switches.

TABLE 1-3-4. TUNING PROCEDURE FOR ISB TRANSMISSION, SBT-350V(A). (Cont'd)

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
3	19, 27, 28, 20	Set LSB knob (19) to CH 1 and USB knob (27) to OFF. Set CARRIER INSERT knob (28) to "0". Advance LSB GAIN knob (20) 1/4 turn clockwise from full counter-clockwise position.	Connects CH 1 audio input to LSB circuitry in SBE-8 and disconnects CH 2 input. Turns down carrier level and adjusts LSB audio level for meter readings.
4	16, 33, 13, 20	Set METER SW knob (16) to RF. Turn up OUTPUT knob (33) to obtain useable reading on meter (13). Adjust LSB GAIN knob (20) for degree of carrier insertion desired as follows: For suppressed carrier operation, adjust knob for a reading of "50%" on audio peaks on meter (13). For 10% carrier insertion, adjust knob for reading of "45%" on peaks. For 20% carrier insertion, adjust knob for reading of "40%" on peaks. For other values, decrease meter reading by "5%" for each 10% increase in carrier insertion.	Connects meter (13) to read LSB rf output level in SBE-8. Adjusts LSB audio input level for desired degree of carrier insertion.

TABLE 1-3-4. TUNING PROCEDURE FOR ISB TRANSMISSION, SBT-350V(A). (Cont'd)

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
5	19,27,26	Set LSB knob (19) to OFF and USB knob (27) to CH 2. Advance USB GAIN knob (26) 1/4 turn clockwise from full counter-clockwise position.	Disconnects CH 1 audio input in SBE-8 and connects CH 2 input to USB circuitry.
6	20,13	Adjust USB GAIN knob (26) for degree of carrier insertion desired in the same manner as that for LSB GAIN in step 5.	Adjusts USB audio input level for desired degree of carrier insertion.
7	19,13	Set LSB knob (19) to CH 2 and observe meter (13). If sideband levels were previously set for suppressed carrier operation, meter should now read "100%" on audio peaks. If set for "10%" carrier insertion, meter should read "90%", etc.	Adds USB and LSB levels at meter (13) reading. Provides check for proper level of sum of sidebands.
8	28,13	For fully suppressed carrier operation, leave CARRIER INSERT knob (28) at "0". For any degree of carrier insertion, advance CARRIER INSERT knob (28) to bring meter (13) reading to "100%". Lock knob with LOCK disc.	Adjusts carrier insert level for desired degree of carrier transmission.

TABLE 1-3-4. TUNING PROCEDURE FOR ISB TRANSMISSION, SBT-350V(A). (Cont'd).

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
9	33,52,51	Return OUTPUT knob (33) to "0". Then set TRANSMITTER PLATES switch (52) to ON. TRANSMITTER PLATES light (51) will go on after 60 seconds.	Turns SBE-8 output down to zero. Connects power voltages to PAL-350.
10	16,1,33,2,13	With METER SW knob (16) set to RF and OFF/x10/x1 switch (1) to x10 position, slowly increase OUTPUT knob (33) setting to bring desired output level on power meter (2). Do not allow reading on meter (13) to exceed "100%" or reading on meter (2) to exceed 350 watts output power.	Switches in meters to read SBE-8 output and transmitter power output. Adjusts total power output level of both sidebands and carrier. Checks output levels to prevent distortion in SBE-8 amplifiers and over-driving of PAL-350 PA tubes.
11	33,1	Lock OUTPUT knob (33) with LOCK disc. Set OFF/x10/x1 switch (1) to OFF.	Disconnects power meter (2) from circuit to prevent damage due to surges in transmitter output power.

TABLE 1-3-5. TUNING PROCEDURE FOR AM TRANSMISSION, SBT-350V(A).

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
1		Tune up carrier as described in table 1-3-1. Leave short across keyer.	Tunes rf section for carrier.
2	33, 52, 51	Turn OUTPUT knob (33) down to "0". Set TRANSMITTER PLATES switch (52) to STANDBY REMOTE. TRANSMITTER PLATES light (51) will go out.	Sets SBE-8 output level to zero. Removes power voltages from PAL-350.
NOTE: The following procedure is for transmitting audio, channel 1 information. For transmitting audio channel 2 or MIKE and USB controls rather than the CH 1 setting.			
3	19, 27, 28, 20	Set LSB knob (19) to CH 1 and USB knob (27) to OFF. Set CARRIER INSERT knob (28) to "0". Advance LSB GAIN knob (20) 1/4 turn clockwise from full counter-clockwise position.	Connects CH 1 audio input to LSB circuitry in SBE-8 and disconnects CH 2 input. Turns down carrier level and adjusts LSB audio level for meter reading.
4	16, 33, 13, 20	Set METER SW knob (16) to RF. Turn up OUTPUT knob (33) for useable reading on meter (13). Adjust LSB GAIN knob (20) for reading of "25%" on meter (13) on audio peaks.	Connects meter (13) to read rf output level in SBE-8. Adjusts LSB audio input level for AM transmission.

TABLE 1-3-5. TUNING PROCEDURE FOR AM TRANSMISSION, SBT-350V(A). (Cont'd).

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
5	19, 27, 26, 13	Set LSB knob (19) to OFF and USB knob (27) to CH 1. Adjust USB GAIN knob (26) for reading of "25%" on meter (13) on audio peaks.	Disconnects CH 1 audio input from LSB circuitry and connects it to USB circuitry. Adjusts USB audio input level for AM transmission.
6	19, 13, 33	Set LSB knob (19) to CH 1 and observe meter (13). Meter should now read "50%" on audio peaks. If necessary, adjust OUTPUT knob (33) to obtain 50%.	Adds USB and LSB levels at meter (13) reading. Provides reference point for adjustment of carrier insertion.
7	28, 13	Advance CARRIER INSERT knob (28) to bring meter (13) reading to "100%". Lock knob with LOCK disc.	Adjusts carrier insert level for AM transmission with 100% modulation.
8	33, 52, 51	Return OUTPUT knob (33) to "0". Then set TRANSMITTER PLATES switch (52) to ON. TRANSMITTER PLATES light (51) will go on after 60 seconds.	Turns SBE-8 output down to zero. Connects power voltages to PAL-350.

TABLE 1-3-5. TUNING PROCEDURE FOR AM TRANSMISSION, SBT-350V(A). (Cont'd).

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
9	16,1,33,2	With METER SW knob (16) set to RF and OFF/x10/x1 switch (1) to x10 position, slowly increase OUTPUT knob (33) setting to bring desired output level to power meter (2). Do not allow reading on meter (2) to exceed 350 watts output power.	Switches in meters to read SBE-8 output and transmitter power output. Adjusts total power output level of both sidebands and carrier. Checks output levels to prevent distortion in SBE-8 amplifiers and over-driving of PAL-350 PA tubes.
10	33,1	Lock OUTPUT knob (33) with LOCK disc. Set OFF/x10/x1 switch (1) to OFF.	Disconnects power meter (2) from circuit to prevent damage due to surges in transmitter output power.

1-3-3. OPERATING PROCEDURE

- a. General. - In the following paragraphs, EXCITER switch (23) is recommended as an on-off control for the transmitted signal. XMTR switch (22), TRANSMITTER PLATES switch (52), or remote "transmitter plates" switch may be used for on-off control; however, there is a subsequent 60 second delay between the time that the switch is set to ON and the continuation of the signal.

NOTE: Unless VOX (voice-operated transmission) control is employed, VOX GAIN knob (21) should be kept in its extreme counter-clockwise position. Otherwise the presence of any sideband component in the signal may automatically transmit while EXCITER switch (23) is in STANDBY.

- b. CW Mode. - Operate the transmitter with a keyer. The transmitter will send carrier when keyer is held down. If EXCITER switch (23) is set to STANDBY, the carrier is shut-off and the keyer is inoperative.
- c. SSB Mode Without VOX or Push-To-Talk Control. - Keep VOX GAIN knob (21) and SQUELCH GAIN knob (25) set in their extreme counter-clockwise positions. The SSB signal (and any carrier inserted) will transmit with EXCITER switch (23) in ON position; placing switch in STANDBY turns off transmitted signal. Transmission is indicated by ignited EXCITER lamp (14).

- d. SSB Mode With VOX Control. - If carrier component in signal is suppressed at least 10db down from PEP (30% maximum carrier) as indicated on meter (13), VOX (voice-operated transmission) control may be used. Set EXCITER switch (23) in STANDBY and adjust VOX GAIN knob (21) and SQUELCH GAIN knob (25). Speaking into mike transmit signal (sideband and any carrier inserted). Transmission is indicated by ignited EXCITER lamp (14). EXCITER switch (23) in ON position may be used to override VOX control for "ON" control.
- e. SSB Mode With Push-To-Talk Control. - Keep VOX GAIN knob (21) and SQUELCH GAIN knob (25) set in their extreme counterclockwise positions. Set EXCITER switch (23) to STANDBY. Holding down push-to-talk button will transmit a signal (sideband and any carrier inserted); releasing the button turns the signal off. Transmission is indicated by ignited EXCITER lamp (14). EXCITER switch (23) in ON position may be used to override push-to-talk button for "ON" control.
- f. ISB Mode. - Both upper and lower sideband signals and any carrier inserted will transmit with EXCITER switch (23) in ON position; placing the switch in STANDBY turns off both sideband signals and carrier. Transmission is indicated by ignited EXCITER lamp (14). Either lower or upper sideband may be turned off and on by means of the LSB switch (19) or USB switch (27), but the carrier will continue to transmit in this case.

- g. AM Mode Without Push-To-Talk Control. - An AM signal (both sidebands and carrier) will transmit with EXCITER switch (23) in ON position; placing the switch in STANDBY turns off the signal. Transmission is indicated by ignited EXCITER lamp (14). To transmit carrier only, leave EXCITER switch (23) in ON position and set both LSB switch (19) and USB switch (27) to OFF.
- h. AM Mode With Push-To-Talk Control. - Set EXCITER switch (23) to STANDBY. Holding down push-to-talk button transmits a signal; releasing the button turns off the signal. Transmission is indicated by ignited EXCITER lamp (14). EXCITER switch (23) in ON position may be used to override the push-to-talk button for "ON" control. To transmit a carrier only, set the EXCITER switch (23) to ON and set LSB switch (19) and USB switch (27) to OFF.

1-3-4. Shutdown Procedure

- a. General. - The SBT-350V(A) may be placed in standby or completely turned off. Standby is recommended when it is intended to transmit again in the near future. This eliminates repeating the one (1) hour crystal warm-up procedure as described in table 1-3-1, steps 1 through 3.
- b. Standby. - To place the SBT-350V(A) in standby condition, set switches as shown in table 1-3-6.
- c. Normal Stopping. - To completely turn off the SBT-350V(A) transmitter, follow the procedure outlined in table 1-3-6, steps 1 and 2, and then set the following switches in the positions as listed:

SWITCH	CONTROL NUMBER (See Fig.1-3-1)	POSITION
OFF/x10/x1	1	OFF
XMTR	22	OFF
EXCITER	23	STANDBY
POWER	24	OFF
OUTPUT	33	"0"
B +	47	STANDBY
MAIN POWER	69	OFF

- d. Emergency Stopping. - To turn off the SBT-350V(A) transmitter in an emergency, set MAIN POWER circuit breaker (69) to OFF.

TABLE 1-3-6. PROCEDURE FOR PLACING SBT-350V(A) IN STANDBY.

STEP	CONTROL NUMBER (See Fig. 1-3-1).	OPERATION	PURPOSE
1	52, 49, 51, 50, 48	Set TRANSMITTER PLATES switch (52) to STANDBY REMOVE and H.V. LINE circuit breaker (49) to OFF. TRANSMITTER PLATES lamp (51) and H.V. LINE lamp (50) will go out. H.V. LINE OVERLOAD (BREAKER OFF) lamp (48) will go on.	Shuts off all plate and screen supplies, and control amplifier and driver stage bias supply in PAL-350.
<p>CAUTION: Wait at least 5 minutes before proceeding to step 2. This delay will gradually cool the PA tubes in the PAL-350 and prolong their lives.</p>			
2	54, 53, 48	Set MAIN LINE circuit breaker (54) to OFF. MAIN LINE lamp (53) and H.V. LINE OVERLOAD (BREAKER OFF) lamp (48) will go out. Blower in PAL-350 will stop.	Cuts off primary line voltage to PAL-350 and subsequent filament supply and PA tubes bias supply.
3	1	Leave OFF/x10/x1 switch (1) in OFF position.	Disconnects meter (2) transmitter output.
4	24, 12, 60, 15, 23	Leave POWER switch (24) in ON position. Dial light for dial (12) and lamp (60) will remain lighted. OVEN lamp (15) will continue to cycle. EXCITER switch (23) should be in STANDBY position, with EXCITER lamp (14) out.	Leaves primary line voltage connected to the SBT-8 and subsequently to crystal oven heating circuits. All filament supplies and all plate supplies (except final SBT-8 output stage) remain connected.

TABLE 1-3-6. PROCEDURE FOR PLACING SBT-350V(A) IN STANDBY. (Cont'd).

STEP	CONTROL NUMBER (See Fig.1-3-1).	OPERATION	PURPOSE
5	69,68	Leave MAIN POWER circuit breaker (69) in ON position. MAIN POWER lamp (68) will remain on.	Leaves the primary line voltage connected to SBT-350V(A) system.

TABLE 1-3-7. DRIVER TUNING KNOB SETTINGS, PAL-350.

DRIVER BAND Setting 2-4		DRIVER BAND Setting 4-8		DRIVER BAND Setting 8-16		DRIVER BAND Setting 16-32	
f (MHz)	DRIVER TUNING Setting	f (MHz)	DRIVER TUNING Setting	f (MHz)	DRIVER TUNING Setting	f (MHz)	DRIVER TUNING Setting
*	0	*	0	*	0	*	0
2	1	4	1	8	1	16	1
2.25	2	4.5	2	9	2	18	2
2.5	3	5	3	10	3	20	3
2.75	4	5.55	4	11	4	22	4
3	5	6	5	12	5	24	5
3.25	6	6.5	6	13	6	26	6
3.5	7	7	7	14	7	28	7
3.75	8	7.5	8	15	8	30	8
4	9	8	9	16	9	32	9
*	10	*	10	*	10	*	10

* BEYOND TUNING RANGE.

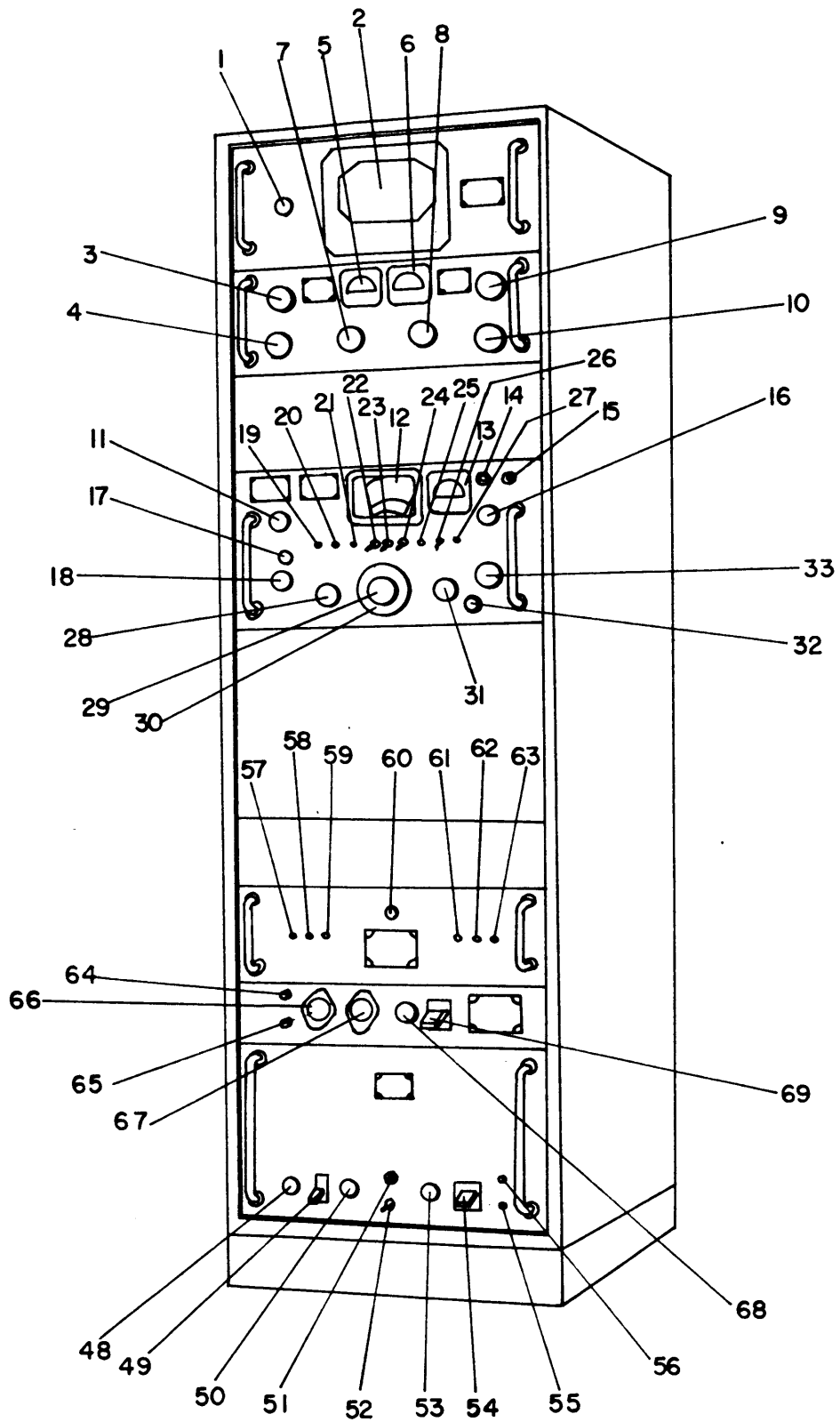


FIGURE 1-3-1. PANEL CONTROLS, SBT 350 V(A)

SECTION 4
PRINCIPLES OF OPERATION

1-4-1. INTRODUCTION

Figure 1-4-1 is a functional diagram of the SBT-350V(A) transmitter, showing the main inter-relationships of the SBE-8, PAL-350 and the SWR-1K. For a detailed functional block diagram and schematic diagram of each unit, refer to the individual manual for the unit. Schematic diagrams for the APP-5 Auxiliary Power Panel and RAK-19 rack wiring are shown in Part VI of this manual (Appendix).

1-4-2. OPERATION

- a. Carrier Generation (Figure 1-4-1). - An rf carrier, in the 2 to 32MHz range, is generated in the SBE-8. The manner in which it is generated is described in paragraph 1-4-2j(1) (Frequency Translation, Carrier Frequency). The carrier is amplified up to the 350 watt level by the PAL-350. The SWR-1K contains a VSWR (voltage standing wave ratio) indicator which simultaneously indicates VSWR, forward power and reflected power for tuning and loading purposes.
- b. CW Transmission (Figure 1-4-1). - One type only of CW transmission is available from the SBT-350V(A) transmitter, a keyer enables and disables the 2-32MHz amplifier stage in the SBE-8, thus controlling the carrier output.

- c. SSB Transmission (Figure 1-4-1). - In the SSB mode, the audio input from CH 1, CH 2 or mike modulates the 2 to 32MHz carrier in the SBE-8. Either the upper or lower sideband is sent out with fully or partially suppressed carrier.
- d. ISB Transmission (Figure 1-4-1). - In the ISB mode, two separate intelligence sources (two audio channels or one audio channel and mike) are introduced at the SBE-8 audio input channels 1 and 2. The two audio channels modulating the 2 to 32MHz carrier are routed to the upper and lower sideband circuitry. Transmission consists of upper and lower sideband with either fully or partially suppressed carrier.
- e. AM Transmission (Figure 1-4-1). - In the AM mode, the audio input from CH 1, CH 2 or mike modulates the 2 to 32MHz carrier in the SBE-8. Both upper and lower sidebands plus full carrier are transmitted.
- f. Frequency Translation (Figure 1-4-2)..-
- (1) Carrier Frequency - Figure 1-4-2 shows the origin of the carrier (270kHz oscillator in the SBE-8) and the two successive modulation stages (MF and HF) which bring it to the 2 to 32MHz range. Since the MF and HF modulation stages each have tuning circuits (MF TUNING and OUTPUT TUNING) in their outputs with dials calibrated to pass the difference frequencies, f_o (carrier frequency) may be described as follows:

$$f_o = 2N - f_m$$

$$f_m = f - .270$$

$$f_o = 2N - (f_{xtl} - .270)$$

$$f_o = 2N - (f_{xtl} + .270)$$

where f_o = output carrier frequency (in MHz)

N = figure appearing below output range on
BAND-MCS dial on SBE-8.

$2N$ = frequency (in MHz) from HF oscillator.

f_m = difference frequency output of MF balanced
modulator (in MHz).

f_{xtl} = frequency of MF stage crystal in SBE-8 (in MHz).

(2) Lower Sideband Frequency - An audio tone input (f_a) at the SBE-8 mixes with the 270kHz from the 270kHz generator circuit to produce upper and lower sideband frequencies. By means of LSB and USB selector switches and LSB i-f modulator and filters, the 270kHz carrier is removed and only the lower sideband frequency (f_{lsb}) is passed on to the mf modulator. MF XTAL SW (f_{xtl}), MF TUNING (f_m), BAND-MCS ($2N$) and OUTPUT TUNING (f_o) have been previously set for the output carrier frequency (f_o) as described in paragraph 1-4-2f (1). The simple formula for the lower sideband output frequency ($f_{lo} = f_o - f_a$) is evolved as follows:

$$f_{lo} = 2N - f_m$$

$$f_m = f_{xtl} - f_{lsb}$$

$$f_{lo} = 2N - (f_{xtl} - f_{lsb})$$

$$f_{lsb} = 270kc - f_a$$

$$f_{lo} = 2N - [f_{xtl} - (270kHz - f_a)]$$

$$f_{lo} = 2N - f_{xtl} + 270kHz - f_a$$

$$f_o = 2N - f_{xtl} + 270kHz \text{ (from paragraph 1-4-2f (1))}$$

$$f_o = f_o - f_a$$

(3) Upper Sideband Frequency - The upper sideband output frequency formula ($f_{uo} = f_o + f_a$) is evolved in the same general manner as is the lower sideband:

$$f_{uo} = 2N - f_m$$

$$f_m = f_{xtl} - f_{usb}$$

$$f_{uo} = 2N - (f_{xtl} - f_{usb})$$

$$f_{usb} = 270\text{kHz} - f_a$$

$$f_{uo} = 2N - [f_{xtl} - (270\text{kHz} + f_a)]$$

$$f_{uo} = 2N - f_{xtl} + 270\text{kHz} + f_a$$

$$f_o = 2N - f_{xtl} + 270\text{kHz} \text{ (from paragraph 1-4-2f (1))}$$

$$f_{uo} = f_o + f_a$$

(4) Carrier Re-insertion (Figure 1-4-2). - In sideband transmission, the 270kHz carrier originating frequency removed by the i-f modulators may be re-inserted by means of the SBE-8 CARRIER INSERT knob. The output carrier frequency (f_o) then evolves as described in paragraph 1-4-2f (1) and is transmitted along-side the sideband in the frequency spectrum. The carrier remains a constant frequency and amplitude as set and the sideband frequency varies in frequency and amplitude as set and the sideband frequency varies in frequency and amplitude as does the audio input frequency (f_a). The CARRIER INSERT control is turned up to full maximum in AM transmission.

g. Interlock System (Figure 1-4-3). - Figure 1-4-3 shows the complete safety interlock system through the transmitter, with its relationship to the SBE-8 XMTR switch, VOX (voice-operated transmission) feature, and PSP-350 TRANSMITTER PLATES switch. The purpose of the interlock system is to shut off high voltages when any one of a series of undesirable conditions exist, to protect personnel and equipment. Essentially a + 150vdc voltage originating in the PAL-350 Power Supply (PSP-350), completes a circuit through a series of interlocks when the PSP-350 TRANSMITTER PLATES switch, SBE-8 XMTR switch, or SBE-8 VOX relay is closed. The interlock links are listed in table 1-4-1. Completing the interlock circuit sends current through the PSP-350 transmitter plates relay coil, energizing this relay. Closed contacts on the relay send plate voltages to the PAL-350 1st amplifier and driver stages. The energized K102 relay also completes the primary line voltage to T102 high voltage transformer when the H.V. LINE circuit breaker is closed. Also, bias voltage is supplied to the 1st amplifier and driver stages (not pictured in figure 1-4-3). In short, energized K102 transmitter plates relay has the effect of adding sufficient power to the signal to transmit it. When any one of the series interlocks is opened, the relay is de-energized, plate voltages are removed from the PAL-350 and the transmitted signal is cut-off.

TABLE 1-4-1. INTERLOCK CIRCUIT COMPONENTS

UNIT	INTERLOCK	WHEN CLOSED
PSP-350	Bottom cover interlock switch S102.	When bottom cover of the PSP-350 is secured in position.
PSP-350	Top cover interlock switch S101.	When top cover of the PSP-350 is secured in position.
PSP-350	Closed contacts of K104 interlock relay.	When K104 interlock relay is energized.
RAK-19	Rack rear door interlock switch S701.	When rack rear door is closed.
RFA-1	Top cover interlock switch S204.	When top cover of the RFA-1 is secured in position.
RFA-1	Bottom cover interlock switch S205.	When bottom cover of the RFA-1 is secured in position.

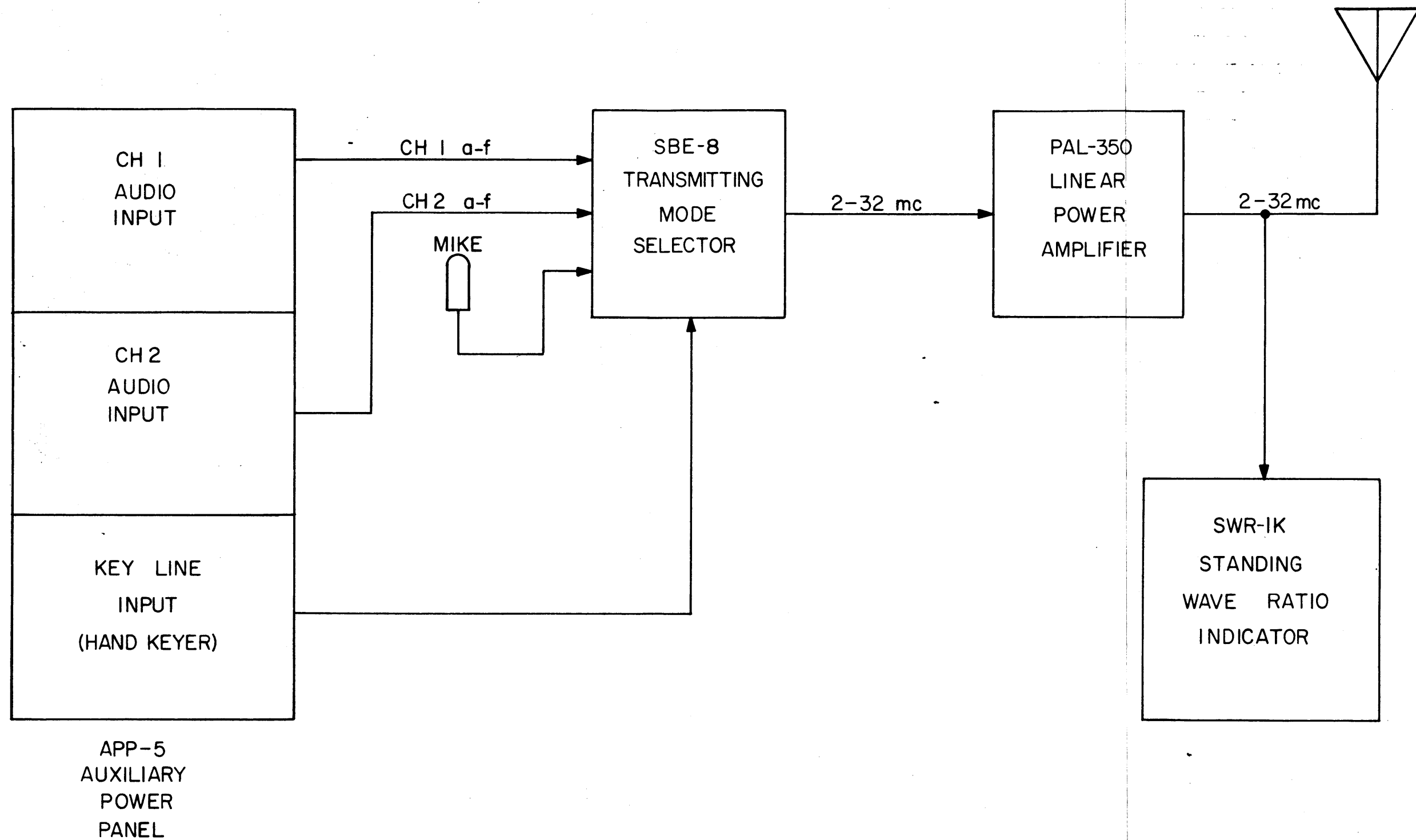


FIGURE I-4-1. FUNCTIONAL BLOCK DIAGRAM , SBT-350 V(A)

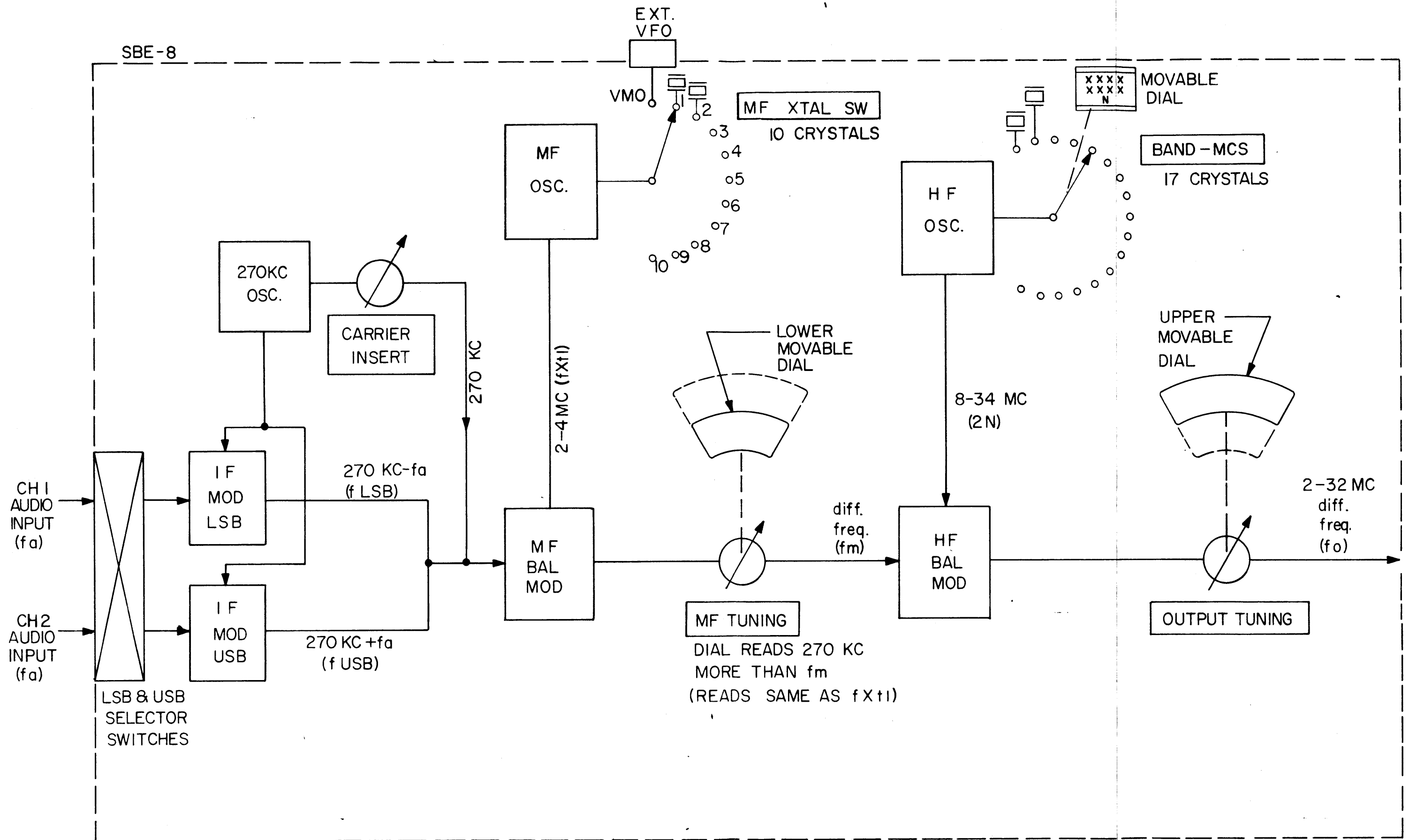


FIGURE I-4-2. FREQUENCY TRANSLATION DIAGRAM, SBT-350 V(A)

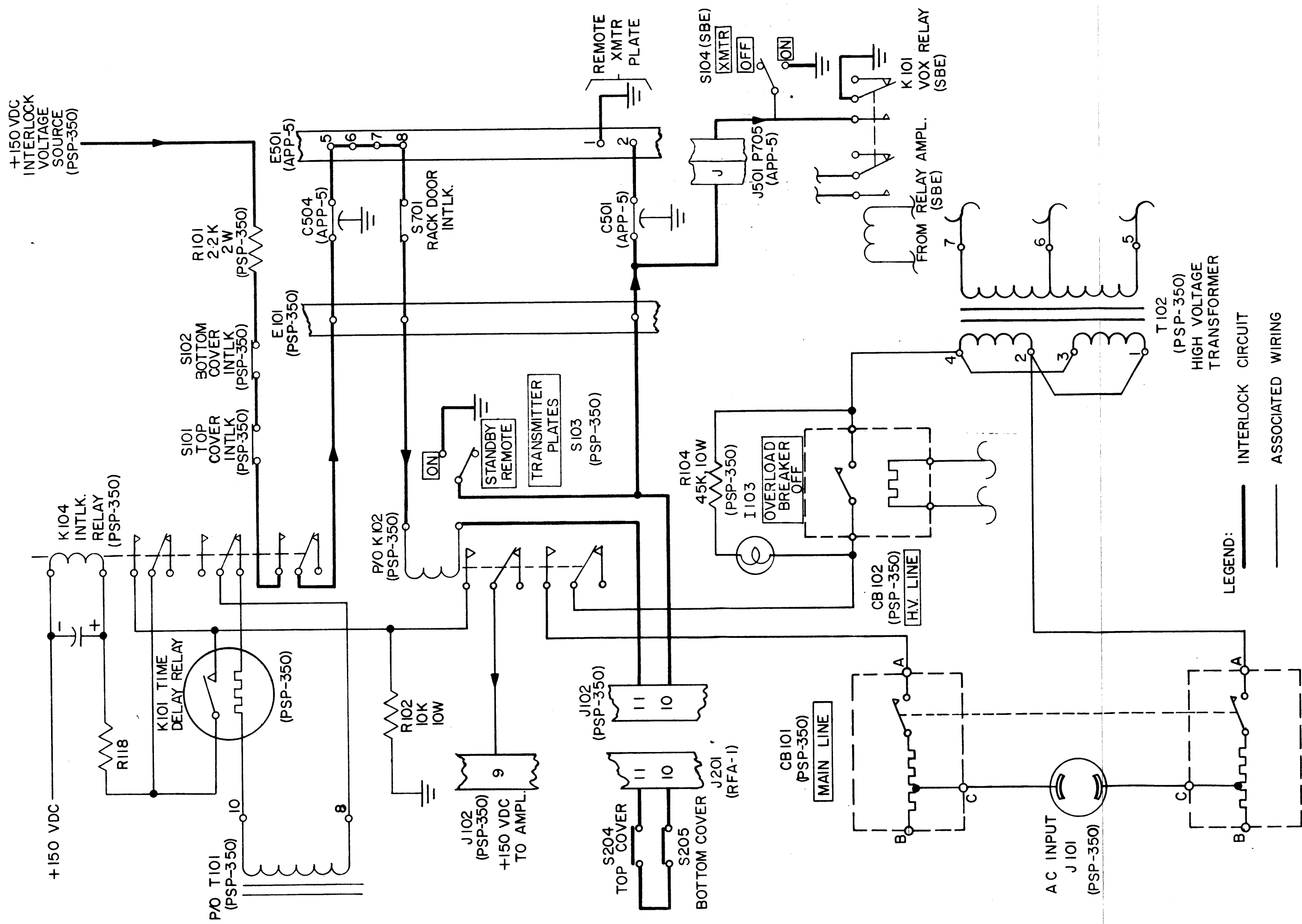


FIGURE I-4-3. SAFETY INTERLOCK CIRCUIT, SBT-350 V(A)