UNCLASSIFIED

TECHNICAL MANUAL

for

GENERAL PURPOSE

TRANSMITTER

MODEL SBT-1K(A)

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PART I

SBT-1K(A) SYSTEM

THE TECHNICAL MATERIEL CORPORATION

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IN-302-I ISSUE DATE: 1 September 1962

TABLE OF CONTENTS

PART I - SBT-1K(A) SYSTEM

SECTION 1 - GENERAL DESCRIPTION

SECTION 2 - INSTALLATION

TABLE OF CONTENTS

(Continued)

TABLE OF CONTENTS

(Continued)

SECTION 5 - TROUBLE-SHOOTING

SECTION 6 - MAINTENANCE

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION 1 - GENERAL DESCRIPTION

SECTION 3 - OPERATOR'S SECTION

SECTION 4 - PRINCIPLES OF OPERATION

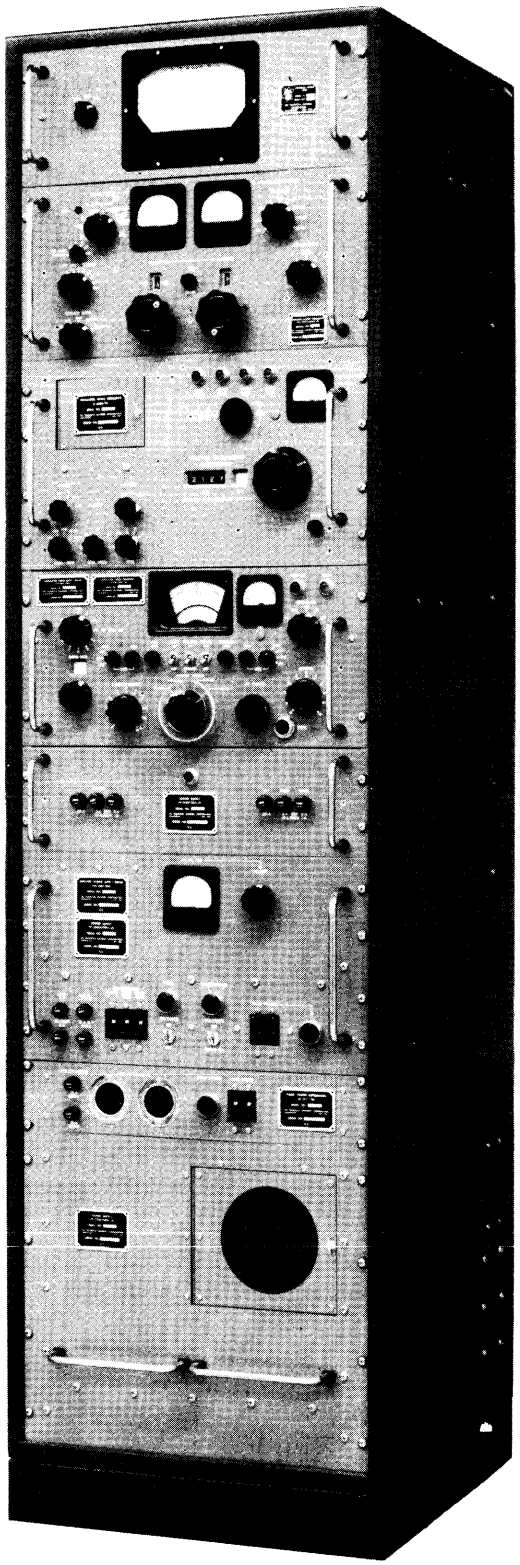


Figure I-1-1a. Front Angle View, SBT-1K(A) General Purpose Transmitter

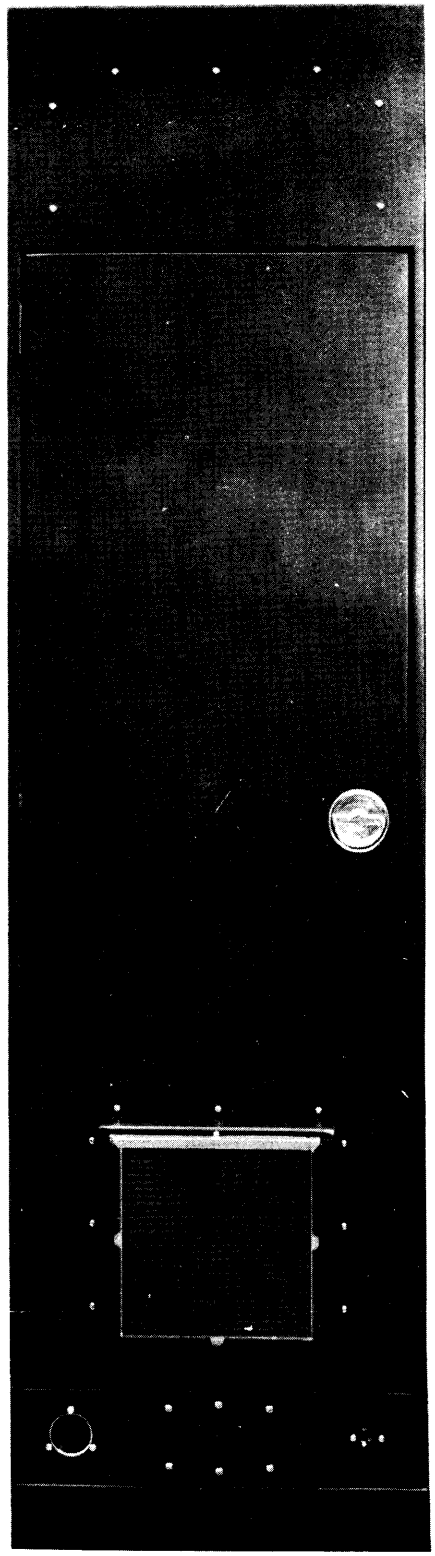


Figure I-1-1b. Rear View, SBT-1K(A) General Purpose Transmitter

SECTION 1

GENERAL DESCRIPTION

I-1-1. INTRODUCTION

Technical Materiel Corporation's General Purpose Transmitter, model SBT-1K(A), frequently called Sideband Transmitter, has an output of 1 kilowatt (PEP) continuously adjustable through the frequency range of 2 to 32 megacycles. By selection made at its front panel controls, it transmits in the following modes:

CW (telegraphy)

SSB (single sideband) with suppressed or adjustable carrier

DSB (double sideband) with suppressed or adjustable carrier

ISB (isolated sidebands) with suppressed or adjustable carrier

AM (carrier amplitude modulation)

I-1-2. FUNCTIONAL DESCRIPTION

Figure I-1-1a is used for a brief functional description of SBT-1K(A). Functions of each removable drawer are described in the following paragraphs in the order as they appear reading from top to bottom.

The first removable drawer contains TMC's Standing Wave Ratio Indicator, model SWR-1K. This unit provides accurate indication of the voltage standing wave ratio in the antenna and simultaneously provides indications of forward and reflected power.

The second removable drawer contains the amplifier unit (RFD-1A) of TMC's RF Linear Amplifier, model PAL-1K(A). This unit amplifies the output of the SBE-2 Exciter up to 1 kilowatt.

The third removable drawer contains TMC's Variable Frequency Oscillator, model VOX-5. This unit is a precision, direct reading, variable frequency oscillator with high stability. It supplies a continuously adjustable injection frequency to the SBE-2 Exciter, thus providing a multitude of carrier frequencies through the 2 to 32 megacycle range.

The fourth removable drawer contains TMC's Transmitting Mode Selector, model SBE-2. From two audio input channels or mike input it translates intelligence into single, double or independent sidebands with suppressed carrier or any degree of carrier. It also generates the conventional AM signal and CW signal.

The fifth removable drawer contains the power supply unit for the SBE-2.

The sixth removable drawer contains the medium voltage power supply unit (PS-4A) for the PAL-1K(A) RF Linear Amplifier.

Under the sixth drawer is the model APP-4 Auxiliary Power Panel which functions as a distributor for line voltage to the drawer units and also contains wiring connections and terminal blocks on the rear of the unit for connection of a variety of equipment external to the SBT-1K(A). Besides connection points for audio input and keyer, points are provided for wiring SBT-1K(A) into a larger transmitter system and/or a transmitter/receiver system utilizing a common antenna. Associated with this function

are relays located in the AX-198 RF output chassis at the top of the rack mounted in back of the SWR-1K.

The seventh removable drawer is the high voltage power supply (PS-5) the PAL-1K(A) RF Linear Amplifier.

An additional capability of the SBT-1K(A) is found in its individual modular units - PAL-1K(A), SBE-2 and VOX-5. These units may be used by themselves, without removing them from the rack. Their many capabilities are described in their individual manuals.

I-1-3. PHYSICAL DESCRIPTION

The SBT-1K(A) is shown in figures I-1-a and I-1-b. The entire transmitter is contained in a single standard relay type rack measuring 72-1/4 inches high x 20-5/8 inches wide x 22-1/2 inches deep. Two types of model SBT-1K(A) are available, varying in rack installation as follows:

Model	Rack Installation
SBT-1K(A)2-B	Base mounted (rigid)
SBT-1K(A)2-S	Shock mounted

The based mounted model comes provided with mounting holes in the base for bolting the rack directly to the floor; the shock mounted model comes equipped with a set of shock mounts for securing the top and bottom of the rack to the mobile unit structure. SBT-1K(A) weighs approximately 675 pounds. It is manufactured in accordance with JAN/MIL specifications wherever practicable. All parts meet or exceed the highest quality standards.

I-4-1. REFERENCE DATA

The SBT-1K(A), crated for shipping, is divided into 5 crates

with sizes and gross weights as follows:

Crate No.	size of crate (inches)	gross weight (lbs)
1	78-1/2 x 23-1/8 x 31-1/2	485
2	26-3/4 x 22-3/4 x 20-5/8	97
3	31-1/2 x 23-3/4 x 29	210
4	31-1/2 x 23-7/8 x 30-3/4	216
5	31-1/2 x 23-7/8 x 30-3/4	284
		1,292 lbs total

Electrical characteristics are given in Table I-1-1.

TABLE I-1-1. ELECTRICAL CHARACTERISTICS, SBT-1K(A)

Output power:	1000 watts PEP for all modes
Frequency range:	2 to 32 megacycles
Modes of operation:	CW, SSB, DSB, ISB, AM (sideband modes with suppressed carrier or any degree of carrier)
Output impedance:	50 ohms unbalanced
Harmonic suppression:	2nd harmonic at least 40db below PEP 3rd harmonic at least 50db below PEP
Signal/distortion ratio:	2-22 mc: distortion at least 40db below either tone of a standard two tone test 22-32 mc: Distortion at least 35db below either tone of a standard two tone test
Frequency stability:	1 part in 1 x 10^6/day
Unwanted sideband rejection:	1000 cps tone at least 60db below PEP
Carrier insertion:	-55db to full output
Audio response:	Flat within 3db in 350 to 3300 cps range

Audio input:	Two 600-ohm channels balanced or unbalanced -20dbm to +20dbm One 500,000-ohm input for crystal or dynamic mike, -50dbm for full output
Tuning:	All tuning and bandswitching controls on front panels (no plug-in components)
Metering:	Front panel meters indicate operation of all critical circuits
ALDC:	An automatic load and drive control is furnished to limit distortion during high drive peaks or load changes.
T/R function:	A co-axial antenna relay and receiver muting circuit is provided to facilitate half-duplex operation.
Cooling:	Pressurized cabinet, filtered forced air for maximum heat dissipation
Safety features:	1. Full interlock protection 2. Full overload and fuse protection
Environmental conditions:	Designed to operate in any ambient temperature between 0^{o} and 50^{o}C., and any value of humidity up to 90%.

SECTION 2

INSTALLATION

I-2-1. INTRODUCTION

Each SBT-1K(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.

I-2-2. INITIAL INSPECTION

The complete SBT-1K(A) will arrive in 5 crates containing components as listed in Part VI of this 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.

I-2-3. 230V LINE VOLTAGE MODIFICATION

a. GENERAL - The SBT-1K(A) is factory wired for 115VAC 50/60 cycle, single phase line voltage unless specified as otherwise on the order. If line voltage is 230VAC, 50/60 cycle, single phase, refer to paragraphs I-2-3b through I-2-3e for modification of SBT-1K(A) wired for 115VAC.

b. PAL-1K(A) RF LINEAR AMPLIFIER - Referring to PAL-1K(A) manual schematics, relocate wiring connections at CB701 circuit breaker and T701 transformer in the PS-4A Low Voltage Power Supply. Relocate wiring connections at T401 transformer in the PS-5 High Voltage Power Supply. Do not change any fuse values.

c. VOX-5 VARIABLE FREQUENCY OSCILLATOR - Relocate wiring connections at T101 transformer and crystal oven heater circuitry as shown in the VOX-5 manual schematics. Change OVENS fuse and POWER fuse to fuses with a current rating that is half that for 115VAC fuses.

d. SBE-2 TRANSMITTING MODE SELECTOR - Relocate wiring connections at T401 transformer and crystal oven heater circuitry as shown in the SBE-2 manual schematics. Change OVEN fuse and MAIN fuse to fuses with a current rating that is half that for 115VAC fuses.

e. APP-4 AUXILIARY POWER PANEL - Change bus straps at CB501 as shown in figure I-2-1.

I-2-4. RACK INSTALLATION

a. LOCATION - The room (or van) in which SBT-1K(A) is located, must have a ceiling height of at least 7 feet to allow for installation of r-f transmission lines. Adequate ventilation must be provided; operation of the transmitter in a poorly ventilated room will cause the surrounding temperature to become too high.

b. INSTALLATION - The four holes in the top of the rack and the four eyebolts included as loose parts in the shipment are for moving the rack with a crane hoist. Holes in the base are for rigid-mounting or shock mounting the rack to the floor. Holes

along the top of the rear wall are for the top shock mounts. Use these holes as a template for drilling holes in the shelter or van.

NOTE

When equipment is to be shockmounted, a shock-mounting kit and separate installation instructions are supplied.

I-2-5. ASSEMBLY OF TRANSMITTER

The rack is shipped with APP-4 Auxiliary Power Panel installed. Install the components as shown in figure I-1-a and make cable connections as described in Part VI. All components are slide-mounted except the SBE-2 Power Supply, SWR-1K Standing Wave Ratio Indicator and the APP-4 Auxiliary Power Panel. Follow this general procedure for installing the slide-mounted units (see figure I-2-2):

(1) Set the component in position on the tracks.

(2) Slide the component on the tracks until the release button catches.

(3) Press the release buttons and push the component into the rack until the release buttons engage the holes in the equipment.

(4) When all the components have been installed and cabled, press the release buttons and push the component into the rack. To prevent the cables extending from the RFD-1A Amplifier and PS-4A Low Voltage Power Supply from snagging, utilize the two reel-mounted springs located inside the rack.

I-2-6. INITIAL ADJUSTMENTS

The SBT-1K(A) has been factory tested and adjusted before disassembly for crating. No initial adjustments of chassis mounted variable components are necessary before operation.

I-2-7. CONNECTION OF EXTERNAL EQUIPMENT

a. INTRODUCTION - The APP-4 Auxiliary Power Panel is a standard modular unit present in all of the SBT-1K(A) series of transmitters. Besides functioning as a distributor for line voltage, it contains wiring enabling connections for many variations of equipment external to the SBT-1K and remote control features. Except for antenna and receiver connections at J609 and J606 on AX-198 unit and MIKE connection on SBE-2 panel, all external connections may be made at two terminal blocks, E501 and E502, located at the rear of APP-4. Figure I-2-3 and the following paragraphs illustrate the possible external connections to SBT-1K(A). Schematic diagrams in Part VI manual and section 8 of individual component manuals may be referred to for tracing through 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 amplication external to the SBT-1K(A). This enables control of the entire transmitter at the SBE-2 panel by means of the XMTR OFF/ON switch. Such a relay is sometimes employed in larger TMC transmitter systems of which SBT-1K(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 PS-4A unit.

d. EXTERNAL INTERLOCKS - Terminals 5, 6, 7 and 8 are provided for connection of additional safety interlock/s external to the SBT-1K(A) transmitter. Such additional interlock/s will be in series with the SBT-1K(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-2 unit.

f. RECEIVER SQUELCH - Terminals 11 and 12 are provided for the attachment to receiver audio output, if receiver "squelch" is desired when using the VOX (voice-operated) feature in the SBE-2 unit. Receiver squelch is used in order to prevent sound from a nearby receiver or other source 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 I-2-3 illustrates connections for either balanced or unbalanced inputs.

h. KEY LINE - Terminals 21 and 22 are provided for the attachment of a keying device in CW mode of transmission. Pushing down on key grounds the cathode circuit of V118 1st RF Amplifier in SBE-2 unit enabling it to operate.

i. RECEIVER MUTING - Terminals 23, 24 and 25 are provided for a receiver muting feature. The purpose of this feature is to automatically disable the receiver when the transmitter is sending and

enable it when the transmitter is in OFF or STANDBY condition. Terminals 23 and 24 make contact with each other through K601 relay to enable the receiver when the transmitter if off (terminals 25 and 24 are disconnected). When transmitter is on, K601 relay connect terminals 25 and 24 to disable the receiver (terminals 23 and 24 are disconnected).

j. RESERVED TERMINALS - Terminals 26 through 32 of E502 are present in all standard APP-4 Auxiliary Power Panels for the interconnection (within certain models of the SBT-1K series) of necessary equipment for FSK (Frequency Shift Keying) and FAX (Facsimile) modes of transmission. The SBT-1K(A) transmitter does not transmit FSK and FAX and these terminals should not be used for connection of external equipment.

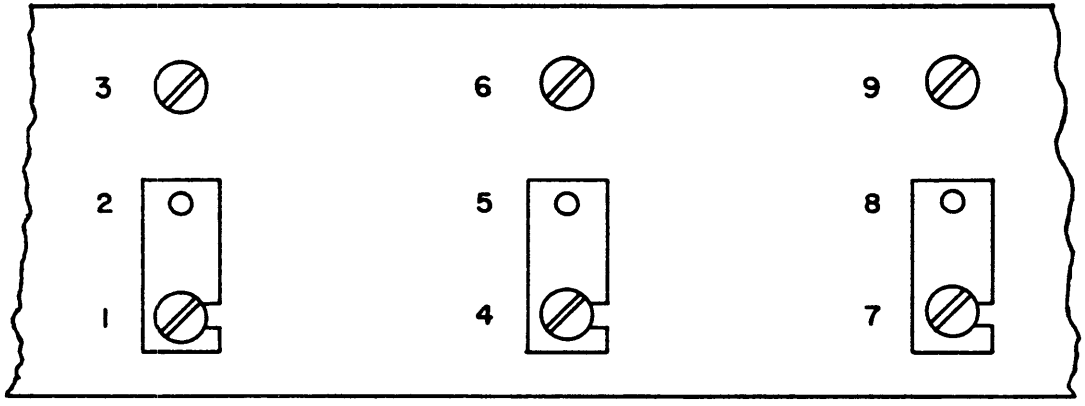
k. ANTENNA - RF receptacle J609 on AX-198 RF Output Chassis and mating plug P606 are provided for the antenna connection. J609 (TMC # JJ-147) is an adapter with a nominal impedance of 50-ohms, adapting a UHF type of connection on the inside of the chassis to a QDS type on the outside. P606 (TMC # PL-150) is a QDS type plug with a nominal impedance of 50-ohms. Use RG-8/U or RG-10/U cable running to antenna connection.

l. TRANSMITTER/RECEIVER ANTENNA - RF receptacle J606 on AX-198 RF Output Chassis and mating plug P624 are provided for connecting the transmitting antenna to a receiver input, thus making the transmitting antenna double for a receiving antenna. K601 antenna relay switches the antenna from transmitter to receiver system and back.

When the transmitter is sending the antenna is connected to the transmitter and disconnected from the receiver. When the transmitter is not sending, the antenna is disconnected from the transmitter and connected to the receiver.

m. MIKE - The MIKE jack on SBE-2 control panel is for the connection of a 50,000-ohm high impedance crystal or dynamic microphone.

n. EXTERNAL ALDC - When ALDC switch located at the rear of RFD-1A Amplifier is placed in INT position, the output of the amplifier acts on its own input stage to effect ALDC (automatic load and drive control). When ALDC switch is placed in EXT position, the ALDC signal is, instead, routed to the SBE-2 exciter to control its output level. The latter position (EXT) is preferable, when the RFD-1A is used in the SBT-1K(A), since it is more effective in preventing overdrive conditions in the RFD-1A.



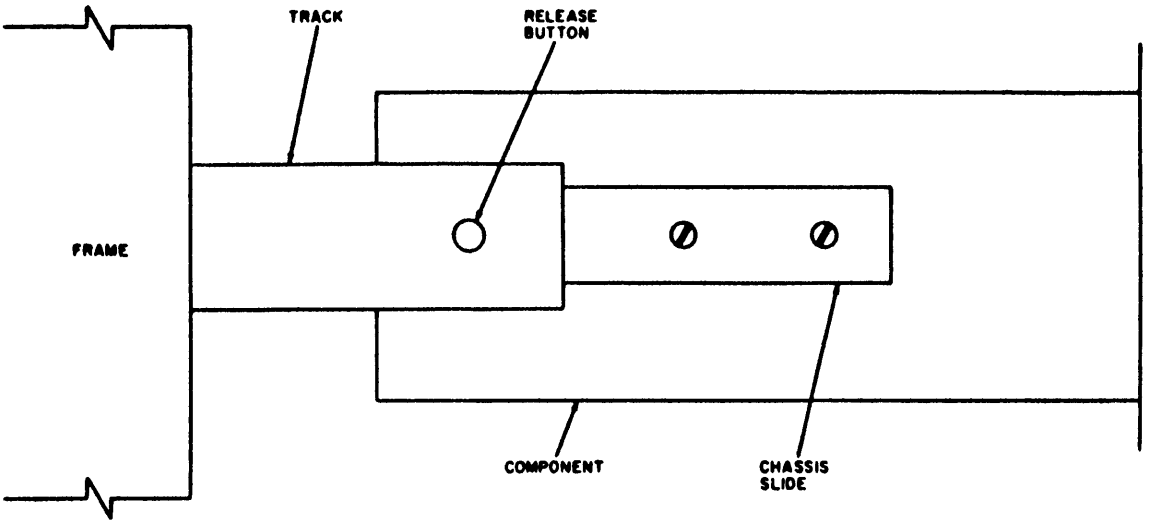
APP-4 BUS STRAP ARRANGEMENT

NOTES:

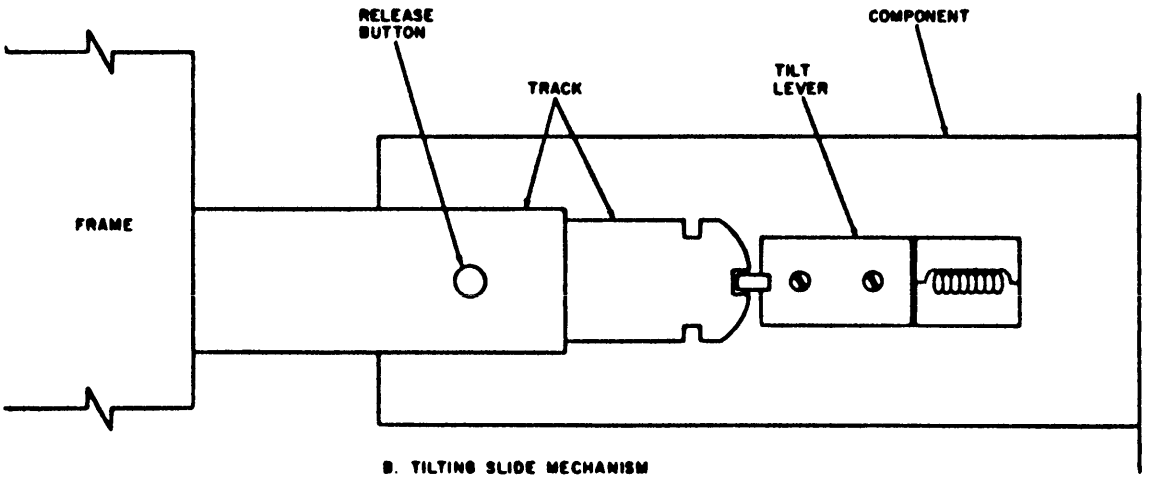
1. For 115VAC operation, connect terminals 1 and 2, 4 and 5, 7 and 8.

2. For 230VAC operation, connect terminals 2 and 3, 5 and 6, 8 and 9.

Figure I-2-1. 230V Line Voltage Modification Diagram, APP-4.



A NON-TILTING SLIDE MECHANISM



B. TILTING SLIDE MECHANISM

FIGURE I-2-2. Slide-mounting Details

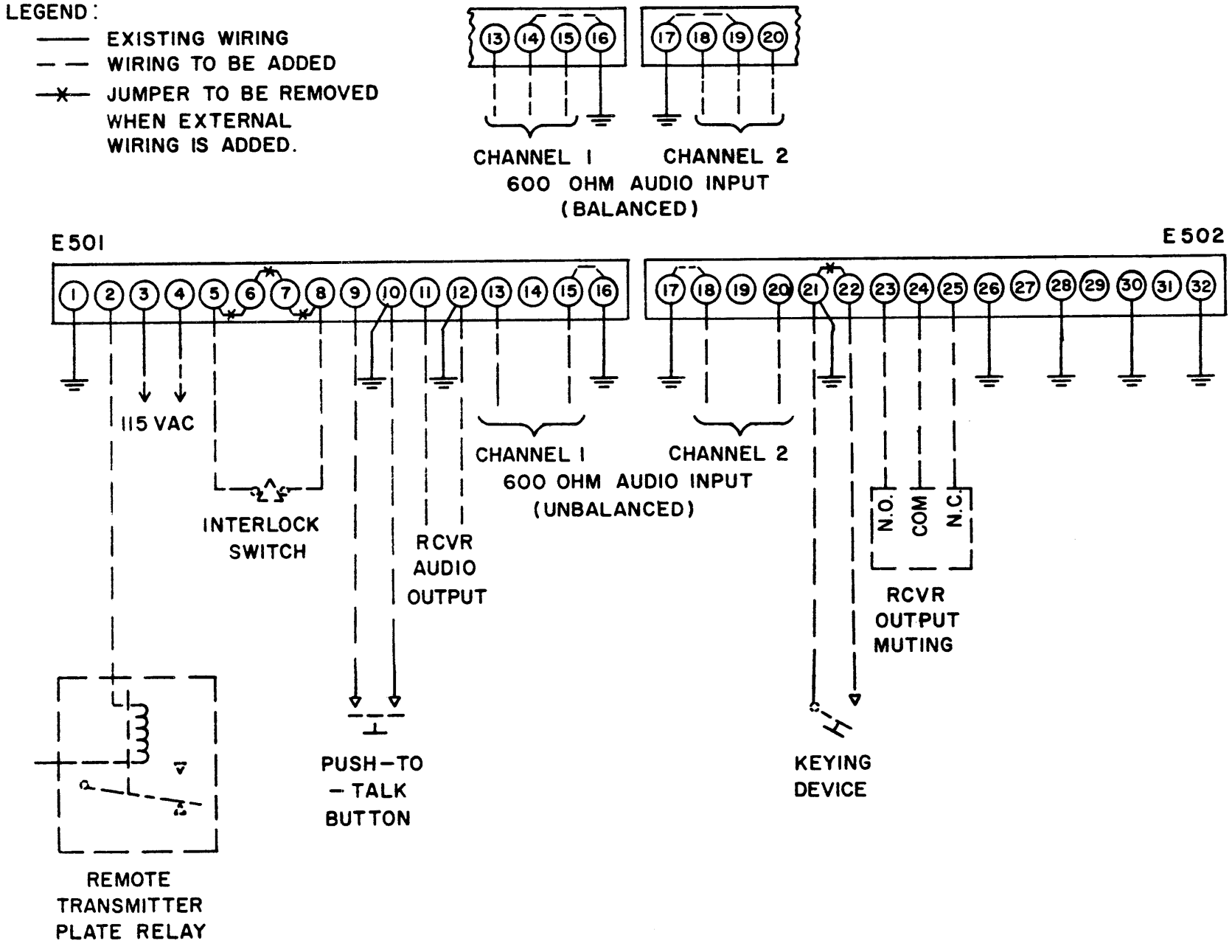


Figure I-2-3. Connection Diagram, External Equipment to SBT-1K(A)

SECTION 3

OPERATOR'S SECTION

I-3-1. GENERAL

There are numerous equally good procedures for tuning the SBT-1K(A) and each individual operator will undoubtedly have his own preferred method. Short cuts from a complete turn-on procedure may be taken in cases where previous operating conditions warrant.

In section 3 of each detailed manual (PAL-1KA, VOX-5 and SBE-3) there is a complete tuning procedure which presents reasons for each operation. Accordingly the turn-on procedure given below is an abridged procedure, simulating a system check-off list.

I-3-2. RECOMMENDED TURN-ON CHART

The SBE is the key equipment, since it is the exciter for the PAL-1K(A). This unit, with its VMO (VOX-5) should be turned on first. If the PAL-1K(A)'s output frequency is f_o, SBE's carrier frequency is .27 mc, VOX's frequency is f_{vox}, and SBE's BAND MCS switch is set for a high frequency oscillator frequency of f_{hfo}, then

$$f_{hfo} - (f_{vox} - 0.27) = f_o$$

$$\text{or, } f_{hfo} - f_o = f_{vox} - 0.27$$

As an example, assume f_o = 11 mc. Since f_{vox} lies in the 2 to 4 mc range and f_{hfo} is in two megacycle steps, in the given case, f_{hfo} is 14.000 mc.

$$14.000 - 11.000 = f_{vox} - 0.27$$

$$\text{or, } f_{vox} = 3.270 \text{ mc}$$

TABLE I-3-1. TUNE-UP OF CARRIER, SBT-1K(A).

STEP	CONTROLS	OPERATIONAL DETAILS
1	See paragraph I-3-2.	Compute SBE's high frequency and VOX's medium frequency oscillator settings for PAL-1KA's output frequency.
2	See section 3 of VOX-5 manual; 66, 67.	Calibrate VOX-5. This will require rack power; MAIN POWER breaker (66) of APP-4 unit must in in ON position; MAIN POWER indicator (67) must be lit.
3	17,14,15,27	POWER (17), ON; BEAT (14), ON; METER (15) to VMO; MASTER FREQUENCY OSCILLATOR (27) to desired frequency. Follow "calibration" procedure as described in section 3 of VOX-5 manual, omitting HFO tuning portion.
4	See section 3 of SBE-2 manual	Tune up on carrier.
5	37,51,48,55,54,43, 44,38,34,53,52,42	EXCITER switch (37), ON; VOX GAIN (51), fully CCW; SQUELCH GAIN (48), fully CCW; LSB (55) OFF/GAIN (54), fully CCW; USB (43), OFF/GAIN (44), fully CCW; POWER toggle sw. (38), ON (oven lights); MF XTAL SW (34), VMO position; BAND MCS (53) to proper MF frequency; CARRIER INSERT (52), fully CW; METER SW (42), MF position.
6	50,49,35	OUTPUT TUNING switch: knob (50) (coarse setting) for proper band and disc (49) (vernier setting) for a frequency slightly below the desired output frequency on multiscale dial (35).

TABLE I-3-1. (Cont'd)

STEP	CONTROLS	OPERATIONAL DETAILS
7	47,39,52,35	MF TUNING knob (47), tune MF; peak SBE's meter (39) reading. Decrease CARRIER INSERT (52) as necessary to avoid an off-scale reading. The reading on single scale dial (35) should agree with the frequency of VMO.
8	49,39,50	METER SW, RF position; OUTPUT TUNING disc (49), tune RF. Peak SBE meter (39) reading. Advance the OUTPUT TUNING vernier switch (50) slightly to peak the reading on the SBE's meter (39).
9	45	Adjust OUTPUT knob (45) to control magnitude of RF output. Output level should be small for following RFD-1A tune up.
10	68	Before turning on the PAL-1K(A), check that its output is properly terminated, that VSWR's OFF/X10/X1 switch (68) is in OFF position.
11	59,58,61,60,62,63, 56	The PAL-1K(A) should be turned on under the following initial conditions: (i) Output of all PS-4A voltages normal. Check that MAIN POWER circuit breaker (59) is in the ON position; that MAIN POWER indicator (58) is lit; that TRANSMITTER VOLTAGES switch (61) is in STANDBY and its indicator (60) is not lit; that FINAL VOLTAGES switch (62) is OFF and its indicator (63) is not lit. PA FIL PRI meter (56) should read 115 volts. PAL-1K(A)'s PS-4A PA OVERLOAD circuit breakers should be ON.

TABLE I-3-1. (Cont'd)

STEP	CONTROLS	OPERATIONAL DETAILS
11 (cont'd)		(ii) Under these conditions the PAL-1K(A) may be turned on by setting TRANSMITTER VOLTAGES switch (61) to ON. Indicator (62) now lights.
12	2	Turn the MULTIMETER switch (2) to the 1ST AMPL PLATE position.
13	45,3	Increase SBE's OUTPUT (45) until a usable reading is obtained on MULTIMETER (3).
14	7,3	Rotate 1ST AMPL TUNING (7) to maximize reading on MULTIMETER (3). Reduce SBE's OUTPUT (45) to bring approximately 1/4 scale reading on MULTIMETER (3).
15	2	Turn the MULTIMETER switch (2) to the PA Eg position.
16	6,3	Rotate the PA GRID TUNING (6) to maximize reading on MULTIMETER (3).
17	45,3	Turn SBE's OUTPUT (45) fully CCW.
18	10	Turn PA TUNING sw. (10) for desired output frequency (see tuning chart).
19	13	Turn PA LOADING sw. (13) for desired output frequency (see tuning chart).

TABLE I-3-1. (Cont'd)

STEP	CONTROLS	OPERATIONAL DETAILS
20	11	Turn PA LOADING knob (11) for desired output frequency (see tuning chart).
21	63,62	Turn FINAL VOLTAGES switch (63) to ON; indicator (62) should light.
22	45,4	Increase SBE's OUTPUT (45) until PA PLATE CURRENT (4) meter indicates 300 ma.
23	10,4	Adjust PA TUNING sw. (10) observing the PA PLATE CURRENT (4) meter for a dip.
24	11,4	Increase PA LOADING sw. (11) until the plate current rises.
25	45,4	Readjust SBE's output until PA PLATE CURRENT (4) meter indicates 300 ma.
26	10,4	Adjust PA TUNING sw. (10) observing the PA PLATE CURRENT (4) meter for a dip.
27	10,11,4,45	Repeat PA TUNING and PA LOADING adjustments until the desired power output is reached with minimum output on SBE as indicated on RFD MULTIMETER (PA Eg). Observe SBE's RF output on meter (39) with METER SW (42) in RF position. The screen current (PA Isg) is (with a resistance load) usually less than 15 ma. At no time should the screen current reading exceed full scale.

TABLE I-3-1. (Cont'd)

STEP	CONTROLS	OPERATIONAL DETAILS
28	45	Turn SBE's OUTPUT (45) fully CCW, momentarily.
29	68,45	Turn VSWR's OFF/X10/X1 switch (68) to the X1 position and slowly increase SBE's OUTPUT (45) until VSWR gives a good indication of forward watts and reflected watts on SBE's low drive. If a satisfactory voltage standing wave ratio is indicated, turn VSWR's OFF/X10/X1 switch (68) to the X10 position and increase SBE's OUTPUT (45) for PAL-1K(A)'s full (1 kw) output power. Check that the VSWR still indicates a satisfactory voltage standing wave ratio.
30		The SBT-1K(A) is now fully tuned and loaded on carrier. The following tables list the additional steps required to enable SBT-1K(A) to provide any of its six modes of transmission.

TABLE I-3-2. TUNING CHART, CW (KEYED CARRIER) MODE, SBT-1K(A)

STEP	CONTROLS	OPERATIONAL DETAILS
1		Perform 30 steps outlined in Table I-3-1.
2		Check that telegraph key is connected to terminals 21 and 22 of E502 on APP-4 as described in paragraph I-2-7h.
3		Manipulation of key enables/disables SBE-2's first RF amplifier, producing CW.

TABLE I-3-3. TUNING CHART, SSB MODE WITH SUPPRESSED CARRIER, SBT-1K(A)
(Example: LSB Operation on Channel 1)

STEP	CONTROLS	OPERATIONAL DETAILS
1		Perform 30 steps outlined in Table I-3-1.
2	52	Turn SBE's CARRIER INSERT (52) fully CCW.
3	55,54,69,39	Turn SBE's LSB selector switch (55) to CH 1 and slowly increase LSB GAIN potentiometer (54) until VSWR's meter (69) indicates desired output on speech peaks and a satisfactory voltage standing wave ratio. Do not advance LSB GAIN to point that brings LSB reading on meter (39) beyond 100%.

TABLE I-3-4. TUNING CHART, SSB MODE WITH A DEGREE OF CARRIER, SBT-1K(A)
(Example: LSB Operation on Channel 1 with 10% Carrier)

STEP	CONTROLS	OPERATIONAL DETAILS
1		Perform 30 steps outlined in Table I-3-1.
2	42,39	Set SBE's METER SW (42) at RF position and note reading on SBE's meter (39).
3	52,55,42,54	Turn CARRIER INSERT (52) fully CCW. Set LSB switch (55) at CH 1. Set METER SW (42) at LSB position. Turn up LSB GAIN (54) to bring 100% of step 2 reading on audio peaks.

TABLE I-3-4. (Cont'd)

STEP	CONTROLS	OPERATIONAL DETAILS
4	42,45,52	Set METER SW (42) at RF. Turn OUTPUT (45) down to bring 90% of step 2 reading on audio peaks. Then turn CARRIER INSERT (52) up to bring 100% of step 2 reading on audio peaks.
5	45,68,39	Adjust OUTPUT (45) to bring satisfactory output peaks and SW ratio on SWR-1K meter (68). Do not exceed "100%" mark on SBE meter (39) scale.

TABLE I-3-5. TUNING CHART, DSB OR ISB MODE, WITH SUPPRESSED CARRIER, SBT-1K(A)
(Examples: CH 1 on USB and LSB for DSB. CH 1 on USB, CH 2 on LSB for ISB)

STEP	CONTROLS	OPERATIONAL DETAILS
1		Perform 30 steps outlined in Table I-3-1.
2	42,39,52	Set SBE's METER SW (42) at RF and note reading on meter (39). Then set CARRIER INSERT (52) fully CCW.
3	43,55,44	Turn USB selector switch (43) to CH 1 and LSB selector switch (55) to OFF. Slowly increase USB GAIN (44) to obtain 50% of step 2 reading on meter (39) on audio peaks. Turn LSB selector switch (55) to CH 1 (DSB mode) or CH 2 (ISB mode) and USB selector switch (43) to OFF. Slowly increase LSB GAIN (44) to obtain 50% of step 2 reading on meter (39) on audio peaks. Set USB selector switch (43) to CH 1.

TABLE I-3-5. (Cont'd)

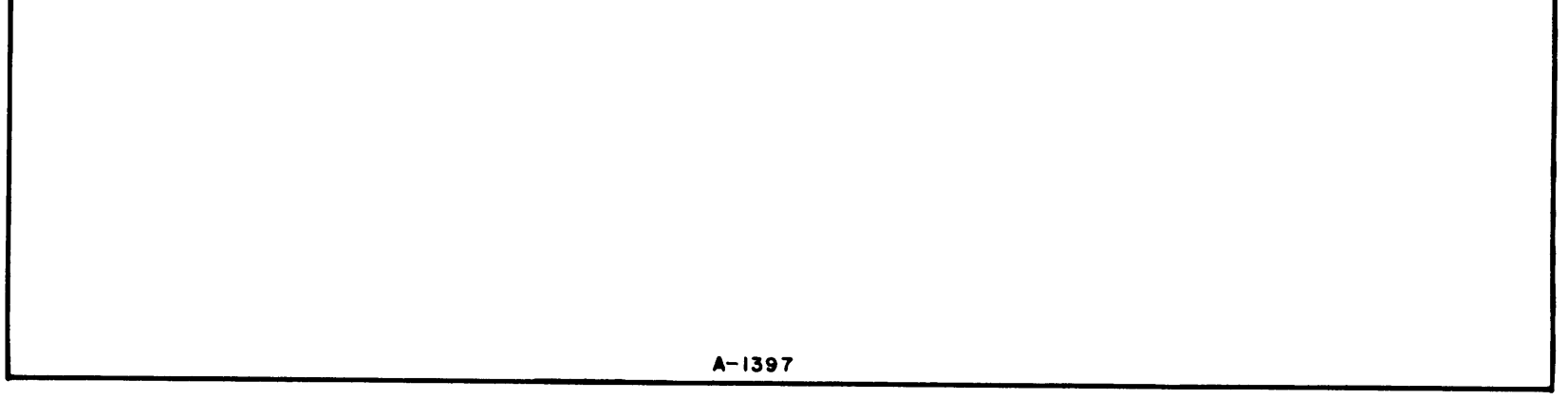
STEP	CONTROLS	OPERATIONAL DETAILS
4	45,68	Adjust OUTPUT (45) to bring satisfactory output peaks and SW ratio on SWR-1K meter (68). Do not exceed "100%" mark on SBE meter (39) scale.

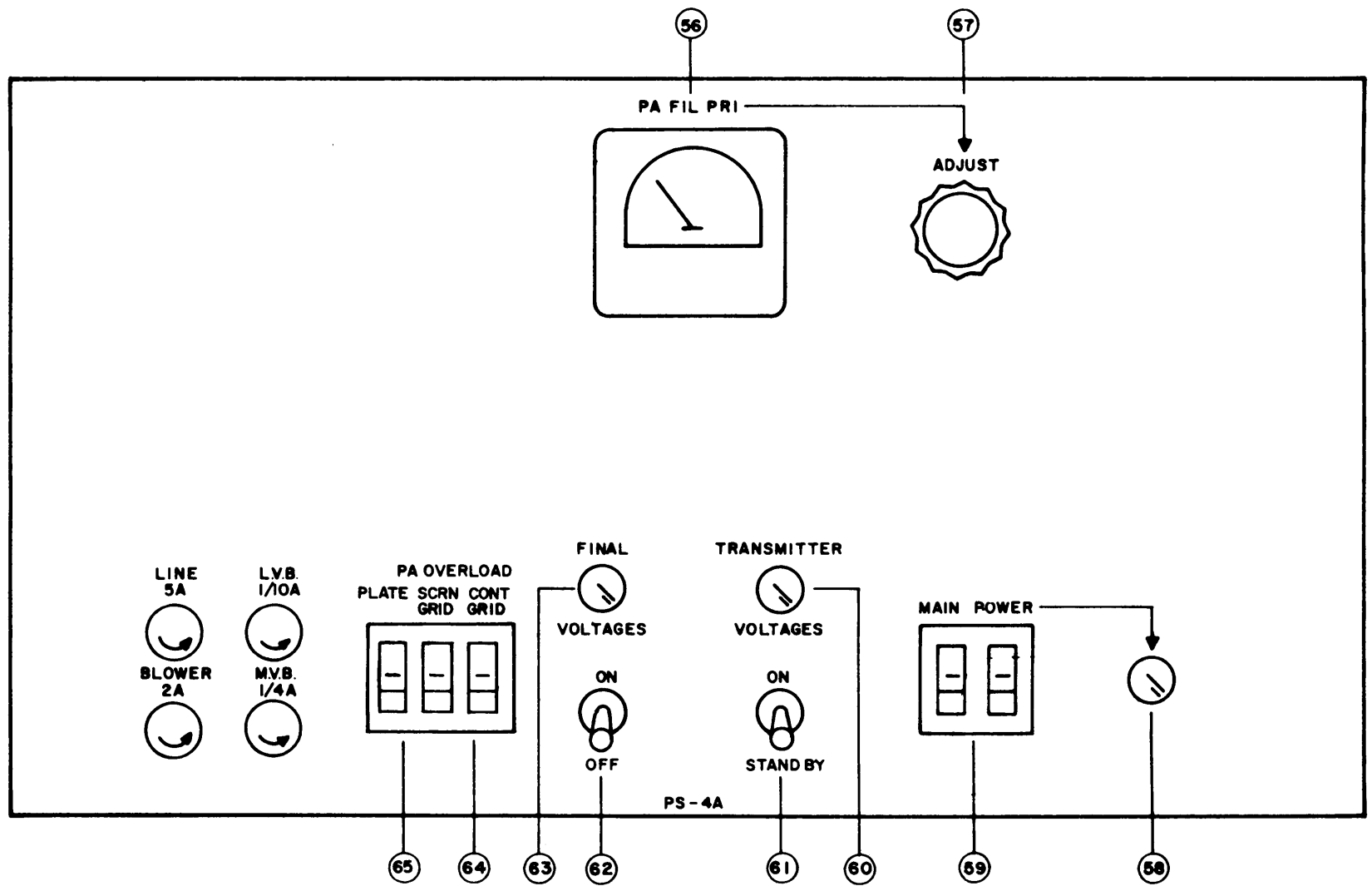
TABLE I-3-6. TUNING CHART, DSB OR ISB MODE WITH A DEGREE OF CARRIER (Examples: CH 1 on USB and LSB, with 10% carrier, for DSB. CH 1 on USB, CH 2 on LSB, with 10% carrier, for ISB).

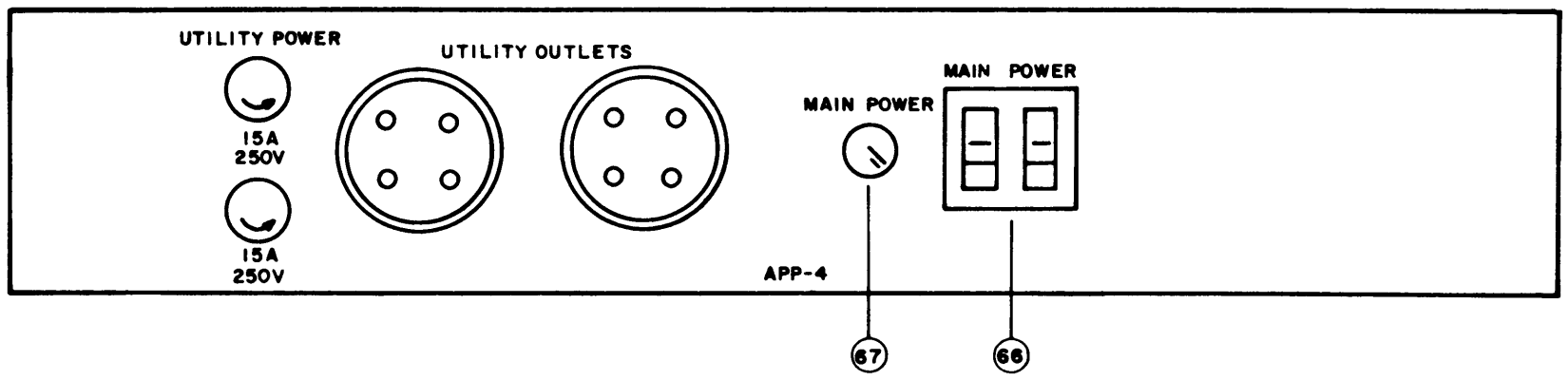
STEP	CONTROLS	OPERATIONAL DETAILS
1		Perform 30 steps outlined in Table I-3-1.
2	42,39,52	Set SBE's METER SW (42) at RF and note reading on meter (39). Then set CARRIER INSERT (52) fully CCW.
3	43,55,44,39,52	Turn USB selector switch (43) to CH 1 and LSB selector switch (55) to OFF. Slowly increase USB GAIN (44) to obtain 45% of step 2 reading on meter (39) on audio peaks. Turn LSB selector switch (55) to CH 1 (DSB mode) or CH 2 (ISB mode) and USB selector switch (43) to OFF. Slowly increase LSB GAIN (44) to obtain 45% of step 2 reading on meter (39) on audio peaks. Set USB selector switch (43) to CH 1. Then increase CARRIER INSERT (52) to obtain 100% of step 2 reading on meter (39) on audio peaks.
4	45,68,39	Adjust OUTPUT (45) to bring satisfactory output peaks and SW ratio on SWR-1K Meter (68). Do not exceed "100%" mark on SBE meter (39) scale.

TABLE I-3-7. TUNING CHART, AM MODE
(Example: CH 1 on USB and LSB)

STEP	CONTROLS	OPERATIONAL DETAILS
1		Perform 30 steps outlined in Table I-3-1.
2	42,39,52	Set SBE's METER SW (42) at RF and note reading on meter (39). Then set CARRIER INSERT (52) fully CCW.
3	43,55,44,39,52	Turn USB selector switch (43) to CH 1 and LSB selector switch (55) to OFF. Slowly increase USB GAIN (44) to obtain 25% of step 2 reading on meter (39) on audio peaks. Turn LSB selector switch (55) to CH 1 and USB selector switch (43) to OFF. Slowly increase LSB GAIN (44) to obtain 25% of step 2 reading on meter (39) on audio peaks. Set USB selector switch (43) to CH 1. Then increase CARRIER INSERT (52) to obtain 100% of step 2 reading on meter (39) on audio peaks.
4	45,68,39	Adjust OUTPUT (45) to bring satisfactory output peaks and VSW ratio on SWR-1K meter (68). Do not exceed "100%" mark on SBE meter (39) scale.







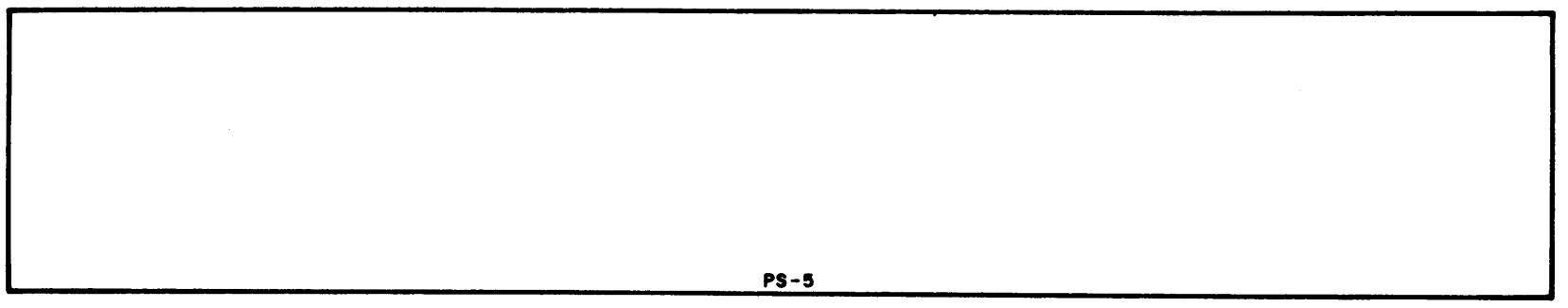
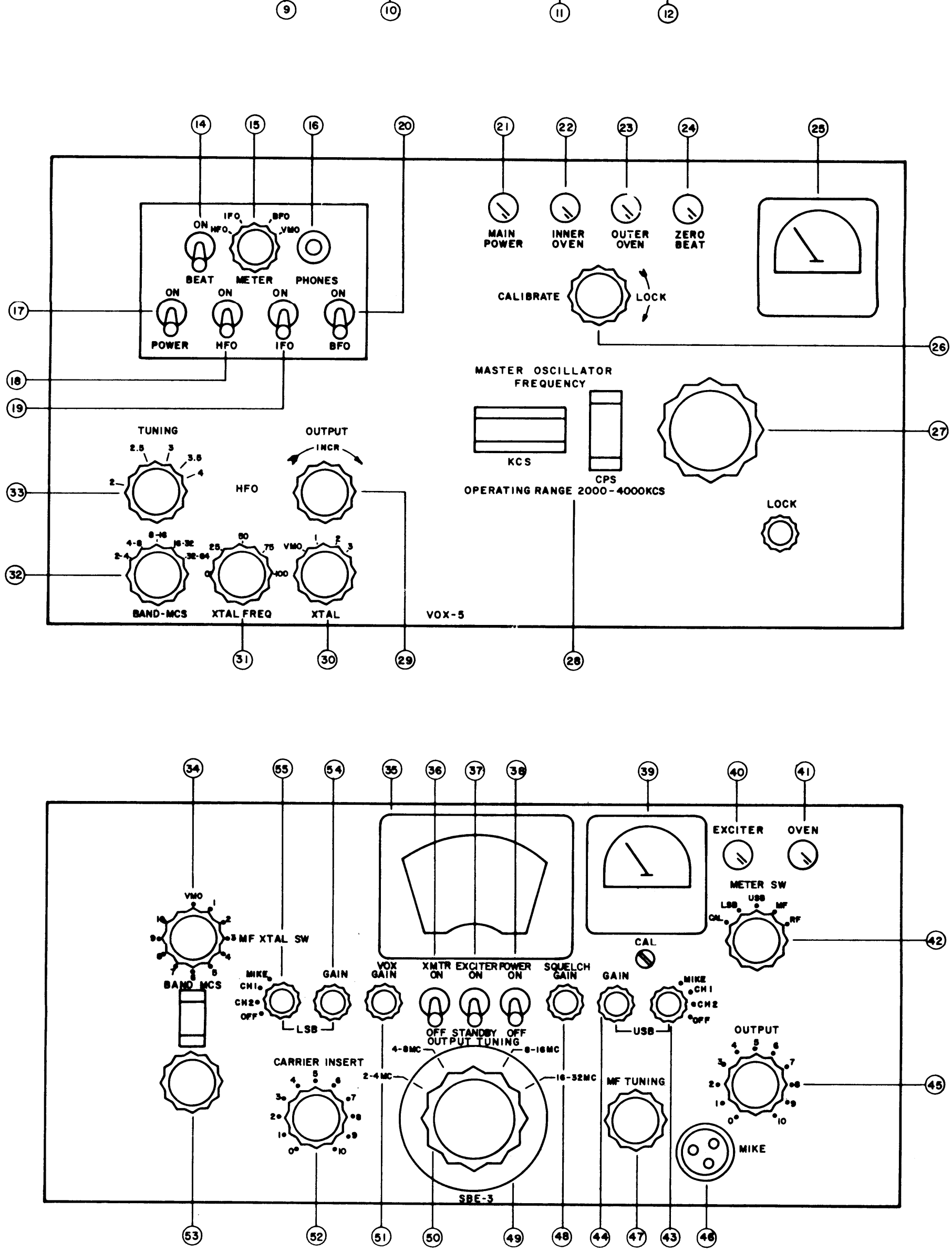
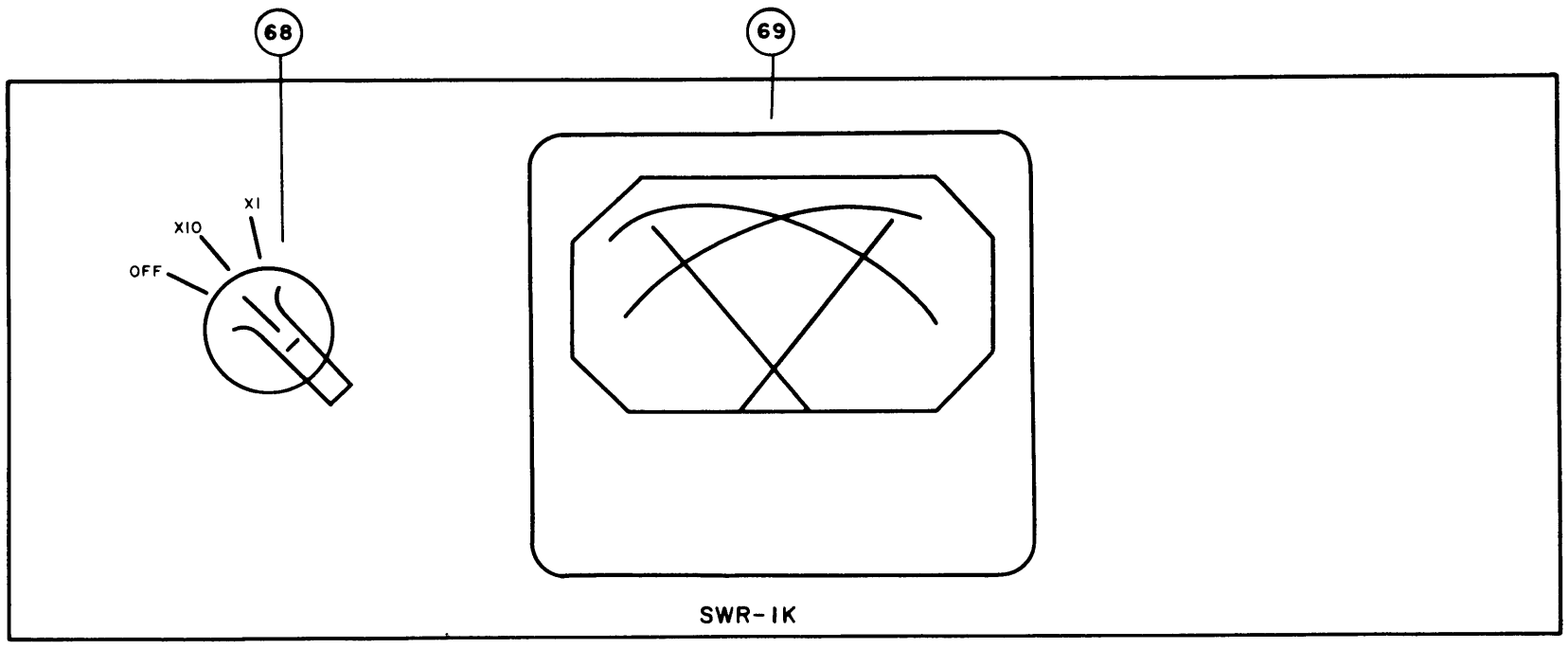
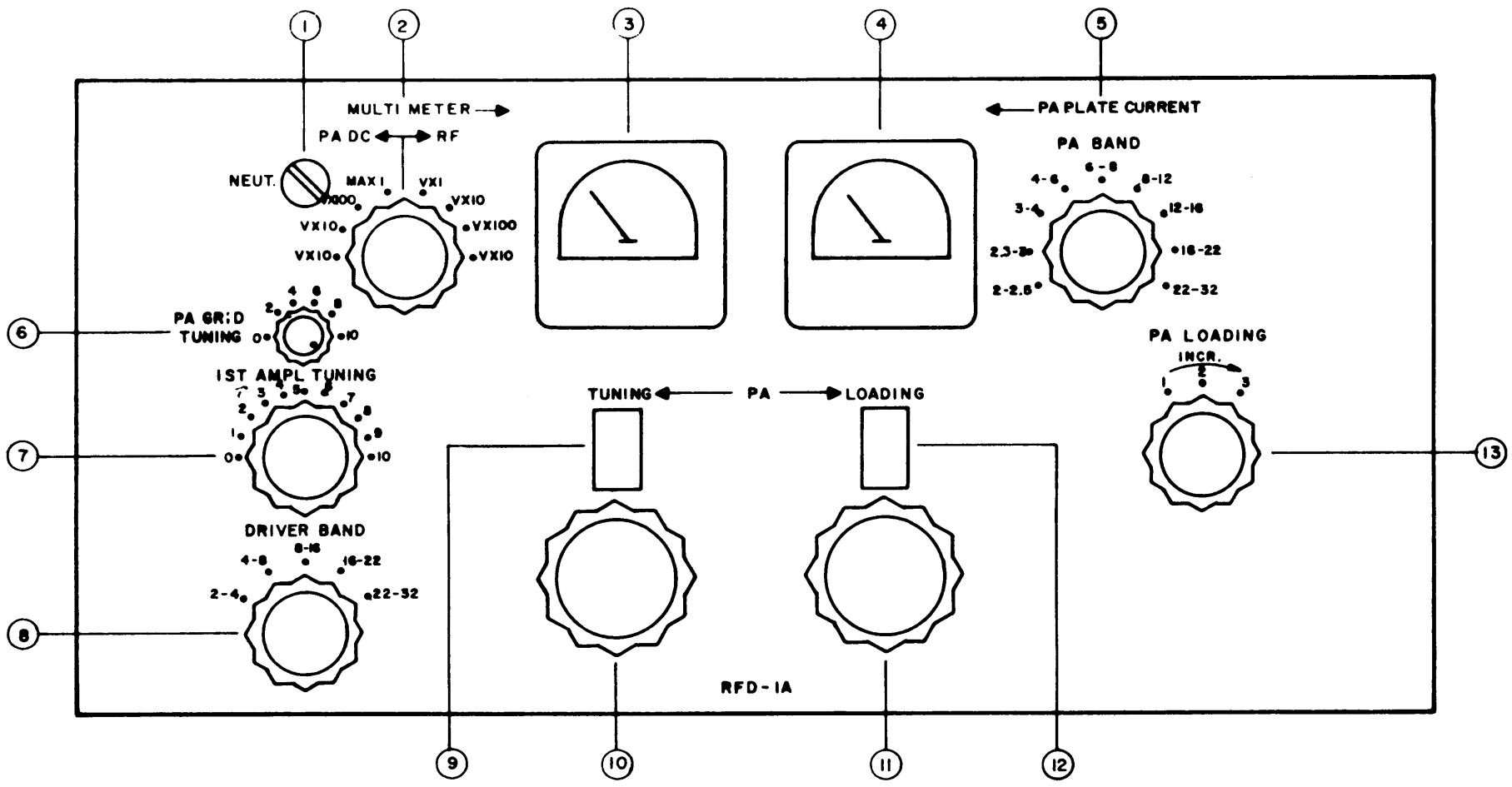


Figure I-3-1. Panel Controls, SBT-1K(A)


9
10
11
12
14
15
16
20
21
22
23
24
25
ON
IFO
BFO
HFO
VMO
BEAT
METER
PHONES
MAIN POWER
INNER OVEN
OUTER OVEN
ZERO BEAT
CALIBRATE
LOCK
17
ON
ON
ON
ON
POWER
HFO
IFO
BFO
26
18
19
MASTER OSCILLATOR FREQUENCY
TUNING
OUTPUT
INCR
2.5
3
3.5
4
2
KCS
CPS
27
33
HFO
OPERATING RANGE 2000-4000KCS
LOCK
4-8
8-16
16-32
32-64
2-4
25
50
75
100
0
VMO
1
2
3
32
BAND-MCS
XTAL FREQ
XTAL
VOX-5
31
30
29
28
34
55
54
35
36
37
38
39
40
41
EXCITER
OVEN
METER SW
VMO
MF XTAL SW
LSB
USB
MF
RF
CAL
BAND MCS
MIKE
CH1
CH2
OFF
GAIN
VOX GAIN
XMTR ON
EXCITER ON
POWER ON
SQUELCH GAIN
CAL
42
LSB
OFF
STANDBY
OFF
USB
OUTPUT TUNING
4-8MC
8-16MC
2-4MC
16-32MC
CARRIER INSERT
MF TUNING
OUTPUT
45
MIKE
SBE-3
53
52
51
50
49
48
44
47
43
46

A-1397


68
69
XI
X10
OFF
SWR-1K


1
2
3
4
5
MULTI METER
PA DC
RF
NEUT.
MAX
VXI
VX10
VX100
PA GRID TUNING
IST AMPL TUNING
DRIVER BAND
PA PLATE CURRENT
PA BAND
4-6
6-8
8-12
12-16
16-22
22-32
2-2.5
2.5-3
3-4
PA LOADING
INCR.
TUNING
PA
LOADING
6
7
8
9
10
11
12
13
RFD-1A

14
15
16
20
21
22
23
24
25
ON
IFO
BFO
HFO
VMO
BEAT
METER
PHONES
MAIN POWER
INNER OVEN
OUTER OVEN
ZERO BEAT
CALIBRATE
LOCK

SECTION 4

PRINCIPLES OF OPERATION

I-4-1. INTRODUCTION

Figure I-4-1 is a functional block diagram of the SBT-1K(A) transmitter, showing the main interrelationships of the SWR-1K, PAL-1K(A), VOX-5 and SBE-2. For a complete functional block diagram and schematic diagram of each unit, refer to the individual manual for the unit. Schematic diagrams for AX-198 RF Output Chassis, APP-4 Auxiliary Power Panel and RAK-9 rack wiring are shown in Part VI.

I-4-2. OPERATION

a. GENERAL - As shown in figure I-4-1, an audio input is translated into sideband or AM signals in the 2-32 mc range. The VOX-5 furnishes a continuously adjustable 2-4 mc as an injection frequency for one of SBE-2's modulation stages, thereby providing continuous adjustment for SBT-1K(A)'s 2-32 mc output. The output of SBE-2 is amplified up to 1 kilowatt by PAL-1K(A). The SWR-1K serves to reflect the VSWR (Voltage Standing Wave Ratio) on the antenna, in order to aid in tuning adjustments to match SBT-1K(A) to antenna. In CW transmission, the VOX-5 generates the 2-4 mc signal which is raised to 2-32 mc range in the SBE-2 and amplified in the PAL-1K(A). Keying is accomplished in the SBE-2. Although VOX-5 is capable of delivering 2-64 mc, only the output of its 2-4 mc master oscillator is used in the SBT-1K(A).

b. INTERLOCK SYSTEM - Figure I-4-2 shows the complete safety interlock system through the transmitter, with its relationship to the TRANSMITTER VOLTAGES and FINAL VOLTAGES switches. The purpose of the interlock system is to prevent the transmitter from operating when any one of a series of undesirable conditions exist, in order to protect personnel and equipment. Essentially, a negative voltage (-200VDC), originated in the PS-4A unit, completes a circuit through a series of interlocks when TRANSMITTER VOLTAGES switch is closed. The completion of this circuit sends current through K703 relay coil (only K703 coil shown in figure I-4-7). Energization of K703 furnishes +500VDC supply to RFD-1A driver tube plate and +250VDC to RFD-1A 1st amplifier tube plate and ALDC. The subsequent manual closing of FINAL VOLTAGES switch sends +500VDC to PA tube screen in RFD-1A and line voltage to PS-5 High Voltage Power Supply which, in turn, supplies +3000VDC to RFD-1A PA tube plate. The SBT-1K(A) interlock system is the same as the PAL-1K(A) interlock system with an additional link running through the APP-4 and AX-198 units. The complete series of links capable of opening the interlock circuit are summarized in table I-4-1.

c. ANTENNA DISCONNECT (Figure I-4-2) - In order to make SBT-1K(A) adaptable to an externally attached T/R (transmitter/receiver) antenna system and receiver muting system, as described in paragraph I-4-2d, relay K601 is inserted in the circuitry. When TRANSMITTER VOLTAGES switch (S702) is closed, the +500VDC source in PS-4A completes a circuit to ground through E701 terminal 9, P607 and J607 pin F, K601 relay coil, normally closed contacts

of K602 relay, P607 and J607 pin E and TRANSMITTER VOLTAGES switch (S702). This energizes K601 relay, closing a set of contacts and thereby connecting the output of RFD-1A amplifier to the antenna. Another set of contacts on K601 also close, providing the -200VDC source for the interlock circuit a path to ground through normally closed contacts of K602 and P607 and J607 pin G. The resulting current through K703 coil energizes this relay and the RFD-1A receives its medium plate voltages. The next step in operating the transmitter is to close the FINAL VOLTAGES switch, in order to supply the RFD-1A amplifier with high voltage. This action also supplies a-c current to the coil of K602 relay. The resulting energization of this relay causes the -200VDC source and the +500VDC source to switch paths to ground. From this point on, it becomes possible to obtain on-off control of the transmitter by manipulation of the TRANSMITTER VOLTAGES switch (S702) as long as FINAL VOLTAGES switch (S703) remains in the ON position. Or it may be controlled, if desired, by methods described in paragraph I-3-3b. However TRANSMITTER VOLTAGES switch control has the additional feature of switching a common antenna over to a receiver when the transmitter is in STANDBY. When TRANSMITTER VOLTAGES switch is returned to STANDBY, relays K703, K602 and K601 become de-energized in that sequence; when switch is then returned to ON position relays K601, K703 and K602 become energized in that sequence. These sequences prevent the antenna from becoming disconnected at an instant when the high plate voltages are still applied to the RFD-1A amplifier.

d. T/R ANTENNA SYSTEM - If suitable connections are made to a receiver (as shown in Figure I-2-3), at terminals 23 through 25 of E502 in APP-4 and J606 on AX-198, a T/R (transmitter/receiver) antenna system may be had. In this system, the receiver and transmitter share the same antenna. K601 relay action, controlled by the TRANSMITTER VOLTAGES switch, serves to switch the antenna between receiver and transmitter. A receiver muting action is also possible in which case the receiver is muted while the antenna is connected to the transmitter.

TABLE I-4-1. INTERLOCK CIRCUIT COMPONENTS

UNIT	INTERLOCK OR CIRCUIT BREAKER	WHEN CLOSED
PS-4A	PA OVERLOAD CONT GRID circuit breaker CB702	When no overload condition exists in the RFD-1A PA grid circuit
PS-4A	PA OVERLOAD SCRN GRID circuit breaker CB703	When no overload condition exists in the RFD-1A screen grid circuit
PS-4A	PA OVERLOAD PLATE circuit breaker CB704	When no overload condition exists in the RFD-1A PA plate circuit
RFD-1A	Air switch interlock S206	When blower motor B201 is operating normally
RFD-1A	Band switch S205	When PA BAND switch S202 is properly set in a detent
RFD-1A	Top cover interlock S207	When top cover of the RFD-1A is secured in position

TABLE I-4-1. (Cont'd)

UNIT	INTERLOCK OR CIRCUIT BREAKER	WHEN CLOSED
RFD-1A	Bottom cover interlock S208	When the bottom cover of the RFD-1A is secured in position
PS-5	Top cover interlock S403	When the top cover of PS-5 is secured in position
PS-5	Door interlock S402	When PS-5 is secured in the rack
RAK-9	Door interlock S602	When rear door of rack is closed
AX-198	Push-button interlock S603	When RFD-1A is secured in rack
AX-198	Switch interlock S604	When antenna cable is connected to AX-198 at J609

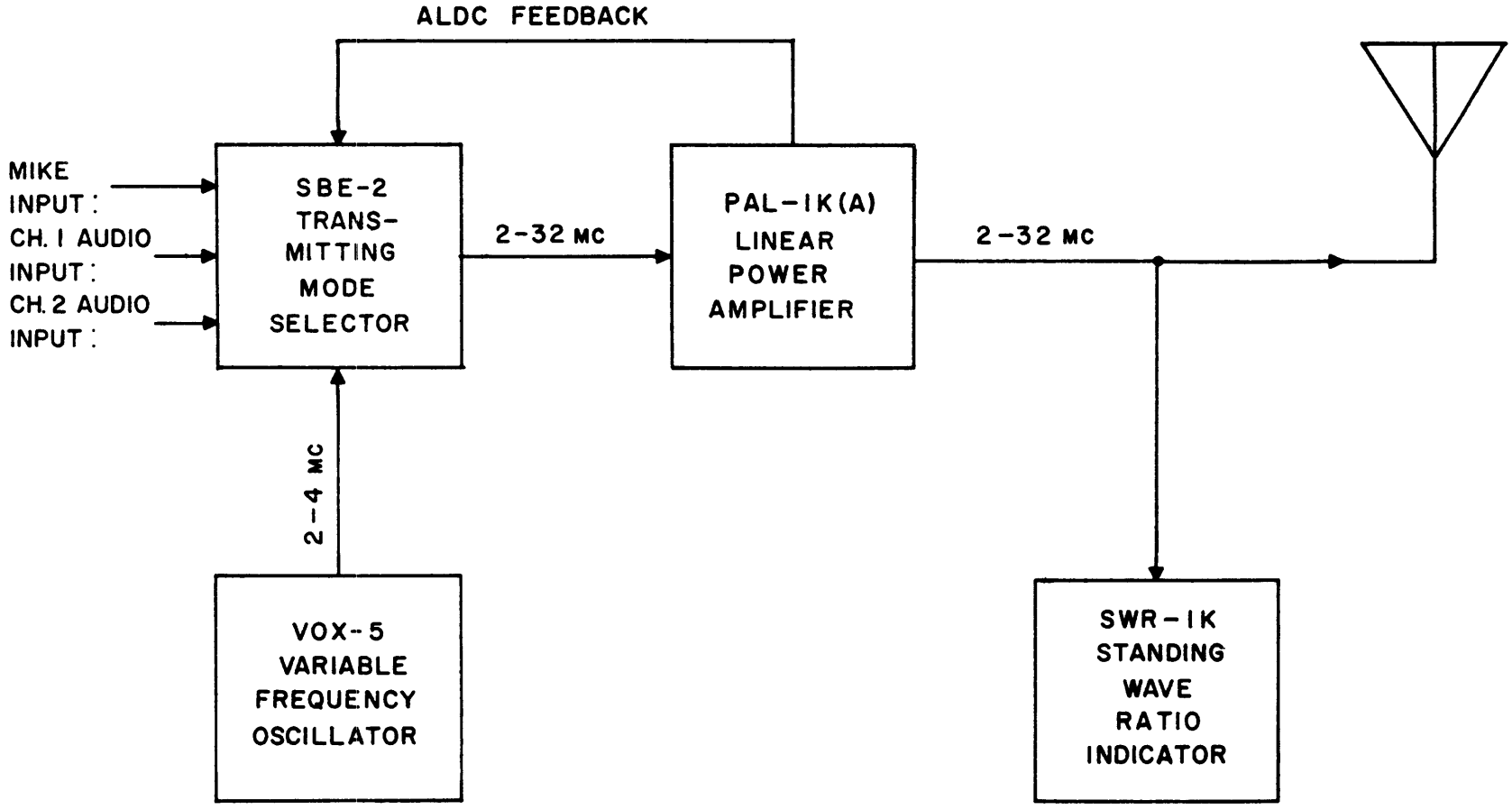


Figure I-4-1. Functional Block Diagram, SBT-1K(A)

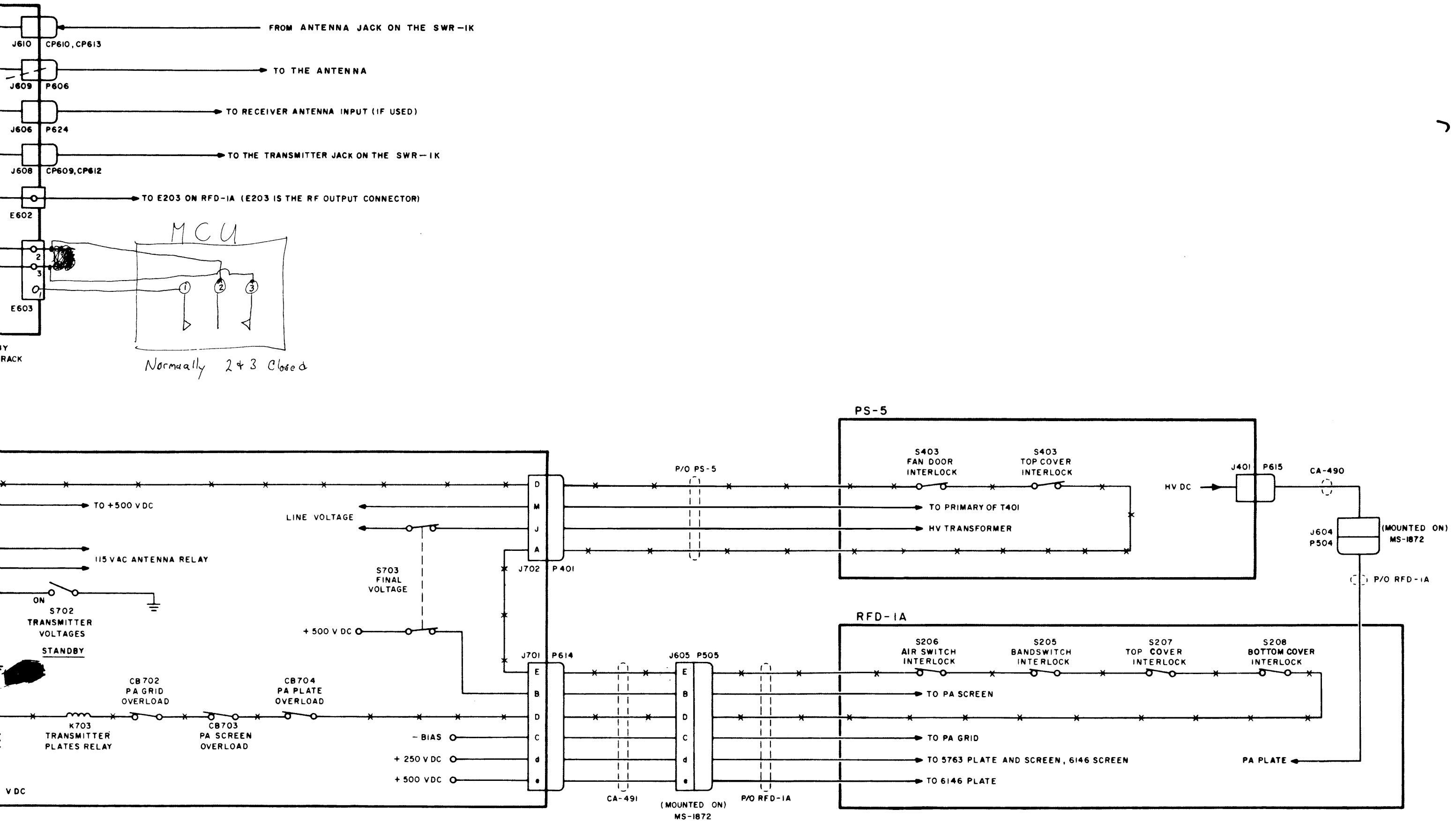


Figure I-4-2. Operational Schematic Illustrating AX-198 Assembly Functions as Used in SBT-1K Transmitters

AX-198 ASSEMBLY

K602 CONTROL RELAY
AC COIL

K601 ANTENNA RELAY
DC COIL

J610 CP610, CP613
FROM ANTENNA

W601
J609 P606
TO THE ANTEN

J606 P624
TO RECEIVER ANTENNA IN

J608 CP609, CP612
TO THE TRANSMITTER JACK

E602
TO E203 ON RFD-1A (E203 IS THE RF OUTPU

R601

S604 INTERLOCK

S603 INTERLOCK

E603

MCU

Normally 2 & 3 Closed

G J K B C D A H E F L
J607
P607

NOTE: S603 CLOSED BY PUSHING RFD-1A INTO RACK

RACK MAIN CABLE CA-506 OR CA-595

S602 RACK REAR DOOR INTERLOCK

PS-4A

3
9
4
6
5
7
8

TO +500 V DC

LINE VOLTAGE

115 VAC ANTENNA RELAY

ON
S702 TRANSMITTER VOLTAGES

+ 500 V DC

STANDBY

E604 E701

CB702 PA GRID OVERLOAD

CB704 PA PLATE OVERLOAD

CB703 PA SCREEN OVERLOAD

K703 TRANSMITTER PLATES RELAY

-200 V DC

903
6
5

CA-597

J911 P626

RACK INTERCONNECT

APP-4

X A H J G J501

9 PUSH TO TALK
10
1 REMOTE TRANSMITTER PLATE
2
22 KEY LINE
21
32
5
6 EXTERNAL INTERLOCK JUMPERS
7
8
NO 23 RECEIVER MUTING
C 24
NC 25

RACK MAIN CABLE

LEGEND
INTERLOCK CIRCUIT

CMO-1 (IF USED)

POWER AMPLIFIER V305 6CL6

E303 E903

2 6

1 5

CA-597

J911 P626

RACK INTERCONNECT

AX-198 ASSEMBLY

K602 CONTROL RELAY

AC COIL

DC COIL

K601 A

G J K B C D A H

RACK MAIN CABLE CA-506 OR CA-595

APP-4

X A H J G J501

9 PUSH TO TALK

10

1 REMOTE TRANSMITTER PLATE

2

22 KEY LINE

21

32

5

6 JUMPERS

7

8

EXTERNAL INTERLOCK

NO 23

C 24

NC 25

RECEIVER MUTING

RACK MAIN CABLE

LE

INTERLOC

SECTION 5

TROUBLE SHOOTING

I-5-1. INTRODUCTION

This section describes procedure of checking the SBT-1K(A) in order to determine which of the 3 major components (PAL-1KA, SBE-2 and VOX-5) is at fault. When this is determined, the individual manual may be referred to for trouble shooting the unit.

Trouble shooting is the art of locating and diagnosing equipment troubles and maladjustments; the information necessary to the equipment troubles is reserved for section 6 (Maintenance Section) of the individual manual for the faulty unit.

I-5-2. GENERAL TROUBLE SHOOTING TECHNIQUES

Often it is unnecessary to follow a lengthy and orderly course of trouble shooting in order to localize and isolate the faulty part. When a piece of equipment has been working satisfactorily and suddenly fails, the cause of failure may be apparent either because of circumstances occurring at the time of failure or because of symptoms analogous to past failures.

A second short cut in trouble shooting is to ascertain that all tubes and fuses are in proper working order; also that equipment receives proper supply voltages. Many times this will eliminate further investigation.

A third short cut is to examine the equipment briefly for burned-out elements, charring, corrosion, arcing, excessive heat,

dirt, dampness, etc. It is important to recognize that defective elements may have become defective due to their own weaknesses or to some contributive cause beyond their control.

Sometimes excessive vibration will cause failure; for example with soldered joints or when components normally isolated from others are shaken together. Such failures are more difficult to locate.

I-5-3. TROUBLE-SHOOTING THE SBT-1K(A) SYSTEM

a. GENERAL NOTES - If trouble occurs during operation of the SBT-1K(A), some general rules may be followed that will sometimes give a quick clue in determining which major unit (PAL-1KA, SBE-2 or VOX-5) is at fault. Perform a general check along the lines listed in paragraphs under I-5-2. If faulty unit is not revealed in this way, refer to paragraph I-5-3b which lists some generalizations as to causes of trouble during operation. If the faulty unit is still not evident, refer to Section 5 of the individual component manual and take voltage readings of each unit. Once the faulty unit has been determined, refer to the individual manual for narrowing down the trouble to the section and the defective component in the unit.

b. TROUBLE SHOOTING BASED ON OPERATIONAL PROCEDURE - In many cases the faulty unit may be evident from referring to tuning tables I-3-1 through I-3-7 and control function tables in the individual manuals. If the various lights and indicators have responded correctly as described in the "operation" column up to a certain step and do not respond in that step, the faulty unit may be pointed out in this way.

Besides this, other generalizations may be stated as listed below:

TROUBLE	CHECK
SBT-1K(A) output frequency is off	VOX-5 master oscillator or SBE-2 crystal oscillators
SBT-1K(A) output power cannot be brought up to desired level	RFD-1A PA tube
SBT-1K(A) has distorted output	RFD-1A amplifier tubes or SBE-2 output frequency or VOX-5 output frequency
SBT-1K(A) output frequency is unstable	VOX-5 output frequency stability
SBT-1K(A) is inoperative	Interlock system (see table I-4-1)*

*NOTE

Failure of the operator to check all the interlocks, particularly the one at the antenna output connector J606, is the most common cause of trouble in this transmitter. The mating plug, P606, (TMC #PL-149) shipped with the transmitter must be used to make up the antenna cable. This plug has the necessary flange on it to close S604 interlock switch in the AX-198 unit.

SECTION 6

MAINTENANCE

I-6-1. INTRODUCTION

Generalized phases of maintenance of the SBT-1K(A) are outlined below. Where this data is inadequate, refer to Parts II through V as pertinent to specific equipment units.

I-6-2. GENERAL

The SBT-1K(A) contains assemblies of many electrical and mechanical parts which may be maintained adequately by conventional preventive and corrective maintenance techniques as outlined in the following paragraphs. Long life and continual operation of moving parts require especially good maintenance. When a component fails in a highly precise frequency-sensitive assembly, it is generally more practical to replace the entire assembly than to attempt to repair it. Such assemblies may then be returned to the factory for repair and adjustment. The same is true of complicated mechanical assemblies. Installation of "parts peculiar" without suitable tools makes the replacement of the entire assembly more practical than disassembly, fabrication, and reassembly. Pieces of the SBT-1K(A) that fall into this category are the master oscillator and oven assembly in VOX-5, master oscillator counters and gears, and large selector switches in SBE-2 and RFD-1A.

I-6-3. OPERATOR'S MAINTENANCE

Operator's maintenance consists in not only maintaining optimum equipment performance at all times but also keeping a detailed record of the equipment performance as well as a log of

of events and happenings, including climatic conditions, pertinent to equipment operation. Such records are useful in spotting gradual equipment degradation and when more general remedial measures are necessary.

I-6-4. PREVENTIVE MAINTENANCE

a. GENERAL - Preventive maintenance is maintenance that detects and corrects trouble producing items before they become serious enough to effect equipment operation adversely. Some trouble producing items are dirt and grime, contact erosion, improper contact pressure, lack of proper lubrication, overheating, unstable power supplies, vacuum tubes with poor emission, loose parts (due to excessive vibration), etc.

It may appear contradictory to state that good preventive maintenance means that one should not constantly poke around and tinker with an equipment that is performing excellently. Overzealous maintenance can readily cause more, rather than less, potential trouble. Good preventive maintenance requires constant vigilance and good judgement of when, what, and how to apply remedial measures.

b. ONCE EACH SHIFT DURING AN "ON THE AIR" PERIOD - Check the operator's SBT-1K(A) performance record for irregularities and possible sources of future trouble. Make minor adjustments of the tuning controls to verify proper tuning. Observe all electrical quantities measurable with built-in meters and compare observations with established standards for irregularities. Observe indicator

lights and rectifier tubes for abnormal color and signs of internal flashing.

c. DAILY DURING AN "OFF THE AIR" PERIOD - Visually and manually inspect all parts in the SBT-1K(A) for overheating and damage. Inspect all sliding and moving coil contacts. Feel blower motors for overheating and observe rotating parts for wear. Note deposits of dust and dirt. Inspect condition of relay contacts. Check operation of all door interlocks.

d. MONTHLY DURING "OFF THE AIR" PERIODS - Recondition rotary switch contacts as necessary. Use crocus cloth and trichloroethylene or ethylenedichloride for cleaning. Remove dirt or grease from non-electrical parts with any good dry-cleaning fluid.

WARNING

When using trichloroethylene or carbon tetrachloride, make sure that adequate ventilation exists. These are toxic substances. Avoid prolonged contact with skin.

Check the condition of the air filters; replace or clean dirty filters. Inspect SBT-1K(A) for loose solder connections or screws, especially in those cases experiencing appreciable vibration in service. Note the condition of gear trains; those showing signs of becoming dry should be lubricated with a drop or two of any high quality, light machine lubricant. Check the condition of all tubes.

I-6-5. CORRECTIVE MAINTENANCE

Corrective maintenance is an aftermath of trouble shooting

as discussed in section 5, or preventive maintenance as discussed in the preceding paragraph. With the exception of those cases when components suddenly fail for no apparent good reason or under extenuating circumstances, an intelligent program of preventive maintenance should produce minimum equipment outage.

After a defective part has been localized and isolated by the trouble shooting techniques presented in various sections 5 of the manual, replacement generally presents no major problem particularly in the case of failure of non-complex electrical and mechanical components.

Refer to Appendix (Part VI of this manual) for guide in reordering components used in the SBT-1K(A).