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for

GENERAL PURPOSE RADIO

TRANSMITTER

MODEL SBT-1K(Q)

AN/FRT-56

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

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FOREWORD

TMC's General Purpose Radio Transmitter, Model SBT-1K(Q) consists of a rack (equipped with cabling and bolted-down components) and five removable drawers of equipment as follows:

SWR-1K Standing Wave Ratio Indicator

RFD-1A (P/O PAL-1KA) RF Power Amplifier

VOX-5 Variable Frequency Oscillator

PS-4A (P/O PAL-1KA) Low Voltage Power Supply

PS-5 (P/O PAL-1KA) High Voltage Power Supply

These five basic units are also included in different combinations in various TMC transmitter and receiving systems, as well as in the SBT-1K(Q). To satisfy this condition most practically, individual manuals on each unit are written, then combined as required to cover any of SBT-1K's multi-model transmitters. In this way, the "building-block" manuals may be assembled in many arrangements in order to fully describe a great many specific equipments. The SBT-1K(Q) manual is made up of individual manuals as described in Table of Contents of General Purpose Radio Transmitter, Model SBT-1K(Q).

The following colloquial terms are used in this manual to simplify formal nomenclature terminology.

FORMAL	COLLOQUIAL
Transmitting Set, Radio, AN/FRT-56	General Purpose Radio Transmitter, SBT-1K(Q)
Indicator, Standing Wave Ratio, IM-166/URT	Standing Wave Ratio Indicator, SWR-1K
Amplifier Power Supply Group, AN/URA-36A	Linear Power Amplifier, PAL-1K(A)
Oscillator, Radio Frequency, 0-330()/FR	Variable Frequency Oscillator, VOX-5

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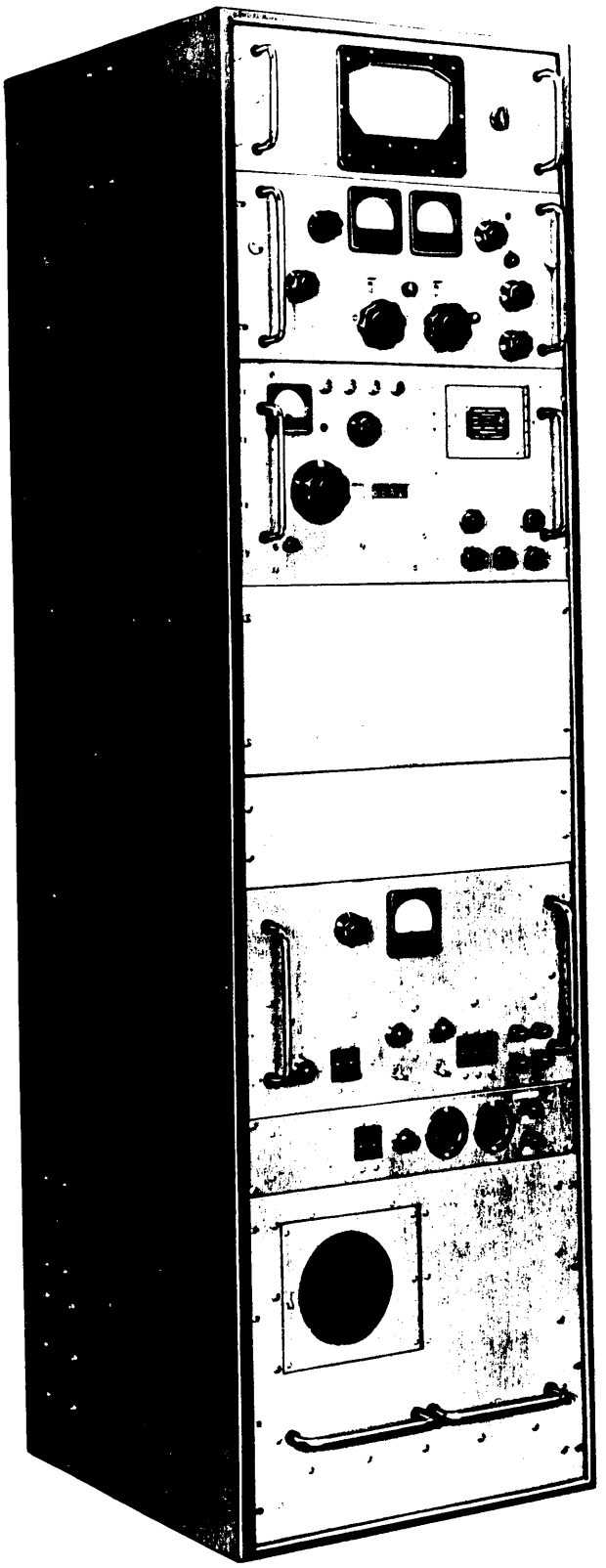


Figure I-1-1a. Front Angle View, SBT-1K(Q) General Purpose Radio Transmitter

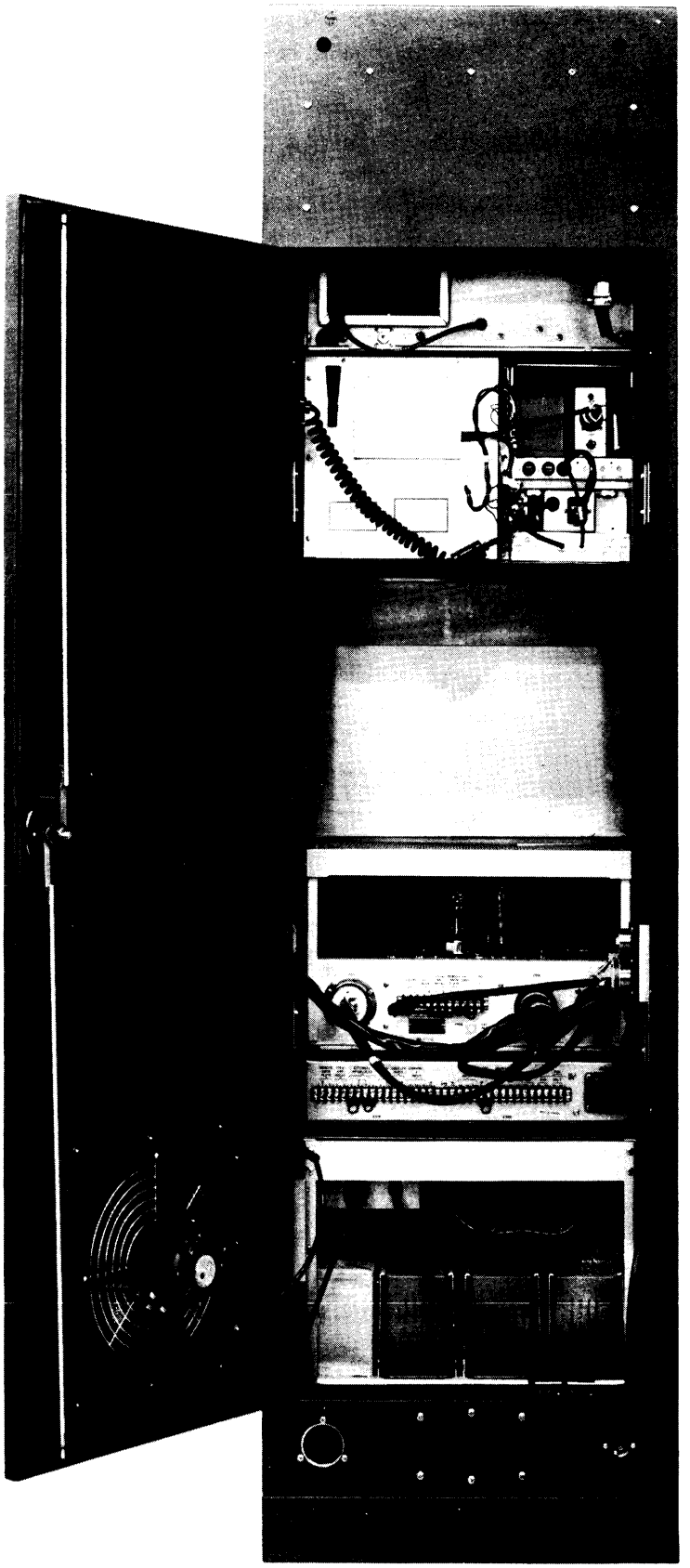


Figure I-1-1b. Rear View, SBT-1K(Q) General Purpose Radio Transmitter

SECTION 1

GENERAL DESCRIPTION

I-1-1. INTRODUCTION

Technical Materiel Corporation's General Purpose Radio Transmitter, model SBT-1K(Q) (see figures I-1-1a and I-1-1b) is basically a 1 kilowatt (PEP) linear power amplifier and master oscillator designed for use with various types of exciter units. The unit is capable of producing continuously adjustable radio frequency signals through the frequency range of 2 to 32 megacycles. The SBT-1K(Q) alone will only produce and amplify the basic carrier frequency. In order to transmit intelligence it must be used with a suitable exciter such as the TMC Transmitting Mode Selector model SBE-3 (AN/URA-28) or the TMC Frequency Shift Exciter model XFK (C-2749A/URT). Use of the above exciters will provide transmission of single sideband (double or independent), amplitude modulated, continuous wave (telegraphy), teletype, or facsimile signals.

I-1-2. EQUIPMENT DESCRIPTION

The SBT-1K(Q) shown in figures I-1-1a and I-1-1b is contained in a single relay type equipment rack measuring 72-1/2 inches high x 20-5/8 inches wide x 22-1/2 inches deep. The front of the rack is open to allow for mounting, maintenance and operation of the various components. The rear of the rack contains

a door, which may be opened for maintenance purposes. A fan is mounted on the rear door to provide air circulation. The equipment rack contains two air filters. One is located adjacent to the fan, and the other at the top of the rack. Attached at the rear of the equipment rack are two spring loaded counterweights. These counterweights are connected to the rear cabling of various components to prevent snagging of the cables when these components are pushed into the rack.

The following paragraphs briefly describe each unit mounted in the rack as they appear in figure I-1-1a reading from top to bottom.

The first unit is TMC's Standing Wave Ratio Indicator, model SWR-1K. This unit is mounted in the equipment rack by four screws and provides accurate indication of the voltage standing wave ratio in the antenna system and simultaneously provides indications of forward and reflected power.

The second unit is the amplifier unit (RFD-1A) of TMC's RF Linear Amplifier, model PAL-1K(A). This unit is slide mounted and capable of amplifying the output of a suitable exciter up to 1 kilowatt.

The third unit is TMC's Variable Frequency Oscillator, model VOX-5. This unit is a precision, direct reading, variable frequency oscillator with high stability. It is used to supply a continuously adjustable injection frequency to an exciter, thus providing a multitude of carrier frequencies through the 2 to 32 megacycle range. This unit is slide mounted.

The fourth unit is the medium voltage power supply unit (PS-4A) for the PAL-1K(A) RF Linear Amplifier. The PS-4A is slide mounted.

The fifth unit is the model APP-4 Auxiliary Power Panel which functions as a distributor for line voltage to the units in the equipment rack and also contains wiring connections and terminal blocks on the rear of the unit for connection of equipment external to the SBT-1K(Q). Included are connections for wiring the SBT-1K(Q) into a larger transmitter system and/or a transmitter/receiver system utilizing a common antenna. Associated with this function are the relays located in the AX-198 RF output chassis mounted at the top of the rack in back of the SWR-1K.

The sixth unit is the high voltage power supply (PS-5) for the PAL-1K(A) RF Linear Amplifier.

An additional capability of the SBT-1K(Q) is found in its individual modular units - PAL-1K(A) 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. SHIPPING DATA

The SBT-1K(Q) is shipped in a single crate measuring 85-1/8" L x 32-1/2" W x 42-1/4" H and weighs 1050 lbs.

TABLE I-1-1. ELECTRICAL CHARACTERISTICS

Output power	1000 watts PEP for all modes
Frequency range	2 to 32 megacycles
Output impedance	50 ohms unbalanced
Harmonic suppression	2nd harmonic at least 40 db below PEP 3rd harmonic at least 50 db below PEP

TABLE I-1-1. (Cont.)

Signal/distortion ratio	2-22 mc: distortion at least 40 db below either tone of a standard two tone test. 22-32 mc: distortion at least 35 db below either tone of a standard two tone test.
Frequency stability	1 part in 1 x 10^6/day
Tuning	All tuning and bandswitching controls on front panel (no plug-in components)
Metering	Front panel meters indicate operation of all critical circuits.
T/R function	A coaxial 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^oC, and any value of humidity up to 90%.

SECTION 2

INSTALLATION

I-2-1. INTRODUCTION

Each SBT-1K(Q) transmitter has been tested and calibrated as a complete system before shipment. Recalibration of the individual rack mounted units is not necessary.

I-2-2. INITIAL INSPECTION

The complete SBT-1K(Q) will arrive in a single crate containing components as listed in Part V of this manual (Appendix-Rack and Accessories). Inspect the 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(Q) 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-2-3d for modification of SBT-1K(Q) wired for 115VAC.

b. PAL-1K(A) RF LINEAR AMPLIFIER - Referring to PAL-1K(A) manual schematics (Part IV), 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 (Part IV) manual schematics. Change OVENS fuse and POWER fuse to fuses with a current rating that is half that for 115VAC fuses.

d. 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(Q) 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 shockmounting kit and separate installation instructions are supplied.

I-2-5. INITIAL ADJUSTMENTS

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

I-2-6. EXTERNAL CONNECTIONS

a. INTRODUCTION - The APP-4 Auxiliary Power Panel is a standard modular unit present in all of the SBT-1K(Q) 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 series transmitters and remote control features. Except for antenna and receiver connections at J609 and J606 on AX-198 unit and exciter connections to the VOX-5, all external connections may be made at two terminal blocks, E501 and E502, located at the rear of APP-4. Figure I-2-2 and the following paragraphs illustrate the possible external connections to SBT-1K(Q). Schematic diagrams in Part V 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 (exciter) external to the SBT-1K(Q). This enables control of the entire transmitter at the exciter panel by means of the XMTR OFF/ON switch. Such a relay is sometimes employed in larger TMC transmitter systems of which SBT-1K(Q) is a sub-assembly.

c. 115V ANTENNA RELAY - Terminals 3 and 4 are available for an extension source of the 115VAC used to key the control relay in the AX-198.

d. EXTERNAL INTERLOCKS - Terminals 5, 6, 7 and 8 are provided for connection of additional safety interlock/s external to the SBT-1K(Q) transmitter. Such additional interlock/s will be in series with the SBT-1K(Q) interlocks and form another link in the interlock circuit. When these terminals are not used in this way, the jumpers remain in place.

e. 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 is 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).

f. RESERVED TERMINALS - Terminal 9 through 22 and 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 CW, AM, FSK (Frequency Shift Keying), and FAX (Facsimile) modes of transmission. The SBT-1K(Q) transmitter does not transmit in these modes without the use of an external exciter and these terminals should not be used for connection of external equipment.

g. ANTENNA - RF receptable 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.

h. 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.

I-2-7. EXTERNAL EXCITER CONNECTION

a. INTRODUCTION - As mentioned in section 1 of this manual, in order for the SBT-1K(Q) to transmit intelligence an external exciter must be used to provide the desired type of operation. The following paragraphs describe method for connecting suitable exciters to provide CW (telegraphy) AM and FSK modes of operation.

b. TRANSMITTING MODE SELECTOR TMC MODEL SBE-3 (AN/URA-28) - The SBE-3 is a single sideband exciter and may be used to provide amplitude modulation (carrier), CW telegraphy (A1 or A2) or frequency shift telegraphy modes of operation. The SBE-3 is capable of operating in any of the above modes on single sideband, double sideband, or independent sideband with up to fully suppressed carrier. For single sideband frequency shift operation the SBE-3 is used in

conjunction with a unit such as the Frequency Shift Exciter TMC model XFK (C-2749/URT).

Figure I-2-3 illustrates the required connections between the VOX-5 and SBE-3 when it is used as an exciter in conjunction with the SBT-1K(Q). The rf output to drive the RFD-1A is taken from the RF OUT jack on the rear of the SBE-3. Drive for the RFD-1A is obtained by connecting a cable between the RF OUT jack on the SBE-3 and jack J201 on the RFD-1A.

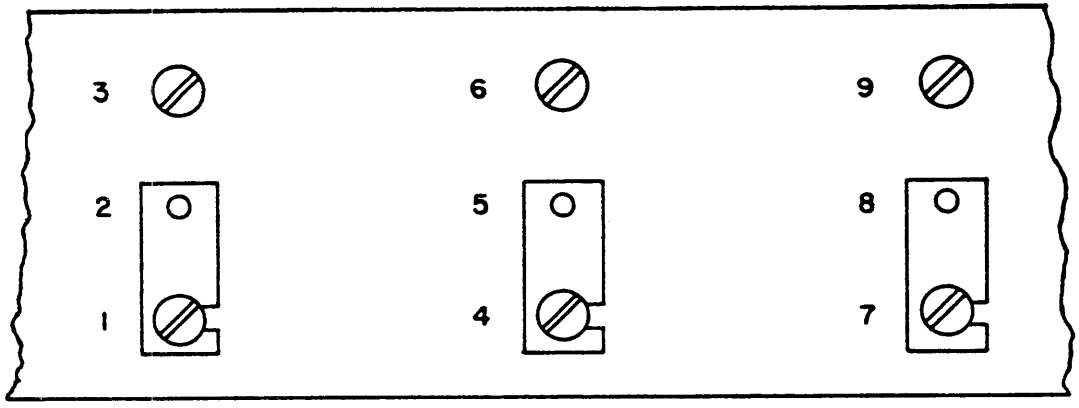
c. FREQUENCY SHIFT EXCITER MODEL XFK (C-2749/URT) - The XFK is a frequency shift exciter which provides a means of shifting on RF carrier for transmission of teleprinter, telegraph, FM telephone, facsimile on telephoto intelligence.

Figure I-2-4 illustrates the required connections between the VOX-5 and the XFK. Making these connections substitutes the variable master oscillator in the VOX-5 for the crystal oscillator in the XFK and connects the RF output from the XFK to the multiplier stages in the VOX-5. This arrangement extends the operating frequency range of the XFK to 32 megacycles. It should be noted that a pad is connected between the output of the XFK and the input to the multiplier stages of the VOX-5. The pad is necessary in order to attenuate the XFK output to the required 1.25 volts rf operating level required by the VOX-5. Drive for the RFD-1A is obtained by connecting a cable between HFO jack J208 on the VOX-5 and jack J201 on the RFD-1A.

d. EXCITER UNIT 05C/FR - The 05C/FR is a frequency shift exciter similar to the TMC model XFK. Its connection to the VOX-5 is

included in this manual as a possible military application of the SBT-1K(Q) (AN/FRT-56) for transmission of intelligence requiring frequency shift keying.

The connections shown in figure I-2-5 for the 05C/FR are similar to those for the XFK. Because, the output of the 05C/FR is different from that of the XFK, the values of the resistors in the pad will have to be determined in order to reduce its output to the required 1.25 volts rf. As with the XFK the drive for the RFD-1A is obtained by connecting a cable between the HFO jack J208 on the VOX-5 and J201 on 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.

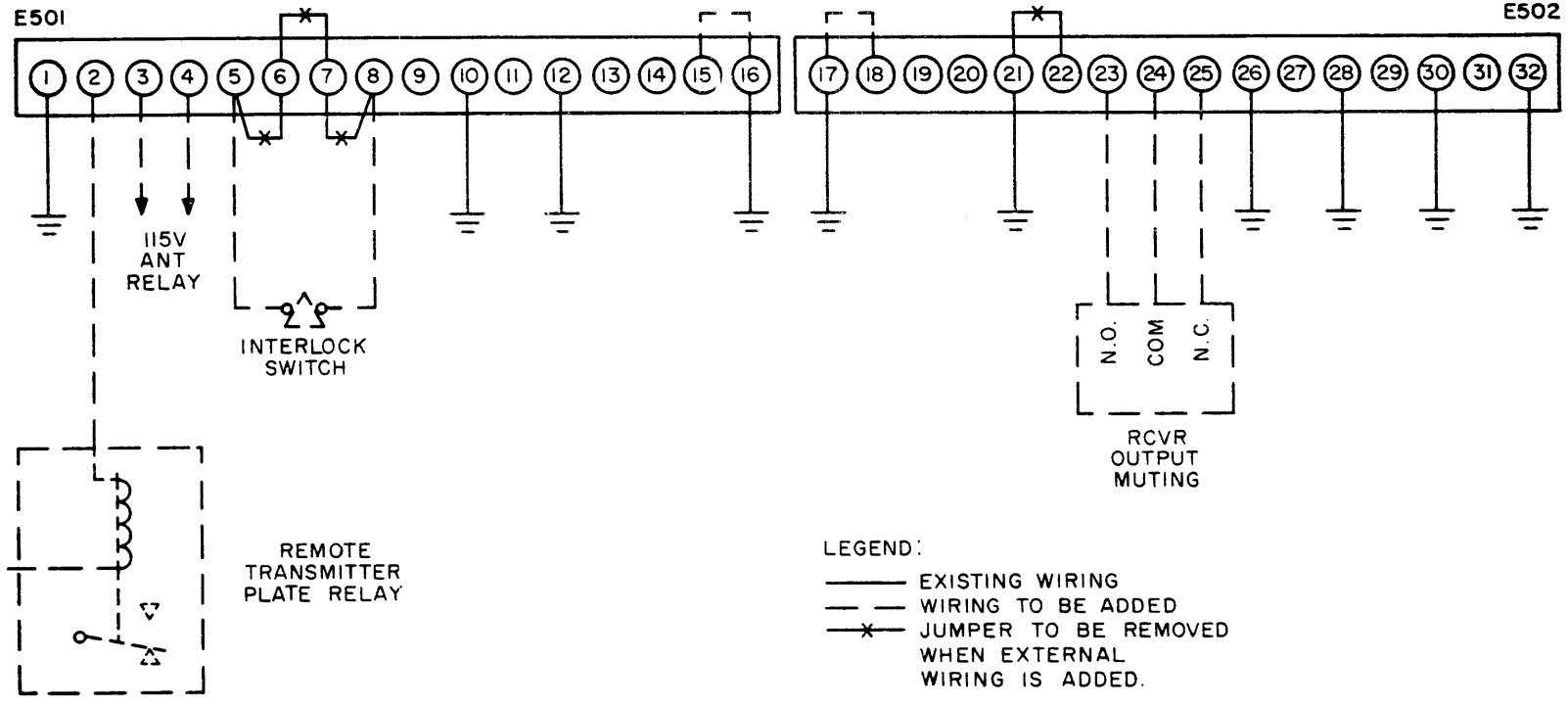


Figure I-2-2. Connection Diagram, External Equipment to SBT-1K(Q)

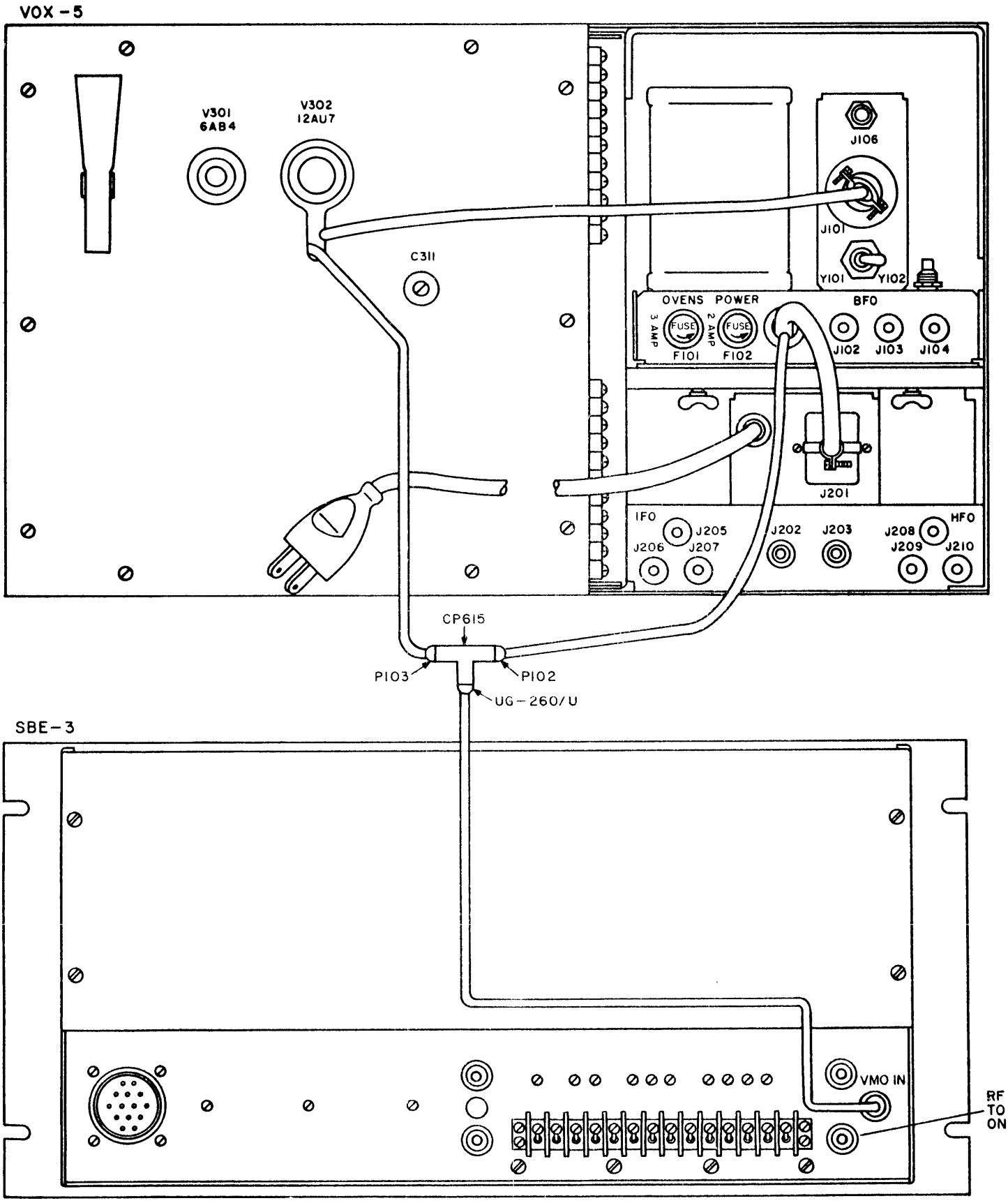


Figure I-2-3. Connection Diagram, VOX-5 and SBE-3

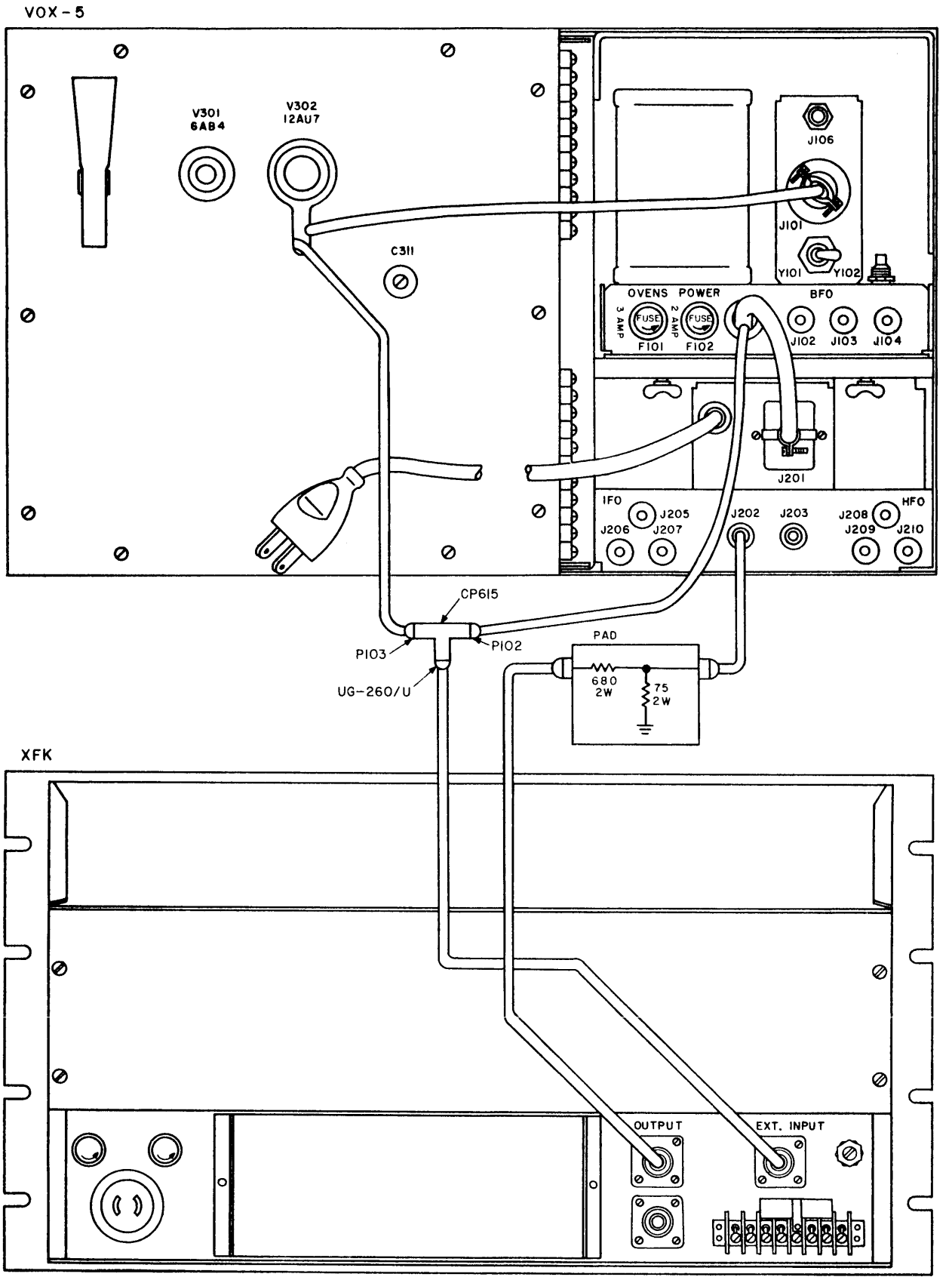


Figure I-2-4. Connection Diagram, VOX-5 and XFK

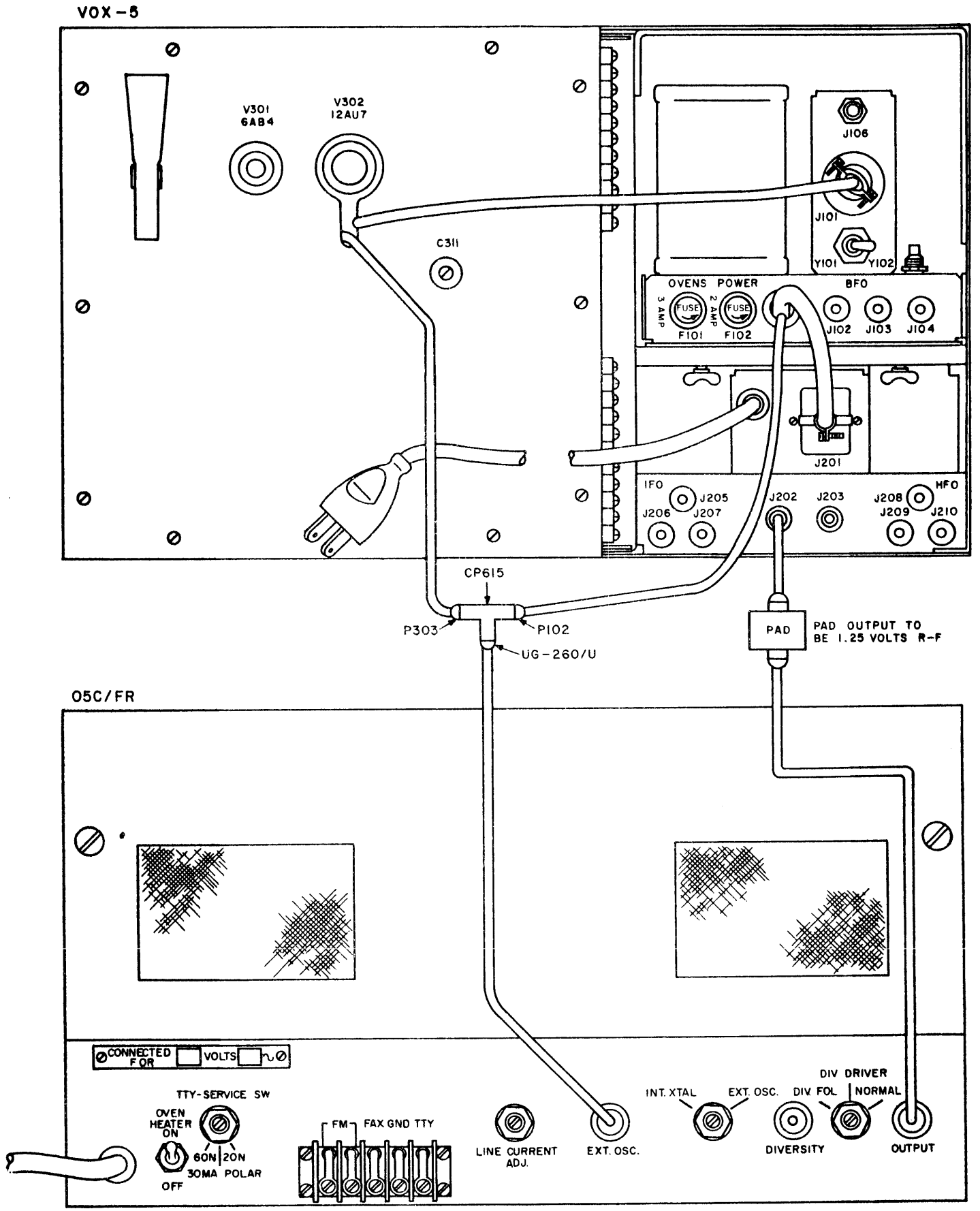


Figure I-2-5. Connection Diagram, VOX-5 and 05C/FR

SECTION 3

OPERATOR'S SECTION

Because the SBT-1K(Q) must be used with external exciters it is impractical to provide a system operating procedure in this manual. For operating procedures refer to the operator's section in the manuals covering the individual units.

SECTION 4

PRINCIPLES OF OPERATION

I-4-1. INTRODUCTION

Figure I-4-1 is a functional block diagram of the SBT-1K(Q) transmitter, showing the main interrelationships of the AX-198, SWR-1K, PAL-1K(A) and VOX-5. Also shown but not part of the SBT-1K(Q) is an XFK frequency shift exciter. The XFK is included to illustrate the relationship of an external exciter when it is used with the SBT-1K(Q). For a complete functional block diagram and schematic diagram of each unit, except the AX-198 which is part of the rack, 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 V.

I-4-2. OPERATION

a. GENERAL - As shown in figure I-4-1, the VOX-5 furnishes a continuously adjustable 2-4 mc as an injection frequency for an external exciter (such as the XFK), thereby providing continuous adjustment for SBT-1K(Q)'s 2-32 mc output. 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(Q). The output of VOX-5 is amplified up to 1 kilowatt by PAL-1K(A). The SWR-1K serves to monitor the VSWR (Voltage Standing Wave Ratio) on the antenna, in order to aid tuning adjustments to match SBT-1K(Q) to antenna. The AX-198 provides for switching of the antenna from the SBT-1K(Q) to an associated receiver to provide a T/R (transmitter/receiver) function allowing utilization of a single antenna for transmitting and receiving.

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 1-4-2). 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(Q) 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(Q) 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 and to terminal 3 and 4 on the APP-4 terminal strip. 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. 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-2-2), 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

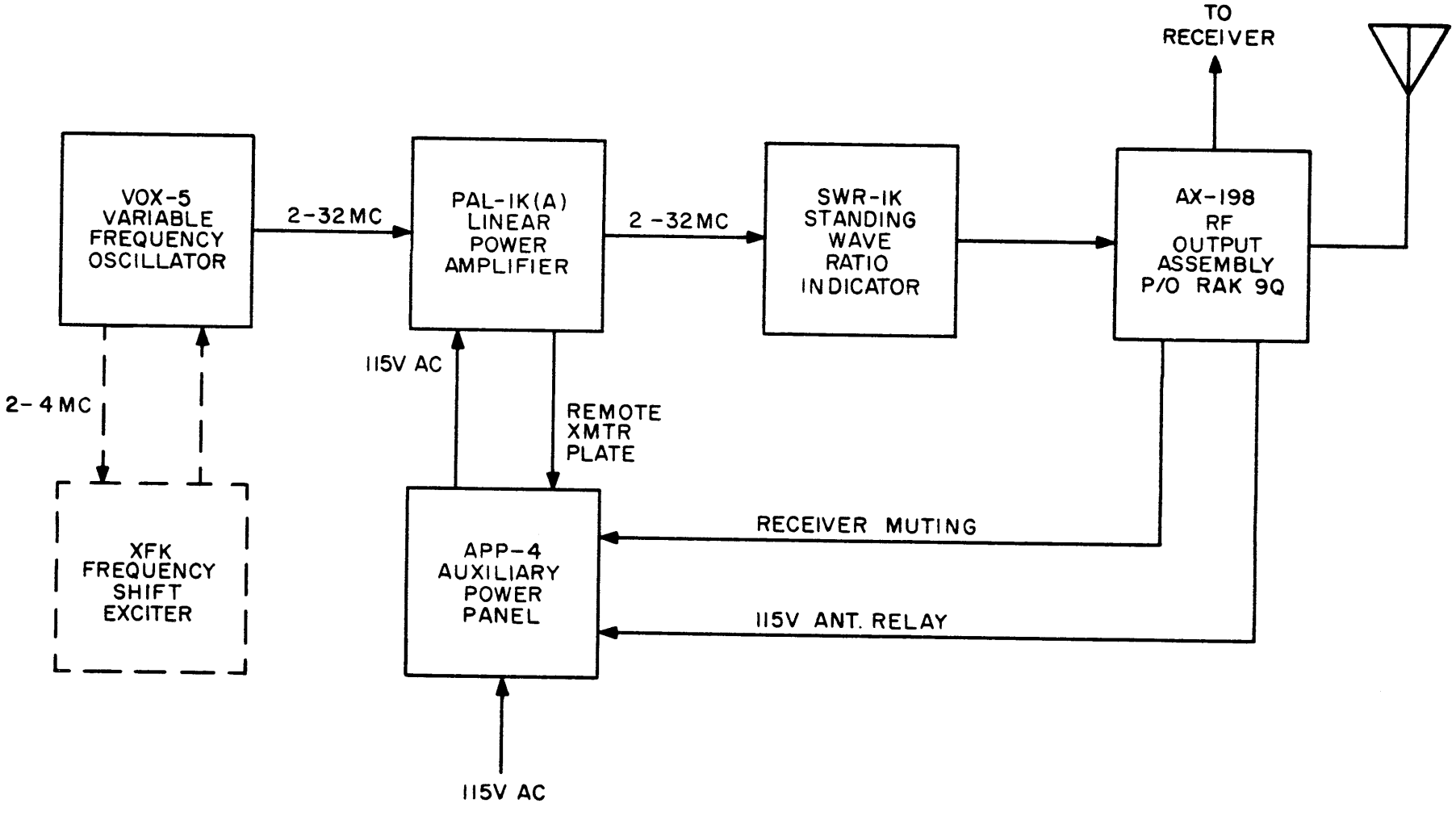


Figure I-4-1. Functional Block Diagram, SBT-1K(Q)

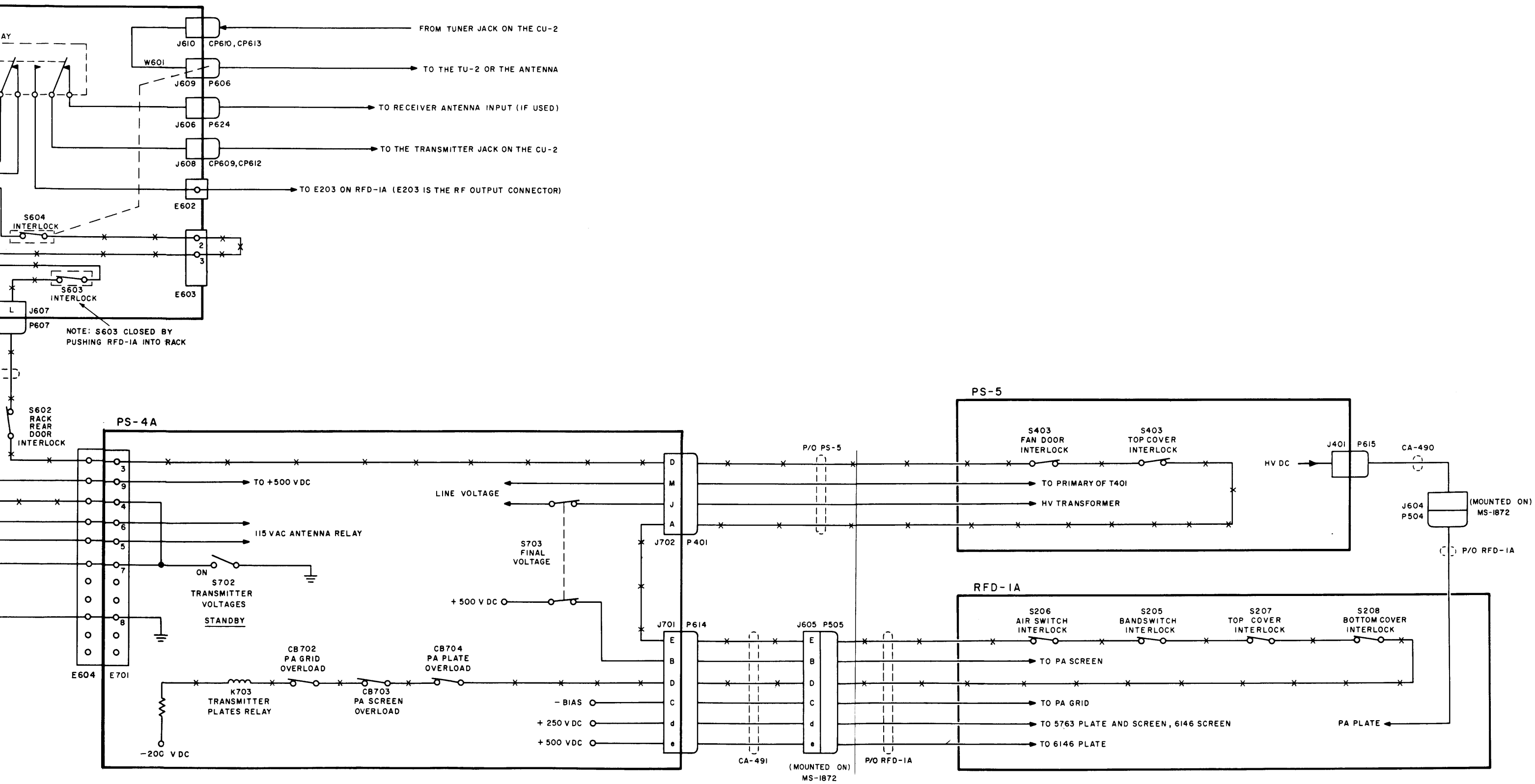
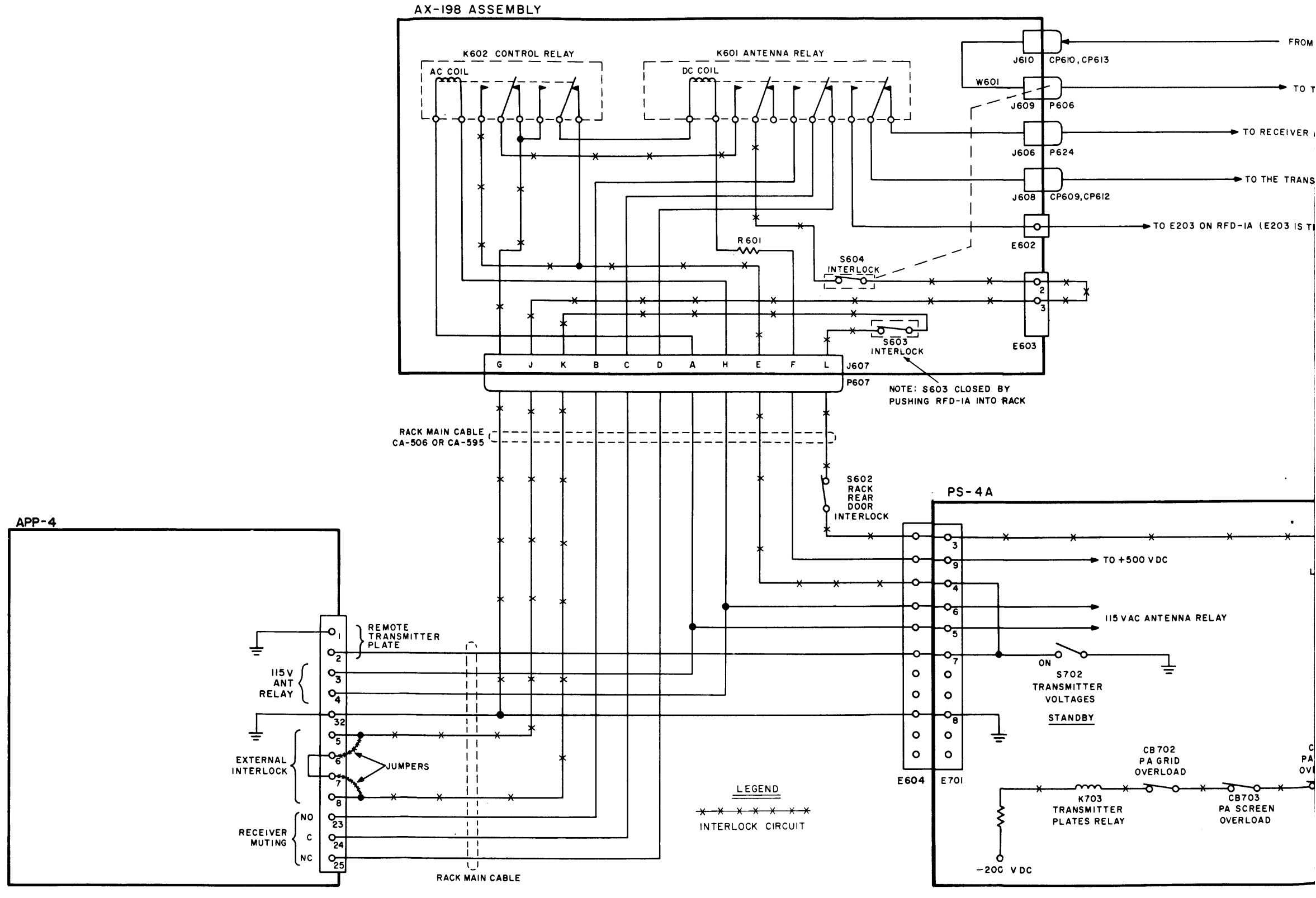


Figure I-4-2. Operational Schematic Illustrating AX-198 Assembly Functions as Used in SBT-1K(Q)


AX-198 ASSEMBLY
K602 CONTROL RELAY
AC COIL
K601 ANTENNA RELAY
DC COIL
J610
CP610, CP613
FROM
W601
J609
P606
TO T
J606
P624
TO RECEIVER
J608
CP609, CP612
TO THE TRANS
E602
TO E203 ON RFD-IA (E203 IS TI
R601
S604
INTERLOCK
2
3
S603
INTERLOCK
E603
G J K B C D A H E F L
J607
P607
NOTE: S603 CLOSED BY
PUSHING RFD-IA 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
115 VAC ANTENNA RELAY
ON
S702
TRANSMITTER
VOLTAGES
STANDBY
E604
E701
CB702
PA GRID
OVERLOAD
K703
TRANSMITTER
PLATES RELAY
CB703
PA SCREEN
OVERLOAD
-200 V DC
APP-4
1
2
3
4
32
5
6
7
8
23
24
25
REMOTE
TRANSMITTER
PLATE
115 V
ANT
RELAY
EXTERNAL
INTERLOCK
JUMPERS
RECEIVER
MUTING
NO
C
NC
RACK MAIN CABLE
LEGEND
INTERLOCK CIRCUIT

SECTION 5

TROUBLE-SHOOTING

I-5-1. INTRODUCTION

This section describes procedure of checking the SBT-1K(Q) 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(Q) SYSTEM

a. GENERAL NOTES - If trouble occurs during operation of the SBT-1K(Q), 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 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(Q) output frequency is off	VOX-5 master oscillator or exciter crystal oscillators
SBT-1K(Q) output power cannot be brought up to desired level	RFD-1A PA tube
SBT-1K(Q) has distorted output	RFD-1A amplifier tubes or exciter output frequency or VOX-5 output frequency
SBT-1K(Q) output frequency is unstable	VOX-5 output frequency stability
SBT-1K(Q) 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(Q) are outlined below. Where this data is inadequate, refer to Parts II through IV as pertinent to specific equipment units.

I-6-2. GENERAL

The SBT-1K(Q) 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(Q) 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 the 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 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 menas 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(Q) 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(Q) 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 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(Q) 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 V of this manual) for guide in reordering components used in the SBT-1K(Q).