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UNCLASSIFIED

TECHNICAL MANUAL

for

GENERAL PURPOSE TRANSMITTER

MODEL SBT-1K(E)

THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N.Y. OTTAWA, ONTARIO

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1 July 1962

FOREWORD

Technical Materiel Corporation's general purpose transmitters, models SBT-1K, frequently called sideband transmitters, have an output of 1 kilowatt (PEP) in the frequency range of 2 to 32 megacycles. Their principle use is sideband transmission, voice and/or FSK.

TMC's models SBT-1K consist of various combinations of modular equipment units; in this way many customer needs may be satisfied. For example, in the model SBT-1K(E) (see following figure 1-1), the equipment units comprise (see following figure 1-2): CBE-1, CPO-1 (consisting, in turn, of CHG-1/2, CMO-1, CLL-1, CHL-1, CSS-1A, CPP-1, and CPP-2), SWR-1K, PAL-1K(A) (consisting, in turn, of RFD-1A, PS-4A, and PS-5), TIS-3, and APP-4. These component equipments are housed in RAK-11 (E/W a wiring harness) and RAK-17(A) (E/W an AX-198 relay assembly and a wiring harness).

The CBE-1, CHG-1/2, CMO-1, and TIS-3 create voice and/or FSK signals for sideband transmission via the PAL-1K(A) transmitter. Other SBT-1K models use the PAL-1K(A) transmitter with other exciter arrangements.

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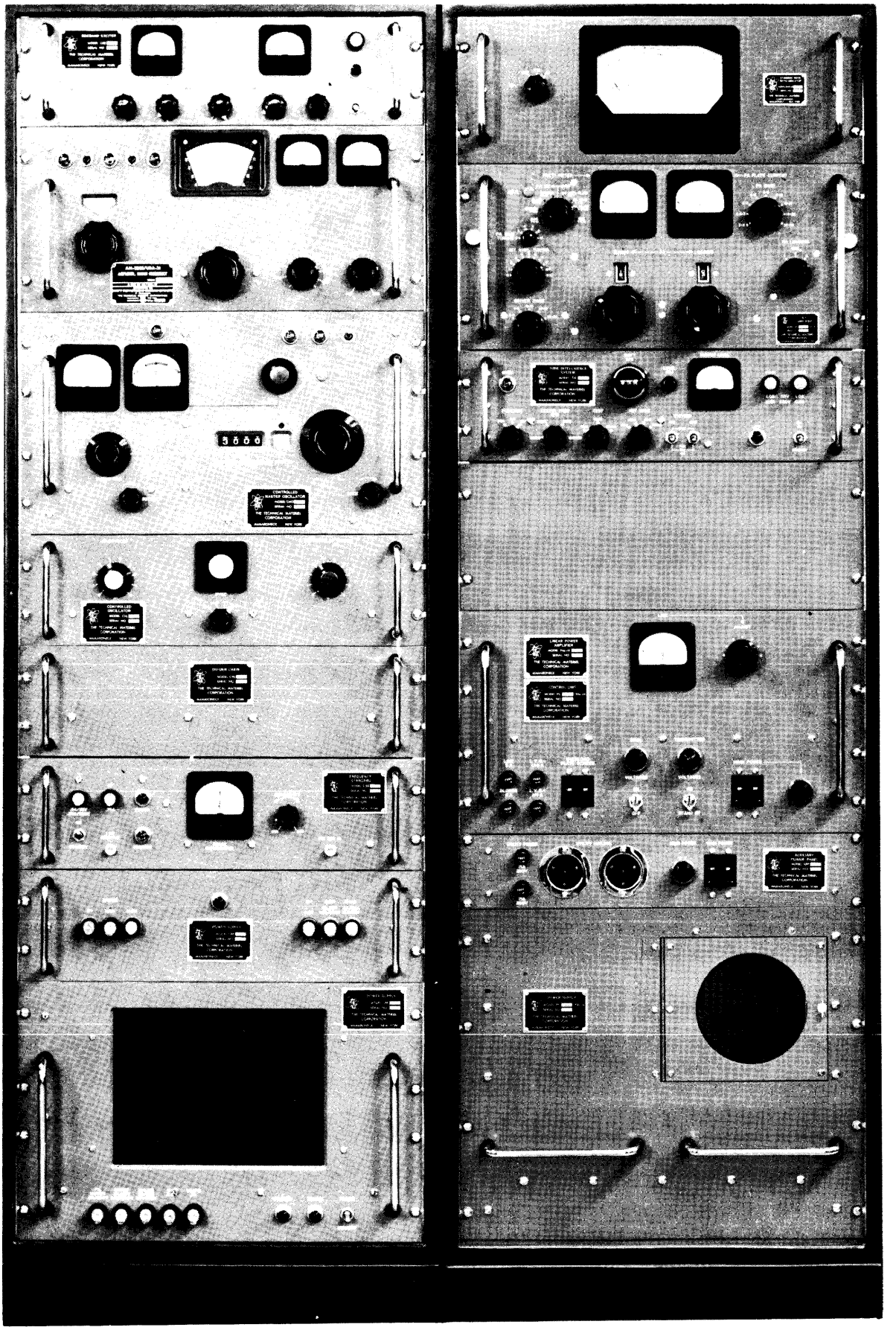


Figure 1-1. Front View of SBT-1K(E)

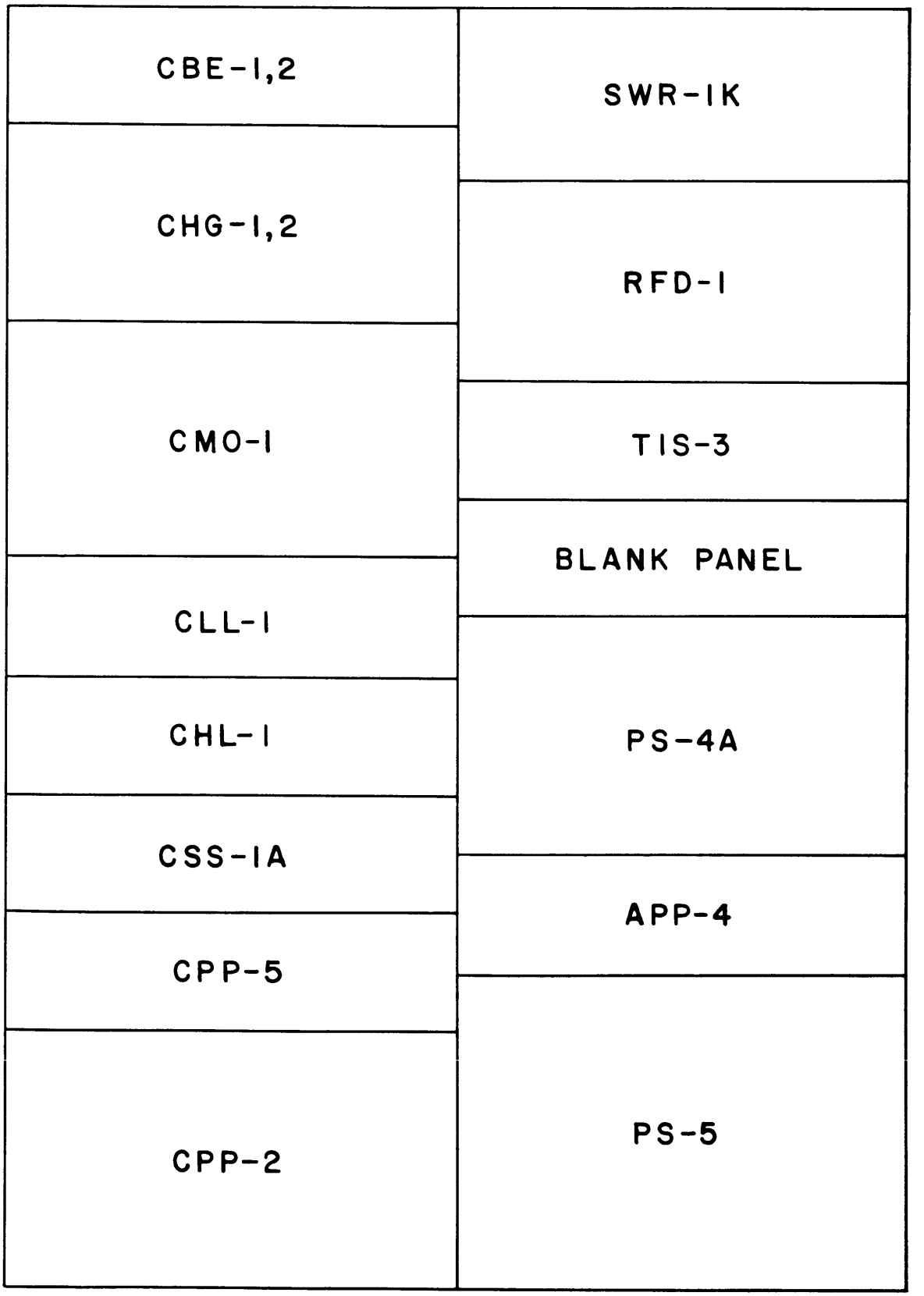


Figure 1-2. Equipment Configuration of SBT-1K(E)

SECTION 1 - INSTALLATION INSTRUCTIONS

1-1. Unpacking Instructions (Figures 1-1 and 1-2)

The SBT-1K(E) is shipped in 8 wooden boxes, as shown in following table 1-1.

TABLE 1-1. SHIPPING DATA FOR SBT-1K(E)

Case		Outside Dimensions Length	Width	Height	Volume Cu. ft.	Weight lbs. Gross (Level A)	Net
1.	RAK-11*	66-1/2	24-1/4	31-1/8	27.6	400	280
2.	CPP-5 CHL-1 CSS-1	31-1/2	23-7/8	31-3/4	13.0	172	66
3.	CLL-1 CBE-1 TIS-3	31-1/2	23-7/8	31-3/4	13.0	174	68
4.	CHG-2	31-1/2	23-7/8	31-3/4	13.0	191	85
5.	CPP-2	27-1/4	21-1/2	17-1/4	5.8	125	67
6.	RAK-17	66-1/2	24-1/4	31-1/8	27.6	400	280
7.	PS-4A RFD-1A SWR-1K	40-1/2	23-7/8	31-3/4	13.8	243	117
8.	PS-5	31-1/2	23-7/8	31-3/4	13.0	285	194

* Contains following assorted items:

1. MANUALS, TECHNICAL, 2 EACH TMC P/N IN-209-E SUPPLIED AS A LOOSE ITEM.

2. TEST DATA, 1 EACH, SUPPLIED AS A LOOSE ITEM.

3. PLUG, ELECTRICAL, 1 EACH, TMC P/N PL-100, REF./SYMBOL P627, SUPPLIED AS A LOOSE ITEM.

4. PLUG, ELECTRICAL, 1 EACH, TMC P/N PL-150, REF./SYMBOL P606, SUPPLIED AS A LOOSE ITEM.

5. PLUG, ELECTRICAL, 1 EACH, TMC P/N PL-190NG, REF./SYMBOL P620, SUPPLIED AS A LOOSE ITEM.

6. EYEBOLT, 4 EACH, TMC P/N SC-142-C, SUPPLIED AS A LOOSE ITEM.

7. EQUIPMENT, MOUNTING HARDWARE, KIT, 1 EACH, CONSISTING OF:
   40 EACH, SCREW, BINDER HEAD, TMC P/N SCBP-1032 BNB
   40 EACH, WASHER, FIBER, TMC P/N WA-101-11

8. PLUG, ELECTRICAL, 1 EACH, TMC P/N UG-260/U, REF./SYMBOL P624, SUPPLIED AS A LOOSE ITEM.

9. PLUG, ELECTRICAL, 1 EACH, TMC P/N UG-59B/U, REF./SYMBOL J202, SUPPLIED AS A LOOSE ITEM.

On arrival, uncrate each box and carefully inspect the equipment for damage. If any damage is found, notify the carrier or supply department immediately. Inspect all packing material for parts shipped as loose items.

The contents of the 8 boxes are packaged according to military specifications. The units are wrapped to avoid being scratched, placed in cartons, cushioned against shock, and wrapped and sealed with waterproof material within which the units are kept dry with a desiccant.

1-2. Installation and Interconnection of Units into Rack

Figure 1-3 presents an isometric view of a RAK-17 rack which has three access holes, located near its bottom panel, for power and signal connections to the SBT-1K. Near the top of the RAK-17 rack are mounted the AX-198 assembly, the SWR-1K unit, and the

RFD-1A unit. A wiring harness that interconnects various units of the SBT-1K is run in a channel in the rear left corner of the rack.

Figure 1-4 is a partial interconnection diagram showing the cabling between the AX-198 and closely associated units. RF input from the PAL-1KA transmitter unit occurs at E602. As seen from figure 1-3, the output from the RFD-1A is a button-type electrical contact and the mating electrical contact on the AX-198 is a spring-socket type.

When the PAL-1KA is transmitting, RF traverses the antenna relay K601, emerging from J608 and is fed to SWR-1K. The path is clearly indicated in figure 1-4. The SWR-1K contains a bridge network that passes the RF to the antenna. Voltage standing wave indications appear on SWR-1K's meter which indicates forward watts, reverse watts, and VSWRs.

Cable CA-506 interconnects the AX-198 (with its antenna relay K601 and control/transfer relay K602) with closely associated circuits in PS-4A, APP-4, and RAK interlock circuits. As will be explained in greater detail in Section 3, the primary function of this circuitry is to disable the receiver in a given sequence of operations when the PAL-1KA is turned on and vice-versa to disable the transmitter in a given sequence of operations when the associated receiver is enabled. It is important when a transmitter is enabled or disabled that the associated receiver does not receive harmful voltages.

Figure 1-5 is the wiring diagram of the SBT-1K(S) in Rack RAK-9.

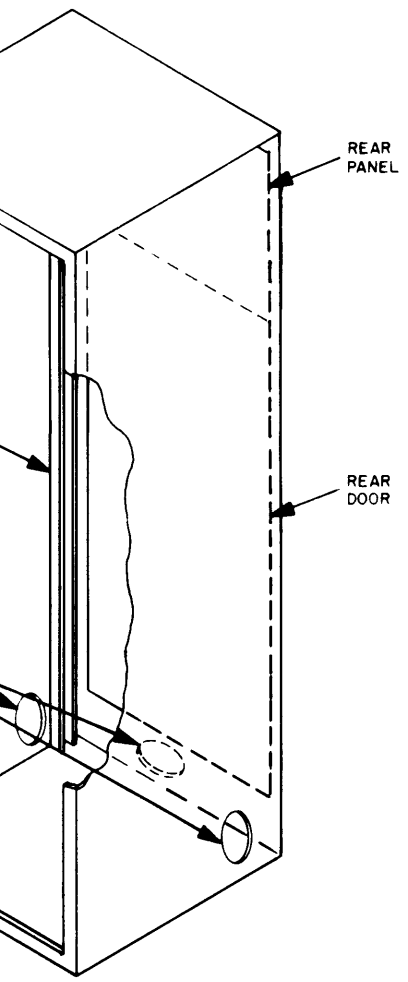
1-3. General Technical Specifications Models SBT-1K

OUTPUT POWER:	1000 watts PEP SSB, CW, FSK
FREQUENCY RANGE:	2 to 32 megacycles
MODES OF OPERATION:	Refer to specifications on individual units.
OUTPUT IMPEDANCE:	50 or 70 ohms unbalanced (dependent upon SWR-1K/ATS-2 ordered)
HARMONIC SUPPRESSION:	1. 2nd harmonic at least 40 db below PEP. 2. 3rd harmonic at least 50 db below PEP.
SIGNAL/DISTORTION RATIO:	1. Distortion at least 40 db below either tone of a standard two tone test 2 to 22 megacycles. 2. Distortion at least 35 db below either tone of a standard two tone test 22 to 32 megacycles.
FREQUENCY STABILITY:	1. Crystal.....1 part in 10^6/day 2. Synthesizer.....1 part in 10^8/day
UNWANTED SIDEBAND REJECTION:	1000 cps tone at least 60 db down.
CARRIER INSERTION:	-55 db to full output.
AUDIO RESPONSE:	1. SBG-2 and SBE-2 Flat within 3 db 350 to 3300 cps. 2. SBG-1 and SBE-3 Flat within 3 db 350 to 7500 cps.
AUDIO INPUT:	1. Two 600 ohm channels, balanced or unbalanced -20 dbm to +20 dbm. 2. One 500,000 ohm input for crystal or dynamic mike, -50 dbm for full output, SBE-2 & 3 only.

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 (SBT-1KJ excluded).
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%.
POWER REQUIREMENTS:	115 volts, 50 or 60 cycles approximately 3 KW.

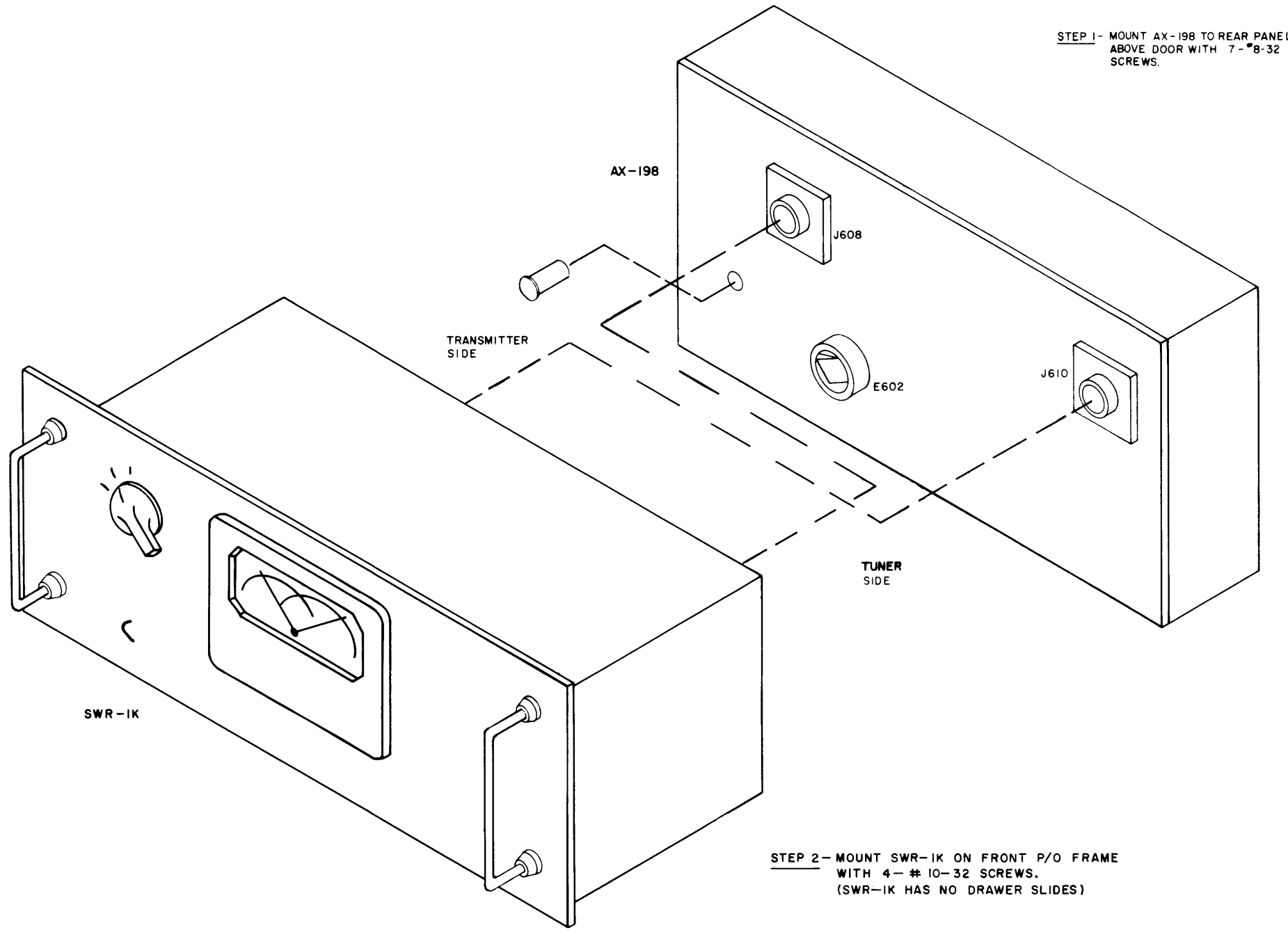
1-4. References

See Part II, General Description of Sideband Generator Model SBG-1,2 Sections 1 and 2.

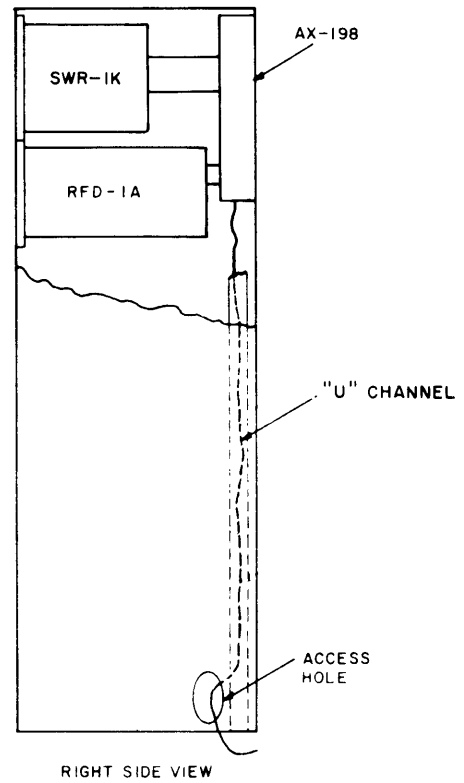


RAK-9C RACK

STEP 1- MOUNT AX-198 TO REAR PANEL ABOVE DOOR WITH 7-#8-32 SCREWS.

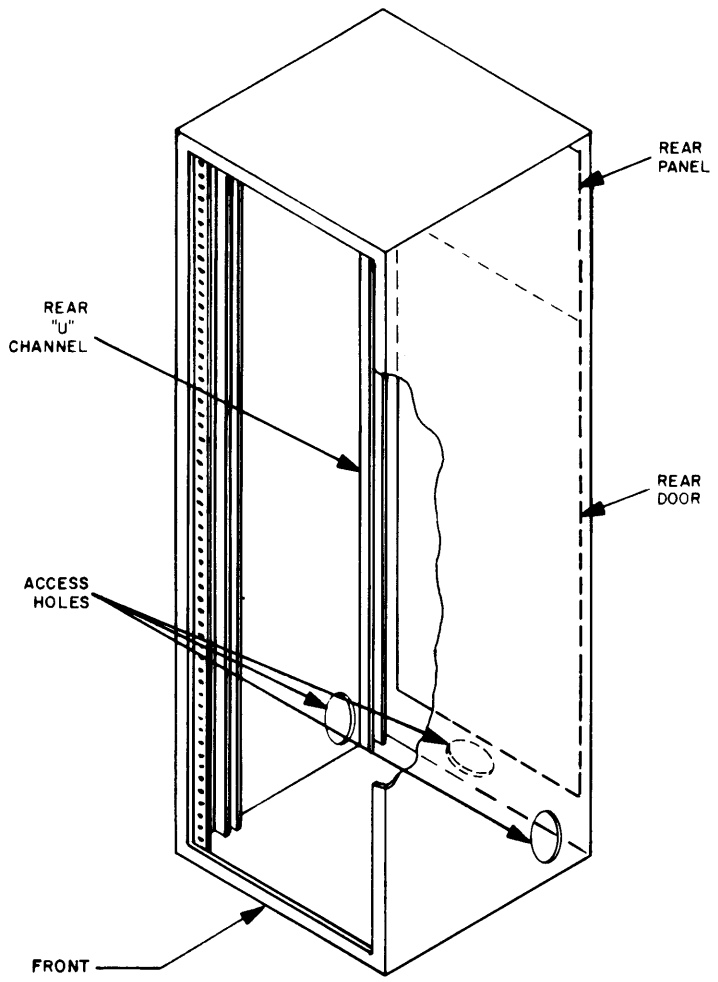


STEP 2- MOUNT SWR-1K ON FRONT P/O FRAME WITH 4- # 10-32 SCREWS. (SWR-1K HAS NO DRAWER SLIDES)

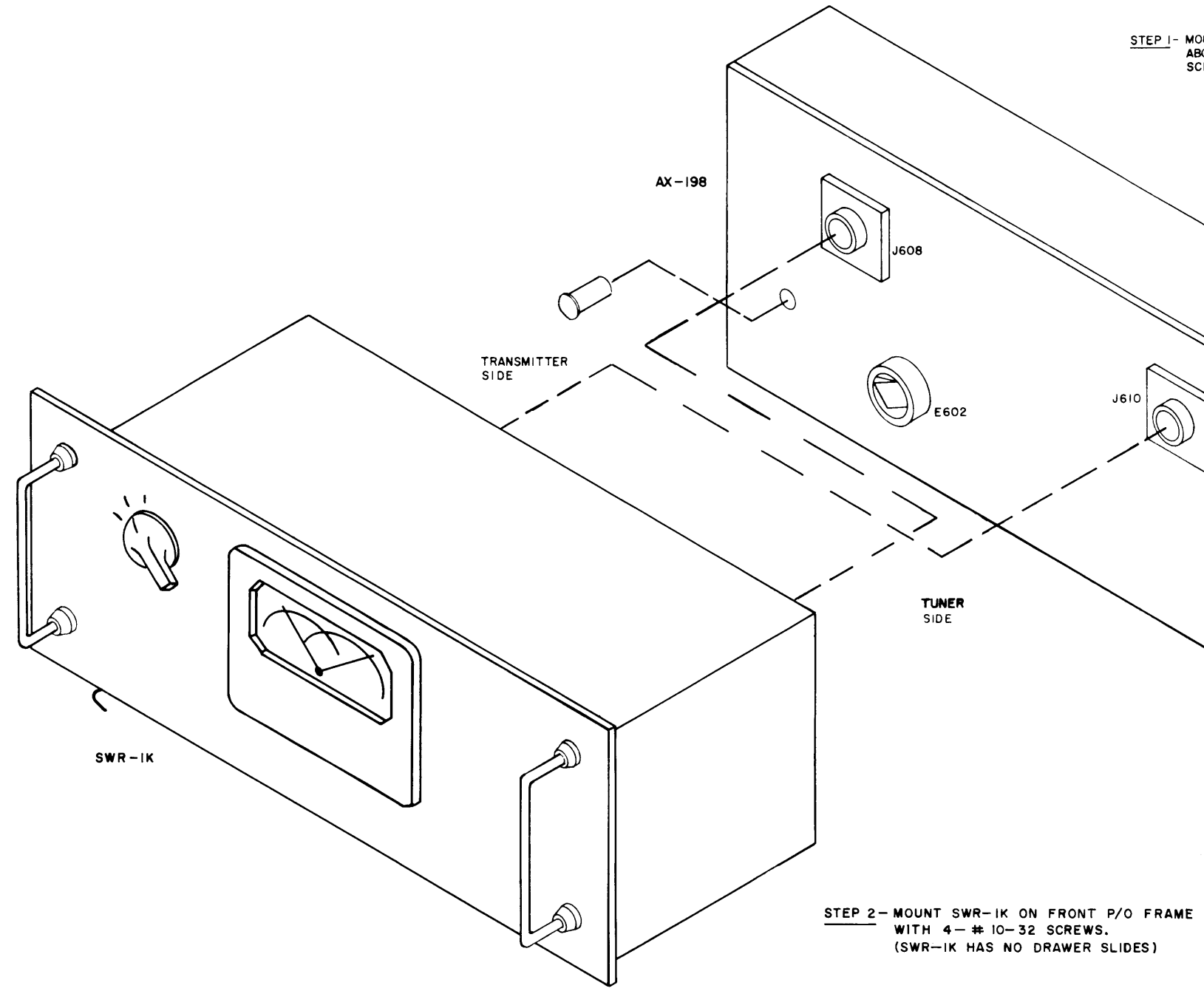


RIGHT SIDE VIEW
OF RAK-9 RACK

Figure 1-3. Isometric Diagram Illustrating Installation of AX-198 Relay Assembly, SWR-1K, and RFD-1A in RAK-17(A)



STANDARD RAK- 9C RACK



STEP 1- MO
AB
SC

STEP 2- MOUNT SWR-1K ON FRONT P/O FRAME WITH 4- # 10-32 SCREWS. (SWR-1K HAS NO DRAWER SLIDES)

Figure 1-3.

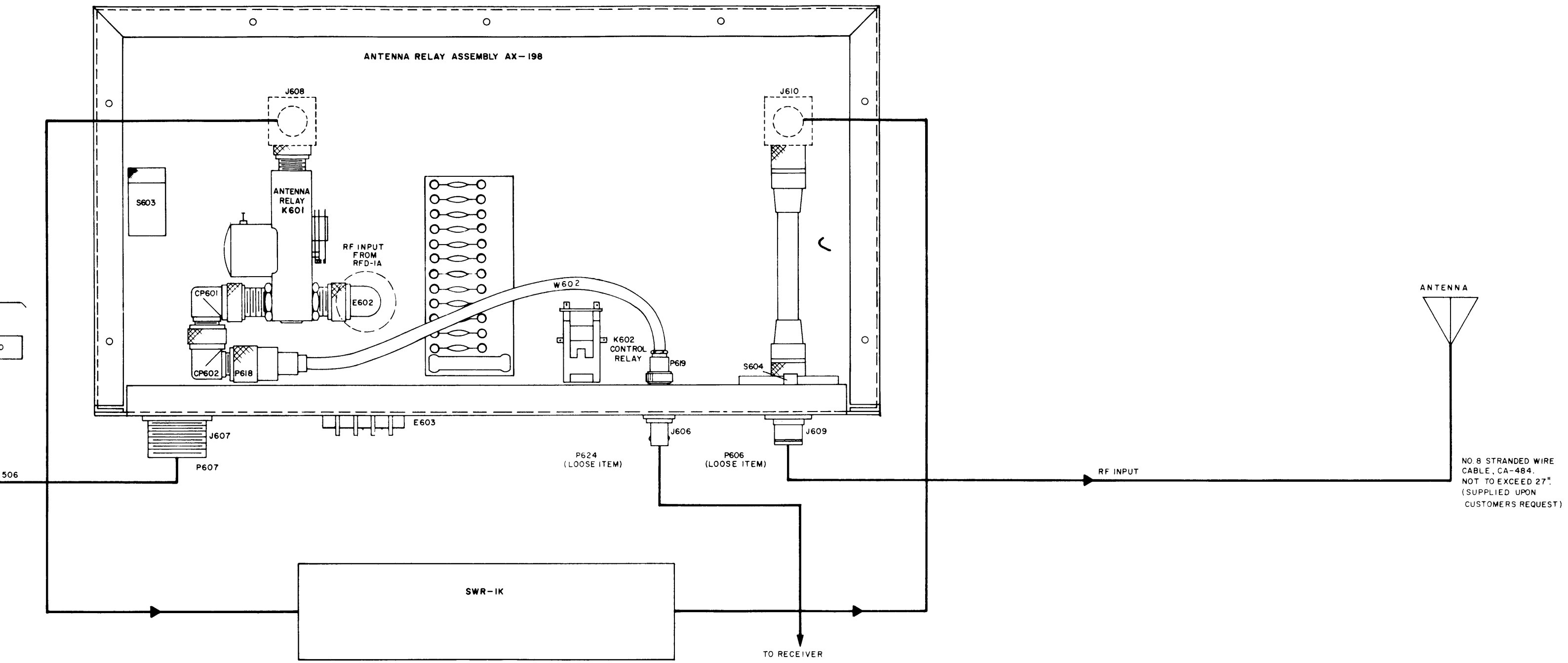
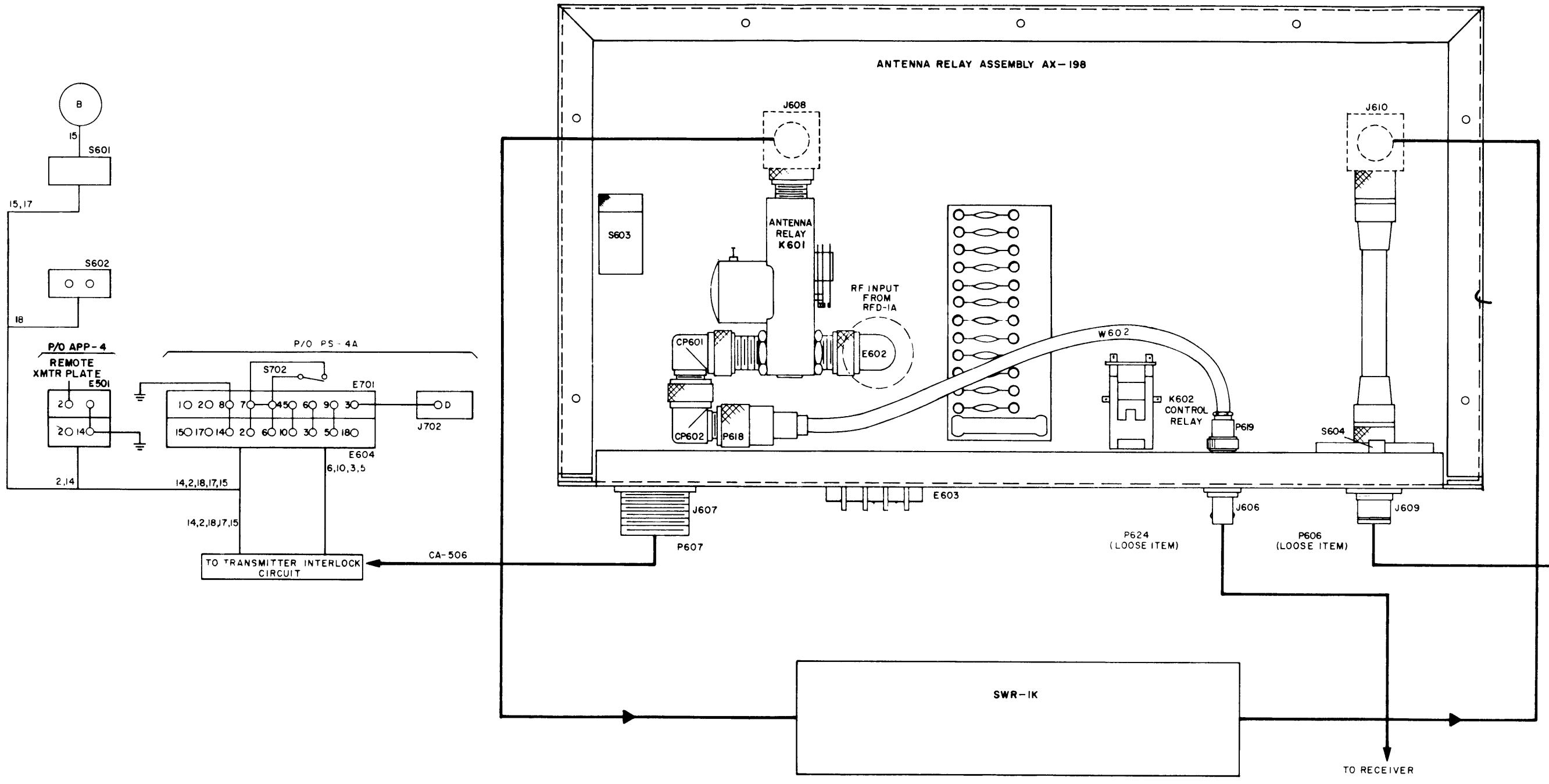


Figure 1-4. Partial Wiring Diagram Showing Interconnections of AX-198 Relay Assembly and Closely Associated Units


B
15
S601
15,17
S602
18
P/O APP-4
REMOTE XMTR PLATE
E501
2
2
14
2,14
P/O PS-4A
S702
E701
1 2 8 7 4 5 6 9 3
15 17 14 2 6 10 3 5 18
D
J702
E604
6,10,3,5
14,2,18,17,15
14,2,18,17,15
TO TRANSMITTER INTERLOCK CIRCUIT
CA-506
ANTENNA RELAY ASSEMBLY AX-198
J608
J610
S603
ANTENNA RELAY K601
RF INPUT FROM RFD-1A
CP601
E602
CP602
P618
W602
K602 CONTROL RELAY
P619
S604
E603
J607
P607
J606
J609
P624 (LOOSE ITEM)
P606 (LOOSE ITEM)
SWR-1K
TO RECEIVER

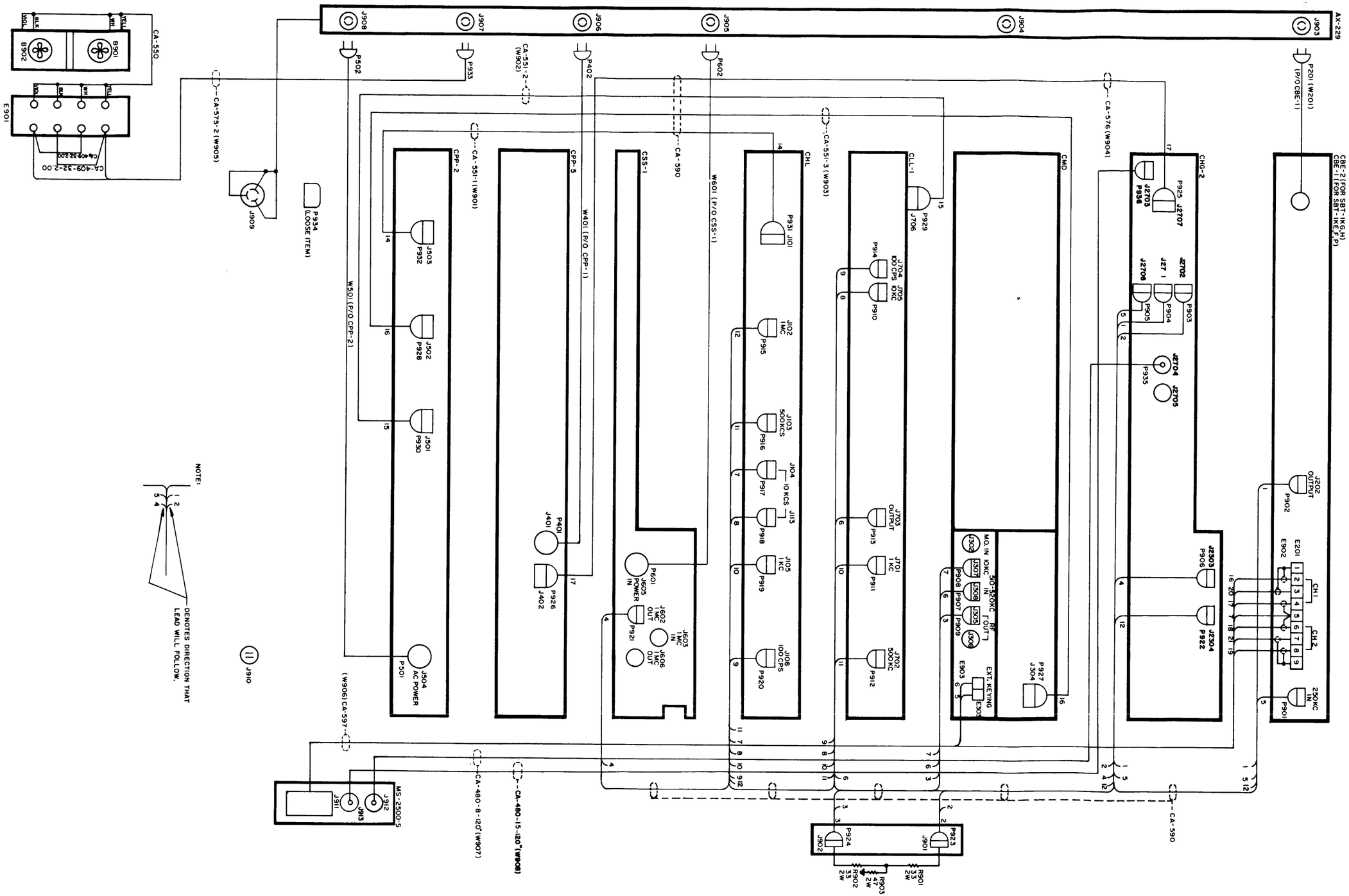


Figure 1-5. Wiring Diagram of SBT-1K(E), Sheet 1 of 2

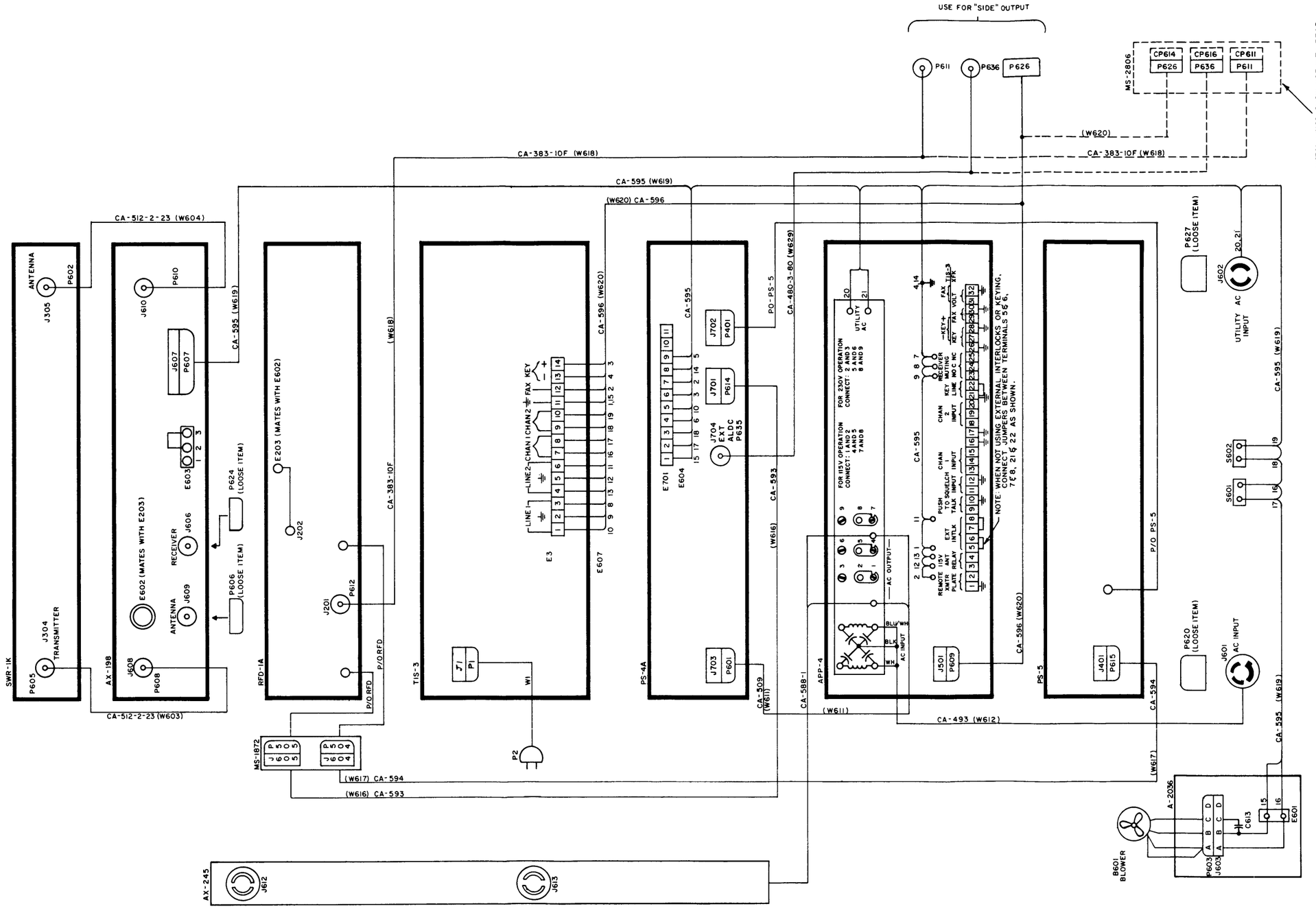


Figure 1-5. Wiring Diagram of SBT-1K(E), Sheet 2 of 2

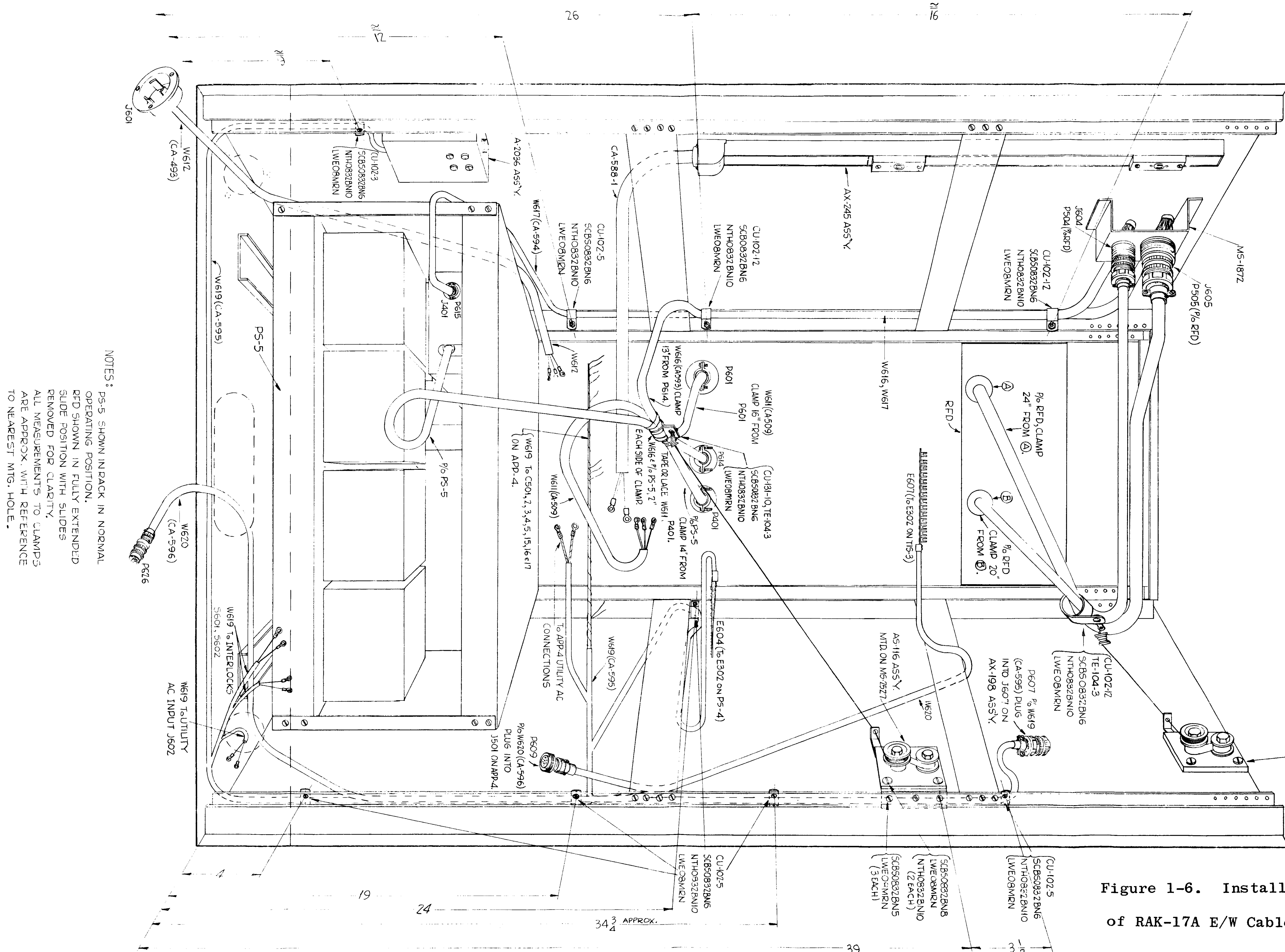
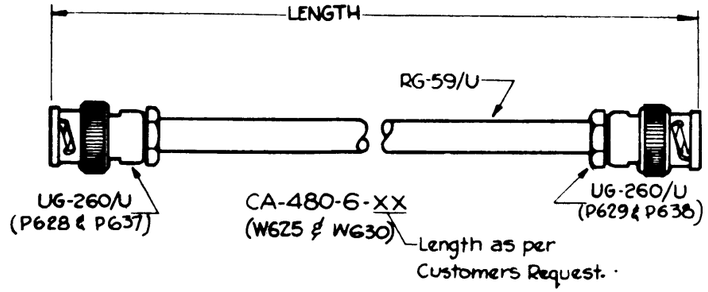
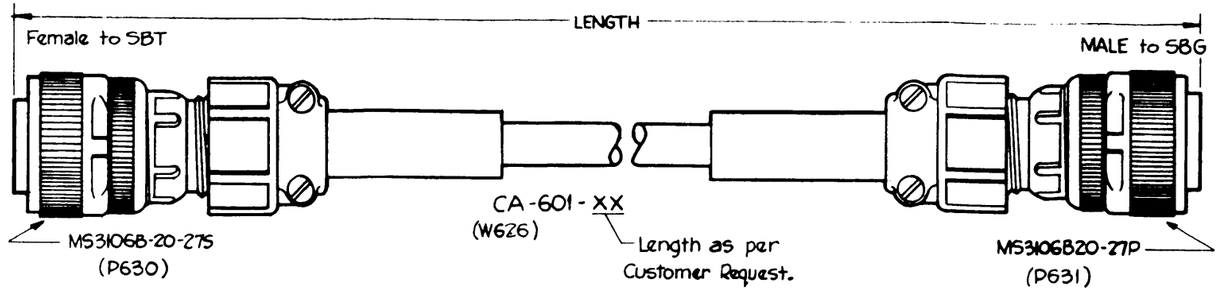


Figure 1-6. Installation Diagram of RAK-17A E/W Cables and Slides

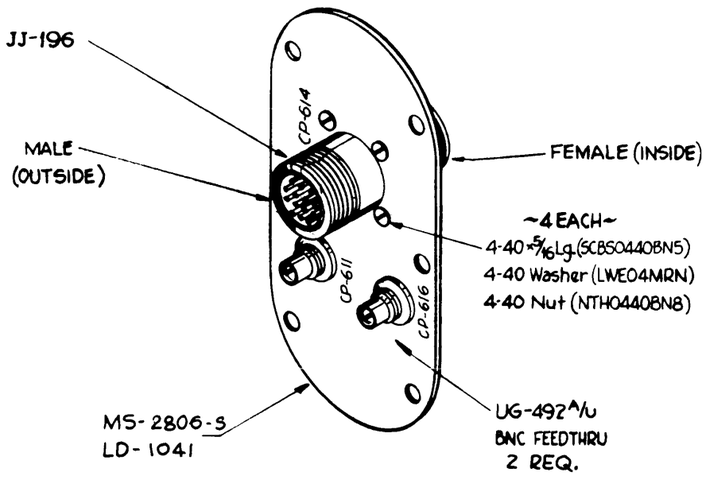
INTERCONNECT CABLE
(2 PER)



INTERCONNECT CABLE
(1 PER)



INTERCONNECT PLATE ASS'Y.
(1 PER)



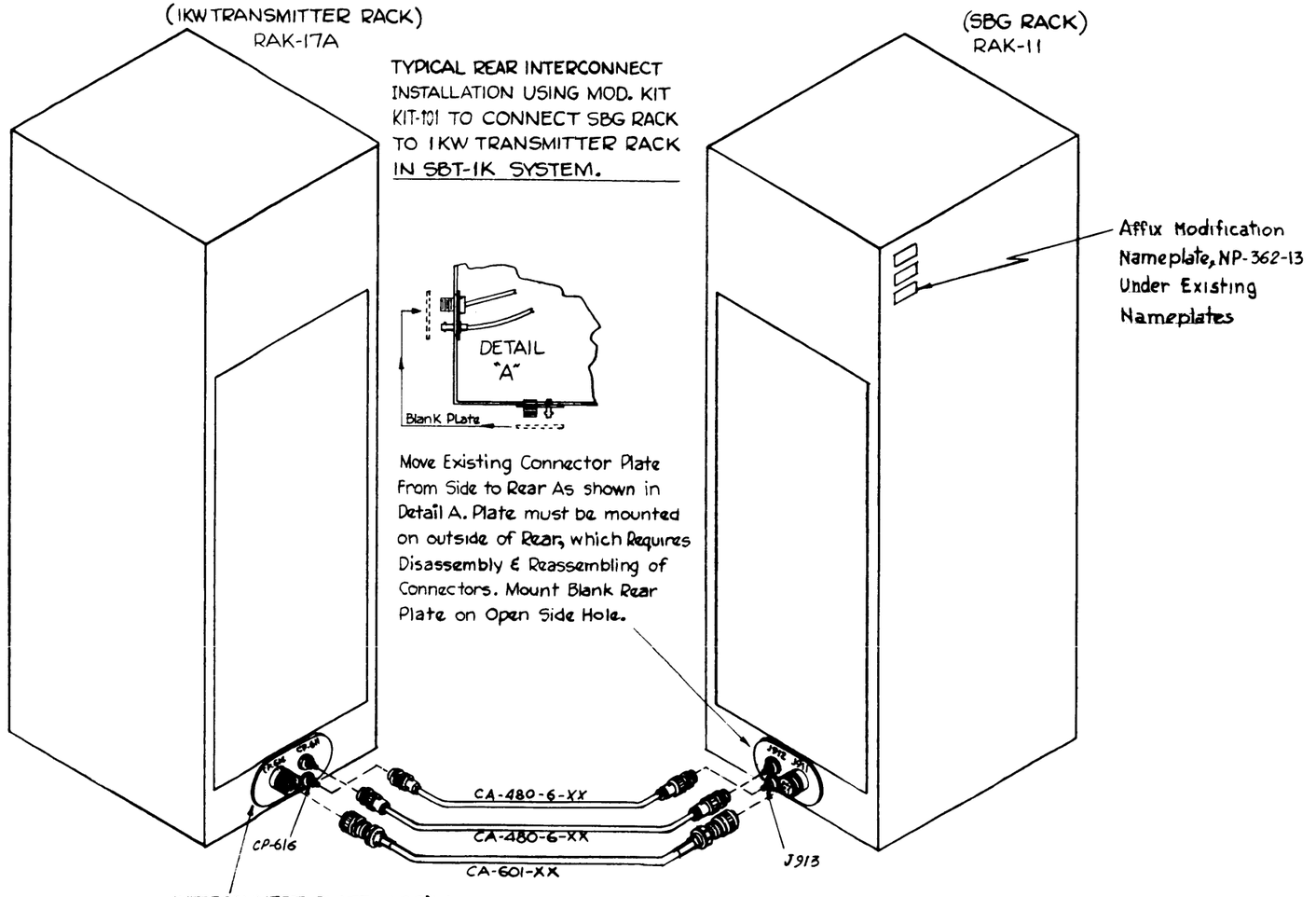


Figure 1-7. Installation Diagram Showing Interconnection of RAK-11 and RAK-17A by means of KIT-132

SECTION 2 - OPERATING INSTRUCTIONS

2-1. General

There are numerous equally good procedures to "turn on" the SBT-1K(E) and each individual operator will undoubtedly have his own preferred method. In section 3 of each detailed manual (SBG-1,2; PAL-1K(A); SWR-1K) there is a complete turn-on procedure on an individual unit basis. Accordingly the turn-on procedure given below is an abridged procedure, simulating a system check-off list.

2-2. Recommended Turn-On Chart

GENERAL PURPOSE TRANSMITTER MODEL SBT-1K(E), FRONT PANEL CONTROLS, OPERATING CHART

STEP	CONTROLS	OPERATIONAL DETAILS
1	See Figure I-3-2 in Part III, General Description of Sideband Generator Model SBG-1,2	The SBG-1,2 may be turned on as stated by the 36 steps contained in Table I-3-1 in Part II, General Description of Sideband Generator Model SBG-1,2.
2	CHG, OUTPUT	Reduce CHG's output temporarily; then advance as necessary during the tuning/loading of PAL-1KA. See following step 3.
3	See Figure 3-1 in Part III, Linear Power Amplifier	Before turning on the PAL-1K(A), check that its output is properly terminated, that SWR-1K's OFF-X10-X1 switch is in the OFF position, and that CHG's output is about midrange.
4 (a)	See Figure 3-1 in Part III, Linear Power Amplifier	Set DRIVER BAND and PA BAND to desired PAL-1KA's output frequency.
(b)	"	The PAL-1KA should be turned on under the following initial conditions: Output of all PS-4A voltages normal. Check that MAIN POWER circuit breaker is in the ON position; that MAIN POWER indicator is lit; that TRANSMITTER VOLTAGES switch is in STANDBY and its indicator is lit; that FINAL VOLTAGES switch is OFF and its indicator is NOT lit. PA FIL PRI meter should read 115 volts. Under these conditions the PAL-1KA may be turned on by setting TRANSMITTER VOLTAGE switch to ON and its indicator should now light

STEP	CONTROLS	OPERATIONAL DETAILS
(c)	See Figure 3-1 in Part III, Linear Power Amplifier	Turn the MULTIMETER switch to the 1ST AMPL position. Adjust CHG's output until a usable reading is obtained on MULTIMETER. Rotate 1ST AMPL TUNING to maximize reading on MULTIMETER.
(d)	"	Turn the MULTIMETER switch to the PA Eg position. Adjust CHG's output untial a usable reading is obtained on MULTIMETER. Rotate PA GRID TUNING to maximize reading on MULTIMETER. CAUTION Reduce CHG's output if PA OVERLOAD kicks off.
(e)	"	Turn CHG's OUTPUT fully CCW (temporarily).
(f)	"	Turn PA TUNING switch for desired output frequency (see tuning chart).
(g)	"	Turn PA LOADING switch for, desired output frequency (see tuning chart).
(h)	"	Turn PA LOADING knob for desired output frequency (see tuning chart).
(i)	"	Turn FINAL VOLTAGES switch to ON; indicator should light.
(j)	"	Increase CHG's output until PA PLATE CURRENT meter indicates 300 ma.
(k)	"	Increase CHG's output sufficiently to carry out following PA tuning and loading operations. Turn on SWR's control OFF-X10-X1 to X10 so that SWR-1K can monitor PAL-1KA's output to antenna.

STEP	CONTROLS	OPERATIONAL DETAILS
(l)	See Figure 3-1 in Part III, Linear Power Amplifier	Adjust PA TUNING switch observing the PA PLATE CURRENT meter for a dip.
(m)	"	Increase PA LOADING switch until the plate current rises.
(n)	"	Readjust CHG's output until PLATE CURRENT meter indicates 300 ma.
(o)	"	Adjust PA TUNING switch observing the PA PLATE CURRENT meter for a dip.
(p)	"	Repeat PA TUNING and PA LOADING adjustments until the desired power output (1000 watts on SWR-1K) is reached with minimum output on CHG as indicated on RFD-1A's MULTIMETER with switch in PA Eg. Observe CHG's RF output. The screen current on RFD-1A's MULTIMETER with switch in PA Isg is (with a resistance load) usually less than 15 ma. At no time should the screen current reading exceed 50 ma. If screen current is too high, increase load and readjust PA TUNING for a dip. CAUTION Equal magnitudes of reflected and forward watts indicates trouble. Antenna termination should be checked. Proper PAL-1KA's tuning and loading should show: forward watts, approximately 1000 reflected watts, approximately 50* dip indication on tuning meter screen grid current, less than 50 ma plate current, approximately 650 ma *Antenna System should be such as to minimize reflected watts to a value such that the VSWR is 1.5 or less.

Section 3 - OPERATING THEORY OF AX-198 ASSEMBLY

The primary functions of the AX-198 are to provide antenna switching for (1) transmitter enabling and receiver disabling and (2) vice-versa; in a sequential operational order; to insure protection of equipment units against the hazard of excessive voltages, transient or steady state. As shown in figure 1-3, the AX-198 is mounted in the rear of RAK-17A, directly behind the RFD-1A and SWR-1K. Interconnection of the AX-198 within the transmitter system is shown in figures 1-4 and 1-5.

3-1. Circuit Operation in Switching from Receiver Operation to Transmitter Operation (figure 3-1).

Figure 3-1 is an operational schematic to illustrate AX-198's performance as above stated. The purpose of this figure is to present a concrete operational picture of the inter-relation of PS-4A, PS-5, RFD-1A and APP-4 control functions, divorced from the many other functions of these equipment units. In other words, other drawings in this manual show complete schematics of these units; however, figure 3-1 shows only the pertinent circuitry to explain the details in paragraphs 3-1, 3-2 and 3-3, below.

Assumptions, as given below, are necessary in order that a logical circuit operation may be presented.

a. The operator is familar with the operation of the SBT-1K system.

b. The SBT-1K system is functioning correctly; the transmitter has been operating at full power and has just been returned to a "non-transmitting" or "receiver" condition by setting S702 on the PS-4A from ON to the STANDBY position. Figure 3-1 illustrates the control circuits involved for returning the transmitter to the

"ON" position. All relays and switches shown on this drawing are in the proper position for the "receiver" condition.

c. PS-4A must be functioning and yielding nominal output voltages:

(i) +500VDC at terminal 9, E701.

(ii) -200VDC at the coil of K703.

(iii) PA bias voltage at pin C (J701) of PS-4A applied to the PA in the RFD-1A through P614, J605 and P505.

(iv) No voltage between terminals 5 and 6 (E701) on the PS-4A and thus none applied to the coil of K602 in the AX-198 through E604, P607 on the AX-198. K602 is therefore de-energized.

(v) K601 in the AX-198 is also de-energized.

NOTE: +500VDC is applied to the coil through E701, E604, P607, J607, the rack main cable but the relay will not be energized because its coil voltage circuit is NOT completed to ground through the normally closed contact of K602; pin E of J607/P607; the rack main cable; E604; and E701 on the PS-4A.

(vi) The receiver (if used) is connected to the antenna through a normally closed contact of K601; J608; through the SWR-1K;V610, W601; J609 and P616.

(vii) K703 in the PS-4A is de-energized. The -200v applied will not cause K703 to energize because the coil voltage circuit is NOT completed through the interlock circuit to ground. The interlock circuit is open at K601.

(viii) As a result of K703 being de-energized, there will be no B+ voltages applied to the RFD-1A.

Let us now change the system from the "receiver" to the "transmitter" condition:

a. Set S702 on the PS-4A to the "ON" position.

b. As an second alternate, jumper terminals 1 and 2 on the APP-4.

By performing either a or b, terminal 4 of E701 on the PS-4A is grounded with the following results:

a. K601 in the AX-198 will energize as its coil circuit will be completed to ground through K602, J607, E604, E701 (terminal 4) on the PS-4A.

b. As a result of item a, the RF output of the RFD-1A is connected to the antenna through K601, J608, SWR-1K, J610, W610, J609 and P606.

c. As a result of item a, the interlock circuit is completed to ground through K601, a normally closed contact of K602 to pin G of J607, the rack main cable, terminal 8 of E701 on the PS-4A. K703 in the PS-4A will now energize since the interlock circuit is closed.

d. Primary voltage will now be applied through K703 to the HV transformer in the PS-5 (via J/M of P401) and plate voltage will be applied to RFD-1A's PA through J401, P615 J604, and P504. At the same time, B+ voltages will be applied to the RFD-1A through pins d, e and B on P505, J605, P614, and J701 on the PS-4A.

e. Now, 115VAC appears across terminals 5/6 on E701 in the PS-4A and hence across the coil of K602 through E604, the rack main cable, P607 and J607 on the AX-198. K602 is now energized and transfers its controls to K601.

f. As a result of item e, transferring the control of the interlock circuit, and also of K703, finalizes action in previous items a through d. Completion of the coil voltage circuit to K601 is transferred from pin 4 E701 directly to ground through pin G of J607.

NOTE: Sequential switching was used to insure that the antenna being connected to the RFD-1A RF output before high voltage was applied. This sequency will be more evident when returning to the "receiver" condition. The transmitter is now switched to the "transmit" condition and the receiver is now disabled (pins 23, 24, and/or 25 on the APP-4).

3-2. Circuit Operation in Switching from Transmitter Operation to Receiver Operation (figure 3-1).

NOTE: Opening the interlock circuit will cause the systems to return to the "receiver" condition. This is done normally by setting S702 on the PS-4A to STANDBY. Alternatively, setting S104 on the SBE-3 to OFF; or opening terminals 1 and 2 or 9 and 10 on the APP-4. See preceding paragraph 3-1, for method of turning transmitter ON. Terminal 4 of E701 on PS-4A is now no longer at ground and the following sequences will occur.

a. Sequentially, K703 in the PS-4A is de-energized because its coil voltage circuit is no longer completed to ground.

b. As a result of item a (K703 being de-energized) all B+ voltage is removed from the RFD-1A and the coil voltage is removed from K602 in the AX-198.

> NOTE: K601 is still energized because its coil voltage circuit is completed directly to ground through pin G of J607. The B+ voltages have therefore been removed from the RFD-1A but the antenna connector E203 is still connected to the antenna.

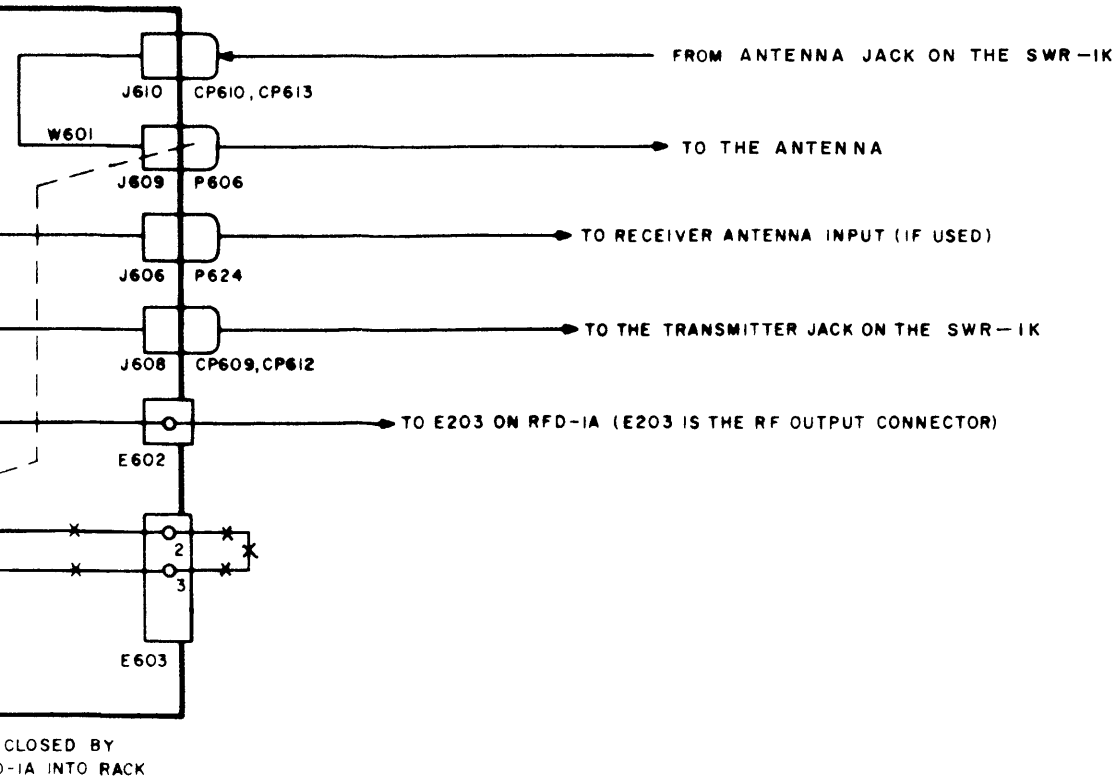
c. Sequentially, K602 is de-energized which returns control to K601 (terminal 4, E701 on PS-4A).

d. Since terminal 4 of E701 is no longer grounded, K601 is de-energized and its coil voltage circuit is no longer complete.

e. The system is now returned to the conditions described above as Receiver.

3-3. SBT-1K(S) Interlock Circuits

See figure 3-1.



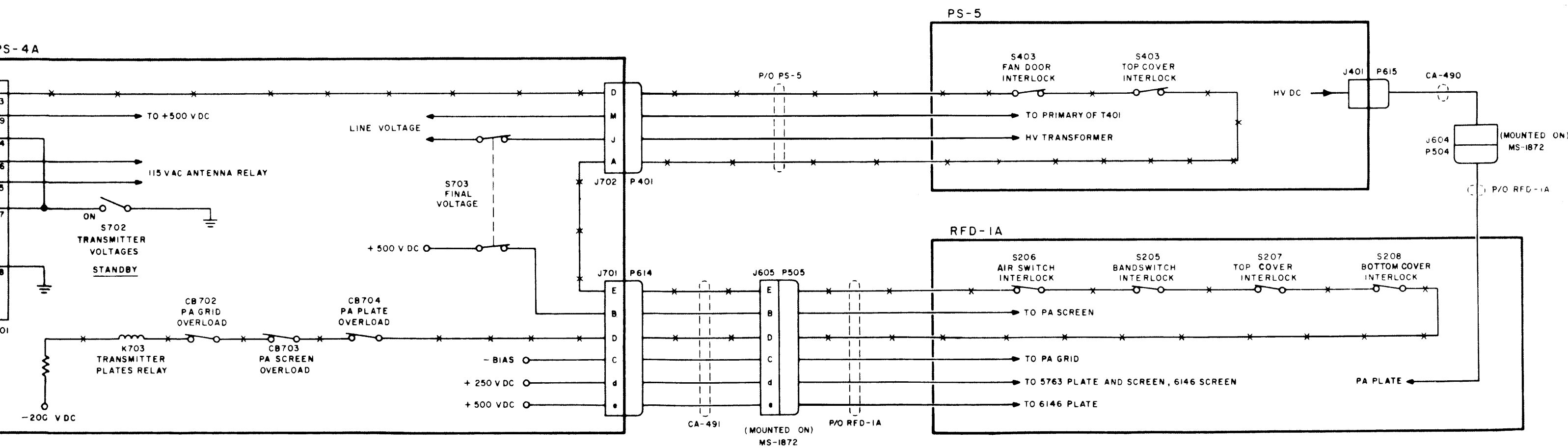
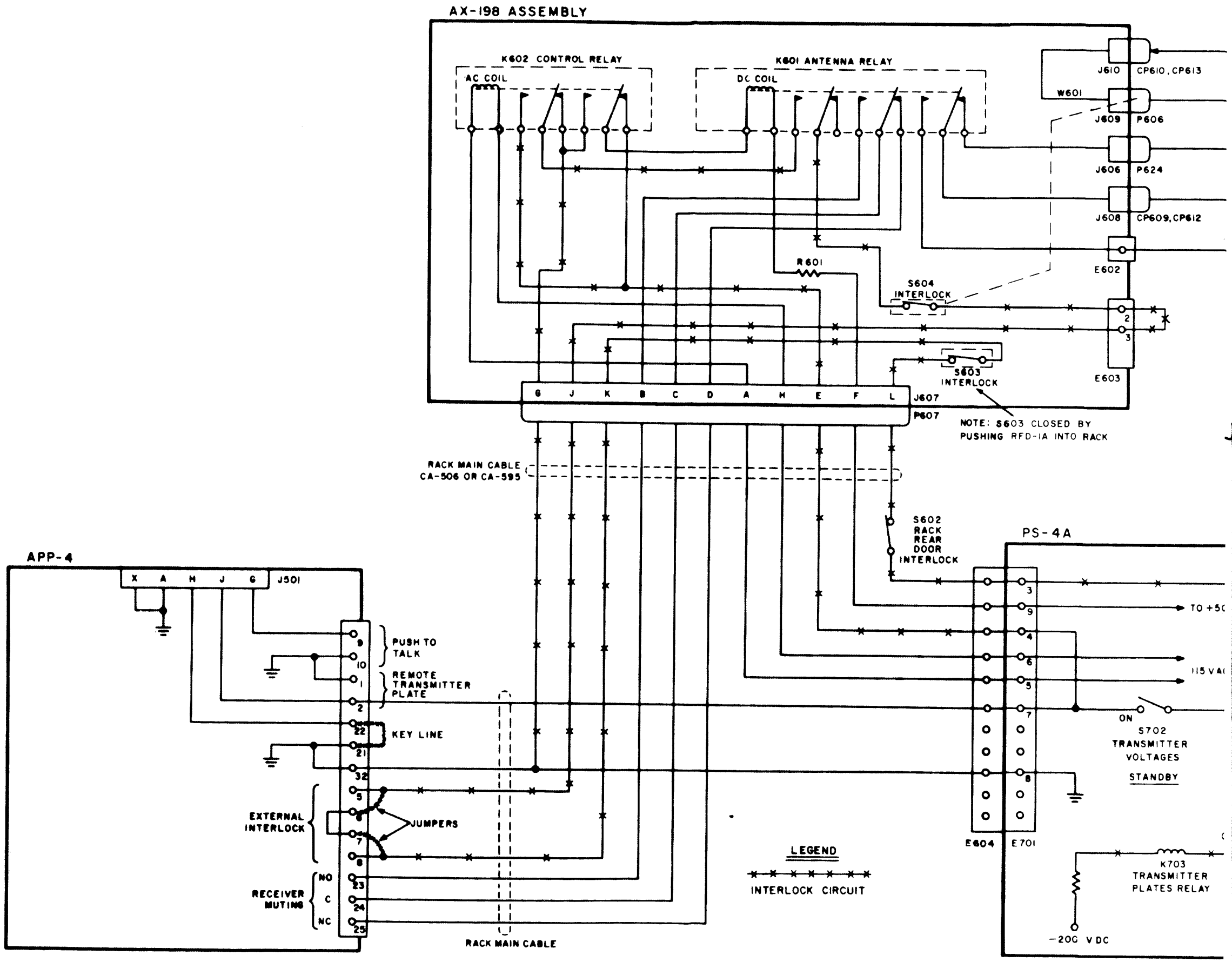


Figure 3-1. Operational Schematic Illustrating AX-198 Assembly Functions as used in SBT-1K(E) Transmitters


AX-198 ASSEMBLY
K602 CONTROL RELAY
AC COIL
K601 ANTENNA RELAY
DC COIL
J610
CP610, CP613
W601
J609
P606
J606
P624
J608
CP609, CP612
E602
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-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 +5(
115 VA(
ON
S702
TRANSMITTER
VOLTAGES
STANDBY
E604
E701
K703
TRANSMITTER
PLATES RELAY
-200 V DC
APP-4
X A H J G J501
9
10
1
2
22
21
32
5
6
7
8
23
24
25
PUSH TO
TALK
REMOTE
TRANSMITTER
PLATE
KEY LINE
EXTERNAL
INTERLOCK
JUMPERS
RECEIVER
MUTING
NO
C
NC
RACK MAIN CABLE
LEGEND
INTERLOCK CIRCUIT

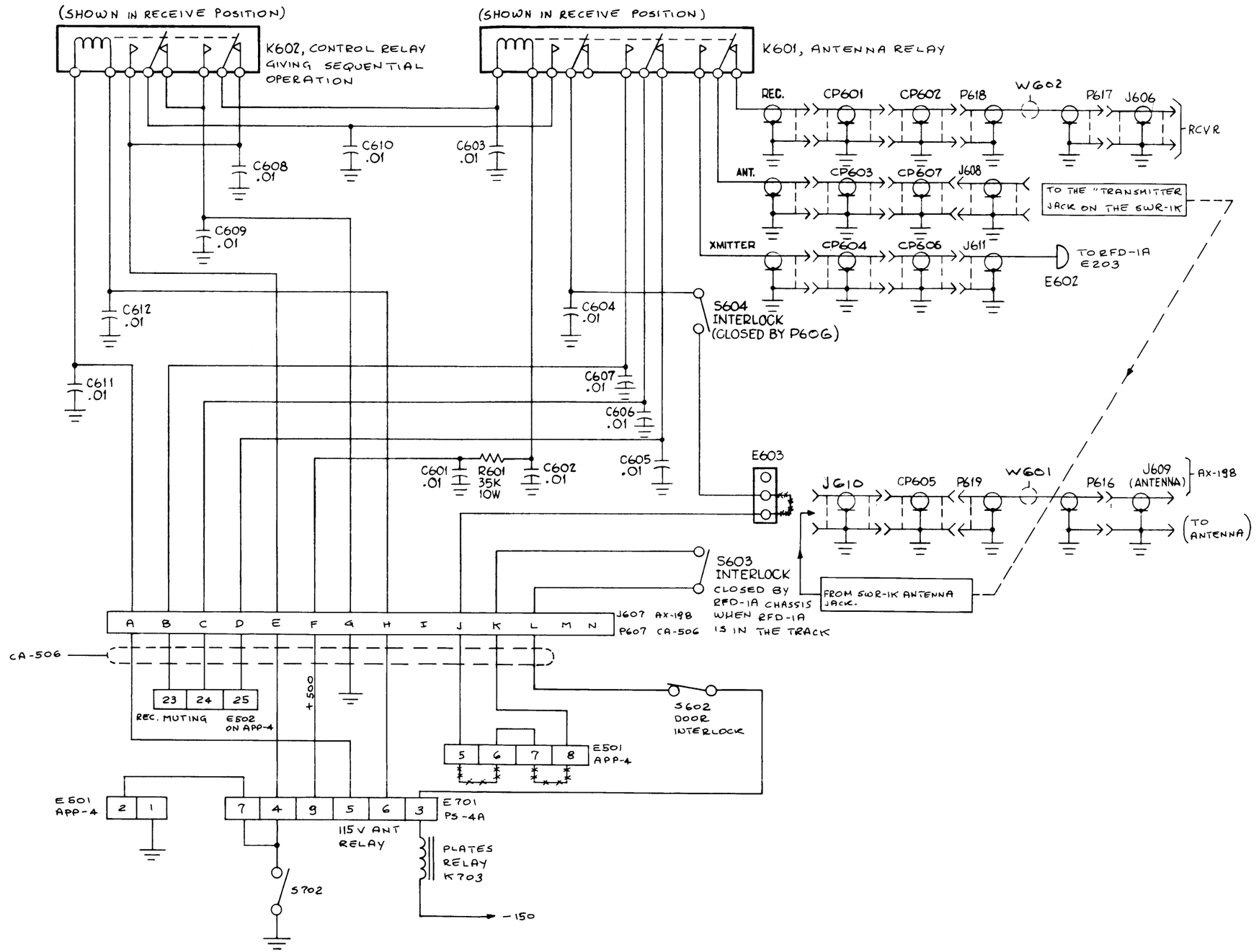
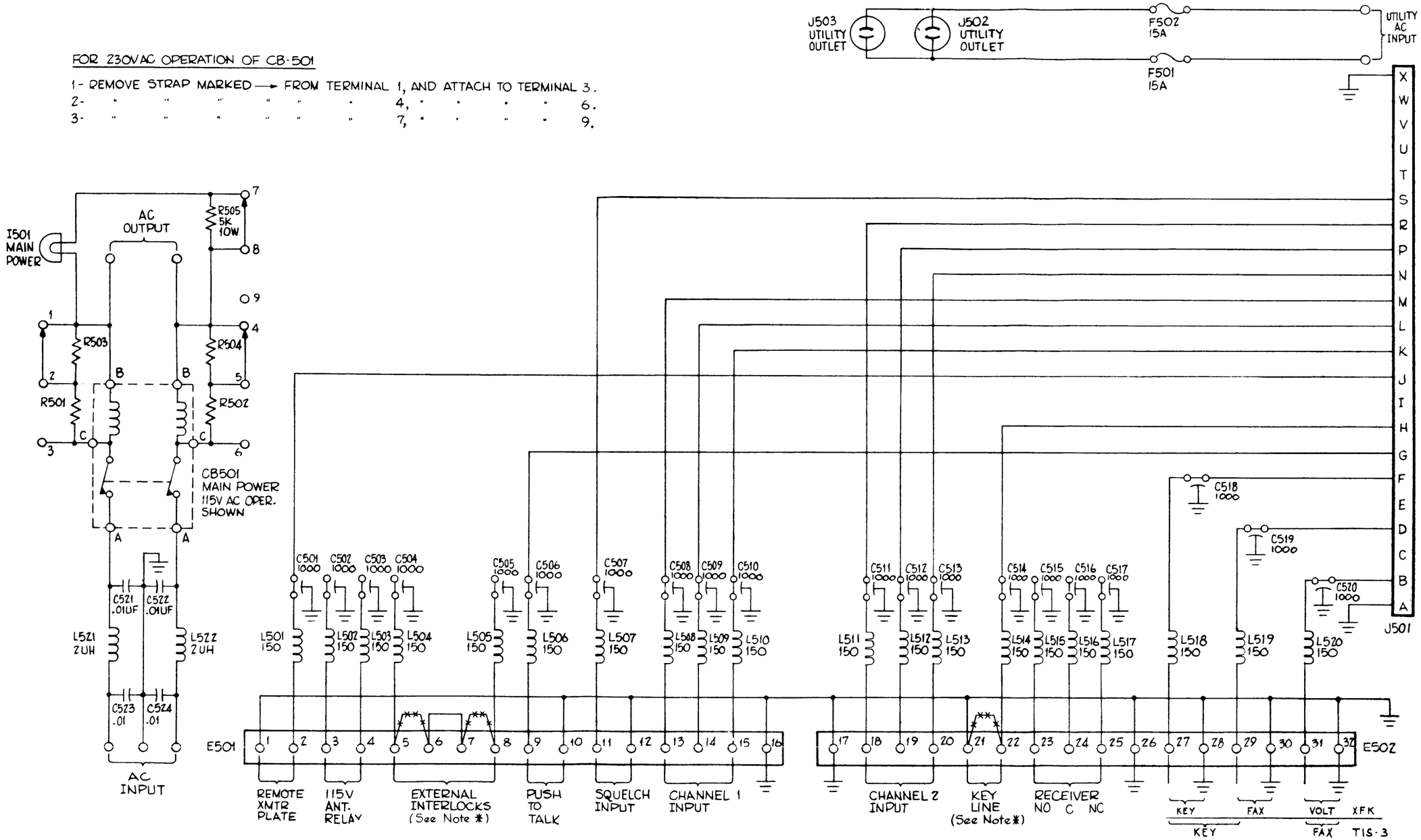


Figure 3-2. Schematic Diagram of AX-198 Assembly

FOR 230VAC OPERATION OF CB-501

1- REMOVE STRAP MARKED —► FROM TERMINAL 1, AND ATTACH TO TERMINAL 3.
2- " " " " " " 4, " " " " " 6.
3- " " " " " " 7, " " " " " 9.



UNLESS OTHERWISE SPECIFIED:

ALL CAPACITORS ARE IN MICRO-MICROFARADS.
ALL COILS ARE IN MILLIHENRIES.

Figure 3-3. Schematic Diagram, APP-4