UNCLASSIFIED

TECHNICAL MANUAL

for

HF COMMUNICATIONS FACILITY (SY-1031)

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

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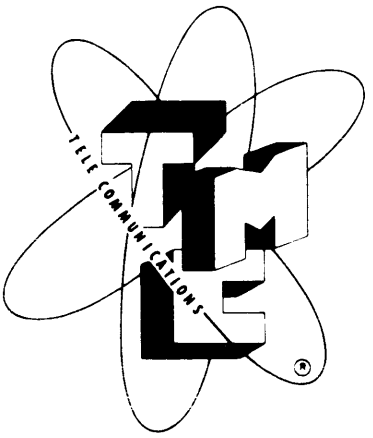

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

IN-236

Issue Date: 1 February 1961

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WARNING

Failure to follow safety precautions may result in serious injury, extreme shock, or death.

Should it become necessary for any reason to make repairs of any kind on the transmitter turn off the main power breaker and proceed as follows:

a. Using a highly insulated shorting bar, and with extreme caution, short the plates of V102 of the RTF to ground;

or

b. Short one of the high voltage condensers, C610, C611, or C612, to ground.

The above permits immediate discharge of the high voltage and ensures safe handling of the units.

When making measurements of high voltage circuits, do not handle instruments or their leads while power is on. Connect leads to component to be measured, with the power turned off; then turn the power on and take reading. To remove leads, turn power off again.

FIRST AID IN CASE OF ELECTRIC SHOCK

a. Protect yourself with dry insulating material.

b. Break the circuit by opening the power switch or by pulling the victim free of the live conductor. Do not touch the victim with your bare hands until the circuit is broken.

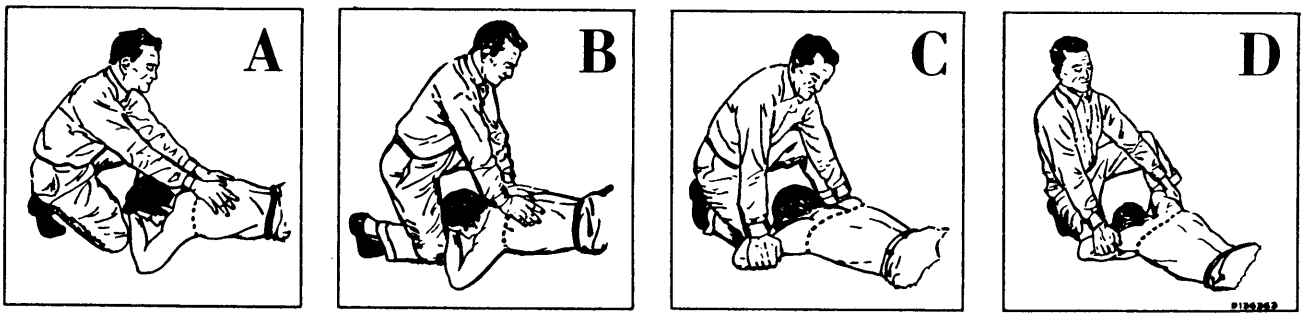
c. Start artificial respiration immediately; seconds count. Do not wait to look for help, to loosen clothing, to warm the victim, or to apply stimulants.

i. With elbows straight, rock forward slowly until arms are vertical. See figure (B). Do not apply more than 35 pounds pressure.

j. Rock back slowly to release pressure.

k. Grasp victim's arms just above elbows and continue backward. See figure (C).

l. Lift arms until tension is felt. See figure (D).



d. Lay victim on his stomach, preferably with head downhill.

e. Check mouth for obstructions, remove foreign objects, pull tongue forward.

f. Place victim's forehead on his crossed hands, face down.

g. Kneel at victim's head on either knee. See figure (A).

h. Place hands, fingers spread with thumbs about two inches apart, heels of hands below line connecting armpits. See figure (A).

m. Lower arms to complete the cycle.

n. After 2 seconds, start again with step f.

o. Repeat the cycle 12 to 15 times per minute.

p. While artificial respiration is continued, have someone else loosen the victim's clothing, summon medical aid, and keep the victim warm.

q. Do not give up. Continue without interruption until the victim is breathing without help or is certainly dead. Four hours or more may be required.

r. Remain in position after victim revives. Be ready to resume artificial respiration if necessary.

s. Do not give liquids while victim is unconscious.

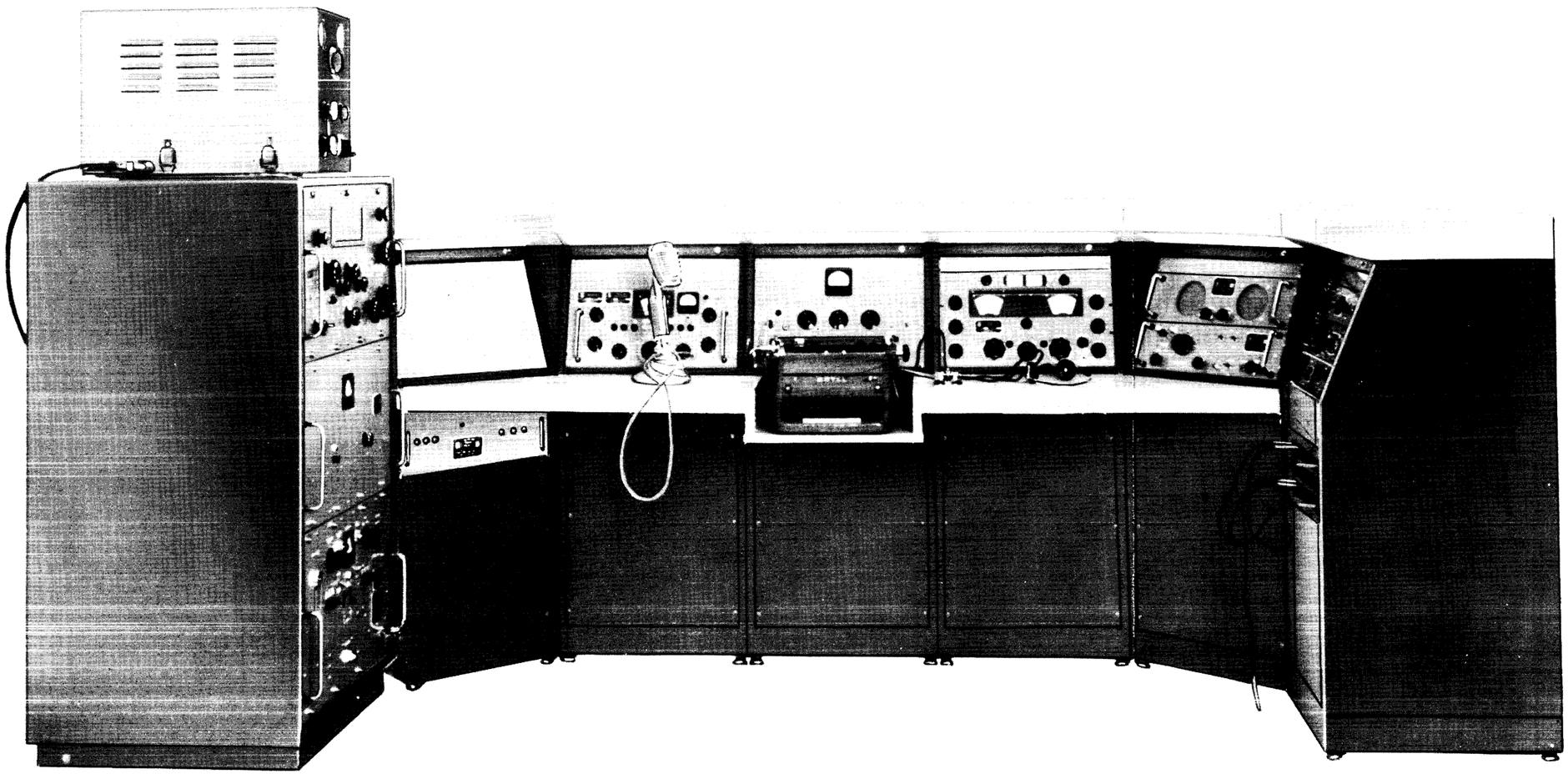


Figure 1-1. Front View,
HF Communications Facility, SY-1031

SECTION 1
GENERAL DESCRIPTION

1-1. EQUIPMENT ILLUSTRATION.

The Technical Materiel Corporation HF Communications Facility Model SY-1031 is shown in figure 1-1. The left-hand unit is TMC Model GPT-750-B2 Radio Transmitter with Antenna Tuning Unit Model TAC-1 mounted on top of Transmitter Cabinet Model CAB-7. The other units are mounted in a TMC six-section console, Model CON-6 FCFA-WT.

The units above the console shelf are from left to right and top to bottom as follows: Frequency Shift Exciter O-5B/FR, Transmitting Mode Selector SBE-2, Remote Control Amplifier RTC-1, Communications Receiver GPR-90RX, Loudspeaker Panel LSP-7 (figure 1-3), Mode Selector Receiving MSR-4, Filter Panel SFP-2, Frequency Shift Converter CFA-1, and Power Supply Assembly PSP-1. Below the shelf in the first console section is the SBE-2 Power Supply Model A1516. In the sixth section, below the shelf, is the Audio and DC Patching Panel Model CPP-4 (figure 1-2). A hybrid coil assembly is located inside the sixth console section and is accessible from the rear.

The overall floor space occupied by the system is about 91 inches by 140 inches. Although the station requires only one operator, sufficient space is available to accommodate two operators. A typewriter well is provided for convenience.

1-2. FUNCTIONAL DESCRIPTION.

The SY-1031 provides efficient point-to-point communication, utilizing several selectable modes of operation. These modes are single sideband with any degree of carrier suppression (SSB), amplitude modulation (AM), continuous wave (CW), and frequency shift (FSK). Independent sideband (ISB), different information on each sideband, is available for transmitting. This multiplicity of modes provides flexibility and assures compatibility with other systems. Simplex transmit/receive operation is achieved with a single antenna. Duplex operation may be used if a second antenna is employed.

Supplied complete with microphone and key, the system requires the following connections for operation:

a. Antenna and ground.

b. Teletype terminal equipment.

c. Telephone terminal equipment.

d. AC power lines.

1-3. TECHNICAL SPECIFICATIONS.

Refer to individual equipment manuals.

1-4. EQUIPMENT LISTS.

a. Equipment supplied; refer to table 1-1.

b. Equipment required but not supplied, O-5B/FR or equivalent. Local teletype machines.

c. Shipping data; refer to table 1-2.

d. Electron tube complement; refer to table 1-3.

e. Fuse and lamp complement; refer to table 1-4.

TABLE 1-1. EQUIPMENT SUPPLIED

ITEM	QUANT	MODEL	DESCRIPTION
1	1	CON 6 FCFA-WT	Console
2	1	TAC-1	Antenna Tuning Unit
3	1	GPT-750-B2	Radio Transmitter
4	1	SBE-2	Transmitting Mode Selector
5	1	RTC-1	Remote Control Amplifier
6	1	GPR-90RX	Communications Receiver
7	1	LSP-7	Loudspeaker Panel
8	1	MSR-4	Mode Selector Receiving
9	1	SFP-2	Filter Panel
10	1	CFA-1	Frequency Shift Converter
11	1	PSP-1	Power Supply Assembly
12	1	CPP-4	Audio and DC Patching Panel

TABLE 1-2. SHIPPING DATA

BOX NO.	CONTENTS	*DIMENSIONS			*WEIGHT
		LENGTH	WIDTH	DEPTH	
1	Cabinet, p/o GPT-750-B2	38-1/2	31	55	600
2	Amplifier-Oscillator, TMC Model RTF, p/o GPT-750-B2	36-1/2	30-1/2	23	225
3	Modulator-Power Supply, TMC Model RTM, p/o GPT-750-B2	36-1/2	30-1/2	23	230
4	Power Supply, TMC Model RTP, p/o GPT-750-B2	36-1/2	30-1/2	23	300
5	Operational Tubes: 2 ea. Type 872A (Removed from RTM) 2 ea. Type 4-250A (Removed from RTF) 2 ea. Type 872A (Removed from RTP) 1 ea. Type Transmit/Receiver Relay TMC P/N TRL-3 1 ea. Loudspeaker Panel, TMC P/N LSP-7 1 ea. Filter Panel, TMC P/N SFP-2 1 ea. Microphone, TMC P/N MK-103 1 ea. Manual Telegraph Key	32	23	27	160
6	TAC-1	33	18	21-1/2	115
7	CPP-4	26-1/2	23	20-1/2	130
8	SBE-2	24-1/2	16	27	98
9	RTC-1	43	25-1/2	17-1/2	200
10	MSR-4	24	23	10	80
11	CFA-1	24	20-1/2	18-1/2	115
12	p/o Console, TMC Model CON-6 one Section	24	24	48	171
13	p/o Console, TMC Model CON-6 one Section	24	24	48	171
14	p/o Console, TMC Model CON-6 one Section	24	24	48	171
15	p/o Console, TMC Model CON-6 one Section	24	24	48	171
16	p/o Console, TMC Model CON-6 one Section	24	24	48	171
17	p/o Console, TMC Model CON-6 one Section	24	24	48	171
18	p/o Console, TMC Model CON-6 one Section	24	24	48	171
19	Top Shelves and all necessary mounting hardware				
20	Additional tubes, fuses, and lamps	28-1/2	24	20-1/2	125

* Unless otherwise stated, dimensions are in inches, weight in pounds.

TABLE 1–3. ELECTRON TUBE COMPLEMENT

	GPT-75032	SBE-2	RTC	PSP-1	CFA-1	MSR-4	GPR-90 RX	TOTAL	RECOMMENDED ONE YEAR
4-250A	2							2	2
IN303	1							1	1
RR-109	2							2	4
0A2	6	2			1	1	1	11	5
6AH6	1	2						3	1
6C4	1							1	1
12AU7	3	2	1					6	2
6BE6	1					2	1	4	1
6BF5	1							1	1
6CL6	1	2						3	1
6146	1	1						2	2
12AT7	3	4	2			1		10	2
6AB4	1	3					1	5	1
872A	2							2	4
5R4GY	3							3	6
6X4	1				1			2	1
0B2	2				3			5	2
IN1084	2							2	1
0A3	1							1	1
6L6	2							2	1
810	2							2	1
6AL5		1			4	1	1	7	2
6U8		2						2	1
5R4		1						1	2
CK711		3						3	2
12AX7			1				1	2	1
5Y3G			1			1		2	4
5Y3GT				1	1			2	4
6Y6G				1	1			2	4
6AU6					4		1	5	2
6J6					3	1		4	1
12AU7A					3	2		5	2
2BP1A					1			1	1
6AG5						1	3	4	1
6AQ5A						1		1	1
6BA6						1	4	5	2
6U8							1	1	2
6CB6							2	2	1
6V6							1	1	1

TABLE 1–4. FUSE AND LAMP COMPLEMENT

	GPT-75082	SBE-2	RTC	PSP-1	CFA-1	MSR-4	GPR-90 RX	TOTAL	RECOMMENDED ONE YEAR
BI-100-51	3	2						5	25
BI-100-51H	1							1	5
BI-102-3	3							3	15
BI-101-44	1		1	1	1		1	5	25
BI-101-47		1				3		4	20
BI-101-44AF							2	2	10
FU-100-5	1							1	5
FU-102-003	4							4	20
FU-102-1.5	4	2						6	30
FU-102-125	1							1	5
FU-102-.300	2							2	10
FU-100-3			1			1		2	10
FU-100-2					1		1	2	10
FU-100-.125				1				1	5
FU-100-1.5				1				1	5
FU-102-2		2						2	10
FU-102-1		2						2	10
FU-102-3		2						2	10
FU-102-.250		2						2	10

SECTION 2
INSTALLATION

2-1. UNPACKING AND HANDLING.

The SY-1031 has been designed for ease of installation and operation. The units comprising the SY-1031 are packed in individual shipping containers and should be carefully unpacked. Packing material should be examined for loose items before discarding. Make a close visual inspection to determine if there is any physical damage to the equipment due to rough handling during shipment. If damage is found, notify the carrier immediately. If reshipment is anticipated, carefully note the packing arrangement and retain all packing materials.

2-2. SITE SELECTION.

No special or unusual factors are involved in site selection. A level floor facilitates proper alignment of the units. Allow sufficient space for easy and comfortable access to the rear of each unit.

2-3. POWER REQUIREMENTS AND DISTRIBUTION.

The units in this system are wired for 115-volt 50- or 60-cycle operation before shipping by the manufacturer. However, should operation from a 230-volt source be desirable, a simple wiring change in the tapped primary of the power transformer of each unit converts the units for 230 volt AC operation. The system requires a power source providing at least 35 amperes for proper operation.

2-4. INSTALLATION PROCEDURE.

a. Figure 2-1 illustrates the physical layout of the SY-1031.

b. Place the console sections and GPT-750-B2 cabinet in position as shown in figure 2-1. The shelf and loose parts of the console are assembled as shown in figure 2-3. Note that the shelf and power wiring (installed later) serve to hold the console sections together.

c. Figure 2-2 illustrates the power wiring for the console. Select a console unit to which the power connection is to be made. The connection may be made at whichever unit is most convenient to the external power connection. Remove the knockout at the rear of the built-in power junction box. Install PL-133-N6 power connector (provided as a loose item) in this hole. Install the armored (BX) cable from this outlet to each of the console boxes.

d. At each box connect wiring to the AC power strip directly above. Where the armored cable passes through the power junction box access hole, attach a CU-105 cable clamp (supplied as a loose item) to the cable.

e. Figure 2-4 illustrates power connections to the back of the GPT-750-B2. Connect a heavy wire, braid, or strap from terminal E506 to the system ground. A good ground system is important to prevent regenerative feedback which may cause instability of the transmitter or receiver.

f. Install each unit in the console as shown in figure 2-1. Attach front panels to the rack using the 10-32 screws and washers (supplied as loose items). Use care to prevent scratching the panels.

g. Assemble the GPT-750-B2 as shown in figure 2-5. Check cabling for correct positioning, and correct jack and plug numbers.

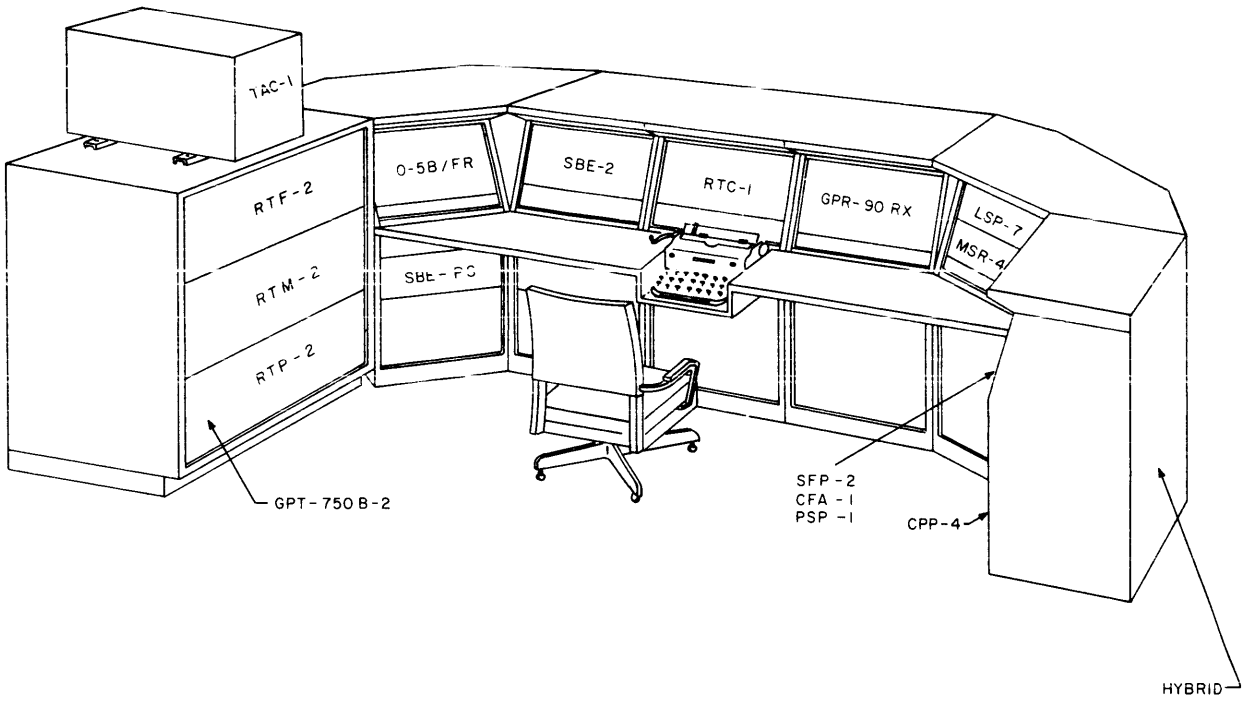
h. Assemble cables CA1 and CA2 to the console as shown in figure 7-2. Plug each power cord, including the power cords for the console lights, into a nearby outlet on the AC strip in the console.

i. An open wire transmission line or single wire may be attached to the designated terminals on the rear of the TAC-1. See figure 2-6 for proper connections.

CAUTION

The teletype output is a 0- to 60-ma current loop. Be sure that the loop current is adjusted to the proper value for the machine being used. This adjustment may be made from the front panel of the PSP-1.

j. Connect the telephone lines and teletype machines to the rear terminals of the CPP-4 as shown in figure 2-5. If remote printer operation is required, see figure 2-7. When all patch cords are removed, telephone line 2 is connected to the hybrid unit. The other lines are not directly connected to the system but are terminated at the CPP-4. Connection may be achieved by use of patch cords.



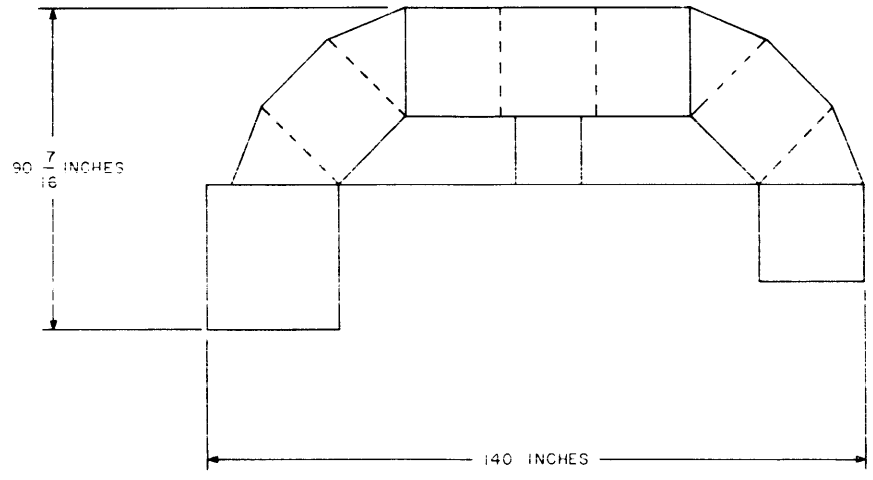
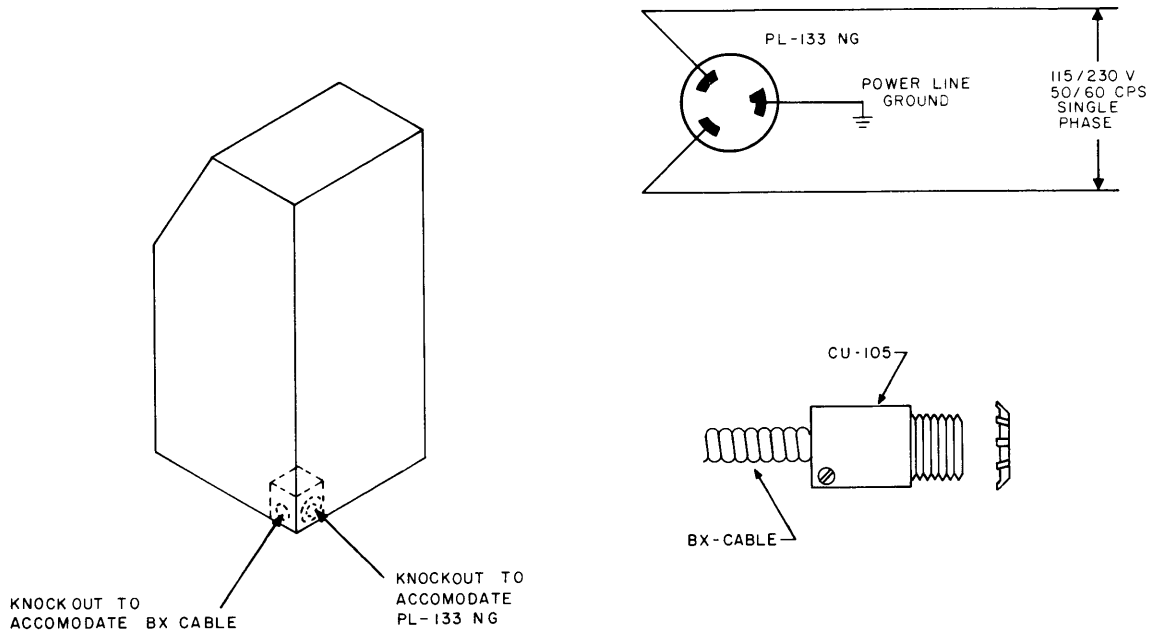
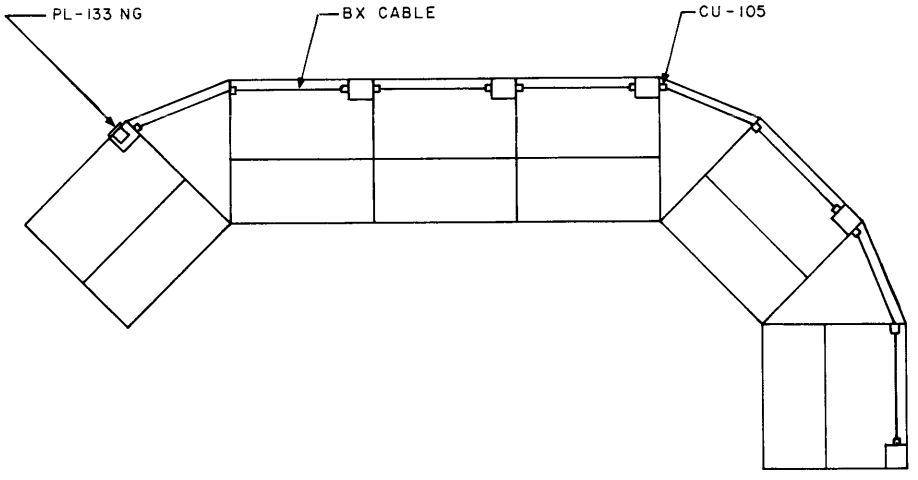


Figure 2-1. Physical Layout, SY-1031

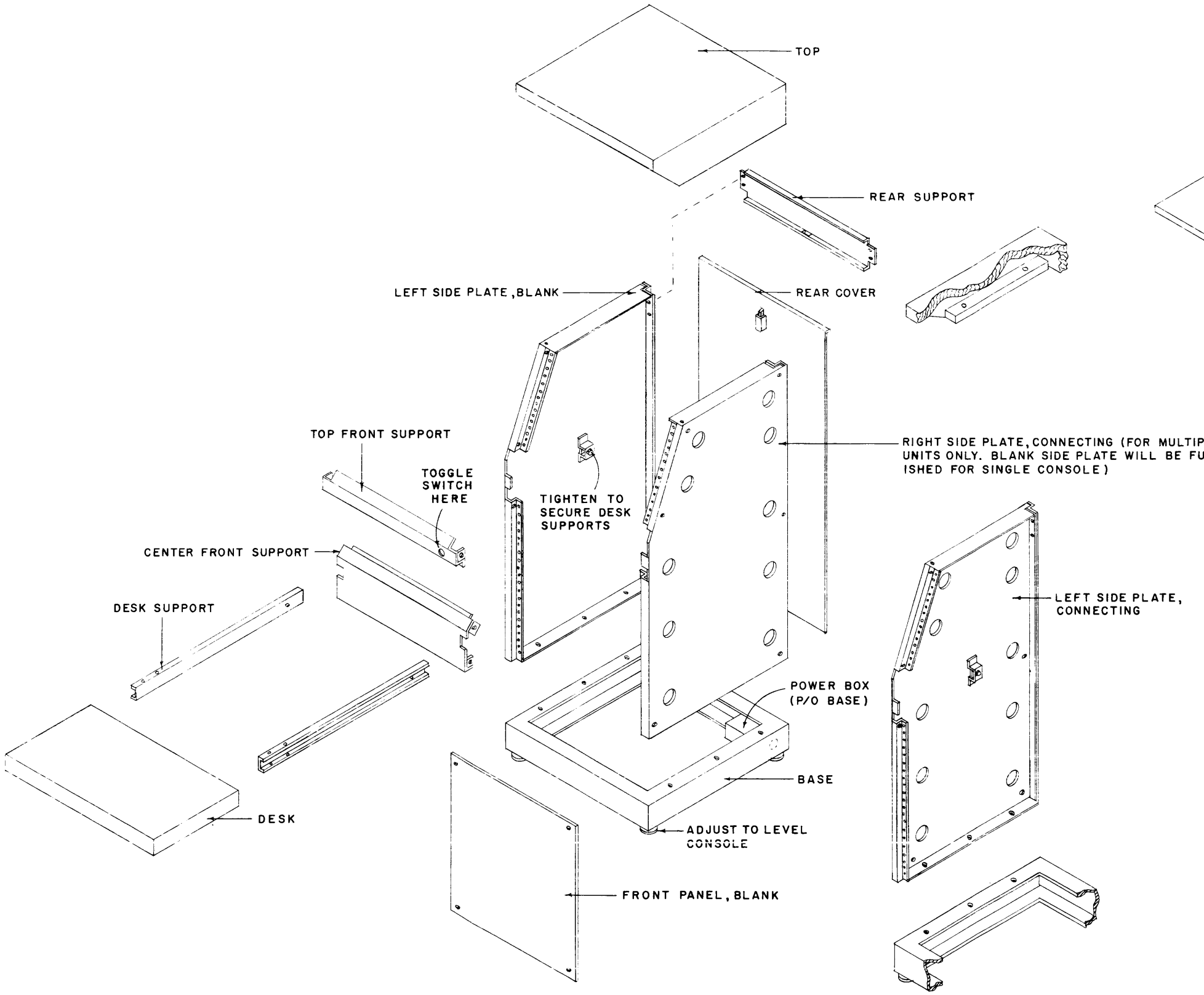


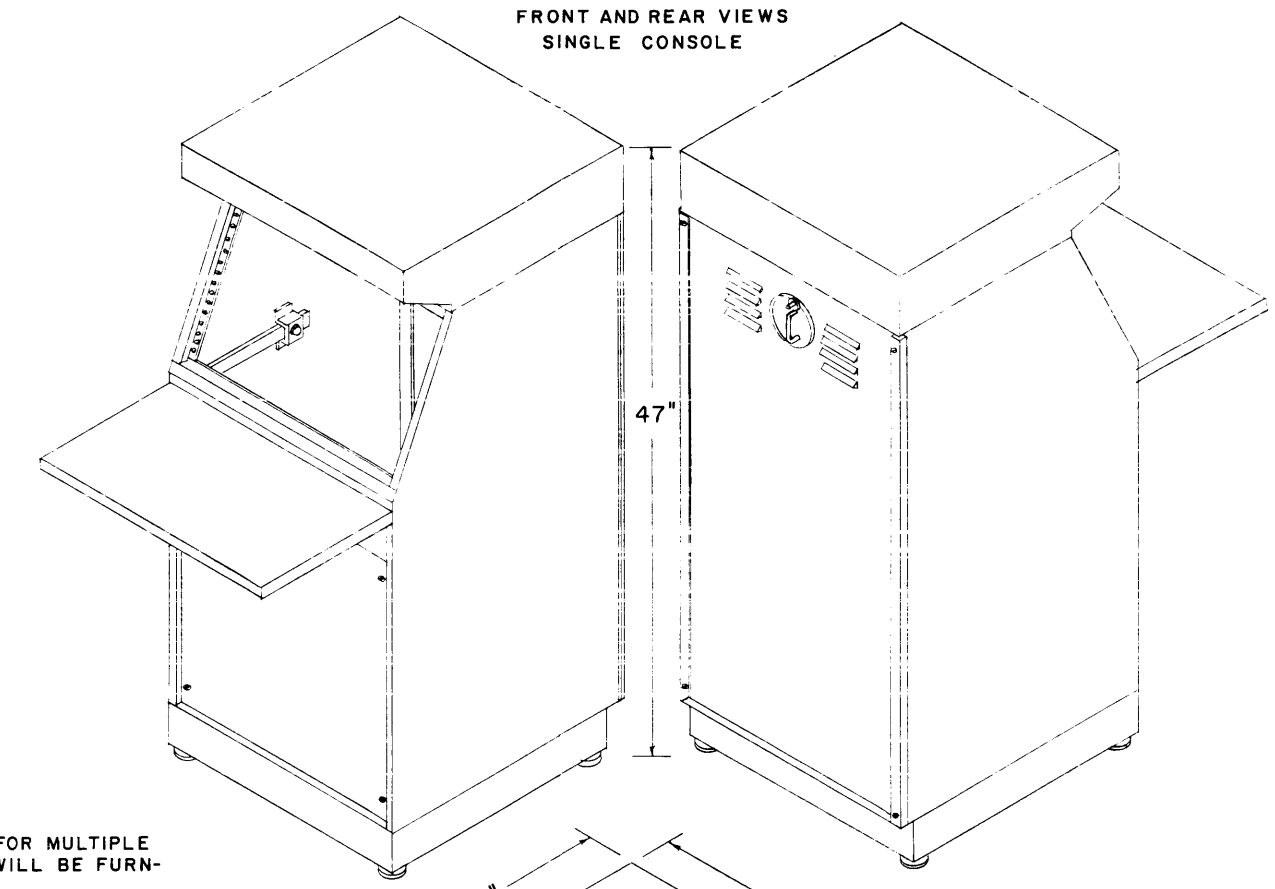


CON - 6

TOP VIEW WITH TOP COVER REMOVED

Figure 2-2. Console Power Wiring





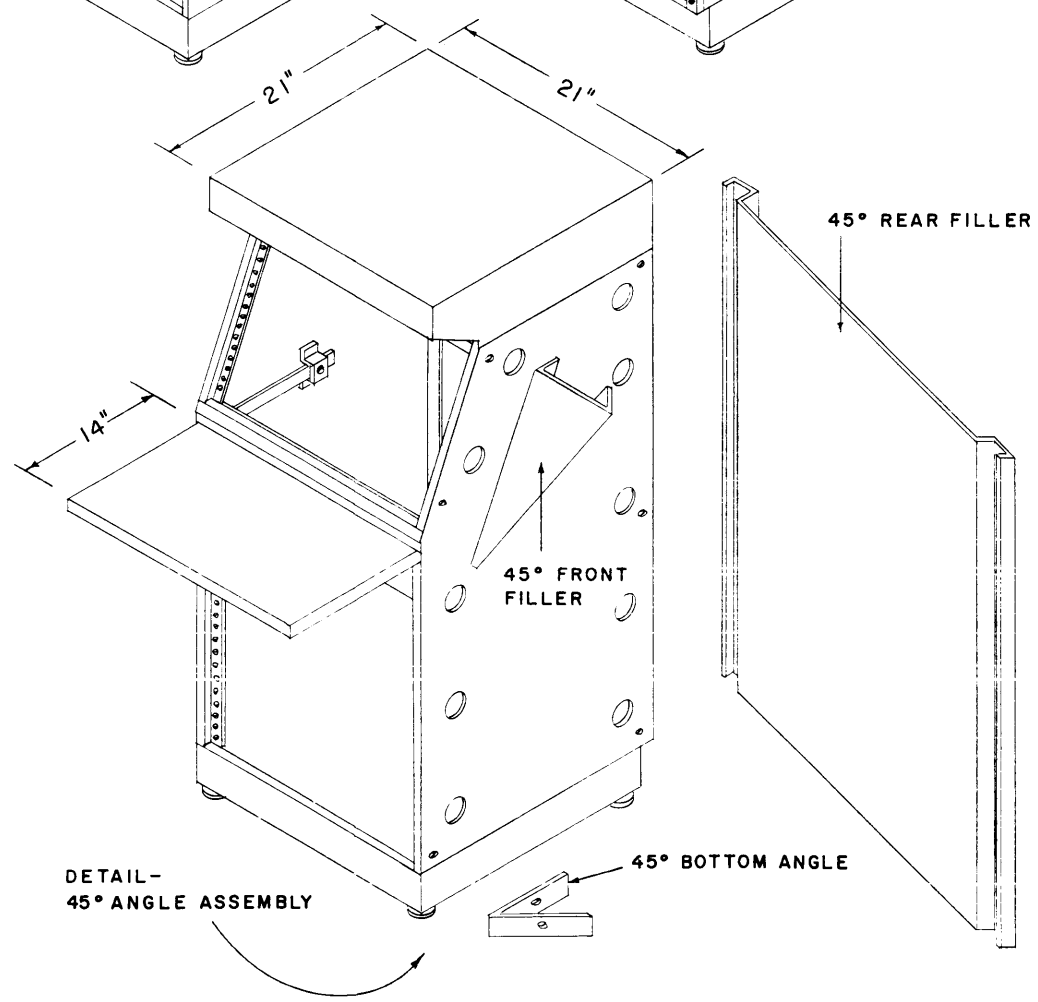
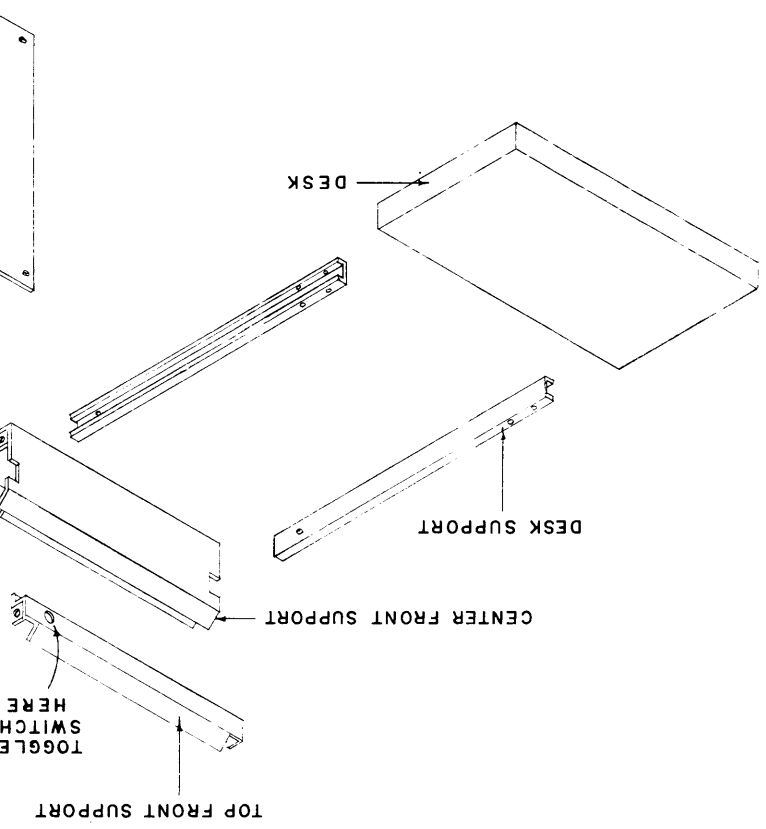


Figure 2-3. Exploded View, Console


DESK
DESK SUPPORT
CENTER FRONT SUPPORT
TOGGLE SWITCH HERE
TOP FRONT SUPPORT

LEFT SIDE F

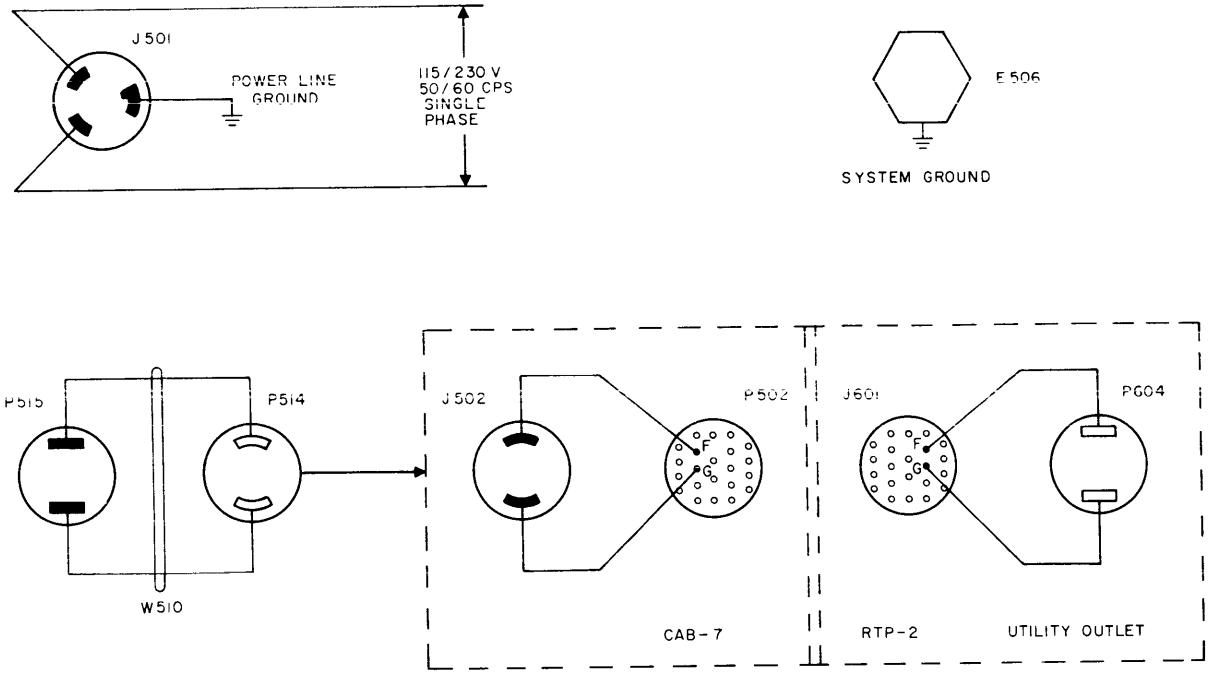


Figure 2-4. Power Connections, GPT-750-B2

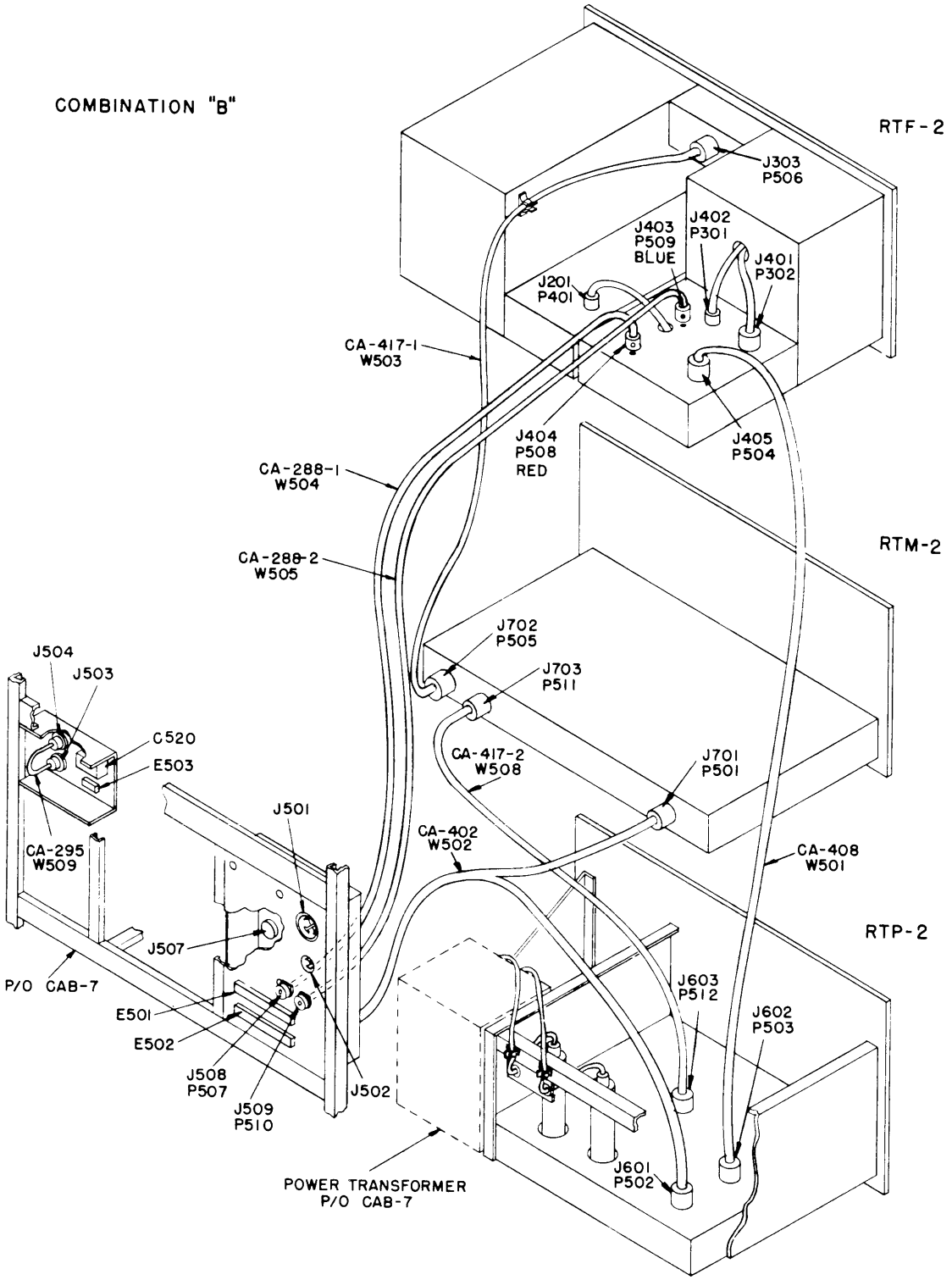


Figure 2-5. Cabling Diagram, GPT-750-B2

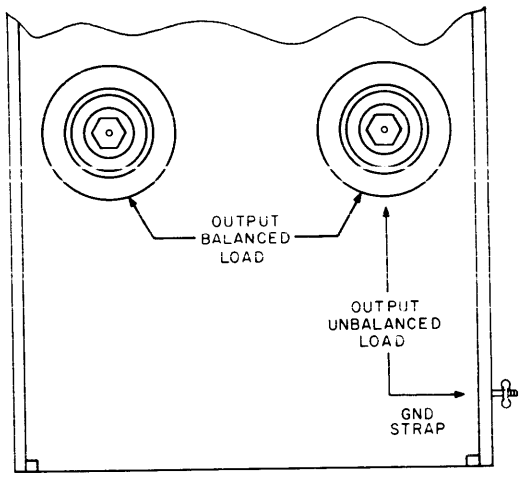


Figure 2-6. Rear Panel Connections, TAC-1

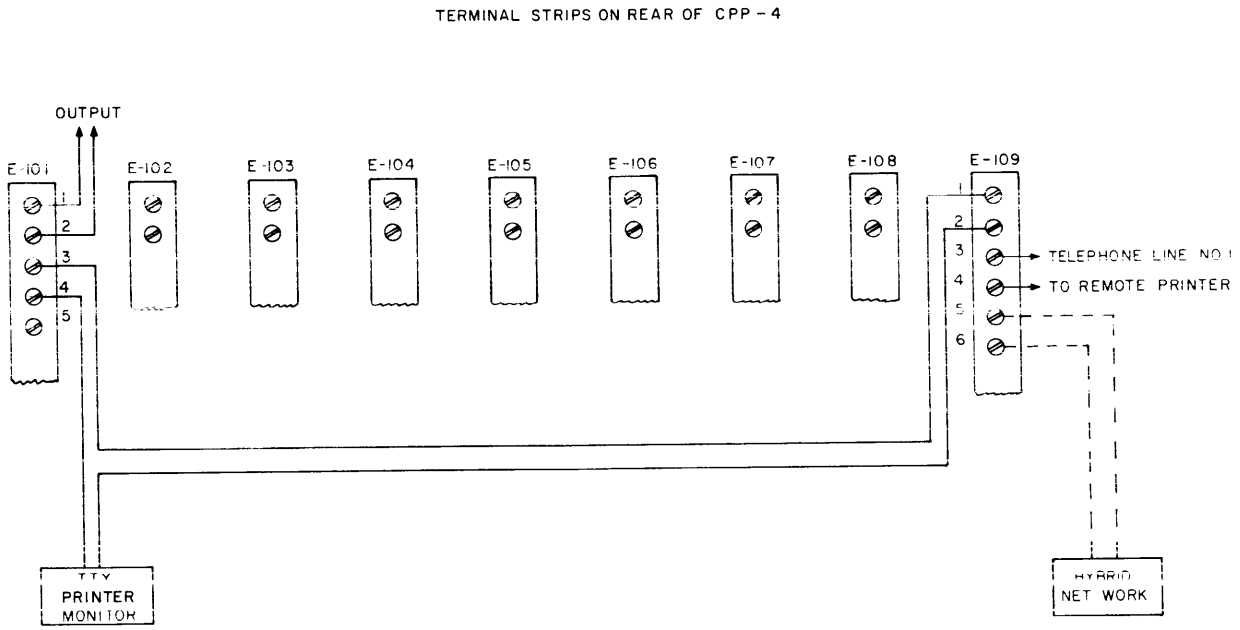


Figure 2-7. Remote Printer Connection

SECTION 3
OPERATOR'S SECTION

3-1. FUNCTIONAL OPERATION.

The SY-1031 may be divided into three groups of equipment: the transmitter group, the receiver group, and the transmit/receive group.

a. The transmitter group consists of the GPT-750-B2, TAC-1, O-5B/FR, SBE-2 and its power supply, and RTC-1. These components provide all necessary functions of generation, amplification, control, and impedance matching required to produce the desired signal.

b. The receiver group consists of GPR-90RX, LSP-7, MSR-4, SFP-2, CFA-1, and PSP-1. These components provide all necessary functions of selection, demodulation, control, and reproduction required to receive the desired signal.

c. The transmit/receive group consists of TRL, CPP-4, and a hybrid unit. The TRL is a transmit/receive relay. Its primary function is to switch the antenna to the transmitter or receiver as required. Other functions are receiver muting and transmitter voltage switching. The CPP-4 permits complete flexibility of interconnecting the various inputs and outputs for voice (local or remote via telephone lines), teletypewriter, and other auxiliary equipment. This patching panel is wired for normally thorough operation. That is, the connections for normal local operation are accomplished with all patch cords removed. The hybrid unit permits connection of both the receiver and transmitter audio lines to a two-wire telephone line and simultaneously provides isolation to prevent feedthrough of the received signal to the transmitter inputs.

d. The GPT-750-B2 is designed for operation in AM, MCW, and CW modes when used in conjunction with the RTC-1. Sideband and frequency-shift modes are obtained by using the SBE-2 and O-5B/FR units, respectively.

NOTE

The SBE-2 and O-5B/FR units are both fed to the transmitter exciter input. Do not operate both exciters at the same time.

3-2. PREPARATION FOR USE.

a. Apply AC power to the transmitter and console connectors. Switch ON all POWER switches except the switch on the GPT-750-B2. Switch console lamps on if desired.

b. Turn the MO BYPASS switch, located on the GPT-750-B2, lower deck, to the BYPASS position. This action switches the oscillator ovens for continuous operation regardless of the position of the MAIN POWER circuit breaker. Allow at least 24 hours for warmup before attempting to calibrate the oscillator.

c. After the warmup period has elapsed, turn the GPT-750-B2 on. (Refer to the GPT-750-B2 manual.) Do not turn the FINAL PLATES switch to ON. Turn the OSCILLATOR switch to CAL. Follow the calibration procedure outlined in paragraph 4-2-3-2 of the instruction manual for Model GPT-750( )-2. Turn the GPT-750-B2 off.

d. If crystals are to be used in the transmitter, exciters, or receivers, calculate the frequencies (refer to respective equipment manuals) and obtain crystals of the recommended types.

3-3. OPERATING PROCEDURES.

Before attempting to operate the equipment, thoroughly review the descriptions of controls provided in each equipment manual. For clarity and consistency, the control designations used on the panels of the equipment are also used in this manual.

Select from the procedure that follows the one step applicable to the desired mode of emission. Follow the selected procedure to put the station in operation.

3-4. TRANSMITTER GROUP TUNING.

a. AM, CW, AND MCW MODES.

(1) PRELIMINARY POWER-OFF ADJUSTMENTS. - Place the following controls in the positions indicated before applying AC power to the GPT-750-B2:

(a) RTF-2.

1. DRIVE	Fully CCW
2. EXCITATION (S402)	CW-PHONE
3. SSB-NORMAL	NORMAL

(b) RTP-2.

1. FILAMENT LINE ADJUST	Position 2 from fully CCW
2. TRANSMITTER PLATES	Standby-Remote

3. FINAL PLATE	OFF
4. MODE	TUNE
5. MAIN POWER	OFF
6. MO BYPASS	Normal

(2) PRELIMINARY POWER-ON ADJUSTMENTS.

(a) See that all previous steps have been accomplished.

(b) Check to determine that a suitable antenna or load is connected to transmitter RF output jack J505.

(c) Check the power line for connection to J501.

(d) Set MAIN POWER switch to ON.

(e) MAIN POWER indicator lamp should go on.

(f) Check the FILAMENT LINE meter for a reading of 115 volts.

(g) Use FILAMENT LINE ADJUST control for correction if necessary.

Adjust the MASTER OSCILLATOR FREQUENCY to the frequency required to reach the assigned operating frequency. Table 3-1 aids in determining the oscillator frequency.

TABLE 3-1. FORMULAS FOR OSCILLATOR SETTINGS

F_{osc} = MASTER OSCILLATOR FREQUENCY indicated on GPT-750-B2 front panel.	
F_{out} = Assigned frequency of operation.	
2-4 mc	$F_{osc} = F_{out}$
4-8 mc	$F_{osc} = \frac{F_{out}}{2}$
8-16 mc	$F_{osc} = \frac{F_{out}}{4}$
16-32 mc	$F_{osc} = \frac{F_{out}}{8}$

(3) TUNING THE GPT-750-B2 FOR CW OPERATION.

(a) Do not alter control settings made in previous steps unless instructed to do so.

(b) Rotate the DRIVE control fully CW.

(c) Turn the DRIVER BAND switch to the range which includes the final carrier frequency.

(d) Turn the MULTIMETER switch to the PA Ig position.

(e) Turn the DRIVER TUNING control to the frequency of the oscillator. A peak in PA grid current indicates the correct point.

(f) Turn the DRIVE control fully CCW.

CAUTION

Be sure an antenna or 1000-watt, 50- or 70-ohm dummy load is connected to J505.

(g) Turn the PA BAND switch to the range which includes the final frequency.

(h) Set the ANTENNA LOADING control to the fully CCW position or roughly preset it according to figure B-3-2, of the GPT-750-B2 manual.

(i) Set the AUX. LOADING control to the + position or as indicated in figure B-3-2, of the GPT-750-B2 manual.

(j) Set the FINAL PLATE switch to ON.

(k) Advance the DRIVE control until the PA PLATE current meter indicates 120 ma.

(l) Turn the PA TUNING control until a definite plate current dip is obtained.

(m) The RF OUTPUT meter may be used as an aid in tuning but it must be understood that it is an output indicator and does not necessarily give absolute values of RF current.

CAUTION

A shunting bar has been provided within the PA compartment for shunting the RF ammeter thermocouple. This is useful when a load with low impedance and high reactance (high standing wave ratio) is to be matched under these conditions. The unshunted circuit would cause the meter to "pin" due to the high reactive current in the load.

(n) Turn the MULTIMETER switch to the PA Isg position.

(o) Advance the DRIVE control until the screen current is about 10 ma.

(p) Turn the ANTENNA LOADING control CW until the screen current drops to almost zero and the plate current begins to rise.

NOTE

At this time, the RF output should be sufficient to obtain a slight reading on the TAC-1 ammeter(s). Tune the TAC-1 according to the chart provided for maximum indication on the ammeter(s).

(q) Adjust the PA TUNING control until the plate dips again and the screen current rises. Continue to advance the ANTENNA LOADING and DRIVE controls (each time redipping the plate current with the PA TUNING control) until the screen current is 10 ma while the plate current is 250 ma.

CAUTION

The plate current dips must be obtained at the lowest PA tuning reading to avoid doubling in the final. If figure B-3-2 of the GPT-750-B2 manual is followed, no such trouble occurs.

(r) Turn the MODE switch to the CW-FS position.

(s) Key the transmitter by either pressing the TEST KEY or by using an external key connected to the KEY jack. The plate current should rise to about 500 ma while the PA Isg current becomes 90 ma. The PA Ig is between 15 and 30 ma depending upon the operating frequency.

(t) If the above results are not obtained, the PA Isg can be increased by advancing the DRIVE control while the PA plate current can be increased by slight advancement of the ANTENNA LOADING control.

(u) Make a final adjustment of the PA TUNING control for a peak in the PA Isg and a corresponding peak in RF OUTPUT. If the transmitter is fully loaded in this manner, it is much easier to adjust the PA TUNING for a screen current peak. The transmitter is now fully prepared to be placed in operation.

(v) For simple ON-OFF control of the tuned transmitter, leave the FINAL PLATE switch in the ON position and the TRANSMITTER PLATES switch in the STANDBY-REMOTE position. To operate under these conditions, the operator needs only to throw the TRANSMITTER PLATES switch to the ON position and key the transmitter.

(w) If the overload protective system throws the transmitter OFF at any time it is probably because excessive screen or plate currents have been drawn. The OVERLOAD RESET controls should then be used to restore operation so correction can be made.

(x) To key the transmitter, plug the key into the KEY jack on the front panel of RTC-1. Turn the ON-OFF switch to the ON position. The OPERATE/STANDBY REMOTE switch on the RTC-1 remotely turns the transmitter on and off. Operation of the key controls the emission of the transmitter. To monitor the keying, it is necessary to plug a set of headphones into the PHONES jack on the RTC-1. A sidetone can be heard in the headphones when the transmitter is keyed. The frequency of the sidetone may be varied by the FUNCTION switch on the RTC-1.

(4) ADDITIONAL INFORMATION.

(a) The absolute settings of the ANTENNA LOADING and AUX. LOADING controls as shown in figure B-3-2 of the GPT-750-B2 instruction manual are approximate because these controls serve to balance out reactance in the antenna system. For this reason, the antenna and frequency that are used influence the final settings of these controls. The AUX. LOADING switch seldom is used in the zero position at frequencies above the 2- to 4-mc band.

(b) When tuning the upper end of the two highest bands (24 to 32 mc), it is necessary to advance the ANTENNA LOADING control almost to its fully CW position in order to obtain a plate current dip with the PA TUNING control.

(5) TUNING THE TRANSMITTER TO THE FREQUENCY OF A RECEIVED SIGNAL. - In some cases, the operator may want to set the transmitter exactly on the same frequency as a signal being received. To set the transmitter to the frequency of a received signal, proceed as follows:

(a) Tune up the transmitter with the exception of the final amplifier (leave the FINAL PLATE switch in OFF position). The master oscillator should be set so that the multiplier output frequency is close to frequency of the desired signal.

(b) Tune the receiver to the desired signal.

(c) Turn on the receiver BFO and vary the VMO frequency until a zero beat is obtained with the received signal carrier.

(d) Pick up the transmitter on the receiver and readjust the master oscillator until a zero beat is heard. The master oscillator is now aligned with the received signal, and remainder of the transmitter may now be properly tuned. If the master oscillator signal cannot be picked up on the receiver insert about 1 foot of a 4-foot length of insulated wire inside the top drawer and close the drawer. This serves to radiate some of the master oscillator signal into the receiver. It is possible in some cases, depending upon the strength of the received signal, to beat the transmitter directly with the received signal and leave the receiver BFO off.

(6) TUNING THE TRANSMITTER FOR AM AND MCW OPERATION. - Tuning procedures for phone operation of the transmitter are identical with those set forth for CW operation except that with the MODE switch in the TUNE position, the final amplifier screen current should be 5 ma and plate current should be 200 ma. This results in a final amplifier screen current of 90 ma and a plate current of 300 ma when the MODE switch is returned to the PHONE position. If these values are not quite obtained, the DRIVE and PA TUNING controls should be retouched as described in the CW tuning procedure.

(7) RTC-1. - Plug the microphone into the MICROPHONE jack. Select NORMAL or CLIP or MCW modes as desired. Adjust CLIPPER and/or GAIN to read 100 percent on the MODULATION meter when speaking into the microphone or depressing the key. Switch the OPERATE/STANDBY REMOTE switch to OPERATE. Speak into the microphone or depress the key and adjust the GAIN control on the RTM-2, center unit of the transmitter, until the MODULATOR CURRENT reads 300 ma on peaks.

(8) REDUCED POWER OPERATION. - The power output of the transmitter is readily adjustable from a minimum of a few watts to its maximum output of 1000 watts CW. To operate at reduced power, proceed as follows:

(a) Tune the transmitter as prescribed for CW or AM operation. Output power is now approximately 1000 watts CW or 750 watts AM.

(b) Adjust the DRIVE control so that screen current drops to approximately 45 ma.

(c) Decrease the antenna loading until the screen current rises again to 90 ma after the final amplifier has been reset for resonance. The power output is now approximately 500 watts. For an output power of less than 500 watts, screen current should be proportionately reduced.

SCREEN CURRENT VALUES FOR REDUCED POWER OPERATION

OUTPUT POWER (W)	SCREEN CURRENT (MA)
500 (and above)	90
400	70
300	55
200	35

(d) Repeat step (c) until the desired power output is obtained.

(e) For phone operation, the modulator current should be adjusted so that on voice peaks or with steady tone input it is approximately equal to the final amplifier plate current.

b. SIDEBAND MODES.

NOTE

The SBE-2 and O-5B/FR units are both fed to the transmitter exciter input. Do not operate both exciters at the same time.

(1) PRELIMINARY POWER-OFF ADJUSTMENTS. - Place the following controls in the positions indicated before applying AC power to the GPT-750-B2:

(a) RTF-2.

1. DRIVE	Fully CCW
2. SSB-NORMAL switch (*S204)	SSB
3. EXCITATION switch (*S402)	To be in L.O. ON position if VMO is used with exciter; in L.O. OFF (SSB) position if not.

*Located in RTF-2 deck. Open drawer for access. Controls are marked plainly.

(b) SBE-2.

1. XMTR ON-OFF	OFF
2. EXCITER ON-STANDBY	STANDBY
3. POWER ON-OFF	OFF
4. OUTPUT	Fully CCW

(c) RTP-2.

1. FILAMENT LINE ADJUST	Position 2 from fully CCW
2. TRANSMITTER PLATES	STANDBY-REMOTE
3. FINAL PLATE	OFF
4. MODE	TUNE
5. MAIN POWER	OFF

(2) PRELIMINARY POWER-ON ADJUSTMENTS.

(a) See that all previous steps have been accomplished.

(b) Check to determine that a suitable antenna or load is connected to transmitter RF output jack J505.

(c) Check the power line for connection to J501.

(d) Set MAIN POWER switch to ON.

(e) MAIN POWER indicator lamp should go on.

(f) Check the FILAMENT LINE meter for a reading of 115 volts.

(g) Use FILAMENT LINE ADJUST control for correction if necessary.

c. SBE-2 OPERATION.

(1) GENERAL. - The SBE tuning is done in a series of steps, depending upon the mode of operation required. The following is a general tuning procedure giving specific examples where needed for clarity. The built-in VTVM may be used for all measurements necessary for operation. Voltage checks called out in the following text may be obtained by use of the METER SW control on the SBE-2.

(2) INITIAL ADJUSTMENTS.

(a) If the VMO in the GPT-750-B2 is to be used, throw the XMTR switch to ON. Note that the system is wired such that the VMO in the GPT-750-B2 may be used to drive an external SBE-2 (as done here) or its normal chain of amplifiers.

(b) Be sure that the GPT-750-B2 FINAL PLATE switch is OFF and the SBE's OUTPUT control is fully CCW.

(c) Set the exciter POWER ON-OFF switch to ON. Allow a 1-hour warm-up period.

(d) Turn the exciter METER SW to the CAL position and zero the meter by use of the screwdriver adjustment (labeled CAL) located directly below the meter on the front panel.

(e) Turn USB, LSB, and XMTR switches to their OFF positions.

(f) Turn the VOX GAIN and SQUELCH GAIN controls fully CCW.

(g) Set the EXCITER ON-STANDBY switch to the STANDBY position. The equipment is now ready to be tuned.

(h) Set the XMTR ON-OFF switch on the SBE-2 to OFF position.

(3) VMO VS CRYSTAL FREQUENCY CONTROL. - The mode of operation as well as the output frequency and power level of the GPT-750-B2 is controlled by the SBE-2. The medium frequency (MF) modulator section of the exciter is the actual frequency controlling stage. It can be supplied with an injection frequency controlled by the crystals in its own thermostatically-governed oven, or with an injection frequency from an external VMO (Variable Master Oscillator).

Crystal control offers the highest degree of stability with the advantage of switching to any of 10 preselected crystals, thereby reducing the number of adjustments necessary in changing frequency. Master oscillator control offers the advantage of a high degree of stability accompanied by an infinite number of output frequency possibilities immediately available within the transmitter range.

Although crystals X-1, X-2, X-3 of the RTF-2 also serve for MF injection, they are not normally used in this manner. These crystals normally serve as fixed frequency oscillators when the GPT-750-B2 is used for other modes of operation without the use of the SBE-2.

(4) SELECTION OF VMO OR CRYSTAL FREQUENCY. - The MF crystal oven of the exciter contains sockets for 10 crystals, any of which may be selected for use by the MF XTAL SW located on the front panel. The formula for selecting the proper crystal for MF injection, according to the output frequency desired is as follows. This formula also applies to the VMO frequency if such is to be used instead of crystals.

Formulas for the general case for crystal or VMO operation from 4.27 to 32 mc, or from the modulation bandswitch on the front panel of the SBE-2 are:

F_{xtal} or $F_{vmo} = 2.000(N) - F_{output} + 0.270$ where all frequencies are in mc and F_{output} is assumed to be the frequency of the transmitted (or suppressed) output carrier. The factor (N) is obtained from the chart below.

For RF output frequencies in the range of 2.0 to 3.73 mc, F_{xtal} of $F_{vmo} = F_{output} + 0.270$ mc:

MODULATOR BAND	N	OUTPUT BAND
4.27 - 6.27	4	4 - 8
6.27 - 8.27	5	4 - 8 and 8 - 16
8.27 - 10.27	6	8 - 16
10.27 - 12.27	7	8 - 16
12.27 - 14.27	8	8 - 16
14.27 - 16.27	9	8 - 16 and 16 - 32
16.27 - 18.27	10	16 - 32
18.27 - 20.27	11	16 - 32
20.27 - 22.27	12	16 - 32
22.27 - 24.27	13	16 - 32
24.27 - 26.27	14	16 - 32
26.27 - 28.27	15	16 - 32
28.27 - 30.27	16	16 - 32
30.27 - 32.27	17	16 - 32

The single exception to the use of this formula is the case where the frequency range of the MF injection source (the VMO in the GPT-750-B2, for example) is not sufficient to permit generation of frequencies above 4.0 mc (for output frequencies in the range of 3.73 to 4.27 mc). Apply the following when such conditions exist:

(a) OPERATING FREQUENCY (F_O): 3.73 to 4.27

(b) BAND MCS SWITCH POSITION: 2 to 4.27

(c) OUTPUT TUNING BANDSWITCH: 2 to 4

(d) VMO: F_O - 0.270

(e) MF TUNING DIAL READING: F_O + 0.270

(f) OUTPUT TUNING DIAL: F_O

All above frequencies are in megacycles. Upper and lower sideband audio channel inputs must be reversed.

(5) MF TUNING, GENERAL. - The medium frequency stages of the SBE-2 must now be tuned to the injection frequency. Proceed as follows:

(a) Turn the exciter METER SW control to the MF position.

(b) Be sure MF XTAL SW is turned to VMO or crystal position of injection frequency desired.

(c) Using MF TUNING control, set MF dial reading to correspond to VMO or crystal (injection) frequency selected. (Note exception above.)

(d) Set the EXCITER ON-STANDBY switch to the STANDBY position.

(e) Rotate the CARRIER INSERT control fully CW.

(f) Adjust the MF TUNING control for a peak reading on the meter. If the meter pins, it may be necessary to reduce the setting of the CARRIER INSERT control. Very little control movement is necessary if the dial reading has been carefully set as indicated above. Rely on the dial reading. Do not tune to an adjacent peak even though it may produce a higher reading on the meter.

(6) MF TUNING, SPECIAL. - This special tuning procedure applies only to the case outlined above where MF injection frequencies above 4.00 mc are not available for the provision of output frequencies in the range of 3.73 to 4.27 mc generated in the normal manner.

(a) Turn METER SW to MF position.

(b) Turn MF XTAL SW to VMO or crystal position to be used.

(c) Set the MF dial to read 270 kc above the desired final output frequency. This action properly tunes the MF amplifier whose tuning is always 270 kc below the dial reading. This dial reading is also 540 kc above the selected MF injection frequency. The MF section provides all final output frequencies when the OUTPUT TUNING bandswitch is in the 2- to 4-mc position.

NOTE

Under normal conditions, the output of the MF modulator-amplifier section is centered on a frequency equal to the MF injection frequency less 270 kc from the 17-kc section. Outputs in the range of 3.73 to 4.27 mc are not obtained in the usual manner when MF injection sources from 4.00 to 4.54 mc are not available. It is for this reason that upper sideband products (centered on the MF injection frequency plus 270 kc from the 17-kc section) are to be used.

(d) Set USB and XMTR switches to their OFF position.

(e) Turn the VOX GAIN control fully CCW.

(f) Set EXCITER ON-STANDBY switch to the STANDBY position.

(g) Turn the CARRIER INSERT control fully CW.

(h) Adjust the MF TUNING control for a peak reading on the meter. If the meter pins it may be necessary to reduce the setting of the CARRIER INSERT control. Very little control movement should be necessary. Rely on the dial reading. Do not tune to an adjacent peak even though it may produce a higher reading on the meter.

(i) Under these conditions the sideband inputs must be reversed in order to obtain their proper relationship. This means that a signal which is to be transmitted as an upper sideband, for example, must be introduced to the exciter on the LSB input.

(7) RF TUNING.

(a) Do not alter MF tuning.

(b) Set BAND MCS switch to frequency range being used.

(c) Set OUTPUT TUNING bandswitch to frequency being used.

(d) Turn METER SW to RF position.

(e) Using OUTPUT TUNING control, set output tuning dial to output frequency.

(f) Set EXCITER ON-STANDBY switch to ON position.

(g) Advance OUTPUT control for a reading on the meter.

(h) Using OUTPUT TUNING control, tune for peak reading on meter. Very little control movement will be necessary. Rely upon the dial reading. Do not tune to a harmonic frequency.

(i) Turn the OUTPUT control fully CCW.

(j) Throw the TRANSMITTER PLATES switch on the RTP-2 to STANDBY-REMOTE.

(k) Throw the EXCITER ON-STANDBY switch to STANDBY.

d. TRANSMITTER TUNING.

(1) DRIVER.

(a) Set the DRIVER BAND switch to the range of the desired output frequency.

(b) Set the DRIVER TUNING control to the position nearest the final output frequency.

NOTE

The basic DRIVER TUNING range as indicated by the engravings on the front panel is 2 to 4 mc. This applies only when the DRIVER BAND switch is in the 2- to 4-mc position. When the DRIVER BAND switch is in the 4- to 8-mc position, the DRIVER TUNING markings are multiplied by 2. In the band of 8 to 16 mc the markings are to be multiplied by 4, and in the band of 16 to 32 mc they are to be multiplied by 8.

(c) Turn the MULTIMETER switch to the PA Eg RF Volts position.

(d) Set the XMTR switch on the SBE-2 to ON.

(e) Advance the OUTPUT control on the SBE-2 to 3.

(f) Turn the DRIVER TUNING control slightly CW or CCW until the PA Eg RF Volts reading is maximum.

(g) Return the OUTPUT control of the SBE-2 to fully CCW.

(h) Set the XMTR switch on the SBE-2 to the OFF position.

(2) PA TUNING.

(a) Set the PA BAND switch to the range which includes the final output frequency.

(b) Turn the MODE switch to the TUNE position.

CAUTION

Be sure that an antenna or 1000-watt 50- or 70-ohm dummy load is connected to RF output jack J505 of the transmitter.

(c) Turn the FINAL PLATES switch ON.

(d) Turn the ANTENNA LOADING control fully CCW.

(e) Set the AUX. LOADING switch to position "0" or "+" as indicated in figure D-3-4 of the GPT-750( )-2 manual.

(f) Set the PA TUNING control to the approximate setting according to figure D-3-4, of the GPT-750( )-2 manual.

(g) Set the XMTR switch on the SBE-2 to ON.

(h) Advance the SBE-2 OUTPUT control until the PA PLATE current increases to approximately 120 ma.

CAUTION

A shunting bar is provided (inside the RTF-2 adjacent to the thermocouple) for the protection of the RF ammeter and thermocouple. It should be inserted in the clips on the thermocouple to prevent off-scale reading of the RF ammeter under conditions of excessive VSWR.

(i) Rotate the PA TUNING control until a definite dip in the PA PLATE current is obtained.

(j) Return the OUTPUT control of the SBE-2 to the fully CCW position.

(k) Turn the MODE switch to the SSB position.

(l) Adjust the OUTPUT control on the SBE-2 for a reading of approximately 20 (PA Eg RF Volts) on the multimeter.

(m) Advance the ANTENNA LOADING control until the PA PLATE current rises to approximately 300 ma.

(n) Readjust the PA TUNING control until the PA PLATE current dips.

(o) Continue to advance the ANTENNA LOADING control, each time readjusting the PA TUNING control for a dip in PA PLATE current, and adjust the SBE-2 OUTPUT control until a PA PLATE current of approximately 250 ma is obtained with minimum drive as indicated by the PA Eg RF Volts meter. The normal PA Eg RF Volts reading under these conditions is between 20 and 30. In no case should the transmitter be so loaded or adjusted as to require a reading in excess of 30 on the PA Eg RF Volts meter. Doing so, results in excessive distortion.

(p) Turn the OUTPUT control of the SBE-2 to the fully CCW position.

(q) Turn the CARRIER INSERT control of the SBE-2 to the fully CCW position.

(r) Set the FINAL PLATES switch to the OFF position.

(3) ADDITIONAL INFORMATION.

(a) The absolute settings of the ANTENNA LOADING and AUX. LOADING controls as shown in figure D-3-4 of the GPT-750( )-2 manual, are approximate because these controls serve to balance out reactance in the antenna. The antenna and frequency used, therefore, influence the final setting of these controls. The AUX. LOADING control seldom is used in the zero position at frequencies above the 2- to 4-mc range.

(b) When tuning the upper end of the two highest bands (24 to 32 mc), it is necessary to advance the ANTENNA LOADING control to almost the fully CW position in order to obtain a plate current dip with the PA TUNING control.

(4) MODE SELECTION, PRELIMINARY INFORMATION. - The SBE-2 provides for the following modes of operation:

(a) Single sideband (SSB) with any degree of carrier insertion.

(b) Double sideband (DSB) with any degree of carrier insertion.

(c) Double sideband with full carrier insertion (low level AM).

(d) Independent sideband (ISB) with any degree of carrier insertion.

(e) Continuous-wave telegraphy (CW).

(5) GAIN CONTROLS AND METERING.

(a) The USB and LSB GAIN controls vary the audio input levels to the upper and lower sideband, respectively.

(b) The CARRIER INSERT control varies the carrier insertion from 0 to 100 percent.

(c) The meter circuits are selected by means of a front panel switch. They are used to indicate the USB and LSB audio levels, the MF radio frequency level, and the RF output level.

(6) RF OUTPUT COMPONENTS. - The RF output normally consists of the following, the sum of which, as indicated by the RF output meter, must never exceed a reading of 100 percent.

(a) Upper sideband.

(b) Lower sideband.

(c) Carrier.

(7) FORMULAS. - The following formulas may be used to determine the proper output levels of the various RF components:

(a) SSB with carrier:

USB or LSB + carrier = 100% RF out

(b) SSB without carrier:

USB or LSB = 100% RF out

(c) AM (conventional low level AM):

USB = 15%, LSB = 15%, carrier = 70%.

(USB and LSB must be equal.)

USB + LSB + carrier = 100% RF out

(d) Double sideband with carrier:

USB + LSB + carrier = 100% RF out.

(USB and LSB must be equal.)

(e) Independent sideband (ISB) with carrier:

USB + LSB + carrier = 100% RF out

(f) Independent sideband (ISB) without carrier:

USB + LSB = 100% RF out

(g) Continuous-wave telegraphy (CW):

Carrier = 100% RF out

(8) PREPARATORY. - Setting of the SBE-2 controls for apportionment of sideband is as follows:

(a) Turn USB and LSB switches OFF.

(b) Turn USB GAIN, LSB GAIN, VOX GAIN, SQUELCH GAIN, and OUTPUT controls to their fully CCW positions.

(c) Turn METER SW to the CAL position.

(d) Adjust meter for zero indication by use of the screwdriver adjustment located directly beneath the meter itself.

(e) Turn the CARRIER INSERT control to its fully CW position.

(f) Turn the MF and RF sections of the SBE-2 as outlined previously.

(g) Turn the METER SW to the RF position.

(h) Advance the OUTPUT control until the meter reads 100.

(i) Turn the CARRIER INSERT control fully CCW.

NOTE

In making the adjustments indicated in (g) above, do not alter the setting of the SBE-2 OUTPUT control. If the control is inadvertently disturbed, repeat steps (e), (g), (h), and (i) above before proceeding further.

(9) APPORTIONMENT OF RF OUTPUT COMPONENTS. - Choose one of the following instructions according to the mode of operation desired and with reference to the formulas.

(a) UPPER SIDEBAND COMPONENT (USB).

1. Turn the USB switch to CH 1, CH 2, or MIKE, as appropriate.

2. Apply audio modulation to input selected in 1 above.

3. Advance USB GAIN control until meter indicates desired percentage on peaks.

(b) LOWER SIDEBAND COMPONENT (LSB).

1. Turn LSB switch to CH 1, CH 2, or MIKE, as appropriate.

2. Apply audio modulation to input selected in 1 above.

3. Advance LSB GAIN control until meter indicates desired percentage on peaks.

(c) BOTH SIDEBANDS.

1. Turn USB switch to CH 1, CH 2, or MIKE, as appropriate.

2. Apply audio modulation to input selected in 1 above.

3. Advance USB GAIN control until meter indicates desired percentage on peaks.

4. Turn LSB switch to CH 1, CH 2, or MIKE, as appropriate.

5. Apply audio modulation to input selected in 4 above.

6. Advance the LSB GAIN control until the meter indicates the desired percentage on peaks. The meter indicates the arithmetical sum of the percentages of the components (USB, LSB, carrier) applied.

NOTE

The meter circuit within the SBE-2, as is the case with most VTVM's, has a small amount of waveform error. Thus, when the sidebands are set up independently of each other, the sum of 50 percent and 50 percent may appear as slightly less than 100 percent on the meter. This is due to the presence of a modulated envelope which is generated when two or more frequencies are present in the output at the same time.

(d) CARRIER.

1. Turn USB and LSB switches to their OFF positions.

2. Advance the CARRIER INSERT control until the meter indicates the desired percentage of carrier insertion.

NOTE

The sum of the USB, LSB, and carrier components of the RF output must never exceed 100 percent as indicated by the RF meter, although each individually may comprise 100 percent when used alone. Once the USB, LSB, and carrier percentages have been set, the OUTPUT control can be varied to provide the proper drive level to the transmitter without altering the RF component proportions in any way.

(10) VOX ADJUSTMENT. - The VOX circuit functions only in the SSB and DSB operation of the unit and not with conventional AM or SSB with carrier.

(a) Set EXCITER ON-STANDBY switch to STANDBY position.

(b) Talking directly into the mike, adjust VOX GAIN until EXCITER lamp remains on with normal speech level but goes off with no speech input. Further adjustment may be necessary to prevent background noises from actuating the exciter.

(11) DRIVING THE TRANSMITTER IN SSB, DSB, ISB, OR AM MODES OF OPERATION.

(a) CONTROL SETTINGS. - The exciter and transmitter must be prepared as instructed above for operation in any of the above modes.

1. Turn the OUTPUT control of the SBE-2 fully CCW.

2. Set the FINAL PLATES switch of the transmitter to the ON position.

3. Set the MULTIMETER switch to the PA Eg RF Volts position.

4. Advance the OUTPUT control of the SBE-2 while modulating the input until the PA PLATE current indicates approximately 250 ma under steady state conditions or does not exceed approximately 250 ma on modulation peaks.

5. Set the XMTR ON-OFF switch on the SBE-2 to the OFF position.

(b) SSB, DSB, ISB, OR AM OPERATION. - The transmitter is now ready to be used on the air. It may be activated by the VOX or push-to-talk controls. Push-to-talk operation must be used in any mode in which carrier is used since the VOX circuit "locks up" upon the insertion of carrier.

e. FREQUENCY-SHIFT MODE.

(1) PRELIMINARY POWER - OFF ADJUSTMENTS. - Place the following controls in the positions indicated before applying power to the transmitter.

(a) RTF-2.

1. DRIVE	Fully CCW
2. EXCITATION	LO OFF
3. SSB-NORMAL	NORMAL

(b) RTP-2.

1. FILAMENT LINE ADJUST	Position 2 from fully CCW
2. TRANSMITTER PLATES	STANDBY-REMOTE
3. FINAL PLATE	OFF
4. MODE	TUNE
5. MAIN POWER	OFF

(2) PRELIMINARY POWER-ON ADJUSTMENTS.

(a) See that all previous steps have been accomplished.

(b) Connect a 1000-watt resistive 70- or 50-ohm load or antenna to RF output jack J505.

(c) Connect power line from appropriate source to J501.

(d) Set MAIN POWER switch to ON. MAIN POWER indicator lamp should go on.

(e) Check the FILAMENT LINE meter for a reading of 115 volts. Use FILAMENT LINE ADJUST control for correction if necessary.

(3) EXCITER TUNING. - Tune the O-5B/FR for operation. Output frequency should be between 2 and 4 mc. Refer to table 3-1 for calculation of the output frequency of the O-5B/FR, a transmitter output on the assigned frequency.

(4) TRANSMITTER TUNING.

(a) Do not alter control settings made in previous steps unless instructed to do so.

(b) Rotate the DRIVE control fully CW.

(c) Turn the DRIVER BAND switch to the range which includes the final carrier frequency.

(d) Set the MULTIMETER switch to the PA Ig position.

(e) Turn the DRIVER TUNING control to the frequency of the oscillator. A peak in PA GRID current indicates the correct point.

(f) Turn the DRIVE control fully CCW.

CAUTION

Be sure an antenna or 1000-watt 50- or 70-ohm dummy load is connected to J505.

(g) Turn the PA BAND switch to the range which includes the final frequency.

(h) Set the ANTENNA LOADING control to its fully CCW position or roughly preset it according to figure C-3-3 of GPT-750( )-2 manual.

(i) Set the AUX. LOADING control to the + position or as indicated in figure C-3-3.

(j) Set the FINAL PLATE switch to ON.

(k) Advance the DRIVE control until the PA PLATE current meter indicates 120 ma.

(l) Turn the PA TUNING control until a definite plate current dip is obtained.

(m) The RF OUTPUT meter may be used as an aid in tuning but it must be understood that it is an output indicator and does not necessarily give absolute values of RF power output.

CAUTION

A shunting bar has been provided within the PA compartment for shunting the RF ammeter thermocouple. This is useful when a load with low impedance and high reactance (high standing wave ratio) is to be matched. Under these conditions the unshunted circuit would cause the meter to "pin" due to the high reactive current in the load.

(n) Turn the MULTIMETER switch to the PA Isg position.

(o) Advance the DRIVE control until the screen current is about 10 ma.

(p) Turn the ANTENNA LOADING control CW until the screen current drops to almost zero and the plate current begins to rise.

(q) Adjust the PA TUNING control until the plate current dips again and the screen current rises. Continue to advance the ANTENNA LOADING and DRIVE controls (each time redipping the plate current with the PA TUNING as before) until the screen current is 10 ma while the plate current is 250 ma.

CAUTION

The plate current dips must be obtained at the lowest PA tuning reading to avoid doubling in the final. If figure C-3-2 of the GPT-750( )-2 manual is followed, no such trouble occurs.

(r) Turn the MODE switch to the CW-FS position.

(s) Key the transmitter by either pressing the TEST KEY or by using an external key connected to the KEY jack. The plate current should rise to about 500 ma while the PA Isg current becomes 90 ma. The PA Isg is between 15 and 30 ma depending upon the operating frequency.

(t) If the above results are not obtained, the PA Isg can be increased by advancing the DRIVE control while the PA PLATE current can be increased by slight advancement of the ANTENNA LOADING control.

(u) Make a final adjustment of the PA TUNING control for a peak in the PA Isg and a corresponding peak in RF OUTPUT. If the transmitter is fully loaded in this manner, it is much easier to adjust the PA TUNING for a screen current peak. The transmitter is now fully prepared to be placed in operation.

(v) For simple ON-OFF control of the tuned transmitter, leave the FINAL PLATE switch in the ON position and the TRANSMITTER PLATES switch in the STANDBY-REMOTE position. To operate under these conditions, the operator needs only to throw the TRANSMITTER PLATES switch to the ON position and key the transmitter.

(w) If the overload protective system throws the transmitter OFF at any time it is probably because excessive screen or plate currents have been drawn. The OVERLOAD RESET controls should then be used to restore operation so correction can be made.

(5) ADDITIONAL INFORMATION.

(a) The absolute settings of the ANTENNA LOADING and AUX. LOADING controls as shown in figure C-3-3 are approximate because these controls serve to balance out reactances in the antenna system. For this reason the antenna and frequency used influence the final settings of these controls. The AUX. LOADING switch is seldom used in the zero position at frequencies above the 2- to 4-mc band.

(b) When tuning the upper end of the two highest bands (24 to 32 mc), it is necessary, to advance the ANTENNA LOADING control almost to its fully CW position in order to obtain a plate current dip with the PA TUNING control.

3-5. RECEIVER GROUP TUNING.

a. AM AND MCW RECEPTION.

(1) Set the controls on the GPR-90RX as follows:

(a) RANGE SELECTOR	Desired band
(b) AVC-MANUAL	AVC
(c) LIMITER switch	OFF
(d) BFO switch	OFF
(e) SEND-REC	SEND
(f) AUDIO SELECTOR	NORMAL
(g) RF SELECTIVITY	NON XTAL

(2) Loosen the dial locks by turning them CCW.

NOTE

The main tuning dial calibration is accurate only if the BAND SPREAD tuning control is set or locked to 100 on the logging scale.

(3) Turn the RF GAIN control fully CW. This control turns the receiver power on, and the dials light. Set the RANGE SELECTOR for the desired listening band and tune the receiver by using the MAIN TUNING knob. At the same time, advance the AUDIO GAIN control to a good listening level. Adjust the ANT. TUNE control (located under the S-meter) for maximum deflection on the S-meter.

(4) To tune the receiver over any amateur band, proceed as follows: Set the MAIN TUNING dial so that the desired amateur band appears under the hair line (located on the logging scale) and lock it; then turn the RANGE SELECTOR to the operating frequency range. Now tune the amateur band with the BAND SPREAD dial.

NOTE

Turn the LS-1 and LS-2 controls on the LSP-7 fully CW to obtain full loudspeaker volume.

(5) When the received signal is accompanied by excessive background noise (other than ignition or pulse type) increasing the RF selectivity of the receiver improves the signal-to-noise ratio. The selectivity should be increased up to the point that a phone signal becomes unintelligible. An almost obliterated signal can sometimes be pulled through the noise hash and received perfectly by the combined use of the RF SELECTIVITY and AUDIO SELECTOR (1200-cycle peak and the AUDIO SPREAD control set to the wide position).

(6) If the signal being received is interfered with or heterodynes with an adjacent carrier, adjust the XTAL PHASE control to reduce the interference. This control is set at zero for normal operation of the crystal filter.

(7) If crystal operation is used, select the desired crystal position and tune controls as above. The tuning controls serve to peak up the signal rather than set the oscillator frequency.

b. S-METER. - The S-meter performs a dual function: it provides a visual means of accurately tuning the receiver to the incoming signal, and it indicates the relative signal strength. The meter is calibrated in S units from 1-9 and to +40 db above S-9. The meter calibration is adjusted so that a 50-uv signal at the antenna terminals gives an S-9 reading at 7 mc. The S-meter calibration is correct only if the RF GAIN control is fully CW and the AVC MANUAL switch is in the AVC position.

(1) Tune receiver to signal frequency.

(2) MSR and receiver AVC ON and SLOW.

(3) MSR BFO switch ON.

(4) MSR MANUAL-XTAL switch to MANUAL.

(5) Upper sideband reception:

(a) MSR on UPPER.

(b) Tune MSR BANDSPREAD control for intelligibility.

(c) For crystal operation set MANUAL-XTAL switch to XTAL. Tune receiver for intelligibility.

(6) LOWER SIDEBAND RECEPTION

(a) MSR set on LOWER.

(b) Tune MSR BANDSPREAD control intelligibility.

(c) For crystal operation set MANUAL-XTAL switch to XTAL. Tune receiver for intelligibility.

c. CW OPERATION.

(1) Tune receiver to signal frequency.

(2) MSR and receiver AVC ON and SLOW.

(3) MSR BFO switch to ON.

(4) MSR MANUAL-XTAL switch to MANUAL.

(5) Tune MSR BANDSPREAD control to obtain desired pitch of signal.

d. FSK OPERATION. - When the desired teletype signal has been located and tuned, use the GPR-90RX and MSR-4 units and proceed as follows to obtain teletype printer operation:

(1) Initial control settings are as follows:

CPP-4

Patch cord is plugged into J23 at the top and into J21 at the bottom.

SFP-2

CHANNEL 1	FILTER IN
CHANNEL 2	FILTER IN

CFA-1

SENSE	+(PLUS)
CH. 1	ON
CH. 2	OFF
THRESHOLD	About 300° from fully CCW
MARK-SPACE-LINE	MARK
POWER	ON

PSP-1	Fully CCW
POWER	ON

(2) Apply power to the teletypewriter and ascertain that it is connected to the patch panel as described in Section 2. Adjust the OUTPUT CURRENT control on the PSP-1 until the meter indicates the proper current for the machine in use. Typically, the value is 20 or 60 ma, depending upon the particular machine. Turn the MARK-SPACE-LINE switch to LINE.

(3) Tune the BANDSPREAD control on the MSR-4 until a rectangular pattern is obtained on one side of the center of the CFA-1 monitor oscilloscope. Tune across the signal and note that the rectangle shifts

to the opposite side of the monitor oscilloscope. This ensures that the signal is approximately tuned. Tune the MSR-4 back toward the center of the signal until a vertical pattern appears in the center of the monitor. This indicates that the signal is properly positioned in the MSR-4's IF section. When the above procedure is properly completed the teletypewriter prints.

3-6. TRANSMIT/RECEIVE GROUP TUNING.

Of the transmit/receive group, only the CPP-4 requires operator attention. When all patch cords are removed, the unit is ready for local operation with hybrid phone connection to land line 2. Figure 3-1 through 3-11 show a few of the possible patching arrangements. When devising original patch arrangements, refer to table 3-2.

3-7. DUPLEX OPERATION.

A separate receiving antenna is required before operation can be attempted. Connect the antenna to the receiver input connection on the rear apron.

Set the SEND-REC switch on the GPR-90RX to REC.

The following precautions are necessary in duplex operation:

a. Provide maximum spacing between transmitting and receiving antennas.

b. Pick frequencies at least a megacycle apart for transmitting and receiving. These frequencies should not be harmonically related.

c. Use headphones for the receiver when a microphone is used in the same room.

TABLE 3-2. JACK DESIGNATIONS

NOTE

The jack designations are numbered from left to right; i.e., J1, J2, etc. Center row is designated "Monitor." From top to bottom, they are designated INPUT, MONITOR, and OUTPUT.

	INPUT	OUTPUT
J1		Land Line 1
J2	Hybrid	Land Line 2
J3		Land Line 3
J4		Land Line 4a
J5		Land Line 4b
J6		Land Line 5a
J7		Land Line 5b
J8		Land Line 6a
J9		Land Line 6b
J10	SBE Chan 2	
J11	Modulator GPT Voice in	RTC Audio Out
J12	GPR 600-ohm Audio Line	
J13	GPR 4-ohm Audio Spkr	LSP-Chanl 2
J14	MSR 4-ohm Audio Spkr	LSP-Chanl 1
J15	SBE Key input	Short-E105 Termls 11 & 12
J16	O5B/FR Key Input	TTY-Send Hoop.
J17	RTC-1 Key Out T/R Line	GPT-Key in
J18	RTC/SBE on/off XMTR out	GPT XMTR "On/Off" in
J19	CFA-1 Out.	TTY Recvr Loop
J20		SFP Chan 2
J21		SFB Chan 1
J22	SBE-2 Ch-1	HYB. XMTR.
J23	MSR-4 600-ohm Audio out	HYB. Recvr.
J24	No Connection	No Connection
J25	No Connection	No Connection
J25	No Connection	No Connection
J26	No Connection	No Connection

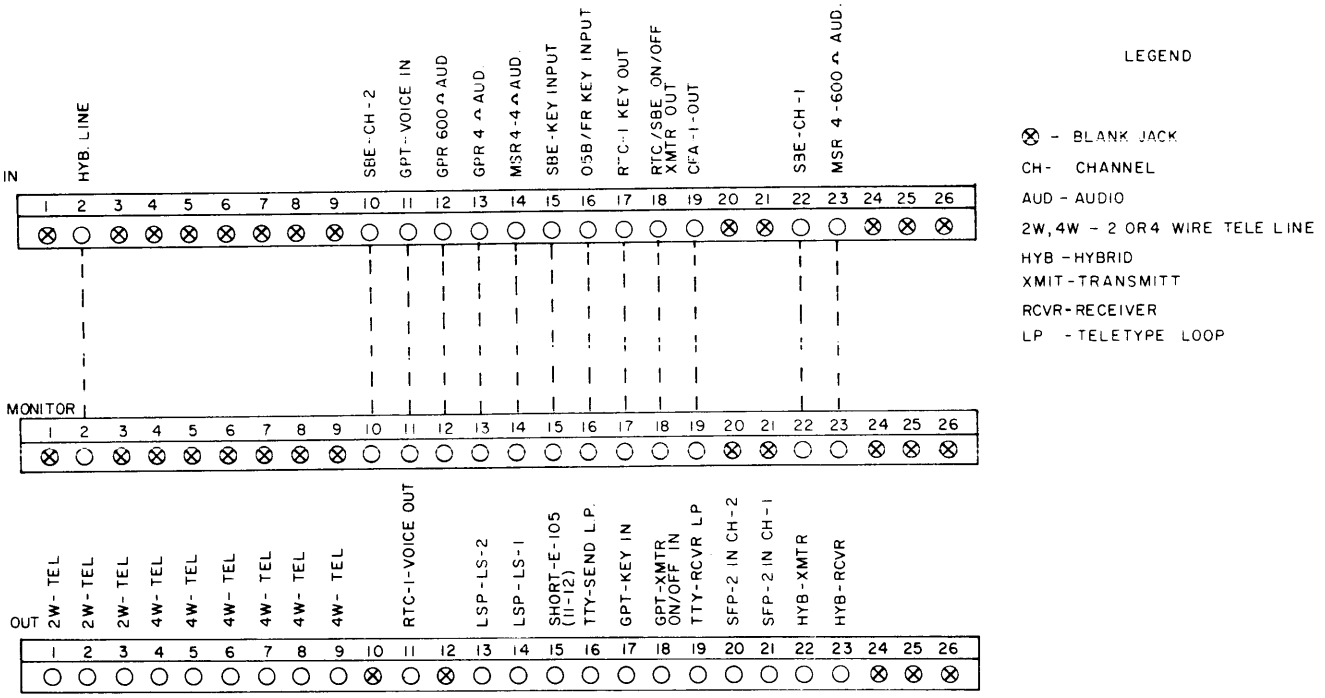
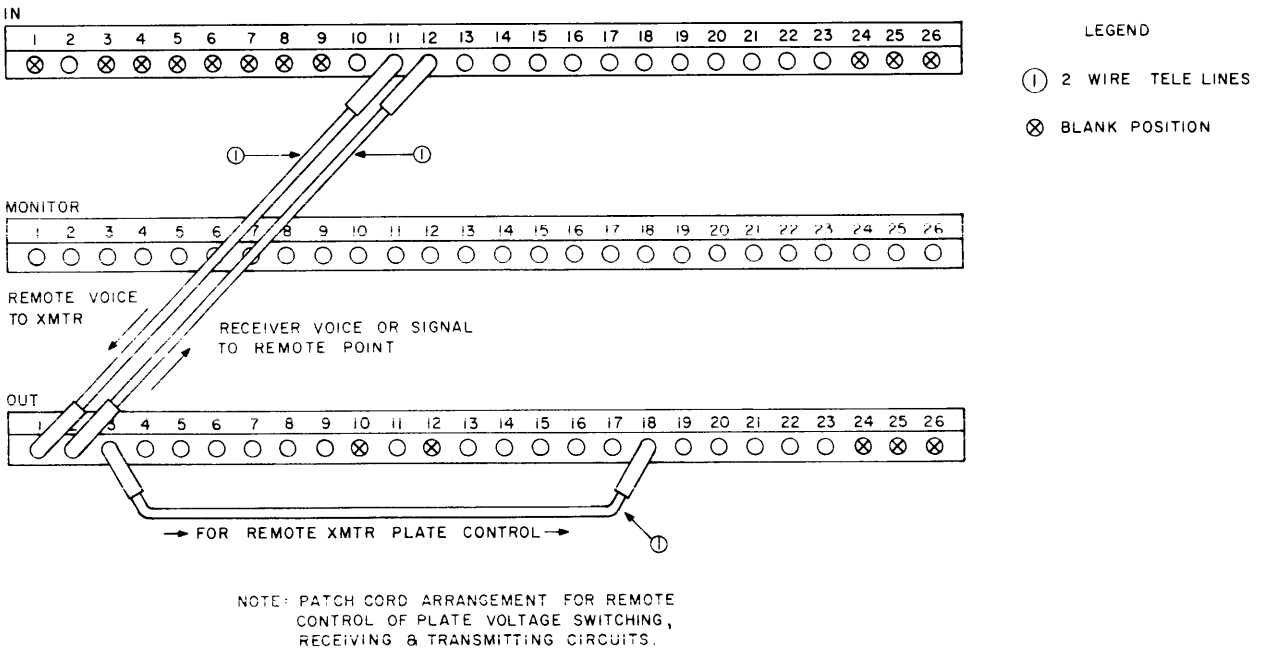
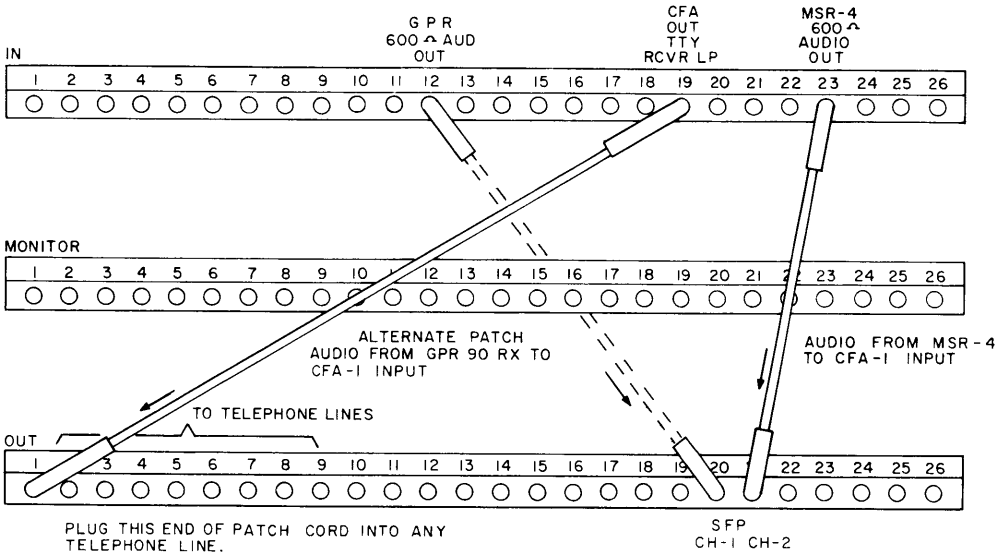


Figure 3-1. Patch Panel Circuits



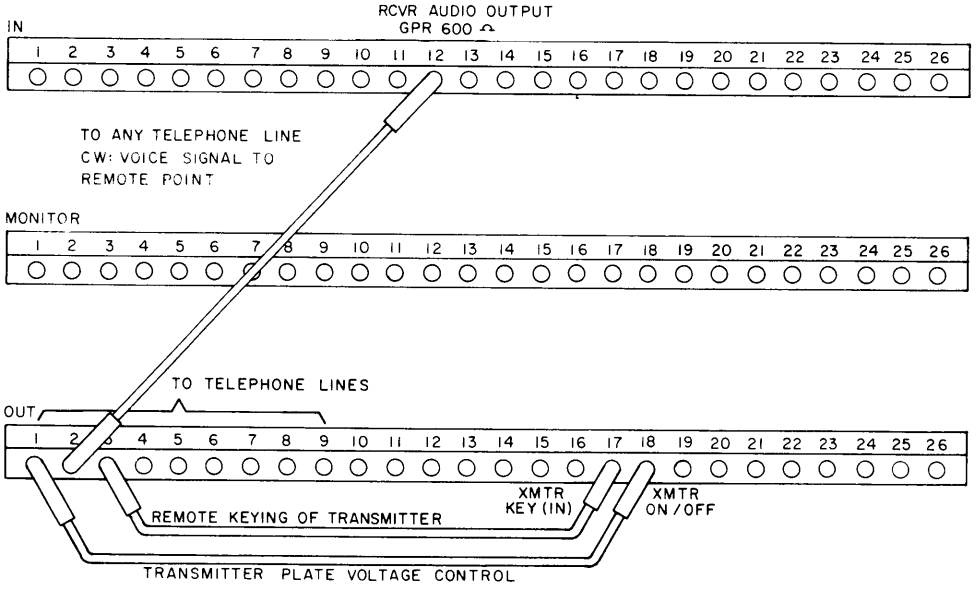
NOTE: PATCH CORD ARRANGEMENT FOR REMOTE CONTROL OF PLATE VOLTAGE SWITCHING, RECEIVING & TRANSMITTING CIRCUITS.

Figure 3-2. Remote Patching



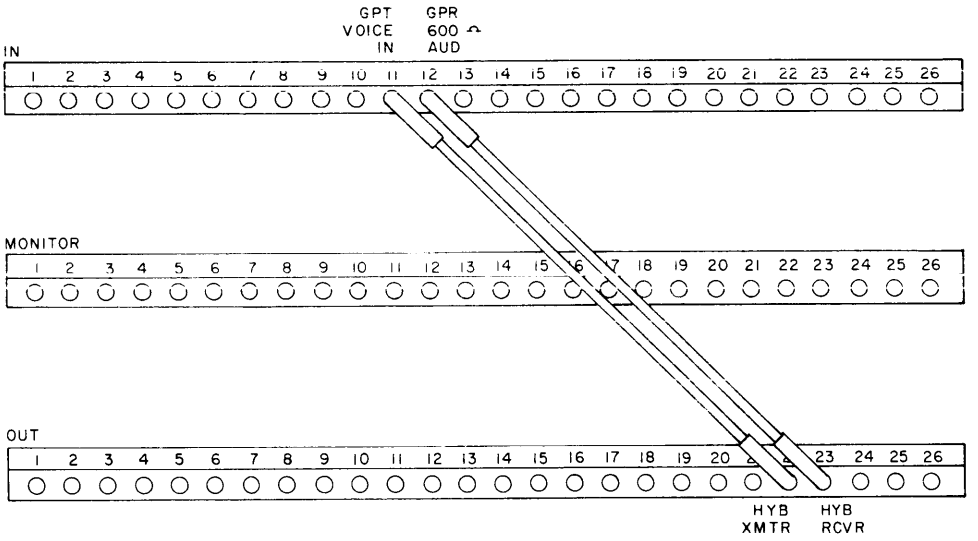
PATCHING ARRANGEMENTS FOR FEEDING A RECEIVED RADIO TTY SIGNAL INTO A TELEPHONE LINE TO REMOTE PRINTER
ALTERNATE PATCH FROM GPR-90-RX 600Ω AUDIO OUTPUT TO SFP-2 CH-1 OR CH-2 IF PREFERRED TO PATCH FROM J23 TO J21

Figure 3-3. Remote Printer Patching



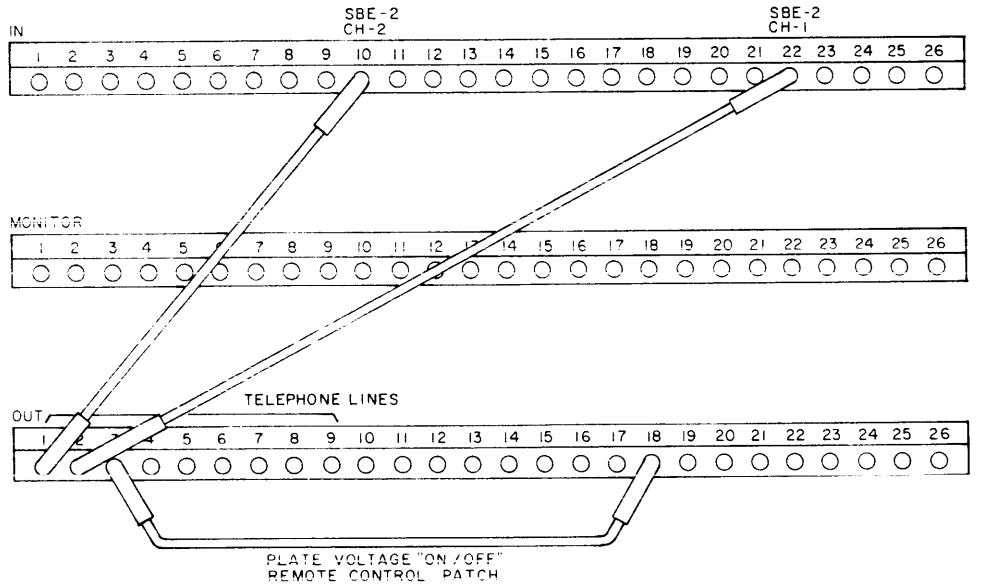
PATCH CORD ARRANGEMENT FOR REMOTE KEYING & RECEIVING OF CW SIGNALS.

Figure 3-4. Remote CW Patching



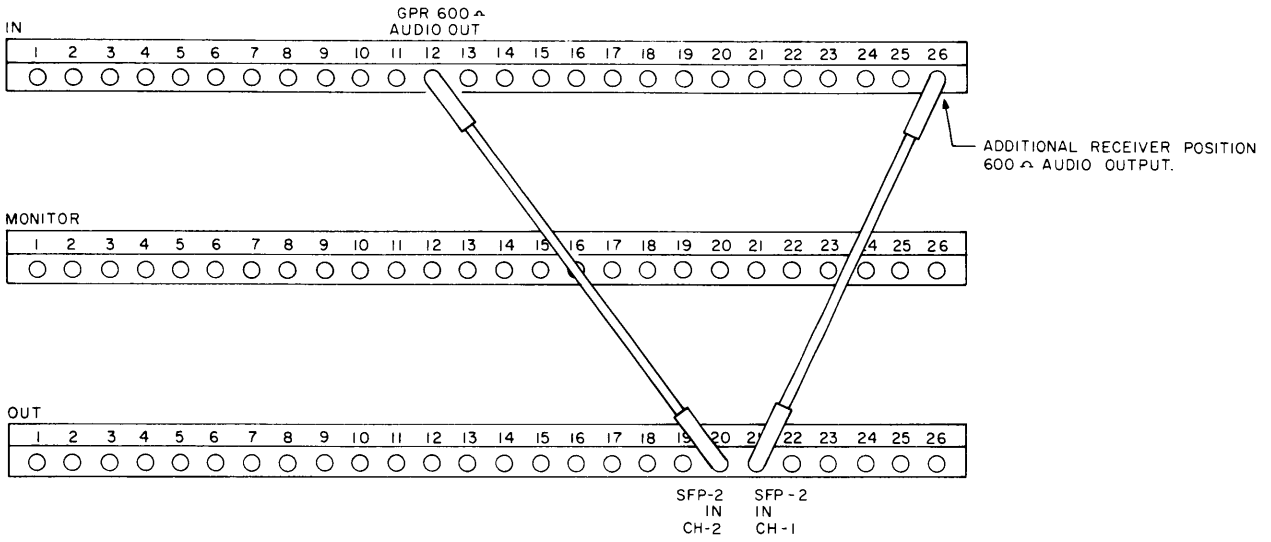
PATCHING FOR 2 WIRE 2 WAY AMPLITUDE VOICE
MODULATION. TELEPHONE CONFERENCE (TELECON)

Figure 3-5. Telephone Conference Patching



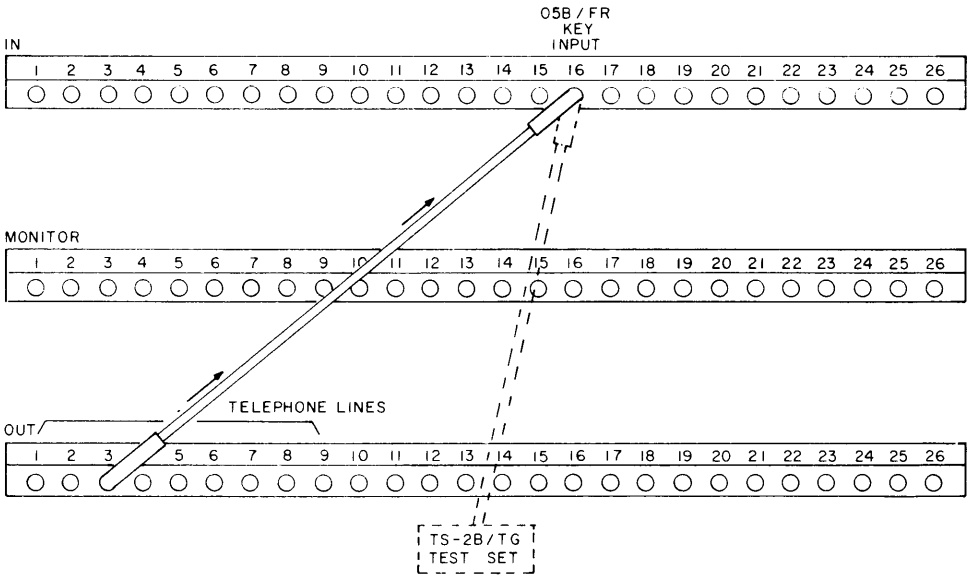
PATCHING ARRANGEMENT FOR REMOTE AUDIO CONTROLLED TRANSMISSION
OF INTELLEGENCE WITH ISB MODE OF TRANSMISSION.

Figure 3-6. Remote Audio Patching



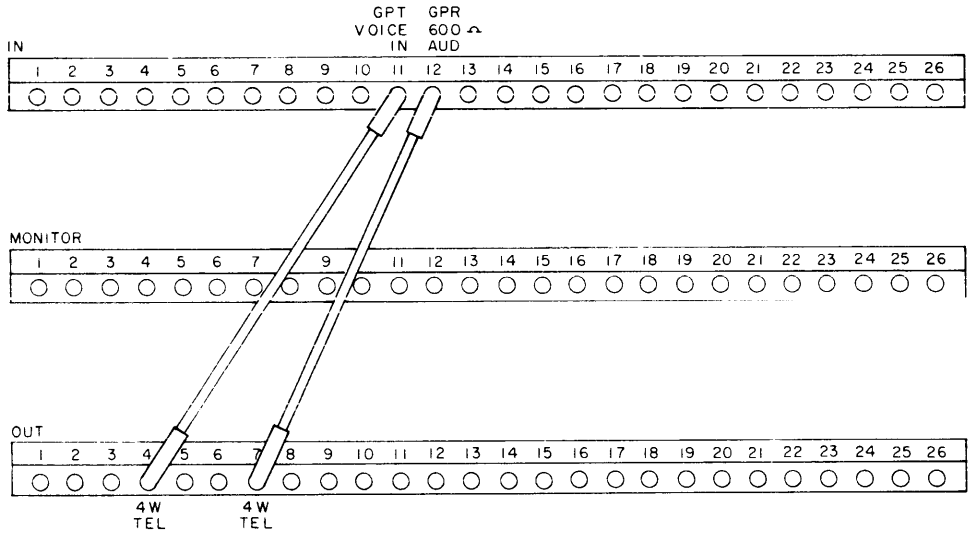
PATCHING ARRANGEMENT WITH TWO RECEIVERS FOR AUDIO DIVERSITY RECEPTION.
SECOND GPR-90-RX 600Ω AUDIO OUTPUT MAY BE CONNECTED TO BLANK J-26 POSITION.

Figure 3-7. Diversity Reception Patching



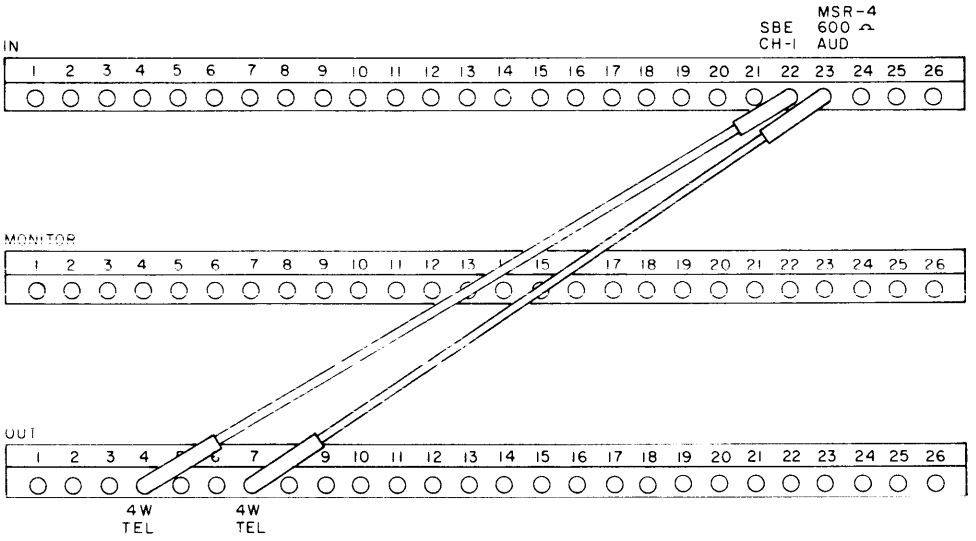
PATCHING ARRANGEMENT FOR REMOTE TTY KEYING SIGNAL
USE OF TS-2B/TG TEST SET IS SHOWN IN DOTTED LINES.

Figure 3-8. Remote Teletypewriter (TTY) Patching



PATCHING FOR 4 WIRE AMPLITUDE MODULATION
TELEPHONE CONFERENCE (TELECON)

Figure 3-9. Telephone Conference Patching (AM)



PATCHING ARRANGEMENT FOR SSB 4 WIRE
TELEPHONE CONFERENCE (TELECON)

Figure 3-10. Telephone Conference Patching (SSB)

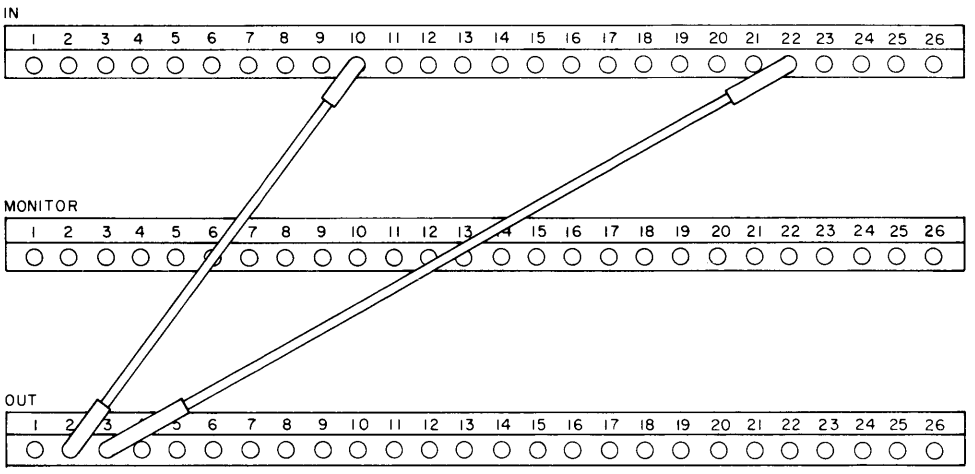


Figure 3-11. Independent Sideband Patching

SECTION 4
PRINCIPLES OF OPERATION

4–1. GENERAL. (See figure 4-1.)

Principles of operation are covered in the respective instruction manuals. Only those units not specifically covered elsewhere are discussed in this section.

4–2. LOUDSPEAKER PANEL LSP-7.

Figure 4-2 shows the arrangement of the LSP-7. Note that the ganged potentiometers form a pad which presents a nearly constant impedance to both the receiver output and loudspeaker, yet permits full adjustment of loudspeaker level.

4–3. AUDIO AND DC PATCHING PANEL CPP–4.

Figure 4-3 shows the wiring arrangement of the CPP-4. The CPP-4 permits the operator to apply an external signal source into any of the units, or, if desired, to connect the output of a unit to external equipments. In addition, by using a patch cord, any combination of units within the system can be patched or connected together by simply inserting the cable plugs into the correct jacks. This facility is accomplished by 78 dual-circuit jacks which are divided into 3 rows, each of which contains 26 jacks. These rows of jacks are designated ROW 1 IN, ROW 2 MON, and ROW 3 OUT. Each ROW 1 IN and ROW 3 OUT jack is connected to a unit input and output, respectively. Each pair of input and output jacks is connected in series. In this manner, with no plug inserted, the two jacks are used to route the signal output from one unit to the input of another. Patch cords may then be used to patch various combinations of units together. Each ROW 2 MON jack bridges a pair of series-connected ROW 1 IN and ROW 3 OUT jacks, thus permitting signal flow between the two units to be monitored externally. Terminal boards E101 through E108 provide the means by which the input and output of each unit in the rack are connected to their respective jacks.

4–4. HYBRID UNIT.

The hybrid unit used in the SY-1031 is of the transformer type. It serves to isolate the receiver output from the transmitter input and permits both to be connected to a two-wire telephone line. Figure 4-4 shows a simplified diagram of the hybrid unit.

The hybrid unit is a variation of the balanced-unbalanced AC bridge. That is, it is balanced to AC, injected into the circuit at one point, and unbalanced when it is applied at another point. Since the hybrid must be balanced for one phase of its operation, there is a requirement for at least one adjustable leg of the bridge. This leg is indicated in the figure by BALANCING NETWORK. This network is designed to provide a compromise value which is suited to typical telephone line impedance values.

4–5. GPT–750–B2 INTERLOCK CIRCUIT.

Figure 7-1 shows the interlock circuit of the GPT-750-B2 which provides safety to the operator.

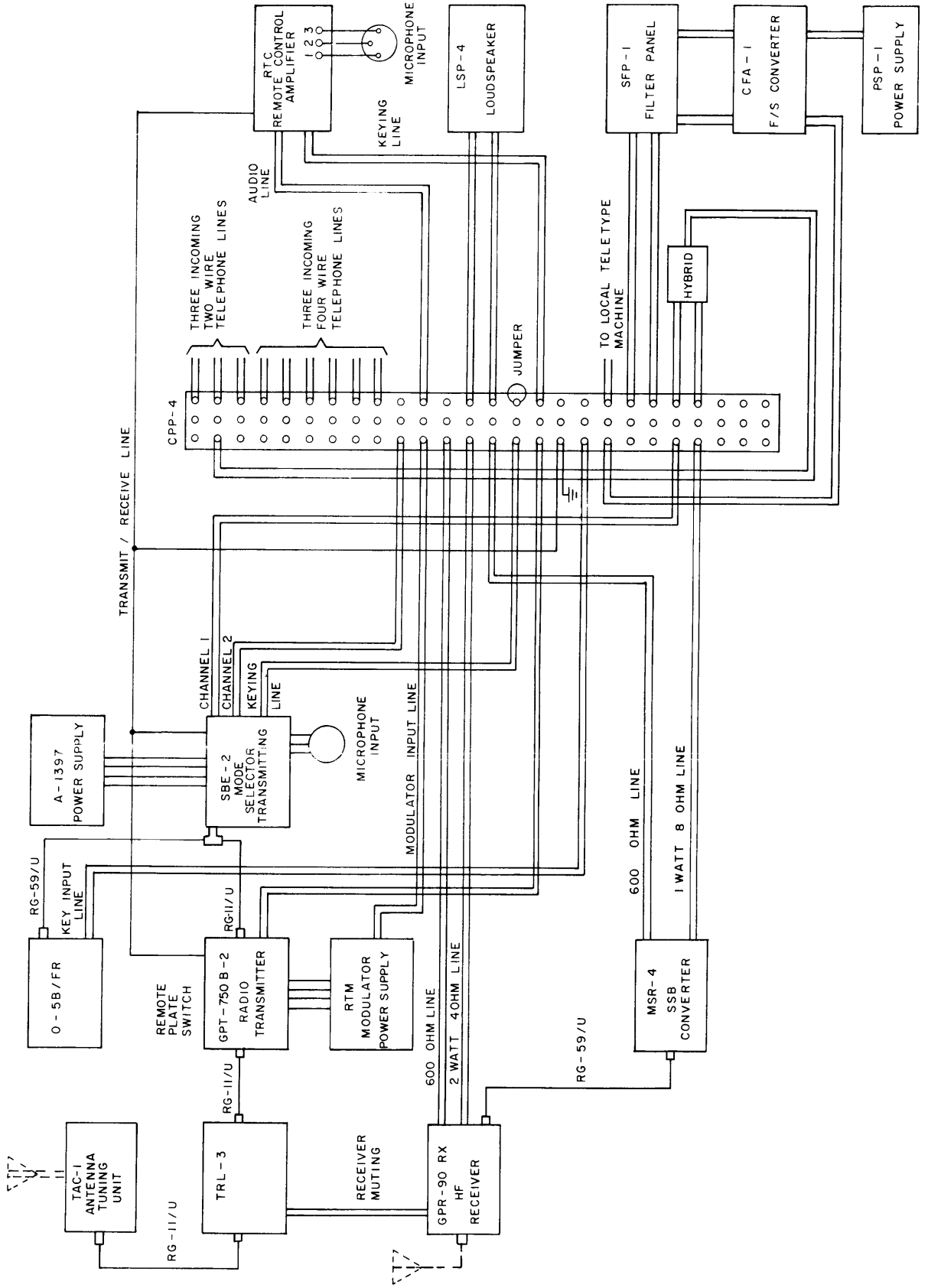


Figure 4-1. Block Diagram, SY-1031

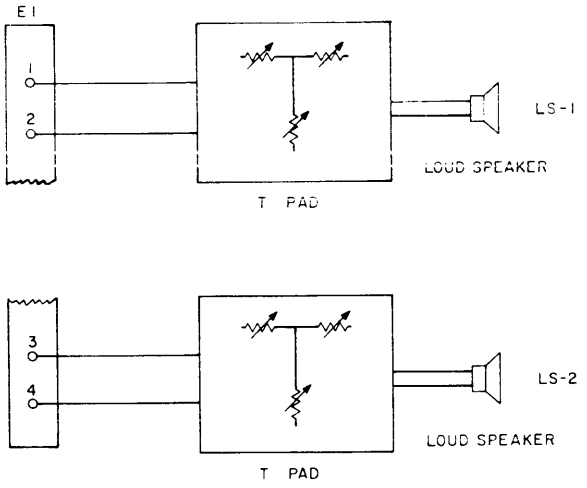


Figure 4-2. Block Diagram, LSP-7

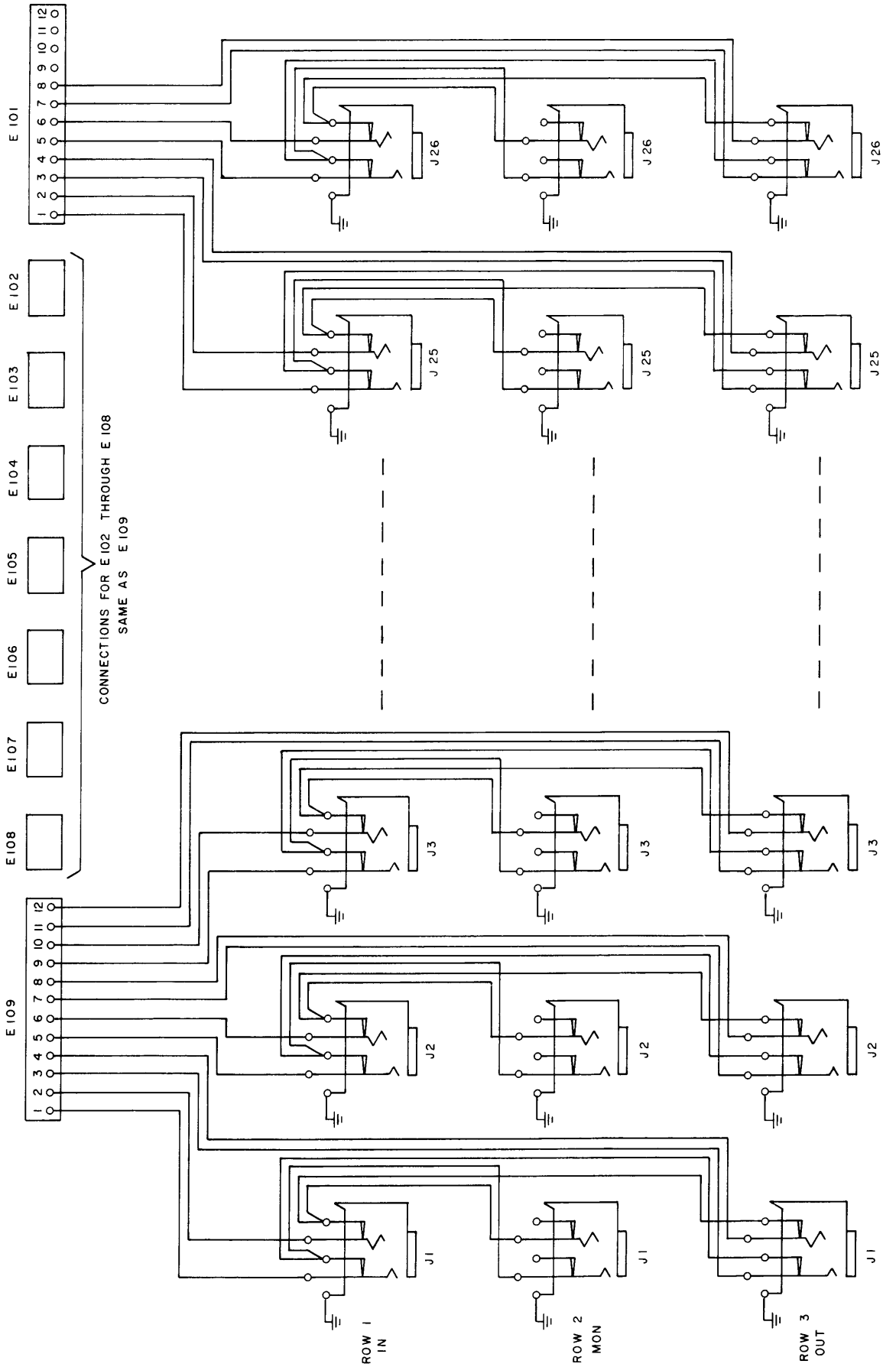


Figure 4-3. Wiring Diagram, CPP-4

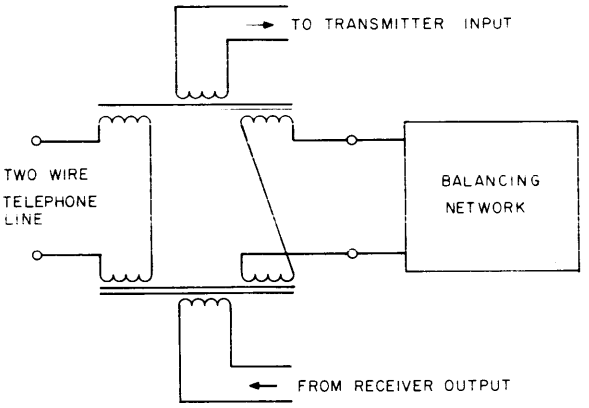


Figure 4-4. Simplified Diagram, Hybrid Unit

SECTION 5
TROUBLE-SHOOTING

5–1. OPERATIONAL FAILURE.

In servicing the equipment, the defective component which caused operational failure should be localized through an orderly systematic procedure. Start the procedure as follows:

a. Observe all meters for abnormal readings; observe indicator lights. Also note any other visual indications such as arcing. This may help to isolate the stage at fault.

b. Check accessible components, such as vacuum tubes, which are a major source of electronic trouble, before proceeding to any detailed servicing. If tubes are not at fault, the defective circuit and its associated components should be checked systematically for continuity, resistance readings, voltage readings, defective resistors, shorted capacitors, loose connections, etc. Test equipment such as a volt-ohm-milliammeter or VTVM are useful for these tests.

c. When performing circuit continuity checks or resistance measurements, take into account other components which may be in parallel with the part under test. In such cases, disconnect one lead of the part being checked before proceeding with measurements. Make full use of all schematic diagrams and trouble-shooting information provided in individual equipment manuals.

d. Intermittent trouble is the most difficult to trace. Electrical faults which are intermittent are usually caused by mechanical failure due to heating. The technician should suspect that heating or overheating is causing a break in the circuit of a component. The break joins when the part cools, but its operational heat breaks the loose joint and the component fails. The fault may be a short circuiting within the part, which occurs when heat expansion brings two elements of the part together and allows them to separate when the part cools. Either of these effects may be found in defective vacuum tubes, wire-wound resistors, chokes, and transformers. A charred appearance or characteristic odor identifies a resistor which has been damaged by overheating. Sealed transformers and chokes are not easily proven defective. Sometimes it is possible to trace the trouble to a transformer or choke only by elimination. Test tubes for intermittent troubles by substituting good tubes. Allow the unit to operate long enough to make sure that the tubes actually were defective.

e. It is not enough to replace a part damaged by overheating. The cause of trouble must be determined whenever possible so that the replacement part is not damaged or destroyed. Examine the wiring as well as adjoining and connected parts until the cause of the trouble is determined and repaired.

f. Should decreased performance become evident, the cause should be located and repaired for dependable performance in case of emergency. The causes are usually due to the gradual failure of a part such as a tube or capacitor.

g. Total failure requires a systematic search of the unit, usually beginning with the power supply, and depends upon voltage and resistance readings obtained at various points.

5–2. VACUUM TUBES.

A major source of trouble is often electron tubes. A tube suspected of causing difficulty should be checked on a reliable tube tester.

5–3. ALIGNMENT.

Alignment should only be attempted if there is a definite indication that it is required. Often an appearance of misalignment is due to an incorrectly positioned bandswitch. Also check knobs to ascertain that the pointers are oriented correctly. When alignment is required, refer to the respective equipment manuals for procedure.

SECTION 6
MAINTENANCE

6–1. GENERAL.

All equipment used in the SY-1031 has been selected for ease of maintenance with maximum accessibility to components. Slide-out drawers in the GPT-750-B2 especially facilitate access.

No special techniques are required for servicing the equipment with the exception of the master oscillator. No attempts should be made to open the oscillator oven, and servicing should be limited to replacement of tubes and the replaceable thermostat assembly. Instructions are given in the GPT-750-B2 manual.

Alignment procedures, voltage charts, resistance charts, and schematics are provided in each manual. These procedures should be followed closely.

SECTION 7
SCHEMATIC DIAGRAMS

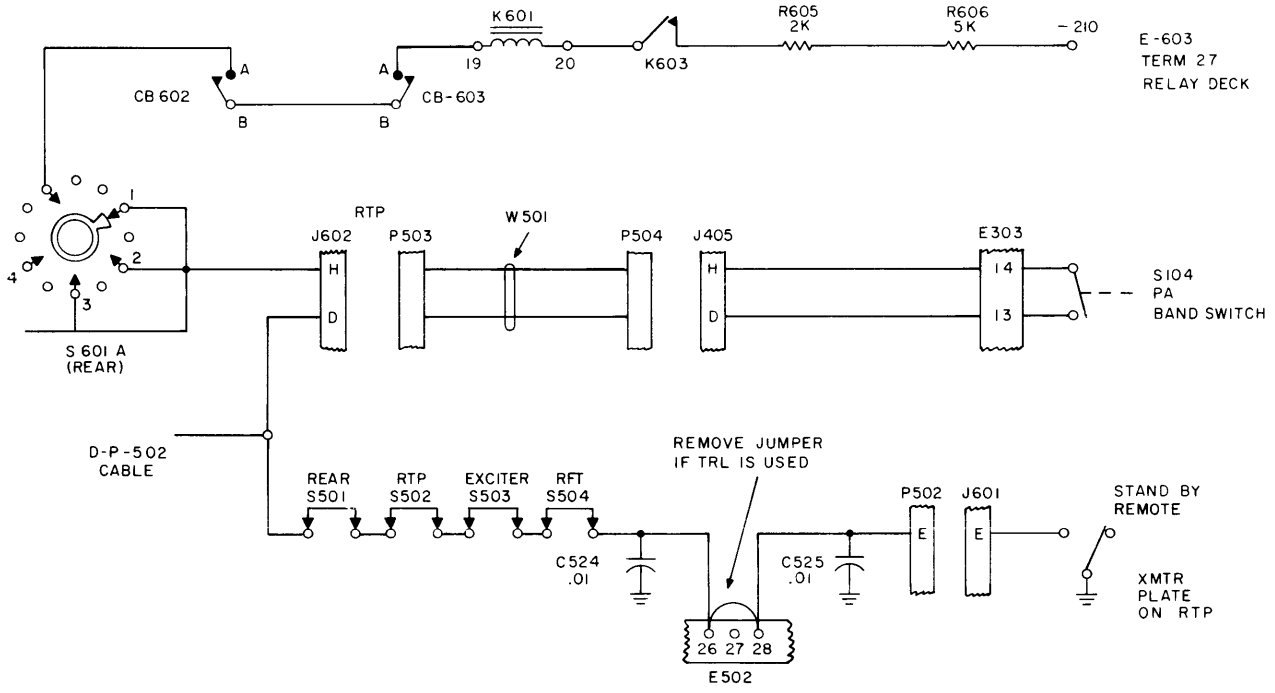


Figure 7-1. Interlock Circuit, GPT-750-B2

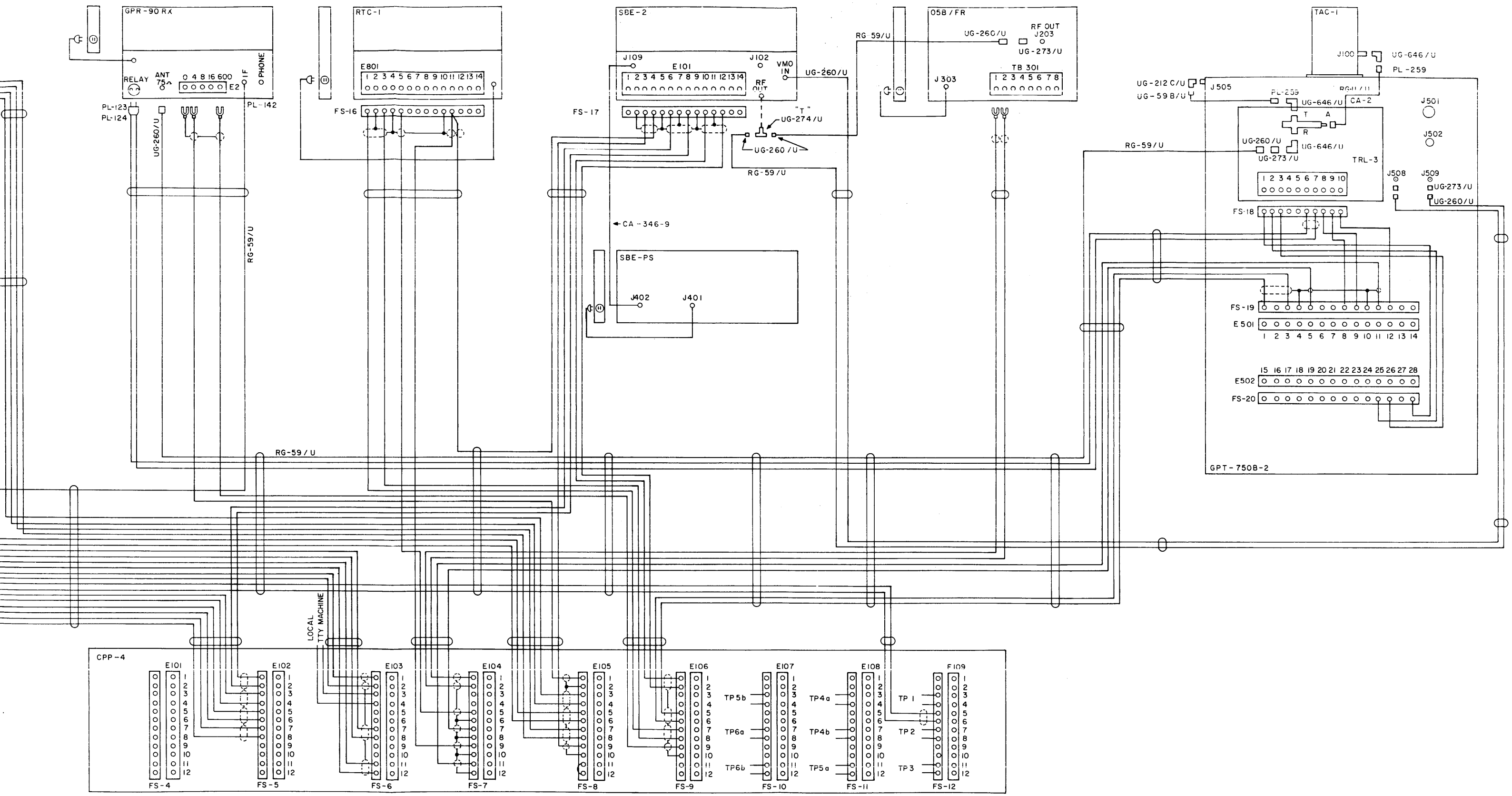
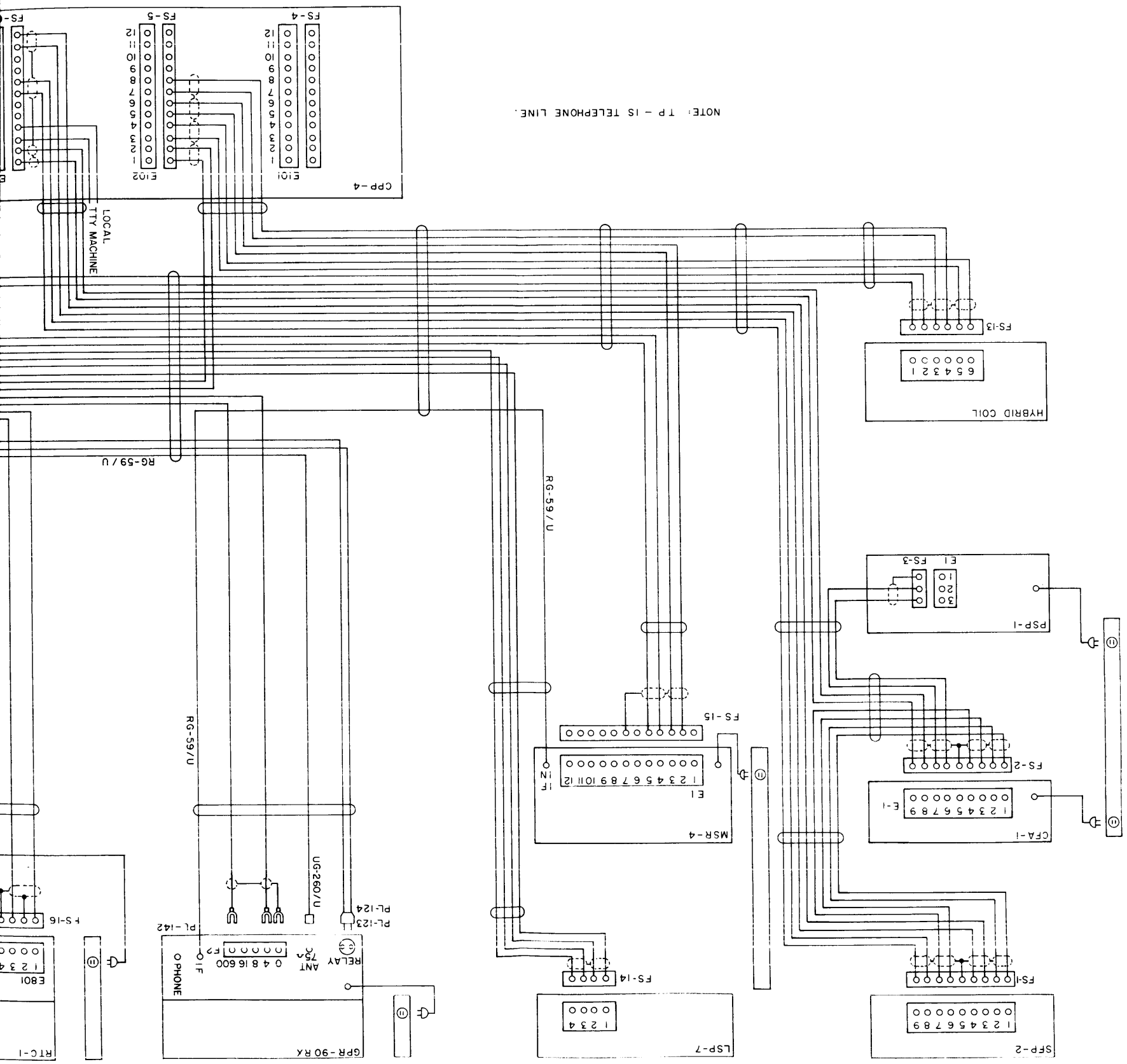


Figure 7-2. Interconnecting Diagram, SY-1031


NOTE: TP - IS TELEPHONE LINE.
CPP-4
FS-4
FS-5
E1C1
E1C2
LOCAL TTY MACHINE
HYBRID COIL
FS-13
RG-59/U
RG-59/U
RG-59/U
UG-260/U
PL-123
PL-124
PL-142
GPR-90 RX
O PHONE
RELAY
ANT 75Ω
FS-16
E801
RTC-1
FS-15
MSR-4
E1
IF IN
FS-14
LSP-7
FS-3
PSP-1
FS-2
CFA-1
E-1
FS-1
SFP-2