

## INSTALLATION AND OPERATION

The digital electric clock, the ten-minute timer, the SWR meter, and the phone patch, are independent sections within the Station Console. The installation and operation of each of these sections will be presented separately. Figure 1 (fold-out from Page 26) shows the location of front panel controls and switches. Figure 2 shows the connectors, jacks, controls, and switch located on the rear of the chassis.

### DIGITAL ELECTRIC CLOCK

#### Installation

No special installation of the clock is required, since it runs whenever the line cord is connected to a 120 volt 60 Hz AC power line.

#### Operation

To set the clock, rotate the numbered minute and hour drums until the correct time appears in the window of the escutcheon. Do not move the drums when the seconds indicator is near 60. If you desire to set the seconds drum to an accurate time standard (National Bureau of Standards station WWV, for example), disconnect the line cord from the AC power line and wait for the time standard seconds to match the seconds indicated on the clock. Then plug in the line cord and set the minute and hour drums as before.

### TEN-MINUTE TIMER

#### Installation

Connect the line cord to a 120 volt 60 Hz AC power line. The ten-minute timer requires no other installation.

#### Operation

Turn the TIMER switch to either VISUAL or AURAL. The neon pilot lamp will indicate that the timer is on. Press the RESET button. After a time interval of approximately ten minutes, slowly turn the Coarse control until the IDENTIFY window in the escutcheon lights. The IDENTIFY window will light and the buzzer will sound when the TIMER switch is in the AURAL position.

NOTE: The timer measures an interval that begins when the RESET button is pressed, or when the TIMER switch is turned from Off to either VISUAL or AURAL. To increase the timing interval, turn the TIMER ADJUST controls clockwise. To decrease the interval, turn the controls counterclockwise. The Coarse control permits you to adjust the time interval to within a minute, and the Fine control allows adjustment to within seconds of the desired interval.

The timed interval repeats automatically after the IDENTIFY window lights or the buzzer sounds. The time interval will restart at any time during the cycle if the RESET button is pressed.

When the timer is used with an amateur station, it is a good practice to press the RESET button at the beginning of a transmission. The IDENTIFY light or the buzzer will remind the operator to give his station identification, or call letters, every ten minutes.

The TIMER switch can be left in the OFF position when the timer is not in use, since the ten-minute timer has no effect on the SWR meter or phone patch sections of the Console.

### SWR METER

#### Installation

The SWR meter section of the Console connects between the transmitter output and the antenna transmission line with standard coaxial connectors. The meter can be used with either 50-52  $\Omega$  or 70-75  $\Omega$  transmission lines, depending on the values of resistors R1 and R2 that were installed in the SWR bridge during assembly. The meter will not perform properly in transmission lines of other impedance, or with lines that are used as tuned feeders. No AC power is needed to operate the SWR meter.

- ( ) Cut the coaxial transmission line at a place that will allow the Console to set at a convenient location. Install male coaxial connectors on the cable ends.



- ( ) Connect the transmitter output cable to the RF Input connector and connect the antenna cable to the RF Output connector on the rear of the Console. See Figure 2.

NOTE: If an antenna coupler is used, connect the SWR meter between the transmitter and the antenna coupler with coaxial cable of proper impedance. Then the tuner can be adjusted for maximum output and minimum standing wave ratio.

## Operation

Before you apply power to the transmitter, turn the MODE switch to SWR METER, the SWR METER switch to FWD, and the SENSITIVITY control to MIN.

1. Turn on the transmitter and tune it. Disregard any SWR Meter readings during transmitter tuning.
2. After the transmitter is tuned, and with power still applied, set the SENSITIVITY control for a midscale reading on the SWR meter.

NOTE: You may wish, at this time, to "touch up" the tuning of the transmitter. If this "touch up" increases your output, as shown by an increase in the SWR meter reading, you will have obtained a closer match between the transmitter and the transmission line.

3. Set the SENSITIVITY control to give a full-scale (SET) meter reading.
4. Turn the SWR METER switch to REV. The standing wave ratio (SWR) can now be read directly on the meter.

NOTE: The SWR meter can be switched between FWD and REV during transmission and no switching transient will result, since the switch is connected in a low-power bridge circuit. The SWR meter may be left connected in the transmission line at all times for continuous monitoring purposes.

## Normal Operating Characteristics

The minimum transmitter output power that is needed to operate the SWR meter varies with frequency. 70 watts are needed for full-scale deflection on 75 meters with the SWR METER switch in the FWD position, while only 2 or 3 watts are required for full-scale deflection on 6 meters. At low power levels where full-scale deflection cannot be obtained, the reflected power indicated with the switch in the REV position will be approximately proportional to the ratio between the actual and full-scale FWD meter readings. For example, if the transmitter output power will only drive the meter to 70% of full scale, then the SWR that you read on the meter in the REV position will only be 70% of the actual SWR in your transmission line.

As the transmitter is voice modulated, the meter will deflect downward slightly. This will occur when the SWR METER switch is in the FWD position; it should not be confused with downward modulation. This effect is generally due to a nonlinear relationship between the voltage and current in the final amplifier of the transmitter, and should not alarm the operator since it is entirely normal with high level modulation.

Control carrier modulation will "kick" the meter indication upward on peaks. SSB and DSB signals will give a bouncing indication when transmitting, so no SWR measurement can be made. Therefore, use a single-tone or CW carrier with sideband transmitters when taking readings. When operating SSB, any meter indication with no modulation indicates spurious or parasitic emission, or poor carrier suppression.

## Physical Placement and Losses

The meter readings may vary if the SWR meter is placed at different locations in the transmission line, or if the length of the transmission line is changed. For this reason, assume that the highest SWR reading is most correct. Keep in mind that the closer the SWR approaches 1:1; the more accurate the SWR meter becomes.

Misleading meter readings may be obtained with long transmission lines, since the losses in the cable tend to "smooth out" the standing waves. This condition may give you a much better indication at the transmitter than actually exists at the antenna. Therefore, if you are using a transmission line long enough to have appreciable losses, locate the SWR meter near the antenna, especially when adjusting beams or tuning traps. You can better understand the extent of this effect when you realize that a line with a 3 db loss will show a SWR of 3 when it is terminated in a dead short. A line with a loss of over 10 db will show a SWR of practically 1:1, on this or any other SWR meter, regardless of what load or termination is connected at the far end.

The power losses in these cases occur in the cable, but the SWR meter reading will not indicate that anything is wrong. When in doubt, make measurements at the antenna and at the transmitter, so future changes in the readings will be meaningful. The values of cable losses

at various frequencies can be obtained from Figure 3. These losses become worse as time and moisture affect the cable.

With a high SWR, the transmission line losses may become so great that the radiated power is appreciably reduced; with high-power transmitters, the cable ratings may be exceeded. Figure 4 shows the effect of increasing cable losses caused by various values of SWR. When these losses occur, the RF power is turned into heat in the cable instead of being radiated from the antenna.

To figure the total losses in a given length of coaxial cable, determine the db loss per foot of the cable from Figure 3. This is done by finding your operating frequency on the bottom line of the chart, and moving up to find the type of cable used. By looking at this same level on the left-hand side of the chart, you can read the db loss per 100 feet of the cable at that frequency.

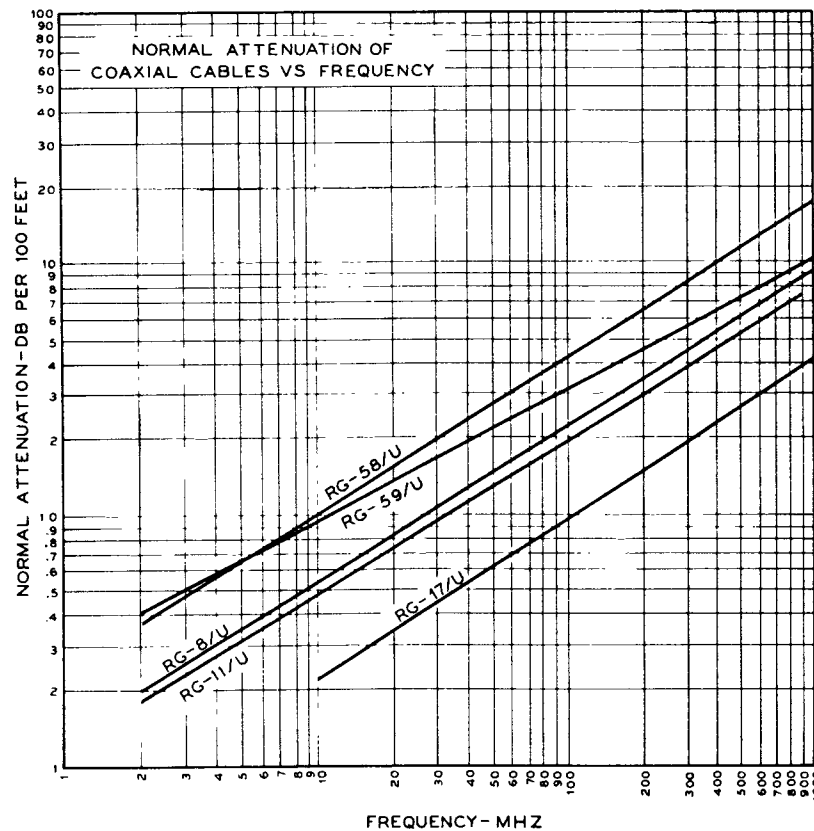


Figure 3

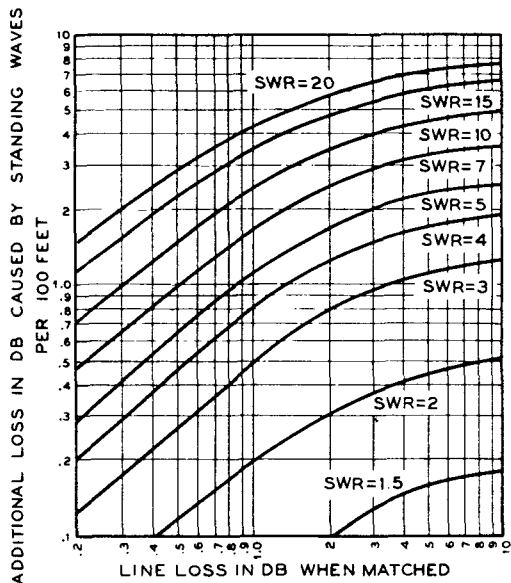


Figure 4

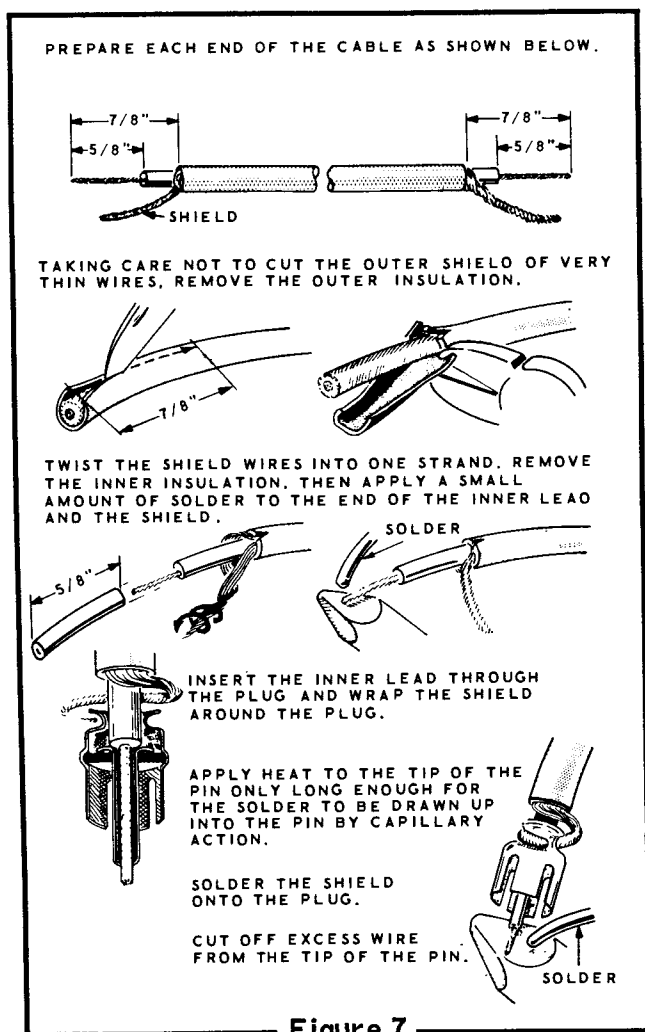
Now determine the additional loss caused by the SWR from Figure 4 as follows: Use the amount of loss determined from Figure 3 and find this value on the bottom line of Figure 4. Now move up the graph until you come to the SWR of your antenna system. Move over to the left-hand side of the graph and determine the amount of loss caused by the SWR. To obtain the total loss of your system, add the value from Figure 3 to the value from Figure 4.

### Loading

The load presented to the transmitter output circuit may create conditions that make it touchy or impossible to load the transmitter. With a low SWR, the load that the transmitter "sees" is practically pure resistive. However, at a high SWR, the apparent load may change from a very low to a very high resistance, accompanied by either capacitive or inductive reactance. These resistance and reactance values change when the transmission line length or frequency is changed.

Remember when you are using 50-52  $\Omega$  or 70-75  $\Omega$  unbalanced feed lines, that the SWR cannot be changed by changing the transmission line length. However, the loading to the transmitter may be changed considerably, thus making it appear that "pruning" the cable length offers improvement, when it actually does not affect the SWR.

The SWR can only be changed by changing the load or termination at the end of the cable. If the transmission line length is changed, for example, with 50  $\Omega$  cable and a SWR of 3, the apparent load to the transmitter may vary from 16-2/3  $\Omega$  to 150  $\Omega$  resistive, with reactance varying from 66-2/3  $\Omega$  capacitive, to zero, to 66-2/3  $\Omega$  inductive. If the transmitter output tuning adjustments will not accommodate this impedance range, the transmitter will be difficult to load until the load is properly matched to the line. When the load is matched, the SWR will be lower.



- ( ) If not previously done, install a phono plug on the end of the lead from your station speaker. Connect this plug to the SPKR socket on the rear of the Console.
- ( ) Connect the SPKR terminal of the transmitter (may be marked "8  $\Omega$ " on transceivers) to the RCVR terminal on the back of the Console. Use the shielded cable provided. The shield wires will make the essential ground connection between the pieces of equipment.
- ( ) Connect the HI-Z phone patch output to the PHONE PATCH input of your transmitting equipment. Use shielded cable.

**CAUTION:** To prevent the telephone ringing voltage from damaging the VU meter, be sure the ON-OFF switch is turned to OFF before you connect any leads to the telephone line.

- ( ) Connect one of the two LINE terminals on the back of the Console to the red wire on the telephone terminal block, and the other LINE terminal to the green wire on the terminal block. Polarity is not important. Disregard the yellow wire on the terminal block.

## PHONE PATCH

### Installation

#### HEATH SB SERIES OF EQUIPMENT

To illustrate installation of the Phone Patch a transceiver, a receiver-transmitter combination, and a speaker have been selected from the Heath SB series of amateur equipment. Use the shielded audio cable and the phono plugs supplied to interconnect the equipment as shown in Figure 5 (fold-out from Page 26) and Figure 6 (fold-out from Page 35). Refer to Figure 7 for the installation of phono plugs.

#### EQUIPMENT OTHER THAN HEATH

Connections to other makes of equipment will vary in details, but the same basic principles will apply. Some notes and suggestions follow:

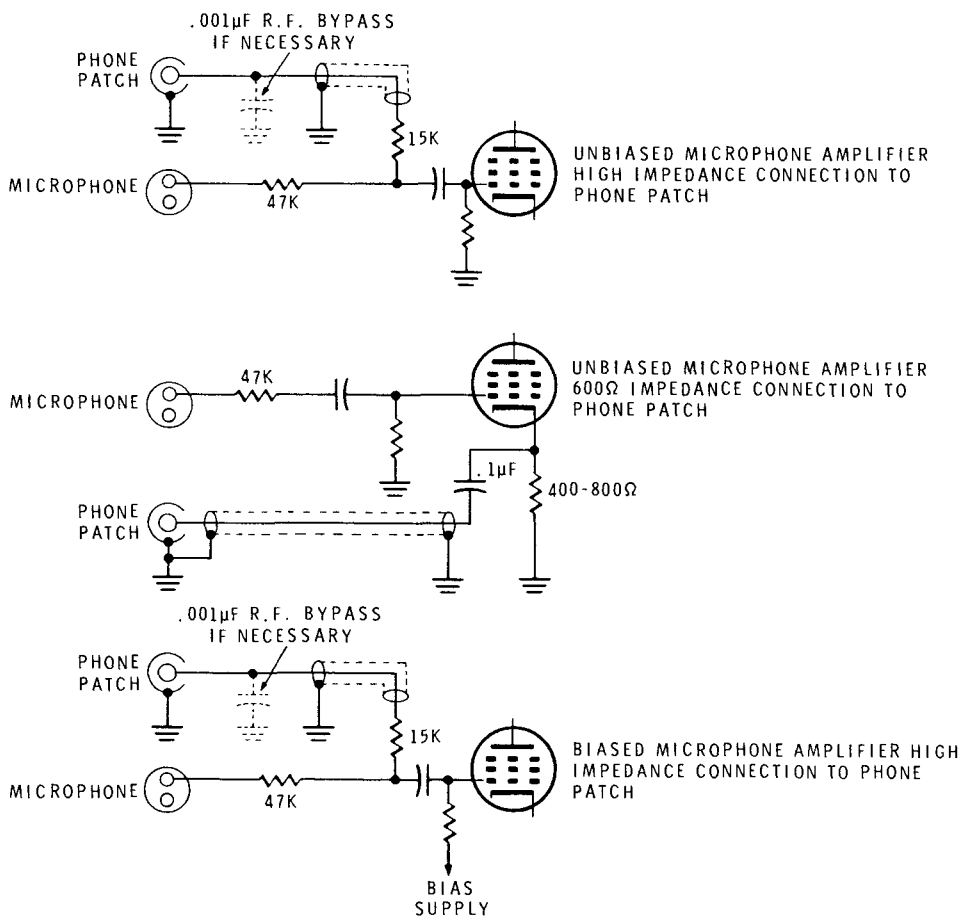
1. Use shielded wire for all audio interconnecting lines as an aid in the suppression of RF feedback. It is usually unnecessary to use shielded wire between the telephone terminal block and the Phone Patch.
2. If not already provided, arrangements should be made to mute your receiver and to open the SPKR lead when transmitting.

3. If you want to use voice control but no anti-vox output is provided on your receiver, use shielded wire to connect the Anti-Vox transmitter input to the SPKR and GND terminals on the back of the Phone Patch.
  4. Usually the HI-Z Phone Patch output will be associated with transmitter grid input circuits and the 600 Ω connection with cathode input circuits. Try both for suitability. Figure 8 shows some suggested microphone and Phone Patch output connections to the first audio stage of your transmitter.
  5. If one of the terminals of your speaker is connected to the metal speaker frame, or is grounded in some other manner, connect this terminal to the GND connection on the Phone Patch, and the other speaker terminal to the SPKR connection. If neither speaker terminal is grounded, polarity is unimportant.
  6. Make sure that shield wires are properly grounded at both ends to the equipment which they connect and that, if necessary, a separate ground wire interconnects all equipment.
- ( ) Readjust the Vox and Anti-Vox controls on your transmitting equipment after connecting the Phone Patch.

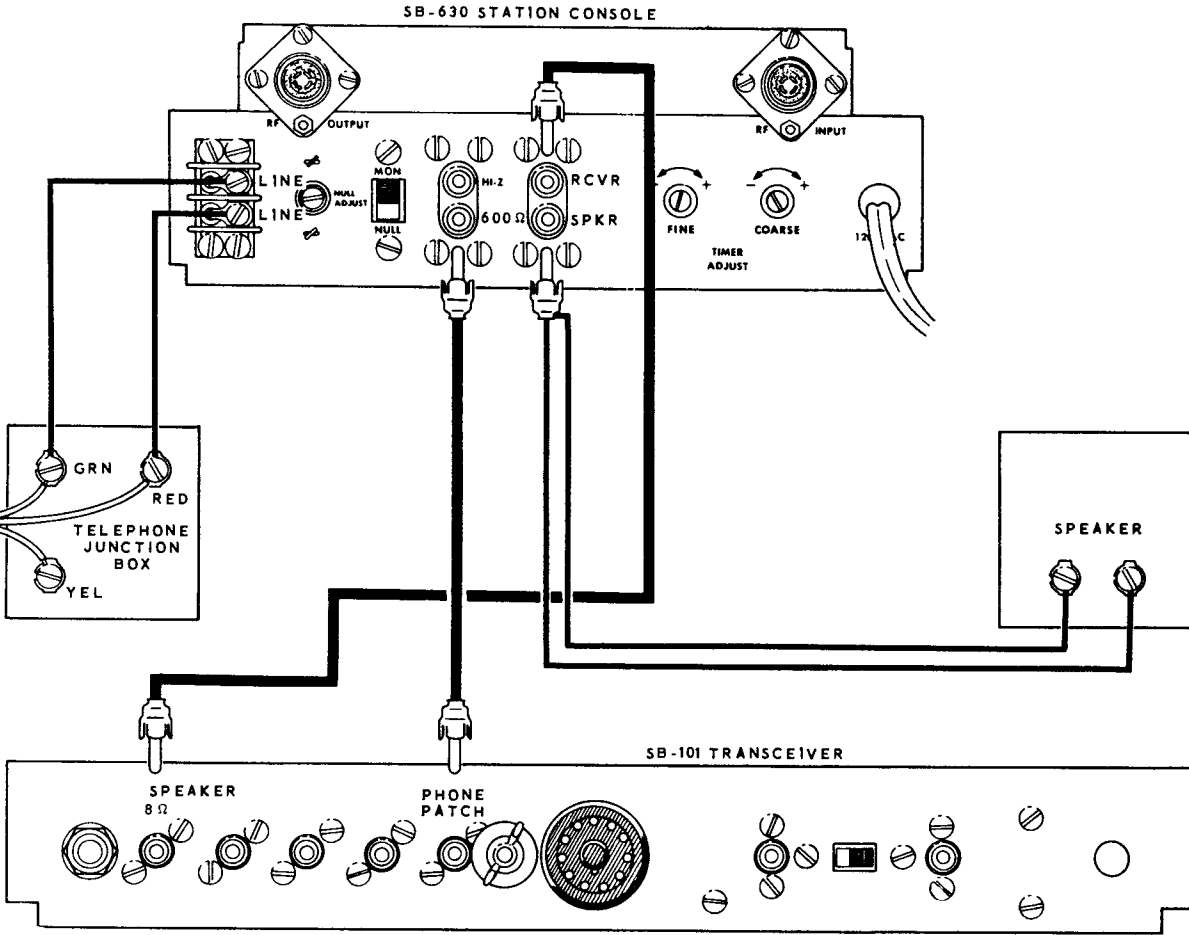
**Null Adjustment**

NOTE: Null adjustment is required only when the phone patch is to be used with voice-control operation. If only manual operation is to be used, omit the following steps and proceed to the Operation instructions.

CAUTION: Never try to make the null adjustment without actually placing a phone call. The impedance of a dead line, obtained when dialing only one digit, is different from the line impedance when a completed call is made.



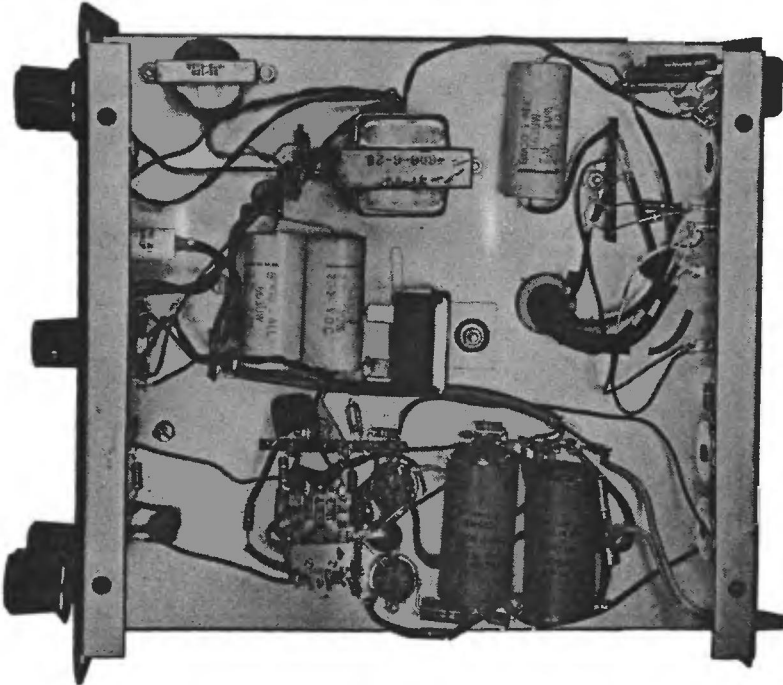
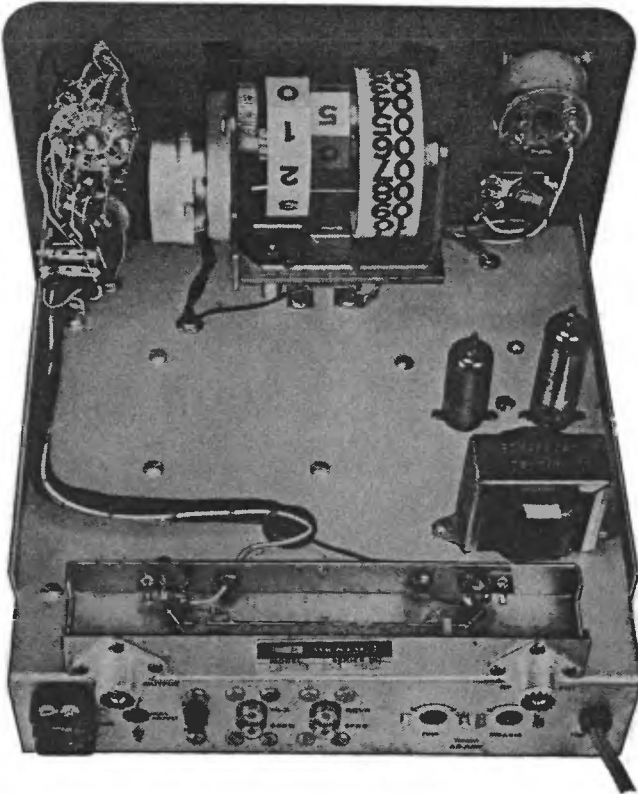
**Figure 8**



NOTE:  
 VOX AND ANTI-VOX ADJUSTMENTS  
 ARE INTERIOR ON THE SB-100 AND  
 SB-110 TRANSCEIVERS

**FIGURE 6**

CHASSIS PHOTOGRAPHS





- ( ) Set the Console controls and switches as follows:

NULL-MON switch - NULL.  
 NULL ADJUST control - Full counter-clockwise.  
 TRANS GAIN control - Full counterclockwise.  
 RCVR GAIN control - 2/3 clockwise.  
 MODE switch - SWR METER.

- ( ) Tune in a strong heterodyne note of about 800 cps on the receiver. This can be done by beating a crystal calibrator against the receiver BFO.
- ( ) Call a friend on the phone. Someone on a different line is best. Explain that there will be a strong tone in the telephone receiver, that he should keep the phone away from his ear, and that he can hang up when the tone stops.
- ( ) Leave your telephone handset off the hook, and turn the MODE switch to PHONE PATCH.
- ( ) Advance the receiver AF gain control until the VU meter on the Console indicates zero VU.
- ( ) Adjust the NULL ADJUST control for a minimum VU meter indication, -20 or less. This dip should occur with about one-half rotation of the NULL ADJUST control.
- ( ) Turn the MODE switch to SWR METER and hang up the telephone handset.
- ( ) Place the NULL-MON switch in the MON position.

This completes the Null Adjustment of the phone patch.

## Operation

The phone patch can be left connected at all times. When the MODE switch is in the SWR METER position, the phone patch is isolated from the telephone line. Use the phone patch in the following manner.

1. Be sure the MODE switch is turned to SWR METER; then dial the desired phone number.
2. When the called party answers, explain the procedure for speaking over a phone patch. Then turn the MODE switch to PHONE PATCH.

NOTE: When the NULL-MON switch is in the MON position, the VU meter indicates the listening level on the telephone lines. The telephone industry permits peaks up to zero VU. In testing the phone patch we have found that this level was much in excess of a comfortable listening level. The exact level will have to be determined by experimentation; however -10 VU seems to be satisfactory in most cases. NEVER PERMIT THE LEVEL TO EXCEED ZERO VU, AS IT MAY CAUSE CROSSTALK BETWEEN TELEPHONE CHANNELS.

3. Adjust the TRANS GAIN control to provide the desired modulation level, and adjust the RCVR GAIN to provide the desired listening level. It is not necessary to change the AF gain controls on the Receiver and Transmitter.
4. It is not necessary to switch the phone patch when changing from transmit to receive. The operator can use the telephone handset for a microphone and headset. When the phone patch call is completed, always turn the MODE switch to SWR METER.

## IN CASE OF DIFFICULTY

Since the SB-630 Station Console consists of several independent circuits, a difficulty that might occur in one circuit would not necessarily affect other functions of the Console.

The following General information can be applied to the circuits, or sections, that do not function properly, without checking those circuits that appear to be normal.

1. Recheck the wiring in the faulty section. Have a friend check your work. Someone who is not familiar with the unit may notice something that is overlooked by the builder.
  2. About 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as described in the Soldering section of the Kit Builders Guide.
  3. Check the values of the parts. Be sure that the proper parts have been wired into each circuit, as shown in the pictorial diagrams and as called out in the wiring instructions.
  4. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring.
- If your difficulty is in the ten-minute timer circuit, make the following additional checks.
5. Check to be sure that the tubes are in their proper locations. Make sure that tube V1 (6EW6) lights up properly.
  6. Check the tubes with a tube tester, or by substitution of tubes of the same types that are known to be good.
  7. If, after careful checks, the trouble is still not located and a voltmeter is available, check voltage readings against those shown on the Schematic Diagram. Note: All voltage readings were taken with an 11 megohm input vacuum tube voltmeter. Voltages may vary as much as 10%.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the Service and Warranty sections of the "Kit Builders Guide", and to the "Factory Repair Service" information on the fold-out from Page 44 of this Manual.

## Troubleshooting Chart

This Chart is divided into the following four parts; Clock Circuit, Timer Circuit, SWR Meter Circuit, and phone patch circuit.

### CLOCK CIRCUIT

DIFFICULTY	POSSIBLE CAUSE
Clock does not run.	<ol style="list-style-type: none"> <li>1. Line cord not connected.</li> <li>2. Fuse blown.</li> <li>3. Seconds dial drum rubbing against escutcheon window.</li> <li>4. Faulty wiring of clock leads to AC power circuit.</li> </ol>

### TIMER CIRCUIT

DIFFICULTY	POSSIBLE CAUSE
Tube V1 (6EW6) filament not lit.	<ol style="list-style-type: none"> <li>1. Timer switch in OFF position.</li> <li>2. Filament burned out.</li> <li>3. Tubes V1 and V2 in wrong sockets.</li> <li>4. Faulty wiring of filament circuit.</li> </ol>
No Identify light when Reset button is pressed; buzzer sounds when Timer switch is in Aural position.	<ol style="list-style-type: none"> <li>1. #47 pilot lamps burned out.</li> <li>2. Faulty wiring of pilot lamps or Timer switch circuits.</li> <li>3. Faulty Timer switch.</li> </ol>
Buzzer does not sound when Reset button is pressed if Timer switch is in Aural position.	<ol style="list-style-type: none"> <li>1. Faulty wiring of buzzer or Timer switch circuits.</li> <li>2. Faulty Timer switch.</li> </ol>
Neither buzzer nor Identify lights operate when Reset button is pressed.	<ol style="list-style-type: none"> <li>1. Timer switch in Off position.</li> <li>2. Dirty or faulty relay contacts 5 and 7.</li> <li>3. Faulty Reset pushbutton switch.</li> <li>4. Open 33 K<math>\Omega</math> resistor R29.</li> <li>5. Faulty Timer switch or its wiring.</li> </ol>
Identify lights and/or buzzer comes on when TIMER switch turned from Off position.	<ol style="list-style-type: none"> <li>1. Tube V1 (6EW6) shorted.</li> <li>2. Neon lamp NE2 shorted.</li> <li>3. Faulty circuit wiring.</li> </ol>

DIFFICULTY	POSSIBLE CAUSE
Identify light or buzzer does not signal ten minute interval.	<ol style="list-style-type: none"> <li>1. Tube V1 (6EW6) weak or dead.</li> <li>2. Capacitors C21, C22, C23, or C24 faulty.</li> <li>3. Resistors R22, R24, R25, R26, or R37 open.</li> <li>4. Faulty diodes D5 or D6.</li> <li>5. Dirty or faulty relay contacts.</li> </ol>

NOTE: Voltage checks in the electronic circuits, when compared with the voltages shown on the Schematic, may help you locate difficulties in the ten-minute timer.

### SWR METER CIRCUIT

DIFFICULTY	POSSIBLE CAUSE
No meter reading when transmitting.	<ol style="list-style-type: none"> <li>1. Mode switch in Phone Patch position.</li> <li>2. Diode D1 or D2 open.</li> <li>3. Jumper wire still connected across meter terminals.</li> </ol>
Meter deflects backward when transmitting.	<ol style="list-style-type: none"> <li>1. Diode D1 or D2 installed backward.</li> <li>2. Meter wires reversed.</li> </ol>
Low meter reading when transmitting.	<ol style="list-style-type: none"> <li>1. SWR Meter switch in REV position.</li> <li>2. Sensitivity control incorrectly set.</li> <li>3. Insufficient transmitter power.</li> <li>4. Resistor R1 or R2 open or wrong value.</li> <li>5. Capacitor C1 or C2 faulty.</li> </ol>

### PHONE PATCH CIRCUIT

DIFFICULTY	POSSIBLE CAUSE
No meter reading when receiving.	<ol style="list-style-type: none"> <li>1. RCVR gain control improperly adjusted.</li> <li>2. Null-Mon switch in Null position.</li> <li>3. Diode D3 faulty.</li> <li>4. Resistor R4 open.</li> <li>5. RCVR and SPKR plugs transposed.</li> </ol>
Poor transmitter gain.	<ol style="list-style-type: none"> <li>1. Null-Mon switch in Null position.</li> <li>2. TRANS gain control improperly adjusted.</li> <li>3. Wrong output impedance used.</li> </ol>
Deep null not obtained.	<ol style="list-style-type: none"> <li>1. Phone dialing not completed.</li> <li>2. Null Adjust control improperly set.</li> </ol>
No transfer of audio between telephone lines and station equipment.	<ol style="list-style-type: none"> <li>1. Mode switch in SWR Meter position.</li> <li>2. RCVR and TRANS gain controls improperly adjusted.</li> <li>3. Resistor R6, R7, R9, or R11 open.</li> <li>4. Transformers T1 and T2 incorrectly wired.</li> </ol>



## SPECIFICATIONS

### CLOCK

Dial. . . . .	4-drum, 24-hour, digital readout.
Motor. . . . .	1 rpm at "seconds" drum; gear driven.
Power Requirements. . . . .	120 VAC, 60 Hz, 3.7 watts. (Internally connected to Console AC line cord.)

### TIMER

Time Interval. . . . .	Adjustable to 10 minutes.
Time Stability. . . . .	Less than .2 percent change per hour in normal ambient temperature.
Time Cycle. . . . .	Instant reset with front panel pushbutton.
Signal. . . . .	Visual or both visual and aural; switch selected from front panel, with Off position.
Circuit. . . . .	Resistance-capacitance network. Neon-discharge, vacuum tube relay control.
Tube Complement. . . . .	6E W6 Relay control. OA2 Voltage regulator.
Power Supply. . . . .	Transformer operated, voltage regulated, fused.
Power Requirements. . . . .	120 VAC 60 Hz, 15 watts.

### SWR METER

Operation. . . . .	Indicates percentage of forward and reflected power, and voltage standing wave ratio (SWR).
RF Power Handling Capability. . . . .	2 kilowatts P.E.P.
Input And Output Impedance. . . . .	50-52 $\Omega$ or 70-75 $\Omega$ .
Band Coverage. . . . .	160 through 6 meters.

### PHONE PATCH

Circuit. . . . .	Telephone hybrid circuit. Allows voice control or manual operation. Single switch places unit in full operation.
Telephone Line Input Impedance. . . . .	Approximately 600 $\Omega$ .
Null Depth. . . . .	At least 30 db isolation between transmit and receive circuits.
Receiver Impedance. . . . .	Effective match from 3 to 16 $\Omega$ .
Transmitter Impedance. . . . .	600 $\Omega$ or high impedance output.

## GENERAL CONSOLE SPECIFICATIONS

Meter. . . . .	100 Microampere movement. VU readings for phone patch monitoring and null depth indication. Relative power and standing wave ratio readings for SWR meter.
Front Panel Controls. . . . .	Mode: SWR Meter, Phone Patch. Timer: Off, Visual, Audio. Reset: Pushbutton. SWR Meter: Forward, Reverse. SWR Meter: Sensitivity. Phone Patch: Transmitter gain. Phone Patch: Receiver gain.
Rear Panel Controls. . . . .	Timer Adjust. Null Adjust. Null - Monitor switch.
Dimensions. . . . .	6-5/8" high x 10" wide x 11-1/8" deep (including knobs).
Net Weight. . . . .	7-1/2 lbs.

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to

incorporate new features in instruments previously sold.

## CIRCUIT DESCRIPTION

Refer to the Schematic Diagram (fold-out from Page 43) while you read this Circuit Description.

The Station Console contains the following independent circuits, which will be described separately: the Clock and Timer Circuit, the SWR Meter Circuit, and the Phone Patch Circuit. A review of the Installation And Operation section of this Manual will also help you understand the function of the circuits.

### CLOCK AND TIMER CIRCUIT

The digital readout clock motor is connected to the AC power line through a 3/16 ampere slow-blow fuse. The clock runs continuously when the line cord is connected to a source of 120 V 60 Hz alternating current.

The timer circuit begins to operate when the Timer switch is turned from Off to either Visual or Aural. The neon pilot lamp indicates when the timer is on.

Power for the timer circuit is obtained from transformer T3, through the voltage doubling and filtering network of diodes D4 and D5 and capacitors C26 and C27. Transformer T3 also supplies 6.3 volts AC for the filament of tube V1, for signal buzzer L3, and for the #47 pilot lamps.

Tube V2 is a voltage regulator which keeps the DC supply voltage at a constant level, and resistor R38 is the limiting resistor for the regulator tube.

Resistors R24, R25, and R26 and capacitors C23 and C24 form an RC network with a very slow charging rate. The capacitors charge slowly through the resistors until the potential across the neon discharge lamp is sufficient to cause the lamp to conduct. When the lamp conducts, a positive pulse is sent through capacitor C22 to the grid of V1. The potential across the neon discharge lamp is governed by the setting of the Timer Adjust controls, which are in the voltage divider circuit of R34, R35, R36, and R37, and series resistor R33.

The positive pulse that is applied to the grid of V1 causes the tube to conduct and pass current through resistor R31 and the coil of the relay. With the relay coil energized, contacts 5 and 7 close to apply 6.3 VAC to the #47 pilot lamps (and to buzzer L3).

When relay contacts 1 and 9 close, capacitor C25 discharges through resistors R32 and R27 to hold the grid positive (and hold the relay closed) for approximately one second. The values of resistors R27 and R32, in series with capacitor C25, determine the length of time required for C25 to discharge. Thus, a higher resistance for R27 would increase the time that the relay would remain closed and the identify window lit. Contacts 2 and 9 of the relay had caused capacitor C25 to charge from the power supply before the relay closed.

While the relay coil is energized, contacts 3 and 8 close to discharge capacitors C23 and C24 through resistor R28; then the timing cycle begins again.

When the Reset button is pressed, current flows from the power supply, through the relay coil, the Reset button contacts, and resistor R29 to ground. This energizes the relay coil to close the relay contacts and restarts the timing cycle.

### SWR METER CIRCUIT

The SWR Meter circuit is based upon the circuit of a device developed at the U.S. Naval Research Laboratory, Washington, D.C., and described in N.R.L. report No. 3538, titled "A Reflectometer for H-F Band." Simplified versions have also been described in various amateur radio publications.

The SWR meter consists of a short section of transmission line to which two small linear inductors are coupled, both inductively and ca-

pacitively. The radio frequency current flowing in each inductor and its load resistor is rectified by a germanium diode and filtered by a ceramic capacitor. Because L1 is terminated at the output and L2 is terminated at the input, the rectified current in L1 indicates forward relative power, while the rectified current in L2 indicates reverse relative power. The SWR Meter switch selects the direct current output of either diode and applies it to a variable-sensitivity metering circuit, consisting of a linear potentiometer and a microammeter.

The Mode switch connects the meter to the output of the sensitivity control in the SWR Meter position, and the meter indicates reflected power, or SWR. In the other position, the Mode switch is connected to the Phone Patch circuit which will be described next.

### PHONE PATCH CIRCUIT

The phone patch circuit is based on the use of special hybrid transformer T1. The hybrid transformer with proper adjustment of the Null-Adjust control, will provide a high degree of isolation between the receiving and transmitting circuits. This feature is required for stable voice-control operation.

The operation of a hybrid transformer is shown in Figures 9 and 10. Refer to the Schematic Diagram (fold-out from Page 43) while reading this Description.

Figure 9 shows the phone patch in the Transmit cycle; that is, energy from the telephone line is being routed to the transmitter. The turns ratio of the hybrid transformer is such that the impedance of windings C, D, and  $Z_T$  are equal. If voltage E (representing an incoming voltage of the telephone line) is impressed on the transformer, it will at a given instant, cause current to flow as shown by the arrows. The opposing voltage drop across winding C will equal that across winding  $Z_T$ . Identical winding D is linked by the same flux as winding C; therefore it will have an induced (opposing) voltage of equal magnitude and in the same direction as winding C. The induced voltage in winding D is equal to the voltage across winding  $Z_T$ , and since their like polarities are connected together, no current flow will occur through  $Z_B$ . The result is that one-half of the incoming energy is available at the transmitter input and the other half is dissipated across  $Z_R$ .

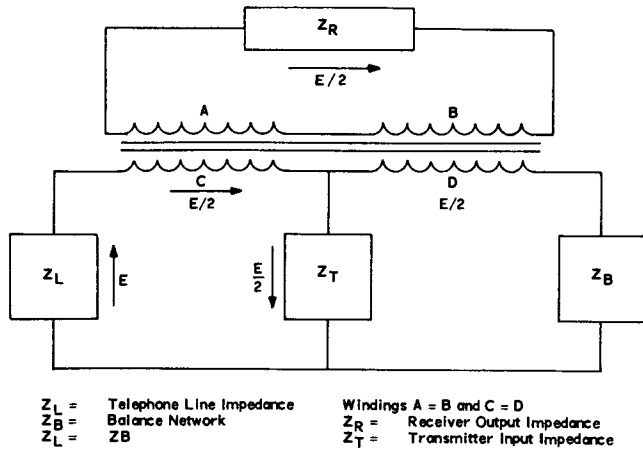


Figure 9

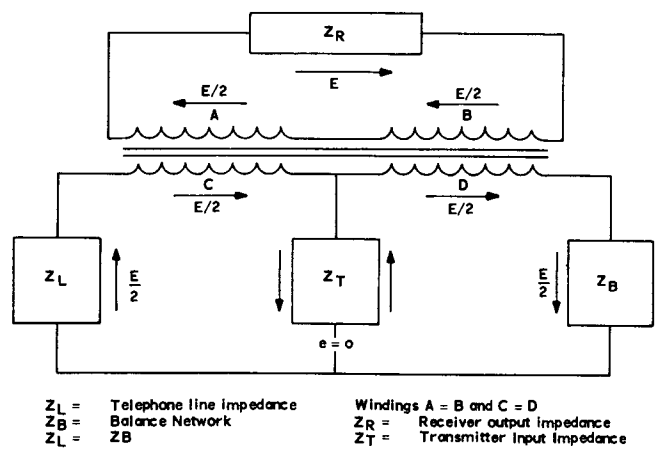


Figure 10

In Figure 10, the phone patch is shown in the receive cycle, with the signal from the receiver routed to the telephone line. If voltage  $E$  (representing a voltage from the receiver) is impressed on the transformer, it will, at a given instant, cause current to flow as shown by the arrows. Windings A and B are connected in series aiding.

Equal voltages are induced in each winding, since winding C equals winding D. The balance network is adjusted so that  $Z_B$  equals  $Z_L$ , therefore the voltage drops across  $Z_B$  and  $Z_L$  are equal. This will cause equal and opposite currents through  $Z_T$ , so there is no voltage across  $Z_T$  and no energy is fed to the transmitter input.

The turns ratio of the transformer windings (T1 and T2) match the speaker and transmitter input impedances to the hybrid windings of transformer T1.

The phone patch circuit, and the meter, are coupled to the telephone line when the Mode switch (S3) is turned to the PHONE Patch position. The meter, coupled through resistors R4 and R5 and diode D3, closely approximates standard VU readings. A zero VU reading represents 4 db above 1 milliwatt in 600  $\Omega$ , and is the maximum voltage allowed on the telephone lines to avoid crosstalk between channels.

A Null-Monitor switch, S2, is provided on the rear apron so the VU meter can be used as a null indicator when the balance network is

adjusted. In the Null position of S2, resistor R5 is switched out of the circuit to increase the sensitivity of the meter.

The telephone line connections to the phone patch are filtered by a balanced pi network to prevent RF from entering the phone lines and/or the transmitter audio circuits.

Since the impedance of telephone lines vary greatly from installation to installation, it is necessary to isolate the line impedance so a simple balance network will provide a sufficient null at every installation. This is accomplished by connecting the telephone line to the phone patch through an H pad. This H pad, which is formed by resistors R6, R7, R8, R9, and R11, has an impedance of 600  $\Omega$ . The pad forces the line impedance to appear as approximately a 600  $\Omega$  resistance. This allows the impedance of Null Adjust control R14 with resistor R13 to equal the line impedance and provide a deep null.

In order to provide a balanced load to the telephone line, an important feature in minimizing hum, the hybrid transformer incorporates additional windings, and the resistive pad is made in the "H" form.

The telephone line is also connected to the phone patch through capacitor C7. This capacitor blocks the DC voltage of the telephone line but allows the audio frequencies to pass. The large value of capacitance has very little reactance at audio frequencies, thus allowing the phone patch to maintain good audio quality.





# HEATH COMPANY

Phone 616-983-3961 • TWX-616-983-3897 • Benton Harbor, Michigan 49022

Dear Customer:

We have included a power transformer that enables you to wire your kit to operate from either a 120 volt or a 240 volt AC power source (50/60 cps). This transformer has two additional leads in its primary windings that are not mentioned in your Manual. The following steps will tell you how to combine these leads to produce the correct voltages in your kit.

NOTE: In the U.S.A. your power source (line voltage) is usually 120 volts AC, while in other countries it is more common to have a power source of 240 volts AC. Perform only one of the following two sets of instructions. USE ONLY THE SET OF INSTRUCTIONS THAT AGREE WITH THE POWER SOURCE IN YOUR AREA!

## Transformer Prewiring for use with a 120 VOLT AC Power Source:

- ( ) Locate the power transformer. Its part number starts with 54- . . .
- ( ) Twist the black lead and the black-green lead together. Place insulating tape around this pair at 1-1/2" intervals.
- ( ) Twist the black-red and the black-yellow leads together. Place insulating tape around this pair also at 1-1/2" intervals.

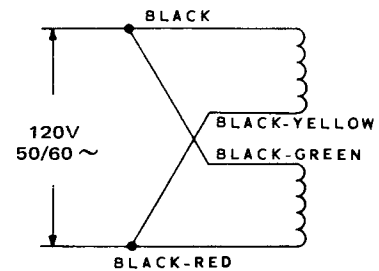


Figure 1

From this point on, please consider each of these taped pairs as one black lead. When, for example, a step in the Manual directs you to prepare, connect or solder a black transformer lead, use both of the leads in the taped pair.

## Transformer Prewiring for use with a 240 VOLT AC Power Source:

- ( ) Locate the power transformer. Its part number starts with 54- . . .
- ( ) Cut the black-yellow and the black-green leads to a 1-1/2" length, measured from where the leads emerge from the transformer.
- ( ) Remove 3/8" of insulation from the end of each of these leads.

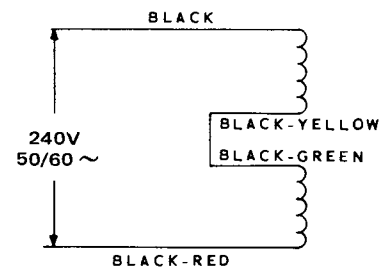


Figure 2

- ( ) Twist the bared ends of the two leads together and solder the connection. Place insulating tape over the joint.

When your Manual directs you to work with the two black transformer leads, please consider the black-red lead as "the other" black lead.

E Transformer  
597-497