TECHNICAL SPECIFICATIONS

POWER SOURCE . . . . . . Model P-26	105 volts to 125 volts, 60 cycles, AC; 290 watts maximum.
MODE OF EMISSION	Determined by exciter and receiver used.
FREQUENCY COVERAGE	144 MC to 148 MC.
RECEIVER/EXCITER FREQUENCY RANGE REQUIRED	28 MC to 30 MC.
TERMINATING IMPEDANCE (All connectors)	50 ohms.
RECEIVER CONVERTER PERFORMANCE:	
Noise Figure	3 DB to 5 DB.
Sensitivity	1.5 μV/10 DB S/N (Limit)
TRANSMITTER CONVERTER PERFORMANCE:	
POWER OUTPUT	
SSB (PEP), CW, FSK, FM, PM, etc.	50 watts
AM (carrier)	12.5 watts
EXCITATION REQUIRED	
High Level Input	25 watts maximum
Low Level Input	0.5 watts approximately
DIMENSIONS	8 inches high x 9.875 inches deep x 17 inches wide
SHIPPING WEIGHT	22.5 pounds

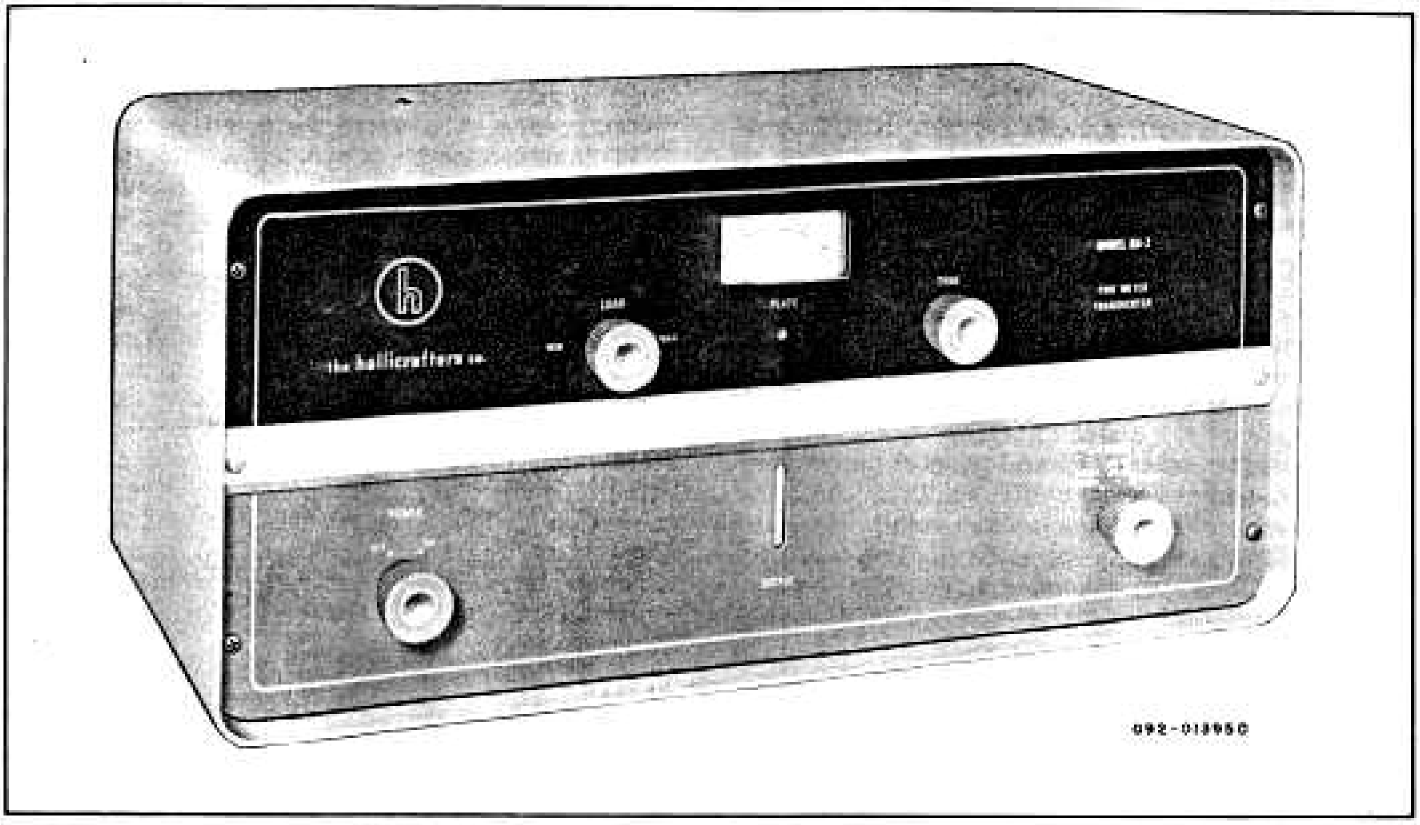


Figure 1. View of the Model HA-2 Transverter.

SECTION I

INTRODUCTION

1-1. DESCRIPTION.

The Model HA-2 Two-Meter Transverter is a two-way converter which is designed to be used in conjunction with a 28-MC to 30-MC transmitter/exciter and receiver to convert the 10-meter signals to the 2-meter band.

The transverter will handle any mode of transmission (CW, SSB, AM, FM, PM, FSK, etc.) supplied by the exciter, since it is basically a linear system and does not change the signal characteristics. The Model HA-2 Two-Meter Transverter may be used in a simple arrangement with an exciter, receiver, two-meter antenna, and power supply, or it may be used as part of a complete system. This system would include the Model HA-6 Six-Meter Transverter and could include automatic switching between the two-meter and six-meter transverters and the present ten-meter station. The cabling diagram, figure 3, gives the details of equipment necessary to perform the automatic switching function.

Two type CR-23/U crystals are supplied to convert the 28-MC to 30-MC output from the exciter to frequency segments of 144 MC to 146 MC, and 146 MC to 148 MC; the same crystals also convert the received frequency segments of 144 MC to 146 MC, and 146 MC to 148 MC into 28 MC to 30 MC for the receiver. If the station transmitter/exciter and/or receiver, used in conjunction with the transverter, cover only the range from 28 MC to 29.7 MC, a spare crystal position is provided for an additional crystal. Exciters, used with the transverter, must have excitation control, such as an RF output level adjustment, or other means to properly set the carrier level required for AM operation.

The transverter receives power from an external supply. The Model P-26 Power Supply has been designed as a companion unit to the Model HA-2 Transverter; however, other power supplies, supplying the required voltage, may be used. One Model P-26 Power Supply will handle both a Model HA-2 and a Model HA-6 (Six-Meter Transverter), and is so interlocked as to prevent the HA-2 and HA-6 from operating at the same time.

The transverter is designed to work with a 28-MC to 30-MC station receiver having a 50-ohm antenna input and provides a 50-ohm coaxial termination for a 28-MC to 30-MC station transmitter/exciter. There are two inputs provided on the rear panel for connection to the exciter.

The HIGH LEVEL INPUT connector is used with an exciter having 25 watts PEP output capability (50 watts when both the HA-2 and HA-6 are connected together). A LOW LEVEL INPUT connector is provided for those exciters with a 0.5-watt PEP output capability (1 watt when both units are connected).

1-2. TVI SUPPRESSION.

The Model HA-2 Two-Meter Transverter has been designed and constructed to suppress spurious signals that may cause television interference (TVI). The TVI problem was given full consideration in the design of every circuit, as well as in the selection and layout of parts. The equipment has been carefully shielded and connector lead bypassing has been provided throughout. Components were specifically selected to avoid undesired resonances and arranged to prevent parasitic oscillation.

The transverter, as received from the factory, has had every advantage of Hallicrafters' engineering experience to minimize television interference. There are, however, some types of TVI that cannot be prevented within the equipment itself. For example, when a television receiver is located in the immediate vicinity of the transverter, it is entirely possible that a fundamental signal will reach the input grid of the receiver with sufficient strength to cause a small amount of interference. In this case, it will be necessary to install a filter or trap at the television receiver to attenuate the transmitted signal. If the interfering signal does not enter the television receiver through the antenna, special shielding or filters on the TV receiver may be necessary. For a more complete discussion of measures that may be used to handle these special television interference problems, refer to the ARRL HANDBOOK.

SECTION II
INSTALLATION

2-1. GENERAL.

The type-5894 final amplifier tube (V4) is removed from its socket, packaged, and shipped inside the cabinet. Therefore, the tube must be unpacked, inserted in its socket, and the clips connected to the plate terminals before the transverter is ready for operation. To gain access to the packaged tube, follow the instructions in paragraph 5-2 for removing the chassis from the cabinet.

2-2. UNPACKING.

After unpacking the transverter, examine it closely for any possible damage that may have occurred during transit. Should any sign of damage by apparent, immediately file a claim with the carrier stating the extent of damage. Carefully check all shipping labels and tags for any special instructions before removing or destroying them.

2-3. LOCATION.

Even though the Model HA-2 Transverter is provided with a built-in cooling fan, excessively warm locations, such as those near radiators and heating vents, should be avoided. The unit should be placed in a location that provides adequate space around it (a minimum of three inches on each side) to permit free circulation of clean air through the cabinet openings. Also, sufficient clearance should be allowed at the rear of the unit to facilitate connecting the Model HA-2 to associated equipment.

2-4. POWER SOURCE.

The Model HA-2 Two-Meter Transverter is designed to operate from a Model P-26 or equivalent external power supply. The Model P-26 Power Supply operates from a 105-volt to 125-volt, 60-cycle, AC power source; power consumption of the equipment will not exceed 290 watts. If a power supply other than the Model P-26 is used as the power source for the transverter, the power supply must meet the requirements specified in the data concerning power supply circuitry, paragraph 2-7.

NOTE

The power outlet must furnish AC (alternating current). If in doubt about the power source, contact the local power company prior to inserting the power cord in a power outlet. Plugging the cord into the wrong power source may cause extensive damage to the power supply unit, requiring costly repairs.

2-5. SINGLE-UNIT INSTALLATION.

The following procedure covers the installation of the Model HA-2 Transverter and the Model P-26 Power Supply.

1. Interconnect the power supply and the transverter by connecting the high voltage cable (HV connectors) and the multi-conductor cable (POWER connectors). The jumper plug supplied with the power supply must be inserted in the unused 11-pin POWER socket of the power supply.

CAUTION

Do not connect the line cord to a source of power until all other wiring is completed and checked.

2. Loosen the cable clamp and slip the shell back on the 11-pin female power cable connector which plugs into the transverter. Connect a No. 22, stranded, insulated wire to pin 2 and replace the protective shell. Run this control wire to the station exciter and connect it to an unused control switch terminal or VOX relay contact which will connect this wire and its circuit to ground during transmission and open it during reception. The relay contact is preferred so that VOX operation, if normally available, can be used for VHF operation also.

NOTE

Do not connect to a relay or switch contact already carrying other exciter circuits. The transverter relay is energized by a 12-volt DC source within the transverter, and grounding the control wire closes the relay during transmission.

3. Interconnect the station receiver's antenna input and the transverter RECEIVER output connectors. Use 50-ohm coaxial cable to insure a well-shielded circuit.

4. Interconnect the antenna output of the station transmitter/exciter with either the HIGH LEVEL INPUT or the LOW LEVEL INPUT connector, depending upon the output power capability of the transmitter/exciter. A 25-watt to 100-watt exciter should be connected to the HIGH LEVEL INPUT. It may be operated without the use of an attenuator pad in the line. A low-level exciter in the 1-watt class must be connected to the LOW LEVEL INPUT. An exciter in the 10-watt to 20-watt class should be first connected to the HIGH LEVEL INPUT to determine whether it is capable of driving the transverter. If not, connect the exciter into the LOW LEVEL INPUT with a suitable 50-ohm attenuator to reduce the drive level reaching the transverter. One-half watt to one watt PEP is sufficient to drive the transverter at the LOW LEVEL INPUT. Use 50-ohm coaxial cable to maintain a low SWR.

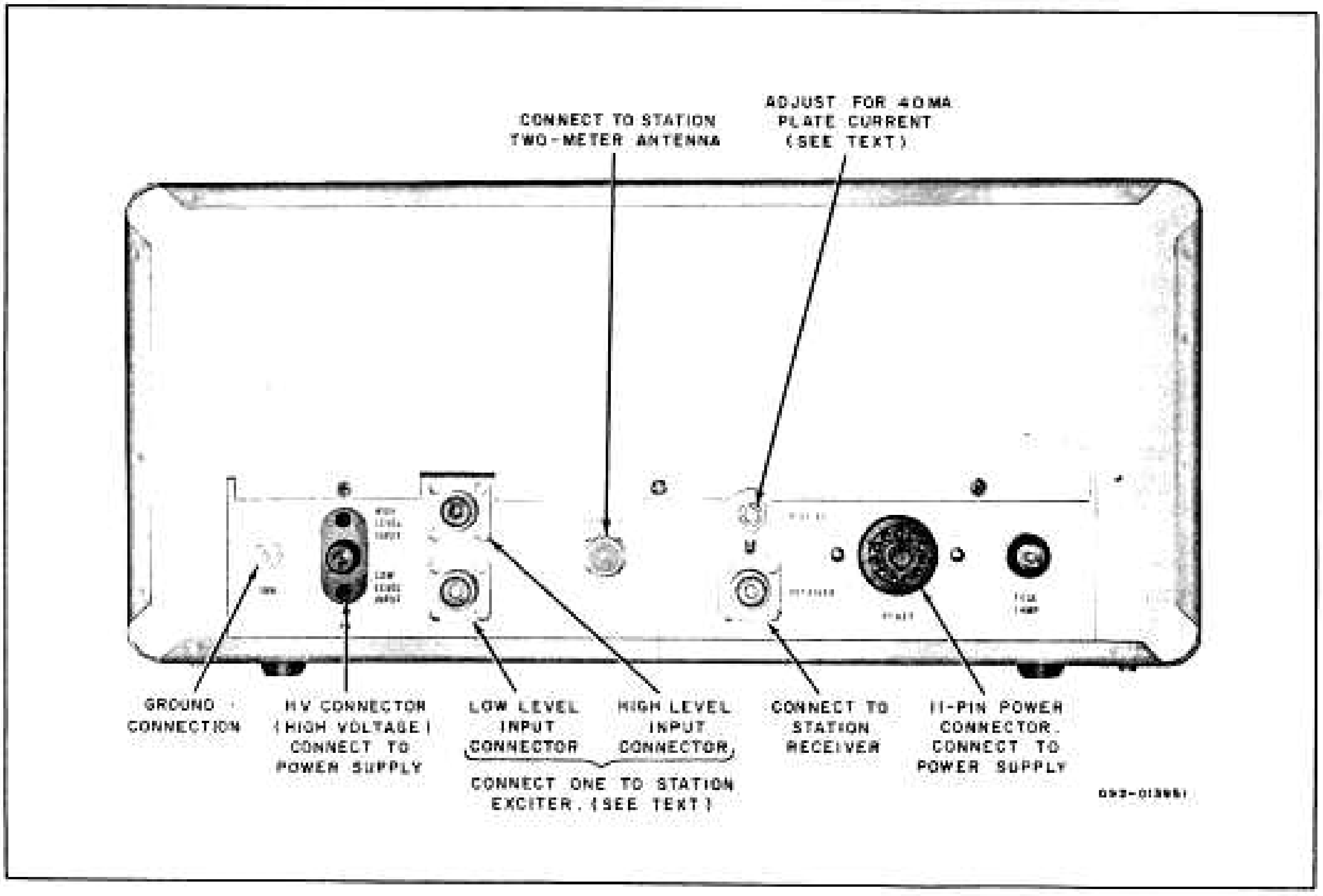


Figure 2. Rear View of Transverter, Showing Connectors.

5. Connect the 50-ohm transmission line from the two-meter antenna to the ANTENNA connector on the transverter.

The Model HA-2 Two-Meter Transverter is now ready for operation and will convert all modes of transmission provided by the ten-meter station exciter unit. Also, VOX operation, if normally used at the station, will continue to function as before.

2-6. TWO-UNIT INSTALLATION.

The following procedure covers the complete six-meter and two-meter installation using transverter Models HA-6 and HA-2, and the Model P-26 power supply. The installation shown in figure 3 provides automatic changeover from low frequency station operation to VHF operation. The VHF band to be used is selected by turning on the particular transverter for that band. Turning on both transverters merely disables the entire operation until one of the units is turned off.

1. Interconnect the power supply and the transverters by connecting the high voltage cables (HV connectors) and the multi-conductor cables (POWER connectors). The jumper plug supplied with the power supply is removed to make room for the second power cable. Keep the jumper plug near at hand in case single unit operation is desired. The jumper plug completes the switching and bias supply circuits so that a single transverter can be operated from the power supply.

2. Loosen the cable clamp and slip the shell back on the 11-pin female power cable connector which plugs into the transverter. Connect a No. 22, stranded, insulated wire to pin 2 and replace the protective shell. Do this for both of the multi-conductor cables. Run both wires to the station exciter and connect them to an unused control switch terminal or VOX relay contact, which will connect these wires to ground during transmission and open them during reception. The relay contact is preferred, so that VOX operation (if normally available) can be used for VHF operation too.

NOTE

Do not connect to a relay or switch contact already carrying other exciter circuits. The transverter relays are energized by a 12-volt DC source within the transverter; grounding the control wire during transmission closes the relay of the transverter which has been turned on.

3. Interconnect the station receiver's antenna input and the transverter RECEIVER output connectors. If automatic changeover from low frequency station operation to VHF operation is desired, use relay RY3 as shown in the cabling diagram. Note that this relay has a 117 VAC coil and is supplied along with relay RY1 by the RELAY output on the power supply, so that both relays will be energized when either transverter is turned on. Refer to the cable diagram for coaxial cable and connector type details. The "Tee" connector can be installed on either transverter, depending upon the requirements of the particular station layout.

4. Interconnect the antenna output of the station transmitter/exciter with either the HIGH LEVEL INPUT or the LOW LEVEL INPUT connectors, depending upon the output power capability of the transmitter/exciter. A 50-watt to 100-watt exciter should be connected to the HIGH LEVEL INPUT of the transverters. A low level exciter in the 1-watt to 2-watt class must be connected to the LOW LEVEL INPUT. Exciters in the 10-watt to 20-watt class, connected to the HIGH LEVEL INPUT, will not be capable of driving the two-unit installation. Therefore, these exciters should be connected to the LOW LEVEL INPUT connectors through a suitable attenuator to drop the PEP output to approximately the 1-watt to 2-watt level, which is required by two transverters connected in parallel. The attenuator should be installed between relay RY1 and the "Tee" connector shown in the cabling diagram. Here again, if the automatic changeover feature is desired, relay RY1 is required in addition to RY3, as shown on the diagram. If the exciter is used extensively for VHF operation, then the relays RY1, RY2, and RY3 can be dispensed with and the two transverter units, with their inputs connected in parallel, are connected directly to the exciter. The parallel connection presents a 2/1 SWR to a 50-ohm exciter output and requires approximately 50 watts PEP at the HIGH LEVEL INPUT connector and approximately 1-watt to 2 watts PEP at the LOW LEVEL INPUT connector. Again, the location of the "Tee" connector is determined by the station layout.

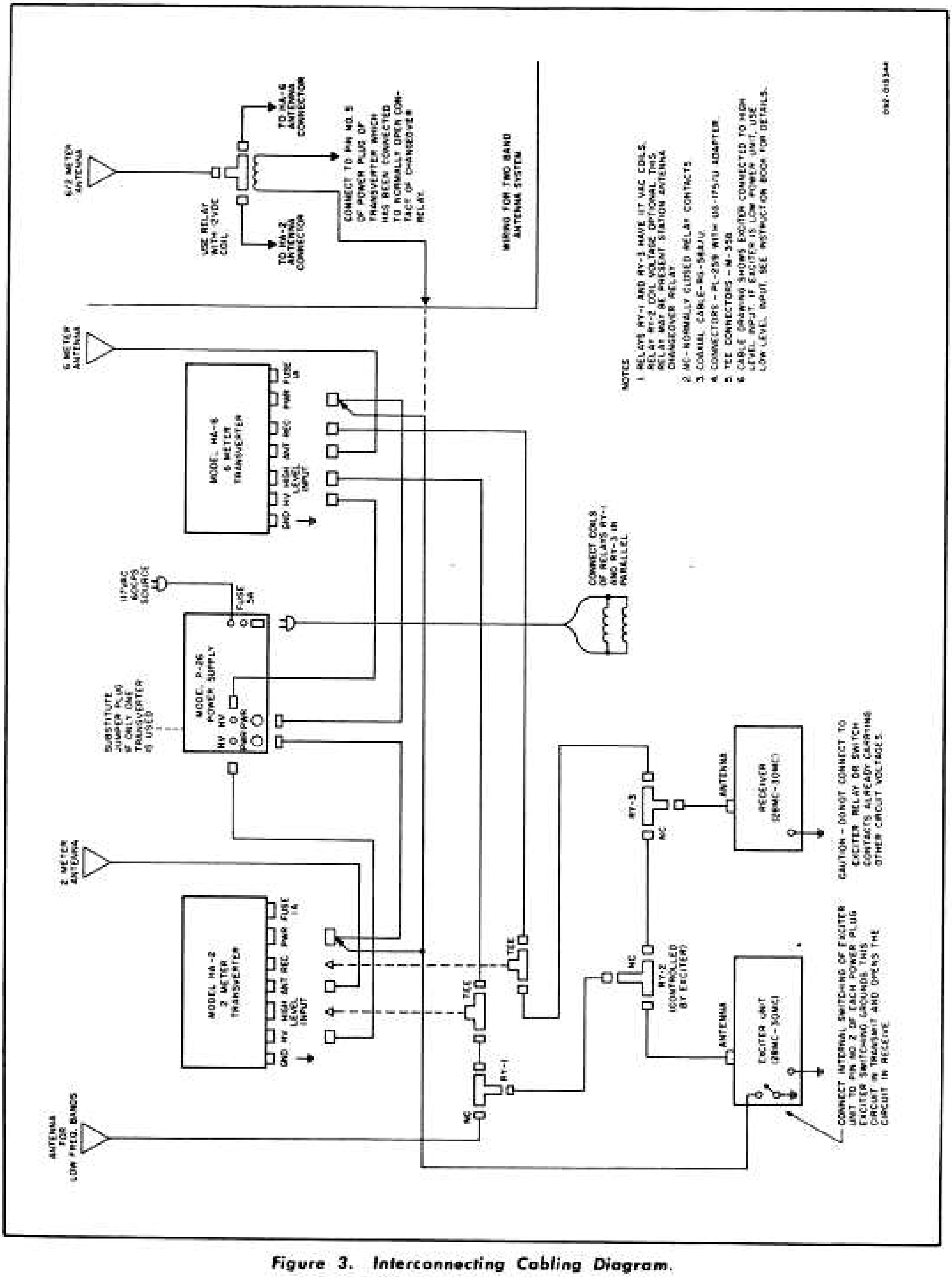


Figure 3. Interconnecting Cabling Diagram.

5. If individual antennas are used on each of the bands, connect the transmission lines to the respective ANTENNA connectors on the transverters. Installations using a single two-band antenna system can have automatic relay switching, as shown in the cable diagram. Note that the antenna selector relay for this system has a 12-volt DC coil and is energized by the 12-volt supply in the transverter. In order to obtain the proper switching of this relay, particular attention should be directed to the wiring conditions specified in the cable diagram. When properly wired, the relay will switch the antenna to the transverter which has been turned on by the operator.

2-7. POWER SUPPLY REQUIREMENTS.

If a power supply, other than the Model P-26, is to be used, it must meet the following requirements:

1. 750 volts DC at 40 MA idle plate current. Approximately 700 volts minimum supply voltage at 150 MA plate current.

2. Low B+ supply of 250 volts to 260 volts DC at a receive load of 40 MA and a transmit load of 125 MA respectively. Check figure 15 and note the center tap resistor used in the Model P-26 Power Supply to accomplish this.

3. Bias supply of minus 60 volts in transmit mode with 6800-ohm transverter loading. If both the HA-2 and HA-6 are to be operated from this supply, bias supply must handle a 3400-ohm load and contain a jumper plug arrangement similar to that used with the Model P-26 supply.

A schematic diagram of the Model P-26 Power Supply is contained in figure 15 of this manual.

SECTION III

CONTROLS AND OPERATION

3-1. GENERAL.

The Model HA-2 Two-Meter Transverter, in the transmit function, accepts 10-meter signals from a transmitter/exciter, converts these signals to two-meter signals, amplifies them, and then feeds the signals to a two-meter antenna for transmission. In the receive function, the Model HA-2 accepts two-meter signals from an antenna, amplifies and converts these signals to 10-meter signals, and applies them to a receiver.

Before turning the transverter on, be certain that the control switch on the transmitter/exciter or on the station control (if used) is in the standby or receive position.

3-2. OPERATING PROCEDURE.

Turn the POWER switch on the transverter to ON. Allow 10 minutes to 15 minutes for the transverter to warm up before placing the transmitter/exciter in the transmit mode. During this

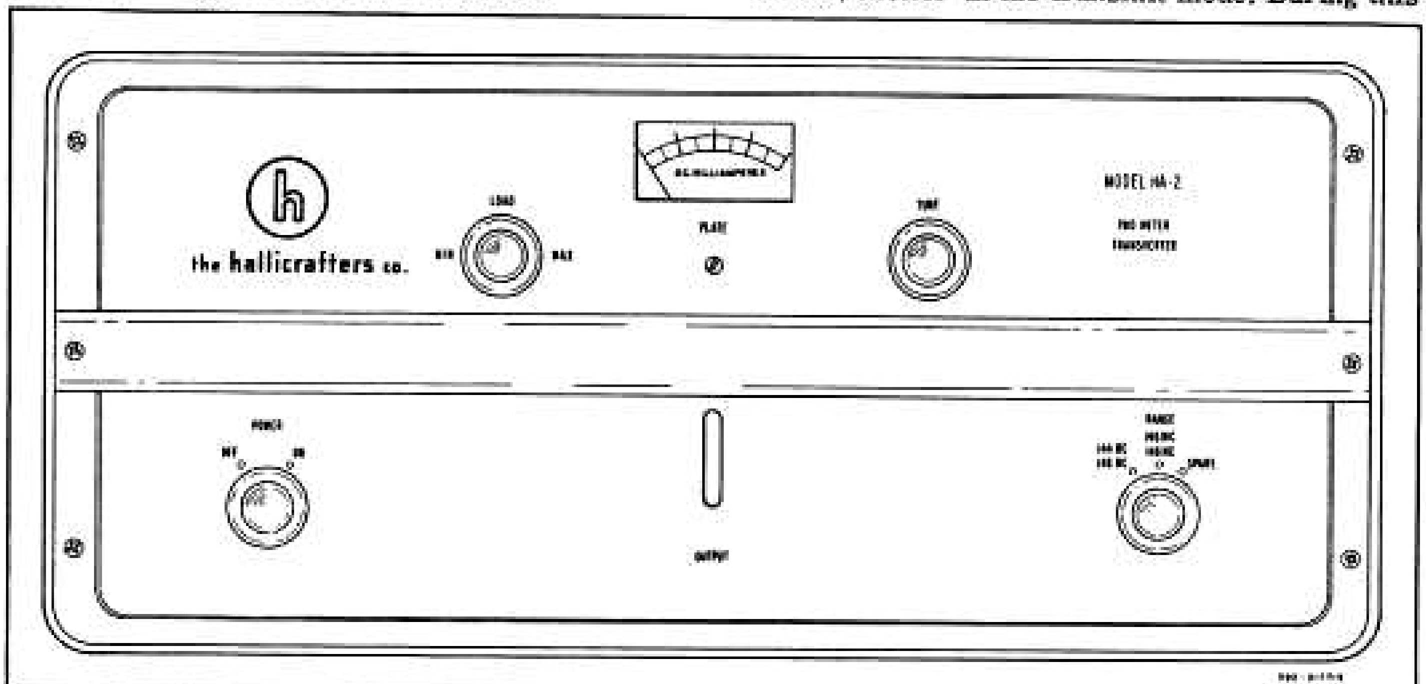


Figure 4. Front Panel View of Transverter.

time, the transverter can be checked out in the receive function and, if the six-meter transverter is used, the interlock function of the power supply can be checked.

To check the interlock function, turn the POWER switch on the unused transverter to ON. If the interlock is functioning properly, power will be removed from both units.

To check the transverter in the receive mode, tune the receiver the same as for ten-meter reception. Note that the receiver tunes only one-half of the two-meter band at a time. The RANGE switch must be used to cover the entire two-meter band. The frequency of the station being received may be determined by referring to figure 5.

After the transverter has warmed up, turn the transmitter/exciter to transmit, but do not apply excitation to the transverter. Note the idling plate current on the PLATE current meter on the front panel of the transverter. If the idling plate current does not show 40 milliamperes, adjust the BIAS ADJ. control on the rear apron of the transverter to obtain this idling plate current.

Set the RANGE switch to the desired segment (144 MC to 146 MC, or 146 MC to 148 MC).

3-3. TUNING AND LOADING (CW or SSB Operation).

1. Set the LOAD control on the transverter to approximately mid-position.
2. Set the station transmitter/exciter for CW operation. Adjust the carrier level for approximately 100 milliamperes of plate current on the PLATE meter of the transverter and immediately adjust the TUNE control for maximum RF output, as shown on the OUTPUT indicator. Maximum output is indicated when the gap between the two shafts of light on the indicator is the narrowest.
3. Adjust the output of the exciter to maintain a transverter plate current of 180 to 200 milliamperes while making the loading adjustment. The final amplifier tube is operating at its peak dissipation at this time, so perform the loading adjustment rapidly. Adjust the LOAD and TUNE controls for maximum output as indicated by the OUTPUT indicator. As the operating frequency is changed, it will be found necessary to touch up the TUNE control only. The LOAD control will, generally, not change setting.

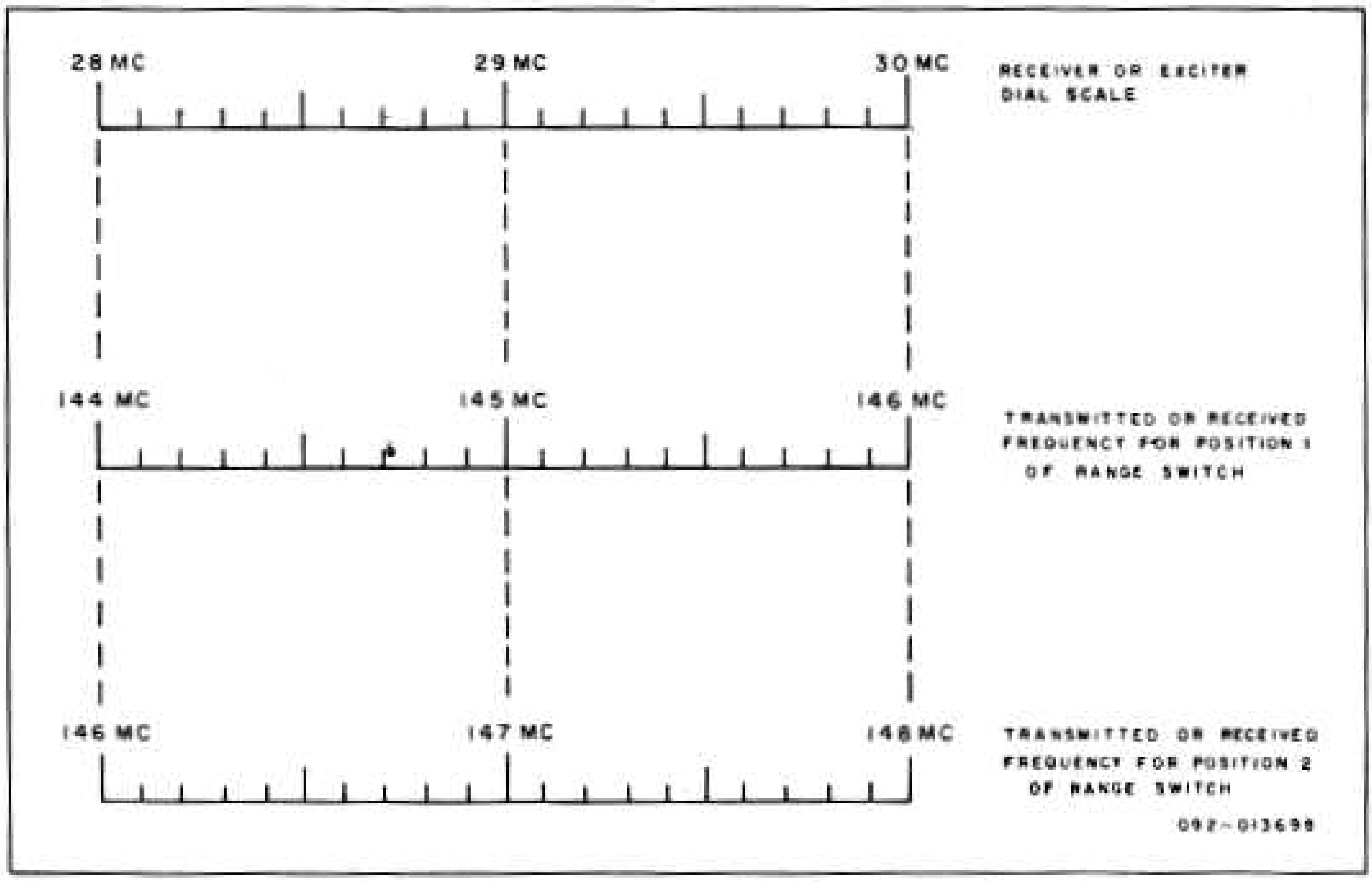


Figure 5. Frequency Conversion (Dial Scale Interpolation).

4. Set the drive level of the station exciter to obtain a transverter plate current reading of 150 milliamperes for CW, FM, FSK teletype and similar modes of transmission.

5. Switch the exciter to SSB and check single-sideband transmission. Advance the microphone gain control on the exciter and watch the OUTPUT indicator while talking into the microphone. The drive level is approximately correct when the OUTPUT indicator gap closes or shows signs of saturation levels on voice peaks and the plate current swings to approximately mid-scale.

3-4. TUNING AND LOADING (AM).

1. Perform steps 1, 2, and 3 as outlined in paragraph 3-3 for tuning and loading for CW operation.

2. The station exciter and transverter are now tuned and loaded at the 200-MA plate current level. To set up the required carrier level, slowly advance the carrier level control of the exciter, starting from a low level, until the OUTPUT indicator of the transverter shows evidence of saturation. This will generally occur when the plate current of the transverter reaches approximately 180 milliamperes. If the station exciter has an RF voltmeter in its output circuit, reduce the carrier level to 1/2 this voltage (reduce it 6 DB if a decibel scale is provided). This sets up the maximum permissible carrier level that this transverter output tube can accept and still handle modulation peaks without flat-topping. If the exciter does not have an RF output metering system, the carrier injection can be set for approximately 110 milliamperes of plate current on the transverter. Set the microphone gain for 100% modulation by watching the OUTPUT indicator and final plate current. Overmodulation will be evident when the plate current of the transverter begins to shift, in step with the voice peaks, from its unmodulated carrier reading.

3-5. MATCHING RECEIVER AND TRANSMITTER FREQUENCY.

Many times the operator finds it desirable to transmit and receive on the same frequency. The transverter uses the same heterodyning oscillator for both transmit and receive; therefore, it is merely necessary to zero the station receiver to the station exciter on the ten-meter band in the usual manner. Normally, the local radiation from the exciter reaches the receiver in sufficient strength to produce the desired beat. If not, a wire connected to the receiver antenna and placed near the station exciter unit will increase the coupling, but also may increase the ten-meter band feed-through when receiving.

3-6. SIDEBAND SWITCHING ON TWO METERS.

The upper and lower sideband positions on the two-meter band remain as they were for the ten-meter band. The heterodyning frequency used in the transverter falls below the two-meter band; therefore, the mixing action involves the addition of the frequencies involved and the relative position of the sidebands does not reverse.

3-7. RECEIVERS WITH 28.0MC TO 29.7MC BAND COVERAGE.

Should the station receiver cover a frequency range of only 28.0 MC to 29.7 MC on the ten-meter band, the alternate crystal setup shown in figure 6 may be used. Note that the crystal supplied in position 1 is retained and two new crystal frequencies are recommended to cover the two-meter band completely. Generally, the new crystals may be inserted in the crystal holder in positions 2 and 3 without circuit readjustment; however, it would be well to check the rectified grid voltage at the grid of the 12BY7A mixer, as outlined under Heterodyne Oscillator Alignment.

SECTION IV

THEORY OF OPERATION

4-1. GENERAL.

The Model HA-2 Two-Meter Transverter is basically a heterodyning system complete with a linear power amplifier for transmission, and a low-noise front end for reception. The conversion takes place between the ten-meter band and the two-meter band. Since the ten-meter band is only two megacycles wide, the two-meter band must be covered in two steps, as it is four megacycles wide. This is accomplished by changing the heterodyne oscillator frequency. By using a common heterodyne oscillator for transmission and reception, the two-meter frequency will be exactly the same for transmitter and receiver if the two units are matched for frequency on the ten-meter band. The transverter can handle any mode of transmission or reception normally handled by the station's ten-meter equipment, since it is for all practical purposes a linear system.

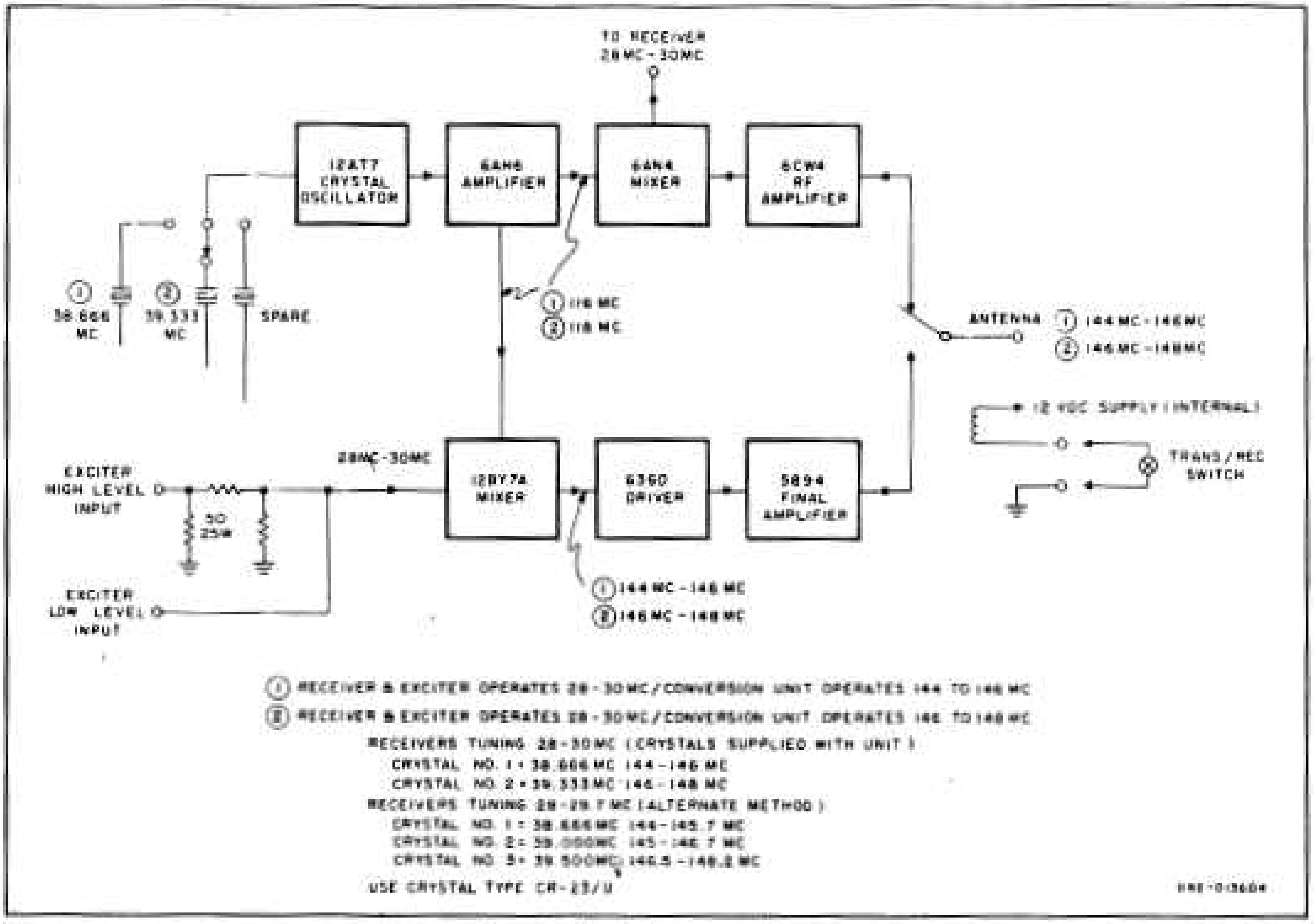


Figure 6. Block Diagram of Transverter.

4-2. HETERODYNING OSCILLATOR.

The heterodyning signal is supplied by a Butler-type crystal oscillator and amplifier (tubes V6 and V7). Inasmuch as a minimum of two heterodyne frequencies are required to cover the two-meter band, the crystal oscillator and amplifier are bandpass coupled and a total of three crystals can be accommodated for range switching. If conventional 28-MC to 30-MC receivers and transmitters are used with the transverter, the two heterodyning frequencies will be 116 MC and 118 MC and the crystal frequencies used are 38.666 MC and 39.333 MC or 1/3 of the injection frequency. The oscillator uses CR-23/U type crystals which operate on the third mode and at series resonance.

4-3. RECEIVE FUNCTION.

For the receive function, the changeover relay is unenergized. The two-meter signal at the antenna is thus coupled through transformer L1 to the type 6CW4 low-noise, RF amplifier. The output of the RF amplifier is bandpass coupled to the type 6AN4 mixer which, in turn, is bandpass coupled to the station receiver so that tuning by the operator in the transverter unit is not required. The coupling unit in the plate of the mixer is designed to match a receiver with a 50-ohm antenna input.

During the receive function, the relay disconnects the 250-volt supply from the transmitter mixer and amplifier stages and also switches in resistance at the center tap of the plate supply transformer to account for the load change in the receive function.

4-4. TRANSMIT FUNCTION.

For the transmit function, the changeover relay is energized. Since the DC source for the relay is supplied by the transverter, only external switching of the single coil return lead is required to control the unit.

For the transmit function, the relay transfers the 250-volt source from the receiver converter mixer and amplifier stages to the transmitter converter mixer and amplifier stages. At the same time, the relay also grounds the center tap of the plate transformer in the power supply to accommodate the change in load.

The ten-meter signal from the station exciter is fed into the transverter at either of two inputs, depending upon the output power capabilities of the exciter. The HIGH LEVEL INPUT provides a 50-ohm, 25-watt termination and requires approximately 25 watts of signal to drive the transverter to full output. The LOW LEVEL INPUT provides approximately a 50-ohm termination but requires only one-half watt of drive.

Before reaching the 12BY7A mixer tube, the exciter signal must pass through a low-pass filter to avoid spurious signals caused by its harmonic content.

At the 12BY7A mixer, the 28-MC to 30-MC signal mixes with the same two heterodyning oscillator signals used for reception. The 144-MC to 146-MC signal is produced with the 116-MC oscillator signal, and the 146-MC to 148-MC signal is produced with the 118-MC oscillator signal.

From the plate of the mixer through the type 6360 driver stage to the grids of the final amplifier, the tuned circuits are bandpass coupled so that operator tuning of these stages is avoided. Therefore, the only tuning required is at the plate of the final amplifier and the series resonant loading control. The driver and final amplifier stages are linear amplifiers operating class A and AB_1, respectively. Since screen grid tubes cannot operate safely without a load, a fixed link is provided to insure that a good percentage of the load is coupled to the tube at all times. The series resonant link adjustment permits additional loading for optimum power transfer to the antenna transmission line through the coaxial relay.

To help the operator establish optimum loading, a sample of the transmission line RF voltage is taken at the output of the link and rectified. The rectified DC voltage is then applied to the grid of the 6FG6 output indicator where it is amplified and used to drive a fluorescent display electrode. By adjusting both the TUNE and LOAD controls for maximum RF voltage at the maximum output level capability, the operator is assured of best linearity at all drive levels, including PEP.

SECTION V

SERVICE DATA

5-1. TUBE AND LAMP REPLACEMENT.

To gain access to the tubes and dial lamps, refer to paragraph 5-2, CHASSIS REMOVAL. The tube and lamp locations are shown in figure 9. Replace the meter lamp with a type 47 bayonet base lamp.

5-2. CHASSIS REMOVAL.

The Model HA-2 Transverter cabinet was designed to provide RF shielding. For this reason, replace all hardware when returning the chassis unit to the case. To remove the chassis from the cabinet: 1) remove the three phillips-head screws at the cabinet rear directly above the connectors, 2) remove the three screws and external-tooth lockwashers from the bottom of the cabinet, 3) remove the six phillips-head screws from the front panel, three on each side (the trim strip comes off when the center screws are removed), and 4) slide the chassis forward out of the cabinet.

5-3. VOLTAGE AND RESISTANCE MEASUREMENTS.

The voltages and resistances to ground on the pins of each tube within the Model HA-2 Transverter are contained in the Voltage and Resistance Charts, figures 7 and 8. The conditions of operation at the time these readings were made are specified on the charts.

5-4. SERVICE AND OPERATING QUESTIONS

For further information regarding operation or servicing of the transverter, contact the Hallicrafters' dealer from whom the equipment was purchased. The Hallicrafters Company maintains an extensive system of Authorized Service Centers where any required service will be performed promptly and efficiently at a nominal charge. All Hallicrafters Authorized Service Centers display the sign shown below. For the location of the one nearest you, consult your local telephone directory.

Do not make any service shipments to the factory unless instructed to do so by letter. The Hallicrafters Company will not accept the responsibility for unauthorized shipments.

The Hallicrafters Company reserves the privilege of making revisions in current production of equipment and assumes no obligation to incorporate these revisions in earlier models.

Authorized hallicrafters Service Center

communications equipment

92X1601-C

CAUTION

A POTENTIAL OF 750 VOLTS DC EXISTS ON THE PLATE CIRCUIT OF THE FINAL AMPLIFIER TUBE WHEN THE TRANSVERTER IS TURNED ON. **EXERCISE CAUTION WHEN MAKING SOCKET VOLTAGE MEASUREMENTS.**

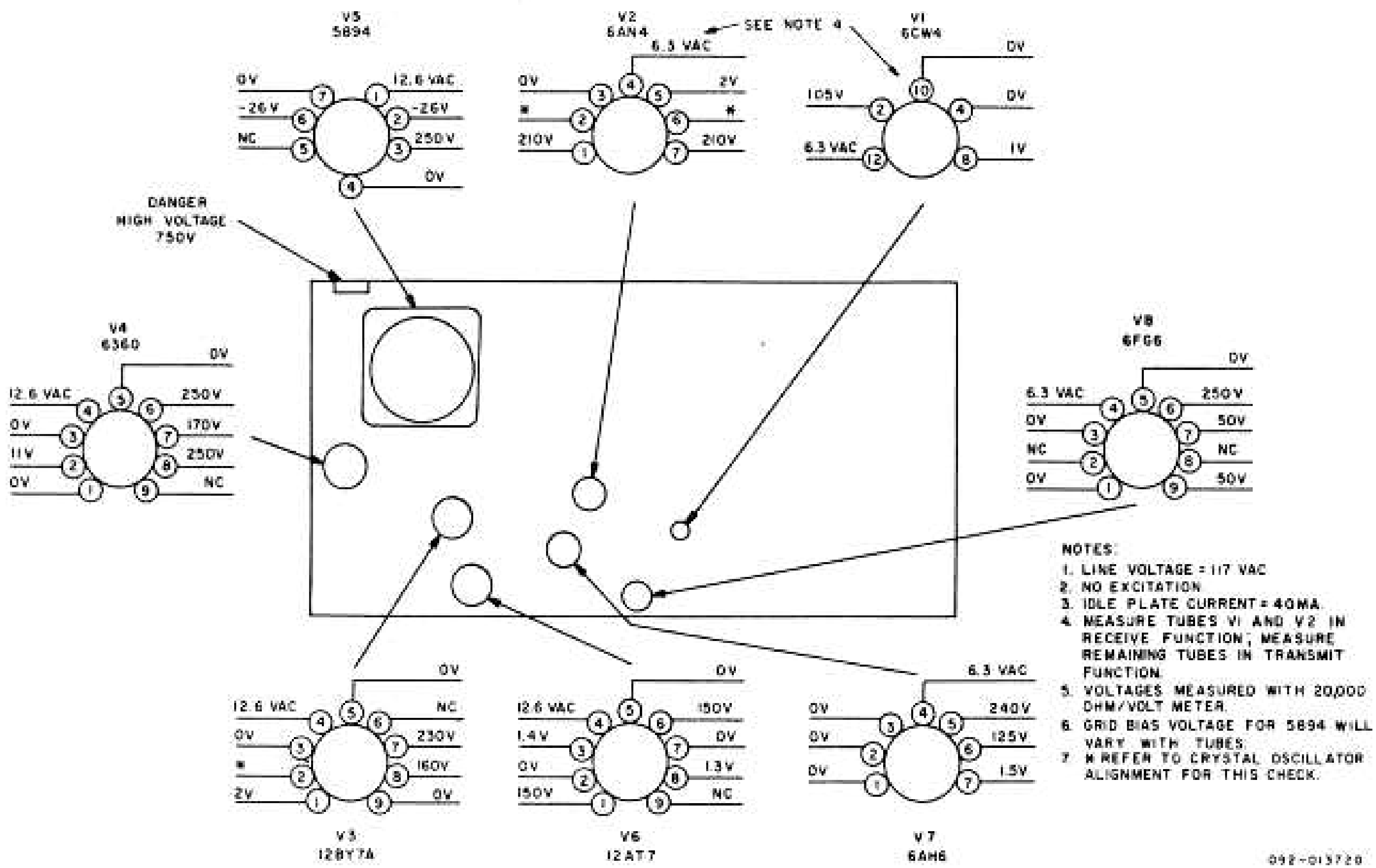


Figure 7. Voltage Chart.

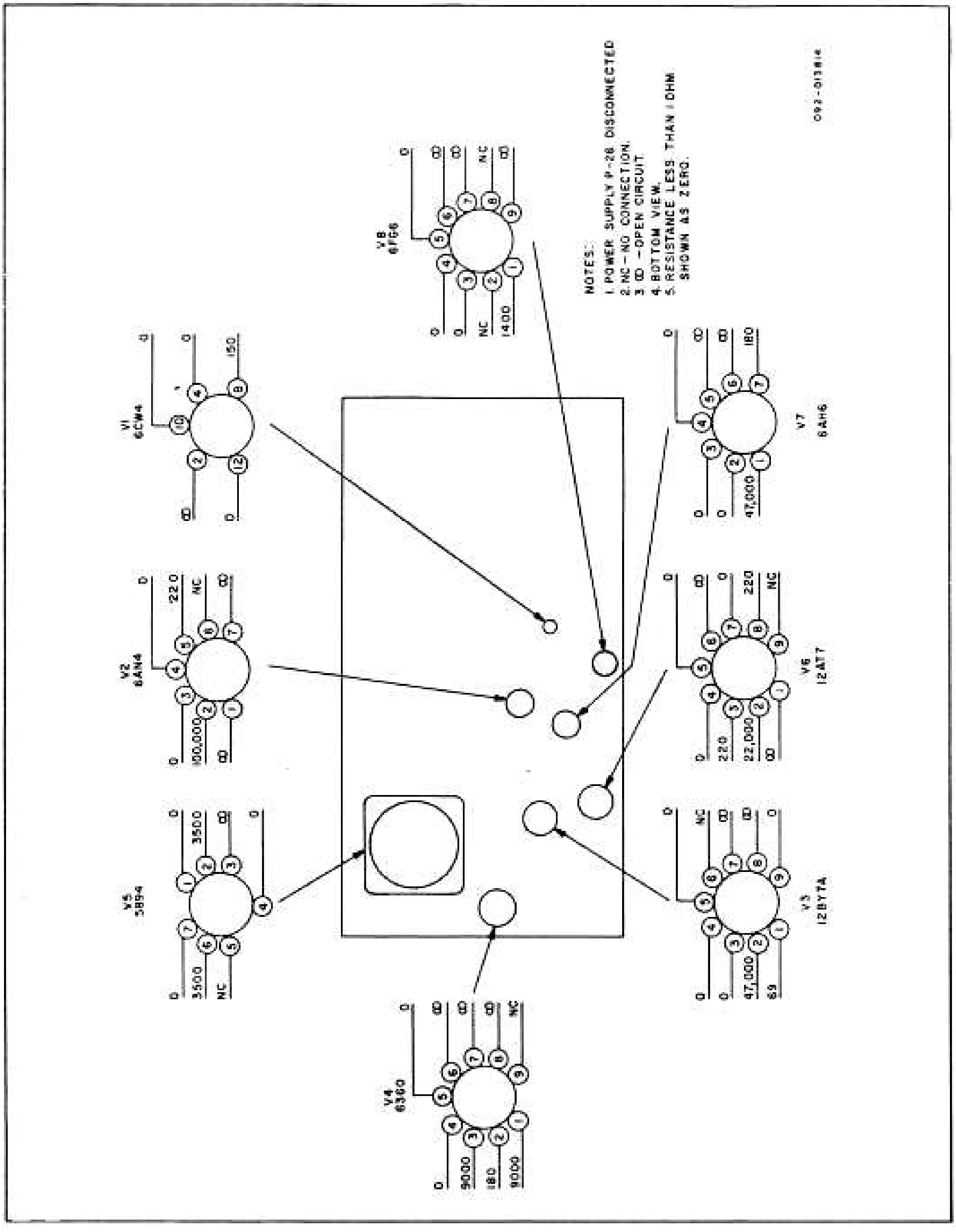


Figure 8. Resistance Chart.

SECTION VI

ALIGNMENT

6-1. GENERAL.

The Model HA-2 Two-Meter Transverter has been carefully aligned at the factory and with normal usage will not require major realignment unless extensive circuit repair is required which would upset the resonant circuits. Alignment should not be attempted until all other possible causes of faulty operation have been investigated.

Alignment should only be performed by persons having access to and familiarity with the use of sweep equipment. Refer to figures 9, 10, and 11 for the location of all alignment adjustments.

6-2. EQUIPMENT REQUIRED.

The following equipment is required when aligning the Model HA-2 Transverter:

1. Dummy load - 50 ohms non-inductive to 150 MC, rated at 100 watts.
2. Vacuum tube voltmeter (VTVM); Hewlett Packard Model 410 or equal, having an RF probe good to 150 MC.
3. Oscilloscope (5 millivolt/CM vertical deflection sensitivity).
4. Sweep frequency signal generator with a 50-ohm output termination capable of sweeping frequency ranges of 35 MC to 170 MC and 18 MC to 78 MC; Jerrold Model 601 or equivalent.
5. 50-ohm calibrated attenuator with 1-DB step position; Kay Electric Company type or equivalent.
6. Signal generator with a 50-ohm termination, tunable through 28 MC to 32 MC and 140 MC to 150 MC bands; Hewlett Packard Model 608 or equivalent.

6-3. BIAS ADJUSTMENT.

The bias adjustment control is located on the rear chassis apron of the transverter (see figure 2). The control is set for 40 MA plate current after placing the unit in the transmit condition (no signal applied). This adjustment will normally hold over long periods of time. A small temporary change in idling plate current may show after a heavy plate current load during tuneup but generally will settle back after the tube cools off.

6-4. CRYSTAL OSCILLATOR ALIGNMENT.

CHECKING CRYSTAL OSCILLATOR INJECTION. - Before altering the alignment adjustments for the crystal oscillator, check, as follows, to determine whether realignment is required:

1. Remove the type 5894 tube and disconnect the HV cable between the transverter and the power supply. For convenience, the transverter may be operated outside the cabinet for this check. The type 5894 tube and HV cable are removed for safety reasons, both for the operator and the tube, since removing the high voltage alone would damage the screen of the tube.
2. Turn on the transverter and allow approximately 15 minutes for equipment to stabilize.
3. Place the transverter in transmit condition by grounding the relay coil return wire (pin 2 of POWER plug).
4. With a 100K-ohm isolating resistor connected to the probe of a high impedance DC voltmeter, check the rectified grid voltage at the grid (pin 2) of the 12BY7A mixer tube. If the injection voltage is equal for both RANGE switch positions and is approximately minus 5 volts, switch the transverter over to the receive condition (disconnect relay coil return wire from ground) and move the DC voltmeter probe with the 100K-ohm isolating resistor to the junction of coil L3 and resistor R3 at the 6AN4 receiver mixer tube (V2). If the rectified grid voltage at this point is also equal for both RANGE switch positions and is approximately minus 3 volts DC, no alignment adjustments of the crystal section will be required.

ALIGNMENT PROCEDURE FOR CRYSTAL OSCILLATOR STAGE. - If the check outlined above indicates that alignment is necessary, proceed as follows:

1. As outlined above, the 5894 tube and HV cable are removed for this adjustment. For convenience, the transverter may be operated outside the cabinet. The 5894 tube and HV cable are removed for safety reasons, both for the operator and tube, since removing the high voltage alone would damage the screen of the tube.

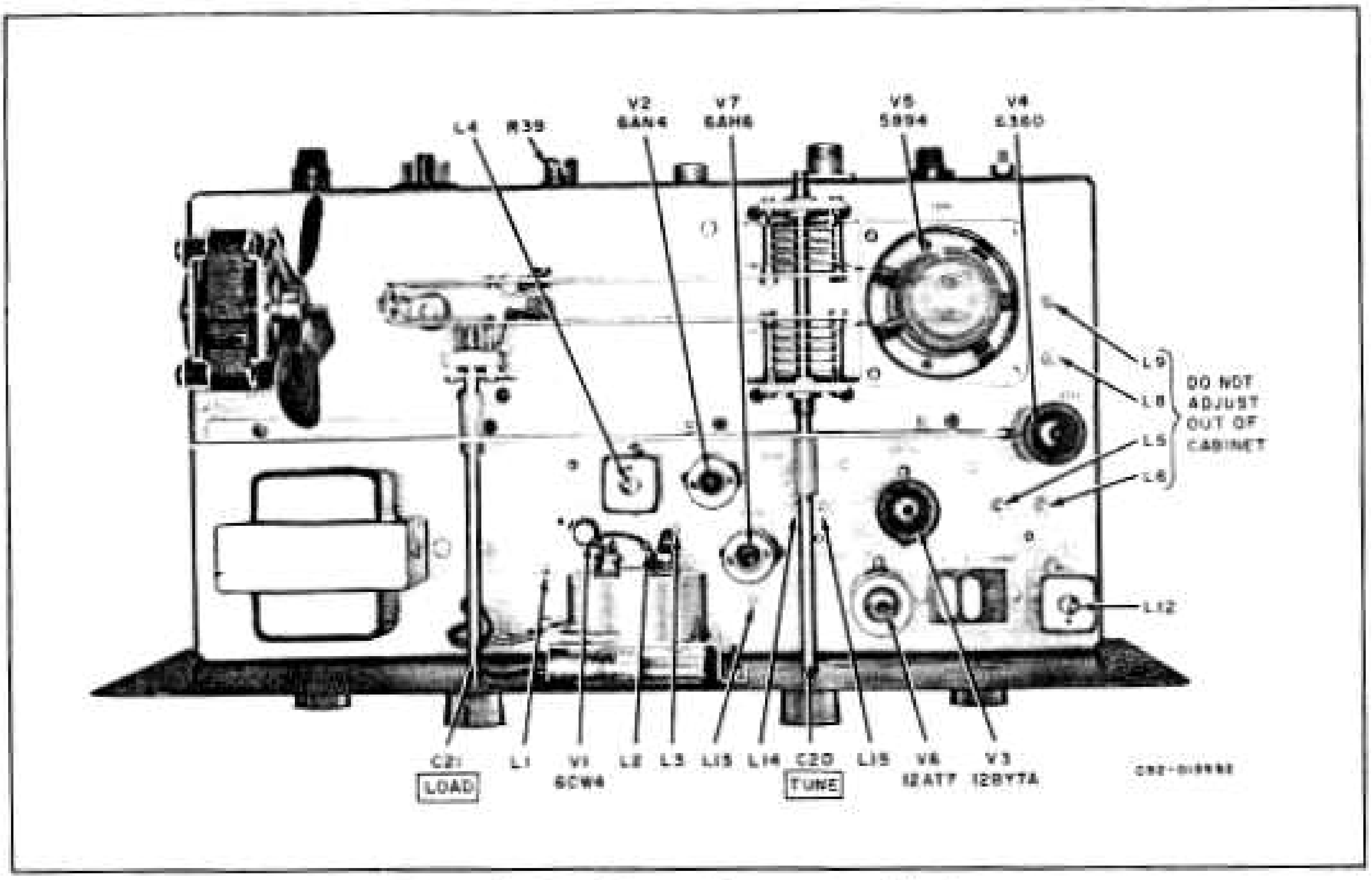


Figure 9. Top View of Transverter Chassis.

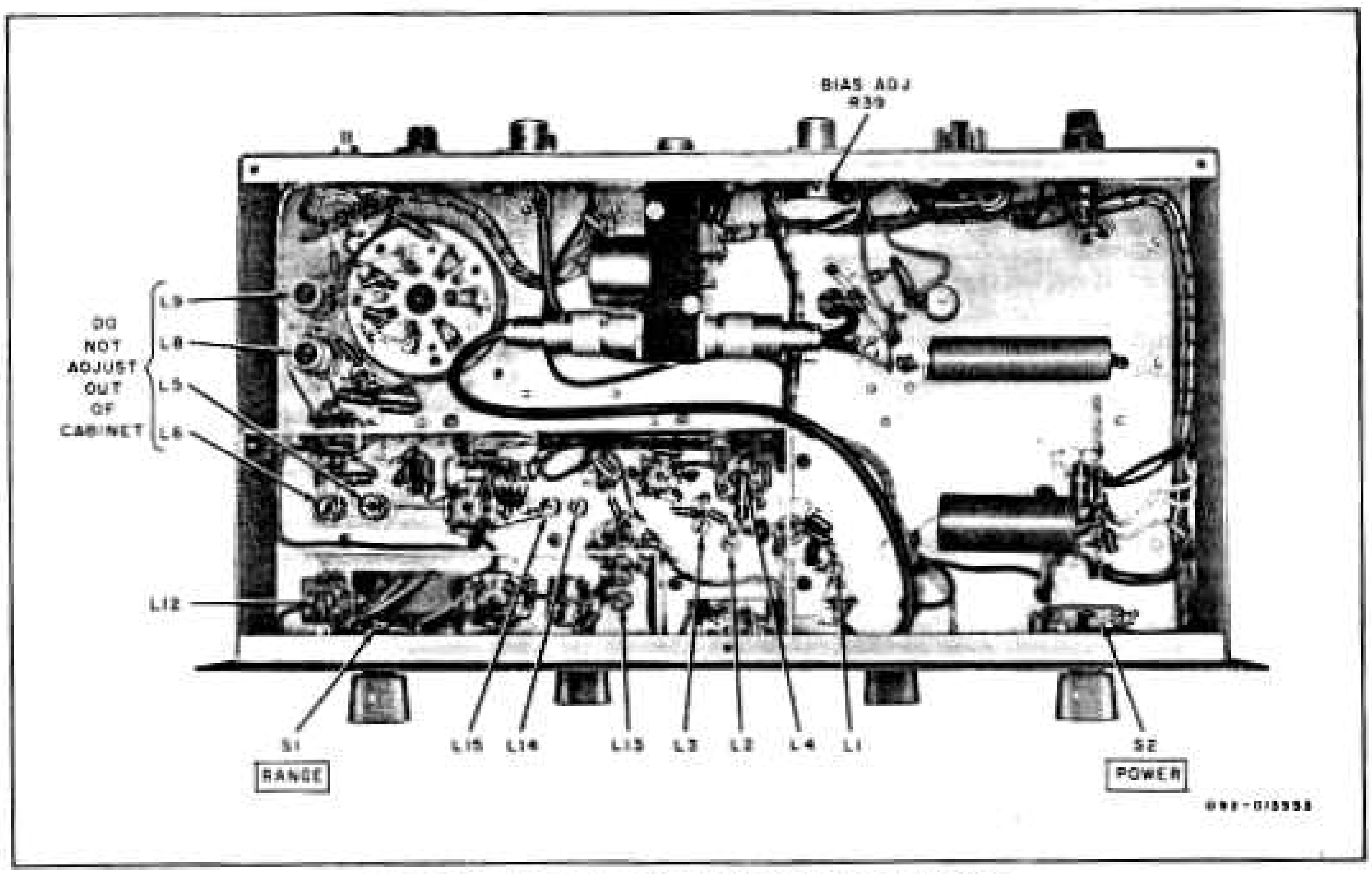


Figure 10. Bottom View of Transverter Chassis.

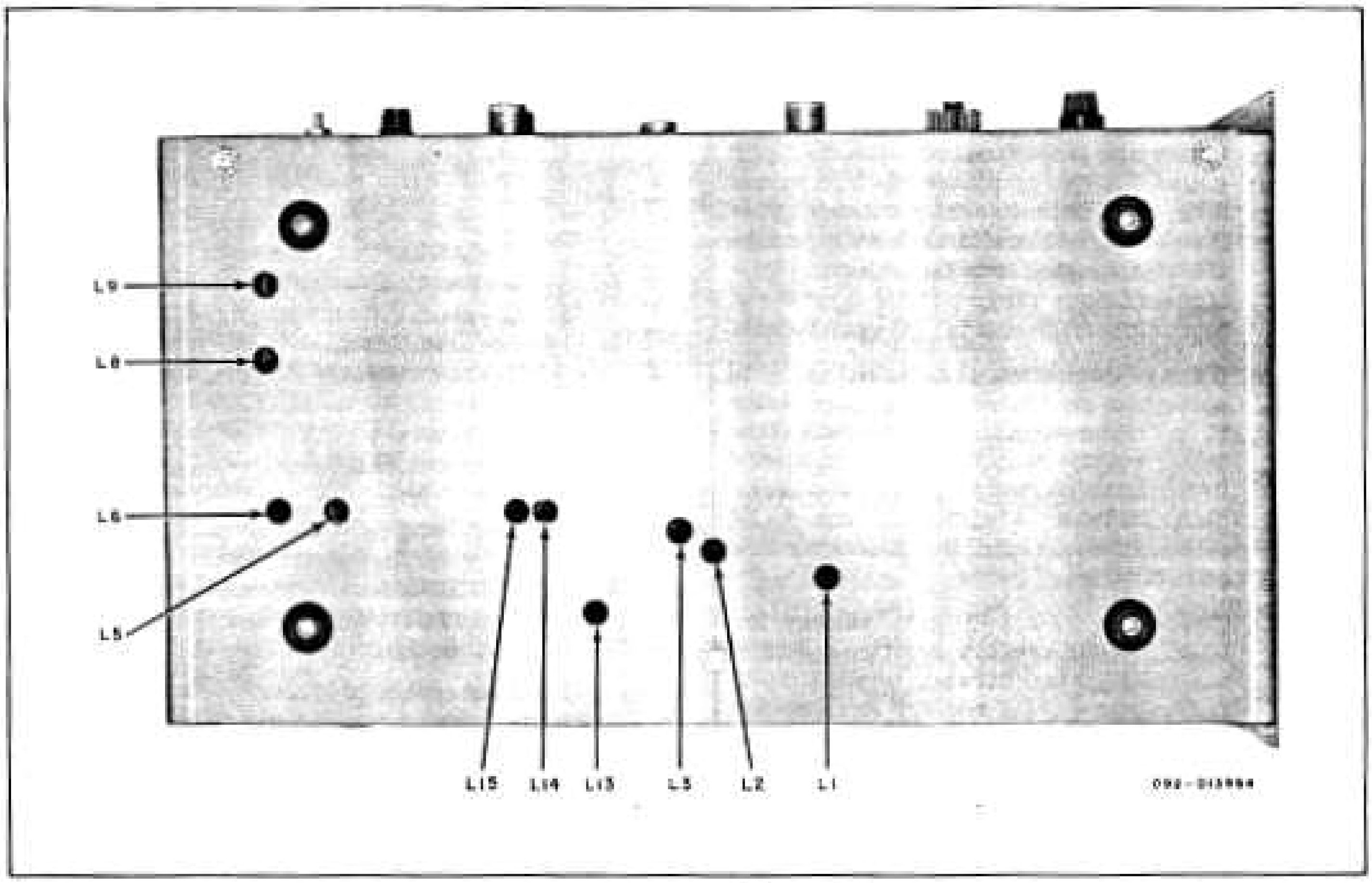
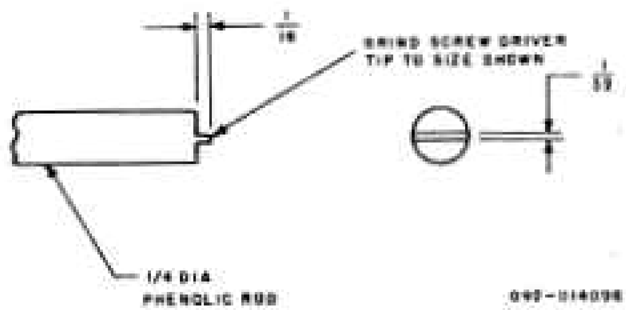


Figure 11. Bottom View of Transverter Cabinet, Showing Alignment Holes.

The drawing at the right shows the alignment tool to be used when adjusting coils L5, L6, L8, and L9 through the bottom of the cabinet. As the cores of the coils are delicate, do not file the blade of the tool narrower than 1/32 of an inch or the slot of the core may chip.



2. Place the transverter in the transmit condition (ground relay return wire at pin 2 of POWER socket).

3. Adjust coils L12, L13, L14, and L15 for maximum and equal rectified DC grid voltage at pin 2 of the 12BY7A mixer tube, for both range positions. Note that coils L13 and L15 have a minor effect on equalizing the injection voltage for both range positions, and can be compromised early in the procedure.

4. After obtaining equal rectified DC grid voltage in step 3, place the transverter in the receive condition (disconnect the relay return wire from ground) and move the voltmeter probe with the 100K-ohm isolating resistor to the 6AN4 mixer grid circuit, the junction of L3 and R3.

5. Check the rectified grid voltage for both RANGE switch positions, and if the voltages fall between minus 2 volts and minus 4 volts and are equal within 0.2 volt to 0.3 volt, alignment is complete.

6. If equal voltages are not obtained, make minor adjustments of coils L12 and L14 to equalize the injection, then repeat step 3 with the transverter switched back to transmit condition.

7. Crystal stage alignment is completed when maximum rectified DC grid voltages are obtained, which are equal to each other within 0.2 volt to 0.3 volt for the two RANGE switch positions for both transmit and receive conditions.

6-5. RECEIVER CONVERTER ALIGNMENT.

The crystal oscillator section must be aligned for equal mixer injection from each RANGE switch position before proceeding with alignment. The receiver converter stages are aligned with the chassis removed from the cabinet.

1. Remove the 5894 tube and disconnect the HV cable.

2. Connect the sweep signal generator to the ANTENNA connector through a 50-ohm calibrated attenuator.

3. Connect the vertical deflection input of the oscilloscope to the junction of coil L3 and resistor R3 through a 47K-ohm isolating resistor. Interconnect the horizontal sweep of the oscilloscope and the sweep signal generator to obtain the synchronized horizontal deflection required.

4. Connect the diode detector unit to the RECEIVER outlet to provide a termination for the transverter mixer output. See figure 12.

5. Center the passband about the 146-MC marker by adjusting coils L1, L2, and L3 for maximum display height. Do not stagger-tune the adjustments. Adjust the sweep generator output so that a scope sensitivity of 20 millivolts per centimeter deflection will provide a full size display on a 5-inch diameter oscilloscope tube.

6. The response normally passes through the 1-DB points of the curve at approximately 142 MC and 150 MC, and the peak-to-valley ratio will not exceed 1/2 DB.

7. If the core position of the mixer grid coil L3 is altered considerably during alignment, recheck the rectified DC grid voltage levels as outlined under

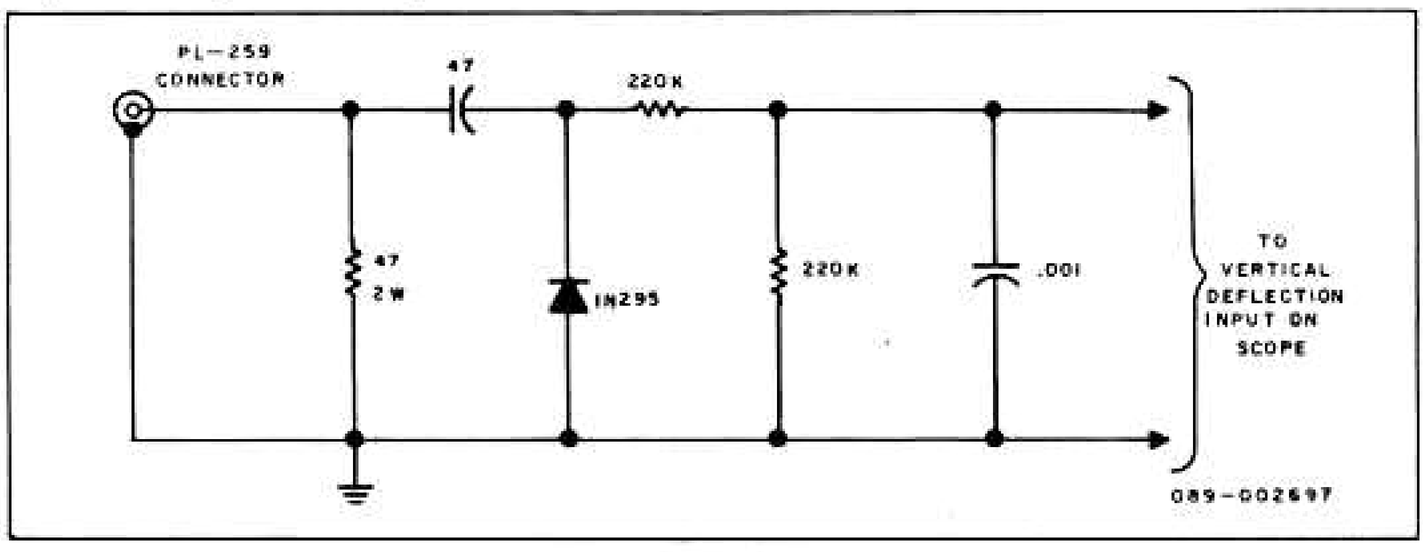


Figure 12. Diode Detector.

Crystal Oscillator Stage Alignment.

8. Disconnect the oscilloscope from the mixer grid circuit and connect the vertical input of the scope to the output of the diode detector unit, which was connected to the RECEIVER outlet in step 4.

9. Switch the RANGE switch to 144 MC to 146 MC (position 1). With the 145-MC marker signal injected, adjust coil L4 for a response centered on the 145-MC marker. Adjust the sweep generator output so that a 10-millivolt per centimeter scope sensitivity will provide a full display on a 5-inch oscilloscope.

10. Switch the RANGE switch to 146 MC to 148 MC (position 2). With the 147-MC marker signal injected, the marker will fall on the peak of the response curve display.

11. If the crystal oscillator injection is not of equal amplitude for both RANGE switch positions, the amplitude of the IF output display will not be equal.

12. Normal response runs less than 1/2 DB down at 144 MC to 146 MC, and 146 MC to 148 MC for each RANGE control position respectively.

6-6. TRANSMITTER CONVERTER ALIGNMENT.

The transmitter converter stages must be aligned with the chassis mounted in the cabinet. The shielding provided by the cabinet is required for proper operation of the transmitter section; all cabinet screws should be replaced when alignment or operation of the unit as a transmitter is attempted.

1. Connect a 470-ohm, 2-watt, carbon resistor across the final tank coil at the stator lugs of the split-stator capacitor.

2. Install the 5894 tube and assemble the unit in the cabinet. Use ALL mounting screws.

3. Attach the HV cable between the power supply and the transverter unit.

CAUTION

DO NOT INTERCONNECT THE HIGH VOLTAGE CABLE WITH THE POWER SUPPLY TURNED ON.

4. Connect the sweep generator through a 50-ohm calibrated attenuator to the LOW LEVEL INPUT connector.

5. Connect the 47-ohm diode detector unit to the ANTENNA connector. Connect the oscilloscope to the output of the diode detector.

6. Turn on the transverter and allow sufficient time for the idle plate current to stabilize with the transverter in the transmit condition. (Relay coil return wire grounded.)

7. Set the BIAS ADJ. control for a 40-milliampere idle plate current (no signal applied). The bias setting affects overall response, therefore, it must be set before alignment.

8. Set the RANGE switch to 144 MC to 146 MC (position 1).

9. Set the frequency of the sweep generator to sweep the 28-MC to 32-MC range. Adjust the output level to fill a 5-inch oscilloscope tube with scope sensitivity set for 20 millivolts per centimeter.

10. Inject a 30-MC marker signal.

11. Adjust LOAD and TUNE controls for maximum display amplitude. Note that the TUNE control rocks the passband as it is tuned through maximum. Watch the 30-MC marker (146-MC output) and set the TUNE control for maximum at this point of the curve.

12. Adjust coils L5, L6, L8, and L9 for maximum amplitude centered about the 30-MC (146-MC output) marker. Do not stagger-tune the adjustments. Adjustment of the coils is accomplished through the cabinet bottom with a phenolic tool. See figure 11.

CAUTION

DO NOT BLOCK OFF THE AIR INTAKE AND EXHAUST OPENINGS IN THE CABINET SIDES WHEN OPERATING WITH THE UNIT SET ON END TO REACH THE ALIGNMENT OPENINGS AT THE BOTTOM OF THE CABINET. PROP UP THE CABINET SIDE WHICH RESTS ON THE BENCH TOP SO THAT AIR CAN FLOW UP THROUGH THE UNIT.

13. Normal response will be less than 1/2 DB down at the 28-MC (144-MC output) and 32-MC (148-MC output) markers. The peak-to-valley ratio will be less than 1/4 DB.

14. Remove the 470-ohm, 2-watt resistor before making any operating checks after alignment.

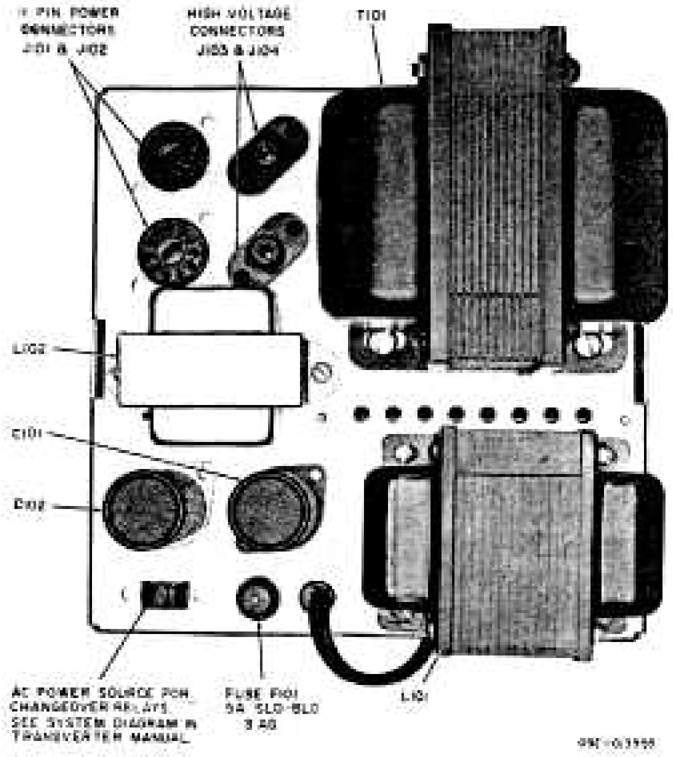


Figure 13. Top View P-26 Power Supply.

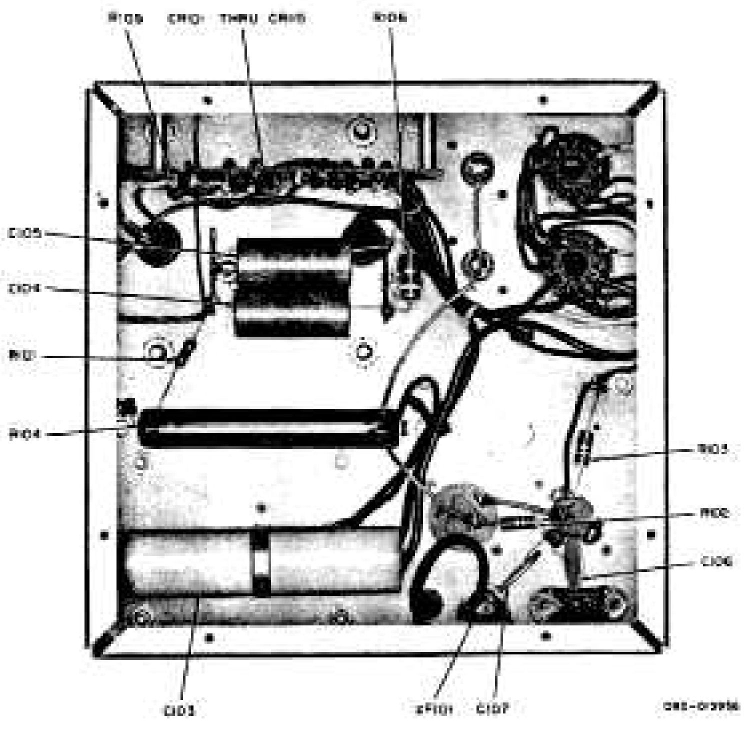


Figure 14. Bottom View P-26 Power Supply.

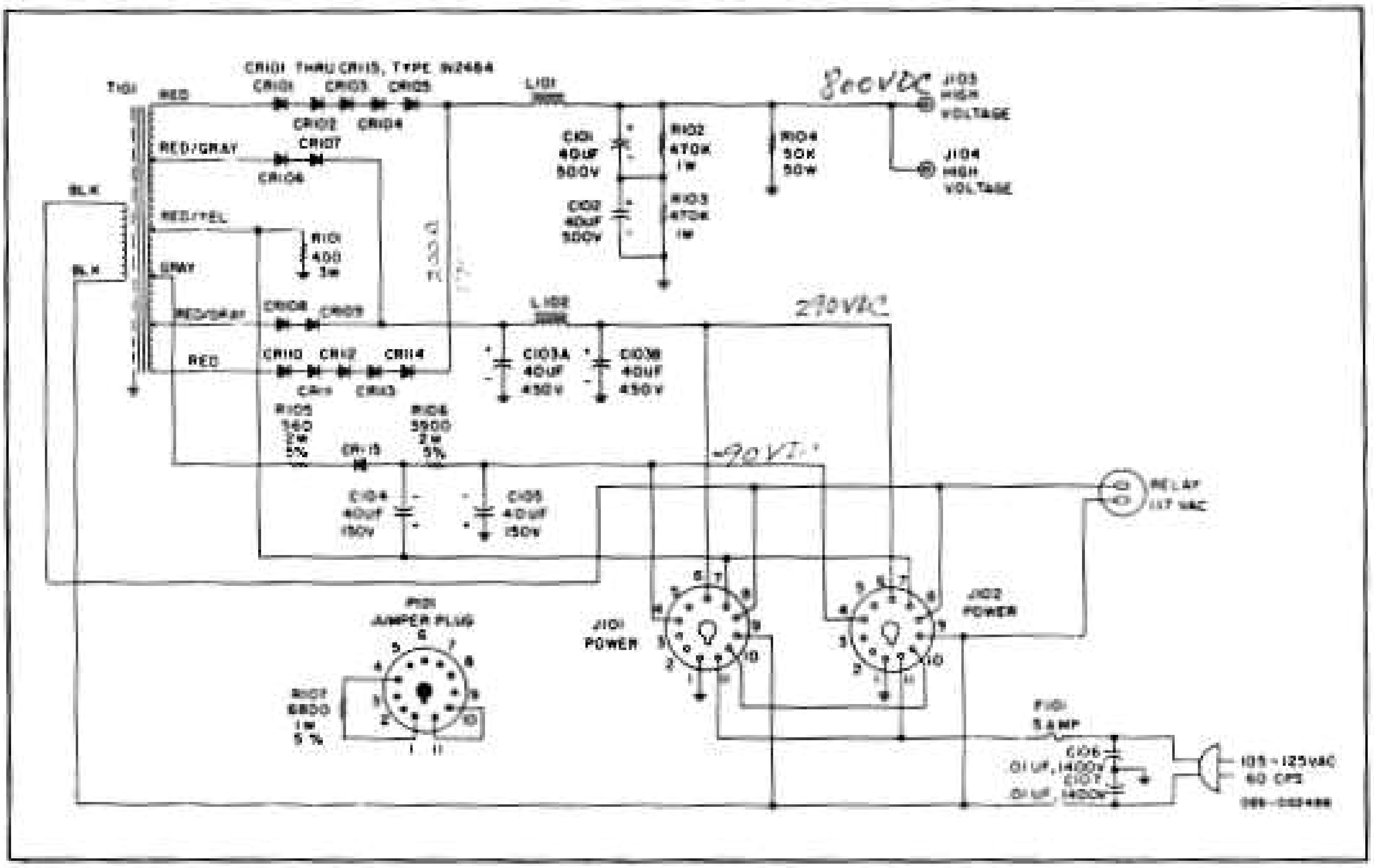


Figure 15. Schematic Diagram of Model P-26 Power Supply.

MODEL P-26
REPAIR PARTS LIST

Schematic Symbol	Description	Hallicrafters Part Number
C101, 102	Capacitor, Electrolytic, 40 µF, 500V	045-000792
C103A, B	Capacitor, Electrolytic, 40 x 40 µF, 450V	045-000794
C104, 105	Capacitor, Electrolytic, 40 µF, 150V	045-200509
C106, 107	Capacitor, Ceramic Disc 0.01 µF, 1400V	047-001309
CR101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115	Rectifier, Silicon, Type 1N2484	019-002634
F101	Fuse, 5 ampere, 3AG	039-100460
J101, 102	Socket, Power (11-pin)	006-100707
J103, 104	Connector, High Voltage	010-002257-3
L101	Coil, Choke, Swinging Filter, 6 to 27 henry	056-000476
L102	Coil, Choke, Filter, Smoothing, 9 henry	056-000477
P101	Plug, 11-Pin	035-100043
R101	Resistor, Wirewound, 400 ohm, 5%, 3 watt	446-011401
R102, 103	Resistor, Composition, 470K ohm, 10%, 1 watt	451-352474
R104	Resistor, Wirewound, 50K ohm, 5%, 50 watt	024-001408
R105	Resistor, Composition, 560 ohm, 5%, 2 watt	451-651561
R106	Resistor, Composition, 3900 ohm, 5%, 2 watt	451-651392
R107	Resistor, Composition, 6800 ohm, 5%, 1 watt	451-351682
	Feet, Rubber Bumper	016-200983
	Fuseholder	006-200845
	Line Cord	087-204690
	Lock, Line Cord	076-100953
	Plate, Bottom	063-005442
	Plug Assembly, Jumper (11-pin) (Inc. P101 and R107)	150-003323
	Strap, Nylon	076-102950

MODEL HA-2
SERVICE REPAIR PARTS LIST

CAPACITORS

Schematic Symbol	Description	Hallicrafters Part Number
C1, 25	10 μμf, 5%, 500V, Duramica	482-132100
C2, 10, 20, 33	47 μμf, 5%, 500V, Duramica	482-152470
C3, 5, 7, 8, 9, 12, 13, 14, 15, 16, 17, 18, 19, 23, 24, 27, 28, 29, 30, 34, 35, 39, 40, 41, 42, 44, 48, 49, 50, 51, 52, 53, 54, 55, 57	0.001 μf, GMV, 500V, Ceramic Disc	047-200230
C4	0.68 μμf, 10%, 500V, Composition	047-200403-1
C6	20 μμf, 2%, 500V, Duramica	482-151200
C11	100 μμf, 5%, 500V, Duramica	482-152101
C20A, B	Variable, Final TUNE	048-000520
C21	Variable Link, LOAD	048-000521
C22	0.001 μf, 5000V, Ceramic Disc	047-100397
C31, 32	82 μμf, 2%, 500V, Duramica	481-161820
C36	10 μμf, 20%, 500V, Ceramic Feed-Thru	047-001626
C37	1.0 μμf, 10%, 500V, Comp.	047-200403-3
C38	1.0 μμf, ±0.25 μμf, 500V, Ceramic Tubular	481-001010-33
C43, 45, 46, 47	0.005 μf, 1000V, GMV, Ceramic Disc	047-100486
C56	500 μf, 25V, Electrolytic	045-000784

RESISTORS*

Schematic Symbol	Description	Hallicrafters Part Number
R1	150 Ohm	451-252151
R2, 10, 15	18K Ohm, 1 watt	451-352183
R3	100K Ohm	451-252104
R4, 23, 25	220 Ohm	451-252221
R5, 6, 22, 26, 30	2200 Ohm	451-252222
R7, 27, 37	47K Ohm	451-252473
R8	47K Ohm, 2 watt	451-652473
R9	22 Ohm	451-252220
R11, 42	1000 Ohm	451-252102
R12, 13	18K Ohm	451-252183
R14, 16	180 Ohm, 1 watt	451-352181
R17, 43	470 Ohm	451-252471
R18, 19	4700 Ohm	451-252472
R20	100 Ohm, 1 watt	451-352101
R21	10K Ohm	451-252103
R24	22K Ohm	451-252223
R28	180 Ohm	451-252181
R29	68K Ohm	451-252683
R31	100 Ohm, 5%, 1 watt	451-351101
R32, 33	1000 Ohm, 5%, 2 watt	451-651102
R34, 35	470K Ohm	451-252474
R36	50 Ohm, 5%	024-001403
R38	8200 Ohm, 2 watt	451-652822
R39	Variable, 5K Ohm, BIAS ADJ	025-002032
R40	1800 Ohm, 5%, 2 watt	451-651182
R41	270 Ohm, 2 watt	451-652271

*All RESISTORS are carbon type, 1/2 watt, 10% unless otherwise specified.

COILS AND TRANSFORMERS

Schematic Symbol	Description	Hallicrafters Part Number
L1	Transformer, Antenna	051-003289
L2	Coil, RF Amplifier Plate (Receive)	051-003288
L3	Coil, Mixer Grid (Receive)	051-003286
L4, 13	Coil, Crystal Oscillator and Mixer Plate	051-003258
L5	Coil, Mixer Plate (Transmit)	051-003284
L6	Coil, Driver Grid	051-003279
L7	Coil, RF Choke (2.2 μH)	053-000641
L8	Coil, Driver Plate	051-003282
L9	Coil, Final Amplifier Grid	051-003283
L10	Coil, Plate Tank	051-003116
L11	Coil, Link	051-003287
L12	Coil, Crystal Oscillator Plate	051-003281
L14	Coil, Crystal Amplifier Plate	051-003280
L15	Coil, Mixer Grid (Transmit)	051-003278
L16	Coil, Low Pass Filter	051-003285
T1	Transformer, Filament	052-000823

TUBES AND DIODES

Schematic Symbol	Description	Hallicrafters Part Number
V1	Electron Tube, Type 6CW4	090-001462
V2	Electron Tube, Type 6AN4	090-901103
V3	Electron Tube, Type 12BY7A	090-901193
V4	Electron Tube, Type 6360	090-001253
V5	Electron Tube, Type 5894	090-900643
V6	Electron Tube, Type 12AT7	090-900034
V7	Electron Tube, Type 6AH6	090-900733
V8	Electron Tube, Type 6FQ6 (OUTPUT)	090-001463
CR1	Diode, Type 1N295	019-301980
CR2	Diode, Type 1N2484	019-002634

MISCELLANEOUS

Schematic Symbol	Description	Hallicrafters Part Number
	Adapter, Plug (UG-175/U)	010-100271
	Base, Shield (9- pin socket)	069-001417
	Base, Shield (7- pin socket)	069-001550
	Blade, Fan	080-000782
	Bracket, Capacitor Mounting (C20)	067-009343
	Bracket, Capacitor Mounting (C21)	067-009753
	Bracket, Fan Motor Mounting	067-009780
	Bracket, Meter Mounting	067-205730
	Cabinet	150-002193
	Cable Assembly, Power	087-007135
	Cable Assembly, HV Supply	087-007137
	Clip, Fahnstock	076-003707
J1, 2, 3	Connector, Coaxial	010-100096
J4	Connector, High Voltage	010-002257-2
	Core, Coil Tuning (L3, 6)	077-003689
	Core, Coil Tuning (L1, 2, 3, 13, 14, 15)	077-002700
	Core, Coil Tuning (L8, 9)	077-002701
	Crystal Mounting Board Assembly	150-003380

MISCELLANEOUS (CONT)

Schematic Symbol	Description	Hallicrafters Part Number
Y1	Crystal, Quartz (39666.666 KC)	019-003813
Y2	Crystal, Quartz (39333.333 KC)	019-003814
	Foot, Rubber Bumper	016-200983
	Front Panel	150-002791
F1	Fuse, 1 ampere, 3AG	039-100306
	Fuseholder	006-200845
	Insulator, Feed-Thru	008-100056
	Insulator, Feed-Thru	008-100057
	Insulator, Stand-Off	008-007090
	Iron Core (L4, 13)	002-101536
	Knob, LOAD and TUNE	015-001734
	Knob, POWER and RANGE	015-001735
DS1	Lamp, Pilot (#47)	039-100004
M1	Meter, PLATE Current (0-200 MA)	082-000552
B1	Motor, Fan	020-000331
	Plug Assembly (PL-259)	010-100173
K1	Relay, Coaxial (12 VDC)	021-000806
	Ring, Retaining	076-100532
	Shaft, Capacitor Adjust (C21)	074-002564
	Shaft, Variable Capacitor	074-002573
	Shield, Top	069-001503
	Shield, RF	069-001502
XV2, 7	Socket, 7-Pin Miniature Tube	006-000946
XV3, 4, 5, 8	Socket, 9-Pin Miniature Tube	006-000947
XV6	Socket, Electron Tube	006-000999
XV1	Socket, Nuvistor	006-000936
	Socket, Pilot Lamp	086-000591
S1	Switch, Rotary, Wafer (RANGE)	060-002407
S2	Switch, Rotary, DPDT (POWER)	060-002405
	Trim Strip	007-000818
	Washer, Insulator	[illegible]

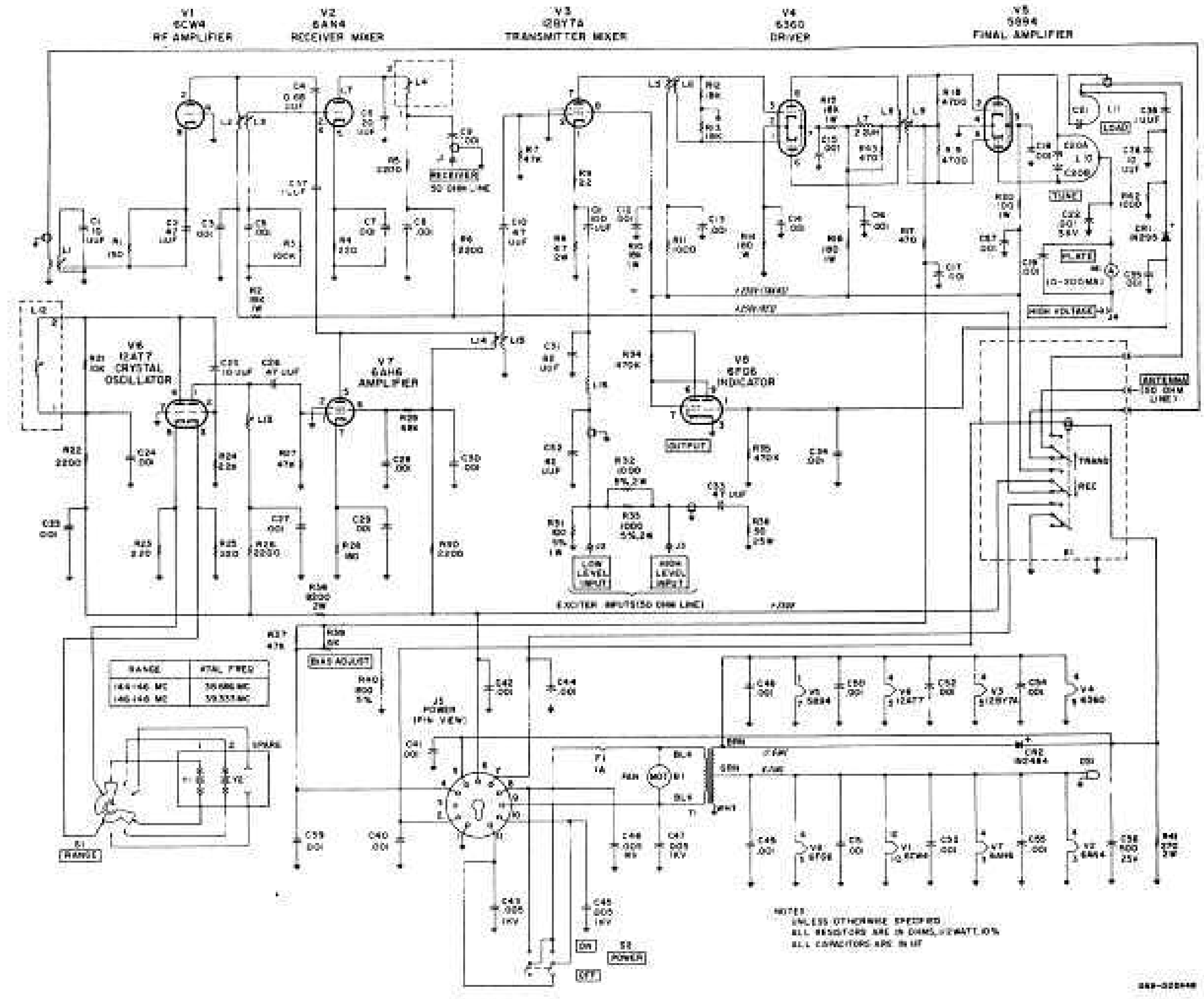


Figure 16. Schematic Diagram of the Model HA-2 Two-Meter Transverter.