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**TEN**  
**TEN - TEC**

**OWNER'S  
MANUAL**

**OMNI • A**  
**OMNI • D**  
**ORIGINAL SERIES**



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*Series B*

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Part No. 74083  
11-79

## SECTION I

## INTRODUCTION

Carefully remove your @MNI from the packing carton and examine it for signs of shipping damage. Should any shipping damage be apparent, notify the delivering carrier or dealer immediately, stating the full extent of the damage. It is recommended that you keep the shipping cartons. In the event that storage, moving, or reshipment becomes necessary, they come in handy. Accessory hardware, cables, etc., are packed with the @MNI. Make sure that you have not overlooked anything.

The @MNI is a medium power transceiver employing the latest techniques in solid state technology. @MNI-A, Model 545, features analogue frequency readout and a pulsed crystal calibrator. @MNI-D, Model 546, features digital frequency readout which inherently contains a crystal oscillator for accuracy. The only difference between these two models is the circuitry associated with the method of frequency readout. Differences in controls and procedures are noted in the text of this manual.

As shipped from the factory, the @MNI contains all necessary crystals for transceive operation in the 160, 80, 40, 20, 15, and 10 meter amateur bands. It will only receive in the 10.0 to 10.5 MHz band (WWV) and contains one unused bandswitch position. The @MNI has provisions to add transmit capability on the 10.0 to 10.5 MHz band and full transceive capability on the open AUX band should new frequencies be granted. There are some limitations as to which frequencies can be added, but proposed frequencies as of this writing should be compatible. Added components will be provided by TEN-TEC if and when new bands become available, at a charge yet to be determined.

The @MNI is extremely versatile. Although essentially a fixed station, it is equally at home when used mobile or portable. It operates from 12-14 volts dc or from 115/230 volts ac with an external power supply.

As you become more familiar with the operation of your @MNI, you will value the built-in operating conveniences more and more. "Tune-O-Matic" band changing completely eliminates transmitter tune-up. The panel meter automatically switches from an "S" meter to an SWR meter when transmitting. The normal sideband is selected, whether it be upper or lower, according to the band in use. Indicator light emitting diodes (LEDs) are provided for offset tuning (OT) and automatic level control (ALC). These are just a few of the many features you will enjoy. All in all, the @MNI is designed for active, serious amateurs.

## CONDENSED OPERATING INSTRUCTIONS

The following instructions will enable the operator to quickly place the @MNI into operation. For a more detailed description of the controls and their functions, refer to SECTION II.

FRONT PANEL CONNECTIONS

MIC - For SSB operation, plug a high impedance dynamic, ceramic, or crystal microphone, such as the TEN-TEC Model 215P Microphone, into this jack. Amplified microphones can be used if the output level is adjusted to a low enough value to prevent the microphone channel from overloading.

Use standard 1/4" stereo type phono plug -- tip to PTT switch; band to microphone signal; barrel to ground. Use shielded cable to prevent rf pickup. PTT switch should be SPDT type which shorts out microphone in the receive mode.

REAR PANEL CONNECTIONS

**POWER** - Use a 12 to 14 VDC power source capable of delivering 18 amperes, well regulated. When powering from a TEN-TEC power supply such as the Model 252M, interconnect units with the cable supplied. When other supplies or a battery are used, pin connections to the power socket are:

- Pin 1 - Negative 12-14 volts (GND); Pins 2 & 3 - Power Switch;
- Pin 4 - Positive 12-14 VDC.

Power Switch contacts, Pins 2 and 3, should not be used to switch the high current dc directly, due to switch contact ratings and voltage drop across the switch. If it is desired to switch power on and off from the front of the transceiver, use these pins to switch the primary ac voltage in cases where an ac power pack is used, or to actuate an intermediate relay such as the Guardian 200 Series or Potter Brumfield PR3DY0, either of which have sufficient current handling contact ratings in 12-14 VDC installations.

For minimum cable loss, use number 12 or 14 guage wire for the plus and minus leads. Smaller guage wire can be used for the switch leads.

When operating the @MNI fixed, portable, or mobile with an external power supply or any other source other than a TEN-TEC power supply, the protective circuitry for the final amplifier, being in the TEN-TEC ac power supplies, is not present. In order to protect the final amplifier, it is necessary to limit any over-current that may be caused by excessive drive or improper antenna matching. This may be accomplished by inserting TEN-TEC Model 1140 Circuit Breaker in series with the twelve volt supply line. The circuit breaker will also function as an external on/off switch.

**ANTENNA** - Connect a 50 to 75 ohm, unbalanced resonant antenna, such as a beam, dipole, or vertical. Balanced antennas and those with higher impedances should be matched with an antenna tuner such as the TEN-TEC Model 247 Antenna Tuner.

**RECEIVE-TRANSCIVE SWITCH** - For normal transceiver operation, position this switch in the TRANSCIVE position. If an external amplifier or a separate receiving antenna is to be used, refer to the detailed instructions in SECTION II. (Use a small probe to actuate switch. Raised bezel prevents accidental throwing of switch.)

**KEY** - For cw operation, connect a straight key, bug, or electronic keyer such as TEN-TEC Model 645 ULTRAMATIC to this jack. Electronic keyers other than TEN-TEC models preferably should be of the reed relay type, since a low resistance to ground contact is required on the KEY line for proper transmitter keying.

FRONT PANEL CONTROLS

**INITIAL TRANSMITTER CONTROL SETTINGS - CW or SSB**

- 1.) Select desired band or band segment with BAND switch.
- 2.) Tune dial to frequency of operation.
- 3.) Set ALC control fully clockwise.
- 4.) Push POWER switch, located on AF control, in.
- 5.) Rotate MODE switch to LOCK position.
- 6.) Rotate DRIVE control until ALC light glows.
- 7.) Observe SWR reading on meter. For efficient operation, SWR should be less than 3 to 1. If it isn't, make alteration to antenna system to reduce SWR.

- 8.) Switch MODE switch to desired mode -- SB-N or CW. In SB-N, select either VOX or PTT switch position. For cw operation, the setting of the DRIVE control in the LOCK mode, step 6 above, is correct setting. In ssb, DRIVE control setting should be readjusted so that the ALC indicator just lights on voice peaks.

#### INITIAL RECEIVER CONTROL SETTINGS

- 1.) Select desired band and frequency.
- 2.) Rotate RF control fully clockwise and push knob in.
- 3.) Advance AF control to suitable audio level.
- 4.) Rotate NOTCH control fully clockwise.
- 5.) Set SELECTIVITY switch to 2.4 kHz position.
- 6.) Set MODE switch to CW or SB-N.
- 7.) Peak RESONATE control for maximum receiver sensitivity.

#### SPECIFICATIONS

##### GENERAL

FREQUENCY COVERAGE - 1.8-2.3, 3.5-4.0, 7.0-7.5, 14.0-14.5, 21.0-21.5, 28.0-28.5, 28.5-29.0, 29.0-29.5, 29.5-30.0 MHz transceive; 10.0-10.5 MHz receive only.

VFO STABILITY - Less than 15 Hz change per F° averaged over a 40° change from 70° to 110° after 30 minutes warmup. Less than 10 Hz change from 105 to 125 VAC line voltage when using a TEN-TEC power supply.

TUNING RATE - Vernier, 18 kHz per revolution, typical.

READOUT - ◊MNI-A: Slide rule dial indicates 100 kHz segment, dial skirt increment to 1 kHz. Three dial scales.  
 ◊MNI-D: Six digit, 0.43" LED numerals. Least significant digit indicating 100 Hz green, all others red.

ACCURACY - ◊MNI-A: ± 1 kHz from nearest 25 kHz calibration point.  
 ◊MNI-D: ± 100 Hz.

SEMICONDUCTORS - ◊MNI-A: 13 IC's, 43 transistors, 63 diodes.  
 ◊MNI-D: 20 IC's, 44 transistors, 63 diodes, 6 LED readouts.

PC BOARDS - ◊MNI-A: 14 plug-in, 9 integral.  
 ◊MNI-D: 13 plug-in, 10 integral.

CONSTRUCTION - Rigid aluminum chassis. Dark painted aluminum front and rear panels, black vinyl covered aluminum top and bottom. Satin etched and extruded panel trim and bail.

POWER REQUIRED - ◊MNI-A: 12-14 VDC, 400 mA receive, 18.0 A maximum transmit.  
 ◊MNI-D: 12-14 VDC, 850 mA receive, 18.5 A maximum transmit.

DIMENSIONS - HWD 5-1/2" x 14-1/4" x 14", less bail.

NET WEIGHT - 14-1/2 lbs.

##### RECEIVER

SENSITIVITY - Tailored from 2.0 uV on 1.8 MHz band to .3 uV on 28 MHz band for 10 dB S+N/N.



SELECTIVITY - 8 pole ladder filter. 2.4 kHz bandwidth. 1.7 to 1 shape factor @ 6/60 dB. With Model 217 installed: 500 Hz bandwidth, 1.9 to 1 shape factor. With Model 218 installed: 1800 Hz bandwidth, 1.8 to 1 shape factor.

INTERMEDIATE FREQUENCY - 9 MHz.

ANTENNA INPUT - Low impedance, unbalanced.

AUDIO OUTPUT - 1-1/2 watts @ 4 ohms with less than 2% distortion. Two built-in speakers, external PHONES jack.

SPURIOUS RESPONSE - All below equivalent 10 dB S+N/N signal except 1.838 MHz (less than 15 dB S+N/N), 21.320 MHz (less than 20 dB S+N/N), and 28.980 MHz (which can be eliminated by using low end of 29.0-29.5 MHz band segment).

S-METER - Automatically switched on when receiving.

DYNAMIC RANGE - 85 dB, typical.

ATTENUATOR - PIN diode, 18 dB, typical, for increased dynamic range.

OFFSET TUNING - Dual range: MAX  $\pm$  5 kHz, MIN  $\pm$  500 Hz, typical.

CW FILTER - Built-in. 150 Hz bandwidth centered at 750 Hz. Shape factor 7.2 to 1 @ 6/60 dB. 3 selectable response curves.

ZERO BEAT - Disables transmitter offset in cw mode for accurate frequency adjustment.

NOTCH FILTER - 40 dB audio rejection notch filter tunable from 250 Hz to greater than 6 kHz.

NOISE BLANKER - Optional plug-in accessory. TEN-TEC Model 248. I-f type with monolithic filter to prevent overloading by adjacent signals.

WWV - Reception at 10 MHz.

#### TRANSMITTER

DC POWER INPUT - Max. input power 200 watts @ 14 VDC, cw and ssb. 100% duty cycle.

RF POWER OUTPUT - 85-100 watts, typical.

OUTPUT IMPEDANCE - 50 ohms, unbalanced.

MICROPHONE INPUT - High impedance crystal, ceramic, or dynamic.

T/R SWITCHING - VOX or PTT on ssb. Instant break-in on cw.

CW SIDETONE - Internally generated. Adjustable tone and volume independent of af control. Operates only in cw mode.

SSB GENERATION - 9 MHz, 8 pole crystal ladder filter. Balanced modulator.

CARRIER SUPPRESSION - 60 dB, minimum.

SIDEBAND SUPPRESSION - 60 dB, minimum, at 1 kHz tone.

SPURIOUS OUTPUT - Less than - 40 dB.

METER - Indicates SWR on transmit.

CW OFFSET - 750 Hz, automatic.

ALC CONTROL - Front panel, LED indicator.

FRONT PANEL CONNECTIONS AND CONTROLS

Receiver RESONATE; OFFSET; QSK (FAST/SLOW); VOX-PTT; RX-OT (MAX/MIN/OFF); PHONES jack; MIC jack; BAND switch; ZERO BEAT (push button); Main Tuning Knob; Vox ANTI; Vox DELAY; Vox GAIN; XTAL CAL (push button in Model 545 only); ALC; BLANKER (pull-on); DRIVE; NOTCH; SELECTIVITY; RF gain; ATT. ON-OFF (pull-on); AF gain; POWER ON-OFF (push-on); MODE switch.

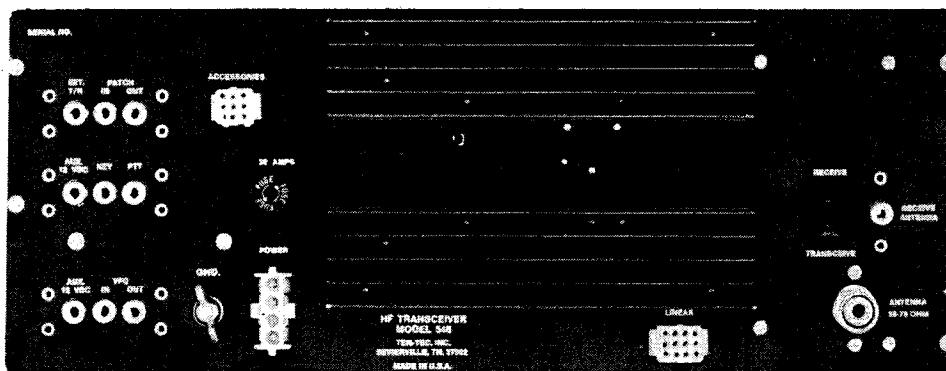
REAR APRON CONNECTIONS AND CONTROLS

EXT. T/R jack; PATCH IN jack; PATCH OUT jack; AUX 12 VDC jacks (2); KEY jack; PTT jack; VFO IN jack; VFO OUT jack; ACCESSORIES socket; FUSE (20 A); GND terminal; POWER socket; LINEAR socket; RECEIVE-TRANSCIVE switch; RECEIVE ANTENNA jack; ANTENNA coaxial connector.

1-79  
V-343/340

SECTION II  
DETAILED OPERATING INSTRUCTIONS

REAR PANEL CONNECTIONS



POWER SOCKET

A supply of 12 to 14 VDC capable of supplying 18 amperes, negative ground is required. The OMNI may be operated with any mobile installation having a 12 volt battery, or powered from an ac supply, such as TEN-TEC Model 252M.

For battery operation, as well as operation with any power source other than a TEN-TEC power supply, it is recommended that a cable of at least 12 guage conductors be run directly from the battery or power source to the transceiver through a circuit breaker of sufficient rating, such as TEN-TEC Model 1140.

For fixed station installation, cable length from the power supply should be as short as possible and made from 12 guage wire or larger. The chassis should be strapped to a good earth ground system as should all other equipment, both as a personal hazard precaution and for optimum performance.

A power switch is located on the af control and is wired only to pins 2 and 3 of the four pin power socket on the rear apron. The switch is not in series with the power input leads. The switch need not be used for ac operation if on-off switching is desired at the power supply location. Or, the switch may be connected in series with the 115/230 volt primary lead to the supply if switching function is desired from the front panel. In this case, the power supply switch should permanently be positioned in the "on" position. The TEN-TEC Model 252M power supply, which is designed for use with the OMNI, already has provisions for this mode of switching.

For dc operation, the contact rating of the switch on the AF control is NOT sufficiently high to carry the 18 amperes required. Switch contact resistance will result in an appreciable voltage drop across the switch. The insertion of TEN-TEC Model 1140 Circuit Breaker in series with the 12 VDC supply line will protect the final amplifier from over-current conditions and provide an external on-off switch.

Pin connections for the power socket are: Pin 1 = GND; Pins 2 and 3 = ON-OFF switch; Pin 4 = +12-14 VDC. Pin 1 has a rib on the plastic part of the cable connector and Pin 4 has a rib on the chassis connector.

Because of the similarity of the male and female cable ends on the power cable supplied, the plastic cable ends have color coded dots on them which correspond to color coded dots on the rear apron of the transceiver and power supply: ORANGE to power supply and GREEN to transceiver.

The +12 volt line is fused with a 20 ampere fast-blo fuse, and a high power diode is connected across the line to ground in a normally reverse-biased polarity. Under these circumstances, the diode does not conduct. If reverse polarity is applied, the diode conducts heavily and blows the fuse, thereby protecting the transistors and electrolytic capacitors.

#### GROUND STRAP

To reduce the possibility of stray rf pickup on interconnecting cables which may cause parasitic oscillations, all station equipment should be well grounded to earth. It is also important to strap the equipment chassis together with short, heavy leads, preferably with braid. The strap between the power supply and the transceiver also serves to reduce voltage drop on the negative 12 volt lead caused by resistance in the connector contacts. In mobile installations, connect a ground strap between the rear panel ground lug and the automobile chassis (dash board).

#### ANTENNA

Any matched antenna presenting 50 to 75 ohms impedance will load satisfactorily. Random length antennas and open wire feed systems will require a matching system such as TEN-TEC Model 247 Antenna Tuner. Most popular mobile antennas will operate without special matching. When they are used as portable antennas, a good ground system or counterpoise should be provided. The @MNI is designed for use with an unbalanced feed system. Coaxial shield is connected to the shell and the center conductor to the pin of the PL-259 connector.

#### EXT T/R

This jack is intended to actuate a high power linear amplifier. It is derived from a set of normally open contacts of the auxiliary relay located on the OT-TR Board. One side of this switch is also at ground potential and therefore should not be used to switch the 115/230 volt line. When operating cw, a drop-out delay is incorporated in the relay circuit and is adjustable with a thumb potentiometer located on the OT-TR assembly. When operating ssb, this drop-out delay is switched out of the circuit. Since this relay does not control any of the internal functions of the transceiver, delay is factory set to an average value when shipped. It should be adjusted for suitable delay only when external equipment is controlled by this relay.

CAUTION: There are two potentiometers located on the OT-TR assembly. It is very important that the setting of the FINAL BIAS ADJUSTMENT not be disturbed. Improper setting of this bias potentiometer may result in highly distorted audio transmission or output transistors overheating and possibly failing. Refer to the OT-TR assembly description in SECTION III for the location of these potentiometers.

#### KEY

The key actuates a series of circuits on the CONTROL BOARD assembly that supply operating voltages to various transmitter and receiver circuits. When the key is closed, bias is removed from the receiver stages and applied to the transmitter. The receiver antenna circuit is also grounded during transmit with a reed relay. There is a small time constant in the audio muting circuit to eliminate clicks in the speaker while keying. It is not long enough to interfere with the complete break-in feature. The cw sidetone and key operate only when the MODE switch is in the cw position. Sidetone volume is independent of the af volume control. It may be set to the desired level with the thumb potentiometer accessible through the hole in the bottom plate. A second potentiometer adjacent to the level control adjusts sidetone pitch over approximately one octave.

For proper transmitter operation, the key line requires a very low resistance path to chassis, with no appreciable voltage across it. Hence, electronic keyers utilizing reed relay switching are recommended. Some transistor switched keyers may not key the transmitter in the case of negative voltage circuits, or may present too high of a saturation dc residual voltage in positive voltage circuits. Improper keying line conditions may cause lower than rated power input, improper keying envelope and/or key clicks. Any TEN-TEC keyers whether relay or transistor types will key the @MNI.

AUX 12 VDC

Either of these jacks may be used to power external equipment such as an electronic keyer or external VFO. The TEN-TEC Model 645 ULTRAMATIC Keyer and TEC-TEC Model 243 External VFO are two such items and are available as accessories to the  $\Theta$ MNI.

Each of these jacks is connected to the +12 VDC line after the protective fuse and is rated at a maximum of 2 amperes @ 12 VDC. If an ac power supply is employed, its current capacity must be great enough to supply the transceiver requirements plus that of any equipment powered through either or both of the AUX 12 VDC jacks.

ACCESSORIES SOCKET

A nine pin female chassis mounted MOLEX connector is available for interfacing an external VFO, counter or other peripheral equipment to the  $\Theta$ MNI. Refer to main block schematic diagram for pin identifications.

LINEAR

This socket consists of a twelve pin female chassis mounted MOLEX connector for front panel bandswitching of a linear amplifier or antenna relays. Eight band positions corresponding to the 1.8, 3.5, 7.0, 10.0, 14.0, AUX, 21.0 and four 10 meter segments of the switch, a common terminal for the switch, a ground, and "T" voltage are all available. Refer to main block schematic diagram for pin identifications.

PATCH IN-OUT

These jacks provide bridging connections to the microphone and speaker for an external phone patch.

The PATCH OUT jack may also be used for driving an external speaker without disabling the internal speakers.

RECEIVE ANTENNA

This jack provides an antenna connection directly to the receiver input. It can be disconnected from the transmitting circuits by placing the RECEIVE-TRANSCIVE switch in the RECEIVE position. In this mode, there are no protective devices, either back to back diodes or shorting relay, across the receiver input. This allows for the use of an external receiver when the switch on the rear panel is placed in the TRANSCIVE position.

RECEIVE-TRANSCIVE

This switch, in the RECEIVE position, connects the receiver antenna terminal to the RECEIVE ANTENNA jack directly. It is used when an instant break-in linear or separate receiving antenna is used. In the TRANSCIVE position, the receive input is connected to the ANTENNA socket for normal transceiver operation.

VFO IN-OUT

These jacks provide means to switch the internal VFO signal on and off when using TEN-TEC Model 243 Remote VFO accessory. As shipped from the factory, these two jacks are connected externally with a U shaped jumper pin.

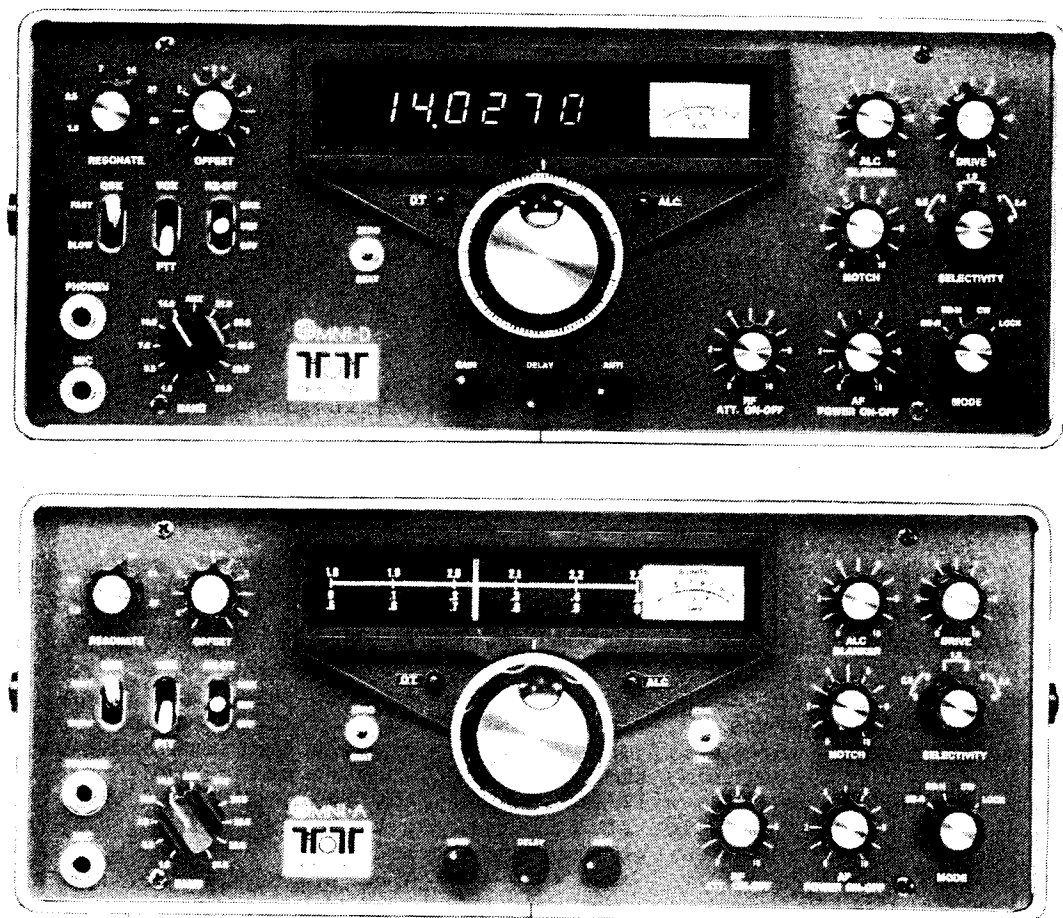
PTT

This jack is in parallel with the push-to-talk line on the microphone jack. It may be used as an external transmit/receive station switch and is operable only in the ssb mode.

FUSE

The fuse is a 3AG, fast-blo, 20 ampere type which is connected in the +12 VDC line. Replace with an equivalent type. Do not substitute with a slo-blo type.

## FRONT PANEL CONTROLS

RF-AF

The RF gain controls the bias to the i-f amplifiers. It is used to reduce susceptibility to overload in the presence of extremely strong signals. The AGC is dependent on the setting of the RF control.

The AF control varies the input level to the audio power amplifier assembly and should be used in conjunction with the RF control to minimize AGC pumping. To do this, temporarily set RF control fully clockwise. Adjust AF setting while receiving a strong station, S7 or better, to a level just a bit louder than desired. Then reduce the level of this station, and all other stations, to the desired value with the RF control. In this way, only one setting of the AF control need be made. This procedure also eliminates inter-character signal blasting when operating cw with QRM present.

POWER ON-OFF

This push-pull switch is located on the AF control and shorts pins 2 and 3 of the four pin power connector when pushed in.

ATT. ON-OFF

This pull-on switch is located on the RF gain control and inserts an 18 dB attenuator in the receiver antenna line for use when strong signals cause severe overload.

MODE SWITCH

The SB-N setting of this switch is used for ssb transmissions on the normal side of the carrier frequency. It will provide lower sideband signals on

160, 80, and 40 meters, and upper sideband on 20, 15, and 10 meters. This is accomplished by using either the sum or the difference frequencies in the mixer. The opposite or reverse sideband can be selected by rotating the MODE switch to the SB-R position. In the ssb modes, the transmitter can only be energized by shorting the PTT line to chassis. The cw key line is disconnected.

In the CW position, the sidetone signal is fed to the audio system. Its level and pitch can be adjusted with the two adjacent thumb potentiometers, accessible through the large hole in the bottom plate.

In cw, the transmitted frequency is automatically offset 750 Hz from the receiver setting. This compensates for the 750 Hz beat note of the received signal and puts the transmitter exactly on the received frequency. This 750 Hz frequency was selected as the offset to correlate with the center frequency of the cw filters. When the received signal is peaked on the S-Meter, the beat note will be 750 Hz.

The transmitter can be switched on only by shorting the KEY jack to chassis in the cw mode. PTT lines in the MIC jack and the external PTT jack are disconnected.

The LOCK position of the MODE switch is used for system checks and SWR measurements. It energizes the transmitter on the cw frequency but does not key the sidetone oscillator.

#### BAND SWITCH

The BAND switch selects the amateur bands of 1.8, 3.5, 7.0, 14.0, 21.0, and 28.0 to 30.0 MHz. With a full 500 kHz range per band, the marine band in the 1.3 to 2.3 MHz range is covered. As shipped from the factory, the  $\Theta$ MNI will receive on the 10.0 to 10.5 MHz band (WWV). Provisions are included to add transmit capability on this band and both transmit and receive capability in the AUX position, should new frequencies be granted. The added components for these bands will be installed by TEN-TEC if and when any new frequencies become available, at a charge yet to be determined. All pertinent boards have the necessary circuitry included.

#### MAIN TUNING

In the  $\Theta$ MNI-D, Model 546, megahertz, kilohertz, and hundreds of hertz are displayed on the six digit LED display. Hundreds of hertz are in green to easily separate the fraction of kHz from the rest of the reading. When using TEN-TEC Model 243 Remote VFO, the display will read the frequency in use at the time. The counter can be accurately set to WWV as outlined in SECTION III. The main tuning knob skirt has 1 kHz markings to facilitate quick, relatively small fraction excursions, such as used when QSYing to avoid QRM, or when passing traffic in net operation. (Up or down 5 or 10 kHz is easily accomplished without having to read the digital display.)

In the  $\Theta$ MNI-A, Model 545, the main tuning knob dial skirt is marked in 1 kHz increments up to 100 kHz. This scale is used in determining the frequency of operation within the 100 kHz segment indicated on the slide rule dial. Three slide rule scales provide easy determination of frequency for bands starting with even or half MHz points. The 1.8 to 2.3 MHz scale is only for 160 meters.

Since the VFO shaft is raised from chassis potential to eliminate frequency jumping caused by poor sliding contacts, there is a very small hand capacity effect on frequency when either dial skirt or knob insert are touched. To eliminate this effect, grasp only the plastic portion of the main tuning knob, or use the finger spinner when fine tuning the VFO.

#### XTAL CAL

In the  $\Theta$ MNI-A, Model 545, the crystal calibrator produces a distinctive pulsed tone at 25 kHz intervals. The calibrator is activated by depressing the red push button. It will remain operating for a period of 5 to 10 seconds, depending on the setting of the TIME SET thumb control on the XTAL

CAL assembly. With the calibrator operating, the incoming signals are attenuated approximately 20 dB for easier identification of the calibrator signal. To calibrate the VFO, tune the main tuning knob to the 25 kHz point closest to the desired frequency and zero beat the pulsed tone making sure that you do not tune off into the suppressed sideband area. If dial skirt does not read to the proper 25 kHz indication, hold the large tuning knob with one hand to prevent its rotation and then rotate the friction held dial skirt so that it registers correctly. The transceiver is then calibrated to an accuracy of better than 1 kHz for 13 kHz either side of this frequency.

No crystal calibrator is necessary in the OMNI-D, Model 546, since the frequency counter, which is crystal controlled and set to WWV, is extremely accurate.

#### DIAL POINTER ZERO SET

In the OMNI-A, Model 545, when calibrating at any 100 kHz point, the slide rule dial pointer may be set exactly to the scale marking for this frequency with the aid of the serrated disc knob protruding from the bottom of the case. It is located between the main tuning knob and the rf control. This adjustment need be made only occasionally as the string system ages, since the pointer is not intended for exact indications of frequency, but rather as a segment indicator telling in which 100 kHz segment you are tuned. Accurate frequency determination is made by the use of the 0-100 dial skirt on the OMNI-A.

#### OFFSET TUNING

The OFFSET control tunes the receiver independently of the transmitter through two selectable excursion ranges as determined by the selector position of the RX-OT switch. Clockwise rotation from the center zero position increases the receiver frequency, and counterclockwise rotation decreases frequency.

Offset tuning is advantageous when several stations are being worked in a roundtable, and all are not exactly on the same frequency. The received stations can then be "zeroed in" with the OFFSET control without upsetting the frequency of the transmitter. Also, it is very useful in working DX where the DX station is working stations slightly off his frequency.

The indicator on the front panel, marked OT, lights when the offset circuits are switched on. (You will notice that the indicator will go off when transmitting and when the ZERO BEAT button is depressed.)

#### RX-OT SWITCH

The receiver offset (OT) has two selectable range choices: MIN and MAX. In the MAX position, excursion is about  $\pm 5$  kHz. In the MIN position, excursion is about  $\pm 500$  Hz, for fine tuning.

#### RESONATE

The RESONATE control operates a mechanical assembly that permeability tunes the receiver rf amplifier circuits. Peak this control on the received signal. It has no effect on any of the transmitter circuits. The band notations around the knob are only general indications of correct positions. The correct peak will be found to move substantially from one end of the 160 and 80 meter bands to the other, and to a lesser degree on the other bands. It is possible to peak the control on the image frequency or the internal 9 MHz oscillator on all but the 1.8 and 3.5 MHz bands. Care should be taken to see that the correct peak is tuned. For instance, the 9 MHz oscillator can be peaked on the 7 MHz band clockwise from the desired 7 MHz, and on the 14 MHz band counterclockwise from the desired position. Also, the image on the 21 MHz band occurring at approximately 15 MHz can be found counterclockwise from the desired 21 MHz peak. And, on the 28 MHz band, the 10 to 12 MHz image is heard fully counterclockwise although it is not fully peaked.

#### VOX-PTT SWITCH

This switch selects either the internal voice operated transmitter (VOX) or the manual push-to-talk (PTT) circuitry. VOX performance is established using the ANTI, DELAY, and GAIN controls located under the Main Tuning Knob.



VOX OPERATION

The ANTI, DELAY, and GAIN controls located under the Main Tuning Knob are adjusted to optimize voice actuated operation. In order to accurately adjust these controls, proceed as follows:

- 1.) Adjust AF control completely counterclockwise.
- 2.) Adjust VOX GAIN clockwise to point where reliable T/R switching is attained with normal conversational voice level while speaking into microphone held twice normal distance from mouth.
- 3.) Adjust AF control for comfortable receiving level.
- 4.) Without speaking into microphone, adjust VOX ANTI control for elimination of sustained tripping action caused by speaker signals feeding into microphone. Microphone should be in approximate location typically used when transmitting.
- 5.) Set QSK switch to FAST position. Adjust VOX DELAY control clockwise so that T/R tripping does not occur between words and phrases when speaking into microphone.

SELECTIVITY

This is a dual function switch. Around the outer edge of the switch are the three possible crystal filter bandwidths: 2.4, 1.8, and 0.5 kHz. The 2.4 kHz comes installed as standard equipment. The 1.8 and 0.5 kHz filters are options which may be installed by the user. Unless either or both of the optional filters are installed, the 2.4 kHz crystal filter will determine the i-f bandwidth.

Around the inner ring of the switch are numbers indicating the number of audio filters in use: 0 indicates none, etc. However, in the 3 position, all four sections of the audio filter are in the circuit. Positions 1, 2, and 3 have bandwidths of 540, 350, and 150 Hz respectively, with a center frequency of 750 Hz. Since the OMNI uses an audio derived AGC, only signals passing through the audio filtering will affect the AGC. In ssb operation, the first section of the audio filtering is often useful in reducing "monkey chatter" and high frequency ignition noise components when operating mobile.

ZERO BEAT

This function is intended for use only in the cw mode. When this button is depressed, the carrier oscillator in receive is shifted the same 750 Hz that it is in transmit, and the OFFSET control is automatically disabled. When this is done, it is possible to adjust the transmitting frequency exactly to the incoming signal by zero-beating the received signal. Beat notes will be heard on both sides of the center frequency, which facilitates zero-beating the signal. After this is accomplished, releasing the ZERO BEAT button results in the beat note being heard.

QSK (FAST/SLOW)

This switch determines the recovery speed of the receiver when operating cw. FAST QSK permits true break-in operation of up to 50 WPM. SLOW QSK increases the recovery time of the receiver by a factor of six and effectively mutes the receiver between characters down to a speed of about 10 WPM. The SLOW QSK position is effective in heavy QRM or QRN, such as when operating mobile, by providing an interference free sidetone signal.

DRIVE

Both microphone gain and cw level are adjusted with the DRIVE control. For ssb, advance control under normal speech operation until ALC indicator lights on voice peaks. For cw, advance the control until ALC indicator lights on key-down. The setting should be the same whether dits, dahs, or a continuous signal are used. For cw, the DRIVE setting can be made in the LOCK position also. However, this setting does not hold for ssb operation since microphone type, closeness to lips, and loudness of speech all determine the ssb DRIVE setting.

### ALC CONTROL

This control sets the threshold level at which the automatic level control starts. When fully clockwise, input power is factory adjusted for 200 watts on the least efficient band when the ALC indicator just starts to light. Input power can be reduced below this level to approximately 25 watts when control is fully counterclockwise. A change in ALC setting requires a readjustment of the DRIVE setting.

The control enables the user to set the power output level below its maximum while still retaining ALC control in cases such as when driving high power linears that do not require the full output capabilities of the transmitter, where antenna SWR is so high that power supply demands are exceeded, or where reliable communications can be attained at reduced power levels.

### NOTCH

This control determines the frequency of the notch filter. Notch frequency increases with clockwise rotation from .25 to 7.0 kHz. The notch is effectively removed from the circuit at the full clockwise position. In ssb operation, the notch is used to eliminate cw carrier interference and in cw, it can remove an unwanted station from the passband.

### MICROPHONE

The microphone input circuit has been designed for high impedance crystal, ceramic, or dynamic microphones. Transistorized microphones may also be used, providing their output level is set so that the input stage is not overdriven. The cable, which preferably should provide shielding for all leads, is terminated with a standard 1/4" stereo type phone plug. The shield and/or ground lead are connected to the barrel, the PTT switch to the tip, and the microphone signal lead to the band. Failure to shield both microphone and PTT leads may result in rf getting into the audio circuits.

Since the crystal ladder filter system is common to both the receiver and transmitter circuits, any audio signal picked up by the microphone while receiving may be applied to the system and appear in the audio output. Acoustic feedback may occur and cause a sustained howl. To completely eliminate any microphone pickup, it is recommended that a SPDT switch be used for the PTT function in the microphone, and that the microphone signal lead be shorted to ground during receive. The TEN-TEC Model 215P Microphone has such an arrangement.

The PTT switch operates with respect to ground. When transmitting, the switch is closed.

### PHONES

This jack is provided for an external speaker or headphones. When in use, the internal speakers are automatically disconnected. The amplifier output is designed for a 4 or 8 ohm load but will operate satisfactorily with high impedance phones. Since the amount of power required to drive headphones to a satisfactory level is much less than for a speaker, it is recommended that an attenuating network be used between the PHONES jack and the headphones, when using low impedance phones. The attenuator will greatly reduce residual noise and audio feed-through when transmitting because the audio amplifier will be operating with a more favorable signal to noise setting of the AF control. A simple resistor network consisting of approximately 15 ohms in series with the phones and a shunt resistor of 2.7 to 3.3 ohms across the phones should suffice. The resistors, both 1/2 watt types, can be soldered to the phone plug terminals and concealed in the shell of the male phone plug.

### NOISE BLANKER

This switch, located on the ALC control, accommodates TEN-TEC Model 248 Noise Blanker, an optional plug-in accessory. The blanker is energized by pulling knob out.

WWV

Broadcasts of WWV may be received on 10 MHz for the purpose of checking the accuracy of the crystal calibrator on the  $\Theta$ MNI-A, Model 545, or for checking the accuracy of the time base oscillator in the  $\Theta$ MNI-D, Model 546. In addition, WWV broadcasts propagation reports and time verification.

- 1.) Set BAND switch to 10.0 MHz.
- 2.) Rotate Main Tuning Knob so that frequency readout is 10.0 MHz.
- 3.) Set SELECTIVITY switch to SB.
- 4.) Set MODE switch to SB-N.
- 5.) Peak RESONATE control.
- 6.) In  $\Theta$ MNI-A, Model 545, zero beat the WWV signal. Rotate the dial skirt to zero while holding the large knob. Check accuracy of crystal calibrator by depressing button. The calibrator pulsed zero beat should coincide with the zero beat from WWV. If it does not, it can be adjusted as outlined in SECTION III.

In  $\Theta$ MNI-D, Model 546, zero beat the WWV signal. The digital readout should read 10.0000. If it does not, the time base oscillator may be adjusted as outlined in SECTION III.

MOBILE OPERATION

The  $\Theta$ MNI is ideally suited for mobile operation in a car, boat, plane, or other vehicle. It operates directly from a 12 volt battery source and is self-contained except for key, microphone, and antenna. When operating from any power source other than a TEN-TEC power supply, the protective circuitry for the final amplifier is not present. TEN-TEC specifies the use of Model 1140 Circuit Breaker in series with the +12 volt supply line. The Model 1140 Circuit Breaker will function as both an external on-off switch and an over-current protection device for the final amplifier.

The SWR meter is especially useful in setting mobile whip antenna lengths to the operating frequency.

When using an alternator charged battery, start and stop the vehicle's engine with the  $\Theta$ MNI turned off. This prevents any high voltage transients, caused by momentarily open regulator contacts, from being applied to the transceiver circuits.

FIXED STATION

The  $\Theta$ MNI, with conventional antennas, will perform with distinction in any ham shack. With a linear, power can be increased to any value desired up to the legal limit. For an emergency or stand-by station, it will operate for long periods of time with a 12 volt automobile storage battery. Increased battery operating time can be achieved by setting the ALC control down from its maximum position.

PORTABLE

The small size and weight of the  $\Theta$ MNI make it an ideal traveling companion. Antennas are a matter of choice and convenience. A mobile whip may be used with a suitable ground system (radials) or a good earth ground. Matched resonant dipoles are fine if there is support for them. Random length "long wires" are also effective but must be matched with an antenna tuner such as TEN-TEC Model 247 Antenna Tuner. In any event, try to maintain a 3 to 1 or better SWR.

BAIL STAND

The movable bail is primarily intended to raise the front panel to a convenient slanting position. In this position, the speaker output is effectively radiated forward due to the "V" formed by the transceiver bottom and the table top. The bail may be locked in the desired position by removing the two screws and outer plastic cup washers holding the bail to the chassis, flipping the washers over so that the flat surface is facing outward, and re-inserting them through the bail, inner plastic bearings, and bottom cover. Tightening down screws will lock bail. Two adhesive backed rubber bumpers, provided, may be attached to outer surface of bail to prevent marring of table top.

The bail may also be used as a carrying handle, but care should be taken to prevent deforming it.

## OPERATING HINTS

1. When setting up the station, provide adequate ventilation for the heat sinks on the transceiver and power supply. Do not confine units to a small volume without forced ventilation to circulate cool air around the heat sinks.
2. When operating RTTY, SSTV, or other high duty-cycle modes, it is recommended that a small fan be directed on the heat sink. The sink temperature may reach as high as 200° Fahrenheit, which is still within the rating for the transistors, but certainly hot enough to cause a serious burn if touched.
3. The  $\Theta$ MNI may be operated as a QRPp transceiver simply by adjusting the DRIVE control downward. To determine input power, insert a DC ammeter in the +12 volt line. (Meter provided in TEN-TEC Model 252M Power Supply.) For every ampere increase over the no-drive quiescent level in the LOCK position of the MODE switch, the power input to the final amplifier is increased by about 13 watts. For example, assuming that the quiescent current is 2 amperes, a 4 ampere reading on the ammeter indicates 26 watts input.
4. The S-Meter will be accurate only when RF control is fully clockwise. The meter is factory calibrated for a 50  $\mu$ V reading at S9 on the 14 MHz band.
5. To determine SWR, set MODE switch to LOCK position, ALC control fully clockwise, and advance DRIVE control until ALC indicator lights. Read SWR on lower scale.
6. Sidetone level and pitch controls are accessible through finger hole located in bottom plate.
7. In SB-R mode, dial calibration will be off approximately 3.0 kHz from the SB-N setting. On the 1.8, 3.5, and 7.0 MHz bands, the indicated frequency will be higher than the actual value, and on 14, 21, and 28 MHz bands, it will be lower.
8. In the cw mode, the indicated frequency is the received frequency. To accurately read an incoming frequency, therefore, it is necessary to zero beat the signal, not peak it on the S Meter. This holds true no matter where the OFFSET control is set. When transmitting cw, the indicated frequency will be 750 Hz removed from the true transmitted frequency due to the BFO shift to bring the oscillator into the filter pass band. This shift will be in the same direction as the shift when working the SB-R mode, i.e. the indicated frequency will be higher than the transmitted frequency for frequencies below 7.5 MHz, and lower for frequencies of 14 MHz and above. Due to the 750 Hz switch in frequency, every time the key is actuated when using the  $\Theta$ MNI-D, an accurate transmitted frequency count cannot be made while sending code. To accurately determine the transmitted frequency, make the reading in LOCK or key-down condition and either add or subtract 750 Hz from the reading, depending on the band in use. (Example: To set up a transmitting frequency of 3.545 0 MHz, place MODE switch in LOCK position and adjust tuning for a reading of 3.545 7 MHz. For 14.062 0 MHz, set read-out to 14.061 3 MHz.)

Catch the wave.



## Great Audio.

Distinctive audio is what separates one brand of HF transceiver from another. Ten-Tec's reputation for having the finest transmit audio in Amateur Radio dates back to the release of the first Omni transceivers in the late 1970's. The Omni-VI set a new standard for 3rd order SSB IMD transmit performance when reviewed by ARRL for a Product Review in 1993. We've continued the same high performance engineering in the 21st century with tailorable transmit audio available on all of our current HF rigs: Orion II, Omni-VII, and Jupiter. Heard a great sounding signal on the air lately? Ask what they're running. Chances are, it's a Ten-Tec.

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9. Increasing the DRIVE setting over that required to just light ALC indicator will not result in any appreciable increase in power out. However, overdrive may increase ssb distortion products and destroy cw keying characteristics.
10. To minimize AGC pumping when receiving strong signals and eliminate loud bursts between transmitted cw characters, reduce setting of RF control so that S-Meter reads approximately half scale.
11. The VFO oscillator, like any LC tuned oscillator, may be adversely affected by ac magnetic fields cutting the coil turns. The oscillator output is frequency modulated at the line frequency, causing a "dirty" cw note and/or poor ssb quality in both transmit and receive modes. When installing the  $\Theta$ MNI, locate any ac operated equipment which may generate magnetic fields, such as power supplies, electric clocks, keyers, rotator controls, and other station accessories as far as possible from it. Since the VFO is located front and center, the most common cause of FMing is from placing these accessories on top of the unit. A check of purity of a received cw signal should be made at the time of installation.
12. Due to the possibility of high voltage transients being generated in the output rf amplifier during bandswitching, changing bands should not be done while transmitting power to the load. Either place the  $\Theta$ MNI in the receive mode or be certain of a key-up condition in cw. YOU RISK THE POSSIBILITY OF DESTROYING THE OUTPUT TRANSISTORS IF THIS PRECAUTION IS NOT OBSERVED.
13. Although improper antennas will not damage the final, we suggest an SWR below 3 to 1 be achieved for maximum performance. In cases where the antenna cannot be matched to a better SWR, and the TEN-TEC Power Supply repeatedly shuts down due to over-current conditions, the  $\Theta$ MNI can be operated at reduced input power by rotating the ALC control counter-clockwise to a position where the supply does not trip out.
14. In order to eliminate the internal, spurious 28.980 MHz signal found in the 28.5 to 29.0 band segment, change BAND switch to 29.0 to 29.5 band segment and tune below the lower edge of this band segment for 28.980 MHz.

#### AN IMPORTANT MESSAGE

In order for you to obtain top performance from your  $\Theta$ MNI, we feel that you should be briefed on new technology such as solid state no-tune rf amplifiers. Misconceptions sometimes arise from incomplete knowledge which result in erroneous conclusions being drawn that the equipment is faulty, erratic, or not performing to specifications. It is the purpose of this message to inform you in these areas so that you can knowledgeably approach and correct any apparent improper performance characteristic.

#### Ten Points To Observe When Installing The $\Theta$ MNI

1. The transmitter will give best performance when properly loaded.
2. Even though the output transistors are resistant to damage from improper loads, they will not operate satisfactorily under all load conditions and will not operate to specifications.
3. The output transistor dissipation will increase if the  $\Theta$ MNI is not properly loaded.
4. Reactive impedance components in the antenna are applied to the transistors and may cause parasitic oscillations.
5. A given SWR reading does not tell you anything about the reactive components and is not accurate unless the load is a pure resistance.

6. A given SWR indicates one of two possible impedances. Each acts differently on the transceiver performance.
7. The most efficient operating point is when the load is 50 ohms, resistive.
8. The ALC light is not an indication of the input power, but the output power. It may not light even though the power supply is delivering enough current to trip the breaker.
9. If the breaker repeatedly trips, it is an indication that the load is enough removed from optimum so as to cause high transistor dissipation.
10. It is possible for the power supply regulator to drop out of regulation just prior to its tripping the breaker with low ac line voltages, (brown-outs or long ac power runs). Under these conditions, hum modulation will appear on the transmitted signal. With proper load and line voltage, the current drain will be considerably below the tripping point so no hum should appear on the carrier.

### Technical Facts of Life

Although vacuum tubes and transistors both can be made to amplify rf power, there are some fundamental differences in how this is accomplished. We are all familiar with vacuum tube principles, but not with those of transistors. A better understanding of what we can expect under various operating conditions will aid in recognizing correct or incorrect performance.

1. Broadband vs Resonant Tanks - Almost all tube circuits use resonant tanks in the plate circuit. The OMNI uses a broadband system. In class AB operation, these two approaches act similarly without drive being applied. The idle current is relatively low and within the device dissipation rating, even with load impedance variations from open to short circuit.

However, with drive applied, the two act very differently. In the case of tubes, the dissipation within the tube depends on both the tuning of the tank and the load applied. If the tank is resonated and the load is very light, the internal power dissipated is quite small as indicated by the null which reduces plate current almost to the level with no drive. Out of resonance, the plate current, and hence dissipation, increases rapidly and may damage the tube from overheating. In resonance, as the load is increased, the null becomes more shallow at a higher plate current as a result of the power being delivered to the load. As the tank is tuned to resonance, the load impedance which is usually on the order of 50 ohms is transformed to a relatively high impedance of several thousand ohms to match the plate circuit impedance. Small load reactive components--either capacitive or inductive--can usually be balanced out in the tank resonating function.

With transistors, drive applied and no load, there is no resonant high impedance to limit the collector current, and so power is poured into the circuit (much as the out-of-resonance tank condition). Since there is no load power, all has to be dissipated in the transistor. So even with no load, the power supply circuit breaker may trip. The broad-band transformer system used with transistors transforms the 50 ohm load impedance not higher, but much lower (in the order of 4 or 5 ohms) to match the transistor output impedance. Since this transformation is fixed in design, any reactive component in the load impedance is applied in a transformed way to the collector circuit. Certain reactances at this point, especially inductive, give rise to parasitic oscillation. To correct for this, the antenna impedance should be changed to remove this reactance, or a matching network should be inserted between antenna

and transceiver. It is important to remember that any antenna changes its impedance with frequency, so that one that resonates well at one end of the band may well cause oscillations to trip the circuit breaker on the other end. If entire band operation is desired, especially on the lower bands, the adjustable matching network would be the better choice, rather than to try to make the antenna behave over the entire band on a cut-and-try basis.

A final point to bring out regarding broadband vs tank systems is that there is a limit to the amount of current you can draw from an emitting filament, and this saturation current will limit the amount of power drawn from the supply. In the case of transistors, where the collector internal impedance is only a fraction of an ohm, extremely high currents can be demanded of the power supply, especially with mismatched loads well below 50 ohms. A fuse is provided in the OMNI for protection when operating from a power source that is not limited. TEN-TEC power supplies have current limiting circuitry.

2. SWR - Two Kinds - The standing wave ratio is a direct measure of the ratio between two impedances, i.e. an SWR of 3 to 1 tells us that one impedance is three times the other. Therefore, the unknown impedance can be either three times as large or three times as small as the known one. If the desired impedance that the transceiver wants to see is 50 ohms, an SWR of 3 to 1 on the line may mean a load impedance of either 150 ohms or one of 17 ohms. If it is 150 ohms, the transmitter will act differently than if it is 17 ohms. In the first case, the power demanded from the power supply will be much lower, and will not be large enough to trip the supply. In the second case, even though the SWR reads the same, the supply may repeatedly trip out. The SWR reading gives no indication of reactive components, nor can it separate the resistive from the reactive components. It is calibrated with a pure resistive load and therefore has its greatest accuracy with pure resistive loads. The SWR bridge should be used only as an indicator when attempting to adjust antenna system to a pure 50 ohm resistive impedance at the transmitter output point.
  
3. Efficiency - Since transistor amplifiers have a very low value of output impedance, they act more or less as a constant voltage source. That is, the rf output voltage tends to remain at a fixed value regardless of the load impedance. Hence, the output power will vary depending on the value of the load, and increase as the load impedance goes down. It can be seen that a 3 to 1 SWR on the low side of 50 ohms will ask the amplifier to deliver much more power than a 3 to 1 SWR on the high side. Since the amplifier does have a finite value of output impedance, the amount of power delivered to the load with efficiency will change with load. Unless the load is near the design value, the transistors will heat up unnecessarily without delivering any more power to the antenna.

Protective Circuitry and ALC - ALC serves three major functions. It assures the maximum power from the transmitter without careful adjustment of the input drive, it prevents the amplifier from being overdriven into the non-linear, distortion-producing area, and it serves as a power limiting device which protects the output transistors. It does the first two very well, but the third only partially. To absolutely protect the system, we add the current limiting circuitry to the power supply, or a fast acting magnetic circuit breaker in the dc supply line.

The ALC system senses the power output and adjusts drive accordingly. Note that it does not sense the power into the final. Therefore, some load conditions may exist where the ALC system will not limit the transistor dissipation. One instance is where there is a highly reactive load. It is not possible to make a purely reactive load absorb power, so the ALC light will not go on, even though high power is being supplied to the final in the way of internal dissipation.



Under these conditions, the power supply protective circuits take over and trip the breaker. So it is very possible that the breaker will repeatedly trip without the ALC light going on. If this occurs, it indicates a change in the antenna system or matching network is needed.

A final comment regarding this situation-- when the breaker in the power supply trips, the amount of current drawn from the supply may be high enough to cause the supply to drop out of regulation, especially with low line voltages. Under these conditions, the output may become hum modulated. The output light on the power supply will also start to dim a bit. This condition should be rectified by antenna and/or matching changes since the emitted quality of the signal will be poor. (Whereas the breaker will trip in the LOCK position, it probably will not with cw or ssb, even though the regulator drops out and produces poor quality signals.)

If the above precautions are observed, we are sure that you will be more than delighted with the performance of your @MNI.

#### Recommended Reading

1. ARRL HANDBOOK
2. Antenna Handbook, Ken Glanzer, Cowan Publishing
3. W8NWU Teeter Totter Tuners, Schultz, CQ Magazine, February 1969, P. 27

## SECTION III

## ALIGNMENT AND SERVICE

This section is subdivided into descriptions of the main chassis and each plug-in assembly. Pin and transistor voltages are given for each unit. Readings should be within 15% of listed values when measured with a dc voltmeter with at least a 20,000 ohms-per-volt impedance. All readings are dc and positive with respect to chassis GND unless stated otherwise. Plug-in pin locations are in the same relative positions on the assemblies as noted on the schematics. In other words, if the assembly is placed component side up on the schematic in the same position as shown in the photograph, the individual pin functions are the same as those noted on the schematic.

When removing a plug-in assembly, note the orientation of the board in the chassis so that it can be replaced correctly. Most assemblies can be inadvertently inserted incorrectly if care is not taken. Figures 1 and 2 show correct placements.

To remove a plug-in, first remove screws holding the assembly to the sockets and any screws or nuts securing single socket boards. Then, with long nose pliers, work the assembly straight up out of the socket or sockets by pulling on the end pins in sequence.

To facilitate location of the various components that may require alignment or adjustment, refer to the table below.

<u>Function</u>	<u>Assembly</u>
Receiver rf Amplifier	Trimmer Board, 80446
Receiver 9 MHz Trap	RF Amplifier, 80460
Receiver Mixer	RX Mixer, 80452
Receiver i-f Amplifier	I.F.-AGC, 80448
S-Meter Adjustment	I.F.-AGC, 80448
Crystal Calibrator Adjust	Xtal Calibrator, 80437 (545 only)
Counter Calibrate	Timebase-Preamp. 80442 (546 only)
Offset Zero Adj.	Control Board, 80464
USB and LSB Carrier Adj.	SSB Generator, 80449
CW Transmit Offset	SSB Generator, 80449
Carrier Balance	SSB Generator, 80449
Sidetone Level	Audio-Sidetone, 80447
Sidetone Pitch	Audio-Sidetone, 80447
Transmitter Mixer Null	TX Mixer, 80453
ALC Level	Low Level Driver, 80444
SWR Null	SWR-TR, 80450
SWR Calibrate	SWR-TR, 80450
External Relay Delay	OT-TR, 80281
Final Amp. Bias Set	OT-TR, 80281
Driver Bias Set	Final Amp., 80491
10/15M Offset	Oscillator Mixer, 80455
L.O. Mixer Null	Oscillator Mixer, 80455

REMOVAL OF TOP

Remove the upper two of the four screws located on each side panel. Slide top back and out from under rear lip of extruded aluminum frame.

REMOVAL OF BOTTOM

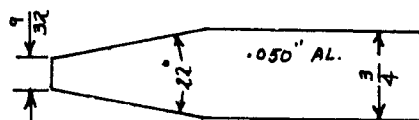
Remove lower two of four screws located on each side. As bail is removed, note orientation of screw assembly. Remove single Phillips head screw nearest rear panel, on bottom surface. Loosen, by one turn, two counterbored screws securing extruded aluminum frame. With unit upside down and front panel facing toward you, position thumbs on heat sink and finger tips on rear lip of bottom cover. Using leverage, push down on heat sink with thumbs and carefully lift

rear lip of bottom cover up with finger tips. Slide bottom back and out.  
**CAUTION:** Speaker wires will limit removal of bottom cover. Unsolder speaker cable at speaker terminals. When re-assembling, first position side trim strips flush with rear apron, then replace screws and bail.

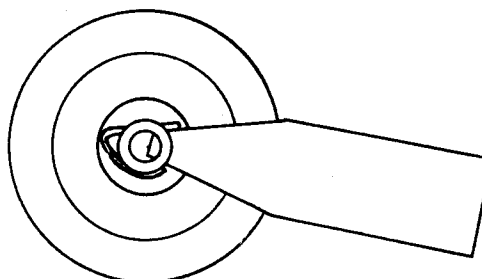
#### DIAL SKIRT REMOVAL AND REPLACEMENT

The main tuning dial skirt is friction mounted to the shaft and can be easily removed by pulling it straight off the shaft after the plastic knob is removed. The felt washers between knob and skirt provide a slight amount of friction to eliminate any backlash between the two.

To replace the dial skirt, either a specially constructed tool as shown below, or a screwdriver with a blade width of approximately  $9/32$ " can be used. With the tool, spread the "D" spring on the skirt hub so that the straight portion does not show through in the hub bore. If the tool tip shows in the bore, this is OK for now. Start the skirt on the shaft, with the tool handle pointing downward in relation to the front panel. This puts the handle of the tool out in the open. Push the skirt on the shaft until the tip of the tool in the hub bore hits the brass portion of the two diameter shaft. While maintaining inward pressure on the skirt, slowly remove the tool from the groove by using a rotational motion on the handle. As the tip is pulled from the hub bore, it will allow the skirt to be pushed on the shaft before the spring can regain its unstressed condition. Seat the skirt as far as it will go.



Dimensional details  
of insertion tool.



Rear view of dial skirt  
with tool inserted.

#### REMOVAL OF FRONT PANEL

First remove top. Remove BAND switch knob with aid of a small flat-bladed screwdriver. Then remove main tuning knob, dial skirt and knobs using a 4-40 allen wrench provided. Turn unit over and remove two screws in the bottom. Using a large flat-bladed screwdriver inserted between the front panel and sub-panel through the gap in the extruded aluminum frame between the two screws, gently pry the entire front panel up. VOX knobs will come off. Separate panel from main chassis. Remove ZERO BEAT (and XTAL CAL in Model 545) pushbutton. Unplug cable going to PC board mounted in front panel.

#### PILOT LAMP REPLACEMENT

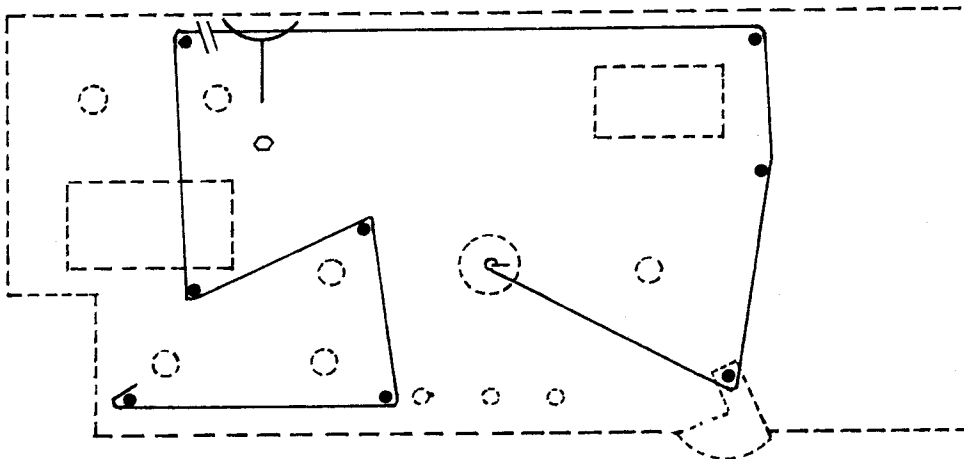
OMNI-D and OMNI-A both have a miniature 6 volt, 50 mA lamp located in the dial bezel that edge lights the scale. In addition, the OMNI-A has two more lamps located in the sides of this same dial bezel. To replace, remove front panel as described above. Then remove bezel by removing small screws holding it to panel. The leads going to the bulb to be replaced should be unsoldered from the PC board and the bulb slipped out of the assembly. Replace with similar type bulb, available from TEN-TEC for 50¢ each.

Meter lamp is a standard 6 volt bayonet type, No. 47. Access to this bulb is by removing top of unit.

## DIAL CORD REPLACEMENT IN THE MODEL 545

The dial string mechanism consists of two parts, a .020" diameter dacron non-stretchable string and an elastic cord. The diameter of the dacron is important for proper pointer readout, since it is wound on the tuning shaft and carries the pointer across the scale. Replace only with a string of the same diameter. The stretchable section provides string tension. Both are available from TEN-TEC for 25¢. To install, remove front panel as described above. Attach one end of the elastic section to the #4 lug located at extreme left side of the panel, just below the BAND switch shaft. With long nose pliers squeeze the lug to secure it firmly without severing it. Turn main tuning dial fully counterclockwise. Knot one end of dacron string around the small pin in the tuning shaft and put on one turn, counterclockwise. (String should lead off from bottom of the shaft toward the right.) After setting serrated zero adjustment mechanism to its center of travel, run the dacron under the small uppermost plastic pin in this mechanism and then up to the lower of two pulleys to the right of the meter. Then on up over the top pulley and straight across, left, to OFFSET control location. Temporarily tape free end of the dacron to top edge of the sub-panel here. Now run the elastic cord to the left, around and under nearby pulley, then horizontally to the right, under and around pulley located directly to the left of the ANTI shaft, then vertically up and over top right side of pulley located above and to the right of the ZERO BEAT wiring aperture, to the left and down under pulley located just below the OFFSET switch, up between RESONATE and OFFSET control to the left and over top pulley located above and to the left of the OFFSET control shaft. Without stretching cord in the least, form a loop at the location of this last pulley, using the small metal band from the old assembly. Pass free end of the dacron string that was taped to the panel through this loop and feed both string and elastic around the two pulleys so that string runs parallel to top edge of panel. Adjust string length so that elastic now stretches to the point where the two come together directly over OFFSET control shaft. Secure the two with a knot in the dacron. (This will now prestretch the elastic about three inches.) Attach the plastic dial pointer to string portion near the knot by hooking string around the two hooks on pointer, with the string passing under the long vertical bar. Slide pointer along the string so that it is exactly over the hex-headed screw near OFFSET control when the tuning shaft is fully counterclockwise. If pointer tends to ride off the panel at the bottom, rotate it several turns on a horizontal axis to pre-load it with twist in the string.

Make sure string around the main tuning shaft is in the groove and is as close to the panel side of the groove as possible. As shaft is turned clockwise, the string should wind evenly without one turn going over the other, otherwise indexing will be somewhat off at the top end of the scale.



## ROTARY SWITCH CARE

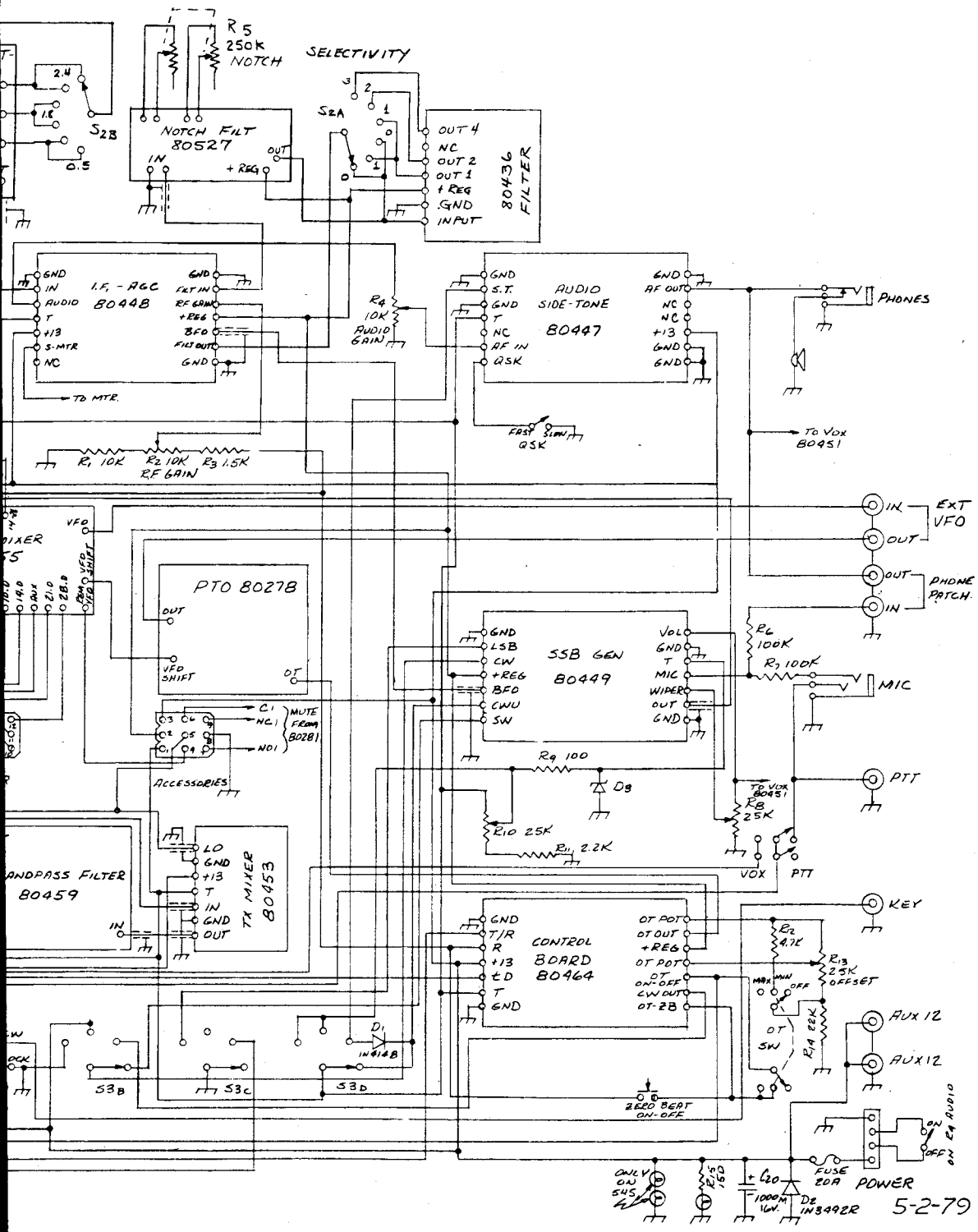
Selector switches are specially lubricated by the manufacturer for maximum life. Brushing on or dipping switch in solvents will wash away the special lubricants and shorten the life of the switch. Cleaning rosin from soldered connections is not recommended since there is a hazard of the dissolved rosin running into the switch causing resistance problems. Never use commercial contact cleaners on switches.

## FUSE REPLACEMENT

The fuse located on the back panel protects the OMNI from heavy overload and reverse polarity conditions. Replace with a 3 AG fast-blo 20 ampere type.









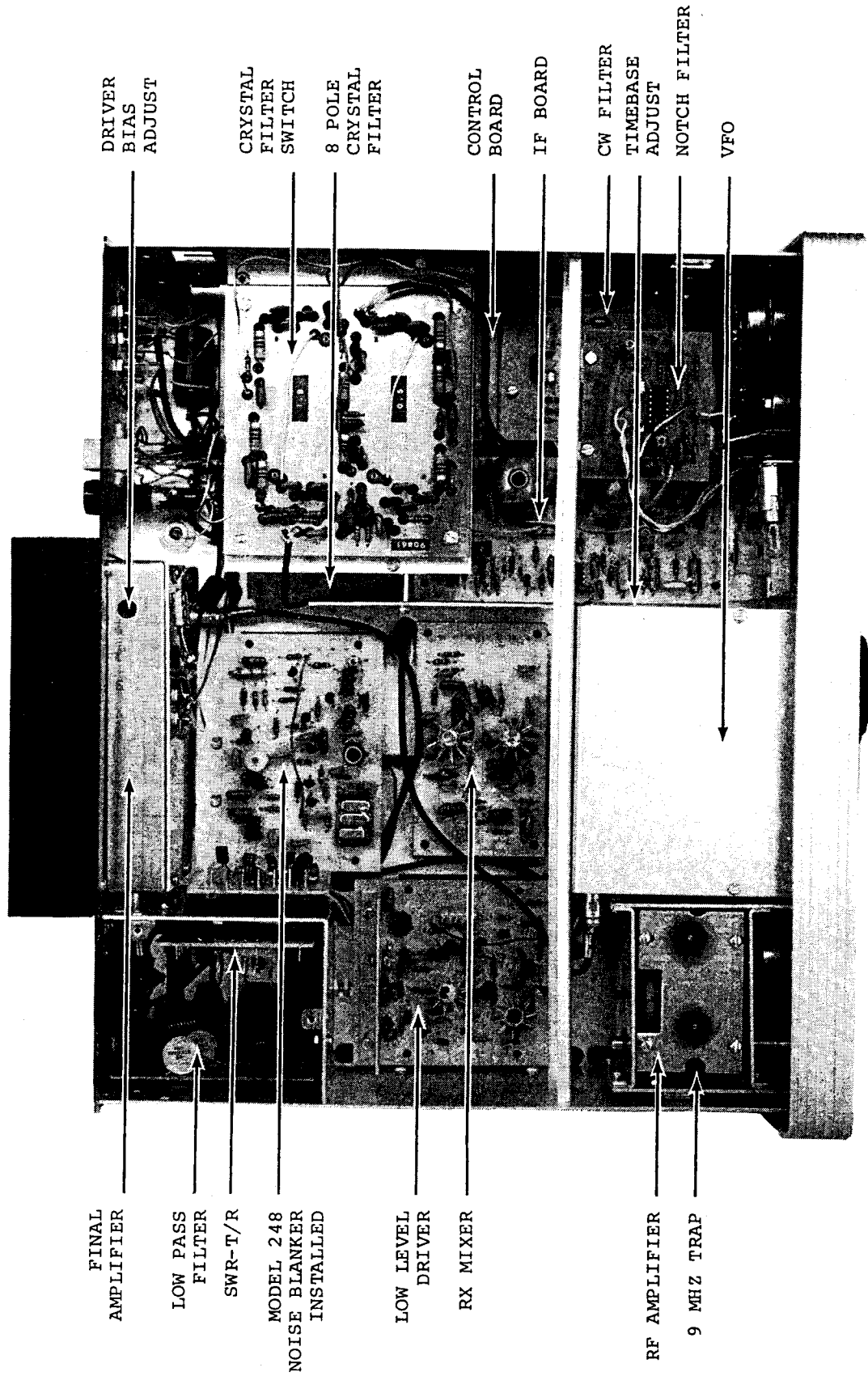


FIGURE 1 - TOP VIEW

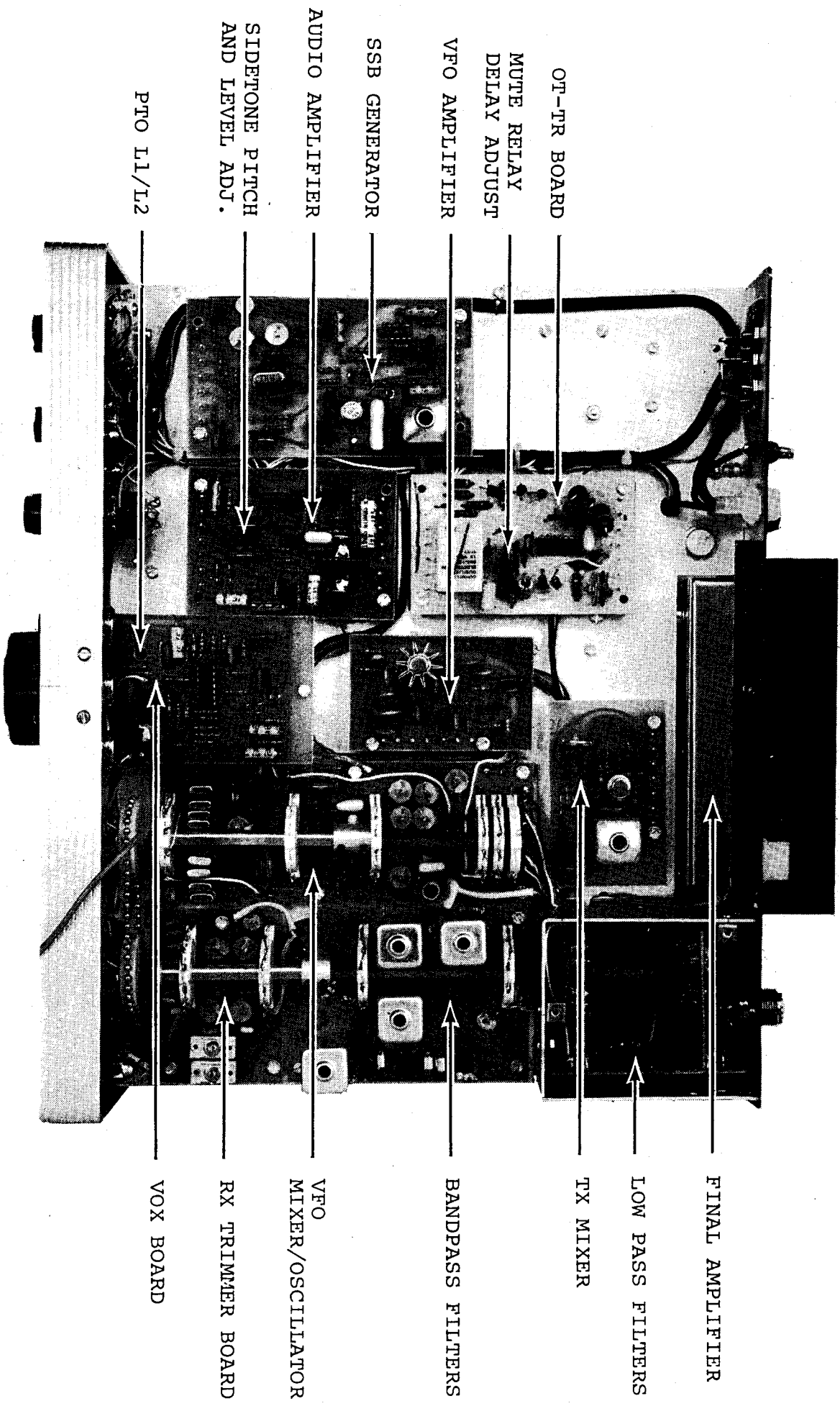


FIGURE 2 - BOTTOM VIEW

80445 RF ATTENUATOR

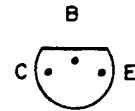
To prevent antenna signals from possibly coupling into the sensitive circuits located near the front panel, the 18 dB rf attenuator uses PIN diodes switched by a dc voltage rather than direct rf switching from a front panel control. The attenuator is an L-pad formed by R5 and R6. The front panel ATT. ON-OFF switch is normally open, allowing the attenuator switch (SW) line to the board to rise to 12 volts. This turns Q1 on, supplying forward bias to D2 which allows the antenna signal to by-pass the attenuator. When the ATT. ON-OFF switch is pulled out, the SW line is shorted to ground, turning off Q1 and Q2 and turning on Q3 which supplies forward bias to D1. D1 connects the attenuated output of the pad to the output pin. The forward current through either diode returns to ground through R4. The voltage produced back-biases the non-conducting diode.

Pin Voltage Readings - (Receive mode, ATTENUATOR off, no signal conditions.)

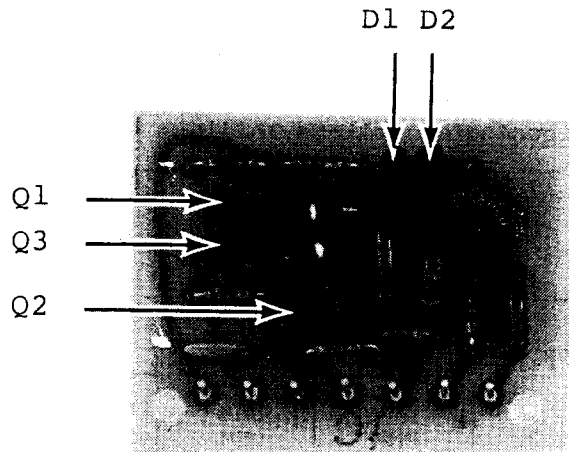
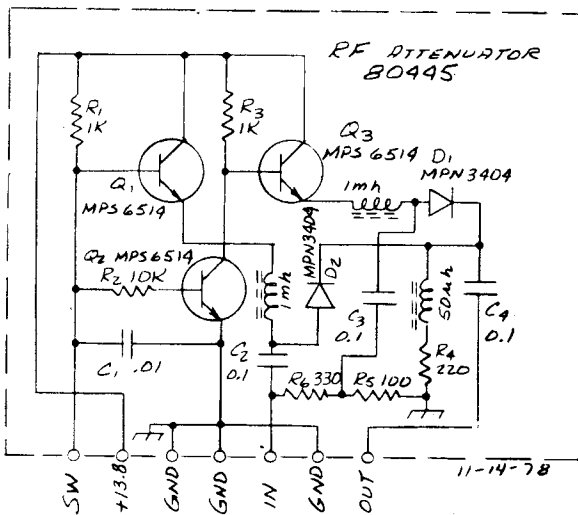
Pin	Receive
SW	12.3
+12	13.8
GND	0
IN	0
OUT	0

Semiconductor Voltage Readings

Transistor	Collector	Base	Emitter
Q1	13.8	12.3	11.6
Q2	0	.7	0
Q3	13.8	0	0



Transistor pins viewed from top of PC board



80445 RF ATTENUATOR

20 273/340

80437 CRYSTAL CALIBRATOR  
(MODEL 545 ONLY)

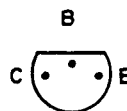
Transistor Q1 is a crystal controlled oscillator operating at 100 kHz. It is set to the correct frequency by adjusting the capacitive load across the crystal with C1 trimmer. This setting is made while zero-beating calibrator output with WWV signal as outlined in Section II.

The output of the oscillator is applied to one input of a dual input NAND gate whose second gate is fed from a slow running multivibrator made up of two similar gates in IC-1. The multivibrator causes the calibrating signal to pulse at approximately 3 cycles/second. Speed of the multivibrator is controlled with R11, but oscillation will not result if the control is set to either extreme. To further divide the pulsed signal down to 25 kHz, dual flip-flop, IC-2, is used. Output from this stage, as well as from the 100 kHz signal, is fed to the OUT terminal. The fourth gate in IC-1 is used as an inverting buffer for the pulsed 100 kHz output signal. It also isolates the 25 kHz output from the inputs of IC-2, which might otherwise cause incorrect operation of IC-2.

IC-3 operates as an adjustable timer, the output of which provides power for operation of the crystal oscillator and logic circuits. When the START pin is grounded, the timer is activated and pin 3 of IC-3 goes to approximately +12 volts for the duration of the time interval. This +12 volts output powers Q1 and the +5 zener regulator, D1, which provides power for IC-1 and IC-2. The length of the on-time is adjusted by R6 and varies from approximately 5 to 15 seconds. When the calibrator is on, Q2 is turned on, grounding the ATT pin and activating the ATTENUATOR circuit. This reduces the rf amplifier gain by about 18 dB, just as the ATT. ON-OFF switch does. The terminal marked 25/100 is not used in Model 545, but converts the calibrator to 100 kHz mode if grounded.

Pin Voltage Readings - (Receive mode, CALIBRATOR push button depressed.)

Pin	On	Off
+12	13.8	13.8
ATT	0	0
START	13.6	0
OUT	0	0
25/100	-	-

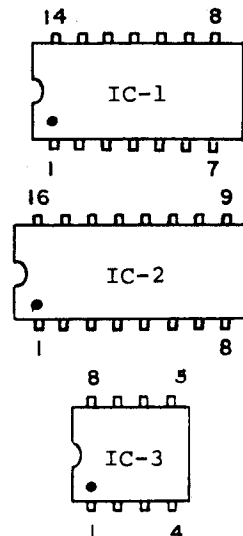


Transistor pins viewed from top of PC board

Semiconductor Voltage Readings - (Receive mode, CALIBRATOR push button depressed.)

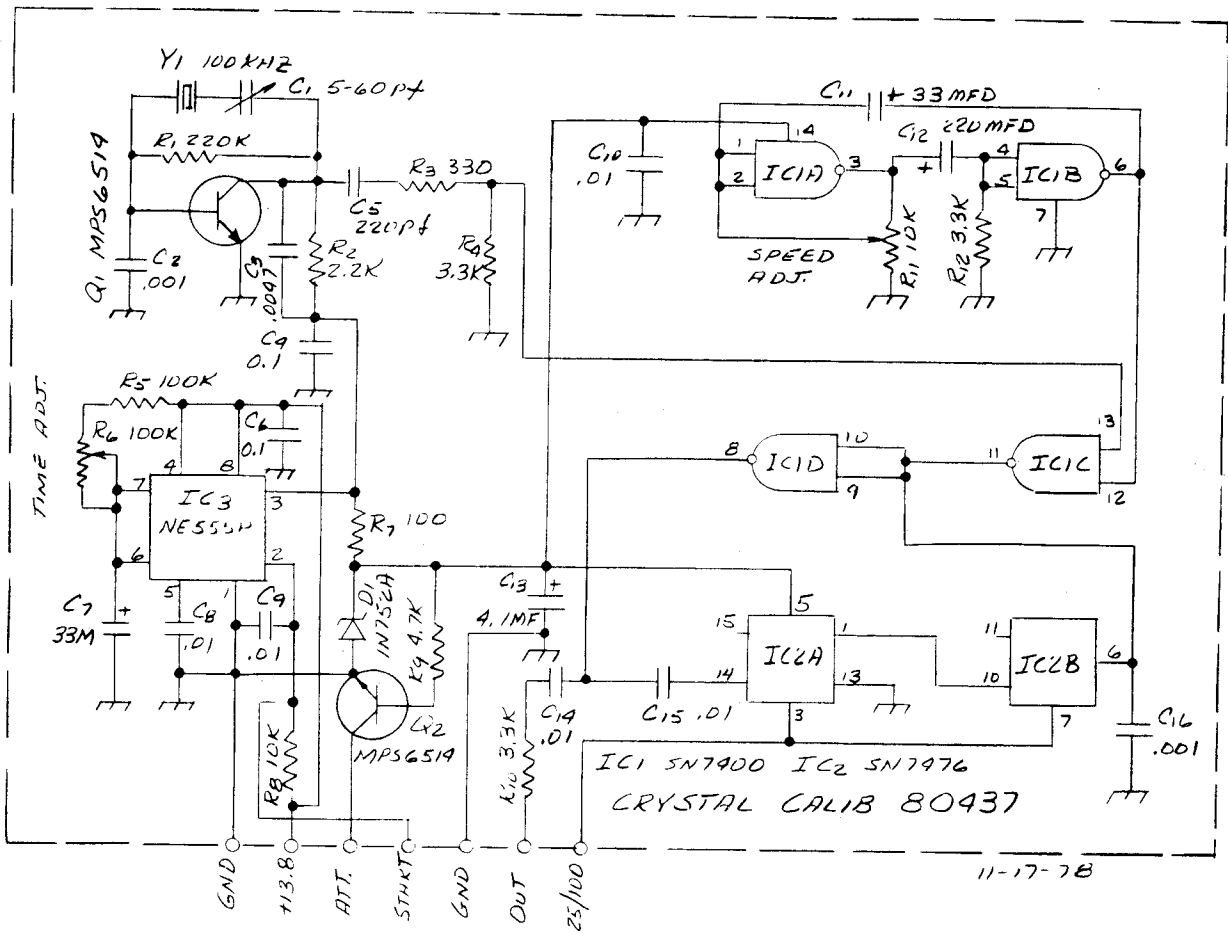
Transistor	Collector	Base	Emitter
Q1	4.3	1.1	0
Q2	0	.7	0

Pin	IC-1	IC-2	IC-3
1	DNM	DNM	0
2	DNM	DNM	0
3	DNM	DNM	12.2
4	DNM	DNM	13.8
5	DNM	5.7	9.2
6	DNM	DNM	DNM
7	0	DNM	DNM
8	DNM	DNM	13.8
9	DNM	DNM	
10	DNM	DNM	
11	DNM	DNM	
12	DNM	DNM	
13	DNM	0	
14	5.7	DNM	
15		DNM	
16		DNM	

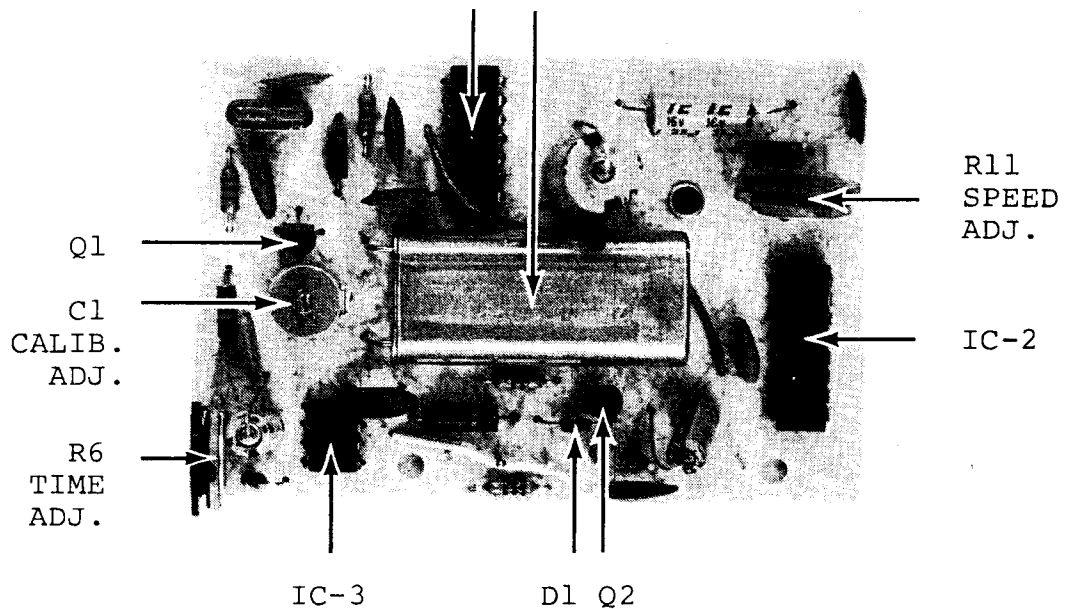


DNM  
Do Not Measure

Semiconductor pins viewed from top of PC board



IC-1 Y1  
100 kHz



80437 CRYSTAL CALIBRATOR

## 80460 RF AMPLIFIER

The rf amplifier in the receiving section is located on the rf amp sub-chassis which contains the permeability tuned rack mechanism. It is part of the main chassis. The amplifier is a single stage, dual gate MOSFET, Q1, with tuned antenna coil, L1, and output coil, L2. These inductances are slug tuned and ganged by means of the rack assembly. Corresponding capacitors for the tuned circuits are not included on the PC board. A set of six fixed capacitors are switched across L1 and a set of six adjustable trimmer capacitors, located on a separate PC board beneath the amplifier board, are switched across L2. The antenna input lead contains a 9 MHz trap to trap direct i-f frequency signals.

The stage is powered through the R terminal and is biased for maximum dynamic range. This bias remains constant.

To align the tuned circuits, proceed as follows:

1. Connect a Ballantine or other suitable ac voltmeter to the receiver audio output.
2. Connect signal generator to antenna terminal and position RECEIVE-TRANSCIVE switch in the TRANSCIVE position. Set bandswitch and generator frequency to 3.5 MHz.
3. Temporarily connect a .01 mfd capacitor from the wiper of S1B located on trimmer PC board, to chassis. See Figure 2. Set generator level to several hundred uV and tune to receive the signal. Adjust the RESONATE control for a peak on the ac meter, keeping signal level sufficiently low so that S-Meter does not register.
4. Disconnect .01 mfd capacitor, turn generator level to approximately 1 uV and peak 3.5 MHz trimmer capacitor.
5. Set frequency to 4.0 MHz, reconnect .01 mfd to same terminal and chassis, and increase generator level until signal is heard at 4.0 MHz. Readjust RESONATE control for peak output. Disconnect .01 mfd capacitor, turn down level to approximately 1 uV and peak L2 for maximum output. See below.
6. Repeat steps 4 and 5 until there is no increase in output. This procedure aligns the 3.5 MHz band and tracks L2 to L1. (L1 should not need any change from factory setting.)
7. Switch to 7.0 MHz band and set frequency to 7.15 MHz. Reconnect the .01 mfd capacitor. Using the same procedure, as in steps 3 and 4 above, adjust 7.0 MHz trimmer. (No further adjustment of L2 is necessary.)
8. Using same procedure as in step 7, align 1.820, 10.010, 14.200, 21.200, and 29.000 MHz.

#### 9 MHz TRAP ADJUSTMENT

1. Set receiver to 7.0 MHz band and RESONATE control for maximum noise.
2. Without changing settings, adjust a signal generator to 9 MHz and increase output until a signal is heard. Tune trimmer capacitor, C1, for null. Refer to Figure 1 for trimmer location. It is mounted on top of the PC board and accessible through the half-round cutout in rack plate. Use insulated tuning wand. Null is very sharp.

## 80278 PTO

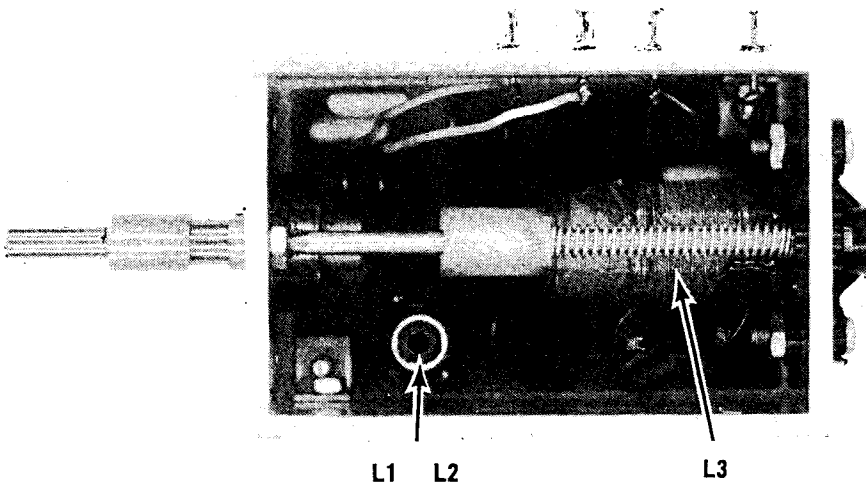
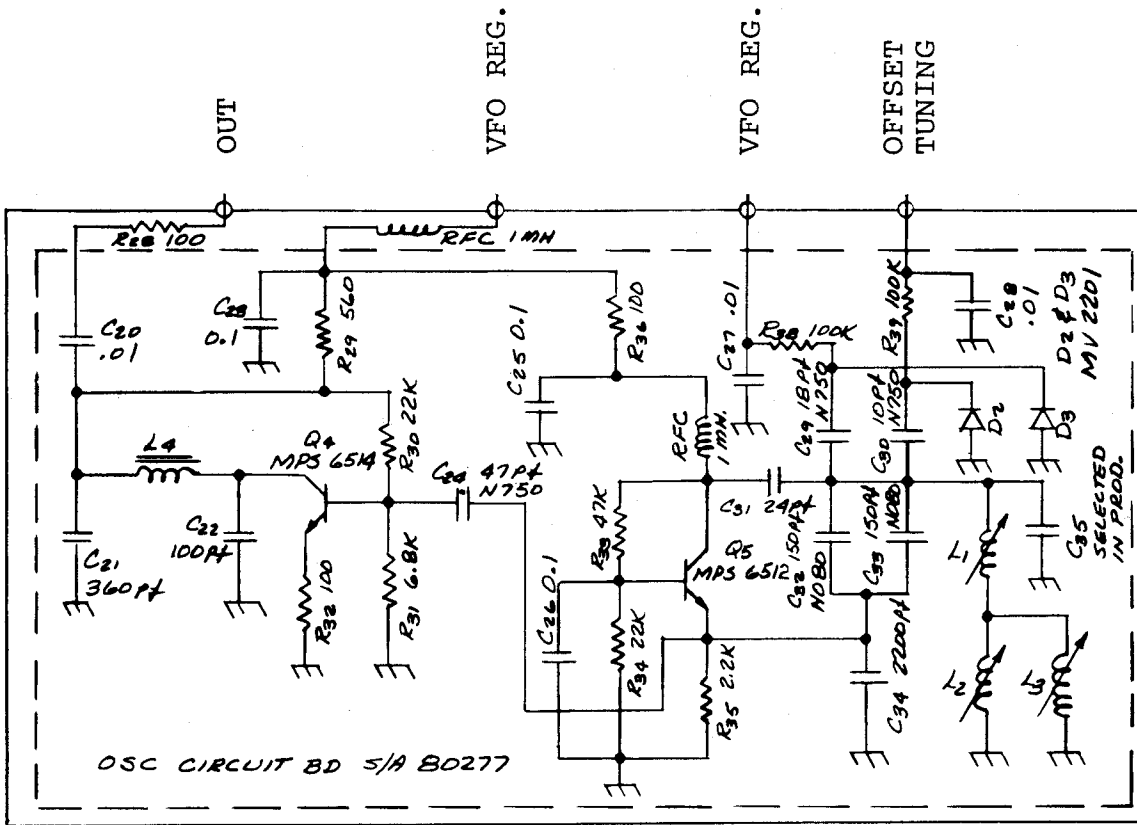
The permeability tuned oscillator (PTO) provides the variable part of the VFO signal for both receive and transmit. The PTO operates between 5.0 and 5.5 MHz, and the output is mixed with signals from a crystal oscillator for translation to the proper frequency for each band, except on 14 MHz, where the 5.0 to 5.5 MHz signal is used directly.

The PTO is housed in the main tuning coil assembly on a separate PC board. The main coil, L3, is shunted by L2 and has L1 in series. Adjustment of these two slug tuned coils, which are both on the same coil form, determines the linearity and band edge points.

PTO ALIGNMENT (necessary in Model 545 only)

1. Turn RX-OT switch to OFF. Connect a frequency counter with at least 100 mV sensitivity to the VFO OUT jack on the rear panel.
2. Set BAND switch to 14.0 MHz and power transceiver in receive mode.
3. Set main tuning shaft 40 kHz up from full counterclockwise position as indicated on dial skirt. Dial skirt should be zeroed and dial pointer should indicate close to left index scale mark, and within range of being set to index with serrated zero-set knob.
4. Observe counter reading and if it is not 5.000 MHz, slightly touch up L2 slug. Slug position in the coil should be such that a clockwise rotation of the slug decreases frequency. The slugs are accessed through a hole in the VOX board.
5. Run tuning knob up scale and note counter readings at each 100 kHz of increase. If readings are within  $\pm 5$  kHz, linearity may be improved, especially if frequency reading at 5.500 MHz is not exactly aligned, or if all deviations from the first setting are in the same direction.
6. If VFO range is compressed, i.e. reading on counter at what should be 5.5 MHz is less than this, reset tuning to 5.0 position, turn L2 slug a fraction of a turn clockwise and then compensate for this decrease in frequency by turning L1\* slug also clockwise for a 5.0 MHz counter reading. Repeat step 5 to see if correction was sufficient or too much.
7. If range of VFO is expanded instead of compressed, compensation in the opposite direction is indicated. This is accomplished by turning slugs in opposite direction.

\*NOTE: To reach L1 slug without upsetting position of L2 slug, use the tuning tool with reduced shank that is provided with  $\text{ØMNI}$ . Also note that L2 is used to adjust spread of VFO range and L1 to bring frequency to correct value.



PTO 80278



# “Great sounding rig! Must be a Ten-Tec.”

All the Ten-Tec rigs that I've owned have excelled in audio. I owned a pair of (other brand) transceivers but Ten-Tec beats them in transmit audio - K4NTY

Great audio! Full, rich, natural! - K4TEN

*Good audio quality and it sounds like my natural voice - K6WLM*



Excellent audio. I was working a station in Puerto Rico and he stopped the calling stations and asked me what I was running. I told him the Jupiter and he said “I should have known it was a Ten-Tec.” - WD4PG

I'm confident that I will have the best signal I can possibly produce! - W1RGO



I am amazed how clean and clear I sound - W4WUQ



*Very well balanced audio; natural sounding, pleasing to listen to. One of the best sounding rigs on the band. Well rounded with clarity. - KA4ICK*

I get great unsolicited audio reports with the Ten-Tec Orion - WA8VSJ

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## 80455 OSCILLATOR-MIXER

The oscillator-mixer produces proper injection frequencies for the transmitter and receiver circuits, using a 9 MHz i-f system. This is accomplished by utilizing a permeability tuned master oscillator for all bands, operating between 5.0 and 5.5 MHz, whose output is mixed in an IC double balanced mixer with signals from a crystal oscillator. Crystal frequencies are selected by the BAND switch. The 14 MHz band uses the 5.0 to 5.5 MHz directly.

Output from the mixer is filtered for each band with double tuned resonant circuits and then sent to a darlington follower stage. Frequencies for the various bands are as follows:

<u>BAND (MHz)</u>	<u>VFO OUTPUT (MHz)</u>
1.8	10.8-11.3
3.5	12.5-13.0
7.0	16.0-16.5
10.0	19.0-19.5
14.0	5.0- 5.5
21.0	12.0-12.5
28.0	19.0-19.5
28.5	19.5-20.0
29.0	20.0-20.5
29.5	20.5-21.0

The permeability tuned oscillator (PTO) is housed in the main tuning coil housing in a separate, sealed PC enclosure.

OFFSET ADJUSTMENT FOR 21.0 and 28.0 MHZ BANDS

To eliminate band edge birdies on these two bands, the crystal oscillator frequencies are chosen 10 kHz lower than what normally would be needed, compared to other bands. The variable PTO oscillator compensates for this deviation by switching varactor diode D3 into the circuit by means of switch S1E, so that when switching from band to band, the kHz portion of the digital reading will not materially change. The amount of varactor capacitance inserted is controlled by the value of dc voltage applied through potentiometer R21. To set this adjustment, proceed as follows:

1. With power removed from the transceiver, follow the instructions for removal of the bottom cover.
2. (545 ONLY) Connect frequency counter to VFO OUT jack on rear panel.
3. Apply power to transceiver. Set BAND switch to 21.0 and main tuning dial to 21.000 0 (12.000 0 MHz on counter for Model 545).
4. Switch BAND switch to 14.0 position and without moving setting of main tuning knob, adjust R21 so that readout is 14.000 0 MHz.

MIXER OUTPUT ADJUSTMENTS

The double-tuned circuits connected to the mixer output on all but the 14.0 MHz band are wide band, over-coupled resonant circuits that are best aligned using a sweep oscillator system. Because they are wide band, realignment is seldom necessary, except in the case where a tuned circuit component is replaced. Only if alignment is definitely indicated should the following alternate procedure be used.

1. Connect an rf oscilloscope and/or rf voltmeter to the LO output pin on the VFO AMP board 80454.
2. Capacitors C6, C7, and C9 through C14 are used in conjunction with transformer T1 to peak the VFO output on all bands except 14.0 MHz. This band derives its output frequency directly from the 5.0 to 5.5 MHz PTO assembly.

3. 10 Meter Alignment: T1 is adjusted on this band. If T1 does not need alignment, proceed to step 4.
  - A. Set  $\text{MNI}$  tuning to 28.000 0. Adjust both top and bottom slugs of T1 for maximum output at 19.000 0 MHz. Being over-coupled, one adjustment will affect the other.
  - B. Note voltmeter reading and switch to 30.000 0 MHz. If the reading is appreciably lower, touch up the top slug of T1 and recheck 28.000 0 MHz. When properly tuned, the frequency response should peak near each frequency extreme with a shallow dip in the center. Readjustments of both slugs may be necessary to achieve the proper passband curve.
  - C. The output voltage should be no less than 0.5 V rms at any frequency, and may range up to 0.7 V. If this is not the case, adjust R23, the crystal oscillator injection control, for 0.5 V at the lowest point. **CAUTION:** Too high injection will not improve performance and will increase unwanted mixer products.
4. 3.5 and 21.0 MHz Band Adjustment: Since the VFO output frequency for the 3.5 MHz band is 12.5 to 13.0 MHz and for the 21.0 MHz band 12.0 to 12.5 MHz, these two bands have a common set of trimmer capacitors, C11 and C12. The VFO mixer output curve is broadbanded to cover 12.0 to 13.0 MHz. The desired output curve should show peak outputs at 12.0 and 13.0 MHz with a slight saddle between them because of the over-coupled design. Proceed as follows:
  - A. Set BAND switch to 3.5 MHz and dial to 4.000 0 MHz.
  - B. Peak C11 and C12 for maximum voltage reading on meter or scope. Note reading.
  - C. Tune to 21.000 0 MHz.
  - D. Repeak C11 for maximum reading.
  - E. Recheck values of output voltage at 4.000 0 MHz and again peak C12. (There is some interaction on tuning between these two trimmers.) Check to see whether the output slightly decreases as you tune down from 4.0 and up from 21.0 MHz.
  - F. Touch up C11 and C12 until desired curve is obtained.
5. The same VFO injection frequency is used on 10 MHz as on 28 MHz. Therefore, no adjustment for 10 MHz is necessary.
6. 7.0 MHz Alignment:
  - A. Set BAND switch to 7.0 and dial to 7.200 0.
  - B. Adjust trimmers C10 and C13 for maximum output.
  - C. Check output for uniformity from 7.0 to 7.3 MHz and touch up C10 and C13 as necessary to obtain constant output.
7. 1.8 MHz Alignment:
  - A. Set BAND to 1.8 and dial to 1.900 0 MHz.
  - B. Adjust trimmers C9 and C14 for maximum voltage output.
  - C. Check for output uniformity from 1.8 to 2.0 MHz. Touch up C9 and C14 as necessary for constant output.

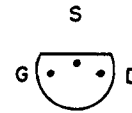
MIXER BALANCE

To balance the mixer output for minimum crystal oscillator feed-through, proceed as follows:

1. Set BAND switch to 1.8 MHz.
2. Set dial for 1.950 0 MHz.
3. If a tone or "birdie" is heard, adjust the mixer balance control, R2, for a null in the tone. It should be possible to null this to less than 10 dB signal to noise audio output. If not, the crystal oscillator injection control, R23, is probably set too high and should be checked.

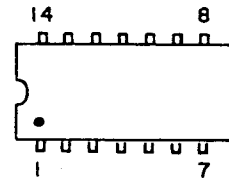
Semiconductor Voltage Readings - (BAND switch on 3.5 MHz.)

Transistor	Drain	Gate	Source
Q1 JFET	7.8	0	0

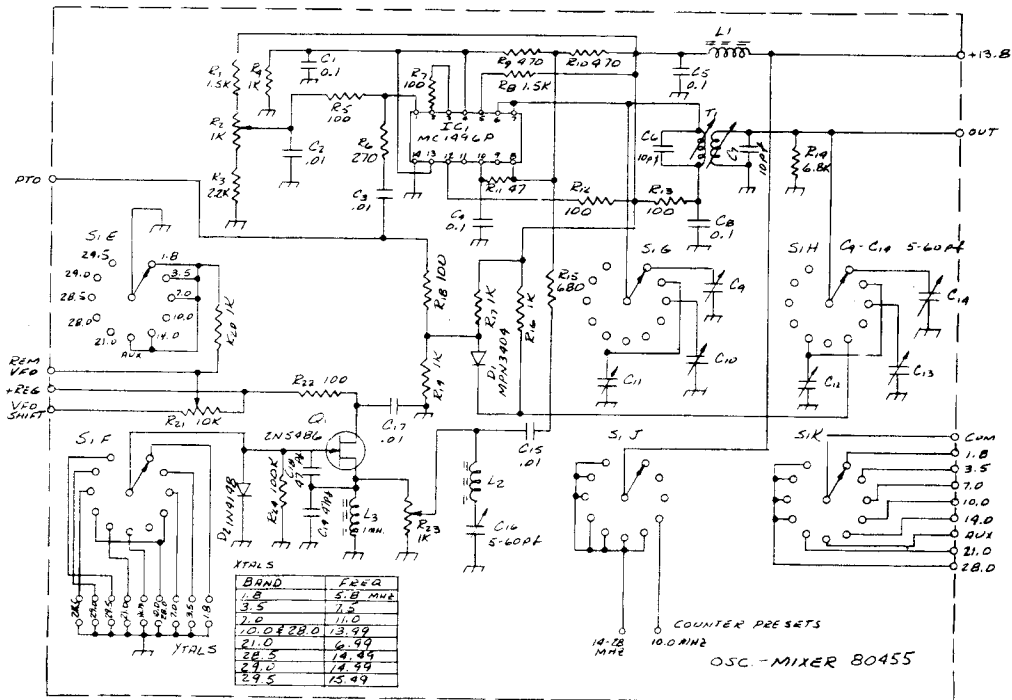


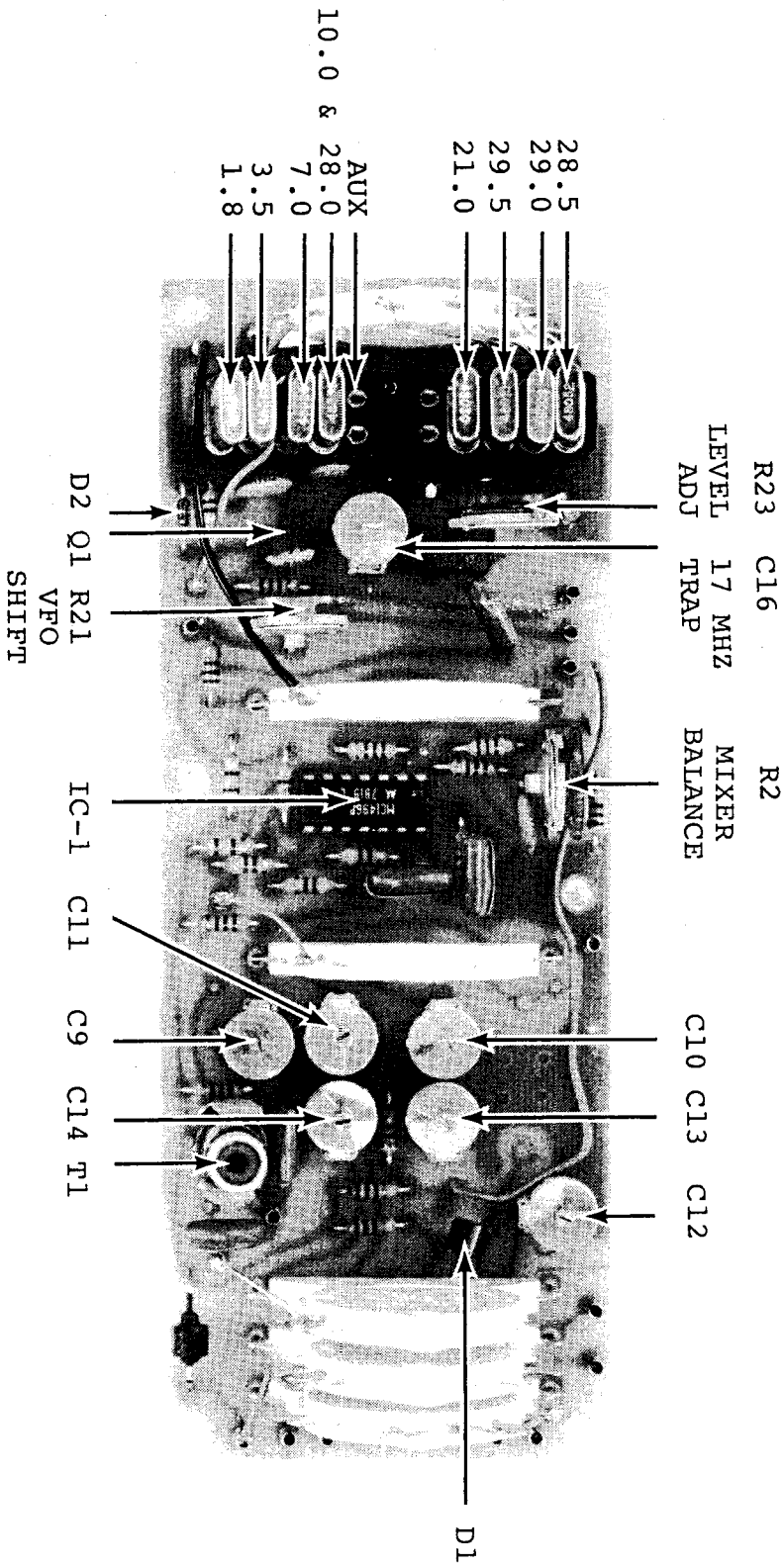
IC-1

Pin	Receive	Pin	Receive
1	6.8	8	10.1
2	6.1	9	0
3	6.1	10	10.1
4	6.8	11	0
5	4.5	12	12.7
6	12.7	13	6.8
7	12.7	14	0



Semiconductor pins viewed from top of PC board



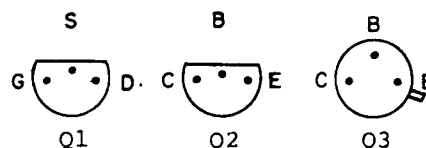


## 80454 VFO AMPLIFIER

This board contains two amplifiers and a low pass filter. The first amplifier, consisting of FET Q1 and transistor Q2, acts as a buffer and impedance converter for the mixed VFO output from the oscillator-mixer board. The signal is amplified to approximately 0 dBm (0.22 V) and applied to the second amplifier, Q3, and to the RX MIXER. The high level (13 dBm) signal from Q3 goes through the low pass filter (C1, C2, C3, L1, and L2) and drives the TX MIXER. This output also drives the counter display in Model 546.

Pin Voltage Readings - (Receive mode.)

Pin	Receive*
GND	0
OUT	0
N/C	0
Rx MIX	0
13.8	13.8
IN	0
GND	0

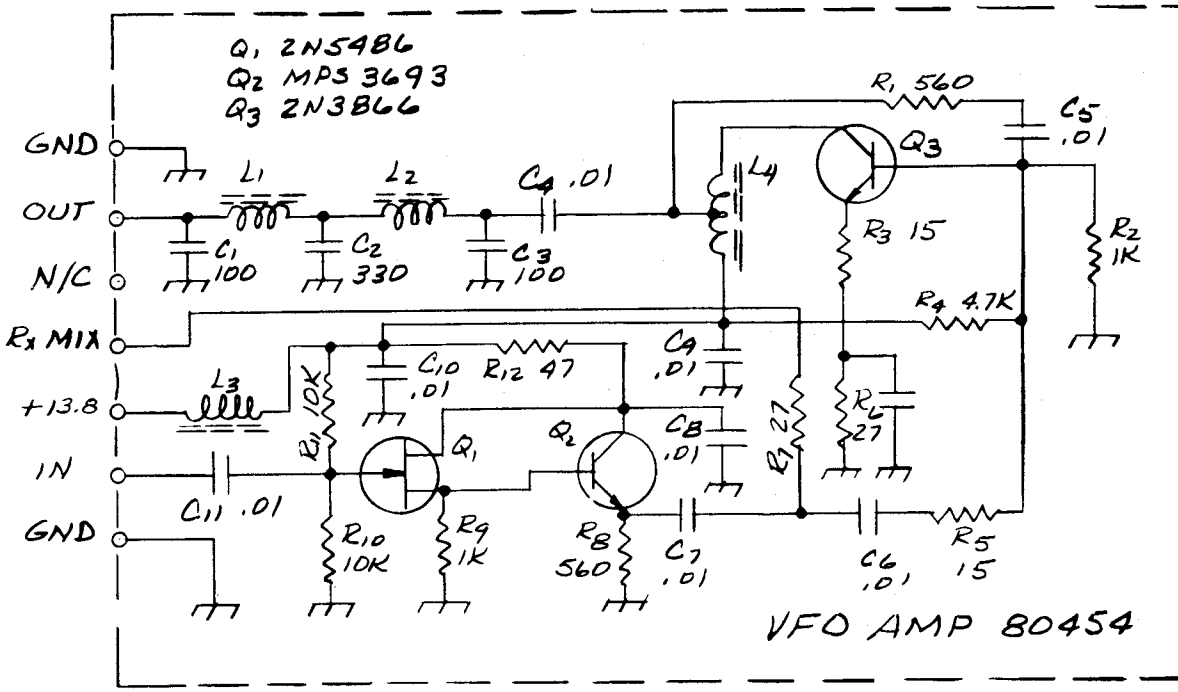


Transistor pins viewed  
from top of PC board

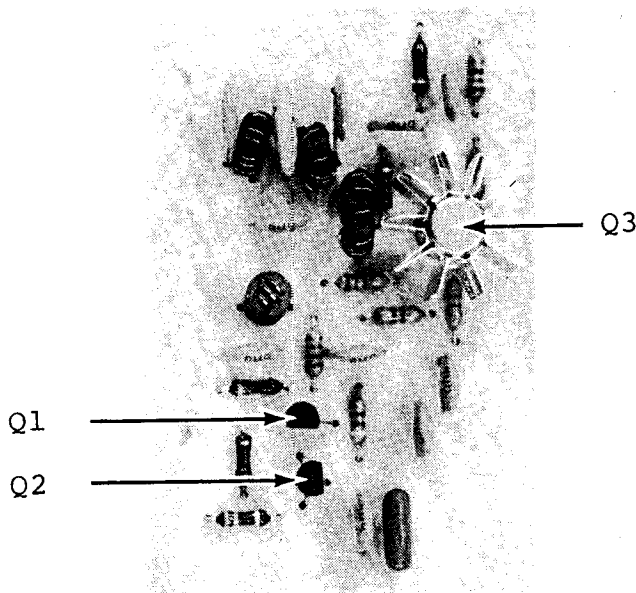
Semiconductor Voltage Readings

Transistor	Collector Drain	Base Gate	Emitter Source
Q1 JFET	12.8	8.3	7.6
Q2	8.3	6.9	12.9
Q3	13.8	-	-

\* Voltages are the same in transmit and receive modes.



11-27-78



80454 VFO AMP

## DIGITAL READOUT

The frequency counter and digital display section of Model 546 consist of four interconnected printed circuit assemblies located in an aluminum enclosure, which is secured to the sub-panel. The large scale integrated circuit, display interface circuitry, a ten-to-one prescaler, and a +5 volt regulator are contained on the 80441 LOGIC assembly which is mounted on the bottom of the counter enclosure. The six digit display, 80440, plugs into a 24 pin socket mounted on the 80441 LOGIC assembly. The preset switching circuit, which determines the first two digits' information, is contained on the 80465 PRESET-AMP assembly. The 80465 PRESET assembly also contains a preamp and shaping circuit for the VFO signal to be counted. The control signals for the preset circuit are generated on the 80455 OSC-MIXER assembly and are connected to feed through pins mounted on the counter enclosure. The fourth assembly, 80442 TIME BASE, contains the counter time base oscillator and necessary divider stages. This oscillator is crystal controlled and can be adjusted by means of trimmer capacitor, C3, which is accessible through a hole in the counter enclosure.

Since this portion of the transceiver is highly complex and contains MOS and CMOS integrated circuits that are susceptible to damage from static burn-out if improperly handled, the following information will be limited to a general description of circuit operation.

Servicing information will give sufficient data to locate a faulty assembly. It is suggested that a complete defective assembly be replaced instead of individual components. Full schematics and individual photos are included for those with adequate digital knowledge and test equipment. Many of the circuits carry pulse signals so that straight dc measurements cannot be made. Rather, oscilloscope analysis is the only way to properly troubleshoot these circuits. Since it is not within the scope of these instructions to present detailed waveform analysis, general guidelines for troubleshooting are given, along with dc voltage measurements where they are valid.

THEORY OF OPERATION

The counter incorporates the latest in large scale integration. MOSTEK type MK50398N circuit accomplishes all of the counting, latching, multiplexing, output decoding, and driving functions on a single chip. This IC is located on the 80441 assembly mounted on the bottom of the counter enclosure.

Input signal from the VFO output is first passed through amplifier-shaper IC-1 on the 80465 PRESET-AMP assembly. The amplified and squared-up signal is then divided by IC-5 on the 80441 LOGIC assembly. Since VFO frequencies range between 5.0 and 21.0 MHz, the scaled down output which is applied to the LSI (Large Scale Integrated) circuit range between 500 kHz and 2.1 MHz.

Time base oscillator IC-2 on 80442 operates at a crystal controlled frequency of 5.24288 MHz. This IC also divides the output by a factor of  $2^{20}$ , resulting in an output of 5 square waves per second. This timing signal gates the scaler on and off so that the input is counted for one tenth of a second (100 milliseconds). During the remaining 100 ms the counter preset information and the transfer of the counter information to display circuits is carried out through two timing pulses, STORE and LOAD terminals on 80442, applied to pins 10 and 24 of the LSI circuit IC-4 on 80441 LOGIC assembly. These pulses are derived from IC-1 on 80442. It is a dual monostable multivibrator. Input to this circuit is also from the 5 Hz square wave. The pulse widths are controlled by R4 and C6 (load pulse) and R3 and C5 (store pulse). The load pulse is positive and typically 5 ms long while the store pulse is negative and 50 ms long. Trimmer C3 in the crystal oscillator circuit serves to accurately set the time base frequency.

The preset information needed to convert the readout indication from the actual counted frequency to the operating frequency (9 MHz away) is provided through the four program lines, pins 11 through 14 on the LSI chip. Only pins 11 and 14 are required to be switched for the various bands. The programming circuit is located on 80465 PRESET-AMP assembly. On the 1.8, 3.5 and 7.0 MHz bands, 01.000 0 is preset by diode D7. On the 10.0 MHz band, 91.000 0 is preset by diodes



D2, D3, D7, and by transistor Q1. On the remaining bands, 09.000 0 is preset by diodes D4, D7, and by transistor Q2. On the 1.8, 3.5, and 7.0 MHz bands, the leading digit is blanked. On the 10.0 MHz band, the leading digit is activated by diode D6 and transistor Q3. On the remaining bands, the leading digit is activated by diode D5 and transistor Q3.

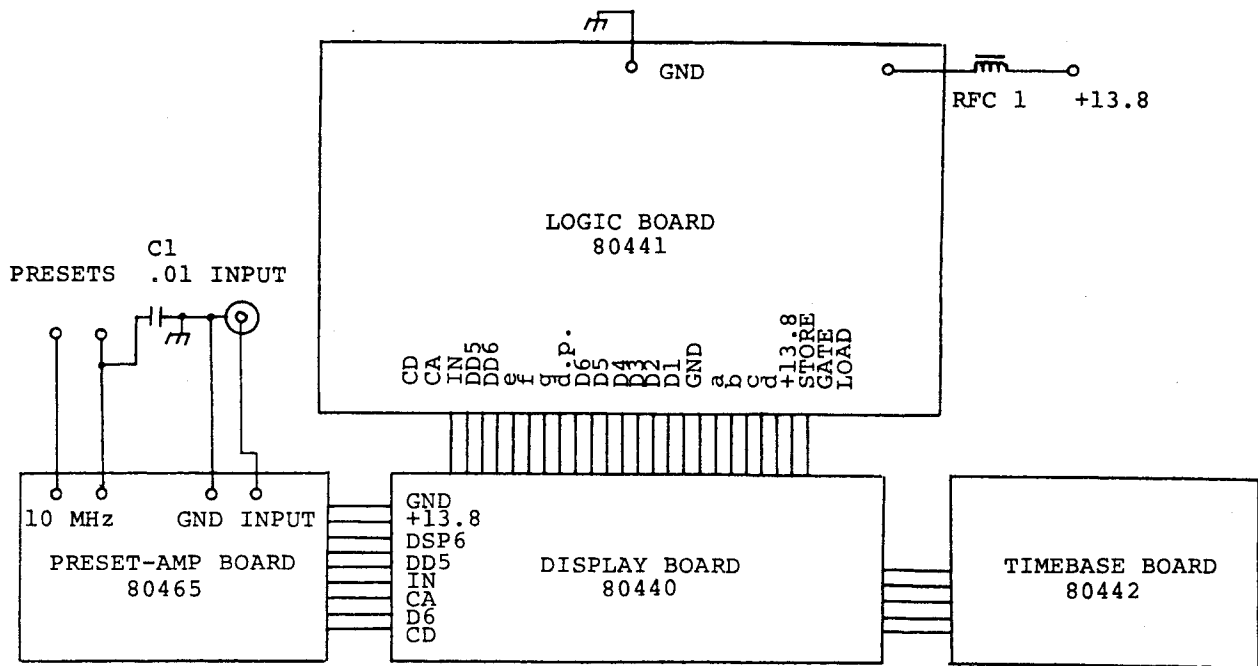
IC-6 on assembly 80441 is a voltage regulator which provides +5 volts to operate IC-5, the TTL 7490 decade counter. All other circuits are fed from the +12 volt line through appropriate decoupling circuits.

DISPLAY assembly 80440 consists of six 0.43" high LED, seven segment numerical displays mounted on a PC board. The board is painted black prior to installation of the readouts. Five readouts are red and the least significant digit is green. All voltages for the display come from LOGIC assembly 80441. The display is multiplexed in the LSI circuit and frequency runs typically between two and three kHz, as determined by C2 on 80441. Interface driver IC's between the common cathode LED numerals and the LSI circuit are contained on LOGIC assembly 80441. Integrated circuit IC-1 provides the multiplexed digit-enable signals to the cathodes of the display digits. Integrated circuits IC-2 and IC-3 supply the multiplexed segment signals to the display segment anodes.

#### SERVICING HINTS

Use the following procedures to locate the faulty assembly. If well versed in digital techniques, check waveform and signal paths as indicated.

1. Check all dc voltages given for TIMEBASE 80442 assembly and PRESET-AMP 80465 assembly. If any is more than 20% different than the value indicated, look to this area of the circuit for faulty component.
2. If all dc measurements are within normal range, determine probable malfunctioning area by analyzing trouble symptoms. If, for example, one digit is dark or always reads 8, trouble is indicated in the particular digit-enable circuitry or the LED itself. Or, if any one bar of the seven segments is dark or lit all of the time on all six digits, look to the particular driver IC's and associated connections for that particular segment.
3. With oscilloscope check signal path at these locations:
  - A. No indication on the digital readout may indicate input signal from VFO is not passing through IC-1 on 80465, or IC-5 on 80441. Or, IC-5 reset line, pin 2, may inhibit signal from reaching the input to LSI.
  - B. Check operation of crystal time base oscillator, output from divider, pin 12 of IC-2, and output pulses from monostable multivibrators, pin terminals marked STORE and LOAD.
  - C. Since multiplexed readout contains six digits, the enable pulse to each digit should have a pulse width equal to one sixth of the time for one complete scan. Scan frequency is determined by the 560 pfd capacitor C2 on 80441 LOGIC board.
4. Correct preset information from 80465 PRESET-AMP assembly results in the digits to the left of the decimal point displaying correct MHz for the various bands. If any of these do not indicate correctly, check connections between this assembly and 80441, and condition of diodes and transistors.



COUNTER ASSEMBLY  
80468

1-19-79

Pin Voltage Readings on 80645 PRESET-AMP BOARD - (BAND switch on 21 MHz.)

Pin	Volts	Pin	Volts
INPUT	DNM	GND	0
GND	0	+12	13.8
PRESET 14, 21, 28-30	13.8	DSP6	DNM
PRESET 10	0	DD6	DNM
		DD5	DNM
		IN	DNM
		CA	DNM
		D6	DNM
		CD	DNM

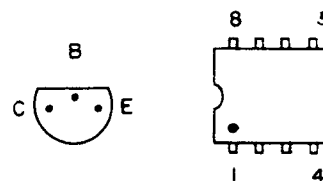
Semiconductor Voltage Readings on 80465 PRESET-AMP BOARD

Transistor	Collector	Base	Emitter
Q1	.9	DNM	DNM
Q2	13.7	DNM	DNM
Q3	DNM	10.3	DNM

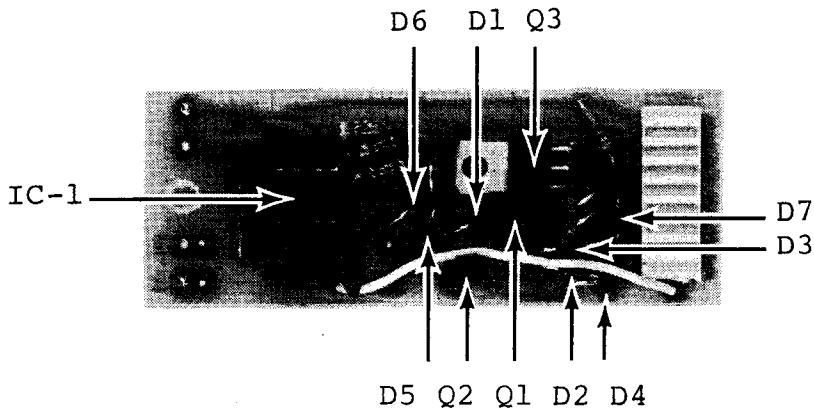
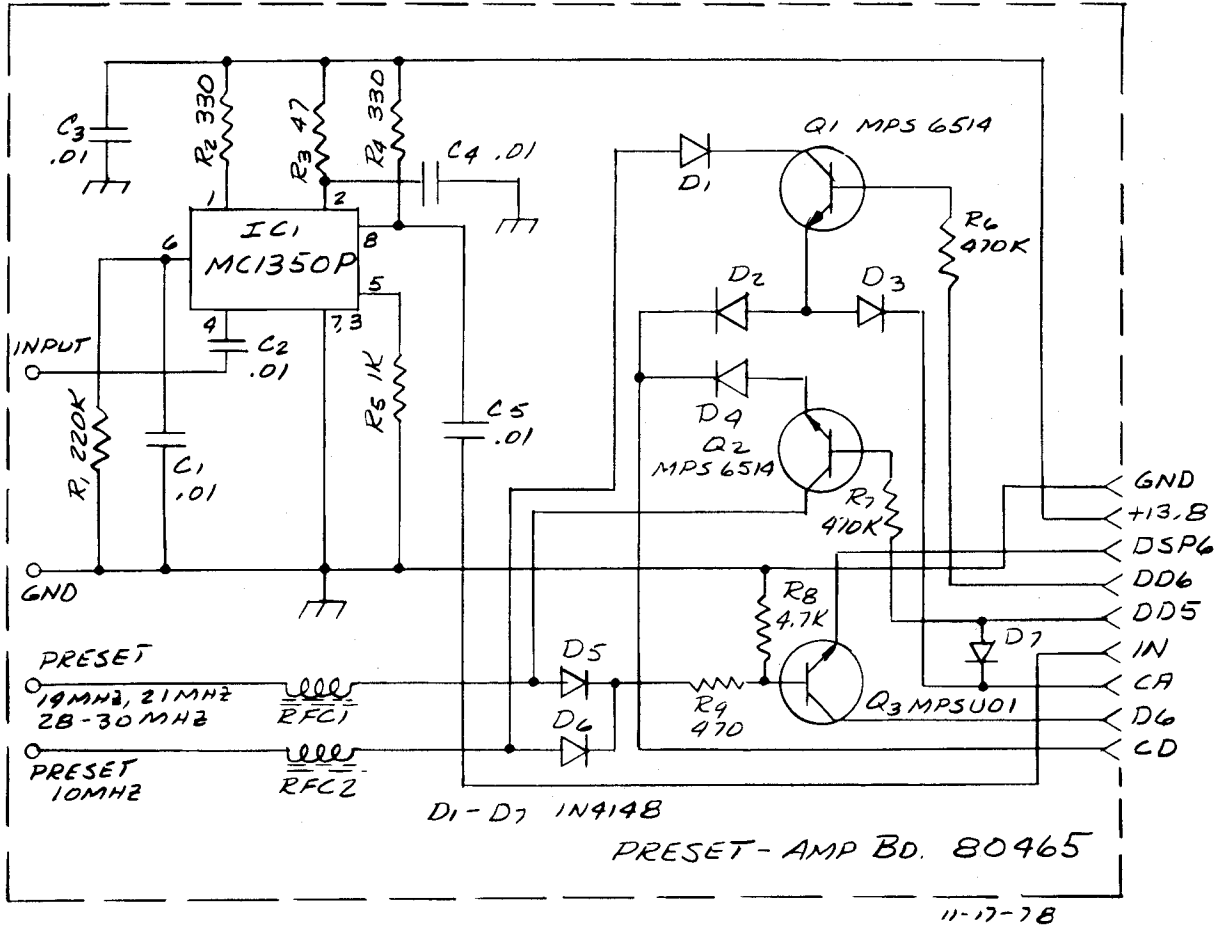
DNM  
Do Not Measure.  
Pulses Present.

IC-1

Pin	Volts
1	12.8
2	13.3
3	0
4	4.5
5	1.9
6	4.5
7	0
8	12.6



Semiconductor pins  
viewed from top of  
PC board



80465 PRESET-AMP

80441 LOGIC BOARD

IC-4, the LSI circuit, should have approximately 11 volts at pins 1, 2, and 28. Pins 15, 17, and 26 should be at chassis ground potential. All other pins have pulses and cannot be measured with a dc voltmeter. IC-1, IC-2, and IC-3 should have approximately 13.8 volts at pin 11 and 0 volts on pin 4. All other pins contain pulses.

Pin Voltage Readings on 80441 LOGIC BOARD

Pin*	Volts
GND	0
+12	13.8

\* All other pins, DNM = Do Not Measure. Pulses Present.

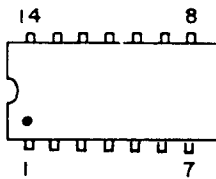
Semiconductor Voltage Readings on 80441 LOGIC BOARD

Pin	IC-1	IC-2	IC-3	IC-4	IC-5	IC-6
1	DNM	DNM	DNM	11	DNM	NA
2	DNM	DNM	DNM	11	DNM	NA
3	DNM	DNM	DNM	DNM	4.8	NA
4	0	0	0	DNM	DNM	
5	DNM	DNM	DNM	DNM	4.8	
6	DNM	DNM	DNM	DNM	0	
7	DNM	13.8	DNM	DNM	0	
8	DNM	DNM	DNM	DNM	DNM	
9	DNM	DNM	DNM	DNM	DNM	
10	DNM	DNM	DNM	DNM	0	
11	13.8	13.8	13.8	DNM	DNM	
12	DNM	DNM	DNM	DNM	DNM	
13	DNM	DNM	DNM	DNM	DNM	
14	DNM	DNM	DNM	DNM	DNM	
15				0		
16				DNM		
17				0		
18				DNM		
19				DNM		
20				DNM		
21				DNM		
22				DNM		
23				DNM		
24				DNM		
25				DNM		
26				0		
27				DNM		
28				11		

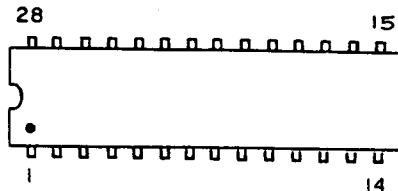
DNM

(NA = Not Accessable)

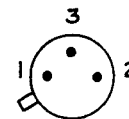
Do Not Measure  
Pulses Present.



IC-1, 2, 3, 5



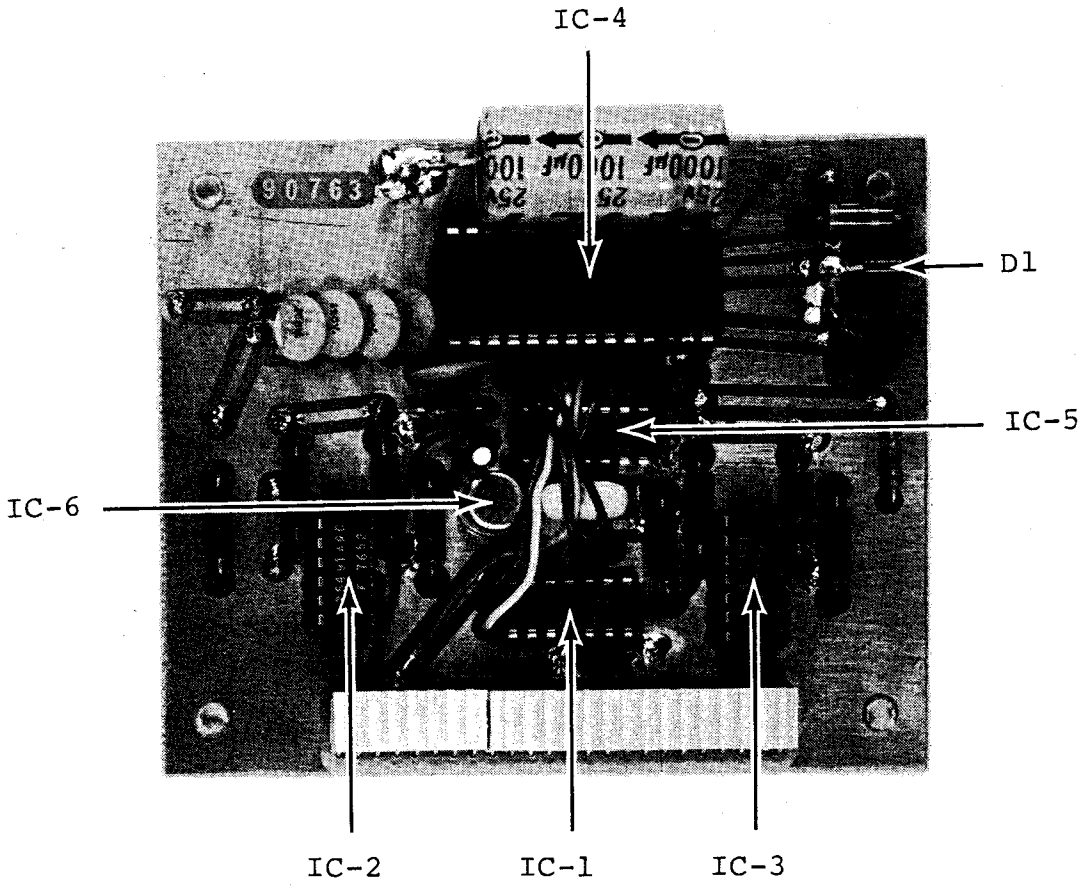
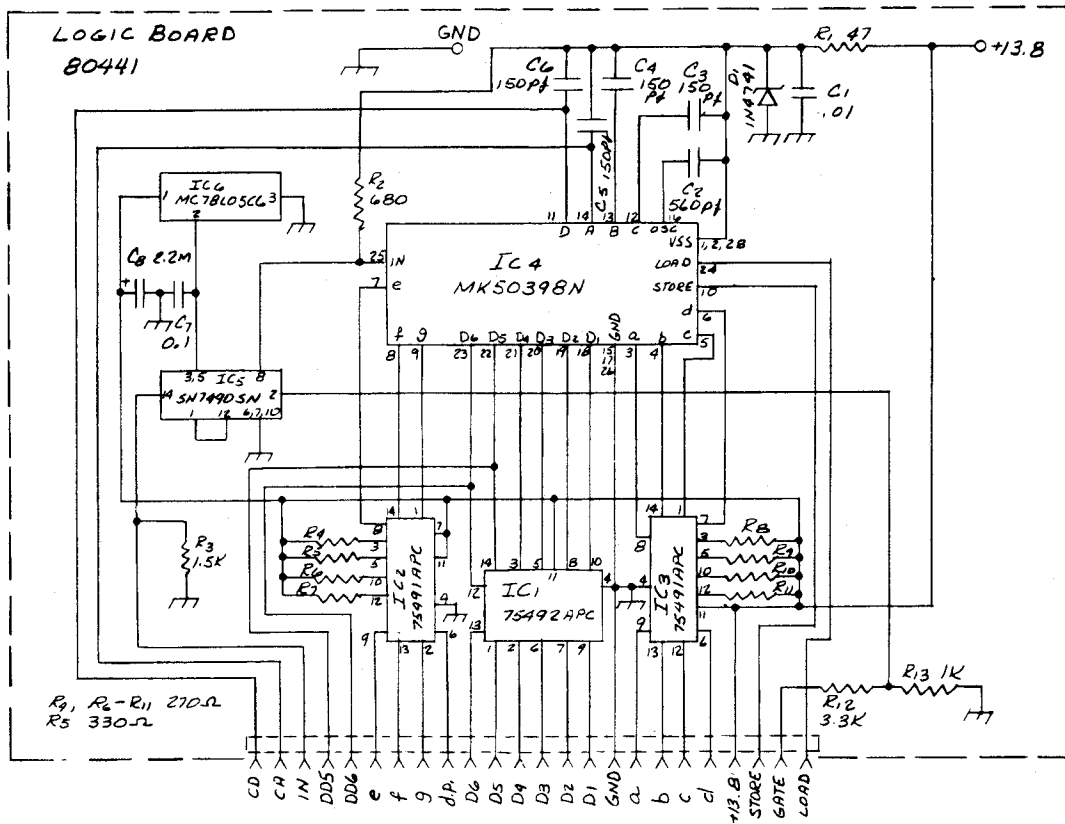
IC-4



IC-6

Semiconductor pins  
viewed from top of  
PC board

4/-545/546

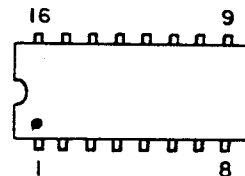


80441 LOGIC

Pin Voltage Readings on 80442 TIMEBASE BOARD

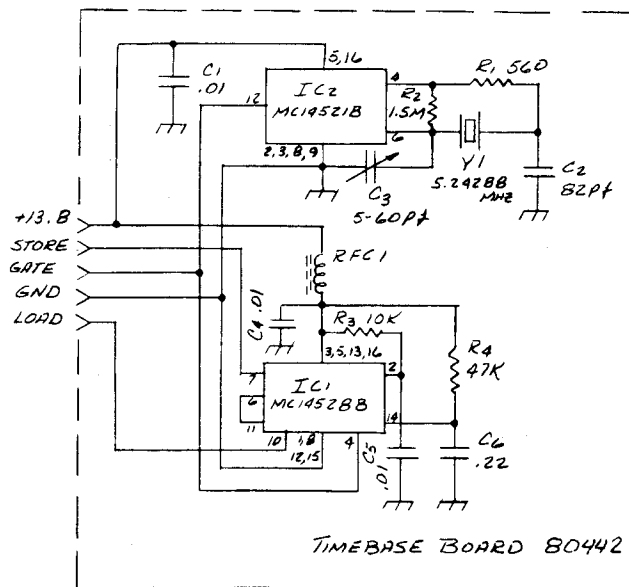
Pin	Volts
+12	13.8
STORE	DNM
GATE	DNM
GND	0
LOAD	DNM

Semiconductor pins viewed from top of PC board



Semiconductor Voltage Readings on 80442 TIMEBASE BOARD

Pin	IC-1	IC-2
1	0	DNM
2	13.7	0
3	13.8	0
4	DNM	7
5	13.8	13.8
6	DNM	6.3
7	DNM	DNM
8	0	0
9	DNM	0
10	DNM	DNM
11	DNM	DNM
12	0	DNM
13	13.8	DNM
14	DNM	DNM
15	0	DNM
16	13.8	13.8

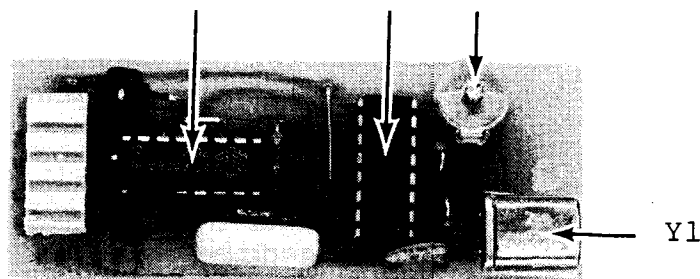


DNM

Do Not Measure.  
Pulses Present.

C3  
TIMEBASE  
ADJUST

IC-1      IC-2



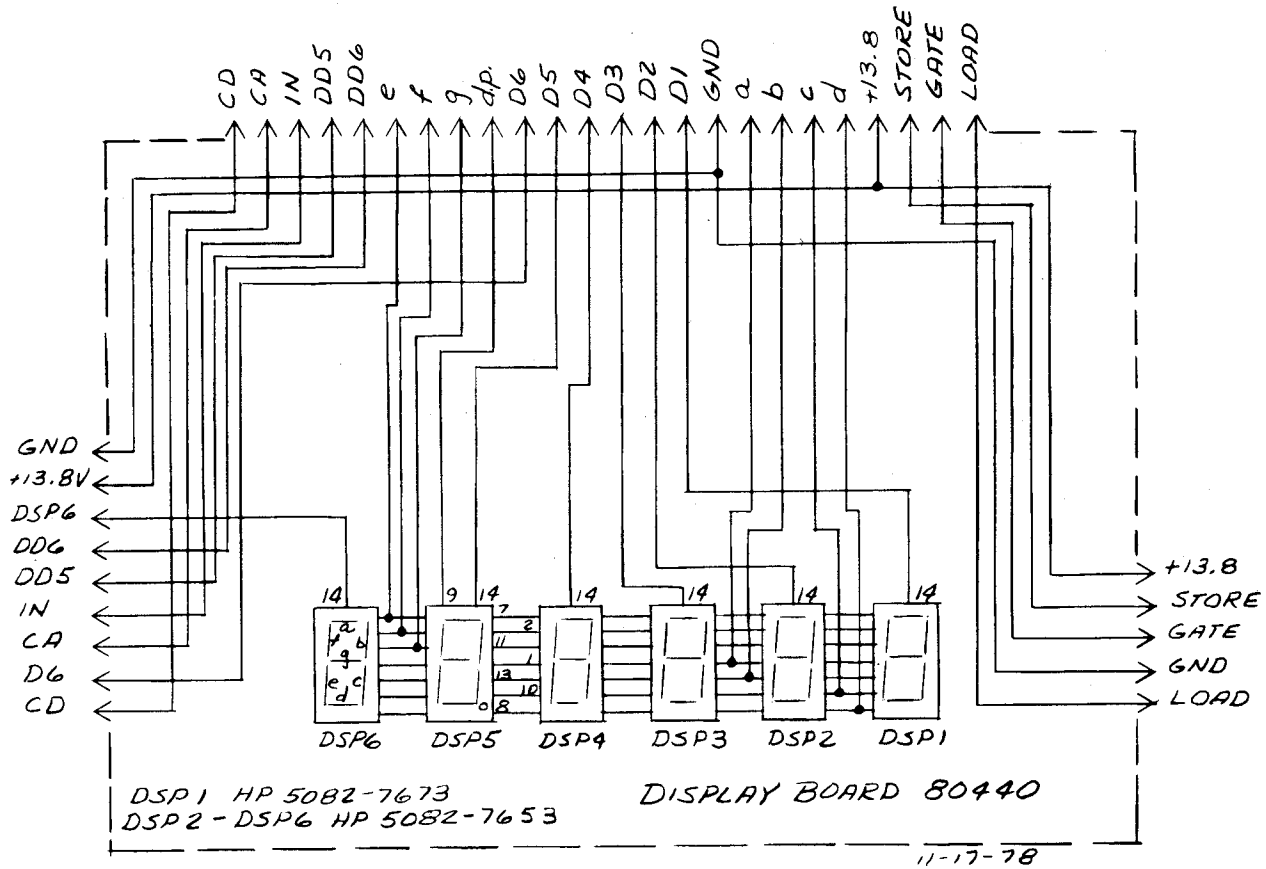
80442 TIMEBASE

32-242/240

Pin Voltage Readings on 80440 DISPLAY BOARD

Pin*	Volts
GND	0
+12	13.8

\* All other pins, DNM = Do Not Measure. Pulses Present.



## 80452 RX MIXER

This board contains the high level double balanced diode quad mixer, a low noise high level i-f preamplifier, and a broadband high level local oscillator (LO) amplifier. The LO is applied at approximately +13 dBm to the mixer. Mixer amplitude and phase balance are set using R1 and C1. On transmit, bias to both amplifiers is removed and the mixer is disconnected from the i-f preamplifier by PIN diode D5.

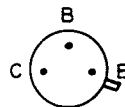
The mixer balance controls are adjusted as follows:

1. Set BAND switch to 21.0 MHz and dial to 21.320 0.
2. Peak RESONATE control for maximum signal.
3. Remove antenna and terminate ANTENNA jack with a 50 ohm load.
4. Null, using R1 and C1, any "birdie" that may be received.

Resistors R10 through R12 form a 3 dB attenuator which is necessary for proper out-of-band termination of the mixer.

Pin Voltage Readings - (Receive mode, no signal.)

Pin	Receive
GND	0
IF	0
+12	13.8
NC	0
R	12.8
LO	0
GND	0



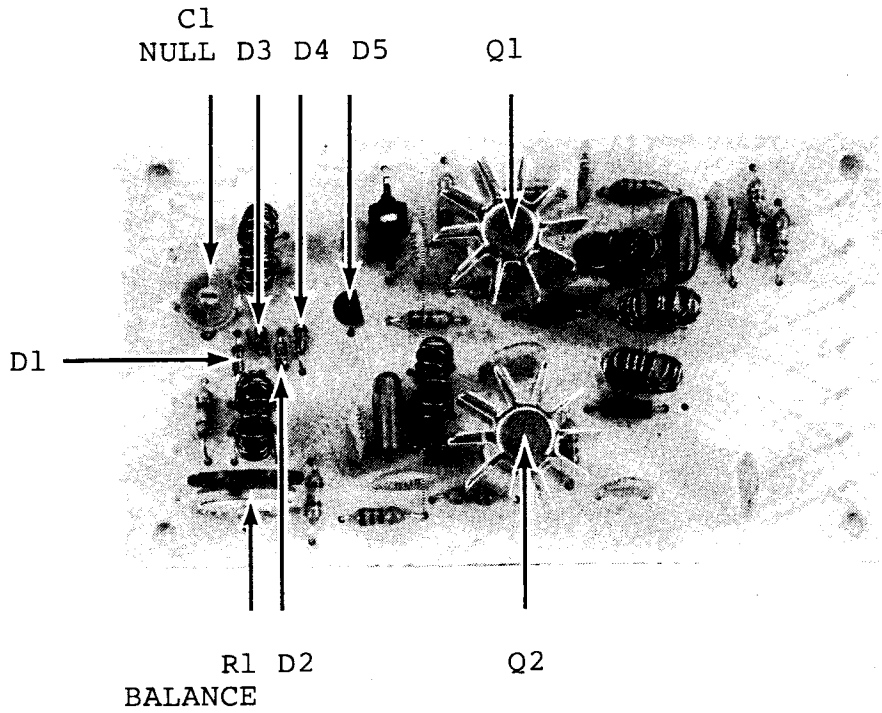
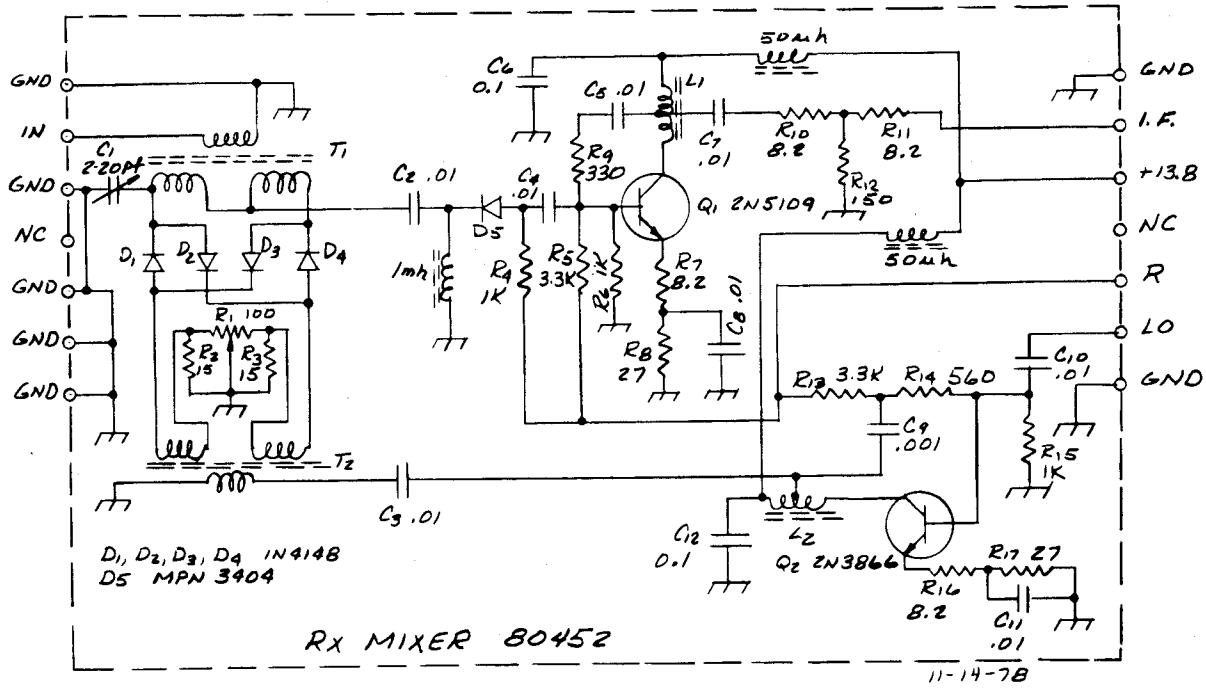
Transistor pins viewed  
from top of PC board

Semiconductor Voltage Readings

Transistor	Collector		Base		Emitter	
	Transmit	Receive	Transmit	Receive	Transmit	Receive
Q1	13.8	13.8	NA	NA	NA	NA
Q2	13.8	13.8	NA	NA	NA	NA

(NA = Not Accessable)





80452 RX MIXER

## 80526 CRYSTAL FILTER SWITCH

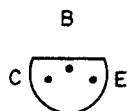
This board contains a double pole, triple throw electronic switch, a buffer amplifier, Q1, and sockets for the installation of two optional crystal filters. The buffer amplifier provides a proper terminating load for both the 2.4 kHz crystal filter and the optional filters. Since it is powered from the R voltage, it effectively disconnects the receive i-f system during transmit. The electronic 3P2T switch consists of diodes D1 thru D12. The position of the switch is determined by which of the three control lines receives +12V from the SELECTIVITY switch. The excess forward bias voltage from the switch in use appears across R6 and R10, and reverse biases the two other sections. Isolation through these switches is in excess of 90 dB. When the 0.5 switch is selected, switch Q2 adds some emitter bypassing to Q1 which increases the buffer gain from 1 to 7 dB. This compensates for the 6 dB higher loss in the 0.5 filter.

Pin Voltage Readings - (SELECTIVITY switch setting 2.4.)

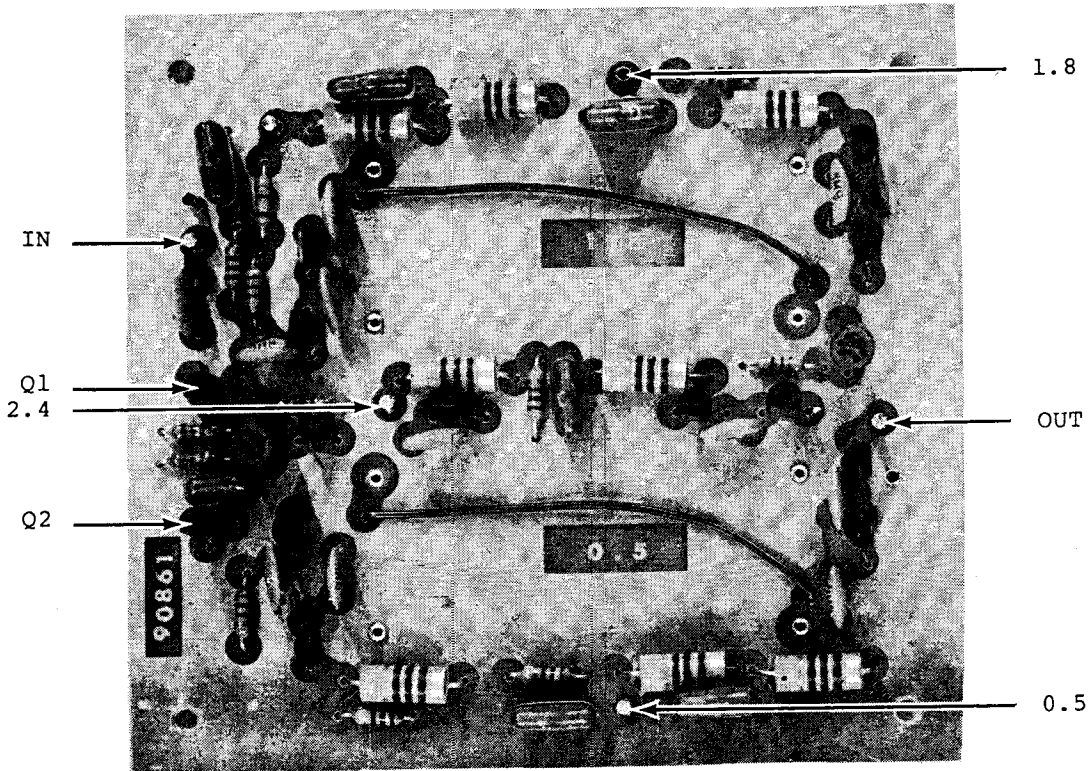
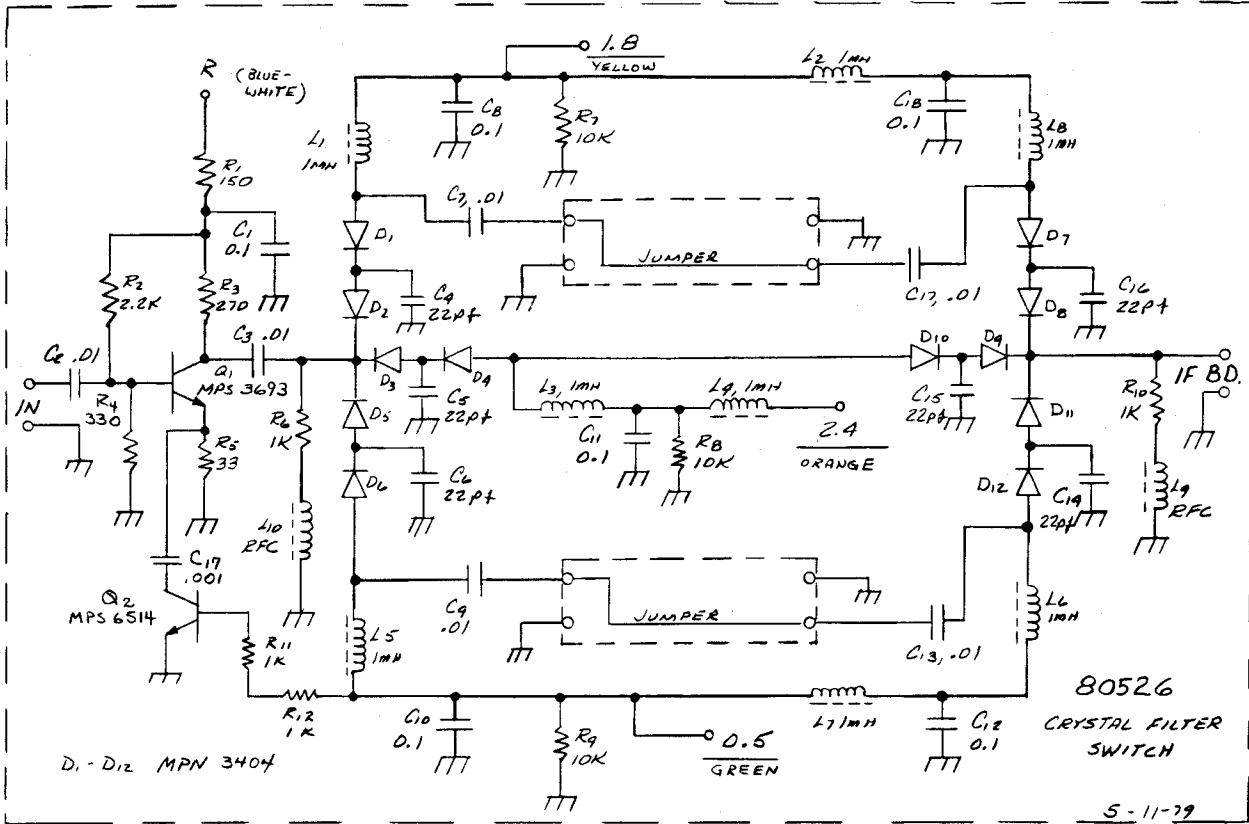
Pin	Transmit	Receive
2.4	13.8	13.8
1.8	0	0
0.5	0	0
R	0	12.5
IN	0	0
OUT	11.7	11.7

Semiconductor Voltage Readings - (Receive mode, SELECTIVITY switch in 0.5 position.)

Transistor	Collector	Base	Emitter
Q1	5.5	1.2	0.5
Q2	0	0.8	0



Transistor pins viewed  
from top of PC board



80526 CRYSTAL FILTER SWITCH

80448 IF-AGC

The 9 MHz i-f amplifier utilizes two stages, both of which are gain controlled for AGC. Input signal is derived from the output of the receiver mixer after being passed through the 8 pole crystal ladder filter. PIN diodes D1, D2, and D3 present variable resistances across the signal path in the i-f stages. The amount of shunting is determined by the amount of AGC voltage developed in the dc darlington stage, Q4 and Q5. Output of the i-f amplifier is converted into an audio signal by product detector Q3. It then goes to the FILT IN terminal through the cw filter and returns through the FILT OUT terminal. If no filter is being used, these terminals are jumpered together by the SELECTIVITY switch.

The audio signal applied to the FILT OUT terminal is amplified in one section of dual op-amp IC-1, and fed to the AUDIO terminal. The second op-amp further amplifies the signal for AGC purposes. The S-Meter is driven by the AGC darlington output stage, as well as the PIN diodes, in the receive mode, but is disconnected when transmitting by blocking diode, D4.

Three adjustments are required on this assembly. The first two, i-f transformers T1 and T2, are peaked for maximum S-Meter reading while receiving a weak signal. Maintain a meter reading less than S-5 by detuning the RESONATE control so that AGC action is held to a minimum.

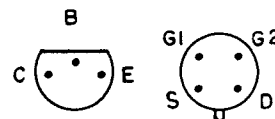
S-Meter calibration is accomplished by setting potentiometer R20 to an S-9 reading when 50 uV signal at 14.100 0 MHz is applied to ANTENNA terminal. R20 should be adjusted after RESONATE control is peaked and main tuning adjusted for maximum meter deflection.

Pin Voltage Readings - (Receive mode, no signal conditions.)

Pin	Transmit	Receive	Pin	Transmit	Receive
GND	0	0	GND	0	0
IN	0	0	FILT IN	0	0
AUDIO	0	0	RF GAIN	0	8.65
T	10.8	.01	+REG	8.06	8.06
+12	13.8	13.8	BFO	5.7	5.7
S MTR	0	0	FILT OUT	0	0
NC	0	0	GND	0	0

Semiconductor Voltage Readings

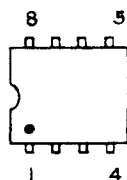
Transistor	Collector Drain	Base Gate 1	Emitter Source	Gate 2
Q1	13.8	1.3	0.6	
Q2	13.5	1.4	0.7	
Q3 MOSFET	5.4	0.7	1.0	0.9
Q4	13.8	1.2	0.7	
Q5	13.8	0.7	0.1	
Q6	1.2	0	0	
Q7	8.1	8.6	8	



Transistor pins viewed from top of PC board

IC-1

Pin	Volts
1	6.9
2	6.9
3	6.8
4	0
5	6.9
6	6.9
7	7.3
8	13.8



IC pins viewed from top of PC board

# OMNI-VII

"I was struck by how clean, natural and quiet the receiver sounded in comparison to some DSP based radios. I found the Omni-VII a real pleasure to listen to - in any mode." - W1ZR, in the ARRL Product Review, QST July 2007

"What a neat little package! I'm having more fun with this thing!" - K1SA

"In 40+ years and many receivers, the Omni-VII is the most sensitive, most QRM proof and most pleasant to operate I have enjoyed. The noise blanker and noise reduction systems really help me in dealing my sometimes noisy location." - K6LE

"High quality manufacturing... overall a very impressive transceiver" - W9AC

"As an avid CW operator, it is like listening to your favorite music while operating." - N1SW

"I can say that in my 30+ years of operating I've never enjoyed a rig more than the Omni-VII. The audio is superb as is the QSK, ergonomics, receiver characteristics and on and on." - W7TEA

"Close-in dynamic range unsurpassed by any other general coverage radio." - Radio Society of Great Britain RadCom review, September 2007

"Once again, Ten-Tec has produced a superb transceiver, with great SSB audio and their infamous QSK." - K4SQR

"My Dad, KB2LAU, in Florida has become active again using my Omni-VII in Vermont. He is enjoying daily contacts [via Internet remote control]. Being a ham with limited to no antenna options, this has been a great opportunity." - W1ZN

## Are you next?

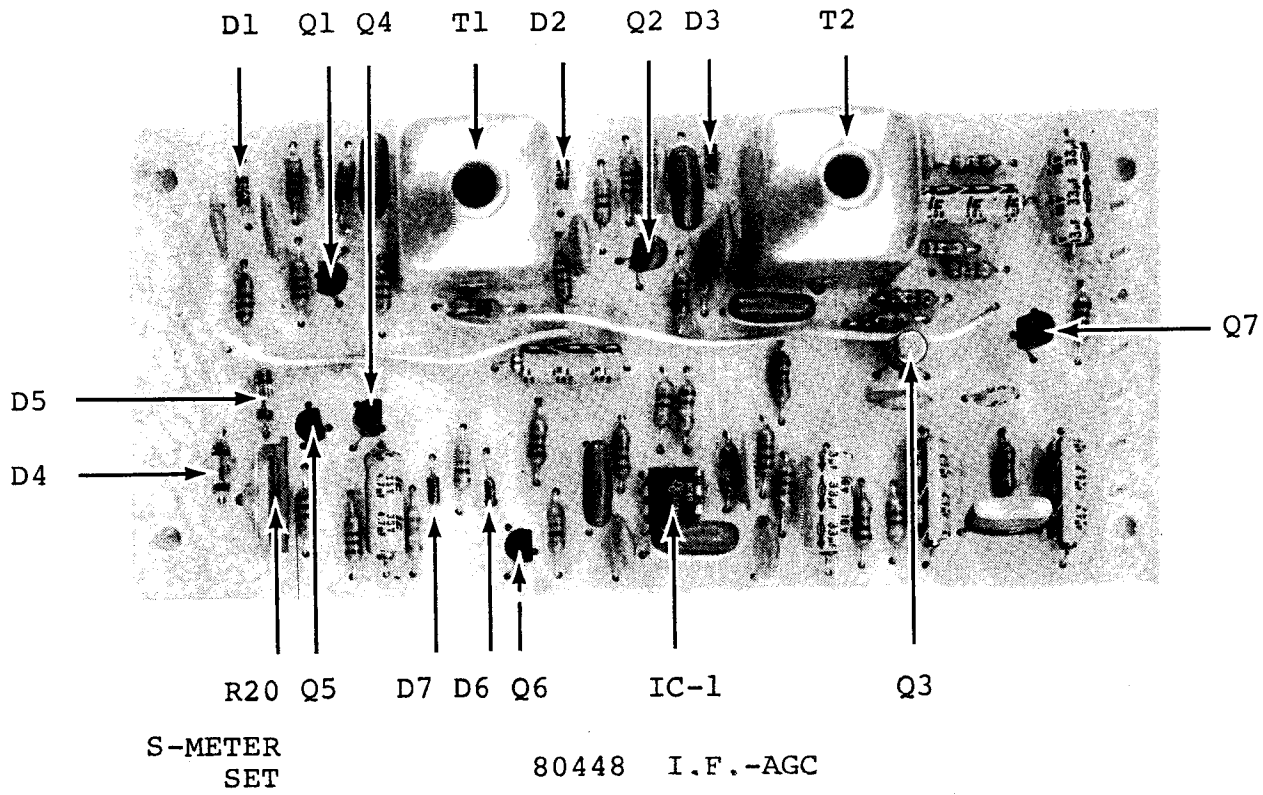
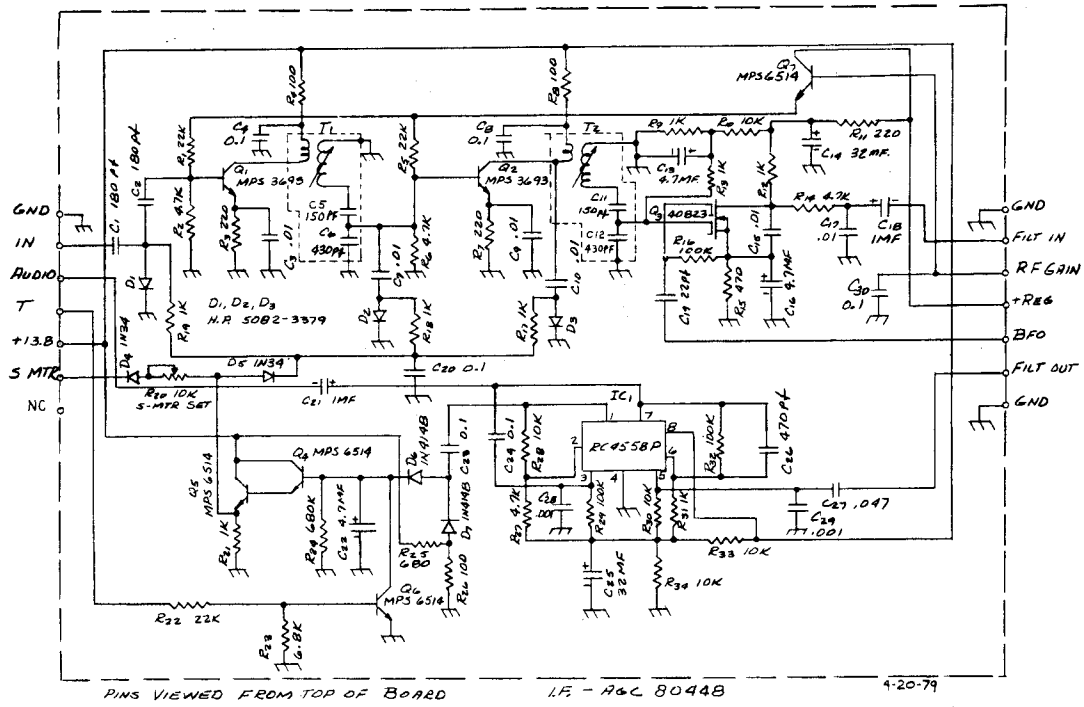
Find out what they found out about the new Ten-Tec Omni-VII. Nothing in its price category matches it for receiver performance, ease of use, remote control capability or features! Contact us for complete information today - or see the Omni-VII demo video at [www.tentec.com](http://www.tentec.com)

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**TEN-TEC**



## 80436 CW FILTER

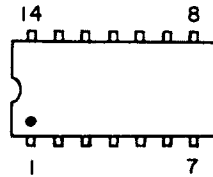
The CW FILTER contains four two-pole active operational amplifier filters whose center frequency is 750 Hz. The four filters are connected in series, with each output brought out to a pin on the board. The filters are selected by the SELECTIVITY switch and when selected, are placed between the product detector and the AGC detector. Thus, when any of the filters are in use, the AGC will respond only to signals passing the filter and will not be "pumped" by out of-band signals as in conventional audio filter applications.

Pin Voltage Readings - (Receive mode, MODE switch in SB-N.)

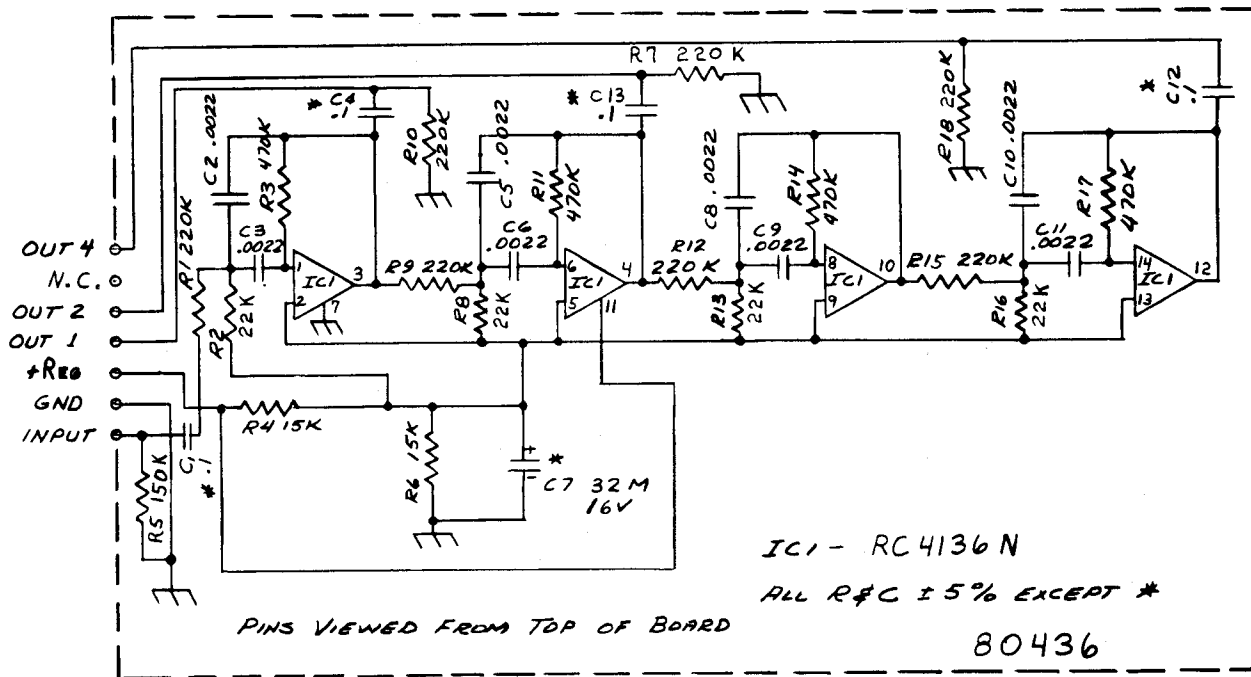
Pin	Volts
OUT 4	0
N.C.	0
OUT 2	0
OUT 1	0
+REG	8.0
GND	0
INPUT	0

Integrated Circuit Voltage Readings

Pin	Volts
1	4.0
2	4.0
3	3.9
4	3.9
5	3.9
6	4.0
7	0
8	4.0
9	3.9
10	3.9
11	8.0
12	3.9
13	3.9
14	3.9

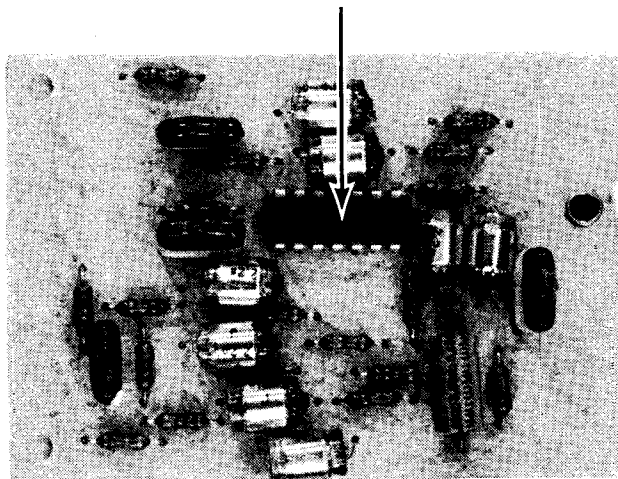


IC pins viewed from  
top of PC board



8-4-78

IC-1



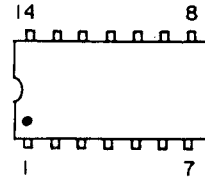
80436 CW FILTER



A three stage "biquad" circuit and a separate summing amplifier, U1 A-D, are used to provide a notch filter with 50 to 60 dB of depth and simple tuning. The frequency of the notch is set by RS, a dual 250K ohm potentiometer. Frequency range is 250 Hz to 7.0 kHz. Since the notch is quite narrow, it is removed from the circuit by tuning it above the passband of the i-f, i.e. greater than 6 kHz or full clockwise rotation.

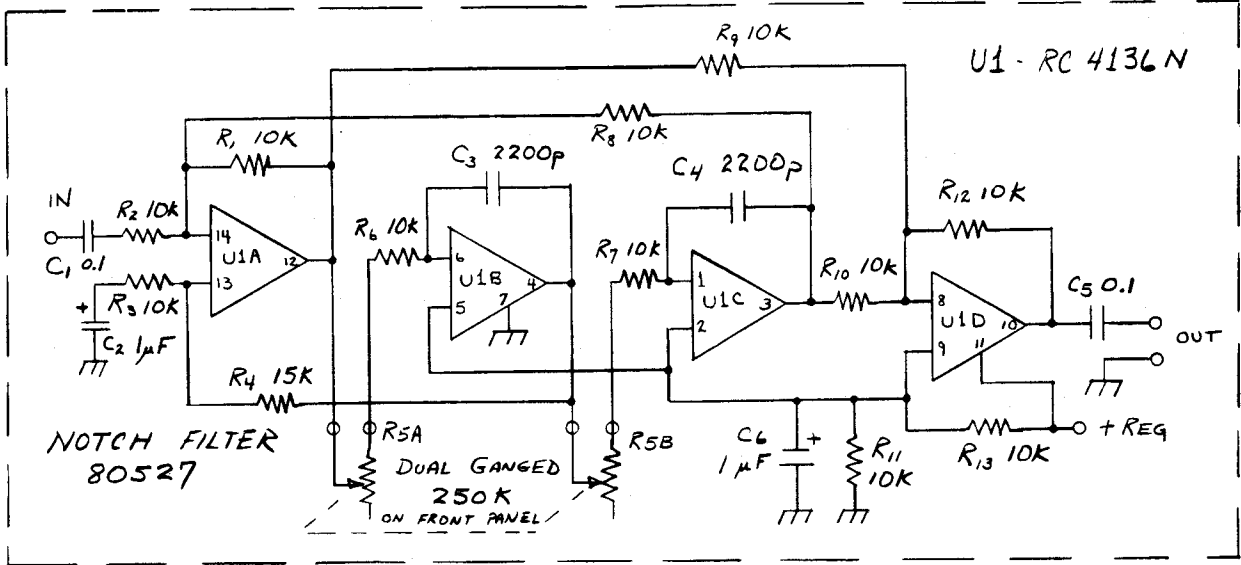
#### Semiconductor Voltage Readings

Pin	Volts	Pin	Volts
1	4.0	8	4.0
2	4.0	9	4.0
3	4.0	10	4.0
4	4.0	11	8.0
5	4.0	12	4.0
6	4.0	13	4.0
7	0	14	4.0

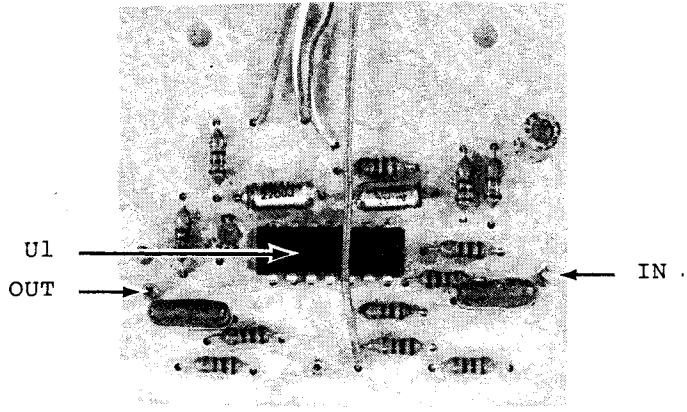


Semiconductor pins  
viewed from top of  
PC board

58-545/546



5-1-79 RF



80527 NOTCH FILTER

## 80447 AUDIO-SIDETONE

Integrated circuit JC-1 contains the complete audio power and preamplifier. Input is applied to pin 2 and output taken from pin 8. Input signal may be from one of two sources, the received signal, which is applied to the INPUT terminal and passes through the muting circuit when open, or from the sidetone oscillator consisting of Q1 and Q3.

Input signal is shorted to ground whenever muting transistor Q2 is put into the conducting state. This occurs in the transmit mode by the application of the "T" voltage to its base circuit through D1. C2, R10, and R11 form a short time constant RC circuit to slightly delay the turn-on time of the audio signal. When in QSK SLOW position, capacitor C3 is switched in parallel with C2 to increase the delay time.

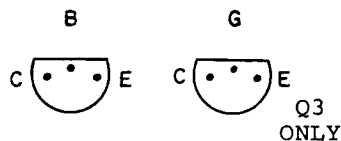
The sidetone oscillator is a relaxation type made up of unijunction transistor Q3. C6, in conjunction with R3 and pitch control R4 determine the frequency. Q1 is the turn-on switch, controlled by the application of the SIDETONE voltage at its base. The SIDETONE control voltage is the "T" voltage, and is applied only in the CW position of the MODE switch. Sidetone level is adjusted by R6. The sidetone signal is prevented from being muted along with the incoming signal by its isolating resistor, R8.

Pin Voltage Readings - (No signal conditions, CW mode, DRIVE fully CCW, SQUELCH fully CCW and pushed in.)

Pin	Transmit	Receive	Pin	Transmit	Receive
GND	0	0	GND	0	0
S.T.	10.8	0	AF OUT	0	0
GND	0	0	N.C.	0	0
T	10.8	0	N.C.	0	0
N.C.	0	0	+13.8	13.8	13.8
AF IN	0	0	GND	0	0
QSK	0	0	GND	0	0

Semiconductor Voltage Readings -

Transistor	Collector		Base/Gate		Emitter	
	Transmit	Receive	Transmit	Receive	Transmit	Receive
Q1	0	0	0.7	0	0	0
Q2	0	0	0.7	0	0	0
Q3 UJT	8.3	8.1	4.4	2.4	0	0

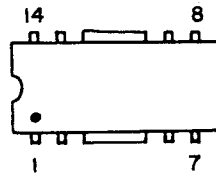


Semiconductor pins  
viewed from top of  
PC board

7-79  
01-333/330

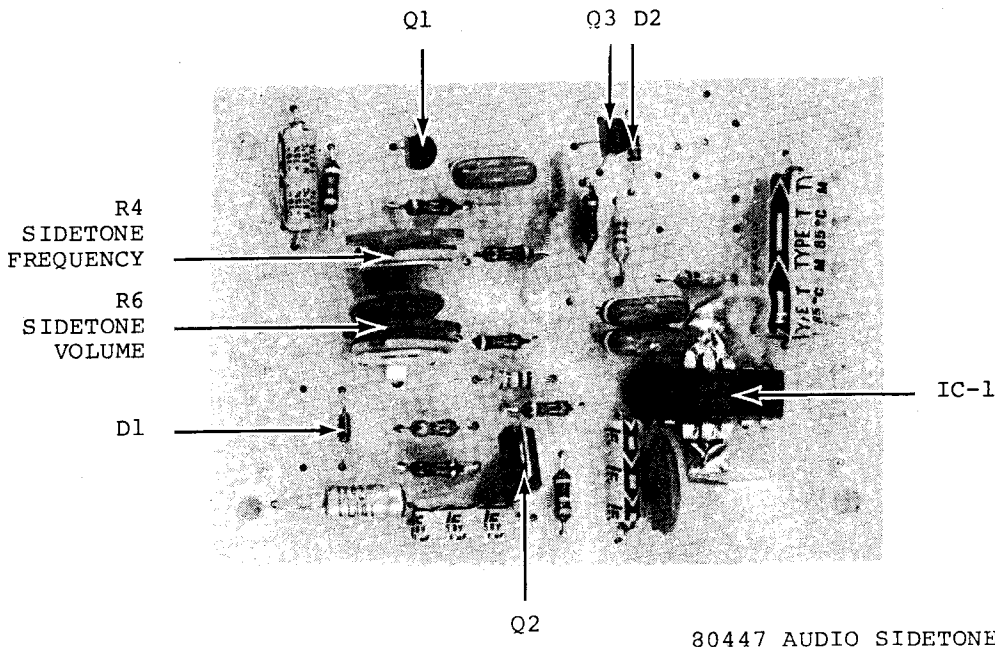
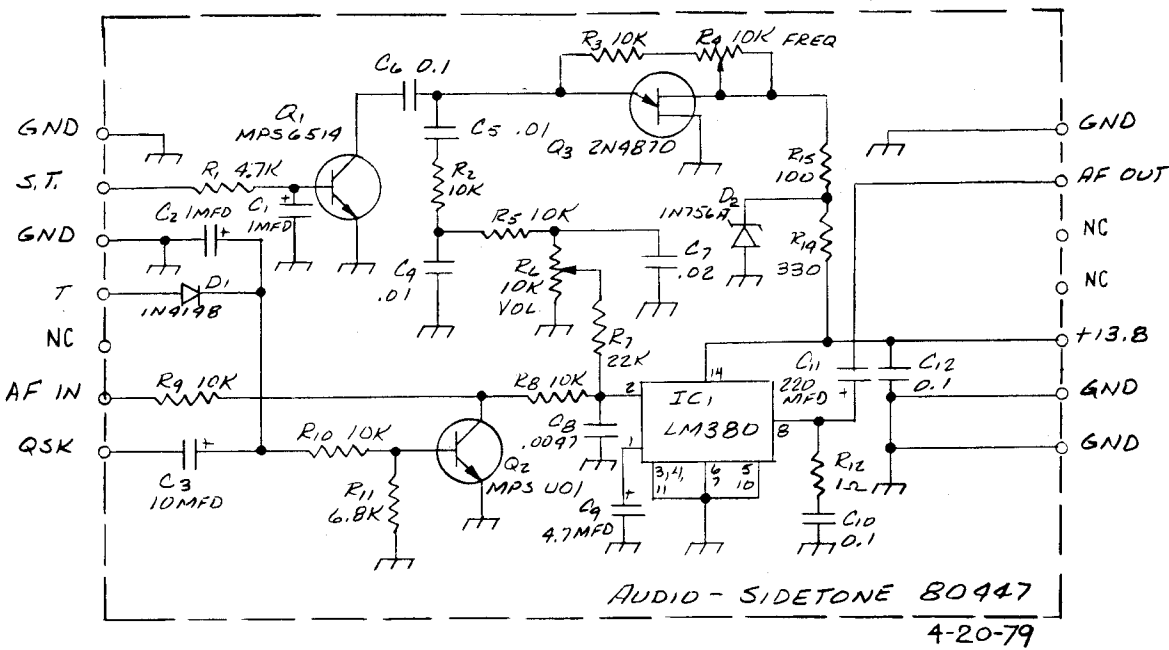
IC-1

Pin	Receive*
1	7.1
2	0
6	0
7	0
8	6.5
9	0
13	0
14	13.8



IC pins viewed from top of PC board

\* Voltages are the same in transmit and receive modes



80447 AUDIO SIDETONE

## 80449 SSB GENERATOR

This assembly contains the carrier (BFO) crystal oscillator which operates at 9 MHz, balanced modulator for ssb generation, and a two stage microphone audio amplifier.

Q3 is the carrier oscillator operating at approximately 9 MHz. Its exact frequency is determined by which of three trimmer capacitors, C3, C4, C5, are placed in the crystal circuit. C3 is in the circuit under all MODE switch conditions and sets the carrier to the desired frequency on the high side of the ladder filter skirt. (This position is used in the SB-R mode.) In this mode, both C4 and C5 are removed from the crystal circuit by transistor switches Q1 and Q2, respectively. Their bases are grounded through the MODE switch.

In SB-N, both of these capacitors are inserted into the circuit by removing the base grounds, and the three capacitors in parallel set the oscillator frequency down on the opposite (low frequency) skirt. In the CW mode, C4 is removed via switch Q1 so that the carrier frequency increases 750 kHz into the filter passband. C3 and C5 determine this setting.

Output from the carrier oscillator is fed to the BFO terminal and the product detector on the IF-AGC assembly, and also to balanced modulator IC-2 where it is mixed with an audio signal from the microphone amplifier, IC-1. Output in the ssb modes is a double sideband, suppressed carrier signal, whose unwanted sideband is removed by the ladder filter. Further carrier reduction also occurs in the filter.

For cw operation, the balance of IC-2 is upset when terminal CWU is grounded through the MODE switch. This also is the case in LOCK mode. Audio from the microphone channel is eliminated by this same shorting procedure. The amount of "T" voltage (controlled by setting of DRIVE control in CW mode) applied to pin 7 of the balanced modulator determines the gain of the modulator and hence the level of carrier signal applied to the TX-MIXER.

CARRIER OSCILLATOR ALIGNMENT

Proper alignment of C3, C4, and C5 requires use of a frequency counter and either an rf VTVM or oscilloscope with response to 10 MHz. These capacitors should not be readjusted on general principles but only after it is definitely found that the carrier is not where it should be on the passband curve, or that the cw frequency is not 750 Hz up from the SB-N carrier frequency. To make the adjustments, proceed as follows:

1. Connect counter to junction of R16 and R17 in emitter circuit of Q3. If there is no dc blocking capacitor in counter input, connect through .01 ufd.
2. Connect either rf VTVM or 'scope to ANTENNA jack. Load with dummy load.
3. Set MODE switch to SB-R position and DRIVE control fully counterclockwise.
4. Completely unbalance modulator by setting CARRIER BAL. potentiometer, R11, to either extreme.
5. Temporarily set C3 for frequency reading of 9,001,700 Hz. This places carrier approximately in center of passband.
6. Short PTT line to chassis to place the unit in transmit mode.
7. Advance CARRIER BALANCE control so that output of 20 volts, rms is read on VTVM or 60 volts, peak-to-peak is displayed on oscilloscope.
8. Readjust C3 to decrease capacitance and increase frequency to point where output decreases to 1 volt, rms or 3 volts, peak-to-peak on 'scope. This presents a point 26 dB down on the skirt.

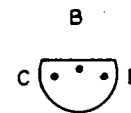
9. Set MODE switch to SB-N, temporarily set C5 to half capacitance and adjust C4 so that output is 1 volt, rms or 3 volts, peak-to-peak on 'scope. Frequency should now be on low skirt. Note and record frequency. It should be within 100 Hz of 9.0000 MHz.
10. Set MODE switch to LOCK. Adjust C5 so that frequency is 750 Hz higher than in step 9. Amplitude of output should return to approximately that on step 7.
11. Repeat steps 8 through 10 in sequence until no further adjustments are necessary. C4 and C5 both determine low skirt frequency and both have a slight effect on C3. Readjustment of all three is necessary after any one is altered.
12. With MODE switch in SB-N position and without changing DRIVE setting of previous steps, turn up sensitivity of 'scope or VTVM. Null CARRIER
13. Remove jumper from PTT line.

Pin Voltage Readings - (No signal, DRIVE fully CCW.)

Pin	Transmit SB-N	Receive SB-N	Receive SB-R	Receive CW	Receive LOCK
GND	0	0	0	0	0
LSB	4.4	4.4	0	4.4	4.4
CW	13.8	13.8	0	3	.04
+REG	8	8	8	8	8
BFO	5.7	5.7	5.9	5.7	5.8
CWU	0	0	0	0	10.9
SW	8	8	8	8	0
T	6.6	0	0	0	6.6

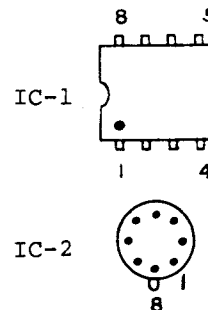
Semiconductor Voltage Readings - (SB-N mode, DRIVE fully CCW.)

Transistor	Collector	Base	Emitter
Q1	0	.8	0
Q2	0	.8	0
Q3	7.7	5.9	5.6
Q4	8	0	0

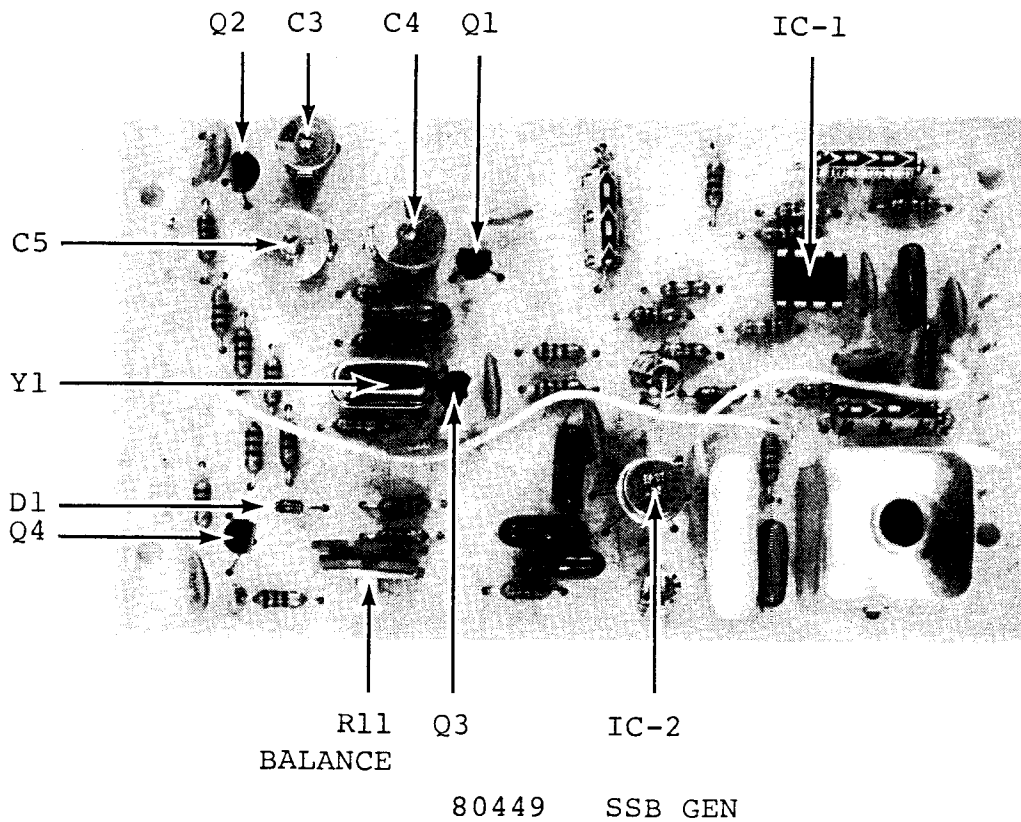
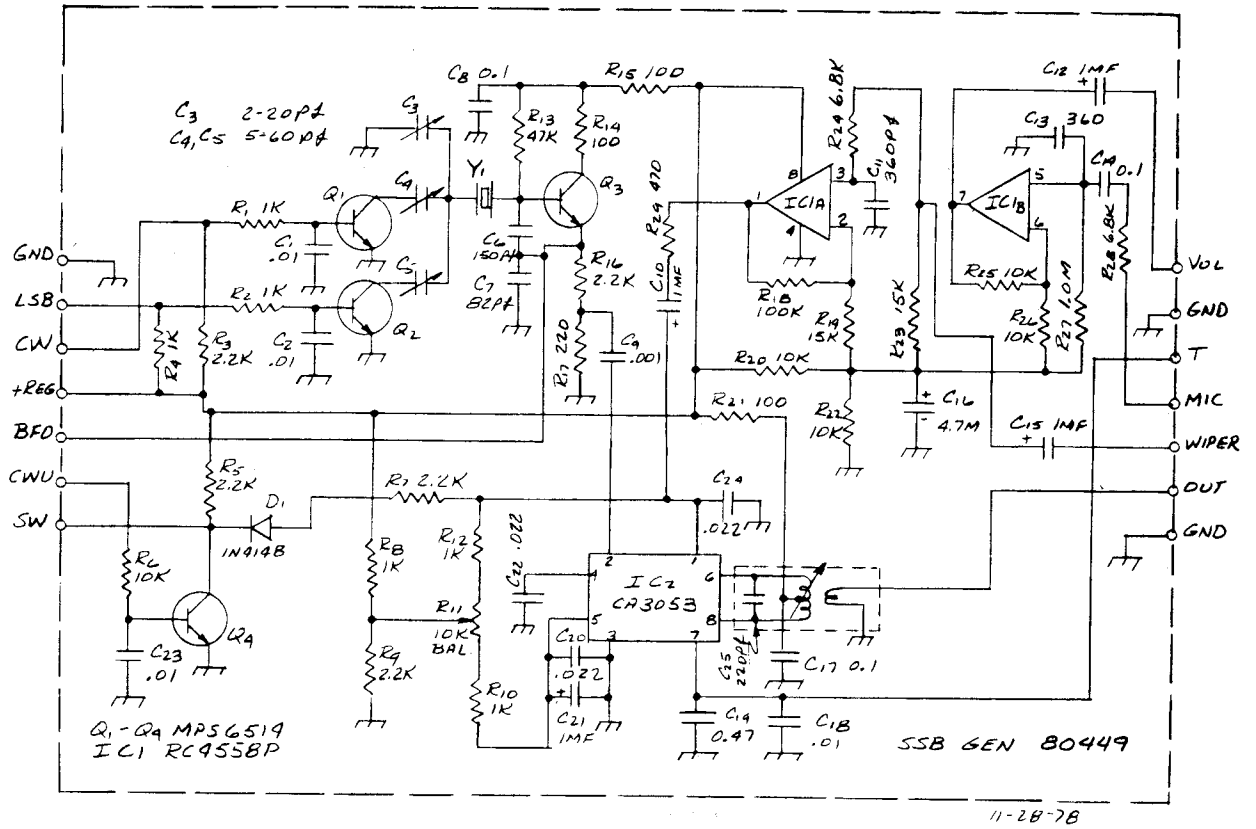


Transistor pins viewed from top of PC board

Pin	IC-1		IC-2	
	Transmit	Receive	Transmit	Receive
1	5.4	5.5	-	4.1
2	2.3	0	-	4.1
3	0	0	-	4.1
4	0	1.6	-	0
5	5.4	5.5	-	3.6
6	7.7	8	-	4.2
7	6.6	0	-	4.3
8	7.7	8	-	8



IC pins viewed from top of PC board



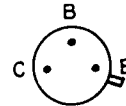
## 80453 TX-MIXER

This board contains the double balanced diode quad transmit mixer and the 9 MHz TX i-f amp. The 9 MHz ssb or cw signal generated on the SSB GENERATOR BOARD is fed via the crystal filter to the amplifier and mixer where it is mixed with the VFO signal from the VFO amp. In cw, the amplitude of the 9 MHz signal is set by the DRIVE control and in ssb, audio information unbalances the 9 MHz signal with the proper information, both functions being performed on the SSB GENERATOR assembly. Hence, the mixer output contains all needed modulation characteristics.

R1 and R2 are carrier balance controls. With the MODE switch in LOCK, BAND switch on 28 MHz, rf scope across the output into a dummy load, and DRIVE set at full CCW position, R1 is adjusted for minimum output. R2 is set the same way with the BAND switch on 21 MHz. T3 is set for maximum output on either band, with DRIVE increased 1/4 turn or 9 o'clock position.

Pin Voltage Readings - (Drive fully CCW.)

Pin	Transmit	Receive
LO	0	0
GND	0	0
+12	13.8	13.8
T	10.4	0
IN	0	0
GND	0	0
OUT	0	0



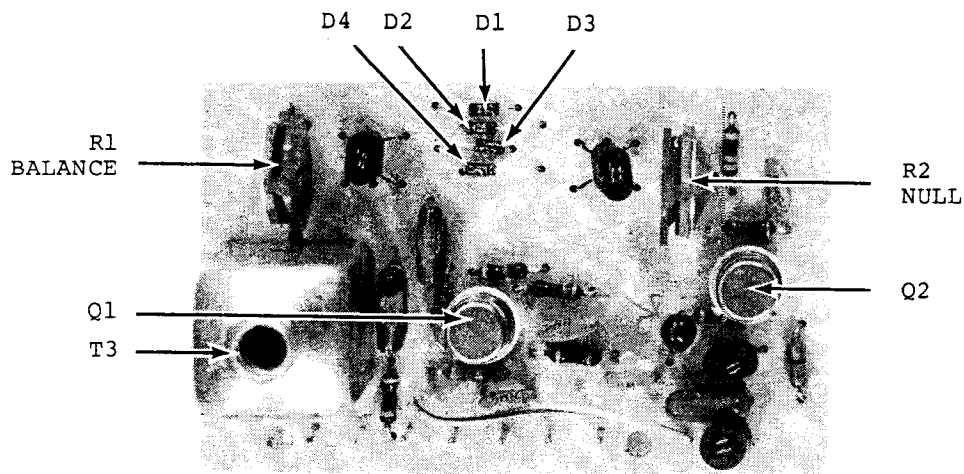
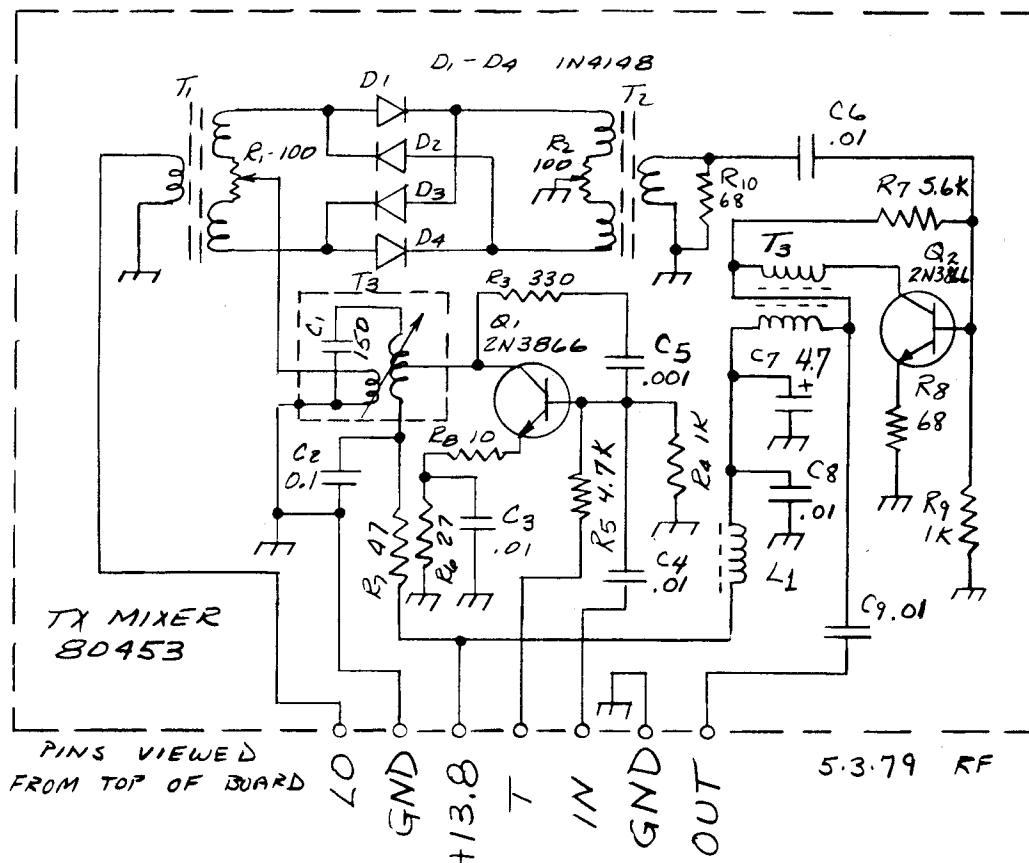
Transistor pins viewed  
from top of PC board

Semiconductor Voltage Readings

Transistor	Collector	Base	Emitter
Q1	13.8	NA	NA
Q2	13.8	NA	NA

(NA = Not Accessable)



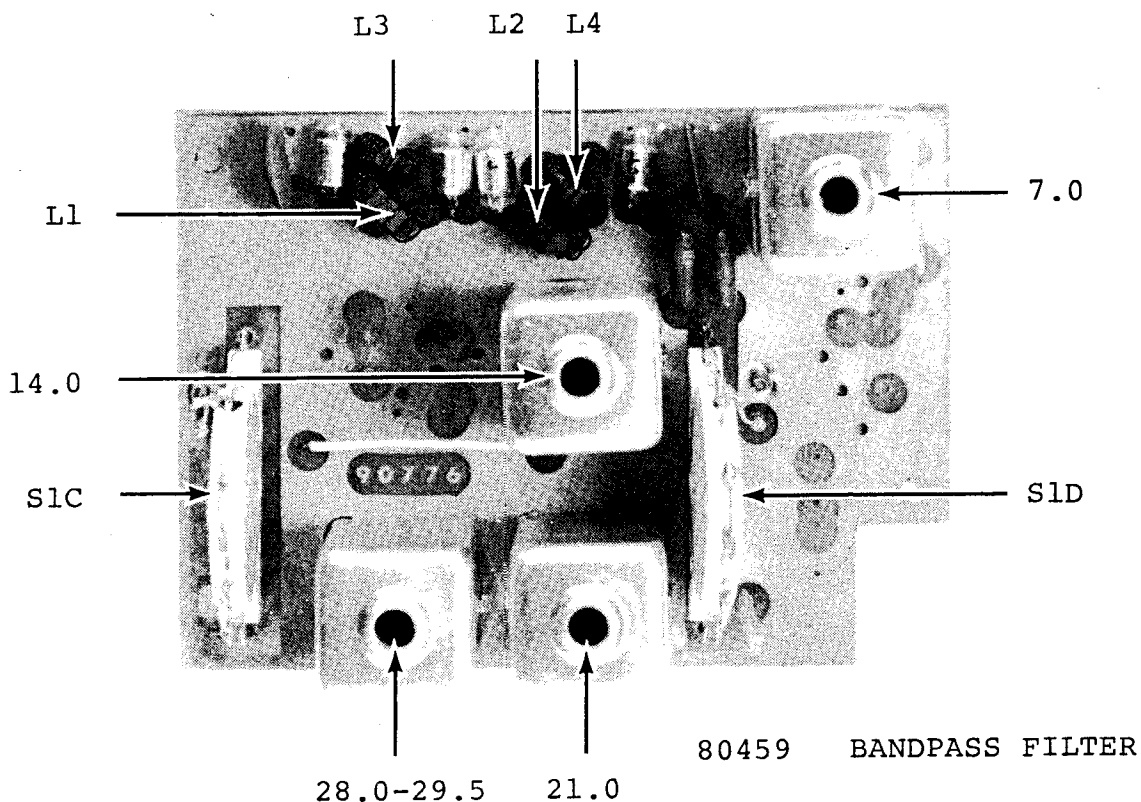
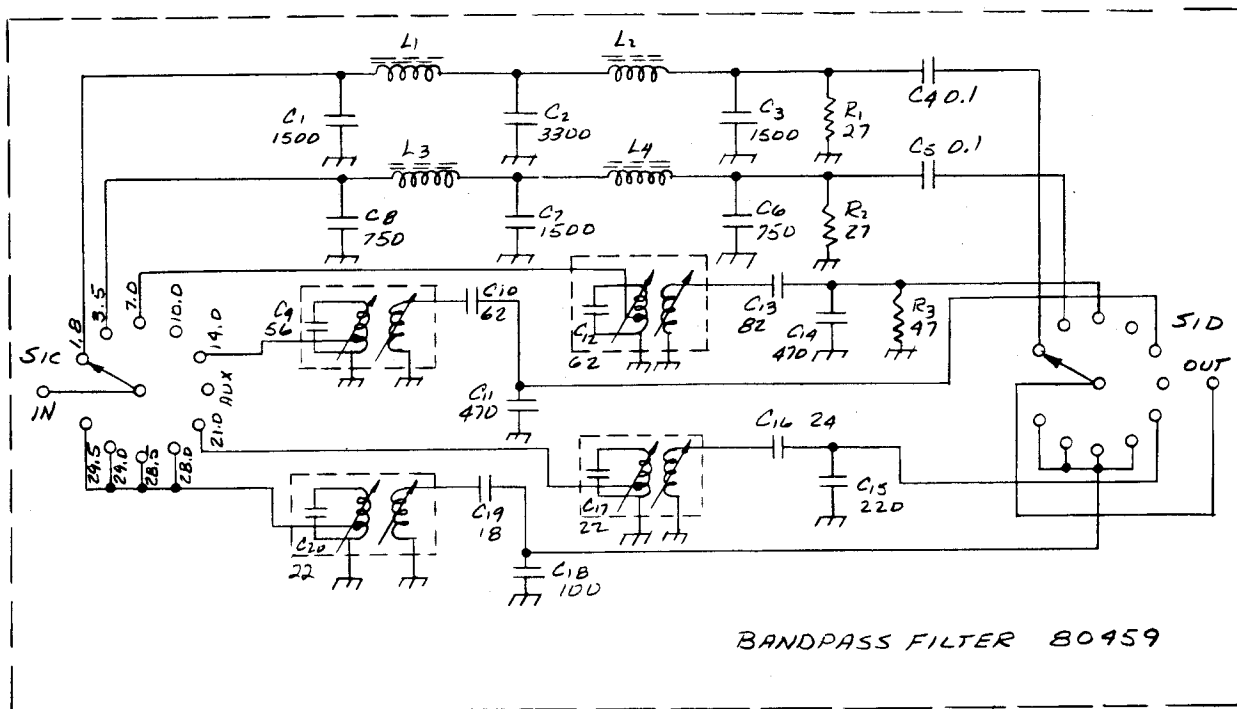


80453 TX MIXER

80459 BANDPASS FILTERS

This assembly contains six passive filters which are selectively switched into the TX-MIXER output circuit by means of the BAND switch. They are double tuned, over-coupled bandpass units for all but the 3.5 and 1.8 MHz bands. A five pole low pass filter is used for each of these bands.

These filters are very broad and require no field alignment. Since they are passive, no voltage measurements are required.



## 80444 LOW LEVEL DRIVER

This assembly contains three linear Class A amplifier stages to increase the level of the rf signal from the TX-MIXER and BANDPASS FILTERS to that required to drive the final driver stage. The first two stages, Q1 and Q3, are ALC controlled by transistors Q2 and Q4 in their emitter circuits. The third stage operates at a fixed gain. Bias for the second and third stages is provided whenever the "T" voltage is applied to the "T" terminal, with diodes D1 and D2 determining the value of bias voltage. The first stage bias is similarly derived from diodes D3 and D4, but the turn-on is delayed a small fraction of a second. Voltage applied to these diodes from terminal tD is delayed from the normal "T" voltage by circuits on the CONTROL BOARD assembly. The delay is a necessary part of the sequential keying circuit that provides clickless cw. Since all three amplifier stages are broad band designs, no tuning or adjustments are necessary. The forward power is sensed and converted to a dc control voltage on the SWR board. It is buffered by emitter follower Q8 and then applied to ALC driver stages Q6 and Q7. Output is applied to the low level rf amplifier. The ALC indicator is connected in the collector circuit of Q8. Both R21, the ALC maximum threshold adjustment, and the panel ALC control setting determine the overall gain of the amplifier. To set R21, set ALC control fully clockwise, power the unit in the LOCK position into a wattmeter and dummy load. With a dc ammeter in the +12 volt lead, advance DRIVE control to where wattmeter reads 100 watts. (R21 should be set to its extreme where ALC indicator does not light.) Then, turn R21 down from this extreme until ALC indicator starts to light. Check ammeter reading on all other bands, and if reading goes above 18 amperes before ALC indicator lights, reset R21 on this band to 18 ampere reading. Final setting of R21 is correct if band indicating highest reading does not exceed 18 amperes.

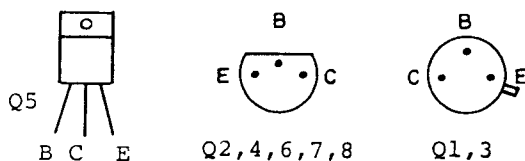
## Pin Voltage Readings - (SB-N mode, DRIVE fully CCW, ALC fully CW.)

Pin	Transmit	Receive	Pin	Transmit	Receive
T	10.8	.01	GND	0	0
GND	0	0	OUT	0	0
GND	0	0	+12	13.8	13.8
td	4.3	0	GND	0	0
GND	0	0	ALC LED	12.7	12.7
GND	0	0	ALC CONT	0	0
IN	0	0	ALC	0	0

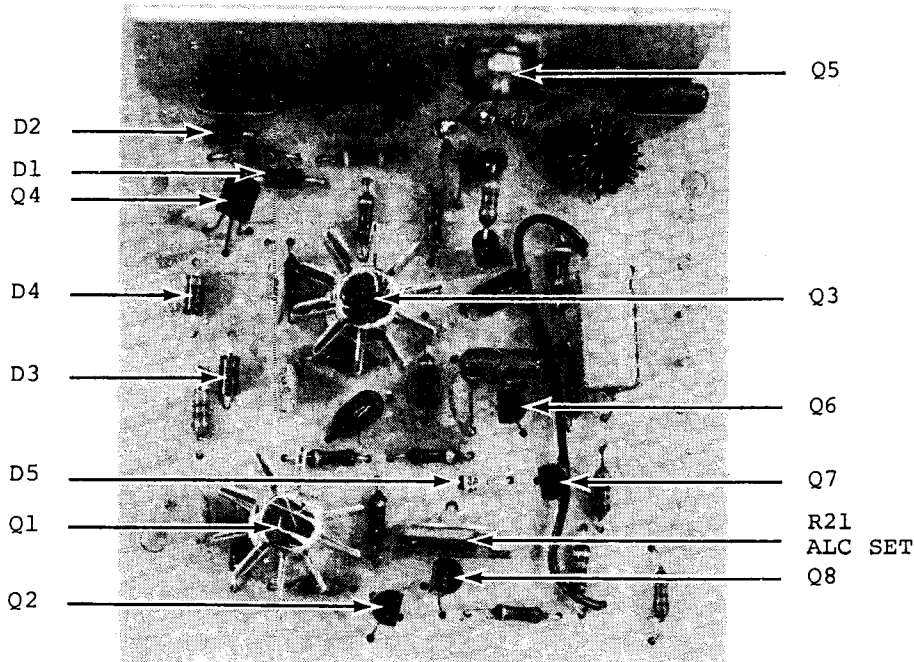
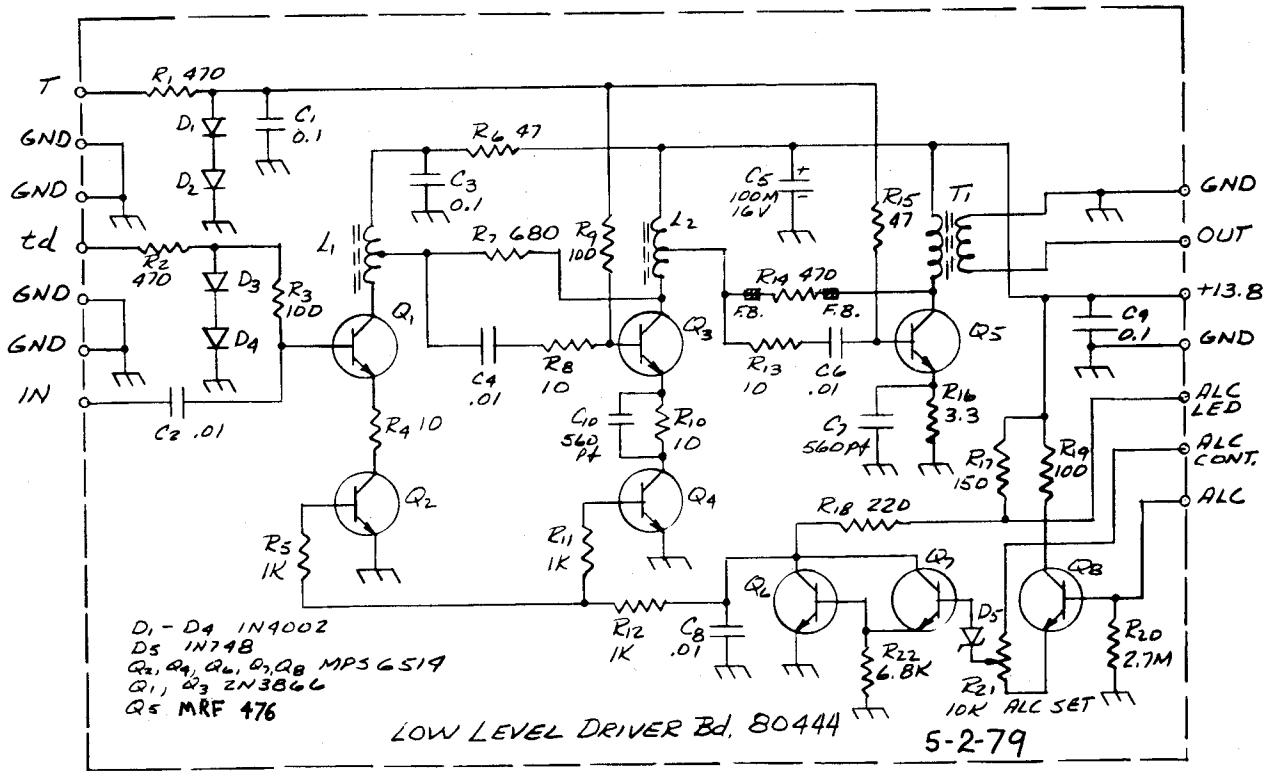
## Semiconductor Voltage Readings

(NA = Not Accessable)

Transistor	Collector		Base		Emitter	
	Transmit	Receive	Transmit	Receive	Transmit	Receive
Q1	12	13.8	-	-	-	-
Q2	.08	.01	.8	.8	0	0
Q3	13.8	13.8	-	-	-	-
Q4	.1	.01	.8	.8	0	0
Q5	13.8	13.8	1.2	.01	.6	0
Q6	11.2	11.2	0	0	0	0
Q7	11.2	11.2	0	0	0	0
Q8	13.8	13.8	0	0	0	0



Transistor pins viewed from top of PC board



80444 LOW LEVEL DRIVER

## 80491 FINAL AMPLIFIER

The high power rf amplifier and its push-pull drive stage are housed in a metal box which is an integral part of the heat sink assembly. The unit is attached to the back panel with four screws and connections are made by means of two phono connectors for rf input and output and five soldered-on leads for control voltages.

Q1 and Q2 constitute a Class AB linear push-pull driver stage of wide band design. Impedance matching into and out of this stage is by means of transformers T1 and T2. Bias is applied whenever "T" voltage is applied to the terminal so marked, and quiescent current in the collector circuit is adjusted to a value of between 4 and 8 mA with potentiometer R11. Access to this control is by means of the small hole in the brass box as shown in Figure 1 of this section. To adjust bias, unsolder the small jumper red wire connecting the second small feed through terminal to the large +12 volt lug. Insert a dc milliammeter between the two, set DRIVE control fully CCW and MODE switch to LOCK position. If driver collector current is not between the recommended limits, readjust trimpot (clockwise to increase current) by rotating the trimpot plastic serrated knob through the shield box hold with the aid of a small awl type probe.

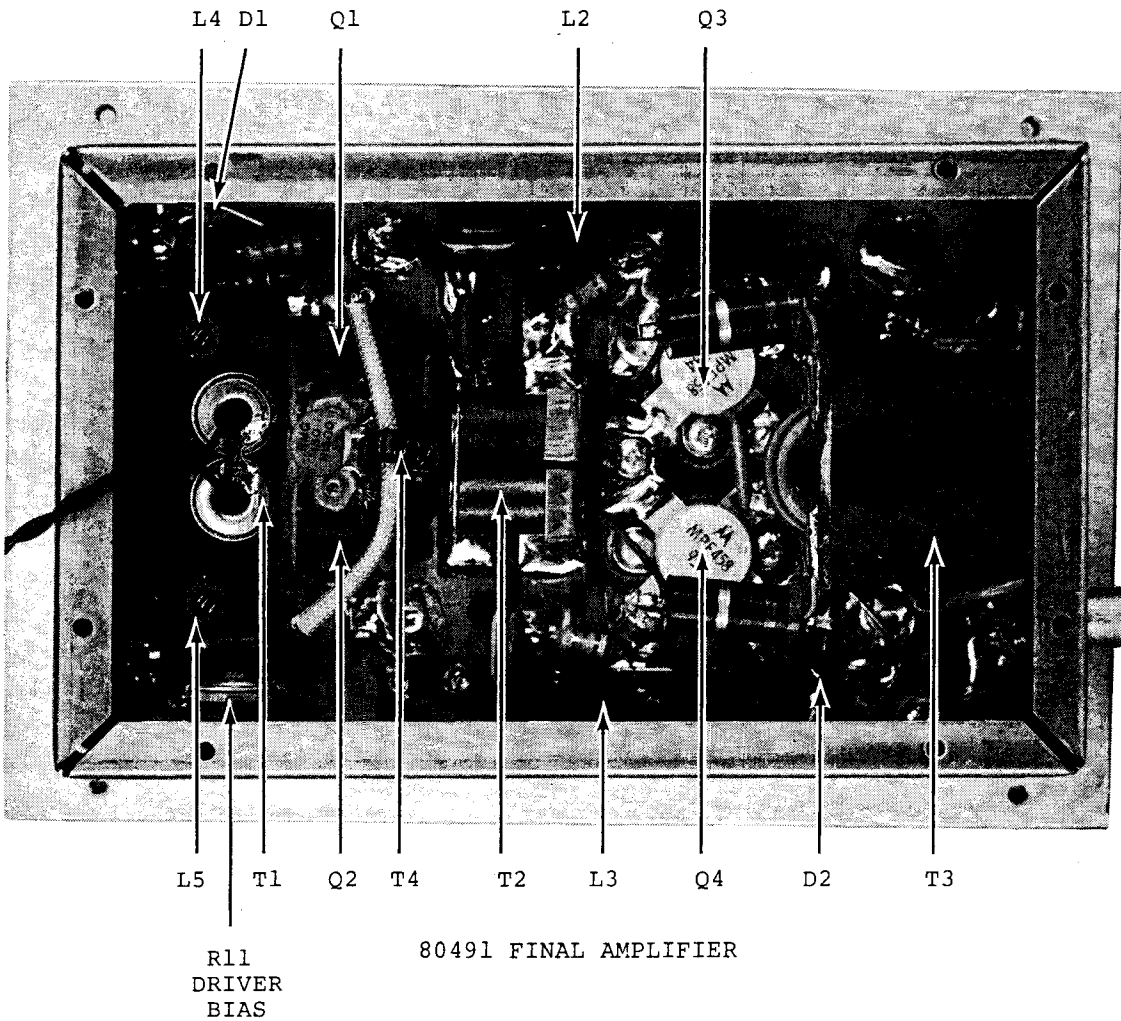
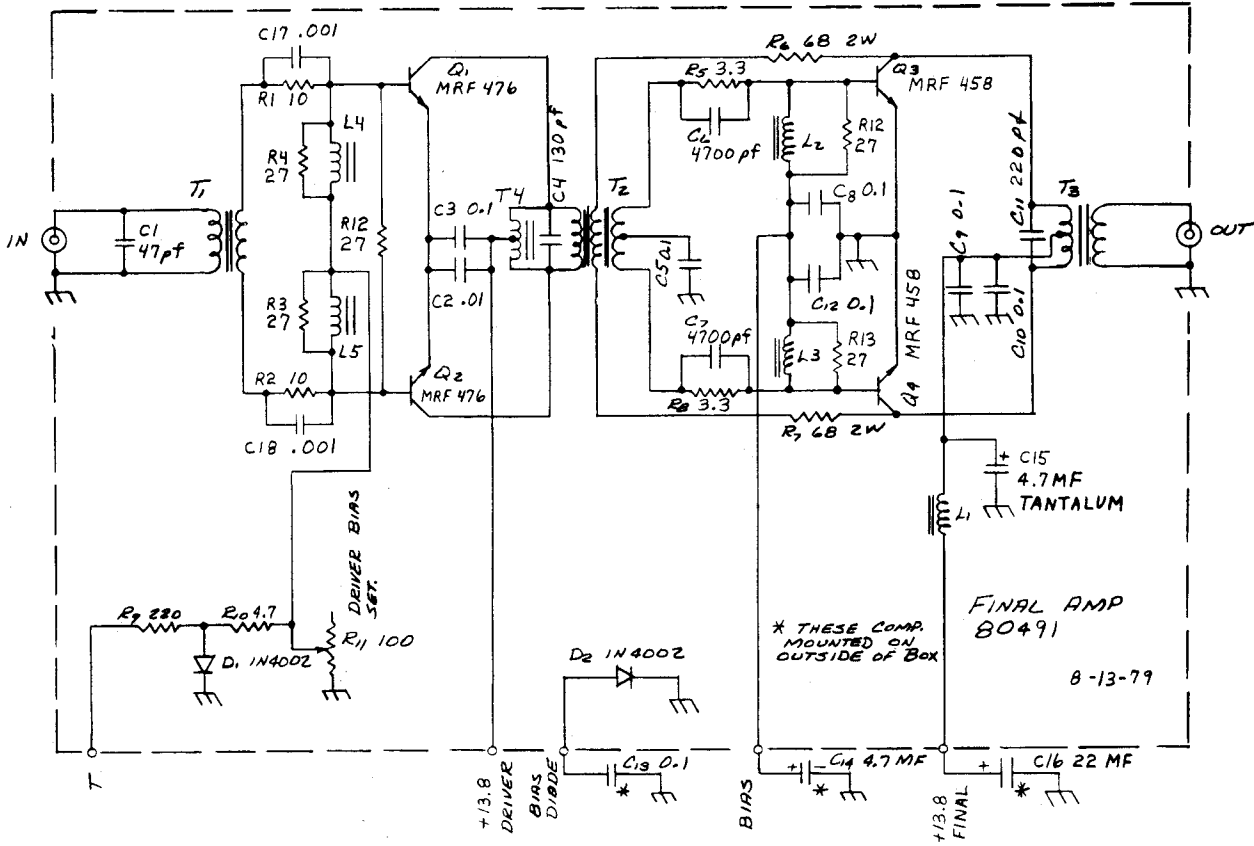
Power amplifier transistors Q3 and Q4 are also in a Class AB push-pull arrangement. Bias is applied to the bases in a shunt feed system through L2 and L3. Bias is fed to this stage from a regulated and controlled supply on the OT-TR assembly. Quiescent current for the finals is adjusted as outlined in the section on the OT-TR assembly.

Bias for both stages are temperature compensated to maintain a relatively constant operating point by mounting the bias diodes in direct contact with the heat sink. D1 controls the driver stage and D2 the output stage.

Since all transistors are inaccessible in the shield can, no voltage measurements can be made at their terminals. However, voltages going to the feed-through terminals can be checked to the following values:

Terminal Voltage Readings - (SB-N mode, DRIVE fully CCW.)

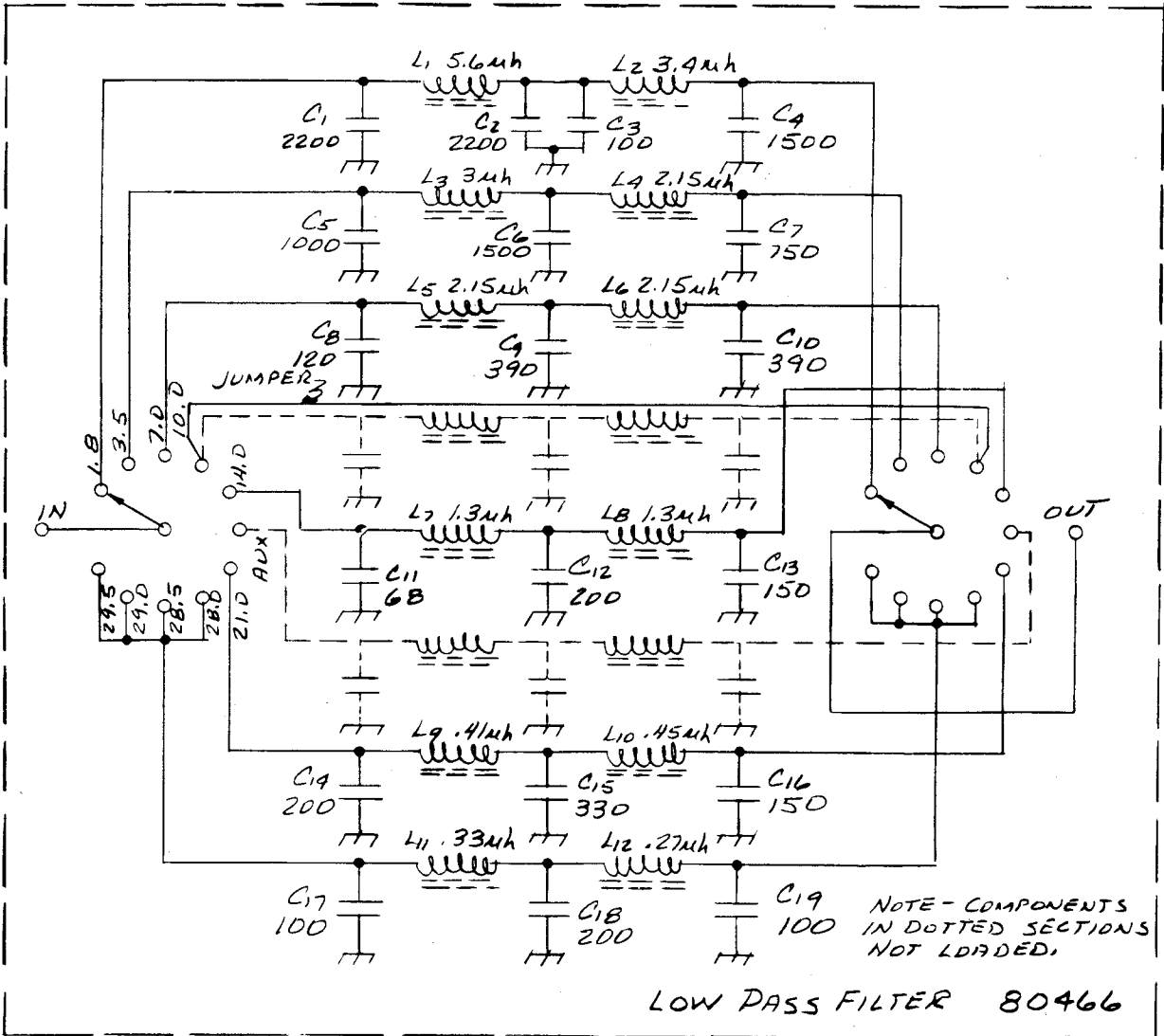
Terminal	Wire Color	Transmit	Receive
T	Yellow	10.4	0.2
+12 DRIVER	#24 Red	13.8	13.8
+12 FINAL	#14 Red	13.8	13.8
BIAS DIODE	White	0.6	0
BIAS	Grey	0.7	0



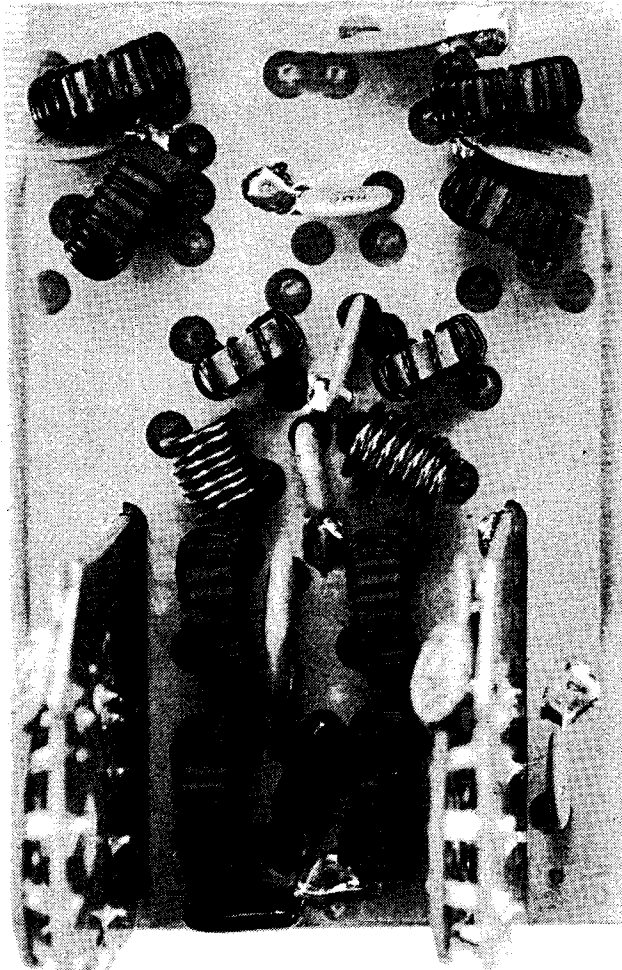
80466 LOW PASS FILTERS

The output signal from the final rf amplifier, although linear with regards to its power-in/power-out character, contains harmonic components above desirable levels. The push-pull configuration decreases the even order harmonic components to some degree, but does nothing for the odd harmonics. To further decrease evens and odds, the signal is passed through a set of five pole, low pass filters before being radiated. The proper filter is selected by the BAND switch.

The assembly containing the filters and switch is permanently mounted in the rear corner of the chassis, adjacent to the ANTENNA jack. No active components are contained on the assembly, and no tuning is required.



11-27-78



IN → ← OUT

80466 LOW PASS FILTER



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## **302R REMOTE/ENCODER KEYPAD**

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**\$139**

## 80450 SWR-TR

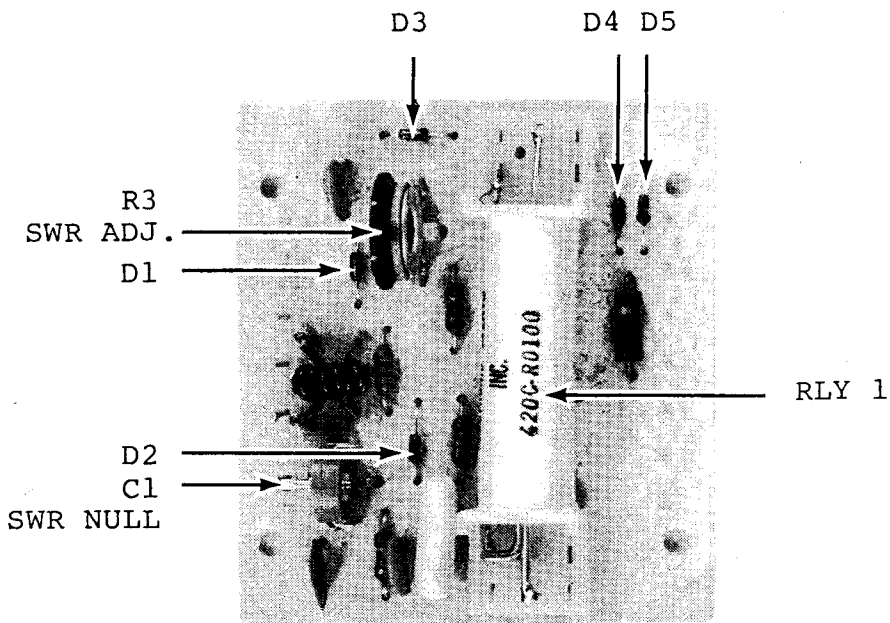
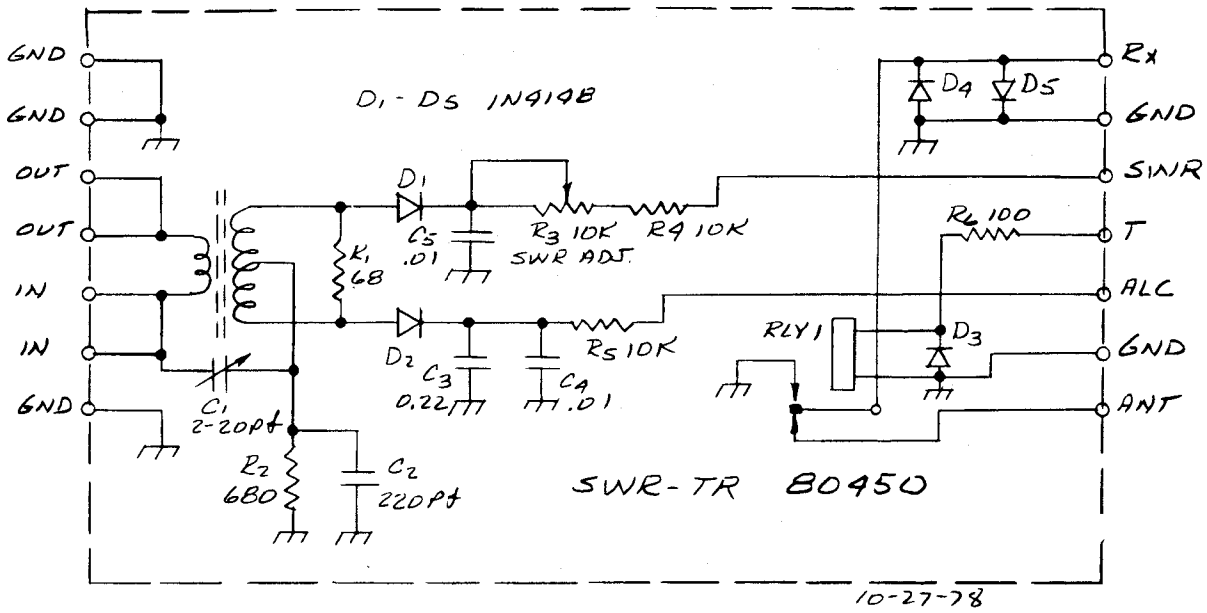
This assembly contains the SWR bridge components and the receiver antenna relay.

Rf energy on its way to the ANTENNA jack first passes through the primary of transformer T1 in the SWR bridge. The bridge is balanced on the 28.0 MHz band by setting the trimmer capacitor C1 so that there is a null on the meter when a 50 ohm resistive dummy load is connected to the ANTENNA jack. Reflected power is sensed through diode D1, filtered to a dc component in C5 and applied to the meter by way of the REV terminal. R3, in series with the meter, is adjusted for a 3 to 1 SWR meter indication when the load is changed to 150 ohms. This adjustment should be made with DRIVE set so that ALC indicator lights. Forward power is sensed and converted to a dc control voltage through D2 and C3. This signal is fed to the ALC pin to the LOW LEVEL DRIVER board.

Relay K1 connects the receiver antenna input circuit to the ANTENNA jack when receiving and to ground when transmitting. It is a fast acting reed relay with SPDT contacts which is energized by the "T" voltage.

Pin Voltage Readings - (SB-N mode, DRIVE fully CCW.)

Pin	Transmit	Receive	Pin	Transmit	Receive
GND	0	0	RX	0	0
GND	0	0	GND	0	0
OUT	0	0	SWR	0	0
OUT	0	0	T	10.8	0
IN	0	0	ALC	0	0
IN	0	0	GND	0	0
GND	0	0	ANT	0	0



80450 SWR-TR

## 80281 OT-TR

This assembly contains the final rf amplifier bias regulator, mute relay with adjustable drop-out delay, and offset lamp drive.

Bias for the final amplifier is determined by the setting of R9 potentiometer in the integrated circuit regulator IC-1. Temperature correction is achieved with a temperature sensing diode connected mechanically to the final amplifier heat sink and electrically to the IC regulator. Output from the integrated circuit in turn controls power transistor Q1 so that a higher level of current can be regulated. To adjust bias, place a dc ammeter in the +12 volt dc supply lead. Load into a dummy load, set MODE switch to LOCK position and DRIVE control fully counterclockwise. Note current reading and then slowly rotate R9 in the direction that decreases the current reading. After determining which direction decreases current, set control fully in this direction. This will cut off final transistors. Note quiescent current drawn by the remaining transmitter circuits. Then advance R9 so that reading increases by 1/2 ampere--no more. This value should be approximately 1-1/2 to 2 amperes. Too low a bias setting will cause distorted audio in ssb due to the amplifier operating as a Class C amplifier. Too high a quiescent current will increase power dissipation in the output transistors with undue overheating.

The mute relay does not control any internal active functions, but is added for control of external equipment. One set of SPST contacts are brought out to the unit's rear panel and are designated as N.O. and N.C. on the ACCESSORIES socket. The second set is brought out only as a normally open set and designated EXT. T/R. In both cases, one terminal is connected to chassis ground. If both leads are desired above ground in either or both sets of contacts, as in switching 115V ac, this can be accomplished by rewiring the plug-in socket. The relay leads on the PC board are isolated from the common ground, but are connected to chassis at the connector socket. Terminal pin C1 is the common terminal of the N.O. and N.C. contacts, and C2 the lead for the EXT. T/R jack.

**CAUTION NOTE:** Do NOT attempt to control 110V ac circuitry (ie. relays) unless both sides of the relay contact are removed from chassis ground at all times.

The drop-out relay is adjusted to a value in accordance with the external equipment requirements with trimpot R12. In adjusting this potentiometer, do NOT upset the final bias control setting, R9, on the same assembly.

Transistors Q3 and Q4 turn on the offset tuning OT indicator LED whenever the unit is in the receive mode with the OFFSET knob pushed in. When transmitting, or with the knob pulled out, a control voltage at the OT ON-OFF terminal serves to disable the LED.

Pin Voltage Readings - (SB-N mode, DRIVE fully CCW, OFFSET knob in.)

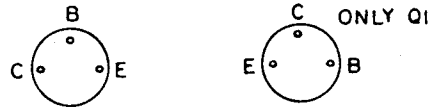
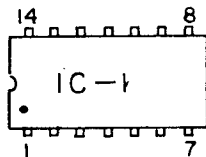
Pin	Transmit	Receive	Pin	Transmit	Receive
GND	0	0	NO2	0	0
DIODE	0.6	0	NO1	0	0
BIAS	0.7	0	NC1	0	0
NC	-	-	C2	0	0
T	10.4	0.2	C1	0	0
+12	13.8	13.8	OT ON-OFF	10.4	0.2
GND	0	0	OT LITE	13.8	12.0

Semiconductor Voltage Readings

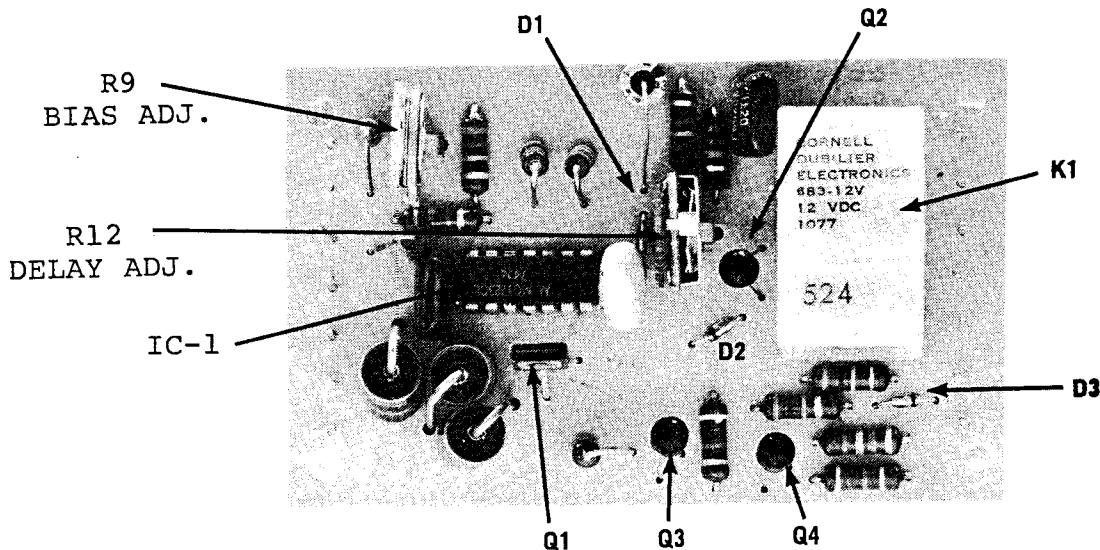
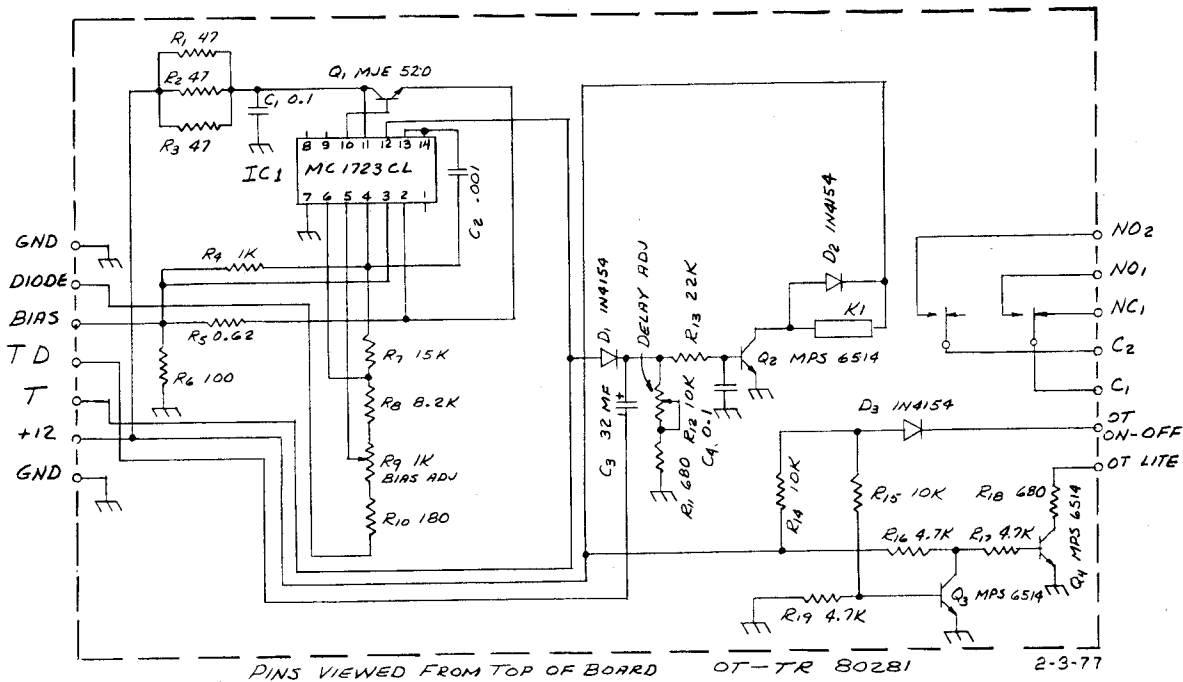
Transistor	Collector		Base		Emitter	
	Transmit	Receive	Transmit	Receive	Transmit	Receive
Q1	13.5	13.8	1.2	0.1	0.6	0
Q2	13.8	13.8	1.3	0	0	0
Q3	0	7.2	0.7	0.2	0	0
Q4	13.4	0.1	.05	0.7	0	0

IC-1

Pin	Transmit	Receive	Pin	Transmit	Receive
1	-	-	8	-	-
2	0.69	0	9	-	-
3	0.67	0	10	1.2	0.1
4	1.0	0	11	13.8	13.8
5	1.0	0	12	10.4	0.2
6	7.2	0	13	0.7	0
7	0	0	14	0.7	0



Semiconductor pins viewed from top of PC board.



80281 OT-TR

## 80464 CONTROL BOARD

This assembly contains a set of synchronous transistor switches for controlling the "T" and "R" voltages that switch the unit from transmit to receive mode. It also contains an integrated circuit voltage regulator which powers the frequency and voltage sensitive circuits in the VFO, SSB GENERATOR and product detector, and the OFFSET control voltages.

Transistors Q2, Q3, and Q4 constitute the "T" voltage switch which presents operating voltage at the "T" terminal whenever the T/R is grounded. This occurs whenever the PTT jack is shorted or when the key line is closed. The presence of "T" voltage at the base of Q5 switches off the normally present "R" voltage from switch Q6 and Q7 and terminal R. Whenever "T" voltage is switched on, it is delayed by R8, C2, and R7 and applied to Q1, which momentarily delays the arrival of the "T" voltage at the tD terminal. This delay is necessary for sequential keying in cw which eliminates key clicks. No adjustments are necessary for these circuits.

Regulated voltage of approximately 8 volts is developed in integrated circuit IC-1 and transistor Q11 and fed to voltage sensitive circuits. No adjustments are needed in the regulator.

The OFFSET control voltage for the varactor diode in the VFO is derived through steering diode D2 through terminal OT. The amount of control voltage varies between about 3 and 6 volts as determined by the setting of the OFFSET control. Transistor Q9, which is effectively in shunt with this voltage and ground, is in an off state and has no effect on the offset voltage when receiving and with the OFFSET switch off. When transmitting, or with the OFFSET switch on, Q9 is turned on, thereby shunting the voltage at its collector to ground. This back-biases D2 and disconnects the voltage divider from the OT terminal. At the same time, Q8 which was previously conducting and back-biasing diode D1, goes to an off state and inserts the voltage developed by the setting of R16, in series with resistors R15 and R17, through forward biased D1 to the OT terminal. Trimpot R16 is adjusted to a value equal to the center position voltage of the OFFSET control, in essence the voltage representing no offset.

To adjust R16 properly, tune in a station or carrier and while switching between MIN and MAX, adjust the OFFSET control so the two positions are the same. Then, turn the RX-OT switch to OFF and adjust R16 for the same pitch as before. If OFFSET knob pointer is not at 12 o'clock position under these conditions, reset with aid of allen wrench supplied.

Pin Voltage Readings - (SB-N mode, DRIVE fully CCW, OFFSET off.)

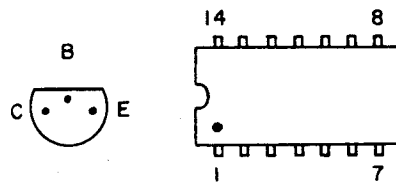
Pin	Transmit	Receive	Pin	Transmit	Receive
GND	0	0	OT POT	2.8	2.8
T/R	0	2.4	OT OUT	3	3
R	0	12.8	+REG	8.06	8.06
+12	13.8	13.8	OT POT	0	0
tD	4.3	.01	OT ON-OFF	5.5	5.5
T	10.8	.01	CW OUT	0	3
GND	0	0	OT-ZB	10	0

Semiconductor Voltage Readings

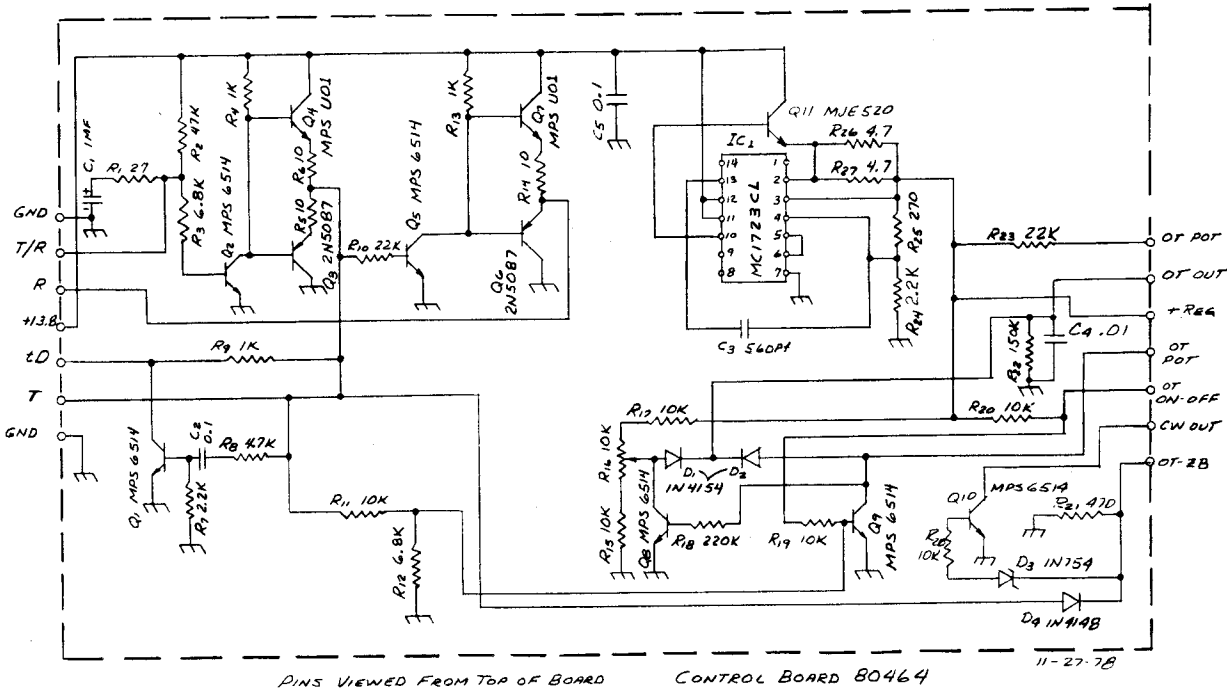
Transistor	Collector		Base		Emitter	
	Transmit	Receive	Transmit	Receive	Transmit	Receive
Q1	4.3	0	0	0	0	0
Q2	13.1	.01	0	.7	0	0
Q3	0	0	13.1	.1	10.8	0
Q4	13.8	13.8	13.1	.1	12.5	0
Q5	.1	13.7	.7	0	0	0
Q6	0	0	.1	13.7	0	12.8
Q7	13.8	13.8	.1	13.7	0	13
Q8	3.4	3.4	0	0	0	0
Q9	0	0	.7	.7	0	0
Q10	0	3	.7	0	0	0
Q11	13.8	13.8	9.1	9.1	8.5	8.5

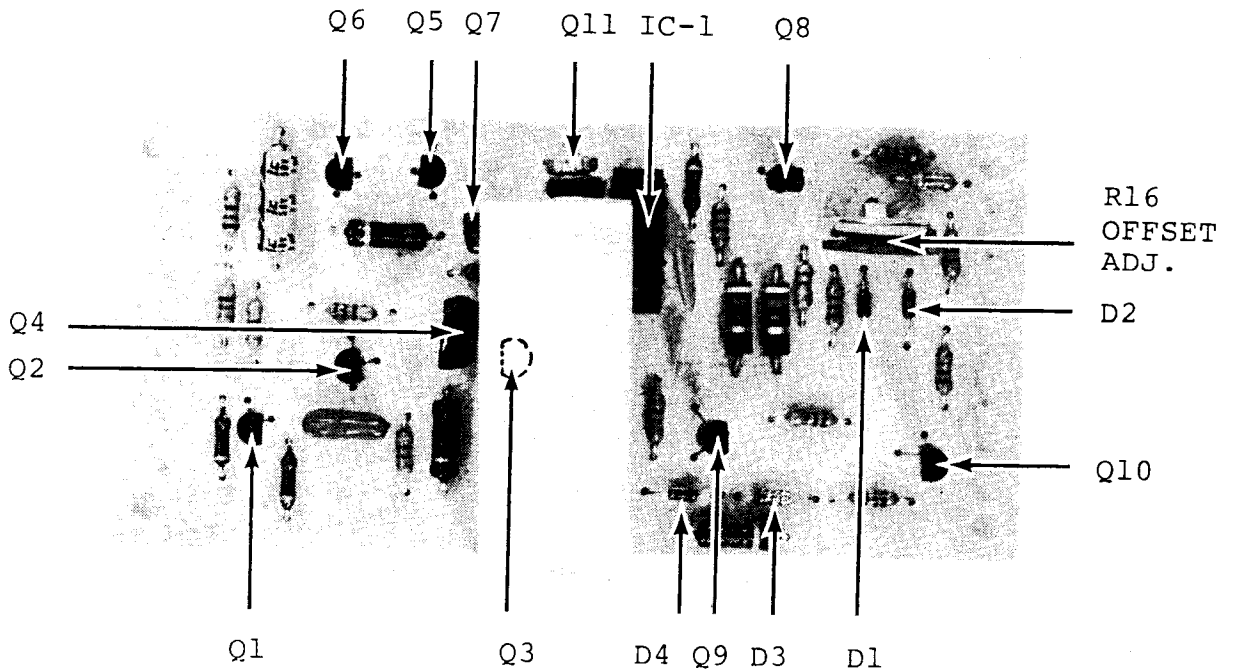
IC-1

Pin	Receive	Pin	Receive
1	0	8	0
2	8.5	9	0
3	8.1	10	9.1
4	7.2	11	13.8
5	7.2	12	13.8
6	7.2	13	10.4
7	0	14	0



Semiconductor pins viewed from top of PC board





80464 CONTROL BOARD



80451 VOX

The microphone input to the VOX circuit is taken from the top end of the DRIVE control knob and applied to the first of two amplifiers IC-1A and IC-1B, with the VOX GAIN setting independent of the DRIVE setting. The signal is then rectified and filtered by D3, D4, and C11, and applied to the summing point as a positive going dc voltage. The anti-vox signal is taken from the speaker amplifier, through the ANTI gain control to amplifier IC-1C. The anti-vox signal is rectified and filtered in D1, D2, and C4, and applied to the summing point as a negative going voltage.

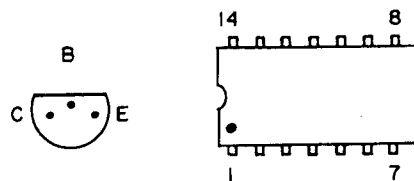
The summing point voltage is applied to IC-1D which compares the summing voltage with a fixed reference from divider R17-R18. When the summing voltage is more positive than the reference, the output of IC-1D goes to +12 volts and charges C12 through blocking diode D5. The charge on C12 activates the transistor switch Q1 which shorts the PTT line. The decay time for the charge on C12 is determined by the setting of the DELAY pot.

Semiconductor Voltage Readings - (Receive mode.)

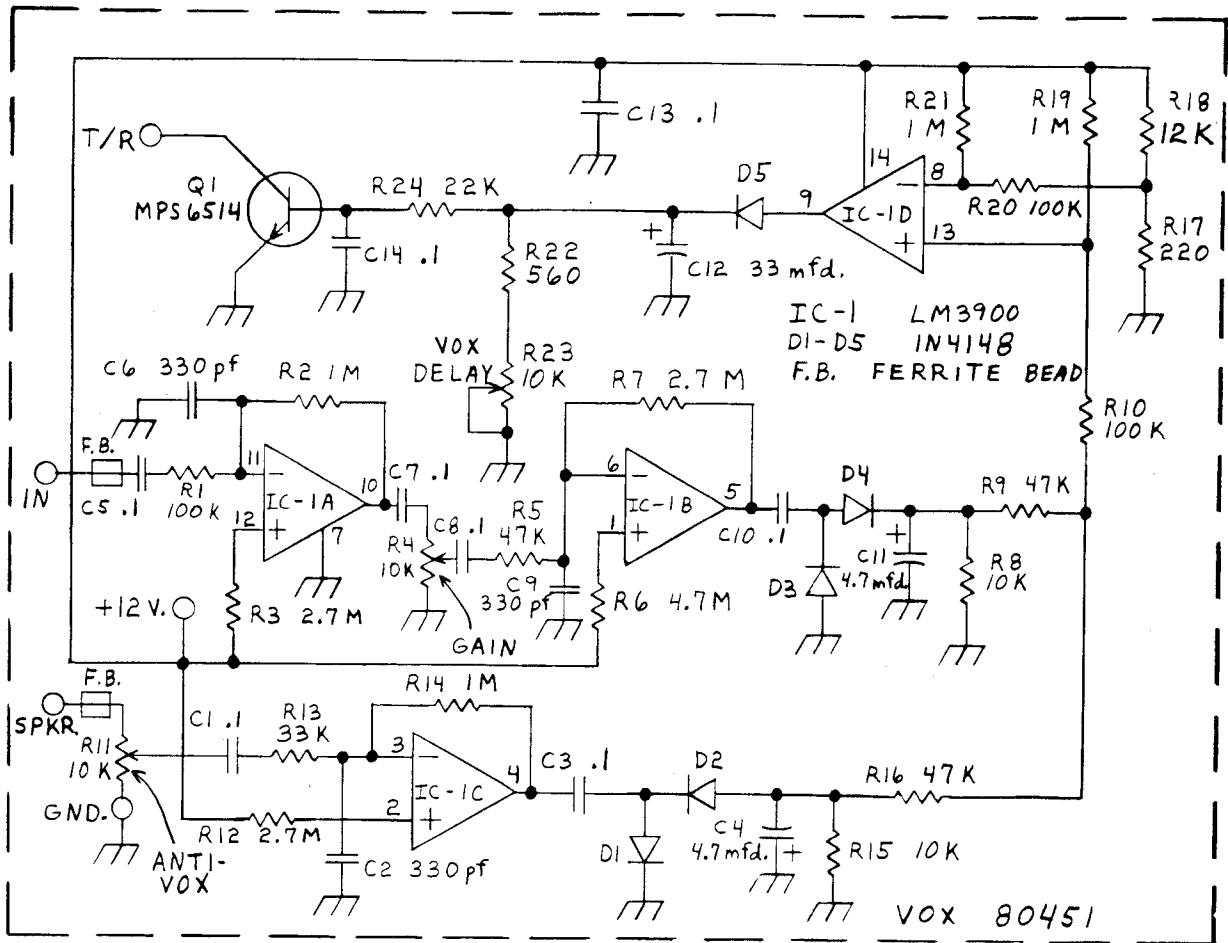
Transistor	Collector	Base	Emitter
Q1	0	0	0

IC-1

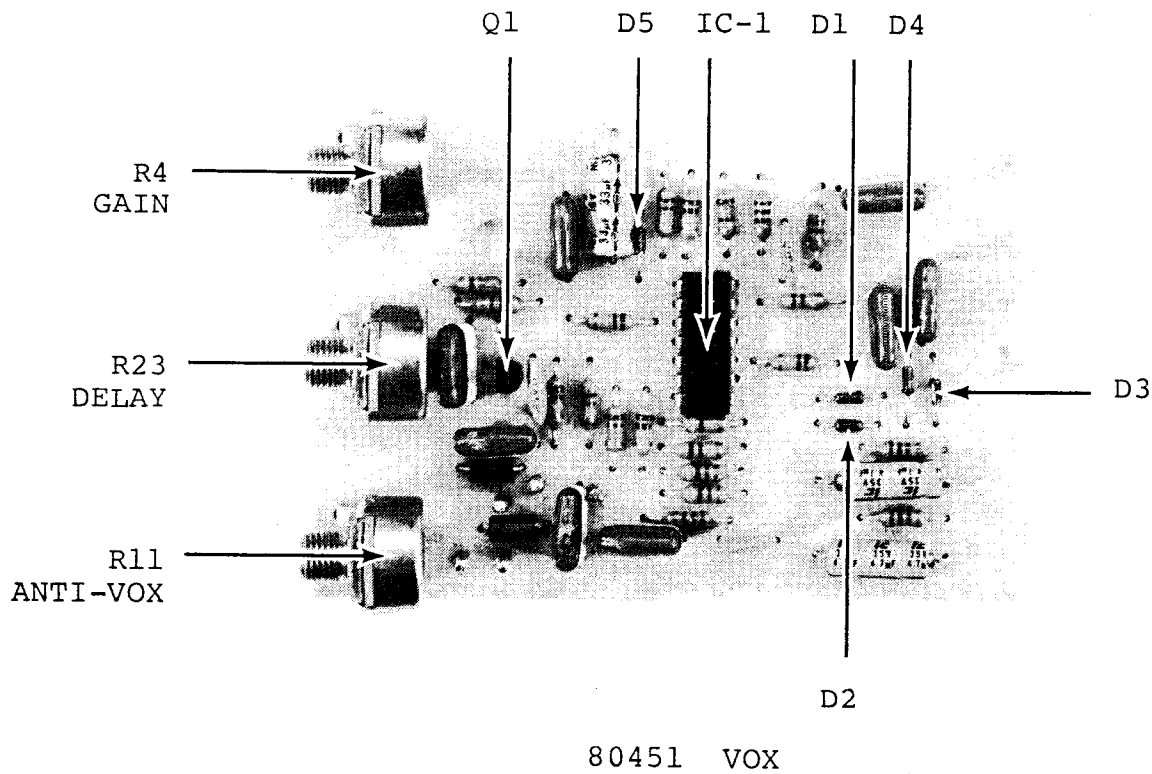
Pin	Volts	Pin	Volts
1	.5	8	.5
2	.5	9	.2
3	.5	10	5.2
4	5.5	11	.5
5	8.4	12	.5
6	.5	13	.5
7	0	14	13.8



Semiconductor pins viewed from top of PC board



5-279





Ten-Tec, Inc.  
1185 Dolly Parton Parkway  
Sevierville, TN 37862  
Repair Service: (865) 428-0364

#### LIMITED WARRANTY AND SERVICE POLICY, U.S.A. AND CANADA

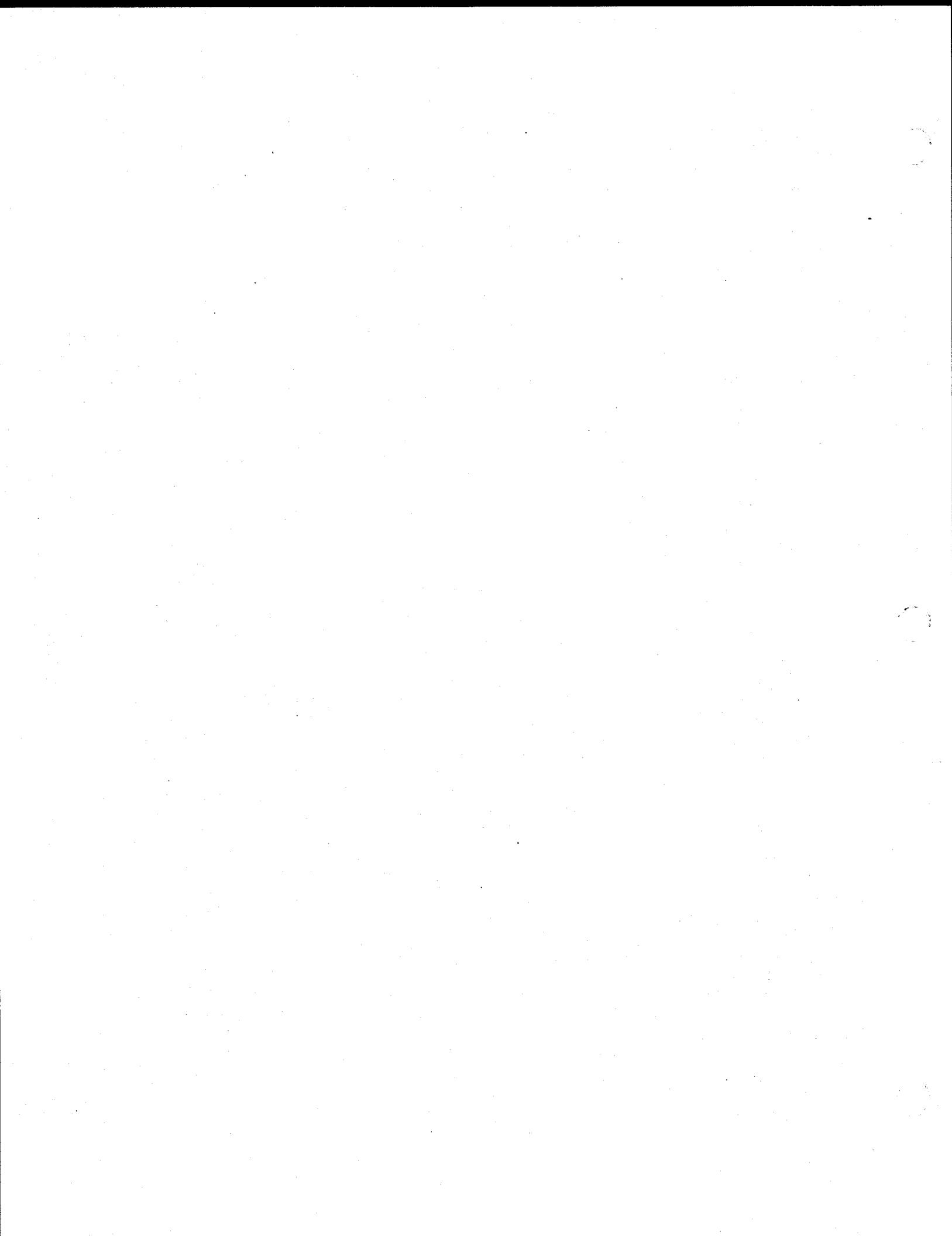
Ten-Tec, Inc., warrants this product to be free from defects in material and workmanship for a period of one (1) year from the date of purchase, under these conditions:

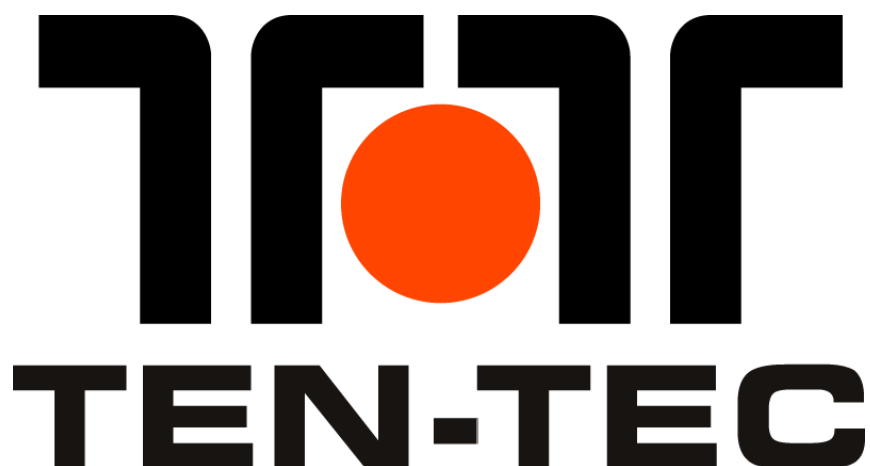
1. **THIS WARRANTY APPLIES ONLY TO THE ORIGINAL OWNER.** It is important that the warranty registration card be sent to us promptly.
2. **READ THE MANUAL THOROUGHLY.** This warranty does not cover damage resulting from improper operation. Developing a thorough understanding of this equipment is your responsibility.
3. **IF TROUBLE DEVELOPS** we recommend you contact our customer service group direct at the address or phone number shown above. It has been our experience that factory direct service is expeditious and usually results in less down-time on the equipment. Some overseas dealers do offer warranty service and, of course, have our complete support.
4. **EQUIPMENT RETURNED TO THE FACTORY** must be properly packaged, preferably in the original shipping carton(s). You pay the freight to us and we prepay surface freight back to you. Canadian customers must have proper customs documentation sent with incoming repair equipment. Duties or fees charged due to improper documenting are the responsibility of the owner of the equipment.
5. **EXCLUSIONS.** This warranty does not cover damage resulting from misuse, lightning, excess voltages, polarity errors or damage resulting from modifications not recommended or approved by Ten-Tec. In the event of transportation damage, a claim must be filed with the carrier. Under no circumstances is Ten-Tec liable for consequential damages to persons or property caused by the use of this equipment.
6. **TEN-TEC RESERVES** the right to make design changes without any obligation to modify equipment previously manufactured, or to notify owners of changes to existing equipment.
7. **THIS WARRANTY** is given in lieu of any other warranty, expressed or implied.

#### SERVICE OUTSIDE OF THE U.S.A. OR CANADA

Many of our international dealers provide warranty service on the equipment they sell. Many of them also provide out of warranty service on all equipment whether they sold it or not. If your dealer does not provide service or is not conveniently located, follow the procedure outlined above. Equipment returned to us will be given the same attention as domestic customers but roundtrip freight expense, customs and broker fees will be paid by you.

Part no. 74244





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