

I.

R4245 ADDENDUM SHEET 1

<u>IDENTIFICATION PREFIX</u>	<u>CIRCUIT BOARD/ MODULE</u>	<u>PAGE</u>	<u>BOARD NO.</u>	<u>R. L. DRAKE ASS'Y NO.</u>
00	Parent Board Ass'y	3-5	D-4724	2100399
01	Auxiliary Program	3-12	C-3823	2100501
02	Digital Control	3-17	C-4396	2100405
03	Audio/VRTO Buffer	3-22	B-4485	2100403
04	Up-Converter	3-27	C-4665	2100404
05	PLL/VCO	3-34	C-3746	2100305
06	Translator	3-39	C-3712	2100327
07	2nd Mixer	3-44	B-4546	2100407
08	Noise Blanker NB-7A	3-49	B-4700	2100408
09	IF Selectivity	3-54	C-3818	2100282
10	Passband Tuning/Reference	3-61	C-4295	2100410
11	2nd/3rd IF/AGC	3-68	C-4367	2100411
12	Jumper	3-73	C-3990	2100312
13	Band Pass Filter Sw, Front	3-78	B-4375	2100413
14	Band Pass Filter Sw, Rear	3-78	B-4376	2100414
15	Band Pass Filter, Bands 1-6	3-82	C-4373	2100415
16	Band Pass Filter, Bands 7-11	3-86	C-4374	2100416
17	Antenna Splitter Bd.	3-93	A-5403	2100423
	Antenna Switch Ass'y	3-93	--	2055156
18	+13.8 VDC Regulator	3-98	B-4491	2100422
19	+25,+10,+5,-5 VDC Regulator	3-103	B-4935	2100418
30	VRTO ÷ N/Mix	3-127	B-5007	2100271
31	VRTO VCO	3-122	B-5006	2100270
32	VRTO Digital	3-138	E-5037	2100273
	VRTO Display Board	3-143	C-5036	2100274
34	VRTO Parent	3-116	B-4920	2100272
	Opt. Sw. Source Connector	3-117	--	2055130
	Opt. Sw. Pickup Connector	3-117	--	2055131
	Shaft Encoder Ass'y	3-117	--	2050074
	Opt. Sw. Transistor	3-117	--	3039900
80	Line Amp Module	3-108	B-5169	2101230
85	RP-700 Receiver Protector	3-113	B-4929	2102032

II. PAGE 2-3

Replace entire synthesizer numerical example with the following:

Desired Operating Freq.:	14.2835 MHz
VRTO (Minor loop) Freq.:	
5.050 MHz + .2835 MHz=	5.3335 MHz
Reference freq. to loop mixer	<u>+ 40.0000 MHz</u>
Variable Reference Frequency	45.3335 MHz

R4245 ADDENDUM SHEET 2



Major Loop VCO Freq.:		
Operating freq. + I.F.		14.2835
		<u>+ 48.0500</u>
		62.3335
$\frac{1}{N}$ Input Freq.:		
62.3335 MHz - 45.3335 MHz =		17.0 MHz
$\frac{1}{N}$ Output Freq.		.500 MHz
N = 17.0 $\div$ .5 =		34
BCD Load Number		
92 - N =		58

II. Add to Bottom of Page 3-8

Specifying Fixed Frequency Crystals:

A. For  $X.0000 \leq$  Operating Freq.  $< X.5000$  (X = 0 to 30)  
 Crystal Freq. = 5.050 + (Operating Freq. - X.000) MHz

ex. For 12.230 MHz

$$\text{Crystal Freq.} = 5.050 + (12.230 - 12.000) \text{ MHz} \\ = 5.280 \text{ MHz}$$

B. For  $X.5000 \leq$  Operating Freq.  $< Y.0000$   
 Crystal Freq. = 5.050 + (Operating Freq. - X.500) MHz

ex. For 12.730 MHz

$$\text{Crystal Freq.} = 5.050 + (12.730 - 12.500) \text{ MHz} \\ = 5.280 \text{ MHz}$$

Crystal Specifications

Crystal Frequency	_____ MHz
Load	32 pF Parallel (Fundamental)
Holder	HC -25/U
Make Tolerance	$\pm .003\%$ @ +25°C Max.
Temp Tolerance	$\pm 30\text{ppm}$ 0°C to + 60°C
Resistance	35 $\Omega$ Max.
Aging	$\pm 20$ ppm/year
Markings	_____ MHz on side or top

V. PAGE 4-2

Under Section 4-4c) Change from: "tune L1013 and L1014 for maximum output"  
 to: "tune L1007 and L1010 for maximum output"

Under Section 4-6e) Change from: "should indicate 16.0  $\pm$  0.5 VDC"  
 to: "should indicate 15.0  $\pm$  0.5 VDC"

V. PAGE 4-5

Replace entire page with sheet provided.

#### 4-15. VRTO +N/MIX BOARD ALIGNMENT

If only a minor adjustment is required to correct a slight frequency discontinuity as the main tuning is tuned from XXXXX.9 kHz to XXXXX.0 kHz, a slight readjustment of R3006 may be all that is required.

To gain access to R3006, unplug the VRTO Digital board from the radio referring to the VRTO Digital board removal instructions pg. 3-131, but DO NOT unplug the 26 conductor flex-cable connector from the VRTO Digital board. Position the VRTO Digital board to the side and plug in the Digital Jumper board (Figure 3-27, pg. 3-73) with (12) pin connector at Digital Control bd. end and (9) pin connector at Translator bd. end. With the radio in this configuration, both the major and minor VCO loops should be locked and the radio fully operational. Also, R3006 can be adjusted through an access hole in the front top shield cover using a straight slot screwdriver.

Tune in the calibrator signal for an audio beat note of approximately 1000 Hz with the display indicating XXXX0.9 kHz. Very slowly continue tuning up in frequency until the display changes to XXXX1.0 kHz. If there is more than the normal 10 Hz frequency step or if the beat note audio frequency changes in the wrong direction slightly for one count — slightly readjust R3006 until a smooth transition is obtained. This procedure assumes that L3001 and L3002 are properly set. If there is any doubt the following procedure should be followed.

- a) Remove top front shield cover. Place the VRTO +N/Mix board on extender board. The VRTO Digital board and Digital Jumper board must be operating as explained previously.
- b) Connect the RF VTVM to the +N/Mix board test point shown in figure 3-49.
- c) Tune L3002 and L3003 for maximum RF level. A level of approximately 500mVRMS can be expected. DO NOT retouch settings of these two coils after this step.
- d) Remove RF VTVM connection and connect a frequency counter with 1 PPM accuracy and 1 megohm input impedance to the test point.
- e) Set R3006 to the center of its range.
- f) Tune main tuning up in frequency very slowly until the display just reads XXXX1.0.
- g) Then tune down in frequency extremely carefully until the display just changes to XXXX0.9.

- h) Being very careful not to bump main tuning (LOCK button may be depressed), tune L3001 for an indication of 46.5100 MHz on the frequency counter.
- i) Tune main tuning up in frequency extremely slowly until display just changes back to XXXX1.0.
- j) Adjust R3006 for a frequency of 46.5000 MHz on the counter.
- k) Repeat g through j several times until no further refinement can be obtained.
- l) Remove counter from test point. Reinstall +N/Mix board in radio if extenders were used.
- m) Turn unit on and tune receiver through calibrator signal checking for smooth 10 Hz step transition as the display changes from XXXX0.9 to XXXX1.0. If there is noticeable discontinuity, slightly readjust R3006 as described at the beginning of this section.

#### 4-16. VRTO DIGITAL BOARD AND OPTICAL SWITCH ALIGNMENT

There are only three electrical adjustments on this board. Potentiometers R32015 and R32013 set the bias for the shaft encoder optical switches. If a new VRTO Digital board is being installed in the radio or if one or both optical switches have been replaced, these bias adjustments will most likely need to be reset. The following procedure should be followed.

- a) Turn on unit. Display should come up at the usual preset frequency in the center of the 500 kHz tuning range.
- b) Depress LOCK pushbutton.
- c) Connect VTVM to test point — TP1 — see figure 3-52. Rotate main tuning dial continuously and adjust R32013 for an average DC reading of 5.0 volts on the VTVM.
- d) Connect VTVM to test point — TP2. Rotate main tuning dial continuously and adjust R32015 for an average DC reading of 5.0 volts on VTVM.

#### NOTE

The VTVM used in steps c and d above must be an analog type. A digital meter cannot display the average value required for this adjustment. Alternatively, an oscilloscope can be used. Adjust the potentiometer for a sine wave symmetrical around the 5.0 volt DC level while tuning the main tuning dial.



# SERVICE MANUAL

# **R4245**

## **H.F. RECEIVER**

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Printed in U. S. A.

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## SECTION 1 OPERATION

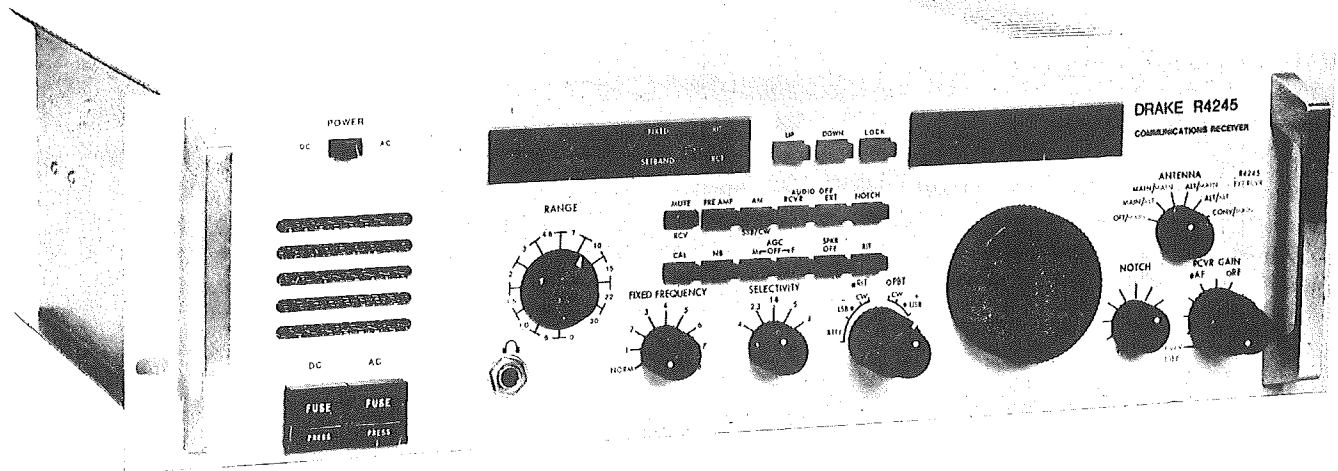


Fig. 1-1 R4245 H.F. Receiver

### 1-1. DESCRIPTION

The R4245 is a solid-state, broadband, SSB/CW/AM receiver which embodies several unique state-of-the-art design features. Due to its unique design, the R4245 offers excellent sensitivity and selectivity, very high dynamic range and completely synthesized frequency control with variable rate main tuning and general coverage capability.

A front panel switch allows the operator to select any of five receiver selectivities.

The front panel passband tuning (PBT) control is a valuable aid in reducing or eliminating interfering signals. The PBT control electronically shifts the receiver intermediate frequency (IF). In addition, the third mixer injection frequency is simultaneously shifted, thus maintaining the operating frequency to which the receiver is tuned. Since the crystal passband is fixed, this allows the operator to electronically move interfering signals out of the receiver passband, providing maximum utilization of the excellent selectivity characteristics afforded by the eight pole crystal filters in the IF strip.

A high level double balanced mixer is used as the first receiver mixer in an up-conversion mode. The use of this device assures the reduction of both front-end overload and intermodulation to a minimum. Careful attention to filter matching and losses in the input circuit keeps the receiver noise figure low to insure good sensitivity.

The R4245 features a highly stable frequency synthesizer for accurate frequency control. Frequency resolution is approximately 10 Hz, providing an essentially continuous tuning feel. The digital read-out displays frequency to the nearest 100 Hz. The main tuning control tunes over a 500 kHz range and the variable rate tuning feature provides rapid frequency change or high resolution tuning without a need to manually select different tuning rates. In addition, two pushbutton controls allow the R4245 synthesizer to be stepped up or down in frequency in 500 kHz increments, thus allowing continuous frequency coverage from 10 kHz to 30 MHz. For fixed frequency operation, up to eight (8) crystal controlled frequencies are selectable by the front panel fixed frequency switch.

While normal receiver sensitivity will usually be more than adequate, an internal preamp may be switched in for reception of satellites, use with an external low-gain VHF receiving converter, shortened or non-resonant antennas, or other extraordinary receiving conditions. The preamp increases receiver gain by about 10 dB and typically improves sensitivity by 5 to 6 dB.

The antenna selector switch allows selection of up to three antennas or receiving converters. When used with another receiver or transceiver, this switch also allows selection of either of two antennas for the external receiver, a special antenna splitter circuit is also included to allow both receivers to use the same antenna simultaneously.

Other features include a notch filter for eliminating interfering heterodynes, switchable AGC with three selectable time constants with an OFF position, a built-in 25 kHz calibrator, speaker and audio ON/OFF switches, noise blanker (NB7A), 600  $\Omega$  line amplifier, RP700 Receiver Protector, a special low distortion AM detector, transceive operation with the TR4310, receiver incremental tuning (for transceive operation) and operation on either DC or AC supply voltage.

The modular construction of the R4245 reduces service time to a minimum. Each module is designed to perform a specific function, thus simplifying any required alignment and troubleshooting.

## 1-2. SPECIFICATIONS

Frequency Coverage:	10 kHz to 30 MHz continuous plus 8 possible crystal controlled channels.
Frequency Control:	Variable over 500 kHz wide ranges with resolution to approximately 10 Hz with smooth shaft encoder variable rate tuning. 500 kHz UP/DOWN range switching is pushbutton controlled. Up to eight crystal controlled fixed frequencies may be added using fixed frequency function.
Frequency Readout:	Frequency is displayed to nearest 100 Hz when using VRTO frequency control. Accuracy is 15 ppm $\pm$ 100 Hz.
Frequency Stability:	15 ppm over 0 to 50° C temperature range.
Receiver Incremental Tuning (RIT):	RIT is provided to offset receiver $\pm$ several hundred Hz from transceive XMIT frequency.
Sensitivity (SSB,CW): (2.3 kHz BW)	1.8 to 30 MHz less than .20 $\mu$ V for 10 dB (S+N)/N with preamp on (typically .15 $\mu$ V) (Noise floor typically -134 dBm) Less than .50 $\mu$ V for 10 dB (S+N)/N without preamp (typically .30 $\mu$ V) (Noise floor typically -128 dBm). 0.01 to 1.5 MHz less than 1.0 $\mu$ V for 10 dB (S+N)/N.
Sensitivity (AM): (30% Mod., 4.0 kHz BW)	1.8 to 30 MHz less than 1.2 $\mu$ V for 10 dB (S+N)/N @ 30% modulation, preamp on. Less than 2.0 $\mu$ V for 10 dB (S+N)/N @ 30% modulation, preamp off. .01 to 1.5 MHz less than 4.0 $\mu$ V for 10 dB (S+N)/N @ 30% modulation.

**Selectivity:**

	-6 dB BW	-60 dB BW	Ultimate Rejection
a.	4 kHz	8 kHz	-100 dB
b.	2.3 kHz	4.4 kHz	-100 dB
c.	1.8 kHz	3.5 kHz	-100 dB
d.	500 Hz	1.1 kHz	-100 dB
e.	300 Hz	700 Hz	-100 dB

**IF and Image Rejection:**

Greater than 80 dB(48.05 MHz 1st IF, 5.645 MHz 2nd IF, 50 kHz 3rd IF).

**Power Requirements:**

100/120/200/240 VAC  $\pm$  10%, 50/60 Hz, 60 watts or 11.0 to 16.0 VDC (13.8 VDC nominal), 3 amps maximum, or 20-28 VDC (24 VDC nominal) 3 amps maximum.

**AGC Performance:**

Less than 4 dB audio output variation for 100 dB input signal change above AGC threshold. AGC threshold is typically .8  $\mu$ V with preamp off and .25  $\mu$ V with preamp on.

**Blocking:**

>145 dB above noise floor.

**Intermodulation: (100 kHz tone spacing)**
**Preamp Off:**

Two-tone Dynamic Range: 99 dB (1.8 to 30 MHz)

Third Order Intercept Point: +20 dBm

**Preamp On:**

Two-tone Dynamic Range: 95 dB (1.8 to 30 MHz)

Third Order Intercept Point: +10 dBm

**AGC Attack Time:**

1 millisecond. Three selectable release times: Slow — 2 sec; Medium — 400 Msec; Fast — 75 Msec, Also, "OFF" position is provided.

**Antenna Input Impedance:**

Nominal 50 ohms. (200 ohms on .01 to .5 MHz range.)

**Audio Output:**

2.5 watts with less than 10% T.H.D. into nominal 4 ohm load.

**Dimensions:**

12.5" D (31.75 cm) excluding knobs and connectors, 19" W (48.26 cm), 5.25" H (13.33 cm).

**Weight:**

19 lbs. (8.6 kg)

Available with cabinet, size approximately  
14.5" D  $\times$  20.75" W  $\times$  7.5" H (36.8  $\times$  51.4  $\times$  19 cm)

## 1-3. ACCESSORIES

### R4245/TR4310 TRANSCEIVE CABLE KIT, MODEL 1548

Provision has been made in the R4245 to allow it to transceive with the TR4310. The cable kit contains an interconnect cable to effect transfer of certain reference signals and DC control functions between the two units. Included are cables that allow antenna patching between units and audio mixing. Refer to figure 1-3 for a proper interconnect diagram and section 1-8 for transceive operation discussion.

## 1-4. UNPACKING

Carefully remove the R4245 from the shipping carton and examine it for evidence of damage. If any damage is found, immediately contact the transportation company responsible for delivery of the unit or return the unit to the dealer where the unit was purchased. Keep the shipping carton and all packing material for the transportation company to inspect. The original carton and packing material will make it much easier to return the unit, if necessary. Inspect the packing material for any accessories or printed matter before storing. Locate the registration card, fill out immediately, and return to the R. L. Drake Company to insure registration and validation of the warranty.

## 1-5. LOCATION

Care should be taken to insure that adequate clearance is provided to allow free circulation of air around the power supply compartment.

## 1-6. ANTENNA REQUIREMENTS

Install the antenna as recommended by the antenna manufacturer. Connect a 50 ohm coaxial cable from the antenna to the MAIN, ALT, or CONV antenna connector at the rear of the R4245.

## 1-7. POWER REQUIREMENTS

The R4245 Receiver is designed to operate on 100 VAC, 120 VAC, 200 VAC, or 240 VAC  $\pm$  10%, 50/60 Hz. It can also be operated on a DC voltage of 20-28 VDC (24 VDC nominal) or 11-16 VDC (13.6 VDC nominal), 3 amps maximum. The correct DC operat-

ing voltage may be selected with the switch located on the rear panel near the MAIN antenna input connector (See figure 1-5). Voltages outside the programmed AC or DC ranges may either damage the receiver or cause improper operation.

The correct AC supply voltage may be selected with two switches located on the rear panel (see figures 1-2 and 1-3). To change the AC line voltage programming, remove the two screws holding the cover plate that secures the programming switches. Referring to figure 1-2, set the two switches for the correct voltage. Reinstall the cover plate. If programming is correct, the proper voltage will show through the cut-out in the plate. It is recommended that the receiver not be operated without the cover plate in place to prevent inadvertent movement of the line voltage programming switches.

## 1-8. TRANSCEIVE OPERATION

Transceive operation with the TR4310 transceiver is possible by connecting the two units as shown in figure 1-3. With the two units connected in this way, the TR4310 transmit frequency may be controlled either by its internal variable rate tuned oscillator (VRTO) or by the VRTO in the R4245. The latter function may be selected by depressing the RCT (Remote Controlled Transmit) button on the TR4310.

Because the 40 MHz master oscillators in the TR4310 and R4245 are locked to the same frequency during transceive operation, the two units should be locked to almost exactly the same frequency. A small difference on the order of perhaps 10 Hz may be noticed, however. If this is objectionable, the 8.05 MHz heterodyne oscillator in the TR4310 must be adjusted. To do this, remove the sixteen screws securing the TR4310 cover to the top of the chassis, and remove the cover. The 8.05 MHz oscillator adjustment control is C1030 located on the PBT/REF oscillator board. This capacitor is accessible through a hole in the shield located on the top of the chassis at the center rear of the radio. To make the adjustment, connect the TR4310 and R4245 as in figure 1-3 with a 50 ohm dummy load in place of the antenna. Also attach a microphone to the TR4310 microphone jack. Depress the TR4310 RCT button, and make sure the R4245 mute button is in the "out" position. Adjust the R4245 volume control for normal listening level, and turn up the TR4310 microphone gain control to about 12 o'clock. Make sure

both the receiver and transceiver are on the same sideband. Key the PTT switch on the microphone and hold it near the R4245 speaker until you hear a "canary chirp" beat note. Adjust C1030 until the chirps slow down to a steady tone.

In transceive operation, the MUTE button on the R4245 controls the mute function in the R4245 only. When the button is depressed, the R4245 stops receiving whenever the TR4310 goes into transmit. When the button is out, the R4245 receives continuously.

With the audio mix cable connected as in figure 1-2 both the TR4310 receiver output and R4245 audio can be heard simultaneously in the R4245 speaker or headphones. The TR4310 volume control continues to control the volume from the TR4310 receiver section, and the R4245 volume control continues to control audio gain from the R4245 only. For example: in CW operation the audio sidetone level is adjustable by the TR4310 VOLUME control and is heard in the R4245. The TR4310 RF GAIN control may be adjusted full CCW to disable the TR4310 on receive.

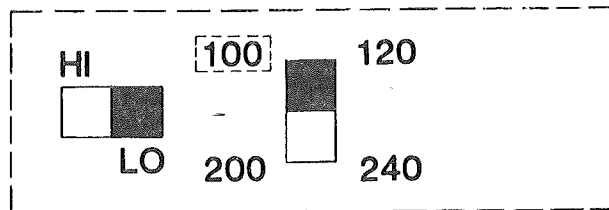
**NOTE**

Whenever the two antenna patch cables are interconnected between the TR4310

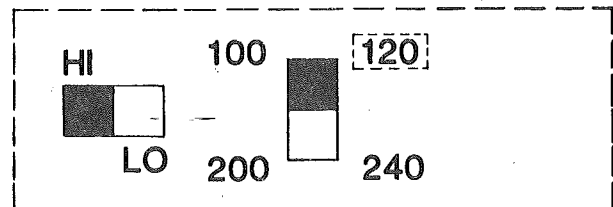
and R4245, the following applies: To select, within the R4245, the antenna connected to the TR4310 SO-239 connector (antenna port), make certain that the TR4310 Bandswitch is set to a position higher in frequency or equal to the setting of the R4245 Bandswitch. If this is not done, signals sent to the R4245 via the antenna patch cable (connected to the EXT RCVR port on TR4310 end) will be attenuated. This is the case since the TR4310 bandswitched low pass filter is connected in series with the SO-239 connector (TR4310) and the EXT RCVR port (TR4310) in the receive mode.

**1-9. EXTERNAL SPEAKER REQUIREMENTS**

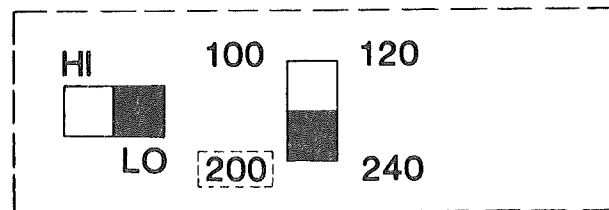
The R4245 contains a built-in speaker, however, if an external speaker is used, be sure that it is a 4 or 8 ohm impedance speaker, capable of handling at least 2.5 watts of audio. The internal R4245 speaker is automatically disabled when an external speaker is connected.



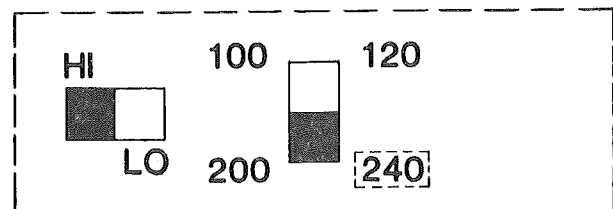
**100V Programming**



**120V Programming**

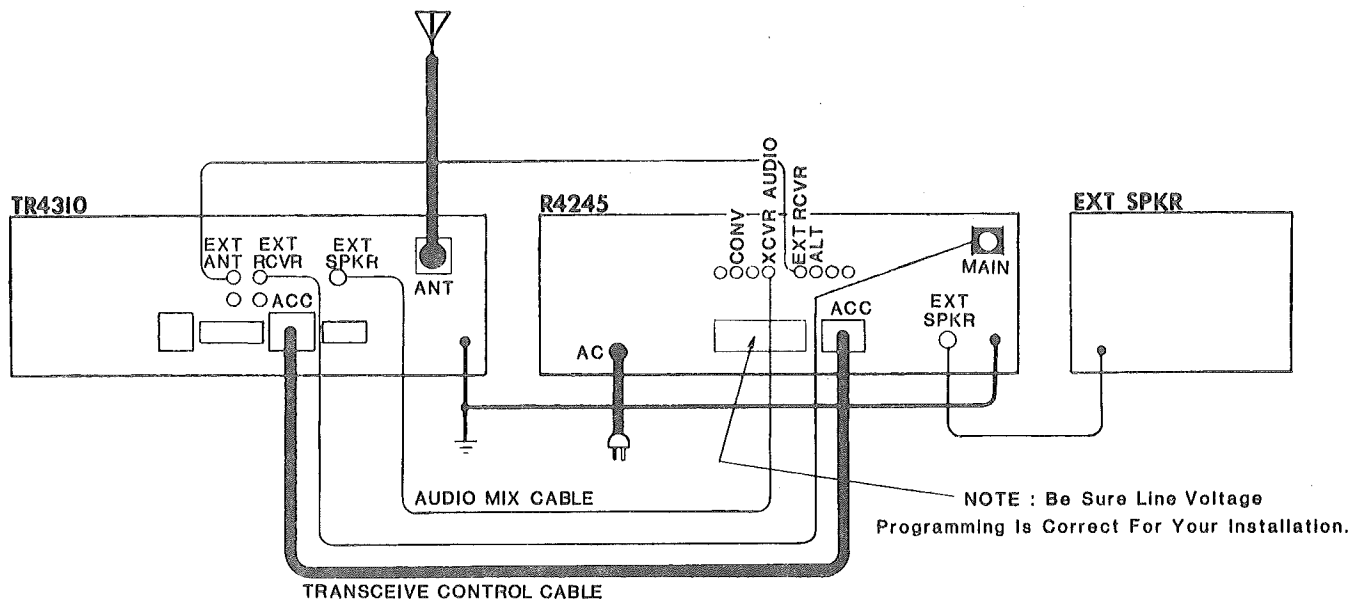


**200V Programming**



**240V Programming**

*Fig. 1-2 R4245 Power Connection*



(Transceiver Cables Provided In DRAKE  
Accessory Transceiver Cable Kit Model 1548)

Fig. 1-3 R4245/TR4310 Transceive Interconnection Diagram

## 1-10. FRONT PANEL CONTROLS

- A. **METER** — Indicates relative level of received signals. Each S-unit is approximately 5 dB, with S9 equal to approximately  $50 \mu\text{V}$  (Preamp OFF).
- B. **STATUS INDICATORS** —
1. **FIXED** — Indicates fixed frequency operation has been selected.
  2. **SET BAND** — Indicates the need to set the bandswitch to the proper range when the **FIXED FREQUENCY** mode is selected.
  3. **RIT** — Indicates that RIT (Receiver Incremental Tuning) is enabled.
  4. **RCT** — Indicates that the TR4310 TRANSMIT frequency is being controlled by the R4245 VRTO or R4245 Fixed Frequency Oscillator.
- C. **MUTE SWITCH** — With button depressed, receiver is muted. However, in transceive operation with the TR4310, receiver is muted during transmit only. With button out, receiver is operational continuously. To mute with a transmitter other than a TR4310, merely supply a switched ground line to pin 11 of accessory connector. With button depressed and pin 11 grounded, receiver is operational. During transmit, remove ground.
- D. **PREAMP SWITCH** — Depressing button enables a 10 dB gain preamp following the input antenna filters. It is operational from 1.5 to 30 MHz and improves sensitivity approximately 5-6 dB. The receiver dynamic range is reduced slightly with the preamp on and thus it should be turned off when not needed. S-meter indication will increase approximately 2 S-units or 10 dB with preamp on with a signal applied. Preamp does not increase calibrator reading.
- E. **AM/SSB/CW SWITCH** — Depressing button enables AM mode of receiver operation.
- F. **AUDIO OFF — RCVR SWITCH** — Depressing button turns off the R4245 receiver detected audio to the final audio amplifier.

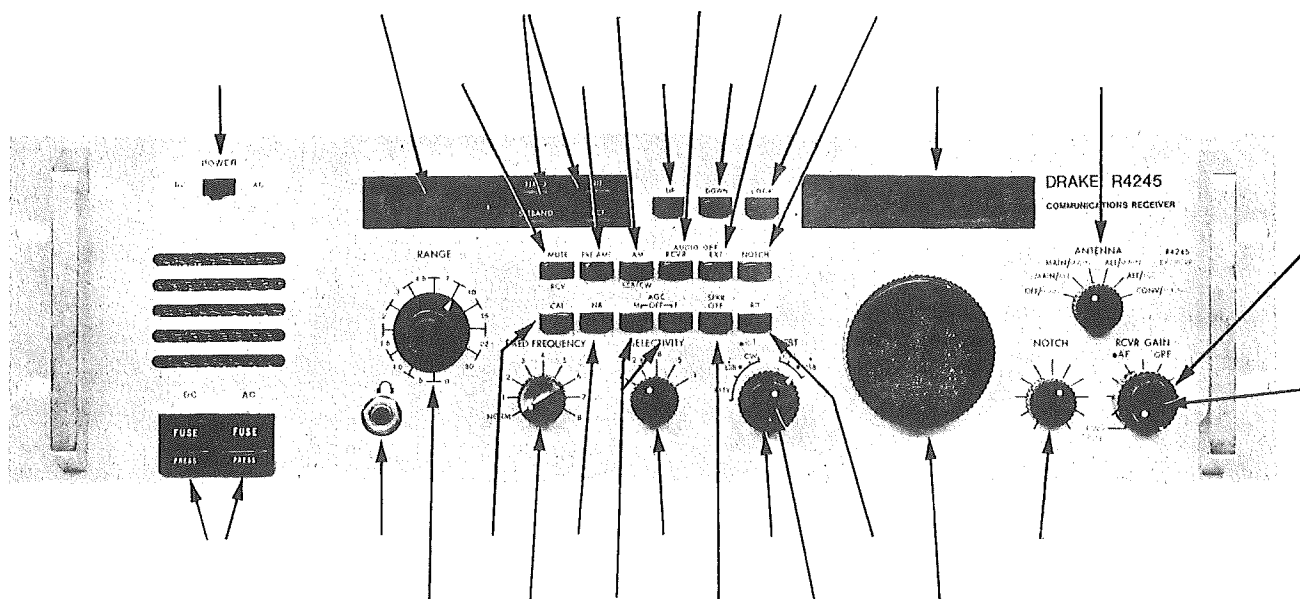


Fig. 1-4 Front Panel Controls and Connections

- G. **AUDIO OFF — EXT SWITCH** — Depressing button turns off the audio source present at the R4245 rear panel XCVR AUDIO jack.
- H. **NOTCH-SWITCH** — Enables notch control allowing IF null to be tuned approximately  $\pm 3$  kHz from IF center frequency.
- I. **UP CONTROL** — Each time this momentary contact pushbutton is depressed, the R4245 operating frequency will increase 500 kHz. This action will continue until the upper limit of the selected band range is reached, at which point the bandswitch must be reset to allow further increase.
- J. **DOWN CONTROL** — Operation exactly the same as the UP control (I), except that the operating frequency is decreased 500 kHz for each switch actuation.
- K. **LOCK CONTROL** — When depressed, this control disables the main tuning control. The receiver will remain on its present frequency. The RIT function is still operative if selected.
- L. **FREQUENCY READOUT** — Presents a digital display of operating frequency to the nearest 100 Hz.
- M. **ANTENNA SWITCH** — Works in conjunction with antenna ports on rear panel of radio. The MAIN, ALTERNATE and CONVERTER jacks are antenna inputs. The RP700 receiver protector is in series with the MAIN input jack only. The EXT RCVR jack is a switched antenna output. Depending on the selected switch position, the appropriate antenna is selected for the R4245 receiver's input (indicated by BLACK colored legend) and the same or another antenna is connected to the EXT RCVR jack (indicated by RED colored legend). The EXT RCVR port becomes the antenna source for another receiver, e.g. TR4310 in transceive mode. (See figure 1-3 for transceive interconnection diagram.) The CONVERTER jack is connected to the R4245 only and in one switch position only. This allows for a nominal 75 dB or greater isolation between the MAIN, ALTERNATE, or EXT RCVR port and the R4245 receiver input. The isolation between the R4245 receiver input and the unused antenna port

varies from 45 dB to 75 dB nominally in the first five (5) switch positions.

- N. RF GAIN — Controls the R.F. gain of the receiver. Normally used in the fully clockwise position for maximum gain.
- O. AF GAIN — Controls the receiver audio gain. Turn fully counterclockwise to turn off the R4245.
- P. NOTCH — With NOTCH pushbutton depressed, this controls the IF null frequency. Merely tune for minimum interference from an unwanted carrier or CW signal by listening for the audio null or observing the S-meter dip. The knob rotation sense is such that when the PBT control is CW of center, the notch control is CW of center and vice versa. Although the S-meter dip indicates only 20 dB notch depth, the actual audio null can be adjusted to approximately 40 dB depth.
- Q. TUNING KNOB — Adjusts the frequency of receiver. See section 1-13 of the manual for detailed description of the variable rate tuning operation.
- R. PBT CONTROL — Shifts the receiver 2nd IF and 3rd IF injection together (BFO constant frequency), thus maintaining a constant receiver operating frequency. Since the crystal filter passband is fixed, this control can be used to position interfering signals outside the receiver passband. Front panel markings indicate nominal settings for various modes. Merely position the receiver passband for the most pleasing receiver audio response and/or best interference rejection.
- S. RIT CONTROL — When the RIT switch (BB) is depressed, this control allows the receiver frequency to be varied over a range of several hundred Hz. In RCT transceive mode, this RIT function is disabled.
- T. SELECTIVITY SWITCH — Selects receiver passband width independent of mode or passband tuning position.

- U. FIXED FREQUENCY SWITCH — Selects the desired fixed frequency crystal when installed in the corresponding position in the AUX7 board.
- V. HEADPHONES — Provides a connection for headphones. Internal or external speaker is not muted when this jack is used. An internal 220  $\Omega$  resistor is installed in series with this jack. This jack is "hot" regardless of "SPKR" switch position.
- W. BAND SWITCH — Selects the desired band of operation. One 500 kHz range is automatically selected when the bandswitch is turned to each position. Other 500 kHz ranges are selected using the UP and DOWN pushbuttons (I & J).
- X. CAL SWITCH — Enables the built-in 25 kHz calibrator. Due to the nature of the calibrator signal, it is normal to experience some receiver intermodulation and spurious response when the calibrator is enabled.
- Y. NB SWITCH — Enables the noise blanker.
- Z. AGC SWITCHES — Selects one of the three AGC speeds and an OFF position. In the AGC "OFF" position, receiver gain must be controlled by the RF Gain control.

SWITCH "M"	SWITCH "F"	AGC RESPONSE
OUT	OUT	SLOW
IN	OUT	MEDIUM
OUT	IN	FAST
IN	IN	OFF

- AA. SPKR SWITCH — When depressed, the receiver internal or external speaker is disconnected. However, the headphone jack is always operational in either switch position.
- BB. RIT SWITCH — Enables the front panel RIT control. Disables RIT when pressed again. RIT is also disabled if the main tuning knob is turned.

CC. AC/DC POWER SWITCH — Selects either AC or DC voltage mode of operation without connecting or disconnecting any power cables to effect changeover.

DD. AC/DC FUSES — Unit is to be fused according to the following chart:

**AC FUSING**

100/120 VAC — 3/4 Amp, 250 VAC Slo-Blo

200/240 VAC — 3/8 Amp, 250 VAC Slo-Blo

**DC FUSING**

11-16 VDC — 3 Amp, Standard, 3AG

20-28 VDC — 3 Amp, Standard, 3AG

**1-11. REAR PANEL CONTROLS AND CONNECTIONS**

A. CONV JACK — Antenna input port selected by ANTENNA switch located on front panel. This particular input is selectable to R4245 receiver only.

B. AUDIO JACK — Connected to the top of the AF GAIN control. As such, this jack can be used for audio input to the receiver audio amplifier or audio output to an accessory tape recorder. Output level is nominally 0.5 volt RMS at high impedance.

C. XCVR AUDIO JACK — Connected through resistive padding and summed with the internal audio from the volume control. As such, this jack can be used for audio mixing of internal audio and audio from TR4310, for example. In the transceive mode, connecting audio from TR4310 EXT SPKR jack to R4245 XCVR AUDIO jack provides sidetone when in CW transmit mode. Sidetone level is adjustable by TR4310 VOLUME control. (See figure 1-3.)

D. EXT RCVR JACK — Connected to one of the main or alternate receiver jacks either directly or through the built-in antenna splitter, depending on antenna switch position located on front panel. This port should be connected to the external antenna input of an external receiver.

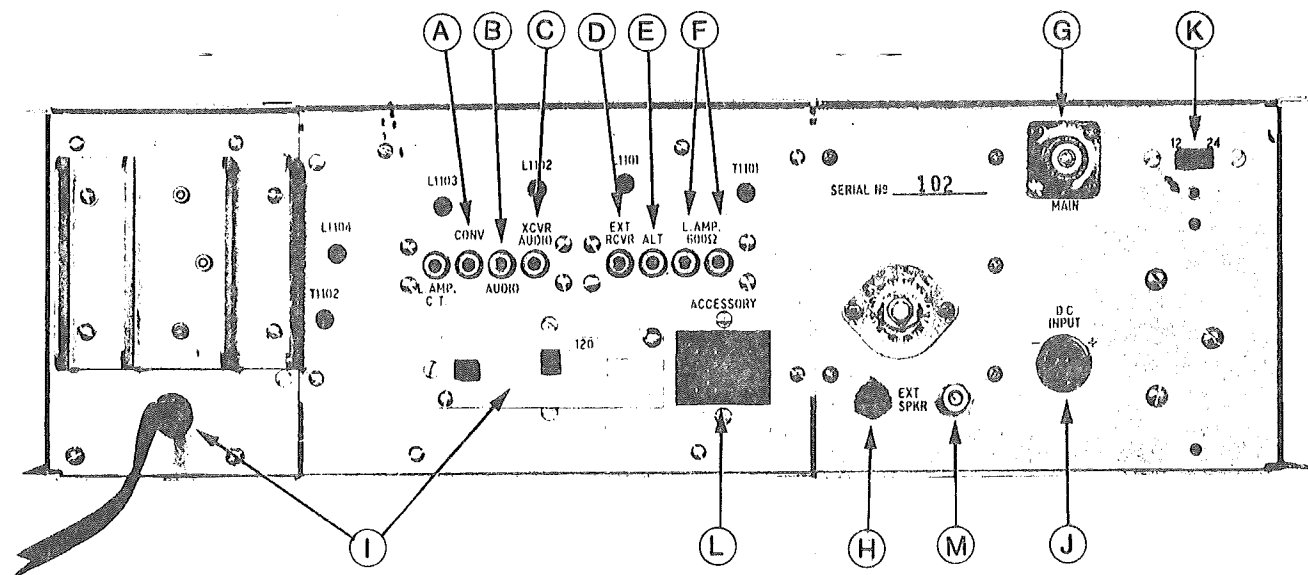


Fig. 1-5 Rear Panel Controls and Connections

- E. **ALT JACK** — Alternate antenna input connected to R4245 receiver input in two (2) antenna switch selectable positions and connected to the external receiver jack in two (2) positions.
- F. **LINE AMPLIFIER OUTPUTS** — Provides a nominal 0 dBm audio level into a 600 ohm balanced line. The CT socket is not connected to the receiver cabinet.
- G. **MAIN JACK** — As its name implies, this jack is the normal R4245 receiver antenna input. The RP700 receiver protector is in series with this jack only. It is connected to the R4245 receiver in two (2) antenna switch selectable positions and connected to the external receiver jack in four (4) positions.
- H. **EXTERNAL SPEAKER** — Connection for an external 4 ohm speaker rated at 2.5 watts or more. Internal speaker is automatically muted when external speaker is connected. Plug should be wired so tip is 'hot'.
- I. **POWER INPUT** — Primary AC power is provided to the receiver via the line cord. The programming plate window should indicate the proper supply operating voltage (see figure 1-2).
- J. **DC INPUT CONNECTOR** — The receiver can be powered via this input from a DC voltage source. Depending on the programming switch setting (K), the receiver is operable from either 11-16 VDC or 20-28 VDC, 3 amp maximum. Observe proper polarity.
- K. **DC POWER PROGRAMMING PLATE** — This plate locks the DC programming switch into either the 12 volt (11-16 VDC range) or 24 volt (20-28 VDC range) configuration. Merely position the cover plate and switch so that the desired operating voltage appears in the window.
- L. **ACCESSORIES** — Mates with a P-312-CCT plug. This connector provides for a wide range of accessory interconnections, primarily connection to the TR4310 ACCESSORY CON-

NECTOR. The transceive accessory cable (part of Model 1548) plugs into this connector.

- M. **GROUND** — Provides for grounding receiver cabinet to good earth or water pipe ground.

## 1-12. GENERAL OPERATING INFORMATION

For normal SSB/CW receiver operation, preset the receiver controls as follows:

All 15 Pushbuttons:	Out position
FIXED FREQUENCY:	NORM
SELECTIVITY:	2.3
PBT Knob:	USB or LSB as desired
RF Gain:	Fully Clockwise
AF GAIN:	Adjust for comfortable listening level.
ANTENNA:	To Desired Antenna

If the frequency display of the R4245 is blank when the receiver is first turned on, check to be sure that the **FIXED FREQUENCY** switch is in the **NORM** position. If no audio is heard with the **RF** and **AF** gain controls set at normal listening level, check to be sure that the **MUTE**, **SPKR** and **AUDIO OFF** switches are in the out position and that an antenna is connected to the proper jack on the back panel as selected by the **ANTENNA** switch.

The **PBT** (Passband Tuning) control may be adjusted to emphasize the high or low frequencies on a received SSB signal. The adjustment of this control is largely one of operator preference, and should be one that produces the most pleasing audio response with minimum interference. In particular, use of the accessory 1.8 kHz filter in conjunction with careful adjustment of the **PBT** control will often greatly improve reception of SSB signals under conditions of heavy interference.

For receiving **AM** under high interference conditions, the 4 kHz accessory filter may be useful. The R4245 synchrophase **AM** detector, unlike conventional **AM** envelope detectors, allows the user to select either the upper or lower sideband of the transmitted **AM** signal, without causing distortion.

The 4.0 kHz (SL4000) filter will allow for maximum utilization of this feature. When a strong adjacent channel interfering signal is present, the sideband furthest away from the interfering signal may be selected by adjustment of the PBT control. Using the 4.0 kHz filter with the PBT control properly set, the audio response will extend to approximately 3000 Hz. The 6.0 kHz (SL6000) filter may be used in the R4245 in place of the SL4000. This filter will allow wider audio frequency response as may be desired when receiving U.S. AM broadcast stations. Tuning is also less critical with the SL6000, although, as mentioned above, the SL4000 may be used to advantage in very severe interference situations. The 4 kHz filter may also be useful for quality SSB reception under strong signal conditions.

For AM reception within the 0.5 to 1.5 MHz range (U.S.A. broadcast) the following applies. Because of the wide variation in antennas used on this range, an attenuator pot (R1502), located on the input filter module (#15) is provided to allow the R4245 to be optimized for the particular antenna in use (see figure 2-3). This adjustment is factory preset to the middle of its range, and as such, reduces the sensitivity within this band. To increase or decrease the sensitivity simply adjust the pot (accessible from the top of radio after removing the top cover) while observing the S-meter reading. For instance, if the R4245 is connected to a long wire antenna resulting in some cross modulation, adjust the pot until inter-

ference disappears. Conversely, sensitivity can be increased for distant DX reception when shorter antennas are used.

### 1-13. VARIABLE RATE TUNING

The main tuning control is interfaced to the synthesizer by means of a shaft encoder and its associated pulse generating circuitry. This circuitry produces 200 pulses for each revolution of the tuning control. At slow tuning speeds, each pulse increments the synthesizer 10 Hz thus achieving a 2 kHz per revolution tuning rate.

As the tuning control is tuned faster, additional circuitry, which is monitoring the tuning speed, adds pulses at a rate dependent upon tuning speed. These additional pulses cause the synthesizer to increment more 10 Hz steps than would occur at a slower tuning speed for the same amount of dial rotation, thus increasing the tuning rate. The tuning rate increases to approximately 20 kHz per revolution at faster tuning rates allowing rapid frequency change over wide frequency excursions. This tuning rate change occurs gradually as tuning speed increases, so as to provide smooth continuous tuning. The automatically variable tuning rate eliminates the need for manual rate change switches.

### NOTES:

NOTES:

## SECTION 2

### BASIC SERVICE INFORMATION

#### 2-1. USING THE R4245 SERVICE MANUAL

The remainder of this manual is divided into several sections for clarity and ease of use. Each major section is written with the assumption that the preceding portions of the manual have been read and understood by the user.

Section 2 is introductory in nature, and provides a general discussion of operating theory, module location, troubleshooting techniques and tool requirements.

Section 3 contains complete information on each functional element of the R4245. This information includes detailed circuit description, parts list, component location and schematic diagram. This section of the manual is divided by functional element such as circuit board, module, chassis, etc. for the purpose of rapid circuit, component and problem identification.

Section 4 is a complete alignment procedure for the R4245, and includes test equipment requirements/recommendations and test point locations.

#### 2-2. LOCATING A MALFUNCTION

The modular design of the R4245 allows easy exchange of most of the printed circuit boards. All modules are easily removed with the exception of the Bandpass Filter Module, the VRTO boards and the Antenna Switch Module.

The first step in troubleshooting the R4245 should be isolation of the malfunction to the module or board level. Refer to Section 2-3 for a general discussion of theory of operation and determine which module (or modules) would cause the problem at hand. In most cases, the problem will involve only one board, and substituting a board known to be in good operating condition will easily isolate the problem. Locating problems on the filter module may require removing these boards from the chassis by removing the

bandswitch shaft and unsoldering the harness connections.

Once the problem has been isolated, refer to the appropriate portion of Section 3 for a full scale description of the circuit.

#### 2-3. GENERALIZED THEORY OF OPERATION

The following discussion covers the theory of operation of the R4245 in a general manner. Detailed circuit descriptions are found in Section 3 of the manual. Refer to figure 2-2 (R4245 Block Diagram) and figure 2-3 (R4245 Module Locations) for aid in following this discussion. The discussion is divided into three sections (receiver, frequency control and transceive functions) for clarity.

##### 2-3.1 RECEIVER SECTION

Incoming signals from the MAIN antenna input first pass through the RP-700 receiver protector, through the antenna switch and finally through a bandswitched bandpass filter module, the limits of which are defined by the front panel BAND switch. Incoming signals from the ALTERNATE or CONV inputs are routed through the antenna switch and bandpass filter module.

The bandpass filter output is routed to a preamplifier which may be switched in or out as desired. The output of the preamp along with the 25 kHz calibrator output is connected to the input of the Up-Converter. Signals at the input of the Up-Converter module are mixed with the output of the synthesizer VCO to create a 48.05 MHz intermediate frequency (IF) signal. Conversion is accomplished by a high-level, double-balanced mixer to provide a very wide dynamic range. The output of this mixer is amplified by a low-noise, high dynamic range junction FET amplifier to insure adequate receiver sensitiv-

ity. This stage is followed by a four-pole monolithic 48.05 MHz crystal filter. The purpose of this filter is to attenuate signals removed more than  $\pm 4$  kHz from 48.05 MHz, thus protecting the remaining stages of the receiver from strong interfering signals. In this manner, optimum receiver dynamic range is preserved while providing excellent sensitivity.

The output of the Up-Converter module is routed to the input of the 2nd Mixer module. This module provides additional gain at the 48.05 MHz 1st IF frequency and converts this signal to the 5.645 MHz 2nd IF frequency. Additional gain is provided at 5.645 MHz in the selectivity positions designated .5 kHz and .3 kHz. This is to offset the loss added by these narrow accessory filters. Automatic gain control (AGC) voltage is applied to the 1st IF amplifier to supplement the control range supplied by later stages.

The 5.645 MHz signal from the 2nd Mixer module is routed through the noise blanker module to the IF Selectivity Module. The noise blanker acts on noise pulses prior to the IF crystal filters to prevent ringing in these filters from stretching the pulses. Maximum noise blanker effectiveness is thus assured.

The IF Selectivity module contains provisions for four crystal filters in addition to the standard 2.3 kHz filter. These filters determine the overall bandwidth of the receiver, and are selected by PIN diode switching controlled from the receiver front panel. Careful attention has been given to the switching circuit design and physical layout of this module to minimize stray coupling paths which would degrade the ultimate selectivity of the receiver. The result is extremely high rejection of unwanted off-channel signals.

Following the IF Selectivity module, the 5.645 MHz signal is routed to the 2nd IF module. This module amplifies the 5.645 MHz signal and converts it to 50 kHz, after which it passes through the notch filter circuitry and further amplification. The signal is then demodulated using an AM or product detector, depending on mode.

The demodulated signal is then amplified to a level sufficient to drive a speaker by an integrated circuit audio amplifier. AGC voltage, developed prior to demodulation, is used to control the gain of the IF

stages. The same AGC signal is used to drive the S-meter circuit to provide signal strength indication. AGC decay time constants are selected by the front panel AGC switches.

## 2-3.2 FREQUENCY CONTROL

The R4245 features synthesizer control of the operating frequency. This gives the receiver continuous frequency coverage from 10 kHz to 30 MHz without the use of range crystals or other frequency determining elements.

The reference for the synthesizer is generated by a 40 MHz crystal oscillator on the PBT/Reference board. The output of this oscillator is first divided by 5 to produce 8 MHz. The 8 MHz output is then divided by 16 to produce 500 kHz. The 500 kHz is divided by 10 to produce 50 kHz. And finally, the 50 kHz is divided by 2 to produce 25 kHz.

The 40 MHz and 500 kHz signals are routed to the synthesizer boards, which are described later in this section. When CAL is depressed, the 25 kHz signal is derived which is rich in harmonics. This signal is injected into the input of the Up-Converter board and produces calibration markers at 25 kHz intervals.

The passband tuning control is connected to a 13.695 MHz voltage-controlled crystal oscillator (VCXO). By adjustment of this control, the frequency of the oscillator is moved over a limited range (approximately  $\pm 3$  kHz) centered on 13.695 MHz. This signal is then mixed with the 40 MHz crystal oscillator signal to produce 53.695 MHz. The 13.695 MHz signal is also mixed with an 8 MHz signal derived from the 40 MHz divider chain to produce 5.695 MHz. The BFO, derived from the 40 MHz divider chain, is a fixed frequency 50 kHz signal.

The 53.695 MHz (nominal) signal is the injection for the 2nd Mixer board, which converts the 48.05 MHz 1st IF signal to 5.645 MHz (nominal), 2nd IF. This signal is then mixed with the 5.695 MHz (nominal) 3rd L.O. to produce 50 kHz, 3rd IF.

Since the 13.695 MHz (nominal) oscillator is used to generate both signals, it can be moved in frequency without changing the receiver operating frequency. Therefore, as the third mixer injection frequency is changed (by changing the PBT control voltage), the 53.695 MHz (nominal) injection signal is changed by an equal amount. This allows the 2nd IF to be positioned anywhere within a  $\pm 3$  kHz range with respect to the crystal filter passband while the receiver remains tuned to the incoming signal. This technique provides the passband tuning feature.

Injection for the Up-Converter board is supplied by the VCO board. This board includes a voltage controlled oscillator (VCO) which operates over the range of 48.05 MHz to 78.05 MHz. When mixed with the 0-30 MHz incoming signals, the result is the 48.05 MHz 1st IF frequency. The VCO is tuned by a filtered control voltage derived from a phase detector which compares the frequency and phase of the 500 kHz reference from the PBT/Reference board and the 500 kHz from the Translator board.

The Translator board combines the 40 MHz reference signal and the synthesized 5.05-5.55 MHz output of the VRTO which is controlled by the main tuning dial. The resulting 45.05 MHz to 45.55 MHz signal is filtered and mixed with the VCO signal to produce a 3 MHz to 33 MHz signal, depending on operating frequency. This signal is filtered, amplified and applied to the programmable divider (+N) which is programmed by the Digital Control board. The output of the +N is exactly 500 kHz when the VCO is tuned to the correct frequency, thus satisfying the phase detector and locking the loop.

The Digital Control board generates programming information for the +N by processing information from both the band switch and the frequency programmer on the VRTO Digital board. The BAND switch information generates the proper +N load number for the frequency range preset when the bandswitch is changed. The frequency programmer is then used to increment this load number UP or DOWN by the desired amount as the UP or DOWN pushbuttons are used.

The following example will help to illustrate the operation of the synthesizer:

Operating Frequency:	12.2835 MHz
	<u>+48.0500 MHz</u>
VCO Frequency:	60.3335 MHz
VRTO Frequency:	
5.05 MHz + 0.2835 MHz =	5.3335 MHz
	<u>+40.0000 MHz</u>
Variable Reference Frequency:	45.3335 MHz
+N Input Frequency:	
60.335 MHz - 45.335 MHz =	15 MHz
+N Output	.5 MHz
(Load Number = 30)	

It can be seen from the above that for each time the +N load number is increased or decreased by one, the VCO frequency will be forced to change by 500 kHz to satisfy the phase detector and maintain a locked condition. By the same token, as the VRTO is tuned, the VCO must follow exactly to maintain phase lock.

The 5.05 to 5.55 MHz signal from the VRTO is generated in the following manner. A 50.5 to 55.5 MHz VCO on the VRTO VCO board is mixed with a 46.5 to 46.510 MHz VCXO signal. The resulting 4 to 9 MHz IF signal is prescaled by two and then divided by a three stage programmable divider. When the loop is locked, the programmable divider output is 5 kHz and is used as one input to the phase/frequency detector. A 5 kHz reference signal for this phase detector is generated from the 40 MHz standard oscillator.

It can be seen that if the programmable divider division is changed by 1, the VCO frequency must move 10 kHz to maintain lock. Correction voltage from the phase/frequency detector controls the VCO to maintain lock when the divider programming is changed.

The VCO output is also divided by 10 to obtain the 5.05-5.55 MHz VRTO output. Thus, the divided output changes 1 kHz for each change of 1 of the programmable divider.

To obtain finer than 1 kHz resolution, the 46.5 MHz oscillator in the VRTO loop is tuned over a 10 kHz range by a varicap driven from a digital to analog converter. This 10 kHz range translates to a 1 kHz range after the VCO output is divided by 10. Because

the D-A converter provides 100 discrete levels, the smallest tuning increment becomes  $1 \text{ kHz} \div 100$  or 10 Hz.

The twelve BCD programming lines to the three stage programmable divider plus the eight BCD input lines to the 100 step D-A converter for the 46.5 MHz VCXO provide a total of twenty frequency control lines for the VRTO. These lines represent the 100 kHz, 10 kHz, 100 Hz, and 10 Hz digits of the frequency programming. This programming information is obtained from the VRTO Digital board counter chain.

This counter is preset at band center when power is applied and is then incremented up or down by pulses from the main tuning control shaft encoder.

A detector and pulse generator circuit add additional pulses to increment the counter chain when the tuning dial speed exceeds a certain threshold, thus automatically increasing the tuning rate at higher tuning speeds.

The BCD frequency information from the VRTO counter chain is also applied to decoder-drivers which in turn drive the LED frequency readout. The 10 MHz and 1 MHz display information is decoded from the main synthesizer load number information by a ROM and other decoding circuitry.

### 2-3.3 TRANSCEIVE FUNCTIONS

Circuitry which allows the R4245 to operate with the TR4310 in a transceive configuration is built into the R4245. The accessory transceive cable kit, Model 1548, includes the four interconnecting cables between the R4245 and TR4310. (See Section 1 of this manual, pages 1-4 and 1-5). A brief discussion of the transceive functions follows.

The transceive control cable interconnects the R4245 and TR4310 12 pin accessory connectors. This cable supplies the R4245 with 40 MHz reference from the TR4310. See section 3-11 for further discussion. The

cable also provides the TR4310 with the R4245 VRTO during receiver controlled transmit (RCT) mode. The VRTO buffer and output switching is covered in section 3-4. The audio mix cable connects the TR4310 audio to the R4245 internal audio amplifier (Section 3-4). With the transceive control cable connected to both the TR4310 and R4245, the R4245 will mute during transmit only with button depressed, and will operate continuously with button out. The circuitry involved is covered in Sections 3-1 and 3-12. A sampling of R4245 audio is supplied through a 100 ohm resistor to the TR4310 anti-VOX circuitry. This is shown in figure 3-3. The remaining two cables are used to interconnect the R4245 and TR4310 antenna switching ports. (See Section 1 of the Manual, figure 1-3).

## 2-4. SPECIAL TOOLS AND FIXTURES

A special set of tools and fixtures is available for servicing the R4245. This set includes all unique board extenders, a jumper board, and alignment tools needed to troubleshoot and align the receiver. This kit is available from the R. L. Drake Company for a nominal fee.

### 2-4.1 BOARD EXTENDERS

In order to extend a circuit card out of the card cage for servicing, refer to figure 2-1 and select the proper board extenders from the table. Remove the circuit card to be tested, install the board extenders so that each pin of each circuit card connector is extended, and reinstall the circuit card on the extenders. To service a card located underneath the VRTO Digital board, remove it and replace with the jumper board included in the service kit.

#### NOTE

Performance of the R4245 will be degraded when some cards are extended. After replacing a faulty component or otherwise correcting a problem, the receiver should be realigned in accordance with Section 4 with all the boards in place in the card cage.

**EXTENDER TYPE AND NUMBER REQUIRED**

CIRCUIT CARD	3 PIN	4 PIN	5 PIN	6 PIN	9 PIN	.100 SPACING			
						5 PIN	8 PIN	10 PIN	12 PIN
Aux. Program Board		1	1	1	1				
Digital Control (See Note 1)		1	1	1	1				
Audio/VRTO Buffer (See Note 2)	1	2	1	1					
Up-Converter	2								
VCO (See Note 2)	1	1			1				
Translator (See Note 3)	2				1				
2nd Mixer	2	1							
Noise Blanker		1		1					
IF Selectivity	3								
PBT/Reference	1	1		1	2				
2nd/3rd IF/AGC	1	2	1	1	1				
+13.8 VDC Regulator				2					
+25, +10, +5, -5 VDC Power Supply (See Note 4)									
VRTO Digital Board				2	1				
VRTO VCO							1	1	
VRTO $\pm$ N/Mixer								1	1

**NOTES**

1. Use a 9 pin extender on translator end of jumper board.
2. Extend jumper board with (2) 6 pin and (1) 9 pin extenders
3. Use (2) 6 pin extenders on Digital Control end of jumper board.
4. Limit Operating time to 15 minutes due to lack of heat sink.

*Fig. 2-1 Board Extender Selection Chart*

**NOTES:**

NOTES:

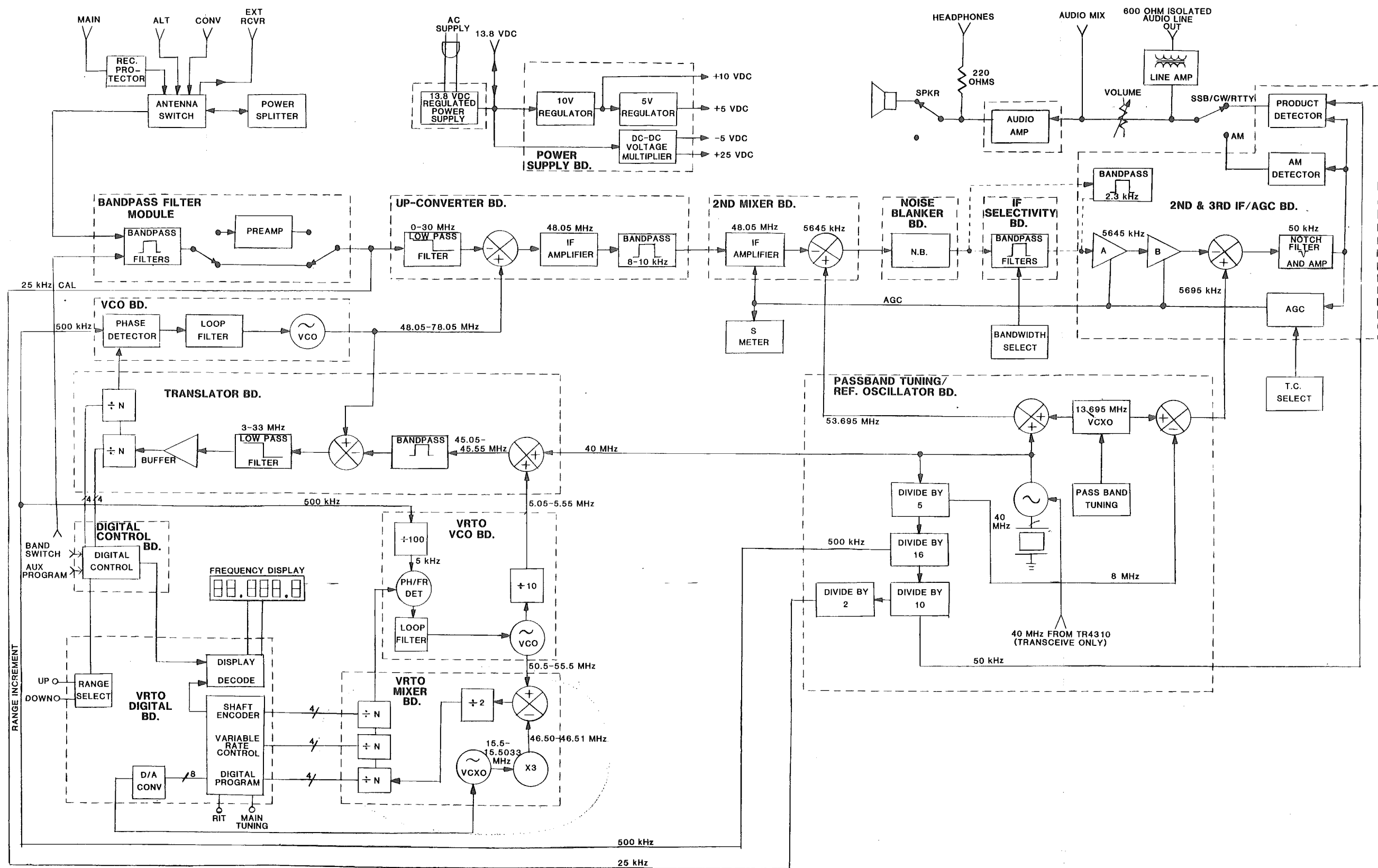
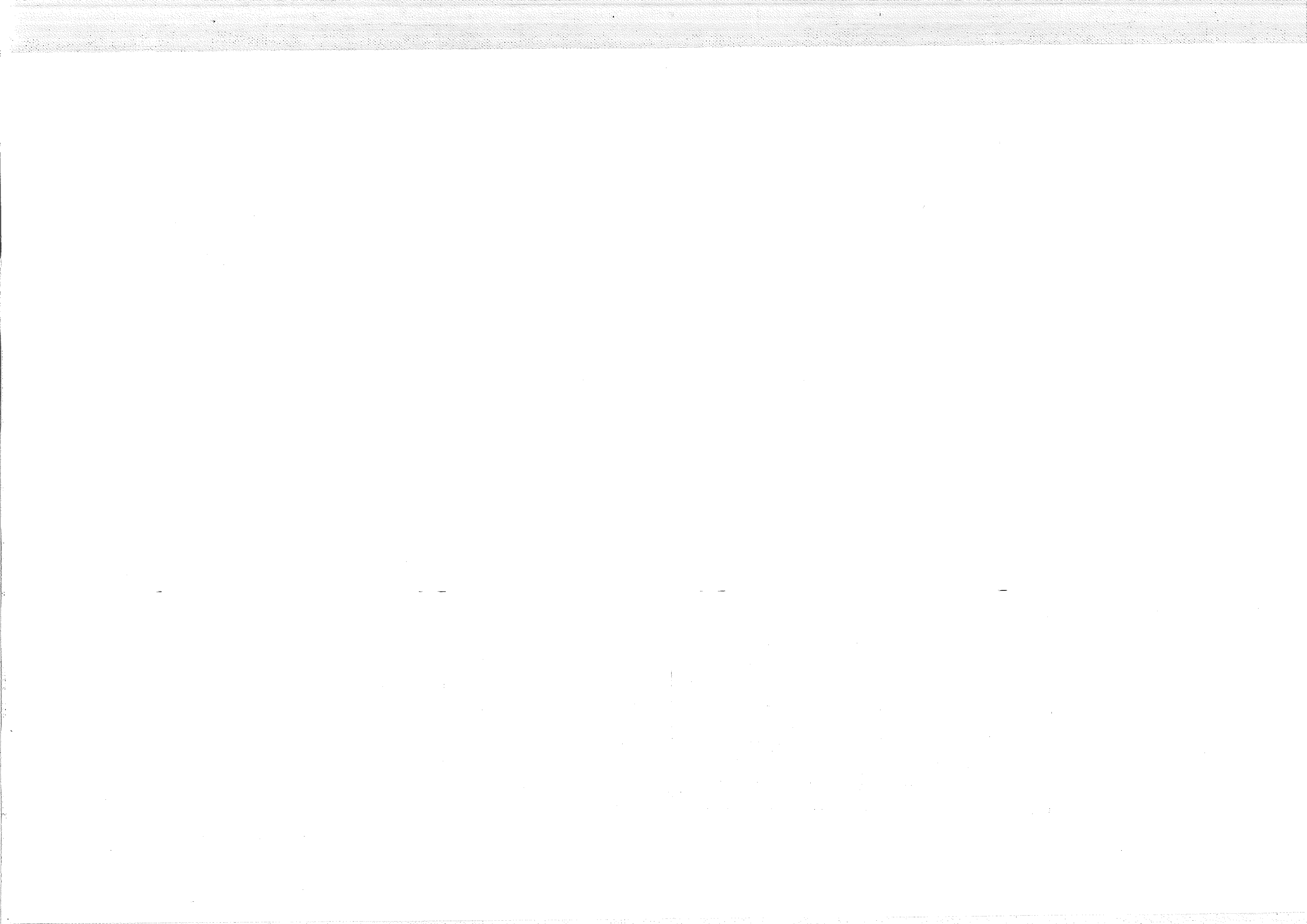


Fig. 2-2 R4245 Block Diagram



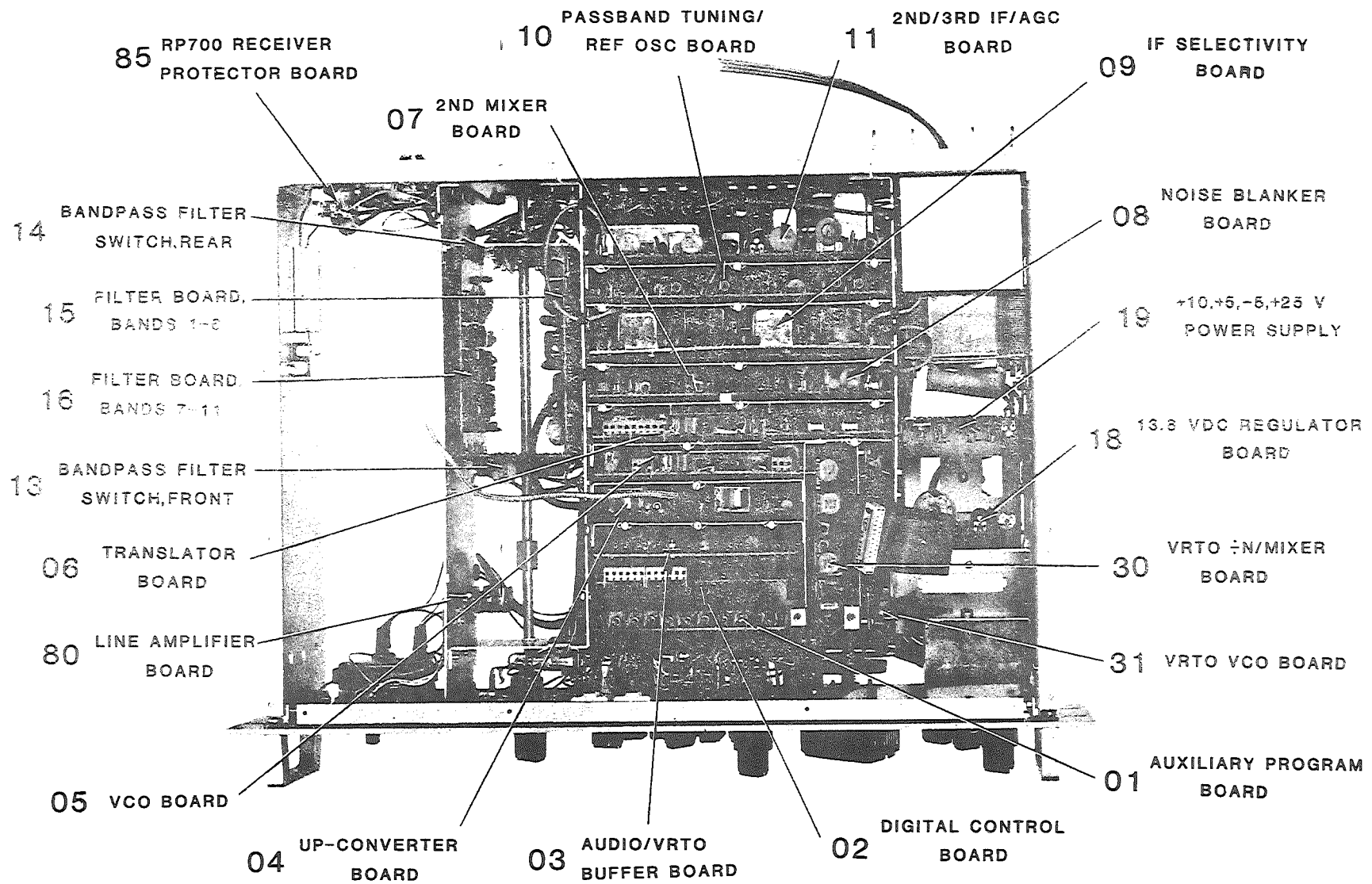


Fig. 2-3 R4245 Module Locations

NOTES:

## SECTION 3

### CIRCUIT DESCRIPTION

#### 3-1. PARENT BOARD/CHASSIS

The Parent Board and Chassis (Wiring Harness) combine to interconnect the various circuit cards and modules in the R4245. Refer to figure 3-3 for schematic and figure 3-1 for parts location information. Figure 3-1 also identifies the major interconnection circuits on the Parent Board as an aid for troubleshooting and alignment.

Each circuit board/module has been assigned an identifying number for circuit description and parts identification purposes in accordance with the following list:

IDENTIFICATION PREFIX	CIRCUIT BOARD/ MODULE
00	Parent Board
01	Auxiliary Program Board
02	Digital Control
03	Audio/VRTO Buffer
04	Up-Converter
05	PLL/VCO
06	Translator
07	2nd Mixer
08	Noise Blanker
09	IF Selectivity
10	Passband Tuning/Reference
11	2nd/3rd IF/AGC
12	Jumper
13	Band Pass Filter Switch, Front
14	Band Pass Filter Switch, Rear
15	Band Pass Filter, Bands 1-6
16	Band Pass Filter, Bands 7-11
17	Antenna Splitter
18	+13.8 VDC Regulator
19	+25, +10, +5, -5 VDC Regulator
30	VRTO +N/Mix
31	VRTO VCO Board
32	VRTO Digital Board
34	VRTO Parent Board
80	Line Amp Module
85	RP700 Receiver Protector

The identification prefix is used whenever referring to a particular circuit card. For example, the designator for resistor number 25 on the Passband Tuning/Reference board is R1025. Pin 16 on the same card is numbered 10/16. Figures 3-1 and 3-3 include these identification prefixes for reference.

Refer to figure 2-2 to aid in following the signal flow through figure 3-3. Note that several power and/or control lines are identified by function. For example, the notation +10 CAL indicates that +10 VDC is present on this line when the calibrator is enabled. It is possible to isolate a large number of faults to the board level by making the necessary measurements on the Parent Board, utilizing figures 3-1 and 3-3 for location information.

The VFO switching circuitry selects the frequency controlling signal of the R4245 and applies this signal to pin 38 of the Translator board. Frequency control can be derived from one of three sources: the internal VRTO, the crystal controlled oscillator on the AUX7 (for fixed frequency operation), or pin 7 of the accessory connector on the rear panel. Pin diodes CR6 through CR9 select the desired signal and couple it through C6 to the Translator board. Since R33 is a common DC return for all the pin diode switches, back bias is automatically applied to the unused signal paths.

The muting circuit is comprised of Q2 and Q3 with associated circuitry. When the R4245 stands alone, and the mute button is enabled, the R4245 will mute. If then, the transceive cable from the TR4310 is inserted, the R4245 will mute only when the TR4310 goes to transmit. Disabling the mute button when transceiving will inhibit the muting circuitry in transmit and the R4245 will not mute.

R17/C2 and R18/C1 are the slow AGC timing components selected via the front panel switches S5C and S5D. These switches provide fast, medium, and slow AGC speeds depending upon the combination selected by the front panel switches.

Q1 is a transistor switch which enables the RCT lamp during transceive operation with the TR4310 RCT pushbutton depressed. Thus RCT lamp indicates when R4245 VRTO is actually controlling TR4310 operating frequency.

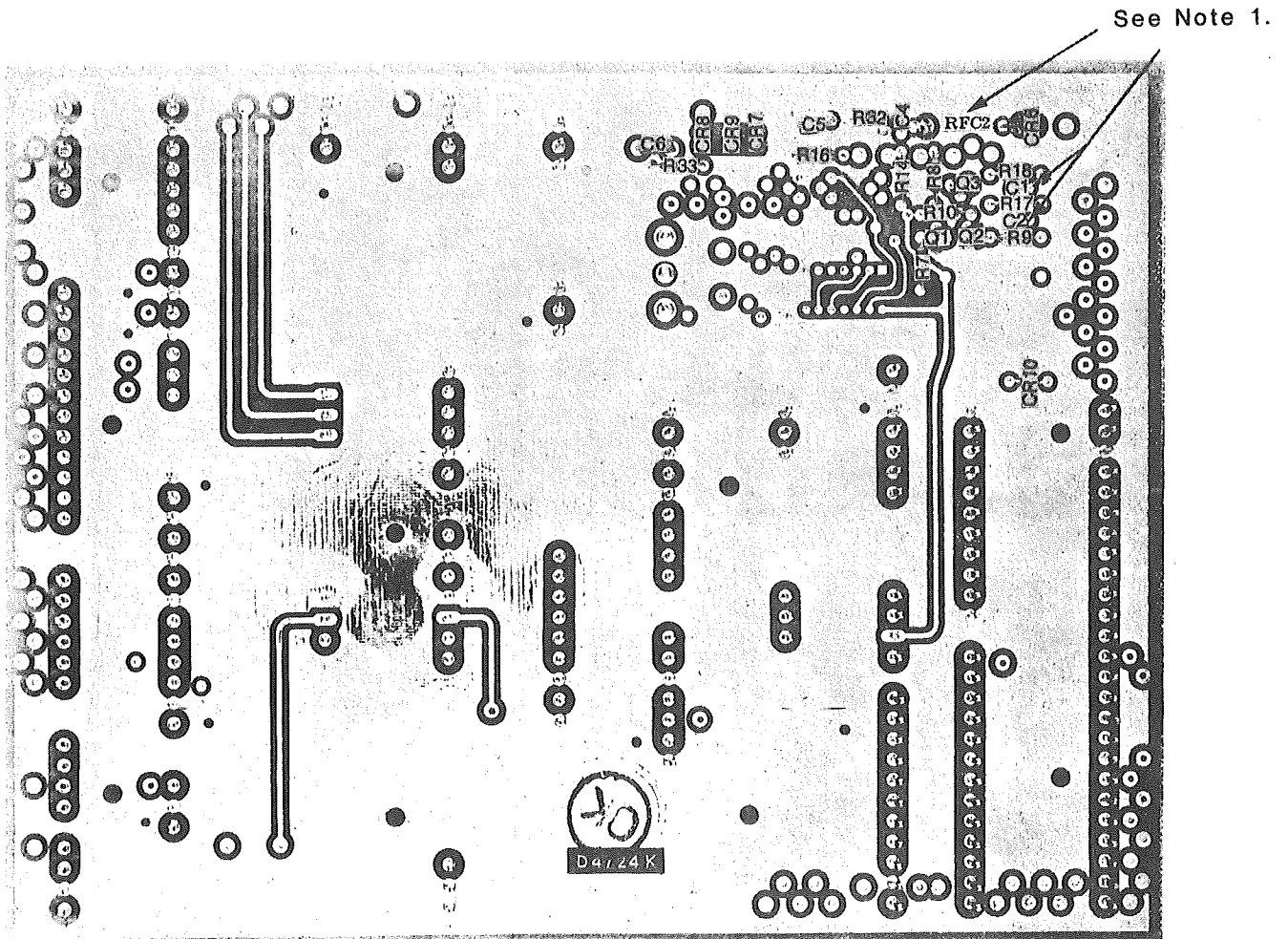
NOTES:

## PARENT BOARD/CHASSIS

REF DES	DESCRIPTION	PART NO.
C1	Capacitor, Tantalum, .22 $\mu$ F $\pm$ 10%, 35 V	3183100
C2	Capacitor, Tantalum, .22 $\mu$ F $\pm$ 10%, 35 V	3183100
C3	Capacitor, Disc, .05 $\mu$ F + 80%, 16 V	3161600
C4	Capacitor, Tantalum, .22 $\mu$ F $\pm$ 10%, 35 V	3183100
C5	Capacitor, Disc, 100 pF $\pm$ 10%, 500 V	3161070
C6	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C7	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C8	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C9	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C10	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C11	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C12	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C13	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C14	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161390
C15	Capacitor, Disc, .001 $\mu$ F $\pm$ 29%, Z5U	3161390
CR1	Diode, M4G5	3020260
CR2	Diode, M4G5	3020260
CR5	Diode, MR501	3020270
CR6	Diode, MPN3404	3020265
CR7	Diode, MPN3404	3020265
CR8	Diode, MPN3404	3020265
CR9	Diode, MPN3404	3020265
CR10	Diode, 1N4148	3020090
DS1	Lamp, Miniature	3471905
DS2	Lamp, Miniature	3471905
DS3	Lamp, Miniature	3471905
DS4	Lamp, Miniature	3471905
DS5	Lamp, #53	3470053
DS6	Lamp, #53	3470053
F1	Fuse, 3/4 Amp Sol-Blo, 3AG	3420080
F2	Fuse, 3 Amp, Standard, 3AG	3420130
J1	Jack, Phone	3281020
J2	Jack, DC In/Out	3281732
J3	Receptacle, Phono, 4 P 174	3281710
J4	Receptacle, Phono, 4 P 174	3281710
J5	Receptacle, Phono, 4 P 174	3281710
J6	Receptacle, Phono, 4 P 174	3281710
J7	Receptacle, Phono, 4 P 174	3281710
J8	Receptacle, Phono, 4 P 174	3281710
J9	Receptacle, Phono, 4 P 174	3281710
J10	Receptacle, Phono, 4 P 174	3281710
J11	Connector, Socket, S312AB	3280560
J12	Jack, Phone, Close Circuit	3221030
M1	Meter, R4245	3580300
Q1	Transistor, TIP33	3030390
Q2	Transistor, 2N3904	3030105
Q3	Transistor, 2N3904	3030105
Q4	Transistor, 2N3904	3030105
R3	Resistor, Variable, Dual Section, 10K/10K	3260648
R4	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R5	Resistor, Carbon Film, 82 $\Omega$ $\pm$ 5%, 1/4 W	3220050

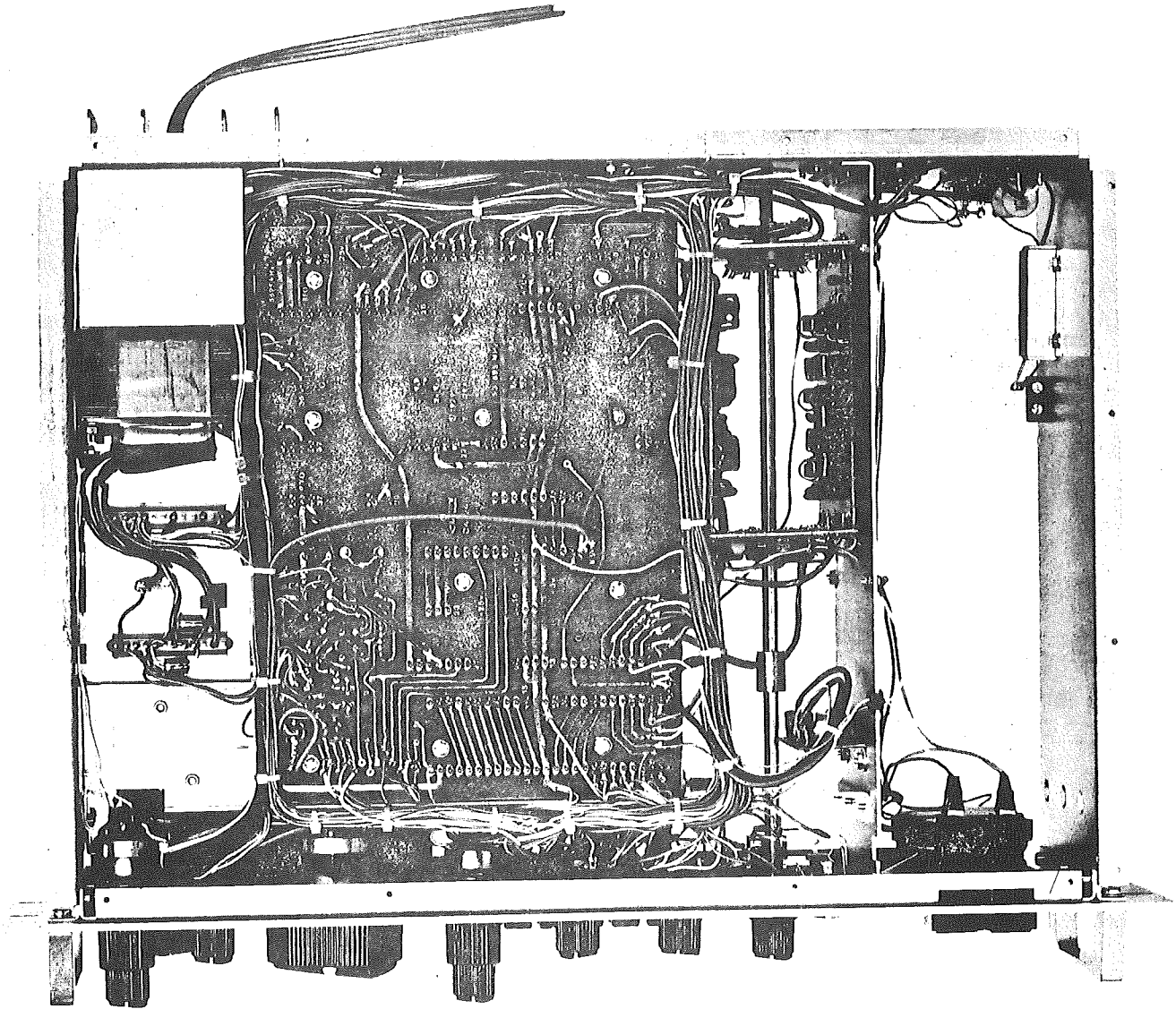
REF DES	DESCRIPTION	PART NO.
R7	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R8	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R9	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R10	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R11	Resistor, Variable, Dual Section, 3K/10K	3260646
R12	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R13	Resistor, Carbon Film, 220 $\Omega$ $\pm$ 5%, 1/4 W	3220075
R14	Resistor, Carbon Film, 12 K $\Omega$ $\pm$ 5%, 1/4 W	3220240
R15	Resistor, Variable, 10 K $\Omega$	3260710
R16	Resistor, Carbon Film, 3.9 K $\Omega$ $\pm$ 5%, 1/4 W	3220205
R17	Resistor, Carbon Film, 33 K $\Omega$ $\pm$ 5%, 1/4 W	3220275
R18	Resistor, Carbon Film, 33 K $\Omega$ $\pm$ 5%, 1/4 W	3220275
R32	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R33	Resistor, Carbon Film, 470 $\Omega$ $\pm$ 5%, 1/4 W	3220110
R34	Resistor, Wire Wound, 2 $\Omega$ , 15 W, 5%	3250070
RFC1	Choke, 270 $\mu$ H, MUD271	3520590
RFC2	Choke, 270 $\mu$ H, MUD271	3520590
S1	Switch, Slide, DPDT	3670520
S2	Switch, Slide, DPDT	3670520
S3	Part of R11	
S4	Switch, Pushbutton, 6 Station	3670076
S5	Switch, Pushbutton, 6 Station	3670076
S6	Switch, Rotary, Aux. Program	3661000
S7	Switch, Rotary, IF Selectivity	3661072
S8	Switch, Rotary, Ant. Select	3661070
S9	Switch, Slide, DPDT, SS50 11/32	3670520
S10	Switch, Slide, DPDT, SS50 1/2	3670520
T1	Transformer, Power	3690430

NOTES:

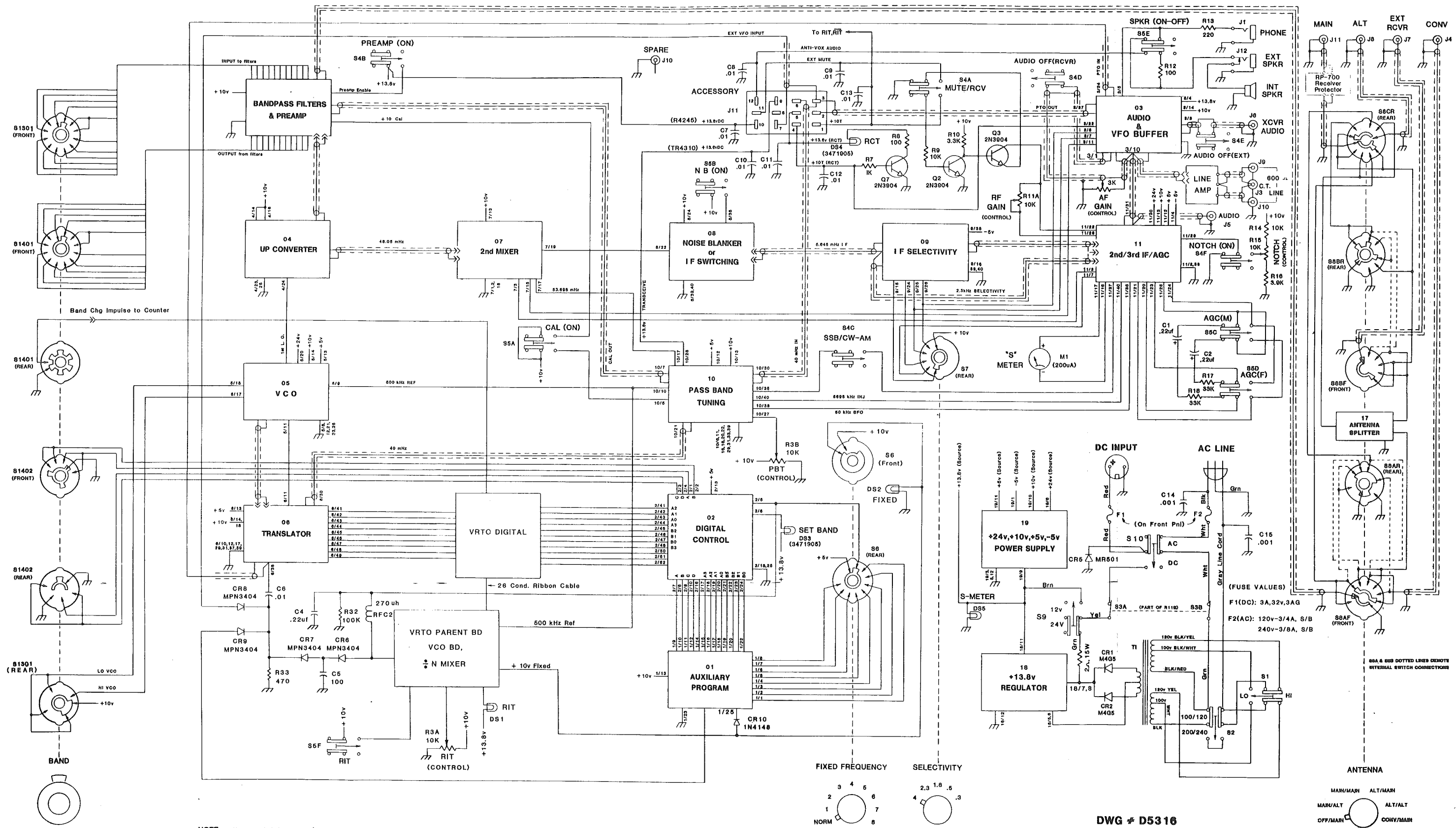


Note 1. Components on opposite side of board.

Fig. 3-1 Parent Board Pictorial (Top View)



*Fig. 3-2 Parent Board Pictorial (Bottom View)*



NOTE: All Rotary Switches Shown in Extreme CCW Position & All Push Button Switches Shown in The Released Position.

DWG # D5316  
R4245 Interconnection Schematic Diagram

Fig. 3-3 Parent Board/Chassis Interconnection Schematic

### 3-2. AUX7 AUXILIARY PROGRAM BOARD

In the R4245, the AUX7 provides for programming of up to eight fixed frequency channels. These channels are selected by the front panel FIXED FREQUENCY switch, which applies 5 volts to pins 1-8 of the board for channel selection and 10 volts to pin 25 of the board for oscillator bias. All eight channels are identical in operation, so the following discussion for channel 1 can be applied to any channel.

Channel 1 is selected by applying 5 volts to pin 1 of the AUX7 via the front panel FIXED FREQUENCY switch. This voltage is applied to pin 1 of the channel range module and to the anode of CR101 through R101. R101 sets the current through CR101, while R101 and C101 form an RF decoupling network. The current through CR101 effectively grounds one end of C102 and C103, thus enabling the channel 1 crystal (if installed).

The RRM-7 range modules are diode arrays arranged in such a manner that pin 1 is connected to the anode of all diodes. The cathodes of the diodes are connected to module pins 2 through 14. Thus, when 5 volts is applied to pin 1, approximately 4.3 volts will appear at all other pins of the modules which have

not been removed during range programming. See figure 3-4 for module programming information. In this manner, BCD data is supplied to the Digital Control module for band and range control. Band information is present on AUX7 pins 9 through 12, and range information is found on pins 15 through 22.

Whenever one of the eight FIXED FREQUENCY channels are selected (i.e. all positions 1-8, except NORM), 10 volts is applied to pin 25 of the AUX7. This voltage is applied through L101 (for RF decoupling) to the anode of CR109 thus enabling the fixed oscillator output, pin 24. At the same time, 10 volts is supplied to Q101, the fixed crystal oscillator stage, and Q102, the fixed output buffer stage, allowing these stages to operate. The output of the buffer (Q102) is routed through an attenuator consisting of R115, R116, and R117 to the anode of CR109, from which it is connected through the switching network on the Parent board to the Translator module in place of the VRTO signal.

The only alignment required in the AUX7 is the setting of C103, C106, C109, C112, C115, C118, C121 and C124, which are provided to set the eight fixed channel crystals exactly on frequency.

#### NOTES:

C=Cut off pin

RANGE	MODULE PIN NUMBERS														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
*0.0-0.5	TR4310 ONLY	C			C	C	C	C			C		C	C	
*0.5-1.0			C		C	C	C	C			C		C	C	
*1.0-1.5			C		C	C	C	C			C		C	C	
1.5-2.0	COMMON PIN. DO NOT REMOVE.			C	C	C	C	C			C		C	C	
2.0-2.5			C		C	C	C	C					C	C	
2.5-3.0				C	C	C	C	C					C	C	
3.0-3.5			C	C	C	C	C	C				C		C	
3.5-4.0				C	C					C		C	C		C
4.0-4.5			C	C	C						C		C		C
4.5-5.0						C					C				C
5.0-5.5			C			C							C		C
5.5-6.0				C		C							C		C
6.0-6.5			C	C		C							C		C
6.5-7.0					C	C							C		C
7.0-7.5			C		C	C							C		C
7.5-8.0				C	C	C							C		C
8.0-8.5			C	C	C	C							C		C
8.5-9.0				C	C		C						C		C
9.0-9.5			C	C	C		C						C		C
9.5-10.0						C	C						C		C
10.0-10.5			C			C	C								C
10.5-11.0				C		C	C								C
11.0-11.5			C	C		C	C								C
11.5-12.0					C	C									C
12.0-12.5			C		C	C	C								C
12.5-13.0				C	C	C	C								C
13.0-13.5			C	C	C	C	C								C
13.5-14.0				C	C			C							C
14.0-14.5			C	C	C			C	C	C	C				C
14.5-15.0						C		C	C	C	C				C
15.0-15.5			C			C		C	C	C	C			C	C
15.5-16.0				C		C		C	C	C	C			C	C
16.0-16.5			C	C		C		C	C	C	C			C	C
16.5-17.0				C	C		C	C	C	C			C	C	
17.0-17.5		C		C	C		C	C	C	C			C	C	
17.5-18.0			C	C	C		C	C	C	C			C	C	
18.0-18.5		C	C	C	C		C	C	C	C			C	C	
18.5-19.0			C	C		C	C	C	C	C			C	C	
19.0-19.5		C	C	C		C	C	C	C	C			C	C	
19.5-20.0					C	C	C	C	C	C			C	C	
20.0-20.5		C			C	C	C	C	C	C			C	C	
20.5-21.0			C		C	C	C	C	C	C			C	C	
21.0-21.5		C	C		C	C	C	C	C	C			C	C	
21.5-22.0				C	C	C	C	C	C	C			C	C	
22.0-22.5		C		C	C	C	C	C	C	C			C	C	
22.5-23.0			C	C	C	C	C	C	C	C			C	C	
23.0-23.5		C	C	C	C	C	C						C	C	
23.5-24.0			C	C				C	C				C	C	
24.0-24.5		C	C	C				C	C				C	C	
24.5-25.0					C			C	C				C	C	
25.0-25.5		C			C			C	C				C	C	
25.5-26.0			C		C			C	C				C	C	
26.0-26.5		C	C		C			C	C				C	C	
26.5-27.0				C	C			C	C				C	C	
27.0-27.5		C		C	C			C	C				C	C	
27.5-28.0			C	C	C			C	C				C	C	
28.0-28.5		C	C	C	C			C	C				C	C	
28.5-29.0			C	C		C		C	C				C	C	
29.0-29.5		C	C	C		C		C	C				C	C	
29.5-30.0					C	C		C	C				C	C	
0.0-0.5	R4245 ONLY	C			C	C	C	C							
0.5-1.0			C		C	C	C	C			C	C			
1.0-1.5			C	C		C	C	C	C			C			

LEAVE PIN ON MODULE FOR TRANSMIT. REMOVED AT FACTORY ON RRM.

\*Use VLF antenna input (pin 7 on accessory connector) for reception on these ranges. Transmission is not possible between 0.0 and 1.5 MHz. Band switch may be set to 1.5 MHz to extinguish set band indicator.

Fig. 3-4 RRM & RTM Module Programming

## AUXILIARY PROGRAM BOARD

REF DES	DESCRIPTION	PART NO.
C101	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C102	Capacitor, Disc, 27 pF $\pm$ 5%, NPO	3160650
C103	Capacitor, Variable, 5-20 pF	3205375
C104	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C105	Capacitor, Disc, 27 pF $\pm$ 5%, NPO	3160650
C106	Capacitor, Variable, 5-20 pF	3205375
C107	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C108	Capacitor, Disc, 27 pF $\pm$ 5%, NPO	3160650
C109	Capacitor, Variable, 5-20 pF	3205375
C110	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C111	Capacitor, Disc, 27 pF $\pm$ 5%, NPO	3160650
C112	Capacitor, Variable, 5-20 pF	3205375
C113	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C114	Capacitor, Disc, 27 pF $\pm$ 5%, NPO	3160650
C115	Capacitor, Variable, 5-20 pF	3205375
C116	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C117	Capacitor, Disc, 27 pF $\pm$ 5%, NPO	3160650
C118	Capacitor, Variable, 5-20 pF	3205375
C119	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C120	Capacitor, Disc, 27 pF $\pm$ 5%, NPO	3160650
C121	Capacitor, Variable, 5-20 pF	3205375
C122	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C123	Capacitor, Disc, 27 pF $\pm$ 5%, NPO	3160650
C124	Capacitor, Variable, 5-20 pF	3205375
C125	Capacitor, Mica, 500 pF $\pm$ 10%, DM-15	3170420
C126	Capacitor, Mica, 210 pF $\pm$ 5%, DM-15	3170230
C127	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C128	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C129	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C130	Capacitor, Disc, .01 $\mu$ F + 80%, 25 V	3161500
C131	Capacitor, Disc, 100 pF $\pm$ 10%, X5F	3161070
C132	Capacitor, Tantalum, .22 $\mu$ F $\pm$ 10%, 35 V	3183100
CR101	Diode, 1N4148	3020090
CR102	Diode, 1N4148	3020090
CR103	Diode, 1N4148	3020090
CR104	Diode, 1N4148	3020090
CR105	Diode, 1N4148	3020090
CR106	Diode, 1N4148	3020090
CR107	Diode, 1N4148	3020090
CR108	Diode, 1N4148	3020090
CR109	Diode, MPN3404	3020265
L101	Choke, 270 $\mu$ H, MUD271	3520590
Q101	Transistor, 2N3563	3030060
Q102	Transistor, 2N3563	3030060
R101	Resistor, Carbon Film, 1.0 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R102	Resistor, Carbon Film, 1.0 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R103	Resistor, Carbon Film, 1.0 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R104	Resistor, Carbon Film, 1.0 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R105	Resistor, Carbon Film, 1.0 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R106	Resistor, Carbon Film, 1.0 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R107	Resistor, Carbon Film, 1.0 K $\Omega$ $\pm$ 5%, 1/4 W	3220160

REF DES	DESCRIPTION	PART NO.
R108	Resistor, Carbon Film, 1.0 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R109	Resistor, Carbon Film, 18 K $\Omega$ $\pm$ 5%, 1/4 W	3220255
R110	Resistor, Carbon Film, 47 K $\Omega$ $\pm$ 5%, 1/4 W	3220285
R111	Resistor, Carbon Film, 1.0 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R112	Resistor, Carbon Film, 2.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220195
R113	Resistor, Carbon Film, 2.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220195
R114	Resistor, Carbon Film, 180 $\Omega$ $\pm$ 5%, 1/4 W	3220070
R115	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R116	Resistor, Carbon Film, 10 $\Omega$ $\pm$ 5%, 1/4 W	3220005
R117	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R118	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
	Socket, Crystal	3282020
	Socket, I.C.	3282104
U101	I.C., Diode Array BC-1206	3042100
U102	I.C., Diode Array BC-1206	3042100
U103	I.C., Diode Array BC-1206	3042100
U104	I.C., Diode Array BC-1206	3042100
U105	I.C., Diode Array BC-1206	3042100
U106	I.C., Diode Array BC-1206	3042100
U107	I.C., Diode Array BC-1206	3042100
U107	I.C., Diode Array BC-1206	3042100

NOTES:



### 3-3. DIGITAL CONTROL BOARD

The Digital Control board decodes the binary coded bandswitch information to provide frequency range programming and band control. In addition, it selects between normal and auxiliary frequency range programming. Refer to figure 3-8 for schematic and figure 3-7 for parts location information.

Binary coded band information from the bandpass filter module rear switch board is connected to Digital Control board pins 1 through 4 via the Parent board. This information is coded as follows (L=low; H=high):

BAND	PIN 1	PIN 2	PIN 3	PIN 4	DECIMAL CODE
0	H	H	H	H	15
0.5	L	L	H	H	12
1.0	H	L	H	H	13
1.5	L	H	L	L	2
2.0	H	H	L	L	3
4.0	L	L	H	L	4
6.0	H	L	H	L	5
8.0	L	H	H	L	6
12.0	H	H	H	L	7
16.5	L	L	L	H	8
22.0	H	L	L	H	9

This data is connected to the address inputs of a 32 × 8 PROM, U201, which directly converts the data to the correct synthesizer range programming numbers

corresponding to the band switch.

When the front panel FIXED FREQUENCY switch is in the NORM position, 5 volts is applied to module pin 5. This allows Q201 to provide a switched ground to pin 15 of U201. In this normal state, U201 pins 1 through 7 and 9, output preprogrammed range information to the synthesizer via the Jumper Board or VRTO Digital board.

When one of the eight FIXED FREQUENCY channels is selected, module pin 5 is disconnected from 5 volts, thus switching U201 outputs to the high impedance state. This action allows the information (from the AUX7) on the AUX INPUT lines 17 through 24 to program the synthesizer frequency range. At the same time, band information from the AUX7 (pins 7-10) is compared with the bandswitch information in the quad exclusive — or, U202. When both sets of data are equal, the outputs are all low, thus yielding a high output at U203 pin 1. This action causes a low output on U203 pin 13, thus turning off Q202 and extinguishing the SET BAND lamp. In the NORM mode, pin 9 of U203 is held in the HIGH state, forcing the output pin 13 of the NOR gate to stay low at all times, thus causing the SET BAND light to remain off.

The Digital Control board does not require alignment.

#### NOTES:

NOTES:

## DIGITAL CONTROL BOARD

REF DES	DESCRIPTION	PART NO.
Q201	Transistor, 2N3904	3030105
Q202	Transistor, 2N3904	3030105
R201	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R202	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R203	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R204	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R205	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R206	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R207	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R208	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R209	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R210	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R211	Resistor, Carbon Film, 3.9 K $\Omega$ $\pm$ 5%, 1/4 W	3220205
U201	I.C., 32 $\times$ 8 PROM	3040083
U202	I.C., MC14070BCP	3041059
U203	I.C., MC14002BCP	3041005

## NOTES:

NOTES:

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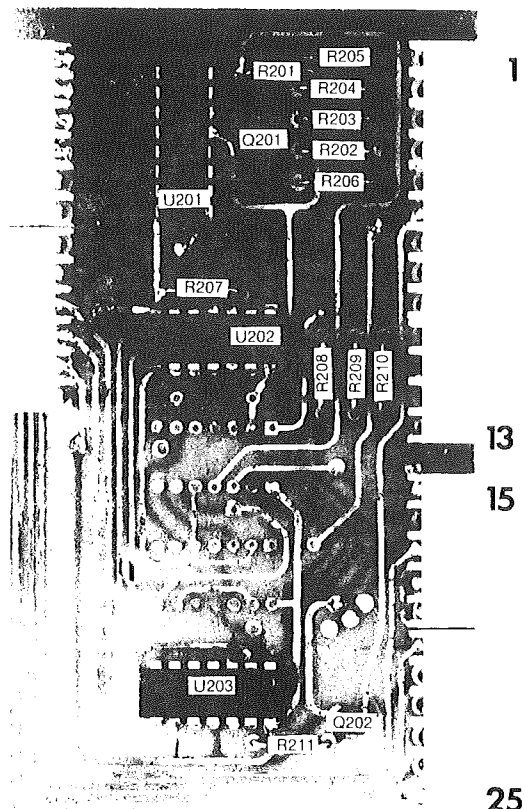


Fig. 3-7 Digital Control Board Pictorial

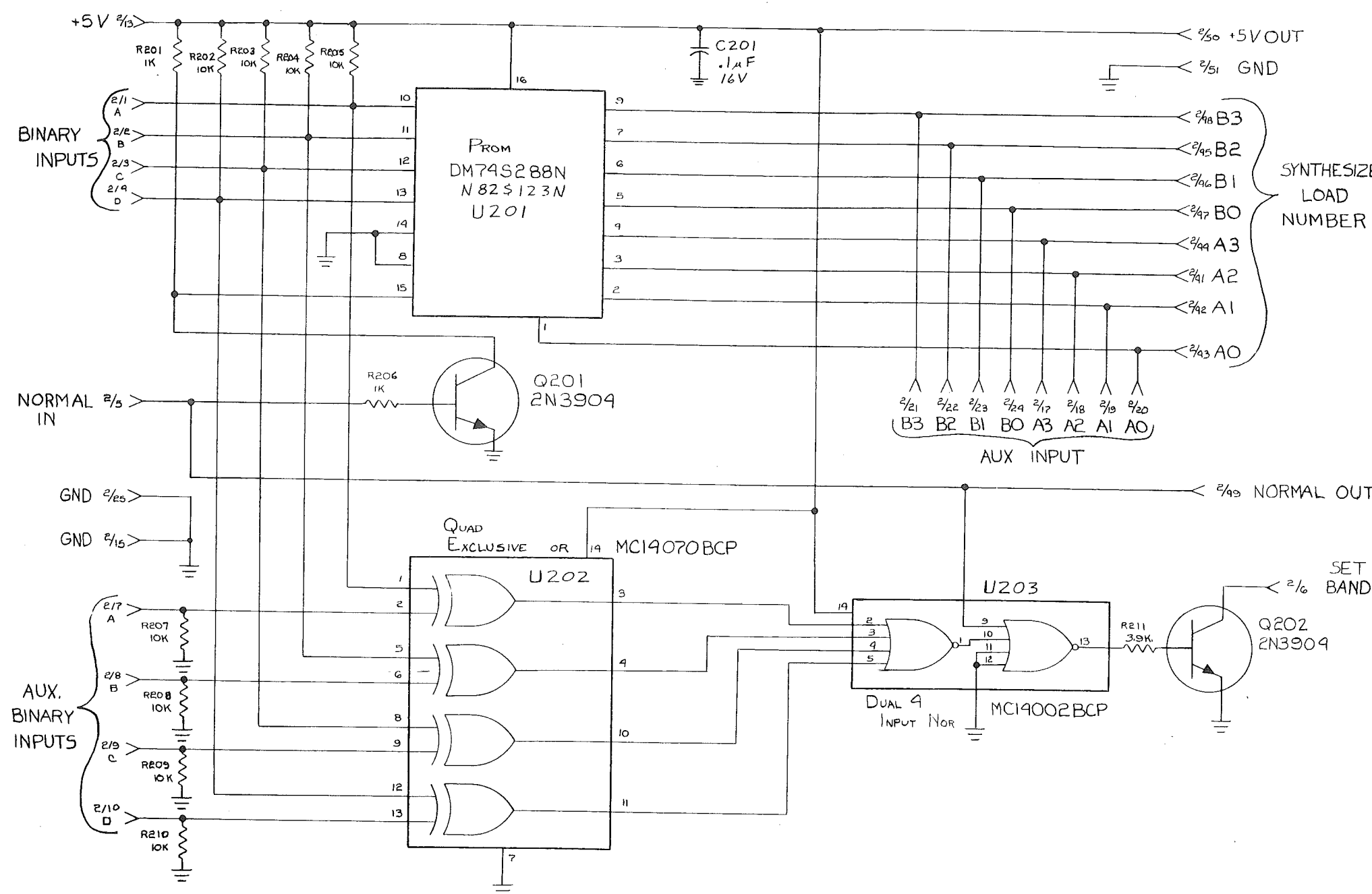


Fig. 3-8 Digital Control Board Schematic

### 3-4. AUDIO/VRTO BUFFER BOARD

This board contains circuitry for the final audio amplification, audio high frequency roll-off in the 0.5, 0.3 kHz IF selectivity positions, and buffering of the internal VRTO signal for transceive RCT function. Refer to figure 3-10 for schematic and to figure 3-9 for parts location information.

The audio amplifier portion of the schematic is centered around the audio amplifier integrated circuit, U301. Audio from the front panel volume control wiper is applied to module pin 1. C316, R311, R310, C306 and C308 provide audio shaping before amplification. R307, R308 and C309 provide feedback affecting circuit gain. C313 and R309 provide circuit stability with varying speaker loads. External audio from the XCV E AUDIO connector is padded by R315, R314, R313 and R312, and mixed with the internal R4245 audio.

When the front panel SELECTIVITY switch is placed in the 0.5 or 0.3 kHz positions, +10 V is present on module pins 3/6 or 3/7 respectively. This action causes the 5.645 MHz amplifier (located on 2nd Mixer board, Section 3-8) to switch to an increased gain mode. At the same time, Q302 is switched on, connecting C314 across the audio input to the top of the volume control. This action lowers the overall high frequency audio response.

Q301 and associated circuitry form a buffer amplifier to provide VRTO input to the TR4310 transceiver in the RCT mode. When +10 V (RCT) is applied to module pin 22, CR301 turns on through an identical diode and load resistor located in the TR4310, thus coupling R4245 VRTO to the TR4310 synthesizer.

#### NOTES:

**NOTES:**

## AUDIO/VRTO BUFFER BOARD

REF DES	DESCRIPTION	PART NO.
C301	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C302	Capacitor, Tantalum, .22 $\mu$ F $\pm$ 10%, 35 V	3183100
C303	Capacitor, Mica, 490 pF $\pm$ 5%, DM-15	3170410
C304	Capacitor, Mica, 490 pF $\pm$ 5%, DM-15	3170410
C305	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161510
C306	Capacitor, Disc, .05 $\mu$ F $\pm$ 80%, M16V	3161600
C307	Capacitor, Tantalum, .22 $\mu$ F $\pm$ 10%, 35 V	3183100
C308	Capacitor, Disc, 68 pF $\pm$ 5, NPO	3160950
C309	Capacitor, Electrolytic, 47 $\mu$ F, 16 V	3180125
C310	Capacitor, Electrolytic, 100 $\mu$ F, 15 V	3180290
C311	Capacitor, Electrolytic, 100 $\mu$ F, 15 V	3180290
C312	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161510
C313	Capacitor, Disc, .1 $\mu$ F $\pm$ 80%, Y5T	3161650
C314	Capacitor, Tantalum, .1 $\mu$ F $\pm$ 10%, 35 V	3183098
C315	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161510
C316	Capacitor, Disc, .05 $\mu$ F $\pm$ 20%, Z5U	3161630
C317	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C318	Capacitor, Disc, 47 pF $\pm$ 5%, NPO	3160840
C319	Capacitor, Electrolytic, 1 $\mu$ F, 50 V	3180008
CR301	Diode, MPN3404	3020265
CR302	Diode, 1N4148	3020090
CR303	Diode, 1N4148	3020090
L301	Coil, Axial, 2.2 $\mu$ H	3524208
Q301	Transistor, 2N3904	3030105
Q302	Transistor, 2N3904	3030105
R301	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R302	Resistor, Carbon Film, 18 K $\Omega$ $\pm$ 5%, 1/4 W	3220255
R303	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R304	Resistor, Carbon Film, 150 $\Omega$ $\pm$ 5%, 1/4 W	3220065
R305	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R306	Resistor, Carbon Film, 15 K $\Omega$ $\pm$ 5%, 1/4 W	3220245
R307	Resistor, Carbon Film, 180 $\Omega$ $\pm$ 5%, 1/4 W	3220070
R308	Resistor, Carbon Film, 5.1 $\Omega$ $\pm$ 5%, 1/4 W	3220003
R309	Resistor, Carbon Film, 3.3 $\Omega$ $\pm$ 5%, 1/4 W	3220002
R310	Resistor, Carbon Film, 47 K $\Omega$ $\pm$ 5%, 1/4 W	3220285
R311	Resistor, Carbon Film, 27 K $\Omega$ $\pm$ 5%, 1/4 W	3220270
R312	Resistor, Carbon Film, 47 K $\Omega$ $\pm$ 5%, 1/4 W	3220285
R313	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R314	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R315	Resistor, Composition, 15K $\Omega$ $\pm$ 10%, 1 W	3240010
RFC301	Choke Assy., 270 $\mu$ H, MUD271	3520590
RFC302	Choke Assy., 270 $\mu$ H, MUD271	3520590
T301	Inductor, Toroid	2510028

**NOTES:**

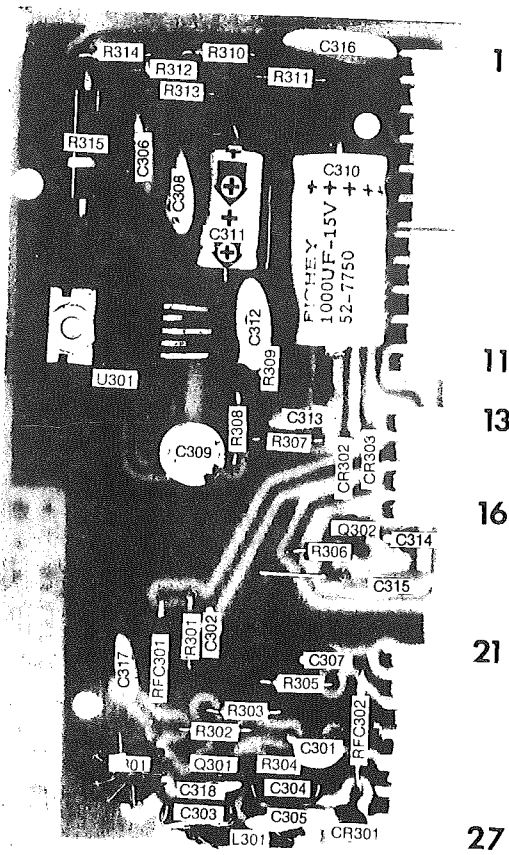
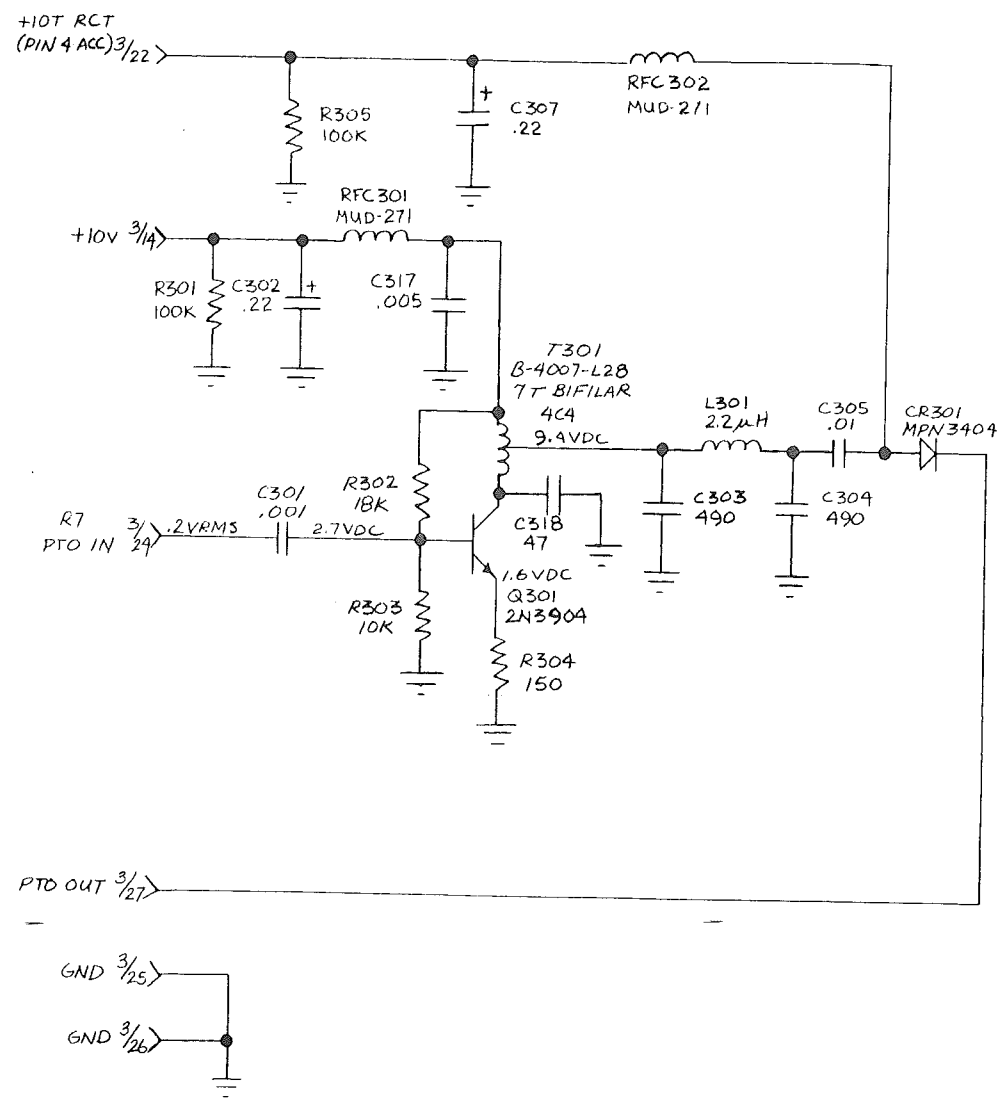


Fig. 3-9 Audio/VRTO Buffer Board Pictorial



HIGHEST NUMBERED CAPACITOR C319  
 HIGHEST NUMBERED RESISTOR R315

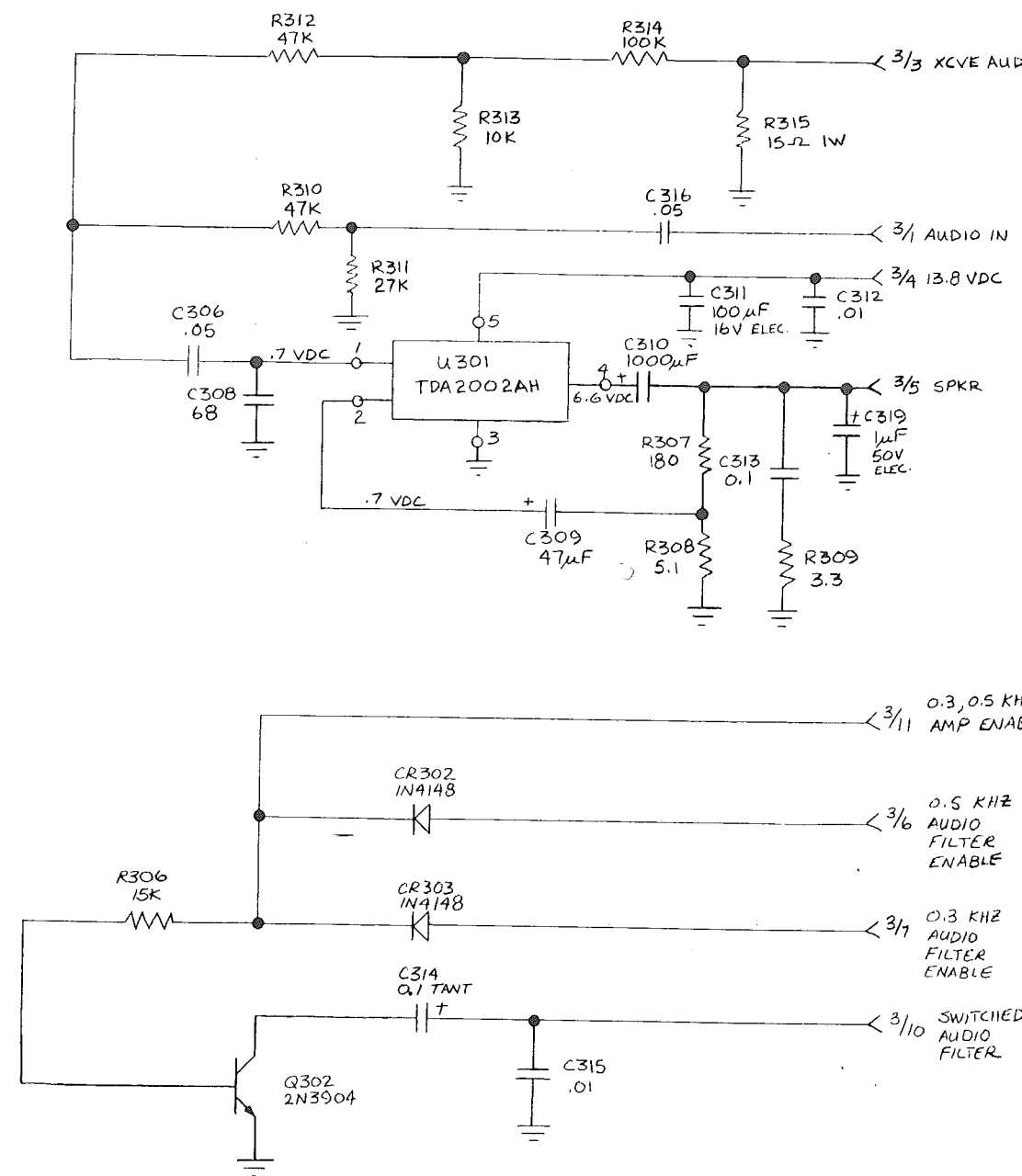


Fig. 3-10 Audio/VRTO Buffer Board Schematic

### 3-5. UP-CONVERTER BOARD

The Up-Converter board converts incoming received signals to the 1st IF of 48.05 MHz using the output of the synthesizer VCO. Refer to figure 3-12 for schematic and figure 3-11 for parts location information.

Received signals from the antenna are routed to the Up-Converter via the antenna switch and the Band Pass Filter module. These signals first pass through a master low pass filter consisting of C408-C415 and L402 and L404. This filter is employed to improve image and spurious response performance, and has a cut-off frequency of approximately 35 MHz. The output of this filter is connected to the signal input of a high-level double balanced mixer, which is a packaged, diode-ring device. The injection input of this mixer is driven by an amplifier, Q401, whose input is the output of the synthesizer VCO. Q401 is a broadband amplifier, with a flat passband over the 48-78 MHz injection range. R407, R408 and R409 form a pad to insure proper termination of both the amplifier and the mixer.

The 48.05 MHz difference signal is coupled from the IF port of the mixer to the source of IF amplifier Q402 through capacitor C416. C418 and the primary of T402 tune the output of Q402, and this signal is

coupled to the 48.05 MHz filter through the secondary of T402.

The 48.05 MHz filter module consists of two monolithic filter elements, each of which is a two-pole filter. Matching is accomplished by C419, C420 and L405 on one end, and C421, C422 and L406 on the other end. L405 and L406 are tuned at the factory using sophisticated equipment, and should not require readjustment unless a filter element is replaced. Nominal bandwidth of this filter is 8-12 kHz.

Due to high frequencies involved, proper grounding is very important on this module. If any shields are removed for servicing, be sure that they are replaced and soldered as originally produced. In addition, be sure that all eight grounding clips are properly installed. These clips may be soldered to the shield if necessary. Proper attention to these details will insure that spurious responses are minimized.

Alignment of this module is covered in Section 4.

#### NOTES:



NOTES:

## UP-CONVERTER BOARD

REF DES	DESCRIPTION	PART NO.
C401	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C402	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C403	Capacitor, Disc, .001 $\mu$ F, $\pm$ 20%, Z5U	3161380
C404	Capacitor, Disc, .001 $\mu$ F, $\pm$ 20%, Z5U	3161380
C405	Capacitor, Disc, .001 $\mu$ F, $\pm$ 20%, Z5U	3161380
C406	Capacitor, Disc, .001 $\mu$ F, $\pm$ 20%, Z5U	3161380
C407	Capacitor, Tantalum, 10 $\mu$ F $\pm$ 20%, 25 V	3183030
C408	Capacitor, Disc, .05 $\mu$ F, + 80%, M16V	3161600
C409	Capacitor, Disc, 100 pF, $\pm$ 5%, N750	3161060
C410	Capacitor, Disc, 68 pF, $\pm$ 5%, N750	3160990
C411	Capacitor, Disc, 33 pF, $\pm$ 5%, NPO	3160700
C412	Capacitor, Disc, 100 pF, $\pm$ 5%, N750	3161060
C413	Capacitor, Disc, 150 pF, $\pm$ 5%, N750	3161150
C414	Capacitor, Disc, 39 pF, $\pm$ 5%, NPO	3160760
C415	Capacitor, Disc, 82 pF, $\pm$ 5%, N750	3161040
C416	Capacitor, Disc, .01 $\mu$ F, + 80%, M25V	3161500
C417	Capacitor, Disc, .005 $\mu$ F, $\pm$ 20%, Z5U	3161470
C418	Capacitor, Variable Trimmer, 5.0-20 pF	3205375
C419	Capacitor, Disc, 9 pF, $\pm$ 5%, NPO	3160320
C420	Capacitor, Disc, 3.9 pF, 39, NPO5/32	3160090
C421	Capacitor, Disc, 3.9 pF, 39, NPO5/32	3160090
C422	Capacitor, Disc, 9 pF, $\pm$ 5%, NPO	3160320
L401	Inductor, Choke, Wide Band	2512526
L402	Inductor, Toroid	2510019
L403	Inductor, Toroid	2510019
L404	Inductor, Toroid	2510010
L405	Coil, Variable, 16-1/2T	3524106
L406	Coil, Variable, 16-1/2T	3524106
L407	Inductor, Choke, Wide Band	2512526
L408	Choke Assy., 5.6 $\mu$ H, L56G	3520510
Q401	Transistor, 2N3866	3030095
Q402	Transistor, J-310	3030501
R401	Resistor, Carbon Film, 270 $\Omega$ $\pm$ 5%, 1/4 W	3220085
R402	Resistor, Carbon Film, 2.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220195
R403	Resistor, Carbon Film, 680 $\Omega$ $\pm$ 5%, 1/4 W	3220140
R404	Resistor, Carbon Film, 22 $\Omega$ $\pm$ 5%, 1/4 W	3220015
R405	Resistor, Carbon Film, 10 $\Omega$ $\pm$ 5%, 1/4 W	3220005
R406	Resistor, Carbon Film, 10 $\Omega$ $\pm$ 5%, 1/4 W	3220005
R407	Resistor, Carbon Film, 270 $\Omega$ $\pm$ 5%, 1/4 W	3220085
R408	Resistor, Carbon Film, 22 $\Omega$ $\pm$ 5%, 1/4 W	3220015
R409	Resistor, Carbon Film, 270 $\Omega$ $\pm$ 5%, 1/4 W	3220085
R410	Resistor, Carbon Film, 10 $\Omega$ $\pm$ 5%, 1/4 W	3220005
R411	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R412	Resistor, Carbon Film, 6.8 K $\Omega$ $\pm$ 5%, 1/4 W	3220220
T401	Inductor, Toroid	2510003
T402	Inductor, Toroid	2510002
Y401	Crystal Filter Set	3140125



NOTES:

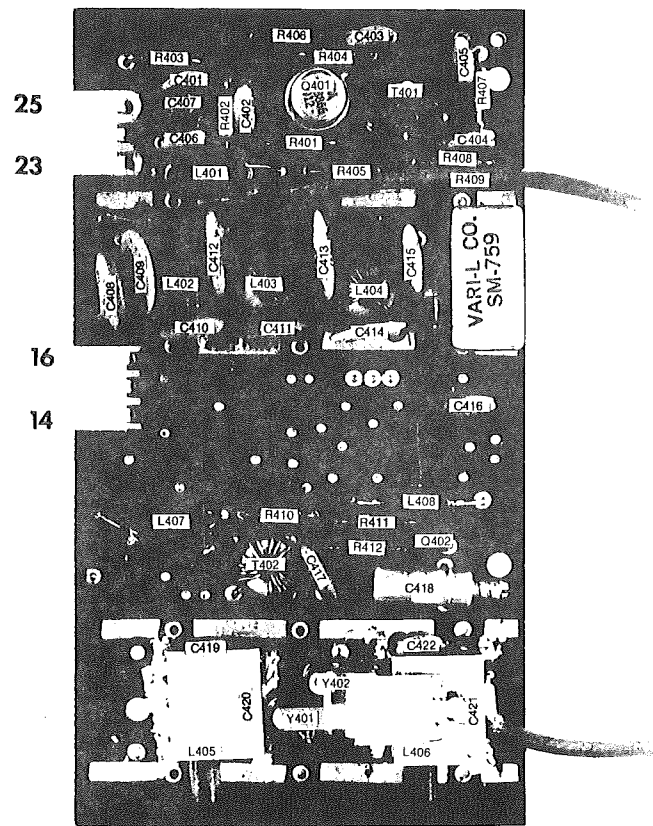


Fig. 3-11 Up-Converter Board Pictorial

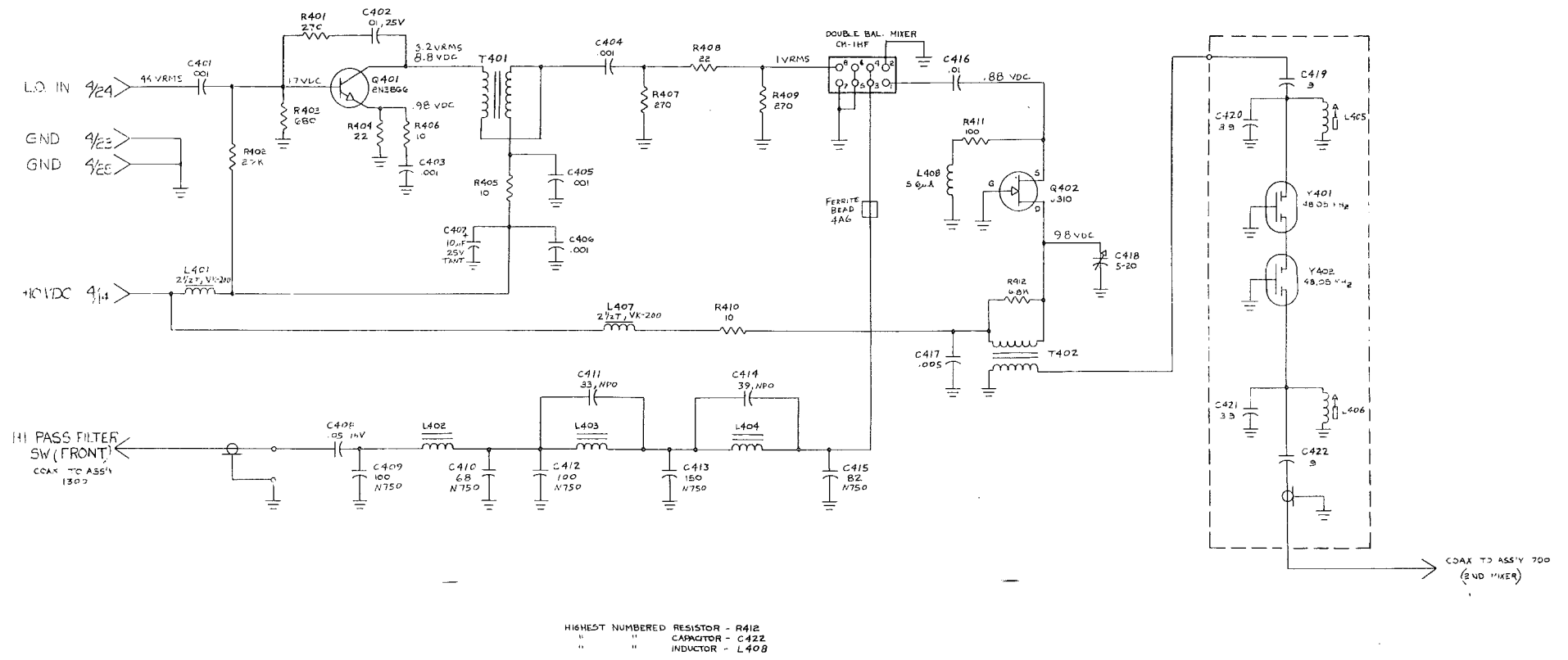


Fig. 3-12 Up-Converter Board Schematic

### 3-6. VCO BOARD

The VCO Board provides the injection signal to the Up-Converter board (Section 3-5), and includes the phase detector and loop filter portions of the synthesizer. Refer to figure 3-14 for schematic and figure 3-13 for parts location information.

The VCO actually consists of two oscillators; one for low band (0-15 MHz) operation, and one for high band (15-30 MHz) operation. The two oscillators are quite similar in design, and the following discussion of the low band VCO can be applied to the high band VCO as well.

Q501 and Q502 form a push-pull oscillator which is tuned by L501 and varactors CR503-CR506. The high band VCO uses one less varactor, since the operating frequency is higher. Power for the oscillator is obtained from the VCO select line, which comes from the bandswitch. A 5 VDC regulator, U501, is used to insure a well regulated and filtered power source. CR503-CR505 are controlled by the coarse tune line from the phase detector circuitry, and CR506 is controlled by the fine tune line. Two control lines are required to insure that the VCO will always tune to the correct frequency.

The VCO output is coupled through a buffer stage, Q503, and a PIN diode, CR507, to T503, which provides additional isolation between the VCO and other circuits in the transceiver. T504 splits the output of T503, and the resulting outputs drive the Up-Converter and Translator boards.

The low band VCO tunes between 48.05 and 63.05 MHz, corresponding to an operating range of 0 to 15 MHz. The high band VCO tunes between 63.05 and 78.05 MHz, corresponding to an operating range of 15 to 30 MHz.

Phase detector U503 compares the 500 kHz reference from the PBT/Reference board (Section 3-11) with the output of the programmable divider on the Translator board (Section 3-7). The phase detector output is filtered by R521, R522 and C538, and amplified, inverted and filtered by U504A and associated components. The output of U504A is the fine tune line.

U504B is biased by R538 and R539 to amplify the fine tune line when it exceeds 15 volts, indicating that it is approaching the end of its range. The output of U504B is the coarse tune line. Large excursions of this line cause CR515/517 or CR516/518 to conduct to allow a fast slew rate. When the synthesizer loop is locked, the diodes cease to conduct, allowing R533 and C524 to filter the coarse tune line.

When the synthesizer loop is out of lock, pulses are produced by the phase detector at pin 1. These pulses are amplified by Q507, and integrated by R527 and C543 to produce a DC level. C539 is used to filter noise spikes from the output of Q507 during the locked state. The DC level produced by this circuit is used to turn on Q508, thus providing a ground at pin 10 of the circuit board during out-of-lock conditions.

Alignment of the VCO board consists of setting L501 and L502 for proper oscillator range, and is covered in Section 4. If parts replacement is required, be sure to replace the shield and ground clip exactly as installed at the factory to insure proper synthesizer operation. In addition, note that the oscillator transistors must be replaced in matched pairs in the high and low band VCOs.

NOTES:

## VCO BOARD

REF DES	DESCRIPTION	PART NO.
C501	Capacitor, Disc, 15 pF ± 5%, NPO	3160510
C502	Capacitor, Disc, 15 pF ± 5%, NPO	3160510
C503	Capacitor, Mica, 390 pF ± 5%, DM-15	3170370
C504	Capacitor, Mica, 390 pF ± 5%, DM-15	3170370
C505	Capacitor, Disc, .001 μF ± 20%, Z5U	3161380
C506	Capacitor, Tantalum, 47 μF ± 20%, 6 V	3183070
C507	Capacitor, Electrolytic, 1 μF, ± 20%, 50 V	3180008
C508	Capacitor, Disc, .001 μF ± 20%, Z5U	3161380
C509	Capacitor, Electrolytic, 22 μF, ± 20%, 16 V	3180105
C510	Capacitor, Disc, .001 μF ± 20%, Z5U	3151380
C511	Capacitor, Disc, 51 pF ± 5%, N750	3160860
C512	Capacitor, Disc, 150 pF ± 20%, Z5U	3161170
C513	Capacitor, Disc, 470 pF ± 20%, Z5U	3161350
C514	Capacitor, Disc, 8.3 pF ± 5%, NPO	3160300
C515	Capacitor, Disc, 8.2 pF ± 5%, NPO	3160300
C516	Capacitor, Mica, 180 pF ± 5%, DM-15	3170180
C517	Capacitor, Mica, 180 pF ± 5%, DM-15	3170180
C518	Capacitor, Disc, .001 μF ± 20%, Z5U	3161380
C519	Capacitor, Tantalum, 47 μF ± 20%, 6 V	3183070
C520	Capacitor, Electrolytic, 1 μF, ± 20%, 50 V	3180008
C521	Capacitor, Disc, .001 μF ± 20%, Z5U	3161380
C522	Capacitor, Electrolytic, 22 μF, ± 20%, 16 V	3180105
C523	Capacitor, Disc, .001 μF ± 20%, Z5U	3161380
C524	Capacitor, Tantalum, 1 μF ± 20%, 35 V	3183010
C525	Capacitor, Disc, .001 μF ± 20%, Z5U	3161380
C526	Capacitor, Disc, 51 pF ± 5%, N750	3160860
C527	Capacitor, Disc, 150 pF ± 20%, Z5U	3161170
C528	Capacitor, Disc, 470 pF ± 20%, Z5U	3161350
C529	Capacitor, Disc, 470 pF ± 20%, Z5U	3161350
C530	Capacitor, Disc, .001 μF ± 20%, Z5U	3161380
C531	Capacitor, Disc, .001 μF ± 20%, Z5U	3161380
C532	Capacitor, Disc, 51 pF ± 5%, N750	3160860
C533	Capacitor, Disc, .005 μF ± 20%, Z5U	3161470
C534	Capacitor, Electrolytic, 10 μF, ± 20%, 25 V	3180062
C535	Capacitor, Electrolytic, 10 μF, ± 20%, 25 V	3180062
C536	Capacitor, Disc, .001 μF ± 20%, Z5U	3161380
C537	Capacitor, Disc, .001 μF ± 20%, Z5U	3161380
C538	Capacitor, Disc, 500 pF ± 10%, X5F	3161360
C539	Capacitor, Disc, .01 μF + 80%, M25V	3161500
C540	Capacitor, Electrolytic, 1 μF, ± 20%, 50 V	3180008
C541	Capacitor, Film, .01 μF @ 100 V, 10%	3184040
C542	Capacitor, Disc, .01 μF + 80%, M25V	3161500
C543	Capacitor, Electrolytic, 10 μF, ± 20%, 25 V	3180062
C544	Capacitor, Disc, 470 pF ± 20%, Z5U	3161350
C545	Capacitor, Tantalum, .1 μF ± 10%, 35 V	3183098
C546	Capacitor, Disc, .01 μF + 80%, M25V	3161500
C547	Capacitor, Electrolytic, 1 μF, ± 20%, 50 V	3180008
C548	Capacitor, Electrolytic, 1 μF, ± 20%, 50 V	3180008
C549	Capacitor, Disc, .005 μF ± 20%, Z5U	3161470
C550	Capacitor, Disc, .01 μF + 80%, M25V	3161500
C551	Capacitor, Disc, 6.2 pF ± 5%, NPO	3160200

REF DES	DESCRIPTION	PART NO.
C552	Capacitor, Disc, 6.2 pF ± 5%, NPO	3160200
CR501	Diode, 1N4148	3020090
CR502	Diode, 1N4148	3020090
CR503	Diode, MV104	3020274
CR504	Diode, MV104	3020274
CR505	Diode, MV104	3020274
CR506	Diode, MV209	3020278
CR507	Diode, MPN3404	3020265
CR508	Diode, 1N4148	3020090
CR509	Diode, 1N4148	3020090
CR510	Diode, MV104	3020274
CR511	Diode, MV104	3020274
CR512	Diode, MV209	3020278
CR513	Diode, MPN3404	3020265
CR514	Diode, 1N4148	3020090
CR515	Diode, 1N4148	3020090
CR516	Diode, 1N4148	3020090
CR517	Diode, 1N4148	3020090
CR518	Diode, 1N4148	3020090
L501	Inductor, Variable	2513003
L502	Inductor, Variable	2513001
Q501	Transistor, SPF796, Matched FET	3030355
Q502	Transistor, SPF796, Matched FET	3030355
Q503	Transistor, J310	3030501
Q504	Transistor, SPF796, Matched FET	3030355
Q505	Transistor, SPF796, Matched FET	3030355
Q506	Transistor, J310	3030501
Q507	Transistor, 2N4125	3030110
Q508	Transistor, 2N3904	3030105
R501	Resistor, Carbon Film, 1 M Ω ± 5%, 1/4 W	3220355
R502	Resistor, Carbon Film, 1 M Ω ± 5%, 1/4 W	3220355
R503	Resistor, Carbon Film, 33 Ω ± 5%, 1/4 W	3220025
R504	Resistor, Carbon Film, 10 M Ω ± 5%, 1/4 W	3220380
R505	Resistor, Carbon Film, 33 Ω ± 5%, 1/4 W	3220025
R506	Resistor, Carbon Film, 4.7 K Ω ± 5%, 1/4 W	3220210
R507	Resistor, Carbon Film, 1 M Ω ± 5%, 1/4 W	3220355
R508	Resistor, Carbon Film, 1 M Ω ± 5%, 1/4 W	3220355
R509	Resistor, Carbon Film, 33 Ω ± 5%, 1/4 W	3220025
R510	Resistor, Carbon Film, 10 M Ω ± 5%, 1/4 W	3220380
R511	Resistor, Carbon Film, 33 Ω ± 5%, 1/4 W	3220025
R512	Resistor, Carbon Film, 4.7 K Ω ± 5%, 1/4 W	3220210
R513	Resistor, Carbon Film, 100 Ω ± 5%, 1/4 W	3220055
R514	Resistor, Carbon Film, 470 Ω ± 5%, 1/4 W	3220110
R515	Resistor, Carbon Film, 5.1 Ω ± 5%, 1/4 W	3220003
R516	Resistor, Carbon Film, 220 Ω ± 5%, 1/4 W	3220075
R517	Resistor, Carbon Film, 220 Ω ± 5%, 1/4 W	3220075
R518	Resistor, Carbon Film, 100 Ω ± 5%, 1/4 W	3220055
R519	Resistor, Carbon Film, 2.7 K Ω ± 5%, 1/4 W	3220195
R520	Resistor, Carbon Film, 2.7 K Ω ± 5%, 1/4 W	3220195
R521	Resistor, Carbon Film, 4.7 K Ω ± 5%, 1/4 W	3220210
R522	Resistor, Carbon Film, 4.7 K Ω ± 5%, 1/4 W	3220210
R523	Resistor, Carbon Film, 22 K Ω ± 5%, 1/4 W	3220260
R524	Resistor, Carbon Film, 2.7 K Ω ± 5%, 1/4 W	3220195

REF DES	DESCRIPTION	PART NO.
R525	Resistor, Carbon Film, 8.2 K $\Omega \pm 5\%$ , 1/4 W	3220230
R526	Resistor, Carbon Film, 8.4 K $\Omega \pm 5\%$ , 1/4 W	3220230
R527	Resistor, Carbon Film, 47 K $\Omega \pm 5\%$ , 1/4 W	3220285
R528	Resistor, Carbon Film, 3.9 K $\Omega \pm 5\%$ , 1/4 W	3220205
R529	Resistor, Carbon Film, 15 $\Omega \pm 5\%$ , 1/4 W	3220010
R530	Resistor, Carbon Film, 2.7 K $\Omega \pm 5\%$ , 1/4 W	3220195
R531	Resistor, Carbon Film, 4.7 K $\Omega \pm 5\%$ , 1/4 W	3220210
R532	Resistor, Carbon Film, 100 K $\Omega \pm 5\%$ , 1/4 W	3220315
R533	Resistor, Carbon Film, 10 M $\Omega \pm 5\%$ , 1/4 W	3220380
R534	Resistor, Carbon Film, 4.7 K $\Omega \pm 5\%$ , 1/4 W	3220210
R535	Resistor, Carbon Film, 100 $\Omega \pm 5\%$ , 1/4 W	3220055
R536	Resistor, Carbon Film, 5.1 $\Omega \pm 5\%$ , 1/4 W	3220003
R537	Resistor, Carbon Film, 100 K $\Omega \pm 5\%$ , 1/4 W	3220315
R538	Resistor, Carbon Film, 8.2 K $\Omega \pm 5\%$ , 1/4 W	3220230
R539	Resistor, Carbon Film, 3.9 K $\Omega \pm 5\%$ , 1/4 W	3220205
RFC501	Choke Assy., 5.6 $\mu$ H, L56G	3520510
RFC502	Choke Assy., 5.6 $\mu$ H, L56G	3520510
RFC503	Choke Assy., 5.6 $\mu$ H, L56G	3520510
RFC504	Choke Assy., 5.6 $\mu$ H, L56G	3520510
RFC505	Choke Assy., 5.6 $\mu$ H, L56G	3520510
RFC506	Choke Assy., 5.6 $\mu$ H, L56G	3520510
RFC507	Choke Assy., 270 $\mu$ H, MUD271	3520590
RFC508	Choke Assy., 270 $\mu$ H, MUD271	3520590
T501	Transformer, Toroid	2510007
T502	Transformer, Toroid	2510006
T503	Transformer, Toroid	2510003
T504	Transformer, Toroid	2510003
U501	I.C., 78L05A	3040030
U502	I.C., 78L05A	3040030
U503	I.C., MC14046B	3041046
U504	I.C., UA739PC	3020535

**NOTES:**

NOTES:



### 3-7. TRANSLATOR BOARD

The Translator board combines the 40 MHz signal from the Passband Tuning/Reference board, the 5.05-5.55 MHz VRTO VCO board output and the 48.05-78.05 MHz VCO signal to create an input to the programmable divider. The output of this divider is routed to the phase detector on the VCO board for frequency and phase correction of the VCO. Refer to figure 3-16 for schematic and figure 3-15 for parts list information.

The 5.05-5.55 MHz VRTO signal is applied to one input of a double balanced mixer consisting of T604, T605 and CR605-608. The 40 MHz signal from the PBT/Reference board is amplified by Q604 and applied to the other input of this mixer. The resulting 45.05-45.55 MHz signal is filtered by a bandpass filter consisting of L609-L611 and C623-C629, and routed to one input of a double balanced mixer consisting of T602, T503 and CR601-CR604. The other input of this double balanced mixer is connected to the output of the VCO board, which varies from 48.05-78.05 MHz.

The output of this mixer is a signal which varies from 3 to 32.5 MHz, depending on the range of operation. This signal remains at a constant frequency for any selected 500 kHz segment, since the VCO frequency is forced by the phase detector to track the VRTO frequency.

The 3-32.5 MHz signal is passed through a low-pass

filter to remove undesired mixing products, amplified by Q603 and Q602 and buffered by Q601. This signal processing is required in order to achieve a sufficient level to drive the programmable divider.

The programmable divider is comprised of U601 through U604, and is programmed to divide by a whole integer between 6 and 65, depending on the 500 kHz range selected. Programming information comes from the Digital Control board (Section 3-3) and is modified by the frequency programmer section of the VRTO Digital board. Load number information to the Translator board is present on pins 41-49 (the top connector) and is coded in BCD. The least significant digit of the load number is connected to pins 41-44, and the most significant digit to pins 46-49.

The output of the programmable divider, which is 500 kHz when the synthesizer is locked, is connected via the Parent board to the phase detector on the VCO board.

Alignment of the Translator board consists of aligning the 45.05-45.55 MHz band pass filter, and is covered in Section 4. Note that the shields on the board need not be removed for alignment. If parts replacement is required, be sure to replace all shield and ground clips to insure proper performance.

#### NOTES:

NOTES:

## TRANSLATOR BOARD

REF DES	DESCRIPTION	PART NO.
C601	Capacitor, Tantalum, .22 $\mu$ F $\pm$ 10%, 35 V	3183100
C602	Capacitor, Tantalum, .22 $\mu$ F $\pm$ 10%, 35 V	3183100
C603	Capacitor, Tantalum, .22 $\mu$ F $\pm$ 10%, 35 V	3183100
C604	Capacitor, Tantalum, .22 $\mu$ F $\pm$ 10%, 35 V	3183100
C608	Capacitor, Disc, 68 pF $\pm$ 5%, N750	3160990
C609	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C610	Capacitor, Tantalum, .22 $\mu$ F $\pm$ 10%, 35 V	3183100
C611	Capacitor, Mica, 190 pF $\pm$ 5%, DM-15	3170190
C612	Capacitor, Mica, 68 pF $\pm$ 5%, DM-15	3170060
C613	Capacitor, Mica, 120 pF $\pm$ 5%, DM-15	3170130
C614	Capacitor, Mica, 150 pF $\pm$ 5%, DM-15	3170150
C615	Capacitor, Mica, 130 pF $\pm$ 5%, DM-15	3170140
C616	Capacitor, Mica, 90 pF $\pm$ 5%, DM-15	3170090
C617	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C618	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C619	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C620	Capacitor, Tantalum, .22 $\mu$ F $\pm$ 10%, 35 V	3183100
C621	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C622	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C623	Capacitor, Disc, 12 pF $\pm$ 5%, NPO	3160430
C624	Capacitor, Mica, 68 pF $\pm$ 5%, DM-15	3170060
C625	Capacitor, Tubular, 2.7 pF, NPO	3185060
C626	Capacitor, Disc, 82 pF $\pm$ 5%, N750	3161040
C627	Capacitor, Tubular, 2.7 pF, NPO	3185060
C628	Capacitor, Mica, 68 pF $\pm$ 5%, DM-15	3170060
C629	Capacitor, Disc, 12 pF $\pm$ 5%, NPO	3160430
C630	Capacitor, Mica, 100 pF $\pm$ 5%, DM-15	3170110
C631	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C632	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C633	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C634	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C635	Capacitor, Tantalum, .22 $\mu$ F $\pm$ 10%, 35 V	3183100
C636	Capacitor, Disc, 27 pF $\pm$ 5%, NPO	3160650
C637	Capacitor, Mica, 68 pF $\pm$ 5%, DM-15	3170060
C638	Capacitor, Disc, 47 pF $\pm$ 5%, NPO	3160840
C639	Capacitor, Disc, 51 pF $\pm$ 5%, N750	3160860
C640	Capacitor, Disc, 6.2 pF $\pm$ 5%, N750	3160200
C650	Capacitor, Disc, 82 pF $\pm$ 5%, N750	3161040
C651	Capacitor, Disc, 330 pF $\pm$ 10%, Y5E	3161300
C652	Capacitor, Disc, 330 pF $\pm$ 10%, Y5E	3161300
C653	Capacitor, Disc, 82 pF $\pm$ 5%, N750	3161040
CR601	Diode, MBD-101	3020263
CR602	Diode, MBD-101	3020263
CR603	Diode, MBD-101	3020263
CR604	Diode, MBD-101	3020263
CR605	Diode, 1N4148	3020090
CR606	Diode, 1N4148	3020090
CR607	Diode, 1N4148	3020090
CR608	Diode, 1N4148	3020090
L602	Ferrite Bead	3523207
L603	Inductor, Toroid	3510017

REF DES	DESCRIPTION	PART NO.
L604	Inductor, Toroid	2510016
L605	Inductor, Toroid	2510015
L607	Inductor, Toroid	2510015
L609	Inductor, Variable	3524100
L610	Inductor, Variable	3524100
L611	Inductor, Variable	3524100
Q601	Transistor, 2N4125	3030110
Q602	Transistor, 2N3563	3030060
Q603	Transistor, 2N3563	3030060
Q604	Transistor, 2N3563	3030060
R601	Resistor, Carbon Film, 47 $\Omega$ $\pm$ 5%, 1/4 W	3220035
R602	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R603	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R604	Resistor, Carbon Film, 39 $\Omega$ $\pm$ 5%, 1/4 W	3220030
R605	Resistor, Carbon Film, 150 $\Omega$ $\pm$ 5%, 1/4 W	3220065
R606	Resistor, Carbon Film, 470 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R607	Resistor, Carbon Film, 470 $\Omega$ $\pm$ 5%, 1/4 W	3220110
R608	Resistor, Carbon Film, 4.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220210
R609	Resistor, Carbon Film, 2.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220190
R610	Resistor, Carbon Film, 150 $\Omega$ $\pm$ 5%, 1/4 W	3220065
R611	Resistor, Carbon Film, 370 $\Omega$ $\pm$ 5%, 1/4 W	3220085
R612	Resistor, Carbon Film, 1.8 K $\Omega$ $\pm$ 5%, 1/4 W	3220180
R613	Resistor, Carbon Film, 8.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220230
R614	Resistor, Carbon Film, 1.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220170
R615	Resistor, Carbon Film, 2.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220190
R616	Resistor, Carbon Film, 68 $\Omega$ $\pm$ 5%, 1/4 W	3220045
R617	Resistor, Carbon Film, 5.1 $\Omega$ $\pm$ 5%, 1/4 W	3220003
R618	Resistor, Carbon Film, 10 $\Omega$ $\pm$ 5%, 1/4 W	3220005
R619	Resistor, Carbon Film, 220 $\Omega$ $\pm$ 5%, 1/4 W	3220075
R620	Resistor, Carbon Film, 5.1 $\Omega$ $\pm$ 5%, 1/4 W	3220003
R622	Resistor, Carbon Film, 15 $\Omega$ $\pm$ 5%, 1/4 W	3220010
R623	Resistor, Carbon Film, 150 $\Omega$ $\pm$ 5%, 1/4 W	3220065
R627	Resistor, Carbon Film, 10 $\Omega$ $\pm$ 5%, 1/4 W	3220005
R628	Resistor, Carbon Film, 33 $\Omega$ $\pm$ 5%, 1/4 W	3220025
R629	Resistor, Carbon Film, 8.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220230
R630	Resistor, Carbon Film, 2.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220190
RFC601	Choke Assy.	2512506
RFC602	Choke Assy., 270 $\mu$ H, MUD271	3520590
RFC603	Choke Assy., 270 $\mu$ H, MUD271	3520590
RFC650	Choke Assy., 3.3 $\mu$ H	3520505
RFC651	Choke Assy., 5.6 $\mu$ H	3520510
RFC652	Choke Assy., 3.3 $\mu$ H	3520505
T601	Transformer, Toroid	2510009
T602	Transformer, Toroid	2510002
T603	Transformer, Toroid	2510002
T604	Transformer, Toroid	2510004
T605	Transformer, Toroid	2510014
U601	I.C., SN74S113N	3040495
U602	I.C., SN74196	3040470
U603	I.C., SN74196	3040470
U604	I.C., SN74S11N	3040485

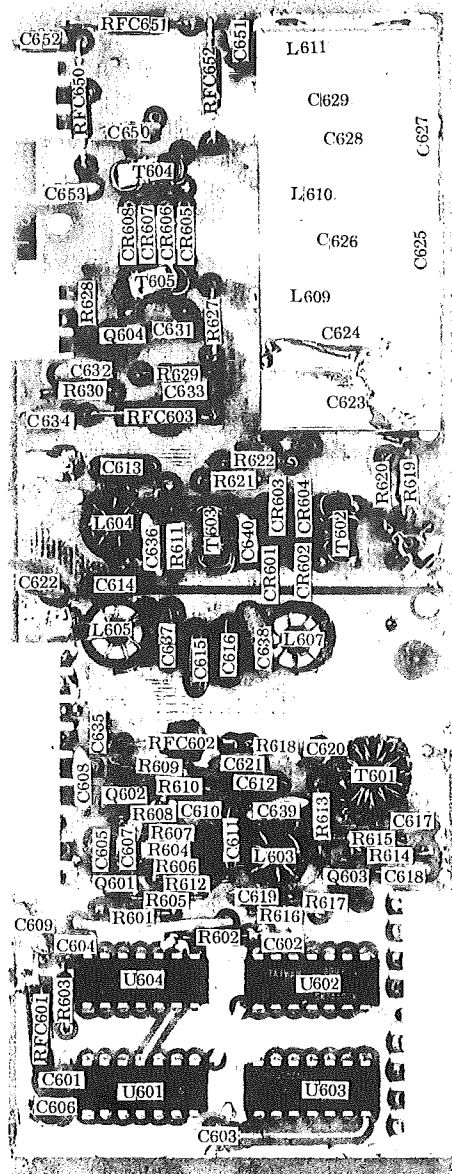


Fig. 3-15 Translater Board Pictorial

C	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634		
R	619	620	601	602	611	622	623	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	
L									604	609	605	610	607	611																						

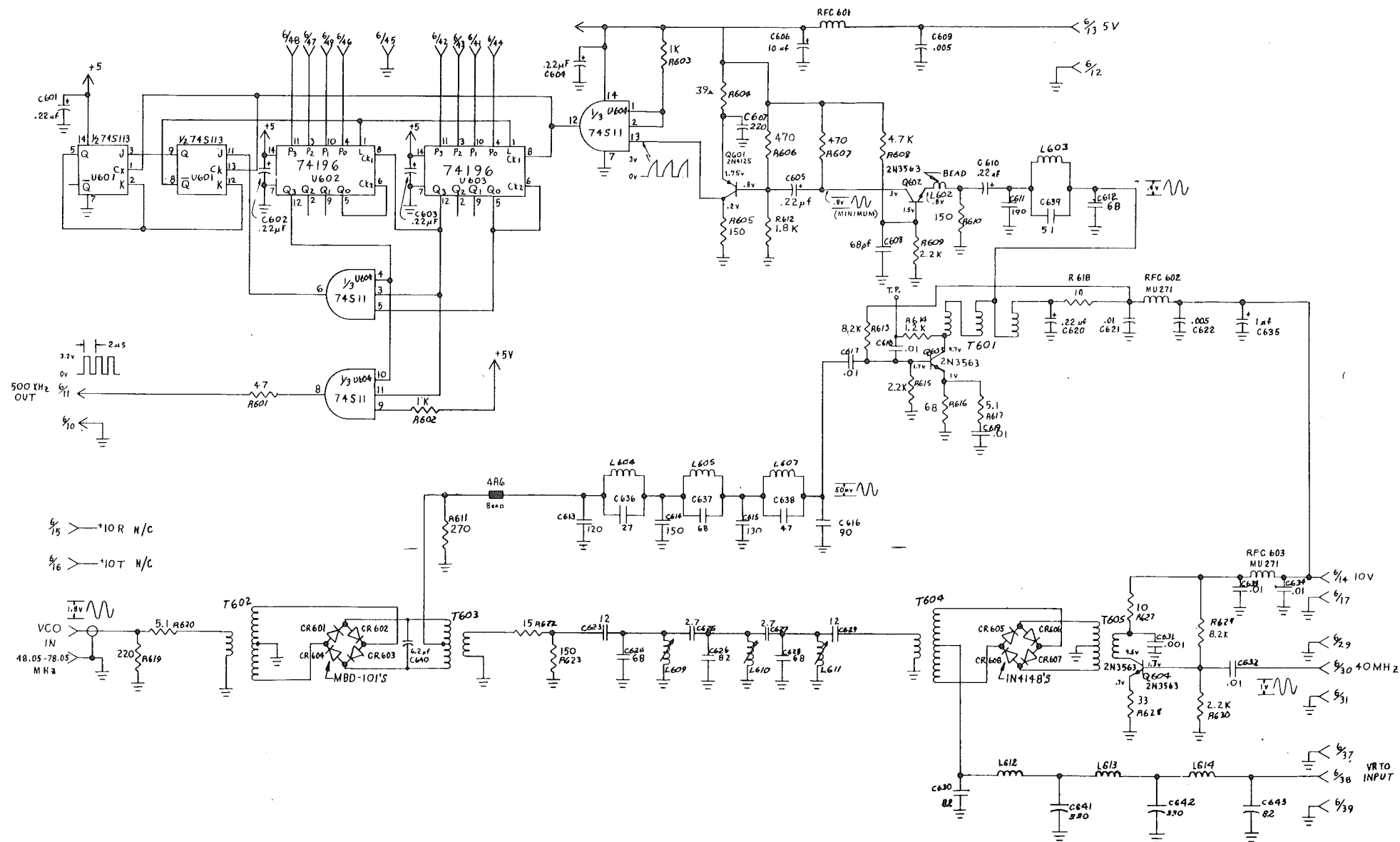


Fig. 3-16 Translater Board Schematic

### 3-8. 2ND MIXER BOARD

The 2nd Mixer board boosts the 48.05 MHz 1st IF signal level in a gain-controlled amplifier and converts it to the 5.645 MHz 2nd IF. Refer to figure 3-18 for schematic and figure 3-17 for parts location information.

48.05 MHz 1st IF signals from the Up-Converter are coupled through C704 to the input of amplifier Q702. C705, C706 and L701 form an input matching network. AGC is applied to Q702 via R707. The output of Q702 is tuned by C715, C716 and L705 and coupled to one input of a double balanced mixer.

The injection for the mixer is a 53.695 MHz (nominal) signal which is developed on the PBT board (Section 3-11). This signal is amplified by Q701, the output which is tuned by C713, C714 and L703 and connected to the injection input of the mixer via R715, R716 and R717 which form a pad to insure

proper termination of both amplifier and mixer.

The double balanced mixer is a diode ring type, consisting of CR701 through CR704 and R722 and transformers T701 and T702. The output of the mixer is the difference of the 53.695 MHz injection and the 48.05 MHz IF signal, or 5.645 MHz. This signal is coupled to Q703 and C717. Q703 provides gain at 5.645 MHz. R719 sets the stage gain with normal selectivity filters. To compensate for the additional loss of narrow selectivity filters, CR705 is forward biased with +10 volts via R721. This switches in C719, which provides gate bypassing, thus increasing stage gain. The output of Q703 is tuned via L706, C720 and C721.

Alignment of the 2nd Mixer board is covered in Section 4 of this manual.

#### NOTES:

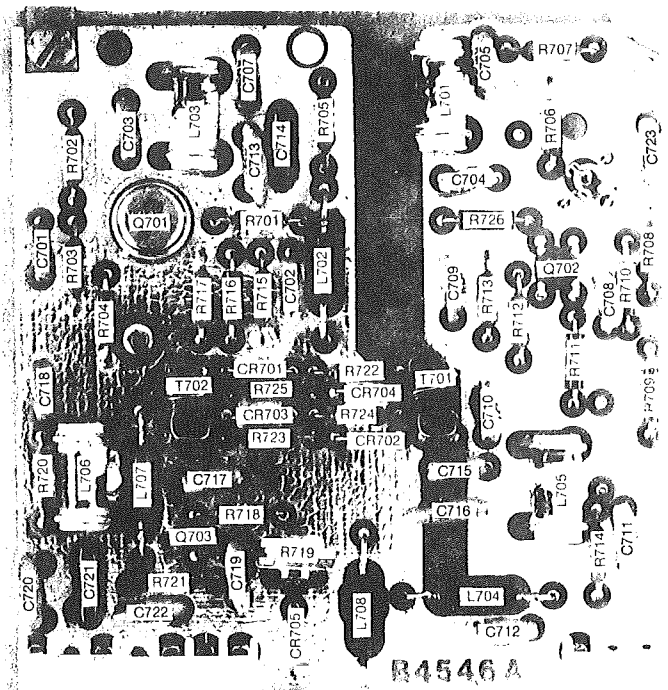
NOTES:

## 2ND MIXER BOARD

REF DES	DESCRIPTION	PART NO.
C701	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C702	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C703	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C704	Capacitor, Disc, 8.2 pF $\pm$ .25, N750	3160290
C705	Capacitor, Disc, 390 pF $\pm$ 10%, X5F	3161320
C706	Capacitor, Disc, 20 pF $\pm$ 5%, NPO	3160580
C707	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C708	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C709	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C710	Capacitor, Disc, 10 pF $\pm$ 5%, NPO	3160360
C711	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C712	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C713	Capacitor, Disc, 82 pF + 5%, N750	3161040
C714	Capacitor, Mica, 220 pF $\pm$ 5%, DM-15	3170240
C715	Capacitor, Disc, 10 pF $\pm$ 5%, NPO	3160360
C716	Capacitor, Disc, 82 pF $\pm$ 5%, N750	3161040
C717	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C718	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C719	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C720	Capacitor, Disc, 68 pF $\pm$ 5%, N750	3160990
C721	Capacitor, Mica, 680 pF $\pm$ 5%, DM-15	3170500
C722	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C723	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C724	Capacitor, Disc, 10 pF $\pm$ 5%, NPO	3160360
CR701	Diode, 1N4148	3020090
CR702	Diode, 1N4148	3020090
CR703	Diode, 1N4148	3020090
CR704	Diode, 1N4148	3020090
CR705	Diode, 1N4148	3020090
L701	Inductor, Var., blk/blu	2513014
L702	Choke Assy., 5.6 $\mu$ H, L56G	3520510
L703	Inductor, Var., Violet	2513012
L704	Choke Assy., 5.6 $\mu$ H, L56G	3520510
L705	Inductor, Var., blk/blu	2513014
L706	Inductor, Var., white	2513007
L707	Choke Assy., 5.6 $\mu$ H, L56G	3520510
L708	Choke Assy., 270 $\mu$ H, MUD271	3520590
Q701	Transistor, 2N5109	3030137
Q702	Transistor, TIS-153	3030400
Q703	Transistor, J310	3030501
R701	Resistor, Carbon Film, 4.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220210
R702	Resistor, Carbon Film, 1.5 K $\Omega$ $\pm$ 5%, 1/4 W	3220175
R703	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R704	Resistor, Carbon Film, 22 $\Omega$ $\pm$ 5%, 1/4 W	3220015
R705	Resistor, Carbon Film, 10 $\Omega$ $\pm$ 5%, 1/4 W	3220005
R706	Resistor, Carbon Film, 470 $\Omega$ $\pm$ 5%, 1/4 W	3220110
R707	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R708	Resistor, Carbon Film, 33 K $\Omega$ $\pm$ 5%, 1/4 W	3220275
R709	Resistor, Carbon Film, 68 K $\Omega$ $\pm$ 5%, 1/4 W	3220300
R710	Resistor, Carbon Film, 47 $\Omega$ $\pm$ 5%, 1/4 W	3220035
R711	Resistor, Carbon Film, 68 $\Omega$ $\pm$ 5%, 1/4 W	3220045

REF DES	DESCRIPTION	PART NO.
R712	Resistor, Carbon Film, 33 $\Omega$ $\pm$ 5%, 1/4 W	3220025
R713	Resistor, Carbon Film, 220 $\Omega$ $\pm$ 5%, 1/4 W	3220075
R714	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R715	Resistor, Carbon Film, 270 $\Omega$ $\pm$ 5%, 1/4 W	3220085
R716	Resistor, Carbon Film, 22 $\Omega$ $\pm$ 5%, 1/4 W	3220015
R717	Resistor, Carbon Film, 270 $\Omega$ $\pm$ 5%, 1/4 W	3220085
R718	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R719	Resistor, Variable, 10 K $\Omega$	3260665
R720	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R721	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R722	Resistor, Carbon Film, 5.1 $\Omega$ $\pm$ 5%, 1/4 W	3220003
R723	Resistor, Carbon Film, 5.1 $\Omega$ $\pm$ 5%, 1/4 W	3220003
R724	Resistor, Carbon Film, 5.1 K $\Omega$ $\pm$ 5%, 1/4 W	3220003
R725	Resistor, Carbon Film, 5.1 K $\Omega$ $\pm$ 5%, 1/4 W	3220003
R726	Resistor, Carbon Film, 47 $\Omega$ $\pm$ 5%, 1/4 W	3220035
T701	Transformer, Toroid	2510002
T702	Transformer, Toroid	2510002

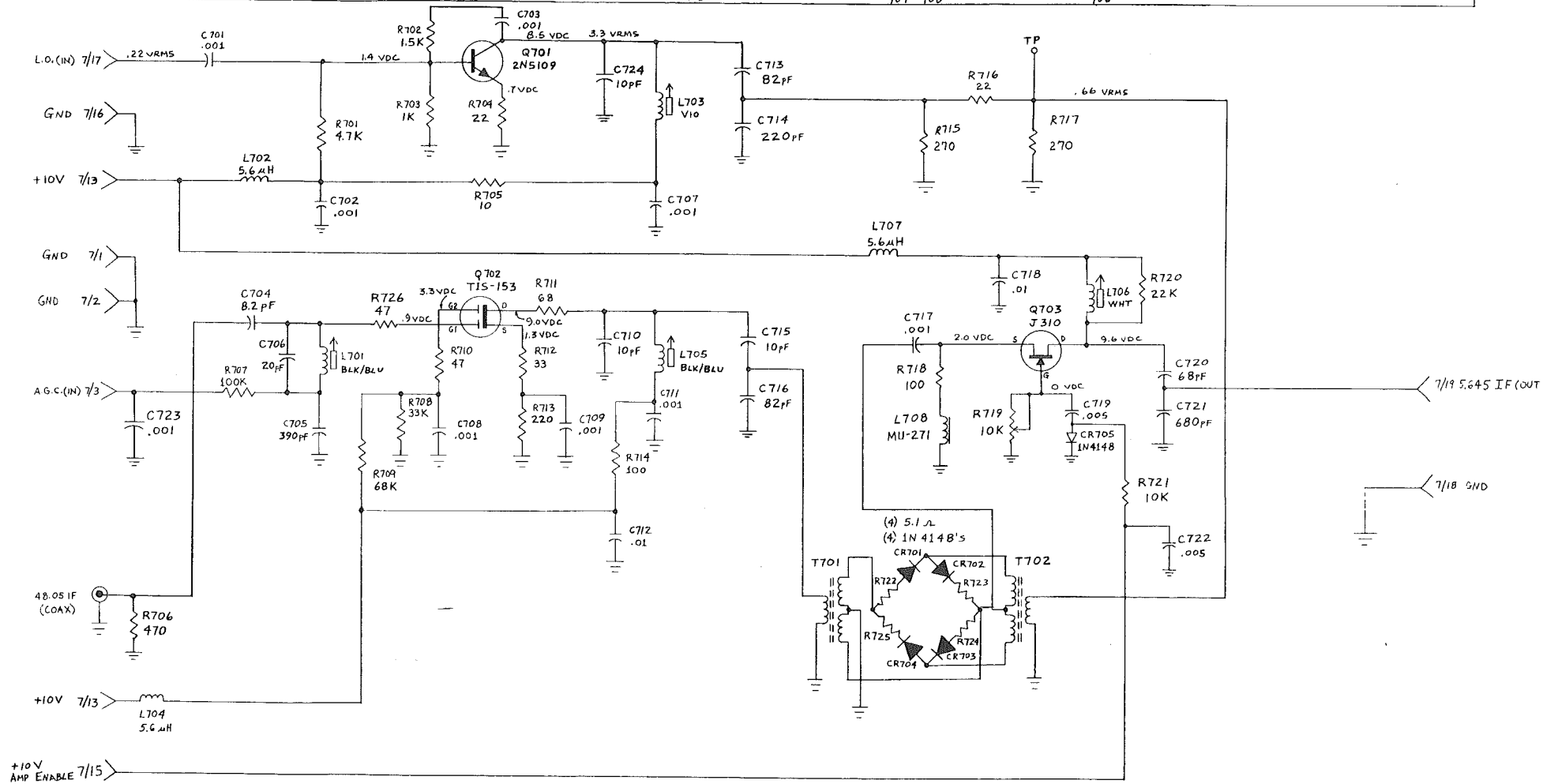
## NOTES:



19                      13                      3                      1

Fig. 3-17 2nd Mixer Board Pictorial

C	723	701	704	705	702	708	703	709	724	710	711	713	715	717	717	718	719	720	721
R	706	707	701	709	710	702	711	704	713	712	715	718	722	713	717	719	720	721	
L	704	702	701							703		707	708			706			



HIGHEST NUMBERED CAPACITOR - C724  
 " " RESISTOR - R726  
 " " DIODE - CR705

ALL CAPACITOR VALUES IN  $\mu$ F UNLESS SPECIFIED OTHERWISE  
 ALL RESISTOR " " OHMS " " " "

Fig. 3-18 2nd Mixer Board Schematic

## 3-9. NB7A NOISE BLANKER BOARD

The NB7A Noise Blanker, unlike noise clippers or limiters commonly found in communication equipment is an advanced noise blanker which mutes the receiver for the duration of the noise pulse. Between noise pulses full receiver gain is restored, and receiver AGC is affected only by the desired signal and not by noise. The NB7A is most effective on strong, periodic noise impulses such as automobile ignition noise and LORAN.

### 3-9.1 CIRCUIT DESCRIPTION

This noise blanker system is composed of the three major networks described below. Refer to the schematic diagram, figure 3-20 to follow this circuit description.

### 3-9.2 TRANSMIT PATH

In transmit, diode CR815 is turned on with +10T via RFC812 and RFC813 from pin 37. The 5.645 MHz double sideband transmit signal is fed to the output coax connector through C833, CR815 and C838. When CR815 is on, CR814 will be reverse biased, thus holding the receive path off. This path is not used when the blanker is used in the R4245 receiver.

### 3-9.3 RECEIVE PATH

In receive, diode CR814 is turned on with +10R via RFC810 and RFC811 from pin 24. The receive signal is applied to pin 22 and passes through filter Y810. Q816 amplifies the signal to make up for the loss in Y810. The output of stage Q816 is applied to the blanking gate comprised of T810, CR812, CR813 and T822, then through C830, CR814 and C838 to the output coax connector. C844 provides input matching. When CR814 is on, CR815 will be reverse biased, thus holding the transmit path off.

### 3-9.4 NOISE PROCESSOR

The Noise Amplifiers consist of Q810, Q811 and U810 cascaded and tuned to 5.645 MHz by L810,

L811 and L812 respectively. The output of the noise amplifier string is split by C828 to the pulse detector and C827 to the noise amplifier AGC circuit. Q812 and associated circuitry comprise the noise amplifier AGC detector and amplifier. The AGC voltage is applied to gate 1 of Q810 and Q811 via R826 and R829 respectively.

The pulse detector, CR811, responds only to the positive half of the amplified bipolar input pulse. The network of R839, C831 and C835 waveshape the pulse at the base of the pulse amplifier Q813. Again, the output pulse of Q813 is shaped by R847 and C840 and is applied to the gate driver Q814. Resistor network R842 and R843 provide fixed reverse bias for the blanking gate. Q816 is a DC switch for +10R and +10NB.

### 3-9.5 THEORY OF OPERATION

The 5.645 MHz receive signal, with noise pulses, is applied to pin 22. Filter Y810 removes undesired responses that could affect the blanker AGC but has adequate bandwidth to prevent lengthening of noise pulses. Amplifier Q816 amplifies the signal and noise pulses. Tuned amplifier Q810, Q811 and U810 amplify this low level signal up to a high level to drive the pulse detector CR811.

This detector responds only to the positive going portion of each noise pulse from the output of U810. Following the detector is an RC network which shapes the pulses for driving the level shifter Q813. Again, on the output of Q813 is still another RC network for waveshaping. The gate driver transistor Q814 responds to the negative going pulse from Q813 which allows the blanking gate to turn off, thus muting the receive path and blanking the noise pulse.

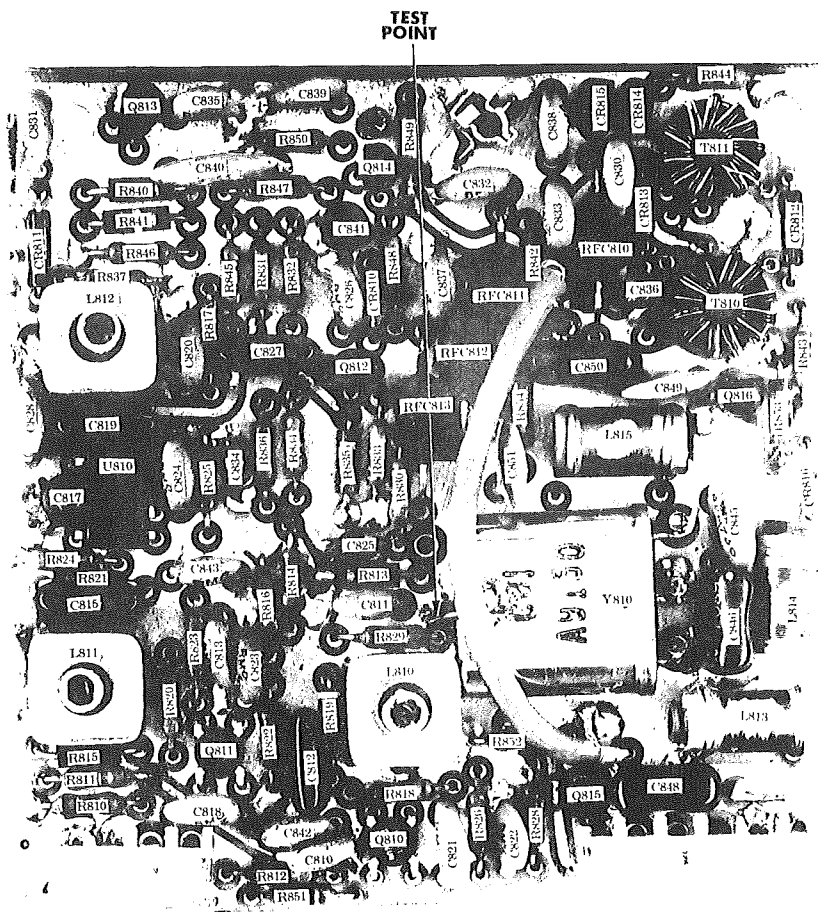
Since the noise amplifiers run such high gain, Q812 and associated circuitry comprise an AGC loop to maintain a near constant output level to the detector. This allows detection and processing of very weak as well as very strong noise pulses without degrading the blanking action.

NOTES:

## NB7A NOISE BLANKER

REF DES	DESCRIPTION	PART NO.
C810	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C811	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C812	Capacitor, Mica, 390 pF $\pm$ 5%, DM-15	3170370
C813	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C814	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C815	Capacitor, Mica, 290 pF $\pm$ 5%, DM-15	3170370
C817	Capacitor, Tantalum, 10 $\mu$ F $\pm$ 20%, 25 V	3183030
C818	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C819	Capacitor, Mica, 390 pF $\pm$ 5%, DM-15	3170370
C820	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C821	Capacitor, Disc, .0024 $\mu$ F $\pm$ 20%, Z5U	3161440
C822	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C823	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C824	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C825	Capacitor, Tantalum, 1 $\mu$ F $\pm$ 20%, 35 V	3183010
C826	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C827	Capacitor, Mica, 180 pF $\pm$ 5%, DM-15	3170180
C828	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C831	Capacitor, Disc, .05 $\mu$ F $\pm$ 80%, M16V	3161600
C834	Capacitor, Tantalum, 1 $\mu$ F $\pm$ 30%, 25 V	3183010
C835	Capacitor, Disc, 330 pF $\pm$ 10%, Y5E	3161300
C836	Capacitor, Tantalum, 1 $\mu$ F $\pm$ 20%, 35 V	3183010
C838	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C839	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C840	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C841	Capacitor, Tantalum, 10 $\mu$ F $\pm$ 20%, 25 V	3183030
C842	Capacitor, Disc, 470 pF $\pm$ 20%, Z5U	3161350
C843	Capacitor, Disc, 470 pF $\pm$ 20%, Z5U	3161350
C845	Capacitor, Disc, 82 pF $\pm$ 5%, N750	3161040
C846	Capacitor, Mica, 680 pF $\pm$ 5%, DM-15	3170500
C847	Capacitor, Disc, 82 pF $\pm$ 5%, N750	3161040
C848	Capacitor, Mica, 680 pF $\pm$ 5%, DM-15	3170500
C849	Capacitor, Disc, 82 pF $\pm$ 5%, N750	3161040
C850	Capacitor, Mica, 680 pF $\pm$ 5%, DM-15	3170500
C851	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161460
CR810	Diode, 1N4148	3020090
CR811	Diode, AN119/1N541	3020040
CR812	Diode, AA119/1N541	3020040
CR813	Diode, AA119/1N541	3020040
CR816	Diode, 1N4148	3020090
L810	Inductor, Variable Can	2511021
L811	Inductor, Variable Can	2511021
L812	Inductor, Variable Can	2511021
L813	Inductor, Variable, Wht.	2513007
L814	Inductor, Variable, Wht.	2513007
L815	Inductor, Variable, Wht.	2513007
Q810	Transistor, TIS-153	3030480
Q811	Transistor, TIS-153	3030480
Q812	Transistor, 2N4402	3030120
Q813	Transistor, 2N3904	3030105
Q814	Transistor, 2N3904	3030105

REF DES	DESCRIPTION	PART NO.
Q815	Transistor, 2N4402	3030120
Q816	Transistor, J-310	3030501
R810	Resistor, Carbon Film, 6.8 K $\Omega$ $\pm$ 5%, 1/4 W	3220220
R811	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R812	Resistor, Carbon Film, 27 $\Omega$ $\pm$ 5%, 1/4 W	3220020
R813	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R814	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R815	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R816	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R817	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R818	Resistor, Carbon Film, 68 $\Omega$ $\pm$ 5%, 1/4 W	3220045
R819	Resistor, Carbon Film, 47 K $\Omega$ $\pm$ 5%, 1/4 W	3220285
R820	Resistor, Carbon Film, 27 $\Omega$ $\pm$ 5%, 1/4 W	3220020
R821	Resistor, Carbon Film, 6.8 K $\Omega$ $\pm$ 5%, 1/4 W	3220220
R822	Resistor, Carbon Film, 820 $\Omega$ $\pm$ 5%, 1/4 W	3220145
R823	Resistor, Carbon Film, 27 $\Omega$ $\pm$ 5%, 1/4 W	3220020
R824	Resistor, Carbon Film, 1.5 K $\Omega$ $\pm$ 5%, 1/4 W	3220175
R825	Resistor, Carbon Film, 5.6 K $\Omega$ $\pm$ 5%, 1/4 W	3220215
R826	Resistor, Carbon Film, 330 K $\Omega$ $\pm$ 5%, 1/4 W	3220340
R828	Resistor, Carbon Film, 820 K $\Omega$ $\pm$ 5%, 1/4 W	3220145
R829	Resistor, Carbon Film, 330 K $\Omega$ $\pm$ 5%, 1/4 W	3220340
R830	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R831	Resistor, Carbon Film, 2.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220190
R832	Resistor, Carbon Film, 8.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220230
R833	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R834	Resistor, Carbon Film, 330 K $\Omega$ $\pm$ 5%, 1/4 W	3220340
R835	Resistor, Composition, 4.7 M $\Omega$ $\pm$ 5%, 1/4 W	3220208
R836	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R837	Resistor, Carbon Film, 470 K $\Omega$ $\pm$ 5%, 1/4 W	3220345
R838	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R839	Resistor, Carbon Film, 1 M $\Omega$ $\pm$ 5%, 1/4 W	3220355
R840	Resistor, Carbon Film, 1 M $\Omega$ $\pm$ 5%, 1/4 W	3220355
R841	Resistor, Carbon Film, 680 K $\Omega$ $\pm$ 5%, 1/4 W	3220350
R842	Resistor, Carbon Film, 15 K $\Omega$ $\pm$ 5%, 1/4 W	3220245
R843	Resistor, Carbon Film, 2.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220190
R845	Resistor, Carbon Film, 36 K $\Omega$ $\pm$ 5%, 1/4 W	3220280
R846	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R847	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R848	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R849	Resistor, Carbon Film, 1.5 K $\Omega$ $\pm$ 5%, 1/4 W	3220175
R850	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R851	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R852	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R853	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R854	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R855	Resistor, Carbon Film, 1 M $\Omega$ $\pm$ 5%, 1/4 W	3220355
T810	Inductor, Toroid	2510023
T811	Inductor, Toroid	2510023
U810	I.C., MC1350P	3040110
Y810	Crystal Filter	3140282



40

37

27

22

Fig. 3-19 Noise Blanker Board Pictorial

R	810	826	811	818	823	820	819	814	829	830	822	823	815	851	834	844	845	836	839	837	817	838	843	844	845
C	810	847	821	825	811	849	822	812	842	813	832	823	826	831	814	815	843	824	834	837	835	828	840	819	870
L		813	815	814	810							811									812				

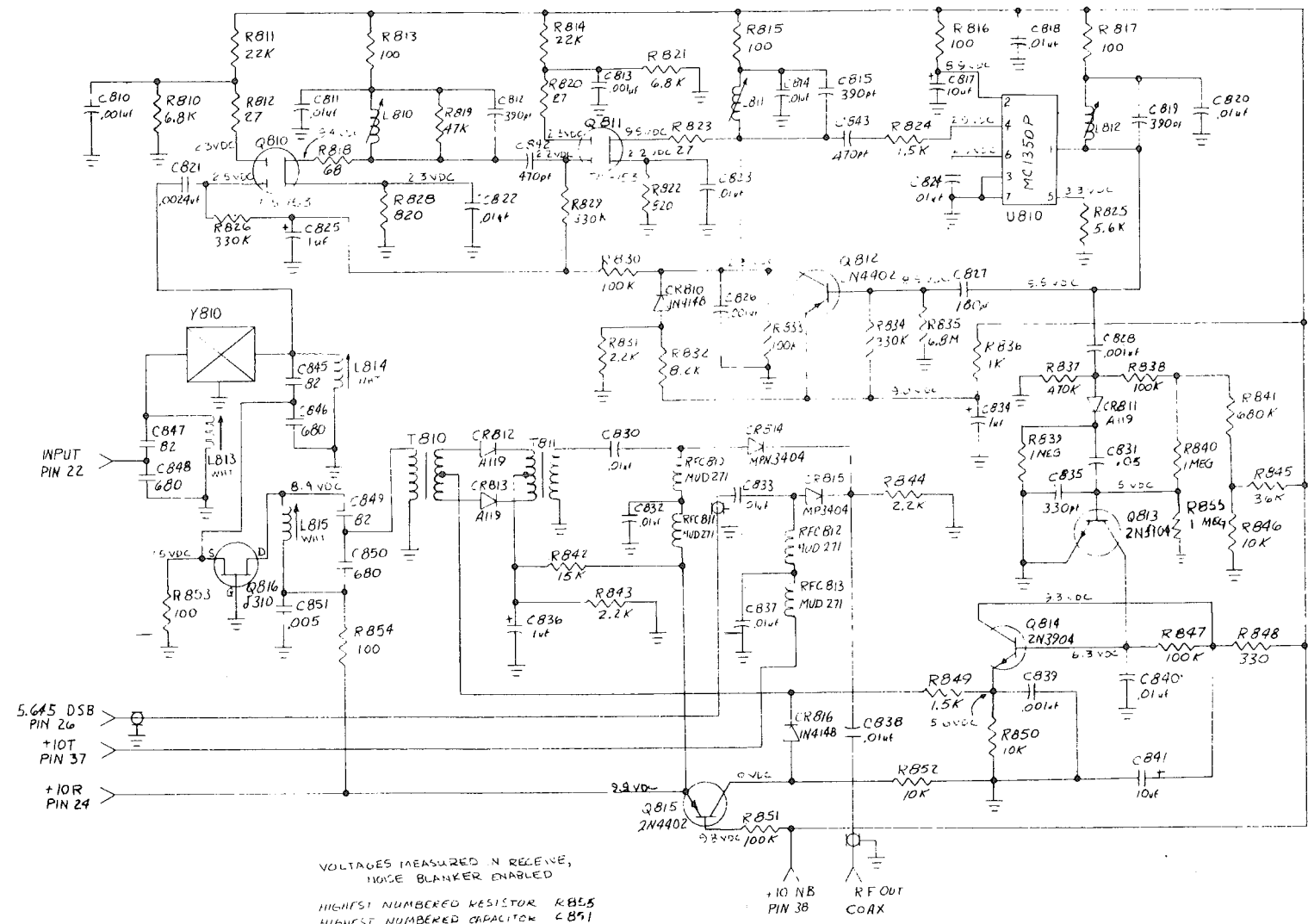


Fig. 3-20 Noise Blanker Board Schematic

### 3-10. IF SELECTIVITY BOARD

The IF Selectivity board contains four 5.645 MHz crystal filters of various bandwidths in the R4245. The standard 2.3 kHz filter (6 dB bandwidth), is located on the 2nd/3rd IF/AGC board (Section 3-12). Each of the filter positions is identical, with the same circuitry used for selection. Refer to figure 3-22 for schematic and to figure 3-21 for parts location information.

In the R4245, +10V is routed to module pin 15 via the front panel Selectivity switch when the position marked 4 kHz is selected. This voltage turns on series diodes CR903 (via R903, RFC901 and R901) and CR906 (via R905, RFC902, and R922). The same voltage back biases shunt diodes CR904 and CR905. In the unselected positions (2.3, 1.8, 0.5 and 0.3 kHz in this case), -5 volts from pin 38 causes the shunt diodes to conduct and the series diodes to be back biased. This has the effect of opening and isolating all signal paths except the desired path through the 4 kHz filter. A 5.645 MHz signal from the noise

blanker is coupled through C930 to a common input line. In addition, a second coax is tied at the input side of C930 and is routed to the input coax connector at C1102 (2nd/3rd IF/AGC board, Section 3-12). Since the series diodes in positions 1.8, 0.5 and 0.3 on the IF Selectivity board, and the series diodes in position 2.3 on the 2nd/3rd IF/AGC board are all back biased, the signal is routed through CR906, C908, and C907 to the 4 kHz filter. After filtering, the signal is coupled through C904, C902, CR903 and C901 to the output of the board, a coax to the 2nd/3rd IF/AGC board at T1101 input coax connector.

When servicing the IF Selectivity board, be sure to replace all shields and grounds, if removed, in the original locations. Failure to do so may seriously degrade the ultimate selectivity of the crystal filter, resulting in signals outside the desired passband 'leaking around' the filters.

#### NOTES:

NOTES:



## IF SELECTIVITY BOARD

REF DES	DESCRIPTION	PART NO.
C901	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C902	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C903	Capacitor, Disc, .02 $\mu$ F $\pm$ 80%, Z5U	3161580
C904	Capacitor, Disc, .01 $\mu$ F $\pm$ 80%, M25V	3161500
C905	Capacitor, Disc, .02 $\mu$ F $\pm$ 80%, Z5U	3161580
C906	Capacitor, Disc, .02 $\mu$ F $\pm$ 80%, Z5U	3161580
C907	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C908	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C909	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C910	Capacitor, Disc, .02 $\mu$ F $\pm$ 80%, Z5U	3161580
C911	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C912	Capacitor, Disc, .02 $\mu$ F $\pm$ 80%, Z5U	3161580
C913	Capacitor, Disc, .02 $\mu$ F $\pm$ 80%, Z5U	3161580
C914	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C915	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C916	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C917	Capacitor, Disc, .02 $\mu$ F $\pm$ 80%, Z5U	3161580
C918	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C919	Capacitor, Disc, .02 $\mu$ F $\pm$ 80%, Z5U	3161580
C920	Capacitor, Disc, .02 $\mu$ F $\pm$ 80%, Z5U	3161580
C921	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C922	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C923	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C924	Capacitor, Disc, .02 $\mu$ F $\pm$ 80%, Z5U	3161580
C925	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C926	Capacitor, Disc, .02 $\mu$ F $\pm$ 80%, Z5U	3161580
C927	Capacitor, Disc, .02 $\mu$ F $\pm$ 80%, Z5U	3161580
C928	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C929	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C930	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
CR901	Diode, 1N4148	3020090
CR902	Diode, 1N4148	3020090
CR903	Diode, MPN3404	3020265
CR904	Diode, MPN3404	3020265
CR905	Diode, MPN3404	3020265
CR906	Diode, MPN3404	3020265
CR907	Diode, MPN3404	3020265
CR908	Diode, MPN3404	3020265
CR909	Diode, MPN3404	3020265
CR910	Diode, MPN3404	3020265
CR911	Diode, MPN3404	3020265
CR912	Diode, MPN3404	3020265
CR913	Diode, MPN3404	3020265
CR914	Diode, MPN3404	3020265
CR915	Diode, MPN3404	3020265
CR916	Diode, MPN3404	3020265
CR917	Diode, MPN3404	3020265
CR918	Diode, MPN3404	3020265
R901	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R902	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R903	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160

REF DES	DESCRIPTION	PART NO.
R904	Resistor, Carbon Film, 3.9 K $\Omega$ $\pm$ 5%, 1/4 W	3220205
R905	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R906	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R907	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R908	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R909	Resistor, Carbon Film, 3.9 K $\Omega$ $\pm$ 5%, 1/4 W	3220205
R910	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R911	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R912	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R913	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R914	Resistor, Carbon Film, 3.9 K $\Omega$ $\pm$ 5%, 1/4 W	3220205
R915	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R916	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R917	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R918	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R919	Resistor, Carbon Film, 3.9 K $\Omega$ $\pm$ 5%, 1/4 W	3220205
R920	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R921	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R922	Resistor, Carbon Film, 1.0 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
RFC901	Choke Assy. 270 $\mu$ H, MUD271	3520590
RFC902	Choke Assy. 270 $\mu$ H, MUD271	3520590
RFC903	Choke Assy. 270 $\mu$ H, MUD271	3520590
RFC904	Choke Assy. 270 $\mu$ H, MUD271	3520590
RFC905	Choke Assy. 270 $\mu$ H, MUD271	3520590
RFC906	Choke Assy. 270 $\mu$ H, MUD271	3520590
RFC907	Choke Assy. 270 $\mu$ H, MUD271	3520590
RFC908	Choke Assy. 270 $\mu$ H, MUD271	3520590
Y901	Crystal Filter, 4.0 kHz	3140289
Y902	Crystal Filter, 1.8 kHz	3140286
Y903	Crystal Filter, 0.5 kHz	3140287
Y904	Crystal Filter, 0.3 kHz	3140288

**NOTES:**

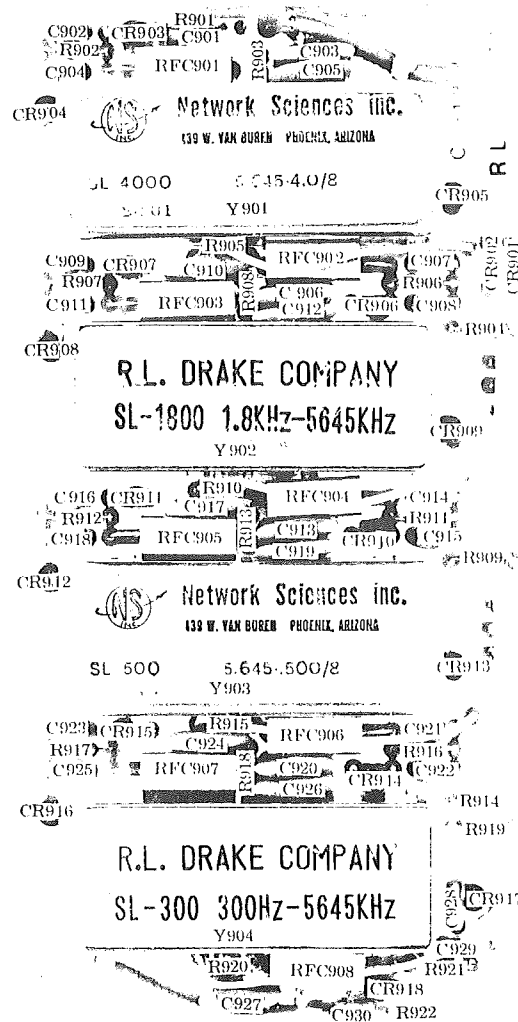


Fig. 3-21 IF Selectivity Board Pictorial

C	901	903	905	902	904		910	912	909	911		917	919	916	918		924	926	923	925	
R	901	904	903	902	907		909	908	910	907		914	913	915	912		919	918	920	921	928
RFC		901	902	906				903	904				915	916				907	922	921	

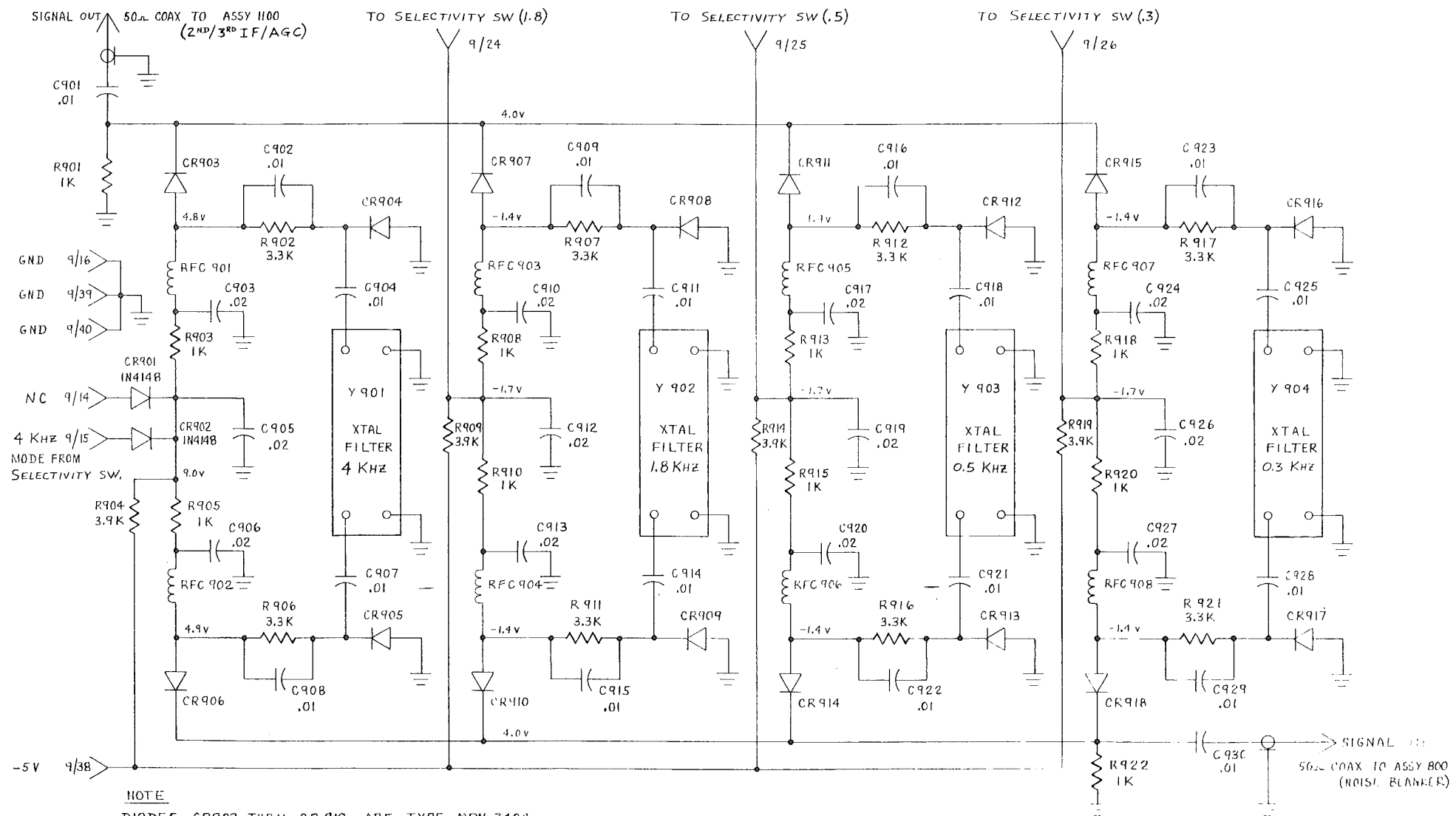


Fig. 3-22 IF Selectivity Board Schematic

### 3-11. PBT/REFERENCE BOARD

The Passband Tuning/Reference board contains a 40 MHz crystal oscillator (master reference), a 13.695 MHz (nominal) VCXO and dividers to obtain 500 kHz (reference), 50 kHz (BFO) and 25 kHz (calibrator) signals. In addition, the board includes mixers to generate the 53.695 MHz 2nd L.O. and 5.695 MHz 3rd L.O. signals in addition to circuitry to accomplish the electronic passband tuning. Refer to figure 3-24 for schematic and figure 3-23 for parts location information.

Q1001 is a highly stable 40 MHz crystal oscillator. The oscillator is set to exactly 40 MHz with L1001, and is designed to maintain this adjustment over long periods of time. The output of the oscillator is buffered by Q1002 to reduce the effects of varying load impedance on frequency. The output of the buffer is tuned by L1006, and coupled through C1014 to all associated circuitry.

When the transceive cable is inserted into the R4245 and TR4310 accessory sockets, and the TR4310 is turned on, +13.6 VDC (TR4310) on accessory pin 9 switches Q1012 off, disabling the R4245 internal 40 MHz oscillator. Also, the 40 MHz signal from the TR4310 is applied to module pin 30 via the transceive cable. L1011 and C1012 form a series tuned trap. This signal is then fed into amplifier Q1003. The output of Q1003 is coupled by C1008 into the collector load of Q1001, which then acts as a very narrow 40 MHz filter. Q1002 again acts as a buffer, tuned by L1006, and the output signal is coupled by C1014 to all associated circuitry.

500 kHz for the synthesizer phase detector (Section 3-6) is derived from the 40 MHz reference by coupling the reference signal to driver transistor Q1004 through C1013. The output of Q1004 drives the +5 section of U1001, which drives U1002, a +16. At the QD output of U1002, the 500 kHz reference is obtained and is connected to board pin 10 through R1063 for use in the synthesizer, and is also routed to U1003A, a +10. At the QA output of U1003A, 50 kHz is derived and is connected through R1030, C1029 and CR1005 to board pin 38 for use as the 50 kHz BFO signal.

When the calibrator is activated by application of 10 volts to board pin 5, Q1007 grounds the clear input, pin 14, of U1003B. This allows the +10 section of U1003A to drive the +2 section of U1003B. The result

is a 25 kHz signal at the QA output of U1003B, pin 13. This 25 kHz signal is rich in harmonics and is injected into the antenna input of the receiver when the calibrator is enabled, and produces a calibration marker every 25 kHz.

10 volts is applied to board pin 35 in both SSB and CW, which enables Q1008, thus grounding the clear input, pin 2, of U1003A. In AM this 10 volts is removed, thus causing the output of Q1008 to go high, inhibiting U1003A, which removes the 50 kHz BFO for AM reception. However, when the calibrator 10 volts is applied, CR1007 forward biases and applies 10 volts back onto the 10 SSB/CW line, enabling Q1008 and U1003A for proper calibrator operation. Also in AM operation, 10 volts is applied on the 50 kHz BFO line which back biases the diode switch, CR1006. This blocks the BFO signal from being applied to board pin 38 when the calibrator is activated.

The 40 MHz reference signal is also coupled to a power splitter, T1001. One output of this splitter is connected to board pin 21 for use by the Translator board (Section 3-7). The other output of T1001 drives buffer stage Q1005, which boosts the signal to a sufficient level to drive one input of a double balanced mixer consisting of T1002, T1003 and CR1002 through CR1005. The second input to the mixer is the output of 13.695 MHz (nominal) VCXO. This oscillator consists of Q1009 and buffer stage Q1010. The frequency is controlled by Y1002, a 13.695 MHz crystal which is pulled approximately  $\pm 3$  kHz by a varactor, CR1001 and L1004. The varactor is controlled by a voltage derived from the front panel passband tuning control. This control will tune the VCXO from approximately 13.692 to 13.698 MHz. This control is enabled all the time.

The output of the double balanced mixer, 2nd L.O., is the sum of the reference and VCXO signals, or 53.695 MHz (nominal). The exact frequency of course depends on the position of the front panel passband control. This signal is filtered by L1007 and C1027 and amplified by Q1006. The output of Q1006 is tuned by L1010 and C1033. C1034 and C1035 provide a capacitive tap matching to module pin 17, thereby feeding the 53.695 MHz (nominal) signal to the 2nd Mixer board (Section 3-8).

A third L.O. of 5.695MHz (nominal) is also generated from the 13.695 MHz (nominal) VCXO. A portion of the VCXO signal is coupled through C1040, filtered by L1005 and C1041, and is coupled through C1042 to gate 2 of Q1011, an autodyne converter. 8 MHz is coupled through C1020 and R1039 from the QC output of U1001 and applied to gate one of Q1008. The difference between 13.695 MHz (nominal) and 8 MHz is 5.695 MHz (nominal), which appears at the drain of Q1008. The output is tuned by C1046 and L1008, filtered by C1047, L1009 and C1048 then coupled to board pin 40 for connection to the 2nd/3rd IF/AGC board (Section 3-12). R1054, R1055 and R1056 form a fixed attenuator pad for the line.

Troubleshooting of the Passband Tuning/Reference board is straightforward. The 40 MHz oscillator

should be checked first, since it affects all outputs. The 13.695 MHz VCXO should be checked next, and then the autodyne converter. In any case, an analysis of which outputs are missing will isolate any problems to an individual oscillator.

Alignment of the board should be exactly in the sequence given in Section 4, which is:

1. 40 MHz Oscillator
2. 13.695 MHz (nominal) VCXO

Failure to observe this sequence will almost certainly result in improper R4245 operation due to frequency error and incorrect passband centering.

#### NOTES:

## PBT/REFERENCE BOARD

REF DES	DESCRIPTION	PART NO.
C1001	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C1002	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C1003	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C1004	Capacitor, Mica, 50 pF $\pm$ 5%, DM-20	3170040
C1005	Capacitor, Disc, .001 $\mu$ F + 20%, 250	3161380
C1006	Capacitor, Disc, 35 pF $\pm$ 5%, NPO	3160730
C1007	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C1008	Capacitor, Disc, 27 pF $\pm$ 5%, NPO	3160640
C1009	Capacitor, Disc, .05 $\mu$ F + 80%, M16V	3161600
C1010	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C1011	Capacitor, Disc, 10 pF $\pm$ 5%, NPO	3160350
C1012	Capacitor, Disc, 15 pF $\pm$ 5%, NPO	3160510
C1013	Capacitor, Mica, 220 pF $\pm$ 5%, DM-15	3170240
C1014	Capacitor, Disc, 15 pF $\pm$ 5%, NPO	3160510
C1015	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C1016	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C1017	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C1018	Capacitor, Mica, 100 pF $\pm$ 5%, DM-15	3170110
C1019	Capacitor, Disc, 330 pF + 10%, Y5E	3161300
C1020	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C1021	Capacitor, Disc, .01 $\mu$ F $\pm$ 20% Z5U	3161510
C1022	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161510
C1023	Capacitor, Electrolytic, 22 $\mu$ F $\pm$ 20%, 16 V	3180105
C1024	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C1025	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C1026	Capacitor, Disc, 12 pF $\pm$ 5%, NPO	3160430
C1027	Capacitor, Mica, 68 pF $\pm$ 5%, DM-15	3170060
C1028	Capacitor, Disc, 12 pF $\pm$ 5%, NPO	3160430
C1029	Capacitor, Mica, 390 pF $\pm$ 5%, DM-15	3170370
C1030	Capacitor, Disc, 100 pF $\pm$ k9%, X5F	3161070
C1031	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C1032	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C1033	Capacitor, Mica, 68 pF $\pm$ 5%, DM-15	3170060
C1034	Capacitor, Disc, 39 pF $\pm$ 5%, NPO	3170760
C1035	Capacitor, Disc, 68 pF $\pm$ 5%, N750	3160990
C1036	Capacitor, Disc, 180 pF $\pm$ 5%, N1500	3161200
C1037	Capacitor, Disc, 33 pF $\pm$ 5%, N750	3160705
C1038	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C1039	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C1040	Capacitor, Disc, 6.2 pF $\pm$ .25, N750	3160200
C1041	Capacitor, Disc, 51 pF $\pm$ 5%, N750	3160860
C1042	Capacitor, Mica, 150 pF $\pm$ 5%, DM-15	3170150
C1043	Capacitor, Disc, .1 $\mu$ F + 80%, Y5T	3161650
C1044	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C1045	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C1046	Capacitor, Mica, 220 pF $\pm$ 5%, DM-15	3170240
C1047	Capacitor, Tubular 4.5 pF, NPO	3185100
C1048	Capacitor, Mica, 220 pF $\pm$ 5%, DM-15	3170240
C1049	Capacitor, Disc, 57 pF $\pm$ 5%, NPO	3160900
C1050	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C1051	Capacitor, Electrolytic, 22 $\mu$ F $\pm$ 20%, 16 V	3180105

REF DES	DESCRIPTION	PART NO.
C1052	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C1053	Capacitor, Disc, 470 pF $\pm$ 20%, Z5U	3161350
C1054	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
CR1001	Diode, MV209	3020278
CR1002	Diode, 1N4148	3020090
CR1003	Diode, 1N4148	3020090
CR1004	Diode, 1N4148	3020090
CR1005	Diode, 1N4148	3020090
CR1006	Diode, 1N4148	3020090
CR1007	Diode, 1N4148	3020090
L1001	Inductor, Var., Blk.	2513001
L1002	Inductor, Choke RFC	2512511
L1003	Inductor, Var., Wht.	2513007
L1005	Inductor, Var., Blk.	2513001
L1006	Inductor, Var., Yel.	2513003
L1007	Inductor, Var., Vio.	2513012
L1008	Inductor, Var., Grn.	2513004
L1009	Inductor, Var., Grn.	2513004
L1010	Inductor, Var., Vio.	2513012
L1011	Inductor, Var., Blk.	2513001
Q1001	Transistor, 2N3563	3030060
Q1002	Transistor, 2N3563	3030060
Q1003	Transistor, 2N3563	3030060
Q1004	Transistor, 2N4125	3030110
Q1005	Transistor, 2N3563	3030060
Q1006	Transistor, 2N3563	3030060
Q1007	Transistor, 2N3904	3030105
Q1008	Transistor, 3N3904	3030105
Q1009	Transistor, 2N3904	3030105
Q1010	Transistor, 2N3563	3030060
Q1011	Transistor, TIS-153	3030480
Q1012	Transistor, 2N4402	3030120
R1001	Resistor, Carbon Film, 10 $\Omega$ $\pm$ 5%, 1/4 W	3220005
R1002	Resistor, Carbon Film, 2.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220190
R1003	Resistor, Carbon Film, 27 $\Omega$ $\pm$ 5%, 1/4 W	3220020
R1004	Resistor, Carbon Film, 18 K $\Omega$ $\pm$ 5%, 1/4 W	3220255
R1005	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R1006	Resistor, Carbon Film, 470 $\Omega$ $\pm$ 5%, 1/4 W	3220110
R1007	Resistor, Carbon Film, 68 $\Omega$ $\pm$ 5%, 1/4 W	3220045
R1008	Resistor, Carbon Film, 68 $\Omega$ $\pm$ 5%, 1/4 W	3220045
R1009	Resistor, Carbon Film, 18 K $\Omega$ $\pm$ 5%, 1/4 W	3220255
R1010	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R1011	Resistor, Carbon Film, 10 $\Omega$ $\pm$ 5%, 1/4 W	3220005
R1012	Resistor, Carbon Film, 470 $\Omega$ $\pm$ 5%, 1/4 W	3220110
R1013	Resistor, Carbon Film, 22 $\Omega$ $\pm$ 5%, 1/4 W	3220015
R1014	Resistor, Carbon Film, 270 $\Omega$ $\pm$ 5%, 1/4 W	3220085
R1015	Resistor, Carbon Film, 39 $\Omega$ $\pm$ 5%, 1/4 W	3220030
R1016	Resistor, Carbon Film, 150 $\Omega$ $\pm$ 5%, 1/4 W	3220065
R1017	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R1018	Resistor, Carbon Film, 2.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220190
R1019	Resistor, Carbon Film, 8.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220230
R1020	Resistor, Carbon Film, 33 $\Omega$ $\pm$ 5%, 1/4 W	3220025
R1021	Resistor, Carbon Film, 10 $\Omega$ $\pm$ 5%, 1/4 W	3220005

REF DES	DESCRIPTION	PART NO.
R1022	Resistor, Carbon Film, 10 $\Omega$ $\pm$ 5%, 1/4 W	3220005
R1023	Resistor, Carbon Film, 220 $\Omega$ $\pm$ 5%, 1/4 W	3220075
R1024	Resistor, Carbon Film, 2.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220190
R1025	Resistor, Carbon Film, 8.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220230
R1026	Resistor, Carbon Film, 33 $\Omega$ $\pm$ 5%, 1/4 W	3220025
R1027	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R1028	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R1029	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R1030	Resistor, Carbon Film, 15 K $\Omega$ $\pm$ 5%, 1/4 W	3220245
R1031	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R1032	Resistor, Carbon Film, 3.3 $\Omega$ $\pm$ 5%, 1/4 W	3220002
R1033	Resistor, Carbon Film, 10 $\Omega$ $\pm$ 5%, 1/4 W	3220005
R1034	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R1035	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R1036	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220060
R1037	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R1038	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R1039	Resistor, Carbon Film, 4.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220210
R1040	Resistor, Carbon Film, 8.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220230
R1041	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R1042	Resistor, Carbon Film, 5.6 K $\Omega$ $\pm$ 5%, 1/4 W	3220215
R1043	Resistor, Carbon Film, 470 $\Omega$ $\pm$ 5%, 1/4 W	3220110
R1044	Resistor, Carbon Film, 180 $\Omega$ $\pm$ 5%, 1/4 W	3220070
R1045	Resistor, Carbon Film, 5.6 K $\Omega$ $\pm$ 5%, 1/4 W	3220215
R1046	Resistor, Carbon Film, 56 K $\Omega$ $\pm$ 5%, 1/4 W	3220295
R1047	Resistor, Carbon Film, 470 K $\Omega$ $\pm$ 5%, 1/4 W	3220345
R1048	Resistor, Carbon Film, 1 M $\Omega$ $\pm$ 5%, 1/4 W	3220355
R1049	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R1050	Resistor, Carbon Film, 68 $\Omega$ $\pm$ 5%, 1/4 W	3220045
R1051	Resistor, Carbon Film, 510 $\Omega$ $\pm$ 5%, 1/4 W	3220115
R1052	Resistor, Carbon Film, 82 $\Omega$ $\pm$ 5%, 1/4 W	3220050
R1053	Resistor, Carbon Film, 10 $\Omega$ $\pm$ 5%, 1/4 W	3220005
R1054	Resistor, Carbon Film, 68 $\Omega$ $\pm$ 5%, 1/4 W	3220045
R1055	Resistor, Carbon Film, 120 $\Omega$ $\pm$ 5%, 1/4 W	3220060
R1056	Resistor, Carbon Film, 68 $\Omega$ $\pm$ 5%, 1/4 W	3220045
R1057	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R1058	Resistor, Carbon Film, 68 K $\Omega$ $\pm$ 5%, 1/4 W	3220300
R1059	Resistor, Carbon Film, 47 K $\Omega$ $\pm$ 5%, 1/4 W	3220285
R1061	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R1062	Resistor, Carbon Film, 6.8 K $\Omega$ $\pm$ 5%, 1/4 W	3220220
R1063	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R1064	Resistor, Carbon Film, 180 $\Omega$ $\pm$ 5%, 1/4 W	3220070
R1065	Resistor, Carbon Film, 1.8 K $\Omega$ $\pm$ 5%, 1/4 W	3220180
RFC1001	Choke Assy., 270 $\mu$ H, MUD271	3520590
RFC1002	Choke Assy., 270 $\mu$ H, MUD271	3520590
RFC1003	Choke Assy., 5.6 $\mu$ H, L56G	3520510
RFC1004	Choke Assy., 5.6 $\mu$ H, L56G	3520510
RFC1005	Choke Assy., 270 $\mu$ H, MUD271	3520590
RFC1006	Choke Assy., 5.6 $\mu$ H, L56G	3520510
RFC1007	Choke Assy., .33 $\mu$ H	2512506
T1001	Inductor, Toroid	2510003
T1002	Inductor, Toroid	2510002
T1003	Inductor, Toroid	2510002

REF DES	DESCRIPTION	PART NO.
T1004	Inductor, Toroid	2510029
U1001	I.C., SN74S196N	3040471
U1002	I.C., SN74LS197	3040473
U1003	I.C., SN74LS390	3040478
Y1001	Crystal, 40.000 MHz	3120283
Y1002	Crystal, 13.695 MHz	3120282

## NOTES:



### 3-12. 2ND/3RD IF/AGC BOARD

The 2nd/3rd IF/AGC board provides AGC controlled 5.645 MHz gain, signal conversion to 50 kHz IF, notch filtering, signal demodulation and S-meter functions. It also includes the standard 2.3 kHz, 8-pole IF crystal filter and corresponding circuitry. See figure 3-26 for schematic and figure 3-25 for parts location information.

The 5.645 MHz 2nd IF signals from the output of the Noise Blanker board (common with input to the IF Selectivity board) are connected to the input coax connector at C1102. With the front panel Selectivity switch set at 2.3 kHz, +10V is present on module pin 7. This voltage turns on series diodes CR1103 (via R1190, RFC1104 and R1109) and CR1113 (via R1189, RFC1103 and R1191). The same voltage back biases shunt diodes CR1111 and CR1112. The signal path is through C1102, CR1103, C1164, C1161 to the 2.3 kHz filter. After filtering, the signal is coupled through C1160, C1162, CR1113 and C1167 to the primary of T1101. With the front panel selectivity switch set at any position other than 2.3 kHz, the 5.645 MHz 2nd IF signals from the output of the IF Selectivity board are connected to the input coax connector at T1101.

Regardless of the selectivity filter signal path, T1101 matches the input signal to the first stage of amplification, Q1101. The output of Q1101 is tuned by L1101 and coupled to the input of the second stage of gain, Q1102, through C1110. The output of Q1102 is tuned by L1102 and coupled to the input of the 3rd mixer, Q1103, through C1120. The injection for the mixer is a 5.695 MHz (nominal) signal which is developed on the PBT board (Section 3-11) and amplified by Q1109 and tuned by L1105. It is then coupled through C1136 to Gate 2 of Q1103. The output of Q1103 is tuned to 50 kHz by L1103 and applied to the notch filter circuitry. The mixer conversion gain is adjusted by R1138. The notch filter employs an operational amplifier, U1101, in a differential amplifier configuration. For signal frequencies other than the parallel resonant frequency of the circuit comprised of L1104, C1133, CR1108 and CR1109, the voltage gain from the output of Q1103 to pin 6 of U1101 is approximately two. However, at the resonant notch frequency, the signal level appearing at pin 2 of U1101 is exactly equal to that level appearing at pin 3. The voltage gain in that case is zero, thus producing the null. CR1108 and CR1109 are varactor diodes whose capacitance is adjusted by

DC voltage. L1104 is adjustable to allow for centering of the front panel notch control when the 3rd IF frequency is 50 kHz. R1147 adjusts the circuit gain to insure the best possible signal null at resonance. The output of the notch filter is coupled to gate one of Q1104 through C1134 and R1154. With the receiver operational, module pin 22 is a switched ground, thus allowing drain current to flow. Amplifier gain is approximately 20 dB in this case. When the receiver is muted, ground is removed from module pin 22, reducing amplifier gain to zero. The output of Q1104 is tuned to 50 kHz by T1102, with a sampling of the signal sent to the AGC detector and the transformer secondary driving the AM and product detectors.

Thus AGC is developed prior to detection by sampling the output of Q1104 through R1145 and C1125. This signal is applied to the base of Q1105 which is biased to a point just below conduction. As the output of Q1104 increases (with increasing signal input to the receiver), Q1105 starts to conduct, applying AGC voltage to the gates of Q1101 and Q1102. Stronger input signals cause Q1105 to conduct harder, thus developing a higher AGC voltage. This action holds the output of Q1104 essentially constant, which controls the drive to the detectors, holding the audio output of the receiver to a constant level.

AGC release time constants are controlled by switching in resistor-capacitor networks consisting of R18-C1 (Parent board mounted), R17-C2 (Parent board mounted), R1121-C1113 and R1129-C1119 via the front panel AGC pushbutton switches. In SLOW AGC, the discharging of C1 and C2 through R1133 determines the release time. In MEDIUM AGC, the discharging of C1113 and C1119 through R1133 determines the release time. In FAST AGC, the discharging of C1114 and C1118 through R1133 determines the release time. Diodes CR1104 and CR1105 provide a slight amount of hysteresis to the AGC line to prevent the developed AGC voltage from following the audio envelope present at the detector, Q1105. In the AGC OFF mode, all networks determining decay time are shorted out and diodes CR1114 through CR1116 clamp the AGC line. IF gain is controlled solely by the front panel RF GAIN control in this mode. A sample of the AGC voltage is coupled through R1111 to control the gain of the first IF amplifier (Section 3-8). In addition, the control

signal is coupled through R1120 to a source follower, Q1106, to drive the S-meter. R1106 is used to set +60 over S9 meter indication and R1119 is used to establish S-meter no signal indication. A small pedestal voltage is set by R1127 to allow the receiver to run a maximum gain under no signal conditions. Adjustment of these controls is described in the alignment procedure (Section 4). It is important to follow the exact sequence of adjustments to avoid improper AGC operation.

The secondary of T1102 couples signal through C1156 to the signal input ports of balanced demodulator, U1102, and through C1159-R1193 to an amplifier stage, Q1107. In the SSB/CW mode, amplifier stage Q1107 is turned off, but Q1108 amplifies the 50

kHz BFO signal (present at module pin 38) to a level sufficient to drive the carrier ports of U1102. The demodulated audio appears at U1102, pin 12, and is amplified by Q1110 and coupled out to module pin 31 through C1147. In the AM mode, +10V appears at module pin 37, enabling Q1107 and back biasing diode CR1006 (located on PBT board) to block any residual BFO from the PBT board. The AM signal is routed through C1156 to U1102 signal port, and is also amplified by Q1107 and Q1108 to a level sufficient to drive the carrier ports of U1102. As in SSB/CW, the AM demodulated audio appears at U1102 pin 12.

Alignment of the 2nd/3rd IF/AGC board is covered in Section 4.

#### NOTES:

## 2ND/3RD IF/AGC BOARD

REF DES	DESCRIPTION	PART NO.
C1101	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C1102	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C1103	Capacitor, Mica, 330 pF $\pm$ 5%, DM-15	3170320
C1104	Capacitor, Disc, 470 pF $\pm$ 20%, Z5U	3161350
C1105	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C1106	Capacitor, Tantalum, 10 $\mu$ F $\pm$ 20%, 25 V	3183030
C1107	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1108	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1109	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C1110	Capacitor, Disc, 470 pF $\pm$ 20%, Z5U	3161350
C1111	Capacitor, Mica, 390 pF $\pm$ 5%, DM-15	3170370
C1112	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C1113	Capacitor, Disc, .05 $\mu$ F + 80%, Z5U	3161630
C1114	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C1115	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1116	Capacitor, Tantalum, 10 $\mu$ F $\pm$ 20%, 25 V	3183030
C1117	Capacitor, Mica, 390 pF $\pm$ 5%, DM-15	3170370
C1118	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C1119	Capacitor, Disc, .05 $\mu$ F + 80%, Z5U	3161630
C1120	Capacitor, Disc, 470 pF $\pm$ 20%, Z5U	3161350
C1121	Capacitor, Disc, .05 $\mu$ F + 80%, Z5U	3161630
C1122	Capacitor, Disc, .1 $\mu$ F $\pm$ 20%, 16 V	3161680
C1123	Capacitor, Disc, .0024 $\mu$ F $\pm$ 20%, Z5U	3161430
C1124	Capacitor, Tantalum, 1.0 $\mu$ F $\pm$ 20%, 35 V	3183010
C1125	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1126	Capacitor, Tantalum, 1 $\mu$ F $\pm$ 20%, 35 V	3183010
C1127	Capacitor, Mica, 220 pF $\pm$ 5%, DM-15	3170240
C1128	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C1129	Capacitor, Tantalum, 1 $\mu$ F $\pm$ 20%, 35 V	3183010
C1130	Capacitor, Tantalum, 1 $\mu$ F $\pm$ 20%, 35 V	3183010
C1131	Capacitor, Tantalum, 10 $\mu$ F $\pm$ 20%, 25 V	3183030
C1132	Capacitor, Mica, 180 pF $\pm$ 5%, DM-15	3170180
C1133	Capacitor, Mica, 390 pF $\pm$ 5%, DM-15	3170370
C1134	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C1135	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1136	Capacitor, Mica, 180 pF $\pm$ 5%, DM-15	3170180
C1137	Capacitor, Mica, 180 pF $\pm$ 5%, DM-15	3170180
C1138	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1139	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1140	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1141	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1142	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1143	Capacitor, Electrolytic, 10 $\mu$ F $\pm$ 20%, 25 V	3180062
C1144	Capacitor, Electrolytic, 10 $\mu$ F $\pm$ 20%, 25 V	3180062
C1145	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1146	Capacitor, Tantalum, 22 $\mu$ F $\pm$ 20%, 15 V	3183050
C1147	Capacitor, Tantalum, .47 $\mu$ F $\pm$ 10%, 35 V	3183110
C1148	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C1149	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C1150	Capacitor, Tantalum, 1 $\mu$ F $\pm$ 20%, 35 V	3183010
C1151	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520

REF DES	DESCRIPTION	PART NO.
C1152	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1153	Capacitor, Disc, .05 $\mu$ F + 80%, Z5U	3161630
C1154	Capacitor, Tantalum, 1 $\mu$ F $\pm$ 20%, 35 V	3183010
C1155	Capacitor, Disc, .02 $\mu$ F + 80%, Z5U	3161580
C1156	Capacitor, Disc, .05 $\mu$ F + 80%, Z5U	3161630
C1157	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1158	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1159	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C1160	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C1161	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C1162	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C1163	Capacitor, Disc, .02 $\mu$ F + 80%, Z5U	3161580
C1164	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C1165	Capacitor, Disc, .01 $\mu$ F + 80%, Z5U	3161580
C1166	Capacitor, Disc, .02 $\mu$ F + 80%, Z5U	3161580
C1167	Capacitor, Disc, .02 $\mu$ F + 80%, M25V	3161500
C1168	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
CR1101	Diode, 1N4148	3020090
CR1102	Diode, 1N4148	3020090
CR1103	Diode, MPN3404	3020265
CR1104	Diode, 1N4148	3020090
CR1105	Diode, 1N4148	3020090
CR1106	Diode, 1N4148	3020090
CR1107	Diode, 1N4148	3020090
CR1108	Diode, MVAM-109	3020272
CR1109	Diode, MVAM-109	3020272
CR1110	Diode, 1N4148	3020090
CR1111	Diode, MPN3404	3020265
CR1112	Diode, MPN3404	3020265
CR1113	Diode, MPN3404	3020265
CR1114	Diode, 1N4148	3020090
CR1115	Diode, 1N4148	3020090
CR1116	Diode, 1N4148	3020090
L1101	Inductor, Variable Can	2511021
L1102	Inductor, Variable Can	2511021
L1103	Inductor, Variable Can, IF Xfmr.	2511061
L1104	Inductor, Variable Can	2511030
L1105	Inductor, Variable	2513004
Q1101	Transistor, TIS-153	3030480
Q1102	Transistor, TIS-153	3030480
Q1103	Transistor, TIS-153	3030480
Q1104	Transistor, TIS-153	3030480
Q1105	Transistor, 2N4402	3030120
Q1106	Transistor, TIS-153	3030480
Q1107	Transistor, 2N3904	3030105
Q1108	Transistor, 2N3904	3030105
Q1109	Transistor, 2N3904	3030105
Q1110	Transistor, 2N3904	3030105
R1101	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R1102	Resistor, Carbon Film, 6.8 K $\Omega$ $\pm$ 5%, 1/4 W	3220220
R1103	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R1104	Resistor, Carbon Film, 27 $\Omega$ $\pm$ 5%, 1/4 W	3220020
R1105	Resistor, Carbon Film, 470 K $\Omega$ $\pm$ 5%, 1/4 W	3220345

REF DES	DESCRIPTION	PART NO.
R1106	Resistor, Variable, 10 K $\Omega$	3260665
R1107	Resistor, Carbon Film, 2.2 K $\Omega \pm 5\%$ , 1/4 W	3220190
R1108	Resistor, Carbon Film, 820 $\Omega \pm 5\%$ , 1/4 W	3220145
R1109	Resistor, Carbon Film, 1 K $\Omega \pm 5\%$ , 1/4 W	3220160
R1110	Resistor, Carbon Film, 68 $\Omega \pm 5\%$ , 1/4 W	3220045
R1111	Resistor, Carbon Film, 2.2 M $\Omega \pm 5\%$ , 1/4 W	3220360
R1112	Resistor, Carbon Film, 100 $\Omega \pm 5\%$ , 1/4 W	3220055
R1113	Resistor, Carbon Film, 22 K $\Omega \pm 5\%$ , 1/4 W	3220260
R1114	Resistor, Carbon Film, 1 K $\Omega \pm 5\%$ , 1/4 W	3220160
R1115	Resistor, Carbon Film, 470 K $\Omega \pm 5\%$ , 1/4 W	3220345
R1116	Resistor, Carbon Film, 22 K $\Omega \pm 5\%$ , 1/4 W	3220260
R1117	Resistor, Carbon Film, 27 $\Omega \pm 5\%$ , 1/4 W	3220020
R1118	Resistor, Carbon Film, 1 K $\Omega \pm 5\%$ , 1/4 W	3220160
R1119	Resistor, Variable, 500 $\Omega$	3260650
R1120	Resistor, Composition, 10 M $\Omega \pm 10\%$ , 1/4 W	3220380
R1121	Resistor, Carbon Film, 180 K $\Omega \pm 5\%$ , 1/4 W	3220325
R1122	Resistor, Carbon Film, 820 $\Omega \pm 5\%$ , 1/4 W	3220145
R1123	Resistor, Carbon Film, 6.8 K $\Omega \pm 5\%$ , 1/4 W	3220220
R1124	Resistor, Carbon Film, 1 M $\Omega \pm 5\%$ , 1/4 W	3220355
R1125	Resistor, Carbon Film, 68 $\Omega \pm 5\%$ , 1/4 W	3220045
R1126	Resistor, Carbon Film, 150 $\Omega \pm 5\%$ , 1/4 W	3220065
R1127	Resistor, Variable, 5 K $\Omega$	3220660
R1128	Resistor, Carbon Film, 2.2 M $\Omega \pm 5\%$ , 1/4 W	3220360
R1129	Resistor, Carbon Film, 180 K $\Omega \pm 5\%$ , 1/4 W	3220325
R1130	Resistor, Carbon Film, 1 M $\Omega \pm 5\%$ , 1/4 W	3220355
R1131	Resistor, Carbon Film, 470 K $\Omega \pm 5\%$ , 1/4 W	3220345
R1132	Resistor, Carbon Film, 56 K $\Omega \pm 5\%$ , 1/4 W	3220295
R1133	Resistor, Composition, 10 M $\Omega \pm 10\%$ , 1/4 W	3220380
R1134	Resistor, Carbon Film, 15 K $\Omega \pm 5\%$ , 1/4 W	3220245
R1135	Resistor, Carbon Film, 1 K $\Omega \pm 5\%$ , 1/4 W	3220160
R1136	Resistor, Carbon Film, 68 $\Omega \pm 5\%$ , 1/4 W	3220045
R1137	Resistor, Carbon Film, 680 $\Omega \pm 5\%$ , 1/4 W	3220140
R1138	Resistor, Variable, 10 K $\Omega$	3220665
R1139	Resistor, Carbon Film, 33 K $\Omega \pm 5\%$ , 1/4 W	3220275
R1140	Resistor, Carbon Film, 10 K $\Omega \pm 5\%$ , 1/4 W	3220235
R1141	Resistor, Carbon Film, 47 K $\Omega \pm 5\%$ , 1/4 W	3220285
R1142	Resistor, Composition, 10 M $\Omega \pm 10\%$ , 1/4 W	3220380
R1143	Resistor, Carbon Film, 150 $\Omega \pm 5\%$ , 1/4 W	3220065
R1144	Resistor, Carbon Film, 150 $\Omega \pm 5\%$ , 1/4 W	3220065
R1145	Resistor, Carbon Film, 22 K $\Omega \pm 5\%$ , 1/4 W	3220260
R1146	Resistor, Carbon Film, 68 K $\Omega \pm 5\%$ , 1/4 W	3220300
R1147	Resistor, Variable, 20 K $\Omega$	3260140
R1148	Resistor, Carbon Film, 680 K $\Omega \pm 5\%$ , 1/4 W	3220350
R1149	Resistor, Carbon Film, 470 $\Omega \pm 5\%$ , 1/4 W	3220110
R1150	Resistor, Carbon Film, 220 $\Omega \pm 5\%$ , 1/4 W	3220075
R1151	Resistor, Carbon Film, 22 K $\Omega \pm 5\%$ , 1/4 W	3220260
R1152	Resistor, Carbon Film, 470 K $\Omega \pm 5\%$ , 1/4 W	3220345
R1153	Resistor, Carbon Film, 100 K $\Omega \pm 5\%$ , 1/4 W	3220315
R1154	Resistor, Carbon Film, 22 K $\Omega \pm 5\%$ , 1/4 W	3220260
R1155	Resistor, Carbon Film, 150 K $\Omega \pm 5\%$ , 1/4 W	3220320
R1156	Resistor, Carbon Film, 220 K $\Omega \pm 5\%$ , 1/4 W	3220330
R1157	Resistor, Carbon Film, 3.3 $\Omega \pm 5\%$ , 1/4 W	3220002
R1158	Resistor, Carbon Film, 4.7 K $\Omega \pm 5\%$ , 1/4 W	3220210

REF DES	DESCRIPTION	PART NO.
R1159	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R1160	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R1161	Resistor, Carbon Film, 8.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220230
R1162	Resistor, Carbon Film, 47 $\Omega$ $\pm$ 5%, 1/4 W	3220035
R1163	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R1164	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R1165	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R1166	Resistor, Carbon Film, 1.5 K $\Omega$ $\pm$ 5%, 1/4 W	3220175
R1167	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R1168	Resistor, Carbon Film, 47 K $\Omega$ $\pm$ 5%, 1/4 W	3220285
R1169	Resistor, Carbon Film, 4.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220210
R1170	Resistor, Carbon Film, 1.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220170
R1171	Resistor, Carbon Film, 4.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220210
R1172	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R1173	Resistor, Carbon Film, 4.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220210
R1174	Resistor, Carbon Film, 820 $\Omega$ $\pm$ 5%, 1/4 W	3220145
R1175	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R1176	Resistor, Carbon Film, 4.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220210
R1177	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R1178	Resistor, Carbon Film, 4.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220210
R1179	Resistor, Carbon Film, 1.5 K $\Omega$ $\pm$ 5%, 1/4 W	3220175
R1180	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R1181	Resistor, Carbon Film, 47 K $\Omega$ $\pm$ 5%, 1/4 W	3220285
R1182	Resistor, Carbon Film, 4.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220210
R1183	Resistor, Carbon Film, 1.5 K $\Omega$ $\pm$ 5%, 1/4 W	3220175
R1184	Resistor, Carbon Film, 270 $\Omega$ $\pm$ 5%, 1/4 W	3220085
R1185	Resistor, Carbon Film, 47 K $\Omega$ $\pm$ 5%, 1/4 W	3220285
R1186	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R1187	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R1188	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R1189	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R1190	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R1191	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R1192	Resistor, Carbon Film, 3.9 K $\Omega$ $\pm$ 5%, 1/4 W	3220205
R1193	Resistor, Carbon Film, 1.8 K $\Omega$ $\pm$ 5%, 1/4 W	3220180
R1194	Resistor, Carbon Film, 68 $\Omega$ $\pm$ 5%, 1/4 W	3220045
RFC1101	Choke, 270 $\mu$ H, MUD271	3520590
RFC1102	Choke, 270 $\mu$ H, MUD271	3520590
RFC1103	Choke, 270 $\mu$ H, MUD271	3520590
RFC1104	Choke, 270 $\mu$ H, MUD271	3520590
T1101	Transformer, Input	2511041
T1102	Transformer, Output	2511050
U1101	I.C., MC1741S-CP1	3040101
U1102	I.C., MC1496P	3040112
Y1101	Crystal Filter, 2.3 kHz, 8 Pole	3140280

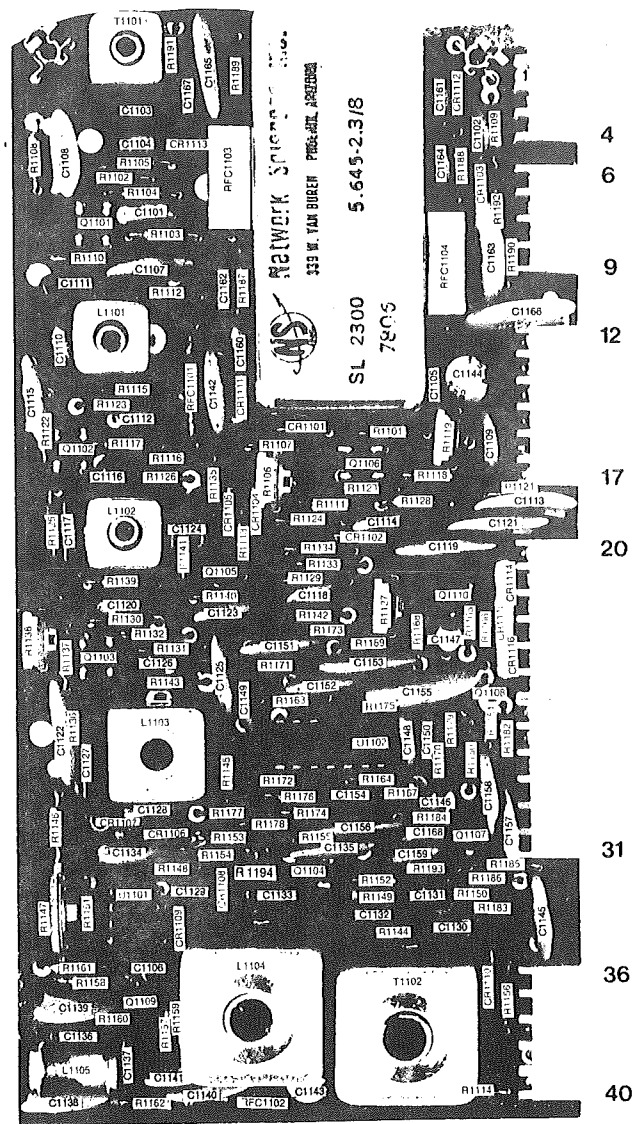


Fig. 3-25 2nd/3rd IF/AGC Board Pictorial

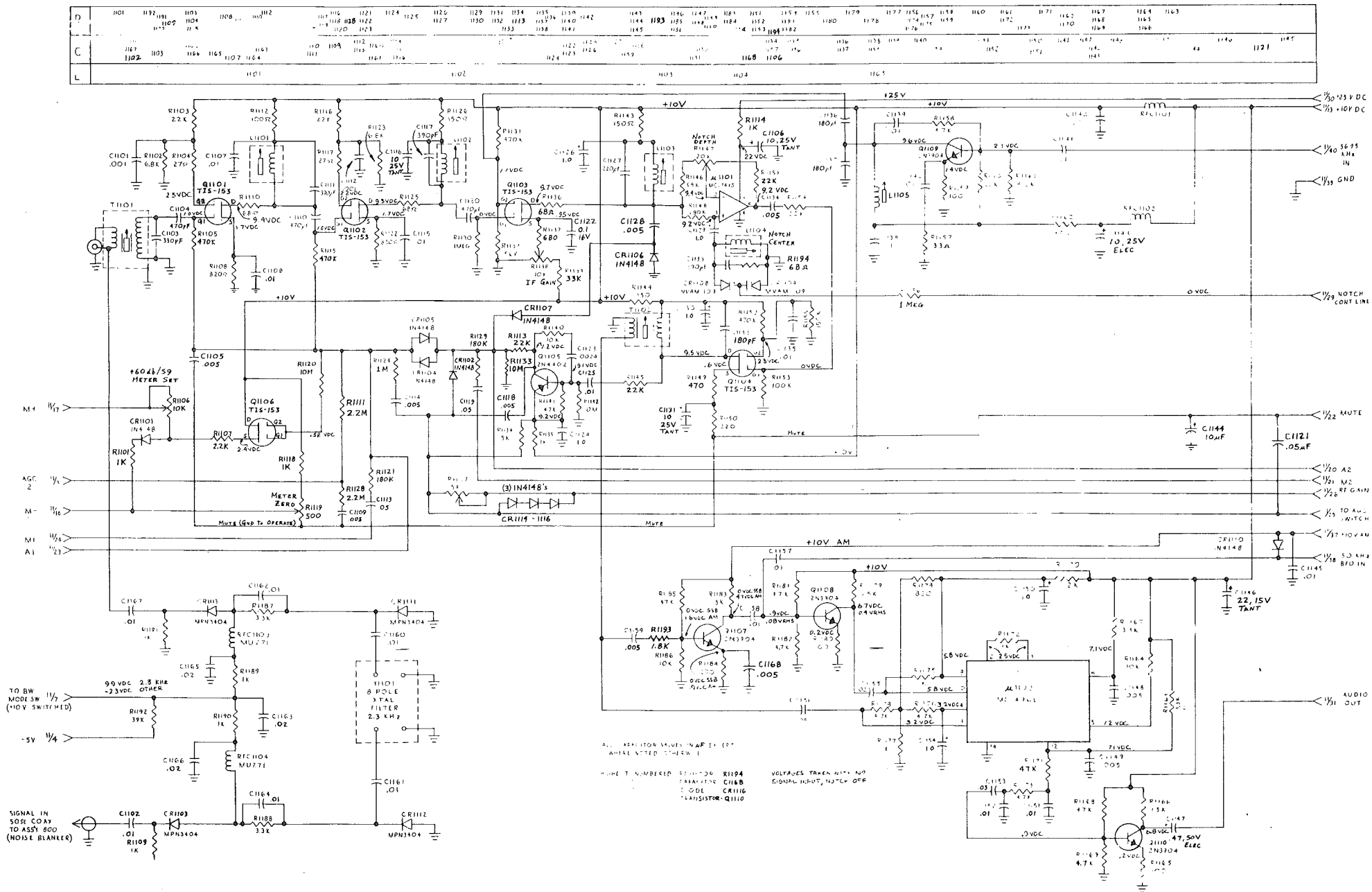


Fig. 3-26 2nd/3rd IF/AGC Board Schematic

### 3-13. JUMPER BOARD

The Jumper board is used for servicing only. It allows the VRTO Digital board to be removed from the Digital Control and Translator board connections in the R4245. The Jumper board is required to transfer band programming information to the Translator board from the Digital Control board.

The Jumper board consists of two CMOS integrated

circuits, U1201 and U1202. These IC's are high current hex buffers. They buffer the CMOS output levels of the Digital Control board which in turn drive the Translator board. Note the input code (12 pin connector) should be the same as the output code (9 pin connector). However, the output pin directly across from the input is not necessarily the same code bit. See figure 3-28 for schematic and figure 3-27 for parts list information.

#### NOTES:

NOTES:

## JUMPER BOARD

REF DES	DESCRIPTION	PART NO.
C1201	Capacitor, Disc, .01 $\mu$ F + 80%, M25 V	3161500
R1201	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R1202	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R1203	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R1204	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R1205	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R1206	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R1207	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R1208	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
U1201	I.C., MC14050B	3041050
U1202	I.C., MC14050B	3041050

## NOTES:

NOTES:

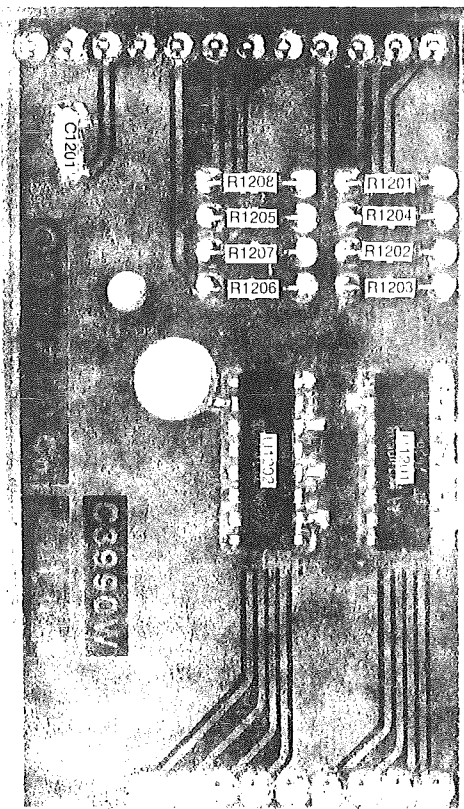


Fig. 3-27 Jumper Board Pictorial

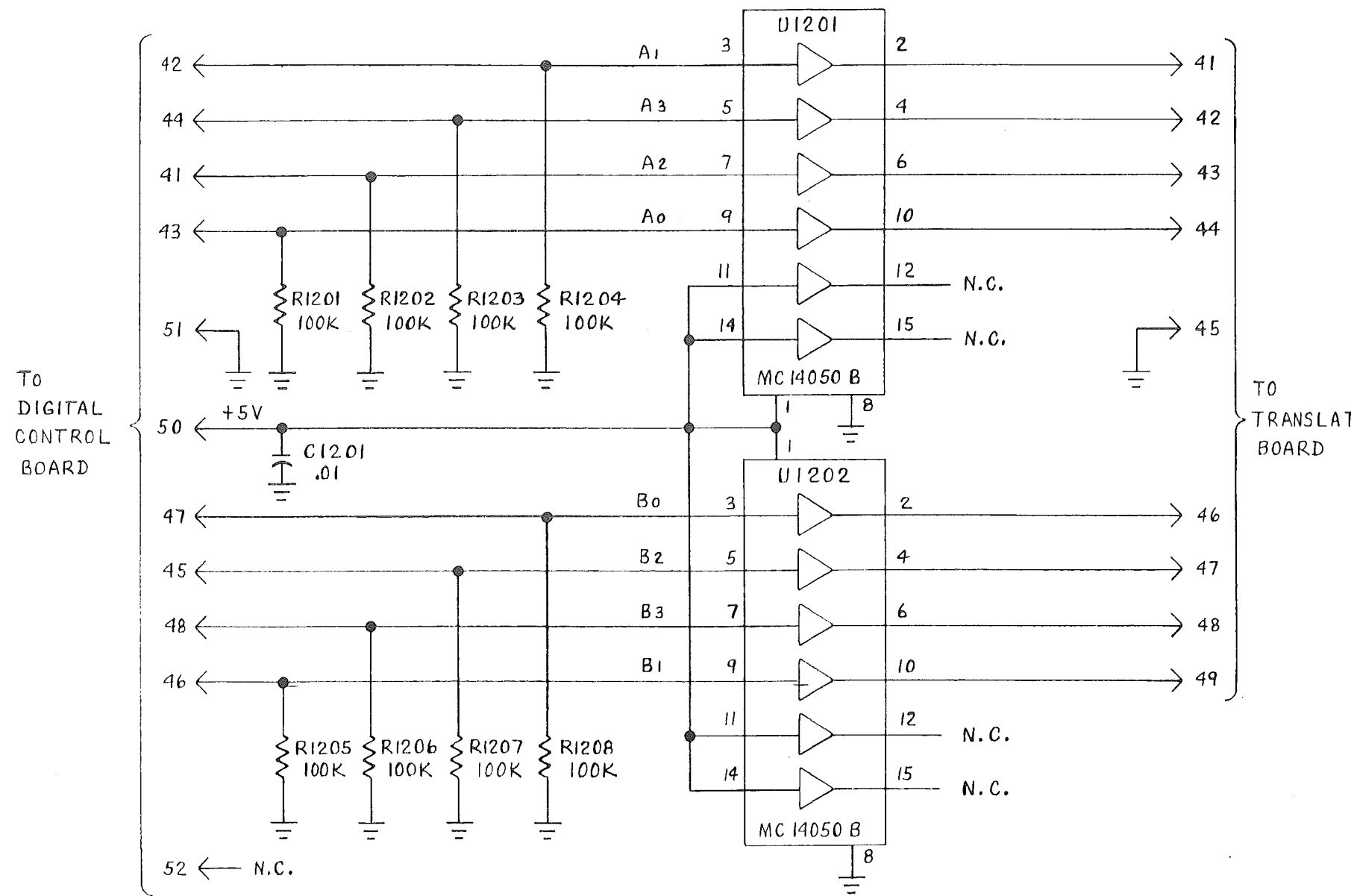


Fig. 3-28 Jumper Board Schematic

### 3-14. BANDPASS FILTER MODULE

The Bandpass Filter Module consists of four printed circuit boards; a front switch board (assy. 1300), a rear switch board (assy. 1400), a BAND 1-6 filter board (assy. 1500), and a BAND 7-11 filter board (assy. 1600). Refer to figure 3-32 for schematic and figures 3-29 through 3-31 for parts location information.

The rear switch board accepts signals from the front panel antenna switch and routes them through C1401 (front) to one of ten filters. S1401 is positioned by the bandswitch shaft. S1401 (rear) provides a momentary ground impulse for band change information to the VRTO Digital Board. Also mounted to this board assembly is S1402 (front and rear) which provides binary coded information to the Digital Control board (Section 3-3). S1402 is also positioned by the bandswitch shaft.

On the front switch board, S1301 (front) connects to one of ten filters and routes the signal through the normally closed relay contacts of K1301 and through C1303 to the Up-Converter module (Section 3-5). The preamplifier is enabled by applying +13.8 VDC to the relay when a DC current path to ground is supplied through R1303, S1301 (front) and first coil encountered in bandpass filters 4-11. Thus the preamp is disabled on bands 1-3 by C1532 and C1533. With K1301 energized, a signal routed through S1301 and through one pole of K1301, normally open contacts, is applied to the base of Q1302, amplified and sent through C1307 and second pole of normally open contacts to C1303 and Up-Converter input. The 25 kHz calibrator signal, applied electrically following the preamp, is connected to the Up-Converter input via switching diodes CR1301 and CR1302 in the calibrate mode. S1301 (rear) provides +10 VDC to the LO VCO line for frequencies below 15 MHz (Bands 1-9). For the two bandswitch positions above 15 MHz, +10 VDC is switched to the HI VCO line and removed from the LO VCO line.

Band 1-6 filter board (assy. 1500) contains five filters. Each filter corresponds to one bandswitch position except for Bands 2 and 3 (0.5-1.5 MHz), which share one filter. Filters on bands 1 and 2-3 are of the lowpass variety. On band 2-3 filter, R1502 may be adjusted for increased filter loss to eliminate any AM broadcast interference that may occur.

Band 7-11 filter board (assy. 1600) contains five bandpass filters. Each filter corresponds to one bandswitch position. The approximate cut-off frequencies of the ten filters are:

BAND	FREQUENCY RANGE	CUT-OFF FREQUENCIES	
		LOWER	UPPER
1	10 kHz-0.5 MHz	—	0.5 MHz
2 & 3	0.5 MHz-1.5 MHz	—	1.65 MHz
4	1.5 MHz-2.0 MHz	1.75 MHz	2.2 MHz
5	2.0 MHz-3.0 MHz	2.0 MHz	3.0 MHz
6	3.0 MHz-4.5 MHz	2.8 MHz	4.8 MHz
7	4.5 MHz-7.0 MHz	4.4 MHz	7.5 MHz
8	7.0 MHz-10.0 MHz	6.9 MHz	10.3 MHz
9	10.0 MHz-15.0 MHz	9.8 MHz	16.0 MHz
10	15.0 MHz-22.0 MHz	14.5 MHz	23.0 MHz
11	22.0 MHz-30.0 MHz	21.0 MHz	30.5 MHz

Note that the lower cut-off frequency of the band 4 filter is above the lowest frequency of interest. This is necessary to provide sufficient rejection to strong AM broadcast signals which can create interfering intermodulation products in the 160 meter amateur band. As a result, sensitivity may be degraded below 1.75 MHz in this bandswitch position.

Removal of the Bandpass Filter Module is accomplished by removing the bandswitch shaft and unsoldering the wires connected to the front and rear switch board assemblies. Be sure to label each lead so that it can be correctly reinstalled. Remove the two screws holding the bandswitch detent in the rear panel. Loosen the rear set screw in the bandswitch coupler. Then slide the switch shaft straight back until it clears the front and rear switch wafers. The module must then be slid toward the side of the radio so that the rubber grommet in assembly 1500 slides off of the locating metal standoff. The module can then be pulled up out the top of the chassis. Reverse this procedure to install the module. Be sure to orient the notch in the switch wafers in the proper direction when reinstalling the bandswitch shaft. In addition, do not force the switch shaft into the rotor or damage will result.

The above procedure is somewhat time-consuming, and it is recommended only in those cases that absolutely require removal of the module. Note that most repairs can be accomplished in the radio, due to the

open construction.

The Bandpass Filter Module does not require alignment.

**NOTES:**

### BAND PASS FL. SW., FRONT

REF DES	DESCRIPTION	PART NO.
C1301	Capacitor, Disc, 330 pF ± 10%, Y5E	3161300
C1302	Capacitor, Disc, .001 μF ± 20%, Z5U	3161370
C1303	Capacitor, Disc, .05 μF + 80%, Z5U	3161630
C1304	Capacitor, Disc, .005 μF ± 20%, Z5U	3161460
C1305	Capacitor, Disc, .005 μF ± 20%, Z5U	3161460
C1306	Capacitor, Disc, .005 μF ± 20%, Z5U	3161460
C1307	Capacitor, Disc, .005 μF ± 20%, Z5U	3161460
C1308	Capacitor, Disc, 47 pF ± 5%, NPO	3160840
CR1301	Diode, MPN3404	3020265
CR1302	Diode, MPN3404	3020265
CR1303	Diode, IN4005/B5G5	3020220
K1301	Relay, DPDT	3620110
L1301	Inductor, Toroid	2510030
Q1301	Transistor, 2N4125	3030110
Q1302	Transistor, 2N5109	3030137
R1301	Resistor, Carbon Film, 1 KΩ ± 5%, 1/4 W	3220160
R1302	Resistor, Carbon Film, 1 KΩ ± 5%, 1/4 W	3220160
R1303	Resistor, Carbon Film, 4.7 KΩ ± 5%, 1/4 W	3220210
R1304	Resistor, Carbon Film, 470 Ω ± 5%, 1/4 W	3220110
R1305	Resistor, Carbon Film, 270 Ω ± 5%, 1/4 W	3220085
R1306	Resistor, Carbon Film, 22 Ω ± 5%, 1/4 W	3220015
R1307	Resistor, Carbon Film, 1 KΩ ± 5%, 1/4 W	3220160
R1308	Resistor, Carbon Film, 4.7 KΩ ± 5%, 1/4 W	3220210
RFC1301	Choke Assy., 270 μH, MUD271	3520590
S1301	Wafer #1, Band Switch	4660010

### BAND PASS FL. SW., REAR

REF DES	DESCRIPTION	PART NO.
C1401	Capacitor, Disc, .05 μF + 80%, Z5U	3161630
S1401	Wafer #2, Band Switch	4660011
S1402	Wafer #3, Band Switch—Binary Coded Band Info.	4660012

NOTES:

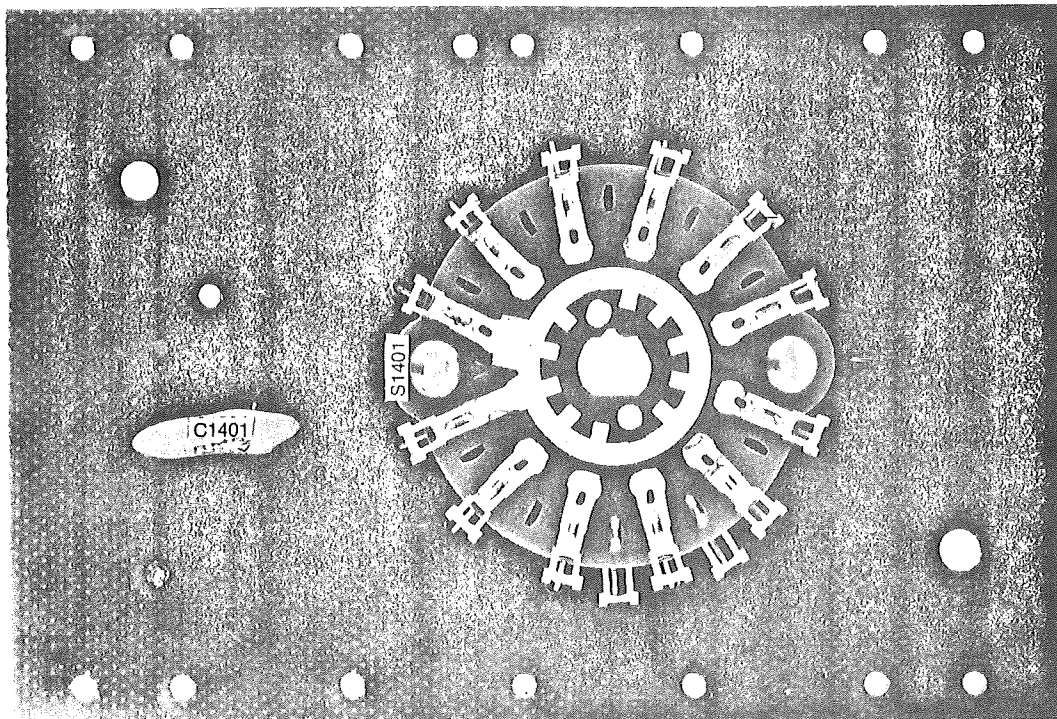
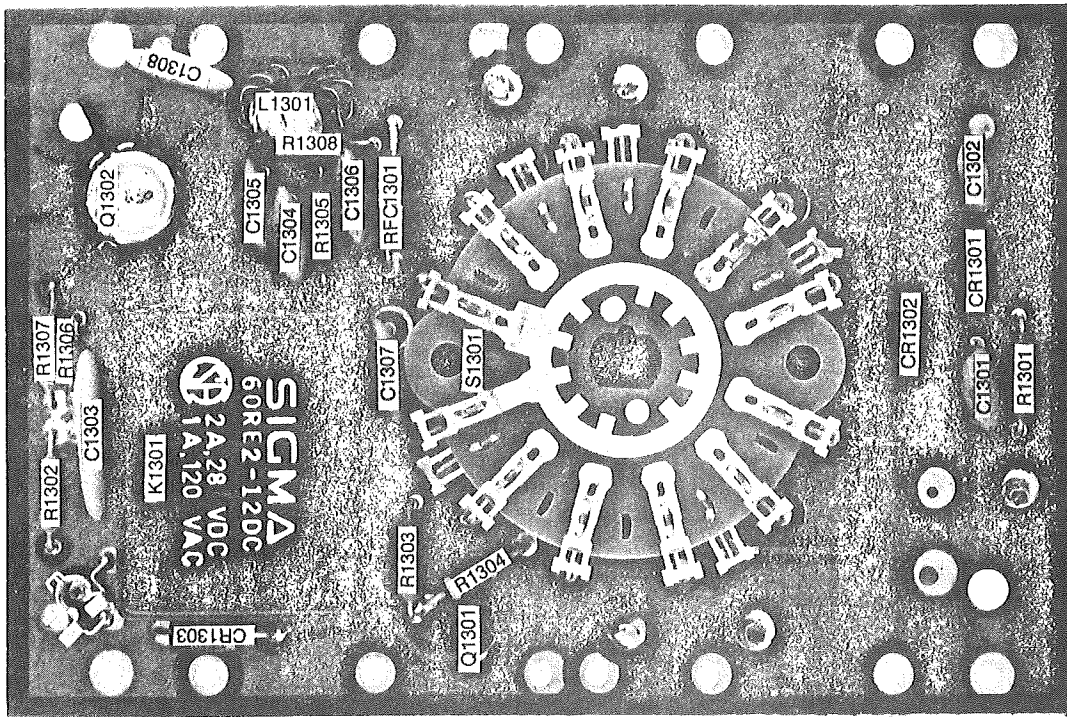


Fig. 3-29 Bandpass Filter Switch Pictorial (Front & Rear)

NOTES:

## BAND PASS FILTERS, BANDS 1 - 6

REF DES	DESCRIPTION	PART NO.
C1501	Capacitor, Mica, 1000 pF ± 2%, DM-15	3170560
C1502	Capacitor, Mica, 600 pF ± 5%, DM-19	3170480
C1503	Capacitor, Mica, 490 pF ± 5%, DM-15	3170410
C1504	Capacitor, Mica, 600 pF ± 5%, DM-19	3170480
C1505	Capacitor, Mica, 1600 pF ± 2%, DM-19	3170620
C1506	Capacitor, Mica, 600 pF ± 5%, DM-19	3170480
C1507	Capacitor, Mica, 1600 pF ± 2%, DM-19	3170620
C1508	Capacitor, Disc, .001 μF ± 20%, Z5U	3161370
C1509	Capacitor, Mica, 680 pF ± 5%, DM-19	3170510
C1510	Capacitor, Disc, .001 μF ± 20%, Z5U	3161370
C1511	Capacitor, Mica, 3000 pF ± 5%, DM-19	3170670
C1512	Capacitor, Mica, 1300 pF ± 2%, DM-19	3170600
C1513	Capacitor, Mica, 1000 pF ± 2%, DM-15	3170560
C1514	Capacitor, Mica, 1300 pF ± 2%, DM-19	3170600
C1515	Capacitor, Mica, 3000 pF ± 5%, DM-19	3170670
C1516	Capacitor, Mica, 1300 pF ± 2%, DM-19	3170600
C1517	Capacitor, Mica, 5000 pF ± 1%, DM-19	3170700
C1518	Capacitor, Mica, 1300 pF ± 2%, DM-19	3170600
C1519	Capacitor, Mica, 865 pF ± 5%, DM-20	3170540
C1520	Capacitor, Disc, .0024 μF ± 20%, Z5U	3161430
C1521	Capacitor, Disc, .001 μF ± 20%, Z5U	3161370
C1522	Capacitor, Disc, .0024 μF ± 20%, Z5U	3161430
C1523	Capacitor, Disc, .001 μF ± 20%, Z5U	3161370
C1524	Capacitor, Mica, 865 pF ± 5%, DM-20	3170540
C1525	Capacitor, Mica, 3000 pF ± 5%, DM-19	3170670
C1526	Capacitor, Mica, 3000 pF ± 5%, DM-19	3170670
C1527	Capacitor, Mica, 3000 pF ± 5%, DM-19	3170670
C1528	Capacitor, Mica, 1300 pF ± 2%, DM-19	3170600
C1529	Capacitor, Mica, 3000 pF ± 5%, DM-19	3170670
C1530	Capacitor, Mica, 1300 pF ± 2%, DM-19	3170600
C1531	Capacitor, Mica, 2000 pF ± 1%, DM-20	3170640
C1532	Capacitor, Disc, .05 μF ± 80%, Z5U	3161630
C1533	Capacitor, Disc, .05 μF ± 80%, Z5U	3161630
L1501	Coil, Axial, 1.5 μH	3524207
L1502	Coil, Axial, 1.5 μH	3524207
L1503	Coil, Axial, 1.5 μH	3524207
L1504	Coil, Axial, 2.2 μH	3524208
L1505	Coil, Axial, 2.2 μH	3524208
L1506	Coil, Axial, 2.2 μH	3524208
L1507	Coil, Axial, 2.2 μH	3524208
L1508	Coil, Axial, 3.3 μH	3524209
L1509	Coil, Axial, 1.2 μH	3524206
L1510	Coil, Axial, 1.2 μH	3524206
L1511	Coil, Axial, 1.2 μH	3524206
L1512	Coil, Axial, 6 μH	3524210
L1513	Coil, Axial, 6 μH	3524210
L1514	Coil, Axial, 10 μH	3524211
L1515	Coil, Axial, 6 μH	3524210
L1516	Coil, Axial, 82 μH	3524214
L1517	Coil, Axial, 51 μH	3524213
L1518	Coil, Axial, 47 μH	3524212



REF  
DES

DESCRIPTION

PART  
NO.

R1501  
R1502

Resistor, Carbon Film,  $150 \Omega \pm 5\%$ , 1/4 W  
Resistor, Variable  $1 K\Omega$

3220065  
3260690

NOTES:

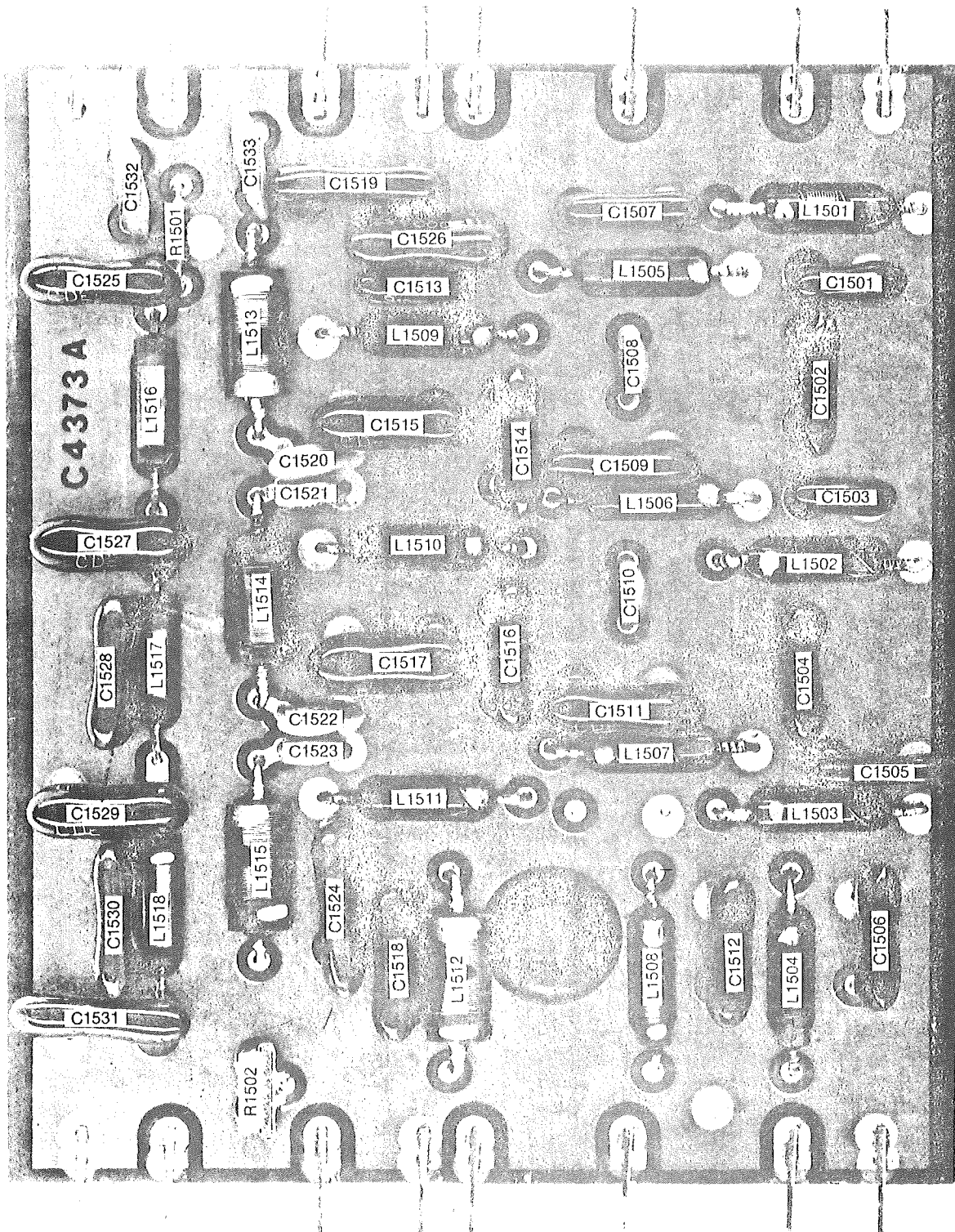


Fig. 3-30 Bandpass Filters, Bands 1-6

NOTES:



## BAND PASS FILTERS, BANDS 7 - 11

REF DES	DESCRIPTION	PART NO.
C1600	Capacitor, Mica, 150 pF ± 5%, DM-15	3170150
C1601	Capacitor, Mica, 90 pF ± 5%, DM-15	3170090
C1602	Capacitor, Mica, 90 pF ± 5%, DM-15	3170090
C1603	Capacitor, Mica, 220 pF ± 5%, DM-15	3170240
C1604	Capacitor, Mica, 220 pF ± 5%, DM-15	3170240
C1605	Capacitor, Mica, 250 pF ± 5%, DM-20	3170270
C1606	Capacitor, Mica, 120 pF ± 5%, DM-15	3170130
C1607	Capacitor, Mica, 120 pF ± 5%, DM-15	3170130
C1608	Capacitor, Mica, 120 pF ± 5%, DM-15	3170130
C1609	Capacitor, Mica, 250 pF ± 5%, DM-20	3170270
C1610	Capacitor, Mica, 330 pF ± 5%, DM-15	3170320
C1611	Capacitor, Mica, 180 pF ± 5%, DM-15	3170180
C1612	Capacitor, Mica, 150 pF ± 5%, DM-15	3170150
C1613	Capacitor, Mica, 180 pF ± 5%, DM-15	3170180
C1614	Capacitor, Mica, 330 pF ± 5%, DM-15	3170320
C1615	Capacitor, Mica, 600 pF ± 5%, DM-19	3170480
C1616	Capacitor, Mica, 270 pF ± 5%, DM-15	3170280
C1617	Capacitor, Mica, 300 pF ± 5%, DM-15	3170300
C1618	Capacitor, Mica, 270 pF ± 5%, DM-15	3170280
C1619	Capacitor, Mica, 910 pF ± 5%, DM-19	3170545
C1620	Capacitor, Mica, 300 pF ± 5%, DM-15	3170300
C1621	Capacitor, Mica, 600 pF ± 5%, DM-19	3170480
C1622	Capacitor, Mica, 390 pF ± 5%, DM-15	3170370
C1623	Capacitor, Mica, 220 pF ± 5%, DM-15	3170240
C1624	Capacitor, Mica, 390 pF ± 5%, DM-15	3170370
C1625	Capacitor, Mica, 1000 pF ± 2%, DM-15	3170560
C1626	Capacitor, Mica, 390 pF ± 5%, DM-15	3170370
L1600	Coil, 3-1/2T, .14 μH	3524077
L1601	Coil, 3-1/2T, .14 μH	3524077
L1602	Coil, 3-1/2T, .14 μH	3524077
L1603	Coil, 5-1/2T, .26 μH	3524076
L1604	Coil, 5-1/2T, .26 μH	3524076
L1605	Coil, 5-1/2T, .26 μH	3524076
L1606	Coil, 7-1/2T, .40 μH	3524075
L1607	Coil, 7-1/2T, .40 μH	3524075
L1608	Coil, 7-1/2T, .40 μH	3524075
L1609	Coil, 9-1/2T, .50 μH	3524074
L1610	Coil, 9-1/2T, .50 μH	3524074
L1611	Coil, 9-1/2T, .50 μH	3524074
L1612	Coil, Axial, 1.1 μH	3524205
L1613	Coil, Axial, 1.1 μH	3524205
L1614	Coil, Axial, 1.1 μH	3524205
L1615	Coil, Axial, 1.1 μH	3524205
L1616	Coil, Axial, 1.2 μH	3524206

NOTES:

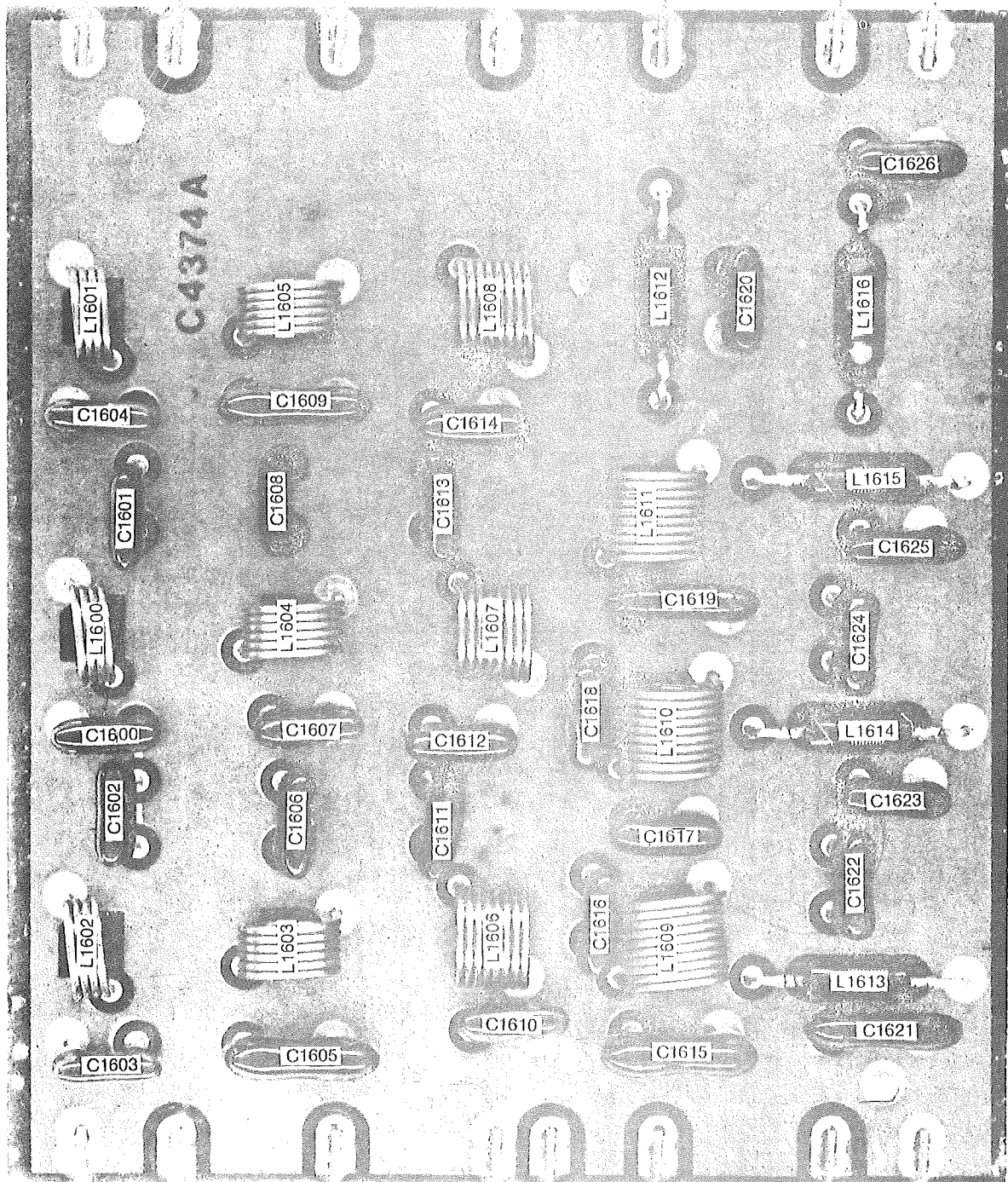


Fig. 3-31 Bandpass Filters, Bands 7-11

NOTES:

C	1301 1307 1303	1302	1306 1305 1304	1503 1507 1610 1501 1605 1533 1519 1621 1603 1532 1525 1615	1504 1514 1606 1508 1602 1502 1622 1616	1505 1509 1603 1505 1602 1501 1516 1613 1623	1518 1520 1612 1521	1529 1518 1510 1509 1624 1618	1613 1608 1601	1530 1619 1523 1614 1517 1609 1511 1604 1505 1625	1620 1504 1518 1512 1506 1626	1501
L	1301											1501
R	1301 1303 1308 1306 1304 1305 1302 1307											1502

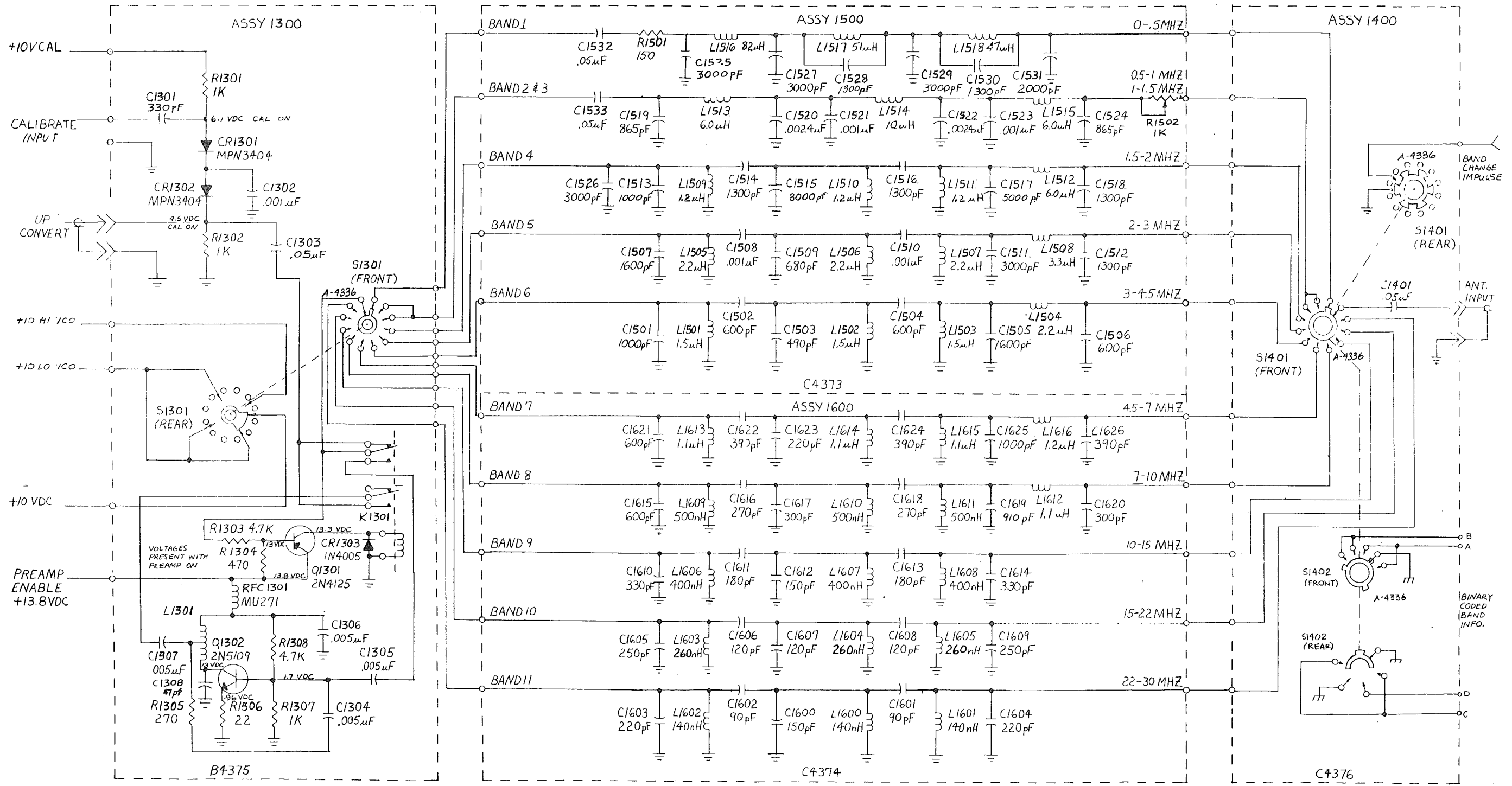


Fig. 3-32 Bandpass Filter Module Schematic

### 3-15. ANTENNA SWITCH MODULE

The Antenna Switch Module provides for the switching of the MAIN, ALTERNATE and CONVERTER antenna input jacks to the R4245 receiver and/or EXTERNAL receiver output jack depending on switch position. The components for antenna splitting are mounted on the antenna splitter board and is included in this module. See figure 3-34 for splitter schematic and figures 3-33 and 3-35 for parts location and module pictorial information.

When the MAIN/MAIN or ALT/MAIN switch positions are selected, an incoming signal is connected to T1701. It is matched by C1701 to the toroidal power splitter T1702. R1701 reduces the variations in driving point impedance (T1701 input) due to output impedance loads different from 50 ohms at OUT 1 and OUT 2 ports.

For minor service or inspection of the Antenna Switch Module, merely remove the two nuts at the rear of the switch module outer shield and the one screw and washer securing the shield to the sub-panel. Remove the shield carefully. The switch wafers and associated wiring will now appear as in figure 3-35. Refer to the antenna switch section of the R4245 Interconnection Schematic diagram, figure 3-3, for wiring details. Note that the wafers are identified by S8A, B and C as per pictorial and schematic. If the entire antenna switch module must be removed from the radio, the front panel of the radio will have to be removed. Remove the four screws securing two handles, all front panel knobs and the nut securing the front panel at the headphone jack. Then, with the front panel pulled partially away from the subpanel, the nut securing the antenna switch to the subpanel can now be removed. To reinstall the module, reverse the above procedure.

#### NOTES:

NOTES:

## ANTENNA SPLITTER

REF DES	DESCRIPTION	PART NO.
C1701	Capacitor, Mica, 90 pF $\pm$ 5%, DM-15	3170090
R1701	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
T1701	Inductor, Toroid	2510026
T1702	Inductor, Toroid	2510027

## NOTES:

NOTES:

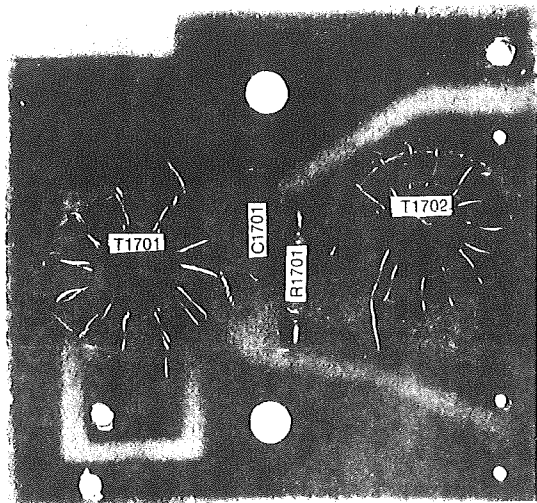


Fig. 3-33 Antenna Splitter Board Pictorial

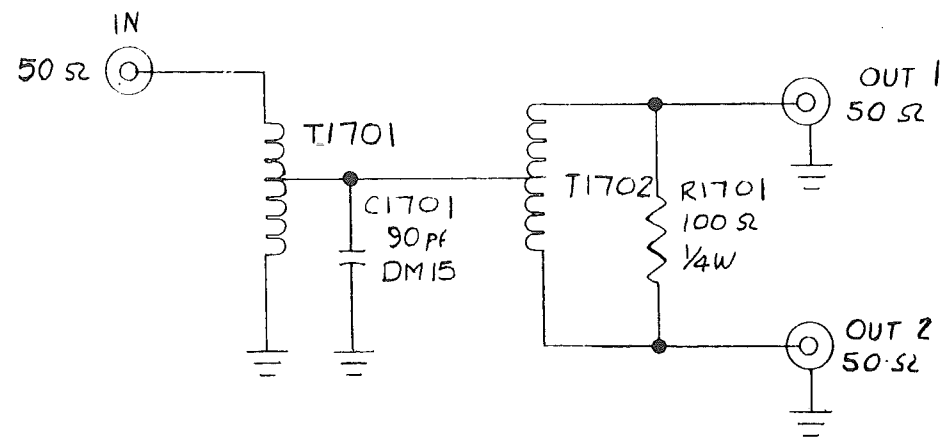


Fig. 3-34 Antenna Splitter Board Schematic

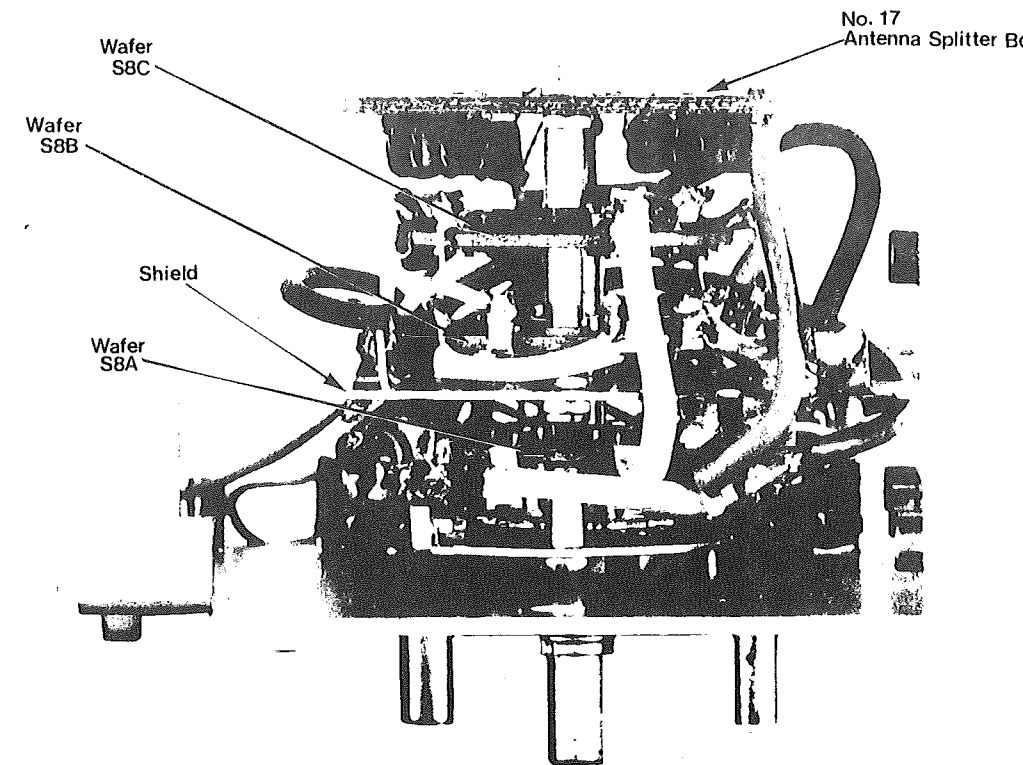


Fig. 3-35 Antenna Switch Module Pictorial

### 3-16. +13.8 VDC REGULATOR BOARD

The +13.8 VDC Regulator board accepts an unregulated DC input voltage and outputs a regulated DC voltage adjustable to +13.8 VDC. The board contains all the regulator circuitry except the series pass transistor, Q1. Refer to figure 3-37 for schematic and figure 3-36 for parts location information.

Incoming line voltage is fed through programming switches S1 and S2 to the transformer primary T1. The secondary voltage is rectified by CR1 and CR2 and fed to filter capacitor C1801. Q1801 is used as a current amplifier whose base current is regulated by integrated circuit voltage regulator, U1801. The collector current of Q1801 is the base drive for the externally heat sunk power transistor, Q1. Resistors R1803 and R1804 in series form a current sensing resistor, which, together with R1805 and R1806 form a foldback current limiting action under output short circuit conditions. At normal load currents, the voltage at U1801 pin 10 is only slightly higher than the voltage at pin 3, with the divider action of R1805 and R1806 causing the voltage at pin 2 to approximately equal the voltage at pin 3. Any action that causes the voltage at pin 2 to exceed that

of pin 3 (to a maximum of approximately 0.6 VDC), will reduce the base drive at pin 11, thus reducing the load current handled by Q1. As the load current increases beyond the limiting current value, the voltage at pin 10 and thus at pin 2, begins to increase above that at pin 3. With current drive to Q1801 decreasing, the output voltage will decrease. Less output current is now required to keep the voltages at pin 10 and 2 at a level sufficient to further reduce current drive at Q1801 base. The output current will continue to "foldback" as the output voltage decreases, until an output short circuit current level is reached when the output voltage is zero. Thus the current under shorted output conditions is actually a value less than the normal operating current. R1808 adjusts the regulated output voltage level. CR1801 protects regulator components, mainly U1801, from any damaging reverse voltages that could mistakenly be applied when operating the radio from an external DC source.

The only alignment required of this board is the setting of R1808 to yield +13.8 VDC output. This is mentioned in Section 4.

#### NOTES:

NOTES:

## +13.8 VDC REGULATOR BOARD

REF DES	DESCRIPTION	PART NO.
C1801	Capacitor, Electrolytic, 4700 $\mu$ F @ 35VDC	3180352
C1802	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1803	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C1804	Capacitor, Mica, 500 pF $\pm$ 10%, DM-15	3170420
C1805	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C1806	Capacitor, Electrolytic, 220 $\mu$ F @ 16V	3180212
CR1801	Diode, IN4005/B5G5	3020220
Q1801	Transistor, TIP-30	3030371
R1801	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R1802	Resistor, Composition, 68 $\Omega$ $\pm$ 10%, 1/2 W	3230105
R1803	Resistor, Wire Wound, .15 $\Omega$ $\pm$ 10%, 2 W	3250010
R1804	Resistor, Wire Wound, .15 $\Omega$ $\pm$ 10%, 2 W	3250010
R1805	Resistor, Carbon Film, 33 $\Omega$ $\pm$ 5%, 1/4 W	3220025
R1806	Resistor, Carbon Film, 820 $\Omega$ $\pm$ 5%, 1/4 W	3220145
R1807	Resistor, Carbon Film, 6.8 K $\Omega$ $\pm$ 5%, 1/4 W	3220220
R1808	Resistor, Variable, 5 K $\Omega$	3260660
R1809	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
U1801	I.C., MC1723CP	3040100

### NOTES:

NOTES:

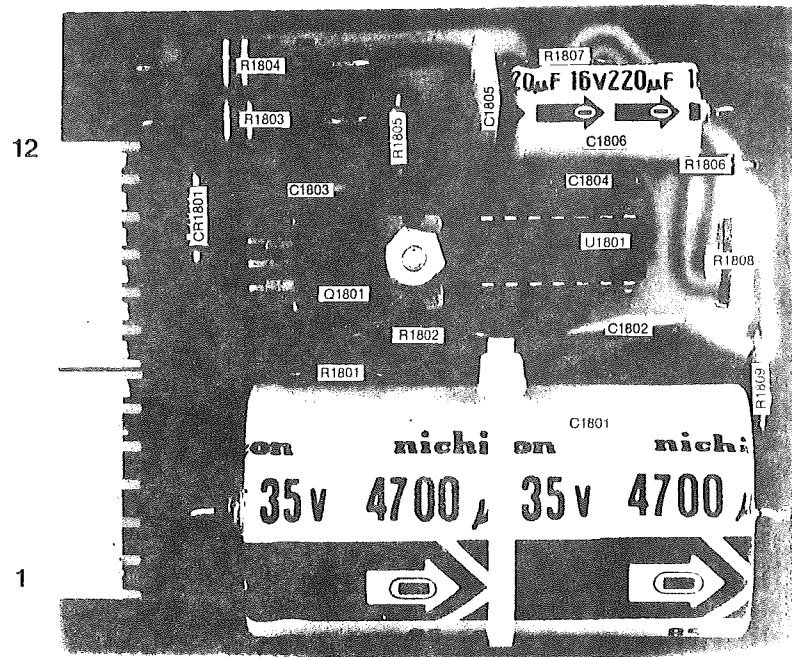


Fig. 3-35 +13.8 VDC Regulator Board Pictorial

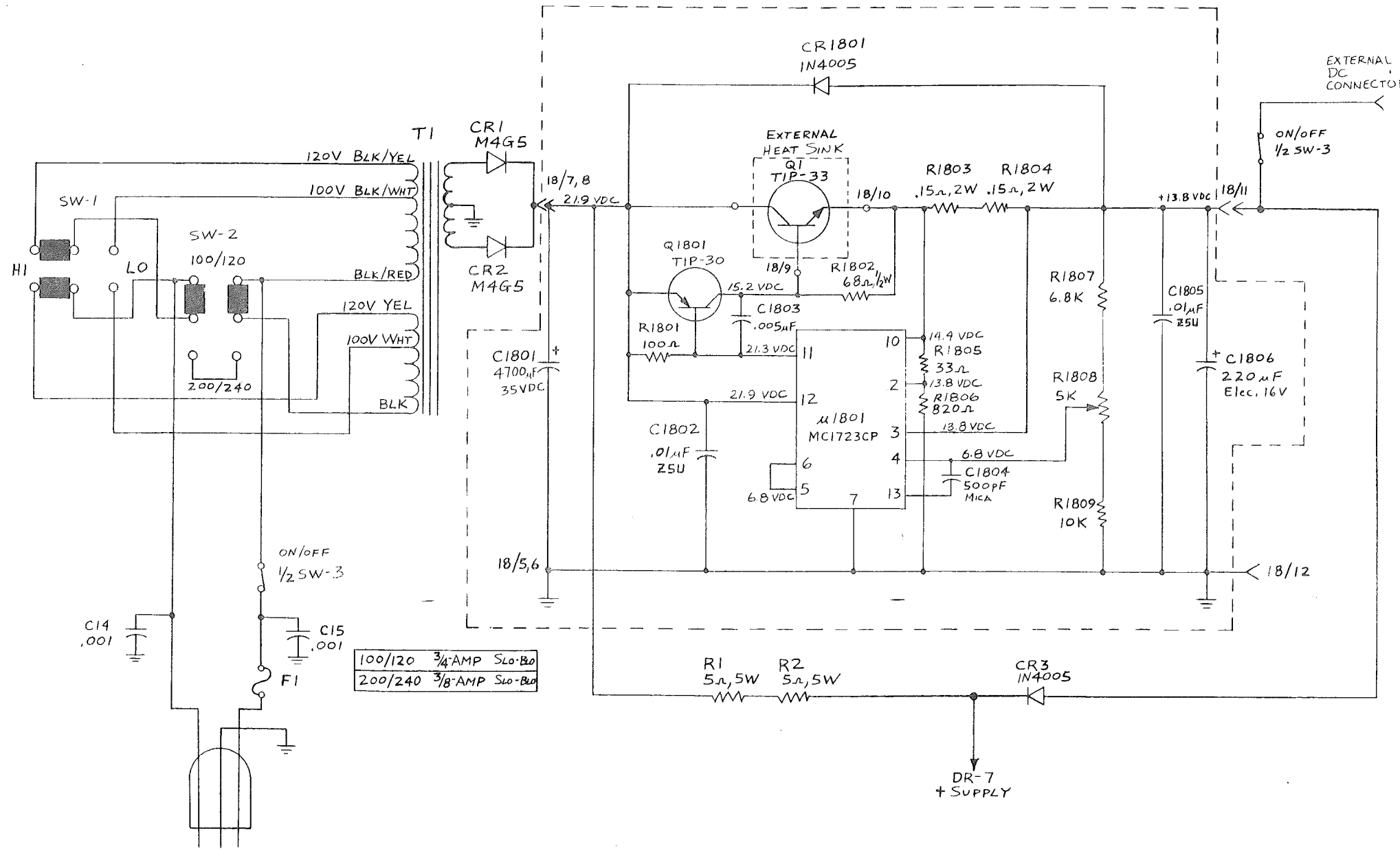


Fig. 3-37 +13.8 VDC Regulator Board Schematic

### 3-17. POWER SUPPLY BOARD

The Power Supply board provides +10, +5, +24 VDC regulated and -5 VDC unregulated. Refer to figure 3-39 for schematic and figure 3-38 for parts location information.

Unregulated 11-16 VDC is applied to board pin 9. Q1901, Q1902, and U1901 comprise the 10 volt regulator circuit. Q1901 is the pass transistor while Q1902 provides the base drive boost from U1901 to Q1901. R1909 and R1910 provide short circuit sensing. If the 10 VDC buss is shorted to ground, the voltage drop across R1909 and R1910 increases. At 0.7 VDC, Q1903 turns on, which forces U1901 to clamp the drive to Q1902, which in turn holds Q1901 at a fixed output of 5 amperes maximum short circuit current.

R1912, R1903 and R1902 provide the error voltage feedback path to allow U1901 to maintain +10 VDC out. CR1901 is for temperature compensation. As the output line changes, the above components form a voltage divider network which allows U1901 to compare an internal reference of approximately 7 VDC to the error voltage from the wiper of R1903. +10 VDC output is on pin 10. +5 VDC regulated is provided by U1902 and is derived from the +10 VDC line. +5 VDC output is on pin 11.

The +24 VDC regulated and -5 VDC unregulated supplies are created by a DC to DC voltage multiplier circuit. The voltage multiplier consists of three sections: an oscillator, an amplifier and the voltage multiplier section itself. Supply voltage for these three major circuit elements is the unregulated 11-16 VDC input at pin 9. RFC1901, C1912 and C1913 decouple the amplifier and voltage multiplier from the 11-16 VDC line. Q1904 and associated components form a sine wave oscillator. The frequency of this sine wave is approximately 10 kHz. It is coupled through C1911 to U1903, an audio amplifier, which is biased by R1918 and R1919 to provide a slightly clipped sine wave to the actual voltage multiplier section. The multiplication factor is (3) three; with C1916, CR1903, CR1902, and C1921 comprising section one. C1917, CR1904, CR1905 and C1922 form section two. The third and final section, made up of C1918, C1906, CR1907 and C1923, outputs the multiplied DC voltage to the input pin of the voltage regulator IC, U1904. R1922 and R1923 program the IC to output a regulated +24 VDC at module pin 6. -5 VDC is generated by coupling the output of U1903 through C1919 to a half wave rectifier, CR1908. The output of CR1908 is filtered and applied to pin 1.

The only alignment required of this board is the setting of R1903 to yield +10 VDC output. This is mentioned in Section 4.

#### NOTES:

NOTES:



## POWER SUPPLY BOARD

REF DES	DESCRIPTION	PART NO.
	<i>ASSEMBLY B 4 777</i>	
C1901	Capacitor, Disc, .01 $\mu\text{F}$ + 80%, M25V PT	3161500
C1902	Capacitor, Disc, .01 $\mu\text{F}$ $\pm$ 20%, Z5U	3161520
C1903	Capacitor, Disc, .01 $\mu\text{F}$ + 80%, M25V PT	3161500
C1904	Capacitor, Electrolytic, 22 $\mu\text{F}$ $\pm$ 20%, 16 V	3180105
C1905	Capacitor, Tantalum, .22 $\mu\text{F}$ $\pm$ 10%, 35 V	3183100
C1906	Capacitor, Tantalum, .22 $\mu\text{F}$ $\pm$ 10%, 35 V	3183100
C1907	Capacitor, Electrolytic, 10 $\mu\text{F}$ $\pm$ 20%, 35 V	3180062
C1908	Capacitor, Disc, .01 $\mu\text{F}$ $\pm$ 20%, Z5U	3161520
C1909	Capacitor, Disc, .005 $\mu\text{F}$ $\pm$ 20%, Z5U	3161470
C1910	Capacitor, Disc, .005 $\mu\text{F}$ $\pm$ 20%, Z5U	3161470
C1911	Capacitor, Disc, .05 $\mu\text{F}$ + 80%, M16V PT	3161600
C1912	Capacitor, Electrolytic, 220 $\mu\text{F}$ @ 16 V	3180212
C1913	Capacitor, Electrolytic, 220 $\mu\text{F}$ @ 16 V	3180212
C1914	Capacitor, Electrolytic, 10 $\mu\text{F}$ $\pm$ 20%, 35 V	3180062
C1915	Capacitor, Electrolytic, 22 $\mu\text{F}$ $\pm$ 20%, 16 V	3180105
C1916	Capacitor, Electrolytic, 10 $\mu\text{F}$ $\pm$ 20%, 35 V	3180062
C1917	Capacitor, Electrolytic, 10 $\mu\text{F}$ $\pm$ 20%, 35 V	3180062
C1918	Capacitor, Electrolytic, 1 $\mu\text{F}$ $\pm$ 20%, 50 V	3180008
C1919	Capacitor, Electrolytic, 10 $\mu\text{F}$ $\pm$ 20%, 35 V	3180062
C1920	Capacitor, Electrolytic, 10 $\mu\text{F}$ $\pm$ 20%, 35 V	3180062
C1921	Capacitor, Electrolytic, 10 $\mu\text{F}$ $\pm$ 20%, 35 V	3180062
C1922	Capacitor, Electrolytic, 10 $\mu\text{F}$ $\pm$ 20%, 35 V	3180062
C1923	Capacitor, Electrolytic, 1 $\mu\text{F}$ $\pm$ 20%, 50 V	3180008
C1924	Capacitor, Electrolytic, 10 $\mu\text{F}$ $\pm$ 20%, 35 V	3180062
CR1901	Diode, 1N4148	3020090
CR1902	Diode, 1N4148	3020090
CR1903	Diode, 1N4148	3020090
CR1904	Diode, 1N4148	3020090
CR1905	Diode, 1N4148	3020090
CR1906	Diode, 1N4148	3020090
CR1907	Diode, 1N4148	3020090
CR1908	Diode, 1N4148	3020090
Q1901	Transistor, 2N5986	3030205
Q1902	Transistor, 2N3904	3030105
Q1903	Transistor, 2N4125	3030110
Q1904	Transistor, 2N3904	3030105
R1901	Resistor, Carbon Film, 1.5 K $\Omega$ $\pm$ 5%, 1/4 W	3220175
R1902	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R1903	Resistor, Variable PT10H 2.5 1K Lin.	3260655
R1904	Resistor, Carbon Film, 220 $\Omega$ $\pm$ 5%, 1/4 W	3220075
R1905	Resistor, Composition, 68 $\Omega$ $\pm$ 10%, 1/2 W	3230105
R1906	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R1907	Resistor, Composition, 100 $\Omega$ $\pm$ 10%, 1/2 W	3220115
R1908	Resistor, Carbon Film, 2.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220190
R1909	Resistor, Wire Wound, .27 $\Omega$ $\pm$ 5%, 1/4 W	3220025
R1910	Resistor, Wire Wound, .27 $\Omega$ $\pm$ 5%, 1/4 W	3220025
R1911	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R1912	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R1913	Resistor, Carbon Film, 2.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220190
R1914	Resistor, Carbon Film, 22 $\Omega$ $\pm$ 5%, 1/4 W	3220015
R1915	Resistor, Carbon Film, 4.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220210

REF DES	DESCRIPTION	PART NO.
R1916	Resistor, Carbon Film, 4.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220210
R1917	Resistor, Carbon Film, 820 $\Omega$ $\pm$ 5%, 1/4 W	3220145
R1918	Resistor, Carbon Film, 150 $\Omega$ $\pm$ 5%, 1/4 W	3220065
R1919	Resistor, Carbon Film, 5.1 $\Omega$ $\pm$ 5%, 1/4 W	3220003
R1920	Resistor, Carbon Film, 82 $\Omega$ $\pm$ 5%, 1/4 W	3220050
R1921	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R1922	Resistor, Carbon Film, 220 $\Omega$ $\pm$ 1%, 1/4 W	3220075
R1923	Resistor, Carbon Film, 3.9 K $\Omega$ $\pm$ 1%, 1/4 W	3220205
RCF1901	Choke Assy., 33 $\mu$ H	2512506
RCF1902	Choke Assy., 5.6 $\mu$ H, L56G	3520510
U1901	I.C., MC1723CP	3040100
U1902	I.C., MC7805CP	3040160
U1903	I.C., TDA2002AH	3040550
U1904	I.C., LM317LZ	3040092

## NOTES:

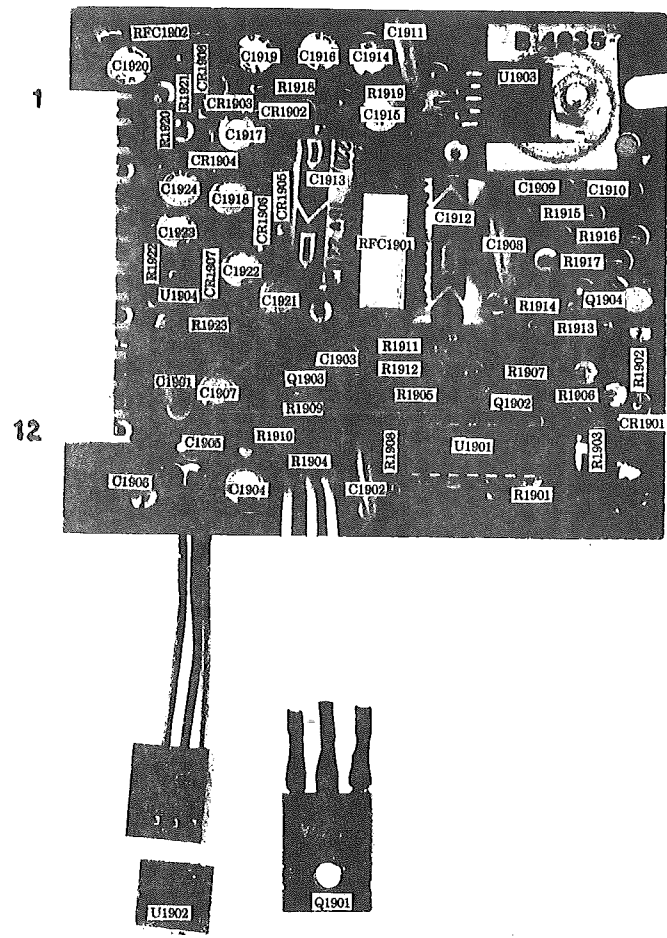
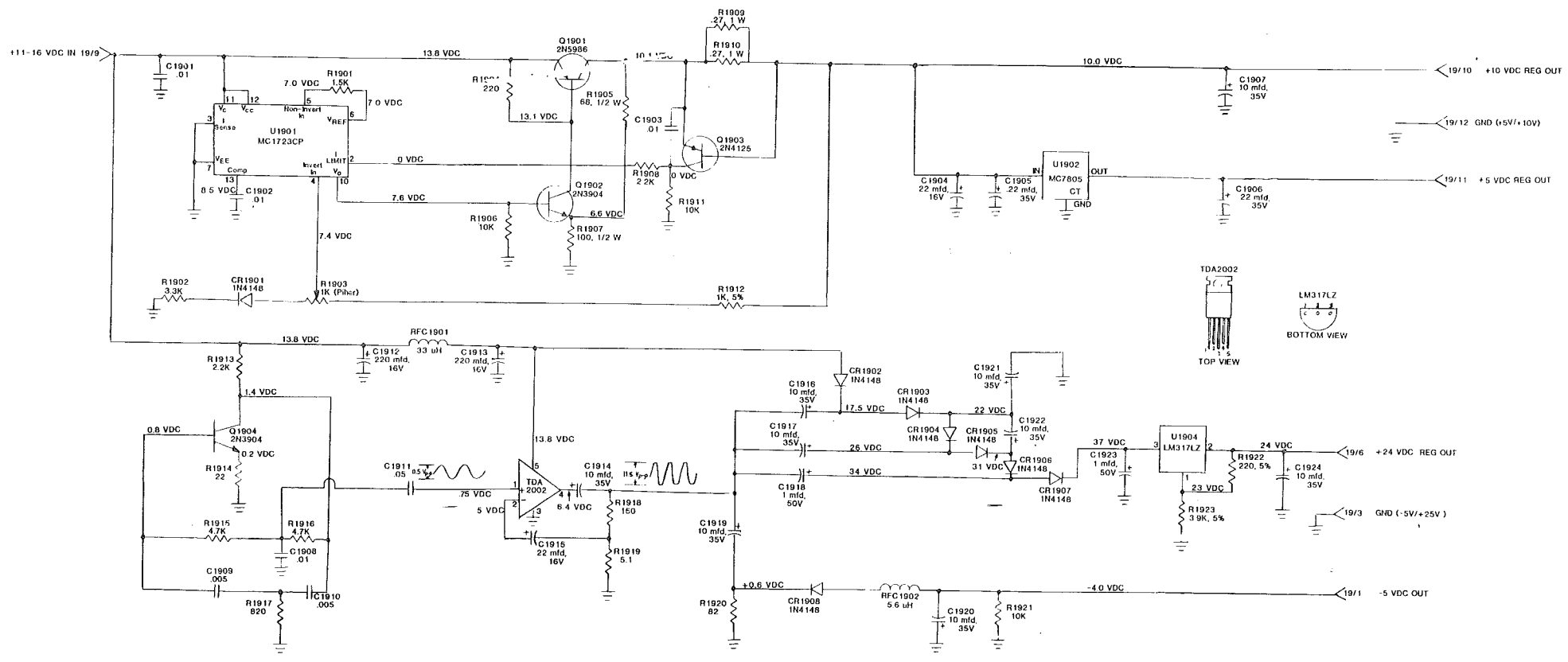


Fig. 3-38 Power Supply Board Pictorial

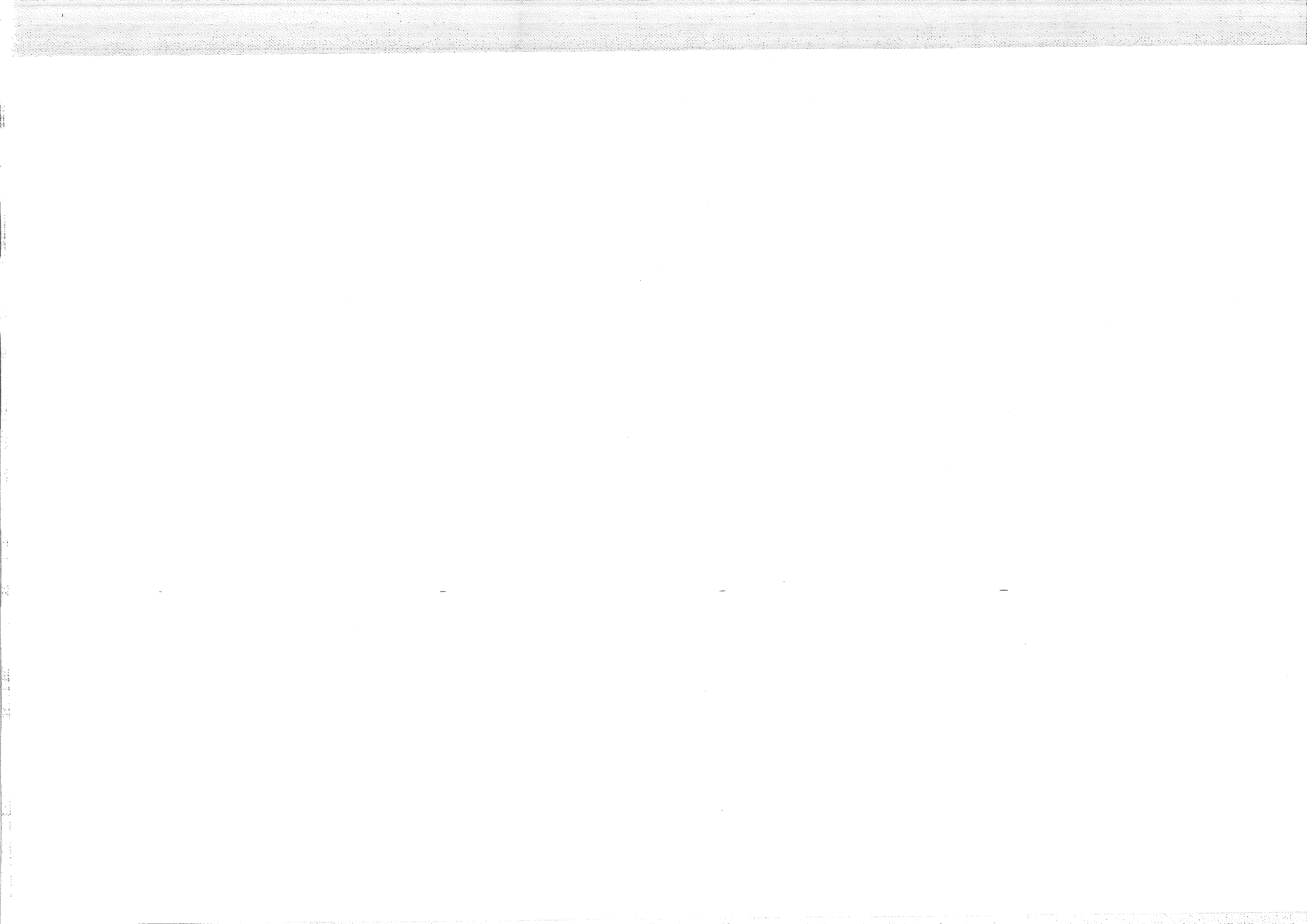
R	R1802	R1913	R1917	R1901	R1904	R1907	R1908	R1911	R1908	R1921	R1923	R1922						
C	C1901	C1902	C1908	C1910	C1912	C1911	C1913	C1914	C1915	C1916	C1904	C1905	C1921	C1922	C1923	C1907	C1906	C1924
CR	CR1901																	



NOTES:  
 1. All resistors in Ohms.  
 2. All resistors 1/4 W, 10% unless noted otherwise.  
 3. All capacitors are mfd.

HIGHEST NUMBER RESISTOR - R1923  
 " " CAPACITOR - C1924  
 " " TRANSISTOR - Q1904  
 " " IC - U1904  
 " " DIODE - CR1908  
 " " RFC - RFC1902

Fig. 3-39 Power Supply Board Schematic



### 3-18. LINE AMPLIFIER BOARD

This board contains circuitry for amplifying and transformer isolating the receiver internal audio prior to the volume control. The audio output from this board is capable of delivering a 0 dBm level into a 600 ohm line. Refer to figure 3-41 for schematic and figure 3-40 for parts location information.

Audio prior to the volume control is coupled through

R8002 and C8001 to the amplifier stages Q8001 and Q8002. The 1200 ohm primary of T8001 is in the collector circuit of Q8002. The amplified audio is transformer coupled to the 600 ohm secondary and hence the output. R8010 is used to adjust the audio output level into a 600 ohm line. This is mentioned in Section 4.

#### NOTES:

NOTES:

## LINE AMPLIFIER BOARD

REF DES	DESCRIPTION	PART NO.
C8001	Capacitor, Electrolytic, 1 $\mu$ F $\pm$ 20%, 50 V	3180008
C8002	Capacitor, Electrolytic, 10 $\mu$ F $\pm$ 20%, 35 V	3180062
C8003	Capacitor, Electrolytic, 10 $\mu$ F $\pm$ 20%, 35 V	3180062
C8004	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
Q8001	Transistor, 2N3904	3030105
Q8002	Transistor, 2N3904	3030105
R8001	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R8002	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R8003	Resistor, Carbon Film, 47 K $\Omega$ $\pm$ 5%, 1/4 W	3220285
R8004	Resistor, Carbon Film, 4.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220210
R8005	Resistor, Carbon Film, 2.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220195
R8006	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R8007	Resistor, Carbon Film, 18 K $\Omega$ $\pm$ 5%, 1/4 W	3220255
R8008	Resistor, Carbon Film, 3.9 K $\Omega$ $\pm$ 5%, 1/4 W	3220205
R8009	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R8010	Resistor, Variable, PT10H, 2.5 1 K Lin.	3260655
R8011	Resistor, Carbon Film, 2.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220190
T8001	Transformer, Audio M7934-ND	3690305

### NOTES:

NOTES:



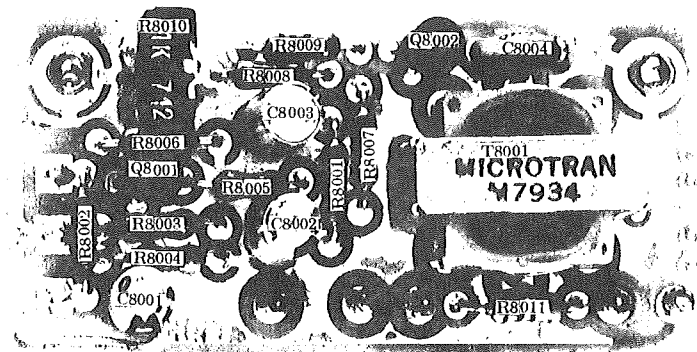


Fig. 3-40 Line Amplifier Board Pictorial

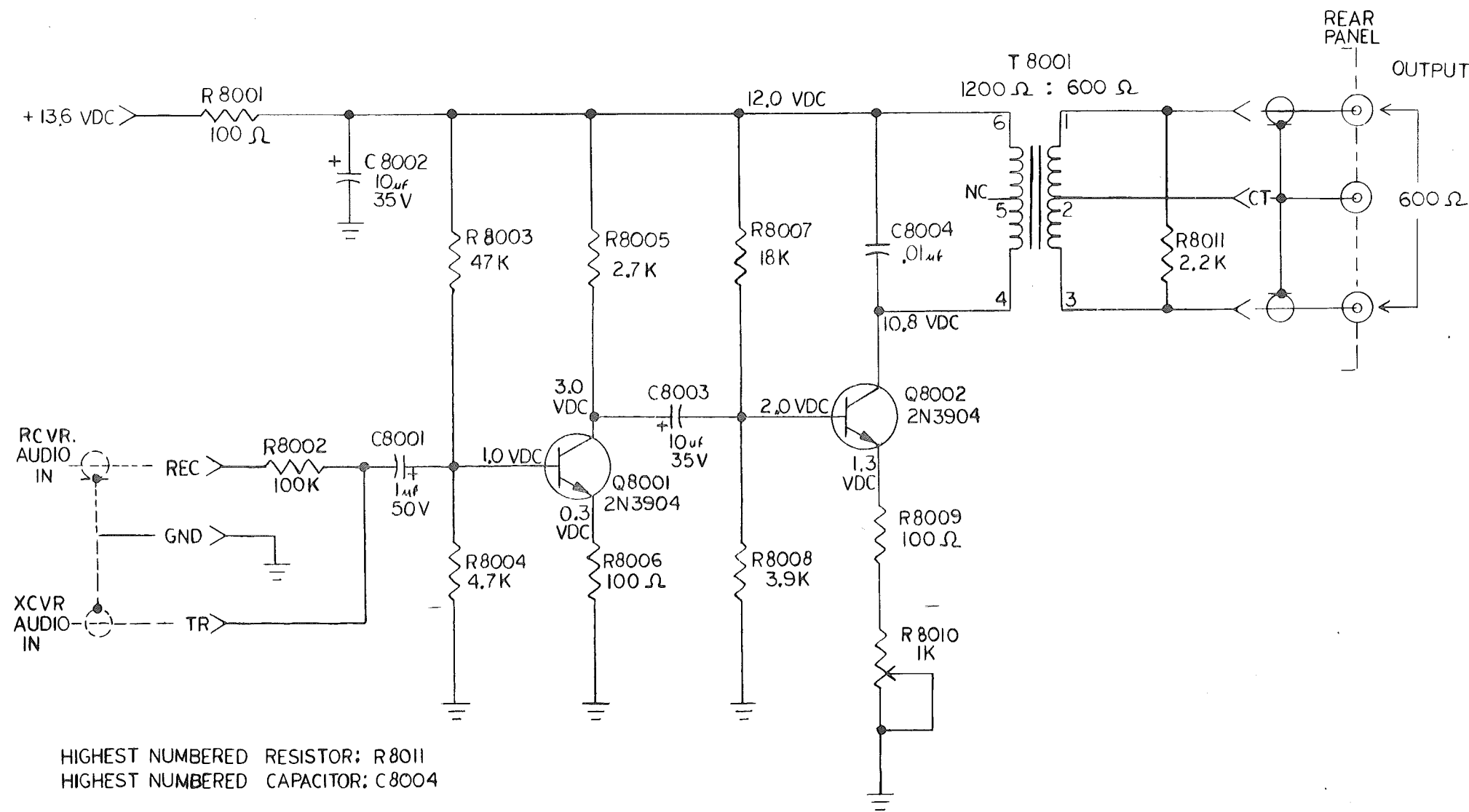


Fig. 3-41 Line Amplifier Board Schematic

### 3-19. RP700 RECEIVER PROTECTOR

The RP700 Receiver Protector offers receiver protection necessary to allow operation in close proximity to high-power transmitters. The solid state circuitry furnishes protection to all RF signals, even those in the microwave band.

With the RP700 the receiver is protected at all times, even when in the off position or tuned to other fre-

quencies. The protector is inserted in the transmission line between the antenna and the receiver and limits the signal level applied to the receiver while providing very low insertion loss under lower signal conditions.

Refer to figure 3-43 for schematic and figure 3-42 for parts location information.

#### NOTES:

NOTES:



## RP700 RECEIVER PROTECTOR

REF DES	DESCRIPTION	PART NO.
C8501	Capacitor, Disc, .05 F + 80%, Z5U	3161630
C8502	Capacitor, Disc, .05 F + 80%, Z5U	3161630
CR8501	Diode, 1N4148	3020090
CR8502	Diode, 1N4148	3020090
CR8503	Diode, 1N4148	3020090
CR8504	Diode, UM9401	3020330
CR8505	Diode, 1N4148	3020090
CR8506	Diode, 1N4148	3020090
CR8507	Diode, 1N4148	3020090
CR8508	Diode, UM9401	3020330
L8501	Inductor, Air 4-1/4T	2514090

## NOTES:

**NOTES:**

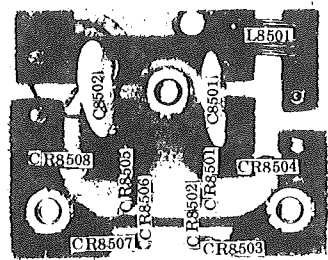


Fig. 3-42 RP700 Receiver Protector Pictorial

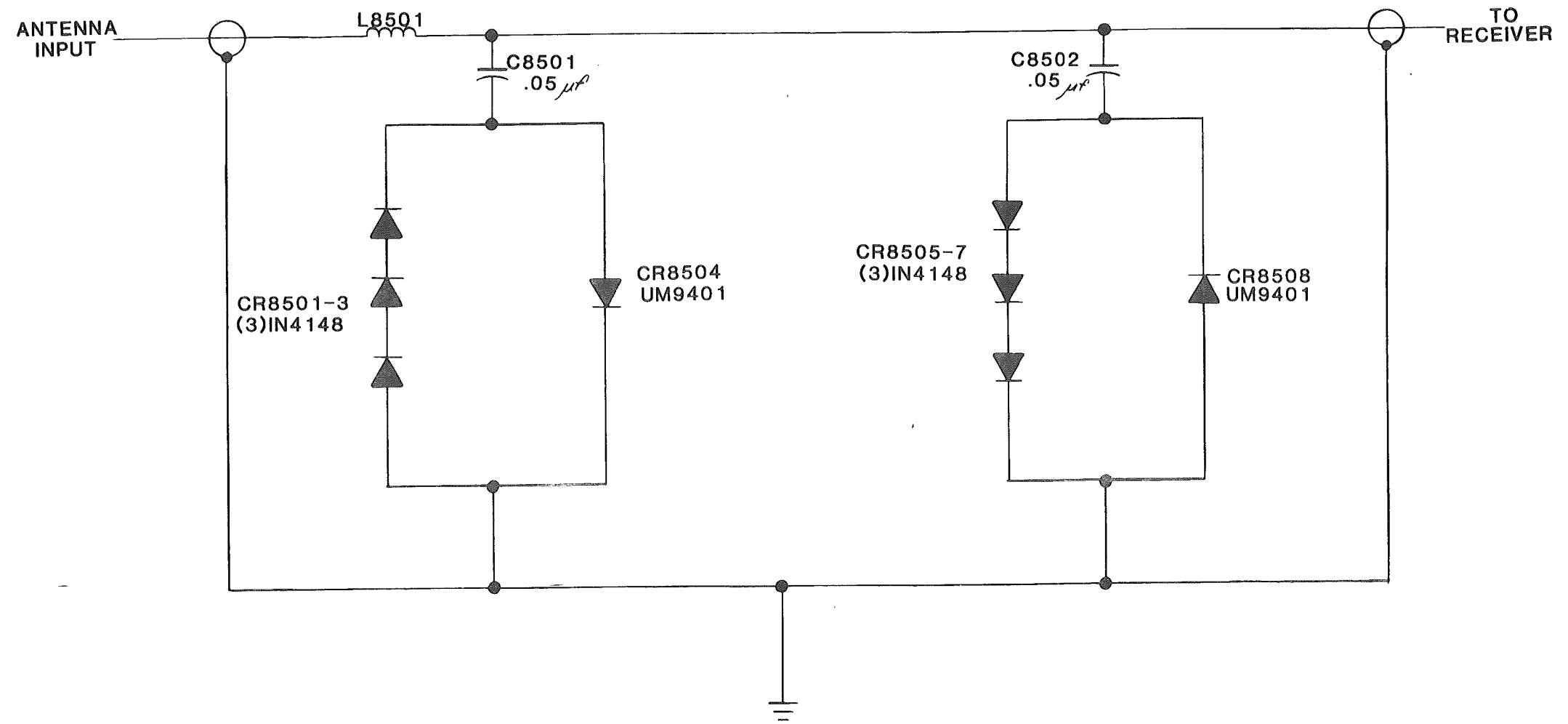


Fig. 3-43 RP700 Receiver Protector Schematic

### 3-20. VRTO PARENT BOARD

The variable rate tuning oscillator (VRTO) circuitry consists of the VRTO VCO board and VRTO +N/Mix board, both of which plug into the VRTO Parent board, and the VRTO Digital and Display section, which connects via a 26 conductor cable to the VRTO Parent board.

Besides providing the interconnections between the other VRTO boards, the VRTO Parent board has a 5 volt regulator assembly connected to it to provide the 5 volt supply to the VRTO circuits.

The VRTO Parent board covers a few parts on the main Parent board. If it is necessary to obtain access to the main Parent board beneath the VRTO Parent board, the VRTO Parent board may be removed by the following procedure.

First, remove all other VRTO boards. Tilt the front panel assembly forward by hinging it on the two bottom side mounting screws after the other four mounting screws at the sides and one screw at partition between speaker and S-meter have been removed. Also remove the four screws holding the front handles. The bandswitch shaft will have to be retracted or removed.

Remove the screw near the front of the VRTO Parent board and then slide the board forward until the rear of the board clears the two side mounting lances.

The VRTO Parent board may now be swung out of the way to obtain access to the main Parent board.

#### NOTES:

**NOTES:**

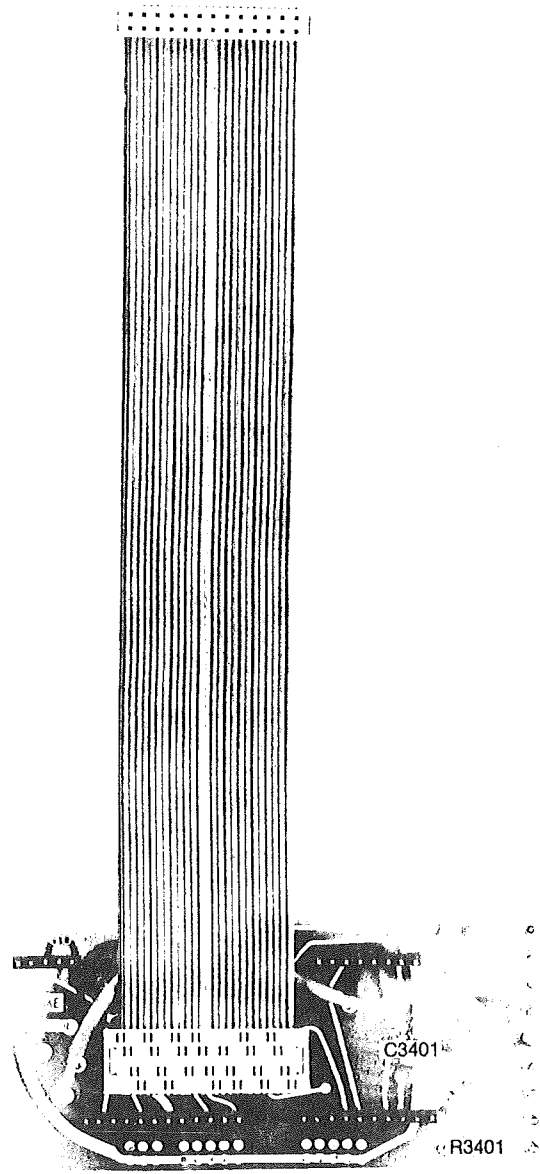


Fig. 3-44 VRTO Parent Board Pictorial

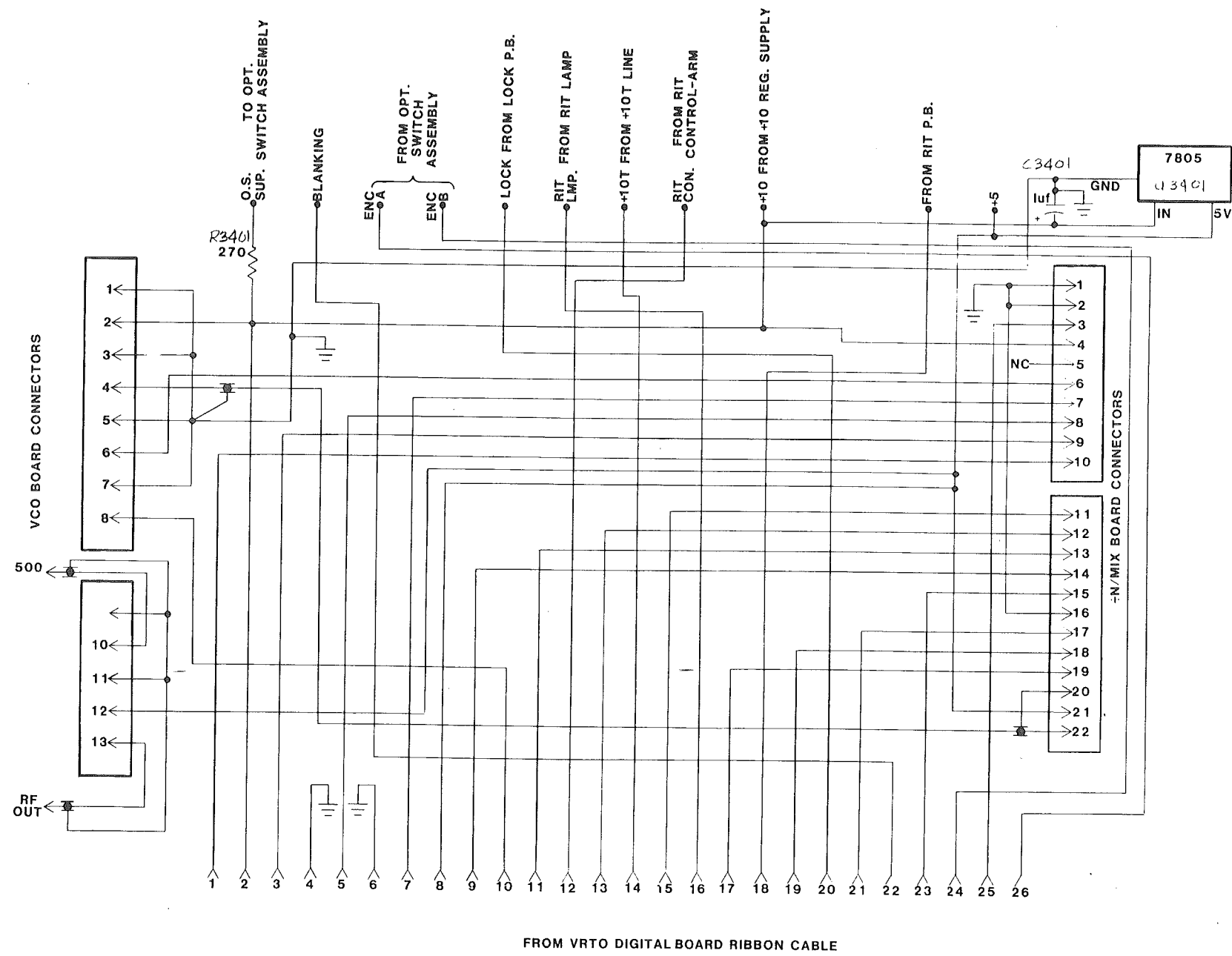
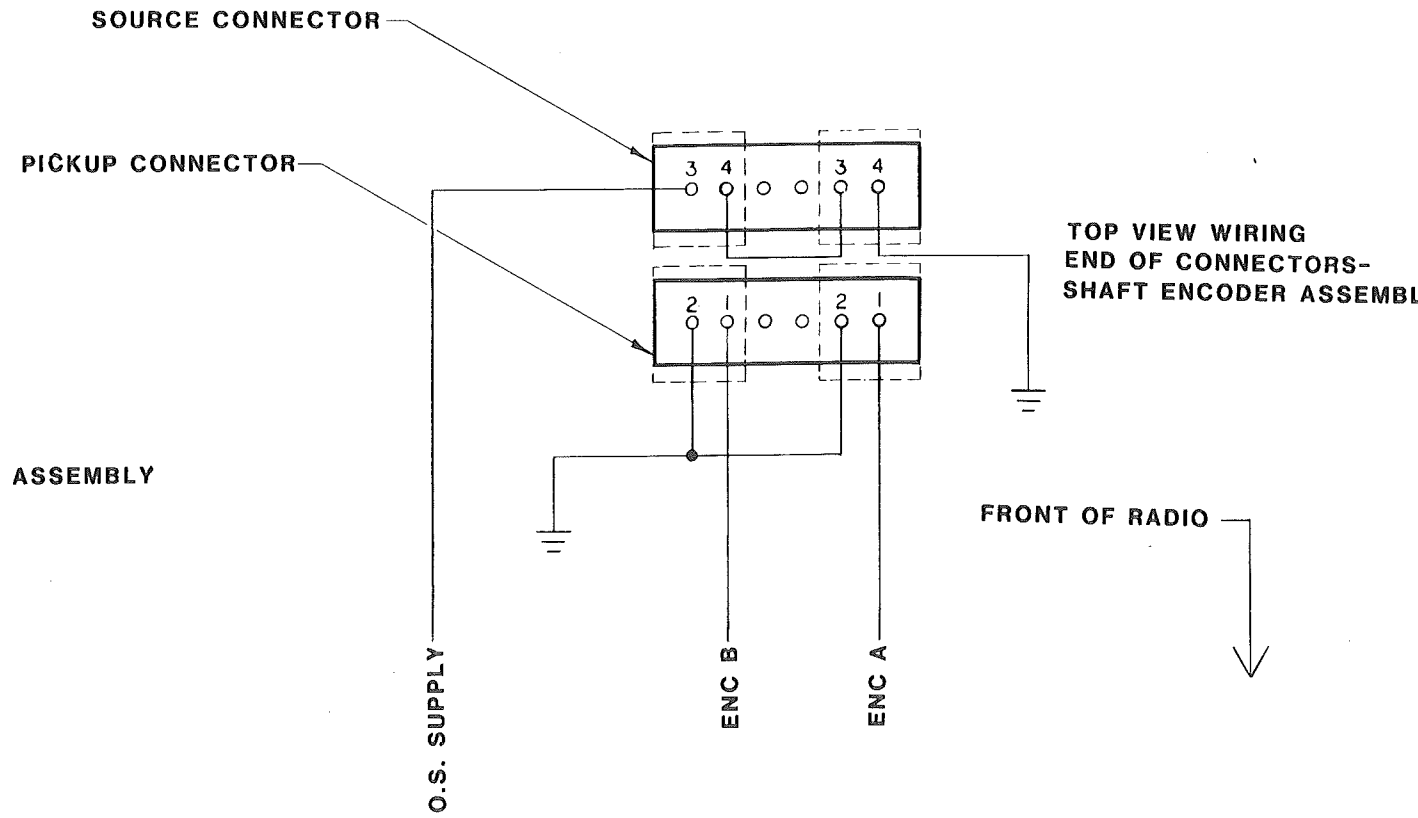
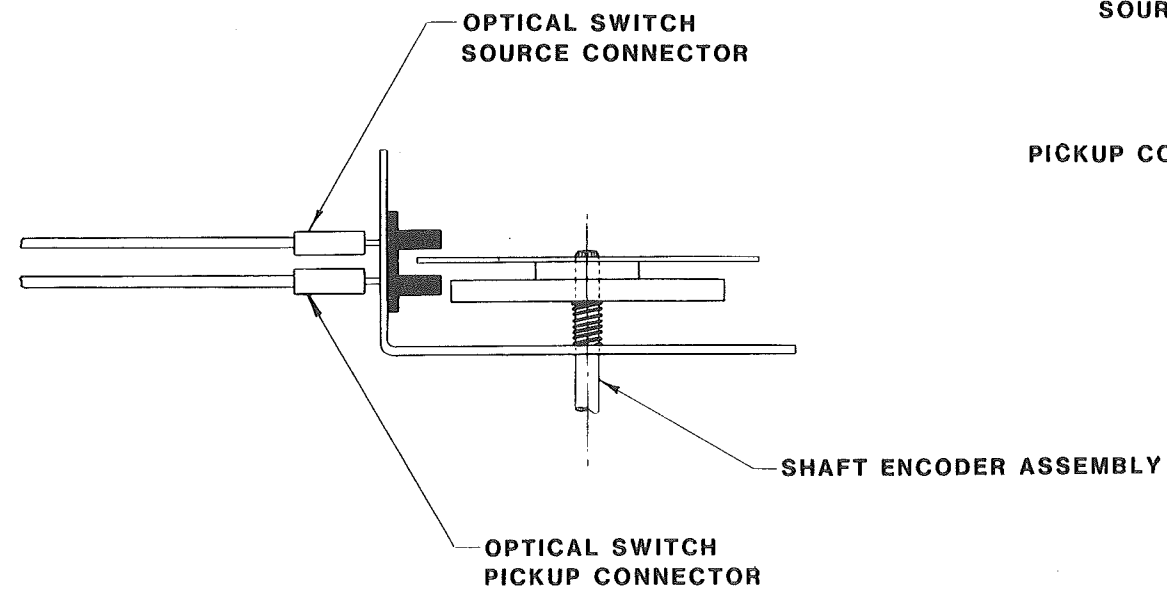
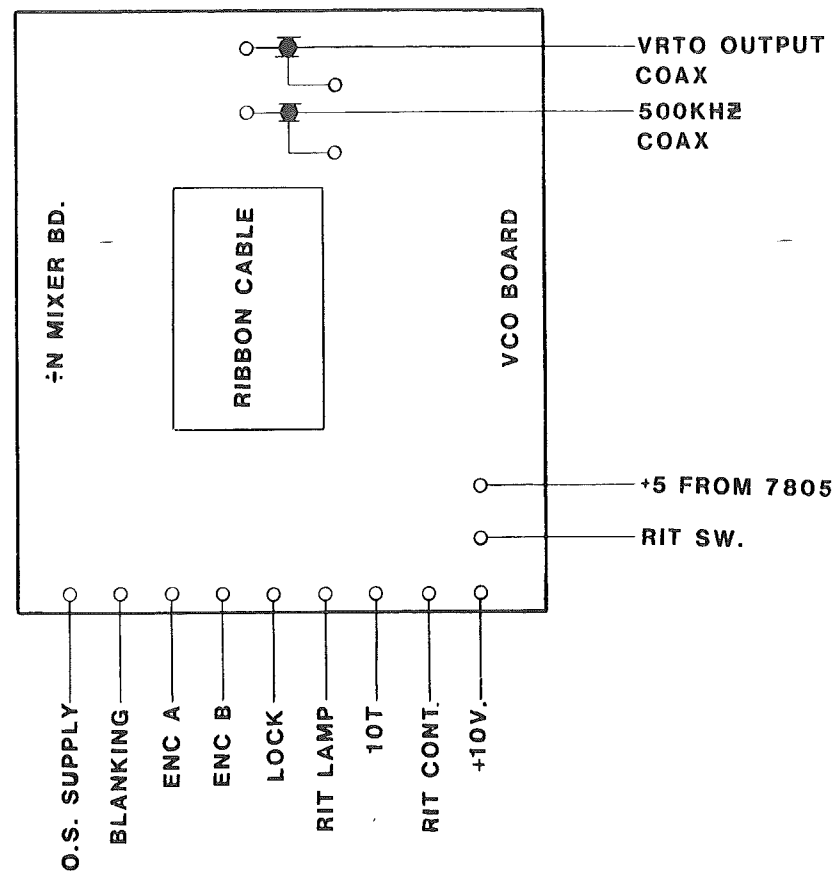


Fig. 3-45 VRTO Parent Board Schematic



TOP VIEW VRTO PARENT BD.



SCHEMATIC-SHAFT ENCODER ASSEMBLY

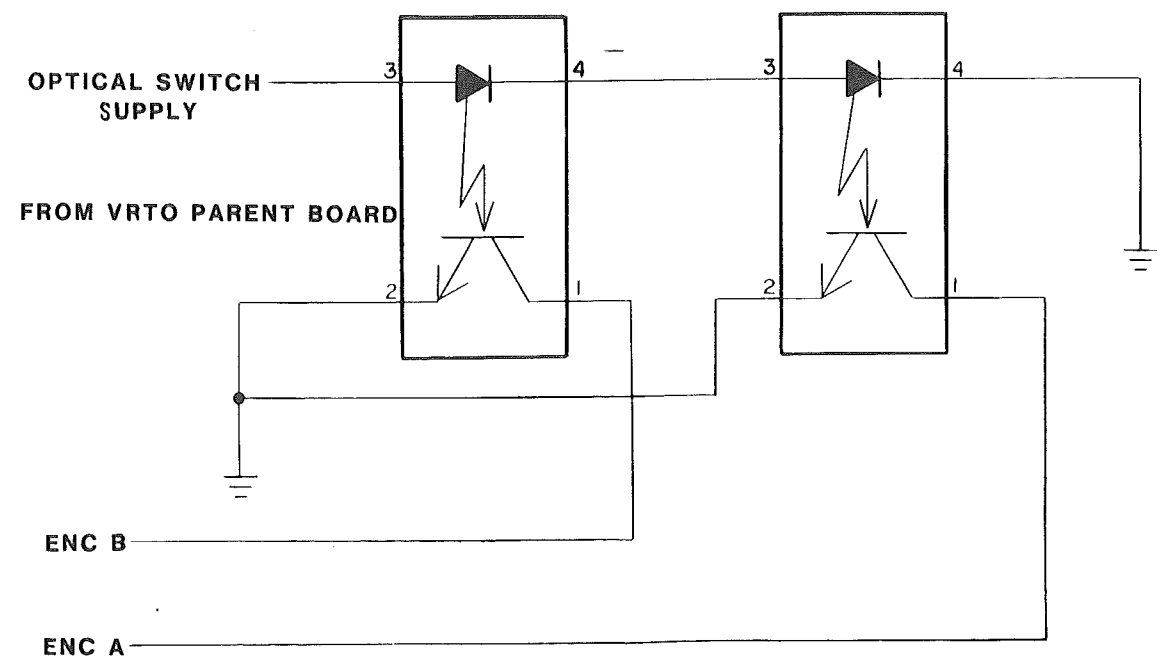


Fig. 3-46 VRTO Optical Switch and Parent Board Wiring

### 3-21. VRTO VCO BOARD

The VRTO VCO board contains a 50.5-55.5 MHz voltage controlled oscillator, a divide by ten divider, the phase detector and the reference divider circuitry for the VRTO portion of the synthesizer. Refer to figure 3-48 for the schematic and to figure 3-47 for parts list information.

Q3101 and Q3102 and associated components form a class C push-pull oscillator which is tuned over the range of 50.5 to 55.5 MHz by the coarse tune and fine tune varicaps. CR3102 through CR3105 provide most of the resonating capacity and are voltage controlled by the coarse tune voltage from the VRTO Digital board. CR3106, controlled by the phase locked loop error correction voltage, fine tunes the oscillator to maintain phase lock.

Some of the VCO output is coupled via C3108 to buffer amplifier Q3105. The buffered output is fed to the loop mixer located on the  $\pm N$ /Mix board.

Another portion of the VCO output is coupled via C3110 to buffer Q3104. This buffer drives a level shifter, Q3103, which in turn drives U3101. U3101 is a divider which obtains the desired 5.05 to 5.55 MHz output range by dividing the 50.5 to 55.5 MHz VCO

by 10. The output of U3101 is attenuated by R3117 and R3118 and is then coupled to the Translator board.

U3102 and Q3107 make up the phase/frequency detector which maintains acquisition and phase lock of the VRTO phase locked loop. R3130, C3126, R3131, C3127, R3132, R3133, and CR3111 and CR3112 have critical component values which determine the time constant and stability of the phase locked loop.

R3128 and C3123 form a RC low pass filter to remove reference harmonics from the VCO control line. R3122, R3123, C3120, R3124, C3121, and C3122 form a notch filter to reject the 5 kHz reference frequency energy which appears on the control line.

Q3106 is a buffer amplifier for the 5 kHz signal input from the programmable divider.

Finally U3103 connected in a divide by 100 configuration divides the 500 kHz reference signal, from the R4245 main synthesizer loop, down to the 5 kHz reference needed for the VRTO phase/frequency detector. Consequently the accuracy of the VRTO loop reference is directly related to the 40 MHz reference oscillator.

#### NOTES:

NOTES:

## VRTO VCO BOARD

REF DES	DESCRIPTION	PART NO.
C3101	Capacitor, Electrolytic 100 $\mu$ F $\pm$ 20%, 16 V	3180148
C3102	Capacitor, Disc, 20 pF $\pm$ 5%, NPO	3160580
C3103	Capacitor, Disc, 20 pF $\pm$ 5%, NPO	3160580
C3104	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C3105	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C3106	Capacitor, Electrolytic, 1 $\mu$ F $\pm$ 20%, 50 V	3180008
C3107	Capacitor, Electrolytic, 10 $\mu$ F $\pm$ 20%, 35 V	3180062
C3108	Capacitor, Composition, 1 pF	3187060
C3109	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C3110	Capacitor, Disc, 20 pF $\pm$ 5%, NPO	3160580
C3111	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C3112	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C3113	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C3114	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C3115	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C3116	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C3117	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C3118	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C3119	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C3120	Capacitor, Mica, 1000 pF $\pm$ 2%, DM15	3170560
C3121	Capacitor, Mica, 500 pF $\pm$ 2%, DM15	3170415
C3122	Capacitor, Mica, 500 pF $\pm$ 2%, DM15	3170415
C3123	Capacitor, Electrolytic, .22 $\mu$ F, 50 V	3180002
C3124	Capacitor, Electrolytic, 10 $\mu$ F $\pm$ 20%, 35 V	3180062
C3125	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C3126	Capacitor, Electrolytic, 1 $\mu$ F $\pm$ 20%, 50 V	3180008
C3127	Capacitor, Electrolytic, .1 $\mu$ F, 50 V	3180001
C3128	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C3129	Capacitor, Electrolytic, 1 $\mu$ F $\pm$ 20%, 50 V	3180008
C3130	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
CR3101	Diode, 1N4148	3020090
CR3102	Diode, MV209	3020278
CR3103	Diode, MV209	3020278
CR3104	Diode, MV209	3020278
CR3105	Diode, MV209	3020278
CR3106	Diode, MV104	3020274
CR3108	Diode, 1N4148	3020090
CR3109	Diode, 1N4148	3020090
CR3110	Diode, 1N4148	3020090
CR3111	Diode, 1N4148	3020090
CR3112	Diode, 1N4148	3020090
L3101	Choke Assy., 5.6 $\mu$ H, L56G	3520510
L3102	Choke Assy., 5.6 $\mu$ H, L56G	3520510
L3103	Choke Assy., 270 $\mu$ H, MUD271	3520590
Q3101	Transistor, SPF796, Matched FET	3030355
Q3102	Transistor, SPF796, Matched FET	3030355
Q3103	Transistor, MPSH20	3030293
Q3104	Transistor, J-310	3030501
Q3105	Transistor, MPSH20	3030293
Q3106	Transistor, 2N3904	3030105
Q3107	Transistor, 2N3904	3030105

REF DES	DESCRIPTION	PART NO.
R3101	Resistor, Carbon Film, 1 M $\Omega$ $\pm$ 5%, 1/4 W	3220355
R3102	Resistor, Carbon Film, 1 M $\Omega$ $\pm$ 5%, 1/4 W	3220355
R3103	Resistor, Carbon Film, 47 $\Omega$ $\pm$ 5%, 1/4 W	3220035
R3104	Resistor, Carbon Film, 47 $\Omega$ $\pm$ 5%, 1/4 W	3220035
R3105	Resistor, Carbon Film, 37 $\Omega$ $\pm$ 5%, 1/4 W	3220035
R3106	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R3107	Resistor, Carbon Film, 8.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220230
R3108	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R3109	Resistor, Carbon Film, 68 K $\Omega$ $\pm$ 5%, 1/4 W	3220300
R3110	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R3111	Resistor, Carbon Film, 470 $\Omega$ $\pm$ 5%, 1/4 W	3220110
R3112	Resistor, Carbon Film, 470 $\Omega$ $\pm$ 5%, 1/4 W	3220110
R3113	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R3114	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R3115	Resistor, Carbon Film, 470 $\Omega$ $\pm$ 5%, 1/4 W	3220110
R3116	Resistor, Carbon Film, 3.3 $\Omega$ $\pm$ 5%, 1/4 W	3220002
R3117	Resistor, Carbon Film, 150 $\Omega$ $\pm$ 5%, 1/4 W	3220065
R3118	Resistor, Carbon Film, 68 $\Omega$ $\pm$ 5%, 1/4 W	3220045
R3119	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R3120	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R3121	Resistor, Composition, 10 M $\Omega$ $\pm$ 10%, 1/4 W	3220380
R3122	Resistor, Film, 63.4 K $\Omega$ $\pm$ 1%, 1/4 W	3250485
R3123	Resistor, Film, 63.4 K $\Omega$ $\pm$ 1%, 1/4 W	3250485
R3124	Resistor, Film, 31.6 K $\Omega$ $\pm$ 1%, 1/4 W	3250465
R3125	Resistor, Carbon Film, 3.3 M $\Omega$ $\pm$ 5%, 1/4 W	3220365
R3126	Resistor, Carbon Film, 4.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220210
R3127	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R3128	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R3129	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R3130	Resistor, Carbon Film, 1.5 K $\Omega$ $\pm$ 5%, 1/4 W	3220175
R3131	Resistor, Carbon Film, 150 $\Omega$ $\pm$ 5%, 1/4 W	3220065
R3132	Resistor, Carbon Film, 1.2 K $\Omega$ $\pm$ 5%, 1/4 W	3220170
R3133	Resistor, Carbon Film, 680 $\Omega$ $\pm$ 5%, 1/4 W	3220140
R3134	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
T3101	Coil, Variable, 6-1/2 T, SK-138	3524101
U3101	I.C., SN74S195N	3040471
U3102	I.C., MC4044P	3040150
U3103	I.C., SN74LS390	3040478

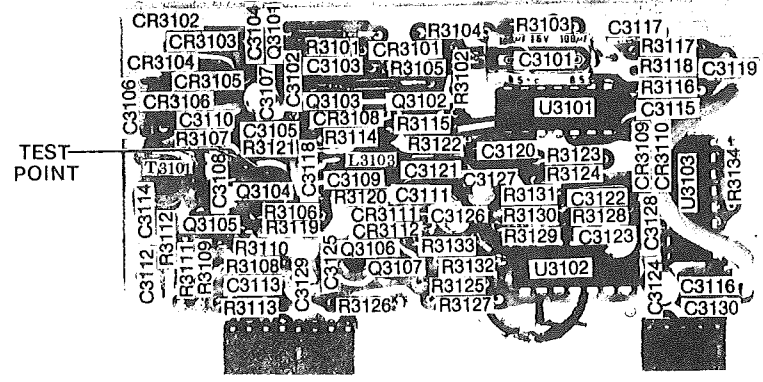


Fig. 3-47 VRTO VCO Board Pictorial

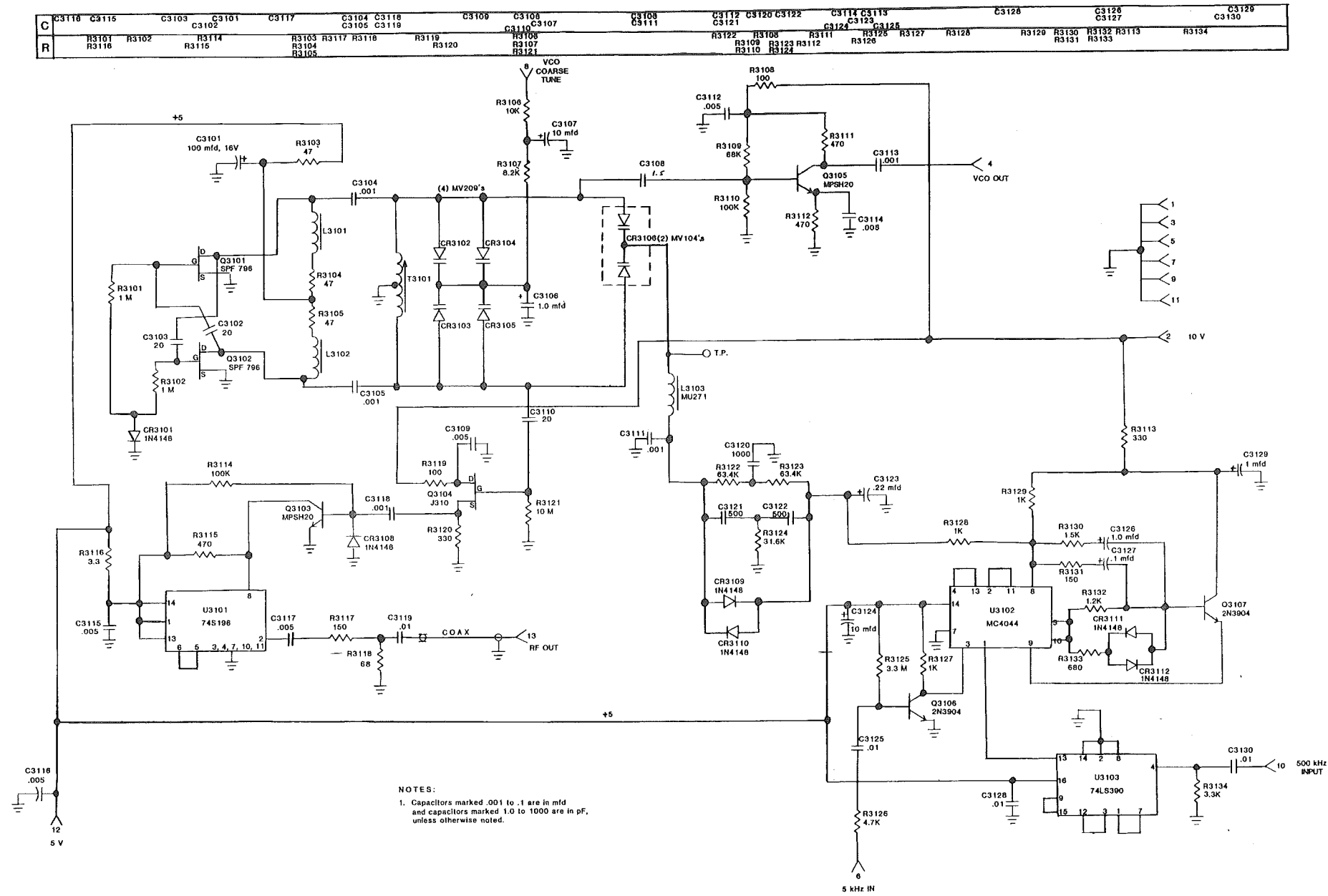


Fig. 3-48 VRTO VCO Board Schematic

### 3-22. VRTO $\pm$ N/MIX BOARD

The VRTO  $\pm$ /Mix Board contains the loop mixer,  $\pm 2$  prescaler, and programmable dividers for the VRTO phase locked loop. The 46.50 to 46.51 MHz VCXO is also located on this board.

Q3001 is a Colpitts oscillator. The oscillation frequency of this oscillator is determined by the 15.5 MHz crystal, Y3001. To allow the frequency of oscillation to be pulled the desired amount a voltage variable reactance is inserted in series with this crystal. L3001 and CR3001 form a series resonant circuit at approximately 15.5 MHz. By varying the capacity of CR3001, a net capacitive or inductive reactance can be obtained which is in series with the crystal. Thus, by varying the varicap control voltage, the oscillator frequency may be pulled. R3006 determines the pulling range and compensates for variations in crystals. In operation the crystal oscillator frequency is between 15.500 and 15.5033 MHz. The collector circuit of Q3001 is tuned to the third harmonic of the oscillator frequency — 46.500 to 46.510 MHz.

An amplifier stage consisting of Q3002 and associated components amplifies this 46.5 MHz signal and applies it to the double balanced mixer consisting of diodes CR3002 to CR3005 and transformers T3001 and T3002.

The other input to the double balanced mixer is the 50.5 to 55.5 MHz VCO signal from the VRTO VCO board. This signal combined with the 46.5 MHz VCXO signal results in a desired 4 to 9 MHz difference IF signal and a high frequency sum IF signal. R3011 and C3014 separate the desired 4 to 9 MHz signal from the undesired. Q3003 amplifies the 4 to 9 MHz IF signal up to a level adequate to drive the  $\pm 2$  prescaler, U3001. The resulting 2 to 4.5 MHz prescaler output is routed to the 3 stage BCD programmable divider consisting of U3003 and U3002. When the loop is locked the VCO frequency will be such that the programmable divider output frequency is 5 kHz. This 5 kHz output is supplied to the VRTO VCO board to the phase/frequency detector.

#### NOTES:

NOTES:

## VRTO ÷N/MIX BOARD

REF DES	DESCRIPTION	PART NO.
C3001	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C3002	Capacitor, Mica, 390 pF $\pm$ 5%, DM15	3170370
C3003	Capacitor, Electrolytic, 10 $\mu$ F $\pm$ 20%, 35 V	3180062
C3004	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C3005	Capacitor, Mica, 150 pF $\pm$ 5%, DM15	3170150
C3006	Capacitor, Disc, 39 pF $\pm$ 5%, NPO	3160760
C3007	Capacitor, Disc, 82 pF $\pm$ 5%, N750	3161040
C3008	Capacitor, Disc, 39 pF $\pm$ 5%, NPO	3160760
C3009	Capacitor, Electrolytic, 1 $\mu$ F $\pm$ 20%, 50 V	3180008
C3010	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C3011	Capacitor, Mica, 150 pF $\pm$ 5%, DM15	3170150
C3012	Capacitor, Disc, 39 pF $\pm$ 5%, NPO	3160760
C3013	Capacitor, Disc, 33 pF $\pm$ 5%, NPO	3160700
C3014	Capacitor, Disc, 33 pF $\pm$ 5%, NPO	3160700
C3015	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C3016	Capacitor, Disc, .006 $\mu$ F $\pm$ 20%, Z5U	3161470
C3017	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C3018	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C3019	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C3020	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
C3021	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C3022	Capacitor, Disc, .01 $\mu$ F $\pm$ 20%, Z5U	3161520
CR3001	Diode, MV209	3020278
CR3002	Diode, 1N4148	3000090
CR3003	Diode, 1N4148	3020090
CR3004	Diode, 1N4148	3020090
CR3005	Diode, 1N4148	3020090
CR3006	Diode, 1N4148	3020090
L3001	Inductor, Variable, Orange	2513006
L3002	Inductor, Variable, Blk/Blu	2513014
L3003	Inductor, Variable, Blk/Blu	2513014
Q3001	Transistor, 2N3904	3030105
Q3002	Transistor, 2N3904	3030105
Q3003	Transistor, 2N3904	3030105
R3001	Resistor, Carbon Film, 47 K $\Omega$ $\pm$ 5%, 1/4 W	3220285
R3002	Resistor, Carbon Film, 12 K $\Omega$ $\pm$ 5%, 1/4 W	3220240
R3003	Resistor, Carbon Film, 47 $\Omega$ $\pm$ 5%, 1/4 W	3220035
R3004	Resistor, Carbon Film, 150 $\Omega$ $\pm$ 5%, 1/4 W	3220065
R3005	Resistor, Carbon Film, 18 K $\Omega$ $\pm$ 5%, 1/4 W	3220255
R3006	Resistor, Variable, 50 K $\Omega$	3260703
R3007	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R3008	Resistor, Carbon Film, 680 $\Omega$ $\pm$ 5%, 1/4 W	3220140
R3009	Resistor, Carbon Film, 47 $\Omega$ $\pm$ 5%, 1/4 W	3220035
R3010	Resistor, Carbon Film, 3.3 K $\Omega$ $\pm$ 5%, 1/4 W	3220200
R3011	Resistor, Carbon Film, 47 $\Omega$ $\pm$ 5%, 1/4 W	3220035
R3012	Resistor, Carbon Film, 150 K $\Omega$ $\pm$ 5%, 1/4 W	3220320
R3013	Resistor, Carbon Film, 680 $\Omega$ $\pm$ 5%, 1/4 W	3220140
R3014	Resistor, Carbon Film, 37 $\Omega$ $\pm$ 5%, 1/4 W	3220035
R3015	Resistor, Carbon Film, 3.3 $\Omega$ $\pm$ 5%, 1/4 W	3220002
R3016	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R3017	Resistor, Carbon Film, 680 $\Omega$ $\pm$ 5%, 1/4 W	3220140

REF DES	DESCRIPTION	PART NO.
R3018	Resistor, Carbon Film, 100 $\Omega$ $\pm$ 5%, 1/4 W	3220055
R3019	Resistor, Carbon Film, 220 K $\Omega$ $\pm$ 5%, 1/4 W	3220330
T3001	Transformer, Inductor	2512200
T3002	Transformer, Inductor	2512200
U3001	I.C., SN74LS74N	3040506
U3002	I.C., MC14569BCP	3041148
U3003	I.C., MC14522BCP	3041124
Y3001	Crystal, 15.5 MHz	3120133

## NOTES:

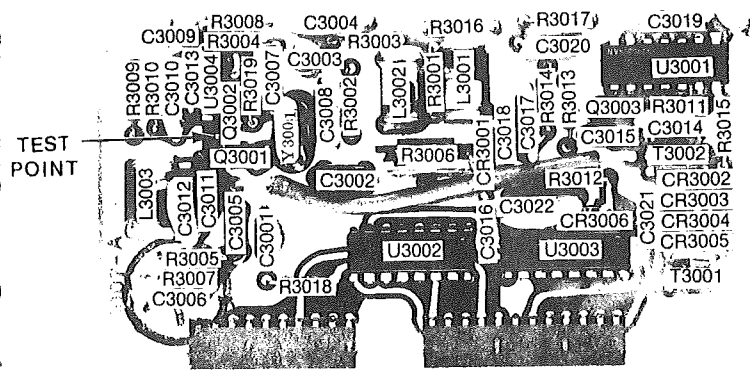


Fig. 3-49 VRTO +N/Mix Board Pictorial

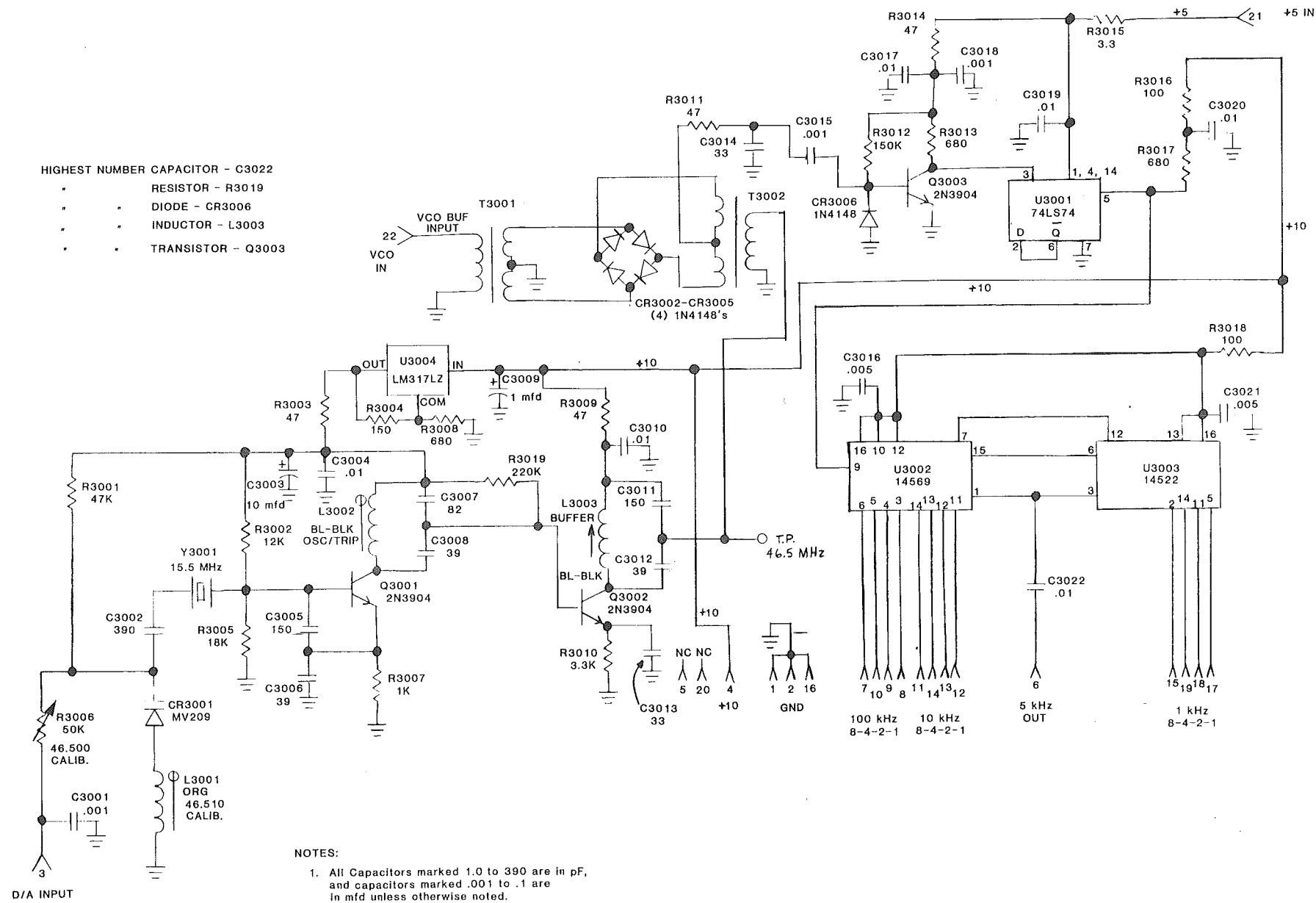


Fig. 3-50 VRTO +N/Mix Board Schematic

### 3-23. VRTO DIGITAL BOARD

The VRTO Digital board provides all of the synthesizer frequency programming information for the R4245. The UP-DOWN counters U32024 and U32025 supply load number programming to the main range synthesizer. Counters U32004 to U32008 supply the additional frequency information to the VRTO programmable divider and VCXO.

Counters U32024 and U32025 are preset from information from the Digital Control board each time the band switch is tuned or the power is turned on. The UP and DOWN pushbuttons increment these counters to select other than the initial preset 500 kHz wide ranges.

Counters U32004-U32008 are preset upon power-up to the center of their 500 kHz wide tuning range and are then incremented up or down by tuning the main tuning knob.

#### 3-23.1 500 kHz RANGE PROGRAMMING SECTION

The major functions of the range programming section are to take the synthesizer load number provided by the Digital Control board and increment or decrement the load number with the UP or DOWN front panel switches within the limits of the input bandpass filters. When the bandswitch is changed from one band to another U32027A(1) is momentarily grounded via the wire going to the bandpass filter module. If the FIXED FREQUENCY switch is in NORM, U32027(3) will go high and trigger U32028B, a one shot. The negative pulse out of the one shot will cause U32027(4) to go high, latching the BCD load number present at pins 2/41 through 2/48 into the programmable up-down counters U32024 and U32025.

The one shot insures the data from the band switch is valid before latching the number. In FIXED FREQUENCY switch positions 1-8 U32027(6) is held low, causing U32027(4) to stay high. This allows any load number at the counter inputs to be fed directly to the outputs. The outputs of the counters are buffered by the high current drivers U32022 and U32023 and applied to the divide by N inputs of

the Translator board. When the UP or DOWN pushbutton is depressed, a negative pulse is generated at the output of one shot U32028(7) and applied to the clock inputs of the counters. When the DOWN pushbutton is depressed U32027(11) remains low, the counters will decrement by one and the VCO frequency will increase. The load number is fed to the inputs of READ ONLY MEMORY U32021. When a load number corresponding to a band edge is programmed, U32021(12) and/or (11) will go low and disable the UP or DOWN latches. Refer to figure 3-4 to determine the proper load number for a particular 500 kHz segment.

#### 3-23.2 VARIABLE RATE MAIN TUNING CIRCUITRY

As mentioned above, a five stage UP-DOWN counter made up of U32004 to U32008 supplies the digital frequency programming information to the VRTO synthesizer programmable divider and VCXO. At the low end of any given 500 kHz range, the VRTO output frequency is 5.050 MHz. At this frequency the programmable divider "N" number is 400. The remaining two digits of frequency data for the VCXO are 00. Thus the counter chain range is from 40000 at the low end of the range, to 90000 at the top end of the 500 kHz range. Overtravel of +50 kHz on the high end and -200 kHz on the low end is permitted.

When power is applied, the charging current through C32019 sends a preset enable pulse to U32004 through U32008. The preset inputs are programmed for: U32008=6; U32007=5; U32006 through U32004=0. Thus, upon power-up the counter chain is programmed for 65000 corresponding to the center of the 500 kHz range.

The output data from U32008, U32009 and U32006 is used to program the programmable divider on the +N/Mix board. The output data from U32005 and U32004 is connected to a digital to analog conversion resistor network made up of resistors R32021 through R32024 and R32026 through R32029. The analog output voltage from this D/A network is coupled to the VCXO varicap on the +N/Mix board.

The outputs of counters U32008, U32007, U32006 and U32005 also drive another digital to analog conversion network consisting of resistors R32053 through R32059 and R32073 through R32080. The DC voltage produced which is related to the VRTO frequency is used as coarse tuning voltage for the 50.5 to 55.5 MHz VCO on the VRTO VCO board.

When the main tuning knob is tuned, lines on the shaft encoder disc interrupt the light beam to the phototransistor section of each optical switch. Potentiometers R32013 and R32015 adjust the lines on each optical switch phototransistor so that a symmetrical output waveform is obtained. The optical switch tuning assembly is set up such that the two encoder inputs, A and B, are 90° out of phase.

U32001A and U32001B are Schmitt Trigger buffers which create square wave outputs from the two shaft encoder inputs. Outputs from U32001 A and B are connected to the inputs of a two input exclusive NOR gate. The resulting output is double the frequency of either incoming signal. Because there are 100 lines on the shaft encoder disc and thus 100 pulses from U32001A or U32001B per each revolution of the main tuning dial, consequently there are 200 pulses produced at the output of U32010D for each dial resolution. These pulses are applied to the counter chain input through R32020. As the main tuning dial is tuned the pulses produced increment the counter chain one count per pulse. One dial revolution creates 200 pulses and each counter increment moves the VRTO output frequency 10 Hz, thus 1 dial revolution produces 2 kHz of frequency change. The above discussion is accurate as long as the dial is tuned slow enough and the variable rate circuitry has not started acting.

Pulses from the output U32001B are also sent to a differentiator circuit comprised of C32010 and R32063. Narrow pulses are created for each edge of the square wave input. U32001E and U32001F invert and reinvert these resulting pulses which in effect rectify the differentiator output so that only positive going pulses are remaining. This pulse train at the output of U32001F drives an integrator circuit made up of R32064 and C32012. The time constant is chosen such that a DC voltage proportional to tuning speed is created over a normal range of tuning speeds. This DC voltage controls the amount of current which passes through Q32006

and in turn changes C32009, the timing capacitor for the pulse generator.

If the main tuning dial is rotated slower than a certain speed, not enough current can pass through Q32006 to charge C32009 and no oscillator or output pulses are produced from U32003.

As the main tuning dial is rotated faster, C32009 is able to charge up to a high enough level to trigger U32003. The resulting astable oscillator configuration of U32003 generates additional pulses in between the other pulses from U32001D and increments the counter chain. As the main tuning dial is tuned faster, more pulses from U32003 can fit between each two pulses from U32001D. Thus, the tuning rate is increased as dial speed is increased. Potentiometer R32067 adjusts the fixed bias on Q32006 which changes the threshold of the variable rate circuitry and determines the tuning rate at fast tuning speeds. Normally this adjustment is set to provide approximately a 20 kHz per revolution tuning rate at fast dial rotations.

U32002A is a J-K flipflop which determines the direction of rotation of the main tuning knob and provides the UP-DOWN counter chain with a control signal to determine whether the counter counts up or counts down.

When the main tuning is rotated clockwise, each rising edge of the square wave input to the CLOCK input of U32002A occurs when the J input is high and the K input is low. This is always true due to the 90 degree phase shift between the two encoder inputs. Under this condition, the Q output of U32002A is a logic 1 and thus programs the counter chain to count up. When the main tuning is rotated counterclockwise, each rising edge at the clock input of U32002A occurs when the J input waveform is low and the K input is high. In this case, the Q output becomes a logic 0 and the counter chain is programmed to count down.

U32010A, U32010B, U32010C, and U32009B monitor the outputs of counter stage U32008. When a binary 1 is detected, indicating that the VRTO has been tuned more than 200 kHz below the lower end

of the 500 kHz range, a logic 1 at the output of U32009B is applied to the set input of U32002A, forcing the flipflop to a logic 1 regardless of the other inputs. This changes the UP-DOWN program line to a logic 1 and thus prohibits any further down counting.

In a similar manner, when the counter chain count increases above 94999 to 95000, U32009A detects the 9 and 5 and provides a logic 1 output to the reset input of Q32002A. This forces U32002A to the down-count 0 logic output and thus prevents any further counter incrementing upward.

### 3-23.3 RIT CONTROL

The receiver incremental tuning (RIT) function is accomplished by overriding the DC output of the D-A converter with DC voltage from the RIT potentiometer. Switch Q32004 allows this to occur only when RIT has been selected and the TR4310, if connected and used in the RCT mode, is in receive.

When the RIT switch is depressed, the charging current through C32011 toggles flipflop U32002B to a logic 1 output state. This turns on Q32003 which sinks current from the RIT lamp, thus lighting this indicator. Q32004 is also turned on thus applying the RIT potentiometer voltage to the D-A output line.

If the RIT switch is depressed a second time, flipflop U32002B toggles again to the logic 0 state, deactivating the RIT. If the main tuning dial is turned while the RIT is on, a pulse from U32001F will also reset U32002B and disable the RIT.

In transmit, Q32005 temporarily disables the RIT but allows reactivation of the RIT mode upon return to receive.

### 3-23.4 DISPLAY DECODING

The 100 Hz, 1 kHz, and 10 kHz display digits are controlled directly by the outputs of their respective UP-DOWN counter. Decoder drive IC's, U32011 through U32013 convert the BCD information to a seven segment display code and drive the LED display digit on the attached display board.

The 100 kHz counter information must be processed before it is displayed. If a XX.0 to XX.5 MHz range has been selected as indicated by an even synthesizer load number, a 4 must be subtracted from the value of the 100 kHz counter. This is necessary to obtain a 0 to 5 range instead of the 4 to 9 range present at the counter. U32015 performs this conversion by adding 6, which gives the same result as subtracting 4 because the carry information is not used.

When a XX.5 to XX.0 range is selected, only 1 is added to the 100 kHz counter output to generate a 5 to 0 display range. U32014 takes the result from U32015 and displays the 100 kHz digit.

To display the 1 MHz and 10 MHz digits, the main synthesizer load number must be decoded. A look-up table is stored in U32018, a 1 K × 8 ROM. The two BCD digits of load number information are connected to eight input lines of the ROM. Two additional inputs come from U32019B and U32019D. These gates, along with U32020D and U32019C monitor the 100 kHz digit to determine if a carry or borrow to (from) the 1 MHz digit is necessary. The inputs to the ROM result in eight lines of output information. These lines are the two BCD digit information lines for the 1 MHz and 10 MHz display digits. U32016 and U32017 are the BCD to seven segment decoder/drivers for these two digits.

U32020A, U32020B, and U32020C decode a leading zero condition and provide blanking of any leading zeros in the 10 MHz or 1 MHz positions only.

## VRTO DIGITAL BOARD REMOVAL

(Refer to Pictorial Fig. 3-51)

1. Unplug (2) two connectors (one 6-pin and one 26-pin) from the VRTO Digital board. Position cables carefully so that they will be free of the VRTO Digital board when it is lifted out. Remove the retaining screw and lockwasher (adjacent to U32025).
2. Unplug the coax and blue wire from the filter module. Slide the grommet off the coax and blue wire.
3. Using the card puller supplied with the radio, hook one end under the front edge of the large hole adjacent to U32022 (shown in figure 3-51). Grasp the tool and pull upwards firmly, but slowly, to disengage one 12 pin and one 9 pin connectors. Once the connectors have been disengaged, remove the card puller.
4. Grasping the board along both sides, tilt the rear portion of the board upwards at an angle

sufficient to fully disengage the connectors and slide the board toward the rear of the radio. As this is done, note that the display LEDs should slide out of the aluminum bezel at the front panel.

NOTE: Do not tilt the board excessively before the display LEDs are free of the locating aluminum bezel, or damage will result to either the displays or the VRTO Digital board.

5. Once the display and connectors are free, lift the VRTO Digital board straight up, allowing the coax to slide out of the clearance hole provided for it.
6. Now either the VRTO Digital board or Jumper board can be plugged in on extender cards and the coax plugged into the filter module to service the radio.

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## VRTO DIGITAL BOARD INSTALLATION

1. Position (2) two connectors (one 6-pin and one 26-pin) and associated cables to be free of VRTO Digital board during installation. Check that all 21 connector pins on the VRTO Digital board are straightened and perpendicular to the board.
2. Thread the Up-Converter coax through the hole in the VRTO Digital board (adjacent to U32018). Tilt the display LED portion of the VRTO Digital board downward and slide the LEDs into the locating aluminum bezel at the front panel.
3. Start the 12 pin connector on the VRTO Digital board (adjacent to U32027) into the receptacle on the Digital Control board, noting visually

that the connector pins are aligned properly with the receptacle.

4. With the 12 pin connector sufficiently engaged, start the 9 pin connector (adjacent to U32021) into the receptacle in the Translator board, again noting visually that the connector pins are aligned properly with the receptacle.
5. Press down firmly, but carefully, on the VRTO Digital board to fully seat all connectors.
6. Install the retaining screw and lockwasher (adjacent to U32025). Plug in (2) two connectors (one 6-pin and one 26-pin). Slide the grommet over the coax and blue wire. Plug the coax and blue wire into the filter module, position the grommet in the chassis wall cutout.

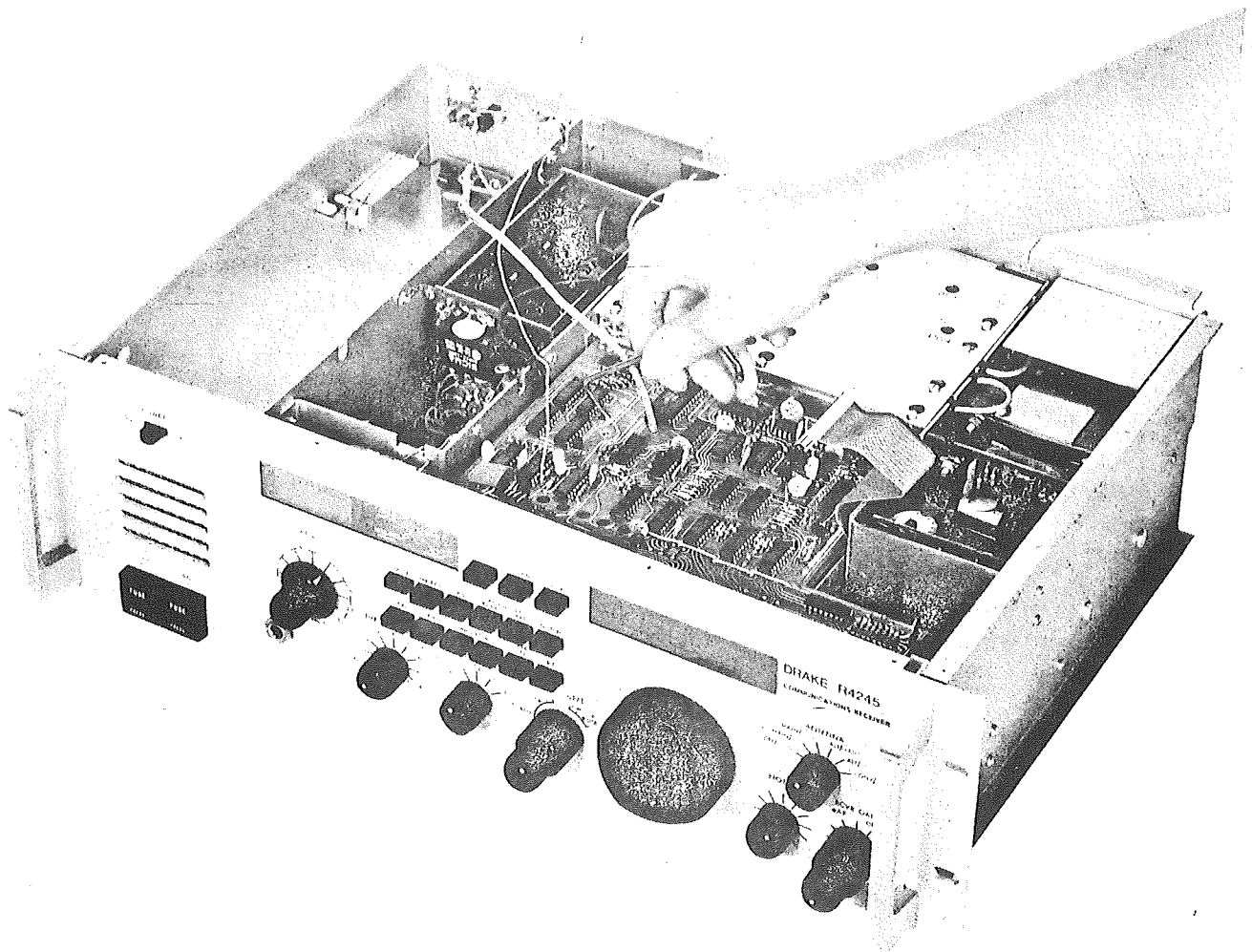


Fig. 3-51 VRTO Digital Board Removal

NOTES:

## VRTO DIGITAL BOARD

REF DES	DESCRIPTION	PART NO.
C32001	Capacitor, Disc, .1 $\mu$ F + 80%, Y5T	3161660
C32002	Capacitor, Disc, .1 $\mu$ F + 80%, Y5T	3161660
C32003	Capacitor, Disc, 100 pF $\pm$ 10%, X5F	3161070
C32004	Capacitor, Electrolytic, 1 $\mu$ F $\pm$ 20%, 50 V	3180008
C32005	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C32006	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C32007	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C32008	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
C32009	Capacitor, Disc, .05 $\mu$ F + 80%, M16V	3161600
C32010	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C32011	Capacitor, Disc, .001 $\mu$ F $\pm$ 20%, Z5U	3161380
C32012	Capacitor, Tantalum, .1 $\mu$ F $\pm$ 10%, 35 V	3183098
C32013	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C32014	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C32015	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C32016	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C32017	Capacitor, Electrolytic, 1 $\mu$ F $\pm$ 20%, 50 V	3180008
C32018	Capacitor, Electrolytic, 1 $\mu$ F $\pm$ 20%, 50 V	3180008
C32019	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C32020	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C32021	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3151470
C32022	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C32023	Capacitor, Disc, .005 $\mu$ F $\pm$ 20%, Z5U	3161470
C32024	Capacitor, Disc, .01 $\mu$ F + 80%, M25V	3161500
CR32001	Diode, 1N4148	3020090
CR32002	Diode, 1N4148	3020090
CR32003	Diode, 1N4148	3020090
CR32004	Diode, 1N4005, Glass	3020220
CR32005	Diode, 1N4148	3020090
CR32006	Diode, 1N4148	3020090
CR32007	Diode, 1N4148	3020090
CR32008	Diode, 1N4148	3020090
CR32009	Diode, 1N4148	3020090
CR32010	Diode, 1N4148	3020090
CR32011	Diode, 1N4148	3020090
Q32001	Transistor, 2N3904	3030105
Q32002	Transistor, 2N3904	3030105
Q32003	Transistor, 2N3904	3030105
Q32004	Transistor, 2N4125	3030110
Q32005	Transistor, 2N3904	3030105
Q32006	Transistor, 2N5953	3030200
R32001	Resistor, Carbon Film, 470 K $\Omega$ $\pm$ 5%, 1/4 W	3220345
R32002	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R32003	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R32004	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R32005	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R32006	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R32007	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R32008	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R32009	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R32010	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315

REF DES	DESCRIPTION	PART NO.
R32011	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R32012	Resistor, Carbon Film, 1 M $\Omega$ $\pm$ 5%, 1/4 W	3220355
R32013	Resistor, Variable, 10 K $\Omega$	3260664
R32014	Resistor, Carbon Film, 1.5 K $\Omega$ $\pm$ 5%, 1/4 W	3220175
R32015	Resistor, Variable, 10 K $\Omega$	3260664
R32016	Resistor, Carbon Film, 1.5 K $\Omega$ $\pm$ 5%, 1/4 W	3220175
R32017	Resistor, Carbon Film, 15 K $\Omega$ $\pm$ 5%, 1/4 W	3220245
R32018	Resistor, Carbon Film, 47 K $\Omega$ $\pm$ 5%, 1/4 W	3220285
R32019	Resistor, Carbon Film, 1.5 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R32020	Resistor, Carbon Film, 1.5 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R32021	Resistor, Film, 24.9 K $\Omega$ $\pm$ 1%, 1/4 W	3250464
R32022	Resistor, Film, 49.9 K $\Omega$ $\pm$ 1%, 1/4 W	3250469
R32023	Resistor, Film, 100 K $\Omega$ $\pm$ 1%, 1/4 W	3250487
R32024	Resistor, Film, 200 K $\Omega$ $\pm$ 1%, 1/4 W	3250488
R32025	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32026	Resistor, Film, 2.37 K $\Omega$ $\pm$ 1%, 1/4 W	3250323
R32027	Resistor, Film, 4.99 K $\Omega$ $\pm$ 1%, 1/4 W	3250361
R32028	Resistor, Film, 10 K $\Omega$ $\pm$ 1%, 1/4 W	3250425
R32029	Resistor, Film, 20 K $\Omega$ $\pm$ 1%, 1/4 W	3250463
R32030	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32031	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32032	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32033	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32034	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32035	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32036	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32037	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32038	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32039	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32040	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32041	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32042	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32043	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32044	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32045	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32046	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32047	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32048	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R32049	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32050	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32051	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32052	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32053	Resistor, Composition, 22 M $\Omega$ $\pm$ 10%, 1/4 W	3220390
R32054	Resistor, Composition, 10 M $\Omega$ $\pm$ 10%, 1/4 W	3220380
R32055	Resistor, Carbon Film, 4.7 M $\Omega$ $\pm$ 5%, 1/4 W	3220370
R32056	Resistor, Carbon Film, 470 K $\Omega$ $\pm$ 5%, 1/4 W	3220345
R32057	Resistor, Carbon Film, 1 M $\Omega$ $\pm$ 5%, 1/4 W	3220355
R32058	Resistor, Carbon Film, 2.2 M $\Omega$ $\pm$ 5%, 1/4 W	3220360
R32059	Resistor, Carbon Film, 3.3 M $\Omega$ $\pm$ 5%, 1/4 W	3230365
R32060	Resistor, Carbon Film, 1 K $\Omega$ $\pm$ 5%, 1/4 W	3220160
R32061	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R32062	Resistor, Carbon Film, 10 $\Omega$ $\pm$ 5%, 1/4 W	3220005
R32063	Resistor, Carbon Film, 15 K $\Omega$ $\pm$ 5%, 1/4 W	3220245

REF DES	DESCRIPTION	PART NO.
R32064	Resistor, Carbon Film, 1.5 K $\Omega$ $\pm$ 5%, 1/4 W	3220175
R32065	Resistor, Carbon Film, 1 M $\Omega$ $\pm$ 5%, 1/4 W	3220355
R32066	Resistor, Carbon Film, 1 M $\Omega$ $\pm$ 5%, 1/4 W	3220355
R32067	Resistor, Variable, 10 K $\Omega$	3260667
R32068	Resistor, Composition, 10 M $\Omega$ $\pm$ 10%, 1/4 W	3220380
R32069	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R32070	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R32071	Resistor, Carbon Film, 33 K $\Omega$ $\pm$ 5%, 1/4 W	3220275
R32072	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R32073	Resistor, Carbon Film, 360 K $\Omega$ $\pm$ 5%, 1/4 W	3220342
R32074	Resistor, Carbon Film, 220 K $\Omega$ $\pm$ 5%, 1/4 W	3220330
R32075	Resistor, Carbon Film, 100 K $\Omega$ $\pm$ 5%, 1/4 W	3220315
R32076	Resistor, Carbon Film, 47 K $\Omega$ $\pm$ 5%, 1/4 W	3220285
R32077	Resistor, Carbon Film, 4.7 K $\Omega$ $\pm$ 5%, 1/4 W	3220210
R32078	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R32079	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32080	Resistor, Carbon Film, 39 K $\Omega$ $\pm$ 5%, 1/4 W	3220282
R32081	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32082	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32083	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32084	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32085	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R32086	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32087	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32088	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32089	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32090	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32091	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32092	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32093	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32094	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32095	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32096	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32097	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32098	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32099	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32100	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32101	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32102	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32103	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32104	Resistor, Composition, 10 M $\Omega$ $\pm$ 10%, 1/4 W	3220380
R32105	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R32106	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32107	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32108	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32109	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32110	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32111	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32112	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32113	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32114	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32115	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32116	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090

REF DES	DESCRIPTION	PART NO.
R32117	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32118	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32119	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32120	Resistor, Carbon Film, 330 $\Omega$ $\pm$ 5%, 1/4 W	3220090
R32121	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32122	Resistor, Carbon Film, 22 K $\Omega$ $\pm$ 5%, 1/4 W	3220260
R32123	Resistor, Carbon Film, 10 K $\Omega$ $\pm$ 5%, 1/4 W	3220235
R32124	Resistor, Carbon Film, 47 $\Omega$ $\pm$ 5%, 1/4 W	3220035
U32001	I.C., MC14584BCP	3041159
U32002	I.C., MC14027BCP	3041039
U32003	I.C., MC1455P1	3040113
U32004	I.C., MC14510BCP	3041105
U32005	I.C., MC14510BCP	3041105
U32006	I.C., MC14510BCP	3041105
U32007	I.C., MC14510BCP	3041105
U32008	I.C., MC14510BCP	3041105
U32009	I.C., MC14082BCP	3041071
U32010	I.C., MC14077BCP	3041066
U32011	I.C., MC14547BCP	3041136
U32012	I.C., MC14547BCP	3041136
U32013	I.C., MC14547BCP	3041136
U32014	I.C., MC14547BCP	3041136
U32015	I.C., MC14560BCP	3041140
U32016	I.C., MC14547BCP	3041136
U32017	I.C., MC14547BCP	3041136
U32018	I.C., EA8308A, ROM	3042005
U32019	I.C., MC14011BCP	3041010
U32020	I.C., MC14071BCP	3041060
U32021	I.C., 74S387	3040015
U32022	I.C., MC14050BCP	3041050
U32023	I.C., MC14050BCP	3041050
U32024	I.C., MC14510BCP	3041105
U32025	I.C., MC14510BCP	3041105
U32026	I.C., MC14023BCP	3041035
U32027	I.C., MC14011BCP	3041010
U32028	I.C., MC14538BCP	3041134



**NOTES:**



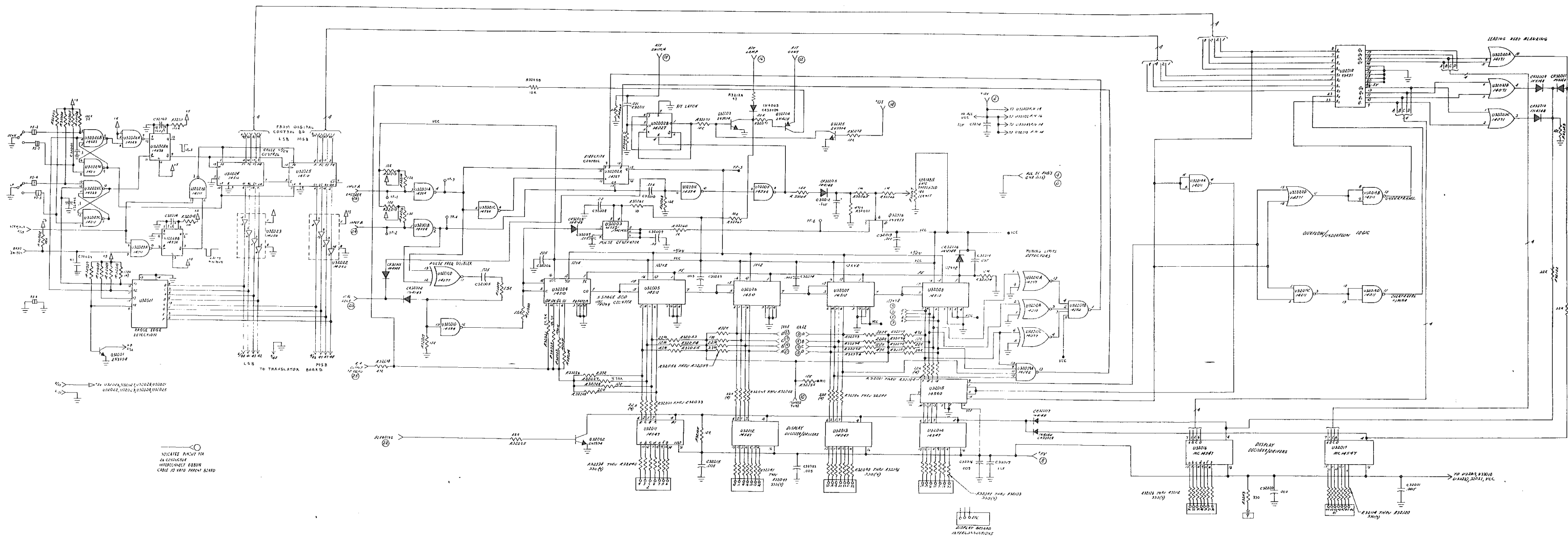


Fig. 3-53 VRTO Digital Board Schematic

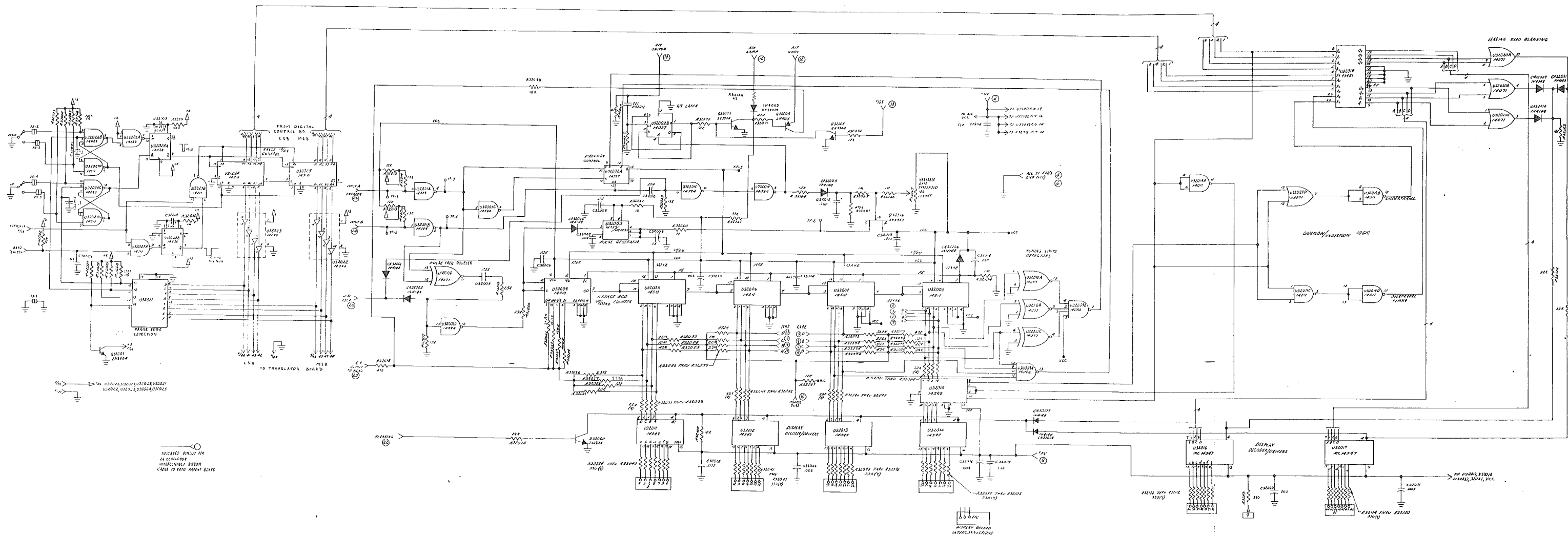


Fig. 3-53 VRTO Digital Board Schematic

### 3-24. VRTO DISPLAY BOARD

The Display board provides connection to the six LED displays. It is connected to the VRTO digital

board by way of two 24 conductor cable jumper assemblies.

#### NOTES:

NOTES:

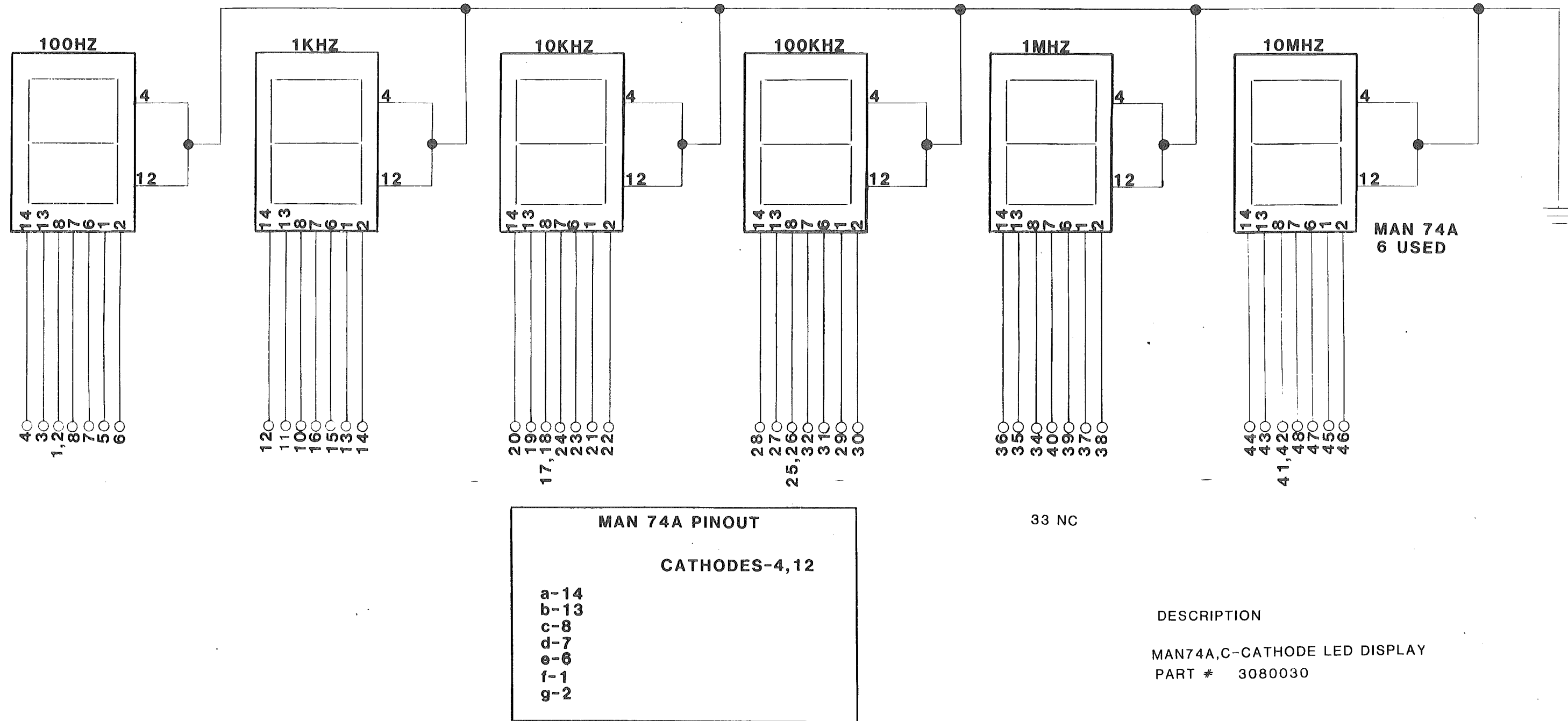


Fig. 3-54 VRTO Display Board Schematic

## SECTION 4

### ALIGNMENT PROCEDURE

The following alignment procedure can be accomplished with a VTVM, RF voltmeter, audio voltmeter, 60 MHz frequency counter and a signal generator with well calibrated output level. In addition, a good high-frequency (30-50 MHz) oscilloscope is recommended, but not required.

The procedure is structured in such a manner that it may be entered at any point and followed to conclusion. That is, if you are sure that all adjustments preceding those of interest are correct, you may start at the section which addresses the problem at hand. However, all sections following the starting point must be completed to insure proper operation. If any doubt exists, it is recommended that the entire procedure be executed.

It is not necessary to use the board extenders for any of the following adjustments. In fact, use of the extenders will distort the alignment settings. The board extenders should only be used for troubleshooting and repair.

#### 4-1. 13.8 VOLT ADJUSTMENT

Using an accurate voltmeter, adjust R1808 on the +13.8 VDC Regulator Board (Section 3-16) for 13.8 VDC  $\pm$  0.2 VDC, measured at S-meter pilot lamp socket. Although the voltage setting is not critical, a setting considerably higher than 13.8 V will shorten pilot lamp life; a setting considerably lower will limit maximum audio output power.

#### 4-2. 10 VOLT ADJUSTMENT

Using an accurate voltmeter, adjust R1903 on the Power Supply board (Section 3-17) for exactly 10 VDC, measured on the 10 volt trace of the Parent board (Section 3-1). Note that adjusting the 10 volt regulator will affect all circuits in the receiver thus requiring a full alignment.

#### 4-3. 40 MHz OSCILLATOR ALIGNMENT

Adjust L1006 on the PBT/Reference board (Section 3-11) for maximum 40 MHz output on pin 21. Use an RF voltmeter, and measure this level on the Parent

board. A level of about .25 volts can be expected.

Connect an accurate frequency counter through a 470 ohm, 1/4 W, 10% resistor to pin 21 of the PBT/Reference board and adjust L1001 for exactly 40 MHz. Note that any error in this adjustment will result in a calibration and readout accuracy discrepancy. Do not connect directly to pin 21 for this frequency adjustment, since the load of the counter may cause the 40 MHz oscillator to shift frequency slightly.

Although adjustment with a frequency counter is preferred, it is possible to set the 40 MHz oscillator using WWV. Peak L1006 as described above and tune to the strongest available WWV signal in your area. Place the radio in the AM mode, and wait until WWV is transmitting an unmodulated carrier. Enable the calibrator and carefully adjust L1001 for exact zero beat with WWV. This method requires that WWV be of comparable signal strength with the calibrator. As such, it may be necessary to select the proper time of day as well as frequency for your area to achieve the desired results.

To insure proper R4245/TR4310 transceive operation, connect the R4245 accessory socket to the TR4310 accessory socket using the transceive cable (part of Model 1548). Remove the R4245 rear card cage top cover. With the TR4310 turned off, turn on the R4245. Observe the level and frequency of the signal at pin 21, again measuring through a 470 ohm resistor. Turn on the TR4310 and again note the level and frequency at the R4245 pin 21 point. The TR4310 being used in this alignment should now be supplying the 40 MHz reference frequency for the R4245; and thus should also be adjusted accurately to 40 MHz. Tune L1011 for a peak indication at pin 21 and note the level. Turn the TR4310 off and again note the level. The difference in the two levels should not exceed 6 dB.

#### 4-4. 13.695 MHz VCXO ADJUSTMENT

This adjustment should be performed accurately and exactly as outlined below to insure that the passband tuning is correct. Be sure that the 40 MHz oscillator is on frequency before attempting this adjustment.

- a) Position the front panel PBT control at the center of rotation (indicator straight up).
- b) Connect a frequency counter to pin 17 of the PBT/Reference board and adjust L1004 for exactly 53.695 MHz. This is the 2nd L.O. frequency, which is the sum of the 40 MHz and 13.695 oscillators, thus it is important that the 40 MHz oscillator be on frequency.
- c) Connect an RF voltmeter to pin 17 of the PBT/Reference board and tune L1013 and L1014 for maximum output. A level of approximately 200 mV RMS can be expected.

#### 4-5. 5.695 MHz 3RD L.O. TUNING

These adjustments include no frequency determining elements as the 5.695 MHz injection is derived from the previously set 40 MHz and 13.695 oscillators. With rear card cage top cover removed, merely tune L1005, L1008 and L1009 for maximum output level at pin 40 of PBT/Reference board, as measured with an RF voltmeter. A level of approximately 30 mV RMS can be expected.

#### 4-6. VCO ALIGNMENT

The VCO should not normally require alignment. This section can be skipped if there is not reason to believe the VCO alignment is required.

If alignment is required, the following procedure should be used. See figure 3-14.

- a) Attach a VTVM to the alignment test point shown in figure 3-14.
- b) Tune receiver to 14.500 MHz.
- c) The VTVM should indicate  $16.0 \pm 0.5$  VDC. If not, adjust L501 for exactly 16 VDC.
- d) Change frequency to 29.00 MHz.
- e) The VTVM should indicate  $16.0 \pm 0.5$  VDC. If not, adjust L502 for exactly 15 VDC.

In order to gain access to L501 and L502, the VRTO Digital board must be set up on extenders and front circuit card shield cover must be removed.

#### 4-7. TRANSLATOR ALIGNMENT

Translator alignment should be necessary only when parts on the circuit board have been replaced. Remove the VRTO Digital board and front circuit card shield cover, and reinstall the VRTO Digital board on board extenders with the 26 conductor cable connected to the VRTO Digital board. Perform the following steps in the order listed to insure correct alignment.

- a) Set BAND switch to 1.5 MHz and tune main tuning until display indicates 2.0 MHz.
- b) Connect an RF voltmeter to the alignment test point indicated in figure 3-16.
- c) Back out the slug in L610 two turns, or until RF voltage decreases by 50%.
- d) Peak L609 and L611 for maximum.
- e) Peak L610 for maximum — do not retune L609 and L611.

#### 4-8. 2ND/3RD IF/AGC ALIGNMENT

The following procedure describes a coarse tune of the 2nd/3rd IF/AGC board and will be required if parts in the IF stages have been changed or board has been mistuned for any reason.

- a) Remove the rear card cage cover.
- b) With R4245 operational, set SELECTIVITY switch to 2.3 kHz, FAST AGC button depressed, all other buttons out, RF GAIN fully clockwise and FIXED FREQUENCY switch on NORM.
- c) Set AGC bias pot (R1127) in the middle of its range.
- d) Turn S-meter zero pot (R1119) until the meter moves upscale slightly and then back it down to S-2.
- e) Turn RF GAIN control fully counterclockwise and set 60 dB/S9 meter set pot (R1106) for full scale meter reading. Return RF GAIN control to fully clockwise.
- f) Set IF GAIN pot for full clockwise.
- g) Set SELECTIVITY switch to 4 kHz position (whether filter is installed or not).
- h) Feed in 5.645 MHz signal from signal generator into IF board input terminal located at

upper left hand corner of board as viewed from front of radio. Internal connection to this board will, of course, have to be unplugged (AGC should remain on FAST).

- i) Adjust generator level for about 1/3 scale S-meter reading and adjust T1101, L1101, L1102, L1103 and T1102 for maximum S-meter reading. Keep reducing generator level as cans are tuned to maintain 1/3 scale meter reading.
- j) Adjust L1105 for maximum S-meter reading.

Remove generator, reconnect internal IF input coax and set SELECTIVITY switch to 2.3 kHz position.

#### 4-9. UP-CONVERTER AND 2ND MIXER TUNING

The following procedure describes both a coarse and fine tune for the Up-Converter board and 2nd Mixer board. All steps will be required if parts have been changed on either board or boards have been mistuned for any reason. If an accessory crystal filter has been installed in the 0.5 or 0.3 kHz selectivity positions, make adjustments according to step e.

- a) Attach scope or RF voltmeter to test point post on 2nd Mixer board. Adjust L703 for maximum indication. A level of approximately 0.9 V RMS can be expected. Remove probe from test point.
- b) Feed in a 12.3 MHz signal into the antenna terminal and tune in for zero beat. The SSB/CW-AM button should be in the SSB/CW position, and the passband tuning control should be in the center. Selectivity switch should be in the 2.3 kHz position.
- c) Adjust generator level to give about 1/3 scale reading on S-meter. If a signal generator is not available, the internal calibrator signal can be used instead for this adjustment.
- d) Set R719 to end of rotation at maximum gain (full CCW). Adjust C418 on Up-Converter board, and L701 and L705 on 2nd Mixer board for maximum S-meter reading. Keep reducing generator output level as these adjustments are made to keep S-meter reading about 1/3 scale.
- e) If 0.5 or 0.3 kHz accessory crystal is installed, set selectivity switch to one of these used positions. Adjust L706 for maximum S-meter reading. Note the reading and switch to 2.3 kHz position, noting that reading. The difference, if

any, between the readings should be less than 1/2 S-unit. If not, switch between 2.3 kHz and narrow filter, adjusting R719 slightly to minimize difference. If a 0.3 or 0.5 kHz filter is not available, peak L706 in the 2.3 kHz bandwidth position; then adjust R719 for 1/2 S-unit drop from maximum gain point.

#### 4-10. AGC, IF GAIN AND S-METER FINAL ADJUSTMENT

The following procedure describes the fine tune of the 2nd/3rd IF/AGC and 2nd Mixer boards. The rear card cage cover must be removed for these adjustments.

- a) Connect an audio voltmeter across R4245 speaker terminals.
- b) Adjust AGC bias pot (R1127) fully clockwise.
- c) Apply a 0.5  $\mu$ V signal at 12.3 MHz to the MAIN/ALT antenna input. Place radio in the 2.3 kHz, SSB/CW mode. Turn main tuning dial for maximum audio output. Peak L701 (cover removed). Tune IF gain pot (R1138) clockwise until audio output no longer increases with additional increase in pot setting. Then turn pot counterclockwise until audio output decreases 3 dB.
- d) Increase signal generator input to 1  $\mu$ V and adjust S-meter zero pot (R1119) for a reading of S1-1/2 on S-meter.
- e) Increase signal generator input to 50,000  $\mu$ V and adjust 60 dB over S9 meter set pot (R1106) for 60 dB over S9 on meter.
- f) Repeat steps d and e until no further change is noted.
- g) Install rear card cage cover. Repeat L701 with signal generator level of approximately 1  $\mu$ V.

#### 4-11. NOTCH TUNING

- a) Turn on calibrator and tune in for zero beat at any 100 kHz point.
- b) Position both NOTCH and PBT pots exactly in the center. Depress NOTCH pushbutton.
- c) Adjust notch coil L1104 and notch depth pot R1147 located on 2nd IF board for maximum

notch depth.

- d) Tune main tuning to yield 800 Hz (approximately) tone. Adjust notch control on front panel and depth pot (R1147) for least audio tone output.

#### 4-12. LINE AMPLIFIER ADJUSTMENT

With a 600 ohm resistive load attached across the line amplifier output and a calibrator signal tuned in for an approximate 1 kHz audio tone, adjust the pot (R8010) to yield 0 dBm (600  $\Omega$ ) level as measured on an AC voltmeter.

#### 4-13. NOISE BLANKER ALIGNMENT

The Noise Blanker is easily aligned via the following procedures:

##### Equipment Required:

High Input Impedance VTVM  
(11 Megohms or greater)

The following parts from the  
R4245 Maintenance Kit:

- (1) 6-pin extender card
- (1) 4-pin extender card
- (2) Tuning Tools —  
Small White Hex #SK-55;  
Small White Blade #SK-462

- a) Remove the Noise Blanker.
- b) Carefully install extender cards making sure they properly match the connectors on the Noise Blanker and the pins in the R4245 card cage.
- c) Connect coax from IF Selectivity card to the coax receptacle on top of the noise blanker. NOTE — if coax will not reach, remove IF Selectivity card and cut wire tie on coax to facilitate connection of coax.
- d) Turn R4245 on and depress calibrator switch. Tune in calibrator signal, band switch in 10-15 MHz range, USB mode. Turn PBT control fully clockwise. Retune main tuning for maximum S-meter indication.
- e) Tune receiver main tuning down in frequency (high pitched audio note) until S-meter reading

drops approximately 20 dB (4 S-units) below peak calibrator reading.

- f) Peak L813 and L814 for maximum S-meter reading.
- g) Set PBT control in center. Retune receiver main tuning for maximum S-meter reading on calibrator. This will be approximately zero beat. Peak L815 for maximum S-meter reading.
- h) Refer to figure 3-20 and connect VTVM to test pad. Depress NB switch to activate Noise Blanker.
- i) Tune L810, L811 and L812 for maximum DC voltage.
- j) Remove VTVM and turn off R4245.
- k) Remove Noise Blanker and extender cards.
- l) Reinstall Noise Blanker.

#### 4-14. VRTO VCO ADJUSTMENT

This board should not normally require alignment unless the adjustment of VCO coil, T3101, has been moved.

- a) Remove the VRTO Digital board.
- b) Remove the front top circuit and shield cover.
- c) Remove the VRTO VCO board and reinstall on extender.
- d) Re-install the VRTO Digital board on extenders.
- e) Turn on unit with Band Switch to 12 MHz band. The frequency display should indicate 12250.0.
- f) Connect a high impedance VTVM to the VRTO VCO test point. If the voltage is not between 4.9 and 5.1 volts adjust T3101 for a reading of 5.0 volts.
- g) While observing the voltage reading on the VTVM tune the main tuning dial through its complete 500 kHz+ (include overtravel) range. The test point voltage should vary between 4.0 and 6.0 volts over the entire tuning range. It will not vary in a direct linear relationship versus frequency, however. If the test point voltage exceeds the 4.0 to 6.0 volt limits, a problem in the coarse tune voltage programming in the VRTO Digital board may be indicated.

#### 4-15. VRTO +N/MIX BOARD ALIGNMENT

If only a minor adjustment is required to correct a slight frequency discontinuity as the main tuning is tuned from XXXXX.9 kHz to XXXXX.0 kHz, a slight readjustment of R3006 may be all that is required.

Place the VRTO Digital board on extenders so that a short screwdriver can be used to adjust R3006 through the access hole in the front top shield cover. Disconnect the antenna from the unit.

Tune in the calibrator signal for an audio beat note of approximately 1000 Hz with the display indicating XXXX0.9 kHz. Very slowly continue tuning up in frequency until the display changes to XXXX1.0 kHz. If there is more than the normal 10 Hz frequency step or if the beat note audio frequency changes in the wrong direction slightly for one count — slightly readjust R3006 until a smooth transition is obtained. This procedure assumes that L3001 and L3002 are properly set. If there is any doubt the following procedure should be followed.

- a) Remove top front shield cover. Place VRTO +N/ Mix board on extender or it may be possible to reach test point without using the extender. The VRTO Digital board must be installed on extenders and operating.
- b) Connect the RF VTVM to the +N/Mix board test point shown in figure 3-49.
- c) Tune L3002 and L3003 for maximum RF level. Do not retouch settings of these two coils after this step.
- d) Remove RF VTVM connection and connect a frequency counter with 1 PPM accuracy and 1 megohm input impedance to the test point.
- e) Set R3006 to the center of its range.
- f) Tune main tuning up in frequency very slowly until the display just reads XXXX1.0.
- g) Then tune down in frequency extremely carefully until the display just changes to XXXX0.9.
- h) Being very careful not to bump main tuning (LOCK button may be depressed), tune L3001 for an indication of 46.5100 MHz on the frequency counter.
- i) Tune main tuning up in frequency extremely slowly until display just changes back to XXXX1.0.

- j) Adjust R3006 for a frequency of 46.5000 MHz on the counter.
- k) Repeat g through j several times until no further refinement can be obtained.
- l) Remove counter from test point. Reinstall +N/Mix board in radio if extenders were used.
- m) Turn unit on and tune receiver through calibrator signal checking for smooth 10 Hz step transition as the display changes from XXXX0.9 to XXXX1.0. If there is noticeable discontinuity, slightly readjust R3006 as described at the beginning of this section.

#### 4-16. VRTO DIGITAL BOARD AND OPTICAL SWITCH ALIGNMENT

There are only three electrical adjustments on this board. Potentiometers R32015 and R32013 set the bias for the shaft encoder optical switches. If a new VRTO Digital board is being installed in the radio or if one or both optical switches have been replaced, these bias adjustments will most likely need to be reset. The following procedure should be followed.

- a) Turn on unit. Display should come up at the usual preset frequency in the center of the 500 kHz tuning range.
- b) Depress LOCK pushbutton.
- c) Connect VTVM to test point — TP1 — see figure 3-52. Rotate main tuning dial continuously and adjust R32015 for an average DC reading of 5.0 volts on the VTVM.
- d) Connect VTVM to test point — TP2. Rotate main tuning dial continuously and adjust R32013 for an average DC reading of 5.0 volts on VTVM.

#### NOTE

The VTVM used in steps c and d above must be an analog type. A digital meter cannot display the average value required for this adjustment. Alternatively, an oscilloscope can be used. Adjust the potentiometer for a sine wave symmetrical around the 5.0 volt DC level while tuning the main tuning dial.

#### NOTE

If either R32015 or R32013 reaches the end of its adjustment before 5.0 volts is obtained, R32016 or R32014 fixed resistors may be changed in the appropriate direction to allow adjustment to 5.0 volts average. Normally R32016 or R32014 should not exceed 22 K  $\Omega$  or be less than 1 K  $\Omega$ .

- e) Connect the VTVM to test point 3. (COUNT UP/COUNT DOWN test point). The LOCK pushbutton should be depressed. While tuning the main tuning dial clockwise, in a continuous, smooth rotation, test point 3 should measure a steady 10 volts with no flicker at any part of dial rotation. While tuning the dial counterclockwise, test point 3 should measure a steady 0 volts with no upward flicker during any part of the dial's counterclockwise rotation. If this test checks OK, proceed to step g. If a slight flicker is noted during either direction rotation of the tuning dial a very slight adjustment of either R32015 or R32013 may correct the situation. If R32015 or R32013 must be changed more than .5 volt from 5.0 volts, as per steps c and d, and a steady reading still cannot be obtained at the count up/count down test point, improper mechanical alignment of the optical switch assembly is indicated. See step f below.
- f) Optical Switch Assembly Mechanical Adjustment. This assembly is preset on a test fixture at the factory and should not require adjustment unless it has been bent or has come loose. To set the optical switch phasing, with the assembly in the radio, proceed as follows:
- 1) Repeat steps a through d in this section.
  - 2) Depress the LOCK pushbutton. Connect the VTVM to test point 3.
  - 3) Loosen the two screws holding the sliding optical switch. Do not loosen the screws too loosely, just enough to slide the assembly slightly. By making very small adjustments in the spacing between the two optical switches, adjust the spacing until the condition described in e above is obtained. That is for clockwise rotation of the dial, a 10 V output at TP3 and for counterclockwise rotation a 0 V output at TP3. When this is

obtained tighten the two adjustment plate retaining screws snugly and recheck. Some trial and error may be required to obtain the correct setting by this method.

- g) Variable Rate Tuning Threshold Adjustment. Be sure the LOCK pushbutton is not depressed for this adjustment. Potentiometer R32067 determines the tuning speed threshold which activates the tuning rate speed-up circuitry. The voltage on test point 4 (TP4), when the main tuning dial is stationary, gives a rough indication of the threshold setting.

When R32067 is at its counterclockwise extreme, voltage at TP4 will be very low and no increase in tuning rate will result regardless of the speed at which the main tuning is rotated. This condition would result in a 2 kHz per revolution tuning rate at all times.

To set R32067 to the recommended setting, preset R32067 to a voltage reading of 4.0 volts on TP4 while the main tuning is stationary. Turning the main tuning dial slowly should still result in a 2 kHz per revolution tuning rate. As the main tuning is tuned faster a higher tuning rate should occur. Usually a 15 kHz per revolution tuning rate is most desirable when the main tuning is rotated one revolution very quickly. This normally occurs near the 4.0 volt resting voltage setting at TP4. R32067 should be adjusted slightly from the 4.0 volt setting to obtain the desired high speed tuning rate. The exact setting may be one of operator preference.

A setting of R32067 which is too far clockwise results in a very fast tuning rate which may make fine tuning difficult and should be avoided. If R32067 is advanced to its extreme, the tuning will start to increment even when the main tuning dial is not being turned.

An alternate method of setting R32067 is to note the amount of time required to tune over a 500 kHz range while tuning at a fast tuning speed. Start with R32067 at the 4.0 V point on TP4. Slightly alter R32067 until the time required to tune over a 500 kHz range is approximately 10 to 15 seconds. A slower tuning rate may be chosen if desired.