



# WESTERN RADIO SERVICES LTD.

VANCOUVER, CANADA

## WR-494 TRANSMITTER MODULE

9T90A-0

### Specifications:

Power requirements transmit	13.6 VDC at 3 A. typ.
Power requirements std. by	13.6 VDC at 50 mA. typ.
Frequency	406 to 512 MHz.
R.F. power output	12 watts
Output impedance	50 ohms
Frequency stability	$\pm 0.0005\%$ , -30 to +60 °C
Spurious, harmonic emission	70 dB below carrier
Modulation	16F3, $\pm 5$ KHz. 100% at 1000 Hz.
Audio response	+1, -3 dB from 6 dB/octave pre-emphasis 300 to 3000 Hz.
Audio distortion	less than 5% at 1000 Hz. for 3 KHz. deviation
Hum and noise	-50 dB from 3 KHz. deviation at 1000 Hz.
Physical size	260 mm x 60 mm x 108 mm

### Description:

The WR-494 transmitter is contained in a plug-in module. It utilizes phase-modulation and has a crystal frequency multiplication of 9 times. Power, control and audio connections are made through a rear-mounted 15-pin connector. A front-panel, 14-pin metering receptacle is provided for test and alignment using a model M90 Test Set. The R.F. output is fed through a coaxial connector on the rear-panel.

### Functional Connections (by pin number):

1	+13.6V	+13.6 volt supply input.
2	+13.6V	+13.6 volt supply input.
3	SW TX +9.5V	TX +9.5V switched by the Line-Local channel selector switch, this output is used to enable line channel selection.

Functional Connections (by pin number) (cont.):

7	PTT	Application of ground to PTT will key the transmitter on.
8	TX +9.5V	During the transmit state this pin will be at +9.5 volts.
9	TONE MOD	Tone modulation input. The tone interface network components depend on the tone frequency band. See WR-494 Transmitter Module Schematic Diagram.
11	VOICE MOD	Voice modulation input.
12	OSC 1	Channel 1 oscillator control.
13	OSC 2	Channel 2 oscillator control.
14	GND	Common ground.
15	GND	Common ground.

Circuit Description:

1. Audio Circuit

Audio Amplifier-1, consisting of Q11 and Q12, amplifies the microphone audio to a level sufficient for the instantaneous deviation control (IDC) CR8,9. The circuit also provides pre-emphasis with R48 and C68. External voice-frequency signals are applied to the second stage, Q11, with R60 as an attenuator. This is a flat input and signals such as voice must be externally pre-emphasized. The DEVIATION ADJ control, R41, sets the peak deviation. Tone modulation is connected to the input of Audio Amplifier-2 through an interface network consisting of R61-63 and C106-107. The voice signals from R41 are also applied to the input of Audio Amplifier-2 consisting of Q9 and Q10. The output of this stage is sufficient to apply to the modulator through the low-pass filter C56-58, L17-18.

2. Oscillator-Modulator

Q1 and Q8 are the channel-1 and channel-2 oscillators, respectively. The crystals are third-overtone and their frequency is one ninth of the channel frequency. RT1 and RT2 are for low temperature compensation. For two-channel operation, switch S1 is used to select the channel locally or allow remote selection in the center position by applying TX +9.5V to pin 3 of P1. This voltage is used to enable

## Circuit Description (cont.):

remote channel selection. CR2 and CR7 are switching diodes that isolate the unused oscillator from L2. CR5 and CR6 make up the modulator.

### 3. Exciter

Q3 through Q7 supply amplification and frequency multiplication up to the carrier frequency. The output of Q7 is fed through a band-pass filter to the pre-driver Q13. This filter reduces the level of unwanted frequency components in the exciter output.

### 4. Power Stages

Q13, Q14 and Q15 are the pre-driver, driver and power-amplifier stages respectively. The power-amplifier output passes through a harmonic filter L29 to L31 before leaving the module at J1.

### 5. Power Supply

Regulator U2 provides an adjustable supply to Q13 and Q14 so that the drive to the power-amplifier can be set to the value required for rated output. This voltage is adjusted using the front-panel control labeled AVR, R64. Regulator U1 provides a fixed supply voltage of +9.5 volts.

Q16 is the PTT switch. This transistor generates TX +9.5V which keys the transmitter oscillator. CR1 is a front-panel LED indicator labeled TRANSMIT that lights when the module is in the transmit state by utilizing the base current of Q16. The TX +9.5V signal is available at pin 8 of P1 for external applications such as activating an antenna switch in simplex stations.

## Adjustments:

### 1. Equipment

The following test equipment and tools are recommended for performing the various adjustments.

-terminating RF wattmeter	50 ohms 25 watts F.S.
-AF signal generator	
-FM communications monitor	
-power supply	11 to 16 VDC over 4 amps.
-test microphone	
-test set	WR M90 Test Set
-tuning tools	insulated
-screw drivers	slot and phillips head

## Adjustments (cont.):

### 2. Alignment

Set the power supply voltage to 13.6 volts. Connect the power supply and the terminating wattmeter to P1 and J1 on the WR-494 transmitter module rear-panel. Connect the test microphone and the M90 Test Set to J3 and J2 on the front-panel. The PTT button on the microphone or the one on the Test Set may be used to place the transmitter in the transmit mode. The keying time should be less than one minute until the transmitter is fully aligned. Table 1 :- Transmitter Alignment, gives the tuning instructions. The typical values shown for the Test Set readings are given as a guide only. Optimum performance may still be achieved with readings different from these.

Table 1 :- Transmitter Alignment

Test Point	Test Set Range uA	Typical Reading uA	Align	Set to
1	100	52	L2	Note 1
2	50	41	L3	max.
3	50	29	L4,5,6	max.
4	50	14	L7,8	max.
5	50	35	L9,10,C44	max.
6	50	29	C48,72,74,77,79	max.
7	50	46	C84	max.
8	50	40	C90	max.
wattmeter	25W	15W	C97	max.
wattmeter	25W	12W	AVR	12W

Note 1. Tune to a peak then decrease to 80% of the peak by increasing the inductance of L2. The final reading of the test point should be about 52 uA.

If the indicated Test Set range is not used, the given typical values will not apply. Some of the test points are voltage sources. The first position of the Test Set (13.6V) measures the input supply. The scale is 15 volts full-scale, nominal reading 45.3 uA.

## Adjustments (cont.):

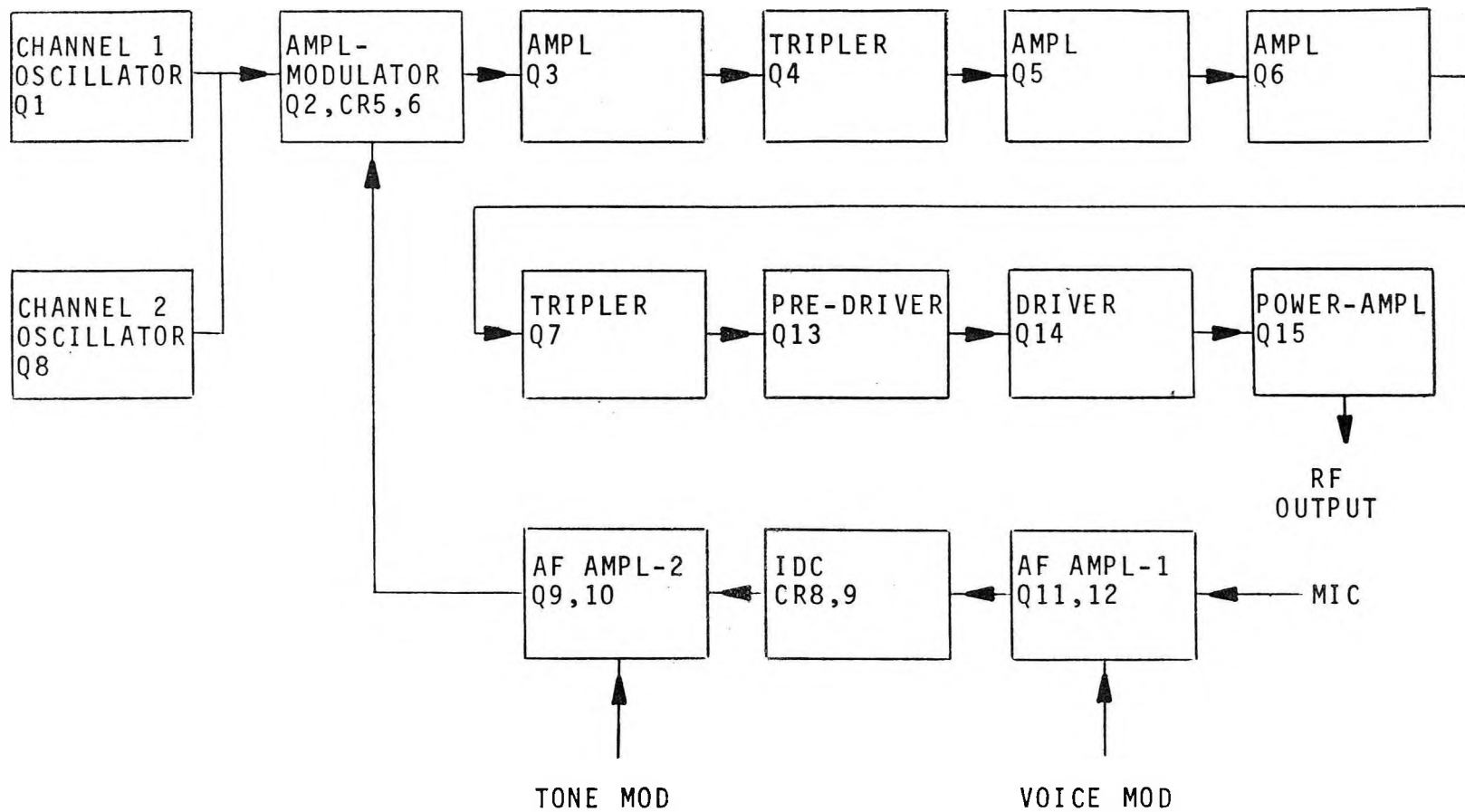
### 3. Crystal Frequency

Select the correct channel. Observe the carrier frequency on the FM communications monitor. Adjust capacitor C5 (C54) to mid range. Set carrier frequency with coarse control L1 (L16) and fine control C5 (C54). The components in brackets refer to channel 2. Note that later adjustment of L2 will affect the crystal frequency slightly.

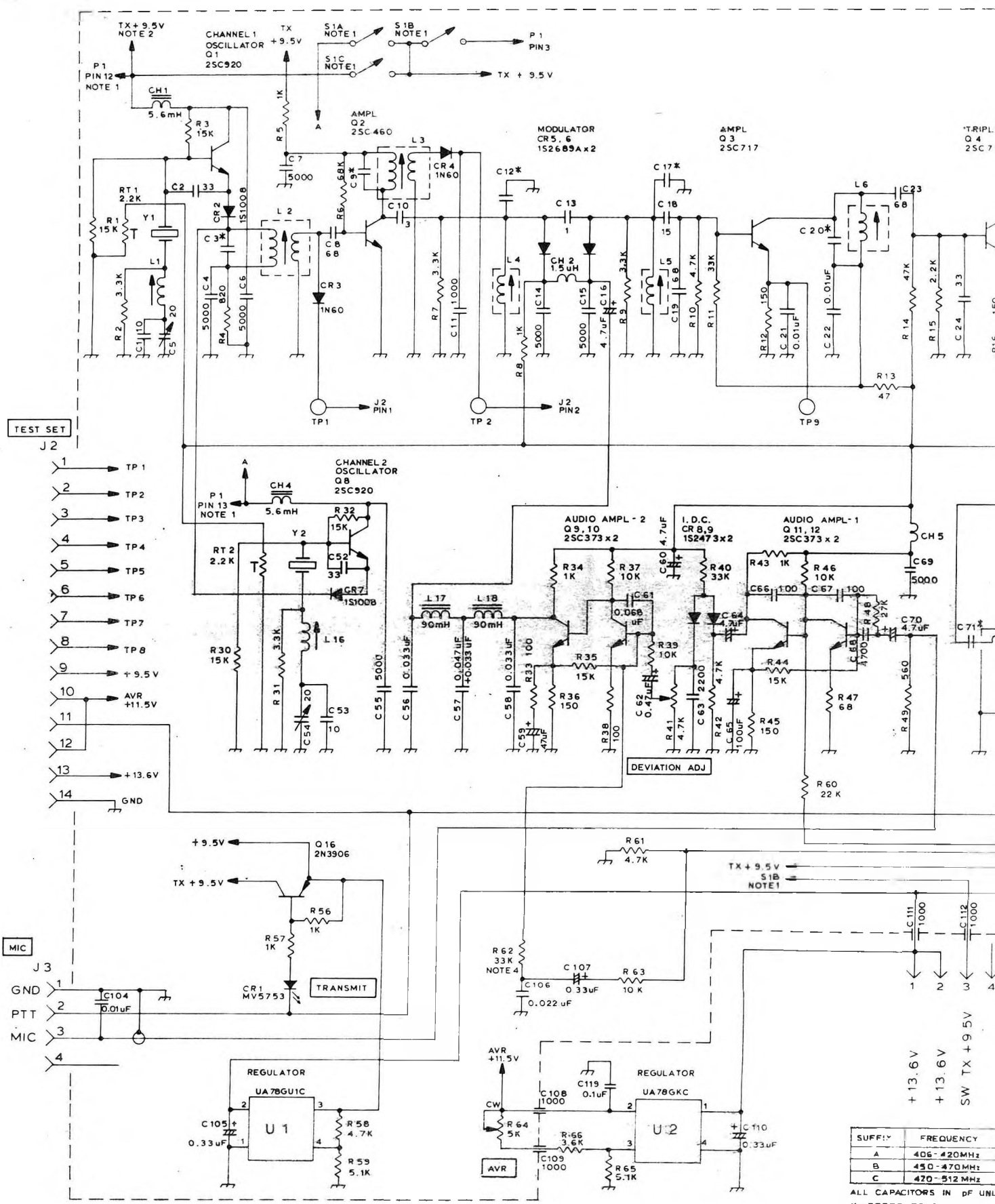
### 4. Deviation

The DEVIATION ADJ control, R41, is located on the transmitter exciter circuit board. Monitor the transmitter modulation on the FM communications monitor. If the test microphone is used for this adjustment, the DEVIATION ADJ control should be set so that loud speech into the microphone produces a peak deviation no greater than 5 KHz. If an AF signal generator is used, set the DEVIATION ADJ control to maximum and apply a 1000 Hz. tone to pin 3 of J3, the microphone connector. Set the generator level for 3 KHz. deviation. Increase the output by 26 dB and reduce the DEVIATION ADJ control for 5 KHz. peak deviation.

Repeater and Remote Base applications normally require that the test microphone not be left connected unless the microphone element is switched.

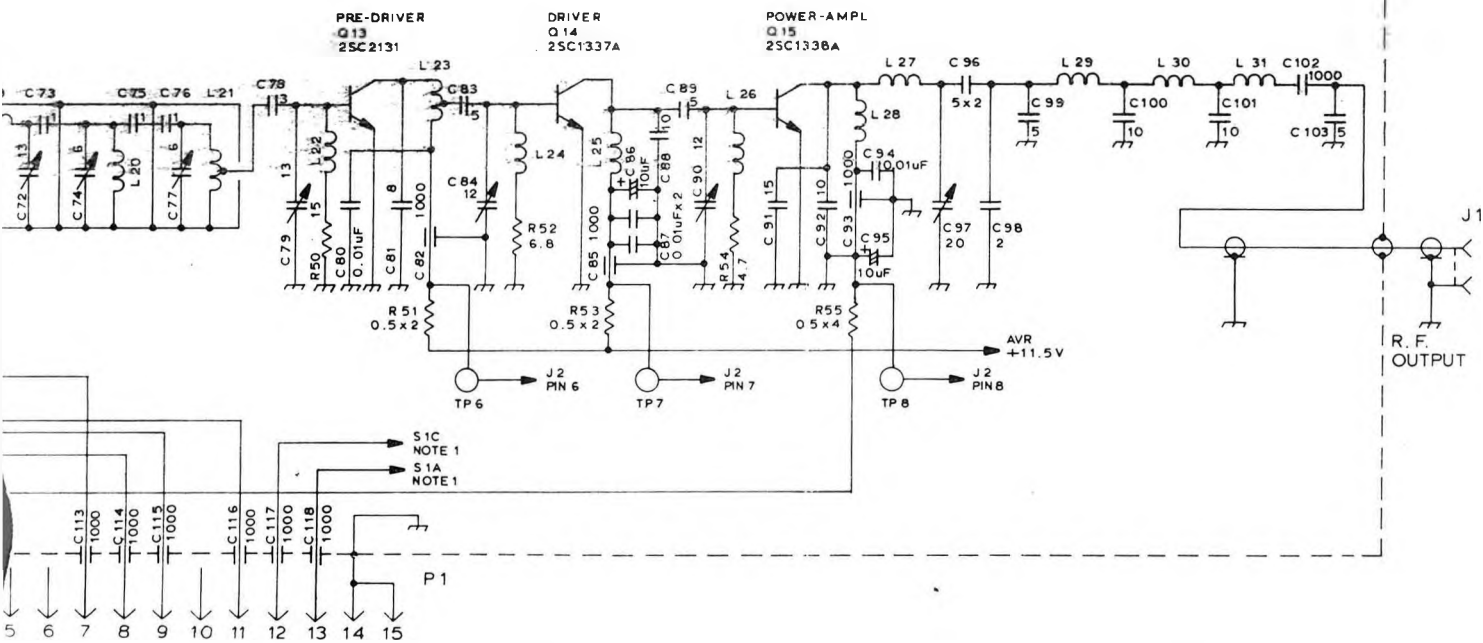
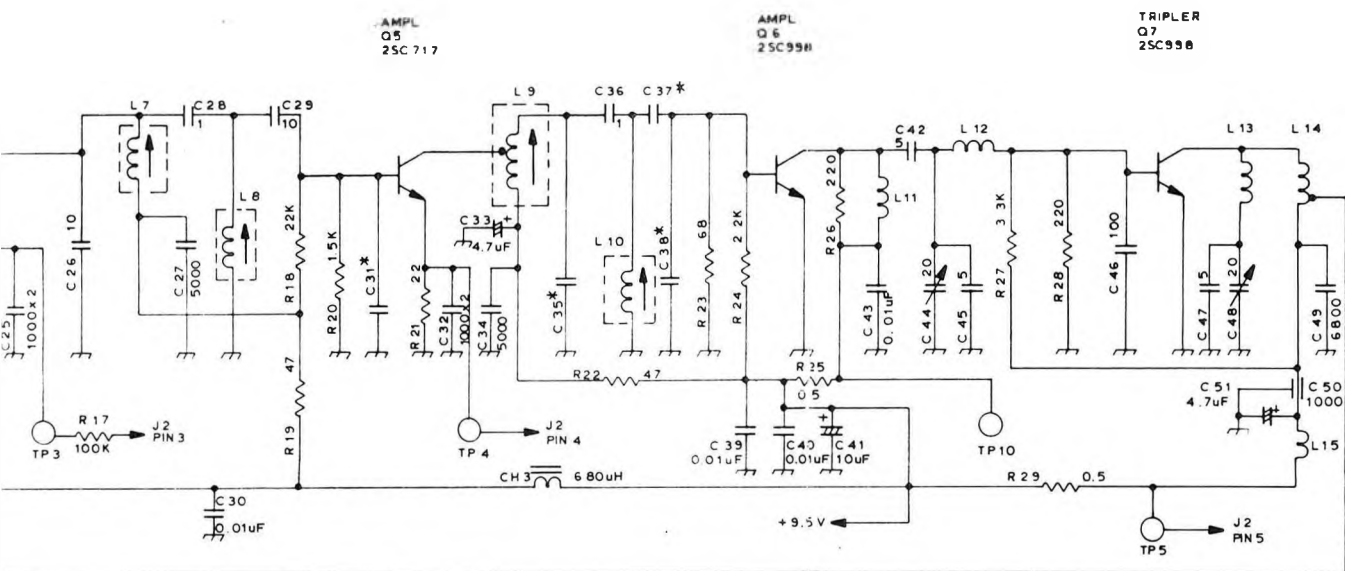


WR-494 Transmitter Module Block Diagram



SUFFIX	FREQUENCY
A	405 - 420MHz
B	450 - 470MHz
C	470 - 512MHz

ALL CAPACITORS IN pF UNL  
 \*. REFER TO PARTS LIST



PTT TX + 9.5V NOTE 3  
TONE MOD  
VOICE MOD  
OSC 1 NOTE 1  
OSC 2 NOTE 1  
GND  
GND

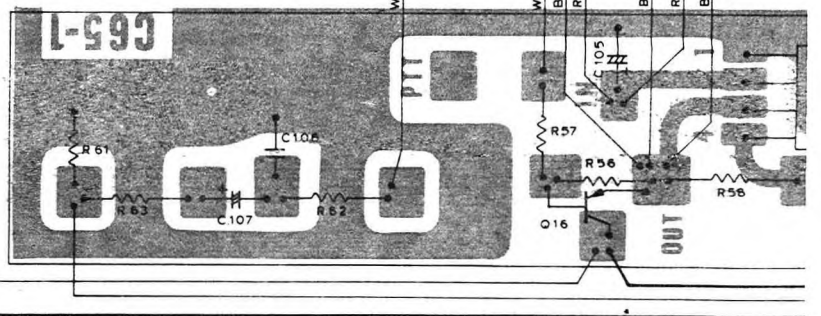
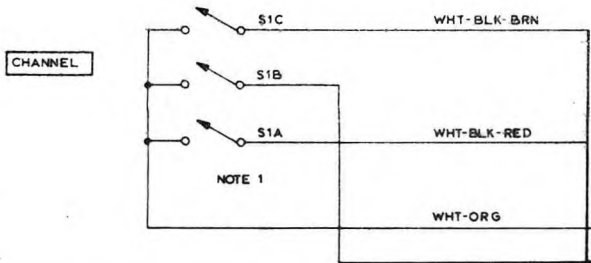
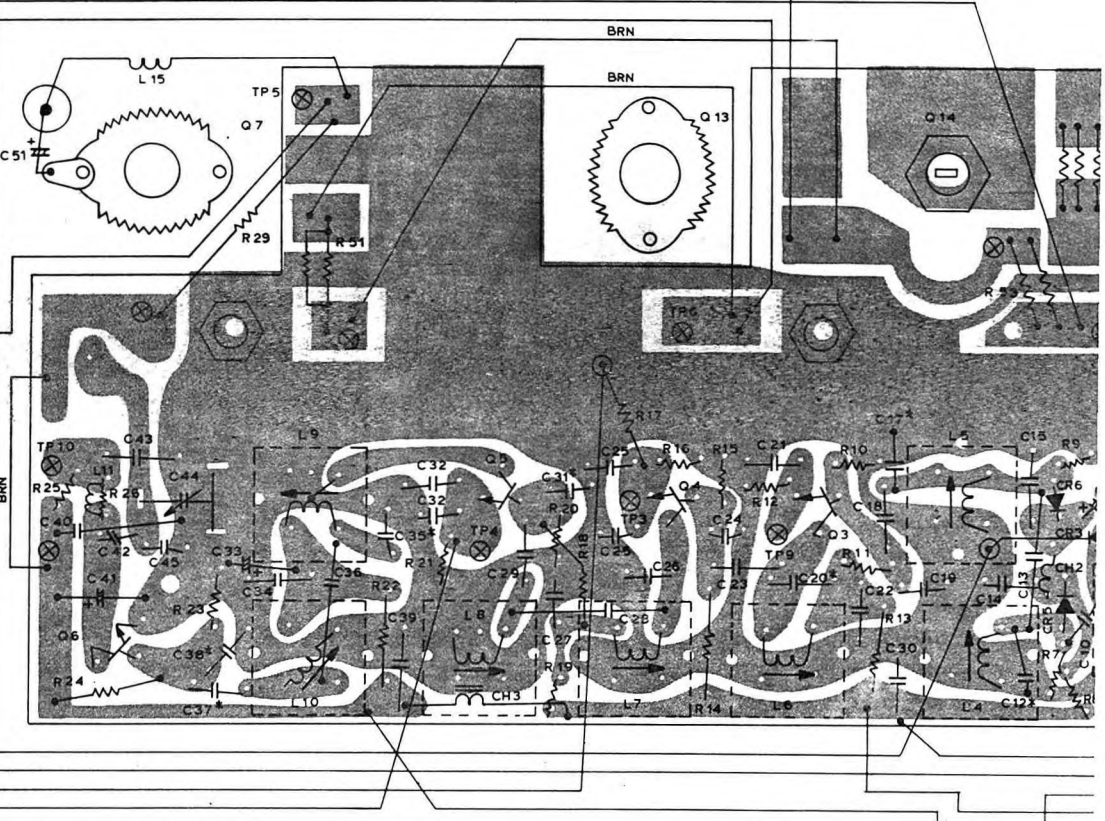
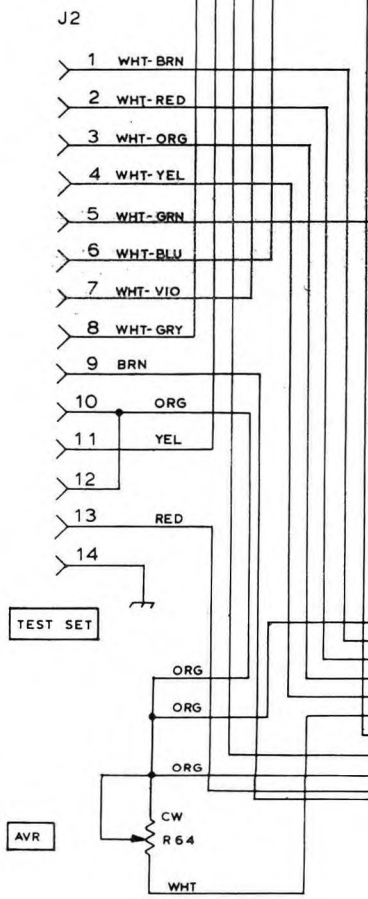
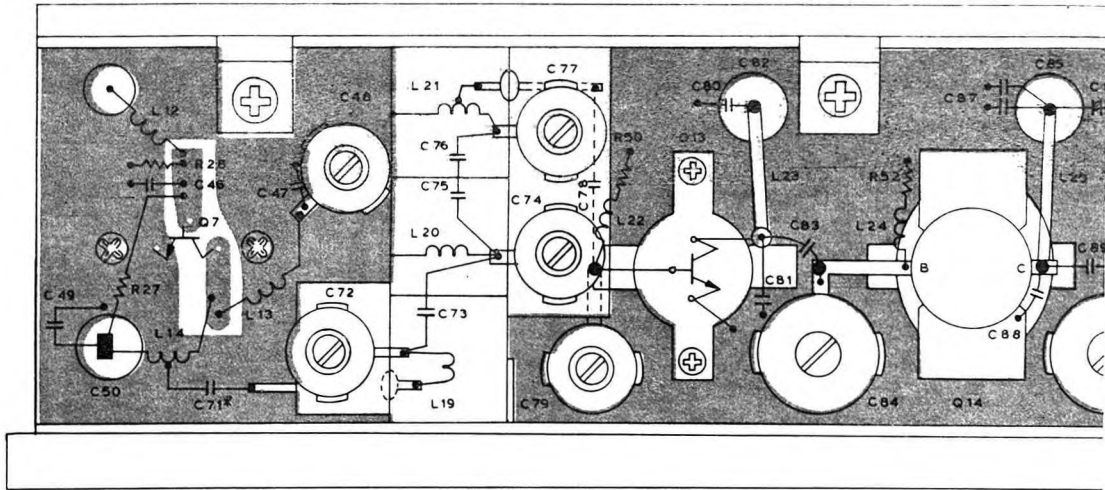
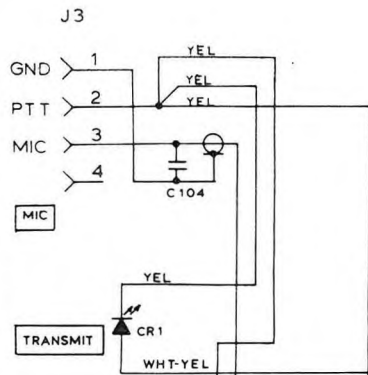
NOTE 1 CONNECTION FOR TWO-CHANNEL TRANSMITTER  
NOTE 2 CONNECTION FOR SINGLE-CHANNEL TRANSMITTER  
NOTE 3 USED FOR SIMPLEX STATION AND LINE OPERATED TWO-CHANNEL TRANSMITTER  
NOTE 4 R52 IS 10K OHMS FOR TONE FREQ ABOVE 250 Hz

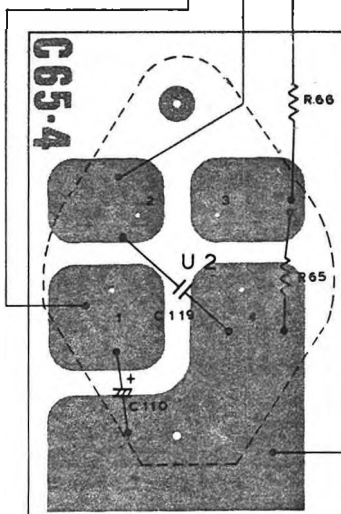
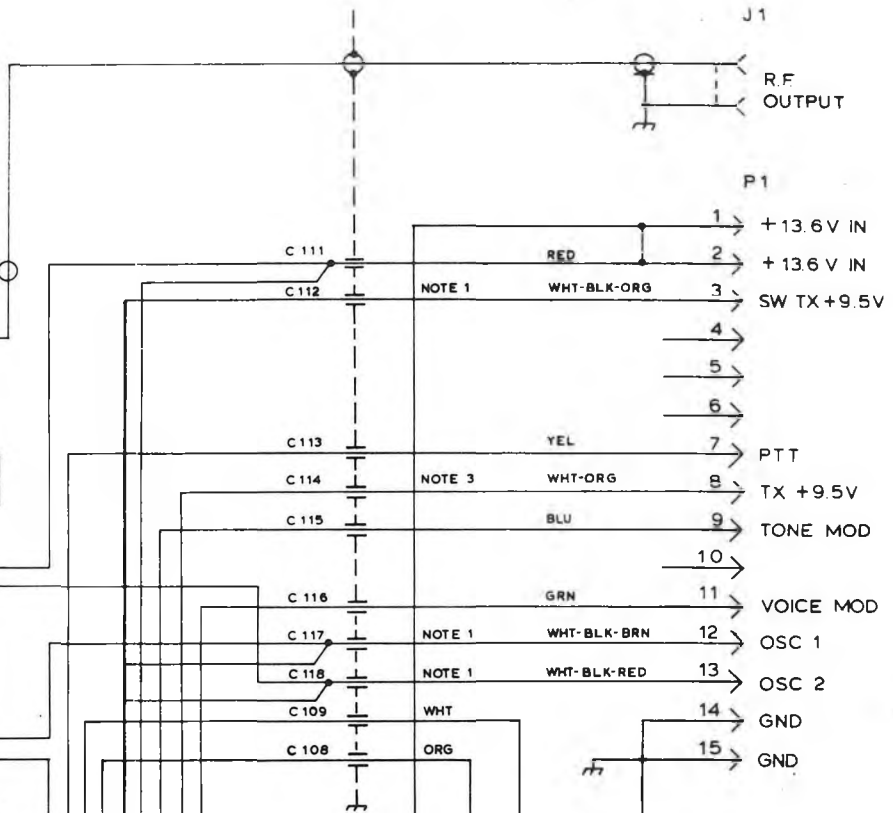
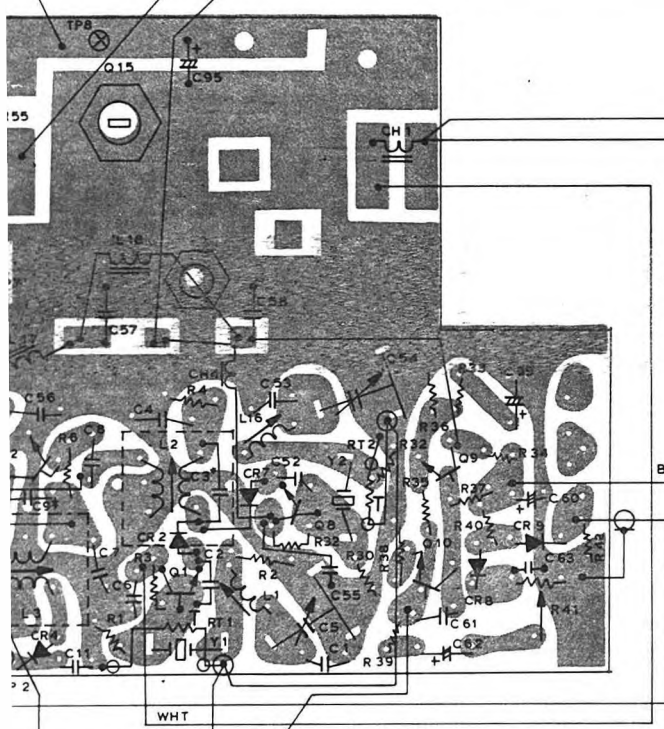
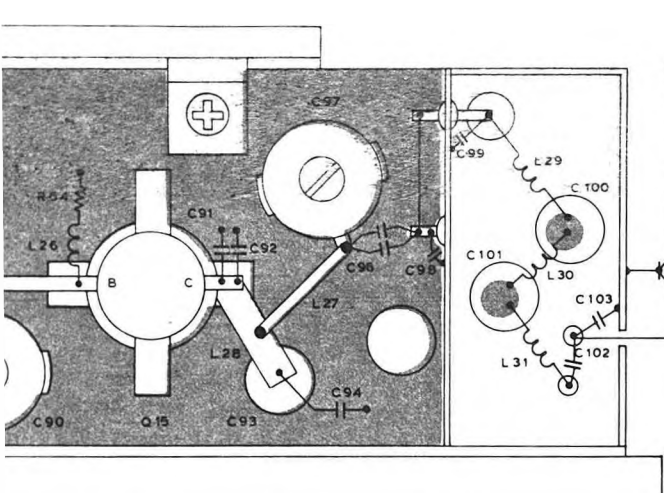
C 3	C 9	C 12	C 17	C 20	C 31	C 35	C 37	C 38	C 71
33 p	27 p	10 p	10 p	15 p	22 p	15 p	15 p	15 p	10 p
33 p	27 p			15 p	22 p	15 p	10 p	10 p	5 p
27 p	18 p			10 p	12 p	8 p	8 p	8 p	5 p

5 OTHERWISE INDICATED

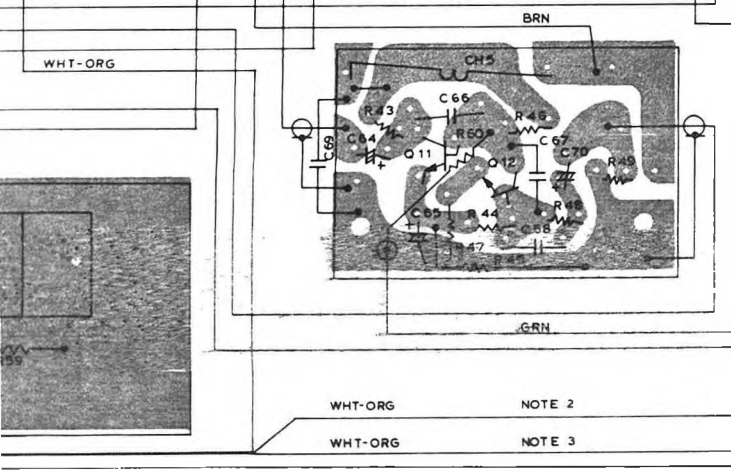
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<b>WESTERN RADIO SERVICES LTD.</b> VANCOUVER B.C., CANADA					
TITLE: WR-494 TRANSMITTER MODULE SCHEMATIC DIAGRAM					
DRAWN		DATE FEB 28, 1978		DRAWING NUMBER	
CHECKED		SCALE		65-32	
APPROVED					







NOTE 1: CONNECTION FOR TWO-CHANNEL TRANSMITTER  
 NOTE 2: CONNECTION FOR SINGLE-CHANNEL TRANSMITTER  
 NOTE 3: USED FOR SIMPLEX STATION AND LINE OPERATED TWO-CHANNEL TRANSMITTER



REV	DATE	DESCRIPTION	DRN	CHKD	APPVD
<b>WESTERN RADIO SERVICES LTD.</b> VANCOUVER B.C., CANADA					
TITLE: WR-494 TRANSMITTER MODULE WIRING AND ASSEMBLY DIAGRAM					
DRAWN	T	DATE	JAN. 9, 1978	DRAWING NUMBER	
CHECKED	K	SCALE		65-59	
APPROVED					