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Service Manual

21-1562

21.9449

TRC-449

CB TRANSCEIVER

Catalog Number: 21-1562



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1. SPECIFICATIONS

GENERAL:

Channels	: 40 Channels for AM, Upper Side Band and Lower Side Band, utilizing Digital Circuitry
Frequency Range	: 26.965 MHz to 27.405 MHz
Frequency Control	: Digital (Phase Lock Loop) Synthesizer
Frequency Accuracy	: ±100 Hz
Operating Temperature Range	: -20°C to +50°C
Power Requirements	: 13.8V DC (12-16 volts DC, negative or positive ground)
Antenna	: 52 ohm (Coaxial connector)
Microphone	: 600 ohm Dynamic Type
Speaker	: 8 ohm, 3 Watt
Size	: 2-3/8" x 7-7/8" x 10-1/2" (HWD) (6 x 20 x 26.6 cm [HWD])
Weight	: 6 lbs. (approx.) (2.65 kg)
Accessories	: DC Cord with in-line Fuse, Microphone and Microphone Hanger and Mounting Brackets

MEASUREMENT CONDITION:

Power Source	: 13.8V DC
Antenna Impedance	: 50 ohm
Test Temperature	: 25°C
AM Modulation Frequency	: 1 kHz
SSB Modulation Frequency, Transmit	: Two tone: 500 Hz and 2400 Hz Single tone: 1 kHz
Mean Signal Input Level	: 1000 μV
Reference Audio Output Power	: 0.5 W
Reference AM Modulation Percentage	: 1 kHz 30%
Audio Frequency, SSB Receive	: 1 kHz
Audio Output Load	: 8 ohms resistive
Measuring Channel	: 19

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RECEIVER : (ANL & Noise Blanker Switch OFF)		UNIT	NOMINAL	LIMIT
Max. Sensitivity	: AM	μV	0.5	1
	SSB	μV	0.25	0.5
Sensitivity for 10 dB S/N	: AM	μV	0.5	1
	SSB	μV	0.25	0.5
AGC Figure of Merit 50 mV for 10 dB Change in Audio Output	: AM	dB	90	80
	SSB	dB	90	80
Overload AGC Characteristics from 10 mV to 100 mV	: AM	dB	±3	±5
	SSB	dB	±3	±5
Overall Audio Fidelity at 6 dB Down				
Upper Frequency	: AM	Hz	2100	1750 ~ 2500
	SSB	Hz	3500	2500 ~ 5000
Lower Frequency	: AM	Hz	450	300 ~ 650
	SSB	Hz	450	300 ~ 650
Cross Modulation, RS Standard	: AM	dB	60	50
Adjacent Channel Selectivity (10 kHz)	: AM	dB	65	54
	SSB	dB	65	54
Maximum Audio Output Power	: AM	W	4	3
	SSB	W	4	3
Audio Output Power at 10% THD	: AM	W	3	2.5
	SSB	W	3	2.5
THD at 500 mW Audio Output				
AM: 1 mV Input, 30% modulation	: AM	%	3	6
80% modulation	: AM	%	5	12
SSB: 1 mV Input 1 kHz Single tone	: SSB	%	3	6
RF Gain Control Range at Max. Sensitivity Level	: AM	dB	40	30 ~ 50
	SSB	dB	40	30 ~ 50
S/N Ratio at Input 1 mV	: AM	dB	50	40
	SSB	dB	50	40
Squelch Sensitivity at Threshold	: AM	μV	0.5	1
	SSB	μV	0.25	0.5
S Meter Sensitivity at "S-9" (No Modulation AM)	: AM	μV	100	25 ~ 400
	SSB	μV	100	25 ~ 400
Image Rejection Ratio. fo+(2x7.8 MHz)	: AM	dB	80	70
	SSB	dB	80	70
1/2 IF Rejection Ratio. fo+7.8 MHz/2	: AM	dB	90	80
	SSB	dB	90	80
IF Rejection Ratio. 7.8 MHz	: AM	dB	85	75
	SSB	dB	85	75
Oscillator Dropout Voltage	: AM	V	9	11
	SSB	V	9	11
Clarifier Range	: AM	kHz	±1.25	±0.6 ~ ±2.5
	SSB	kHz	±1.25	±0.6 ~ ±2.5
Spurious Rejection Ratio In band	: AM	dB	65	56
	SSB	dB	65	56
Out of Band	: AM	dB	60	50
	SSB	dB	60	50

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		UNITS	NOMINAL	LIMIT
Battery Drain at No Signal	: AM	mA	550	1000
	SSB	mA	550	1000
Battery Drain at Maximum Output Power	: AM	mA	1500	2000
	SSB	mA	1500	2000

PUBLIC ADDRESS:

Microphone Sensitivity for 3W Output Power at 1 kHz		mV	1	3
Maximum Output Power		W	4	3

TRANSMITTER:

Frequency Tolerance at 25°C (5 Minutes after switch on)	: AM	%	±0.0005	±0.003
	SSB	%	±0.0005	±0.003
Carrier Power at No Modulation	: AM	W	3.8	4.0
PEP Power, Two Tone	: SSB	W PEP	12	12.0
Modulation Distortion at 1 kHz, 80% Modulation	: AM	%	3	10
Spurious Harmonic Emission	: AM	dB	-65	-60
	SSB	dB	-65	-60
Carrier Suppression	: SSB	dB	-55	-40
Unwanted Sideband Suppression at 25 kHz	: SSB	dB	-55	-40
Modulation Frequency Response (1 kHz, 0 dB reference)				
Lower at 450 Hz, EIA	: AM	dB	-6	-10
	SSB	dB	-6	-14
Upper at 2.5 kHz, EIA	: AM	dB	-6	-10
	SSB	dB	-6	-10
Carrier Power Uniformity, Ch to Ch at No Modulation	: AM	W	0.3	0.4
Mic Input Level Uniformity, Ch to Ch for 4 watts Output .25 kHz Single tone - SSB		dB	2	3
Mic Input Level Uniformity, LSB to USB for 4 watts Output, 1.5 kHz Single Tone		dB	1	3
Microphone Sensitivity				
AM: For 50% Modulation	: AM	mV	1.0	2.0
SSB: For 4 watts PEP	: SSB	mV	1.0	2.0
AMC Range				
AM: 50 ~ 100% Modulation	: AM	dB	46	40
SSB: 10 ~ 13.2 watts PEP	SSB	dB	46	40
Battery Drain at No Modulation	: AM	mA	2200	2600
	SSB	mA	1000	1500
Battery Drain				
AM: 80% Modulation	: AM	mA	2600	3000
SSB: 10 watts PEP, Two tone	SSB	mA	2000	2700

Note;

Nominal Specs represent the design specs; all units should be able to approximate these, some will exceed and some may drop slightly below these specs.

Limit Specs represent the absolute worst condition which still might be considered acceptable, in no case should a unit perform to less than within any Limit Spec.

2. DISASSEMBLY INSTRUCTIONS

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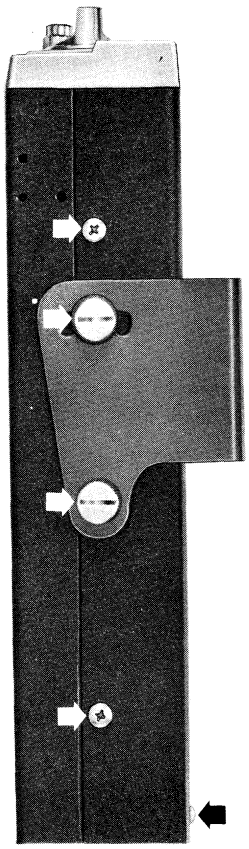


Figure 1

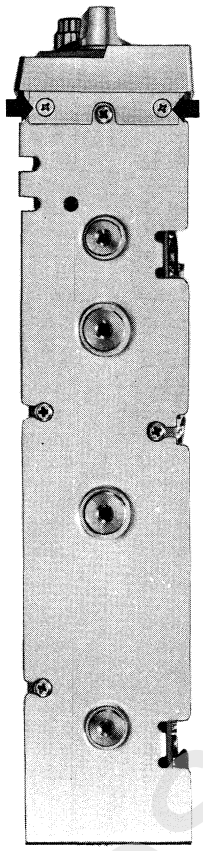


Figure 2

1. **To remove Top & Bottom Cover: (Figure 1)**
   Remove 4 screws from each side and a screw from top. Slide the top toward the rear of the chassis and remove.

2. **To remove Front Panel: (Figure 2)**
   Remove 2 screws from each side.

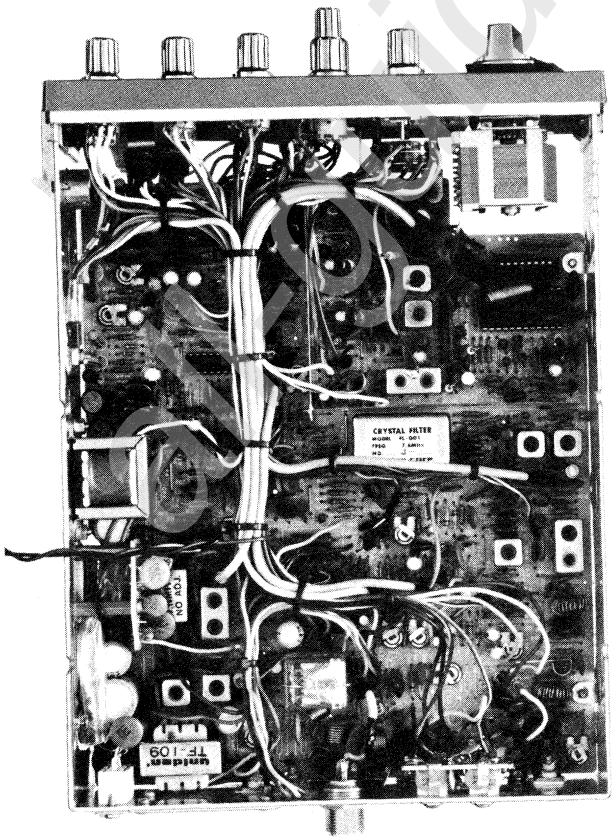


Figure 3

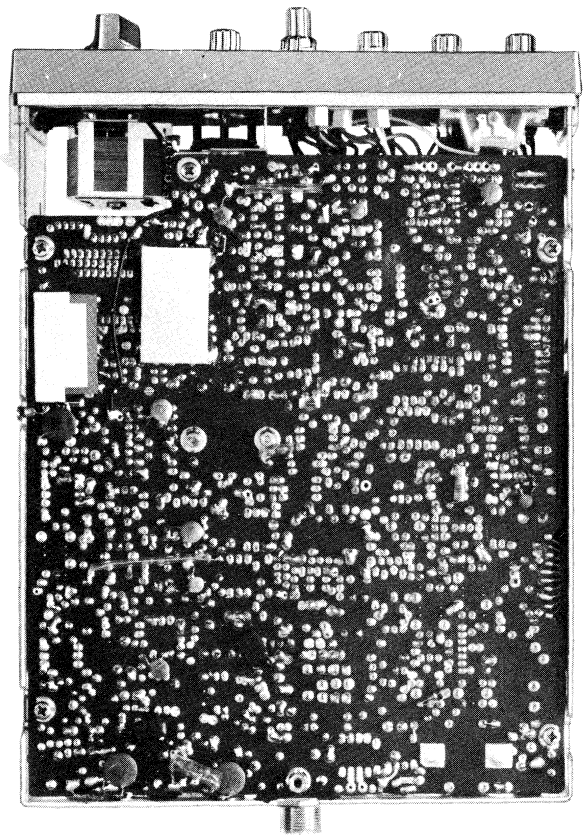
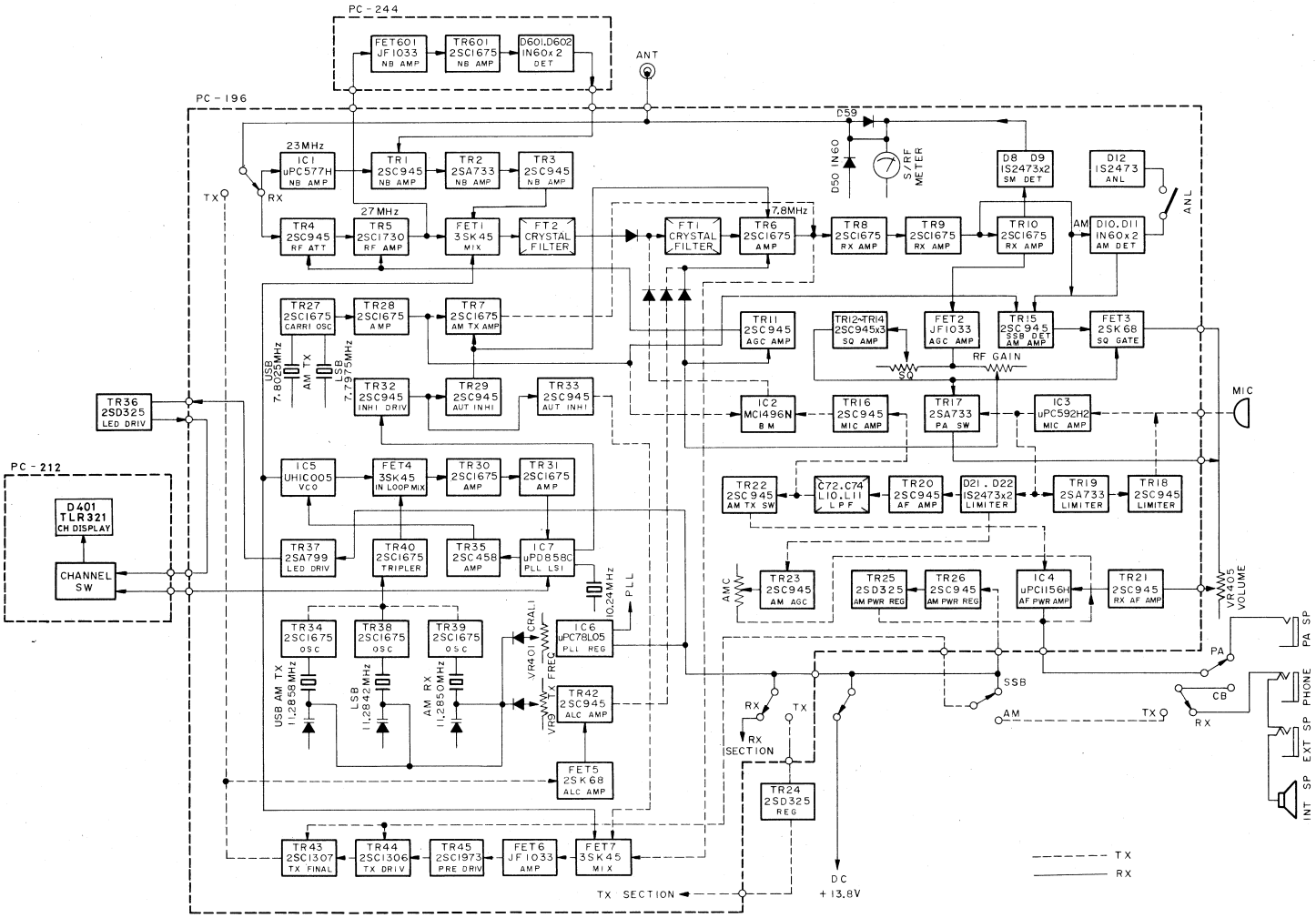


Figure 4

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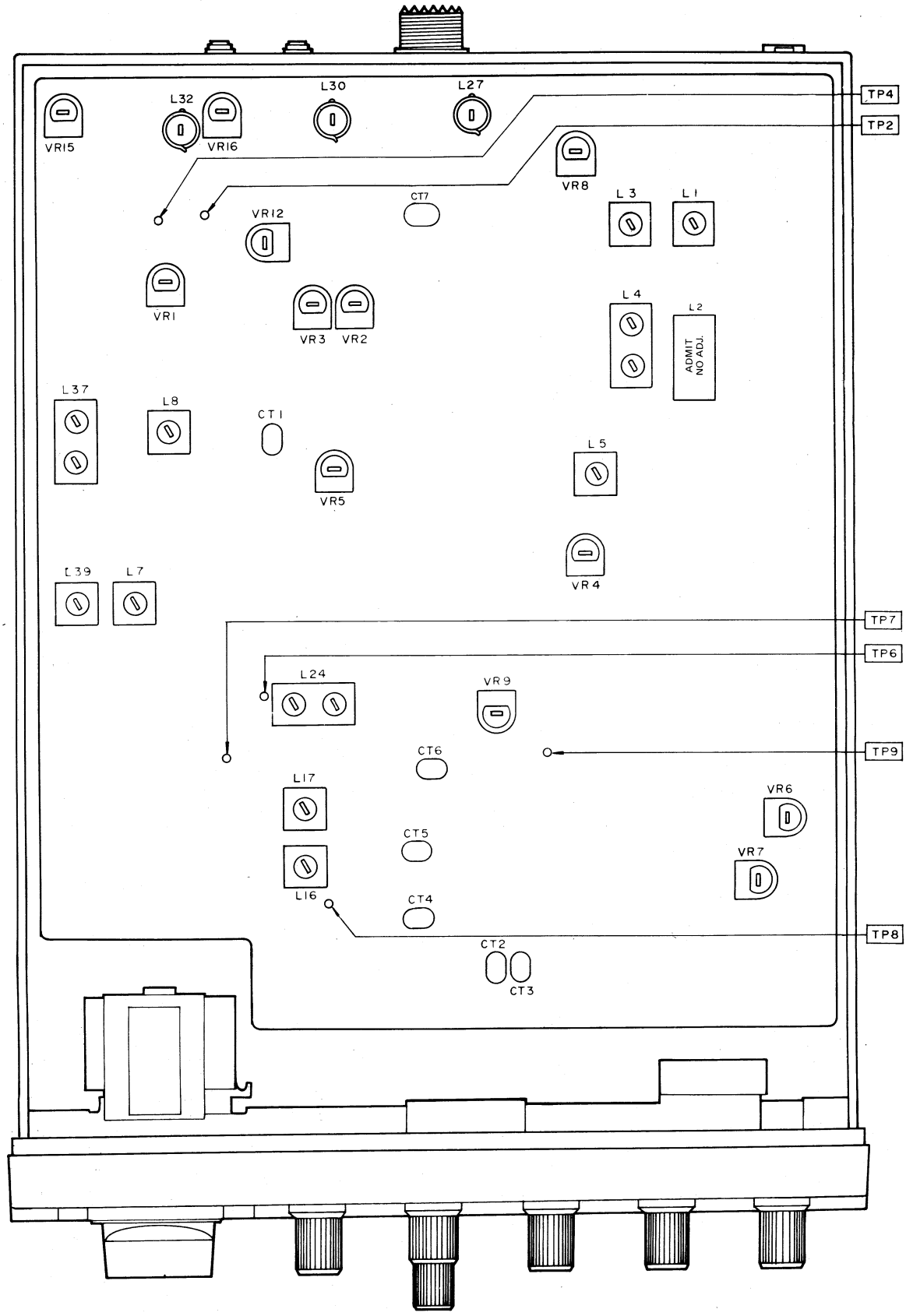
3. BLOCK DIAGRAM



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4. ALIGNMENT INSTRUCTIONS

CHASSIS LAYOUT-ALIGNMENT POINTS



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ALIGNMENT OF PLL AND CARRIER OSCILLATOR

1. Test equipment required:

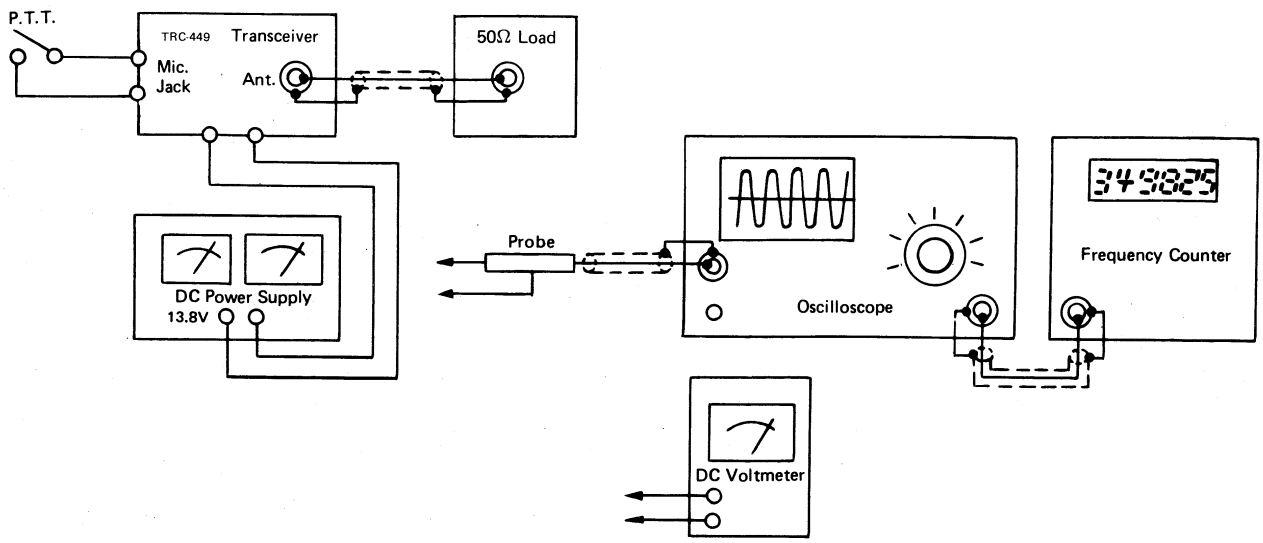
a. Oscilloscope (DC – 50 MHz)
b. Frequency counter (0 – 30 MHz)
c. DC Power Supply (13.8V 100 mA)
d. DC Voltmeter (10V Maximum 100Kohm/V)
e. 50 ohm Load

2. Alignment procedure: (See page 8)

Connect Test Equipment as shown below.

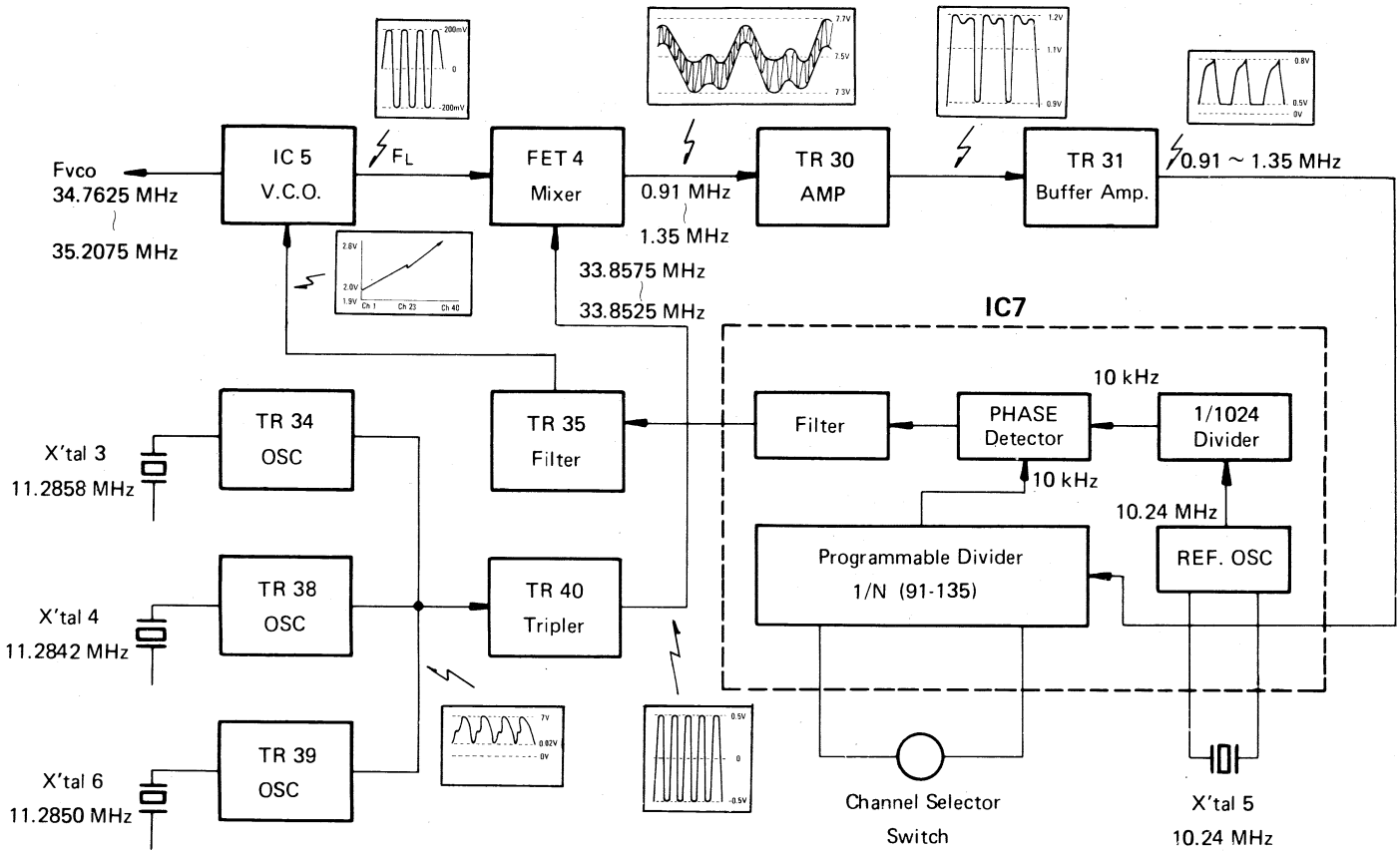
STEP	PRESET TO	CONNECTIONS	ADJUSTMENT	REMARKS
1	RX, AM, CH19 Clarifier: in center position	TP6	L24	Adjust for max. output.
2	RX, AM, CH 1 Clarifier: in center position	TP7	L17	Adjust for 2 V reading on Voltmeter.
3	Same as Step 1	TP8	L16	Adjust for max. output.
4	Same as Step 1	TP8	CT6	Adjust to obtain 34.985 MHz ±20 Hz on frequency Counter.
5	RX, USB, CH19 Clarifier, in center position	TP8	CT4	Adjust to obtain 34.9875 MHz ±20 Hz on frequency Counter.
6	RX, LSB, CH19 Clarifier: in center position	TP8	CT5	Adjust to obtain 34.9825 MHz ±20 Hz on frequency Counter.
7	TX, LSB, CH19	TP8	VR9	Adjust to obtain 34.9825 MHz ±20 Hz on frequency Counter.
8	Same as Step 7	TP9	CT3	Adjust to obtain 7.7975 MHz ±5 Hz on frequency Counter.
9	TX, USB, CH19	TP9	CT2	Adjust to obtain 7.8025 MHz ±5 Hz on frequency Counter.

PLL AND CARRIER OSCILLATOR TEST EQUIPMENT SETUP



PLL (Phase Lock Loop) CIRCUIT DESCRIPTION

The PLL (Phase Lock Loop) circuit used in the TRC-457 consists of 6 major components; Voltage Controlled Oscillator (VCO), 1/N Divider, Reference Oscillator, 1/1024 Divider, Phase Detector and Low Pass Filter.



The VCO is an oscillator which controls oscillation frequency in accordance with input voltage changes. The VCO output is mixed with a signal in the transmitter or receiver circuitry. A portion of the VCO frequency is fed to FET4 and mixed with a 33.8525 - 33.8575 MHz frequency from X3, X4 or X6 and then goes through TR30 Amplifier and TR31 Buffer Amp and then added to the 1/N Divider. This is applied to one input of the Phase Detector. "N" for the 1/N Divider is determined by the Channel Selector Switch (by BCD) and varies from 91 to 135.

On the other hand, a 10.24 MHz frequency from the Reference Oscillator is divided to 10 kHz by 1/1024 Divider and applied to another input of the Phase Detector. The Phase Detector detects the difference of these two input signals and produces a voltage which controls the VCO frequency. The Low Pass Filter integrates the outpuf voltage of the Phase Detector which controls the VCO frequency and the 1/N Divider produces a 10 kHz frequency.

Thus the Phase Detector receives two input signals (both 10 kHz). It compares the phase difference of the two, generating an error voltage, which acts on the VCO to bring the two frequencies exactly in-phase. When this condition occurs, the PLL circuit is "locked".

WAVE FORM OF IC7

IC7 Pin No.	1	2 & 3	4	5 & 6	7 & 12
Wave Form	H = UNLOCKED L = LOCKED where H = 3.5 – 6V L = 0 – 1.0V	2.4V DC 2.4V 0	2.8V DC 2.8V 0	5V 0	5V DC 5V 0
IC7 Pin No.	8	9	10	11	24
Wave Form	5V 0	3.2V 1.5V 0	5V 0	5V 0	5V 0

Note: Pin No. 13 through 18, 20 & 21 are as in frequency chart.
Pin No. 19, 22 & 23 are fixed to Low level.

By varying the constant N, the output frequency from the VCO can be locked and varied one 10 kHz step at a time. The constant N is controlled by the Channel Selector Switch. A frequency shift of 2.5 kHz (required for AM RX, USB and AM TX and LSB RX/TX) is obtained by switching to X3, X4 or X6 as shown in Frequency Chart.

For a more detailed description of how this circuit functions, refer to Abbreviated Block Diagram as well as the full Block Diagram and Schematic.

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1) PLL LOCAL OSCILLATOR

F_L, the frequency of the VCO, is controlled by the PLL synthesizer system as follows. The output frequency of the VCO (IC5) is applied to one of the inputs of the In-loop Mixer FET4 and mixed with the off-set frequency which is generated by the Off-set Oscillator TR34 or TR38 and multiplied by three by Tripler TR40.
The resultant difference frequencies are produced at the output of FET4 as follows:

$$F_1 = F_L - (3 \times F_0)$$

F_1 : Output frequency of FET4
F_0 : Off-set frequency, approximately, 11.2858 MHz on AM or USB mode and 11.2842 MHz on LSB mode.
$3 \times F_0$: 33.8575 MHz on AM or USB mode. 33.8525 MHz on LSB mode.

F_1 falls into the range of 910 kHz to 1350 kHz in increments of 10 kHz.

F_1 is applied to the Programmable Frequency Divider in the PLL IC, IC7, after being amplified by TR30 and TR31, and then is divided by the programmed-divide-ratio, N, by the Programmable Divider.

The resultant frequency is applied to the Phase Detector in IC7 and is compared (phase-detected) with the reference frequency of 10 kHz applied to another input of the Phase Detector.
The Phase Detector generates the control voltages for VCO to minimize the difference between F_1 divided by N and the reference frequency.

Thus, under locked condition of the loop, the local frequency F_L is locked stable and is calculated by the following formula:

$$F_L = N \times 10\,kHz + 3 \times F_0$$

2) CHANNEL SELECTION PROGRAM

The divide ratio, N, of the Programmable Frequency Divider is determined by supplied voltages to the program input terminals, Pin No. 13 through Pin No. 22 of the IC7.

The program input voltages for Pin No. 19, No. 22 and No. 23 are fixed to "low level", and the voltages for Pin No. 13 through No. 18, No. 20 and No. 21 are supplied from the channel selector switch S408.

The function of the program input terminals is as follows:

Pin No.	: 13	14	15	16	17	18	19	20	21	22
Function	: 1A	1B	1C	1D	2A	2B	2C	2D	3A	3B
Significant number	: 1	2	4	8	10	20	40	80	100	200

* Program Input "high level" 19 and 20 are Kept "low" (off).

The divide ratio N of the Programmable divider is provided by the sum of the significant numbers which are effective by supplying "high level" input. For example, when the channel switch is set to Channel No. 1, the input of 1A, 2A and 2D is in "high level" and the others are in "low level". Therefore, the divide ratio N is determined as follows:

$$N = 1 + 10 + 80 = 91$$

In the same manner, the divide ratio N for Channel No. 1 through No. 40 is determined as shown in Frequency Chart.

3) TRANSMITTING FREQUENCY CALCULATION

For an example, when the unit is operated on Channel 19, the transmitting frequency is calculated as shown in the following table for each mode.

	AM mode	LSB mode	USB mode
N	113	113	113
$3 \times F_0$ (MHz)	33.8575	33.8525	33.8575
N x 10 kHz (MHz)	1.13	1.13	1.13
F_L (MHz)	34.9875	34.9825	34.9875
F_{IF} (MHz)	7.8025	7.7975	7.8025
F_t (MHz)	27.185	27.185	27.185

FREQUENCY CHART

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CH	ANTENNA OUTPUT FREQUENCY	N	1/N INPUT FREQUENCY	IC7 VOLTAGE								LOCAL OSC OUTPUT FREQUENCY		
				1A	1B	1C	1D	2A	2B	2D	3A	AM.RX	USB&AM.TX	LSB
1	26.965	91	910	1	0	0	0	1	0	1	0	34.765	34.7675	34.7625
2	26.975	92	920	0	1	0	0	1	0	1	0	34.775	34.7775	34.7725
3	26.985	93	930	1	1	0	0	1	0	1	0	34.785	34.7875	34.7825
4	27.005	95	950	1	0	1	0	1	0	1	0	34.805	34.8075	34.8025
5	27.015	96	960	0	1	1	0	1	0	1	0	34.815	34.8175	34.8125
6	27.025	97	970	1	1	1	0	1	0	1	0	34.825	34.8275	34.8225
7	27.035	98	980	0	0	0	1	1	0	1	0	34.835	34.8375	34.8325
8	27.055	100	1000	0	0	0	0	0	0	0	1	34.855	34.8575	34.8525
9	27.065	101	1010	1	0	0	0	0	0	0	1	34.865	34.8675	34.8625
10	27.075	102	1020	0	1	0	0	0	0	0	1	34.875	34.8775	34.8725
11	27.085	103	1030	1	1	0	0	0	0	0	1	34.885	34.8875	34.8825
12	27.105	105	1050	1	0	1	0	0	0	0	1	34.905	34.9075	34.9025
13	27.115	106	1060	0	1	1	0	0	0	0	1	34.915	34.9175	34.9125
14	27.125	107	1070	1	1	1	0	0	0	0	1	34.925	34.9275	34.9225
15	27.135	108	1080	0	0	0	1	0	0	0	1	34.935	34.9375	34.9325
16	27.155	110	1100	0	0	0	0	1	0	0	1	34.955	34.9575	34.9525
17	27.165	111	1110	1	0	0	0	1	0	0	1	34.965	34.9675	34.9625
18	27.175	112	1120	0	1	0	0	1	0	0	1	34.975	34.9775	45.9725
19	27.185	113	1130	1	1	0	0	1	0	0	1	34.985	34.9875	34.9825
20	27.205	115	1150	1	0	1	0	1	0	0	1	35.005	35.0075	35.0025
21	27.215	116	1160	0	1	1	0	1	0	0	1	35.015	35.0175	35.0125
22	27.225	117	1170	1	1	1	0	1	0	0	1	35.025	35.0275	35.0225
23	27.255	120	1200	0	0	0	0	0	1	0	1	35.055	35.0575	35.0525
24	27.235	118	1180	0	0	0	1	1	0	0	1	35.035	35.0375	35.0325
25	27.245	119	1190	1	0	0	1	1	0	0	1	35.045	35.0475	35.0425
26	27.265	121	1210	1	0	0	0	0	1	0	1	35.065	35.0675	35.0625
27	27.275	122	1220	0	1	0	0	0	1	0	1	35.075	35.0775	35.0725
28	27.285	123	1230	1	1	0	0	0	1	0	1	35.085	35.0875	35.0825
29	27.295	124	1240	0	0	1	0	0	1	0	1	35.095	35.0975	35.0925
30	27.305	125	1250	1	0	1	0	0	1	0	1	35.105	35.1075	35.1025
31	27.315	126	1260	0	1	1	0	0	1	0	1	35.115	35.1175	35.1125
32	27.325	127	1270	1	1	1	0	0	1	0	1	35.125	35.1275	35.1225
33	27.335	128	1280	0	0	0	1	0	1	0	1	35.135	35.1375	35.1325
34	27.345	129	1290	1	0	0	1	0	1	0	1	35.145	35.1475	35.1425
35	27.355	130	1300	0	0	0	0	1	1	0	1	35.155	35.1575	35.1525
36	27.365	131	1310	1	0	0	0	1	1	0	1	35.165	35.1675	35.1625
37	27.375	132	1320	0	1	0	0	1	1	0	1	35.175	35.1775	35.1725
38	27.385	133	1330	1	1	0	0	1	1	0	1	35.185	35.1875	35.1825
39	27.395	134	1340	0	0	1	0	1	1	0	1	35.195	35.1975	35.1925
40	27.405	135	1350	1	0	1	0	1	1	0	1	35.205	35.2075	35.2025

0 = Low level (0 – 1.0 volt)
1 = High level (3.5 – 6 volts)

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1. AUDIO LIMITER AND AUTOMATIC MODULATION CONTROL

The modulation control for this model consists of 2 loops of AMC which detect a signal from the output of the audio limiter (mic preamp) and from the audio power amp and feed it back to limiter diodes.

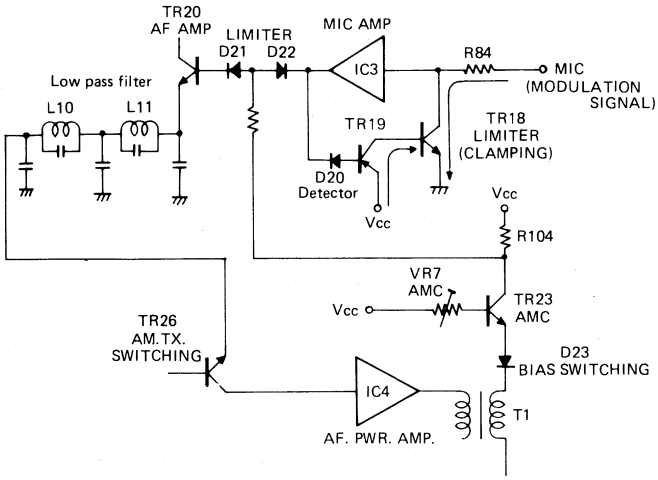


Fig. 1 Circuit Diagram of Audio Limiter and Automatic Modulation Control

1-A. AUDIO LIMITER

The mic signal is applied to pin 2 of IC3. The signal is picked up at Pin 6 and detected by D20 (negative part of waveform). This current flows into the base of TR19, effectively decreasing it's C-E impedance; which increases the Vcc applied to TR18's base. And TR-18's C-E impedance drops as its base current increases. This provides a variable voltage divider at the input of IC3 (dividing between R84 and TR18), thus making it possible to attenuate and control the modulation signal right at the input to the mic gain stages.

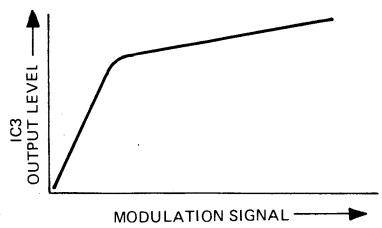


Fig. 2 Audio Limiter Characteristics

1-B. AUTOMATIC MODULATION CONTROL (AMC)

The output level of IC3 is already controlled by the audio limiter. However, to control maximum modulation more precisely and stably, the AMC circuit which feeds back the output amplifier(IC4) into the limiter diode(D21, D22) is provided. The output of IC3 is subjected to impedance matching by the AF AMP(TR20) through the low pass filter(L10, L11) and TX(AM) switching(TR22). The output of IC4 is subjected to impedance matching by the output transformer(T1) and supplied to the TX FINAL and DRIVER stage. This modulation signal is detected at the secondary of T1 by the bias switching diode(D23) and makes collector current flow in TR23, AMC transistor. At this time, a voltage drop is developed across the resistor(R104) which causes collector voltage to decrease and forward bias current of both D21 and D22 is reduced. In other words, the output voltage of IC3 is clipped for both positive and negative. However, the clipped waveform as shown in Fig. 2-D causes the band-width to increase, thus a low pass filter(L10, L11), which has the characteristics as shown in Fig. 3, is used.



Fig. 2A Modulation Wave at Antenna Terminal

Fig. 2B Output at T-1

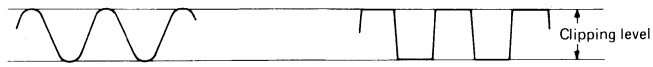
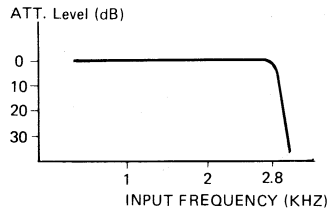


Fig. 2C Limiter Output with small input signal

Fig. 2D Limiter Output with large input signal

Fig. 3 Low Pass Filter Frequency Response



2. AUTOMATIC LIMITER CIRCUIT(ALC) (SSB mode)

Both AMC and ALC circuits function for AM and SSB. For SSB we have an additional circuit as described here.

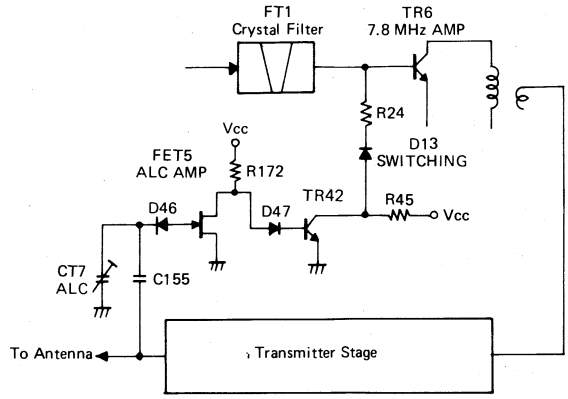


Fig. 4 ALC circuit (abbreviated)

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The SSB signal is processed through FT1, amplified by the 7.8 MHz amplifier(TR6) and fed to the TX stage. The peak-to-peak power output of the TX stage is subjected to negative detection by D46 and applied to the gate of FET5 ALC amplifier. At this time, if the gate becomes negative, drain voltage is increased up to about Vcc level. This increased voltage is applied to the base of TR42 ALC amplifier, and therefore, base current is increased which also increases collector current; this increases R45 voltage drop and decreases collector voltage.

The base bias of TR6 is supplied from the collector of TR42 through the switching diode(D13). With a decrease in the collector voltage of TR42, the base bias current of TR6 is reduced and the operating point is shifted, thus amplifier output level is decreased as shown in Fig.5. This decrease will limit the power output at the antenna terminal.

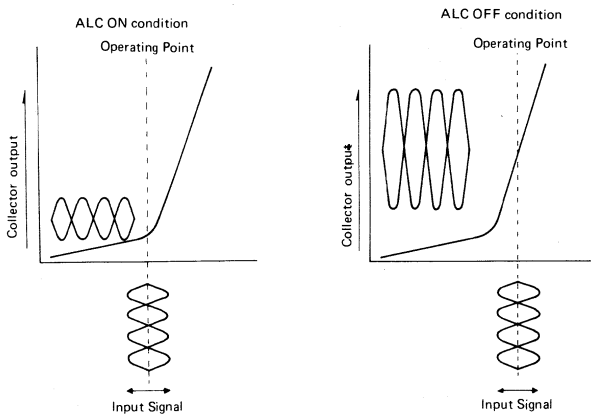


Fig. 5 Operating Characteristics of TR-6

3. NOISE BLANKER CIRCUIT

3-A. NOISE AMPLIFIER CIRCUIT

The Noise Blanker circuit is tuned to 23 MHz. Any noise that exists in the 27 MHz frequency range will also be present at 23 MHz. L1 is tuned to 23 MHz, IC1 amplifies the 23 MHz band of frequencies and L2 provides further tuning. This signal is then amplified and detected (utilizing the non-linear characteristic portion of the operating curve) by TR2, N.B. AMP. Also, the phase of the signal is reversed in TR2 and fed to the base of TR3 for further amplification. Base current flows when a pulse is applied; then the C-E impedance is reduced to about 10-20 ohms. Since the collector is connected to the hot side of L5 (RX 7.8 MHz), the primary side of L5 is in effect short-circuited and so the pulse noise is eliminated from the Receive signal.

3-B. N.B. AGC CIRCUIT

In some N.B. circuits, under conditions of high signal and high noise, when N.B. is turned on, there is more noise than with N.B. off. This is due to a lack of AGC. To prevent this effect, a portion of the 27 MHz signal is picked off of L4 and applied through FET601 and TR601, N.B. AGC amplifiers. This signal is detected by D601 and D602 and applied through D603 to the base of TR1, which drives the base into saturation. At the same time, collector current increases, which drops most of Vcc across R4; thus reducing the gain of the N.B. Amplifier chain. This AGC effectively controls the N.B. loop and its effect on the 27 MHz RF amplifier circuitry. N.B. AGC is set to operate with an incoming 27 MHz signal level of 100-500 μV.

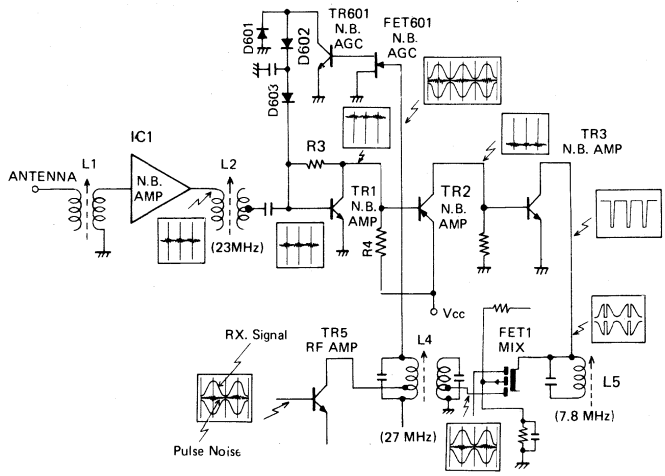


Fig. 6 Noise Blanker Circuit

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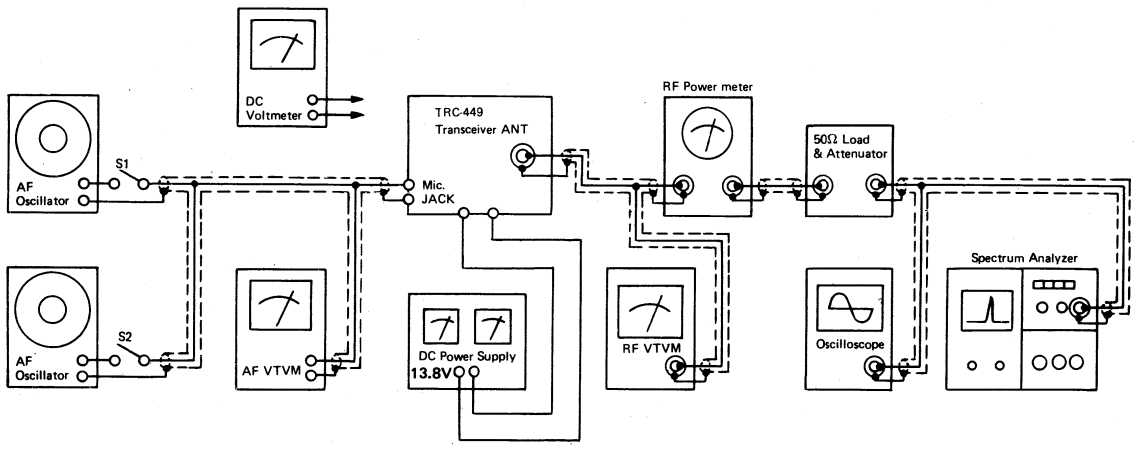
ALIGNMENT OF TRANSMITTER SECTION

1. **Equipment Required:**
   a. AF Oscillator (two required)
   b. AF VTVM (Full scale: 1V DC with RF probe)
   c. DC VOM
   d. RF Power Meter
   e. 50 ohm load and Attenuator
   f. Oscilloscope
   g. RF VTVM
   h. Tunable Field Strength Meter (Wave meter) (or Spectrum Analyzer)
   I. DC Power Supply (13.8 V/3 amp.)

2. **PROCEDURE (See page 8)**
   Connect Test Equipment as shown below.

STEP	PRESET TO	ADJUSTMENTS	REMARKS
1	S1, S2: off USB, TX mode	VR15	Break circuit at TP4, place DC mA Meter in series. Adjust for approximately 40 mA reading. Restore circuit.
2	Same as step 1	VR16	Break circuit at TP2, place mA Meter in series. Adjust for approximately 15 mA reading. Restore circuit.
3	Same as step 2	VR4	Adjust for minimum carrier leakage for both USB and LSB on Oscilloscope (or Spectrum Analyzer, if available).
4	VR6: fully CW CT7: Max. Cap. AF OSC1: 500 Hz AF OSC2: 2400 Hz S1 and S2: ON	L30,L32 L37,L39	Adjust level of OSC1 and OSC2 for 500 mV reading on AF VTVM and then adjust coils for max. reading on RF VTVM.
5	Same as step 4	CT7	Adjust for 24 volt reading on RF VTVM.
6	S1 and S2: OFF AM, TX mode	VR8	Adjust for 3.8 to 4.0 watt reading on RF Power Meter.
7	S1: ON AF OSC: 10000 Hz	VR6	Adjust output of OSC1 for 0.5 mV reading on AF VTVM then adjust VR6 for 50% modulation on Scope.
8	Same as step 7	VR7	Adjust output of OSC1 for 200 mV reading on AF VTVM then adjust VR7 for 95 to 98% modulation on Scope.
9	Same as step 8	L27	Adjust L27 to show min. 2nd harmonic (54 MHz) on Tunable Field Strength Meter (or Spectrum Analyzer, if available).
10	S1 and S2:OFF AM, TX mode	VR12	Adjust VR12 so the TRC-449's power meter reads between red and white area.

TRANSMITTER TEST EQUIPMENTS SETUP



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ALIGNMENT OF RECEIVER SECTION

1. Equipment Required

a. RF Signal Generator (455 kHz and 27 MHz Band, 50 ohm output impedance)
b. AF VTVM
c. Oscilloscope
d. RF Voltmeter
e. DC Power Supply
f. 8 ohm load

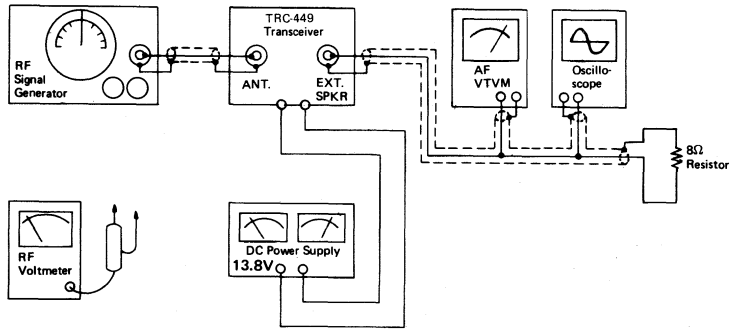
2. Procedure (See page 8)

Connect Test Equipment as shown below.

Note;
L2 is adjusted at the factory so no adjustment should be made.

STEP	SIGNAL GENERATOR SETUP	PRESET TO	ADJUSTMENT	REMARKS
1	27.185 MHz, modulated 1 kHz (30%)	RX, AM, CH 19 VOL. & RF Gain Control : Max. SQUELCH : Min. ANL & N.B.: Off	L3, L4, L5, L6, L7, L8	Adjust for a max. output.
2	Same as Step 1	Same as Step 1	VR 5	Adjust for 2 volts output with a SG output level of 0.5 μV.
3	1 kHz NO MOD	RX, USB, CH 19 VOL. & RF Gain Control: Max. SQUELCH : Min. ANL & NB : Off	CT 1	Adjust for 2 volts output with a SG output level of 0.25 μV.
4	Same as Step 3	Same as Step 3	VR 1	Adjust for a reading of S-9 on the Transceiver's S-Meter, with SG output level of 100 μV.
5	Same as Step 1 Set RF Generator level to 1 mV	RX, USB, CH 19 VOL. & RF Gain Control: Max. SQUELCH : Max. ANL & NB : Off	VR 3	Adjust so squelch circuit just opens with 1 mV signal.
6	Same as Step 1	RX, USB, CH 19 RF Gain Control : Max. SQUELCH : Min. ANL & NB : Off	(Volume Control)	Adjust for 2 volts output with a SG output level of 0.5 μV.
7	Same as Step 1	RX, USB, CH 19 RF Gain Control : Min. SQUELCH : Min. ANL & NB : Off	VR 2	Adjust for 2 volts output with a SG output level of 50 μV.
8	23.5 MHz NO MOD	RX, USB, CH 19 RF Gain Control : Max. SQUELCH : Min. NB : On ANL : Off	L1	Adjust for max. output with Volt-Meter connected to TP5, with SG output level of 200 μV.

RECEIVER TEST EQUIPMENT SETUP



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5. TROUBLESHOOTING HINTS

UNIT WILL NOT TURN ON

1. Broken DC Power cable.
2. Fuse blown. Be sure you check the cause.
3. Defective power switch.
4. Defective wires or poor soldering in power supply circuit.

NO RECEIVE SOUND

1. Defective RF circuit in receiver.
2. Defective Noise Blanker.
3. Defective AGC circuit.
4. Defective PLL circuit.
5. Defective antenna connector.

NO NOISE

1. Defective RX power circuit.
2. Defective RX audio circuit.
3. Defective PLL circuit and/or channel switch.
4. Defective squelch.
5. Defective PA-CB switch and/or EXT SP. Jack.

NO TRANSMISSION

1. Broken or bad contact in microphone connector and/or push-to-talk switch.
2. Broken or bad contact in antenna connector.
3. Defective Relay.
4. Defect in power supply.
5. Defect in PLL and/or Carrier Oscillator (Improper adjustment).
6. Inoperative microphone amplifier and/or balanced modulator in SSB mode.
7. Defective TX AMP.
   (Between mixer and final stage)

NO MODULATION

1. Defective microphone.
2. Defective microphone connector.
3. Defective TR20 or IC4, (AM mode.)
4. Inoperative microphone amplifier, (both AM and SSB modes.)

FOR MORE HINTS, SEE BELOW:

NO RECEIVE SOUND

A) Check for short circuit or broken wire in the winding of the output transformer(T-1) or cold soldering between the wires and printed circuit board. The DC resistance of the output transformer winding is approximately 0.2 ohm on the primary side and 0.5 ohm on the secondary side (use accurate V.O.M. if available to check this resistance).

B) Defective Audio Power IC4.
Check the DC voltage at pin 10 of IC4. If voltage reads approximately 7 V (supply voltage/2), then problem is not with this IC.

C) Squelch is ON all the time.
If the gate voltage of FET3 is +6 V or less with Squelch Control in the C.C.W. position, the Squelch Circuit is defective. So, check the circuits of TR12, TR13 and TR14 and also ground terminal of Squelch Control (VR404) for cold soldering.
If the collector voltage of TR12 is 6 V or more, check the circuit of TR21 and Volume Control (VR405).

D) If the Signal strength meter deflects when the external antenna is connected, you can assume that RF thru IF stages are OK. So, checks should be made on detector and ANL circuit (D10, D11 and D12).
If a negative voltage appears at the cathode of D12, detector and ANL circuit should be all right, so, check the circuit of TR15.
If the collector voltage of TR15 is approx. 6 to 7 V, TR15 is all right.

E) No receive sound even with carrier oscillation (7.8 MHz) on USB/LSB mode.
In case of no signal strength meter deflection at the check of D) above: If a RF voltage of 2V /P-P(34 MHz) or more is at the first gate of FET1 and this frequency is as shown in the frequency chart, the local oscillator (PLL) should be all right.

F) Check the voltage of each part of the following stages: TR9, TR8, TR6, FET1, TR5 and TR4 (in this order).

NO TRANSMISSION (AM)

A) Connect the DC meter in series with DC power cable. If reading is 1.5 A or more, you can assume that there is contact failure between relay and antenna circuit or short circuit between final transistor (TR43) and antenna circuit.
If the current reads 1.5 A or less, check prior stages.

B) If the output voltage (7.8 MHz) of carrier oscillation (TR27, TR28) is 100 mV or more at TP-9, the carrier oscillation circuit is all right.

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C) If a RF voltage of 20 mV/P-P or more at the base and 300 mV/P-P or more at the collector of the 7.8 MHz AMP (TR7), the 7.8 MHz AMP is all right.
If no RF voltage is present at the base, check D7 and D35 circuits.

D) If a RF voltage of 34 MHz, 2 V/P-P or more is readable at the first gate of the mixer (FET7) no problem should be expected with Local Oscillator.

E) Check DC and RF voltages of each of the following circuits: TR43, TR44, TR45, FET6 and FET7 (in this order).

F) If voltages do not appear at the collector of TR43 or TR44, check the regulators (TR25 or TR26). If the regulator has a DC output of approx. 5 to 7 V. the regulator should be all right.

NO TRANSMISSION (SSB)

A) If AM transmit and modulation are working properly, the problem is in the circuit of 7.8 MHz AMP (TR6) or in the circuit of Balanced Modulator (IC2) or in the Microphone AMP (TR16).
If no RF voltage of 7.8 MHz, 50 mV/P-P appears at pin 8 of IC2, check circuits from TR28 to pin 8 of IC2.
If no audio signal of approx. 70 mV/rms appears at pin 1 of IC2 under modulation, check circuits before TR16.

B) If the voltage reading at pin 8 and pin 1 of IC2 are correct then problems are with TR6 bias circuit or D6.

C) If the output of TR6 is produced properly check item D) and E) of NO TRANSMIT (AM) above.

NO AM MODULATION

The signal in the modulation circuit flows through IC3 - D22 - D21 - TR20 - TR22 - IC4. Therefore check to determine at what stage this signal ceases (to isolate a defective part). If no signal appears at pin 2 of IC3, it is probable that there is a short circuit between the collector and emitter of the clamping transistor (TR18) or between the collector and emitter of the TR19.

NO NOISE BLANKER OPERATES

A) If the RF output voltage of TP-5 is 100 mV or less with Noise Blanker ON, when signal of 23.5 MHz 200 μV carrier is applied to antenna, check the RF AMP circuits (IC1) and L1 and L2.

B) If a pulse noise is amplified to 0.7 V/P-P or more at the base of TR3 when an ignition noise (or pulse noise) of 100 mV/P-P or more is applied to the antenna, the circuits of TR1 and TR2 should be all right. And if a pulse noise of approx. 0.2 V/P-P is produced at the collector of TR3, it also is all right.

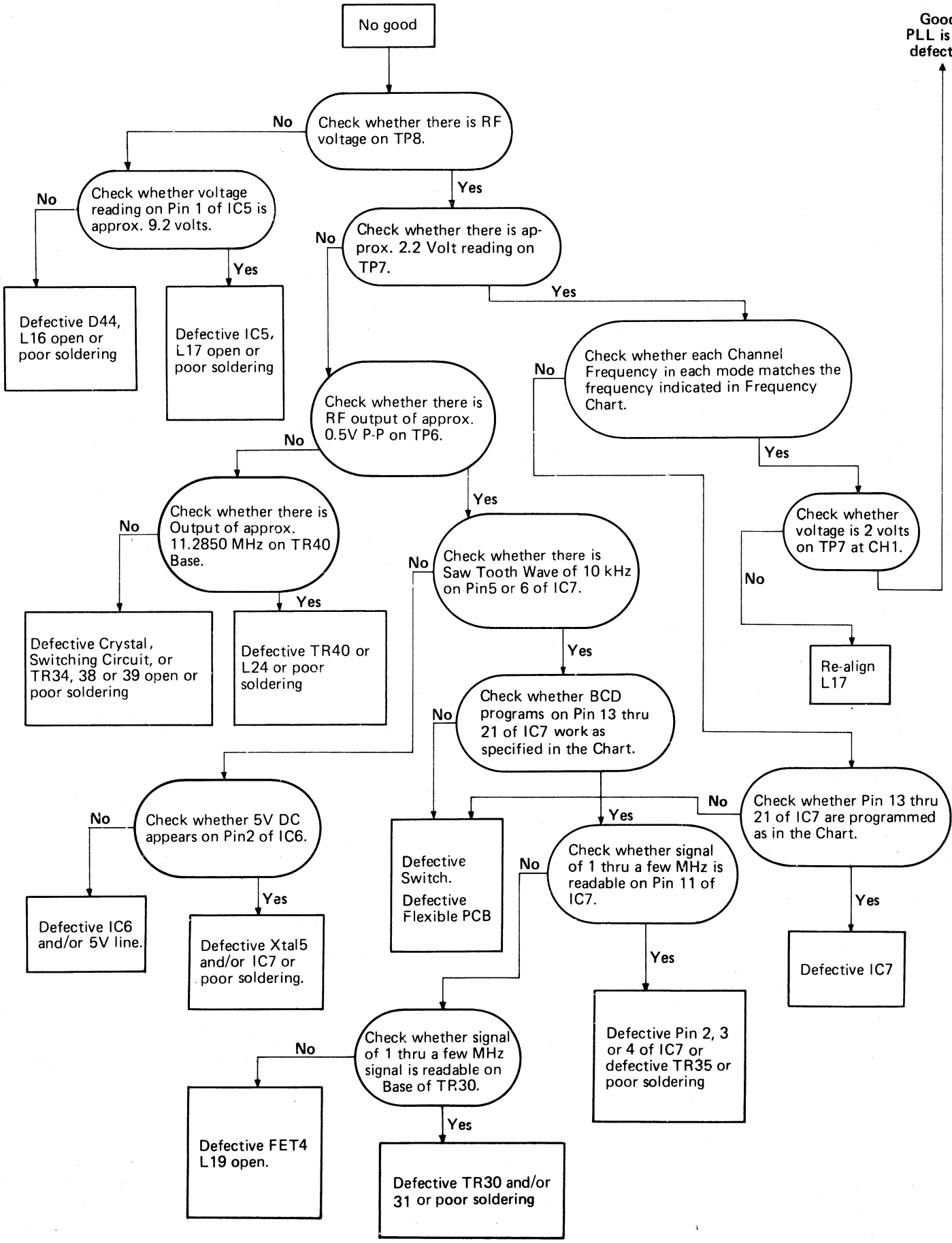
NO LED CHANNEL INDICATOR LIGHTS

A) In the event a specific channel fails to light, it is probable that there is an open circuit in the LED display or bad contact in the channel selector switch.

B) If all channels fail to light, the regulator (TR36 & TR37) circuit is defective.

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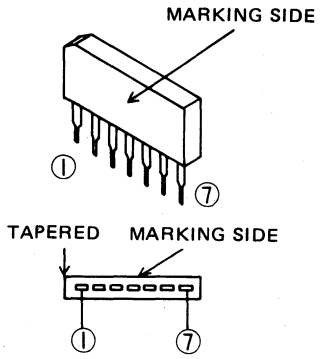
6. PLL CIRCUIT TROUBLESHOOTING HINTS



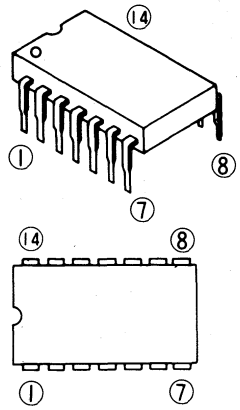
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7. IC, TRANSISTOR & DIODE LEAD IDENTIFICATIONS

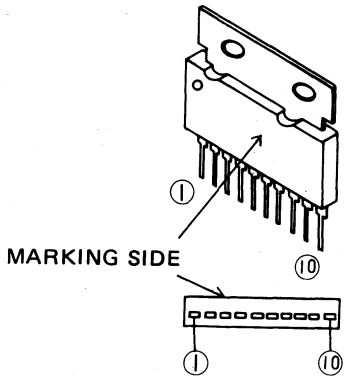
IC-1, μPC577H
IC-3, μPC592H2



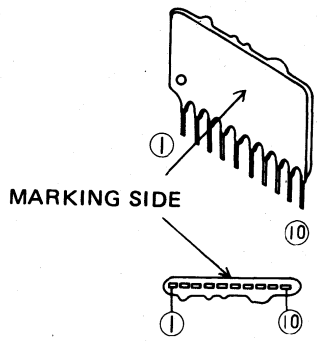
IC-2, MC1496N



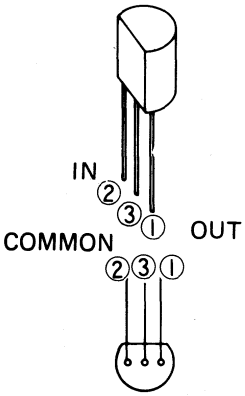
IC-4, μPC1156H



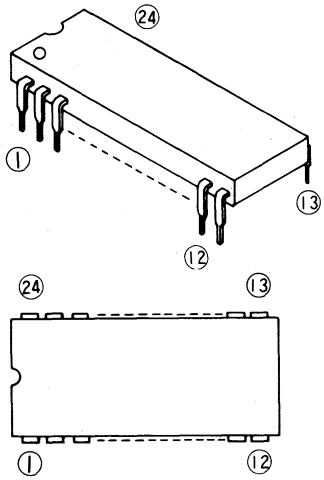
IC-5, UHIC-005



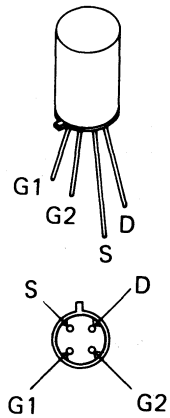
IC-6, μPC78L05



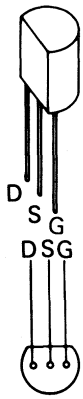
IC-7, μPD858C



FET-1, 4, 7



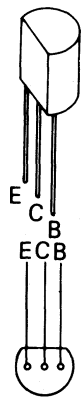
FET-2, 6, 601



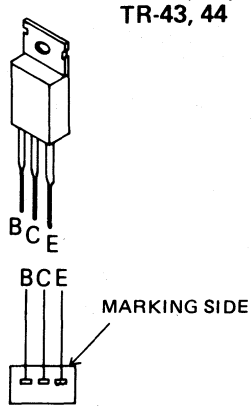
FET-3, 5



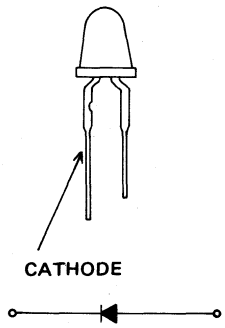
TR-1 ~ TR-23
TR-26 ~ TR-34
TR-37 ~ TR-42
TR-45
TR-601



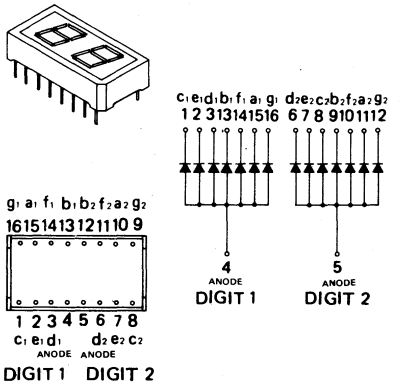
TR-24, 25, 36
TR-43, 44



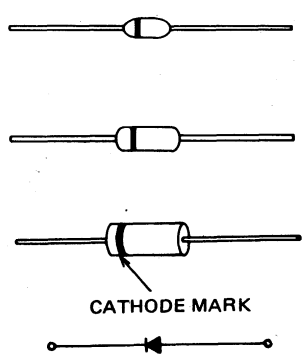
LED
LR-070 2R



TLR-321



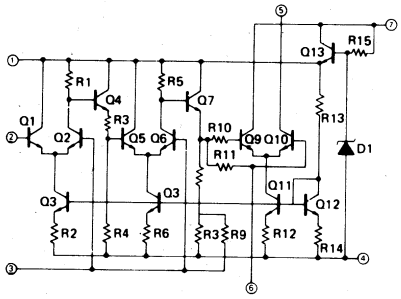
DIODES : 1S2473, 1N60P
SR1K-2



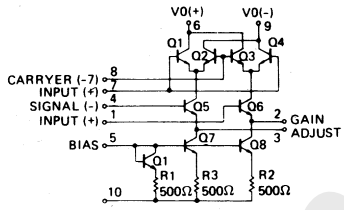
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8. IC & COMPOUND PARTS INTERNAL DIAGRAMS

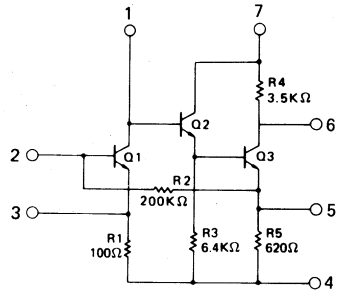
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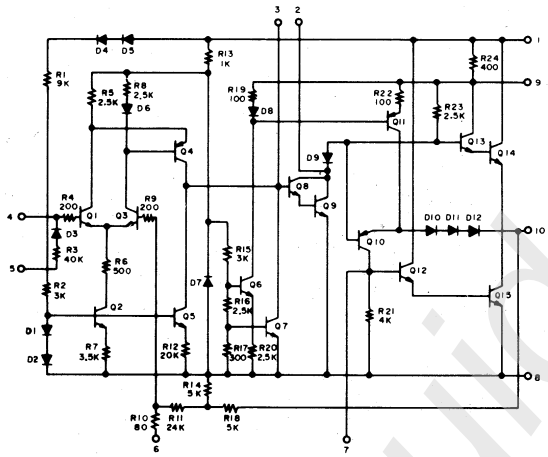
IC-2, MC1496N



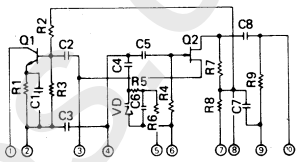
IC-3, μPC592H2



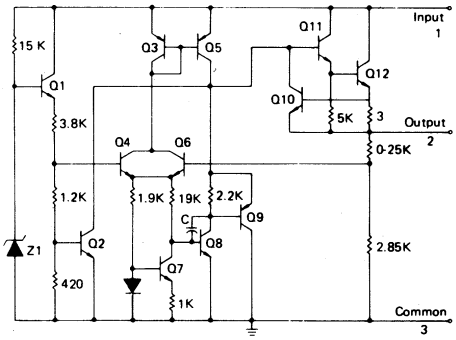
IC-4, μPC1156H



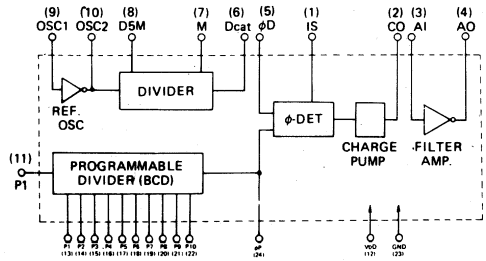
IC-5, UHIC005



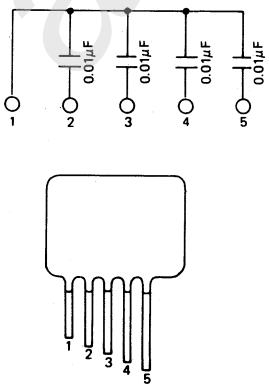
IC-6, μPC78L05



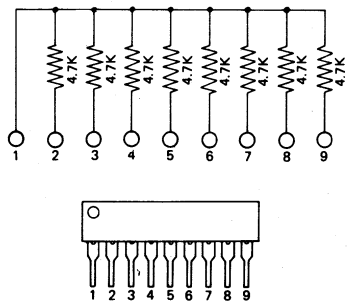
IC-7, μPD858C



CC-1 & CC-2 (HA-003)

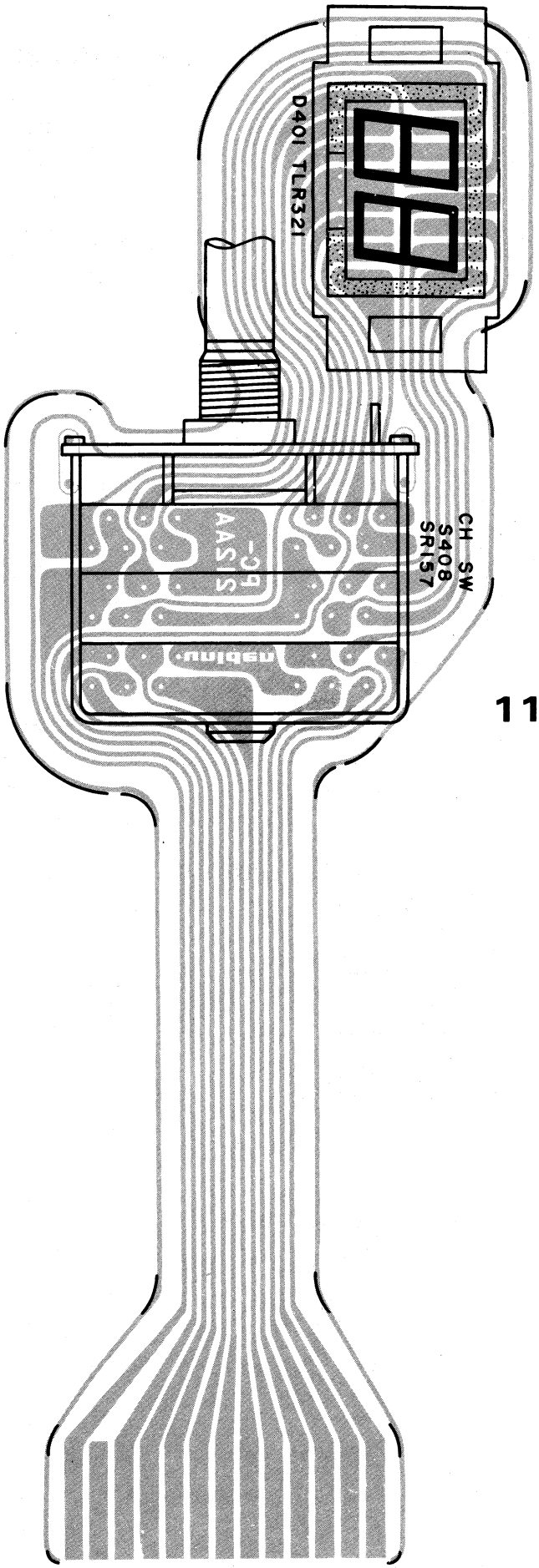


RR-1 (HA-004)

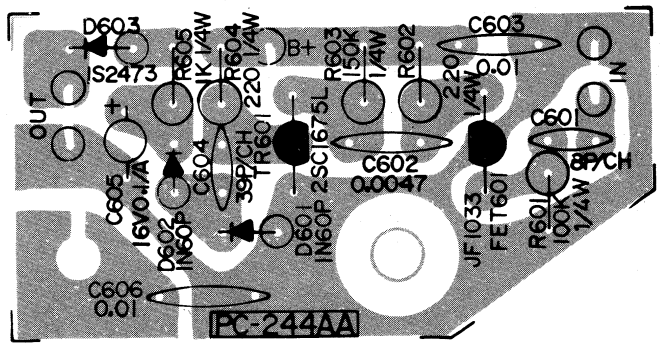


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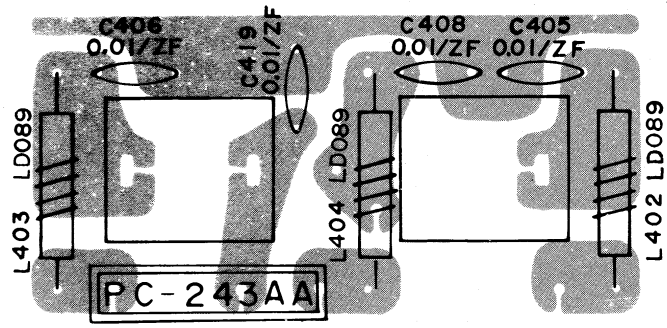
9. CHANNEL SWITCH P.C. BOARD (FLEXIBLE)



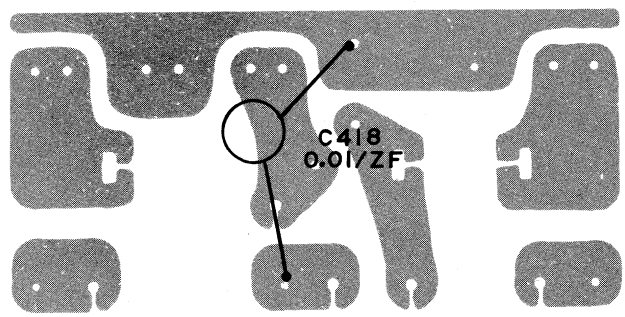
10. NOISE BLANKER P.C. BOARD



11. SPEAKER JACK P.C. BOARD



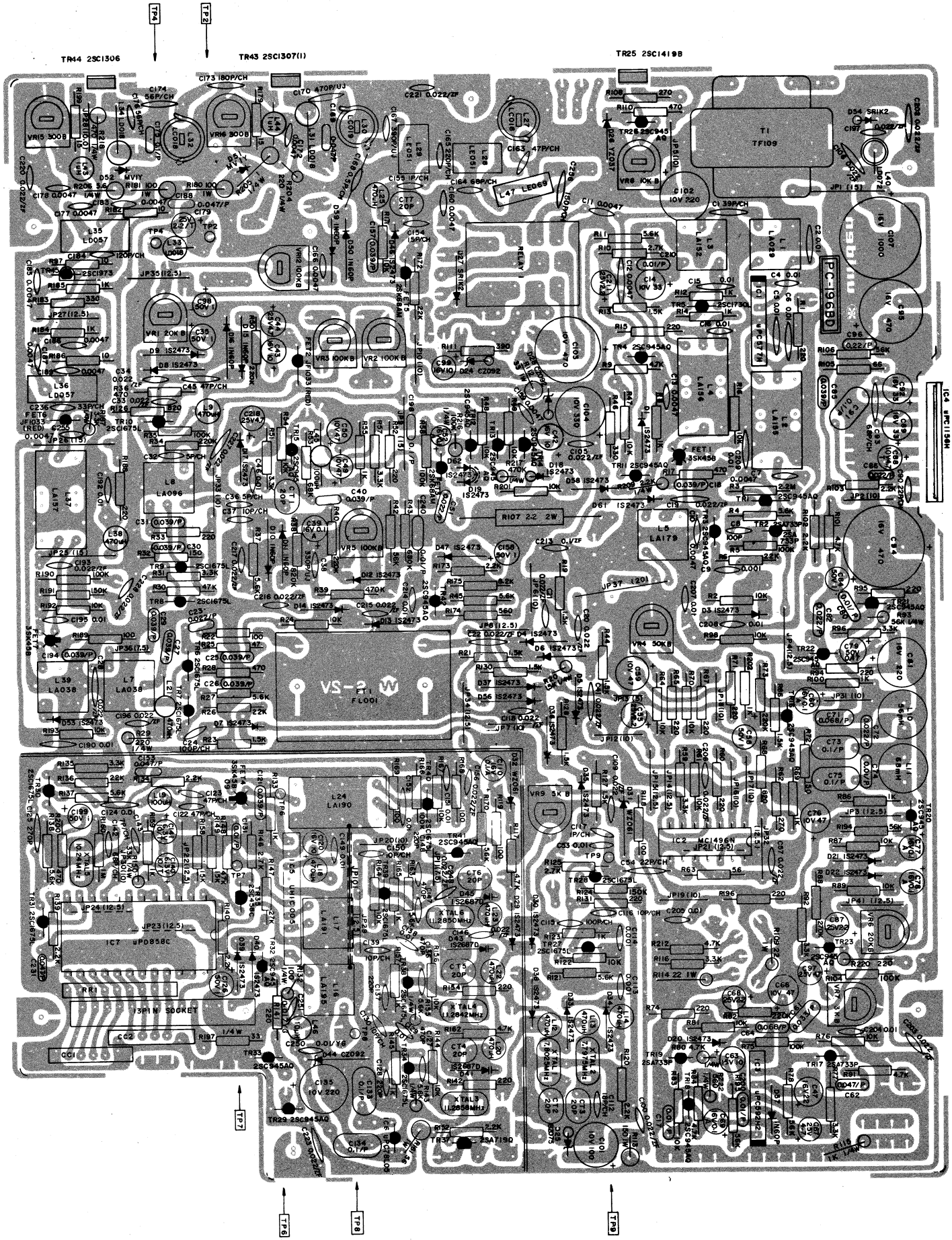
(TOP VIEW)



(BOTTOM VIEW)

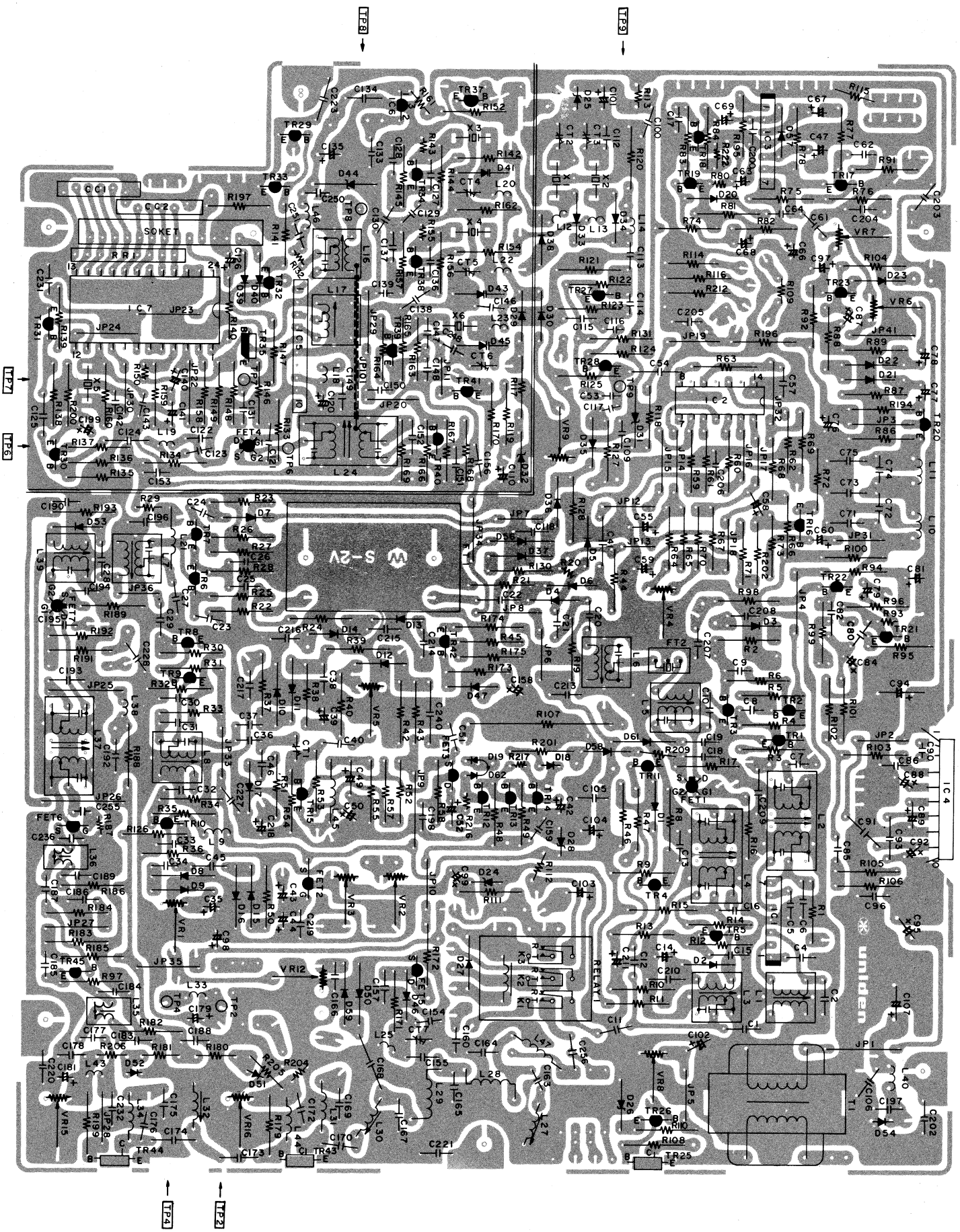
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12. MAIN P.C. BOARD (TOP VIEW)



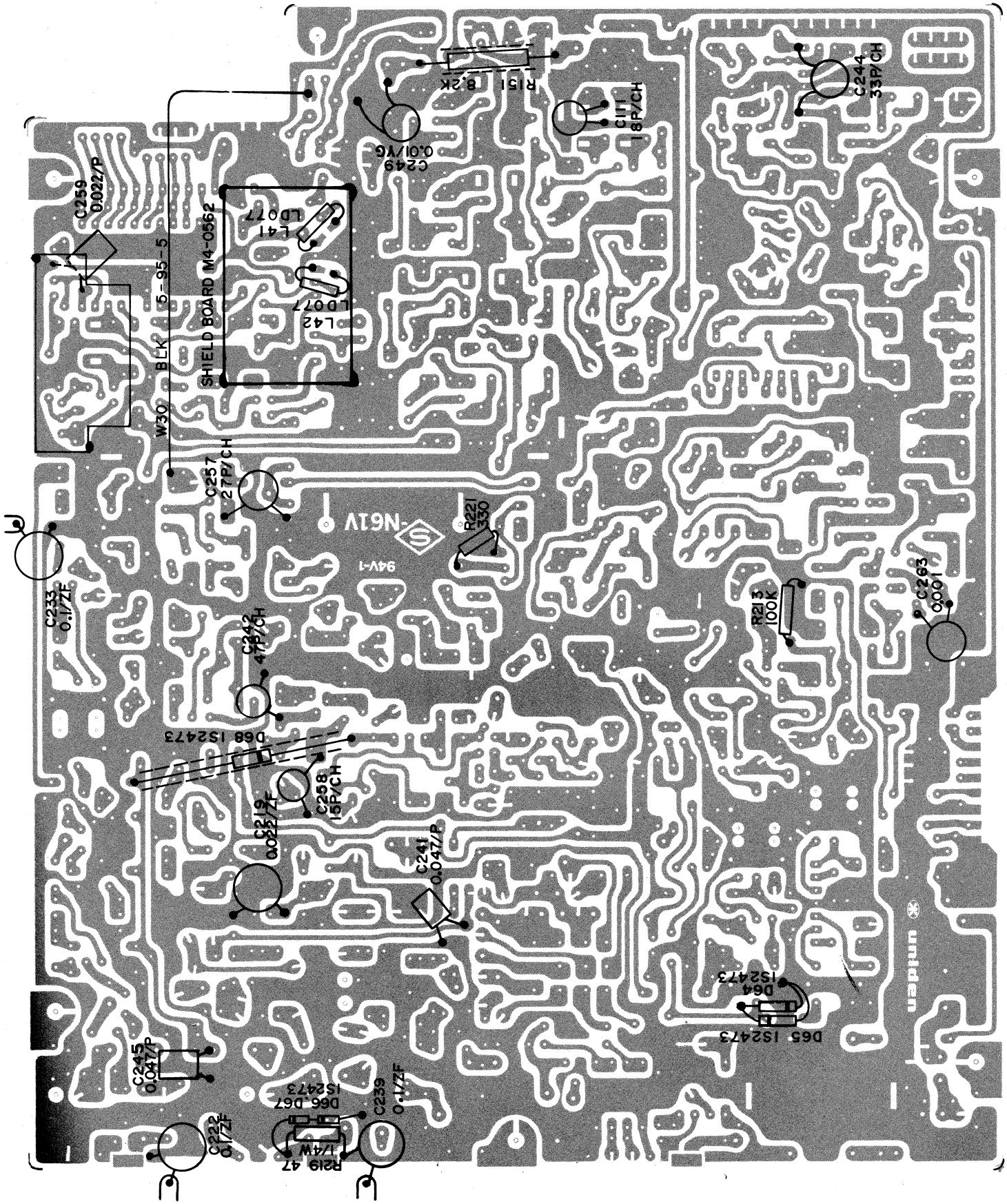
13. MAIN P.C. BOARD (BOTTOM VIEW)

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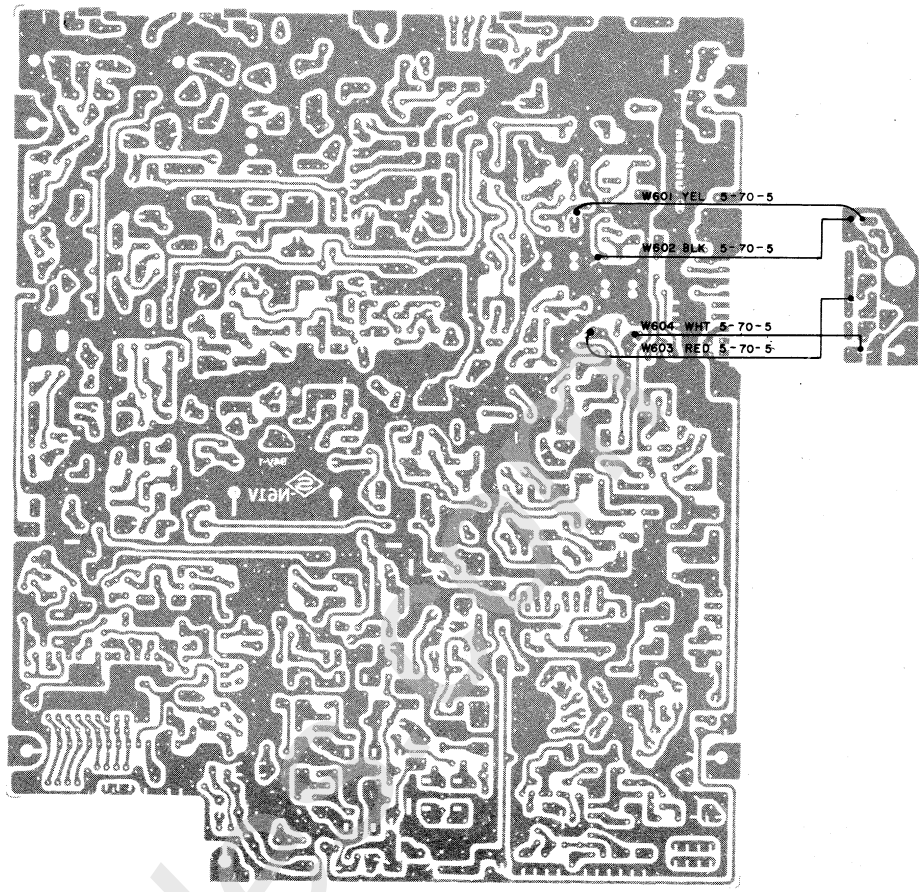
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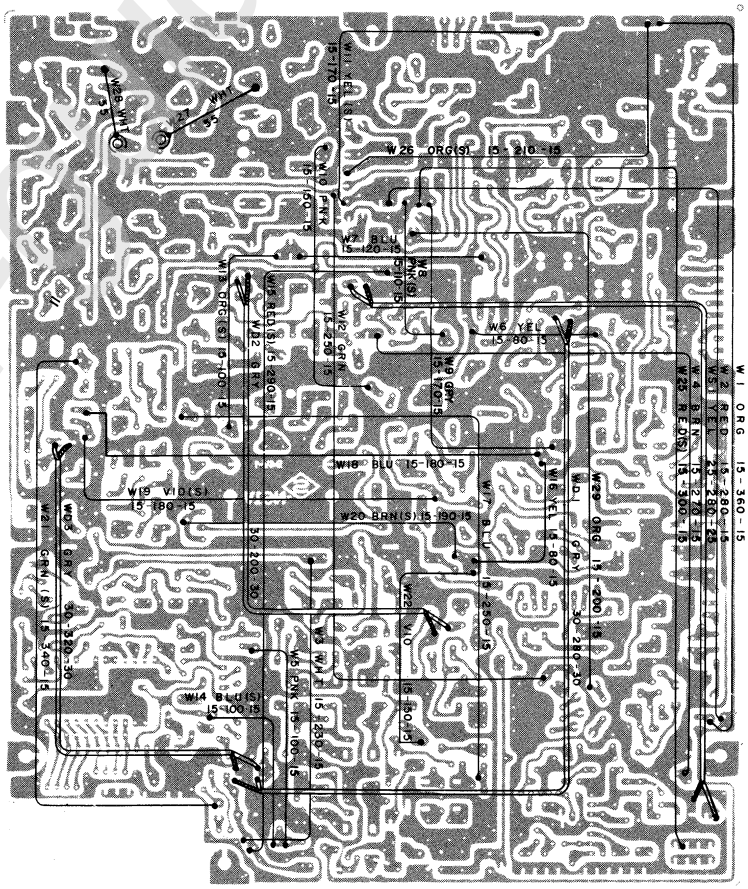
14. ADDITIONAL PARTS ON THE BOTTOM



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15. WIRING DIAGRAM

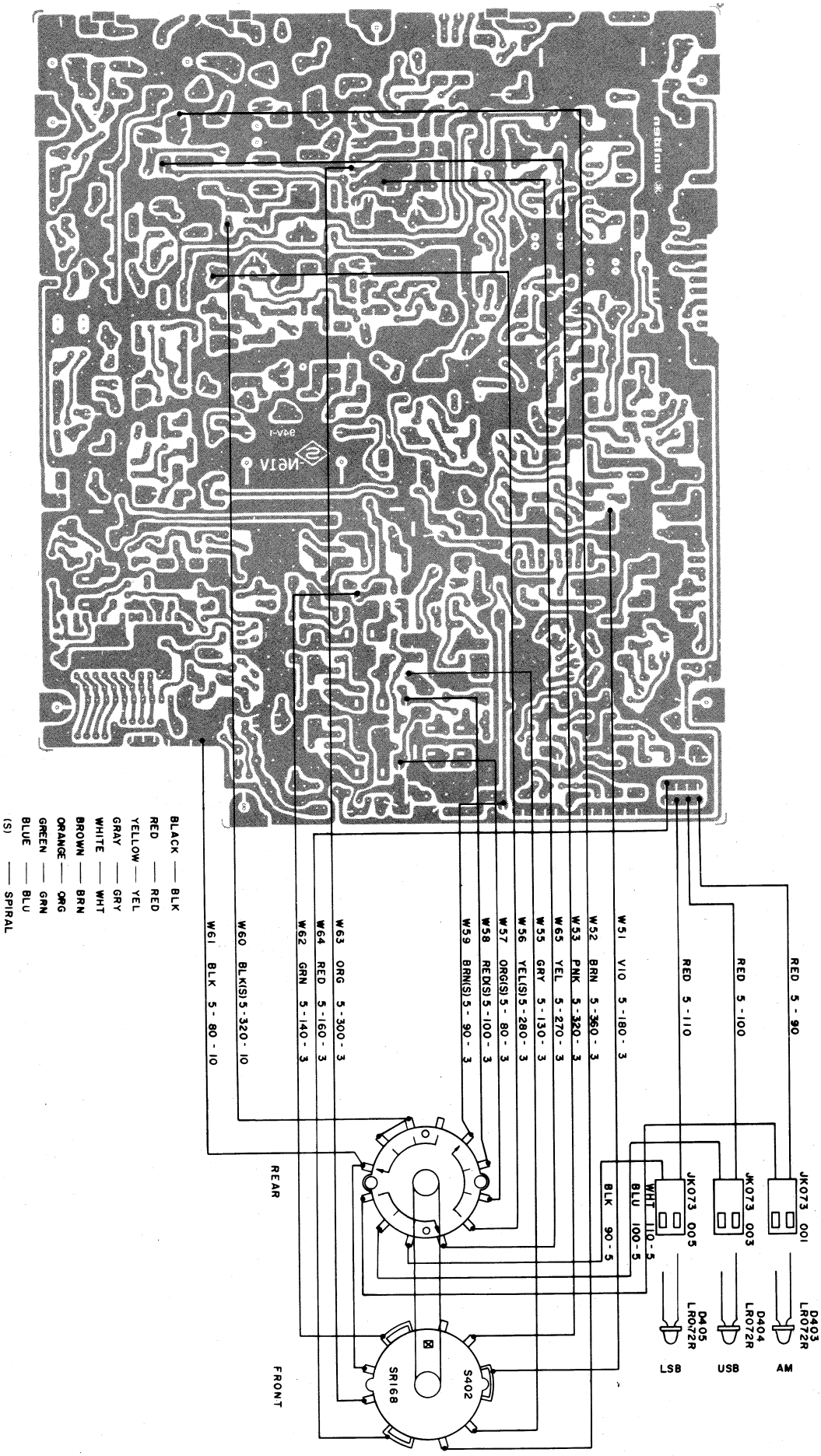




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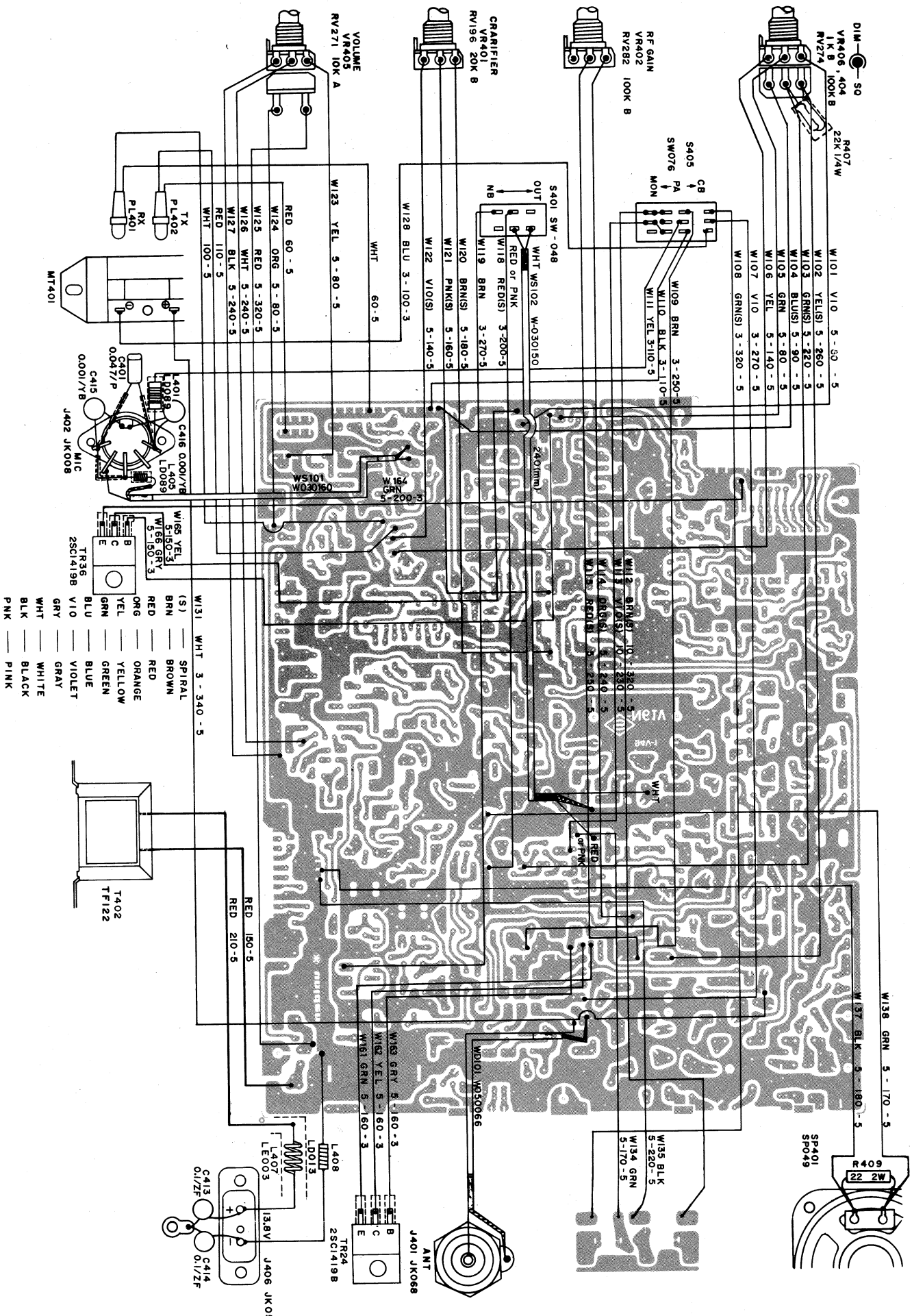
16. WIRING DIAGRAM

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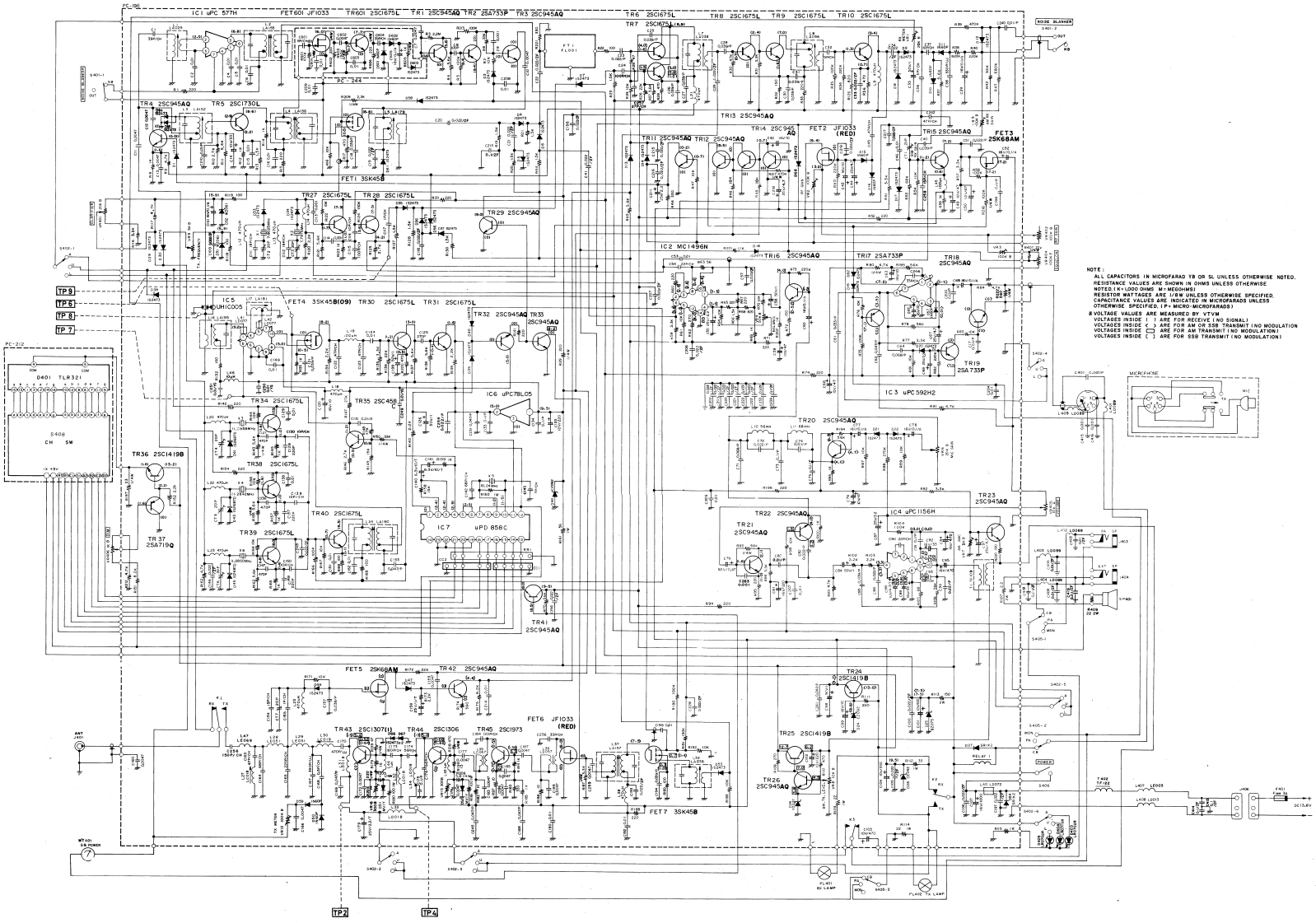
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17. WIRING DIAGRAM



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20. SCHEMATIC DIAGRAM For TRC-449 (21-1562)



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