

SECTION VI- MAINTENANCE AND ALIGNMENTS

This transceiver has been carefully aligned and tested at the factory prior to shipment. The reliability of the solid devices used in TS-788DX should provide years of trouble-free services if the equipment is not abused and the proper routine maintenance is carried out. This section describes the adjusting sequence and procedures of TS-788DX. Please do not attempt to adjust the transceiver without using the proper measuring instruments listed in this manual.

RECEIVER ADJUSTMNT

I. Measuring Instruments:

- a) DC Power Supply 11-16V
- b) Signal Generator
- c) Voltmeter

2. Sensitivity Adjustment:

- (1) Mode.....AM, Freq.....28.000 MHz Frequency Figure.....100 KHz
 - i. Connect the signal generator to the antenna receptacle and set the output of the SG to 90 dB. Adjust L5 for maximum reading on the voltmeter so that AGC will become best.
 - ii. Set the output of the SG to -10dB. Adjust L1, 2, 3 & 4 for maximum reading on the voltmeter.
 - iii. Set the output of the SG to -10dB. And adjust the RIT potentiometer for maximum reading on the voltmeter so that the transceiver tunes to 28,000 MHz correctly. And then adjust L1, 2, 3 & 4 again for maximum reading on the voltmeter.
 - iv. Set the output of the SG to 60dB. and place the VSWR switch on the rear panel in S/R position. Set the indicator of RX meter to 9 by adjusting VR28. This is for RX meter adjustment.
 - v. Set the output of the SG to -8dB and switch off the squelch potentiometer. Check and confirm on the voltmeter if the difference between "ON" and "OFF" of the squelch switch is over 15dB. This is ANL adjustment.
- (2) Mode.....FM, Freq.,.....28,000 (or 27,065 MHz)
For adjustment FM, you should not rotate both RIT potentiometer and Channel Selector. Connect the SG to the antenna receptacle and set the output of the SG to 20dB. Adjust L6 for maximum reading on the voltmeter.
- (3) Mode.....SSB and CW
No special adjustments are necessary for receiver sensitivity.

3. Adjustment of Frequency Range (26,000-29,999 MHz):

If L1, 2, 3, 4 & 5 are adjusted properly as described above, the adjustment of frequency range is unnecessary. In case these adjustments are not well enough performed, rotate L1 clockwise so that the good S/N of high channel side (29,999 MHz) can be obtained. Good S/N of low channel side (26,000 MHz) can be obtained by rotating L1 counter-clockwise.

4. Adjustment of Scanning Stop Sensitivity:

- i. Set the output of the SG to 20dB in 28,000 MHz.
- ii. Adjust VR1 so that scanning stops with 25-35 dB.

- iii. Rotate VR30 so that its resistance becomes maximum.

Move the frequency of the transceiver around 20-30 KHz from 28,000 MHz up or down by turning the frequency selector knob, and let the transceiver start scanning down or up. It will stop at the point of catching RX signal. Even if it stopped, for example, during up scanning, it will never start scanning again if you rotate the frequency selector knob upward again. This is because VR30 has been so adjusted. Now you keep rotating the frequency selector knob upward and simultaneously return to rotate VR30 to the point carefully where it just starts scanning.

TRANSMITTER ADJUSTMENT

I. Measuring Instruments:

- a) Voltmeter
- b) Signal Generator
- c) Power Supply 11-16V DC
- d) Watt Meter
- e) Frequency Counter
- f) Oscilloscope
- g) Two Tone Generator (Audio Generator)
- h) FM Linear Detector
- i) Tester

2. Adjustments of Output Power and Modulation Capacity:

- (1) Mode.....AM, TX Freq.....28,000 MHz

- i. Connect the frequency counter and watt meter to the antenna receptacle of transceiver. Rotate the core of L8, 9, 10, 12 & 14 so that the watt meter will give the maximum indications. Before the above adjustments, check up the frequency counter and confirm on the frequency counter whether the transceiver is sending the correct frequency.
- ii. Adjust VR7 until the watt meter reading indicates 20-30W as the high power. Connect the output of the audio generator to the Mic. input and feed 1 KHz signal to the transceiver. Adjust VR11 & 13 to get the good modulation sensitivity and modulation wave on the oscilloscope.
- iii. If there is the difference of TX output power between high channel and low channel, adjust it as follows:
 1. Set the frequency to 29.999 MHz and adjust L9, 10 & 12 and VR15 for the maximum reading on the watt meter.
 2. Set the frequency to 26.000 MHz and adjust L8 for the maximum reading on the watt meter.

In this way you can keep the balance between the high channel and low channel within about $\pm 2.5W$. In case that the power of 26.000 MHz is higher than one of 29.999 MHz., adjust it by rotating L10 clockwise.

iv. ALC:

Adjust VR20 and make the good balance of frequency range (26.000-29.999 MHz) checking on the watt meter.

(2) Mode.....FM or CW

If AM power is adjusted properly, no adjustment is required as to FM or CW power. If the output is weak, adjust VR7 checking on the watt meter. When you move VR7, confirm again whether AM power is still correct.

ALC:

Adjust VR21 and make the good balance of frequency range (26.000-29.999 MHz) checking on the watt meter.

Adjust FM Modulation Capacity by VR25 checking on the FM linear detector and control the deviation around 2KHz in 26.000 MHz and around 0.5-2 KHz in 29.999 MHz. In this case Modulation Input power is 3mV.

(3) Mode.....USB or LSB

If AM or FM power is adjusted properly, no adjustment is required as to SSB power.

Adjustment of SSB Wave Figure:

Connect the output of the signal generator to mic. input. Adjust mic. sensitivity by VR12 and Carrier Balance of Balance Modulation Circuit by VR9 & 10. Connect the two tone generator to mic. input. Adjust the bias of SSB drive position by VR16 so that the distortion of SSB wave will be corrected.

Adjust the low power by VR8 checking on the watt meter.

(4) Adjustment of CW Keying Monitor

It is the adjustment of keying monitor volume when sending CW signal. Set VR5 at the center position where the voltmeter reading will indicate 1V.

(5) Standardized TX Output Power

	High Power	Low Power
AM	20 — 30 W	over 4 — 10 W
FM, CW	60 — 80 W	over 20 — 40 W
USB	50 — 70 W	10 — 30 W
LSB	50 — 70 W	10 — 30 W

* Electric current: within 12A. maximum

3. Meter Adjustment:

(1) RF Meter

Mode.....FM or CW

High power: Set the VSWR switch of rear panel to S/R position. Adjust VR19 to 20dB on the S/RF meter.

(2) SWR Meter

Mode.....FM or CW

Set the SWR meter of rear panel to the middle position, C (Calibration). Set the pointer of meter to the full scale by adjusting volume knob of transceiver. Next, change the VSWR switch to the bottom position, SWR. Adjust TC4 to the minimum scale. Keep the SWR meter within 1.5 : 1 in 50 Ohm Load.

4. Protection Circuit Adjustment:

Mode.....AM

Voltage of Power Supply.....11V

Antenna.....Open or Short circuit

This circuit operates mainly to protect the final transistor TR21 by ceasing the work of TR16 when SWR exceeds 3 : 1.

After switching on the power, adjust VR29 and observe the lighting of protection circuit lamp. Move VR29 clockwise seeing from the front panel side and set VR29 at the position where a red lamp just lights up.

ADJUSTMENT OF LOCAL OSCILLATOR AND SUB-PRINTED BOARD

1. Measuring Instruments:

- a) Frequency Counter
- b) Oscilloscope
- c) DC Power Supply 14V
- d) Tester

2. Local Oscillator Adjustment:

(1) Main Printed Board

Crystal, X1 for LSB: Adjust the frequency of 10.7015 MHz. by TC1.

Crystal, X2 for USB: Adjust the frequency of 10.6985 MHz. by TC2.

Crystal, X3 for AM & FM: Adjust the frequency of 10.7000 MHz. by TC3.

The hint of the above measurement:

Couple a condenser of the smallest possible capacitance on the probe and apply to the emitter of TR9 and read the following frequencies on the frequency counter.

	AM, FM	CW	USB	LSB
RX	—	10.6985 (X2)	10.6985 (X2)	10.7015 (X1)
TX	10.7000 (X3)	10.7000 (X3)	10.6985 (X2)	10.7015 (X1)

(2) Sub-Printed Board

Crystal, X4 for PLL Base Oscillator Frequency:
Adjust the frequency of 10.240 MHz by TC9.

The hint of the measurement:

Apply the probe coupling the condenser of the smallest possible capacitance to Pin 2 of IC25 and read the frequency of 10.240 MHz on the frequency counter.

Crystal, X5 for PLL Local Oscillator (Adjustment of PLL 11.3 MHz)

Mode.....AM or FM

Freq..... 28.000 MHz

- i. Set the Trimmer Capacitor, TC5, 6, 7 & 8 to the center position.
- ii. Switch off RIT Volume and produce the frequency of 11.3 MHz by rotating L30.
The hint of this measurement:
Connect the frequency counter to the secondary position of L29 and read the frequency of 11.3 MHz.

3. PLL LOCK:

- (1) PLL Lock is achieved after X5 (11.3 MHz), X4 (10.240 MHz) and VCO (X1, 2 & 3) were properly adjusted. Set the channel to 29.999 MHz and rotate L26 clockwise checking the frequency counter so that you will find the place that the frequency is locked. From that position rotate L26 about 60 degrees to the clockwise position so that you can read 19.3 MHz on the secondary position of L27. Change the channel to 26.000 MHz and confirm the frequency of 15.3 MHz. All channels are now being locked consequently.

(Note) When PLL Lock is performed, the voltage should be between 0.5V (26.000 MHz) and 4.7V (29.999 MHz) on Pin 3 of IC25.

Please be noted that the Local Oscillator is actually adjusted within $\pm 500 - 1,500$ Hz for both 15.3 MHz in low channel (26.000 MHz) and 19.3 MHz in high channel (29.999 MHz). That is why the influence of temperature or long-term use are previously considered. Such the adjustment is performed by TC5, 6, 7 & 8 as follows:

Mode	Trimmer Capacitor	26.000 MHz.		29.999 MHz.	
		15.3 MHz	0	19.3 MHz.	0
AM & FM	TC5	15.3 MHz	0	19.3 MHz.	0
CW	TC6	15.3007 MHz	+ 700 Hz.	19.3007 MHz	+ 700 Hz.
USB	TC7	15.3015 MHz	+ 1,500 Hz.	19.3015 MHz.	+ 1,500 Hz.
LSB	TC8	15.2985 MHz	- 1,500 Hz.	19.2985 MHz.	- 1,500 Hz.

(2) Channel Selector:

Adjust the voltage of low channel (26.000 MHz) and high channel (29.999 MHz) by moving the following pots.

* Frequency.....26.000 MHz (low channel)

Set the frequency figure to 100 KHz and adjust VR23 so that the tester indicates 1.5V. Next, set the frequency figure to 100 Hz and adjust VR24 to 1.8V on the tester.

* Frequency.....29.999 MHz (high channel)

Set the frequency figure to 100 Hz and adjust VR26 to 4V on the tester. Next, set the frequency figure to 100 KHz and adjust VR27 to 4.5V on the tester.

The hint of the above measurements:

Apply the tester to Pin 1 of IC1 for adjustment of VR24 & 26 and to Pin 7 of IC1 for adjustment of VR23 & 27.

4. RIT Adjustment:

- i. First, switch off the RIT Volume and check the frequency on the frequency counter.
- ii. Switch on the RIT Volume and observe if the same frequency as of the above i. is found in some place within the variable range of the RIT.
- iii. Next, adjust VR4 so that the frequency as above stays on the center of the variable range of the RIT. The difference under 100-200 Hz will be acceptable.

5. The Correction of TX Frequency:

Mode.....AM or FM

Rit Volume.....OFF.

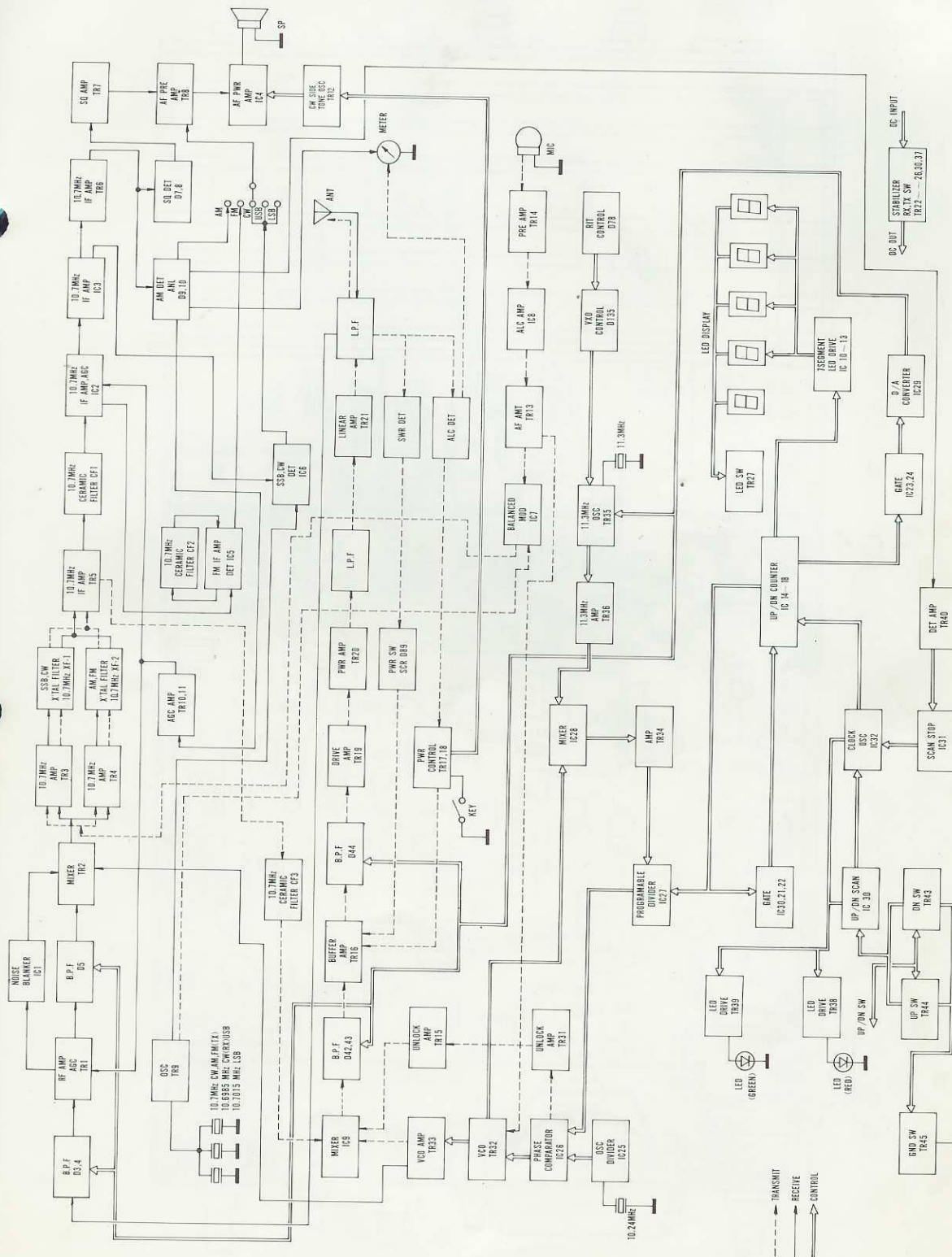
Apply the probe of the frequency counter to the secondary position of L27 and adjust VR14 so that TX and RX frequency stays same.

(Remark:)

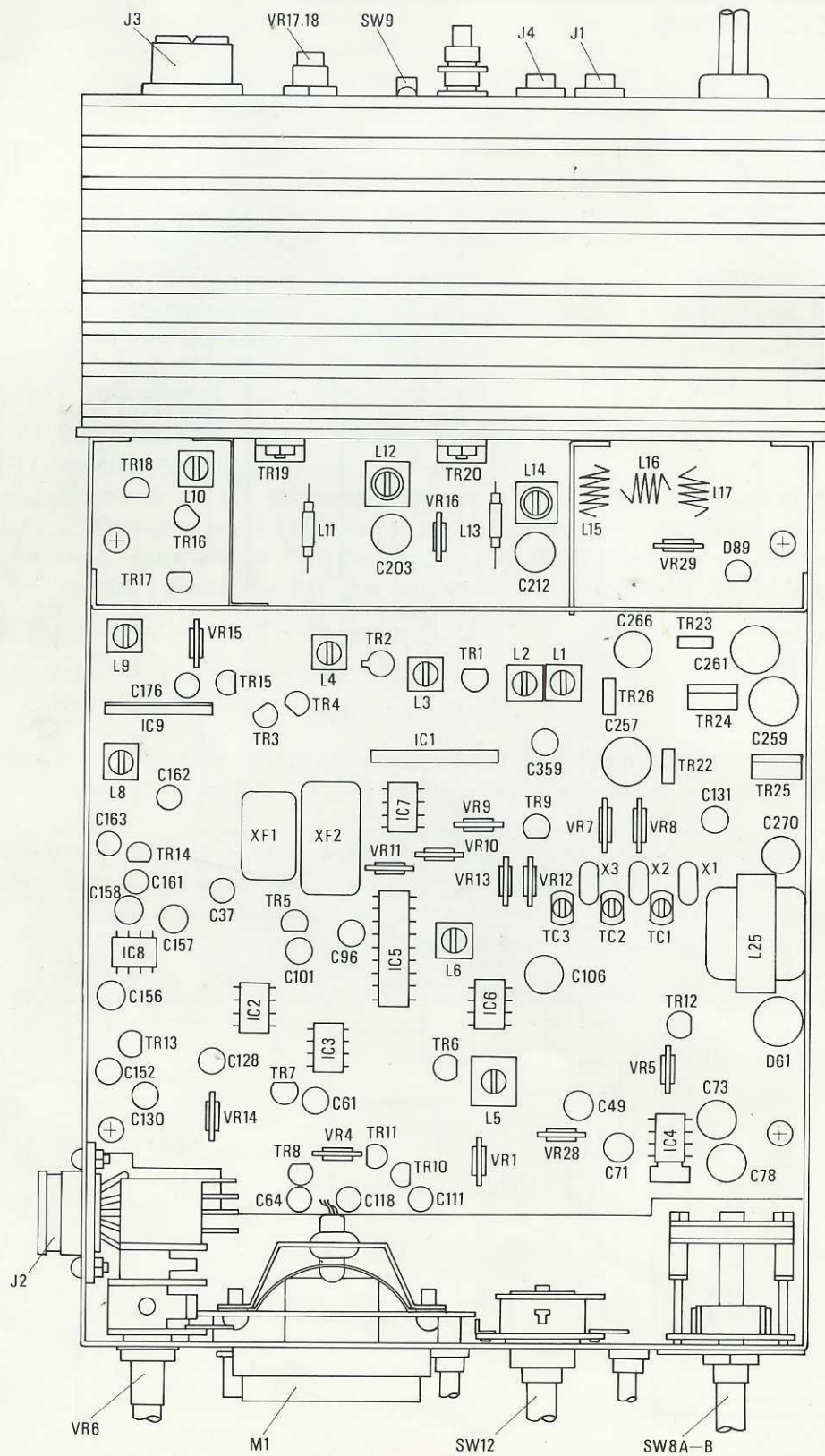
After finishing all adjustments, it is absolutely necessary to connect the speaker connectors to the proper poles, the red wire to the positive pole (+) and the black wire to the negative pole (-). Otherwise it may self-oscillate on FM mode.

SECTION VII-DIAGRAMS & LAYOUTS

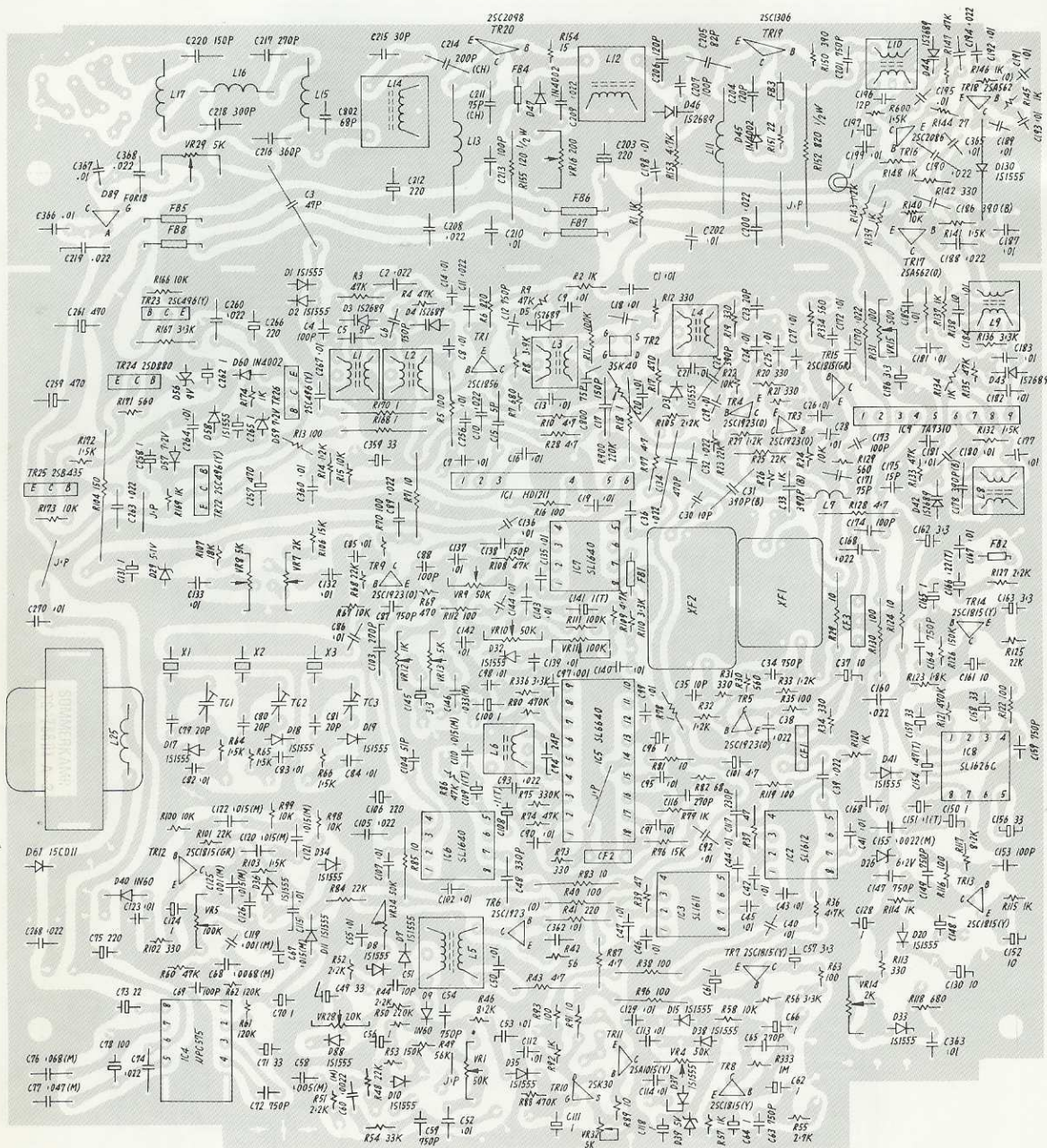
BLOCK DIAGRAM



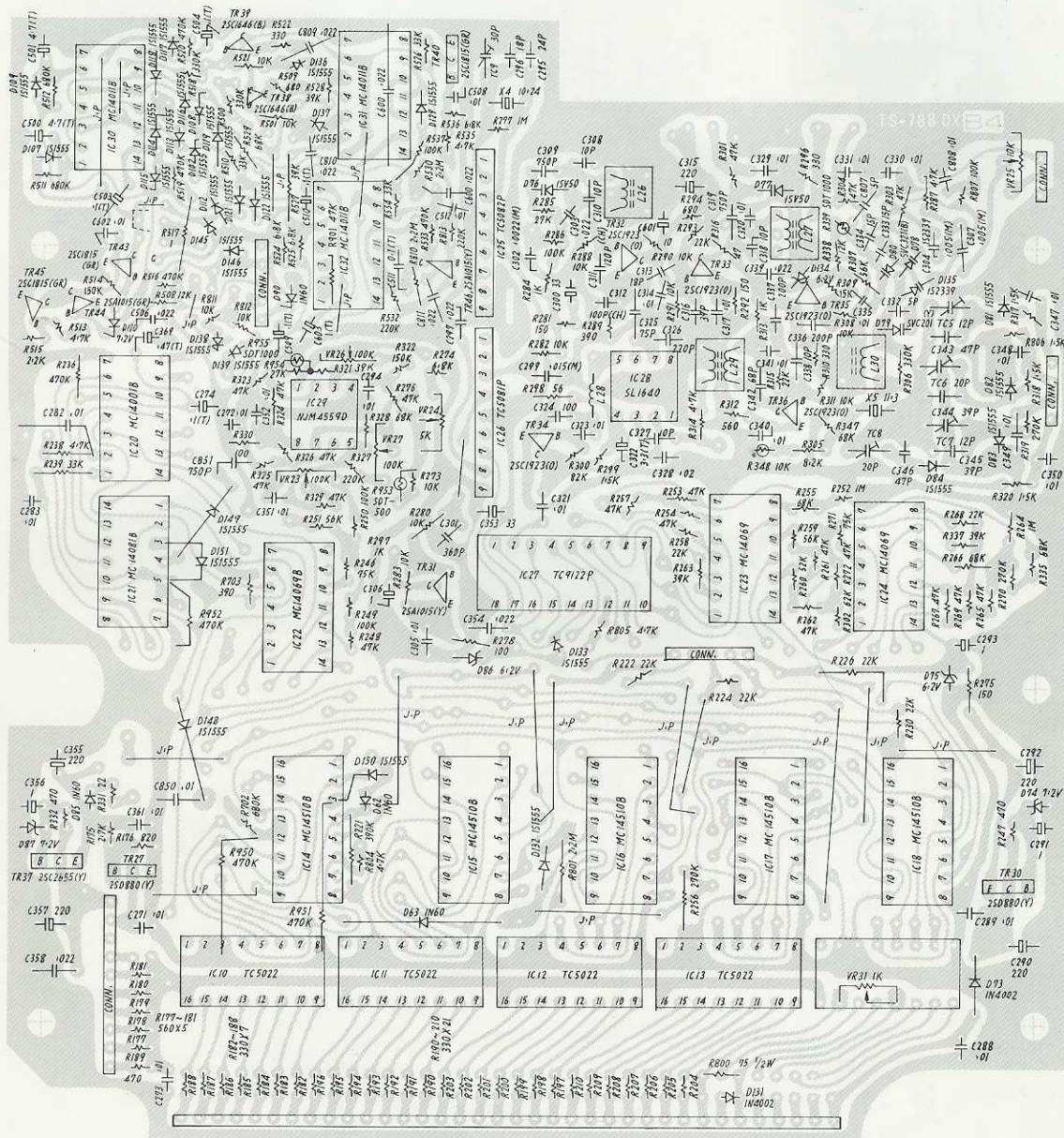
COMPLETE PARTS LAYOUT



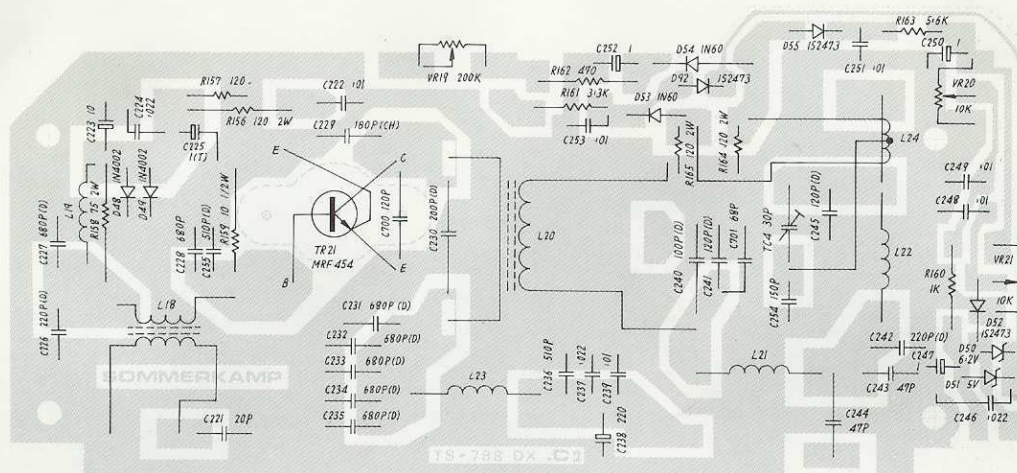
PRINTED CIRCUIT BOARD PARTS LAYOUT (MAIN)



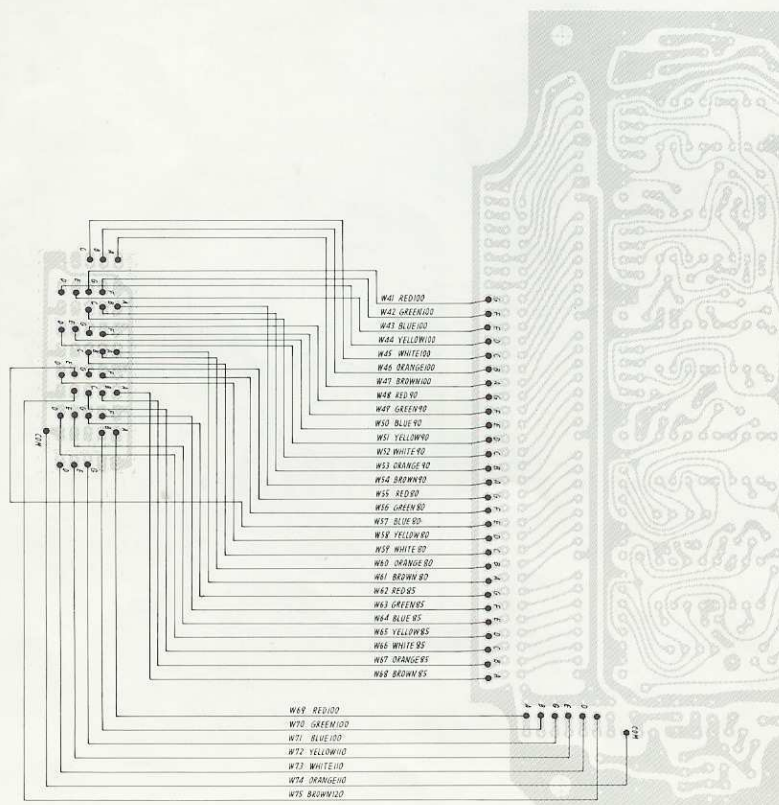
PRINTED CIRCUIT BOARD PARTS LAYOUT (SUB)

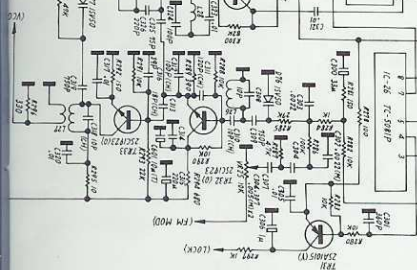
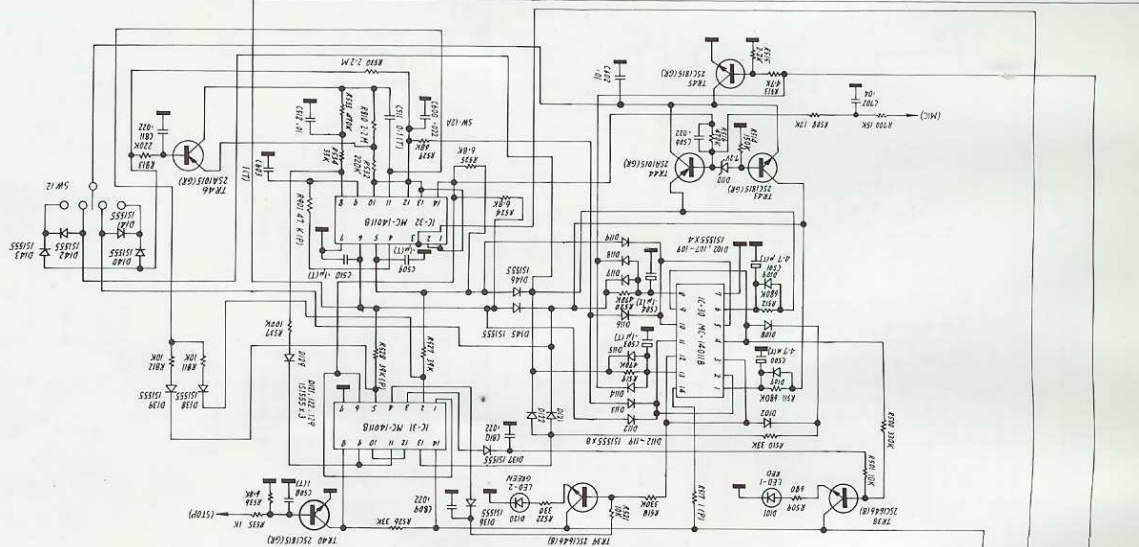


PRINTED CIRCUIT BOARD PARTS LAYOUT

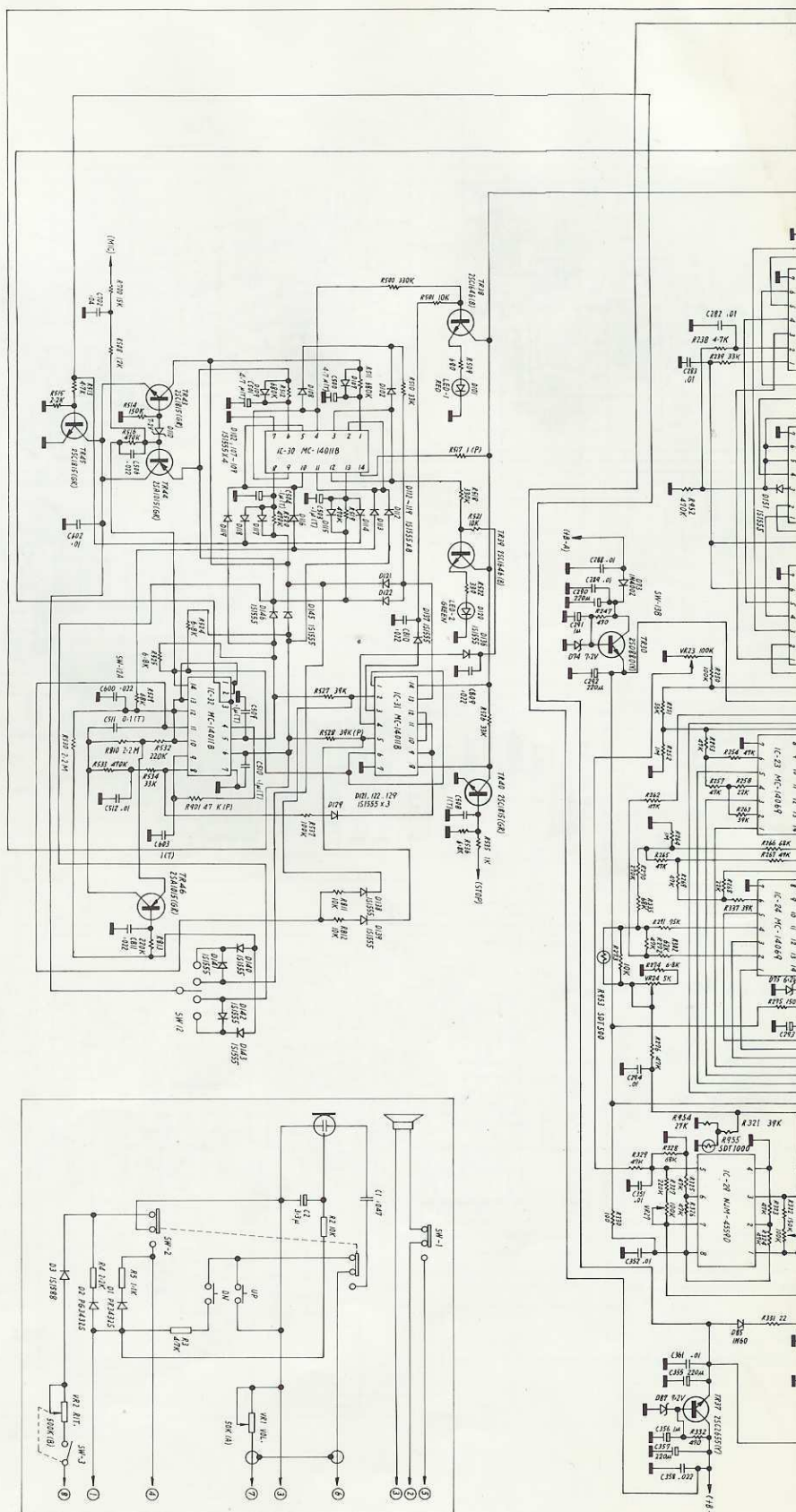


WIRING LAYOUT

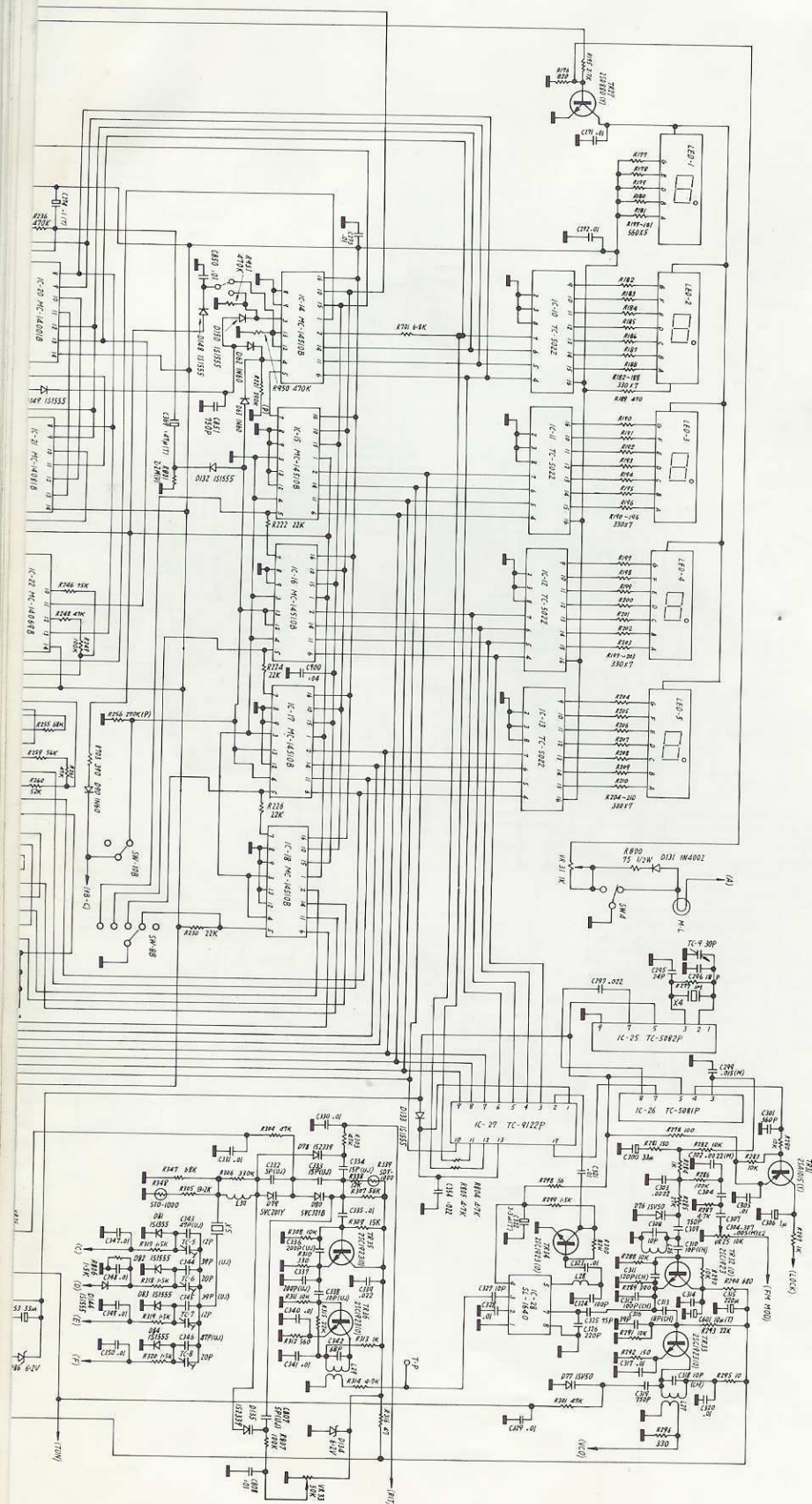




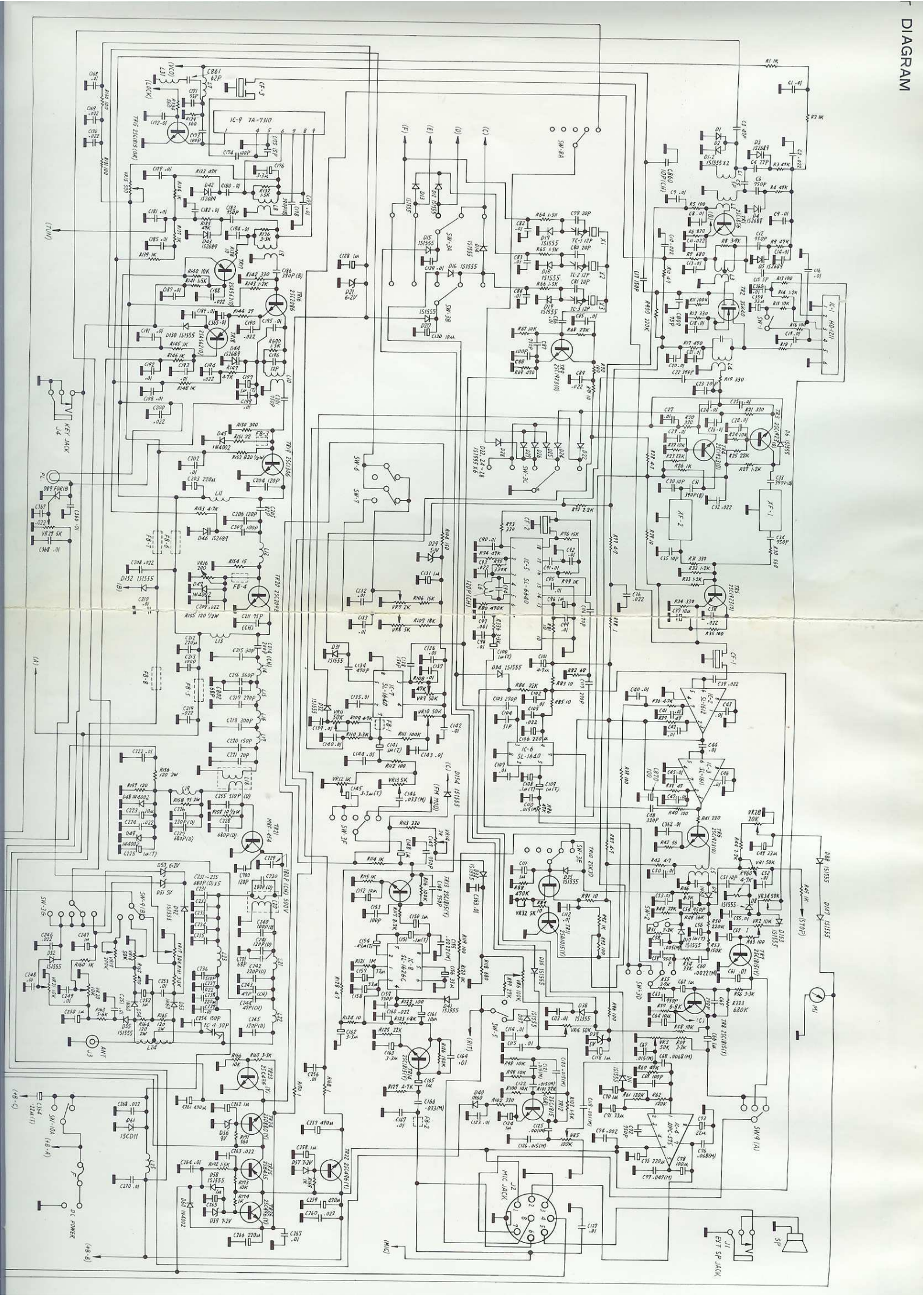
CIRCUIT DIAGRAM

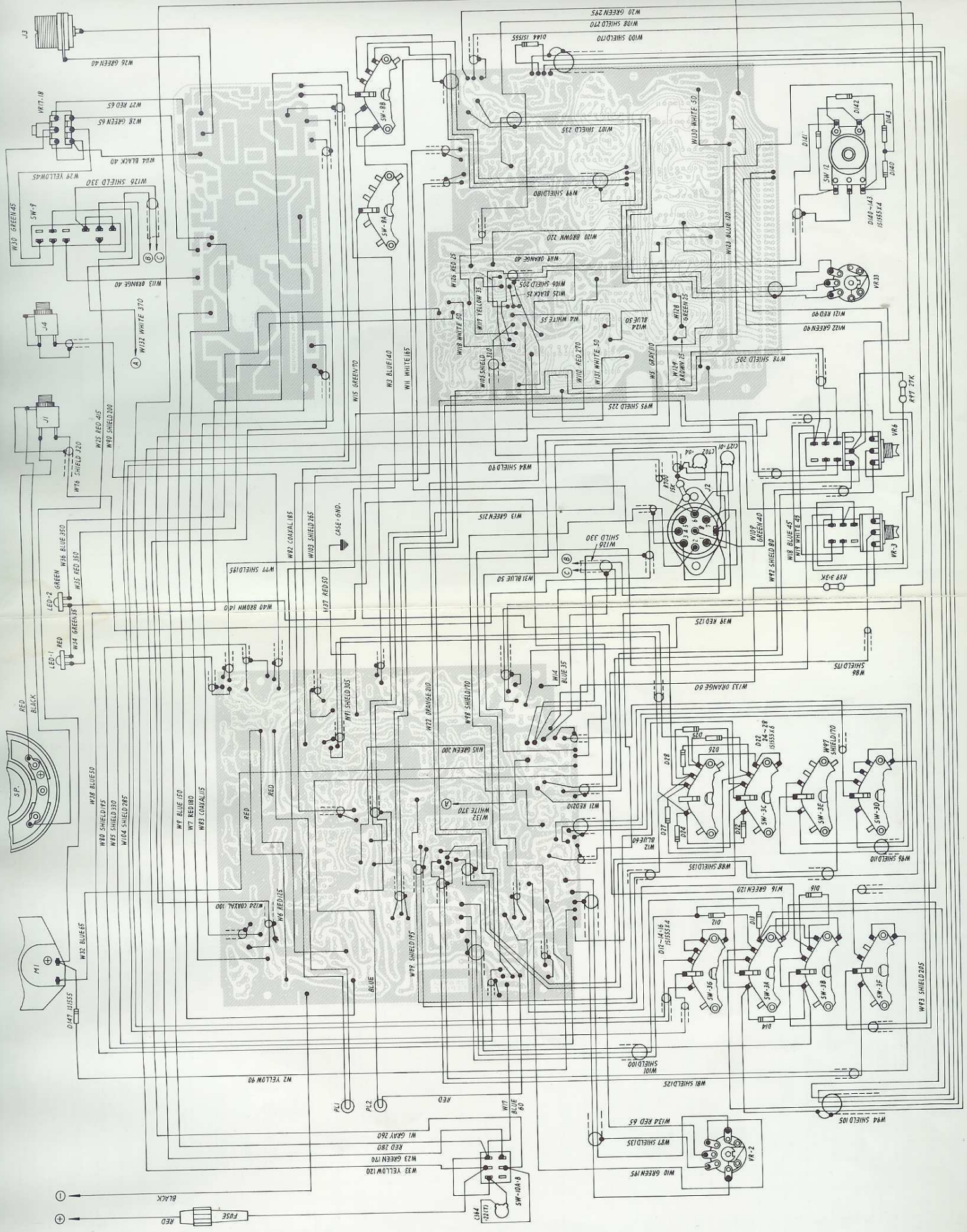


Subject to cha



ge without notice.





VOLTAGE CHART

NOTE: (T) TRANS. (R) RCIV.

TESTER
DC: — 20K Ω /V
AC: — 30MHz Scope

DC VOLT (Voltage in bracket Vpp)				DC VOLT (Voltage in bracket Vp-p)			
TR.NO	TR	BASE	EMITTER	COLLECTOR	TR	BASE	EMITTER
1	2SC1856	2.5	1.8	5.4	26	2SC496(Y)	7.2
3	2SC1923(O)	1.8	1	3.3	27	2SD880(Y)	0.8
4	2SC1923(O)	1.9	0.8	4.5	30	2SD880(Y)	7
5	2SC1923(O)	3.2	2.4	5.6	31	2SA1015(Y)	5.6
6	2SC1923(O)	1.5	0.8	6	32	2SC1923(O)	2
7	2SC1815(Y)	—	—	7	33	2SC1923(O)	1.4(0.3)
8	2SC1815(Y)	0.7	0.4	2.3	34	2SC1923(O)	1
9	2SC1923(O)	1.8	1.2 (0.3)	6.2	35	2SC1923(O)	0.8
11	2SA1015(Y)	1.5	2.2	—	36	2SC1923(O)	1.8
12	2SC1815(6R)	1.5	1	2.7	37	2SC2060(O)	0.9
13	2SC1813(Y)	2.4	2.2	4.2	38	2SC1646(B)	6.6
14	2SC1815(Y)	1.9	1.6	5.7	39	2SC1646(B)	9
15	2SC1815(6R)	—	—	2.5	40	2SC1815(6R)	7
16	2SC2086	0.8	0.6	13.5	43	2SC1815(6R)	0.2
17	2SA562(O)	4.8	13.8	13.8	44	2SA1015(6R)	6
18	2SA562(O)	0.3	0.5	—	45	2SC1815(6R)	1.5
19	2SC1306	0.4	—	13.5	46	2SA1015(6R)	0.8
20	2SC2098	0.4	—	13.5	—	—	3.3
21	MRF45A	0.5	—	13.8	—	—	3.2
22	2SC496(Y)	7.2	6.5	13.8	—	—	—
23	2SC496(Y)	0.4	—	8.5	—	—	—
24	2SD880(Y)	9	8.5	13	—	—	—
25	2SB435	12	13.8	13	—	—	—

DC VOLT	ON	OFF
VXO		
RIT		

DC VOLT (Voltage in bracket Vp-p)			
TR.NO	FET	GATE (1)	GATE (2)
2	3SK40	—	5.9
10	2SK30	—	6

PIN NO / DC VOLT (Voltage in bracket Vpp)		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
IC.NO	IC	—	0.8	2.2	6	5.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	HD-1211	—	6	2.3	—	0.9	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	SL-1612	—	5.5	1.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	SL-1611	—	5.5	1.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	MPC-575	1.6	13.8	13	7.2	6.2	13.8	0.3	1.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	SL-6640	5	5.2	0.8	4	4	5.8	1.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	SL-1640	—	2.8	2.7	5.9	5.2	—	2.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7	SL-1640	—	3	3	6.2	5.6	—	2.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8	SL-1626C	0.3	2.9	6	1.2	1	—	1.4	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9	TA-7310	2.6	—	—	2.6	—	4.6	2.2	4.6	13.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
25	TC-5082P	—	2	2.4	—	5.5	—	1.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
26	TC-50891P	—	—	—	—	—	—	—	2.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
28	SL-1640	—	2.3	2.5	5	4.5	—	2.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
29	NJM-4559D	1.5	3	0.9	—	0.9	3	2.6	6.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

VOLTAGE CHART

NOTE: (T) TRANS. (R) RCIV.

TESTER
DC: — 20K Ω /V
AC: — 30MHz Scope

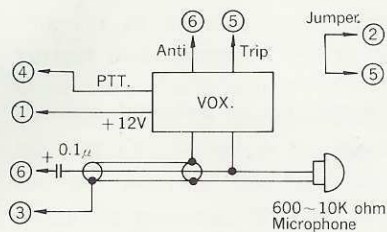
DC VOLT (Voltage in bracket Vpp)				DC VOLT (Voltage in bracket Vp-p)			
TR.NO	TR	BASE	EMITTER	COLLECTOR	TR	BASE	EMITTER
1	2SC1856	2.5	1.8	5.4	26	2SC496(Y)	7.2
3	2SC1923(O)	1.8	1	3.3	27	2SD880(Y)	0.8
4	2SC1923(O)	1.9	0.8	4.5	30	2SD880(Y)	7
5	2SC1923(O)	3.2	2.4	5.6	31	2SA1015(Y)	5.6
6	2SC1923(O)	1.5	0.8	6	32	2SC1923(O)	2
7	2SC1815(Y)	—	—	7	33	2SC1923(O)	1.4(0.3)
8	2SC1815(Y)	0.7	0.4	2.3	34	2SC1923(O)	1
9	2SC1923(O)	1.8	1.2 (0.3)	6.2	35	2SC1923(O)	0.8
11	2SA1015(Y)	1.5	2.2	—	36	2SC1923(O)	1.8
12	2SC1815(6R)	1.5	1	2.7	37	2SC2060(O)	0.9
13	2SC1813(Y)	2.4	2.2	4.2	38	2SC1646(B)	6.6
14	2SC1815(Y)	1.9	1.6	5.7	39	2SC1646(B)	9
15	2SC1815(6R)	—	—	2.5	40	2SC1815(6R)	7
16	2SC2086	0.8	0.6	13.5	43	2SC1815(6R)	0.2
17	2SA562(O)	4.8	13.8	13.8	44	2SA1015(6R)	6
18	2SA562(O)	0.3	0.5	—	45	2SC1815(6R)	1.5
19	2SC1306	0.4	—	13.5	46	2SA1015(6R)	0.8
20	2SC2098	0.4	—	13.5	—	—	3.3
21	MRF45A	0.5	—	13.8	—	—	3.2
22	2SC496(Y)	7.2	6.5	13.8	—	—	—
23	2SC496(Y)	0.4	—	8.5	—	—	—
24	2SD880(Y)	9	8.5	13	—	—	—
25	2SB435	12	13.8	13	—	—	—

DC VOLT	ON	OFF
VXO		
RIT		

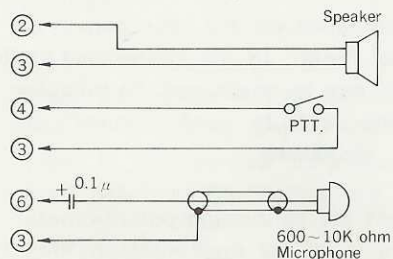
DC VOLT (Voltage in bracket Vp-p)			
TR.NO	FET	GATE (1)	GATE (2)
2	3SK40	—	5.9
10	2SK30	—	6

PIN NO / DC VOLT (Voltage in bracket Vpp)		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
IC.NO	IC	—	0.8	2.2	6	5.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	HD-1211	—	6	2.3	—	0.9	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	SL-1612	—	5.5	1.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	SL-1611	—	5.5	1.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	MPC-575	1.6	13.8	13	7.2	6.2	13.8	0.3	1.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	SL-6640	5	5.2	0.8	4	4	5.8	1.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	SL-1640	—	2.8	2.7	5.9	5.2	—	2.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7	SL-1640	—	3	3	6.2	5.6	—	2.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8	SL-1626C	0.3	2.9	6	1.2	1	—	1.4	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9	TA-7310	2.6	—	—	2.6	—	4.6	2.2	4.6	13.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
25	TC-5082P	—	2	2.4	—	5.5	—	1.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
26	TC-50891P	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
28	SL-1640	—	2.3	2.5	5	4.5	—	2.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
29	NJM-4559D	1.5	3	0.9	—	0.9	3	2.6	6.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

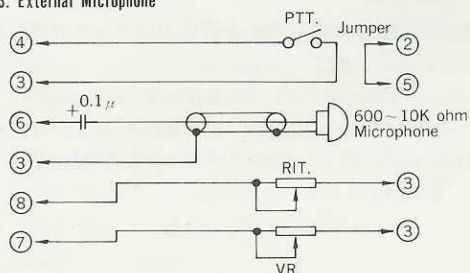
1. Microphone with VOX.



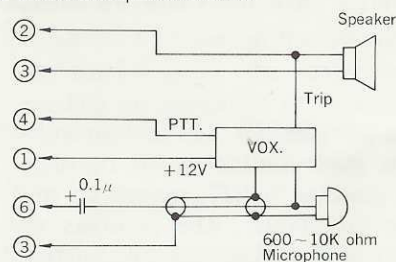
2. Headset or Telephoneset with PTT.



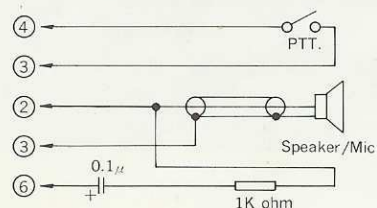
3. External Microphone



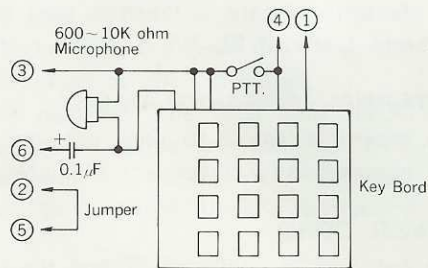
4. Headset or Telephoneset with VOX.



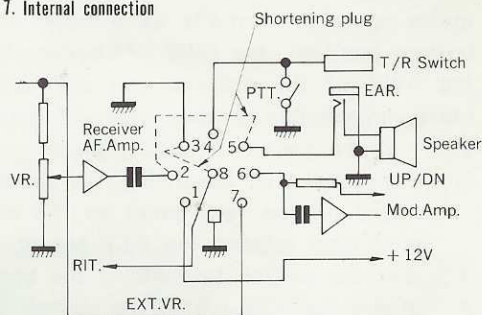
5. External Microphone Speaker with PTT.



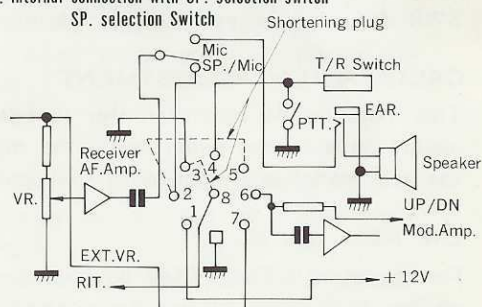
6. Telephone encoder Mic.



7. Internal connection



8. Internal connection with SP. selection switch



9. Connections number

