7-ULTRA
(SERVICE MANUAL)

SPECIFICATION

1.RECEIVER

Description	AM 40 Channel
Frequency Range	26.965~27.405 (MHz)
Frequency Response	-6dB 300~3000Hz
Power Source	13.8 (V) DC
Audio Output Lode	8 Ohm Resistive
Audio Output	0.5 (W)
Squelch Adustable From	0.5 μV to 1mV
Sensitivity	0.5 μV or Batter for 10 dB (S+N)/N
Intermeniate Frequency	1 ST 1F - 10.695 MHz 2 ND 1F - 455KHz
HUM & Noise	More Than 35 dB
Blocking	More Than 50 dB
Desensitization Immunity	More Than 40 dB
Adjacent Channel Rejection	More Than 40 dB (2 Signal State)
Osillator Drop Out Voltage	Less Than 9 V
Currant Drain	250 mA (N0 Signal) 1000 mA (10% Audio)

2.TRANSMITTER

Carrier Power	4 Watts
Current Drain	1000 mA (No Modulation)
(13.8 Volts Supply)	1700 mA (Full Modulation)
Modulation Capabilities	+90%~-90%
Spurious Radiation	Less Than -60 dB
Antenna Impedance	50 Ohms
Frequency Tolereance	0.002 %
HUM & Noise	More Than 40 dB
Frequency Response Range	-6 dB 300~2500 Hz
AMC Range (50 to 100% MOD)	More Than 35 dB
Mic Senstivity (at 1 KHz)	5 mV (50% MOD) 10 mV (80% MOD)

OPERATING INSTRUCTIONS

Having properly installed your batteries and hooked-up the antenna, you are now ready to adjust your radio for optimum reception and voice transmission.

Turn the power "On"

Set to the desired channel.

Adjust the squelch control knob to reduce any undesirable background nois when no signal is being received. To do this, select a channel where no signals are present, or wait until signals cease on your channel. Than, rotate the squelch control knob clockwise to a point where the background noise ceases.

NOTE: When the squelch is set properly, the speaker will remain quiet until a signal is received. In order to recive weak signals, do not set the squelch too high.

Adjust the volume to the desired listening level.

To Transmit

Press and hold the push-to-talk button. Speak slowly and clearly in a normal voice two to three inches from the microphone. A built-in modulation control circuit will automatically adjust the microphone input level. There is no need to speak loudly.

To Receiver

Release the push-to talk button.

THEORY OF OPERATION

1.INTRODUCTION
The synthesizer is implemented with the pollowing
Components: PLL IC (IC501)
X-TAI (X 1)
LED Display (LED)

IC1 is a cmos lsi that includes most of PLL block. The VCO with varicap diode D601 as part of the osillator tank circuit. Q602 is a switching transistor to connect or disconnect the tuning capacitor in the VCO osillator tank circuit for transmitter or receiver.

2.REFERENCE FREQUENCY
The crystal, X1(10.240 MHz) and other components at pin 10 and 11 of IC501 from an oscillator with an amplifier internal to IC501.

3.VCO
Q603 is connected as a hartler type oscillator with varicap diode as part of the tank circuit. With appropriate control voltage on D601 the VCO can be made to oscillate over the required range of 13.4825 MHz to 16.710 MHz.

4.PROGRAMMABLE DIVIDER AND ITS CONTROL
The programmable inputs (7-segment code) are fed to pins 1 to 7 IC501. The programmble input consist a 7-segment code to light channel indicator LED (LED Display). For CH.1 "b" and "c" of the first LED element of LED display will light. The programmable input "b" gose low to porduce CH.1 devide (RX:N=3254, TX:N=5393)

For each channel number input, an internal code converterrom provides the apropriater binary control to the programmble divider for that channel. Since the binary number required is different during transmit and receive, an additional bit is required at pin22 of IC501 to allow the rom to recognize the TX/RX status. Pin 24 is internally tied to plus 5 volts which is the receive status.

During transmit the puse to talk switch rounds pin 24 thru diode (D902,D903) which is the transmit status.

The programmable divider output is fed to the phase detector for comparison with the 2.5 KHz reference see table 1 for actual input and divide ratio on all channels.

5.PHASE DETECTOR AND VCO CONTROL
The phase detector is a digital phase comparator which compares the leg edges of the reference with programmable divider output square waves and develops a series of pulses whose DC leve; depends on whether the phase error is leading or lagging. The phase detector pulse output is fed to a charge pump and then to pin 5 of IC501. The charge pump output is fed to an active low pass filter whith consists of R967. R608, C521 and the amplifier between pin 16 and 16 of IC501. The low pass filter output at pin 15 of IC501 is purther filtered and fed to varicap D601 control the VCO frequency.

The result is a second order PLL with the loop dynamics essentially controlled by the active low pass filter.

6.TRANSMIT/RECEIVE BUFFER AMP

The VCO output is fed into buffer AMP Q601 from the secondary of L501.

7.TRANSMIT DOUBLER

The Q603 output is obtained as emitter follower output tank circuit is double transistor Q701. At this stage. The frequency is doubled. The Q701 output tank circuit is double tuning circuitries (27 MHz) L701 and L702 to stop the 13.5 MHz frequency.

8.SWITCHING OF TURNG CAPACITOR IN VCO OSILLATOR TANK CIRCUIT

The VCO circuit must turn with a wide range of frequencies 13.4825 MHz~13.7025 MHz for transmitter and 16.27 MHz~16.710 MHz for receiver. The use of one tuning capacitor in common has adverse effects as a decrease in C in the tuning circuit and the occurrence of may spuriouses. To eliminate these effects. The tuning capacitance is switched for transmission or reception. The tank circuit consists of the primary of L501, C602, C609. When receivin Q602 becomes on. So, the primary of L501 and the paralel capacitance of C603 and C609 make turning function.

9.RECEIVER LOCAL OSCILLATOR OUTPUTS

First Mixer:

The secondary output of VCO tank circuit L501 is injected through buffer AMP Q601 and the emitter follower output through the base of 1'st mixer Q103.

Second Mixer:

The oscillation output. Oscillated with 10.240 MHz crystal X1 across pins 10 and 11 of IC501, is output from pin 11 and injected into the bases of Q201.

10.FREQUENCY STABILITY LET : FO = Crystal oscillator frequency

FR = Phase detector reference frequncy

FVCO = VCO Frequency

THEN: FR = FO/4096

And under locked conditions : FR = FVCO/N

where N is the programmable divider divide ration

THEN : FVCO = N * FR = N(FO/4096)

From which it can be seen that the percentage error in FT is the same as the percntage error in fo. The stability of the crystal oscillator is determined primarily by the crystal and to a lesser extent by the active and passive components of the oscillator. He choice of crystal and components is such that the required frequency stability is maintained over the required voltage and temperature range.

11.DESCRIPTION OF OTHER CIRCUITS

TRANSMITTER

a. RF Amplification

The output of doubler AMP Q701 is FED theough double tuning (27 KHz) L701 and L702 to the base of pre AMP Q702. The output is then supplied through tuning circuit RFC701. To RF driver AMP Q703. The Q703 output is capacitance devided by tuning circuit C715 and C716 and passed theough L-C tuning circuit.

b. Circuit for Suppression of Spurious Radiation

The tuning circuit between frequency synthesizer and fianl AMP Q704 and 4-stage "PI" network C801, L801, C802, L802, C803, L803, C804, L804 in the Q704 output circuit serve to suppress spurious radiation this network serve to impedance match Q704 to the antenna and to reduce spurious content to acceptable levels in the frequency synthesizer.

c.Circuits for Limiting Power

Diring factory alicnment, the series base resistor of final Q704 (R711)is selected to limit the available power to sightly more then 4 watts. The tuning is adjusted so that the actual power is from 3.6 to 3.9 watts. There are no other controls for adjusting power.

d.Modulation

The mic input is FED to audio power IC401 which feeds modulation transformer T1. The audio output at the secondary of T-1 is FED inseries with the B+ voltage thru diode D404 to the collectors of driver Q703 and final Q704 to collector modulate both these stages.

e.Circuits for Limiting Modulation

A portion of the modulating voltage is rectified by D403 which turns on Q402 which attenuates the mic input to R407. The resulting feedback loop keeps the modulation from exceeding 100 percent for inputs approximately 40dB greater that required to produce-50 percent modulation. The attack time is about 20ms. And the release time is about 300mS.

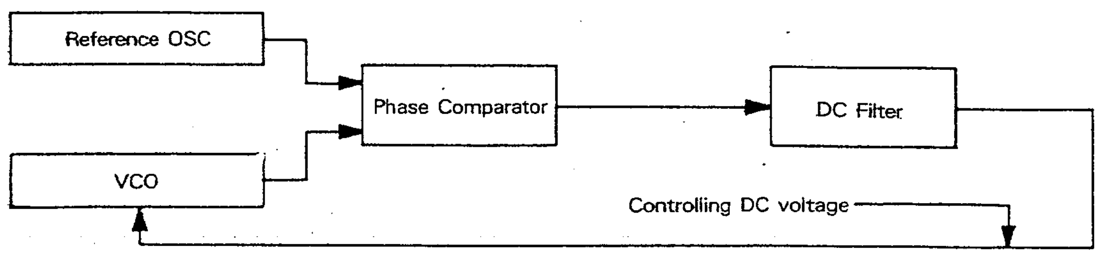
RECEIVER

The receiver is a double conversion conversion super heterodyne with first if at 10.695 MHz and the second if at 455 KHz. The synthesizer supplies the first local oscillator 10.695 MHz below the received frequency and the second local oscillator at 10.240 MHz. The detector output provides reverse AGC to all previous stages except Q204. Squelch is controled by Q401.

1. Fundamental theory of PLL Circuitry

The purpose of P.L.L. (Phase Locked Loop) circuit is to generate multiple number programable frequencies from a signal reference frequency with quartz crystal accuracy.
A basic PLL circuitry consists of reference oscillator. VCO. phase comparator and DC filter (low pass filte
With the above circuit the VCO (Voltage Controlled Oscillator) Frequency is effectively locked to the reference oscillator, and its accuracy is as good as the reference oscillator.
Since the CB radio's adjacent channel spacing is 10KHz (or multiple of 2.5KHz), our purpose should be to produce multiple of programable frequencies that are spaced apart by 10KHz.

(Figure 1)

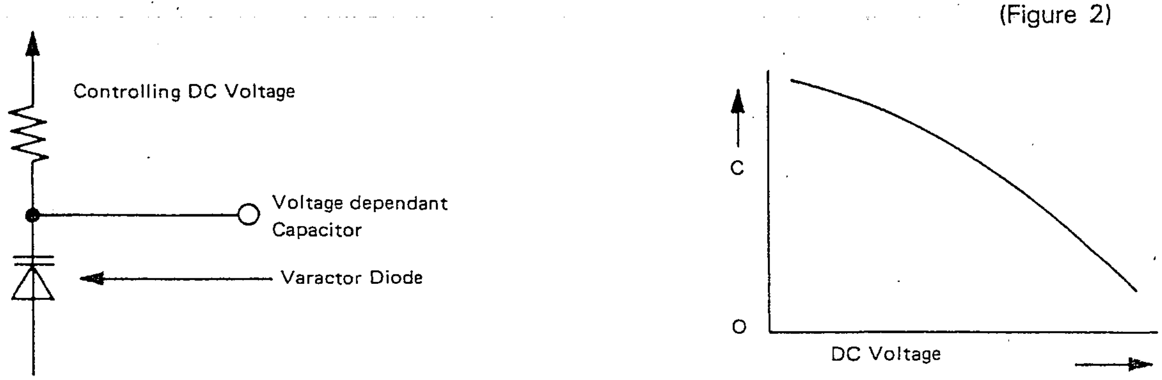


Therefore the basic PLL circuitry is expanded as follow:
Note that the reference frequency of 2.5KHz is obtained by dividing the 10.24MHz by 4096 times.
(2.5KHz reference is used instead of 10KHz for division convenience).
See Table 1 for transmit/receive mode VCO frequencies.

2. Transmitter Circuit

The VCO frequency selected by the channel selector switch is doubled to generate desired transmit frequency.
The doubling is done by the Q701.
The resulting transmit frequency is filtered by L701, and L702.
Q702 is an amplifier/switch circuit. When VCO frequency is out of "Lock" condition pin 18 of IC1 pulls down bias voltage of Q702 to ground disabling Q702 from passing possible illegal frequencies Q21 is a RF power driver circuit, and Q704 is the final RF power amplifier.
The most important part of VCO circuitry is a voltage controlled variable capacitor called vari-cap or varactor diode whose capacitance depends on DC voltage applied to its cathode.

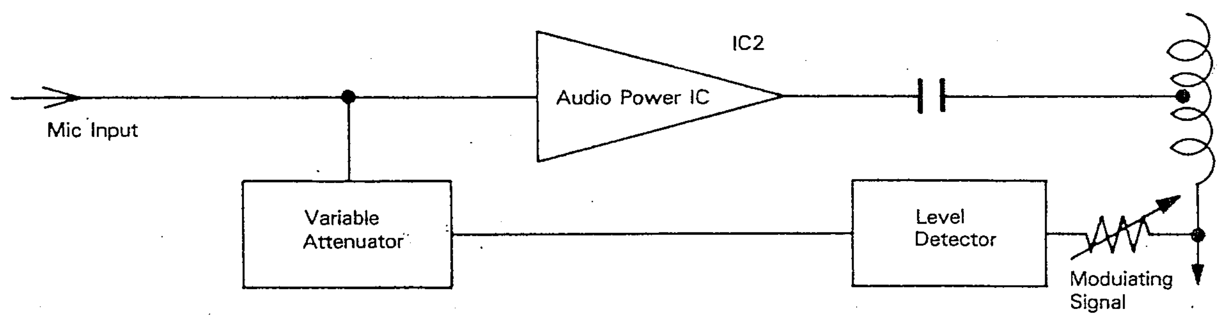
(Figure 2)



The varactor diode is responsible for setting VCO frequency, and once set it regulates the VCO frequency against the reference.
The VCO frequencies are chosen in 13 to 16MHz range as shown on Table 1.
To obtain transmitt signal the VCO is doubled. As an example for channel 1:
13.4825 × 2 = 26.965MHz
For receiver mode the VCO is used as a first local oscillator. For channel 1:
26.965-16.27 = 10.695MHz
The above first IF of 10.695MHz is mixed again with 10.24MHz crystal oscillator frequency which serves as the second local oscillator.
10.695-10.24 = 0.455MHz
As can be seen above the VCO frequency shifts from 13.485 to 16.27MHz when changed from transmitt to receive for the same channel 1.
The shift is accomplished by "read only memory" incorporated inside the PLL IC1 between the selector switch and the VCO divider (programable).
When the transmitter mode to the ICI through pin 30, the programable divider will divide incoming VCO frequency by 5393 to produce 2.5KHz sampling signal.
13.485 ÷ 5393 = 2.5KHz
For the receiver mode the programable divider will automatically change to divide the VCO frequency by 5396 to produce 2.5KMz Sampling sign.
16.27 ÷ 3254 = 5KHz

A modulating audio signal is applied to the collectors of Q703 and Q704 through a audio power transformer T1
The audio signal (mic input) amplified by a signal power IC401.
The modulation limiting is accomplished by a automatic level control circuit switch is as follow:

(Figure 3)



L11 and C89 are series resonator, and L12, L13, C90, C301 and C91 make up pie-low pass filter.

3. Receiver Circuit

In the receiver mode of operation, Q506 transistor is turned off.
Also bias voltage is applied to Q202 and a proper bias and AGC voltage is established to Q102, Q103 and Q201.

Q102 is a 27MHz RF input amplifier and any excessive input signal is limited by diodes D101 and D102
The amplified 27MHz is mixed with VCO frequency selected by channel switch.
For channel 1 VCO is set at 16.27MHz. The resulting first IF is 26.965-16.27 = 10.695MHz.

Q103 is the first converter, and the 10,695MHz is sharply filtered by L104 and a ceramic filter CF-1.

The first IF is again mixed with a second local oscillator of 10.24MHz. 10.695-10.24 = 0.445MHz. Q201 is the second converter and the 455KHz second IF is filtered by a razor sharp ceramic filter of CF-2 coupled with L902.

Q202 is a first 455KHz amplifier.
D201 is a detector diode which produces audio signal as well as a negative DC voltage for AGC action. The negative voltage also provides forward biasing to the cathode of ANL clipping. TR of Q204.
The biasing voltage has a time constance determined by R217 and C209.

Program Data and Frequency Division

CHANNEL	U.S.A.		
	FREQ	TX VCO FREQ (TX F IN)	RX VCO FREQ (RX F IN)
1	26.965	13.4825	16.27
2	26.975	13.4875	16.28
3	26.985	13.4925	16.29
4	27.005	13.5025	16.31
5	27.015	13.5075	16.32
6	27.025	13.5125	16.33
7	27.035	13.5175	16.34
8	27.055	13.5275	16.36
9	27.065	13.5325	16.37
10	27.075	13.5375	16.38
11	27.085	13.5425	16.39
12	27.105	13.5525	16.41
13	27.115	13.5575	16.42
14	27.125	13.5625	16.43
15	27.135	13.5675	16.44
16	27.155	13.5775	16.46
17	27.165	13.5825	16.47
18	27.175	13.5875	16.48
19	27.185	13.5925	16.49
20	27.205	13.6025	16.51
21	27.215	13.6075	16.52
22	27.225	13.6125	16.53
23	27.255	13.6275	16.56
24	27.235	13.6175	16.54
25	27.245	13.6225	16.55
26	27.265	13.6325	16.57
27	27.275	13.6375	16.58
28	27.285	13.6425	16.59
29	27.295	13.6475	16.60
30	27.305	13.6525	16.61
31	27.315	13.6575	16.62
32	27.325	13.6625	16.63
33	27.335	13.6675	16.64
34	27.345	13.6725	16.65
35	27.355	13.6775	16.66
36	27.365	13.6825	16.67
37	27.375	13.6875	16.68
38	27.385	13.6925	16.69
39	27.395	13.6975	16.70
40	27.405	13.7025	16.71

TROUBLESHOOTING HINTS

TX

Symptom	Defective circuit	Cause	Renedy
NO TX	Power supply	1.Discharged battery 2.Defective power cord 3.Defective Q505, Q506	⋆Replace ⋆Replace ⋆Check the Voltages/Replace if defective
	TX Oscillation	1.Defective Q601~Q603 2.Unlocked PLL 3.Defective Q701~Q704	⋆Check the Voltages/Replace if defective ⋆Check the PLL cirwit and readjust ⋆Check the Voltages/Replace if defective
	MIC AMP	1.Open MIc connection 2.Defective IC401 3.Incorrectly adjusted RV2	⋆Soldering ⋆Check the Voltages/Replace if defective ⋆Readjust
Weak TX	RF AMP	1.Incorrectly adjusted L701/L702/L801/RFC705 2.Defective Q702/Q703/Q704	⋆Readjust ⋆Check the Voltages/Replace if defective

RX

Symptom	Defective circuit	Cause	Remedy
NO TX	Power supply	1.Discharged battery 2.Defective Q505,Q507	⋆Replace ⋆Check the voltages/Replace if defective
	RX Oscillation	Incorrectly adjusted L901~903/L102/L104	⋆Readjust
Weak RX	Mixer detector	1.Defective RF AMP module 2.Defective IF AMP module 3.Incorrectly adjusted L102/L104/L901~L903	⋆Check the voltages/Replace if defective ⋆Check the voltages/Replace if defective ⋆Readjust

TEST EQUIPMENT SETUP
AND ALIGNMENT INSTRUCTIONS

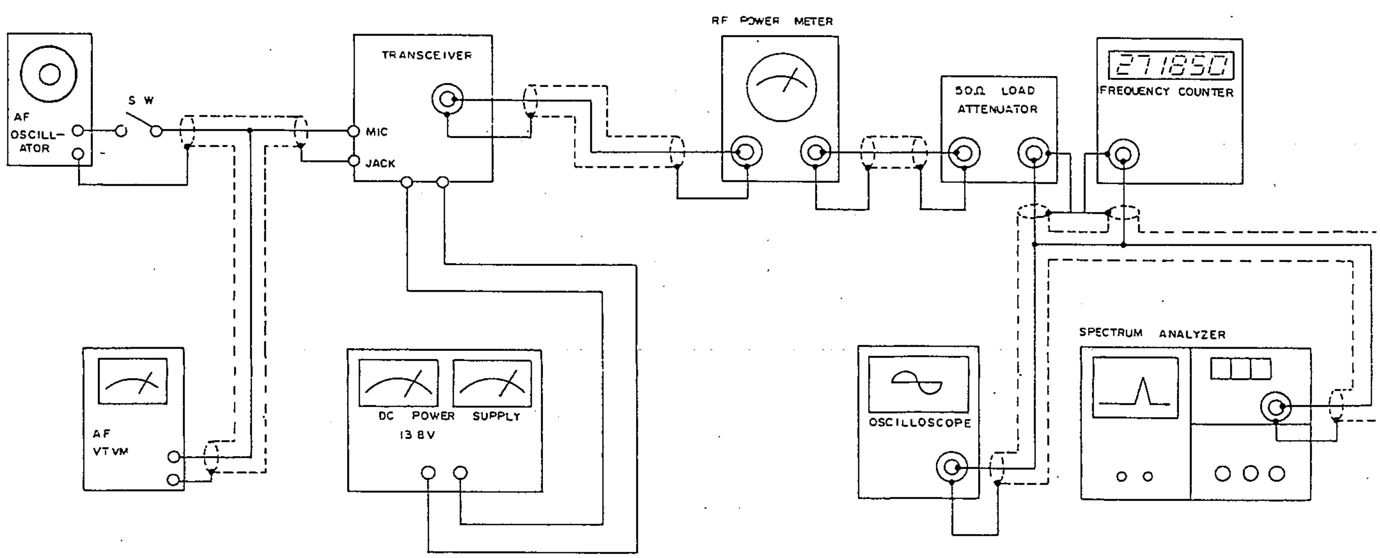
1. Test Voltage
DC 13.8V ± 5%, unless otherwise specified.

2. Test Equipment
All Test equipment should be properly callibrated.
1. Audio signal generator, 10Hz-20KHz.
2. VTVM 1mV measurable.
3. DC ampere meter, 2A.
4. Regulated power supply, DC 0-20V, 2A or higher.
5. Frequency counter, 0-40MHz, high input impedance type.
6. RF VTVM probe type.
7. Oscilloscope, 30MHz, high input impedance.
8. RF watt meter, thermo-couple type, 50 ohm, 5W.
9. Standard signal generator, 100KHz-500MHz, −10-100dB, ohm unbalanced.
10. Speaker dummy resistor, 8 ohm, 5W.
11. Circuit tester, DC 20K ohm/V.

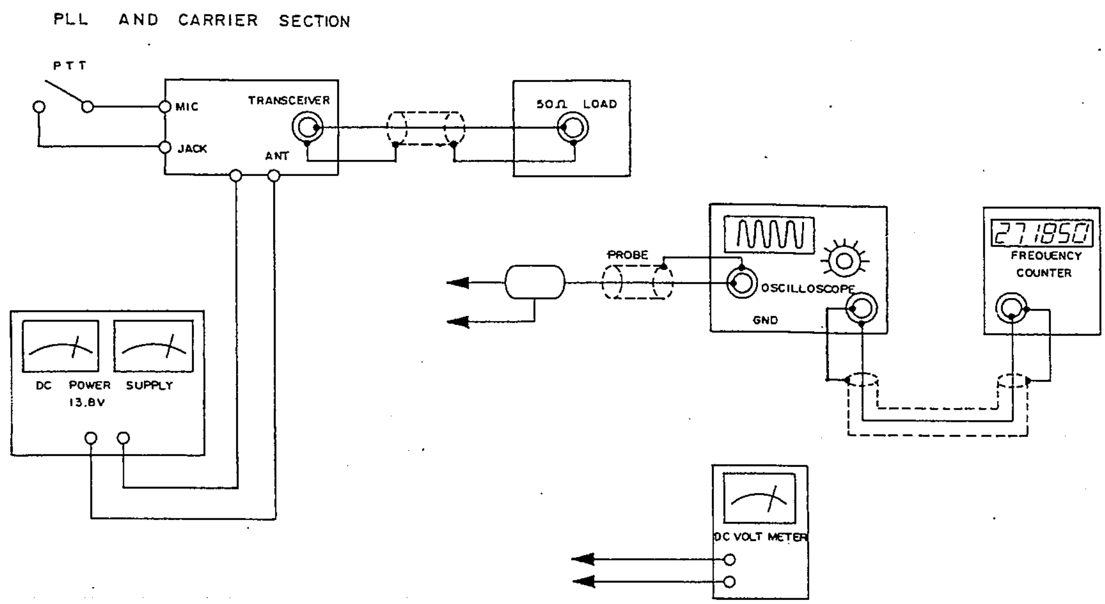
3. Alignment of Transmitter Circuitry

3.1 Test Setup

TRANSMITTER SECTION



3.2 PLL Circuit alignment



3.2.1 10.24MHz

Connect a frequency counter to the pin 11 and check to see 10.240000MHz-100Hz. Whan a defective crystal is replaced, and if the frequency is higher than by 100Hz, the CT1 should be increased. If the frequency is lower, the CT1 should be reduced in capacitance.

3.2.2 VCO alignment

1. Set the Radio to channel 40 and in receive mode.
2. Connect a circuit tester between C521/and ground.
3. Adjust L501 to obtain about 4V DC.
4. Set the Radio to channel/and in receive mode.
5. Check to see the TP/DC voltage dropping to a level about 2V DC.
   As long as the DC level stays between 4V DC for receive at channel 40 and about 2V DC for receiver at channel 1 the VCO is set properly.

3.3 RF driver stage alignment

1. Select channel "19".
2. Connect an oscillocope to the base of Q702 and ground.
3. Adjust L701 and L702 for maximum amplitude of scope display (27.185MHz signal).
4. Connect the scope to Q703 collector.

3.4 RF Power amplifier alignment

1. Set power supply voltage to 13.8V and set the radio into channel 19 position.
2. Connect a watt meter to the antenna connector.
3. Adjust L701, L702 for maximum power indication.
   Also again touch up L10 to peak power.
4. When all coils are peaked, the power meter should indicate above 4.0 watts.
5. Turn L801 until the power reading of 4.0 watts is obtained.

3.5 Transmit frequency check

1. Set the radio into transmit mode with no modulation.
2. Connect the frequency counter to the antenna load or to the tab provided at the wattmeter.
   The frequency should be within ±800Hz from each channel center frequency as tabulated in the frequency table attached.

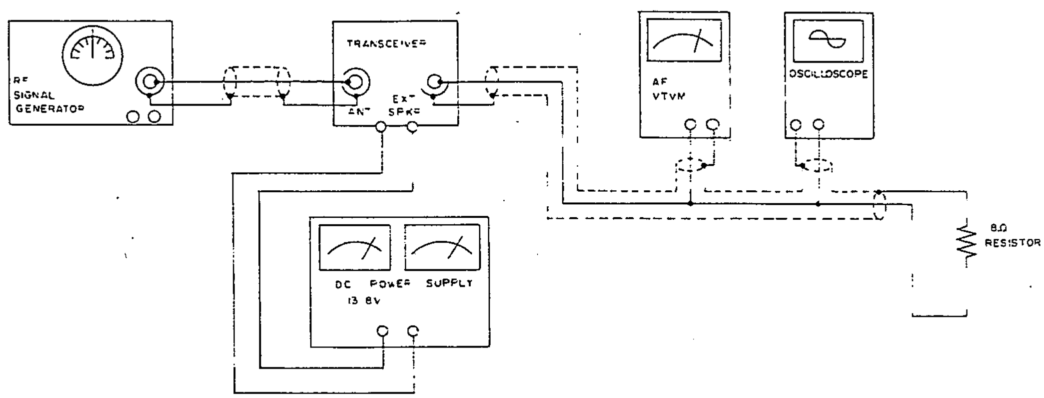
3.6 Modulation sensitivity alignment

1. Set the unit into transmit mode and apply 6mV, 1KHz signal to the Mic input circuit.
2. RV2 should be adjusted to obtain 85% modulation at this condition.
3. Next, decrease signal input to 1.5mV and observe that the modulation ratio is keeping the value higher than 50%.

4. Alignment of Receiver Circuitry

4.1 Test Set-up

RECEIVER SECTION



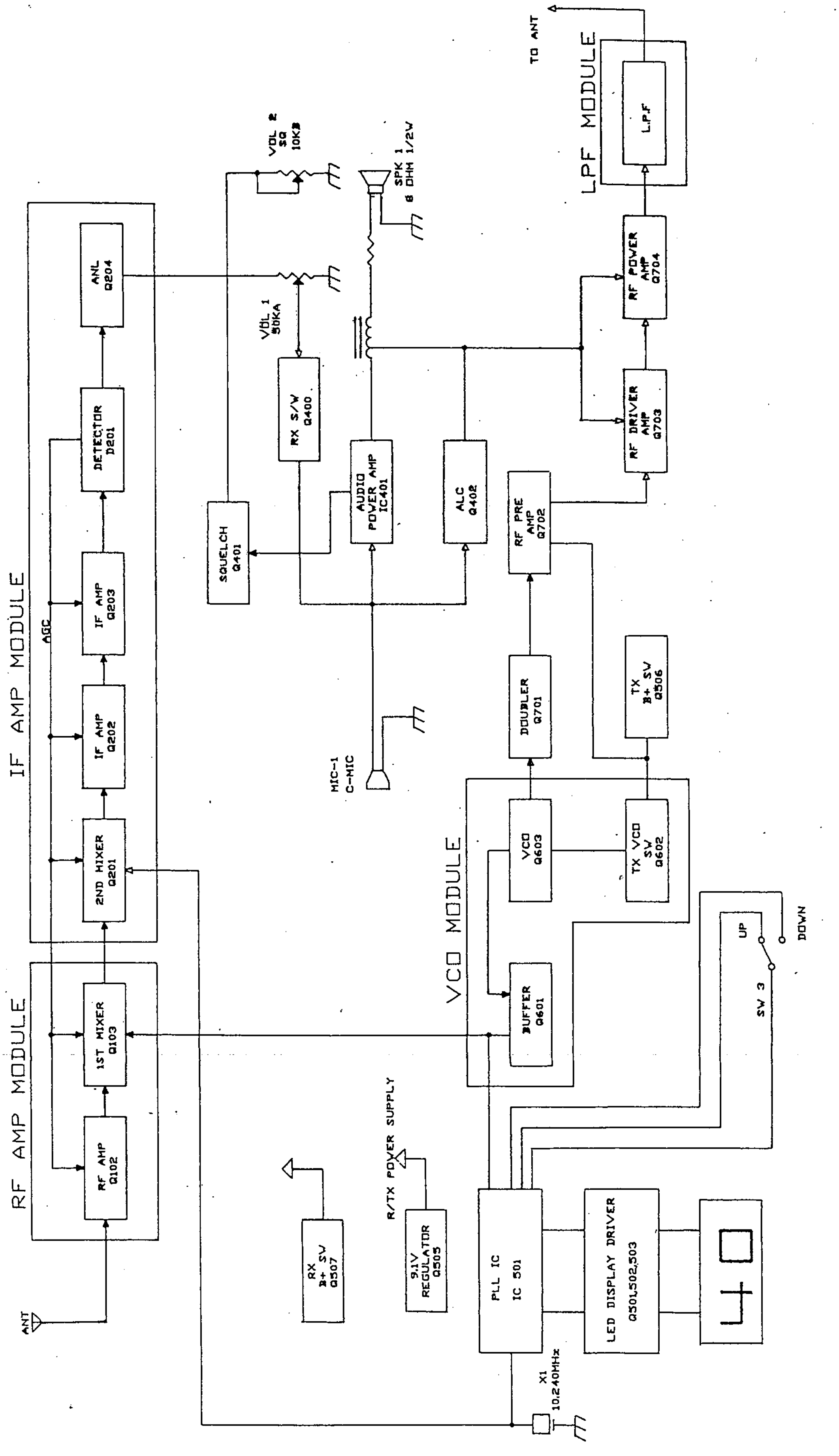
4.2 Receiver Sensitivity Alignment

1. Set the signal generator at 27.185MHz, 1KHz and 30% modulation.
   Also set the radio at channel 19 position.
2. Adjust L901, L102, L104, L902 and L903 for maximum audio output across the 8 ohm dummy load resistor. This alignment should be performed by gradually decressing the signal generator output signal to a minimum level required for tuning to aboid inaccurate alignment due to AGC action.

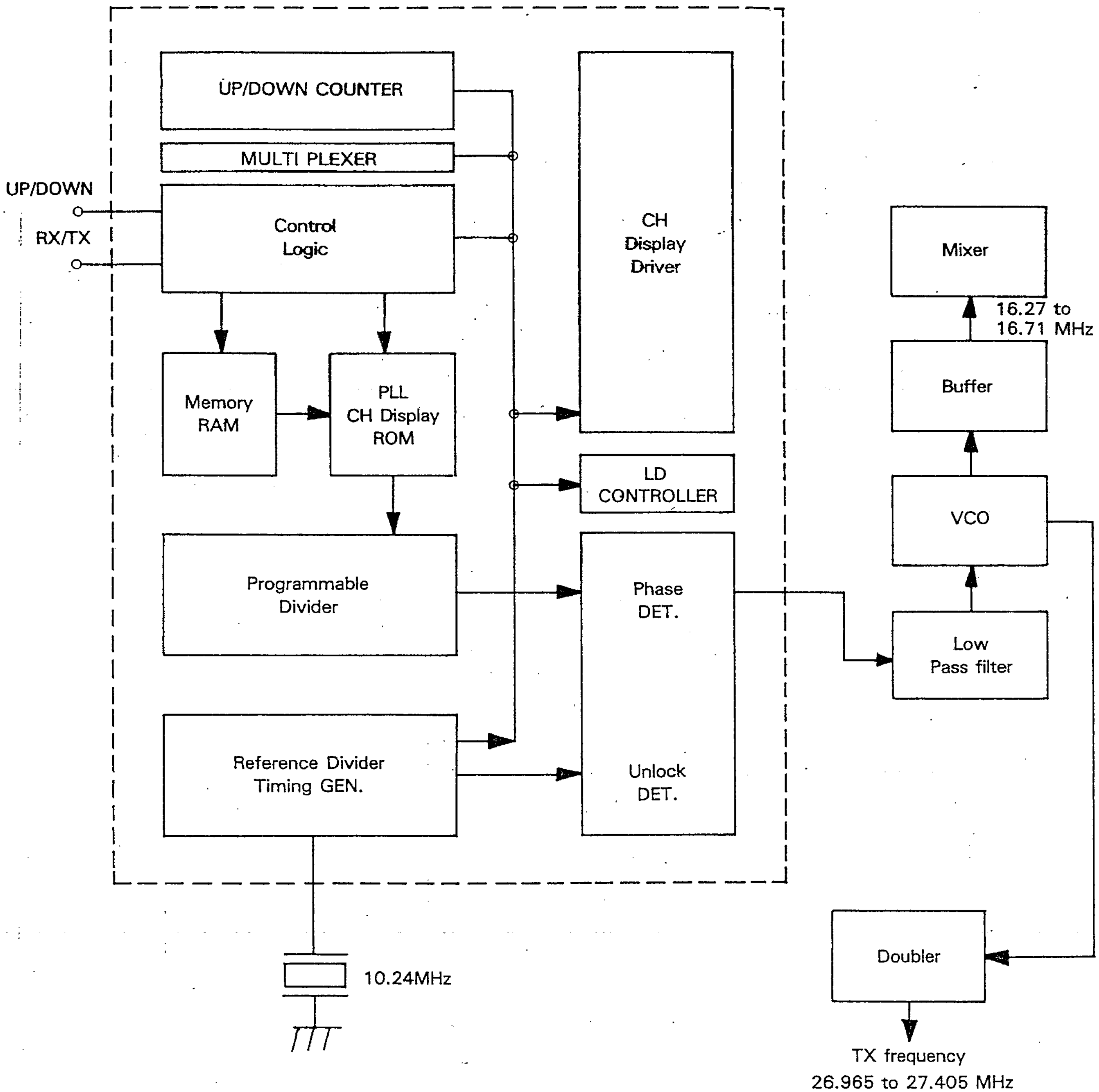
4.3 Squelch circuit alignment

1. Set the signal generator to provide RF input signal of 60dB (1KHz, 30% modulation).
2. Rotate the squelch control in full clockwise direction.
3. Temperarily adjust RV1 for maximum audio output, and note the audio output level. Then adjust RV1 so that the audio output level just disappeard position.

BLOCK DIAGRAM



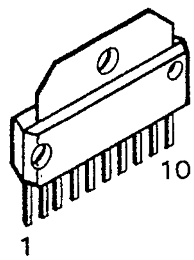
PLL CIRCUIT BLOCK DIAGRAM



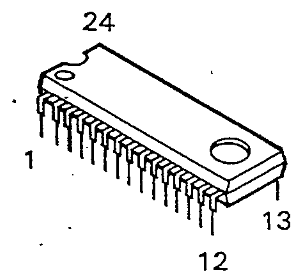
SEMI CONDUCTOR LEAD IDENTIFICATION AND IC INTERNAL CONNECTIONS

Integrated Circuits

KTA7217AP

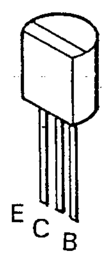


C5122A

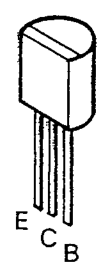


Transistors

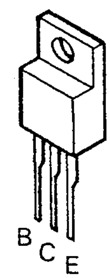
KTC3194(O)
KTC3198(GR)
KTA1266(GR)



KTC1006

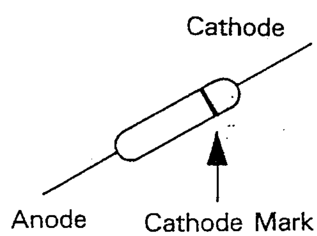


KTC 2075

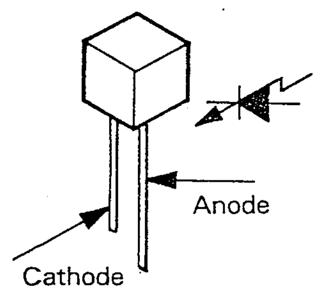


Diodes

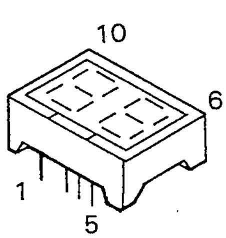
IN60
IN4148
IN4004

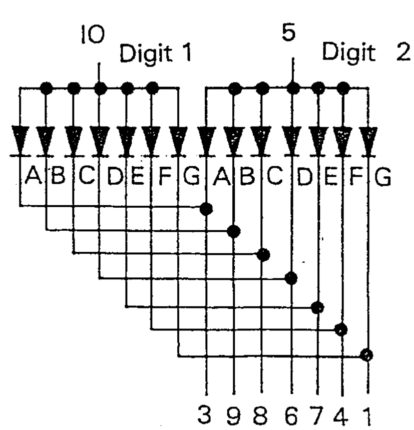


SLB55VR3



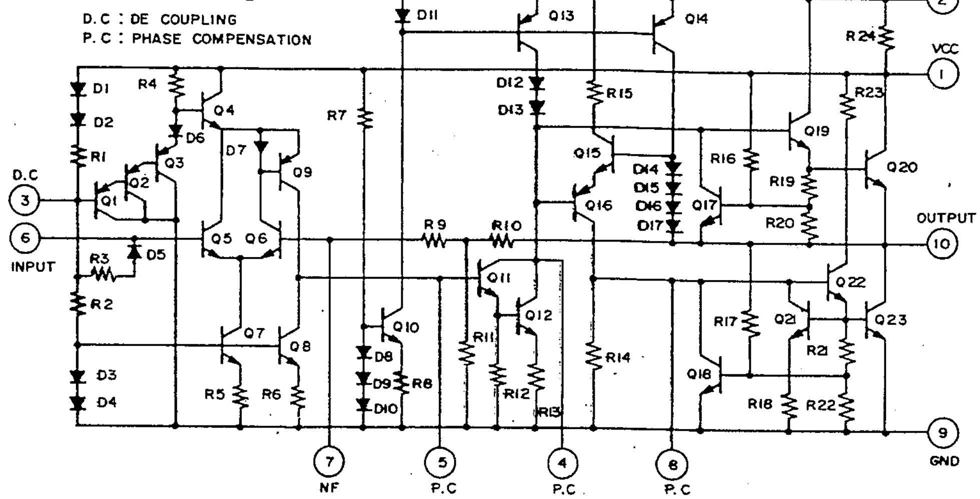
LTD323L-Y7



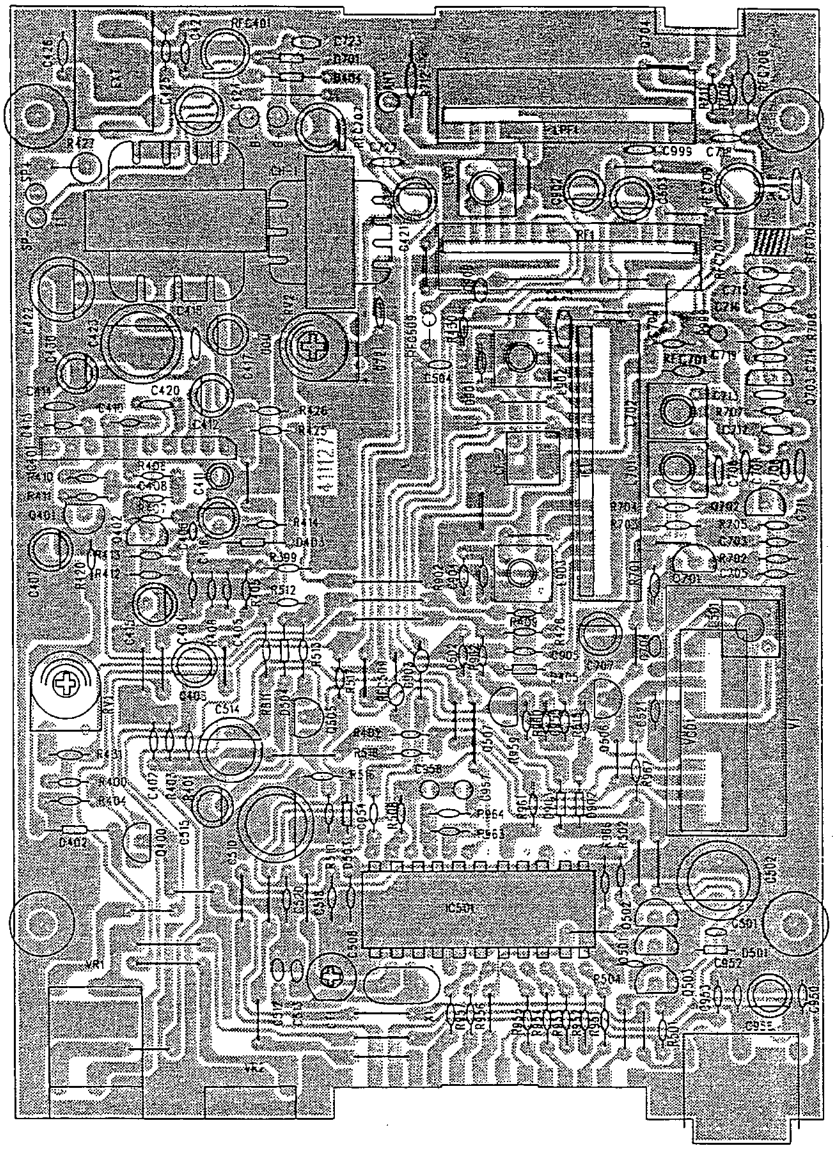


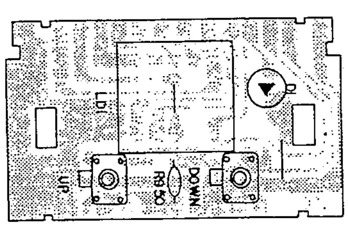
IC Internal Diagram

KIA 7217AP Schematic Diagram

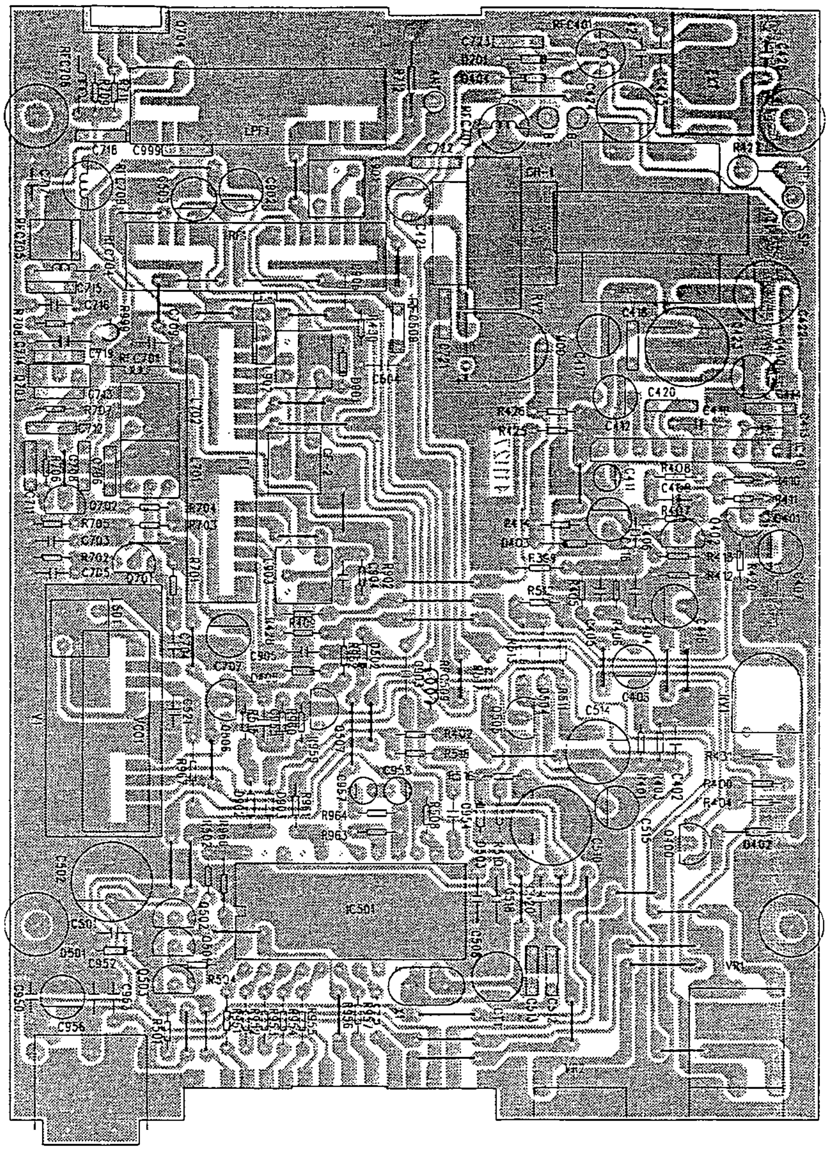


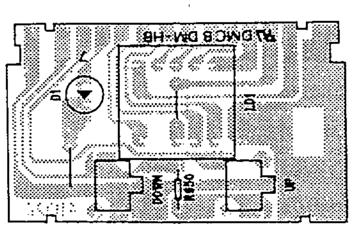
TOP VIEW OF PCB BORD





BOTTOM VIEW OF PCB BORD





VOLTAGE CHART

TR	RX			TX		
	E	C	B	E	C	B
Q400	0	0	0.5	0	0	0
Q401	0	3.5	0	0	3.3	0
Q402	0	0	0	0	0	0
Q501	4.4	3.9	4.8	4.3	3.6	4.7
Q502	4.4	2.0	4.7	4.3	1.8	4.6
Q503	4.4	2.4	3.9	4.3	2.3	3.8
Q505	8.5	13.2	9.2	8.5	12.5	3.2

TR	RX			TX		
	E	C	B	E	C	B
Q506	8.6	0	8.5	8.5	8.4	7.7
Q507	7.7	8.5	8.4	0	8.5	0.64
Q701	0	0	0	1.5	2.1	8.6
Q702	0	13.4	0	1.1	13.3	1.8
Q703	0	13.5	0	0	11.4	0
Q704	0	13.4	0	0	12.6	0

	Pin	RX	TX
IC501 C5122	1	3.1	3.1
	2	3.1	3.1
	3	3.1	3.1
	4	3.1	3.1
	5	5.7	5.7
	6	3.1	3.1
	7	3.1	3.1
	8	0	0
	9	N.C	N.C
	10	2.9	2.9
	11	2.7	2.7
	12	0	0
	13	2.6	2.9
	14	5.9	5.9
	15	2.5	3.1
	16	3.0	3.0
	17	3.0	3.0
	18	5.9	5.9
	19	N.C	N.C

	Pin	RX	TX
	20	0	5.4
	21	N.C	N.C
	22	3.0	3.0
	23	N.C	N.C
	24	3.1	3.0
IC401 KIA7217	1	13.5	13.0
	2	12.3	11.7
	3	3.9	3.7
	4	8.2	8.0
	5	1.5	1.4
	6	3.3	3.1
	7	3.4	3.2
	8	1.2	1.1
	9	0	0
	10	6.9	6.6
L.P.F MODULE	1	0	0
	2	0	0
	3	0	0
	4	0	0

	Pin	RX	TX
	5	0	0
	6	0	0
	7	13.4	11.2
IF MODULE	1	0	0
	2	0.7	0
	3	4.7	0.1
	4	4.6	0.1
	5	2.0	0
	6	5.8	0.1
	7	1.9	0
	8	N.C	N:C
	9	13.3	11.5
	10	0	0
	11	0	0
	12	0.7	0
	13	0.7	0
	14	0	0
	1	0	0
	2	0	0

	Pin	RX	TX
RF MODULE	3	13.4	12.3
	4	5.8	0.1
	5	1.9	0
	6	2.0	0
	7	0	0
	8	1.2	0
	9	0	0
	10	1.2	0
	11	0	0
VCO MOCULE	1	0	0
	2	0	0
	3	2.5	1.8
	4	0	0
	5	8.5	8.5
	6	2.1	1.9
	7	0	8.6
	8	0	0