IC–211

2 METER SSB FM CW DIGITAL SYNTHESIZED TRANSCEIVER

TABLE OF CONTENTS

SECTION I SPECIFICATIONS

GENERAL

Number of Semi-Conductors:	Transistors 92 FET 15 IC (Includes LSI) 32 Diodes 92
Frequency Coverage	144.000 – 148.000MHz
Frequency Stability	± 1.5KHz under the temperature ranges of -10°C – 60°C
Modulation Type	SSB (A3J, USB/LSB), CW (A1), FM (F3)
Antenna Impedance	50 ohms unbalanced
Power Supply	DC13.8V ±15% or AC115V 50/60Hz ±10%
Current Drain	Transmitting SSB (PEP10W) 3.0A CW,FM (10W) 3.3A FM (1W) 1.8A Receiving at Max. Audio output 1.1A at Min. 0.9A
Dimensions	141mm (H) x 241mm (W) x 264mm (D)
Net Weight	Approx. 6.1Kgs

TRANSMITTER

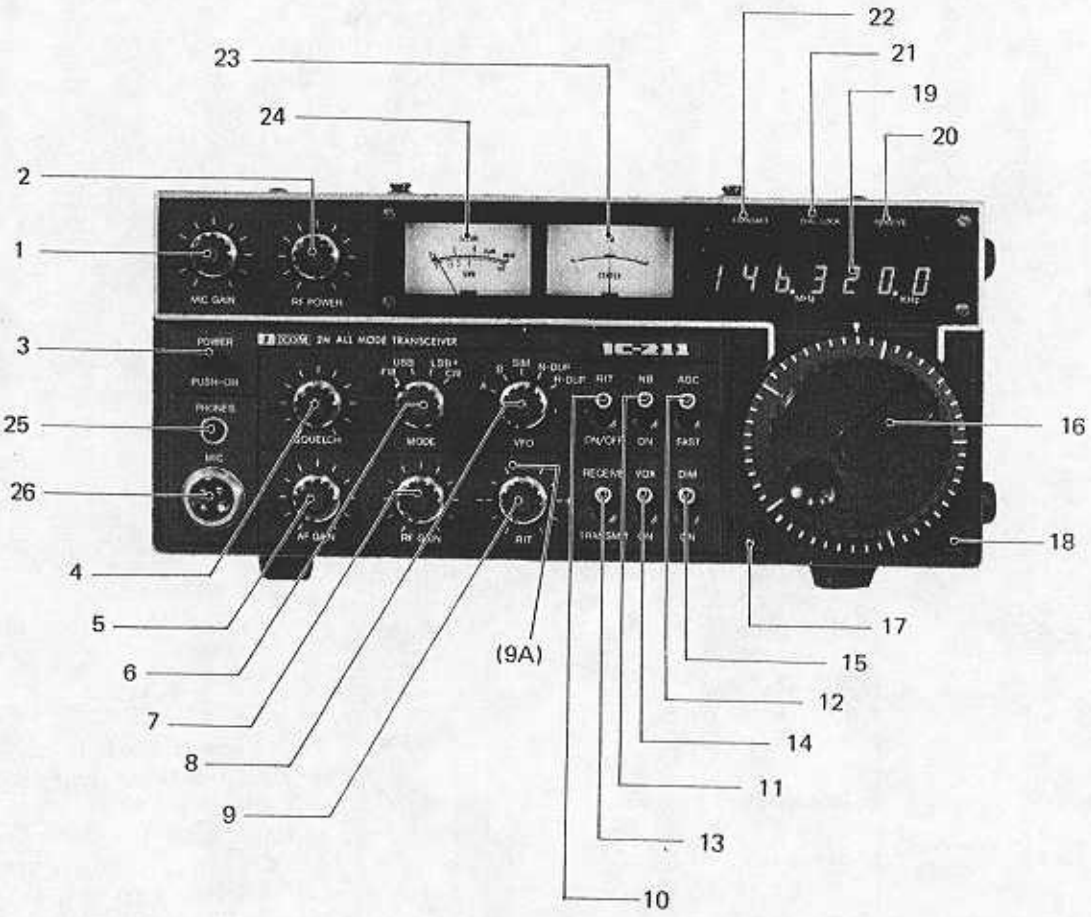
Frequency Coverage	144.000 – 148.000MHz
Output Power:	SSB 10W (PEP) CW 10W FM 1W~10W
Modulation Type	SSB Balanced modulation FM Phase modulation
Max. Frequency Deviation (FM)	± 5KHz
Suprious Radiation	Better than -60dB
Carrier Suppression (SSB)	Better than 40dB
Opposite Side Band Suppression	Better than 40dB
Microphone Impedance	600 ohms

RECEIVER

Frequency Coverage	Same as Transmitter
Receiving System	SSB,CW Single Super Heterodyne FM Double Super Heterodyne
Intermediate Frequency	SSB,CW 10.7MHz FM 10.7MHz, 455KHz
Sensitivity	SSB,CW 0.5μV at (S+N)/N 10dB or better FM 1μV at S+N+D/N+D 30dB or better Noise Suppression Sensitivity 20dB 0.6μV or less
Squelch Sensitivity (FM)	0.4μV or less
Suprious Sensitivity	-60dB or better
Selectivity	SSB CW ± 1.2KHz or better at -6dB ± 2.4KHz or better at -60dB FM ± 7.5KHz or better at -6dB ± 15KHz or better at -60dB
Audio Output	More than 1.5W
Audio Output Impedance	8 ohms

The Front Panel has all of the controls and indicators for operation of the IC-211. Study Figure 1. and the following brief description carefully.

FRONT VIEW



SECTION III CONTROLS AND INDICATOR FUNCTIONS

CONTROL OR INDICATOR	FUNCTION OR INDICATION
1. MIC GAIN	Controls microphone gain in transmit.
2. RF Power	Controls RF Power.
3. Power Switch	Applies operational power in the PUSH-on position and removes all but the MEMORY POWER in the off position.
4. SQUELCH Control	Controls squelch threshold level.
5. AF GAIN	Controls Audio level of receiver section.
6. MODE Switch	Selects FM, USB, LSB, and CW operation.
7. RF GAIN	Controls RF GAIN of Receiver Section.
8. VFO Switch	Selects either A or B VFO and desired Simplex/Duplex operation.
9. RIT (9A RIT LED)	Controls Receiver Incremental Tuning (Indicates RIT on)
10. RIT Switch	Activates and releases RIT function.
11. NB (noise blank) Switch	Activates Noise Blanker.
12. AGC/FAST Switch	Sets AGC Release time of 50 milliseconds FAST or 500 milliseconds in other position.
13. Receive/Transmit	Selects transmitter independent of other switching circuits.
14. VOX Switch	Activates VOX circuit.
15. DIM Switch	Decreases intensity of all indicators.
16. Tuning Control	Selects Frequency.
17. Tuning Speed Button	Selects 100Hz or 5KHz steps of tuning control.
18. Dial Lock	Locks and unlocks tuning control when momentarily pressed.
19. Frequency Display	Digitally displays selected operating frequency.
20. Receive Indicator	Illuminates during Receive.
21. Dial Lock Indicator	Illuminates during Dial Locked condition.
22. Transmit Indicator	Illuminates during Transmit condition.
23. Discriminator Meter	Shows when FM signal has been centered.
24. Multi-function Meter	Shows various signal levels.

JACK OR CONNECTOR	FUNCTION OR INDICATION
25. Phones Jack	Accepts headphone plug.
26. MIC connector	Accepts microphone plug.

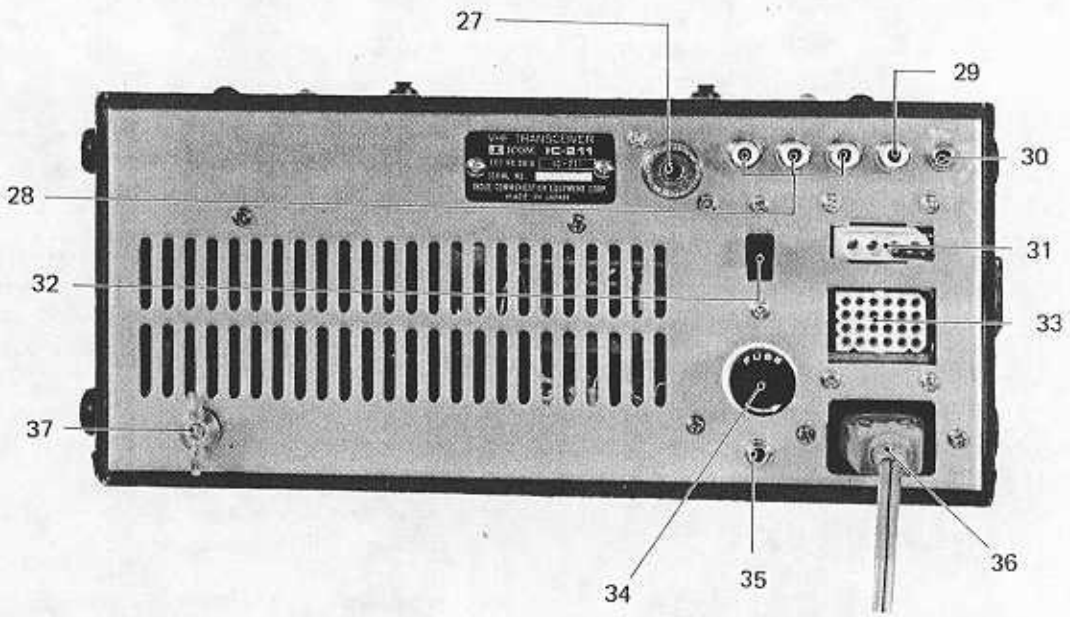
2. The Rear Panel contains connectors and jacks necessary for operation and accessories. Study Figure 2 and the following brief discription carefully.

CONNECTOR OR JACK	FUNCTION
27. ANT Antenna	Accepts standard PL259 Antenna cable connector.
28. SPARE Jack	For optional use.
29. SCOPE Jack	Output of 10.2MHz Receiver Mixer.
30. External Speaker Jack	For External Speaker.
31. DC Input	Accepts DC Power plug.
32. MEMORY Switch	Applies and cuts power to MEMORY circuit.
33. ACCESSORY Jack	24 pin connector for accessories.
34. Fuse Holder	Holder for Fuse.
35. KEY Jack	Accepts Key Plug for CW operation
36. AC Socket	Accepts plug for AC Power.
37. E Lug	Ground Terminal.

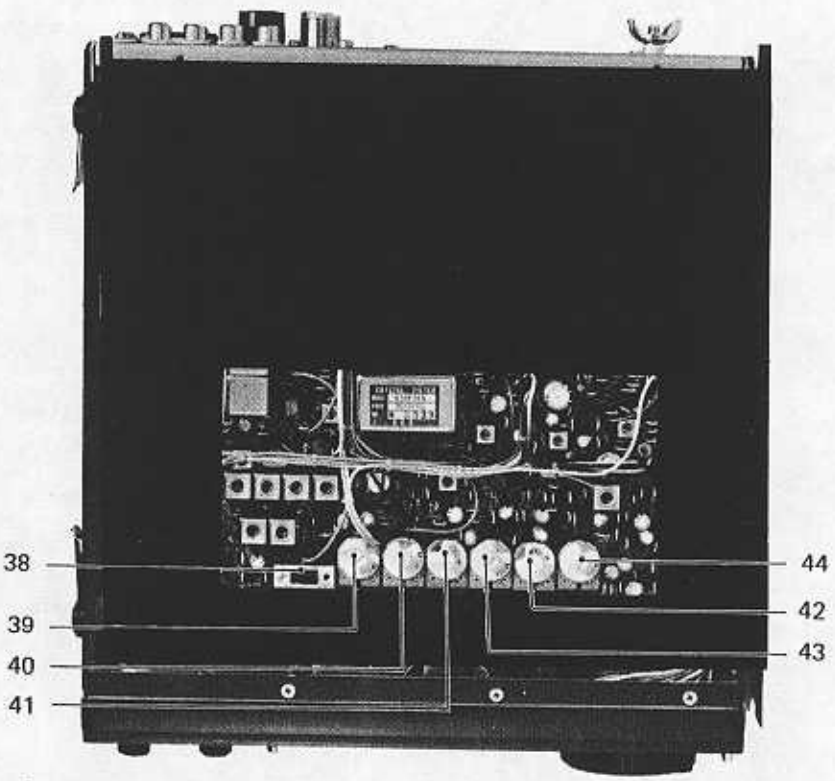
3. Inside the ACCESS Cover are various controls and trimmers for adjustment. Study Figure 3 and the following brief description.

CONTROL	FUNCTION
38. SWR Switch	Selects SWR Set or Read function.
39. SWR SET	Adjusts Multi-meter SWR Reading.
40. CW Monitor	Adjusts CW Monitor output Level.
41. CW DELAY	Adjusts CW reception recovery time.
42. VOX DELAY	Adjusts VOX DELAY level.
43. ANTI-VOX	Adjusts Anti-VOX level.
44. VOX GAIN	Adjusts VOX GAIN level.

BACK VIEW



TOP VIEW



SECTION IV DETAIL DESCRIPTION

The following is a detailed description of the controls and connections on the front panel. Refer to Figure. 1.

CONTROL or CONNECTION	DESCRIPTION
1. MIC GAIN	Adjusts the level of modulation according to the input of the microphone. As the input will vary with different microphones and different voices, clockwise rotation increases mic gain. Adjust for the proper modulation accordingly.
2. RF Power	The IC-211 has an output power of 0.5 - 10 watts which can be varied by the RF Power control. Tunning the control clockwise will increase power, while turning counter clockwise will decrease it.
3. Power Switch	Push lock type ON/OFF switch controls the supplied power, either AC or DC, to the set. Push the switch in (lock position) to apply power to the circuit. Push again to unlock the switch to remove power from the set. (In the unlocked position, power for the memory circuit will remain if the memory switch is in the on (up) position. Refer to No. 32.)
4. SQUELCH	Adjusts the SQUELCH threshold for proper operation in the FM MODE. The SQUELCH circuit does not operate in either SSB (USB/LSB) or CW MODE. Clockwise rotation increases SQUELCH action.
5. AF GAIN	Adjusts the audio output level of the receiver unit. Clockwise rotation increases audio output. Adjust for a suitable level.
6. MODE Swtich	Selects either side band, LSB or USB, for SSB operation. And for FM or CW operation, set the switch in the desired mode.
7. RF GAIN	Controls the gain of the RF and IF section of the receiver unit. Clockwise rotation gives maximum gain with no signal present. As the control is rotated counter-clockwise, the needle of the Multi-Function meter rises, and only signals stronger than indicated on the meter will be heard. This will eliminate noise during the absence of signals.

8. VFO Switch	The IC-211, designed specifically for U.S.A. 2 meter band plan, utilizes a Large Scale Intergrated circuit chip (LSI) developed by ICOM. Dual independant VFO's, capable of 100Hz or 5KHz step resolution, are incorporated into the LSI chip. The VFO Switch also selects the relationship of the VFO's to each other. In the "A" position "A" VFO is selected. Both transmit and receive frequencies are determined by "A" VFO. "B" VFO remains uneffected. In "B" position, transmit and receive frequencies are determined by "B" VFO remains uneffected. In "SIMPLEX" position transmit and receive frequencies are controlled by "A" VFO. However, "B" VFO will follow "A" VFO at the same frequency difference they were set at. Example: "A" VFO is set 100KHz above "B" VFO. In the SIMPLEX position, as "A" VFO is increased or decreased in frequency "B" VFO will follow at the 100KHz difference. In the U.S.A. 2 meter FM deplex plan, the TRANSMIT frequency is generally 600KHz lower than the RECEIVE frequency between 146 - 147MHz and 600KHz higher than the receiver frequency between 147 - 148MHz. The IC-211 has a built in circuit, which will automatically reverse the relationship of the dual VFO's in the duplex mode. In duplex (TX frequency "A" VFO, RX frequency "B" VFO) set the normal –600KHz difference between the transmit and receive frequencies (TX –600KHz). When the Receive frequency is brought up to 147.000MHz frequency, the receiver display will flash on and off, this will continue even when the tunning control is rotated until the transmit frequency reaches 147.000MHz. Then the changeover circuit will automatically reverse the relationship of the VFO's. The originally higher Receive frequency ("A" VFO) will revert to the lower frequency ("B" VFO). The originally lower Transmit frequency ("B" VFO) will revert to the higher frequency ("A" VFO). Therefore, the UFO's are actually reversed and the normal +600KHz transmit to receive relationship is achieved. (Between 147 and 148MHz).

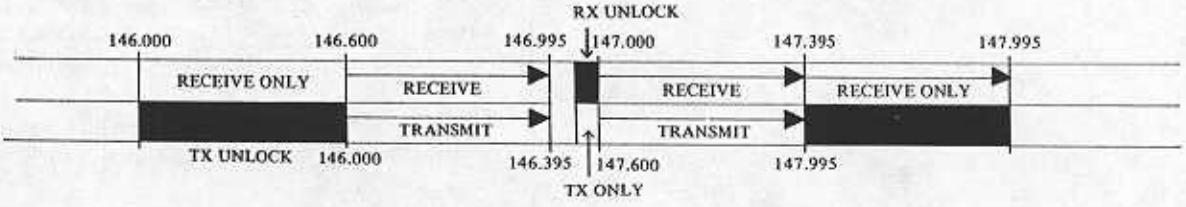
Likewise, when the receive frequency is brought down to 146.995 (the first step past 147.000MHz), the opposite will occur, and the VFO's revert to the normal transmit/receive relationship for 146–147MHz.

In the Reverse Duplex Mode, when tuning up past 146.995 or down past 147.000, the receive frequency readout will not flash indicating unlock. Auto changeover will occur when the frequency reaches the revert point. Flashing in Normal Duplex may be stopped by placing the VFO switch in the Simplex position.

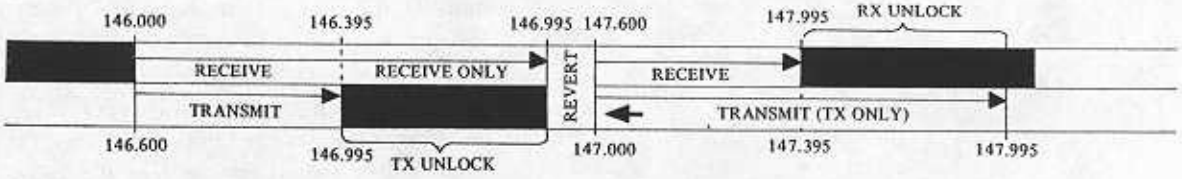
The charts are for 600KHz split between "A" and "B" VFO's, but are representative of the action of most any split.

Note: Any frequency split upto 955KHz can be used however the actually usable frequency range will be reached the greater the split used.

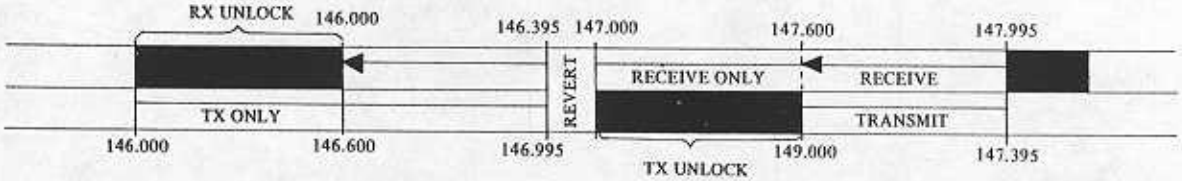
TUNING UP OR DOWN IN NORMAL DUPLEX



TUNING UP FROM 146.000 IN REVERSE DUPLEX



TUNING DOWN FROM 147.995 IN REVERSE DUPLEX



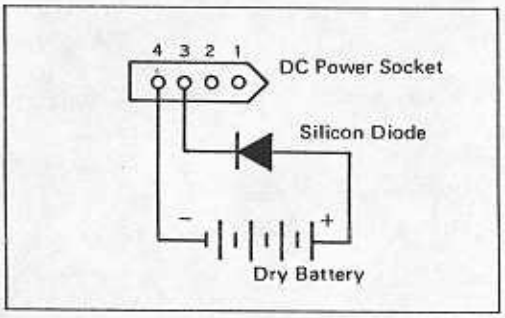
	Note: Frequencies given for transmit are actual transmit frequencies not frequency displayed on frequency readout while tuning in the receive mode.
9. RIT Control	Shifts the receiver frequency ±1KHz either side of the transmit frequency. When the RIT is on, the RIT LED (9A) is illuminated. The LED also represents the "O" position. Rotating the control to the (+) side raises the receiver frequency, and rotating to the (–) side reduces the receive frequency. With the RIT on, if the tuning control (16) is moved one increment, the RIT circuit is automatically pulsed off. Therefore it is not necessary to manually turn off the RIT when changing operating frequency.
10. RIT Switch	The RIT switch is a spring loaded switch, which is depressed once to turn on the RIT circuit, and pressed again to turn it off.
11. NB Switch	Turns on the Noise Blanker circuit to suppress ignition or other noise so weak signals can be received.
12. AGC Switch	Changes the time constant of the Automatic Gain Control circuit for SSB reception. The switch is placed in the up (slow) position, activating the 500 millisecond AGC holding circuit. In the down (FAST) position, the AGC time constant is 50 milliseconds, and is used for CW reception or tuning for SSB signals.
13. Transmit/Receive Switch	Used to manually switch between transmit and receive. In the receive position, the set will transmit when the mic PTT button is pushed or the VOX circuit is on.
14. VOX Switch	The VOX circuit is activated in the ON position, allowing voice operated T/R switching. Also can be used in CW for semi break-in operation.
15. DIM Switch	Reduces the intensity of the meter lights, frequency readout, and LEDs to prevent glare or eye strain.
16. Tuning Knob	Turning clockwise increases frequency, and turning counter clockwise reduces frequency. Between 144 - 146MHz frequency is increased or decreased in 100Hz steps, and 5KHz steps between 146 - 148MHz. On the rear of the Tuning Shaft is a large flywheel to keep tuning smooth and stable. There is a soft pad brake that rides on the flywheel to give "feel" to the tuning knob. However, when the knob is spun fast, the brake releases and allows tuning through a large portion of the frequency band. As the knob slows, the brake is again activated.

17. Tuning Speed Button	Between 144 - 145.999.9, pushing the tuning speed button, while rotating the tuning knob will result in changing the frequency in 5KHz steps. This will allow faster tuning through the lower band. Pressing the button during tuning from 146 - 147.995MHz has no effect as the frequency is already changing in 5KHz steps. To calibrate the tuning knob with the frequency, tune to a frequency in the 144 - 146MHz band with a zero (0) in the 1KHz digit. (Example = 145.990.0). Release the button and align one of the long vernier lines around the tuning knob with the center indicator at the top. Press the tuning speed button to clear the KHz and 100Hz segments of the frequency display and the knob is now calibrated. When tuning up past 147.995.0MHz, the frequency will automatically revert to 144.000.0MHz. Likewise, when tuning down past 144.000.0MHz, the frequency will automatically revert to 147.990MHz.
18. Dial Lock Button	For mobile use or whenever vibration or other circumstances could cause the tuning knob to be inadvertently moved a dial lock circuit can be activated. After setting the frequency, a momentary push of the dial lock LED located above the frequency display. The tuning knob will remain free to turn, however, the frequency will locked. To release the dial lock, press once again momentarily on the button, and the VFO will be unlocked and the dial lock LED will go out. In the locked condition the tuning flywheel brake will remain engaged even if spun.
19. Frequency Display	Frequency, both transmit and receive, are displayed on seven 7 segment bright Light Emitting Diodes (LED). Transmit and Receive frequencies are displayed during their respective operations.
20. Receive LED	When in the receive mode, the receive LED will be continuously lit in either USB, LSB, or CW modes, and lit only when a signal breaks the squelch in the FM mode.
21. Dial Lock LED	The LED is lit when the dial lock button is pushed, turn-on the dial lock circuit. It goes out when the button is pushed again.
22. Transmit LED	The LED is lit in transmit mode by either the microphone PTT switch, Transmit/Receive switch, VOX or Key operation.

23. Discriminator Meter	In the FM mode, the discriminator meter indicates when the incoming signal has been "centered" on frequency.
24. Multi-Function Meter	Shows relative output power, and SWR level with the SWR switch ON in the transmit mode, and RF Gain level and strength of the incoming signal is the receive mode.
25. Phones	When the headphone plug is inserted half way into the jack, audio is applied to both the speaker and the headphones. Inserting the plug fully into the jack applies power to only the headphones.
26. Microphone	Connect the supplied microphone or optional microphone to this jack. Refer to the following drawing for connection of an optional microphone.

The following is a detail discription of the rear panel connections. Refer to Fig. 2.

CONTROL or CONNECTION	FUNCTION
27. Antenna Connector	Attach a high quality gain type antenna of 50 ohms impedance to this connector. The connector accepts a standard PL-259 connector.
28. Spare Jacks	Spare Jacks are provided for connection to circuits requiring shielded RF coaxual cable.
29. Scope Jack	The 10.2MHz IF from the mixer stage of the receiver is brought up to this jack. Receiver signals can thus be observed.
30. External Speaker	An external speaker of 8ohms impedance can be connected here. Connection will mute the internal speaker.
31. DC Input	13.8V DC power is connected here for DC operation. When AC power is used, a jumper plug is placed in the DC input socket. From the angled end of the socket, pin 1 13.8V DC, pin 2 13.8V DC output from the AC power supply pin 3 6 - 12V DC input for the memory circuit, and pin 4 Ground.



32. Memory Switch	In the ON (up) position, separate power is supplied to the memory circuit. In this position, the programmed frequency will be retained even if the power switch is turned off. Placing the switch in the OFF (down) position, memory power is cut off with the power switch.
33. AC Input	The 3 hole AC socket is connected for AC power. When AC power is used, the jumper must be inserted into the DC socket. (See No. 31. DC Input).
34. Fuse Holder	The proper size fuse is placed in the fuse holder.

SECTION V INITIAL CONNECTION AND CONTROL SETTINGS

Make the following connections and control settings for initial operation. Refer to Fig. 1 & 2 for control and connection locations.

SSB OPERATION

CONTROL or CONNECTION	POSITION/CONDITION
1. MIC GAIN	Fully counter clockwise.
2. RF Power	Fully counter clockwise.
3. Power Switch	OFF (Button popped out).
4. SQUELCH	Fully counter clockwise.
5. AF GAIN	Fully counter clockwise.
6. MODE	Desired Side Band (USB/LSB).
7. RF GAIN	Fully clockwise.
8. VFO Switch	"A", "B" or Simplex ("A" VFO).
9. RIT Knob	Center (Mark pointing to LED).
9A. (Rit LED)	(OFF).
10. RIT Switch	OFF (LED unlit).
11. NB Switch	OFF (up).
12. AGC Switch	SLOW (up).
13. Receiver Transmit Switch	Receive (up).
14. VOX Switch	OFF (up).
15. DIM Switch	OFF (up).
16. Tunning Knob	Round indentation at top, large vernier line at center.
17. Tunning Speed	As is (LED unlit).
18. Dial Lock	As is (LED unlit).
25. Phones	Connect phones if desired.
26. MIC	Connect Microphone.
27. Antenna	Connect Antenna.
28. Spare	No connection.
29. Scope	No connection.
30. External Speaker	Connect if desired.
31. DC input	Connect only using DC Power.
32. MEMORY Switch	ON (up).
33. Accessory Socket	No connection.
34. FUSE Holder	As is (Fuse installed).
35. KEY Jack	No connection.
36. AC Socket	Connect only if using AC Power.
37. E. Lug	Connect to ground.

SECTION VI INITIAL INDICATIONS

When the controlls and connection have been initial made and power is applied. The following indications should be visable on the front panel. Refer to Fig. 1. (3. Power switch ON (pushed in)).

INDICATOR	INDICATION
10. RIT LED	Unlit
19. Frequency Display	144.000.0
20. RECEIVE LED	ON (lit).
21. DIAL LOCK	OFF (unlit).
22. Transmit LED	OFF (unlit).
23. Discriminator Meter	Illuminated.
24. MULTI-FUNCTION METER	Illuminated.

If any of the indicators show something different, recheck all the control functions.

CW OPERATION.

Initial connections and control setting for CW operation are the same as for SSB with the exception of the following. Refer to Fig. 1 and 2.

CONTROL or CONNECTION	POSITION/CONDITION
6. MODE Switch	CW
35. KEY Lock	Insert KEY Plug.

Indications on the front panel will be the same as for SSB.

FM OPERATION

Initial connection and control settings for FM operation are the same as for SSB with the exception of the following.

CONTROL or CONNECTION	POSITION/CONDITION
6. MODE Switch	FM

Indications on the front panel will be the same as for SSB.

SECTION VII EXPLANATION OF THE MAIN UNIT

Antenna Switching Circuit	D21, D22 connected between antenna the coil and Low-pass Filter changes to very low resistance when a forward current is applied to the diodes, thus signals from the antenna are transmitted to the R.F. Amplifying Circuit with low loss. When transmitting, the diodes are reverse biased by self-rectification, and are reduced only to junction capacity of the Diodes connected in series. Transistor Q48 is for controlling D21 and D22. When receiving, +9V is applied to the Emitter. This causes the collector to go to +9V and supplies forward bias current to D21, D22 via R194. When transmitting, because the Emitter voltage of Q48 is zero and Q48 is not conducting, no current is present in D21, D22. In the case where SWR has deteriorated, self-rectifying voltage of the Diodes is boosted. Therefore, a high voltage breakdown transistor (VCER 180V) is used for Q48.
RF Amplifier Circuit	Signals from the antenna are stepped up by L52, and amplified by Q47. Good selectivity is obtained the five-stage helical filter and it reduces interferences and intermod from nearby paging, public service and telephone transmitters.
First Mixer Circuit	Proper circuit design is necessary for the crowded 2m band to provide minimum desnse and cross modulation due to excessive input. A four-pole MOSFET having good square-low characteristics is used for Q46 and optimum voltage is applied to the 2nd Gate by passing local oscillating output from the PLL through a Bifilar would transformer through D43. A part of the 10.7MHz generated on the Drain side is taken out by C194 and is fed to the STP (Spectrum Test Point) provided at the rear surface by the Source Follower Q45. 10.7MHz signals of 20KHz width are obtained from the Crystal Filter through a matching transformer.
Signal Switching Circuit	In the case of SSB or CW Reception, diode D42 conducts and 10.7MHz produced by the First Mixer is supplied to the Crystal Filter Matching Transformer for SSB. In the FM mode, D40 conducted and 10.7MHz is fed to the Second FM Mixer input circuit. In transmit, D40 and D42 are reverse biased through D41 and thus switched off.
FM Second Mixer Local Oscillator Circuit	10.245MHz signals from the Switching Circuit and Oscillator output, generated by Q44, are injected at Q43's Gate and converted into 455KHz. A resistive drain load is used to facilitate matching of the ceramic filter of the following stage.

FM Intermediate Frequency Amplifier Circuit	455KHz signals from the Second Mixer obtain proper band width through band ceramic filters. Signals from the filter are amplified by Q42, Q41, Q40, a part of which is rectified by D38 and deflects the multi-meter needle by diode D36. D39 connected to the Collector of Q42 is for maintaining stability with strong signals. R167 connected to the Emitter Circuit is to adjust the multi-meter in the FM mode. The output of Q40 is connected to IC3, where 455KHz signals are further amplified. As this IC is a differential direct-coupled 3-stage Amplifier, it provides very good limiting characteristics.
FM Demodulating Circuit	455KHz signals obtained from IC3 are demodulated by the discriminator comprising DS1, D20 and D35. DS1 ceramic discriminator is 15KHz or more wide at the S curve PP value and 30PPM or less in temperature characteristics. Thus, this dicriminator is superior to the conventional IC discriminator and is most suitable for narrow-band demodulation.
Discriminator Meter Circuit	DC voltage from the discriminator is supplied to the Discriminator Meter by Source Follower Q38. R148 adjusts sensitivity of the meter and R146 adjusts zero point. Zener diode D55 is connected in series with the Meter Circuit, and B voltage is to remove deflection which is caused by some voltage remaining in EMR 9V in SSB or CW receiving modes.
Intergrating Low-pass Filter Circuit	AF signals from the Discriminator pass through the circuit of R196 and Q206 and are amplified by Q49. At this stage, squelch control is provided to minimize abnormal noises. S/N ratio has been improved by Q50, an Active Low-pass Filter, which stops any component of 3KHz or more which is unnecessary for transmission.
Squelch SIG LED Circuit	This is noise squelch circuit to stop limiter noise in receiving signals. The noise component is selectively amplified at around 25KHz so that is will not be influenced by normal audio signals. The SQL control is provided before noise amplification so as to enlarge the dynamic range. While Q54 is temperature compensated by R224, the noise component alone is amplified by L56 and C224 on the load side. This noise component is further amplified by Q53. The amplified noise component oversides the Bias Circuit of D45 which also acts as a temperature compensator. The noise is doubled in voltage and is then rectified. The recti-

	fied DC voltage is then filtered by C218, C219, R217 and R216 and operates the Squelch Circuit Switch Q52. When no signals are present, Q52 turns ON due to noise rectifying voltage and the AF Amplifier Q49 and receive LED Switch Q51 turns OFF. Upon arrival of a signal, noise and the recticied voltage drops and Q52 turns OFF. Therefore, Q49 amplifies the audio signal, with bias supplied by R197, R199 and R198. Q51 is fed with current via R197 and turns ON to light the Receive LED. Resistor R215 connected to the base of Q52, while the SQL is in operation, eliminates squelch opening (Noise) when change from transmit to receive.
Noise Blanker Gate Crystal Filter Circuit	10.7MHz signals from the Crystal Mechanical Filter have the noise pulses removed at the Noise Blanker Gate comprised of D5 and D6 through Matching Transformer L5. Selectivity of 2.4KHz (−6dB) is obtained by the Crystal Filter for SSB. Both D7 and D8 are connected to the Crystal Filter. In SSB, CW receiving, D8 conducts and feeds signals to the succeeding SSB, CW receiving circuits. In SSB, CW transmitting, D7 conducts and converts DSB or CW signals from the Balanced Modulator into SSB, or CW signals by passing them through the SSB Crystal Filter. Signals are then supplied to the Transmit Mixer Circuit via D5 and D57.
SSB, CW Intermediate Frequency Amplifier, Multi-Function Meter Circuit	IF signals from DS are amplified by Q7, Q8 and Q10. In this stage, stable amplification, high gain and a wide range of AGC are required. Accordingly, a 4-pole MOSFET is used for Q7 and Q8, and Q10 is composed of a differential amplifier to obtain the required characteristics. AGC voltage is applied to the Second Gate of Q7, Q8 so as to widen the AGC range. Considering that the source voltage of Q8 drops by applying AGC voltage, the S meter in SSB, or CW receiving is deflected by measuring the bias of Q9. R26 connected to the Emitter Circuit of Q9 and adjusts deflection of the meter and R132 adjusts zero point. D9 performs temperature-compensation of Q9.
SSB, CW Demodulating Circuit	IC1 is composed of a constant-current source and differental amplifier. BFO output side and both inputs of the differential amplifier have the output of the Intermediate Frequency Amplifying Circuit put into there. One part of the AF signals demodulated by IC1 is supplied to the AF Amplifying Circuit and the other is supplied to the AGC Control Circuit.

SSB, CW Amplifier Circuit	Demodulated signals are amplified by Q11 and are connected to the Low-pass Filter Circuit of Q50.
AGC Control Circuit	AF output of IC1 is amplified by Q27 and is supplied to the AGC Detecting Circuit which follows. R106, connected to Emitter of Q27, adjusts the level at which AGC is applied by varying gain at the stage. Output of Q27 is divided at R105, R314 and put in the Peak Value Detecting Circuit. This action makes Q23 work as an Emitter Follower on the positive peak of aural signals and supplies the Consenser Time Constant Circuit C75, R94, C81 with charge, while giving rising dynamic characteristic. When Q23 passes through the positive peak, it is reverse biased by charging voltage of Time Constant Circuit. Discharge control on Time Constant Circuit is affected by Q24, Q25 and Q26. Similar to Q23 is Q26, a Peak Value Detecting Circuit is so that its input level is higher than in the case of Q23. Therefore, it charges C77 sooner. This voltage is divided at R101, R100, D14 is for temperature-compensation. If then turns Q25 ON and Q24 OFF, holding the voltage of the Time Constant Circuit. When incoming signals cease to exist, charging voltage of C77 is discharged via R101 and Q25 is cut off, whereupon Q24 turns ON and discharges charging voltage of Time Constant Circuit via R95. With AGC FAST, Q25's bias is connected to −9V, whereupon Q25 turns OFF and Q26 turns ON and thus Holding Circuit is put out of operation.
AGC Return Circuit	When it is required to charge the Time Constant Circuit, rise of recieving ¡9V should be differentiated when transmit is changed over to receive so as to discharge Time Constant Circuit by turning Q22 ON temporarily and to return the AGC output to non-signal bias.
AGC Amplifying RG GAIN Control Circuit	Voltage of the Time Constant Circuit is received by FET Q21 where has high input impedance, and amplified at Q20, and applied to the Second Gate of the RF's. IF Amplifying Circuit to control gain. R92 is provided at the time of no-signal. As Q19 makes the voltage of the RF GAIN POT override the AGC output line by Emitter Follower, it is the RF GAIN control which determines the AGC threshold.
FM RF GAIN Meter Circuit	RF GAIN can be operated even during reception. This controlling voltage carries out meter reading by affecting the DC amplifying at Q39 and by super inposing direct current on FM S meter Circuit via D37.

Noise Blanker Circuit	Noise components including 10.7MHz signals of about 20KHz width are received at the junction type FET Q1 which has a high input impedence and by the Crystal Mechanical Filter and are amplified at Q2 and Q3. This output is doubled in voltage and rectified at D1 and D2. The Mean value component is amplified at Q4 so as to the change bias voltage of Q2 and Q3 and to supress the noise blanker's abnormal action when nearby strong signals are present. The peak value of the noise pulse is taken out at Q5. D4 is provided in order to raise threshold level when taking a pulse and to facilitate discrimination between the signal and noise pulse. Pulses obtained at D4 are emplified at Q6, thereby turning D5 ON and D6 OFF to cut off the signal route during the noise period.
AF Power Amplifier Circuit	Output from the low-pass filter is amplified at IC5 to such an extent that it works the Speaker, through the Sound Volume Control. The amplification of IC5 reduces gain and improve residual noise, distortion, etc. by providing series resistance to the outside NFB Control Terminal. In FM and SSB transmitting, muting is effected by bias to this terminal via D54. It is so designed that in CW, CW monitoring can be done by putting a single tone of 800Hz in this terminal.
Microphone Pre-amplifier Circuit	The pre-amplifying circuit is comprised of an NPN, PNP direct-coupled two-stage amplifier Q17 & Q18, IF has low-noise transisitors and a large quantity of DC feedback to obtained a high S/N and high stability of the first stage. In this stage, gain is reduced in SSB not to decrease distortion. A part of this output is supplied to VOX amplifying circuit and also to the IDC circuit for common use of SSB and FM, via MIC GAIN VR.
IDC Circuit	With the trend of narrow channel spacing operation adjoining channels with overmodulation has become a problem. In order to improve input audio limiter characteristics still further, improvement have been made on the low distortion factors and over-input performances by means of a 3-stage direct-coupled circuit at Q14, Q15 and Q16. As this 3-stage direct-coupled circuit is decreased in input impedance by applying series feedbacks, it improves the frequency charact of the differentiation circuit comprising R75 and C61. R67 connected between Feedback Circuit and ground adjusts the bias point of Q14 and makes the Click Waveform symetrical. D12 and D13 are for temperature-

	compensation. As the output of the limiter forms a nearly square wave and includes high frequency components, it is cut by 3KHz or more at the Active Filter of Q13. This output is compensated by Themistor of R60 so that its frequency deviation may not become large due to temperature. FM is adjusted to narrow frequency deviation at R59 and is supplied to FM Modulation Circuit. After temperature-compensation, SSB is supplied to the integration circuit and balanced modulator circuit via Q66. R273 provided at Emitter of Q66 sets MIC GAIN of SSB.
FM Modulation 10.7MHz Oscillator Circuit	FM Modulation Circuit Q12 in the VXO Oscillator Circuit employs a quartz crystal of special specifications and has improved temperature characteristics. Signals from the IDC applied to the anode side of the variable capacity diode, D11. In order to improve the temperature characteristics still further, the cathode side of D11 is compensated by Thermistor R56. L12 connected to the cathode side of D11 adjusts the oscillating frequency to 10.7MHz.
Balanced Modulator Circuit	IC4 is a double balanced modulator composed of three differential amplifiers. Carrier suppression of 65dB (standard carrier suppresion of 50dB plus 15dB attenuation at Xtal filter) can be obtained. This balanced adjustment is effected by R270. In the SSB MODE, the BFO output of USB 10.69MHz or LSB 10.7015 is put in but in the CW MODE, the output, which is about +800Hz shifted from CW, is obtained by unbalancing the Balanced Modulation Circuit.
ALC Controlled Circuit	DSB and CW signals from IC4 are amplified by Q63 and operate as ALC-Controlled by causing negative bias on the gate. Matching of the crystal filter is facilitated by making the drain side a resistivc load. Generation of splatter by overmodulation is suppressed by applying ALC at the front stage of crystal filter. DSB and CW signals amplified here are supplied to the crystal filter circuit.
CW Control Circuit	Q62 connected to Drain of Q64 obtains. Keyed signal, Q62 turns ON at key-up via R241, R236 and lowers drain voltage of Q63. By the lowering of impedance between Collector and Emitter, CW signals from Balanced Modulation Circuit are cut off. At key-down, base bias ceases to be present and Q62 turns OFF, whereby CW signals can be obtained.

BFO Circuit	The non-adjusting type of Oscillating Circuit composed at Q67 generates the carrier necessary for USB, LSB and CW. In LSB, D53 turns ON and 10.7015MHz is provided by X4. In USB and CW, D52 turns ON and oscillation is governed by X3. In USB, CW receiving and USB transmitting, D51 turns ON and 10.6985MHz is obtained. In CW transmitting, D51 is reserve biased through D50 and turns OFF shifting the signal about +800Hz. This BFO output is supplied to the Balanced Return Circuit and Balanced Modulation Circuit through the Emitter Follower Q68.
Transmitting Mixer Circuit	IC2 is composed of a constant-current and differential amplifier. FM, SSB and CW signals are converted at L14 through Diodes D10 and D57 respectively and go into both differential amplifier inputs of IC2. LO from the PLL goes in the input of the constant-current source via D3 which is ON in transmit. Output mixed here are balanced at L16 and accordingly components of the LO are canceled. After mixing, the desired signals of the LO + 10.7MHz are taken out by band pass filter (BPF) L17 – L21.
Intermediate Amplifier Circuit	Output of the BPF are amplified to about 2mW PEP, by the 4-pole MOS FET, Q28, which has good linearity. This stage also works as the ALC controlled when in APC and FM.
Pre-Driver Amplifier Circuit	Intermediate-amplifier outputs are amplified to about 100mW PEP by Q30. D15 provided at the secondary side of L23 is a detector for adjustment.
Driver Amplifier Circuit	Pre-driver outputs are amplified to about 1.6w PEP by Q31. D16 connected to the base circuit is for biasing and temperature-compensation. Idling current for removing crossover distortion is set by R127.
Power Amplifier Circuit	Output of the driver stage is amplified by Q32 and outputs of low PEP are obtained the ANT Terminal. Q32, the output transistor, was developed for SSB and is superior both in power gain and linearity. As this stage involves particularly much power, special attention has been paid to its reliability, namely, effective heat sinking is given by the side die-cast chassis through an L-shape drawn material of 3mm thickness, and a padding Type Mica Trimmer of superior temperature characteristic with small dielectric loss is the employed. D16 and D17 are for bias and are adjusted by R130.

Low-Pass Filter, SWR Detecting Circuit	As outputs of power amplification include higher harmonic, they are sent to the ANT Terminal via two Chebyshev sections and one Fixed K section filter to reduce the higher harmonics to less than -60dB. This low-pass filter is set at about 180MHz cut-off frequency and minimized loss. The SWR Detecting Circuit is comprised of D24 and D25. The closer this circuit is to the ANT Terminal, the more its detecting circuit characteristics are improved, but higher harmonics are caused due to Diode rectification. In order to avoid this, SWR Detecting Circuit is located at the intermediate part of the low-pass filter. D24 and D25 rectify forward and reflected power, respectively, and supply signals to the APC amplifier. Forward and reflected are selected at S1 on the main board, and are set by R134 and are supplied to the meter via D23.
APC Circuit	Reflected outputs from the SWR Detecting Circuit are set at R136 and are DC amplified by Q33 and Q29. If the matching of the ANT has deteriorated, the fianl stage drive level is lowered by raising the source voltage of Q28 and by dropping the gain of the intermediate amplifier and thus failure of the transistor due to overload can be prevented.
ALC and Power Control Circuit	The drive level of SSB or CW is detected by a threshould type voltage, double rectifier, D18 and D19 which depend upon the bias of R129. This rectified voltage is applied to the gate of Q63 through D58 to control final stage drive level. This ALC voltage is applied to the gate of Q64 via R257 in FM transmitting, is amplified by Q65, in the power control circuit, and changes the drain voltage of the intermediate amplifier and controls drive level. This ALC voltage is applied to the gate of Q64 via R257 in FM transmitting, is amplified by Q65, in the power control circuit, and changes the drain voltage of the intermediate amplifier and control drive level. In SSB, CW, the source voltage of Q64 is boosted, whereupon Q65 turns ON and drain voltage of the intermediate amplifier becomes 9V.
VOX Anti-VOX	The AF signal from the microphone pre-amp circuit is amplified at Q75 via R310, the VOX GAIN Adjustment. This signal is rectified by the rectifying circuit of Q74 where the output changes due to the ANTI-VOX voltage. Receiving IF output is amplified by Q69 via the ANTI-VOX Adjustment control, R291. This signal has some release time at the peak value rectifying circuit, Q70, is amplified by Q71 and Q72. The amplified DC voltage is sent to the Emitter of VOX

	Circuit Q74, and suppresses VOX rectification. Rectified voltage obtained from the VOX circuit charges C229 in the Delay Circuit, of Q74. VOX delay time is adjusted by R235. DC voltage from the Delay Circuit is given hysteresis at the Schmidt Circuit, composing Q57 and Q56, fed through D47, and turns Stand-by Control transistor Q55 ON thus putting it in transmit.
Break-in Monitor	With the key down, Q59 turns OFF and the charging circuit of Q58 charges C229 in the delay circuit abruptly. Similar to the action of the VOX, this turns Q55 ON and puts it in transmit. Delay time is adjusted by R235. Q61 is a phase type oscillator circuit which oscillates at about 800Hz. Control on this oscillator is by switching emitter by-pass condenser C230 of Q61 and Q60.
Power Circuit	9 volt regulated voltage is generated at the anode of D33 in the circuit comprising R144, D33 and zener diode D32, and buffered by the Emitter Follower, Q37. This voltage is supplied to the Microphone Pre-amplifier IDC, AGC, AF Amplifier circuits and also to the CW Monitor, BFO and VOX Circuits through the Mode switch. For receive 9V, regulated voltage is taken from the Emitter Follower, Q34. Clamping Circuit comprised of R138, D26 and E32. This voltage is supplied to the RF Amplifier, Mixer, SSB IF and the FM IF Circuits through the Mode Switch. It is also supplied to the Noise Blanker Circuit. Transmit 9V, is regulated and buffered by emitter follower Q35 from the Clamping Circuit including R143, D31 and D32. This voltage is supplied to the Transmit Mixer, Intermediate Amplifier, Balanced Modulator, and FM Modulator Circuits, through the Mode Switch.
Stand-by Circuit	The cathode side of D27, D28 and D29 is connected to Microphone PTT Switch and the SEND SW and also to the Stand-by Control Transistor. When this line is grounded, the base voltage of Q34 is lowered through D27 and receive 9V is reduced zero. The Base voltage of Q36 is also lowered through D29, whereby Q36 turns OFF and transmit 9V is produced and the LET which indicates transmit is lighted. When this line is released, D27 turns OFF and Q36 turns ON, whereby base of Q35 goes low through D30 and accordingly transmit D30 9V is killed. D28 is installes so as to discharge any charge remaining in the receiving 9V line's filter acpacutors. D56 is provided to retain memory (storage) of the Up Down Counter inside the LS1. If a DC source is connected, and the memory switch is ON, memo-

ry switch is ON, memory is retained irrespective of power source switch. D34 is for protection against reverse connection.

Outline of the LS1 Clip

IC1 is composed or reference oscillator, frequency divider for the reference oscillator, phase detector, I/N frequency divider, two sets of up-down counters, etc. As this LS1 is a C-MOS type, it requires very small power of 25mW. Action of each terminal of this LS1 is outlines below.

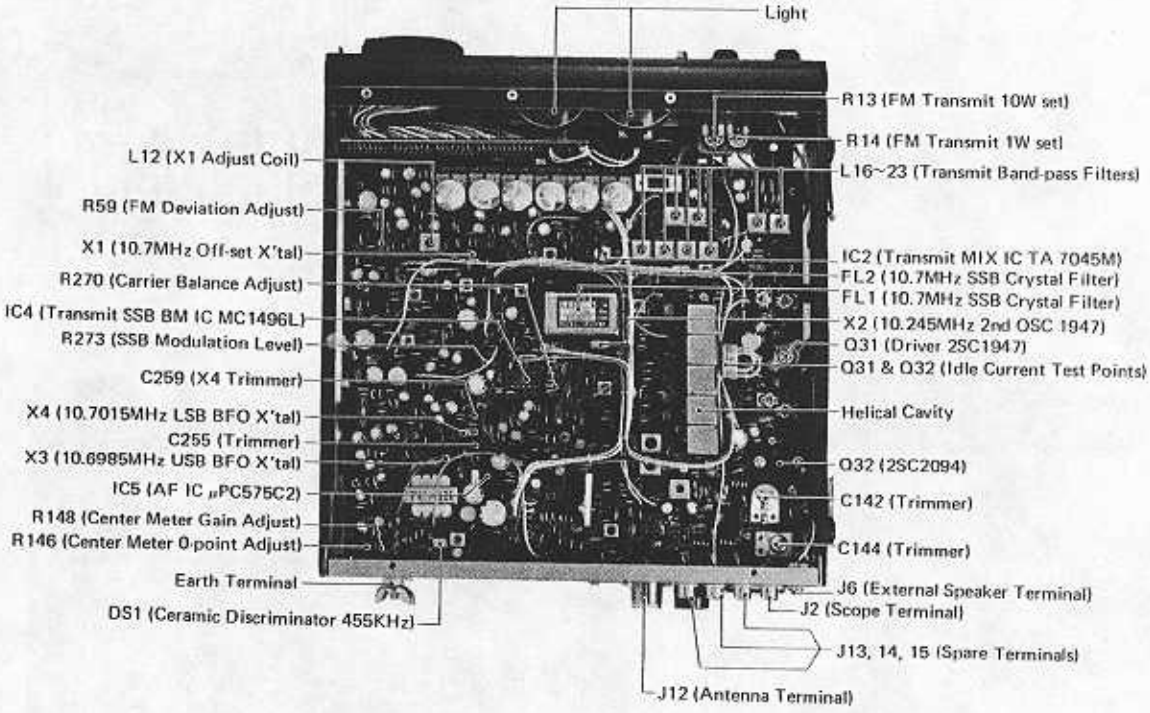
FIN	Applies input signals ot the PLL phase comparator thru the I/N.
ϕIn, ϕOut	Effects crystal oscillating of 5MHz by external of the CMOS Inverter.
FS	Switches oscillator frequency to 1/200 of 1/500. In out case, oscillator frequency is set at 1/500 to obtain a reference frequency of 10KHz.
K0–K8	Terminal for a keyboard input. These are connected to the ACC socket.
FCL	Resets the internal specified digit counter for key input.
CK	Operates the internal up-down counter by rulses from dial.
CL	Resets the up-down counter, for the digit specified.
SL	Switches input and output of 2 sets of up-down counters.
G	Regardless of the state of SL, G applies from the dial and up-down signals to two sets of up-down counters.
X,Y,Z	Effects step control of each up-down counter. By varying the inputs of X,Y,Z, up-down steps of 1, 50, 100, 1000 and 10000 are possible. Normally 100Hz steps are usual but in FAST, it changes to 5KHz.
UD	Controls up-down of the internal up-down counter.
A0–B4	BCD output terminals of internal up-down counter selected by SL. Supplied to Indicating Circuit for readout.
PD	Output of the PLL phase comparator. Supplied to the outside active low-pass filter and lock-off Detecting Circuit.
VDD	Power voltage terminal of 5V.
VSS	Ground terminal.

D/A Converter	BCD output of the LS1 (A0 – D1) output is converted into a DC output having 100 steps by the D/A Converter, R1/R9. This output is adjusted by R17 and R18. R20 is for temperature-compensation.
Local Oscillator	In the VXO oscillator circuit composed of Q9, Diode Switch D9, which is controlled by B4, turns ON at 144 – 146MHz and the circuit oscillates at XZ. This oscillating frequency is varied by applying output voltage from the D/A convertere thru R43 and output voltage of the PLC network to variable capacity diodes D7 and D8 and thus variable frequencies in 5KHz section can be obtained. In the case of 146 – 148MHz, when the LS1 B4 is Hi, D10 turns ON, D9 turns OFF and oscillation is controlled by X. This oscillating frequency depends on ON OFF of Switching Transistor of Q8 which is controlled by LS1 and A1. At A1 Hi, local oscillating output rises by 5KHz. Providing 5KHz steps in the FM Band at Q9, 14MHz is generated, which is tripled at Q10 and is further tripled at Q11. Thus, local oscillator output of 130MHz obtained.
Frequency Converter, Wide-band Amplifier	Output from the VCO and output of the local oscillator are converted in the Mixer, IC4. Frequencies of 1MHz and IC4 3MHz ore obtained from the Chebyshev low-pass filter of the following stage. Outputs thus obtained are amplified to more than 1V P-P by the wide-band amplifier of IC5, and then they are applied to the FIN Terminal of LS1 and divided by Programmable Divider for phase comparison with standard frequency of 10KHz.
Low-pass Filter	Phase detector output from LS1 determines the dynamic characteristics of the PLL by using a low-pass filter of two-stages, direct-coupled Q4 & Q6. Then, noise components contained in the VCO control voltage are suppressed by Secondary Low-pass Filter.
Shooting Circuit	In the case where lock inhibit should take place, phase detecting output from LS1 changes to a wide pulse corresponding to a I think should be frequency not difference. In such a case, outputs are rectified at D5 and D6 and applied to the based Q3 which is switched. These outputs make the transmit 9V of the Main unit go to zero and inhibit transmitting when lock-off took place. Therefore, if lock-off occurred during transmitting, SIG LED is lighted.

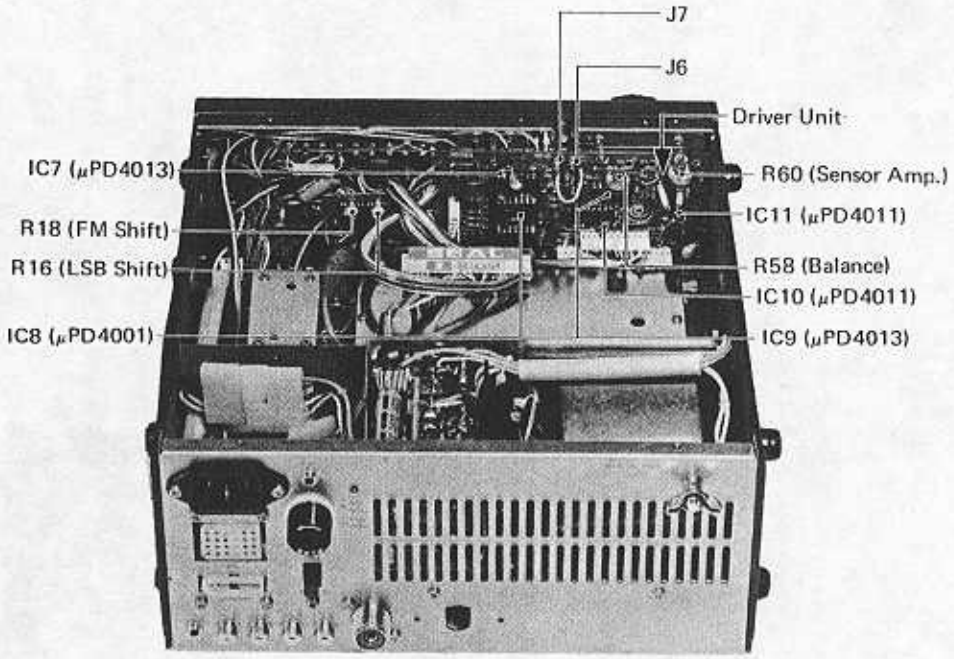
Power	IC6 is the IC for normal use and converts input of 13.8V into 5V. This voltage is supplied to LS1, dimmer, driver, ISL, and X control. IC7 is a unit including oscillator, rectification, constant-voltage, etc. and generates -9V, with supply voltage of 5V from IC6 through Q12. This voltage is supplied to AGC the Circuit and High Power Set Circuit. Q12 cuts off IC7 at power OFF. IC8 an D-11 is IC for udrnae use and produces 9V voltage from input of 13.8V. This voltage is supplied to the VCO and low-pass filter, PLL, MIX, wide-band amplifier and ripple filter of Q1.
X Control Circuit	The X Control Circuit is composed of IC2 and IC3, when switched to FAST, then change frequency by 10KHz step 146MHz and 147MHz change by 5KHz step, irrespective of FAST switching.

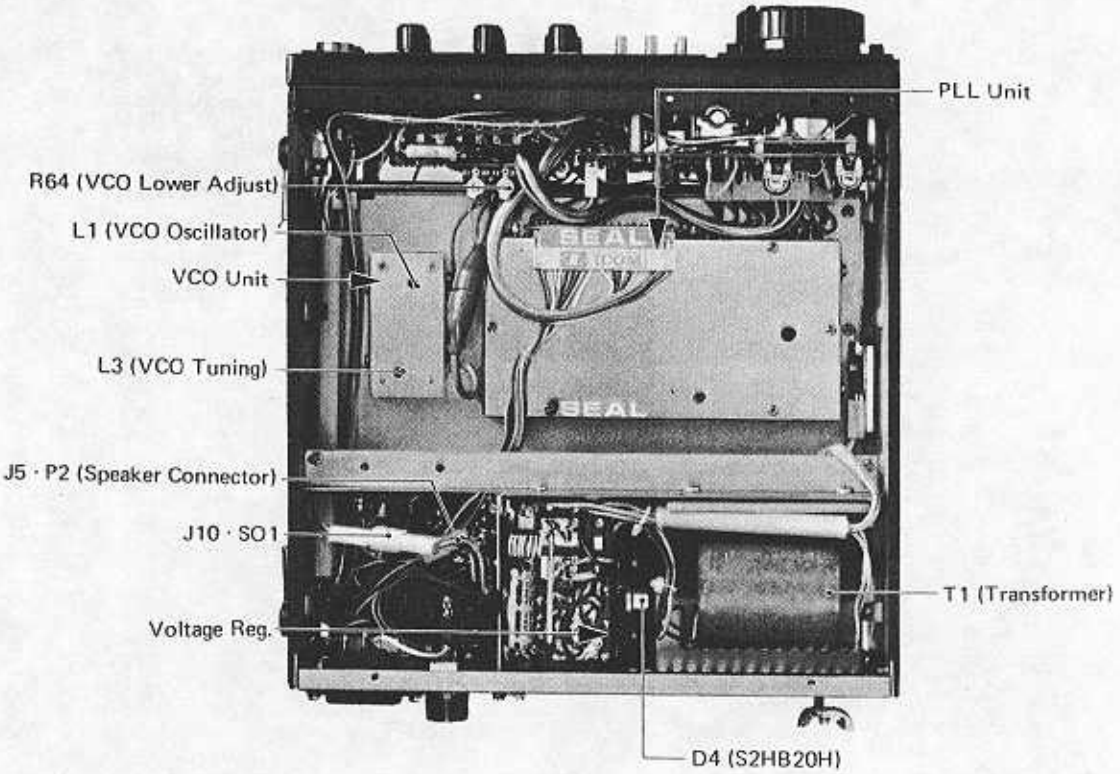
INSIDE VIEW

MAIN PC BOARD SIDE



PLL UNIT SIDE





SECTION VIII PARTS LIST

EF UNIT		
Q1	Transistor	MJE3055
Q2	Transistor	2SC945
Q3	Transistor	2SC945
Q4	Transistor	2SC945
D1	LED	SLP-119B
D2	Diode	GP08A
D3	Diode	1SS53
D4	Diode	1SS53
D5	Diode	1SS53
D6	Diode	1SS53
R1	Valiable	PR15-10KB15K
R2	Valiable	PR15-10KA15K
R3	Valiable	PR15-10KB15K
R4	Valiable	PR15-10KB15K
R5	Valiable	PR15-10KA15K
R6	Valiable	PR15-500B15K
R13	Trimmer	1K FR-10
R14	Trimmer	3K FR-10
R20	Trimmer	50K FR-10
C1	Chemical	100u 10V
C2	Chemical	220u 10V
S1	Snap SW.	SLC-22C
S2	Snap SW.	SLC-22C
S3	Snap SW.	SLC-22C
S4	Snap SW.	SLC-22C
S5	Snap SW.	SLC-22C
S6	Push SW.	Y1-5974
S7	Slide SW.	S-1
S8	Rotary SW.	ESR-E-264K15ZE
S9	Rotary SW.	ESR-E-134K15ZE
S10		
S11		
S12	Snap SW.	SLC-22C
FH1	Fuse Holder	FH-032
J1	Connector	4P Base
J2	Pin Jack	CN-3561S
J3	Connector	1625-24R-1
J4	Head phone Jack	LJ-035-1-2
J5	Connector	1625-3R
J6	SPR Jack	SJ-296
J7	Key Jack	SJ-296
J8	—	—
J9	AC Jack	S16045
J10	Connector	1653-5R-1
J11	Connector	1490-4P
J12	ANT Connector	FM-MDRmi
J13	Pin Jack	CN-3561S
J14	Pin Jack	CN-3561S
J15	Pin Jack	CN-3561S
PL1	Lamp	14V 50mA
PL2	Lamp	14V 50mA

MAIN UNIT		
Q1	FET	2SK49-H2
Q2	Transistor	2SC1583-G
Q3	Transistor	2SC1583-G
Q4	Transistor	2SC945-P
Q5	Transistor	2SC945-P
Q6	Transistor	JA1050-G/W
Q7	FET	3SK40-M
Q8	FET	3SK40-K
Q9	Transistor	JA1050-G/W
Q10	Transistor	2SC1583-G
Q11	Transistor	2SC1571-G
Q12	Transistor	2SC945-P
Q13	Transistor	2SC945-P
Q14	Transistor	2SC945-P
Q15	Transistor	2SC945-P
Q16	Transistor	2SC1571-G
Q17	Transistor	JA1050-G
Q18	Transistor	2SC1571-G
Q19	Transistor	JA1050-G
Q20	Transistor	2SC945-P
Q21	FET	2SK30A-GR
Q22	Transistor	2SC945-P
Q23	Transistor	2SC945-P
Q24	Transistor	2SC945-P
Q25	Transistor	2SC945-P
Q26	Transistor	2SC945-P
Q27	Transistor	2SC945-P
Q28	FET	3SK40-M
Q29	Transistor	JA1050-G/W
Q30	Transistor	2SC2053
Q31	Transistor	2SC1947
Q32	Transistor	2SC2094
Q33	Transistor	2SC945-P
Q34	Transistor	JA1600-G
Q35	Transistor	2SD359-D
Q36	Transistor	2SC945-P
Q37	Transistor	JA1600-G

Q38	FET	2SK44-D
Q39	Transistor	2SC945-P
Q40	Transistor	2SC945-P
Q41	Transistor	2SC945-P
Q42	Transistor	2SC945-R
Q43	FET	2SK49-H2
Q44	Transistor	2SC945-P
Q45	FET	2SK49-H2
Q46	FET	3SK40-M
Q47	FET	3SK40-M
Q48	Transistor	2SA639
Q49	Transistor	2SC1571-G
Q50	Transistor	2SC945-R
Q51	Transistor	2SC945-P
Q52	Transistor	2SC945-P
Q53	Transistor	2SC945-P
Q54	Transistor	2SC945-P
Q55	Transistor	2SC945-P
Q56	Transistor	2SC945-P
Q57	Transistor	2SC945-P
Q58	Transistor	2SC945-P
Q59	Transistor	2SC945-P
Q60	Transistor	2SC945-P
Q61	Transistor	2SC945-P
Q62	Transistor	2SC945-P
Q63	FET	2SK49-H2
Q64	FET	2SK44-D
Q65	Transistor	JA1050-G/W
Q66	Transistor	2SC945-P
Q67	Transistor	2SC945-P
Q68	Transistor	2SC945-P
Q69	Transistor	2SC945-P
Q70	Transistor	2SC945-P
Q71	Transistor	2SC945-P
Q72	Transistor	JA1050-G/W
Q73	Transistor	JA1050-G/W
Q74	Transistor	2SC945-P
Q75	Transistor	2SC945-P
IC1	IC	TA7045M
IC2	IC	TA7045M
IC3	IC	upc577H
IC4	IC	MC1496L
IC5	IC	upc575C2
D1	Diode	IN60
D2	Diode	IN60
D3	Diode	1SS53
D4	Diode	GPO8A
D5	Diode	1SS53
D6	Diode	1SS53
D7	Diode	1SS53
D8	Diode	1SS53
D9	Diode	IN60
D10	Diode	1SS53
D11	Varicap.	1S2688E
D12	Diode	IN60
D13	Diode	IN60
D14	Diode	GPO8A
D15	Diode	IN60
D16	Diode	1SS53
D17	Diode	GPO8A
D18	Diode	1SS53
D19	Diode	IN60
D20	Diode	IN60
D21	Diode	1SS55
D22	Diode	1SS55
D23	Diode	IN60
D24	Diode	IN60
D25	Diode	IN60
D26	Diode	1SS53
D27	Diode	1SS53
D28	Diode	GPO8A
D29	Diode	1SS53
D30	Diode	1SS53
D31	Diode	1SS53
D32	Zenier	XZO96
D33	Diode	1SS53
D34	Diode	SR-10N2R
D35	Diode	IN60
D36	Diode	1SS53
D37	Diode	1SS53
D38	Diode	IN60
D39	Diode	1SS53
D40	Diode	1SS53
D41	Diode	1SS53
D42	Diode	1SS53
D44	Diode	IN60
D45	Diode	1SS53
D46	Diode	IN60
D47	Diode	1SS53
D48	Diode	1SS53
D49	Diode	1SS53
D50	Diode	1SS53
D51	Diode	1SS53
D52	Diode	1SS53
D53	Diode	1SS53
D54	Diode	1SS53
D55	Zenier	WZO56

D56	Diode	SR1-10FM2
D57	Diode	1SS53
D43	Diode	1SS53
D58	Diode	1SS53
L1	Choke	100
L2	Choke	100
L3	Coil	LS-55
L4	Choke	102
L5	Coil	LS-66
L6	Coil	LS-66
L7	Coil	LS-66
L8	Choke	102
L9	Coil	LS-66
L10	Coil	LS-67
L11	Choke	100
L12	Coil	LS-80
L13	Choke	101
L14	Coil	LS-66
L15	Choke	101
L16	Coil	LS-73
L17	Coil	LS-73
L18	Coil	LS-73
L19	Coil	LS-73
L20	Coil	LS-73
L21	Coil	LS-73
L22	Coil	LS-73
L24	Choke	101
L25	Coil	LA-71
L26	Coil	LW-1
L27	Coil	LA-97
L28	Coil	LA-109
L29	Coil	LW-1
L30	Coil	LA-2
L31	Coil	LW-1
L32	Coil	LA-71
L33	Coil	LA-73
L34	Coil	LA-71
L35	Coil	LA-71
L36	Coil	LA-71
L37	Coil	LR-10
L38	Coil	LA-85
L39	Choke	TC-1B
L40	Coil	LS-16
L41	Choke	102
L42	Choke	102
L43	Coil	LS-20
L44	Coil	LS-79
L45	Coil	LS-79
L46	Coil	LR-17
L47	Coil	LB-1-3A
L48	Coil	LB-1-1
L49	Coil	LB-1-1
L50	Coil	LB-1-1
L51	Coil	LB-1-3A
L52	Coil	LS-4
L53	Choke	101
L54		
L55	Choke	101
L56	Choke	101
L57	Coil	LA-96
FL1	Xtal Filter	FEC-103-1
FL2	Xtal Filter	10M20A
FL3	Ceramic Filter	CFU-455E
FL4	Ceramic Filter	CFU-455E
DS1	Ceramic Discri	455D
S1	Slide SW	SJ-0237
B1	P.C. Board	B-196A
CP1	Check Point	
CP2	(R312)	
CP3	Check Point	
CP4	Check Point	
CP5	Check Point	
CP6	Check Point	
CP7	(R174)	
CP8	Check Point	
CP9	(R318)	
CP10	Check Point	
CP11	Check Point	
CP12	Check Point	
X1	Xtal	HC-18/U 10.700MHz
X2	Xtal	HC-18/U 10.245MHz
X3	Xtal	HC-18/U 10.6985MHz
X4	Xtal	HC-18/U 10.7015MHz
C1	Ceramic	500P 50V
C2	Ceramic	0.01 50V
C3	Ceramic	0.01 50V
C4	Ceramic	50P 50V
C5	Ceramic	50P 50V
C6	Ceramic	0.01 50V
C7	Ceramic	0.01 50V
C8	Ceramic	35P 50V
C9	Chemical	47 16V

C10	Ceramic	0.001 50V
C11	Ceramic	100P 50V
C12	Milar	0.039 50V
C13	Milar	0.1 50V
C14	Ceramic	0.01 50V
C15	Ceramic	0.001 50V
C16	Miler C	0.0022 50V
C17	Ceramic	100P 50V
C18	Ceramic	0.01 50V
C19	Ceramic	0.01 50V
C20	Ceramic	0.01 50V
C21	Ceramic	0.01 50V
C22	Ceramic	0.04 50V
C23	Ceramic	120P 50V
C24	Ceramic	0.01 50V
C25	Ceramic	0.01 50V
C26	Ceramic	0.01 50V
C27	Ceramic	120P 50V
C28	Ceramic	0.01 50V
C29	Ceramic	0.01 50V
C30	Ceramic	0.01 50V
C31	Ceramic	0.01 50V
C32	Ceramic	0.01 50V
C33	Ceramic	120P 50V
C34	Ceramic	0.01 50V
C35	Ceramic	0.01 50V
C36	Ceramic	40P 50V
C37	Ceramic	0.01 50V
C38	Ceramic	0.01 50V
C39	Ceramic	0.01 50V
C40	Chemical	4.7 25V
C41	Ceramic	0.01 50V
C42	Ceramic	0.01 50V
C43	Ceramic	0.01 50V
C44	Milar C	0.1 50V
C45	Ceramic	0.01 50V
C46	Chemical	47 10V
C47	Ceramic	0.01 50V
C48	Ceramic	N2200 200P 50V
C49	Ceramic	N2200 100P 50V
C50	Ceramic	NPO 10P 50V
C51	Milar	0.01 50V
C52	Milar	0.0047 50V
C53	Milar	0.1 50V
C54	Milar	0.0033 50V
C55	Milar	0.01 50V
C56	Milar	0.01 50V
C57	Chemical	100 16V
C58	Chemical	4.7 25V

C59	Milar	0.0047 50V
C60	Chemical	100 16V
C61	Ceramic	0.01 50V
C62	Ceramic	100P 50V
C63	Chemical	4.7 25V
C64	Chemical	220 10V
C65	Chemical	4.7 25V
C66	Ceramic	0.02 50V
C67	Ceramic	0.01 50V
C68	Chemical	47 10V
C69	Ceramic	0.001 50V
C70	Chemical	4.7 25V
C71	Ceramic	0.001 50V
C72	Chemical	33 10V
C73	Chemical	220 16V
C74	Chemical	10 16V
C75	Chemical	0.47 50V
C76	Chemical	220 16V
C77	Chemical	33 63V
C78	Chemical	3.3 25V
C79	Chemical	3.3 25V
C80	Chemical	10 16V
C81	Chemical	10 16V
C82	Ceramic	10P 50V
C83	Ceramic	0.01 50V
C84	Ceramic	0.01 50V
C85	Ceramic	100P 50V
C86	Ceramic	0.01 50V
C87	Ceramic	0.01 50V
C88	Ceramic	0.01 50V
C89	Ceramic	6P 50V
C90	Ceramic	0.01 50V
C91	Ceramic	10P 50V
C92	Ceramic	0.35P 50V
C93	Ceramic	0.35P 50V
C94	Ceramic	0.35 50V
C95	Ceramic	0.5P 50V
C96	Ceramic	8P 50V
C97	Ceramic	6P 50V
C98	Ceramic	6P 50V
C99	Ceramic	8P 50V
C100	Ceramic	6P 50V
C101	Chemical	10. 16V
C102	Ceramic	0.01 16V
C103	Ceramic	0.01 16V
C104	Ceramic	33 16V
C105	Ceramic	0.001 50V
C106	Ceramic	0.01 50V
C107	Ceramic	0.01 50V

C108	Ceramic	0.01 50V
C109	Ceramic	0.01 50V
C110	Ceramic	0.01 50V
C111	Ceramic	6P 50V
C112	Ceramic	25P 50V
C113	Ceramic	7P 50V
C114	Ceramic	0.5P 50V
C116	Ceramic	0.01 50V
C117	Ceramic	0.001
C118	Ceramic	0.01 50V
C119	Trimmer	CVC20-11
C120	Ceramic	45P 50V
C121	Ceramic	0.01 50V
C122	Ceramic	0.01 50V
C123	Trimmer	CVC20-11
C124	Ceramic	30P 50V
C125	Chemical	10 16V
C126	Ceramic	0.01 50V
C127	Kantsu	0.001 DFT-5
C128	Chemical	47 25V
C129	Ceramic	0.01 50V
C130	Chemical	10 16V
C131	Ceramic	50P 50V
C132	Trimmer	CVC20-11
C133	Ceramic	100P 50V
C134	Trimmer	CVC20-11
C135	Ceramic	15P 50V
C136	Ceramic	15P 50V
C137	Ceramic	0.01 50V
C138	Ceramic	0.01 50V
C139	Kantsu	0.001 DFT-5
C140	Chemical	47 16V
C141	Ceramic	0.01 50V
C142	Trimmer	CVO1B150
C143	Ceramic	25P 50V
C144	Trimmer	TYPE C 70P
C145	Ceramic	30P 50V
C146	Ceramic	2P 50V
C147	Ceramic	3P 50V
C148	Ceramic	20P 50V
C149	Ceramic	0.01 50V
C150	Ceramic	0.01 50V
C151	Chemical	22 16V
C152	Ceramic	0.01 50V
C153	Ceramic	4P 50V
C154	Ceramic	0.01 50V
C155	Ceramic	0.01 50V
C156	Ceramic	15P 50V
C157	Ceramic	0.001 50V

C158	Ceramic	15P 50V
C159	Ceramic	15P 50V
C160	Chemical	10 16V
C161	Chemical	470 16V
C162	Ceramic	0.04 50V
C163	Milar	0.1 50V
C164	Milar	0.1 50V
C165	Milar	0.1 50V
C166	Milar	0.056 50V
C167	Milar	0.056 50V
C168	***	***
C169	Milar	0.056 50V
C170	Chemical	47 10V
C171	Milar	0.0022 50V
C172	Milar	0.039 50V
C173	Milar	0.056 50V
C174	Milar	0.047 50V
C175	Ceramic	0.01 50V
C176	Milar	0.056 50V
C177	Milar	0.056 50V
C178	Milar	0.0033 50V
C179	Ceramic	0.01 50V
C180	Ceramic	0.01 50V
C181	Milar	0.039 50V
C182	Milar	0.039 50V
C183	Ceramic	0.01 50V
C184	Milar	0.039 50V
C185	Milar	0.039 50V
C186	Ceramic	0.01 50V
C187	Ceramic	1P 50V
C188	Ceramic	0.01 50V
C189	Stycon	100P 50V
C190	Stycon	100P 50V
C191	Ceramic	NPO 30P 50V
C192	Ceramic	0.01 50V
C193	Ceramic	0.001 50V
C194	Ceramic	0.001 50V
C195	Ceramic	0.01 50V
C196	Ceramic	0.01 50V
C197	Ceramic	0.01 50V
C198	Ceramic	0.01 50V
C199	Ceramic	0.01 50V
C200	Ceramic	0.001 50V
C201	Ceramic	0.001 500V
C202	Ceramic	0.001 500V
C203	Ceramic	10P 50V
C204	Ceramic	0.001 50V
C205	Ceramic	0.01 50V
C206	Milar	0.056 50V

C207	Chemical	0.47 50V
C208	Chemical	1 50V
C209	Chemical	10 16V
C210	Chemical	10 16V
C211	Chemical	0.47 50V
C212	Milar	0.01 50V
C213	Milar	0.01 50V
C214	Milar	0.01 50V
C215	Chemical	0.47 50V
C216	Ceramic	100P 50V
C217	Chemical	10 16V
C218	Chemical	3.3 25V
C219	Chemical	3.3 25V
C220	Chemical	10 16V
C221	Chemical	4.7 25V
C222	Milar	0.039 50V
C223	Milar	0.0022 50V
C224	Milar	0.039 50V
C225	Milar	0.1 50V
C226	Chemical	10 16V
C227	Milar	0.039 50V
C228	Chemical	10 16V
C229	Chemical	10 16V
C230	Chemical	4.7 25V
C231	Chemical	33 16V
C232	Milar	0.01 50V
C233	Milar	0.01 50V
C234	Milar	0.01 50V
C235	Ceramic	0.01 50V
C236	Chemical	3.3 10V
C237	Milar	0.01 50V
C238	Chemical	33 6.3V
C239	Ceramic	0.01 50V
C240	Chemical	4.7 25V
C241	Ceramic	0.001 25V
C242	Ceramic	0.01 25V
C243	Ceramic	0.01 25V
C244	Ceramic	0.01 25V
C245	Ceramic	0.01 25V
C246	Ceramic	40P 25V
C247	Ceramic	0.01 25V
C248	Milar	0.033 25V
C249	Ceramic	0.01 50V
C250	Chemical	0.47 50V
C251	Ceramic	0.01 50V
C252	Stycon	47P 50V
C254	Ceramic	0.01 50V
C255	Trimmer	CVO5E300
C256	Stycon	47P 50V

C257	Stycon	***
C258	Stycon	15P 50V
C259	Trimmer	CVO5D180
C260	Ceramic	0.01 50V
C261	Stycon	100P 50V
C262	Stycon	100P 50V
C263	Ceramic	0.01 50V
C265	Ceramic	0.001 50V
C266	Chemical	33 6.3V
C267	Chemical	4.7 25V
C268	Ceramic	500P 50V
C269	Chemical	0.47 50V
C270	Chemical	1 16V
C271	Chemical	100 10V
C272	Milar	0.0033 50V
C273	Chemical	220 16V
C274	Milar	0.1 50V
C275	Chemical	0.47 50V
C276	Ceramic	0.01 50V
C277	Chemical	10 16V
C278	Chemical	4.7 25V
C279	Chemical	1 50V
C280	Chemical	33 16V
C281	Chemical	10 16V
C282	Chemical	47 10V
C283	Chemical	4.7 25V
C284	Ceramic	0.01 50V
C285	Chemical	4.7 25V
C286	Ceramic	0.01 50V
C287	Chemical	47 10V
C288	Ceramic	0.01 50V
C289	Chemical	47 10V
C290	Milar	0.056 50V
C291	Ceramic	0.01 50V
C292	Ceramic	0.01 50V
C293	Ceramic	0.001 50V
C294	Chemical	10 10V
C295	Ceramic	0.01 50V
C296	Chemical	22 6.3V
C297	Non Polar Chemical	1 50V
C298	Ceramic	0.001 50V
C299	Ceramic	0.01 50V
C300	Ceramic	0.01 50V
C301	Ceramic	0.01 50V
C302	Chemical	10u 16V
C303	Ceramic	0.01 50V
C304	Ceramic	0.02 50V
C305	Ceramic	0.01 50V
C306	Ceramic	0.001 500V

C307	Ceramic	10P 50V
C308	Ceramic	0.01 50V
C309	Ceramic	0.01 50V
C310	Chemical	22u 16V
R26	Trimmer	3K FR-10
R56	Thermistor	23D29
R59	Trimmer	1K FR-10
R60	Thermistor	33D28
R67	Trimmer	3K FR-10
R92	Trimmer	100K FR-10
R106	Trimmer	3K FR-10
R127	Trimmer	1K FR-10
R129	Trimmer	1K FR-10
R130	Trimmer	100 FR-10
R132	Trimmer	300 FR-10
R134	Trimmer	EVT-81AS05 B14
R135	Trimmer	100 FR-10
R136	Trimmer	100K FR-10
R146	Trimmer	500 FR-10
R148	Trimmer	1K FR-10
R167	Trimmer	1K FR-10
R224	Thermistor	33D28
R235	Trimmer	EVT-81AS05 B15
R249	Trimmer	EVT-81AS05 B14
R270	Trimmer	30K FR-10
R273	Trimmer	3K FR-10
R291	Trimmer	EVT-81AS05 B14
R302	Trimmer	EVT-81AS05 B15
R310	Trimmer	EVT-81AS05 B14

VCO UNIT

Q1	FET	2SK19 GR
Q2	FET	3SK40 K
D1	Varicap	Mv201
L1	Coil	LS-92
L2	Coil	LW-5
L3	Coil	LS-3A
R1	Resistor	ELR25 100K
R2	Resistor	ELR25 100K
R3	Resistor	ELR25 100
R4	Resistor	ELR25 100K
R5	Resistor	ELR25 100K
R6	Resistor	ELR25 150K
R7	Resistor	ELR25 47
R8	Resistor	ELR25 47
R9	Resistor	ELR25 220
R10	Resistor	ELR25 22
C1	Feed Through	DFT-5
C2	Ceramic	0.01u 50V
C3	Chemical	47u 10V
C4	Super Dip	150P
C5	Ceramic	NPO 30P 50V
C6	Ceramic	NPO 10P 50V
C7	Ceramic	NPO 40P 50V
C8	Ceramic	NPO 80P 50V
C9	Ceramic	0.01u 50V
C10	Ceramic	0.01u 50V
C11	Ceramic	0.01u 50V
C12	Ceramic	8P 50V
C13	Ceramic	0.01u 50V
C14	Ceramic	0.01u 50V
C15	Ceramic	0.01u 50V
C16		HB363Y-R102PSH02

DISPLAY DRIVER UNIT

IC1	IC	M53247P
IC2	IC	M53247P
IC3	IC	M53247P
IC4	IC	M53247P
IC5	IC	M53204P
IC6	IC	M53200P
IC7	IC	uPD4013C
IC8	IC	uPD4001C
IC9	IC	uPD4013C
IC10	IC	uPD4011C
IC11	IC	uPD4011C
Q1	Transistor	2SC945
Q2	Transistor	2SC945
Q3	Transistor	JA1600
Q4	Transistor	2SC945
Q5	Transistor	JA1600
Q6	Transistor	2SC945
Q7	Transistor	2SC945
Q8	Photo Transistor	PH101
Q9	Photo Transistor	PH101
Q10	Transistor	JA1050
Q11	Transistor	2SC945

D1	Diode	GPO08A
D2	Diode	1SS53
D3	LED	SR106C
D4	LED	SR106C
D8	Diode	1SS53
R58	Trimmer R	FR-10 3K
R60	Trimmer R	7K FR-10
C1	Milar C	.039u 50V
C2	Chemical	3.3u 25V
C3	Chemical	.47u 50V
C4	Milar C	.0047u 50V
C5	Milar C	.01u 50V
C6	Ceramic	.001u 50V
C7	Ceramic	.001u 50V
C8	Ceramic	.001u 50V
C9	Milar C	.056u 50V
C10	Ceramic	.00u 50V
C11	Ceramic	.001u 50V
J1	Connector	3022-06A
J2	Connector	3022-06A
J3	Connector	3022-10A
J4	Connector	3022-10A
J5	Connector	3022-10A
IC12	7-Seg LED	TLR313
IC13	7-Seg LED	TLR313
IC14	7-Seg LED	TLR313
IC15	7-Seg LED	TLR313
IC16	7-Seg LED	TLR313
IC17	7-Seg LED	TLR313
IC18	7-Seg LED	TLR313
D5	LED	SEL103S
D6	LED	SEL103S
D7	LED	SEL103S

SECTION IX VOLTAGES CHARTS

Unit	No.	Transmit				Receive				Notes
		Base or Gate 1	Gate 2	Collector or Drain	Emitter or Source	Base or Gate 1	Gate 2	Collector or Drain	Emitter or Source	
U-121	Q1					0		8.5	0.2	NB SW-ON
"	Q2(1)					1.0		8.0	1.0	"
"	Q2(2)					1.7		8.0	1.0	"
"	Q3(1)					1.6		9.2	1.0	"
"	Q3(2)					1.6		9.2	1.0	"
"	Q4					0		1.7	E	"
"	Q5					0		7.4	0	"
"	Q6					7.4		0	8.0	"
"	Q7					0	4.0	8.6	0.4	SSB IF
"	Q8					0	3.9	8.2	0.8	"
"	Q9					1.3		0	0.8	"
"	Q10 (1)					3.7		9.0	3.0	"
"	Q10 (2)					3.5		9.0	3.0	"
"	Q11					1.6		3.6	1.0	"
"	Q12	4.3		9.0	3.8					FM MOD
"	Q13	5.4		9.1	5.0					IDC
"	Q14	0.6		1.6	0					"
"	Q15	0.5		0.6	0					"
"	Q16	0.5		0.5	0					"
"	Q17	8.6		5.5	0					MIC AMP
"	Q18	6.3		8.6	5.7					"
"	Q19					5.8		-8.8	4.0	AGC
"	Q20					-7.0		3.9	-7.8	"
"	Q21					-7.6		9.2	-7.0	"
"	Q22					-8.6		-7.6	-8.8	"
"	Q23					-8.5		9.1	-7.6	"
"	Q24					-8.2		-8.8	-8.8	"
"	Q25					-8.2		3.4	-8.8	"
"	Q26					-8.4		8.9	-7.8	"
"	Q27					-4.6		1.2	-5.2	"
"	Q28	0	4.2	8.0	0.2					PA
"	Q29	9.2		0.2	9.2					"
"	Q30	1.2		13.5	0.5					"
"	Q31	0.4		13.5	E					"
"	Q32	0.4		13.5	E					"
"	Q33	0		9.0	E					"
"	Q34					10		13.5	9.2	R9V
"	Q35	10		13.5	9.2					T9V
"	Q36	10		0.7	0.2					"
	Q37	10		13.5	9.2	10		13.5	9.2	

Unit	No.	Transmit				Receive				Notes
		Base or Gate 1	Gate 2	Collector or Drain	Emitter or Source	Base or Gate 1	Gate 2	Collector or Drain	Emitter or Source	
U-121	Q38					0		3.7	0.2	
"	Q39					0.6		0.6	0	
"	Q40					4.4		6.2	4.0	
"	Q41					0.5		2.0	0	
"	Q42					2.0		9.0	1.4	
"	Q43					0		7.0	0.8	
"	Q44					2.5		7.5	2.3	
"	Q45					0		9.0	0.3	
"	Q46					0	0	8.8	E	
"	Q47					0	3.8	9.0	0	
"	Q48					8.4		9.0	9.0	
"	Q49					1.4		5.0	0.8	
"	Q50					5.0		9.2	4.6	
"	Q51					0.5		0	E	
"	Q52					0.2		7.4	E	
"	Q53					1.3		4.2	0.9	
"	Q54					1.3		8.8	0.7	
"	Q55	0.6		0	E	0		9.2	E	
"	Q56	0.1		8.4	0.2	0.1		0	0.1	VOX SW-ON
"	Q57	0.8		0.2	0.2	0.7		0.1	0.1	
"	Q58	6.4		7.0		6.4		7.0	6.0	
"	Q59	0		6.4		0		6.4	0	
"	Q60	0.6		0	0.6	0.6		0	0.6	
"	Q61	1.2		3.1	0.6	1.2		3.1	0.6	
"	Q62	0.1		7.4	E	0.7		0	E	
"	Q63	-0.7		7.4	E	0		0	E	
"	Q64	-4.2		8.4	-5.0					
"	Q65	8.4		9.0	9.0					
"	Q66	4.3		7.9	3.7					
"	Q67	2.0		2.8	1.4	2.0		2.8	1.4	
"	Q68	1.4		2.8	1.2	1.4		2.8	1.2	
"	Q69	1.9		5.6	1.3					
"	Q70	0		8.5	0					
"	Q71	0		8.5	0					
"	Q72	8.2		0	8.6					
"	Q73	8.2		0	8.2					
"	Q84	0		8.2	0					

Unit	No.	Transmit				Receive				Notes
		Base or Gate 1	Gate 2	Collector or Drain	Emitter or Source	Base or Gate 1	Gate 2	Collector or Drain	Emitter ro Source	
PX-67	Q1					2.0		15.5	1.8	
,,	Q2					15.5		21.5	14.5	
,,	Q3					6.2		15.5	5.6	
EF	Q1					14.5		23.0	13.8	
,,	Q2					-8.1		-7.8	-8.8	
,,	Q3					-7.9		E	-8.1	
,,	Q4					0		0	0	

		Transmit Pin No.														
Unit	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Notes
Main Board U-121	IC2	5.1	2.6	E	2.0	5.1	7.6	8.0	7.8							T. MIX
,,	IC4	2.0	1.4	1.4	2.0	1.4	7.0	0	4.0	0	4.0	0	7.0	0	E	B M
,,	IC-6	1.3	1.3	0	4.5	4.5										FM-T

		Receive Pin No.														
Unit	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Notes
Main Board U-121	IC-1	2.6	2.0	0	1.0	2.6	3.6	3.2	3.6							SSB DET
,,	IC-3	5.0	1.6	1.6	E	6.9	2.8	6.9								FM IF
,,	IC-5	1.9	0	13.5	6.6	7.8	13.5	13.5	1.8							AF

Unit	No.	Transmit				Receive				Notes
		Base or Gate 1	Gate 2	Collector or Drain	Emitter or Source	Base or Gate 1	Gate 2	Collector or Drain	Emitter or Source	
U-116 PLL	Q1	8.5		8.6	7.8					
"	Q2	0		8.6	3.9					
"	Q3	0		0.9	0					
"	Q4	0		7.8	0					
"	Q6	0		7.8	0.3					
"	Q7	7.5		7.6	7.0					
"	Q8	4.5		5	5					
"	Q9	1.8		8.3	1.0					
"	Q10	1.4		8.4	0.8					
"	Q11	1.4		8.4	0.8					

		Transmit Pin No.														
Unit	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Notes
U-116 PLL	IC-1															
	IC-2	0	0	5	0	0	5	0	0	5	5	5	0~5	0	5	
	IC-3	5~0	0	0	0	5	5	0	5	0	5	0~5	5	5	5	
	IC-4	5	2.6	E	1.9	5	6.7	7.5	7.5							
	IC-5	5.1	1.9	1.9	E	5.4	3	6								
	IC-6	10.6	E	5.0												1=B 2=C 3=E

		Receive Pin No.														
Unit	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Notes
U-116 PLL	IC-7	5	-9.3													1=Output 2=Input
"	IC-8	13.8	0	8.4												1=B 2=C 3=E
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
		5	1.5	0.8	1.4	5	0	0	0	0	0	0	0	0	0	
U-116 PLL	IC-1	15	16	17	18	19	20	21	22	23	24	25	26	27	28	21~28
		0	0	0	0	0~5	0	0~5	0~5	0~5	0~5	0~5	0~5	0~5	0~5	D.LSW.ON-5V T.S SW.ON-0
		29	30	31	32	33	34	35	36	37	38	39	40			29~33
		0~5	0~5	0~5	0~5	0~5	0	5	0	0	0	0	2.8			D.L SW ON-5V

Unit	No.	Transmit				Receive				Notes
		Base or Gate 1	Gate 2	Collector or Drain	Emitter or Source	Base or Gate 1	Gate 2	Collector or Drain	Emitter ro Source	
PX-87	Q1					2.0		15.5	1.8	
"	Q2					15.5		21.5	14.5	
"	Q3					6.2		15.5	5.6	
EF	Q1					14.5		23.0	13.8	
"	Q2					-8.1		-7.8	-8.8	
"	Q3					-7.9		E	-8.1	
"	Q4					0		0	0	

		Transmit Pin No.														
Unit	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Notes
Main Board U-121	IC2	5.1	2.6	E	2.0	5.1	7.6	8.0	7.8							T, MIX
"	IC4	2.0	1.4	1.4	2.0	1.4	7.0	0	4.0	0	4.0	0	7.0	0	E	B M
"	IC-6	1.3	1.3	0	4.5	4.5										FM-T

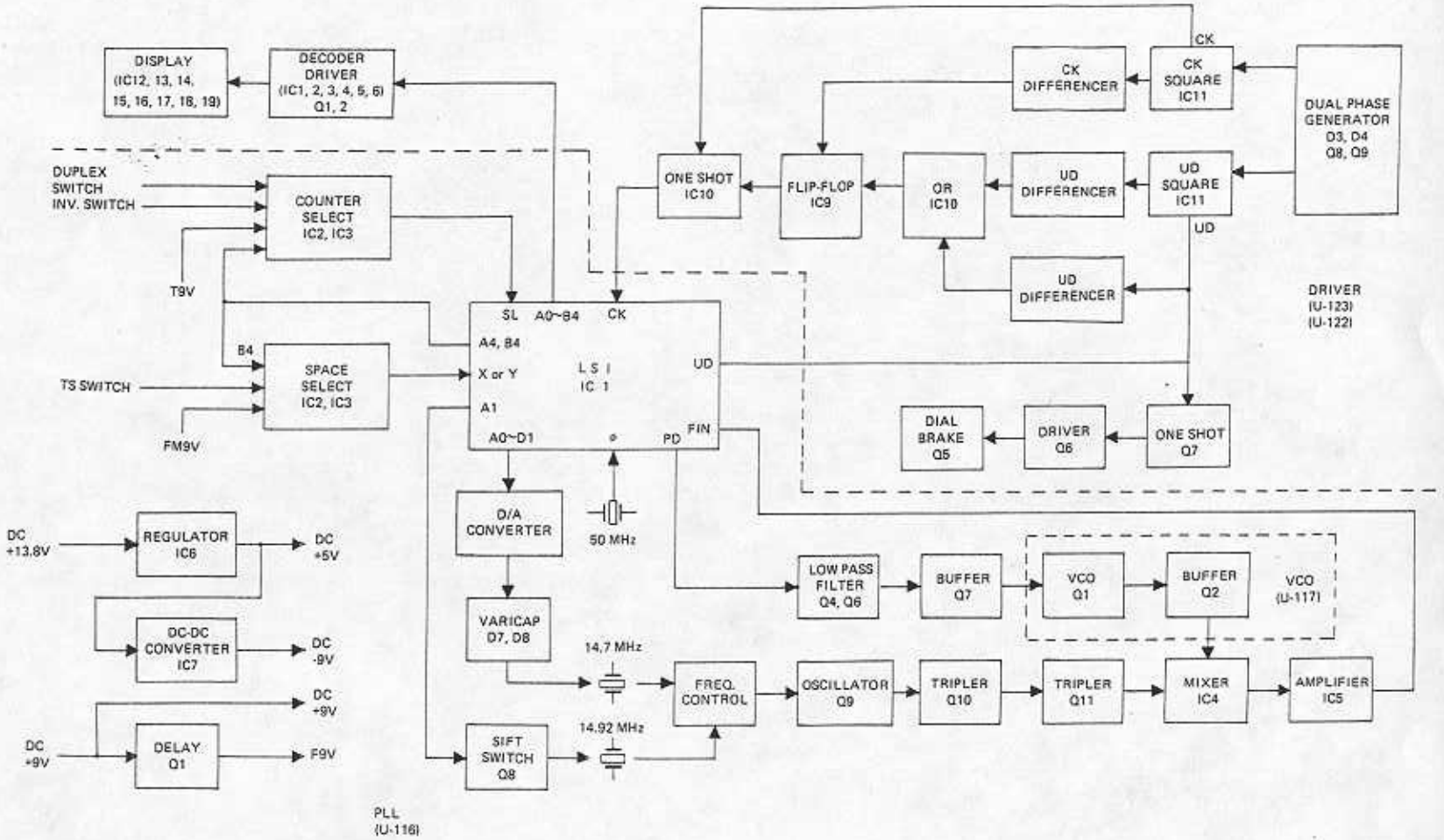
		Receive Pin No.														
Unit	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Notes
Main Board U-121	IC-1	2.6	2.0	0	1.0	2.6	3.6	3.2	3.6							SSB DET
"	IC-3	5.0	1.6	1.6	E	6.9	2.8	6.9								FM IF
"	IC-5	1.9	0	13.5	6.6	7.8	13.5	13.5	1.8							AF

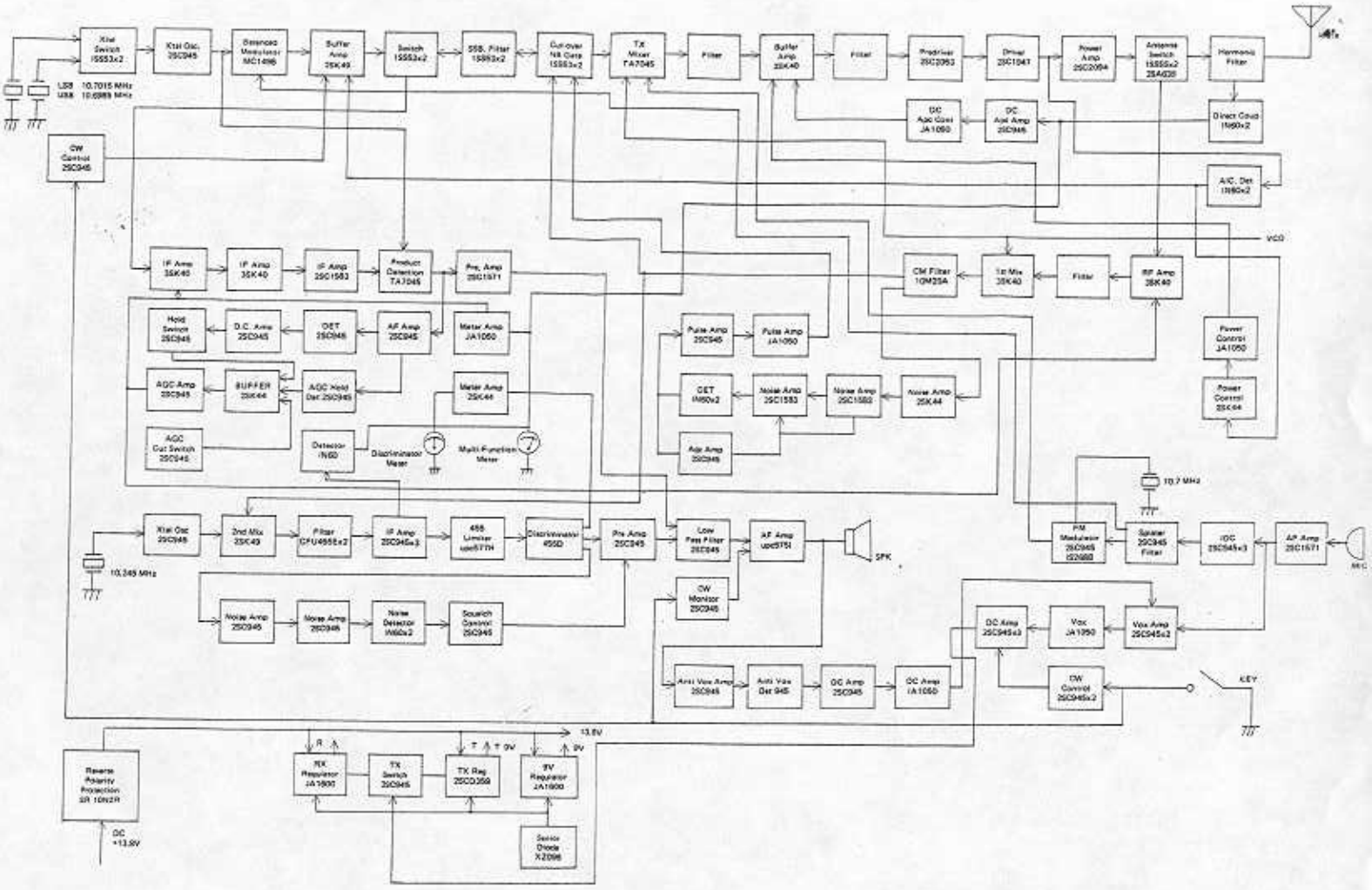
Unit	No.	Transmit				Receive				Notes
		Base or Gate 1	Gate 2	Collector or Drain	Emitter or Source	Base or Gate 1	Gate 2	Collector or Drain	Emitter or Source	
U-116 PLL	Q1	8.5		8.6	7.8					
"	Q2	0		8.6	3.9					
"	Q3	0		0.9	0					
"	Q4	0		7.8	0					
"	Q6	0		7.8	0.3					
"	Q7	7.5		7.6	7.0					
"	Q8	4.5		5	. 5					
"	Q9	1.8		8.3	1.0					
"	Q10	1.4		8.4	0.8					
"	Q11	1.4		8.4	0.8					

		Transmit Pin No.														
Unit	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Notes
U-116 PLL	IC-1															
	IC-2	0	0	5	0	0	5	0	0	5	5	5	0~5	0	5	
	IC-3	5~0	0	0	0	5	5	0	5	0	5	0~5	5	5	5	
	IC-4	5	2.6	E	1.9	5	6.7	7.5	7.5							
	IC-5	5.1	1.9	1.9	E	5.4	3	6								
	IC-6	10.6	E	5.0												1=B 2=C 3=E

		Receive Pin No.														
Unit	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Notes
U-116 PLL	IC-7	5	-9.3													1=Output 2=Input
"	IC-8	13.8	0	8.4												1=B 2=C 3=E
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
		5	1.5	0.8	1.4	5	0	0	0	0	0	0	0	0	0	
U-116 PLL	IC-1	15	16	17	18	19	20	21	22	23	24	25	26	27	28	21~28
		0	0	0	0	0~5	0	0~5	0~5	0~5	0~5	0~5	0~5	0~5	0~5	D.LSW.ON-5V T.S SW.ON-0
		29	30	31	32	33	34	35	36	37	38	39	40			29~33
		0~5	0~5	0~5	0~5	0~5	0	5	0	0	0	0	2.8			D.L SW ON-5V

SECTION X BLOCK DIAGRAM




Xtal Switch 1SS53x2
Xtal Osc. 2SC945
Balanced Modulator MC1496
Buffer Amp 2SK49
Switch 1SS53x2
SSB. Filter 1SS53x2
Cut-over NB Gate 1SS53x2
TX Mixer TA7045
Filter
Buffer Amp 2SK40
Filter
Predriver 2SC2053
Driver 2SC1047
Power Amp 2SC2054
Antenna Switch 1SS55x2 2SA628
Harmonic Filter
USB 10.7015 MHz
LSB 10.6985 MHz
DC Ajst Circ. JA1060
DC Ajst Amp 2SC945
Direct Coupl 1N60x2
CW Control 2SC945
A/C. Det 1N60x2
VCO
IF Amp 3SK40
IF Amp 3SK40
IF Amp 2SC1583
Product Detection TA7045
Reg. Amp 2SC1671
CM Filter 10M25A
1st Mix 3SK40
Filter
RF Amp 3SK40
Hold Switch 2SC945
D.C. Amp 2SC945
DET 2SC945
AF Amp 2SC945
Meter Amp JA1060
Pulse Amp 2SC945
Pulse Amp JA1060
Power Control JA1060
AGC Amp 2SC945
BUFFER 2SK44
AGC Hold Det 2SC945
Meter Amp 2SK44
DET IN60x2
Noise Amp 2SC1583
Noise Amp 2SC1583
Noise Amp 2SK44
Power Control 2SK44
AGC Out Switch 2SC945
Detector IN60
Discriminator Meter
Multi-Function Meter
Adr Amp 2SC945
10.7 MHz
Xtal Osc 2SC945
2nd Mix 2SK49
Filter CFU455Ex2
IF Amp 2SC945x3
455 Limiter upc577H
Discriminator 455D
Pre Amp 2SC945
Low Pass Filter 2SC945
AF Amp upc575
SPK
PM Modulator 2SC945 IS2688
Speaker 2SC945 Filter
IDC 2SC945x3
AP Amp 2SC1671
MIC
10.245 MHz
Noise Amp 2SC945
Noise Amp 2SC945
Noise Detector IN60x2
Squelch Control 2SC945
CW Monitor 2SC945
DC Amp 2SC945x3
Vox JA1350
Vox Amp 2SC945x2
Anti Vox Amp 2SC945
Anti Vox Det 945
DC Amp 2SC945
DC Amp IA1060
CW Control 2SC945x2
KEY
13.8V
R
T
T 9V
9V
Reverse Polarity Protection SR 10N2H
DC +13.8V
RX Regulator JA1900
TX Switch 2SC945
TX Reg 2SCD359
9V Regulator JA1900
Sevice Diode X2096