

2. MAINTENANCE

2.1 Disassembly

Turn the power switch off and remove the battery and antenna before disassembly and reassembly

2.1.1 Bottom Cover and Front Case

– Bottom Cover –

Remove the two screws (A) and detach the bottom cover, then remove the two screws (B) fixing the front case.

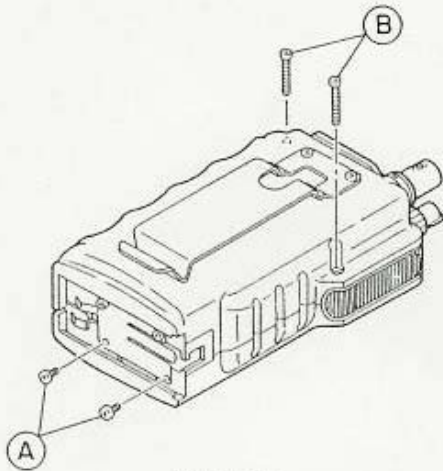


Figure 2-1

– Front Case –

Open the front case in the direction of an arrow and disconnect the connector (C).

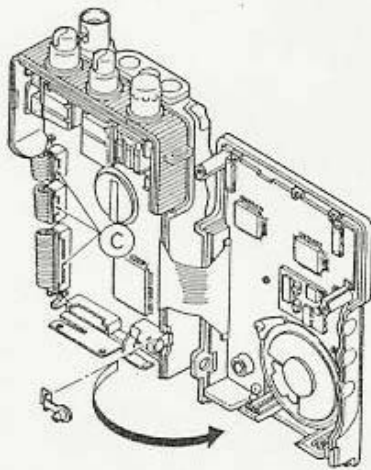


Figure 2-2

2.1.2 Display P.C. Board

Remove the six screws (D) and two screws (E), and you will be able to disconnect the display P.C. board.

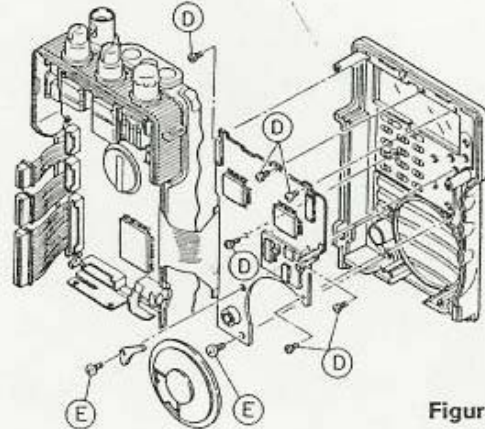


Figure 2-3

2.1.3 AF and RF P.C. Boards

Remove the four screws (F), then the four screws (G), four spacers (H) and (I) and five screws (J), and you will be able to disconnect each board.

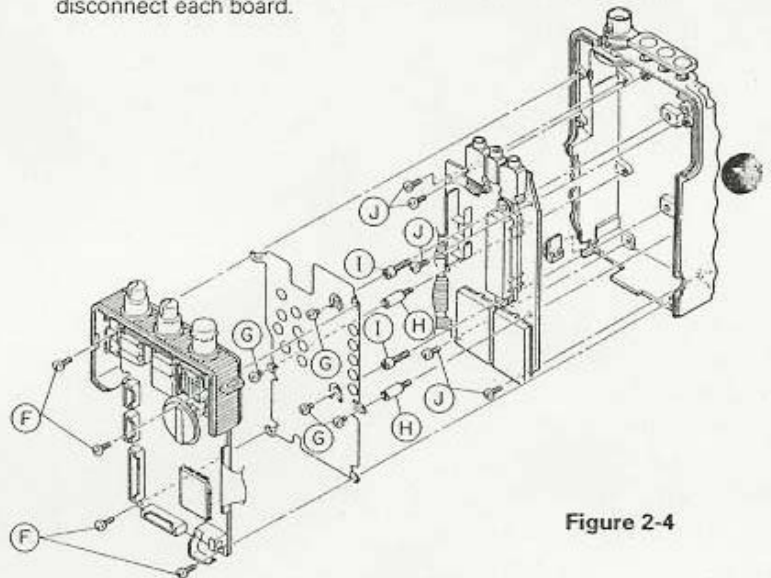


Figure 2-4

2.1.4 Accessory (Tone Squelch Board: CTN520)

- Turn OFF the power of the transceiver, and install the tone squelch board to the transceiver by two accessory screws.
- Plug the connector of the tone squelch board securely into the socket of the transceiver.

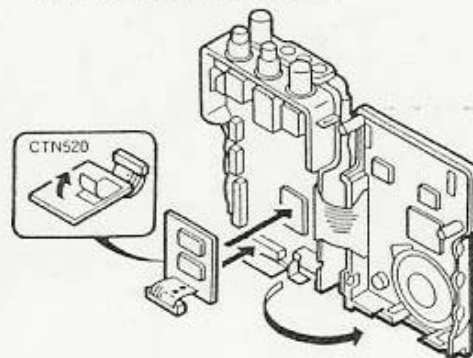


Figure 2-5

Warm up the instruments for at least 30 minutes before use.

General Conditions

Note: Of RF alignment, the audio output is 10mW.

Supply voltage 7.2 V DC
Audio output 75 mW

AF dummy load	8 Ω
Standard modulation	± 3.5 kHz at 1 kHz
RF dummy load	50 Ω
Adjustment frequencies	
Receive frequency	VHF 145.990MHz
	UHF 435.000 MHz
Transmit frequency	VHF 145.990 MHz
	UHF 435.000 MHz

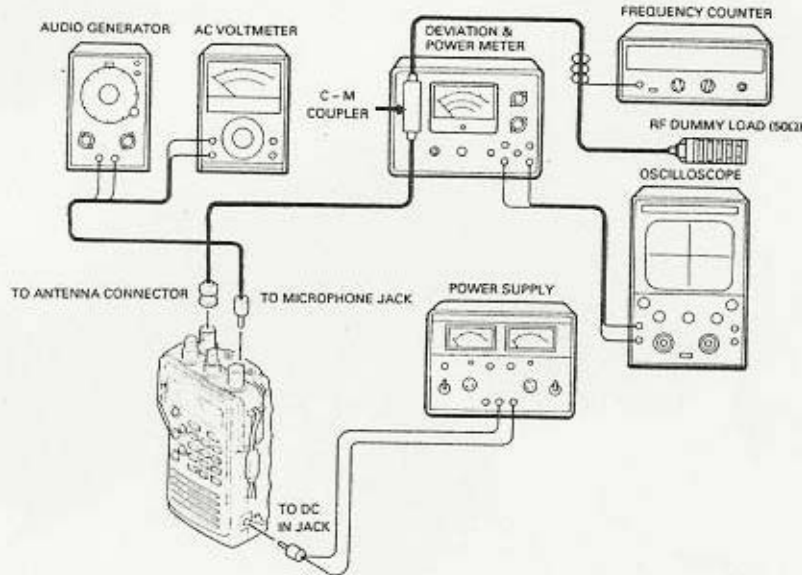


Figure 2-6 Transmitter test set up

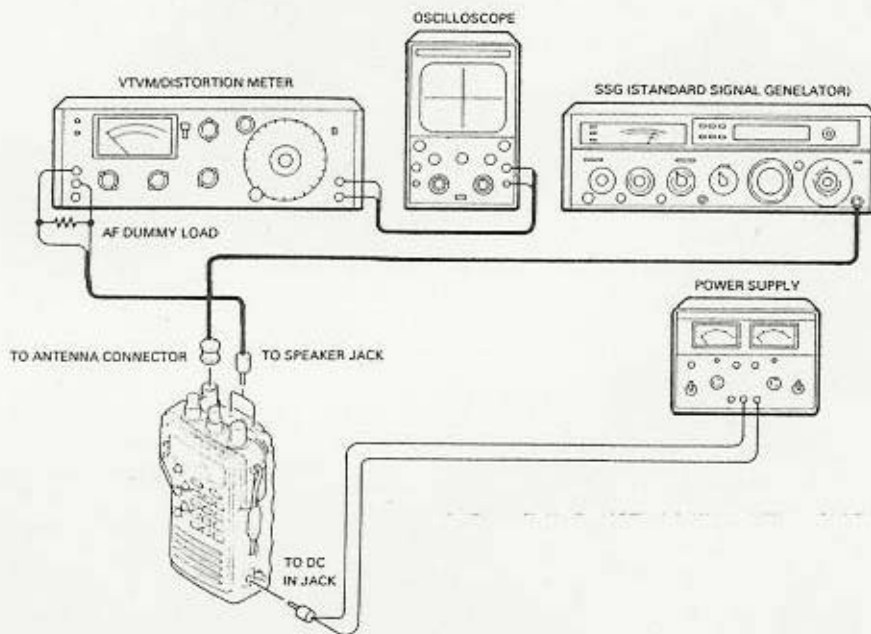


Figure 2-7 Receiver test set up

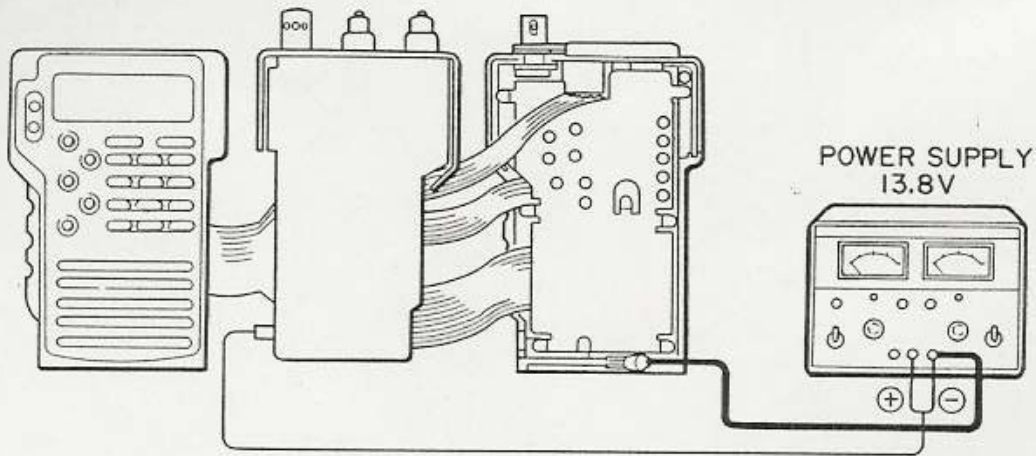


Figure 2-8 Ground cable running for transmit power alignment

2.3 Alignment Reference Points

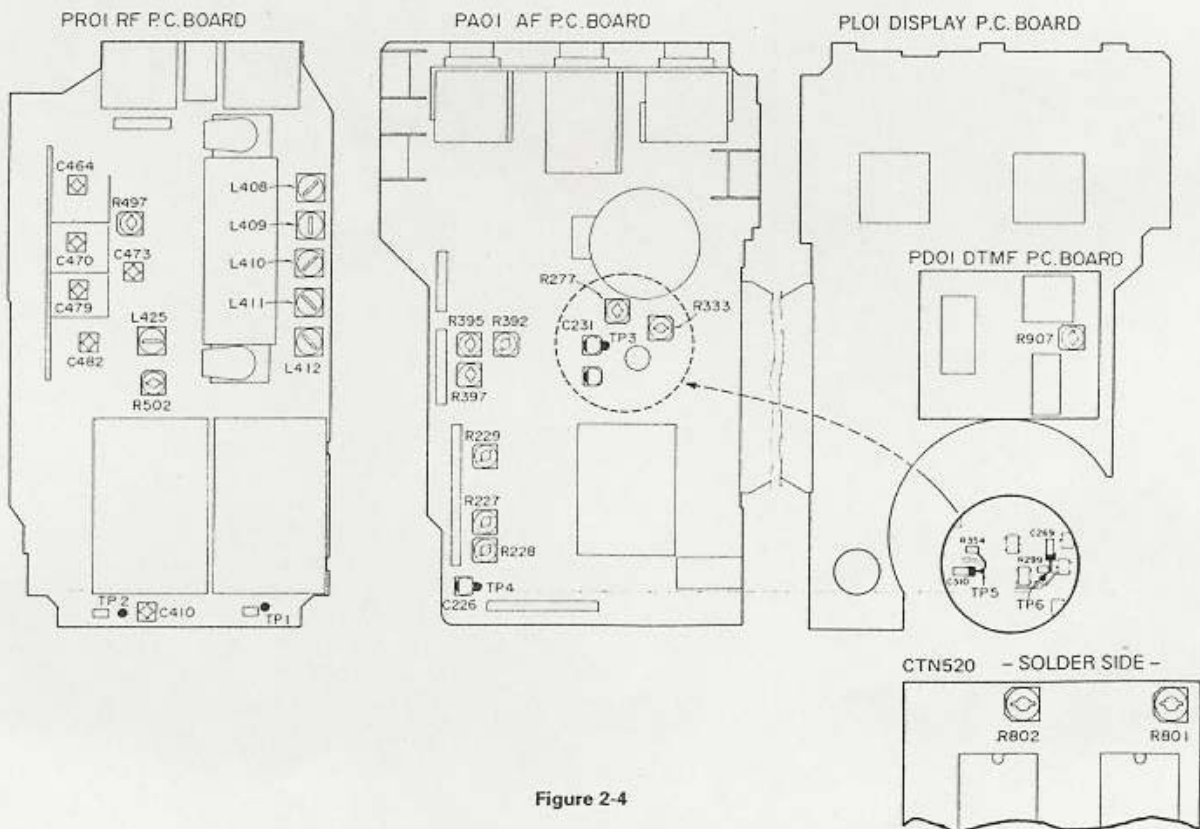


Figure 2-4

2.4 Alignment and Performance Check

2.4.1 Power Supply

- 4 V/5 V Regulator -

- Apply a supply voltage of 7.2 V DC to the transceiver, and set the power switch to ON.
- Connect a voltmeter to TP3 and check that the regulator voltage at TP3 is between 4.75 and 5.25 V DC.
- Connect a voltmeter to TP4 and check that the regulator voltage at TP4 is between 3.8 and 4.2 V DC.
- The VHF current drain will be around 38 mA with squelch ON, and the UHF current consumption around 45 mA with squelch ON.

2.4.2 Microprocessor

- Clock -

NOTE: The microprocessor clock is 4 MHz. The internal tone frequency is produced from the microprocessor clock. Accordingly, the tone frequency alignment becomes the microprocessor clock alignment.

2.4.3 PLL Synthesizer

- VCO Frequency Setting -

- Set the channel frequency of the transceiver to 145.990 MHz in the receive mode.
- Connect a voltmeter to TP1 and check that the voltage at TP1 is between 1.25 and 1.55 V DC.
- Key the transmitter and check that the voltage at TP1 is between 1.4 and 1.7 V DC.
- Set the channel frequency of the transceiver to 435.000 MHz in the receive mode.
- Connect a voltmeter to TP2 and check that the voltage at TP2 is between 2.35 and 2.65 V DC.
- Key the transmitter and check that the voltage at TP2 is between 1.65 and 1.95 V DC.

- Local Frequency -

- Display frequencies of the VHF and UHF bands (in twin mode), and set the channel frequency of the transceiver to 435.000 MHz.
- Key the transmitter and measure by a frequency counter the output passed through a C - M coupler.
- Adjust C410 so that the frequency counter reads 435.00000 MHz.

2.4.4 Receiver

NOTE: Perform alignment with the RF P.C. board's shield plate remaining attached.

- UHF Sensitivity -

- Rotate the UHF and VHF squelch control knobs of the transceiver fully counterclockwise and clockwise, respectively.
- Set the channel frequency of the (Standard Signal Generator) transceiver and the SSG frequency to 435.000 MHz. The SSG signal shall be subject to standard modulation. Connect the speaker plug in to the SPU terminal (UHF external speaker jack).
- Connect a voltmeter to TP5 and raise the SSG output level so that the voltage at TP5 becomes about 0.5 V DC.
- Set the channel frequency of the transceiver to 435.050 MHz. Adjust C464, C470, C473, C479, C482 and L425 in this order and repeat this sequence twice to maximize the reading of the voltmeter.
- Set the channel frequency of the transceiver to 439.950 MHz, and adjust C482 so that the reading of the voltmeter is maximized.
- Set the channel frequency of the transceiver to 435.050 MHz, and adjust C464, C470, C473 and C479 in this order so that the reading of the voltmeter is maximized.
- Set the channel frequency of the transceiver to 435.050 MHz, and check that SINAD is less than -8 dBu.
- Check that SINAD is less than 1.5 dB against the center value in a range of 430.050 MHz to 439.950 MHz.
- Set the channel frequency of the transceiver to 435.050 MHz, and check that 20 dB QS is less than -5 dBu.
- Set the channel frequency of the transceiver to 439.950 MHz, and check that the first image ratio is more than 45 dB.

NOTE: If out of standard, reperform from step d).

- Set the channel frequency of the transceiver to 435.050 MHz, and check that the S/N ratio is more than 44 dB.
- With the SSG output level set to 20 dBu, adjust R333 so that the reading of the signal meter maximized.
- Check that when the reading of the signal meter is maximum between 430.050 MHz and 439.950 MHz the SSG output level is between 16 dBu and 24 dBu.

- VHF Sensitivity -

- Rotate the VHF and UHF squelch control knobs of the transceiver fully counterclockwise and clockwise, respectively.
- Set the channel frequency of the transceiver and the SSG frequency to 145.990 MHz. The SSG signal shall be subject to standard modulation. Connect the speaker plug in to the SPV terminal (VHF external speaker jack).
- Connect a voltmeter to TP6 and raise the SSG output level so that the voltage at TP6 becomes about 0.5 V DC.
- Set the channel frequency of the transceiver to 145.990 MHz, and adjust L408, L409, L410, L411 and L412 in this numerical order so that the reading of the voltmeter is maximized. At this time, check that SINAD is less than -9.5 dBu.
- Set the channel frequency of the transceiver and the SSG frequency to 145.500 MHz. Then, with the SSG output level set to 20 dBu, adjust R277 so that the reading of the signal meter is maximized.

2.4.5 Transmitter

– UHF RF Output –

NOTE: Before alignment, put the supply voltage and the transceivers voltage in agreement with each other. For accurate alignment of the transmission output, the RF P.C. board's shield plate should remain attached. Then, connect the ground cable as shown in Figure 2-8.

- a) Set the supply voltage of the transceiver to 13.8 V, and the transmission output to the high power mode. Then, rotate R228 fully counterclockwise.
- b) Connect a voltmeter to the antenna connector and set the channel frequency of the transceiver to 435.000 MHz. Key the transmitter and check that the maximum output power is more than 6.5 W.
- c) After step b), set the transceiver to the VHF, transmission output and high power mode. Key the transmitter and check the output power is more than 5.5 W.
- d) Set the channel frequency of the transceiver to 435.000 MHz, and set the transmission output to the high power mode. Key the transmitter and adjust R502 so that the output power is 6.5 W.
- e) Set the supply voltage of the transmitter to 7.2 V DC, and set the transmission output to the low power mode.
- f) Set the channel frequency of the transceiver to 435.000 MHz. Then, Key the transmitter and adjust R229 so that the output power is 0.4 W. At this time, check that the current drain is between 480 mA and 580 mA.
- g) Set the supply voltage of the transceiver to 13.8 V DC, and set the RF output to the high power mode. Key the transmitter and adjust R227 so that the output power is 5.2 W. At this time, check that the current drain is between 1.2 A and 1.5 A.
- h) Set the RF output to the middle power mode. Key the transmitter and adjust R228 so that the output power is 2.8 W. At this time, check that the current drain is between 900 mA and 1100 mA.
- i) Set the supply voltage of the transceiver to 6.0 V DC, and set the RF output to the high power mode. Key the transmitter and check that the output power is more than 1.2 W.
- j) Set the supply voltage of the transceiver to 13.8 V DC and set the transmission output to the high power mode.
- k) Check that between 430.000 MHz and 439.950 MHz, when Key the transmitter the difference between maximum and minimum in RF output level is within 0.5 W.

– VHF RF Output –

NOTE: Be sure to perform the VHF transmission output alignment after the termination of the UHF transmission output alignment.

- a) Set the supply voltage of the transceiver to 13.8 V, and set the RF output to the high power mode.
- b) Connect a voltmeter to the antenna connector, and set the channel frequency of the transceiver to 145.990 MHz. Key the transmitter and adjust R497 so that the output power is 5.2 W. At this time, check that the current drain is between 0.9 A and 1.25 A.
- c) Set the RF output to the mid power mode. Then, check that the output level is between 2.2 W and 2.8 W. At this time, check that the current drain is between 800 mA and 1100 mA.
- d) Set the supply voltage of the transceiver to 7.2 V DC, and set the RF output to the low power mode. Check that the output level is between 0.24 watt and 0.45 W. At this time, check that the current drain is between 480 mA and 580 mA.

– UHF Modulation –

- a) Set the supply voltage and channel frequency of the transceiver to 7.2 V DC and 435.000 MHz. Connect the microphone plug as shown in Figure 2-10 below in to the external microphone jack, and adjust R397 so that the frequency deviation is ± 5 kHz provided that the AG output is a sine wave of 1 kHz, 60 mV.
- b) Turn ON the time constant 750 usec of the linear detector filter. Then, check that the frequency difference between the plus and minus areas in ± 5.0 kHz deviation is within 0.30 kHz.
- c) Adjust the AG output and set the deviation to ± 3.5 kHz, thereupon measure the distortion. At this time, check that the distortion is within 3%.
- d) After step c), check that with the microphone plug released from AG, the AG output voltage is between 4 mV AC and 8 mV AC.

- VHF Modulation -

- Set the supply voltage and channel frequency of the transceiver to 7.2 V DC and 145.990 MHz. Connect the microphone plug as shown in Figure 2-10 below in to the external microphone jack, and adjust R395 so that the frequency deviation is ± 5 kHz provided that the AG output is a sinewave of 1 kHz, 60 mV.
- Turn ON the time constant 750 usec of the linear detector filter. Then, check that the frequency difference between the plus and minus areas in ± 5.0 kHz deviation is within 0.30 kHz.
- Adjust the AG output and set the deviation to ± 3.5 kHz, thereupon measure the distortion. At this time, check that the distortion is within 5%.
- After step c), check that with the microphone plug released from AG, the AG output voltage is between 4 mV AC and 8 mV AC.

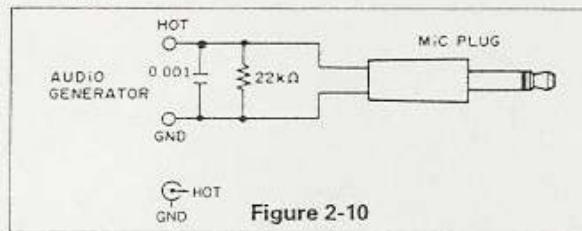


Figure 2-10

- VHF Tone Squelch Board: CTN520 -

- Install the tone squelch board into the transceiver, after which set the pertinent switch of the transceiver to ON.
- Turn ON the tone squelch and set the tone frequency to 67 Hz.
- Set the channel frequency of the transceiver to 145.990 MHz. Then, check that the tone frequency deviation is between ± 0.5 kHz and ± 0.9 kHz, and the distortion is within 15%. If without, adjust R80 so that the deviation is ± 0.75 kHz.
- Set the tone frequency to 250.3 Hz. Then, check that the tone frequency deviation is between ± 0.5 kHz and ± 0.9 kHz, and the distortion is within 15%.

Table 2-1

TONE FREQUENCY (Hz)			
67.0	97.4	136.5	192.8
71.9	100.0	141.3	203.5
74.4	103.5	146.2	210.7
77.0	107.2	151.4	218.1
79.7	110.9	156.7	225.7
82.5	114.8	162.2	233.6
85.4	118.8	167.9	241.8
88.5	123.0	173.8	250.3
91.5	127.3	179.9	
94.8	131.8	186.2	

- Built-in Touch Tone Board -

- Perform transmission with the microphone plug connected in to the external microphone jack. At this time, the audio generator (AG) output shall be zero.
- Set the channel frequency of the transceiver to 435.000 MHz.
- Adjust R907 so that when the "8" key is pressed, the frequency deviation is ± 3.2 kHz. At this time, check that the monitor sound is heard from the speaker.
- Set the channel frequency of the transceiver to 145.950 MHz, and connect the microphone plug in to the external microphone jack, then Key the transmitter.
- Check that when the "8" key is pressed, the frequency deviation is between ± 2.7 kHz and ± 3.8 kHz.

- UHF Tone Squelch Board: CTN520 -

- Install the tone squelch board into the transceiver, after which set the pertinent switch of the transceiver to ON.
- Turn ON the tone squelch and set the tone frequency to 67 Hz.
- Set the channel frequency of the transceiver to 430.050 MHz. Then, check that the tone frequency deviation is between ± 0.5 kHz and ± 0.9 kHz, and the distortion is within 15%. If without, adjust R802 so that the deviation is ± 0.6 kHz.
- Set the tone frequency to 250.3 Hz. Then, check that the tone frequency deviation is between ± 0.5 kHz and ± 0.9 kHz, and the distortion is within 15%.

- UHF Tone Burst -

- Set the channel frequency of the transceiver to 435.000 MHz.
- Engage the transmission mode with the microphone plug connected in to the external microphone jack.
- Press the CALL button and emit the burst signal.
- Adjust R392 so that the frequency deviation is ± 3.5 kHz.
- Check that the tone burst frequency is between 1,730 Hz and 1,770 Hz, the frequency deviation is between ± 3.2 kHz and ± 3.8 kHz and the distortion is within 7%.

- VHF Tone Burst -

- Set the channel frequency of the transceiver to 146.000 MHz.
- Engage the transmission mode with the microphone plug connected in to the external microphone jack.
- Press the CALL button and emit the burst signal.
- Check that the tone burst frequency is between 1,730 Hz and 1,770 Hz, the frequency deviation is between ± 3.2 kHz and ± 3.8 kHz, and the distortion is within 7%.

3. Specifications

Unless otherwise noted, the following specifications apply to both UHF and VHF bands for the C528.

3.1 General Specifications

Transmit/receive frequency range	VHF 144.000 to 147.995 MHz UHF 430.000 to 439.995 MHz
Tuning step	5, 10, 12.5, 20, 25, 50 kHz
Modulation type	16 F3
Nominal voltage	7.2 V DC
Input voltage range	6.0 to 16.0 V DC (with external voltage jack)
Current drain	
Transmit	
13.8 V DC Hi	
Hi (5.0 W):	Approx. 1100 mA (VHF) Approx. 1300 mA (UHF)
Mid (2.5 W):	Approx. 900 mA (VHF) Approx. 1000 mA (UHF)
7.2 V DC Hi (2.0 W):	Approx. 850 mA (VHF) Approx. 1000 mA (UHF)
Mid (2.0 W):	Approx. 850 mA (VHF) Approx. 1000 mA (UHF)
13.8/7.2 V DC Lo (0.35 W):	Approx. 480 mA (VHF) Approx. 480 mA (UHF)
Standby receive (Twin band mode):	Approx. 70 mA (VHF/UHF)
(Mono band mode):	Approx. 36 mA (VHF) Approx. 45 mA (UHF)
Battery save (Twin band mode):	Approx. 32 mA (VHF/UHF)
(Mono band mode):	Approx. 17 mA (VHF) Approx. 18 mA (UHF)
Auto Power OFF (A.P.O.):	Approx. 1 mA (VHF/UHF)
Microphone input impedance	600 Ω
Speaker impedance	8 Ω
Dimensions of transceiver itself (without projections):	157 (H) x 55 (W) x 31 (D) mm
Weight	450 g (with batteries and antenna)

3.2 Receiver

– Measurements are made in accordance with EIA-J Standard ART-04. –

Receiving system	Double superheterodyne
Intermediate frequency	VHF: First IF 21.80 MHz (lower) Second IF 455 kHz (lower) UHF: First IF 23.05 MHz (lower) Second IF 455 kHz (upper)
Receive sensitivity (12 dB SINAD):	–10 dB (–16 dB for JAIA method)
S/N ratio (at input 0.5 V)	30 dB or more
Squelch open sensitivity	–14 dB
Audio output power	200 mW (distortion 10% at 8 Ω)

3.3 Transmitter

– Measurements are made in accordance with EIA-J Standard ART-03. –

RF output power	Hi: 2.4 W (with VHF CBT151) 2.0 W (with UHF CBT151) 2.8 W (with VHF CNB150, CNB151, CNB153) 2.5 W (with UHF CNB150, CNB151, CNB153) 5.0 W (with VHF CNB152) 5.0 W (with UHF CNB152) Mid: 2.3 W (with VHF CBT151) 1.8 W (with UHF CBT151) 2.5 W (with VHF CNB150, CNB151, CNB153) 2.5 W (with UHF CNB150, CNB151, CNB153) Lo: 0.35 W (VHF/UHF)
Spurious ratio	–60 dB or better
Maximum frequency deviation	± 5.0 kHz
Modulation method	Reactance modulation

3.4 Internal Touch Tone Board

– Decoder –

Squelch open sensitivity: ≤ 20 dB SINAD
(* The squelch open sensitivity refers to the value when the conditions a)–d) to follow are met.)

- When the frequency response of modulation is flat.
- When the frequency deviation with the "8" key is ± 3.2 kHz.
- When operation is made on paging mode 777*777.
- When signal is operated at the timing of 50 msec ON and 50 msec OFF for each digit of transmission code.

3.5 Accessory

Tone Squelch Board: CTN520

– Encoder –

Tone frequency (f): $67.0 \leq f \leq 250.3$ Hz
Tone frequency deviation within: $\leq \pm 5\%$
Output level (with VOL max.): ≥ 350 mV (at 179.9 Hz)
Tone frequency distortion: $\leq \pm 10\%$

– Decoder –

Open level: ≤ 25 mV (at 179.9 Hz)
Response time: ≤ 200 m Sec (at 166.2 Hz)
Current drain: ≤ 8 mA (max)

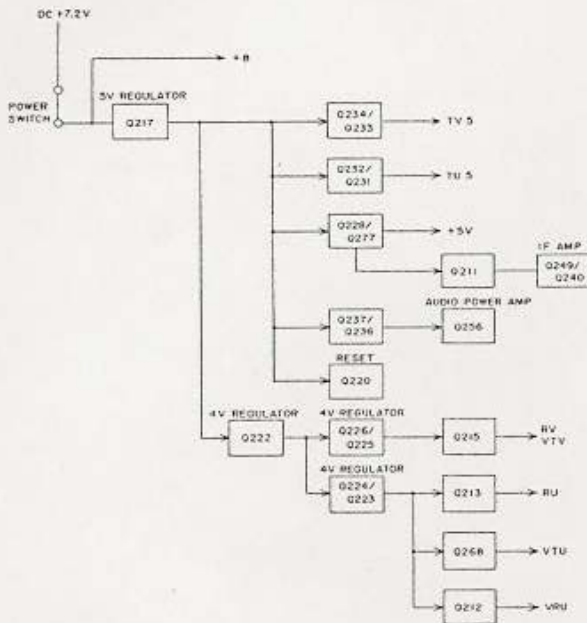
Performance specifications are nominal, unless otherwise indicated, and are subject to change without notice.

4. THEORY OF OPERATION

4.1 Power Supply

Those voltages on which C528 operates are summarized in the following.

Table 4-1 Voltages



4.2 PLL Synthesizer

4.2 PLL Synthesizer

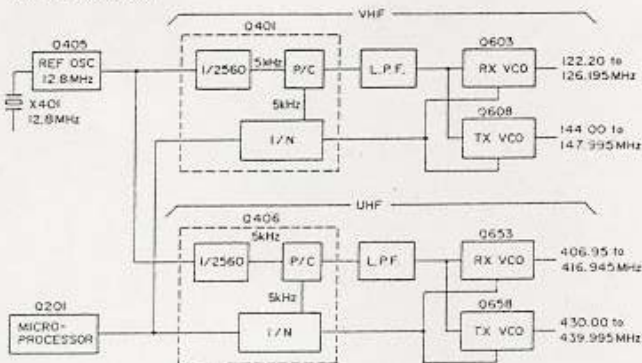


Figure 4-1 PLL Block Diagram

- VHF/UHF -

The PLL circuit contains two systems for VHF and UHF, respectively. Moreover, are incorporated total four VCO members, two for VHF transmission and reception, and other two for UHF transmission and reception. Each VCO oscillation frequency is determined by the information from the micro-processor. During reception, a VCO oscillation frequency is lower by 21.8 MHz than the display frequency in case of VHF and lower by 23.05 MHz in case of UHF.

During transmission, a VCO oscillates just at the display frequency whether VHF or UHF.

- VHF -

The PLL local oscillation frequency is made by VCO Q603 for reception, and by VCO Q608 for transmission. The output signal of either VCO is input to the transmission or reception circuit. Part of this output signal is applied to the input pin 8 of the prescaler of the PLL IC by way of switching diode Q605, and is thereat divided into 5 kHz (tuning step 25 kHz) by a programmable counter (into 6.25 kHz for tuning step 12.5 kHz). The PLL reference oscillation frequency which is 12.8 MHz due to X401 and Q405 is divided into the reference frequency of 5 kHz (or 6.25 kHz) by programmable counter Q401. This reference frequency is phase compared with the former 5 kHz (or 6.25 kHz) at phase comparator Q402. That phase difference is output to pin 5, from which it is then applied to the PLL loop filter (low pass filter). Thereby removing the 5 kHz (6.25 kHz) component, it is converted into a form of a DC voltage, which is in turn applied as the control voltage to vari-cap diode Q601 and Q602 for reception, and to vari-cap diode Q606 and 607 for transmission. In the modulation circuit, the VCO signal is subject to direct modulation by vari-cap diode Q609.

- UHF -

The PLL local oscillation frequency is made by VCO Q653 for reception, and by VCO Q658 for transmission. The output signal of either VCO is input to the transmission or reception circuit. Part of this output signal is applied to the input pin 8 of the prescaler of the PLL IC by way of buffer amplifier Q655, and is thereat divided into 5 kHz (tuning step 25 kHz) by a programmable counter (into 6.25 kHz for tuning step 12.5 kHz). The PLL reference oscillation frequency which is 12.8 MHz due to X401 and Q405 is common with VHF. The subsequent process up to the control voltage is the same as with VHF. The control voltage is applied to vari-cap diode Q651 and Q652 for reception, and to vari-cap diode Q656 and Q657 for transmission. In the modulation circuit, the VCO signal is subject to direct modulation by vari-cap diode Q659.

4.3 Receiver

The receiving system is a double-conversion super-heterodyne system with the first IF of 21.8 MHz (lower) and the second IF of 455 kHz (lower) for VHF, and the first IF of 23.05 MHz (lower) and the second IF of 455 kHz (upper) for UHF.

4.3.1 Front End

The RF signal picked up by the antenna is subject to discrimination between VHF and UHF by way of a duplexer (VHF: low pass filter, UHF: band pass filter).

- VHF -

The RF signal through the duplexer is applied to RF coil L408 by way of the antenna switching circuit. The signal tuned by L408, after being amplified by RF amplifier Q412, is applied to the gate of a first mixer Q413 by way of a band pass filter (L409, L410, L411).

– UHF –

The RF signal through the duplexer is applied to RF coil L417 by way of the antenna switching circuit. The signal tuned by L417, after being amplified by RF amplifier Q415, is further amplified by another RF amplifier Q416 through a band pass filter (L418, L419), after which it is then applied to the base of a first mixer Q417 by way of another band pass filter (L420, L421).

4.3.2 First Mixer

– VHF –

The receive signal (f_0) amplified by RF amplifier Q412 is applied to the gate of Q413, and the PLL local signal ($f_0 - 21.8$ MHz) is applied to the source of Q413. At Q413, there are created a sum and a difference of f_0 and ($f_0 - 21.8$ MHz). However, by a crystal filter circuit (L412, F401, F403), the difference of 21.8 MHz is selected, and after removal of spurious signal, applied to IF amplifier Q414.

– UHF –

The receive signal (f_0) amplified by RF amplifier Q416 and the PLL local signal ($f_0 - 21.8$ MHz) are applied to the base of Q417. At Q415, there are created a sum and a difference of f_0 and ($f_0 - 21.8$ MHz). However, by a crystal filter circuit (L425, F402, F404), the difference of 21.8 MHz is selected, and after removal of spurious signal, applied to IF amplifier Q421.

4.3.3 IF

– VHF –

The signal converted into the first IF is applied to a first IF amplifier Q414, and after amplification thereat, applied to the pin 20 of VHF detector circuit Q240. The first IF signal applied to the pin 20 is mixed with the second local signal of 21.345 MHz at the second mixer in Q240, after which it is then converted into the second IF of 455 kHz.

The second IF signal is output from pin 4 and, after removal spurious signal by ceramic filter F201, is applied to pin 6.

The second IF signal applied to pin 6 is demodulated at the second IF limiter amplifier and quadrature detector circuit in Q240, and is output as an audio signal from pin 11.

– UHF –

The signal converted into the first IF is applied to a first IF amplifier Q421, and after amplification thereat, applied to the pin 20 of UHF detector circuit Q249. The first IF signal applied to the pin 20 is mixed with the second local signal of 23.05 MHz at the second mixer in Q249, after which it is then converted into the second IF of 455 kHz.

The second IF signal is output from pin 4 and, after removal spurious signal by ceramic filter F202, is applied to pin 6.

The second IF signal applied to pin 6 is demodulated at the second IF limiter amplifier and quadrature detector circuit in Q249, and is output as an audio signal from pin 11.

4.3.4 Audio Circuitry

– VHF –

The audio signal output from the pin 11 of Q240, after making its AF frequency response of less than 3 kHz by the deemphasis circuit (R307, C272, R308, C273), is applied to muting circuit Q246. The output of Q246 is volume-controlled by AF volume control R312 and is amplified at audio preamplifier Q248 for driving speaker E101, after which it is applied to the pin 6 of audio power amplifier Q256 (1/2) for amplification.

– UHF –

The audio signal output from the pin 11 of Q249, after making its AF frequency response of less than 3 kHz by the deemphasis circuit (R358, C313, R359, C314), is applied to muting circuit Q253. The output of Q253 is volume-controlled by AF volume control R363.

With the speaker plug unconnected in to the SPU terminal (UHF external speaker jack), the signal is amplified at audio preamplifier Q248 by way of analog switch Q254, after which it is applied to the pin 6 of audio power amplifier Q256 (1/2) for amplification. At this time, VHF and UHF sounds are heard from the speaker at the same time.

With the speaker plug connected in to the SPU terminal (UHF external speaker jack), the signal is amplified at audio preamplifier Q255 with analog switch Q254 OFF, after which it is applied to the pin 7 of audio power amplifier Q256 (1/2) for amplification. At this time, the VHF audio signal is output from the SPV terminal (VHF external speaker jack), while from the SPU terminal the UHF audio signal is output, thus in a UHF/VHF separate manner.

4.3.5 Squelch Circuitry

– VHF –

Of the audio signal from the pin 11 of Q240, its 455 kHz component is removed by a low pass filter (R283, C256) and a squelch adjustment line is set by squelch control R285. Subsequently, the noise component alone is extracted by a high pass filter (C258, R287, C259) and is applied to pin 12. The noise component amplified in Q240 is output from pin 14, then rectified in Q241 into a DC voltage and applied to the pin 15 of Q201. At this time, when the DC voltage at pin 15 is 0.7 V or more, the squelch signal from pin 16 becomes "low" so that the squelch operates, where as the DC voltage at pin 15 is less than 0.7 V, the squelch signal from pin 16 becomes "high" so that the squelch does not operate.

The squelch signal from pin 16 is input to the pin 24 of Q201 for use in control over a feature operation.

– UHF –

Of the audio signal from the pin 11 of Q249, its 455 kHz component is removed by a low pass filter (R339, C296) and a squelch adjustment line is set by squelch control R341. Subsequently, the noise component alone is extracted by a high pass filter (C298, R342, C299) and is applied to pin 12. The noise component amplified in Q249 is output from pin 14, then rectified in Q250 into a DC voltage and applied to the pin 15 of Q241. At this time, when the DC voltage at pin 15 is 0.7 V or more, the squelch signal from pin 16 becomes "low" so that the squelch operates, whereas the DC voltage at pin 15 is less than 0.7 V, the squelch signal from pin 16 becomes "high" so that the squelch does not operate.

The squelch signal from pin 16 is input to the pin 24 of Q201 for use in control over a feature operation.

4.3.6 Signal Meter Circuitry

– VHF –

A part of the signal from the pin 6 of Q240, as the signal meter signal, is applied to semi-fixed resistor R277 and is amplified at Q242. The signal meter signal thus amplified is converted into a DC voltage at Q243 and is applied to the pin 32 of Q201, after which it is A/D converted and then works for the signal meter on the display.

– UHF –

A part of the signal from the pin 6 of Q249, as the signal meter signal, is applied to semi-fixed resistor R333 and is amplified at Q242. The signal meter signal thus amplified is converted into a DC voltage at Q252 and is applied to the pin 32 of Q201, after which it is A/D converted and then works for the signal meter on the display.

4.4 Transmitter

4.4.1 Microphone Amplifier and Modulation

– VHF/UHF –

The sound, after being converted into an audio signal through the internal or external microphone, is applied to microphone amplifier Q261 for amplification. Q261 consists of a single stage of an operation amplifier, including a pre-emphasis circuit. The audio signal thus amplified is input to the low pass filter consisting of a single stage of an operation amplifier. By the low pass filter in Q261 attenuates audio frequency of more than 3 kHz by 18 dB/oct. The deviation is level adjusted by semi-fixed resistor R395 (VHF) or R397 (UHF), and is applied to the VCO modulation circuit. The tone burst signal is level adjusted by semifixed resistor R392 (dev. adjustment), and through a low pass filter (R392, R393, C343), is applied to the noninverting input pin 3 of a low pass filter in Q261.

4.4.2 Power Amplifier

– VHF –

The signal output from the OTV pin of a VCO for VHF is amplified at younger amplifier Q424 and is input to the pin 1 of power module Q425. The signal amplified at Q424 is further amplified at Q425 to 5.0 W (at 13.8 V) in the high power operation.

The signal amplified at Q425 is output from pin 4, and after the sufficient attenuation of the second and third harmonics by way of a low pass filter, an antenna switching circuit and a low pass filter in the duplexer, is supplied to the antenna.

In the transmission output adjustment, by R497, the "high" power is set to 5.0 W, the "mid" power is to between 2.0 and 3.0 W, and the "low" power is to between 0.2 and 0.6 W.

– UHF –

The signal output from the OTV pin of a VCO for UHF is amplified at younger amplifier Q432 and is input to the pin 1 of power module Q433. The signal amplified at Q432 is further amplified at Q433 to 5.0 W (at 13.8 V) in the high power operation.

The signal amplified at Q433 is output from pin 5, and after the sufficient attenuation of the second and third harmonics by way of a low pass filter, an antenna switching circuit and a low pass filter in the duplexer, is supplied to the antenna.

In the transmission output adjustment, by R227, the "high" power is set to 5.0 W, the "mid" power is to 2.5 W and the "low" power is to 0.35 W.

4.4.3 A.P.C (Automatic Power Control) Circuit

– VHF –

A part of the RF output to a low pass filter (L406, C580, C435, C434) is detected by diode Q429 and converted into a DC voltage. The detection voltage converted into a DC voltage is input to the APC circuit (Q439, Q440, Q441, Q442). The detection voltage to the pin 1 of Q493 controls the APC voltage supplied to the VHF VCO by way of Q440, Q442 and Q441 to keep the RF output constant.

– UHF –

A part of the RF output to a low pass filter (L415, C539, C460, C581) is detected by diode Q434 and converted into a DC voltage. The detection voltage converted into a DC voltage is input to the APC circuit (Q439, Q440, Q441, Q442). The detection voltage to the pin 1 of Q493 controls the emitter current of younger amplifier Q432 by way of Q440, Q442, Q441 and Q443 to keep the RF output constant.

4.5 Control Section

The I/O port functions are as follows:

4.5.1 Microprocessor Q201

Table 4-2

Pin No.	I/O	Symbol	Description
1	O	OE	High: Output of output data control signal to touch tone decoder IC Q901.
2	O	PD	High: Output of power down signal to touch tone decoder IC Q901.
3	O	$\overline{\text{CSLV}}$	VHF LCD driver Q101 chip select signal output.
4	O	$\overline{\text{CSLU}}$	Low: UHF LCD driver Q102 chip select signal output.
5	O	D U/V	Output selection between VHF and UHF of IF detection signal to touch tone decoder IC Q901. High: VHF Low: UHF
6	O	LCSO	Serial data output to LCD drivers Q101, Q102, and touch tone decoder IC Q901.
7	I	RESET	Low: Microprocessor reset
8	—	X2	Ceramic oscillator connection pin
9	—	X1	Ceramic oscillator connection pin
10	O	$\overline{\text{LCKK}}$	Data clock signal output to LD drivers Q101, Q102 and touch tone decoder IC Q901.
11	O	$\overline{\text{SQCU}}$	UHF squelch operation High: Operation Low: Non-operation
12	O	$\overline{\text{SQCV}}$	VHF squelch operation High: Operation Low: Non-operation
13	O	$\overline{\text{RX LED}}$	Low: Reception of UHF or VHF, or both
14	I/O	KD3 (BUSY)	
15	I/O	KD2	
16	I/O	KD1	
17	I/O	KD1Ø	Keyboard data line
18	I/O	K3 (SQOF)	Low: When squelch OFF button is pressed
19	I/O	K2 (LAMP)	Low: When lamp button is pressed
20	I/O	K1 (VHF)	Low: VHF button is pressed
21	I/O	KØ (UHF)	Low: When UHF button is pressed
22	—	MTX2	
23	—	MTX1	Diode matrix line
24	I	SQLV	VHF squelch input signal High: Squelch non-operation Low: Squelch operation
25	I	SQLU	UHF squelch input signal High: Squelch non-operation Low: Squelch operation
26	—	VSS	Ground
27	I	CALL	High: When CALL button is pressed
28	I	BACK UP	High: Operation on regular power Low: Power backup
29	I	EU	High: The UP signal when the rotary channel selector is rotated clockwise is subject to signal counting.
30	I	ED	High: The DOWN signal when the rotary channel selector is rotated counterclockwise is subject to signal counting.
31	I	SMU	UHF signal meter analog signal input
32	I	SMV	VHF signal meter analog signal input
33	I	SQTU	UHF tone detection input with tone squelch connected High: For tone decoding
34	I	SQTV	VHF tone detection input with tone squelch connected High: For tone decoding
35	I	PTT	High: When PTT button is pressed
36	I	FUNC	High: When FUNCTION button is pressed
37	O	MUTE	High: Mute operation for touch tone output
38	—		
39	O	BZ/BST	Buzzer/tone square wave output
40	O	TEU	Tone squelch UHF tone data strobe signal output
41	I	SI (BST)	High: when tone burst is set
42	O	SO	Serial data signal output to PLL and tone squelch
43	O	SCK	Data clock signal output to PLL and tone squelch
44	I	UL	High: With VHF/UHF PLL not in phase lock Low: With VHF/UHF PLL in phase lock

Table 4-2

Pin No.	I/O	Symbol	Description
45	O	\overline{RU}	Low: For UHF reception
46	O	\overline{RV}	Low: For VHF reception
47	—	—	—
48	—	—	—
49	O	\overline{TUV}	Low: Power supply to UHF VCO for transmission
50	O	\overline{TW}	Low: Power supply to VHF VCO for transmission
51	O	\overline{TU}	Low: For UHF transmission
52	O	\overline{TV}	Low: For VHF transmission
53	O	POW	High: Power backup Low: Operation on regular power
54	O	PEU	Data strobe signal output to UHF PLL High: Latch up
55	O	PEV	Data strobe signal output to VHF PLL High: Latch up
56	O	\overline{LAMP}	Low: LCD back light lights.
57	—	VDD	Power supply pin (positive), approx. 4.3 V DC
58	I	VDD	Power supply pin (positive), approx. 4.3 V DC
59	O	H	Low: For high power operation of transmission
60	O	M	Low: For middle power operation of transmission
61	O	C/D (DV)	LCD drivers Q101/Q102 command/data signal output
62	O	MONI	High: Audio power amplifier ON
63	O	TEV	Tone squelch VHF tone data strobe signal output
64	O	EN	Touch tone encode shift register Q902 enable signal output High: Latch up

4.6 Built-in Touch Tone Board

4.6.1 Decoder

As to a part of the second IF signal from the pin 11 of Q240 or Q249, the inverter Q257 and VHF/UHF selection switch Q258 or Q259 are operated by the signal from the pin 5 of microprocessor Q201 to input the IF detection signal to the AFD pin. The IF detection signal input to the AFD pin is then entered to the pin 2 of DTMF encoder Q901. The signal thus entered is judged as to whether it is valid or invalid. When valid, from the pins 12 to 15 of Q901, the DTMF signal decoded into digital form is output to the D0 to D3 pins.

4.6.2 Encoder

The serial data output from the pin 6 of Q201 is entered to the pin 2 of 8-stage shift register Q902. The serial data thus entered is converted into a 8-bit parallel form, and output from pins 4 to 7 and 11 to 14.

The parallel signal output from these pins is input to the pins 4 to 6, 10 and 12 to 15 of DTMF encoder Q903, after which the DTMF signal corresponding to the input data is emitted from pin 17.

4.7 Tone Squelch Board: CTN520

4.7.1 Decoder

— VHF —

From the AFIV pin, the VHF IF detection signal is input to the pin 27 of Q801, and Q803 is switched according to the output of the pin 17 of Q801 so that the tone squelch signal is output to the SQTU pin. When the tone signal is in agreement, the pin 17 of Q801 becomes "high". Thereby, the SQTU pin goes open so that the squelch turns OFF.

When the tone signal is not in agreement, the pin 17 of Q801 becomes "low". Thereby, the SQTU pin becomes "high" so that the squelch turns ON.

— UHF —

From the AFIU pin, the UHF IF detection signal is input to the pin 27 of Q802, and Q804 is switched according to the output of the pin 17 of Q802 so that the tone squelch signal is output to the SQTU pin. When the tone signal is in agreement, the pin 17 of Q802 becomes "high". Thereby, the SQTU pin goes open so that the squelch turns OFF.

When the tone signal is not in agreement, the pin 17 of Q802 becomes "low". Thereby, the SQTU pin becomes "high" so that the squelch turns ON.

4.7.2 Encoder

— VHF —

The tone signal, after output from the pin 18 of Q801, is emitted to the TONEV pin through semi-fixed resistor R801.

— UHF —

The tone signal, after output from the pin 18 of Q802, is emitted to the TONEU pin through semi-fixed resistor R802.

4.8 Terminal Description

4.8.1 Transceiver Board

Terminal	Description
W401 (J201)	
RV	4.0 V DC for VHF reception
IFV	VHF 21.80 MHz IF line
5V	5.0 V DC line
MODU	UHF VCO modulation line
MODV	VHF VCO modulation line
VTU	UHF TX VCO 4.0 V DC line
VRU	UHF RX VCO 4.0 V DC line
TV5	5.0 V DC line for VHF transmission
VTV	VHF TX VCO 4.0 V DC line
UL	Unlock signal line High when unlock
SCK	PLL IC data clock signal
SO	PLL IC data signal
PEU	UHF PLL IC data strobe signal
PEV	VHF PLL IC data strobe signal
W402 (J202)	
TU5	5.0 V DC for UHF transmission
POW	TX power level line
RU	4.0 VDC for UHF transmission
+B	Line passing the power switch
IFU	UHF 23.05 MHz IF line
GND	Ground
W403 (J203)	
SPA	VHF speaker line
SPK	Internal speaker line
SPG	Speaker ground
SPS	Speaker switch (Low to High when SPU terminal is plugged)
SPU	UHF speaker line
MIC	Microphone line

4.8.2 Built-in Touch Tone Board

Terminal	Description
-	
DTMF	Touch tone signal output line
AFD	Touch tone IF detection signal input line
5V	5.0 V DC line
EN	Touch tone encode shift register enable signal
OE	Touch tone decode output data control (High: Enabled)
PD	Touch tone decode power down signal (High: Power down)
DO	Touch tone data line
D1	
D2	
D3	
DV	Touch tone decode detection signal line (When detected: High)
GND	Ground
LCSO	Touch tone encode shift register data signal
LCKK	Touch tone encode shift register data clock signal

Terminal	Description
W101	
GND	Ground
CALL	CALL signal line (High to Low when calling)
K0	Keyboard data lines
K1	
K2	
K3	
KD0	Keyboard data lines (Touch tone data lines)
KD1	
KD2	
KD3	
C/D (DV)	LCD driver command/data signal
CSDU	UHF LCD driver chip select signal
CSLV	VHF LCD driver chip select signal
MICG	High to Low when PTT button is pressed
MIC	Microphone line
LCSO	LCD driver touch tone data signal
LCKK	LCD driver touch tone data clock signal
AFD	Touch tone IF detection signal input line
PD	Touch tone decode IC Q901 Power down signal (High: Power down)
OE	Touch tone decode IC Q901 Output data control signal (High: Enabled)
EN	Touch tone encode shift register enable signal
DTMF	Touch tone signal output line
5V	5.0 V DC line
SP	Internal speaker line
SPG	Speaker ground
LAMP	Lamp line
GND	Ground

4.8.3 Tone Squelch Board

Terminal	Description
W801 (J204) (Tone Squelch Board)	
TONU	UHF TX tone signal output
TONV	VHF TX tone signal output
AFIU	UHF RX tone squelch IF detection input line
AFIV	VHF RX tone squelch IF detection input line
SO	Tone squelch IC data signal
SCK	Tone squelch data clock signal
SQTU	UHF RX tone squelch detection output (Squelch ON/OFF signal)
SQTV	VHF RX tone squelch detection output (Squelch ON/OFF signal)
GND	Ground
TEU	UHF tone data strobe signal
TEV	VHF tone data strobe signal
5V	5.0 V DC line

6. EXPLODED PARTS VIEW AND PARTS LIST

6.1 General

Information on most electrical and mechanical parts is included in the parts list. The parts are listed by reference symbols in alphanumeric order.

6.2 Chip Parts

First through fourth digit of part number indicates chip part as follows:

– CAPACITORS –

DD4
DD5
DD9
DK4
DK5
DK9
DF9
EY

– SEMICONDUCTORS –

BA
HX
HY
HZ

– RESISTORS –

RI
NI
NN

– INDUCTORS –

LU

6.3 Ordering Replacement Parts

Please note that dealer may not be able to fill replacement parts orders without such identifying information as:

- Reference Symbol
- Part Number
- Description
- Unit Model Serial Number