

MAIN-1 UNIT DESCRIPTION

1. VCO / PLL circuit

【R-VCO】

- The LO VCO for Right-display VCO is composed of 2 VCOs.
 - VHF band VCO : Composed of the VHF oscillator circuit (Q233、D225、D226) and buffer AMP (Q236).
 - UHF band VCO : Composed of the UHF oscillator circuit (Q232、D223、D224、D227) and buffer AMP (Q235).
- The MIC signal from the MIC AMP is applied to the UHF band VCO (D227) to modulate the oscillating signal.
- IC205 mutes the modulation.
- IC315 turns Q228 and D230 ON/OFF to switch the VHF band VCO oscillating frequency range.
- IC315 turns Q227 and D229 ON/OFF to switch the UHF band VCO oscillating frequency range.

The VHF band LO signal from Q236 is applied to the wide band AMP (as a buffer AMP (IC208)), and passed through the filter, through D235 and D237, and then output as the VHF band LO signal for Right-display.

The UHF band LO signal from Q235 is applied to the wide band AMP (as a buffer AMP (IC208)), and passed through the filter, through D234 and D236, and then output as the UHF band LO signal for Right-display.

Each LO signal is applied to the 1st-Mix circuit.

- Q234 is an LO AMP that amplifies the LO signal before it is applied to the PLL IC (IC206: 5pin).

【R-PLL】

- IC206 is a PLL-IC that controls the RVC0 for Right-display.
- The applied VCO output signal is divided according to the serial data from IC303, and compared with the reference frequency on the phase difference.
- The reference frequency, which is generated by dividing the 15.3MHz signal from X201, is compared with the RVC0 output signal (mentioned above) on the phase difference, then outputs resulting pulse signal.
- The reference signal, which is generated by X201, is also applied to IC120 and the 2nd LO signal for the right-display.
- The resulting pulse signal is passed through the charge pump in IC206, and then output from 20pin. The pulse signal is passed through the loop filter, and controls the VCO as the lock voltage. The lock voltage is applied to IC300, through Q221, used as reference voltage for adjustment.
- IC207 is a fast lock up circuit. IC316 and Q222 turn IC207 ON/OFF to reduce the lock up time.

【L-VCO】

- LO VCO for left-display is composed of 3 VCOs:
 - VHF band VCO : Oscillating circuit (Q211, D203, D204, D228) and buffer AMP (Q215).
 - VHF band VCO for reverse heterodyne (used when heterodyne (A BAND VHF) function is set "Reverse") : Oscillating circuit (Q237, D238, D239) and buffer AMP (Q215).
 - UHF band VCO : Oscillating circuit (Q210, D201, D202) and buffer AMP (Q214).
- The MIC signal from the MIC AMP is applied to the variable capacitor D228 of VHF band VCO to modulate the oscillating signal.
- IC205 mutes the modulation.
- IC315 turns Q207 and D206 ON/OFF to switch the VHF band VCO oscillation frequency range.
- IC315 turns Q205 and D205 ON/OFF to switch the UHF band VCO oscillation frequency range.
- The output signal from Q215 (VHF band) is applied to the wide band AMP (IC203) as the buffer AMP, and passed through the filter, through D212 and D217, then output as the VHF LO signal for left-display.
- The output signal from Q214 (UHF band) is applied to the wide band AMP (IC203) as the buffer AMP, and passed through the filter, through D213 and D216, then output as the UHF LO signal for left-display.
- Each LO signal is applied to the 1st-Mix circuit.
- Q213 is an LO AMP that amplifies the LO signal before it is applied to the PLL IC (IC201: 5pin).

【L-PLL】

- IC201 is a PLL-IC that controls the LVC0 for Left-display.
- The applied VCO output signal is divided according to the serial data from IC303, and compared with the reference frequency on the phase difference.
- The reference frequency, which is generated by dividing the 12.8MHz signal from X200, is compared with the LVC0 output signal (mentioned above) on the phase difference, then outputs resulting pulse signal.
- The reference signal, which is generated by X200, is also applied to IC121 and the 2nd LO signal for the Left-display.
- The resulting pulse signal is passed through the charge pump in IC201, and then output from 20pin. The pulse signal is passed through the loop filter, and controls the VCO as the lock voltage. The lock voltage is applied to IC300, through Q201, used as reference voltage for adjustment.
- IC202 is a fast lock up circuit. IC316 and Q202 turn IC202 ON/OFF to reduce the lock up time.

2. VHF TX CIRCUITS

【DRIVE】

- The VCO output signal is passed through D50, LPF which removes the unwanted components and ATT and amplified by Q36 and the driver AMP (Q40) to obtain the RF input level of IC3.

【PA】

- The TX signal which is amplified by the driver (Q40) is applied to IC3 and amplified to the TX output power level.
- IC3 is a VHF band PA module with power MOS_FET. The output of IC3 is passed through D66 and LPF which reduces the harmonic components to the specified level.
- While transmitting, the voltage on the VT8 line is applied to D66, D69, D70, D77 to turn them on, thus the TX signal path is ON and the RX signal path is OFF to prevent the TX signal entering to the RX circuits.
- While receiving, D66, D69, D70, D77 are turned OFF, thus the RX signal from the antenna is applied to the RF circuit.
- D81 protects the RF circuit from the over input.

【APC】

- A portion of output signal from IC3 is rectified by the power detector circuit (D59 and D63) to produce the DC, whose voltage is in proportion to the TX power level, then applied to IC2:2pin.
- IC2 is an APC AMP which is commonly used for VHF and UHF bands. The power setting voltage from the D/A converter (IC103(40 pin)), which is controlled by IC300, is applied to 3pin.
- IC2 is a differential AMP. When the TX power sensing voltage (IC2:2pin) increases, the output voltage decreases. And thus the gate voltage of IC3(2pin) also decreases so that the TX power is controlled stable.
- Applying 8V to IC2(2pin) from the D/A converter (IC1:11pin) through Q48, the output voltage of IC3(2pin) is 0V, and thus the TX is muted.
- R252 is a chip thermal register mounted on opposite side of D66. When the temperature accidentally increases, the resistance also increases to reduce the control voltage applied to IC2(3pin) to decrease the TX power to prevent the circuit damage.

3. UHF TX CIRCUITS

【DRIVE】

- The VCO output signal is passed through D52, LPF which removes the unwanted components and ATT and amplified by Q38 and the driver AMP (Q41) to obtain the RF input level of IC4.

【PA】

- The TX signal which is amplified by the driver (Q41) is applied to IC4 and amplified to the TX output power level.
- IC4 is a UHF band PA module with power MOS_FET. The output of IC4 is passed through D68, D84 and LPF which reduces the harmonic components to the specified level.
- While transmitting, the voltage on the UT8 line is applied to D68, D84, D73, D75 to turn them on, thus the TX signal path is ON and the RX signal path is OFF to prevent the TX signal entering to the RX circuits.
- While receiving, D68, D84, D73, D75 are turned OFF, thus the RX signal from the antenna is applied to the RF circuit.
- D79 protects the RF circuit from the over input.

【APC】

- A portion of output signal from IC4 is rectified by the power detector circuit (D62 and D67) to produce the DC, whose voltage is in proportion to the TX power level, then applied to IC2:6pin.
- IC2 is an APC AMP which is commonly used for VHF and UHF bands. The power setting voltage from the D/A converter (IC103(41 pin)) controlled by IC300, is applied to 5pin.
- IC2 is a differential AMP. When the TX power sensing voltage (IC2:6pin) increases, the output voltage decreases. And thus the gate voltage of IC4(2pin) also decreases so that the TX power is controlled stable.
- Applying 8V to IC2(6pin) from the D/A converter (IC1:11pin) through Q46, the output voltage of IC4(2pin) is 0V, and thus the TX is muted.
- R234 is a chip thermal register mounted on opposite side of D68 and D84. When the temperature accidentally increases, the resistance also increases to reduce the control voltage applied to IC2(5pin) to decrease the TX power to prevent the circuit damage.

4. RX CIRCUITS(LEFT DISPLAY)

【PRE-AMP】

- The VHF RX signal from the ANT terminal is applied to the gate terminal of pre-AMP (Q24) and amplified to the appropriate level.

【RF AMP】

1) 144MHz band

The amplified signal is passed through the BPF (D28 and D88) and applied to Q20.

The filtered signal is passed through another BPF (D20 and D87) to reduce unwanted signal components, then applied to the 1st mixer.

D34 is an RX attenuator controlled by the output signal from Q22.

2) 430MHz band

The amplified signal is passed through the BPF (D24 and D26) and applied to Q18.

The filtered signal is passed through another BPF (D12 and D16) to reduce unwanted signal components, then applied to the 1st mixer.

D30、D22、D18、D10 shift the tuning range, driven by Q33 and Q9, controlled by the L400_S signal from IC317.

D32 is an RX attenuator controlled by the output signal from Q22.

Each BPF tuning voltage is provided by DAC (IC1) controlled by IC300.

【1st-MIX】

- The RX signal is applied to the double-balanced mixer (L207, L208, L209, IC125), and mixed with the LO signal from the VCO UNIT, resulting in the 38.85MHz 1st IF signal.

【1stIF circuit】

- The 1st IF signal is applied to the impedance-matched IF filter (FI105).
- FI105 is a high selectivity filter which contains two crystal filters inside. The filtered 1st IF signal is amplified the 1st IF AMP (Q138).
- D118 and D114 are input signal limiters for the IF IC.

【2ndIF circuit】

- The 1st IF signal from Q138 is applied to IC121:20pin.
- IC121 contains 2nd-MIX circuit, limiter AMP, noise AMP, quadrature detector, AM detector, AGC control circuit and S-meter circuit in its package.
- The reference frequency (12.8MHz) signal is oscillated by X200, and tripled by Q200, resulting in 38.4MHz 2nd LO signal. The 2nd LO signal is applied to IC121:1pin and mixed with the 1st IF signal from 20pin, resulting 450kHz 2nd IF signal, which is output from 3pin.
- The 2nd IF signal is passed through the ceramic filter (FI102 or FI103), and then re-applied to IC121(5pin and 7pin).
- The ceramic filters (FI102 for narrow, FI103 for wide) are switched by PIN diodes (D107、D108、D111 and D112) and the switching drivers (Q122、Q124、Q142), using the L_WN_SEL signal from IC316.

●FM detector circuit

- The 2nd IF signal applied to IC121:7pin is amplified by the internal limiter AMP, and detected by the quadrature detector (with ceramic resonator X102), then the detected AF signal is output from 11pin. The output AF signal is either applied to the squelch circuit or RX AF circuit, through the AF SW (IC119).

●AM detector circuit

- The 2nd IF signal applied to IC121:5pin is amplified by the internal IF AMP, and detected by the AM detector, then the detected AF signal is output from 14pin. The output AF signal is either applied to the AGC circuit (from 18pin) or the AF SW (IC119).
- While receiving in the AM mode, the AGC voltage from IC121:17pin drives Q134 to control the gate voltage of Q18 and Q20 and base voltage of Q138.

The AF signal is passed through the AM/FM SW (IC119), AF filter (Q113), AF buffer (IC117) and tone filter.

【SQL circuit】

- A portion of AF signal from IC121:11pin is applied to IC103:22pin and adjusted in level, then applied to the noise AMP in IC121.
- The output signal from the noise AMP is applied to the OP AMP (IC123), and applied to IC300 as the L_SQL signal to control the SQL.

5. RIGHT-DISPLAY CIRCUIT

【PRE-AMP】

- The UHF RX signal from the ANT terminal is applied to the gate terminal of pre-AMP (Q23) and amplified to the appropriate level.

【RF AMP】

1) 144MHz band

The amplified signal is passed through the BPF (D27 and D85) and applied to Q19.

The filtered signal is passed through another BPF (D19 and D86) to reduce unwanted signal components, then applied to the 1st mixer.

D33 is an RX attenuator controlled by the output signal from Q21.

2) 430MHz band

The amplified signal is passed through the BPF (D23 and D25) and applied to Q17.

The filtered signal is passed through another BPF (D11 and D15) to reduce unwanted signal components, then applied to the 1st mixer.

D9, D17, D21, D29 shift the tuning range, driven by Q31 and Q8, controlled by the R400_S signal from IC317.

D31 is an RX attenuator controlled by the output signal from Q21.

Each BPF tuning voltage is provided by DAC (IC1) controlled by IC300.

【1st-MIX】

- The RX signal is applied to the double-balanced mixer (L204, L205, L206, IC124), and mixed with the LO signal from the VCO UNIT, resulting in the 46.35MHz 1st IF signal.

【1stIF circuit】

- The 1st IF signal is applied to the impedance-matched IF filter (FI104).
- FI104 is a high selectivity filter which contains two crystal filters inside. The filtered 1st IF signal is amplified the 1st IF AMP (Q137).
- D113 and D117 are input signal limiters for the IF IC.

【2ndIF circuit】

- The 1st IF signal from Q137 is applied to IC120:20pin.
- IC120 contains 2nd-MIX circuit, limiter AMP, noise AMP, quadrature detector, AM detector, AGC control circuit and S-meter circuit in its package.
- The reference frequency (15.3MHz) signal is oscillated by X201, and tripled by Q220, resulting in 45.9MHz 2nd LO signal. The 2nd LO signal is applied to IC120:1pin and mixed with the 1st IF signal from 20pin, resulting 450kHz 2nd IF signal, which is output from 3pin.
- The 2nd IF signal is passed through the ceramic filter (FI100 or FI101), and then re-applied to IC120(5pin and 7pin).
- The ceramic filters (FI100 for narrow, FI101 for wide) are switched by PIN diodes (D105, D106, D109 and D110) and the switching drivers (Q121, Q123, Q141), using the R_WN_SEL signal from IC316.

●FM detector circuit

- The 2nd IF signal applied to IC120:7pin is amplified by the internal limiter AMP, and detected by the quadrature detector (with ceramic resonator X101), then the detected AF signal is output from 11pin. The output AF signal is either applied to the squelch circuit or RX AF circuit, through the AF SW (IC119).

●AM detector circuit

- The 2nd IF signal applied to IC120:5pin is amplified by the internal IF AMP, and detected by the AM detector, then the detected AF signal is output from 14pin. The output AF signal is either applied to the AGC circuit (from 18pin) or the AF SW (IC119).
- While receiving in the AM mode, the AGC voltage from IC120:17pin drives Q133 to control the gate voltage of Q17 and Q19 and base voltage of Q137.

The AF signal is passed through the AM/FM SW (IC119), AF filter (Q113), AF buffer (IC117) and tone filter.

【SQL circuit】

- A portion of AF signal from IC120:11pin is applied to IC103:16pin and adjusted in level, then applied to the noise AMP in IC120.
- The output signal from the noise AMP is applied to the OP AMP (IC122), and applied to IC300 as the R_SQL signal to control the SQL.

6. AF CIRCUITS

AF circuits are commonly used for both VHF/UHF bands, according to the operating condition.

1) TONE DECODING

The demodulated signal from IC119 is passed through the LPF (Q125 or Q126), and applied to IC300, then decoded.

2) ANALOG RX AUDIO

- The demodulated signal (Left side) is AM/FM SW (IC119), AF filter (Q113) and Digital/Analog SW (IC111), then electric volume (IC110:3pin). Q140 switches the audio response of the AF filter and de-emphasis characteristic.
- The demodulated signal (Right side) is AM/FM SW (IC119), AF filter (Q112) and Digital/Analog SW (IC111), then electric volume (IC110:4pin). Q139 switches the audio response of the AF filter and de-emphasis characteristic.

3) SIGNALING

The WX alert signal in the demodulated signal is filtered by the passive LPF, and applied to IC300, then decoded to the WX alert signal.

4) DIGITAL RX AUDIO

The digital voice baseband signal in the demodulated signal is amplified by the buffer (IC117), filtered by the LPF, and passed through IC406, IC407, then applied to IC402 through the ATT.

The digital voice baseband signal is converted into the analog audio signal by the DSP, then output from IC402. The analog audio signal is passed through the HPF and LPF (IC406 and IC407), then applied to the digital/analog AF SW (IC111).

5) MINI REPEATER

The demodulated signal from IC117 is passed through the Repeater SW (IC113) and LPF and DAC (IC103), then output as the TX modulation signal.

6) TX SUDIO

The MIC signal from the MIC connector (J100:6pin) is passed through BT MIC SW and MIC gain SW (IC100), and amplified by IC102, then applied to IC103, through the MIC mute SW (IC104).

• ANALOG

The MIC signal is passed through the pre-emphasis circuit, IDC AMP and splatter filter (IC103), then applied to the digital/analog AF SW (IC104).

• DIGITAL

The MIC signal is passed through the ALC AMP (IC103), which limits the amplitude, and converted into the digital signal by the codec and DSP, then applied to the digital/analog AF SW (IC104).

The TX signal from IC104 is passed through the LPF (IC103), and adjusted in level by the DAC (IC103), then applied to the VCO and TCXO, through the modulation mute SW (IC205).

7. AF POWER AMP

- The AF signal from the electric volume (IC110) is passed through the AF line selector (IC109), which toggles the audio source between right and left band, and applied to the speaker.
- The AF signal from IC109 is passed through the mute SW (Q104, Q105, Q106, IC108), and applied to the AF AMP (IC105 or IC106). IC105 drives the internal speaker and left side external speaker, and IC106 drives the right side external speaker.

8. POWER SUPPLY CIRCUITS

13.8V from the power supply is supplied to every circuit in the transceiver after being converted by the following power supply circuits.

- IC309 converts 13.8V from the power supply to 6V, and this is supplied to the following circuits.
The super capacitor (C1340) and 4.2V regulator (IC323) can keep supplying circuits listed below, even if the power source is temporally cut off.
 - CPU3.3V generated by IC311.
 - BT3.3V generated by IC306.
 - SD3.3V generated by IC305.
- When the PWR SW is pushed, the transceiver is turned ON. At the same time, the control signal from IC300 turns ON Q301, and it turns ON Q303, Q302 and Q306, and thus the VCC and 5VS lines supply the current to each circuit.
- The VCC line supplies the following regulators.
 - IC313, which generates 8V.
 - IC321, which generates CONT8V
- The 5VS line supplies the following regulators.
 - IC403, which generates DSP3.3V.
 - IC404, which generates DSP1.4V.
 - IC314, which generates 3VS.
- 8V is supplied to the R-VC0 (VHF band VC0 and UHF band VC0), through Q229, Q230, Q243 and Q231.
- 8V is also supplied to the L-VC0 (VHF band VC0, VHF band VC0 for reverse heterodyne and UHF band VC0), through Q208, Q209, Q242, Q212, Q240 and Q241.
- 8V is supplied to IC209 which generates VCP6V for L-VC0 PLLIC charge pump power supply (IC201:18pin).
- 8V is supplied the following circuits which is controlled by VTX_C and UTX_C lines from IC303.
 - Q27 and Q28, which generates VT8.
 - Q32 and Q34, which generates UT8.

9. COMMUNICATION, CONTROL and OTHER CIRCUITS

【MAIN CPU】

- IC300 is a 32-bit CPU that controls SRAM (IC304), EEPROM (IC301), expanders (IC315 to IC317) and IC303.
- IC308 is a voltage detecting IC that outputs “H” level when it detects the CPU3.3V line voltage exceeds the threshold level, to reset the CPU.

【DATA COMMUNICATION】

- The control signals “TX_DATA” from IC300 and “RX_DATA” from IC2 on the CONTROL-1 UNIT are exchanged through 2 data lines via J300.

【S-METER】

- The RSSI signals “L_RSSI” from IC121 and “R_RSSI” from IC120 are applied to IC300.
- The applied voltage is analog-to-digital converted, and send the RSSI indication data to IC2 on the CONTROL-1 UNIT.

【PTT circuit】

- When the PTT on the MIC, which connected to J100, is pushed, the base terminal of Q102 turns “L”, and the corrector terminal turns “H”, and thus IC300 detects the PTT input.

【DATA COMPALATOR】

- When the multifunction MIC is connected, the serial data from the MIC is applied through the OP AMP (IC101).

【COOLING FAN CONTROLLER】

- IC1, whose output voltage is controlled by IC300, drives Q29 and Q30 which drives the cooling fan (MF1 (CHASSIS)).

【SD_CARD】

- The SD card connector (J305) is connected to and controlled by IC300.

【Bluetooth】

- Bluetooth unit (UT-133) mount connector (J301) is connected to and controlled by IC300.
- The audio signal from the UT-133 is applied to the MIC/Bluetooth SW (IC100), through the buffer (IC307).
- The AF signal from the electronic volume (IC110) is applied to either internal speaker, external speaker or UT-133, through buffer (IC107).

【VOLTAGE DROP DETECTION】

- When the voltage of 13.8V line drops, the voltage detecting ICs (IC320 and IC324) detects controls the SD card and UT-133 to terminate them.

【REAL TIME CLOCK】

- IC302 and X301 composes the real time clock circuit.
- BT300 is a backup lithium cell.

【CURRENT DETECTING CIRCUIT】

- The current flow detecting circuit (IC310 and R1002) send the voltage, which is in proportion to the current, to IC300.

【CLOCK SHIFT CIRCUIT】

- X300 is 12.288MHz crystal oscillator which generates the clock of IC300.
- Switching the capacitance of D303 and D304, the clock frequency is shifted, to prevent spurious components.
- X302 is 19.6608MHz crystal oscillator which generates the clock of IC303.
- Switching the capacitance of D306, the clock frequency is shifted, to prevent spurious components.
- X400 is 12.288MHz crystal oscillator which generates the clock of DSP.
- Q402 changes the frequency control voltage of X400, to prevent spurious components.

【CLONING CIRCUIT】

- The cloning data from J102 is applied to IC300, through the cloning circuit (IC312、Q304、Q305、D327). The cloning data from IC300 is output through the cloning terminal.

【VOX】

- The audio signal from the MIC AMP (IC102) is amplified by the VOX AMP (IC103), then rectified by D102 and D103, and then applied to IC300 as the VOX signal.

【RS-232C CIRCUIT】

- IC318 is RS-232C standard serial interface which converts the voltage.

CONTROL-1 UNIT CIRCUIT DESCRIPTION

【CPU】

IC2 is a 32-bit CPU which controls switch, volume, touch window and CONTROL UNIT, and also serial data communication and display control.

【CPU RESET CIRCUIT】

IC5 is a voltage monitoring IC which output “H” when the voltage of the VDD terminal exceeds the threshold level, to reset IC2.

【LCD DISPLAY】

ID-5100 employs the full-dot custom LCD module which displays numbers, frequency, s-meter and TX indicator with large character.

The backlight is contained in the module, controlled by IC2.

【LCD BACKLIGHT】

The LCD module contains the LED backlight which is controlled by the CPU (IC2).

【DATA COMMUNICATION】

The control signals “TX_DATA” from IC300 on the MAIN-1 UNIT and “RX_DATA” from IC2 are exchanged through 2 data lines via J6.

【POWER SUPPLY】

The 8V power supply voltage for the CONTROL UNIT is supplied from the MAIN-1 UNIT.

IC6 converts 8V from the MAIN-1 UNIT to 3.3V.

【GPS】

The GPS module connected to J3 is controlled by the CPU.

【TOUCH WINDOW】

The touch panel is composed of touch window (LCD) connected to J7 and the touch window controller, and send the sensing data to the CPU.