SECTION 4 CIRCUIT DESCRIPTION

4-1 RECEIVER CIRCUITS

4-1-1 ANTENNA SWITCHING CIRCUIT (RF UNIT)

The RF signals from the antenna connector pass through the antenna switching circuit (D3, D6, D9). The passed signals are then applied to either Duplexer or RX band switching circuit.

4-1-2 DUPLEXER CIRCUIT (RF UNIT)

The transceiver has a duplexer (low-pass and bandpass filters) on the frist stage from the antenna switcing diode to separate the signals into VHF and UHF signals.

(1) RF signals below 175.0 MHz

The RF signals are passed through the low-pass filter (L56–L58, C8–C11, C57) and are applied to the VHF RF circuit.

(2) RF signals 330.0 MHz to 469.995 MHz

The RF signals are pass through the bandpass filter (L3–L5, C21–C24, C218) and are applied to the UHF RF circuit.

4-1-3 RX BAND SWITCHING CIRCUIT (RF UNIT)

Received signals from the antenna connector pass through an antenna switching circuit (D6, D9). The signals are then applied to the RX RF circuit via the band switching circuit (D11, D13, D31) which suppress out-of-band signals.

4-1-4 RX RF CIRCUIT (RF UNIT)

The RF circuit amplifies the received signals within the range of frequency coverage and filters out-of-band signals.

(1) 470.0 MHz–1026.995 MHz signals

RF signals (470 MHz–1026.995 MHz) from a band switching circuit (D11) pass through a bandpass filter (L7, L8, L42) and are amplified at an RF amplifier (Q24). The amplified signals are then applied to the 1st mixer circuit (IC1) through the band switching diode (D32).

(2) 30.0 MHz–117.995 MHz, 175 Mhz–329.995 MHz

The 30.0 MHz–117.995 MHz, 175 Mhz–329.995 MHz signals pass through a low-pass filter (L9, L10) via the band switching diode (D13), and are then amplified at the RF amplifier (Q36). The amplified signals are applied to the 1st mixer circuit (IC1) via the band switching diode (D34).

(3) 1027.0 MHz–1309.995 MHz

The 1027.0 MHz–1309.995 MHz signals pass through a bandpass filter (L11, L12, L43) via the band switching diode (D13), and are then amplified at the RF amplifier (Q36). The amplified signals are applied to the 1st mixer circuit (IC1) via the band switching diode (D36).

4-1-5 VHF/UHF RF CIRCUIT (RF UNIT)

The VHF/UHF RF circuit amplifies the received signals within the range of frequency coverage and filters out-of-band signals.

(1) VHF RF CIRCUIT

The filtered signals from the low-pass filter circuit are amplified at the VHF RF amplifier (Q14) after passed through the T/R swiching diode (D15) and are passed through the two stage of tunable bandpass filters (D1, D2, L28, L1). The filtered signals are applied to the 1st mixer circuit via the band switching diode (D25).

(2) UHF RF CIRCUIT

The filtered signals from the bandpass filter circuit are amplified at the UHF RF amplifier (Q35) via the T/R switching diode (D27) and are passed through the two stage of tunable bandpass filters (D4, D5, L61, L60). The filtered signals are applied to the 1st mixer circuit via the band switching diode (D29). The filtered signals are applied to the 1st mixer circuit.

The tunable bandpass filters employ varactor diodes (D1, D2, D4, D5) to tune the center frequency of the RF passband for wide bandwidth receiving and good image response rejection. These diodes are controlled by the CPU (LOGIC unit; IC11, pin 9).

4-1-6 1ST MIXER CIRCUIT (RF UNIT)

The 1st mixer circuit converts the received RF signals to a fixed frequency of the 1st IF signal with a PLL output frequency. By changing the PLL frequency, only the desired frequency will pass through the bandpass filters at the next stage of the 1st mixer.

The filtered RF signals are mixed with 1st LO signals at the 1st mixer circuit (IC1) to produce a 266.7 MHz 1st IF signal. The 1st IF signal is output from pin 6, and passed through the bandpass filter (FI1) to suppress unwanted harmonic components. The filtered 1st IF signal is applied to the IF circuit.

The 1st LO signals are generated at the V VCO (Q32, D45) or U VCO (Q28, Q30, D54) circuit (according to the receiving frequency band), and are applied to the 1st mixer (IC1, pin 3) directly or passed through the doubler circuit (Q31) after being amplified at the buffer amplifier (IC4, Q40).

4-1-7 1ST IF AND 2ND MIXER CIRCUITS (RF UNIT)

The 2nd mixer circuit converts the 1st IF signal to a 2nd IF signal.

The filtered 266.7 MHz 1st IF signal from the bandpass filter is mixed with the 2nd LO signal at the 2nd mixer circuit (IC10) to produce a 19.65 MHz 2nd IF signal. The 2nd IF signal pass through (except WFM mode) or bypass (WFM mode) the bandpass filter (FI3) and is amplified at the buffer amplifier (Q5). The amplified signal is applied to the demodulator circuit.

4-1-8 DEMODULATOR CIRCUITS (RF UNIT)

The demodulator circuit converts the 2nd IF signal into AF signals.

The 19.65 MHz 2nd IF signal from the buffer amplifier (Q5) is applied to the 3rd mixer section of the FM IF IC (IC2, pin 16) and is then mixed with the 3rd LO signal for conversion to a 450 kHz 3nd IF signal.

IC2 contains the 3nd mixer, limiter amplifier, quadrature detector and S-meter detector, etc. A frequency from the PLL reference oscillator is used for the 3nd LO signal (19.20 MHz).

(1) FM mode

The 3rd IF signal is output from pin 3 and passed through the ceramic bandpass filter (FI2). The filtered signal is fed back to the FM IF IC (pin 5) and amplified at the limiter amplifier section (pin 10), then demodulated into AF signals at the quadrature detector section and L21. The demodulated AF signals are output from pin 9 and are applied to the AF circuit (LOGIC unit).

(2) WFM mode

The 3rd IF signal from the 3rd mixer bypasses the ceramic filter (FI2) and fed back to the limiter amplifier section (pin 5). The amplified signal is demodulated at the quadrature detector section (pin 10) and L21. The AF signals are output from pin 9 and are applied to the AF circuit (LOGIC unit).

By connecting R55 to R54 in parallel, the output characterstics of pin 12, "RSSI", change gradually. Therefore, the FM IF IC can detect WFM components.

(3) AM mode

The filtered 3rd IF signal from the bandpass filter (FI2) is amplified at the IF amplifier (Q1). The amplified IF signal is applied to the AM detector circuit (Q4) to converted into AF signals, and the signals are applied to the AF circuit (LOGIC unit).

4-1-9 AF AMPLIFIER CIRCUIT (LOGIC UNIT)

The AF amplifier circuit amplifies the demodulated AF signals to drive a speaker.

While in FM mode, AF signals from the demodulator circuit (RF unit) are passed through the de-emphasis and high-pass filter and are then applied to the pre amplifier (Q31). While in AM mode, AF signals are pass through the high-pass filter and are then applied to the pre-amplifier (Q31). While in WFM mode, AF signals are applied to the pre-amplifier (Q31) directly.

The pre-amplified AF signals pass through the AF mute circuit (Q37) and are then applied to the electronic volume control circuit (IC14, pin 6). The level controlled AF signals are output from pin 7 and applied to the AF power amplifier (IC10, pin 1) via the buffer amplifier (Q35). The power amplified AF signals are applied to the internal speaker via the [EXT SP] jack.

The electronic volume control circuit controls AF gain, therefore, the AF output level is according to the [VOL] setting and also the squelch conditions.

4-2 TRANSMITTER CIRCUITS

4-2-1 MICROPHON AMPLIFIER CIRCUIIT (LOGIC UNIT)

The microphone amplifier circuit amplifies the audio signals from the microphone, within +6dB/octave pre-emphasis characteristics, to a level needed for the modulation circuit. The microphone amplifier circuit is used for both the VHF and UHF bands.

The AF signals from the microphone are amplified at the microphone amplifier (Q12) and the limiter amplifier (Q2) which has a negative feedback circuit for +6 dB/octave pre-emphasis.

The amplified signals are applied to the low-pass filter (Q7) to filter out RF components and are then applied to the RF unit as the "MOD" signal.

4-2-2 MODULATION CIRCUIT (RF UNIT)

The modulation circuit modulates the VCO oscillating signal (RF signal) using the microphone AF signals.

(1) VHF VCO

The amplified signals from the limiter amplifier changes the reactance of D45 to modulate the oscillated signal at the VHF VCO circuit (Q32). The modulated signal is amplified at the buffer amplifiers (IC4, Q40) and is then applied to the drive amplifier circuit for VHF band.

(2) UHF VCO

The amplified signals from the limiter amplifier changes the reactance of D54 to modulate the oscillated signal at the UHF VCO circuit (Q28, Q30). The modulated signal is amplified at the buffer amplifiers (IC4, Q40) and is then applied to the drive amplifier circuit for UHF band.

4-2-3 DRIVE/POWER AMPLIFIER CIRCUITS (RF UNIT)

The amplifier circuit amplifies the VCO oscillating signal to the output power level.

(1) VHF PA

The signal from the buffer amplifier (Q40) is passed through the Tx/Rx switching circuit (D23), and are amplified at the driver amplifiers (Q23, Q13) and the power amplifiers (Q9–Q12) to obtain 350 mW of RF power.

The amplified signal is passed through the antenna switching circuit (D16) and low-pass filter, and is then applied to the antenna connector.

(2) UHF PA

The signal from the buffer amplifier (Q40) is passed through the Tx/Rx switching circuit (D28), and are amplified at the driver amplifiers (Q22, Q21) and the power amplifiers (Q17–Q20) to obtain 300 mW of RF power.

The amplified signal is passed through the antenna switching circuit (D40) and bandpass filter, and is then applied to the antenna connector.

4-3 PLL CIRCUITS

4-3-1 PLL CIRCUIT (RF UNIT)

A PLL circuit provides stable oscillation of the transmit frequency and the receive 1st/2nd LO frequencies. The PLL circuit compares the phase of the divided VCO frequency to the reference frequency. The PLL output frequency is controlled by the divided ratio (N-data) of a programmable divider.

An oscillated signal from the 1st VCO passes thorough the buffer amplifiers (IC4, Q43) is applied to the PLL IC (IC3, pin 19) and is prescaled in the PLL IC based on the divided ratio (N-data). The reference signal is generated at the reference oscillator (X1) and is also applied to the PLL IC. The PLL IC detects the out-of-step phase using the reference frequency and outputs it from pin 13. The output signal is passed thorough the loop filter (Q2, Q45) and is then applied to the VCO circuit as the lock voltage.

4-3-2 VCO CIRCUIT (RF UNIT)

The 1st VCO circuit contains a separate VHF-VCO (Q32, D45) and UHF-VCO (Q28, Q30, D54). The oscillated signal is amplified at the buffer amplifiers (IC4, Q40), and is then applied to the T/R switching circuit (D23, D28, D42, D43, D44). Then the Tx and Rx signals are applied to the pre-driver (Q23: for VHF, Q22: for UHF) and 1st mixer (IC1) respectively.

A portion of the signal from IC4 is amplified at the buffer amplifier (Q43) and is then fed back to the PLL IC (IC3 pin 2) as the comparison signal.

4-3-3 2ND LO VCO CIRCUIT (RF UNIT)

The 2nd LO circuit generates the 2nd LO frequencies, and the signals are applied to the 2nd mixer circuit.

The generated signals from the 2nd VCO (Q6, D17) are applied to the 2nd mixer (IC10), then mixed with the 1st IF signal.

An oscillated signal from the 2nd VCO passes thorough the low-pass filter (L69) and is applied to the PLL IC (IC3, pin 2), and is then output from pin 8.

ADJUSTMENT

Adjustment	No.	Adjustment Conditions & Tuning	Location	Value	Adjust
1st VCO LOCK voltage (V.VCO)	1	Frequency : 145.00MHz ·Transmitting	Connect a digital multimeter or an oscilloscope to L68(side IC4) on the RF UNIT.	2.0V±0.5V	L68
	2	Frequency : 449.980MHz · Receiving		Less than 7.2V	Verify
(U.VCO)	1	Frequency : 282.900MHz · Receiving		Less than 11.0V	Verify
	2	Frequency : 283.000MHZ · Receiving		2.3V±0.5V	Verify
	3	Frequency : 493.295MHz · Receiving		Less than 9.2V	Verify
	4	Frequency : 493.300MHz · Receiving		2.4V±0.5V	Verify
2nd VCO LOCK voltage	1	Frequency : 430.000MHz · Receiving	Connect a digital multimeter or an oscilloscope to R37(side R67) on the RF UNIT	0.7V±0.5V	Verify
	2	Frequency : 433.500MHz · Receiving		Less than 2.5V	Verify

Reference Frequency	1	Frequency : 439.800MHz(FR ch) ・Transmitting	Loosely couple a frequency counter to the antenna connector.	439.800MHz ±100Hz	S9 (LOGIC)
Detect output	1	Frequency : 145.600MHz(tk ch) ・Receiving ・Connect a SSG to the antenna connector and set as: Level : 1.0mV(−47dm) Modulation : OFF	Connect a digital multimeter or an oscilloscope to [QUAD] check point on the LOGIC UNIT.	1.0V	L21 (RF)
VHF Sensitivity	1	Frequency : 145.600MHz(tk ch) ・Receiving ・Connect a SSG to the antenna connector and set as: Level : 1.0 μ V(−107dm) Modulation : OFF	Connect a digital multimeter or an oscilloscope to [SEN]check point on the LOGIC UNIT.	Maximum voltage	S9 (LOGIC)
UHF Sensitivity	1	Frequency : 435.600MHz(tk ch) ・Receiving ・Connect a SSG to the antenna connector and set as: Level : 1.0 μ V(−107dm) Modulation : OFF	Connect a digital multimeter or an oscilloscope to [SEN]check point on the LOGIC UNIT.	Maximum voltage	S9 (LOGIC)
S-meter	1	Frequency : 145.100MHz(RS ch) ・Receiving ・Connect a SSG to the antenna connector and set as: Level : 1.0 μ V(−107dm) Modulation : OFF	Push call key	3 dot	Verify
	2	Frequency : 435.100MHz(RS ch) ・Receiving SSG Level : −6db μ		3 dot	Verify
	3	Frequency : 230.100MHz(RS ch) ・Receiving SSG Level : −6db μ		3 dot	Verify

	4	Frequency : 851.100MHz(RS ch) ・Receiving SSG Level : −6db μ		3 dot	Verify
	5	Frequency : 1280.100MHz(RS ch) ・Receiving SSG Level : −0db μ		3 dot	Verify
SQL level	1	Frequency : 145.100MHz(RS ch) SQL MODE : [AUTO] ・Set the SSG as: Modulation : ±3.5kHz Level : −15dB μ (−122dBm) ・Receiving	Connect an SSG to the antenna connector.	Open SQL	Verify
	2	Frequency : 435.100MHz(RS ch) SSG Level : −13dB μ (−120dBm) ・Receiving			Verify
	3	Frequency : 230.100MHz(RS ch) SSG Level : −10dB μ (−117dBm) ・Receiving			Verify
	4	Frequency : 851.100MHz(RS ch) SSG Level : −5dB μ (−112dBm) ・Receiving			Verify
	5	Frequency : 1280.100MHz(RS ch) SSG Level : 5dB μ (−102dBm) ・Receiving			Verify
Output power	1	Frequency : VHF BAND ・Transmitting	Connect a RF power meter to the antenna connector.	More than 0.2W	Verify
	2	Frequency : UHF BAND ・Transmitting		More than 0.2W	Verify

VHF Deviation	1	Frequency : VHF BAND center (RS ch) ・Connect an audio generator to the [MIC] jack connector and set as: 1KHz/95mV ・Set an FM deviation meter as: HPF : OFF LPF : 20KHz De-emphasis : OFF Detector : (P-P)/2 ・Transmitting	Connect a FM deviation meter to the antenna connector through an attenuator.	4.4KHz	R214 (RF)
UHF Deviation	1	Frequency : UHF BAND center (RS ch) ・Connect an audio generator to the [MIC] jack connector and set as: 1KHz/95mV ・Set an FM deviation meter as: HPF : OFF LPF : 20KHz De-emphasis : OFF Detector : (P-P)/2 ・Transmitting		4.4KHz	R212 (RF)
T.CALL Deviation (Only #02,04)	1	Frequency : V/U BAND center (CA ch) ・Set an FM deviation meter as: HPF : OFF LPF : 20KHz De-emphasis : OFF Detector : (P-P)/2 ・Transmitting	Connect a FM deviation meter to the antenna connector through an attenuator	3.5KHz ±100Hz	S9 (LOGIC)

CTCSS Deviation	1	Frequency : V/U BAND Tone frequency : 88.5Hz Tone SQL : [TSQL] ・Set an FM deviation meter as: HPF : OFF LPF : 20KHz De-emphasis : OFF Detector : (P-P)/2 ・Transmitting	Connect a FM deviation meter to the antenna connector through an attenuator	0.75KHz ±0.25KHz	Verify