7. THEORY OF OPERATION

Circuit Composition And Operation Theory

The basic explanation for the circuit composition

the two board controlling the analog circuit parts and the digital circuit parts for the other control.

Receiver

Transmission parts is composed in the double conversion system, which has the 1st IF Frequency of 21.7MHz and the 2nd IF frequency of 450khz. With the saw filter which has an excellent band characteristic and skite characteristic, the 2 pole MCF used in the 1st IF, and the 4 pole ceramic filter(450khz) in the 2nd IF, the reception interrupting factors such as the image and the sensitivity repression are reduced for the more stable reception.

RF Front-end

The signal received by the antenna will be transmitted to the band pass filter through the antenna switching circuit consisted of L305~L307, C316, C317,C321 and C6. The front RF amplifier transistor Q101 consists of the LC filter (L101,C81,C82,C84,L102,C87 and L105,107,C102,103,104,105,106,107,108,109). LC-filters has the bandwidth of approximately 6MHz, primarily diminishes the other signal rather then the 1st IF image and other signal within the reception band and amplifies only the necessary signal within the RF.

1st Mixer

The receiver signals which has been amplified in the RF front-end is provided to the base of the 1st mixer Q102. The 1st L/O signal provide from the VCO is supplied to the emitter of Q102 and converted to the 1st IF 21.7MHz.

1st IF Filter and 1st IF Amplifier

The signals covered by Q102 to 21.7MHz, the 1st frequency, change its impedance through C116,C113, L108 and then is infused to the fundamental MCF which has the center frequency of 21.7MHz and the band width of +/-3.75KHz.

Here, the signal reduces the image and other unwanted signal for the 2nd IF, and changes its impedance again through the C116,C113, L108. Then the signal is infused to the Q103, the 1st IF amplifier. The signal infused to the Q103 is amplified approximately by 20dB in other to acquire the required reception sensitivity, and infused to the IC101 which functions as the 2nd

mixer, the 2nd IF amplifier, and the FM detector.

2nd Mixer, 2nd IF, FM Detector (IC101)

The receiver IF signal of 21.7MHz, which has been infused to IC101 is mixed with the 2nd L/O signal of 21.250MHz, and converted to 450KHz, the 2nd IF frequency. The receiver signal converted to the 2nd IF frequency passed through the CF103, the ceramic filter of 450KHz again. After the limiting inside the IC101 and the FM demodulating by the quadrature detector inside the IC101, the signal offers the output through the 9th pin of the IC101.
The 2nd L/O signal of 21.250MHz, which infused to the IC101 filters and uses directly the crystal of 21.250MHz. The squelch circuit is composed to detect the noises from the received signal demodulate in the 9th pin of the IC101. For this purpose, the noise filter is using the OP amplifier inside the IC101.

De-Emphasis

The audio signal which has been FM demodulate in the IC101 is supplies to the R130,C131 which function as the De- emphasis.

Audio Power Amplifier (U102)

The received audio signal which has been adjusted to the appropriate electrical volume in the R135~ R137 are supplied to the 2nd pin of the IC102 and amplified approximately by 20dB. Then, it turns up the speaker with the maximum output of 0.3Watts.
The #2 pin of the IC102 is the audio mute and voltage supply terminal. If a voltage supply to the #2 pin of the IC102 is supplied to this terminal, the IC102 stops functioning as the audio power amplifier regardless of the signal supplied to the 2nd pin of the IC102, and there is no sound emitter from the speaker.

Transmitter

The transmission parts of the 1010 is designed to amplify the RF signal oscillated and modulated by the synthesizer to approximately 500mW by the power transistor of Q303~305.

Pre-emphasis and 300Hz HPF, Limiter (IC401D/A)

The voice signal input from the microphone is pre-emphasized at the IC401D
The signals which comes out of the IC401D is limited to a certain amplitude at the IC401D for the voice signal not to exceed the allowable band width assigned for transmission.

3KHz LPF (IC401A)

After passing the IC401D limiter and IC401A is supplied to the 3KHz LPF has the 4th characteristices and adjusts the assigned frequency band width not to exceed the allowable range.

TX Power (Q303~Q305)

The transmitted signal of approximately 10mW, combined at the driver TR is supplied to the base of the Q303~Q305 amplifier. The transmitted signal amplified to 0.47W here passes the TX LPF of the 2nd characteristiced of the L306 and the L307, and RX/TX switching takes place by the D302,D303. After this, the signal is provided to the antenna the TX LPF of the 1st characteristics, consisted of the L308.

Frequency Synthesizer

Voltage Control Oscillator (VCO)

The VCO of oscillates 462.5625MHz to 467.7125MHz under the transmission condition and 440.8625MHz to 446.0125MHz under the reception condition. The VCO consists of the clip oscillator of the Q201, and contains the oscillator frequency of approximately 21.7MHz during the transmission / reception conversion. That is since the VCO should oscillate relatively low frequency during reception compared to transmission, the D202 is directly biased by the Q201. Therefore as a result, the C209 is added in parallel to the resonance circuit of the VCO to oscillate a low frequency. During transmission, a relatively high frequency should be oscillater compared to reception. Therefore, the D202 is adversely biased by the Q200, and as a result, the C209 which is added in parallel to the resonance circuit of the VCO is removed to oscillate the desired transmission frequency.

The VCO is controlled by controlled by the IC201 PLL IC in order to oscillate the accurate frequency. The VCO is controlled by the IC201 PLL IC in order to oscillate accurate frequency. The output frequency of the VCO is supplied to the IC201 PLL IC immediately. At the IC201, the X-tal (21.250MHz) is compared to the output frequency of the VCO. The VCO is controlled through the loop filter consisted of the R208,R209, C215,C216,C217 in order to oscillate the stable frequency wanted for the radio.

The VCO controlled voltage which ahs passed the loop filter is supplies to the D201 varactor diode, and the VCO an oscillate the PLL programmed frequency by the capacity variable in the D201. In addition, the L201 on the VCO circuit functions as frequency for the VCO to be properly controlled by the IC201 PLL IC.

VCO Buffer Amplifier (Q203)

The RF signal oscillate at the VCO is provide to the Q102 RX 1st mixer through the Q101 during the reception, and is provide to the Q303~Q305 power driver amplifier through the Q203 during the transmission.

PLL Frequency Synthesizer (IC201)

The PLL synthesizer of the signal loop PLL circuit with the reference of 12.5KHz. The IC201 PLL IC includes all the functions such as the reference oscillator, the driver, the phase detector, the lock detector, and the programmable divider.

At the reference oscillator, the X-tal (21.250MHz) is connected to the pin 11 of the IC201 to oscillate the frequency of 21.250MHz. The X-tal(21.250MHz) is the temperature compensation circuit to maintain the frequency within the allowable error range even under a low temperature of -20℃.

The phase detector send out the output power to the loop filter through 3rd pin of the IC201. If the oscillation frequency of the VCO is low compared to the referenced frequency, the phase detector sends out the output power in positive pulse. If the oscillation frequency of the VCO is high, phase detector send out can maintain the frequency set.

The programmable decider divider maintains the desired frequency with the control from the CPU. The dividing ratio, "N" to oscillate the desired frequency is as below :

N = VCO oscillation frequency / reference frequency

If the desired frequency is 462.5625MHz

N = 462.5625MHz / 0.0125MHz = 37005

TX deviation control

The TX voice signal through the IC401D/A 3Khz LPF filter, and supplies to the RV401 TX deviation control volume.