

Circuit Composition and Operation Theory

The basic explanation for the circuit composition GMRS-220 consists mainly of the one board controlling the analog circuit parts for the other control.

A. Receiver

GMRS-220 transmission part is composed in the double conversion system, which has the 1st IF frequency of 21.4 MHz and the 2nd IF frequency of 450kHz. With the RF fronted which has an excellent band characteristics and skirt characteristics, the 2 pole MCF used in the 1st IF, and the 3 pole ceramic filter in the 2nd IF, the reception interrupting factors such as the image and the sensitivity repression are reduced for the more stable reception.

A.1 RF Front-end

The signal received by antenna will be transmitted to the band pass filter through the antenna switching circuit consisted of L1 L2 L3 L4 C1 C2 C3 C4 C5 D1 D2. The front RF amplifier transistor Q1 consists of the C8 C9 C10 L5 input band pass filter and FIL1 output band filter, primarily diminishes the other signal rather than the 1st IF image and other signal within the reception band and amplifies only the necessary signal within the RF.

A.2 1st Mixer

The receiver which has been amplified in the RF front-end is provided to the base of the 1st mixer Q2. The 1st LO signal provided from VCO is supplied to the base of Q2 and converted to the 1st IF 21.4MHz.

A.3 1st IF Filter

The signal converted by Q2 to 21.4MHz, the 1st frequency, changes its impedance through L8 C15 and then is infused to the fundamental MCF which has the center frequency of 21.4MHz and the width of +/- 7.5kHz. Here, the signal reduces the image and other unwanted signal for the 2nd IF.

A.4 2nd Mixer, and IF,FM Detector (U3)

The receiver IF signal of 21.4MHz, which has been infused to U3, is mixed with the 2nd LO converted to 450kHz, the 2nd IF frequency. The receiver signal converted to the 2nd IF signal frequency passed through the FIL2, the ceramic filter of 450kHz again. After the limiting inside the U3 and the FM demodulating by the quadrature detector inside the U3, the signal offers the output through in the 9th pin of U3.

The squelch circuit is composed to detect the noises from the received signal demodulated in the 9th pin of the U3. For this purpose, the noise filter is using the OP amplifier inside the U3.

A.5 Audio Power Amplifier (U03)

The receiver audio signal, which has been adjusted to the appropriate electrical volume by controlled CPU and Tone IC, is supplied to the 2nd pin of the U03 and amplified approximately by 20 dB. Then, it turns up the speaker with the maximum output of 0.2 watts.

B. Transmitter

The transmitter parts of the GMRS-220 are designed to amplify the RF signal oscillated and modulated by the synthesizer to approximately 2W by the power transistor of Q8.

B.1 Microphone Amplifier

The voice signal input from the microphone amplifies at the U02A. The signal which comes out of the U02B is limited to a certain amplitude for the voice signal not to exceed the allowable band width assigned for transmission.

B.2 TX Power (Q8)

The transmitted signal of approximately 10mW, combined at the driver TR is supplied to the gate of the Q8 amplifier. The transmitted signal amplifier to 2W here passes the TX LPF of the 2nd characteristics of L1, L2. And RX/TX switching takes place by the D1. After this signal is provided to the antenna the TX LPF of the 1st characteristics consisted of the L1,L2,L3,C1,C2,C3,C4,C5.

C. GMRS Frequency Synthesizer

C.1 Voltage Control Oscillator (VCO)

The VCO oscillates 462.5625MHz /2 to 462.7250MHz /2 and the transmission condition and 441.1625MHz /2 to 441.325MHz /2 and reception condition. The VCO consists of the clip oscillator of the Q5 and contains the oscillator frequency of approximately 10.7MHz during the transmission/reception conversion.

The VCO is controlled by U2 PLL IC in order to oscillate accurate frequency. The output frequency of VCO is supplied to the U2 PLL IC immediately.

The VCO is controlled the loop filter consisted of the R31,R32,R33,C50,C51 in order to oscillate the stable frequency wanted for radio.

The VCO controlled voltage which has passed the loop filter is supplied to the D9 varactor diode, on the VCO circuit function as frequency for the VCO to be properly controlled the U2 PLL IC.

C.2 Buffer Amplifier (Q6)

The RF signal oscillates at the VCO is provided to the Q2 1st mixer through the Q6 during the reception, and is provided to the Q9 Q7 power driver amplifier through the Q6 during the transmission.

C.3 PLL Frequency Synthesizer

The PLL synthesizer of the signal loop PLL circuit with the reference of 6.25kHz. The PLL IC includes all the function such as the reference oscillator, the driver, the phase detector, the lock detector, and programmable divider. The phase detector sends out the output power to loop filter through 5th pin of the U2. If the oscillation frequency of the VCO is low compared to the reference frequency, the phase detector sends out output power in positive pulse, If the oscillation frequency of the VCO is high compared to the reference frequency, the phase detector sends out can maintain the frequency set. The programmable divider maintains the desired frequency with control from the CPU. The dividing ratio, "N" to oscillate the desired frequency is as below.

$$N = \text{VCO oscillation frequency} / \text{reference frequency}$$