

## **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 1<sup>st</sup> IF frequency of 21.4 MHz and the 2<sup>nd</sup> IF frequency of 450kHz. With the RF fronted which has an excellent band characteristics and skirt characteristics, the 2 pole MCF used in the 1<sup>st</sup> IF, and the 3 pole ceramic filter in the 2<sup>nd</sup> 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 1<sup>st</sup> IF image and other signal within the reception band and amplifier only the necessary Signal within the RF.

#### **A.2 1<sup>st</sup> Mixer**

The receiver which has been amplifier in the RF front-end is provided to the base of the 1<sup>st</sup> mixer Q2. The 1<sup>st</sup> LO signal provide from VCO is supplied to the base of Q2 and Converted to the 1<sup>st</sup> IF 21.4MHz

#### **A.3 1<sup>st</sup> IF Filter**

The signal converted by Q2 to 21.4MHz, the 1<sup>st</sup> frequency, change 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 2<sup>nd</sup> IF.

#### **A.4 2<sup>nd</sup> Mixer, and IF,FM Detector (U3)**

The receiver IF signal of 21.4MHz, which has been infused to U3 is mixed with the 2<sup>nd</sup> LO converted to 450kHz, the 2<sup>nd</sup> IF frequency. The receiver signal converted to the 2<sup>nd</sup> 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 9<sup>th</sup> pin of U3.

The squelch circuit is composed to detect the noises from the received signal demodulate in the 9<sup>th</sup> 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 are supplied to the 2<sup>nd</sup> 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 is 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 amplify 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 2<sup>nd</sup> 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 1<sup>st</sup> characteristics consisted of the L1,L2,L3,C1,C2,C3,C4,C5.

## **C. GMRS Frequency Synthesizer**

### **C.1 Voltage Control Oscillator (VCO)**

The VCO of oscillates 462.5625MHz /2 to 462.7250MHz /2 und the transmission condition and 441.1625MHz /2 to 441.325MHz /2 und reception condition. The VCO consist 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 as passed the loop filter is supplies 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 oscillate at the VCO is provide to the Q2 1<sup>st</sup> mixer through the Q6 during the reception, and is provide 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 send out the output power to loop filter through 5<sup>th</sup> pin of the U2. If the oscillation frequency of the VCO is low compared to the reference frequency, the phase detector send out output power in positive pulse, If the oscillation frequency of the VCO is high compared to the reference frequency, the phase detector send out can maintain the frequency set. The programmable divder maintains the desired frequency with control from the CPU .The dividing ratio, “N” to oscillate the desired frequency is as below.

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