

## 5. DESCRIPTION OF RADIO CIRCUIT

### 5-1. Frequency synthesizer

Frequency synthesizer consists of VCO, loop filter and RFIC. RFIC includes MIX, IF, Comander and PLL. Frequency synthesizer uses the PLL of the RFIC.

#### a) VCO

VCO is composed of ONE VCO

Oscillation circuit takes colpitts circuit using variable Diode. The VCO generates GMRS frequencies and consists of L17, D5, C65, L19, C69, C70,

R45, R44, R46, C71, C72, Q14, R47, C74, R48, Q15, L29, C147, C151.

VCO control voltage through loop filter adjusts frequency and Microphone

Signal through Modulation terminal makes modulation.

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

If the desired frequency is 462.5625 MHz

1) TX :  $N = 462.5625 \text{ MHz} / 0.00625 \text{ MHz} = 74010$

2) RX :  $N = [462.5625 \text{ MHz} - 21.7 \text{ MHz}] / 0.00625 \text{ MHz} = 70538$

#### A. PLL IC

RFIC(PLL) is adjustable IC to produce the wished frequency which VCO provides through loop filter. It has internal counter using 21.25MHz. reference frequency to make 6.25kHz as reference Signal. VCO frequency from prescaled input is divided signal is compared with Reference signal phase in phase comparator. Built-in charger pump changes voltage (until two signals are in phase) and charged voltage supplies VCO through loop filter to produce the desired frequency.

Frequency data associated with channel goes to PLL IC by CPU through CLOCK , DATA. PLL IC enables by strobe line of CPU.

##### b) Loop Filter

Loop filter is composed of C98, C166,R77, C37,R78, C102, R115 and Change spulse from U2.46 to DC . And eliminates harmonic component in Pulse. It helps VCO oscillate clearly as DC voltage is supplied into Varicap.

#### 5-2. Receiver

This is composed of Dual Conversion Super Heterodyne. First IF is 21.7Mhz.

Local oscillator frequency is lower in 1<sup>st</sup> IF than Rx frequency.

It is called low side injection. Second IF is 450kHz . 2<sup>nd</sup> local oscillator

Frequency comes to 21.25MHz.

##### a) Rx / Tx Conversion Circuit

Rx signal goes to Rx / Tx conversion circuit through FIXED antenna connector, low pass filter (L1,L2,L3,C6,C1,C2,C3,C4,C5) and receiver resonance circuit composed of L4,C24. When transmitting, Voltage through R1,L5,D1 supplies,D2 of receive input is short and Tx is on condition. When PIN diode is off in condition of Rx, C87 resonate serially and make impedance matching at receiver bandpass filter.(FL1)

##### b) Front End

Front-end has Q6 to provide a high sensitivity and low noise feature.

It employs SAW filter as band pass filter to eliminate image frequency and to produce enough pass band by Q6 input and output.

##### c) 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 Q7. The 1<sup>st</sup> L/O signal provide from the VCO is supplied to the emitter of Q7 and Converted to the 1<sup>st</sup> IF 21.7 MHz

##### d) 1<sup>st</sup> IF Filter

The signal covered by Q7 to 21.7 MHz, the 1<sup>st</sup> frequency, change its impedance through C48, and then is infused to the fundamental MCF which has the center frequency of 21.7 MHz and the width of +/- 3.75 KHz.

Here, the signal reduces the image and other unwanted signal for the 2<sup>nd</sup> IF, and changes its impedance again through the R24. This filtered signal flows in the 1<sup>st</sup> IF amplifier of RFIC(U2).

**e) 2<sup>nd</sup> Mixer, and IF FM Detect (U2)**

The receiver IF signal of 21.7 MHz, which has been infused to U2 is mixed with the 2<sup>nd</sup> L/O converted to 450 KHz, the 2<sup>nd</sup> IF frequency. The receiver signal converted to the 2<sup>nd</sup> IF signal frequency passed through the FL3, the ceramic filter of 450 kHz again.

The squelch circuit is composed to detect the noises from the received signal demodulate in the 40<sup>th</sup> pin of the U2. For this purpose, the noise filter is using the OP amplifier inside the U2

**f) CTCSS Detector(U3, U4)**

The 2<sup>nd</sup> IF frequency comes from No.26 pin of U2 and goes to MPU through the active filter having U3 and U4.

**g) Audio Amplifier(U10)**

Demodulated audio signal enters to pin3 of AF IC (U10).

It comes out to pin5 then, it reaches at speaker.

### 5-3. Transmitt

When Tx develops with pressing PTT switch, VCO output amplifies through Q4,Q2,Q9,Q28,Q30 transmits by antenna through low pass filter.

Tx RF signal produced from Tx VCO is amplified by Buffer Q4, Driver Q2, Q9 through C13,C10, L8 and entered Q28,Q30 Power Transistor input terminal with final amplification. After this stage, the signal is emitted at

antenna through 50 matching circuit to low pass filter (L3,L2,L1,C6,C5

C4,C3,C2,C1) to eliminate harmonic.

**a) Audio Modulation and Audio Amplification**

Audio signal produced by external or internal microphone, limits amplification, low pass filter by IC U4.

Max. Frequency modulation deviation is adjusted by U4,VR1 keeps noise and audio from entering to VCO at time of Tx. Audio modulation and Audio

Amplification has characteristic of 6 /OCT pre-emphasis by U4.

10. CHANNEL

DATA

1) GMR5 Frequency Chart

Main Channel Frequencies:

| Channel | Frequency(MHz) | Channel | Frequency(MHz) |
|---------|----------------|---------|----------------|
| 1       | 462.5625       | 12      | 467.6625       |
| 2       | 462.5875       | 13      | 467.6875       |
| 3       | 462.6125       | 14      | 467.7125       |

|    |          |    |          |
|----|----------|----|----------|
| 4  | 462.6375 | 15 | 462.5500 |
| 5  | 462.6625 | 16 | 462.5750 |
| 6  | 462.6875 | 17 | 462.6000 |
| 7  | 462.7125 | 18 | 462.6250 |
| 8  | 467.5625 | 19 | 462.6500 |
| 9  | 467.5875 | 20 | 462.6750 |
| 10 | 467.6125 | 21 | 462.7000 |
| 11 | 467.6375 | 22 | 462.7250 |

**NOTE:** Channels 1 through 7 are shared between GMRS and FRS radios.  
The channel number 20 is used for emergency channel.

## 2) Weather Frequency Chart

| Channel | Frequency(MHz) | Channel | Frequency(MHz) |
|---------|----------------|---------|----------------|
| 1       | 162.550        | 6       | 162.500        |
| 2       | 162.400        | 7       | 162.525        |
| 3       | 162.475        | 8       | 161.650        |
| 4       | 162.425        | 9       | 161.775        |
| 5       | 162.450        | 10      | 163.275        |

## 3) CTCSS Tone Frequency Chart

| NO | FREQ.(Hz) | NO | FREQ. (Hz) | NO | FREQ. (Hz) |
|----|-----------|----|------------|----|------------|
| 1  | 67.0      | 14 | 107.2      | 27 | 167.9      |
| 2  | 71.9      | 15 | 110.9      | 28 | 186.2      |
| 3  | 74.4      | 16 | 114.8      | 29 | 179.9      |
| 4  | 77.0      | 17 | 118.8      | 30 | 186.2      |
| 5  | 79.7      | 18 | 123.0      | 31 | 192.8      |
| 6  | 82.5      | 19 | 127.3      | 32 | 203.5      |
| 7  | 85.4      | 20 | 131.8      | 33 | 210.7      |
| 8  | 88.5      | 21 | 136.5      | 34 | 218.1      |
| 9  | 91.5      | 22 | 141.3      | 35 | 225.7      |
| 10 | 94.8      | 23 | 146.2      | 36 | 233.6      |
| 11 | 97.4      | 24 | 151.4      | 37 | 241.8      |
| 12 | 100.0     | 25 | 156.7      | 38 | 250.3      |
| 13 | 103.5     | 26 | 162.2      | OF | 0          |