

## 5. DESCRIPTION OF RADIO CIRCUIT

### 5-1. Frequency synthesizer

Frequency synthesizer consists of VCO, loop filter and RFIC. RFIC includes MIX, IF, Compander 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 FRS frequencies and consists of L17, D5, C65, L19, C57, C70, R45, R44, R46, C71, C72, Q14, R47, C74, R48, Q15, L29.

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

#### b) 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.

#### c) Loop Filter

Loop filter is composed of C104,R77,C37,R78,C102,R113 and changes pulse from U3.46 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, C28,Q6

L12,C87 resonate serially and make impedance matching at receiver band-pass filter.(FL1,FL2)

**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 C126. This filtered signal flows in the 1<sup>st</sup> IF amplifier of RFIC(U3).

**e) 2<sup>nd</sup> Mixer, and IF, FM Detect (U3)**

The receiver IF signal of 21.7 MHz, which has been infused to U3 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 U3. For this purpose, the noise filter is using the OP amplifier inside the U3

**f) CTCSS Detector(U2,U4)**

The 2<sup>nd</sup> IF frequency comes from No.26 pin of U2,U4 and goes to MPU through the active filter having U2,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 Q3,Q2,Q16,Q1,Q19 transmits by antenna through low pass filter.

Tx RF signal produced from Tx VCO is amplified by Buffer Q3, Driver Q2,Q16 through C13, L9 and entered Q1,Q19 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.