

5. DESCRIPTION OF RADIO CIRCUIT

5.1 Frequency synthesizer

Frequency synthesizer consists of VCO, PLL IC (built in PRESCALER) and loop filter. (the same of NOAA,FM Radio)

a) GMRS-1500XTM VCO

VCO is composed of ONE VCO. Oscillation circuit takes colpitts circuit Using variable Diode. And VCO is composed of D8, Q6, C38, C35, L16, C31, VC2, C28, C29.

VCO control voltage through loop filter adjusts frequency and Microphone signal through Modulation terminal makes modulation.

b) NOAA VCO

NOAA VCO is similar to FR1500XTM VCO. VCO is composed of ONE VCO. Oscillation circuit takes colpitts circuit using variable Diode. And VCO is composed of D9, C84, L17, C83, C80, C81 Q12.

VCO control voltage through loop filter adjusts frequency.

c) FM Radio VCO

FM VCO is composed of ONE VCO. Oscillation circuit takes colpitts circuit Using variable Diode. And VCO is composed of D10, C132, L23, C128, C129. VCO control voltage of through loop filter adjusts frequency.

d) PLL IC (with FM Radio)

PLL IC is adjustable IC to produce the wished frequency which VCO Provides through loop filter.

TB31202FN is one packaging two systems prescaler and PLL for receiver and Transmitter.

It has internal counter using 21.25MHz reference frequency to make 6.25KHz As reference Signal.

GMRS-1500XTM VCO is selected of U4A analog switch, and then PLL IC Output Port(pin14) is same.

Only FM Radio VCO is used other output Port(pin3) of PLL IC.

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 STB line of CPU.

e) Loop Filter (with FM Radio)

Loop filter is composed of R25,R26,C42,C43. (FM Radio: R80,R81,C133,C134).

And DC voltage with pulse is supplied from 14 pin of PLL IC. At that time

Loop filter eliminates harmonic component in pulse.

It helps VCO,FM Radio 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 1st IF than Rx frequency. It called Low side injection. Second IF is 450kHz. 2nd local oscillator frequency comes to 21.25MHz. GMRS-1500XTM and NOAA is capable of Dual Conversion Super Heterodyne, But FM Radio is only U3 used.

a) RX /TX /FM Radio Conversion Circuit

Rx signal goes to Rx/Tx/FM Radio Rx conversion circuit through FIXED Antenna connector, low pass filter(L1,L2,L3,L4,C2,C3,C4,C5) and GMRS-1500XTM Receiver resonance circuit composed of L10,C64. And FM Radio receiver resonance circuit composed Of L11,C136 . when transmitting, voltage through R1,L21, D2 supplies,D3.D4 of Receive input is short and Tx is on condition. When PIN diode is off in condition of Rx, L10 and C64 resonate serially and make impedance matching at receiver. When the FM Radio mode, C136,L11 make impedance matching, and the other Circuit is VCC off(except for system VCC).

b) Front-End (GMRS-500XTM, FM Radio)

Front-End has Q7 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 Q7 input and output. FM Radio Front-End is composed of Q20,L11,C136.

c) Mixer (GMRS-1500XTM)

Mixer has one base BFQ 67W(Q9) to feature high low noise Feature high Low noise quality. FM Radio is not mixer and audio signal is output of U3 pin14. It has RF signal through L1, L10, SF1 and Q7 RF signal from Local oscillator mixed. It develops 1st IF 21.7MHz. 1st IF goes to 1st IF amplifier Q10 (2SC4083) Base through X-tal filter XF1. IF of mixing signals is selected and taken into X-tal filter.output impedance Of mixer is direct matched with input impedance of X-tal filter. Matching of filter satisfies pass bandwidth of filter, ripple elimination with In pass band, and attenuation characteristic of stop band. X-tal filter is composed of two pole monolithic X-tal filter,8KHz of IF band-Width 8kHz of IF bandwidth R48 is used as impedance matching with 1st IF Amp Q10.

d) IF AMP and Detection (GMRS-1500XTM)

1st IF AMP Q10 supplies IF (U2) mixer input pin16 through output resistor R50 And C89 to need gain in insertion loss of X-tal filter and last stage circuit. Multi-use IF IC makes up of mixer IF AMP. Pin 2nd local frequency enter to pin1. It supplies mixer of internal IC. Mixer output of IC through pin3 passes 450KHz Ceramic filter, supplies 2nd IF amplifier and limits. After 2nd IF AMP has a process of enough gain and AM rejection, it comes to Quadrature detection. Demodulated audio signal by T1(Quad Coil) is amplified And Comes out to pin9. Detected audio signal through R58, C96 and input in audio amp.IC U215 through C97.

e) Squelch Circuit (GMRS-1500XTM)

Noise component of detected outputs has amplification squelch threshold is controlled by Resistor R55,C94,R51,C95,VR1.

Squelch is not operating FM Radio mode.

f) Audio Amplifier (GMRS-1500XTM , FM Radio)

Demodulated audio signal enters to pin3 of U215. After above signal amplifies in U215 pin5 through C243. It comes out to pin5 Then, It reaches at speaker.

5.3 Transmitter

When Tx develops with pressing PTT switch, VCO output amplifies through Q1,Q2 Transmits by antenna through low pass filter.

Tx RF signal produced from Tx VCO is amplified by DRIVER Q2 through C15 and Entered Q1 POWER TR input terminal with final amplification. After this stage, The signal is emitted at antenna through 50 Ω matching circuit to lowpass filter (L1,L2,L3,L4,C2,C3,C4,C5) to eliminate harmonic.

5.3-1 Audio Modulation and Audio Amplification

Audio signal produced by external or internal microphone, limits amplification By IC U206A,206B. It enters to VCO modulation circuit through scrambler IC(U210) And tone IC(U202). And 3KHz low pass filter(U207A).

Max Frequency deviation is adjusted by VR2 keeps noise and audio from entering To VCO at time of TX.

Audio modulation and Audio Amplification has characteristic of 6dB/OCT Pre-emphasis by U207B.

5.4 TEMPERATURE CIRCUIT

Temperature circuit is composed of U209(S-8120ANP).

It is transfer of CPU for sensing temperature from indoor, outdoor.

The measuring analog data read A/D port(pin75),then LCD display by CPU.

5.5 COMPASS SENSORS CIRCUIT

Compass sensors circuit is composed of U211,L201,L202. The output of sensor Circuit is inherently digital, and can be fed directly into a CPU. This Eliminates the need for any signal conditioning or analog/digital interface Between the sensor and a CPU.

2. SPECIFICATION

2.1 GENERAL SPECIFICATIONS

- a) Frequency Range : 462.5625 ~ 462.7250 MHz
- b) Output Impedance : 50 Unbalanced
- c) Modulation Type : 8K50F3E , 8K50F1D(selective calling)
- d) Communication Mode : Simplex
- e) Channel Capacity : 15 channel
- f) Channel spacing : 12.5 KHz
- g) Power : 6.0V(ALCA 1.5V X 4AAA)
- h) Battery Life : ALCA. 1000mAh > about 18hour
NI-MH 600mAh > about 11hour
(Tx:800mA) 5% ,(Rx:150mA) 5% ,(Stand-by 10mA) 90%
- i) Operating Temperature : -20 +60
- j) Dimension Only set 114(H) x 62.5(W) x31(D)mm
Only ANT 70(H)
- k) Weight : 190g (with Battery)

2.2 ELECTRICAL SPECIFICATION

a) TRANSMITTER

- 1) Output power : Max. 2.0 W
- 2) Frequency Stability : ± 5 ppm (-20 +60 °C)
- 3) Modulation Method : FM
- 4) Oscillation Method : PLL SYNTHESIZER
- 5) Max. Frequency Deviation : ± 2.5 KHz (with tone)
- 6) Cooling Method : air-cooling Method
- 7) Conducted Spurious Emission : ≤ -13 dBm
- 8) FM Hum/Noise : ≥ 40 dB(1kHz 60% modulation)
- 9) Distortion : $\leq 5\%$ (1kHz 60% modulation)
- 10) Tx Audio Response : 6dB /OCT ± 3 dB PRE-EMPHASIS(300Hz ~ 2.5kHz)

b) RECEIVER

- 1) Receive Method : Double Super Heterodyne
- 2) Receive Sensitivity : less than -120dBm (12dB SINAD)
- 3) FM Radio Sensitivity : less than -110 (20dB SINAD ,FM:10KHz)
- 4) Weather Sensitivity : less than -120dBm (12dB SINAD)
- 5) Squelch Sensitivity : -120dBm -130dBm (Audio On/Off Point)
- 6) Bandwidth : $> 8.5\text{kHz}$
- 7) Adjacent channel rejection : $< 60\text{dB}$ (12.5kHz)
- 8) Local Frequency Stability : $\pm 5\text{ppm}$ (-20 $+60$)
- 9) Spurious Response : $> 50\text{dB}$
- 10) Audio output : 200mW (Internal 8 Ω load THD 10%) EXt 100mW
- 11) Distortion : $< 5\%$ (1kHz 60% Modulation)
- 12) RX Audio Response : 6dB/OCT $\pm 1/-10\text{dB}$ DE-EMPHASIS (300Hz 2.5kHz)
- 13) S/N Ratio : $< 40\text{dB}$ (1kHz 60% Modulation)
- 14) IF : 1st IF = 21.7MHz
2nd IF = 450kHz
- 15) Local Frequency : 1st Local Frequency = $f_c - 21.7\text{MHz}$
2nd Local Frequency = 21.25MHz