TECHNICAL DOCUMENTS FOR FCC

Model : FRS101
462- 467 MHz Band 14 Channels
FRS (Family Radio Service)
with CTCSS

CONTENTS

CIRCUIT DESCRIPTION

Circuit Composition and Operation Theory

The basic explanation for the circuit composition of FRS101 consist mainly of the one board controlling the analog circuit parts and the digital circuit parts for the other control.

RECEIVER

FRS101 transmission parts is composed in the double conversion system, which has the 1st IF frequency of double 21.7 MHz and the 2nd IF frequency of 450 MHz. With the RF front-end 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.

RF Front-end

The signal received by the antenna will be transmitted to the band pass filter through the antenna switching circuit consisted of CT20, LT4, LT7. The front RF amplifier transistor QR1 consists of the LR5, LR6, CR71, CR72, CR81 input band pass filter and LR2, LR3, CR2, CR7, CR16 output band pass 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.

1st Mixer

The receiver which has been amplifier in the RF frontend is provided to thebase of the 1st mixer QR2. The 1st L/O signal provide from the VCO is supplied to the emitter of Q2 and converted to the 1st IF 21.7 MHz.

1st IF Filter and 1st IF Amplifier

The signal recovered by QR2 to 21.7 MHz, the 1st frequency, change its impedance through C43, L6 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 2nd IF, and changes its impedance again through the RR11. Then signal is infused to QR3, the 1st IF Amplifier. The signal infused to the QR3 is amplified approximately by 20dB in order to acquire the required reception sensitivity, and infused to the IC1 which functions as the 2nd mixer, the 2nd IF amplifier, and the FM detector.

2nd Mixer, and IF, FM Detector (IC101)

The received IF signal of 21.7 MHz, which has been infused to IC1 is mixed with the 2nd L/O converted to 450KHz, the 2nd IF frequency. The receiver signal converted to the 2nd IF signal frequency passed through the CF2, the ceramic filter of 450 KHz again. After the limiting inside the IC1 and the FM demodulating by the quadrature detector inside the IC1, the signal offers the output through the 9th oin of IC1.
The squelch circuit is composed to detect the noises from the received signal demodulated in the 9th pin of the IC1. For this purpose, the noise filter is using the OP amplifier inside the IC1.

Audio Power Amplifier (IC102)

The received audio signal, which has been filtered by U4, U5 and adjusted to the appropriate volume by MCU, QR5, QR6, QR7 supplied to the 4th pin of the U6 and amplified approximately by 20dB. Then, it turns up the speaker with the maximum output of 1000mV. The 1st pin of U6 is the speaker power control. If a voltage supply to the 1st pin of U6 is supplied to this terminal, the U6 stops functioning as the audio power amplifier regardless of the signal supplied to the 4th pin of U6, and there is no sound can hear from the spaker.

TRANSMITTER

Pre-emphasis(U5)

The voice signal input from the microphone is pre-emphasized at the U5C. The signal which comes out of the U5A is limited to a certain amplitude for the voice signal not to exceed the allowable bandwidth assigned for transmission.

TXPower(QT3)

The transmitted signal of approximately 7mW, combined at the driver TR is supplied to the base of QT3 amplifier. The transmitted signal amplifier to 0.4 W here passes the TX LPF of the 2nd characteristics of the LT4and LT5, and RX/TX switching takes place by DT2. After this, the signal is provided to the antenna through thr TX LPF of the 1st characteristics consisted of the LT10.

"FRS' FREQUENCY SYNTHEIZER

Voltage Control Oscillator (VCO)

The VCO oscillates 462.5625 MHz to 467.7125 MHz under the transmission condition and 440.8625 MHz to 446.3125 MHz under the reception condition. The RX/TX VCO consist of the oscillator of the QT13, LT13, DT10, DT11 and QS12. VCO should oscillate relatively low frequency during reception compared to transmission, the DT10 is biased by the QS12. Therefore as a result, the C232 is added in parallel to the resonance circuit of the VCO to oscillate a low frequency. During transmission, a relatively high frequency should oscillate compared to reception. Therefore, the DT is adversely biased by the QT10, and as aresult, the C232 which is added unparalled to the circuit of the VCO is removed to oscillate the desired transmission frequency.

The VCO is controlled by the IC4 PLL IC in order to oscillate accurate frequency. The output frequency of the VCO is supplied to the IC4 PLL IC immediately. At the IC4, TCXO(21.25MHz) is compared to the output frequency of the VCO. The VCO is controlled is controlled the loop filter consisted of the RL4, RL5, CL4 , CL5 and the RL6, C230, LT12 in order to oscillate the stable frequency wanted for the radio.

The VCO is controlled voltage which as passed the loop filter is supplies to the DT11 varactor diode, and the VCO and oscillate the PLL programmed frequency by the capacity variance in the DT10. In addition, the LT13 on the VCO circuit function as frequency for the VCO to be properly controlled by the IC 4 PLL IC.

PLL Frequency Synthesizer (IC4)

The PLL Synthesizer of the signal loop PLL circuit with the reference of 6.25KHz. The IC4 PLL IC includes all the function such as the reference oscillator, the driver, the phase detector, the lock detector, and the programmable divider. At the reference oscillator, the 21.25 MHz TCXO is connected to the pin 11 of the IC 4 to oscillate the frequency of 21.25 MHz. The TCXO (21.25MHz) is the temperature compensation circuit to maintain the frequency within the allowable error range even under a low temperature of -30°C. The phase detector send out the output power to the loop filter through 3rd pin of IC4. If the oscillation frequency of the VCO is low compared to the reference frequency, the phase detector send out output power in positve pulse. If the oscillation of the VCO is high, phase detector send out can maintain the frequency set. The programmable divider maintains the desired frequency with control fro the CPU. The dividing ratio, "N" to oscillate the desired frequency is as follows:

N = VCO oscillation frequency / reference frequency

If the desired frequency is 462.5625 MHz

a) TX
N = 462.5625 MHz / 0.00625 = 74010

b) RX
N = [462.5625 MHz -21.7MHz] / 0.00625 = 70538

ALIGNMENT PROCEDURE

1. TRANSMITTER

Note : Power Supply Voltage
The power supply voltage should be set to 4.5 VDC measured at the radio during transmit. Periodically check the supply voltage during the alignment procedure.

1.1 TX VCO Adjustment

a. Connect the DC Voltmeter to the test point 1 (TP1)
b. Press the PTT Button.
c. Adjust LT13
d. Specification : 1.0VDC +/- 0.3 V @ CH1

1.2 Frequency Adjustment

a. Connect a frequency counter to the Antenna terminal.
b. Press the PTT switch.
c. Adjust the CTX1 such that output frequency is equal to the channel frequency.
d. Release the PTT switch.
e. Specification : TX Frequency +/- 200 Hz

1.3 TX Power Check

a. Connect the RF Level meter to the Antenna terminal (RF Impedance : 50 Ohms)
b. Press the PTT switch.
c. Check the TX Power
d. Release the PTT switch.
e. Specification : 350mW but not greater than 500mW

1.4 Max. Deviation Adjustment

a. Connect the deviation meter to the Antenna terminal.
b. Apply the audio signal 1 KHz, 4mVrms to the test point at Mic input.
c. Press the PTT switch.
d. Adjust the audio generator level to 100 mVrms.
e. Adjust RV3 for maximum deviation.
f. Release the PTT switch.
g. Specification : 2.3 KHz +/- 0.2 KHz

1.5 Modulation Sensitivity Adjustment

a. Connect the deviation meter to the Antenna terminal.
b. Apply the audio signal 1KHz, 8mVrms to the test point at Mic input.
c. Press the PTT switch.
d. Adjust RV3.
e. Specification : 0.9 to 1 KHz

1.6 Call Data Modulation Sensitivity Check

a. Press the Call Button and observe the deviation meter to check the deviation.
b. Specification : 1.8 KHz +/- 0.5KHz

2. RECEIVER

Note: Insure that the proper channel has been selected before proceedings with the alignment procedure.

The proper voltage for testing is 4.5 VDC.

2.1 RX VCO Check

a. Connect the DC Voltmeter to test point 1 (TP1)
b. Check the DC Voltage
c. Specification : 1.2 VDC +/- 0.3 @ CH1

2.2 RX Sensitivity Check

a. Connect an RF signal generator or Communication Service Monitor to the antenna terminal.
b. Connect a SINAD meter and oscillocope across the speaker terminals with 8 Ohms load.
c. Set the output level of the RF signal generator for -47 dBm, the generator should be set for +/- 1.5 KHz deviation of a 1KHz tone.
d. Reduce the output level of the RF signal generator to produce a 12 dB SINAD indication.
e. Specification: < -116dBm

2.3 Squelch Sensitivity Check

a. Connect the Scope Channel 2 to the squelch Test Point
b. Follow procedure a to d of RX Sensitivity Check.
c. Observe the scope monitor DC changing point.
d. Specification : <-116dBm

2.4 Speaker Out Level Check

a. Connect the Audio level meter to speaker out test point
b. Connect the 8 ohms load to speaker terminal out test point
c. Press the volume button till its maximum level.
d. Adjust the modulation deviation of RF signal generator.
e. Check the clipping start deviation and level
f. Specification: 1000 mV +/- 300 mV

3. OTHER PARAMETER CHECKING

3.1 Low Battery Detect Voltage Check.

a. Change the voltage until the Battery icon flashing on the LCD.
b. Check the voltage
c. Specification : 3.2 Vdc +/- 0.2V

FREQUENCY TABLE

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	462.5625	8	467.5625
2	462.5875	9	467.5875
3	462.6125	10	467.6125
4	462.6375	11	467.6375
5	462.6625	12	467.6625
6	462.6875	13	467.6875
7	462.7125	14	467.7125

SUB-FREQUENCY TABLE

CTCSS Channel	Frequency (Hz)	CTCSS Channel	Frequency (Hz)	CTCSS Channel	Frequency (Hz)
1	67.0	14	107.2	27	167.9
2	71.9	15	110.9	28	173.8
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	0	No Tone