

6. THEORY OF OPERATION

Circuit Composition And Operation Theory

The basic explanation for the circuit composition

KF-2200 consists mainly of the two boards controlling the analog circuit parts and the digital circuit parts for the other control.

Receiver

KF-2200 receiving parts is composed in the double conversion system, which has the 1st IF Frequency of 21.4MHz and the 2nd IF frequency of 455KHz. With the front end circuit which has an excellent band characteristics and skirt characteristics, the 1 pole MCF used in the 1st IF, and the pole ceramic filter in the 2nd IF, the reception interruption 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 front end through the antenna switching circuit consisted of L101, L102, C102, C103 and D101(PIN DIODE). The front end consists of the RF amplifier transistor Q250 and input/output band pass filter. The input/output band pass filter has the bandwidth of approximately 10MHz, 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 signal which has been amplified in the RF front end is provided to the base of the 1st mixer Q2. The 1st L/O signal provided from the PLL circuit is supplied to the emitter of Q2 and converted to the 1st IF 21.4MHz.

1st IF Filter and 1st IF Amplifier

The signal covered by Q2 to 21.4MHz, the 1st IF frequency changes its band and is infused to the fundamental MCF which has center frequency of 21.4MHz and the bandwidth of +/-3.75KHz.

Here, the signal reduces the image and other unwanted signal for the 2nd IF, and changes its impedance again through the L6 and C10. Then the signal is infused to the Q3, the 1st IF amplifier. The signal infused to the Q3 is amplified approximately by 20dB in order to acquire the required reception sensitivity, and is infused to the IC101 which functions the 2nd mixer, the 2nd IF amplifier, and the FM detector.

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

The receiver IF signal of 21.4MHz, which has been infused to IC101 is mixed with the 2nd L/O signal of 20.945MHz, and converted to 455KHz, the 2nd IF frequency. The receiver signal converted to the 2nd IF frequency passed through the CF3, the ceramic filter of 455KHz again. After the limiting inside the IC101 and the FM demodulating by the quadrature detector inside the IC101, the signal offers the output through the 9th pin of the IC101.

The squelch circuit is composed to detect the noises from the received signal demodulate in the 9th pin of the IC101. For this purpose, the noise filter is using the OP amplifier inside the IC101.

De-Emphasis and 300Hz HPF(IC401)

The audio signal which has been FM demodulate in IC101 is supplied to the IC401 which function as the De-emphasis and 300Hz HPF.

Since the IC401D has the 300Hz HPF with the 1st characteristics and the DE-emphasis characteristics with the corner frequency of approximately 200Hz, and the IC401A, the IC401B, and the IC401C has the 300Hz HPF with the 6th characteristics, they function as a normal DE-emphasis and also reduce the signal such as CTCSS to avoid unwanted noises from the speaker.

Audio Power Amplifier (IC403)

The received audio signal which has been adjusted to the appropriate volume in the VR1 are supplied to the 2nd pin of the IC402 and amplified approximately by 20dB. Then, it turns up the speaker with the maximum output of 0.3Watts.

The 7th pin of the IC402 is the audio mute terminal. If a voltage supply to the 7th pin of the IC402 is not supplied to this terminal, the IC402 stops functioning as the audio power amplifier regardless of the signal supplied to the 6th pin of the IC402, and there is no sound emitter from the speaker.

Transmitter

The transmission part of the KF-2200 is designed to amplify the RF signal oscillated and modulated by synthesizer to approximately below 500mw(ERP) by the power transistor of Q101.

Pre-emphasis and VOX Operation (IC301)

The voice signal input from the microphone is pre-emphasized the at IC301A. The signal which comes out of the IC301B is limited to a certain amplitude for the voice signal not to exceed the allowable band width assigned for transmission.

Voice signal is input through microphone. This amplified signal flows into IC301C and IC301D, and its output is converted to either ON or OFF by hi/+ and low +/- terminals of IC301D. Then it activates 'VOX' function with Q304 and Q305.

TX Power

The transmitted signal of approximately 7mW. combined at the PLL module is supplied to the base of the Q102 amplifier. The transmitted signal amplified to 0.4 Watts here passes the TX LPF of the 2nd characteristics of the L104 and the L103, and RX/TX switching takes place by the D102. After this, the signal is provided to the antenna the TX LPF of the 1st characteristics, consisted of the L101.

TX CTCSS Tone Processing

The TX CTCSS Tone composed at the IC502 CPU is properly reduced at the R516, R519, R520, R521, R522, R524, IC405, IC406 and supplied to the IC402 Switched Capacitor Filter to reduce enough the components in the high frequency which can affect the voice signal through the IC405, IC406 CTCSS Tone Filter and supplied to the RV401 TX Dev iation

Frequency Synthesizer

Voltage Control Oscillator (vco)

The VCO of the KF-2200 oscillates 462.5625MHz under the transmission condition and 441.1625MHz under the reception condition. The VCO consists of the colpitt oscillator of the Q202, and contains the oscillator frequency of approximately 21.4MHz during the transmission / reception conversion. That is since the VCO should oscillate relatively low frequency during reception compared to transmission, the D201 is directly biased by the Q203.

Therefore as a result, the C208 is added in parallel to the resonance circuit of the VCO to oscillate a low frequency. During transmission, a relatively high frequency should be oscillate compared to reception. Therefore, the D201 is adversely biased by the Q203, and as a result, the C208 which is added in parallel to the resonance circuit of the VCO is removed to oscillate the desired transmission frequency.

The VCO is controlled by controlled by the IC102 PLL IC in order to oscillate the accurate frequency. The VCO is controlled by the IC102 PLL IC in order to oscillate accurate frequency. The output frequency of the VCO is supplied to the IC102 PLL IC immediately. At the IC102, TCXO(12.8MHz) by the TCXO is compared to the output frequency of the VCO. The VCO is controlled through the loop filter consisted of the R122, C130 and the C131 in order to oscillate the stable frequency wanted for the radio. The VCO controlled voltage which passed the loop filter is supplies to the D202 varistor diode, and the VCO an oscillate the PLL programmed frequency by the capacity variation in the D202. In addition, the L202 on the VCO circuit function as frequency for the VCO to be properly controlled by the IC102 PLL IC.

RX/TX Buffer Amplifier (Q105, Q106)

The RF signal oscillate at the VCO is provide to the Q2 RX 1st mixer through the Q106 during the reception, and is provide to the Q102 power driver amplifier through the Q105 during the transmission.

PLL Frequency Synthesizer (IC102)

The PLL synthesizer of the KF-2200 consists of the signal loop PLL circuit with the reference of 6.25KHz. The IC102 PLL includes all the functions as the reference oscillator, the driver, the phase detector, lock detector, and the programmable divider.

At the reference oscillator, the 12.8MHz TCXO of the TCXO is connected to the pin 11 of the IC102 to oscillate the frequency of 12.8MHz. The TCXO(12.8MHz) is the temperature compensation circuit to maintain the frequency within the allowable error range even under a low temperature of -20°C.

The phase detector send out the output power to the loop filter through 3rd pin of the IC102. If the oscillation frequency of the VCO is low compared to the referenced frequency, the phase detector sends out the output power in positive pulse. If the oscillation frequency of the VCO is high, phase detector sends out the output power in negative pulse. Therefore, the VCO can maintain the frequency set.

The programmable divider maintains the desired frequency with the control from the CPU. The dividing ratio, "N" to oscillate the desired frequency is as below :

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

If the desired frequency is 462.5625MHz

$$N = 462.5625\text{MHz} / 0.00625\text{MHz} = 74010$$

CPU

controlled by the IC502 CPU. The IC502
e, and the program for the operation of
own switch programed in cpu

Most of the control function of the KF-2200 are controlled by the IC502 CPU. The IC502 CPU has the internal ROM in the capacity of 8Kbyte.

This cpu control the 14channel display by up and down