21-1803 FRS circuit description

RF Receiver Board

A. Basic Principle of Receiver Board

The receiver board employs the traditional double conversion superheterodyne method. It mainly consists of a LNA (low noise amplifier), a LO(local oscillator), a mixer, a IF (intermediate frequency) amplifier and a FM-IF demodulation IC.

The LNA,which is composed by transistor Q203 and Q201, is using cascode configuration with the merits of having low noise figure, highly stabilized and high insertion gain.

The LO, which is composed by Q206 and crystal X201, is using a standard Clopitt configuration. The signal is then slightly coupled to the mixer.

The first image rejection filter is a SAW (surface acoustic wave) device, with the merits of having low insertion loss and high stop band attenuation.

The mixer is a common emitter configured transistor Q204.

When the RF signal is filtered and mixed with the LO signal, the IF signal output from the mixer will further be filtered by the crystal filter FIL201.

The IF amplifier, Q205, is used to further amplify the filtered IF signal before inputting to the FM-IF (IC3361) chip.

Inside the FM-IF chip, the IF signal is further down converted to 455kHz second IF for demodulation. The second LO frequency is controlled by the 20.945MHz tuning type crystal. The second IF is also further filtered by the ceramic filter for better adjacent channel rejection response. The second IF signal is then demodulated by the quadrature coil L213 and the demodulated audio signal is fed the main board for further processing.

Main Board

A. Basic Principle of Main Board

The main board of FRS 1803 mainly handles the baseband signal including audio signal amplification, transmitting signal modulation, CTCSS tone encoding and decoding etc.

It receives the baseband signal from the receiver board and the MCU U309 would control the analog switch U301 and switch-capacitor-filter U302 for CTCSS decoding. Besides, the baseband signal will pass through the high pass filter which is realised by op-amp U303 before inputting to the audio power amplifier U304 to the speaker.

The design circuitry includes transforming audio signal to modulate the RF carrier. The audio signal picked up from the microphone would be pre-emphasised first. The pre-emphasised audio signal would be further amplified and level limited. The limited signal would pass through a low pass filter in order to comply with the FCC modulation standard. All these circuit is realised by the op-amp U307.

The FRS 1803 has a build-in call tone function and the call tone is generated by the audio transistor Q310 with simple RC feedback network.

For the FRS CTCSS encoding signal, the sub-audio tone is generated by the MCU. The CTCSS tone generated by the MCU is in square wave form, hence it need to be low-passed before modulating the RF carrier, otherwise user may hear some background noise which is the harmonics of the CTCSS tone. The low pass filter for the CTCSS tone encoding also employs the switch-capacitor filter to perform the filter function.

All the tact switches are directly mounted on this main PCB, they includes all the monitor, PTT and call functions which is handled by the MCU.

Transmitter Board

A. Basic Principle

The transmitter board consists of three sections. Q101 forms the first section as a crystal oscillator. The crystal frequency is calculated by divding six times the transmitted frequency. That is, crystal frequency is 77.093 MHz. The crystal's load capacitance should be infinity. Q102 is the driver stage. Matching of this stage comes from L103 -- L107 and the coupling capacitors. The final stage is the power amplifier Q103. The output power is about 21~ 22 dBm. Frequency adjustment of the crystal is controlled by CV101. The required frequency is 462.5625MHz ± 200Hz. FM modulation comes from varying the capacitance of varactors VD101 ~ VD103.