21-1856 FRS circuit description

VCO

21-1856 is a single board design with a VCO module on it. The VCO circuit composes of a common configuration Colpitts oscillator. 1 RF transistors Q203 realise the configuration., the resonating element is a wire wound type air coil L203. By controlling the bias voltage of varactor diode VD201(and hence the capacitance), the resonating frequency of the oscillator will then be under controlled. The VCO had a tuning range of about 35MHz which will be used as both transmitting carrier and receiving LO. The transistors Q211,Q212 serves as a buffer amplifier to the VCO which can improve the load-pull characteristics of the oscillator.

A. Main Board

The main PCB consists of TX, RX , baseband and all the necessary control circuitry. Basically RF and baseband circuit are subdivided into two parts. The RF portion are put on the upper half of the PCB and remaining lower half PCB will be the baseband and MCU circuitry.

A: RX section

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

The LNA, which is composed by transistor Q17 and Q18, is using cascode configuration with the merits of having low noise figure, highly stabilized and high insertion gain.

The LO signal is generated by the VCO module as mentioned before. The LO frequency is controlled by the PLL (phase locked Loop) chip KB8825 The reference frequency of the PLL chip is 10.25MHz which is generated by the TCXO X2, the frequency of the VCO is stabilized within 2.5ppm from -20 to 50 degree C.

The first image rejection filter, F1, is a SAW (surface acoustic wave) device, with the merits of low insertion loss and high stop band attenuation.

The mixer is a common emitter configured transistor , Q20. It converts the RF signal to an IF of 10.7MHz. This IF will further be filtered by the ceramic filter F3.

Inside the FM-IF chip, the IF signal is further down converted to second IF at 450 kHz for demodulation. The second LO signal is generated by the reference oscillator of the PLL chip. 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 L4. The demodulated audio signal will be de-emphasised and input to the audio amplifer , U5 to drive the speaker. The ON/OFF and sound level of the speaker is controlled by adjusting the variable resistor SW4.

Lastly, the Squelch level of the unit is controlled by adjusting (VR2) the demodulated noise level to the internal op-amp of the FM IF chip 3361.

B: TX section

The TX carrier is also generated by the VCO module with the control from PLL chip. The VCO signal is coupled to amplifier Q10. The amplified signal from Q10 will feed to the driver stage by Q12. The output signal will be generated by the class-C power amplifier Q14 and Q15. The harmonic of the carrier will be suppressed by the low-pass filter realised by L13, L15, L8, L1 and the nearby capacitors.

C: Baseband Section

The operating voltage of the circuit is stabilised by the voltage regulator U4. Since this product is a three channel selectable device, either CH1 or CH2 or CH8 is selected by the slide switch SW5. The demodulated audio signal will go through the de-emphasis process before feeding to the audio amplifier and the volume is controlled by adjusting VR SW4.

The acoustic input picked up by the microphone will be pre-emphasised, amplified and level limited by U7B. The audio signal will be then band limited by U7A. Before modulating the carrier, this signal amplitude is controlled by the variable resistor VR1.

The baseband signal is mainly controlled by the audio amplifier U5, op-amp U7 and the MCU U3. In order to have a longer battery life, power management is inevitable. Under normal or stanby circumstances, the MCU will be in RX mode for a short moment with speaker muted to check whether we need to turn on the speaker to alert the user. However, in most of the time, the MCU will shut down the whole unit to save power. As a result, by turning on and off the units with different duty cycle, the current consumption can be saved to extend the battery life.

The low battery detection circuit is realised by the op-amp U7C. Since the op-amp U7 has 4 internal individual stage, the modulation limiter and pre-emphasis is realised by U7B and U7A respectively. .

21- 1856 has 3 external keys for PTT, Monitor and Call function. Once the PTT is pressed, the MCU will generate a beep tone to the speaker to alert the user the unit is under TX mode. When the Call key is pressed, a MCU generated dual tone signal will modulate the carrier to alert the recipient. The maximum duration of each call tone is 5 seconds less than 15 seconds as required by FCC. When the Monitor key is pressed, the unit will be forced to RX mode to monitor any signal exists in the air.