Circuit Description

1. Frequency Configuration

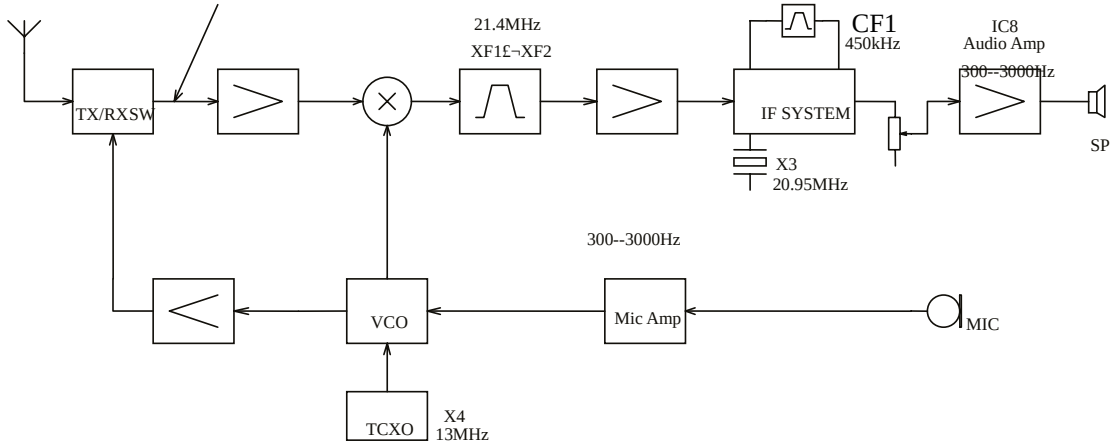

Figure1 Frequency Configuration

This radio adopts the 2nd Mixer, the 1st IF 49.95MHz, the 2nd IF 450kHz.
The receiver's first local oscillation is generated by the frequency synthesizer. The second local oscillation is generated by the crystal oscillator.
The transmitter signals are generated by frequency synthesizer.
The reference frequency of frequency synthesizer is generated by TCXO.

2. Receiver (RX)

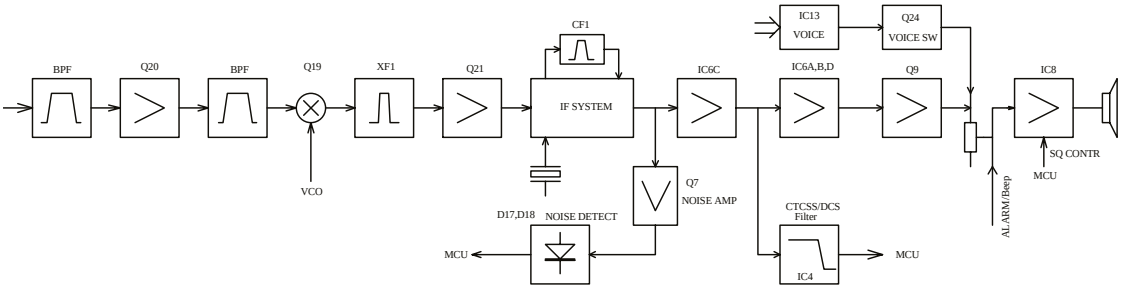

Figure 2 Receiver Illustration

The Receiver Front Terminal
Signals from the antenna pass through the RX/TX switch (D1, D2, D4, D5); and then undesirable out-of-band signals will be filtered out at the band pass filter (BPF) consisting of C227, L8, L15, C70, C126, C218, L9, C217, L10, C127; then signals are amplified at the low noise amplifier (LNA) consisting of Q20 and its peripheral components.

The output from the LNA passes the BPF consisting of L5, L6, L7, C228, C124, and C132 for filtering and then is sent to the first grade frequency mixer (Q19).

MCU produces output voltages and alters the capacitance of the variable capacitor diodes D21, D22, D23, D24, D26, D30 to control the center frequency of the band-pass filter.

The First Frequency Mixer

After mixing the receiving signals and the first local oscillation signals from the frequency synthesizer, the 1st IF signals （49.95MHz）are generated. The first IF signals pass the crystal filter (XF1, XF2) , which will filter the signals of adjacent channel and those out of band.

IF Circuit

The 1st IF signals from the crystal filter are amplified at the first IF amplifier (Q21), and then are sent to the IF processing IC (IC5, MC3361). The IF IC consists of the 2nd frequency mixer, the 2nd local oscillator, IF amplifier, limiter, phase frequency detector, and noise amplifier.

IC5 inner circuit and X3 (49.5MHz) compose the 2nd local oscillator. The 2nd local oscillation (49.5MHz) and the 1st IF signal (49.95MHz) are mixed at IC5 to generate the 2nd IF（450MHz）.

After the 2nd IF signal is amplified and its amplitude is limited at IC5, and then filtered at porcelain filter (CF1,450kHz), IC5 demodulates and sends out audio signals.

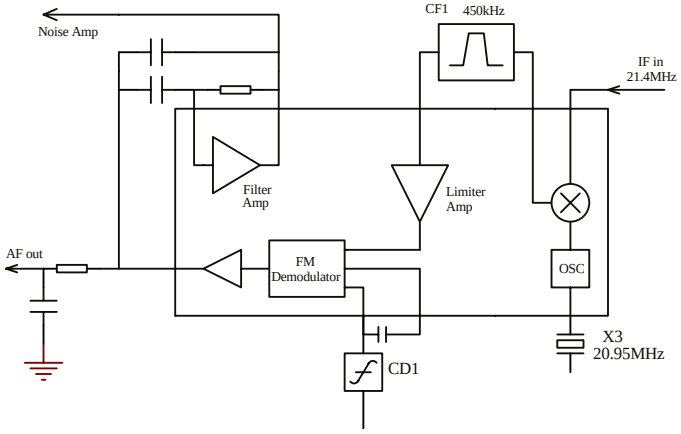

Figure 3 IF System

Receiver Audio Signal Processing

IC6 and its peripheral circuit compose the receiver audio signal processing circuit. IC5 sends audio signals to IC6-C for amplification, and then to IC4 (CTCSS signaling filtering circuit) and IC6-D. After the signals are amplified, de-emphasized, filtered at IC6 and other cells, the HF (high frequency) and LF (low frequency) will be eliminated, and the remaining 300-3000Hz audio is sent to Q9 for amplification and then to volume potentiometer for adjustment and finally sent to the audio amplifier (IC8).

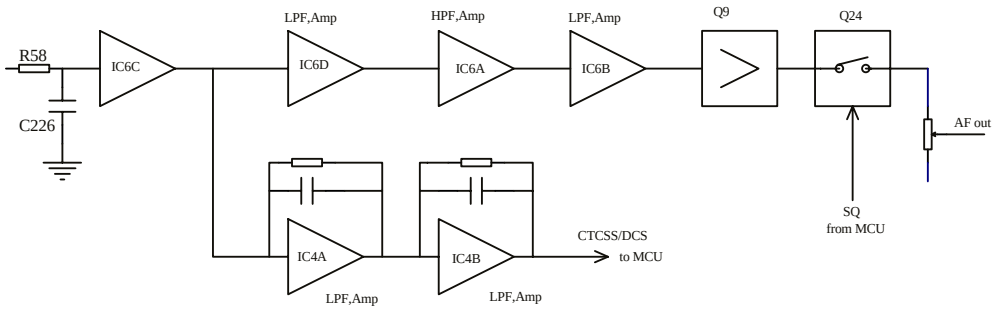

Figure 4 Receiver Audio Processing

Squelch Circuit

Demodulation output from IC5 is sent to the selection frequency noise amplifier, which consists of IC5 inner noise amplifier and C107, R124, R152, C33, and C35, to be filtered off the noise. After being amplified at Q7, noise is sent to D17 and D18 for wave checking and then sent to MCU, which determines the noise volume to control the squelch.

Audio Amplifier

IC8 and peripheral components construct the audio amplifier.

Receiving audio signals, voice indication signals, indication tone signals and warning tone signals are collected for audio amplification to drive the speaker. Warning tone has no volume control.

When AFCO is at the high level, Q37, Q8, Q33, and Q38 will be connected, and IC8 starts working and voice comes out from the speaker.

Q36: Receiving audio signal switch

Q35: Warning tone switch

Q25: Indication tone switch

CTCSS Signal Filtering

The IC5 demodulated output audio signals may contain CTCSS (continuous tone coded squelch system) and DCS (digital coded squelch). The frequency spectrum of CTCSS/DCS is 2-250Hz. The filtering circuit constructed by IC4 can filter out the signals out of the CTCSS/DCS frequency spectrum to ensure MCU to decode CTCSS/DCS more precisely.

3. Transmitter (TX)

Transmitter Amplifier

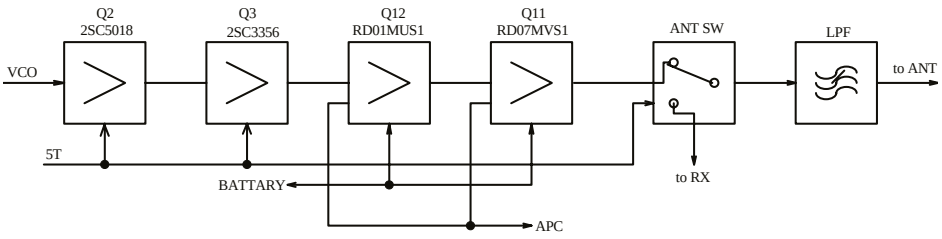

Figure 5 Amplifier and Antenna Switch Diagram

The modulated signals from VCO are amplified at Q2, Q3, and Q12 and then are sent to Q11 for amplification. Q11 output power: 4.5W.

The Q11 and Q12 gate offset is controlled by APC circuit. Changing gate-offset voltage can control the transmitter output power conveniently.

APC (Auto Power Control)

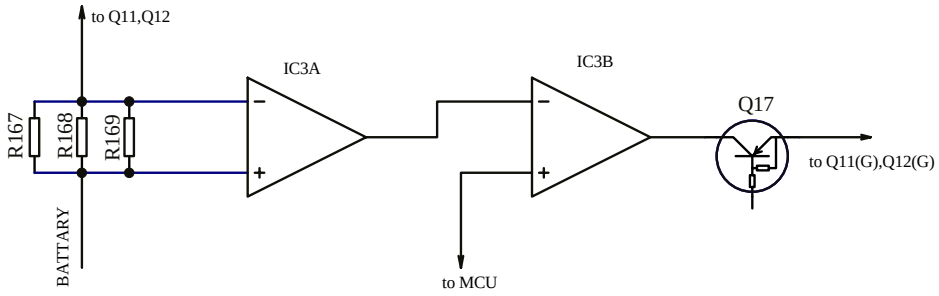

Figure 6 APC Circuit

R167, R168, and R169 are the amplifier current checker; IC3A is the sample amplifier of the amplification current; IC3B is the power comparison amplifier.

If the transmitter output power is too big, the amplifier current will increase, IC3A output will mount, IC3B output voltage decrease, the offset voltage added to Q11 and Q12 will decrease, and then the transmitter output power will decrease. Vice versa, such can ensure steady transmitter output power in different working circumstances.

MCU changes the input power to IC3B to set the power.

Transmitter Audio Signal Processing

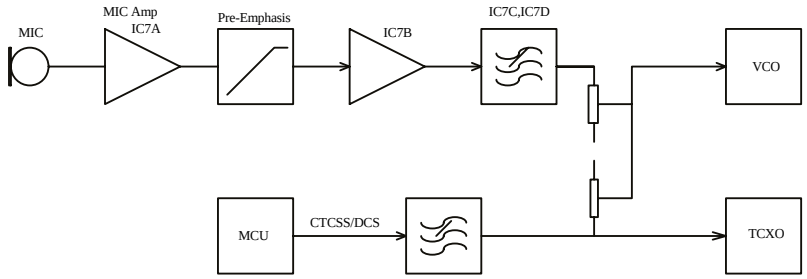

Figure 7 Transmitter Audio Circuit

IC7 and the peripherals components construct the transmitter audio processing circuit. After the audio signals from MIC are amplified, the amplitude of them is limited, and are filtered, they are sent to VCO together with CTCSS/DCS for modulation.

D13, D308, and Q24 constitute AGC circuit which decreases signal amplitude to avoid signal distortion when MIC signal is too big.

Q34 is the power switch of audio processing circuit. It supplies power to IC7 only when in transmitting and it is controlled by MCU.

J2 is the external MIC socket. When external MIC is used, the inner MIC will cut off

automatically, but PTT will remain activated.

4. Frequency Synthesizer

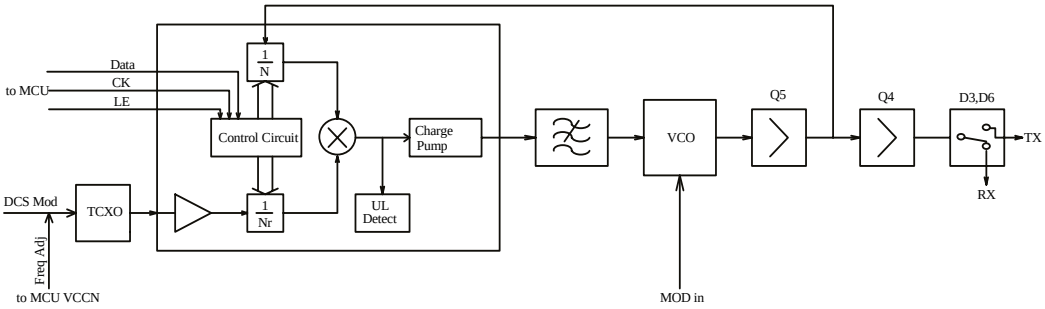

Figure 8 Frequency Synthesizer

The radio adopts PLL (Phase Locked Loop) frequency synthesizer.

The frequency synthesizer consists of standard oscillator, voltage controlled oscillator (VCO), programmable frequency demultiplier, phase comparator, and low pass filter.

Q14, L30, C120, C88, C142, C180, D8, and D9 constitute RX VCO. D12 is the modulation circuit of VCO.

ICI (MB15E03) is PLL integrated circuit, including programmable reference frequency demultiplier, programmable swallowing frequency demultiplier, phase comparator, and charge pump.

R244, c193, R202, R40, C207, R141, C205, R2, and C204 construct the low pass filter.

The standard frequency is supplied by X4 (TCXO, 13MHz).

The standard frequency fromTCXO (Temperature Control Transistor Oscillator) are demultiplied by the programmable reference frequency demultiplier at IC1 to acquire 5kHz or 6.25kHz reference frequency (controlled by MCU according to the preset channel frequency).

The oscillation frequency from VCO is sent to IC1, and demultiplied by swallowing frequency demultiplier and compared with reference frequency to acquire the error signals. Then pass the low pass filter and are sent to VCO to change VCO oscillation frequency to the preset value, and then VCO is locked.

$N=F_{VCO}/F_R$

N： Frequency demultiplication times

F_{VCO}： VCO oscillation frequency

F_R： Reference frequency

Check Loss of Lock: When PLL is in loss of lock, IC pin14 sends out low level signals to MCU, which controls the transmitter not to transmit and initiate warning tome.

Q6: Power filter to supply more pure power to reduce the noise of the frequency synthesizer.

5. Voice Indication Circuit

The radio features voice indication, which is very useful at night or in the environment of dim light.

IC15 is a voice memory chip which stores the voice indication of channels, and every time you change the channel, the speaker will sound voice annunciation of the current channel number.

Press voice annunciation key will repeat the voice annunciation of the current channel number.

If the voice annunciation function has been set, press “voice annunciation” key in the stand by mode and the speaker will sound voice annunciation of the current channel number. If turn on the radio again with the “voice annunciation” key pressed, the voice type will be changed. Repeat turning on the radio with the “ voice annunciation” key pressed, the voice type will change in the sequence “Chinese Male--- English Male--- Chinese Female --- English Female ---- No Indication”.

6. Power Supply

The radio is equipped with 7.4V, 1200mAh Li-Ion battery. The battery supplies power directly to the transmitter amplifier circuit (Q11, Q12) and the receiver amplifier (IC8). The power supply of other circuits is the regulated 5V power.

IC12: 5V low voltage difference, micropower regulator, together with Q10, and Q30 supply big current 5V power to the whole radio.

Q29: 5T switch, controlled by MCU.

5T: Supplies power for the front terminal of the transmitter.

Q31: 5R switch, controlled by MCU.

5R: Supplies power for the receiver RF amplification, mixing, IF processing, audio signal processing.

Q32: 5C switch, controlled by MCU

5C: The 5V power controlled by power saving supplies power for the frequency synthesizer.

7. MCU

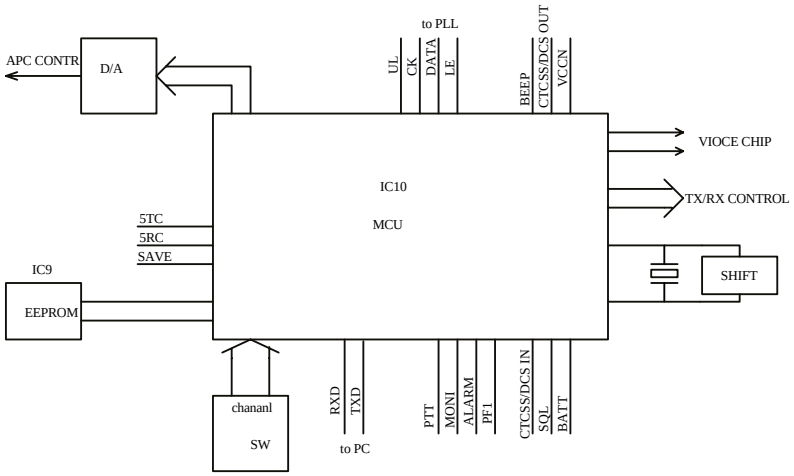

Figure 9 MCU Diagram

MCU controls the working of each unit of the radio to realize all the radio functions.

Connects with the PC

Accesses the radio status data

Controls PLL to generate the receiving and transmitting local oscillation frequency.

Accesses the current channel status.

Controls the LED status indication

Controls the power supply of each location
Checks the action of each function key
Generates CTCSS signals
Generates DCS signals
DCS decoding
Squelch check and control
Controls the content of voice indication

Memorizer （E2PROM，AT24C08）
Memorizes the radio channel data, CTCSS/DCS data, and other data of function setting and parameter adjustment.

CTCSS/DCS Encoding and Decoding
CTCSS/DCS signals generated by MCU (output form pin5) are filtered at R155, R156, C242, and C243, and then sent to VCO and TCXO for modulation.
CTCSS/DCS signals from the receiver are sent to MCU(pin1) for demodulation. MCU determines whether the signals contain the same CTCSS/DCS as that set on the radio and decides whether to turn on the speaker.