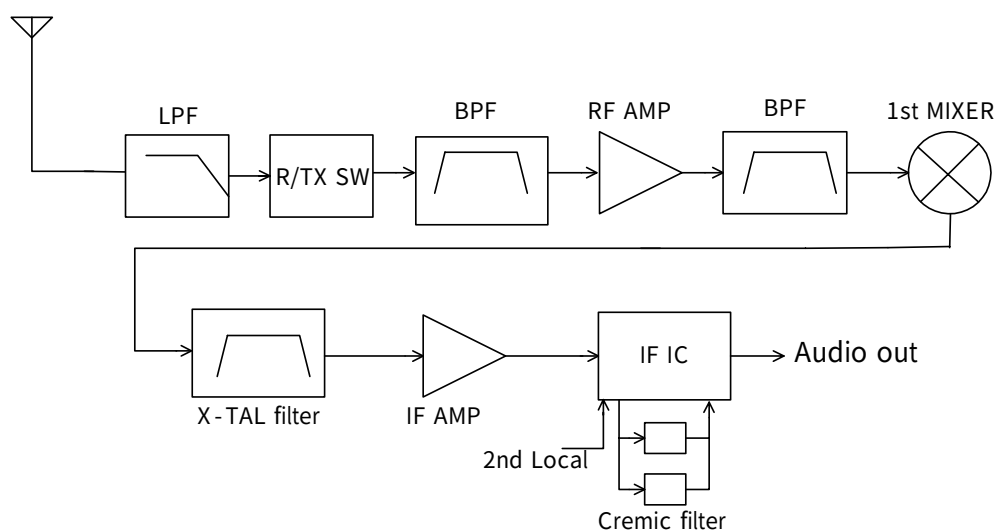


Theory of Operation

1. Overview

PL2415,2215 is VHF handheld transceivers that consist of a receiver, a transmitter, a phase-locked loop(PLL) frequency synthesizer, control circuits and power supply circuits.

2. Receiver system



The receiver is double conversion super heterodyne with 1st IF 45.1MHz and 2nd IF 455kHz

2-1 Front-end

Front-end consists of pre-selector filter, RF Amplifier, Post-selector filter. The receive signal from antenna is applied to band pass filter C72,L6,C143,C43,C51,L18,C144 and routed to an RF amplifier (Q1) after passing transmit/receive switch(D5,6).

The signal from pre-selector is amplified around 13dB at RF amp(Q1) and filtered again by Post-selector before applying to Mixer.

The pre-selector and post-selector is band-shift type filter to remove unwanted signals.

2-2 First mixer

The signal from Front-end is inputted to Q2 base to be heterodyned with 1st local signal generated from VCO to be 1st IF frequency (45.1MHz). The 1st IF frequency is resonated at tank circuit C61,L14and inputted to Pair crystal filter.

2-3 IF Amplifier

The 1st IF signal is amplified about 15dB by IF amp Q3 and inputted to IF IC(IC1) to be mixed with 2nd local frequency (44.645MHz).

1st IF frequency(45.1MHz) and 2nd local frequency(44.645MHz) are mixed in IC1 which makes 2nd IF frequency(455KHz)

The 2nd IF frequency passes through ceramic filter to eliminate undesired signal and demodulated by demodulator in IC1

2-4 AF Amplifier

300Hz High Pass Filter U2 removes all signals under 300Hz to keep any undesired signal from being heard from speaker. After passing through this filter, audio signal is de-emphasized by R55,C91 to get 6db/oct response. The de-emphasized audio signal passes through volume control and is amplified to a sufficient level to drive a loud speaker by IC5 Audio AMP.

2-5 Squelch

IC1 has a filter that passes noise and an internal amplifier that amplifies the noise and make it as DC voltage to control mute system. So if the noise level is under a threshold, the microprocessor in the radio detects the DC level and un-mutes the radio. If the noise level is over a threshold, the microprocessor mutes the radio.

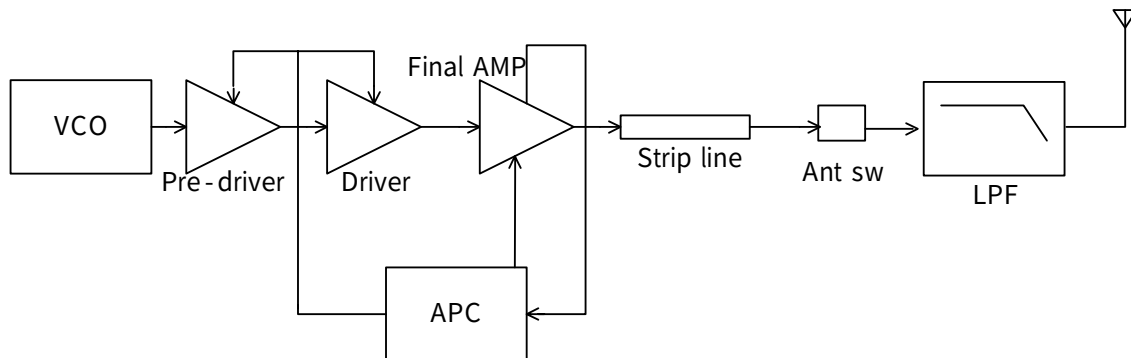
2-6 Audio AMP

After CTCSS,DCS signal is removed at 300Hz High Pass Filter and de-emphasized to – 6 dB/Oct at R55 and C91, the volume of audio signals is controlled by sw/vol1.

IC5 amplifies audio signals from sw/vol1 to a sufficient level to drive a speaker.

IC5 has mute/un-mute function. If port2 is low, the IC goes to active mode. If the port is high, the IC goes to mute mode.

3. Transmitter system



The transmitter consists of Micro phone, Pre-emphasis, Modulator, Drivers, Power Amplifier, Low-Pass Filter, Antenna Switch and Auto-Power Control.

3-1 Micro phone and pre-emphasis

If users push PTT button, the microprocessor activates whole transmitter section including micro phone. The audio signal from microphone passes through high pass filter and amp (U5-A,D) that has 6db/oct pre-emphasis function. The pre-emphasized audio signal is adjusted to a proper level by RV4 and passes through 3KHz low pass filter(U5-B) before being modulated.

3-2 Modulator

The audio signals from low pass filter(U5-B) is applied to D15 varicap diode in VCO to be modulated.

3-3 Drivers

-3dBm TX RF signal from VCO is amplified to around +25dBm by drivers

Q7,8 to have desired output power at final Amp.

Pie style resistor attenuator is used for isolation between VCO and power amps.

3-4 Power Amplifier

TX RF Signal from driver Amps is amplified by final amp Q6, passes through strip line for impedance matching and Low pass filter to suppress unwanted harmonics.

3-5 Low Pass Filter

5th Low Pass Filter reduces the unwanted spurious for TX output power from final Amp.

C184,46,53,11 and L9,10 are Chebyshev Filter.

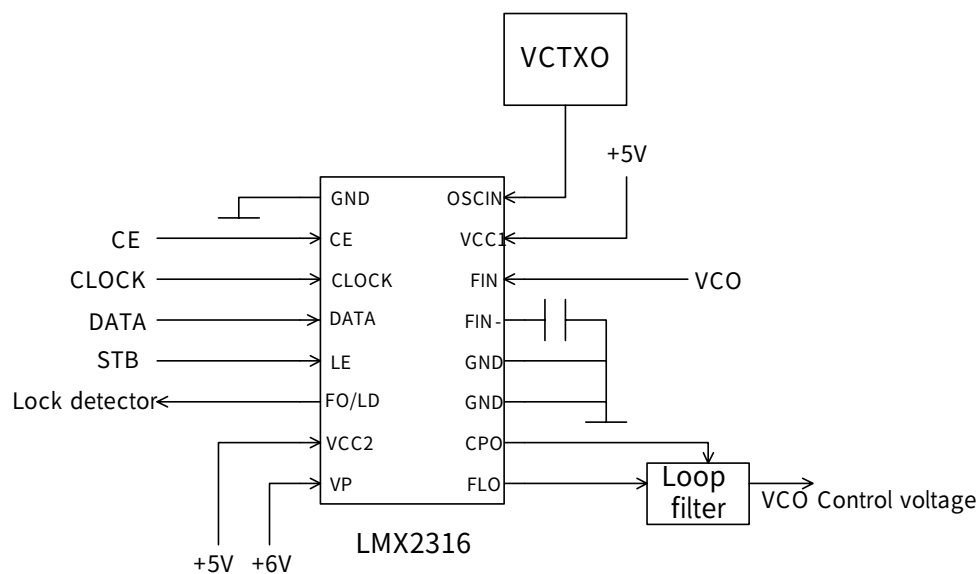
3-6 Antenna Switch

Ant Switch is for TX section and RX to share the antenna. D5,6 is turned on in TX mode and turned off in RX mode.

3-7 Auto-Power Control

This circuit stabilizes TX power at a pre-determined level adjusted by RV5,6. It detects the drain current of final amp Q6. Actually APC detects the current at the drain of Q6 and if the current is changed due to change of battery voltage or load, APC controls gate voltage of Q6 and collector voltage of Q7,8 to keep TX power stable.

4. PLL Synthesizer



Reference frequency is 12.8Mhz VCTCXO(Voltage Controlled Temperature Compensated X-tal Oscillator). So main frequency can be adjusted by changing VCTCXO voltage. The frequency from VCO is applied to IC2 PLL IC and internal phase comparator compares this signal with reference frequency and internal charge pump outputs VCO control voltage though loop filter

5. Audio and Control circuit

IC4 controls all functions of the radio as a Microprocessor.

It detects outer conditions such as pushing PTT, mute/un-mute condition, changing channel etc.. and make the radio operate correctly.

U1 is 250Hz LPF to pass CTCSS,DCS signal and block any other signals. Q24 changes this sub-tone to logic signal so that micro processor can decodes CTCSS,DCS correctly.

U3-A,C are CTCSS,DCS Encode Filter. It mixes signals from 4 ports of microprocessor and this mixed signal passes through this filter to be clear CTCSS,DCS signals.