

Theory of Operation on ML3215 MOBILE Series

The ML32XX MOBILE Radio Transceivers are comprised of one main PCB.

The main PCB contains the transmitter, receiver, and control circuits.

1) Receiver

The receiver circuit adopts dual conversion super heterodyne with 1st IF 45.1MHz and 2nd IF 455kHz

A. Front-end

Front-end consists of pre-selector filter, RF Amplifier, Post-selector filter. The receive signal is routed through C2 and selected by C7, C17, L2, L3, L5, L6 to amplified around 10dB at RF amp. Q1. Front-end adjusts bandwidth by varicap diode tuning.

This circuit removes unnecessarily spurious 1st Image.

B. First Mixer

The signal from Front-end is input to Q6 base of 1st mixer. 1st local signal generated from VCO is input to Q6, emitter. These two signals are mixed at Mixer into 1st IF signal 45.1Mhz, which is resonated in parallel at C42, L13 and inputted to XF1, Pair crystal filter.

C. IF Amplifier

1st IF signal from XF1 is amplified about 15dB at IF amp Q7 and inputted to IC2, IF IC.

2nd Local Oscillator is 44.645MHz. The signal from 2nd Mixer is refined removing unnecessary spurious signal and detected through high gain linear amp. This detected signal is inputted to IC2 pin9.

D. AF Amplifier

300Hz High Pass Filter IC403 removes the signal under 300Hz of the demodulated signal from IC2 so that noise under sub tone use is removed.

De-emphasis functions to get 6dB/oct by R497, C444 and this signal controls volume of sound by VR801.

IC408 can operate a speaker as audio current amplifier amplifying the signal. The operating current can be reduced by mute signal.

E. Squelch

The demodulated signal from IC2 is coupled of noise to C162. The noise

is filtered and amplified by IC7, C65, R29 and rectified by double voltage at D17, C67 and transformed to DC level. And this DC signal is used as the signal to mute VR801 audio.

F. Audio AMP

After CTCSS,DCS signal is removed at 300Hz High Pass Filter and de-emphasized to -6 dB/Oct at R497, C444, the volume of sound is controlled by VR801.

IC408 is doing low frequency current amplify as audio amplifier to operate a speaker.

IC408 has mute function and if Pin 1, mute port is high, it's on mute. If it is low, it's unmute.

2) Transmitter

The transmitter consists of Buffer, Power Amplifier, Low-Pass Filter, Antenna Switch, Auto-Power Control.

2-1) Buffer

-6 dBm TX RF signal from VCO is amplified to around $+40$ dBm by buffer Q21,22,23 to have desired output power at final Amp.

Pie style resister attenuator is used between VCO and Buffer Amp. To minimize the effect of load caused by transmit amplifier in TX.

2-2) Power Amplifier

TX RF Signal form buffer Amp. Gains 45Watt output by final Amp Q24.

Collect impedance of Q24 states in low so that it is matching to 50ohm by C96, 97,4,22,27,23 strip line and inputted to 5th Low Pass Filter.

2-3) Low Pass Filter

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

L25, 26,27, C103, 105 are Chebisheve Filter.

2-4) Antenna Switch

Ant. Switch is to share the antenna in TX and RX. It prevents TX

sensitivity from degradation by LPF. Also, it protects receive circuit by blocking TX signal to receive end, turning on D1, 2.

Flow of the signal in RX is designed to minimize the loss of the signal using the character of series resonance of L1, C2.

2-5) **Auto-Power Control**

This circuit controls TX Power by detection on the output power through C28, R79, D8, C29.

The voltage difference from these detector is gets the voltage comparing the this signal with the reference voltage from R113, 114 at IC6-B.

This voltage difference is kept to stable value by RV1, RV2 changing gate and drain voltage of Final Amp.

3) **PLL Synthesizer**

Reference frequency is 12.8Mhz and this oscillated frequency is compensated in temperature.

The frequency from VCO is inputted to PLL IC and this inputted signal is divided by the ratio set by data and compared with reference step frequency.

Then, the difference comes to IC1 pin18,20 Port. ML32XX SERISE consists of external charge pump.

Charge pump output turns into DC by PLL LPF R94, 95, 96, C121, 122, 123, 124 so that it can vary VCO control voltage to have set frequency.

For TX and RX switch, Q305 base switch to control voltage.(TXEN1)

4) **Audio and Control circuit**

IC401 controls all factions of the radio as Microprocessor.

It detects outer condition such as function data on frequency, Power supply switching and make it operate correctly.

IC404-B consists of 250Hz LPF to function CTCSS/DCS decoding corretly and the output of this filter is amplified at IC404-A. Then, it goes to Q407 to be changed to logic signal so that CTCSS/DCS decoding is enabled.

IC406-B is CTCSS/DCS encode filter. It mixes the signals from 3 ports and this mixed signal goes through this filter to get clear CTCSS/DCS signal.

IC406-A, D, and C is TX Audio Amp and limiter. It amplifies the voice signal from C-Mic and have the character of 6dB/Oct Pre-Emphasis.

This voice signal is controlled by RV401 for the volume.

U406-C is 3KHz LPF and has the character that reduces to 18dB/Oct.

This character minimizes the interference of adjacent channel by voice signal.