TK-3140(K3) Circuit Description

The KENWOOD model TK-3140(K3) is a UHF/FM hand-held transceiver designed to operate in the frequency range of 400 to 430 MHz. (FCC ID: ALH32263130). The unit consists of a receiver, a transmitter, a phase-locked loop (PLL) frequency synthesizer, a digital control unit, power supply circuits and a signaling unit.

1. RECEIVER CIRCUIT

The receiver is double conversion superheterodyne, designed to operate in the frequency range of 400MHz to 430MHz (FCC ID: ALH32263130).

1.1 FRONT-END RF AMPLIFIER

An incoming signal from the antenna is applied to an RF amplifier (Q207) after passing through a transmit/receive switching circuit (D104 and D105 are off). After the signal is amplified, the signal is filtered by a Band-shift type band-pass filter to eliminate unwanted signals before it is routed to the first mixer.

1.2 FIRST MIXER

The signal from the RF amplifier is heterodyned with the first local oscillator signal from the PLL frequency synthesizer circuit at the first mixer (Q206) to become a 44.85MHz first intermediate frequency (IF) signal. The first IF signal is fed through two monolithic crystal filters (MCFs: XF201) to further remove spurious signals.

1.3 IF AMPLIFIER

The first IF signal is amplified by Q205, and then enters IC200 (FM IC).The signal is heterodyned again with a second local oscillator signal with in IC200 to become a 455kHz second IF signal. The second IF signal is fed through a 455kHz ceramic filter , CF200 (for Wide), CF201 (for Narrow) to further eliminate undesired signals before it is amplified and FM detected in IC200.

1.4 AUDIO AMPLIFIER

The recovered audio signal obtained from IC200 is amplified by IC300, The audio signal is then passed through an audio frequency switch (Q204),low-pass filtered by IC500 high-pass filtered by IC500 and band-eliminate filtered by IC500. and de-emphasized by IC500. The processed audio signal passes through an audio volume control and is amplified to a sufficient level to drive a loudspeaker by an audio power amplifier (IC313) display board.

1.5 SQUELCH AND MUTE CIRCUIT

The output signal from the squelch circuit, which consists of IC200,IC201 and Q208, is applied to the microprocessor. The microprocessor passes information to the shift register (IC311, IC312) and it controls the mute control lines (AF MUTE and AC) according to the input signal (noise pulse) and the microprocessor task condition.

2. TRANSMITTER

2.1 MICROPHONE CIRCUIT

The signal from the microphone is high-pass filtered by IC500, passed through microphone mute circuit (Q501), limited and pre-emphasized by IC500.

2.2 MODULATOR CIRCUIT

The output of the low-pass filter network (IC500) is passed to the D/A converter (IC307) for maximum deviation adjustment and the summing amplifier (IC305) before being applied to a varactor diode (D5) in the voltage controlled oscillator (VCO) located in the frequency synthesizer section.

2.3 DRIVER AND FINAL POWER AMPLIFIER CIRCUITS

The transmit signal is directly generated by the VCO. The transmit signal obtained from the VCO buffer amplifier Q8, is amplified by Q100 and Q101, to approximately 17dBm. This amplified signal is passed to the power amplifier, Q103, Q106, consist of a 2-stage FET amplifier and is capable of producing up to 4W.

2.4 TRANSMIT/RECEIVE SWITCHING CIRCUIT

The power module output signal is passed through a 3-stage low-pass filter network and a transmit/receive switching circuit before it is passed to the antenna terminal. The transmit/receive switching circuit is comprised of D102, D103. D104 and D105 are turned on (conductive) in transmit mode and turned off (isolated) in receive mode.

2.5 AUTOMATIC POWER CONTROL(APC)CIRCUIT AND TRANSMITTER OUTPUT LEVEL SWITCH

The automatic power control (APC) circuit stabilizes the transmitter output power at a pre-determined level by sensing the collector current of the final RF amplifier FET. The voltage comparator (IC100) compares the voltage obtained by the above collector current with a reference voltage, set using the microprocessor and Q107.
An APC voltage proportional to the difference between the sensed voltage and the reference voltage appears at the output of IC100. This output voltage controls the gate of the FET power amolifier, which keeps the transmitter output power constant. The transmitter output power can be varied to lW by the microprocessor,
which in turn changes the reference voltage of IC300, and hence the output power.

3. PLL FREQUENCY SYNTHESIZER

3.1 PLL

The frequency step of the PLL circuit is 5 or 6.25kHz. A 16.8MHz reference oscillator signal is divided at IC1 by a fixed counter to produce the 5 or 6.25kHz reference frequency. The VCO output signal is buffer amplified by Q1, then divided in IC1, by a dual-modules programmable counter in this case. The divided signal is compared in phase with the 5 or 6.25kHz reference signal in the phase comparator also in IC1. The output signal from the phase comparator is low-pass filtered and passed to the VCO to control the oscillator frequency.

3,.2 VOLTAGE CONTROLLED OSCILLATOR (VCO)

The operating frequency is generated by voltage controlled oscilator (VCO) in transmit mode and VCO in receive mode. The oscillator frequency is controlled by applying the VCO control voltage, obtained from the phase comparator to the varactor diodes. The TX/RX pin is set high in receive mode causing IC312, and turn on.

3.3 UNLOCK DETECTOR CIRCUIT

If a pulse signal appears at the LD pin of IC1, an unlock condition occurs, the DC voltage, causes the voltage applied to the UL pin of the microprocessor to go low. When the microprocessor detects this

condition, the transmitter is disabled by ignoring the push-to-talk switch input signal.

4. DIGITAL CONTROL CIRCUIT

4.1 KEY SWITCHES AND ROTARY ENCODER INPUT CIRCUIT

The key switches and rotary encoder (channel selector) in formation are entered directly into the microprocessor (IC309).

4.2 RESET CIRCUIT

When the power is initially turned on, the reset circuit (IC400).

4.3 LAMP CIRCUIT

An LED is provided to illuminate the LCD and its operation is controlled by the display microprocessor.

4.4 SHIFT REGISTER CIRCUIT

Serial data is sent to the shift register (IC311,IC312) from the microprocessor to control various functions in the unit.

5. POWER SUPPLY CIRCUIT

5.1 POWER SWITCHING CIRCUIT

A 5V reference voltage is derived from an external power supply or an internal battery applied to the three AVR's IC401 supplies 5V(5M) to the control circuit, and IC403 supplies 5V(5C) to the common circuit. IC402 supplies to the TX circuit , the RX circuit and common circuit of needless save mode.

6. ADDITIONAL CIRCUIT

6.1 QT, DQT ENCODE

The QT, DQT encoder tone is set by the data from the microprocessor (IC309). The QT, DQT tones are applied to the VCO and TCXO (X1) after passing through the D/A converter (IC307) for tone deviation adjustment and the summing amplifier (IC305).

6.2 QT, DQT DECODE

A part of the recovered audio signal obtained at the amplifier IC300 are the QT and DQT tones, and are low-pass filtered by IC306 and passed to the microprocessor for decoding.

6.3 DTMF ENCODE

Once a signal is passed from the DTMF key pad to the microprocessor. The microprocessor passes this information to the DTMF encoder. The encoded signal is then passed to IC307 (D/A converter) for DTMF deviation adjustment. This signal provides a TX DTMF tone and a RX DTMF tone. The TX DTMF tone is passed to the pre-emphasis circuit (mic. amplifier) and then to the VCO. The RX DTMF tone is passed to the de-emphasis circuit, audio power amplifier and then to the speaker.

6.4 DTMF DECODE

The DTMF input signal from the IF IC is amplified by IC300 and goes to IC301 DTMF decoder.