TK-190 Circuit Description

The KENWOOD model TK-190 is a VHF/FM hand-held transceiver designed to operate in the frequency range of 29.7 to 50 MHz. 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 29.7MHz to 50MHz.

1.1 FRONT-END RF AMPLIFIER

An incoming signal from the antenna is applied to on RF amplifier (Q200) after passing through a transmit/receive switch circuit (D2 and D3 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 (IC200) to become a 128.55MHz first intermediate frequency (IF) signal. The first IF signal is fed through two monolithic crystal filters (XF300) to further remove spurious signals.

1.3 IF AMPLIFIER

The first IF signal is amplified by Q302, and then enters IC300 (FM processing IC).The signal is heterodyned again with a second local oscillator signal(129.005MHz) with in IC300 to become a 455kHz second IF signal. The second IF signal is fed through a 455kHz ceramic filter, CF300 and CF301 to further eliminate unwanted signals before it is amplified and FM detected in IC300.

1.4 AUDIO AMPLIFIER

The recovered audio signal obtained from IC300 is amplified by IC601,IC607, low-pass filtered by IC607 high-pass filtered by IC607 and band-eliminate filtered by IC607. The audio signals then passed through an audio frequency switch (Q8) and de-emphasized by IC607. 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 BTL(IC1).

1.5 SQUELCH CIRCUIT

The output signal from IC300 enters FM IC again, then passed through a band-pass filter.
The noise component output from IC300 is amplified by Q304 and rectified by D301 to produce a DC voltage corresponding to the noise level. The DC voltage is sent to the analog port of the CPU(IC406). And IC300 outputs a DC voltage(RSSI)corresponding to the input of the IF amplifier.

2. TRANSMITTER

2.1 MICROPHONE CIRCUIT

The signal from the microphone is high-pass filtered by IC607, passed through microphone mute circuit (Q403), limited and pre-emphasized by IC607,D601.

2.2 MODULATOR CIRCUIT

The output of the Audio-processor (IC607) is passed to the D/A converter (IC603) for maximum deviation adjustment and the summing amplifier (IC605) before being applied to a varactor diode in the voltage controlled oscillator (VCO) located in the frequency synthesizer section.

2.3 DRIVER AND FINAL POWER AMPLIFIER CIRCUITS

The transmit signal is generated by the TX mixer(Q102). The transmit signal obtained from the buffer amplifier Q32, is amplified by Q1 to approximately 16dBm. This amplified signal is amplified by Q2 to approximately 0.5W. and this signal is passed to the FINAL stage. The RF power amplifier consists of MOS FET transistor and is capable of producing up to 6W of RF power.

2.4 TRANSMIT/RECEIVE SWITCHING CIRCUIT

The final output signal is passed through a transmit/receive switching circuit before it is passed to the antenna terminal. The transmit/receive switching circuit is comprised of D2 and D3. D2 and D3 are turned on (conductive) in transmit mode and turned off (isolated) in receive mode.

2.5 AUTOMATIC POWER CONTROL, CIRCUIT AND TRANSMITTER

The automatic power control (APC) circuit stabilizes the transmitter output power at a pre-determined level by sensing the collector current of the final amplifier FET transistor in the final stage. The voltage comparator (IC2) compares the voltage obtained by the above collector current with a reference voltage, set using the microprocessor and Q4. An APC voltage proportional to the difference between the sensed voltage and the reference voltage appears at the output of IC2. This output voltage controls Q8, which in turn controls the voltage at pin 2 of the final unit, which keeps the transmitter output power constant. The transmitter output power can be varied to lW output power by the microprocessor, which in turn changes the reference voltage and hence the output power.

3. PLL FREQUENCY SYNTHESIZER

3.1 PLL

The frequency step of the PLL circuit is 5 kHz. A 16.8MHz reference oscillator signal is divided at IC101 by a fixed counter to produce the 5 kHz reference frequency. The VCO output signal is buffer amplified by Q105,106, then divided in IC101, by a dual-modules programmable counter in this case. The divided signal is compared in phase with the 5 kHz reference signal in the phase comparator also in IC101. 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 Hybrid Integrated Circuit(HIC) in transmit mode and HIC in receive mode. The oscillator frequency is controlled by applying the VCO control voltage, obtained from the phase comparator to the varactor diodes.

3.3 UNLOCK DETECTOR CIRCUIT

If a pulse signal appears at the LD pin of IC101, an unlock condition occurs, 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 CIRCUIT

The key switches channel switches (channel selector) in formation are entered directly into the display microprocessor (IC406).

4.2 RESET CIRCUIT

When the power is initially turned on, the reset circuit (IC409).

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 (IC400,IC403,IC404,IC405) 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 by IC402. This reference is used to provide a 5V supply in transmit mode [5T,5TB], and a 5V supply in receive mode [5R,5RB] and a 5V supply common in both modes [5C] and[5CM] based on the control signal sent from the microprocessor or shift register. IC400 in the control unit provide a 5V supply for the control and display circuits.

6. ADDITIONAL CIRCUIT

6.1 QT, DQT ENCODE

The QT, DQT encoder tone is set by the data from the microprocessor. QT, DQT tone is generated by the microprocessor(IC406). The output is applied to the VCO(L800) after passing through the D/A converter (IC603) for tone deviation adjustment and the summing amplifier (IC605).

6.2 QT, DQT DECODE

A part of the recovered audio signal obtained at the amplifier IC601(2/2) are the QT and DQT tones, and are low-pass filtered by IC602 and passed to the microprocessor for decoding.