TK-860G
Circuit Descriptions

The Kenwood model TK-860G is an all solid-state frequency synthesized UHF/FM transceiver designed for operation in the frequency range of 450MHz to 490MHz (ALH29383110).TK-860G is 128 Number of channels, and TK-862G is 8 Number of channels.
The unit consists of a TX-RX unit and LCD assembly and its transmitter is rated for 25W output power .

1. TX-RX Unit

The TX-RX unit consists of a Voltage Control Oscillator (VCO) sub-unit, a receiver section, a transmitter section, a control section and a power supply section.

1.1 PLL Frequency Synthesizer

The transmit signal and the receiver first L. O. signal are generated by the PLL digital frequency synthesizer. The frequency synthesizer consists of a transmitter voltage controlled oscillator (TX VCO, Q103), a receiver voltage controlled oscillator (RX VCO, Q101), a buffer amplifier (Q106), an RF amplifier (Q9), a low-pass filter, a PLL IC (IC3) and TX VCO/RX VCO switches (Q104 and Q105).

In the transmit signal mode, an operating frequency programming data is sent to IC3,from the control unit, to set the programmable counter within IC3. Q104 is turned on to activate the TX VCO and the output signal of the TX VCO is amplified by Q106 and Q9 before it is routed to IC3.
The signal is then divided down in frequency, at the programmable counter in IC3, to 5.0kHz or 6.25kHz which is compared in phase with a 5.0kHz or 6.25kHz reference signal, derived from 16.8MHz crystal oscillator and a 1/3360 or a 1/2688 fixed counter in IC3, at the phase comparator also in IC3. The crystal oscillator operates at 16.8MHz and its frequency stability is maintained within 2.5ppm (temperature range of –30 to +60℃) .
The phase comparator output signal is fed into a low-pass filter before being applied to the TX VCO as a frequency control voltage. If an unlock condition occurs in the phase locked loop, this condition is detected by D9. This cause the transmitter 8V supply cut off, resulting the prevention of an unauthorized transmission.

The transmitter modulation signals (processed Mic. audio and sub-audible signaling) are applied to the TX VCO for frequency modulation.

In the receive mode, the VCO is substituted with Q101 (RX VCO) and it generates the receiver first local oscillator signal according to the data sent from the control unit. The basic operation of the synthesizer remains the same.

1.2 Receiver Circuit

The receiver is a double conversion super-heterodyne, designed to operate in the frequency range of 450 MHz to 490MHz (ALH29383110).

The receiver RF and IF sections consist of an RF amplifier (Q34), a first mixer (Q15), and an FM IF IC (IC5).

An incoming RF signal from the antenna is fed into a band-pass filter which consists of L22 and variable capacitors (D28 and D31) after going through an antenna switch in the transmitter power amplifier section. The D28 and D31 will be electrically tuned by TV voltage for the best BPF response. This RF signal is then amplified by an RF amplifier (Q34) and filtered again by band-pass filters (L13 and D18, D23). After amplification and filtering, the signal is applied to the first mixer (Q15) for mixing with the first local oscillator signal generated by the frequency synthesizer.

The heterodyning action of the first mixer produces a 49.950MHz intermediate frequency (first IF), which is applied into two monolithic crystal filters. The signal out of the crystal filters is amplified by a first IF amplifier (Q13) and is sent to the FM IF IC (IC5).

The FM IF IC (IC5) contains a second mixer, a second local oscillator, second IF amplifiers, a second IF filter, an FM detector and a RSSI output. The signal applied to IC5 is mixed with 50.400MHz, which produces a 450kHz second IF signal. The signal obtained at the second mixer is filtered by a 450kHz ceramic filter (CF1 for narrow or CF2 for wide) and it is amplified by limiting amplifiers. The recovered audio signal from the incoming signal is obtained from quadrature type FM demodulator. This recovered audio signal is then sent to the audio amplifier circuit and to the noise actuated squelch circuit.

The recovered audio signal obtained at IC5 is de-emphasized and further amplified for driving a loud speaker.

1.3 Transmitter Circuit

The transmitter circuit consists of a microphone amplifier, an RF power amplifier driver (Q22,Q25 and Q27), an RF power amplifier module (IC400), an antenna switching network, a spurious and harmonics low-pass filter, and an automatic power control (APC).

The audio signal, originating at the microphone, is applied to the microphone amplifier (IC507, IC508). The audio signal is amplified, pre-emphasized (IC508), voltage limited and low-pass filtered. The signal is then switched by transistors to the TX VCO for modulating the transmit carrier signal or to public address operation.

The transmit signal, generated at the frequency synthesizer, is applied to the RF power amplifier driver to gain a sufficient signal level to drive the RF power amplifier.

The output signal from the RF power amplifier driver is further amplified, in the RF power amplifier module, up to the level of the transmitter rated output power. This signal is routed to the antenna connector after going through the antenna switching network and the low-pass filter. This filter has a minimum attenuation of 65dB at the second harmonic frequency.

This output power level once it was set it will be maintained at a constant output level by automatic power control unit (D35, D36, IC15, Q31and Q32).

1.4 Control Section

The control section consists of a CPU (IC502), LCD unit and associated interface circuits.

The CPU (IC502) is connected to an external EEPROM (IC505), which stores the operating frequency information.

The CPU (IC502) performs the following functions:

(1) Switches transmit and receive mode based on the push-to-talk line information at the Mic. connector (J501).
(2) Detects control signals from key pad and converts the information to a serial format.
(3) Retrieves the transmit and receive frequency programming data from the EEPROM (IC505), and sends it to the frequency synthesizer.
(4) Detects control signals from each function switch, and sends the information to the associated peripheral circuits in a serial format.
(5) Controls squelch and audio-mute.
(6) Generate the sub-audible signaling encode data (QT, DQT,2TONE) and DTMF signals.
(7) Decodes the sub-audible signaling data (QT, DQT, 2TONE) and DTMF signals.
(8) Detects the noise level from Q10, and controls the noise squelch operation.

2. LCD (Liquid Crystal Display) Assembly

The display receives the data from the CPU-(IC502) in a control circuit and the data is displayed as a visual indication to the operator.

TK-860G
Tuning procedure

Before attempting to tune the transceiver, connect the unit to a suitable power supply. Whenever the transmitter tuned, unit must be connected to a suitable dummy load, unless the instruction specify otherwise. The speaker output connector must be terminated with a 4 Ohms dummy load at any time during the tuning and connected to an AC voltmeter and an audio distortion meter or a SINAD measurement at all the time during the tuning.

1.1Enter into tuning mode

Press "SCN" key while turn on the transceiver. After about 1 second, the tuning mode starts.

1.2Frequency version selection

The following operation frequency band can be chosen for the set under tuning.

Panel Display	Frequency
UHF F1	450 to 490MHz

Following keys on the panel can be used for frequency selection:

▲ key Next (Up) frequency selection
▼ key Next (Down) frequency selection
Channel down key Enter (or confirm)

Once, the channel down key is pressed the set tuning items will be started.

1.3Transmitter tuning

Use "SCN", "▼" key to choose tuning item and "A", "▼", "D/A" key to adjust tuning requirement.

1.3.1 Connect a voltmeter to TP1
1.3.2 Be sure the voltage should be below 7.5V at the test channel 3 and more than 1.0V at the test channel 2 in the Transmission and Reception mode.
1.3.3 Select the test channel 1 and adjust the transmission frequency to 470.100MHz ±100Hz.
1.3.4 Select Tuning Item 2, RF power adjustment.
Adjust RF output power to 25W ±1W.
1.3.5 Select Tuning Item 4, DQT balance adjustment.
Adjust the DQT pulse shape to obtain neat demodulation wave-form.
1.3.6 Select Tuning Item 5, Max. deviation adjustment.
Apply a 1000Hz tone with a 50mV RMS level to the Microphone input.
Adjust the maximum deviation to 3.9kHz ±0.1kHz (for the Wide band), or 1.9kHz ±0.05kHz (for the Narrow band).
1.3.7 Reduce a 1000Hz tone voltage to 5mV.
Be sure the deviation should be in ±2.5kHz to ±3.5kHz.
1.3.8 Select Tuning Item 6, QT deviation adjustment.
Adjust the QT deviation to 0.75kHz ±50Hz (for the Wide band), or 0.35kHz ±25kHz (for the Narrow band).
1.3.9 Select Tuning Item 7, DQT deviation adjustment.
Adjust the DQT deviation to 0.75kHz ±50Hz (for the Wide band), or 0.35kHz ±25kHz (for the Narrow band).
1.3.10 Be sure the DTMF deviation should be in ±2.8kHz to ±3.2kHz (for the Wide band), or ±1.4kHz to ±1.6kHz (for the Narrow band).

1.4 Receiver tuning

1.4.1 Select Tuning Item 8, sensitivity adjustment.
Apply a 470.050MHz to the transceiver antenna terminal.
1.4.2 Tune L13 and L22 to obtain the maximum receiver SINAD.
1.4.3 Tune on the frequencies of 450.050MHz and 489.950MHz,
Change the TV voltage using "∧" and "∨" key to obtain the maximum receiver SINAD.
1.4.4 Select Tuning Item 9, squelch adjustment.
Apply a 470.050MHz with 3dB subtracted from the sensitivity value of 12dB SINAD to the transceiver.
1.4.5 Be sure to make the squelch closed once then opened.
1.4.6 Set the RF signal level to 8dB SINAD. Confirm the squelch should be opened.
1.4.7 Turn off the RF signal. Then confirm the squelch should be closed.