

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 400MHz to 430MHz (ALH29383130).

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°C).

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 causes the transmitter 8V supply cut off, resulting in 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 400 MHz to 430MHz (ALH29383130).

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, Q31 and 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.

PARTS LIST

○ TK-860G TX/RX UNIT (X57-5960-14)

SYMBOL	PARTS NUMBER	PARTS NAME	DISCRIPTION
D1	HSB123	DIODE	SURGE ABSORPTION
D2	02DZ20(Y,Z)	DIODE	VOLTAGE REFERENCE
D3	HSB123	DIODE	SURGE ABSORPTION
D4	HSB123	DIODE	SURGE ABSORPTION
D5	HSB123	DIODE	SURGE ABSORPTION
D8	DAN235K	DIODE	IF SWITCH (WIDE/NARROW)
D9	1SS355	DIODE	DC SWITCH
D10	DAN235K	DIODE	IF SWITCH (WIDE/NARROW)
D11	MA742	DIODE	LIMITTER
D12	HSB123	DIODE	VOLTAGE REFERENCE
D13	HSB123	DIODE	VOLTAGE REFERENCE
D14	1SS355	DIODE	SURGE ABSORPTION
D15	DAN202K	DIODE	OR GATE
D16	DAN235K	DIODE	RF SWITCH(TX/RX)
D17	1SS355	DIODE	TEMPERATURE COMPENSATION
D18	1SV280	VARICAP	RF BPF TUNING
D19	1SS355	DIODE	SURGE ABSORPTION
D20	1SS355	DIODE	REVERCE CURRENT PREVENTION
D21	02DZ18(X,Y)	ZENER DIODE	VOLTAGE REFERENCE
D23	1SV280	VARICAP	RF BPF TUNING
D24	02DZ15(X,Y)	ZENER DIODE	VOLTAGE REFERENCE
D27	1SS355	DIODE	REVERCE CURRENT PREVENTION
D28	1SV280	VARICAP	RF BPF TUNING
D29	DSM3MA1	DIODE	REVERCE CURRENT PREVENTION
D30	MA4PH633	DIODE	ANT SW
D31	1SV280	VARICAP	RF BPF TUNING
D33	XB15A709A0HR	DIODE	ANT SW
D34	XB15A709A0HR	DIODE	ANT SW
D35	MA742	DIODE	APC VOLTAGE DETECT
D36	MA742	DIODE	APC VOLTAGE DETECT
D39	UDZ4.7(B)	ZENER DIODE	VOLTAGE REFERENCE
D40	MA742	DIODE	LIMITTER
D41	1SS355	DIODE	TEMPERATURE COMPENSATION
D501	MA2S111	DIODE	REVERCE CURRENT PREVENTION
D502	MA2S111	DIODE	REVERCE CURRENT PREVENTION
D503	MA2S111	DIODE	REVERCE CURRENT PREVENTION
D504	MA2S111	DIODE	REVERCE CURRENT PREVENTION
D505	MA2S111	DIODE	REVERCE CURRENT PREVENTION
D507	MA2S111	DIODE	REVERCE CURRENT PREVENTION
D508	MA742	DIODE	LIMITTER
D509	B30-2171-05	LED	LIGHT EMISSION
D510	B30-2171-05	LED	LIGHT EMISSION
D511	B30-2171-05	LED	LIGHT EMISSION
D512	B30-2171-05	LED	LIGHT EMISSION
D513	B30-2171-05	LED	LIGHT EMISSION
D514	B30-2171-05	LED	LIGHT EMISSION
D521	B30-2151-05	LED	LIGHT EMISSION

SYMBOL	PARTS NUMBER	PARTS NAME	DISCRIPTION
D523	DAN202U	DIODE	OR GATE
D524	HSB123	DIODE	SURGE ABSORPTION
D525	HSB123	DIODE	SURGE ABSORPTION
D526	1812L075PR	POLY SW	CURRENT PROTECTION
D527	HSB123	DIODE	SURGE ABSORPTION
D528	HSB123	DIODE	SURGE ABSORPTION
D529	MA742	DIODE	LIMITTER
IC1	TA75S01F	IC	SUM AMPLIFIER
IC2	TA75S01F	IC	AMPLIFIER
IC3	MB15A02	IC	PLL SYNTHESIZER
IC4	NJM4558M	IC	AMPLIFIER
IC5	TA31136FN	IC	FM DEMODULATION
IC6	M62363FP	IC	D/A CONVERT
IC7	NJM2904	IC	AMPLIFIER
IC9	BU4094BCF	IC	SHIFT/STORE RESISTOR
IC10	NJM78L05UA	IC	5V AVR
IC11	AN8009M	IC	8V AVR
IC12	TA7808S	IC	8V AVR
IC13	LA4422	IC	AF AMP
IC14	TC4013BF(N)	IC	POWER SUPPLY LOGIC CIRCUIT CONTROL
IC15	TA75S01F	IC	AMPLIFIER
IC400	S-AU27AL(K3)	IC	POWER MODULE
IC501	AT29C020-90TI	IC	FLASH ROM
IC502	30622M4102GP	IC	CPU
IC503	RH5VL42C	IC	RESET IC
IC505	AT2408N10SI2.5	IC	EEPROM
IC507	NJM2904V	IC	AMPLIFIER
IC508	TC35453F	IC	AUDIO PROCESSER
IC509	BU4066BCFV	IC	ANALOG SWITCH
IC510	BU4094BCFV	IC	SHIFT/STORE RESISTOR
IC511	LC73872M	IC	DTMF DECODE
IC512	NJM78L05UA	IC	5V AVR
IC513	TA75W588FU	IC	AMPLIFIER
IC514	TA75W588FU	IC	AMPLIFIER
Q1	DTD114EK	TRANSISTOR	DC SWITCH (HOR)
Q2	DTA114EKA	TRANSISTOR	DC SWITCH (5S)
Q3	DTA114EKA	TRANSISTOR	DC SWITCH (W/N)
Q4	DTC114EKA	TRANSISTOR	DC SWITCH (W/N)
Q5	DTC114EKA	TRANSISTOR	DC SWITCH (HNC)
Q6	DTC114EKA	TRANSISTOR	DC SWITCH (IGN.)
Q7	2SC4649(N,P)	TRANSISTOR	BUFFER AMP.
Q8	2SC2412K	TRANSISTOR	LIPPLE FILTER
Q9	2SC5110(O)	TRANSISTOR	BUFFER AMP.
Q10	DTC114EKA	TRANSISTOR	NOISE AMP.
Q11	2SA1832(GR)	TRANSISTOR	CHARGE POMP
Q12	2SC4738(GR)	TRANSISTOR	CHARGE POMP
Q13	2SC2059K(P)	TRANSISTOR	IF AMP
Q14	2SC5110(O)	TRANSISTOR	BUFFER AMP.
Q15	3SK228	FET	MIXER
Q16	DTC114EKA	TRANSISTOR	DC SWITCH (8R)
SYMBOL	PARTS NUMBER	PARTS NAME	DISCRIPTION