

TEKK INCORPORATION

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SD4000

SERVICE
~~USER~~ MANUAL

2 WATT WIRELESS LAN SYSTEM

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FEATURES

- 12.5KHz/25KHz Channel Spacing: Dual Mode Capability
- PLL synthesized Operation
- Double Superhetrodyne Operation
- RF Output Power : 2W
- BAUD RATE : 4800BPS/12.5KHz, 9600BPS/25KHz
- Operating Temperature : -30 ~ +60°C
- Frequency Range : 440MHz ~ 470MHz
- FCC RULE : Part 15 and Part 90
- 1 Channel Fix PC Programable Type
- Pin Connection
 - .6Pin Connector

RF Main Board		9D-Sub Connector
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Pin1. SQ(CD)	—————>	Pin9
Pin2. Data In	—————>	Pin4
Pin3. Data Out	—————>	Pin5
Pin4.PTT	—————>	Pin3
Pin5.B+	—————>	Pin1
Pin6.GND	—————>	Pin2

- .3Pin Connector

RF Main Board		9D-Sub Connector
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Pin1. RSSI	—————>	Pin8
Pin2. GND	—————>	Pin7
Pin3. SI/O	—————>	Pin6

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SPECIFICATIONS

Parameter	Specification
General	
Channel Capability	1 CH. fix.
Frequency Range	440~470MHz
Operational Bandwidth	30MHz
Channel Spacing	Wide Band 25KHz
	Narrow Band 12.5KHz
Size (W×D×H)	94.3×60.3×30.1(mm)
Weight	140gr
First IF	45MHz
Second IF	455KHz
First Local Osc. Frequency	Fo - 45MHz
PLL Reference Frequency	14.4MHz
Power Source	DC 13.8V
Current Drain	900mA
Receive	50mA, Max.
Transmit-2Watt	950mA,Max.
Antenna impedance	50 ohms
Frequency Stability	±2.5ppm Max.
Operation Temperature	-30℃ to +60℃ (-22°F to +140°F)

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SPECIFICATIONS

Receiver

Sensitivity(12dB SINAD)		0.35uV Max.
Squelch Sensitivity		0.25uV Max.
Selectivity(Adjacent Channel)	Wide Band	-45dB Min.
	Narrow Band	-55dB Min.
Spurious Rejection		-70dB Min.
Intermodulation	Wide Band	-60dB Min.
	Narrow Band	-55dB Min.
Hum and Noise Ratio	Wide Band	-40dB Min.
	Narrow Band	-34dB Min.
RX Spurious Emission (Conducted)		-54dBm Min.
AF Distortion (-47dBm/1KHz/3KHz)		5 %

Transmitter

RF Output Power		2W
Frequency Error		+25PPM
Spurious/Harmonic Emissions		-53dBm
Modulation	Wide Band	$\pm 5\text{KHz}$
	Narrow Band	$\pm 2.5\text{KHz}$
FM Hum and Noise	Wide Band	-40dB Min.
	Narrow Band	-34dB Min.
Adjacent Channel Power	Wide Band	-60dB Min.
	Narrow Band	-50dB Min.
Audio Distortion (3KHz DEV / 1KHz)		5% Max.

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PROGRAMMED CHANNEL DATA INSTRUCTION
(FOR FCC APPROVAL)

CH NO.	RX FREQ. MHz	TX FREQ. MHz	CHANNEL SPACING, KHz
1	440.025	440.025	12.5/25
2	455.025	455.025	12.5/25
3	470.025	470.025	12.5/25

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THEORY OF OPERATION

GENERAL INFORMATION

The SD4000 has one printed circuit board.

Circuitry is described in the following order: Microprocessor/Control Section, VCO/Synthesizer Section, Transmitter Section and Receiver Section and Battery. Refer to the Block Diagram and Schematics.

MICROPROCESSOR / CONTROL SECTION

The microprocessor IC5 is constantly operating when the E.U.T is turned ON. It is continuously monitoring the keyboard, The PTT line and other internal inputs such as the squelch detect, etc. When a change occurs, the microprocessor makes the appropriate response. The microprocessor is used for control. The E.U.T emits a beep on channel change and the synthesizer is loaded with the correct frequency information. The microprocessor runs off a 4.19 MHz oscillator which is composed of X3, C65, C66, and R34.

When the E.U.T is first turned on, the microprocessor reads the E.U.T status from the EEPROM IC4. The microprocessor determines the receive frequency codes, then loads the synthesizer via its pins 5, 6 and 7.

VCO / SYNTHESIZER SECTION

This section consists of the Temperature-Compensated Crystal Oscillator(TCXO), Voltage Controlled Oscillator(VCO), Synthesizer and the Loop Filter.

Temperature-Compensated Crystal Oscillator (TCXO)

The reference oscillator(TC1) is a temperature compensated crystal- oscillator, VR3 is used to adjust the oscillator on frequency (14.4MHz) at room temperature (22°C). The reference oscillator is held within the specified ± 2.5 PPM from -30 to +80°C.

Voltage-Controlled Oscillators

Only one of the VCOs runs at a time, which is controlled by Q19,Q20 and IC5. When receive mode, IC5 pin11 goes low (approx. 0V) enabling the Q19 and biases on Q10 to enable the receive VCO. When transmit mode, IC5 Pin12 goes low enabling the Q20 and biases on Q14 to enable the transmit VCO.

The receive VCO consists of C143, C144, C157, C161, C153,VC1, L11, L12, L13, and Q11, D7. This VCO oscillates at 45 MHz below the programmed receive frequency. The VCO's oscillating frequency is tuned by the varactors D7. The tuning voltage is supplied from the output of the Loop Filter. The output of the VCO is AC coupled (C104) to the output buffer Q13 respectively.

The transmitter VCO consists of C97, C163, C98, C99, C101, C102, VC2, L7, L9, L10 and Q12, D5, D6. This VCO oscillates on the programmed transmit frequency. The VCO's oscillating frequency is tuned by the varactors D6. The tuning voltage is supplied from the output of the Loop Filter. The output of the VCO is AC coupled(C103) to the output buffer Q13 respectively.

The transmit voltage controlled oscillator is directly frequency-modulated and operates on the carrier frequency. In the receive mode, the transmit VCO is disabled and the receive VCO is enabled, producing the receive local oscillator signal at a frequency 45MHz below the incoming receive frequency. The synthesizer is tuned in 6.25kHz step.

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Synthesizer

The frequency synthesizer is a large scale monolithic synthesizer integrated circuit IC6.

The synthesizer IC contains a two dual modular prescaler, four programmable counter, two phase detector and two selectable gain charge pumps necessary to provide the control voltage for two external loop filter and VCO loops. Digital filtered lock detects for both PLLs are included.

RF output from the active VCO is AC coupled(C74) to the synthesizer IC6 Main prescaler input at Pin 12. The prescaler consists of the fin pins which are one of two complimentary inputs to a differential pair amplifier. The complimentary inputs are internal coupled to ground with a 10pF capacitor and not brought out to a pin. The input buffer drives the A counter's ECL D-type flip flops in a dual modulus configuration. A 8/9 for 500MHz option prescale ratio is provided for the LMX1600/01/02. The prescaler clocks the subsequent CMOS flip-flop chain comprising the fully programmable A and B counters.

The main phase (frequency) detectors are driven from their respective N and R counter outputs. The Max. frequency at the phase detector inputs 10MHz. The phase detector's current source outputs pump charge (Q8 and Q9) into an external loop filter, which then converts the charge into the VCO's control voltage.

The synthesizer unlock detector circuit prevents the operation of the transmitter, when the phase lock loop (PLL) is unlocked. The following discussion assumes the unit has been placed in the transmit mode. IC6 lock detector Pin 1 goes high when the PLL is locked. This high level is applied to Pin 8 of the microprocessor IC5. Then microprocessor changes the TX line (pin 12) to a low, thus Q20 is enabled and biases on Q14 to enable transmit VCO. When the PLL become unlocked, the lock detector at IC6 Pin 1 will begin pulsing low. A RC circuit converts pulsing low to a low level for the microprocessor. Then microprocessor changes the TX line (pin 12) to a high, thus Q20 is disabled and biases off Q14 to disable transmit VCO.

Loop Filter

The Loop Filter, a passive lead-lag filter consisting of R56-R59 and C86-C88, integrates the charge pump output to produce the DC turning voltage for the VCO. One parasitic pole, consisting of R59/C87 and RF chokes L7/L11, prevent modulation of the VCOs by the reference energy remaining at the output of the loop filter.

The modulation circuit consists of R73, D5, C163, C100, C110, VR2, VR4, C70, C69, R38, and C123.

TRANSMITTER SECTION**RF POWER Amplifier**

After the PTT is pressed, the TX line(pin 12) switches to approximately 0V. Q20 is turned on enabling transmit VCO.

The pre-drive and drive power amplifier are biased on by Q18 and Q21, which is biased on by the TX SW line switching to 5V. RF output from the transmit VCO(Q12) is applied to the VCO output buffer Q13.

Output from Q13 feeds the pre-drive amplifier Q15. The output signal from Q15 feeds the drive amplifier Q16, whose output from the driver stage feeds the final RF power amplifier Q17 to produce the rated output power of 2 watts. The output of the final is applied to the transmit/receive switch D8. RF power is then fed to the antenna via the output low-pass filter consisting of C150, C152, C154, C155, C156, C158, and L24,25,26.

Antenna Switching

Switching of the antenna between the transmitter and the receiver is accomplished by the antenna transmit/receive switch consisting of diodes D8 and D9. In the transmit mode, switched VCC 8V is applied through R94, R95, and RF choke L22, hard forward biasing the two diodes on. D8 thus permits the flow of RF power from output of the low-pass filter fed by the output amplifier to the output low-pass filter. D9 shorts the receiver input to C2, which is AC coupled to ground. L23 and C159 then function as a lumped constant quarter-wave transmission line, thus presenting a high impedance to the RF output path, effectively isolating the receiver input and transmitter output sections.

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ALIGNMENT /ADJUSTMENTS

GENERAL

For proper alignment, the unit should be programmed with the following channel and frequency information.

CH. No	RECEIVE FREQ. (MHz)	TRANSMIT FREQ. (MHz)	CHANNEL SPACING, KHz
CH1	440.025	440.025	12.5/25
CH2	455.025	455.025	12.5/25
CH3	470.025	470.025	12.5/25

Make connections to the Unit per Figure 1 (Equipment Test Set-up) below.

For the location of the components called out in these procedures, refer to RF Board and SUB Board.

B. VCO CONTROL VOLTAGE / FREQUENCY ADJUSTMENT

-. VCO CHECK

NOTE: VCO check must be accomplished before proceeding with the Transmitter and or Receiver Alignment

1. Connect the voltmeter to TP.
2. Place the Unit on channel select ..
3. Tune VC1 in Receive mode for $2.0V \pm 0.05V$ at TP.
4. Push the PTT switch (TX) and tune VC2 for $2.0V \pm 0.05V$ at TP.

-. FREQUENCY ADJUSTMENT

1. Connect the E.U.T in accordance with Figure 1.
2. Place the Unit on channel select.
3. Operate the transmitter and adjust VR3 for a Frequency Counter reading within $\pm 50Hz$ of the programmed transmit frequency.

C. MODULATION ADJUSTMENT

1. Connect the E.U.T in accordance with Figure 1.
2. Place the E.U.T on channel select.
 - . Apply a 9600 Baud SQ. wave signal to the E.U.T.
 - . Set the SQ. wave generator's output level at approximate 5Vrms.
 - . Operate the transmitter and adjust VR2 and VR4(MOD.ADJ) for $\pm 5.0kHz$ deviation.
3. Place the E.U.T on channel select.
 - . Apply a 4800 Baud SQ. wave signal to the E.U.T.
 - . Set the SQ. wave generator's output level at approximate 5Vrms.
 - . Operate the transmitter and adjust VR2 and VR4(MOD.ADJ) for $\pm 2.50kHz$ deviation.

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RECEIVER SECTION**Receiver Front End**

In the receive mode, the RF signal enters thorough the antenna, then through the low-pass filter(C158, C156, C155, C154, C152, C150, and L24-26). The diodes D8 and D9 are biased off so that the output of the low-pass filter is coupled (C2) to the first helical filter, T1 and to the Front End RF overload protection diode pair D1. The signal from the band-pass filter is applied to the input of the RF amplifier Q1.

The output of the RF amplifier feeds the input to the second helical filters T2. The output from the second helical filter is applied to the mixer's Q2.

Local Oscillator (LO)

The Receive VCO provides the LO signal. The VCO is running at 45 MHz below the desired receive frequency and is applied to output Buffer Q13/Q3. The output of the buffer, Q3 through the low-pass filter C16-C17 L3 and applied to the mixer Tr. Q3..

Mixer

The mixer is a active type (Q3). The mixer LO frequency is 45 MHz below the desired receiver frequency.

When the receiver frequency is present, the mixer output will be a 45MHz signal. The signal of the mixer output is filtered by crystal filter F1 and amplified by Q4 before being applied to the input of the IF IC IC1.

Inside IC1, the 45MHz IF signal becomes the input to a second mixer with a LO frequency of 44.545 MHz set by X1. The 455kHz ceramic filter F2 filters the second mixer's output which is the second IF signal. The mixer's output is then fed to the internal limiting amplifier and then on to the FM decoder.

FM Detector and Squelch

The FM detector output is used for squelch, decoding tones and audio output. The setting of the squelch adjustment potentiometer VR1 sets the input to the squelch amplifier. The squelch amplifier is internal to IC1 and its output is fed to an internal rectifier and squelch detector. The output on IC1 Pin 25 signals the microprocessor IC5 with a low ($\sim 0V$) to unmute the E.U.T.