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SD4000

SERVICE
~~USER~~ MANUAL

2 WATT WIRESS LAN SYSTEM

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SD4000

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FEATURES

- 12.5KHz/25KHz Channel Spacing: Dual Mode Capability
- PLL synthesized Operation
- Double Superheterodyne 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
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
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(㎜)
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		+-2.5PPM
Spurious/Harmonic Emissions		-53dBMin.
Modulation	Wide Band	±5KHz
	Narrow Band	±2.5KHz
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 mic roprocessor 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℃). The reference oscillator is held within the specified ±2.5 PPM from -30 to +80℃.

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, whitch 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 ± 0.05V at **TP**.
4. Push the PTT switch (TX) and tune **VC2** for 2.0V ± 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 ± 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 ±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 ±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 (~ 0V) to unmute the E.U.T.