19-1528; Rev 0; 8/99

EVALUATION KIT MANUAL FOLLOWS DATA SHEET

Monolithic Voltage-Controlled Oscillators

General Description

The MAX2622/MAX2623/MAX2624 self-contained voltage-controlled oscillators (VCOs) combine an integrated oscillator and output buffer in a miniature 8-pin µMAX package.

The inductor and varactor elements of the tank circuits are integrated on-chip, greatly simplifying application of the part. In addition, the center frequency of oscillation and frequency span are factory preset to provide a guaranteed frequency range versus control voltage. An external tuning voltage controls the oscillation frequency. The output signals are buffered by an amplifier stage (easily matched to 50Ω), using only capacitors to provide higher output power and isolate the devices from load impedance variations.

The MAX2622/MAX2623/MAX2624 operate from a +2.7V to +3.3V supply voltage and require only 9mA of supply current. In shutdown mode, the supply current is reduced to 0.1µA.

Applications

866MHz to 868MHz European ISM Band (MAX2622)

DECT 1/2 Frequency LO (MAX2623)

902MHz to 928MHz ISM Band, ±10.7MHz IF (MAX2623)

902MHz to 928MHz ISM Band, 45MHz to 70MHz IF (MAX2624)

Pin Configuration appears at end of data sheet

Features

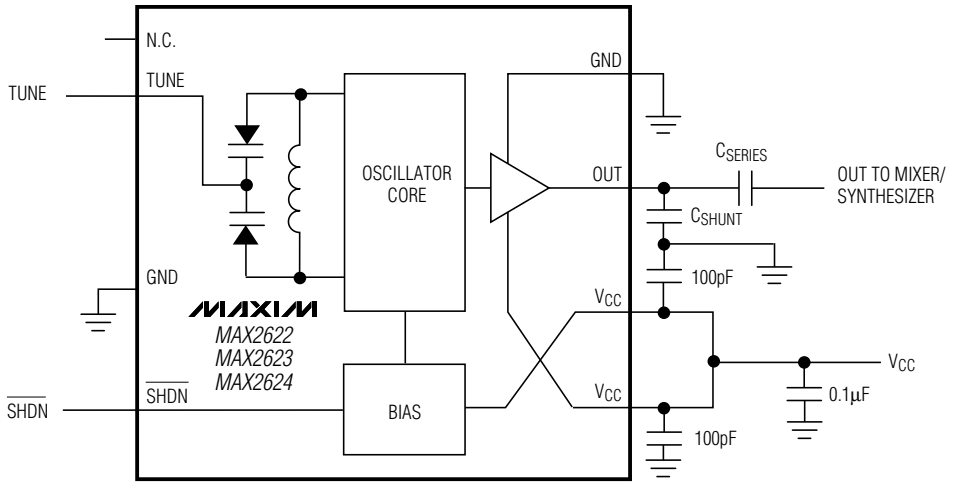
- **Fully Monolithic**
- **Guaranteed Performance**
- **Wide Choice of Frequencies**
  - **855MHz to 881MHz (MAX2622)**
  - **885MHz to 950MHz (MAX2623)**
  - **947MHz to 998MHz (MAX2624)**
- **+2.7V to +3.3V Single-Supply Operation**
- **Low-Current Shutdown Mode**
- **Smaller than Modules (8-pin µMAX package)**

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX2622EUA	-40°C to +85°C	8 µMAX
MAX2623EUA	-40°C to +85°C	8 µMAX
MAX2624EUA*	-40°C to +85°C	8 µMAX

**Future product—contact factory for availability.*

Typical Operating Circuit



Monolithic Voltage-Controlled Oscillators

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND .....-0.3V to +6V
TUNE, $\overline{SHDN}$ to GND .....-0.3V to (V_{CC} + 0.3V)
OUT to GND .....-0.3V to (V_{CC} + 0.6V)
Continuous Power Dissipation (T_A = +70°C)
8-pin µMAX (derate 5.7mW/°C above T_A = +70°C)...457mW
Operating Temperature Range .....-40°C to +85°C
Junction Temperature .....+150°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10sec) .....+300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

DC ELECTRICAL CHARACTERISTICS

(*Typical Operating Circuit*, V_{CC} = +2.7V to +3.3V, V_{TUNE} = 1.4V, $V_{\overline{SHDN}}$ = 2V, OUT = unconnected, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V_{CC} = +3V, T_A = +25°C.) (Note 1)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage		2.7		3.3	V
Supply Current			9	11.5	mA
Shutdown Supply Current	$V_{\overline{SHDN}} \le 0.6V$		0.1	10	µA
$\overline{SHDN}$ Input Voltage Low	V_{CC} = 3.3V			0.6	V
$\overline{SHDN}$ Input Voltage High	V_{CC} = 2.7V	2.0			V
$\overline{SHDN}$ Input Current Low	$V_{\overline{SHDN}}$ = 0.6V, V_{CC} = 3.3V	-0.5		0.5	µA
$\overline{SHDN}$ Input Current High	$V_{\overline{SHDN}}$ = 2.0V, V_{CC} = 3.3V	-0.5		0.5	µA
TUNE Input Current	0.4V ≤ V_{TUNE} 2.4V		0.2		nA

AC ELECTRICAL CHARACTERISTICS

(*Typical Operating Circuit,* V_{CC} = +2.7V to +3.3V, V_{TUNE} = 0.4V to 2.4V, $V_{\overline{SHDN}}$ = 2V, T_A = +25°C, unless otherwise noted. Typical values measured at V_{CC} = +3V.) (Note 1)

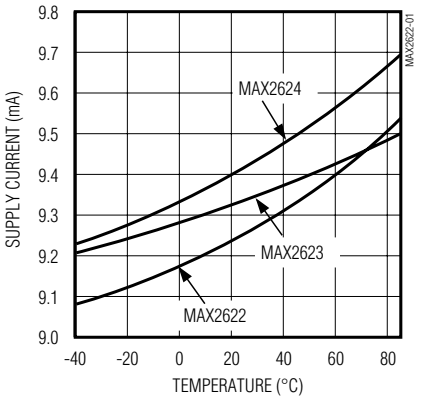
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Oscillator Frequency Range	MAX2622, V_{TUNE} = 0.4V to 2.4V, T_A = -40°C to +85°C	855		881	MHz
	MAX2623, V_{TUNE} = 0.4V to 2.4V, T_A = -20°C to +75°C	885		950	
	MAX2624, V_{TUNE} = 0.4V to 2.4V, T_A = -40°C to +85°C	947		998	
Phase Noise	f_{OFF} = 100kHz		-101		dBc/Hz
	f_{OFF} = 1MHz		-119		
Noise Floor			-156		dBm/Hz
Tuning Gain (Note 2)	V_{TUNE} = 0.4V to 2.4V		80	110	MHz/V
Output Power	V_{TUNE} = 0.4V (Note 3)		-8		dBm
Return Loss (Notes 3, 4)			-12		dB
Harmonics			-30		dBc
Load Pulling	VSWR = 2:1, all phases		0.5		MHz_{p-p}
Supply Pushing	V_{CC} stepped from 2.8V to 3.3V		200		kHz/V

Note 1: Specifications are production tested at T_A = +25°C. Limits over temperature are guaranteed by design and characterization.
Note 2: Maximum tuning gain is measured at V_{TUNE} = 0.4V with a 0.2V step to 0.6V. This represents the worst-case (highest) tuning gain.
Note 3: Measurements taken on MAX262_ EV kit.
Note 4: Return loss is optimized across all frequencies via external shunt/series capacitor matching.

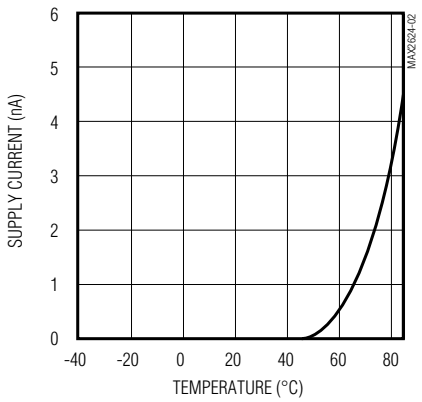
Typical Operating Characteristics

(V_{CC} = +3.0V, V_{TUNE} = 1.4V to 2.4V, $V_{\overline{SHDN}}$ = 2V, T_A = +25°C, unless otherwise noted.)

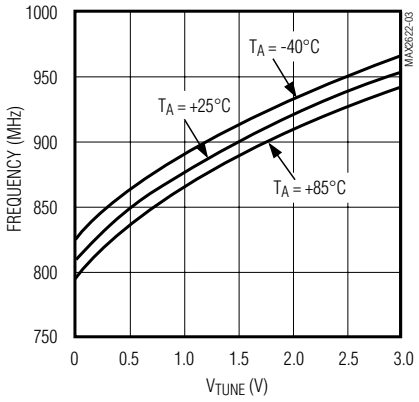
SUPPLY CURRENT vs. TEMPERATURE



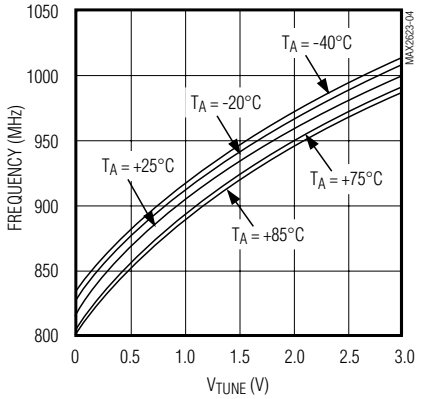
MAX2624 SHUTDOWN SUPPLY CURRENT vs. TEMPERATURE



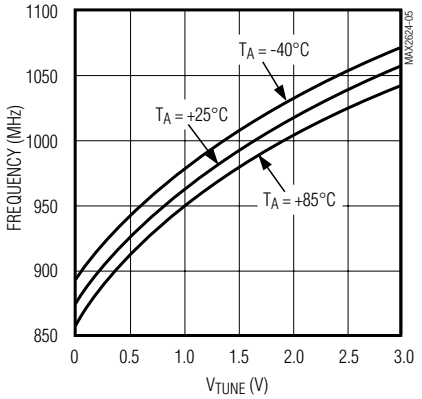
MAX2622 VCO TUNING CURVE



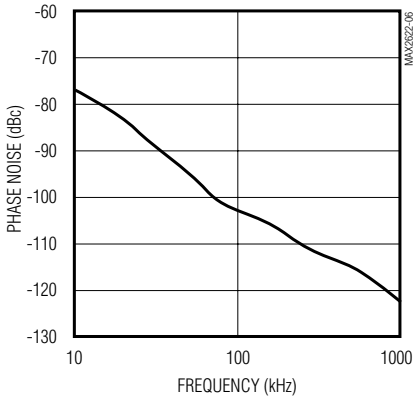
MAX2623 VCO TUNING CURVE



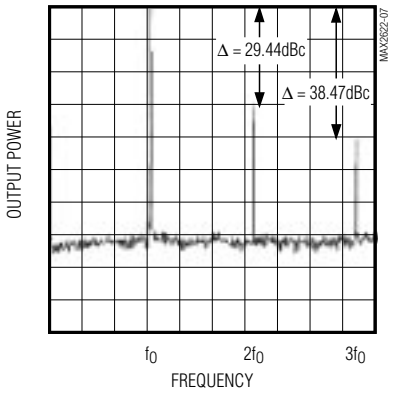
MAX2624 VCO TUNING CURVE



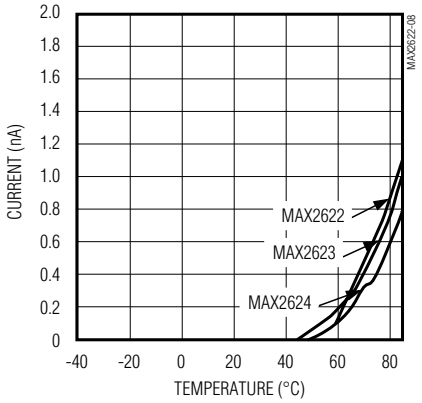
PHASE NOISE



NORMALIZED HARMONIC OUTPUT SPECTRUM



TUNE CURRENT vs. TEMPERATURE



Monolithic Voltage-Controlled Oscillators

Pin Description

PIN	NAME	FUNCTION
1	N.C.	Not connected. Do not make any connections to this pin.
2	TUNE	Oscillator Frequency Tuning Voltage Input. High-impedance input with a voltage input range of 0.4V (low frequency) to 2.4V (high frequency) adjustment.
3	GND	Ground Connection for Oscillator and Biasing. Requires a low-inductance connection to the circuit board ground plane.
4	$\overline{SHDN}$	Shutdown Logic Input. A high-impedance input logic level low disables the device and reduces supply current to 0.1µA. A logic level high enables the device.
5	V_{CC}	Output Buffer DC Supply Voltage Connection. Bypass with a 100pF capacitor to GND for best high-frequency performance.
6	V_{CC}	Bias and Oscillator DC Supply Voltage Connection. Bypass with a 100pF capacitor to GND for low noise and low spurious content performance from the oscillator.
7	OUT	Buffered Oscillator Output. DC blocking capacitor required.
8	GND	Ground Connection for Output Buffer. Requires a low-inductance connection to the circuit board ground plane.

Detailed Description

Oscillator

The MAX2622/MAX2623/MAX2624 VCOs are implemented as an LC oscillator topology, integrating all of the tank components on-chip. This fully monolithic approach provides an extremely easy-to-use VCO, equivalent to a VCO module. The frequency is controlled by a voltage applied to the TUNE pin, which is internally connected to the varactor. The VCO core uses a differential topology to provide a stable frequency versus supply voltage and improve the immunity to load variations. In addition, there is a buffer amplifier following the oscillator core to provide added isolation from load variations and to boost the output power.

Output Buffer

The oscillator signal from the core drives an output buffer amplifier. The amplifier is constructed as a common-emitter stage with an integrated on-chip pull-up inductor at the output. An external shunt-series capacitor circuit optimizes the match to 50Ω. The output amplifier has its own V_{CC} and GND pins to minimize load-pulling effects. The amplifier boosts the oscillator signal to a level suitable for driving most RF mixers.

Applications Information

Output Matching

Although the output amplifier internally provides a partial match to 50Ω, a simple external shunt series capacitor network is needed to optimize the match to 50Ω. The off-chip capacitors are low-cost surface-mount components. No inductors are required. The capacitors are configured as shown in the *Typical Operating Circuit*. The recommended values of C_{SERIES} and C_{SHUNT} for the MAX2622/MAX2623/MAX2624 are shown in Table 1. A typical application circuit is shown in Figure 1.

Tuning Line

The tuning input is typically connected to the output of the PLL loop filter. The loop filter is presumed to provide an appropriately low-impedance source. It may incorporate an extra RC filter stage to reduce high-frequency noise and spurious signals. Any excess noise on the tuning input is directly translated into FM noise, which can degrade the phase-noise performance of the oscillator. Therefore, it is important to minimize the noise introduced on the tuning input. A simple RC filter with low corner frequency may be needed during testing in order to filter the noise present on the voltage source driving the tuning line.

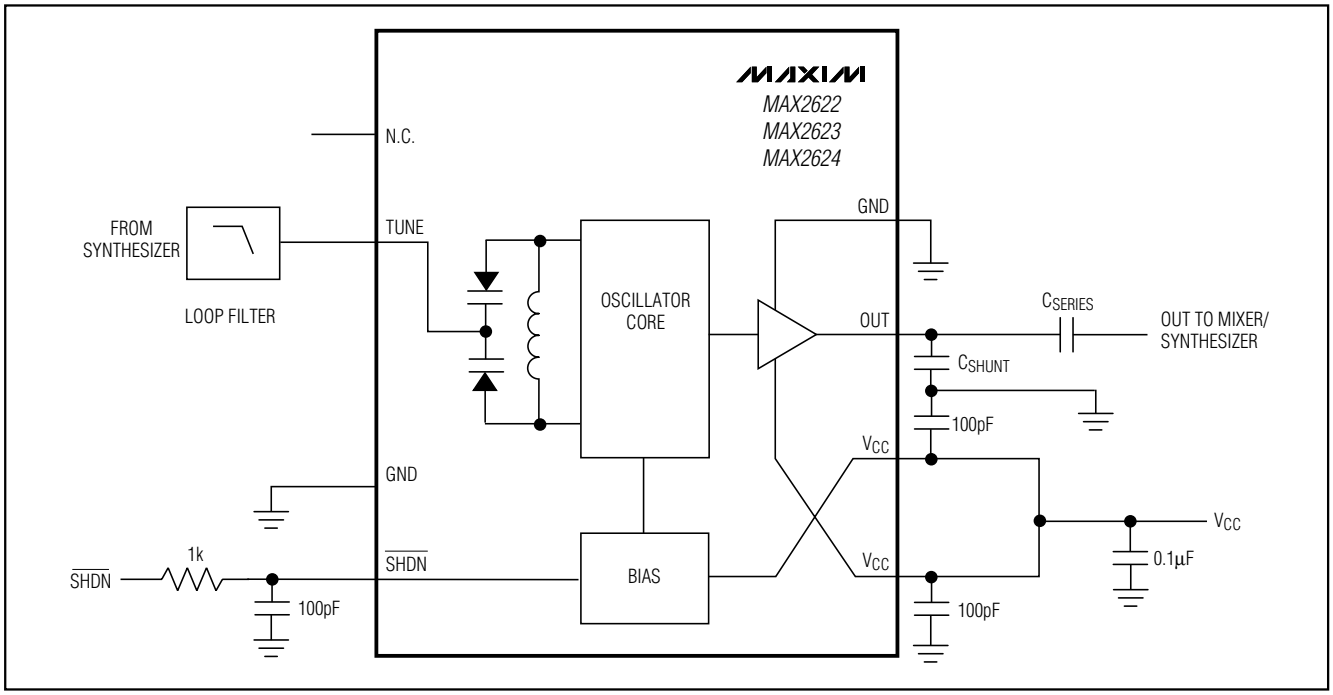


Figure 1. Typical Application Circuit

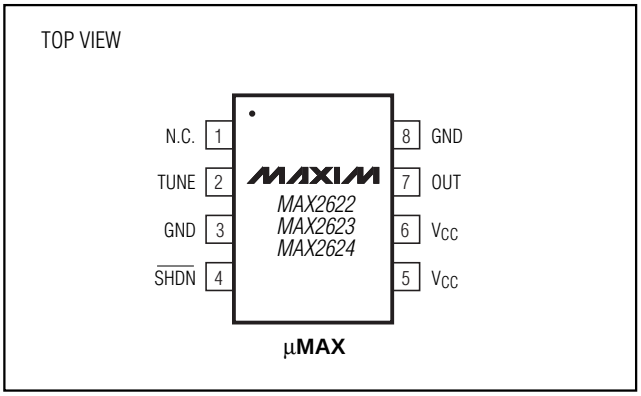
Table 1. Output Matching Components for 50Ω Match

DEVICE	C_{SERIES} (pF)	C_{SHUNT} (pF)
MAX2622	2	1
MAX2623	1.5	1
MAX2624	1.3	0.7

Layout Issues

A properly designed PC board is essential to any RF/microwave circuit/system. Always use controlled impedance lines (microstrip, coplanar waveguide, etc.) on high-frequency signals. Always place decoupling capacitors as close to the V_{CC} pins as possible. For long V_{CC} lines, it may be necessary to add additional decoupling capacitors located further from the device. Always provide a low-inductance path to ground. Keep GND vias as close to the device as possible. Thermal reliefs on GND pads are **not** recommended.

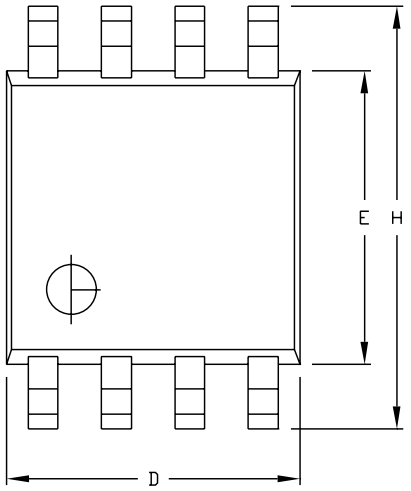
Pin Configuration



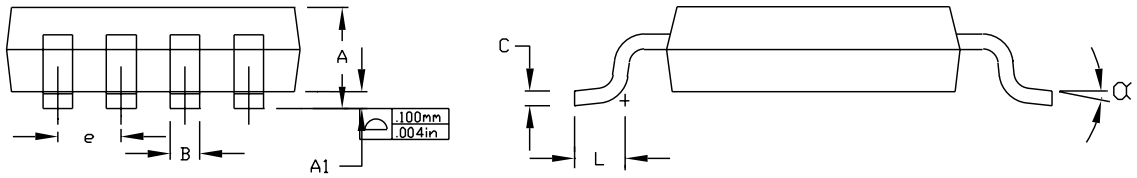
Monolithic Voltage-Controlled Oscillators

Package Information

8LUMAXD.EPS



	INCHES		MILLIMETERS		JEDEC INCHES		JEDEC MILLIMETERS	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	0.037	0.043	0.94	1.10	---	0.043	---	1.10
A1	0.002	0.006	0.05	0.15	0.002	0.006	0.05	0.15
B	0.010	0.014	0.25	0.36	0.010	0.016	0.25	0.40
C	0.005	0.007	0.13	0.18	0.005	0.009	0.13	0.23
D	0.116	0.120	2.95	3.05	0.114	0.122	2.9	3.1
e	0.0256 BSC		0.65 BSC		0.0256 BSC		0.64 BSC	
E	0.116	0.120	2.95	3.05	0.114	0.122	2.9	3.1
H	0.188	0.198	4.78	5.03	0.193 BSC		4.9 BSC	
L	0.016	0.026	0.41	0.66	0.016	0.027	0.40	0.70
α	0°	6°	0°	6°	0°	6°	0°	6°



NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm(.006").
3. CONTROLLING DIMENSION: MILLIMETERS.
4. MEETS JEDEC MO-187.

MAXIM
PROPRIETARY INFORMATION

TITLE:
8L uMAX PACKAGE OUTLINE DWG.

APPROVAL	DOCUMENT CONTROL NO.	REV	
	21-0036	F	1/1