ANALOG DEVICES

HMC512LP5/LP5E

v06.0114

MMIC VCO WITH HALF FREQUENCY OUTPUT 9.6 - 10.8 GHz

Typical Applications

Low noise MMIC VCO w/Half Frequency, Divide-by-4 Outputs for:

- Point to Point/Multipoint Radio
- Test Equipment & Industrial Controls
- SATCOM
- Military End-Use

Features

Triple Output: Fo = 9.6 - 10.8 GHz
Fo/2 = 4.8 - 5.4 GHz
Fo/4 = 2.4 - 2.7 GHz

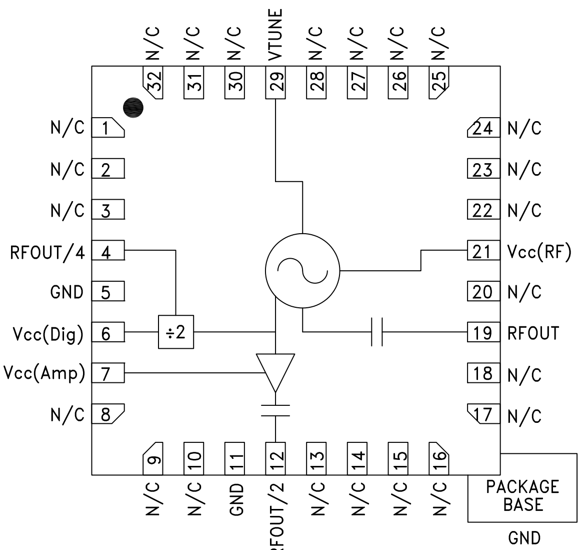
Pout: +9 dBm

Phase Noise: -110 dBc/Hz @100 kHz Typ.

No External Resonator Needed

32 Lead 5 x 5 mm SMT Package: 25 mm²

Functional Diagram



General Description

The HMC512LP5 & HMC512LP5E are GaAs InGaP Heterojunction Bipolar Transistor (HBT) MMIC VCOs. The HMC512LP5 & HMC512LP5E integrate resonators, negative resistance devices, varactor diodes and feature half frequency and divide-by-4 outputs. The VCO's phase noise performance is excellent over temperature, shock, and process due to the oscillator's monolithic structure. Power output is +9 dBm typical from a +5V supply voltage. The prescaler and RF/2 functions can be disabled to conserve current if not required. The voltage controlled oscillator is packaged in a leadless QFN 5x5 mm surface mount package, and requires no external matching components.

Electrical Specifications, T_A = +25° C, Vcc (Dig), Vcc (Amp), Vcc (RF) = +5V

Parameter		Min.	Typ.	Max.	Units
Frequency Range	Fo Fo/2		9.6 - 10.8 4.8 - 5.4		GHz GHz
Power Output	RFOUT RFOUT/2 RFOUT/4	+3 +6 -8		+15 +14 -3	dBm dBm dBm
SSB Phase Noise @ 100 kHz Offset, Vtune= +5V @ RFOUT			-110		dBc/Hz
Tune Voltage	Vtune	2		13	V
Supply Current	Icc(Dig) + Icc(Amp) + Icc(RF)	250	330	370	mA
Tune Port Leakage Current (Vtune= 12V)				10	µA
Output Return Loss			3		dB
Harmonics/Subharmonics	1/2 2nd 3rd		33 25 35		dBc dBc dBc
Pulling (into a 2.0:1 VSWR)			5		MHz pp
Pushing @ Vtune= 5V			30		MHz/V
Frequency Drift Rate			1.2		MHz/°C

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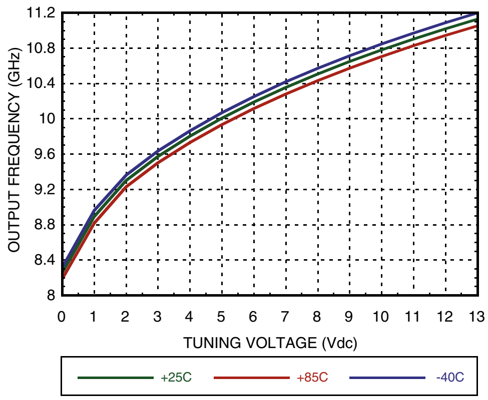
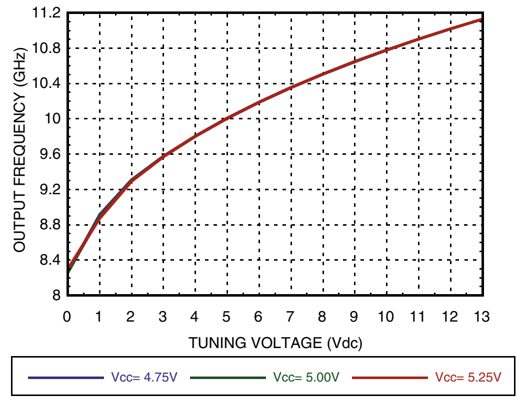
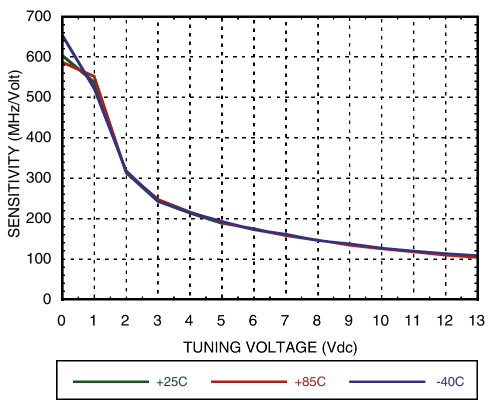
Frequency vs. Tuning Voltage



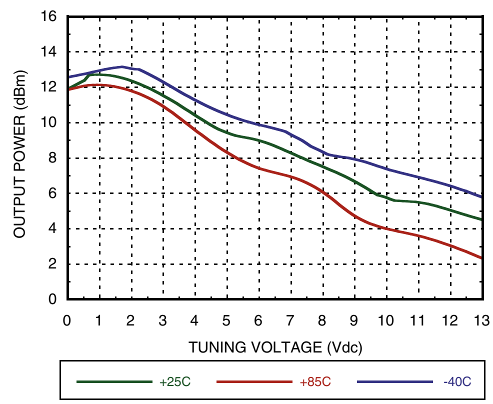
Frequency vs. Tuning Voltage, T = 25°C



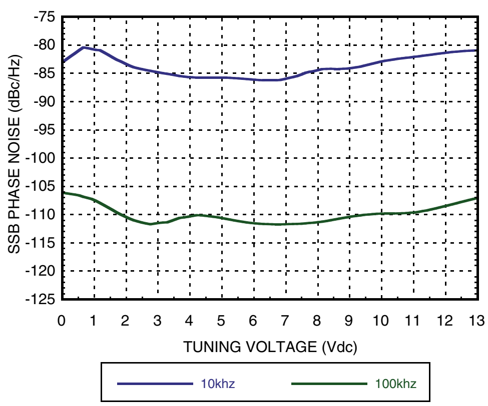
Sensitivity vs. Tuning Voltage



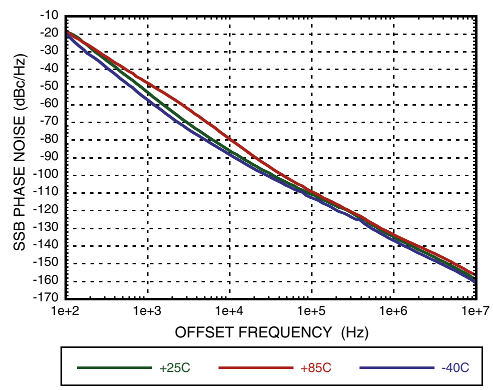
Output Power vs. Tuning Voltage



SSB Phase Noise vs. Tuning Voltage



SSB Phase Noise @ Vtune = +5V



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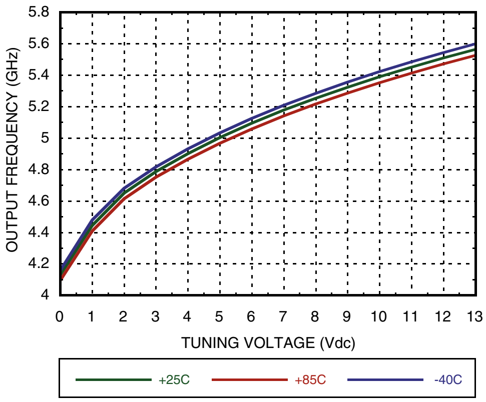
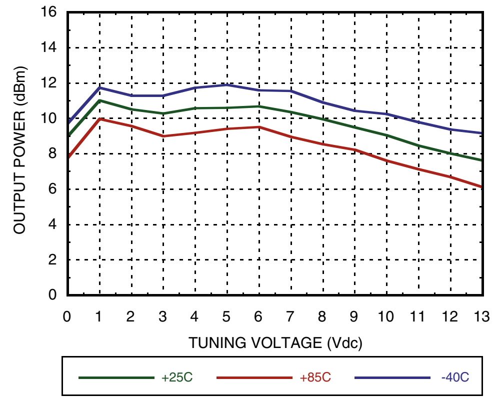
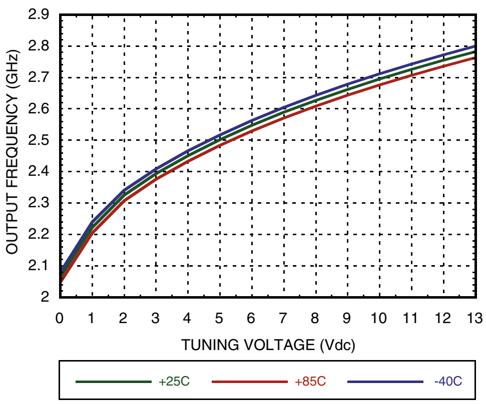
RFOUT/2 Frequency vs. Tuning Voltage



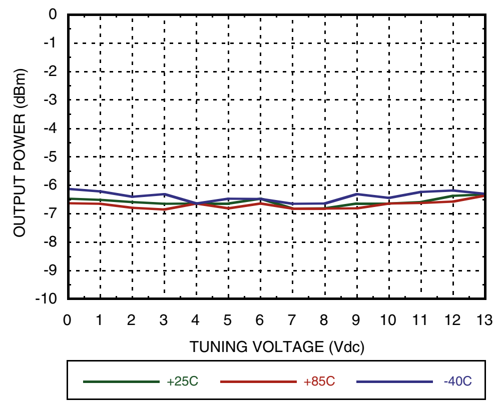
RFOUT/2 Output Power vs. Tuning Voltage



Divide-by-4 Frequency vs. Tuning Voltage



Divide-by-4 Output Power vs. Tuning Voltage



Absolute Maximum Ratings

Vcc(Dig), Vcc(Amp), Vcc(RF)	+5.5 Vdc
Vtune	0 to +15V
Storage Temperature	-65 to +150 °C

ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Reliability Information

Junction Temperature to Maintain 1 Million Hour MTTF	135 °C
Nominal Junction Temperature (T = 85 °C)	123 °C
Thermal Resistance (junction to ground paddle)	23 °C/W
Operating Temperature	-40 to +85 °C

Typical Supply Current vs. Vcc

Vcc (V)	Icc (mA)
4.75	300
5.00	330
5.25	360

Note: VCO will operate over full voltage range shown above.

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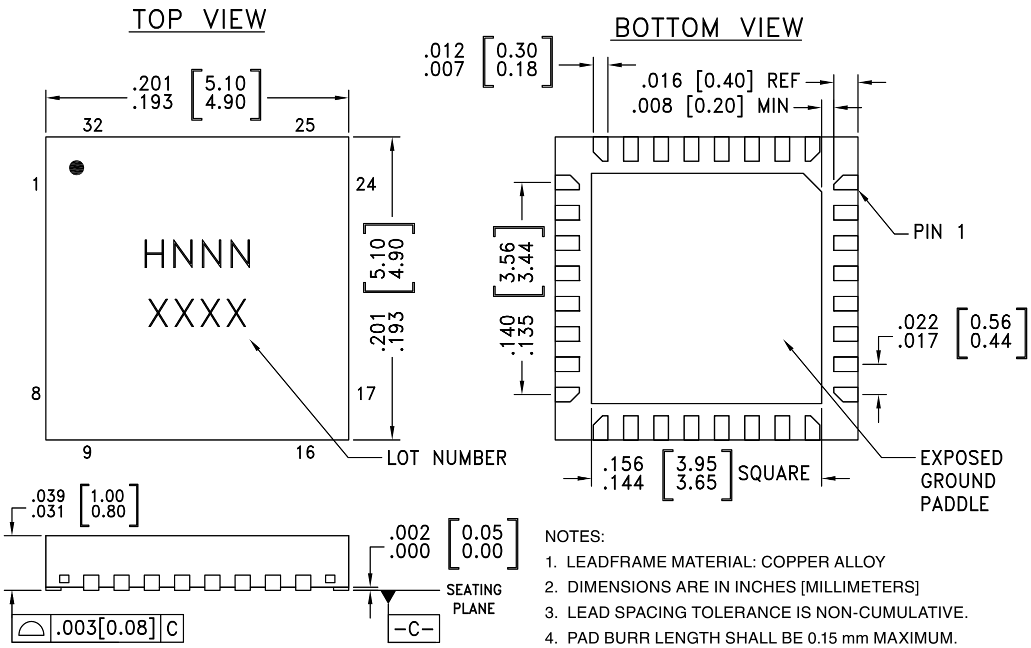
Outline Drawing



NOTES:

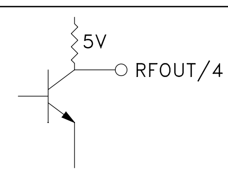
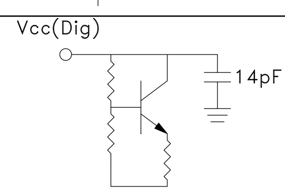
1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS]
3. LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
4. PAD BURR LENGTH SHALL BE 0.15 mm MAXIMUM. PAD BURR HEIGHT SHALL BE 0.05 mm MAXIMUM.
5. PACKAGE WARP SHALL NOT EXCEED 0.05 mm.
6. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
7. REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED LAND PATTERN.

Package Information

Part Number	Package Body Material	Lead Finish	MSL Rating	Package Marking [3]
HMC512LP5	Low Stress Injection Molded Plastic	Sn/Pb Solder	MSL3 [1]	H512 XXXX
HMC512LP5E	RoHS-compliant Low Stress Injection Molded Plastic	100% matte Sn	MSL3 [2]	<u>H512</u> XXXX

[1] Max peak reflow temperature of 235 °C
[2] Max peak reflow temperature of 260 °C
[3] 4-Digit lot number XXXX

Pin Descriptions

Pin Number	Function	Description	Interface Schematic
1 - 3, 8 - 10, 13 - 18, 20, 22 - 28, 30 - 32	N/C	No Connection. These pins may be connected to RF/DC ground. Performance will not be affected.	
4	RFOUT/4	Divide-by-4 output. DC block required.	
6	Vcc (Dig)	Supply voltage for prescaler. If prescaler is not required, this pin may be left open to conserve approximately 65 mA of current.	

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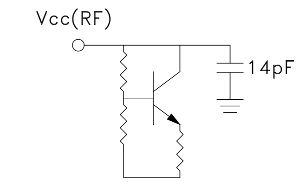
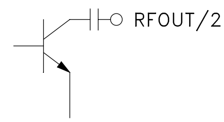
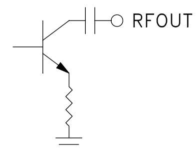
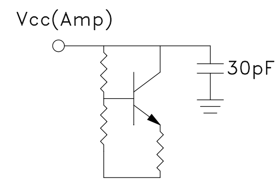
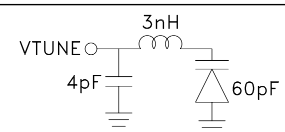
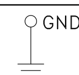
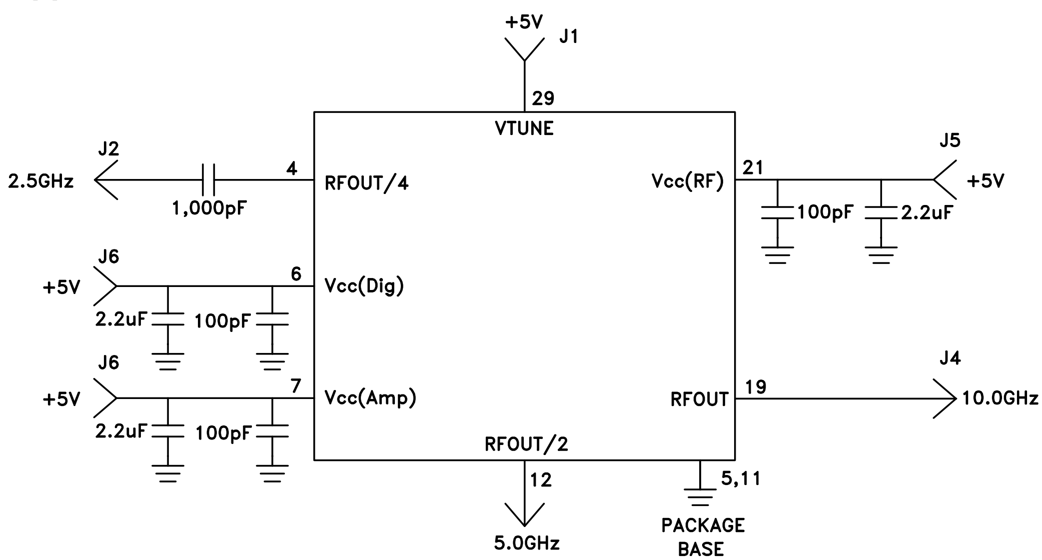
Pin Descriptions

Pin Number	Function	Description	Interface Schematic
7	Vcc (Amp)	Supply voltage for RFOUT/2 output. If RFOUT/2 is not required, this pin may be left open to conserve approximately 30 mA of current.	
12	RFOUT/2	Half frequency output (AC coupled).	
19	RF OUT	RF output (AC coupled).	
21	Vcc (RF)	Supply Voltage, +5V	
29	VTUNE	Control voltage and modulation input. Modulation bandwidth dependent on drive source impedance. See “Determining the FM Bandwidth of a Wideband Varactor Tuned VCO” application note.	
5, 11, Paddle	GND	Package bottom has an exposed metal paddle that must be connected to RF/DC ground.	

Typical Application Circuit



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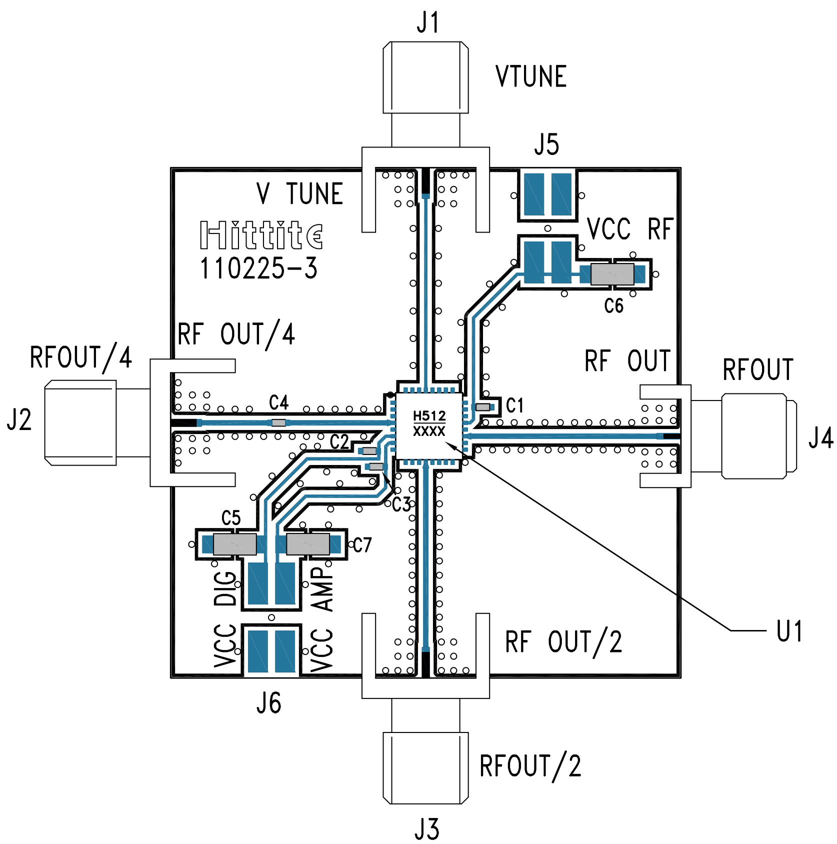
Evaluation PCB



List of Materials for Evaluation PCB 110227 [1]

Item	Description
J1 - J4	PCB Mount SMA RF Connector
J5 - J6	2 mm DC Header
C1 - C3	100 pF Capacitor, 0402 Pkg.
C4	1,000 pF Capacitor, 0402 Pkg.
C5 - C7	2.2 µF Tantalum Capacitor
U1	HMC512LP5 / HMC512LP5E VCO
PCB [2]	110225 Eval Board

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

The circuit board used in the application should use RF circuit design techniques. Signal lines should have 50 Ohm impedance while the package ground leads and backside ground paddle should be connected directly to the ground plane similar to that shown. A sufficient number of via holes should be used to connect the top and bottom ground planes. The evaluation circuit board shown is available from Hittite upon request.

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