11.07 GHz to 11.62 GHz, MMIC VCO with Half Frequency Output

Data Sheet

HMC1165

FEATURES

- Dual output frequency range
  - f_{OUT} = 11.07 GHz to 11.62 GHz
  - $f_{OUT}/2$ = 5.535 GHz to 5.810 GHz
- Output power (P_{OUT}): 8 dBm
- Single-sideband (SSB) phase noise: −113 dBc/Hz at 100 kHz
- No external resonator needed
- RoHS-compliant, 5 mm × 5 mm, 32-lead LFCSP: 25 mm²

APPLICATIONS

- Point to point and multipoint radios
- Test equipment and industrial controls
- Very small aperture terminals (VSATs)

FUNCTIONAL BLOCK DIAGRAM

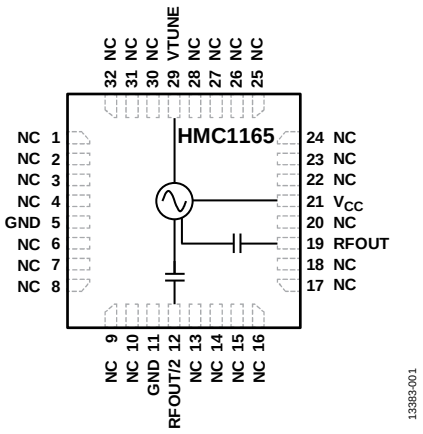


Figure 1.

GENERAL DESCRIPTION

The HMC1165 is a monolithic microwave integrated circuit (MMIC), voltage controlled oscillator (VCO) that integrates a resonator, a negative resistance device, and a varactor diode, and features a half frequency output.

Because of the monolithic construction of the oscillator, the output power and phase noise performance are excellent over temperature.

The output power is 8 dBm typical from a 5 V supply voltage. The VCO is housed in a RoHS-compliant LFCSP and requires no external matching components.

Rev. 0

Document Feedback

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 781.329.4700
©2015 Analog Devices, Inc. All rights reserved.
Technical Support
www.analog.com

TABLE OF CONTENTS

Features 1
Applications 1
Functional Block Diagram 1
General Description 1
Revision History 2
Specifications 3
Absolute Maximum Ratings 4
ESD Caution 4
Pin Configuration and Function Descriptions 5
Interface Schematics 6
Typical Performance Characteristics 7
Applications Information 9
Evaluation Printed Circuit Board (PCB) 10
Bill of Materials 10
Packaging and Ordering Information 11
Outline Dimensions 11
Ordering Guide 11

REVISION HISTORY

10/15—Revision 0: Initial Version

SPECIFICATIONS

T_A = −40°C to +85°C, V_{CC} = 5 V, unless otherwise noted.

Table 1.

Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
FREQUENCY					
Range					
Output Frequency (f_{OUT})	11.07		11.62	GHz	
Half Output Frequency (f_{OUT}/2)	5.535		5.810	GHz	
Drift Rate		1.2		MHz/°C	
Pulling		0.35		MHz p-p	Pulling into a 2.0:1 voltage standing wave ratio (VSWR)
Pushing		10		MHz/V	At VTUNE = 5 V
OUTPUT POWER (P_{OUT})					
RFOUT	4.5	8	11.5	dBm	
RFOUT/2	2	5	10	dBm	
Supply Current (I_{CC})		185		mA	V_{CC} = 4.75 V
	160	210	280	mA	V_{CC} = 5.00 V
		230		mA	V_{CC} = 5.25 V
HARMONICS, SUBHARMONICS					
1/2		35		dBc	
3/2		16		dBc	
Second		14		dBc	
Third		25		dBc	
TUNING					
Voltage (VTUNE)	2		13	V	
Sensitivity	70		310	MHz/V	
Tune Port Leakage Current			10	µA	VTUNE = 13 V
OUTPUT RETURN LOSS		4		dB	
SSB PHASE NOISE					
10 kHz Offset		−88	−82	dBc/Hz	
100 kHz Offset		−113	−109	dBc/Hz	

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
V_{CC}	5.5 V dc
VTUNE	0 V to 15 V
Temperature	
Operating	−40°C to +85°C
Storage	−65°C to +150°C
Nominal Junction (to Maintain 1 Million Hours Mean Time to Failure (MTTF))	135°C
Nominal Junction (T_A = 85°C)	117°C
Maximum Reflow Temperature (MSL3 Rating)	260°C
Thermal Resistance (Junction to Ground Paddle)	27.6°C/W
ESD Sensitivity (Human Body Model)	Class 1A

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

ESD CAUTION



ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

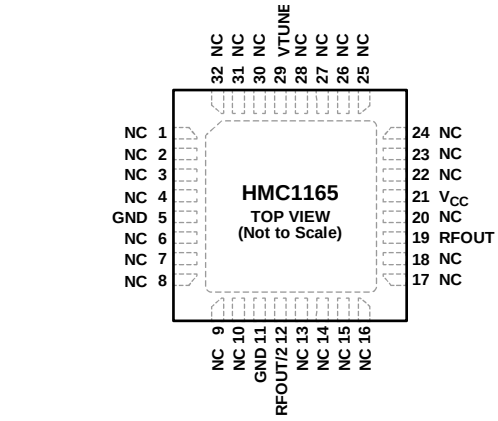


Figure 2. Pin Configuration

Table 3. Pin Function Descriptions

Pin No.	Mnemonic	Description
1 to 4, 6 to 10, 13 to 18, 20, 22 to 28, 30 to 32	NC	No Connect. However, these pins can be connected to RF/dc ground without affecting the performance of the device.
5, 11	GND	Ground. These pins must be connected to RF/dc ground.
12	RFOUT/2	Half Frequency Output. This pin is ac-coupled.
19	RFOUT	RF Output. This pin is ac-coupled.
21	V_{CC}	Supply Voltage (5 V).
29	VTUNE	Control Voltage and Modulation Input. The modulation bandwidth is dependent on the drive source impedance.
	EP	Exposed Pad. The package bottom has an exposed metal pad that must be connected to RF/dc ground.

INTERFACE SCHEMATICS

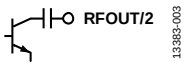


Figure 3. RFOUT/2 Interface

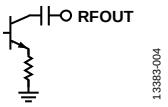


Figure 4. RFOUT Interface

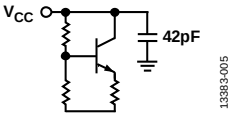


Figure 5. V_{CC} Interface

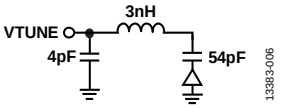


Figure 6. VTUNE Interface



Figure 7. GND Interface

TYPICAL PERFORMANCE CHARACTERISTICS

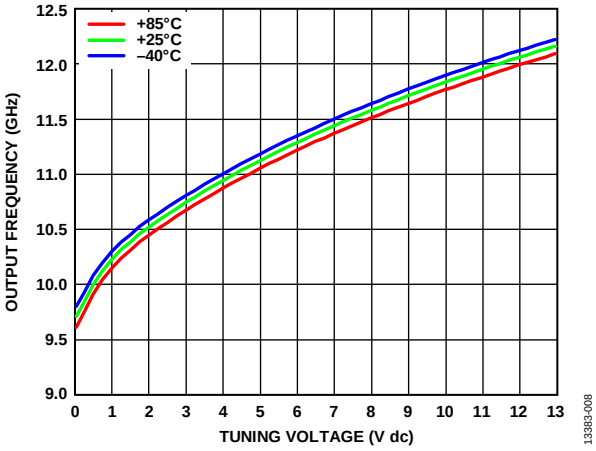


Figure 8. Output Frequency vs. Tuning Voltage

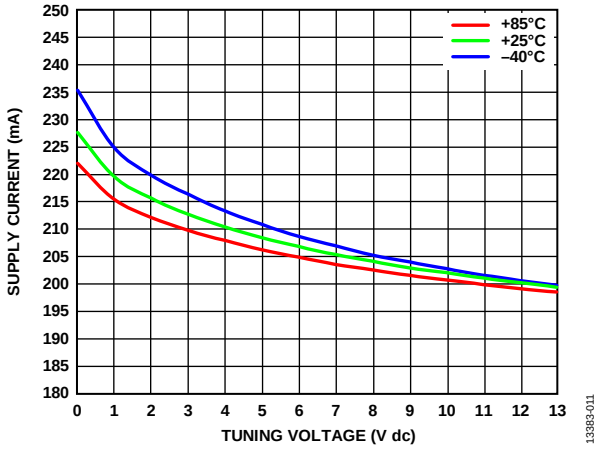


Figure 11. Supply Current vs. Tuning Voltage

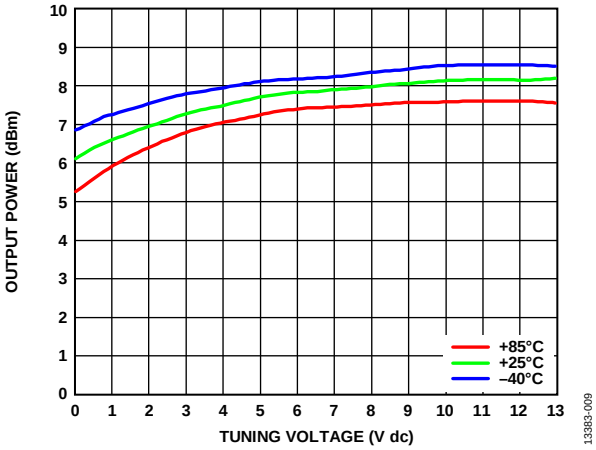


Figure 9. Output Power vs. Tuning Voltage

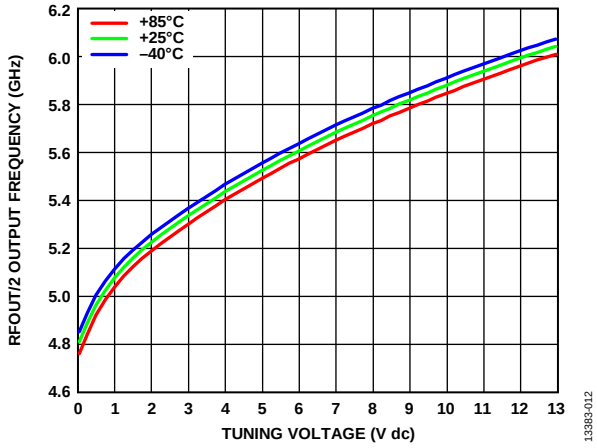


Figure 12. RFOUT/2 Output Frequency vs. Tuning Voltage

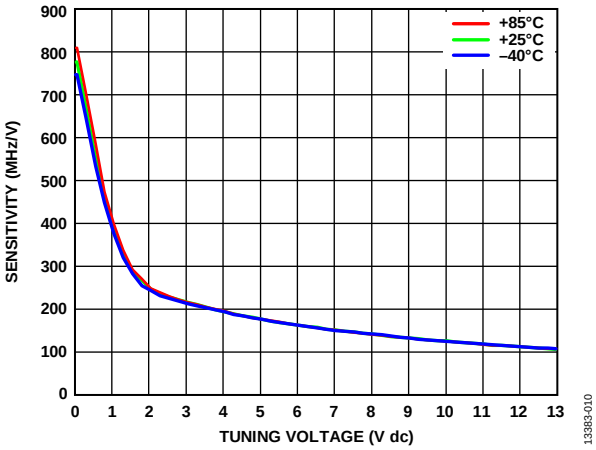


Figure 10. Sensitivity vs. Tuning Voltage

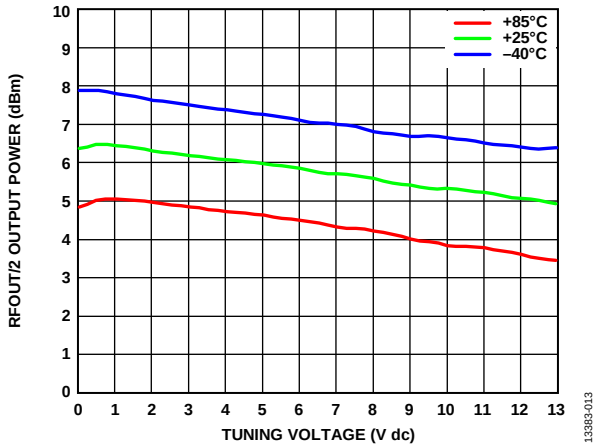


Figure 13. RFOUT/2 Output Power vs. Tuning Voltage

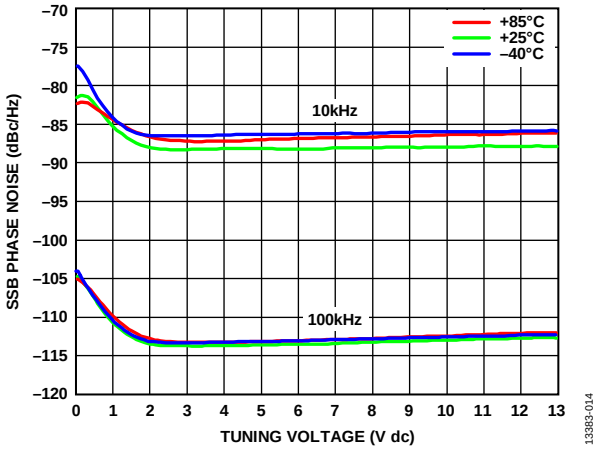


Figure 14. SSB Phase Noise vs. Tuning Voltage

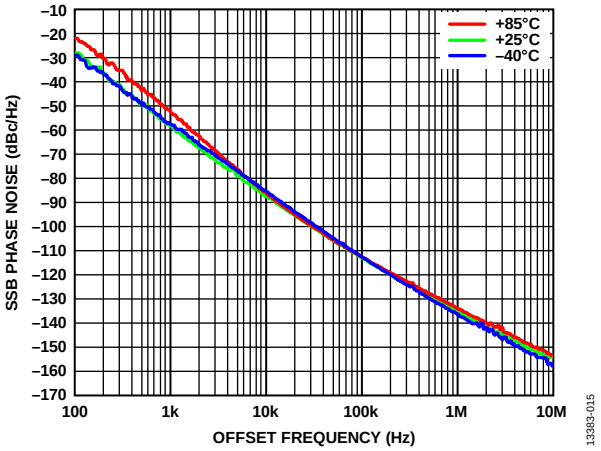


Figure 15. SSB Phase Noise vs. Offset Frequency at VTUNE = 5 V

APPLICATIONS INFORMATION

The HMC1165 serves as the local oscillator (LO) in microwave synthesizer applications. The primary applications are point to point microwave radios, military, radars, test and measurement, as well as industrial and medical equipment. The low phase noise allows higher orders of modulation and offers improved bit error rates in communication systems, whereas the linear, monotonic tuning sensitivity allows a stable loop filter design. The higher output power minimizes the gain required to drive subsequent stages. The half frequency output reduces the input frequency to the prescaler without the addition of residual phase noise to the input of the phase-locked loop synthesizer.

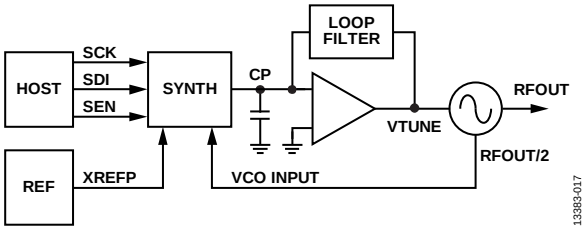


Figure 16. Typical Application Diagram

EVALUATION PRINTED CIRCUIT BOARD (PCB)

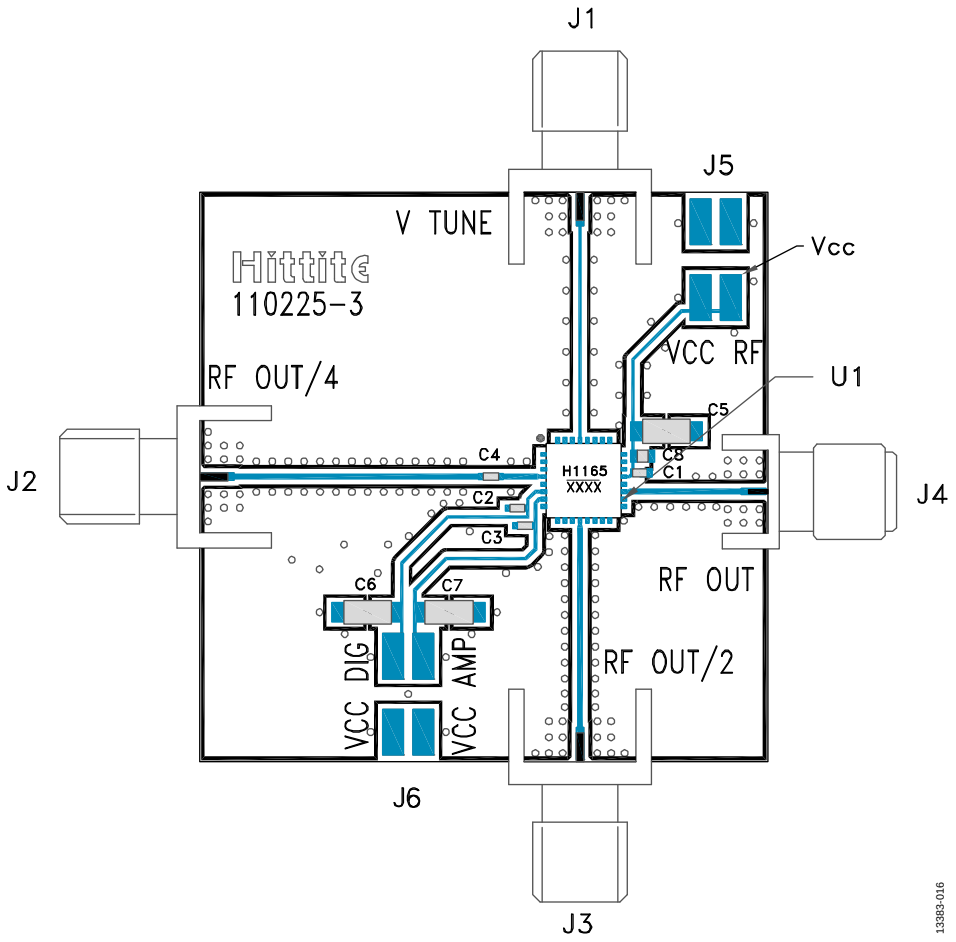


Figure 17. Evaluation Board

The circuit board used in an application uses RF circuit design techniques. Ensure that the signal lines have 50 Ω impedance and that the package ground leads and backside ground paddle are connected directly to the ground plane.

Use a sufficient number of via holes to connect the top and bottom ground planes. The evaluation circuit board shown in Figure 17 is available from Analog Devices, Inc., upon request.

BILL OF MATERIALS

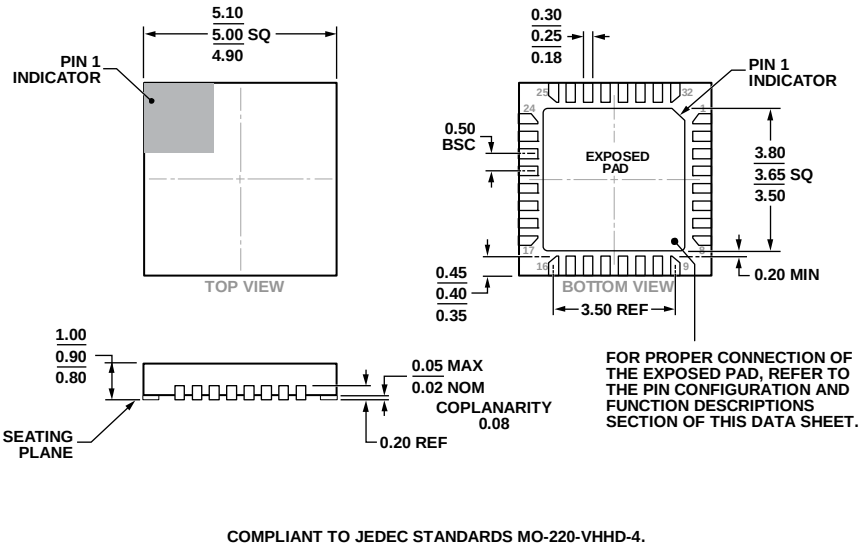
Table 4. Bill of Materials, EV1HMC1165LP5

Item	Description
J1 to J4	PCB mount SMA RF connectors
J5, J6	2 mm dc headers
C1 to C3	100 pF capacitors, 0402 package
C4	1000 pF capacitor, 0402 package
C5 to C7	2.2 µF tantalum capacitors
C8	0.01 µF capacitor, 0603 package
U1	HMC1165 VCO
PCB[1]	110225 evaluation board[2]

[1] Circuit board material is Rogers 4350.
[2] Reference this number when ordering the complete evaluation PCB.

PACKAGING AND ORDERING INFORMATION

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-220-VHHD-4.

Figure 18. 32-Lead Lead Frame Chip Scale Package [LFCSP_VQ]
5 mm × 5 mm Body, Very Thin Quad
(HCP-32-1)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1]	Temperature Range	MSL Rating[2]	Package Description	Package Option	Qty.	Brand[3]
HMC1165LP5E	−40°C to +85°C	MSL3	32-Lead LFCSP_VQ	HCP-32-1		H1165/XXXX
HMC1165LP5ETR	−40°C to +85°C	MSL3	32-Lead LFCSP_VQ, 7″ Tape and Reel	HCP-32-1	500	H1165/XXXX
EV1HMC1165LP5			Evaluation Board			

[1] The HMC1165LP5E and HMC1165LP5ETR are RoHS compliant parts.
[2] See the Absolute Maximum Ratings section, Table 2.
[3] XXXX is a placeholder for the 4-digit lot number.

©2015 Analog Devices, Inc. All rights reserved. Trademarks and registered trademarks are the property of their respective owners.
D13383-0-10/15(0)