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# MMIC VCO with Half Frequency Output, 8.45 GHz to 9.30 GHz

Data Sheet **HMC1160**

## FEATURES

**Dual output: $f_O$ = 8.45 GHz to 9.3 GHz**
**$f_O/2$ = 4.225 GHz to 4.65 GHz**
**$P_{OUT}$: 12 dBm**
**Phase noise: −116 dBc/Hz at 100 kHz**
**No external resonator needed**
**RoHS compliant, 5 mm × 5 mm SMT package: 25 mm²**

## APPLICATIONS

**Point to point and multipoint radio**
**Test equipment and industrial controls**
**VSAT**

## FUNCTIONAL BLOCK DIAGRAM

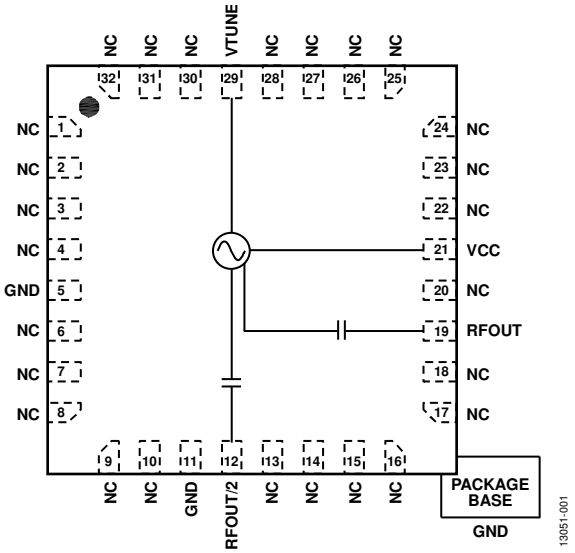



*Figure 1.*

## GENERAL DESCRIPTION

The HMC1160 is a MMIC voltage controlled oscillator 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, output power and phase noise performance are excellent over temperature.

Power output is 12 dBm typical from a 5 V supply voltage. The voltage controlled oscillator is housed in a RoHS compliant SMT package and requires no external matching components.

**Rev. A** Document Feedback


One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 781.329.4700 
Technical Support www.analog.com

# HMC1160* PRODUCT PAGE QUICK LINKS

Last Content Update: 02/23/2017

## COMPARABLE PARTS

View a parametric search of comparable parts.

## EVALUATION KITS

- EV1HMC1160LP5 Evaluation Board

## DOCUMENTATION

**Data Sheet**

- HMC1160: MMIC VCO with Half Frequency Output, 8.45 GHz to 9.30 GHz Data Sheet

## REFERENCE MATERIALS

**Quality Documentation**

- Package/Assembly Qualification Test Report: LP3, LP4, LP5 & LP5G (QTR: 2014-00145)

## DESIGN RESOURCES

- HMC1160 Material Declaration
- PCN-PDN Information
- Quality And Reliability
- Symbols and Footprints

## DISCUSSIONS

View all HMC1160 EngineerZone Discussions.

## SAMPLE AND BUY

Visit the product page to see pricing options.

## TECHNICAL SUPPORT

Submit a technical question or find your regional support number.

## DOCUMENT FEEDBACK

Submit feedback for this data sheet.

# TABLE OF CONTENTS



## REVISION HISTORY

**5/15—v00.0814 to Rev. A**

This Hittite Microwave Products data sheet has been reformatted to meet the styles and standards of Analog Devices, Inc.

Updated Format ..... Universal
Added Interface Schematics Section, Renumbered Figures Sequentially ..... 6
Reordered Figure Sequence, Typical Performance Characteristics Section ..... 7
Deleted Figure: Frequency vs. Tuning Voltage, T = 25°C, Renumbered Figures Sequentially ..... 7
Deleted Typical Applications Circuit ..... 9
Changes to Ordering Guide ..... 11

# 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 | | | | | |
| $f_O$ | 8.45 | | 9.3 | GHz | |
| $f_O/2$ | 4.225 | | 4.65 | GHz | |
| Drift Rate | | 0.74 | | MHz/°C | |
| Pulling | | 4.5 | | MHz p-p | Pulling into a 2.0:1 VSWR |
| Pushing | | 5.5 | | MHz/V | At VTUNE = 5 V |
| POWER OUTPUT | | | | | |
| RFOUT | 9 | | 17 | dBm | |
| RFOUT/2 | 0 | | 8 | dBm | |
| Supply Current ($I_{CC}$) | | 240 | | mA | $V_{CC}$ = 4.75 V |
| | 195 | 260 | 325 | mA | $V_{CC}$ = 5.00 V |
| | | 275 | | mA | $V_{CC}$ = 5.25 V |
| HARMONICS, SUBHARMONICS | | | | | |
| 1/2 | | 37 | | dBc | |
| Second | | 18 | | dBc | |
| Third | | 30 | | dBc | |
| TUNING | | | | | |
| Voltage (VTUNE) | 2 | | 13 | V | |
| Sensitivity | 40 | | 250 | MHz/V | |
| Tune Port Leakage Current | | | 10 | µA | VTUNE = 13 V |
| OUTPUT RETURN LOSS | | 2 | | dB | |
| SSB PHASE NOISE | | | | | |
| 10 kHz Offset | | −90 | −85 | dBc/Hz | |
| 100 kHz Offset | | −116 | −110 | 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 MTTF) | 135°C |
| Nominal Junction (T = 85°C) | 125°C |
| Maximum Reflow Temperature (MSL3 Rating) | 260°C |
| Thermal Resistance (Junction to Ground Paddle) | 31°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

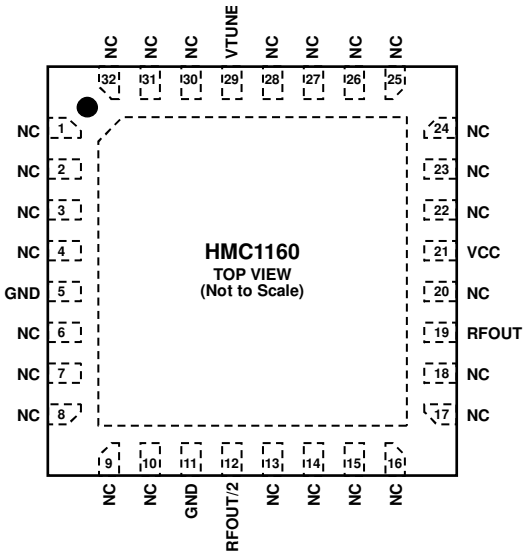



*Figure 2. Pin Configuration*

**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. |
| 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. |
| 5, 11 | GND | Ground. These pins must be connected to RF/dc ground. |
| | EP | Exposed Paddle. The package bottom has an exposed metal paddle that must be connected to RF/dc ground. |

## INTERFACE SCHEMATICS

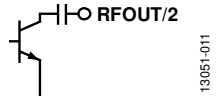



Figure 3. RFOUT/2 Interface

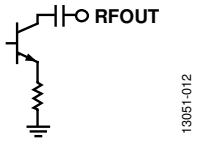



Figure 4. RFOUT Interface

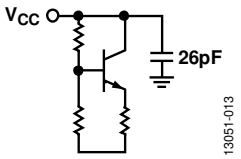



Figure 5. $V_{CC}$ Interface

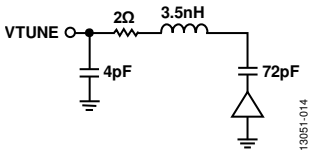



Figure 6. VTUNE Interface

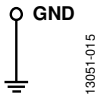



Figure 7. GND Interface

# TYPICAL PERFORMANCE CHARACTERISTICS

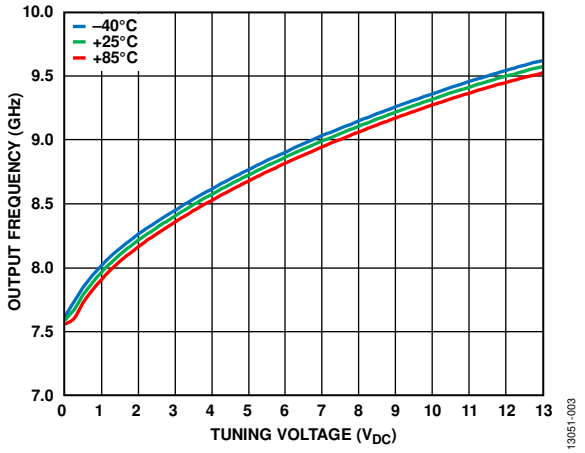



Figure 8. Frequency vs. Tuning Voltage

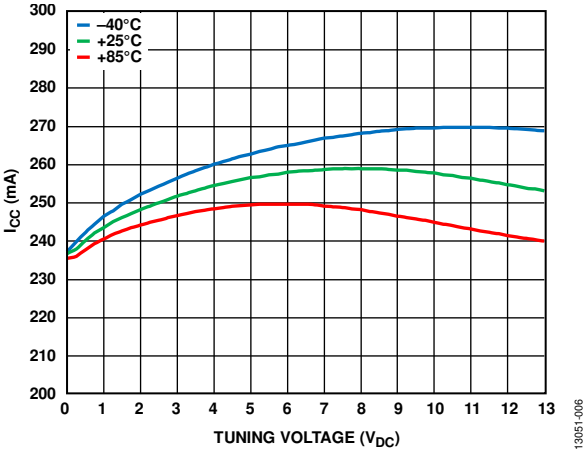



Figure 11. Supply Current ($I_{CC}$) vs. Tuning Voltage

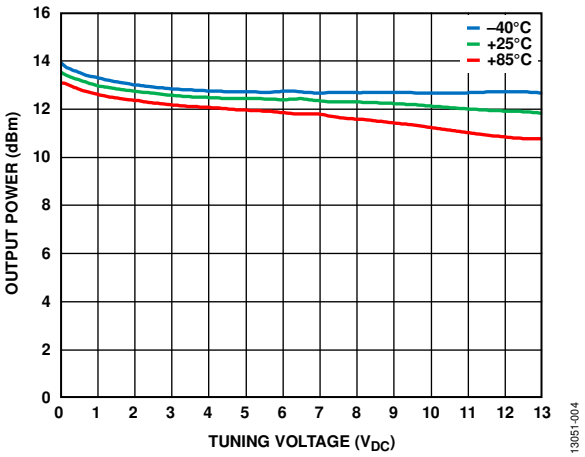



Figure 9. Output Power vs. Tuning Voltage

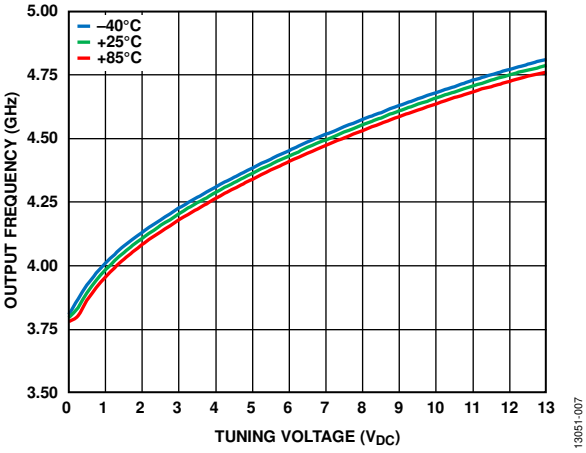



Figure 12. RFOUT/2 Output Frequency vs. Tuning Voltage

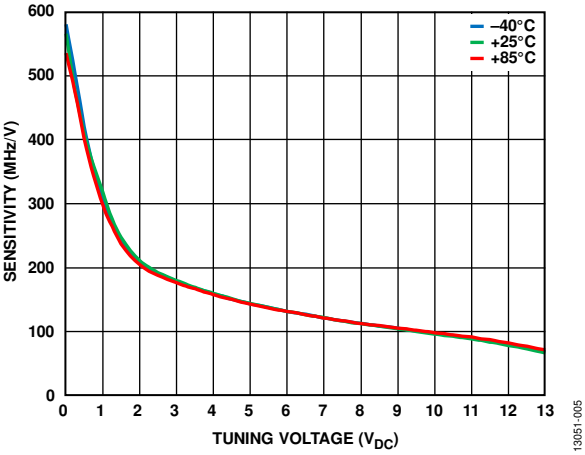



Figure 10. Sensitivity vs. Tuning Voltage

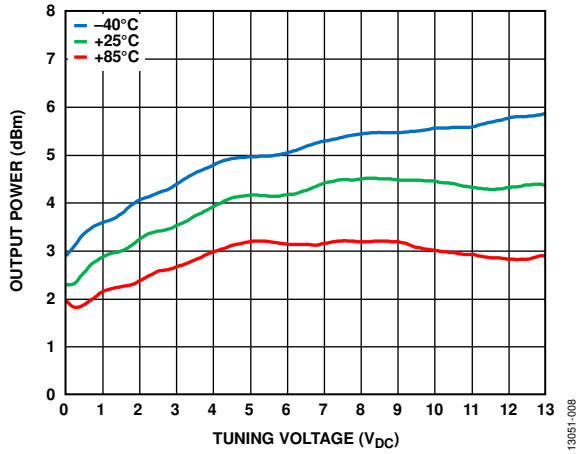



Figure 13. RFOUT/2 Output Power vs. Tuning Voltage

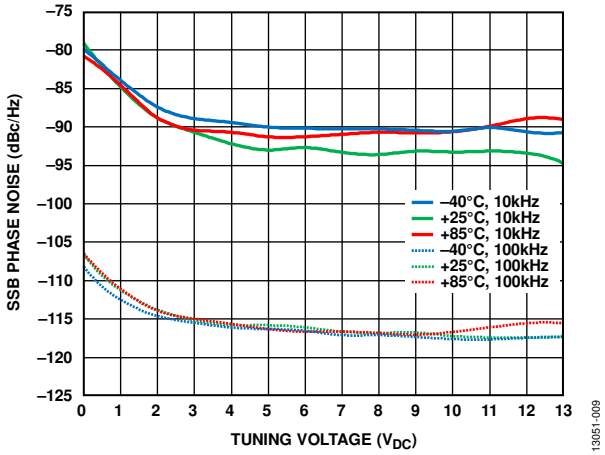



Figure 14. SSB Phase Noise vs. Tuning Voltage

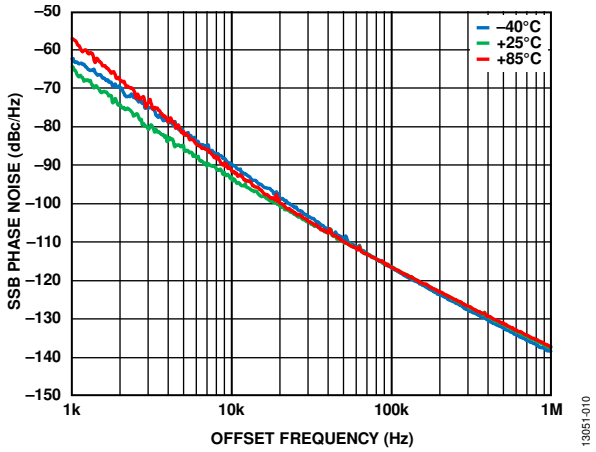



Figure 15. SSB Phase Noise at VTUNE = 5 V

# EVALUATION PRINTED CIRCUIT BOARD (PCB)

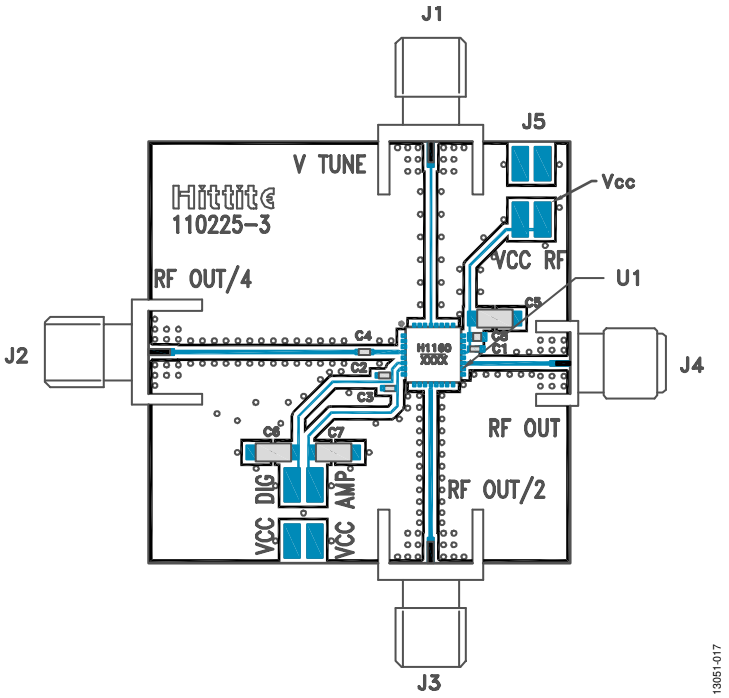



*Figure 16. Evaluation Board*

The circuit board used in an application uses RF circuit design techniques. Ensure that 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 16 is available from Analog Devices, Inc., upon request.

## BILL OF MATERIALS

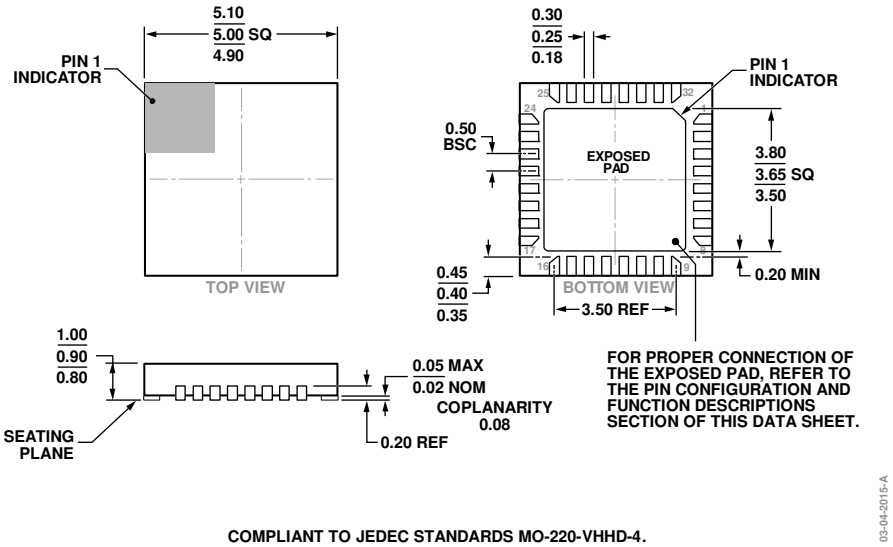
**Table 4. Bill of Materials EV1HMC1160LP5**

| Item | Description |
|---|---|
| J1 to J4 | PCB mount SMA RF connector |
| J5, J6 | 2 mm dc header |
| C1 to C3 | 100 pF capacitor, 0402 package |
| C4 | 1000 pF capacitor, 0402 package |
| C5 to C7 | 2.2 µF tantalum capacitor |
| C8 | 0.01 µF capacitor, 0603 package |
| U1 | HMC1160 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 17. 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] |
|---|---|---|---|---|---|---|
| HMC1160LP5E | −40°C to +85°C | MSL3 | 32-Lead LFCSP_VQ | HCP-32-1 | | H1160<br>XXXX |
| HMC1160LP5ETR | −40°C to +85°C | MSL3 | 32-Lead LFCSP_VQ, 7" Tape and Reel | HCP-32-1 | 500 | H1160<br>XXXX |
| EV1HMC1160LP5 | | | Evaluation Board | | | |

[1] The HMC1160LP5E and HMC1160LP5ETR are RoHS compliant parts.
[2] See the Absolute Maximum Ratings section, Table 2.
[3] XXXX is a placeholder for the 4-digit lot number.


D13051-0-5/15(A)