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## MMIC VCO WITH HALF FREQUENCY OUTPUT 9.25 - 10.10 GHz

### Typical Applications

Low noise MMIC VCO w/half frequency output for:

- Point to point/multipoint radio
- Test equipment and industrial controls
- VSAT

### Features

Dual output:  $F_o = 9.25 \text{ GHz} - 10.10 \text{ GHz}$   
 $F_o/2 = 4.625 \text{ GHz} - 5.050 \text{ GHz}$

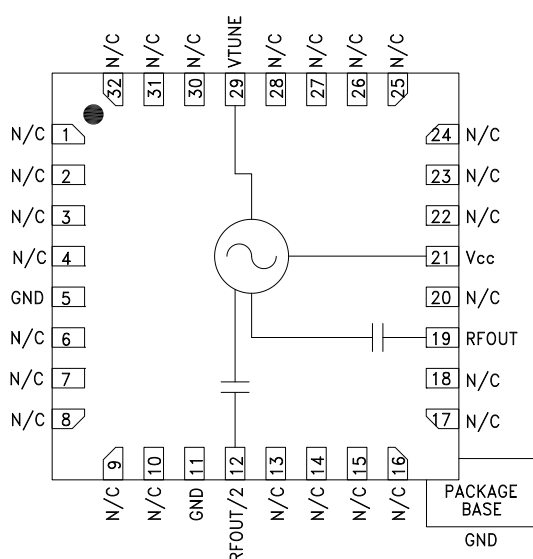
Pout: +11 dBm

Phase noise: -115 dBc/Hz @ 100 kHz

No external resonator needed

RoHS compliant 5 x 5 mm SMT package: 25 mm<sup>2</sup>

### Functional Diagram



### General Description

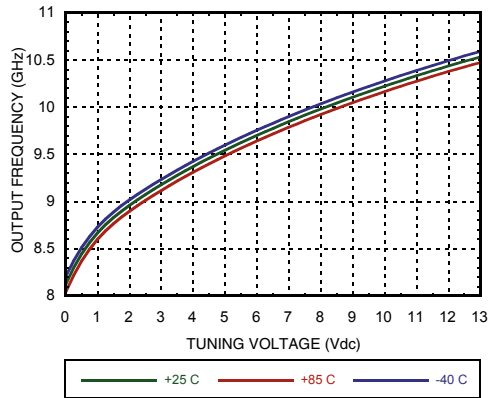
The HMC1162P5E is a MMIC voltage controlled oscillator that integrates resonator, negative resistance device, varactor diode and features a half frequency output. Output power and phase noise performance are excellent over temperature due to the oscillators' monolithic construction. Power output is +11 dBm typical from a +5V supply voltage. The voltage controlled oscillator is housed in a RoHS compliant SMT package and requires no external matching components.

### Electrical Specifications, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ , $V_{cc} = +5\text{V}$

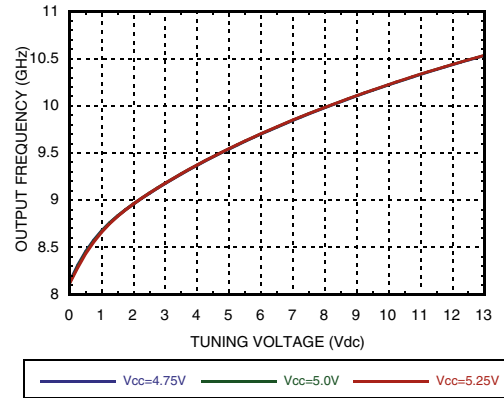
| Parameter                                             | Min.                            | Typ.                          | Max.        | Units                    |
|-------------------------------------------------------|---------------------------------|-------------------------------|-------------|--------------------------|
| Frequency range                                       | $F_o$<br>$F_o/2$                | 9.25 - 10.10<br>4.625 - 5.050 |             | GHz<br>GHz               |
| Power output                                          | RFOUT<br>RFOUT/2                | 7<br>3                        | 15<br>12    | dBm<br>dBm               |
| SSB phase noise                                       | 10 kHz offset<br>100 kHz offset | -86<br>-115                   | -83<br>-110 | dBc/Hz<br>dBc/Hz         |
| Tune voltage                                          | Vtune                           | 2                             | 13          | V                        |
| Supply current ( $I_{cc}$ ) ( $V_{cc} = +5\text{V}$ ) |                                 | 160                           | 310         | mA                       |
| Tune port leakage current ( $V_{tune} = 13\text{V}$ ) |                                 |                               | 10          | $\mu\text{A}$            |
| Tuning sensitivity                                    |                                 | 50                            | 350         | MHz/V                    |
| Output return loss                                    |                                 | 7                             |             | dB                       |
| Harmonics/subharmonics                                | 1/2<br>3/2<br>2nd<br>3rd        | 39<br>23<br>14<br>22          |             | dBc<br>dBc<br>dBc<br>dBc |
| Pulling (into a 2.0:1 VSWR)                           |                                 | 0.5                           |             | MHz pp                   |
| Pushing @ $V_{tune} = 5\text{V}$                      |                                 | 6                             |             | MHz/V                    |
| Frequency drift rate                                  |                                 | 1.0                           |             | MHz/ $^\circ\text{C}$    |

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**9.25 - 10.10 GHz**

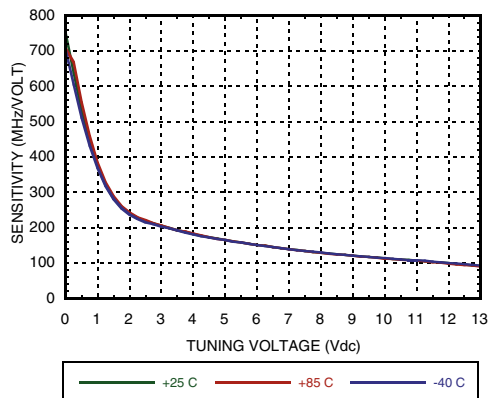
**Frequency vs. Tuning Voltage**



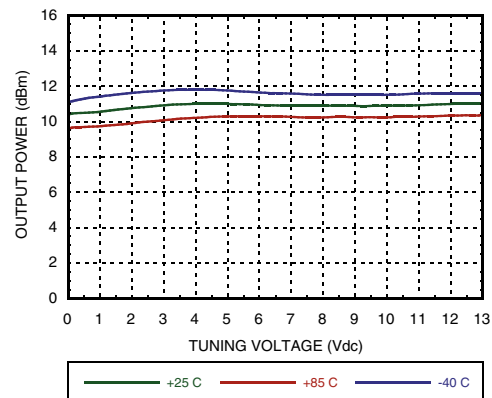
**Frequency vs. Tuning Voltage,  $T = 25^{\circ}\text{C}$**



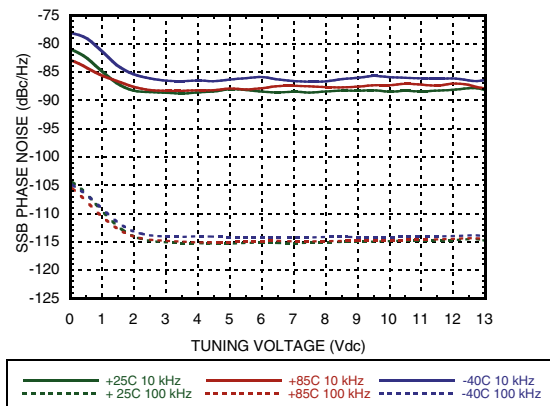
**Sensitivity vs. Tuning Voltage**



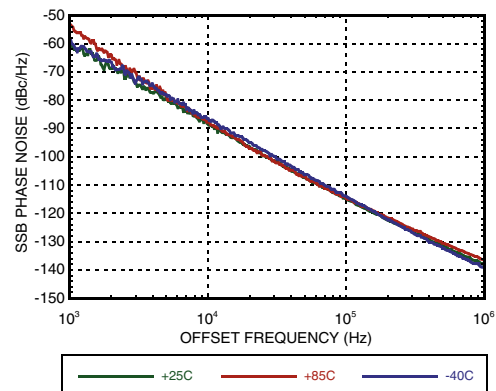
**Output Power vs. Tuning Voltage**



**SSB Phase Noise vs. Tuning Voltage**

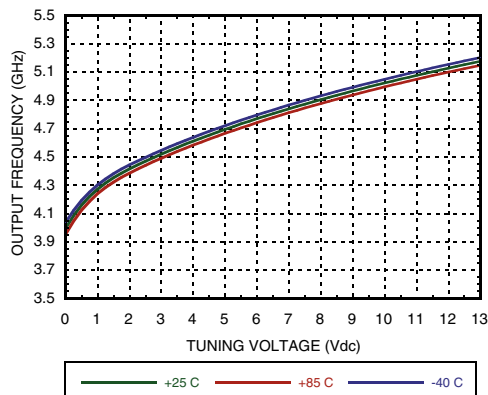


**SSB Phase Noise @  $V_{\text{tune}} = +5\text{V}$**

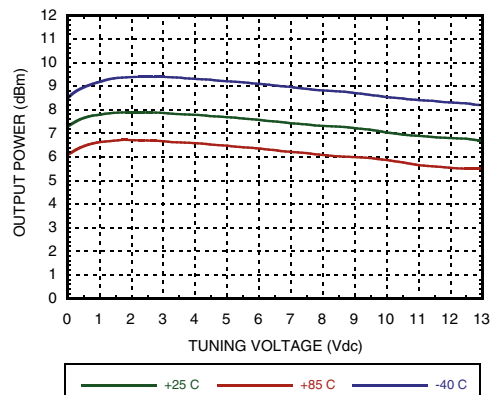


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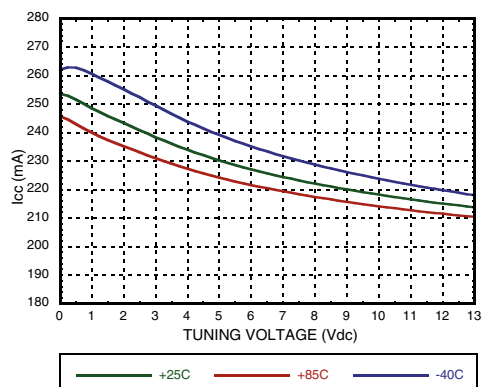
**RFOUT/2 Frequency vs. Tuning Voltage**



**RFOUT/2 Output Power vs. Tuning Voltage**



**Supply Current vs. Tuning Voltage**



**Typical Supply Current vs. Vcc**

| Vcc (V) | Icc (mA) |
|---------|----------|
| 4.75    | 205      |
| 5.00    | 230      |
| 5.25    | 250      |

**Absolute Maximum Ratings**

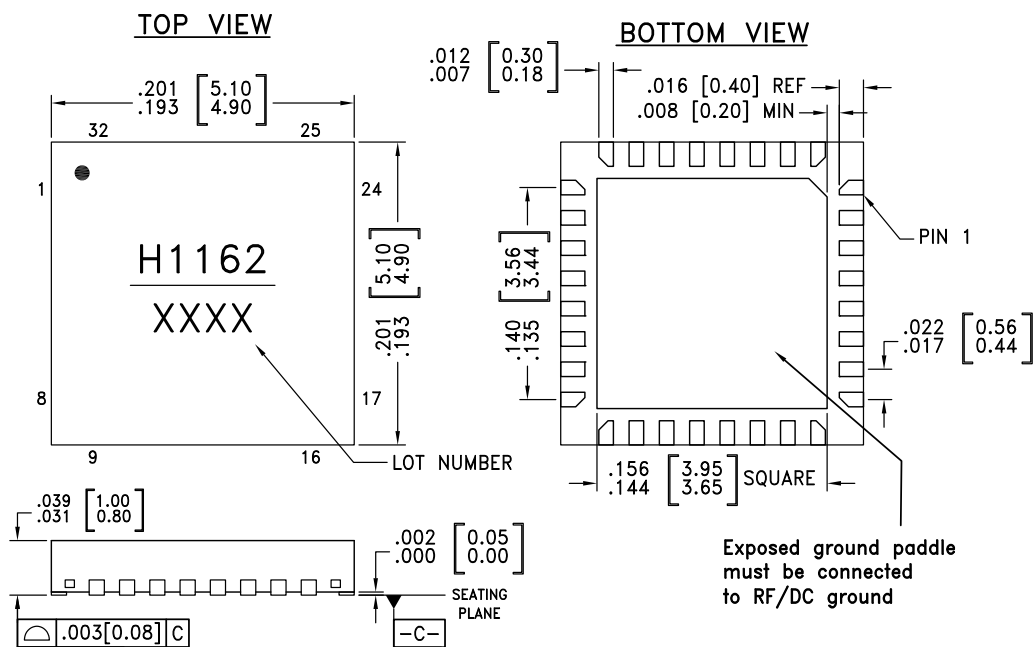
|                       |                   |
|-----------------------|-------------------|
| Vcc                   | +5.5 Vdc          |
| Vtune                 | 0V to +15V        |
| Storage temperature   | -65 °C to +150 °C |
| ESD sensitivity (HBM) | Class 1A          |

**Reliability Information**

|                                                       |                  |
|-------------------------------------------------------|------------------|
| Junction temperature to maintain 1 million hours MTTF | 135 °C           |
| Nominal junction temperature (T = +85 °C)             | 116.3 °C         |
| Thermal resistance (junction to ground paddle)        | 24.3 °C/W        |
| Operating temperature                                 | -40 °C to +85 °C |

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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.
8. MAX PEAK REFLOW TEMPERATURE OF 260 °C

**Package Information**

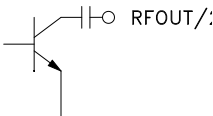
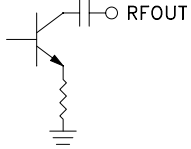
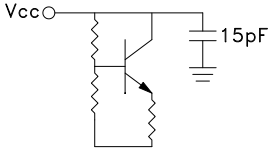
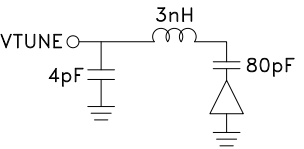
| Part Number | Package Body Material                              | Lead Finish   | MSL Rating          | Package Marking <sup>[1]</sup> |
|-------------|----------------------------------------------------|---------------|---------------------|--------------------------------|
| HMC1162LP5E | RoHS-compliant low stress injection molded plastic | 100% matte Sn | MSL3 <sup>[2]</sup> | H1162<br>XXXX                  |

[1] 4-digit lot number XXXX

[2] Max peak reflow temperature of 260 °C

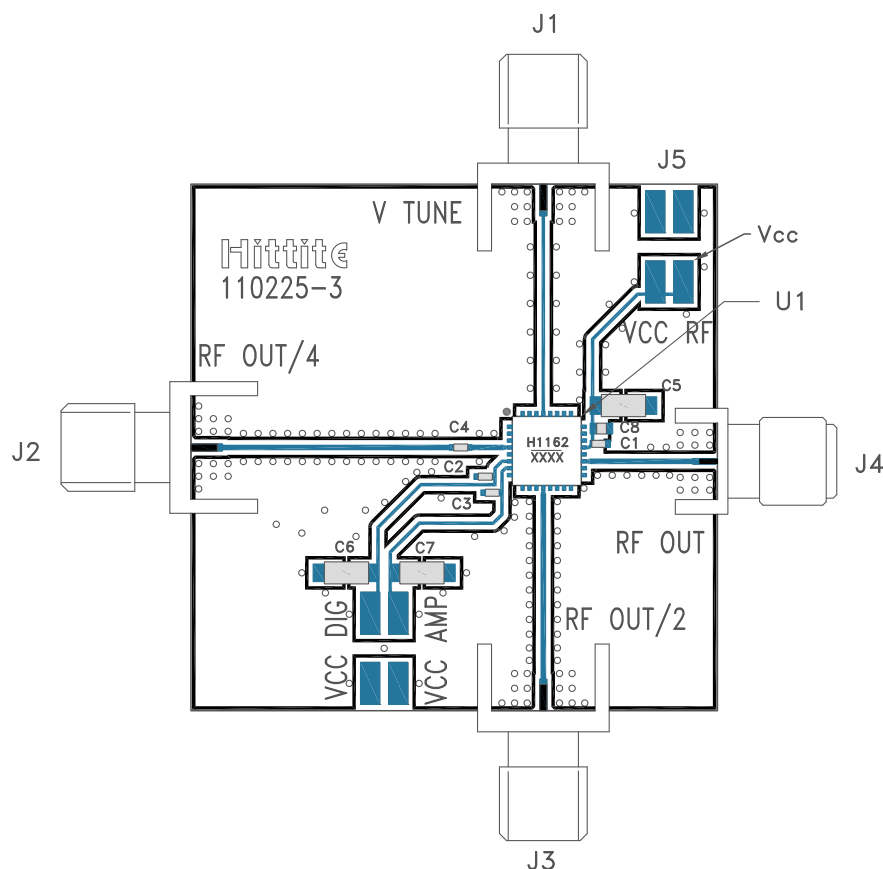
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**Pin Descriptions**

| Pin Number                                      | Function | Description                                                                                     | Interface Schematic                                                                   |
|-------------------------------------------------|----------|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 1 - 4, 6 - 10, 13 - 18,<br>20, 22 - 28, 30 - 32 | N/C      | No connection. These pins may be connected to RF/DC ground. Performance will not be affected.   |                                                                                       |
| 12                                              | RFOUT/2  | Half frequency output (AC coupled).                                                             |    |
| 19                                              | RF OUT   | RF output (AC coupled).                                                                         |    |
| 21                                              | Vcc      | Supply voltage, +5V                                                                             |    |
| 29                                              | VTUNE    | Control voltage and modulation input. Modulation bandwidth dependent on drive source impedance. |   |
| 5, 11, Paddle                                   | GND      | Package bottom has an exposed metal paddle that must be connected to RF/DC ground.              |  |

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**Evaluation PCB**



**List of Materials for Evaluation PCB EV1HMC1162LP5 [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 $\mu$ F tantalum capacitor    |
| C8      | 0.01 $\mu$ F Capacitor, 0603 pkg. |
| U1      | HMC1162LP5E 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  $\Omega$  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.