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HMC398* Product Page Quick Links

Last Content Update: 11/01/2016

[Comparable Parts](#)

View a parametric search of comparable parts

[Evaluation Kits](#)

- HMC398QS16G Evaluation Board

[Documentation](#)

Data Sheet

- HMC398 Data Sheet

[Reference Materials](#)

Quality Documentation

- HMC Legacy PCN: QS##, QS##E and QS##G, QS##GE packages - Relocation of pre-existing production equipment to new building
- Package/Assembly Qualification Test Report: Plastic Encapsulated QSOP (QTR: 02015 REV: 11)
- Semiconductor Qualification Test Report: GaAs HBT-A (QTR: 2013-00228)

Technical Articles

- Low Cost Plastic MMIC VCOs

[Design Resources](#)

- HMC398 Material Declaration
- PCN-PDN Information
- Quality And Reliability
- Symbols and Footprints

[Discussions](#)

View all HMC398 EngineerZone Discussions

[Sample and Buy](#)

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Typical Applications

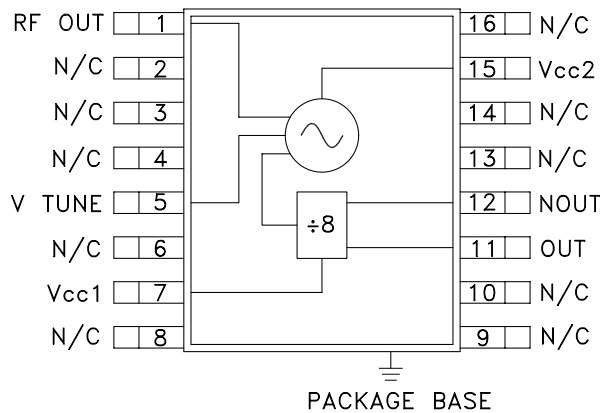
Low noise MMIC VCO w/Divide-by-8 for Ku-Band applications such as:

- Point-to-Point Radios
- Point-to-Multi-Point Radios / LMDS
- VSAT

Features

- Pout: +7 dBm
- Phase Noise: -105 dBc/Hz @100 kHz Typ.
- No External Resonator Needed
- Single Supply: 5V @ 325 mA
- QSOP16G SMT Package

Functional Diagram



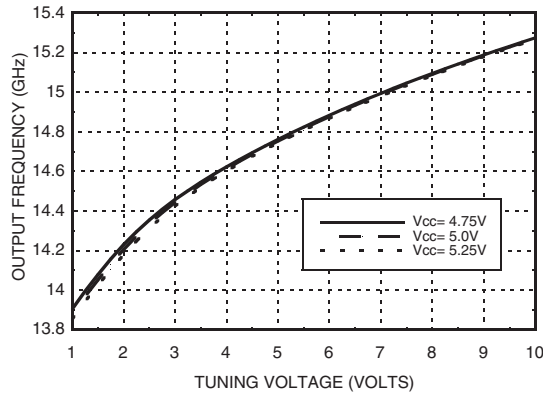
General Description

The HMC398QS16G & HMC398QS16GE are single chip GaAs InGaP Heterojunction Bipolar Transistor (HBT) MMIC VCOs. The HMC398QS16G & HMC398QS16GE integrate resonators, negative resistance devices, varactor diodes and divide-by-8 prescalers. The VCO's phase noise performance is excellent over temperature, shock, and process due to the oscillator's monolithic structure. Power output is +7 dBm typical from a 5V supply voltage. The voltage controlled oscillator is packaged in a low cost, surface mount 16 leaded QSOP package with an exposed base for improved RF and thermal performance. The HMC398QS16G & HMC398QS16GE require no external components

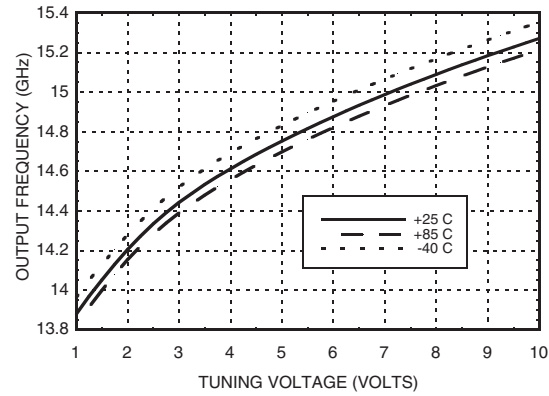
Electrical Specifications, $T_A = +25^\circ\text{C}$, $V_{cc1}, V_{cc2} = +5.0\text{V}$

| Parameter | Min. | Typ. | Max. | Units |
|---|-------------------------------|----------|--------------------------|--------------------------|
| Frequency Range | 14.0 - 15.0 | | | GHz |
| Power Output | RF Output Divided Output | +3 -9 | +7 -6 | dBm dBm |
| SSB Phase Noise @ 100 kHz Offset, $V_{tune} = +5\text{V}$ @ RF Output | | -105 | | dBc/Hz |
| Tune Voltage | V_{tune} | 1.0 | 10.0 | V |
| Supply Current | Icc 1 (Digital) Icc 2 (RF) | | 65 260 | mA mA |
| Tune Port Leakage Current ($V_{tune} = 10\text{V}$) | | | 10 | μA |
| Output Return Loss | | 2 | | dB |
| Harmonics/Subharmonics | 1/2 3/2 2nd 5/2 | | -20 -30 -12 -40 | dBc dBc dBc dBc |
| Pulling (into a 2.0:1 VSWR) | | 4 | | MHz pp |
| Pushing @ $V_{tune} = 5\text{V}$ | | 30 | | MHz/V |
| Frequency Drift Rate | | 1.5 | | MHz/ $^\circ\text{C}$ |

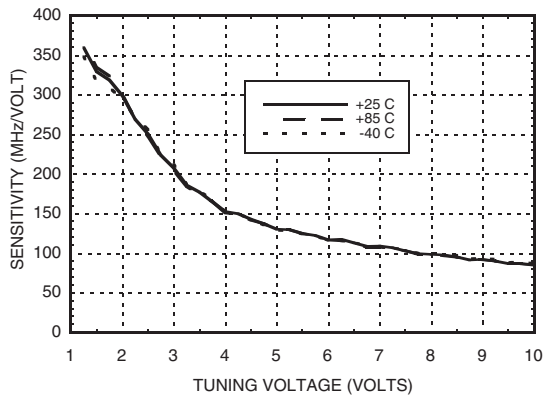
Frequency vs. Tuning Voltage, $T = 25^{\circ}\text{C}$



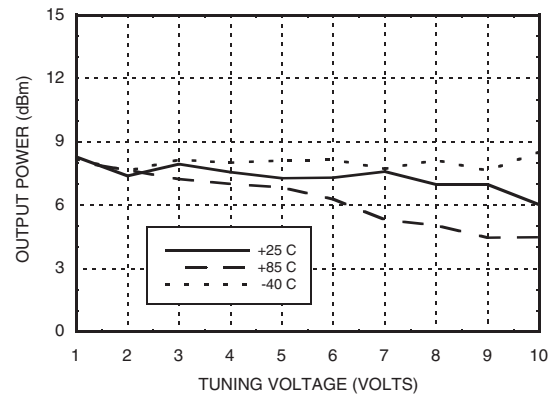
Frequency vs. Tuning Voltage, $V_{cc} = +5V$



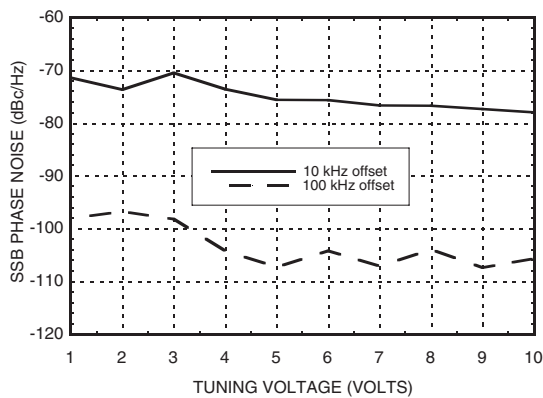
Sensitivity vs. Tuning Voltage, $V_{cc} = +5V$



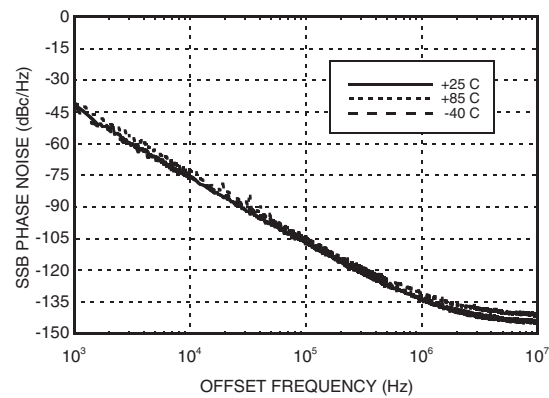
Output Power vs. Tuning Voltage, $V_{cc} = +5V$

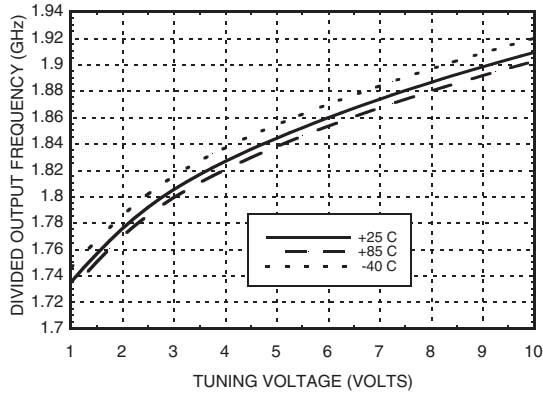
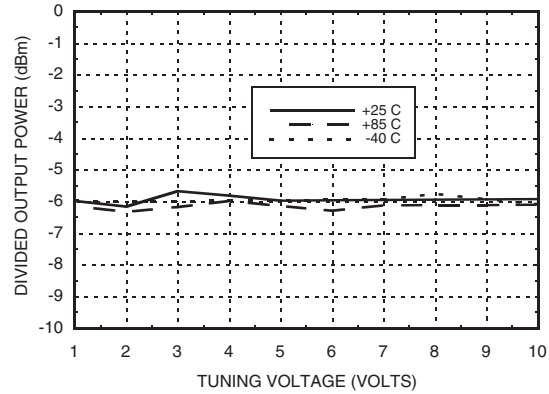
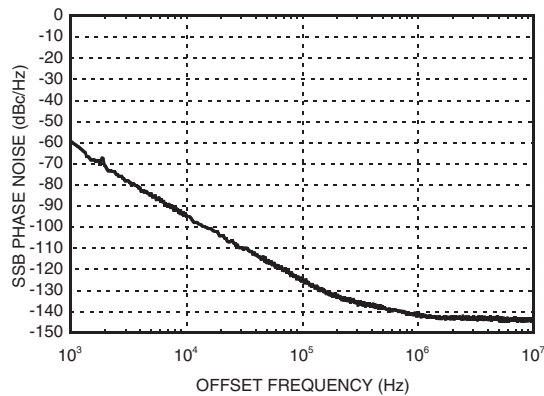


SSB Phase Noise vs. Tuning Voltage



SSB Phase Noise @ $V_{tune} = 5V$



**Divided Output
Frequency vs. Tuning Voltage, Vcc= +5V**

**Divided Output
Power vs. Tuning Voltage, Vcc= +5V***

**Divided Output
SSB Phase Noise @ Vtune = 5V**

Absolute Maximum Ratings

| | |
|-----------------------|----------------|
| Vcc1, Vcc2 | +5.5 |
| Storage Temperature | -65 to +150 °C |
| Operating Temperature | -40 to +85 °C |
| Vtune | 0 to 11V |

Typical Supply Current vs. Vcc

| Vcc (V) | Icc (mA) |
|---------|----------|
| 4.75 | 300 |
| 5.0 | 325 |
| 5.25 | 350 |

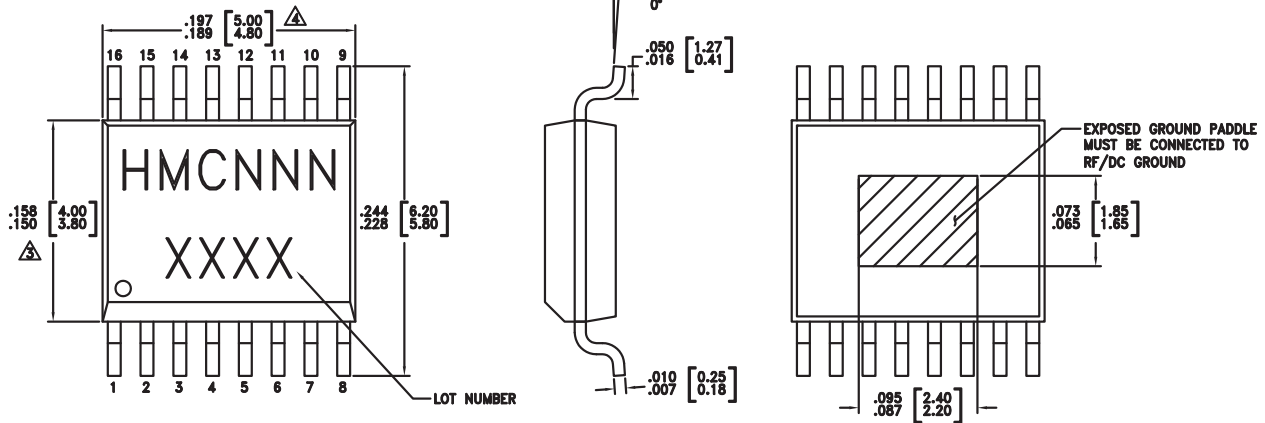
Note: VCO will operate over full voltage range shown above.



**ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS**

*Note: Tuning voltage must not drop below 1.0V for proper divider output.

Outline Drawing



Package Information

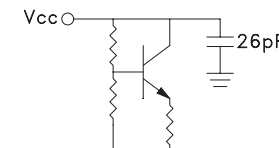
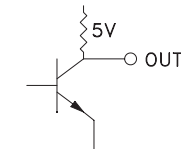
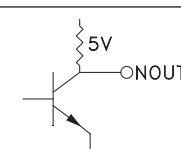

| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking ^[3] |
|--------------|--|---------------|---------------------|--------------------------------|
| HMC398QS16G | Low Stress Injection Molded Plastic | Sn/Pb Solder | MSL1 ^[1] | HMC398 XXXX |
| HMC398QS16GE | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 ^[2] | HMC398 XXXX |

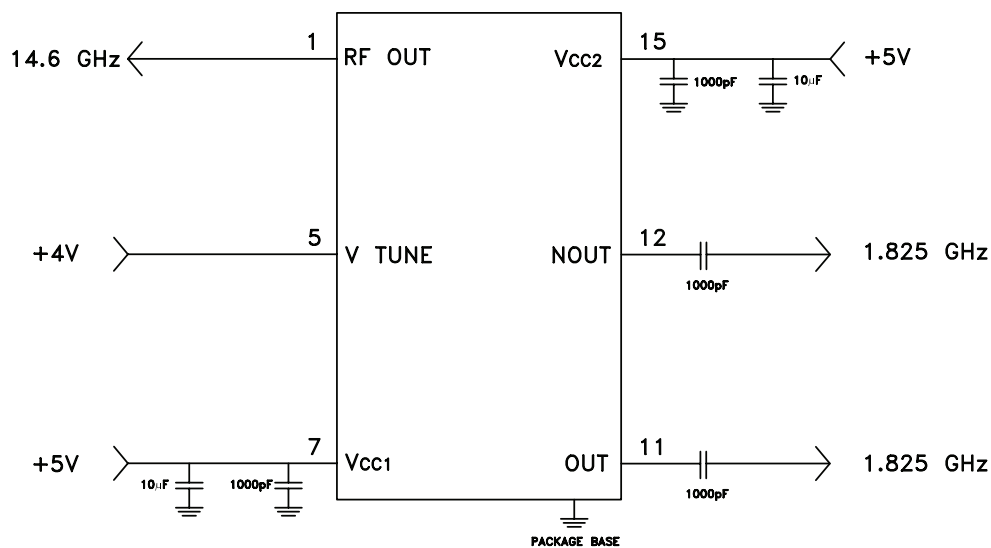
[1] Max peak reflow temperature of 235 °C
 [2] Max peak reflow temperature of 260 °C
 [3] 4-Digit lot number XXXX

Pin Descriptions

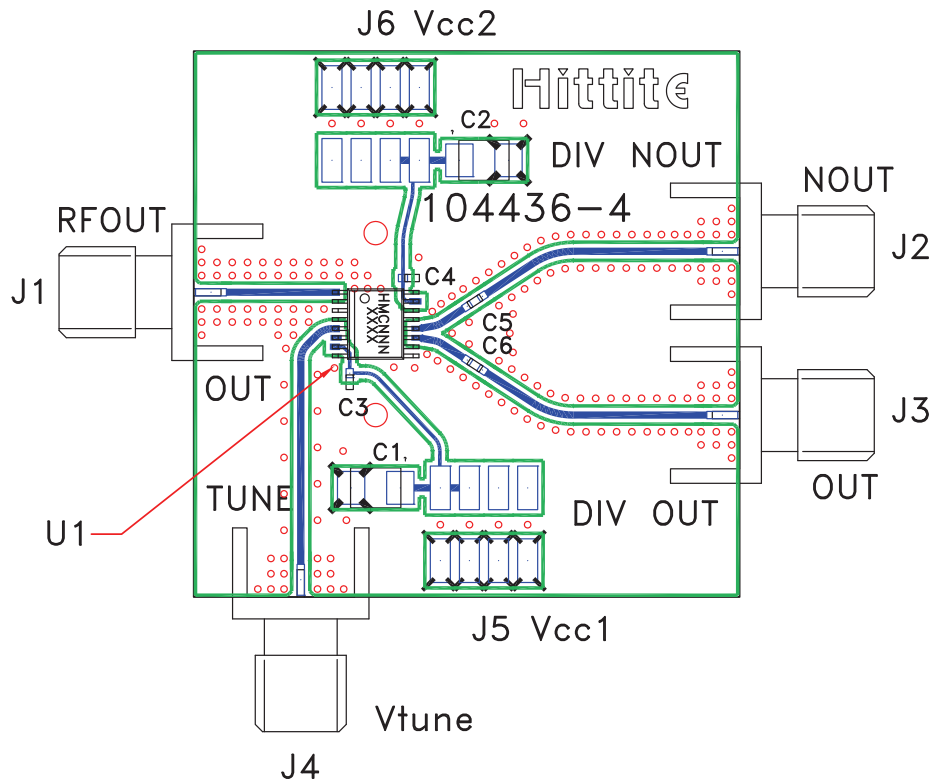
| Pin Number | Function | Description | Interface Schematic |
|----------------------------------|----------|---|---------------------|
| 1 | RFOUT | RF output (AC coupled). | |
| 2, 3, 4, 6, 8, 9, 10, 13, 14, 16 | N/C | No Connection | |
| 5 | VTUNE | Control Voltage Input. Modulation port bandwidth dependent on drive source impedance. | |

Pin Descriptions

| Pin Number | Function | Description | Interface Schematic |
|------------|------------|---|--|
| 7, 15 | VCC1, VCC2 | Supply Voltage, 5V |  |
| 11 | OUT | Divided Output |  |
| 12 | NOUT | Divided Output 180° output phase with pin 11. |  |
| | GND | Package bottom has an exposed metal paddle that must be RF & DC grounded. |  |

Typical Application Circuit


Evaluation PCB



List of Materials for Evaluation PCB 104711 [1]

| Item | Description |
|---------|--------------------------------|
| J1 - J4 | PCB Mount SMA RF Connector |
| J5 - J6 | 2 mm DC Header |
| C1 - C2 | 10 μ F Tantalum Capacitor |
| C3 - C6 | 1,000 pF Capacitor 0402 Pkg. |
| U1 | HMC398QS16G / HMC398QS16GE VCO |
| PCB [2] | 104436 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 slug 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.