**Hittite Microwave Successfully Completes ISO 9001-2000 Transition!**

Hittite Microwave has successfully completed a transition of their Quality Management System culminating in a recertification audit to the requirements of ISO9001-2000. TUV America, Inc. has recommended Hittite Microwave Corporation to the Registration Accreditation Body (RAB) for certification to the ISO9001-2000 Quality Management Systems-Requirements. ISO9001-2000 replaces the previous ISO9000:1994 Quality Management standard that Hittite has been certified to for several years. ISO9001-2000 requires design, manufacturing and service organizations to meet exacting standards. Companies must demonstrate a customer focus, mutually beneficial supplier relationships and the ability to make continuous improvements to processes and procedures triggered by planning and review cycles.

**NEW 2003 CATALOG AVAILABLE!**

Designer’s Guide Details Over 200 Products

New for 2003, this 1440-page Designer’s Guide catalog includes 50 new RFIC and MMIC product data sheets, as well as quality/reliability, application and packaging/layout information. Design engineers will find that the guide is conveniently organized into SMT packaged and chip component sections. Full specifications are provided for over 200 components including: Power & Linear Amplifiers, Gain Blocks, LNAs, Attenuators, Dividers/Multipliers, Mixers, Modulators, Switches, and VCOs covering DC to 42 GHz. These components are well-suited to a wide variety of Cellular, Broadband, Microwave/Millimeterwave and Military/Space applications. The 2003 Designer’s Guide is available in book format as well as on CD-ROM. To request your copy, visit us on-line at www.hittite.com.

**MMIC VCO Product Line Expands!**

Standard Products Cover 2 - 15 GHz, Custom Products to 80 GHz

Hittite announces the release of eight new MMIC Voltage Controlled Oscillators (VCOs) that cover wireless infrastructure, test equipment, microwave radio and military applications between 2 and 6.8 GHz. The addition of these VCOs complements the existing standard product line and expands it to cover from 2 to 15 GHz.

The MMIC VCOs are fabricated on a volume production qualified InGaP GaAs Heterojunction Bipolar Transistor (HBT) process and integrate the resonator structure, negative resistance ciruitry, tuning varactor and output buffer amplifier. The inherent accuracy and repeatability of GaAs HBT wafer processing coupled with automated 4x4mm QFN plastic package IC assembly results in a VCO product that is smaller, more reliable and more consistent than a traditional hybrid VCO.

The center frequency of the MMIC VCO is set by the design of the resonator structure, eliminating the need for tuning or staking to set the VCOs center frequency. MMIC VCOs can minimize other problems associated with hybrid VCOs such as microphonics.

(Continued on page 6)
**InGaP GaAs HBT Gain Block Die Family Cover DC - 10 GHz**

**Features**
- Stable Gain Over Temperature
- P1dB to +15 dBm
- 50 Ohm Matched I/Os
- Military & Space Screening Available

**Performance Table**

<table>
<thead>
<tr>
<th>Part #</th>
<th>HMC395</th>
<th>HMC396</th>
<th>HMC397</th>
<th>HMC405</th>
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</thead>
<tbody>
<tr>
<td>Freq. Range</td>
<td>DC - 4 GHz</td>
<td>DC - 8 GHz</td>
<td>DC - 10 GHz</td>
<td>DC - 10 GHz</td>
</tr>
<tr>
<td>Gain (dB)</td>
<td>15</td>
<td>12</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>P1dB (dBm)</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>OIP3 (dBm)</td>
<td>28</td>
<td>30</td>
<td>24</td>
<td>25</td>
</tr>
</tbody>
</table>

* Data is mid-band typical

**For Military, Space & Microwave Radio**

Hittite Microwave introduces a family of four InGaP HBT Gain Block MMIC amplifiers covering DC to 10.0 GHz. These amplifier die can be used as either cascadable 50 Ohm gain stages or to drive the LO of HMC mixers with up to +17 dBm output power, making them an excellent choice for Microwave Radio, Test Equipment, Military EW/ECM/C3I and Space telecommunications applications. All products require only 50 to 56 mA from a +5V supply, an external bias choke and resistor that offers excellent gain stability over temperature.

---

**HMC392**

**GaAs MMIC Low Noise Amplifier, 3.5 - 7 GHz**

**Features**
- 15.5 dB Gain
- 2.4 dB Noise Figure
- Single +5V Supply
- 50 Ohm Matched I/Os
- Military & Space Screening Available

**Gain and Return Loss**

**For Military, Space & Microwave Radio**

The HMC392 is a GaAs MMIC Low Noise Amplifier die which operates between 3.5 and 7.0 GHz. The amplifier provides 15.5 dB of gain, 2.4 dB noise figure, and 28 dBm IP3 from a +5.0V supply voltage. The HMC392 has six bonding adjustment options which allow the user to select the bias point and output power of the device (+15 to +18 dBm). The HMC392 amplifier can easily be integrated into Multi-Chip-Modules (MCMs) due to its small (1.3 mm²) size.

---

**HMC463**

**GaAs PHEMT MMIC Low Noise Amplifier, 2 - 20 GHz**

**Features**
- 14 dB Gain
- 2.5 dB Noise Figure
- Single +5V Supply
- 50 Matched Ohm I/Os
- Military & Space Screening Available

**Gain and Return Loss**

**Wideband LNA with AGC**

The HMC463 is a GaAs PHEMT Low Noise AGC Distributed Amplifier die which operates between 2 and 20 GHz. The amplifier provides 14 dB of gain, 2.5 dB noise figure and 19 dBm of output power at 1 dB gain compression while requiring only 60 mA from a +5V supply. An optional gate bias (Vctl) is provided to allow Adjustable Gain Control (AGC) of 10 dB typical. Gain flatness is excellent at ±0.15 dB from 6 - 18 GHz making the HMC463 ideal for EW, ECM and RADAR applications. The HMC463 amplifier can easily be integrated into Multi-Chip-Modules (MCMs).
HMC347G8  GaAs MMIC Hermetic SMT SPDT Switch, DC - 8 GHz

**General Description**

The HMC347G8 is a broadband high isolation non-reflective GaAs MESFET SPDT switch in a 8 lead glass/metal (hermetic) surface mount package. Covering DC to 8.0 GHz, the switch features >42 dB isolation up to 2 GHz and >25 dB isolation up to 8.0 GHz. The switch operates using complementary negative control voltage logic lines of -5/0V and requires no bias supply. This SPDT is a good replacement for the HMC132G7 SPDT.

**Features**

- > 30 dB Isolation to 6 GHz
- Non-Reflective I/Os
- Standard Hermetic SMT Package
- Military & Space Screening Available

---

Hermetic SMT InGaP GaAs HBT Frequency Dividers Cover DC - 13 GHz

**Division-By-2, 4 and 8**

Introducing a family of hermetic SMT packaged HBT MMIC Frequency Dividers for hi-rel commercial, military and aerospace PLL applications. The HMC364G8, HMC365G8 and HMC363G8 offer divide ratios of 2, 4, 8 respectively in 8 lead Hermetic SMT packages. These new products complement the company’s existing plastic packaged and die level Frequency Divider line. The low additive phase noise coupled with the +5 dBm nominal output power helps ensure synthesizer designers maintain excellent system noise performance.

**Features**

- Low SSB Phase Noise, to -153 dBc/Hz
- Single +5V DC Supply
- Standard Hermetic SMT Package
- Military & Space Screening Available

**Performance Table**

<table>
<thead>
<tr>
<th>Part #</th>
<th>HMC364G8</th>
<th>HMC365G8</th>
<th>HMC363G8</th>
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</thead>
<tbody>
<tr>
<td>Division</td>
<td>2</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Freq. Range (GHz)</td>
<td>DC - 13</td>
<td>DC - 13</td>
<td>DC - 12</td>
</tr>
<tr>
<td>Output Power (dBm)</td>
<td>+5</td>
<td>+7</td>
<td>+4</td>
</tr>
<tr>
<td>100 kHz SSB Phase Noise (dBc/Hz)</td>
<td>-145</td>
<td>-151</td>
<td>-153</td>
</tr>
</tbody>
</table>

* Data is mid-band typical

---

HMC424G16  0.5 dB LSB GaAs MMIC Hermetic SMT Digital Attenuator, DC - 3 GHz

**General Description**

The HMC424G16 is a broadband 6-bit GaAs IC digital attenuator in a 16 lead glass/metal (hermetic) surface mount package. Covering DC to 3 GHz, the insertion loss is less than 3 dB typical. The attenuator bit values are 0.5 (LSB), 1, 2, 4, 8, and 16 dB for a total attenuation of 31.5 dB. Attenuation accuracy is excellent at ±0.5 dB typical step error with an IIP3 of +32 dBm. Six control voltage inputs, toggled between 0 and -5V, are used to select each attenuation state at less than 70 µA each. A single Vee bias of -5V allows operation at frequencies down to DC.

**Features**

- 0.5 dB Steps to 31.5 dB
- Single Control Line per Bit
- Standard Hermetic SMT Package
- Military & Space Screening Available
HMC467LP3  
2-Bit, 2 dB LSB Digital Attenuator, DC - 6 GHz

Features
- 2 dB LSB Steps to 6 dB
- +50 dBm Input IP3
- +/- 0.2 dB Typical Bit Error
- Single Control Line Per Bit
- Single +5V Supply

Positive Bias Operation to < 1 MHz
The HMC467LP3 is a broadband 2-bit GaAs IC digital attenuator in a low cost leadless surface mount package. Covering DC to 6.0 GHz, the insertion loss is less than 0.7 dB typical. The attenuator bit values are 2 (LSB) and 4 dB for a total attenuation of 6 dB. Attenuation accuracy is excellent at +/- 0.2 dB typical step error with an IIP3 of +50 dBm. Two control voltage inputs, toggled between 0 and +5V, are used to select each attenuation state. A single Vdd bias of +5V is required.

HMC468LP3  
3-Bit, 1 dB LSB Digital Attenuator, DC - 6 GHz

Features
- 1 dB LSB Steps to 7 dB
- +50 dBm Input IP3
- Single Control Line Per Bit
- +/- 0.25 dB Typical Bit Error
- Single +5V Supply

Positive Bias Operation to < 1 MHz
The HMC468LP3 is a broadband 3-bit GaAs IC digital attenuator in a low cost leadless surface mount package. Covering DC to 6.0 GHz, the insertion loss is less than 1 dB typical up to 4 GHz. The attenuator bit values are 1 (LSB), 2 and 4 dB for a total attenuation of 7 dB. Attenuation accuracy is excellent at +/- 0.4 dB typical step error with an IIP3 of +50 dBm. Three control voltage inputs, toggled between 0 and +5V, are used to select each attenuation state. A single Vdd bias of +5V is required.

HMC440QS16G  
Digital Phase Freq. Detector Plus 5-Bit Counter, 10 - 1300 MHz

Features
- 10 kHz SSB Phase Noise Floor: -153 dBc/Hz
- Programmable Divider (N= 2-32)
- Operating up to 2.8 GHz
- Open Collector Output Buffer Amplifiers for Interface w/ Op-Amp Loop Filter
- +5V @ 250 mA

Lower Phase Noise!
The HMC440QS16G integrates a 10 to 1300 MHz digital Phase-Frequency Detector with a DC to 2800 MHz 5-bit Counter (continuous division from 2 to 32) in a miniature 16 lead QSOP plastic package. Its combination of high frequency of operation along with its ultra low phase noise floor make possible synthesizers with wide loop bandwidth and low N resulting in fast settling and very low phase noise. When used in conjunction with a differential loop amplifier, the HMC440QS16G generates an output voltage that can be used to to phase lock a VCO to a reference oscillator.
**HMC485MS8G**

**High IP3 MMIC Mixer with 0 dBm LO, 1.7 - 2.2 GHz**

*Up to +35 dBm Input IP3!*

The HMC485MS8G is a high dynamic range passive MMIC mixer with an integrated LO amplifier in a plastic SMT MSOP covering 1.7 to 2.2 GHz. Excellent input IP3 performance of +35 dBm for down conversion and +27 dBm for up conversion is provided at an LO drive of 0 dBm. Conversion loss is 9.8 dB typical. The 50 to 300 MHz IF frequency response will satisfy many UMTS/PCS transmit or receive frequency plans configured for low side LO. The HMC485MS8G input IP3 performance coupled with its high +19 dBm P1dB rivals traditional active FET mixers while offering a much smaller 14.8mm² standard IC footprint.

**Features**
- +35 dBm Input IP3
- 0 dBm LO Drive
- +5V @ 45 mA Supply
- Ultra Small MSOP Package: 14.8 mm²

![HMC485MS8G](image)

**HMC488MS8G**

**MMIC Mixer with Integrated LO Amplifier, 4 - 7 GHz**

*For UNII, ISM & WLAN Systems*

The HMC488MS8G is an ultra miniature double-balanced mixer with an integrated LO amplifier in an 8 lead plastic SMT MSOP covering 4 - 7 GHz. This passive MMIC mixer integrates a GaAs Schottky diode quad, novel planar transformer baluns and a LO buffer on a single chip yielding a low conversion loss of 7 dB coupled with an input IP3 of +15 dBm. The LO buffer amplifier can be driven from 0 to +6 dBm and requires a single supply of +5V @ 45 mA. The device can be used as an upconverter, downconverter or bi-phase (de)modulator for a variety of point-to-point/multipoint, VSAT, telemetry or broadband WLAN applications.

**Features**
- 7 dB Conversion Loss
- 0 to +6 dBm LO Drive
- +5V @ 45 mA Supply
- Ultra Small MSOP Package: 14.8 mm²

![HMC488MS8G](image)

**HMC491LP3**

**Low Noise Amplifier MMIC with Bypass Mode, 3.4 - 3.8 GHz**

*Efficient WLL Front-End*

The HMC491LP3 is a versatile, integrated, low-noise amplifier (LNA) featuring a bypass mode intended for 3.4 to 3.8 GHz Fixed Wireless & WLL applications. The amplifier provides 16 dB of gain, 2 dB noise figure and +18 dBm output IP3 while requiring only 9 mA from a +3V supply. Using a single control line, the LNA can be switched into a low <2 dB loss bypass mode reducing the current consumption to 20 μA. A low cost, leadless 3x3 mm QFN surface mount package (LP3) houses the amplifier. The LP3 provides an exposed base for excellent RF and thermal performance.

**Features**
- 2 dB Noise Figure
- 16 dB Gain
- 2 dB Insertion Loss in Bypass Mode
- +3V @ 9 mA Supply

![HMC491LP3](image)
vibrations and temperature anomalies because they eliminate chip-to-chip interconnections between the resonator and negative resistance element. These interconnects are often the source of phase transients.

Table 1 summarizes the typical performance of the eight new standard product MMIC VCOs which address a wide range of applications including wireless infrastructure, test equipment, microwave radio and military applications. With the exception of a bypass capacitor on the single +3V DC supply line, the MMICs require no external components. Output signals are delivered at power levels between +3.5 to +5.0 dBm typical from model to model. Both the 10 and 100kHz Single Sideband (SSB) phase noise performance is competitive with comparable hybrid VCO products with levels as good as -89 dBc/Hz and -115 dBc/Hz respectively. The frequency drift rate of the MMIC VCO products range between 0.25 to 0.8 MHz/degC depending on the model number.

These new MMIC VCOs are assembled in an industry standard low cost, leadless QFN 4 x 4 x 1 mm (0.158 x 0.158 x 0.039 inches) plastic injection molded package shown in Figure 1. Occupying only 16 mm2, this QFN package is 10 times smaller than the typical hybrid VCO package of 161.3 mm2 (12.7 x 12.7 x 4.6 mm). The MMIC VCOs are RF and DC tested via a high speed automated QFN handler which also performs automated visual inspection of package marking and orientation inside a tape and reel carrier. The QFN packaging process has passed extensive qualification testing including; temperature cycling, autoclave and solderability.

**Custom VCOs and PLOs**

Hittite also offers custom designed MMIC VCOs and complete synthesizer modules for specific customer requirements. Although the standard product line consists of 15 VCOs, Hittite has designed and evaluated hundreds of MMIC VCO custom products from 2 to 80 GHz. VCO customization includes the addition of dividers, larger output buffers or design of complete Phase Locked Oscillator (PLO) circuits on a single chip. Our product design portfolio can be used to customize VCOs or PLOs for any application. Figure 2 depicts the tuning frequency coverage of some of our custom VCO designs as well as the standard product line.

**Summary**

A MMIC VCO product line has been introduced that meets the phase noise performance of today’s wireless infrastructure, test equipment, microwave radio and military applications while featuring low operating voltage, small size and low cost. The new VCOs require no external components and are designed to interface easily with system PLL circuitry. Hittite has shown that the technology is scalable for custom designs from 2 to 80 GHz with standard versions available in the 2 to 15 GHz frequency range. Data sheets are available at www.hittite.com. These eight new standard product MMIC VCOs are available from stock for sampling or sale.
**Hittite Microwave Adds New Representative in Southwest US!**

Hittite Microwave Corp. today announced the appointment of a new sales representative firm to serve customers in Arizona and New Mexico. Saguaro Technical Sales, Inc. (STSI), established in 1994, is headquartered in Scottsdale, AZ.

STSI specializes in the sale and distribution of radio frequency and microwave microelectronic products. They offer a broad range of components, devices, PC boards and services to customers with both military and commercial applications. Their team of highly-trained sales engineers has extensive backgrounds in design, microwave and project engineering. The company strives to provide a unique approach to selling products, as well as comprehensive coverage of markets and a close working relationship with customers. STSI’s experience, product knowledge and reputation make them an exceptional addition to Hittite’s network of representatives. STSI can be contacted via telephone at (480) 947-3724, via fax at (480) 947-3094 or via email at artstsiaol.com.

**Hittite Expands E-Commerce Product Offering!**

**Die and Hermetic Packaged Parts Now Available for Web Purchase**

Hittite Microwave is pleased to announce that a variety of MMIC die, hermetic & non-hermetic ceramic packaged MMIC products are now available for purchase through the company website at www.hittite.com using either MasterCard or VISA. Minimum order quantity for die & ceramic packaged product purchase is 10 pieces and orders can be placed in multiples of 10 up through 990 units. This expansion of the E-commerce product offering complements the plastic packaged products and evaluation PC boards that have been available for purchase since last year in either bulk or tape and reel shipment packaging. Customers can be assured that all transactions are conducted through a secure server. Orders are confirmed within one business day with delivery information. Orders ship within 48 hours of confirmation.

**Qual Reports Available On-Line!**

Qualification Test Reports (QTRs) for Hittite standard products are now available at www.hittite.com under the Quality & Product Support section. Hittite Microwave qualifies standard products per semiconductor process/wafer supplier, package style/supplier and product thermal dissipation. Products are qualified by similarity when like products share the same semiconductor process/devices, package and/or thermal properties. Each QTR clearly states which products are covered by the report and what product was used as the qualification product and why. The enhanced Quality and Product Support section of the website reiterates Hittite Microwave’s commitment to total quality.

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**NEWS FROM HITTITE!**
What We Do

Hittite Microwave Corporation is an innovative designer and manufacturer of analog/digital ICs and MIC module assemblies for RF and microwave applications covering DC to 90 GHz. Hittite's RFIC/MMIC products are developed using state-of-the-art GaAs, InGaP/GaAs, InP, SOI and SiGe semiconductor processes utilizing MESFET, PHEMT and HBT devices. Our products include:

- Power Amplifiers
- Gain Blocks
- Driver Amplifiers
- LNAs
- Attenuators
- Phase Shifters
- Switches
- Transceivers
- Mixers
- Converters
- IRMs
- Modulators
- VCOs
- Dividers/Detectors
- Multipliers
- PLOs / PLLs
- Driver Amplifiers
- Switches
- IRMs
- Multipliers
- LNAs
- Transceivers
- Modulators
- PLOs / PLLs

We also design and supply highly integrated custom ICs, MCMs and sub-assembly hybrids that combine multiple functions for specific requirements. We select the most appropriate semiconductor and package technologies, uniquely balancing digital and RF integration techniques, to produce a product that is easy and cost effective for our customers to use.

Our custom and standard products support a wide range of wireless and wired communications applications including those listed below:

- Broadband: 802.11a/b/g, BLUETOOTH, UNII, MMDS, WLL, CATV, DBS
- Cellular: GSM, W-CDMA, PCS & UMTS 3G
- Microwave / Millimeterwave: P2P / P2MP / VSAT Radios, Test Equipment & Sensors
- Fiber Optic: OC-48 to OC-192
- Military & Space: RF to Millimeterwave Applications

Every component is backed by Hittite Microwave's commitment to total quality. HMC is ISO9001-2000 certified, and every Hittite employee and subcontractor is responsible for maintaining the highest level of quality. We are constantly working towards improvement of our procedures and processes, thus providing our customers with products that meet or exceed all requirements, are delivered on-time and function reliably throughout their useful life.