+36dBm High Dynamic Range Mixers!
Hittite Microwave announces a new line of high dynamic range monolithic mixers that achieve up to +36dBm input IP3 for Cellular/PCS/3G infrastructure applications. The high linearity performance of these passive GaAs FET MMIC mixers represents the best available for any integrated circuit of its kind in the RFIC industry.

In addition to very high dynamic range, the new UMTS CDMA and GSM based systems are demanding mixers that combine small size, lower cost and low external component count in a product line that will satisfy a wide range of RF/IF frequency plans for up or down conversion. The HMC399MS8, HMC400MS8 and HMC402MS8 meet those requirements by offering; the same standard plastic SMT 8 lead Mini Small Outline Package (MSOP) pin out, inherently lower cost IC construction and specifications to meet low or high side LO frequency plans respectively.

**NEW PLL CALCULATOR RELEASED**
Simulate Synthesizer Phase Noise Using HMC Components

Today’s wired and wireless telecommunications systems utilize complex modulation schemes to securely transport vast amounts of voice and data traffic. The success of these systems depends partly on the phase noise performance of the Phase Lock Loop (PLL) synthesizer. Hittite has introduced a new web-based PLL Phase Noise Calculator tool written in Java. Synthesizer designers will find this tool useful for selecting the best HMC Divider, Phase Frequency Detector and VCO to simulate and achieve optimal PLL phase noise.

52 New Product Introductions in 2002
In 2002 Hittite continued to build their standard product portfolio with the release of 52 new RFIC/MMICs. Notable additions include high IP3 mixers & amplifiers, low phase noise dividers, VCOs, active multipliers and linear control devices covering DC to 40 GHz. Over 200 products are now offered. See the New Product section at www.hittite.com for data sheets.

Hittite Product Showcase
- **1/2 Watt Hi-IP3 Amp**
  - HMC455LP3
  - 1.7 - 2.5 GHz
  - +42 dBm OIP3
  - 13 dB Gain
  - 56% PAE @ +28 dBm Pout
  - See Page 2

- **High Isolation CATV SPDT**
  - HMC348LP3
  - DC - 2.5 GHz
  - > 52dB Isolation
  - 75 or 50 Ohm System Operation
  - +V Bias/Control
  - See Page 4

- **2 GHz SMT MMIC VCO**
  - HMC384LP4
  - 2.05 - 2.25 GHz Fo
  - No External Components
  - +3.5 dBm Pout
  - Low Phase Noise
  - +3V @ 35mA
  - See Page 5
HMC455LP3  
½ Watt High IP3 Amplifier, 1.7 - 2.5 GHz

For PCS/3G Infrastructure
The HMC455LP3 is a 1.7 - 2.5 GHz high output IP3 GaAs InGaP HBT ½ watt MMIC amplifier. Utilizing a minimum number of external components the amplifier provides 13 dB of gain and +28 dBm of saturated power at 56% PAE from a single +5 Vdc supply. The high output IP3 of +42 dBm coupled with the low VSWR of 1.4:1 makes the HMC455LP3 an ideal driver amplifier for PCS/3G infrastructure. A low cost, leadless 3x3 mm QFN SMT houses the linear amplifier, providing excellent RF and thermal performance.

Features
- +42 dBm OIP3
- 13 dB Gain
- 56% PAE @ +28 dBm Pout
- Single +5V Supply

HMC461LP3  
1 Watt High IP3 Dual-Channel Amplifier, 1.7 - 2.2 GHz

For PCS/3G Infrastructure
The HMC461LP3 is a 1.7 - 2.2 GHz high output IP3 GaAs InGaP HBT dual-channel MMIC amplifier. The performance of two HMC455LP3 high IP3 drivers is offered in this single IC, which can be configured as a balanced or push-pull circuit. 12 dB of gain and +30.5 dBm of saturated power at 48% PAE is provided from a single +5 Vdc supply while utilizing external baluns in a balanced configuration. The high +45 dBm output IP3, coupled with the low VSWR of 1.2:1 makes the HMC461LP3 an ideal driver amplifier for PCS/3G infrastructure. A low cost, leadless 3x3mm QFN SMT houses the dual MMIC amplifier IC.

Features
- +45 dBm OIP3 (balanced configuration)
- 12 dB Gain
- 48% PAE @ +30.5 dBm Pout
- Single +5V Supply

HMC311LP3  
InGaP HBT Gain Block MMIC Amplifier, DC - 6 GHz

All Purpose Broadband Amp
The HMC311LP3 is a GaAs InGaP HBT Gain Block DC to 6 GHz SMT amplifier. This 3x3mm QFN packaged amplifier can be used as either a cascadable 50 Ohm gain stage, or to drive the LO of HMC mixers with up to +17 dBm output power. The amp offers 15 dB of gain and an output IP3 of +30 dBm while requiring only +5V @ 56 mA. The Darlington feedback pair used results in reduced sensitivity to normal process variations and yields excellent gain stability over temperature while requiring a minimal number of external bias components.

Features
- 15 dB gain
- +32 dBm OIP3
- +15 dBm P1dB
- 50 Ohm I/Os
HMC380QS16G

PCS/UMTS High IP3 Downconverter, 1.7 - 2.2 GHz

**Features**
- +19 dBm IIP3
- Low LO Drive, -5 dBm
- 11 dB Conversion Gain
- 9 dB Noise Figure
- +5V @ 120mA

**Lower Drive, Higher IP3**
The HMC380QS16G is a 1.7 - 2.2 GHz high linearity down-converter receiver IC suitable for PCS/UMTS infrastructure applications. The receiver IC is designed to support UMTS applications by utilizing a passive mixer coupled with a high dynamic range IF amplifier to achieve an input IP3 of +19 dBm. The converter provides a gain of 11 dB and 9 dB typical single side band noise figure. The design requires no external baluns. IF frequencies between 50 MHz and 300 MHz are supported.

HMC245QS16

SP3T Non-Reflective Switch, DC - 3.5 GHz

**Features**
- 0.5 dB Insertion loss
- 45 dB Isolation
- +48dBm IIP3
- Integrated Decoder
- Single +5V Supply

**Finally... a SP3T!**
The HMC245QS16 is a low cost non-reflective SP3T switch in a 16-lead QSOP surface mount package. Covering DC to 3.5 GHz, the switch offers 30 to 40 dB isolation and a low insertion loss of 0.5 dB. A 2:3 TTL/CMOS compatible decoder is integrated on the switch requiring only 2 control lines and a single +5V bias to select each path, replacing 6 control lines normally required by GaAs SP3T switches. The SP3T offers an “ALL OFF” state with >40dB isolation and is ideal for Cellular/PCS/3G Infrastructure.

HMC274QS16

1dB LSB 5 Bit Digital Attenuator, 0.7 - 2.7 GHz

**Features**
- +54 dBm IIP3
- 1 dB LSB
- 31 dB Range
- +/-0.5 dB Typical Bit Error
- Single Positive Control/Bit

**Accurate, Linear Control**
The HMC274QS16 is a broadband 5-bit positive control GaAs IC digital attenuator in a 16 lead QSOP plastic package. Covering 0.7 to 2.7 GHz the insertion loss is typically less than 2.3 dB. The attenuator bit values are 1 (LSB), 2, 4, 8, and 16 dB for a total attenuation of 31 dB. Accuracy is excellent at ± 0.5 dB typical with an IIP3 of up to +54 dBm. Five bit control voltage inputs, toggled between 0 and +3 to +5 volts, are used to select each attenuation state.
HMC348LP3

**SPDT High Isolation CATV Switch, DC - 2.5 GHz**

**Isolate the Competition!**

The HMC348LP3 is a non-reflective GaAs MESFET SPDT switch in a low cost leadless 3x3mm QFN SMT plastic package ideal for CATV applications. Covering DC to 2.5 GHz, the switch offers high isolation, low insertion loss, integrated 75 Ohm terminations and an “all off” state. The switch operates using complementary positive control voltage logic lines of +5/0V and requires a +5V bias supply (Vdd). This switch offers excellent performance in both 50 Ohm & 75 Ohm systems for either SPDT or SPST functions.

**Features**

- High Isolation
  - 80dB @ 5 MHz
  - 55dB @ 1 GHz
- +89 dBm IP2
- 0.6 dB Insertion Loss
- “All Off” State Isolation

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HMC446

**10 Watt Transmit / Receive Switch, 824 - 894 MHz**

**Linear Power Control**

The HMC446 is a low-cost SPDT GaAs switch in a 6-lead SOT26 package for use in T/R applications which require very low distortion at high signal power levels, up to 10 watts. The device can control signals from 824 - 894 MHz and is especially suited for cellular booster and automotive telematic applications. The design provides exceptional P0.1 dB of +40 dBm and +65 dBm IIP3 on the Tx port. The On-chip circuitry allows single positive supply operation at very low DC current with a single control input (Vctl).

**Features**

- +65 dBm IIP3
- +40 dBm 0.1 dB
- Compression Point
- 0.6 dB Insertion loss
- 0 / +5V to +8V Control

---

HMC441LP3

**GaAs PHEMT Medium Power Amplifier, 6.5 - 13.5 GHz**

**Lower Cost, Broadband Gain!**

The HMC441LM1 is a 7 to 15.5 GHz broadband GaAs PHEMT MMIC Medium Power Amplifier in an SMT leadless chip carrier package. The amplifier provides 15 dB of gain, 21.5 dBm of saturated power at 27% PAE from a +5.0V supply voltage. An optional gate bias is provided to allow adjustment of gain, RF output power, and DC power dissipation. This 50 Ohm matched amplifier does not require any external components making it an ideal linear gain block or driver for HMC SMT mixers.

**Features**

- 14 dB Gain
- +18 dBm P1dB
- 50 Ohm I/Os
- 3 x 3 mm QFN Plastic Package
NEW MMICS FOR FREQUENCY GENERATION

HMC384LP4

MMIC VCO with Buffer Amplifier, 2.05 - 2.25 GHz

Features
+3.5 dBm Pout
-112 dBc/Hz @ 100 kHz Phase Noise
No External Resonator
+3V @ 35 mA

Stable Wireless Source!
The HMC384LP4 is a GaAs InGaP HBT MMIC VCO with integrated resonator, negative resistance device, varactor diode, and buffer amplifier. The VCO's phase noise performance is excellent over temperature, shock, vibration and process due to the oscillator's monolithic structure. Power output is 3.5 dBm typical from a 3.0V supply. The voltage controlled oscillator is packaged in a low cost leadless QFN 4 x 4 mm SMT package and requires no external components.

HMC439QS16G

HBT Digital Phase Frequency Detector, 10 - 1300 MHz

Features
Low 100 kHz Phase Noise
-153dBC/Hz
Differential Input/ Single-Ended Output
2Vpk-pk Output
+5V @ 96 mA

Lower Phase Noise!
The HMC439QS16G is a digital phase-frequency detector intended for use in low noise PLL applications for inputs from 10 to 1300 MHz. 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 switching and very low phase noise. When used in conjunction with a differential loop amplifier, the HMC439QS16G generates an output voltage that can be used to phase lock a VCO to a reference oscillator.

x2, x4, x8, x16 Active Multipliers

Simplify Microwave Radio Designs

Features
Outputs from 9.8 to 32 GHz
0 to 11 dBm Pout
Low 100 kHz Phase Noise to -142 dBC/Hz
Single +5V Supply

Six New Products!
HMC introduces six Active Frequency Multipliers covering 9.8 - 32 GHz F<sub>out</sub> in die and 4x4mm QFN SMT package formats. Utilizing InGaP GaAs HBT technology the products offer multiplication of 2, 4, 8 and 16 while yielding stable outputs between 0 to +11 dBm from a single +5V supply. The low additive SSB phase noise of up to -142 dBc/Hz at 100 kHz offset helps the user maintain excellent system noise performance. This product family is ideal for use in LO multiplier chains in P2P/VSAT microwave radios or fiber optic reference clocks up to 40 Gb/s allowing reduced parts count versus traditional approaches.
The high input IP3 performance of these new MMIC mixers coupled with their high P1dB rivals performance of traditional hybrid active FET mixers for an equivalent +17dBm LO drive while requiring no DC bias. At 15mm², the Hittite Mixer MSOP footprint is 1/10th the size of a typical hybrid mixer J-lead package footprint of 152mm².

The HMC399MS8 covers 700 to 1000 MHz RF and 60 to 250 MHz IF frequencies for GSM/CDMA based cellular transmit or receive frequency plans. Excellent input IP3 performance of up to +35 dBm for down conversion and to +32 dBm for up conversion is provided. With a 1 dB compression of +23 dBm, the RF port will accept a wide range of input signal levels. Conversion loss is 8.5 dB typical and LO isolations are maintained at 23 to 35 dB. This mixer requires only an external inductor and capacitor to optimize the LO frequency response.

The HMC400MS8 covers 1.7 to 2.2 GHz RF and 50 to 300 MHz IF frequencies and satisfies many UMTS/PCS transmit or receive frequency plans configured for low side LO. Excellent input IP3 performance of up to +36 dBm for down conversion and to +31 dBm for up conversion is provided. With a 1dB compression of +21 dBm, the RF port will accept a wide range of input signal levels. Conversion loss is 8.8dB typical and LO isolations are maintained at 22 to 33 dB with no external components or bias required.

The HMC402MS8 covers 1.8 to 2.2 GHz RF and 50 to 500 MHz IF frequencies and satisfies many UMTS/PCS transmit or receive frequency plans configured for high side LO from 1.85 to 2.53 GHz. Excellent input IP3 performance of up to +31 dBm for down conversion and to +27 dBm for up conversion is provided. With a 1dB compression of +21 dBm, the RF port will accept a wide range of input signal levels. Conversion loss is 8.5dB typical and LO isolations are maintained at 24 to 30 dB with no external components or bias required.

The HMC399MS8, HMC400MS8 and HMC402MS8 MMIC mixer family is manufactured on a production GaAs MESFET process and 100% RF tested. Data sheets are available at www.hittite.com and list min/max limits for key parameters such as conversion loss, isolations and IP3. These products are available from stock for sampling or sale.

### Typical Performance of High IP3 Mixers

<table>
<thead>
<tr>
<th>Parameter</th>
<th>HMC399MS8</th>
<th>HMC400MS8</th>
<th>HMC402MS8</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range, RF</td>
<td>740 - 960</td>
<td>1.7 - 2.2</td>
<td>1.8 - 2.2</td>
<td>GHz</td>
</tr>
<tr>
<td>Frequency Range, LO</td>
<td>540 - 900</td>
<td>1.4 - 2.15</td>
<td>1.85 - 2.53</td>
<td>GHz</td>
</tr>
<tr>
<td>Frequency Range, IF</td>
<td>60 - 250</td>
<td>50 - 300</td>
<td>50 - 500</td>
<td>MHz</td>
</tr>
<tr>
<td>LO to RF Isolation</td>
<td>25</td>
<td>33</td>
<td>30</td>
<td>dB</td>
</tr>
<tr>
<td>Input IP3</td>
<td>+35</td>
<td>+36</td>
<td>+31</td>
<td>dBm</td>
</tr>
</tbody>
</table>

The tool was designed to be easily maintained and updated as new HMC parts are introduced. There is an excellent “HELP ?” section that explains detailed information on the PLL calculator use and functions. Try it today!
Hittite Microwave is pleased to welcome several new representative firms to our sales network. Our growing representative network provides our customers worldwide with outstanding customer service, sales and technical support.

In the US, Micro Lambda LLC, with offices in Clarksburg, NJ and Pasadena, MD, joins Hittite to cover southern New Jersey and western Pennsylvania. The company was established in 1977 and focuses primarily on the sale and distribution of radio frequency, microwave and hybrid microelectronic products.

Hittite’s network of reps in Asia has grown significantly in the past few months. Serving customers in mainland China and Hong Kong, Planet Technology (Hong Kong) Ltd., specializes in the sale and distribution of RF/microwave components. The company boasts strong ties with the design centers of local telecommunications companies. MEDs Technologies was founded in 1996 and is headquartered in Singapore. Bandtek, headquartered in Taipei, will service customers in Taiwan. Systron Marketing Private Ltd., located in Bangalore, India, joins the HMC team with an extensive background in RF/microwave sales and distribution. The group has strong ties with local defense, space and communications companies.

In Europe, Hittite has added Special-Ind S.p.A to its team. With offices in Milan and Rome, Special-Ind services HMC customers in Italy, Singapore, Malaysia, Indonesia and the Philippines. MEDs Technologies was founded in 1996 and is headquartered in Singapore. Bandtek International Co., Ltd., headquartered in Taipei, will service customers in Taiwan. Bandtek carries a complete line of RF/microwave components and has close ties to the defense and wireless markets in Taiwan.

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Contact information for all our representatives is located in the box at right, as well as on our website.

ORDER HITTITE PRODUCTS ON-LINE!

E-Commerce available now! Hittite customers can enjoy the convenience of on-line ordering at www.hittite.com. A selection of products can be purchased on-line via a secure shopping cart interface, including:

- Standard products, including all plastic parts
- Low order quantities
- Evaluation PC boards
- Volume Tape & reel packaging on selected products

Payment is made using either MasterCard or VISA. Orders generally ship next business day after confirmation.

NEW 2003 DESIGNER’S GUIDE COMING SOON!

The 2003 edition of Hittite’s popular Designer’s Guide will be available in late February. Log onto our website at www.hittite.com to request your copy. CD-ROM versions will also be available.
What We Do

Hittite Microwave Corporation designs and manufactures high volume integrated circuit (IC) products to support the expanding needs of high-speed voice and data transfer systems. Hittite’s product line of RF to millimeter wave components is recognized across the world because it offers a unique variety of functions and solutions for systems that operate between DC and 40 GHz.

All of Hittite’s high performance ICs are manufactured using cutting edge semiconductor processes, including GaAs InGaP HBT, SiGe, PHEMT, and MESFET technology. When designing a product, we select the most appropriate semiconductor and package technology, and then uniquely balance digital and RF integration techniques to produce a result that is easy and cost effective for our customers to use.

Our reputation of leading the industry with MMIC VCOs, mixers, switches, and surface mount millimeter wave components has opened up new opportunities for our customers. Regardless of frequency, we apply high volume manufacturing techniques across our product groups. Each year Hittite breaks through new technology barriers, and then applies the technology to produce millions of integrated circuits to satisfy our customers. Our customers can then address existing and create new markets for their products.

Products from our standard catalog are shipped to factories that are located across Asia, Australia, North America, South America, and Europe. Our customers manufacture many different types of systems for the wireless and wired telecommunications world including:

- Cellular, PCS, and 3G Platforms
- Broadband Wireless Systems for WLAN and LAST MILE INTERNET Radio Platforms
- Microwave/Millimeterwave Radio Links
- Cable Modem Systems for CATV
- DBS Consumer Electronic Systems
- Fiber Optic Systems from OC-48 to OC-192
- Two-way Pager Systems
- Military and Space