NEW RF TO MILLIMETERWAVE IC PRODUCTS FROM HITTITE

INSIDE.....

* 32 NEW PRODUCTS RELEASED!

Product Showcase

5-Bit Digital Attenuator

**HMC470LP3**

• DC to 3 GHz
• 1 dB LSB Steps to 31 dB
• Single Control Line Per Bit
• +/- 0.3 dB Typical Step Error

See Page 2

2 Watt Power Amplifier

**HMC487LP5**

• 9 to 12 GHz
• OIP3: +36 dBm
• Gain: 20 dB
• 50 Ohm Matched I/Os

See Page 4

Connectorized Prescalers

Divide Ratios of 2, 4 & 8

• 0.5 to 18 GHz \(F_{in}\)
• SSB Phase Noise: -150 dBc/Hz
• Input Power: -15 to +10 dBm
• Hermetically Sealed Module

See Page 5

15 Watt Power Amplifier Module for Cellular!

Unconditionally Stable Performance from 1.8 - 2.2 GHz

Hittite Microwave Corporation announces the first in a series of fully integrated High Power Amplifier Modules which are ideal for Cellular/3G repeater, laboratory, and Automatic Test Equipment (ATE) applications.

The HMC-C008 Power Amplifier Module provides 42 dB of gain, and a minimum output P1dB of 15 watts from 1.8 to 2.2 GHz. Under W-CDMA test conditions, the HMC-C008 provides +34.5 dBm of Channel Output Power at -45 dBc ACPR. For CDMA2000

(Continued on page 6)

I/Q MMIC Mixers Deliver 40 dB Image Rejection!

New Family of 11 Products Cover 4 to 32 GHz

Hittite introduces nine new I/Q MMIC Mixer die and two new SMT I/Q MMIC Mixers for IRM & SSB converter circuits. These IC mixer products deliver up to 40 dB of image rejection making them ideal for microwave radio, test, sensor, military and space applications.

The I/Q Mixers offer wide IF bandwidth of up to DC - 3.5 GHz, conversion loss as low as 7.0 dB, input IP3 as high as +28 dBm and excellent RF to LO isolation of up to

(Continued on page 6)

RoHS Compliant “Green” Products Available!

Hittite Microwave Corporation has qualified and released to production the first of our RoHS Compliant plastic packaged GaAs & SiGe products. HMC will be qualifying and releasing versions of all of our plastic packaged products to the RoHS “Green” product standard by mid-2005. Currently Hittite offers 198 RoHS Compliant RFIC & MMIC standard catalog products.

The following RoHS Compliant product package types are released and are qualified to JEDEC MSL1; MS8, MS10, LP3, LP4 and LP5. RoHS Compliant products from Hittite are designated with an “E” part number suffix; HMCxxxLP4E. Our Earth Friendly “E” products are form, fit & functional replacements for their related non-RoHS released HMC product.

HMC has built qualification lots for each of our plastic package styles using halogen free plastic mold compounds and lead (Pb) free terminal plating. We conduct our own package qualification testing including solder reflow and Moisture Sensitivity Level (MSL). The current versions of our “E” products are backwards compatible with the current standard SnPb solder as well as future higher temperature “Pb free” solder profiles.

Products such as all bare die (chips) and ceramic based packages (C8, G7, G8, G16 LC3, LC3B, LC4, LH5, LM1, LM3, P7) have always been RoHS compliant. These are released and available from stock and do not require an “E” part number suffix. Hittite will continue to offer the original non-RoHS versions of our plastic packaged products. For more information please contact earthfriendly@hittite.com.

Order Online at: www.hittite.com

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HMC478MP86

+5V SiGe HBT Gain Block, DC - 4 GHz

1,000V ESD Rating!
The HMC478MP86 is a SiGe HBT Gain Block MMIC SMT amplifier covering DC to 4 GHz. This “Micro-X” packaged amplifier can be used as a cascadable 50 Ohm RF/IF gain stage as well as a LO or PA driver with up to +20 dBm output power. The HMC478MP86 offers 22 dB of gain with a +32 dBm output IP3 at 850 MHz while requiring only 62mA from a single positive supply.

Features
- P1dB Output Power: +18 dBm
- Gain: 22 dB
- Output IP3: +32 dBm
- Cascadable 50 Ohm I/Os
- Single Supply: +5V to +8V
- Robust 1,000V ESD, Class 1C

HMC478ST89

+5V SiGe HBT Gain Block, DC - 4 GHz

Robust Performance, 22 dB Gain!
The HMC478ST89 is a SiGe HBT Gain Block MMIC SMT amplifier covering DC to 4 GHz. This SOT89 packaged amplifier can be used as a cascadable 50 Ohm RF/IF gain stage as well as a LO or PA driver with up to +20 dBm output power. The HMC478ST89 offers 22 dB of gain with a +31 dBm output IP3 at 850 MHz while requiring only 62 mA from a single positive supply.

Features
- P1dB Output Power: +18 dBm
- Gain: 22 dB
- Output IP3: +31 dBm
- Cascadable 50 Ohm I/Os
- Single Supply: +5V to +8V
- Robust 1,000V ESD, Class 1C

HMC470LP3

5-Bit Digital Attenuator, DC - 3 GHz

Positive Control to <1 MHz!
The HMC470LP3 is a broadband 5-bit GaAs IC digital attenuator in a low cost 3 x 3 mm QFN package. This TTL/CMOS compatible single control line per bit digital attenuator incorporates off chip AC ground capacitors for near DC operation. The insertion loss is less than 1.5 dB typical over DC - 3 GHz. The attenuator bit values are 1 (LSB), 2, 4, 8, and 16 dB for a total attenuation of 31 dB. Attenuation accuracy is excellent at ±0.3 dB typical step error with an IIP3 of +45 dBm.

Features
- 1 dB LSB Steps to 31 dB
- +45 dBm Input IP3
- TTL/CMOS Compatible Control
- +/- 0.3 dB Typical Step Error
- Single +5V Supply
- 3 x 3 mm QFN Plastic Package
HMC472LP4

6-Bit Digital Attenuator, DC - 3 GHz

Positive Control to <1 MHz!
The HMC472LP4 is a broadband 6-bit GaAs IC digital attenuator in a low cost 4 x 4 mm QFN package. This TTL/CMOS compatible single control line per bit digital attenuator incorporates off chip AC ground capacitors for near DC operation. The insertion loss is less than 2.0 dB typical over DC - 3 GHz. 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 ±0.3 dB typical step error with an IIP3 of +45 dBm.

Features
- 0.5 dB LSB Steps to 31.5 dB
- +45 dBm Input IP3
- TTL/CMOS Compatible Control
- +/- 0.3 dB Typical Step Error
- Single +5V Supply
- 4 x 4 mm QFN Plastic Package

HMC536MS8G

GaAs MMIC Broadband T/R Switch, DC - 6 GHz

High Power Handling, +3V Control!
The HMC536MS8G is a DC to 6 GHz GaAs MMIC T/R switch in an 8 lead MSOP8G surface mount package with an exposed ground paddle. The switch is ideal for cellular/3G & WiMAX FWA applications requiring low 0.5 dB insertion loss and high +55 dBm input IP3. Power handling is excellent up through 6 GHz with the switch offering a P0.1dB compression point of +29 (+34) dBm at +3 (+5) volts control. On-chip circuitry allows positive voltage control of 0/+3 volts or 0/+5 volts at very low DC currents.

Features
- Insertion Loss: 0.5 dB
- +34 dBm P0.1 dB Comp. (+5V)
- Input IP3: +55 dBm
- Isolation: 27 dB
- Positive Control: +3V or +5V
- Fast Switching: 15 nS

HMC546MS8G

10 Watt SPDT T/R, 0.2 - 2.2 GHz

Low Insertion Loss, High IIP3!
The HMC546MS8G is a low-cost SPDT switch in a 8-lead MSOP8G surface mount package for use in transmit-receive applications which require very low distortion at high input signal power levels, up to 10 watts. The device can control signals from 200 - 2200 MHz and is especially suited for cellular booster, mobile radio and automotive telematic applications. The design provides exceptional P0.1 dB compression of +40 dBm and +65 dBm IIP3 on the Transmit (Tx) port. On-chip circuitry allows single positive supply/control input operation at very low DC current.
INNOVATIVE SMT & CONNECTORIZED MODULES

HMC342LC4 / 516LC5 / 517LC4

SMT LNAs Covering 9 - 26 GHz

**Features**
- NF: 2 to 3.5 dB
- High Gain: >20 dB
- OIP3: +20 to +25 dBm
- 50 Ohm Matched I/Os
- RoHS Compliant SMT Packages

**High Gain & Low Noise!**
The HMC342LC4, HMC516LC5 and HMC517LC4 are high gain GaAs PHEMT MMIC LNAs housed in leadless RoHS compliant SMT packages. These LNAs provide 19 to 22 dB of small signal gain, 2.0 to 3.5 dB of noise figure and output IP3 of +20 to +25 dBm. The P1dB output power ranges from +9 to +14 dBm enabling the LNAs to also function as LO drivers for balanced, I/Q or image reject mixers. These LNAs allow the use of high volume SMT manufacturing techniques.

HMC441LC3B / 442LC3B

Medium Power Amps Covering 6 - 25.5 GHz

**Features**
- OIP3: +34 to +40 dBm
- Gain: 13 to 17 dB
- P1dB: +20 to +22 dBm
- 50 Ohm Matched I/Os
- RoHS Compliant SMT Packages

**Wideband, High Output IP3!**
The HMC441LC3B and HMC442LC3B are efficient PHEMT MMIC Medium Power Amplifiers housed in leadless, RoHS compliant SMT packages. Operating between 6.0 to 25.5 GHz, these amplifiers provide 13 to 17 dB of gain, +22 to +23 dBm of saturated power at 27% PAE from a +5.0V supply. These 50 Ohm matched amplifiers do not require any external components, making them ideal linear drivers for HMC PAs and mixers. These Power Amplifiers allow the use of high volume SMT manufacturing techniques.

HMC486LP5 / 487LP5 / 489LP5

1 & 2 Watt PAs Covering 7 - 16 GHz

**Features**
- OIP3: +34 to +40 dBm
- Gain: 13 to 22 dB
- P1dB: +31 to +32 dBm
- 50 Ohm Matched I/Os
- 5 x 5 mm QFN Plastic Packages
- RoHS Compliant
- Versions are Available

**Cascadable, Combinable!**
The HMC486LP5, HMC487LP5 and HMC489LP5 are high dynamic range PHEMT MMIC 1 & 2 Watt Power Amplifiers housed in leadless QFN 5 x 5 mm SMT packages. Operating from 7 to 16 GHz, these amplifiers provide 13 to 22 dB of gain, +32 to +33 dBm of saturated power at up to 22% PAE from a +7.0V supply. Output IP3 is +34 to +40 dBm typical. The RF I/Os are DC blocked and matched to 50 Ohms for ease of use. These Power Amplifiers eliminate the need for flange mount packages, allowing use of high volume SMT manufacturing techniques.
HMC-C002 / C003 / C004

**Connectorized Amplifiers Covering 0.01 - 20 GHz**

**Features**
- 50 Ohm Matched I/Os
- Regulated Supply and Bias Sequencing
- Hermetically Sealed Module
- Field Replaceable SMA connectors
- -55 to +85°C Operation

**Applications**
- Telecom Infrastructure
- Microwave Radio & VSAT
- Military & Space
- Test Instrumentation
- Fiber Optics

**HMC-C002**

**Typical Performance**

<table>
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<tr>
<th>Frequency (GHz)</th>
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<td>2 - 20</td>
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<td>+16</td>
<td>+23</td>
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<tr>
<td>OIP3 (dBm)</td>
<td>+26</td>
<td>+34</td>
<td>+33</td>
</tr>
</tbody>
</table>

**Wideband MMIC Modules for LNA, PA & Driver Applications!**

The HMC-C002 Wideband Low Noise Amplifier Module operates from 2 to 20 GHz with 2.0 dB noise figure, 13 dB gain, and a gain flatness of ±1.0 dB. This high dynamic range LNA Module also delivers +18 dBm output P1dB while consuming only 60 mA from a single +12V supply.

The HMC-C003 Wideband Power Amplifier Module operates from 2 to 20 GHz, and delivers +26 dBm output P1dB, and +30 dBm Output IP3. This high linearity PA module also offers 15 dB gain and ±0.5 dB gain flatness from 2 to 12 GHz, while consuming 310 mA from a single +12V supply.

The HMC-C004 Wideband Driver Amplifier Module operates from 10 MHz to 20 GHz, and delivers +24 dBm Psat, and 15 dB gain. This versatile Driver Amplifier module also offers 3.0 dB noise figure at midband, and consumes only 195 mA from a single +12V supply.

**HMC-C005 / C006 / C007**

**Connectorized Freq. Dividers Covering 0.5 - 18 GHz**

**Features**
- Ultra Low SSB Phase Noise
- Single DC Supply: +5V
- Hermetically Sealed Module
- Field Replaceable SMA connectors
- -55 to +85°C Operation

**Applications**
- Pt to Pt / Multi-Pt Radios
- VSAT Radios
- Military & Space
- Test Instrumentation
- Fiber Optics

**HMC-C005**

**Typical Performance**

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<td>0.5 - 18</td>
<td>0.5 - 18</td>
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<tr>
<td>Input Power (dBm)</td>
<td>-15 to +10</td>
<td>-15 to +10</td>
<td>-15 to +10</td>
</tr>
<tr>
<td>Output Power (dBm)</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
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<tr>
<td>Bias Supply</td>
<td>+5V @ 75mA</td>
<td>+5V @ 93mA</td>
<td>+5V @ 98mA</td>
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</table>

**Wideband Prescalers with Divide Ratios of 2, 4 & 8!**

The HMC-C005 is a low noise Divide-by-2 Static Divider operates from 0.5 to 18 GHz input frequency. The low additive SSB phase noise of -150 dBc/Hz at 100 kHz offset helps the user maintain excellent system noise performance.

The HMC-C006 is a low noise Divide-by-4 Static Divider operates from 0.5 to 18 GHz input frequency. The low additive SSB phase noise of -150 dBc/Hz at 100 kHz offset helps the user maintain excellent system noise performance.

The HMC-C007 is a low noise Divide-by-8 Static Divider operates from 0.5 to 18 GHz input frequency. The low additive SSB phase noise of -150 dBc/Hz at 100 kHz offset helps the user maintain excellent system noise performance.
15 Watt Power Amplifier Module... (continued from page 1)

applications, the HMC-C008 delivers +34.5 dBm of Channel Output Power at -55 dBc ACPR.

This module is extremely robust and offers a number of built-in protective features. The RF input and output of the HMC-C008 are internally matched to 50 Ohms and DC blocked. The RF output is further protected by an internal isolator which will allow the Amplifier Module to operate into an open circuit indefinitely. The $V_{in}$ single power supply input accepts a DC voltage from +13V to +15V, and is internally regulated and protected from over voltage and reverse voltage polarity. An Enable feature allows the user to remotely switch the Power Amplifier Module on and off with a logic level input.

Internal temperature sensors and built-in thermal fault protection circuitry protect the unit from insufficient heat sinking conditions by automatically removing DC power from the active circuitry when the base plate temperature exceeds +70°C. Normal operation is automatically resumed when the base plate temperature falls below +50°C. The Thermal Fault Indicator output will provide a logic level low when the thermal fault protection circuitry has been activated. Two specially designed fan cooled heat sinks are available for 115 VAC and 230 VAC applications.

The HMC-C008 is unconditionally stable and internally compensated to maintain typically ±1.0 dB of gain variation and ± 0.5 dB of output P1dB variation over its entire operating temperature range.

This Power Amplifier Module utilizes Hittite's standard MMIC amplifier products taking advantage of the company’s design, manufacturing, and quality knowledge base. Released data sheets are available at www.hittite.com and in-stock products can be ordered via the company’s e-commerce site or via direct purchase order.

I/Q MMIC Mixers... (continued from page 1)

50 dB. Compared with a hybrid based implementation, these I/Q MMIC mixers offer significantly reduced PCB hybrid MIC area, consistent performance, and excellent amplitude and phase balance as a result of their monolithic construction. For example, when configured as an Image Reject Mixer using an external IF hybrid, the HMC521’s inherent symmetry provides greater than 40 dB of image rejection. Such excellent image rejection performance would be difficult, if not impossible to achieve on a production basis using mixers, splitters and couplers in a hybrid MIC or PCB based approach. Each of these mixers is fabricated on a mature, reliable and production qualified high volume GaAs MMIC process.

For applications where a surface mount package is desired, the HMC520LC4 and the HMC522LC4 are offered in RoHS compliant, 4 x 4 mm leadless SMT packages (LC4). All of these I/Q MMIC Mixers will be available in the LC4 package by Q305.

Products are available from stock for sampling or sale and released data sheets are available on-line at www.hittite.com.

I/Q Mixer Product Family

<table>
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<tr>
<th>RF/LO Freq. (GHz)</th>
<th>Function</th>
<th>IF Freq. (GHz)</th>
<th>Conversion Gain (dB)</th>
<th>Image Rejection (dB)</th>
<th>Input IP3 (dBm)</th>
<th>Package</th>
<th>Part Number</th>
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<td>I/Q Mixer / IRM</td>
<td>DC - 3.5</td>
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<td>Chip</td>
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Hittite Expands Global Presence!
Hittite has opened a sixth international office, Hittite Microwave Co. Ltd. (Shenzhen Office), located in Shenzhen P.R.C. Mr. Eric Gao is Hittite’s Applications Engineer for China. The new HMC Shenzhen Office will support sales and application engineering inquiries both directly and through Hittite’s local representatives, Mr. Tae and Seomr. Mr. Gao can be contacted by phone: +86-755-8350-5422, fax: +86-755-8350-5258 or e-mail: shenzhen@hittite.com.

HMC Asia - Korea Office Announcement
Hittite is pleased to announce Mr. Tom Kang will head the Hittite Microwave office in Seoul to focus on supporting Hittite’s sales in Korea. The HMC Asia office is located at POSCO Center Bldg. West Tower 11th Floor, 892 Daechi 4-dong, Kangnam-gu, Seoul, Korea 135-777, Tel: +82-2-559-0638, Fax: +82-2-559-0639 or e-mail: asia@hittite.com.

HMC Adds Eastern North America Sales Office
Hittite is pleased to announce the appointment of Mr. Rodney Hsing to Regional Sales Manager. Mr. Hsing will be responsible for Hittite’s sales efforts for Eastern North America. He can be contacted at phone: (610) 998-1470, fax: (610) 998-1473 or email: usa-east@hittite.com.

2005 Designer’s Guide Released!
Hittite’s New Catalog Details Over 330 Products
HMC announces the release of their 10th edition Designer’s Guide catalog for 2005 detailing over 330 products. This popular publication includes 80 new RFIC and MMIC product data sheets, as well as quality/reliability, application and packaging/layout information on over 2300 pages. Design engineers will find that the guide is conveniently organized into SMT packaged, connectorized module and chip component sections.

Full specifications are provided for over 330 components including: Power & Linear Amplifiers, Gain Blocks, LNAs, Attenuators, Frequency Dividers/Multipliers, Mixers, I/Q Mixers & IRMs, Modulators, Switches, VCOs and Microwave Modules. These components are well-suited to a wide variety of Cellular, Broadband, Microwave/Millimeterwave, Fiber Optic and Military/Space applications. The 2005 Designer’s Guide is also available on CD-ROM. To request your hardcopy or CD-ROM catalog visit us on-line at www.hittite.com and select the “Submit Inquiry” button.

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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 110 GHz. Hittite’s RFIC/MMIC products are developed using state-of-the-art GaAs, InGaP/GaAs, InP, Si and SiGe semiconductor processes utilizing MESFET, PHEMT, MHEMT 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

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, WiMAX, CATV, DBS
- **Cellular**: GSM, W-CDMA, PCS & UMTS 3G, PLMR, & Telematics
- **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 ISO 9001:2000 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.