NEW InGaP HBT Power Amplifiers to 1.6 Watts!

Up to +50 dBm Output IP3 For Cellular/3G Infrastructure

Cellular/3G basestation & repeater design engineers demand high linearity and efficient output power for their transmitter applications. Hittite’s new HMC452QS16G 1 Watt and HMC453QS16G 1.6 Watt Linear Power Amplifiers deliver output IP3 performance as high as +49 dBm over 450 to 2200 MHz for GSM, CDMA & UMTS applications. These high dynamic range GaAs InGaP HBT amplifiers are housed in miniature 16 lead QSO8 plastic packages and utilize a minimal number of external components to optimize performance for each application. These amplifiers also share the same pin out, facilitating common system PCB layouts desired by today’s designers.

(Continued on page 6)

Modulator Offers Unprecedented High Dynamic Range!

100 - 4000 MHz Wideband Performance Covers Cellular/3G & Broadband

Hittite continues to produce direct quadrature modulators with industry leading performance. The new HMC497LP4 is a low noise, high linearity Direct Quadrature Modulator RFIC which is ideal for digital modulation applications including; Cellular/3G, Broadband Wireless Access & ISM circuits. Complementing the previously released HMC495LP3 250 - 3800 MHz Direct Quadrature Modulator, the HMC497LP4 improves RF/LO bandwidth to 100 - 4000 MHz. Additional major mid-band performance enhancements of the new modulator over the first model include; broadband noise floor from -157 to -159 dBm/Hz, output P1dB from +1 to +9 dBm, output IP3 from +13 to +23 dBm and carrier suppression from 36 to >42 dBc.

(Continued on page 6)

Hittite Introduces Wideband SMT Distributed Amplifiers

Standard SMT Packaging for LNAs, Drivers & PAs Covering DC to 20 GHz

Hittite announces the release of four new Wideband GaAs PHEMT Distributed MMIC Amplifiers in standard SMT packages; HMC462LP5, HMC463LP5, HMC464LP5 & HMC465LP5. These Low Noise, Driver & Power Amplifiers are ideal for telecom infrastructure, test equipment, microwave radio and military applications from DC to 20 GHz. Across the product line the small signal gain ranges from 13 to 17 dB with output P1dB performance from +14 to +26 dBm and noise figure as low as 2.5 dB.

Data sheets are available at www.hittite.com and list guaranteed min/max limits for key parameters such as gain, NF and P1dB through their complete frequency ranges up to 20 GHz. These new standard products are available from stock.

(See pages 2 & 3 for details)
**HMC459**  
Wideband PHEMT Power Amplifier Die, DC - 18 GHz  

**Combines High Gain & Power!**  
The HMC459 is a GaAs MMIC PHEMT Distributed Power Amplifier die which operates between DC and 18 GHz. The amplifier provides 17 dB of gain, +31.5 dBm output IP3 and +25 dBm P1dB. Gain flatness is very good, making the HMC459 ideal for EW, ECM, radar, telecom infrastructure and test equipment applications. The HMC459 amplifier I/O’s are internally matched to 50 Ohms facilitating easy integration into Multi-Chip-Modules (MCMs).

**Features**  
- +25 dBm P1dB Output Power  
- 17 dB Gain  
- +31.5 dBm Output IP3  
- Supply Voltage: +8V @ 290 mA  
- 50 Ω Matched Input/Output

**Psat vs. Temperature**

**HMC460**  
Wideband PHEMT LNA Die, DC - 20 GHz  

**Very Low 2.2 dB Noise Figure!**  
The HMC460 is a GaAs MMIC PHEMT Distributed Low Noise Amplifier die which operates between DC and 20 GHz. The amplifier provides 14 dB of gain, 2.2 dB noise figure and +16 dBm P1dB. The HMC460 is ideal for EW, ECM, radar, telecom infrastructure and test equipment applications. The HMC460 amplifier can easily be integrated into Multi-Chip-Modules (MCMs) due to its small size.

**Features**  
- 2.2 dB Noise Figure  
- 14 dB Gain  
- +16 dBm P1dB Output Power  
- Supply Voltage: +8V @ 60 mA  
- 50 Ω Matched Input/Output

**Gain & Noise Figure**

**HMC462LP5**  
Wideband PHEMT Self-Biased SMT LNA, 2 - 20 GHz  

**Excellent LNA or Driver**  
The HMC462LP5 is a GaAs MMIC PHEMT Low Noise Distributed Amplifier in a leadless 5 x 5 mm SMT package which operates between 2 and 20 GHz. The self-biased amplifier provides 13 dB of gain, 2.5 to 3.5 dB noise figure and +14.5 dBm P1dB while requiring only 66 mA from a single +5V supply. Gain flatness is excellent from 2 to 18 GHz making the HMC462LP5 ideal for EW, ECM, radar, telecom infrastructure and test equipment applications. The wideband LNA I/Os are internally matched to 50 Ohms and are internally DC blocked.

**Features**  
- 2.5 dB Noise Figure  
- 13 dB Gain  
- +14 dBm P1dB Output Power  
- 50 Ω Matched Input/Output  
- 25mm² Leadless SMT Package

**Noise Figure vs. Temperature**
HMC463LP5

**Wideband PHEMT SMT LNA with AGC, 2 - 20 GHz**

**Features**
- 2.8 dB Noise Figure
- 13 dB Gain
- +18 dBm P1dB Output Power
- 50 Ω Matched Input/Output
- 25mm² Leadless SMT Package

**8 dB of AGC Range!**
The HMC463LP5 is a GaAs MMIC PHEMT Low Noise AGC Distributed Amplifier packaged in a leadless 5 x 5 mm SMT package operating over 2 - 20 GHz. The amplifier provides 13 dB of gain, 2.2 to 3.5 dB noise figure and +18 dBm P1dB while requiring only 60 mA from a +5V supply. An optional gate bias (Vgg2) is provided for AGC of 8 dB typical. Gain flatness is excellent at ±0.5 dB over 2 - 18 GHz making the HMC463LP5 ideal for EW, ECM, radar, telecom infrastructure and test equipment applications. The wideband LNA I/Os are internally matched to 50 Ohms and are internally DC blocked.

HMC464LP5

**Wideband PHEMT SMT Power Amplifier, 2 - 20 GHz**

**Features**
- +26 dBm P1dB Output Power
- 14 dB Gain
- +30 dBm Output IP3
- 50 Ω Matched Input/Output
- 25mm² Leadless SMT Package

**Efficient Broadband Power!**
The HMC464LP5 is a GaAs MMIC PHEMT Distributed Power Amplifier in a leadless 5 x 5 mm SMT package which operates between 2 and 20 GHz. The amplifier provides 14 dB of gain, +30 dBm output IP3 and +26 dBm P1dB while requiring 290 mA from a +8V supply. Gain flatness is good from 2 - 18 GHz making the HMC464LP5 ideal for EW, ECM, radar, telecom infrastructure and test equipment applications. The wideband power amplifier I/O’s are internally matched to 50 Ohms and the RF input is DC blocked.

HMC465LP5

**Wideband PHEMT SMT Driver Amplifier, DC - 20 GHz**

**Features**
- 15 dB Gain
- Output Voltage to 10Vpk-pk
- +25 dBm Saturated Output Power
- 50 Ω Matched Input/Output
- 25mm² Leadless SMT Package

**Consistent Gain, Phase & Power!**
The HMC465LP5 is a GaAs MMIC PHEMT Distributed Driver Amplifier packaged in a leadless 5 x 5 mm SMT package which operates between DC and 20 GHz. The amplifier provides 15 dB of gain, 3 dB noise figure and +25 dBm of saturated output power while requiring only 160 mA from a +8V supply. Gain flatness is excellent at ±0.25 dB as well as +/- 4 deg deviation from linear phase from DC - 10 GHz making the HMC465LP5 ideal for OC192 fiber optic LN/MZ modulator driver amplifier as well as test equipment applications. The HMC465LP5 amplifier I/Os are internally matched to 50 Ohms.
**HMC469MS8G & HMC471MS8G**

**Dual Channel SiGe Gain Blocks to 5 GHz**

**Features Per Amp**
- 15 to 20 dB Gain
- P1dB of +18 to +20 dBm
- Output IP3 to +34 dBm
- Supply (Vs): +6V to +12V
- 14.9 mm² 8 Lead MSOP

**Typical Performance Table**

<table>
<thead>
<tr>
<th></th>
<th>HMC469MS8G</th>
<th>HMC471MS8G</th>
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<tbody>
<tr>
<td>Gain (dB)</td>
<td>15</td>
<td>20</td>
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<tr>
<td>P1dB (dBm)</td>
<td>+18</td>
<td>+20</td>
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<tr>
<td>OIP3 (dBm)</td>
<td>+34</td>
<td>+34</td>
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<tr>
<td>Noise Figure (dB)</td>
<td>4.0</td>
<td>3.2</td>
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</table>

*Individual Amplifier @ 1GHz

**Cascadable, Combines!**

The HMC469MS8G & HMC471MS8G are SiGe HBT Dual Channel Gain Block MMIC SMT amplifiers covering DC to 5 GHz. These versatile products each contain two gain blocks, packaged in single 8 lead plastic MSOPs, for use as either separate cascadable 50 Ohm RF/IF gain stages, LO or PA drivers. Both amplifiers may be combined utilizing external 90° or 180° hybrids to create a high linearity driver. These products are ideal for LO distribution in a compact footprint. Each product’s combined dual amplifier circuit delivers 2 to 3 dB higher output power and output IP3 for specific application bands through 4 GHz.

**HMC490LP5**

**Medium Power SMT PHEMT LNA, 12 - 16 GHz**

**Features**
- 2.5 dB Noise Figure
- +25 dBm P1dB Output Power
- 23 dB Gain
- +34 dBm Output IP3
- 50 Ω Matched Input/Output

**Gain, NF & OIP3 vs. Supply Voltage @ 14 GHz**

**Delivers Power with Little Noise!**

The HMC490LP5 is a high dynamic range GaAs PHEMT Low Noise Amplifier SMT packaged MMIC which operates over 12 - 16 GHz. The HMC490LP5 provides 23 dB of gain, 2.5 dB noise figure and an output IP3 of +34 dBm from a +5.0 V supply voltage. This versatile amplifier combines excellent, stable +25 dBm P1dB output power with very low NF making it ideal for both receive and transmit applications. The amplifier is packaged in a leadless 5 x 5 mm QFN SMT package which is easily implemented on microwave radio and VSAT system PCBs.

**HMC448 & HMC449**

**GaAs PHEMT x2 Active Multipliers Cover 19 - 33 GHz Fo**

**Features**
- Very Low Phase Noise
- Wide Input Power Range: -4 to +6 dBm
- Single Supply: +5V @ 50 mA
- Ideal for LO Multiplier Circuits
- SMT Packaged Versions
- Available Sept ‘04

**Typical Performance**

<table>
<thead>
<tr>
<th></th>
<th>HMC448</th>
<th>HMC449</th>
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<tr>
<td>Output Freq. Range (GHz)</td>
<td>19 - 25</td>
<td>27 - 33</td>
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<tr>
<td>Output Power (dBm)</td>
<td>+11</td>
<td>+10</td>
</tr>
<tr>
<td>Fo / 3Fo Isolation (dBc)</td>
<td>25/25</td>
<td>34 / 17</td>
</tr>
<tr>
<td>100 kHz SSB Phase Noise (dBc/Hz)</td>
<td>-135</td>
<td>-132</td>
</tr>
</tbody>
</table>

* Data is mid-band typical

**Compact, Low Noise Multipliers!**

The HMC448 & HMC449 are broadband ultra low noise x2 Active Frequency Multiplier chips utilizing GaAs PHEMT technology. When driven by a 0 dBm signal, the multipliers provide +10 dBm typical output power and excellent Fo & 3Fo isolation across their respective output bands. Both the HMC448 & HMC449 are ideal for use in LO multiplier chains for microwave & VSAT radios yielding reduced parts count vs. traditional approaches. The HMC448 may also be used in the generation of a half rate clock for 40 Gbps systems or as part of a multiplier chain to generate a full rate 40 Gbps clock.
COMPETITIVE, HIGH PERFORMANCE MMICs!

HMC381LP6  
**Dual Channel Downconverter Receiver IC, 1700 - 2200 MHz**

**Features**
- +26 dBm Input IP3
- Single Input LO Drive: 0 dBm
- 9 dB Conversion Gain
- 12.5 dB Noise Figure
- 6x6 mm Industry Standard QFN Package

_**Highly Integrated, Highly Linear!**_

The HMC381LP6 is a Dual Downconverter Receiver IC operating over 1.7 - 2.2 GHz and delivering +27 dBm input IP3 for UMTS & PHS applications. The passive mixer outputs and high dynamic range IF amplifier inputs are positioned so that an external IF filter can be placed in series between them. The converter provides a gain of 9 dB and 12.5 dB typical SSB noise figure. The IC operates from a supply of +5V @ 260 mA while requiring a LO drive level of only -4 to +4 dBm. The design requires no external baluns and supports IF frequencies between 50 and 300 MHz.

HMC480ST89  
**InGaP HBT Linear Gain Block, DC - 5 GHz**

**Features**
- P1dB Output Power: +19 dBm to 2.5 GHz
- Gain: 19 dB @ 1 GHz  
  16 dB @ 2 GHz
- +34 dBm Output IP3
- Single Supply: +6V to +8V

_**Standard SOT89 Pin Out!**_

The HMC480ST89 is an InGaP HBT Gain Block MMIC SMT amplifier covering DC to 5 GHz and packaged in an industry standard SOT89. The amplifier can be used as a cascadable 50 Ohm RF/IF gain stage as well as a LO or PA driver for cellular/3G, FWA, CATV, microwave radio and test equipment applications. The amp delivers 19 dB gain with +34 dBm output IP3 at 1 GHz while requiring only 82 mA from a single +8V supply. The HMC480ST89 InGaP gain block offers excellent output IP3 and constant output power performance through 5 GHz compared to equivalent SiGe based products.

HMC349LP4C & HMC349MS8G  
**High Isolation Switches, DC - 4 GHz**

**Features**
- 60 to 70 dB Isolation
- +52 dBm Input IP3
- All Off State
- MSOP8 or QFN Package

_**Single TTL/CMOS Control Input!**_

The HMC349LP4C & HMC349MS8G are high isolation non-reflective DC to 4 GHz GaAs MESFET SPDT switches available in either leadless QFN (LP4C) or 8 lead MSOP (MS8G) low cost packages. The switches are ideal for cellular/3G basestation applications yielding 60 to 70 dB isolation, low 0.9 dB insertion loss and +52 dBm input IP3. Power handling is excellent up through the 3.5 GHz fixed wireless band with both switches offering a P1dB compression point of +31 dBm. On-chip circuitry allows a single TTL / CMOS control. An enable input (EN) set to logic high will put the switch in an “all off” state.
**New InGaP HBT Power Amplifiers...** *(continued from page 1)*

Each amplifier is equipped with a Power Down Control (Vpd) to enable the system designer to either turn down the RF output power completely (Vpd = 0 Vdc) or reduce the output power and device current consumption by adjusting Vpd to between 0 and +5 Vdc. Both products utilize a single +5 V supply (Vs) and are very efficient with a 46% PAE @ +31 dBm Pout for the HMC452QS16G and 42% PAE @ +32 dBm Pout for the HMC453QS16G.

Table 1 shows the typical performance for each amplifier optimized for output IP3. Each product’s input and output match may also be adjusted for best P1dB output power or CDMA output channel power. For the HMC453QS16G power amplifier the CDMA 2000 output channel power is +22.5 dBm at 1960 MHz for -55 dBc Adjacent Channel Power (ACP).

Data sheets are available at www.hittite.com and list guaranteed min/max limits for key parameters such as gain, P1dB and output IP3. These new standard products are available from stock.

**Table 1**

<table>
<thead>
<tr>
<th>Parameter Range (1)</th>
<th>HMC452QS16G 1 Watt Linear PA</th>
<th>HMC453QS16G 1.6 Watt Linear PA</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range (MHz)</td>
<td>450 to 2200</td>
<td>450 to 2200</td>
<td>MHz</td>
</tr>
<tr>
<td>Small Signal Gain (dB)</td>
<td>16</td>
<td>10</td>
<td>14.5</td>
</tr>
<tr>
<td>Input / Output Return Loss (dB)</td>
<td>9 / 12</td>
<td>17 / 15</td>
<td>12 / 15</td>
</tr>
<tr>
<td>Output Power at P1dB (dBm)</td>
<td>+30</td>
<td>+31</td>
<td>+32</td>
</tr>
<tr>
<td>Output IP3 (dBm)</td>
<td>+48</td>
<td>+47.5</td>
<td>+50</td>
</tr>
<tr>
<td>Noise Figure (dB)</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Bias Supply (Vs)</td>
<td>+5 V @ 485 mA</td>
<td>+5 V @ 725 mA</td>
<td></td>
</tr>
</tbody>
</table>

(1) Each amplifier may be optimized for narrow band applications within 450 to 2200 MHz.
(2) Typical performance for T<sub>θ</sub> = 25°C, V<sub>cc</sub> = +5 V, Z<sub>0</sub> = 50 Ohms.

**Modulator Offers Unprecedented High Dynamic Range!** *(continued from page 1)*

The dynamic range of a direct quadrature modulator is critical in maintaining the integrity of digitally modulated signals and is defined as the ratio of its output power at 1 dB compression (dBm) to its output noise floor (dBm/Hz). Figure 1 shows the HMC497LP4 achieving an output P1dB of typically +9 dBm at 1960 MHz and +7 dBm at 3500 MHz. Also shown is the device’s outstanding output noise floor of -159 dBm/Hz at 1960 MHz and -154 at 3500 MHz. These values translate into a dynamic range of 168 dB at 1960 MHz and 161 dB at 3500 MHz which is the highest reported to date for a direct quadrature modulator.

The HMC497LP4 is well suited for applications in software-defined radios (SDRs) where the upconverter must dynamically vary its modulation format depending on changing conditions and requirements. This modulator can be used to create virtually any analog or digital modulation format including BPSK, QPSK, 8PSK, OFDM, and QAM for basestation, access point, and Customer Premise Equipment (CPE) applications in the cellular, PCS, UMTS and fixed wireless bands. This wideband capability allows the transceiver designer to use a common PCB design for multiple frequency bands. Figure 2 shows the excellent ACPR and Output Noise performance of the HMC497LP4 for a WCDMA signal at 2140 MHz.

The HMC497LP4 RF output port is single-ended and internally matched to 50 Ohms while the LO requires -6 to +6 dBm and can be driven in either differential or single-ended mode. The baseband inputs will support modulation inputs from DC - 700 MHz typical. This device consumes 170 mA @ +5.0 V and is housed in a compact 4 x 4 mm (LP4) SMT QFN package. The RFIC requires minimal external components & provides a low cost alternative to more complicated double upconversion architectures. The detailed HMC497LP4 data sheet is found at www.hittite.com and the product is available from stock.

**Figure 1. Output P1dB, OIP3 & Noise Floor**

**Figure 2. ACPR for W-CDMA @ 2140 MHz**

Note: W-CDMA @ 2140 MHz (Test Model-1 with 64 Channels)
HMC PROMOTES
THOMAS HWANG TO DIRECTOR OF SALES!

Hittite is pleased to announce the promotion of Mr. Thomas Hwang to Director of Sales. Formerly Hittite’s Asia Sales Manager, Mr. Hwang is now responsible for our sales efforts worldwide and will now be working from Hittite’s Chelmsford, Massachusetts headquarters.

NEW SUMMER 2004
SELECTION GUIDE RELEASED!

Hittite Microwave Corporation is pleased to announce the availability of the Summer 2004 Product Selection Guide which summarizes 24 new products including new Low Noise, Gain Block, Driver and Distributed Amplifier products. The selection guide’s new features include organization by product line as well as by market applications including: Cellular/3G, Microwave, Broadband and Fiber Optic. Request your copy of the new Summer 2004 Selection Guide at www.hittite.com by selecting the “SUBMIT INQUIRY” left hand navigation button. Product data sheets can be found on-line.

HMC ADDS 4 NEW REPRESENTATIVES!

Repwave will represent HMC in Eastern Canada Repwave Inc., headquartered in Ottawa, Canada is a technical sales agency for industry leading manufacturers of RF/Microwave and Optical components and will serve HMC customers in the Canadian provinces of: Ontario, Quebec, New Brunswick, PEI & Nova Scotia. Contact them at (613) 270-9811 or email frank.masciotra1@sympatico.ca.

Secom Telecom will represent select HMC accounts in China and Hong Kong Secom Telecom Company, headquartered in Shenzhen, China, will work in conjunction with our current China representative, Wai Tat Electronics, and Hittite’s Shanghai & Beijing offices to support Hittite’s direct sales channels in China and Hong Kong by focusing promotion on a select group of key customers. Contact them at (+86-755) 25155888 or email sales@secomtel.com.

SAILES SA will represent HMC in France SAILES SA headquartered in Grigny, France, is a specialist European representative for RF & microwave component & measurement equipment manufacturers from the USA, EU and Asia. Contact at +33 1 69 02 25 70 or email ventes@sales.fr.

Bredengen AS will represent HMC in Norway Bredengen AS, headquartered in Oslo, Norway, is a full service communication components representative company. Contact them at +47 21 00 91 00 or email bredengen@bredengen.no.

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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, SOI 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
- Converters
- Dividers/Detectors
- 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, 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.