**Integrated Transceiver Enables Multi-Band Infrastructure Applications, 700 to 3500 MHz!**

**Low Power Compact Tx & Rx RFIC Chipset Performs Wideband Frequency Conversion!**

As the cellular subscriber base continues to migrate from basic handsets to data hungry smartphones, service providers around the world must keep pace with the growing demand for data capacity on their networks. In an effort to reduce costs, infrastructure equipment builders need to implement system wide architectures which can accommodate diverse frequency bands and multiple data standards. Furthermore, this equipment must be able to be deployed rapidly in the field, consume as little power as possible, and occupy a minimal amount of space. This cycle continues as handset manufacturers introduce new models and subscribers demand more and more rapid access to their most data-intensive applications.

In order to address the trend toward higher integration, Hittite Microwave has introduced a new Receiver (Rx) and Transmitter (Tx) Radio Frequency Integrated Circuit (RFIC) chipset which can be used in a wide range of cellular equipment applications.

The HMC1190LP6GE is a wideband, high linearity Dual Channel Downconverter with Integrated PLL/VCO and is designed specifically for multi-standard receiver applications that require a compact, highly integrated and low power solution. The HMC1190LP6GE was designed to provide excellent IP3 and 2 x 2 spurious product performance, and to support high IF receivers and antenna diversity architectures. This wideband dual channel frequency converter exhibits an unprecedented RF bandwidth of 700 MHz.

(Continued on page 9)

**Hittite Introduces New 3.3V Wideband PLL with Integrated VCO!**

**New Device Dramatically Reduces Power Consumption with Industry Leading Phase Noise & Spurious Performance**

The HMC832LP6GE is a 3.3V wide-band Fractional-N PLL with integrated VCO that generates continuous fractional frequencies between 25 MHz to 3 GHz. The HMC832LP6GE comes with low power consumption of 560 mW, while featuring industry leading phase noise and spurious performance. It includes an innovative Programmable Performance technology that allows designers to further reduce current consumption if demands on the noise floor can be relaxed.

The HMC832LP6GE industry leading phase noise (-110 dBc/Hz at 3 GHz) and spurious performance, across all frequencies, help designers minimize blocker effects, improve receiver sensitivity and increase transmitter spectral purity. Best in class EVM targets even the most demanding applications in cellular and cellular backhaul markets. When used as an IF stage LO in point to point microwave application, the HMC832LP6GE limits phase noise contribution to the system SNR budget, and enables radio designs that utilize highest constellations, such as 2048 and 4096 QAM. In OFDM systems, such as LTE and WiMAX, the HMC832LP6GE ensures that Inter Carrier Interference (ICI) caused by the LO phase noise does not limit the system SNR, thereby providing more design options and reducing the need for DSP resources associated with Common Phase Error (CPE) correction and ICI mitigation.

(Continued on page 10)
## New Wide Dynamic Range SDLVA Module

**Operates to 20 GHz**

See Page 7 for details.

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### New Products by Market Application

Hittite Microwave offers over 1,050 products across 36 product lines. Our custom and standard products support a wide range of wireless/wired/optical communications and radar applications for the following markets.

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Function</th>
<th>Frequency (GHz)</th>
<th>Page Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC998LP5E</td>
<td>Power Amplifier, 2 Watt</td>
<td>0.1 to 20.0</td>
<td>6</td>
</tr>
<tr>
<td>HMC1053</td>
<td>Power Amplifier, 4 Watt</td>
<td>9.0 to 13.3</td>
<td>6</td>
</tr>
<tr>
<td>HMC1049</td>
<td>Wideband LNA</td>
<td>0.3 to 20.0</td>
<td>6</td>
</tr>
<tr>
<td>HMC1049LP5E</td>
<td>Wideband LNA</td>
<td>0.3 to 20.0</td>
<td>6</td>
</tr>
<tr>
<td>HMC374SC70E</td>
<td>Low Noise Amplifier</td>
<td>0.3 to 3.0</td>
<td>5</td>
</tr>
<tr>
<td>HMC3653LP3BE</td>
<td>HBT Driver Amplifier</td>
<td>7 to 15</td>
<td>7</td>
</tr>
<tr>
<td>HMC9000</td>
<td>High Speed Data Acquisition</td>
<td>DC to 18</td>
<td>3</td>
</tr>
<tr>
<td>HMC1090LP3E</td>
<td>Single Channel Downconverter</td>
<td>0.4 to 4.0</td>
<td>5</td>
</tr>
<tr>
<td>HMC1050</td>
<td>3Vp-p Optical Modulator Driver</td>
<td>DC to 30</td>
<td>4</td>
</tr>
<tr>
<td>HMC1051</td>
<td>8Vp-p Optical Modulator Driver</td>
<td>DC to 30</td>
<td>4</td>
</tr>
<tr>
<td>HMC6282A</td>
<td>Quad Optical Modulator Driver</td>
<td>32 Gbps</td>
<td>4</td>
</tr>
<tr>
<td>HMC832LP6GE</td>
<td>Wideband PLL + VCO (3.3V)</td>
<td>25 to 3000</td>
<td>1</td>
</tr>
<tr>
<td>HMC-C088</td>
<td>SDLVA</td>
<td>1 to 20</td>
<td>7</td>
</tr>
<tr>
<td>HMC1055LP2CE</td>
<td>SPST, Non-Reflective</td>
<td>DC to 3.5</td>
<td>5</td>
</tr>
<tr>
<td>HMC1190LP6GE</td>
<td>Wideband Dual-Downconverter w/ Frac-N PLL/VCO</td>
<td>0.7 to 3.5</td>
<td>1</td>
</tr>
<tr>
<td>HMC1197LP7FE</td>
<td>Wideband Dual Modulator w/ Frac-N PLL/VCO</td>
<td>0.4 to 4.0</td>
<td>1</td>
</tr>
<tr>
<td>HMC6000LP711</td>
<td>60 GHz Tx w/ Integrated Antenna</td>
<td>57 to 64</td>
<td>8</td>
</tr>
<tr>
<td>HMC6001LP711</td>
<td>60 GHz Rx w/ Integrated Antenna</td>
<td>57 to 64</td>
<td>8</td>
</tr>
<tr>
<td>HMC6450</td>
<td>60 GHz Tx / Rx Evaluation Kit</td>
<td>57 to 64</td>
<td>8</td>
</tr>
</tbody>
</table>
Capturing high-speed signals for further processing in the digital domain has always been an important objective in the data acquisition realm. The sub-system performing this task is often called a ‘quantizer’ and there is always a need for this sub-system to quantize higher and higher speed signals. In the general case, one purchases expensive test equipment in order to handle multi-GHz signals. Now, Hittite Microwave Corporation has developed a sub-sampling quantizer sub-system called the Multi-GHz Quantizer. This is the industry’s first complete, cost-effective quantizer covering frequencies above 6 GHz. In fact, frequencies up to 18 GHz can be handled by this solution.

The solution utilizes Hittite’s Track-and-Hold (T/H), ADC, PLL and Programmable Clock Delay products to form a complete multi-GHz “frequency-to-bits” solution. (See below for the part numbers that make up this chip-set). The clock delay control chip eliminates the need for complex clock adjustment schemes, and significantly reduces the entry barrier for this solution compared to other T/H and ADC products. For input frequencies at 6 GHz and above, not only does the Multi-GHz Quantizer offer a superior dynamic range, input signal level, T/H noise floor and PLL clock jitter are also state-of-the-art, giving an unprecedented 40 dB SNR at 9 GHz input signal frequency. Combined with a >50 dB SFDR up to 7 GHz, this solution allows direct quantization in sub-sampling applications like Bit Error Rate Testers (BERT), Pulse Doppler Radars and Wideband Microwave Receivers.

Perhaps the best example of the HMC9000 chip set’s utility is the generation of an ‘eye diagram’ - a method that is widely used to test the quality of the very high speed digital signals generated in PC, data communication and storage applications. This method allows a BERT tester to verify the quality of the multi-Gbps digital signal within a fraction of a second, compared to the possible hours and days of test time to verify the error rate of a digital signal. The HMC9000 chip set will directly produce the eye diagram at the ADC output of the multi-GHz digital signal applied at the T/H input by utilizing the excellent accuracy of the Hittite PLL. When the PLL output clock frequency is adjusted to the incoming data rate, the ADC will output the eye diagram directly without any further processing. This output forms an ideal starting point for a Bit Error Rate Tester (BERT) design and offers a huge cost reduction for this application.

Another good application for the HMC9000 chip set is in Pulse Doppler Radars, where the ultra-wide bandwidth of the Hittite track-and-hold ensures that very narrow pulses in the sub-nano second range are captured with high accuracy – such as an ENOB (effective number of bits) better than 6 bits at frequencies up to 7.5 GHz.

Finally, it should be noted that the HMC9000 chip set is the Industry’s first quantizer to cover the microwave X-band. With SNR >38 dB and SFDR >36 dB up to 12 GHz, new architectures can be realized for microwave X-band receivers.

The HMC9000 Multi-GHz Quantizer Evaluation Kit includes:
- HMC9000 Quantizer Chipset (HMC6804 Track & Hold & HMC8101 ADC)
- HMC1034LP6GE Frequency Generation PLL
- HMC988LP3E Programmable Clock Delay Device
- FPGA Code
- Board Schematics
- Layout Files
- EasySuite™ Software

For more information please contact adc@hittite.com.
New Modulator Driver Amplifiers for Fiber Optic & Test and Measurement Applications

HMC6282A

**Features**
- Operation Up to 32 Gbps
- 5.3W Power Dissipation
- Less than 250 fs Additive RMS Jitter
- Quad GPPO Interface
- Hermetically Sealed Module
- OIF Compatible

32 Gbps Eye Diagram

Time Scale: 10.0 ps/div  
Amplitude Scale: 1.67 V/div  
Eye Amplitude: 7.46V  
RMS Jitter: 914 fs  
Rise Time: 12.89 ps  
Eye S/N: 18.10

**Quad Optical Modulator Driver Module, 30 Gbps**

The HMC6282A is a four channel driver amplifier designed for 100 Gbps Mach-Zehnder (MZ) optical modulator driver applications. Four channel driver amplifiers are fully integrated in a compact connectorized hermetically sealed module where the input/output high-speed connectors are GPPO. The HMC6282A is fully compatible with the Optical Internetworking Forum’s (OIF) Integrated Polarization Multiplexed Quadrature Modulated Transmitters Implementation Agreement (OIF-PMQ-TX).

HMC1050

**3 Vp-p Optical Modulator Driver / Wideband Amplifier, DC to 30 GHz**

**Features**
- Low DC Power Dissipation, 0.36W for 2.8 Vp-p Swing
- Integrated Peak-Detect Function
- 14.8 dB Gain @ 16 GHz
- +15 dBm Saturated Output Power
- Low Additive RMS Jitter, <300 fs

32 Gbps Eye Diagram

Time Scale: 10.0 ps/div  
Amplitude Scale: 750 mV/div  
Eye Amplitude: 2.97V  
Peak-to-Peak Jitter: 4.667 ps  
Rise Time: 13.56 ps  
Eye S/N: 12.91

**Flexible Supply Voltage Range**

The HMC1050 is a GaAs MMIC pHEMT Distributed Amplifier die which operates between DC and 30 GHz. The amplifier provides 14 dB of gain, and +14 dBm of output power at 1 dB gain compression. HMC1050 has a wide supply (Vdd) operating range from +5 to +7V.

Integrated Peak-Detect function enables the output power stability for calibration and field monitoring. The HMC1050 amplifier I/Os are internally matched to 50 Ohms facilitating integration into Multi-Chip-Modules (MCMs). 2.80 Vp-p output voltage swing can be obtained with 500 mVp-p input when stimulated with 32 Gbps 2³¹-1 PRBS NRZ data.

HMC1051

**8 Vp-p Optical Modulator Driver / Wideband Amplifier, DC to 30 GHz**

**Features**
- Low DC Power Dissipation: 1.05W for 8 Vp-p Swing
- Integrated Peak-Detect Function
- 16 dB Gain @ 16 GHz
- +22 dBm Saturated Output Power
- Low Additive RMS Jitter: <300 fs

32 Gbps Eye Diagram

Time Scale: 10.0 ps/div  
Amplitude Scale: 2.00 V/div  
Eye Amplitude: 7.81V  
Peak-to-Peak Jitter: 3.556 ps  
Rise Time: 11.56 ps  
Eye S/N: 16.95

**High Speed, Wide Output Swing**

The HMC1051 is a GaAs MMIC pHEMT Distributed Amplifier die which operates between DC and 30 GHz. The amplifier provides 16 dB of gain, and +20 dBm of output power at 1 dB gain compression. HMC1051 has a wide supply (Vdd) operating range from +5V to +7V.

Integrated Peak-Detect function enables the output power stability for calibration and field monitoring. The HMC1051 amplifier I/Os are internally matched to 50 Ohms facilitating integration into Multi-Chip-Modules (MCMs).

8 Vp-p output voltage swing can be obtained with 1250 mVp-p input when stimulated with 32 Gbps 2³¹-1 PRBS NRZ data.
Amplifiers, Control Products & Mixers for Broadband & Wireless Infrastructure

HMC374SC70E

Features
• Single Supply: Vdd = +3 to +5V
• Broadband Performance
• Low Noise Figure: 1.6 dB
• High Output IP3: +35 dBm
• High Gain: 15 dB @ 0.6 GHz

Low Noise Amplifier, 0.3 to 3.0 GHz

The HMC374SC70E is a general purpose broadband Low Noise Amplifier (LNA) for use in the 0.3 to 3.0 GHz frequency range. The LNA provides 15 dB of gain and a 1.6 dB noise figure from a single positive supply of +3.0 to +5.0V. The low noise figure coupled with a high P1dB (17 dBm) and high OIP3 (35 dBm) make this part ideal for wideband cellular applications. The compact LNA is designed for repeatable gain and noise figure performance. To minimize board area the design is offered in a low cost SC70E package that occupies only 0.089” x 0.053”.

HMC1055LP2CE

Features
• High Isolation, Low Insertion Loss
• High Input IP3: +60 dBm
• Single Control: 0 / +3V
• Non-Reflective Topology
• Compact 2 x 2 mm Package

Non-Reflective GaAs MMIC SPST Switch, DC to 4 GHz

The HMC1055LP2CE is low-cost SPST switch in a 2 x 2 mm, 8 lead DFN plastic package for use in switching applications which require a compact package and a non-reflective “off state”. This device exhibits low insertion loss and high isolation, and can be used anywhere within the system where additional isolation is needed. In the “off state”, RF2 is terminated in 50 Ohms on-chip to minimize unwanted reflections. The switch is controlled with a single positive control line and draws minimal DC current.

HMC1090LP3E

Features
• Broadband Operation with No External Matching
• High-Side & Low-Side LO Injection Operation
• High Input IP3 of +25 dBm
• SSB Noise Figure of 10 dB
• Compact 3 x 3 mm QFN Package

Broadband High IP3 Downconverter, 0.4 to 4.0 GHz

The HMC1090LP3E is a high linearity, single channel downconverting mixer optimized for multi-standard diversity receiver applications that require low power consumption and small size. The HMC1090LP3E features new wideband limiting LO amplifiers to achieve an unprecedented RF bandwidth of 700 to 3500 MHz. Unlike conventional narrow-band downconverter RFICs, the HMC1090LP3E supports both high-side and low-side LO injection over the entire RF frequency band. The RF and LO input ports are internally matched to 50 Ω.
**Power & Low Noise Amplifiers for Microwave Radio & Test & Measurement Equipment**

**HMC1053**

**Features**
- High Saturated Output Power: +38 dBm @ 26% PAE
- High Output IP3: +43 dBm
- High Gain: 34 dB
- DC Supply: +7V @ 2400 mA
- No External Matching Required

**5 Watt Power Amplifier Chip with Power Detector, 9 to 14 GHz**

*Powerful Output Amplifier*

The HMC1053 is a four stage GaAs pHEMT MMIC 5 Watt Power Amplifier with Power Detector, which provides 34 dB of gain, +43 dBm output IP3 and +38 dBm of saturated output power at 26% PAE from a +7V power supply. The HMC1053 exhibits excellent linearity and is optimized for high capacity microwave radio systems. The amplifier configuration and high gain make it an excellent candidate for last stage signal amplification before the antenna. The HMC1053 amplifier I/Os are internally matched facilitating integration into Multi-Chip-Modules (MCMs).

**HMC998LP5E**

**Features**
- P1dB Output Power: +31 dBm
- Psat Output Power: +33 dBm
- High Gain: 11 dB
- Output IP3: +41 dBm
- Supply Voltage: Vdd = +15V @ 500 mA

*Wide Bandwidth, High Linearity*

The HMC998LP5E is a GaAs pHEMT MMIC Distributed Power Amplifier which operates between 0.1 and 20.0 GHz. The amplifier provides 11 dB of gain, +41 dBm output IP3, and +31 dBm of output power at 1 dB gain compression while requiring only 500 mA from a +15V supply. The HMC998LP5E exhibits a slightly positive gain from 3 to 17 GHz making it ideal for Wideband applications. The HMC998LP5E amplifier I/Os are internally matched to 50 Ohms and the device is supplied in a leadless QFN 5 x 5 mm surface mount package.

**HMC1049 / HMC1049LP5E**

**Features**
- Low Noise Figure: 1.8 dB
- High P1dB Output Power: +14.5 dBm
- High Psat Output Power: +17.5 dBm
- High Gain: 15 dB
- High Output IP3: +29 dBm

*Wideband Low Noise Amplifiers, 0.3 to 20.0 GHz*

*Available in Chip or SMT Package*

The HMC1049 & HMC1049LP5E are GaAs MMIC Low Noise Amplifiers which operate between 0.3 and 20 GHz. These LNAs provide 15 dB of small signal gain, 1.8 dB noise figure, and output IP3 of 29 dBm while requiring only 70 mA from a +7V supply. The P1dB output power of 14.5 dBm enables these LNAs to function as LO drivers for balanced, I/Q or image reject mixers in a wide range of high linearity applications in military and space as well as microwave radios, SATCOM and test instrumentation. The HMC1049 & HMC1049LP5E I/Os are internally matched to 50 Ohms.
New HBT Gain Block/Driver Amplifier for Microwave Radio

The HMC3653LP3BE is a HBT MMIC amplifier which is ideal for point-to-point and point-to-multipoint radios, VSAT applications from 7 to 15 GHz. Housed in a compact 3 x 3 mm plastic QFN package, the HMC3653LP3BE delivers 15 dB gain with up to +28 dBm output IP3 and up to +15 dBm P1dB.

The amplifier exhibits a low noise figure of 4 dB and can be used as a cascadable IF or RF gain stage in 50 Ohm applications. The HMC3653LP3BE can deliver up to +19 dBm of saturated output power, which makes it ideal for driving the LO port of many of Hittite's single and double-balanced mixers.

The HMC3653LP3BE also incorporates on-chip active bias networks which allow it to operate directly from a single +5V supply while drawing only 44 mA and maintaining excellent output power stability over temperature.

A Selection of Hittite’s Gain Block & Driver Amplifiers

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>Gain (dB)</th>
<th>OIP3 (dBm)</th>
<th>NF (dB)</th>
<th>P1dB (dBm)</th>
<th>Bias Supply</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW! 7 - 15</td>
<td>15</td>
<td>28</td>
<td>4.0</td>
<td>15</td>
<td>+5V @ 44 mA</td>
<td>HMC3653LP3BE</td>
</tr>
<tr>
<td>DC - 8</td>
<td>12</td>
<td>30</td>
<td>6</td>
<td>14</td>
<td>+5V @ 56 mA</td>
<td>HMC396</td>
</tr>
<tr>
<td>DC - 10</td>
<td>15</td>
<td>24</td>
<td>4.5</td>
<td>13</td>
<td>+5V @ 56 mA</td>
<td>HMC397</td>
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<tr>
<td>DC - 8</td>
<td>15</td>
<td>30</td>
<td>5</td>
<td>15</td>
<td>+5V @ 54 mA</td>
<td>HMC311SC70</td>
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<tr>
<td>DC - 10</td>
<td>14</td>
<td>30</td>
<td>7</td>
<td>20</td>
<td>+5V @ 76 mA</td>
<td>HMC788LP2E</td>
</tr>
</tbody>
</table>

Wideband, High Accuracy SDLVA to 20 GHz

The HMC-C088 is a Successive Detection Log Video Amplifier (SDLVA) which operates from 1 to 20 GHz and provides a logging range of 59 dB. Ideal for a wide range of applications. The HMC-C088 is capable of processing RF pulses in the 1 to 20 GHz frequency band with amplitudes from -54 to +d dBm with only 2/7 ns rise and fall times and 21 ns of recovery time. The HMC-C088 also achieves better than of ±2 dB output frequency flatness to 20 GHz at a -30 dBm input power level and is specified for operation over the -55 °C to 85 °C temperature range. This product comes standard with two female SMA field replaceable connectors, but can also be used with blind mate SMP connectors or as a drop-in module. The package size measures 27.58 x 21.6 x 5.84 mm making it ideal for environmentally robust applications where space is limited. The HMC-C088 also features an integrated voltage regulator that allows the SDLVA to operate from a single supply between +7 and +16V without affecting performance.

A Selection of Hittite’s SMT & Module SDLVA Products

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>Function</th>
<th>Dynamic Range (dB)</th>
<th>RSSI Slope (mV/dB)</th>
<th>RF Threshold Level (dBm)</th>
<th>Bias Supply</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 - 20</td>
<td>SDLVA w/ Limited RF Output</td>
<td>50</td>
<td>42</td>
<td>-45</td>
<td>+12V @ 370 mA, -7V @ 20 mA</td>
<td>HMC-C078</td>
</tr>
<tr>
<td>NEW! 1 - 20</td>
<td>SDLVA</td>
<td>59</td>
<td>14</td>
<td>-54</td>
<td>+7V to +16V @ 86 mA</td>
<td>HMC-C088</td>
</tr>
<tr>
<td>0.5 - 18.5</td>
<td>SDLVA</td>
<td>67</td>
<td>15</td>
<td>-62</td>
<td>+3.3V @ 86 mA</td>
<td>HMC1013LP4E</td>
</tr>
</tbody>
</table>
Hittite has launched a new, highly integrated HMC6000LP711E/HMC6001LP711E Antenna-in-Package (AiP) Silicon Transceiver Chipset Solution, which is fabricated with silicon germanium (SiGe) BiCMOS semiconductor process technology and targets 60 GHz applications such as short range Gbps data links, wireless sensors and test applications. The HMC6000LP711E AiP solution combines a 60 GHz antenna with the HMC6000 transmitter IC while the HMC6001LP711E AiP solution combines a 60 GHz antenna with the HMC6001 receiver IC. Both transceivers are available in 7 x 11 mm QFN plastic packages which support low-cost surface mount PCB assembly and require no experience in handling millimeterwave devices. The chipset not only solves many of the key technical challenges encountered at millimeterwave frequencies, but also enables turn-key multi-Gbps communication links at 60 GHz. Lower frequency baseband signals are directly translated to and from 60 GHz, minimizing the need for expensive and complex millimeterwave interconnection components on the printed circuit board.

The HMC6000LP711E AiP Transmitter IC and the HMC6001LP711E AiP Receiver IC provide an integrated frequency synthesizer for tuning across the 57 to 64 GHz band using 500 or 540 MHz steps (a quarter of the IEEE channel spacing) depending on the reference input frequency. An RF antenna provides a low-loss RF transition to free space. Both devices provide a simple four-wire digital serial interface for full control and status reporting for these ICs, including frequency channel selection, gain control, circuit bias and filter bandwidths. The table below summarizes the performance of the chipset.

**Introducing The HMC6450 60 GHz Antenna-in-Package Transceiver Evaluation Kit**

The HMC6450 is a complete 60 GHz AiP Transceiver Evaluation Kit containing both the HMC6000LP711E Transmitter and the HMC6001LP711E Receiver. Complete with configuration software, the HMC6450 provides the user with everything needed to set up a bidirectional millimeterwave link at 60 GHz with a range of 4 meters. A universal analog I and Q interface will translate base band analog I and Q signals with single-sided bandwidth out to 880 MHz to and from the 60 GHz ISM band. The HMC6450 is the quickest way to get 60 GHz up and running in your lab.

The 60 GHz Antenna-in-Package Transceiver Evaluation Kit includes:
- 2 Evaluation daughter-cards with Tx and Rx Antenna-in-Package 60 GHz devices
- 2 Evaluation Boards, with crystal, USB interface, supply regulators and MCX connectors to differential IQ interface
- 2 Wall-mount power supplies (105 VAC to 230 VAC)
- 2 USB 2.0 Male/Male 6’ Cables
- 8 phase matched MCX to SMA cables for baseband interface on both motherboards
- CD-ROM containing Graphical User Interface (GUI) and installation software

**60 GHz Transceiver Solutions**

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>Function</th>
<th>Antenna Gain (dB)</th>
<th>P1dB (dBm)</th>
<th>NF (dB)</th>
<th>Max. Gain (dB)</th>
<th>Gain Adjust (dB)</th>
<th>Phase Noise @ 1 MHz (dBc/Hz)</th>
<th>Power Dissipation (W)</th>
<th>Part Number</th>
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<tbody>
<tr>
<td>57 to 64</td>
<td>60 GHz Integrated Tx</td>
<td>-</td>
<td>12</td>
<td>-</td>
<td>38</td>
<td>17</td>
<td>-86</td>
<td>0.8</td>
<td>HMC6000</td>
</tr>
<tr>
<td><strong>NEW!</strong> 57 to 64 60 GHz Tx w/ Integrated Antenna</td>
<td>7.5</td>
<td>10</td>
<td>-</td>
<td>36</td>
<td>17</td>
<td>-86</td>
<td>0.8</td>
<td>HMC6000LP711</td>
<td></td>
</tr>
<tr>
<td><strong>NEW!</strong> 57 to 64 60 GHz Integrated Rx</td>
<td>-</td>
<td>-</td>
<td>6</td>
<td>67</td>
<td>65</td>
<td>-86</td>
<td>0.6</td>
<td>HMC6001</td>
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<tr>
<td><strong>NEW!</strong> 57 to 64 60 GHz Rx w/ Integrated Antenna</td>
<td>6.5</td>
<td>-</td>
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<td>65</td>
<td>-86</td>
<td>0.6</td>
<td>HMC6001LP711</td>
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</tr>
<tr>
<td><strong>NEW!</strong> 57 to 64 60 GHz Tx / Rx Evaluation Kit</td>
<td>6.5 - 8.5</td>
<td>9</td>
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<td>-86</td>
<td>-</td>
<td>HMC6450</td>
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</tbody>
</table>

For more information please contact txrx@hittite.com.
Compact Tx & Rx RFIC Solutions Enable Wideband Frequency Conversion in Cellular Infrastructure

Integrated Transceivers Enable Multi-Band Infrastructure Applications... (continued from page 1)

to 3500 MHz, and unlike conventional narrow-band downconverters, the HMC1190LP6GE supports both high-side and low-side LO injection over all RF frequencies. The HMC1190LP6GE RF and LO inputs are single-ended and are converted into differential by on-chip integrated LO and RF baluns, while an externally controlled enable/disable feature makes it possible to reduce power consumption dynamically as conditions allow. Balanced high linearity passive mixer cores combined with high-linearity IF amplifiers deliver excellent LO-to-RF, LO-to-IF, and RF-to-IF isolations. With input IP3 to +24 dBm (See figure 1) the HMC1190LP6GE can be used in the most demanding applications from small cells to macro BTS.

For Transmitter chain applications, the HMC1197LP7FE is a low noise, high linearity Direct Quadrature Modulator with integrated Fractional-N PLL/VCO. This wideband transmitter solution is ideal for digital modulation applications from 0.1 to 4.0 GHz and is housed in a compact 7 x 7 mm (LP7) surface mount QFN package. The HMC1197LP7FE requires minimal external components & provides a low cost alternative to more complicated double upconversion architectures. The single-ended RF output port is matched to 50 Ohms with no external components while the auxiliary LO output enables the HMC1197LP7FE to distribute identical frequency and phase signals to multiple destinations within the transmitter or receiver. An integrated programmable bandwidth Low Pass Filter (LPF) in the LO path ensures little or no LO contribution to modulator sideband rejection. Sixteen programmable LPF bands enable true wideband operation, eliminating the need for band specific harmonic filtering hardware and allowing agile LO frequency filtering for different band plans during and after deployment.

Both the HMC1190LP6GE and HMC1197LP7F incorporate a feature-rich, industry leading PLL and wideband VCO. The PLL features a very low Figure of Merit (FOM) of -230 dBm/Hz in integer mode, while the internal VCO and section can generate frequencies from 50 to 4100 MHz. The advanced PLL architecture also provides an external VCO input allowing the HMC1190LP6GE and the HMC1197LP7FE to lock external VCOs, and enables cascaded LO architectures for MIMO radio applications. The integrated Phase Detector (PD) and delta-sigma modulator are capable of operating at up to 100 MHz permitting wider loop-bandwidths with excellent spectral performance. Two separate Charge Pump (CP) outputs enable separate loop filters which can be optimized for both integrated and external VCOs, and support seamless switching between integrated or external VCOs during operation. The PLL/VCO can phase adjust and synchronize multiple Hittite Tx and Rx RFICs enabling scalable MIMO and beam-forming radio architectures. Additional PLL/VCO features include a configurable output mute function, and an Exact Frequency Mode that enables both products to generate fractional frequencies with 0 Hz frequency error and the ability to synchronously change frequencies without changing the phase of the output signal.

These new Receiver and Transmitter products from Hittite uniquely combine the attributes of compact size, wide dynamic range, and wide bandwidth, allowing OEMs to develop flexible system architectures for maximum return on investment. Contact Hittite for complete details and to order samples and evaluation boards.

Hittite’s Low Power Consumption Rx RFIC

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>Function</th>
<th>Input IP3 (dBm)</th>
<th>NF (dB)</th>
<th>Conv. Gain (dB)</th>
<th>PLL FOM (dBC/Hz)</th>
<th>DC Power (W)</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW! 0.7 to 3.5</td>
<td>Wideband Dual-Downconverter w/ Frac-N PLL/VCO</td>
<td>+24</td>
<td>9</td>
<td>8</td>
<td>-230 / -227</td>
<td>2.33</td>
<td>HMC1190LP6GE</td>
</tr>
</tbody>
</table>

Hittite’s Low Power Consumption Tx RFIC

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>Function</th>
<th>Output IP3 (dBm)</th>
<th>Output P1dB (dBm)</th>
<th>Output NF (dBC/Hz)</th>
<th>PLL FOM (dBC/Hz)</th>
<th>DC Power (W)</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW! 0.4 to 4.0</td>
<td>Wideband Direct Modulator w/ Frac-N PLL/VCO</td>
<td>+30</td>
<td>+11</td>
<td>-160</td>
<td>-230 / -227</td>
<td>1.76</td>
<td>HMC1197LP7FE</td>
</tr>
</tbody>
</table>

For more information please contact sales@hittite.com.
Hittite Introduces New 3.3V Wideband PLL with Integrated VCO!... (continued from page 1)

Industry leading spurious performance of the HMC832LP6GE simplifies radio designs and enables radio designers to achieve maximum performance. Unparalleled in the industry, the HMC832LP6GE features <~55 dBc/Hz inside the loop bandwidth spurious performance, and significantly better performance outside the loop bandwidth (<~90 dBc/Hz). More importantly, the HMC832LP6GE does not emit any channel spurs in Exact Frequency Mode. This is critical especially since Exact Frequency Mode is the preferred mode of operation of the PLL/VCO in cellular and microwave radio markets. In these markets, users often program channel step size according to the channel spacing of the particular standard of the radio. Any channel spurs then become interference and/or blockers to adjacent radio channels.

For applications that are even more sensitive to spurious, the HMC832LPGE can be placed in a cascaded configuration to operate virtually spurious free (typically <~90 dBc/Hz spurious) at any frequency and any offset.

The HMC832LP6GE integrated phase detector and delta-sigma modulator can operate at up to 100 MHz frequency and allow wider loop bandwidths for optimized performance and lock time. Exact Frequency Mode enables users to generate fractional output frequencies with 0 Hz frequency error. The device includes Fast Frequency Hopping that can execute any size frequency change in ~ 30 μs and output Mute function, with 50 dB or better isolation over the whole frequency range, to automatically mute the output during frequency changes when the device is not locked. The outputs can be configured as a differential pair or two single-ended outputs if more devices need to be driven with a single LO. The 12 dB of total RF output power control can be programmed in fine 1 dB steps. The HMC832LP6GE is footprint compatible to the industry leading HMC830LP6GE PLL/VCO.

**Hittite’s Wideband PLL with Integrated VCOs**

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>Function</th>
<th>Closed Loop SSB Phase Noise @ 10 kHz Offset</th>
<th>Open Loop VCO Phase Noise @ 1 MHz Offset</th>
<th>Pout (dBm)</th>
<th>RMS Jitter Fractional Mode (fs)</th>
<th>Integrated PN Fractional Mode (deg rms)</th>
<th>Package</th>
<th>ECCN Code</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 - 3000</td>
<td>Wideband PLL+VCO</td>
<td>-114 dBc/Hz @ 2 GHz</td>
<td>-141 dBc/Hz @ 2 GHz</td>
<td>6</td>
<td>159</td>
<td>0.114 @ 2 GHz</td>
<td>LP6G</td>
<td>3A001.a.11.b</td>
<td>HMC830LP6GE</td>
</tr>
<tr>
<td>NEW!</td>
<td>Wideband RF VCO (+3.3V)</td>
<td>-114 dBc/Hz @ 2 GHz</td>
<td>-139 dBc/Hz @ 2 GHz</td>
<td>7</td>
<td>159</td>
<td>0.114 @ 2 GHz</td>
<td>LP6G</td>
<td>3A001.a.11.b</td>
<td>HMC832LP6GE</td>
</tr>
<tr>
<td>25 - 6000</td>
<td>Wideband PLL+VCO</td>
<td>-114 dBc/Hz @ 2 GHz</td>
<td>-141 dBc/Hz @ 2 GHz</td>
<td>-4</td>
<td>159</td>
<td>0.11 @ 2 GHz</td>
<td>LP6G</td>
<td>3A001.a.11.b</td>
<td>HMC833LP6GE</td>
</tr>
<tr>
<td>45 - 1050</td>
<td>Wideband PLL+VCO</td>
<td>-108 dBc/Hz @ 4 GHz</td>
<td>-134 dBc/Hz @ 4 GHz</td>
<td>4</td>
<td>159</td>
<td>0.229 @ 4 GHz</td>
<td>LP6G</td>
<td>3A001.a.11.b</td>
<td>HMC829LP6GE</td>
</tr>
<tr>
<td>45 - 1050</td>
<td>Wideband PLL+VCO</td>
<td>-108 dBc/Hz @ 4 GHz</td>
<td>-134 dBc/Hz @ 4 GHz</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>159</td>
<td>0.23 @ 4 GHz</td>
</tr>
</tbody>
</table>

**Visit Hittite at the 2012 European Microwave Week, Booth #521**

Hittite Microwave will be exhibiting at the 2012 European Microwave Week to be held in Amsterdam, The Netherlands on October 29 through November 1, 2012, Booth #521.

Hittite will feature over 70 new products and will conduct live demonstrations of new products from our Clocks and Timing, ADC, Instrumentation and PLL with Integrated VCO product lines.

For more information about these and other new products please visit us at www.hittite.com.
Hittite Microwave has recently reduced the list price of nine of our high performance module amplifiers. These rugged connectorized amplifiers are ideal for high performance applications in communication, radar systems, test instrumentation and frequency synthesizer applications from 1 to 36 GHz.

The HMC-C059 and the HMC-C027 are GaAs pHEMT Low Noise Amplifier modules which are rated from 1 to 12 GHz and 29 to 36 GHz, respectively. These high performance amplifier modules exhibit noise figures as low as 1.8 dB, with up to 20 dB of gain and up to +30 dBm output IP3. The HMC-C059 LNA module features integrated voltage regulators and consumes 60 mA from a +6V supply, while the HMC-C027 operates directly from a single +3V supply and consumes only 80 mA.

The HMC-C020 and the HMC-C021 are GaAs pHEMT Power Amplifier modules which are rated from 17 to 24 GHz and 21 to 31 GHz, respectively. These powerful amplifier modules deliver up to +24 dBm output P1dB, up to +30 dBm output IP3, and up to 22 dB of gain. The HMC-C026 is a Wideband High Gain GaAs pHEMT Driver Amplifier module which is rated from 2 to 20 GHz and provides up to 31 dB gain and +24 dBm output P1dB, with noise figure as low as 2.5 dB. The HMC-C020, HMC-C021 and the HMC-C026 feature integrated voltage regulators which allow for flexible biasing of both the negative and positive supply pins, while internal bias sequencing circuitry assures robust operation. Each of these lower cost hermetically sealed modules feature internally matched and internally DC blocked RF I/Os, making them ideal for both engineering laboratory and production screening test environments.

The HMC-C072, HMC-C076, HMC-C077, and HMC-C079 are GaAs HBT Ultra-Low Phase Noise Amplifier modules which are rated from 6 to 12 GHz, 7 to 11 GHz, 1.5 to 5.0 GHz, and 3 to 8 GHz, respectively. These high performance amplifier modules exhibit a phase noise contribution as low as -180 dBc/Hz at 10 kHz offset, enabling superior modulation accuracy in high resolution radar and synthesizer applications. Across the product line, these high performance amplifier modules provide up to 14 dB of gain and up to +34 dBm output IP3, with noise figure as low as 4.5 dB. Also ideal for transceiver architectures, these modules deliver up to +25 dBm of saturated output power with good gain flatness and minimal variation over temperature. Specified over the industrial temperature range of -55° to +85°C and housed in miniature hermetic modules with field replaceable SMA connectors, the HMC-C072, HMC-C076, HMC-C077, and HMC-C079 operate from a single +7V supply and consume between 110 and 300 mA of bias current, depending on the model selected. The HMC-C072, HMC-C076, HMC-C077, and HMC-C079 complement Hittite’s broad line of low noise and power amplifier products which are available in die, SMT and connectorized module formats with frequency coverage to 86 GHz.

All of these module amplifiers offer a unique combination of performance, ruggedness and cost, and represent an outstanding value when compared with competing solutions. All connectorized module products are available from stock and can be ordered via the company’s e-commerce site or via direct purchase order. Released data sheets may be found at www.hittite.com.