HITTITE STANDARD PRODUCTS ENABLE ALL SMT MICROWAVE RADIO DESIGN

Microwave and millimeterwave designers have traditionally used die components to satisfy demanding requirements for the transmit (Tx), receive (Rx), LO generation, and LO distribution sections of the radio. In order to reduce overall cost, high frequency designers are turning more often to surface mount (SMT) components and a PCB based approach, in order to leverage in-house automated pick and place and reflow equipment. Within the past year, Hittite Microwave has released 42 new SMT products for the microwave radio and millimeterwave market, all of which are available in RoHS compliant packaging.

(Continued on page 6)

LOW NOISE PLO MMIC FOR 15 GHz VSAT APPLICATIONS

Integrates VCO, Phase/Frequency Detector, Prescaler & Loop Amp.

Building upon our extensive product line of MMIC VCOs, Hittite announces an InGaP HBT Phase Locked Oscillator (PLO) MMIC for VSAT subscriber equipment. The HMC535LP4 PLO MMIC provides a single ended RF output in the range of 14.6 to 15.4 GHz, while delivering high output power of +11 dBm, and extremely low single sideband phase noise of -110 dBc/Hz at 100 kHz offset. Output power and phase noise performance are excellent over temperature and shock due to the monolithic construction.

The PLO MMIC accepts a single-ended, or a differential reference oscillator input signal in the range of 228 to 240 MHz, with a power level between 0 and +10 dBm. The reference signal source may be fixed or swept.

(Continued on page 6)

BROADBAND HIGH DYNAMIC RANGE LNA FOR WIRED & WIRELESS APPLICATIONS

GaAs pHEMT MMIC Combines Low Noise Figure & High IP3 from 0.3 to 3.0 GHz

A new high linearity SMT LNA meets the needs of RF design engineers. The HMC374 LNA is well suited for applications within cellular /3G infrastructure, repeaters, WiMAX, broadband wireless access, and ISM frequency bands between 300 and 3000 MHz. Compared to discrete solutions, the HMC374 GaAs pHEMT MMIC LNA offers higher reliability, smaller PCB footprint and lower component count.

The HMC374 exhibits a low 1.8 dB Noise Figure, with +36 dBm output IP3, and 15 dB small signal gain. This self biased LNA is unconditionally stable & provides very consistent performance over temperature. The high output IP3 is particularly well suited in applications where the output of the LNA is fed directly into a high IP3 mixer, or applications where the LNA is succeeded by a high loss device such as a power splitter, or an attenuator.

The HMC374 is housed in a SOT26 package, and is offered in both standard (HMC374) and RoHS compliant (HMC374E) versions. Evaluation samples and production quantities are available from stock.

Order Online at: www.hittite.com
20 Alpha Road, Chelmsford, MA 01824 Phone: 978-250-3343 Fax: 978-250-3373
Boston • Istanbul • London • Munich • Seoul • Shanghai
HMC474MP86

+5V SiGe Gain Block, DC - 6 GHz

**Features**
- Gain: 15.5 dB
- P1dB Output Power: +8 dBm
- Output IP3: +22 dBm
- Cascadable 50 Ohm I/Os
- Single Supply: +3V to +10V
- Available RoHS Compliant

**Low Cost Gain Stage!**
The HMC474MP86 is a general purpose SiGe HBT Gain Block MMIC SMT Amplifier covering DC to 6 GHz. This Micro-P packaged amplifier can be used as a cascadable 50 Ohm RF/IF gain stage with up to +10 dBm output power. The HMC474MP86 offers 15.5 dB of gain with a +22 dBm output IP3 at 850 MHz while requiring only 25 mA from a single positive supply. The HMC474MP86 is an ideal buffer amplifier for Cellular / 3G, Broadband Cable, Fixed Wireless & IF applications.

HMC383 & HMC451

Medium Power Amplifiers Cover 5 to 30 GHz

**Features**
- Gain: 16 to 22 dB
- Saturated Output Power: +18 to +22 dBm
- Output IP3: +25 to +30 dBm
- Single +5V Supply
- 50 Ohm Matched I/Os

**Compact Size, Flat Output Power!**
The HMC383 and HMC451 are general purpose GaAs PHEMT MMIC Driver Amplifiers operating between 12 to 30 GHz & 5 to 20 GHz. These amplifiers provide 16 to 22 dB of gain and +18 to +22 dBm of saturated power from +5V supply voltages. Consistent gain and output power across each operating band make it possible to use a common driver/LO amplifier approach in multiple radio bands. Both the HMC383 and HMC451 amplifiers can easily be integrated into Multi-Chip-Modules (MCMs) due to their small size.

HMC383LC4

SMT Medium Power Amplifier, 12 - 30 GHz

**Features**
- Gain: 15 dB
- Saturated Output Power: +18 dBm
- Single +5V Supply
- 50 Ohm Matched I/Os
- RoHS Compliant 4 x 4 mm Package

**Multi-Purpose; Easy to Use!**
The HMC383LC4 is a general purpose GaAs PHEMT MMIC Driver Amplifier housed in a leadless RoHS compliant SMT package. The amplifier provides 15 dB of gain and +18 dBm of saturated power from a +5.0 V supply voltage. Consistent gain and output power across the operating band make it possible to use a common driver/LO amplifier approach in multiple radio bands. The RF I/Os are DC blocked and matched to 50 Ohms for ease of use. The HMC383LC4 eliminates the need for wire bonding, allowing use of surface mount manufacturing techniques.
BROADBAND, HIGH PERFORMANCE CONTROL DEVICES

HMC547LP3
Broadband High Isolation SPDT SMT Switch, DC - 20 GHz

Features
- High Isolation:
  - 50 dB @ 5 GHz
  - 38 dB @ 20 GHz
- Low Insertion Loss:
  - 1.5 dB @ 5 GHz
  - 2.0 dB @ 20 GHz
- 3 x 3 mm QFN SMT Package
- Available RoHS Compliant

Ideal for Test Equipment!
The HMC547LP3 is a broadband high isolation non-reflective GaAs MESFET SPDT switch in a leadless 3 x 3 mm QFN SMT plastic package. Covering DC to 20 GHz, the switch offers high isolation of 50 dB @ 5 GHz and 38 dB @ 20 GHz, with +48 dBm IP3 and very fast switching speed of 6 nS. The switch operates using complementary negative control voltage logic lines of -5/0V and requires no bias supply.

HMC346LC3B
Wideband Analog SMT VVA, DC - 18 GHz

Features
- 30 dB Attenuation Range
- Absorptive
- Low Phase Shift vs. Attenuation
- Simplified Voltage Control
- RoHS Compliant 3 x 3 mm SMT Package

Stable Insertion Phase!
The HMC346LC3B is an absorptive Voltage Variable Attenuator (VVA) in a leadless RoHS compliant 3 x 3 mm SMT package operating from DC - 18 GHz. It features an on-chip reference attenuator for use with an external op-amp to provide simple single voltage attenuation control, 0 to -3V. The device is ideal in designs where an analog DC control signal must control RF signal levels over a 30 dB amplitude range.

HMC-C011
High Isolation SPDT Switch Module, DC - 20 GHz

Features
- Isolation: 50 dB
- Insertion Loss: 2 dB
- Fast Switching: 1 nS
- CMOS Control
- Low Video Transients:
  - 20 mV pk-pk
- Field Replaceable SMA Connectors

Ideal for Test Equipment!
The HMC-C011 is a high performance non-reflective SPDT switch in an hermetic connectorized housing with field replaceable SMA connectors. Covering DC to 20 GHz, the switch offers 2 dB of insertion loss, 35 to 65 dB isolation and +23 dBm of input P1dB. The switch includes a high speed CMOS driver providing extremely fast 1 nanosecond rise and fall times, low video transients and requires a single positive +5V bias.

VISIT US AT: www.hittite.com SUMMER 2005
INNOVATIVE, HIGH LINEARITY BROADBAND MIXERS

HMC214MS8

High IP3 SMT Mixer, 2.4 - 4.0 GHz

Ideal for WiMAX & Fixed Wireless!
The HMC214MS8 is a high dynamic range passive MMIC mixer in an 8 lead plastic SMT package covering 2.4 to 4 GHz. Excellent input IP3 performance of +34 dBm for down-conversion and +31 dBm for up-conversion is provided for WiMAX and other 3.5 GHz Fixed Wireless applications at an LO drive of +17 dBm. With a 1 dB compression of +22 dBm, the RF port will accept a wide range of input signal levels. LO to RF & LO to IF isolations are maintained at 25 to 30 dB.

Features
- Input IP3: +34 dBm
- LO to RF Isolation: 28 dB
- Input P1dB: +22 dBm
- No External Components
- Ultra Small MSOP8
- Available RoHS Compliant

HMC129LC4

High Isolation Double-Balanced Passive Mixer, 4 - 8 GHz

Low Conversion Loss!
The HMC129LC4 is a double-balanced MMIC mixer housed in a leadless RoHS compliant SMT package which can be used as an upconverter or downconverter in the 4 to 8 GHz band. The HMC129LC4 is ideally suited for applications where small size, no DC bias, and consistent IC performance are required. This mixer can operate over a wide LO drive input of +9 to +15 dBm and wide IF bandwidth of DC - 3 GHz. It performs equally well as a Bi-Phase modulator or demodulator.

Features
- Conversion Loss: 7 dB
- LO to RF & IF Isolation: 40 dB
- Input IP3: +17 dBm
- +9 to +15 dBm LO Range
- RoHS Compliant 4x4 mm SMT Package

HMC260 / 292 / 329LC3B

Double-Balanced Mixers Covering 14 to 32 GHz

No External Matching!
The HMC260/292/329LC3B are passive double balanced mixers in leadless RoHS compliant SMT packages that can be used as upconverters or downconverters over 14 to 32 GHz. These mixers require no external components or matching circuitry. They provide excellent LO to RF and LO to IF suppression eliminating LO filtering. The mixers operate with LO drive levels from +9 to +15 dBm and are ideal for Microwave Radio, VSAT, Military & Test Equipment applications.

Features
- Input IP3 to +20 dBm
- LO/RF Isolation to 40 dB
- Wide IF Bandwidth: DC - 8 GHz
- Passive: No DC Bias Required
- RoHS Compliant 3 x 3 mm SMT Package

Typical Performance

<table>
<thead>
<tr>
<th>RF/LO Freq. (GHz)</th>
<th>HMC260LC3B</th>
<th>HMC292LC3B</th>
<th>HMC329LC3B</th>
</tr>
</thead>
<tbody>
<tr>
<td>IF Freq. (GHz)</td>
<td>DC - 8</td>
<td>DC - 8</td>
<td>DC - 8</td>
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<tr>
<td>Conv. Gain (dB)</td>
<td>-7.5</td>
<td>-8</td>
<td>-10</td>
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<tr>
<td>LO/RF Isol. (dB)</td>
<td>39</td>
<td>38</td>
<td>40</td>
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<tr>
<td>IIP3 (dBm)</td>
<td>20</td>
<td>19</td>
<td>19</td>
</tr>
</tbody>
</table>
NEW PHASE SHIFTER & VCO PRODUCTS!

HMC247 / 538LP4 / C010

Analog Phase Shifters Covering 6 to 21 GHz

New Product Line for Test Equipment, Telecom & Military / Space!

The HMC247 is a 9 to 21 GHz Analog Phase Shifter die. Phase shift is controlled via an analog DC voltage control from 0 to +10V, providing continuously variable insertion phase of 0 to 300 degrees at 9 GHz. Insertion loss is 5 dB, and is very consistent versus phase shift. The HMC247 is offered in bare die form and is compatible with standard wirebonding and epoxy and eutectic die attach techniques.

For SMT applications, the HMC538LP4 6 - 16 GHz Analog Phase Shifter is housed in a leadless surface mount QFN 4 x 4 mm package. This variable phase shifter accepts an analog control voltage from 0 to +5V, and provides continuously variable insertion phase from 0 to 800 degrees at 6 GHz, and 0 to 450 degrees at 16 GHz.

For test equipment and instrumentation applications, the HMC-C010 offers the same outstanding performance as the HMC538LP4, and is housed in a flanged module with field replaceable SMA connectors.

These phase shifters are particularly useful for adjusting the phase of clocks in fiber optic systems and test equipment.

Features
- Wide Bandwidth
- Continuously Variable
- Stable Insertion Loss vs. Phase Shift
- Alternative Packaging Options

Applications
- Optical Communications
- Instrumentation
- Laboratory Test Sets
- Test Equipment
- Military & Space

HMC513LP5 / 514LP5 / 533LP4

MMIC VCOs Covering Up to 24.8 GHz

MMIC VCOs for Microwave, Military and Sensor Applications!

The HMC513LP5, HMC514LP5, HMC533LP4 are fully integrated GaAs InGaP HBT VCOs. These MMIC VCOs incorporate an integrated resonator, negative resistance device, and varactor diode, resulting in excellent phase noise performance over temperature, shock, and process due to the monolithic structure. These VCOs deliver high output power, operate from a single positive supply voltage, and allow the prescaler function to be disabled in order to reduce power consumption.

The HMC533LP4 is a 23.8 - 24.8 GHz MMIC VCO featuring +12 dBm output power, and a divide-by-16 output. The HMC533LP4 is housed in a leadless QFN 4 x 4 mm surface mount package, operates from a +5V supply, and exhibits -95 dBc/Hz SSB Phase Noise at 100 kHz offset.

The HMC513LP5 10.43 - 11.46 GHz MMIC HBT VCO, and the HMC514LP5 11.17 - 12.02 GHz MMIC HBT VCO feature +7 dBm power output, as well as Fo/2 and divide-by-4 divided outputs. Both VCOs are housed in leadless QFN 5 x 5 mm surface mount packages, operate from a single +3V supply, and exhibits -110 dBc/Hz SSB Phase Noise at 100 kHz offset.

Features
- Pout: +7 to +12 dBm
- Phase Noise: -95 to -110dBc/Hz @100 KHz
- No External Components
- QFN Leadless SMT Packages
- Available RoHS Compliant

Applications
- VSAT Radio
- Pt to Pt/Multi-pt Radios
- Test Equipment
- & Industrial Controls
- Military End-Use

Typical Performance

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Frequency (GHz)</th>
<th>Function</th>
<th>Insertion Loss (dB)</th>
<th>Phase Range (Deg)</th>
<th>2nd Harmonic Pin=0 dBm (dBc)</th>
<th>Control Voltage Range (Vdc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC538LP4</td>
<td>6 - 16</td>
<td>Analog</td>
<td>8</td>
<td>800˚ @ 6 GHz</td>
<td>10</td>
<td>0V to +5V</td>
</tr>
<tr>
<td>HMC-C010</td>
<td>6 - 16</td>
<td>Analog</td>
<td>8</td>
<td>800˚ @ 6 GHz</td>
<td>10</td>
<td>0V to +5V</td>
</tr>
<tr>
<td>HMC247</td>
<td>9 - 21</td>
<td>Analog</td>
<td>5</td>
<td>300˚ @ 9 GHz</td>
<td>50</td>
<td>0V to +10V</td>
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</table>

Typical Performance

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Frequency (GHz)</th>
<th>Function</th>
<th>Output Power (dBm)</th>
<th>10kHz SSB Phase Noise (dBc)</th>
<th>100kHz SSB Phase Noise (dBc)</th>
<th>Bias Supply</th>
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</thead>
<tbody>
<tr>
<td>HMC513LP5</td>
<td>10.43 - 11.46 /</td>
<td>VCO w/ Fo/2 &amp; ÷4</td>
<td>7</td>
<td>-85</td>
<td>-110</td>
<td>+3V @ 275mA</td>
</tr>
<tr>
<td>HMC514LP5</td>
<td>11.17 - 12.02 /</td>
<td>VCO w/ Fo/2 &amp; ÷4</td>
<td>7</td>
<td>-85</td>
<td>-110</td>
<td>+3V @ 275mA</td>
</tr>
<tr>
<td>HMC533LP4</td>
<td>23.8 - 24.8</td>
<td>VCO w/ ÷16</td>
<td>12</td>
<td>-70</td>
<td>-95</td>
<td>+5V @ 220mA</td>
</tr>
</tbody>
</table>
ALL SMT MICROWAVE RADIO DESIGN... (continued from page 1)

The 23 GHz Microwave Radio block diagram below shows how Hittite SMT components can reduce parts count, shorten design cycles and simplify manufacturing.

Hittite low noise VCOs are widely used to generate the fundamental LO signals for various radio designs. The HMC386LP4 VCO w/ Buffer Amp, the HMC439QS16G Phase/Frequency Detector, and the HMC365S8G Divide-by-4 Prescaler can be combined to quickly construct a 2.6 - 2.8 GHz LO signal with +5 dBm output power and very low phase noise.

In the transmit section of the radio, the HMC342LC4 LNA/Driver, and the HMC499LC4 Medium Power Amplifier can be used in cascade to create a driver amplifier or output stage. The combination of these two GaAs pHEMT amplifiers will produce, +24 dBm output power and 37 dB Gain, while operating from a single +5V supply.

Hittite I/O and IRM mixers are ideal for receive chain application which require high IP3 and high image rejection. The new HMC523LC4 offers wide IF bandwidth, high input IP3 and excellent RF to LO Isolation. Compared with a hybrid based implementation, this I/O MMIC mixer offers significantly reduced PCB area, consistent performance, and excellent amplitude and phase balance as a result of its monolithic construction. When configured as an Image Reject Mixer using an external IF hybrid, the HMC523LC4 provides 25 dB of image rejection at midband. Such high levels of image rejection 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, while this mixer achieves such high levels inherently.

All microwave product data sheets are available at www.hittite.com.

LOW NOISE PLO MMIC... (continued from page 1)

The fully integrated HMC535LP4 incorporates a VCO, phase frequency-detector (PFD), fixed modulus prescaler, and loop amplifier. The reference oscillator input and a sample of the divided VCO output are fed to the phase frequency detector and the loop amplifier. In closed loop mode, the integrated phase frequency detector tunes the VCO until phase lock is achieved. A digital Lock Detect (LD) output is provided to confirm the status of the loop. Compared to discrete PLO approaches, the HMC535LP4 will significantly reduces the component count, and the board space required to produce a low phase noise Local Oscillator signal as required by high symbol rate digital radios.

The HMC535LP4 requires +5V and +12V supply voltages, consumes less than 2W of power and is housed in a 4 x 4 mm SMT leadless QFN package. Both standard (HMC535LP4) and RoHS compliant (HMC535LP4E) versions are available. Sample and production quantities are available from stock and may be ordered on-line.

Custom PLO products can be designed for customers’ application specific requirements. Contact hmcsales@hittite.com.
**Hittite Adds New Manufacturers Representatives**

Comp-Tech Sales to Cover Metro NY/NJ

Comp-Tech Sales, headquartered in New Jersey represents a broad line of electronic components with an emphasis on RF/Microwave devices. Their office in Hasbrouck Heights, NJ offers full support to customers in Metro New York, Long Island, Northern New Jersey & Connecticut (Fairfield county). Comp-Tech Sales can be contacted via telephone at 201-288-7400, via fax at 201-288-7583 or email at sales@comp-techsales.com. Visit their website at www.comp-techsales.com.

Brooks Associates to Cover So. NJ, PA & No. NY

Brooks Associates specializes in RF/Microwave sales to the military, space and consumer electronics industries. Their offices in New Jersey and Pennsylvania offer full support to customers in the Southern New Jersey, upstate New York and eastern Pennsylvania. Brooks can be contacted via telephone at 732-873-1900, via fax at (732)-873-9009 or email at brooksrfs@patmedia.net.

Sea-Port Technical Sales to Cover WA & OR


**New Summer 2005 Selection Guide Released!**

HMC is pleased to announce the availability of the Summer 2005 Product Selection Guide which summarizes over 340 products. The selection guide features include organization by product line as well as by market applications including: Automotive, Broadband, Cellular/PCS/3G, Fiber Optic, Microwave & mmWave Communications, Test & Measurement, Military and Space.

This new Selection Guide contains over 52 products not found in the Autumn 2004 Selection Guide and 22 products not found in the 2005 Designer’s Guide Catalog.

Request your copy of the new Summer 2005 Selection Guide at www.hittite.com by selecting the “SUBMIT INQUIRY” left hand navigation button. New product data sheets can be found on-line.
What We Do

Hittite Microwave Corporation is an innovative designer and manufacturer of analog and mixed-signal ICs, MIC modules and sub-assemblies for RF, microwave and millimeter-wave applications covering DC to 110 GHz. Our 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
- Transceivers
- Mixers
- Converters
- IRMs
- Modulators
- VCOs
- Dividers/Detectors
- Multipliers
- PLOs / PLLs

We also design and supply highly integrated custom ICs, MCMs and sub-systems 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 / wired communications and radar applications including those listed below:

- Automotive
- Telematics & Sensors
- Broadband
- CATV, DBS, WiMAX, WLAN, Fixed Wireless & UWB
- Cellular / PCS / 3G
- Handset / Handheld, PLMR & Infrastructure
- Fiber Optic
- OC-48 to OC-192
- Microwave / mmWave Communications
- Pt to Pt / Multi-Pt Radios & VSAT
- Test & Measurement
- Commercial / Industrial Sensors & Test Equipment
- Military
- C3I, ECM & EW
- Space
- Payload Electronics

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.