New DC to Millimeterwave ICs & Modules from Hittite

I/Q DIRECT DEMODULATOR FEATURES ON-CHIP RF BALUN!
Simplifies Broadband Matching from 100 to 4000 MHz

The HMC597LP4(E) is a highly integrated wideband Direct I/Q Demodulator RFIC, and is the first of a family of leading edge I/Q Direct RF Demodulators to be introduced by Hittite Microwave.

The HMC597LP4(E) operates from 100 to 4000 MHz and is optimized for high linearity receivers in wireless infrastructure applications where a RF signal is directly converted into I and Q baseband signals with up to 600 MHz bandwidth. The HMC597LP4(E) incorporates LO amplifiers to drive the double-balanced I and Q mixers. The on-chip RF balun eliminates the need for an expensive off-chip balun and reduces the number of off-chip components. The graph above shows the performance of the HMC597LP4(E) Direct I/Q Demodulator, when operated over the Cellular/3G/WiMAX frequencies of 400 to 2500 MHz.

(Continued on page 6)

RECEIVER MMICS INTEGRATE LNA, I/Q MIXER AND LO MULTIPLIER FOR 7 TO 28 GHZ APPLICATIONS

Hittite Microwave is pleased to announce a family of MMIC Receivers aimed to offer compact and cost effective solutions for microwave communications & radar applications from 7 to 28 GHz.

The HMC570, HMC571 and HMC572 are GaAs MMIC receiver die with noise figures as low as 3 dB and up to 24 dB image rejection. These three converters provide continuous RF frequency coverage from 17 to 28 GHz. Each converter integrates a LNA followed by an image reject mixer, which is driven by an active x2 LO multiplier chain.

(Continued on page 6)

WIDEBAND 0.5 WATT POWER AMPLIFIER
New Power Amplifier Module Operates from 10 MHz to 15 GHz

Hittite Microwave announces two new MMIC based connectorized power amplifier modules. The HMC-C037 10 MHz to 15 GHz Power Amplifier module with integrated heatsink provides flat 12 dB gain up through 12 GHz, making this device ideal for broadband instrumentation, test equipment and communications applications, as band switching is eliminated. Output P1dB is +28 dBm through 7 GHz, and is better than +25 dBm up to 15 GHz. Saturated output power is 0.5 Watt up to 14 GHz.

With similar electrical performance to the HMC-C037, the HMC-C036 operates over the 10 MHz to 15 GHz frequency range offering 12 dB gain with +28 dBm output power. Unlike the HMC-C037, the HMC-C036 is packaged in a miniature, hermetic module, allowing the end-user to specify a mechanical interface optimal to their application. Both amplifiers are specified for operation over the 0 to +85°C range, and are available from stock. Complete datasheets may be found at www.hittite.com.

(Continued on page 6)
OFF-THE-SHELF

LNA, GAIN BLOCK, SWITCH & MIXER PRODUCTS FOR

HMC475ST89(E)  InGaP HBT Gain Block, DC - 4.5 GHz

- Cascadable 50 Ohm I/Os!

The HMC475ST89(E) is an InGaP Heterojunction Bipolar Transistor (HBT) Gain Block MMIC SMT amplifier covering DC to 4.5 GHz. Packaged in an industry standard SOT89, this versatile amplifier can be used as a cascadable 50 Ohm RF/IF gain stage as well as a LO or PA driver with up to +25 dBm output power. The HMC475ST89(E) offers 21 dB of gain and +35 dBm output IP3 at 850 MHz while requiring only 110 mA from a single positive supply.

**Features**
- P1dB Output Power: +22 dBm
- Gain: 21 dB
- Output IP3: +35 dBm
- Single Supply: +8V to +12V
- Industry Standard SOT89 Package

HMC564LC4  GaAs PHEMT MMIC LNA, 7 - 14 GHz

- Ideal for Microwave Radios!

The HMC564LC4 is a high dynamic range GaAs PHEMT MMIC Low Noise Amplifier housed in a leadless RoHS compliant 4x4mm SMT package. Operating from 7 to 14 GHz, the HMC564LC4 features extremely flat small signal gain of 17 dB as well as 1.8 dB noise figure and +24 dBm output IP3 across the operating band. This self-biased LNA is ideal for microwave radios due to its consistent output power, single +3V supply operation, and DC blocked RF I/O’s.

**Features**
- Noise Figure: 1.8 dB
- Gain: 17 dB
- Output IP3: +24 dBm
- Single Supply: +3V @ 51 mA
- 50 Ohm Matched I/Os

HMC565LC5  GaAs PHEMT MMIC LNA, 6 - 20 GHz

- Wideband Performance!

The HMC565LC5 is a high dynamic range GaAs PHEMT MMIC Low Noise Amplifier housed in a leadless RoHS compliant 5x5mm SMT package. Operating from 6 to 20 GHz, the HMC565LC5 features 20 dB of small signal gain, 2.6 dB noise figure and consistent IP3 of +20 dBm across the operating band. This self-biased LNA is ideal for microwave radios due to its single +3V supply operation, and DC blocked RF I/O’s.

**Features**
- Noise Figure: 2.6 dB
- Gain: 20 dB
- Output IP3: +20 dBm
- Single Supply: +3V @ 53 mA
- 50 Ohm Matched I/Os
**HMC536LP2(E)**

*GaAs MMIC T/R Switch, DC - 6.0 GHz*

**Features**
- Input P0.1dB: +33 dBm @ +5V
- Insertion Loss: 0.6 dB
- Positive Control: +3V or +5V
- Isolation: 27 dB
- 2x2 mm Leadless DFN SMT Package

*Ideal for WiMAX & WiBro Radios!*

The HMC536LP2(E) is a DC to 6 GHz GaAs MMIC T/R switch in a leadless 2x2 mm DFN SMT package with an exposed ground paddle. This switch requires only 4 mm² and is ideal for Cellular, WiMAX, & WiBro access point and subscriber applications where small size is required. This SPDT features a low 0.6 dB insertion loss, high +54 dBm IIP3 and excellent power handling up to 6 GHz with P0.1dB compression point of +29 dBm at +3V and +33 dBm at +5V control.

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**HMC585MS8G(E)**

*High IP3 Mixer w/ LO Amplifier, 400 - 650 MHz*

**Features**
- High Input IP3: +33 dBm
- DC to 250 MHz IF
- Low LO Drive: -2 to +4 dBm
- Single Supply: +5V @ 45 mA
- 14.8mm² 8 Lead MSOP Package

**+33 dBm IIP3, 0 dBm LO Drive**

The HMC585MS8G(E) is a high dynamic range passive MMIC mixer with integrated LO amplifier in a plastic MSOP-8 package covering an RF range of 400 to 650 MHz. The LO range of 300 to 750 MHz supports both high and low side LO frequency plans. Excellent input IP3 performance of +33 dBm for down conversion and +30 dBm for up conversion is provided with an LO drive of 0 dBm. RF conversion loss is 9 dB typical, and the DC to 250 MHz IF frequency response serves multiple Tx/Rx applications.

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**HMC581LP6(E)**

*High IP3 Dual Downconverter RFIC, 800 - 960 MHz*

**Features**
- Input IP3: +26 dBm
- Single Input LO @ 0 dBm
- 10 dB Conversion Gain
- 12 dB Noise Figure
- Single Positive Supply: +5V @ 260 mA

**Integrated LO Splitter!**

The HMC581LP6(E) is a high linearity Dual Downconverter RFIC that operates from 800 - 960 MHz and delivers a +26 dBm IIP3 for UMTS & GSM 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. This RFIC operates with only 0 dBm LO drive providing 10 dB conversion gain and 12 dB noise figure. The design requires no external matching and supports IF frequencies from 50 to 300 MHz.
**HMC-C020**

**Wideband Power Amplifier Module, 17 - 24 GHz**

**Features**
- Gain: 22 dB
- P1dB Output Power: +24 dBm
- Noise Figure: 3.5 dB
- Hermetically Sealed Module
- -55 to +85°C Operating Temperature

**Consistent Gain & Power!**
The HMC-C020 is a GaAs MMIC Power Amplifier in a miniature, hermetic module which operates between 17 and 24 GHz. The amplifier provides 22 dB of gain, 3.5 dB NF, +33 dBm OIP3 and up to +24 dBm of OP1dB. The wideband amplifier I/Os are internally matched to 50 Ohms and DC blocked making the HMC-C020 ideal for Military and Test & Measurement. Integrated voltage regulators allow for flexible biasing of both the negative and positive supply pins, while internal bias sequencing circuitry assures robust operation.

**Gain vs. Temperature**

**HMC-C021**

**Wideband Power Amplifier Module, 21 - 31 GHz**

**Features**
- Gain: 15 dB
- P1dB Output Power: +24 dBm
- Noise Figure: 5 dB
- Hermetically Sealed Module
- -55 to +85°C Operating Temperature

**Integrated Voltage Regulation!**
The HMC-C021 is a GaAs MMIC Distributed Power Amplifier in a miniature, hermetic module which operates between 21 and 31 GHz. The amplifier provides 15 dB of gain, 5 dB NF, +33 dBm OIP3 and up to +24 dBm of OP1dB. The wideband amplifier I/Os are internally matched to 50 Ohms and DC blocked making the HMC-C021 ideal for Military and Test & Measurement. Integrated voltage regulators allow for flexible biasing of both the negative and positive supply pins, while internal bias sequencing circuitry assures robust operation.

**Gain vs. Temperature**

**HMC-C038**

**Wideband Driver Amplifier Module, 2 - 35 GHz**

**Features**
- Gain: 12 dB
- P1dB Output Power: +17 dBm
- Noise Figure: 4 dB
- Hermetically Sealed Module
- -55 to +85°C Operating Temperature

**Ideal for Test & Measurement!**
The HMC-C038 is a GaAs MMIC Distributed Power Amplifier in a miniature, hermetic module operating between 2 and 35 GHz. The amplifier provides 12 dB of gain, +29 dBm OIP3 and up to +18 dBm of OP1dB. Gain flatness is excellent from 2 to 16 GHz, and the wideband amplifier I/Os are internally matched to 50 Ohms and DC blocked. Integrated voltage regulators allow for flexible biasing of both the negative and positive supplies, and internal bias sequencing circuitry assures robust operation.

**Gain vs. Temperature**
HMC-C031 / C032 / C033 / C034  
Active x2 Multiplier Modules, 6 to 46 GHz

**Features**
- +3 dBm Input Power
- Up to +17 dBm Output Power
- -130 to -140 dBc/Hz SSB Phase Noise @ 100 kHz Offset
- Hermetically Sealed Module
- -55°C to +85°C Operating Temperature

**Applications**
- SONET OC-192 & SDH STM-64 Clock Generation
- Point-to-Point & VSAT Radios
- Test Instrumentation
- Military EW/Radar
- Space

**Typical Performance**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Function</th>
<th>Input Freq. (GHz)</th>
<th>Output Freq. (GHz)</th>
<th>Output Power (dBm)</th>
<th>100 kHz SSB Phase Noise (dBc/Hz)</th>
<th>Power Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC-C031</td>
<td>Active X2</td>
<td>3 - 5</td>
<td>6 - 10</td>
<td>17</td>
<td>-140</td>
<td>+5V @ 90 mA</td>
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<tr>
<td>HMC-C032</td>
<td>Active X2</td>
<td>9 - 14.5</td>
<td>18 - 29</td>
<td>16</td>
<td>-132</td>
<td>+5V @ 82 mA</td>
</tr>
<tr>
<td>HMC-C033</td>
<td>Active X2</td>
<td>12 - 16.5</td>
<td>24 - 33</td>
<td>17</td>
<td>-132</td>
<td>+5V @ 81 mA</td>
</tr>
<tr>
<td>HMC-C034</td>
<td>Active X2</td>
<td>16 - 23</td>
<td>32 - 46</td>
<td>13</td>
<td>-130</td>
<td>+5V @ 70 mA</td>
</tr>
</tbody>
</table>

**Low Phase Noise Active x2 Multiplier Family Delivers High Pout to +17 dBm!**

Four new Active x2 Multipliers have been added to Hittite’s broad line of active and passive frequency multiplier products. The HMC-C031, HMC-C032, HMC-C033 and HMC-C034 are broadband frequency multipliers utilizing GaAs MMIC technology, and packaged in miniature hermetic 41.66 x 27.59 x 8.50 mm connectorized modules. When driven with a +3 dBm signal, these multipliers provide between +13 dBm and +17 dBm of typical output power over their specified output frequency range. Key specifications for these frequency multipliers are listed in the table below. The Fo and 3Fo isolations for these multipliers range from 12 dBc to 30 dBc with respect to output signal level. The low additive SSB phase noise of up to -140 dBc/Hz at 100 kHz offset helps maintain excellent system noise performance. These devices feature DC blocked I/Os, and are ideal for use in LO multiplier chains for Microwave Communications, Radar, Test Equipment and general Laboratory use. Specified to operate over the -55°C to +85°C temperature range, all of these devices are available from stock and complete datasheets can be found at www.hittite.com.

HMC507 / 508 / 509 / 511LP5(E)

**MMIC VCOs with Fo/2 Output, 6.65 to 10.15 GHz**

**Features**
- Fo and Fo/2 Outputs
- Pout: +13 to +15 dBm
- Phase Noise: -115 dBc/Hz @ 100 kHz typ.
- No External Resonator Required
- QFN Leadless SMT Package

**Applications**
- VSAT Radio
- Point-to-Point & Multi-Point Radio
- Test Equipment & Industrial Sensors
- Military Systems

**Typical Performance**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Fo Frequency (GHz)</th>
<th>Fo/2 Frequency (GHz)</th>
<th>Fo Output Power (dBm)</th>
<th>Fo/2 Output Power (dBm)</th>
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<tbody>
<tr>
<td>HMC507LP5</td>
<td>6.65 - 7.65</td>
<td>3.325 - 3.825</td>
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<td>HMC508LP5</td>
<td>7.3 - 8.2</td>
<td>3.65 - 4.1</td>
<td>15</td>
<td>7</td>
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<td>HMC509LP5</td>
<td>7.8 - 8.8</td>
<td>3.9 - 4.4</td>
<td>13</td>
<td>7.5</td>
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<tr>
<td>HMC511LP5</td>
<td>9.05 - 10.15</td>
<td>4.525 - 5.075</td>
<td>13</td>
<td>8</td>
</tr>
</tbody>
</table>

**MMIC VCOs Feature Low Noise & High Output Power!**

Hittite Microwave announces the addition of four new GaAs InGaP HBT MMIC VCOs to the product line. Ideal for Test Equipment, Industrial Control, VSAT, Point-to-Point/Point-to-Multi-Point Radio and Military applications from 6.65 to 10.15 GHz, these MMIC VCOs are packaged in footprint compatible leadless QFN 5 x 5 mm surface mount packages, and require no external matching components.

The HMC507LP5(E), HMC508LP5(E), HMC509LP5(E) and HMC511LP5(E) are fully integrated VCOs featuring SSB phase noise of -115 dBc/Hz, and half frequency outputs. These VCO products integrate resonators, negative resistance devices, and varactor diodes. They also exhibit excellent phase noise performance over temperature, shock, and process variations due to the oscillator’s monolithic structure. The power output from these MMIC VCOs is typically between +13 dBm and +15 dBm from a +5V supply. All of these devices are available from stock and complete datasheets can be found at www.hittite.com.
**I/Q Direct Demodulator Features On-Chip RF Balun**

Fabricated on a SiGe Bipolar process, and operating from a +5.0 V supply, the HMC597LP4(E) delivers exceptionally high linearity, featuring +23 dBm IIP3 and +57 dBm IIP2 at 1900 MHz with a single-ended LO drive level of 0 dBm. The noise figure under RF drive is much lower than competing products, measuring 15 dB at 1900 MHz. Single-ended RF signals of up to +12 dBm can be directly applied to the chip, while the differential I and Q output ports are 400 Ohms impedance, permitting direct connection to channel filters and ADCs.

The I and Q channels of the HMC597LP4(E) are designed to ensure very precise gain matching to less than 0.3 dB, and phase matching to within 1 degree, since these are critical requirements in contemporary direct conversion receivers. The HMC597LP4(E) also provides superior LO-to-RF isolation of 66 dB, which is essential to maintaining the requirement for low DC offsets within the receiver. Systems which use demodulators with lower performance than the HMC597LP4(E) provides, will require more sophisticated and expensive DC calibration techniques to counteract the effects of DC offsets within the receiver.

This compact direct demodulator significantly reduces costs compared with discrete solutions by virtue of its high level of integration. Unlike other single chip demodulators, the HMC597LP4(E) features an on-chip RF balun, allowing customers the flexibility to tune from 100 MHz to 4000 MHz, using a single external capacitor. This solution avoids the expense and inconvenience of switching banks of external baluns, which may be problematic in other solutions.

The HMC597LP4(E) Direct I/Q Demodulator RFIC meets all of the exacting linearity specifications for wireless infrastructure of all types, such as basestations for GSM, W-CDMA, WiBro, WiMAX (802.16 d,e) as well as for satellite and microwave receivers, high performance radios and instrumentation. These systems also require low noise, high linearity digital modulation schemes, which can easily be addressed with Hittite’s HMC497LP4(E) Direct Quadrature Modulator RFIC. The HMC597LP4(E) and HMC497LP4(E) data sheets may be found at www.hittite.com; products and evaluation boards are available from stock.

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**Receiver MMICs Integrate LNA, I/Q Mixer & LO Multiplier**

The image reject mixer eliminates the need for a band-pass filter after the LNA, which is otherwise required to remove thermal noise at the image frequency. I and Q mixer outputs are provided and an external 90 degree hybrid is used to select the desired IF sideband. These devices have excellent noise figure and in combination with the high IP3 provide a perfect solution for SDH radio applications. These low noise converters are also available in SMT RoHS compliant packages as the HMC567LC5, HMC571LC5 and the HMC572LC5.

The typical 16QAM ETSI radio specification calls for a maximum IMD3 level of -16 dBc, which in turn will impose a minimum Input IP3 value of -12 dBm at the receiver input. With typical IP3 performance of better than -2 dBm, these downconverters clearly exceed the requirements for this application and are also ideal for high dynamic range receivers in EW, ELINT, and satellite communications applications.

The HMC567LC5, HMC568LC5 and HMC569LC5 Receivers provide continuous RF coverage from 7 to 16 GHz, and are aimed at the 7, 8, 10, 10.5, 11, 13 and 15 GHz microwave point-to-point/point-to-multipoint, and Ku band VSAT markets. These devices each consist of a LNA followed by a image reject mixer and include a LO buffer amplifier.

Ideal for use in systems undergoing space or cost reduction, each of these new I/Q receivers are available from stock and data sheets may be found at www.hittite.com.

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<table>
<thead>
<tr>
<th>Part Number</th>
<th>RF Frequency (GHz)</th>
<th>LO Frequency (GHz)</th>
<th>IF Frequency (GHz)</th>
<th>Conversion Gain (dB)</th>
<th>Image Rejection (dB)</th>
<th>Noise Figure (dB)</th>
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</thead>
<tbody>
<tr>
<td>HMC567LC5</td>
<td>7 - 9</td>
<td>3.5 - 12.5</td>
<td>DC - 3.5</td>
<td>10</td>
<td>35</td>
<td>2.5</td>
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<td>HMC568LC5</td>
<td>9 - 12</td>
<td>5.5 - 12.5</td>
<td>DC - 3.5</td>
<td>14</td>
<td>33</td>
<td>2</td>
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<td>HMC569LC5</td>
<td>12 - 16</td>
<td>8.5 - 19.5</td>
<td>DC - 3.5</td>
<td>14</td>
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<td>HMC570</td>
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<td>DC - 3.5</td>
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<td>21 - 25</td>
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<td>21 - 25</td>
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<td>DC - 3.5</td>
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<td>HMC572</td>
<td>24 - 28</td>
<td>9 - 15.5</td>
<td>DC - 3.5</td>
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<tr>
<td>HMC572LC5</td>
<td>24 - 28</td>
<td>9 - 15.5</td>
<td>DC - 3.5</td>
<td>8</td>
<td>20</td>
<td>3.5</td>
</tr>
</tbody>
</table>
Hittite Microwave Co., Limited
hittite.com.

**North America Central Regional Office**

Hittite is pleased to announce the opening of a direct sales office in Dallas, Texas responsible for the company’s sales and customer support efforts in central North America. The office may be contacted via telephone (214) 343-5707, fax (214) 343-5707 or usa-central@hittite.com.

**Hittite Appoints New Korean Sales Representatives**

Hittite is pleased to introduce two new sales representatives, JS Commtech and EZ Hightech, both of whom offer their full support to customers throughout Korea. JS Commtech can be contacted via telephone +82-2-574-6100, fax +82-2-579-0085 or js@commtech.com. EZ Hightech can be contacted via phone +83-031-382-6500, fax +83-031-386-9806 or sales@ezhightech.com.

**Hittite Demonstrates 3 New Product Lines at MTT-S!**

Hittite exhibited a newly expanded booth and product demonstration test lab area at the 2006 IEEE MTT-S International Microwave Symposium & Exhibition at the Moscone Convention Center in San Francisco, CA from June 12-15, 2006.

Hittite introduced many new products, and conducted approximately 100 technical demonstrations on 3 new leading edge product lines, which include the HMC-T1000A 10 MHz to 8 GHz Dual Synthesizer, the HMC600LP4(E) Power Detector and the HMC660LC4 Track-and-Hold Amplifier.

**News From Hittite!**

**New Hittite Regional Offices Opened**

Nordic Regional Office

Hittite is pleased to announce the opening of a direct sales office in Stockholm, Sweden. The Nordic Sales Office will focus on supporting Hittite’s customers in Sweden, Finland, Norway and Denmark and can be contacted via telephone +46-85-602-0120, fax +46-85-031-1313 or europe@hittite.com.

North America Central Regional Office

Hittite is pleased to announce the opening of a sales office in Dallas, Texas responsible for the company’s sales and customer support efforts in central North America. The office may be contacted via telephone (214) 343-5707, fax (214) 343-5707 or usa-central@hittite.com.

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What We Do

Hittite Microwave Corporation is an innovative designer and manufacturer of analog and mixed-signal ICs, modules and subsystems for RF, microwave and millimeterwave applications covering DC to 110 GHz. Our RFIC/MMIC products are developed using state-of-the-art GaAs, GaN, InGaP/GaAs, InP, SOI, SiGe and BiCMOS semiconductor processes utilizing MESFET, pHEMT, mHEMT and HBT devices. Our products include:

- Power Amplifiers
- Gain Blocks
- Driver Amplifiers
- LNAs
- Wideband Amps
- Track-and-Hold Amplifiers
- Attenuators
- Phase Shifters
- Switches
- Transceivers
- Power Detectors
- Mixers
- Converters
- VCOs
- Freq. Dividers
- IRMs
- Freq. Detectors
- Modulators
- Freq. Multipliers
- Demodulators
- PLOs / PLLs
- Synthesizers

We also design and supply highly integrated custom ICs, modules and subsystems that combine multiple functions for specific requirements. We select the most appropriate semiconductor and package technologies, uniquely balancing digital and analog integration techniques.

Our custom and standard products support a wide range of wireless / wired communications and radar applications for the following markets:

- **Automotive**
  - Telematics & Sensors

- **Broadband**
  - CATV, DBS, WiMAX, WLAN, Fixed Wireless & UWB

- **Cellular Infrastructure**
  - GSM, GPRS, CDMA, WCDMA, & UMTS

- **Fiber Optic**
  - OC-48 to OC-768

- **Microwave & mmWave Communications**
  - Backhaul Radio Links
  - Multi-Point Radios & VSAT

- **Military**
  - C3I, ECM & EW

- **Space**
  - Payload Electronics

- **Test & Measurement**
  - Commercial / Industrial
  - Sensors & Test Equipment

Every component is backed by Hittite Microwave’s commitment to total quality. HMC is ISO 9001:2000 and ISO/TS 16949:2002 certified. 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.