

GaAs MMIC I/Q DOWNCONVERTER 27 - 34 GHz



Typical Applications

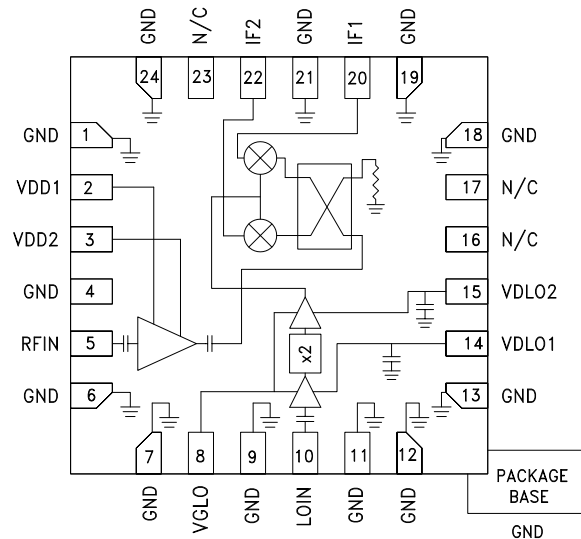
The HMC1065LP4E is ideal for:

- Point-to-Point and Point-to-Multi-Point Radios
- Satellite Communications
- Sensors

Features

- Conversion Gain: 13 dB
- Image Rejection: 17 dBc
- Input Third-Order Intercept (IP3): -2 dBm
- LO Drive Range: -4 dBm to +4 dBm
- 24 Lead 4 mm x 4 mm SMT Package

Functional Diagram



General Description

The HMC1065LP4E is a compact GaAs MMIC Image Reject Low Noise Converter in a leadless RoHS compliant SMT package. This device provides a small signal conversion gain of 13 dB with 17 dBc of image rejection and 2 dBm of Input IP3. The HMC1065LP4E utilizes an RF LNA followed by an I/Q mixer which is driven by an active x2 multiplier. IF1 and IF2 mixer outputs are provided and an external 90° hybrid is needed to select the required sideband. The I/Q mixer topology reduces the need for filtering of the unwanted sideband. The HMC1065LP4E is a much smaller alternative to hybrid style image reject downconverter assemblies and it eliminates the need for wire bonding by allowing the use of surface mount manufacturing techniques.

Electrical Specifications,

$T_A = +25^\circ\text{C}$, $IF = 2000\text{ MHz}$, $LO = +2\text{ dBm}$, $VDLO1 = VDLO2 = 3\text{ V}$, $VDD1 = VDD2 = 3\text{ V}$, **USB** ^[1]

| Parameter | Min. | Typ. | Max. | Units |
|---|------|------|------|-------|
| RF Frequency Range | 27 | | 34 | GHz |
| LO Frequency Range | 11.5 | | 19 | GHz |
| IF Frequency Range | DC | | 4 | GHz |
| LO Drive Range | -4 | | +4 | dBm |
| Conversion Gain | 9 | 12 | | dB |
| Noise Figure | | 3 | | dB |
| Image Rejection | 12 | 17 | | dBc |
| Input Power for 1 dB Compression (P1dB) | | -9 | | dBm |
| Input Third-Order Intercept (IIP3) | | -2 | | dBm |
| Output Third-Order Intercept (OIP3) | | 14 | | dBm |
| 2x LO / RF Isolation | 35 | 45 | | dB |
| 2x LO / IF Isolation | | 20 | | dB |
| Amplitude Balance ^[2] | | -1 | | dB |
| Phase Balance ^[2] | | 7 | | deg |
| Supply Current (IDLO) ^[3] | | 150 | | mA |
| Supply Current (IDD) | | 90 | | mA |

[1] All measurements performed with upper sideband selected and external 90° hybrid at the IF ports, unless otherwise noted.

[2] Data taken without external 90° hybrid, IF = 1000 MHz.

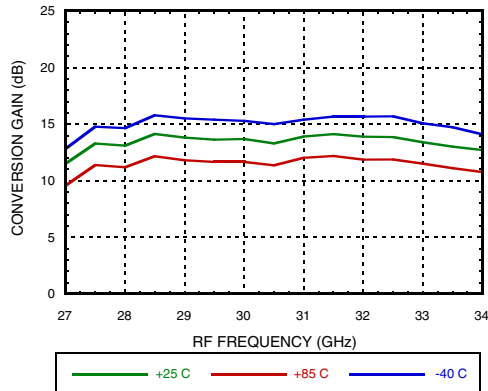
[3] Adjust VGLO1 and VGLO2 between -2 V and 0 V to achieve total quiescent current (IDLO1 + IDLO2) = 150 mA.



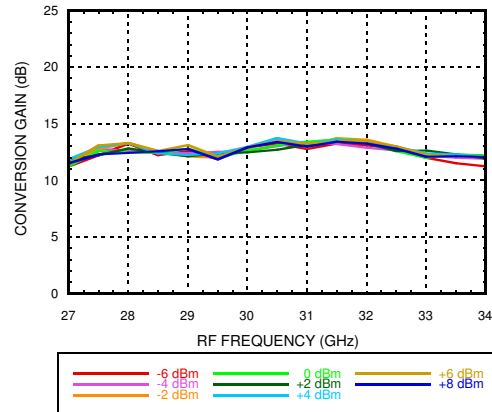
**GaAs MMIC I/Q DOWNCONVERTER
27 - 34 GHz**

Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 2000 MHz

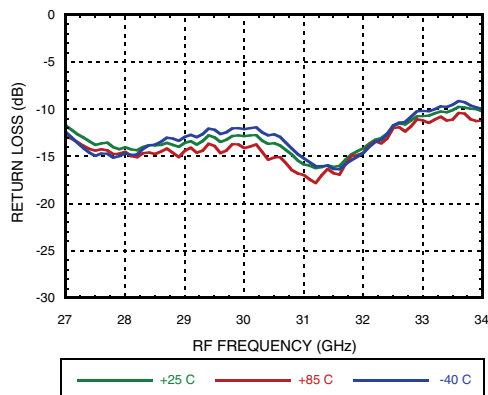
Conversion Gain vs. Temperature, USB



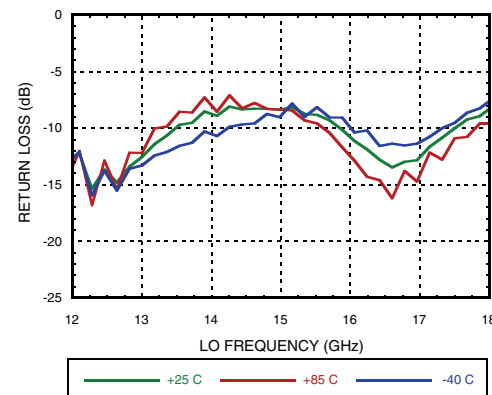
Conversion Gain vs. LO Drive, USB



RF Return Loss vs. Temperature



LO Return Loss vs. Temperature



IF Return Loss [1]

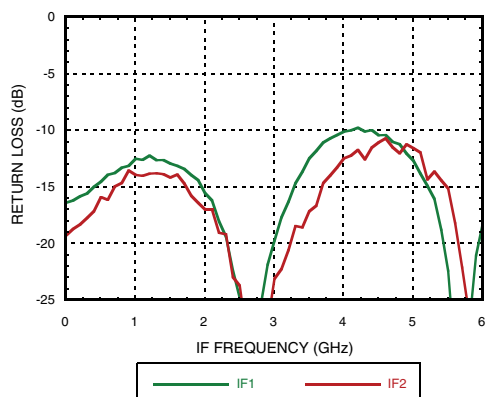
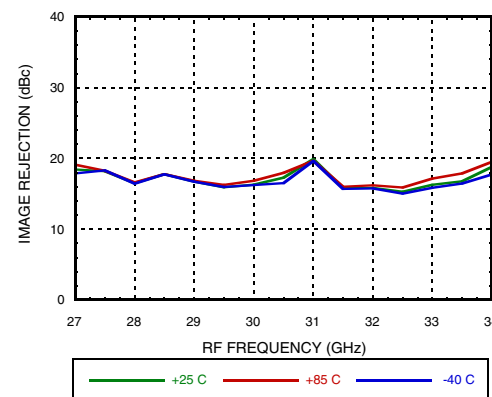


Image Rejection vs. Temperature, USB



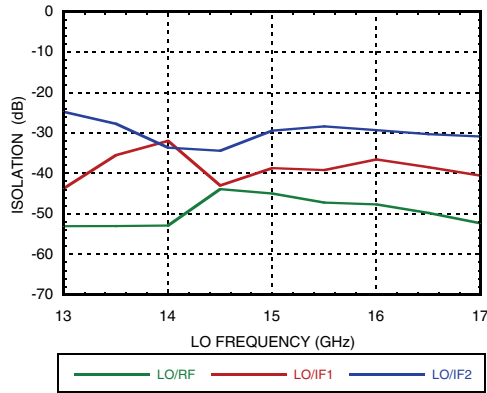
[1] Data taken without external IF 90° hybrid

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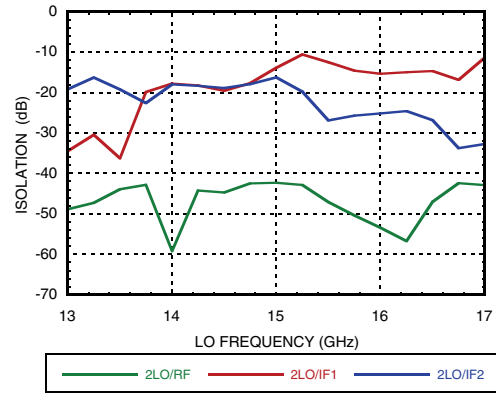


Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 2000 MHz

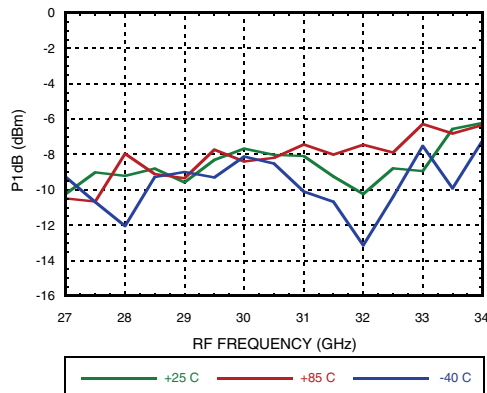
LO Isolation [1]



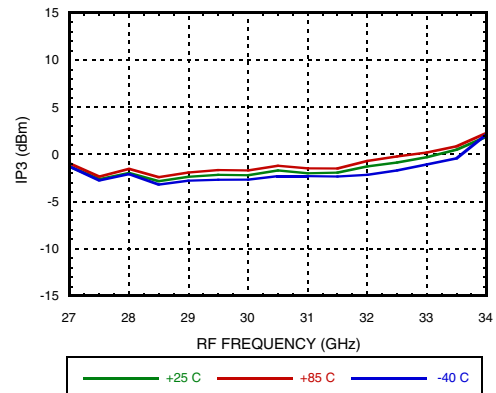
2x LO Isolation [1]



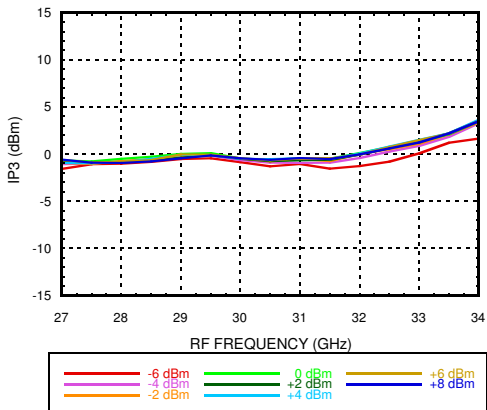
Input P1dB vs. Temperature, USB



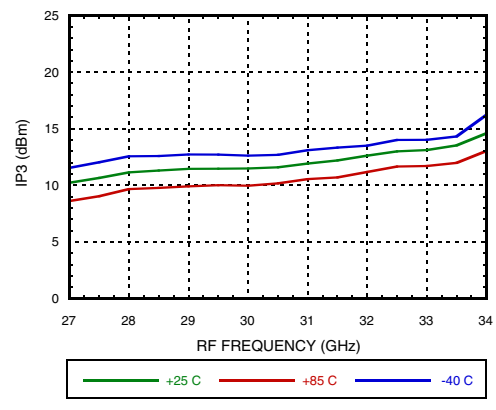
Input IP3 vs. Temperature, USB



Input IP3 vs. LO Drive, USB



Output IP3 vs. Temperature, USB



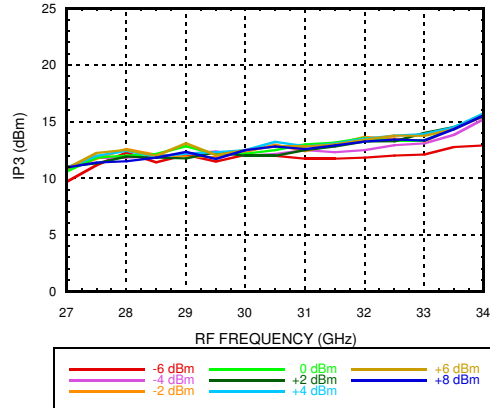
[1] Data taken without external IF 90° hybrid



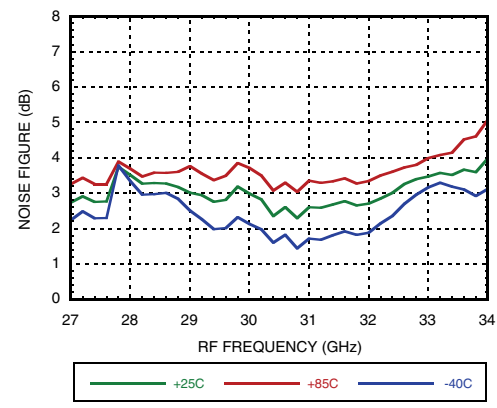
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Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 2000 MHz

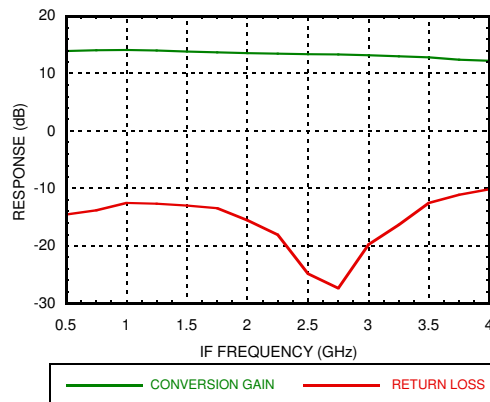
Output IP3 vs. LO Drive, USB



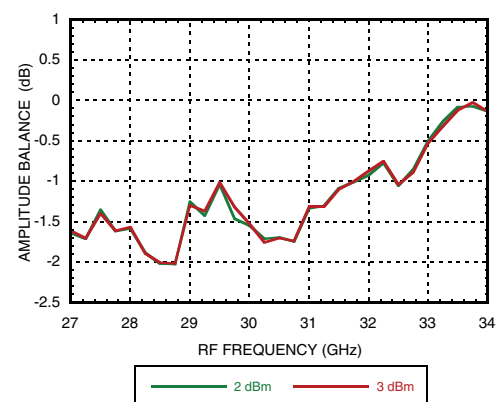
Noise Figure vs. Temperature, USB



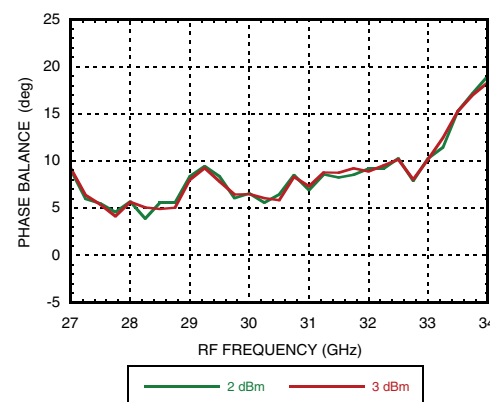
IF Bandwidth [1]



Amplitude Balance vs. LO Drive [1] [2]



Phase Balance vs. LO Drive [1] [2]



[1] Data taken without external 90° hybrid.

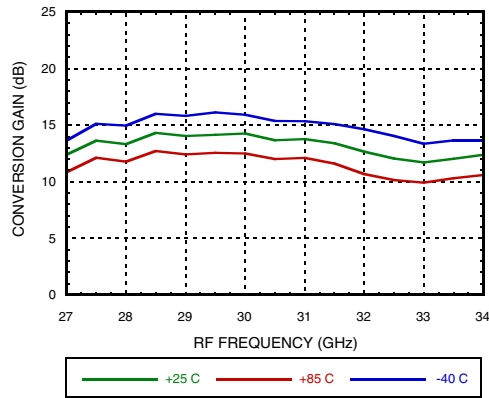
[2] Data taken with IF = 1000MHz.



**GaAs MMIC I/Q DOWNCONVERTER
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Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 2000 MHz

Conversion Gain vs. Temperature, LSB



Conversion Gain vs. LO Drive, LSB

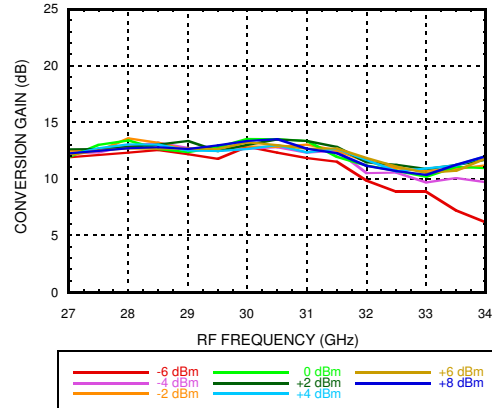
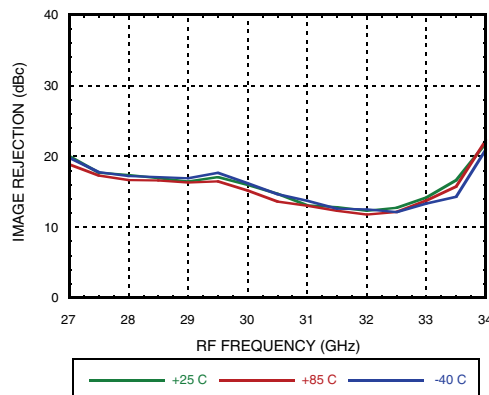
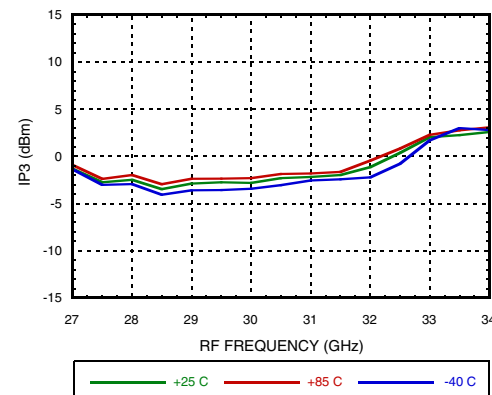


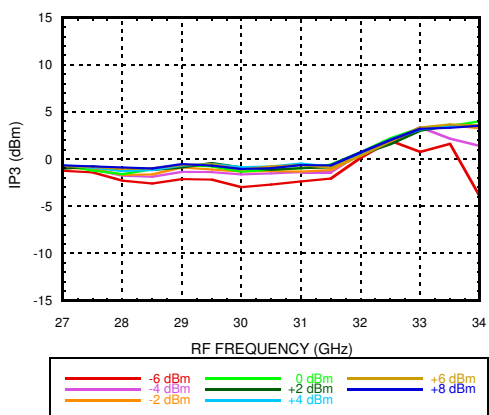
Image Rejection vs. Temperature, LSB



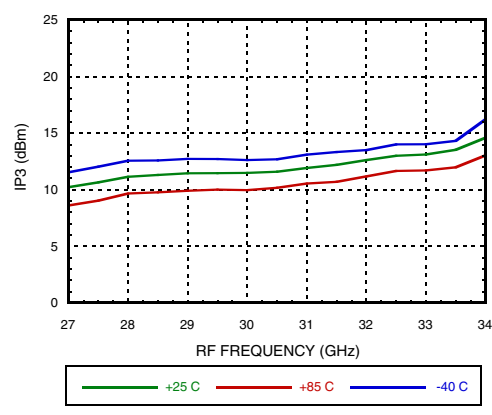
Input IP3 vs. Temperature, LSB



Input IP3 vs. LO Drive, LSB



Output IP3 vs. Temperature, LSB



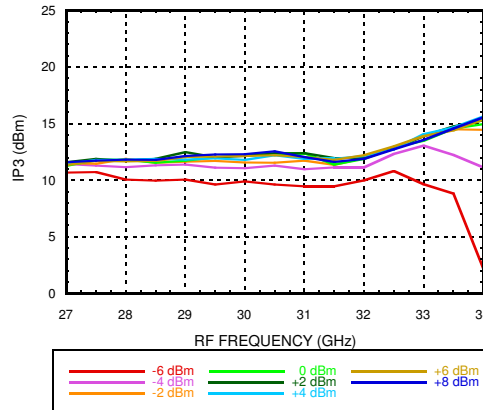
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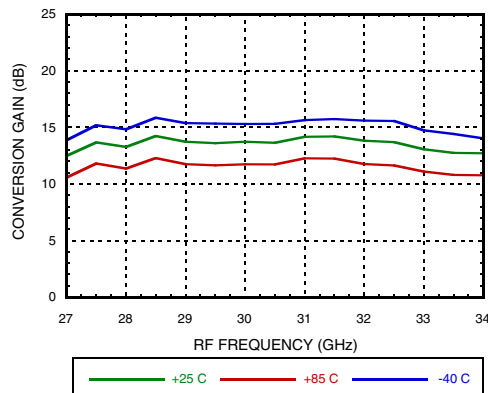
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**Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 2000 MHz
Output IP3 vs. LO Drive, LSB**



Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 1000 MHz

Conversion Gain vs. Temperature, USB



Conversion Gain vs. LO Drive, USB

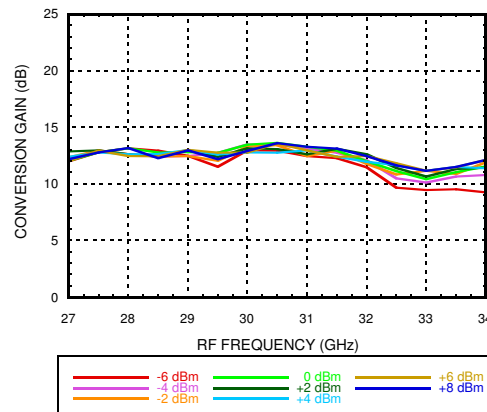
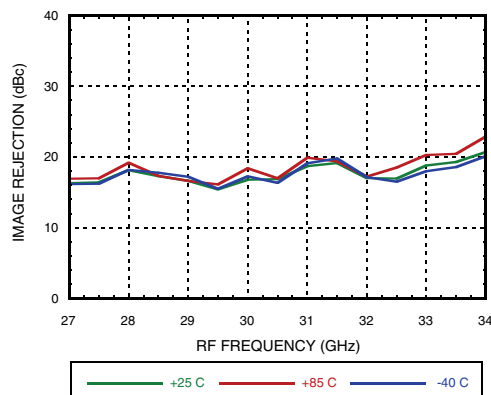
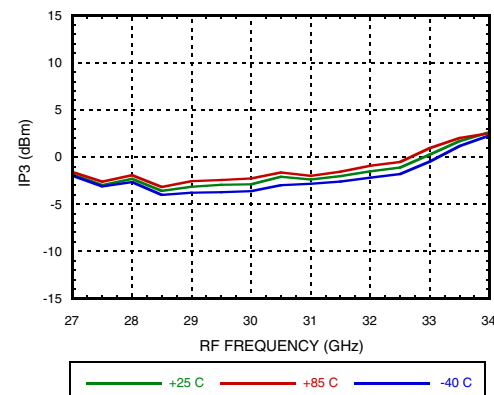


Image Rejection vs. Temperature, USB



Input IP3 vs. Temperature, USB



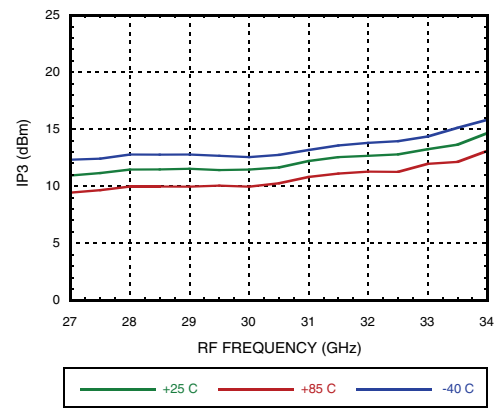
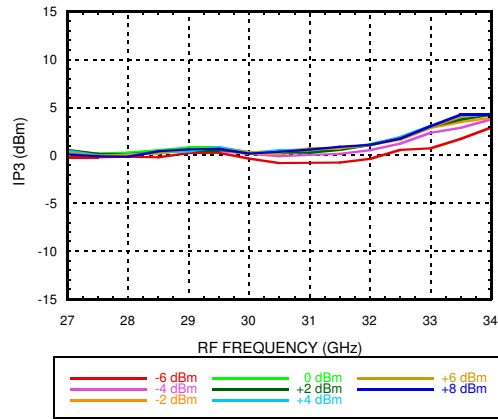
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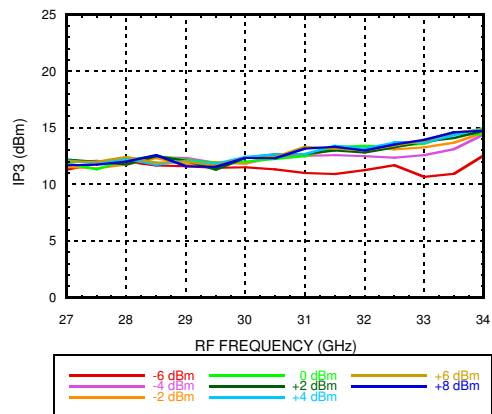
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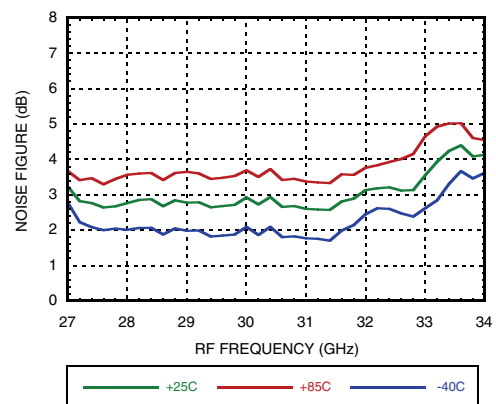
Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 1000 MHz
Input IP3 vs. LO Drive, USB **Output IP3 vs. Temperature, USB**



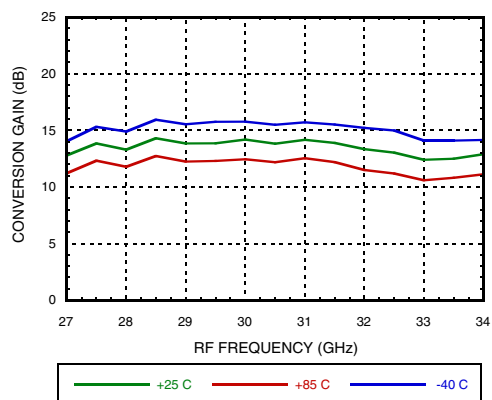
Output IP3 vs. LO Drive, USB



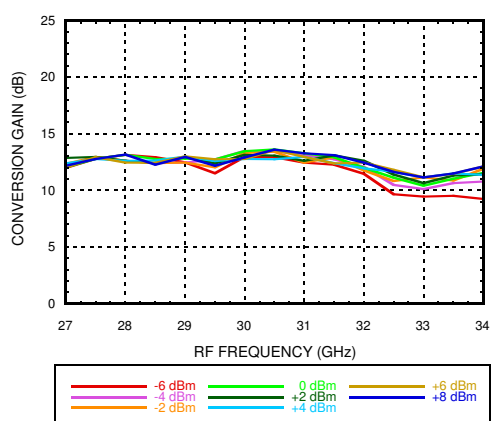
Noise Figure vs. Temperature, USB



Conversion Gain vs. Temperature, LSB



Conversion Gain vs. LO Drive, LSB



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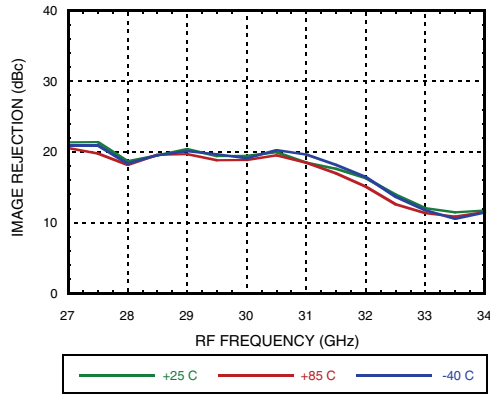
MIXERS - I/Q MIXERS, IRMS & RECEIVERS - SMT



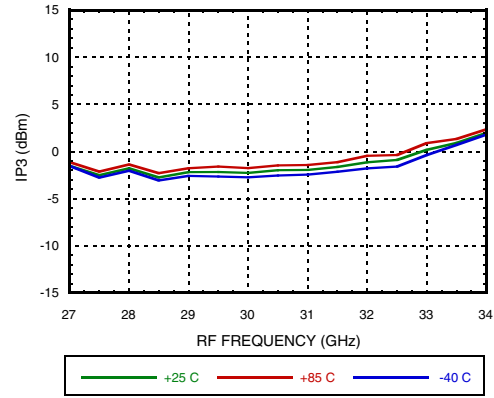
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Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 1000 MHz

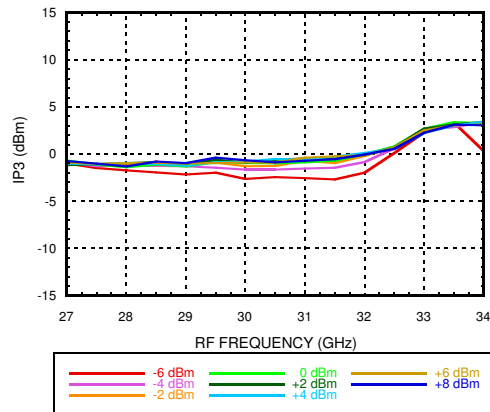
Image Rejection vs. Temperature, LSB



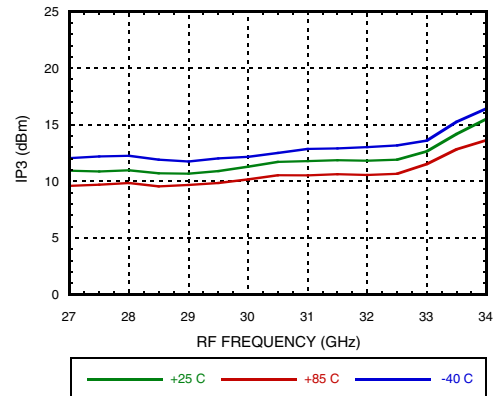
Input IP3 vs. Temperature, LSB



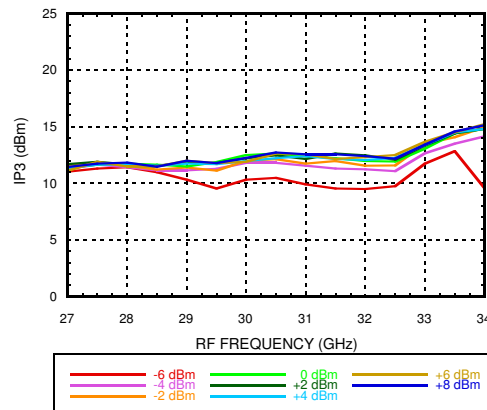
Input IP3 vs. LO Drive LSB



Output IP3 vs. Temperature, LSB



Output IP3 vs. LO Drive, LSB



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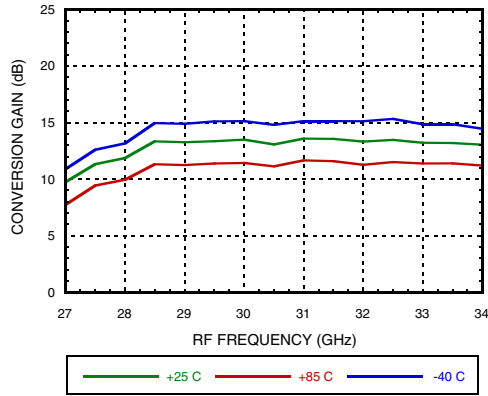
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**GaAs MMIC I/Q DOWNCONVERTER
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Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 3300 MHz

Conversion Gain vs. Temperature, USB



Conversion Gain vs. LO Drive, USB

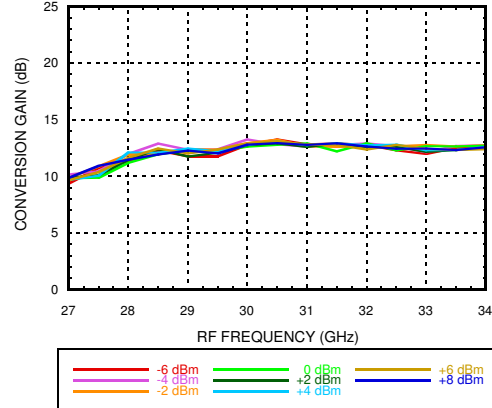
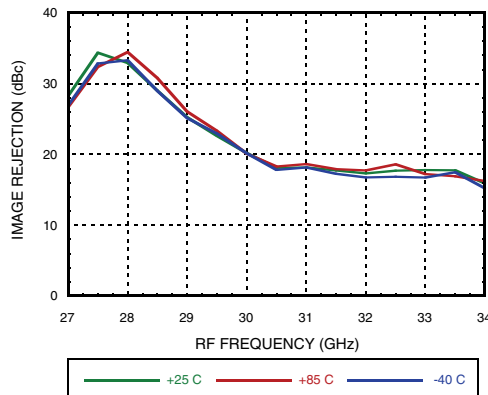
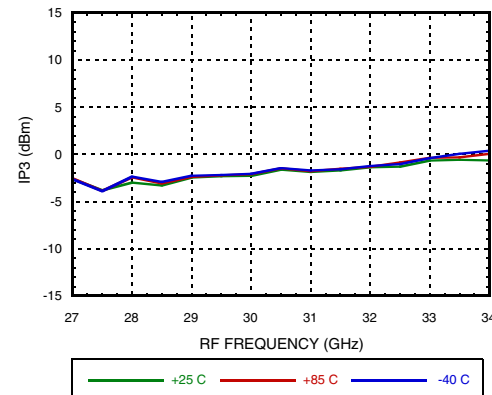


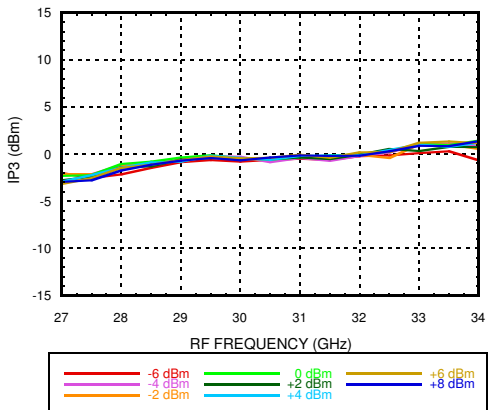
Image Rejection vs. Temperature, USB



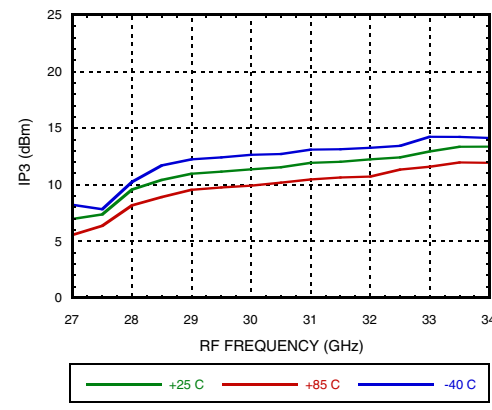
Input IP3 vs. Temperature, USB



Input IP3 vs. LO Drive, USB



Output IP3 vs. Temperature, USB



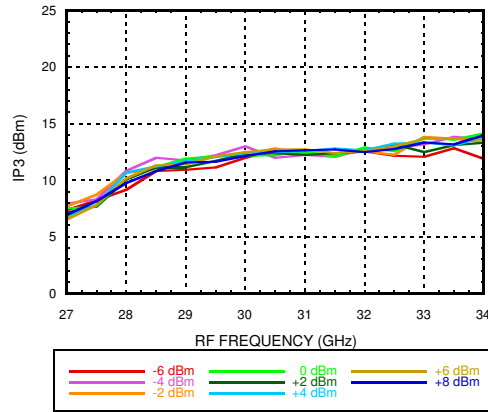
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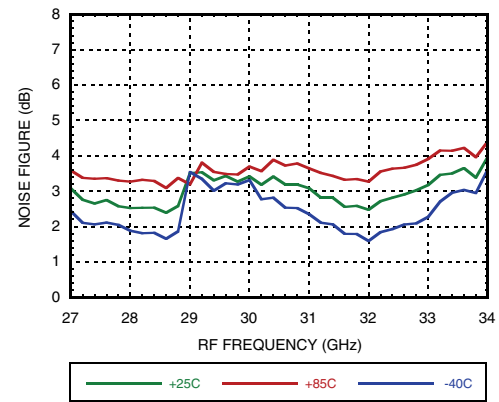


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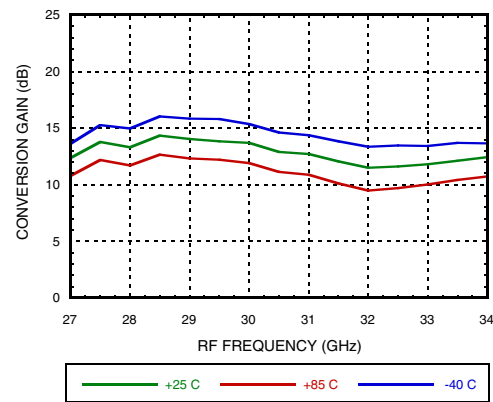
**Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 3300 MHz
Output IP3 vs. LO Drive, USB**



Noise Figure vs. Temperature, USB



Conversion Gain vs. Temperature, LSB



Conversion Gain vs. LO Drive, LSB

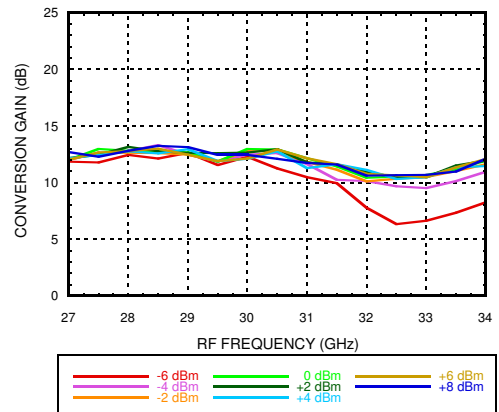
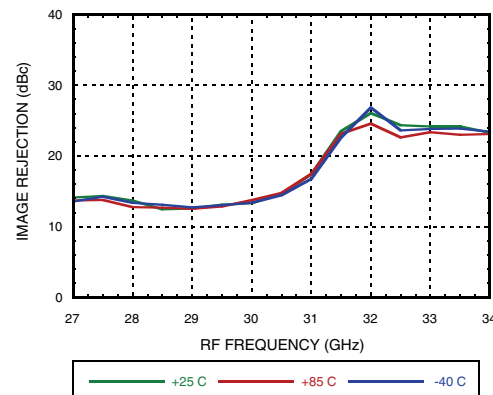
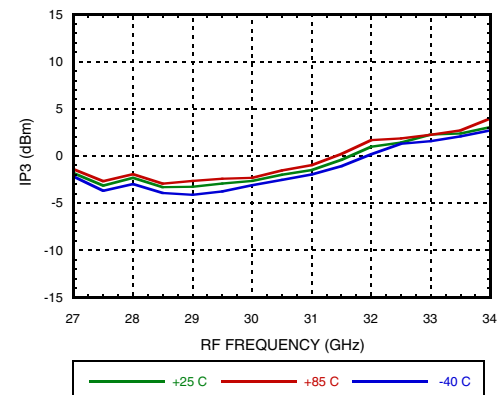


Image Rejection vs. Temperature, LSB



Input IP3 vs. Temperature, LSB



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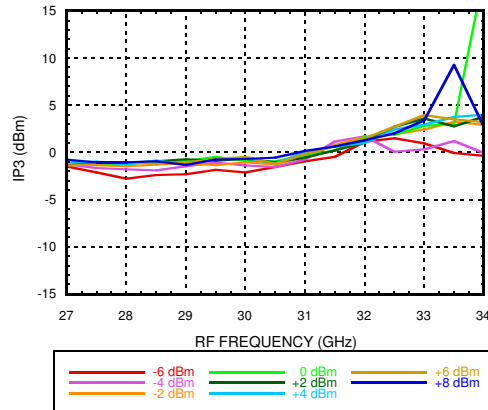
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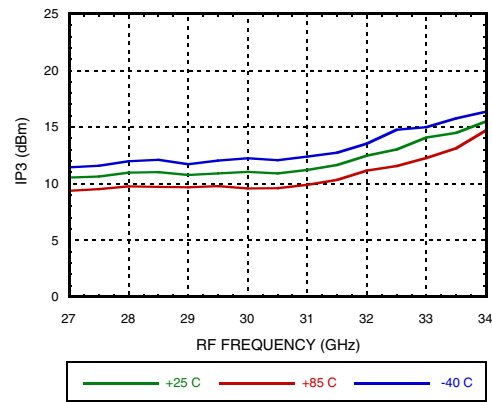
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Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 3300 MHz

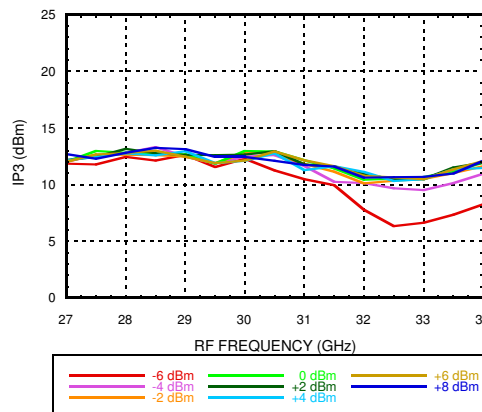
Input IP3 vs. LO Drive, LSB



Output IP3 vs. Temperature, LSB



Output IP3 vs. LO Drive, LSB



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GaAs MMIC I/Q DOWNCONVERTER 27 - 34 GHz



MxN Spurious Outputs, IF = 1 GHz ^[1]

| mRF | nLO | | | | |
|-----|-----|----|----|----|----|
| | 0 | 1 | 2 | 3 | 4 |
| 0 | x | 35 | 18 | 49 | |
| 1 | 7 | 41 | 0 | 48 | 28 |
| 2 | | 59 | 52 | 64 | 35 |
| 3 | | | | 85 | 69 |

RF = 30 GHz @ -8 dBm

LO = 14.5 GHz @ +2 dBm

All values in dBc below IF power level (1RF -2LO)

Spur values are (M x RF) + (N x LO)

MxN Spurious Outputs, IF = 2 GHz ^[1]

| mRF | nLO | | | | |
|-----|-----|----|----|----|----|
| | 0 | 1 | 2 | 3 | 4 |
| 0 | x | 32 | 18 | 52 | |
| 1 | 8 | 48 | 0 | 47 | 31 |
| 2 | | 64 | 61 | 65 | 37 |
| 3 | | | | 86 | 68 |

RF = 30 GHz @ -8 dBm

LO = 14.0 GHz @ +2 dBm

All values in dBc below IF power level (1RF -2LO)

Spur values are (M x RF) + (N x LO)

MxN Spurious Outputs, IF = 3.3 GHz ^[1]

| mRF | nLO | | | | |
|-----|-----|----|----|----|----|
| | 0 | 1 | 2 | 3 | 4 |
| 0 | | 42 | 23 | 46 | |
| 1 | 7 | 50 | 0 | 38 | 28 |
| 2 | | 79 | 60 | 67 | 43 |
| 3 | | | | 88 | 63 |

RF = 30 GHz @ -8 dBm

LO = 13.35 GHz @ +2 dBm

All values in dBc below IF power level (1RF -2LO)

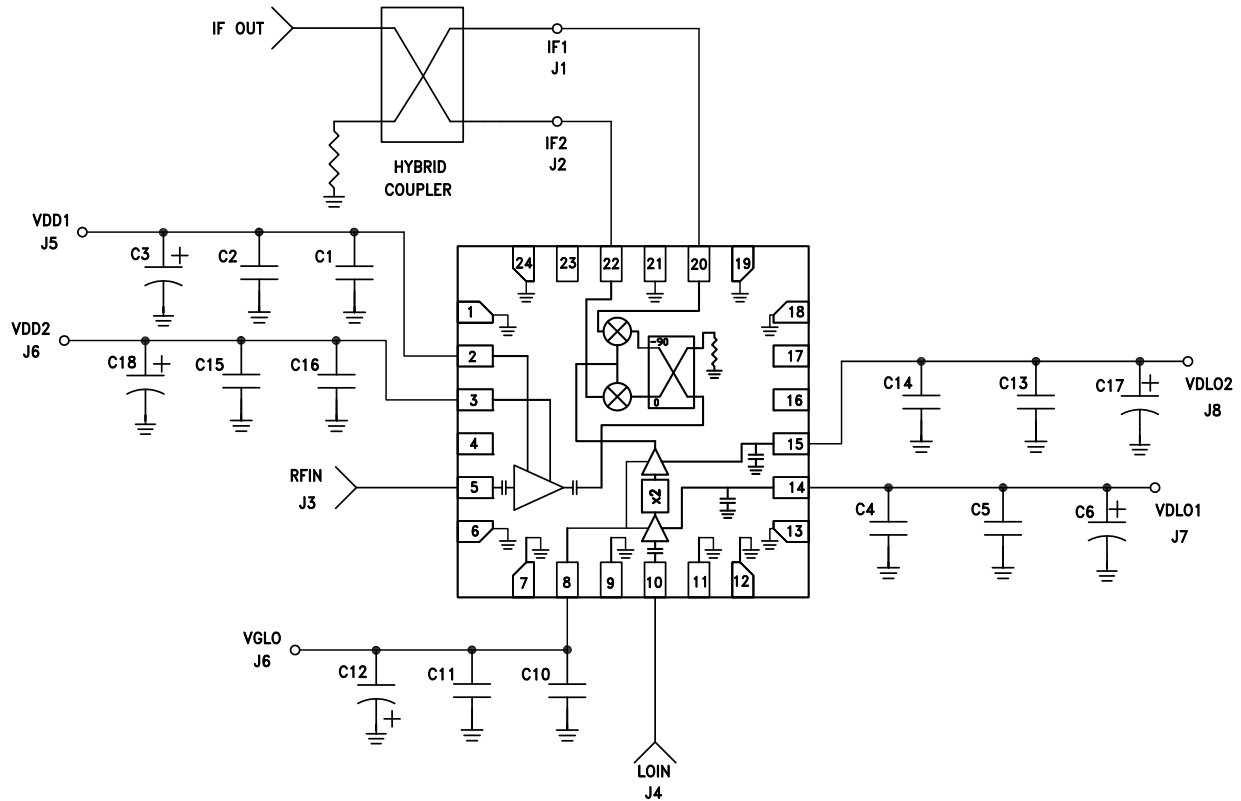
Spur values are (M x RF) + (N x LO)

[1] Data taken without external IF 90° hybrid



**GaAs MMIC I/Q DOWNCONVERTER
27 - 34 GHz**

Typical Application


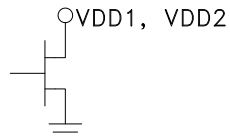
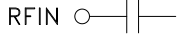

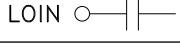
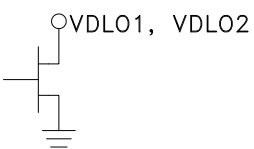
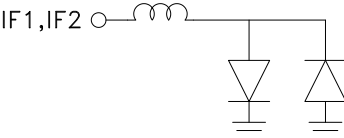


| | |
|-----------------------|-------------------------------|
| C1, C4, C10, C14, C16 | 100 pF Capacitor, 0402 Pkg. |
| C2, C5, C11, C13, C15 | 0.1 uF Capacitor, 0402 Pkg. |
| C3, C6, C12, C17, C18 | 4.7 uF Capacitor, Case A Pkg. |



GaAs MMIC I/Q DOWNCONVERTER 27 - 34 GHz

Pin Descriptions

| Pin Number | Function | Description | Interface Schematic |
|---|----------|---|---|
| 1, 4, 6, 7, 9, 11, 12, 13, 18, 19, 21, 24 | GND | Ground Connect. These pins and exposed ground paddle must be connected to RF/DC ground. |  |
| 2 | VDD1 | Drain Bias for the low noise amplifier. The recommended DC voltage is 3 V. Refer to the typical application circuit for required external components. |  |
| 3 | VDD2 | | |
| 5 | RFIN | Radio Frequency Input. This pin is AC coupled and matched to 50 Ohms. |  |
| 8 | VGLO | Gate Bias for the Local Oscillator. Adjust VGLO from -2 V to 0 V to set total VDLO1 and VDLO2 current to 150mA. Refer to the typical application circuit for required external components. |  |
| 10 | LOIN | Local Oscillator Input. This pin is AC coupled and matched to 50 Ohms. |  |
| 14 | VDLO1 | Drain Bias for the Multiplier Input Buffer Amp. The recommended DC voltage is 3V. Refer to the typical application circuit for required external components. |  |
| 15 | VDLO2 | Drain Bias for the Multiplier output Buffer Amp. The recommended DC voltage is 3V. Refer to the typical application circuit for required external components. | |
| 16, 17, 23 | N/C | No connection required. The pins are not connected internally. However, all data shown herein was measured with these pins connected to RF/DC ground externally. | |
| 20 | IF1 | Quadrature Intermediate Frequency Inputs. These pins are DC coupled. For applications not requiring operation to DC, use an off chip DC blocking capacitor. For operation to DC, these pins must not source/sink more than 3 mA of current or device non-function and failure may result. |  |
| 22 | IF2 | | |



GaAs MMIC I/Q DOWNCONVERTER 27 - 34 GHz

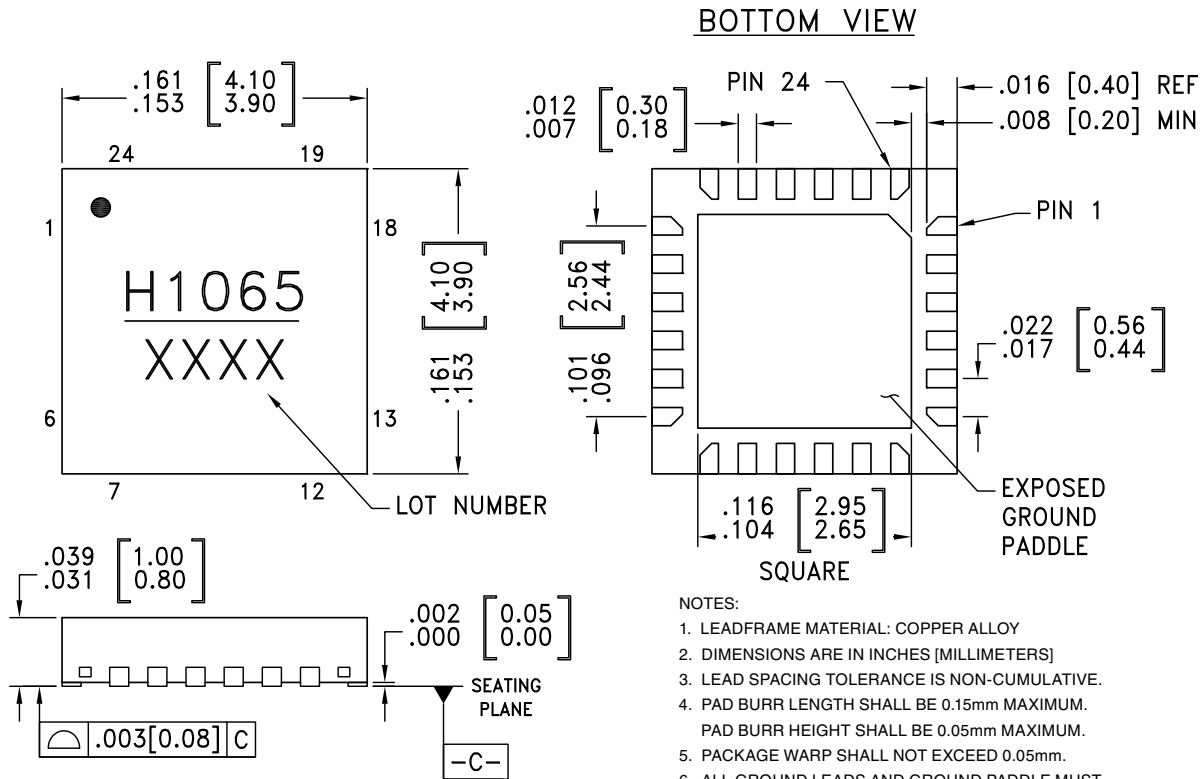
Absolute Maximum Ratings

| | |
|---|------------------|
| RF Input | +8 dBm |
| LO Input | +8 dBm |
| Drain Bias Voltage (Vdd) | +3.5 V |
| Channel Temperature | 175 °C |
| Continuous P _{diss} (T = 85°C) (derate 18.5 mW/°C above 85°C) | 1.66 W |
| Thermal Resistance (channel to ground paddle) | 54.1 °C/W |
| Storage Temperature Range | -65 to +150 °C |
| Operating Temperature Range | -40 to +85 °C |
| ESD Sensitivity (HBM) | 250 V (Class 1A) |



ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Outline Drawing



NOTES:

- LEADFRAME MATERIAL: COPPER ALLOY
- DIMENSIONS ARE IN INCHES [MILLIMETERS]
- LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
- PAD BURR LENGTH SHALL BE 0.15mm MAXIMUM.
PAD BURR HEIGHT SHALL BE 0.05mm MAXIMUM.
- PACKAGE WARP SHALL NOT EXCEED 0.05mm.
- ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
- REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED LAND PATTERN.

Package Information

| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking ^[2] |
|-------------|--|-----------------------|---------------------|--------------------------------|
| HMC1065LP4E | RoHS-compliant Low Stress Injection Molded Plastic | 100% Sn 10 micron min | MSL1 ^[1] | H1065 XXXX |

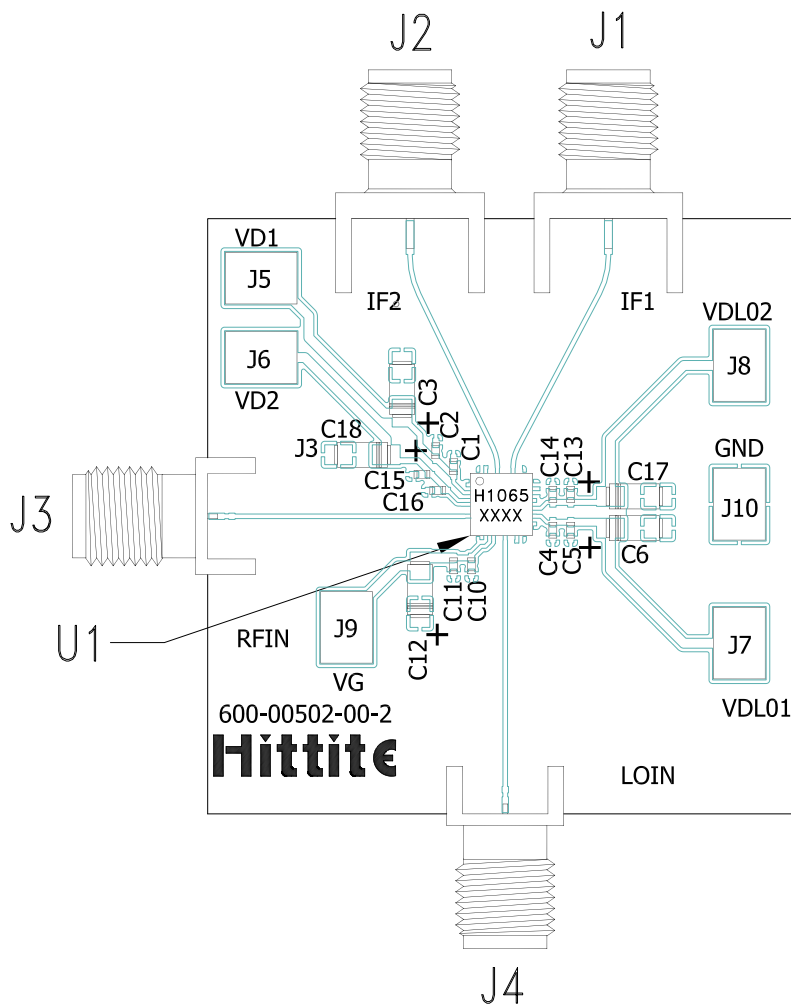
[1] Max peak reflow temperature of 260 °C

[2] 4-Digit lot number XXXX



**GaAs MMIC I/Q DOWNCONVERTER
27 - 34 GHz**

Evaluation PCB



List of Materials for Evaluation PCB Eval01-HMC1065LP4 [1]

| Item | Description |
|-----------------------|-------------------------------|
| J1, J2 | SMA SRI |
| J3, J4 | K-Connector SRI |
| J5 - J10 | DC Pins |
| C1, C4, C10, C14, C16 | 100 pF Capacitor, 0402 Pkg. |
| C2, C5, C11, C13, C15 | 0.1 uF Capacitor, 0402 Pkg. |
| C3, C6, C12, C17, C18 | 4.7 uF Capacitor, Case A |
| U1 | HMC1065LP4E Downconverter |
| PCB [2] | 600-00502-00 Evaluation Board |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Arlon 25FR, FR4 or Rogers 4350

The circuit board used in the application should use RF circuit design techniques. Signal lines should have 50 Ohm impedance while the package ground leads and exposed paddle should be connected directly to the ground plane similar to that shown. A sufficient number of via holes should be used to connect the top and bottom ground planes. The evaluation circuit board shown is available from Analog Devices upon request.

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели,
кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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