HMC1065LP4E

GaAs MMIC I/Q DOWNCONVERTER 27 - 34 GHz

Typical Applications

The HMC1065LP4E is ideal for:

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

Features

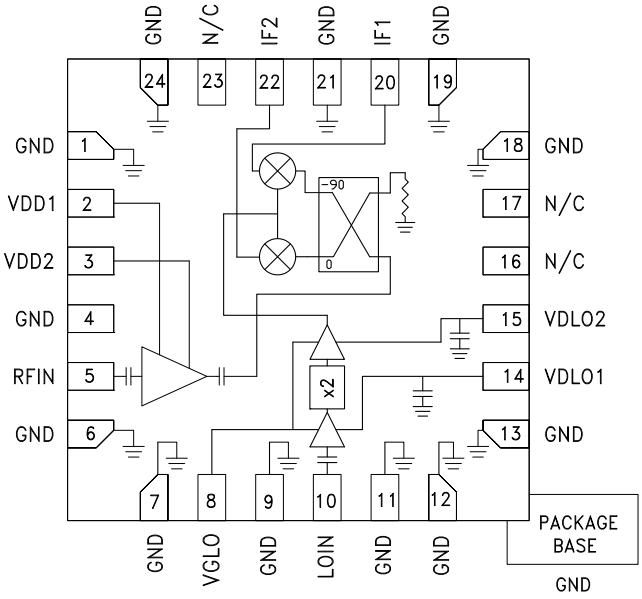
Conversion Gain: 13 dB

Image Rejection: 17 dBc

Input IP3: +2 dBm

24 Lead 4x4 mm SMT Package 16 mm²

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 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 [1][2], T_A = +25°C, IF = 2000 MHz, LO = +2 dBm, VDLO1, 2 = +3V, IDLO = 150 mA, VDRF = +3V, IDRF = 90mA, USB [1][2]

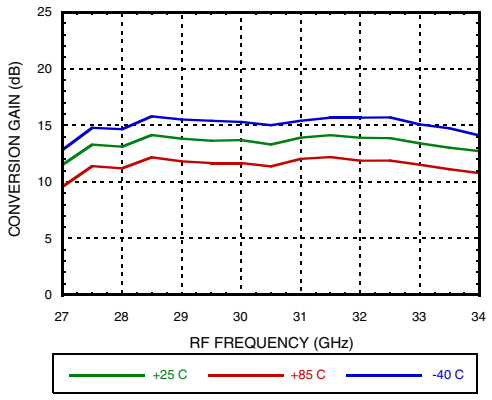
Parameter	Min.	Typ.	Max.	Units
Frequency Range, RF		27 - 34		GHz
Frequency Range, LO		11.5 - 19		GHz
Frequency Range, IF		DC - 4		GHz
Conversion Gain	9	12		dB
Noise Figure		3		dB
Image Rejection	12	17		dBc
1 dB Compression (Input)		-9		dBm
IP3 (Input)		2		dBm
IP3 (Output)		14		dBm
2LO / RF Isolation	35	45		dB
2LO / IF Isolation		20		dB
Amplitude Balance [3]		-1		dB
Phase Balance [3]		7		deg
Supply Current IGLO [2]		150		mA
Supply Current IDD [2]		90		mA

[1] Unless otherwise noted all measurements performed with low side LO, IF = 2000 MHz and external IF 90° hybrid.
[2] Adjust VGLO between -2 to 0V to achieve VDLO1 + VDLO2 = 150 mA quiesent (LO signal is not applied) and IDD = 90 mA is self biased.
[3] Data taken without external 90° hybrid, IF = 1000 MHz

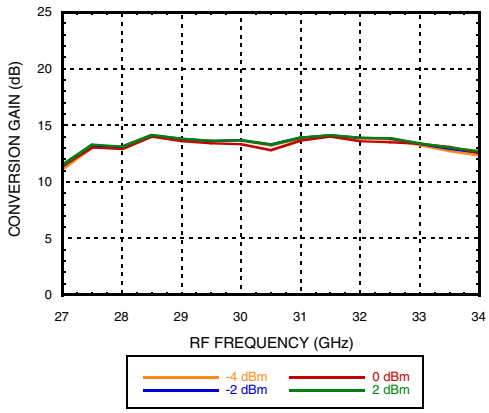
GaAs MMIC I/Q DOWNCONVERTER 27 - 34 GHz

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

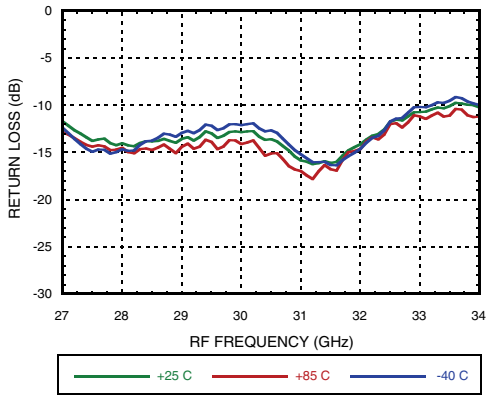
Conversion Gain vs. Temperature, USB



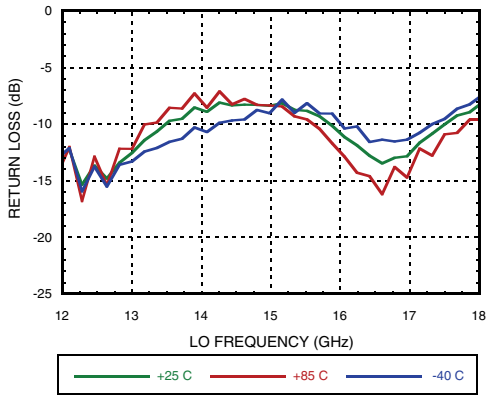
Conversion Gain vs. LO Drive, USB



RF Return Loss vs. Temperature



LO Return Loss vs. Temperature



IF Return Loss [1]

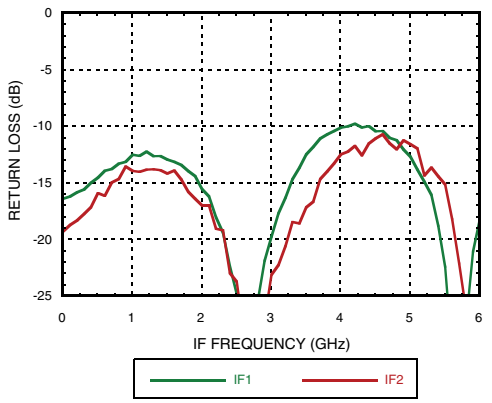
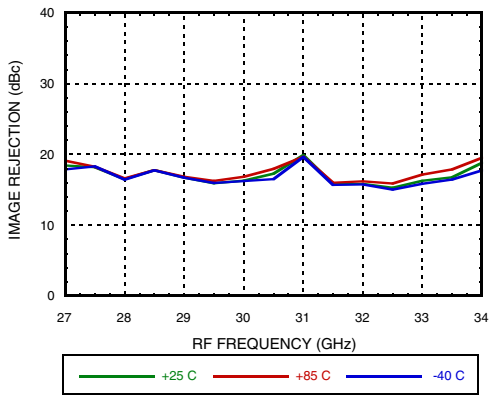


Image Rejection, USB vs. Temperature



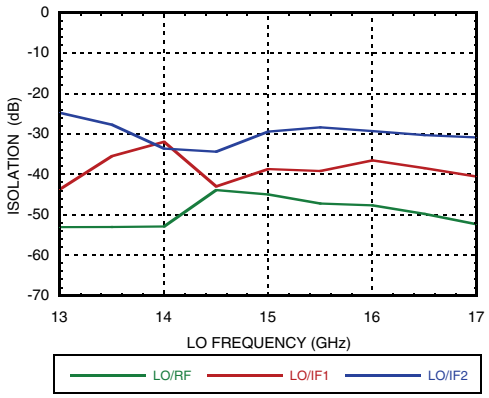
[1] Data taken without external IF 90° hybrid

HMC1065LP4E

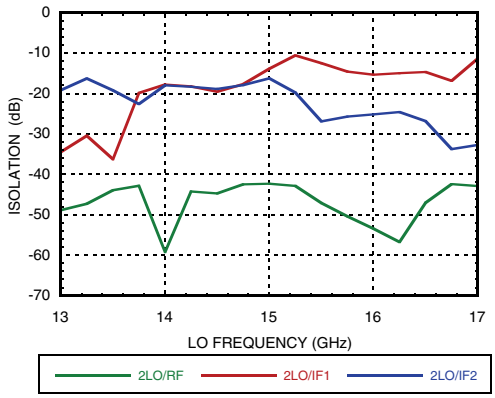
GaAs MMIC I/Q DOWNCONVERTER 27 - 34 GHz

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

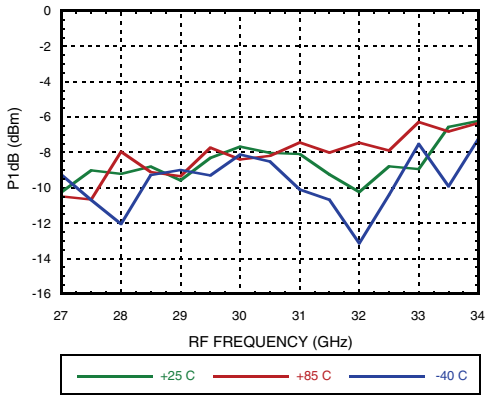
LO Isolation



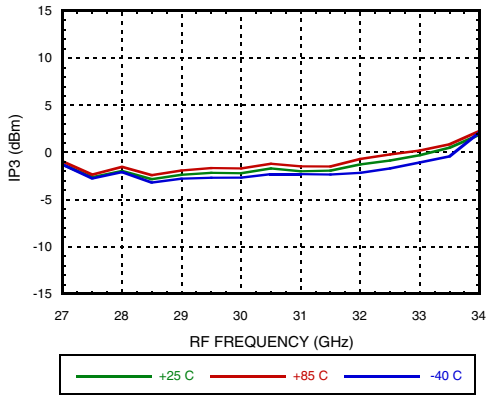
2LO Isolation



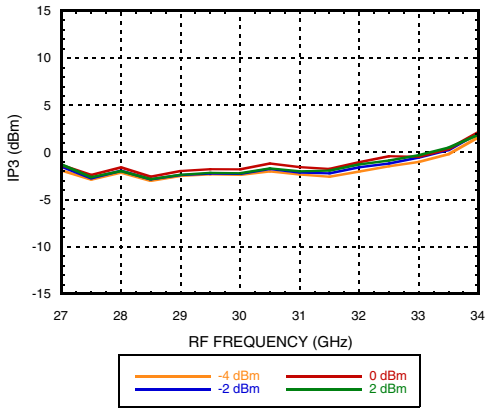
Input P1dB vs. Temperature, USB



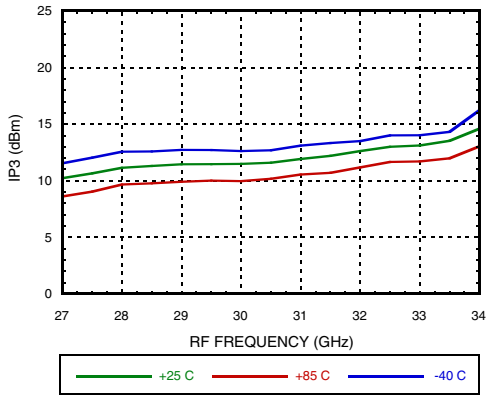
Input IP3 vs. Temperature, USB



Input IP3 vs. LO Drive, USB



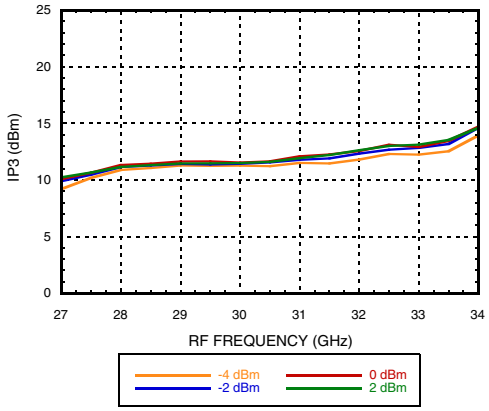
Output IP3 vs. Temperature, USB



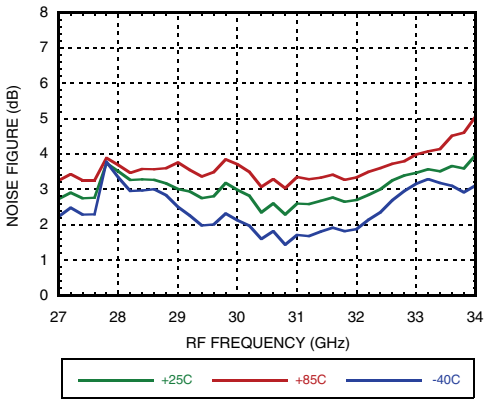
GaAs MMIC I/Q DOWNCONVERTER 27 - 34 GHz

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

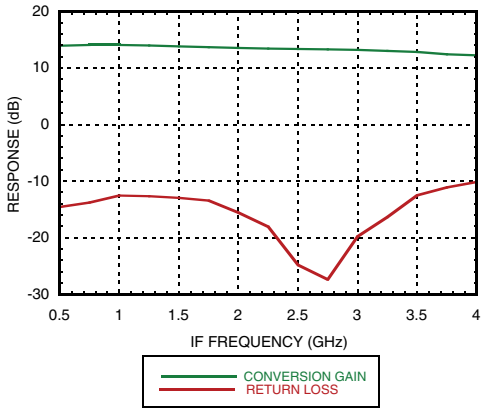
Output IP3 vs. LO Drive, USB



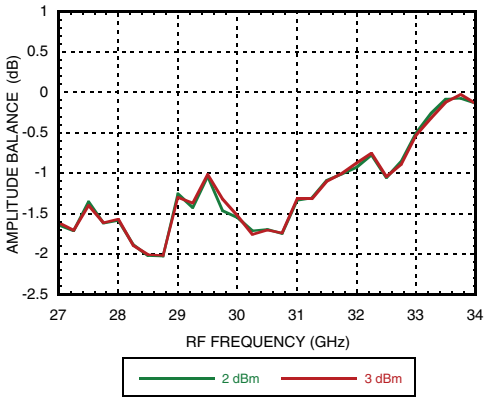
Noise Figure vs. Temperature, USB



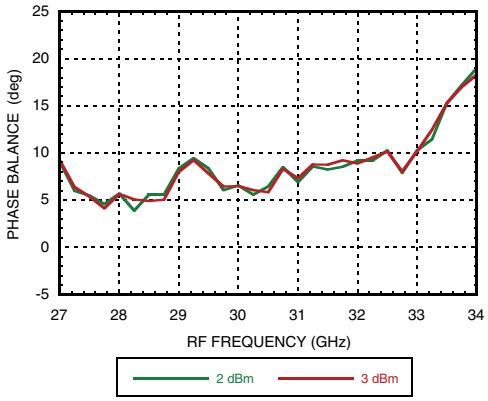
IF Bandwidth [1]



Amplitude Balance vs LO Drive [1] [2]



Phase Balance vs LO Drive [1] [2]



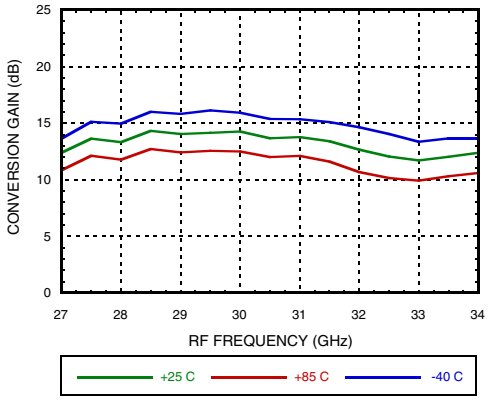
[1] Data taken without external 90° hybrid.

[2] Data taken with IF = 1000MHz.

GaAs MMIC I/Q DOWNCONVERTER 27 - 34 GHz

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

Conversion Gain vs. Temperature, LSB



Conversion Gain vs. LO Drive, LSB

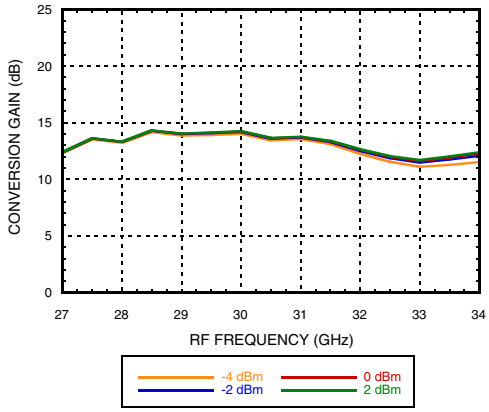
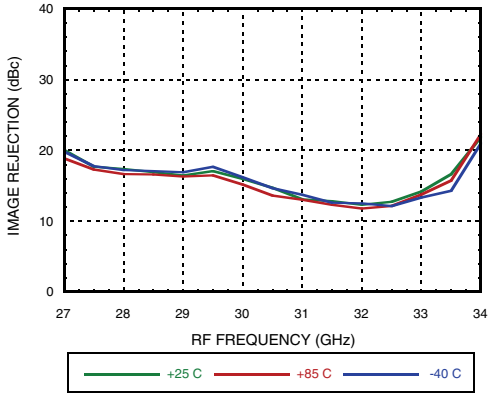
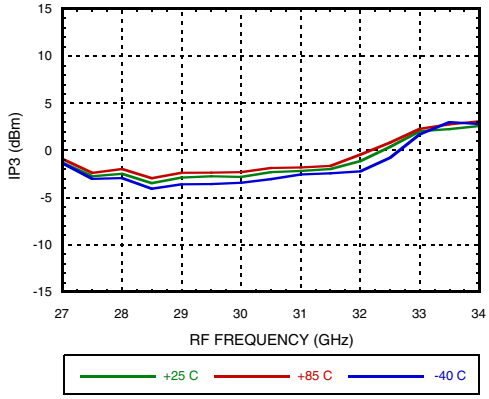


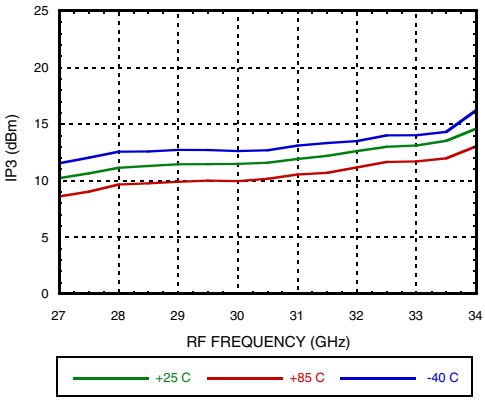
Image Rejection vs. Temperature, LSB



Input IP3 vs. Temperature, LSB



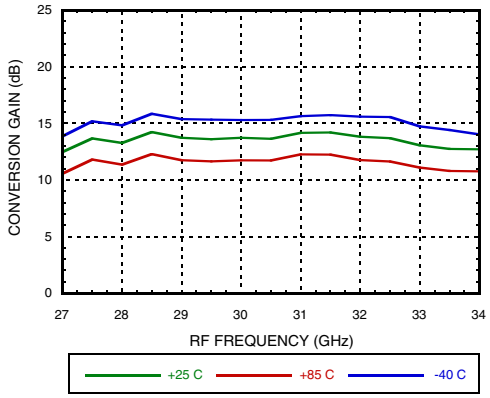
Output IP3 vs. Temperature, LSB



GaAs MMIC I/Q DOWNCONVERTER 27 - 34 GHz

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

Conversion Gain vs. Temperature, USB



Conversion Gain vs. LO Drive, USB

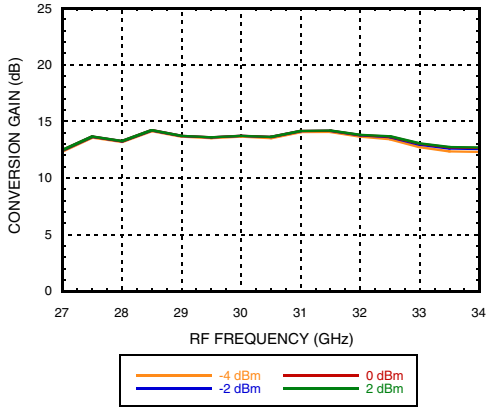
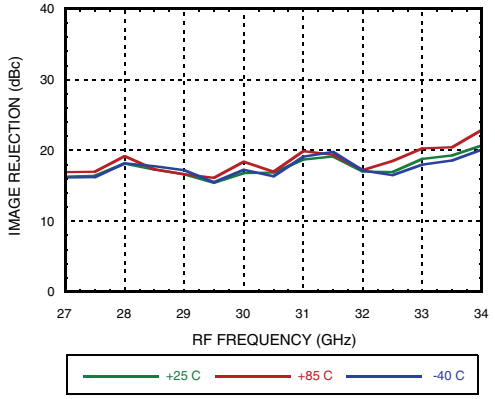
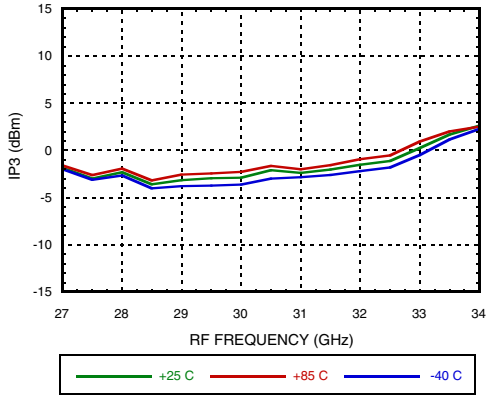


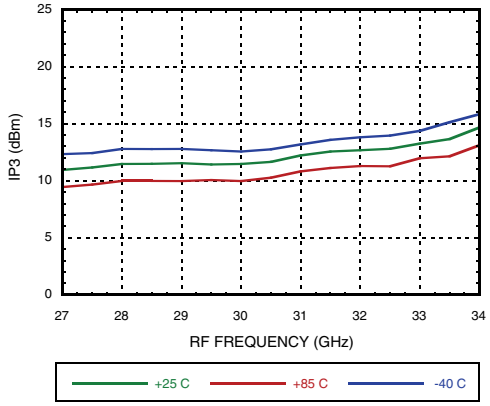
Image Rejection vs. Temperature, USB



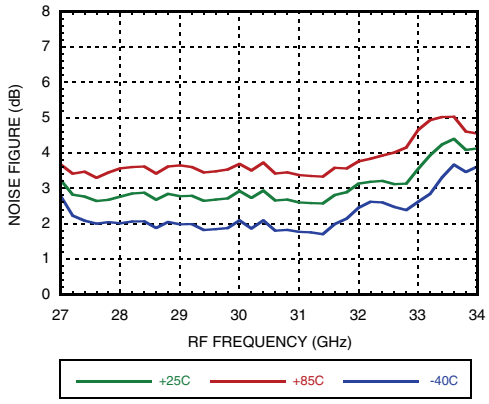
Input IP3 vs. Temperature, USB



Output IP3 vs. Temperature, USB



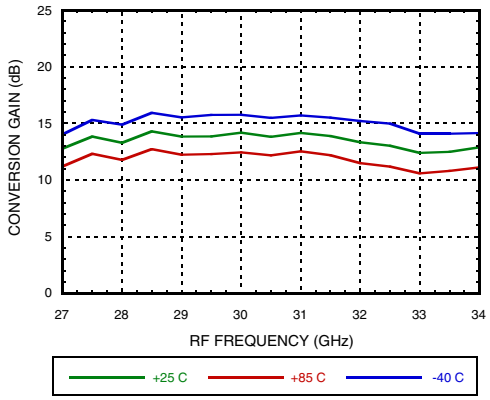
Noise Figure vs. Temperature, USB



GaAs MMIC I/Q DOWNCONVERTER 27 - 34 GHz

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

Conversion Gain vs. Temperature, LSB



Conversion Gain vs. LO Drive, LSB

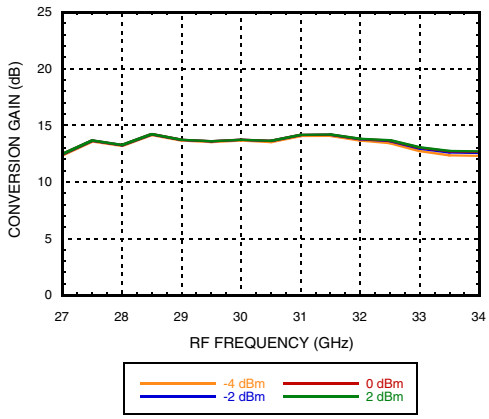
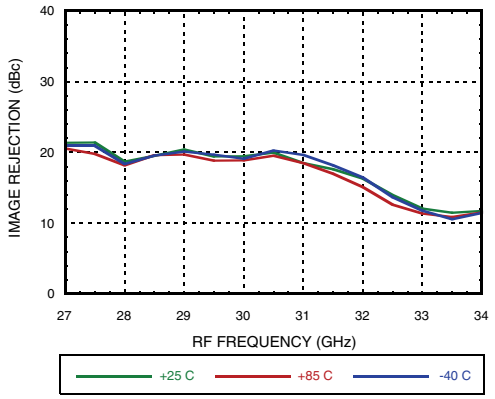
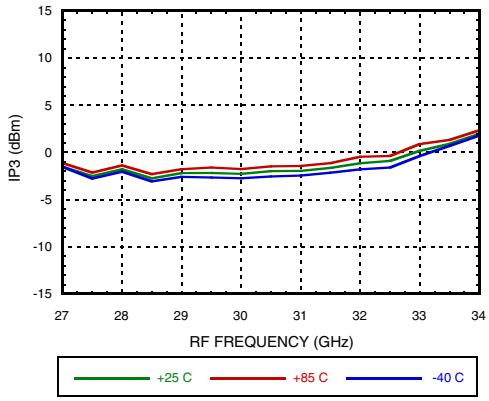


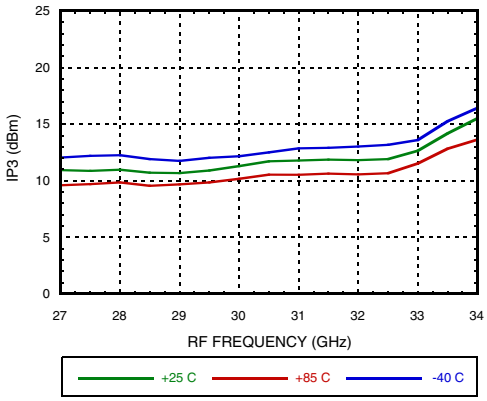
Image Rejection vs. Temperature, LSB



Input IP3 vs. Temperature, LSB

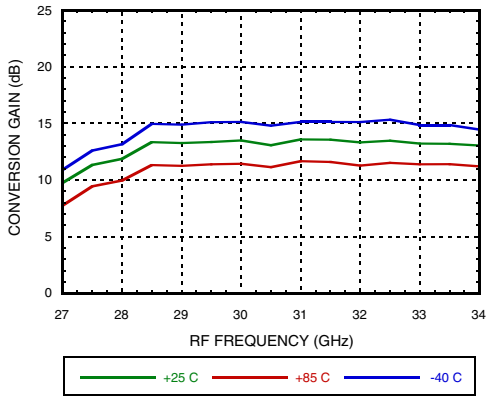


Output IP3 vs. Temperature, LSB



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

Conversion Gain vs. Temperature, USB



Conversion Gain vs. LO Drive, USB

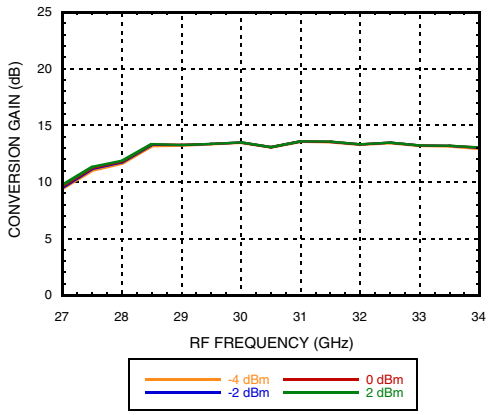
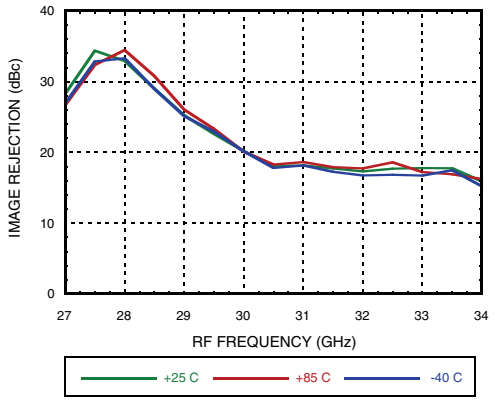
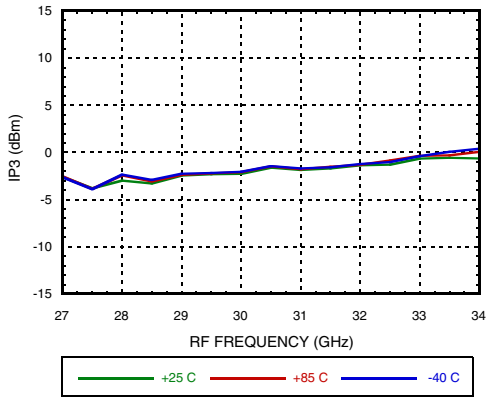


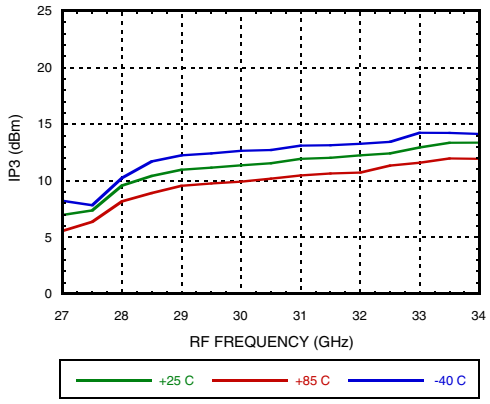
Image Rejection vs. Temperature, USB



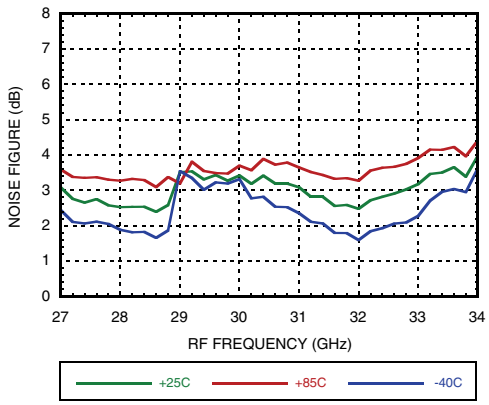
Input IP3 vs. Temperature, USB



Output IP3 vs. Temperature, USB



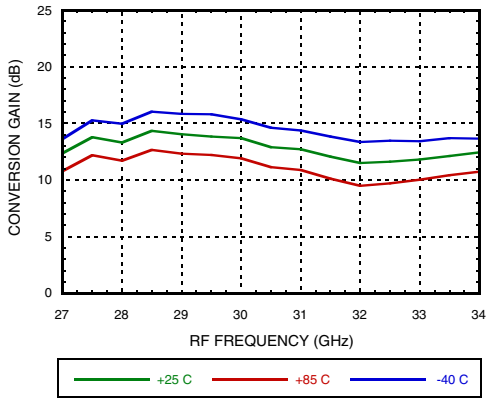
Noise Figure vs. Temperature, USB



GaAs MMIC I/Q DOWNCONVERTER 27 - 34 GHz

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

Conversion Gain vs. Temperature, LSB



Conversion Gain vs. LO Drive, LSB

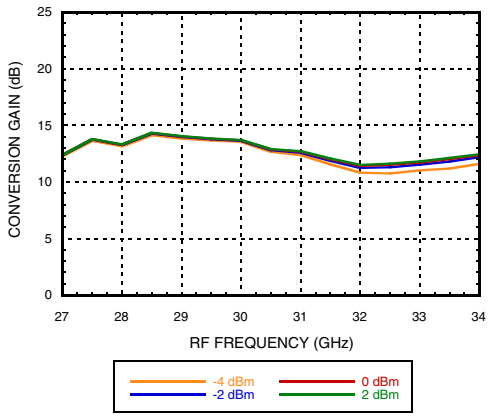
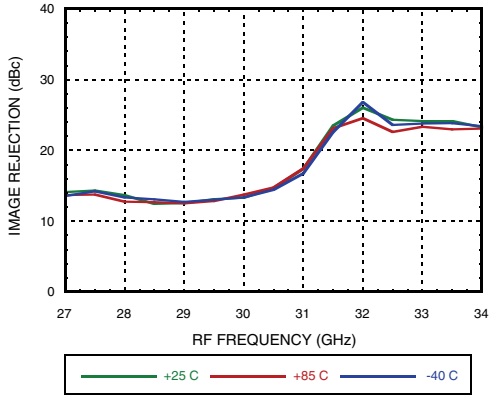
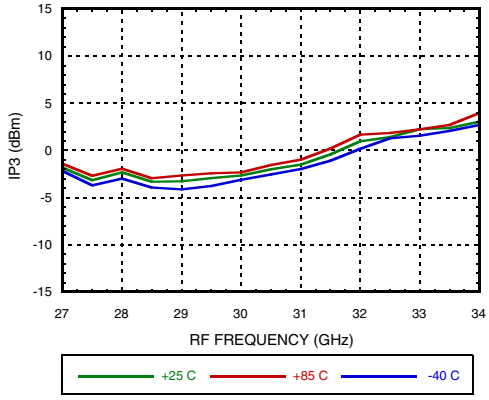


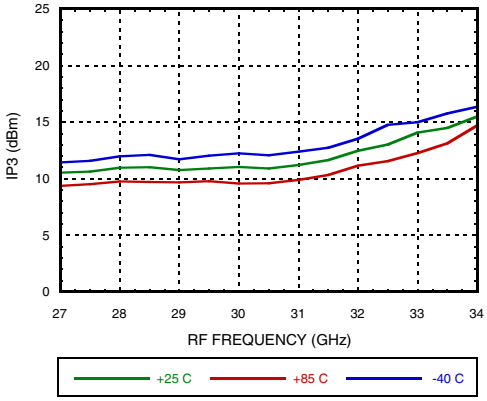
Image Rejection vs. Temperature, LSB



Input IP3 vs. Temperature, LSB



Output IP3 vs. Temperature, LSB



MxN Spurious Outputs [1][2]

	nLO				
mRF	0	1	2	3	4
0	xx	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

MxN Spurious Outputs [1][2]

	nLO				
mRF	0	1	2	3	4
0	xx	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

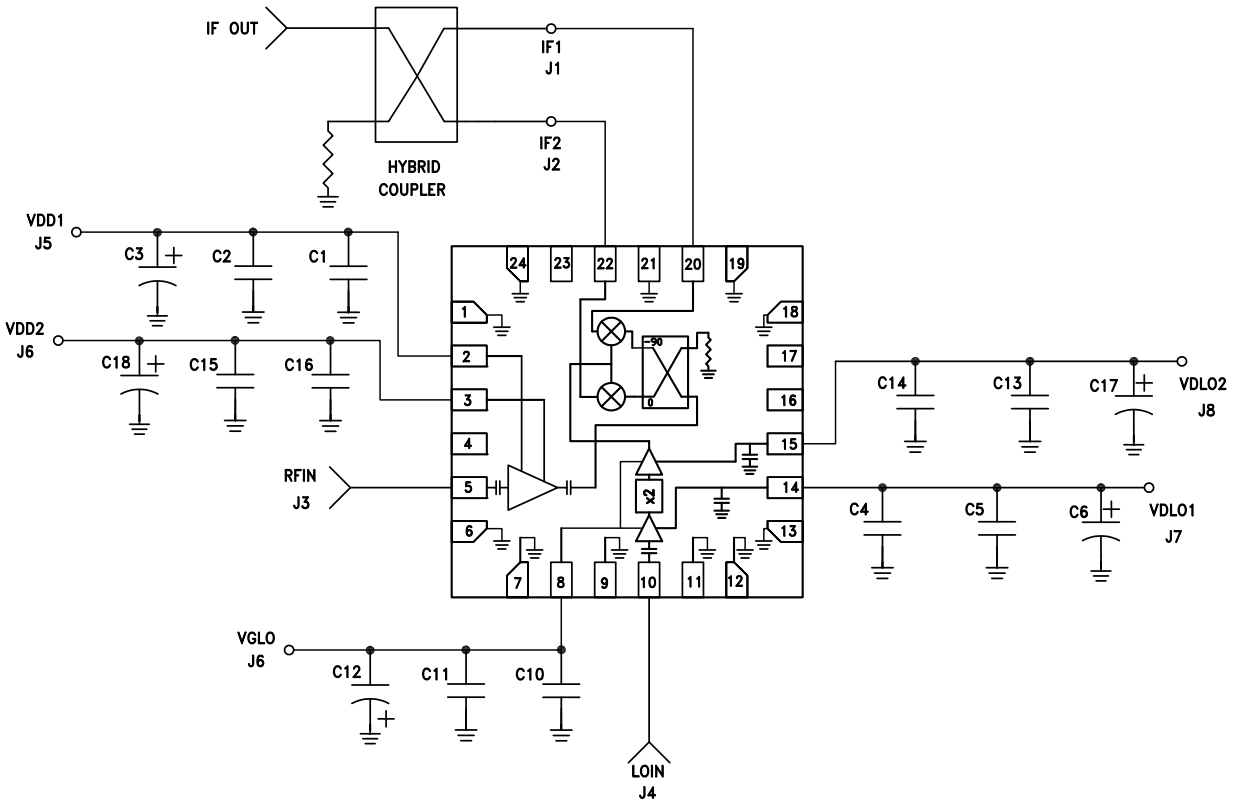
MxN Spurious Outputs [1][2]

	nLO				
mRF	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

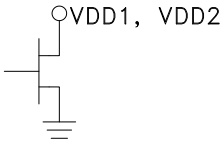
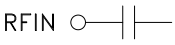
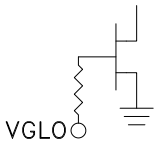
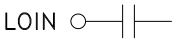
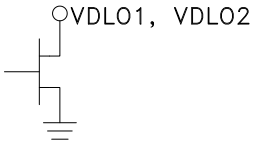
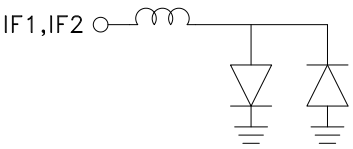
[1] Data taken without external IF 90° hybrid
[2] All values in dBc below RF power level (2LO + IF) USB

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 µF Capacitor, Case A Pkg.

Pin Descriptions

Pin Number	Function	Description	Interface Schematic
1, 4, 6, 7, 9, 11, 12,13, 18, 19, 21, 24	GND	These pins and exposed ground paddle must be connected to RF/DC ground.	
2	VDD1	Bias for LNA. The recommended DC voltage is 3V	
3	VDD2		
5	RFIN	This pin is AC coupled and matched to 50 Ohms.	
8	VGLO	Adjust VGLO for -1V to 0V to set VDLO1 & VDLO2 current to 150mA.	
10	LOIN	LO Input Port. The recommended LO Power is 0 to 3 dBM	
14	VDLO1	Bias for Multiplier input Buffer Amp. The recommended DC voltage is 3V	
15	VDLO2	Bias for Multiplier output Buffer Amp. The recommended DC voltage is 3V	
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	These pins are DC coupled. For applications not requiring operation to DC this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary frequency range. For operation to DC, this pin must not sink / source more than 3 mA of current or part non-function and possible failure will result.	
22	IF2		

HMC1065LP4E

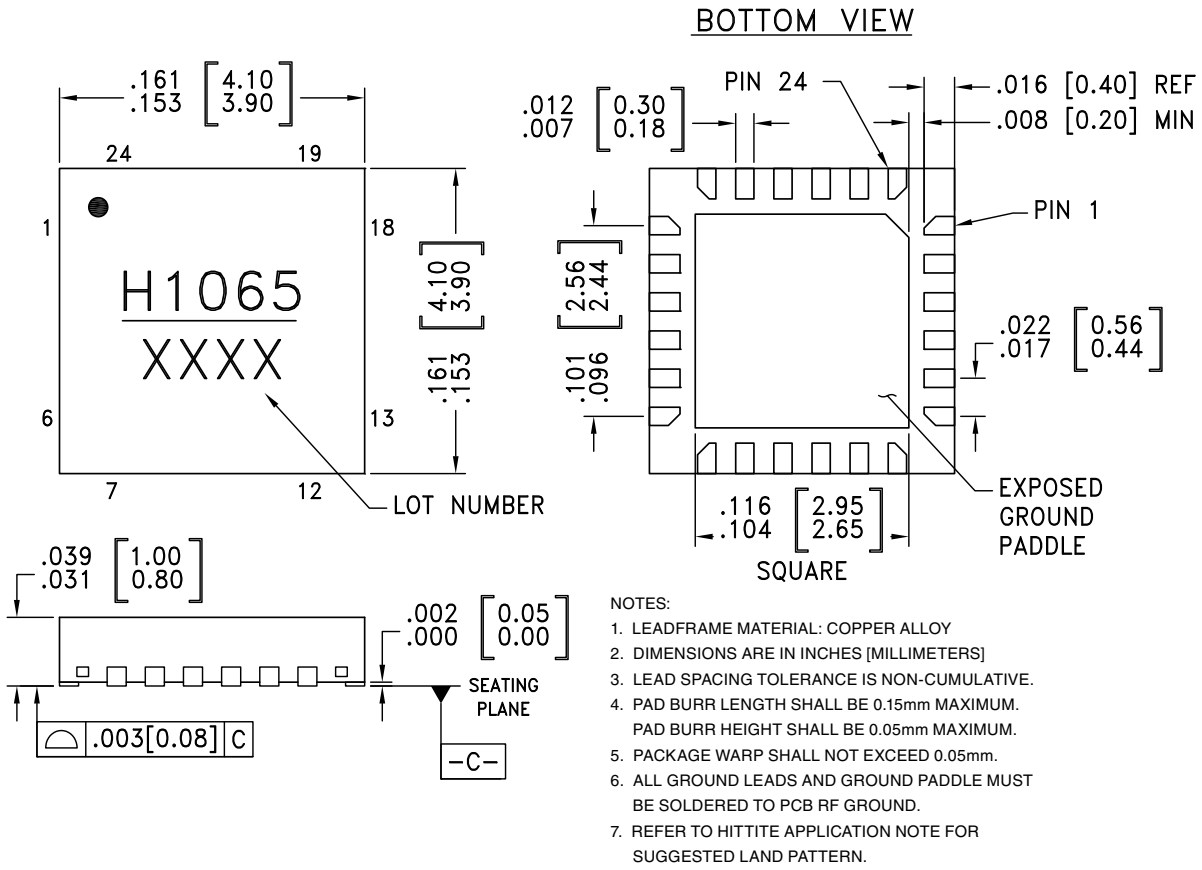
GaAs MMIC I/Q DOWNCONVERTER 27 - 34 GHz

Absolute Maximum Ratings

RF Input	+8 dBm
LO Input	+8 dBm
Channel Temperature	175 °C
Continuous Pdiss (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	-65 to +150 °C
Operating Temperature	-40 to +85 °C
ESD Sensitivity (HBM)	Class 0 (Passed 100V)

ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Outline Drawing



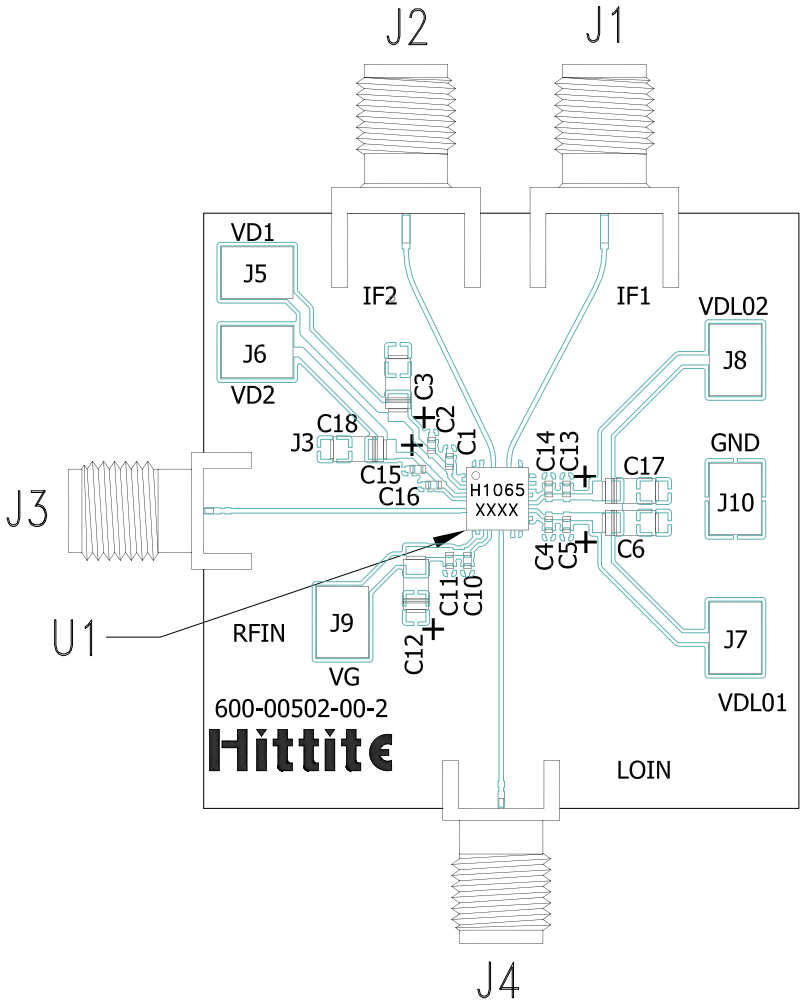
NOTES:
1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS]
3. LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
4. PAD BURR LENGTH SHALL BE 0.15mm MAXIMUM. PAD BURR HEIGHT SHALL BE 0.05mm MAXIMUM.
5. PACKAGE WARP SHALL NOT EXCEED 0.05mm.
6. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
7. 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% matte Sn I	MSL1 [1]	1065 XXXX

[1] Max peak reflow temperature of 260 °C
[2] 4-Digit lot number XXXX

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 µF 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 Hittite upon request.