



HMC686LP4 / 686LP4E

BiCMOS MIXER W/ INTEGRATED LO AMPLIFIER, 700 - 1100 MHz

Typical Applications

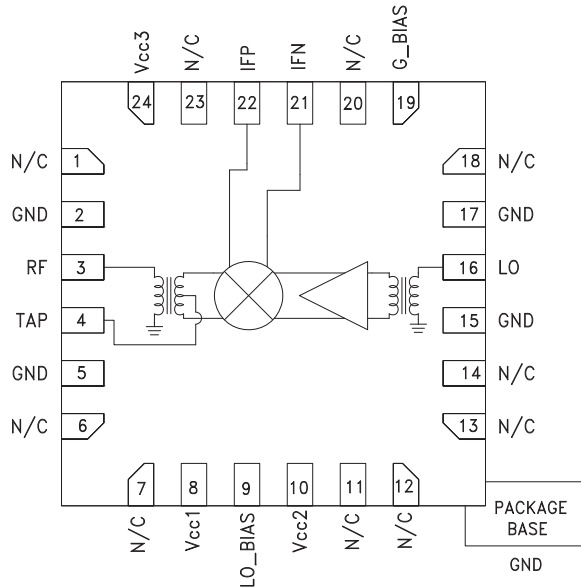
The HMC686LP4(E) is Ideal for:

- Cellular/3G & LTE/WiMAX/4G
- Basestations & Repeaters
- GSM, CDMA & OFDM
- Transmitters and Receivers

Features

- High Input IP3: +34 dBm
- Low Conversion Loss: 7.5 dB
- Low LO Drive: 0 dBm
- Optimized for High Side LO Input
- Upconversion & Downconversion Applications
- 24 Lead 4x4mm SMT Package: 16mm²

Functional Diagram



General Description

The HMC686LP4(E) is a high dynamic range passive MMIC mixer with integrated LO amplifier in a 4x4 SMT QFN package covering 0.7 to 1.1 GHz. Excellent input IP3 performance of +34 dBm for down conversion is provided for 3G & 4G GSM/CDMA applications at an LO drive of 0 dBm. With an input 1 dB compression of +25 dBm, the RF port will accept a wide range of input signal levels. Conversion loss is 7.5 dB typical. The DC to 500 MHz IF frequency response will satisfy GSM/CDMA transmit or receive frequency plans. The HMC686LP4(E) is optimized for high side LO frequency plans and is pin for pin compatible with the HMC684LP4(E) which is a 0.7 - 1.0 GHz converter optimized for low side LO.

Electrical Specifications

$T_A = +25^\circ C$, IF = 150 MHz, LO = 0 dBm, V_{CC1, 2, 3} = +5V, G_BIAS = +3.5V*

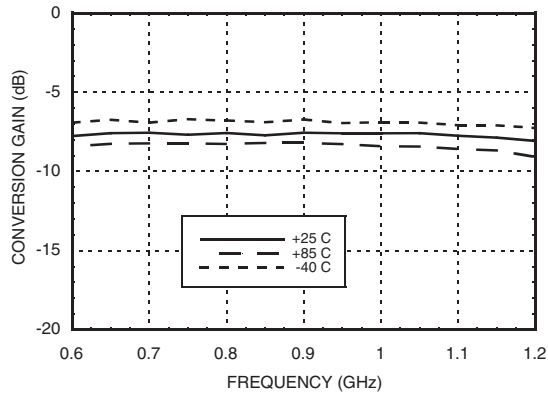
Parameter	Min.	Typ.	Max.	Units
Frequency Range, RF	0.7 - 1.1			GHz
Frequency Range, LO	0.85 - 1.25			GHz
Frequency Range, IF	DC to 500			MHz
Conversion Loss		7.5	9.5	dB
Noise Figure (SSB)		7.5		dB
LO to RF Isolation	18	24		dB
LO to IF Isolation	30	40		dB
RF to IF Isolation	27	35		dB
IP3 (Input)		34		dBm
1 dB Compression (Input)		25		dBm
LO Drive Input Level (Typical)	-3 to +3			dBm
Supply Current I _{CC} Total		105	125	mA

* Unless otherwise noted all measurements performed as downconverter with high side LO & IF = 150 MHz.

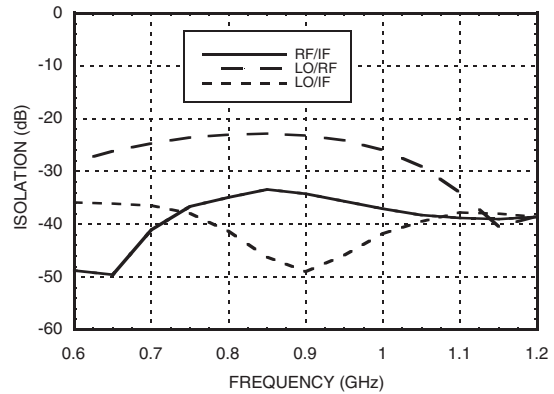


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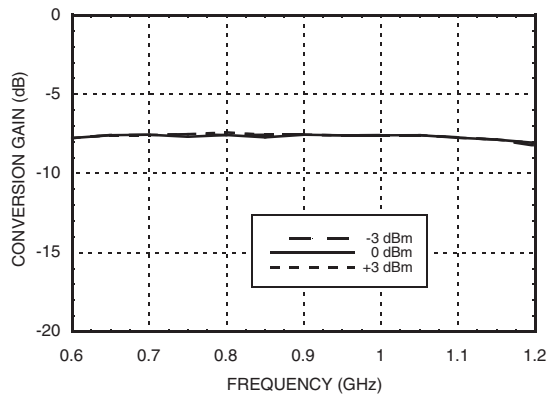
Conversion Gain vs. Temperature



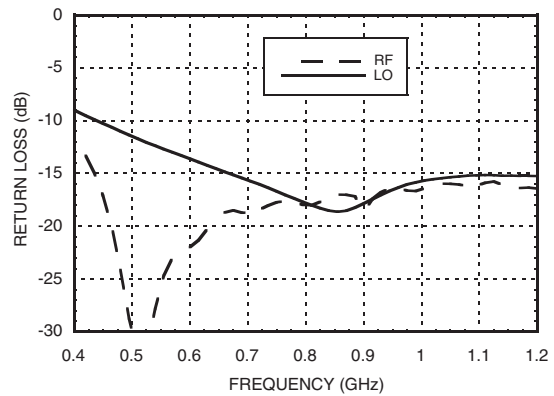
Isolation



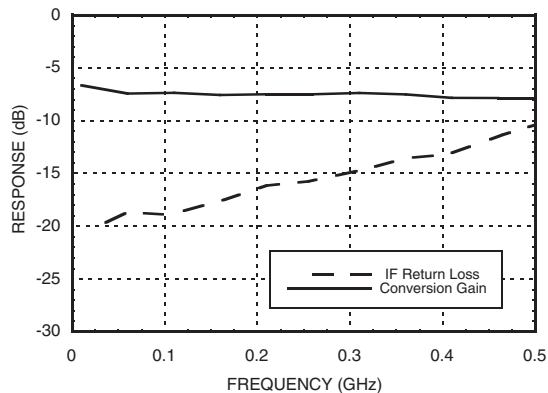
Conversion Gain vs. LO Drive



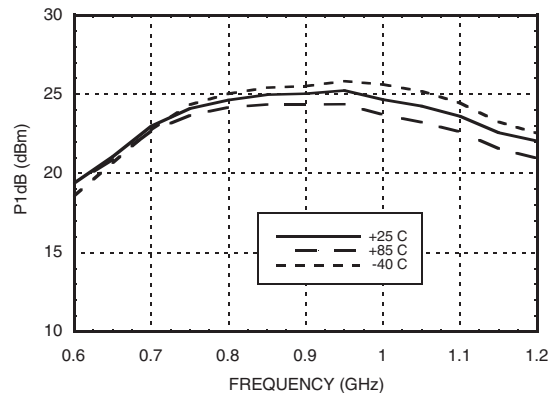
Return Loss



IF Bandwidth (LO = 1.1 GHz)



Input P1dB vs. Temperature





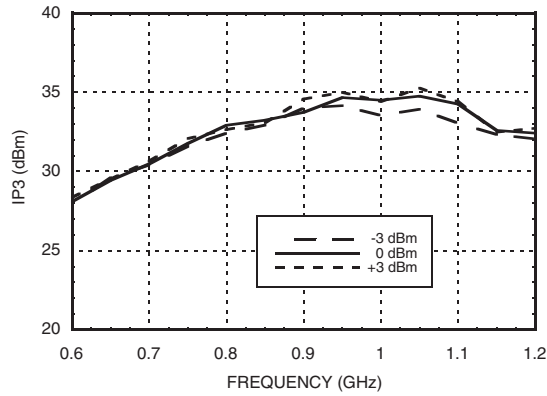
BiCMOS MIXER W/ INTEGRATED LO AMPLIFIER, 700 - 1100 MHz



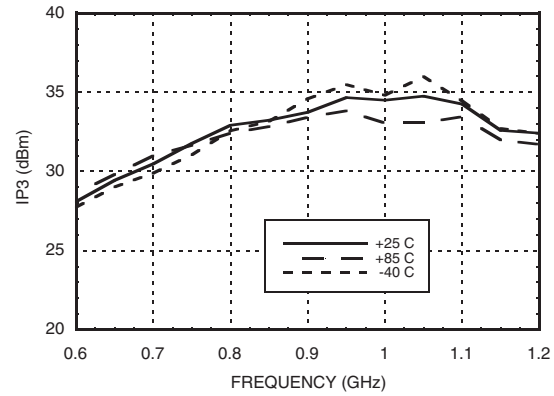
MIXERS - DOWNCONVERTERS - SMT

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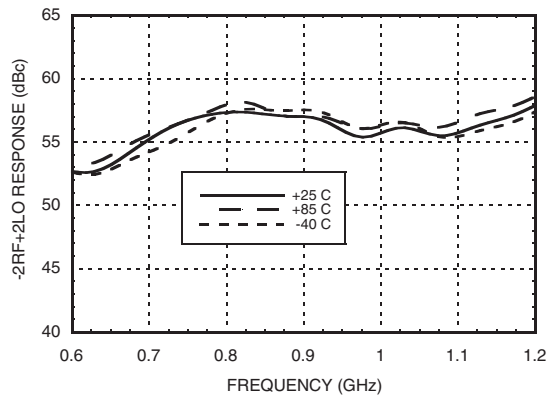
Input IP3 vs. LO Drive ^[1]



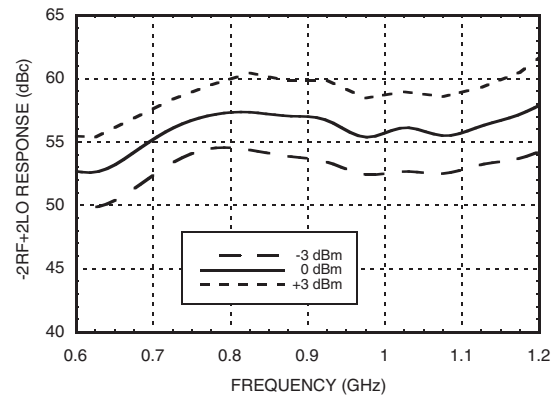
Input IP3 vs. Temperature ^[1]



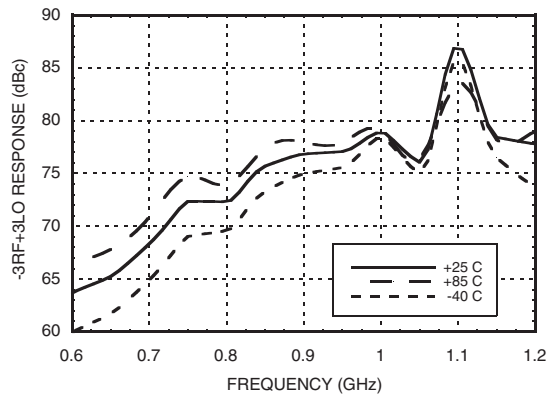
-2RF +2LO Response vs. Temperature ^[2]



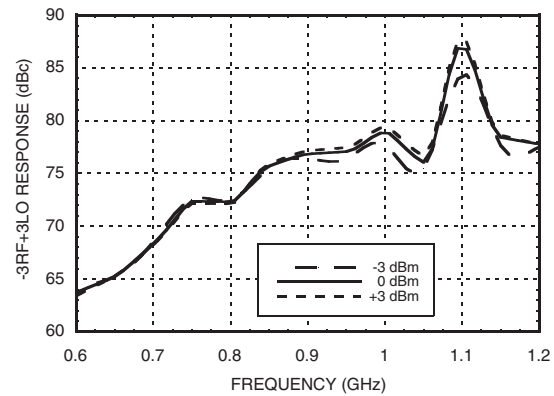
-2RF +2LO Response vs. LO Drive ^[2]



-3RF +3LO Response vs. Temperature ^[2]



-3RF +3LO Response vs. LO Drive ^[2]



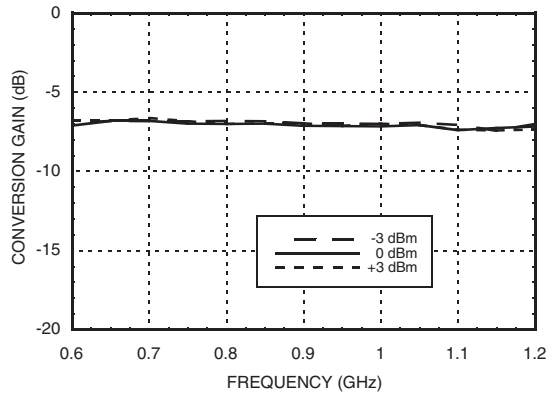
[1] Two-tone input power = +9 dBm each tone, 1 MHz spacing. [2] Referenced to RF Input power at 0 dBm



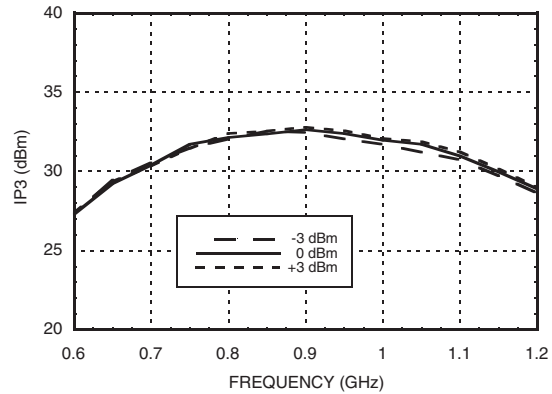
BiCMOS MIXER W/ INTEGRATED LO AMPLIFIER, 700 - 1100 MHz

Upconverter Performance Conversion Gain vs. LO Drive

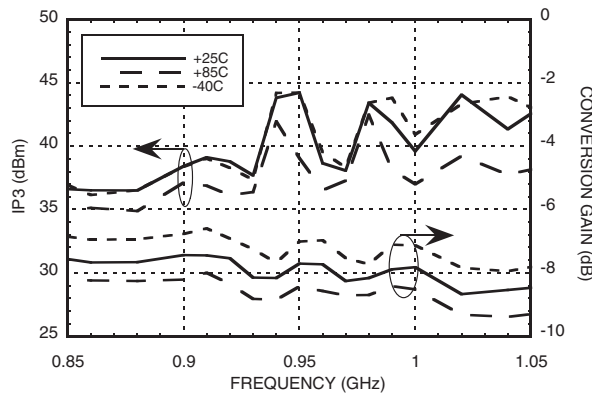
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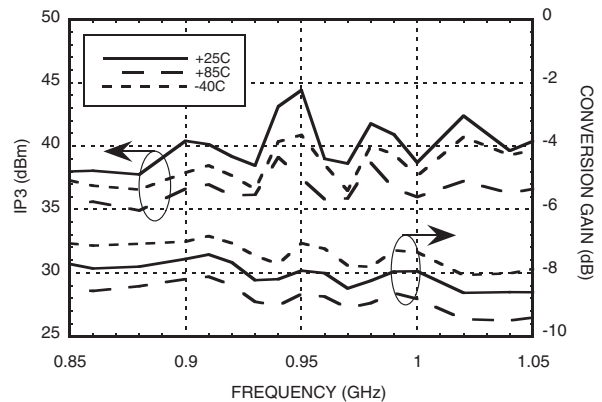
Upconverter Performance Input IP3 vs. LO Drive [1]



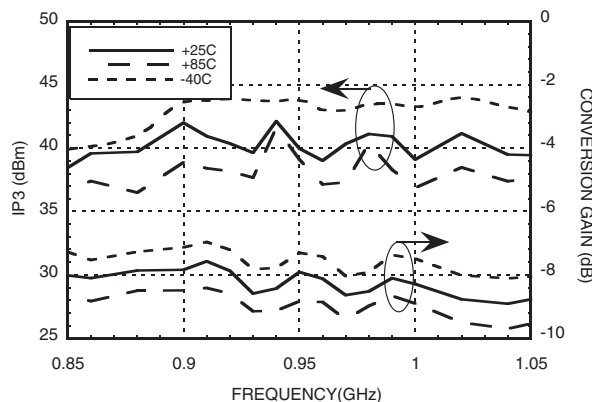
High IP3 Upconverter Tune Conversion Gain and IP3, G_BIAS = 1.5 [2][3]



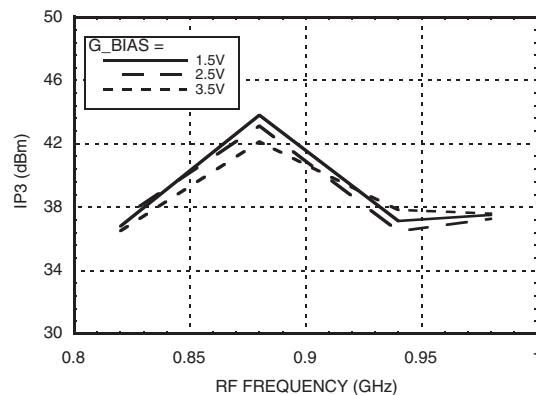
High IP3 Upconverter Tune Conversion Gain and IP3, G_BIAS = 2.5 [2][3]



High IP3 Upconverter Tune Conversion Gain and IP3, G_BIAS = 3.5 [2][3]

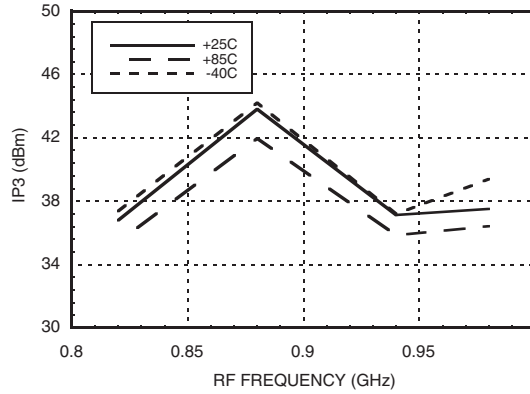


High IP3 Upconverter Tune IP3 vs G_BIAS, LO = 1060 MHz [2]



[1] Two-tone input power = +9 dBm each tone, 1 MHz spacing.
 [2] See Narrowband High IP3 Upconverter Tune Evaluation PCB and schematic.
 [3] IF = 120 MHz

**High IP3 Upconverter Tune
IP3 vs Temperature, G_BIAS = 1.5V, LO = 1060 MHz^[1]**



Absolute Maximum Ratings

RF / IF Input (Vcc1,2,3 = +5V)	+23 dBm
LO Drive (Vcc1,2,3 = +5V)	+10 dBm
Vcc1,2,3	+5.5V
Channel Temperature	125 °C
Continuous Pdiss (T = 85°C) (derate 19 mW/°C above 85°C)	0.76 W
Thermal Resistance (channel to ground paddle)	52 °C/W
Storage Temperature	-65 to 150 °C
Operating Temperature	-40 to +85 °C

MxN Spurious @ IF Port

mRF	nLO				
	0	1	2	3	4
0	xx	41	17	31	40
1	26	0	28	17	46
2	52	50	50	62	58
3	80	66	87	71	87
4	98	97	98	97	98

RF Freq. = 0.9 GHz @ 0 dBm
LO Freq. = 1.0 GHz @ 0 dBm
All values in dBc below IF power level (-1RF + 1LO).



**ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS**

Typical Supply Current vs. Vcc

Vcc1,2,3 (V)	Icc Total (mA)
4.75	100
5.00	105
5.25	110

Product will operate over full voltage range shown above.

Harmonics of LO

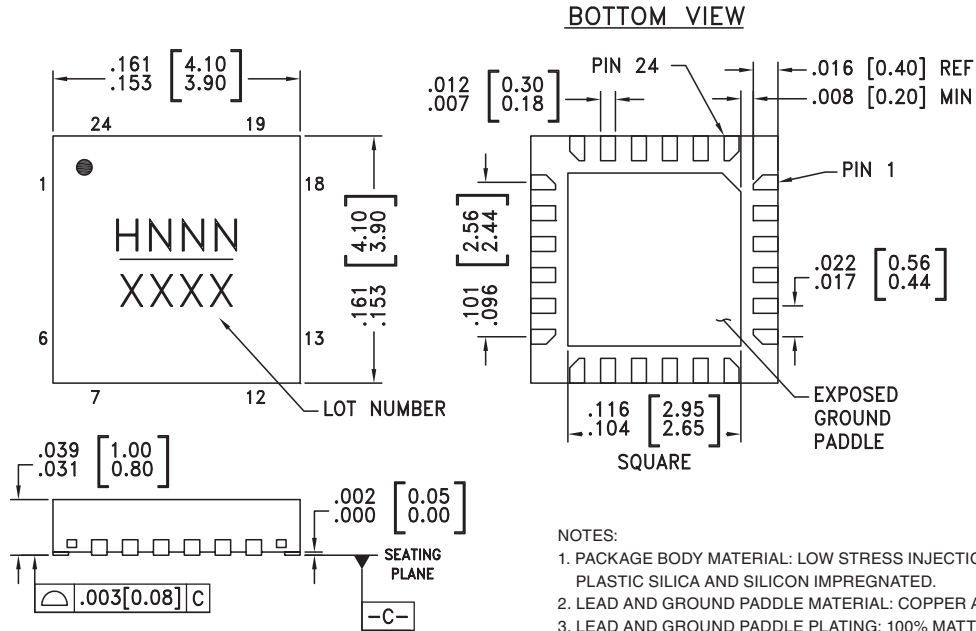
LO Freq. (GHz)	nLO Spur @ RF Port			
	1	2	3	4
0.75	28	40	40	39
0.85	25	34	60	33
0.95	23	29	32	31
1.05	23	28	36	26
1.15	26	23	38	34
1.25	33	19	44	34
1.35	39	18	39	38

LO = 0 dBm
All values in dBc below input LO level measured at RF port

[1] See Narrowband High IP3 Upconverter Tune Evaluation PCB and schematic.

Outline Drawing

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NOTES:

1. PACKAGE BODY MATERIAL: LOW STRESS INJECTION MOLDED PLASTIC SILICA AND SILICON IMPREGNATED.
2. LEAD AND GROUND PADDLE MATERIAL: COPPER ALLOY.
3. LEAD AND GROUND PADDLE PLATING: 100% MATTE TIN.
4. DIMENSIONS ARE IN INCHES [MILLIMETERS].
5. LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
6. PAD BURR LENGTH SHALL BE 0.15mm MAX.
PAD BURR HEIGHT SHALL BE 0.25mm MAX.
7. PACKAGE WARP SHALL NOT EXCEED 0.05mm
8. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
9. REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED PCB LAND PATTERN.

Package Information

Part Number	Package Body Material	Lead Finish	MSL Rating	Package Marking ^[3]
HMC686LP4	Low Stress Injection Molded Plastic	Sn/Pb Solder	MSL1 ^[1]	H686 XXXX
HMC686LP4E	RoHS-compliant Low Stress Injection Molded Plastic	100% matte Sn	MSL1 ^[2]	H686 XXXX


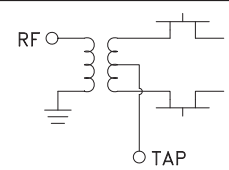
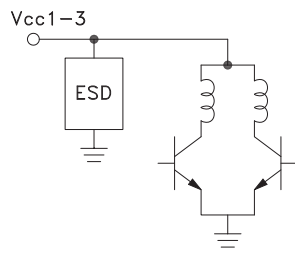
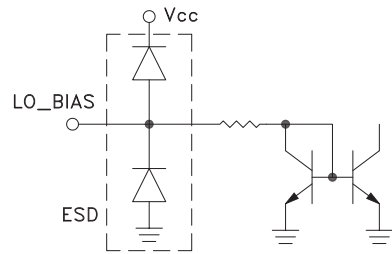
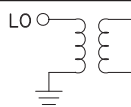
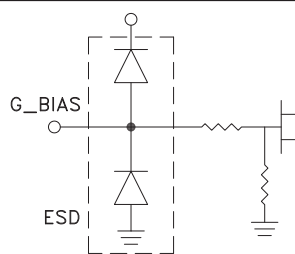
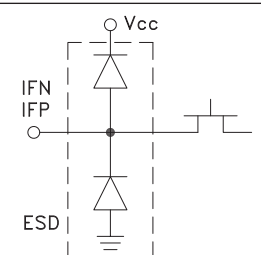
[1] Max peak reflow temperature of 235 °C

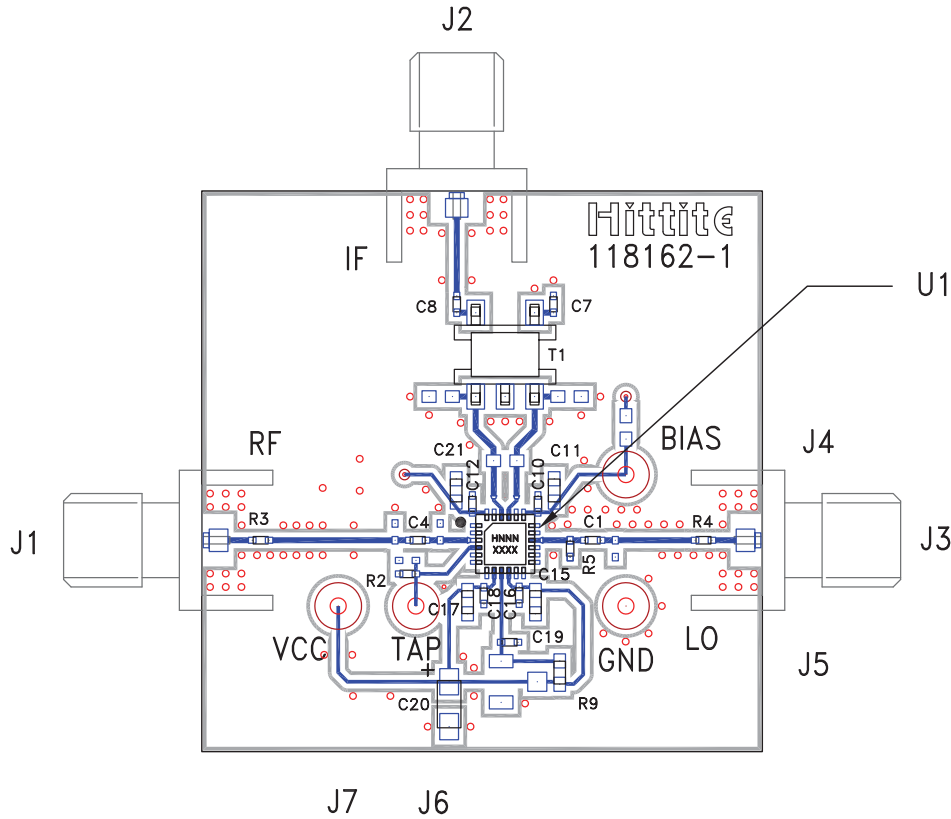
[2] Max peak reflow temperature of 260 °C

[3] 4-Digit lot number XXXX



Pin Descriptions

Pin Number	Function	Description	Interface Schematic
1, 6, 7, 11 - 14, 18, 20, 23	N/C	No connection. These pins may be connected to RF ground. Performance will not be affected.	
2, 5, 15, 17	GND	Package bottom must be connected to RF/DC ground.	
3	RF	This pin is matched single-ended to 50 ohms and DC shorted to ground through a balun.	
4	TAP	Center tap of secondary side of the internal RF balun. Short to ground with zero ohms close to the package.	
8, 10, 24	Vcc1, Vcc2, Vcc3	Power supply voltage. See application circuit for required external components.	
9	LO_BIAS	Adjust the LO buffer current through an external resistor. See application circuit for required external components.	
16	LO	This pin is matched single-ended to 50 ohms and DC shorted to ground through a balun.	
19	G_BIAS	External optional bias. See application circuit for recommended external components. Apply +3.5V for nominal operation. G_Bias can be set to between 0 and 5Vdc. The G_bias pin has an internal 15K ohm resistance to ground. This adjustment allows for a tradeoff between conversion loss and linearity performance of the converter.	
21, 22	IFN, IFP	Differential IF input / output pins matched to differential 50 ohms. For applications not requiring operation to DC an off chip DC blocking capacitor should be used.	



List of Materials for Evaluation PCB 118196 [1]

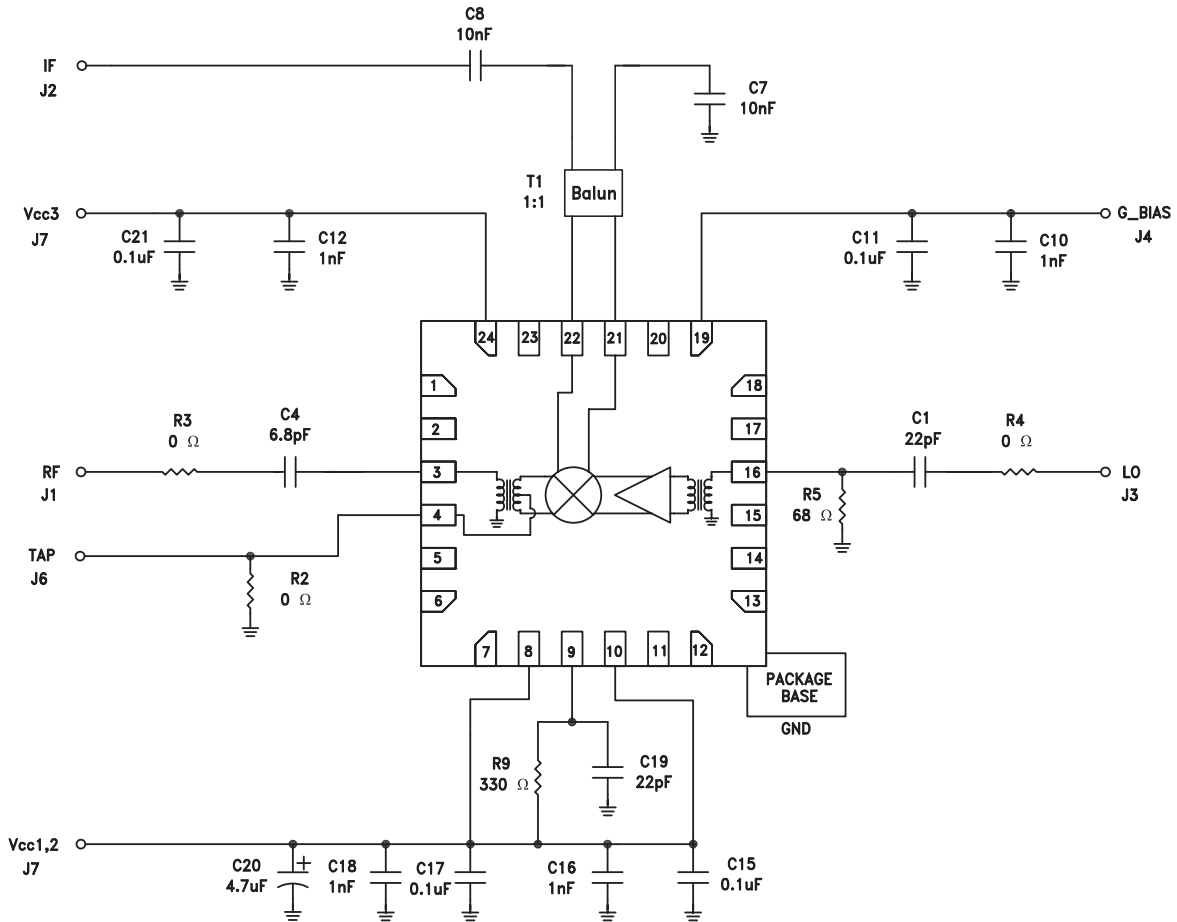
Item	Description
J1 - J3	SMA Connector
J4 - J7	DC Pin
C1, C19	22 pF Capacitor, 0402 Pkg.
C4	6.8 pF Capacitor, 0402 Pkg.
C7, C8	10 nF Capacitor, 0402 Pkg.
C10, C12, C16, C18	1 nF Capacitor, 0402 Pkg.
C11, C15, C17, C21	0.1 μ F Capacitor, 0603 Pkg.
C20	4.7 μ F Case A, Tantalum
R2 - R4	0 Ohm Resistor, 0402 Pkg.
R5	68 Ohm Resistor, 0402 Pkg.
R9	330 Ohm Resistor, 0603 Pkg.
T1	1:1 Transformer - Tyco MABACT0039
U1	HMC686LP4(E) Downconverter
PCB [2]	118162 Evaluation PCB

[1] Reference this number when ordering complete evaluation PCB

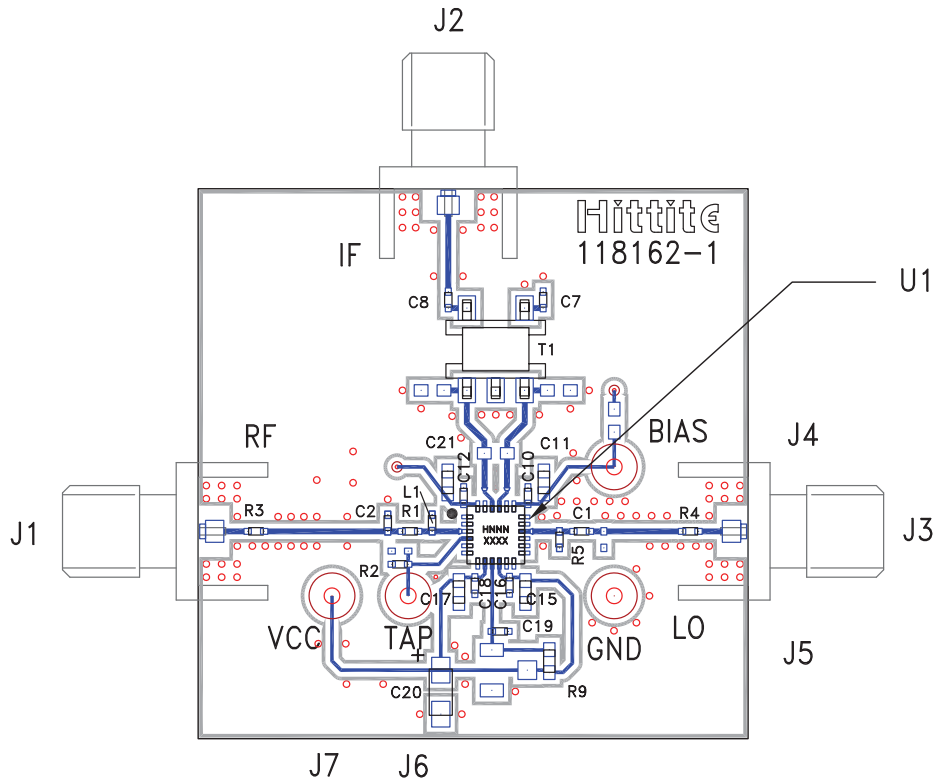
[2] Circuit Board Material: Arlon 25R, FR4

The circuit board used in the final 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.

www.datasheet4u.com **Application Circuit**



www.datasheet4u.com **Evaluation PCB - Narrowband High IP3 Upconverter Tune**



List of Materials for Evaluation PCB 122410 [1]

Item	Description
J1 - J3	SMA Connector
J4 - J7	DC Pin
C1, C19	22 pF Capacitor, 0402 Pkg.
C2	4.7 pF Capacitor, 0402 Pkg.
C7, C8	10 nF Capacitor, 0402 Pkg.
C10, C12, C16, C18	1 nF Capacitor, 0402 Pkg.
C11, C15, C17, C21	0.1 µF Capacitor, 0603 Pkg.
C20	4.7 µF Case A, Tantalum
R1	0 Ohm Resistor, 0402 Pkg.
R2 - R4	0 Ohm Resistor, 0402 Pkg.
R5	68 Ohm Resistor, 0402 Pkg.
R9	330 Ohm Resistor, 0603 Pkg.
T1	1:1 Transformer - Tyco MABACT0039
U1	HMC686LP4(E) Downconverter
L1	5.6 nH Ind, 0402 Pkg.
PCB [2]	118162 Evaluation PCB

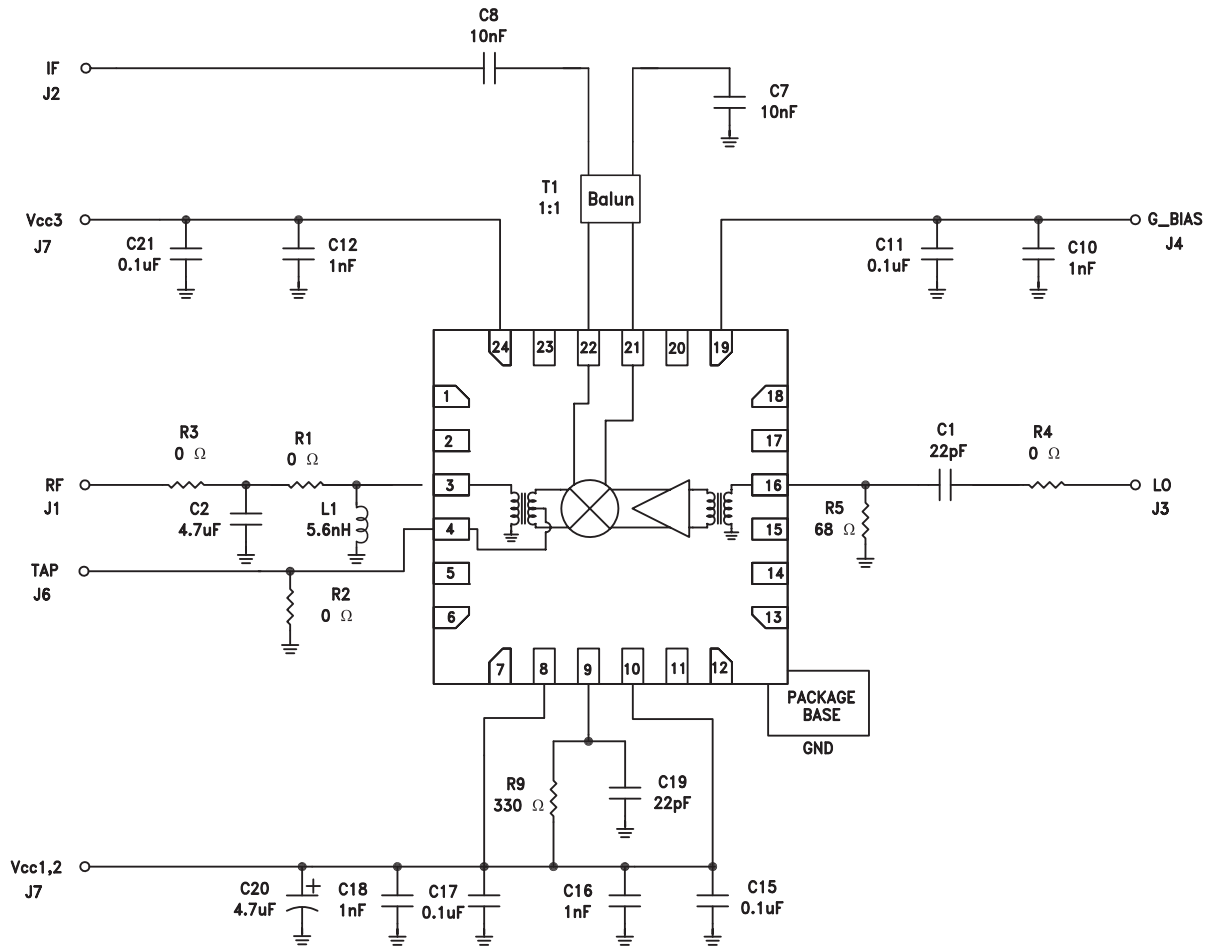
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[2] Circuit Board Material: Arlon 25R, FR4

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Application Circuit - Narrowband High IP3 Upconverter Tune





v02.0708

HMC686LP4 / 686LP4E

**BiCMOS MIXER W/ INTEGRATED
LO AMPLIFIER, 700 - 1100 MHz**

www.datasheet4u.com **Notes**



MIXERS - DOWNCONVERTERS - SMT