XR1015-QH

Receiver
10 - 16 GHz

Rev. V1

Features

- Integrated LNA, Mixer and LO Buffer Amplifier
- 2.5 dB Noise Figure
- 12.0 dB Conversion Gain
- Lead-Free 4 mm 24–lead QFN Package
- 100% RF, DC and NF Testing
- RoHS* Compliant and 260°C Reflow Compatible

Description

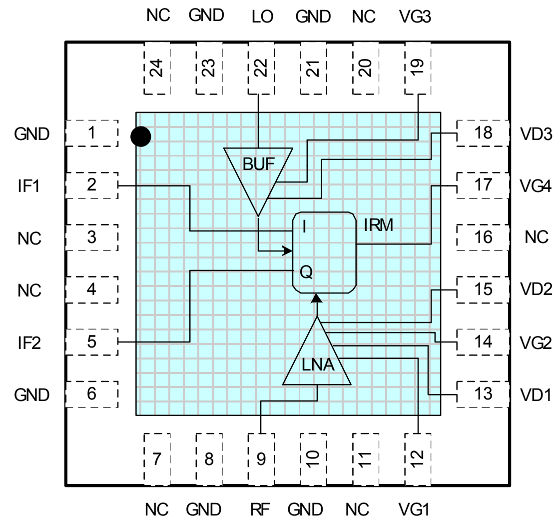
The XR1015-QH is a 10.0-16.0 GHz QFN packaged receiver that has a noise figure of 2.5 dB and 12.0 dB conversion gain. The device integrates an LNA, image reject mixer and LO buffer amplifier within a fully molded 4x4mm QFN package. The image reject mixer eliminates the need for a bandpass filter after the LNA to remove thermal noise at the image frequency. I and Q mixer outputs are provided and an external 90 degree hybrid is required to select the desired sideband. This device uses M/A-COM Technology Solutions' GaAs pHEMT device model technology, and is based upon electron beam lithography to ensure high repeatability and uniformity. This device is specifically designed for Point to Point radio applications and is well suited for other telecom applications such as SATCOM and VSAT.

Ordering Information [1]

Part Number	Package
XR1015-QH-0G00	bulk quantity
XR1015-QH-0G0T	tape and reel
XR1015-QH-EV1	evaluation module

1. Reference Application Note M513 for reel size information.

Functional Schematic



Pin Configuration [2,3]

Pin No.	Function	Pin No.	Function
2	IF1 Output	17	Gate 4 Bias
5	IF2 Output	18	Drain 3 Bias
9	RF Input	19	Gate 3 Bias
12	Gate 1 Bias	22	LO Input
13	Drain 1 Bias	3,4,7,11,16, 20,24	Not Connected
14	Gate 2 Bias	1,6,8,10,21, 23	Ground
15	Drain 2 Bias		

2. The exposed pad centered on the package bottom must be connected to RF and DC ground.
3. It is recommended to externally ground all N/C pins.

* Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.

Electrical Specifications: 10.0-16.0 GHz (RF) (Ambient Temperature T = 25°C)

Parameter	Units	Min.	Typ.	Max.
Frequency Range (LO)	GHz	7.0	-	19.0
Frequency Range (IF)	GHz	DC	-	3.5
Conversion Gain (CG)	dB	10.0	12.0	17.0
Noise Figure (NF)	dB	-	2.5	3.3
Input Third Order Intercept (IIP3)	dBm	-7	2	-
Image Rejection	dBc	15.0	20.0	-
LO Input Drive	dBm	0.0	5.0	10.0
LO/RF Isolation	dB	-	-50.0	-
RF Input Return Loss	dB	-	10.0	-
LO Input Return Loss	dB	-	10.0	-
IF Return Loss	dB	-	10.0	-
Drain Bias Voltage (Vd1,2,3)	VDC	3.7	4.0	4.0
Gate Bias Voltage (Vg1,2,3)[4]	VDC	-1.5	-0.3	-0.1
Gate Bias Voltage (Vg4)[5]	VDC	-3.8	-3.0	-2.0
Supply Current (Id1)	mA	-	30	-
Supply Current (Id2)	mA	-	60	-
Supply Current (Id3)	mA	-	80	-
Supply Current (Ig4)	mA	-	1.5	-

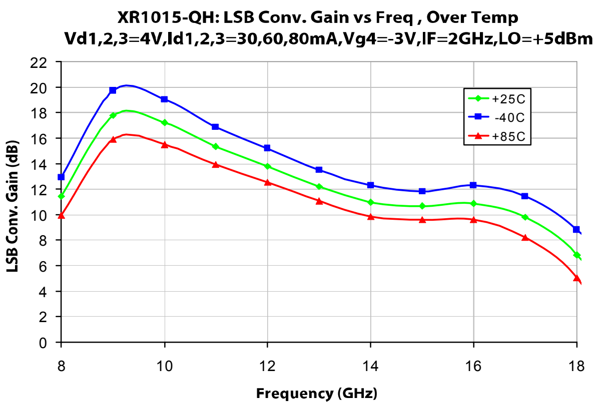
4. Vg1,2 and 3 are adjusted to achieve constant drain current regulation.
5. Vg4 provides mixer bias and is fixed at –3.0V.

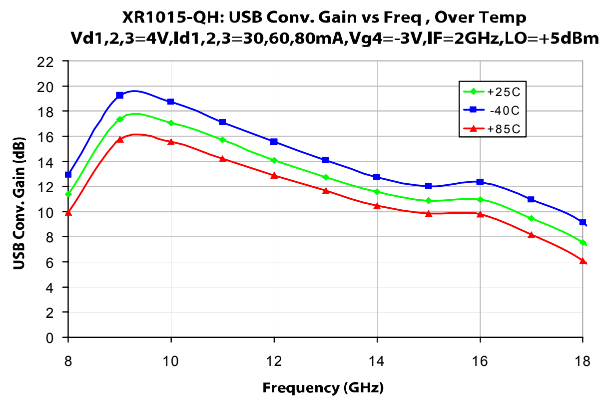
Absolute Maximum Ratings [6,7]

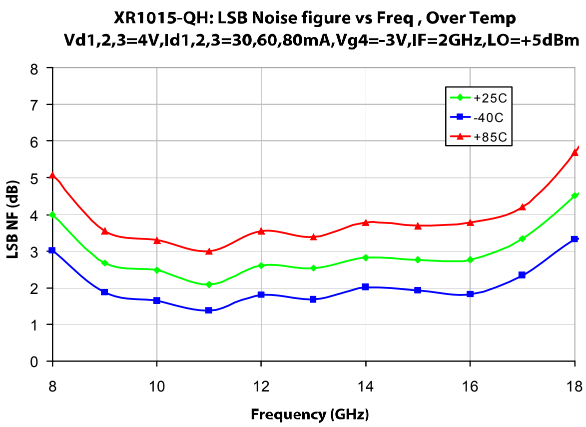
Parameter	Absolute Max.
Supply Voltage (Vd1,2,3)	+4.3 V
Supply Current (Id1,2,3)	200 mA
Gate Bias Voltage (Vg1,2,3)	-1.7 V min., 0 V max.
Gate Bias Voltage (Vg4)	-4 V
Input Power (RF)	+10 dBm
LO Input Power (LO)	+12 dBm
Storage Temperature (Tstg)	-65°C to +150°C
Operating Temperature (Ta)	-55°C to +85°C
Channel Temperature (Tch)	-40ºC to MTTF Graph
ESD-Machine Model	Class A
ESD-Human Body Model	Class 1A
Moisture Sensitivity Level	MSL3

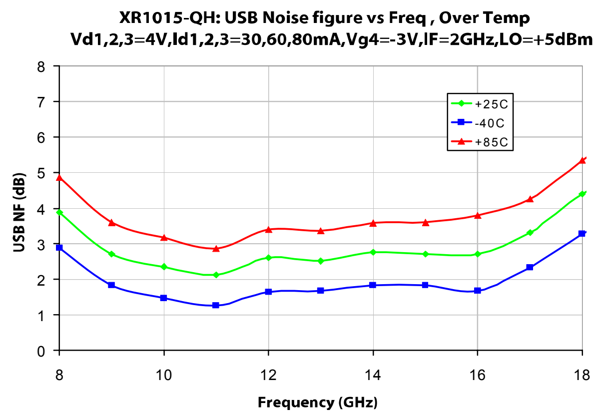
6. Operation of this device above any one of these parameters may cause permanent damage.
7. Channel temperature directly affects a device’s MTTF. Channel temperature should be kept as low as possible to maximize lifetime.

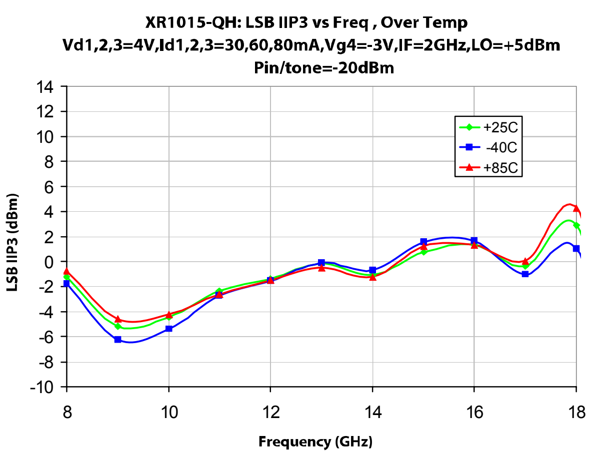
Typical Performance Curves

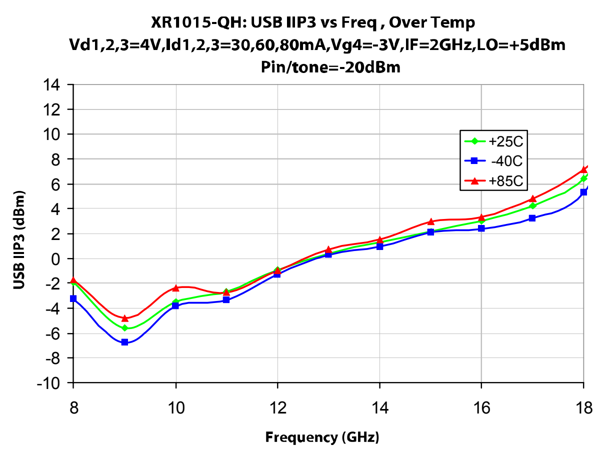




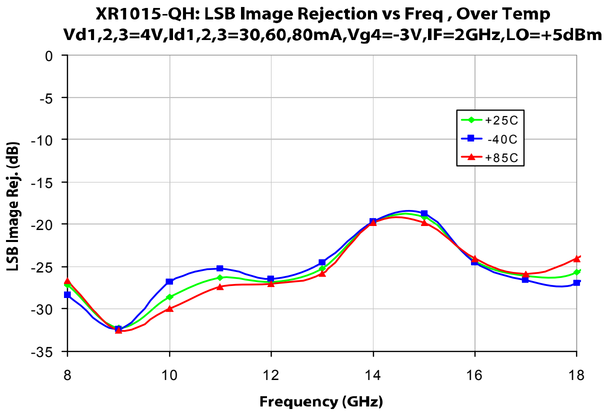


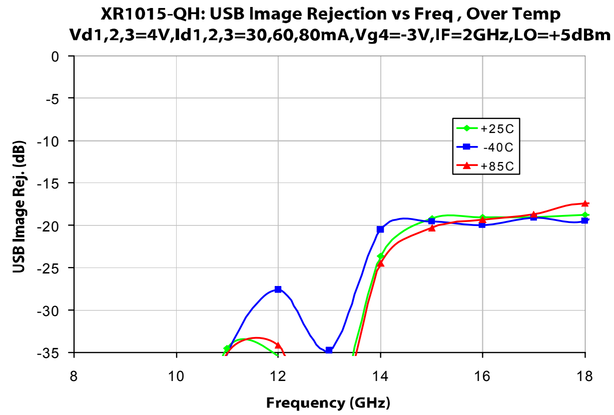


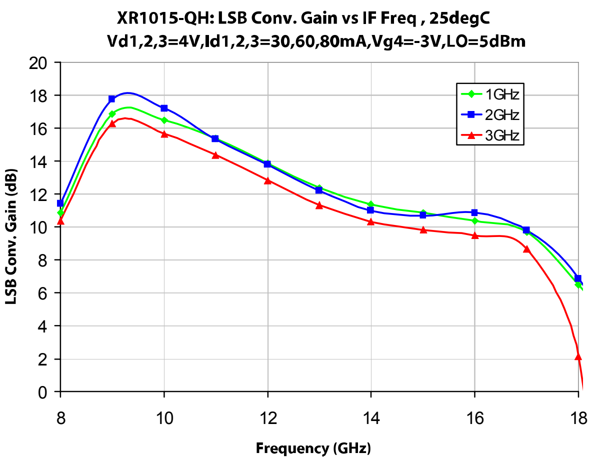


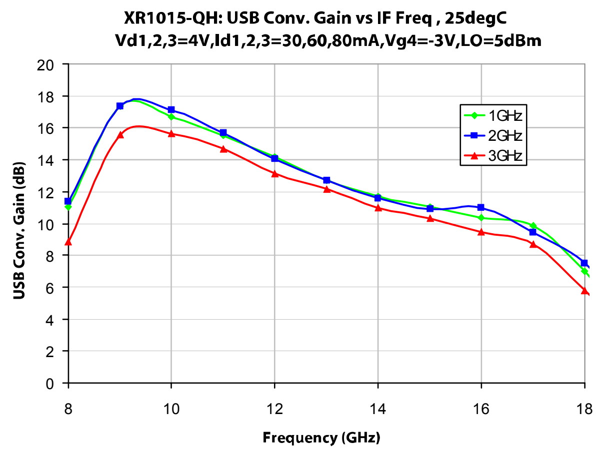


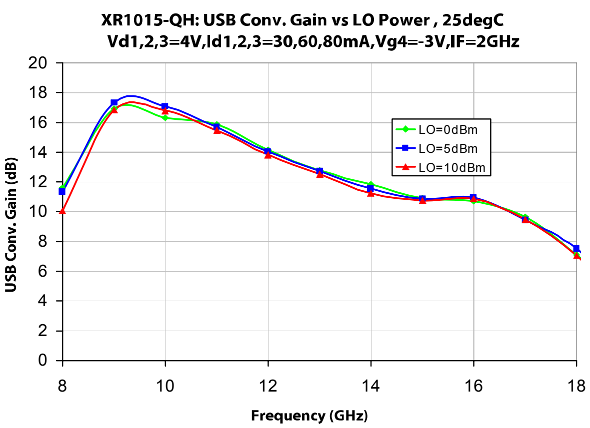
Typical Performance Curves (cont.)

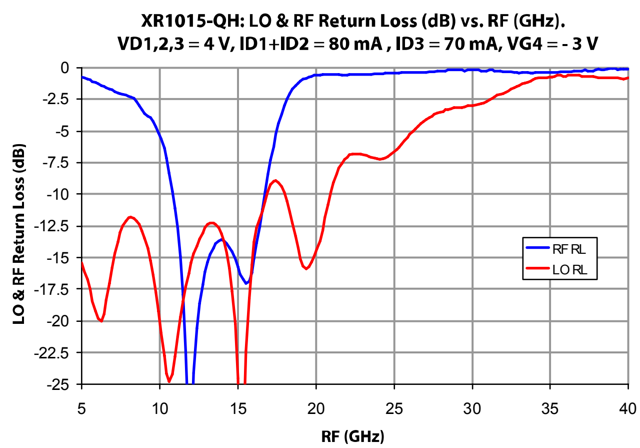






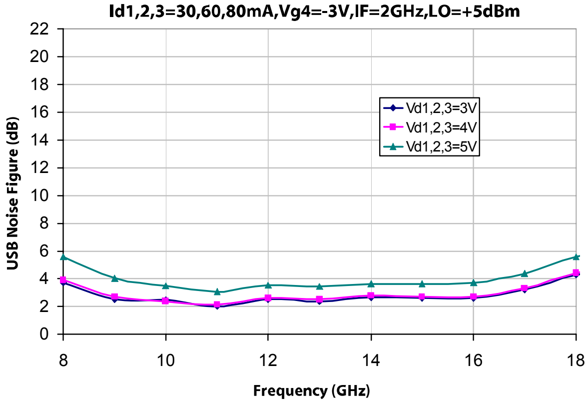




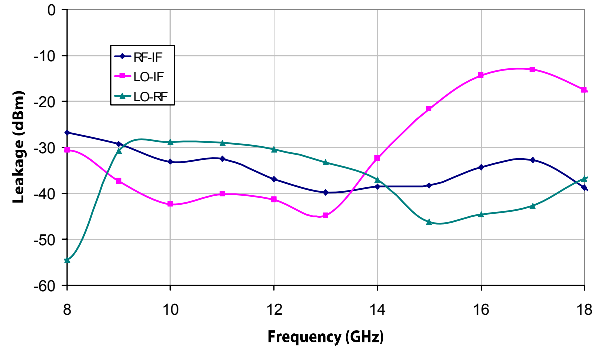


Typical Performance Curves (cont.)

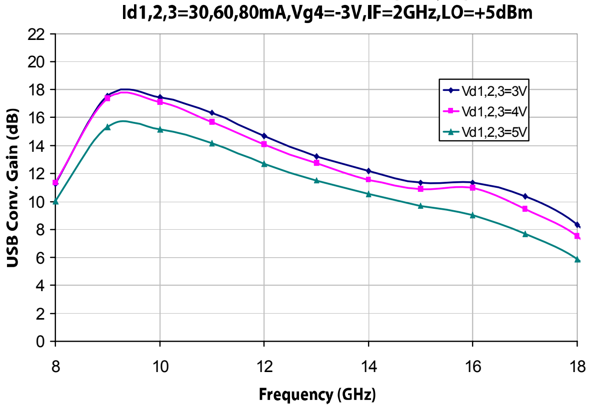
XR1015-QH: USB Noise Figure vs Freq, Varying Vd1,2,3
Id1,2,3=30,60,80mA,Vg4=-3V,IF=2GHz,LO=+5dBm



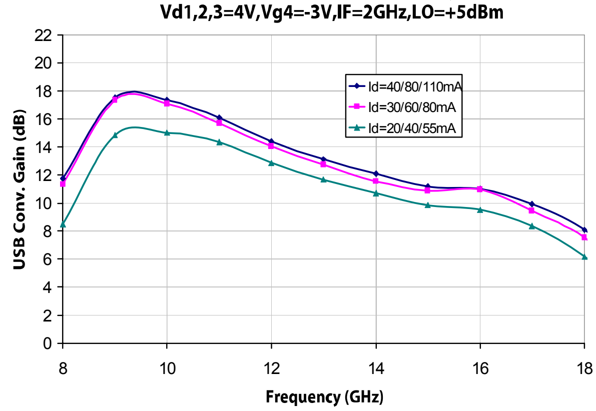
XR1015-QH: Port Leakage vs Freq
Vd1,2,3=4V,Id1,2,3=30,60,80mA,Vg4=-3V,IF=2GHz
LO=+5dBm,Pin=-20dBm



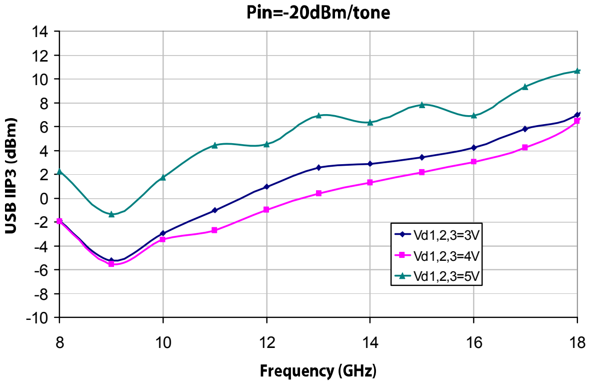
XR1015-QH: USB Conv. Gain vs Freq, Varying Vd1,2,3
Id1,2,3=30,60,80mA,Vg4=-3V,IF=2GHz,LO=+5dBm



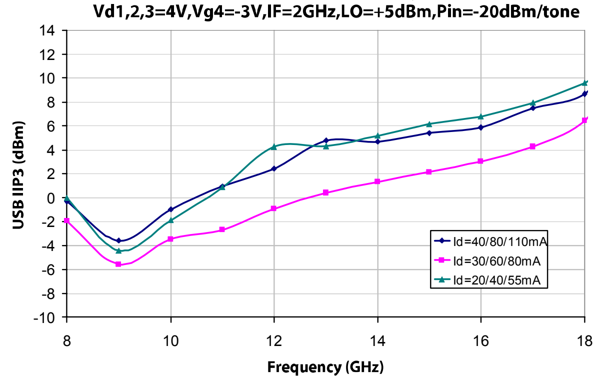
XR1015-QH: USB Conv. Gain vs Freq, Varying Id1,2,3
Vd1,2,3=4V,Vg4=-3V,IF=2GHz,LO=+5dBm



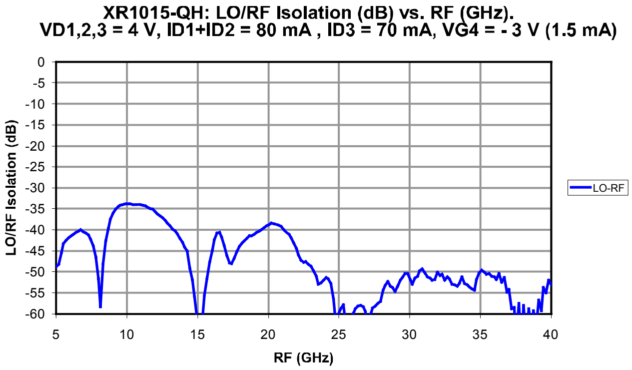
XR1015-QH: USB IIP3 vs Freq, Varying Vd1,2,3
Id1,2,3=30,60,80mA,Vg4=-3V,IF=2GHz,LO=+5dBm
Pin=-20dBm/tone



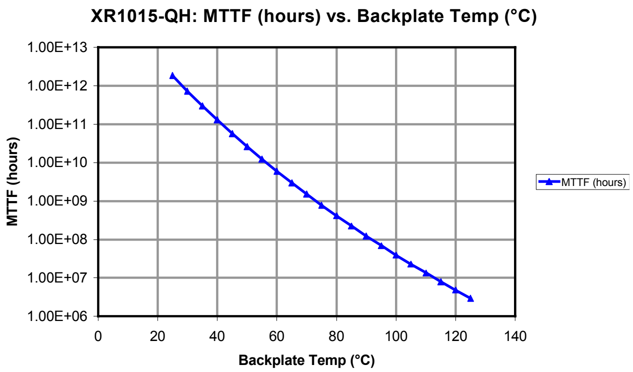
XR1015-QH: USB IIP3 vs Freq, Varying Id1,2,3
Vd1,2,3=4V,Vg4=-3V,IF=2GHz,LO=+5dBm,Pin=-20dBm/tone



Typical Performance Curves (cont.)



MTTF



MTTF is calculated from accelerated life-time data of single devices and assumes an isothermal back-plate.

MxN Spurious Tables

		nLO				
		0	1	2	3	4
mRF	0	-	-32	-42	-48	-55
	1	-26	0	-28	-56	-66
	2	-62	-50	-13	-13	-50
	3	-64	-65	-56	-28	0
	4	-71	-56	-49	-43	-33

RF=10 GHz @ -10 dBm
LO=8 GHz @ +5 dBm

Data measured without 90deg hybrid
All values in dBc below IF power level

		nLO				
		0	1	2	3	4
mRF	0	-	-40	-35	-55	-57
	1	-27	0	-58	-62	-71
	2	-59	-45	-17	-55	-64
	3	-67	-65	-35	-35	-65
	4	-77	-64	-55	-17	-45

RF=10 GHz @ -10 dBm
LO=12 GHz @ +5 dBm

Data measured without 90deg hybrid
All values in dBc below IF power level

		nLO				
		0	1	2	3	4
mRF	0	-	-31	-28	-56	-
	1	-28	0	-63	-62	-80
	2	-81	-63	-20	-65	-78
	3	-	-78	-71	-48	-69
	4	-	-	-	-78	-69

RF=16 GHz @ -10 dBm
LO=14 GHz @ +5 dBm

Data measured without 90deg hybrid
All values in dBc below IF power level

		nLO				
		0	1	2	3	4
mRF	0	-	-18	-42	-	-
	1	-26	0	-53	-58	-
	2	-64	-62	-17	-66	-77
	3	-	-74	-62	-43	-68
	4	-	-	-76	-68	-67

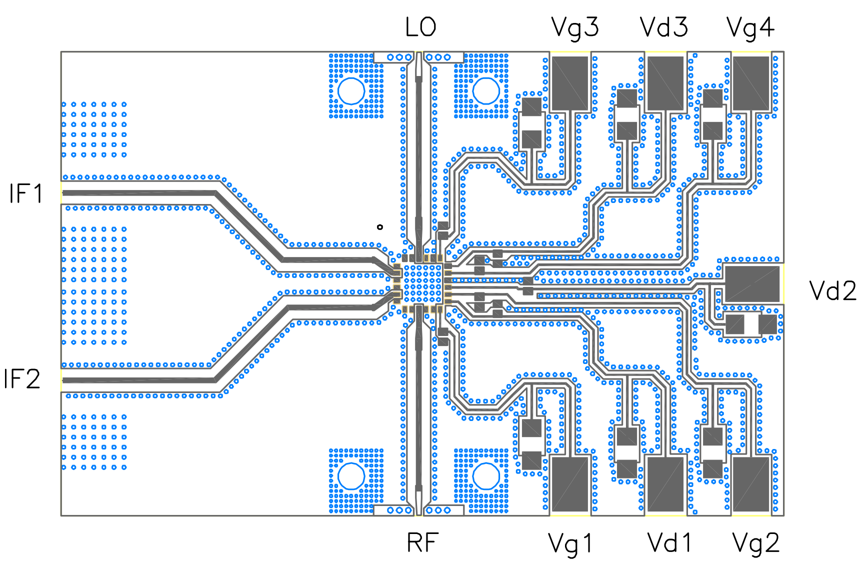
RF=16 GHz @ -10 dBm
LO=18 GHz @ +5 dBm

Data measured without 90deg hybrid
All values in dBc below IF power level

App Note [1] Biasing - As shown in the Pin Designations table, the device is operated by biasing VD1,2,3 at 4.0V with 30, 60, 80mA respectively. Additionally, a fixed voltage bias of -3V is required for mixer bias. It is recommended to use active bias to keep the currents constant in order to maintain the best performance over temperature. Depending on the supply voltage available and the power dissipation constraints, the bias circuit may be a single transistor or a low power operational amplifier, with a low value resistor in series with the drain supply used to sense the current. The gate of the pHEMT is controlled to maintain correct drain current and thus drain voltage. The typical gate voltage needed to do this is -0.3V. Make sure to sequence the applied voltage to ensure negative gate bias is available before applying the positive drain supply.

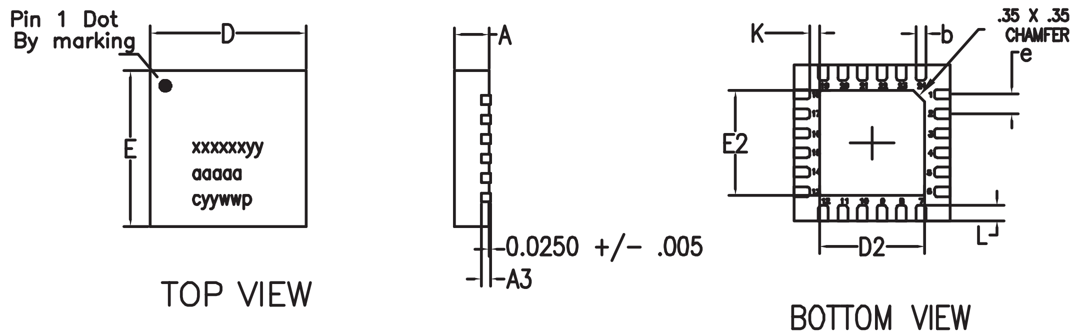
App Note [2] Board Layout - As shown in the board layout, it is recommended to provide 100pF decoupling caps as close to the bias pins as possible, with additional 10 µF decoupling caps.

Recommended Board Layout



Recommended Decoupling Capacitors: 100pF 0402,
10µF 0805
Recommend to externally ground all N/C pins

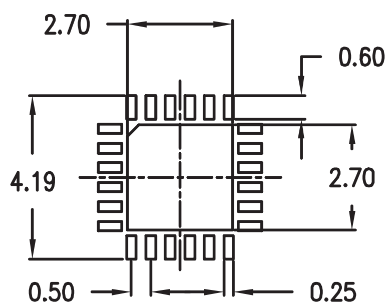
Lead-Free 4 mm 24-Lead PQFN†



MARKINGS:
PIN 1/BOM REV/Pb FREE SYM
MIMIX PART/MODEL NO.
WAFER LOT NUMBER
DATE CODE

NOTES:
1. DIMENSIONS ARE IN MM.

RECOMMENDED SOLDER PAD PITCH AND DIMENSIONS



	MIN	TYP	MAX
A	0.80	0.90	1.00
A3		0.20 REF	
b	0.20	0.25	0.30
K	0.20	–	–
D		4.00 BSC	
E		4.00 BSC	
e		0.50	
D2	2.45	2.60	2.75
E2	2.45	2.60	2.75
L	0.20	0.30	0.40

1. VIEWS ARE NOT TO SCALE: USE DIMENSIONS AND TABLE.

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Plating is 100% matte tin over copper.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.