

# 37.0-40.0 GHz Up-Converter QFN, 4x4mm

March 2010 - Rev 25-Mar-10

## Features

- X Integrates Image Reject (Balanced) Mixer, LO Buffer, LO Doubler and RF Buffer
- X 7 dB Conversion Gain (USB)
- X -25 dBm (2x) LO Leakage (at RF Port)
- X 26 dBm Output Third Order Intercept Point (OIP3)
- X Variable Gain with Adjustable Bias
- X 4x4mm QFN Package
- X 100% RF and DC Testing



## General Description

Mimix Broadband's 37.0-40.0 GHz GaAs MMIC Integrated Up-converter that has a typical conversion gain of 7 dB, and an image rejection of greater than 15 dBc. It has been optimized for USB operation. The device includes a LO doubler and buffer, and can be tuned to give 2xLO leakage of less than -25 dBm. Variable gain regulation can be achieved by adjusting the bias, with turn-down trajectories optimized to maintain linearity and minimal 2xLO leakage over the gain control range. At full gain, an OIP3 of 26 dBm is typical. The device comes in an RoHS compliant 4x4mm QFN surface mount package offering excellent RF and thermal properties. Typical application for this device are as an up-converter stage in a linear 38GHz radio transmit lineup. They device is well suited for Millimeter-wave Point-to-Point Radio, LMDS, SATCOM and VSAT applications.

## Absolute Maximum Ratings

Supply Voltage (Vd1,2,3)	+4.3V
Drain Current (Id1+2+3)	480 mA
Gate Bias Voltage (Vg1,2,3)	-1.5V < Vg < 0V
Gate Bias Voltage (Vg4)	-4.0V min.
Input Power (IFin)	+10 dBm
LO Input Power (LOin)	+13 dBm
Storage Temperature (Tstg)	-65 to +165 °C
Operating Temperature (Ta)	-55 to +85 °C
Max. Operating Junction/Channel Temp.	150 °C
Mounting Temperature	See solder reflow profile
ESD Min. - Machine Model (MM)	Class A
ESD Min. - Human Body Model (HBM)	Class 1A
MSL Level	MSL3

## Electrical Characteristics (Ambient Temperature T = 25 °C)

Parameter	Units	Min.	Typ.	Max.
Frequency Range (RF)	GHz	37.0		40.0
Frequency Range (LO) <sup>1</sup>	GHz	16.75		20.0
Frequency Range (IF)	GHz	DC		3.5
LO Input Power (Plo)	dBm	0		6.0
Conversion Gain	dB	5.0	7.0	9.0
Image Rejection	dBc	15		
Output IP3 (OIP3)	dBm	23.0	26.0	
Spurious (2xLO) [tuned]	dBm	-25		
Spurious (1xLO)	dBm	-45		
Noise Figure (NF)	dB		18.5	
Input Return Loss (IF port)	dB		7.0	
Output Return Loss (RF Port)	dB		7.0	
LO Return Loss	dB		7.0	
Drain Bias Voltage (Vd1,2,3)	V		4.0	4.0
Drain Current (Id1)	mA		120	150
Drain Current (Id2)	mA		120	150
Drain Current (Id3)	mA		150	180
Gate Voltage (Vg4)	V		-3	
Gate Current (Ig4)	mA		7	

(1) LO frequency range limits the performance characteristics to USB only.

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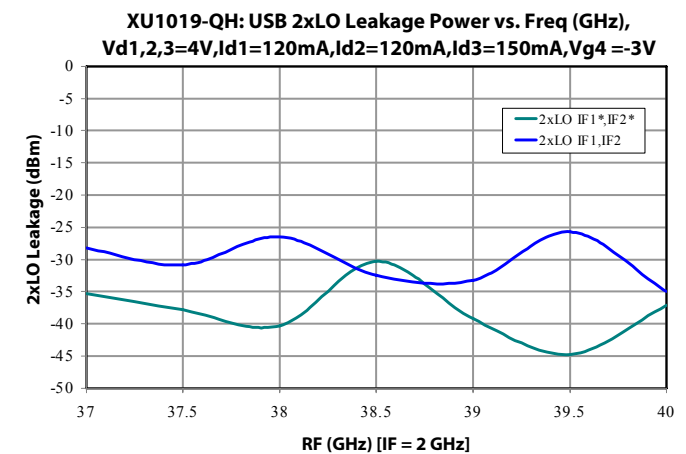
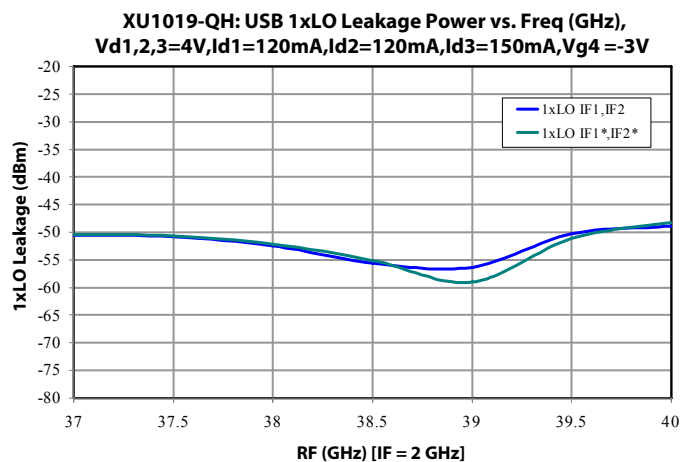
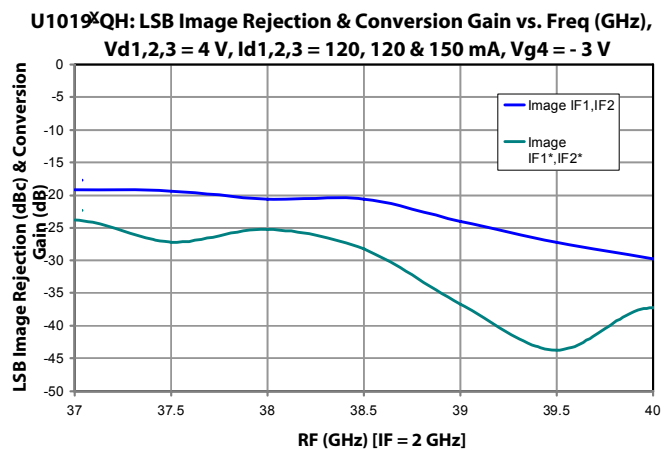
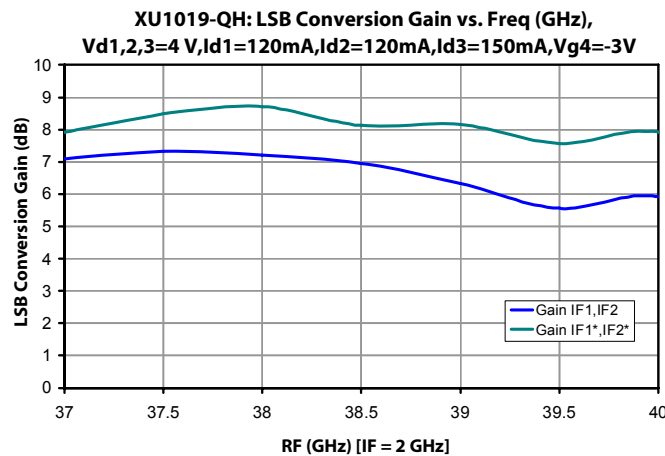
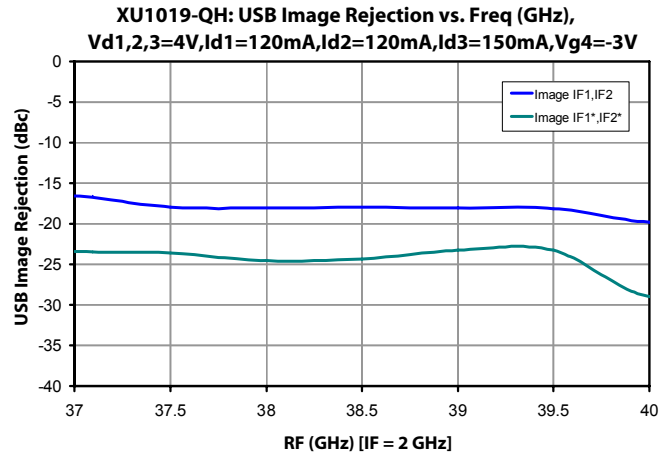
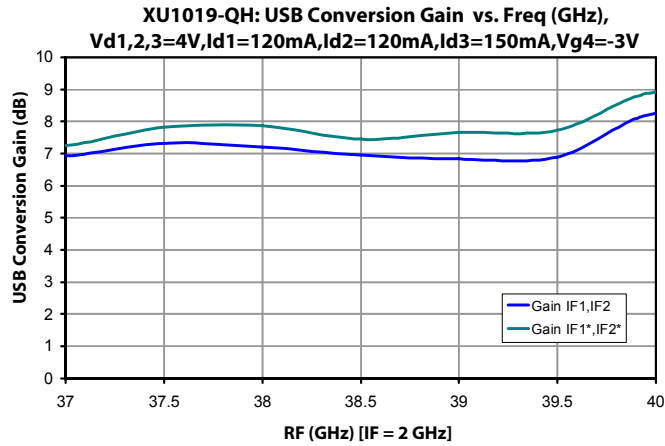
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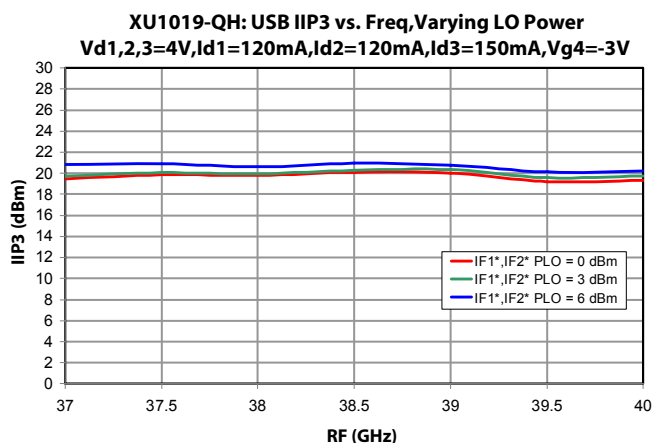
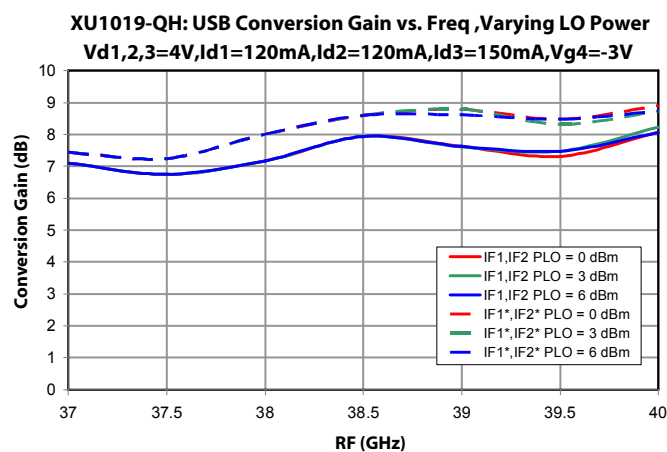
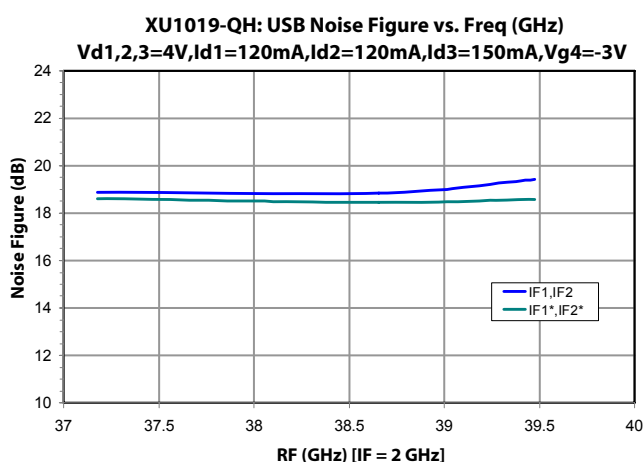
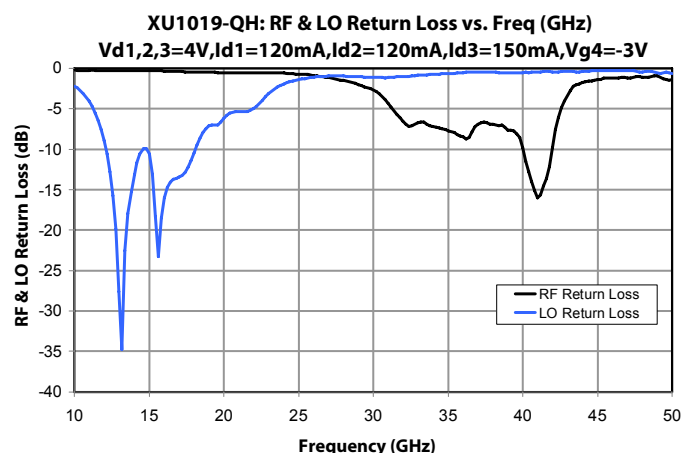
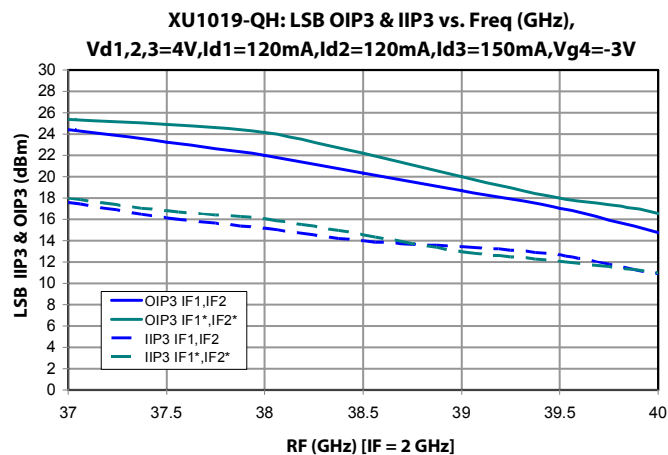
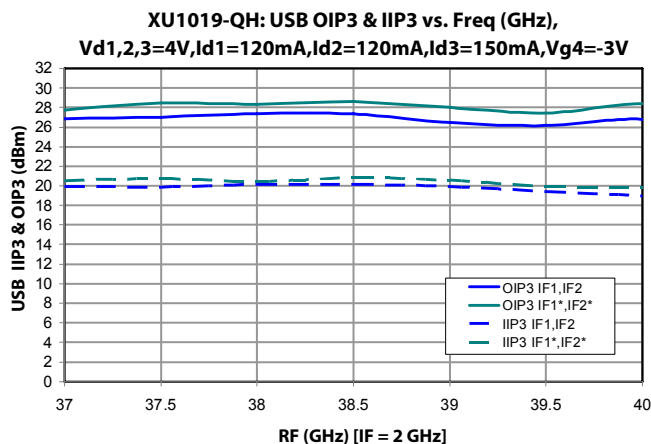
## Up-Converter Measurements



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## Up-Converter Measurements (cont.)

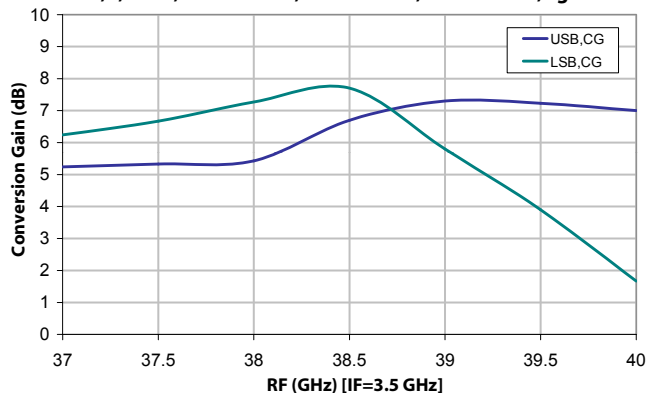


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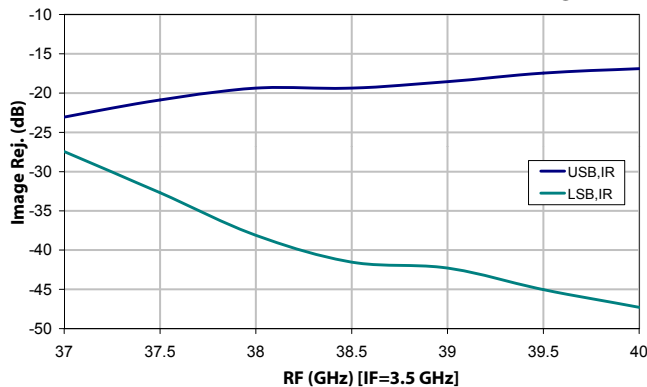
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## Up-Converter Measurements (cont.)

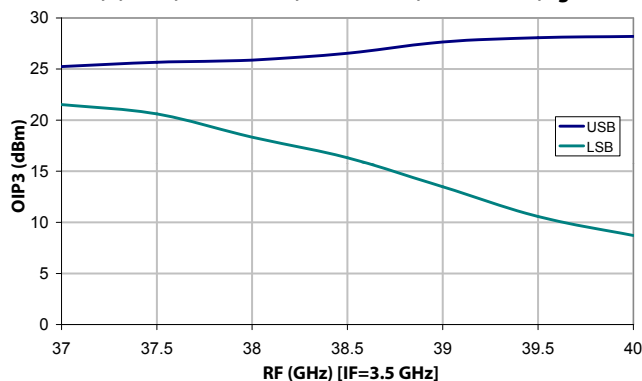
XU1019-QH: Conversion Gain vs Freq, P<sub>scl</sub>=0 dBm, IF1/IF2 used  
V<sub>d1,2,3</sub>=4V; I<sub>d1</sub>=120 mA, I<sub>d2</sub>=120 mA, I<sub>d3</sub>=150 mA, V<sub>g4</sub>=-3V



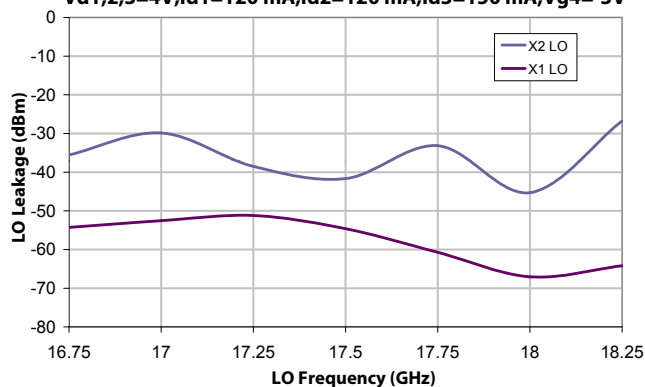
XU1019-QH: Image Rejection vs Freq, P<sub>scl</sub>=0 dBm, IF1/IF2 used  
V<sub>d1,2,3</sub>=4V; I<sub>d1</sub>=120 mA, I<sub>d2</sub>=120 mA, I<sub>d3</sub>=150 mA, V<sub>g4</sub>=-3V



XU1019-QH: OIP3 vs Freq, P<sub>scl</sub>=0 dBm, IF1/IF2 used  
V<sub>d1,2,3</sub>=4V; I<sub>d1</sub>=120 mA, I<sub>d2</sub>=120 mA, I<sub>d3</sub>=150 mA, V<sub>g4</sub>=-3V



XU1019-QH: (USB) LO Leakage vs LO Freq, P<sub>lo</sub>=3 dBm  
V<sub>d1,2,3</sub>=4V; I<sub>d1</sub>=120 mA, I<sub>d2</sub>=120 mA, I<sub>d3</sub>=150 mA, V<sub>g4</sub>=-3V

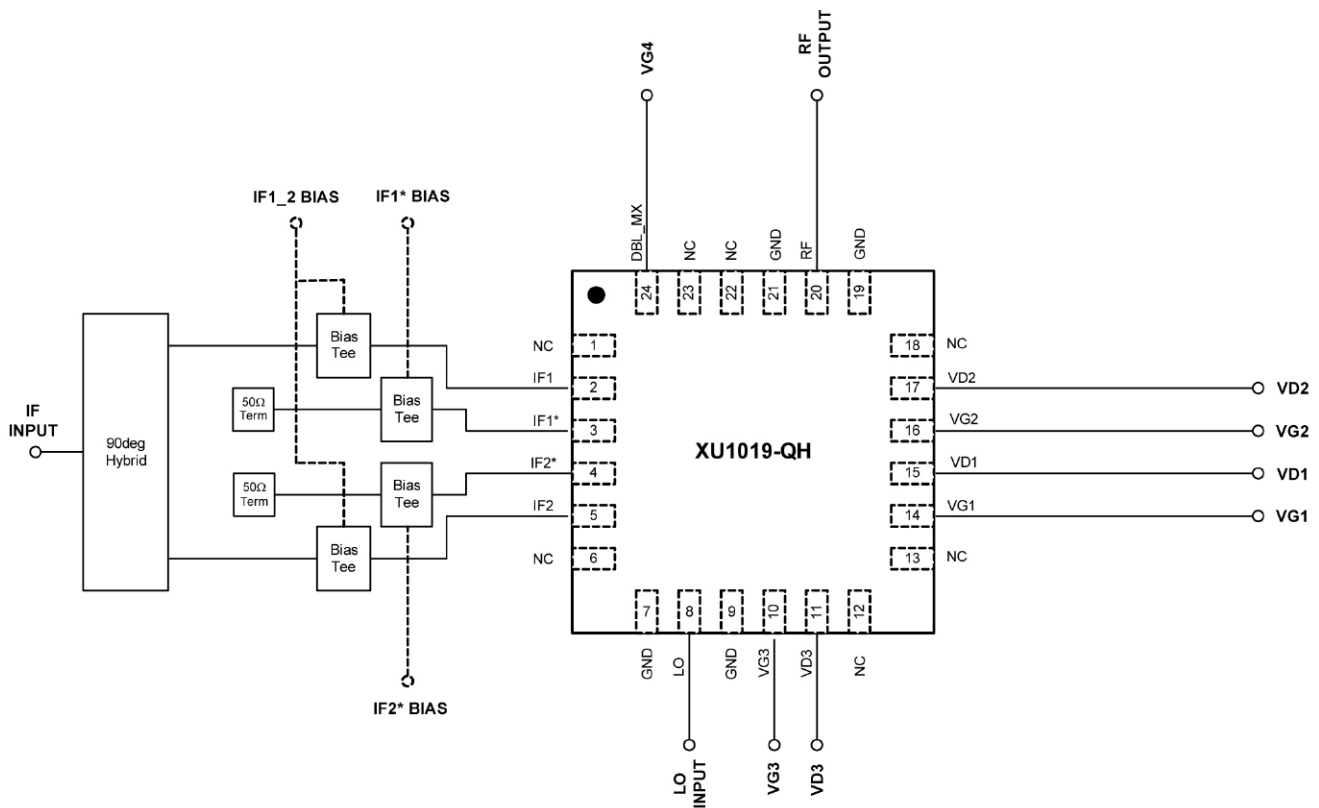


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**App Note [1] Biasing** - As shown in the Pin Designations table, the device is operated by biasing Vd1, Vd2, and Vd3 at 4.0V. The corresponding drain currents are set to 120mA, 120mA, and 150mA respectively. Vg4 requires a fixed voltage bias of nominally -3V. It is recommended to use active bias on Vg1, Vg2, Vg3 to keep the currents in Vd1, Vd2, and Vd3 constant, in order to maintain the best performance over temperature. Depending on the supply voltages available and the power dissipation constraints, the bias circuits may include a single transistor or a low power operational amplifier, with a low value resistor in series with the drain supply to sense the current. Make sure to sequence the applied voltage to ensure negative gate bias is available before applying the positive drain supply.

**App Note [2] IF1/IF2 versus IF1\*/IF2\*** - The IF input to the typical configuration is through a 90deg hybrid coupler. The hybrid splits the IF input into inphase and quadrature phase components. These two signals enter the XU1019-QH on either the IF1/IF2 pair, or the IF1\*/IF2\* complimentary pair. Which ever pair are not used must be terminated into 50 ohms. There are subtle differences between the performance when using the main IF ports (IF1,IF2) versus the complimentary ports (IF1\*, IF2\*) which are shown in the preceding performance curves. For highest gain, best image rejection and lowest noise figure, the complimentary ports (IF1\*, IF2\*) should be used.



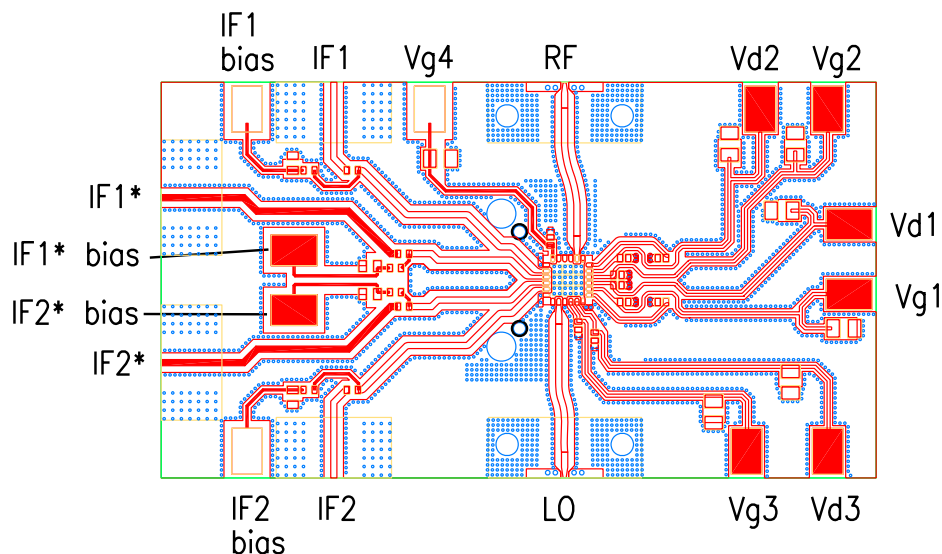
**Typical Configuration**

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**App Note [3] Board Layout** - As shown in the recommended board layout, it is recommended to provide 100pF decoupling capacitors as close to the bias pins as possible. Additional 10nF and 1uF on each of the bias lines are recommended placed a distance further away.

## Recommended Board Layout

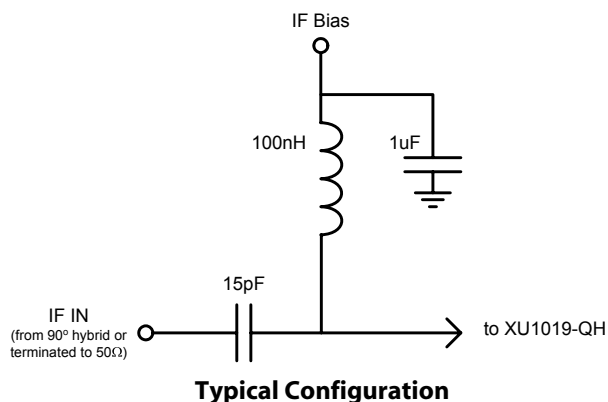


**App Note [4] IF Bias** - To obtain optimum 2xLO leakage performance, tuning is achieved by adjusting the DC bias on each of the IF inputs (IF1, IF2, IF1\*, IF2\*). DC bias is implemented by adding simple bias tees to each of the four IF ports.

The diagram below shows a typical bias tee design used.

If the IF1 and IF2 ports are used for the IF input, the IF1\* and IF2\* ports are DC biased and terminated into 50Ω. A typical tuning arrangement is to apply a fixed 0.3V DC bias to both the used IF input ports (i.e. IF1,IF2 or IF1\*,IF2\*). The remaining two IF ports which have been terminated to 50Ω tuning independently for minimum 2xLO leakage.

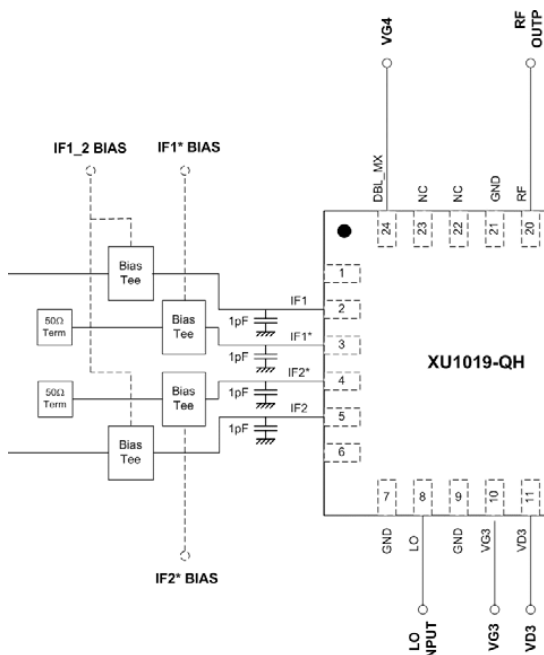
For minimum 2xLO leakage in a system, it may be necessary to correct the IF DC bias for different frequency and temperature conditions. This can be implemented by calibration and offset tables stored in memory, and used to control IF bias over all practical conditions.



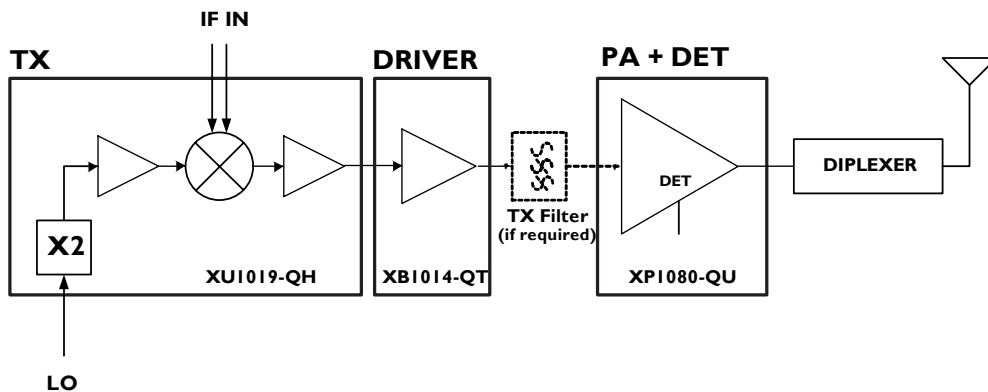
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**App Note [5] Extended IF Frequency Range** - If using the XU1019-QH using IF frequencies greater than 2 GHz, conversion gain roll-off can be minimized by placing 1pF capacitors on each of the four IF ports. The capacitors should be placed close to the package, between the bias tees and the package.



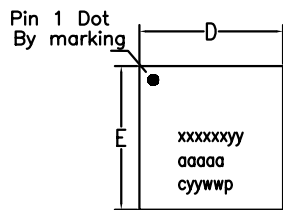
## Typical Application



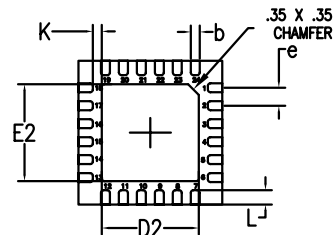
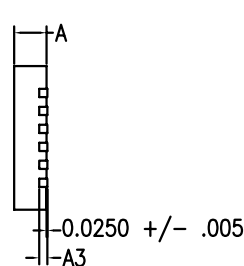
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## Package Dimensions / Layout



TOP VIEW



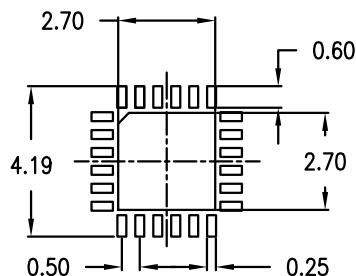
BOTTOM VIEW

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

### NOTES:

1. DIMENSIONS ARE IN MM.

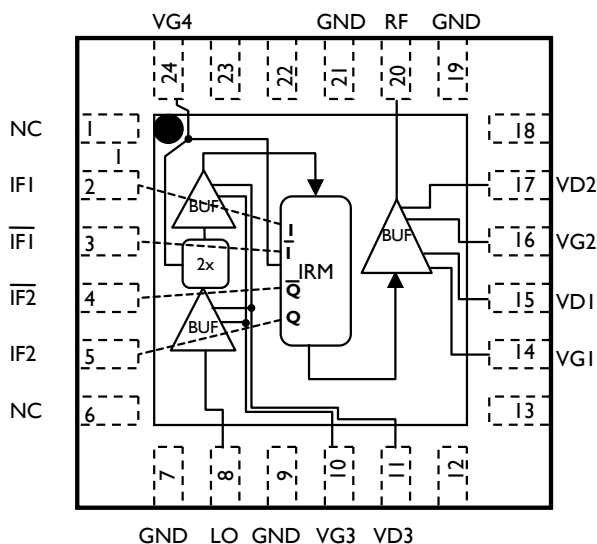
### RECOMMENDED SOLDER PAD PITCH AND DIMENSIONS



	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.

## Functional Block Diagram



## Pin Designations

Pin Number	Pin Name	Pin Function	Nominal Value
1	NC	Not Connected	Tie to GND
2	IF1	IF1 Input	DC bias fixed at 0.3V
3	IF1*	IF1* Input	DC bias tuned
4	IF2*	IF2* Input	DC bias tuned
5	IF2	IF2 Input	DC bias fixed at 0.3V
6	NC	Not Connected	Tie to GND
7	GND	GND	GND
8	LO	LO Input	
9	GND	GND	GND
10	VG3	Gate 3 Bias	~-0.2V
11	VD3	Drain 3 Bias	4.0V, 150 mA
12	NC	Not Connected	Tie to GND
13	NC	Not Connected	Tie to GND
14	VG1	Gate 1 Bias	~-0.3V
15	VD1	Drain 1 Bias	4.0V, 120 mA
16	VG2	Gate 2 Bias	~-0.3V
17	VD2	Drain 2 Bias	4.0V, 120 mA
18	NC	Not Connected	Tie to GND
19	GND	GND	GND
20	RF	RF Output	
21	GND	GND	GND
22	NC	Not Connected	Tie to GND
23	NC	Not Connected	Tie to GND
24	VG4	Gate 4 Bias	-3V, 8 mA

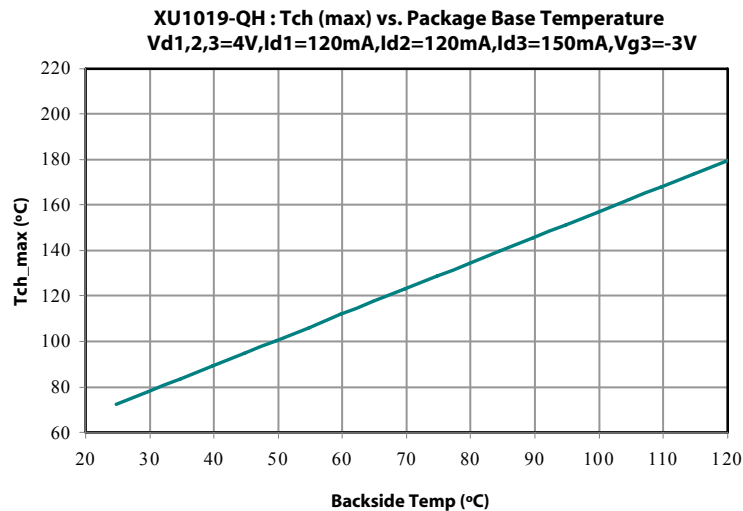
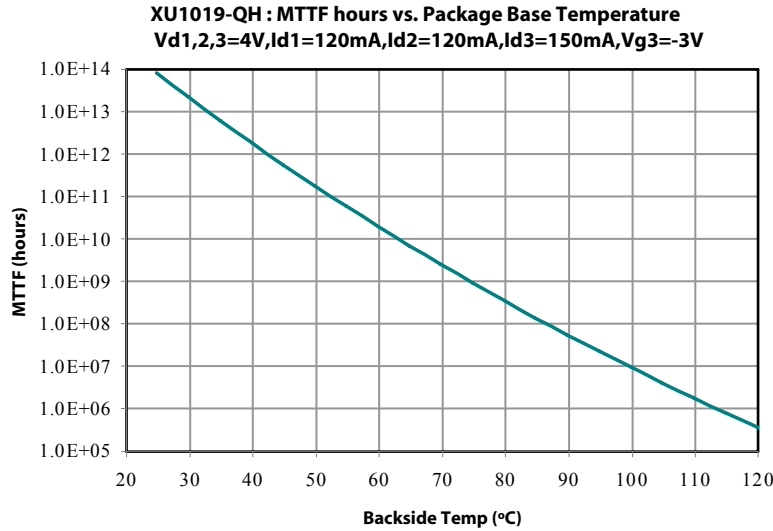


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## MTTF Graphs

These numbers were calculated based on accelerated life test information and thermal model analysis received from the fabricating foundry.



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## Handling and Assembly Information

**CAUTION!** - Mimix Broadband MMIC Products contain gallium arsenide (GaAs) which can be hazardous to the human body and the environment. For safety, observe the following procedures:

- Do not ingest.
- Do not alter the form of this product into a gas, powder, or liquid through burning, crushing, or chemical processing as these by-products are dangerous to the human body if inhaled, ingested, or swallowed.
- Observe government laws and company regulations when discarding this product. This product must be discarded in accordance with methods specified by applicable hazardous waste procedures.

**Electrostatic Sensitive Device** - Observe all necessary precautions when handling.

**Life Support Policy** - Mimix Broadband's products are not authorized for use as critical components in life support devices or systems without the express written approval of the President and General Counsel of Mimix Broadband. As used herein: (1) Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user. (2) A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

**Package Attachment** - This packaged product from Mimix Broadband is provided as a rugged surface mount package compatible with high volume solder installation. Vacuum tools or other suitable pick and place equipment may be used to pick and place this part. Care should be taken to ensure that there are no voids or gaps in the solder connection so that good RF, DC and ground connections are maintained. Voids or gaps can eventually lead not only to RF performance degradation, but reduced reliability and life of the product due to thermal stress.

### Typical Reflow Profiles

Reflow Profile	SnPb	Pb Free
Ramp Up Rate	3-4 °C/sec	3-4 °C/sec
Activation Time and Temperature	60-120 sec @ 140-160 °C	60-180 sec @ 170-200 °C
Time Above Melting Point	60-150 sec	60-150 sec
Max Peak Temperature	240 °C	265 °C
Time Within 5 °C of Peak	10-20 sec	10-20 sec
Ramp Down Rate	4-6 °C/sec	4-6 °C/sec

**Mimix Lead-Free RoHS Compliant Program** - Mimix has an active program in place to meet customer and governmental requirements for eliminating lead (Pb) and other environmentally hazardous materials from our products. All Mimix RoHS compliant components are form, fit and functional replacements for their non-RoHS equivalents. Lead plating of our RoHS compliant parts is 100% matte tin (Sn) over copper alloy and is backwards compatible with current standard SnPb low-temperature reflow processes as well as higher temperature (260°C reflow) "Pb Free" processes.

### Part Number for Ordering

XU1019-QH-0G00  
XU1019-QH-0G0T  
XU1019-QH-EV1

### Description

Matte Tin plated RoHS compliant 4x4 24L QFN surface mount package in bulk quantity  
Matte Tin plated RoHS compliant 4x4 24L QFN surface mount package in tape and reel  
XU1019-QH evaluation board



Proper ESD procedures should be followed when handling this device.

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