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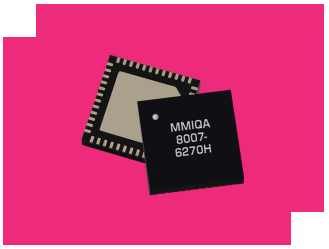
MMIQA-0626HPSM

Integrated Drive GaAs MMIC IQ Mixer

DEVICE OVERVIEW

General Description

The MMIQA-0626HPSM is a versatile, robust, and broadband IQ mixer with an integrated broadband LO driver amplifier. The MMIQA-0626HPSM is ideal for IQ, single sideband, and image reject mixing applications with wide bandwidths. The integrated LO driver amplifier allows for operation with LO powers as low as -2dBm while retaining exceptional conversion loss and linearity.



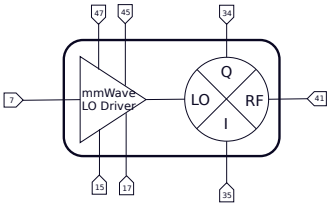
Features

RF/LO response: 6GHz - 26GHz
IF response: DC – 6GHz
I+Q Conversion Loss: 9 dB
Image Rejection: 30dBc
Minimum LO drive: -2dBm

Applications

- Single Sideband and Image Rejection Mixing
- IQ Modulation / Demodulation
- Vector Amplitude Modulation
- Band Shifting

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Green Status	Product Lifecycle	Export Classification
MMIQA-0626HPSM	Integrated Drive GaAs MMIC IQ Mixer	QFN	REACH RoHS	Released	EAR99
EVB-MMIQA-0626H	Integrated Drive GaAs MMIC IQ Mixer	EVB	REACH RoHS	Released	EAR99

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Table Of Contents

Revision History

Revision Code	Revision Date	Comment
-	2024-04-08	Datasheet Initial Release

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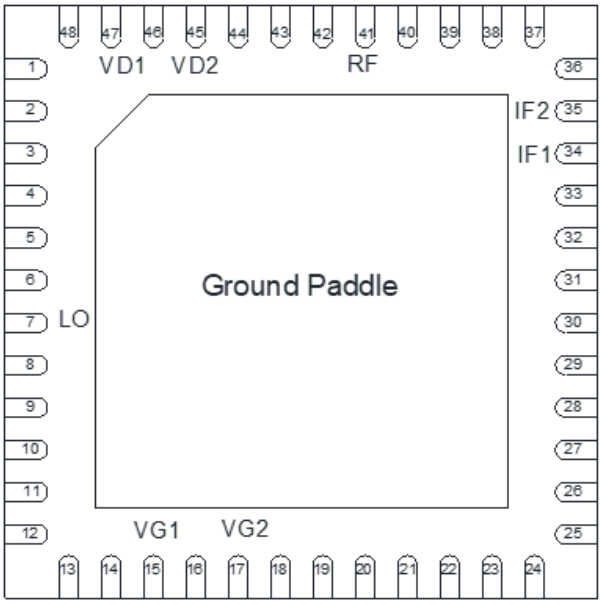
Port Configuration and Functions

Port Diagram

A top-down x-ray view of the MMIQA-0626HPSM's PSM package outline drawing is shown below. The MMIQA-0626HPSM has the input and output ports given in Port Functions.



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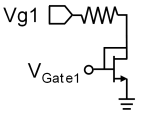
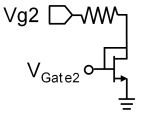
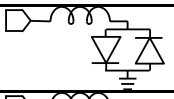
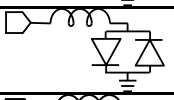
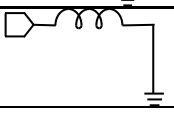
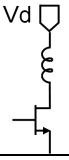
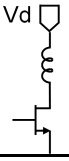
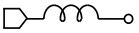
Port Functions

Port	Function	Description	Equivalent Circuit for Package
Pin 15	Vg1	Pin 15 provides bias for an internal current mirror that sets the current draw for amplifier input stage. Increasing current will increase gain at the expense of efficiency. The default series resistor (270 Ohms) is chosen to optimize gain, output power and efficiency when Vg1 and Vd1 are both tied to 5V.	
Pin 17	Vg2	Pin 17 provides bias for an internal current mirror that sets the current draw for amplifier output stage. Increasing current will increase gain at the expense of efficiency. The default series resistor (82.5 Ohms) is chosen to optimize gain, output power and efficiency when Vg2 and Vd2 are both tied to 5V.	
Pin 34	IF-1	Pin 34 is diode coupled and AC matched to 50Ω over the specified IF-1 port frequency range	
Pin 35	IF-2	Pin 35 is diode coupled and AC matched to 50Ω over the specified IF-2 port frequency range.	
Pin 41	RF	Pin 41 is DC short and AC matched to 50Ω over the specified RF frequency range.	
Pin 45	Vd2	Pin 45 is the DC supply pin for the amplifier’s output stage.	
Pin 47	Vd1	Pin 47 is the DC supply pin for the amplifier’s input stage	
Pin 7	LO Input	Pin 7 is DC open and AC matched to 50Ω over the specified LO frequency range.	

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Specifications

Absolute Maximum Ratings

The Absolute Maximum Ratings indicate limits beyond which damage may occur to the device. If any one of these limits are exceeded, the device may become inoperable or have a reduced lifetime. Reliability limits are individual, instantaneous catastrophic limits only. Functional operation limits are indicated below. Operation of the device at multiple absolute maximum limits or for extended periods at a single limit can cause degradation and damage to the device.

Parameter	Maximum Rating	Unit
Bias Current (Ig)	95	mA
Bias Voltage (Vg)	6	V
Drain Current (Id)	400	mA
Drain Supply Voltage (Vd)	6	V
Maximum Operating Temperature	85	°C
Maximum Storage Temperature	125	°C
Minimum Operating Temperature	-40	°C
Minimum Storage Temperature	-65	°C
Pin 29 DC Current (IF1)	30	mA
Pin 30 DC Current (IF2)	30	mA
Power Handling, at any Port	10	dBm

Package Information

Parameter	Details	Rating
Dimensions	-	7x7 mm

Recommended Operating Conditions

The Recommended Operating Conditions indicate the limits, inside which the device should be operated, to guarantee the performance given in Electrical Specifications Operating outside these limits may not necessarily cause damage to the device, but the performance may degrade outside the limits of the electrical specifications. For limits, above which damage may occur, see Absolute Maximum Ratings.

Parameter	Min	Nominal	Max	Unit
Positive DC Voltage	-	5	-	V
LO Input Power	-2	0	8	dBm

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Electrical Specifications

The electrical specifications apply at TA=+25°C in a 50Ω system. Typical data shown is for a down conversion application with a +0dBm LO input to the integrated LO driver amp biased at +5Vd1/+5Vd2/+5Vg1/+5Vg2 unless otherwise specified.

Parameter	Test Conditions	Minimum Frequency (GHz)	Maximum Frequency (GHz)	Min	Typ	Max	Unit
RF Frequency Range	-	-	-	6	-	26	GHz
LO Frequency Range	-	-	-	6	-	26	GHz
I Frequency Range	-	-	-	0	-	6	GHz
Q Frequency Range	-	-	-	0	-	6	GHz
Noise Figure	RF/LO = 6 - 26 GHz I = 0.091 GHz	-	-	-	12	-	dB
Noise Figure	RF/LO = 6 - 26 GHz Q = 0.091 GHz	-	-	-	12	-	dB
Input IP3	RF/LO = 6 - 26 GHz I+Q = 0.091 GHz	-	-	-	26	-	dBm
Amplitude Balance (dB)	RF/LO = 6 - 26 GHz I+Q = 0.091 GHz	-	-	-	0.5	-	dB
Conversion Loss (CL)	RF/LO = 6 - 26 GHz I = 0.01 - 6 GHz	-	-	-	12	-	dB
Conversion Loss (CL)	RF/LO = 6 - 26 GHz I+Q = 0.091 GHz	-	-	-	9	-	dB
Conversion Loss (CL)	RF/LO = 6 - 26 GHz Q= 0.01 - 6 GHz	-	-	-	12	-	dB
Image Rejection (IR)	RF/LO = 6 - 26 GHz I+Q = 0.091 GHz	-	-	-	30	-	dBc
Input P1dB, I	-	0	6	-	11	-	dBm
Input P1dB, Q	-	0	6	-	12	-	dBm
I/Q Phase Balance	RF/LO = 6 - 26 GHz I+Q = 0.091 GHz	-	-	-	5	-	°
Isolation, RF to IF	-	6	26	-	35	-	dB
LO Leakage, LO to IF	-	6	26	-	15	-	dBm
LO Leakage, LO to RF	-	6	26	-	28	-	dBm

Eval board IF and RF traces were de-embedded and LO trace power correction was applied to show the true performance of the QFN. Measured as an I/Q down converter. (i.e., I and Q powers are not combined unless otherwise stated). Mixer Noise Figure typically measures within 0.5 dB of conversion loss for IF frequencies greater than 5 MHz. Image Rejection and Single sideband performance plots are defined by the upper sideband (USB) or lower sideband (LSB) with respect to the LO signal. Plots are defined by which sideband is selected by the external IF quadrature hybrid. Typical IIP3 is measured with I and Q ports combined with an external IF quadrature hybrid coupler.

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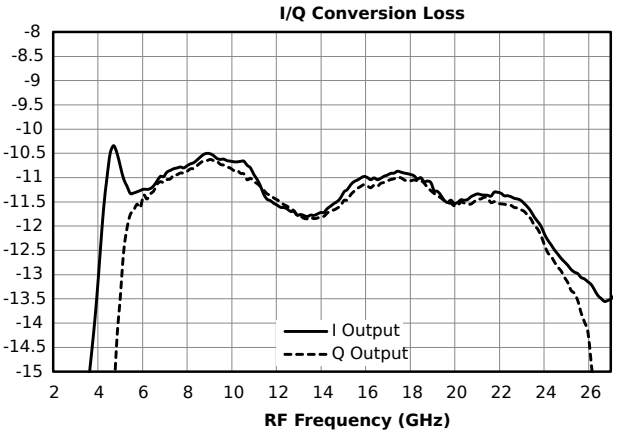
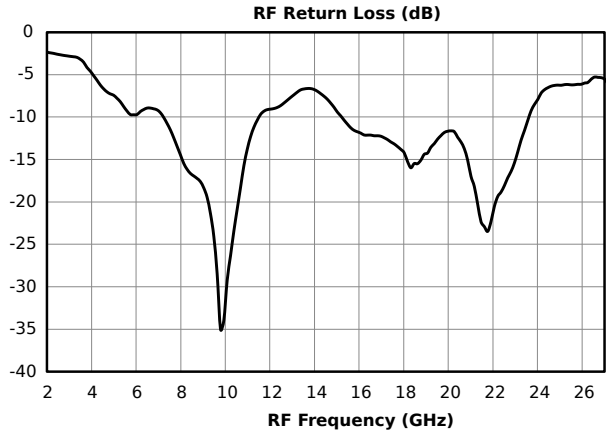
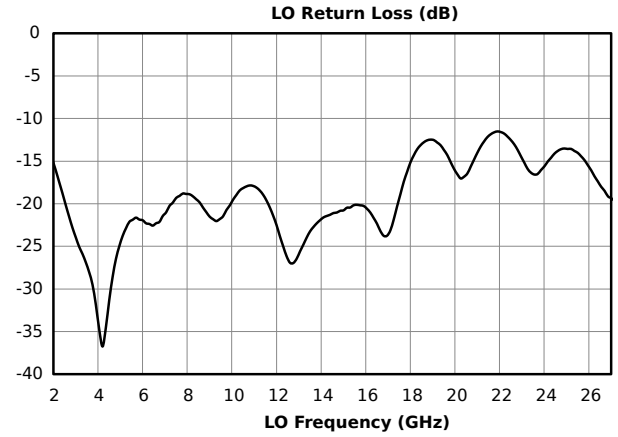
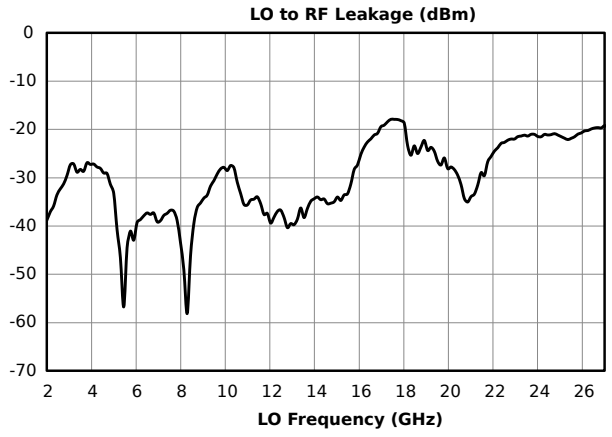
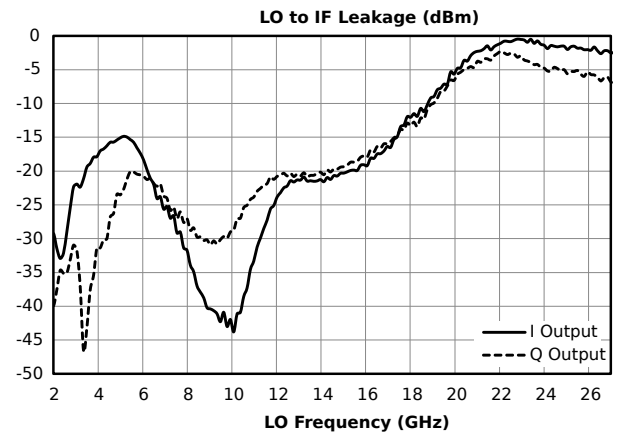
Typical Performance Plots

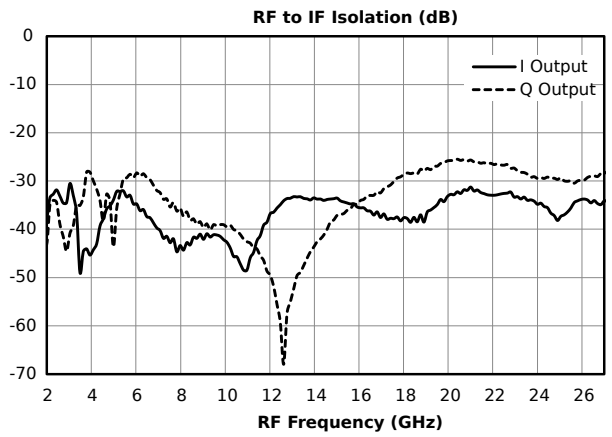


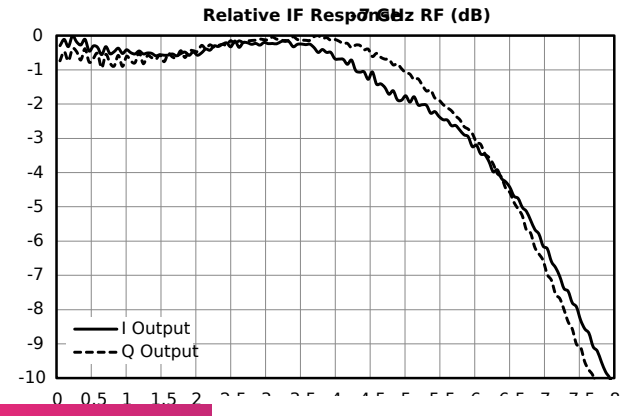


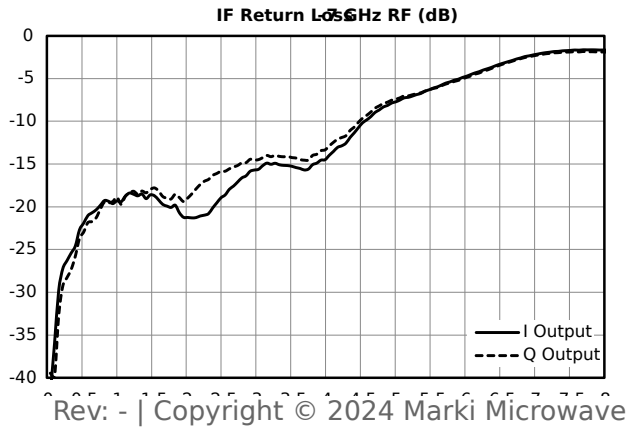












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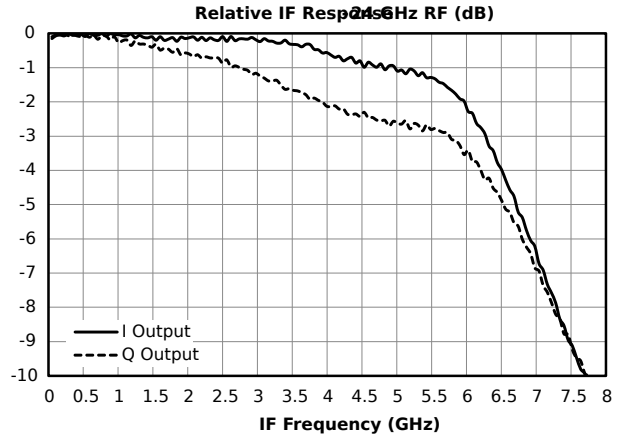

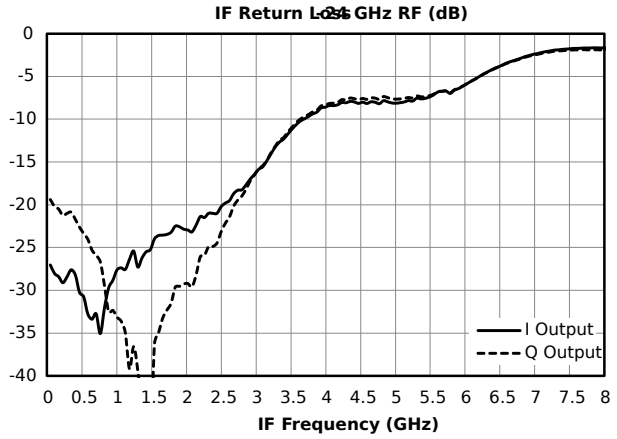

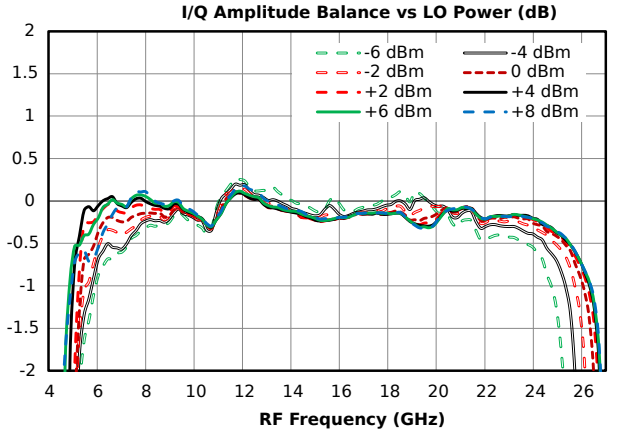

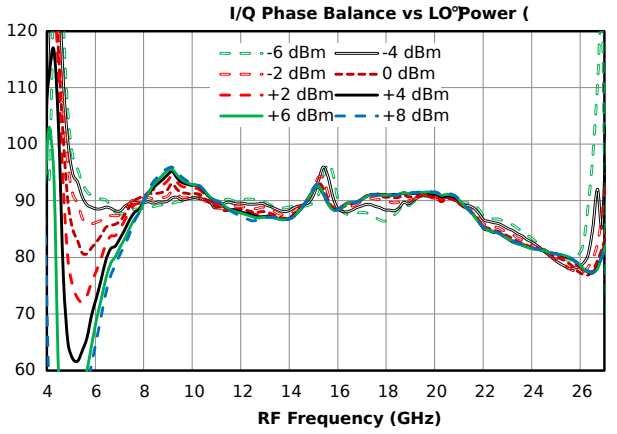

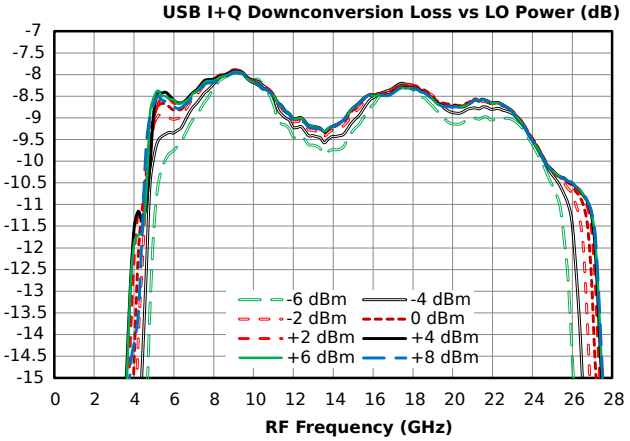

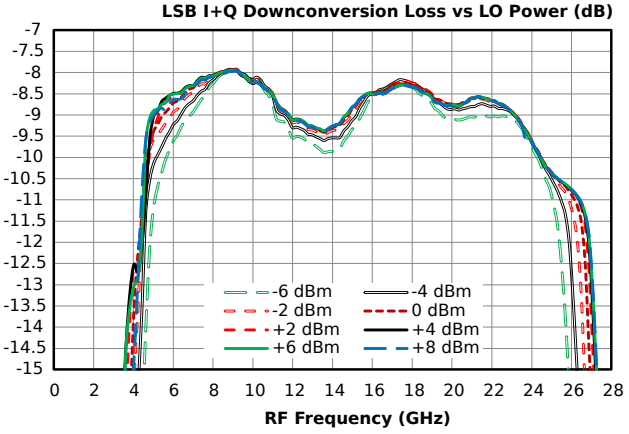

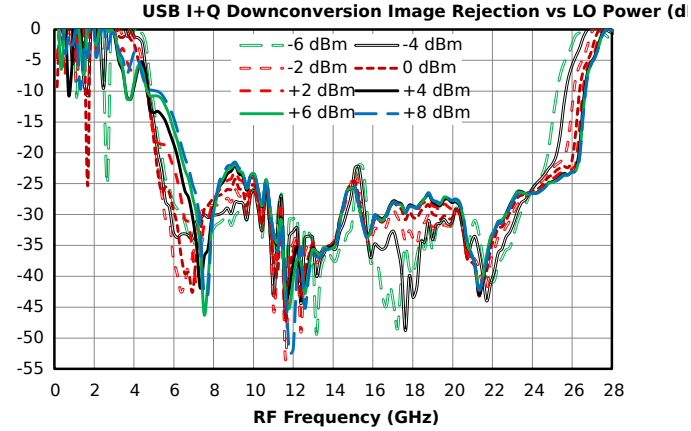

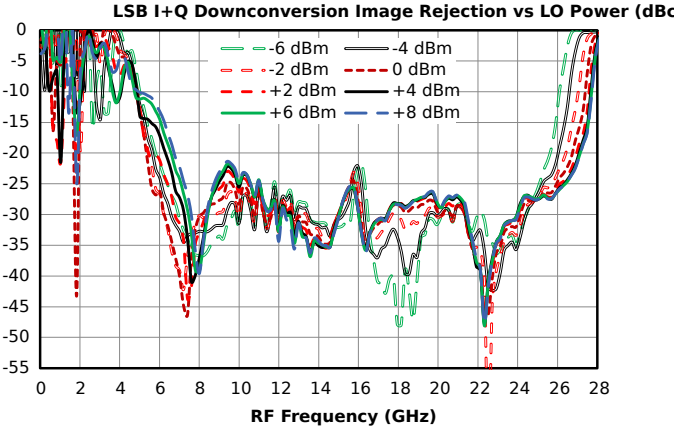

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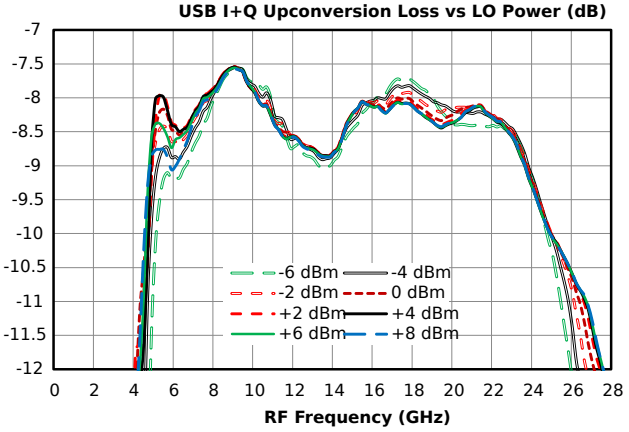
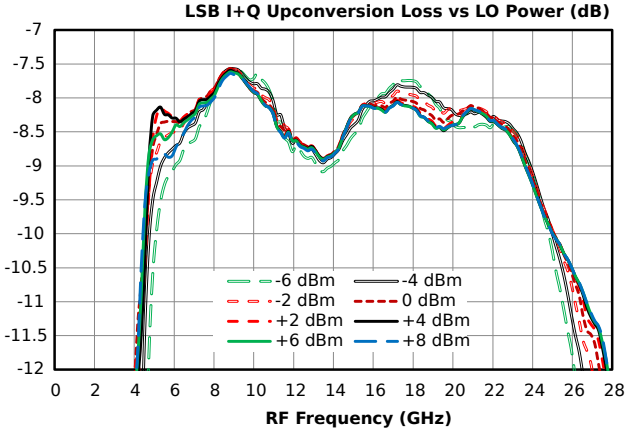
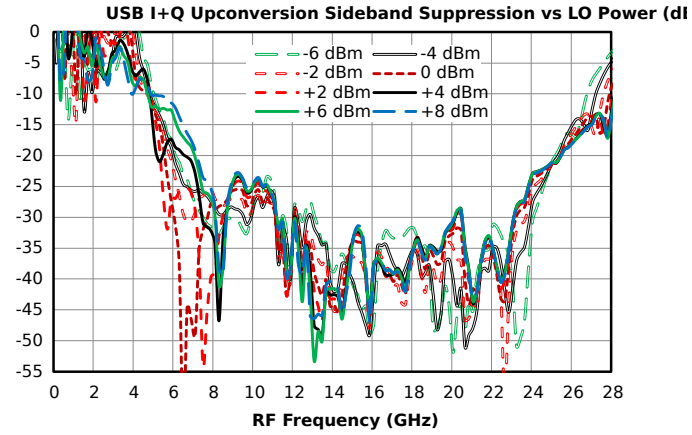
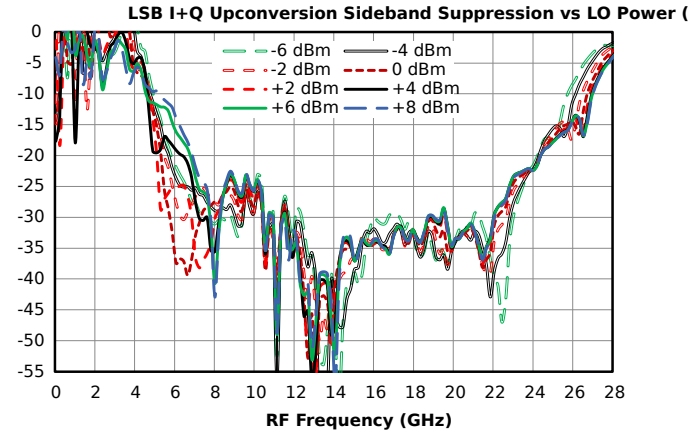
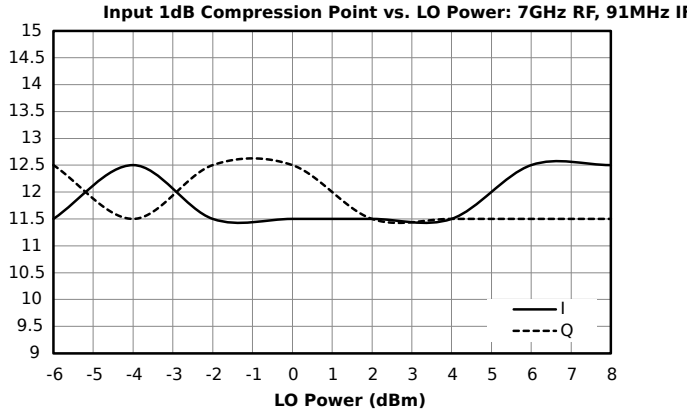
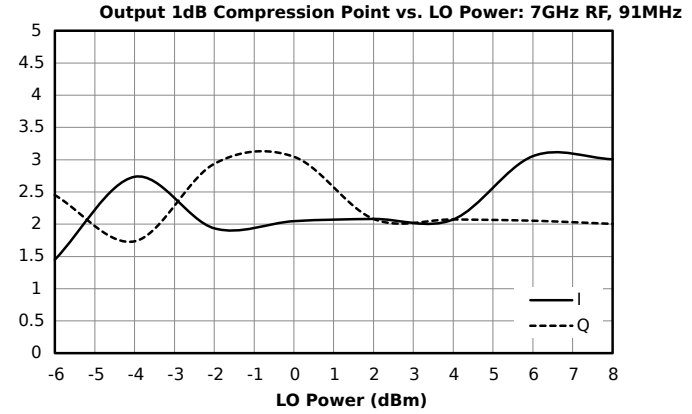




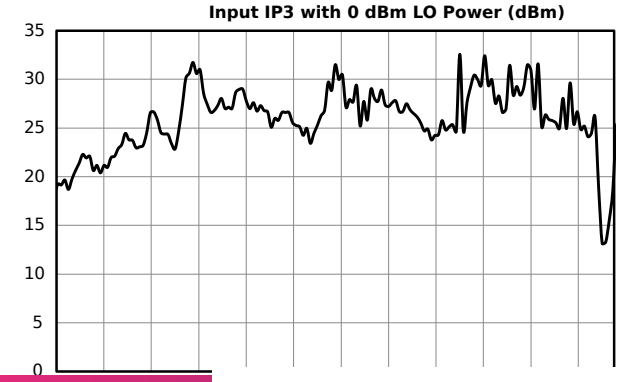


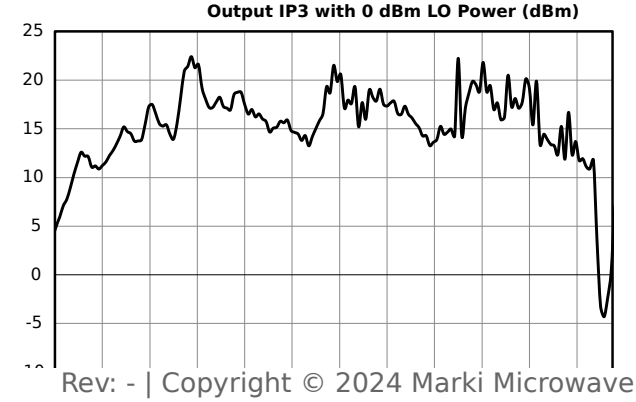






Typical Performance Plots: IP3





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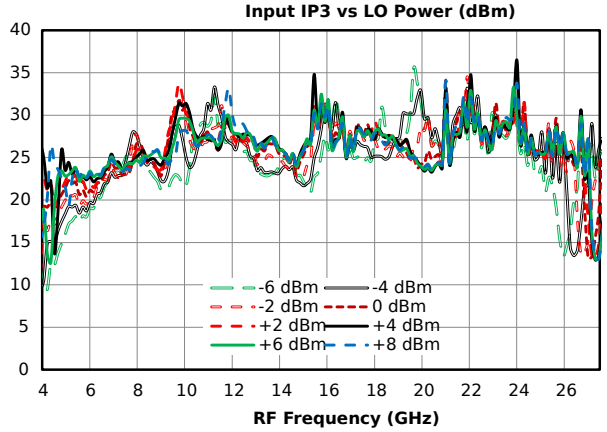
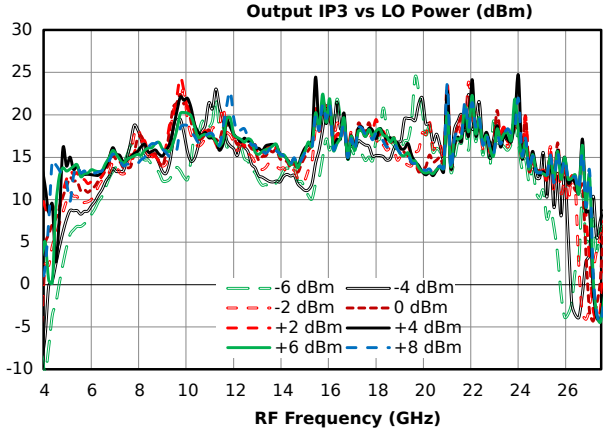
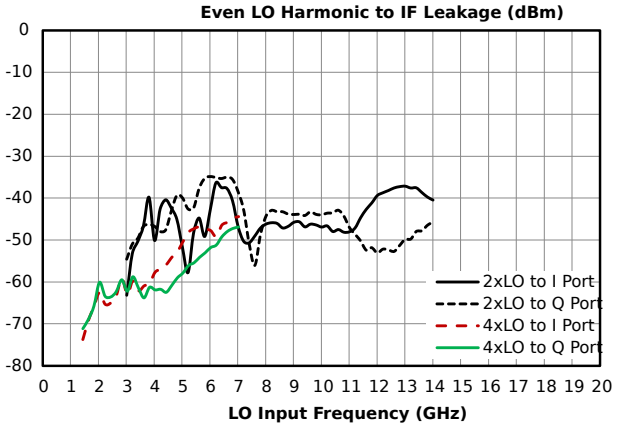
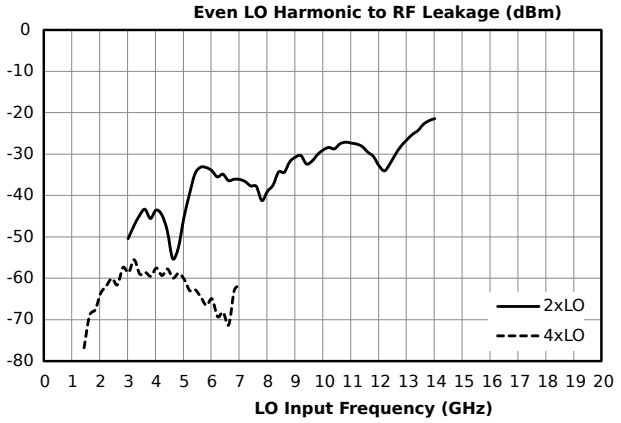
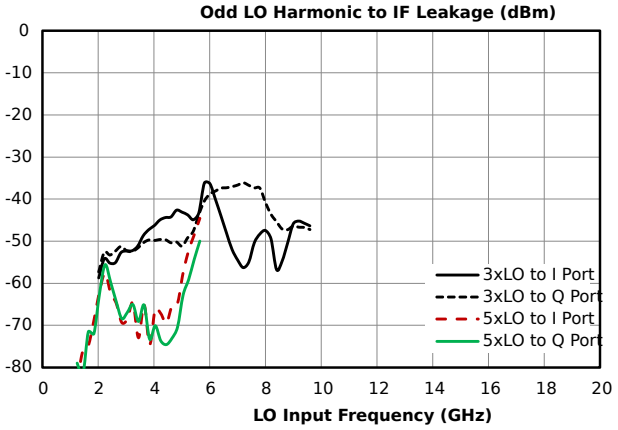


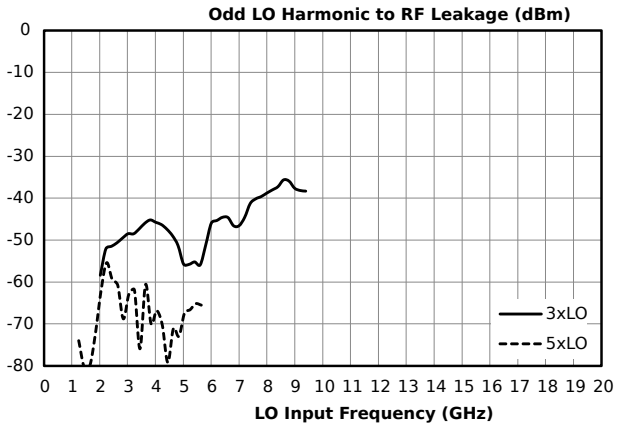


Typical Performance Plots: Harmonic Leakage









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Spur Table

Typical Spurious Performance: Down-Conversion

Typical spurious data is provided by selecting RF and LO frequencies (±m*LO± n*RF) within the RF/LO bands, to create a spurious output within the IF band. The mixer is swept across the full spurious band and the mean is calculated. The numbers shown in the table below are for a -10 dBm RF input. Spurious suppression is scaled for different RF power levels by (n-1), where “n” is the RF spur order. For example, the 2RF x 2LO spur is 74 dBc for a -10 dBm input, so a -20 dBm RF input creates a spur that is (2-1) x (-10 dB) lower, or 84 dBc.

-10 dBm RF Input	0xLO I	0xLO Q	1xLO I	1xLO Q	2xLO I	2xLO Q	3xLO I	3xLO
1xRF	-25	-19	Reference	Reference	-36	-36	-10	-7
2xRF	-79	-75	-66	-62	-74	-70	-74	-69
3xRF	-88	-84	-84	-80	-84	-83	-88	-80
4xRF	-99	-94	-95	-91	-97	-94	-97	-91
5xRF	-108	-105	-105	-102	-106	-102	-106	-10

Typical Spurious Performance: Up-Conversion

Typical spurious data is provided by selecting IF and LO frequencies (±m*LO± n*IF) within the IF/LO bands, to create a spurious output within the RF band. The mixer is swept across the full spurious band and the mean is calculated. The numbers shown in the table below are for a -10 dBm RF input. Spurious suppression is scaled for different IF power levels by (n-1), where “n” is the IF spur order. For example, the 2IF x 1LO spur is 71 dBc for a -10 dBm input, so a -20 dBm RF input creates a spur that is (2-1) x (-10 dB) lower, or 81dBc.

-10 dBm IF Input	0xLO I	0xLO Q	1xLO I	1xLO Q	2xLO I	2xLO Q	3xLO I	3xLO
1xIF	-29	-27	Reference	Reference	-34	-37	-9	-9
2xIF	-80	-80	-71	-70	-73	-73	-76	-74
3xIF	-88	-87	-86	-83	-90	-89	-82	-71
4xIF	-97	-95	-101	-104	-100	-96	-103	-10
5xIF	-108	-108	-113	-112	-110	-112	-113	-11

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Application Information

Application Information

MMIQA-0626HPSM belongs to Marki Microwave's MMIQ family of mixers with integrated LO drivers. The MMIQ product line consists of passive GaAs MMIC mixers designed and fabricated with GaAs Schottky diodes. MMIQ mixers offer excellent amplitude and phase balance due to its on-chip LO quadrature hybrid. 30dBc of image rejection (i.e., single sideband suppression) can be obtained across the operating band by using the MMIQ-0626HPSM as an image rejection or single sideband mixer. The MMIQA-0626HPSM is the sister mixer of the MMIQ-0626HPSM. The MMIQA-0626HPSM requires a lower LO drive to operate the mixer thanks to the integrated LO driver amplifier.

Band support for the low frequency 5G frequencies in K and Ku bands is offered by the ultra-broadband performance of the mixer's RF and LO ports. Direct baseband to Ka band frequency conversions are availableby using of this mixer as an up-converter. Traditional use of this mixer to do image reject or single sideband mixing is available with an external IF quadrature hybrid.

The RF port, and the LO port, supports a 6-26GHz signal. The I and Q ports, support a DC-6 GHz signal. A signal may be input into any port of the mixer which supports that signal's frequency. This is the basis of using the mixer as a band shifter.

For a given LO power within the recommended operating range, the RF (in the case of a down conversion) or IF (in the case of an up conversion) input power should be below the input 1 dB compression point to avoid signal distortion. The input 1 dB compression point will vary across the mixer's operating bandwidth and with LO input power. Careful characterization is required for optimal performance for each application. There is no minimum small signal input power required for operation. Excessive RF/IF input power increases non-desired spurious output power and degrades the fundamental conversion loss. Excessive LO input power can also cause this effect. The table below describes how to use an IQ mixer and quad hybrid to select a single sideband.

Up Conversion		
Hybrid Port	Mixer Port	Sideband Selected
0	I	Lower Sideband
90	Q	
90	I	Upper Sideband
0	Q	
Down Conversion		
Hybrid Port	Mixer Port	Sideband Selected
0	I	Upper Sideband
90	Q	
90	I	Lower Sideband
0	Q	

Down-Converter

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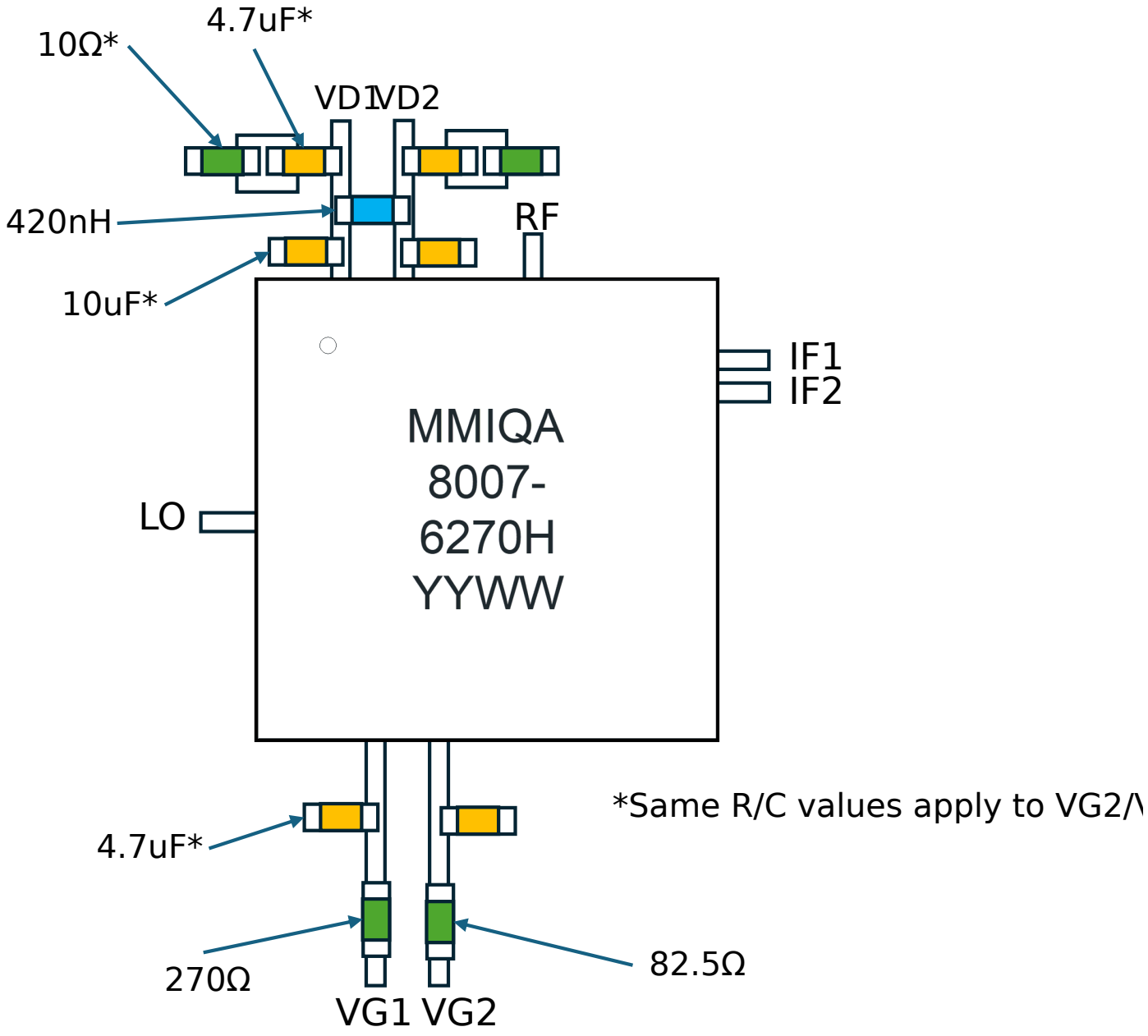
Application Circuit



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Application Circuit Description

The application circuit for the MMIQA-0626HPSM requires 10uF bypass capacitors on the drain lines near the QFN. A 420nH inductor is needed between the VD lines to provide isolation as well as an RC network to ground comprised of a 4.7uF capacitor and 10Ω resistor. The VG lines require 4.7uF bypass capacitors and series resistors of 270Ω in line with the VG supply. The current evaluation circuit is configured for single supply operation, but can be operated as dual supply by removing the 420nH inductor.

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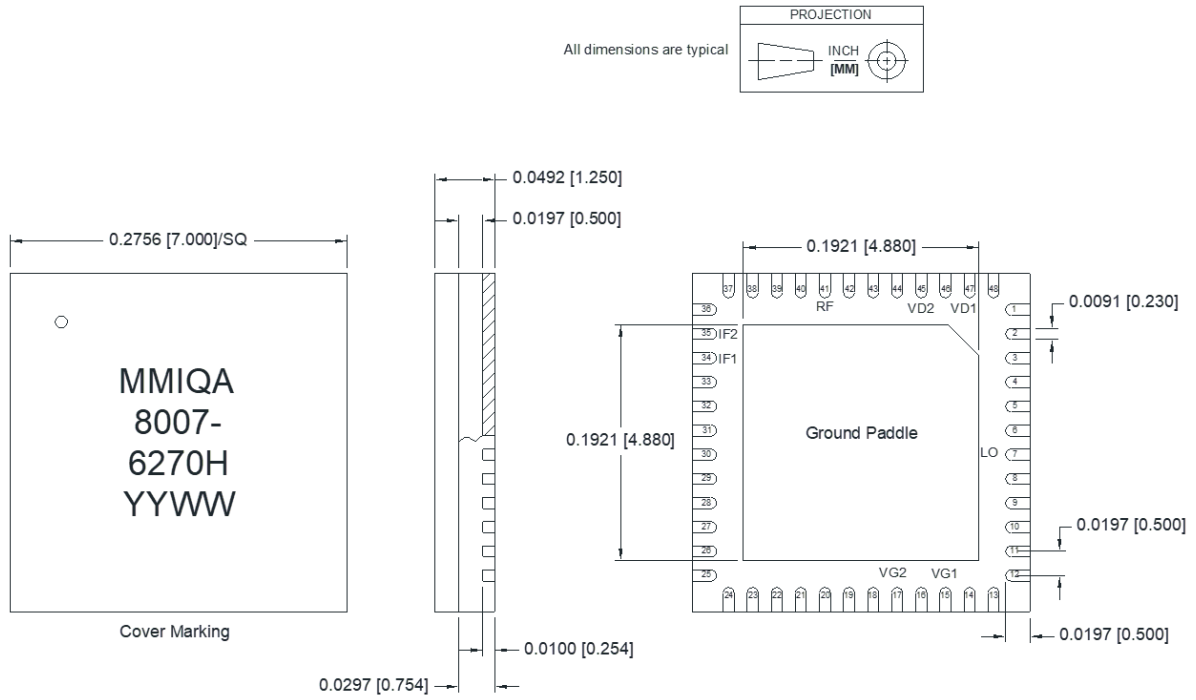
Mechanical Data

Outline Drawing

Download : Outline 2D Drawing



Pin #	Function
1	N/C
2	N/C
3	N/C
4	N/C
5	N/C
6	N/C
7	LO
8	N/C
9	N/C
10	N/C
11	N/C
12	N/C
13	N/C
14	N/C
15	VG1
16	N/C
17	VG2
18	N/C
19	N/C
20	N/C
21	N/C
22	N/C
23	N/C
24	N/C
25	N/C
26	N/C
27	N/C
28	N/C
29	N/C
30	N/C
31	N/C
32	N/C
33	N/C
34	IF1
35	IF2
36	N/C
37	N/C
38	N/C
39	N/C
40	N/C
41	RF
42	N/C
43	N/C
44	N/C
45	VD2
46	N/C
47	VD1
48	N/C

Notes (unless otherwise specified):

1. Substrate material is LCP.
2. I/O Leads and Die Paddle is (from base to finish):
   Ni: 0.5um - 2.0um
   Pd: 0.08um - 0.15um
   Au: 0.003um - 0.050um
3. All unconnected pins should be connected to PCB RF ground.

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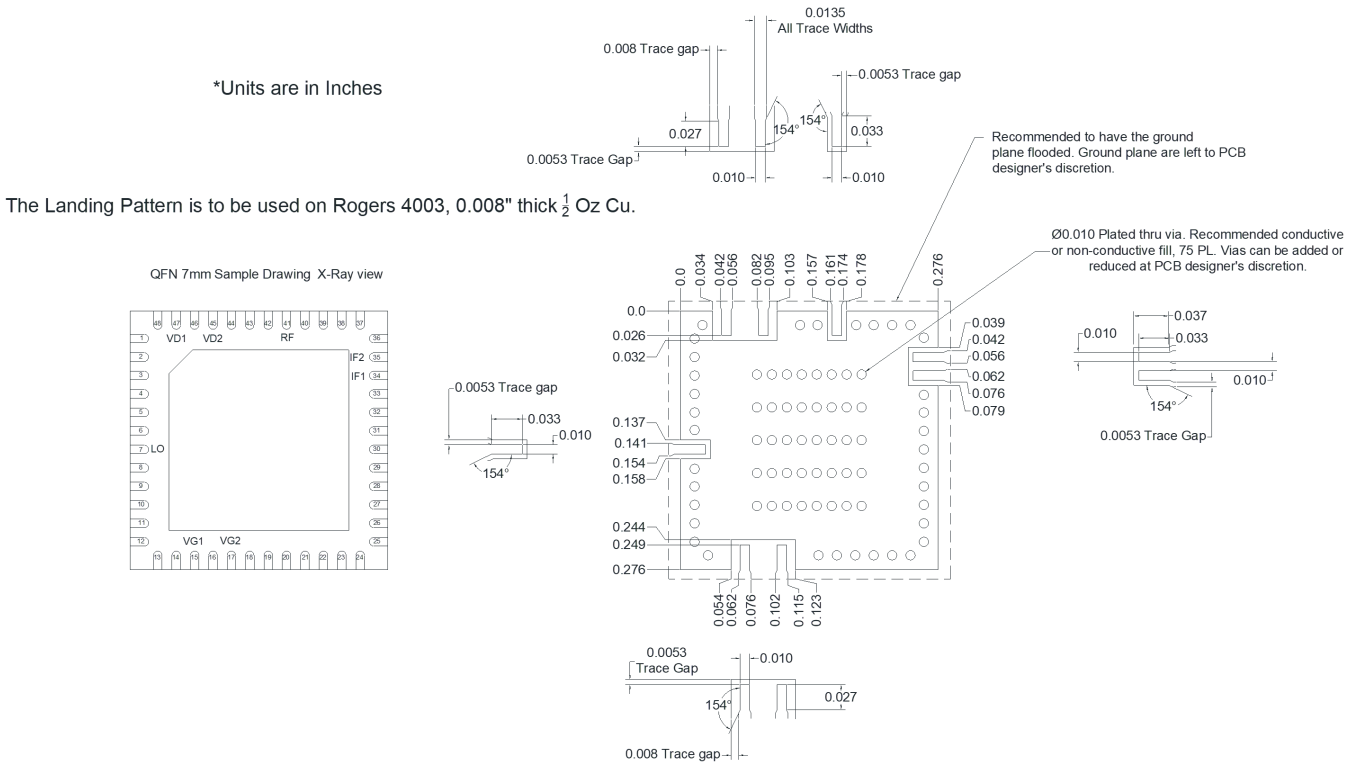
Footprint Image

Download : Footprint Drawing



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