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Tech Support: support@markimicrowave.com

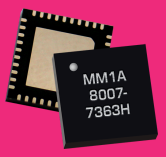
MM1A-0330HPSM

Double Balanced Mixer/LO Amplifier

DEVICE OVERVIEW

General Description

The MM1A-0330HPSM is a versatile, robust, and broadband double balanced mixer with an integrated broadband LO driver amplifier. The MM1A-0330HSM is ideal for applications with wide bandwidths and operation through the K band. The integrated LO driver amplifier allows for operation with LO powers as low as -2 dBm while retaining exceptional conversion loss and linearity.



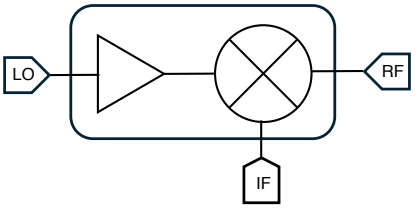
Features

RF/LO response: 3GHz - 30GHz
IF response: DC – 5GHz
Conversion Loss: 7dB
Minimum LO drive: -2dBm

Applications

- Test and Measurement Equipment
- SATCOM
- Radar
- Low LO Drive Applications

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Green Status	Product Lifecycle	Export Classification
MM1A-0330HPSM	Double Balanced Mixer/LO Amplifier	QFN	REACH RoHS	Released	EAR99
EVB-MM1A-0330H	Evaluation Board, Integrated Drive GaAs MMIC Mixer	EVB	REACH RoHS	Released	-

Table Of Contents

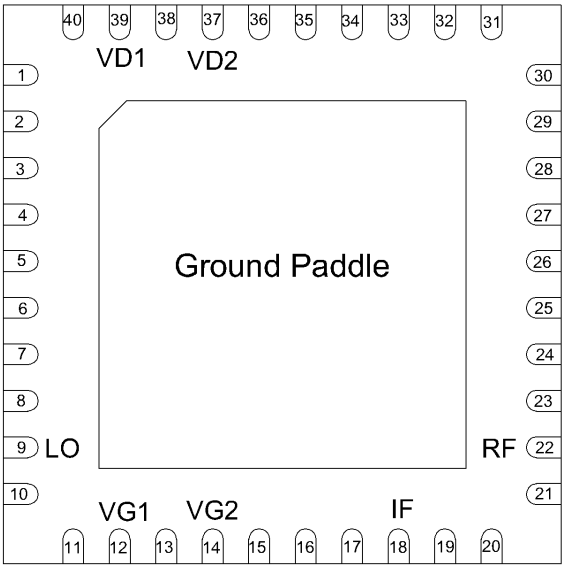
Revision History

Revision Code	Revision Date	Comment
-	2024-12-10	Initial Release

Port Configuration and Functions

Port Diagram

A top-down x-ray view of the MM1A-0330HPSM's PSM package outline drawing is shown below. The MM1A-0330HPSM has the input and output ports given in Port Functions.



Port Functions

Port	Function	Description	Equivalent Circuit for Package
Pin 12	Vg1	Pin 12 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 14	Vg2	Pin 14 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 18	IF	Pin 18 is diode coupled and AC matched to 50Ω over the specified IF port frequency range.	-
Pin 22	RF Input / Output	Pin 22 is DC short and AC matched to 50Ω over the specified RF frequency range.	-
Pin 37	Vd2	Pin 37 is the DC supply pin for the amplifier's output stage.	-
Pin 39	Vd1	Pin 39 is the DC supply pin for the amplifier's input stage.	-
Pin 9	LO Input	Pin 9 is DC open and AC matched to 50Ω over the specified LO frequency range.	-

Specifications

Absolute Maximum Ratings

The Absolute Maximum Ratings indicate limits beyond which damage may occur to the device. If these limits are exceeded, the device may be inoperable or have a reduced lifetime. All Absolute Maximum Ratings are individual and should not be met in parallel.

Parameter	Maximum Rating	Unit
Bias Current (Ig1+Ig2)	95	mA
Bias Voltage (Vg1,Vg2)	6	V
Drain Current (Id1+Id2)	400	mA
Drain Supply Voltage (Vd1,Vd2)	6	V
Maximum Operating Temperature	85	°C
Maximum Storage Temperature	125	°C
Minimum Operating Temperature	-40	°C
Minimum Storage Temperature	-65	°C
Pin 18 DC Current (RF)	15	mA
Power Handling, at any Port	15	dBm

Package Information

Parameter	Details	Rating
Dimensions	-	6 x 6 mm
Moisture Sensitivity Level	-	MSL 1

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
LO Input Power	-2	0	8	dBm
Power Supply DC Voltage (Vg1,Vg2)	-	5	-	V
Power Supply DC Current (Ig1+Ig2) (No RF Input)	11	19	23	mA
Power Supply DC Current (Id1+Id2) (No RF Input)	121	218	259	mA
Positive DC Voltage (Vd1, Vd2)	-	5	-	V
Ambient Temperature	-40	25	85	°C

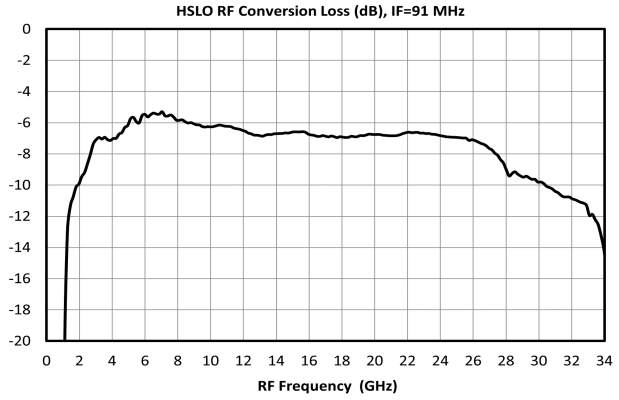
Electrical Specifications

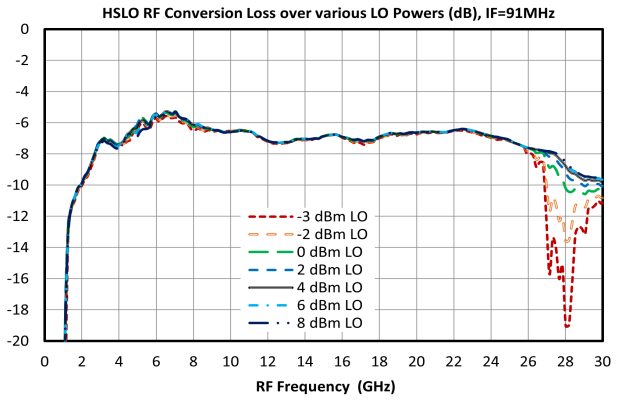
The electrical specifications apply at TA=+25°C in a 50Ω system. Typical data shown is for a down conversion application with a +4dBm LO input to the integrated LO driver amp biased at Vd1=Vd2=Vg1=Vg2=+5V unless otherwise specified.

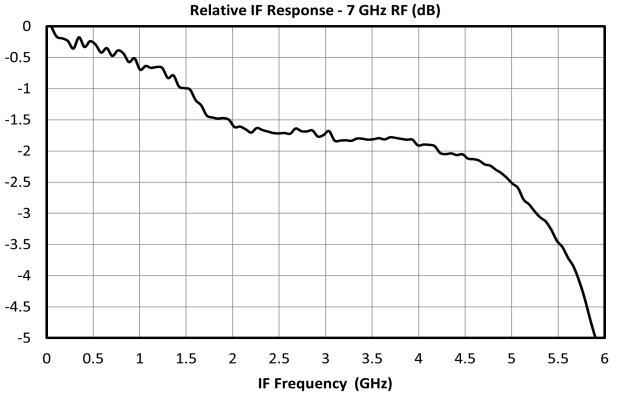
Parameter	Test Conditions	Min	Typ	Max	Unit
Conversion Loss [1]	RF/LO = 3 - 30 GHz I = 91MHz	-	7	-	dB
Conversion Loss [2]	RF/LO = 3 - 30 GHz I = DC – 5 GHz	-	8	-	dB
IF Frequency Range	-	0	-	5	GHz
Input 1dB Gain Compression Point	RF = 25GHz, IF = 91MHz, HSLO=25.091GHz	-	13.5	-	dBm
Input 1dB Gain Compression Point	RF = 4GHz, IF = 91MHz, HSLO=4.091GHz	-	13.5	-	dBm
Input IP3	RF/LO = 3 - 30 GHz I = 91 MHz	-	23	-	dBm
LO Frequency Range	-	3	-	30	GHz
LO Leakage, LO to IF	LO= 3 - 30 GHz	-	18	-	dBm
LO Leakage, LO to RF	LO= 3 - 30 GHz	-	24	-	dBm
Noise Figure [3]	RF/LO = 3 - 30GHz I = DC – 5 GHz	-	7	-	dB
RF Frequency Range	-	3	-	30	GHz
RF to IF Isolation	RF = 3 - 30 GHz	-	34	-	dB

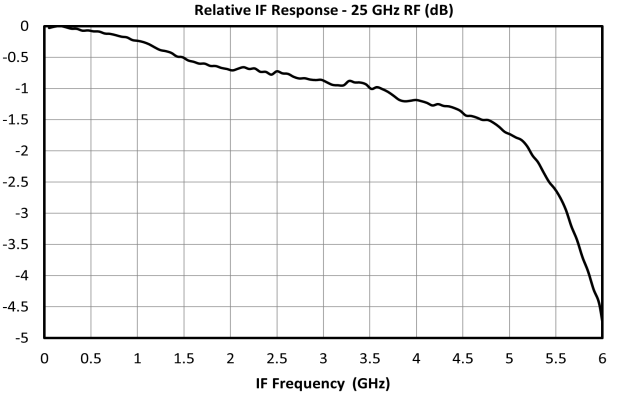
[1] Measured as a down converter to a fixed IF = 91 MHz. EVB IF and RF trace losses de-embedded.
[2] Measured as a down converter. EVB IF and RF trace losses de-embedded.
[3] Mixer Noise Figure typically measures within 0.5 dB of conversion loss for IF frequencies greater than 5 MHz.

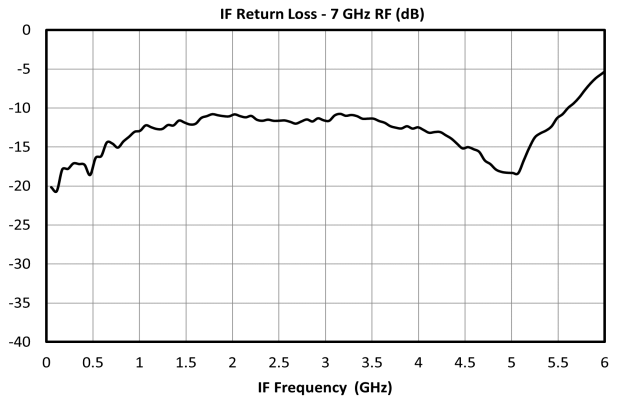
Typical Performance Plots

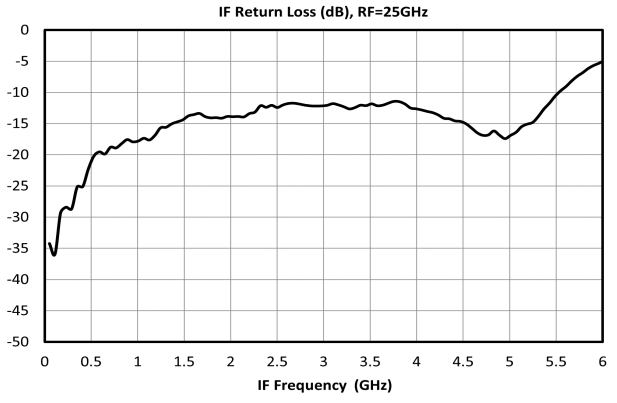


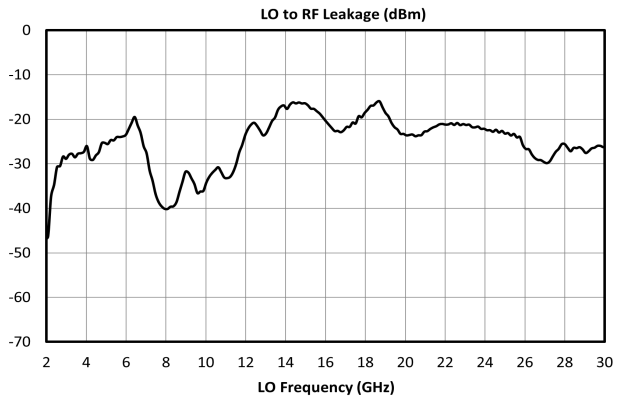


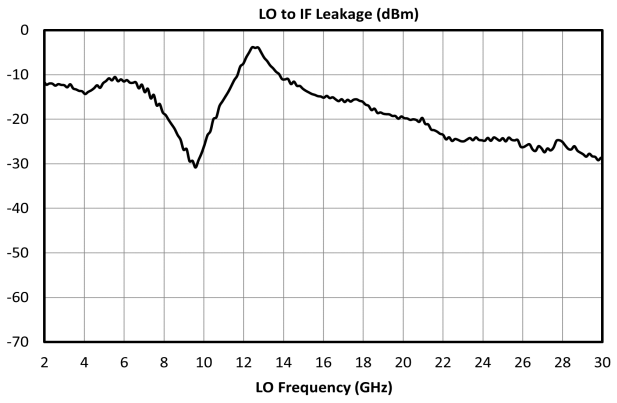




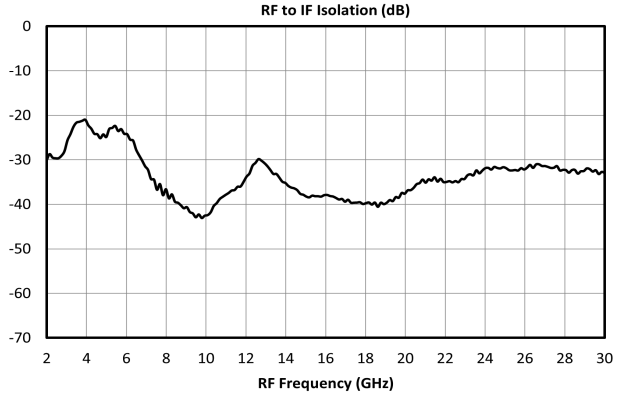




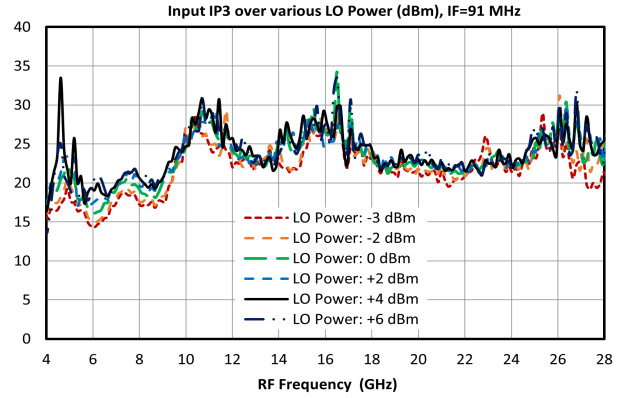




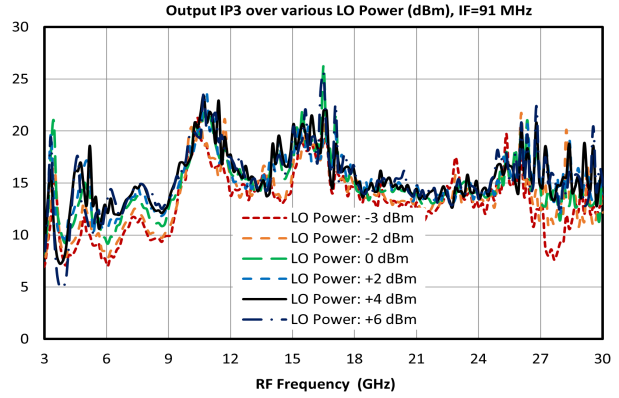
RF to IF Isolation (dB)



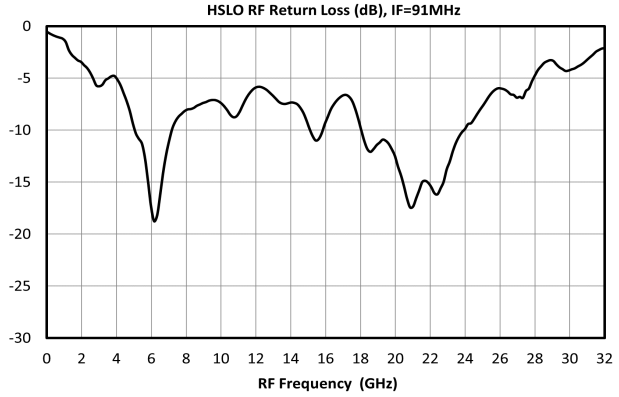
Input IP3 over various LO Power (dBm), IF=91 MHz



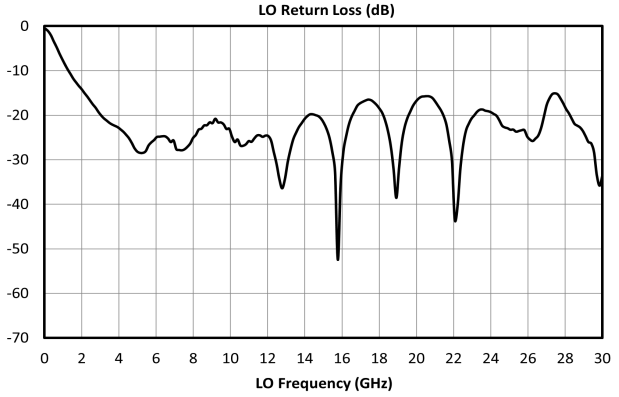
Output IP3 over various LO Power (dBm), IF=91 MHz



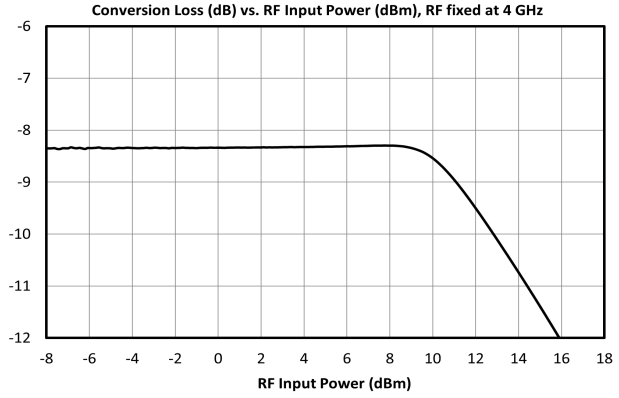
HSLO RF Return Loss (dB), IF=91MHz



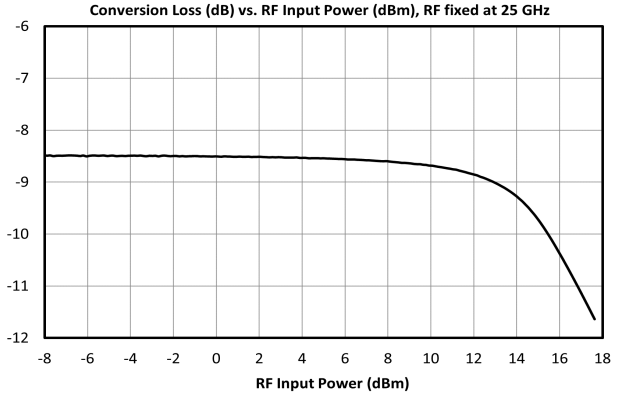
LO Return Loss (dB)

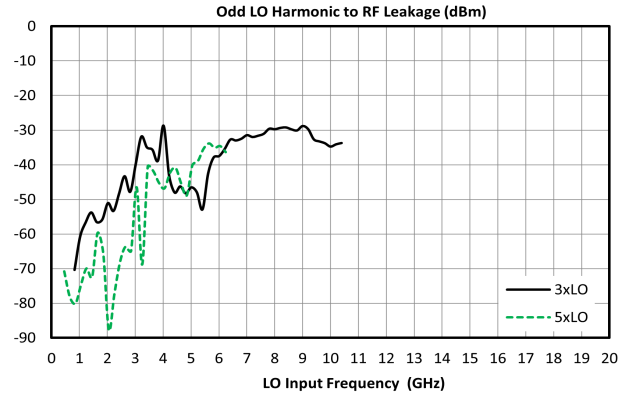


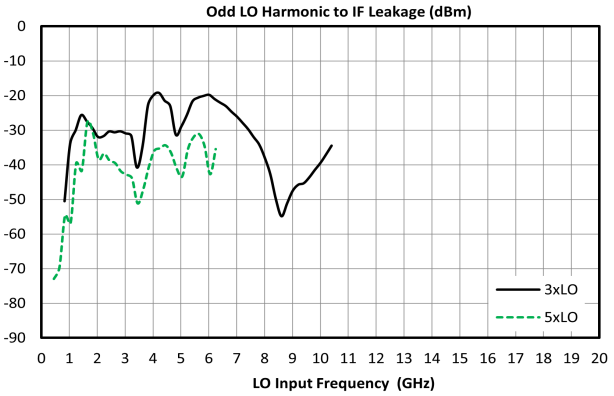
Conversion Loss (dB) vs. RF Input Power (dBm), RF fixed at 4 GHz

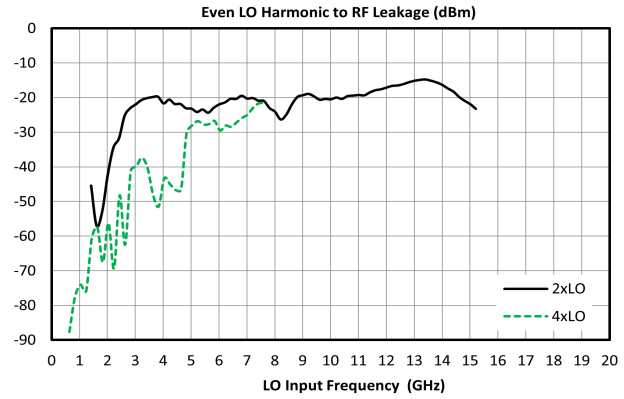


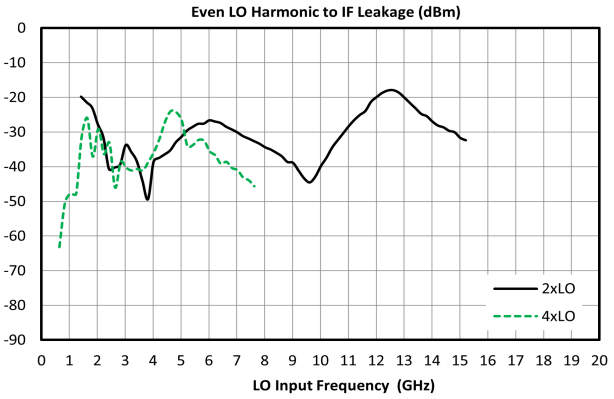
Conversion Loss (dB) vs. RF Input Power (dBm), RF fixed at 25 GHz

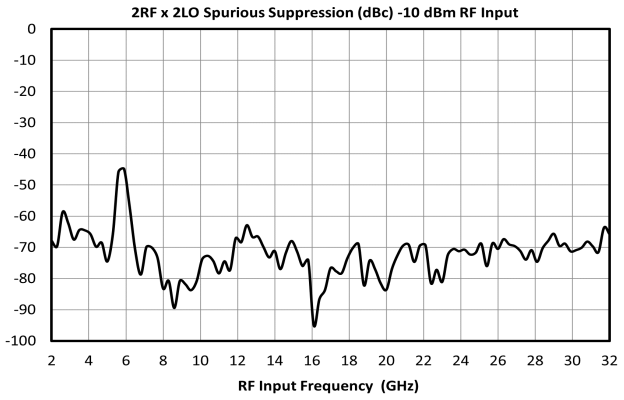


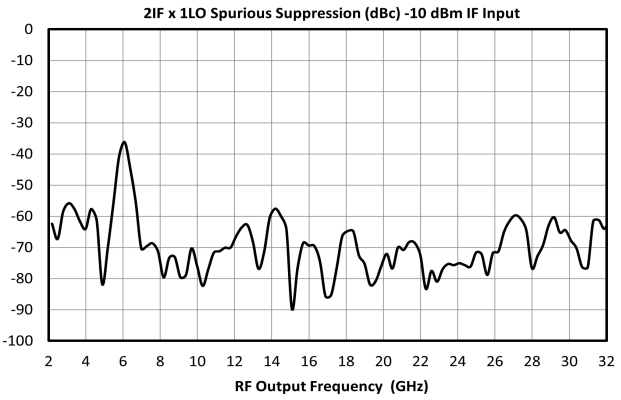












Spur Table

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 73 dBc for a -10 dBm input, so a -20 dBm RF input creates a spur that is (2-1) x (-10 dB) lower, or 83 dBc.

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	29	Reference	23	10	21	19
2xRF	85	61	73	65	71	69
3xRF	84	68	88	81	87	78
4xRF	114	109	116	115	116	115
5xRF	119	123	128	126	127	128

Typical Spurious Performance: Up-Conversion

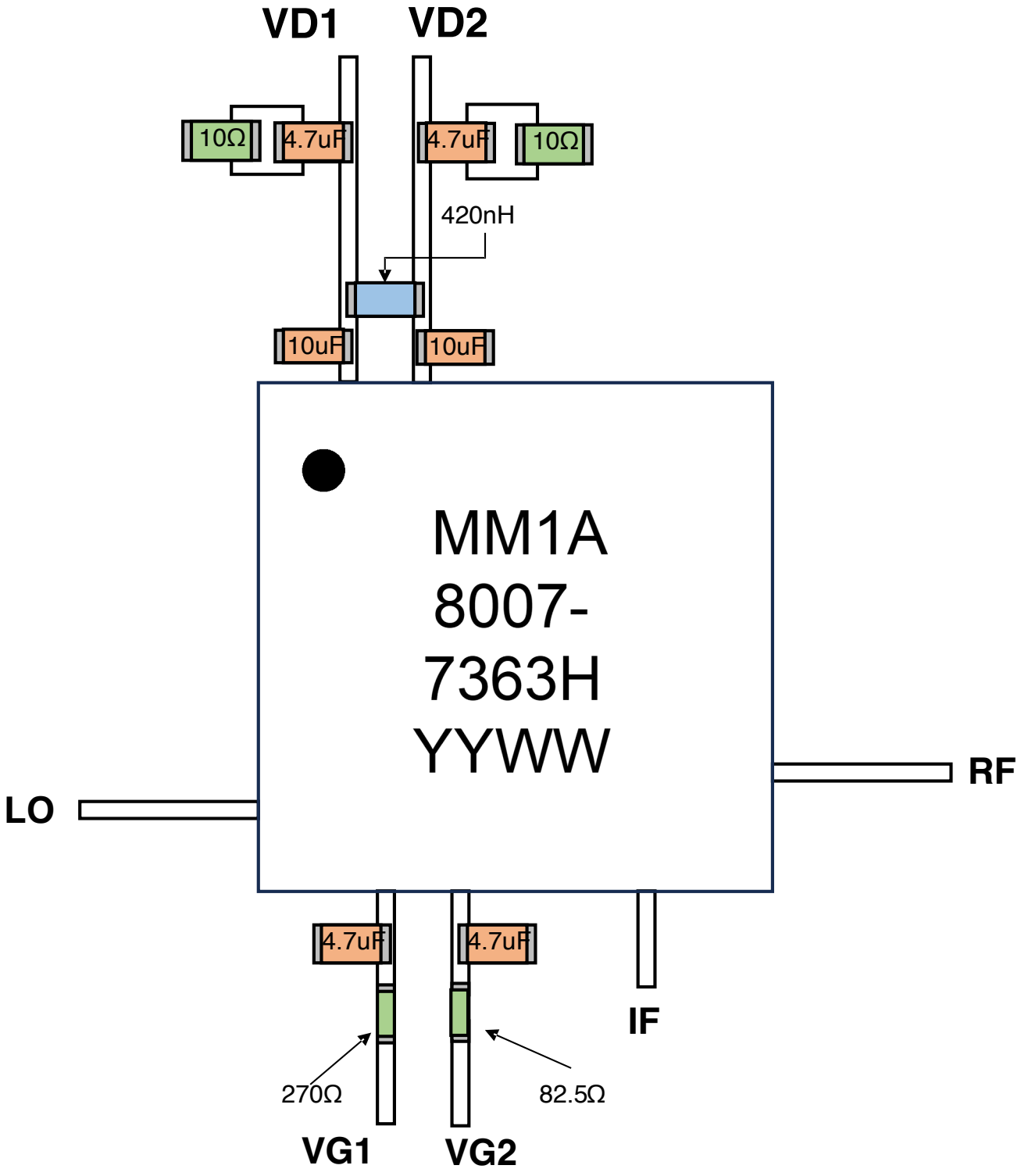
Typical spurious data is taken by mixing an input within the IF band, with LO frequencies (± m*LO ± n*IF), to create a spurious output within the RF output band. The mixer is swept across the full spurious output band and the mean is calculated. The numbers shown in the table below are for a -10 dBm IF input. Spurious suppression is scaled for different IF input power levels by (n-1), where "n" is the IF spur order. For example, the 2IFx1LO spur is typically 72 dBc for a -10 dBm input with a sine-wave LO, so a -20 dBm IF input creates a spur that is (2-1) x (-10 dB) lower, or 82 dBc.

-10 dBm IF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	28	Reference	23	9	23	17
2xIF	83	72	58	62	55	60
3xIF	104	74	77	66	69	62
4xIF	118	114	104	99	96	91
5xIF	129	123	121	112	107	103

Application Information

The application circuit for the MM1A-0330HPSM 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.

Application Circuit



Application Circuit Description

Ports Operation

IF Port – Used as input on an upconversion, output on downconversion, or LO port in a band shifting application. Signals should be connected by 50 ohm microstrip or coplanar traces to well matched broadband 50 ohm sources and loads.

RF Port – Used as input on a downconversion, output on upconversion, or output in a band shifting application. Signals should be connected by 50 ohm microstrip or coplanar traces to well matched broadband 50 ohm sources and loads.

LO Port – The noise floor of the LO input signal should be less than the value of the noise floor plus isolation of the mixer, or a filter is recommended to prevent reduction in dynamic range. An integrated LO amplifier is included, allowing for superior performance with LO power below the typical recommended drive level.

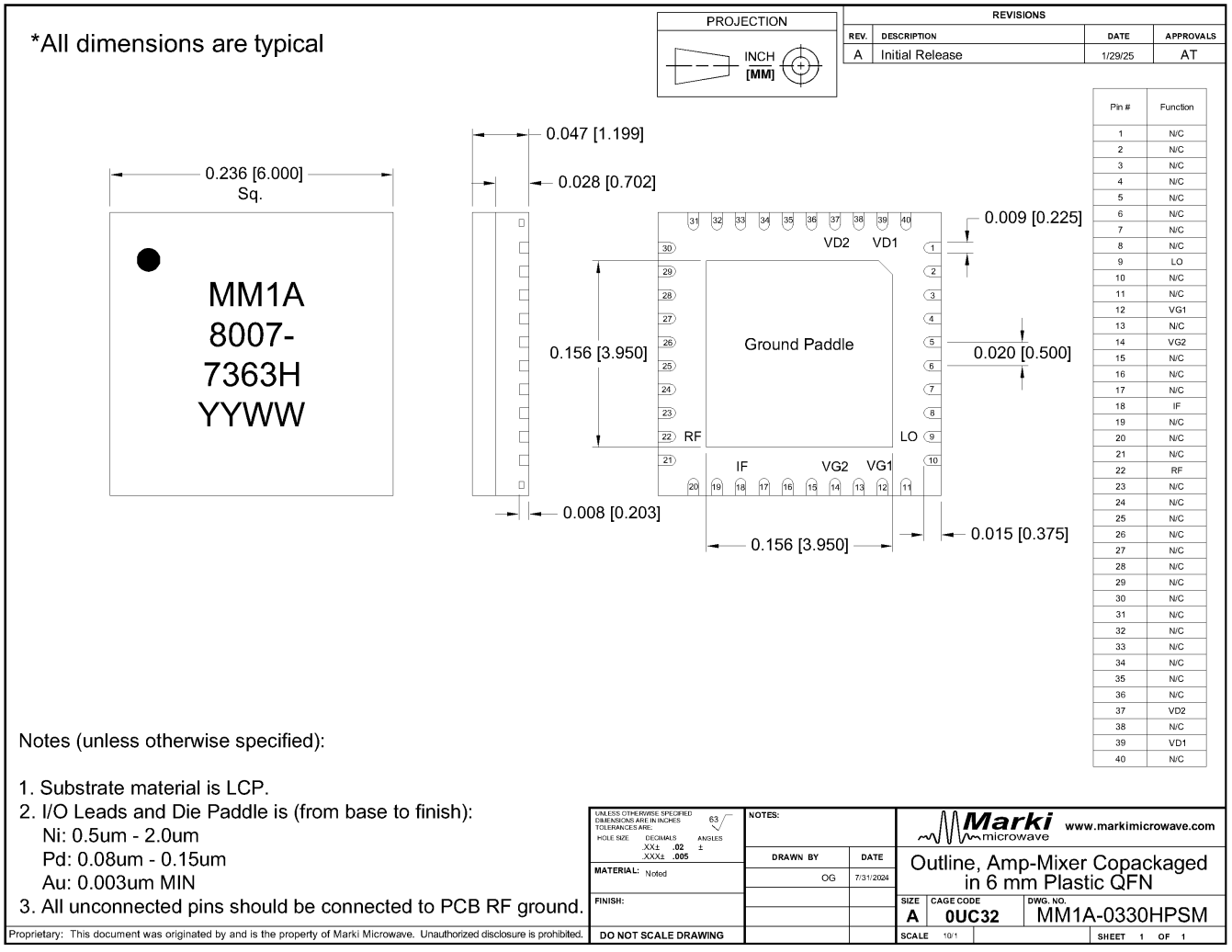
Filtering and Matching- Filtering is generally desired for spurious and image removal on the output port of the mixer. Reflective filters can cause out of band signals to reflect back into the mixer and cause conversion loss ripple, erroneous spurs, and other undesired behaviors. To eliminate these problems it is recommend that the filters be placed as close to the output port as possible. If undesired behavior is still observed, a diplexer with one port terminated or a 1-3 dB attenuator may reduce this problem.

RF Ground – The ground paddle of the QFN should be connected to a low noise RF ground with very low electrical resistance for high frequency operation.

Mechanical Data

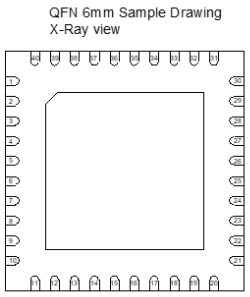
Outline Drawing

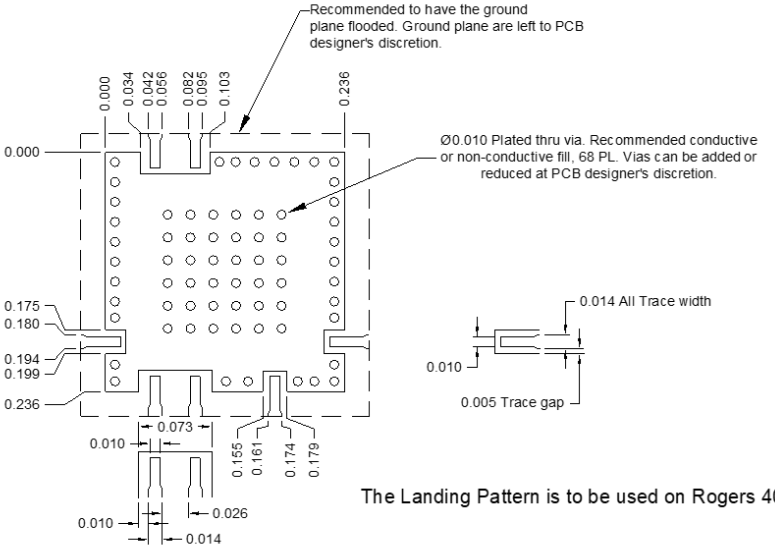
Download : Outline 2D Drawing



Footprint Image

Download : Footprint Drawing





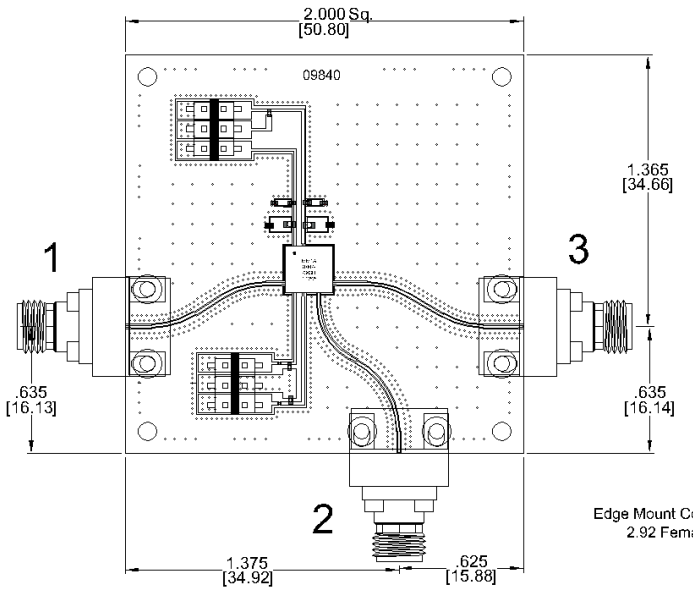
The Landing Pattern is to be used on Rogers 4003, 0.008" thick $\frac{1}{2}$ Oz Cu.

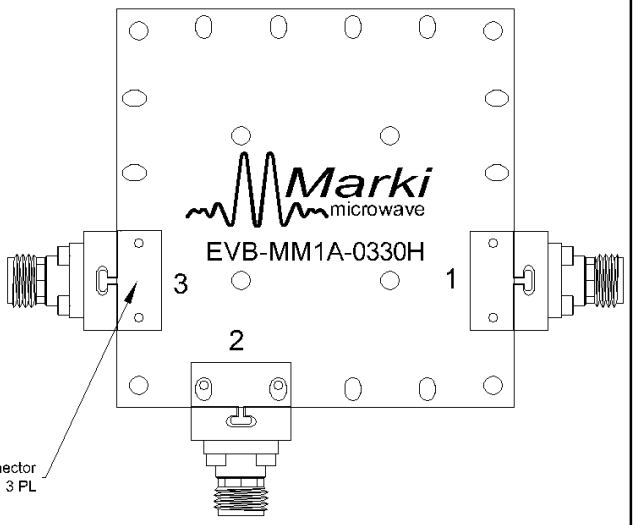
Evaluation Board - Outline Drawing

All Dimensions are typical.

PROJECTION
INCH
[MM]

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVALS
A	Initial Release	1/29/25	AT





Port #	Function	VDC	Connector Type
1	LO	Open Line	2.92mm Female
2	IF	0.660±0.030	2.92mm Female
3	RF	Open Line	2.92mm Female
Note: Eval Connectors are not removeable.			

RoHS Compliant (SN96.5/AG3.5) Components/Assembly

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NOTES:

DRAWN BY	DATE
OG	7/31/2024
CHECKED	

MATERIAL:
FINISH:
DO NOT SCALE DRAWING

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Outline
EVB-MM1A-0330H

SIZE	CAGE CODE	DWG. NO.
A	0UC32	EVB-MM1A-0330H

SCALE 3/1 SHEET 1 OF 1

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