

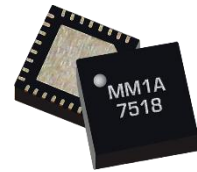
Double Balanced Mixer/LO Amplifier

MM1A-0622HPSM

1. Device Overview

1.1 General Description

The MM1A-0622HPSM is a versatile, robust, and broadband double balanced mixer with an integrated broadband LO driver amplifier. The MM1A-0622HPSM 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 +3dBm while retaining exceptional conversion loss and linearity.



QFN

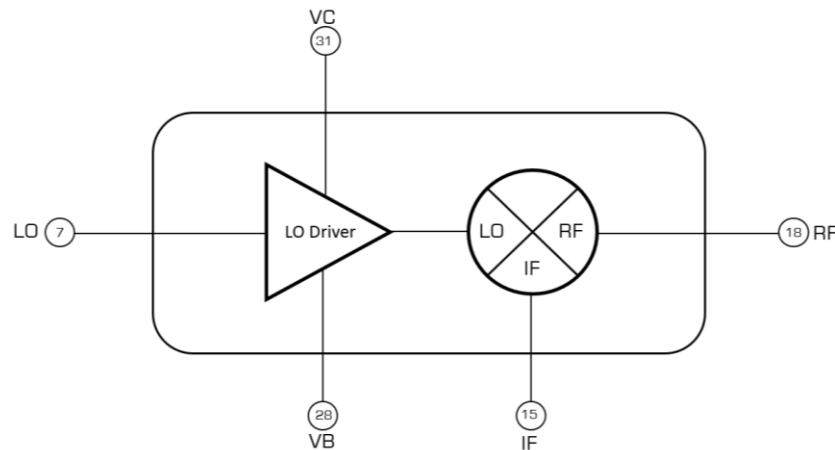
1.2 Features

Parameter	Typical
RF/LO response	6GHz - 22GHz
IF response	DC – 9GHz
Conversion Loss	7.5 dB
Minimum LO drive	+3dBm

1.3 Applications

- Test and measurement equipment
- SATCOM
- Radar
- Low LO Drive Applications

1.4 Functional Block Diagram



1.5 Part Ordering Options¹

Part Number	Description	Package	Green Status	Product Lifecycle	Export Classification
MM1A-0622HPSM-2	5.0 x 5.0 mm QFN	PSM	RoHS	Active	EAR99
EVB-MM1A-0622HP	Connectorized Evaluation Fixture	Eval		Active	EAR99

¹ Refer to our [website](#) for a list of definitions for terminology presented in this table.

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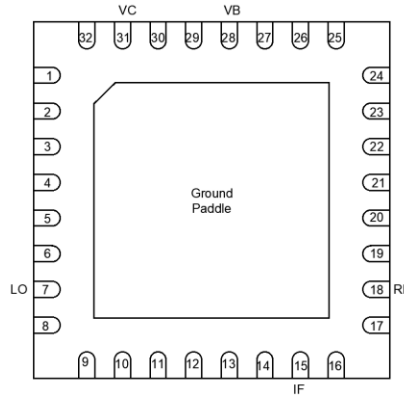
Revision History

Revision Code	Revision Date	Comment
-	September 2022	Datasheet Initial Release

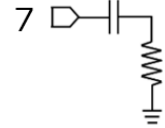
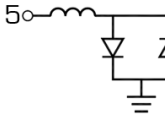
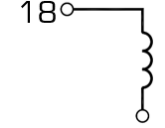
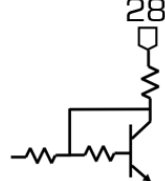
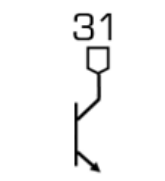
2. Port Configurations and Functions

2.1 Port Diagram

A top-down x-ray view of the MM1A-0622HPSM's PSM package outline drawing is shown below. The MM1A-0622HPSM has the input and output ports given in Port Functions.



2.2 Port Functions

Port	Function	Description	Equivalent Circuit for Package
Pin 7	LO	Pin 7 is the input of the integrated LO driver amplifier and is matched to 50 ohms. It is internally DC blocked.	
Pin 15	IF	Pin 15 is DC coupled to the diodes. Blocking capacitor is optional.	
Pin 18	RF	Pin 18 is DC open and AC matched to 50 Ohms from 6 to 22 GHz. Blocking capacitor is optional.	
Pin 28	VB	Port VB is the DC voltage bias for the current mirror that controls collector current supplied to the amplifier.	
Pin 31	VC	Port VC is the DC voltage supply that supplies the amplifier's collector current.	

3. Specifications

3.1 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	Units
Collector Positive Bias Voltage (Vc)	6	V
Positive Bias Current (Ic)	240	mA
Positive DC Current Mirror Voltage (Vb)	6	V
Pin 7 DC Current (LO)	N/A	mA
Pin 15 DC Current (IF)	15	mA
Pin 18 DC Current (RF)	N/A	mA
RF Power Handling (RF+LO)	+25	dBm
θ_{Jc} , Junction to Case Thermal Resistance	TBD	°C/W
Max Junction Temperature for MTTF > 1E6 hours	TBD	°C
Operating Temperature	-40 to +85	°C
Storage Temperature	-65 to +125	°C

3.2 Package Information

Parameter	Details	Rating
ESD	Human Body Model (HBM), per MIL-STD-750, Method 1020	TBD
Weight	EVAL package	TBD

3.3 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.

	Min	Nominal	Max	Units
T _A , Ambient Temperature	-40	+25	+85	°C
LO Input Power	+3	+6	TBD	dBm
Positive DC Voltage (VC and VB)	4	5	6	V
Current Draw	-	-	225	mA

3.5 Electrical Specifications

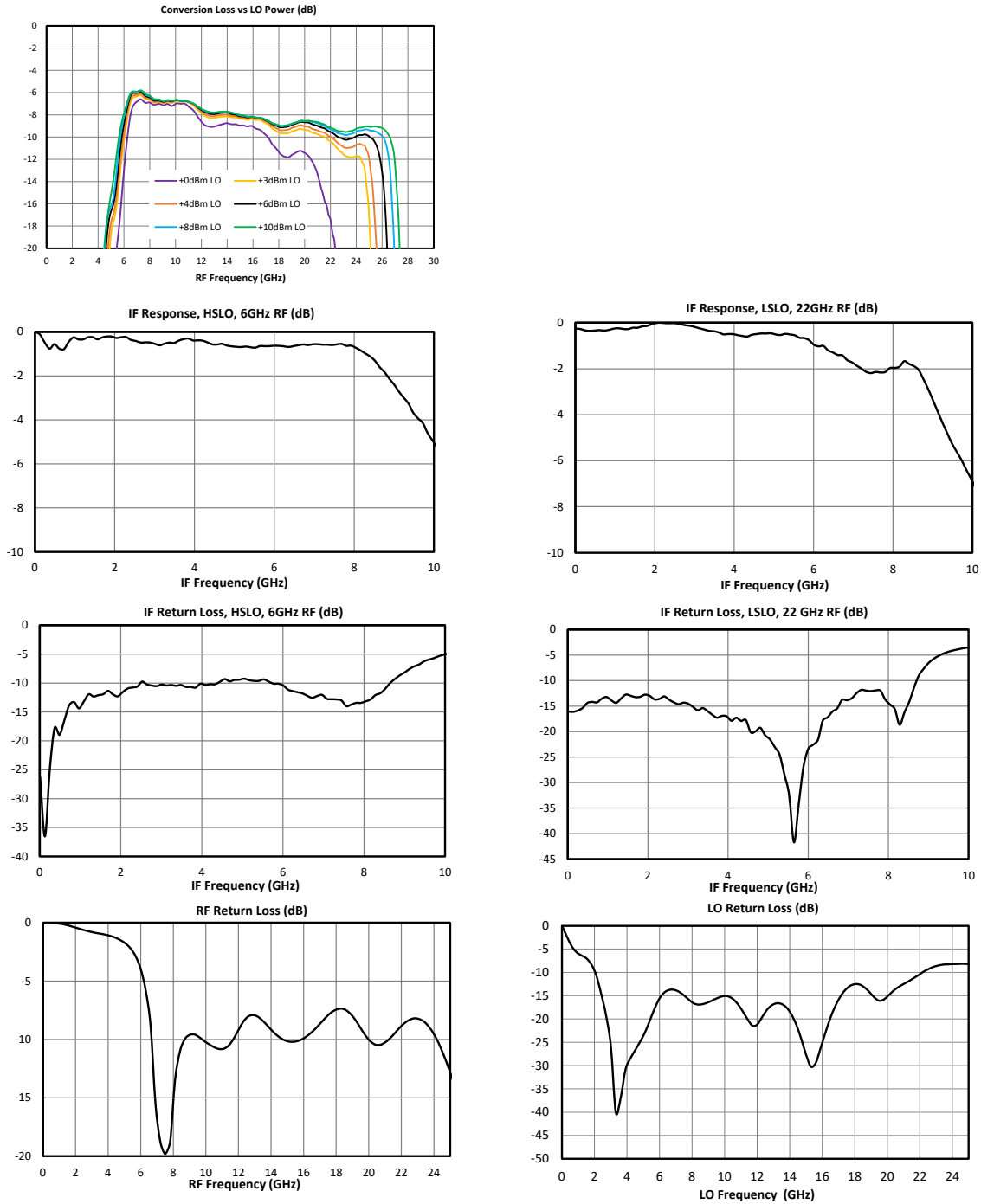
The electrical specifications apply at $T_A = +25^\circ\text{C}$ in a 50Ω system. Typical data shown is for a down conversion application with a +6dBm LO input to the integrated LO driver amp biased at +5Vb/+5Vc unless otherwise specified.

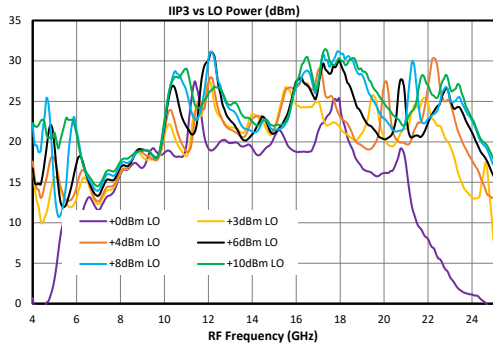
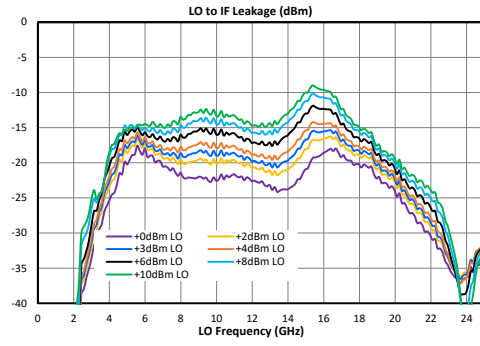
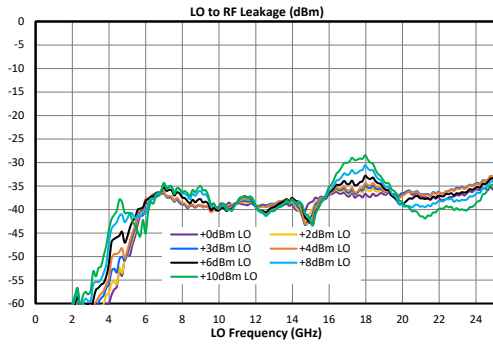
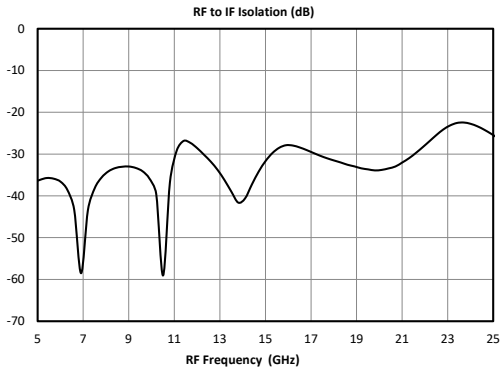
Parameter		Test Conditions	Min	Typical	Max	Units
RF (Pin 11) Frequency Range			6		22	GHz
LO (Pin 2) Frequency Range			6		22	
I (Pin 7) Frequency Range			0		9	
Conversion Loss (CL) ²		RF/LO = 6 - 22 GHz I = DC - 2 GHz		7.5		dB
		RF/LO = 6 - 22 GHz I = 2 - 9 GHz		8.5	13	
Noise Figure (NF) ³		RF/LO = 1.5 - 13 GHz I = DC - 2 GHz		7.5		dB
RF to IF Isolation		RF/LO = 6 - 22 GHz		32		dB
LO Leakage	LO to IF	RF/LO = 6 - 22 GHz		See Plots		dBm
	LO to RF	RF/LO = 6 - 22 GHz		See Plots		
Input IP3 (IIP3)		RF/LO = 6 - 22 GHz I = DC - 2 GHz		+21		dBm
Input 1 dB Gain Compression Point (P1dB)				+9		dBm
Bias Requirements (mA) +5Vb/+5Vc				105		mA

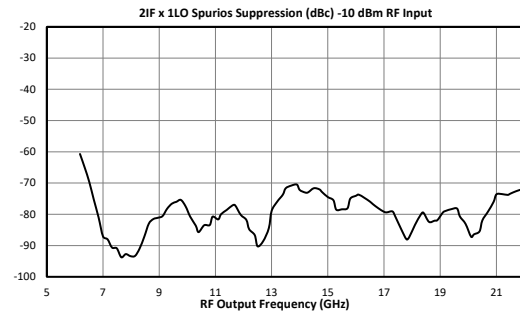
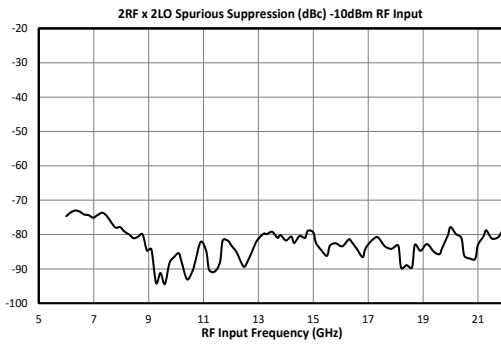
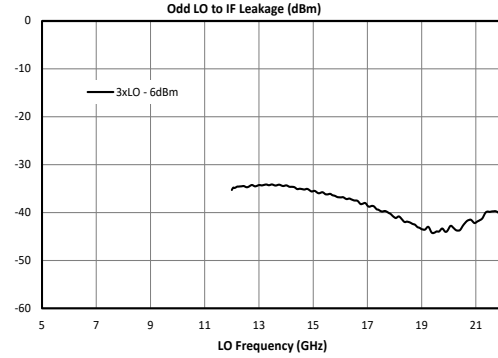
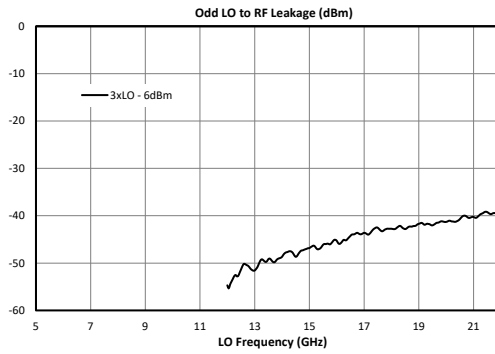
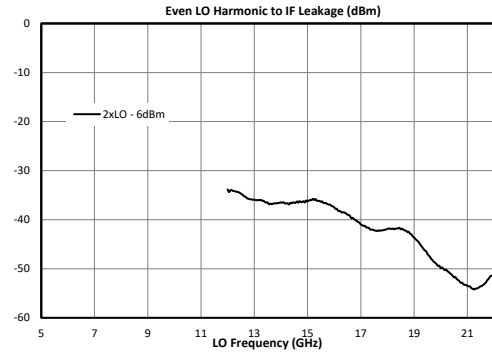
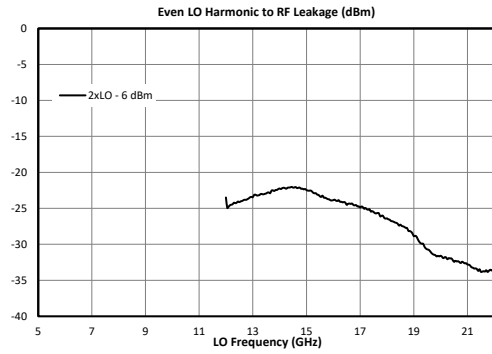
² Measured as a down converter to a fixed 91 MHz IF.

³ Mixer Noise Figure typically measures within 0.5 dB of conversion loss for IF frequencies greater than 5 MHz.

3.6 Typical Performance Plots







3.6.1 Typical Spurious Performance: Down-Conversion

Typical spurious data is provided by selecting RF and LO frequencies ($\pm m \cdot LO \pm n \cdot RF$) 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 75 dBc for a -10 dBm input, so a -20 dBm RF input creates a spur that is (2-1) x (-10 dB) lower, or 85 dBc. Data is shown for the frequency plan in 3.6 Typical Performance. mLOxORF plots can be found in section 3.6.2 .

Typical Down-conversion spurious suppression (dBc)

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	26	Reference	31	13	N/A	N/A
2xRF	82	69	75	68	70	62
3xRF	89	63	63	74	81	72
4xRF	N/A	N/A	118	113	117	115
5xRF	N/A	N/A	113	119	132	126

3.6.2 Typical Spurious Performance: Up-Conversion

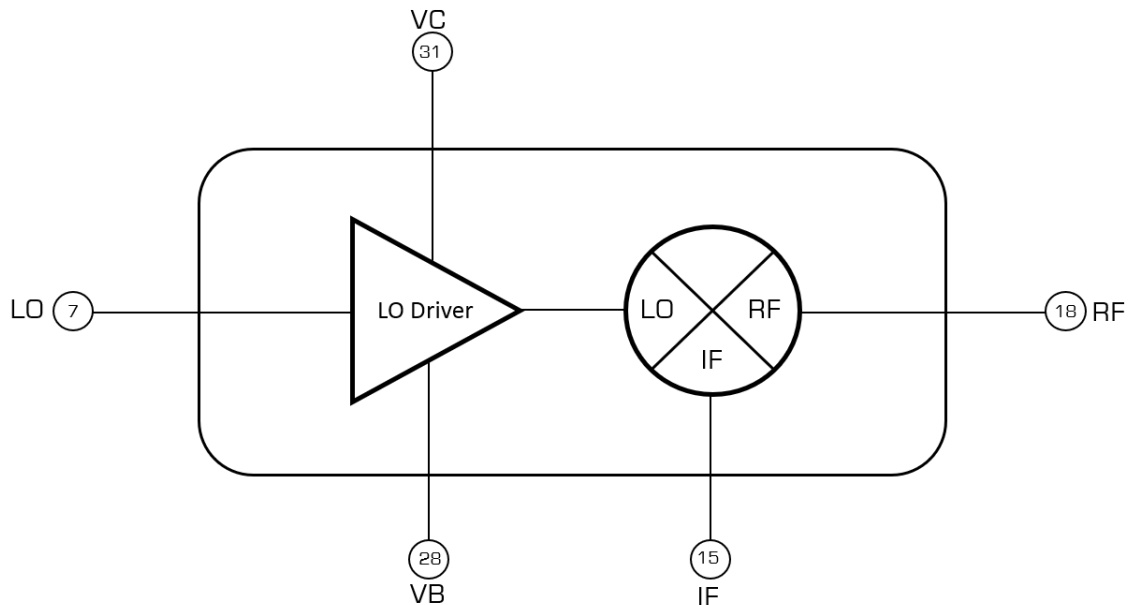
Typical spurious data is taken by mixing an input within the IF band, with LO frequencies ($\pm m \cdot LO \pm n \cdot IF$), to create a spurious output within the RF output band. The mixer is swept across the full spurious output band and the mean is calculated. The numbers shown in the table below 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 71 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 81 dBc. Data is shown for the frequency plan in 3.6 Typical Performance.

Typical Up-conversion spurious suppression (dBc)

-10 dBm IF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	36	Reference	34	12	32	71
2xIF	70	71	66	69	66	63
3xIF	87	68	79	64	74	67
4xIF	115	114	103	102	99	100
5xIF	133	116	128	100	120	107

4. Operation

4.1 Application Circuit Block Diagram



4.2 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.

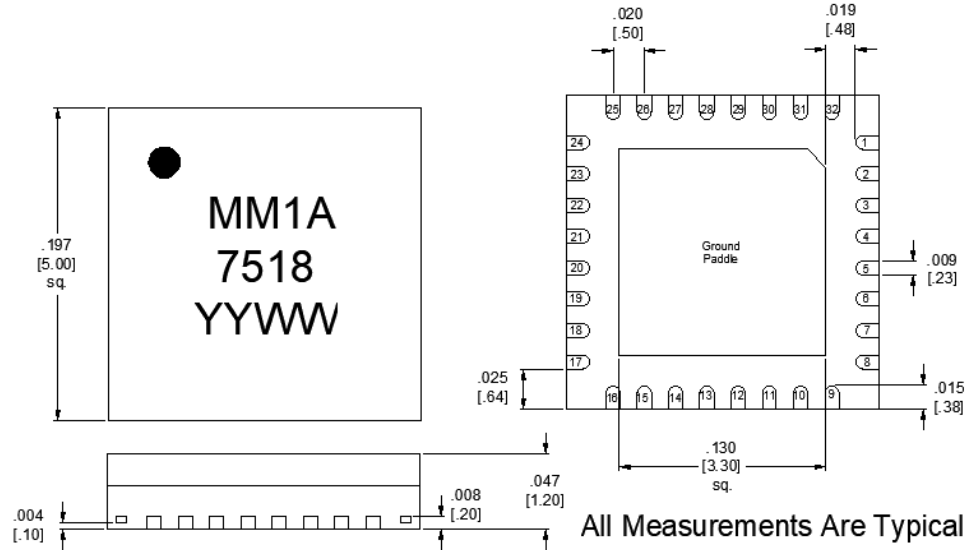
LO Port – The noise floor of the LO input signal should be less than the value of the noise floor plus isolation of the mixer, or a filter is recommended to prevent reduction in dynamic range. An integrated LO amplifier is included, allowing for superior performance with LO power below the typical recommended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

5. Mechanical Data

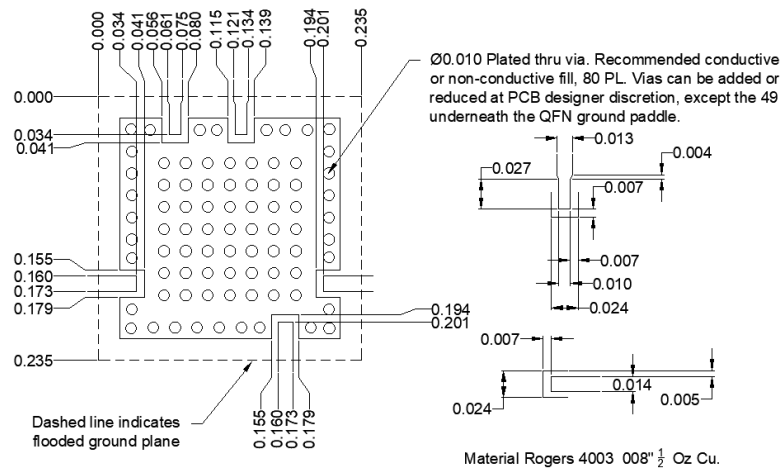
5.1 PSM Package Outline Drawing



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	IF
16	N/C
17	N/C
18	RF
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	VC
32	N/C

- Substrate material is LCP.
- I/O Leads and Die Paddle are: 0.003 microns Gold (MIN)
0.08 - 0.15 microns Palladium
0.5 - 2.0 microns Nickel.
- All unconnected pins should be connected to PCB RF ground.

5.2 PSM Package Footprint

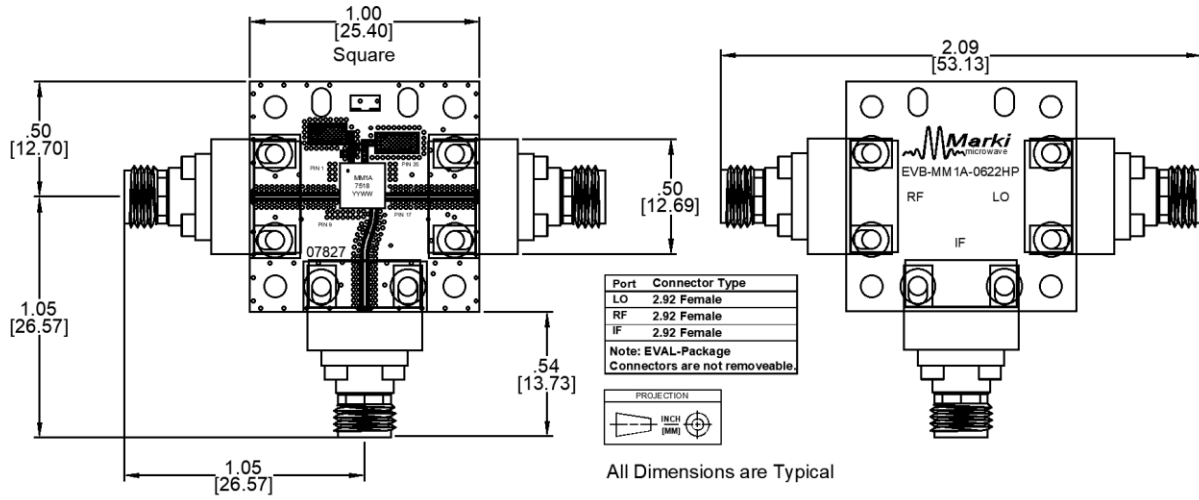


QFN-Package Surface-Mount Landing Pattern

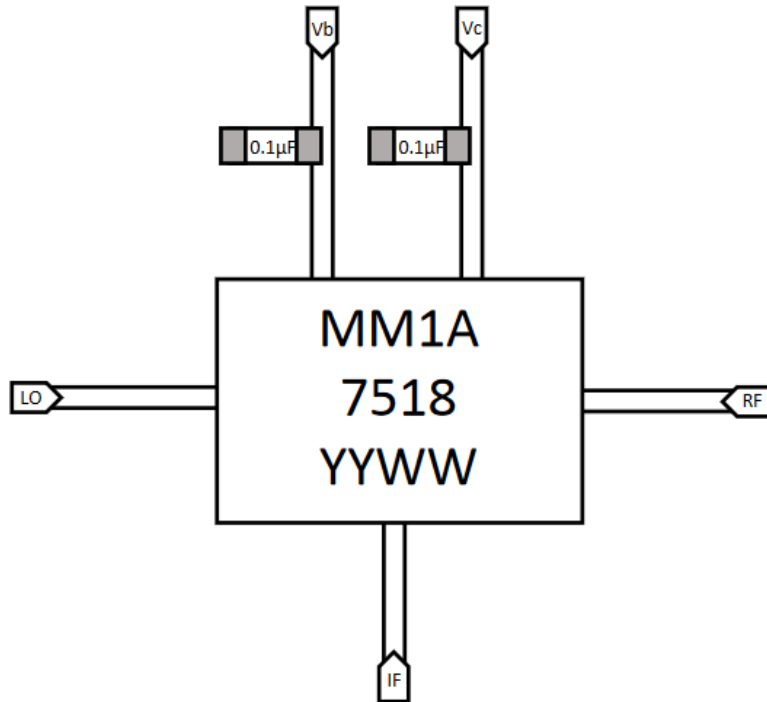
[Click here for a DXF of the above layout.](#)

[Click here for leaded solder reflow.](#) [Click here for lead-free solder reflow](#)

5.3 Evaluation Board Outline Drawing



5.4 Evaluation Board Application Circuit



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