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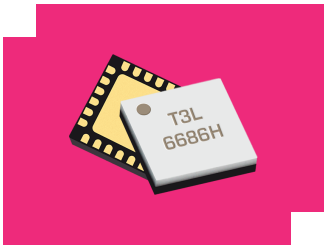
MT3L-0113HSM-2

GaAs MMIC High Dynamic Range Mixer

DEVICE OVERVIEW

General Description

MT3L-0113HSM is a GaAs MMIC triple balanced mixer with high dynamic range and low conversion loss. This mixer belongs to the T3 family which offers high IP3, P1dB, and broad operating bandwidths for applications in the S, C and X bands. MT3L-0113HSM is the monolithic cousin of the MT3-0113HCQG and sister of the MT3H-0113HSM targeted towards lower IF applications in a small footprint. The MT3L-0113HSM is available as both wire bondable die and as connectorized modules.



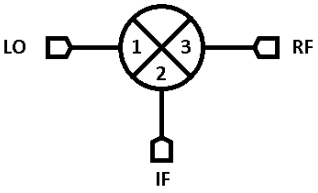
Features

- High LO to RF isolation
- Broad, overlapping RF/LO & IF bands

Applications

- Test and Measurement Equipment
- S/C/X band radar

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Green Status	Product Lifecycle	Export Classification
MT3L-0113HSM-2	GaAs MMIC High Dynamic Range Mixer	QFN	REACH RoHS	Released	EAR99
EVAL-MT3L-0113H	Evaluation Board, GaAs MMIC High Dynamic Range Mixer	EVAL	REACH RoHS	Released	EAR99

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Table Of Contents

Revision History

Revision Code	Revision Date	Comment
-	2019-05-01	Datasheet Initial Release.

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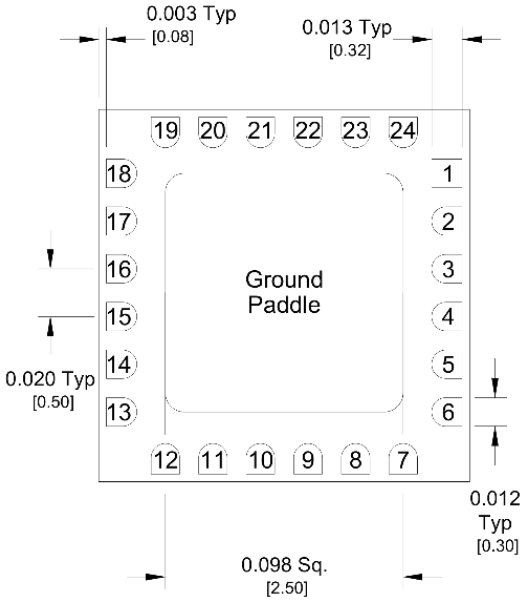
Port Configuration and Functions

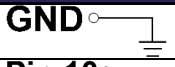
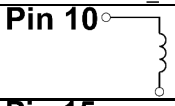
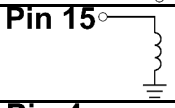
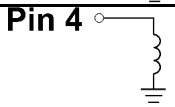
Port Diagram

A top-down view of the MT3L-0113HSM's SM package outline drawing is shown below. The MT3L-0113HSM has the input and output ports given in Port Functions. The MT3L-0113HSM can be used in either an up or down conversion. For configuration A, input the LO into pin 4, use pin 15 for the RF, and pin 10 for the IF. For configuration B, input the LO into pin 15, use pin 4 for the RF, and pin 10 for the IF.



Port Functions

Configuration A

Port	Function	Description	Equivalent Circuit for Package
GND	Ground	SM package ground path is provided through the ground paddle.	
Pin 10	IF	Pin 10 is DC open for the SM package.	
Pin 15	RF	Pin 15 is DC short for the SM package.	
Pin 4	LO	Pin 4 is DC short for the SM package.	

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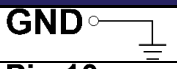
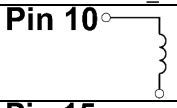
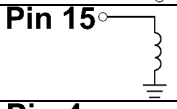
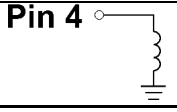
Configuration B

Port	Function	Description	Equivalent Circuit for Package
GND	Ground	SM package ground path is provided through the ground paddle.	
Pin 10	IF	Pin 10 is DC open for the SM package.	
Pin 15	LO	Pin 15 is DC short for the SM package.	
Pin 4	RF	Pin 4 is DC short for the SM package.	

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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.

Parameter	Maximum Rating	Unit
Maximum Operating Temperature	100	°C
Maximum Storage Temperature	125	°C
Minimum Operating Temperature	-55	°C
Minimum Storage Temperature	-65	°C
Power Handling, at any Port	29	dBm

Package Information

Parameter	Details	Rating
ESD	250 to < 500 Volts	HBM Class 1A
Dimensions	-	4 x 4 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	15	-	25	dBm
Ambient Temperature	-55	25	100	°C

Sequencing Requirements

There is no requirement to apply power to the ports in a specific order. However, it is recommended to provide a 50Ω termination to each port before applying power. This is a passive diode mixer that requires no DC bias.

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Electrical Specifications

The electrical specifications apply at TA=+25°C in a 50Ω system. Typical data shown is for the connectorized EVAL package mixer used with a +20 dBm sine wave LO. Typical IP3 data shown for a +23 dBm square wave LO. Min and Max limits apply only to our connectorized units and are guaranteed at TA=+25°C.

Parameter	Port Configuration	Test Conditions	Min	Typ	Max	Unit
Conversion Loss [1]	A	RF/LO = 1.5 - 13 GHz I = 0.75- 5 GHz	-	9.5	-	dB
Conversion Loss [2]	A	RF/LO = 1.5 - 13 GHz I = 0.75 GHz	-	8.5	12	dB
Input 1 dB Gain Compression Point (P1dB)	A	-	-	20	-	dBm
Input IP3 [3]	A	RF/LO = 1.5 - 13 GHz I = 0.75 GHz	-	31	-	dBm
Conversion Loss [4]	B	RF/LO = 1.5 - 13 GHz I = 0.75- 5 GHz	-	11	-	dB
Conversion Loss [5]	B	RF/LO = 1.5 - 13 GHz I = 0.75 GHz	-	10	13	dB
Input 1 dB Gain Compression Point (P1dB)	B	-	-	20	-	dBm
Input IP3 [6]	B	RF/LO = 1.5 - 13 GHz I = 0.75 GHz	-	31	-	dBm
IF Frequency Range	-	-	0.25	-	5	GHz
Isolation, LO to IF	-	IF/LO = 1.5 - 13 GHz	-	39.5	-	dB
Isolation, LO to RF	-	RF/LO = 1.5 - 13 GHz	-	39	-	dB
Isolation, RF to IF	-	RF/IF = 1.5 - 13 GHz	-	38	-	dB
LO Frequency Range	-	-	1.5	-	13	GHz
Noise Figure [7]	-	RF/LO = 1.5 - 13 GHz I = 0.75 GHz	-	8.5	-	dB
RF Frequency Range	-	-	1.5	-	13	GHz

[1][4][5] Measured as a down converter to a fixed 750 MHz IF. Unless otherwise stated, frequency conversion done using a highside LO.
[2] Measured as a down converter to a fixed 750 MHz IF. Unless otherwise stated, frequency conversion done using a highside LO.
[3][6] IP3 depends on LO drive condition. Reported table value is measured with a square wave LO formed using 2x ADM1-0026PA in series with +10 dBm input into the first stage. LO Power reported in plots is of the fundamental tone only. Square wave LO power in plots is stepped down using broadband DC-40 GHz attenuators.
[7] Mixer Noise Figure typically measures within 0.5 dB of conversion loss for IF frequencies greater than 5 MHz.

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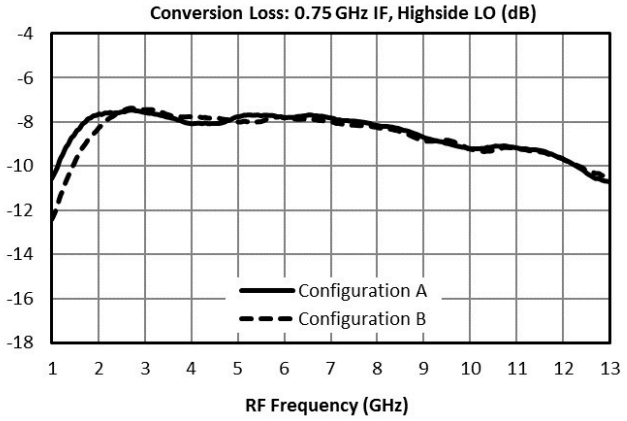
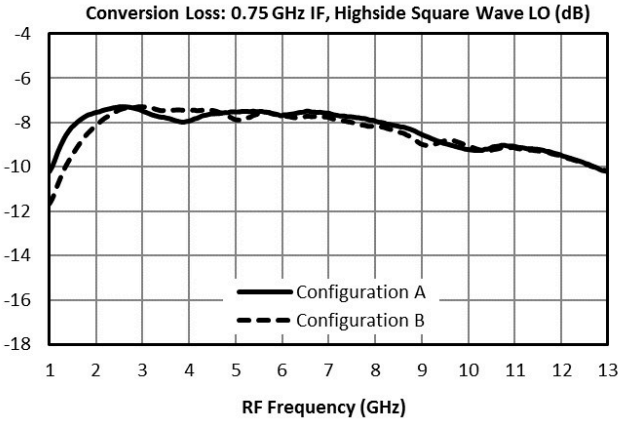
Typical Performance Plots

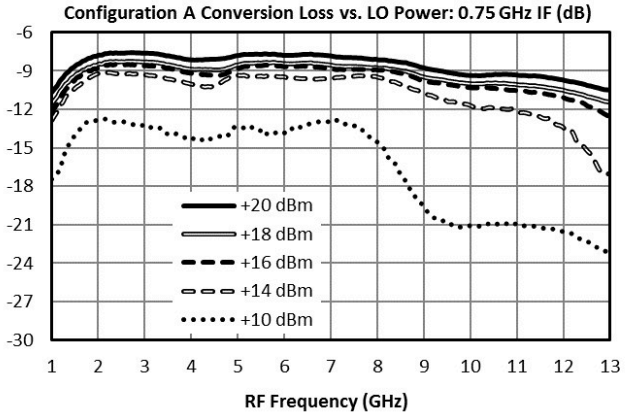
Conversion Loss: 0.75 GHz IF, Highside LO (dB)



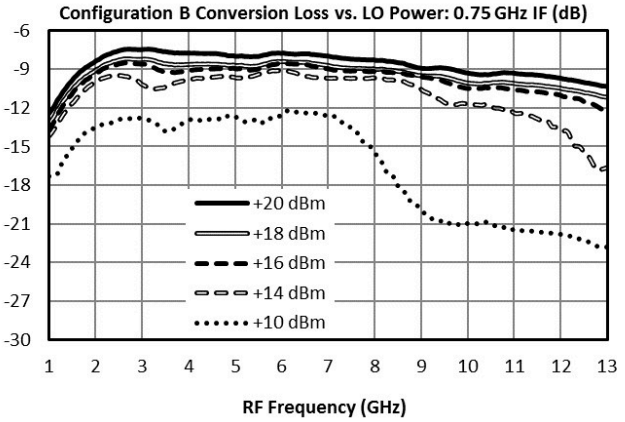
Conversion Loss: 0.75 GHz IF, Highside Square Wave LO (dB)



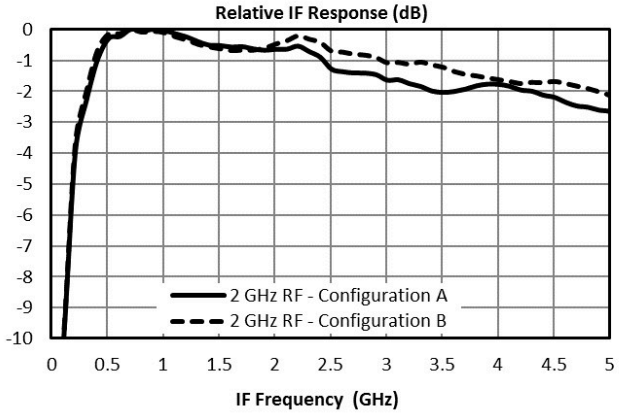
Configuration A Conversion Loss vs. LO Power: 0.75 GHz IF (dB)



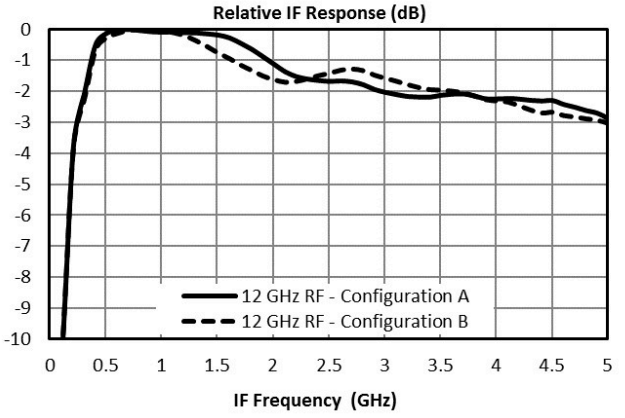
Configuration B Conversion Loss vs. LO Power: 0.75 GHz IF (dB)



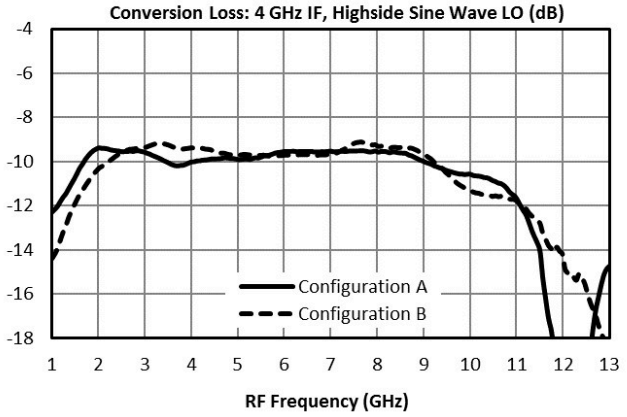
Relative IF Response (dB)



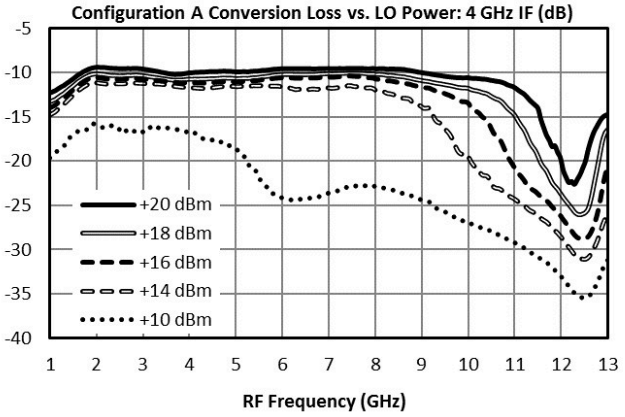
Relative IF Response (dB)



Conversion Loss: 4 GHz IF, Highside Sine Wave LO (dB)



Configuration A Conversion Loss vs. LO Power: 4 GHz IF (dB)



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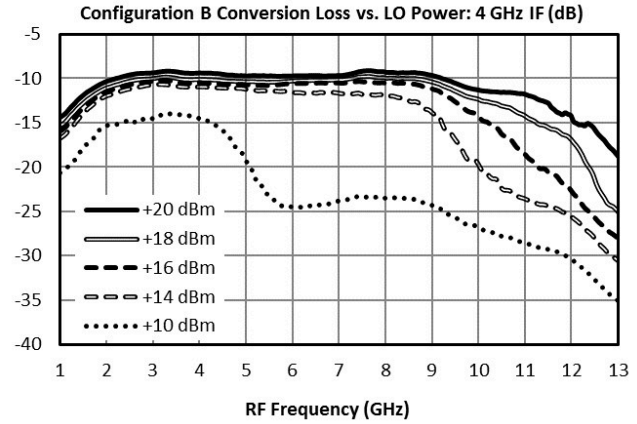
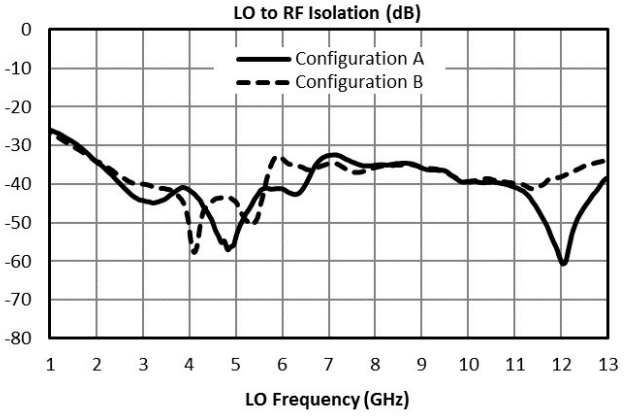
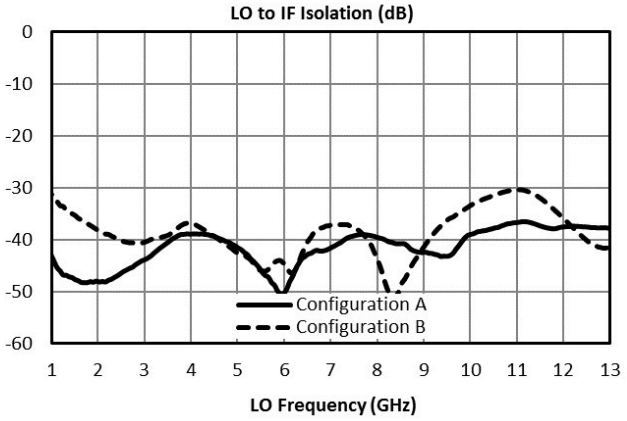
Configuration B Conversion Loss vs. LO Power: 4 GHz IF (dB)



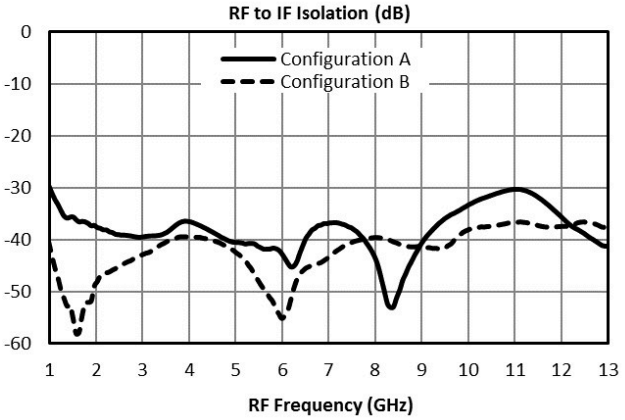
LO to RF Isolation (dB)



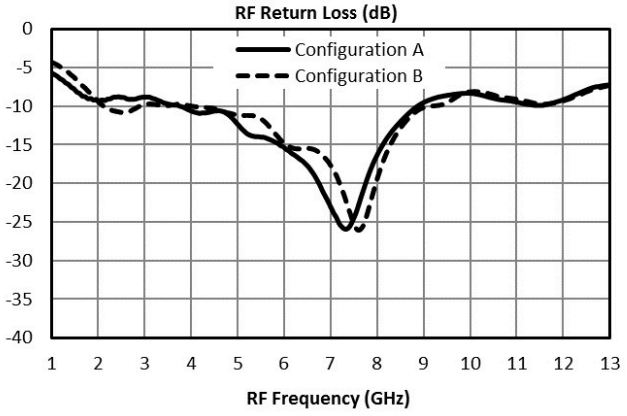
LO to IF Isolation (dB)



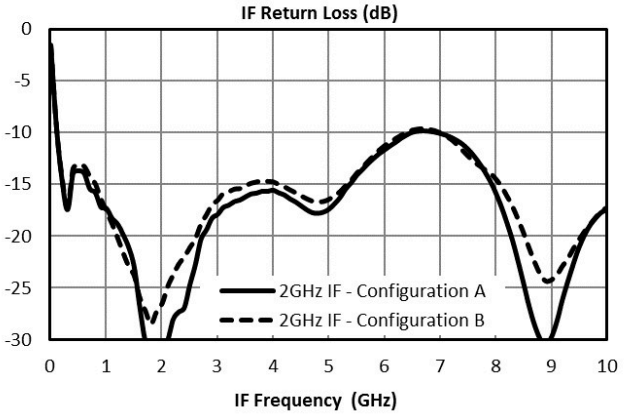
RF to IF Isolation (dB)



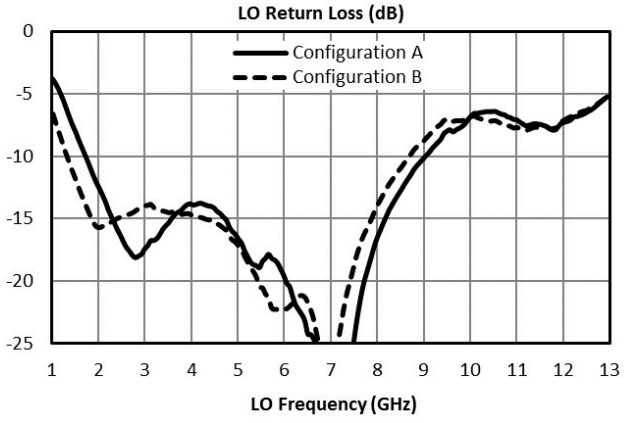
RF Return Loss (dB)



IF Return Loss (dB)



LO Return Loss (dB)



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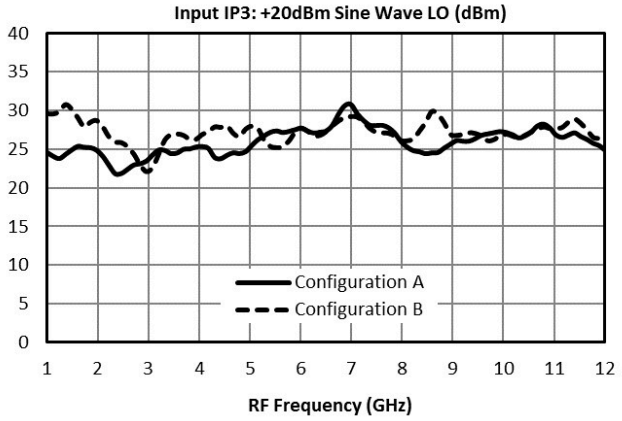
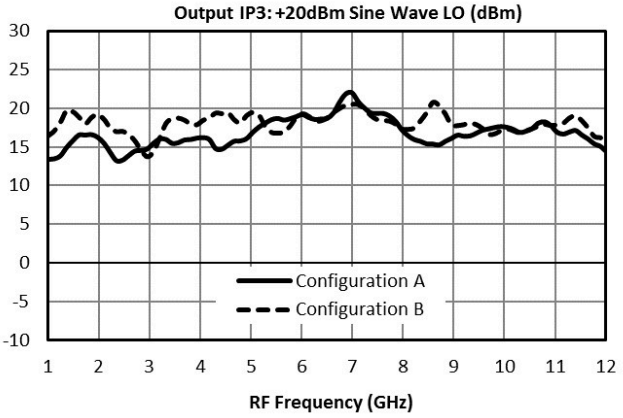
Typical Performance Plots: IP3, Sine Wave LO

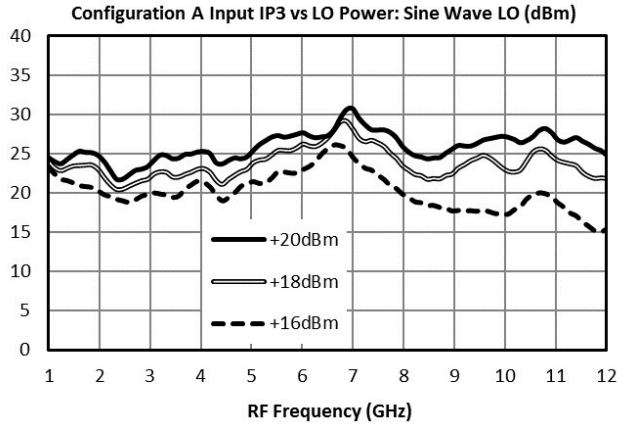
Input IP3: +20dBm Sine Wave LO (dBm)



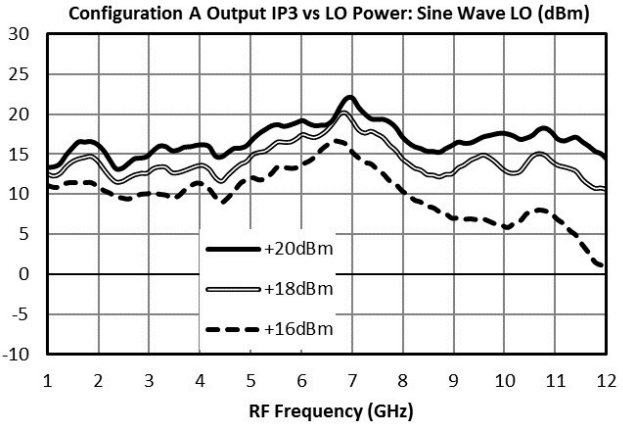
Output IP3: +20dBm Sine Wave LO (dBm)



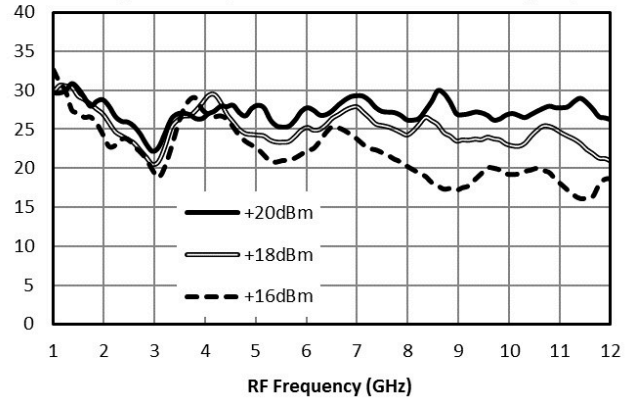
Configuration A Input IP3 vs LO Power: Sine Wave LO (dBm)



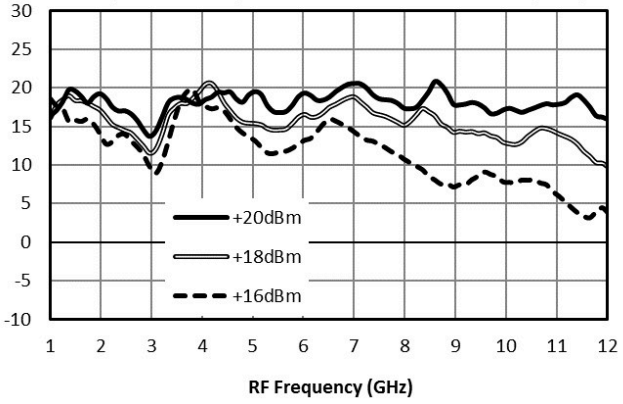
Configuration A Output IP3 vs LO Power: Sine Wave LO (dBm)



Configuration B Input IP3 vs LO Power: Sine Wave LO (dBm)



Configuration B Output IP3 vs LO Power: Sine Wave LO (dBm)



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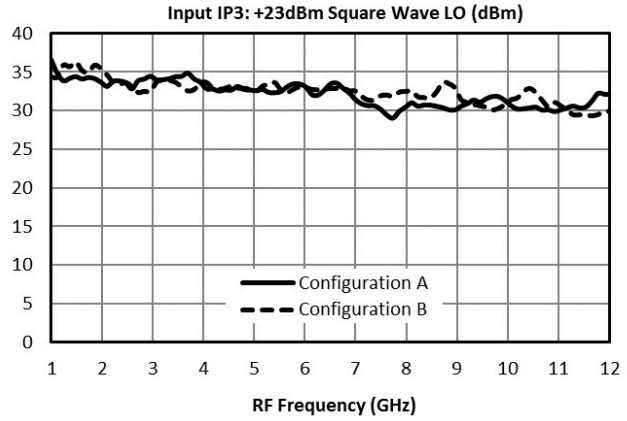
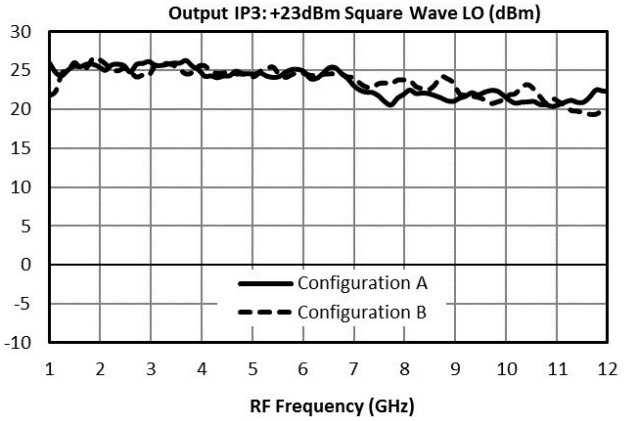
Typical Performance Plots: IP3, Square Wave LO

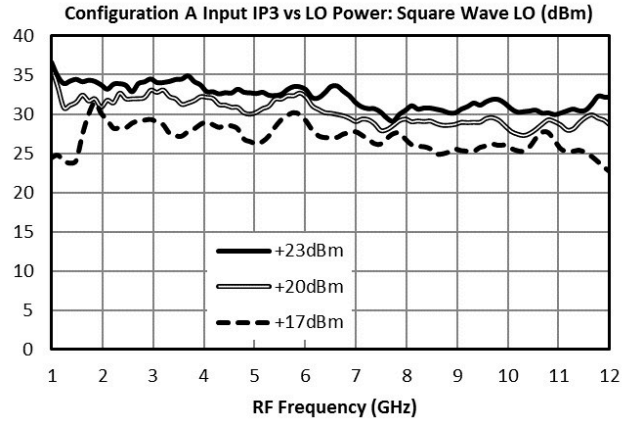
Input IP3: +23dBm Square Wave LO (dBm)



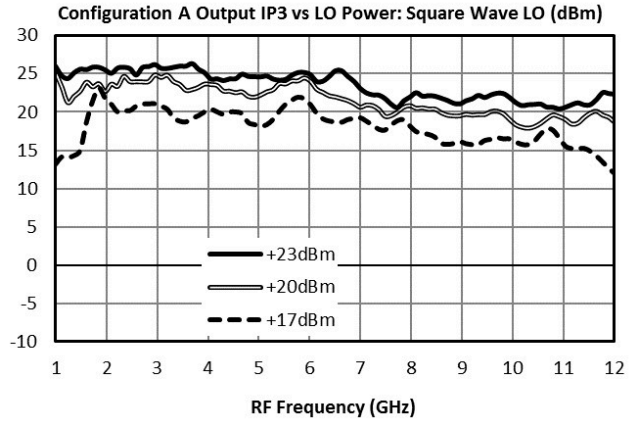
Output IP3: +23dBm Square Wave LO (dBm)



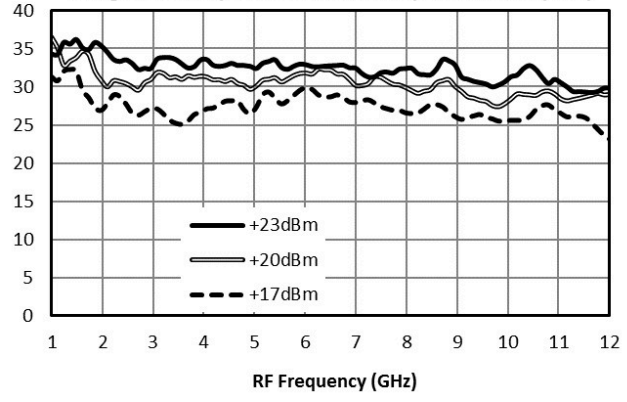
Configuration A Input IP3 vs LO Power: Square Wave LO (dBm)



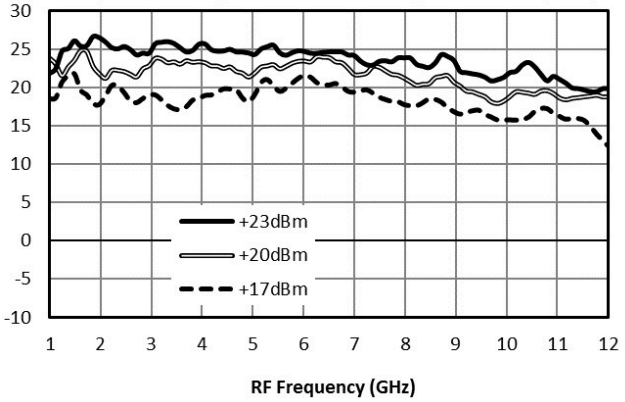
Configuration A Output IP3 vs LO Power: Square Wave LO (dBm)



Configuration B Input IP3 vs LO Power: Square Wave LO (dBm)



Configuration B Output IP3 vs LO Power: Square Wave LO (dBm)



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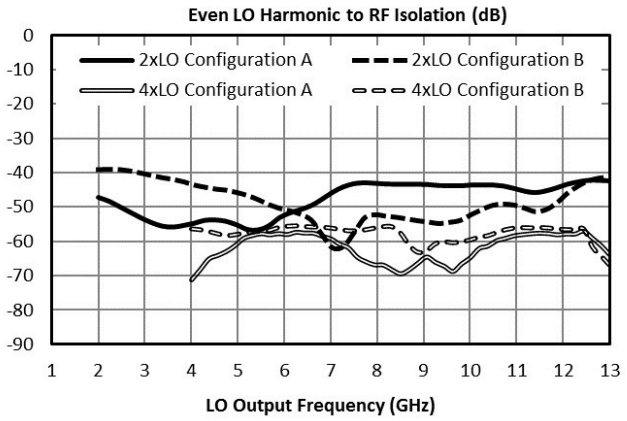
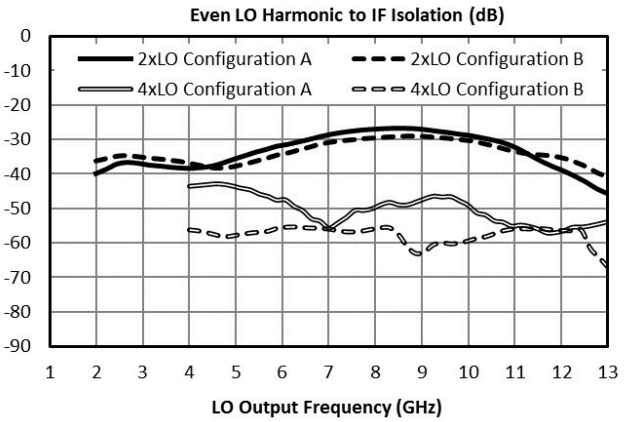
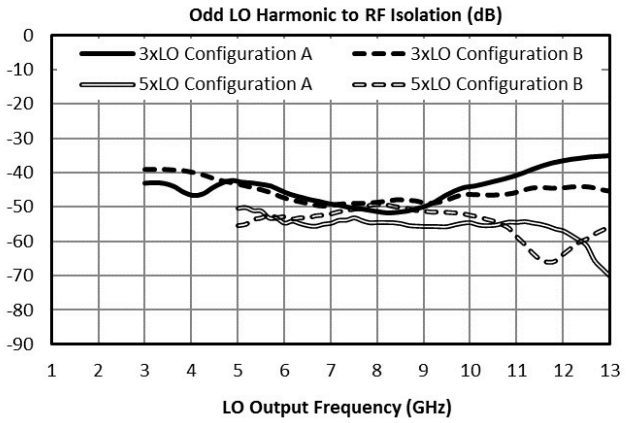
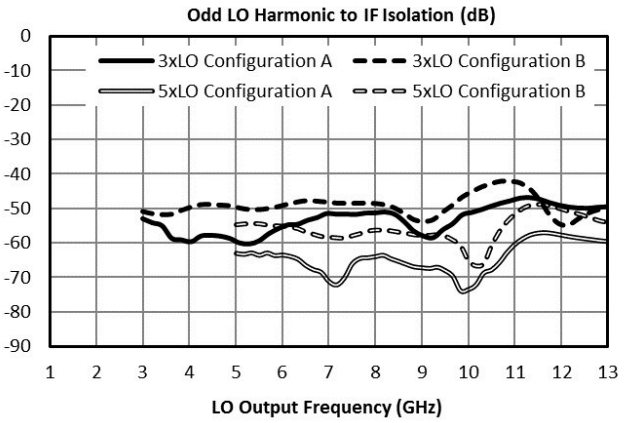
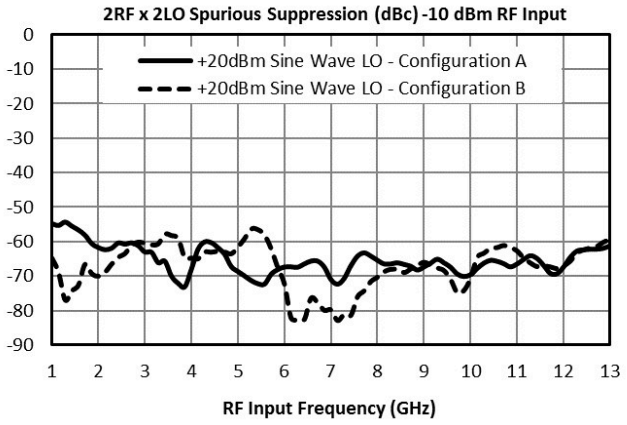
Typical Performance Plots: LO Harmonic Isolation

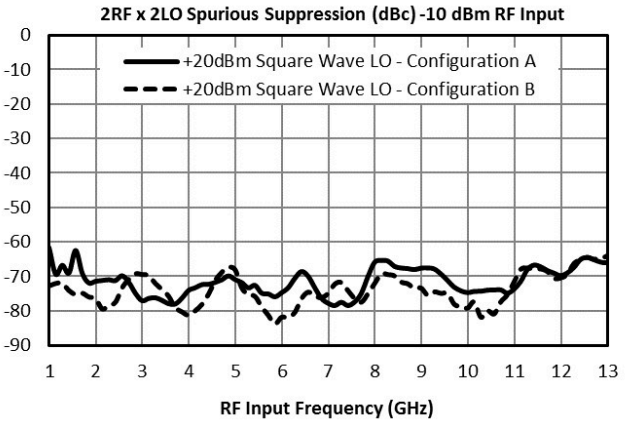


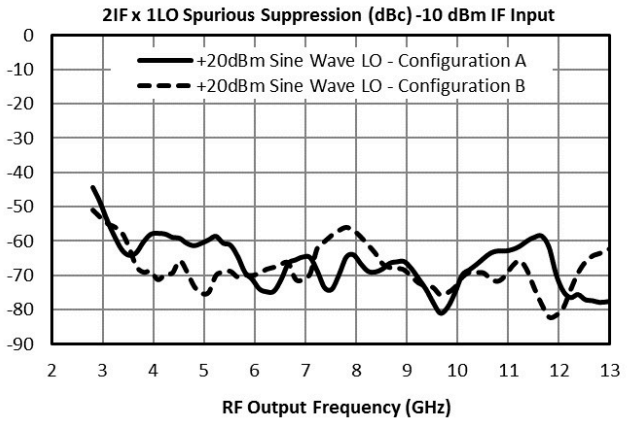


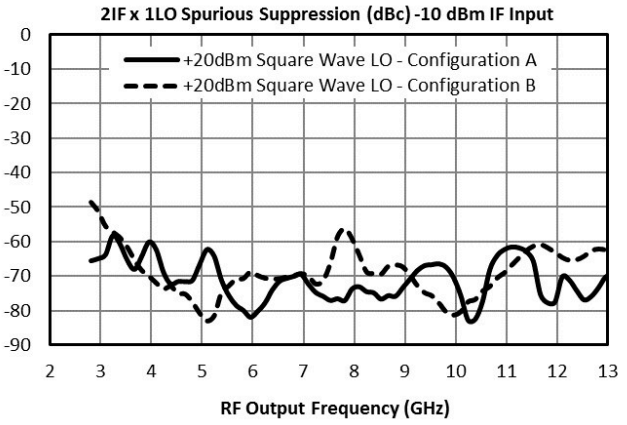












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Spur Table

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

Typical Down-conversion spurious suppression (dBc): Config A (B), Sine Wave LO

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	30 (33)	Reference	37 (41)	19 (20)	31 (35)	20 (22)
2xRF	60 (63)	67 (65)	63 (66)	64 (62)	56 (57)	64 (64)
3xRF	111 (111)	82 (86)	98 (101)	81 (82)	98 (100)	133 (132)
4xRF	130 (130)	144 (144)	123 (126)	128 (128)	123 (126)	129 (127)
5xRF	170 (169)	148 (152)	159 (163)	147 (149)	157 (157)	142 (143)

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Typical Down-conversion spurious suppression (dBc): Config A (B), Square Wave LO

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	29 (33)	Reference	35 (38)	12 (13)	33 (36)	18 (19)
2xRF	65 (62)	68 (67)	70 (72)	73 (69)	62 (65)	69 (72)
3xRF	113 (117)	94 (93)	106 (107)	90 (90)	106 (109)	135 (138)
4xRF	137 (140)	145 (145)	133 (137)	139 (139)	136 (136)	138 (137)
5xRF	174 (184)	157 (162)	165 (171)	161 (161)	167 (169)	161 (162)

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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 64 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 74 dBc.

Typical Up-conversion spurious suppression (dBc): Config A (B), Sine Wave LO

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	23 (29)	Reference	44 (43)	19 (18)	38 (45)	20 (20)
2xIF	72 (64)	64 (66)	60 (56)	55 (57)	60 (56)	51 (57)
3xIF	100 (100)	85 (85)	101 (99)	83 (81)	93 (98)	79 (78)
4xIF	135 (130)	125 (128)	126 (122)	119 (117)	123 (121)	114 (116)
5xIF	163 (155)	151 (153)	158 (156)	149 (146)	151 (151)	143 (143)

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Typical Up-conversion spurious suppression (dBc): Config A (B), Square Wave LO

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	23 (29)	Reference	37 (39)	12 (13)	33 (36)	18 (19)
2xIF	72 (64)	64 (66)	58 (58)	73 (69)	62 (65)	69 (72)
3xIF	100 (100)	90 (90)	107 (112)	90 (90)	106 (109)	135 (138)
4xIF	135 (130)	125 (128)	130 (133)	139 (139)	136 (136)	138 (137)
5xIF	163 (155)	151 (153)	174 (172)	161 (161)	167 (169)	161 (162)

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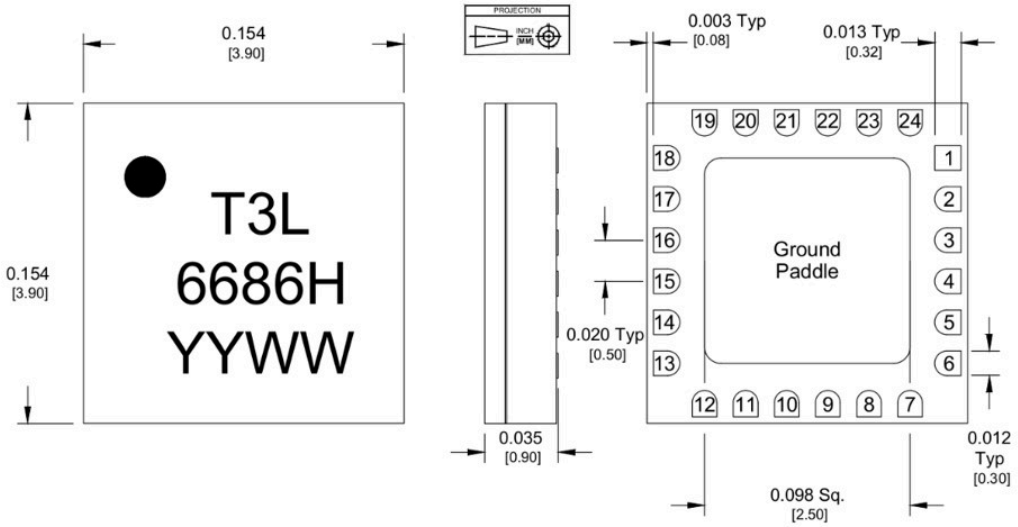
Mechanical Data

Outline Drawing

Download : Outline 2D Drawing | Outline 3D Drawing | Outline 3D STP



Pad #	Configuration A Function	Configuration B Function
1	N/C	N/C
2	N/C	N/C
3	N/C	N/C
4	LO	RF
5	N/C	N/C
6	N/C	N/C
7	N/C	N/C
8	N/C	N/C
9	N/C	N/C
10	IF	IF
11	N/C	N/C
12	N/C	N/C
13	N/C	N/C
14	N/C	N/C
15	RF	LO
16	N/C	N/C
17	N/C	N/C
18	N/C	N/C
19	N/C	N/C
20	N/C	N/C
21	N/C	N/C
22	N/C	N/C
23	N/C	N/C
24	N/C	N/C

1. Substrate material is ceramic.
2. I/O Leads and Ground Paddle plating is (from base to finish):

Ni:	8.89um MAX	1.27um MIN
Pd:	0.17um MAX	0.07um MIN
Au	0.254um MAX	0.03um MIN

3. All unconnected pads should be connected to PCB RF ground.

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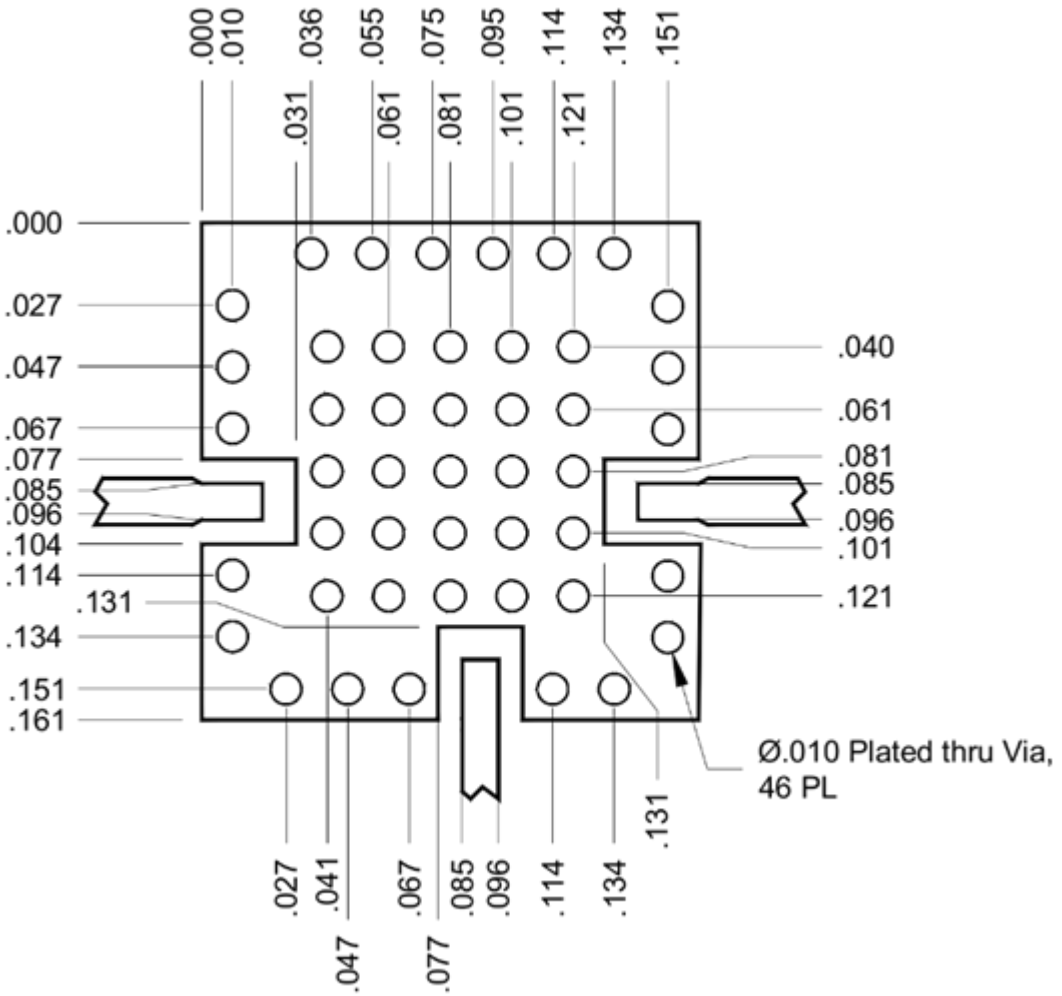
Footprint Image

Download : Footprint Drawing



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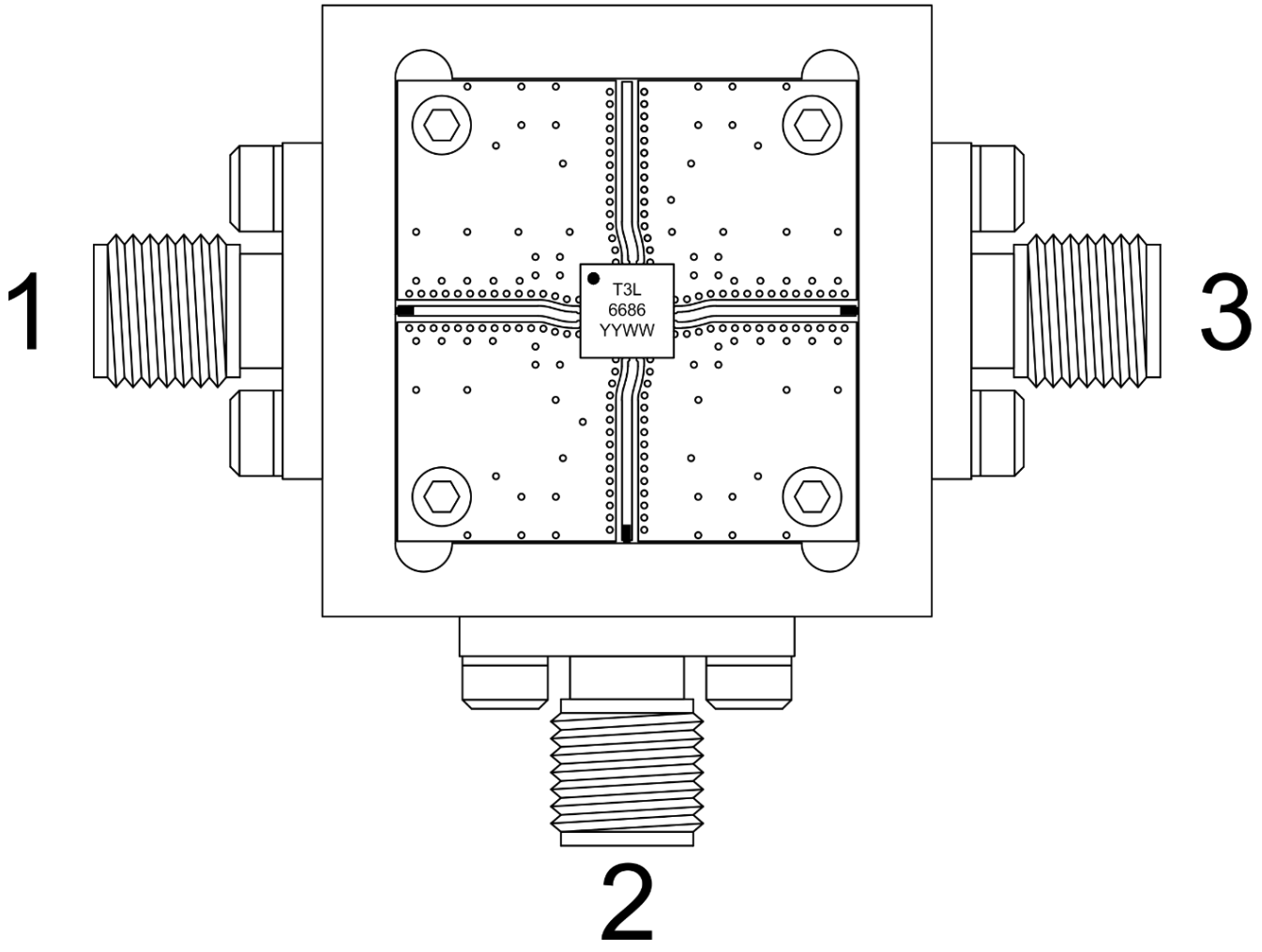
Evaluation Board - Outline Drawing



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