MMIC SURFACE MOUNT

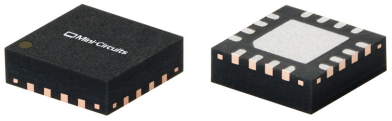
Low Noise Amplifier

PMA3-5123+

50Ω 5.5 to 12.5 GHz High Dynamic Range

THE BIG DEAL

- Low Noise Figure, Typ. 1.0 dB
- High OIP3, Typ. +28.1 dBm
- High P1dB, Typ. +16.8 dBm
- Single Supply Voltage, +4 V & 72 mA
- 3x3 mm 16-Lead QFN-Style Package

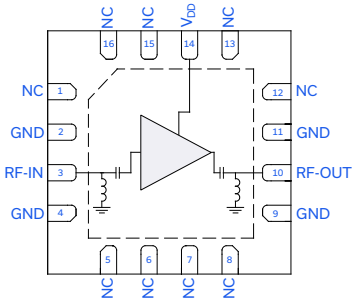


Generic photo used for illustration purposes only

APPLICATIONS

- Test & Measurement Equipment
- Back Haul Radio Systems
- Satellite Communications
- Radar, EW, and ECM Defense Systems

FUNCTIONAL DIAGRAM



PRODUCT OVERVIEW

The PMA3-5123+ is a pHEMT-based ultra-low noise MMIC amplifier with high IP3 and flat gain. Operating from 5.5 to 12.5 GHz, this amplifier features high dynamic range with typical 1.0 dB noise figure, 21.6 dB gain, +16.8 dBm P1dB, and +28.1 dBm OIP3. This combination of characteristics makes it ideal for sensitive, high dynamic range receiver applications. The device is internally DC blocked, and a DC path to ground is present at the RF input and output ports for ESD protection. PMA3-5123+ operates on a single +4 V supply, is well matched to 50Ω, and comes in a small, low profile 3x3 mm QFN-style package for easy integration into dense circuit board layouts.

KEY FEATURES

Features	Advantages
Low Noise Figure, Typ. 1.0 dB	This ultra-low noise MMIC device enables low system noise figure performance without the need for complicated discrete-based solutions.
Low Power Consumption, Typ. +4 V & 72 mA	At only 72 mA, this amplifier is ideal for applications with limited available power or densely packed applications where thermal and power management is critical.
High Dynamic Range: • Gain, Typ. 21.6 dB • OIP3, Typ. +28.1 dBm • P1dB, Typ. +16.8 dBm	The MMIC amplifier's unique combination of low noise figure, high gain, high P1dB, and high OIP3 enables optimum performance in sensitive high dynamic range receivers.
3x3 mm 16-Lead QFN-Style Package	Small footprint saves space in dense layouts while providing low inductance, repeatable transitions, and excellent thermal contact to the PCB. Industry standard packaging allows for ease of assembly in high volume manufacturing processes.

Low Noise Amplifier PMA3-5123+

50Ω 5.5 to 12.5 GHz High Dynamic Range

ELECTRICAL SPECIFICATIONS[1] AT +25°C, V_{DD} = +4 V, UNLESS NOTED OTHERWISE

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units
Frequency Range		5.5		12.5	GHz
Gain	5.5	21.6	22.6		dB
	8	20.9	21.8		
	10	20.7	21.6		
	12	21.1	22.3		
	12.5	20.9	22.4		
Input Return Loss	5.5		13		dB
	8		11		
	10		11		
	12		9		
	12.5		10		
Output Return Loss	5.5		10		dB
	8		16		
	10		17		
	12		12		
	12.5		10		
Isolation	5.5 - 12.5		51		dB
Output Power at 1 dB Compression (P1dB)	5.5		+16.4		dBm
	8		+17.5		
	10		+16.8		
	12		+13.6		
	12.5		+13.0		
Output Third-Order Intercept (P_{OUT} = +5 dBm/Tone)	5.5		+27.2		dBm
	8		+28.9		
	10		+28.1		
	12		+27.5		
	12.5		+27.7		
Noise Figure	5.5		1.0		dB
	8		0.9		
	10		1.0		
	12		1.3		
	12.5		1.3		
Device Operating Voltage (V_{DD})		+3.75	+4.0	+4.25	V
Device Operating Current (I_{DD})[2]			72		mA
DC Current Variation vs. Temperature[3]			3.33		µA/°C
DC Current Variation vs. Voltage[4]			0.024		mA/mV

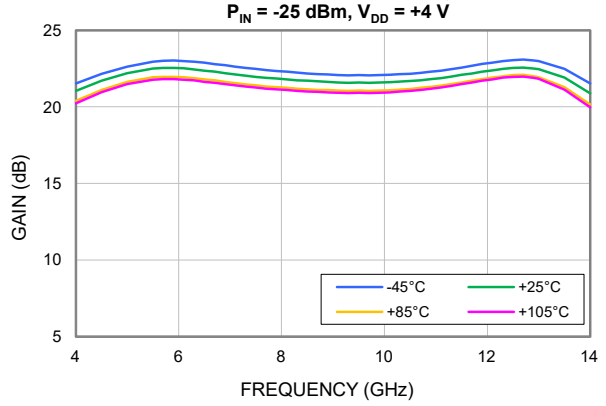
1. Tested on Mini-Circuits Characterization Test Board TB-PMA3-5123C+. See Figure 2. Board loss de-embedded to the device.
2. Current at P_{IN} = -25 dBm. Increases to 74 mA at P1dB.
3. (Current at +105°C - Current at -45°C) / (+150°C)
4. (Current at +4.25 V - Current at +3.75 V) / (+4.25 V - +3.75 V)

Low Noise Amplifier PMA3-5123+

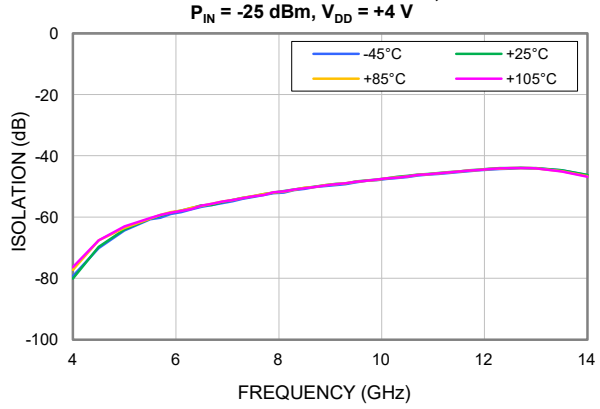
50Ω 5.5 to 12.5 GHz High Dynamic Range

TYPICAL PERFORMANCE GRAPHS

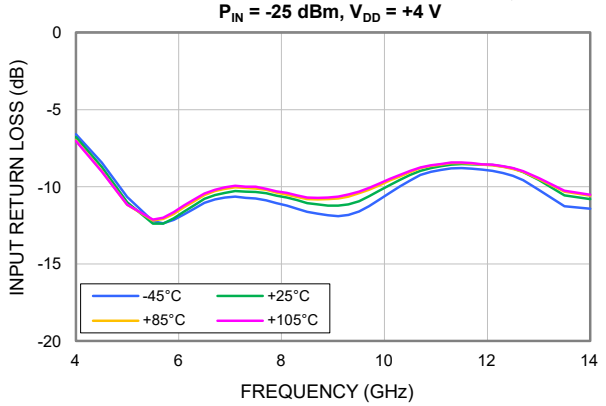
GAIN vs. TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +4 V



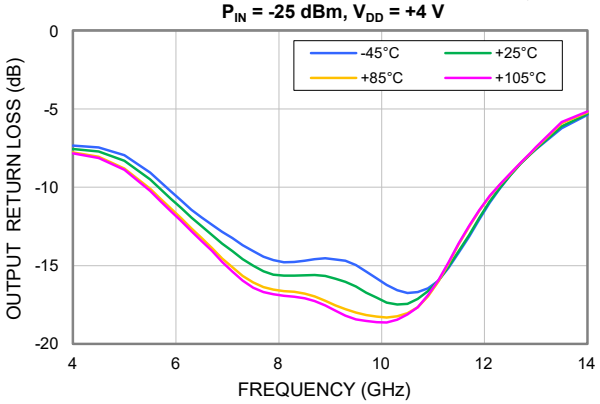
ISOLATION vs.TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +4 V



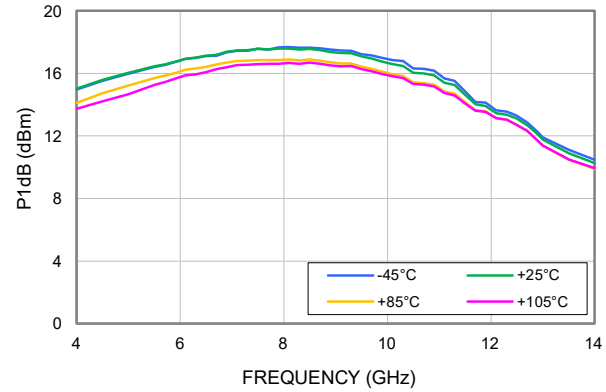
INPUT RETURN LOSS vs.TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +4 V



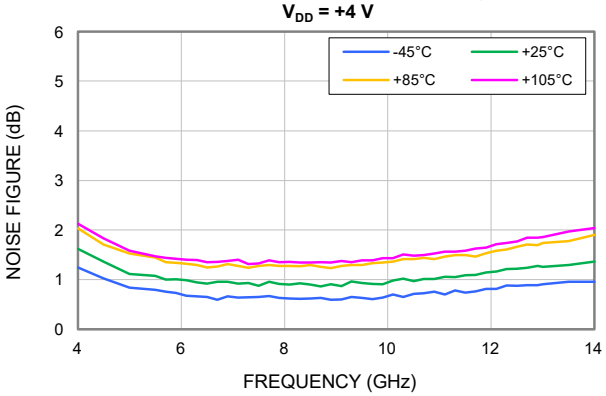
OUTPUT RETURN LOSS vs. TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +4 V



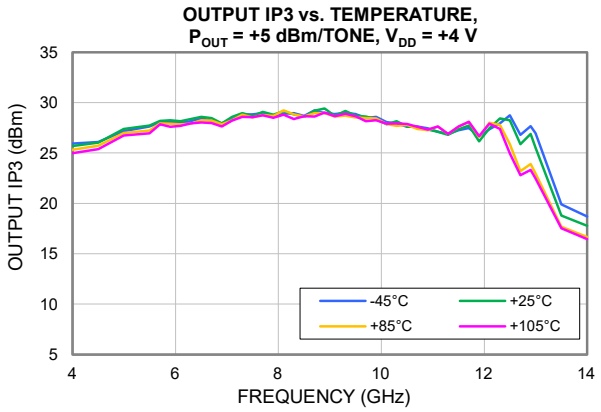
P1dB vs. TEMPERATURE,
V_{DD} = +4 V

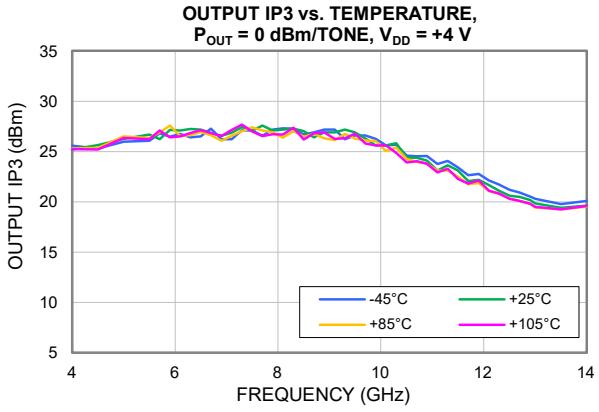


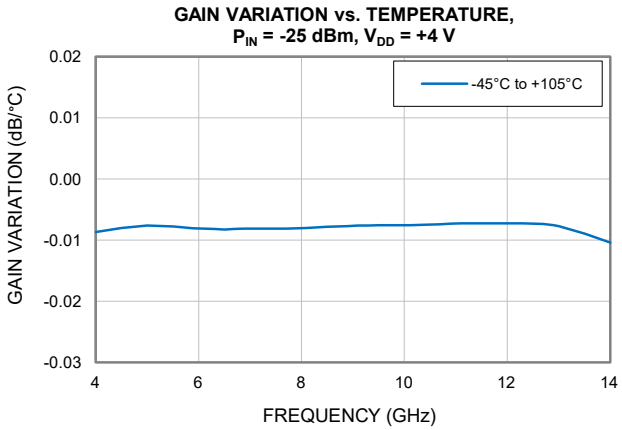
NOISE FIGURE vs. TEMPERATURE,
V_{DD} = +4 V



TYPICAL PERFORMANCE GRAPHS







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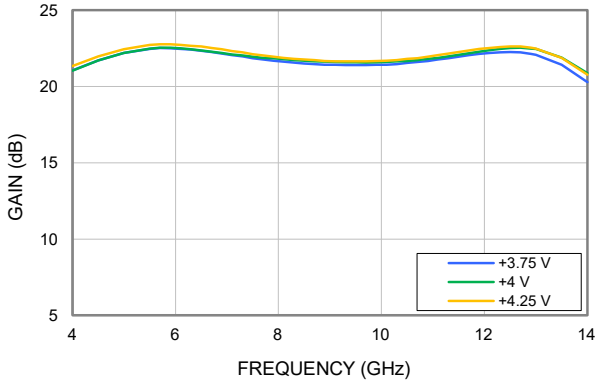
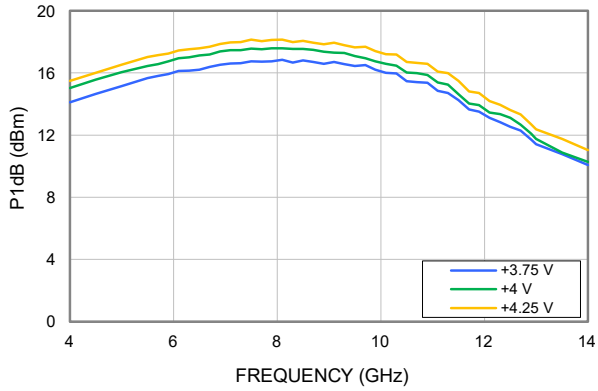
50Ω 5.5 to 12.5 GHz High Dynamic Range

TYPICAL PERFORMANCE GRAPHS

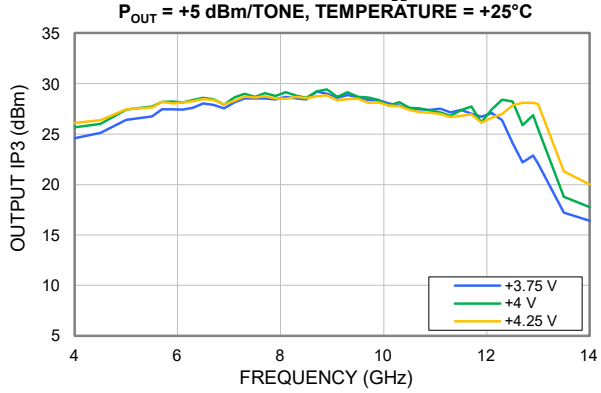
GAIN vs. V_{DD}, TEMPERATURE = +25°C



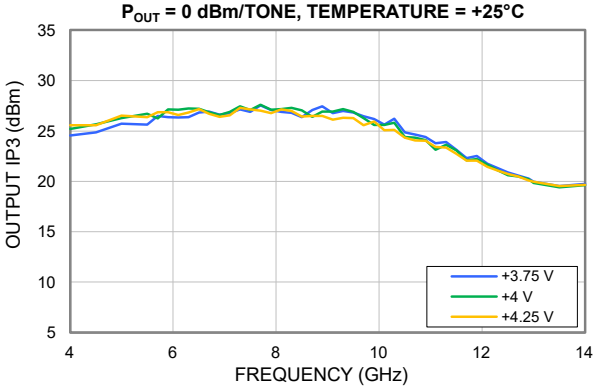
P1dB vs. V_{DD}, TEMPERATURE = +25°C



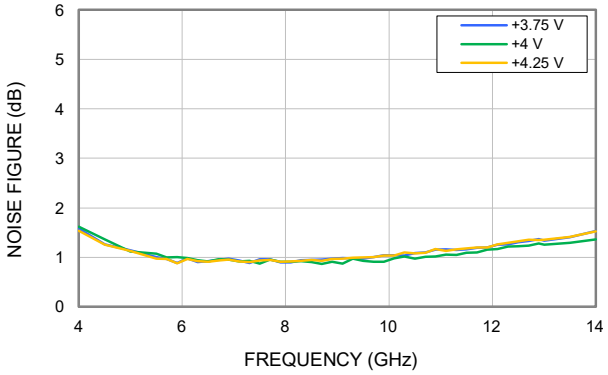
OUTPUT IP3 vs. V_{DD}, P_{OUT} = +5 dBm/TONE, TEMPERATURE = +25°C



OUTPUT IP3 vs. V_{DD}, P_{OUT} = 0 dBm/TONE, TEMPERATURE = +25°C



NOISE FIGURE vs. V_{DD}, TEMPERATURE = +25°C



ABSOLUTE MAXIMUM RATINGS[5]

Parameter	Ratings
Operating Temperature	-45°C to +105°C
Storage Temperature	-65°C to +150°C
Junction Temperature[6]	+150°C
Total Power Dissipation	0.45 W
Input Power (CW), V_{DD} = +4 V	+22 dBm
DC Voltage at V_{DD}	+5 V
DC Current I_{DD}	90 mA

5. Permanent damage may occur if any of these limits are exceeded. Maximum ratings are not intended for continuous normal operation.
6. Peak temperature on top of Die.

THERMAL RESISTANCE

Parameter	Ratings
Thermal Resistance (Θ_{JC})[7]	61.9°C/W

7. Θ_{JC}= (Hot Spot Temperature on Die - Temperature at Ground Lead)/Dissipated Power

ESD RATING

	Class	Voltage Range	Reference Standard
HBM	1C	1000 V to < 2000 V	ANSI/ESDA/JEDEC JS-001-2017
CDM	C3	≥ 1000 V	JESD22-C101F

ESD HANDLING PRECAUTION: This device is designed to be Class 1C for HBM. Static charges may easily produce potentials higher than this with improper handling and can discharge into DUT and damage it. As a preventive measure Industry standard ESD handling precautions should be used at all times to protect the device from ESD damage.

MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020E/JEDEC J-STD-033C

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FUNCTIONAL DIAGRAM

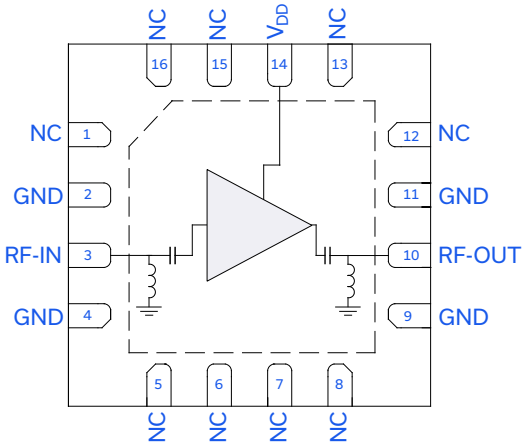

Figure 1. PMA3-5123+ Functional Diagram

PAD DESCRIPTION

Function	Pad Number	Description (Refer to Figure 2)
RF-IN	3	RF-IN Pad connects to RF Input port.
RF-OUT	10	RF-OUT Pad connects to RF Output port.
V_{DD}	14	DC Input Pad connects to voltage input port V_{DD}.
GND	2, 4, 9, 11 & Paddle	Connects to ground.
NC	1, 5-8, 12, 13, 15, 16	Not used internally. Connected to ground on test board.

CHARACTERIZATION TEST BOARD

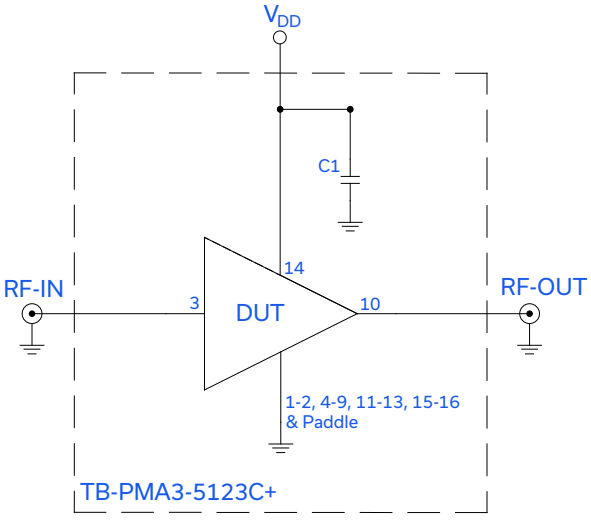

Figure 2. PMA3-5123+ Characterization and Application Circuit.

Electrical Parameters and Conditions
Gain, Return Loss, Output Power at 1dB Compression (P1dB), Output IP3 (OIP3), and Noise Figure measured using N5242A PNA-X microwave network analyzer.

Conditions:
1. Gain and Return Loss: P_{IN} = -25 dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 0 dBm/Tone & +5 dBm/Tone at output.
3. V_{DD} = +4 V

Component	Value	Size	Part Number	Manufacturer
C1	1 µF	0402	GRM155C81E105KE11D	Murata

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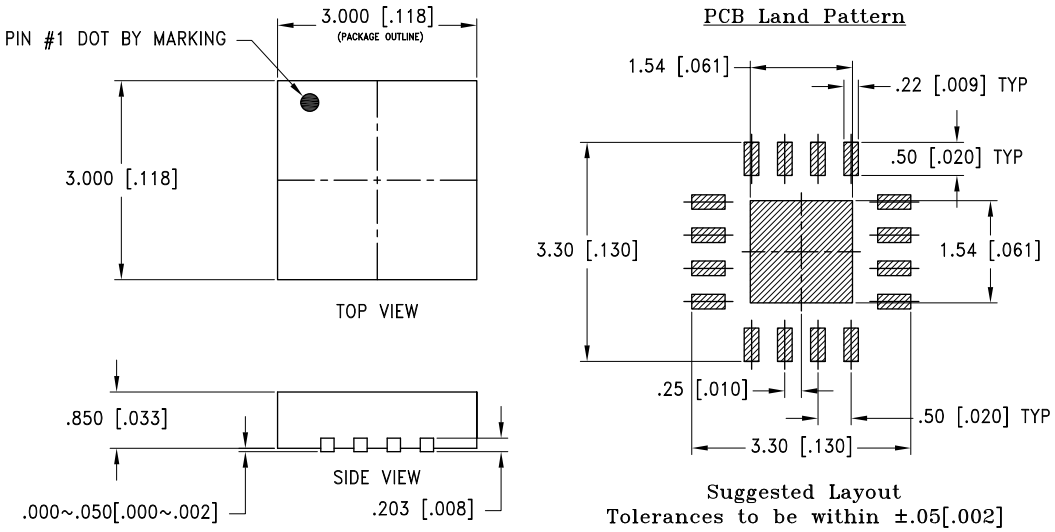
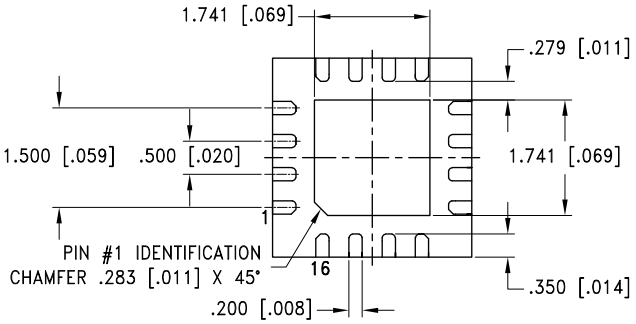
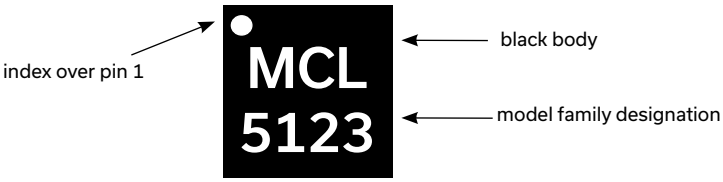
CASE STYLE DRAWING





Weight: .02 grams
Dimensions are in mm [Inches]. Tolerances: 3 Pl. ±.05 [.002]

PRODUCT MARKING



Marking may contain other features or characters for internal lot control

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ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD CLICK HERE

Performance Data & Graphs	Data Graphs S-Parameter (S2P Files) Data Set (.zip file)
Case Style	DQ3005 Plastic package, exposed paddle, Lead Finish: Matte-Tin
RoHS Status	Compliant
Tape & Reel **Standard quantities available on reel**	F104 7" reels with 20, 50, 100, 200, 500, 1000, or 2000 devices
Suggested Layout for PCB Design	PL-782
Evaluation Board	TB-PMA3-5123C+ Gerber File
Environmental Ratings	ENV08T1

NOTES

A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the standard terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/terms/viewterm.html

Typical Performance Data

NOTE: Use PDF Bookmarks to view DATA at required conditions

Definitions:
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: V_{DD} = +4 V, I_{DD} = 72 mA @ Temperature = +25°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output		1dB Comp. Output	Noise Figure
							POUT = +5 dBm/Tone	POUT = 0 dBm/Tone		
(GHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dBm)	(dB)
4.0	21.0	80.1	6.8	7.6	306.97	1.00	25.7	25.2	15.0	1.6
4.5	21.7	69.8	8.7	7.7	95.63	0.94	26.0	25.7	15.6	1.4
5.0	22.2	64.0	11.0	8.3	51.15	0.92	27.4	26.3	16.0	1.1
5.5	22.5	60.6	12.4	9.5	35.51	0.94	27.7	26.7	16.4	1.1
5.7	22.5	59.6	12.4	10.1	32.21	0.96	28.2	26.2	16.6	1.0
5.9	22.5	58.6	12.1	10.7	29.23	0.97	28.2	27.1	16.7	1.0
6.1	22.5	57.9	11.6	11.3	27.00	0.99	28.1	27.1	16.9	1.0
6.3	22.4	57.1	11.2	11.9	25.00	1.01	28.4	27.2	17.0	0.9
6.5	22.4	56.2	10.8	12.5	22.67	1.02	28.6	27.2	17.1	0.9
6.7	22.3	56.1	10.5	13.0	22.70	1.04	28.5	26.9	17.2	1.0
6.9	22.2	55.1	10.4	13.6	20.60	1.05	27.9	26.6	17.4	1.0
7.1	22.1	54.5	10.3	14.1	19.42	1.05	28.6	26.9	17.5	0.9
7.3	22.0	53.7	10.3	14.6	18.18	1.06	29.0	27.4	17.5	0.9
7.5	22.0	53.2	10.3	15.0	17.32	1.06	28.7	27.1	17.6	0.9
7.7	21.9	52.6	10.4	15.4	16.32	1.06	29.1	27.6	17.5	1.0
7.9	21.8	52.0	10.6	15.6	15.41	1.06	28.8	27.1	17.6	0.9
8.1	21.8	51.5	10.7	15.7	14.87	1.06	29.1	27.2	17.6	0.9
8.3	21.7	51.0	10.9	15.7	14.10	1.05	28.8	27.3	17.5	0.9
8.5	21.7	50.5	11.1	15.6	13.51	1.05	28.6	27.0	17.6	0.9
8.7	21.7	50.1	11.1	15.6	12.86	1.05	29.2	26.4	17.5	0.9
8.9	21.6	49.6	11.2	15.7	12.32	1.05	29.4	26.9	17.4	0.9
9.1	21.6	49.3	11.2	15.8	11.89	1.05	28.7	26.9	17.3	0.9
9.3	21.6	49.0	11.1	16.0	11.59	1.05	29.2	27.2	17.3	1.0
9.5	21.6	48.4	10.9	16.3	10.74	1.06	28.7	26.9	17.1	0.9
9.7	21.6	48.1	10.6	16.7	10.37	1.06	28.6	26.3	17.0	0.9
9.9	21.6	47.7	10.3	17.1	9.89	1.07	28.4	25.6	16.8	0.9
10.1	21.6	47.4	9.9	17.4	9.42	1.08	27.8	25.6	16.6	1.0
10.3	21.6	46.8	9.6	17.5	8.75	1.09	28.2	25.8	16.5	1.0
10.5	21.7	46.6	9.2	17.4	8.39	1.10	27.6	24.4	16.0	1.0
10.7	21.7	46.2	9.0	17.1	7.90	1.11	27.6	24.4	16.0	1.0
10.9	21.8	45.9	8.8	16.6	7.51	1.11	27.3	24.1	15.9	1.0
11.1	21.9	45.6	8.7	16.0	7.19	1.11	27.1	23.1	15.4	1.1
11.3	22.0	45.4	8.6	15.0	6.81	1.11	26.8	23.6	15.3	1.0
11.5	22.1	45.1	8.5	14.1	6.45	1.10	27.4	23.1	14.6	1.1
11.7	22.2	44.7	8.5	13.0	6.04	1.09	27.7	22.1	14.0	1.1
11.9	22.3	44.5	8.6	11.9	5.73	1.07	26.2	22.2	13.9	1.2
12.1	22.4	44.2	8.6	10.9	5.42	1.05	27.4	21.7	13.4	1.2
12.3	22.5	44.1	8.7	10.0	5.18	1.03	28.4	21.1	13.4	1.2
12.5	22.5	44.0	8.8	9.2	5.01	1.00	28.2	20.6	13.1	1.2
12.7	22.6	43.9	9.1	8.5	4.88	0.97	25.9	20.5	12.7	1.2
12.9	22.5	43.9	9.4	7.9	4.87	0.94	26.9	20.2	12.1	1.3
13.0	22.5	44.0	9.6	7.6	4.89	0.92	25.5	19.8	11.8	1.3
13.5	21.9	44.7	10.6	6.1	5.37	0.82	18.8	19.4	10.9	1.3
14.0	20.9	46.3	10.8	5.3	6.96	0.75	17.8	19.6	10.3	1.4

Typical Performance Data

Definitions:
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: V_{DD} = +3.75 V, I_{DD} = 65 mA @ Temperature = +25°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output		1dB Comp. Output	Noise Figure
							POUT = +5 dBm/Tone	POUT = 0 dBm/Tone		
(GHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dBm)	(dB)
4.0	21.1	77.7	6.9	8.0	263.17	1.01	24.6	24.5	14.1	1.6
4.5	21.7	68.7	8.8	8.2	91.37	0.96	25.1	24.8	14.6	1.3
5.0	22.2	63.2	10.9	8.9	50.37	0.94	26.4	25.7	15.1	1.1
5.5	22.5	59.8	12.3	9.9	34.08	0.95	26.8	25.6	15.7	1.0
5.7	22.5	58.4	12.5	10.5	29.46	0.96	27.5	26.5	15.8	1.0
5.9	22.5	59.4	12.3	11.1	33.27	0.98	27.4	26.4	15.9	0.9
6.1	22.5	57.4	12.1	11.7	26.73	0.99	27.4	26.3	16.1	1.0
6.3	22.4	57.4	11.7	12.6	27.45	1.01	27.6	26.4	16.2	0.9
6.5	22.4	57.0	11.2	13.4	26.26	1.03	28.0	26.8	16.2	0.9
6.7	22.3	55.8	10.9	14.2	23.29	1.04	27.9	26.9	16.4	1.0
6.9	22.2	54.7	10.6	15.1	20.71	1.06	27.6	26.6	16.5	1.0
7.1	22.1	54.5	10.4	15.8	20.51	1.06	28.1	26.8	16.6	0.9
7.3	22.0	54.0	10.4	16.2	19.63	1.07	28.5	27.2	16.6	0.9
7.5	21.9	52.7	10.3	16.5	17.11	1.07	28.5	26.9	16.7	1.0
7.7	21.8	52.5	10.4	16.4	17.04	1.07	28.5	27.5	16.7	1.0
7.9	21.7	51.9	10.6	16.3	16.11	1.06	28.4	27.1	16.7	0.9
8.1	21.6	51.7	10.7	16.3	15.91	1.06	28.7	26.9	16.8	0.9
8.3	21.6	51.2	10.8	16.0	15.14	1.06	28.5	26.8	16.7	0.9
8.5	21.5	50.4	11.0	15.9	13.93	1.05	28.4	26.4	16.8	0.9
8.7	21.5	50.1	11.1	16.1	13.57	1.05	29.2	27.1	16.7	1.0
8.9	21.4	49.7	11.0	15.9	12.97	1.05	29.0	27.4	16.6	1.0
9.1	21.4	48.9	11.0	16.0	11.89	1.05	28.6	26.7	16.7	1.0
9.3	21.4	48.3	11.0	16.2	11.23	1.05	28.9	27.0	16.6	1.0
9.5	21.4	48.4	10.7	16.3	11.20	1.06	28.7	26.8	16.5	1.0
9.7	21.4	47.7	10.6	16.5	10.44	1.06	28.4	26.4	16.5	1.0
9.9	21.4	47.6	10.3	16.7	10.21	1.07	28.3	26.2	16.2	1.0
10.1	21.4	47.1	10.1	16.5	9.53	1.07	28.0	25.6	16.0	1.0
10.3	21.5	46.9	9.9	16.4	9.27	1.08	27.8	26.2	16.0	1.0
10.5	21.5	46.5	9.8	16.5	8.77	1.08	27.5	24.8	15.5	1.1
10.7	21.6	46.2	9.4	16.1	8.33	1.09	27.5	24.6	15.4	1.1
10.9	21.7	45.9	9.4	15.7	7.89	1.09	27.4	24.4	15.4	1.2
11.1	21.8	45.4	9.3	15.5	7.37	1.09	27.5	23.8	14.8	1.2
11.3	21.9	45.2	9.1	14.9	7.03	1.09	27.1	23.9	14.7	1.1
11.5	22.0	45.0	9.0	14.1	6.75	1.09	27.4	23.1	14.2	1.2
11.7	22.0	44.6	9.0	13.4	6.33	1.08	27.0	22.3	13.6	1.2
11.9	22.1	44.3	9.0	12.6	5.99	1.07	26.7	22.5	13.5	1.2
12.1	22.2	44.1	9.0	11.6	5.73	1.05	27.1	21.7	13.1	1.3
12.3	22.2	44.0	9.1	10.7	5.54	1.03	26.4	21.3	12.8	1.3
12.5	22.3	43.8	9.3	9.7	5.36	1.01	24.1	20.9	12.5	1.3
12.7	22.2	43.8	9.6	8.8	5.27	0.97	22.2	20.6	12.3	1.3
12.9	22.1	43.9	10.0	8.0	5.31	0.93	22.9	20.2	11.7	1.4
13.0	22.1	43.9	10.1	7.7	5.29	0.91	22.1	20.0	11.4	1.3
13.5	21.4	44.7	10.9	6.3	5.97	0.82	17.2	19.5	10.8	1.4
14.0	20.3	46.1	10.7	5.9	7.77	0.79	16.4	19.7	10.1	1.5

Typical Performance Data

Definitions:
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: V_{DD} = +4.25 V, I_{DD} = 78 mA @ Temperature = +25°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output		1dB Comp. Output	Noise Figure
							POUT = +5 dBm/Tone	POUT = 0 dBm/Tone		
(GHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dBm)	(dB)
4.0	21.4	71.6	7.0	7.9	130.95	1.01	26.1	25.6	15.5	1.5
4.5	22.0	73.7	8.9	8.1	195.54	0.96	26.4	25.6	16.0	1.3
5.0	22.4	65.4	11.1	8.8	63.97	0.94	27.5	26.5	16.5	1.1
5.5	22.7	61.0	12.8	9.9	39.03	0.95	27.6	26.4	17.0	1.0
5.7	22.8	59.5	13.0	10.4	32.48	0.96	28.2	26.9	17.1	1.0
5.9	22.8	58.9	12.9	11.0	31.06	0.97	28.0	26.9	17.2	0.9
6.1	22.7	58.7	12.7	11.7	30.64	0.98	28.1	26.6	17.4	1.0
6.3	22.7	57.8	12.3	12.6	28.12	1.00	28.3	26.8	17.5	0.9
6.5	22.6	56.9	11.8	13.4	25.66	1.02	28.5	27.2	17.6	0.9
6.7	22.5	56.0	11.6	14.2	23.46	1.03	28.4	26.7	17.7	0.9
6.9	22.4	55.3	11.2	15.1	21.72	1.04	27.9	26.4	17.9	1.0
7.1	22.3	54.7	11.0	15.7	20.65	1.05	28.3	26.6	18.0	0.9
7.3	22.2	54.6	10.9	16.1	20.65	1.06	28.7	27.3	18.0	0.9
7.5	22.1	53.7	10.9	16.4	18.88	1.06	28.6	27.1	18.1	0.9
7.7	22.0	53.3	10.9	16.4	18.33	1.06	28.7	27.0	18.0	0.9
7.9	22.0	52.2	11.1	16.3	16.38	1.05	28.5	26.8	18.1	0.9
8.1	21.9	51.9	11.2	16.3	16.01	1.05	28.5	27.2	18.1	0.9
8.3	21.8	51.7	11.3	16.0	15.73	1.05	28.7	27.0	18.0	0.9
8.5	21.8	51.2	11.6	15.9	15.10	1.04	28.6	26.4	18.1	1.0
8.7	21.7	50.6	11.7	16.0	14.15	1.04	28.7	26.5	17.9	0.9
8.9	21.7	50.0	11.6	15.9	13.21	1.04	28.8	26.5	17.8	1.0
9.1	21.7	49.7	11.7	15.9	12.81	1.04	28.3	26.1	17.9	1.0
9.3	21.7	49.7	11.7	16.2	12.95	1.04	28.5	26.3	17.8	1.0
9.5	21.6	49.2	11.4	16.3	12.23	1.05	28.5	26.3	17.7	1.0
9.7	21.7	48.3	11.2	16.4	10.98	1.05	28.1	25.5	17.7	1.0
9.9	21.7	48.3	11.0	16.6	10.85	1.06	28.2	25.9	17.4	1.0
10.1	21.7	47.7	10.7	16.4	10.00	1.06	27.8	25.1	17.2	1.0
10.3	21.7	47.4	10.6	16.2	9.66	1.06	27.8	25.1	17.2	1.1
10.5	21.8	47.2	10.4	16.3	9.29	1.07	27.4	24.4	16.7	1.1
10.7	21.9	46.7	10.0	15.9	8.65	1.07	27.2	24.1	16.6	1.1
10.9	21.9	46.3	10.0	15.5	8.10	1.07	27.1	24.0	16.6	1.2
11.1	22.1	46.0	9.9	15.3	7.77	1.07	27.0	23.4	16.1	1.1
11.3	22.2	45.8	9.6	14.7	7.35	1.08	26.7	23.3	16.0	1.2
11.5	22.3	45.7	9.5	13.9	7.18	1.07	26.8	22.7	15.5	1.2
11.7	22.4	45.4	9.5	13.2	6.76	1.06	27.0	22.0	14.8	1.2
11.9	22.5	45.1	9.4	12.4	6.39	1.06	26.1	22.1	14.7	1.2
12.1	22.5	44.9	9.4	11.4	6.13	1.04	26.6	21.4	14.2	1.3
12.3	22.6	44.6	9.5	10.5	5.77	1.02	27.0	21.1	14.0	1.3
12.5	22.6	44.4	9.7	9.6	5.54	0.99	27.9	20.7	13.6	1.3
12.7	22.6	44.4	10.0	8.6	5.39	0.95	28.1	20.5	13.3	1.4
12.9	22.5	44.4	10.3	7.8	5.34	0.92	28.1	20.1	12.7	1.3
13.0	22.5	44.7	10.4	7.5	5.49	0.90	28.0	19.9	12.4	1.4
13.5	21.9	45.2	11.2	6.1	5.91	0.81	21.3	19.5	11.8	1.4
14.0	20.8	46.7	10.9	5.6	7.73	0.77	20.0	19.6	11.0	1.5

Typical Performance Data

Definitions:
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: V_{DD} = +4 V, I_{DD} = 72 mA @ Temperature = -45°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output		1dB Comp. Output	Noise Figure
							POUT = +5 dBm/Tone	POUT = 0 dBm/Tone		
(GHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dBm)	(dB)
4.0	21.5	79.3	6.6	7.3	264.1	1.0	25.9	25.6	15.0	1.2
4.5	22.2	70.1	8.4	7.5	92.4	0.9	26.1	25.3	15.5	1.0
5.0	22.6	64.4	10.7	8.0	49.5	0.9	27.2	26.0	16.0	0.8
5.5	22.9	60.8	12.2	9.1	34.0	0.9	27.6	26.1	16.4	0.8
5.7	23.0	60.2	12.4	9.7	32.1	0.9	28.1	26.8	16.5	0.8
5.9	23.0	58.9	12.2	10.3	28.3	1.0	28.1	26.5	16.7	0.7
6.1	23.0	58.3	11.8	10.9	26.5	1.0	28.0	26.8	16.9	0.7
6.3	22.9	57.5	11.4	11.4	24.5	1.0	28.1	26.4	17.0	0.7
6.5	22.9	56.6	11.0	11.9	22.4	1.0	28.4	26.5	17.1	0.7
6.7	22.8	56.1	10.8	12.4	21.3	1.0	28.2	27.3	17.1	0.6
6.9	22.7	55.5	10.7	12.9	20.2	1.0	27.9	26.2	17.4	0.7
7.1	22.6	54.9	10.6	13.3	19.1	1.0	28.3	26.2	17.4	0.6
7.3	22.5	54.0	10.7	13.7	17.6	1.0	28.8	27.1	17.4	0.6
7.5	22.5	53.5	10.8	14.1	16.8	1.0	28.8	27.1	17.6	0.7
7.7	22.4	52.8	10.9	14.4	15.7	1.0	29.0	26.6	17.5	0.7
7.9	22.4	52.1	11.1	14.7	14.8	1.0	28.6	27.2	17.7	0.6
8.1	22.3	51.9	11.2	14.8	14.7	1.0	28.9	27.3	17.7	0.6
8.3	22.2	51.2	11.4	14.8	13.6	1.0	29.0	27.3	17.6	0.6
8.5	22.2	50.8	11.6	14.7	13.1	1.0	28.7	26.7	17.6	0.6
8.7	22.1	50.2	11.8	14.6	12.4	1.0	29.2	26.9	17.6	0.6
8.9	22.1	49.9	11.9	14.5	12.0	1.0	29.0	27.2	17.5	0.6
9.1	22.1	49.6	11.9	14.6	11.7	1.0	28.8	27.2	17.5	0.6
9.3	22.1	49.3	11.8	14.7	11.3	1.0	29.0	26.2	17.4	0.7
9.5	22.1	48.6	11.6	15.0	10.5	1.0	28.8	26.6	17.2	0.6
9.7	22.1	48.2	11.3	15.4	9.9	1.0	28.5	26.6	17.2	0.6
9.9	22.1	47.9	10.8	15.8	9.6	1.1	28.6	26.3	17.0	0.6
10.1	22.1	47.5	10.4	16.2	9.1	1.1	28.1	25.6	16.9	0.7
10.3	22.1	47.3	10.0	16.6	8.8	1.1	27.9	25.7	16.8	0.7
10.5	22.2	46.9	9.6	16.8	8.2	1.1	27.6	24.6	16.3	0.7
10.7	22.2	46.5	9.2	16.7	7.8	1.1	27.6	24.5	16.3	0.7
10.9	22.3	46.2	9.0	16.4	7.4	1.1	27.4	24.6	16.2	0.8
11.1	22.4	45.9	8.9	16.0	7.0	1.1	27.1	23.8	15.7	0.7
11.3	22.5	45.6	8.8	15.1	6.7	1.1	26.9	24.1	15.5	0.8
11.5	22.6	45.3	8.8	14.2	6.3	1.1	27.2	23.4	14.8	0.7
11.7	22.7	44.9	8.8	13.2	5.9	1.1	27.5	22.6	14.2	0.8
11.9	22.8	44.7	8.9	12.0	5.6	1.1	26.6	22.8	14.1	0.8
12.1	22.9	44.5	9.0	11.0	5.3	1.0	27.4	22.1	13.6	0.8
12.3	23.0	44.3	9.1	10.1	5.1	1.0	27.9	21.7	13.6	0.9
12.5	23.1	44.2	9.3	9.2	4.9	1.0	28.7	21.2	13.3	0.9
12.7	23.1	44.1	9.6	8.5	4.7	1.0	26.8	20.9	12.9	0.9
12.9	23.0	44.1	10.0	7.9	4.7	0.9	27.7	20.5	12.2	0.9
13.0	23.0	44.1	10.2	7.6	4.7	0.9	26.9	20.3	11.9	0.9
13.5	22.5	44.7	11.3	6.2	5.2	0.8	19.9	19.8	11.1	1.0
14.0	21.5	46.4	11.4	5.4	6.57	0.75	18.7	20.1	10.5	1.0

Typical Performance Data

Definitions:
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: V_{DD} = +4 V, I_{DD} = 72 mA @ Temperature = +85°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output		1dB Comp. Output	Noise Figure
							POUT = +5 dBm/Tone	POUT = 0 dBm/Tone		
(GHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dBm)	(dB)
4.0	20.4	77.3	7.0	7.8	247.8	1.0	25.3	25.3	14.1	2.0
4.5	21.1	67.5	9.0	8.1	81.9	1.0	25.7	25.4	14.7	1.7
5.0	21.6	63.5	11.2	8.8	53.0	0.9	27.0	26.5	15.2	1.5
5.5	21.9	60.5	12.2	10.1	38.7	1.0	27.2	26.4	15.7	1.4
5.7	22.0	59.2	12.1	10.7	33.6	1.0	27.9	26.9	15.8	1.4
5.9	22.0	58.3	11.8	11.4	30.6	1.0	27.9	27.6	16.0	1.3
6.1	21.9	57.9	11.3	12.0	29.4	1.0	27.8	26.5	16.2	1.3
6.3	21.9	57.0	10.9	12.6	26.7	1.0	27.9	26.6	16.3	1.3
6.5	21.8	56.4	10.5	13.2	25.4	1.0	28.2	27.0	16.4	1.2
6.7	21.7	55.7	10.3	13.9	23.5	1.1	28.2	26.6	16.6	1.3
6.9	21.6	55.0	10.1	14.5	22.0	1.1	27.8	26.1	16.7	1.3
7.1	21.5	54.5	10.0	15.1	21.0	1.1	28.3	26.6	16.8	1.3
7.3	21.5	53.8	10.1	15.7	19.6	1.1	28.8	27.0	16.8	1.2
7.5	21.4	53.1	10.1	16.1	18.4	1.1	28.5	27.4	16.8	1.3
7.7	21.3	52.5	10.2	16.4	17.6	1.1	28.8	27.1	16.8	1.3
7.9	21.3	52.0	10.4	16.5	16.6	1.1	28.7	26.9	16.8	1.3
8.1	21.2	51.7	10.5	16.6	16.3	1.1	29.2	26.4	16.9	1.3
8.3	21.2	51.0	10.7	16.7	15.3	1.1	28.8	27.0	16.8	1.3
8.5	21.1	50.4	10.8	16.8	14.4	1.1	28.6	26.5	16.9	1.3
8.7	21.1	50.1	10.8	17.0	14.0	1.1	29.0	26.7	16.8	1.3
8.9	21.1	49.6	10.8	17.2	13.2	1.1	28.9	26.3	16.7	1.2
9.1	21.1	49.4	10.8	17.5	12.9	1.1	28.6	26.1	16.6	1.3
9.3	21.0	49.0	10.6	17.8	12.4	1.1	28.7	26.8	16.6	1.3
9.5	21.1	48.5	10.4	18.0	11.7	1.1	28.5	26.3	16.4	1.3
9.7	21.0	48.1	10.2	18.2	11.2	1.1	28.4	26.1	16.3	1.3
9.9	21.1	47.8	9.9	18.3	10.7	1.1	28.4	26.1	16.1	1.3
10.1	21.1	47.4	9.6	18.3	10.1	1.1	27.9	25.1	16.0	1.4
10.3	21.1	47.0	9.3	18.2	9.5	1.1	27.7	25.4	15.8	1.4
10.5	21.2	46.7	9.1	18.0	9.1	1.1	27.8	24.3	15.4	1.4
10.7	21.2	46.3	8.8	17.7	8.6	1.1	27.4	24.0	15.4	1.4
10.9	21.3	46.0	8.7	17.0	8.2	1.1	27.3	23.8	15.3	1.4
11.1	21.4	45.7	8.6	16.0	7.8	1.1	27.6	23.1	14.8	1.5
11.3	21.5	45.4	8.5	14.8	7.3	1.1	26.9	23.1	14.7	1.5
11.5	21.6	45.2	8.5	13.6	6.9	1.1	27.6	22.5	14.2	1.5
11.7	21.7	44.8	8.5	12.5	6.5	1.1	28.1	21.8	13.6	1.5
11.9	21.8	44.6	8.6	11.5	6.2	1.1	26.6	21.9	13.6	1.5
12.1	21.9	44.4	8.6	10.6	5.9	1.0	28.0	21.1	13.2	1.6
12.3	22.0	44.2	8.7	9.8	5.6	1.0	27.8	20.8	13.0	1.6
12.5	22.1	44.0	8.8	9.2	5.4	1.0	25.9	20.4	12.7	1.7
12.7	22.1	44.0	9.0	8.5	5.3	1.0	23.2	20.1	12.3	1.7
12.9	22.0	44.0	9.3	7.8	5.3	0.9	23.9	19.8	11.7	1.7
13.0	22.0	44.1	9.5	7.5	5.3	0.9	22.9	19.4	11.4	1.7
13.5	21.3	45.0	10.3	5.9	6.0	0.8	17.7	19.3	10.5	1.8
14.0	20.2	46.7	10.6	5.2	7.88	0.75	16.6	19.5	9.9	1.9

Typical Performance Data

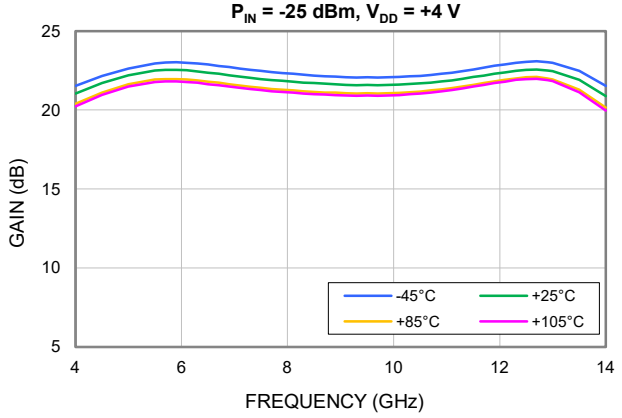
Definitions:
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: V_{DD} = +4 V, I_{DD} = 72 mA @ Temperature = +105°C

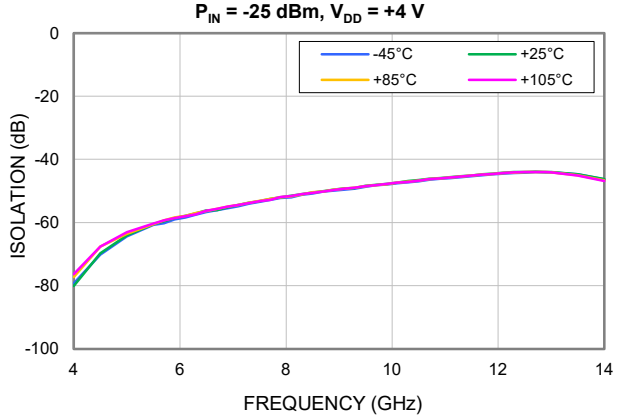
FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output		1dB Comp. Output	Noise Figure
							POUT = +5 dBm/Tone	POUT = 0 dBm/Tone		
(GHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dBm)	(dB)
4.0	20.2	76.3	7.0	7.8	226.5	1.0	25.0	25.2	13.7	2.1
4.5	21.0	67.6	9.0	8.1	84.4	1.0	25.4	25.2	14.2	1.8
5.0	21.5	63.0	11.2	8.9	51.3	0.9	26.7	26.4	14.7	1.6
5.5	21.8	60.3	12.1	10.2	38.3	1.0	26.9	26.2	15.3	1.5
5.7	21.8	59.2	12.0	10.9	34.4	1.0	27.8	27.1	15.4	1.4
5.9	21.8	58.6	11.7	11.5	32.4	1.0	27.6	26.4	15.6	1.4
6.1	21.8	58.0	11.2	12.1	30.2	1.0	27.7	26.5	15.9	1.4
6.3	21.7	57.3	10.8	12.8	28.3	1.0	27.9	26.8	15.9	1.4
6.5	21.6	56.3	10.4	13.4	25.3	1.0	28.0	27.1	16.1	1.4
6.7	21.6	55.7	10.2	14.1	23.9	1.1	28.0	26.9	16.3	1.4
6.9	21.5	54.9	10.0	14.8	22.2	1.1	27.6	26.5	16.4	1.4
7.1	21.4	54.5	9.9	15.4	21.5	1.1	28.2	27.1	16.5	1.4
7.3	21.3	53.8	10.0	16.0	20.1	1.1	28.6	27.7	16.6	1.3
7.5	21.3	53.2	10.0	16.4	19.0	1.1	28.5	27.0	16.6	1.3
7.7	21.2	52.8	10.1	16.7	18.5	1.1	28.7	26.6	16.6	1.4
7.9	21.1	51.9	10.3	16.8	16.8	1.1	28.5	26.7	16.6	1.4
8.1	21.1	51.6	10.4	16.9	16.4	1.1	28.8	26.7	16.7	1.4
8.3	21.0	51.0	10.6	17.0	15.4	1.1	28.4	27.4	16.6	1.3
8.5	21.0	50.6	10.7	17.1	15.0	1.1	28.7	26.2	16.7	1.3
8.7	21.0	50.2	10.7	17.3	14.3	1.1	28.6	26.8	16.6	1.4
8.9	20.9	49.7	10.7	17.6	13.6	1.1	29.0	26.9	16.5	1.3
9.1	20.9	49.3	10.6	17.9	13.1	1.1	28.7	26.3	16.5	1.4
9.3	20.9	48.9	10.5	18.2	12.5	1.1	28.9	26.3	16.5	1.4
9.5	20.9	48.5	10.3	18.4	11.9	1.1	28.7	26.8	16.3	1.4
9.7	20.9	48.1	10.1	18.5	11.3	1.1	28.1	25.8	16.1	1.4
9.9	20.9	47.7	9.8	18.6	10.8	1.1	28.2	25.6	16.0	1.4
10.1	21.0	47.3	9.5	18.6	10.2	1.1	27.9	25.6	15.8	1.4
10.3	21.0	47.1	9.2	18.4	9.8	1.1	28.0	24.9	15.7	1.5
10.5	21.0	46.8	9.0	18.1	9.3	1.1	27.9	23.9	15.3	1.5
10.7	21.1	46.3	8.7	17.7	8.7	1.1	27.6	24.0	15.3	1.5
10.9	21.2	46.0	8.6	16.9	8.3	1.1	27.3	23.8	15.2	1.5
11.1	21.3	45.7	8.5	16.0	7.9	1.1	27.6	22.9	14.7	1.6
11.3	21.4	45.4	8.4	14.8	7.4	1.1	26.9	23.3	14.6	1.6
11.5	21.5	45.1	8.4	13.6	7.0	1.1	27.6	22.3	14.1	1.6
11.7	21.6	44.8	8.5	12.5	6.6	1.1	28.1	21.8	13.6	1.6
11.9	21.7	44.6	8.5	11.4	6.3	1.1	26.7	22.1	13.5	1.6
12.1	21.8	44.4	8.6	10.5	5.9	1.0	27.9	21.1	13.1	1.7
12.3	21.9	44.2	8.7	9.8	5.7	1.0	27.4	20.8	13.0	1.7
12.5	22.0	44.0	8.8	9.1	5.4	1.0	25.0	20.3	12.7	1.8
12.7	22.0	44.0	9.0	8.4	5.3	1.0	22.8	20.1	12.3	1.8
12.9	21.9	44.1	9.3	7.8	5.4	0.9	23.3	19.8	11.7	1.9
13.0	21.8	44.1	9.4	7.5	5.4	0.9	22.4	19.5	11.4	1.9
13.5	21.1	45.0	10.3	5.9	6.1	0.8	17.5	19.2	10.5	2.0
14.0	20.0	46.8	10.5	5.2	8.13	0.75	16.5	19.6	9.9	2.0

Typical Performance Curves

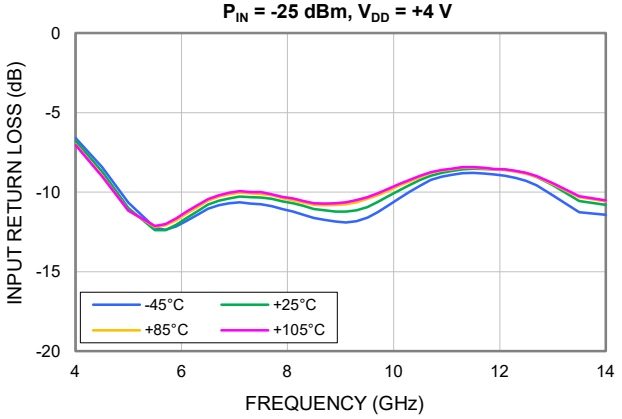
GAIN vs. TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +4 V



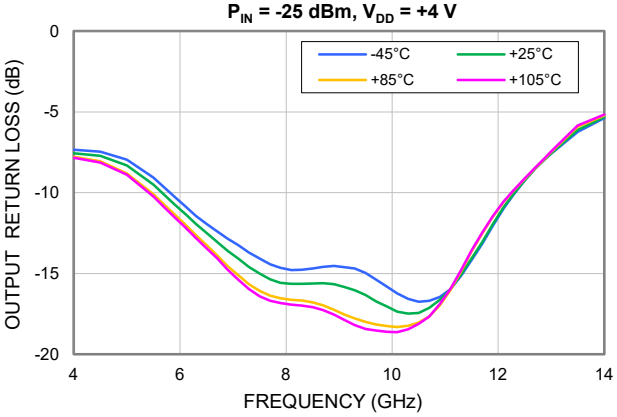
ISOLATION vs.TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +4 V



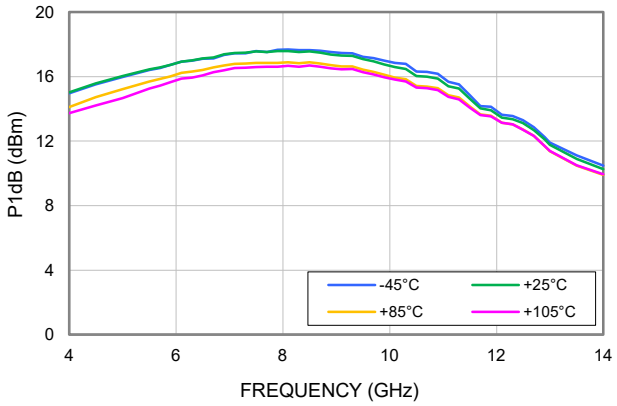
INPUT RETURN LOSS vs.TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +4 V



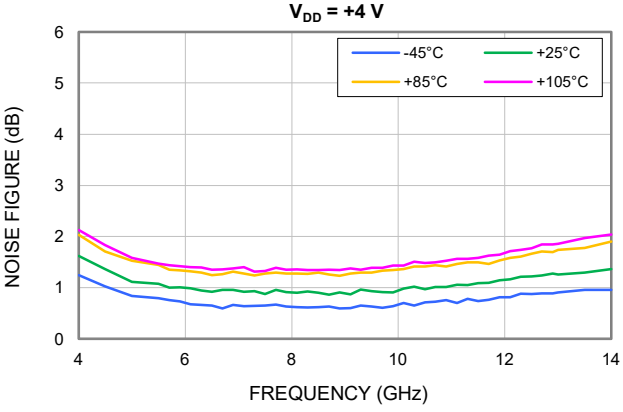
OUTPUT RETURN LOSS vs. TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +4 V



P1dB vs. TEMPERATURE,
V_{DD} = +4 V

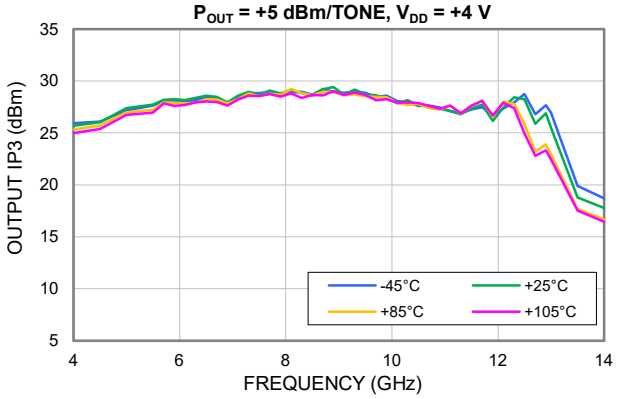


NOISE FIGURE vs. TEMPERATURE,
V_{DD} = +4 V

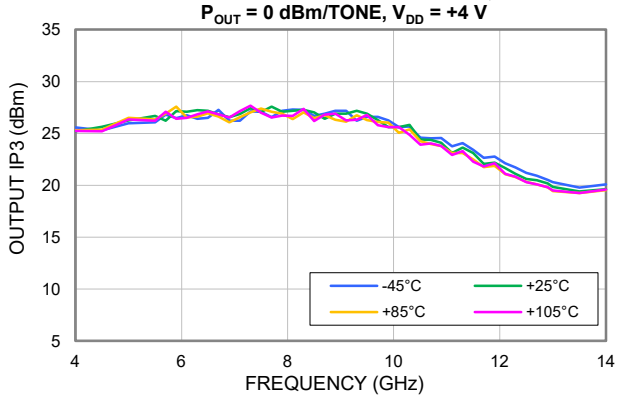


Typical Performance Curves

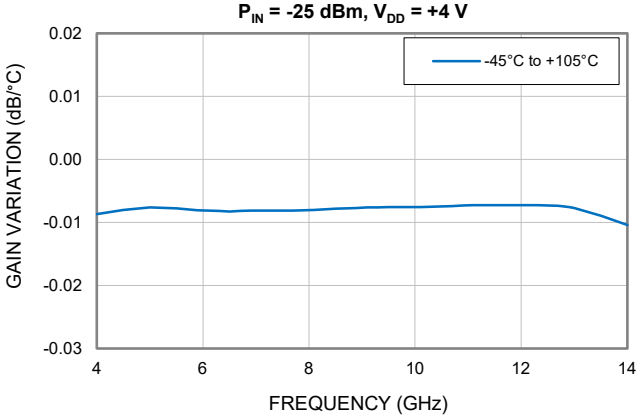
OUTPUT IP3 vs. TEMPERATURE, P_{OUT} = +5 dBm/TONE, V_{DD} = +4 V



OUTPUT IP3 vs. TEMPERATURE, P_{OUT} = 0 dBm/TONE, V_{DD} = +4 V

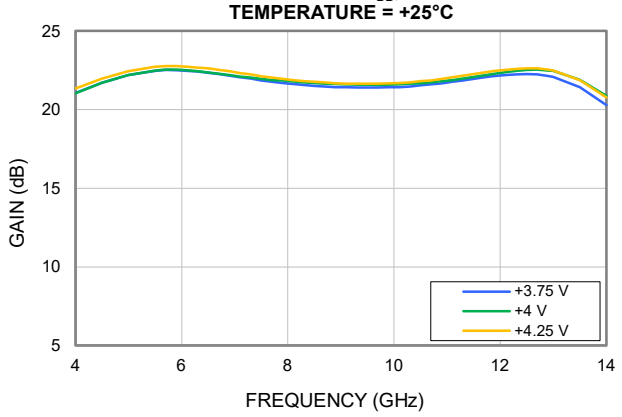


GAIN VARIATION vs. TEMPERATURE, P_{IN} = -25 dBm, V_{DD} = +4 V

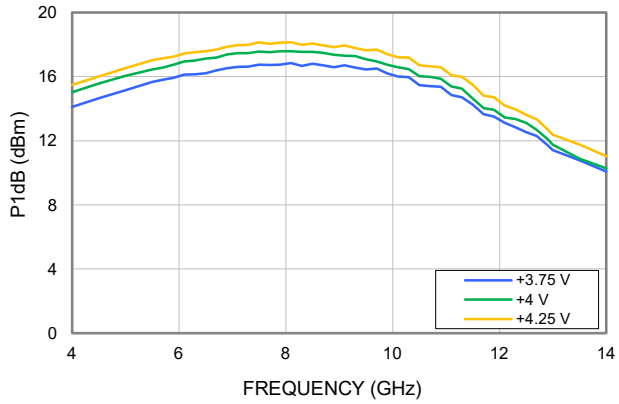


Typical Performance Curves

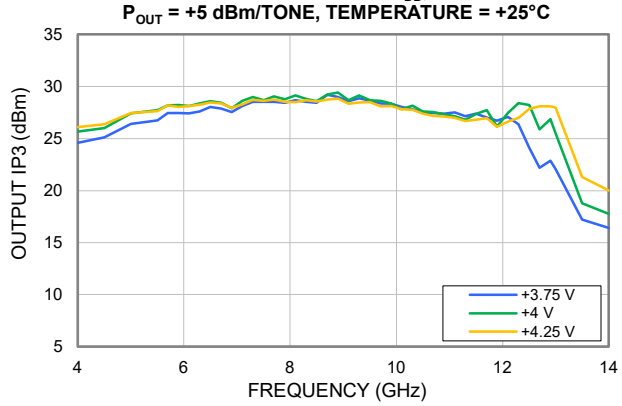
GAIN vs. V_{DD}, TEMPERATURE = +25°C



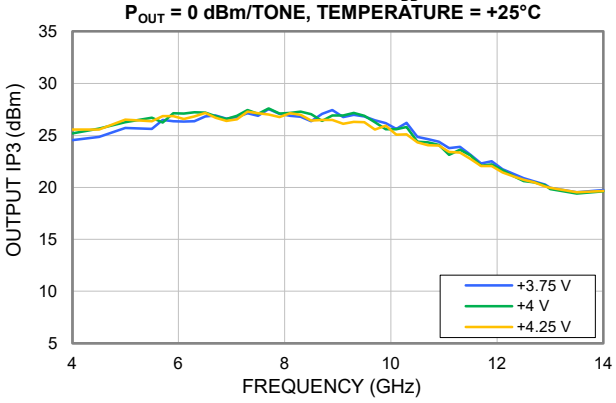
P1dB vs. V_{DD}, TEMPERATURE = +25°C



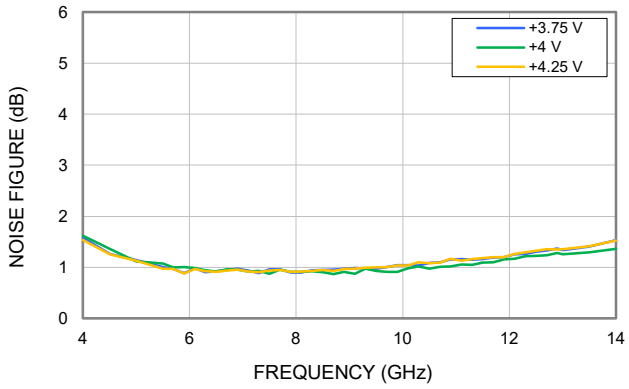
OUTPUT IP3 vs. V_{DD}, P_{OUT} = +5 dBm/TONE, TEMPERATURE = +25°C



OUTPUT IP3 vs. V_{DD}, P_{OUT} = 0 dBm/TONE, TEMPERATURE = +25°C



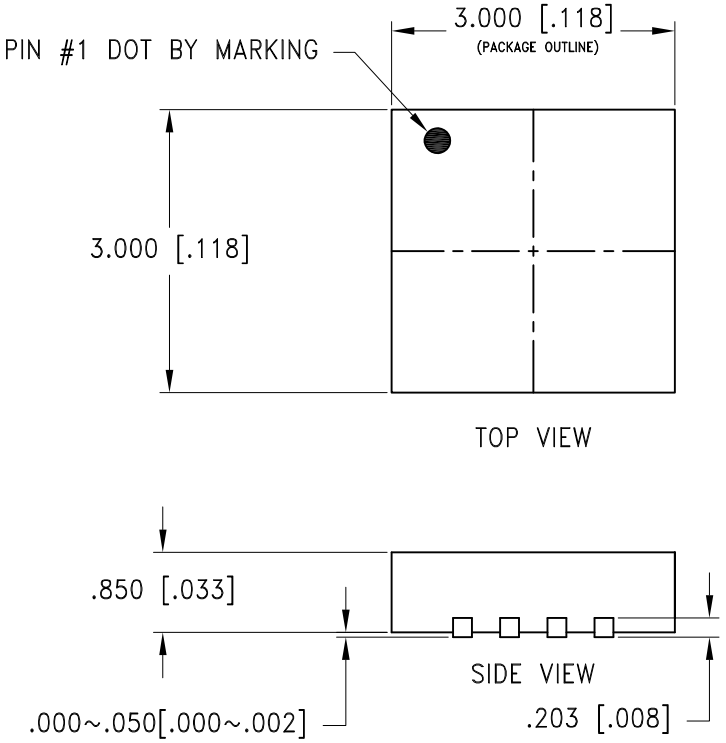
NOISE FIGURE vs. V_{DD}, TEMPERATURE = +25°C

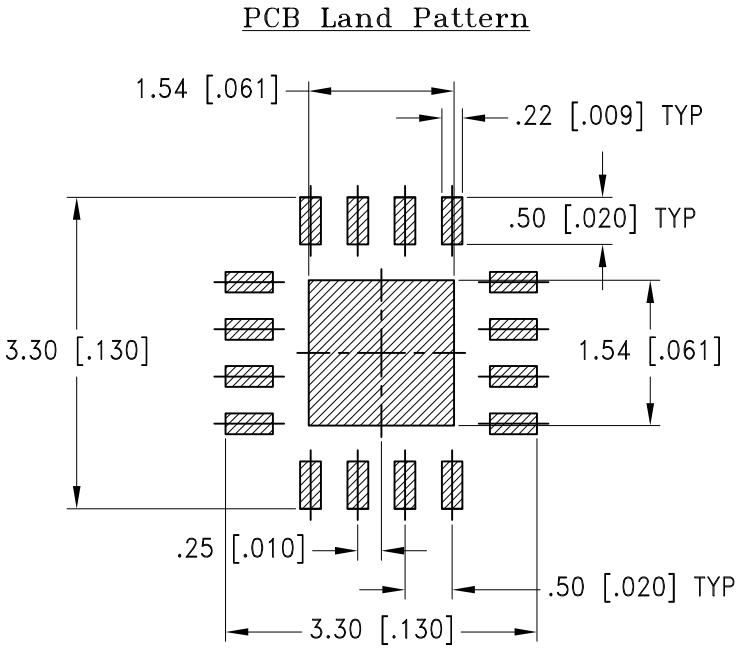


Case Style DQ

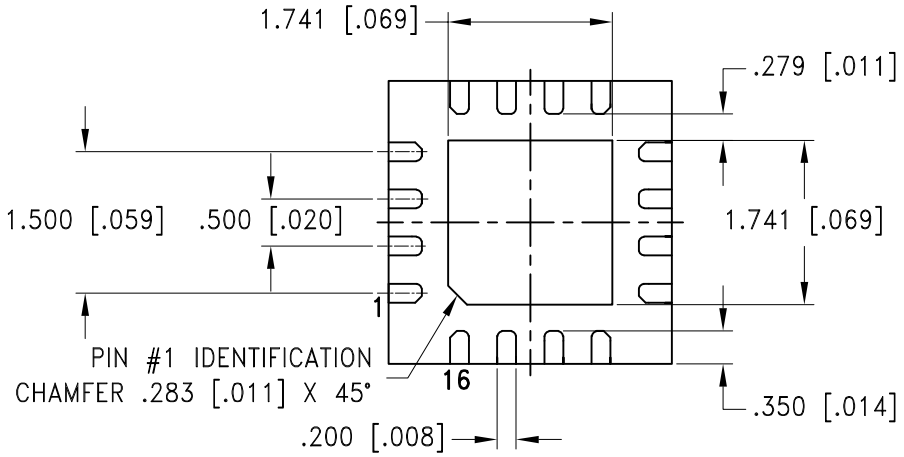
Outline Dimensions

DQ3005





Suggested Layout
Tolerances to be within ±.05[.002]



Weight= .02 Grams

Dimensions are in mm[inches]. Tolerances: 3 Pl. ±.05[.002]

Notes:
1. Case material: Plastic.
2. Termination finish:
   ForRoHS Case Styles: Matte-Tin. All models, (+) suffix.
   For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.

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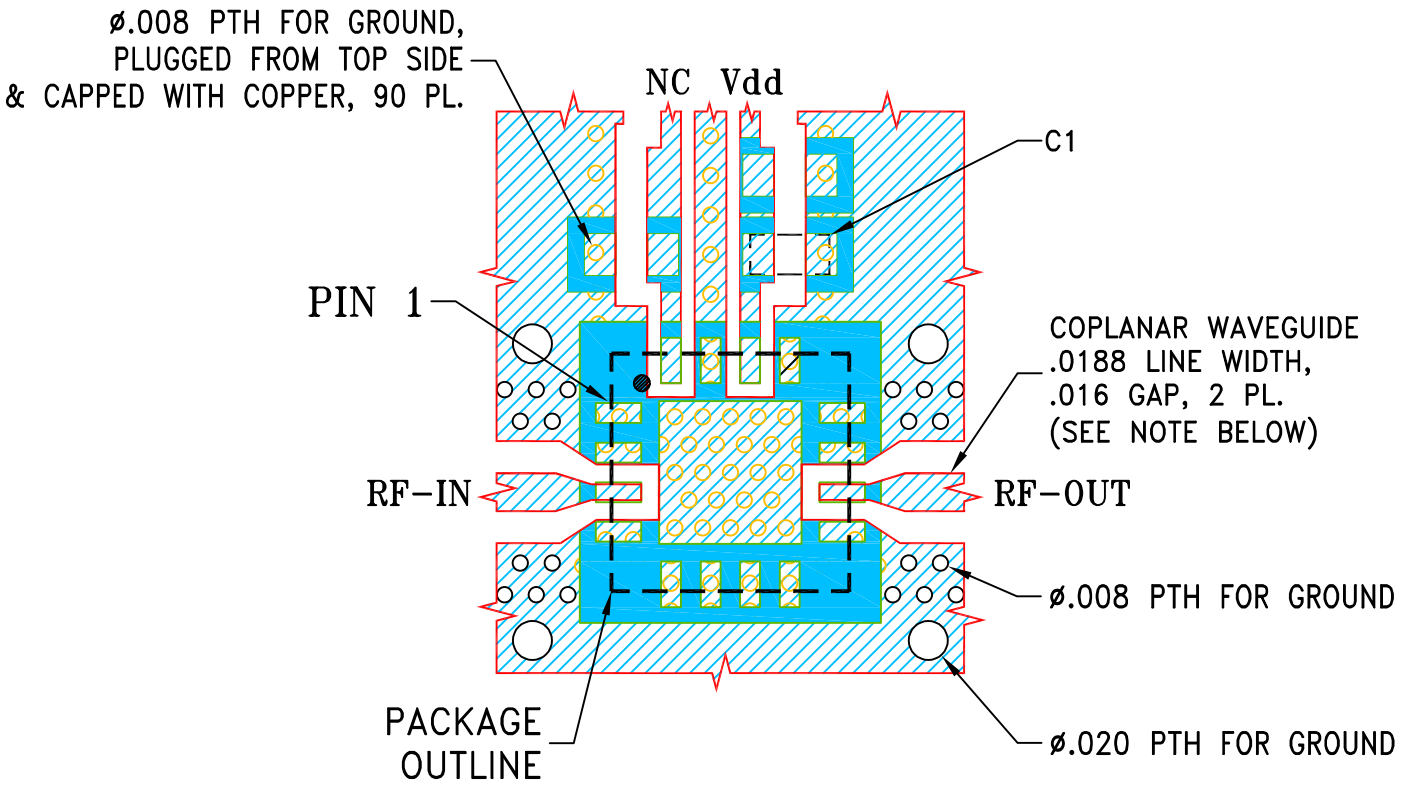
THIRD ANGLE PROJECTION

REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	ECO-021849	NEW RELEASE	05/21/24	ITG	IL

SUGGESTED MOUNTING CONFIGURATION FOR DQ3005 CASE STYLE



COMPONENT	SIZE
C1	0402

NOTES:

1. TRACE WIDTH AND GAP ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .010"; COPPER: 1 OZ. ON EACH SIDE.
   FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
2. CHIP COMPONENT FOOT PRINTS SHOWN FOR REFERENCE. FOR COMPONENT VALUES REFER TO TB-PMA-5123+ OR TB-PMA-5123C+.
3. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER).

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

UNLESS OTHERWISE SPECIFIED		INITIALS	DATE
DIMENSIONS ARE IN INCHES	DRAWN	ITG	05/21/24
TOLERANCES ON:	CHECKED	GF	05/21/24
2 PL DECIMALS ±	APPROVED	IL	05/21/24
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

ASHEETA1.DWG REV:A DATE:01/12/95

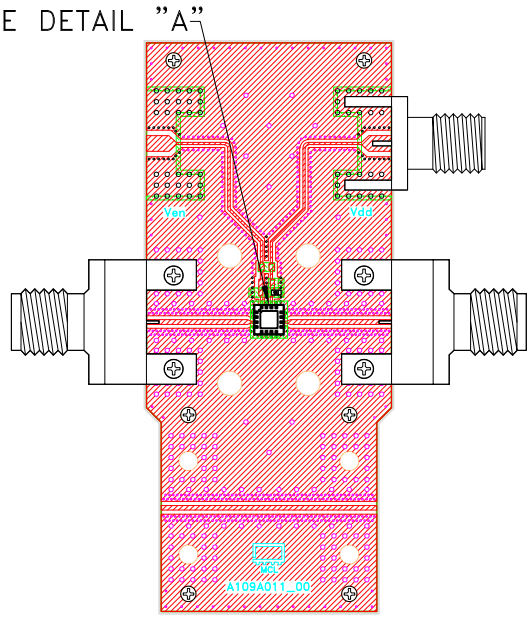
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

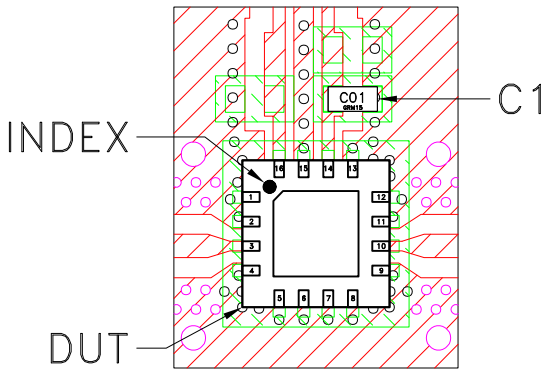
PL,DQ3005,TB-PMA-5123+/5123C+

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-782	OR

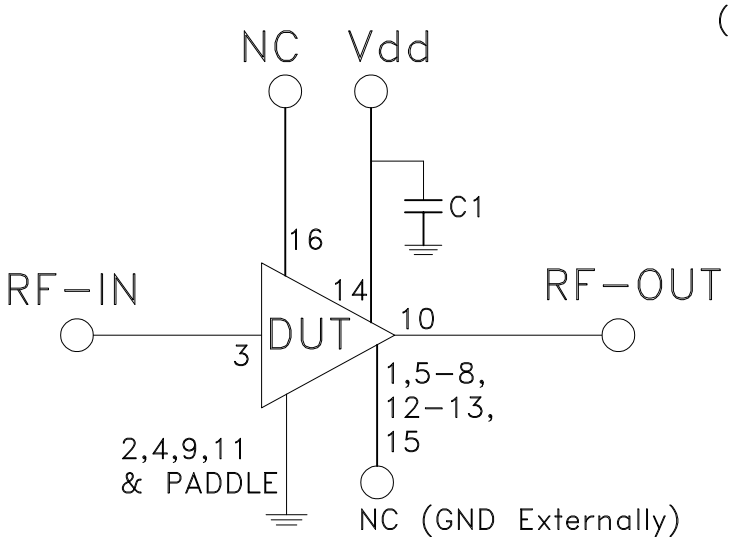
FILE:	SCALE:	SHEET:
98PL782	10:1	1 OF 1

Evaluation Board and Circuit





DETAIL "A"
LOCATION OF
UNITS COMPONENTS
(SCALE 5:1)



SCHEMATIC DIAGRAM

Component	Size	Value	Part Number	Manufacturer
C1	0402	0.1uF	GRM155R71H104KE14J	Murata

Notes:

1. 2.92mm Female Connectors.
2. PCB Material: Roger RO4350B or equivalent,
   Dielectric constant=3.5, Thickness=0.010 inch

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Environmental Specifications ENV08T1

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
Operating Temperature	-40° to 85°C or -45° to 85°C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C or -65° to 150° Ambient Environment	Individual Model Data Sheet
Thermal Shock	-55° to 100°C, 100 cycles	MIL-STD-202, Method 107, Condition A-3, except +100°C
Mechanical Shock	1.5Kg, 0.5 ms, 5 shock pulses, Y1 direction only	MIL-STD-883, Method 2002, Condition B, except Y1 direction only
Vibration (Variable Frequency)	50g peak	MIL-STD-883, Method 2007, Condition B
Autoclave	15 psig, 100% RH, 121°C, 96 hours	JESD22-A102, Condition C
HAST	130°C, 85% RH, 96 hours	JESD22-A110
Solderability	10X Magnification	J-STD-002, Para 4.2.5, Test S, 95% Coverage
Solder Reflow Heat	Sn-Pb Eutetic Process: 240°C peak Pb-Free Process: 260°C peak	J-STD-020, Table 4-1, 4-2 and 5-2; Figure 5-1
Moisture Sensitivity: Level 1	Bake at 125°C for 24 hours Soak at 85°C/85% RH for 168 hours, Reflow 3 cycles at 260°C peak	J-STD-020
Marking Resistance to Solvents	Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C; distilled water + proylene glycol monomethyl ether +	MIL-STD-202, Method 215

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
	monoethanolamine at 63°C to 70°C	