MMIC SURFACE MOUNT

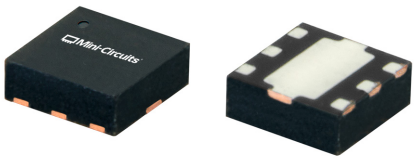
Low Noise Amplifier

PMA1-14LN+

50Ω 0.05 to 10 GHz Wideband Amplifier

THE BIG DEAL

- Low Noise Figure, Typ. 1.1 dB
- High OIP3, Typ. +28.8 dBm
- High P1dB, Typ. +21.5 dBm
- Single Supply Voltage, +6 V at 61 mA
- 1.5x1.5 mm 6-Lead QFN-Style Package

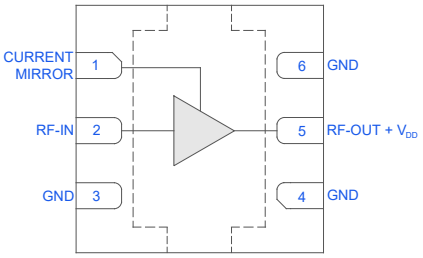


Generic photo used for illustration purposes only

APPLICATIONS

- Test and Measurement Equipment
- 5G MIMO and Back Haul Radio
- Satellite Communication
- Radar, EW, and ECM Defense Systems

FUNCTIONAL DIAGRAM



PRODUCT OVERVIEW

The PMA1-14LN+ is a pHEMT-based low noise MMIC amplifier with high IP3 and flat gain. Operating from 0.05 to 10 GHz, this amplifier features high dynamic range with typical 1.1 dB noise figure, 22 dB gain, +21.5 dBm P1dB, and +28.8 dBm OIP3. This combination of performance makes it ideal for sensitive high dynamic range receiver applications. PMA1-14LN+ operates from a single +6 V supply, is well matched to 50Ω, and comes in a very small, low profile 1.5x1.5 mm QFN-style package for easy integration into dense circuit board layouts.

KEY FEATURES

Features	Advantages
Low Noise Figure, Typ. 1.1 dB	A 50Ω matched low noise MMIC device enables low system noise figure performance without the need for complicated discrete-based solutions.
Low Power Consumption, Typ. +6 V at 61 mA	At only 61 mA, this amplifier is ideal for applications with limited available power or densely packed applications where thermal and power management is critical.
1.5x1.5mm 6-Lead QFN-Style Package	Very small footprint saves space in dense PCB layouts while providing low inductance, repeatable transitions, and excellent thermal contact with the PCB. Industry standard packaging allows for easy assembly in high volume manufacturing processes.

Low Noise Amplifier

PMA1-14LN+

50Ω 0.05 to 10 GHz Wideband Amplifier

ELECTRICAL SPECIFICATIONS[1] AT 25°C, V_{DD} = +6 V, Zo = 50Ω UNLESS NOTED OTHERWISE

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units
Frequency Range		0.05		10	GHz
Gain	0.05	21.0	21.8		dB
	2	21.0	22.0		
	4	20.9	22.0		
	8	21.1	22.3		
	10	21.1	22.3		
Input Return Loss	0.05		20		dB
	2		15		
	4		13		
	8		8		
	10		15		
Output Return Loss	0.05		21		dB
	2		19		
	4		16		
	8		11		
	10		8		
Isolation	0.05 - 10		27		dB
Output Power at 1dB Compression (P1dB)	0.05		+21.2		dBm
	2		+22.8		
	4		+21.5		
	8		+20.6		
	10		+19.6		
Output Third-Order Intercept Point (P_{OUT} = +5 dBm/Tone)	0.05		+30.9		dBm
	2		+29.9		
	4		+28.8		
	8		+27.8		
	10		+26.5		
Noise Figure	0.05		1.6		dB
	2		1.1		
	4		1.1		
	8		1.3		
	10		1.8		
Device Operating Voltage (V_{DD})		+5.75	+6.0	+6.25	V
Device Operating Current (I_{DD})[2]			61		mA
DC Current Variation vs. Temperature[3]			-76.9		µA/°C
DC Current Variation vs. Voltage[4]			29.6		µA/mV

1. Tested on Mini-Circuits Characterization Test Board TB-PMA1-14LNC+. See Figure 2. Board loss de-embedded to the device.
2. Current at P_{IN} = -25 dBm. Increases to 89 mA at P1dB.
3. (Current at +85°C - Current at -45°C) / (+85°C - -45°C)
4. (Current at +6.25 V - Current at +5.75 V) / (+6.25 V - +5.75 V)

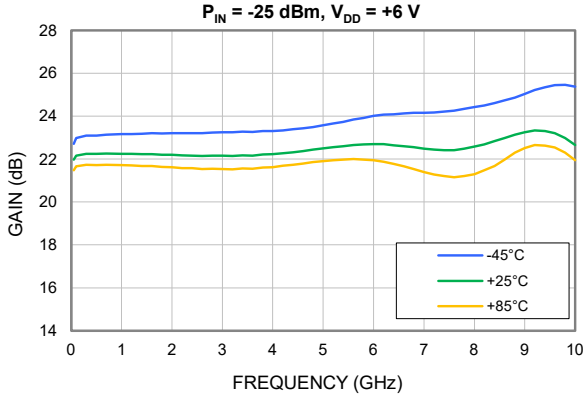
Low Noise Amplifier

PMA1-14LN+

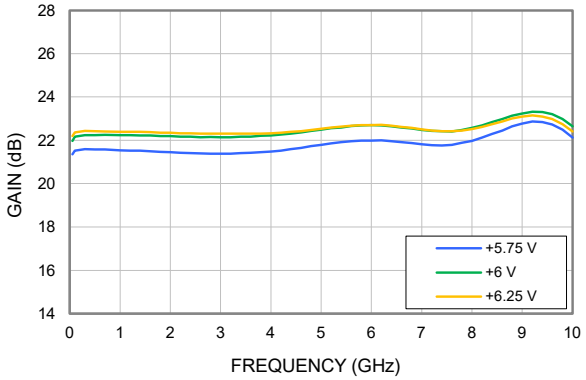
50Ω 0.05 to 10 GHz Wideband Amplifier

TYPICAL PERFORMANCE GRAPHS

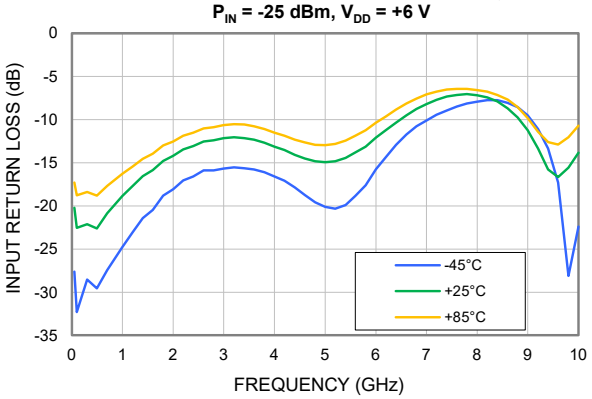
GAIN vs. TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +6 V



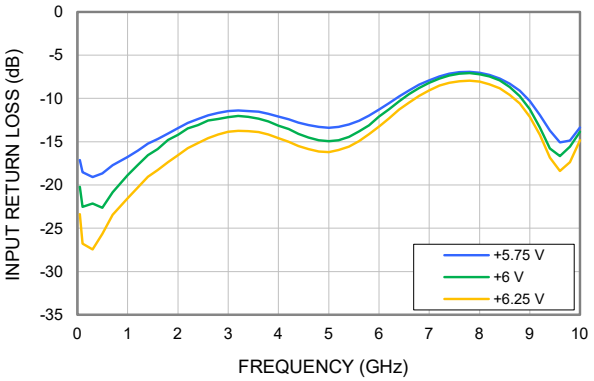
GAIN vs. VOLTAGE,
TEMPERATURE = +25°C



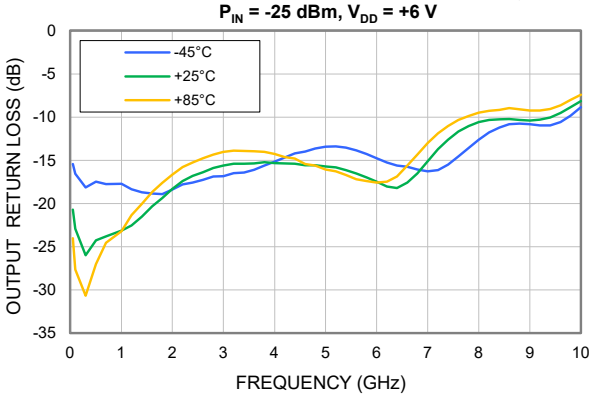
INPUT RETURN LOSS vs.TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +6 V



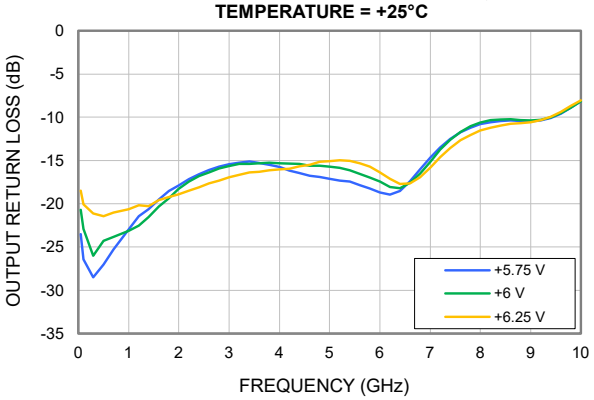
INPUT RETURN LOSS vs. VOLTAGE,
TEMPERATURE = +25°C



OUTPUT RETURN LOSS vs. TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +6 V



OUTPUT RETURN LOSS vs. VOLTAGE,
TEMPERATURE = +25°C



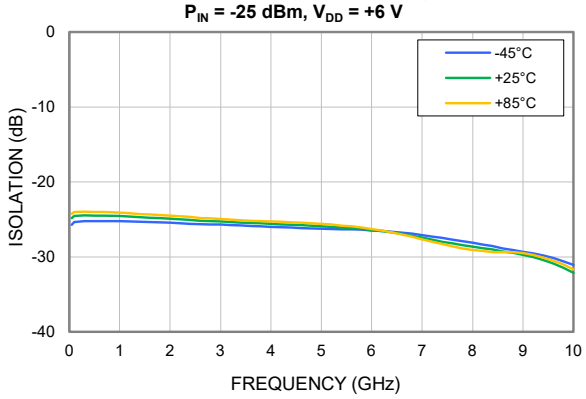
Low Noise Amplifier

PMA1-14LN+

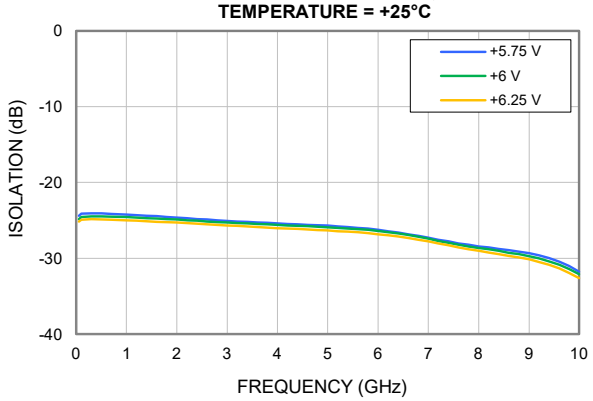
50Ω 0.05 to 10 GHz Wideband Amplifier

TYPICAL PERFORMANCE GRAPHS

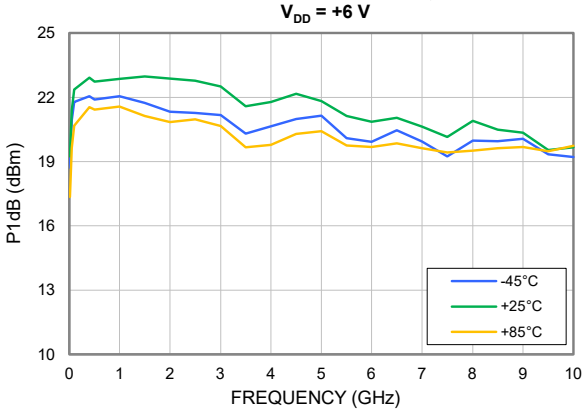
ISOLATION vs.TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +6 V



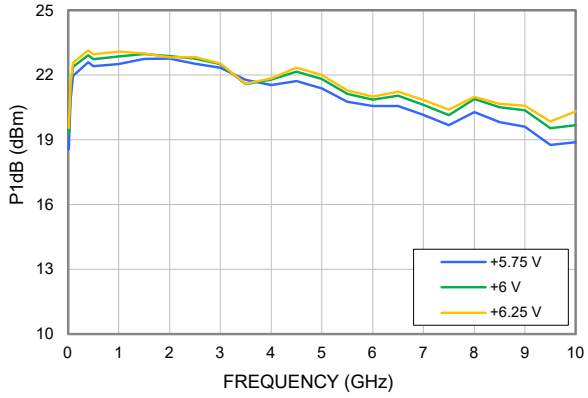
ISOLATION vs. VOLTAGE,
TEMPERATURE = +25°C



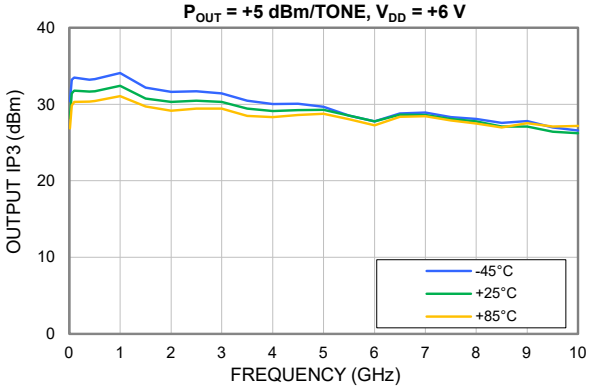
P1dB vs.TEMPERATURE,
V_{DD} = +6 V



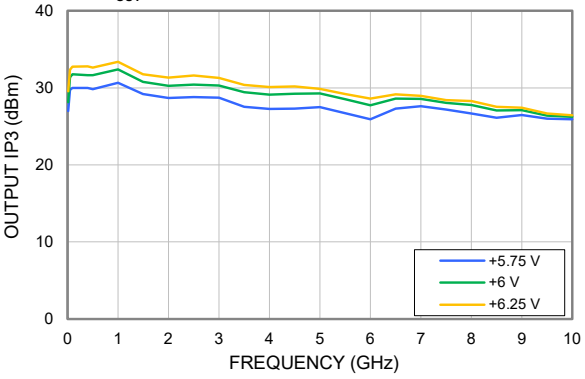
P1dB vs. VOLTAGE,
TEMPERATURE = +25°C



OUTPUT IP3 vs. TEMPERATURE,
P_{OUT} = +5 dBm/TONE, V_{DD} = +6 V



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



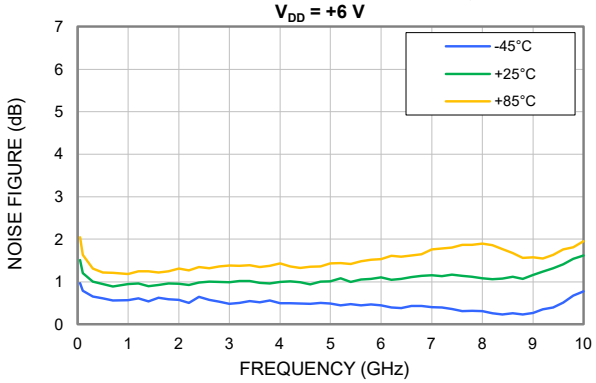
Low Noise Amplifier

PMA1-14LN+

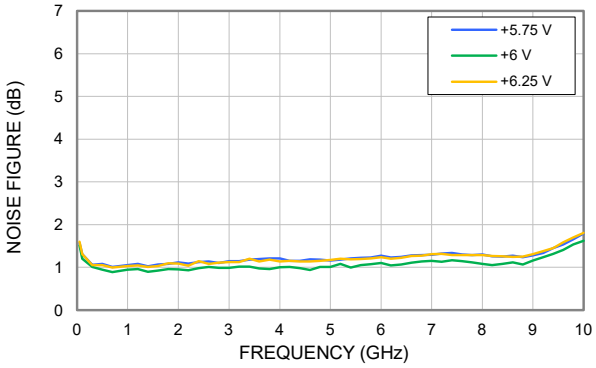
50Ω 0.05 to 10 GHz Wideband Amplifier

TYPICAL PERFORMANCE GRAPHS

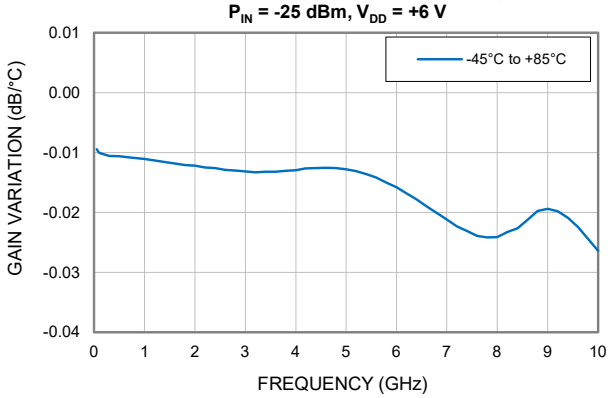
NOISE FIGURE vs. TEMPERATURE,
V_{DD} = +6 V



NOISE FIGURE vs. VOLTAGE,
TEMPERATURE = +25°C



GAIN VARIATION vs. TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +6 V



ABSOLUTE MAXIMUM RATINGS[5]

Parameter	Ratings
Operating Temperature	-45°C to +85°C
Storage Temperature	-65°C to +150°C
Junction Temperature[6]	+150°C
Total Power Dissipation	1.18 W
Input Power (CW), V_{DD} = +6 V	+25 dBm
DC Voltage at V_{DD}	+9 V
DC Current I_{DD}	140 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]	54.9°C/W

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

ESD RATING

	Class	Voltage Range	Reference Standard
HBM	1B	500 V to < 1000 V	ANSI/ESDA/JEDEC JS-001-2023
CDM	C3	> 1000 V	ANSI/ESDA/JEDEC JS-002-2022

ESD HANDLING PRECAUTION: This device is designed to be Class 1B 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

Low Noise Amplifier

PMA1-14LN+

50Ω 0.05 to 10 GHz Wideband Amplifier

FUNCTIONAL DIAGRAM

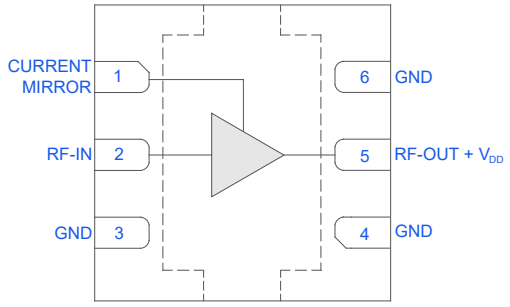


Figure 1. PMA1-14LN+ Functional Diagram

PAD DESCRIPTION

Function	Pad Number	Description (Refer to Figure 2)
RF-IN	2	RF-IN Pad connects to RF Input port.
RF-OUT+V_{DD}	5	RF-OUT Pad connects to RF Output port. V_{DD} is applied via external bias tee.
CURRENT MIRROR[8]	1	Current Mirror Pad. Supplies gate voltage to RF-IN via L1. See details in Figure 2
GND	3, 4, 6 & Paddle	Connects to ground.

8. To achieve specified performance, follow the current mirror circuit described in Figure 2. A feedback loop to RF-IN must be present for the part to operate.

CHARACTERIZATION TEST BOARD

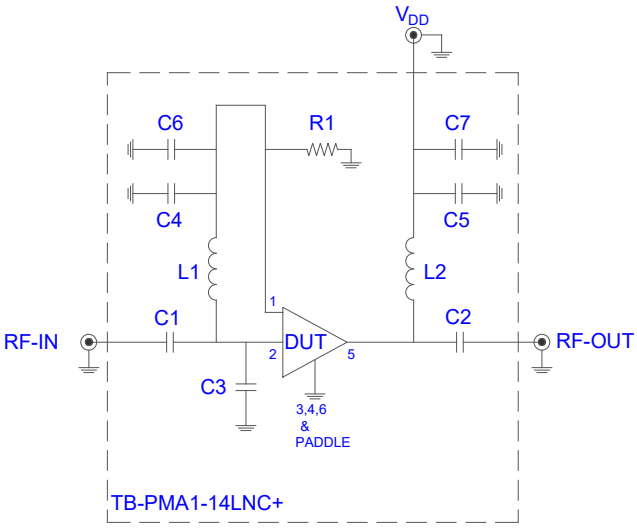


Figure 2. PMA1-14LN+ Characterization and Application Circuit.

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, +5 dBm/Tone at output.
3) V_{DD} = +6 V

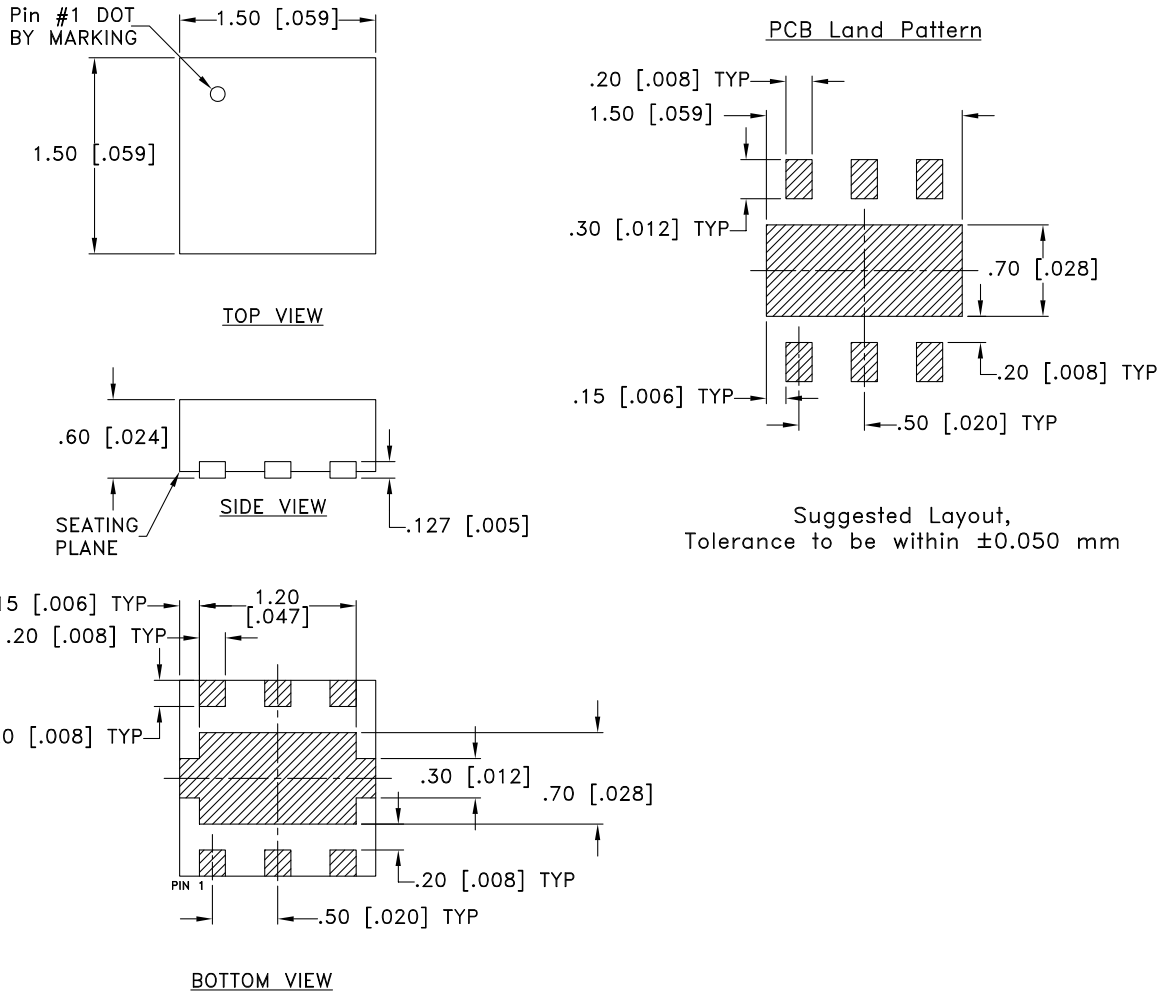
Component	Value	Size	Part Number	Manufacturer
C1, C2	0.01 µF	0402	GRM155R71H103KA88	Murata
C3	0.2 pF	0402	GJM1555C1HR20WB01D	Murata
C4, C5	100 pF	0402	GRM1555C1H101JA01D	Murata
C6, C7	0.1 µF	0402	GRM155R71H104KE14J	Murata
L1[8] , L2	900 nH	0402	0402DF-901XJRU	Coilcraft
R1	510 Ω	0402	RK73H1ETTP3300F	KOA Speer

Low Noise Amplifier

PMA1-14LN+

50Ω 0.05 to 10 GHz Wideband Amplifier

CASE STYLE DRAWING



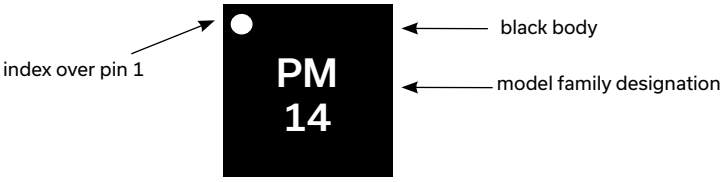
NOTES:

1. ▨ DENOTES METALLIZATION

Weight: .0036 grams

Dimensions are in mm [inches]. Tolerances: 2 Pl.± 0.05 mm

PRODUCT MARKING



Marking may contain other features or characters for internal lot control

Low Noise Amplifier

PMA1-14LN+

50Ω 0.05 to 10 GHz Wideband Amplifier

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	KC3009 Plastic package, exposed paddle, Lead Finish: Nickel-Palladium-Gold
RoHS Status	Compliant
Tape & Reel **Standard quantities available on reel**	F66 7″ reels with 20, 50, 100, 200, 500, 1000, 2000, or 3000 devices
Suggested Layout for PCB Design	PL-803
Evaluation Board	TB-PMA1-14LNC+ Gerber File
Environmental Ratings	ENV08T1

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} = +5.75 V, I_{DD} = 54 mA @ Temperature = +25°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		Noise Figure
(GHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dB)
0.05	21.4	24.4	17.1	23.5	1.05	0.52	1.57
0.1	21.5	24.1	18.5	26.4	1.04	0.47	1.31
0.3	21.6	24.1	19.1	28.5	1.04	0.46	1.06
0.5	21.6	24.1	18.6	27.0	1.04	0.46	1.08
0.7	21.6	24.2	17.7	25.3	1.04	0.47	1.01
1.0	21.5	24.2	16.8	22.9	1.04	0.49	1.05
1.2	21.5	24.3	16.0	21.4	1.05	0.50	1.08
1.4	21.5	24.4	15.2	20.7	1.05	0.51	1.03
1.6	21.5	24.5	14.7	19.5	1.05	0.52	1.06
1.8	21.5	24.5	14.0	18.5	1.06	0.53	1.08
2.0	21.4	24.6	13.4	17.9	1.06	0.54	1.12
2.2	21.4	24.7	12.8	17.2	1.06	0.55	1.09
2.4	21.4	24.8	12.4	16.6	1.07	0.56	1.12
2.6	21.4	24.9	12.0	16.1	1.07	0.57	1.14
2.8	21.4	25.0	11.7	15.7	1.07	0.58	1.11
3.0	21.4	25.1	11.5	15.4	1.07	0.59	1.15
3.2	21.4	25.1	11.4	15.2	1.08	0.60	1.14
3.4	21.4	25.2	11.5	15.1	1.08	0.60	1.18
3.6	21.4	25.3	11.5	15.3	1.08	0.61	1.19
3.8	21.5	25.3	11.8	15.5	1.09	0.62	1.21
4.0	21.5	25.4	12.1	15.7	1.09	0.62	1.21
4.2	21.5	25.5	12.4	16.2	1.10	0.63	1.16
4.4	21.6	25.5	12.8	16.4	1.10	0.63	1.16
4.6	21.6	25.6	13.1	16.8	1.10	0.64	1.19
4.8	21.7	25.6	13.3	16.9	1.10	0.64	1.18
5.0	21.8	25.7	13.4	17.1	1.10	0.65	1.17
5.2	21.9	25.8	13.3	17.3	1.11	0.66	1.18
5.4	21.9	25.9	13.0	17.5	1.11	0.67	1.21
5.6	22.0	26.0	12.6	17.9	1.11	0.68	1.22
5.8	22.0	26.1	12.0	18.2	1.12	0.70	1.23
6.0	22.0	26.3	11.3	18.7	1.12	0.72	1.27
6.2	22.0	26.4	10.5	19.0	1.13	0.74	1.23
6.4	22.0	26.6	9.8	18.5	1.14	0.77	1.25
6.6	21.9	26.8	9.1	17.4	1.14	0.79	1.28
6.8	21.9	27.0	8.4	16.0	1.15	0.81	1.28
7.0	21.8	27.3	7.9	14.7	1.16	0.83	1.29
7.2	21.8	27.5	7.5	13.5	1.18	0.84	1.32
7.4	21.8	27.8	7.2	12.5	1.19	0.85	1.34
7.6	21.8	28.0	7.0	11.7	1.21	0.84	1.31
7.8	21.9	28.2	6.9	11.2	1.22	0.84	1.29
8.0	22.0	28.4	7.0	10.8	1.24	0.83	1.30
8.2	22.1	28.6	7.3	10.6	1.25	0.82	1.26
8.4	22.3	28.7	7.7	10.4	1.27	0.81	1.26
8.6	22.5	28.9	8.3	10.4	1.30	0.80	1.27
8.8	22.6	29.1	9.1	10.4	1.33	0.79	1.24
9.0	22.8	29.3	10.3	10.5	1.36	0.78	1.28
9.2	22.9	29.6	11.9	10.4	1.41	0.77	1.34
9.4	22.8	30.0	13.7	10.1	1.46	0.77	1.46
9.6	22.7	30.4	15.1	9.6	1.53	0.77	1.54
9.8	22.5	31.0	14.9	8.9	1.61	0.77	1.66
10.0	22.1	31.8	13.4	8.1	1.72	0.78	1.79

FREQ	IP-3 Output		1dB Comp. Output
	POUT = 0 dBm/Tone	POUT = +5 dBm/Tone	
(GHz)	(dBm)	(dBm)	(dBm)
0.01	26.1	27.0	18.6
0.05	28.7	29.8	20.9
0.10	29.5	30.0	22.0
0.40	29.6	30.0	22.6
0.50	29.7	29.8	22.4
1.00	30.3	30.7	22.5
1.50	29.0	29.2	22.8
2.00	28.4	28.7	22.8
2.50	28.7	28.8	22.5
3.00	28.8	28.7	22.3
3.50	27.7	27.5	21.8
4.00	27.3	27.3	21.5
4.50	27.6	27.3	21.7
5.00	27.8	27.5	21.4
5.50	27.0	26.7	20.8
6.00	26.3	25.9	20.6
6.50	27.6	27.3	20.6
7.00	27.9	27.6	20.2
7.50	27.3	27.2	19.7
8.00	27.0	26.7	20.3
8.50	26.5	26.1	19.8
9.00	26.9	26.5	19.6
9.50	26.2	26.0	18.8
10.00	26.2	25.9	18.9

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} = +6 V, I_{DD} = 61 mA @ Temperature = +25°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		Noise Figure
(GHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dB)
0.1	22.0	24.8	20.2	20.7	1.04	0.50	1.51
0.1	22.2	24.5	22.5	22.9	1.03	0.44	1.20
0.3	22.2	24.5	22.1	26.0	1.03	0.42	1.01
0.5	22.2	24.5	22.6	24.3	1.03	0.42	0.95
0.7	22.3	24.5	20.9	23.8	1.03	0.43	0.89
1.0	22.2	24.5	18.9	23.1	1.03	0.44	0.95
1.2	22.2	24.6	17.7	22.5	1.03	0.45	0.96
1.4	22.2	24.7	16.6	21.5	1.04	0.46	0.90
1.6	22.2	24.7	15.8	20.3	1.04	0.47	0.92
1.8	22.2	24.8	14.8	19.4	1.04	0.48	0.96
2.0	22.2	24.9	14.2	18.3	1.04	0.49	0.96
2.2	22.2	25.0	13.5	17.4	1.04	0.50	0.93
2.4	22.2	25.0	13.1	16.8	1.05	0.51	0.98
2.6	22.1	25.2	12.5	16.4	1.05	0.53	1.01
2.8	22.1	25.2	12.4	15.9	1.05	0.53	0.99
3.0	22.1	25.3	12.2	15.6	1.05	0.54	0.99
3.2	22.1	25.4	12.1	15.4	1.05	0.55	1.02
3.4	22.2	25.4	12.1	15.4	1.06	0.55	1.02
3.6	22.2	25.5	12.3	15.3	1.06	0.56	0.98
3.8	22.2	25.5	12.7	15.2	1.06	0.56	0.96
4.0	22.2	25.6	13.2	15.3	1.06	0.57	1.00
4.2	22.3	25.6	13.6	15.4	1.07	0.57	1.02
4.4	22.3	25.7	14.1	15.4	1.07	0.58	0.98
4.6	22.4	25.8	14.5	15.6	1.07	0.58	0.94
4.8	22.4	25.8	14.9	15.6	1.07	0.59	1.01
5.0	22.5	25.9	15.0	15.7	1.08	0.60	1.01
5.2	22.6	26.0	14.9	15.8	1.08	0.60	1.08
5.4	22.6	26.1	14.5	16.1	1.08	0.61	1.00
5.6	22.7	26.2	13.8	16.5	1.08	0.63	1.05
5.8	22.7	26.2	13.1	17.0	1.09	0.64	1.07
6.0	22.7	26.4	12.1	17.5	1.09	0.67	1.10
6.2	22.7	26.6	11.3	18.0	1.10	0.69	1.05
6.4	22.6	26.7	10.3	18.2	1.11	0.72	1.07
6.6	22.6	26.9	9.5	17.6	1.11	0.75	1.11
6.8	22.6	27.2	8.8	16.5	1.12	0.77	1.14
7.0	22.5	27.4	8.2	15.1	1.14	0.79	1.16
7.2	22.4	27.7	7.7	13.7	1.15	0.81	1.13
7.4	22.4	28.0	7.4	12.6	1.17	0.81	1.17
7.6	22.4	28.2	7.2	11.7	1.18	0.81	1.14
7.8	22.5	28.4	7.1	11.0	1.20	0.81	1.12
8.0	22.6	28.6	7.2	10.6	1.21	0.80	1.09
8.2	22.7	28.8	7.5	10.3	1.23	0.79	1.06
8.4	22.8	29.0	7.9	10.3	1.26	0.78	1.08
8.6	23.0	29.3	8.7	10.2	1.29	0.77	1.12
8.8	23.1	29.4	9.7	10.3	1.32	0.77	1.07
9.0	23.2	29.7	11.2	10.4	1.36	0.76	1.16
9.2	23.3	30.0	13.4	10.3	1.40	0.76	1.24
9.4	23.3	30.4	15.8	10.0	1.46	0.76	1.32
9.6	23.2	30.8	16.7	9.5	1.51	0.76	1.41
9.8	23.0	31.4	15.6	8.9	1.60	0.77	1.54
10.0	22.7	32.1	13.8	8.1	1.69	0.78	1.62

FREQ	IP-3 Output		1dB Comp. Output
	POUT = 0 dBm/Tone	POUT = +5 dBm/Tone	
(GHz)	(dBm)	(dBm)	(dBm)
0.01	27.7	28.1	19.2
0.05	30.4	31.4	21.4
0.10	31.6	31.8	22.4
0.40	31.5	31.7	22.9
0.50	31.7	31.7	22.7
1.00	32.1	32.4	22.9
1.50	31.1	30.8	23.0
2.00	30.2	30.3	22.9
2.50	30.0	30.5	22.8
3.00	30.4	30.3	22.5
3.50	29.4	29.4	21.6
4.00	29.1	29.1	21.8
4.50	29.3	29.2	22.2
5.00	29.3	29.3	21.8
5.50	28.7	28.5	21.1
6.00	28.0	27.8	20.9
6.50	28.7	28.6	21.0
7.00	28.5	28.6	20.6
7.50	28.0	28.1	20.1
8.00	27.8	27.8	20.9
8.50	26.9	27.1	20.5
9.00	27.1	27.1	20.4
9.50	26.4	26.4	19.5
10.00	26.2	26.2	19.7

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} = +6.25 V, I_{DD} = 69 mA @ Temperature = +25°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		Noise Figure
(GHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dB)
0.05	22.2	25.2	23.4	18.5	1.04	0.50	1.60
0.1	22.4	24.9	26.8	20.1	1.03	0.45	1.31
0.3	22.4	24.8	27.5	21.1	1.03	0.44	1.05
0.5	22.4	24.9	25.7	21.4	1.04	0.44	1.05
0.7	22.4	24.9	23.4	21.0	1.04	0.45	0.99
1.0	22.4	25.0	21.5	20.6	1.04	0.47	1.04
1.2	22.4	25.0	20.3	20.2	1.04	0.48	1.05
1.4	22.4	25.1	19.1	20.3	1.05	0.49	1.01
1.6	22.4	25.2	18.3	19.6	1.05	0.50	1.03
1.8	22.4	25.2	17.4	19.2	1.05	0.51	1.10
2.0	22.3	25.3	16.5	18.9	1.06	0.52	1.09
2.2	22.3	25.4	15.7	18.5	1.06	0.53	1.04
2.4	22.3	25.4	15.2	18.1	1.06	0.54	1.14
2.6	22.3	25.5	14.6	17.6	1.06	0.55	1.09
2.8	22.3	25.6	14.2	17.3	1.06	0.56	1.11
3.0	22.3	25.7	13.9	16.9	1.07	0.57	1.12
3.2	22.3	25.7	13.7	16.6	1.07	0.57	1.12
3.4	22.3	25.8	13.8	16.3	1.07	0.58	1.20
3.6	22.3	25.9	13.9	16.3	1.08	0.59	1.14
3.8	22.3	25.9	14.2	16.1	1.08	0.59	1.18
4.0	22.3	26.0	14.6	16.0	1.08	0.60	1.14
4.2	22.4	26.1	15.0	15.9	1.09	0.61	1.15
4.4	22.4	26.1	15.5	15.7	1.09	0.61	1.14
4.6	22.4	26.2	15.9	15.5	1.09	0.61	1.13
4.8	22.5	26.3	16.1	15.1	1.09	0.61	1.15
5.0	22.5	26.3	16.2	15.1	1.10	0.62	1.17
5.2	22.6	26.4	16.0	15.0	1.10	0.62	1.20
5.4	22.6	26.5	15.6	15.0	1.10	0.63	1.19
5.6	22.7	26.6	14.9	15.3	1.11	0.64	1.20
5.8	22.7	26.7	14.2	15.7	1.11	0.66	1.21
6.0	22.7	26.8	13.2	16.4	1.12	0.68	1.24
6.2	22.7	27.0	12.3	17.1	1.13	0.71	1.20
6.4	22.7	27.1	11.3	17.7	1.14	0.74	1.23
6.6	22.6	27.3	10.5	17.6	1.15	0.76	1.27
6.8	22.6	27.6	9.7	16.9	1.17	0.79	1.27
7.0	22.5	27.8	9.1	15.8	1.18	0.81	1.31
7.2	22.5	28.0	8.5	14.6	1.20	0.82	1.32
7.4	22.4	28.3	8.2	13.6	1.21	0.83	1.29
7.6	22.4	28.6	8.0	12.7	1.24	0.83	1.29
7.8	22.5	28.8	8.0	12.1	1.26	0.83	1.29
8.0	22.5	29.0	8.1	11.5	1.28	0.83	1.29
8.2	22.6	29.2	8.4	11.2	1.31	0.82	1.26
8.4	22.8	29.4	8.9	11.0	1.33	0.81	1.26
8.6	22.9	29.7	9.6	10.8	1.37	0.80	1.25
8.8	23.0	29.9	10.6	10.7	1.40	0.79	1.25
9.0	23.1	30.1	12.1	10.6	1.44	0.79	1.31
9.2	23.2	30.5	14.2	10.3	1.49	0.78	1.39
9.4	23.1	30.8	16.8	9.9	1.54	0.78	1.45
9.6	23.0	31.3	18.4	9.4	1.62	0.78	1.59
9.8	22.8	31.9	17.4	8.7	1.70	0.78	1.70
10.0	22.4	32.6	14.9	8.0	1.81	0.79	1.81

FREQ	IP-3 Output		1dB Comp. Output
	POUT = 0 dBm/Tone	POUT = +5 dBm/Tone	
(GHz)	(dBm)	(dBm)	(dBm)
0.01	28.8	29.6	19.5
0.05	32.1	32.3	21.6
0.10	32.0	32.8	22.6
0.40	32.0	32.8	23.1
0.50	32.5	32.6	23.0
1.00	32.7	33.4	23.1
1.50	31.6	31.8	23.0
2.00	31.3	31.3	22.8
2.50	31.6	31.6	22.8
3.00	31.1	31.3	22.5
3.50	30.5	30.4	21.6
4.00	30.0	30.1	21.9
4.50	30.2	30.2	22.3
5.00	30.0	29.9	22.0
5.50	29.4	29.2	21.3
6.00	28.8	28.6	21.0
6.50	29.4	29.2	21.2
7.00	29.0	29.0	20.8
7.50	28.5	28.4	20.4
8.00	28.3	28.3	21.0
8.50	27.4	27.5	20.7
9.00	27.4	27.4	20.6
9.50	26.6	26.7	19.8
10.00	26.4	26.5	20.3

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} = +6 V, I_{DD} = 69 mA @ Temperature = -45°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		Noise Figure
(GHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dB)
0.05	22.7	25.7	27.6	15.4	1.04	0.49	0.97
0.1	23.0	25.3	32.3	16.6	1.03	0.41	0.79
0.3	23.1	25.2	28.5	18.1	1.02	0.38	0.66
0.5	23.1	25.2	29.5	17.5	1.02	0.38	0.61
0.7	23.1	25.2	27.4	17.7	1.02	0.38	0.55
1.0	23.2	25.2	24.8	17.7	1.02	0.39	0.57
1.2	23.2	25.3	23.1	18.4	1.02	0.40	0.61
1.4	23.2	25.3	21.4	18.7	1.03	0.41	0.54
1.6	23.2	25.4	20.5	18.8	1.03	0.41	0.62
1.8	23.2	25.4	18.8	18.9	1.03	0.43	0.59
2.0	23.2	25.4	18.1	18.4	1.03	0.43	0.57
2.2	23.2	25.5	17.1	17.8	1.03	0.44	0.51
2.4	23.2	25.6	16.6	17.6	1.03	0.45	0.65
2.6	23.2	25.6	15.9	17.3	1.03	0.46	0.57
2.8	23.2	25.7	15.9	16.9	1.03	0.46	0.53
3.0	23.2	25.7	15.7	16.8	1.03	0.47	0.48
3.2	23.3	25.8	15.5	16.5	1.03	0.48	0.51
3.4	23.3	25.8	15.6	16.4	1.03	0.48	0.54
3.6	23.3	25.9	15.8	16.1	1.03	0.49	0.52
3.8	23.3	25.9	16.1	15.6	1.03	0.49	0.57
4.0	23.3	26.0	16.6	15.2	1.03	0.49	0.50
4.2	23.3	26.0	17.1	14.7	1.03	0.50	0.50
4.4	23.4	26.1	17.9	14.2	1.03	0.50	0.49
4.6	23.4	26.2	18.8	14.0	1.04	0.50	0.48
4.8	23.5	26.2	19.6	13.6	1.03	0.49	0.51
5.0	23.6	26.2	20.1	13.4	1.03	0.49	0.49
5.2	23.7	26.3	20.3	13.4	1.03	0.49	0.45
5.4	23.7	26.3	19.9	13.5	1.03	0.49	0.48
5.6	23.8	26.3	18.9	13.8	1.03	0.50	0.45
5.8	23.9	26.4	17.6	14.3	1.03	0.50	0.47
6.0	24.0	26.5	15.8	14.7	1.03	0.52	0.45
6.2	24.1	26.5	14.4	15.3	1.03	0.54	0.39
6.4	24.1	26.7	12.9	15.6	1.03	0.56	0.38
6.6	24.1	26.8	11.7	15.7	1.03	0.58	0.43
6.8	24.1	26.9	10.8	16.1	1.03	0.61	0.43
7.0	24.1	27.1	10.1	16.3	1.04	0.63	0.40
7.2	24.2	27.3	9.5	16.1	1.05	0.66	0.39
7.4	24.2	27.4	9.0	15.5	1.05	0.67	0.37
7.6	24.3	27.7	8.5	14.6	1.06	0.69	0.31
7.8	24.3	27.9	8.1	13.6	1.07	0.69	0.32
8.0	24.4	28.1	7.9	12.6	1.08	0.69	0.31
8.2	24.5	28.3	7.8	11.8	1.09	0.69	0.26
8.4	24.6	28.6	7.8	11.2	1.09	0.69	0.23
8.6	24.7	28.9	8.1	10.9	1.11	0.69	0.26
8.8	24.9	29.1	8.6	10.7	1.12	0.70	0.23
9.0	25.0	29.3	9.5	10.8	1.14	0.69	0.26
9.2	25.2	29.5	11.1	11.0	1.16	0.69	0.36
9.4	25.4	29.8	13.4	11.0	1.18	0.69	0.39
9.6	25.5	30.1	17.3	10.6	1.20	0.69	0.52
9.8	25.5	30.5	28.1	9.9	1.23	0.69	0.67
10.0	25.4	31.0	22.4	8.8	1.26	0.69	0.77

FREQ	IP-3 Output		1dB Comp. Output
	POUT = 0 dBm/Tone	POUT = +5 dBm/Tone	
(GHz)	(dBm)	(dBm)	(dBm)
0.01	28.4	30.4	18.7
0.05	34.6	33.2	20.9
0.10	32.9	33.5	21.8
0.40	33.3	33.2	22.1
0.50	34.0	33.3	21.9
1.00	33.8	34.1	22.0
1.50	32.5	32.2	21.7
2.00	31.7	31.6	21.3
2.50	31.5	31.7	21.3
3.00	31.5	31.4	21.2
3.50	30.8	30.5	20.3
4.00	30.2	30.0	20.6
4.50	29.7	30.1	21.0
5.00	29.3	29.7	21.1
5.50	28.5	28.5	20.1
6.00	27.5	27.8	19.9
6.50	28.3	28.8	20.5
7.00	28.3	28.9	19.9
7.50	27.6	28.3	19.2
8.00	27.7	28.1	20.0
8.50	27.0	27.6	20.0
9.00	27.2	27.8	20.1
9.50	26.2	27.0	19.3
10.00	25.9	26.6	19.2

Typical Performance Data

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

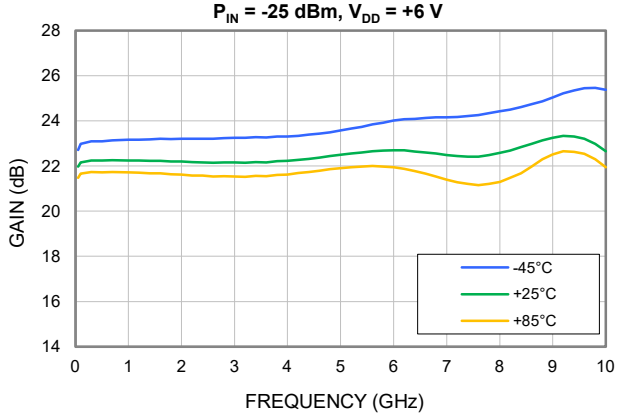
TEST CONDITIONS: V_{DD} = +6 V, I_{DD} = 59 mA @ Temperature = +85°C

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		Noise Figure
(GHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dB)
0.05	21.5	24.2	17.3	24.0	1.04	0.49	2.05
0.1	21.7	24.0	18.8	27.7	1.03	0.44	1.63
0.3	21.7	24.0	18.4	30.7	1.03	0.43	1.31
0.5	21.7	24.0	18.8	27.0	1.03	0.44	1.22
0.7	21.7	24.0	17.7	24.5	1.03	0.44	1.21
1.0	21.7	24.1	16.3	23.2	1.03	0.45	1.18
1.2	21.7	24.2	15.4	21.3	1.04	0.46	1.25
1.4	21.7	24.3	14.6	20.0	1.04	0.48	1.24
1.6	21.7	24.3	14.0	18.7	1.04	0.48	1.22
1.8	21.6	24.4	13.0	17.6	1.04	0.50	1.25
2.0	21.6	24.5	12.5	16.7	1.04	0.50	1.32
2.2	21.6	24.6	11.9	15.8	1.05	0.52	1.26
2.4	21.6	24.7	11.5	15.3	1.05	0.52	1.35
2.6	21.5	24.8	11.0	14.7	1.05	0.54	1.32
2.8	21.5	24.9	10.9	14.3	1.05	0.54	1.36
3.0	21.5	24.9	10.7	14.0	1.06	0.55	1.38
3.2	21.5	25.0	10.5	13.9	1.06	0.56	1.38
3.4	21.6	25.1	10.6	13.9	1.06	0.57	1.39
3.6	21.5	25.1	10.8	13.9	1.07	0.58	1.35
3.8	21.6	25.2	11.1	14.0	1.07	0.58	1.38
4.0	21.6	25.3	11.5	14.3	1.07	0.59	1.43
4.2	21.7	25.3	11.9	14.6	1.07	0.59	1.36
4.4	21.7	25.4	12.3	14.8	1.07	0.60	1.33
4.6	21.8	25.4	12.7	15.4	1.08	0.61	1.35
4.8	21.9	25.5	12.9	15.6	1.08	0.62	1.36
5.0	21.9	25.6	13.0	16.1	1.09	0.63	1.43
5.2	22.0	25.7	12.8	16.3	1.09	0.64	1.44
5.4	22.0	25.8	12.4	16.7	1.10	0.66	1.42
5.6	22.0	25.9	11.9	17.2	1.10	0.68	1.48
5.8	22.0	26.1	11.2	17.4	1.11	0.70	1.52
6.0	21.9	26.3	10.4	17.6	1.12	0.73	1.53
6.2	21.9	26.5	9.7	17.5	1.13	0.76	1.61
6.4	21.8	26.7	8.9	16.9	1.14	0.79	1.59
6.6	21.7	27.0	8.2	15.6	1.16	0.82	1.62
6.8	21.5	27.3	7.6	14.3	1.17	0.85	1.65
7.0	21.4	27.6	7.1	13.0	1.19	0.87	1.76
7.2	21.3	28.0	6.8	11.9	1.22	0.88	1.78
7.4	21.2	28.3	6.5	11.0	1.24	0.88	1.80
7.6	21.1	28.6	6.5	10.3	1.28	0.88	1.87
7.8	21.2	28.9	6.4	9.9	1.30	0.87	1.87
8.0	21.3	29.1	6.6	9.5	1.33	0.86	1.89
8.2	21.5	29.2	6.8	9.3	1.33	0.84	1.86
8.4	21.7	29.3	7.2	9.2	1.35	0.82	1.77
8.6	22.0	29.4	7.7	9.0	1.35	0.79	1.68
8.8	22.3	29.4	8.6	9.1	1.35	0.77	1.56
9.0	22.5	29.5	9.9	9.2	1.37	0.76	1.57
9.2	22.7	29.7	11.4	9.2	1.41	0.75	1.55
9.4	22.6	30.1	12.6	9.0	1.45	0.75	1.63
9.6	22.5	30.5	12.9	8.6	1.50	0.76	1.76
9.8	22.3	31.0	12.1	8.0	1.56	0.77	1.81
10.0	21.9	31.7	10.7	7.4	1.63	0.79	1.96

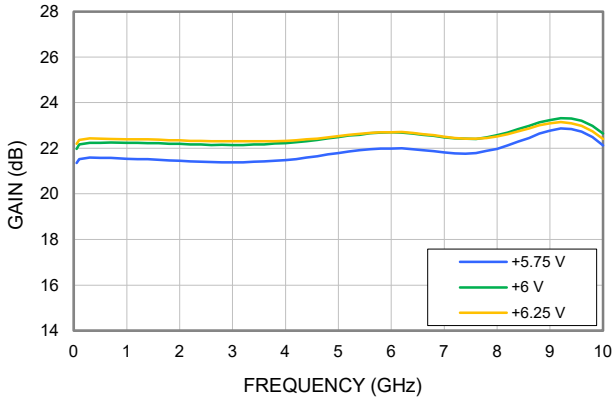
FREQ	IP-3 Output		1dB Comp. Output
	POUT = 0 dBm/Tone	POUT = +5 dBm/Tone	
(GHz)	(dBm)	(dBm)	(dBm)
0.01	26.8	26.8	17.3
0.05	28.8	29.8	19.6
0.10	29.8	30.3	20.7
0.40	30.3	30.4	21.5
0.50	30.4	30.4	21.4
1.00	31.0	31.0	21.6
1.50	29.6	29.7	21.1
2.00	29.2	29.2	20.8
2.50	29.5	29.4	21.0
3.00	29.5	29.4	20.7
3.50	28.5	28.5	19.7
4.00	28.1	28.3	19.8
4.50	28.8	28.6	20.3
5.00	29.1	28.8	20.4
5.50	28.5	28.0	19.8
6.00	27.8	27.3	19.7
6.50	28.8	28.4	19.9
7.00	28.7	28.4	19.6
7.50	28.3	27.9	19.4
8.00	27.7	27.5	19.5
8.50	27.4	26.9	19.6
9.00	27.6	27.5	19.7
9.50	27.5	27.1	19.5
10.00	27.5	27.2	19.7

Typical Performance Curves

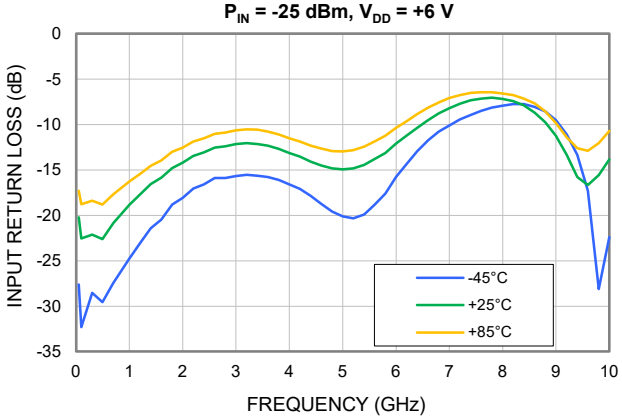
GAIN vs. TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +6 V



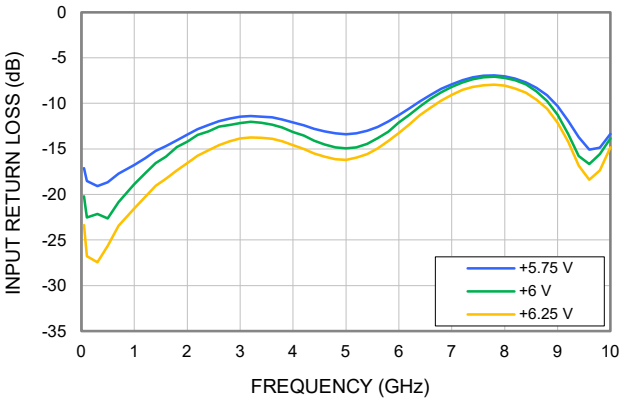
GAIN vs. VOLTAGE,
TEMPERATURE = +25°C



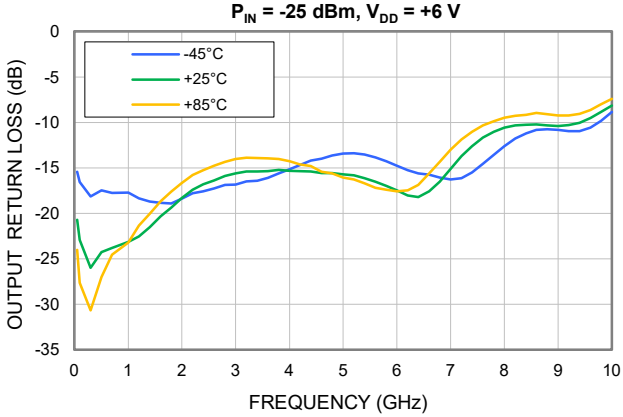
INPUT RETURN LOSS vs.TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +6 V



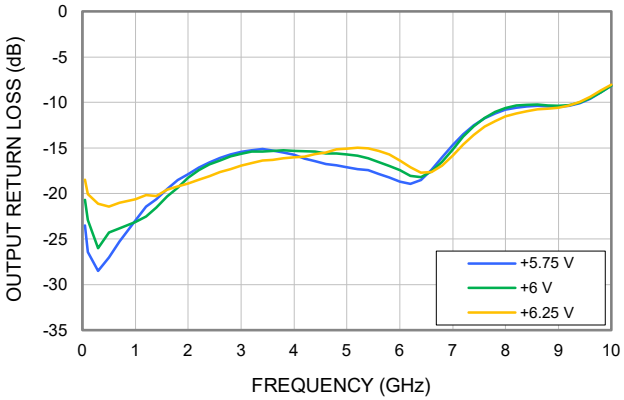
INPUT RETURN LOSS vs. VOLTAGE,
TEMPERATURE = +25°C



OUTPUT RETURN LOSS vs. TEMPERATURE,
P_{IN} = -25 dBm, V_{DD} = +6 V

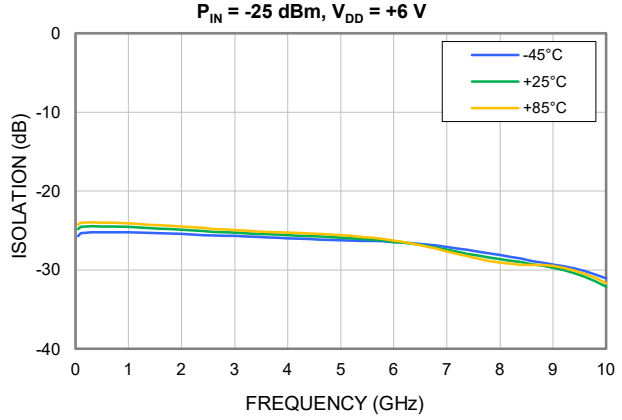


OUTPUT RETURN LOSS vs. VOLTAGE,
TEMPERATURE = +25°C

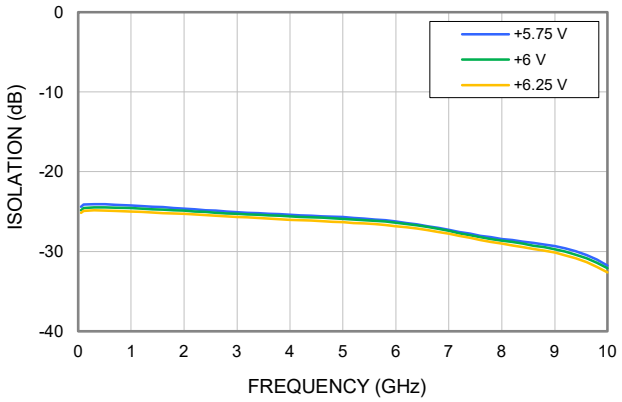


Typical Performance Curves

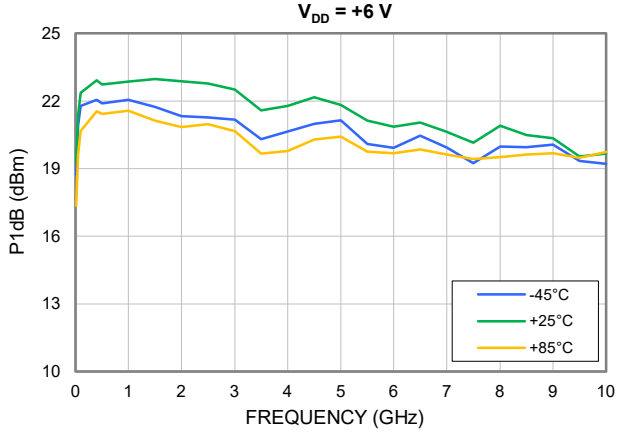
ISOLATION vs.TEMPERATURE, P_{IN} = -25 dBm, V_{DD} = +6 V



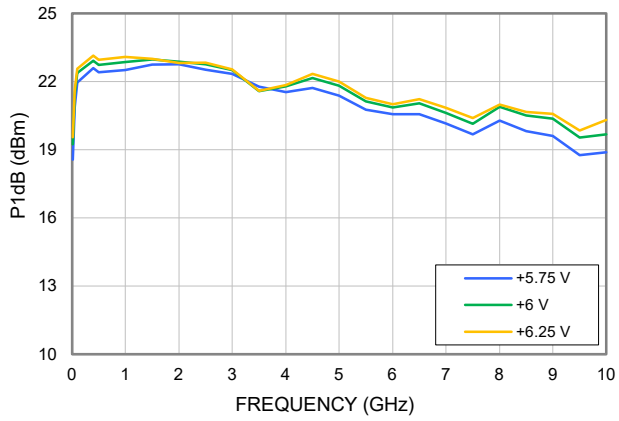
ISOLATION vs. VOLTAGE, TEMPERATURE = +25°C



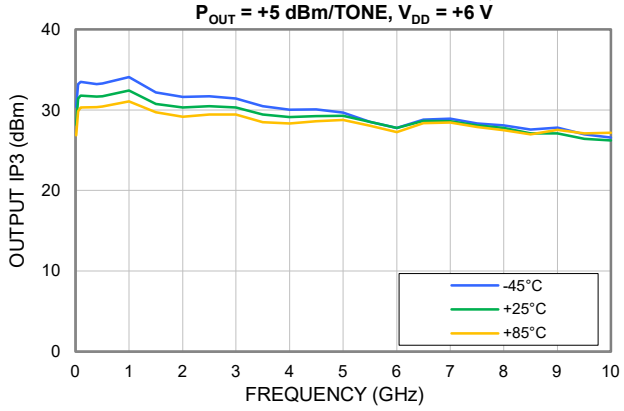
P1dB vs.TEMPERATURE, V_{DD} = +6 V



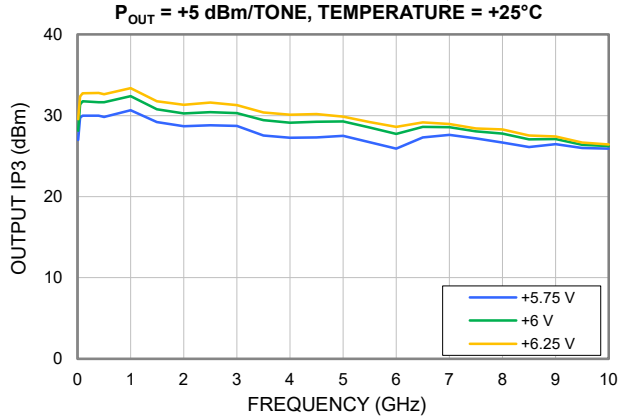
P1dB vs. VOLTAGE, TEMPERATURE = +25°C



OUTPUT IP3 vs. TEMPERATURE, P_{OUT} = +5 dBm/TONE, V_{DD} = +6 V

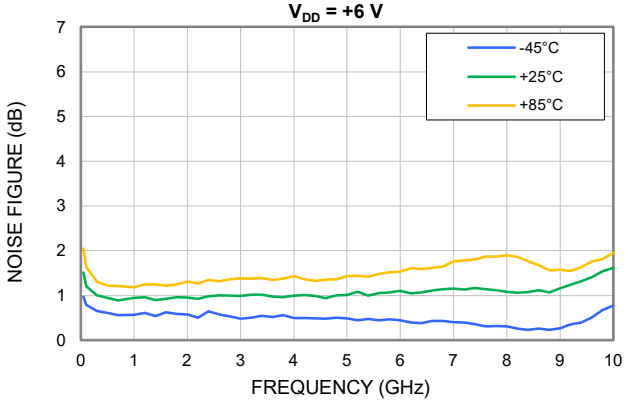


OUTPUT IP3 vs. VOLTAGE, P_{OUT} = +5 dBm/TONE, TEMPERATURE = +25°C

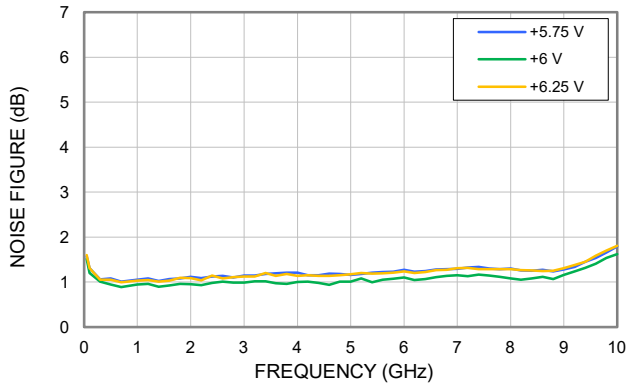


Typical Performance Curves

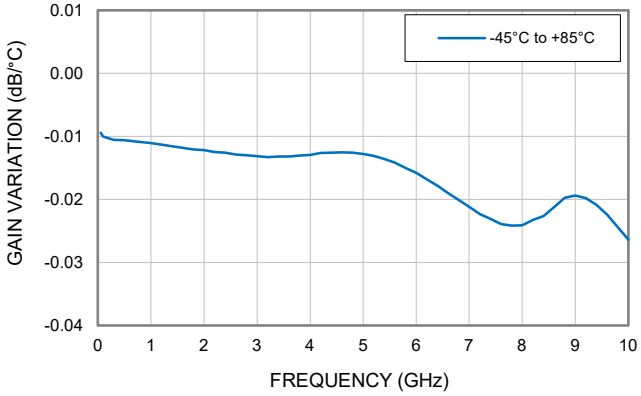
NOISE FIGURE vs. TEMPERATURE, V_{DD} = +6 V



NOISE FIGURE vs. VOLTAGE, TEMPERATURE = +25°C



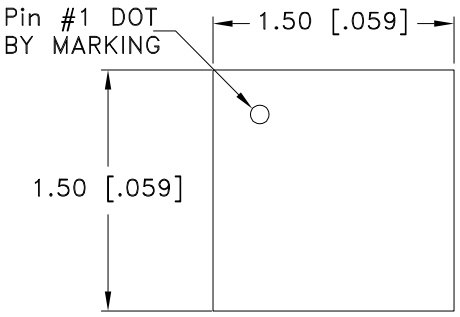
GAIN VARIATION vs. TEMPERATURE, P_{IN} = -25 dBm, V_{DD} = +6 V



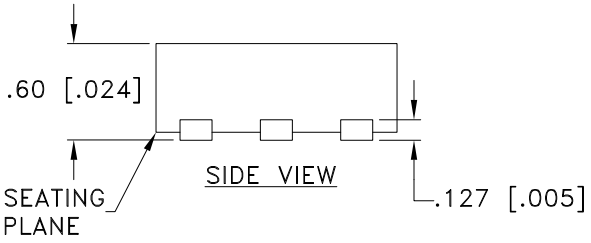
Case Style KC

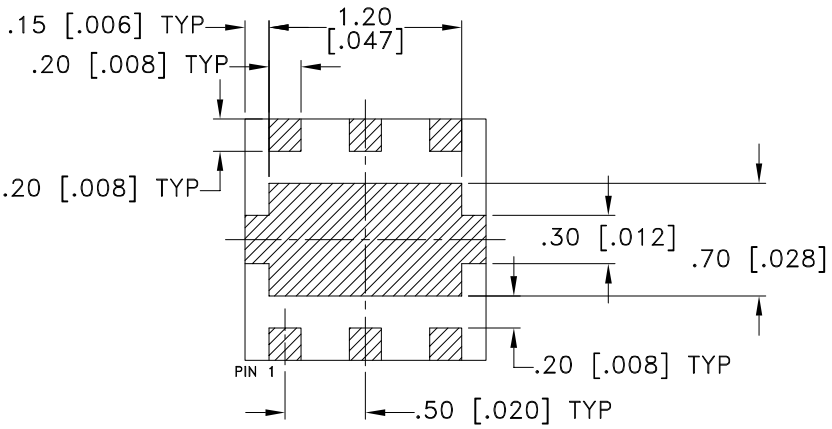
Outline Dimensions

KC3009



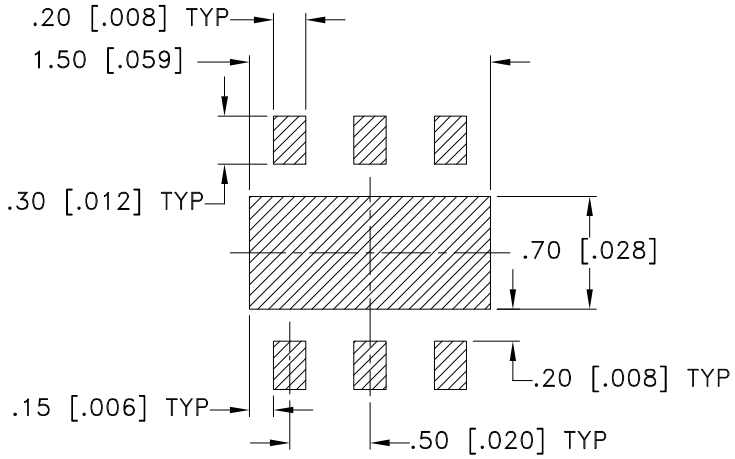
TOP VIEW





BOTTOM VIEW

PCB Land Pattern



Suggested Layout,
Tolerance to be within ±0.050 mm

NOTES:

1. ▨ DENOTES METALLIZATION

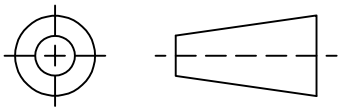
Weight: .0036 grams

Dimensions are in mm [inches]. Tolerances: 2 Pl.± 0.05 mm

Notes:

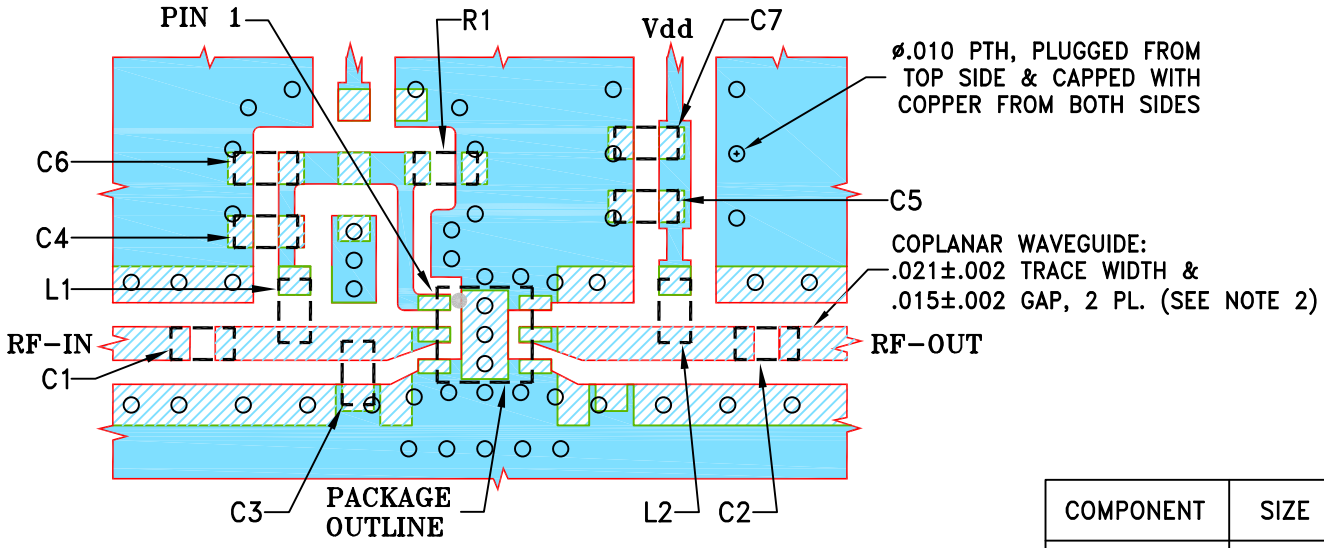
1. Case material: Plastic.
2. Termination finish: NiPdAu (3µm/0.080µm/0.080µm) .

THIRD ANGLE PROJECTION



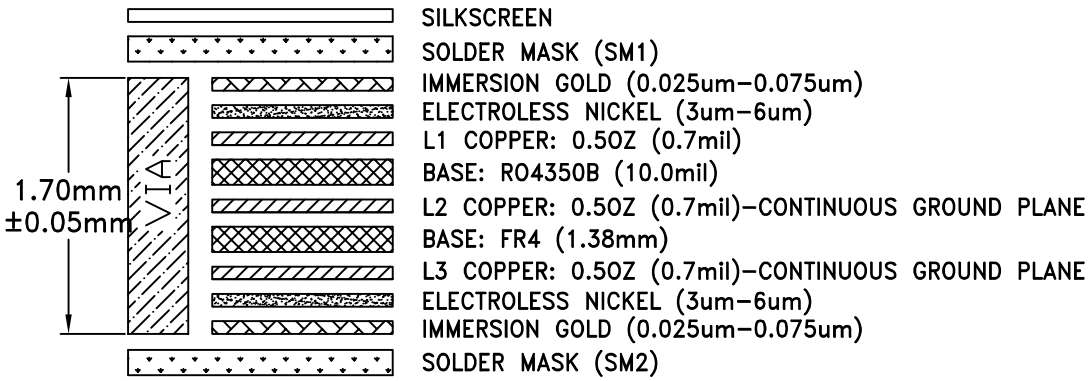
REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	ECO-023602	NEW RELEASE	11/14/24	ITG	IL

SUGGESTED MOUNTING CONFIGURATION FOR KC3009 CASE STYLE



COMPONENT	SIZE
C1-C8	0402
L1, L2	0402
R1	0402

3 LAYER STACKUP DETAIL



NOTES:

1. PCB IS MULTILAYER PCB, SEE STACK-UP DIAGRAM.
2. TRACE WIDTH & GAP PARAMETERS ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .010"; COPPER: 1/2 OZ.
   FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
3. CHIP COMPONENT FOOT PRINTS SHOWN FOR REFERENCE. FOR COMPONENT VALUES REFER TO TB-PMA1-14LNC+.

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	11/13/24
TOLERANCES ON:	CHECKED	GF	11/13/24
2 PL DECIMALS ±	APPROVED	IL	11/13/24
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

Mini-Circuits®

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

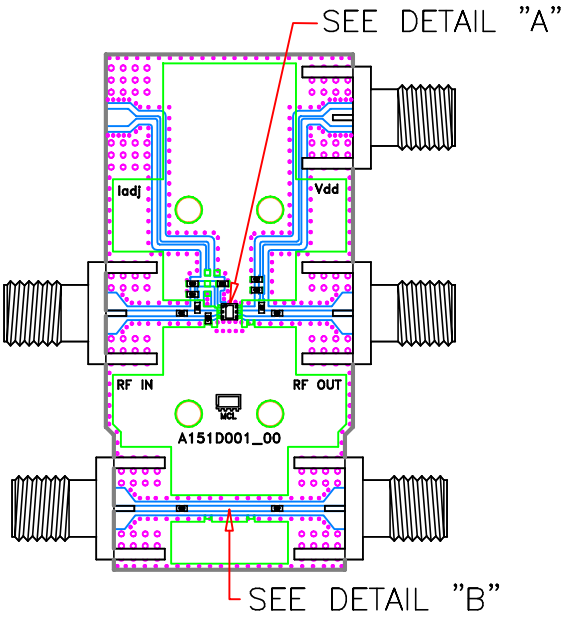
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

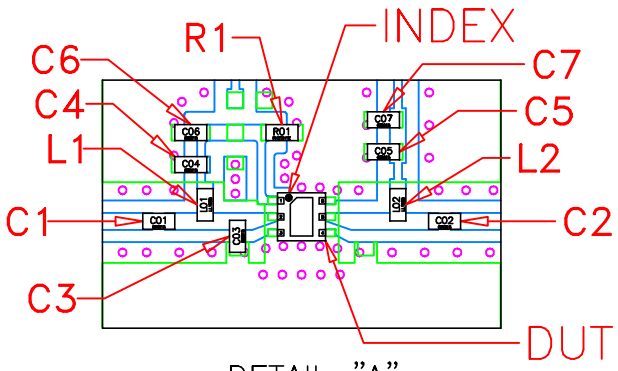
PL, KC3009, TB-PMA-14LNC+

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-803	OR

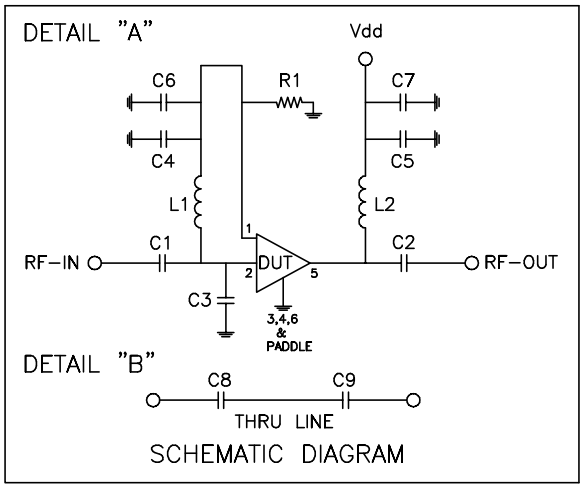
FILE:	SCALE:	SHEET:
98PL803	8:1	1 OF 1

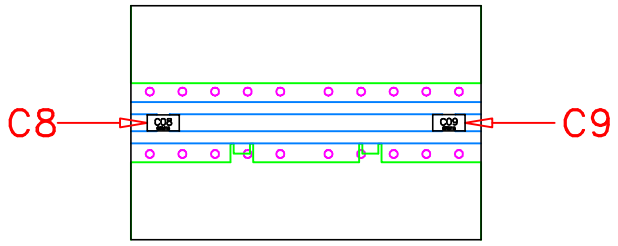
Evaluation Board and Circuit





DETAIL "A"
LOCATION OF
UNITS COMPONENTS
(SCALE 3:1)





DETAIL "B"
LOCATION OF
UNITS COMPONENTS
(SCALE 3:1)

COMPONENTS	SIZE	VALUE	MANUFACTURER	PART NUMBER
C1,C2,C8,C9	0402	0.01 uF	Murata	GRM155R71H103KA88D
C3		0.2 pF		GJM1555C1HR20WB01D
C4,C5		100 pF		GRM1555C1H101JA01D
C6,C7		0.1 uF		GRM155R71H104KE14J
L1,L2		900 nH	Coilcraft	0402DF-901XJRU
R1		330 Ω	KOA Speer	RK73H1ETTP3300F

Notes:

1. 50 Ohm SMA Female Connectors.
2. PCB Material: Roger RO4350B or equivalent,
   Dielectric constant=3.5, Thickness=0.010 inch

Mini-Circuits®

Mini-Circuits

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 or -55° to 105° C or -40° to 105° C or -40° to 95° C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C or -65° to 150° Ambient Environment	Individual Model Data Sheet
HTOL	1000 hours at 125°C	MIL-STD-883, Method 1005, Condition B
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

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
Marking Resistance to Solvents	Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C; distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C	MIL-STD-202, Method 215