

Ultra Low Noise, High IP3

# Monolithic Amplifier

PMA2-33LN+

50Ω 0.4 to 3.0 GHz

## The Big Deal

- Ultra Low Noise Figure, 0.38 dB
- High Gain, High IP3
- Small Size, 2 x 2 x 1mm



2mm x 2mm

## Product Overview

Mini-Circuits PMA2-33LN+ is an E-PHEMT based, ultra-low noise MMIC amplifier with a unique combination of low noise and high IP3, making this amplifier ideal for sensitive, high-dynamic range receiver applications. This design operates on a single 3V supply, is well matched for 50Ω systems, and comes in a tiny, low-profile package accommodating dense circuit board layouts.

## Key Features

Feature	Advantages
Ultra Low Noise, 0.38 dB at 0.9 GHz	Enables lower system noise figure performance.
High IP3, <ul style="list-style-type: none"><li>• +34 dBm at 0.9 GHz and</li><li>• +39 dBm at 3 GHz</li></ul>	Combination of low noise and high IP3 makes this MMIC amplifier ideal for use in low noise receiver front end (RFE) as it gives the user advantages of sensitivity & two-tone IM performance at both ends of the dynamic range.
Low operating voltage, 3V	Achieves high IP3 using lower voltage compared to other devices of its kind.
2 x 2mm 8-lead MCLP package	Tiny footprint saves space in dense layouts while providing low inductance, repeatable transitions, and excellent thermal contact to PCB.
Max input power <ul style="list-style-type: none"><li>• 27 dBm (5 minutes)</li><li>• 14 to +22 dBm (Continuous)</li></ul>	Ruggedized design provides high power handling for input powers common at receiver inputs, eliminating the need for an external limiter in most cases
High reliability	Low signal operating current of 56 mA nominal maintains junction temperatures typically below 93°C at 85°C ground lead temperature.



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0.4-3.0 GHz

## Product Features

- Ultra Low Noise figure, 0.38 dB at 0.9 GHz
- High IP3, 34 dBm typ. at 0.9 GHz, +39 dBm at 3 GHz
- High Pout, P1dB 17.2 dBm typ. at 0.9 GHz
- Class 1A HBM ESD Rating (250V)

## Typical Applications

- Base station infrastructure
- Portable Wireless
- LTE
- GPS
- GSM
- Airborne radar



## PMA2-33LN+

CASE STYLE: MC1631-1

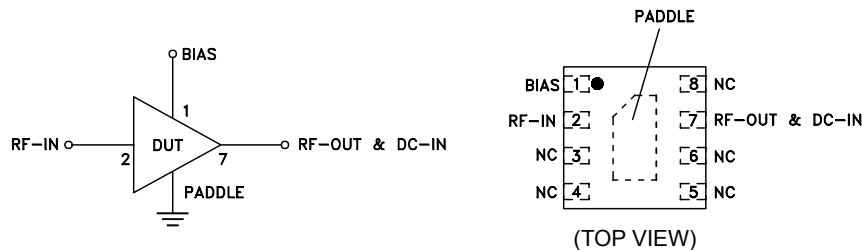
### +RoHS Compliant

The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

## General Description

The PMA2-33LN+ (RoHS compliant) amplifier is fabricated using 0.25  $\mu\text{m}$  E-PHEMT technology and offers extremely high dynamic range with ultra low noise figure and good input and output return loss. Lead finish is SnAgNi. It has repeatable performance from lot to lot and is enclosed in a 2mm x 2mm x 1mm package for very good thermal performance.

## simplified schematic & pad description



Function	Pad Number	Description (See Figure 1)
RF IN	2	Connects to RF input via C1 and Pad 1 via L1
RF-OUT & DC-IN	7	Connects to RF out via C2 and $V_S$ via L2 & R2
Ground	Paddle	Connects to ground
Bias	1	Connects to Supply voltage ( $V_{DD}$ ) via R1 & R6
No Connection	3,4,5,6,8	Not used internally. Connected to ground on test board

**Electrical Specifications<sup>(1)</sup> at 25°C and 3V, unless noted**

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units
Frequency Range		0.4		3.0	GHz
Noise Figure	0.4		0.78	—	dB
	0.9		0.38	0.6	
	1.5		0.36	—	
	2.0		0.46	—	
	3.0		0.78	—	
Gain	0.4		24.4		dB
	0.9		19.1		
	1.5		14.9		
	2.0		12.5		
	3.0		9.1		
Input Return Loss	0.4		9.5		dB
	0.9		10.2		
	1.5		10.0		
	2.0		10.4		
	3.0		12.3		
Output Return Loss	0.4		20.1		dB
	0.9		19.3		
	1.5		17.4		
	2.0		17.3		
	3.0		18.2		
Output Power @ 1 dB compression <sup>(2)</sup>	0.4		17.0		dBm
	0.9		17.2		
	1.5		17.0		
	2.0		17.5		
	3.0		17.3		
Output IP3	0.4		30.4		dBm
	0.9		34.5		
	1.5		35.6		
	2.0		37.5		
	3.0		38.6		
Device Operating Voltage			3.0		V
Device Operating Current at 3V <sup>(2)</sup>			56	67	mA
Device Current Variation vs. Temperature at 3V <sup>(3)</sup>			-27		μA/°C
Device Current Variation vs. Voltage at 25°C			0.025		mA/mV
Thermal Resistance, junction-to-ground lead			54		°C/W

<sup>(1)</sup> Measured on Mini-Circuits Characterization test board TB-736+. See Characterization Test Circuit (Fig. 1)

<sup>(2)</sup> Current increases at P1dB

<sup>(3)</sup> (Current at 85°C - Current at -45°C)/130

**Absolute Maximum Ratings<sup>4</sup>**

Parameter	Ratings
Operating Temperature (ground)	-40°C to 85°C
Storage Temperature	-65°C to 150°C
Junction Temperature	150°C
Total Power Dissipation	0.5 W
Input Power (CW), Vd=3V(Note5)	+27dBm (5minutes max) +14 dBm to 1.5 GHz and +22 dBm over 1.5 to 3 GHz (continuous)
DC Voltage	5.5 V

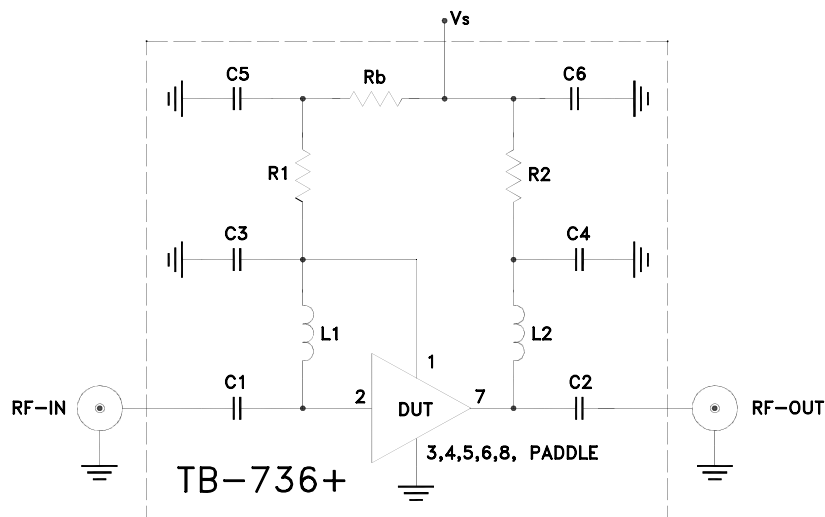
Note:

<sup>(4)</sup> Permanent damage may occur if any of these limits are exceeded.

Electrical maximum ratings are not intended for continuous normal operation.

<sup>(5)</sup> Measured on Mini-Circuits test board, TB-736+

**Recommended Application and Characterization Test Circuit**



Component	Value	Size
C1, C2	100pF	0402
C3, C6	4.7μF	0402
C4	33pF	0402
C5	Not Used	—
L1, L2	33nH	0402
R1	0Ω	0402
R2	10Ω	0603
Rb	4.02kΩ	0402

Fig 1. Application and Characterization circuit  
 Note: This block diagram is used for characterization. (DUT soldered on Mini-Circuits Characterization test board TB-736+)  
 Gain, Return loss, Output power at 1dB compression (P1 dB) , output IP3 (OIP3) and noise figure measured using Agilent's N5242A PNA-X microwave network analyzer.

Conditions:

1. Gain and Return loss: Pin= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 0 dBm/tone at output.

**Product Marking**

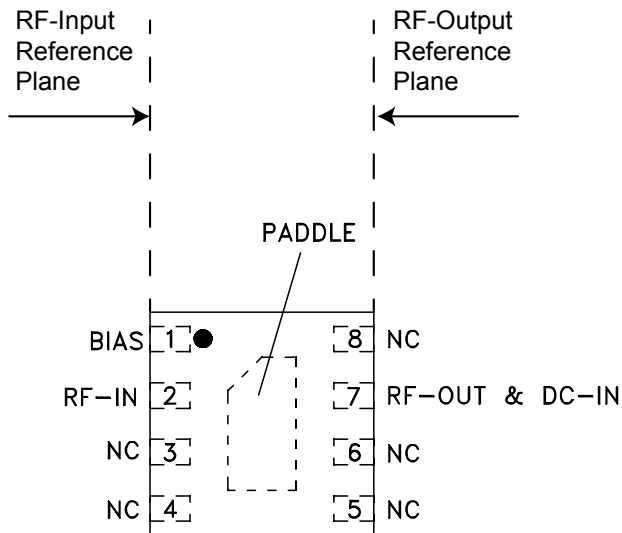


Noise Parameters

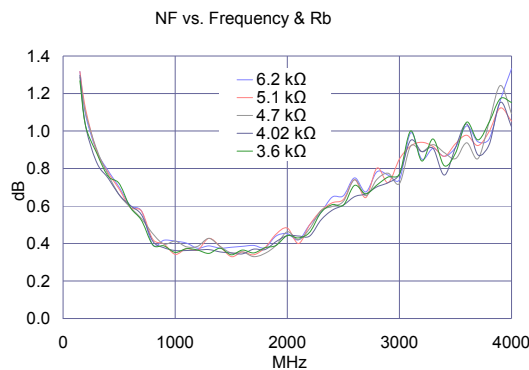
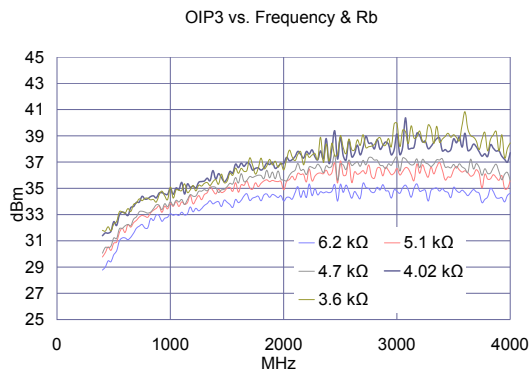
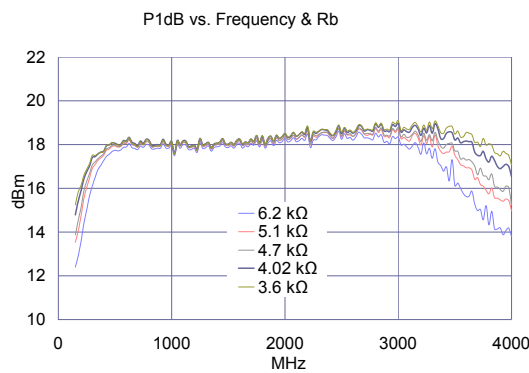
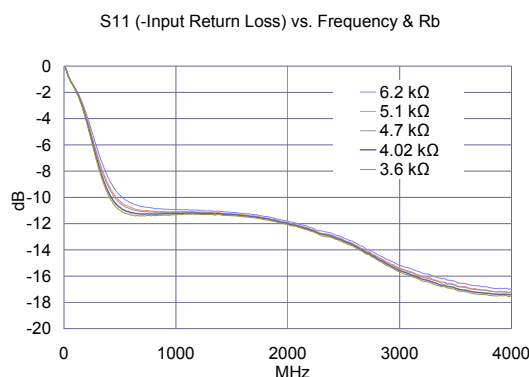
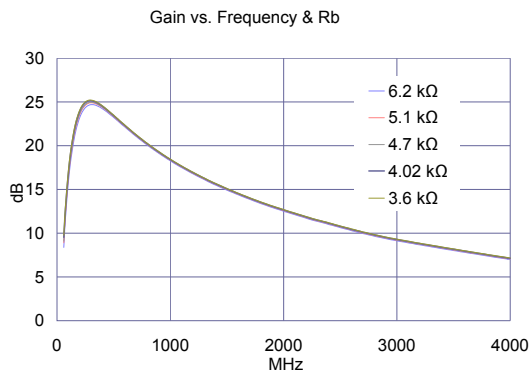
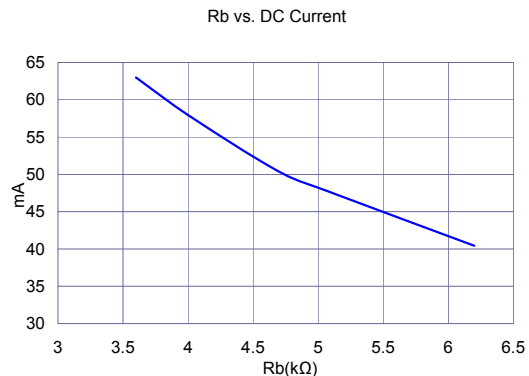
Frequency (MHz)	Fmin (dB)	$\Gamma_{opt}$ Magnitude	$\Gamma_{opt}$ Angle	Rn/50
800	0.26	0.066	79.6	0.039
900	0.22	0.086	98.2	0.032
1000	0.22	0.108	102.9	0.032
1500	0.25	0.214	135.0	0.021
2000	0.27	0.237	-169.4	0.028
2500	0.32	0.317	-162.8	0.022
3000	0.43	0.381	-141.7	0.035

NOTES:

- 1) DUT soldered on test board (50 ohm input and output)
- 2) reference plane is at the end of the RF-IN pad and the output reference plane is at the end of the RF-OUT pad as shown in figure below



Electrical Performance vs. Rb



Additional Detailed Technical Information	
<i>additional information is available on our dash board. To access this information <a href="#">click here</a></i>	
<b>Performance Data</b>	Data Table
	Swept Graphs
	S-Parameter (S2P Files) Data Set (.zip file)
<b>Case Style</b>	MC1631-1 <i>Plastic package, exposed paddle, lead finish: tin silver nickel</i>
<b>Tape &amp; Reel</b> Standard quantities available on reel	F66 <i>7" reels with 20, 50, 100, 200, 500, 1K or 2K devices</i>
<b>Suggested Layout for PCB Design</b>	PL-400
<b>Evaluation Board</b>	TB-736+
<b>Environmental Ratings</b>	ENV08T1

**ESD Rating**

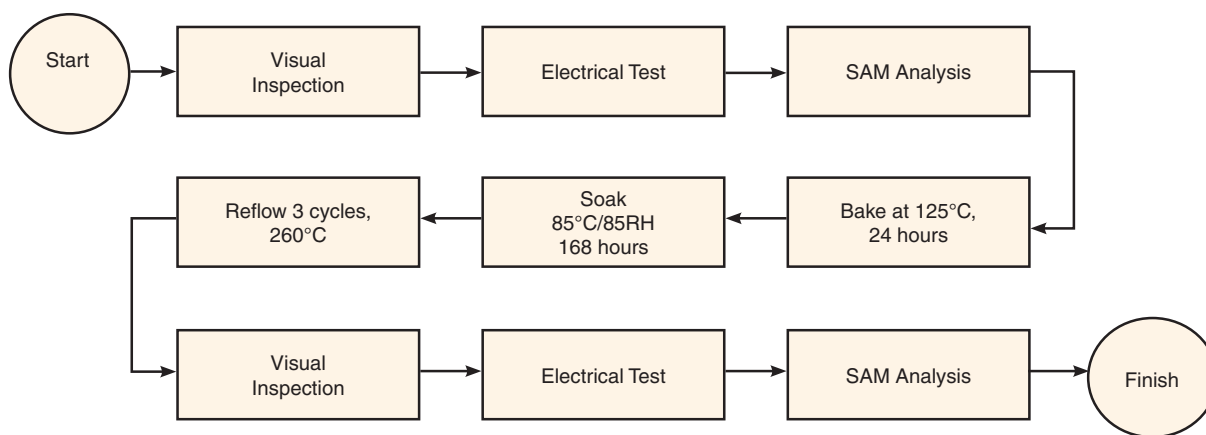
Human Body Model (HBM): Class 1A (250 to <500V) in accordance with ANSI/ESD STM 5.1 - 2001

Machine Model (MM): Class M1 (pass 25V) in accordance with ANSI/ESD STM5.2-1999

**MSL Rating**

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020D

**MSL Test Flow Chart**



**Additional 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/MCLStore/terms.jsp](http://www.minicircuits.com/MCLStore/terms.jsp)