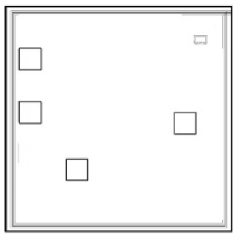
Ultra Low Noise, High IP3

Monolithic Amplifier Die PMA2-43LN-D+

50Ω 1.1 to 4.0 GHz



The Big Deal

- Ultra low noise figure, 0.5 dB
- High gain, high IP3, 33 dBm
- High P1dB, 20.4 dBm

Product Overview

Mini-Circuits PMA2-43LN-D+ is an E-PHEMT based, ultra-low noise MMIC amplifier die 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 5V supply, is well matched for 50Ω systems.

Key Features

Feature	Advantages
Ultra-low noise, 0.5 dB at 1.9 GHz	Enables lower system noise figure performance
High IP3 • +32.9 dBm at 1.9 GHz • +33.2 dBm at 2.5 GHz	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, 5V	Achieves high IP3 using low voltage.
High max input power • +22 dBm (5 minutes) • +14 dBm (continuous)	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 51 mA nominal maintains junction temperatures typically below 103 °C at 85°C temperature at the bottom of the die.

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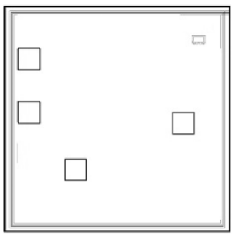


Product Features

- Ultra Low Noise figure, 0.5 dB at 1.5 GHz
- High IP3, 32.3 dBm typ. at 1.5 GHz
- High Pout, P1dB 20.4 dBm typ. at 1.9 GHz

Typical Applications

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

+RoHS Compliant

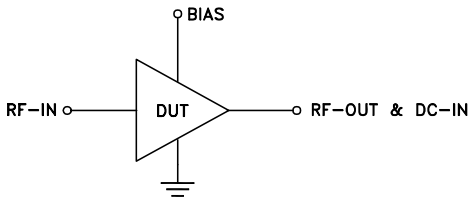
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

General Description

Mini-Circuits PMA2-43LN-D+ is an E-PHEMT based, ultra-low noise MMIC amplifier die 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 5V supply, is well matched for 50Ω systems.

Simplified Schematic and Pad description



Pad Function	Description *(See Figure 1)*
RF-IN	Connects to RF input via C1 and Bias pad via L1
RF-OUT & DC-IN	Connects to RF out via C2 and V_S via L2 & R2
Ground	Connects to ground
BIAS	Connects to Supply voltage (V_S) via R1 & Rb

Electrical Specifications[1] at 25°C and 5V, unless noted

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units
Frequency range		1.1		4.0	GHz
Noise figure	1.1		0.5		dB
	1.5		0.5		
	1.9		0.6		
	2.5		0.7		
	4.0		1.3		
Gain	1.1		22.8		dB
	1.5		21.1		
	1.9		19.4		
	2.5		17.0		
	4.0		11.9		
Input return loss	1.1		11.8		dB
	1.5		16.2		
	1.9		18.3		
	2.5		19.8		
	4.0		13.5		
Output return loss	1.1		8.7		dB
	1.5		10.9		
	1.9		11.5		
	2.5		10.7		
	4.0		6.6		
Output power at 1dB compression	1.1		19.4		dBm
	1.5		20.4		
	1.9		20.4		
	2.5		20.3		
	4.0		18.9		
Output IP3	1.1		30.8		dBm
	1.5		32.3		
	1.9		32.9		
	2.5		33.2		
	4.0		32.1		
Device operating voltage (V_{DD})			5.0		V
Device operating current (I_{DD})		39	53	64	mA
Device current variation vs. voltage			0.020		mA/mV
Thermal resistance, junction-to-ground lead			61		°C/W

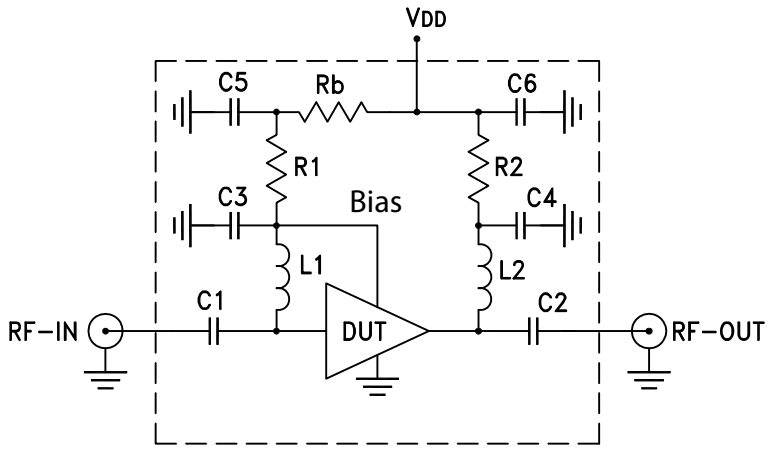
1. Measured on Mini-Circuits Die Characterization test board. See Characterization Test Circuit (Fig. 1)
2. Current increases at P1dB
3. (Current at 85°C - Current at -45°C)/130

Absolute Maximum Ratings[4,5]

Parameter	Ratings
Operating Temperature (ground lead)	-40°C to 85°C
Junction Temperature	150°C
Total Power Dissipation	0.7 W
Input Power (CW), Vd=3V	+22 dBm (5minutes max) +14 dBm (continuous)
DC Voltage	+6V

4. Permanent damage may occur if any of these limits are exceeded.
   Electrical maximum ratings are not intended for continuous normal operation.
5. Die performance measured in industry standard 2x2 mm 8-lead package.

Recommended Application and Characterization Test Circuit



Component	Value	Size
C1, C2	1000pF	0402
C5, C6	4.7µF	0402
C3, C4	100pF	0402
L1	10nH	0402
L2	8.2nH	0402
R1	49.9Ω	0402
R2	0Ω	0603
Rb	5.11kΩ	0402

Fig 1. Application and Characterization circuit
Note: This block diagram is used for characterization. (DUT soldered on Mini-Circuits Characterization test board TB-805+)

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.

Die Layout

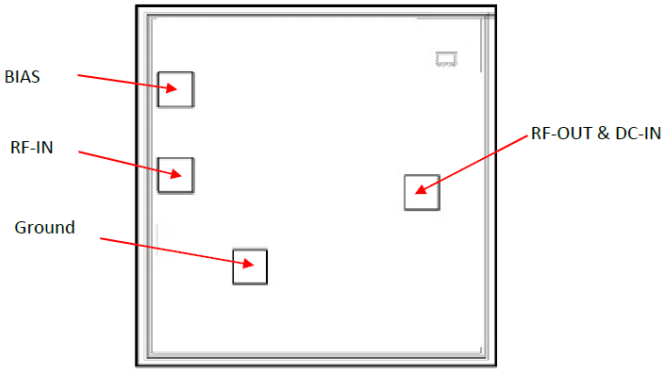


Fig 2. Die Layout

Bonding Pad Position

(Dimensions in µm, Typical)

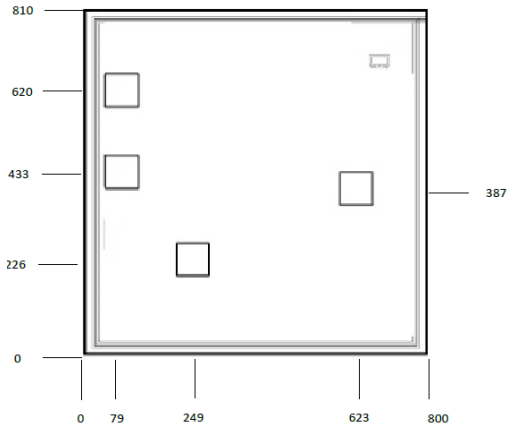


Fig 3. Bonding Pad Positions

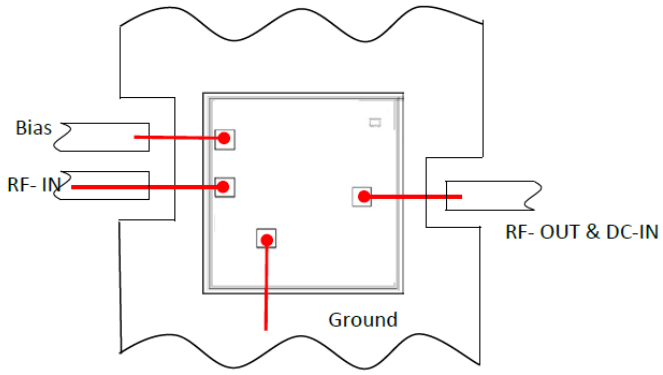
Critical Dimensions

Parameter	Values
Die Thickness, µm	100
Die Width, µm	800
Die Length, µm	810
Bond Pad Size, µm	75 x 75

Assembly and Handling Procedure

1. Storage
   Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC EPHEMPT amplifier dice are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be opened in clean room conditions at an appropriately grounded anti-static worksta tion. Devices need careful handling using correctly designed collets, vacuum pickup tips or sharp antistatic tweezers to deter ESD damage to dice.
3. Die Attach
   The die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are DieMat DM6030HK-PT/H579 or Ablestik 84-1LMISR4. Apply sufficient epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total die periphery. Parts shall be cured in a nitrogen filled atmosphere per manufacturer's cure condition. It is recommended to use antistatic die pick up tools only.
4. Wire Bonding
   Bond pad openings in the surface passivation above the bond pads are provided to allow wire bonding to the dice gold bond pads. Thermosonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1 mil diameter. Bonds must be made from the bond pads on the die to the package or substrate. All bond wires should be kept as short as low as reasonable to minimize performance degradation due to undesirable series inductance.

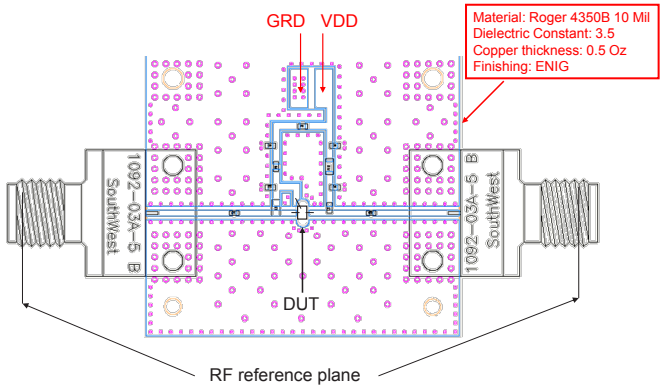
Assembly Diagram



Recommended Wire Length, Typical

Wire	Wire Length (mm)	Wire Loop Height (mm)
RF-OUT & DC IN, Bias	0.60	0.15
GROUND	0.40	0.15
RF-INPUT	1.00	0.15

RF Reference Plane - No port extension



Additional Detailed Technical Information

additional information is available on our dash board.

Performance Data	Data Table	
	Swept Graphs	
	S-Parameter (S2P Files) Data Set with and without port extension(.zip file)	
Case Style	Die	
Die Ordering and packaging information	Quantity, Package	Model No.
	Small, Gel - Pak: 10,50,100 KGD*	PMA2-43LN-DG+
	Medium†, Partial wafer: KGD*<1890	PMA2-43LN-DP+
	Large†, Full Wafer	PMA2-43LN-DF+
	†*Available upon request contact sales representative*	
	Refer to AN-60-067	
Environmental Ratings	ENV-80	

*Known Good Dice ("KGD") means that the dice in question have been subjected to Mini-Circuits DC test performance criteria and measurement instructions and that the parametric data of such dice fall within a predefined range. While DC testing is not definitive, it does help to provide a higher degree of confidence that dice are capable of meeting typical RF electrical parameters specified by Mini-Circuits.

ESD Rating**

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

** Tested in industry standard 2x2mm, 8-lead plastic package.

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.

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