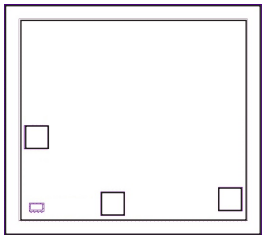
Low Noise, High IP3

Monolithic Amplifier Die PSA4-5043-D+

50Ω 0.05 to 4 GHz



The Big Deal

- Ultra Low Noise Figure, 0.75 dB
- High IP3 and Pout at low DC power consumption
- Class 1B HBM ESD rating (500V)

Product Overview

Mini-Circuits PSA4-5043-D+ is a E-PHEMT based Ultra-Low Noise MMIC Amplifier die operating from 50 MHz to 4 GHz 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 +3 to +5V supply at only 33 mA at 3V and 56mA at +5V, is internally matched to 50 ohms.

Key Features

Feature	Advantages
Ultra Low Noise: 0.8 dB at 1 GHz 1.0 dB at 2 GHz	Outstanding Noise Figure, measured in a 50 Ohm environment without any external matching
High IP3, 34 dBm at 1.0 GHz	Combining Low Noise and High IP3 makes this MMIC amplifier ideal for Low Noise Receiver Front End (RFE) because it gives the user advantages at both ends of the dynamic range: sensitivity & two-tone spur-free dynamic range
High Output Power, +20 dBm at 2 GHz	The PSA4-5043-D+ provides up to +20dBm output power at 1dB compression enabling this amplifier to support high linear dynamic range requirements.-
Broad Band, up to 4 GHz	Operating over a broadband from 50 MHz to 4 GHz, the PSA4-5043-D+ covers the primary wireless communications bands: Cellular, PCS, LTE, WiMAX
Internally Matched	No external matching elements required to achieve the advertised noise and output power over the full band
High Reliability	Low, small signal operating current of 53mA nominal maintains junction temperatures typically below 107°C at 85°C at bottom of die
Class 1B ESD (500V, HBM)	The PSA4-5043-D+ is a super low noise PHEMT based design. Unlike many other PHEMT designs. Mini-Circuits incorporates ESD protection on die to achieve industry leading ESD performance for a low noise amplifier.

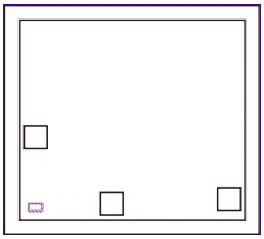
Low Noise, High IP3

Monolithic Amplifier Die PSA4-5043-D+

50Ω 0.05 to 4 GHz

Product Features

- Ultra Low Noise Figure, 0.8 dB typ. at 1 GHz
- Class 1B ESD rating (500V)
- High IP3, up to 34 dBm typ. at 1 GHz
- Output Power at 1dB comp., up to +20 dBm typ. at 2 GHz
- Gain, 18.4 dB typ. at 1GHz
- Supply Voltage, +3V, Id=33mA, +5V, Id=56mA
- Aqueous washable



+RoHS Compliant

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

Ordering Information: Refer to Last Page

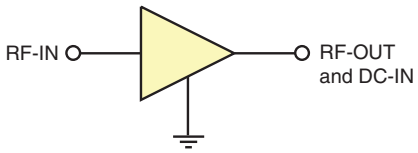
Typical Applications

- Cellular
- ISM
- GSM
- WCDMA
- LTE
- WiMax
- WLAN
- GPS

General Description

PSA4-5043-D+ is an advanced wide band, high dynamic range, low noise, high IP3, high output power, monolithic amplifier die. Manufactured using E-PHEMT* technology enables it to work with a single positive supply voltage.

Simplified Schematic and Pad description



Pad	Description *(See Application Circuit, Fig. 2)*
RF IN	RF input pin (connect to RF-IN via DC blocking cap)
RF-OUT & DC-IN	RF output pin (connected to RF-out via blocking cap C2 and supply voltage Vd via RF Choke L1)
GND	Connections to ground: use via holes as shown in “Suggested Layout for PCB Design” to reduce ground path inductance for best performance.

* Enhancement mode pseudomorphic High Electron Mobility Transistor.

Electrical Specifications[1] at 25°C, Zo=50Ω, *(refer to characterization circuit, Fig. 1)*

Parameter	Condition (GHz)	Vd=5.0V[1]			Vd=3.0V[1]			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Frequency Range		0.05		4.0	0.05		4.0	GHz
at DC Volts (Vd)			5.0			3.0		V
DC Current (Id)		40	58	66		33		mA
Noise Figure	0.05		0.64			0.57		dB
	0.5		0.75			0.75		
	1.0		0.82			0.83		
	2.0		1.0			1.0		
	3.0		1.3			1.27		
	4.0		1.6			1.55		
Gain	0.05		25.2			24.0		dB
	0.5		22.0			21.0		
	1.0		18.4			17.6		
	2.0		13.3			12.7		
	3.0		10.1			9.5		
	4.0		7.8			7.3		
Input Return Loss	0.05		7.4			6.5		dB
	0.5		10.8			9.5		
	1.0		11.5			10.2		
	2.0		12.5			11.0		
	3.0		10.9			9.7		
	4.0		11.1			9.7		
Output Return Loss	0.05		12.4			11.4		dB
	0.5		16.2			16.8		
	1.0		14.2			16.5		
	2.0		13.6			17.3		
	3.0		14.5			19.3		
	4.0		12.6			16.6		
Output IP3	0.05		32.2			27.6		dBm
	0.5		33.3			28.0		
	1.0		34.0			28.5		
	2.0		34.6			29.5		
	3.0		33.9			29.4		
	4.0		32.6			28.5		
Output Power @1dB compression[2]	0.05		18.1			14.9		dBm
	0.5		18.7			15.5		
	1.0		19.0			16.4		
	2.0		19.9			18.1		
	3.0		20.3			18.5		
	4.0		20.2			18.8		
DC Current Variation Vs. Voltage			0.01			0.01		mA/mV
Thermal Resistance[3]			67			67		°C/W

1. Measured on Mini-Circuits Die Characterization test board. See Characterization Test Circuit (Fig. 1)
2. Current increases at P1dB
3. Defined with reference to ground pad temperature measured in industry standard SOT-343 package.

Absolute Maximum Ratings[4]

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Channel Temperature	150°C
DC Voltage	6V
Device Current	76 mA
Power Dissipation	380 mW
Input Power (CW)	23 dBm (5 minutes max), 17dBm (continuous)

4. Permanent damage may occur if any of these limits are exceeded.
These maximum ratings are not intended for continuous normal operation.
Measured in industry standard SOT-343 package.

Characterization Test Circuit

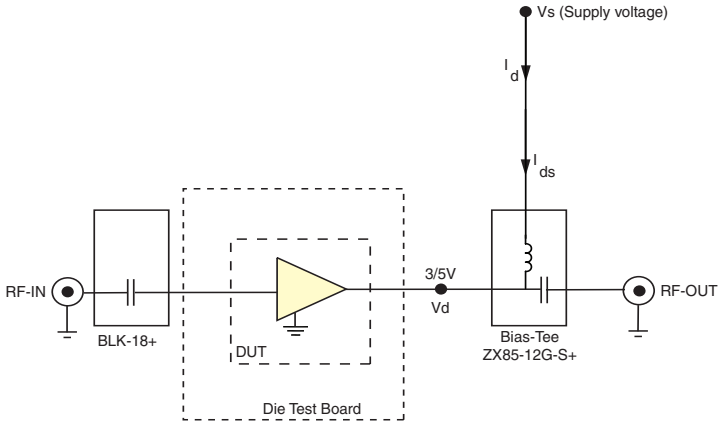


Fig 1. Block Diagram of Test Circuit used for characterization.
Gain, Return loss, Output power at 1dB compression (P1 dB), Output IP3 (OIP3) and Noise Figure measured using Agilent's N5242A PNA-X microwave network analyzer.

Conditions:
1. Gain: Pin= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, +5 dBm/tone at output.

Recommended Application Circuit

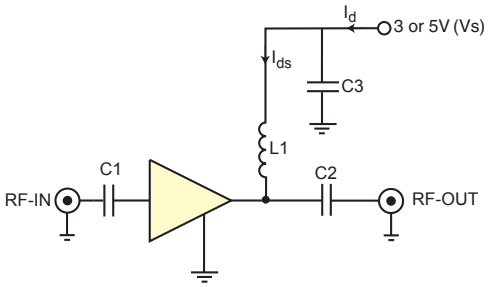


Fig 2. Recommended Application Circuit
C1=1000pF
C2 & L1= TCBT-14+
C3=0.1µF

Die Layout

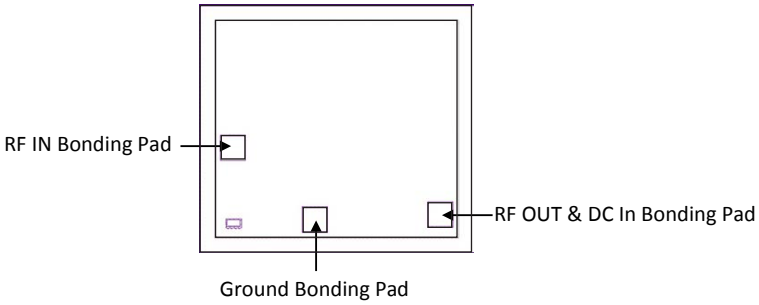


Fig 3. Die Layout

Bonding Pad Position

(Dimensions in µm, Typical)

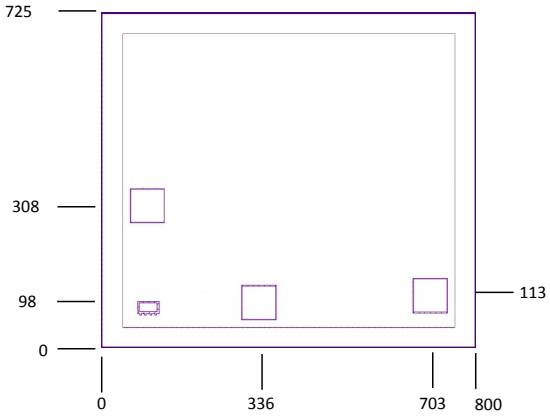


Fig 4. Bonding Pad Positions

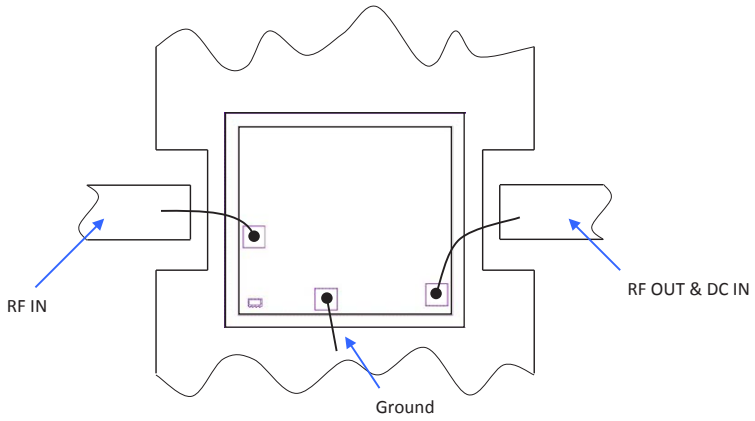
Critical Dimensions

Parameter	Values
Die Thickness, µm	100
Die Width, µm	800
Die Length, µm	725
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.

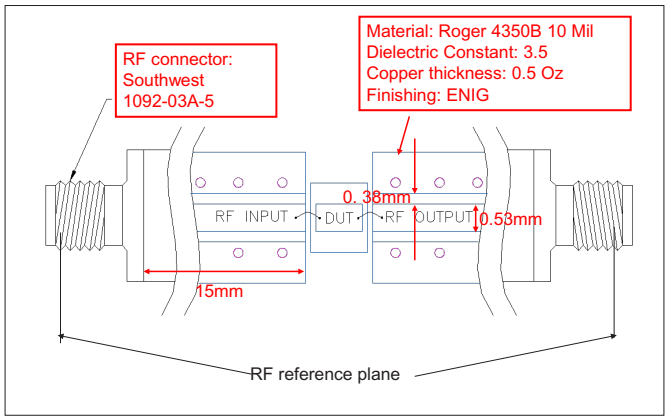
Assembly Diagram



Recommended Wire Length, Typical

Wire	Wire Length (mm)	Wire Loop Height (mm)
RF-IN, RF-OUT & DC-IN	0.50	0.15
GND	0.60	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*	PSA4-5043-DG+
	Medium†, Partial wafer: KGD*<5K	PSA4-5043-DP+
	Large†, Full Wafer	PSA4-5043-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 1B (500 to <1000V) in accordance with ANSI/ESD STM 5.1 - 2001

Machine Model (MM): Class M1 (pass 35V) in accordance with ANSI/ESD STM5.2-1999; passes 35V

** Measured in industry standard SOT-343 pacakage.

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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