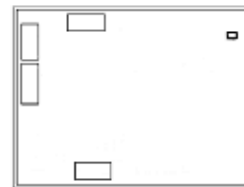


Ultra High Dynamic Range

Monolithic Amplifier Die

PHA-101-D+

50Ω 0.05 to 1.5 GHz



The Big Deal

- Ultra High IP3
- Broadband High Dynamic Range without external Matching Components

Product Overview

PHA-101-D+ (RoHS compliant) is an advanced wideband amplifier die fabricated using E-PHEMT technology and offers extremely high dynamic range over a broad frequency and with low noise figure. In addition, the PHA-101-D+ has good input and output return loss over a broad frequency range without the need for external matching components. Moreover, the PHA-101-D+ has demonstrated excellent reliability and has low thermal resistance.

Key Features

Feature	Advantages
Broad Band: 0.05 to 1.5 GHz	Broadband covering primary wireless communications bands: Cellular, PCS, LTE
Extremely High IP3 Versus DC power Consumption 45 dBm typical at 0.9 GHz	The PHA-101-D+ matches industry leading IP3 performance relative to device size and power consumption. The combination of the design and E-PHEMT Structure provides enhanced linearity over a broad frequency range as evidence in the IP3 being typically 20 dB above the P 1dB point. This feature makes this amplifier ideal for use in: <ul style="list-style-type: none">• Driver amplifiers for complex waveform up converter paths• Drivers in linearized transmit systems• Secondary amplifiers in ultra High Dynamic range receivers
No External Matching Components Required	Mini-Circuits PHA-101-D+ provides Input and Output Return Loss of 9.9-12.5 dB up to 1.5 GHz without the need for any external matching components
Unpackaged die	Enables the user to integrate the amplifier directly into hybrids.



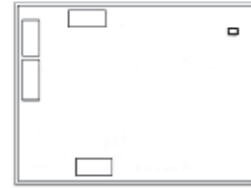
Ultra High Dynamic Range Monolithic Amplifier Die

PHA-101-D+

50Ω 0.05 to 1.5 GHz

Product Features

- High IP3, 45 dBm typ. at 0.9 GHz
- Gain, 15.2 dB typ. at 0.9 GHz
- High Pout, P1dB 26 dBm typ. at 0.9 GHz
- Low noise figure, 4.0 dB at 0.9 GHz
- No external matching components required



Typical Applications

- Base station infrastructure
- CATV
- LTE

+RoHS Compliant

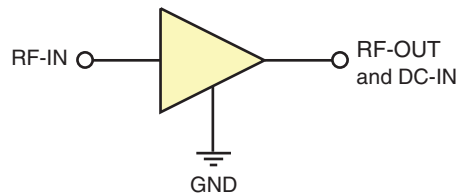
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

General Description

PHA-101-D+ (RoHS compliant) is an advanced wideband amplifier fabricated using E-PHEMT technology and offers extremely high dynamic range over a broad frequency range and with low noise figure. In addition, the PHA-101-D+ has good input and output return loss over a broad frequency range without the need for external matching components and has low thermal resistance.

Simplified Schematic and Pad description



Pad	Description
RF IN	RF input pad. This pad requires the use of an external DC blocking capacitor chosen for the frequency of operation.
RF-OUT and DC-IN	RF output and bias pad. DC voltage is present on this pad; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection.
GND	Connections to ground. Bottom of die.

Electrical Specifications¹ at 25°C, 50 ohms, unless noted

Parameter	Condition (MHz)	Vd=9V ¹			Units
		Min.	Typ.	Max.	
Frequency range		0.05		1.5	GHz
Gain	50		15.3		dB
	450		15.5		
	900		15.2		
	1500		15.0		
Input return loss	50		10.7		dB
	450		11.4		
	900		10.7		
	1500		9.5		
Output return loss	50		13.2		dB
	450		10.7		
	900		10.2		
	1500		8.9		
Reverse isolation			20.5		dB
Output power @ 1dB compression	50		25.3		dBm
	450		26.2		
	900		25.8		
	1500		25.4		
Output IP3 ²	50		47.0		dBm
	450		44.3		
	900		45.0		
	1500		43.8		
Noise figure	50		4.1		dB
	450		3.9		
	900		4.0		
	1500		4.2		
Device operating voltage			9.0		V
Device operating current			182	220	mA
Device current variation vs. temperature ³			-4		µA/°C
Device current variation vs voltage			0.024		mA/mV
Thermal Resistance, junction-to-ground lead at 85°C stage temperature			20		°C/W

1. Measured on Mini-Circuits Characterization test board. Die packaged in SOT-89 Package and soldered on TB-869+.

2. Tested at Pout=8dBm / tone.

3. (Current at 85°C — Current at -45°C)/130

Absolute Maximum Ratings⁴

Parameter	Ratings
Operating Temperature (ground lead)	-40°C to 85°C
Operating Current at 9V	360 mA
Power Dissipation	3.25 W
Input Power (CW)	+24 dBm (5 minutes max.) +20 dBm (continuous)
DC Voltage at RF-OUT & DC-IN Pad	11 V

4. Permanent damage may occur if any of these limits are exceeded.
Electrical maximum ratings are not intended for continuous normal operation.

Characterization Test Circuit

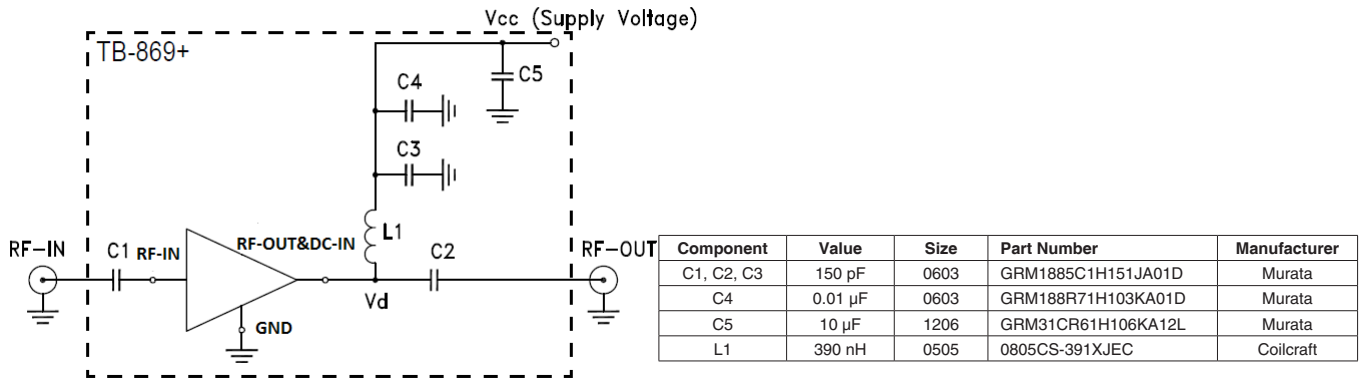


Fig 1. Block Diagram of Test Circuit used for characterization. Die packaged in SOT-89 Package and soldered on TB-869+. Gain, Return loss, Output power at 1dB compression (P1 dB) , output IP3 (OIP3) and Noise figure measured using Agilent's N5242A PNA-X microwave network analyzer.

Conditions:

1. Gain and Return loss: Pin= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 8 dBm/tone at output.

Die Layout

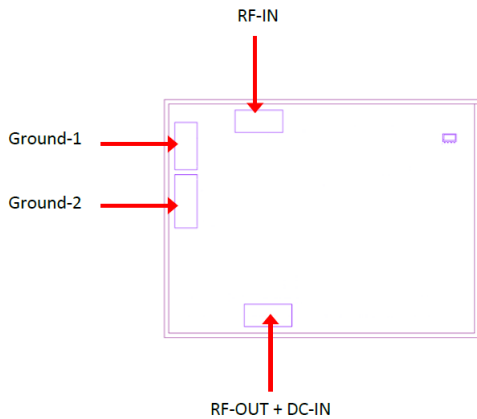


Fig 2. Die Layout

Bonding Pad Position
(Dimensions in μm, Typical)

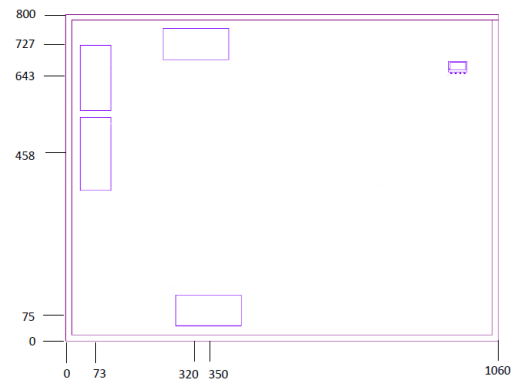


Fig 3. Bonding Pad Positions

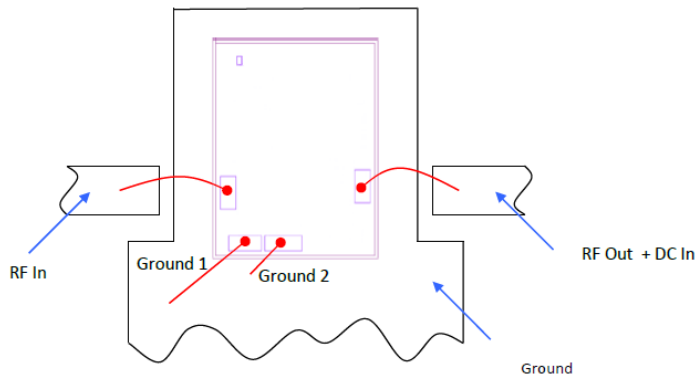
Critical Dimensions

Parameter	Values
Die Thickness, μm	100
Die Width, μm	1060
Die Length, μm	800
Bond Pad Size, μm	75 x 150

Assembly and Handling Procedure

1. Storage
Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
MMIC E-PHEMT 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 workstation. 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	1.90	0.50
RF-Out + DC In	1.65	0.50
Ground 1	1.15	0.50
Ground 2	0.35	0.15

Additional Detailed Technical Information <i>additional information is available on our dash board.</i>	
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: 5,10,50,100 KGD* PHA-101-DG+ Medium†, Partial wafer: KGD*<5K PHA-101-DP+ Large†, Full Wafer PHA-101-DF+
	†Available upon request contact sales representative
	Refer to AN-60-067
Environmental Ratings	ENV08T1

*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

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

** Tested in industry standard SOT-89 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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