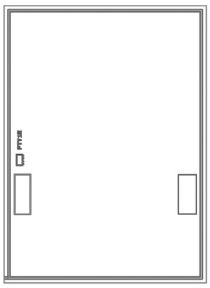
Ultra High Dynamic Range

Monolithic Amplifier Die

PHA-102-D+

50Ω 50 MHz to 6 GHz



The Big Deal

- Ultra Wideband, 0.05 - 6 GHz
- Excellent Gain Flatness 14.3±0.3 from 0.05-3 GHz
- High Linearity, +26.4 dBm P1dB & +50 dBm OIP3 at 0.9 GHz

Product Overview

The PHA-102-D+ (RoHS compliant) is an advanced wideband amplifier die fabricated using PHEMT technology and offers extremely high dynamic range over a broad frequency range and with excellent gain flatness. In addition, the PHA-102-D+ has good input and output return loss over a broad frequency range.

Key Features

Feature	Advantages
Ultra Wideband: 50MHz to 6GHz	Broadband covering primary wireless communications bands
Extremely High IP3 50 dBm typ. at 0.9 GHz 40.3 dBm typ. at 3 GHz	The PHA-102-D+ matches industry leading IP3 performance relative to device size and power consumption. The combination of the design and PHEMT Structure provides enhanced linearity over a broad frequency range as evidence in the IP3 being approximately 17 dB above the P1dB point. This feature makes this amplifier ideal for use in: •Driver amplifiers for complex waveform up converter paths •Drivers in linearized transmit systems •Secondary amplifiers in ultra-High Dynamic range receivers
Excellent Gain Flatness, 50 MHz-3GHz	Typical ±0.3dBgain flatness across theentire frequency range minimizes the needfor externalequalizernetworksmakingitagreatfit forinstrumentationandEWapplication.
Unpackaged Die	Enables the user to integrate the amplifier directly into hybrids

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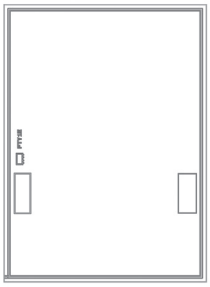

+RoHS Compliant

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

Ordering Information: Refer to Last Page

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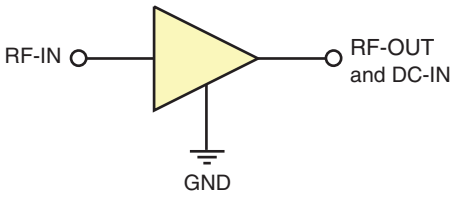
Typical Applications

- WiFi
- WLAN
- LTE
- WiMAX
- S-band Radar

General Description

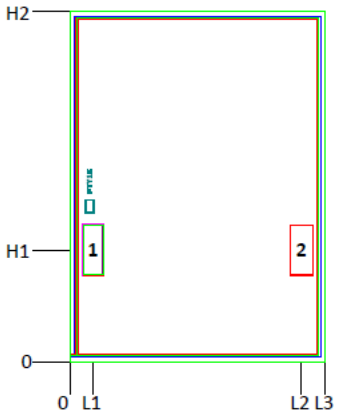
The PHA-102-D+ (RoHS compliant) is an advanced wideband amplifier die fabricated using PHEMT technology and offers extremely high dynamic range over a broad frequency range and with excellent gain flatness. In addition, the PHA-102-D+ has good input and output return loss over a broad frequency range.

Simplified Schematic and Pad description



Pad#	Description
1	RF-IN
2	RF-OUT & DC-IN
Bottom of Die	GND

Bonding Pad Position



Dimensions in µm, Typical

L1	L2	L3	H1	H2
73	725	800	352	1100

Thickness	Die size	Pad Size 1	Pad size 2
100	800 x 1100	59 x 154	69 x 154

Electrical Specifications at 25°C, 50Ω, unless noted

Parameter	Condition (MHz)	V_{DD}=9V[1]			V_S=9V[2]	Units
		Min.	Typ.	Max.	Typ.	
Frequency range		50		6000	50-6000	MHz
Gain	50		14.6		14.2	dB
	900		14.5		14.2	
	2000		14.1		13.8	
	2500		14.0		13.7	
	3000		14.0		13.8	
	6000		11.9		10.9	
Gain flatness	50 - 3000		0.3		0.25	dB
Input return loss	50		14		12	dB
	900		14		13	
	2000		12		13	
	2500		12		14	
	3000		12		15	
	6000		4		4	
Output return loss	50		18		13	dB
	900		17		17	
	2000		15		15	
	2500		14		15	
	3000		14		15	
	6000		4		4	
Output power @1 dB compression	50		26.1		25.4	dBm
	900		26.4		26.0	
	2000		26.5		26.1	
	2500		26.1		25.6	
	3000		25.6		25.0	
	6000		20.4		19.8	
Output IP3 (Pout= 0dBm/Tone)	50		44.8		41.6	dBm
	900		50.0		49.3	
	2000		43.0		42.5	
	2500		41.4		41.4	
	3000		40.3		40.4	
	6000		37.3		38.1	
Noise figure	50		3.6		3.6	dB
	900		3.4		3.6	
	2000		3.7		3.8	
	2500		3.7		3.7	
	3000		4.0		4.0	
	6000		6.7		7.0	
Device operating voltage		8.5	9	9.5	9	V
Device operating current			192	211	191	mA
Device current variation vs. temperature[3]			57.69		57.69	µA/°C
Device current variation vs voltage[4]			0.026		0.026	mA/mV
Thermal resistance, junction-to-ground Lead at 85°C stage temperature			20.4		20.4	°C/W

1. Die is packaged in SOT-89 and soldered on Mini-Circuits Characterization Test Board. See Characterization Test Circuit (Figure 1A, 1B & 1C).
2. Die is packaged in SOT-89 and soldered on Application Evaluation Board TB-PHA-102+. See Application Test Circuit (Figure 2).
3. Device Current Variation vs. Temperature= (Current at 85°C - Current at -45°C)/130°C
4. Device Current Variation vs. Voltage = (Current at 9.5V - Current at 8.5V) / ((9.5V-8.5V)*1000 mV/V)

Absolute Maximum Ratings[5]

Parameter	Ratings
Operating temperature (ground lead)	-40°C to 85°C
Power dissipation	3.18W
Input power (CW)	22 dBm (continuous) 25 dBm (5 minutes max)
DC Voltage (V_{DD})	11V

5. Permanent damage may occur in any of these limits are exceeded.

Characterization Test Circuit for S-Parameter & Noise Figure Measurement

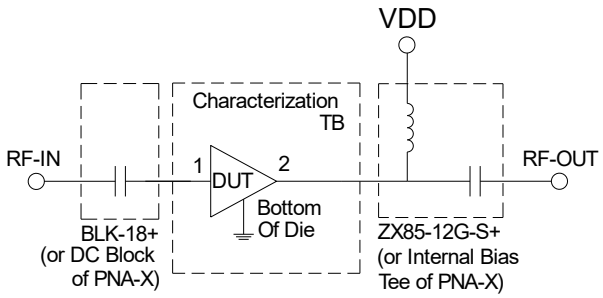


Fig 1A. Block Diagram of Test Circuit used for S-Parameter and Noise Figure Measurement. (DUT is packaged in SOT-89 and soldered on Mini-Circuits Characterization test board.) Gain, Return loss and noise figure are measured using Agilent's N5242A PNA-X microwave network analyzer.

Conditions:
1. Gain and Return loss: Pin= -25dBm

Characterization Test Circuit for P1dB Measurement

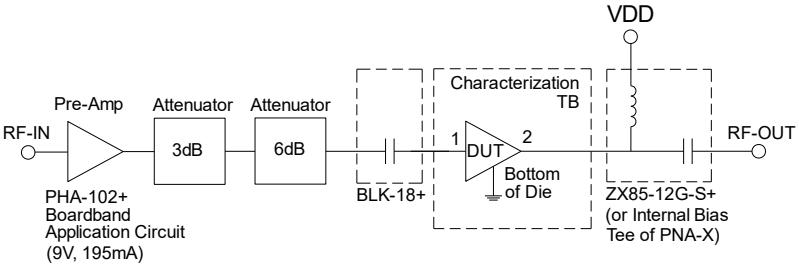


Fig 1B. Block Diagram of Test Circuit used for P1dB Measurement. (DUT is packaged in SOT-89 and soldered on Mini-Circuits Characterization test board.) Output power at1dB compression is measured using Agilent's N5242A PNA-X microwave network analyzer.

Characterization Test Circuit for IP3 Measurement

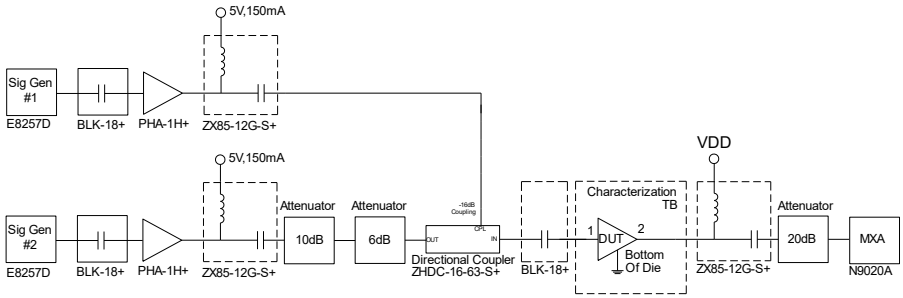
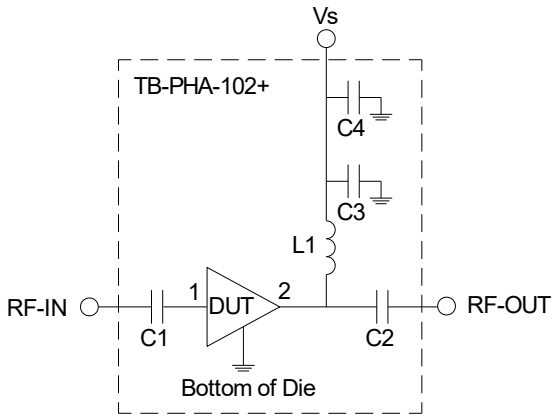


Fig 1C. Block Diagram of Test Circuit used for IP3 Measurement. (DUT is packaged in SOT-89 and soldered on Mini-Circuits Characterization test board) P1dB is measured using two E8257D Signal Generators and one N9020A MXA Signal Analyzer.

Condition:
1. Output IP3 (OIP3): Two Tones spaced 1 MHz apart, 8 dBm/ tone at output.

Application Circuit

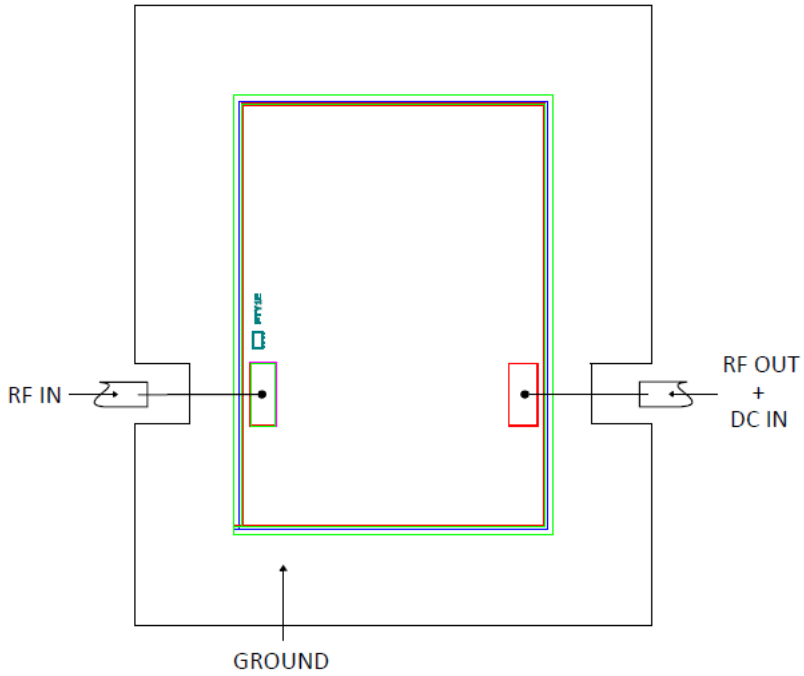


Component	Size	Value	Part Number	Manufacturer
C1	0402	1000pF	GRM1555C1H102JA01D	Murata
C2	0402	1000pF	GRM1555C1H102JA01D	Murata
C3	0402	100pF	GRM1555C1H101JA01D	Murata
C4	0402	10000pF	GRM155R71H103KA88D	Murata
L1	0603	390nH	LQW18CNR39J00D	Murata

Fig 1C. Block Diagram of Test Circuit used for characterization. (DUT is packaged in SOT-89 and soldered on Mini-Circuits Application test board TB-PHA-102+)

Block Diagram of Test Circuit used for characterization. (DUT is packaged in SOT-89 and soldered on Mini-Circuits Application test board TB-PHA-102+)

Assembly Diagram



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.

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: 5,10,50,100 KGD* — PHA-102-DG+ Medium†, Partial wafer: KGD*<1845 — PHA-102-DP+ Large†, Full Wafer — PHA-102-DF+ †*Available upon request contact sales representative* Refer to AN-60-067
Environmental Ratings	ENV80

*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 (pass 250V) in accordance with ANSI/ESD STM 5.1 - 2001

** 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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