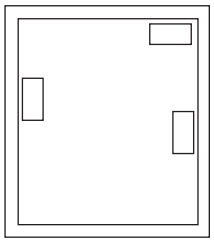
Ultra Linear Low Noise

Monolithic Amplifier Die

PGA-103-D+

50Ω 0.05 to 4 GHz



The Big Deal

- Ultra High IP3
- Broadband High Dynamic Range

Product Overview

PGA-103-D+ (RoHS compliant) is an advanced wideband amplifier die fabricated using E-PHEMT technology and offers extremely high dynamic range over a broad frequency range and with low noise figure. In addition, the PGA-103-D+ has good input and output return loss over a broad frequency range without the need for external matching components and has demonstrated excellent reliability.

Key Features

Feature	Advantages
Broad Band: 0.05 to 4.0 GHz	Broadband covering primary wireless communications bands: Cellular, PCS, LTE, WiMAX
Ultra High IP3 Versus DC power Consumption: 42 dBm typical at 2 GHz at +5.0V Supply Voltage and only 97mA	The PGA-103-D+ provides excellent 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: • Driver amplifiers for complex waveform up converter paths • Drivers in linearized transmit systems • Secondary amplifiers in ultra High Dynamic range receivers
Low Noise Figure: 0.6 dB up to 1.0 GHz	A unique feature of the PGA-103-D+ which separates this design from all competitors is the low noise figure performance in combination with the high dynamic range.

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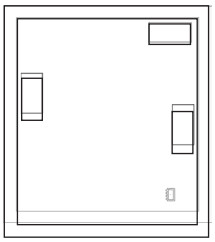


+RoHS Compliant

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

Ordering Information: Refer to Last Page

Product Features

- 5V/3V operation
- High IP3, 42 dBm typ. at 2 GHz, Vd=5V
- Low Noise Figure, 0.6 at 1 GHz; 0.8 dB at 2 GHz
- Gain, 11.3 dB typ. at 2 GHz
- P1dB 22.3 dBm typ. at 2 GHz at Vd=5V
- Protected under US Patent 8,803,612

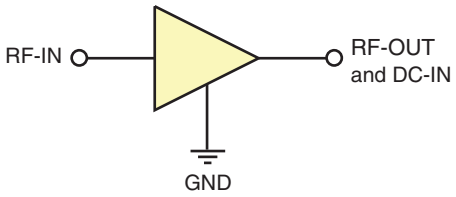
Typical Applications

- Base station infrastructure
- Portable Wireless
- CATV & DBS
- MMDS & Wireless LAN
- LTE

General Description

PGA-103-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 PGA-103-D+ has good input and output return loss over a broad frequency range without the need for external matching components.

simplified schematic and pad description



Pad Function	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, as shown in “Recommended Application Circuit”, Fig. 2
GND	Connections to ground.

Electrical Specifications[1] at 25°C, 50Ω unless noted

Parameter	Condition (GHz)	Vd=5.0V			Vd=3V	Units
		Min.	Typ.	Max.	Typ.	
Frequency range		0.05		4.0	0.05-4.0	GHz
Gain	0.05		26.7		26.1	dB
	0.4		22.3		21.8	
	1.0		16.5		16.1	
	2.0		11.3		10.8	
	3.0		8.1		7.7	
	4.0		6.1		5.6	
Noise figure	0.05		0.4		0.3	dB
	0.4		0.7		0.7	
	1.0		0.6		0.6	
	2.0		0.8		0.8	
	3.0		1.4		1.4	
	4.0		1.6		1.5	
Input return loss	0.05		6.8		6.1	dB
	0.8		11.5		10.4	
	2.0		14.0		12.8	
	3.0		14.5		13.1	
	4.0		12.1		11.2	
	6.0		11.5		10.7	
Output return loss	0.05		13.8		13.4	dB
	0.8		20.0		21.9	
	2.0		16.8		20.7	
	3.0		16.0		20.1	
	4.0		19.1		22.5	
	6.0		18.6		19.7	
Reverse isolation	2.0		21.4			dB
Output power @1dB compression[2]	0.05		19.1		14.8	dBm
	0.8		21.1		17.9	
	2.0		21.5		18.8	
	3.0		22.3		19.5	
	4.0		22.2		19.9	
	6.0		22.8		20.5	
Output IP3	0.05		35.8		31.1	dBm
	0.8		38.0		32.6	
	2.0		40.3		33.4	
	3.0		41.6		34.2	
	4.0		42.2		33.1	
	6.0		42.8		32.4	
Device operating voltage			5.0		3.0	V
Device operating current		72	97	120	60	mA
Device current variation vs voltage			0.035		0.018	mA/mV
Thermal resistance, junction-to-ground lead			32		32	°C/W

1. Measured on Mini-Circuits Die Characterization test board. See Characterization Test Circuit (Fig. 1)
2. Current increases at P1dB

Absolute Maximum Ratings[3]

Parameter	Ratings
Operating Temperature (ground lead)	-40°C to 85°C
Operating Current at 5.0V	200 mA
Power Dissipation at 5.0V	1W
Input Power (CW)	+21 dBm (50 to 2000 MHz) +26 dBm (2000 to 4000 MHz)
DC Voltage on RF-OUT & DC-IN	6V

3. Permanent damage may occur if any of these limits are exceeded.
Electrical maximum ratings are not intended for continuous normal operation.
Measured in industry standard SOT-89 package.

Characterization Test Circuit

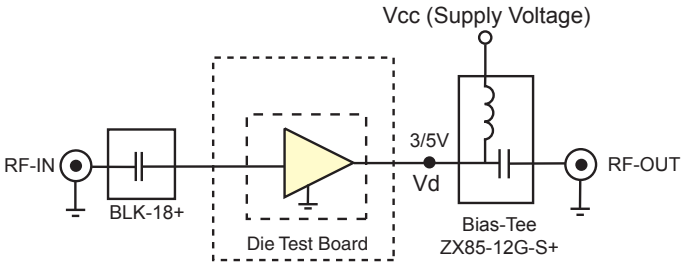
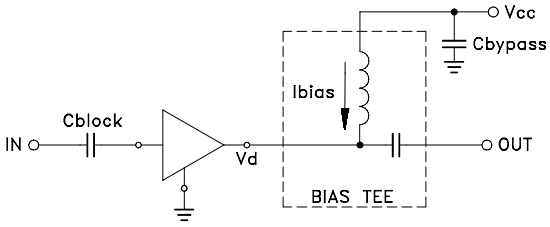


Fig 1. Block Diagram of Test Circuit used for characterization. Gain, Return loss, Output power at 1dB compression (P1 dB) , output IP3 (OIP3) and noise figure measured using Agilent's N5242A PNA-X microwave network analyzer.

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

Recommended Application Circuit



Cblock=0.001μF, Bias-Tee=TCBT-14+, Cbypass=0.1μF

Fig 2a. Simplified

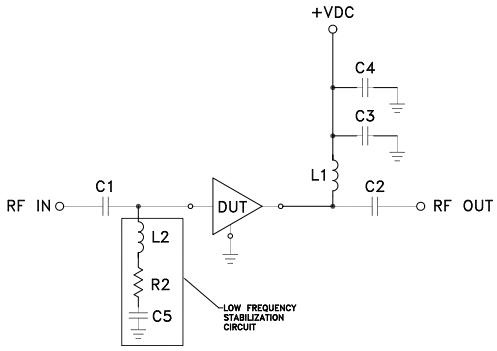


Fig 2b. Unconditionally stable (see note AN-60-064)

SEQ	Manufacturer P/N / Value	Size
A1	PGA-103-D+ in industry standard SOT-89	—
C1, C2	.01 uF	0805
C3	0.33 uF	1206
C4	10 uF	1206
C5	330 pF	0603
L1	TCCH-80+	—
L2	620 nH	.115X.110
R2	150 Ohm	0603

Die Layout

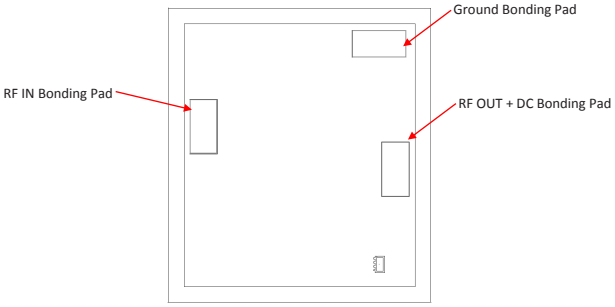


Fig 3. Die Layout

Bonding Pad Position

(Dimensions in μm, Typical)

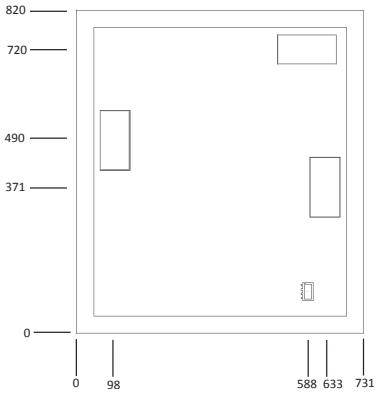


Fig 4. Bonding Pad Positions

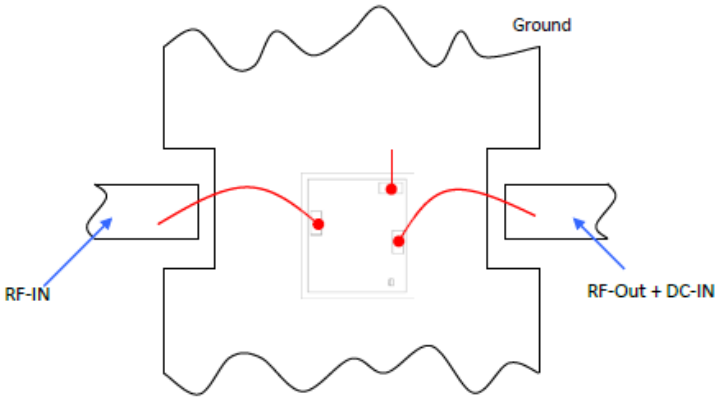
Critical Dimensions

Parameter	Values
Die Thickness, μm	100
Die Width, μm	820
Die Length, μm	731
Bond Pad Size, μm	150 x 75

Assembly and Handling Procedure

1. Storage
   Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC E-PHEMPT 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.

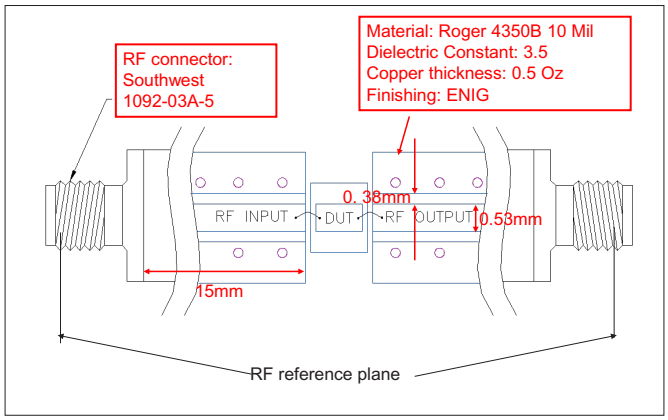
Assembly Diagram



Recommended Wire Length, Typical

Wire	Wire Length (mm)	Wire Loop Height (mm)
RF-IN, RF-OUT + DC-IN	0.6	0.15
GROUND	0.3	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*	PGA-103-DG+
	Medium†, Partial wafer: KGD*<5K	PGA-103-DP+
	Large†, Full Wafer	PGA-103-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

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

** Tested in industry standard SOT-89 package.

Attention
Observe precautions
for handling electrostatic
sensitive devices

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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