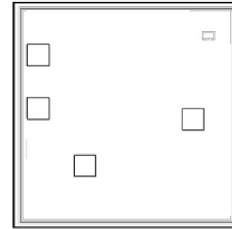


Ultra Low Noise, High IP3

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.



Ultra Low Noise, High IP3

Monolithic Amplifier Die

PMA2-43LN-D+

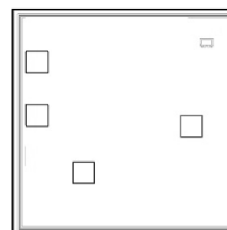
50Ω 1.1 to 4.0 GHz

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

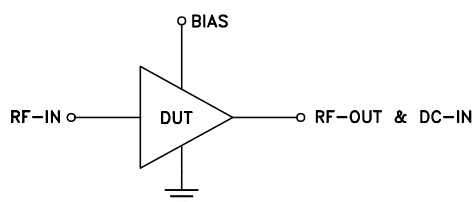
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

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 Specifications¹ 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}

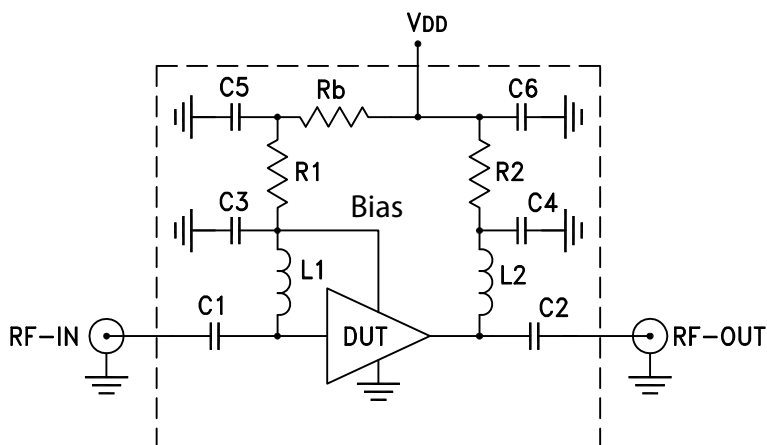
Parameter	Ratings
Operating Temperature (ground lead)	-40°C to 85°C
Junction Temperature	150°C
Total Power Dissipation	0.7 W
Input Power (CW), $V_d=3V$	+22 dBm (5minutes max) +14 dBm (continuous)
DC Voltage	+6V

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

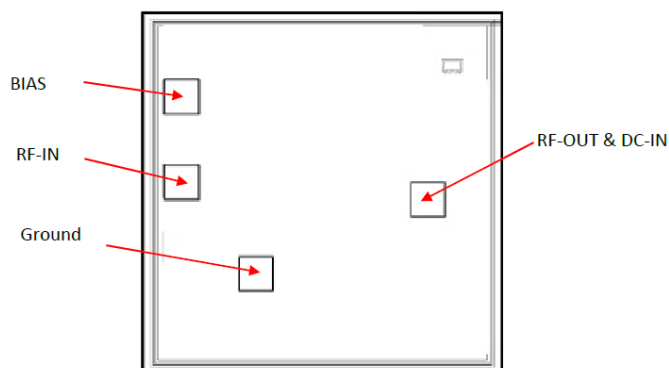


Fig 2. Die Layout

Bonding Pad Position

(Dimensions in μm, Typical)

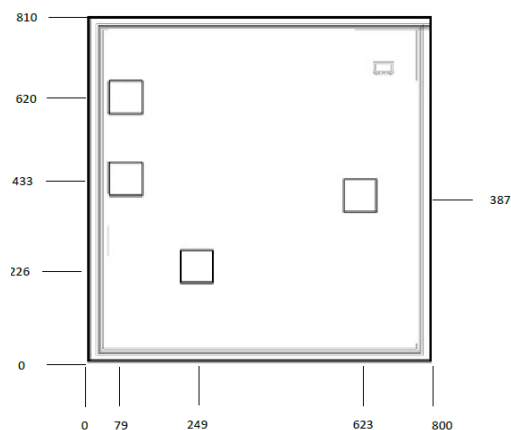


Fig 3. Bonding Pad Positions

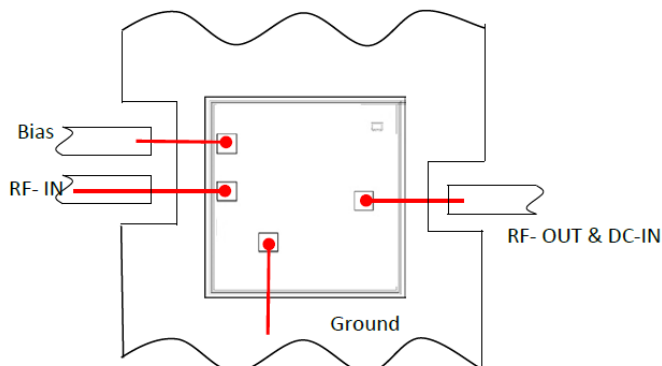
Critical Dimensions

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 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.

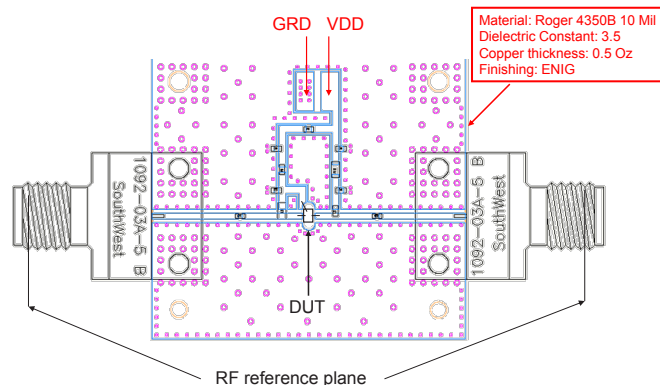
Assembly Diagram



Recommended Wire Length, Typical

Wire	Wire Length (mm)	Wire Loop Height (mm)
RF-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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*Typical Performance Data***Definitions:**

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vd = 5.00V, Id = 53mA @Temperature = +25°C

FREQ.	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
500	19.43	43.36	1.40	1.95	1.48	0.53	23.51	12.35	1.38
600	22.22	39.07	2.43	2.99	1.35	0.61	24.70	14.12	1.01
700	23.42	36.64	4.01	4.36	1.37	0.67	25.76	15.87	0.79
800	23.86	35.27	5.98	5.80	1.42	0.71	27.49	17.15	0.65
900	23.84	34.40	8.07	7.09	1.47	0.74	28.81	18.10	0.56
1000	23.58	33.84	10.05	8.18	1.52	0.76	29.81	18.84	0.51
1100	23.20	33.42	11.78	9.08	1.57	0.78	30.82	19.38	0.49
1200	22.76	33.08	13.23	9.83	1.62	0.80	31.31	19.76	0.47
1300	22.34	32.82	14.45	10.47	1.67	0.82	31.79	20.04	0.47
1400	21.90	32.56	15.45	10.97	1.72	0.83	32.17	20.32	0.48
1500	21.45	32.35	16.24	11.39	1.77	0.84	32.30	20.50	0.50
1600	21.02	32.15	16.88	11.71	1.82	0.85	32.20	20.51	0.52
1700	20.59	31.93	17.43	11.91	1.86	0.86	32.51	20.58	0.54
1800	20.17	31.80	17.89	12.06	1.92	0.87	32.64	20.54	0.55
1900	19.76	31.60	18.27	12.12	1.96	0.87	32.86	20.54	0.57
2000	19.36	31.44	18.67	12.14	2.01	0.88	32.97	20.48	0.58
2100	18.97	31.28	19.02	12.11	2.05	0.88	33.17	20.46	0.59
2200	18.59	31.12	19.33	12.00	2.10	0.88	33.48	20.36	0.59
2300	18.21	30.97	19.62	11.88	2.14	0.89	33.39	20.35	0.61
2400	17.84	30.82	19.82	11.67	2.18	0.89	33.78	20.30	0.64
2500	17.48	30.67	19.96	11.48	2.22	0.89	33.72	20.26	0.68
2600	17.12	30.56	20.01	11.23	2.26	0.89	33.53	20.28	0.74
2700	16.77	30.43	19.92	10.95	2.30	0.89	33.53	20.24	0.80
2800	16.42	30.28	19.74	10.64	2.33	0.88	33.45	20.19	0.86
2900	16.08	30.16	19.43	10.29	2.36	0.88	33.36	20.05	0.89
3000	15.73	30.06	19.02	9.93	2.39	0.88	33.06	19.91	0.88
3100	15.39	29.96	18.53	9.61	2.43	0.87	32.82	19.71	0.90
3200	15.05	29.84	17.98	9.25	2.45	0.87	33.07	19.55	0.93
3300	14.73	29.73	17.41	8.91	2.47	0.86	33.09	19.44	0.97
3400	14.39	29.65	16.83	8.57	2.50	0.86	33.07	19.41	1.02
3500	14.05	29.56	16.27	8.23	2.53	0.85	32.90	19.28	1.05
3600	13.71	29.47	15.72	7.93	2.55	0.85	32.80	19.20	1.08
3700	13.38	29.37	15.24	7.64	2.57	0.84	32.70	19.13	1.11
3800	13.05	29.28	14.75	7.37	2.59	0.83	32.52	19.16	1.14
3900	12.73	29.19	14.34	7.12	2.61	0.83	32.27	19.06	1.18
4000	12.41	29.10	13.96	6.90	2.64	0.82	32.10	18.89	1.23
4100	12.09	29.03	13.62	6.68	2.66	0.81	31.86	18.70	1.28
4200	11.79	28.94	13.30	6.49	2.68	0.81	31.88	18.54	1.32
4300	11.49	28.86	13.03	6.33	2.71	0.80	31.80	18.33	1.36

*Typical Performance Data***Definitions:**

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vd = 4.75V, Id = 48mA @Temperature = +25°C

FREQ.	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
500	19.07	43.16	1.35	1.95	1.47	0.54	22.67	11.65	1.39
600	21.90	38.93	2.30	2.97	1.33	0.62	23.90	13.45	1.02
700	23.14	36.48	3.79	4.34	1.35	0.68	25.00	15.35	0.80
800	23.63	35.05	5.66	5.80	1.40	0.72	26.87	16.78	0.67
900	23.65	34.23	7.69	7.09	1.46	0.75	28.19	17.93	0.58
1000	23.43	33.69	9.64	8.21	1.51	0.77	29.19	18.83	0.52
1100	23.06	33.27	11.33	9.12	1.57	0.79	30.02	19.51	0.49
1200	22.63	32.96	12.76	9.87	1.62	0.81	30.66	19.97	0.47
1300	22.21	32.68	13.95	10.51	1.67	0.82	31.14	20.29	0.48
1400	21.77	32.46	14.93	11.02	1.72	0.84	31.40	20.55	0.49
1500	21.32	32.25	15.72	11.44	1.77	0.85	31.76	20.72	0.52
1600	20.89	32.05	16.37	11.75	1.82	0.86	32.13	20.74	0.53
1700	20.46	31.86	16.93	11.95	1.87	0.87	32.34	20.83	0.54
1800	20.04	31.69	17.40	12.09	1.92	0.87	32.59	20.81	0.56
1900	19.63	31.53	17.80	12.15	1.97	0.88	32.68	20.83	0.58
2000	19.24	31.37	18.21	12.17	2.01	0.88	32.93	20.82	0.58
2100	18.84	31.18	18.56	12.13	2.05	0.88	32.82	20.81	0.60
2200	18.46	31.04	18.87	12.03	2.10	0.89	32.95	20.71	0.59
2300	18.09	30.90	19.15	11.90	2.15	0.89	32.76	20.69	0.61
2400	17.72	30.76	19.35	11.69	2.19	0.89	32.46	20.60	0.64
2500	17.36	30.62	19.46	11.49	2.23	0.89	32.67	20.55	0.68
2600	17.00	30.48	19.48	11.24	2.27	0.89	32.52	20.57	0.75
2700	16.65	30.37	19.36	10.96	2.31	0.89	32.54	20.55	0.81
2800	16.30	30.24	19.17	10.64	2.34	0.89	32.34	20.48	0.87
2900	15.96	30.10	18.86	10.30	2.37	0.88	32.37	20.32	0.90
3000	15.61	30.00	18.47	9.94	2.40	0.88	32.35	20.17	0.89
3100	15.27	29.88	17.99	9.61	2.43	0.88	32.14	19.94	0.91
3200	14.93	29.78	17.47	9.26	2.46	0.87	32.18	19.74	0.94
3300	14.60	29.68	16.94	8.93	2.49	0.87	32.26	19.56	1.00
3400	14.27	29.57	16.40	8.58	2.51	0.86	32.22	19.45	1.03
3500	13.92	29.50	15.88	8.24	2.54	0.86	31.98	19.29	1.06
3600	13.59	29.40	15.37	7.93	2.56	0.85	31.65	19.16	1.08
3700	13.26	29.32	14.93	7.64	2.58	0.84	31.60	19.04	1.12
3800	12.93	29.21	14.48	7.37	2.60	0.84	31.38	18.97	1.16
3900	12.61	29.13	14.10	7.12	2.62	0.83	31.11	18.82	1.19
4000	12.29	29.06	13.74	6.91	2.65	0.82	30.81	18.59	1.25
4100	11.97	28.96	13.43	6.69	2.67	0.82	30.85	18.31	1.29
4200	11.67	28.87	13.14	6.50	2.69	0.81	30.95	18.10	1.33
4300	11.37	28.78	12.88	6.34	2.71	0.80	30.97	17.82	1.39

*Typical Performance Data***Definitions:**

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

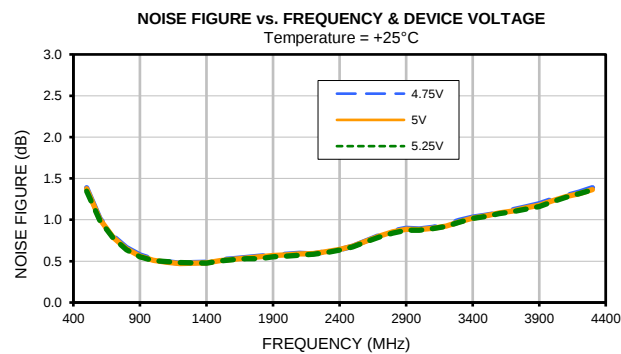
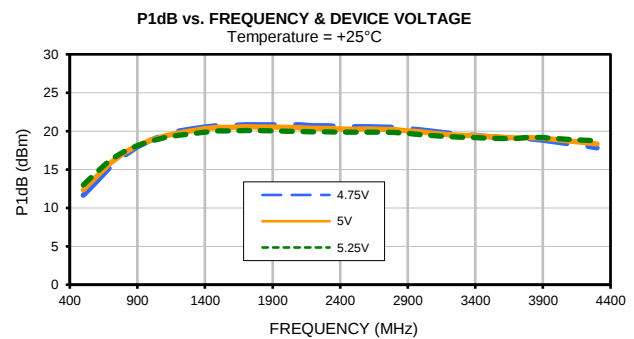
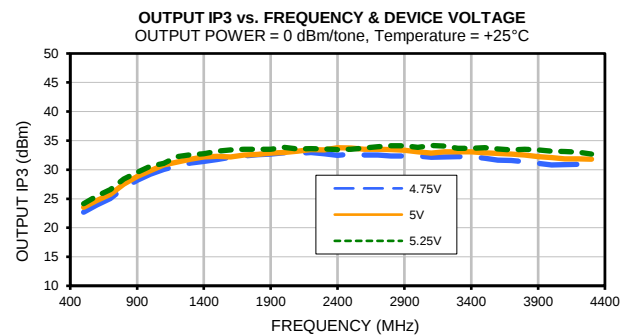
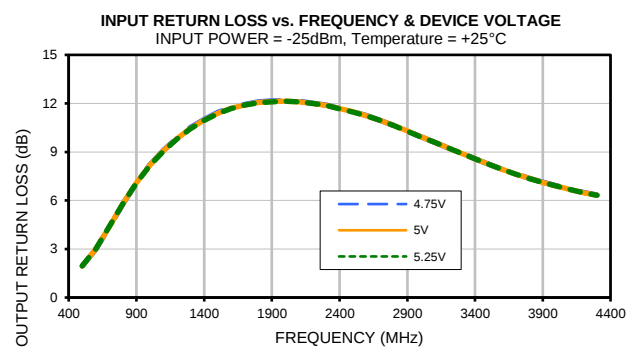
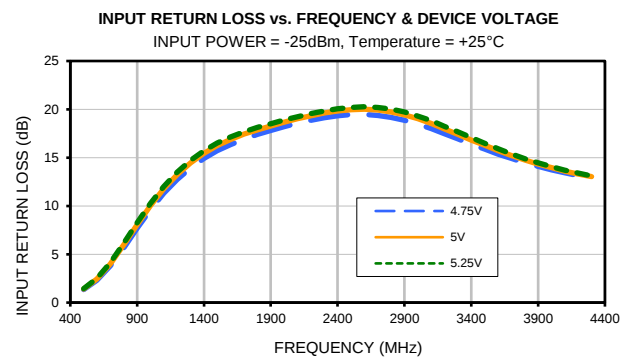
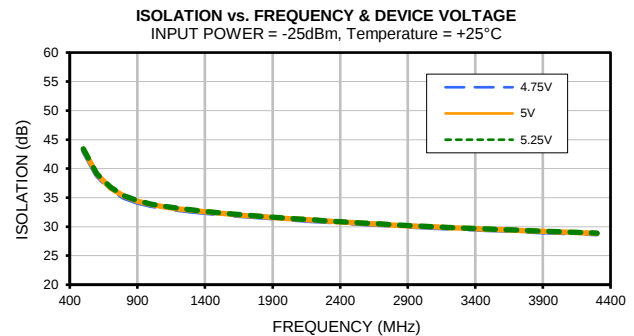
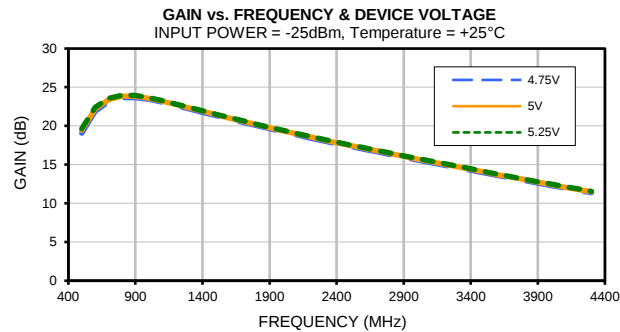
TEST CONDITIONS: Vd = 5.25V, Id = 58mA @Temperature = +25°C

FREQ.	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
500	19.65	43.41	1.44	1.96	1.49	0.53	24.13	13.00	1.35
600	22.41	39.13	2.52	3.01	1.35	0.60	25.46	14.67	0.99
700	23.56	36.80	4.15	4.38	1.38	0.67	26.57	16.28	0.78
800	23.97	35.34	6.16	5.81	1.42	0.71	28.41	17.33	0.64
900	23.92	34.50	8.29	7.08	1.47	0.74	29.53	18.13	0.55
1000	23.64	33.92	10.28	8.17	1.53	0.76	30.57	18.72	0.51
1100	23.27	33.51	12.03	9.06	1.58	0.78	31.08	19.17	0.50
1200	22.83	33.19	13.49	9.81	1.63	0.80	32.22	19.44	0.48
1300	22.41	32.88	14.72	10.44	1.67	0.82	32.58	19.65	0.48
1400	21.97	32.63	15.73	10.95	1.72	0.83	32.72	19.88	0.48
1500	21.52	32.41	16.52	11.38	1.77	0.84	33.18	20.03	0.50
1600	21.09	32.20	17.14	11.69	1.82	0.85	33.39	20.03	0.52
1700	20.66	32.00	17.68	11.89	1.86	0.86	33.50	20.08	0.53
1800	20.23	31.82	18.13	12.05	1.91	0.87	33.51	20.07	0.53
1900	19.83	31.66	18.50	12.10	1.96	0.87	33.52	20.05	0.55
2000	19.43	31.48	18.89	12.13	2.00	0.88	33.85	20.00	0.56
2100	19.04	31.31	19.23	12.10	2.05	0.88	33.55	19.96	0.57
2200	18.66	31.18	19.55	12.00	2.10	0.88	33.61	19.90	0.58
2300	18.28	31.00	19.83	11.88	2.13	0.88	33.59	19.91	0.60
2400	17.91	30.87	20.05	11.67	2.18	0.88	33.45	19.86	0.63
2500	17.55	30.72	20.20	11.48	2.22	0.89	33.51	19.85	0.67
2600	17.19	30.59	20.27	11.23	2.26	0.88	33.71	19.88	0.74
2700	16.84	30.47	20.19	10.95	2.29	0.88	33.98	19.88	0.79
2800	16.49	30.34	20.03	10.63	2.33	0.88	34.10	19.81	0.84
2900	16.15	30.20	19.73	10.29	2.36	0.88	34.10	19.68	0.87
3000	15.80	30.10	19.31	9.93	2.39	0.87	33.85	19.55	0.88
3100	15.46	29.98	18.82	9.60	2.42	0.87	34.17	19.39	0.89
3200	15.12	29.88	18.25	9.25	2.45	0.87	34.04	19.28	0.92
3300	14.79	29.76	17.67	8.91	2.47	0.86	33.70	19.22	0.97
3400	14.45	29.69	17.06	8.57	2.50	0.86	33.65	19.16	1.02
3500	14.11	29.61	16.48	8.23	2.53	0.85	33.78	19.06	1.04
3600	13.78	29.51	15.91	7.92	2.55	0.84	33.56	19.03	1.08
3700	13.44	29.42	15.40	7.63	2.57	0.84	33.43	19.04	1.10
3800	13.12	29.35	14.90	7.36	2.60	0.83	33.49	19.18	1.13
3900	12.79	29.24	14.47	7.11	2.61	0.82	33.41	19.15	1.16
4000	12.47	29.16	14.07	6.89	2.64	0.82	33.20	19.05	1.22
4100	12.16	29.07	13.72	6.68	2.66	0.81	33.13	18.89	1.27
4200	11.85	28.99	13.39	6.48	2.68	0.80	33.00	18.82	1.32
4300	11.55	28.90	13.10	6.33	2.70	0.80	32.71	18.72	1.36

MMIC Amplifier Die

PMA2-43LN-D+

Typical Performance Curves





All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
Operating Temperature	-40° to 85° C or -40° to 105° C or -55° to 105° C Ambient Environment	Refer to Individual Model Data Sheet
Storage Environment	20° to 35° C and 40 to 60% humidity (In Factory Shipped Package)	Individual Model Data Sheet