

25 GHz–45 GHz GaAs MMIC Low Noise Amplifier

MMA127AA



Product Overview

The MMA127AA is a 25 GHz–45 GHz Gallium Arsenide (GaAs) Monolithic Microwave Integrated Circuit (MMIC) pseudomorphic High Electron Mobility Transistor (pHEMT) amplifier. Nominally biased at 3V and 44 mA, the amplifier offers a gain of 22 dB, noise figure of 2.5 dB, and output IP2 of 76 dBm. It is ideal for communications applications requiring low noise and low power consumption. Input is DC coupled and output is AC coupled through hybrid Lange couplers and nominally matched to 50Ω.

Key Features

- Frequency range: 25 Gh–45 GHz
- Gain: 22 dB
- Hybrid Lange-coupled input and output
- Low noise figure: 2.5 dB at 32 GHz
- Very high output IP2 (low)
- Typical supply: 3V at 44 mA
- Self-bias configuration
- Integrated on-chip bias
- Input/output return loss > 14 dB
- Die size: 1.85 mm × 1.15 mm × 0.1 mm

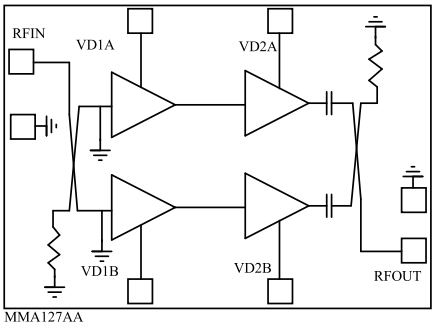
Applications

- Test and measurement instrumentation
- Electronic warfare (EW), electronic countermeasures (ECM), and electronic counter-countermeasures (ECCM)
- Military, A&D, space, SATCOM
- Telecom infrastructure
- Wideband microwave radios
- Microwave- and millimeter-wave communications systems

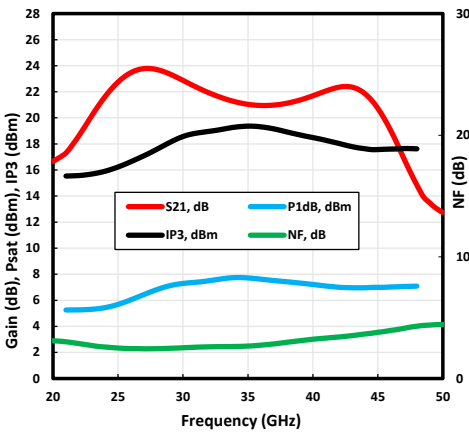
Performance Overview

Parameter	Typ.	Units
Operational frequency range	25–45	GHz
Gain	22	dB
P1dB	7	dBm
IP2	76	dBm
Current at +3V Supply	44	mA

Functional Block Diagram



Performance Curves



Export Classification: 3A001.b.2.d

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1. Electrical Specifications

1.1. Typical Electrical Performance

Table 1-1. Typical Electrical Performance at 25 °C, $V_{DD} = 3V$, and $I_{DD} = 44$ mA (unless otherwise specified).

Parameter	Frequency Range	Min	Typ.	Max	Units
Frequency range		25		45	GHz
Gain	25 GHz–32 GHz	21	22		dB
	32 GHz–45 GHz	20	22		
Gain flatness	25 GHz–32 GHz		±1.5		dB
	32 GHz–45 GHz		±1.5		
Noise figure	25 GHz–32 GHz		2.5	3	dB
	25 GHz–32 GHz		3.2	4.2	
Input return loss	25 GHz–32 GHz	15	17		dB
	32 GHz–45 GHz	13	14		
Output return loss	25 GHz–32 GHz	13	15		dB
	32 GHz–45 GHz	12	15		
P1dB	25 GHz–32 GHz	5	7		dBm
	32 GHz–45 GHz	6	7		
P_{sat}	25 GHz–32 GHz	9	10		dBm
	32 GHz–45 GHz	8	9		
IP3	25 GHz–32 GHz		19		dBm
	32 GHz–45 GHz		19		
IP2	25 GHz–45 GHz		76		dBm
V_{DD} (drain voltage supply)			3		V
I_{DD} (drain current)			44		mA

1.2. Absolute Maximum Ratings

Table 1-2 shows the absolute maximum ratings of the MMA127AA at 25 °C, unless otherwise specified. Exceeding any of the maximum ratings could cause damage and/or latent defects to the device.

Table 1-2. Absolute Maximum Ratings

Parameters	Rating
Drain bias voltage (V_{DD})	8V
RF Input Power (P_{in})	25 dBm
Channel temperature	175 °C
Thermal resistance	31 °C/W
Storage temperature	–65 °C to 150 °C
Operating temperature	–55 °C to 85 °C



ESD Sensitive Device

1.3. Typical Performance Curves

1.3.1. Typical Performances vs. Temperature

The graphs shown in Figures 1-1 through 1-32 represent the typical performance versus temperature curves of the MMA127AA device under specific bias conditions. All measurements were taken using the test circuit shown in [Figure 3-2](#).

Figure 1-1. Gain vs. Temperature at 2.7V

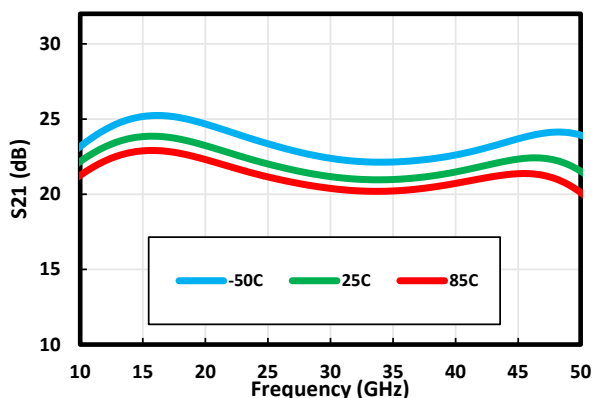


Figure 1-2. Gain vs. Temperature at 3V

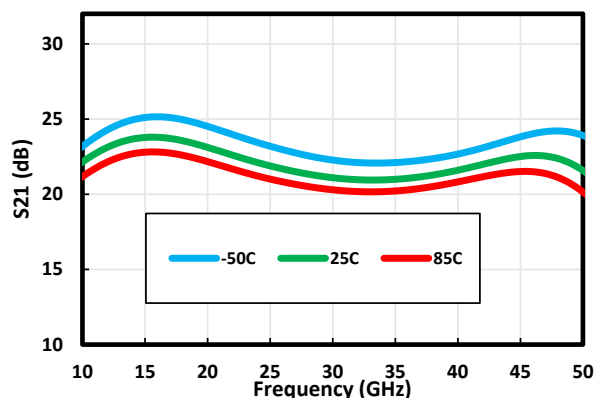


Figure 1-3. Gain vs. Temperature at 5V

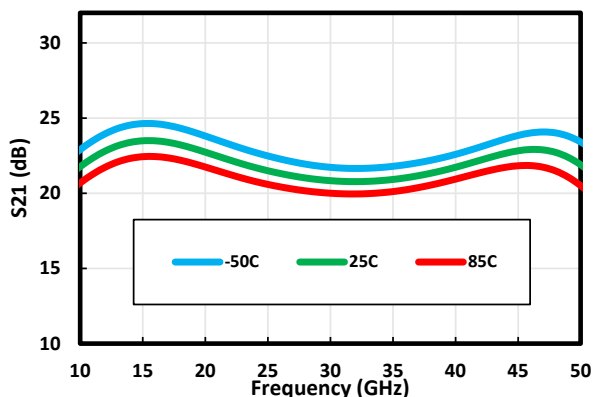


Figure 1-4. S11 vs. Temperature at 2.7V

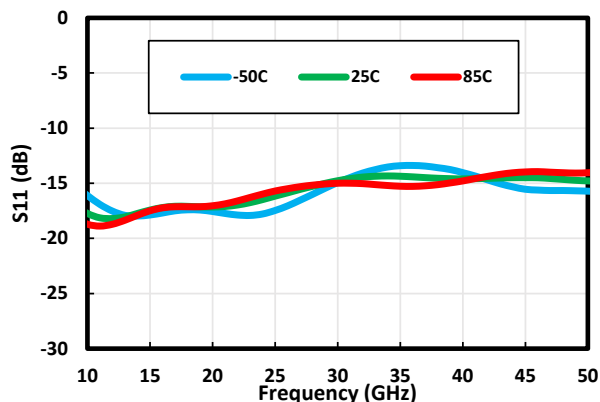


Figure 1-5. S11 vs. Temperature at 3V

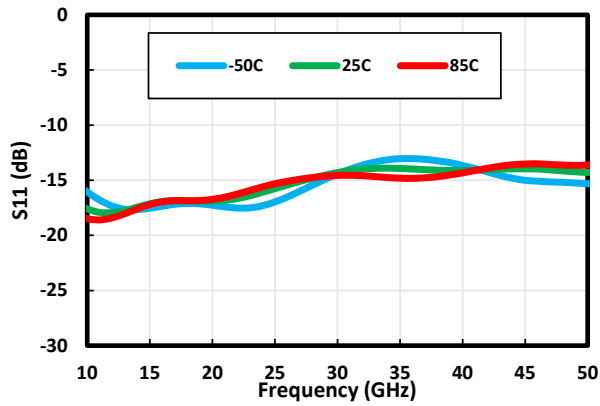


Figure 1-6. S11 vs. Temperature at 5V

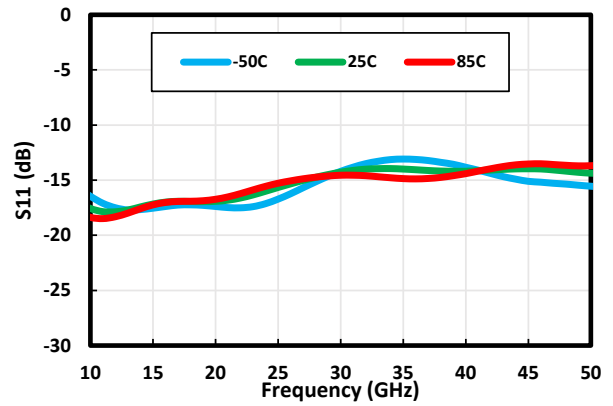


Figure 1-7. S22 vs. Temperature at 2.7V

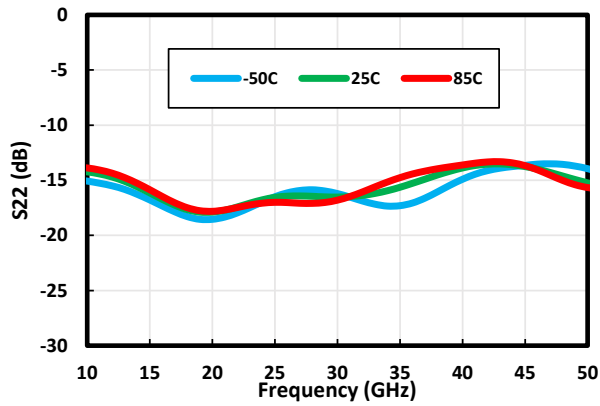


Figure 1-8. S22 vs. Temperature at 3V

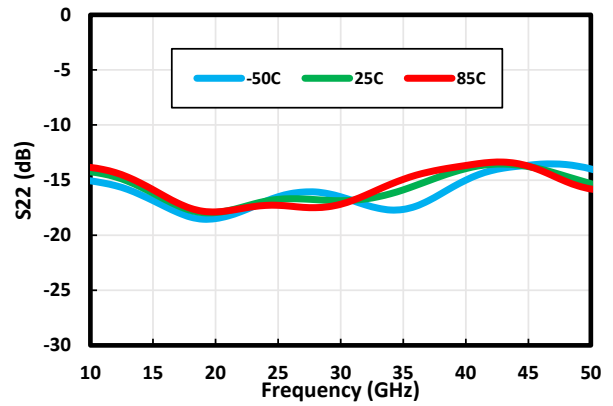


Figure 1-9. S22 vs. Temperature at 5V

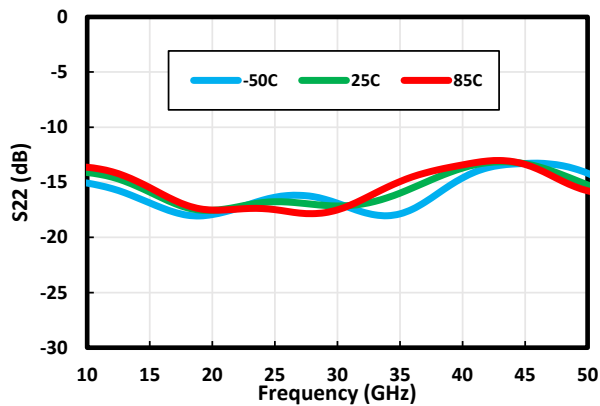


Figure 1-10. NF vs. Temperature at 2.7V

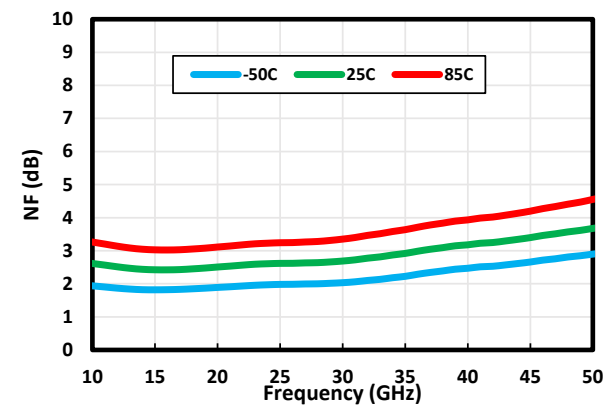


Figure 1-11. NF vs. Temperature at 3V

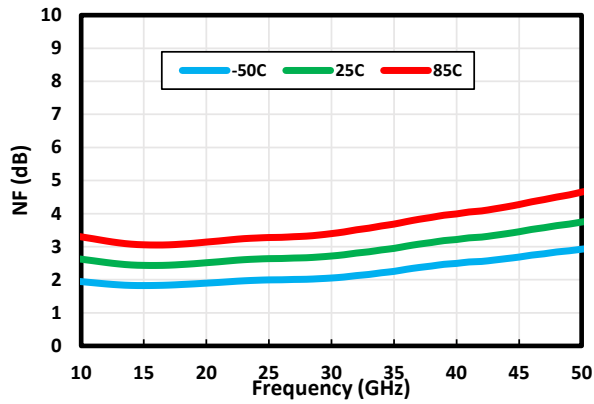


Figure 1-12. NF vs. Temperature at 5V

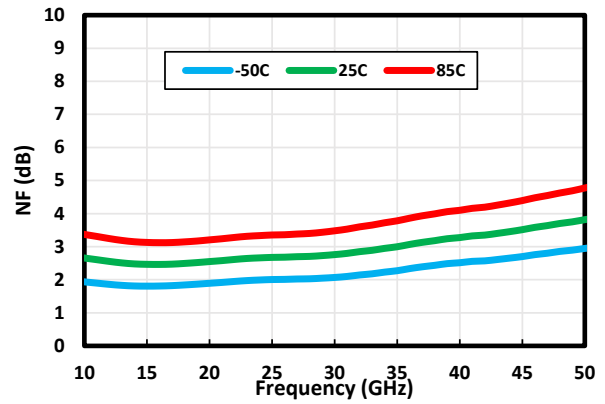


Figure 1-13. P1dB vs. Temperature at 2.7V

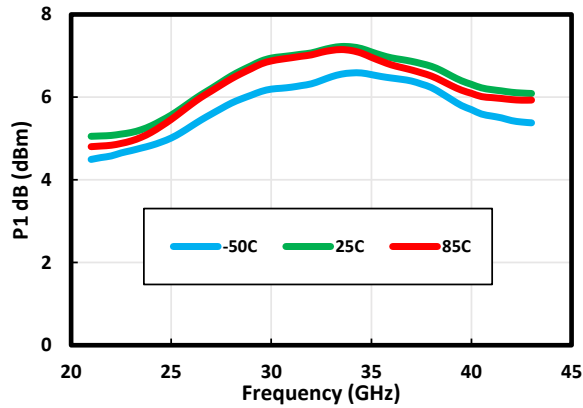


Figure 1-14. P1dB vs. Temperature at 3V

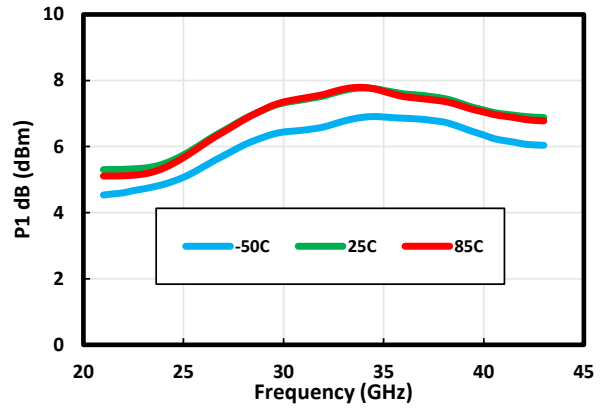


Figure 1-15. P1dB vs. Temperature at 5V

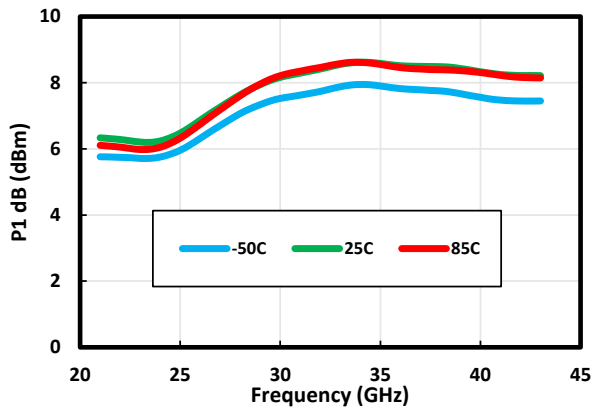


Figure 1-16. P1dB vs. Temperature at 7V

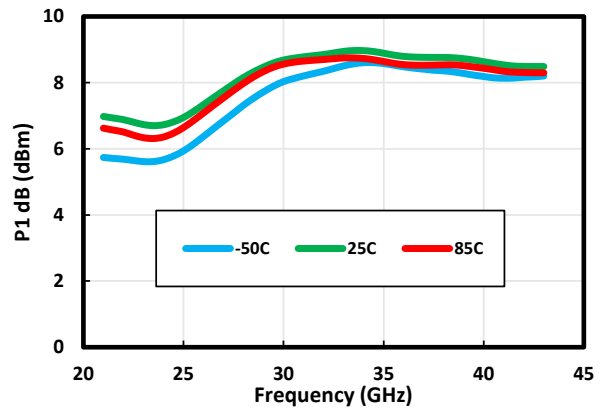


Figure 1-17. P_{sat} vs. Temperature at 2.7V

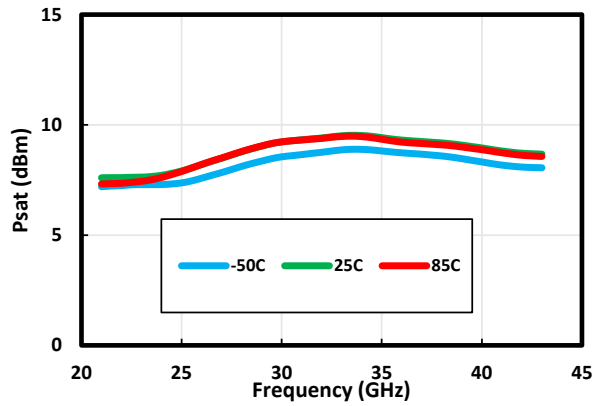


Figure 1-18. P_{sat} vs. Temperature at 3V

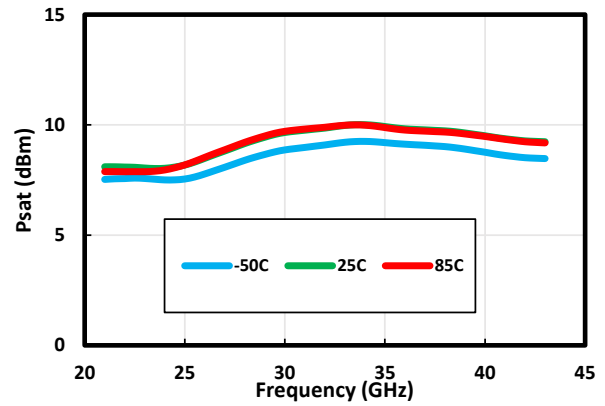


Figure 1-19. P_{sat} vs. Temperature at 5V

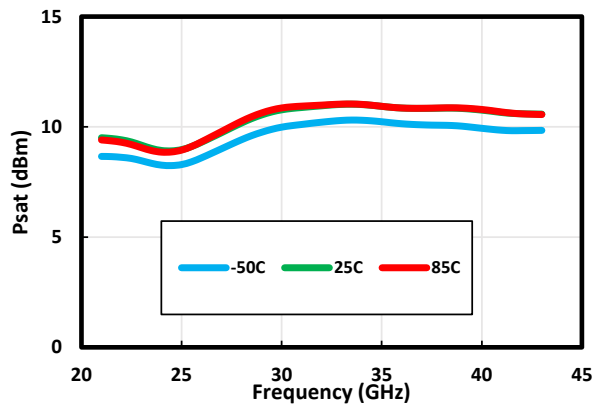


Figure 1-20. P_{sat} vs. Temperature at 7V

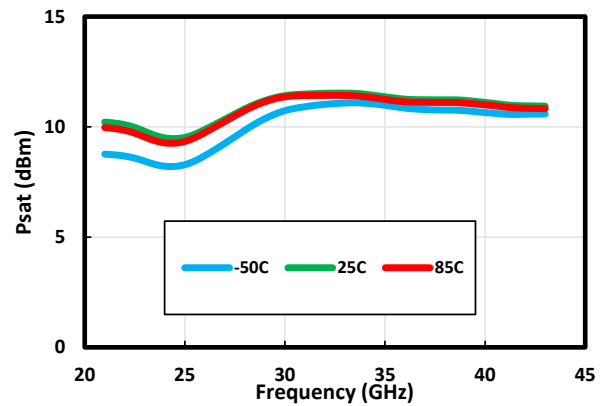


Figure 1-21. IP_2 (low) vs. Temperature at 2.7V

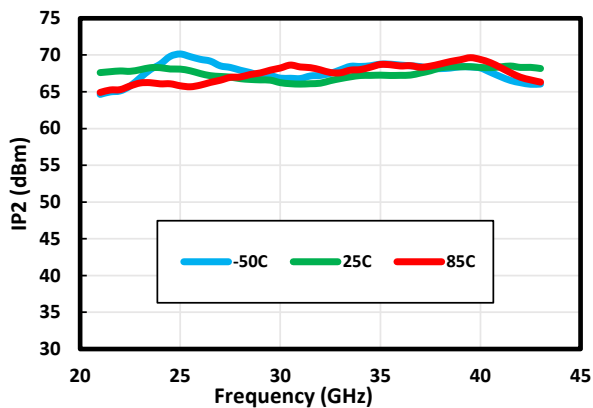


Figure 1-22. IP_2 (low) vs. Temperature at 3V

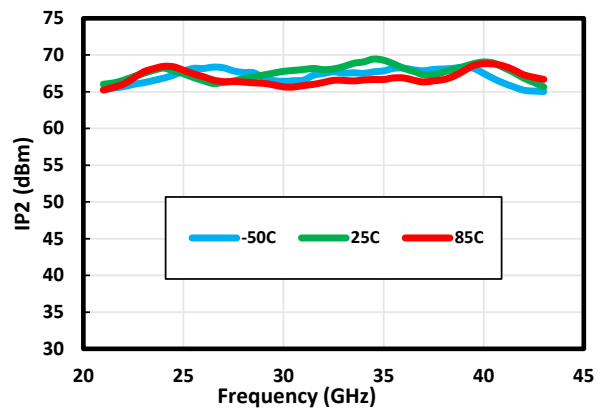


Figure 1-23. IP2 (low) vs. Temperature at 5V

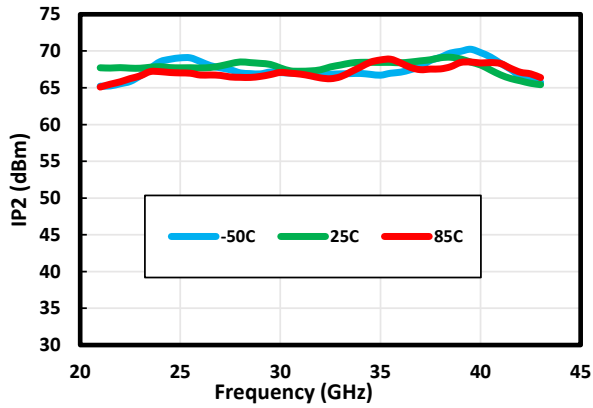


Figure 1-24. IP2 (low) vs. Temperature at 7V

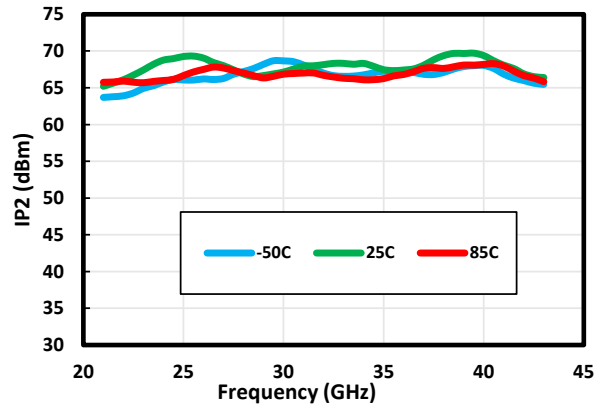


Figure 1-25. IP3 vs. Temperature at 2.7V

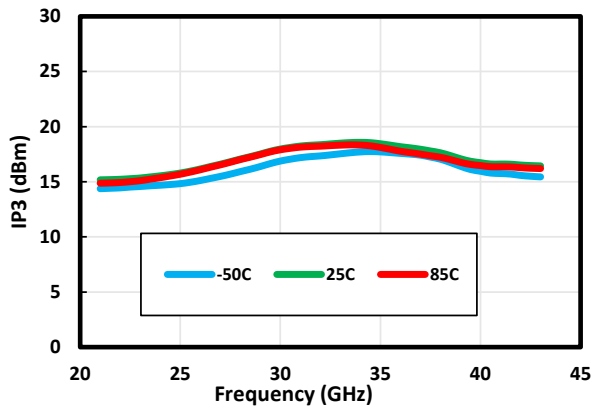


Figure 1-26. IP3 vs. Temperature at 3V

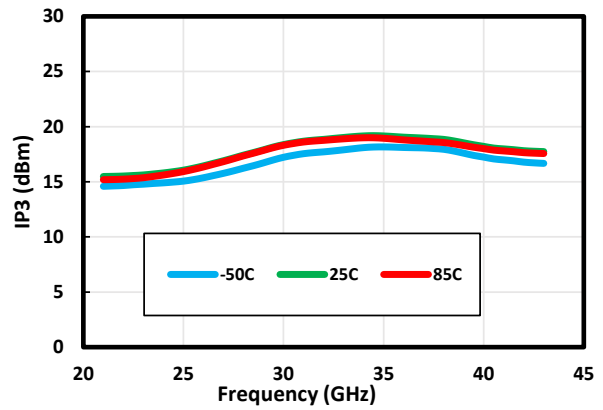


Figure 1-27. IP3 vs. Temperature at 5V

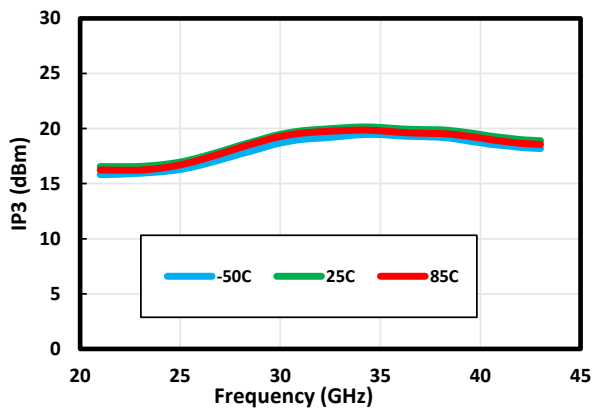


Figure 1-28. IP3 vs. Temperature at 7V

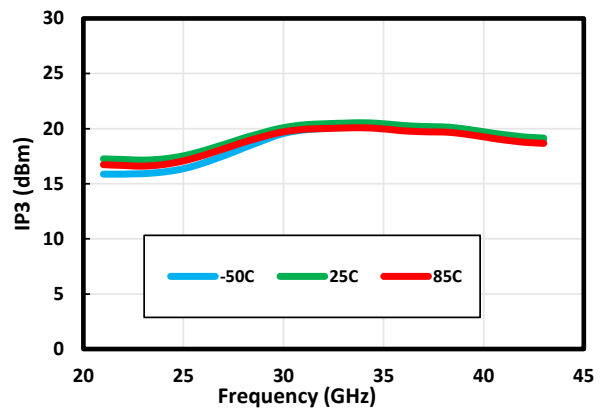


Figure 1-29. IM3 vs. Temperature at 2.7V
and 0 dBm per Tone

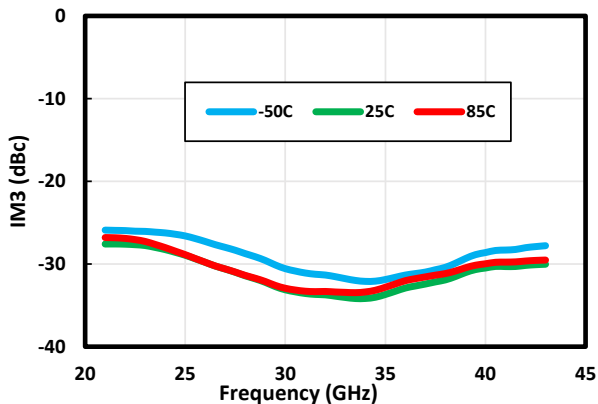


Figure 1-30. IM3 vs. Temperature at 3V
and 0 dBm per Tone

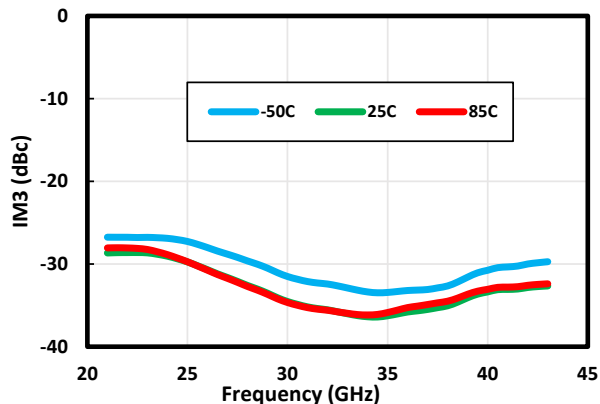


Figure 1-31. IM3 vs. Temperature at 5V
and 0 dBm per Tone

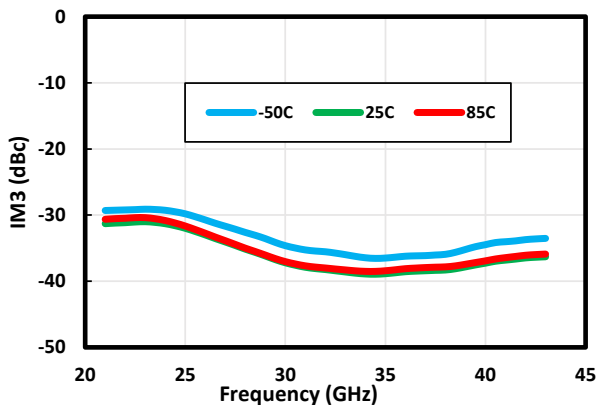
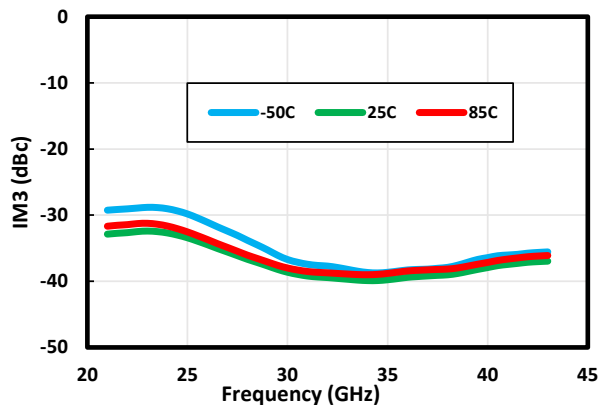


Figure 1-32. IM3 vs. Temperature at 7V
and 0 dBm per Tone



1.3.2. Typical Performances vs. Bias

The graphs shown in Figures 1-33 through 1-41 represent the typical performance versus bias curves of the MMA127AA under constant temperature of 25 °C. All measurements were taken using the test circuit shown in Figure 3-2

Figure 1-33. Gain vs. V_{DD}

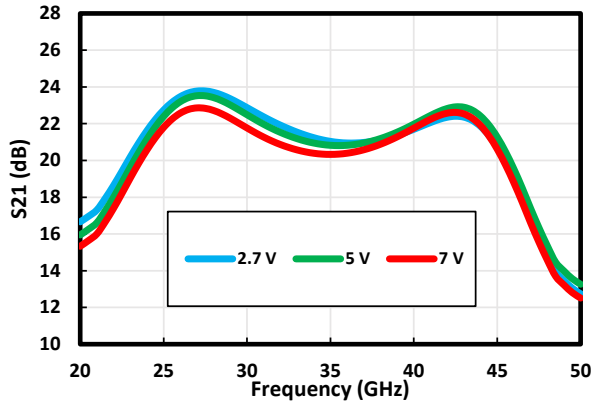


Figure 1-34. S11 vs. V_{DD}

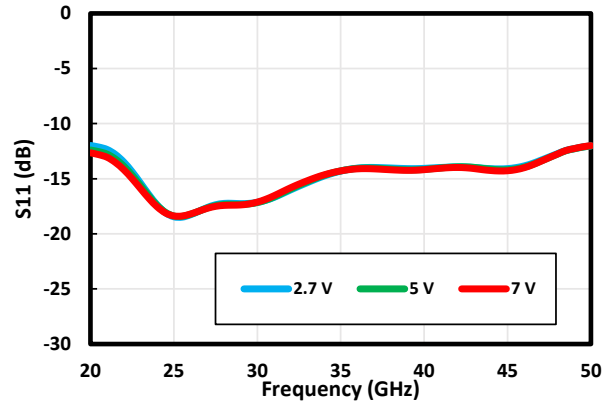


Figure 1-35. S22 vs. V_{DD}

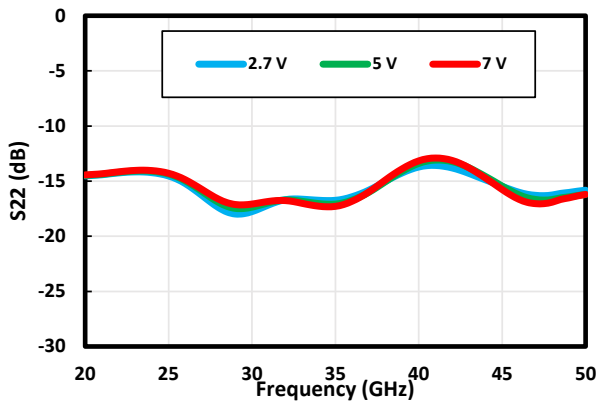


Figure 1-36. NF vs. V_{DD}

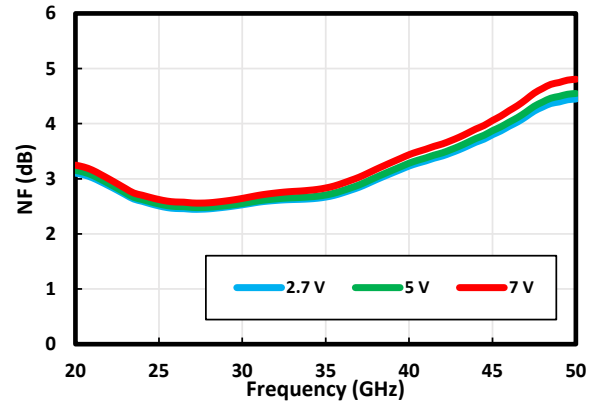


Figure 1-37. P1dB vs. V_{DD}

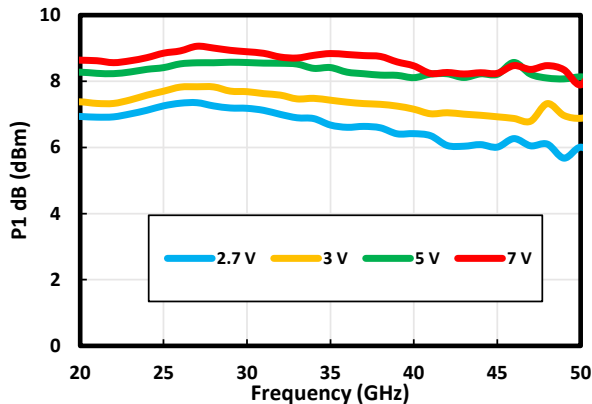


Figure 1-38. P_{sat} vs. V_{DD}

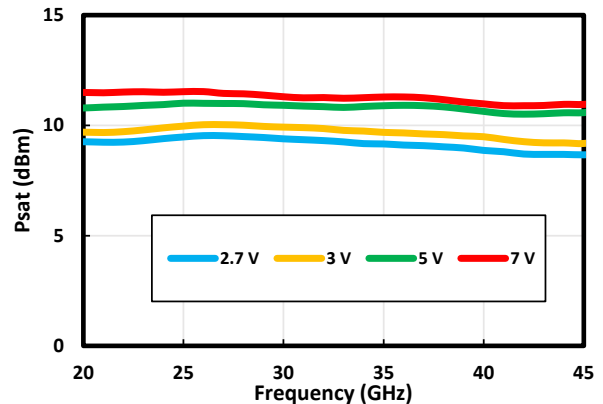


Figure 1-39. IP3 vs. V_{DD}

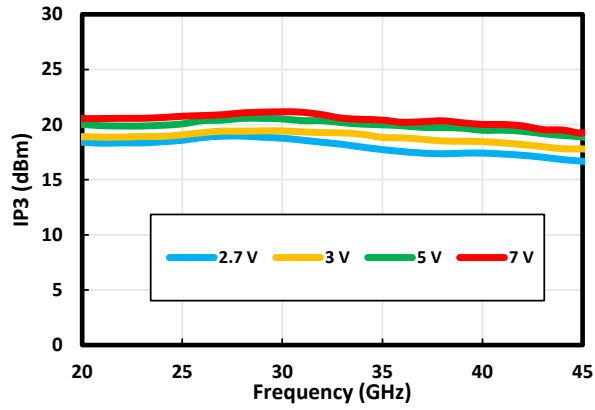


Figure 1-40. IP2_{LOW} vs. V_{DD}

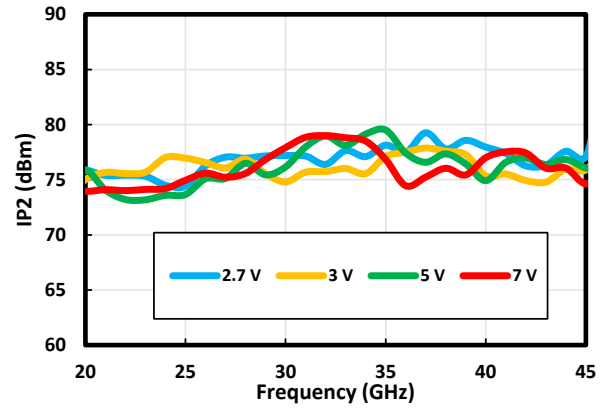
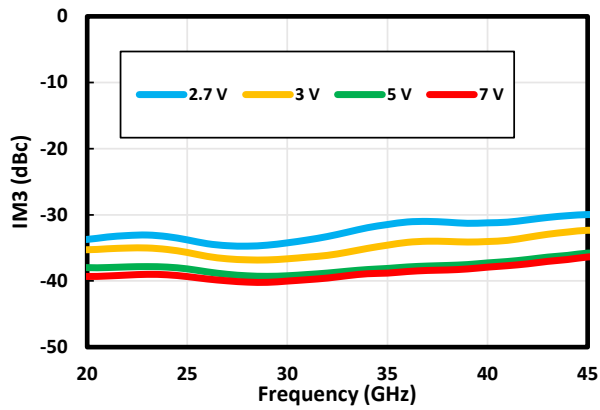


Figure 1-41. IM3 at 0 dBm per Tone vs. V_{DD}



1.3.3. Typical Performances vs. Output Power

The graphs shown in Figures 1-42 through 1-52 represent the typical performance versus output power curves of the MMA127AA under constant temperature of 25 °C. All measurements were taken using the test circuit shown in [Figure 3-2](#)

Figure 1-42. IM2 vs. Power at 2.7V

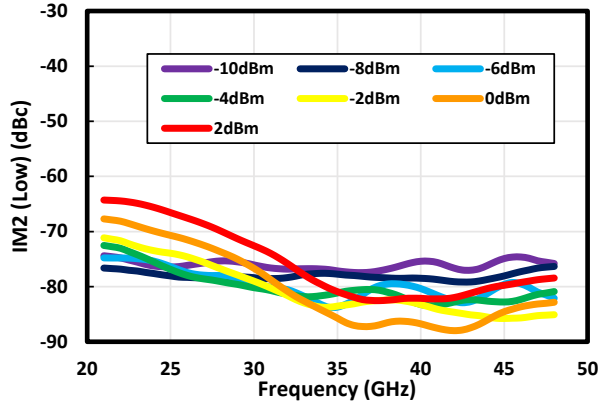


Figure 1-43. IM2 vs. Power at 3V

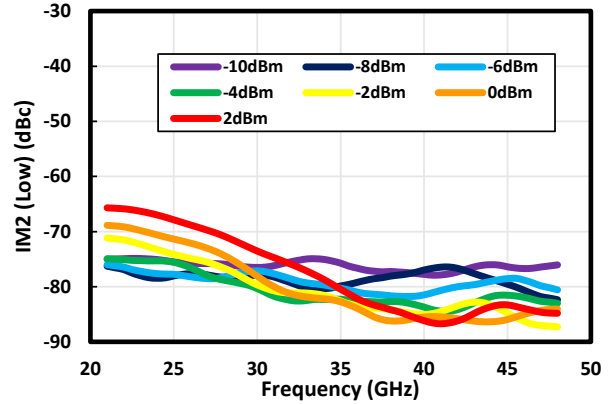


Figure 1-44. IM2 vs. Power at 5V

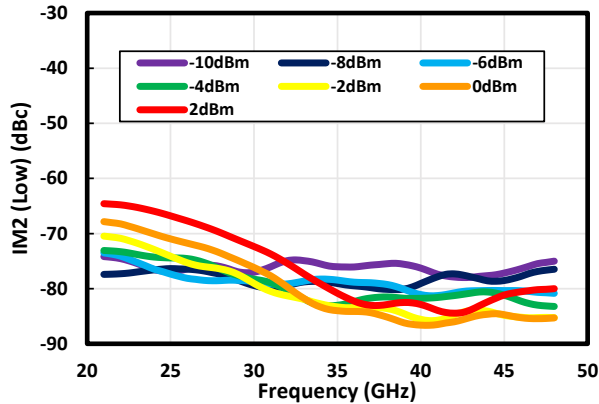


Figure 1-45. IM2 vs. Power at 7V

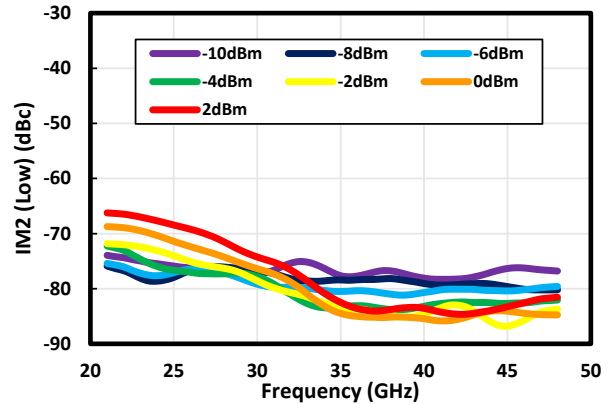


Figure 1-46. IM3 vs. Power at 2.7V

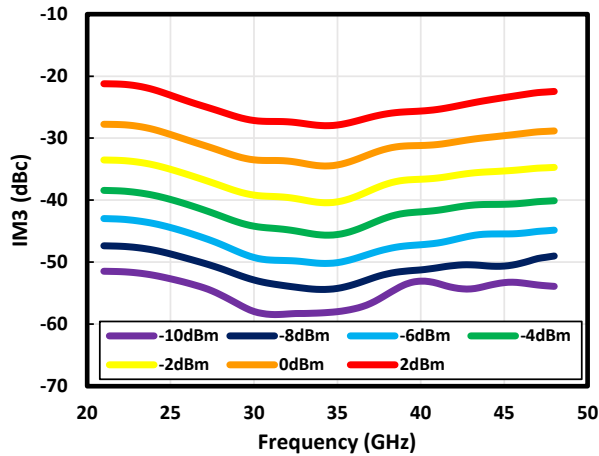


Figure 1-47. IM3 vs. Power at 3V

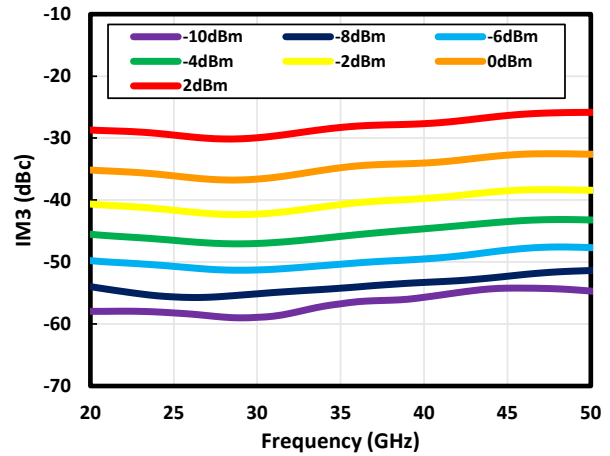


Figure 1-48. IM3 vs. Power at 5V

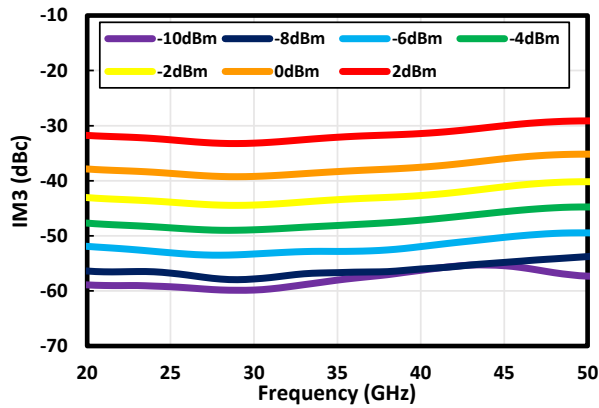


Figure 1-49. IM3 vs. Power at 7V

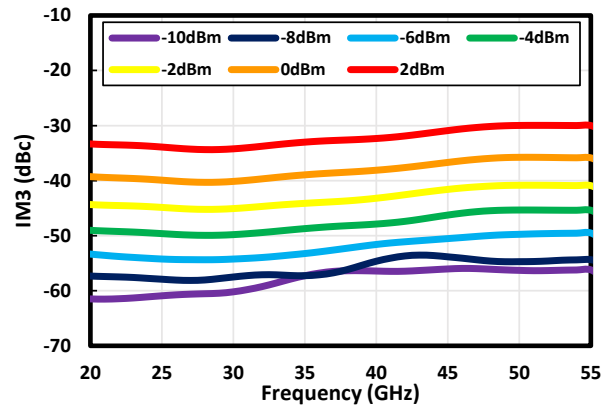


Figure 1-50. 2nd Harmonic vs. Power at 2.7V

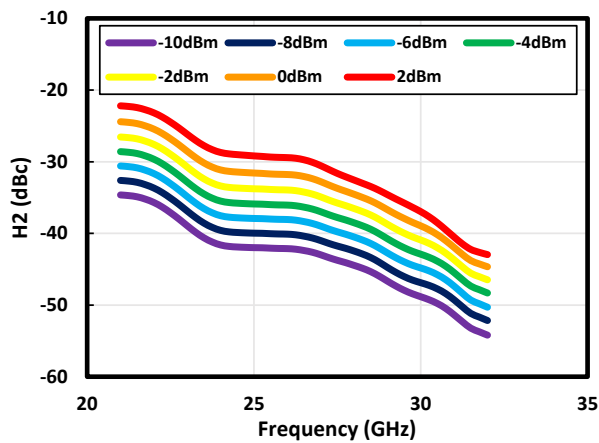


Figure 1-51. 2nd Harmonic vs. Power at 5V

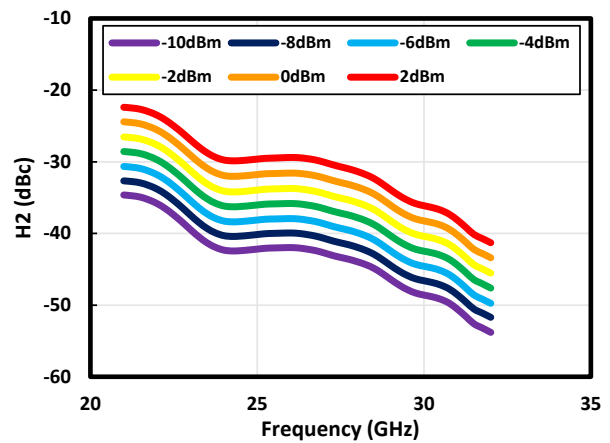
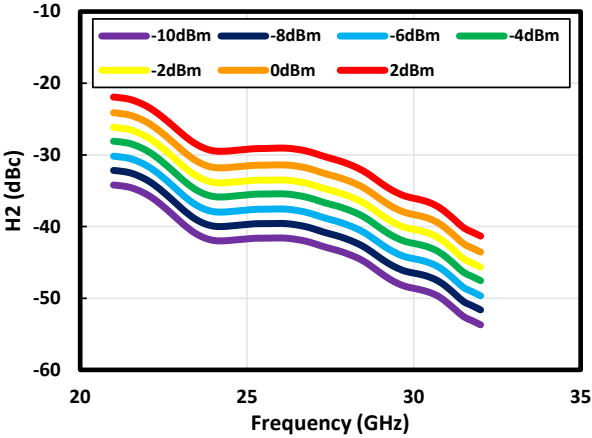
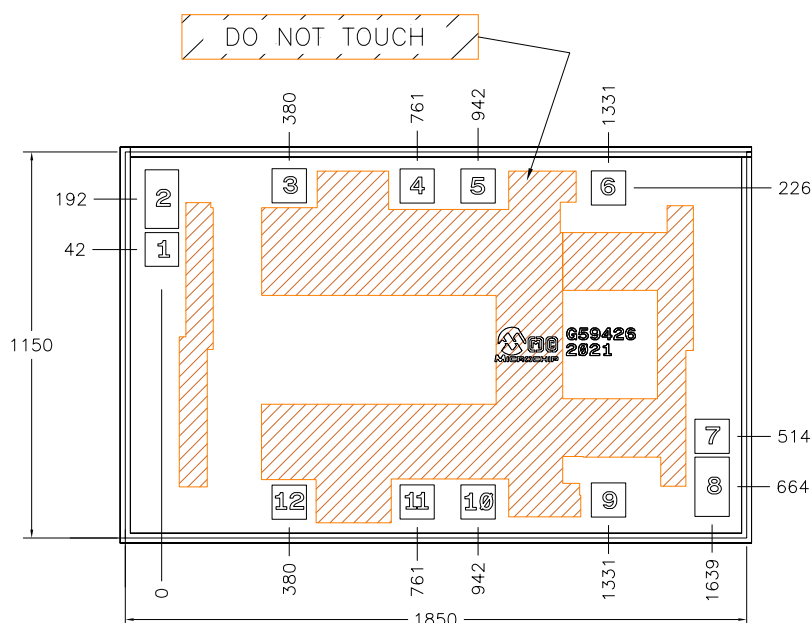


Figure 1-52. 2nd Harmonic vs. Power at 7V



2. Die Specifications

Figure 2-1. Die Outline Drawing (mm)



NOTES:

1. DIE THICKNESS: 100 $\mu\text{m} \pm 10 \mu\text{m}$
2. DIE OVERALL: 1850 μm X 1150 μm
3. ALL DIMENSIONS SHOWN ARE μm WITH A TOLERANCE OF $\pm 5 \mu\text{m}$ UNLESS OTHERWISE SPECIFIED
4. DIE SIZE REFLECTS UN-CUT DIMENSIONS. LASER KERF REDUCES DIE SIZE BY $\sim 25 \mu\text{m}$ EACH DIMENSION.
5. MARKING INFO:
2023 = DESIGN DATE (DOES NOT CHANGE)
G59427B = DIE NAME

Pad Number	Pad Name	Pad Size (μm)
1	GND	100x100
2	RFIN	100x175
3	GND	100x100
4	VD1A	100x100
5	GND	100x100
6	VD2A	100x100
7	GND	100x100
8	RFOUT	100x175
9	VD2B	100x100
10	GND	100x100
11	VD1B	100x100
12	GND	100x100

Table 2-1. I/O Description

Pad Number	Pad Name	Pad Description
2	RFIN	This pad is DC-grounded and matched to 50 Ω .
8	RFOUT	This pad is DC-grounded and matched to 50 Ω .
4, 11	VD1A, VD1B	These pads used to supply +VDD voltage bias to the first stage of the amplifier.
6, 9	VD2A, VD2B	These pads used to supply +VDD voltage bias to the second stage of the amplifier.
1, 3, 5, 7, 10, 12	Ground	Ground connections used for die test purposes; DC/RF ground is using die backside metal.

3. Application Circuit

Figure 3-1. Application Circuit: Schematic

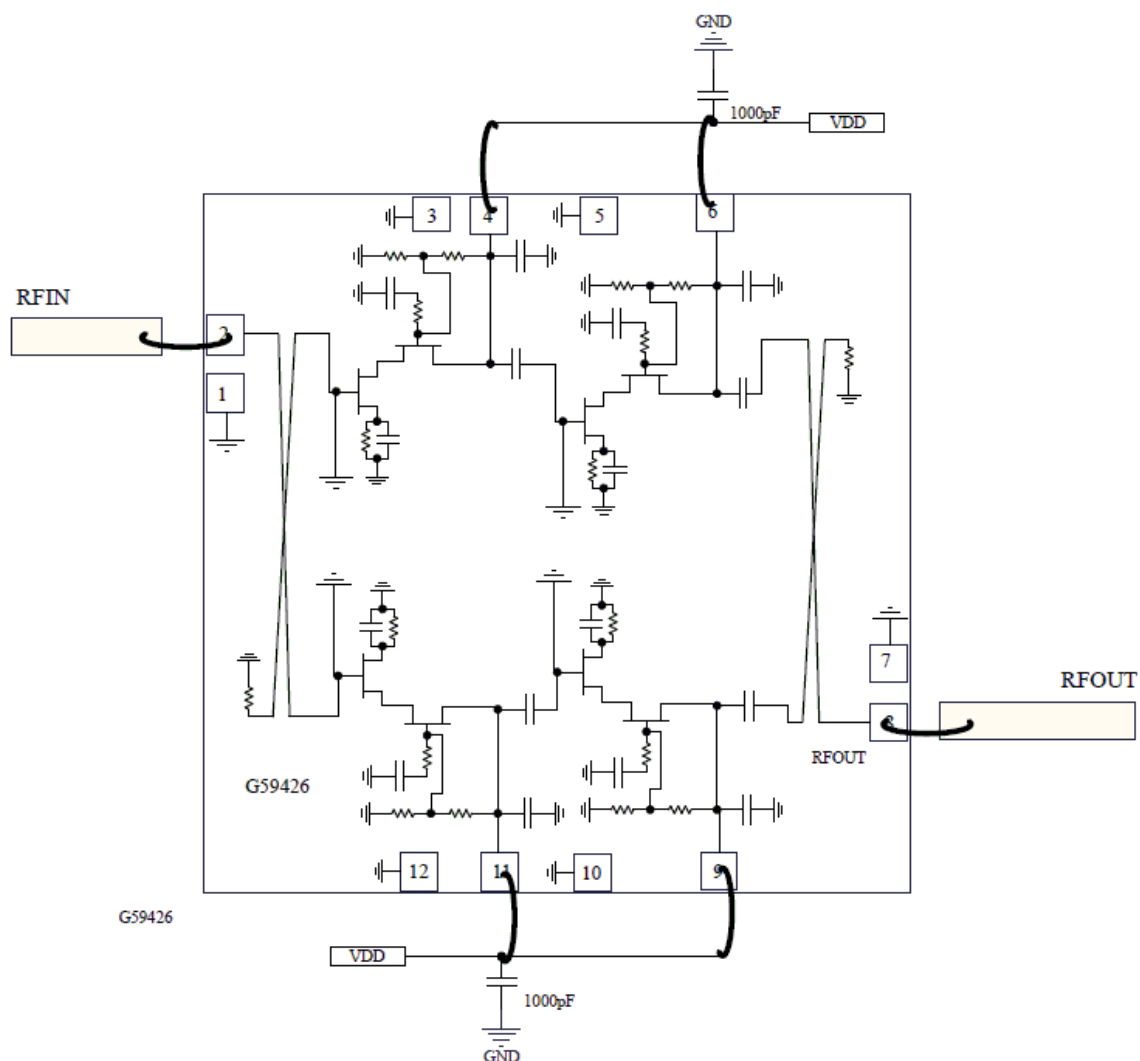


Figure 3-2. Test Circuits 25GHz–45 GHz: Assembly Drawing

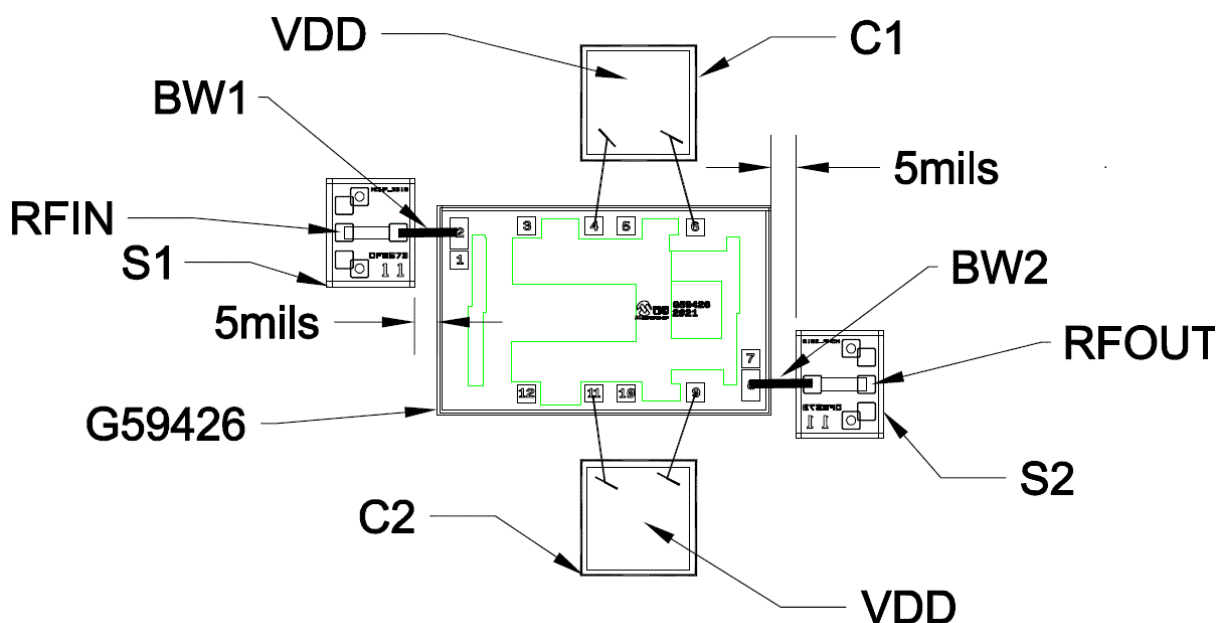


Table 3-1. List of Material for Test Circuit

Reference	Part Number	Description
G59426	MMA127AA	Amplifier die
C1...C2	160U02A102MT4W	Johanson Dielectric, Cer. Cap 1 nF
S1, S2	E57311	Probe launchers
Epoxy	EpoTech H20E	Conductive epoxy for die and cap mount

4. Ordering, Packing, and Handling

4.1. Handling Recommendations

Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. It is recommended to follow all procedures and guidelines outlined in the Microchip application note AN01: GaAs MMIC Handling and Die Attach Recommendations.

4.2. Ordering Information

For additional ordering information, contact your Microchip sales representative.

Part Number	Package
MMA127AA	Die

4.3. Packing Information

Standard Information
Gel pack
50 pieces per pack

5. Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

Revision	Date	Description
A	09/2025	Document created.

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ISBN: 979-8-3371-2039-3

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