MMA043AA Datasheet

0.5 GHz–12 GHz GaAs pHEMT MMIC Wideband Low-Noise Amplifier

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1 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.

1.1 Revision 1.0

Revision 1.0 was the first publication of this document.

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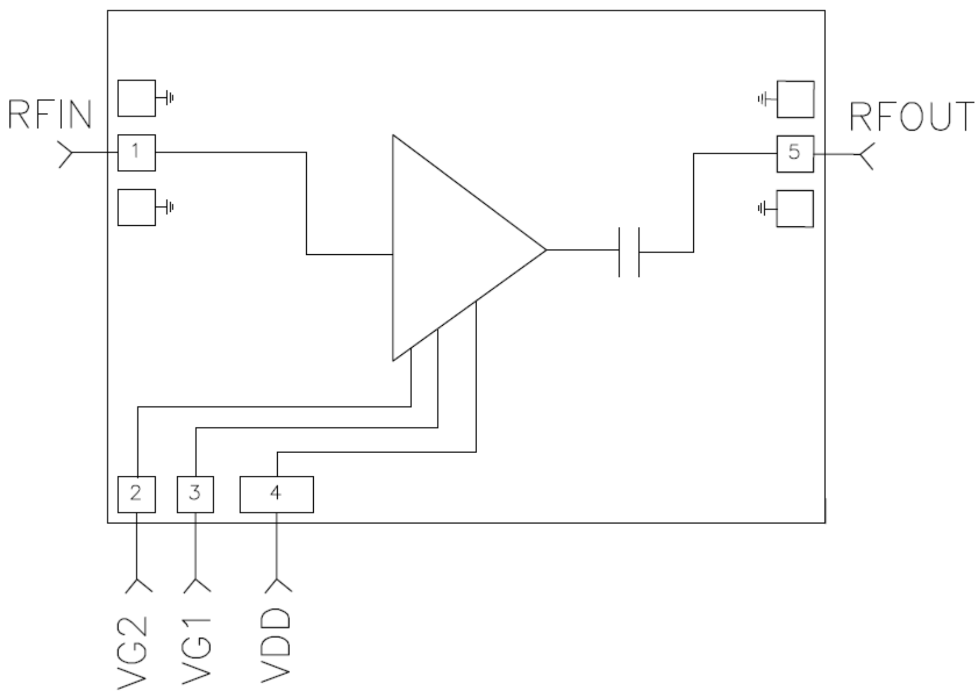
2 Product Overview

The MMA043AA is a gallium arsenide (GaAs) pseudomorphic high-electron mobility transistor (pHEMT) low-noise wideband amplifier die that operates between 0.5 GHz and 12 GHz. The MMA043AA die provides 16.5 dB of gain, 1.4 dB noise figure, and 29 dBm output IP3. The amplifier draws only 55 mA of current from a 5 V supply. The RF ports are internally matched to 50 Ω, which allows for easy integration into multi-chip modules (MCMs).

The following illustration shows the primary functional diagram of the MMA043AA device.

Figure 1 Functional Block Diagram



2.1 Applications

The MMA043AA device is designed for the following applications:

- Test instrumentation
- Wideband communications
- Military and space systems
- Cellular infrastructure
- Microwave radio and VSAT

2.2 Key Features

The following are key features of the MMA043AA device.

- GaAs pHEMT LNA monolithic microwave integrated circuit (MMIC)
- Low-noise figure: 1.4 dB
- High gain: 16.5 dB
- Broadband Performance: 0.5 GHz – 12 GHz
- Excellent P1dB output power (17 dBm)
- High OIP3: 29 dBm
- Compact die size: 2.2 mm × 1.35 mm × 0.1 mm

3 Electrical Specifications

3.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the MMA043AA device.

Table 1 Absolute Maximum Ratings

Parameter	Rating
Storage temperature	–65 °C to 150 °C
Operating temperature	–55 °C to 85 °C
Drain bias voltage (V_{DD})	5.5 V
Gate bias voltage (V_{G1})	–1.5 V to 0 V
Gate bias voltage (V_{G2})	0 V to 2.5 V
RF input power	12 dBm
Channel temperature	150 °C
ESD sensitivity (HBM)	
Thermal impedance	

3.2 Typical Electrical Performance

The following table shows the typical electrical performance of the MMA043AA device at 25 °C, where V_{DD} is 5 V. Unless otherwise indicated, all measurements are derived from the RF probed die according to the assembly diagram shown in Assembly Diagram.

Table 2 Typical Electrical Performance

Parameter	Min	Typ	Max	Units
Operational frequency range		0.5	12	GHz
Gain	15.4	16.5	17.2	dB
Gain variation over temperature		0.01		dB/°C
Noise figure	1.2	1.4	2.1	dB
Input return loss	7.5	10		dB
Output return loss	12	13		dB
Output power for 1 dB compression, P1dB	16.5	17	18.5	dBm
Output third order intercept, OIP3	27.5	29		dBm
V_{DD}		5	5.5	V
Supply current (I_{DD}); V_{DD} = 5 V V_{G2} = 1.7 V typ V_{G1} = –0.4 V, set for nominal current		55		mA

3.3 Typical Performance Curves

The following graphs show the typical performance curves of the MMA043AA device.

Figure 2 Gain vs. Frequency

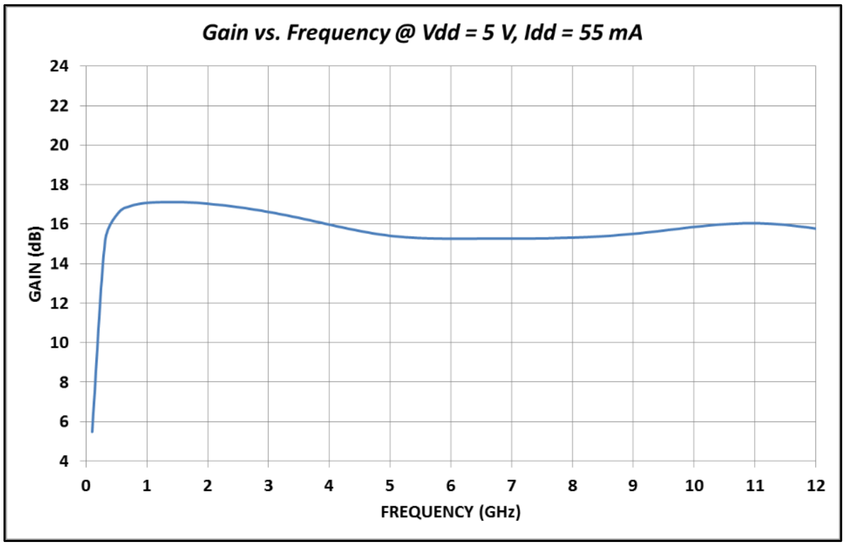


Figure 3 Input Return Loss vs. Frequency

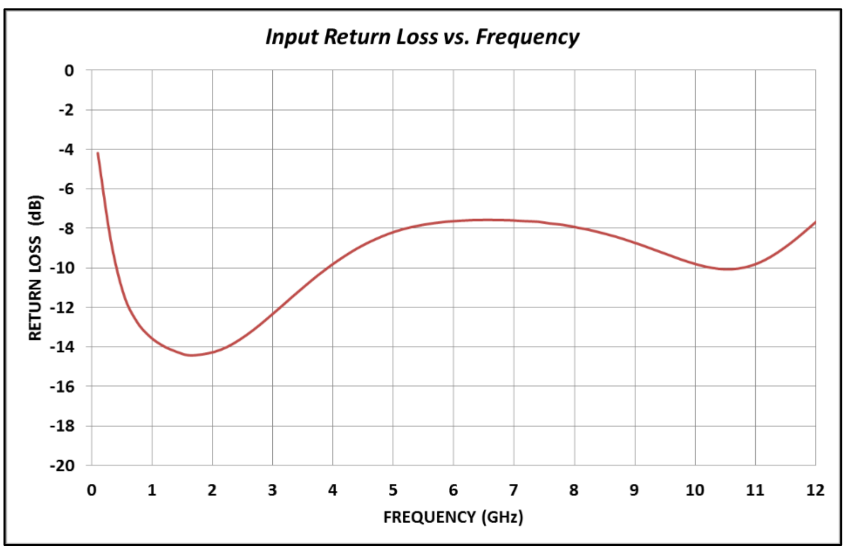


Figure 4 Output Return Loss vs. Frequency

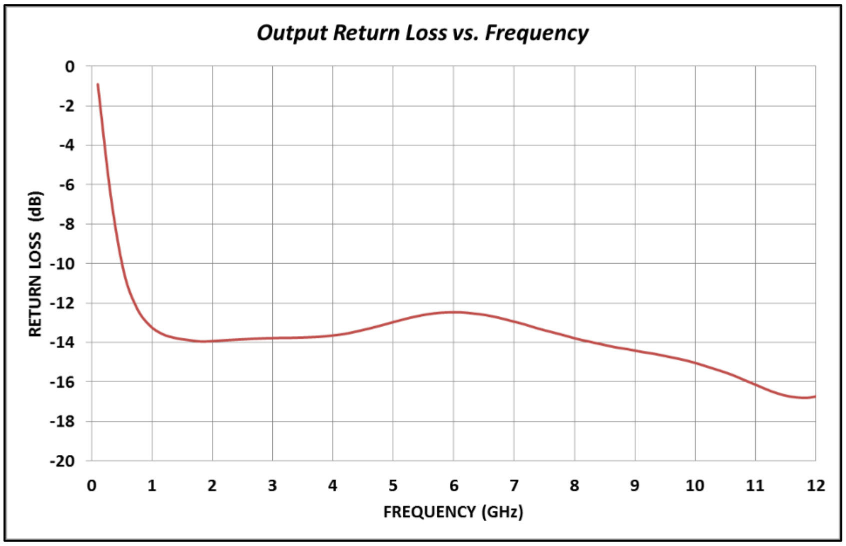


Figure 5 Isolation vs. Frequency

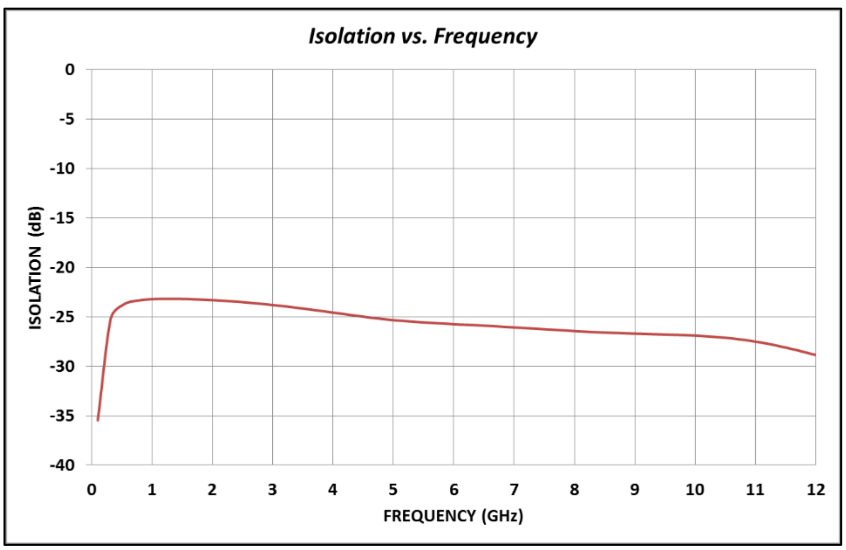


Figure 6 Noise Figure vs. Frequency

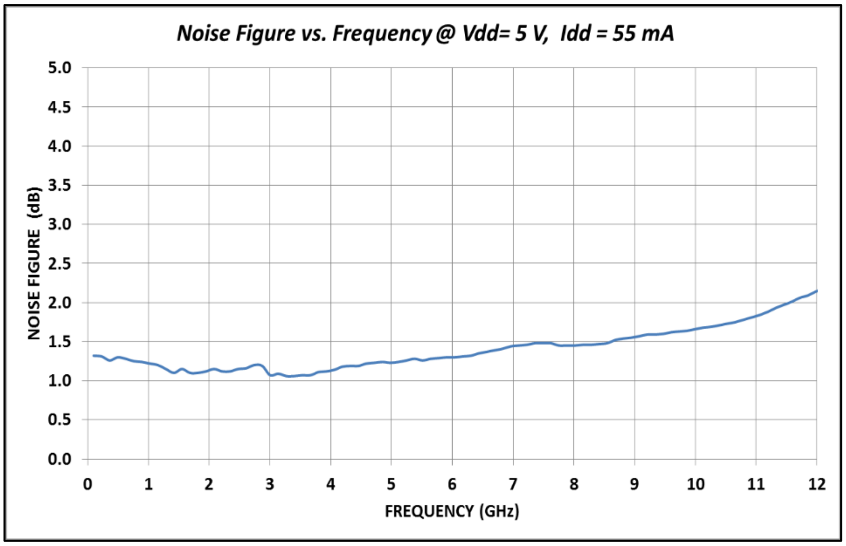


Figure 7 P1dB vs. Frequency

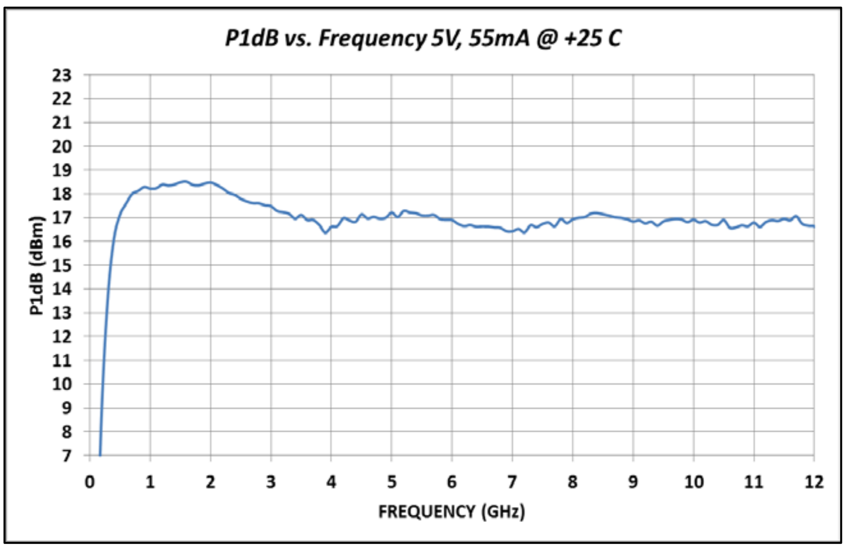


Figure 8 OIP3 vs. Frequency

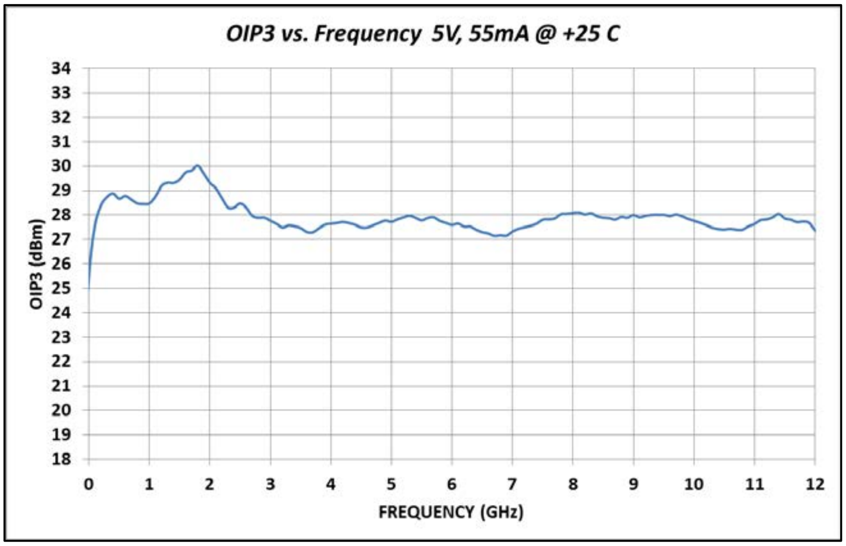


Figure 9 Gain vs. Temperature and Frequency

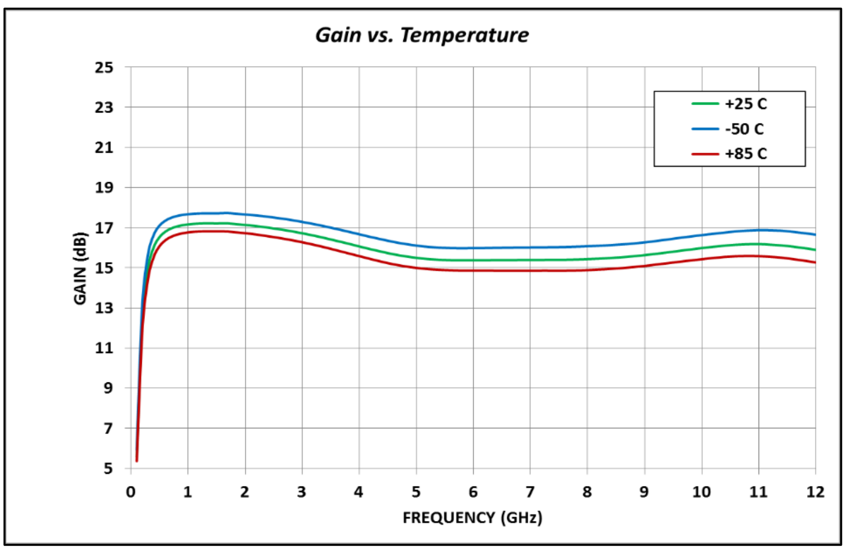


Figure 10 Input Return Loss vs. Temperature and Frequency

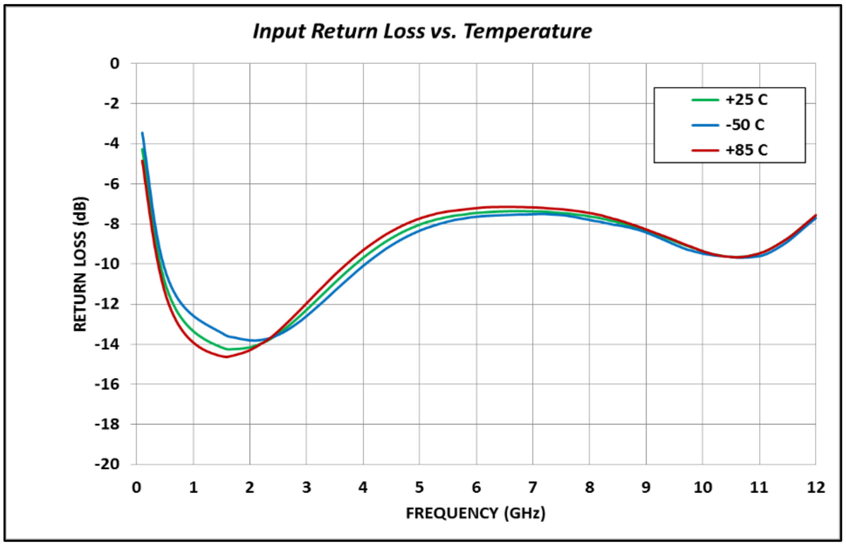


Figure 11 Output Return Loss vs. Temperature and Frequency

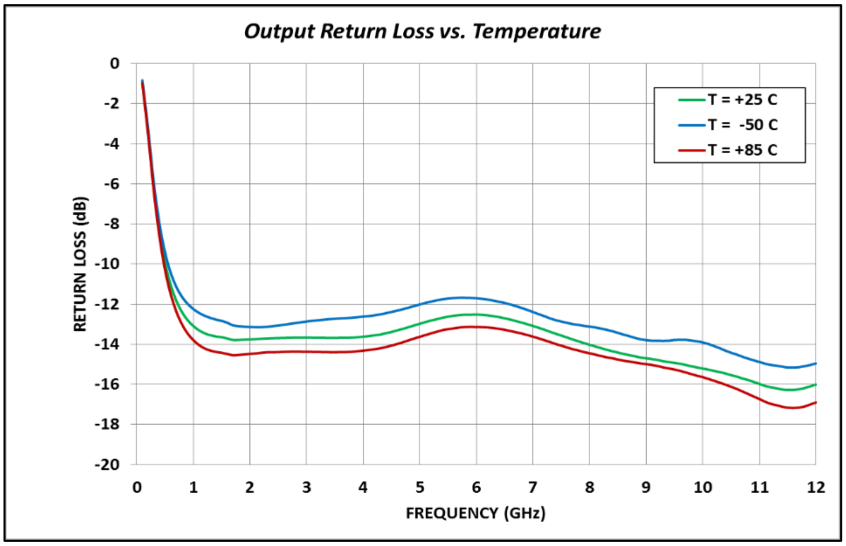


Figure 12 P1dB vs. Temperature and Frequency

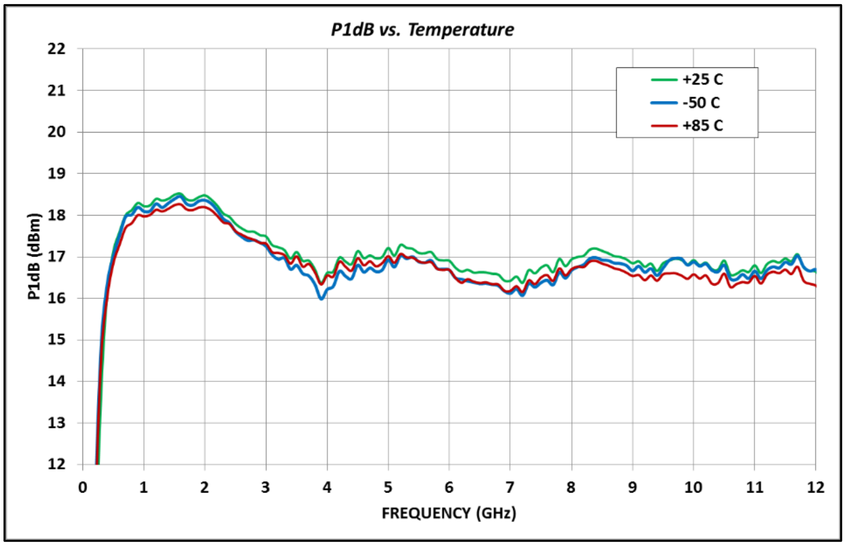
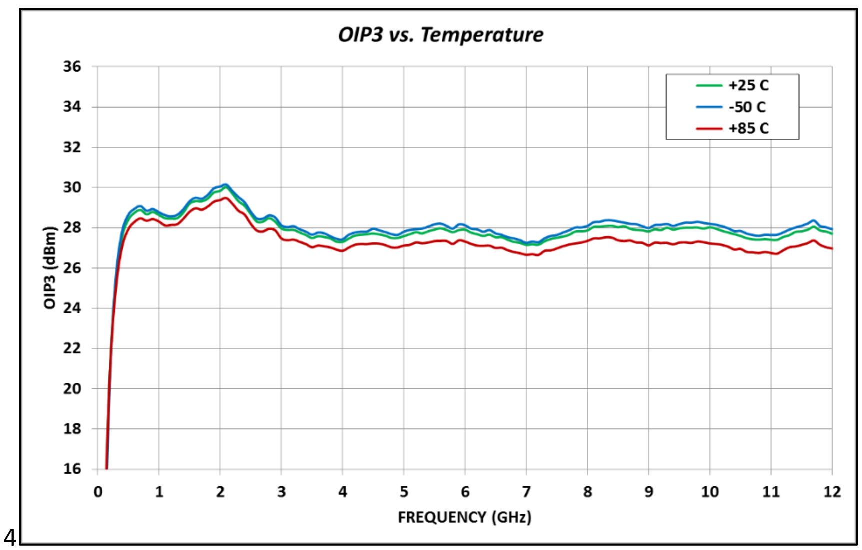


Figure 13 OIP3 vs. Temperature and Frequency



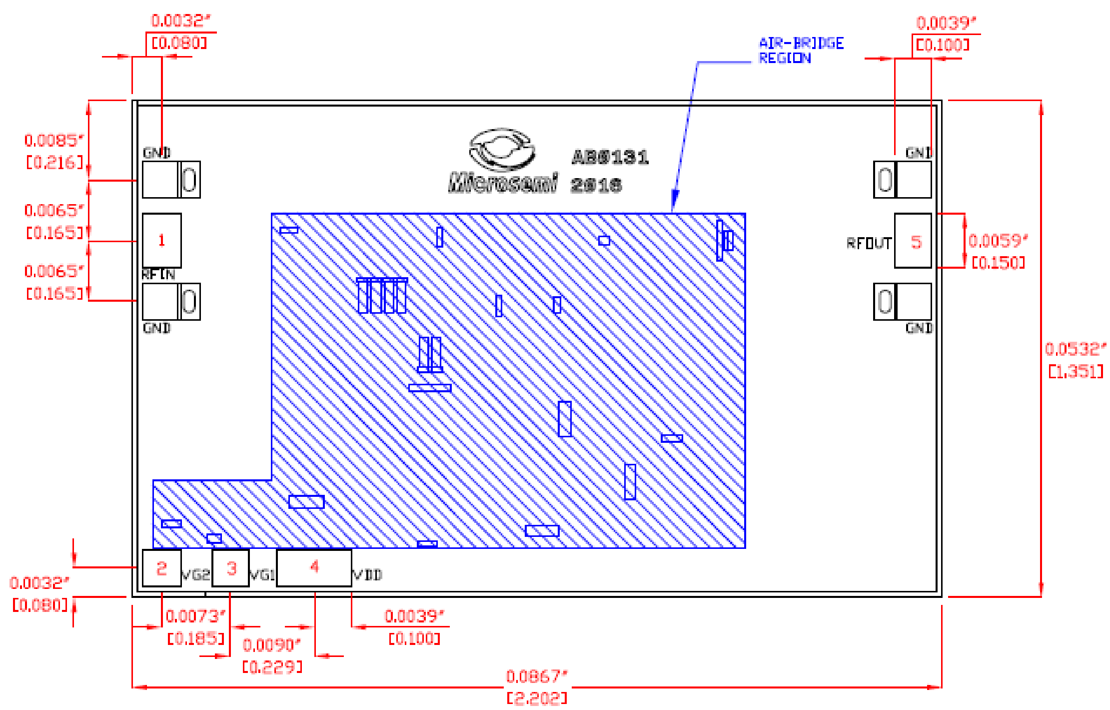
4

4 Chip Outline Drawing, Die Packaging, Bond Pad, and Assembly Information

4.1 Chip Outline Drawing

The following illustration shows the chip outline of the MMA043AA device. Dimensions are shown in inches and millimeters. The minimum bond pad size is 100 µm × 100 µm. Both the bond pad surface and the backside metal are 3 µm gold. The die thickness is 100 µm. The backside is the DC/RF ground. The airbridge keepout region is in crosshatch, and the unlabeled pads should not be bonded.

Figure 14 Chip Outline



4.2 Die Packaging Information

The following table shows the chip outline of the MMA043AA device. For additional packaging information, contact your Microsemi sales representative.

Table 3 Die Packaging Information

Standard Format	Optional Format
Waffle pack	Gel pack
50–100 pieces per pack	50 pieces per pack

4.3 Bond Pad Information

The following table shows the bond pad information for the MMA043AA device.

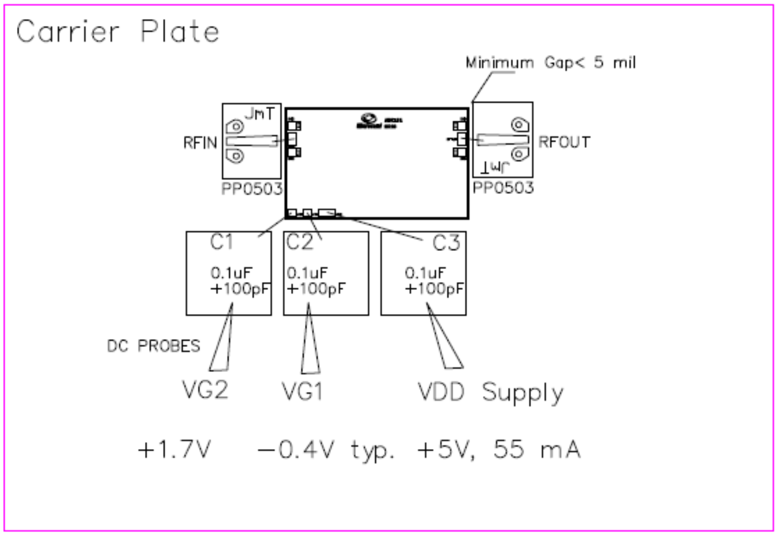
Table 4 Bond Pad Information

Bond Pad Number	Bond Pad Name	Description
1	RF_{IN}	This bond pad is DC-coupled and matched to 50 Ω. External >300 pF DC blocking capacitor is required.
2	V_{G2}	Gate 2 supply voltage for the amplifier. See Assembly Diagram for required external components.
3	V_{G1}	Gate 1 supply voltage for the amplifier. See Assembly Diagram for required external components.
4	V_{DD}	Drain supply voltage for the amplifier. See Assembly Diagram for required external components.
5	RF_{OUT}	This bond pad is AC-coupled and matched to 50 Ω.
Backside paddle	RF/DC GND	RF/DC ground.

4.4 Assembly Diagram

The following illustration shows the assembly diagram of the MMA043AA device. The carrier plate is gold plated. It is necessary to attach components using conductive epoxy. The bypass chip caps are ceramic and must be assembled within 10 mils of the die. Use 1 mil Au bond wires. An input blocking capacitor greater than 300 pF is required external to the MMIC.

Figure 15 Assembly Diagram



BOM: C1, C2, C3: Presidio VB series dual caps (100 pF + 0.1 µF)

P/N: MVB4040X104MEK5C1B; 40 mils × 40 mils × 17 mils

4.5 Bias Sequence Procedure

The following lists show the bias sequence procedures for the MMA043AA device.

Turn on:

1. Set V_{G1} (-ve) to –1 V
2. Set V_{DD} to 5 V
3. Set V_{G2} to 1.7 V
4. Increase V_{G1} to achieve Idq of 55 mA
5. Apply RF input

Turn off:

1. Turn off RF input
2. Reduce V_{G1} to –1 V to achieve Idq of 0 mA
3. Decrease V_{G2} to 0 V
4. Decrease V_{DD} to 0 V

5 Handling and Die Attach 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 Microsemi application note AN01 GaAs MMIC Handling and Die Attach Recommendations.

6 Ordering Information

The following table shows the ordering information for the MMA043AA device.

Table 5 Ordering Information

Part Number	Package
MMA043AA	Die