MMA044AA Datasheet

6 GHz–18 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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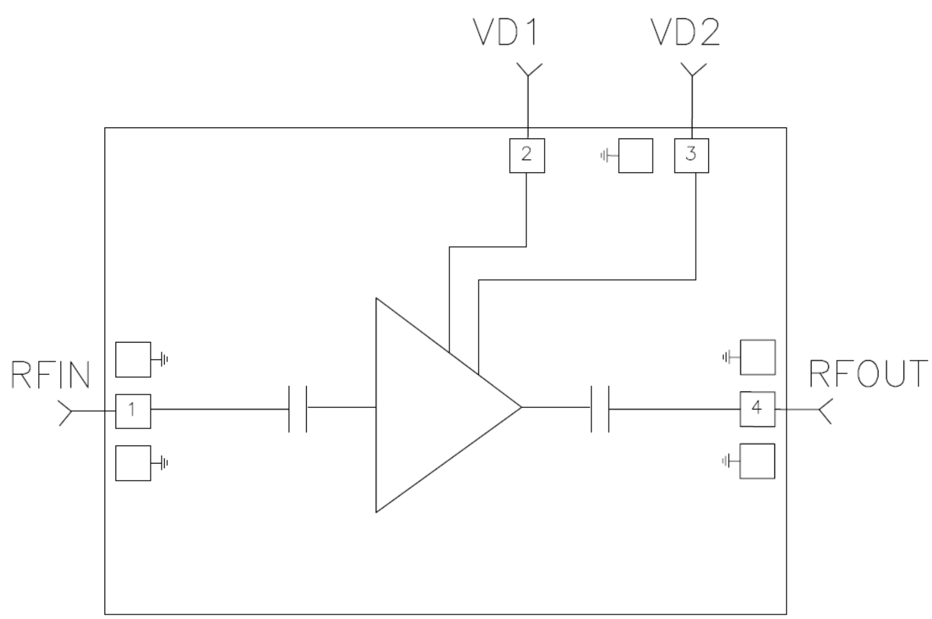
2 Product Overview

The MMA044AA is a gallium arsenide (GaAs) pseudomorphic high-electron mobility transistor (pHEMT) monolithic microwave integrated circuit (MMIC) low-noise wideband amplifier die that operates between 6 GHz and 18 GHz. The MMA044AA die provides 21 dB of small signal gain, 1.7 dB noise figure, and output IP3 of 30 dBm, while requiring only 102 mA from a 4 V supply. The P1dB output power of 17 dBm enables the LNA to function as an LO driver for balanced, in-phase quadrature (I/Q), or image reject mixers. The MMA044AA amplifier also features RF ports that are DC blocked and internally matched to 50 Ω, which allows for easy integration into multi-chip modules (MCMs).

The following illustration shows the primary functional blocks of the MMA044AA device.

Figure 1 Functional Block Diagram



2.1 Applications

The MMA044AA device is designed for the following applications:

- Test instrumentation and VSAT
- Military and space
- Point-to-point and point-to-multi-point radios
- VSAT

2.2 Key Features

The following are key features of the MMA044AA device.

- GaAs pHEMT LNA MMIC
- Broadband performance: 6 GHz–18 GHz
- Low-noise figure: 1.7 dB
- High gain: 21 dB
- 50 Ω input/output match
- Excellent P1dB output power: 17 dBm
- High OIP3: 30 dBm
- Single supply bias: 4 V at 102 mA
- Compact die size: 1.12 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 MMA044AA device at 25 °C, unless otherwise specified.

Table 1 Absolute Maximum Ratings

Parameter	Rating
Drain bias voltage (V_{D1} and V_{D2})	4.5 V
RF input power (P_{IN})	12 dBm
Channel temperature (T_J)	150 °C
Storage temperature (T_S)	–65 to 150 °C
Thermal impedance (channel to die bottom)	
Operating temperature (T_A)	–55 to 85 °C
ESD sensitivity (HBM)	

3.2 Typical Electrical Performance

The following table shows the typical electrical performance of the MMA044AA device at 25 °C, where V_{d1} and V_{d2} are 4 V. Unless otherwise indicated, all measurements are derived from the RF probed die according to the assembly diagram shown in section 4.4.

Table 2 Typical Electrical Performance

Parameter	Min	Typ	Max	Units
Operational frequency range	6		18	GHz
Gain	20.8	21	21.4	dB
Gain variation over temperature		0.02		dB/°C
Noise figure	1.5	1.7	2.2	dB
Input return loss	11.5	14		dB
Output return loss	12	14		dB
Output power for 1 dB compression, P1dB	16.5	17	18	dBm
Output third order intercept, OIP3	28	30	33	dBm
V_{D1}, V_{D2}		4	4.5	V
Supply current, $I_{DD} = I_{D1}+I_{D2}$		102		mA

3.3 Typical Performance Curves

The following graphs show the typical performance curves of the MMA044AA device.

Figure 2 Broadband Gain vs. Frequency

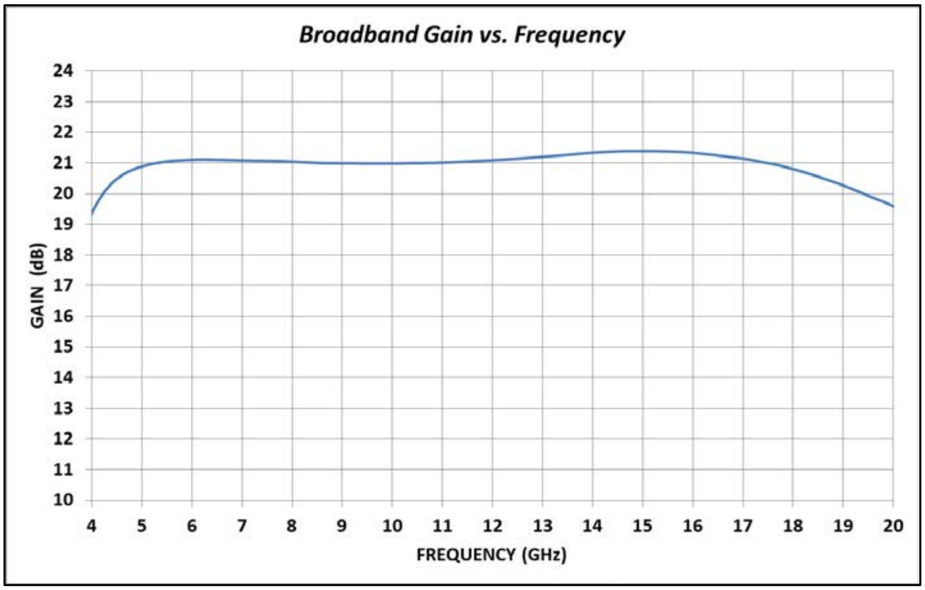


Figure 3 Input Return Loss vs. Frequency

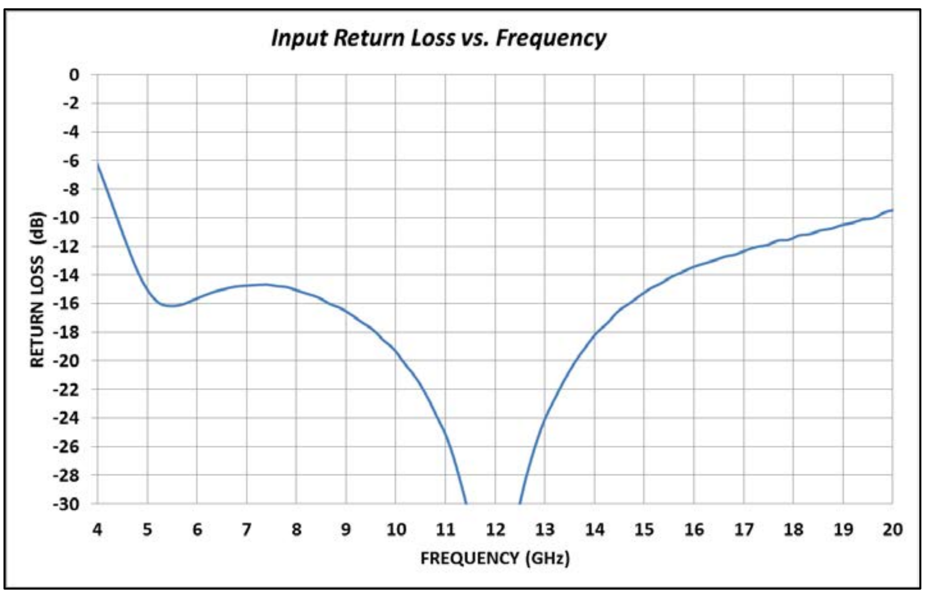


Figure 4 Output Return Loss vs. Frequency

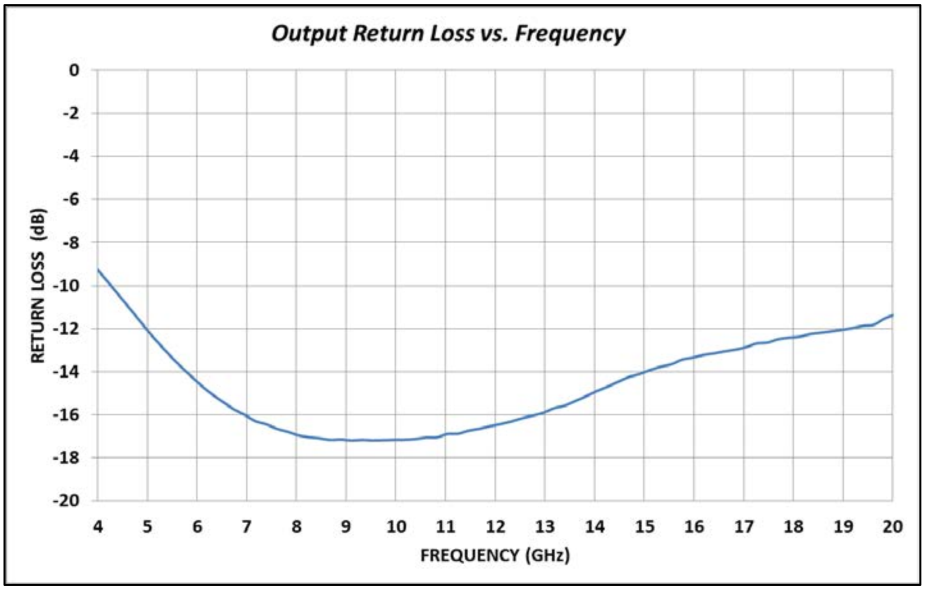


Figure 5 Isolation vs. Frequency

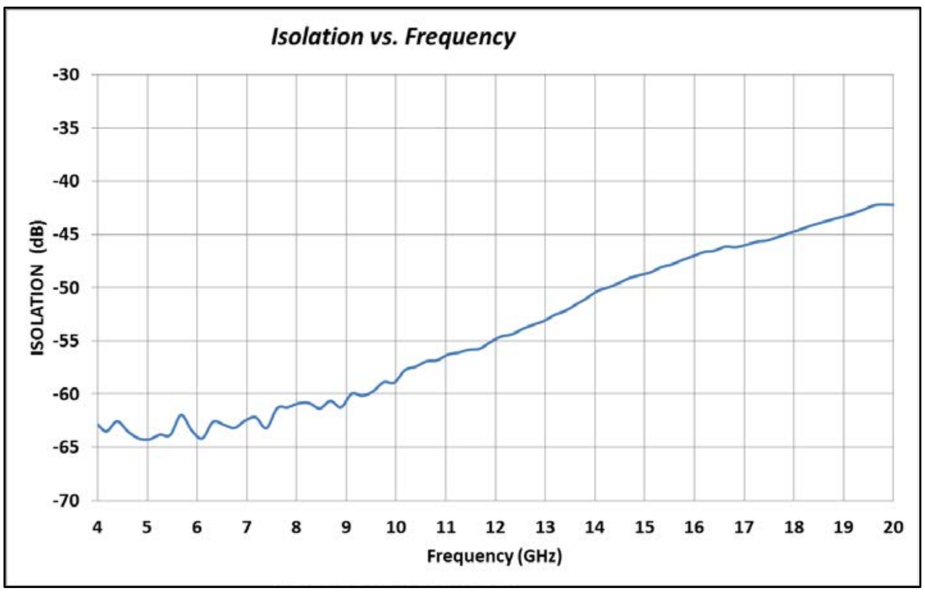


Figure 6 Noise Figure vs. Frequency

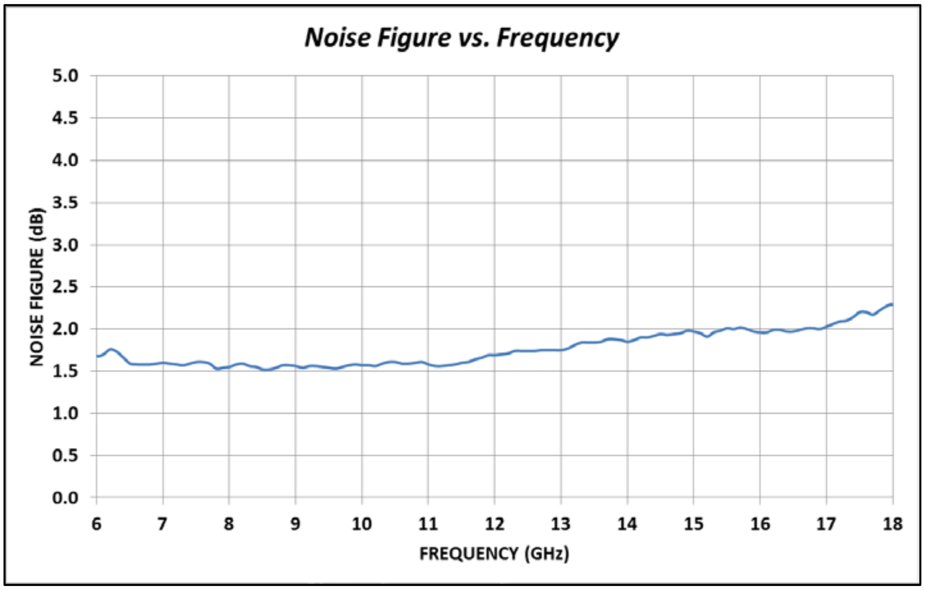


Figure 7 P1dB vs. Frequency

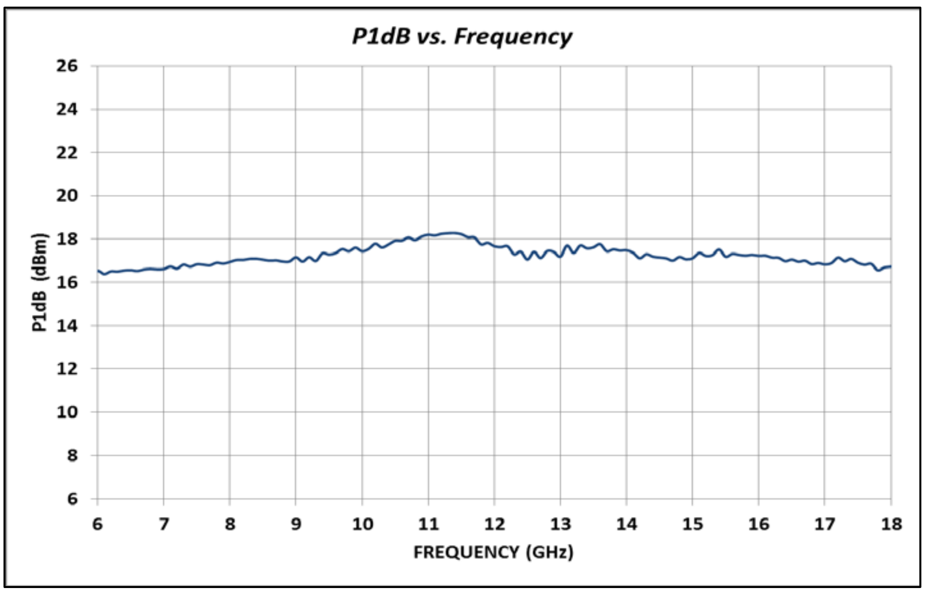


Figure 8 Output IP3 vs. Frequency

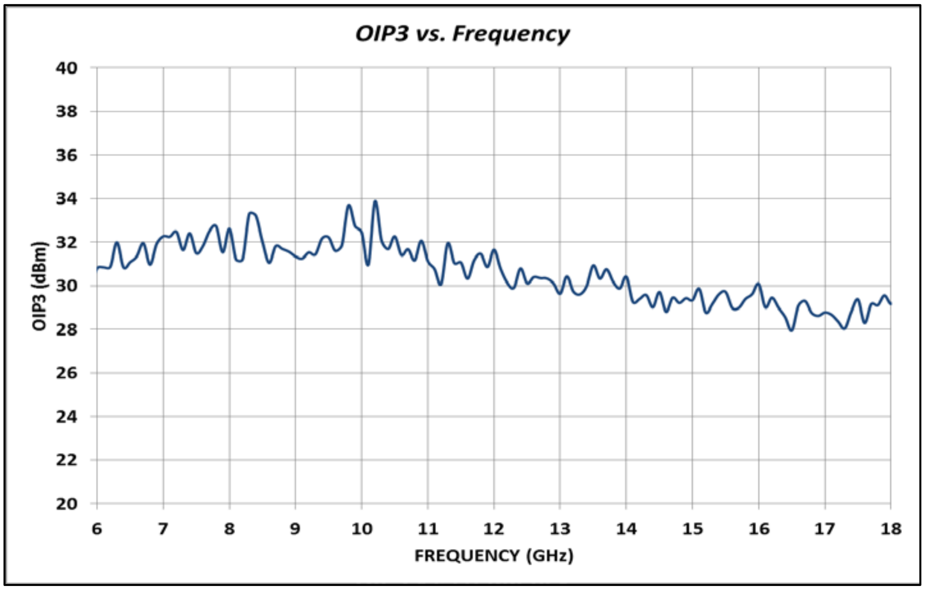


Figure 9 Broadband Gain vs. Temperature

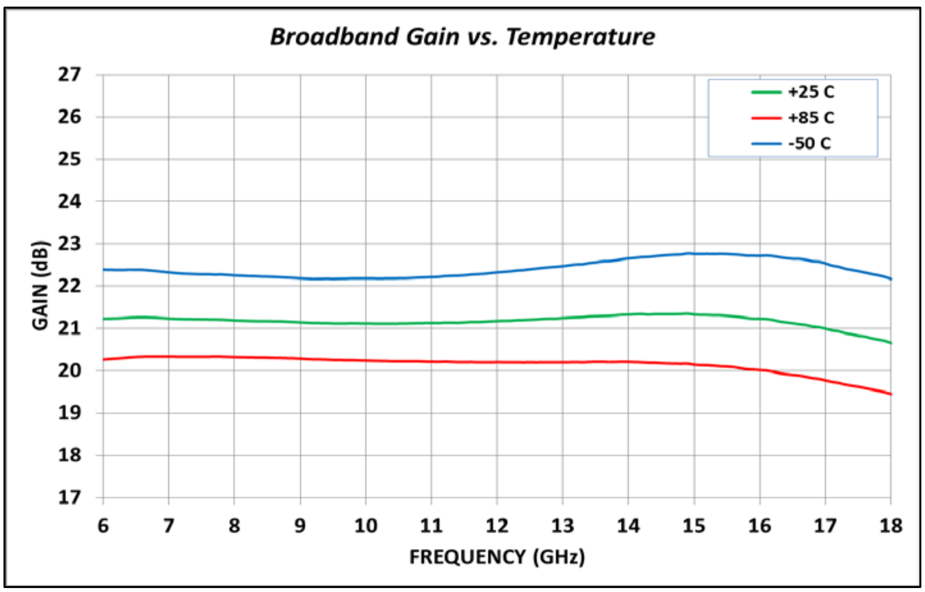


Figure 10 Input Return Loss vs. Temperature

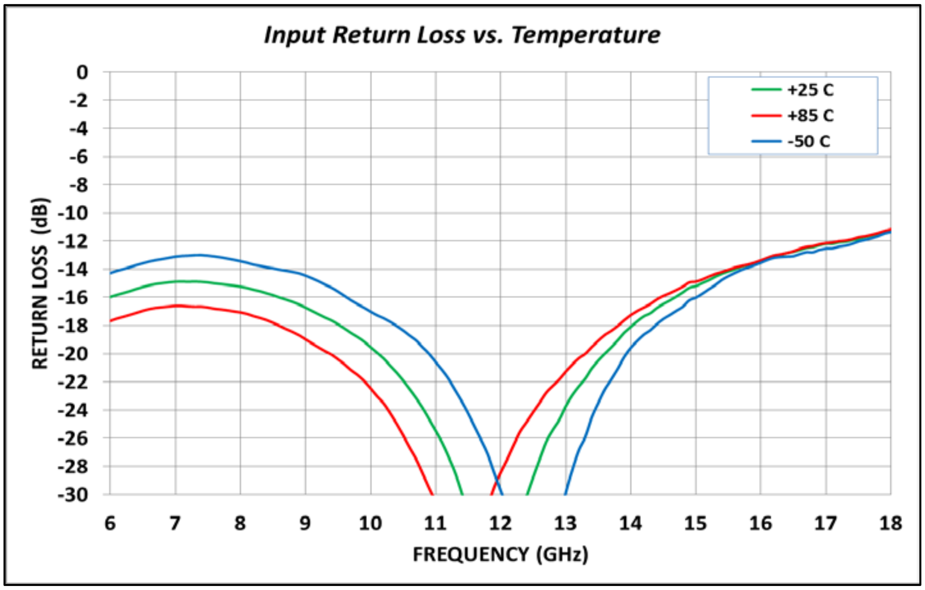


Figure 11 Output Return Loss vs. Temperature

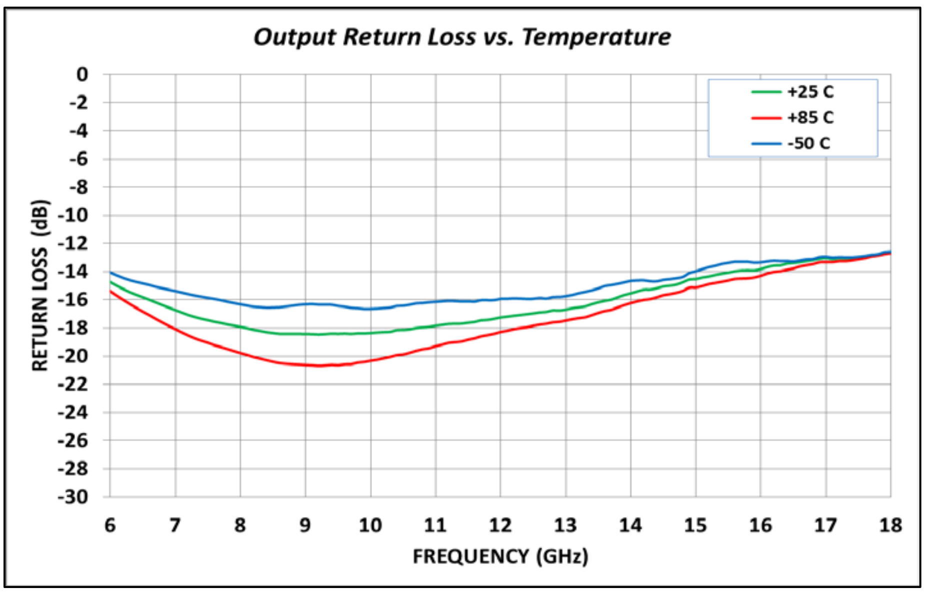


Figure 12 Noise Figure vs. Temperature

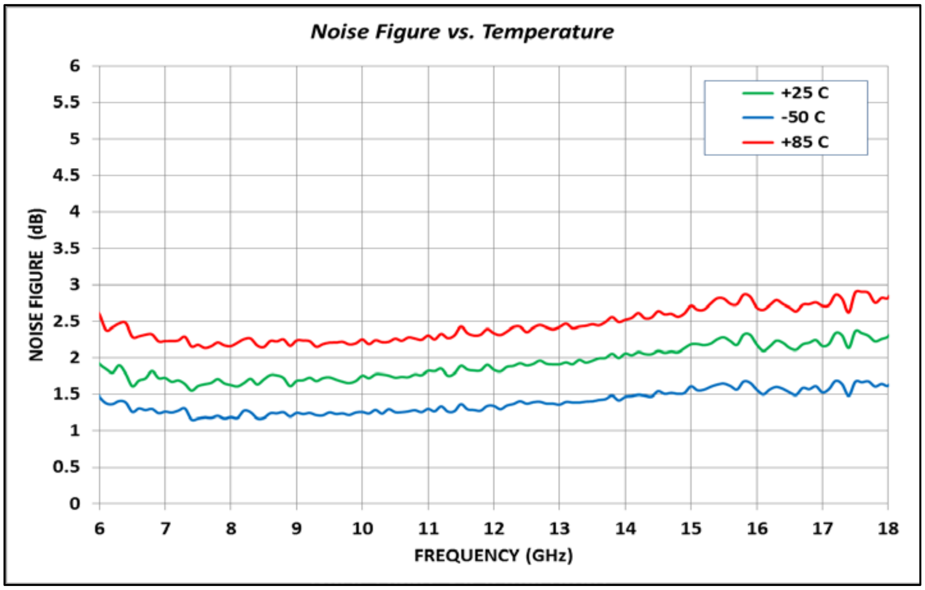


Figure 13 P1dB vs. Temperature

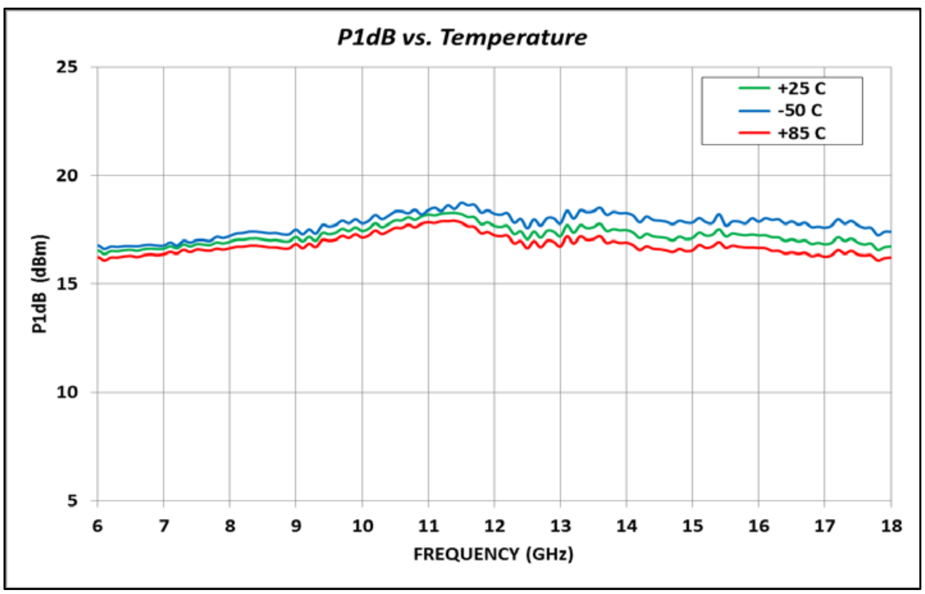
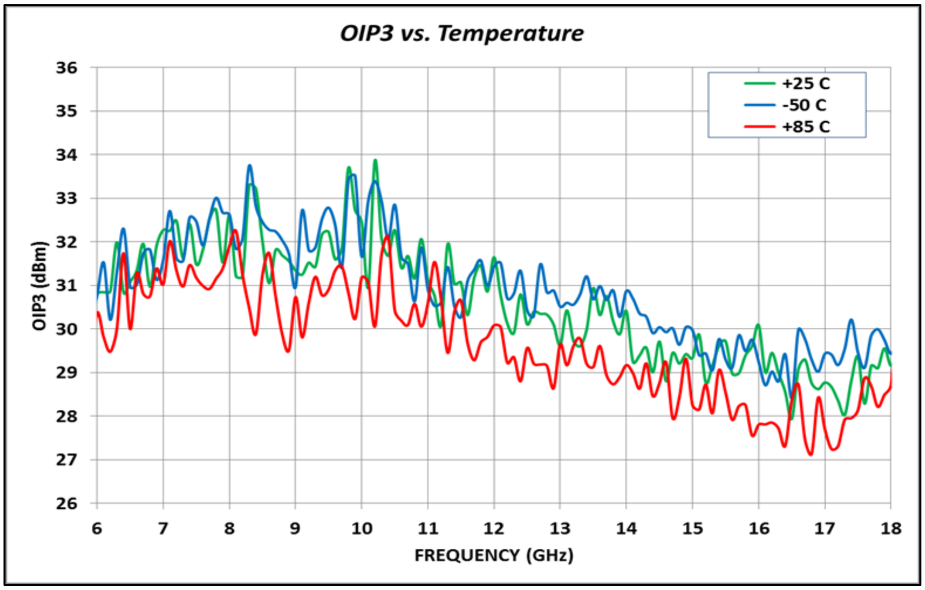


Figure 14 Output IP3 vs. Temperature

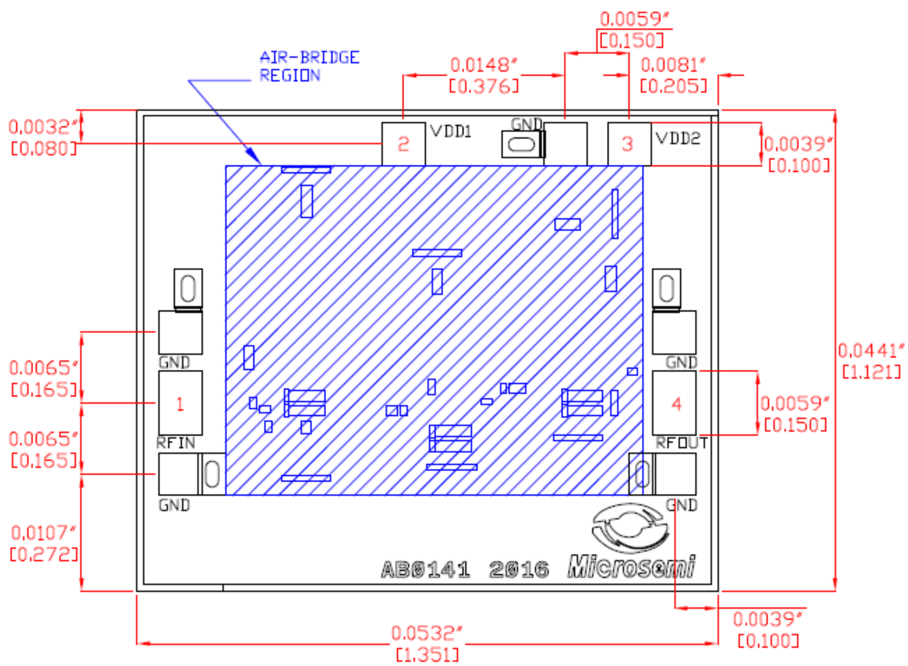


4 Chip Outline Drawing, Die Packaging, Bond Pad, and Assembly Information

4.1 Chip Outline Drawing

The following illustration shows the chip outline of the MMA044AA 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 15 Chip Outline



4.2 Die Packaging Information

The following table shows the chip outline of the MMA044AA 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 of the MMA044AA device.

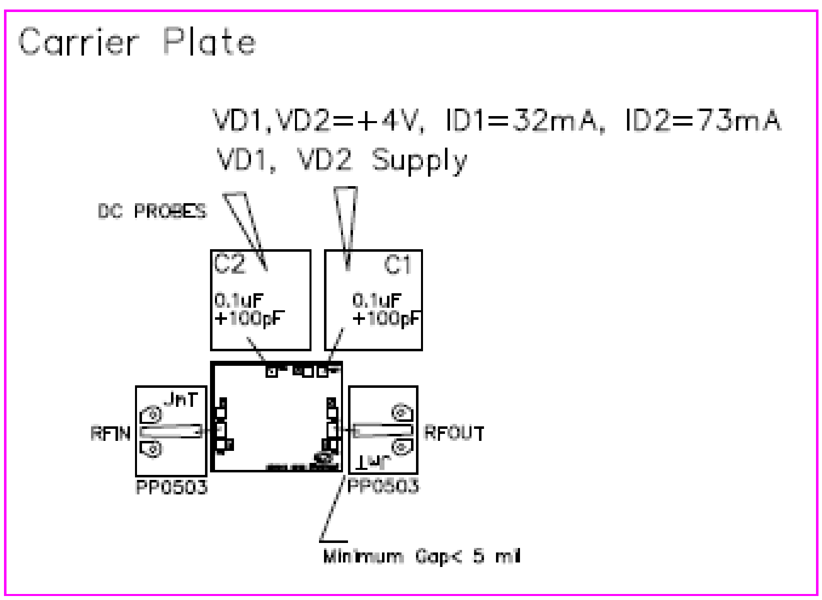
Table 4 Bond Pad Information

Bond Pad Number	Bond Pad Name	Description
1	RFIN	This pad is AC-coupled and matched to 50 Ω.
2, 3	Vdd1, Vdd2	Drain supply voltage for the amplifier. See Assembly Diagram for required external components.
4	RFOUT	This 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 MMA044AA 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

Figure 16 Assembly Diagram



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

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

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 MMA044AA device.

Table 5 Ordering Information

Part Number	Package
MMA044AA	Die