MMA016AA Datasheet

DC–16 GHz Power-Selectable Wideband 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 MMA016AA device is a gallium arsenide (GaAs) monolithic microwave integrated circuit (MMIC) power-selectable wideband amplifier die that operates between DC and 16 GHz. The amplifier provides a gain of 13 dB to 16 dB and 29 dBm P3dB at the highest power option, while requiring only 80 mA from a 4 V supply. Gain flatness is excellent, varying less than 1.4 dB over the –40 °C to 85 °C temperature range, making the MMA016AA device ideal for electronic warfare (EW), electronic countermeasures (ECM), radar, and test equipment applications. The MMA016AA amplifier I/Os are internally matched to 50 Ω, facilitating easy integration into multi-chip modules (MCMs). The MMA016AA device is available as a highly compact 0.5 mm^2 die.

2.1 Applications

The MMA016AA device is designed for the following applications:

- Test instrumentation
- Electronic warfare
- Microwave communications
- Radar

2.2 Key Features

The following are key features of the MMA016AA device:

- Power-selectable from 7 dbm to 19 dBm P1dB and from 16 dBm to 21 dBm P3dB by choosing bond option
- Gain of 13 dB–16 dB and approximately 29 dBm OIP3 at the highest power option
- Gain varies <1.4 dB from –40 °C to 85 °C
- Self-biased with single positive supply
- Input and output matched to 50 Ω
- 0.76 mm × 0.66 mm × 0.1 mm die size

3 Electrical Specifications

3.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the MMA016AA device. The bare die is non-hermetic. It is recommended to use the die in an environmentally sealed package.

Table 1 Absolute Maximum Ratings

Parameter	Value	Units
Drain voltage (V_{DD})	4.5	V
Input power (P_{IN})	19	dBm
Operating channel temperature	175[1]	°C
Operating ambient temperature (T_A)	–55 to 85	°C
Storage temperature	–65 to 150	°C
Thermal resistance, Channel to die backside	175	°C/W

1. MTTF is approximately 10^7 hours at $T_{CHANNEL}$ = 175 °C. The device is intended to small-signal applications only.

3.2 Electrical Characteristics

The following table shows the RF specifications of the MMA016AA device at 25 °C, where V_{DD} = 4 V (the device is intended for small-signal applications only).

Table 2 RF Specifications (CW, Typical Device, RF Probe)

Bond Option	ID	Gain	P1dB	OIP3
None	80	14.5	19	29
R1 to ground	45	12.5	15	25
R2 to ground	32	11.5	12	22
R3 to ground	24	10.5	8	18

The following table shows the specifications (CW, 100% test) of the MMA016AA device at 25 °C, where V_{DD} = 4 V.

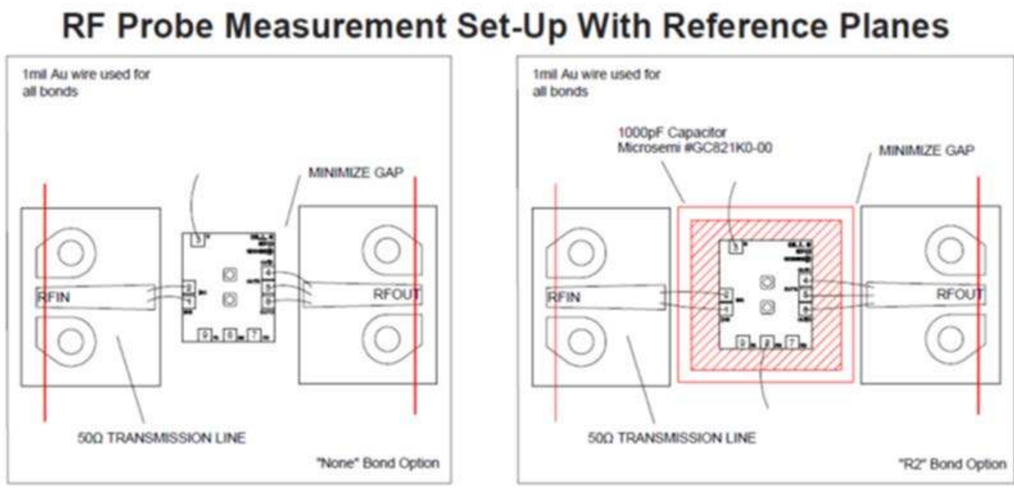
Table 3 Specifications (CW, 100%)

Parameter	Min	Typ	Max	Units
I_{DD}, bond option = “none”	45	80	115	mA

3.3 RF Probe Measurement Set-Up with Reference Planes

The following diagram shows how to set up the RF probe measurement using reference planes. The reference planes are the same for S-parameter files, which are available for download at www.microsemi.com/mmics.

Figure 1 RF Probe Measurement



To use the "none" bonding option, attach the die directly to the baseplate.

To use the "R1", "R2" or "R3" bonding options, mount the die on top of a capacitor to float the source and bond the appropriate pad to ground.

3.4 Typical Performance, RF Probe (No Bond Option)

The following graphs show the typical performance of the MMA016AA device at 25 °C, where V_{DD} = 4 V, I_{DD} = 80 mA, and the bond option is “none,” unless otherwise specified.

Figure 2 S_{11} and S_{22} over V_{DD} and Temperature

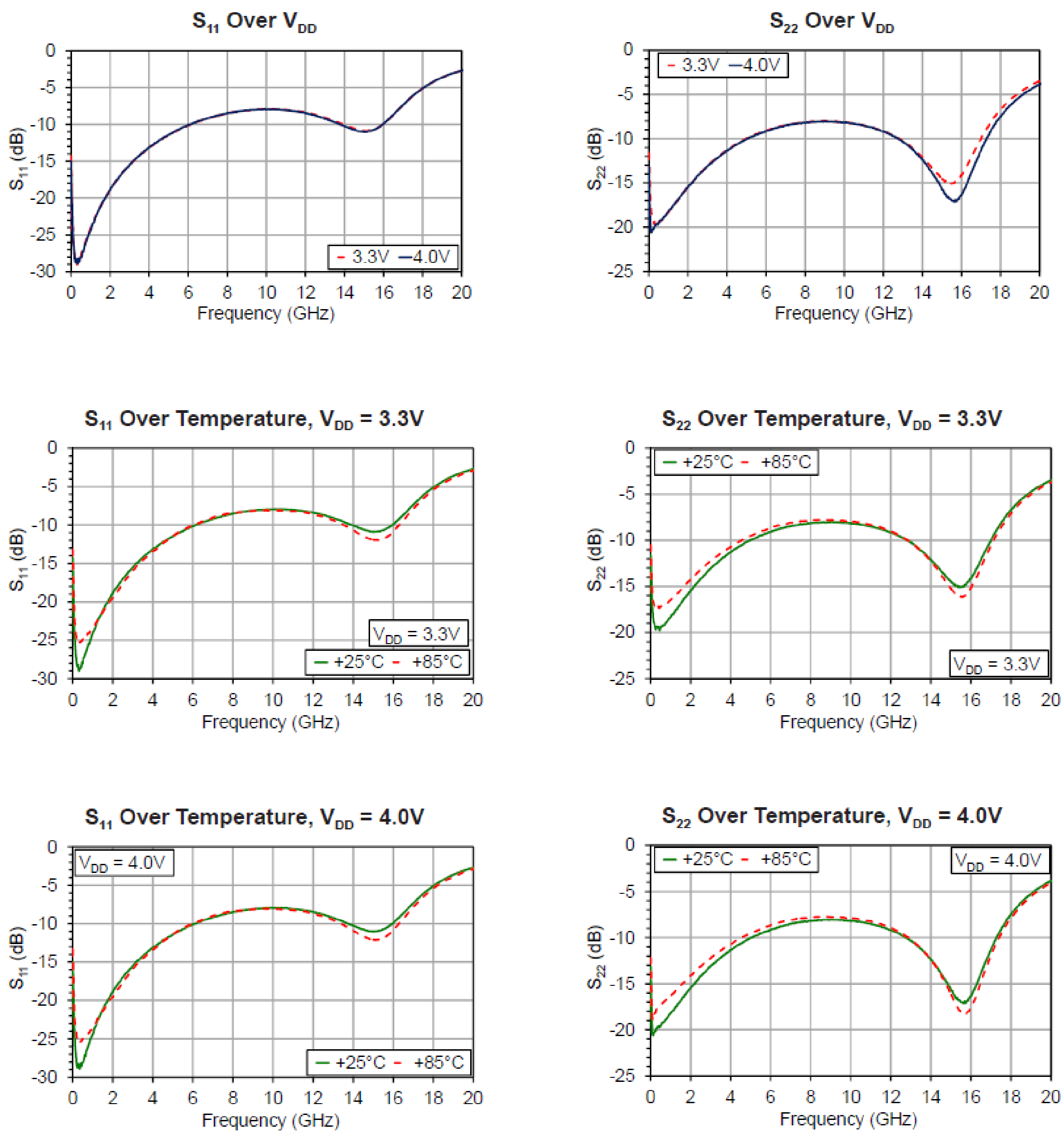


Figure 3 S_{21} and NF over V_{DD} and Temperature

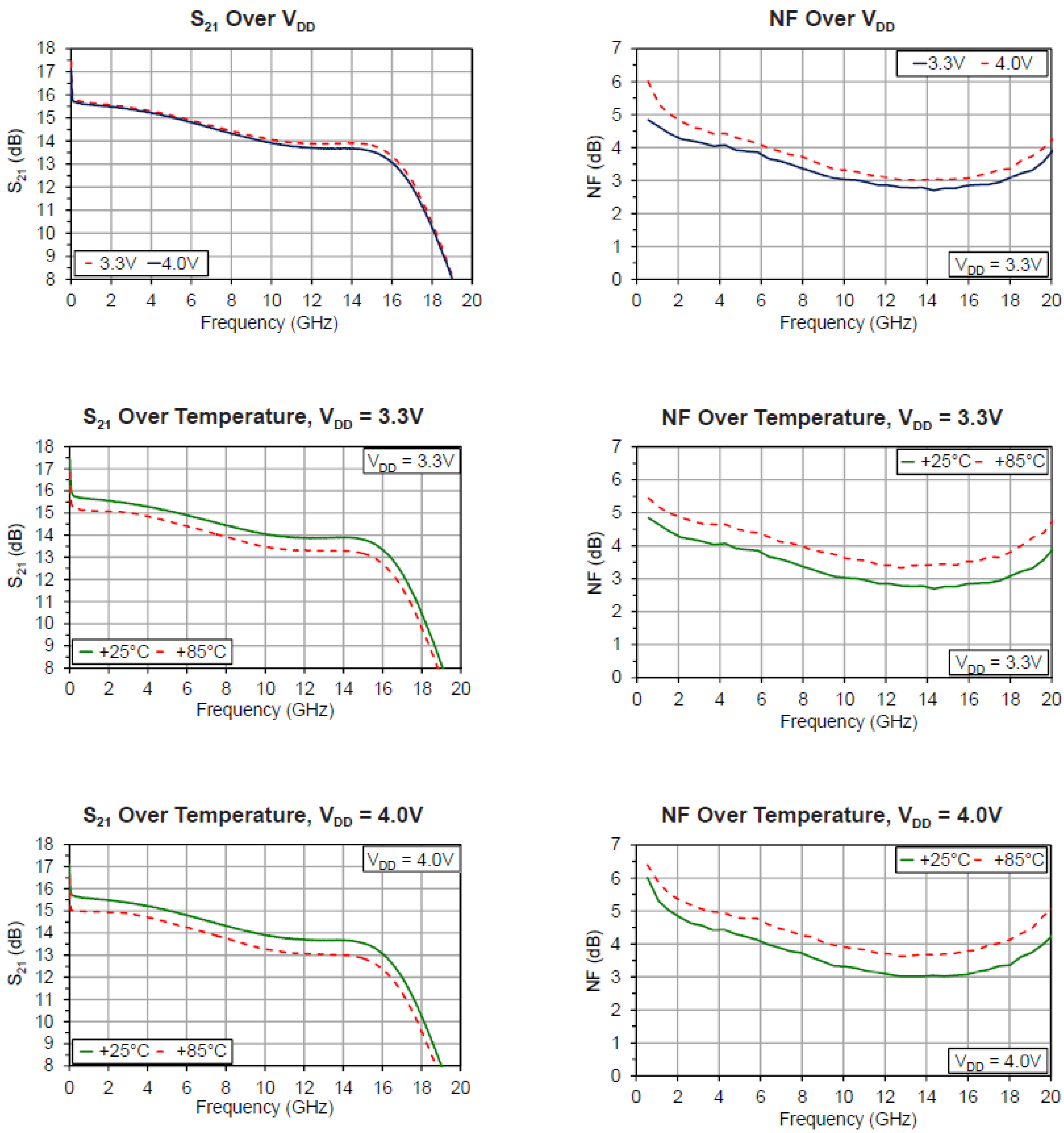


Figure 4 P_{1dB}/P_{3dB}, OIP3, and Power Sweep

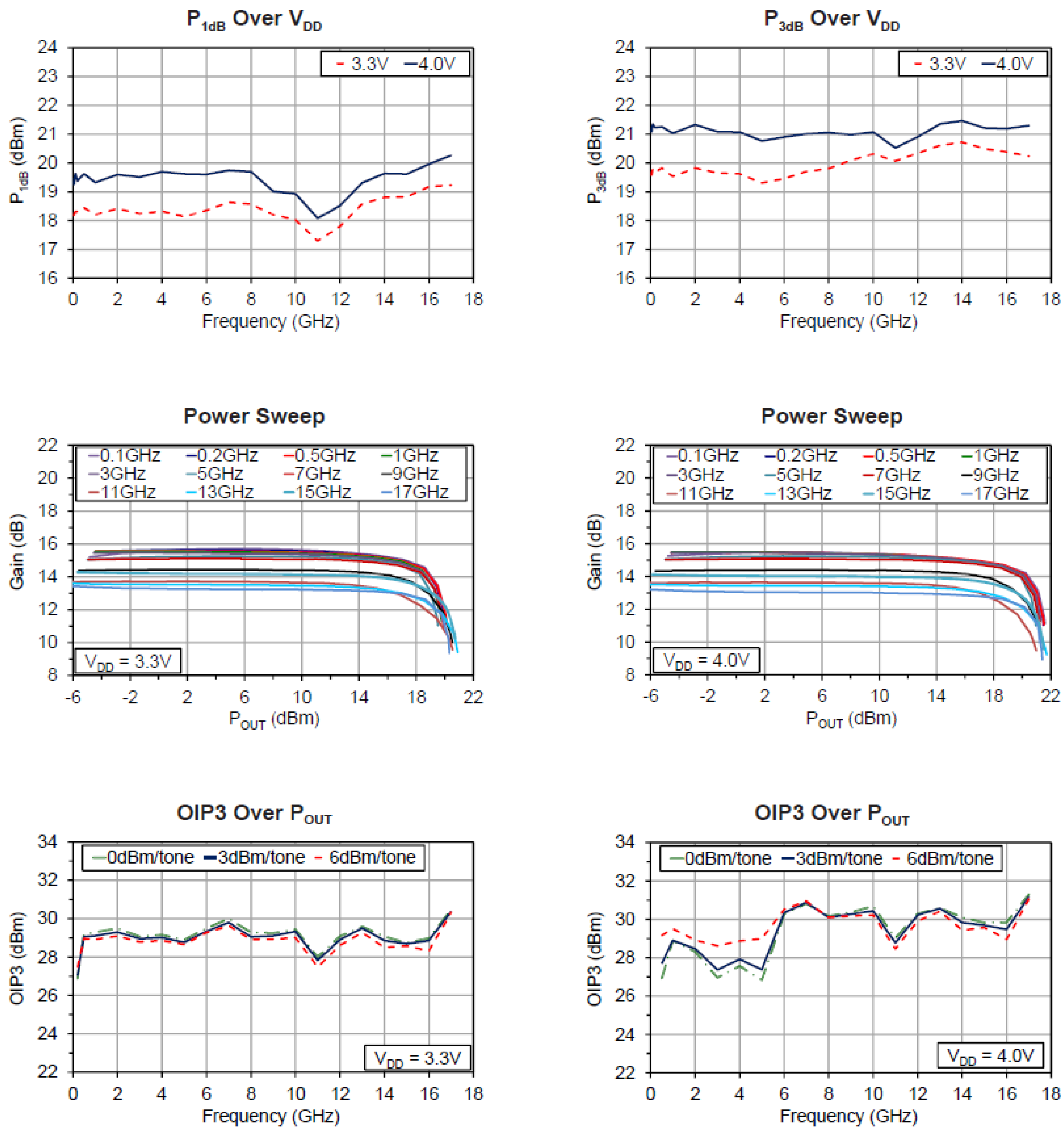
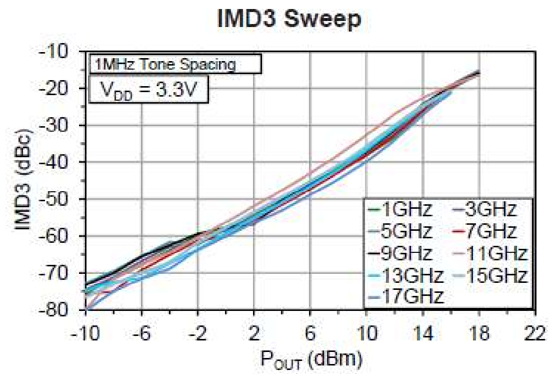
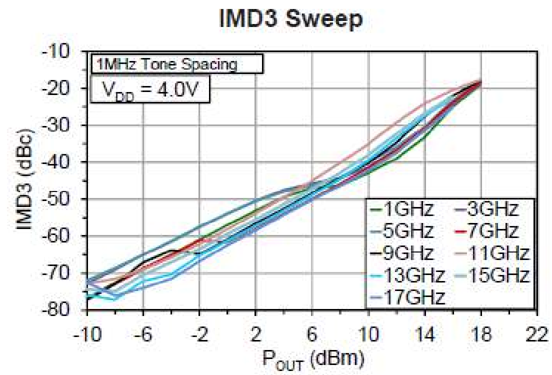


Figure 5 Power Sweep and IMD3 Sweep

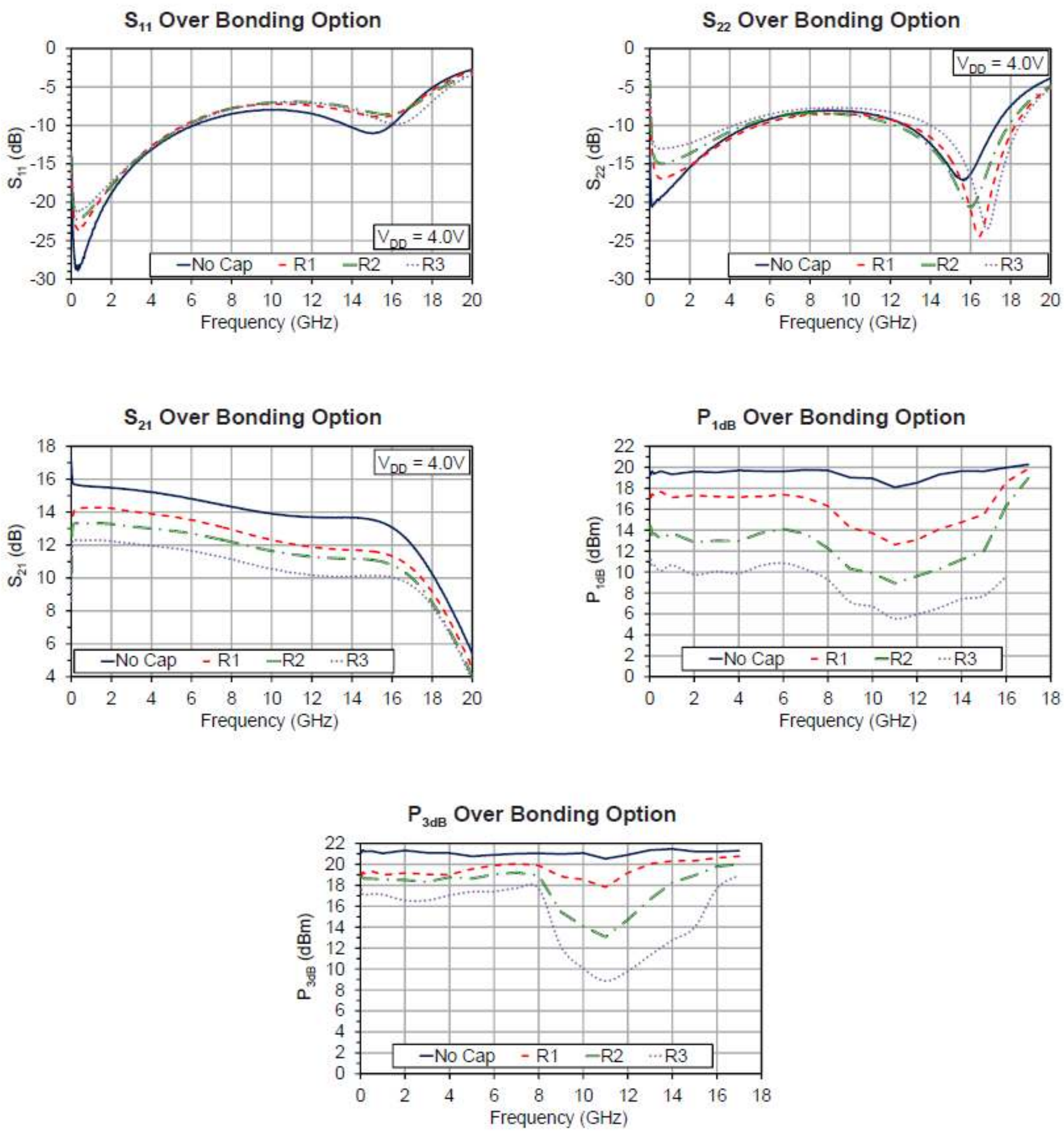




3.5 Typical Performance, RF Probe (Bond Option)

The following graphs show the typical performance of the MMA016AA device at 25 °C, where V_{DD} = 4 V, I_{DD} = 80 mA, and performance is over the bond option.

Figure 6 Bonding Option

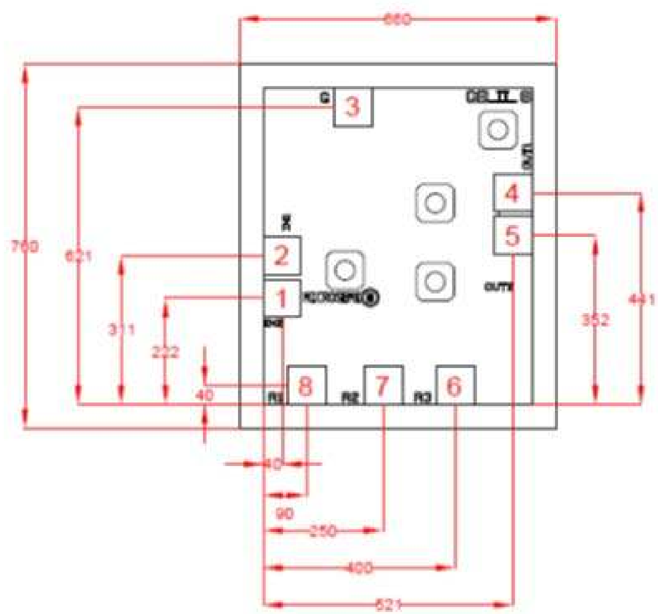


4 Chip Layout and Pad Descriptions

4.1 Chip Layout and Pad Locations

The following illustration shows the chip layout and pad locations of the MMA016AA device. All dimensions are in µm. The die thickness is 100 µm. The backside metal and the bond pad metal are gold. Refer to AN01 GaAs MMIC Handling and Die Attach Recommendations for more information.

Figure 7 Chip Layout and Pad Locations



4.2 Pad Descriptions

The following table shows the pad descriptions for the MMA016AA device. The MMA016AA is a self-biased device with a single positive supply. Apply V_{DD} to RF_{OUT}.

Table 4 Pad Descriptions

Pad	Description	Pad Dimensions (µm)
1, 2	RF_{IN}, DC coupled	75 × 75
3	Grounded	75 × 75
4, 5	RF_{OUT}, DC coupled	75 × 75
6	R3 bond option	75 × 75
7	R2 bond option	75 × 75
8	R1 bond option	75 × 75
Die backside	See RF Probe Measurement Set-Up with Reference Planes	

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

6 Ordering Information

The following table shows the ordering information for the MMA016AA device.

Table 5 Ordering Information

Part Number	Package
MMA016AA	Die