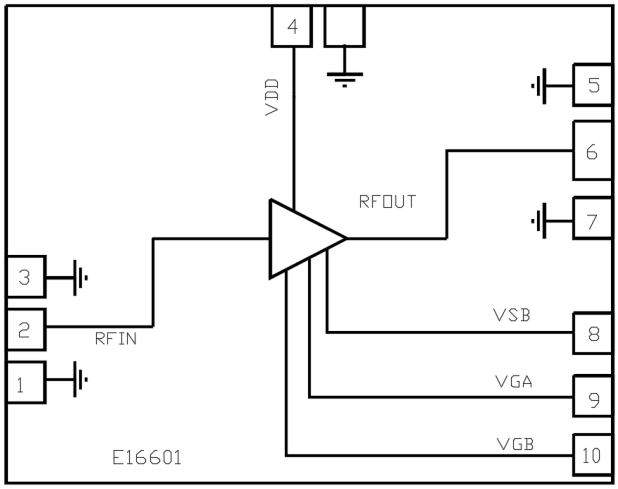
MMA042AA 2 GHz-26 GHz GaAs MMIC Distributed Self Biased Low-Noise Amplifier

1 Product Overview

MMA042AA is a gallium arsenide (GaAs) monolithic microwave integrated circuit (MMIC) pseudomorphic high-electron mobility transistor (pHEMT) distributed amplifier die that operates between 2 GHz and 26 GHz. It is ideal for test instrumentation, defense, and space applications. The amplifier provides a 2 dB positive gain slope with a typical gain of 18 dB, 2 dB noise figure, 19 dBm of output power at 1 dB gain compression, and 29 dBm output IP3 at 10 GHz. The MMA042AA amplifier features RF I/Os that are internally matched to 50 Ω, which allows for easy integration into multi-chip modules (MCMs).

The following illustration shows the functional block diagram for the MMA042AA device.

Figure 1 • MMA042AA Functional Block Diagram



1.1 Applications

The MMA042AA device is designed for the following applications:

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

1.2 Key Features

The following are key features of the MMA042AA device:

- Frequency range: 2 GHz to 26 GHz
- High gain: 18 dB (at 10 GHz) with 2 dB upslope
- High-output IP3: 29 dBm at 10 GHz
- Low-noise figure: 2 dB at 10 GHz
- Supply voltage: 6 V at 120 mA
- 50 Ω matched I/O

- Compact die size: 2.02 mm × 1.47 mm × 0.1 mm

2 Electrical Specifications

This section details the electrical specifications for the MMA042AA device.

2.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the MMA042AA device at 25 °C unless otherwise specified. Exceeding one or any of the maximum ratings potentially could cause damage or latent defects to the 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_D)	8 V
First-gate bias voltage (V_{G1})	–1 V to 0.5 V
V_D current (I_{DD})	200 mA
RF input power	19 dBm
DC power dissipation (T= 85 °C)	1.6 W
Channel temperature	150 °C
Thermal impedance	17 °C/W

2.2 Typical Electrical Performance

The following table lists the typical electrical performance of the MMA042AA device at 25 °C, where V_{DD} is 6 V and I_{DD} is 120 mA.

Table 2 • Typical Electrical Performance

Parameter	Frequency Range	Min	Typ	Max	Units
Operational frequency range		2		26	GHz
Gain	3 GHz–8 GHz	16	18		dB
	8 GHz–15 GHz	17	18.5		dB
	15 GHz–26 GHz	18	20		dB
Gain flatness *0.1 dB/GHz upslope subtracted	3 GHz–8 GHz		±0.5		dB
	15 GHz–26 GHz		±0.5		dB
Noise figure	3 GHz–8 GHz		2.5	3.5	dB
	8 GHz–15 GHz		2	2.5	dB
	15 GHz–26 GHz		3.5	6	dB
Input return loss	3 GHz–8 GHz		12		dB
	8 GHz–15 GHz		12		dB
	15 GHz–26 GHz		10		dB
Output return loss	3 GHz–8 GHz		10		dB
	8 GHz–15 GHz		10		dB
	15 GHz–26 GHz		10		dB

Parameter	Frequency Range	Min	Typ	Max	Units
P1dB	3 GHz–8 GHz	18	20		dBm
	8 GHz–15 GHz	18	20		dBm
	15 GHz–26 GHz	16	18		dBm
OIP3	3 GHz–8 GHz		30		dBm
	8 GHz–15 GHz		30		dBm
	15 GHz–26 GHz		28		dBm
V_{DD} (drain voltage supply)			6		V
I_{DD} (drain current)			120		mA

2.3 Typical Performance Curves

The following graphs show the typical performance curves of the MMA042AA device at 25 °C, unless otherwise indicated.

Figure 2 • Gain vs. Temp. (VDD = 6 V, IDD = 120 mA)

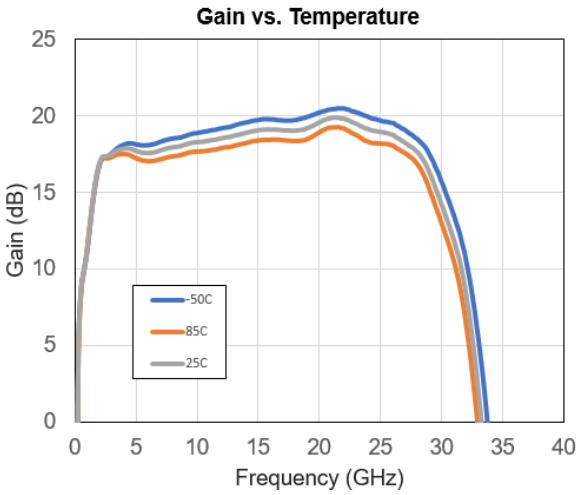


Figure 3 • Gain vs. Drain Voltage (VDD = 6 V, IDD = 120 mA)

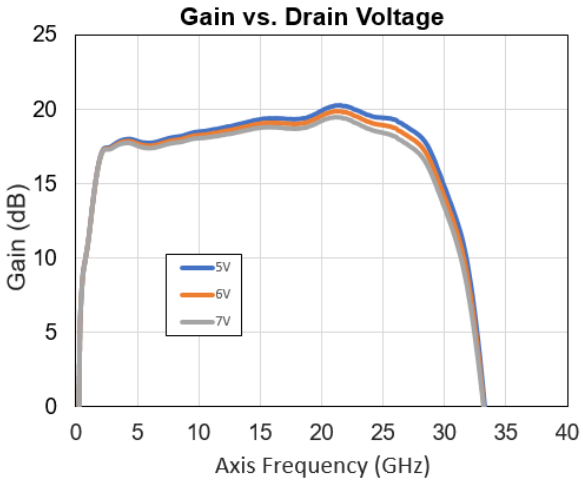


Figure 4 • Gain vs. Drain Current (IDD = 120 mA, T = 25 C)

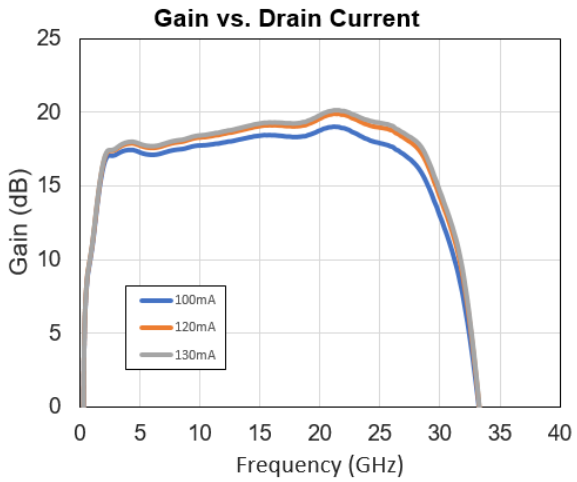


Figure 5 • S11 vs. Temp. (VDD = 6 V, IDD = 120 mA)

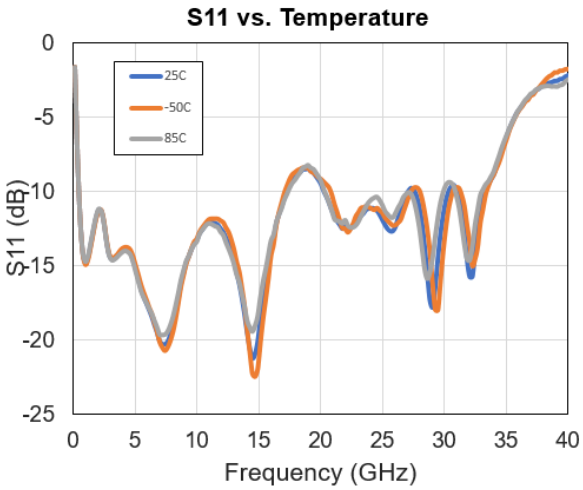


Figure 6 • S22 vs. Temp. (VDD = 6 V, IDD = 120 mA)

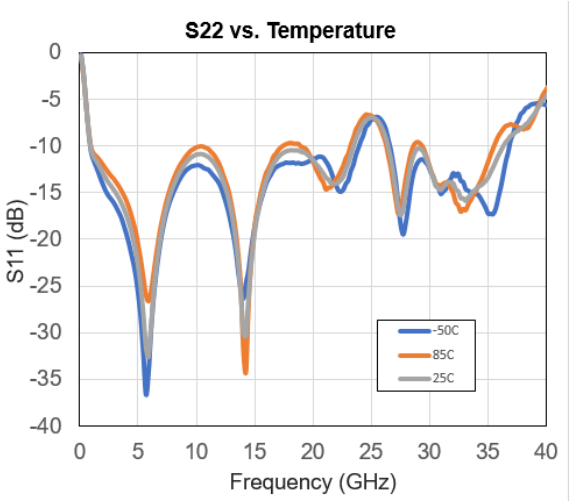


Figure 7 • S12 vs. Temp. (VDD = 6 V, IDD = 120 mA)

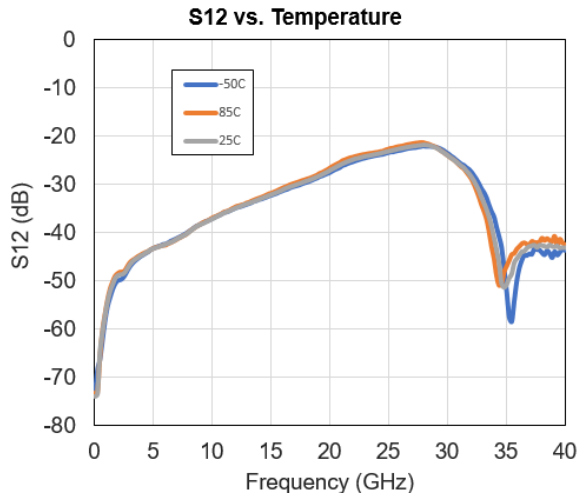


Figure 8 • NF vs. Temperature (VDD = 6 V, IDD = 120 mA)

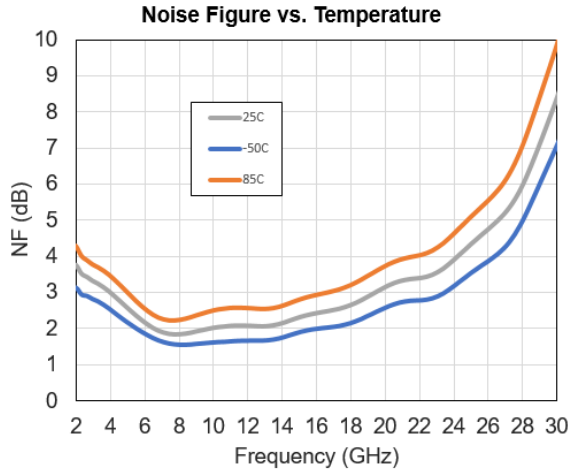


Figure 9 • NF vs. Drain Voltage (IDD = 120 mA, T = 25 C)

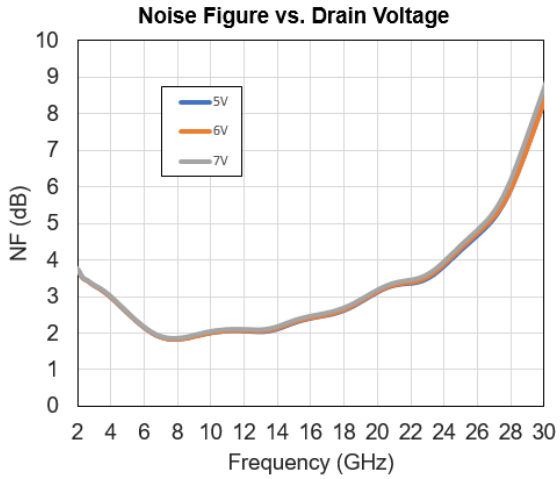


Figure 10 • NF vs. Drain Current (VDD = 6 V, IDD = 120 mA)

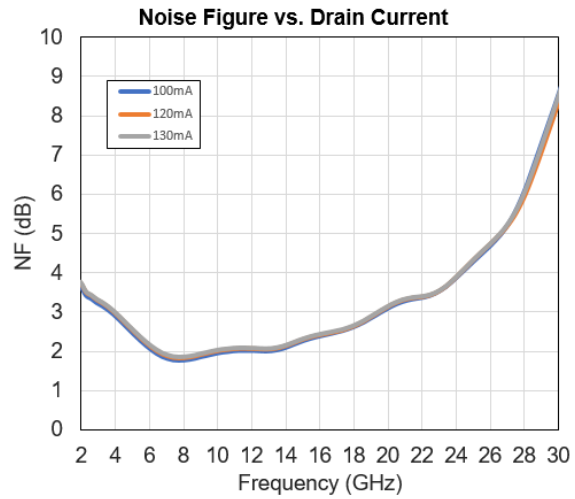


Figure 11 • P1dB vs. Temperature

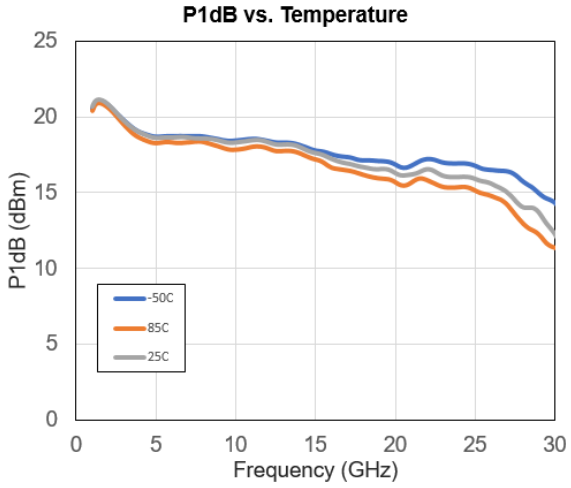


Figure 12 • P3dB vs. Temp. (VDD = 6 V, IDD = 120 mA)

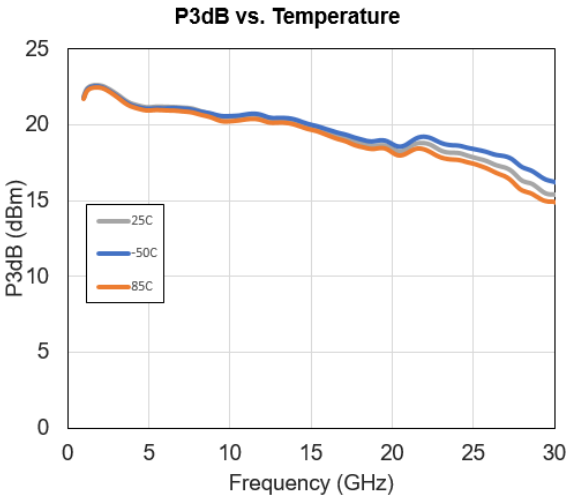


Figure 13 • P1dB vs. VDD (IDD = 120 mA, T = 25 C)

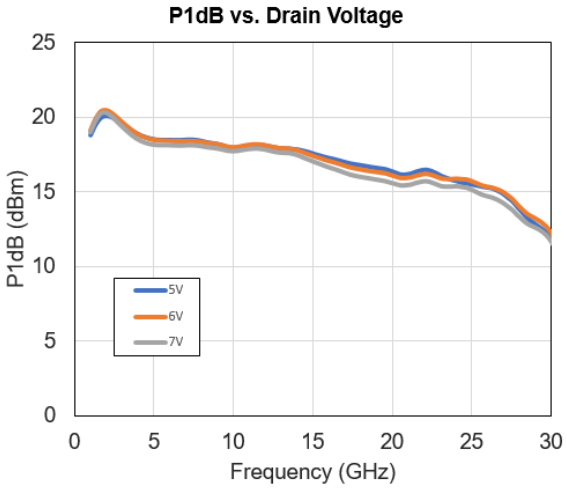


Figure 14 • P1dB vs. Drain Current

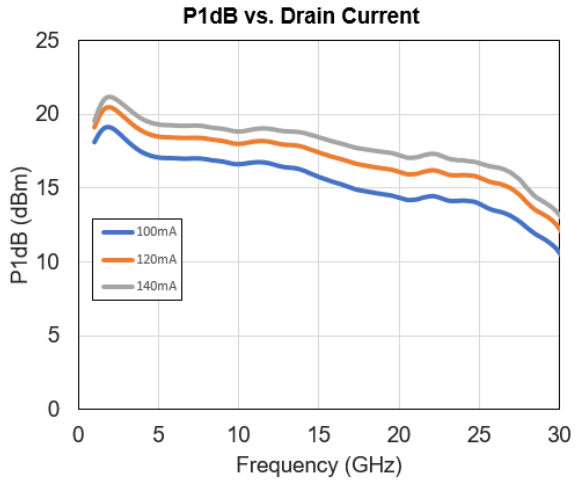


Figure 15 • OIP3 vs. Temperature

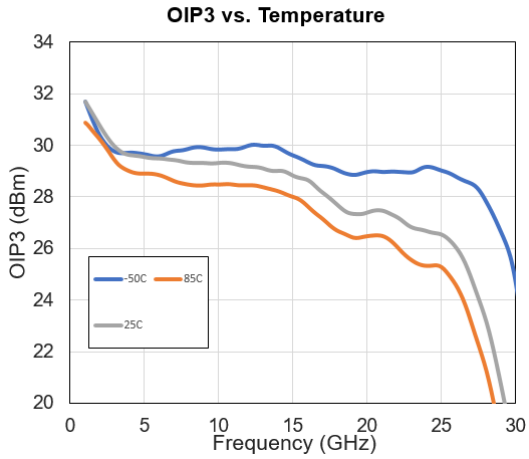


Figure 16 • OIP3 vs. VDD

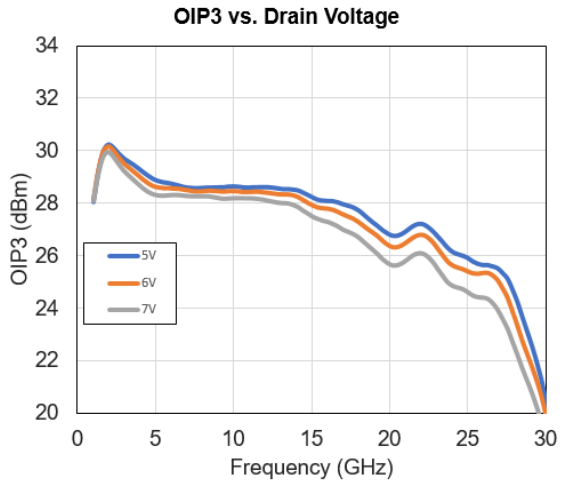


Figure 17 • OIP3 vs. Drain Current

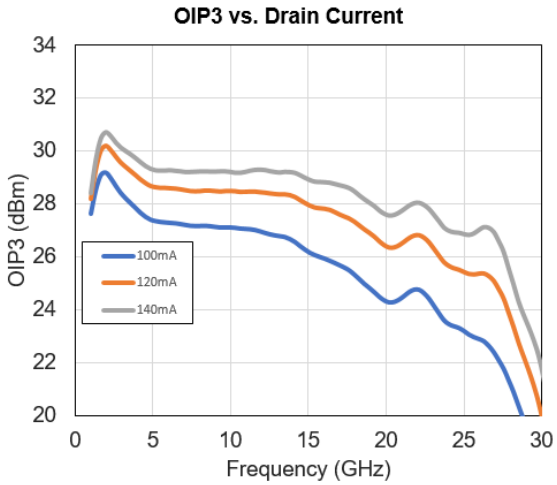
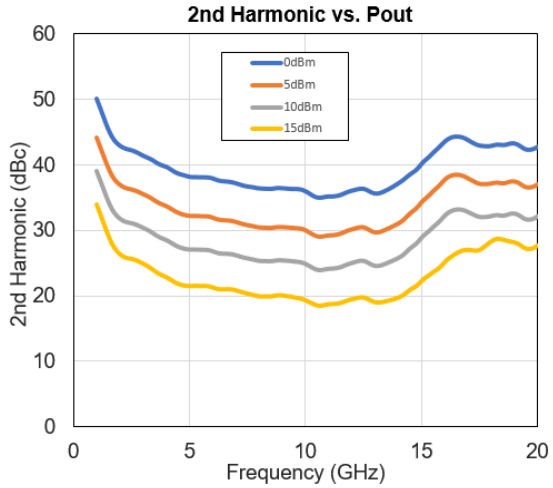


Figure 18 • 2nd Harmonic vs. Pout (VDD = 6 V, IDD = 120 mA, T = 25 C)

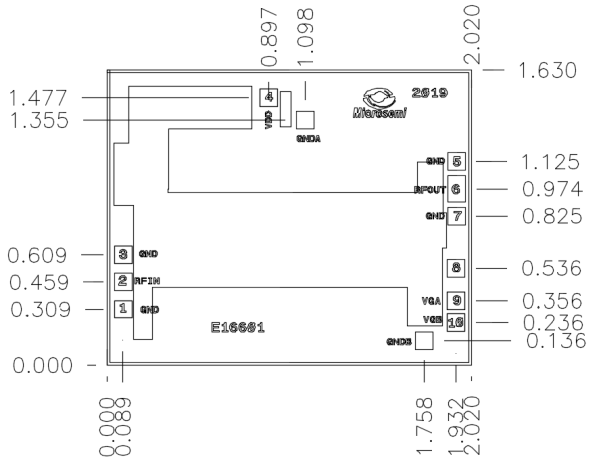


3 Chip Outline Drawing, Die Packaging, Bond Pad, and Assembly Information

This section shows the chip outline drawing, die packaging, bond pad, and assembly information for the MMA042AA device.

3.1 Chip Outline Drawing

The following illustration shows the chip outline drawing for the MMA042AA device.



3.2 Die Package Information

The following table lists the die package information for the MMA042AA device. For additional packaging information, contact your Microsemi sales representative.

Table 3 • Die Package Information

Standard Format
Gel pack
50 pieces per pack

3.3 Bond Pad Information

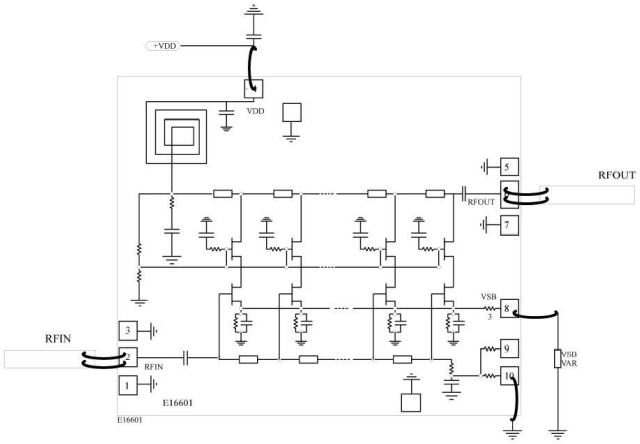
The following table shows the bond pad information for the MMA042AA device.

Table 4 • Bond Pad

Pad Number	Pad Name	Pad Description
2	RFIN	Matched to 50 Ω
6	RFOUT	Matched to 50 Ω
4	V_{DD}	V_{DD} supply
8	V_{SB}	Used to change I_{DD}. See table 5.
9, 10	V_{GA}, V_{GB}	Access to gate 1. Connect one to ground.
1, 3, 5, 7	GND	RF/DC ground
Backside paddle	RF/DC GND	Die bottom must be connected to RF/DC ground

The following illustration shows the functional schematic for the MMA042AA device.

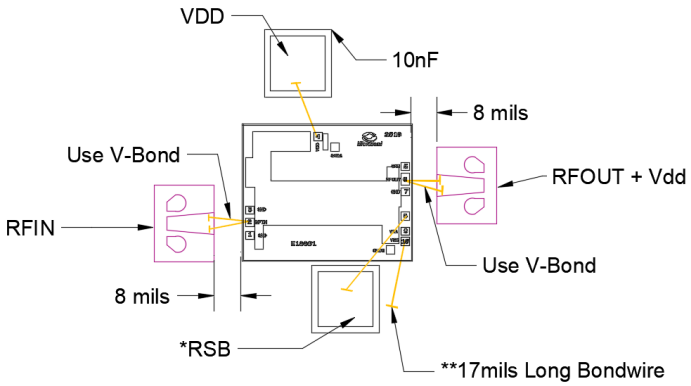
Figure 19 • Functional Schematic



3.4 Assembly Diagram

The following illustration shows the assembly diagram for the MMA042AA device.

Figure 20 • Application Circuit



The pad labeled VSB, pad 10, is connected internally to the drain so that the drain current can be changed by shunting different resistors externally. The average drain current values are listed below in table 5.

*Rsb is the resistor installed between Vsb termination and the ground.

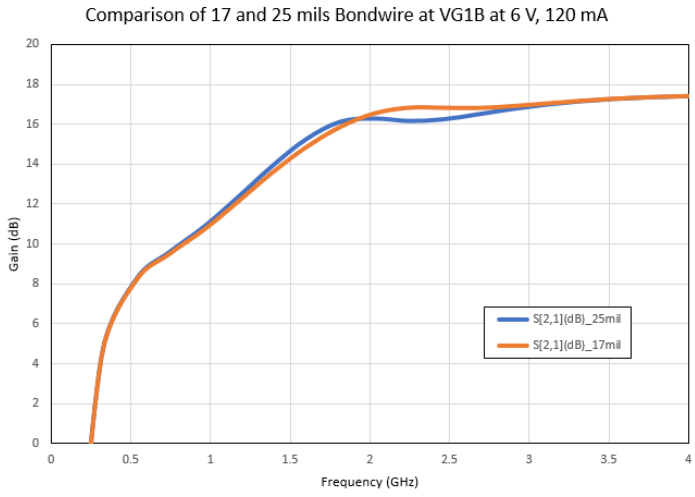
**17mil bondwire or greater is to extend the low frequency performance. See the Low-frequency S21 figure below.

Table 5 • RSB Values vs. Drain Current at 6 V

R_{SB} (Ω)	I_{DD} (mA) at 5 V	I_{DD} (mA) at 6 V	IDD (mA) at 7 V
0	130	131	136
1	122	125	129
2	116	120	123
3	112	115	119
4	108	112	116
5	106	109	113
6	103	107	110
7	101	104	108
8	100	103	106
9	98	101	105
10	96	100	103
11	95	98	102
12	94	97	101
13	93	97	100
14	92	96	99
15	92	95	98
16	91	94	97
17	90	94	97
18	90	93	96
19	89	92	96
20	89	92	95

The following figure shows the comparison of 17 mil and 25 mil bondwire at VG1B at 6 V and 120 mA.

Figure 21 • Low-frequency S21



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

5 Ordering Information

The following table lists the ordering information for the MMA042AA device.

Table 6 • Ordering Information

Part Number	Package
MMA042AA	Die

Microsemi Headquarters
One Enterprise, Aliso Viejo,
CA 92656 USA
Within the USA: +1 (800) 713-4113
Outside the USA: +1 (949) 380-6100
Sales: +1 (949) 380-6136
Fax: +1 (949) 215-4996
Email: sales.support@microsemi.com
www.microsemi.com

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