

MMA053PP5 Datasheet

DC–10 GHz 1 W GaAs MMIC pHEMT Distributed Power Amplifier



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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 is the first publication of this document.

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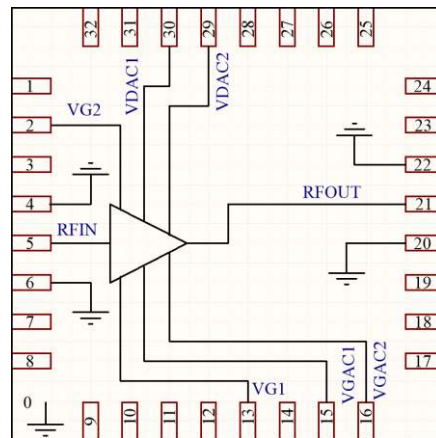
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2 Product Overview

MMA053PP5 is a gallium arsenide (GaAs) monolithic microwave integrated circuit (MMIC) pHEMT distributed power amplifier that operates between DC and 10 GHz. The plastic packaged amplifier provides 17 dB of gain, 43 dBm output IP3, and 32 dBm of output power at 3 dB compression. Gain flatness over the 100 MHz to 10 GHz frequency range varies by only ± 1 dB, making the MMA053PP5 ideal for EW, ECM, radar, and test equipment applications. The MMA053PP5 amplifier features compact plastic SMT package size and I/Os that are internally matched to 50 Ω , which is ideal for any surface mount technology (SMT) assembly equipment.

The following figure is a functional block diagram for the MMA053PP5 device.

Figure 1 Functional Block Diagram



2.1 Applications

The MMA053PP5 device is designed for the following applications:

- Military and Space
- Test instrumentation
- Telecom infrastructure
- Microwave radio and VSAT
- Microwave communications

2.2 Key Features

The following are key features of the MMA053PP5 device:

- Frequency range: DC to 10 GHz
- Gain: 17 dB
- NF: 2.8 @ 6GHz
- High P3dB output power: 32 dBm
- High OIP3: 43 dBm
- Bias VDD = 10 V/ 420 mA
- 50 Ω matched I/O
- Package size: 5mm x 5mm, 32L plastic QFN

3 Electrical Specifications

3.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings 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 to 150 °C |
| Operating temperature | –55 to 85 °C |
| Drain bias voltage, (V_{DD}) | 12 V |
| Drain bias current, (I_{DD}) | 500 mA |
| First gate bias voltage, (V_{G1}) | 0 V |
| RF input power | 18 dBm |
| DC power dissipation ($T = 85$ °C) | 6 W |
| Junction Channel temperature | 150 °C |
| Thermal impedance | 14 C/W |

3.2 Typical Electrical Performance

The following table lists the specified electrical performance of the MMA053PP5 device at 25 °C, where V_{DD} is 10 V, I_{DD} is 420mA, and V_{GG} is –0.7 V.

Table 2 Specified Electrical Performance

| Parameter | Frequency Range | Min | Typ | Max | Units |
|--|-----------------|------|------|-----|-------|
| Operational frequency range | | DC | | 10 | GHz |
| Gain | DC-6 GHz | 16 | 17 | | dB |
| | 6-10 GHz | 15 | 16.5 | | dB |
| Noise figure | DC-6 GHz | | 4 | | dB |
| | 6-10 GHz | | 2.8 | 3.5 | dB |
| Input return loss | DC-6 GHz | | 23 | 20 | dB |
| | 6-10 GHz | | 14 | 12 | dB |
| Output return loss | DC-6 GHz | | 16 | 14 | dB |
| | 6-10 GHz | | 14 | 12 | dB |
| P _{1dB} @ 11V, 420mA | DC-6 GHz | 27 | 29 | | dBm |
| | 6-10 GHz | 26.5 | 29 | | dBm |
| P _{3dB} @ 11V, 420mA | DC-6 GHz | 31 | 33 | | dBm |
| | 6-10 GHz | 30.5 | 32 | | dBm |
| OIP ₃ | DC-6 GHz | 42 | 44 | | dBm |
| | 6-10 GHz | 41 | 43 | | dBm |
| V _{DD} (drain voltage supply) | | | 10 | | V |
| I _{DD} (drain current) | | | 420 | | mA |
| V _{GG} (gate voltage supply) | | | -0.7 | | V |

3.3 Typical Performance Curves

The following graphs show the typical performance curves of the MMA053PP5 device at 25 °C, unless otherwise indicated. These measurements were taken on the evaluation board.

Figure 2 Gain vs V_{DD} ($I_{DD} = 420\text{mA}$, $T = 25\text{ }^\circ\text{C}$)

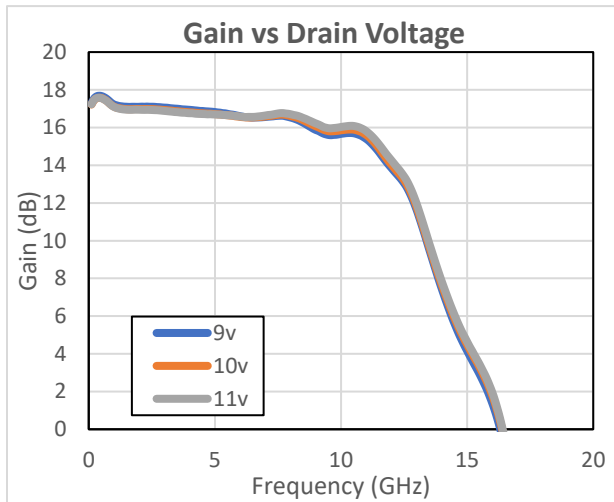


Figure 4 Gain vs Temperature ($V_{DD} = 10\text{ V}$, $I_{DD} = 420\text{mA}$)

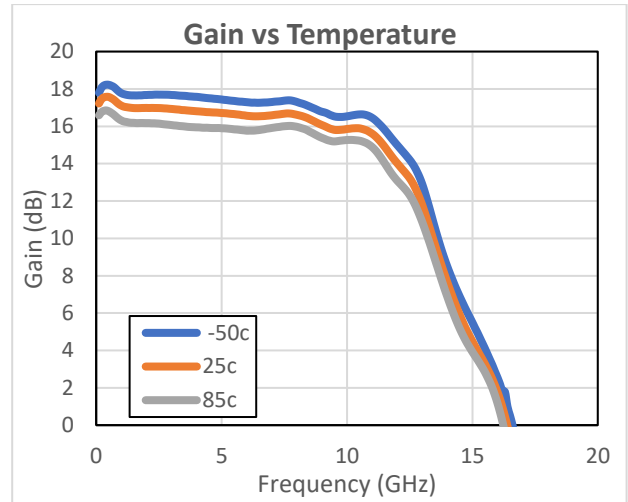


Figure 3 Gain vs I_{DD} ($V_{DD} = 10\text{ V}$, $T = 25\text{ }^\circ\text{C}$)

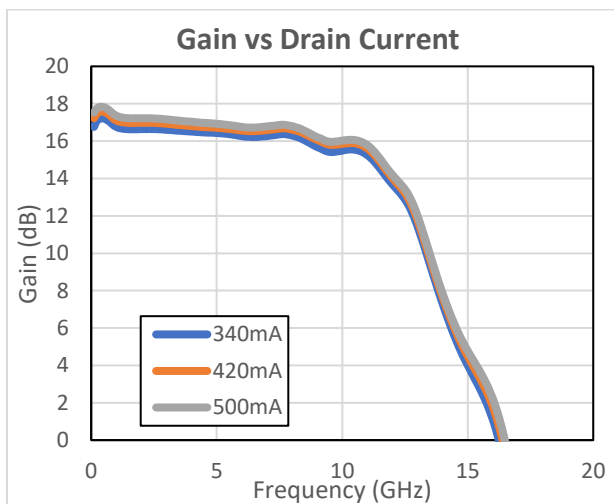


Figure 5 S_{11} vs Temperature ($V_{DD} = 10\text{ V}$, $I_{DD} = 420\text{mA}$)

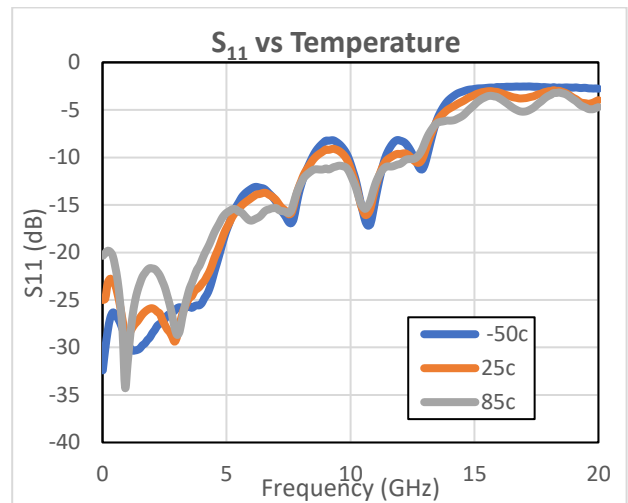


Figure 6 S_{22} vs Temperature ($V_{DD} = 10\text{ V}$, $I_{DD} = 420\text{mA}$)

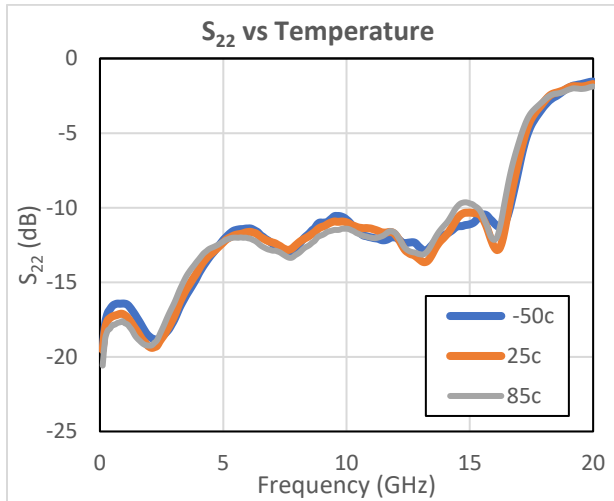


Figure 9 P1dB vs Temperature ($V_{DD} = 10\text{ V}$, $I_{DD} = 420\text{mA}$)

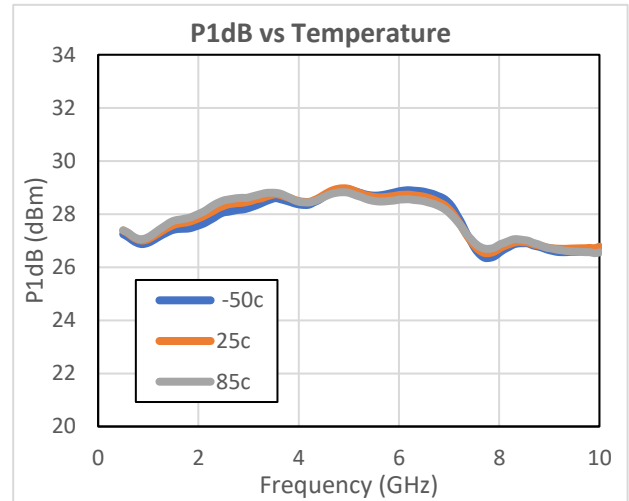


Figure 7 Noise Figure vs Temperature ($V_{DD}=10\text{ V}$, $I_{DD}=420\text{mA}$)

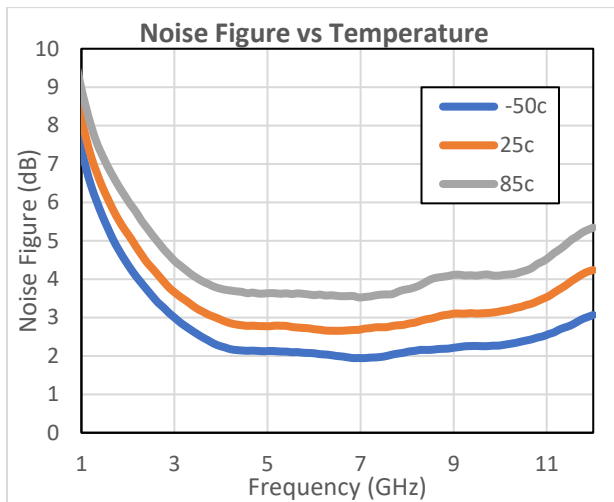


Figure 10 P1dB vs V_{DD} ($I_{DD} = 420\text{mA}$, $T = 25\text{ }^\circ\text{C}$)

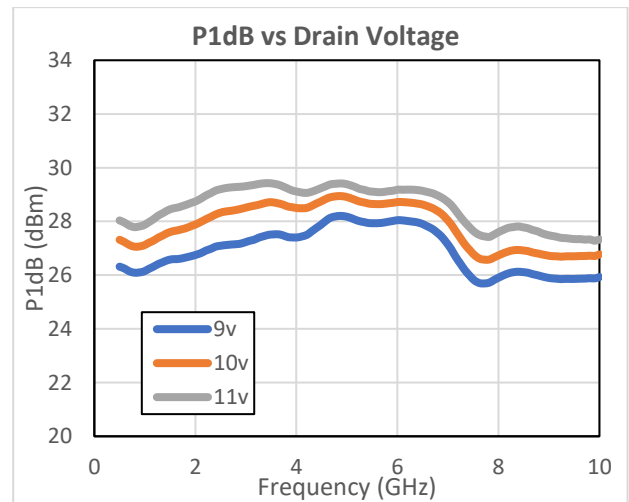


Figure 8 Noise Figure vs I_{DD} ($I_{DD} = 420\text{mA}$, $T = 25\text{ }^\circ\text{C}$)

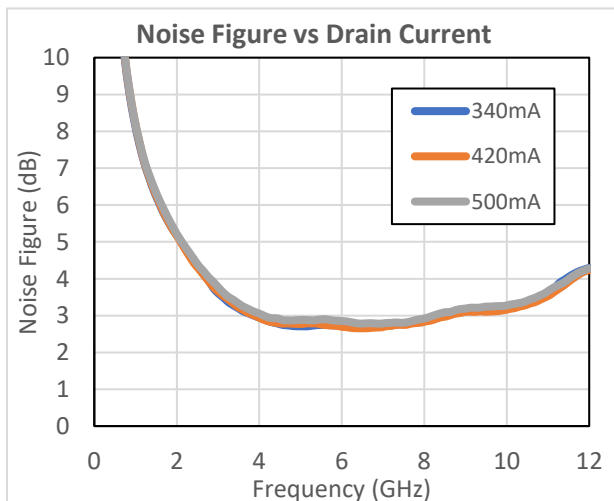


Figure 11 P3dB vs Temperature ($V_{DD} = 10\text{ V}$, $I_{DD} = 420\text{mA}$)

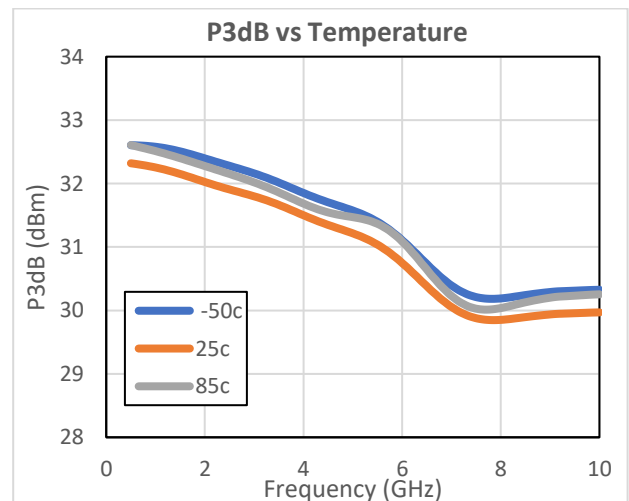


Figure 12 P3dB vs V_{DD} (I_{DD} = 420mA, T = 25 °C)

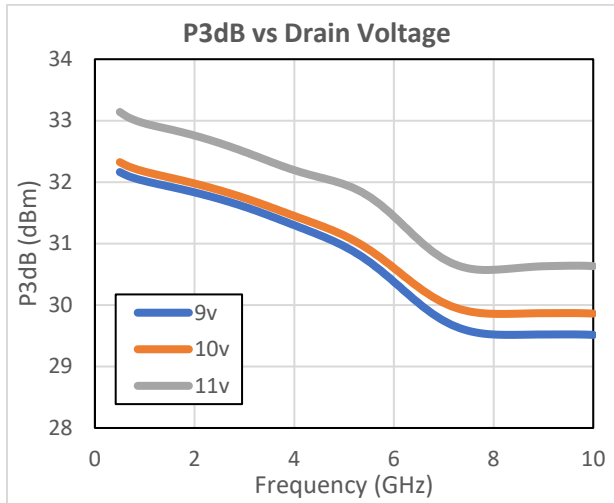


Figure 14 OIP3 vs I_{DD} (V_{DD} = 10 V, T = 25 °C)

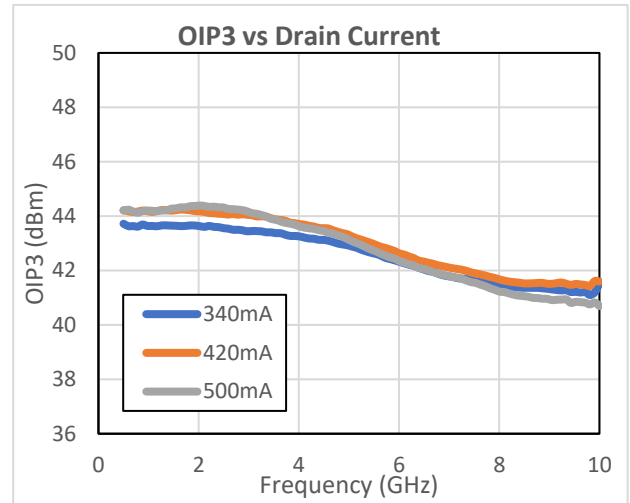


Figure 13 OIP3 vs Temperature (V_{DD} = 10 V, I_{DD} = 420mA, Output Power = 10dBm)

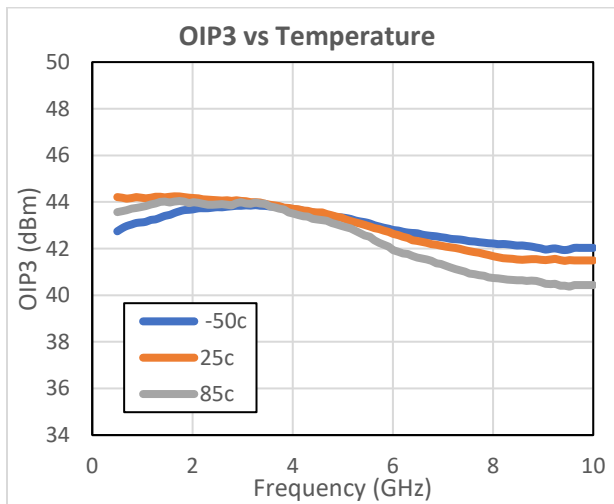


Figure 15 IM3 vs Output Power (V_{DD} = 10 V, I_{DD} = 420mA, T = 25 °C)

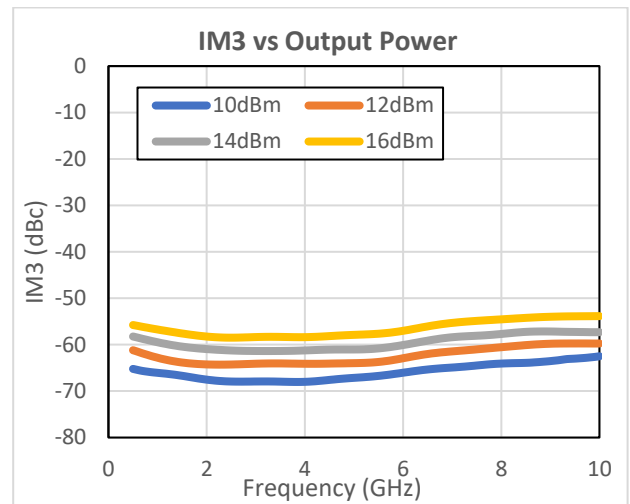
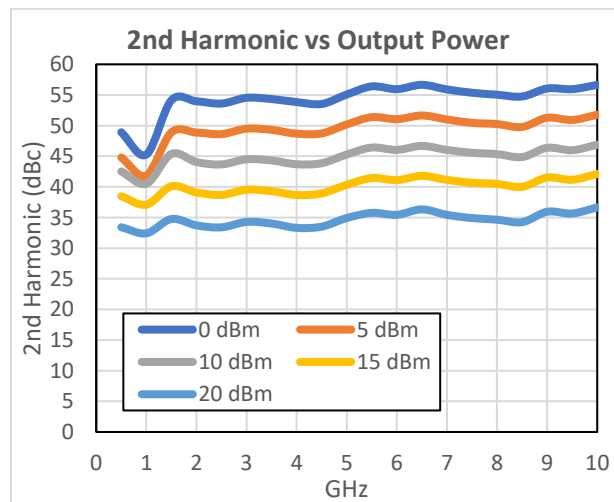


Figure 16 Second Harmonic vs Output Power (V_{DD} = 10 V, I_{DD} = 420mA, T = 25 °C)



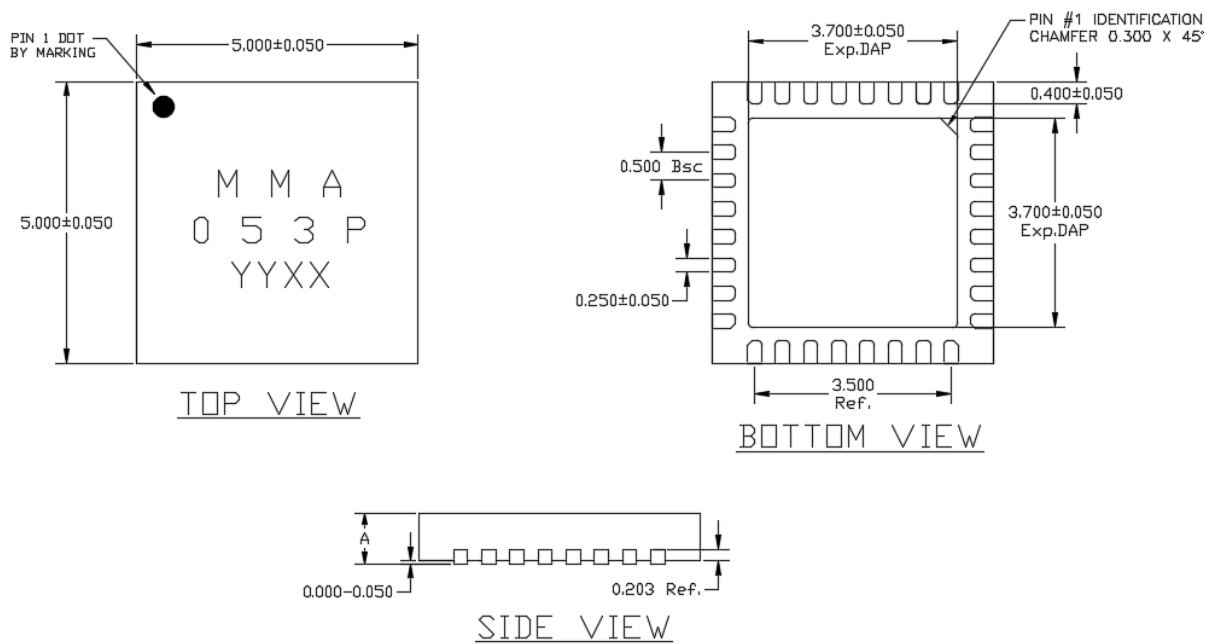
4 Package Specification

This section details the package specifications of the MMA053PP5 device.

4.1 Package Outline Drawing

The following illustration shows the package outline of the MMA053PP5 device. Dimensions are in millimeters.

Figure 15 Outline Package



4.2 Packaging Information

Table 3 Packaging Information

| Part Number | Package Body Material | Lead Finish |
|-------------|---|-------------|
| MMA053PP5 | RoHS - Compliance Low-stress injection molded plastic | Matte Sn |

4.3 Pin Descriptions

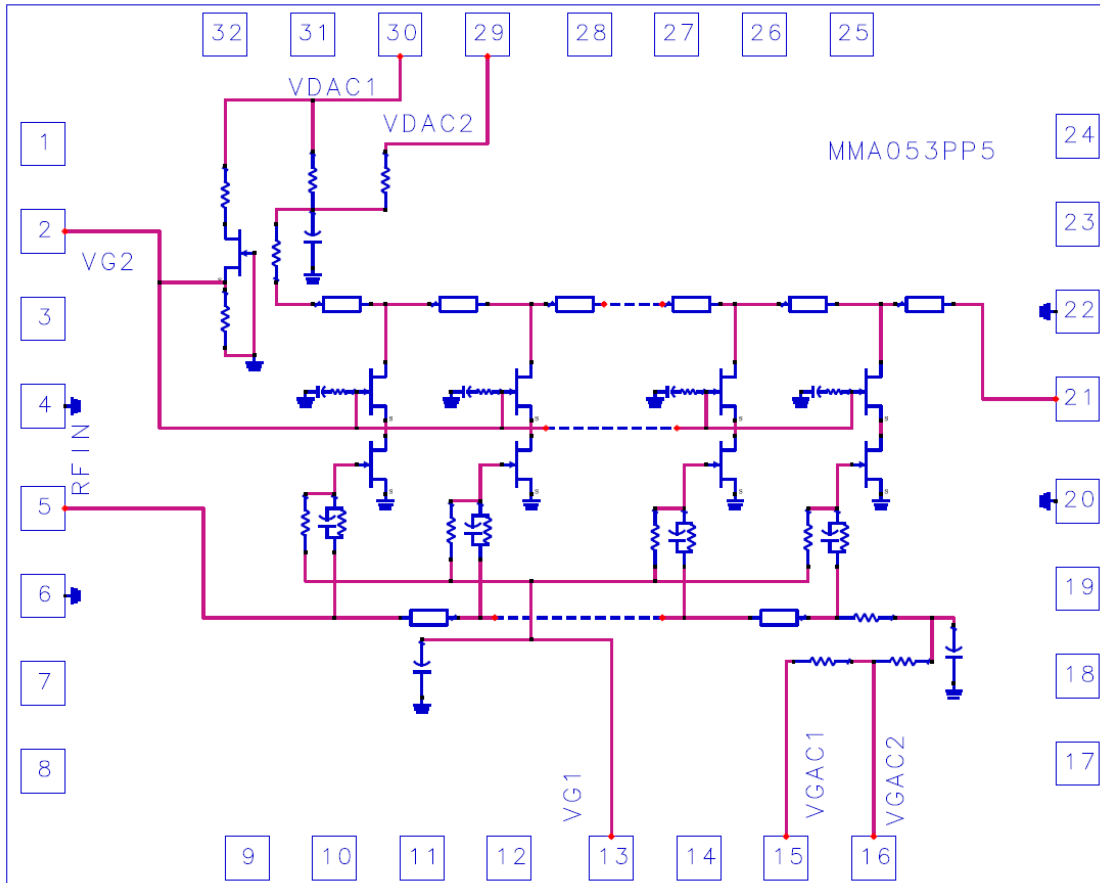
The following table describes the pins of the MMA053PP5 device.

Table 4 Pin Description

| Pin Number | Pin Name | Description |
|---|--------------------|--|
| 2 | V_{G2} | Low-frequency termination. Connect bypass capacitors per application circuit below. |
| 5 | RF_{IN} | Pin 5 on the layout and is matched to 50 Ω , and DC coupled to gate 1. |
| 13 | V_{G1} | First gate Bias. Adjust to achieve required I_{DD} . |
| 15, 16 | V_{G1A}, V_{G1B} | Low-frequency termination. Connect bypass capacitors per application circuit below. |
| 21 | $RF_{OUT}+V_{DD}$ | Pin 21 is matched to 50 Ω , and DC coupled to V_{DD} . Bias V_{DD} through a bias tee. |
| 29, 30 | V_{DB}, V_{DA} | DC linked V_{DD} internally. External bypass capacitors are required to extend RF match and gain flatness below 2 GHz. |
| 4, 6, 20, 22 | GND | Ground paddle. connect to RF/DC ground. |
| Backside Paddle | RF/DC GND | RF/DC ground. |
| 1, 3, 7, 8, 9, 10, 11, 12, 14, 17, 18, 19, 23, 24, 25, 26, 27, 28, 31, 32 | N/C | Connect to ground. |

The following image shows the functional schematic of the MMA053PP5 device.

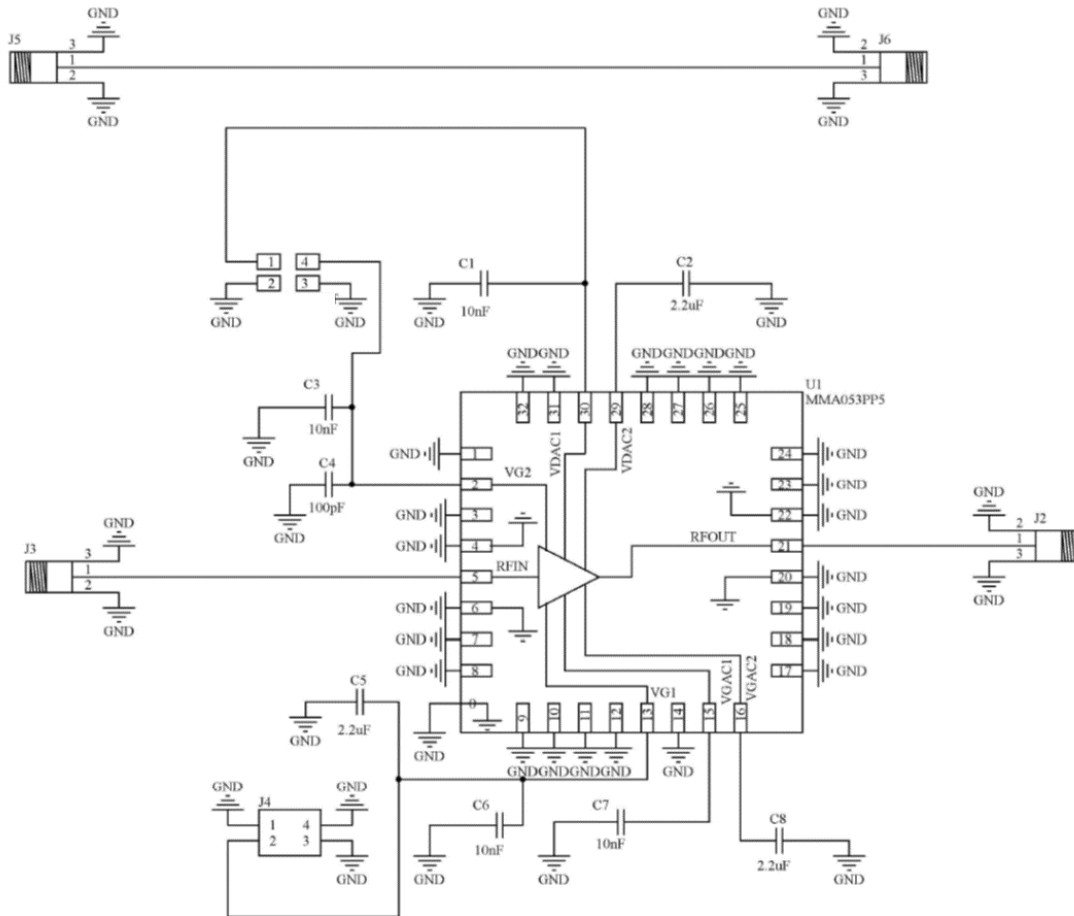
Figure 17 Functional Schematic



4.4 Application Circuit

The following illustration shows the application circuit of the MMA053PP5E device. Note that there is no internal DC blocking capacitor on the input or the output, and a bias tee must be used on pin 21 for biasing V_{DD} .

Figure 18 Application Circuit



5 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](#).

6 Evaluation Board Information

The following image shows the evaluation board of the MMA053PP5E device.

Figure 19 Evaluation Board

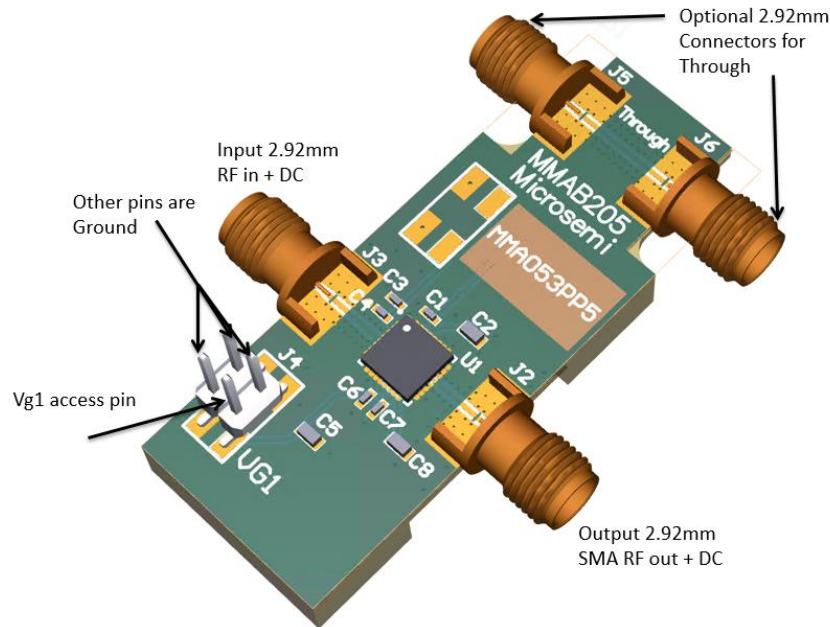


Table 5 List of Materials for Evaluation PCB MMA053PP5E

| Item | Description |
|----------------|---|
| C1, C3, C6, C7 | CAP 10 nF 50 V –20% to +80% 0402 |
| C2, C5, C8 | 2.2 μ F 16 V ceramic capacitor X5R 0603 |
| C4 | CAP 100 pF 50 V \pm 10% 0402 |
| J4 | Header, 2-pin, dual row |
| J2, J3, J5, J6 | CONN 2.92 mm female PCB edge mount .012 pin |

Table 6 Bias Sequence

| Bias Sequence | |
|---------------|--|
| 1) | Set the gate voltage VG1 to -1V |
| 2) | Set drain voltage VDD to 10V |
| 3) | Adjust the gate voltage until the drain current is 420mA |

7 Ordering Information

Table 7 Ordering Information

| Part Number | Description | Minimum Quantity |
|--------------------|--------------------|-------------------------|
| MMA053PP5 | 32 Lead SMT | 1 |
| MMA053PP5E | Evaluation Board | 1 |
| MMA053PP5TR | Tape and Reel | 500 |