

C/X-Band Low Noise Amplifier with High Input Power Handling

Product Overview

The MMA047PP4 is a Gallium Arsenide (GaAs), monolithic microwave integrated circuit (MMIC), Pseudomorphic High Electron Mobility Transistor (PHEMT), distributed amplifier operating from 4 to 14 GHz. Packaged in a fully molded 4x4mm QFN package, the amplifier operates reliably with input powers up to 32dBm of RF CW power. Noise Figure is 1.5dB, 21dB of gain, 34dBm OIP3, and 21dBm of output power at 1 dB compression. The MMA047AA amplifier is internally matched to 50 Ω.

Key Features

- **Frequency range: 5 to 14 GHz**
- **Gain: 21 dB**
- **High OIP3: 34 dBm**
- **Noise Figure: 1.5 dB**
- **CW Input Power rating: 32dBm**
- **Single Supply with Adjustable Current**
- **On-Chip Bias Choke**
- **Supply: 7V @ 170mA**
- **RF/DC ESD Protection on Chip**
- **50 Ohm Matched Input/Output**
- **Package: 4x4mm QFN**

Functional Block Diagram

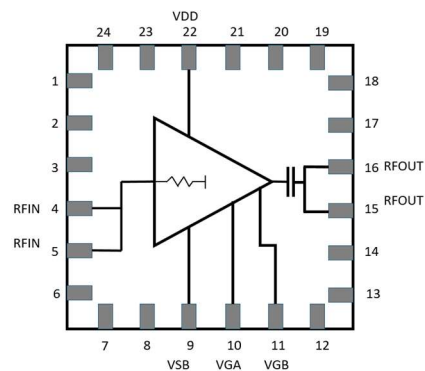


Figure 1 - Gain, NF Performances

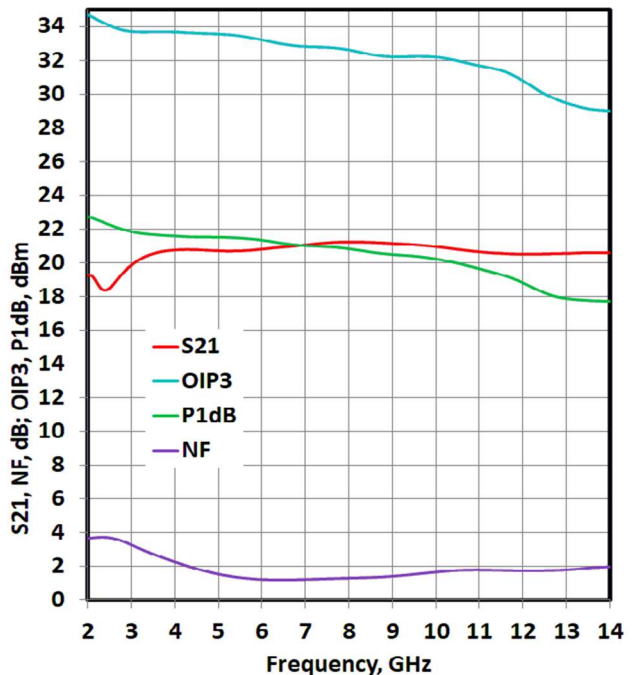
Applications

- Telecommunications
- Military and space
- Wideband microwave radios
- SatCom

Performance Overview

Parameter	Typ.	Units
Operational frequency range	5-14	GHz
Gain	21	dB
Noise Figure	1.5	dB
P1dB	21	dBm
OIP3	34	dBm
Current @ +7V Supply	170	mA

Export Classification: EAR-99



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1. Electrical Specifications

1.1. Typical Electrical Performance

Table 1 - Typical Electrical Performance at 25 C, V_{dd}=7V, I_{dd}=170 mA (Unless otherwise mentioned)

Parameter	Frequency Range	Min	Typ.	Max	Units
Frequency range		4		14	GHz
Gain	4 GHz -14 GHz		21		dB
Gain flatness	4 GHz -14 GHz		±0.5		dB
Noise figure	6 GHz -12 GHz		1.5		dB
Input return loss	4 GHz -14 GHz		15		dB
Output return loss	4 GHz -14 GHz		10		dB
P1dB	4 GHz -14 GHz		21		dBm
Psat	4 GHz -14 GHz		23		dBm
OIP3	4 GHz -14 GHz		34		dBm
Hot Switching (ON/OFF)	4 GHz -14 GHz		50		ns
Phase Noise	100Hz Offset		-135		dBc/Hz
	1kHz Offset		-135		dBc/Hz
	10kHz Offset		-150		dBc/Hz
	100kHz Offset		-150		dBc/Hz
Stability k-factor	4 GHz -14 GHz	1.5			
Input Power Survivability (CW)	4 GHz -14 GHz			32	dBm
VDD (drain voltage supply)			7		V
IDD (drain current)			170		mA

1.2. Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the MMA047PP4 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 2 - Absolute Maximum Ratings

Parameter	Rating
Drain bias voltage (V_{DD})	8 V
Drain bias current (I_{DD})	200 mA
Gate bias voltage (V_G)	-2 V to 0.5 V
RF input power (P_{in})	+32 dBm (CW)
Channel temperature	175 °C
Thermal resistance	12 °C/W
Storage temperature	-65 °C to 150 °C
Operating temperature	-55 °C to 85 °C
ESD	Class 1B (500V HBM)



1.3. Typical Performance Curves

The following graphs show the typical performance curves of the MMA047AA device at 25 °C, 7V, 170mA unless otherwise indicated, measured off GSG pads (see Figure 20) using SOLT calibration.

Figure 2 - Gain vs. Vdd

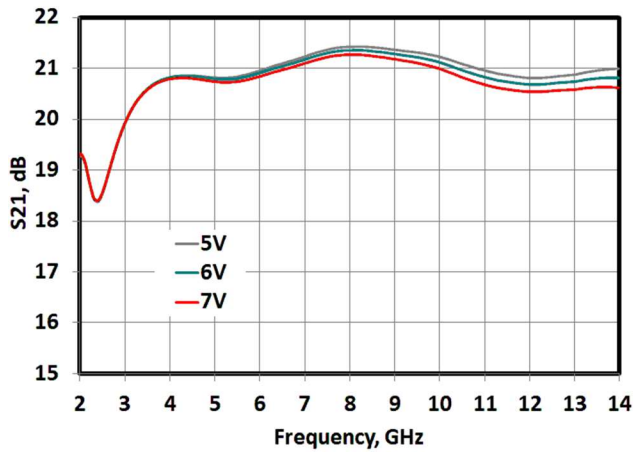


Figure 3 - NF vs. Vdd

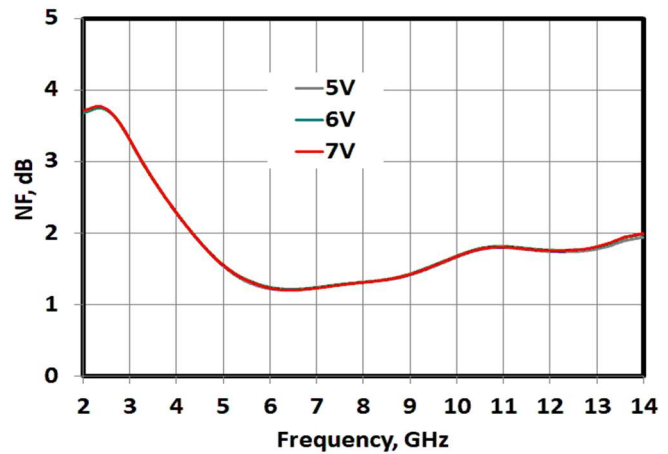


Figure 4 - S11 vs. Vdd

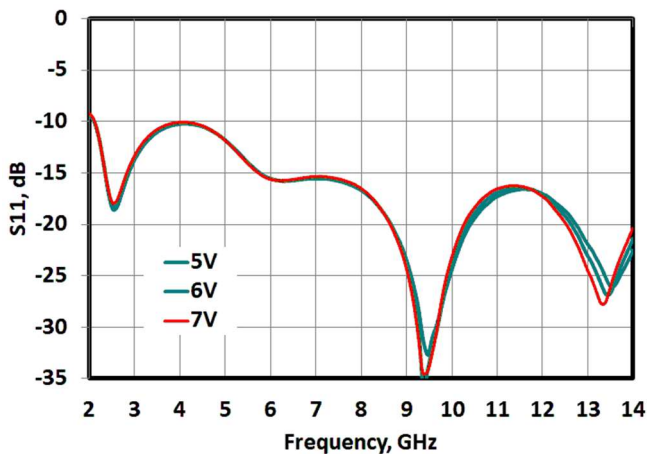


Figure 5 - S22 vs. Vdd

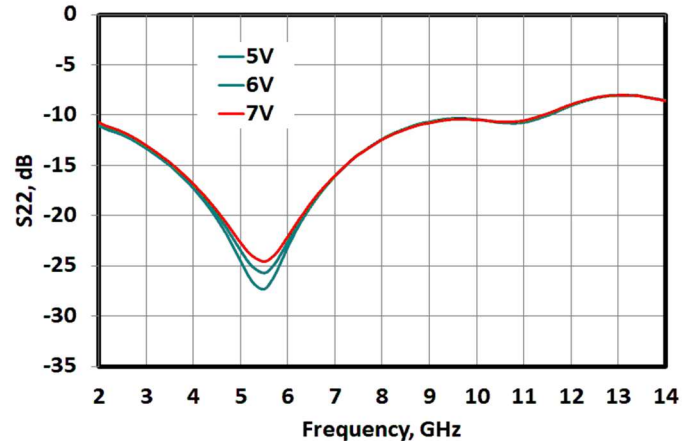


Figure 6 - OIP3 vs. Vdd

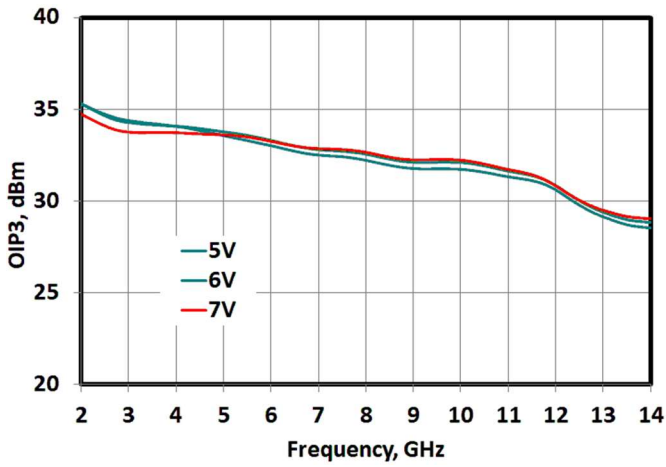


Figure 7 - P1dB vs. Vdd

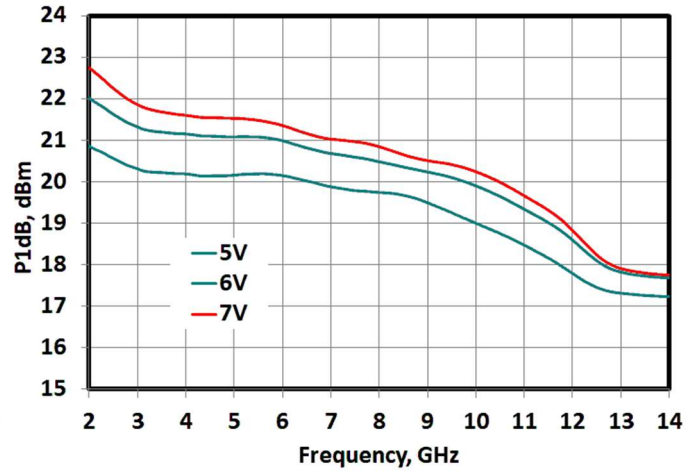
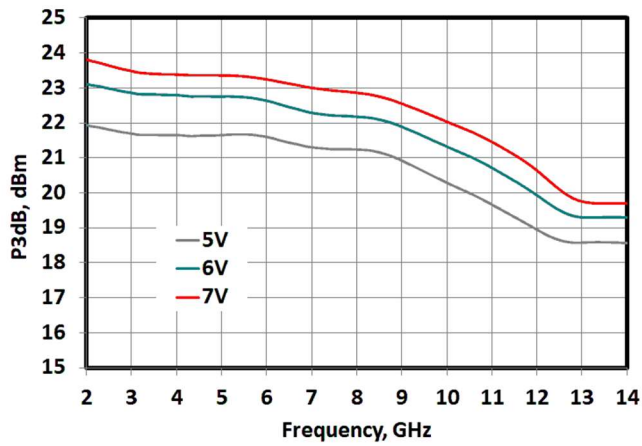
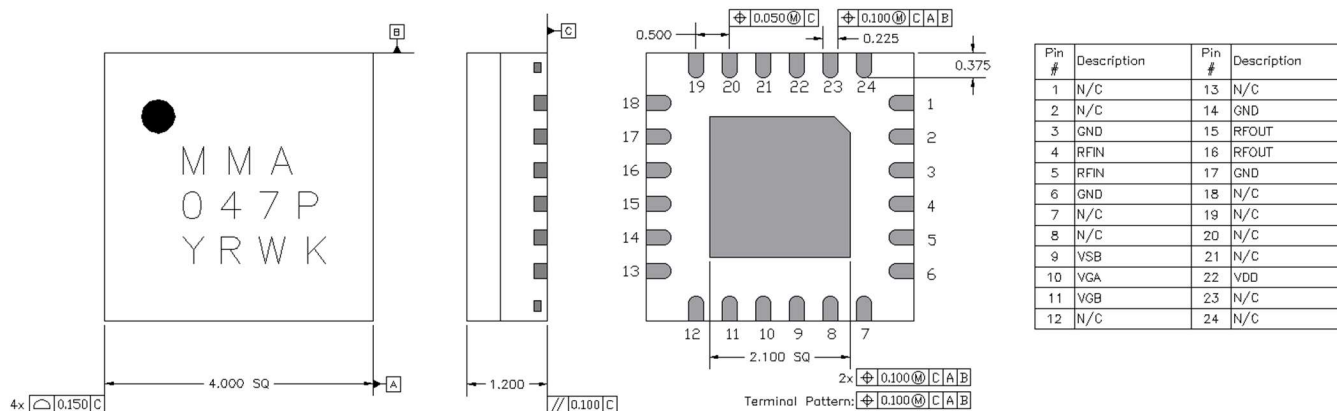


Figure 8 - P3dB vs. Vdd



2. Package Specifications

For additional packaging information, contact your Microchip sales representative.



NOTES:

1. MATERIAL; LEADFRAME
2. PLATING;
 - Ni: 0.50 um min
 - Pd: 0.02 um min
 - Au: 0.05 um max

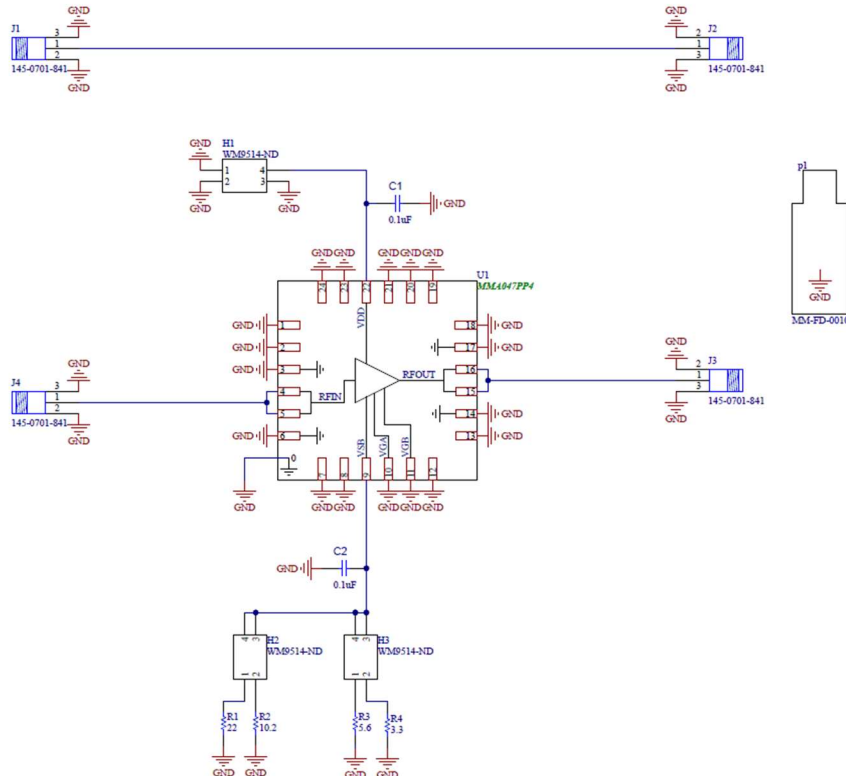
Table 3 - I/O Description

Pin Number	Pin Name	Pin Description
4,5	RF _{IN}	These pads are DC-coupled to 50 Ohm termination and matched to 50 Ω RF.
15, 16	RF _{OUT}	These pads are decoupled from DC and matched to 50 Ω RF.
22	V _{DD}	Vdd bias supply
10, 11	V _{GA} V _{GB}	Connect to RF/DC ground
9	V _{SB}	Used to control bias current (See table below)
3, 6, 14, 17 and Backside Paddle	Ground	
1, 2, 7, 8, 12, 13, 18, 19, 20, 21, 23, 24	N/C	Not connected internally, but recommend they are grounded on the PCB

Table 4. Idd current vs Rsb resistance termination on Vsb pin

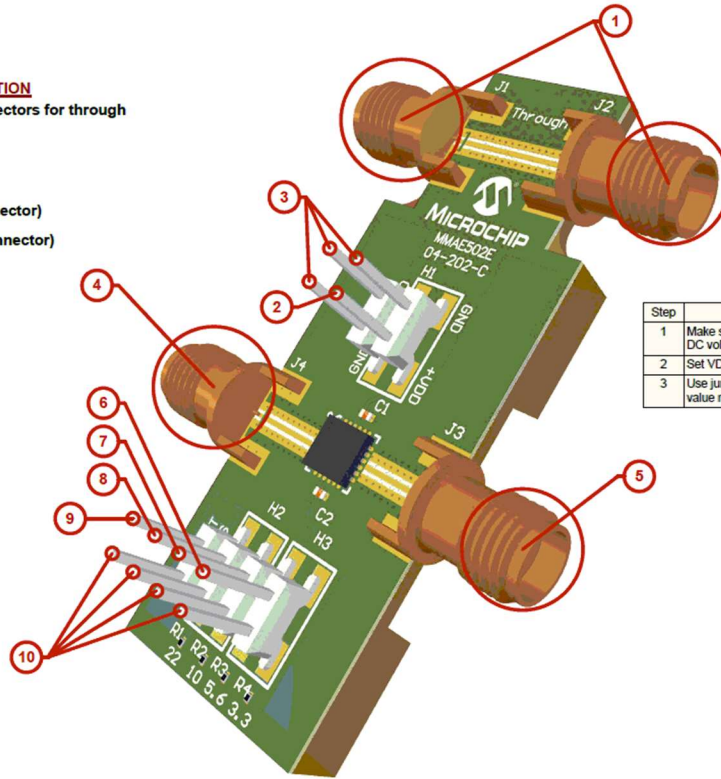
RSB (Ohms)	Idd@-50C	Idd@25C	Idd@85C
0	164	171	171
1	151	157	158
2	141	147	148
3	134	139	141
4	129	133	135
5	124	129	130
6	120	125	126
7	117	122	123
8	115	119	121
9	112	117	118
10	111	115	116
11	109	113	115
12	107	112	113
13	106	110	112
14	105	109	111
15	104	108	110
16	103	107	109
17	102	106	108
18	101	105	107
19	100	104	106
20	99	104	105

3. Application Circuits



DESCRIPTION

- ① Optional 2.92mm connectors for through calibration
- ② VDD access pin
- ③ Ground pins
- ④ RF Input (2.92mm connector)
- ⑤ RF Output (2.92mm connector)
- ⑥ R4 (3.3Ω) access pin
- ⑦ R3 (5.6Ω) access pin
- ⑧ R2 (10.2Ω) access pin
- ⑨ R1 (22Ω) access pin
- ⑩ Ground pins



MMA047PP4E Bias Procedure

Step	Instruction
1	Make sure all DC and RF connections are attached before activating any DC voltage power supplies.
2	Set VDD to +6.0V with current compliance at 200mA.
3	Use jumper shorts to set proper current. See product datasheet for RSB value reference table.

Table 5. List of Materials for Evaluation Board

Designator	Description	Manufacturer Part Number 1	Quantity
C1, C2	0.1 μ F \pm 10% 16V Ceramic Capacitor X7R 0402	CL05B104K05NNNC	2
EPOX1	Epoxy Ablefilm, ECF 563	ECF 563-002	1
H1, H2, H3	Header, 2-Pin, Dual row	15912040	3
J1, J2, J3, J4	Connector, 2.92mm Jack PCB Edge Mount .012" pin	145-0701-841	4
p1	PCB Baseplate, 2.0"x0.75"	MM-FD-0010	1
R1	22 Ohms \pm 1% 0.05W, 1/20W Chip Resistor 0201	ERJ-1GEF22ROC	1
R2	10.2 Ohms \pm 1% 0.05W, 1/20W Chip Resistor 0201	ERJ-1GEF10R2C	1
R3	5.6 Ohms \pm 5% 0.05W, 1/20W Chip Resistor 0201	ERJ-1GEJ5R6C	1
R4	3.3 Ohms \pm 5% 0.05W, 1/20W Chip Resistor 0201	ERJ-1GEJ3R3C	1
SOLD1	Solder Paste, No Clean, SAC305	ANY	1
U1	MMIC, 4-14 GHz, Self-Biased LNA, QFN 4x4 Plastic PKG	MMA047PP4	1

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.

5. Ordering Information

For additional ordering information, contact your Microchip sales representative.

Part Number	Package
MMA047PP4	4mm X 4mm, 24L Plastic QFN

5.1. Packing Information

Standard Format
Tape and Reel

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