

## DC to 45GHz Broadband MMIC Amplifier with PLFX

### Features

- Integrated PLFX technology:
  - Allows use of less-expensive coil
- Excellent 1.5-40GHz performance:
  - 10.25 ± 1dB gain
  - 20dBm Psat, 17dBm P1dB
  - 14dB return loss, 32dB isolation
- Broadband 45GHz performance:
  - 10 ± 1dB gain, 19dBm Psat
- >30dB dynamic gain control
- Integrated a temperature-referenced power detector output
- 100% DC, RF, and visually tested
- Size: 1640x920um (64.6x36.2mil)
- ECCN 3A001.b.2.d

### Description

The MMA029AA is an eight stage traveling wave amplifier. The amplifier features Microsemi PLFX (Passive Low Frequency eXtension) circuitry designed to reduce the integration cost of the amplifier. PLFX isolates the amplifier from bias inductor resonances, allowing use of a less-expensive coil.

### Application

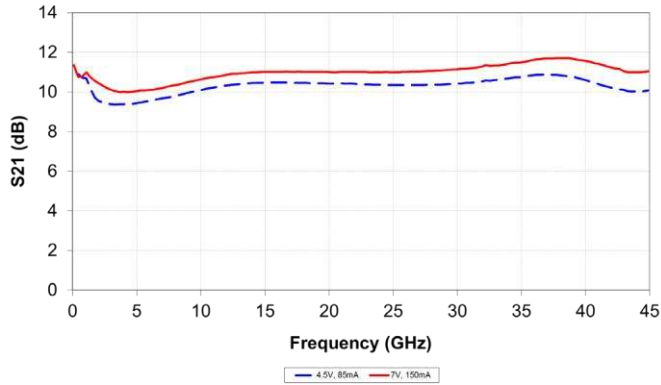
The MMA029AA Broadband MMIC Amplifier with PLFX is designed for general purpose broadband applications in RF and microwave communications, test equipment and military systems. By using specific external components, the bandwidth of operation can be extended below 40MHz.

**Key Characteristics:** Vdd=7V, Idd=150mA, Zo=50Ω

Specifications pertain to wafer measurements with RF probes and DC bias cards @ 25°C

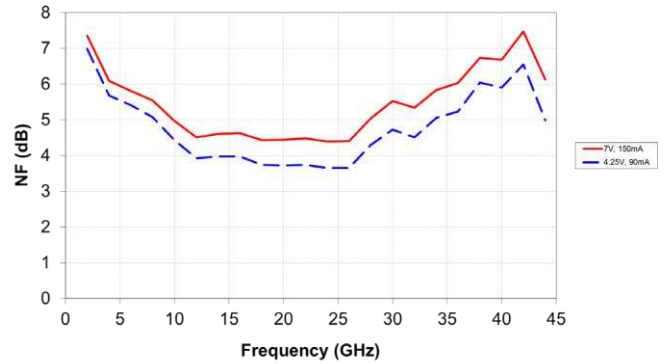
Parameter	Description	1.5 - 40GHz			0.04 - 45GHz		
		Min	Typ	Max	Min	Typ	Max
S21 (dB)	Small Signal Gain	9.5	10.25	-	8.5	10	-
Flatness (±dB)	Gain Flatness	-	1.0	1.25	-	1.0	1.5
S11 (dB)	Input Match	-	-18	-14	-	-17	-13
S22 (dB)	Output Match	-	-14	-12	-	-11	-8
S12 (dB)	Reverse Isolation	-	-32	-27	-	-30	-25
P1dB (dBm)	1dB Compressed Output Power	15.5	17	-	14.5	16	-
Psat (dBm)	Saturated Output Power	18.5	20	-	17.5	19	-
NF (dB)	Noise Figure	-	7.5	-	-	7.5	-
RF <sub>det</sub> (mV/mW)	RF Detector Sensitivity	-	0.7	-	-	0.7	-

## S21



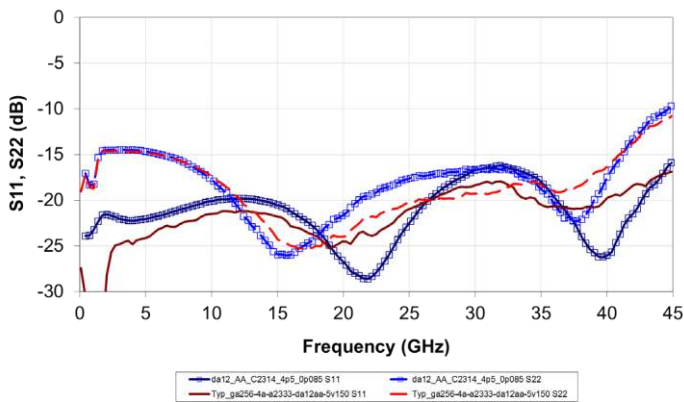
Typical IC performance measured on-wafer

## Noise Figure



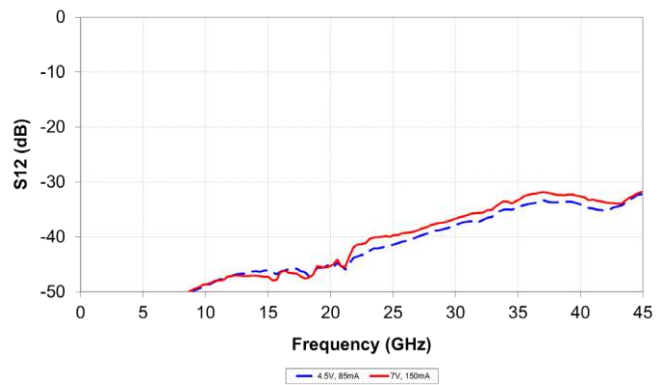
Typical IC performance with package de-embedded

## S11, S22



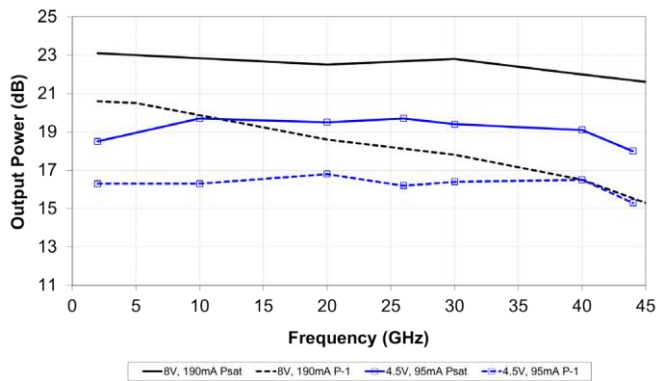
Typical IC performance measured on-wafer

## S12



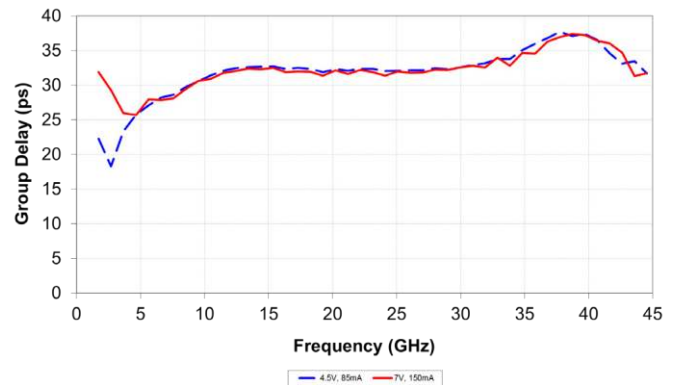
Typical IC performance measured on-wafer

## Output Power



Typical IC performance measured on-wafer

## Group Delay



Typical IC performance measured on-wafer

**Table 1: Supplemental Specifications**

Parameter	Description	Min	Typ	Max
V <sub>dd</sub>	Drain Bias Voltage	-	7V	8.2V
I <sub>dd</sub>	Drain Bias Current	-	150mA	250mA
V <sub>g1</sub>	1st Gate Bias Voltage	-4V	-	+0.5V
V <sub>g2</sub>	2nd Gate Bias Voltage	V <sub>dd</sub> - V <sub>g2</sub> < 7V	N/C	+4V
P <sub>in</sub>	Input Power (CW)	-	-	22dBm
P <sub>dc</sub>	Power Dissipation	-	1.05W	-
T <sub>ch</sub>	Channel Temperature	-	-	150°C
Θ <sub>ch</sub>	Thermal Resistance (T <sub>case</sub> =85°C)	-	19° C/W	-



Caution, ESD  
Sensitive Device

**DC Bias:**

The MMA029AA features a patented on-chip passive bias circuit called 'PLFX'. This circuit isolates the amplifier from bias coil resonances above 14GHz, allowing the use of less expensive coils; traditional biasing requires bias coils with self-resonances outside the operating range of the amplifier.

The device is biased by applying a positive voltage to the drain (Vdd), then setting the drain current (Idd) using a negative voltage on the gate (Vg1). The nominal bias is Vdd=7V, Idd=150mA.

Improved performance can be achieved with gate bias adjustment; use the drain termination bypass to alter the output voltage (detected from the drain sense).

**Gain Control:**

Dynamic gain control is available when operating the amplifier in the linear gain region. Negative voltage applied to the second gate (Vg2) reduces amplifier gain.

**RF Power Detection:**

RF output power can be calculated from the difference between the RF detector voltage and the DC detector voltage, minus a DC offset. Please consult the application note available on the Microsemi website.

**Low-Frequency Use:**

The MMA029AA has been designed so that the bandwidth can be extended to low frequencies. The low end corner frequency of the device is primarily determined by the external biasing and AC coupling circuitry.

**Matching:**

The amplifier incorporates on-chip termination resistors on the RF input and output. These resistors are RF grounded through on-chip capacitors, which are small and become open circuits at frequencies below 1GHz.

A pair of gate and drain termination bypass pads are provided for connecting external capacitors required for the low frequency extension network. These capacitors should be 10x the value of the DC blocking capacitors.

**DC Blocks:**

The amplifier is DC coupled to the RF input and output pads; DC voltage on these pads must be isolated from external circuitry.

For operation above 2GHz, a series DC-blocking capacitor with minimum value of 20pF is recommended; operation above 40MHz requires a minimum of 120pF.

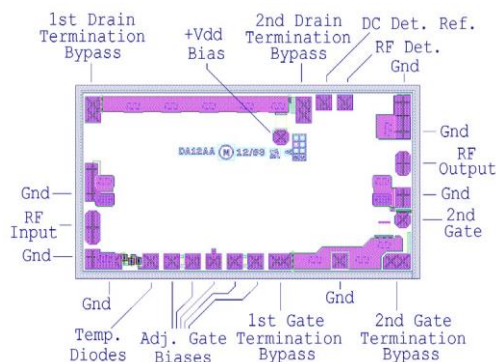
**Bias Inductor:**

DC bias applied to the drain (Vdd) must be decoupled with an off-chip RF choke inductor. The amount of bias inductance will determine the low frequency operating point. Inductive biasing can also be applied to the chip through the RF output.

For many applications above 2GHz, a bondwire from the Vdd pad will suffice as the biasing inductor. Ensure the correct bond length as shown in the assembly diagrams.

### Die size, pad locations, and pad descriptions

Chip size: 1640x920um (64.6x36.2mil)  
 Chip size tolerance:  $\pm 5\mu\text{m}$  (0.2mil)  
 Chip thickness:  $100 \pm 10\mu\text{m}$  ( $4 \pm 0.4\text{mil}$ )  
 Pad dimensions: 80x80um (3.1x3.1mil)



#### Pick-up and Chip Handling:

This MMIC has exposed air bridges on the top surface. **Do not pick up chip with vacuum on the die center**; handle from edges or use a collet.

#### Thermal Heat Sinking:

To avoid damage and for optimum performance, you must observe the maximum channel temperature and ensure adequate heat sinking.

#### ESD Handling and Bonding:

**This MMIC is ESD sensitive**; preventive measures should be taken during handling, die attach, and bonding.

**Epoxy die attach is recommended.** Please review our application note MM-APP-0001 handling and die attach recommendations, on our website for more handling, die attach and bonding information.

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