

## Distributed Amplifier 18 - 40 GHz

Rev. V2

### Features

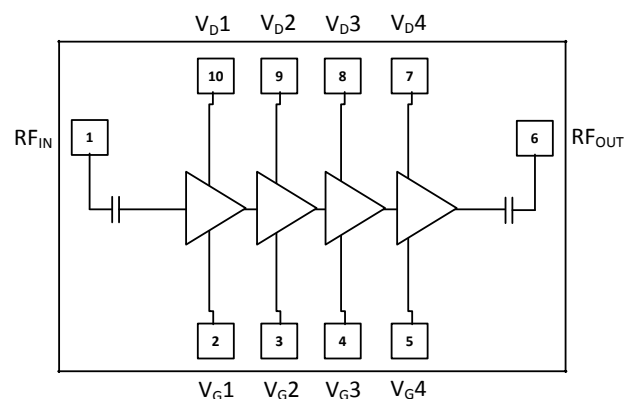
- Wideband Distributed Amplifier
- 26 dB Small Signal Gain
- +20 dBm P1dB Compression Point
- +30 dBm IP3
- 6 dB Noise Figure
- 100% On Wafer DC and RF Testing
- 100% Visual Inspection to MIL-STD-883 Method 2010

### Description

The MAAM-015023-DIE is a four stage 18 - 40 GHz GaAs MMIC distributed amplifier that has a small signal gain of 26 dB and a P1dB Compression Point of +20 dBm. The device has a Third Order Intercept Point of +30 dBm.

This device is well suited for Millimeter-wave Point-to-Point Radio, Radar, SATCOM and VSAT applications.

### Block Diagram



### Pad Configuration

Pad No.	Function	Description
1	RF <sub>IN</sub>	RF Input
2	V <sub>G1</sub>	1 <sup>st</sup> Stage Gate Voltage
3	V <sub>G2</sub>	2 <sup>nd</sup> Stage Gate Voltage
4	V <sub>G3</sub>	3 <sup>rd</sup> Stage Gate Voltage
5	V <sub>G4</sub>	4 <sup>th</sup> Stage Gate Voltage
6	RF <sub>OUT</sub>	RF Output
7	V <sub>D4</sub>	4 <sup>th</sup> Stage Drain Voltage
8	V <sub>D3</sub>	3 <sup>rd</sup> Stage Drain Voltage
9	V <sub>D2</sub>	2 <sup>nd</sup> Stage Drain Voltage
10	V <sub>D1</sub>	1 <sup>st</sup> Stage Drain Voltage

### Ordering Information<sup>1</sup>

Part Number	Package
MAAM-015023-DIE	DIE in Gel Pack

\* Restrictions on Hazardous Substances, European Union Directive 2011/65/EU.

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Electrical Specifications<sup>3</sup>: Freq. = 18 - 40 GHz, T<sub>A</sub> = +25°C

Parameter	Units	Min.	Typ.	Max.
Small Signal Gain 21.0 - 35.0 GHz 17.7 GHz 40.0 GHz	dB	22 20 20	26 — —	—
Gain Flatness	dB	—	+/- 0.5	—
Input Return Loss	dB	—	10	—
Output Return Loss	dB	—	10	—
Noise Figure	dB	—	6	—
Saturated Power	dBm	—	22	—
Output Power @ Pin = -2 dBm 21.0 - 35.0 GHz 17.7 GHz 40.0 GHz	dBm	18 16 16	21 — —	—
Output IP3 @ 10 dBm per tone	dBm	—	30	—
P1dB	dBm	—	20	—
Supply Current (I <sub>D</sub> 1,2,3,4)	mA	—	335	—
Drain Voltage (V <sub>D</sub> 1,2,3,4)	V	—	4.0	—
Gate Voltage (V <sub>G</sub> 1,2,3,4)	V	—	-0.3	—

3. Gate voltage must be applied prior to drain voltage. Set V<sub>G</sub>1, V<sub>G</sub>2, V<sub>G</sub>3, V<sub>G</sub>4, to -1.0V, apply V<sub>DD</sub>, then adjust V<sub>G</sub>1, V<sub>G</sub>2, V<sub>G</sub>3, V<sub>G</sub>4 to achieve specified current.

Absolute Maximum Ratings<sup>4,5</sup>

Parameter	Absolute Maximum
Input Power	+10 dBm
Supply Voltage	+5 VDC
Gate Bias Voltage	-1.5 V ≤ V <sub>g</sub> ≤ -0.1 V
Supply Current	500 mA
Storage Temperature	-65°C to +165°C
Operating Temperature	-40°C to +85°C
Junction Temperature	+175°C

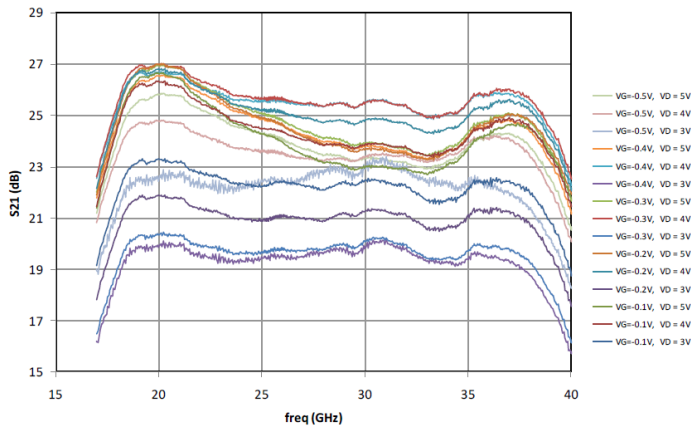
4. Exceeding any one or combination of these limits may cause permanent damage to this device.  
 5. MACOM does not recommend sustained operation near these survivability limits.

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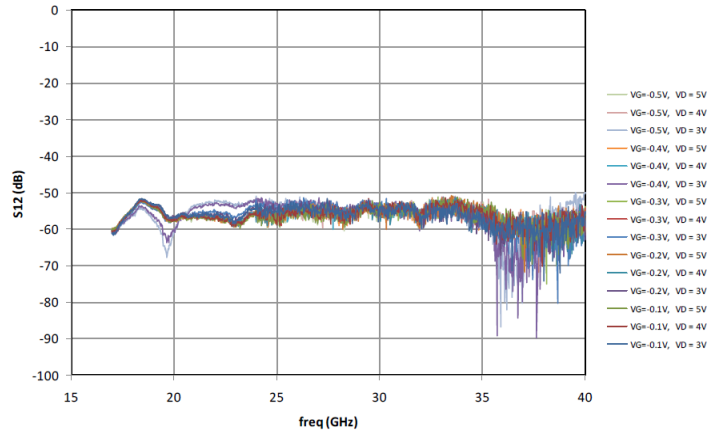
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### Typical Performance Curves

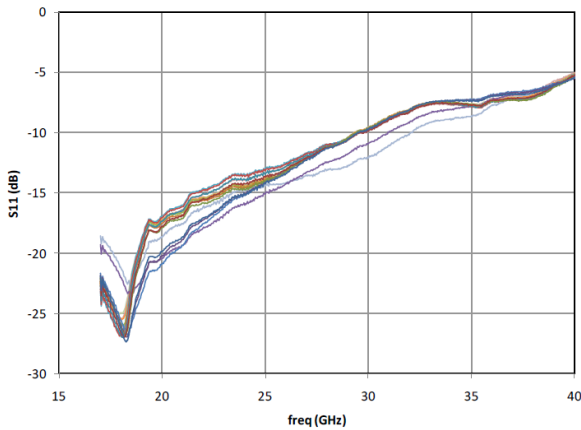
Gain vs. Frequency



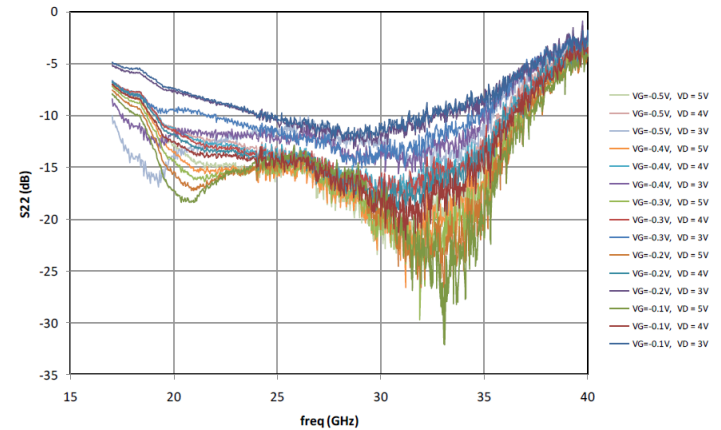
Reverse Isolation vs. Frequency



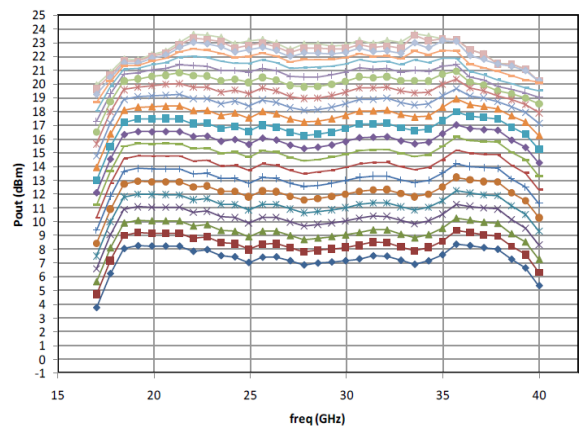
Input Return Loss vs. Frequency



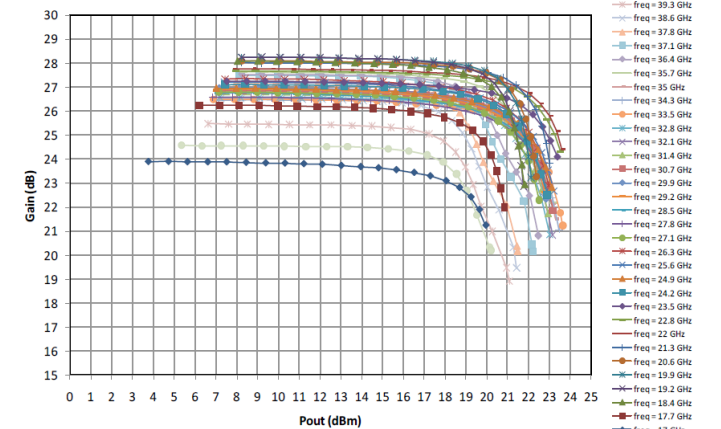
Output Return Loss vs. Frequency



Output Power vs. Frequency,  $V_G = -0.3$  V,  $V_D = 4$  V



Gain vs.  $P_{OUT}$ ,  $V_G = -0.3$  V,  $V_D = 4$  V

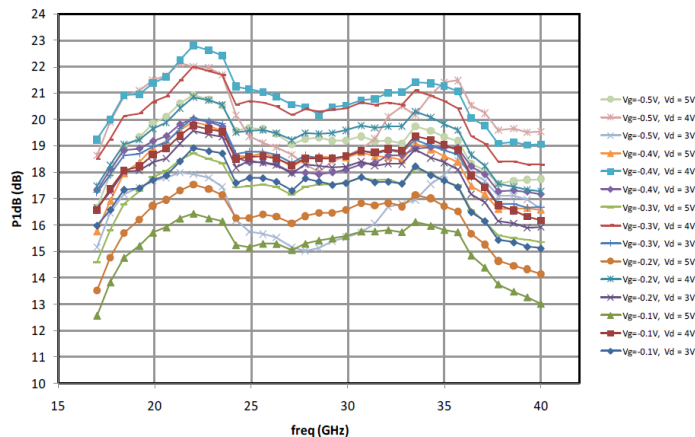


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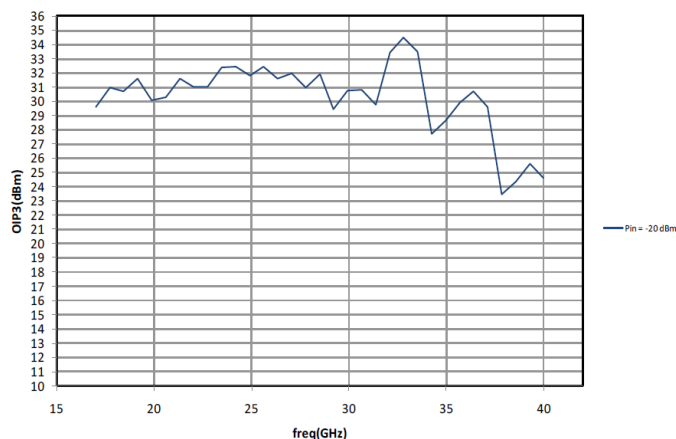
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### Typical Performance Curves

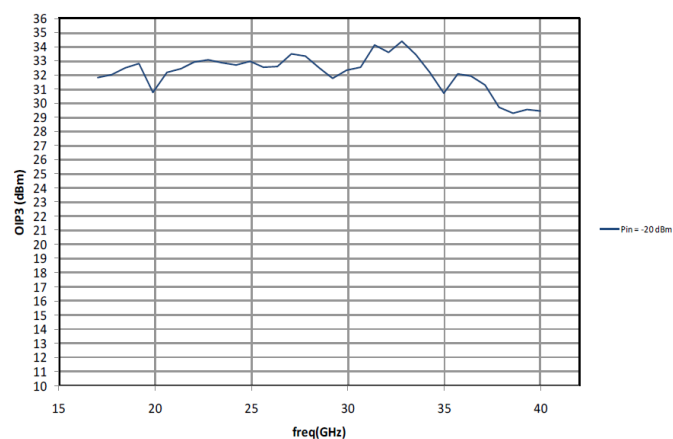
#### *P1dB vs. Frequency*



#### *Output IP3 vs. Frequency (Lower Side Band)*

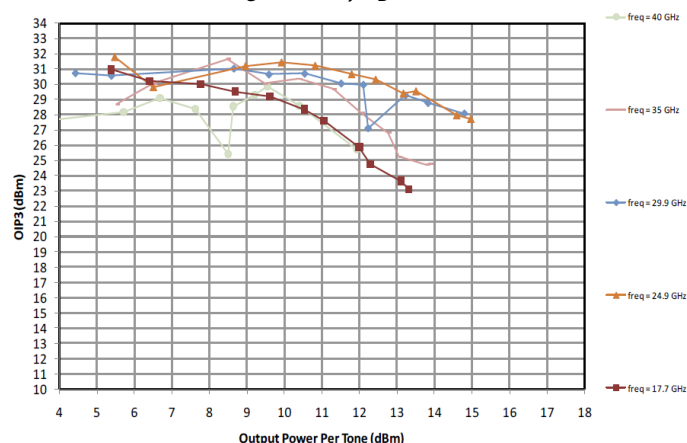


#### *Output IP3 Loss vs. Frequency (Upper Side Band)*



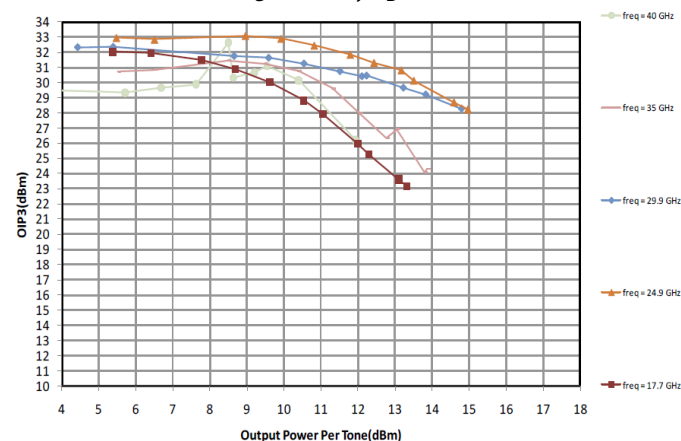
#### *Output IP3 vs. Output Power per tone (Lower Side Band)*

$$V_G = -0.3 \text{ V}, V_D = 4 \text{ V}$$



#### *Output IP3 vs. Output Power per tone (Upper Side Band)*

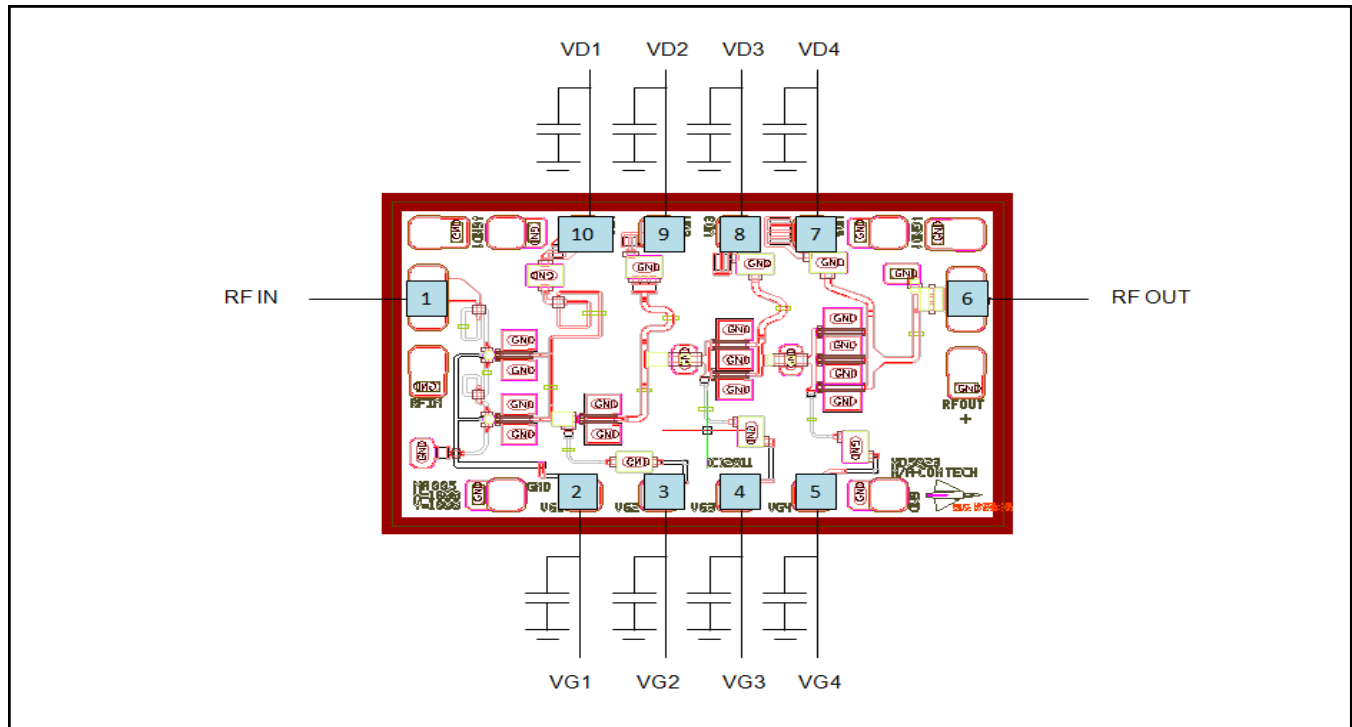
$$V_G = -0.3 \text{ V}, V_D = 4 \text{ V}$$



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### Bias Arrangement



### App Note [1] Biasing

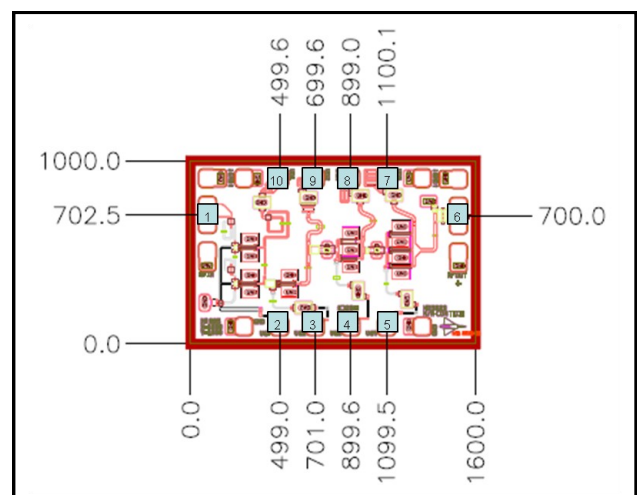
The gate bias (Vg1, Vg2, Vg3 and Vg4) should always be applied before the drain voltage (Vd1, Vd2, Vd3 and Vd4) is applied and when switching off the amplifier the drain voltage must be switched off first before the gate voltage.

The MAAM-015023-DIE is biased directly through the gates (Vg1, Vg2, Vg3 and Vg4). The amplifier is biased typically with Vg = -0.3 V and Vd = 4 V.

### App Note [2] Bias Arrangement

Each DC pin (Vd and Vg) needs to have DC bypass capacitance of 100 pF as close to the device as possible. It is recommended to also use a further capacitance of 10 nF on the DC pins.

### Mechanical Dimensions



## Applications Section

### Handling Procedures

Please observe the following precautions to avoid damage:

### Static Sensitivity

Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

### Die Attachment

This product is 0.100 mm (0.004") thick and has vias through to the backside to enable grounding to the circuit. Microstrip substrates should be brought as close to the die as possible. The mounting surface should be clean and flat. If using conductive epoxy, recommended epoxies are Tanaka TS3332LD, Die Mat DM6030HK or DM6030HK-Pt cured in a nitrogen atmosphere per manufacturer's cure schedule. Apply epoxy sparingly to avoid getting any on to the top surface of the die. An epoxy fillet should be visible around the total die periphery. For additional information please see the MACOM "Epoxy Specifications for Bare Die" application note. If eutectic mounting is preferred, then a flux-less gold-tin (AuSn) preform, approximately 0.0012 thick, placed between the die and the attachment surface should be used. A die bonder that utilizes a heated collet and provides scrubbing action to ensure total wetting to prevent void formation in a nitrogen atmosphere is recommended. The gold-tin eutectic (80% Au 20% Sn) has a melting point of approximately 280°C (Note: Gold Germanium should be avoided). The work station temperature should be 310°C +/- 10°C. Exposure to these extreme temperatures should be kept to minimum. The collet should be heated, and the die pre-heated to avoid excessive thermal shock. Avoidance of air bridges and force impact are critical during placement.

### Wire Bonding

Windows in the surface passivation above the bond pads are provided to allow wire bonding to the die's gold bond pads. The recommended wire bonding procedure uses 0.076 mm x 0.013 mm (0.003" x 0.0005") 99.99% pure gold ribbon with 0.5 - 2% elongation to minimize RF port bond inductance. Gold 0.025 mm (0.001") diameter wedge or ball bonds are acceptable for DC Bias connections. Aluminium wire should be avoided. Thermo-compression bonding is recommended though thermo-sonic bonding may be used providing the ultrasonic content of the bond is minimized. Bond force, time and ultrasonic's are all critical parameters. Bonds should be made from the bond pads on the die to the package or substrate. All bonds should be as short as possible.

### Life Support Policy

This product is not authorized for use as critical components in life support devices or systems without the express written approval of the President and General Counsel of MACOM. As used herein: (1) Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user. (2) A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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