

### **MAAM-011238-DIE**

Rev. V4

### Features

- Gain: 14 dB @ 6 V, 30 GHz
- P1dB: 18 dBm @ 6 V, 30 GHz
- P3dB: 20 dBm @ 6 V, 30 GHz
- Integrated Power Detector
- Gain Control with Only Positive Bias Voltages
- 50  $\Omega$  Input and Output Match
- Bias Voltage: VDD = 4 6 V
- Bias Current: IDSQ = 125 150 mA
- Die size: 2.1 x 1.05 mm
- RoHS\* Compliant

### Description

MAAM-011238-DIE is an easy-to-use, wideband amplifier that operates from 100 kHz to 67.5 GHz. The amplifier provides 14 dB gain, 4.5 dB noise figure and 20 dBm of P3dB output power @ 30 GHz. It is matched to 50  $\Omega$  with typical return loss better than 12 dB. The amplifier requires only positive bias voltages and would typically be operated at 6 V and 135 mA.

MAAM-011238-DIE is suitable for a wide range of applications in instrumentation and communication systems.

### **Ordering Information**

Part Number	Package
MAAM-011238-DIE	Die in Gel Pak

## **Functional Schematic**



## Pad Configuration<sup>1</sup>

Pin #	Pin Name	Description
1	RF <sub>IN</sub>	RF Input / Gate Voltage
2, 7, 9, 12,15	GND	DC & RF Ground to Backside Via
3	V <sub>G</sub> 2	Gate Voltage 2
4	V <sub>DD</sub>	Drain Voltage
5	VD <sub>AUX</sub>	Auxiliary Drain Voltage
6	V <sub>DET</sub>	Detector Voltage
8	RFout	RF Output / Drain Voltage
10	VG <sub>AUX</sub>	Auxiliary Gate Voltage
11	V <sub>G</sub> 1	Gate Voltage 1
13,14	NC	Not Connected

1. The backside of the die must be connected to RF, DC and thermal ground.

\* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

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#### **Test Conditions** Parameter Units Min. Typ. Max. 0.0001 - 10 GHz 15.9 14 10 - 20 GHz 13.8 15.5 20 - 30 GHz 13.3 15.0 Gain 30 - 40 GHz dB 12.5 14.0 40 - 50 GHz 11.5 13.0 50 - 60 GHz 11.5 60 - 67.5 GHz 7.0 2.8 - 10 GHz 6.0 10 - 20 GHz 4.1 Noise Figure 20 - 30 GHz dB 4.7 30 - 40 GHz 6.0 40 - 50 GHz 9.0 0.0001 - 10 GHz 18.0 10 - 20 GHz 17.0 20 - 30 GHz Input Return Loss dB 17.0 30 - 40 GHz 16.6 40 - 67.5 GHz 15.0 0.0001 - 10 GHz 17.0 10 - 20 GHz 15.0 20 - 30 GHz **Output Return Loss** dB 13.0 30 - 40 GHz 13.5 40 - 67.5 GHz 12.0 P1dB 40 GHz dBm 15 17.6 0.0001 - 10 GHz 22.0 10 - 20 GHz 21.0 20 - 30 GHz 20.0 P3dB 30 - 40 GHz dBm 19.0 40 - 50 GHz 18.0 50 - 60 GHz 16.0 60 - 67.5 GHz 14.0 0.0001 - 10 GHz 29.0 10 - 20 GHz 28.0 20 - 30 GHz 27.0 Output IP3 30 - 40 GHz dBm 26.5 40 - 50 GHz 25.0 50 - 60 GHz 22.0 60 - 67.5 GHz 16.0 **Drain Current Quiescent Bias** mΑ 135

## Electrical Specifications: $T_c = +25^{\circ}C$ , $V_D = 6 V$ , $Z_0 = 50 \Omega$

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Parameter	Test Conditions	Units	Min.	Тур.	Max.
Gain	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 50 GHz 50 - 60 GHz 60 - 67.5 GHz	dB	_	16.5 16.0 16.0 16.0 16.0 15.0 12.0	_
Noise Figure	2.8 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 50 GHz	dB	_	6.0 4.1 4.7 6.0 9.0	_
Input Return Loss	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 67.5 GHz	dB		18.0 17.0 17.0 16.6 15.0	
Output Return Loss	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 67.5 GHz	dB	_	17.0 15.0 13.0 13.5 12.0	_
P1dB	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 50 GHz 50 - 60 GHz 60 - 67.5 GHz	dBm	_	18.0 17.6 17.0 17.5 15.5 15.0 14.0	_
P3dB	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 50 GHz 50 - 60 GHz 60 - 67.5 GHz	dBm	_	21.5 21.0 19.5 18.5 17.5 17.0 16.0	_
Output IP3	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 50 GHz 50 - 60 GHz 60 - 67.5 GHz	dBm		25.0 26.0 25.5 25.5 24.0 22.5 17.0	
Drain Current	Quiescent bias	mA		150	

## Electrical Specifications: $T_c = +25^{\circ}C$ , $V_D = 5 V$ , $Z_0 = 50 \Omega$

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### Absolute Maximum Ratings<sup>3,4</sup>

Parameter	Absolute Maximum
Input Power	16 dBm
Drain Supply Voltage	8 V
Junction Temperature <sup>5,6</sup>	+150°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C

3. Exceeding any one or combination of these limits may cause permanent damage to this device.

- MACOM does not recommend sustained operation near these survivability limits.
- Operating at nominal conditions with T<sub>J</sub> ≤ +150°C will ensure MTTF > 1 x 10<sup>6</sup> hours.
- 6. Junction Temperature  $(T_J) = T_A + \Theta_{JC} * ((V * I) (P_{OUT} P_{IN}))$ Typical thermal resistance  $(\Theta_{JC}) = 22.1 \text{ °C/W}.$

For  $T_A = +85^{\circ}C$ ,

 $T_{\rm J}$  = +103 °C at V = 6 V, I =  $\,0.135$  A

## **Application Schematic**



### Component List

Part	Value	Size	Part Number
C1, C2	1200 pF	25 mil	TECDIA SKT03C122V12A6
C3, C4	10 µF	0603	any

### **Operating Conditions**

One of the recommended biasing conditions is  $V_{DD}$  = 6 V,  $I_{DSQ}$  = 135 mA. (controlled with  $V_{G1}$ ).  $I_{DSQ}$  is set by adjusting V<sub>G1</sub> after correctly setting V<sub>DD</sub>. (Refer to turn on sequence.)

There are 3 possible bias methods:

- 1. The use of an external DC block on the input and a bias tee. The required  $V_{DD}$  is applied at  $RF_{OUT}/V_{DD}$  through the bias tee and  $V_G$  is set to provide the required current bias ( $I_{DSQ}$ ) This provides wide band performance of 40 MHz -67.5 GHz. (depending on the bandwidth of the bias tee)
- The direct application of drain voltage to VDD using a wideband conical. No external bias tee is required. However DC blocking is required on both the RFIN and RFOUT. Using this method provides for an operational frequency of 40 MHz - 67.5 GHz.
- 3. For compatibility with systems requiring  $V_G1 > 3 V VG_{AUX}$  can be grounded. Note that this configuration will cause  $I_G1$  to be 21 mA (instead of 0.65 V @ 1 mA).

For low frequency extension, the addition of 2 bypass capacitors on VG1 and  $VD_{AUX}$  of 1200 pF and 10  $\mu$ F will improve the frequency of operation down to 100 kHz.. These capacitors should be positioned as close to the device as possible.

Dynamic gain control is available when operating in the linear gain region through the application of 0 to 1.6 V to VG2.

The evaluation board is configured with bias option 1. Bypass capacitors on  $V_G1$  and  $V_{AUX}$  are also included for operation down to 100 kHz. Data in this datasheet was measured using option 1.

# Operating the MAAM-011238-DIE Turn-on

1. Apply  $V_G1$  to 0 V.

- 2. Apply V<sub>DD</sub> to 6 V.
- 3. Set  $I_{DSQ}$  by adjusting  $V_G1$  more positive.
  - (typically 0.65 V for  $I_{DSQ}$  = 135 mÅ).
- 4. Apply RF<sub>IN</sub> signal.

#### Turn-off

- 1. Remove RF<sub>IN</sub> signal.
- 2. Decrease V<sub>G</sub>1 to 0 V.
- 3. Decrease  $V_{DD}$  to 0 V.



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## Typical Performance Curves: $V_D = 6 V$ , $T_A = +25^{\circ}C$

Input Return Loss



0 — — 125 mA -5 150 mA -10 (dB) -15 -20 -25 -30 -35 -40 0 10 20 30 40 50 60 70 Frequency (GHz)

### Reverse Isolation







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## Typical Performance Curves: $V_D = 6 V$ , $I_D = 125 mA$

Input Return Loss



0 - - -40°C -5 +25°C ----+85°C -10 (dB) -15 -20 -25 -30 -35 -40 0 10 20 30 40 50 70 60 Frequency (GHz)

#### Output Return Loss

**Reverse Isolation** 



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## Typical Performance Curves: $V_D = 6 V$ , $I_D = 135 mA$ , $T_A = +25^{\circ}C$

Output P1dB Output P3dB - - 5 V Output P3dB (dBm) Output P1dB (dBm) Frequency (GHz) Noise Figure at  $T_A = 25^{\circ}C$ OIP3 at  $T_A = 25^{\circ}C$ -- 5 V Noise Figure (dB) 





Frequency (GHz)



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#### Output P3dB Output P1dB Output P1dB (dBm) Output P3dB (dBm) -40°C -40°C +25°C +25°C -+85°C --+85°C Frequency (GHz) Frequency (GHz) Noise Figure OIP3 -40°C +25°C +85°C Noise Figure (dB) OIP3 (dBm) -40°C +25°C ----+85°C

## Typical Performance Curves: $V_D = 6 V$ , $I_D = 135 mA$

Frequency (GHz)

Frequency (GHz)

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## Die Dimensions<sup>7,8</sup>



## Bond Pad Detail

Pin #	Size (x)	Size (y)
1	99	155
2, 6,10,11,12	69	69
3, 4, 5	69	89
7,9	89	69
8	69	168

7. All dimensions shown as microns ( $\mu$ m) with a tolerance of +/-5  $\mu$ m, unless otherwise noted.

8. Die thickness is 100 µm +/- 10 µm.

### **Handling Procedures**

Please observe the following precautions to avoid damage:

### Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1C devices.



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