

## Wideband Distributed Amplifier 30 kHz - 44 GHz

Rev. V2

### Features

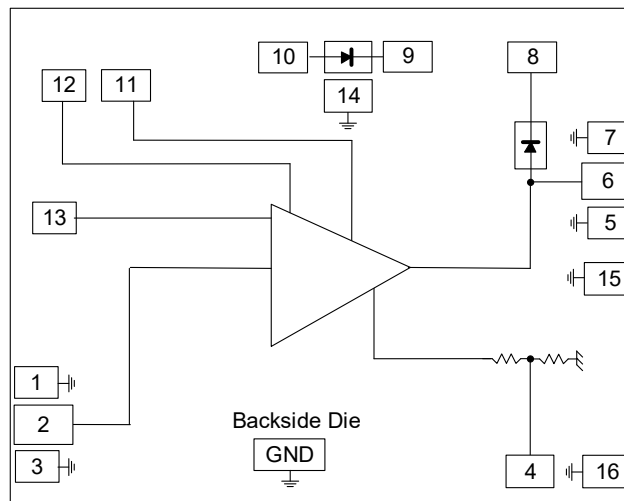
- Wide Frequency Range: 30 kHz - 44 GHz
- 16 dB Gain
- 3 - 8 V DC, 200 mA
- 22 dBm P1dB @ 22 GHz
- Integrated Power Detector with a Detector Reference Voltage Generator
- 50  $\Omega$  Input and Output Match
- RoHS\* Compliant
- Die Size: 2.3 x 1.0 x 0.1 mm

### Description

MAAM-011286-DIE is an easy-to-use, wideband amplifier that operates from 30 kHz to 44 GHz. The amplifier provides 16 dB gain, 22 dBm output power and 5.3 dB noise figure. It is matched to 50  $\Omega$  with typical return loss better than 13 dB.

MAAM-011286-DIE is suitable for a wide range of applications in instrumentation and communication systems.

### Functional Schematic<sup>1</sup>



1. Image not to scale.

### Pad Configuration<sup>2</sup>

Pad #	Pad Name	Description
1,3,5,7,14,15,16	GND	Ground
2	RF <sub>IN</sub>	RF Input
4	V <sub>G1</sub>	Gate Voltage 1
6	RF <sub>OUT</sub> /V <sub>DD</sub>	RF Output
8	DET <sub>OUT</sub>	Output Detector
9	DET <sub>REF</sub>	Reference Detector
10	DET <sub>BIAS</sub>	Detector Bias
11	V <sub>DD</sub>	Drain Voltage
12	V <sub>DAUX</sub>	Auxiliary Drain Voltage
13	V <sub>G2</sub>	Gate Voltage 2

2. Backside of die must be connected to RF, DC and thermal ground.

### Ordering Information

Part Number	Package
MAAM-011286-DIE	Gel Pack

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

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**Electrical Specifications:  $T_C = 25\text{ }^\circ\text{C}$ ,  $V_{DD} = 7\text{ V}$ ,  $Z_0 = 50\text{ }\Omega$**

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	1 - 44 GHz	dB	15	16	—
Gain Flatness	1 - 44 GHz	dB	—	$\pm 1.0$	—
Input Return Loss	1 - 44 GHz	dB	—	15	—
Output Return Loss	1 - 44 GHz	dB	—	13	—
P1dB	22 GHz	dBm	20	22	—
P3dB	22 GHz	dBm	23	24	—
Output IP3	$P_{IN} = +2\text{ dBm / tone}$ , 22 GHz tone spacing = 2 MHz	dBm	—	30	—
Noise Figure	26 GHz 40 GHz	dB	—	5.3 6.8	—
Drain Current <sup>3</sup>	Quiescent bias	mA	—	200	—

3. Set by adjusting  $V_{G1}$  as outlined in operating conditions on page 3.

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

Parameter	Absolute Maximum
Input Power <sup>6</sup>	17 dBm
Drain Supply Voltage	10 V
$V_{G1}$	$-4\text{ V} < V_{G1} < 0\text{ V}$
$V_{G2}$	$-3.5\text{ V} < V_{G2} < +4\text{ V}$
Drain Supply Current	340 mA
Junction Temperature <sup>7,8</sup>	$+150\text{ }^\circ\text{C}$
Operating Temperature	$-40\text{ }^\circ\text{C}$ to $+85\text{ }^\circ\text{C}$
Storage Temperature	$-65\text{ }^\circ\text{C}$ to $+150\text{ }^\circ\text{C}$

- 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.
- MACOM does not recommend sustained operation of power levels above 3 dB gain compression.
- Operating at nominal conditions with  $T_J \leq +150\text{ }^\circ\text{C}$  will ensure  $MTTF > 1 \times 10^6$  hours.
- Junction Temperature ( $T_J$ ) =  $T_A + \theta_{JC} * ((V * I) - (P_{OUT} - P_{IN}))$   
Typical thermal resistance ( $\theta_{JC}$ ) =  $14.2\text{ }^\circ\text{C/W}$ .

### 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 1A devices.

### Operating Conditions

The recommended biasing conditions are  $V_{DD} = 7\text{ V}$  and  $I_{DSQ} = 200\text{ mA}$ , with  $I_{DSQ}$  set by adjusting  $V_{G1}$  after correctly setting  $V_{DD}$  (refer to turn on sequence). To maintain the best performance MACOM recommends using an active bias circuit for constant  $I_{DD}$ .

It is noted that any biasing arrangement used, including active biasing, must be able to source at least 10 mA into the  $V_{G1}$  port. This is because the  $V_{G1}$  port contains a resistive divider with a total resistance to ground of 244  $\Omega$ . For the recommended  $I_{DSQ}$  of 200 mA obtained at a  $V_{G1}$  voltage of around 2.5 V, 10 mA of  $V_{G1}$  current ( $I_{G1}$ ) is expected. These values of  $V_{G1}$  and  $I_{G1}$  will vary slightly between devices.

There are two possible methods for biasing  $V_{DD}$ :

1. Apply  $V_{DD}$  through a bias tee connected to the  $RF_{OUT}/V_{DD}$  port and connect an external DC block to the  $RF_{IN}$  port. This provides wide band performance of 40 MHz to 50 GHz (depending on the bandwidth of the bias tee).
2. Apply  $V_{DD}$  through a wideband conical inductor connected to the  $V_{DD}$  port. No external bias tee is required at the  $RF_{OUT}/V_{DD}$  port; however, external DC blocks are required at both the  $RF_{IN}$  and  $RF_{OUT}$  ports. Using this method provides for an operational frequency of 40 MHz to 50 GHz.

### Operating the MAAM-011286-DIE

#### Turn-on

1. Apply  $V_{G1}$  (-4 V).
2. Increase  $V_{DD}$  to +7 V.
3. Set  $I_{DSQ}$  by adjusting  $V_{G1}$  more positive. (typically -2.5 V for  $I_{DSQ} = 200\text{ mA}$ ).
4. Apply  $RF_{IN}$  signal.

#### Turn-off

1. Remove  $RF_{IN}$  signal.
2. Decrease  $V_{G1}$  to -4 V.
3. Decrease  $V_{DD}$  to 0 V.

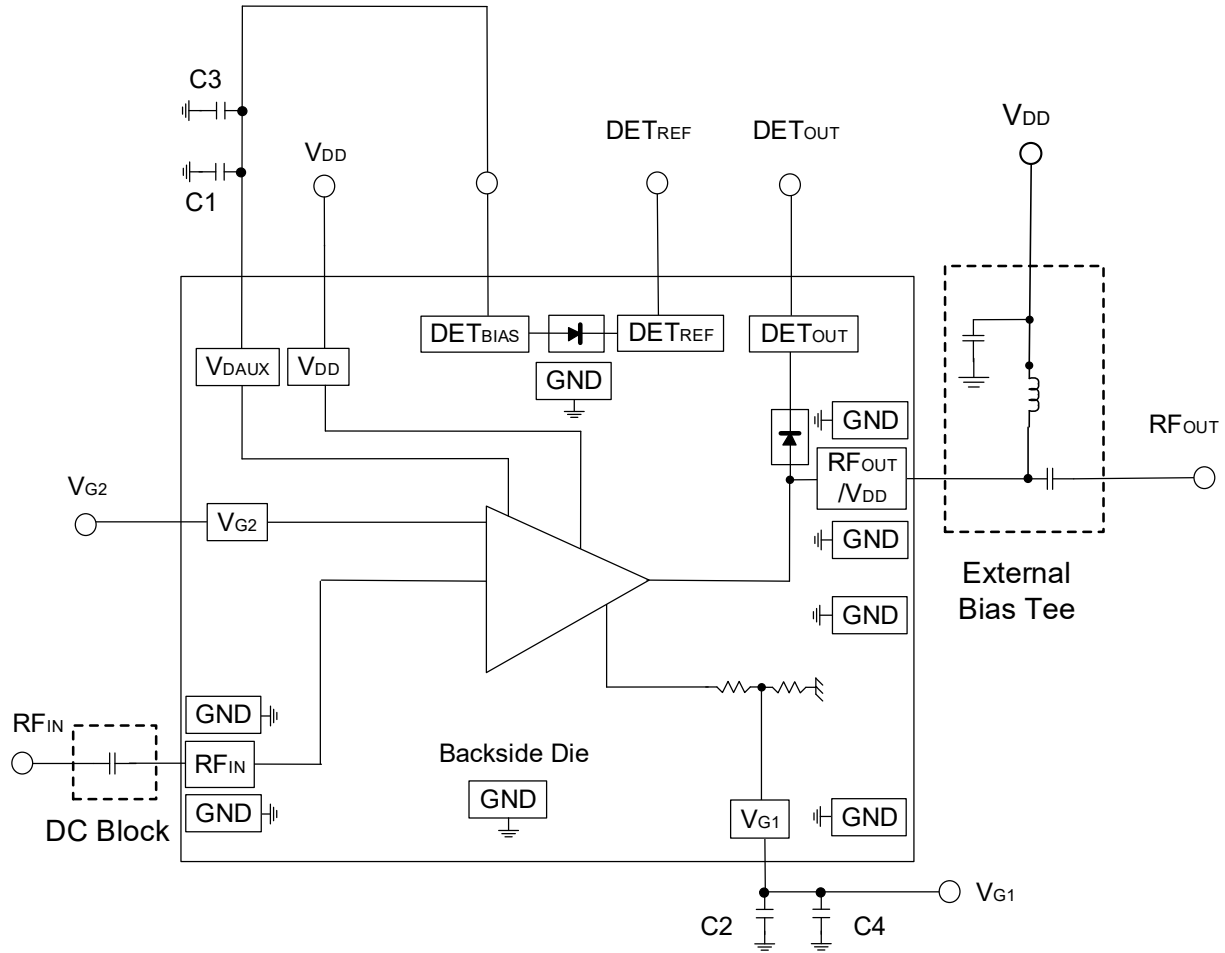
$V_{G2}$  can be used for gain control in all bias configurations. If gain control is not required,  $V_{G2}$  should be left open-circuited.

Regardless of bias method used, 2 bypass capacitors of 100 pF and 1  $\mu\text{F}$  should be connected to  $V_{DAUX}$ . This provides for improved gain flatness below 2 GHz down to 30 kHz when required.

The 100 pF capacitor can be a single layer capacitor or an SMT device on the PCB. Although it should be positioned as closely to the device as practically possible, the frequency response is not particularly sensitive to this. The 1  $\mu\text{F}$  capacitor can be placed further away on the PCB.

Data in this datasheet was measured using bias option 1 and 100 pF (C1) and 1  $\mu\text{F}$  (C3) capacitors on  $V_{DAUX}$ .

## Application Schematic



All bond pads labelled GND have vias to the backside metal. Bond wires on these pads are optional.

## Component List

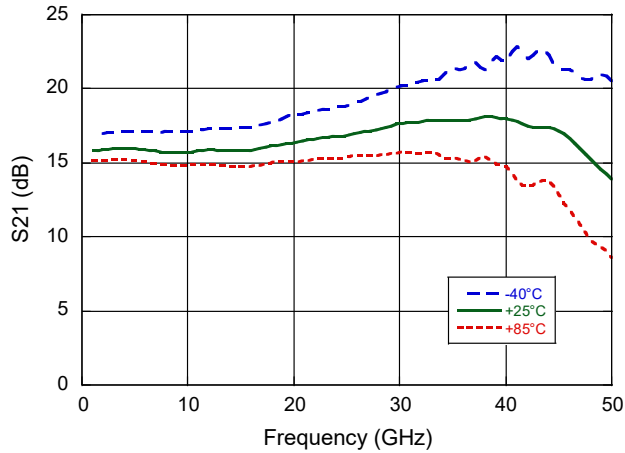
Part	Value	Size
C1	100 pF	Single Layer
C2	1000 pF	0402
C3, C4	1 $\mu$ F	0402

## Wideband Distributed Amplifier 30 kHz - 44 GHz

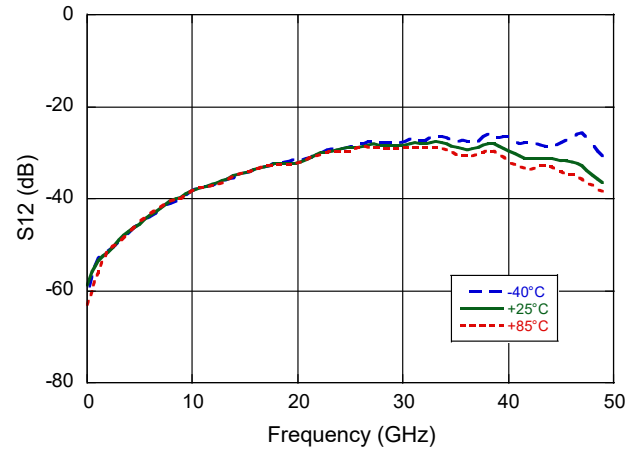
Rev. V2

Typical Performance Curves:  $V_{DD} = 7\text{ V}$ ,  $I_{DSQ} = 200\text{ mA}$

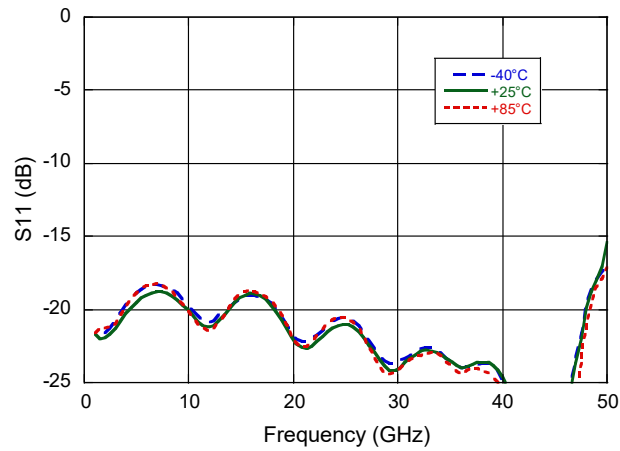
**Gain**



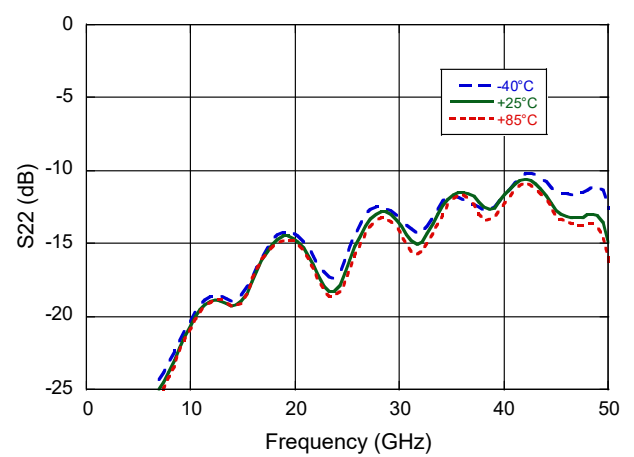
**Reverse Isolation**



**Input Return Loss**



**Output Return Loss**

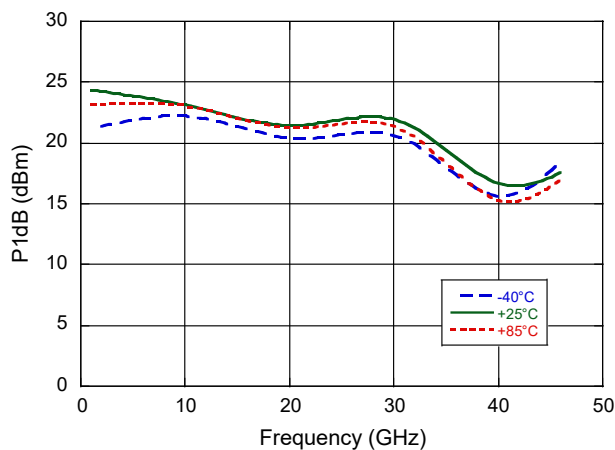


## Wideband Distributed Amplifier 30 kHz - 44 GHz

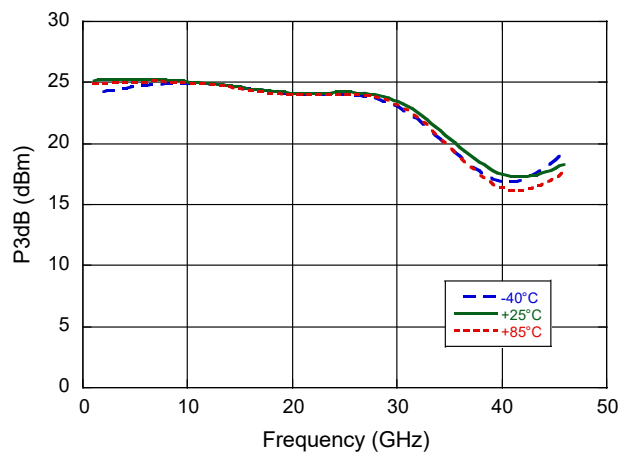
Rev. V2

Typical Performance Curves:  $V_{DD} = 7\text{ V}$ ,  $I_{DSQ} = 200\text{ mA}$

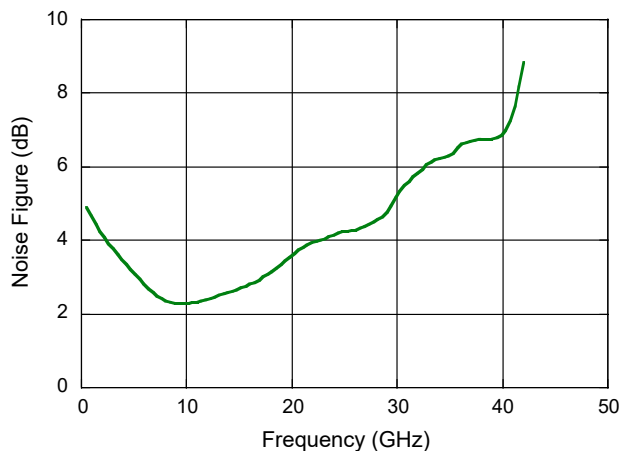
Output P1dB



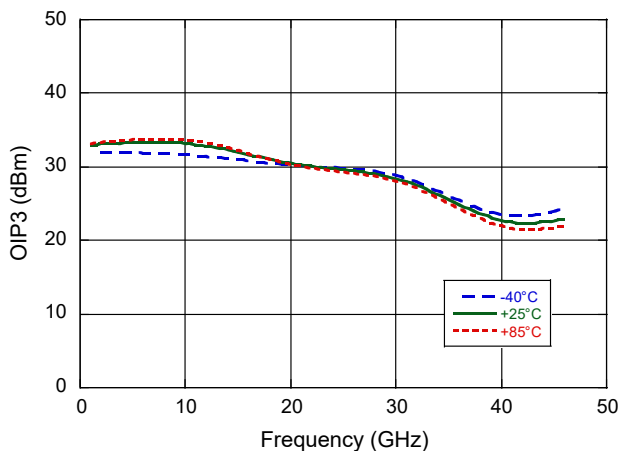
Output P3dB



Noise Figure @ +25°C

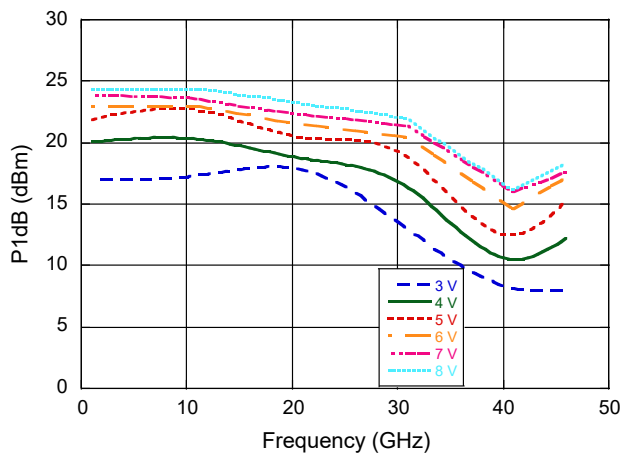


OIP3, +2 dBm / tone, tone spacing = 2 MHz

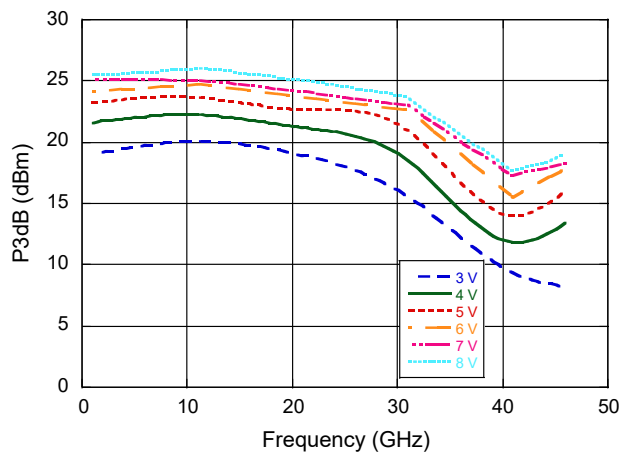


Typical Performance Curves:  $T_A = +25^\circ\text{C}$ ,  $I_{DSQ} = 200\text{ mA}$

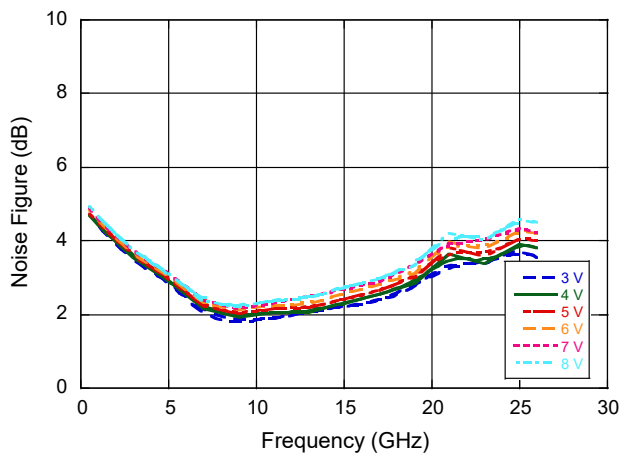
Output P1dB vs.  $V_{DD}$



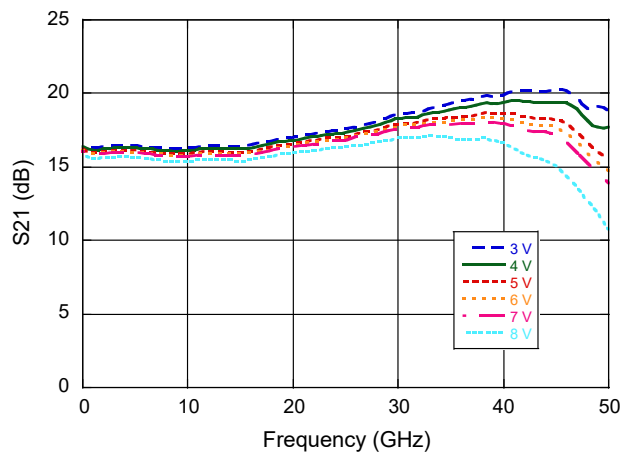
P3dB vs.  $V_{DD}$



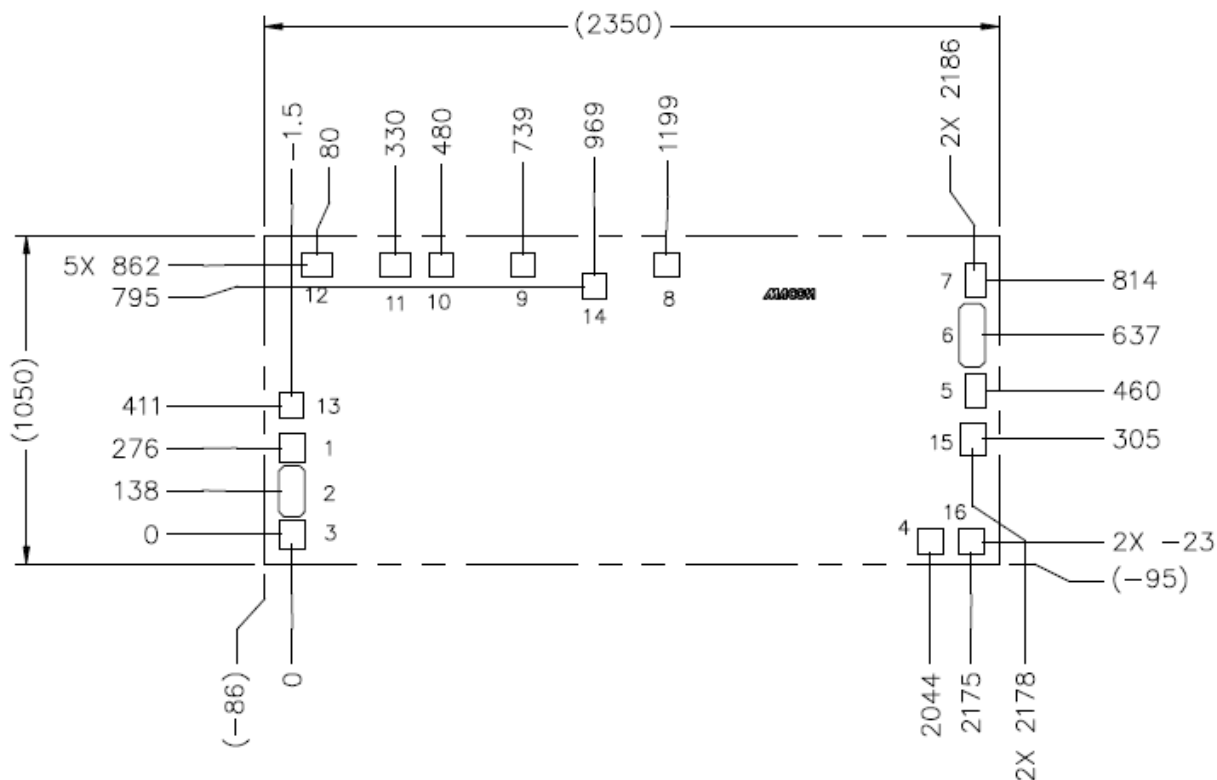
Noise Figure vs.  $V_{DD}$



Gain vs.  $V_{DD}$



## Die Dimensions<sup>9,10,11,12</sup>



- 9. All units in  $\mu\text{m}$ , unless otherwise noted, with a tolerance of  $\pm 5 \mu\text{m}$ .
- 10. Die thickness is  $100 \pm 10 \mu\text{m}$ .
- 11. Die size reflects un-cut dimensions. Laser kerf reduces die size by  $\sim 25 \mu\text{m}$  each dimension.
- 12. Bond Pad / Backside Metallization : Gold

## Bond Pad Detail

Pad	X ( $\mu\text{m}$ )	Y ( $\mu\text{m}$ )
1,3	80	90
2	80	160
4,8,9,10,13,14,16	80	80
5,7	65	110
6	80	200
11,12	100	80
15	80	100



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