

# Wideband Distributed Amplifier

## 30 kHz - 40 GHz



MAAM-011275-DIE

Rev. V4

### Features

- Wide Frequency Range: 30 kHz - 40 GHz
- 15 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 0.05 mm

### Applications

- Instrumentation and Communication Systems

### Description

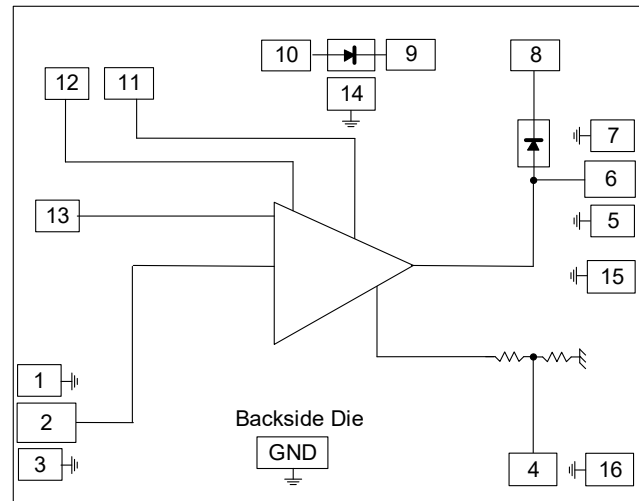
MAAM-011275-DIE is an easy-to-use, wideband amplifier that operates from 30 kHz to 40 GHz. The amplifier provides 15 dB gain, 22 dBm output power and 5.3 dB noise figure. It is matched to 50  $\Omega$  with typical return loss better than 13 dB.

MAAM-011275-DIE is suitable for a wide range of applications in instrumentation and communication systems.

### Ordering Information

Part Number	Package
MAAM-011275-DIE	Die in Gel Pack

### 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.

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

**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 - 40 GHz	dB	13.5	15	—
Gain Flatness	1 - 40 GHz	dB	—	$\pm 0.75$	—
Input Return Loss	1 - 40 GHz	dB	—	15	—
Output Return Loss	1 - 40 GHz	dB	—	13	—
P1dB	22 GHz	dBm	—	21	—
P3dB	22 GHz	dBm	22.5	24	—
Output IP3	$P_{IN} = +2\text{ dBm}$ / tone, 22 GHz tone spacing = 2 MHz	dBm	—	33	—
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	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>6,7</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.
- 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 ( $\theta_{JC}$ ) =  $11.9\text{ }^\circ\text{C/W}$ .

**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.

$V_{G2}$  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  $V_{DAUX}$ .

### Operating the MAAM-011275-DIE

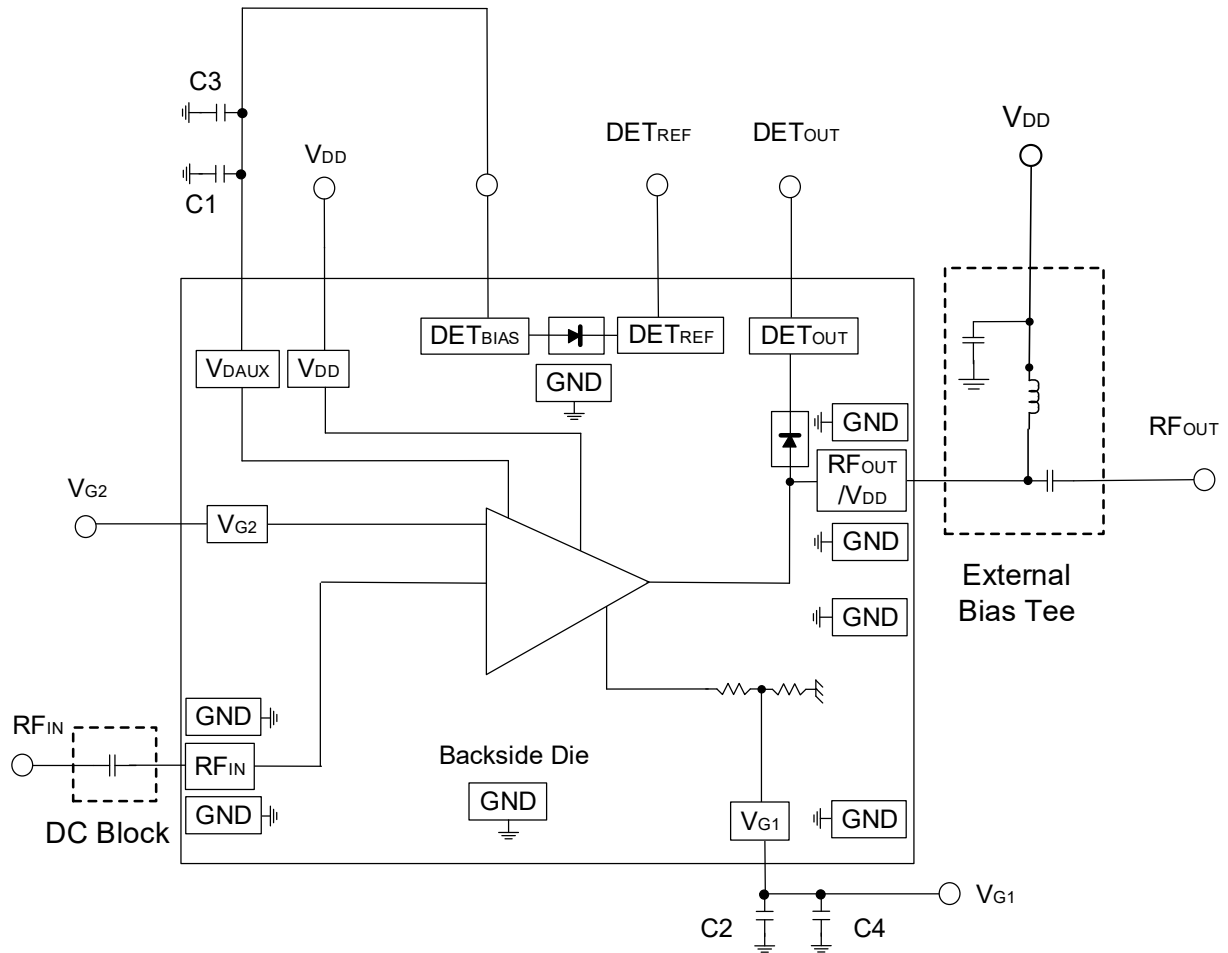
#### Turn-on

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.

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 - 40 GHz

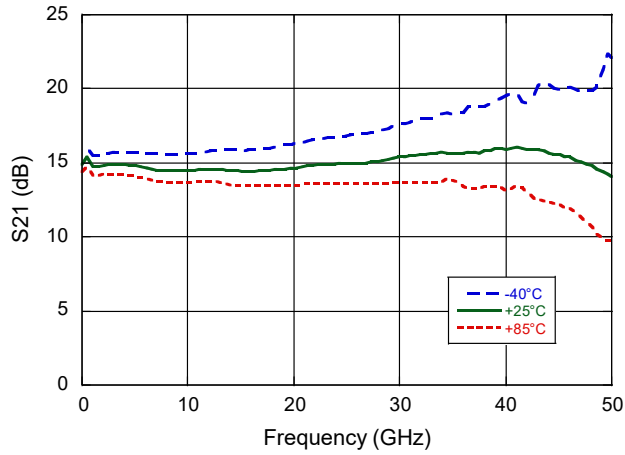


MAAM-011275-DIE

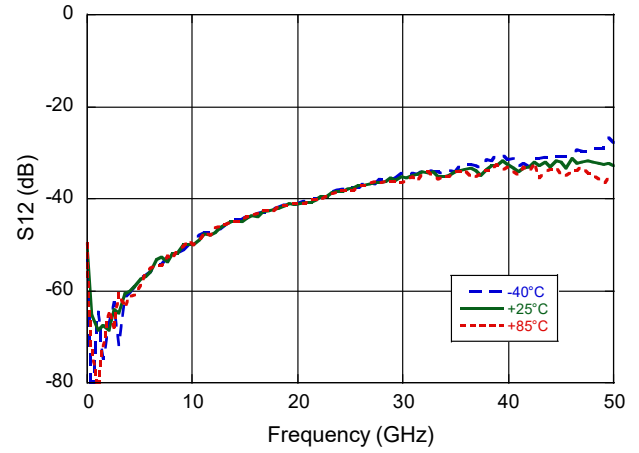
Rev. V4

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

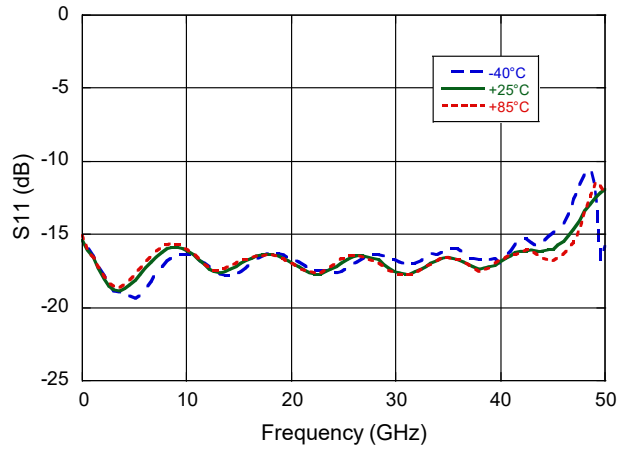
**Gain**



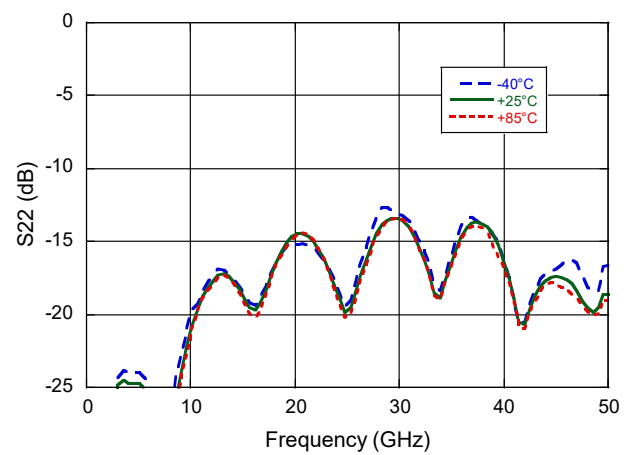
**Reverse Isolation**



**Input Return Loss**



**Output Return Loss**



# Wideband Distributed Amplifier

## 30 kHz - 40 GHz

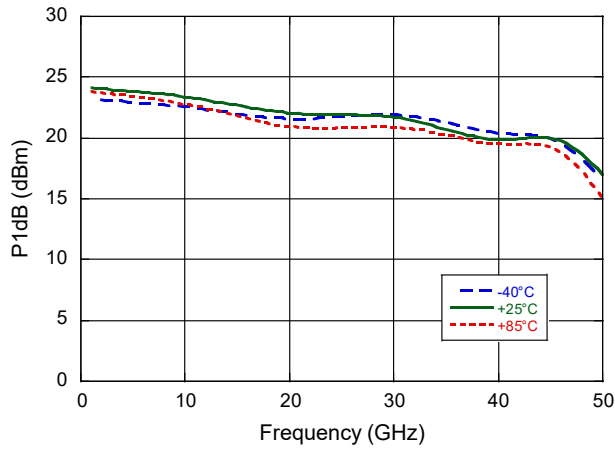


MAAM-011275-DIE

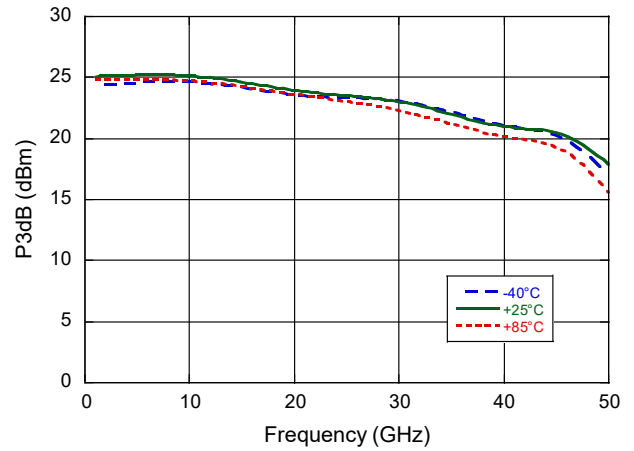
Rev. V4

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

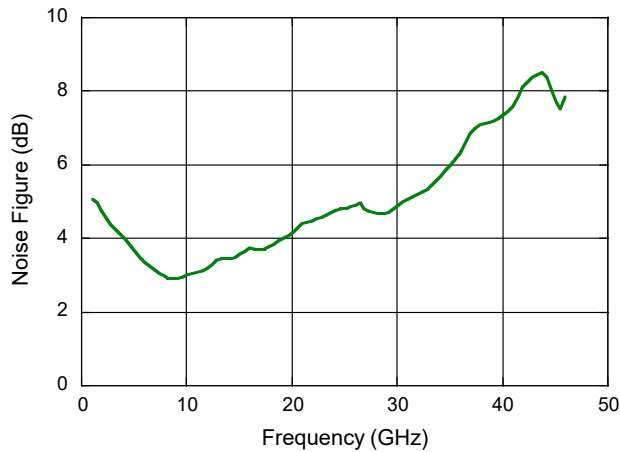
Output P1dB



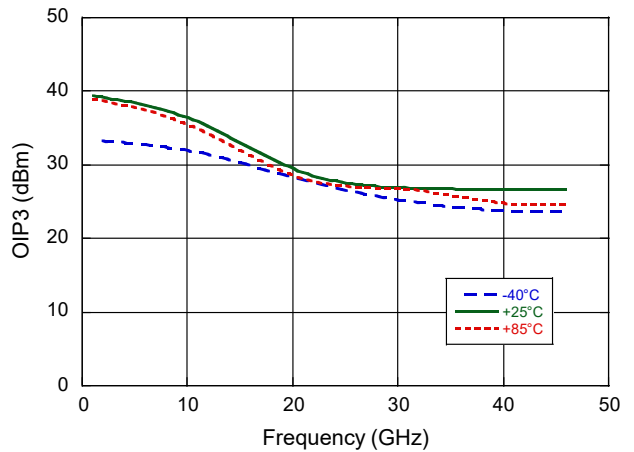
Output P3dB



Noise Figure @ +25°C



OIP3



# Wideband Distributed Amplifier

## 30 kHz - 40 GHz

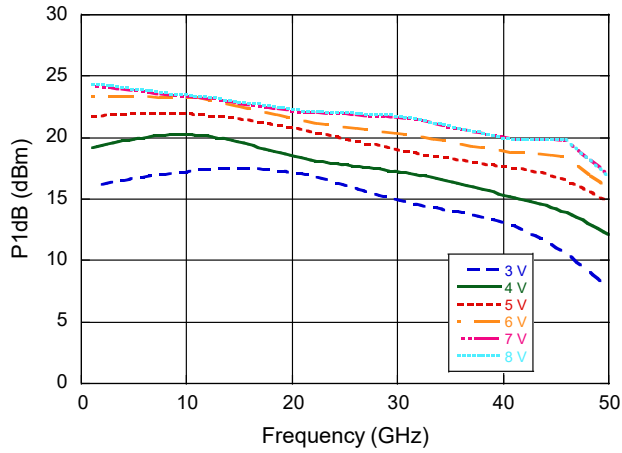


MAAM-011275-DIE

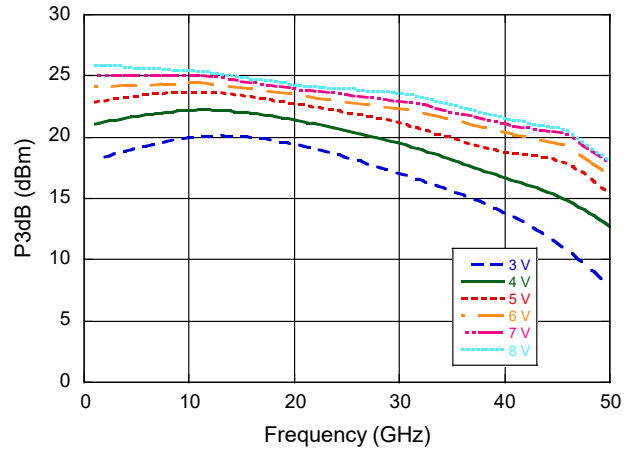
Rev. V4

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

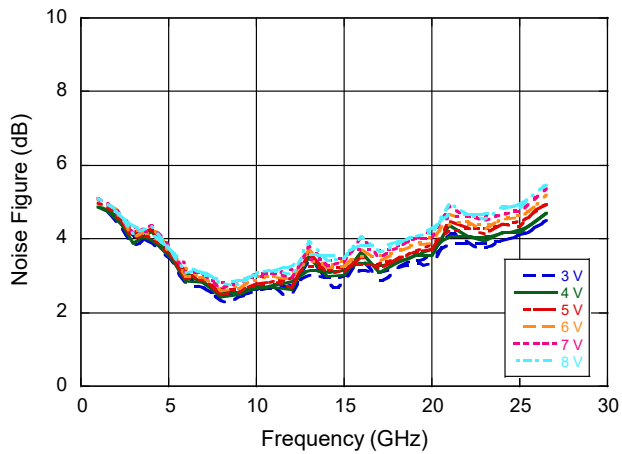
Output P1dB vs.  $V_{DD}$



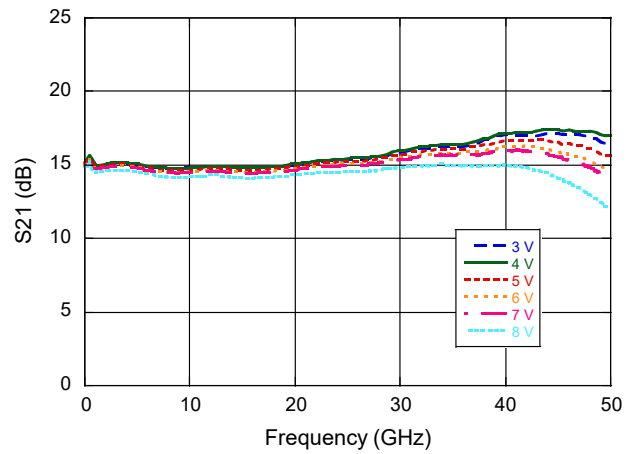
P3dB vs.  $V_{DD}$



Noise Figure vs.  $V_{DD}$



Gain vs.  $V_{DD}$



# Wideband Distributed Amplifier 30 kHz - 40 GHz

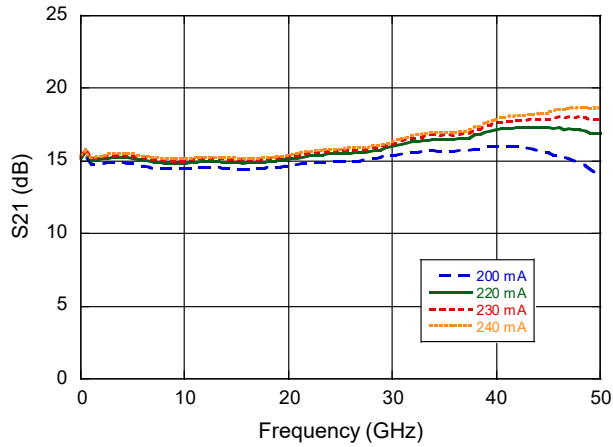


MAAM-011275-DIE

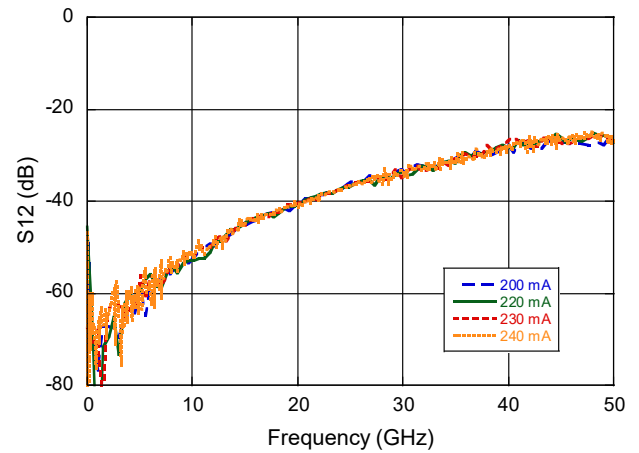
Rev. V4

## Typical Performance Curves: $V_{DD} = 7\text{ V}$ , $T_A = +25^\circ\text{C}$

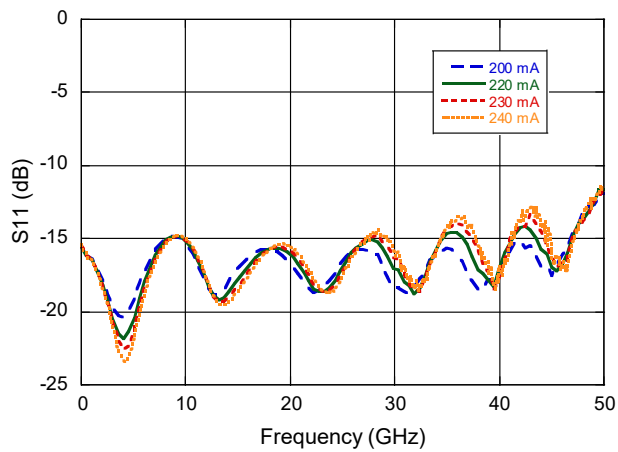
Gain vs.  $I_{DD}$



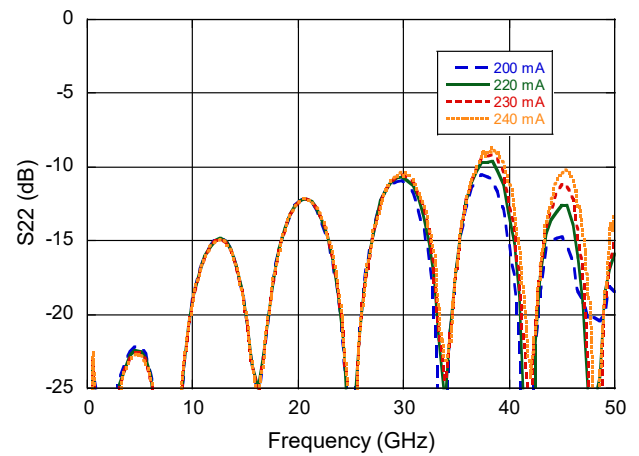
Reverse Isolation vs.  $I_{DD}$



Input Return Loss vs.  $I_{DD}$



Output Return Loss vs.  $I_{DD}$





# Wideband Distributed Amplifier

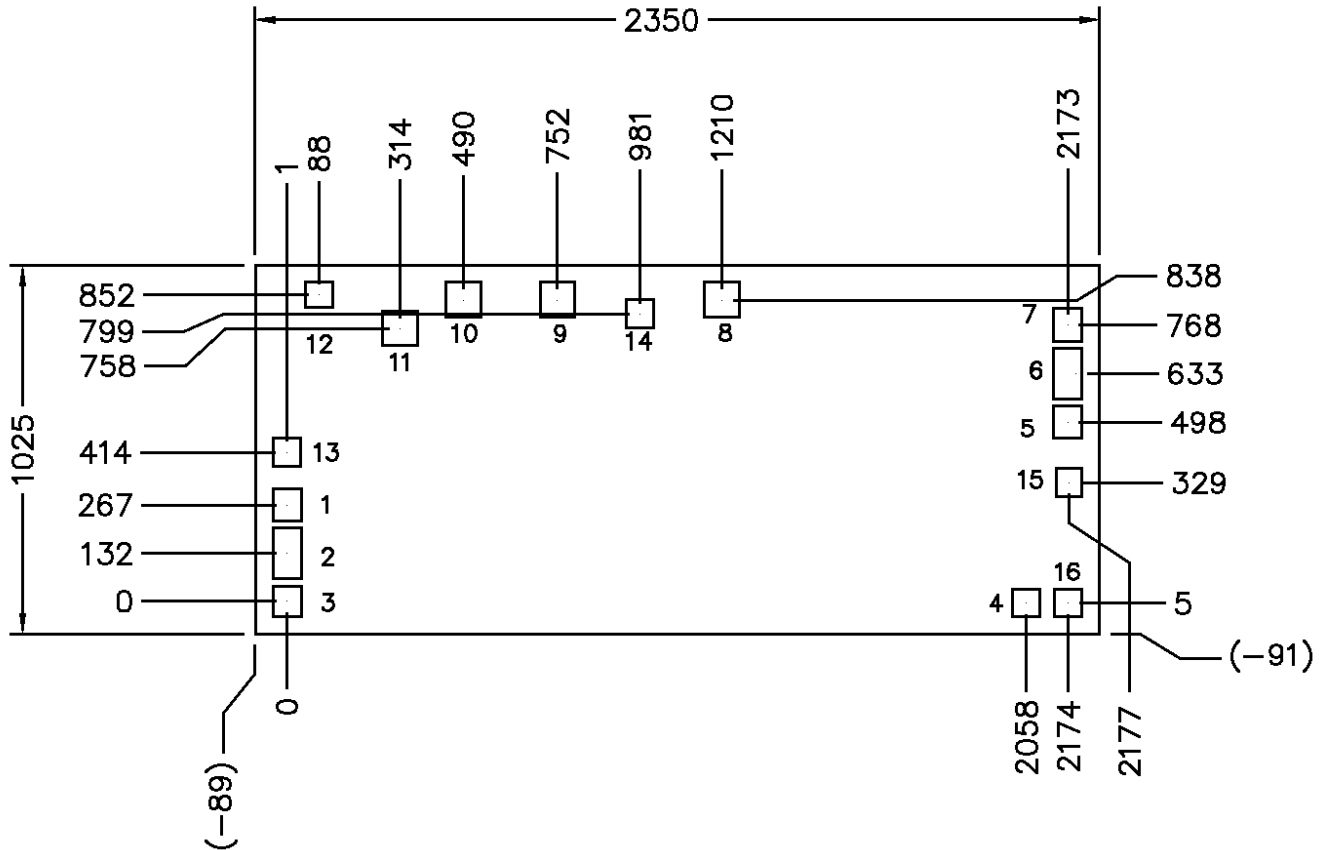
## 30 kHz - 40 GHz



MAAM-011275-DIE

Rev. V4

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



- 9. All units in  $\mu\text{m}$ , unless otherwise noted, with a tolerance of  $\pm 5 \mu\text{m}$ .
- 10. Die thickness is  $50 \pm 5 \mu\text{m}$ .
- 11. Die size reflects un-cut dimensions. Laser kerf reduces die size by  $\sim 25 \mu\text{m}$  each dimension.

### Bond Pad Detail

Pad	X ( $\mu\text{m}$ )	Y ( $\mu\text{m}$ )
1,3,5,7	74	89
2, 6,	74	140
4,13,14,16	76	76
8,9,10,11	96	96
12	76	71
15	71	76

MACOM Technology Solutions Inc. ("MACOM"). All rights reserved.

These materials are provided in connection with MACOM's products as a service to its customers and may be used for informational purposes only. Except as provided in its Terms and Conditions of Sale or any separate agreement, MACOM assumes no liability or responsibility whatsoever, including for (i) errors or omissions in these materials; (ii) failure to update these materials; or (iii) conflicts or incompatibilities arising from future changes to specifications and product descriptions, which MACOM may make at any time, without notice. These materials grant no license, express or implied, to any intellectual property rights.

THESE MATERIALS ARE PROVIDED "AS IS" WITH NO WARRANTY OR LIABILITY, EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHT, ACCURACY OR COMPLETENESS, OR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.