

### Features

- Noise Figure: 2.5 dB @ 24 GHz
- High Gain: 23 dB @ 24 GHz
- 50  $\Omega$  match on input and output
- Single Voltage Bias: 3 V to 5 V range
- Integrated Active Bias Circuit
- Current adjustable from 1 mA - 80 mA
- Lead-Free 2 mm 8-lead PDFN Package
- Halogen-Free “Green” Mold Compound
- RoHS\* Compliant

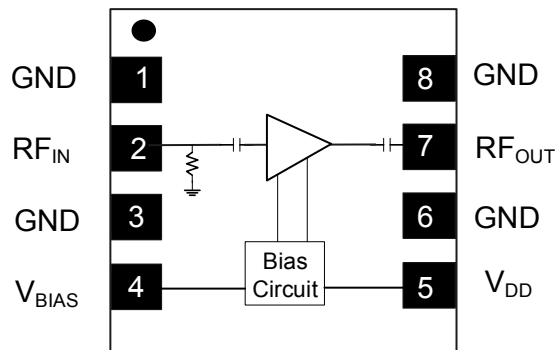
### Description

The MAAL-011129 is an easy-to-use three stage low noise amplifier with high gain and broadband 50  $\Omega$  match. It is designed for operation from 18 to 31.5 GHz and housed in a lead-free 2 mm 8-lead PDFN plastic package.

The MAAL-011129 has an integrated active bias circuit and bias tee to allow direct connection to  $V_{DD}$  without external chokes or DC blocks. The bias current is set by a simple external resistor,  $R_B$ , so the user can customize the power consumption. When  $V_{BIAS} = 0$  V, the device is placed in power down mode.

The MAAL-011129 offers a surface-mount, easy-to-use, low noise amplifier solution that is well suited to diverse receiver applications such as VSAT, Point-to-Point and 24 GHz ISM.

### Functional Schematic



### Pin Configuration<sup>3</sup>

Pin No.	Pin Name	Description
1	GND	Ground
2	RF <sub>IN</sub>	RF Input
3	GND	Ground
4	V <sub>BIAS</sub>	Bias Control Voltage
5	V <sub>DD</sub>	Drain Voltage
6	GND	Ground
7	RF <sub>OUT</sub>	RF Output
8	GND	Ground
	Paddle	RF + DC Ground

3. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

### Ordering Information<sup>1,2</sup>

Part Number	Package
MAAL-011129-TR3000	3000 piece reel
MAAL-011129-SMB	Sample Board

1. Reference Application Note M513 for reel size information.  
2. All sample boards include 5 loose parts.

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

**Electrical Specifications: Freq. = 24 GHz, T<sub>A</sub> = 25°C, V<sub>DD</sub> = 5 V, R<sub>B</sub> = 1 kΩ, Z<sub>0</sub> = 50 Ω**

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Noise Figure	—	dB	—	2.5	3.3
Gain	P <sub>IN</sub> = -20 dBm	dB	20	23	—
Input Return Loss	P <sub>IN</sub> = -20 dBm	dB	—	-13	—
Output Return Loss	P <sub>IN</sub> = -20 dBm	dB	—	-13	—
Output IP3	P <sub>IN</sub> = -22 dBm/tone (10 MHz Tone Spacing)	dBm	—	25	—
Output P1dB	—	dBm	—	16	—
Isolation	P <sub>IN</sub> = -20 dBm	dB	—	45	—
Bias Current	—	mA	—	50	65

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

Parameter	Absolute Maximum
Input Power	10 dBm
Operating Voltage	6 V
Junction Temperature <sup>6,7</sup>	+150°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°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.
6. Operating at nominal conditions with T<sub>J</sub> ≤ +150°C will ensure MTTF > 1 x 10<sup>6</sup> hours.
7. Junction Temperature (T<sub>J</sub>) = T<sub>C</sub> + Θ<sub>jc</sub> \* (V \* I)  
Typical thermal resistance (Θ<sub>jc</sub>) = 102°C/W.
  - a) T<sub>C</sub> = +25°C,  
T<sub>J</sub> = 51°C @ 5 V, 50 mA
  - b) T<sub>C</sub> = +85°C,  
T<sub>J</sub> = 111°C @ 5 V, 50 mA

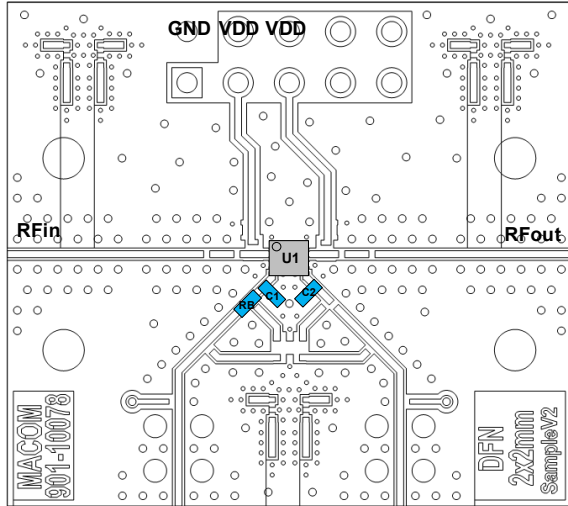
### Handling Procedures

Please observe the following precautions to avoid damage:

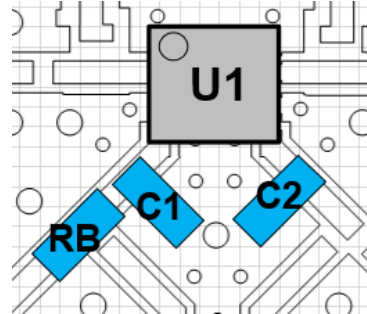
### Static Sensitivity

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 devices.

## Sample PCB



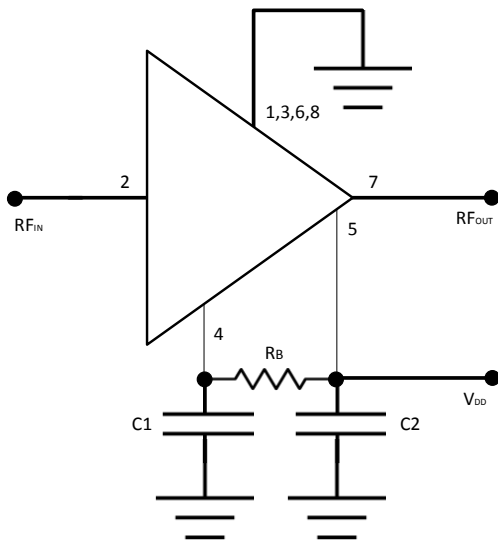
## Sample PCB Layout



## Parts List

Des	Value	Size	Part Number	Purpose
C1 C2	0.01 $\mu$ F	0201	Murata GRM033R70J103KA01D	Bypass
RB	See chart	0201	various	Bias Resistor
U1	—	2 mm	MACOM MAAL-011129	LNA

## Application Schematic



## Application Information

The MAAL-011129 is designed to be easy to use yet provide high performance. The ultra small size, with no matching, and simple bias application allows easy placement on system boards.

## Single Bias Operation

Connecting  $V_{DD}$  to  $V_{BIAS}$  using an external resistor  $R_B$  enables single bias operation of the amplifier, and the value of external resistor  $R_B$  sets the desired current  $I_{DD}$ . The following table shows drain current ( $I_{DD}$ ) versus external resistor ( $R_B$ ) values for  $V_{DD}$  voltages of 5 V and 3.3 V:

$V_{DD} = 3.3 \text{ V}$		$V_{DD} = 5 \text{ V}$	
$R_B (\Omega)$	$I_{DD} (\text{mA})$	$R_B (\Omega)$	$I_{DD} (\text{mA})$
Open	15	Open	25
200	50	200	80
400	40	400	70
1k	30	1k	50
2k	25	2k	40

With pin 4 ( $V_{BIAS}$ ) left open the amplifier will default to low power mode. When pin 4 ( $V_{BIAS}$ ) is set to 0 V through  $R_B$ , the device enters power down mode. In order to use power down mode a second supply is required that directly drives the  $R_B$  resistor.

## Grounding

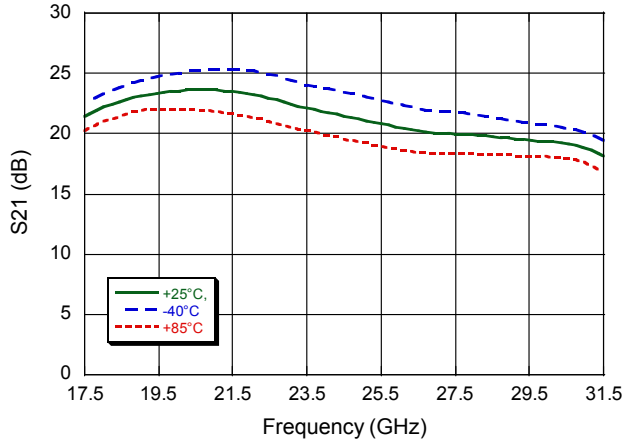
It is recommended that the total ground (common mode) inductance not exceed 0.03 nH (30 pH). This is equivalent to placing at least four 8-mil (200- $\mu$ m) diameter vias under the device, assuming an 8-mil (200- $\mu$ m) thick RF layer to ground.

## Low Noise Amplifier 18 - 31.5 GHz

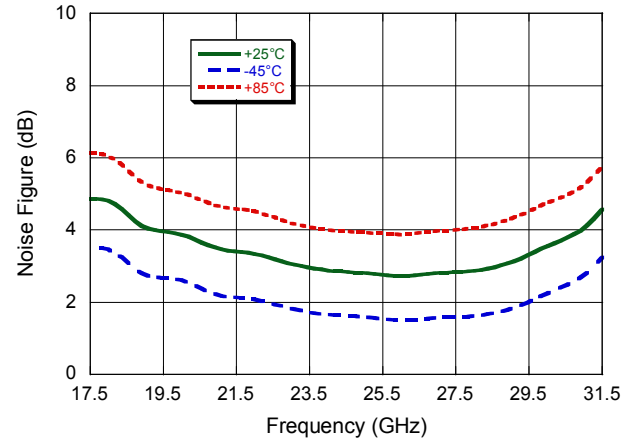
Rev. V1

### Typical Performance Curves $V_{DD} = 5\text{ V}$ , $R_B = 1\text{ k}\Omega$

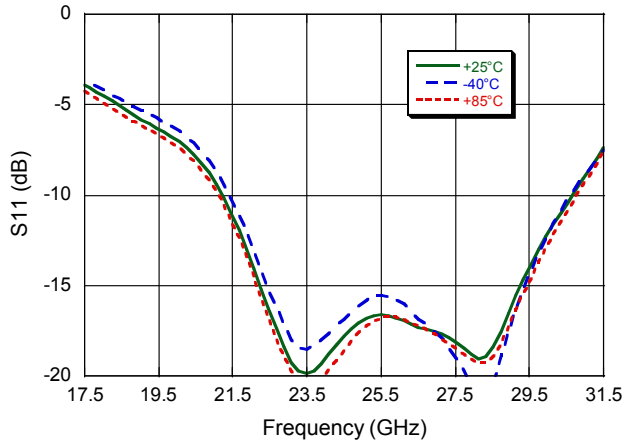
**Gain**



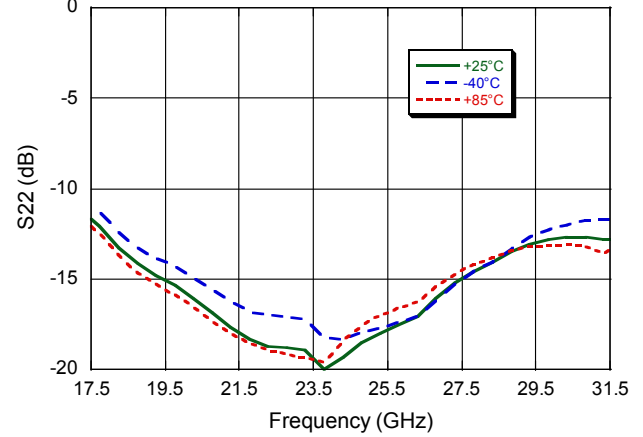
**Noise Figure**



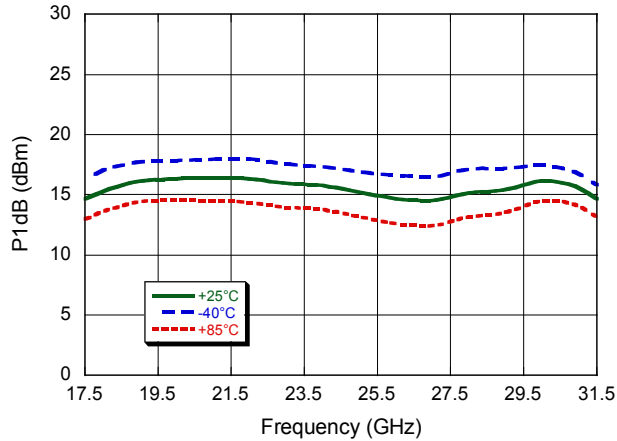
**Input Return Loss**



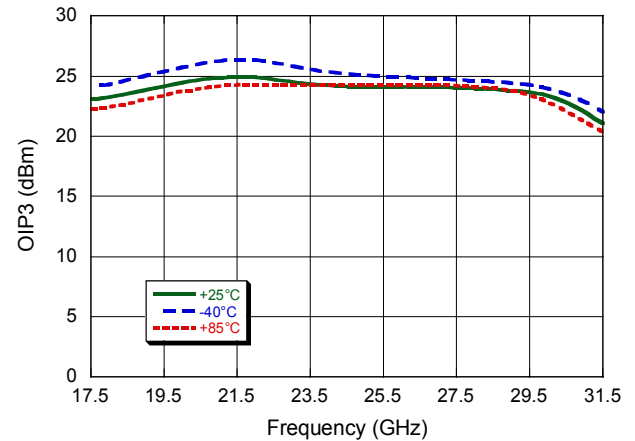
**Output Return Loss**



**P1dB**



**OIP3**

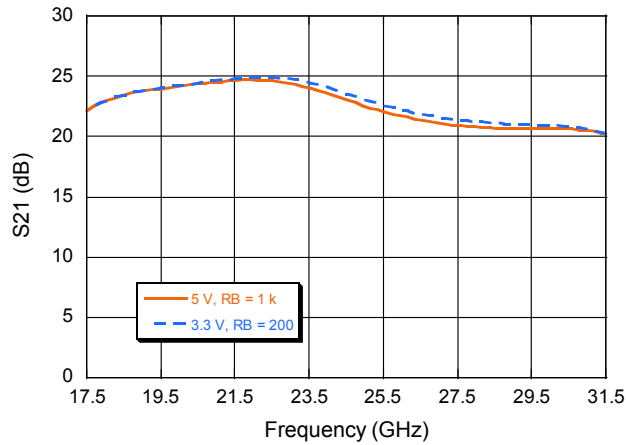


## Low Noise Amplifier 18 - 31.5 GHz

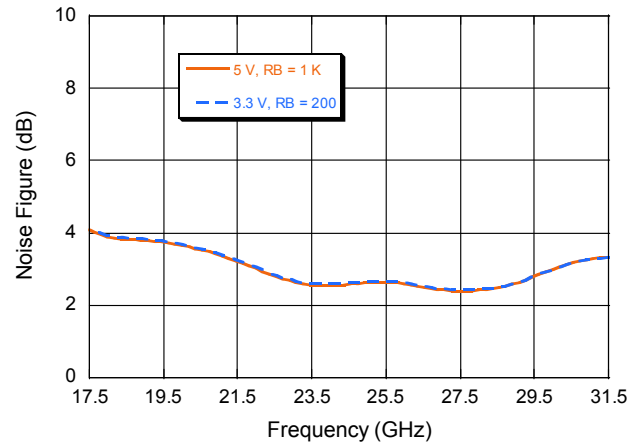
Rev. V1

### Typical Performance Curves $V_{DD} = 3.3\text{ V} \& 5\text{ V}$

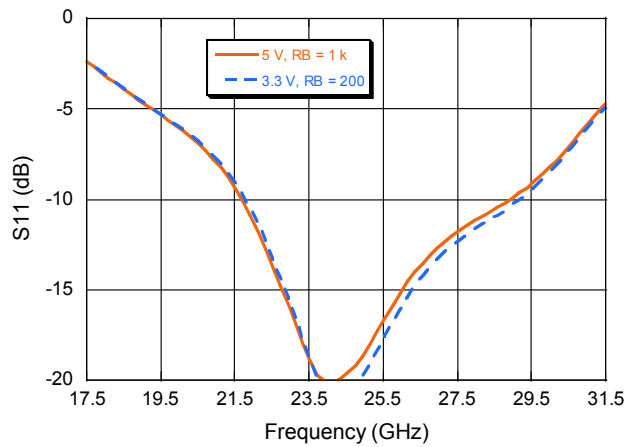
**Gain**



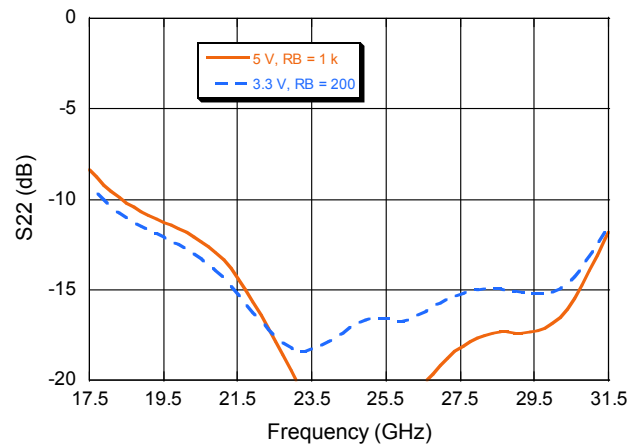
**Noise Figure**



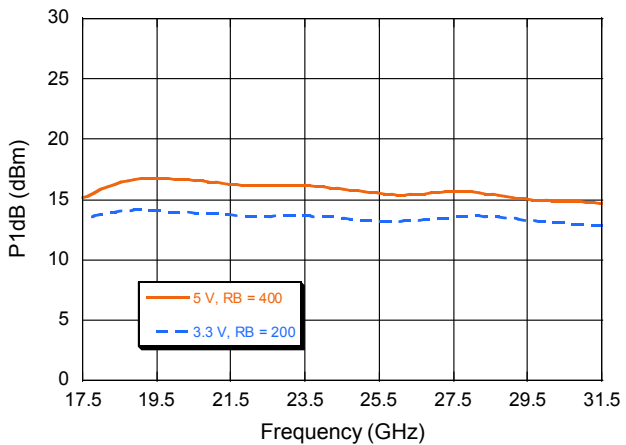
**Input Return Loss**



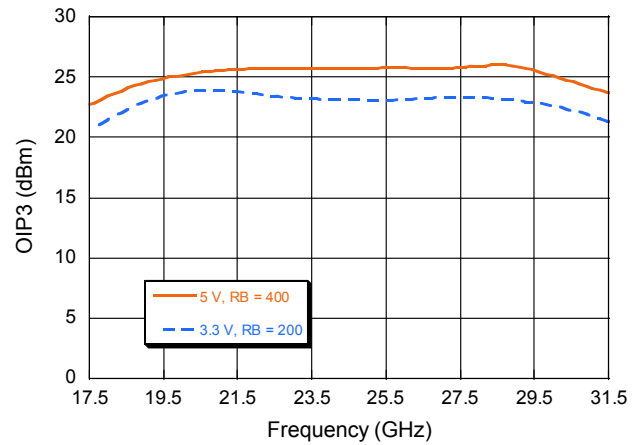
**Output Return Loss**



**P1dB**



**OIP3**

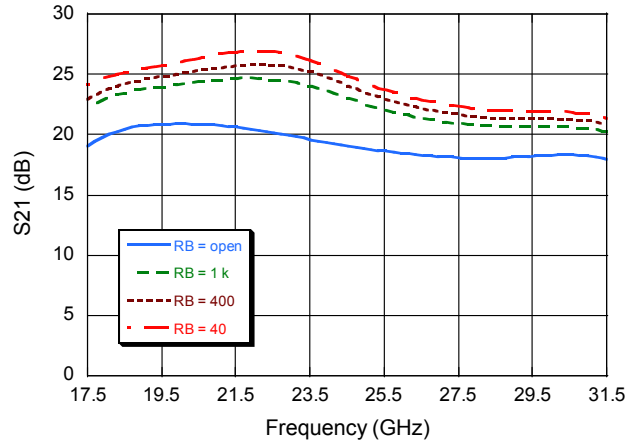


## Low Noise Amplifier 18 - 31.5 GHz

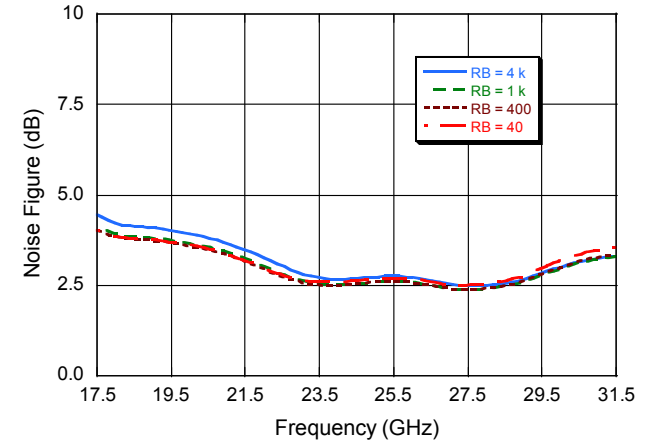
Rev. V1

### Typical Performance Curves VDD = 5 V, I<sub>DD</sub> varied by R<sub>B</sub>

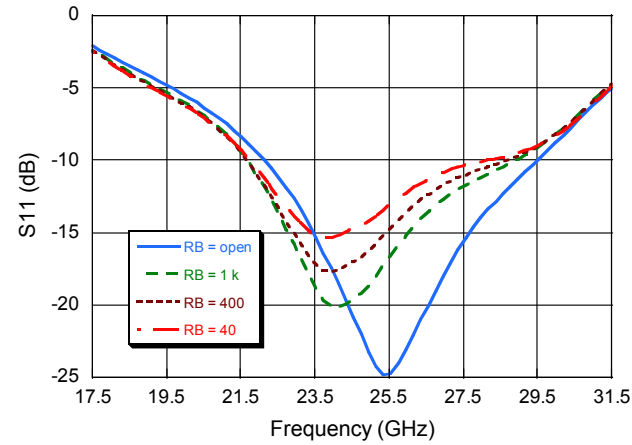
**Gain**



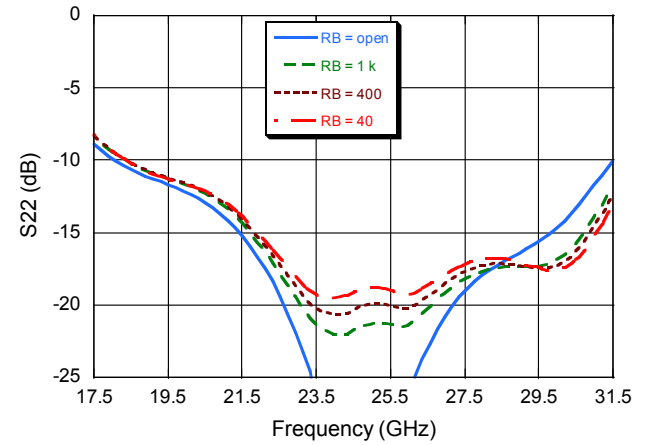
**Noise Figure**



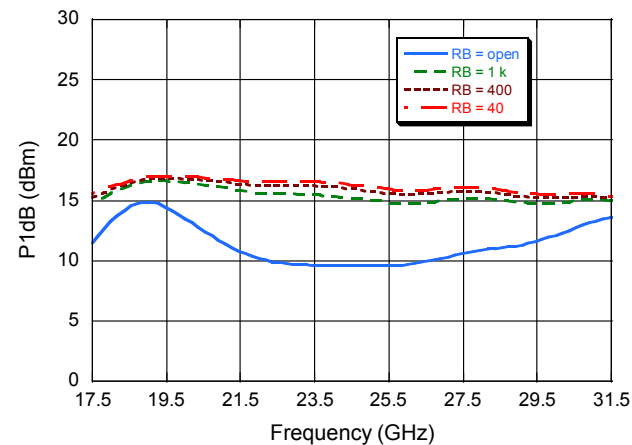
**Input Return Loss**



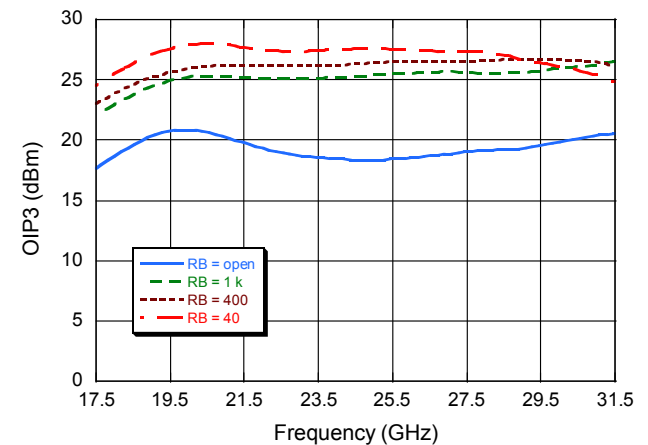
**Output Return Loss**



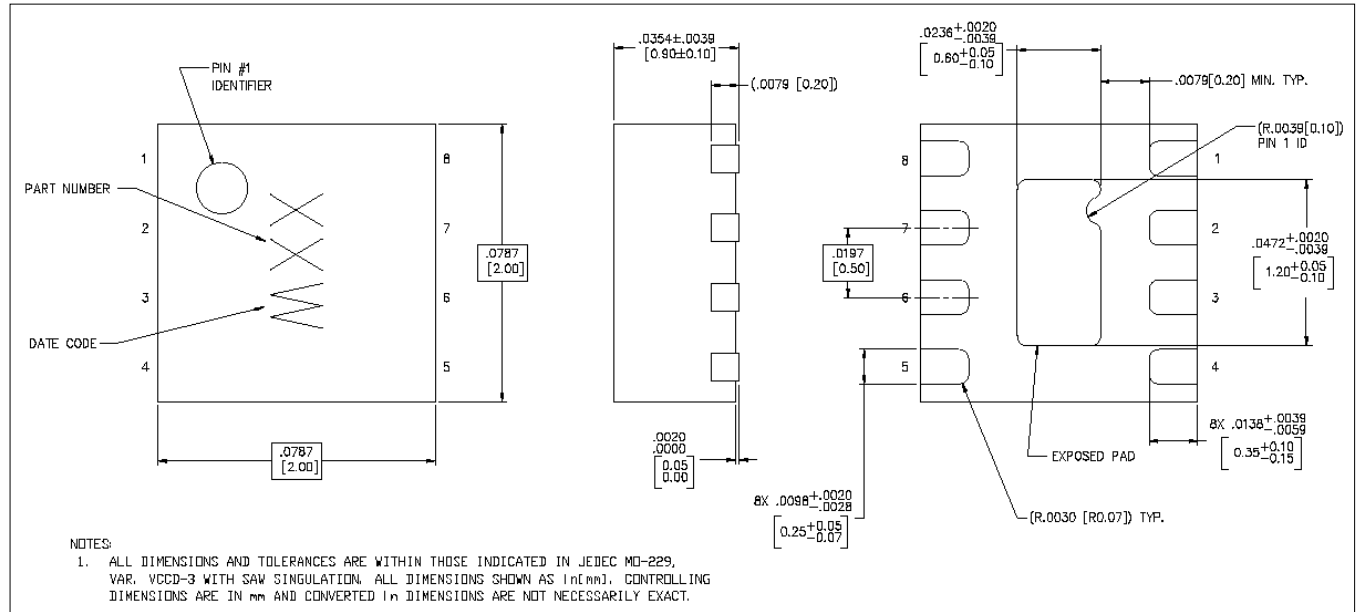
**P1dB**



**OIP3**



## Lead Free 2 mm 8 Lead PDFN Package<sup>†</sup>



<sup>†</sup> Reference Application Note S2083 for lead-free solder reflow recommendations.  
Meets JEDEC moisture sensitivity level 1 requirements.  
Plating is 100% Matte Tin over Copper

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