MAAL-011129

Low Noise Amplifier
18 - 31.5 GHz

Rev. V1

Features

- Noise Figure: 2.5 dB @ 24 GHz
- High Gain: 23 dB @ 24 GHz
- 50 Ω 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

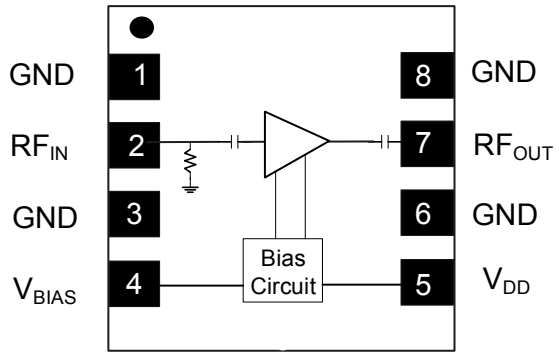
Description

The MAAL-011129 is an easy-to-use three stage low noise amplifier with high gain and broadband 50 Ω 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[3]

Pin No.	Pin Name	Description
1	GND	Ground
2	RF_{IN}	RF Input
3	GND	Ground
4	V_{BIAS}	Bias Control Voltage
5	V_{DD}	Drain Voltage
6	GND	Ground
7	RF_{OUT}	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[1,2]

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_A = 25°C, V_{DD} = 5 V, R_B = 1 kΩ , Z_0 = 50 Ω

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

Absolute Maximum Ratings[4,5]

Parameter	Absolute Maximum
Input Power	10 dBm
Operating Voltage	6 V
Junction Temperature[6,7]	+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 $T_J \leq$ +150°C will ensure MTTF > 1 x 10^6 hours.
7. Junction Temperature (T_J) = T_C + Θjc * (V * I)
   Typical thermal resistance (Θjc) = 102°C/W.
   a) T_C = +25°C,
   T_J = 51°C @ 5 V, 50 mA
   b) T_C = +85°C,
   T_J = 111°C @ 5 V, 50 mA

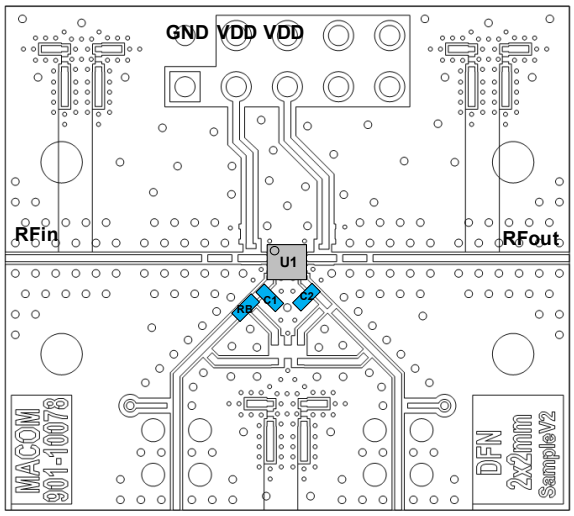
Handling Procedures

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.

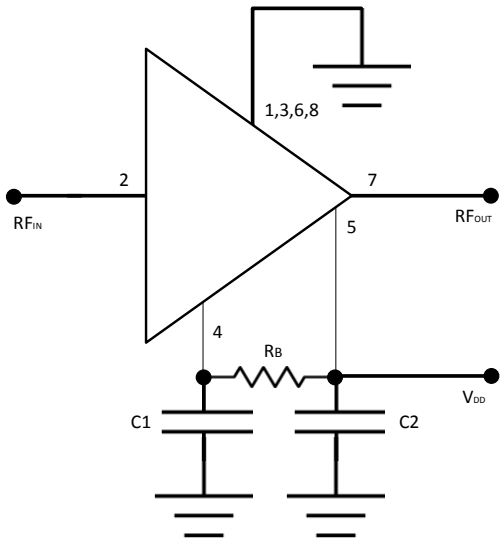
Sample PCB



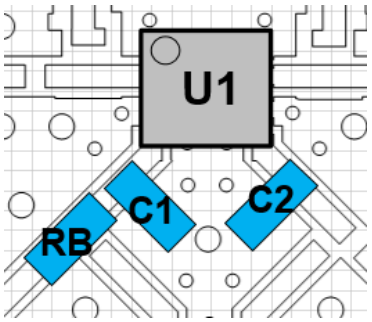
Parts List

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

Application Schematic



Sample PCB Layout



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

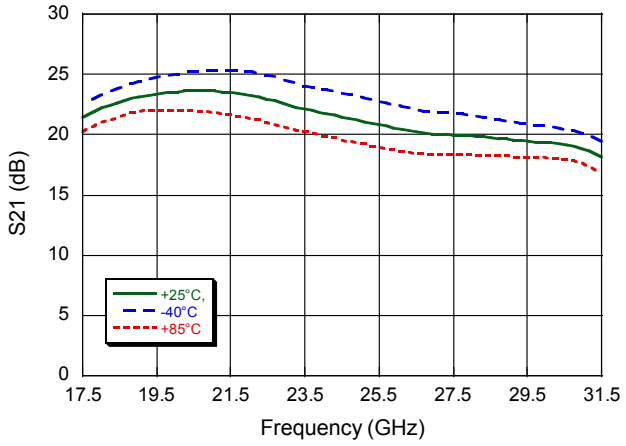
With pin 4 (V_{BIAS}) left open the amplifier will default to low power mode. When pin 4 (V_{BIAS}) is set to 0 V through RB, the device enters power down mode. In order to use power down mode a second supply is required that directly drives the RB resistor.

Grounding

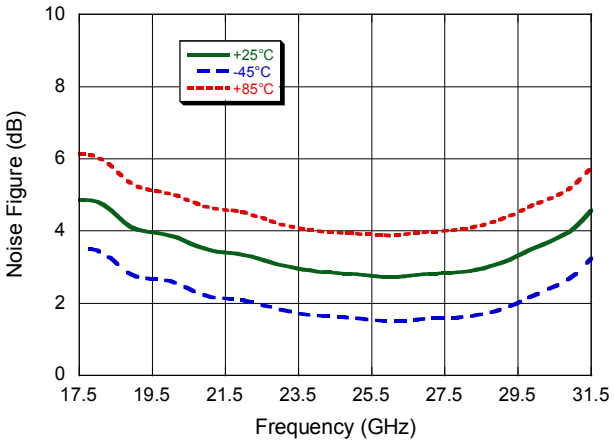
It is recommended that the total ground (common mode) inductance not exceed 0.03 nH (30 pH). This is equivalent to placing at least four 8-mil (200-µm) diameter vias under the device, assuming an 8-mil (200-µm) thick RF layer to ground.

Typical Performance Curves V_{DD} = 5 V, R_B = 1 kΩ

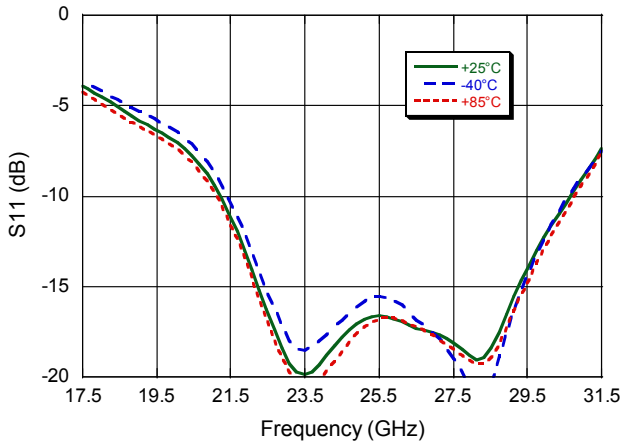
Gain



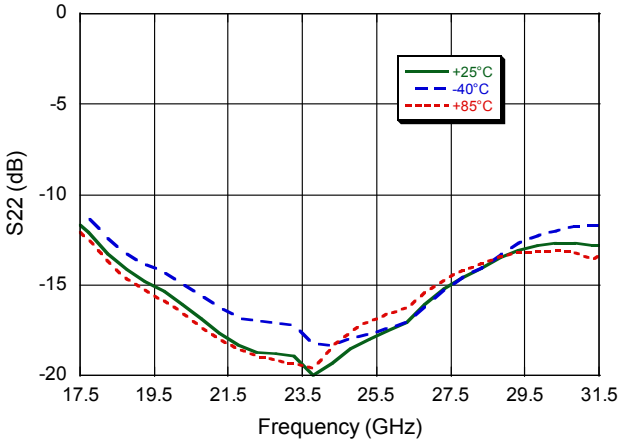
Noise Figure



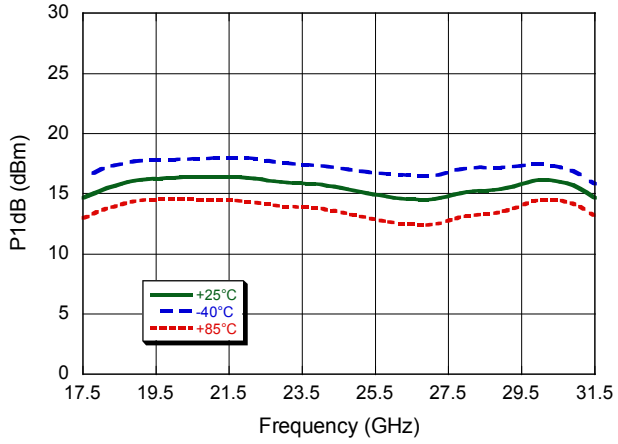
Input Return Loss



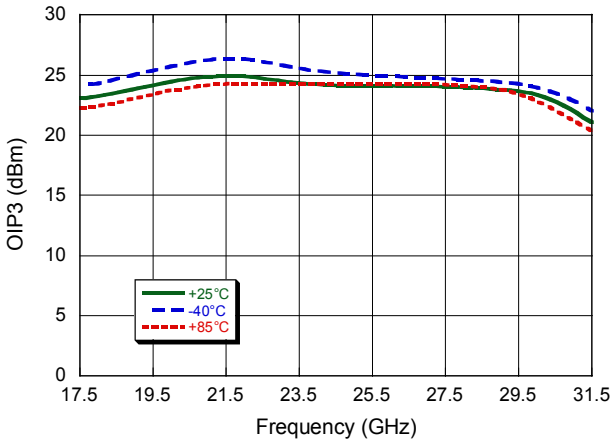
Output Return Loss



P1dB

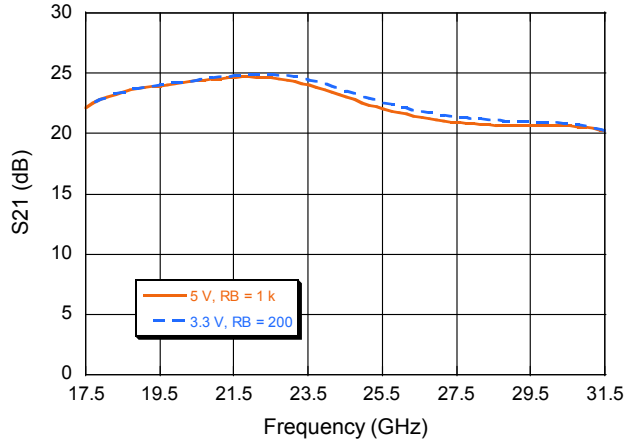


OIP3

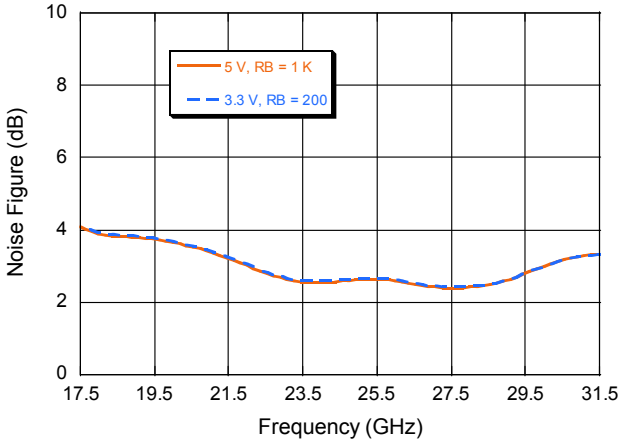


Typical Performance Curves V_{DD} = 3.3 V & 5 V

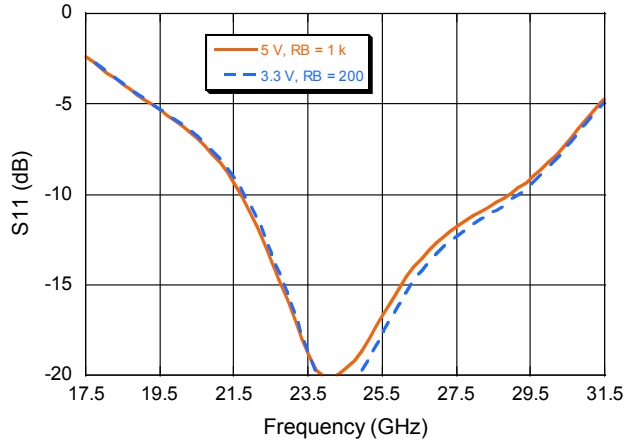
Gain



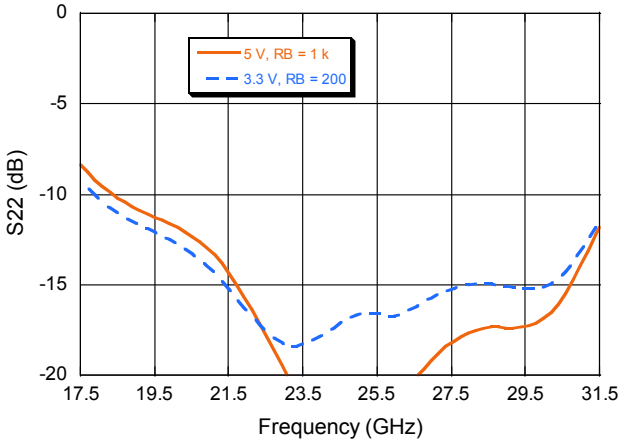
Noise Figure



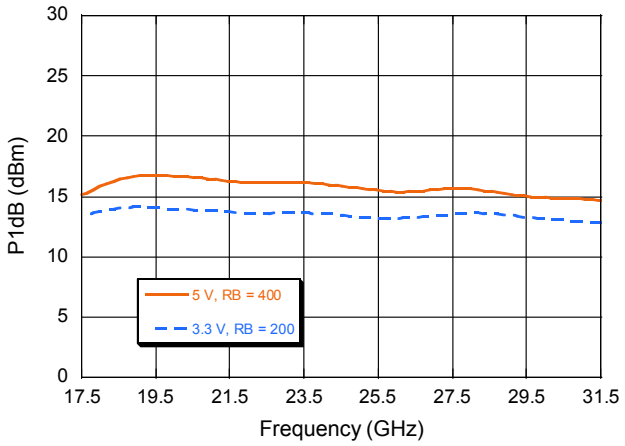
Input Return Loss



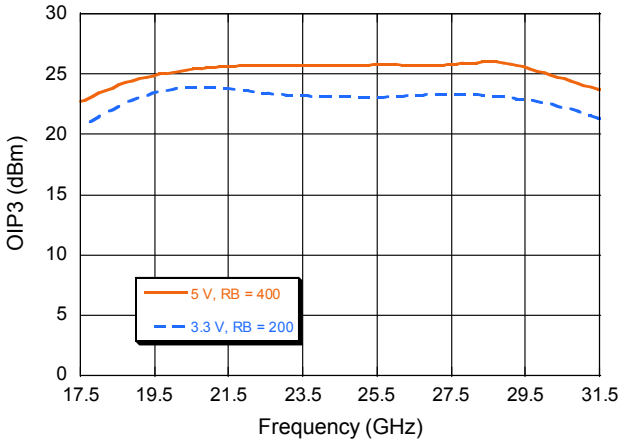
Output Return Loss



P1dB

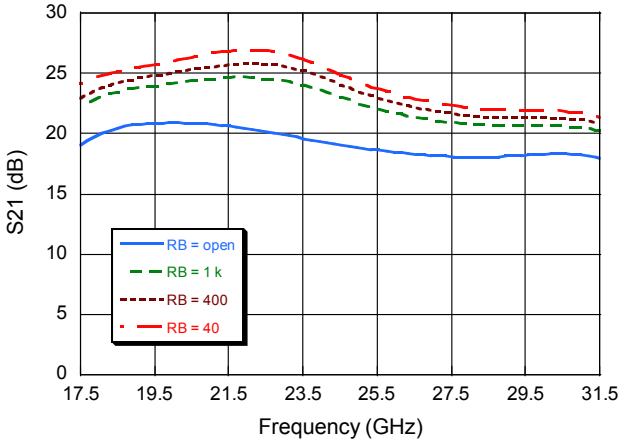


OIP3

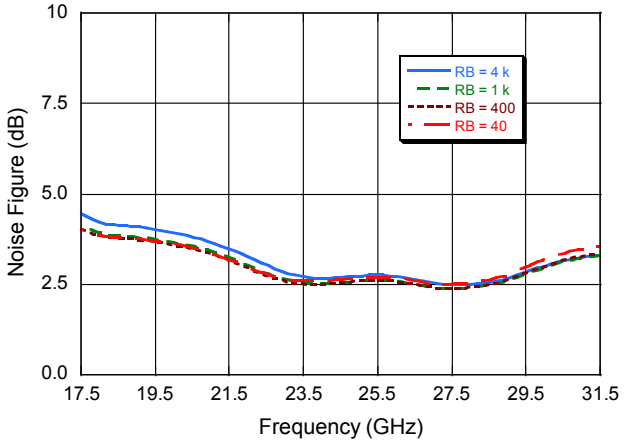


Typical Performance Curves VDD = 5 V, I_{DD} varied by R_B

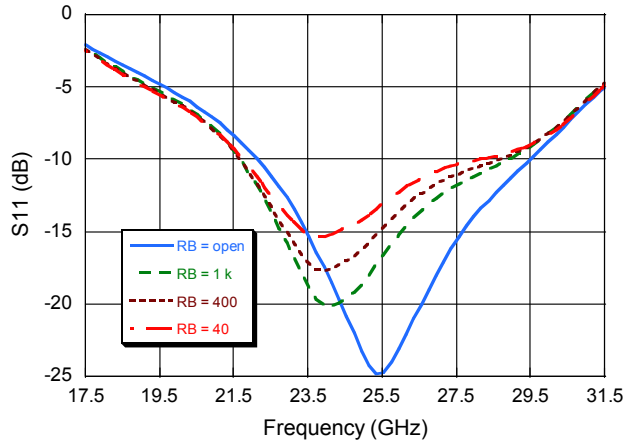
Gain



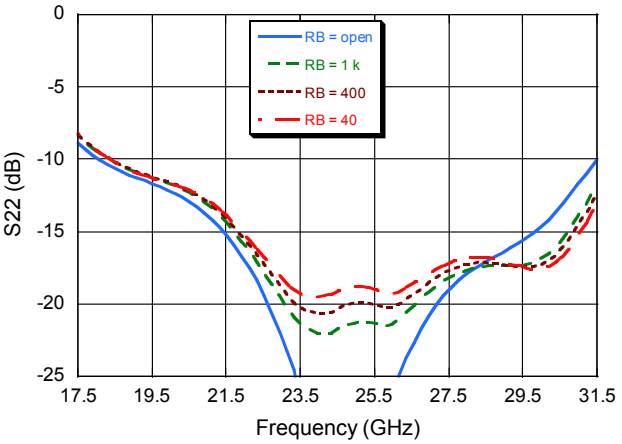
Noise Figure



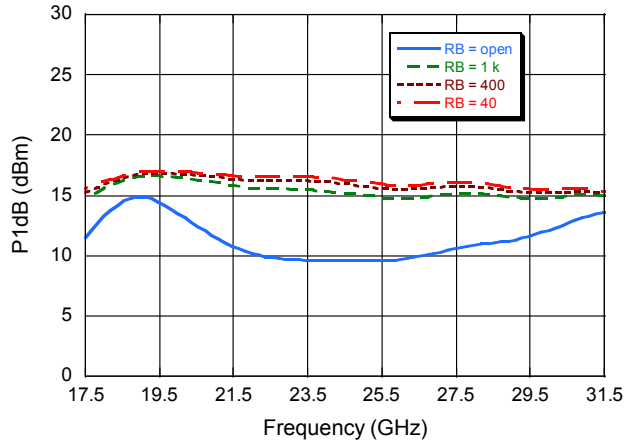
Input Return Loss



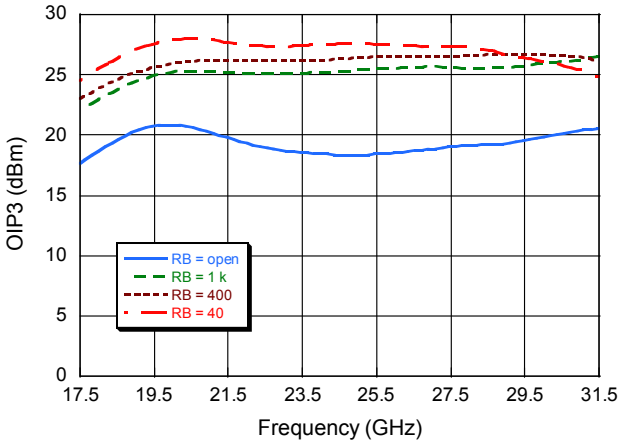
Output Return Loss



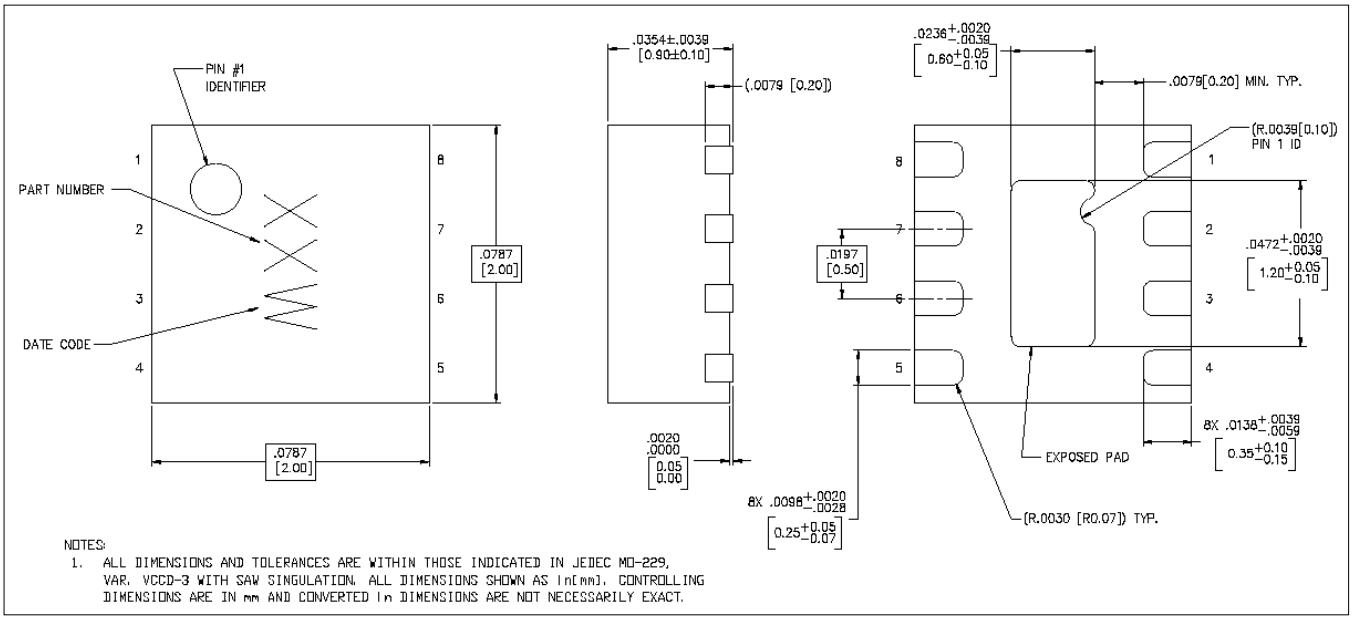
P1dB



OIP3



Lead Free 2 mm 8 Lead PDFN Package†



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