

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

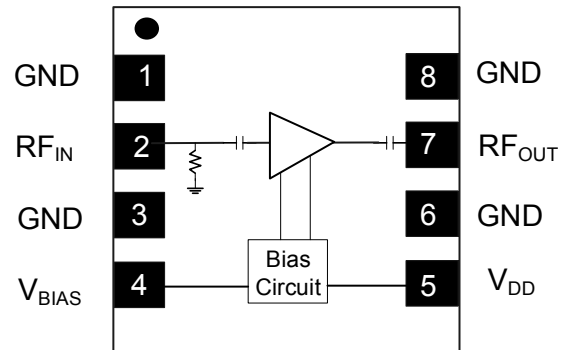
Description

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 Configuration³

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, Z₀ = 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 ≤ +150°C will ensure MTTF > 1 x 10⁶ hours.
7. Junction Temperature (T_J) = T_C + Θ_{JC} * (V * I)
Typical thermal resistance (Θ_{JC}) = 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

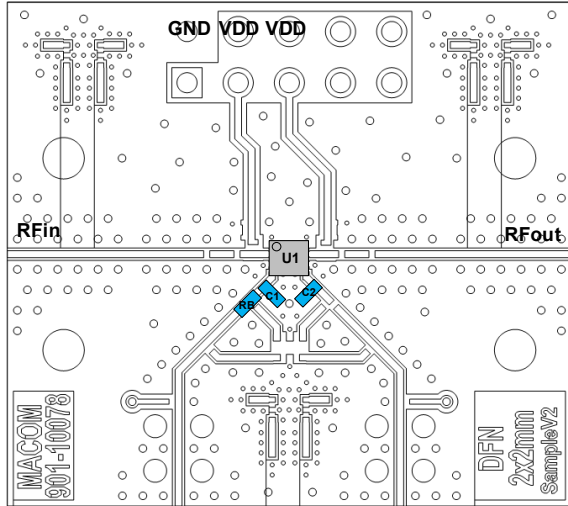
Handling Procedures

Please observe the following precautions to avoid damage:

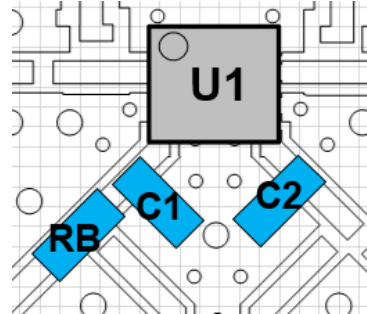
Static Sensitivity

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



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.

Parts List

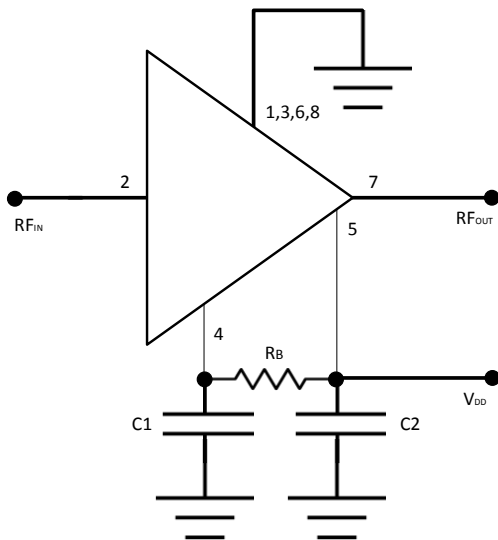
Des	Value	Size	Part Number	Purpose
C1 C2	0.01 μ F	0201	Murata GRM033R70J103KA01D	Bypass
RB	See chart	0201	various	Bias Resistor
U1	—	2 mm	MACOM MAAL-011129	LNA

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

Application Schematic



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

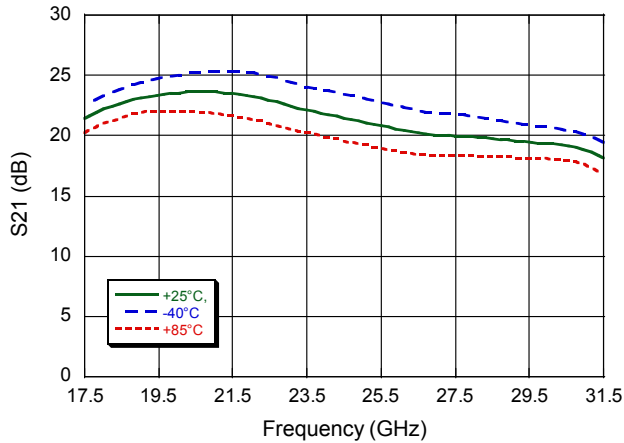
It is recommended that the total ground (common mode) inductance not exceed 0.03 nH (30 pH). This is equivalent to placing at least four 8-mil (200- μ m) diameter vias under the device, assuming an 8-mil (200- μ m) thick RF layer to ground.

Low Noise Amplifier 18 - 31.5 GHz

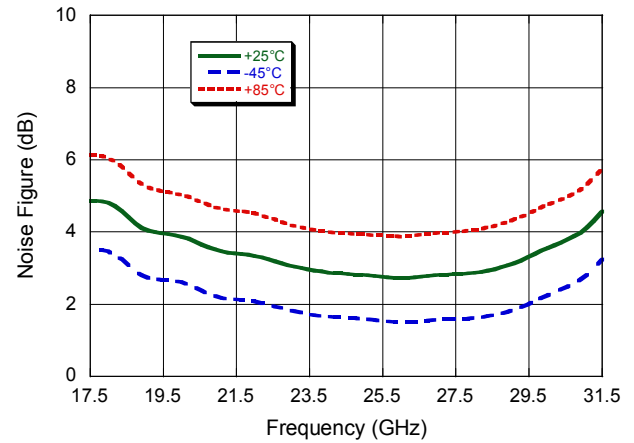
Rev. V1

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

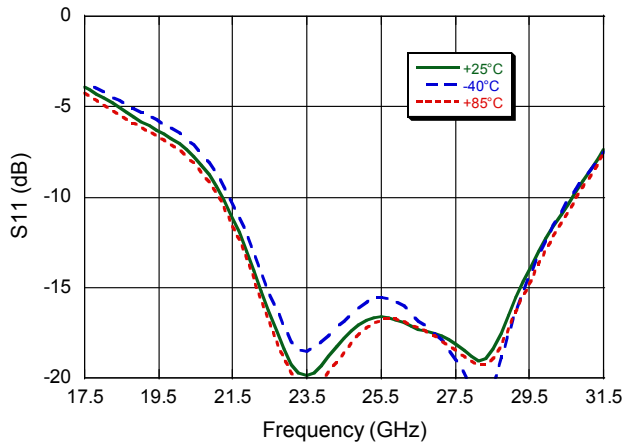
Gain



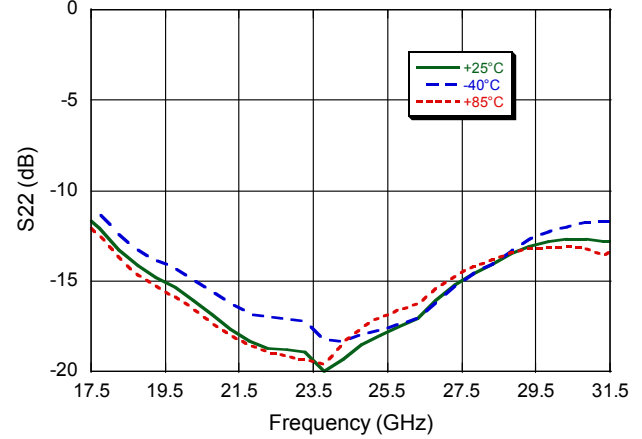
Noise Figure



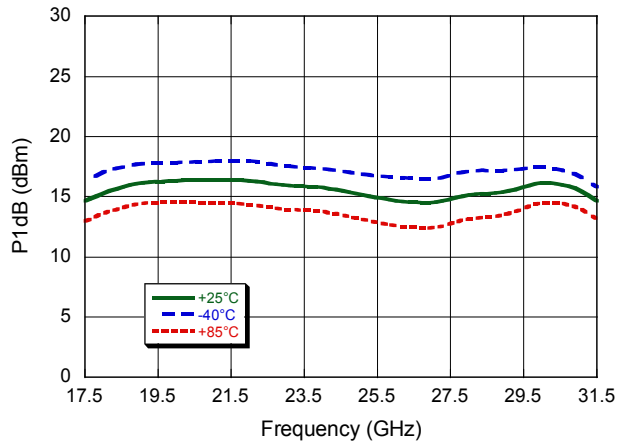
Input Return Loss



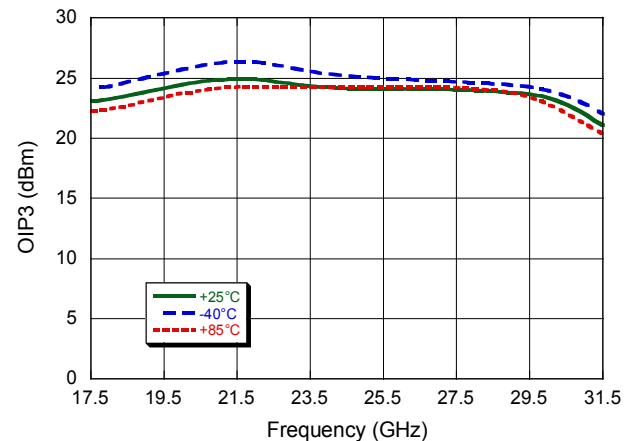
Output Return Loss



P1dB



OIP3

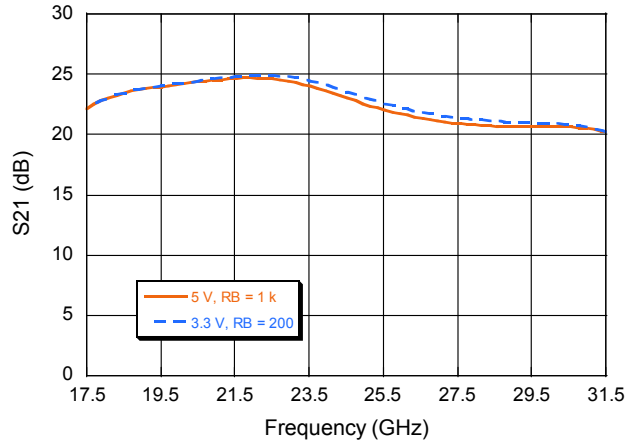


Low Noise Amplifier 18 - 31.5 GHz

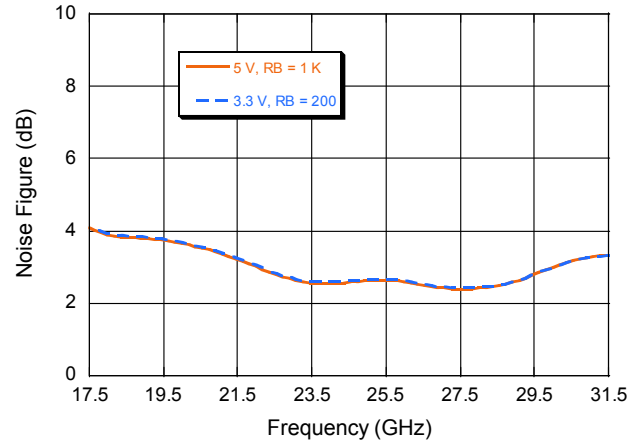
Rev. V1

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

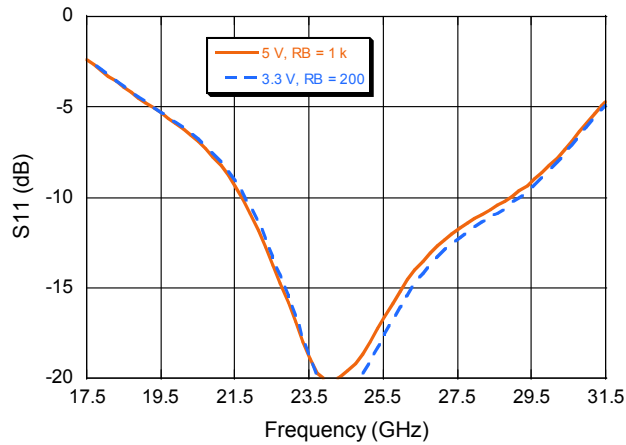
Gain



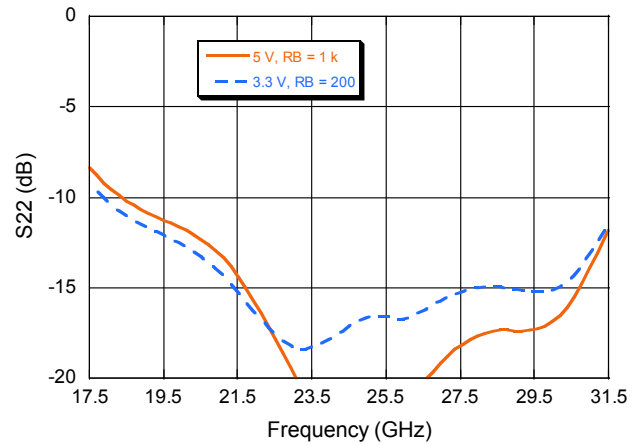
Noise Figure



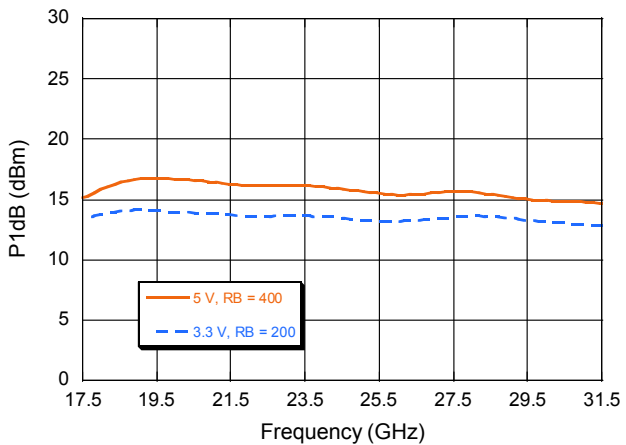
Input Return Loss



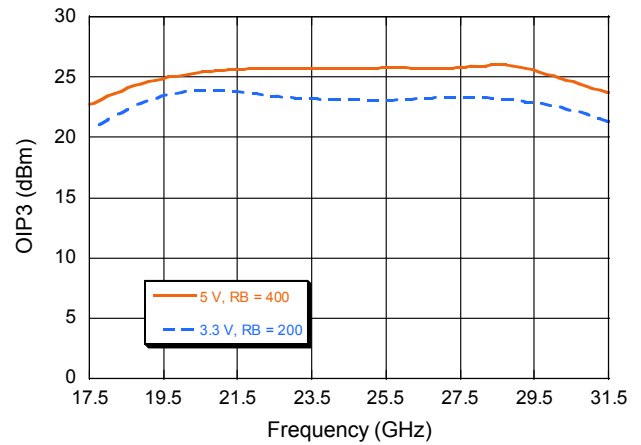
Output Return Loss



P1dB



OIP3

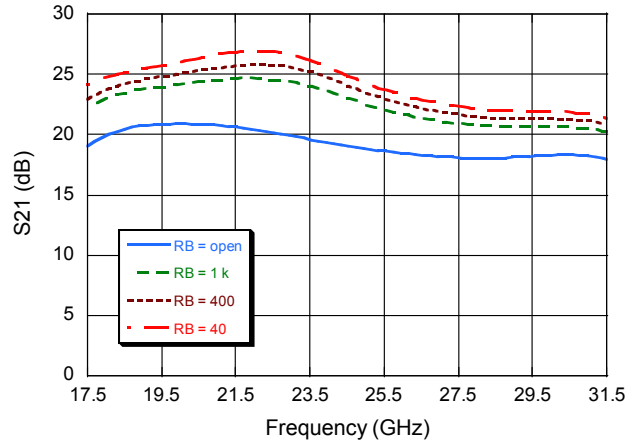


Low Noise Amplifier 18 - 31.5 GHz

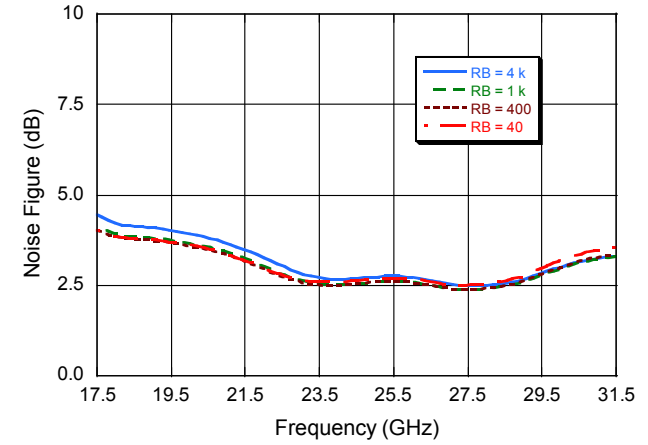
Rev. V1

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

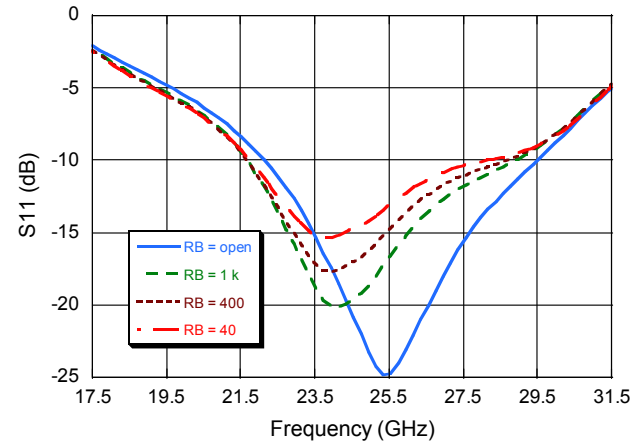
Gain



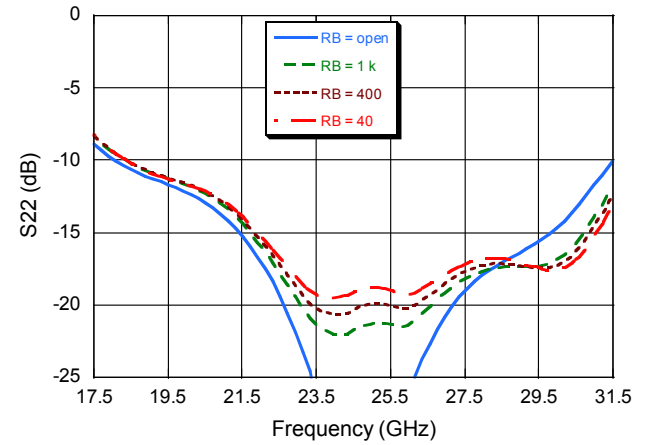
Noise Figure



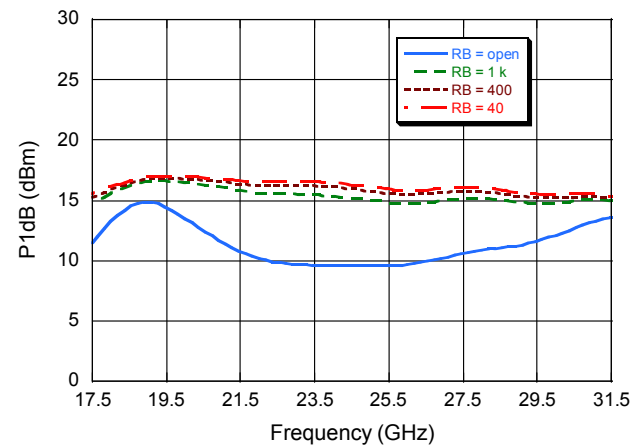
Input Return Loss



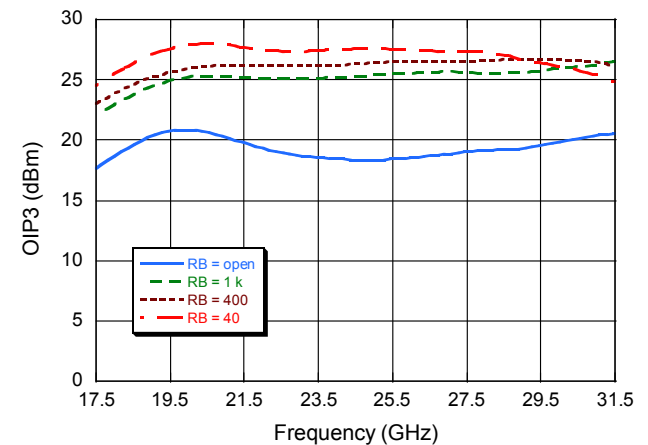
Output Return Loss



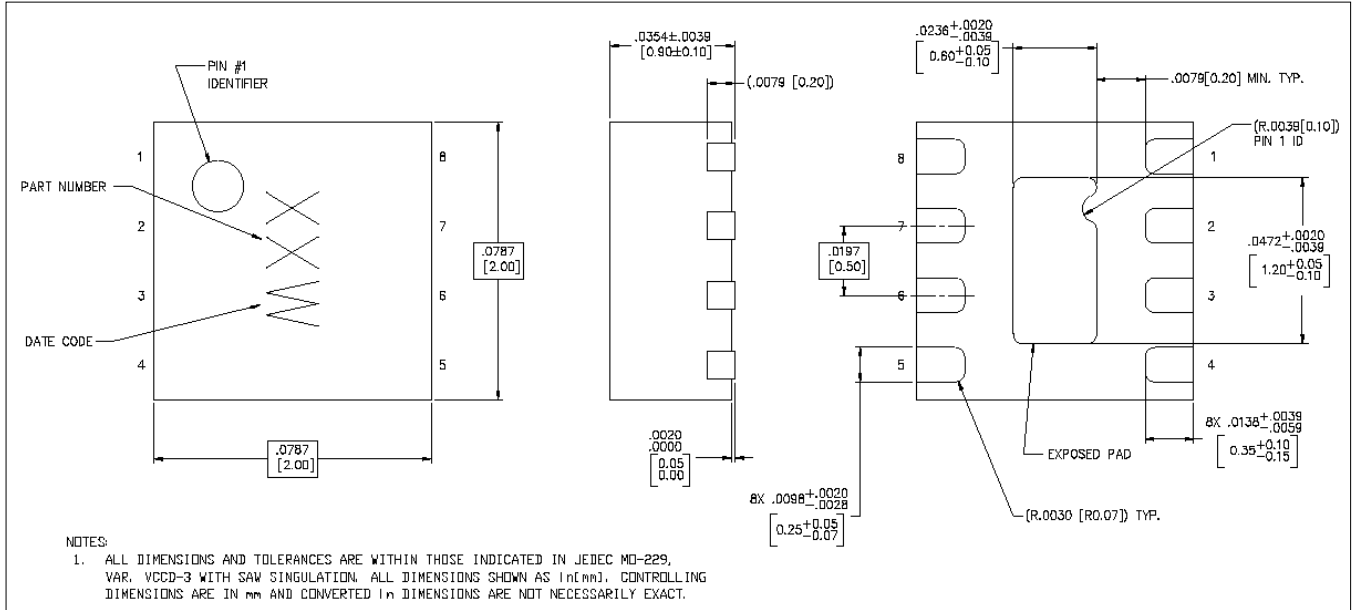
P_{1dB}



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

MACOM Technology Solutions Inc. All rights reserved.

Information in this document is provided in connection with MACOM Technology Solutions Inc ("MACOM") products. These materials are provided by MACOM as a service to its customers and may be used for informational purposes only. Except as provided in MACOM's Terms and Conditions of Sale for such products or in any separate agreement related to this document, MACOM assumes no liability whatsoever. MACOM assumes no responsibility for errors or omissions in these materials. MACOM may make changes to specifications and product descriptions at any time, without notice. MACOM makes no commitment to update the information and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to its specifications and product descriptions. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document.

THESE MATERIALS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, CONSEQUENTIAL OR INCIDENTAL DAMAGES, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. MACOM FURTHER DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. MACOM SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS, WHICH MAY RESULT FROM THE 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.