Low Noise Amplifier
32 - 37 GHz

MAAL-011198
Rev. V2

Features

- Gain: 18.5 dBm
- Noise Figure: 3 dB
- Output IP3: 23 dBm
- Drain Supply: 3.3 V
- 2 mm, 8 lead PDFN Package
- RoHS* Compliant

Applications

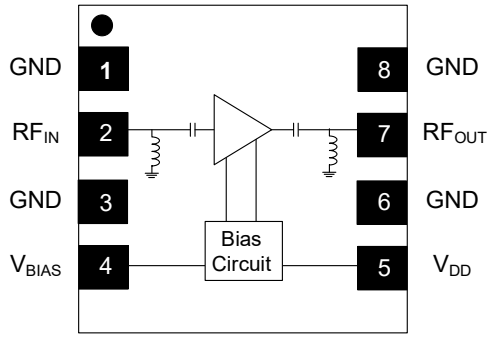
- Ka-Band Low Noise
- Ka-Band Driver Amplifier

Description

The MAAL-011198 is a Ka-band low noise amplifier with an operating frequency range of 32 to 37 GHz. This LNA has a 3 dB noise figure, 19 dB gain, and a 23 dBm output IP3. The output P1dB is 18 dBm. A 3.3 V supply voltage is required with a typical current draw of 90 mA.

The MAAL-011198 is designed for Ka-band low noise and driver applications. The 2 mm, 8 lead PDFN package is lead free and RoHS compliant.

Block Diagram



Pin Configuration[3]

Pin #	Pin Name	Description
1,3,6,8	GND	Ground
2	RF_{IN}	RF Input
4	V_{BIAS}	Bias Voltage
5	V_{DD}	Voltage Supply
7	RF_{OUT}	RF Output

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-011198-TR1000	1000 piece reel
MAAL-011198-TR3000	3000 piece reel
MAAL-011198-SMB	Sample Board

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

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

Electrical Specifications: Freq. = 32 - 37 GHz, V_{DD} = +3.3 V, V_{BIAS} = open, T_A = 25°C, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	P_{IN} = -20 dBm	dB	15.0	18.5	—
Gain Flatness	P_{IN} = -20 dBm	dB	—	+/-0.5	—
Noise Figure	—	dB	—	3	4.5
Input Return Loss	P_{IN} = -20 dBm	dB	—	10	—
Output Return Loss	P_{IN} = -20 dBm	dB	—	12	—
Output IP3	P_{IN} = -22 dBm/tone, 10 MHz spacing	dBm	—	23	—
P1dB	—	dBm	—	18	—
DC Current	I_{DQ}	dBm	—	90	—

Maximum Operating Conditions

Parameter	Maximum
TX Input Power	5 dBm
V_{DD}	4 V
Junction Temperature[4,5]	+160°C
Operating Temperature[6]	-40°C to +85°C

4. Operating at nominal conditions with $T_J \leq$ +160°C will ensure MTTF > 1 x 10^6 hours.
5. TX Junction Temp. (T_J) = T_C + Θjc * ((V * I) - (P_{OUT} - P_{IN})).
   Typical TX thermal resistance (Θjc) = 131°C/W.
   a) For T_C = +85°C,
   T_J = 124°C @ 3.3 V, 90 mA
6. MTTF must be greater than 1 x 10^6 hours.

Absolute Maximum Ratings[7,8]

Parameter	Absolute Maximum
TX Input Power[9]	23 dBm
V_{DD}	6 V
Junction Temperature[10]	+170°C
Storage Temperature	-55°C to +150°C

7. Exceeding any one or combination of these limits may cause permanent damage to this device.
8. MACOM does not recommend sustained operation near these survivability limits.
9. Based on surviving a CW input for 1 minute.
10. Junction temperature directly effects device MTTF. Junction temperature should be kept as low as possible to maximize lifetime.

Handling Procedures

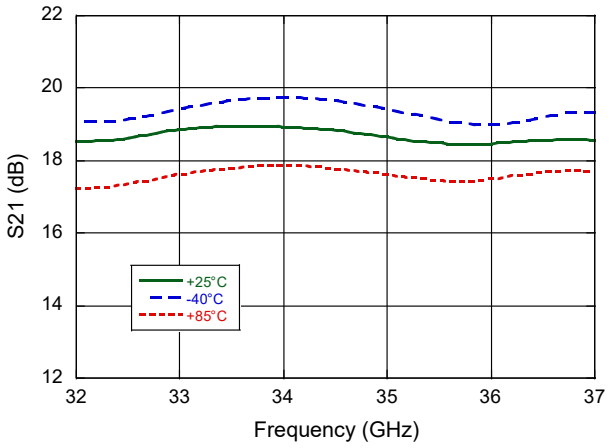
Please observe the following precautions to avoid damage:

Static Sensitivity

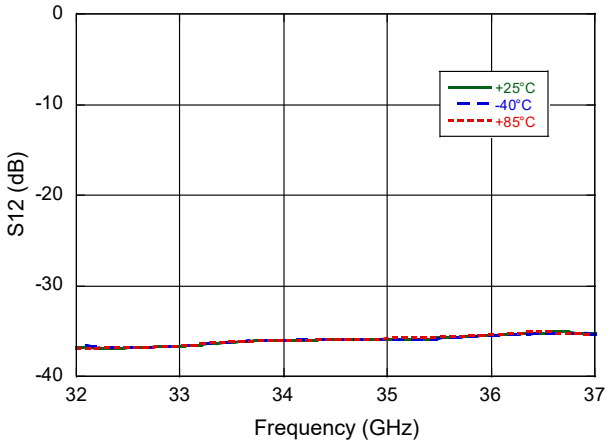
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these class 1C (HBM) & C3 (CDM) devices.

Typical Performance Curves @ 3.3 V

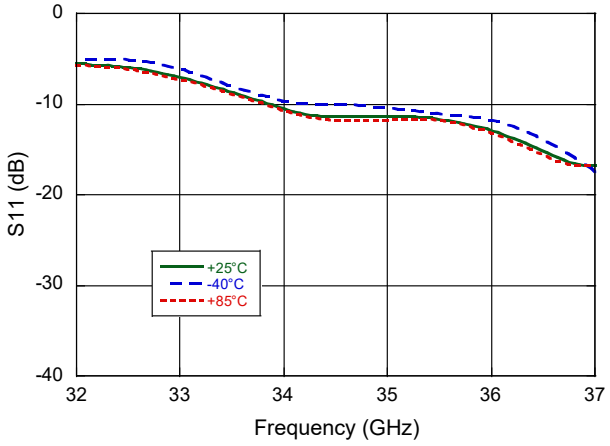
Gain



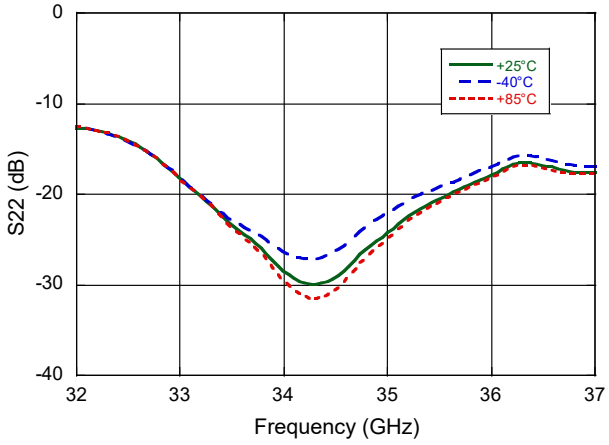
Isolation



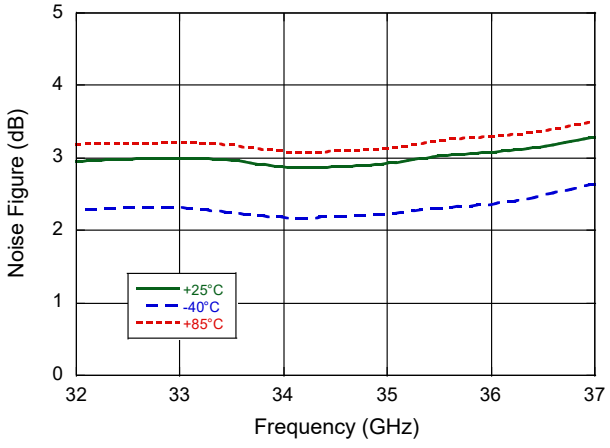
Input Return Loss



Output Return Loss

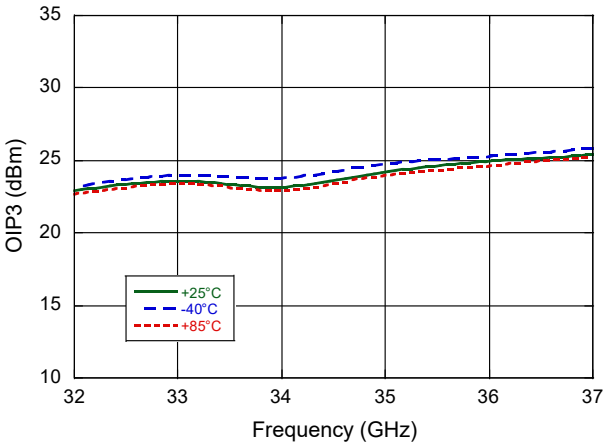


Noise Figure

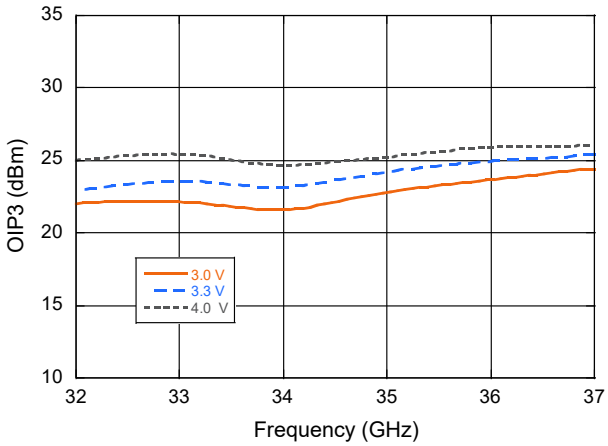


Typical Performance Curves

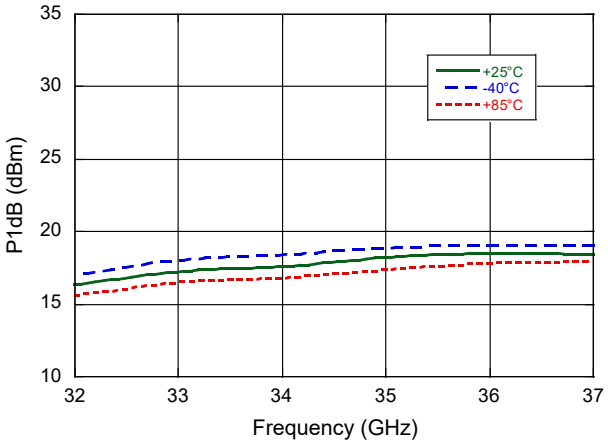
OIP3 vs. Temperature



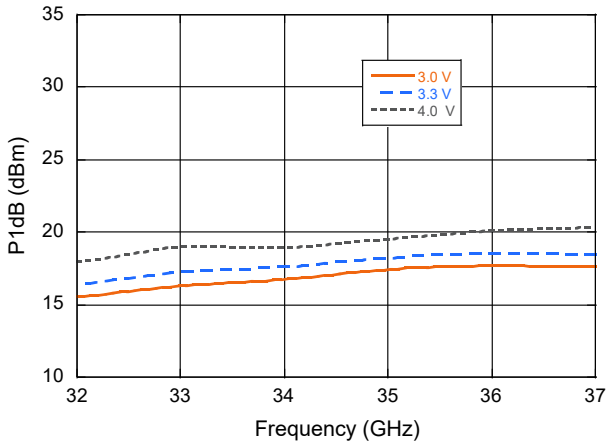
OIP3 vs. V_{DD}



P1dB vs. Temperature

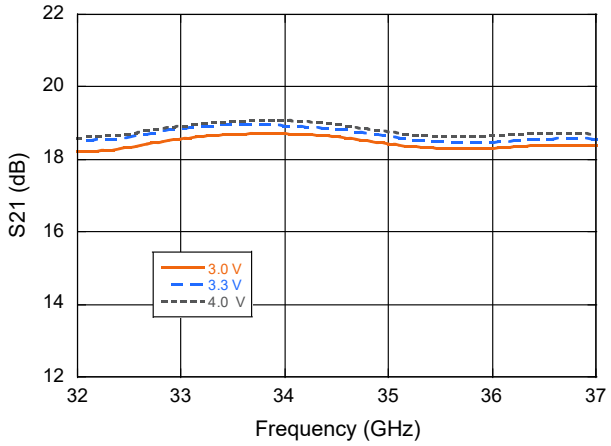


P1dB vs. V_{DD}

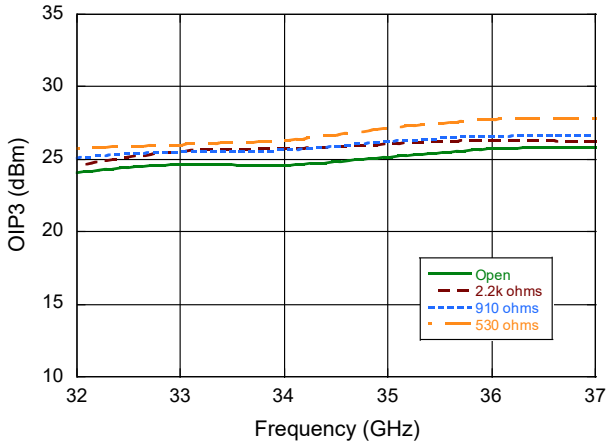


Typical Performance Curves

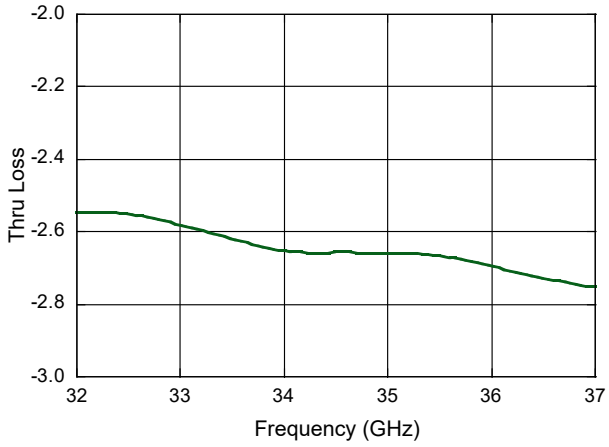
Gain vs. V_{DD}



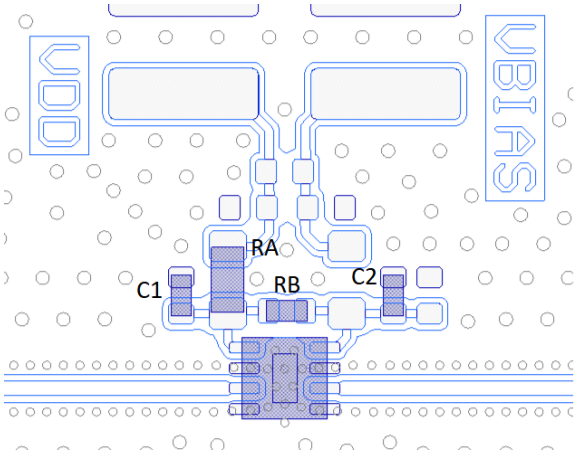
OIP3 vs. RB @ 3.3V



Sample Board Loss (RFIN + RFOUT)



Sample PCB Layout



Parts List

Des	Value	Size	Part Number	Purpose
C1, C2	100 pF	0402	Murata GRM022R71C101ME14	Bypass
R_A[11]	See chart	0603	various	Bias Resistor
R_B[12]	See chart	0402	various	Bias Resistor
U1	—	2 mm	MACOM MAAL-011198	LNA

11. R_A: Used as voltage dropping resistor when VDD is higher than 4 V
12. R_B: (optional) used to adjust current draw and OIP3 for use only at VDD= 3.3 V.

V_{DD} = 3.3 V		
R_B (Ω)	R_A (Ω)	I_{DD} (mA)
Open	0	90
500	0	110
1000	0	102
2k	0	95

V_{DD} = 4 V		
R_B (Ω)	R_A (Ω)	I_{DD} (mA)
Open	0	100

V_{DD} = 5 V		
R_B (Ω)	R_A (Ω)	I_{DD} (mA)
Open	10	100

Application Information

The MAAL-011198 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

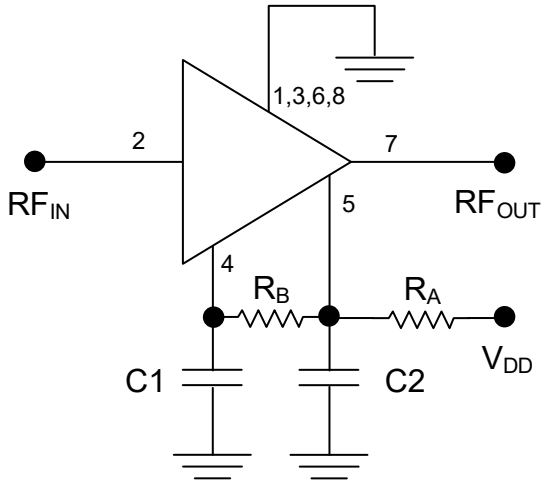
Connecting V_{DD} to V_{BIAS} using an external resistor R_B enables single bias operation of the amplifier, and the value of external resistor R_B sets the desired current I_{DD}. The following table shows drain current (I_{DD}) versus external resistor (R_B) values:

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.

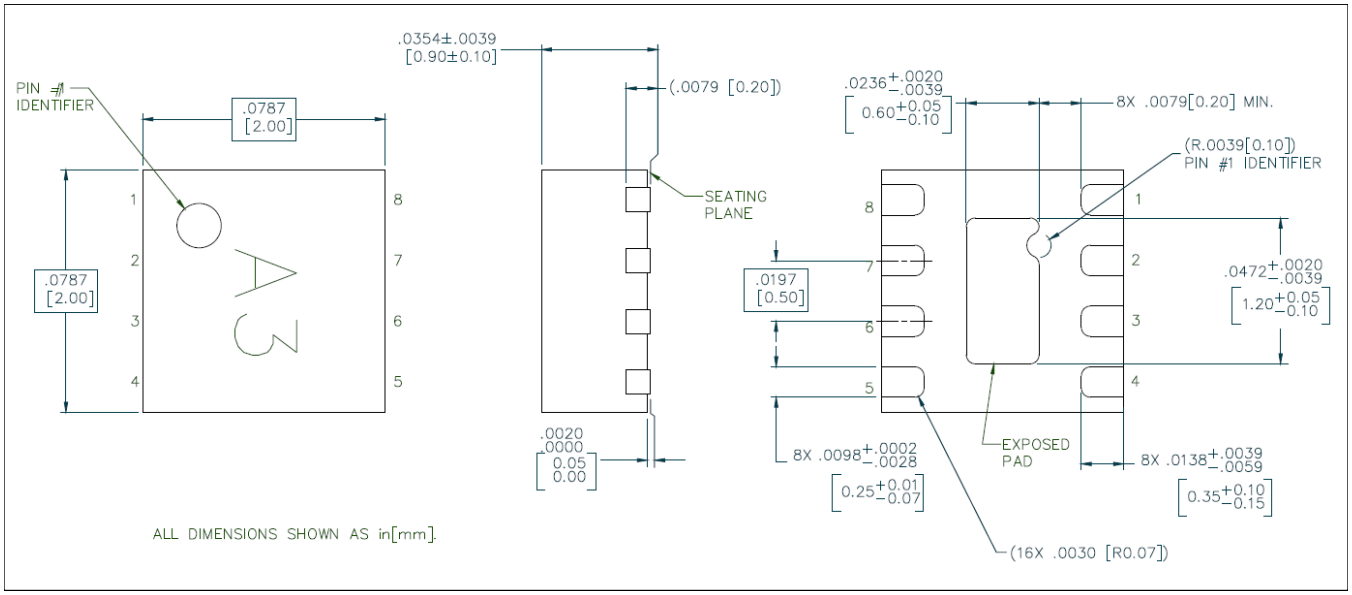
Grounding

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-µm) diameter vias under the device, assuming an 8-mil (200-µm) thick RF layer to ground.

Application Schematic



Lead-Free 2 mm 8-Lead PDFN†



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