Broadband Low Noise Amplifier
0.05 - 4 GHz

MAAM-011229
Rev. V3

Features

- 19 dB flat Broadband Gain to 3.25 GHz
- Low Noise Figure:
  1.3 dB @ 1.2 GHz
  1.8 dB @ 3.25 GHz
- High Linearity OIP3:
  36 dBm @ 1.2 GHz
  33 dBm @ 3.25 GHz
- Internal Matching to 50 Ω
- Single Voltage Bias: 3 - 5 V
- Integrated Active Bias Circuit
- Current Adjustable 20 - 120 mA
- Lead-Free 2 mm 8-Lead PDFN Package
- RoHS* Compliant

Applications

- CATV, Broadcast, ISM/MM

Description

The MAAM-011229 is a broadband high dynamic range, single stage MMIC LNA assembled in a lead-free 2 mm 8 Lead PDFN plastic package. The amplifier is internally matched to provide flat gain and excellent return losses to 3.25 GHz without any external matching components. Use of external matching could extend usable frequency range beyond 4 GHz.

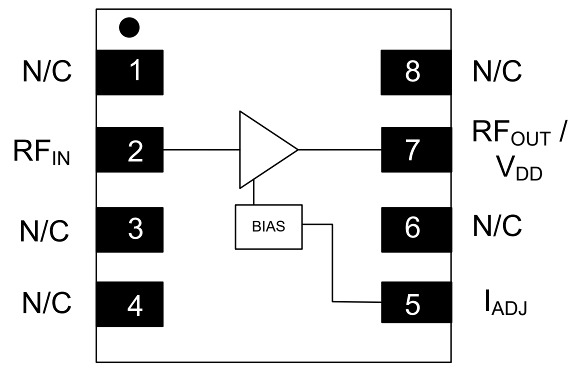
This low noise amplifier has an integrated active bias circuit allowing direct connection to 3 V or 5 V bias and minimizing variations over temperature and process. The bias current can be adjusted with an optional external resistor, so the user can customize the power consumption to fit the application. I_{ADJ} pin can be utilized as an enable pin to power the device up and down during operation.

Ordering Information[1,2]

Part Number	Package
MAAM-011229-TR1000	1000 piece reel
MAAM-011229-TR3000	3000 piece reel
MAAM-011229-SMB	Sample Board

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

Functional Block Diagram



Pin Configuration[3]

Pin #	Pin Name	Description
1, 3, 4, 6, 8	N/C	No Connection
2	RF_{IN}	RF Input
5	I_{ADJ}	Bias Current Adjust
7	RF_{OUT} / V_{DD}	RF Output / Drain Voltage
9	Pad[4]	Ground

3. MACOM recommends connecting all No Connection (N/C) pins to ground.
4. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

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

Electrical Specifications: V_{DD} = 5 V, +25ºC, Z_0 = 50 Ω, Typical Application Circuit

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	0.05 - 3.25 GHz 4 GHz	dB	17 —	19 18	—
Noise Figure	0.05 - 1.2 GHz 1.2 - 3.25 GHz 4 GHz	dB	—	1.3 1.6 2.1	— 2.2 —
Input Return Loss	0.05 - 3.25 GHz	dB	—	16	—
Output Return Loss	0.05 - 3.25 GHz	dB	—	14	—
Output IP3	P_{IN} = -15 dBm per tone, 6 MHz spacing 0.05 - 1.2 GHz 1.2 - 3.25 GHz	dBm	—	36 33	—
Output IP2	P_{IN} = -15 dBm per tone, 6 MHz spacing 0.05 - 1.2 GHz 1.2 - 3.25 GHz	dBm	—	45 36	—
Output P1dB	0.05 - 1.2 GHz 1.2 - 3.25 GHz	dBm	—	19.5 18.5	—
Current	I_{DD}	mA	—	80	115

Maximum Operating Conditions

Parameter	Absolute Maximum
RF Input Power CW	4 dBm
V_{DD}	7 V
Operating Temperature[5]	-40ºC to +85ºC
Junction Temperature[6]	+150ºC

5. Operating at nominal conditions with $T_J \le 150°C$ will ensure MTTF > 1 x 10^6 hours.
6. Junction Temperature (T_J) = $T_C + \Theta_{JC} * ((V * I) - (P_{OUT} - P_{IN}))$
   Typical thermal resistance (Θ_{JC}) = 85°C/W
   a) For T_C = +25°C,
      T_J = 59°C @ 5 V, 80 mA
   b) For T_C = +85°C,
      T_J = 119°C @ 5 V, 80 mA

Absolute Maximum Ratings[7,8]

Parameter	Absolute Maximum
RF Input Power CW	30 dBm
V_{DD}	8 V
Storage Temperature	-55ºC to +150ºC
Junction Temperature[6]	+175ºC

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.

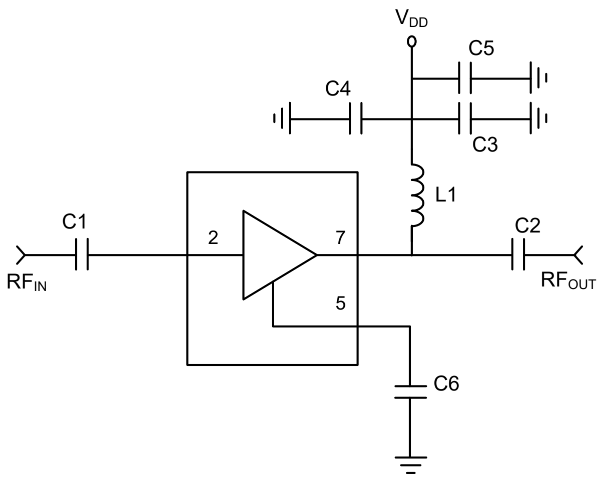
Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Typical Application Circuit



Typical Parts List, V_{DD} = 5 V & 3 V

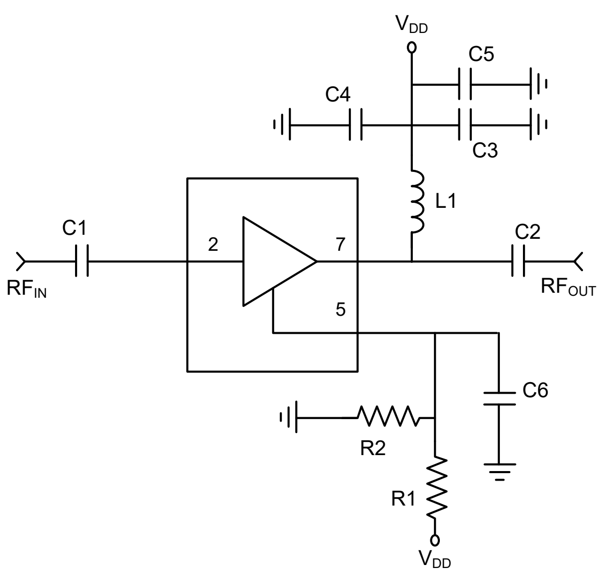
Component	Value	Package
C1 - C3, C6	1000 pF	0402
C4	0.1 µF	0402
C5	47 pF	0402
L1	Ferrite Bead[9]	0402

9. Murata, part number BLM15HD182SN.

Current Adjust Options[10]

The I_{ADJ} (pin 5) of MAAM-011229 may be used to adjust the DC operating current by placing either R1 or R2 as shown the schematic below. Placing resistor R2 to ground will reduce the current from typical application level. When using R2 to reduce current do not place (DNP) R1. To increase current from typical application circuit install resistor R1 and connect to V_{DD}.

The table below shows values of R1 and R2 for a range of operating currents for V_{DD} = 5 V and 3 V.

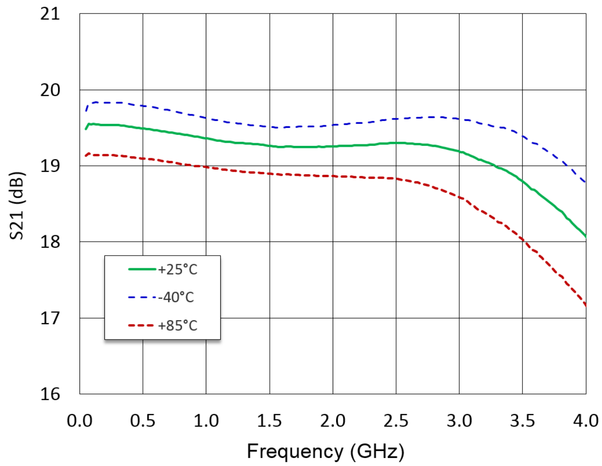


I	V_{DD} = 5 V		V_{DD} = 3 V	
(mA)	R1	R2	R1	R2
20	DNP	820 Ω	DNP	2.0 kΩ
40	DNP	1.2 kΩ	DNP	4.7 kΩ
60	DNP	2.7 kΩ	*Typical application without R1 and R2*	
80	*Typical application without R1 and R2*		5.0 kΩ	DNP
100	12 kΩ	DNP	2.4 kΩ	DNP
120	5 kΩ	DNP	not recommended	

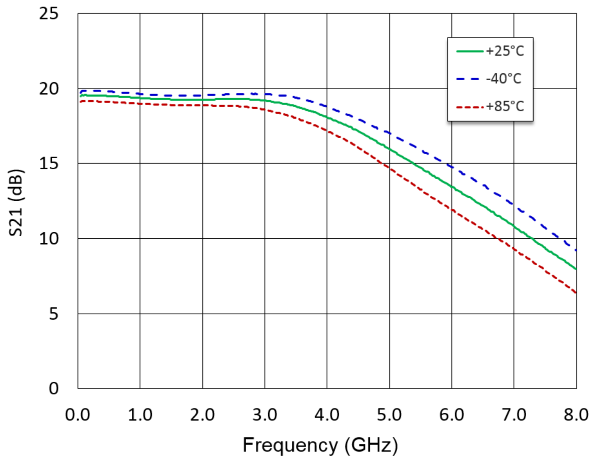
10. Some lot to lot variation in current may be observed, requiring a small adjustment in resistor value for a target current. Operation below 20 mA can result in lower gain.

Typical Performance Curves @ 5 V / 80 mA, Z_0 = 50 Ω

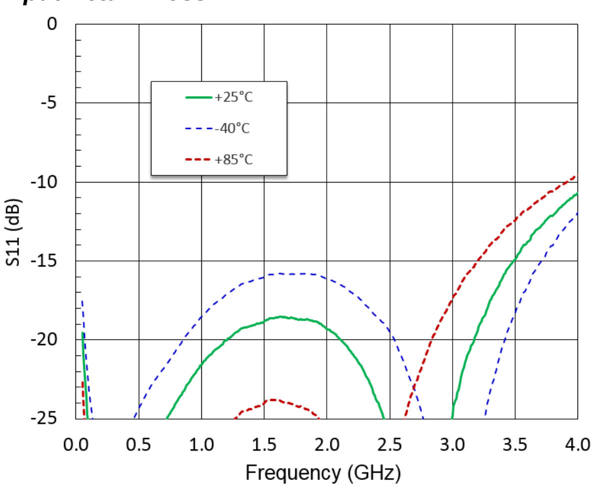
Gain to 4 GHz



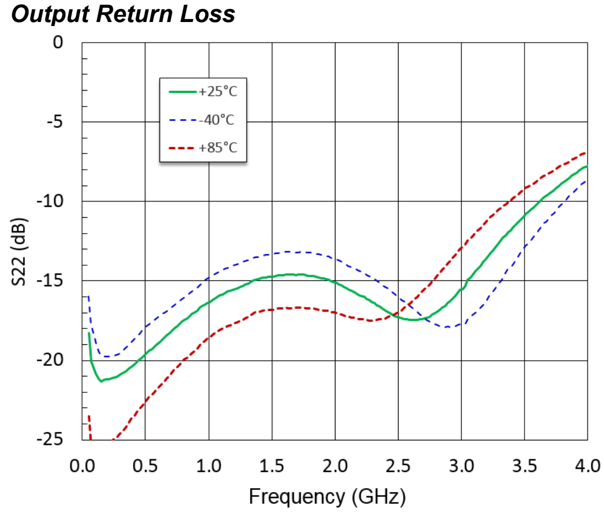
Gain to 8 GHz



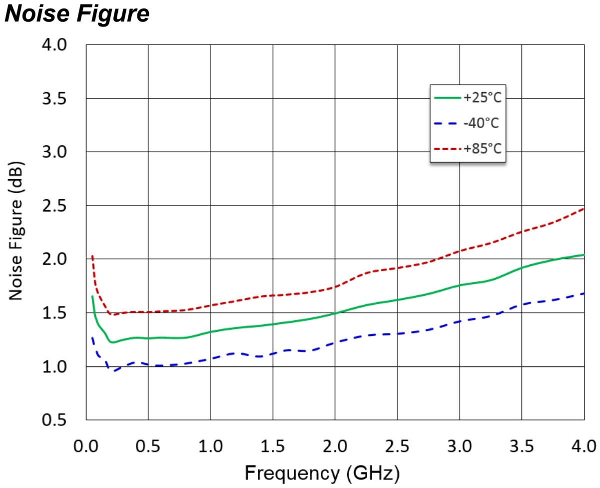
Input Return Loss



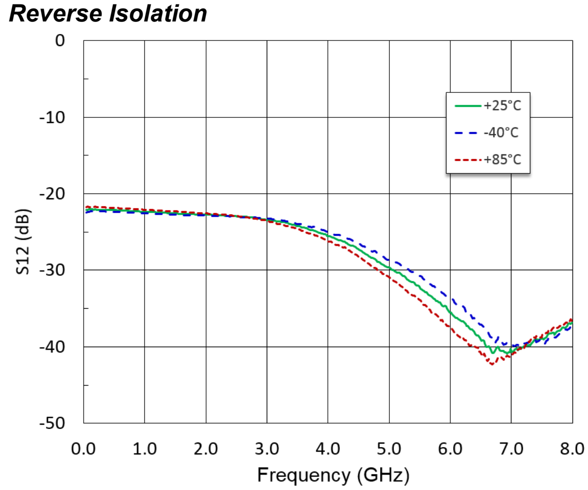
Output Return Loss



Noise Figure

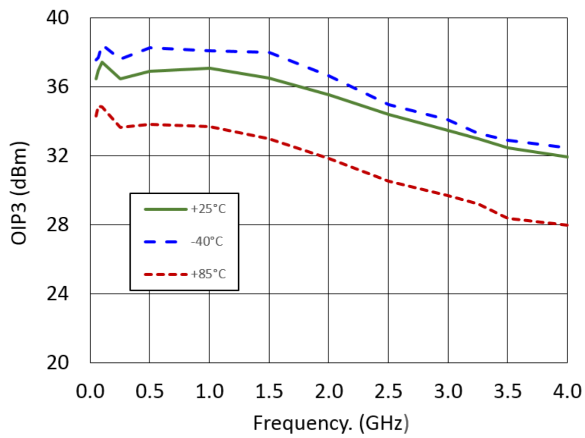


Reverse Isolation

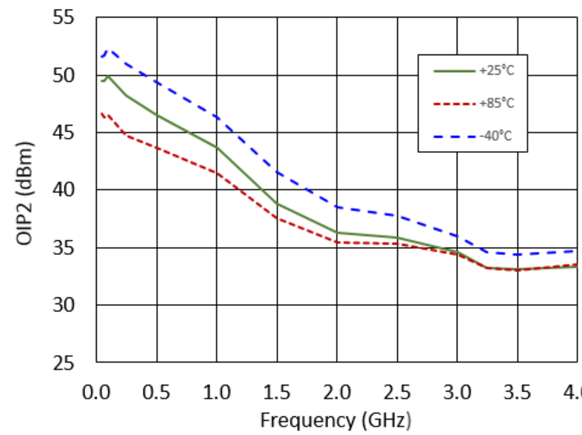


Typical Performance Curves @ 5 V / 80 mA , Z_0 = 50 Ω

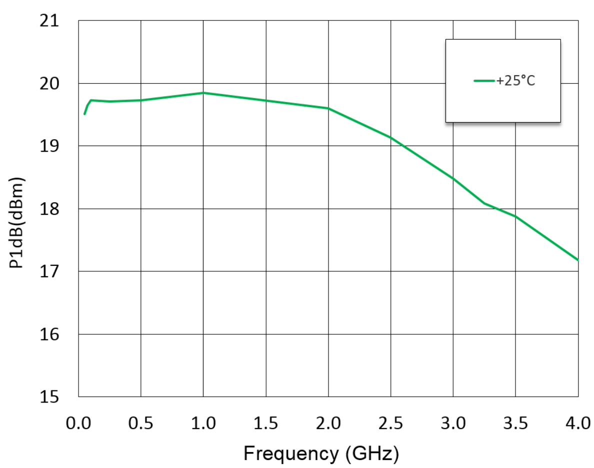
OIP3



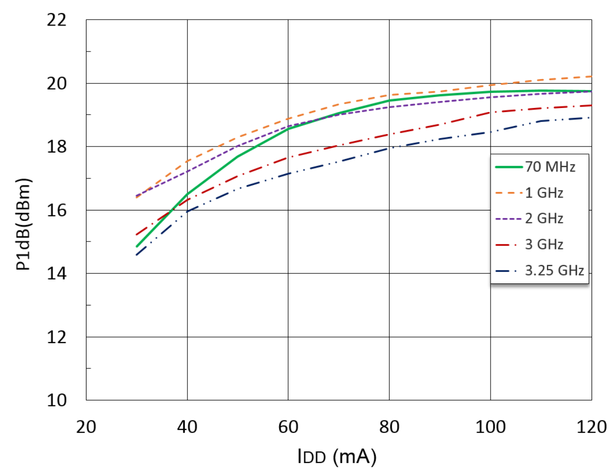
OIP2



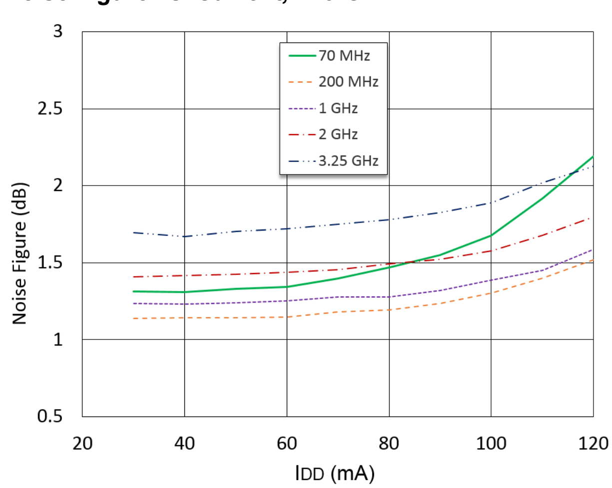
P1dB



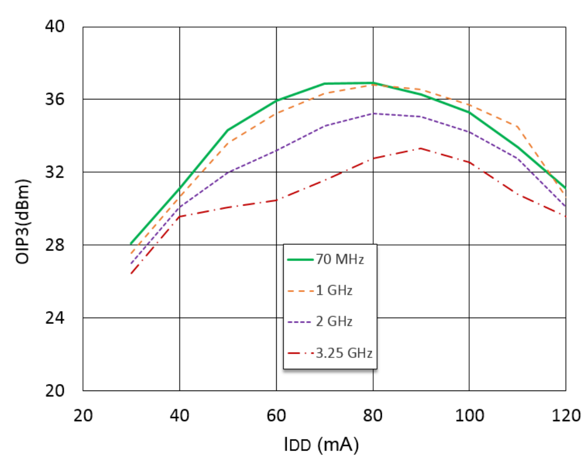
P1dB vs. Current, +25ºC



Noise Figure vs. Current, +25ºC



OIP3 vs. Current, +25ºC

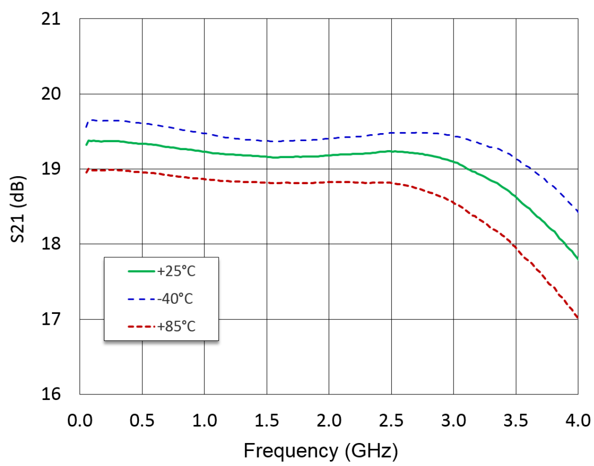


Electrical Specifications: V_{DD} = 3 V, +25ºC, Z_0 = 50 Ω, Typical Application Circuit

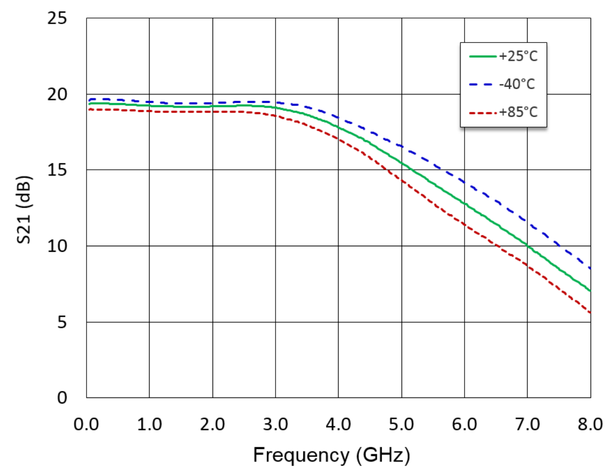
Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	0.05 - 3.25 GHz 4 GHz	dB	—	19 18	—
Noise Figure	0.05 - 1.2 GHz 1.2 - 3.25 GHz 4 GHz	dB	—	1.3 1.6 2.1	—
Input Return Loss	0.05 - 3.25 GHz	dB	—	16	—
Output Return Loss	0.05 - 3.25 GHz	dB	—	14	—
Output IP3	P_{IN} = -15 dBm per tone, 6 MHz spacing 0.05 - 1.2 GHz 1.2 - 3.25 GHz	dBm	—	33 40	—
Output IP2	P_{IN} = -15 dBm per tone, 6 MHz spacing 0.05 - 1.2 GHz 1.2 - 3.25 GHz	dBm	—	43 37	—
Output P1dB	0.05 - 1.2 GHz 1.2 - 3.25 GHz	dBm	—	17.0 15.5	—
Current	I_{DD}	mA	—	60	—

Typical Performance Curves @ 3 V / 60 mA, Z_0 = 50 Ω

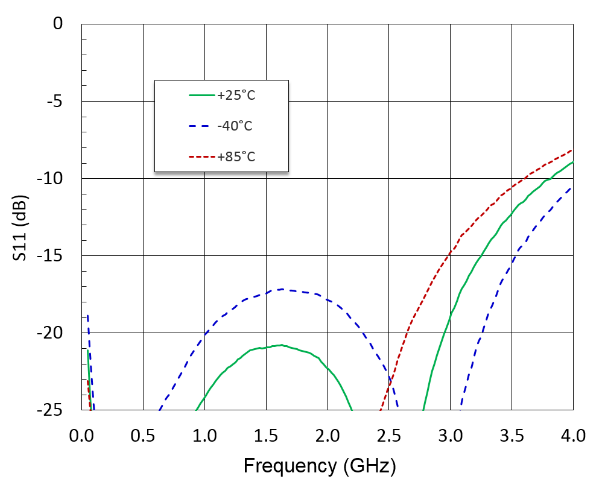
Gain to 4 GHz



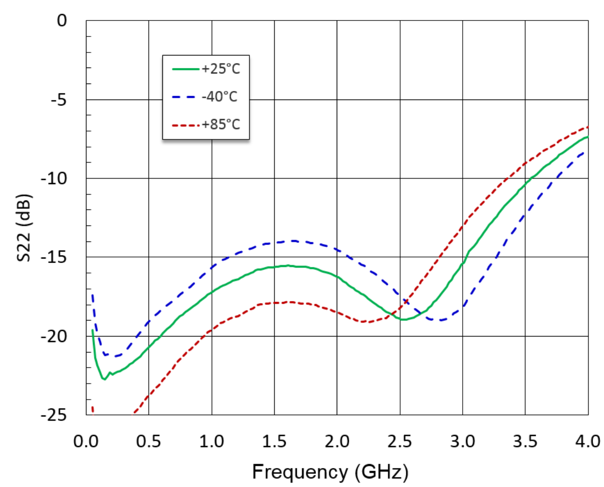
Gain to 8 GHz



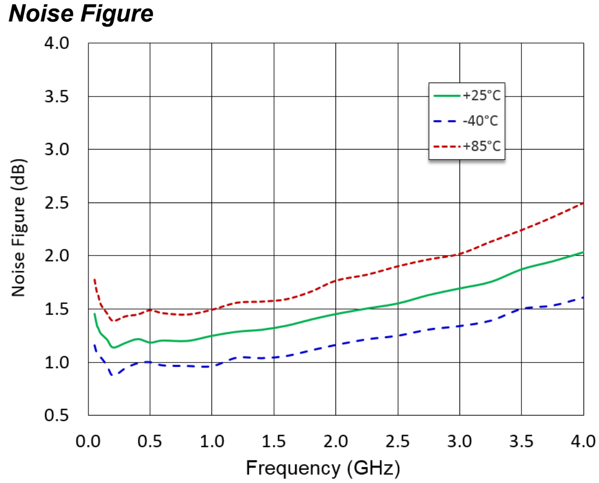
Input Return Loss



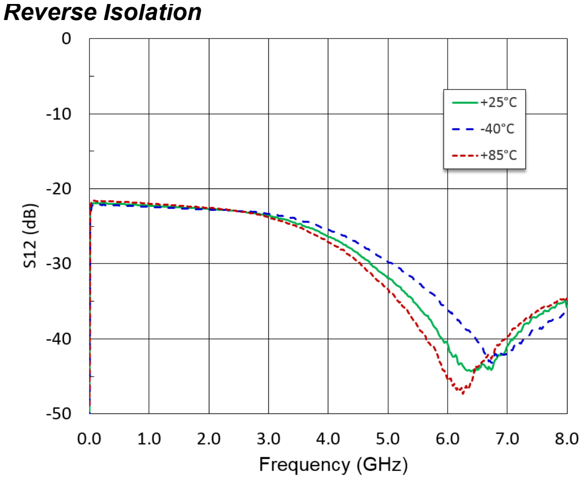
Output Return Loss



Noise Figure

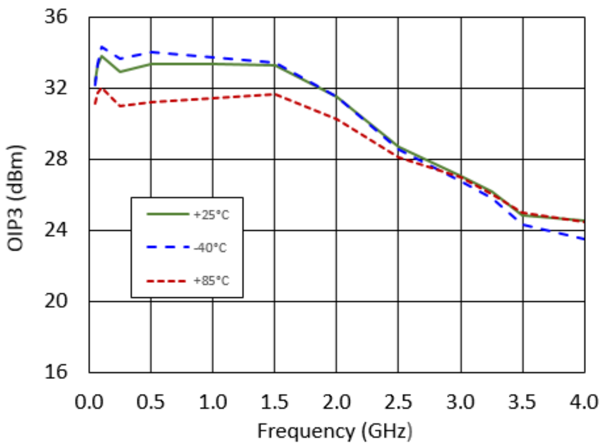


Reverse Isolation

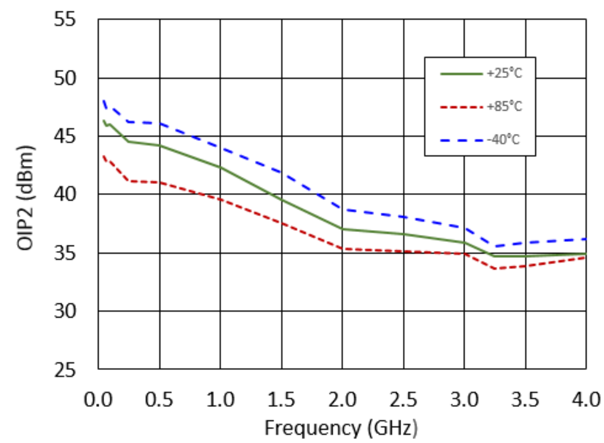


Typical Performance Curves @ 3 V / 60 mA, Z_0 = 50 Ω

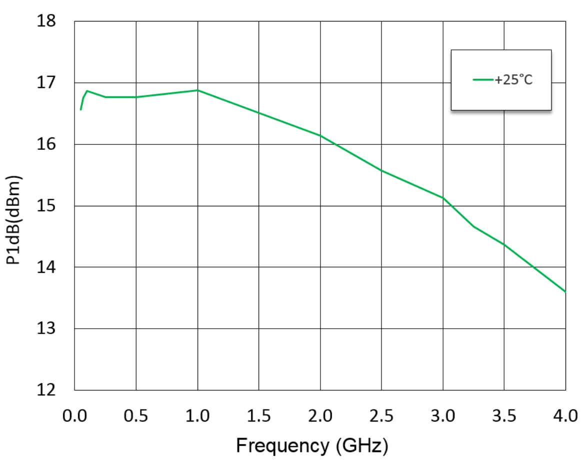
OIP3



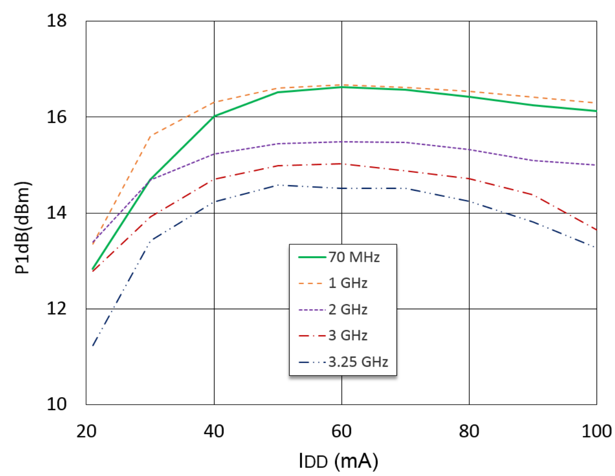
OIP2



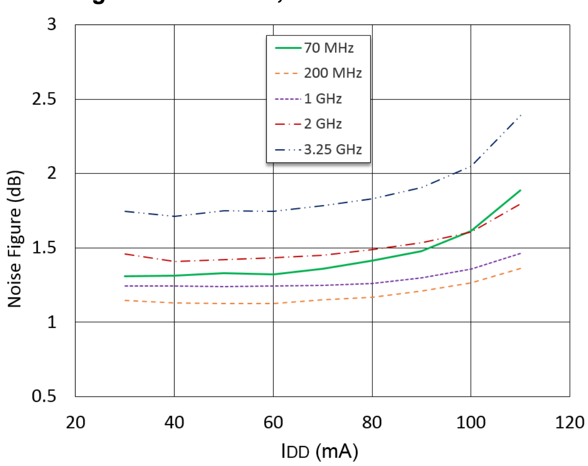
P1dB vs. Frequency



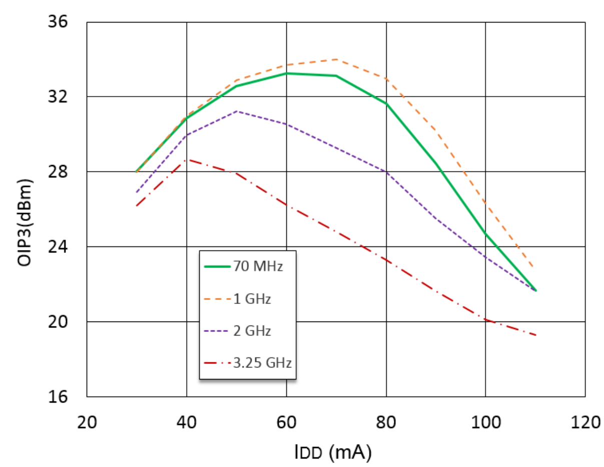
P1dB vs. Current, +25ºC



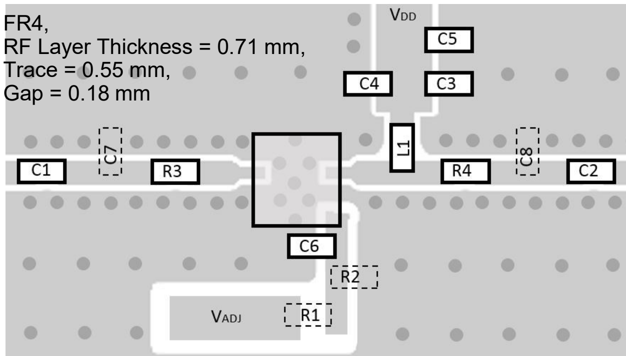
Noise Figure vs. Current, +25ºC



OIP3 vs Current, +25ºC



Recommended PCB Layout



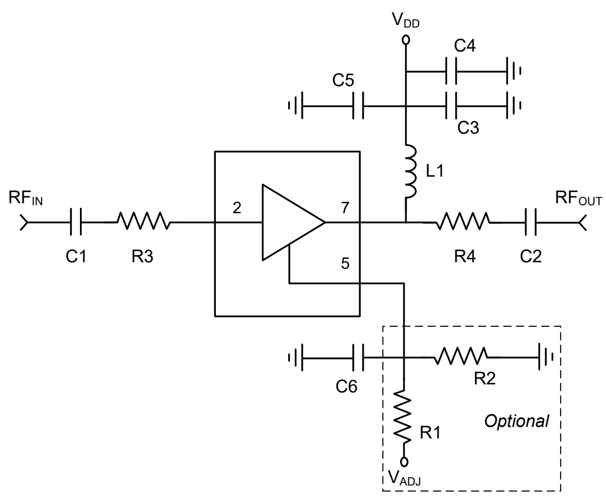
The recommended PCB layout includes place holders for additional components that are not necessary for typical applications but may be useful for extending performance to higher frequencies or optimizing a particular performance parameter at different bias conditions.

Sample Board Parts List

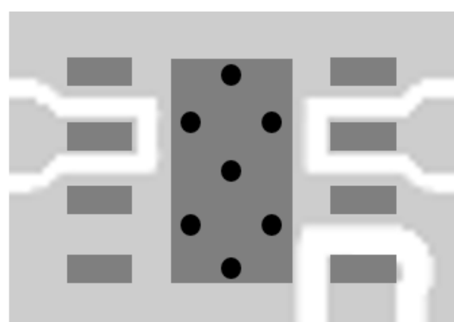
Component	Value	Package
C1 - C3, C6	1000 pF	0402
C4	0.1 µF	0402
C5	47 pF	0402
C7, C8	DNP	0402
R3, R4	0 Ω	0402
R1, R2	DNP	0402
R3, R4	0 Ω	0402
L1	Ferrite Bead[10]	0402

10. Murata, part number BLM15HD182SN.

Sample Board Schematic

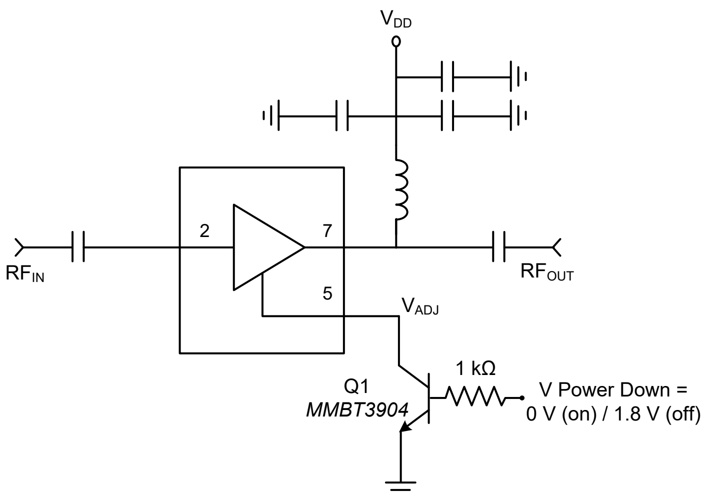


PCB Land Pattern

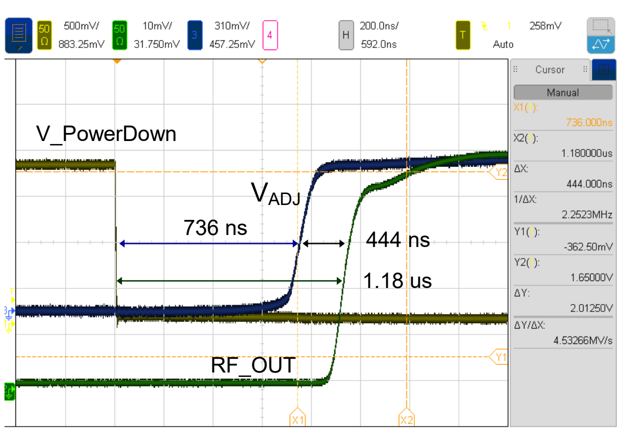


Applications Section: Power Down Option

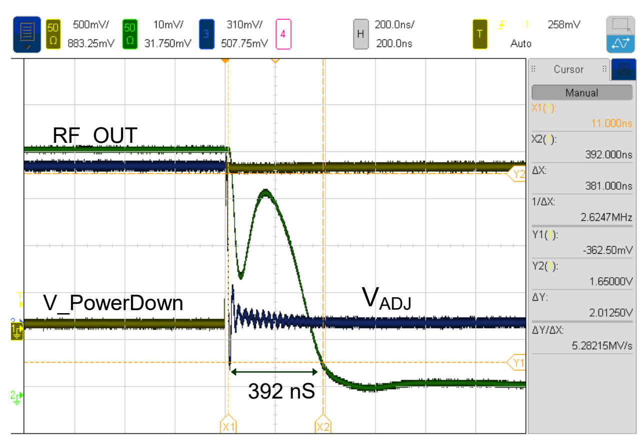
The I_{ADJ} (pin 5) of MAAM-011229 may be used to power down and turn on the amplifier. The critical characteristics of the power down circuit are that it presents a low impedance to DC ground in the off mode and that it presents a high impedance (much greater than 5 kΩ) in the on mode. The single very low cost MMBT3904 NPN switching transistor (available from many suppliers) may be added externally along with a 1 kΩ resistor to provide this function. As shown in plots below, the time from when voltage on the I_{ADJ} pin (V_{ADJ}) goes HIGH to the time RF reaches 90% of final amplitude is 444 ns. The total turn-on time, however, from change of power down signal is 1.18 µs (736 ns of this time is consumed in time for MMBT3904 to transition). Alternate choice for switching transistor could reduce total turn-on time. Total turn off time is 392 ns.



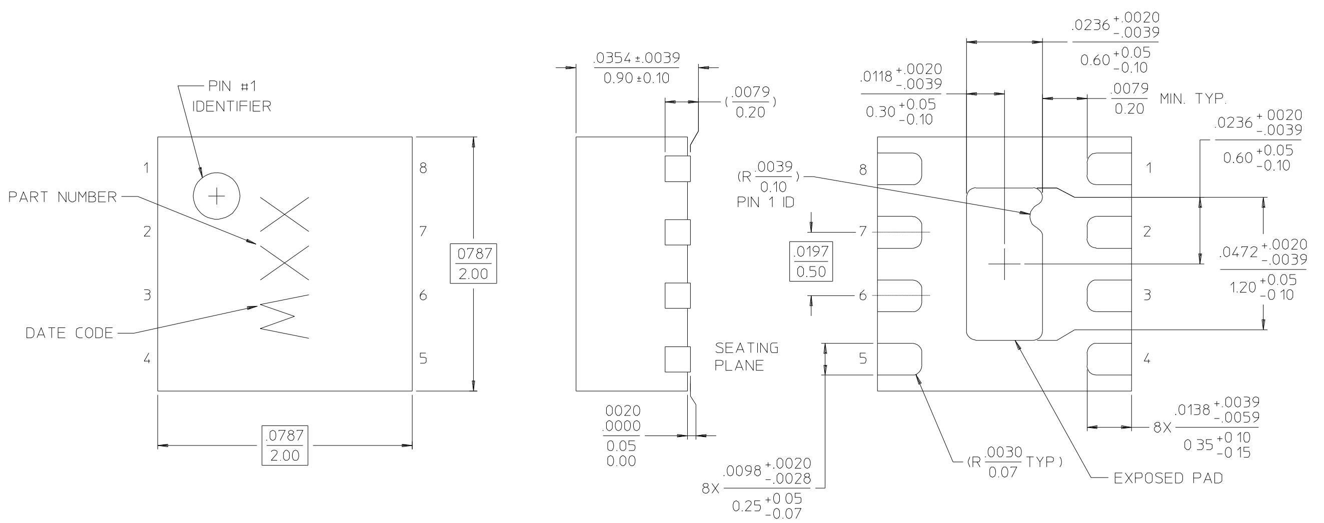
Turn ON Time



Turn OFF Time



Lead-Free 2 mm 8-Lead PDFN†



NOTES: 1. REFERENCE JEDEC MO-229, VAR. VCCD-3 FOR ADDITIONAL DIMENSIONAL AND TOLERANCE INFORMATION.
2. REFERENCE S2083 APPLICATION NOTE FOR PCB FOOTPRINT INFORMATION.
3. ALL DIMENSIONS SHOWN AS INCHES/MM

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