MAAL-011151-DIE

Ultra Low Phase Noise Amplifier
2 - 18 GHz

Rev. V1

Features

- Wideband Performance
- Noise Figure: 4 dB @ 8 GHz
- Phase Noise: -154 dBc/Hz @ 1 kHz
- Bias Voltage: 5 V
- Bias Current: 60 mA
- 50 Ω Matched Input / Output
- Positive Voltage Only
- Die Size: 2.8 x 1.73 x 0.1 mm
- RoHS* Compliant

Description

The MAAL-011151-DIE is an easy to use, wideband low noise distributed amplifier die. It operates from 2 to 18 GHz and provides 17 dB of linear gain, 16 dBm of P1dB and 4 dB of noise figure at 8 GHz. The input and output are fully matched to 50 Ω with typical return loss >15 dB.

The RF input and RF output ports are DC blocked. Amplifier control is available through the use of a control circuit or by direct bias injection.

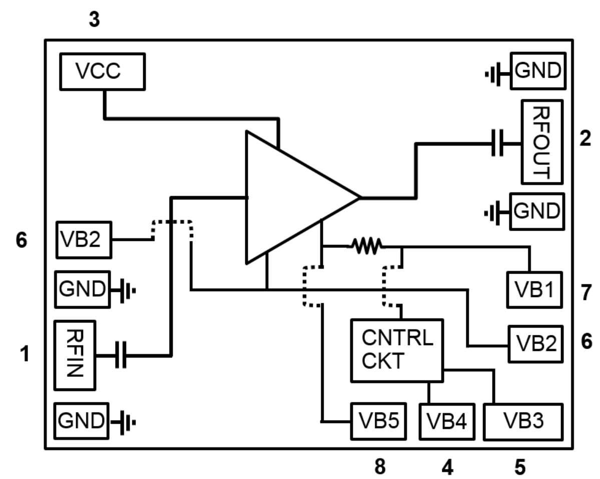
This product is fabricated using a low phase noise HBT process which features full passivation for enhanced reliability.

The MAAL-011151-DIE can be used as a low noise amplifier stage for signal generation applications. This device is ideally suited for Test and Measurement, EW, ECM, and Radar applications where ultra low phase noise and drive power is required.

Ordering Information

Part Number	Package
MAAL-011151-DIE	gel pack

Functional Schematic[1]



1. Image not to scale.

Pin Configuration[2]

Pin #	Pin Name	Description
1	RFIN	RF Input
2	RFOUT	RF Output
3	VCC	Collector Voltage
4	VB4	Bias Voltage 4
5	VB3	Bias Voltage 3
6	VB2	Bias Voltage 2
7	VB1	Bias Voltage 1
8	VB5	Bias Voltage 5

2. Backside of die must be connected to RF, DC and thermal ground.

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

Electrical Specifications: T_A = +25°C, VC = VCT[3] = 5 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	P_{IN} = -15 dBm 2 GHz 10 GHz 18 GHz	dB	15.0 14.0 13.5	16.5 16.0 15.5	—
Output P3dB[4]	2 GHz 10 GHz 18 GHz	dBm	—	23 19 14	—
Output Power	P_{IN} = +4.5 dBm, 2 GHz P_{IN} = +2.8 dBm, 10 GHz P_{IN} = -3.0 dBm, 18 GHz	dBm	18.0 15.0 9.0	20.0 17.5 11.5	—
Input Return Loss	P_{IN} = -15 dBm	dB	—	10	—
Output Return Loss	P_{IN} = -15 dBm	dB	—	10	—
Noise Figure	2 GHz 10 GHz 18 GHz	dB	—	8 5 8	—
Isolation	P_{IN} = -15 dBm 2 GHz 10 GHz 18 GHz	dB	—	50 42 30	—
Phase Noise	P_{IN} = +3 dBm, 12 GHz 100 Hz 1 kHz 10 kHz 1 MHz	dBc/Hz	—	-144 -150 -156 -162	—
ICQ	-15 dBm P_{IN}, VC = 5 V	mA	—	60	—
ICT[3]	Total current into R1, R2	mA	—	2	—

3. Reference detailed bias conditions on pages 3-4.
4. MACOM does not recommend sustained operation at power levels above 3 dB compression.

Maximum Operating Conditions

Parameter	Rating
Input Power[4]	P_{IN} ≤ 3 dB compression level
ICQ	90 mA
Junction Temperature[5,6]	+130°C
Operating Temperature	-40°C to +85°C

5. Operating at nominal conditions with junction temperature ≤ 130°C will ensure MTTF > 1 x 10^6 hours.
6. Junction Temperature (T_J) = T_C + Θ_{JC} * ((V * I) - (P_{OUT} - P_{IN})). Typical thermal resistance (Θ_{JC}) = 120°C/W.
   a) For T_C = +25°C
      T_J = +72°C @ 5 V, 98 mA, P_{OUT} = 20 dBm, P_{IN} = 4.5 dBm
   b) For T_C = +85°C
      T_J = 129°C @ 5 V, 88 mA, P_{OUT} = 19 dBm, P_{IN} = 4.5 dBm

Absolute Maximum Ratings[7,8]

Parameter	Absolute Maximum
Input Power	12 dBm
ICQ	120 mA
VCC	6 V
VB1, VB2, VB3, VB4, VB5	6 V
VB1, VB2, VB3, VB4, VB5 Current	5 mA
Junction Temperature[9]	+150°C
Storage Temperature	-65°C to +125°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. Junction temperature directly effects device MTTF. Junction temperature should be kept as low as possible to maximize lifetime.

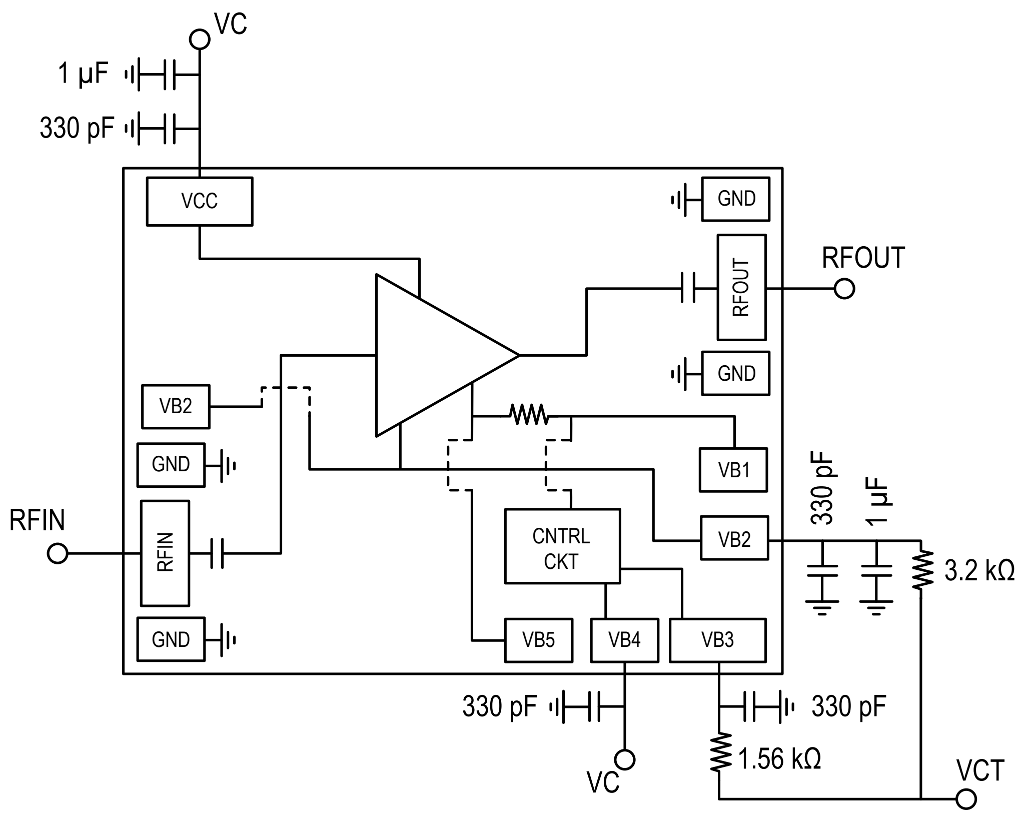
Handling Procedures

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 HBM Class 1A devices.

Application Schematic

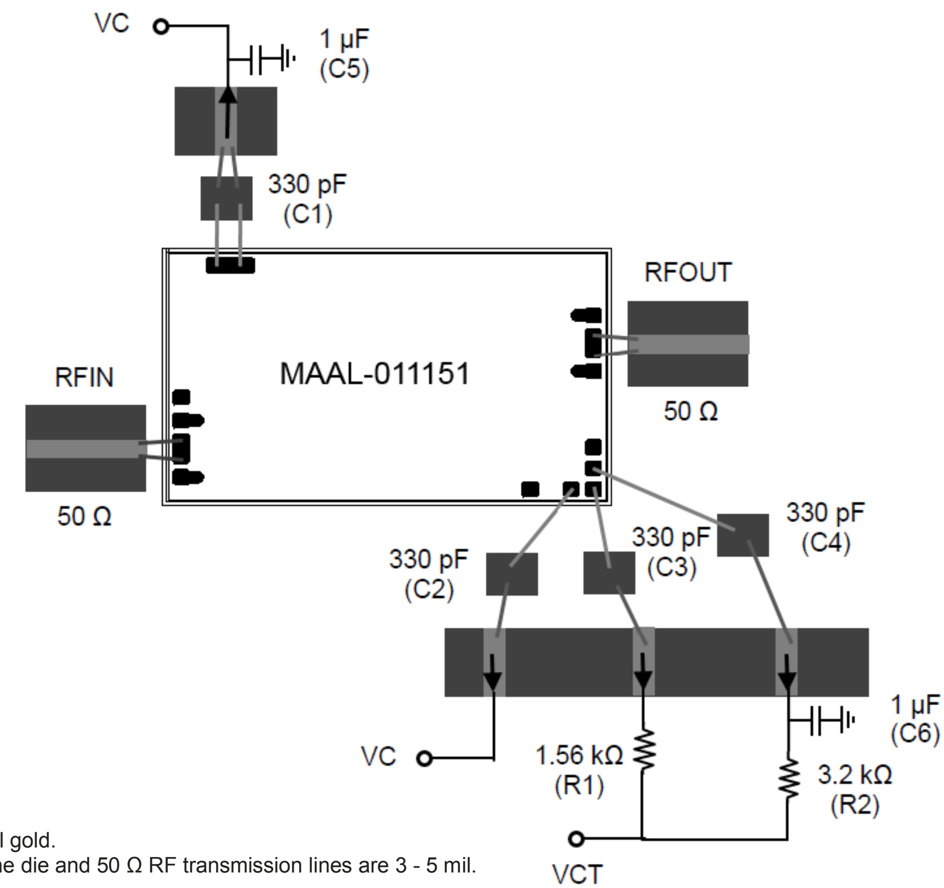


Operating Conditions

Recommended biasing conditions are VC = 5 V applied to the VB4 and VCC pads. Apply 5 V to the amplifier control VCT node through the offset resistors to VB2 and VB3 pads according to the application schematic as shown. Applying VCT = 5 V will turn the LNA on, which should draw 60 mA from VC. Applying VCT = 0 V will turn off the LNA. The VCT will draw <2 mA at 5 V. All DC supplies need to be low noise to prevent degradation of the amplifier phase noise.

Recommended Bonding Diagram & PCB Layout

RF input and output port matching circuit patterns are designed to compensate for bonding wires. Input and output bonding configuration are identical.



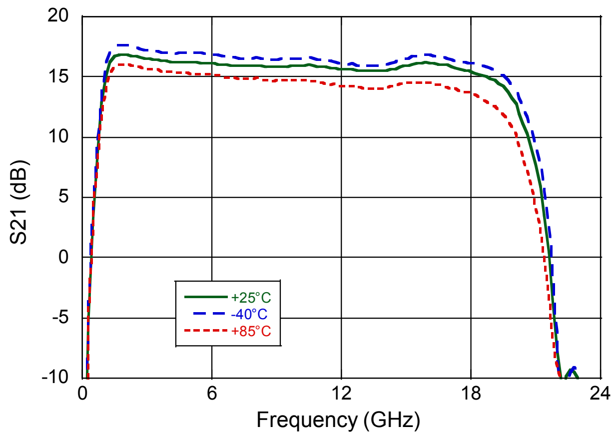
All wirebonds are 1 mil gold.
Separation between the die and 50 Ω RF transmission lines are 3 - 5 mil.

Parts List

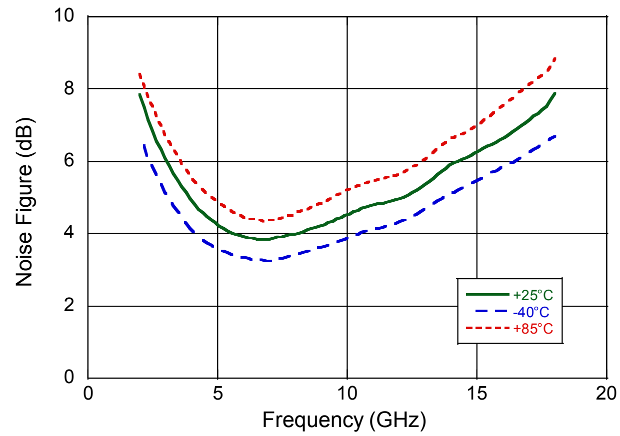
Part #	Value	Case Style
C1 - C4	330 pF	Single Layer
C5, C6	1 µF	0402
R1	1.56 kΩ	Thin film
R2	3.2 kΩ	Thin film

Typical Performance Curves: 5 V, ICQ = 60 mA

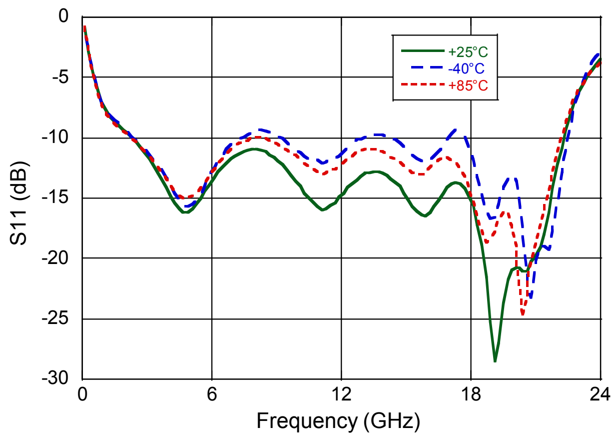
Gain



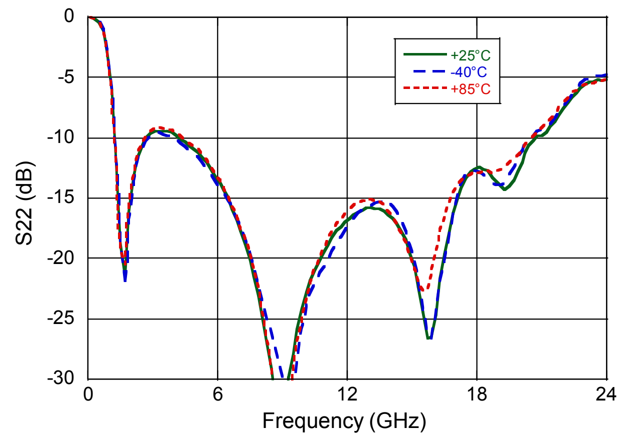
Noise Figure



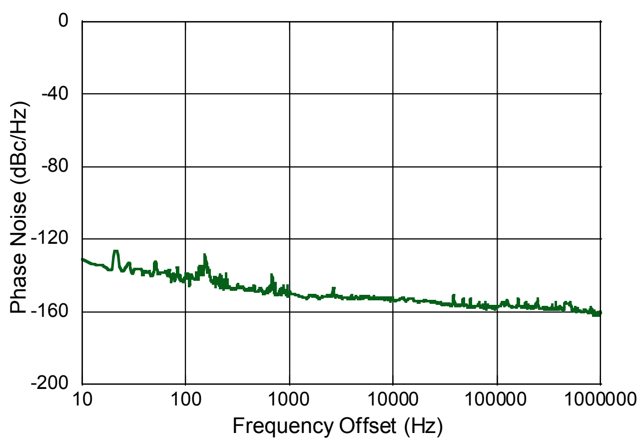
Input Return loss



Output Return Loss

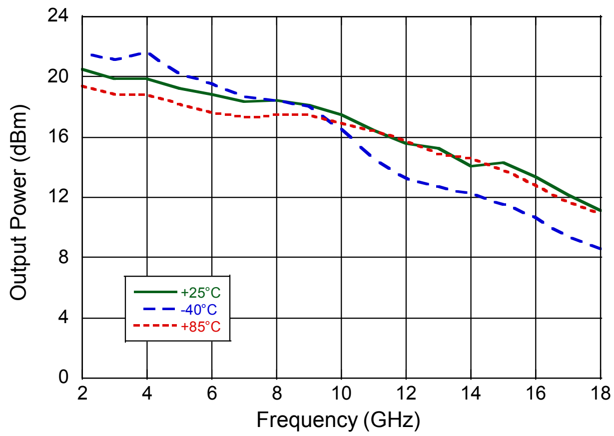


Phase Noise @ +25°C

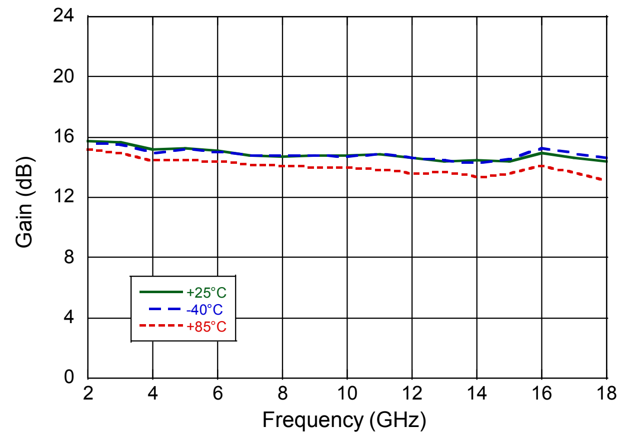


Typical Performance Curves: P1dB @ ICQ = 60 mA

P$_{OUT}$

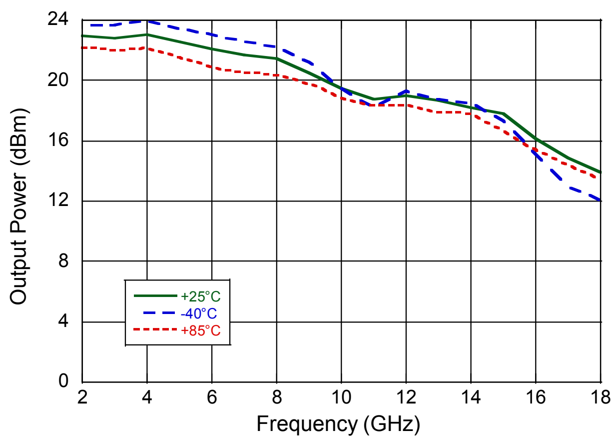


Gain

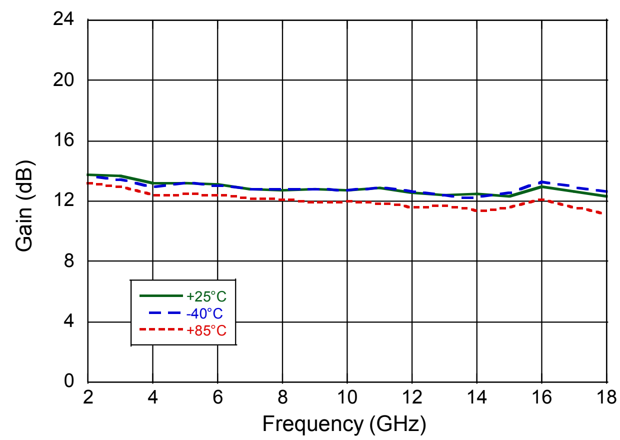


Typical Performance Curves: P3dB @ ICQ = 60 mA

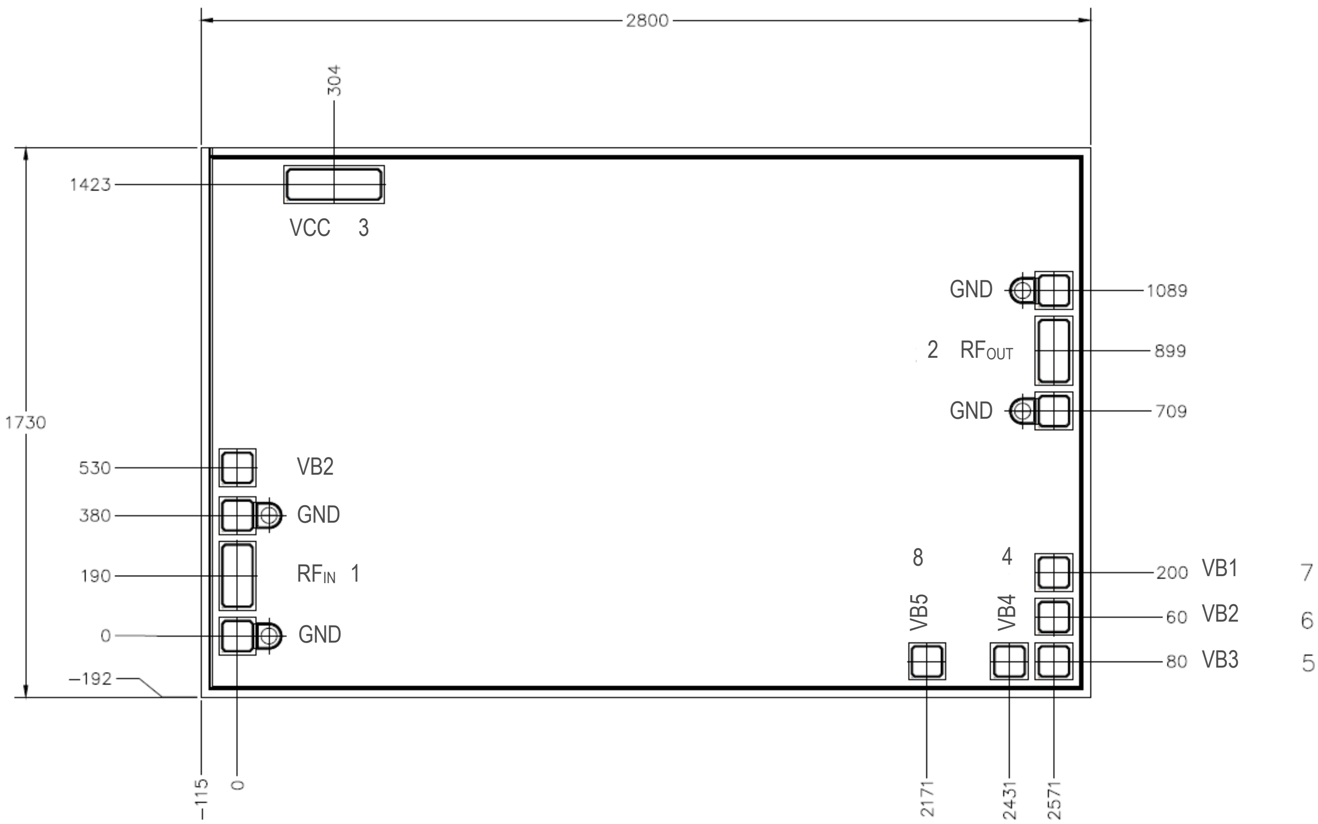
P$_{OUT}$



Gain



MMIC Die Outline



Bond Pad Detail[10,11]

Pin #	Size (x)	Size (y)
1 - 2	100	200
3	300	100
4 - 8	100	100

10. All dimensions shown as microns (µm) with a tolerance of +/-5 µm, unless otherwise noted.
11. Die thickness is 100 µm +/-10 µm.

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