## Broadband 2-Stage LNA 1 - 6 GHz



**MAAL-011188** 

Rev. V2

#### **Features**

- Broadband 2-Stage LNA
- Gain:

35.2 dB @ 2.50 GHz 35.1 dB @ 3.75 GHz 35.2 dB @ 4.70 GHz

Noise Figure:

0.79 dB @ 2.50 GHz 0.86 dB @ 3.75 GHz 0.92 dB @ 4.70 GHz

- Single 5 V Supply
- Enable Pin with 1.8 V logic
- Low DC Current: 80 mA
- Lead-Free 3 mm 16 Lead QFN Package
- RoHS\* Compliant

#### **Applications**

- 5G Massive MIMO
- Wireless Infrastructure
- General purpose wireless
- TDD or FDD systems

#### **Description**

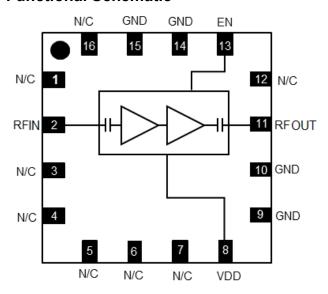
The MAAL-011188 is a compact surface mount, highly integrated 2-stage low noise amplifier (LNA). This LNA is designed for operation from 1 to 6 GHz and is housed in a lead-free 3 mm 16-lead QFN plastic package.

The MAAL-011188 features low noise figure, high gain and low power consumption. The LNA requires a single 5 V supply and the Enable pin is 1.8 V CMOS compatible. All the bias circuitry and matching components are internal to the device.

## **Ordering Information**

Part Number	Package
MAAL-011188-TR1000	1000 part reel
MAAL-011188-001SMB	Sample Board

#### **Functional Schematic**



## Pin Configuration<sup>1</sup>

Pin#	Pin Name	Description	
1,3,4,5,6, 7,12,16	N/C	No Connect	
9,10, 14,15	GND	Ground	
2	RFIN	RF Input	
8	VDD	Supply Voltage	
11	RFOUT	RF Output	
13	EN	LNA Enable	
17	Paddle <sup>2</sup>	Ground	

- MACOM recommends connecting GND and N/C pins to ground.
- The exposed pad centered on the package bottom must be connected to PCB ground with low electrical and thermal resistances.

<sup>\*</sup> Restrictions on Hazardous Substances, compliant to current RoHS EU directive



MAAL-011188 Rev. V2

## AC Electrical Specifications (LNA ON Mode): $P_{IN}$ = -30 dBm, $T_C$ = +25°C, $V_{DD}$ = 5 V, $Z_0$ = 50 $\Omega$

Parameter	Test Conditions	Units	Min.	Тур.	Max.
Gain	2.50 GHz 3.75 GHz 4.70 GHz	dB	32 32 —	35.2 35.1 35.2	_
Input IP3	P <sub>IN</sub> /tone = -30 dBm, Tone Delta = 2 MHz, 2.50 GHz 3.75 GHz 4.70 GHz	dBm	_	-5.2 -3.7 -4.8	_
Input P1dB	2.50 GHz 3.75 GHz 4.70 GHz	dBm	_	-17.4 -17.6 -18.8	_
Noise Figure	2.50 GHz 3.75 GHz 4.70 GHz	dB	_	0.79 0.86 0.92	
RF <sub>IN</sub> Port Return Loss	RF <sub>IN</sub> Port, 2.50 GHz RF <sub>IN</sub> Port, 3.75 GHz RF <sub>IN</sub> Port, 4.70 GHz	dB	_	24 21 18	_
RF <sub>OUT</sub> Port Return Loss	RF <sub>OUT</sub> Port, 2.50 GHz RF <sub>OUT</sub> Port, 3.75 GHz RF <sub>OUT</sub> Port, 4.70 GHz	dB	_	15 20 16	_
Reverse Isolation	2.50 GHz 3.75 GHz 4.70 GHz	dB	_	55 56 55	_

## **Transient Electrical Specifications:**

Freq. = 2.5 GHz,  $P_{IN}$  = -30 dBm,  $T_C$  = 25°C,  $V_{DD}$  = 5 V,  $Z_0$  = 50  $\Omega$ 

Parameter	Test Conditions	Units	Min.	Тур.	Max.
EN Gain Settling Time	RF <sub>IN</sub> to RF <sub>OUT</sub> gain settling time within 0.3 dB of final value after EN command	μs	_	0.3	_
Power on Gain Settling Time	RF <sub>IN</sub> to RF <sub>OUT</sub> gain settling time within 0.5 dB of final value after DC power on	ms	_	1	_

## DC Electrical Specifications: $T_C = 25^{\circ}C$ , $V_{DD} = 5$ V, $Z_0 = 50$ $\Omega$

Parameter	Test Conditions	Units	Min.	Тур.	Max.
Supply Voltage		V	4.75	5	5.25
Amplifier Bias Current	LNA ON Mode Disable Mode	mA	_	80 2.3	_
EN Control Voltage	LNA ON Mode, Logic High Disable Mode, Logic Low	V	_	1.8 0	_
EN Logic Input Current	LNA ON Mode, Logic High Disable Mode, Logic Low	μA	_	40 +/-0.03	_

## Broadband 2-Stage LNA 1 - 6 GHz



MAAL-011188 Rev. V2

#### **Control Truth Table**

EN Control				
LNA ON Mode	Logic High			
Disable Mode	Logic Low or Open			

## Absolute Maximum Ratings<sup>3,4</sup>

Parameter	Absolute Maximum
RF <sub>IN</sub> Input Power <sup>5</sup> Freq. = 3.75 GHz: LNA ON Mode	23 dBm LTE (8 dB PAR), 26 dBm CW
DC Voltages: V <sub>DD</sub> & RF <sub>IN</sub> EN & RF <sub>OUT</sub>	-0.5 to +5.5 V -0.5 to +2.75 V
Junction Temperature: LNA ON Mode <sup>6,8</sup>	+150°C
Operating Temperature <sup>7</sup>	-40°C to +105°C
Storage Temperature	-55°C to +150°C

- 3. Exceeding any one or combination of these limits may cause permanent damage to this device.
- 4. MACOM does not recommend sustained operation near these survivability limits.
- 5. Single event, up to 10 seconds duration.
- 6. Operating at nominal conditions with  $T_J \le +150$  °C (LNA ON Mode) will ensure MTTF >> 1 x  $10^6$  hours.
- 7. Operating/Case temperature (T<sub>C</sub>) is the temperature of the exposed paddle.
- 8. Junction Temperature  $(T_J) = T_C + \Theta_{JC} * P_{DISS}$  where  $P_{DISS}$  is the total DC & RF dissipated power.
  - LNA ON Mode: Typical thermal resistance (Θ<sub>JC</sub>) = 33.4°C/W.

#### **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 1 A and CDM Class C3 devices.

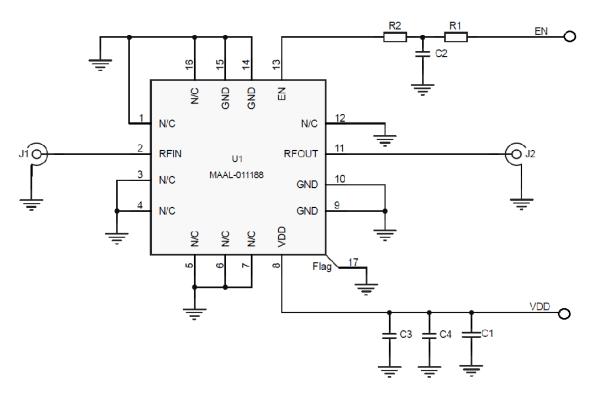
#### **Power Supplies**

De-coupling capacitors should be placed at the VDD supply pin to minimize noise and fast transients. Supply voltage change or transients should have a slew rate smaller than 1 V / 10  $\mu$ s. In addition, all control pins should remain at 0 V (+/- 0.3 V) and no RF power should be applied while the supply voltage ramps or while it returns to zero.

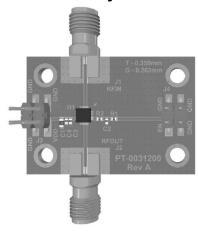


Rev. V2

## **Sample Board Schematic**



## **Sample Board PCB Layout**



#### **Parts List**

Part	Value	Case style
C1	10 µF	0603
C2	5 pF	0402
C3	470 pF	0402
C4	10 nF	0402
R1	1 kΩ	0402
R2	100 Ω	0402

• Material: Rogers 4003C

Dielectric thickness: 0.203 mm

Track/Gap: 0.350/0.263 mm

Finished copper thickness: 44 μm +/- 10 μm

Finish both sides: 0.075 μm gold over 4.5μm nickel

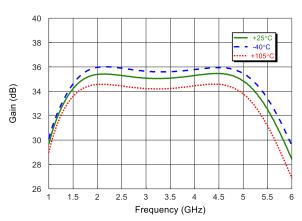
Further layout information available on request

Rev. V2

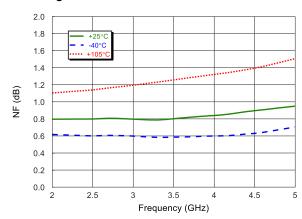
## **Typical Performance Curves:**

 $P_{IN} = -30$  dBm,  $V_{DD} = 5$  V,  $T_C = +25$ °C,  $Z_0 = 50$   $\Omega$  (unless otherwise indicated)

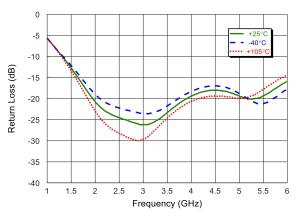
#### Gain9



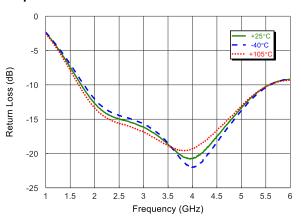
#### Noise Figure<sup>9</sup>



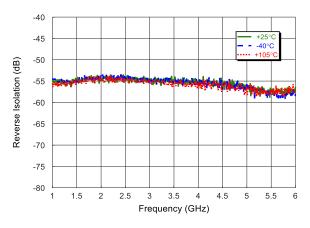
#### Input Return Loss



#### **Output Return Loss**



#### Port Reverse Isolation - RX Mode



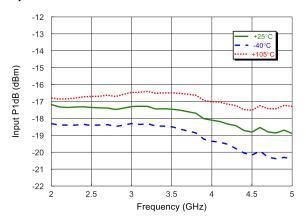
9. For gain, noise figure and isolation plots, RF trace and connector losses are de-embedded.



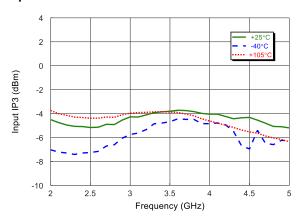
Rev. V2

# Typical Performance Curves: $P_{IN}$ = -30 dBm, $V_{DD}$ = 5 V, $T_{C}$ = +25°C, $Z_{0}$ = 50 $\Omega$ (unless otherwise indicated)

#### Input P1dB



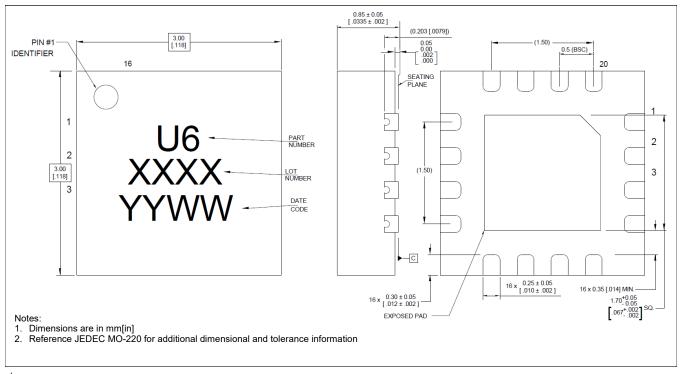
#### Input IP3





Rev. V2

## Lead-Free 3 mm 16-Lead QFN<sup>†</sup>



<sup>†</sup> Reference Application Note S2083 for lead-free solder reflow recommendations. Meets JEDEC moisture sensitivity level 1 requirements in accordance to JEDEC J-STD-020D. Plating is NiPdAu over Copper

## Broadband 2-Stage LNA 1 - 6 GHz



MAAL-011188

Rev. V2

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