Low Noise Amplifier
27 - 31.5 GHz

MAAL-FR1245
Rev. V3

Features

- Single Supply Architecture
- Noise Figure: 1.2 dB
- Gain: 26 dB
- P1dB: 5 dBm
- Input Return Loss: 15 dB
- Output Return Loss: 8 dB
- Power Supply: 48 mA @ 1.5 V
- Chip Size: 3 x 3 mm² PQFN
- 100% RF Tested, Known Good Die
- Demonstration Boards Available
- RoHS* Compliant

Applications

- RADAR
- SATCOM

Description

The MAAL-FR1245 is a very low noise three stage LNA designed to operate from 27 to 31.5 GHz with 1.2 dB of noise figure and 26 dB of gain. This amplifier is a single positive and single negative voltage bias which include a DC current regulation. This LNA is matched to 50 Ω at both input and output ports.

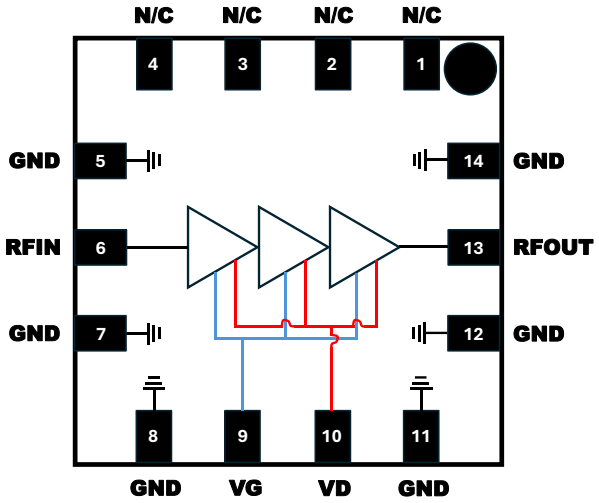
The die is manufactured using a 0.07 µm gate length pHEMT technology. The MMIC uses gold bond pads and backside metallization and is fully protected with Silicon Nitride passivation to obtain the highest level of reliability.

This product is available in die form: MAAL-011245-DIE.

Ordering Information

Part Number	Package
MAAL-FR1245-TR0500	500 part reel
MAAL-FR1245-001SMB	Evaluation Board

Block Diagram



Pad Configuration[1]

Pad #	Pad Name	Function
1,2,3,4	N/C	Not Connected
5,7,8,10,12,14	GND	Ground
6	RF_{IN}	RF Input
9	V_G	Voltage Gate
10	V_D	Voltage Drain
13	RF_{OUT}	RF Output
15	Paddle[2]	Paddle

1. MACOM recommends connecting unused package pins to ground.
2. The exposed pad centered on the package bottom must be connected to RF and DC ground.

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

Electrical Specifications: Freq. = 27 - 31.5 GHz, T_A = +25°C, V_D = +1.5 V, V_G = -1.5 V

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	—	dB	21.5	26	—
Noise Figure	—	dB	—	1.2	2.0
Drain Supply Voltage	—	V	—	1.5	—
Drain Supply Current	—	mA	—	48	—
Reverse Isolation	RF_{OUT} / RF_{IN}	dB	—	-55	—
P1dB	—	dBm	—	5	—
Output IP3	—	dBm	—	12	—
Output IM3	Tone Spacing = 100 MHz	dBc	—	19	—
Input Return Loss	50 Ω	dB	—	-15	—
Output Return Loss	50 Ω	dB	—	-8	—

Absolute Maximum Ratings[3,4]

Parameter	Absolute Maximum
Input RF ports	15 dBm
DC Voltage Drain Supply	2 V
DC Voltage Gate Supply	-2 V
Junction Temperature[5,6]	+150°C
Operating Temperature[5]	-40°C to +85°C
Storage Temperature	-40°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. Operating at nominal conditions with $T_J \leq$ +150°C will ensure MTTF > 1 x 10^{11} hours.
6. Junction Temperature (T_J) = T_C + Θjc * (V * I)
   Typical thermal resistance (Θjc) = 360 °C/W.
   a) For T_C = +25°C,
   T_J = 49.1°C @ 1.5 V, 48 mA
   b) For T_C = +85°C
   T_J = 113.5°C @ 1.5 V, 48 mA

Recommended Operating Conditions

Parameter	Typical
Input RF ports	-35 dBm
DC Supply V_D	+1.5 V
DC Supply V_G	-1.5 V

Handling Procedures

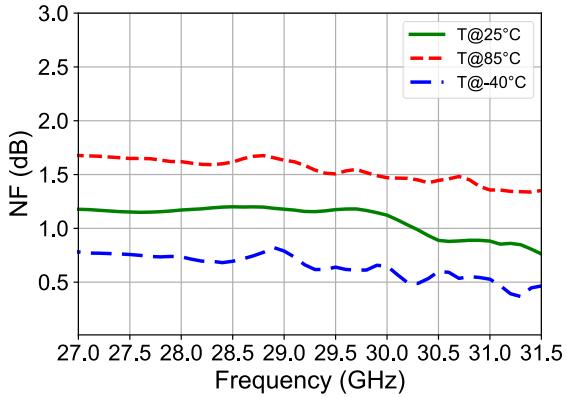
Please observe the following precautions to avoid damage:

Static Sensitivity

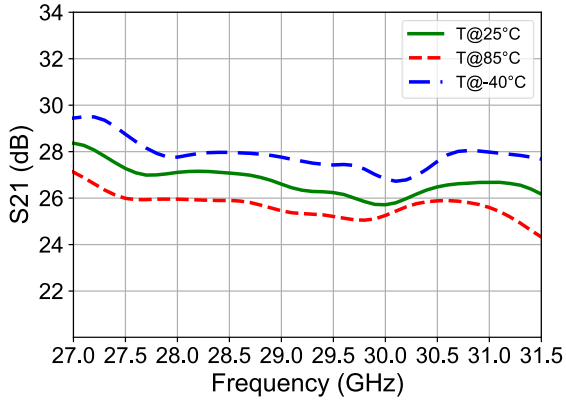
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Typical Performance Curves: @ PCB level with De-Embedding at different temperature
V_D = +1.5 V, V_G = -1.5 V, I_D = 48 mA

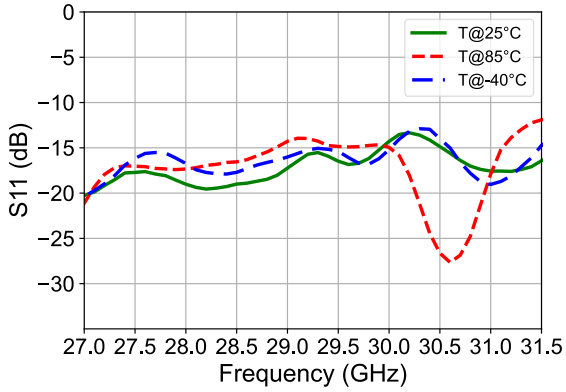
Noise Figure over Frequency



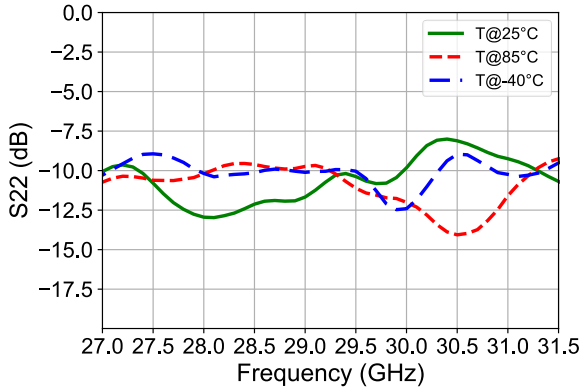
Gain over Frequency



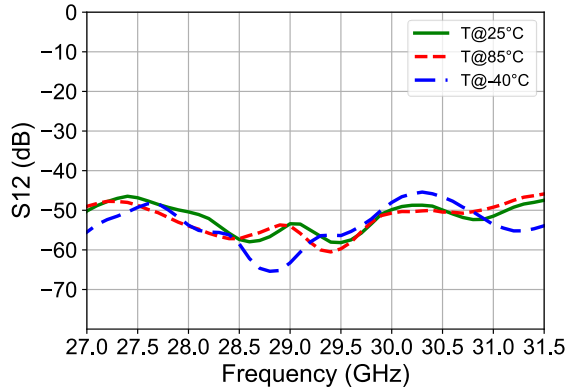
Input Return Loss over Frequency



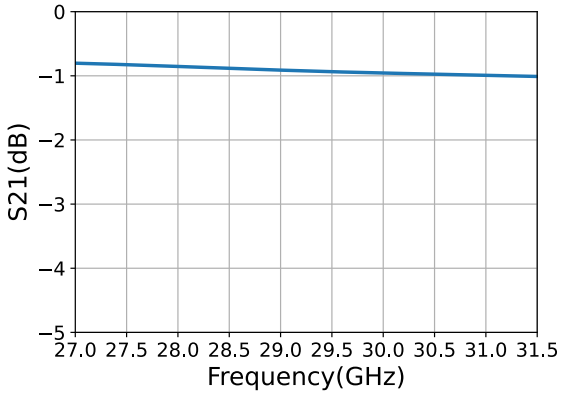
Output Return Loss over Frequency



Reverse Isolation over Frequency

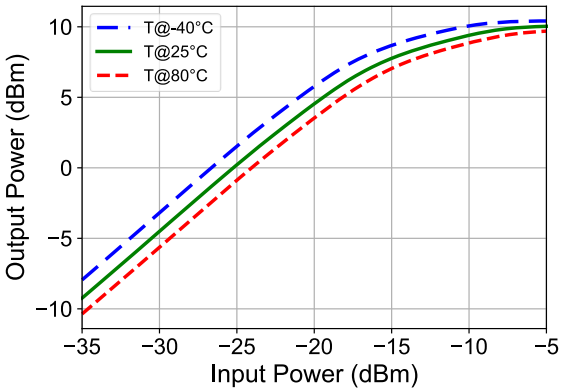


RF access line & connector Losses over Frequency

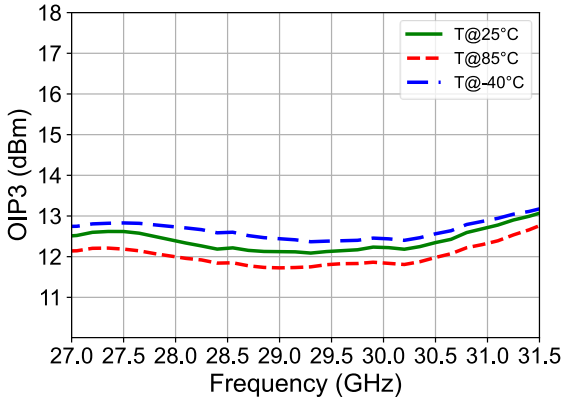


Typical Performance Curves: @ PCB level with De-Embedding at different temperature
V_D = +1.5 V, V_G = -1.5 V, I_D = 48 mA

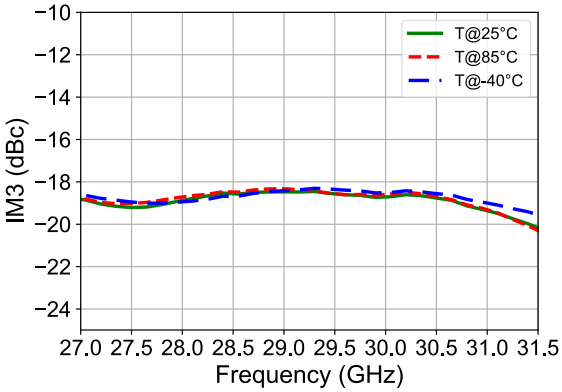
Output power over Input power



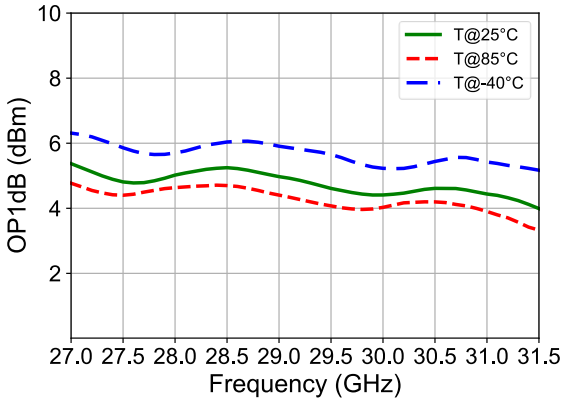
OIP3 over Frequency



IM3 over Frequency



P1db over Frequency

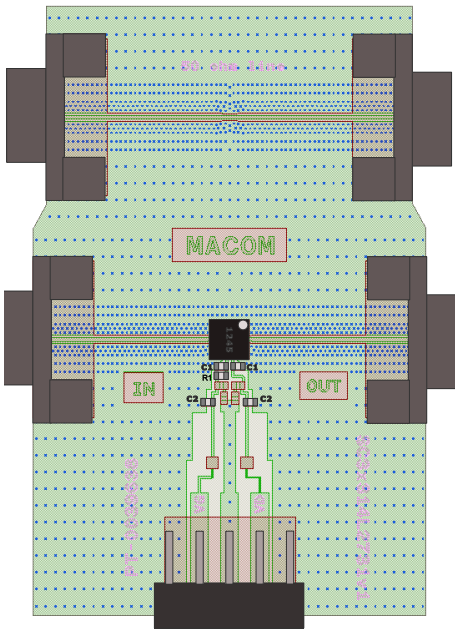


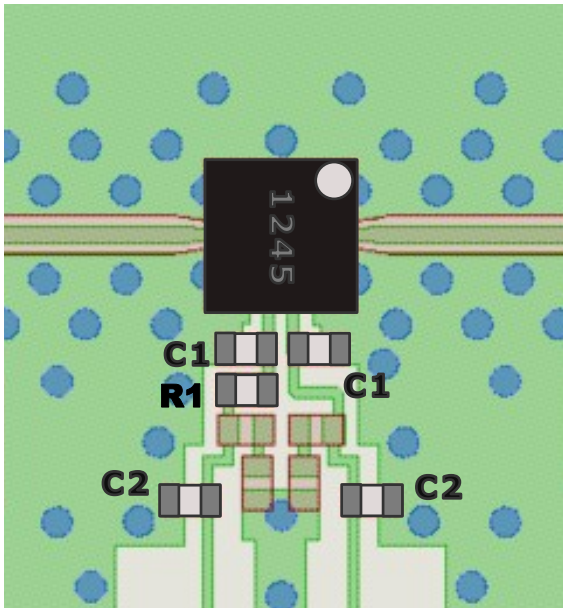
Biasing Procedure

Biasing UP
Set I_D limit to 60 mA
Ensure voltages are at 0 before turning on DC supply
Set V_G to -1.5 V
Set V_D to +1.5 V

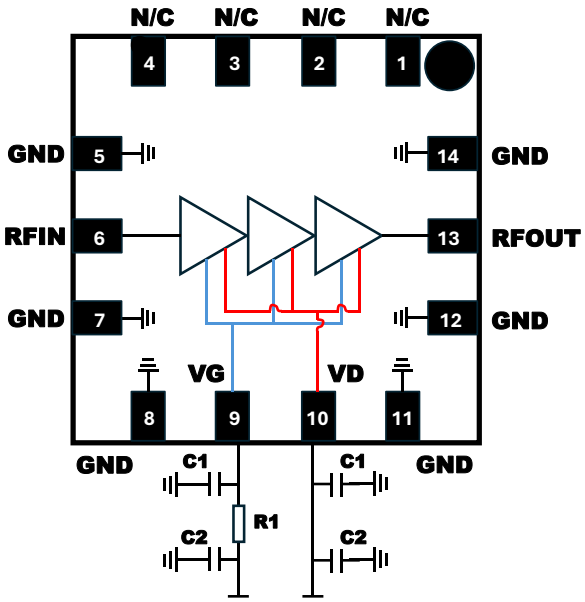
Biasing DOWN
Set V_D to 0 V
Set V_S to 0 V
Turn off DC supply

PCB Layout





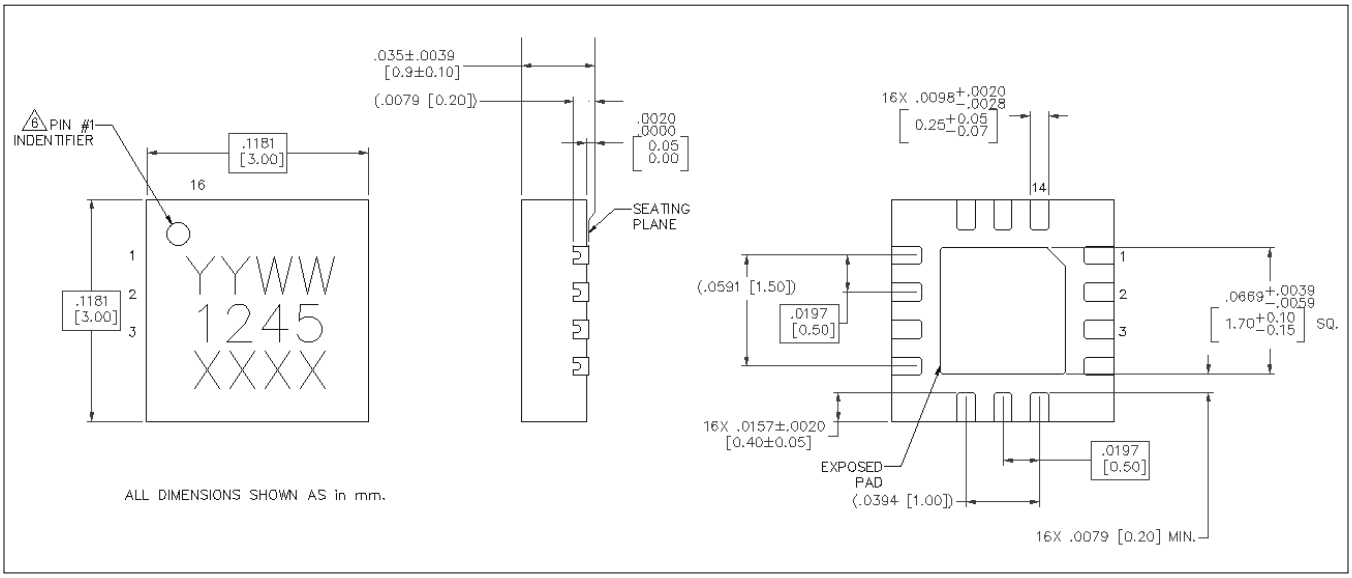
Functional Schematic



Parts List

Part	Value	Case Style	Manufacturer	Manufacturer's Part number
C1	47 pF	0402	Murata	GRT1555C1H470JA02D
C2	10 nF	0402	Murata	GRT188R71E474KE13D
R1	0 Ω	0402	Panasonic	ERJ2GE0R00X

Lead-Free 3mm 14-Lead SMT [1]



[1] Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensity level 3 requirements in accordance to JEDEC J-STD-020D.
Plating is NiPdAu over Copper.

Revision History

Rev	Date	Change Description
V1	17/12/24	Initial Release
V2	28/01/25	Change of chip size by QFN dimensions.
V3	03/06/25	Thermal resistance value updated