

Low Noise Amplifier

27 - 31.5 GHz



MAAL-FR1245

Rev. V1

Features

- Single Supply Architecture
- Noise Figure: 1.2 dB
- Gain: 26 dB
- P1dB: 5 dBm
- Return Loss: 15/8 dB
- Power Supply: 48 mA @ 1.5 V
- Chip Size: 1.5 x 1 mm
- 100% RF Tested, Known Good Die
- Demonstration Boards Available
- RoHS* Compliant

Applications

- RADAR
- SATCOM

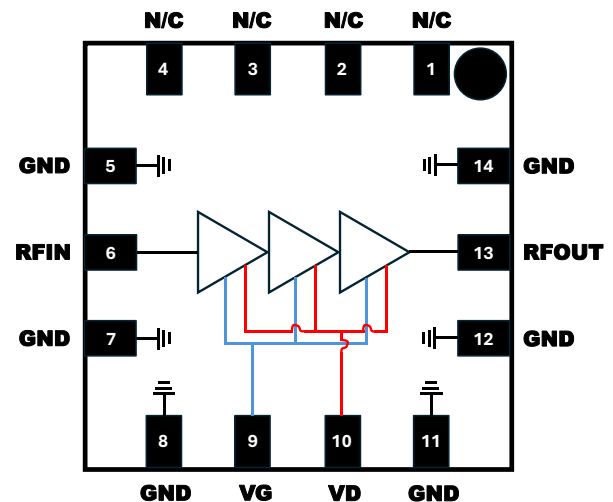
Description

The MAAL-FR1245 is a very low noise three stage LNA designed to operate from 27 to 31.5 GHz with 1 dB of noise figure and 25 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-FR1245-DIE

Block Diagram



Pad Configuration

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

Ordering Information

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

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

Electrical Specifications: Freq. = 27 - 31.5 GHz, $T_A = +25^\circ\text{C}$, $V_D = +1.5\text{ V}$, $V_G = -1.5\text{ V}$

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

Recommended Operating Conditions

Parameter	Symbol	Unit	Min.	Typ.	Max.
Input RF ports	RF_{IN}	dBm	—	-25	—
DC Supply V_D	V_D	V	—	+1.5	—

Absolute Maximum Ratings^{1,2}

Parameter	Symbol	Unit	Min.	Max.
Input RF ports	RF_{IN}	dBm	—	+10
DC Voltage Drain Supply	V_D	V	—	+2
Junction Temperature ^{3,4}	T_J	$^\circ\text{C}$	—	+150
Operating Temperature	T_C	$^\circ\text{C}$	-40	+85
Storage Temperature		$^\circ\text{C}$	-40	+150

1. Exceeding any one or combination of these limits may cause permanent damage to this device.

2. MACOM does not recommend sustained operation near these survivability limits.

3. Operating at nominal conditions with $T_J \leq +150^\circ\text{C}$ will ensure MTTF > 1×10^{11} hours.

4. Junction Temperature (T_J) = $T_C + \Theta_{jc} * (V * I)$

Typical thermal resistance (Θ_{jc}) = 327 $^\circ\text{C}/\text{W}$.

a) For $T_C = +25^\circ\text{C}$,

$T_J = 35,5^\circ\text{C}$ @ 1.5V, 48 mA

b) For $T_C = +85^\circ\text{C}$

$T_J = 97,3^\circ\text{C}$ @ 1.5V, 48 mA

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.

Low Noise Amplifier

27 - 31.5 GHz

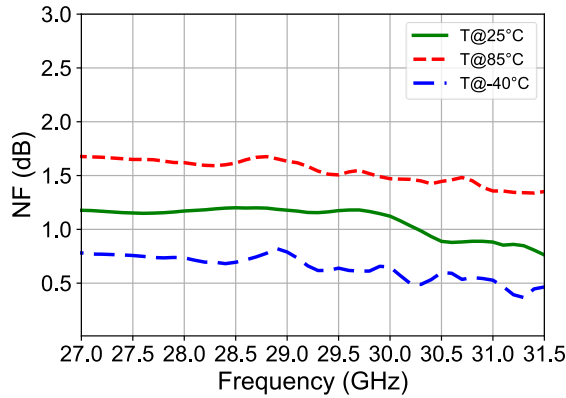


MAAL-FR1245

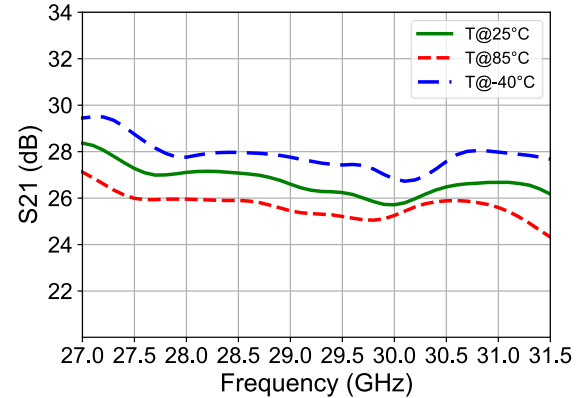
Rev. V1

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

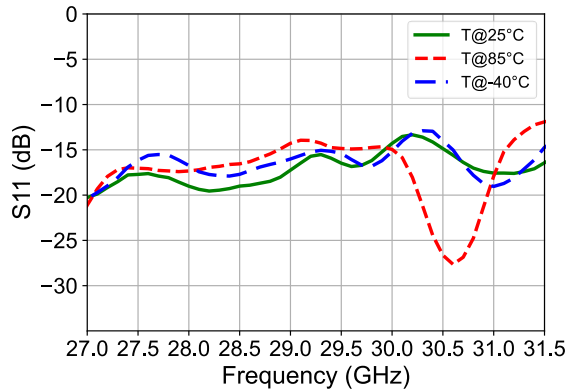
Noise Figure over Frequency



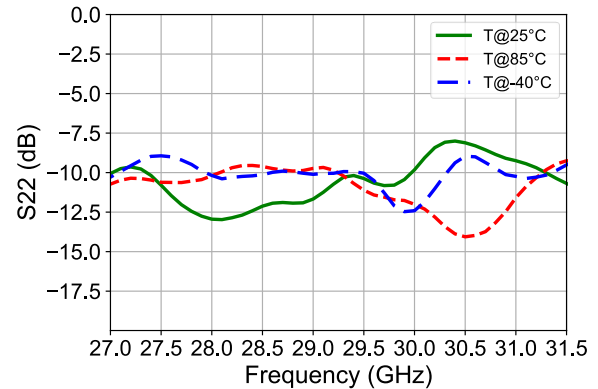
Gain over Frequency



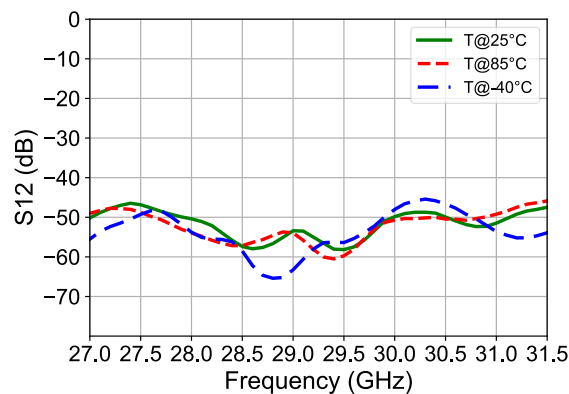
Input Return Loss over Frequency



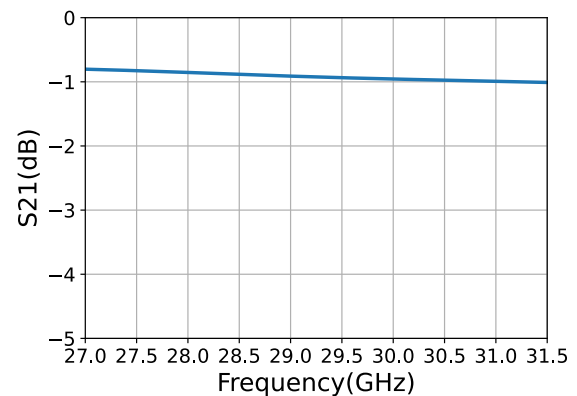
Output Return Loss over Frequency



Reverse Isolation over Frequency

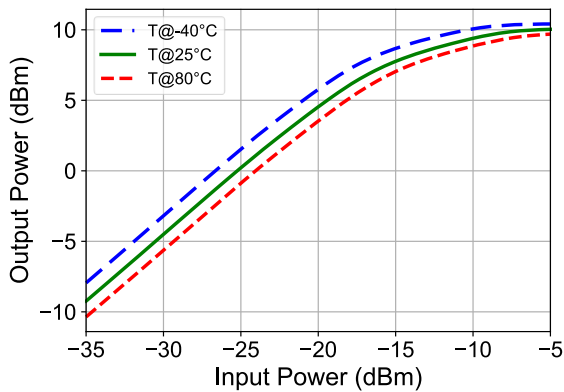


RF access line & connector Losses over Frequency

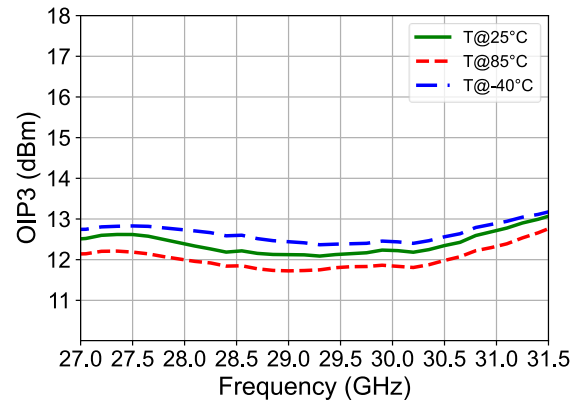


Typical Performance Curves: In board with De-Embedding at different temperature

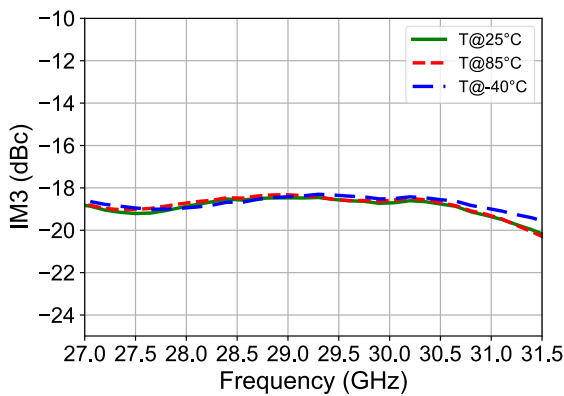
Output power over Input power



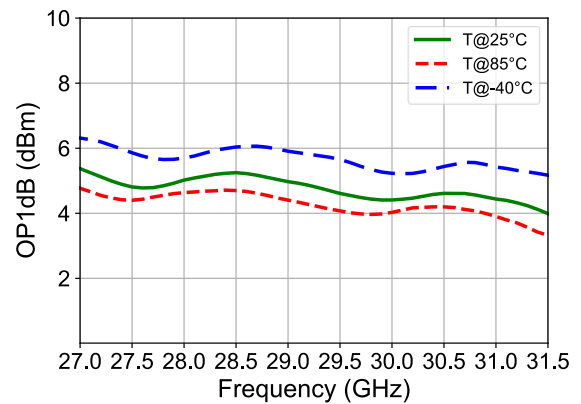
OIP3 over Frequency



IM3 over Frequency



P1db over Frequency



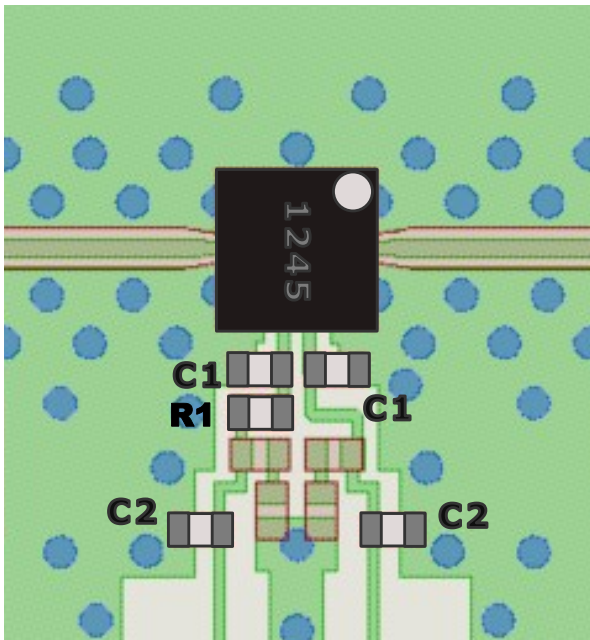
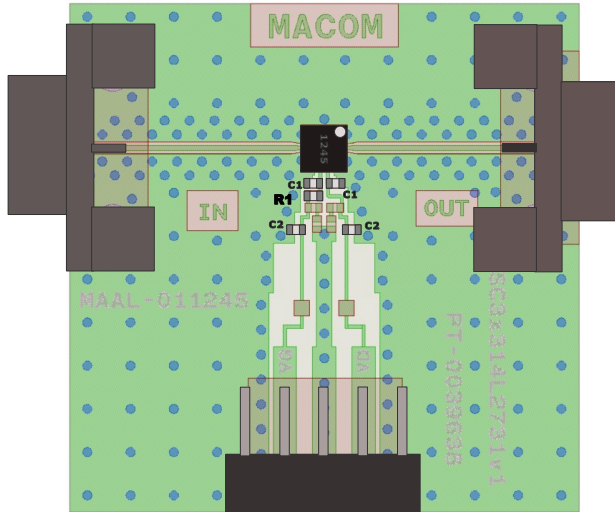
Low Noise Amplifier 27 - 31.5 GHz



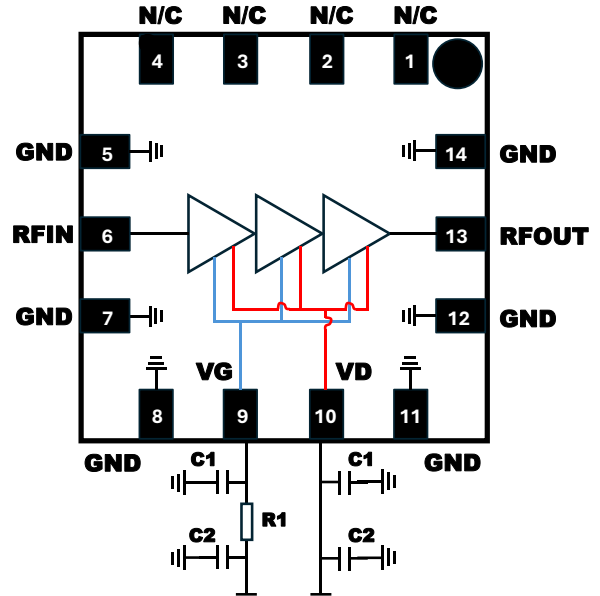
MAAL-FR1245

Rev. V1

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

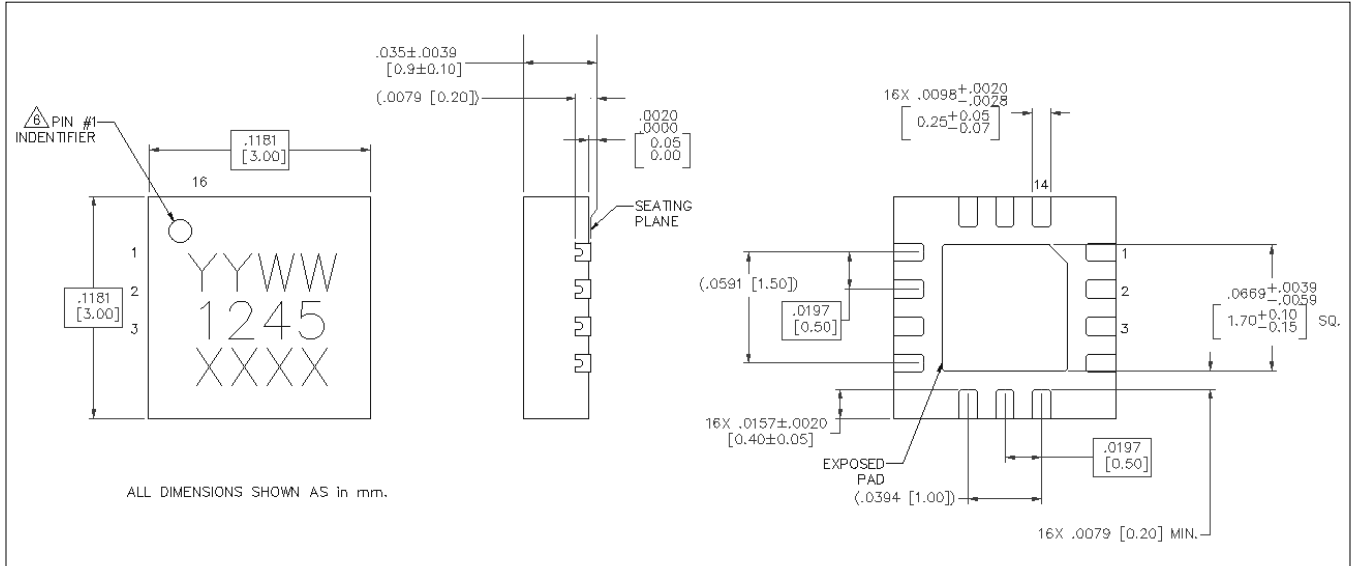
Low Noise Amplifier 27 - 31.5 GHz



MAAL-FR1245

Rev. V1

Lead-Free 3mm 14-Lead SMT¹



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

MACOM Technology Solutions Inc. ("MACOM"). All rights reserved.

These materials are provided in connection with MACOM's products as a service to its customers and may be used for informational purposes only. Except as provided in its Terms and Conditions of Sale or any separate agreement, MACOM assumes no liability or responsibility whatsoever, including for (i) errors or omissions in these materials; (ii) failure to update these materials; or (iii) conflicts or incompatibilities arising from future changes to specifications and product descriptions, which MACOM may make at any time, without notice. These materials grant no license, express or implied, to any intellectual property rights.

THESE MATERIALS ARE PROVIDED "AS IS" WITH NO WARRANTY OR LIABILITY, EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHT, ACCURACY OR COMPLETENESS, OR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.