RF Low Noise Amplifier
1 - 18 GHz

MAAL-FR0001
Rev. V1

Features

- Noise Figure: 1.2 dB
- Gain: 29 dB
- Current: 50 mA DC Consumption
- Voltage: 1.5 V
- Lead-Free 3 mm PQFN
- RoHS* Compliant

Applications

- ISM
- Multimarket

Description

The MAAL-FR0001 is a 3 stage high performance GaAs wide band low noise amplifier designed to operate from 1 to 18 GHz. This amplifier has an exceptionally low noise figure of 1.2 dB and high gain of 29 dB as well as low power consumption. The drain voltage is typically 1.5 V and the total current consumption is 50 mA.

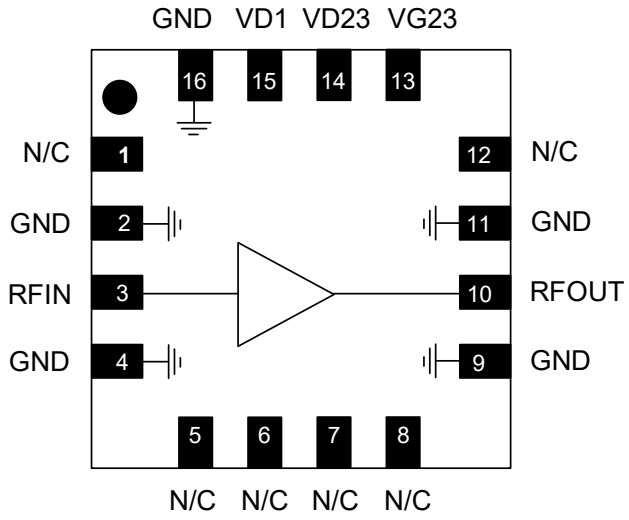
The die is manufactured using a high performance 70 nm gate length high indium content MHEMT low noise technology. The MMIC uses gold bonding pads and backside metallization. The die is fully protected with silicon nitride passivation to obtain the highest level of reliability.

Ordering Information[1,2]

Part Number	Package
MAAL-FR0001-TR0500	500 Part Reel
MAAL-FR0001-001SMB	Evaluation Board

1. Reference Application Note M513 for reel size information.
2. The product is available in die form: CGY2230UH/C1.

Functional Schematic



Pin Configuration[3]

Pin #	Function
1,5,6,7,8,12	No Connect
2,4,9,11,16	Ground
3	RF Input
10	RF Output
13	V_G23
14	V_D23
15	V_D1
17	Paddle[4]

3. MACOM recommends connecting unused package pins to ground.
4. 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. = 1 - 18 GHz, T_A = +25°C, V_D = 1.5 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Current	Total DC current included (ID_1+ID_{23})	mA	—	50	—
Input Power	—	dBm	—	-50	—
Noise Figure	—	dB	—	1.2	—
Gain	—	dB	25	29	—
Output P1dB	12 GHz	dBm	—	-3.5	—
Input Return Loss	—	dB	—	-10	—
Output Return Loss	—	dB	—	-15	—
IM3	@ tone spacing 1 MHz	dBc	—	-40	—

Absolute Maximum Ratings[5,6]

Parameter	Absolute Maximum
Input RF ports	+10 dBm
DC Voltage Drain Supply	+2 V
Junction Temperature[7,8]	+150°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-40°C to +150°C

5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation near these survivability limits.
7. Operating at nominal conditions with $T_J \leq$ +150°C will ensure MTTF > 1 x 10^{11} hours.
8. Junction Temperature (T_J) = T_C + Θjc * (V * I)
   Typical thermal resistance (Θjc) = 233 °C/W.
   a) For T_C = +25°C,
   T_J =44.2 °C @ 1.5V, 50 mA
   b) For T_C = +85°C,
   T_J = 107.9 °C @ 1.5 V, 55 mA

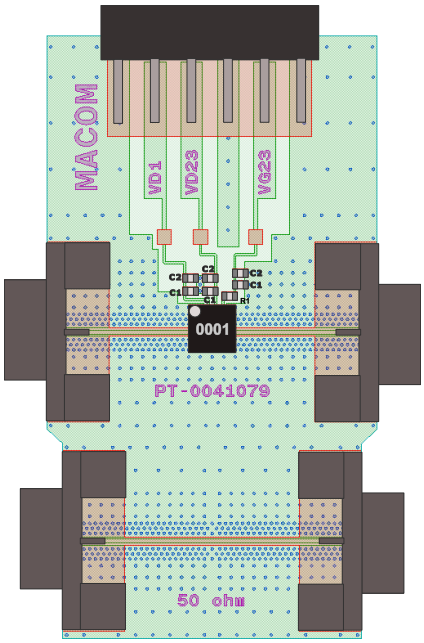
Handling Procedures

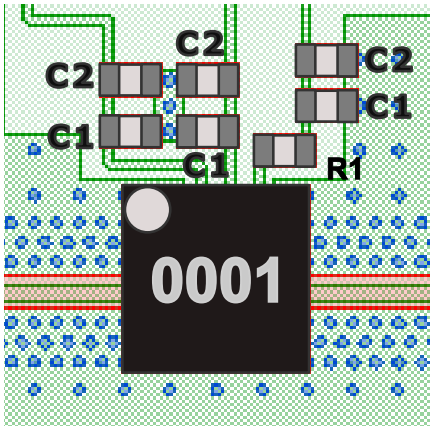
Please observe the following precautions to avoid damage:

Static Sensitivity

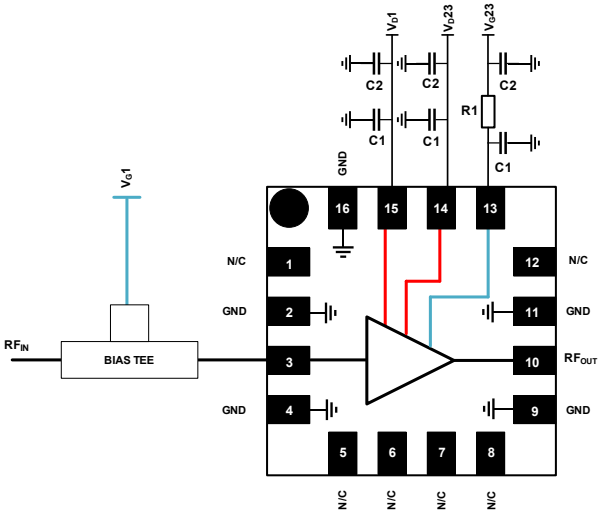
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

PCB Layout





Application Schematic

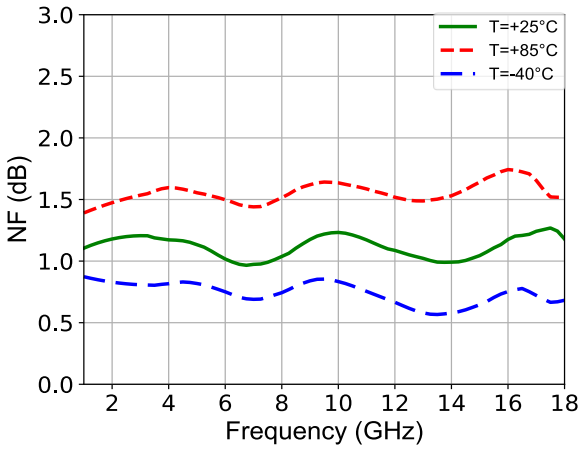


Parts List

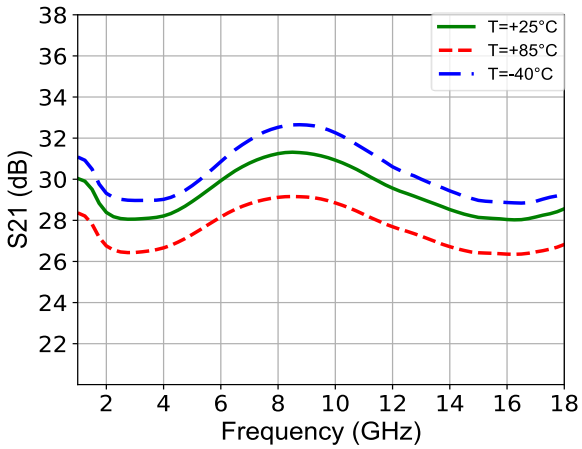
Part	Value	Case Style	Manufacturer	Manufacturer's Part number
C1	10nF	0402	KYOCERA AVX	0402YC183KAT2A
C2	1µF	0402	Murata	GRM155R70G105KA12D
R1	0 Ω	0402	Panasonic	ERJ2GE0R00X
External Bais TE	[0,03-67]GHz	4X4mm	Macom	MABT-011011

Typical Performance Curves

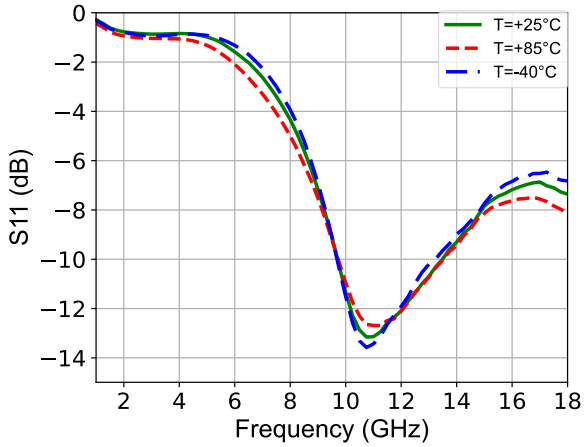
Noise Figure over Frequency



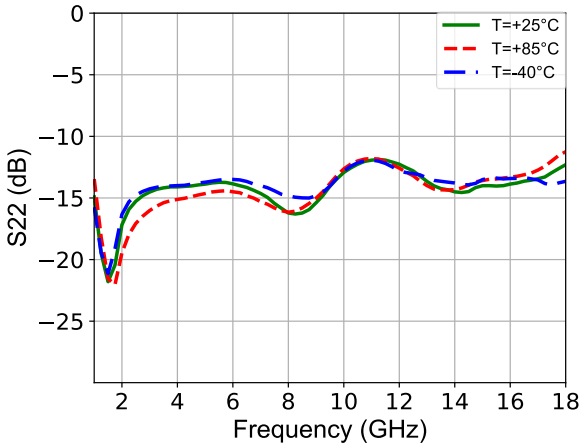
Gain over Frequency



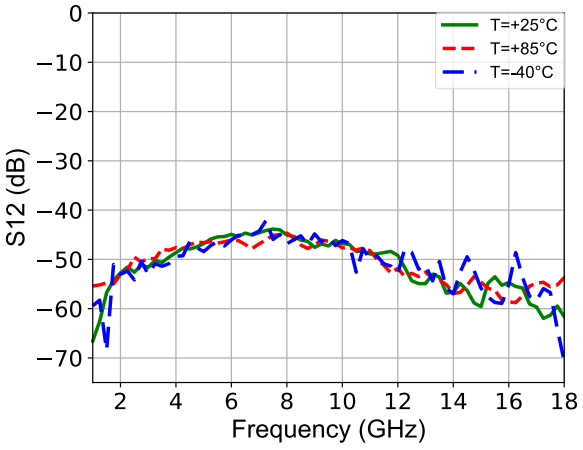
Input Return loss over Frequency



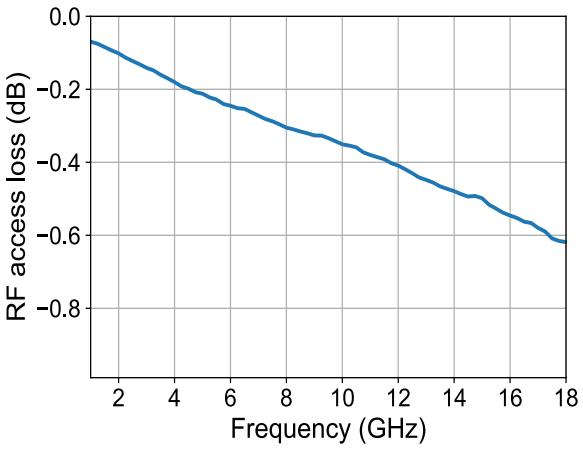
Output Return loss over Frequency



Reverse Isolation over Frequency

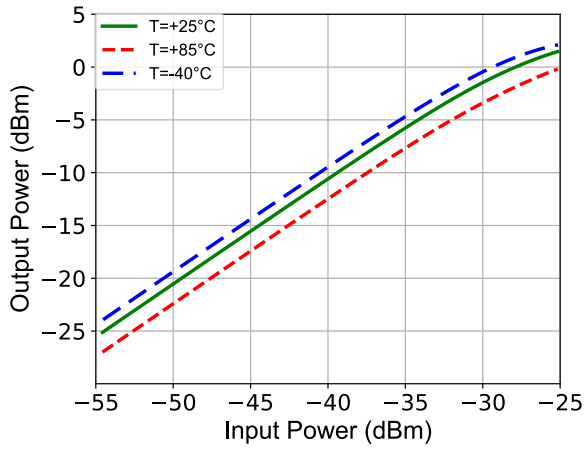


RF access Line & connector losses over frequency

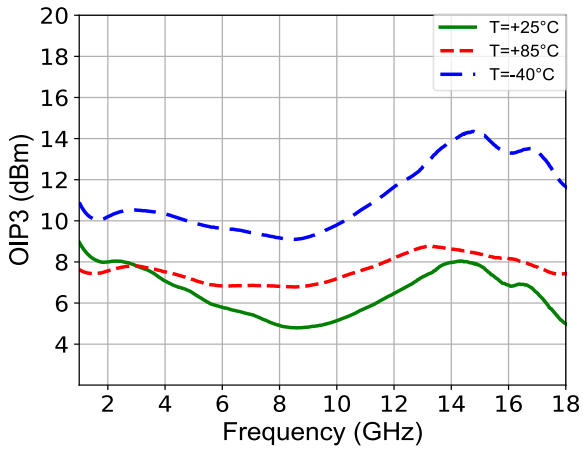


Typical Performance Curves

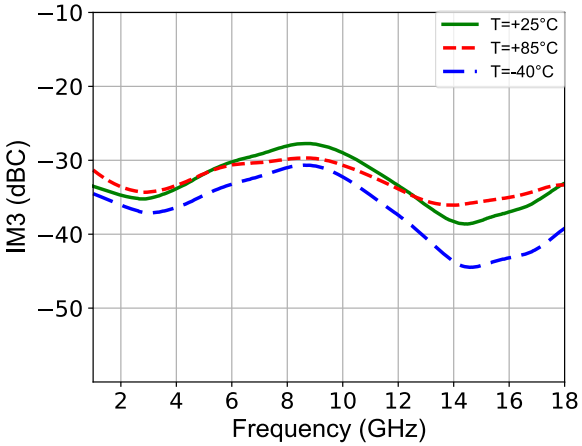
Output power over Input power @12 GHz



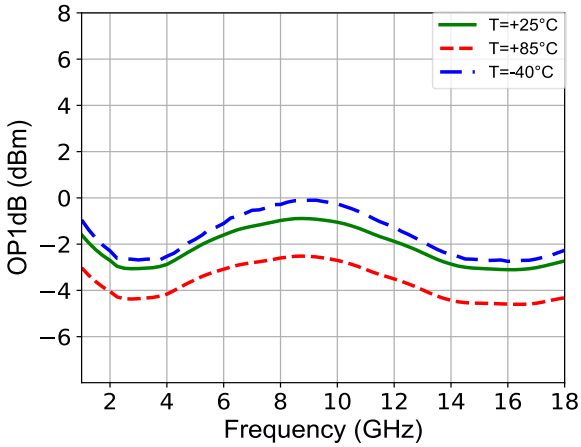
OIP3 over Input power @ 12 GHz tone spacing @ 1MHz



IM3 over Frequency @ -40 dBm tone spacing @1MHz



P1db over Frequency

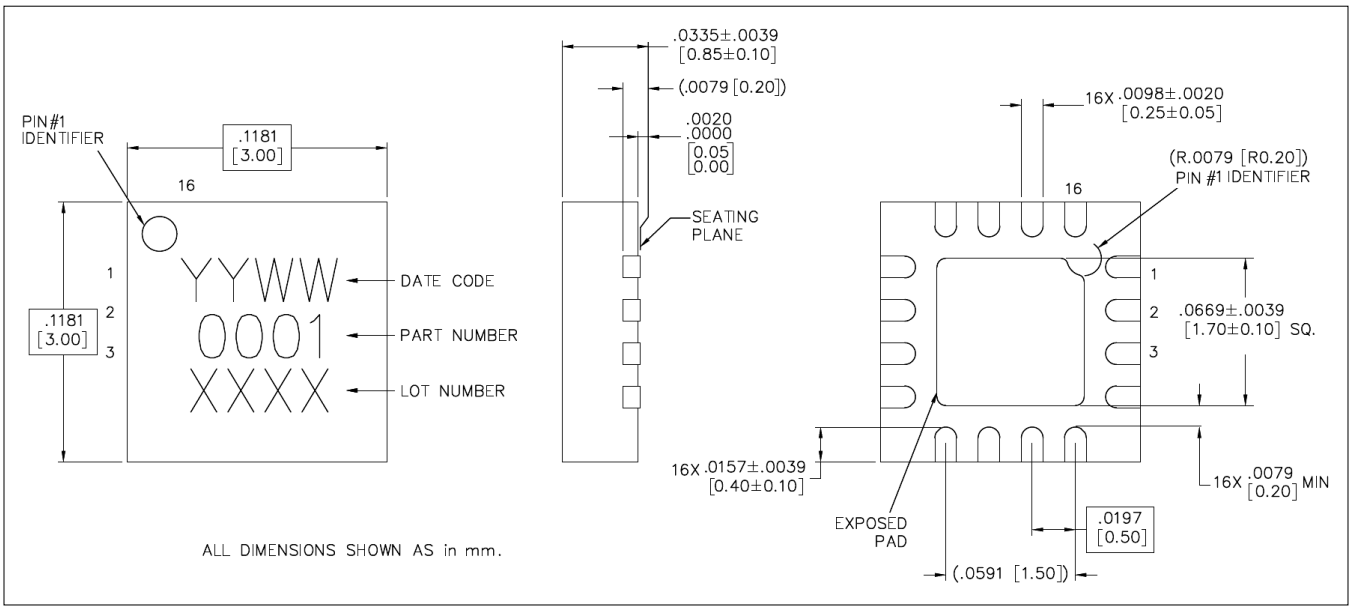


Biasing Procedure

Bias UP
Set I_{D1} limit to 22 mA & I_{D23} limit to 43 mA
Ensure voltages are at 0 before to turn on DC supply
Set V_{G1} &V_{G23} to -1.5 V
Set V_{D1} &V_{D23} to +1.5 V
Increase V_{G1} & VG23 to have I_{D1}≈17 mA and I_{D23}≈33 mA

Bias Down
Set V_{D1} &V_{D23} to 0 V
Set V_{G1} &V_{G23} to 0 V
Turn off DC supply

Lead-Free 3 mm 16-Lead PQFN†



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