10 W, Ka-Band Power Amplifier
27 - 31 GHz

MAAP-011410-DIE
Rev. V2

Features

- Gain: 22 dB
- Output Power: 40.5 dBm @ 29 GHz
- PAE: 22%
- Power Supply: 12 V, 4 A @ Saturated Power
- Input & Output Matched: 50 Ω
- Die Size: 3500 x 1560 x 100 µm
- RoHS* Compliant

Applications

- Radar
- SATCOM

Description

MAAP-011410-DIE is a 10 W high-performance GaN Power Amplifier MMIC designed to operate from 27 to 31 GHz and is offered in bare die form. It is fully matched across the frequency band.

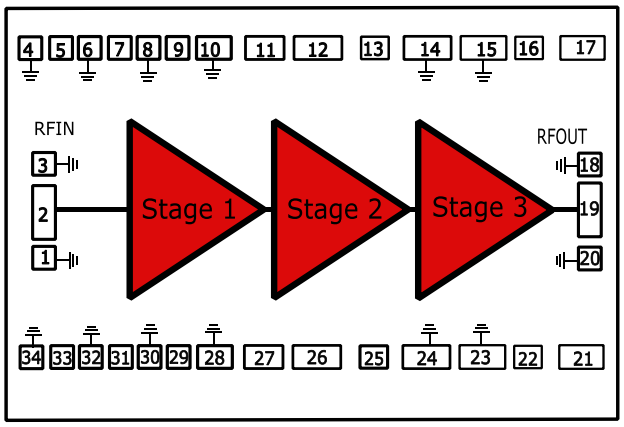
The MAAL-011410-DIE has 40.5 dBm of output power and 22% PAE and can be used an a power amplifier stage. This device is ideally suited to satellite communication and radar applications.

The MAAL-011410-DIE is manufactured using a high performance 100 nm gate length GaN on Si HEMT power technology (D01GH). The MMIC uses gold bonding pads and backside metallization and is fully protected with silicon nitride passivation to obtain the highest level of reliability.

Ordering Information

Part Number	Package
MAAP-011410-DIE	Bare die
MAAP-011410-SB2	Evaluation Board

Block Diagram



Pad Configuration

Pad #	Function
1,3,4,6,8,10,14,15,18,20, 23,24,28,30,32,34	Ground
2	Input RF
5	Gate Voltage Stage 1 North
7	Gate Voltage Stage 2 North
9	Gate Voltage Stage 3 North
11	Drain Voltage Stage 1 North
12	Drain Voltage Stage 2 North
13, 25	Sense Drain Voltage Stage 2
16, 22	Sense Drain Voltage Stage 3
17	Drain Voltage Stage 3 North
19	Output RF
21	Drain Voltage Stage 3 South
26	Drain Voltage Stage 2 South
27	Drain Voltage Stage 1 South
29	Gate Voltage Stage 3 South
31	Gate Voltage Stage 2 South
33	Gate Voltage Stage 1 South

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

Electrical Specifications :
Freq. = 27 - 31 GHz, $VD_{1,2,3}$ = 12 V, Quiescent Bias Currents (ID_1= 110 mA ID_2= 220 mA, ID_3= 600 mA), T_A = + 25°C with a duty cycle of 1% (pulse mode)

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Drain Voltage $V_{D1A,D2A,D3A}$ and $V_{D1B,D2B,D3B}$	—	V	—	12	—
Drain Current $I_{D1,D2,D3}$	At Saturated Power	A	—	4	—
Small Signal Gain	—	dB	19	22	—
Saturated Power	—	dBm	39	40.5	—
Power Added Efficiency	—	%	20	25	—
Input Reflection Coefficient	—	dB	—	-11	—
Output Reflection Coefficient	—	dB	—	-14	—

Recommended Operating Conditions

Parameter	Unit
Voltage Bias	12 V
Quiescent Current	0.93 A
Junction Temperature	+200°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-40°C to +150°C

Absolute Maximum Ratings[1,2,3,4]

Parameter	Absolute Maximum
Drain Voltage	+20 V
Gate Voltage	-3 V to 0 V
Breakdown Voltage	+50 V
Input Power	30 dBm
Junction Temperature	200°C
Storage Temperature	-40°C to 150°C
Assembly Temperature	300°C per 60 seconds

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 $T_J \leq$ +200°C will ensure MTTF > 1 x 10^7 hours.
4. Junction Temperature (T_J) = T_C + Θjc * (V * I)
   a) For T_C = +20°C,
   R_{TH} = 3.7 °C /W @ Saturated Power
   b) For T_C = +80°C,
   R_{TH} = 4.5°C /W @ Saturated Power

Handling Procedures

Please observe the following precautions to avoid damage:

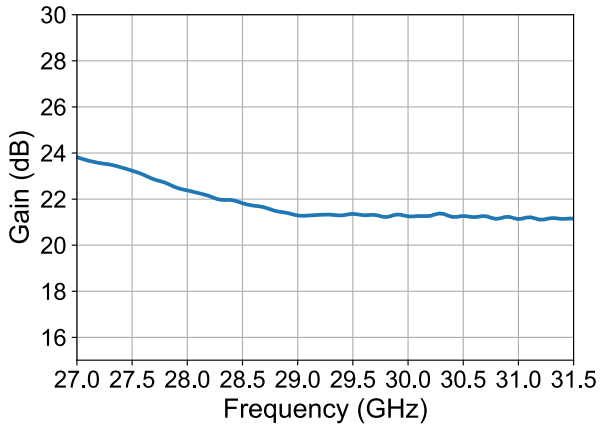
Static Sensitivity

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.

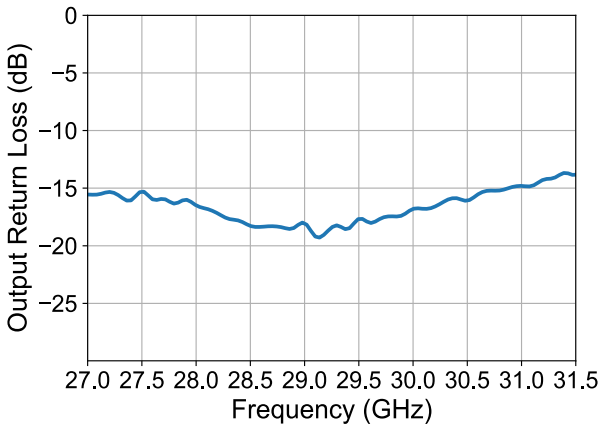
Typical Performance Curves probed measured on wafer

S-parameters with 0.1nH assumed Wirebond

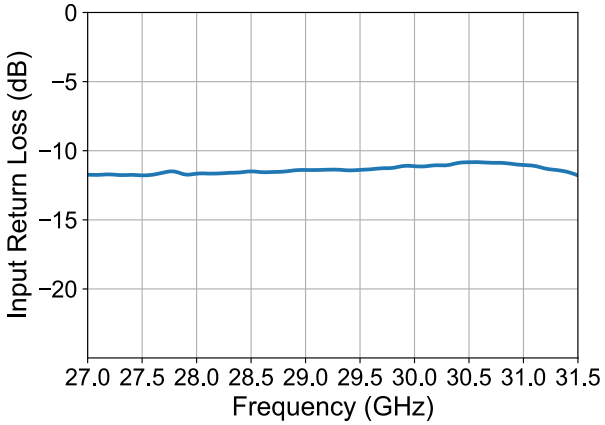
Gain over Frequency



Output Return Loss over Frequency

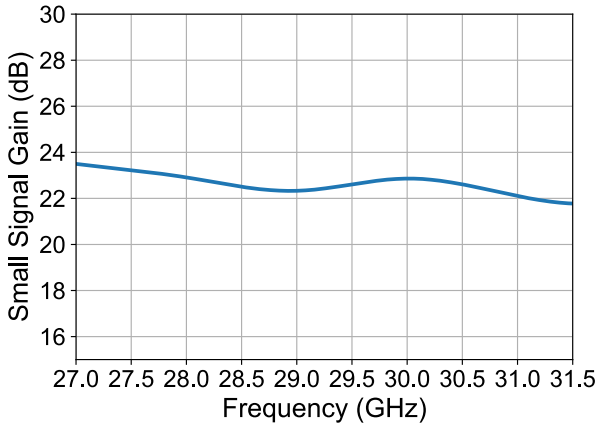


Input Return Loss over Frequency

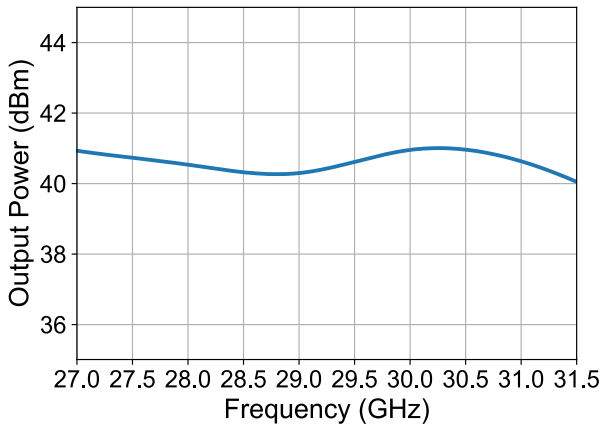


Typical Performance Curves probed measured on wafer

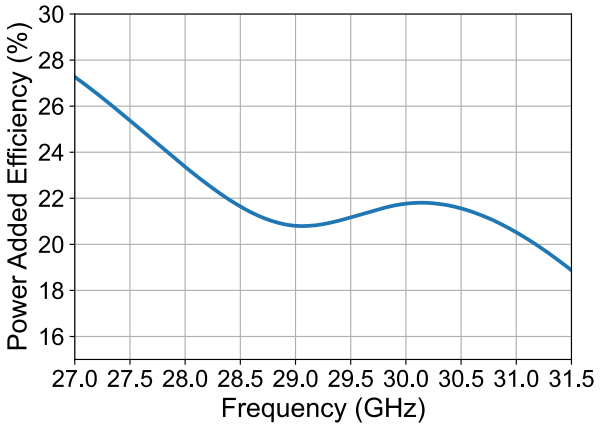
Small Signal Gain over Frequency



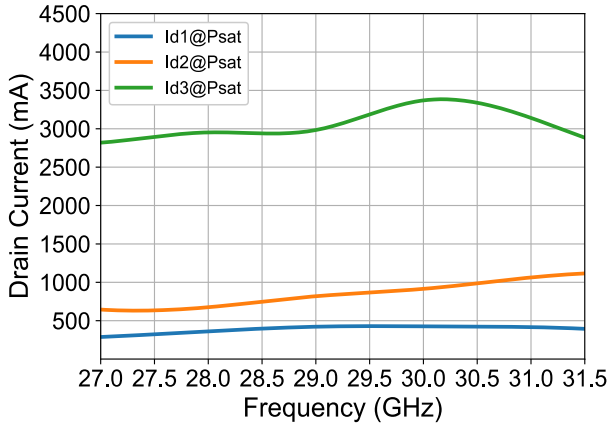
Saturated Power over Frequency



Power Added Efficiency over Frequency



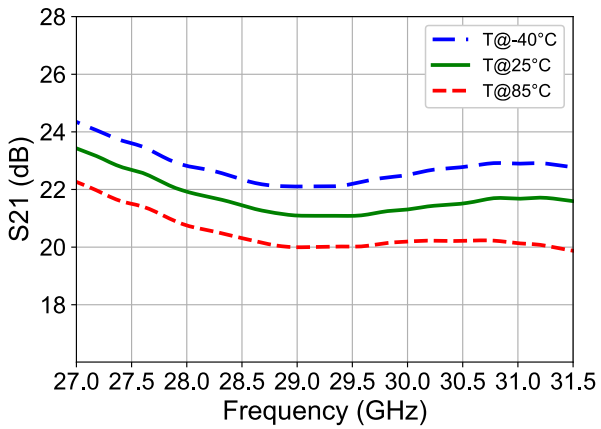
DC Current at Saturated Power over Frequency



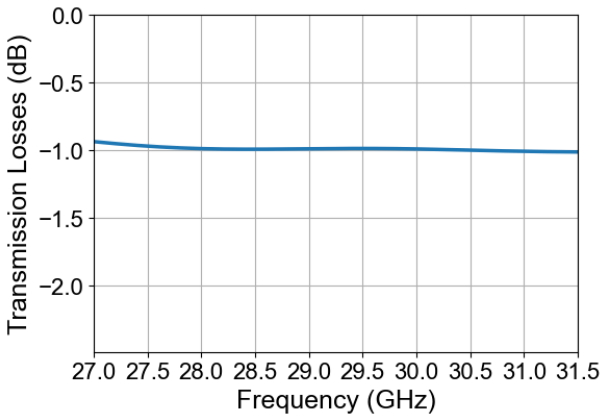
Typical performance

S-parameters in CW at PCB level with De-Embedding at different temperature

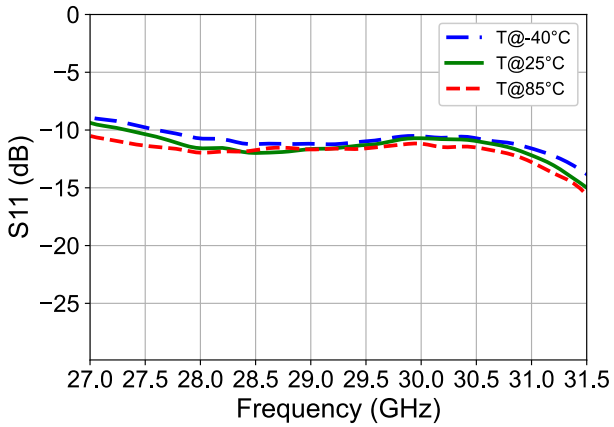
Gain over Frequency



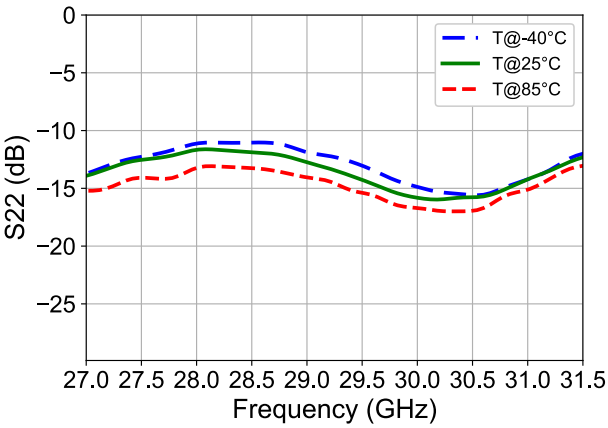
RF access line & connector Losses over Frequency



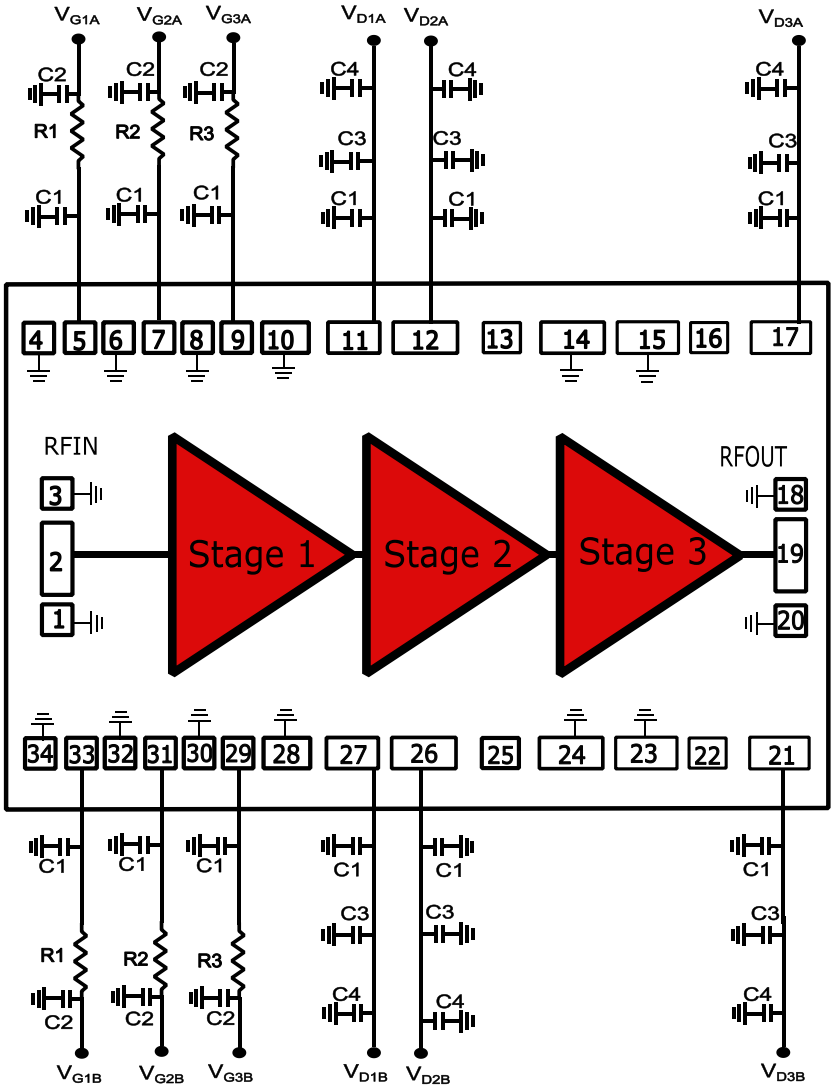
Input Return Loss over Frequency



Output Return Loss over Frequency



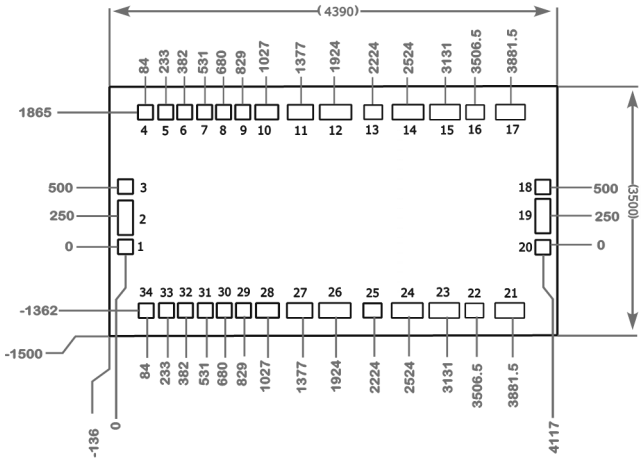
Functional Schematic



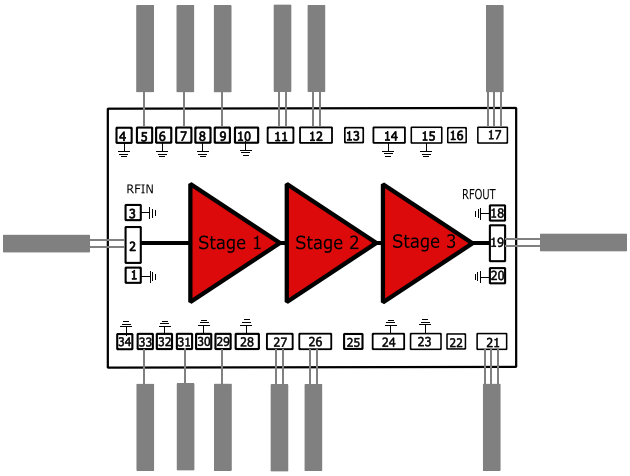
Parts List

Part	Value	Case Style	Manufacturer	Type	Manufacturer's Part #
C1	47 pF	0.381 mm	KYOCERA AVX	single layer capacitor	116RG470M100TT
C2	1 µF	1005 mm	Murata	SMD multi layer capacitor	GRM155R70G105KA12D
C3	10 nF	1005 mm	KYOCERA AVX	SMD multi layer capacitor	0402YC103KAT2A
C4	220 nF	1005 mm	TDK	SMD multi layer capacitor	CGA2B3X7R1E224K050BB
R1	50 Ω	1005 mm	KOA	SMD resistor	RN73R1ETTP50R0F50
R2	25 Ω	1005 mm	YAGEO	SMD resistor	RC0402FR-0724R9L
R3	10 Ω	1005 mm	YAGEO	SMD resistor	RC0402JR-0710RL

Die Layout



Recommended Bonding Diagram



PAD Dimensions (µm)

Pad #	X	Y
1,3,18,20	102	97
2,19	102	247
4,5,6,7,8,9,13,16,22,25,29,30, 31,32,33,34	97	107
10,28	194	107
11,27	297	107
12,14,24,26	397	107
15,17,21,23	547	107

Revision History

Rev	Date	Change description
V1	12/29/23	PTRR
V2	12/03/24	Production Release