10 W, GaN Power Amplifier
32 - 38 GHz

MAAP-011413-DIE
Rev. V2

Features

- Gain: 20 dB
- Output Power: 40 dBm
- PAE: 28%
- Power Supply: 12 V, 3.2 A @ Saturated Power
- Input & Output Matched: 50 Ω
- Die Size: 3360 x 3390 x 100 µm
- RoHS* Compliant

Applications

- Radar
- SATCOM

Description

MAAP-011413-DIE is a 10 W high-performance GaN Power Amplifier MMIC designed to operate from 32 to 38 GHz and is offered in bare die form. It is fully matched across the frequency band.

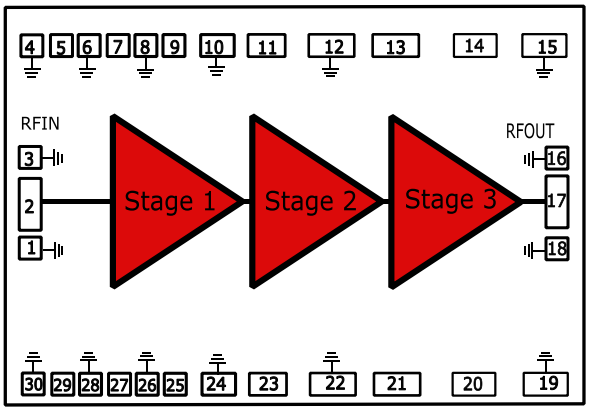
The MAAP-011413-DIE has 40 dBm of output power, 28% PAE, 20dB of gain and can be used as a power amplifier stage. This device is ideally suited to satellite communication and radar applications.

The MAAL-011413-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-011413-DIE	Bare die
MAAP-011413-SB2	Evaluation Board

Block Diagram



Pad Configuration

Pad #	Function
1,3,4,6,8,10,12,15,16,18, 19,22,24,26,28,30	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
13	Drain Voltage Stage 2 North
14	Drain Voltage Stage 3 North
17	Output RF
20	Drain Voltage Stage 3 South
21	Drain Voltage Stage 2 South
23	Drain Voltage Stage 1 South
25	Gate Voltage Stage 3 South
27	Gate Voltage Stage 2 South
29	Gate Voltage Stage 1 South

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

Electrical Specifications :
Freq. = 32 - 38 GHz, $VD_{1,2,3}$ = 12 V, ID_1 = 100 mA, ID_2 = 200 mA, ID_3 = 400 mA T_A = +25°C with a duty cycle of 1%

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Drain Voltage $V_{D1N,D2N,D3N}$ and $V_{D1S,D2S,D3S}$	—	V	—	12	—
Drain Current $I_{D1,D2,D3}$	At Saturated Power	A	—	3.2	—
Small Signal Gain	—	dB	16	20	—
Saturated Power	33 - 36 GHz	dBm	39	40	—
Saturated Power	32 - 33 GHz and 36 - 38 GHz	dBm	38	39	—
Power Added Efficiency	35 GHz	%	—	24	—
Input Reflection Coefficient	—	dB	—	-10	—
Output reflection coefficient	—	dB	—	-12	—

Recommended Operating Conditions

Parameter	Unit
Voltage Bias	12 V
Quiescent Current	0.7 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 = +70°C,
   R_{TH} = 4.65 °C /W @ Saturated Power

Handling Procedures

Please observe the following precautions to avoid damage:

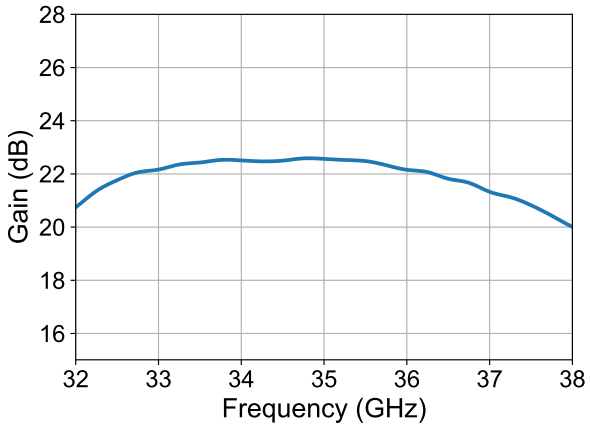
Static Sensitivity

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.

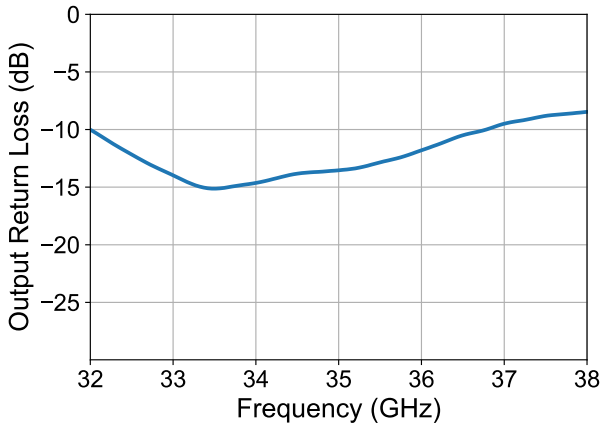
Typical Performance Curves probed measured on wafer

S-parameters with 0.1nH assumed Wirebond

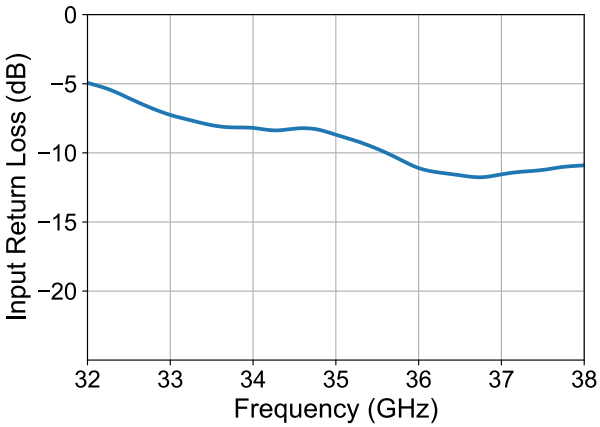
Gain over Frequency



Output Return Loss over Frequency

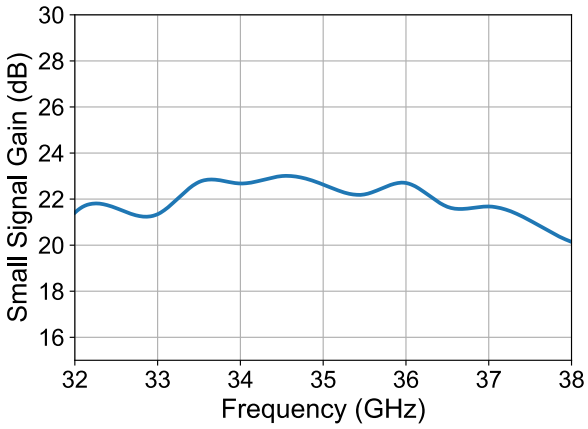


Input Return Loss over Frequency

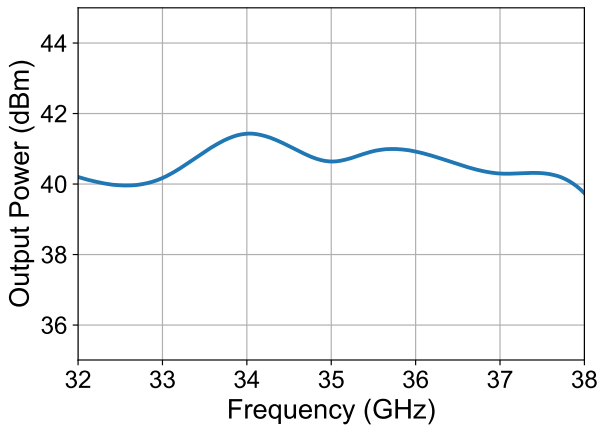


Typical Performance Curves probed measured on wafer

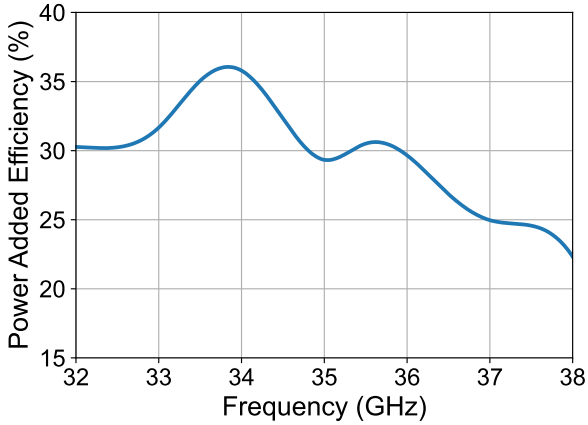
Small Signal Gain over Frequency



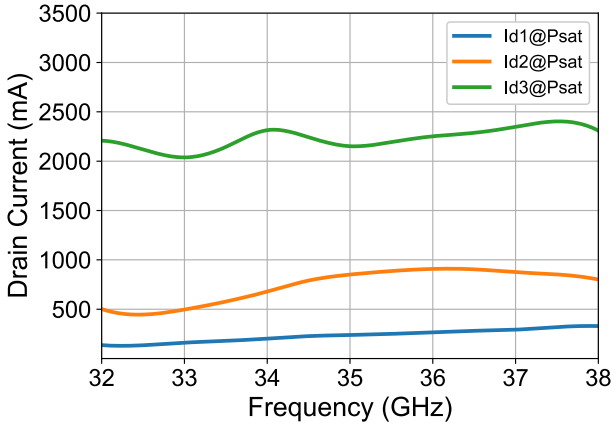
Saturated Power over Frequency



Power Added Efficiency over Frequency



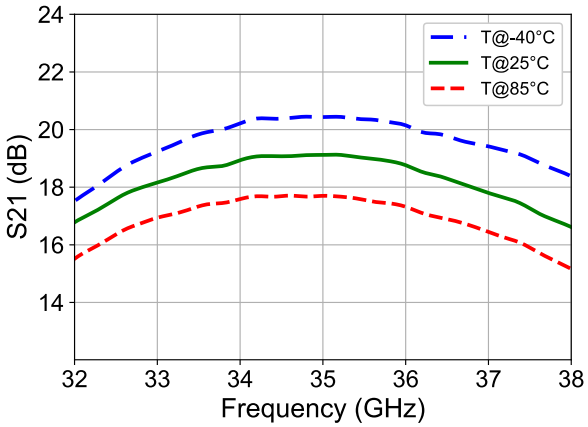
DC Current at Saturated Power over Frequency



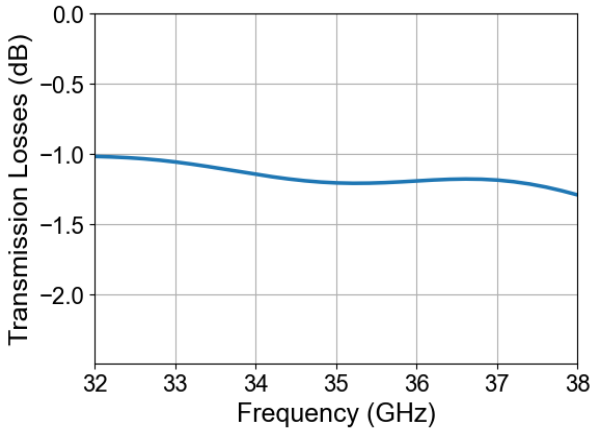
Typical performance

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

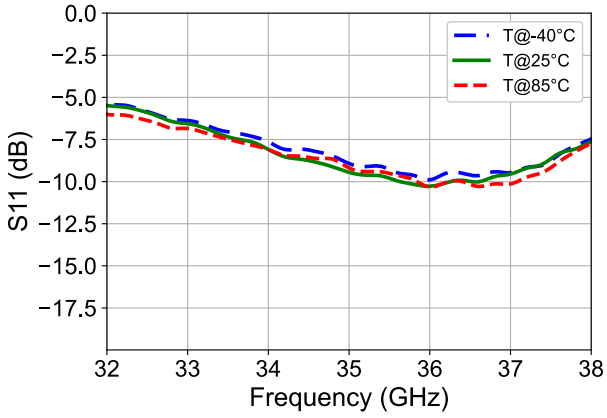
Gain over Frequency



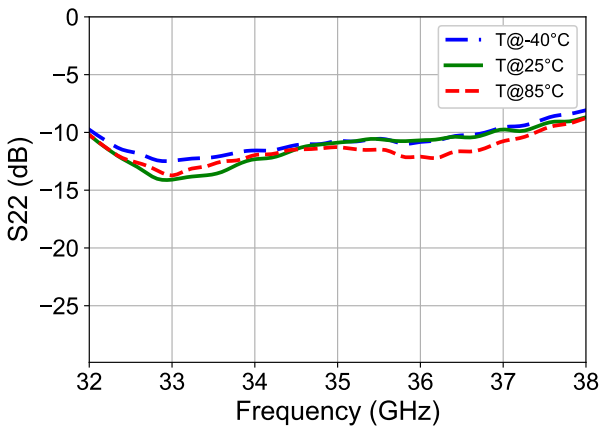
RF access line & connector Losses over Frequency



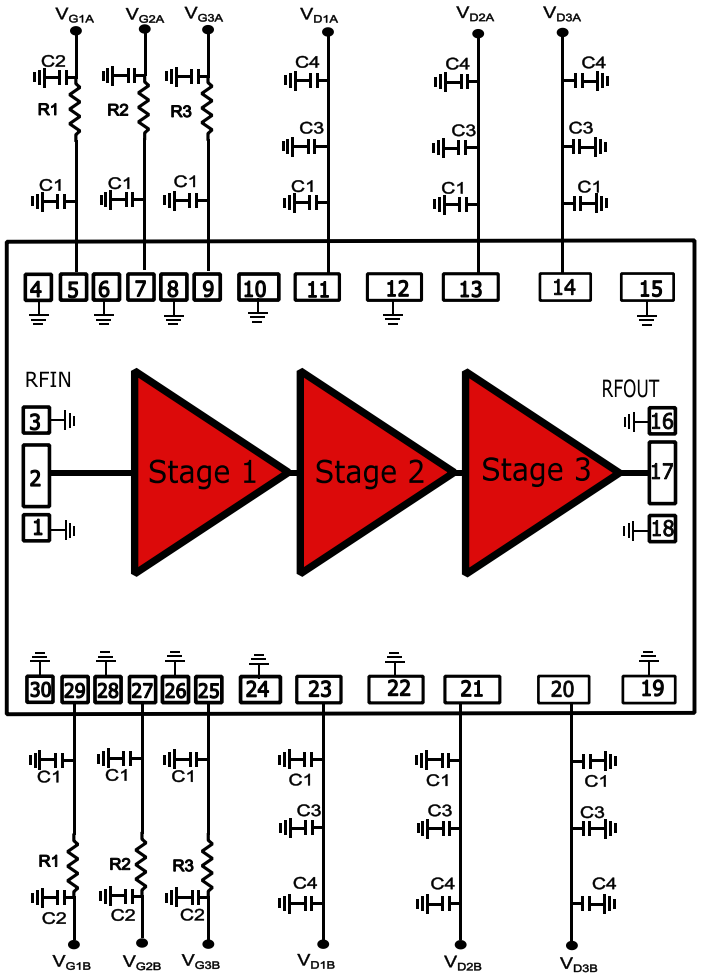
Input Return Loss over Frequency



Output Return Loss over Frequency



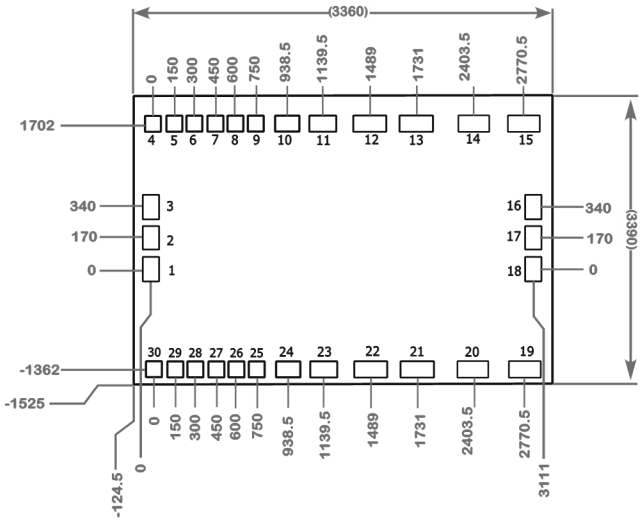
Functional Schematic



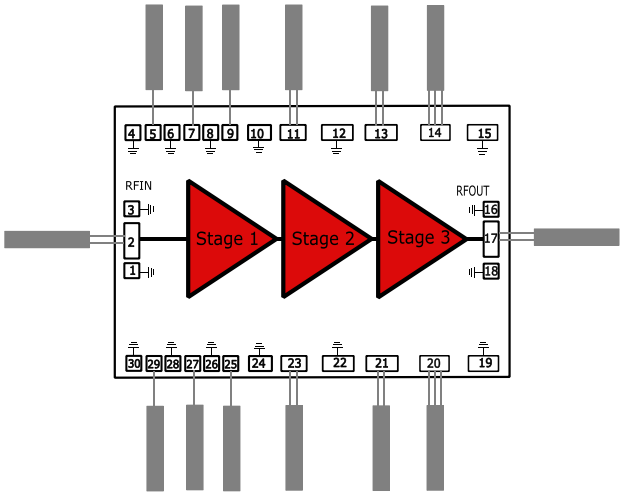
Parts List

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	220 nF	1005 mm	TDK	SMD multi layer capacitor	CGA2B3X7R1E224K050BB
C4	10 nF	1005 mm	KYOCERA AVX	SMD multi layer capacitor	0402YC103KAT2A
R1	820 Ω	1005 mm	YAGEO	SMD resistor	RC0402FR-07820RL
R2	390 Ω	1005 mm	YAGEO	SMD resistor	RC0402FR-07390RL
R3	200 Ω	1005 mm	YAGEO	SMD resistor	RC0402FR-07200RL

Die Layout



Recommended Bonding Diagram



Pad Dimensions (µm)

Pad #	X	Y
1,3,17	79	162
2,18,16	79	120
4,5,6,7,8,9,25,26,27,28,29,30	79	79
10,11,23,24	162	79
12,13,21,22	204	79
14,15,19,20	328	79
15,17,21,23	547	107

Revision History

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