Power Amplifier, 0.25 W
DC - 27 GHz

MAAP-011324
Rev. V3

Features

- High Gain: 18 dB
- P1dB: 25.5 dBm
- P3dB: 27 dBm
- Output IP3: 34.5 dBm
- Bias Voltage: V_{DD} = 8 V
- Bias Current: I_{DSQ} = 220 mA
- 50 Ω Matched Input / Output
- Temperature Compensated Output Power Detector
- Lead-Free 5 mm 32-lead AQFN Package
- RoHS* Compliant

Applications

- Test & Measurement
- EW, ECM, and Radar

Description

The MAAP-011324 is a 0.25 W distributed power amplifier offered in a lead-free 5 mm 32-lead AQFN package. The power amplifier operates from DC to 27 GHz and provides 18 dB of linear gain and 27 dBm of output power at 3-dB compression. The device is fully matched across the band and includes a temperature compensated output power detector.

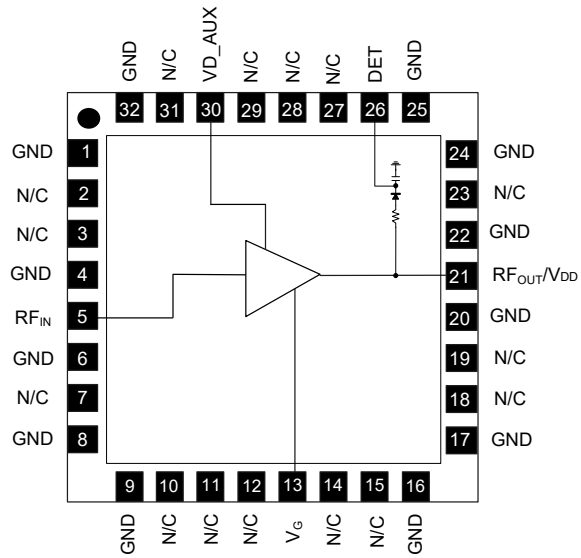
The MAAP-011324 can be used as a power amplifier stage or as a driver stage in higher power applications.

Ordering Information[1]

Part Number	Package
MAAP-011324-TR0500	500 piece reel
MAAP-011324-TR1000	1000 piece reel
MAAP-011324-SMB	Sample Board

1. Reference Application Note M513 for reel size information.

Functional Schematic



Pin Configuration[2,3]

Pin #	Pin Name	Description
1, 4, 6, 8, 9, 16, 17, 20, 22, 24, 25, 32	GND	Ground
2, 3, 7, 10 - 12, 14, 15, 18, 19, 23, 27 - 29, 31	N/C	No Connection
5	RF_{IN}	RF Input
13	V_G	Gate Voltage
21	RF_{OUT}/ V_{DD}	RF Output / Drain Voltage
26	DET	Power Detector
30	VD_AUX	VD_Auxiliary

2. MACOM recommends connecting all no connection pins to ground.
3. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

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

Electrical Specifications: T_A = +25°C, V_{DD} = 8 V, I_{DSQ} = 220 mA, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	2 GHz 12 GHz 22 GHz 27 GHz	dB	17.0 16.5 17.0 —	18.5 18.0 18.5 17.5	—
P_{OUT}	P_{IN} = +10 dBm 2 GHz 12 GHz 22 GHz 27 GHz	dBm	—	28.5 27.0 23.5 20.5	—
P1dB	2 GHz 12 GHz 22 GHz 27 GHz	dBm	24.0 22.5 19.5 —	26.0 24.0 21.5 19.5	—
OIP3	P_{out} = +13 dBm/tone (10 MHz Tone Spacing) 2 GHz 12 GHz 22 GHz 27 GHz	dBm	—	37.5 34.5 32.5 28.5	—
PAE	P_{IN} = +10 dBm 2 GHz 12 GHz 22 GHz 27 GHz	%	—	26.5 22.5 13.0 6.0	—
Input Return Loss	P_{IN} = -10 dBm	dB	—	15	—
Output Return Loss	P_{IN} = -10 dBm	dB	—	15	—
I_{DD} (with RF drive)	P_{IN} = +10 dBm	mA	—	250	—
I_G	—	mA	—	4	—

Maximum Operating Ratings

Parameter	Rating
Input Power	13 dBm
Junction Temperature[4,5]	+150°C
Operating Temperature	-40°C to +85°C

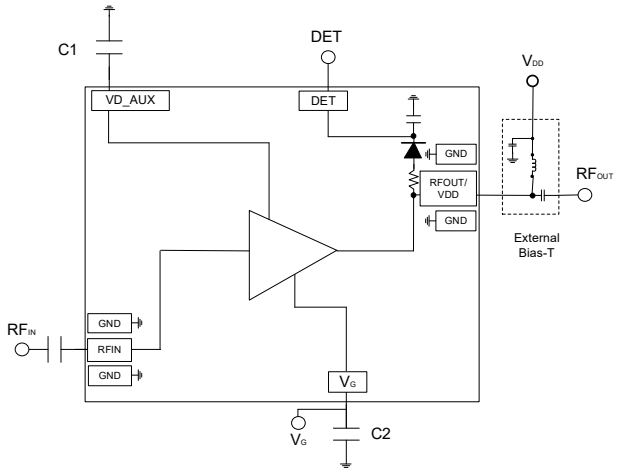
4. Operating at nominal conditions with junction temperature ≤ +150°C will ensure MTTF > 1 x 10^6 hours.
5. Junction Temperature (T_J) = T_C + Θ_{JC} * ((V * I) - (P_{OUT} - P_{IN}))
   Typical thermal resistance (Θ_{JC}) = 10.8 °C/W.
   a) For T_C = +25°C,
   T_J = +43.3 °C @ 8 V, 239 mA, P_{OUT} = 23.4 dBm, P_{IN} = 8 dBm
   b) For T_C = +85°C,
   T_J = +103.6 °C @ 8 V, 239 mA, P_{OUT} = 23 dBm, P_{IN} = 8 dBm

Absolute Maximum Ratings[6,7]

Parameter	Absolute Maximum
Input Power	25 dBm
Drain-Voltage	+10 V
Gate Voltage	-5 to 0 V
Junction Temperature[8]	+175°C
Storage Temperature	-65°C to +125°C

6. Exceeding any one or combination of these limits may cause permanent damage to this device.
7. MACOM does not recommend sustained operation near these survivability limits.
8. Junction temperature directly effects device MTTF. Junction temperature should be kept as low as possible to maximize lifetime.

Application Schematic



Bill of Materials[9,10,11]

Part	Value	Size	Comment
C1, C2	1 µF	0402	bypass

9. C1 & C2 are required for operation below 1 GHz.
10. High power external bias tee was used for measurements.
11. External DC block was used on input.

Biasing Conditions

Recommended biasing conditions are V_{DD} = 8 V, I_{DSQ} = 220 mA (controlled with V_G).

By-pass capacitor C1 for the auxiliary pad is for a low frequency operation extension (below 1 GHz). This provides wide band performance of 100 kHz - 27 GHz (depending on the bandwidth of the bias tees).

To bias the drain:
1. The required V_{DD} is applied at RF_{OUT}/V_{DD} through the bias tee.

There are 2 possible methods to bias the gate:
1. V_G is applied using the V_G pad (pin 13) and set using to provide the required current bias (I_{DSQ}). No external bias tee is required at the RF input but an external DC block is required.
2. V_G is applied at the RF input (pin 5) through an external bias tee on the RF input line and set to provide the required current bias (I_{DSQ}).

Operating the MAAP-011324

Turn ON

1. Apply V_{G1} (-4.5 V).
2. Increase V_{DD} to 8 V.
3. Set I_{DSQ} by adjusting V_G more positive (typically -0.53 V for I_{DSQ} = 220 mA).
4. Apply RF_{IN} signal.

Turn OFF

1. Remove RF_{IN} signal.
2. Decrease V_G to -4.5 V.
3. Decrease V_{DD} to 0 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 HBM Class 1B devices.

Recommended PCB Information

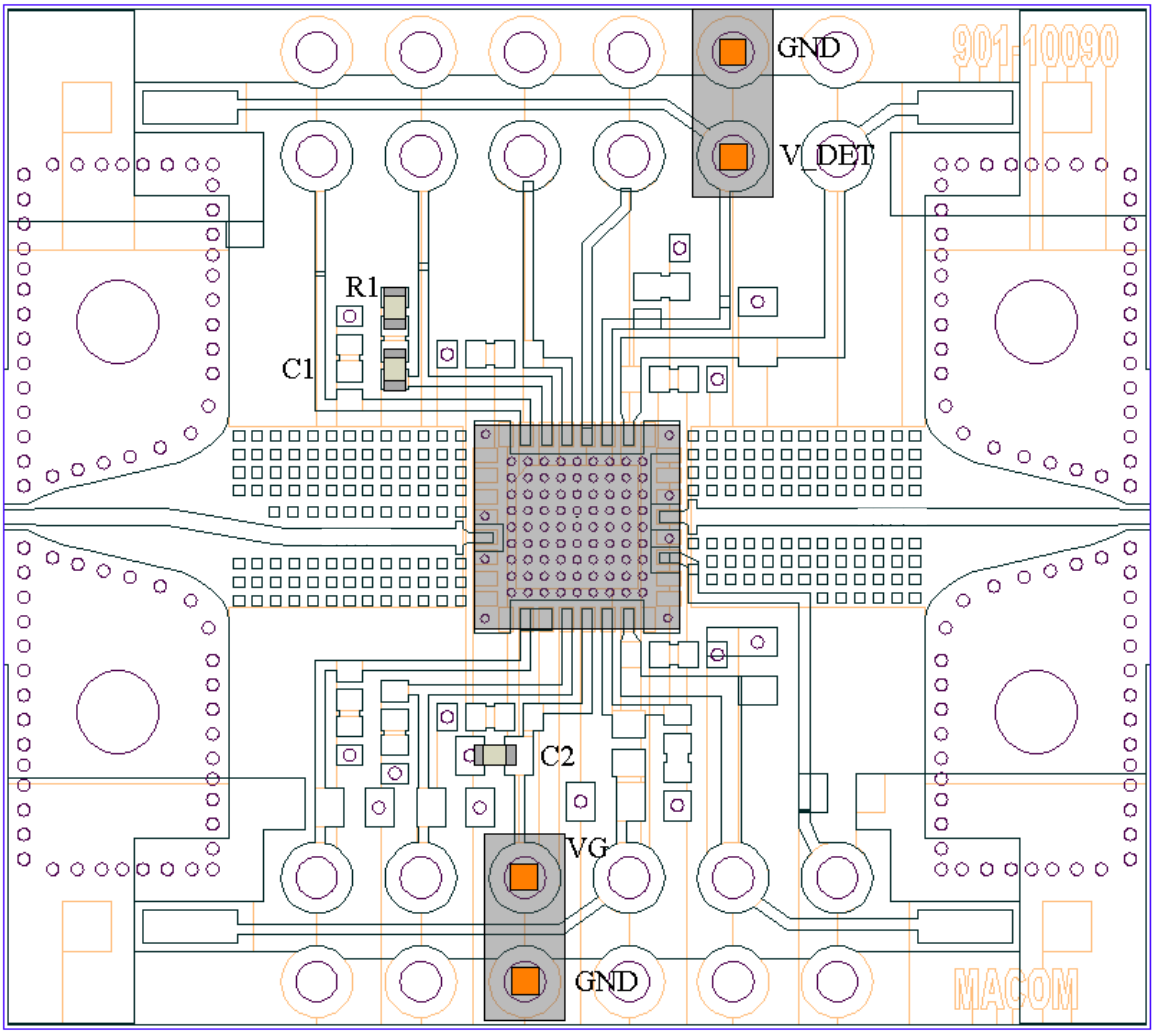
RF input and output are 50 Ω transmission lines. Single layer 8 mil Rogers RO4008 with 1/2 oz. Cu. Use copper filled vias under ground paddle.

Grounding

It is recommended that the total ground (common mode) inductance not exceed 0.03 nH (30 pH). This is equivalent to placing at least four 8-mil (200-µm) diameter vias under the device, assuming an 8-mil (200-µm) thick RF layer to ground.

Sample Board Layout

R1 is a zero ohm resistor and vias underneath package need to be solid copper filled and plated over. Do not use copper paste for vias. The MACOM sample board uses 81 vias underneath the IC. Gerber files are available upon request.

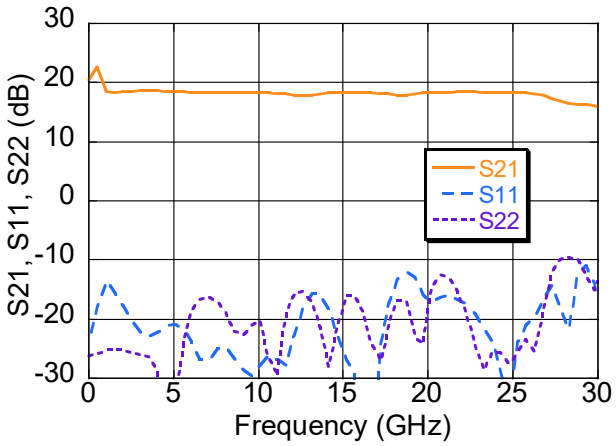


Sample Board Material Specifications

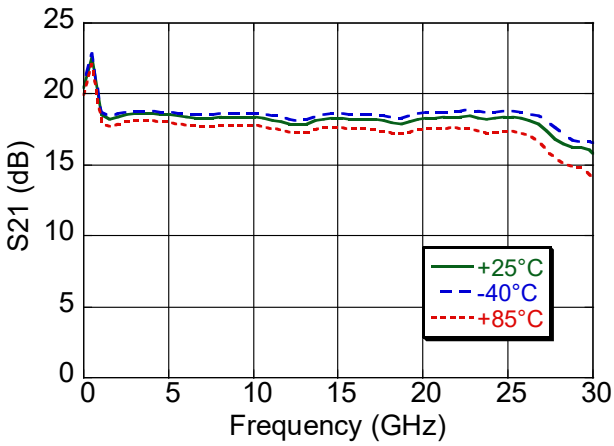
Top Layer: 1/2 oz Copper Cladding, 0.017 mm thickness
Dielectric Layer: Rogers RO4003C 0.203 mm thickness
Bottom Layer: 1/2 oz Copper Cladding, 0.017 mm thickness

Typical Performance Curves V_{DD} = 8 V, I_{DSQ} = 220 mA, V_G = -0.53 V typical

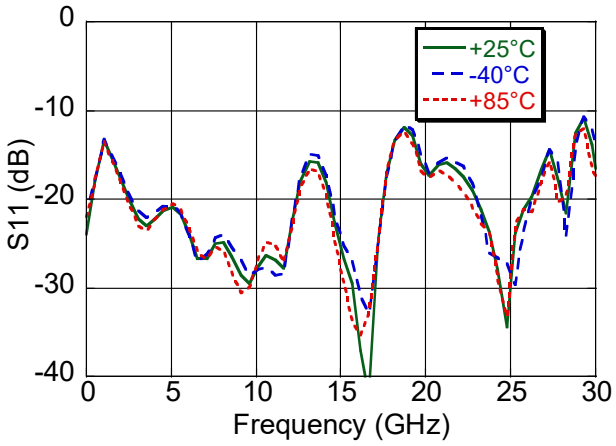
S Parameters



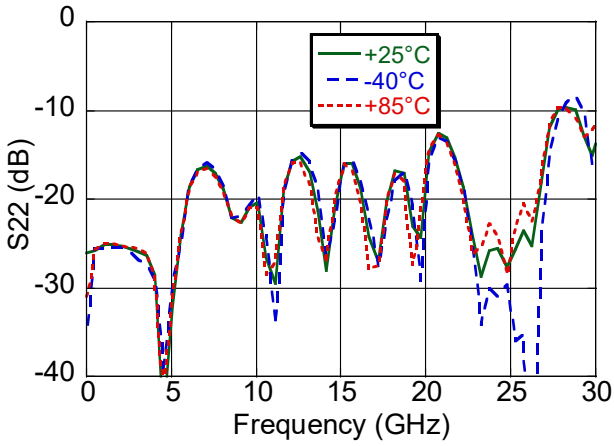
Gain



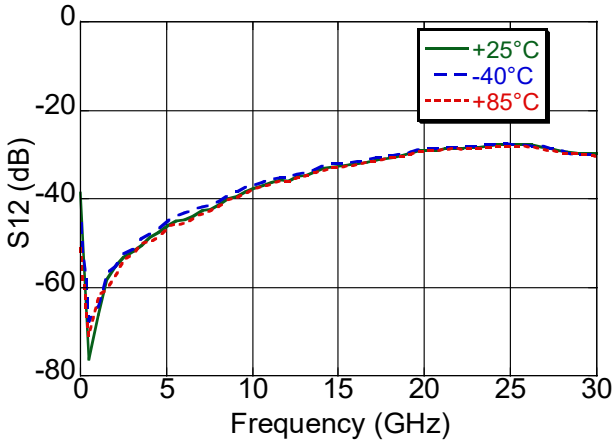
Input Return Loss



Output Return Loss

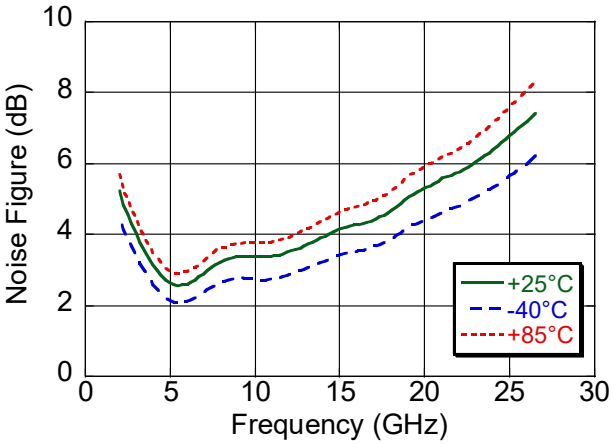


Isolation

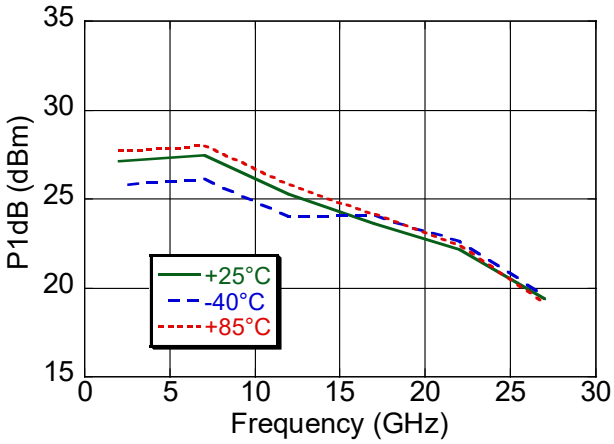


Typical Performance Curves V_{DD} = 8 V, I_{DSQ} = 220 mA, V_G = -0.53 V typical

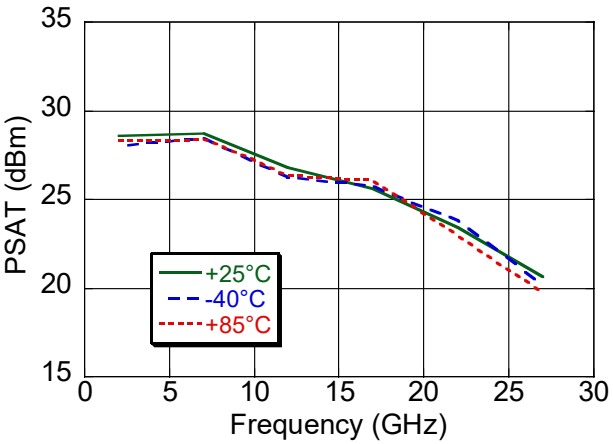
Noise Figure over Temperature



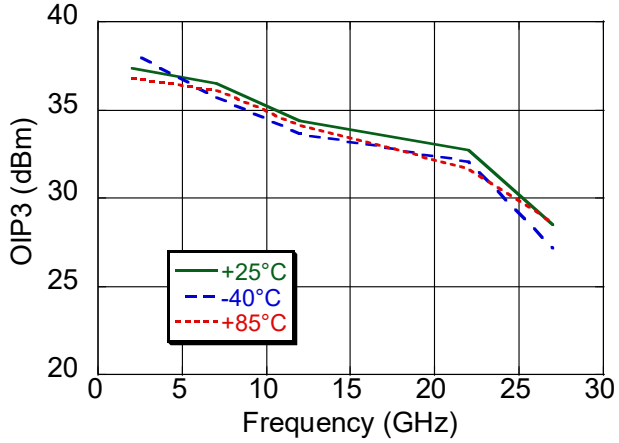
P1dB over Temperature



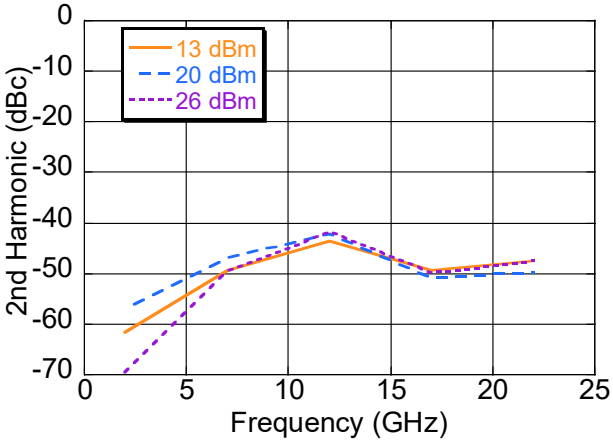
P_{SAT} over Temperature



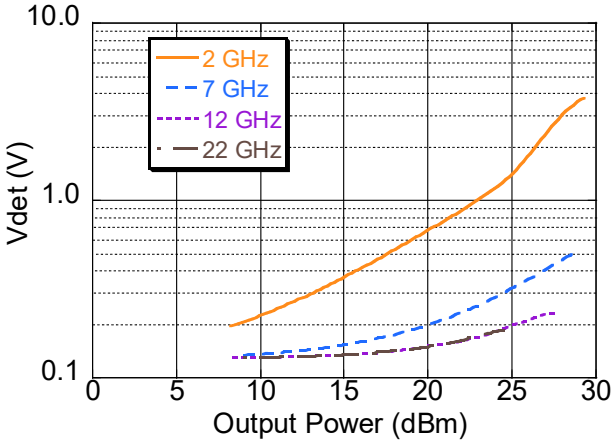
Output IP3 over Temperature @ 14 dBm per tone



2nd Harmonic

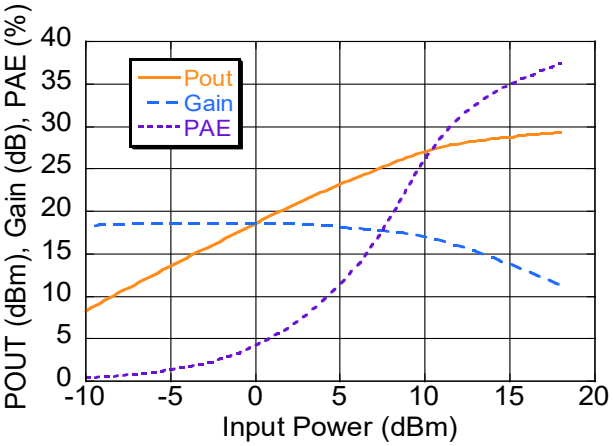


Detected Voltage

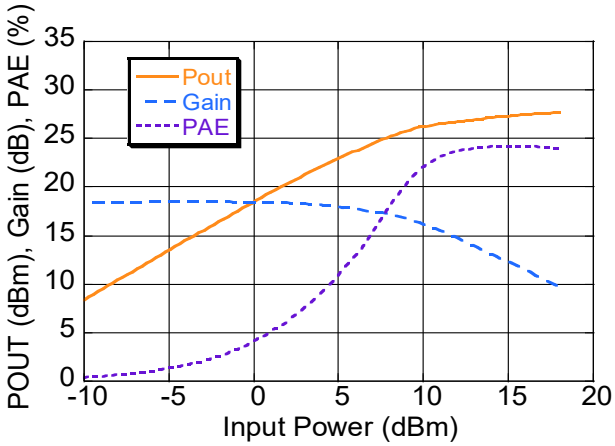


Typical Performance Curves V_{DD} = 8 V, I_{DSQ} = 220 mA, V_G = -0.53 V typical

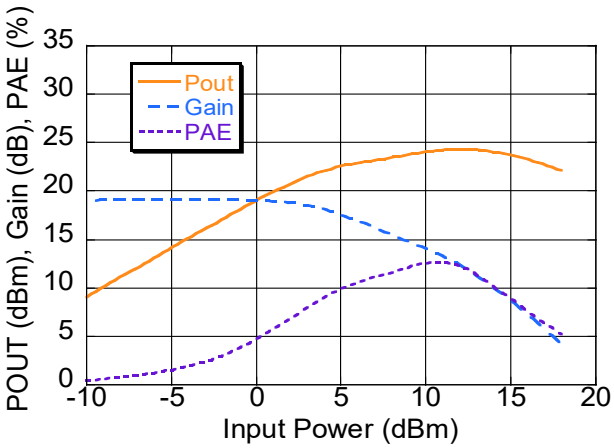
Power Compression @ 2 GHz



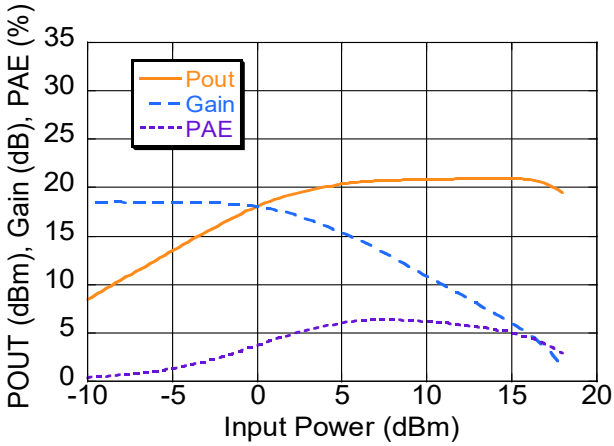
Power Compression @ 12 GHz



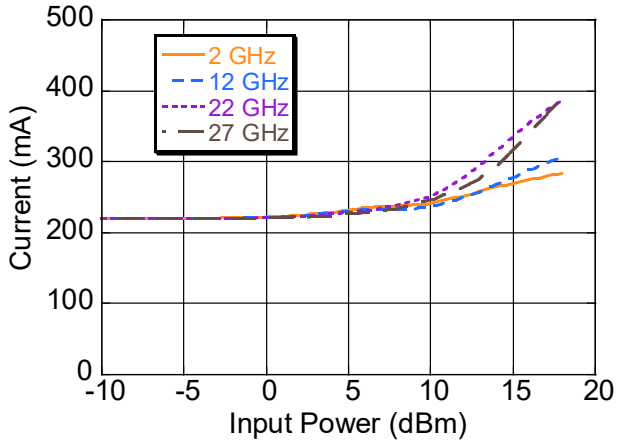
Power Compression @ 22 GHz



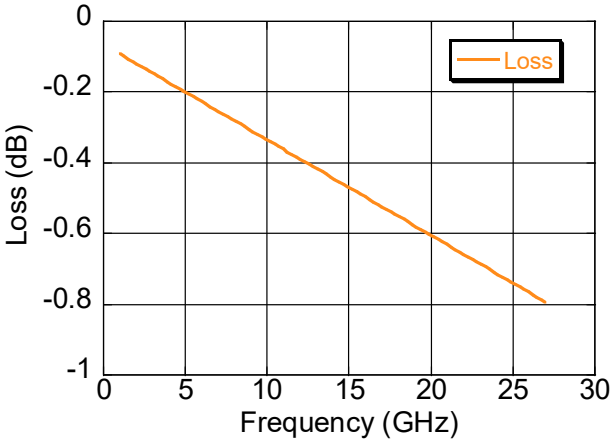
Power Compression @ 27 GHz



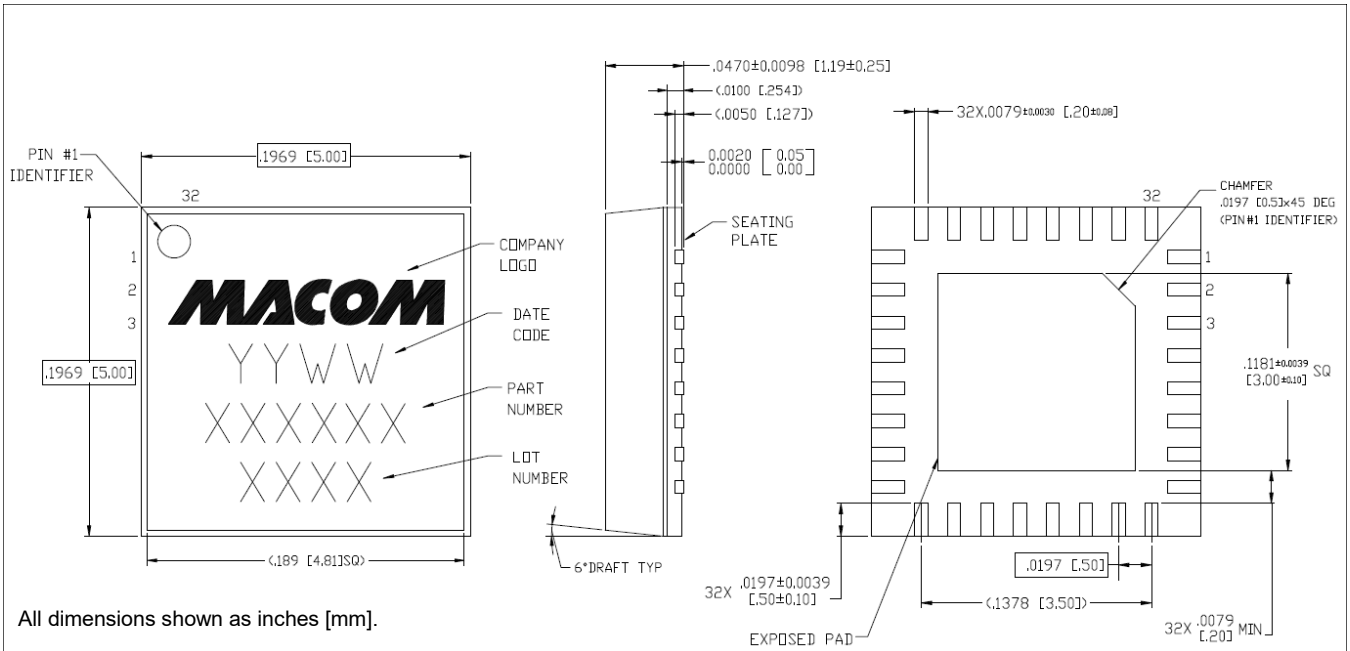
Current



Test Board Loss including Connector



Lead-Free 5 mm 32-lead AQFN Package†



All dimensions shown as inches [mm].

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is NiPdAu.

Mouser Electronics

Authorized Distributor

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MACOM:

MAAP-011324-TR0500