Features

- Positive Gain Slope
- High Gain: 13.5 dB @ 18 GHz
- P1dB: 28.5 dBm @ 18 GHz
- P_{SAT}: 30.5 dBm @ 18 GHz
- Output IP3: 47 dBm @ 18 GHz
- Bias Voltage: V_{DD} = 10 V
- Bias Current: I_{DSQ} = 500 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-011327 is a 1 W distributed power amplifier offered in a lead-free 5 mm 32-lead AQFN package. The power amplifier operates from 0.001 to 22 GHz and provides 13.5 dB of linear gain and 30.5 dBm of output power at saturation. The device is fully matched across the band and includes a temperature compensated output power detector.

The MAAP-011327 can be used as a power amplifier stage or as a driver stage in higher power applications. This device is ideally suited for test and measurement, EW, ECM, and radar applications.

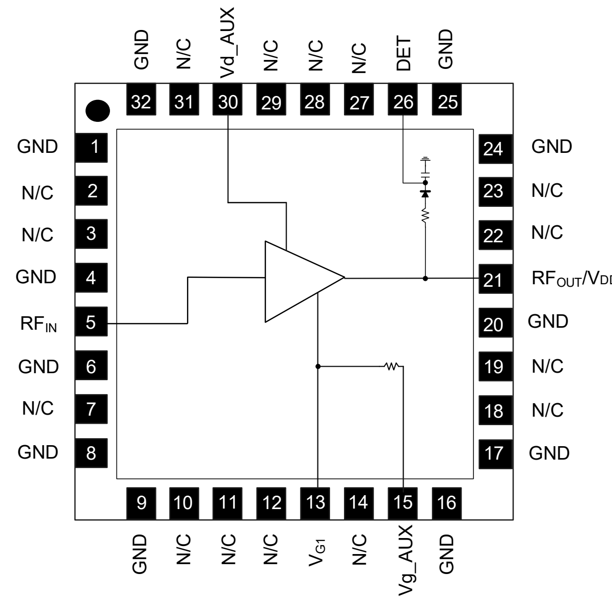
This product is fabricated using a GaAs pHEMT process which features full passivation for enhanced reliability.

Ordering Information[1]

Part Number	Package
MAAP-011327-TR0500	500 Piece Reel
MAAP-011327-TR1000	1000 Piece Reel
MAAP-011327-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, 24, 25, 32	GND	Ground
2, 3, 7, 10 - 12, 14, 18, 19, 22, 23, 27 - 29, 31	N/C	No Connection
5	RF_{IN}	RF Input
13	V_{G1}	Gate Voltage
15	Vg_AUX	Auxiliary Gate
21	RF_{OUT}/V_{DD}	RF Output / Drain Voltage
26	DET	Power Detector
30	Vd_AUX	Auxiliary Drain

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} = 10 V, I_{DSQ} = 500 mA, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	2 GHz 10 GHz 18 GHz 22 GHz	dB	— 11.0 11.5 12.5	13.0 13.0 13.5 14.5	—
P_{SAT}	P_{IN} = +24 dBm 2 GHz 10 GHz 18 GHz 22 GHz	dBm	—	32.0 31.5 30.5 31.0	—
P1dB	2 GHz 10 GHz 18 GHz 22 GHz	dBm	— 28.0 26.5 25.5	28.5 29.0 28.5 27.5	—
OIP3	P_{OUT} = +18 dBm/tone (10 MHz Tone Spacing) 2 GHz 12 GHz 18 GHz 22 GHz	dBm	—	45.0 45.0 47.0 39.5	—
PAE	P_{IN} = +22 dBm 2 GHz 12 GHz 18 GHz 22 GHz	%	—	27.5 24.5 19.5 19.5	—
NF	10 GHz 18 GHz 22 GHz	dB	—	3.0 3.5 3.75	—
Input Return Loss	P_{IN} = -20 dBm	dB	—	12	—
Output Return Loss	P_{IN} = -20 dBm	dB	—	12	—
I_{DD} (with RF drive)	P_{IN} = +23 dBm	mA	—	600	—
I_{G1} (with RF drive)	P_{IN} = +23 dBm	mA	—	-0.1	—

Maximum Operating Ratings

Parameter	Rating
Input Power	24 dBm
Drain Voltage	+12 V
Junction Temperature[6,7]	+150°C
Operating Temperature	-40°C to +85°C

6. Operating at nominal conditions with junction temperature ≤ +150°C will ensure MTTF > 1 x 10^6 hours.
7. Junction Temperature (T_J) = T_C + Θ_{JC} * ((V * I) - (P_{OUT} - P_{IN}))
   Typical thermal resistance (Θ_{JC}) = 14.0°C/W.
   a) For T_C = +85°C and 22 GHz,
   T_J = +146°C @ 10 V, 0.5 A, P_{OUT} = 28.5 dBm, P_{IN} = 18 dBm

Absolute Maximum Ratings[8,9]

Parameter	Absolute Maximum
Input Power	30 dBm
Drain Voltage	+13 V
Gate Voltage	-2 to 0 V
Junction Temperature[10]	+175°C
Storage Temperature	-65°C to +125°C

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

Biasing Conditions

Recommended biasing conditions are V_{DD} = 10 V, I_{DSQ} = 500 mA (controlled with V_{G1}).

V_{DD} bias must be applied through a resonant free high inductance on the RF output line.

Bypass capacitors C1 and C2 for the auxiliary pads are required for a low frequency operation extension (below 1 GHz).

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 2 and CDM Class C3 devices.

Operating the MAAP-011327

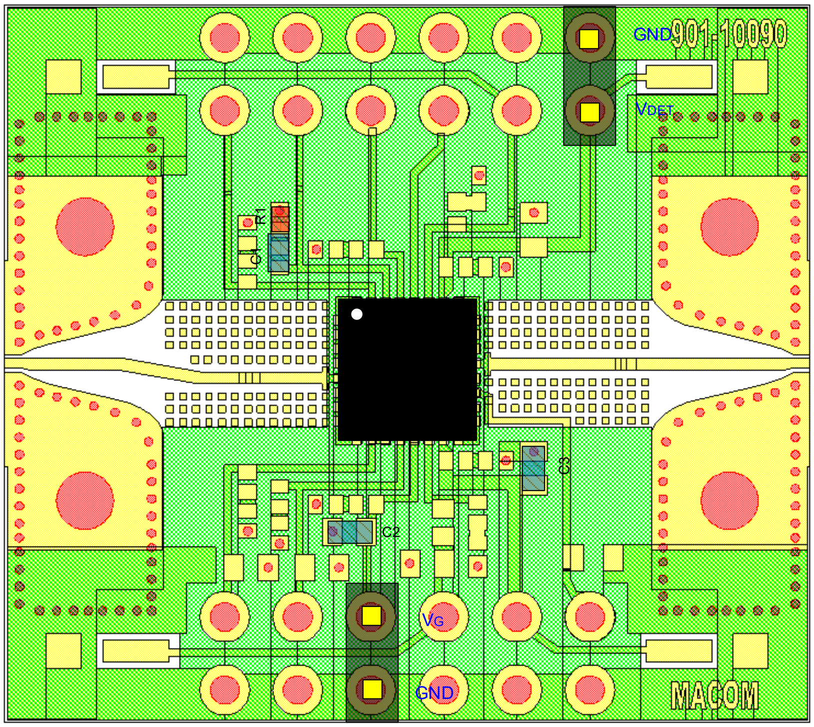
Turn-on

1. Apply V_{G1} (-1.5 V).
2. Increase V_{DD} to 10 V.
3. Set I_{DSQ} by adjusting V_{G1} more positive (typically -0.8 V for I_{DSQ} = 500 mA).
4. Apply RF_{IN} signal.

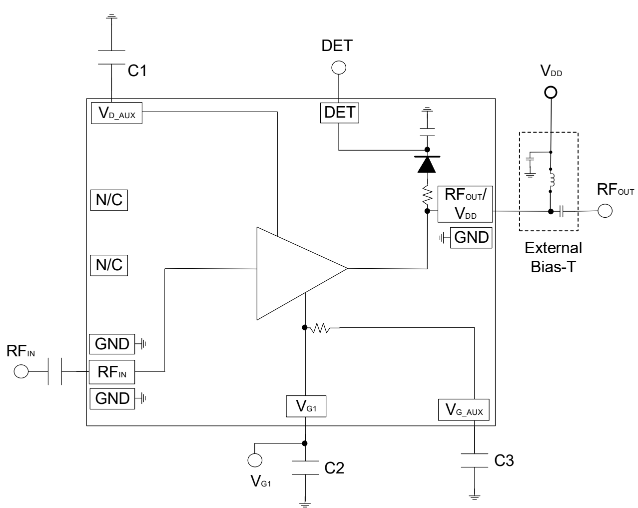
Turn-off

1. Remove RF_{IN} signal.
2. Decrease V_{G1} to -1.5 V.
3. Decrease V_{DD} to 0 V.

Sample Board Layout



Application Schematic



Parts List

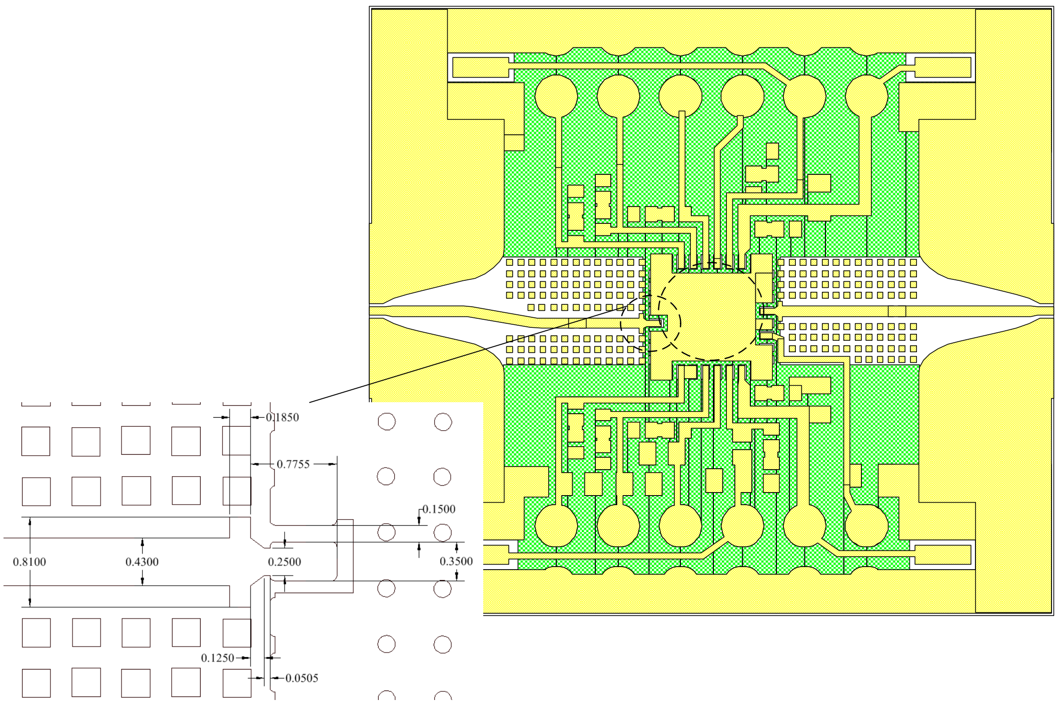
Part	Value	Case Style
C1 - C3	0.1 µF	0402
R1	0 Ω	0402

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
Finished overall thickness: 0.238 mm

Recommended PCB Layout Detail:

The RF input and output pre-matching circuit patterns are identical and are designed to compensate packaging effects. Transmission line dimensions apply to a PCB with 0.203 mm thick Rogers RO4003C laminate dielectric. Performance curves shown in this data sheet were measured with these circuit patterns.



Recommended PCB Information

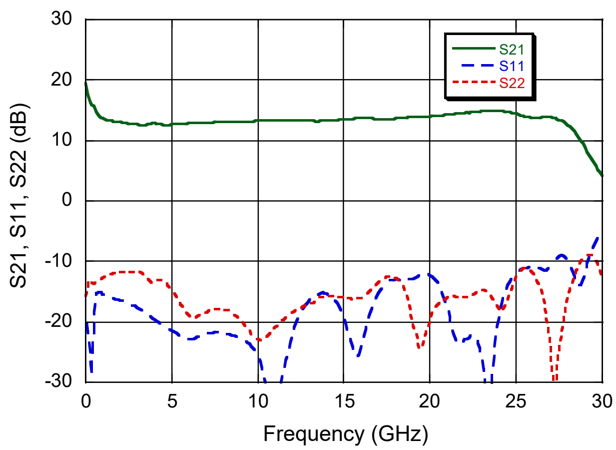
RF input and output are 50 Ω transmission lines on single layer 8 mil Rogers RO4003C with 1/2 oz. Cu. Use copper filled vias under ground paddle. Do not use copper paste as the thermals will cause over heating.

Grounding and Thermal Vias

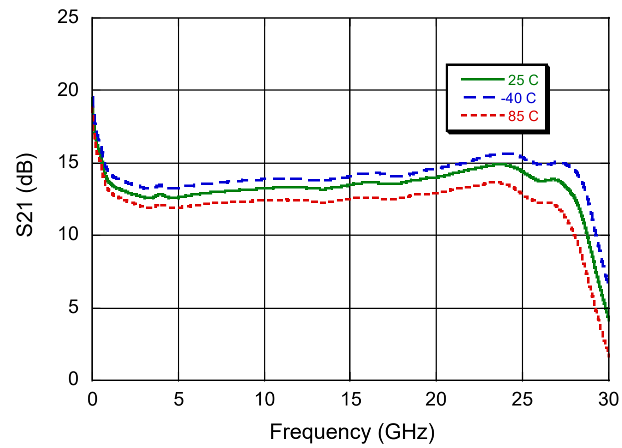
It is recommended that the total ground (common mode) inductance not exceed 0.03 nH (30 pH). This is equivalent to placing at least four 8 mil (200 µm) diameter vias under the device, assuming an 8 mil (200 µm) thick RF layer to ground. For best thermal management, use as many copper filled vias as physically possible. 0.3 mm diameter in a 9 x 9 array are shown here.

Typical Performance Curves V_{DD} = 10 V, I_{DSQ} = 500 mA, V_{G1} = -0.8 V typical

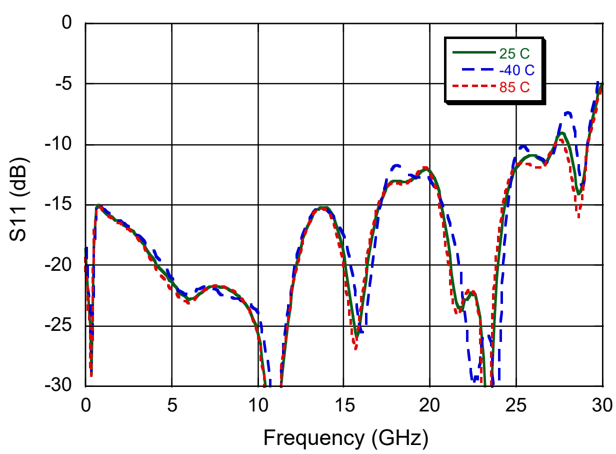
S-Parameters



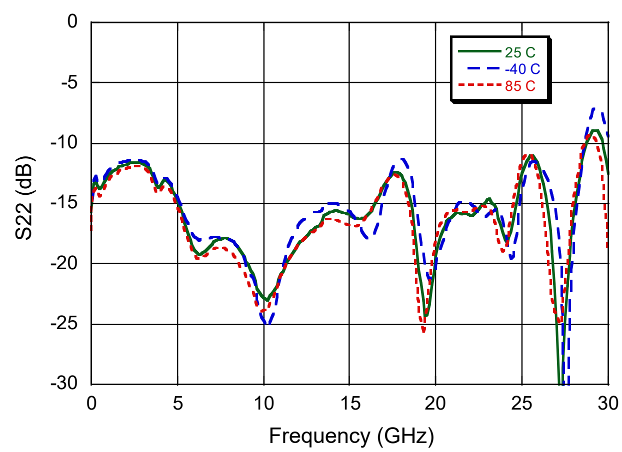
Gain



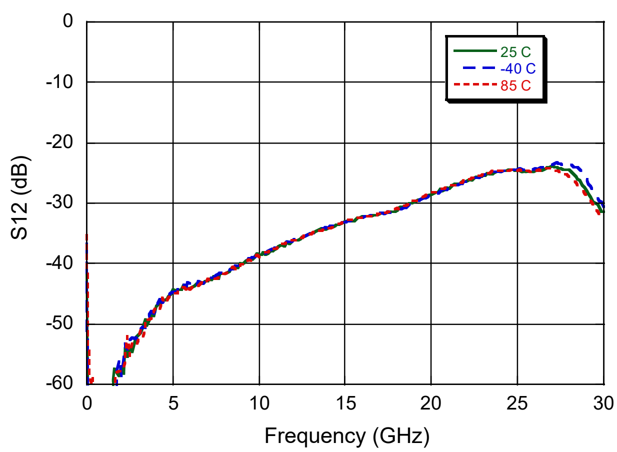
Input Return Loss



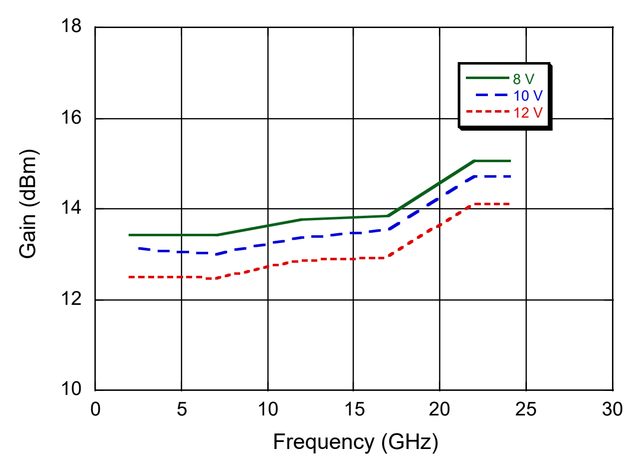
Output Return Loss



Isolation

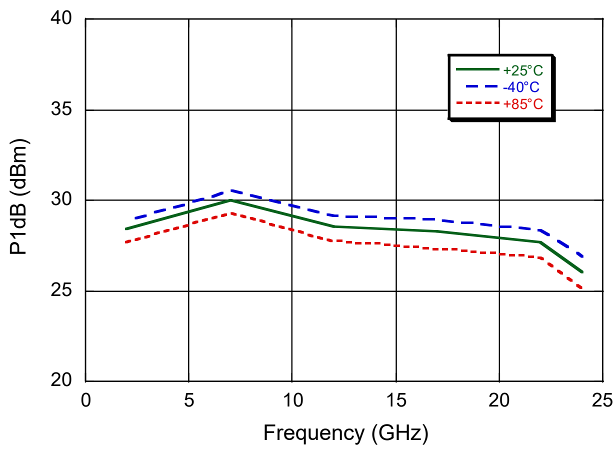


Gain over Voltage

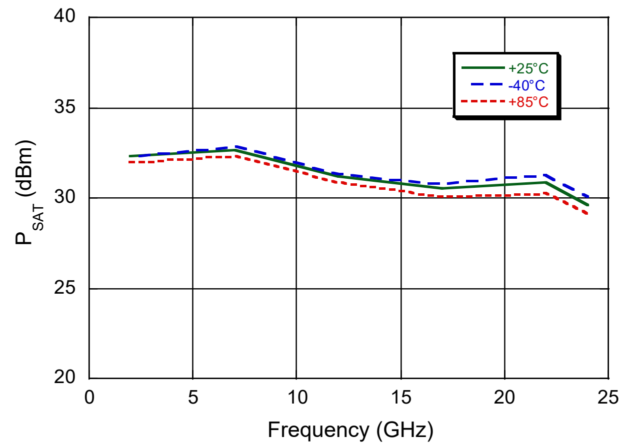


Typical Performance Curves V_{DD} = 10 V, I_{DSQ} = 500 mA, V_{G1} = -0.8 V typical

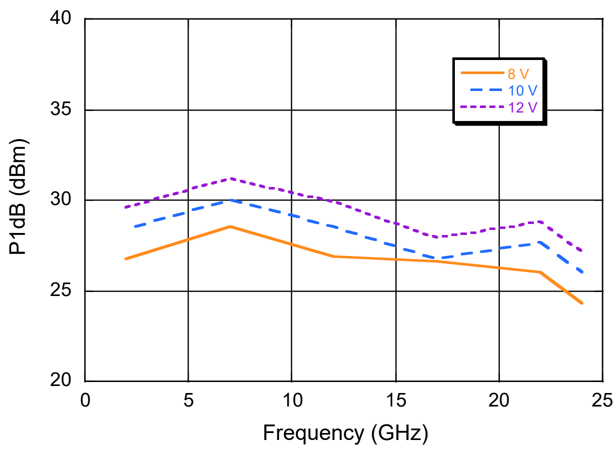
P1dB over Temperature



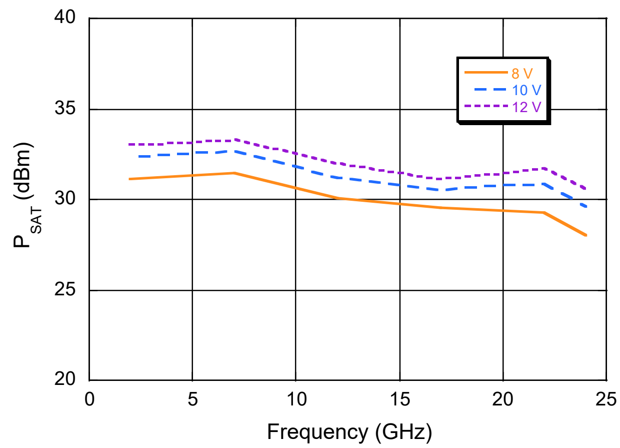
P_{SAT} over Temperature



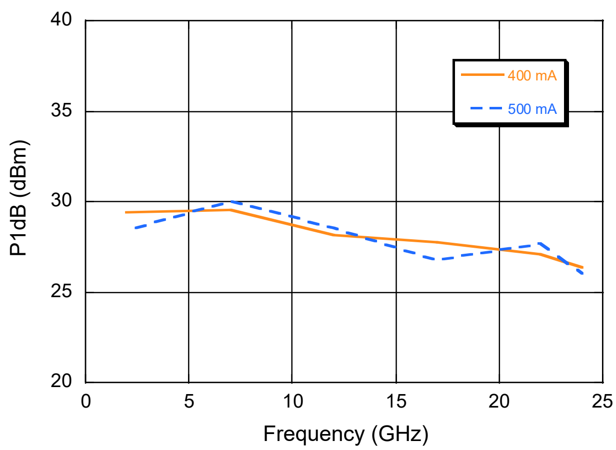
P1dB over Voltage



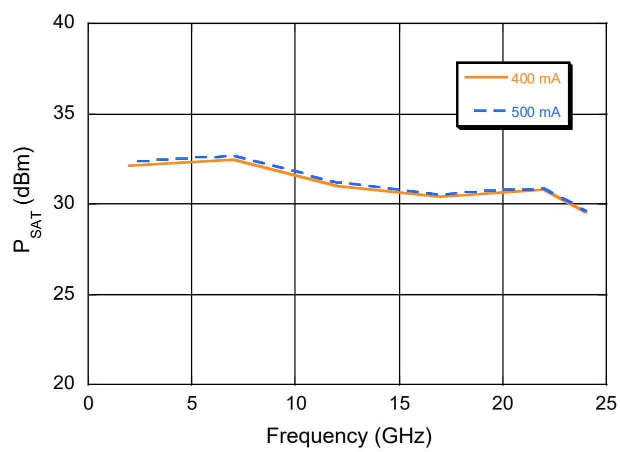
P_{SAT} over Voltage



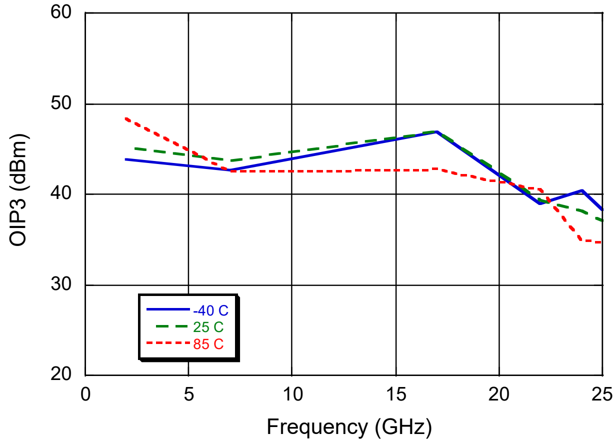
P1dB over Current



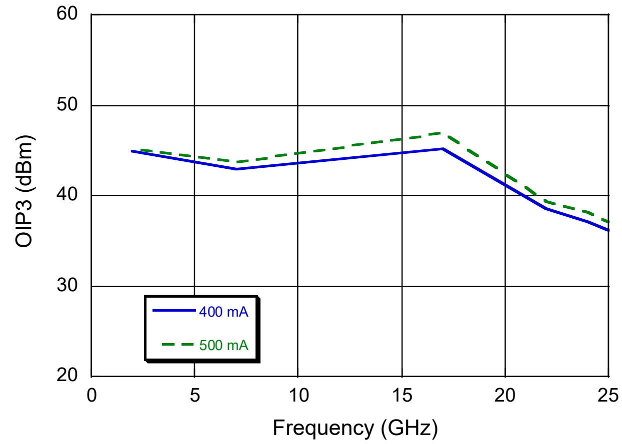
P_{SAT} over Current



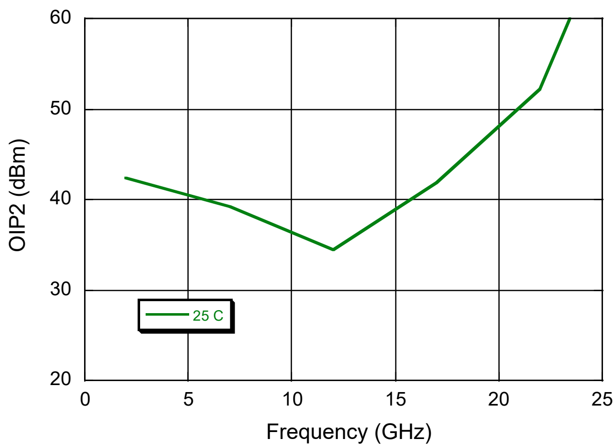
Output IP3 vs. Frequency over Temperature @Po=18dBm/tone



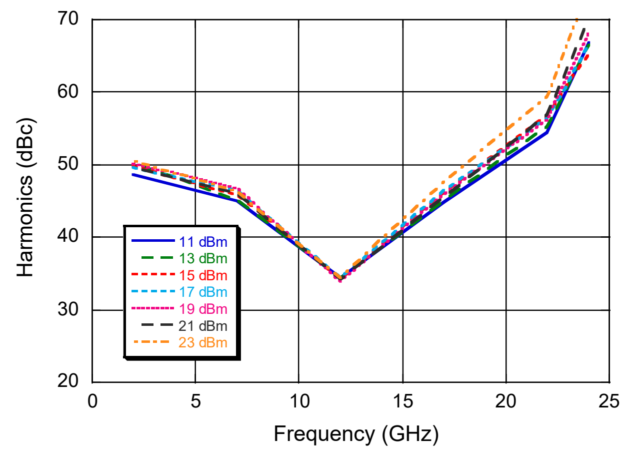
Output IP3 vs. Frequency over Drain Current @Po=18dBm/tone



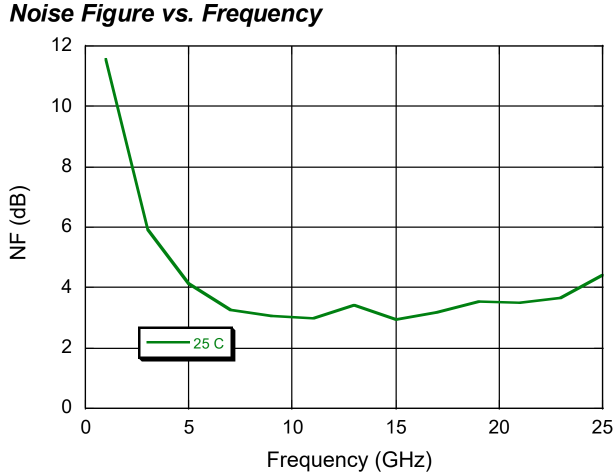
Output IP2 vs. Frequency @Po=18dBm/tone



2nd Harmonic level vs. Frequency over Output Power

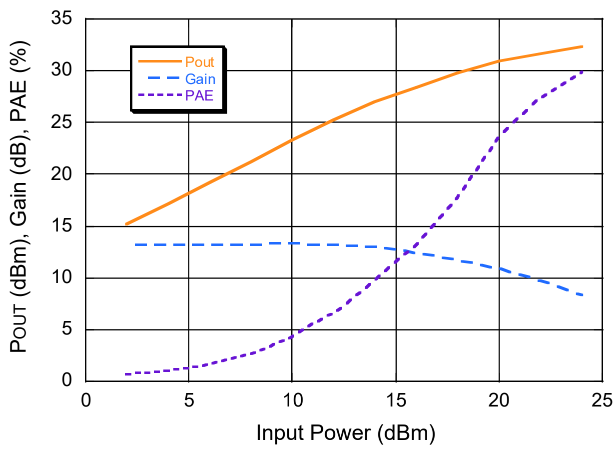


Noise Figure vs. Frequency

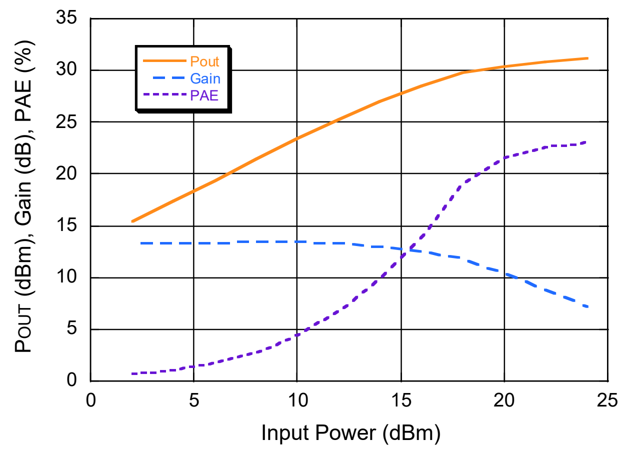


Typical Performance Curves V_{DD} = 10 V, I_{DSQ} = 500 mA, V_{G1} = -0.8 V typical

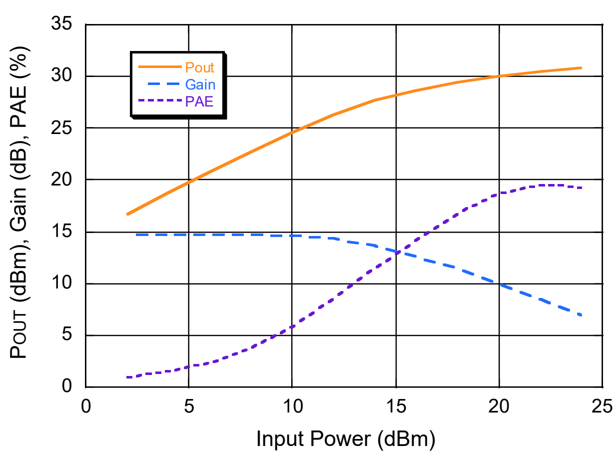
Power Compression @ 2 GHz



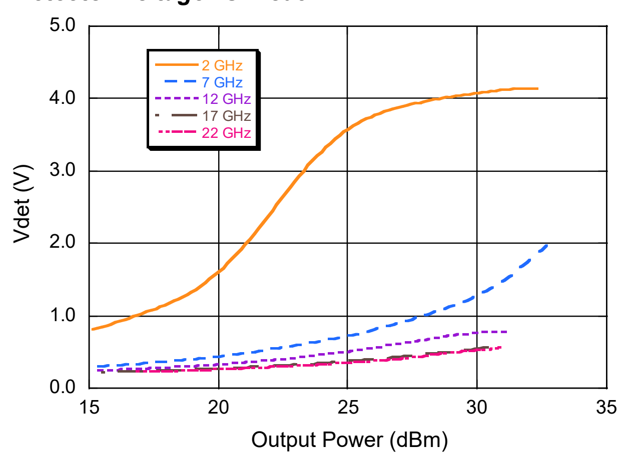
Power Compression @ 12 GHz



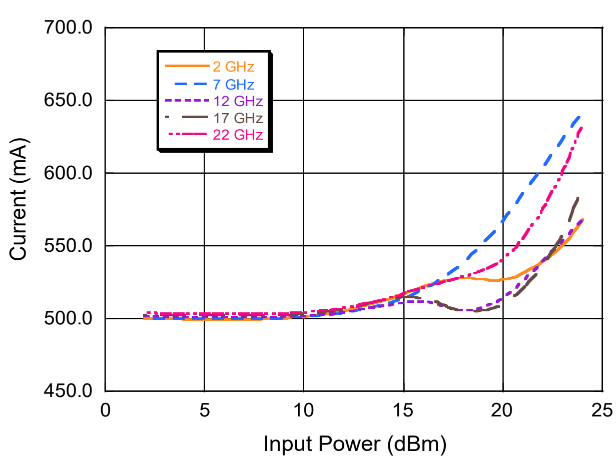
Power Compression @ 22 GHz



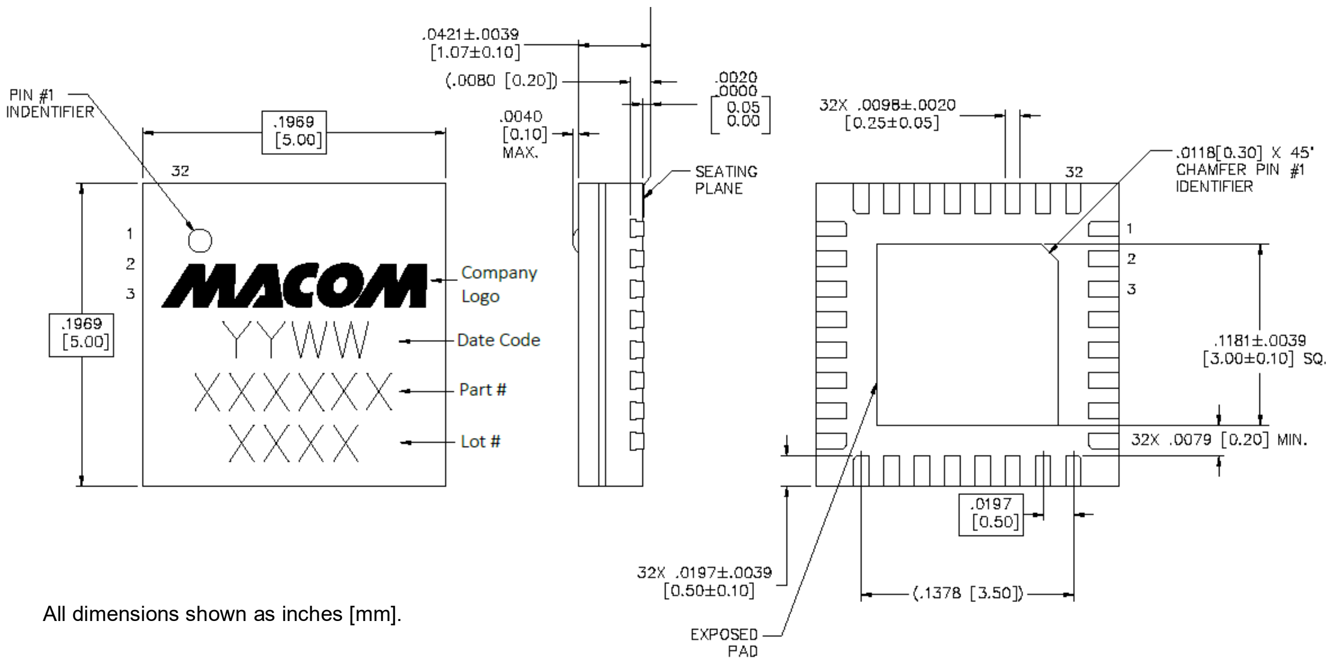
Detector Voltage vs. Pout



Current



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.