MAAP-011233

Power Amplifier, 4 W
28.5 - 31.0 GHz

Rev. V2

Features

- High Gain: 25 dB @ 30 GHz
- P1dB: 34.5 dBm
- P3dB: 36.0 dBm
- IM3 Level: -27 dBc @ P_{OUT} 29 dBm/tone
- Power Added Efficiency: 27.5% @ P3dB
- Lead-Free 5 mm 32-lead AQFN Package
- RoHS* Compliant

Description

The MAAP-011233 is a 4-stage, 4 W power amplifier assembled in a lead-free 5 mm 32-lead AQFN plastic package. This power amplifier operates from 28.5 to 31.0 GHz and provides 26 dB of linear gain, 4 W saturated output power and 27.5% efficiency while biased at 6 V.

The MAAP-011233 can be used as a power amplifier ideally suited for VSAT communications.

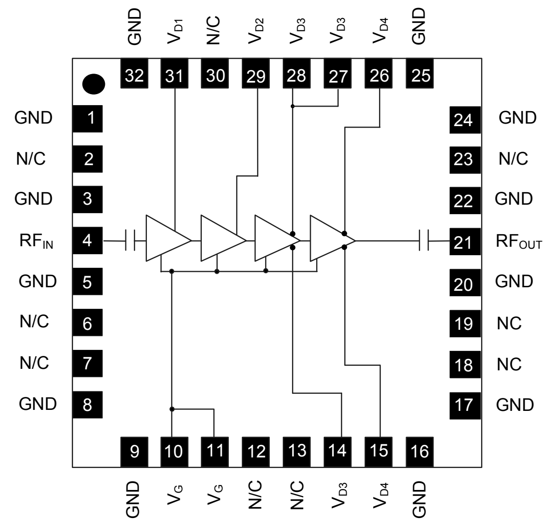
This product is fabricated using a GaAs pHEMT process which features full passivation for enhanced reliability.

Ordering Information[1,2]

Part Number	Package
MAAP-011233	Bulk
MAAP-011233-TR0500	500 Piece Reel
MAAP-011233-SMB	Sample Board

1. Reference Application Note M513 for reel size information.
2. All sample boards include 3 loose parts.

Functional Schematic



Pin Configuration[3,4]

Pin #	Pin Name	Description
1, 3, 5, 8, 9, 16, 17, 20, 22, 24, 25, 32	GND	Ground
2, 6, 7, 12, 13, 18, 19, 23, 30	N/C	No Connection
4	RF_{IN}	RF Input
10, 11	V_G	Gate Voltage
14, 27, 28	V_{D3}	Drain Voltage 3
15, 26	V_{D4}	Drain Voltage 4
21	RF_{OUT}	RF Output
29	V_{D2}	Drain Voltage 2
31	V_{D1}	Drain Voltage 1

3. MACOM recommends connecting all No Connection (N/C) pins to ground.
4. 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: Freq. = 30 GHz, T_A = +25°C, V_D = 6 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	P_{IN} = 0 dBm	dB	22	25.0	—
P_{OUT}	P_{IN} = +14 dBm	dBm	34.5	36.0	—
IM3 Level	P_{OUT} = 29 dBm / tone	dBc	—	-27.0	—
Power Added Efficiency	P_{IN} = +14 dBm	%	—	27.5	—
Input Return Loss	P_{IN} = -20 dBm	dB	—	10	—
Output Return Loss	P_{IN} = -20 dBm	dB	—	10	—
Quiescent Current	I_{DQ} (see bias conditions, page 4)	mA	—	2000	—
Current	P_{IN} = +14 dBm	mA	—	2800	3600

Maximum Operating Ratings

Parameter	Rating
Input Power	14 dBm
Junction Temperature[5,6]	+160°C
Operating Temperature	-40°C to +85°C

5. Operating at nominal conditions with junction temperature ≤ +160°C will ensure MTTF > 1 x 10^6 hours.
6. Junction Temperature (T_J) = T_C + $Θ_{JC}$ * [(V * I) - (P_{OUT} - P_{IN})]. Typical thermal resistance ($Θ_{JC}$) = 4.4 °C/W.
   a) For T_C = +25°C,
      T_J = +82°C @ 6 V, 2.8 A, P_{OUT} = 36 dBm, P_{IN} = 14 dBm
   b) For T_C = +85°C,
      T_J = +137°C @ 6 V, 2.5 A, P_{OUT} = 35 dBm, P_{IN} = 14 dBm

Absolute Maximum Ratings[7,8]

Parameter	Absolute Maximum
Input Power	20 dBm
Drain Voltage	6.5 V
Gate Voltage	-3 to 0 V
Junction Temperature[9]	+175°C
Storage Temperature	-65°C to +125°C

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

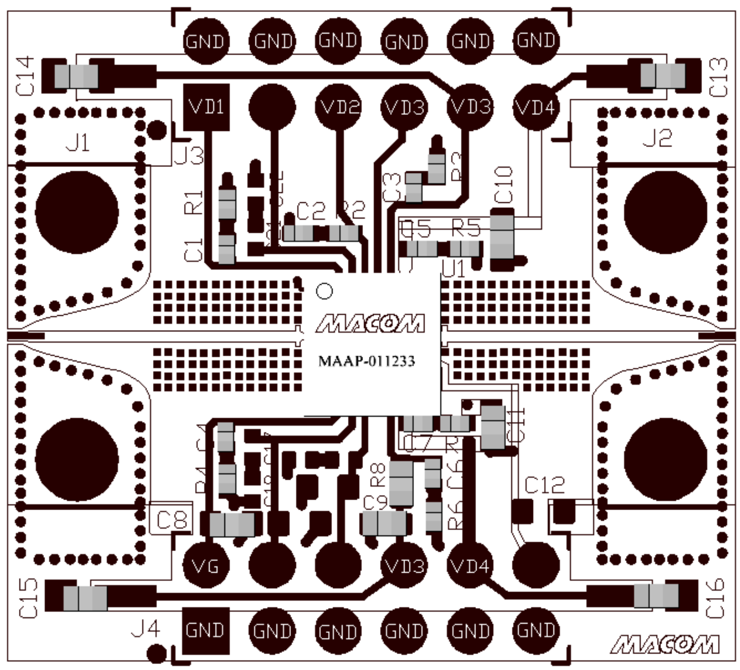
Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

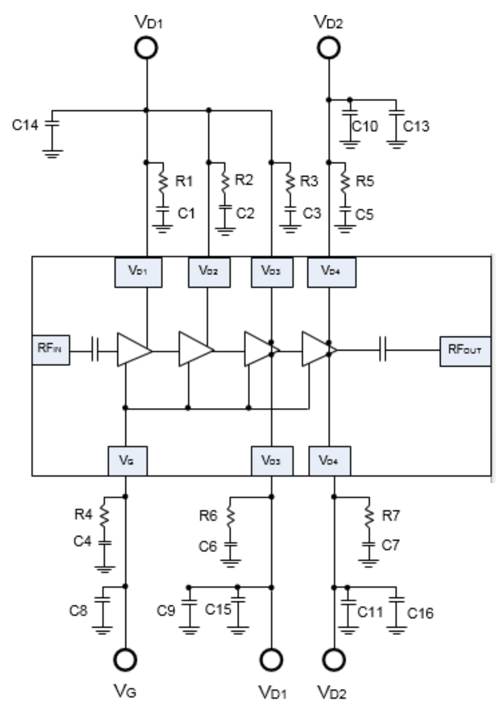
These electronics devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1A devices.

Sample Board Layout



GND TERMINALS ARE CONNECTED TOGETHER ON THE PCB BY METAL.

Application Schematic



Parts List

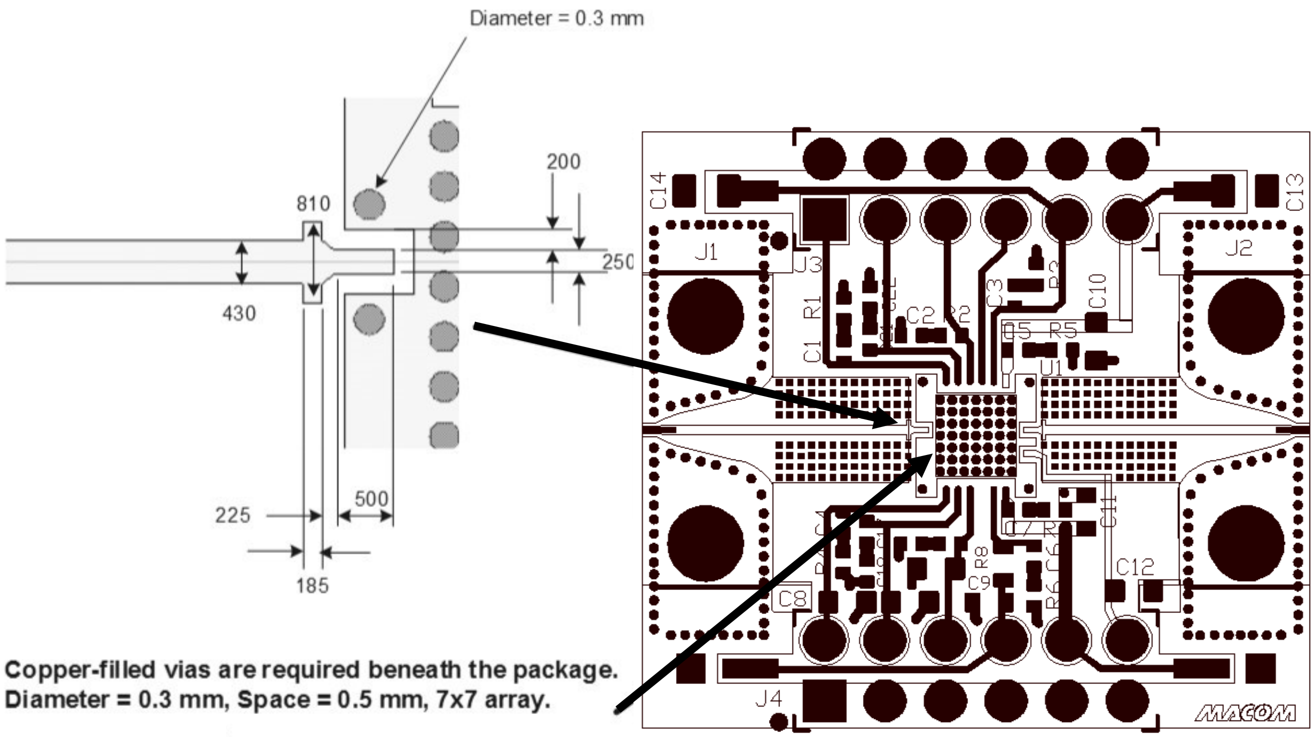
Part	Value	Case Style
C1 - C7	0.01 µF	0402
C8 - C12	1 µF	0603
C13 - C16	10 µF	0805
R1 - R7	10 Ω	0402

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

Sample Board Layout:

RF input and output port pre-matching circuit patterns are designed to compensate for packaging effects. Input and output patterns are identical.



Biasing Conditions

Recommended biasing conditions are V_D = 6 V, I_{DQ} = 2 A (controlled with V_G). The drain bias voltage range is 3 to 6 V, and the quiescent drain current biasing range is 1.5 to 2.5 A.

V_G pins 10 and 11 are connected internally; choose either pin for layout convenience. Muting can be accomplished by setting the V_G to the pinched off voltage (V_G = -2 V).

V_D bias must be applied to V_D1, V_D2, V_D3, and V_D4 pins.

V_D3 pins 14 and either pin 27 or 28 are required for current symmetry. Pins 27 and 28 are connected internally; choose either pin for layout convenience.

Both V_D4 pins 15 and 26 are required for current symmetry.

Operating the MAAP-011233

Turn-on

1. Apply V_G (-1.5 V).
2. Apply V_{D1}, V_{D2}, V_{D3}, V_{D4} (6.0 V typical).
3. Set I_{DQ} by adjusting V_G more positive (typically -0.9 to -1.0 V for I_{DQ} = 2 A).
4. Apply RF_{IN} signal.

Turn-off

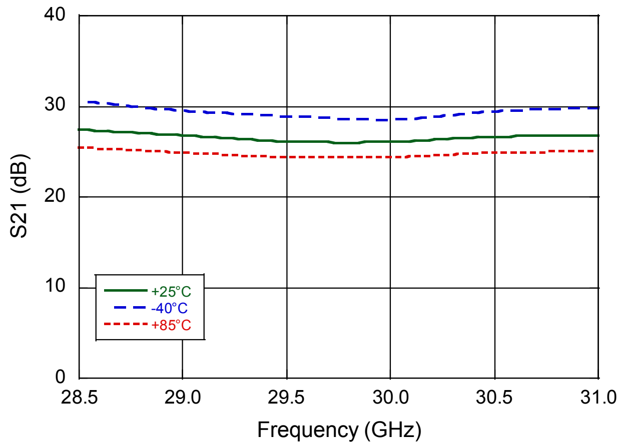
1. Remove RF_{IN} signal.
2. Decrease V_G to -1.5 V.
3. Decrease V_{D1}, V_{D2}, V_{D3}, V_{D4} to 0 V.

Application Information

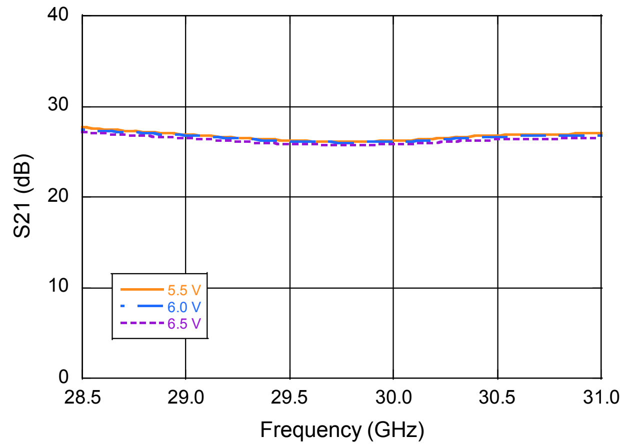
The MAAP-011233 is designed to be easy to use yet high performance. The ultra small size and simple bias allow easy placement on system board. RF input and output ports are DC de-coupled internally.

Typical Performance Curves

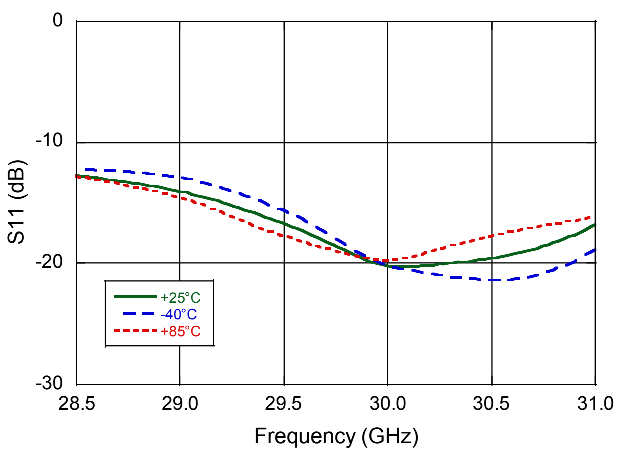
Small Signal Gain vs. Frequency over Temperature



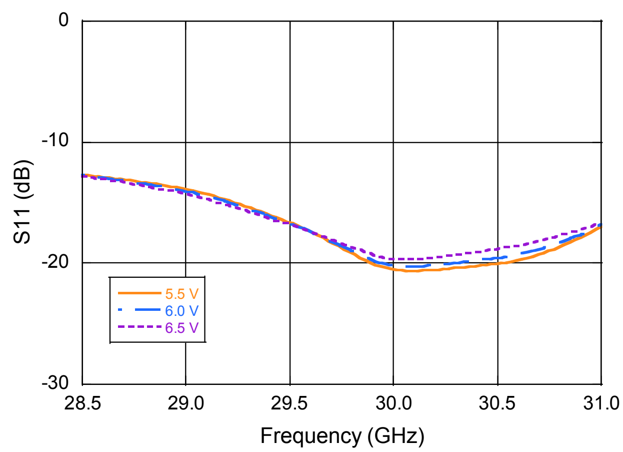
Small Signal Gain vs. Frequency over Bias Voltage



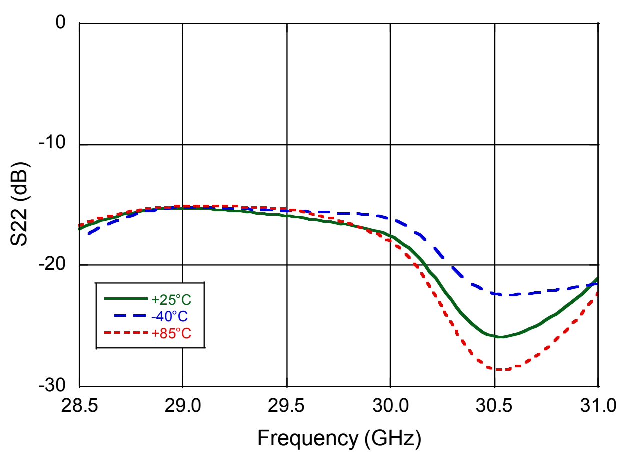
Input Return Loss vs. Frequency over Temperature



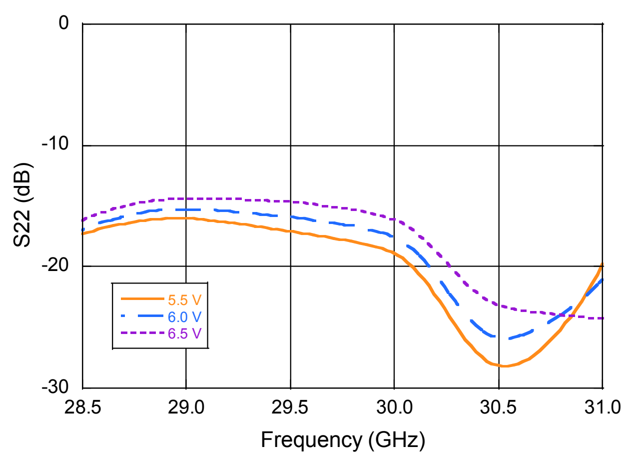
Input Return Loss vs. Frequency over Bias Voltage



Output Return Loss vs. Frequency over Temperature

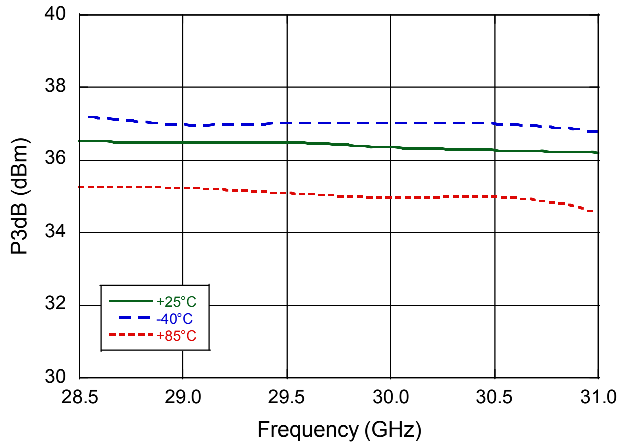


Output Return Loss vs. Frequency over Bias Voltage

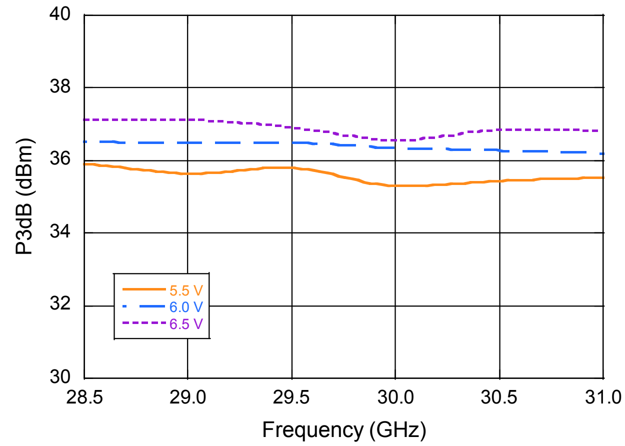


Typical Performance Curves

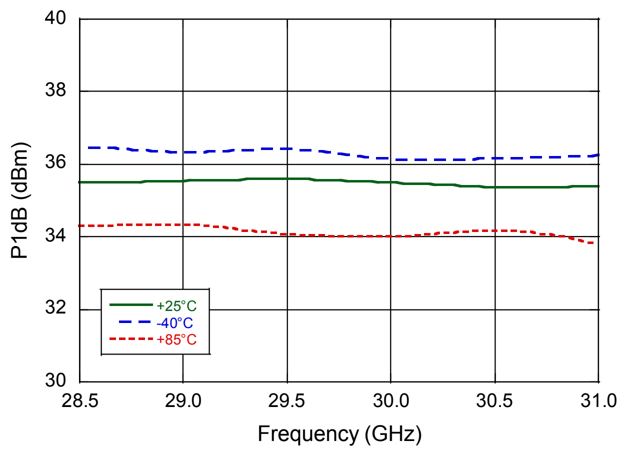
P3dB vs. Frequency over Temperature



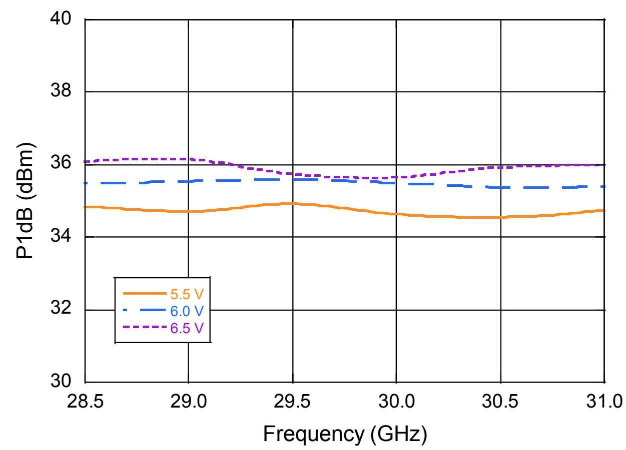
P3dB vs. Frequency over Bias Voltage



P1dB vs. Frequency over Temperature

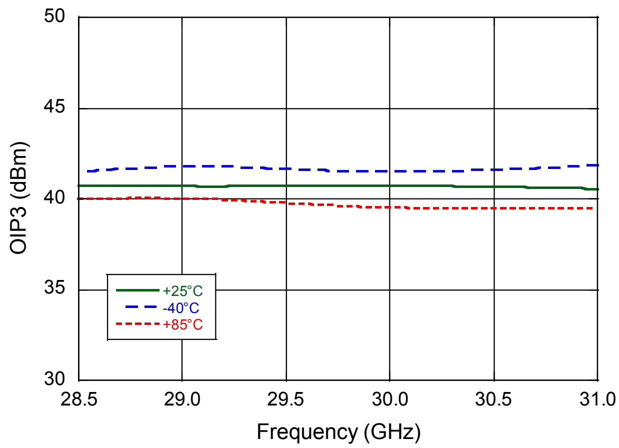


P1dB vs. Frequency over Bias Voltage

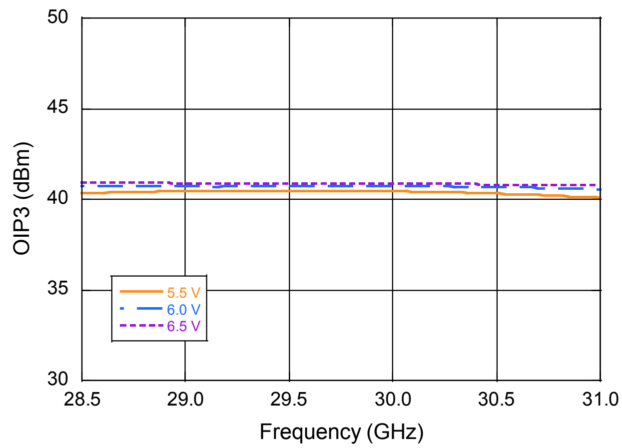


Typical Performance Curves: P_{OUT} = 29 dBm / Tone

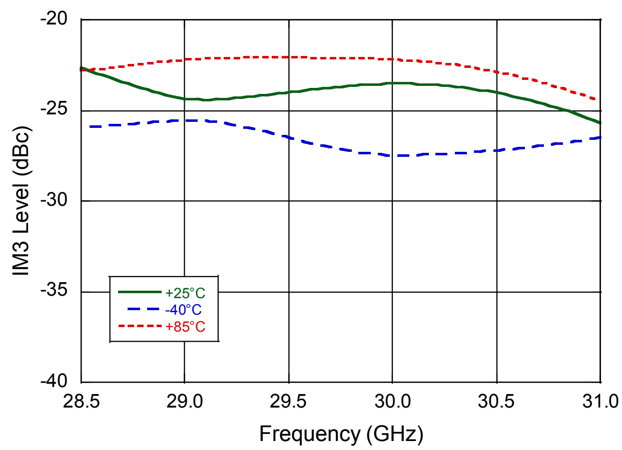
Output IP3 vs. Frequency over Temperature



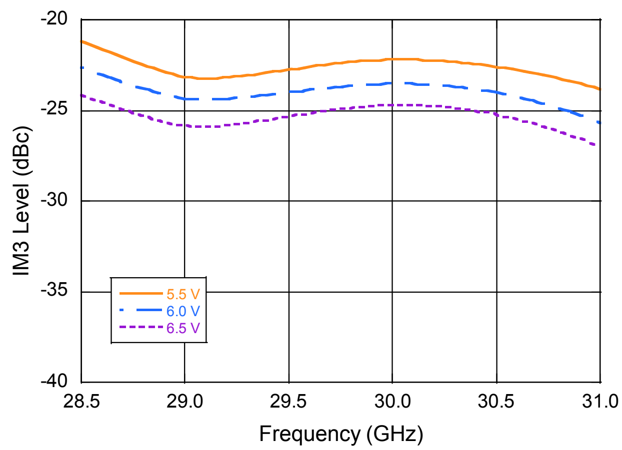
Output IP3 vs. Frequency over Bias Voltage



IM3 vs. Frequency over Temperature

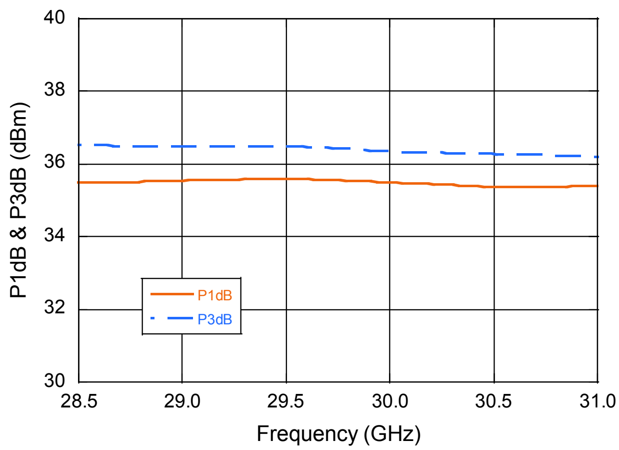


IM3 vs. Frequency over Bias Voltage

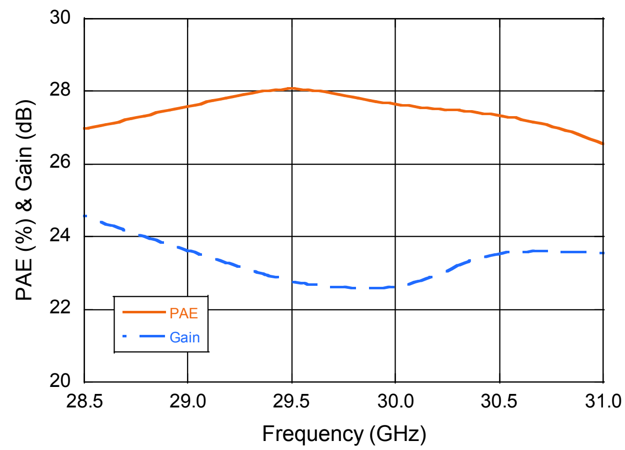


Typical Performance Curves

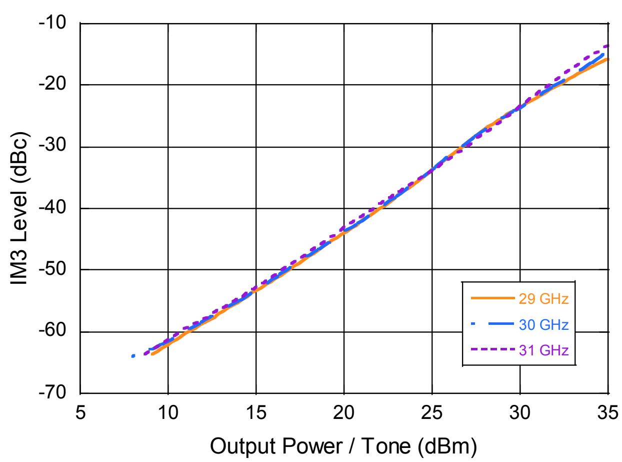
P1dB & P3dB vs. Frequency



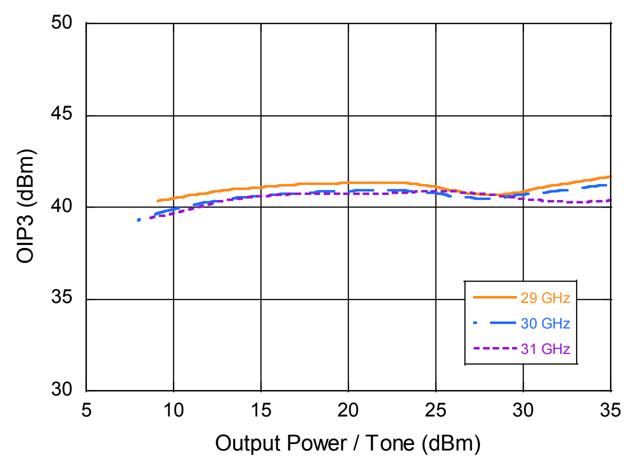
PAE & Gain @ P3dB vs. Frequency



IM3 vs. Output Power

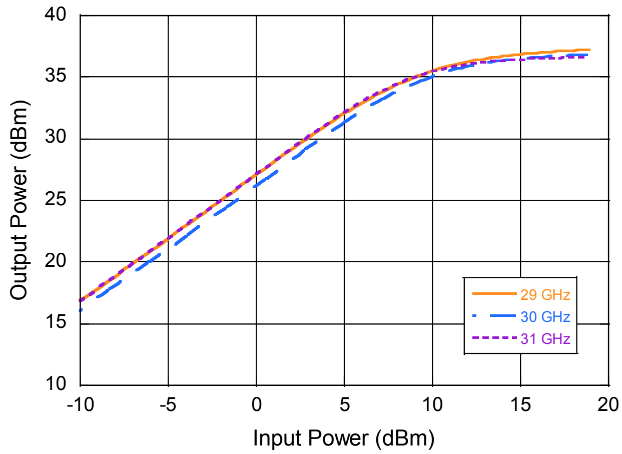


Output IP3 vs. Output Power

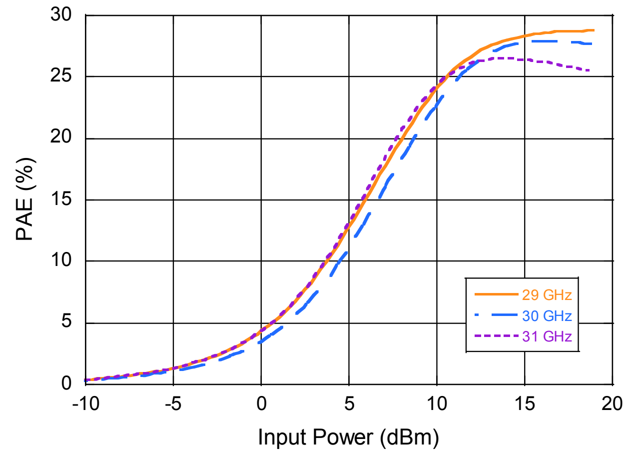


Typical Performance Curves

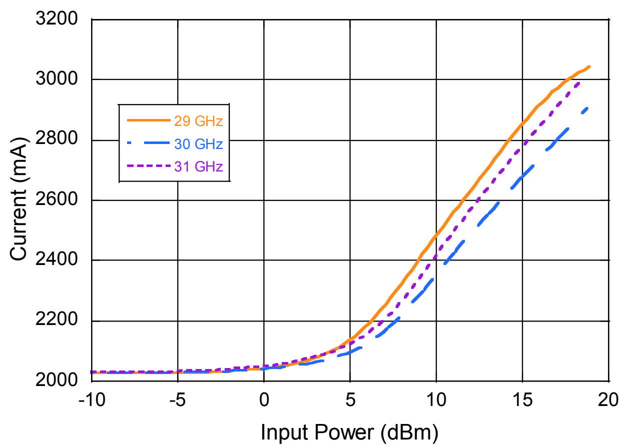
Output Power vs. Input Power



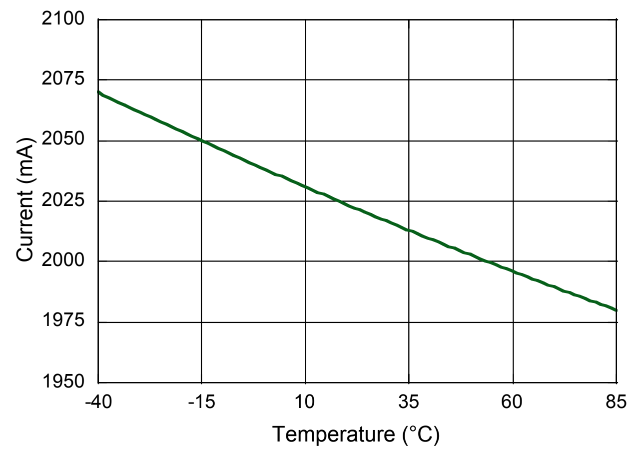
PAE vs. Input Power



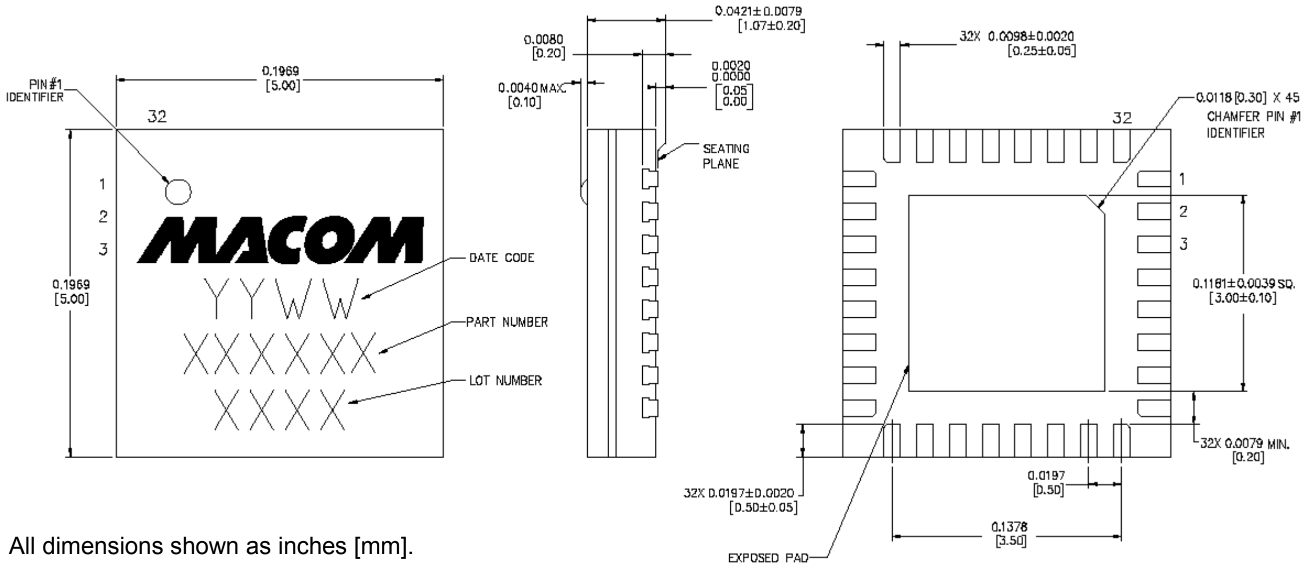
Bias Current vs. Input Power



Quiescent Drain Current vs. Temperature



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.