MAAP-011250

Power Amplifier, 4 W
27.5 - 30 GHz

Rev. V2

Features

- High Gain: 24 dB
- P1dB: 34.8 dBm
- P3dB: 36 dBm
- IM3 Level: -23 dBc @ P_{OUT} = 30 dBm/tone
- Power Added Efficiency: 20% @ P3dB
- Temperature Compensated Output Power Detector
- Lead-Free 5 mm AQFN 32-lead Package
- RoHS* Compliant

Description

The MAAP-011250 is a balanced 4 W, 4-stage power amplifier assembled in a lead-free 5 mm 32-lead AQFN plastic package. This power amplifier operates from 27.5 to 30 GHz and provides 24 dB of linear gain, 4 W saturated output power and 20 % efficiency while biased at 6 V.

The MAAP-011250 can be used as a power amplifier stage or as a driver stage in higher power applications. This device is ideally suited for VSAT and 28 GHz PTP applications.

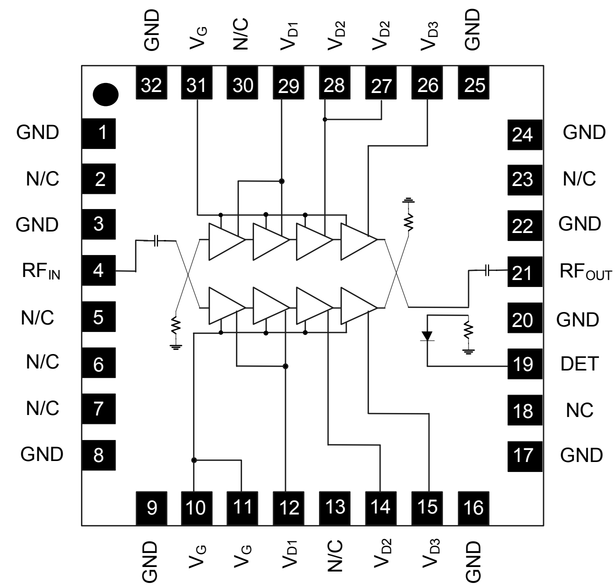
This product is fabricated using a GaAs pHEMT process which features full passivation for enhanced reliability.

Ordering Information[1,2]

Part Number	Package
MAAP-011250-TR0500	500 Piece Reel
MAAP-011250-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, 8, 9, 16, 17, 20, 22, 24, 25, 32	GND	Ground
2, 5, 6, 7, 13, 18, 23, 30	N/C	No Connection
4	RF_{IN}	RF Input
10, 11, 31	V_G	Gate Voltage
12, 29	V_{D1}	Drain Voltage 1
14, 27, 28	V_{D2}	Drain Voltage 2
15, 26	V_{D3}	Drain Voltage 3
19	DET	Detector
21	RF_{OUT}	RF Output

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. = 27.5 & 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, 27.5 GHz P_{IN} = 0 dBm, 30.0 GHz	dB	21.0 21.0	26.0 24.5	—
P_{OUT}[5]	P_{IN} = 14.5 dBm, 27.5 GHz P_{IN} = 15.0 dBm, 30.0 GHz	dBm	34.5 34.5	37.0 36.0	—
IM3	P_{OUT} = 30 dBm / tone Freq. = 27.5 - 30 GHz	dBc	—	-23	—
Power Added Efficiency	P_{IN} = 14.5 dBm Freq. = 27.5 - 30 GHz	%	—	20	—
Input Return Loss	P_{IN} = -20 dBm Freq. = 27.5 - 30 GHz	dB	—	15	—
Output Return Loss	P_{IN} = -20 dBm Freq. = 27.5 - 30 GHz	dB	—	15	—
Quiescent Current	I_{DSQ} (see bias conditions, page 4)	mA	—	2300	—
Drain Current (VD1 + VD2 + VD3)	P_{IN} = 14.5 dBm	mA	—	3600	4300

5. MACOM does not recommend sustained operation at power levels above 3 dB gain compression.

Maximum Operating Ratings

Parameter	Rating
Input Power[5]	15 dBm
Junction Temperature[6,7]	+160°C
Operating Temperature	-40°C to +85°C

6. Operating at nominal conditions with junction temperature ≤ +160°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}) = 4°C/W.
   a) For T_C = +25°C
      T_J = +88°C @ 6 V, 3.3 A, P_{OUT} = 36 dBm, P_{IN} = 14.5 dBm
   b) For T_C = +85°C
      T_J = 146°C @ 6 V, 3.0 A, P_{OUT} = 34.5 dBm, P_{IN} = 14.5 dBm

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

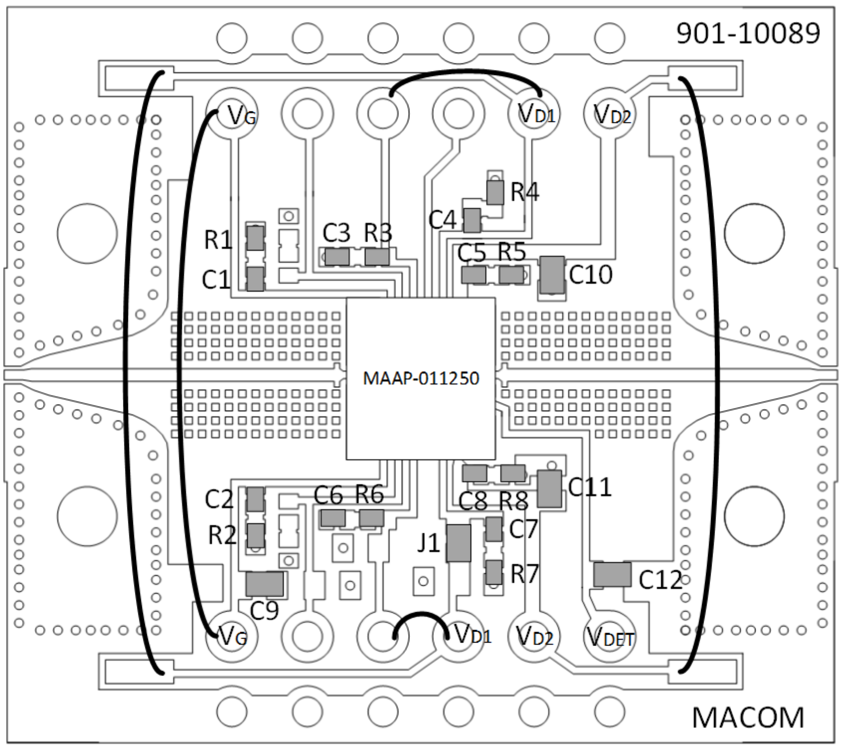
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1A devices.

Absolute Maximum Ratings[8,9]

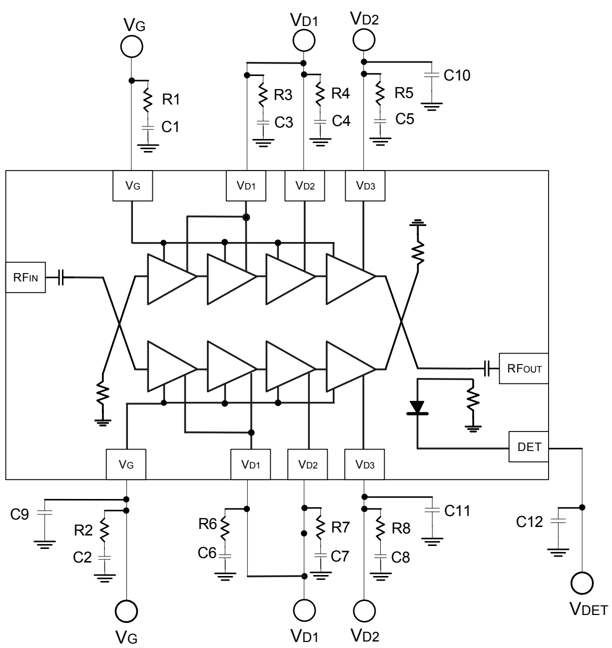
Parameter	Absolute Maximum
Input Power	17.5 dBm
Drain Voltage	+6.5 V
Gate Voltage	-3 to 0 V
Junction Temperature[10]	+175°C
Storage Temperature	-65°C to +125°C

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.

Sample Board Layout



Application Schematic



Parts List

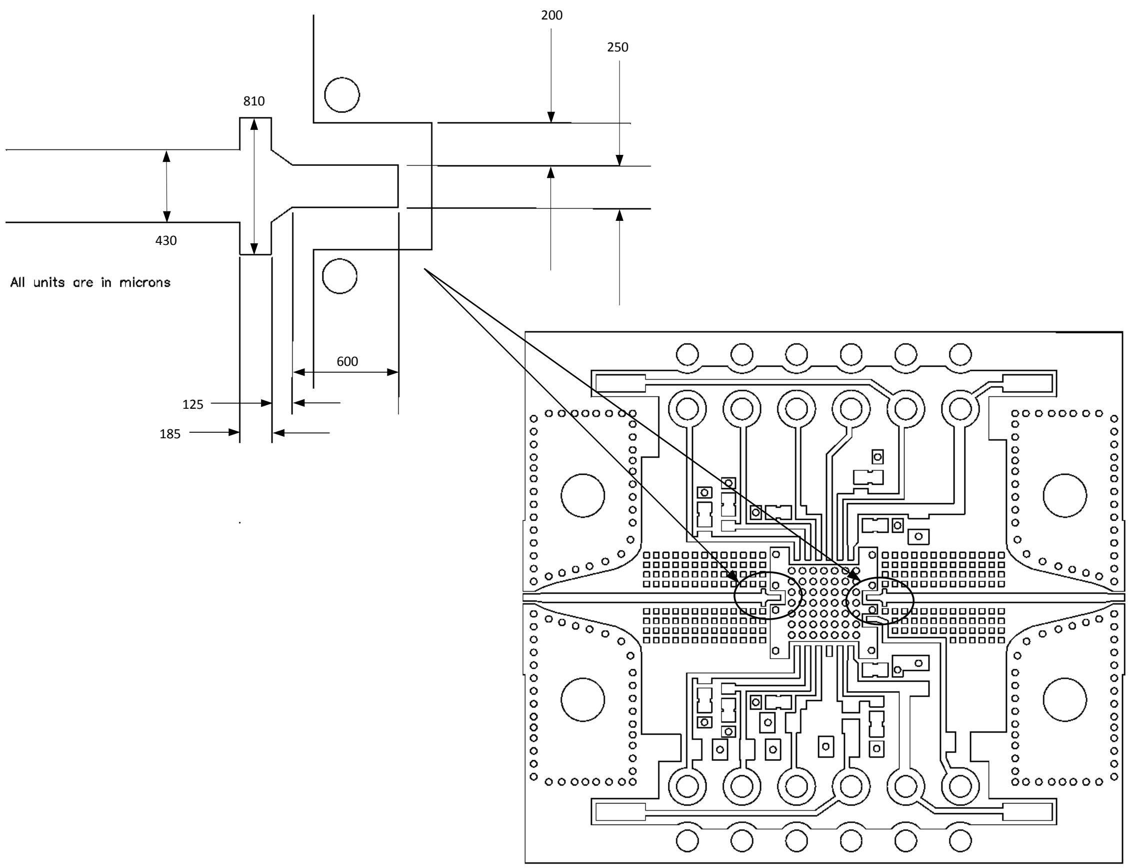
Part	Value	Case Style
C1 - C8	0.01 µF	0402
C9 - C12	22 µF	0603
R1 - R8	10 Ω	0402
J1	jumper	0603

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:

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.



Biasing Conditions

Recommended biasing conditions are V_D = 6 V, I_{DSQ} = 2.3 A (controlled with V_G). The drain bias voltage range is 3 to 6 V, and the quiescent drain current biasing range is 2 to 2.5 A.

V_G pins 10 and 11 are connected internally but are not connected to pin 31; V_G bias must be applied to pins 31 and 10 or 11. 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 all V_{DX} pins (V_{D1}, V_{D2}, and V_{D3}) on both sides of device as these pins are not internally connected.

Operating the MAAP-011250

Turn-on

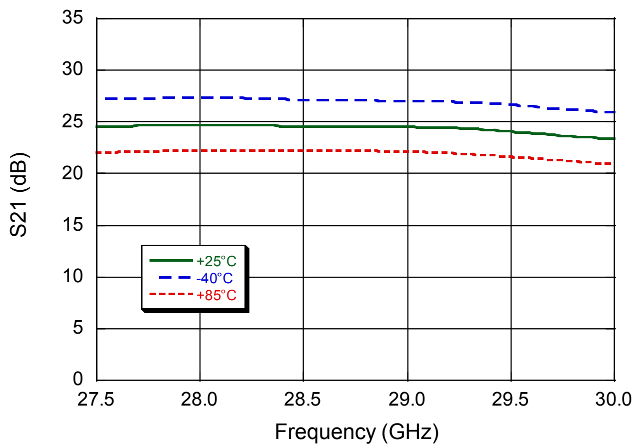
1. Apply V_G (-1.5 V).
2. Apply V_D (6.0 V typical).
3. Set I_{DQ} by adjusting V_G more positive (typically -0.9 to -1.0 V for I_{DSQ} = 2.3 A).
4. Apply RF_{IN} signal.

Turn-off

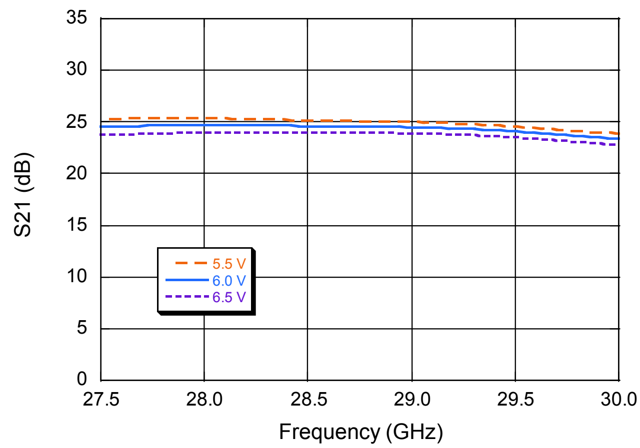
1. Remove RF_{IN} signal.
2. Decrease V_G to -1.5 V.
3. Decrease V_D to 0 V.

Typical Performance Curves: V_D = 6 V, I_{DSQ} = 2300 mA

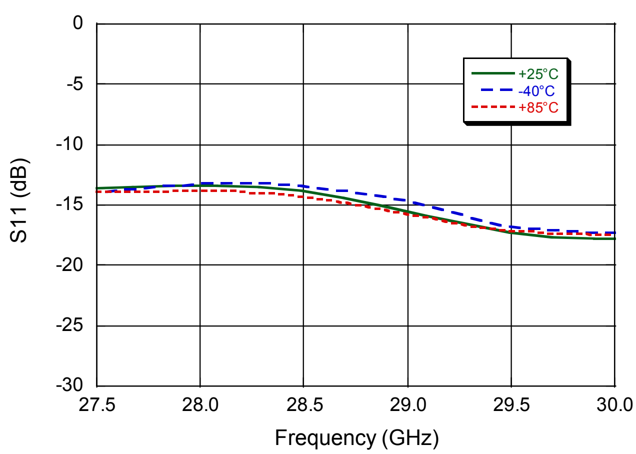
Small Signal Gain vs. Frequency over Temperature



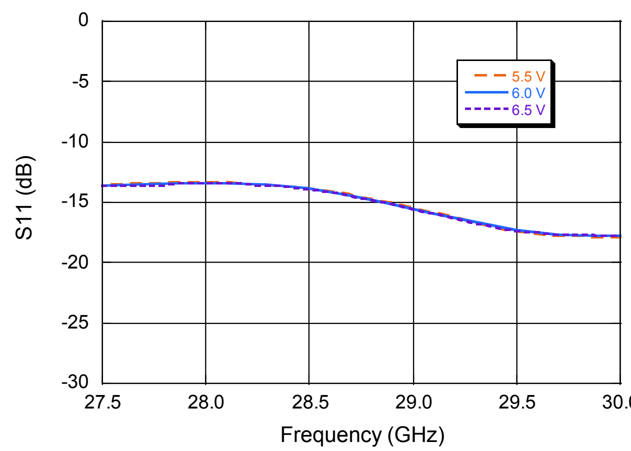
Small Signal Gain vs. Frequency over Bias Voltage



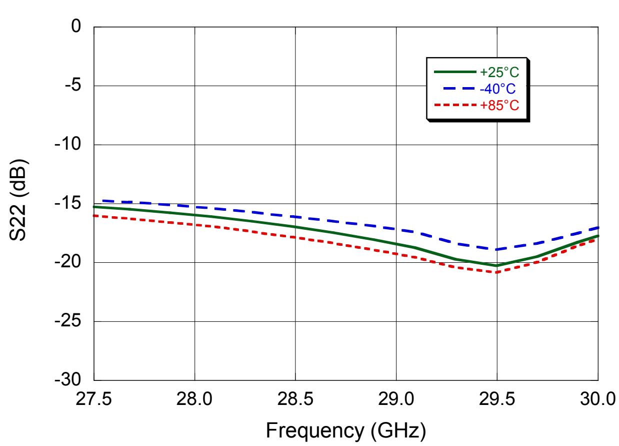
Input Return Loss vs. Frequency over Temperature



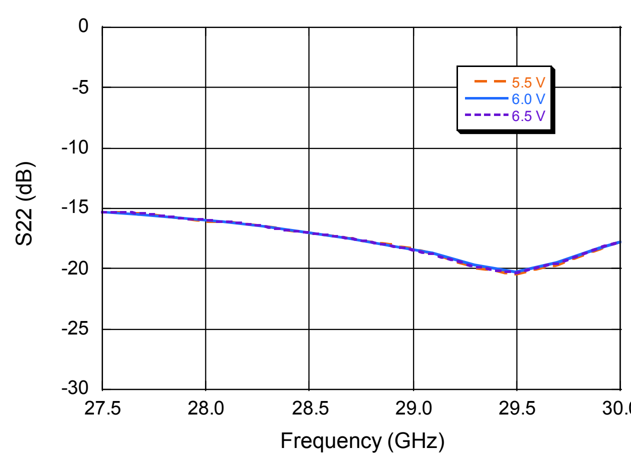
Input Return Loss vs. Frequency over Bias Voltage



Output Return Loss vs. Frequency over Temperature

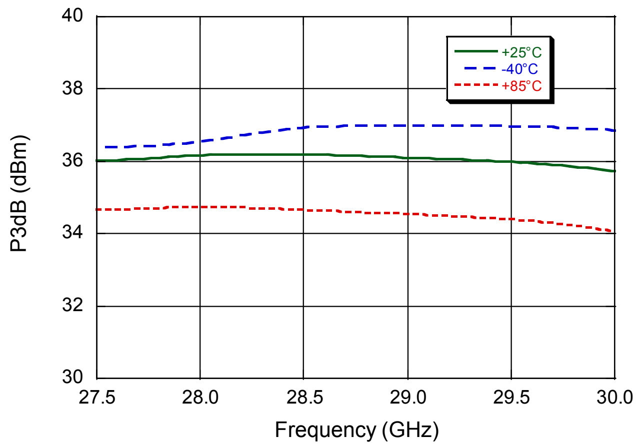


Output Return Loss vs. Frequency over Bias Voltage

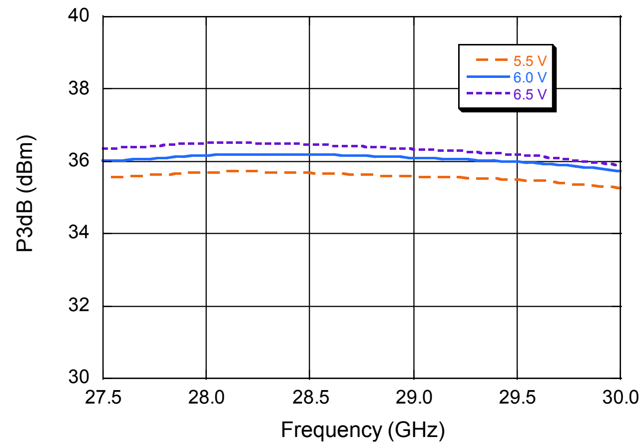


Typical Performance Curves: V_D = 6 V, I_{DSQ} = 2300 mA

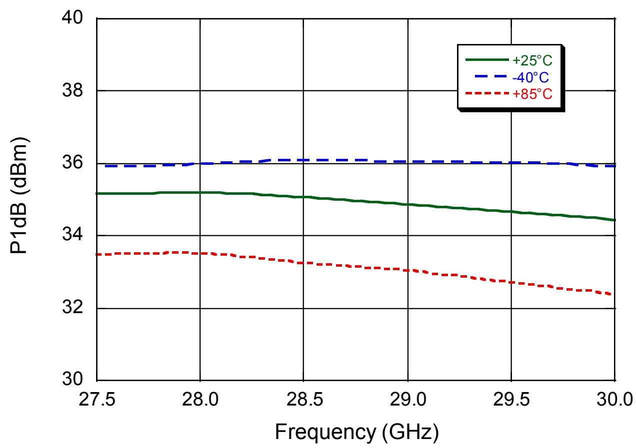
P3dB vs. Frequency over Temperature



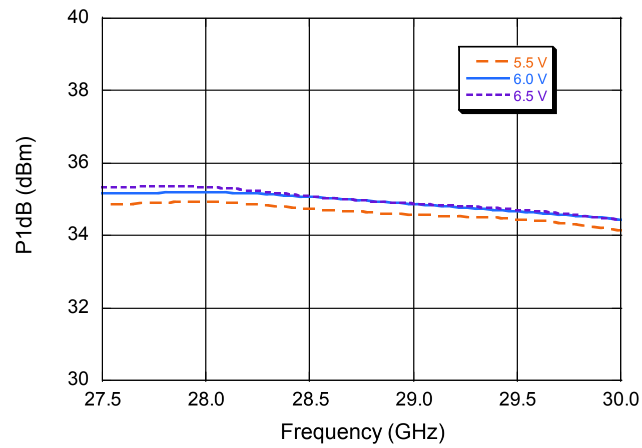
P3dB vs. Frequency over Bias Voltage



P1dB vs. Frequency over Temperature

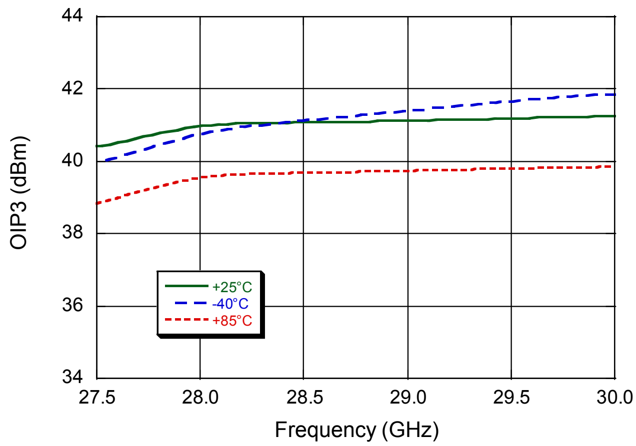


P1dB vs. Frequency over Bias Voltage

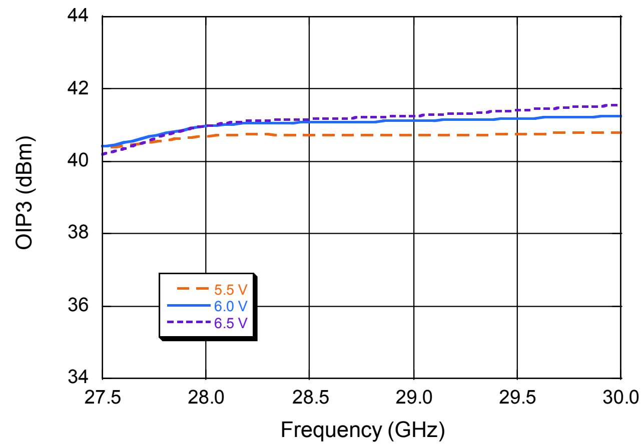


Typical Performance Curves: V_D = 6 V, I_{DSQ} = 2300 mA

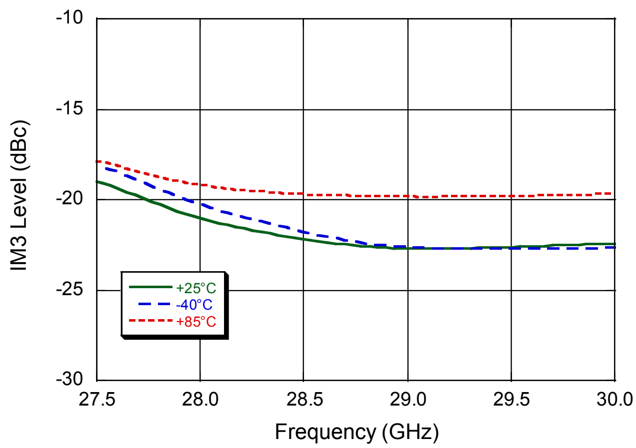
Output IP3 over Temperature (P_{OUT} = 30 dBm / Tone)



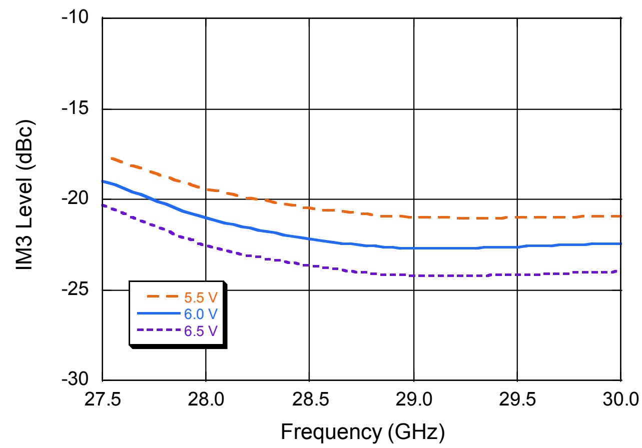
Output IP3 over Bias Voltage (P_{OUT} = 30 dBm / Tone)



IM3 over Temperature (P_{OUT} = 30 dBm / Tone)

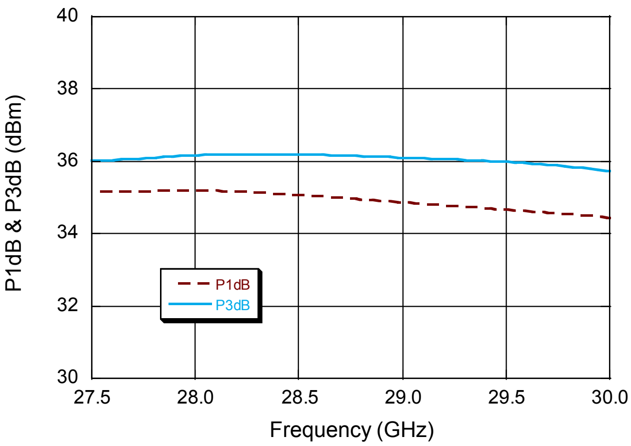


IM3 over Bias Voltage (P_{OUT} = 30 dBm / Tone)

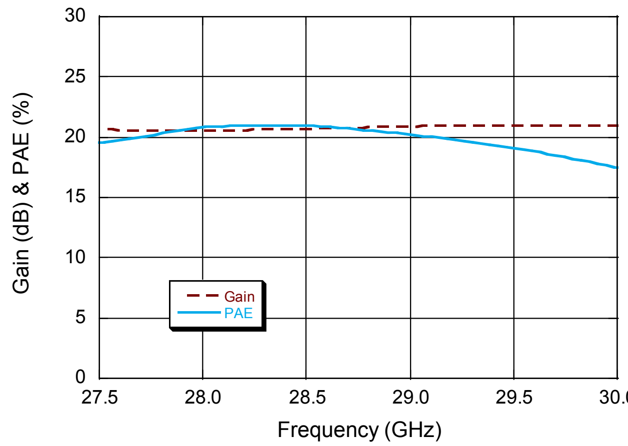


Typical Performance Curves: V_D = 6 V, I_{DSQ} = 2300 mA

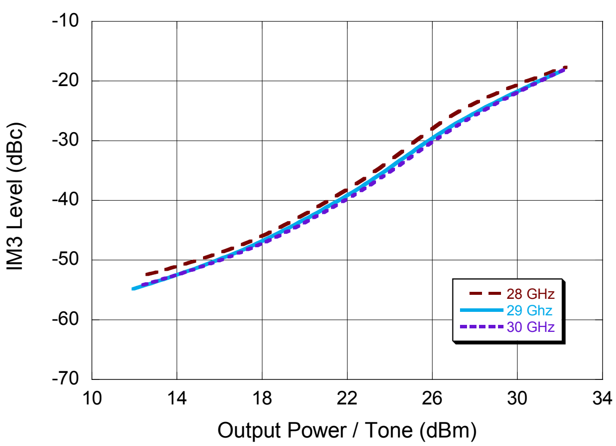
P1dB, P3dB vs. Frequency



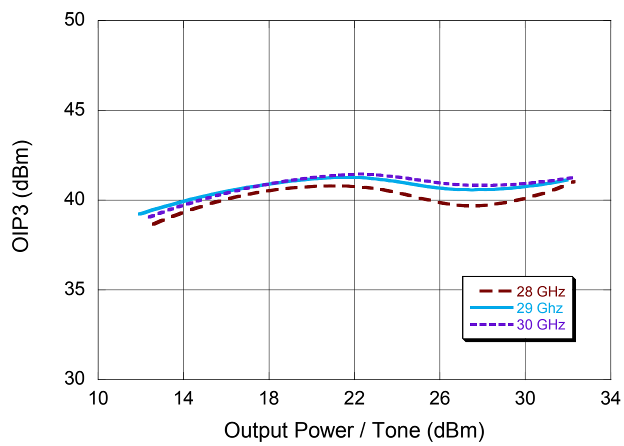
Gain and PAE @ P3dB vs. Frequency



IM3 vs. Output Power

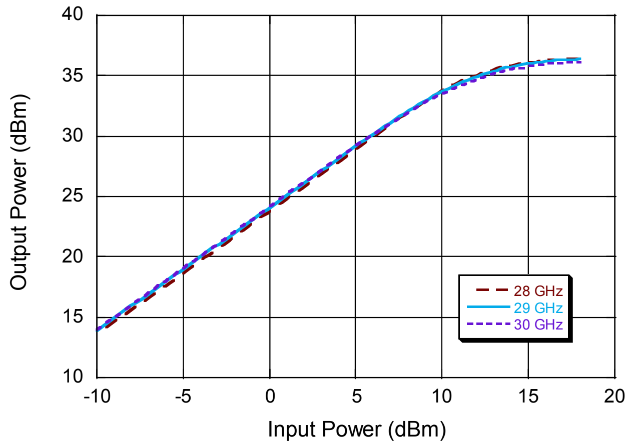


Output IP3 vs. Output Power

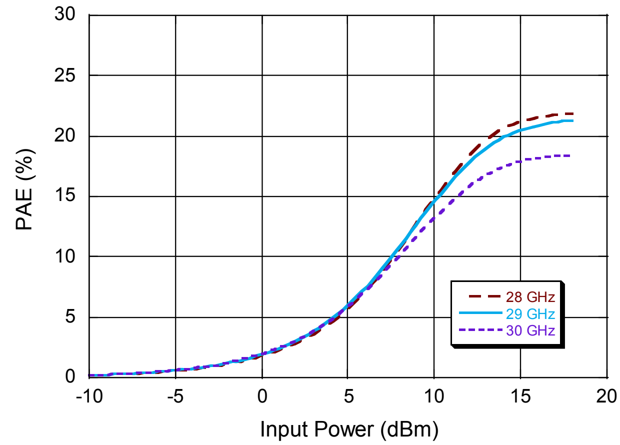


Typical Performance Curves: V_D = 6 V, I_{DSQ} = 2300 mA

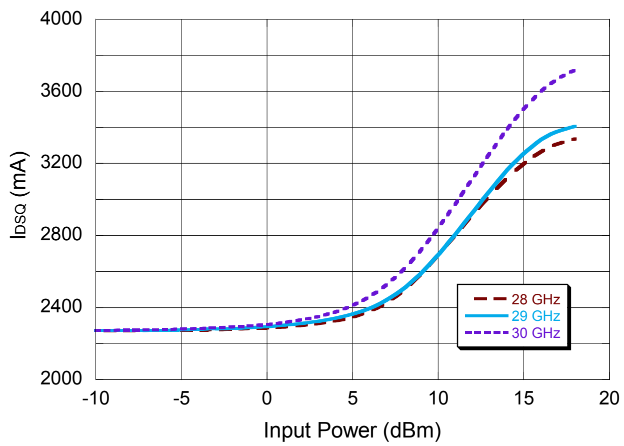
Output Power vs. Input Power



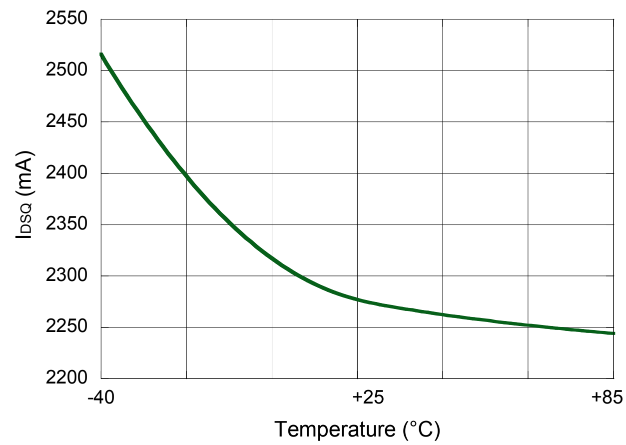
PAE vs. Input Power



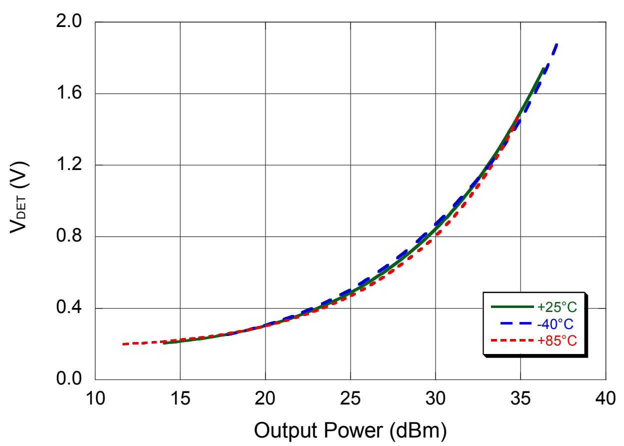
Bias Current vs. Input Power



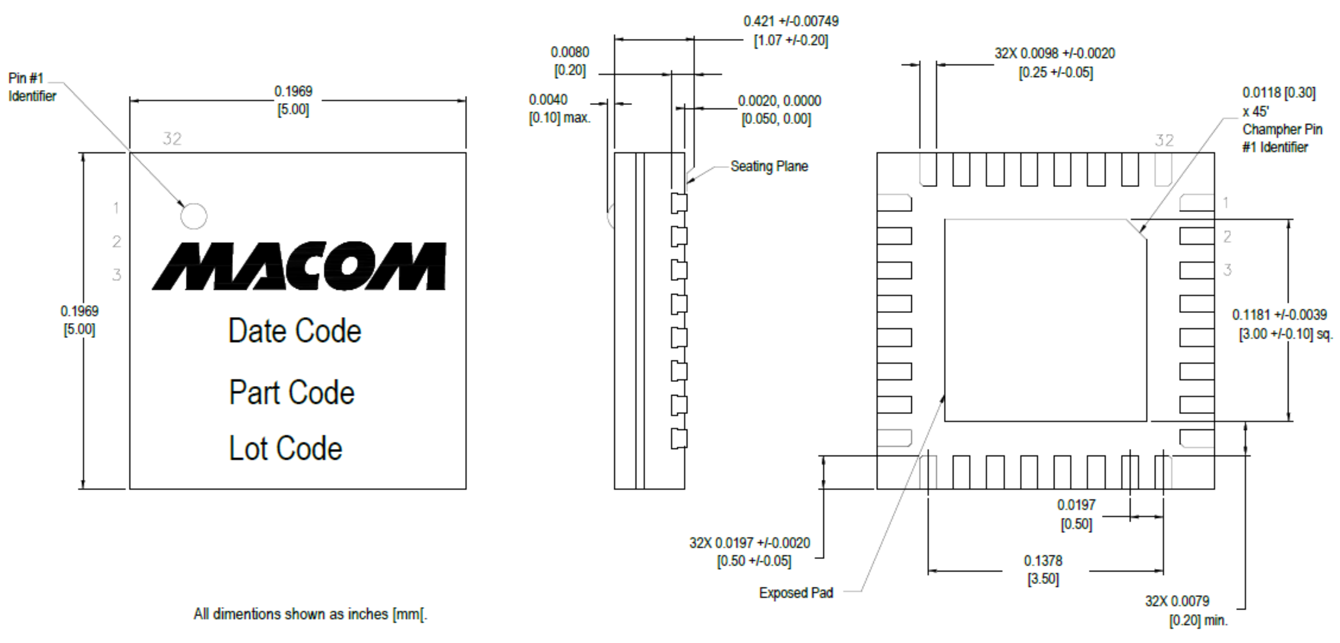
Quiescent Drain Current vs. Temperature



Detector Voltage vs. Output Power @ 29 GHz



Lead-Free 5 mm 32-Lead AQFN Package†



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