# 0.5 W Ka-Band Power Amplifier
# 27 - 31.5 GHz

**MAAP-011341**
**Rev. V2**

## Features

- 28 dB Gain
- 36 dBm Output IP3
- 27 dBm P1dB
- 28 dBm P3dB
- 5.5 V Drain Supply
- 4 mm, 24 lead AQFN Package
- RoHS* Compliant

## Applications

- Satellite Communications

## Description

The MAAP-011341 is a 1/2 W Ka-band power amplifier. The PA has a 27 dBm typical P1dB and a 28 dBm typical P3dB with 28 dB of gain. The drain bias supply is 5.5 V. The gate voltage is adjusted to set the drain current to 450 mA.

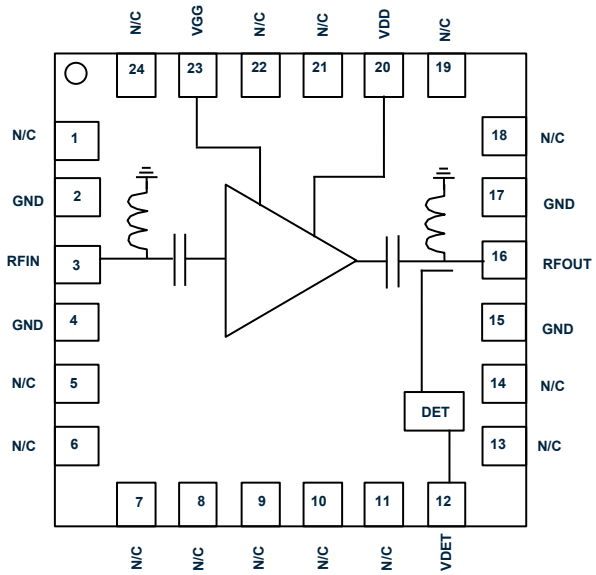
The MAAP-011341 is designed for medium power applications in the 27 - 31.5 GHz band. The 4 mm, 24 lead AQFN package is lead free and RoHS compliant.

It is also available as a bare DIE product under part number MAAP-011341-DIE.

## Ordering Information

| Part Number | Package |
|---|---|
| MAAP-011341-TR1000 | 1000 Piece Reel |
| MAAP-011341-TR3000 | 3000 Piece Reel |
| MAAP-011341-SMB | Sample Board |

## Block Diagram




## Pin Configuration[1,2]

| Pin # | Pin Name | Description |
|---|---|---|
| 1,5-11, 13, 14, 18, 19, 21, 22, 24 | N/C | No Connect |
| 2,4,15,17 | GND | Ground |
| 3 | $RF_{IN}$ | RF Input |
| 12 | $V_{DET}$ | Detector Voltage |
| 16 | $RF_{OUT}$ | RF Output |
| 20 | $V_{DD}$ | Drain Voltage |
| 23 | $V_{GG}$ | Gate Voltage |

1. It is recommended that all NC (No Connect) pins be grounded.
2. 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: $V_{DD}$ = +5.5 V, IDQ = 450 mA, $T_A$ = 25°C, $Z_0$ = 50 Ω

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| Gain | 27 - 31.5 GHz | dB | 24.5 | 28 | — |
| Gain Flatness | 27 - 31.5 GHz | dB | — | 0.5 | — |
| Input Return Loss | 27 - 31.5 GHz | dB | — | 10 | — |
| Output Return Loss | 27 - 31.5 GHz | dB | — | 10 | — |
| P1dB | 27 - 31.5 GHz | dBm | — | 27 | — |
| P3dB | 27 - 31.5 GHz | dBm | — | 28 | — |
| $P_{OUT}$ | 27 GHz, $P_{IN}$ = 4.0 dBm<br>31.5 GHz, $P_{IN}$ = 3.5 dBm | dBm | 26.5<br>26.0 | 28.0<br>27.5 | — |
| IP3 | 27 - 31.5 GHz, $P_{OUT}$ = 16 dBm/tone 10 MHz | dBm | — | 36 | — |
| Noise Figure | 27 - 31.5 GHz | dB | — | 5 | — |
| $V_{DET}$ | 3 dBm Output Power<br>27 dBm Output Power | V | — | 0.1<br>1.5 | — |

## Maximum Operating Conditions

| Parameter | Maximum |
|---|---|
| Input Power | 8 dBm |
| $V_{DD}$ | +6 V |
| $V_{GG}$ | -3 to 0 V |
| Junction Temperature[3,4] | +160°C |
| Operating Temperature | -40°C to +85°C |

3. Operating at nominal conditions with $T_J \leq$ +160°C will ensure MTTF > 1 x $10^6$ hours.
4. TX Junction Temp. ($T_J$) = $T_C$ + Θjc * ((V * I) - ($P_{OUT}$ - $P_{IN}$)).
   Typical TX thermal resistance (Θjc) = 29.3°C/W.
   a) For $T_C$ = +85°C and 31 GHz,
   $T_J$ = 148°C @ 5.5 V, 460 mA, $P_{OUT}$ = 26 dBm, $P_{IN}$ = 4.5 dBm
   b) For $T_C$ = +25°C and 31 GHz,
   $T_J$ = 83°C @ 5.5 V, 460 mA, $P_{OUT}$ = 27.5 dBm, $P_{IN}$ = 3.5 dBm

## Bias Sequence

All gate voltages must be applied prior to applying drain voltages.

1. Apply $V_{GG}$ (about -1.5 V) to pin 23.
2. Apply $V_{DD}$ (+5.5 V) to pin 20.
3. Adjust $V_{GG}$ to set $I_{DQ}$ to 450 mA.

Shut down by setting $V_{DD}$ = 0 V first.

## Absolute Maximum Ratings[5,6]

| Parameter | Absolute Maximum |
|---|---|
| Input Power | 10 dBm |
| $V_{DD}$ | +6.5 V |
| $V_{GG}$ | -5 to 0 V |
| Junction Temperature[7] | +180°C |
| Storage Temperature | -55°C to +150°C |

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

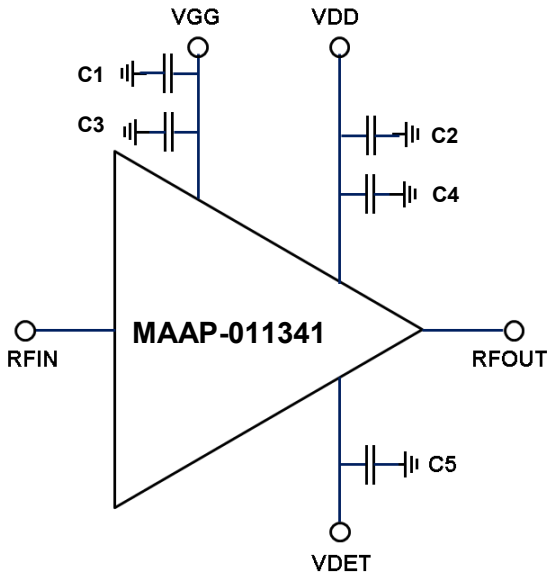
## Handling Procedures

Please observe the following precautions to avoid damage:

## Static Sensitivity

These 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.

## Application Schematic



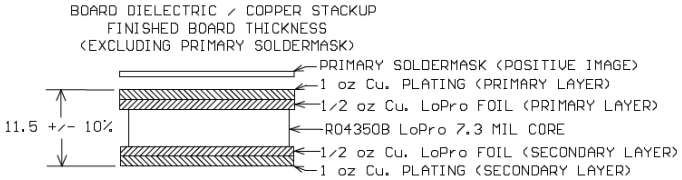

## Parts List

| Part # | Value | Case Style |
|---|---|---|
| C1, C2 | 10 µF | 1210 |
| C3, C4 | 1000 pF | 0402 |
| C5 | 1 µF | 0402 |
| J1, J2 | 100-mil pitch double row DC header | |
| J3 - J6 | Southwest 2.4 mm, 5 mil pin diameter | |

## Recommended PCB Information

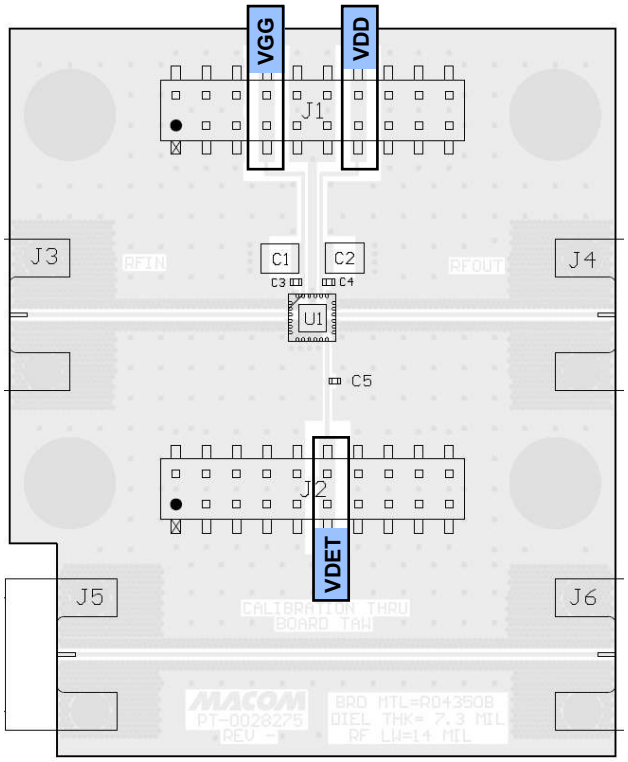
RF input and output are 50 Ω transmission lines on single layer 7.3 mil Rogers RO4350B LoPro with 1.5 oz. Cu. For best thermal management, use as many copper filled vias under the device as physically possible. The filled vias should be plated over. 8 mil diameter vias in a 5 x 5 array are used on this sample board.

## PCB Layout Stack-Up

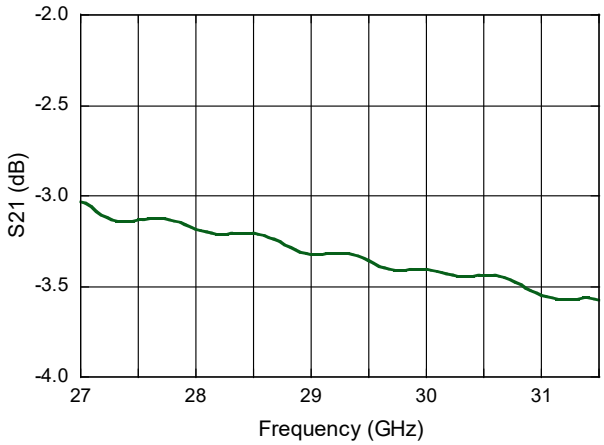



Finished board thickness is in mils

## Sample Board Layout

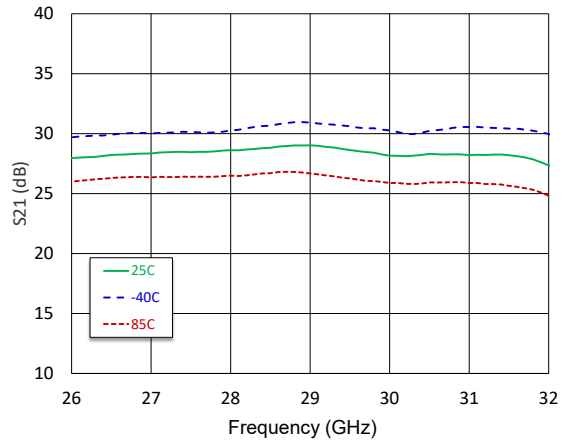



***Sample Board Thru Line Loss***

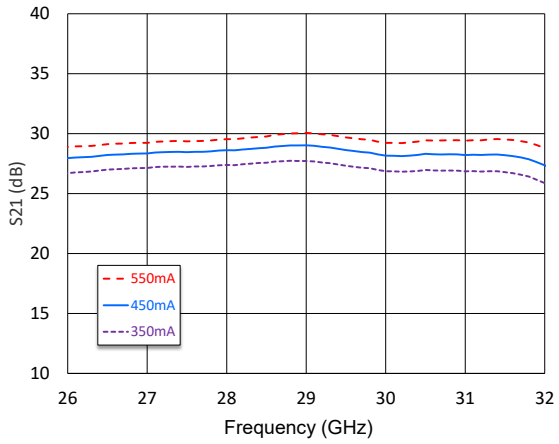


## Typical Performance Curves: $V_{DD}$ = 5.5 V, $I_{DQ}$ = 450 mA

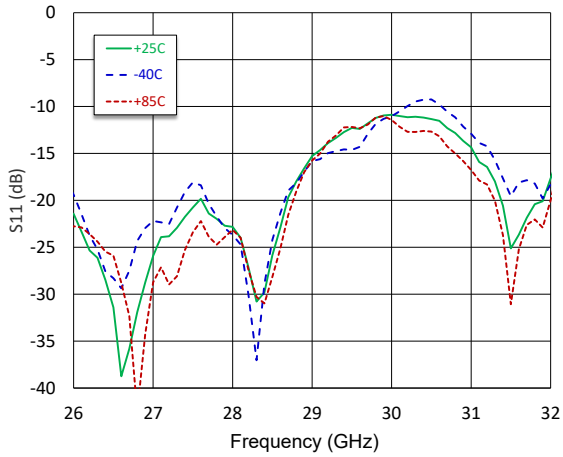
***Small Signal Gain vs. Frequency over Temperature***



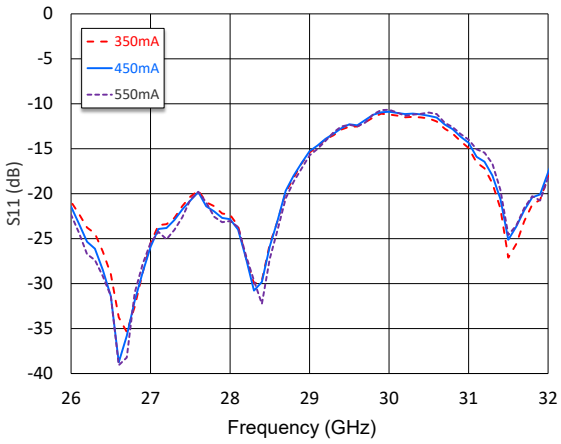

***Small Signal Gain vs. Frequency over Bias Current***



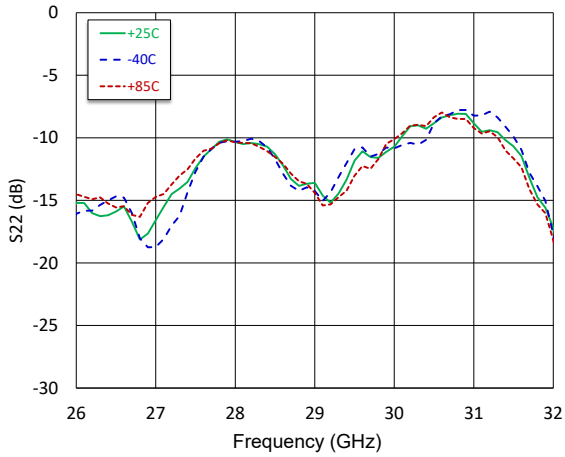

***Input Return Loss vs. Frequency over Temperature***



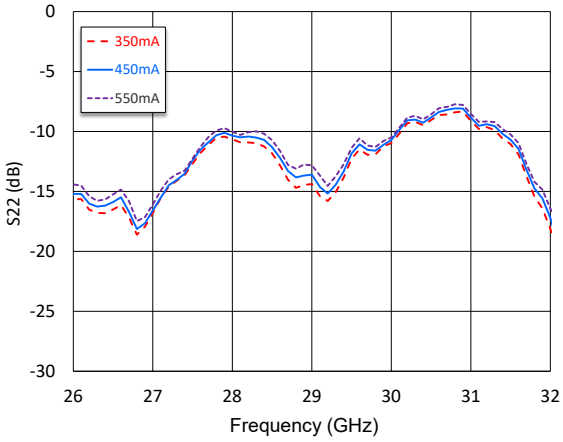

***Input Return Loss vs. Frequency over Bias Current***




***Output Return Loss vs. Frequency over Temperature***

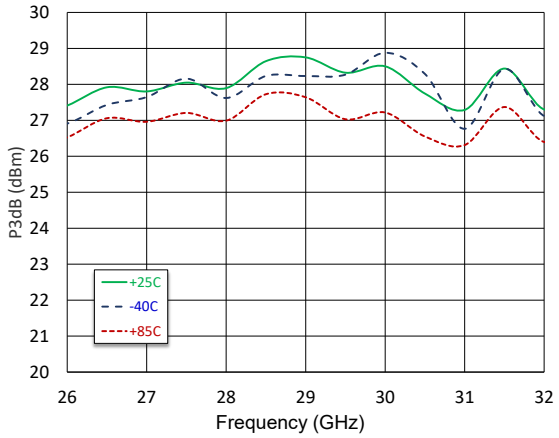



***Output Return Loss vs. Frequency over Bias Current***

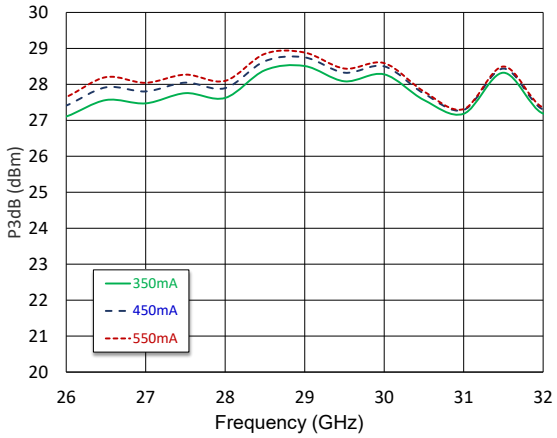


## Typical Performance Curves: $V_{DD}$ = 5.5 V, $I_{DQ}$ = 450 mA

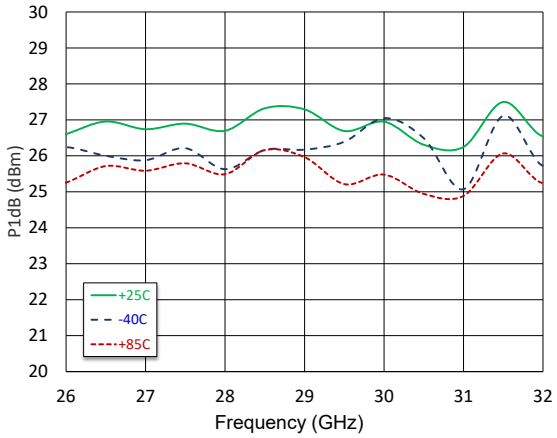
***P3dB vs. Frequency over Temperature***



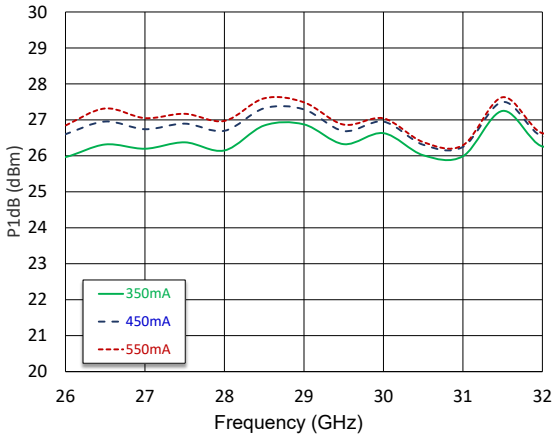

***P3dB vs. Frequency over Bias Current***




***P1dB vs. Frequency over Temperature***

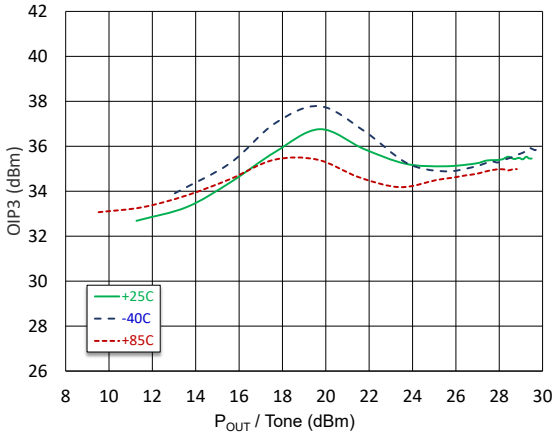



***P1dB vs. Frequency over Bias Current***

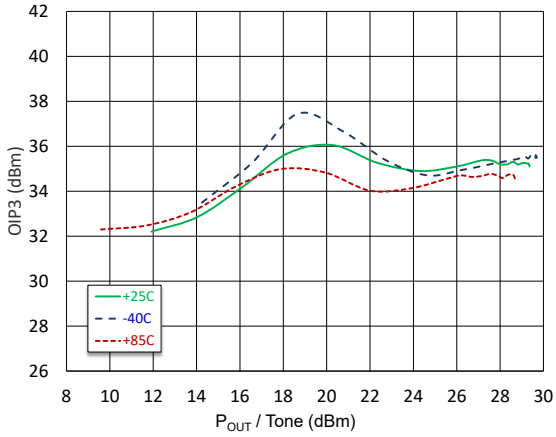


## Typical Performance Curves: $V_{DD}$ = 5.5 V, $I_{DQ}$ = 450 mA

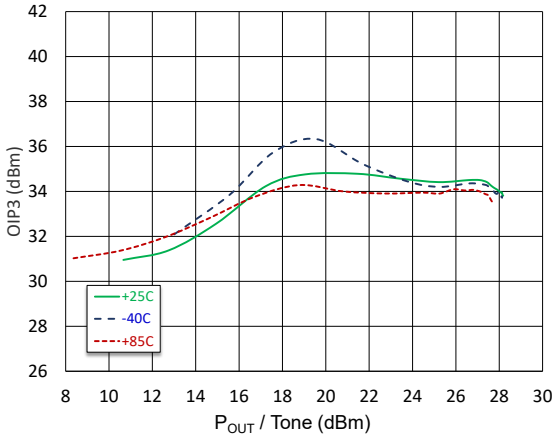
***Output IP3 vs. Frequency over Temperature @ 27 GHz***



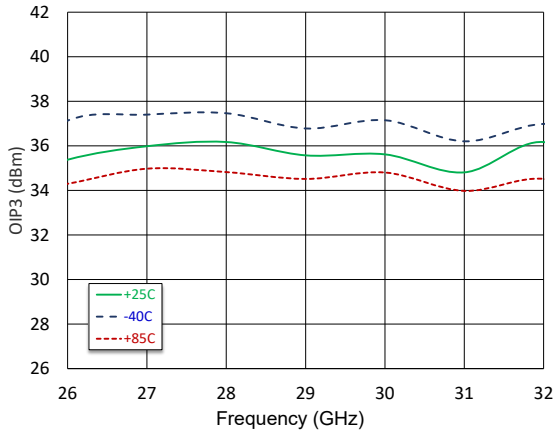

***Output IP3 vs. Frequency over Temperature @ 29 GHz***




***Output IP3 vs. Frequency over Temperature @ 31 GHz***

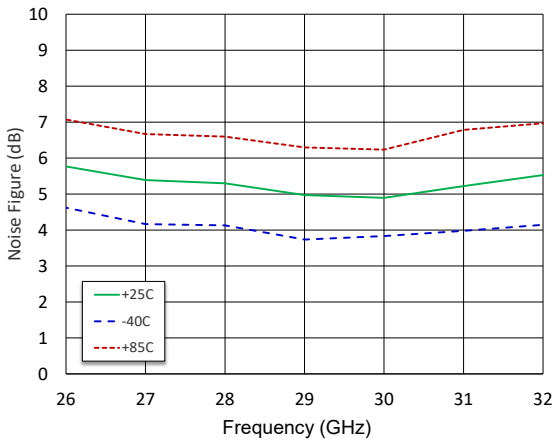



***Output IP3 vs. Frequency over Temperature @ 19 dBm/TONE***

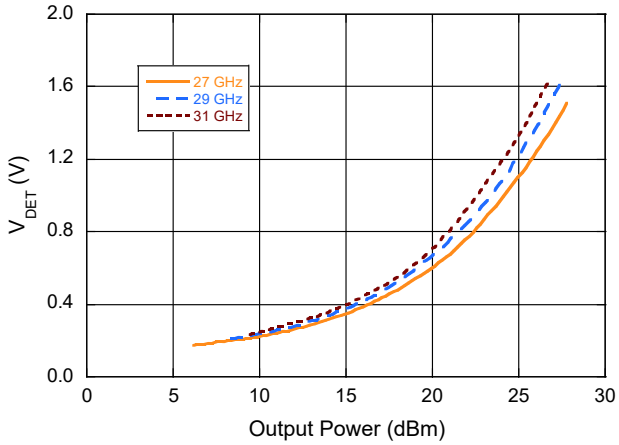


## Typical Performance Curves: $V_{DD}$ = 5.5 V, $I_{DQ}$ = 450 mA

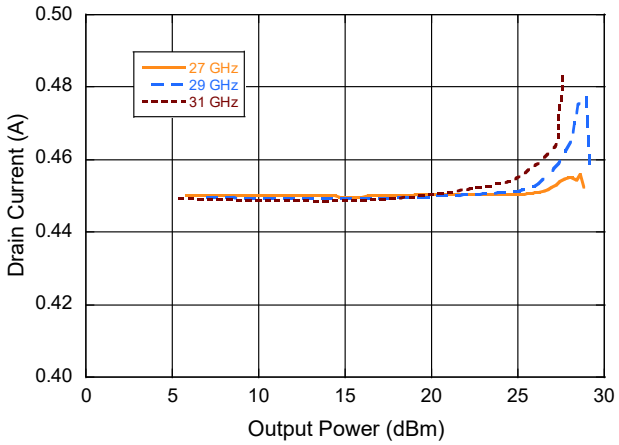
### *Noise Figure vs. Frequency over Temperature*



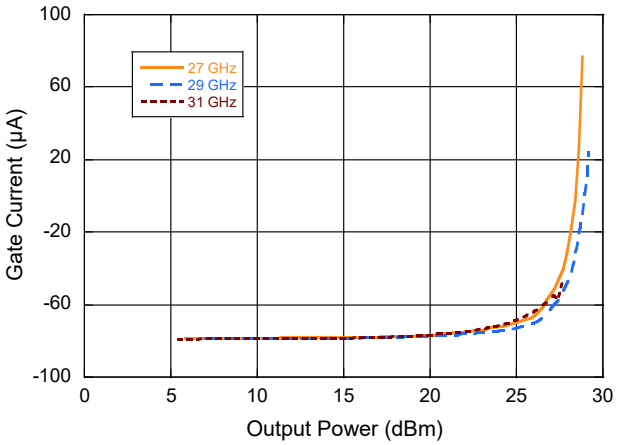

### *Detector Voltage vs. Output Power*



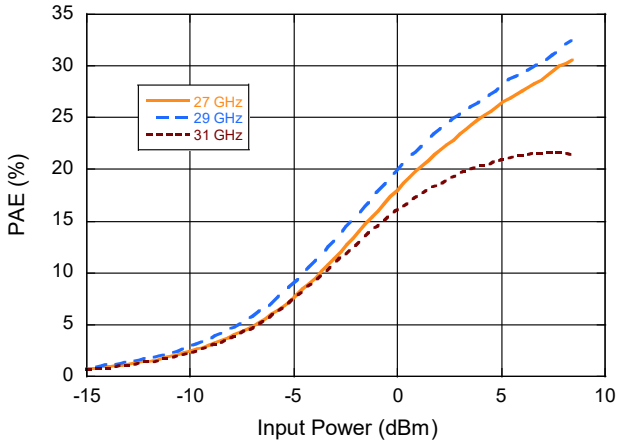

### *Drain Current vs Output Power*



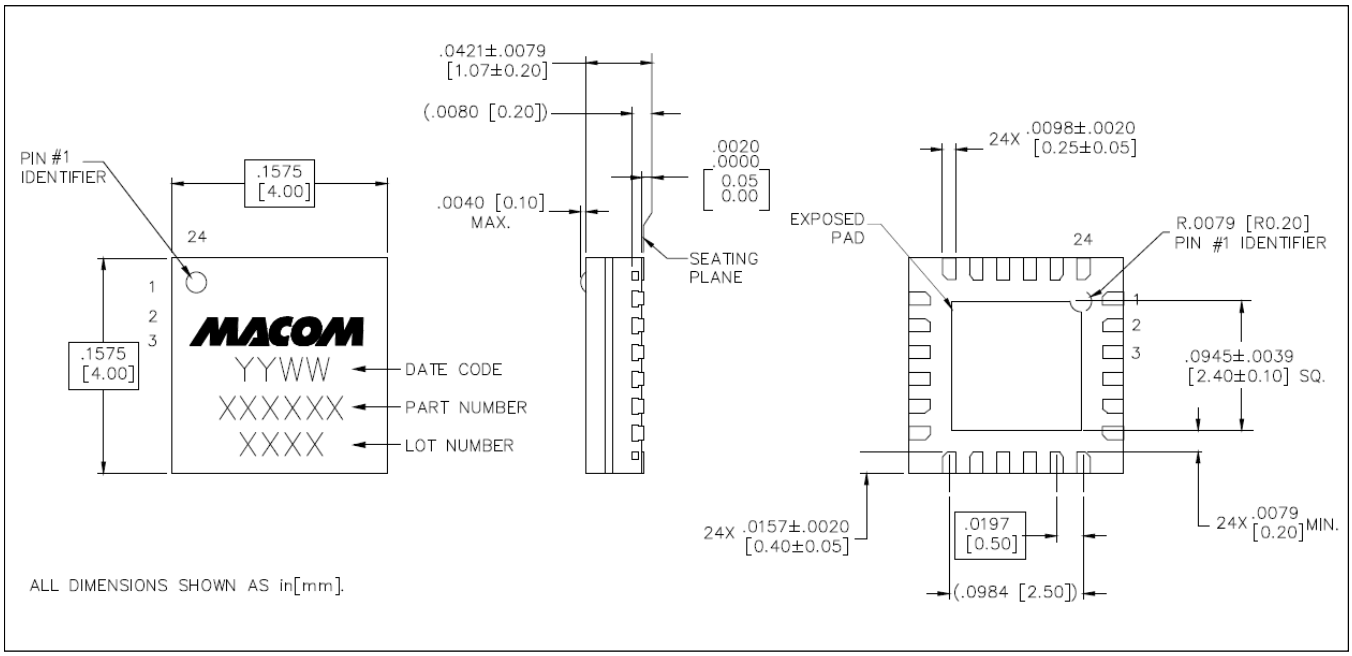

### *Gate Current vs Output Power*




### *PAE vs Input Power*



## Lead-Free 4 mm 24-Lead AQFN Package†




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