

Power Amplifier, 3 W 12.7 - 13.3 GHz

Rev. V2

Features

- 23 dB Small Signal Gain
- 42 dBm Third Order Intercept Point (OIP3)
- >2.5 W Output P1dB
- Integrated Power Detector
- Bias 1200 mA @ 6 V
- Lead-Free 5 mm 24-lead QFN Package
- RoHS* Compliant and 260°C Reflow Compatible

Description

The MAAP-010516 is a packaged linear power amplifier that operates from 12.7 - 13.3 GHz. The device provides 23 dB gain and 42 dBm Output Third Order Intercept Point (OIP3) with 34 dBm output P1dB.

The packaged amplifier comes in an industry standard, fully molded 5 mm QFN package and is comprised of a three stage power amplifier with an integrated, temperature compensated on-chip power detector. The device includes on-chip ESD protection structures and DC by-pass capacitors to ease the implementation and volume assembly of the packaged part.

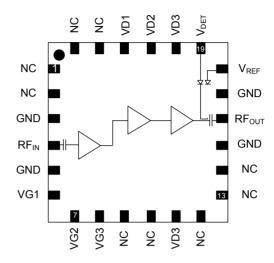
The device is specifically designed for use in 13 GHz point-to-point radios for cellular backhaul applications.

Ordering Information¹

| Part Number | Package |
|--------------------|-------------------|
| MAAP-010516-000000 | bulk quantity |
| MAAP-010516-TR0500 | 500 piece reel |
| MAAP-010516-001SMB | evaluation module |

^{1.} Reference Application Note M513 for reel size information.

Functional Schematic



Pin Configuration²

| Pin # | Function | Pin# | Function |
|-----------------|---------------|-----------------|---------------|
| 1,2 | No Connection | 15 | Ground |
| 3 | Ground | 16 | RF Output |
| 4 | RF Input | 17 | Ground |
| 5 | Ground | 18 | Pwr Det Ref |
| 6 | Gate 1 Bias | 19 | Pwr Det |
| 7 | Gate 2 Bias | 20 ² | Drain 3 Bias |
| 8 | Gate 3 Bias | 21 | Drain 2 Bias |
| 9,10 | No Connection | 22 | Drain 1 Bias |
| 11 ² | Drain 3 Bias | 23,24 | No Connection |
| 12,13,14 | No Connection | 25 ³ | Paddle |

- 2. Drain 3 Bias can be connected from either pins 11 or 20
- The exposed pad centered on the package bottom must be connected to RF and DC ground.

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^{*} Restrictions on Hazardous Substances, European Union Directive 2011/65/EU.



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Electrical Specifications⁴:

Freq. = 12.7 - 13.3 GHz, I_{DO}^{5} = 1200 mA, V_{DET} Bias = 5 V^{6} , V_{D} = 6 V, T_{A} = +25°C

| Parameter | Units | Min. | Тур. | Max. |
|------------------------|-------|------|------|------|
| Small Signal Gain | dB | 20.5 | 23.0 | _ |
| Input Return Loss | dB | _ | 15 | _ |
| Output Return Loss | dB | _ | 12 | _ |
| Noise Figure | dB | _ | 7 | _ |
| P1dB | dBm | _ | 34.0 | _ |
| P _{SAT} | dBm | 34.0 | 34.5 | _ |
| Output IP3, 20 dBm SCL | dBm | 39.5 | 42.0 | _ |

^{4.} It is recommended to use active bias on gate voltages to keep the drain currents constant in order to maintain the best performance over temperature.

Maximum Operating Ratings^{7,8,9}

| Parameter | Absolute Maximum |
|------------------------------------|------------------|
| Input Power | 18 dBm |
| Drain Supply Voltage | 7 V |
| Junction Temperature ¹⁰ | +160°C |
| Operating Temperature | -40°C to +85°C |
| Storage Temperature | -65°C to +150°C |

Exceeding any one or combination of these limits may cause permanent damage to this device.

10. Junction Temperature (T_J) = $T_C + \Theta_{JC} * ((V * I) - (P_{OUT} - P_{IN}))$ Typical thermal resistance (Θ_{JC}) = 7.9°C/W

a) For $T_C = +25^{\circ}C$,

 $T_J = 91^{\circ}C @ 6 V, 1.85 A, P_{OUT} = 34.5 dBm, P_{IN} = 14 dBm$

b) For $T_C = +85^{\circ}C$,

 T_J = 146°C @ 6 V, 1.75 A, P_{OUT} = 34.5 dBm, P_{IN} = 14 dBm

Absolute Maximum Ratings^{11,12}

| Parameter | Absolute Maximum |
|---|------------------|
| Supply Gate Voltage | -3 V |
| Supply Current | 2200 mA |
| Drain to Gate Voltage | 10 V |
| Continuous Power Dissipation @ +85°C | 11.3 W |
| Junction Temperature | +175°C |

Channel temperature directly affects a device's MTTF.
 Channel temperature should be kept as low as possible to maximize lifetime.

^{5.} Adjust V_G1,V_G2 and V_G3 between -1.2 and -0.1 V to achieve specified I_{DQ} ($I_{DQ}=I_D1+I_D2+I_D3$). V_G1,V_G2 and V_G3 should be the same voltage.

^{6.} See page 3 for schematic on how to connect V_{DET} and V_{REF} pins.

MACOM does not recommend sustained operation near these survivability limits.

^{9.} Operating at nominal conditions with $T_J \le 160^{\circ} C$ will ensure MTTF > 1 x 10^{6} hours.

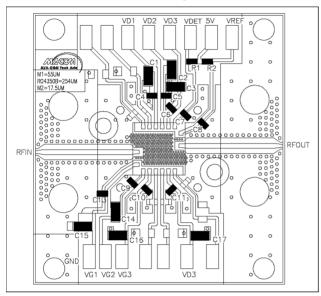
For saturated performance it is recommended that the sum of (2*V_{DD} + abs(V_{GG})) <17 V.



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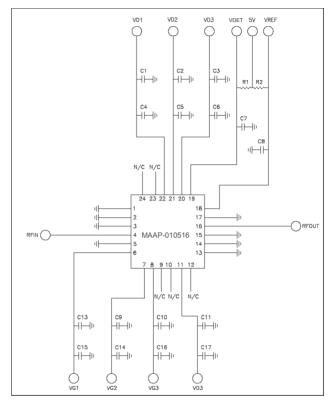
Recommended PCB Layout



Parts List

| Component | Value | Package |
|-----------------------------------|---------|---------|
| C1,C2,C3,C14, C15,C16,C17 | 2.2 µF | 0603 |
| C4,C5,C6,C7,C8, C9,C10,C11,C13 | 1000 pF | 0402 |
| R1 | 100 ΚΩ | 0402 |
| R2 | 91 ΚΩ | 0402 |

Schematic



Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

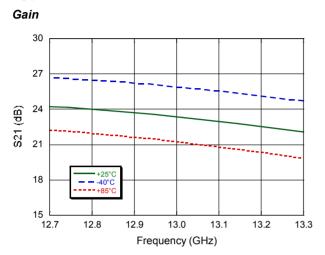
Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these Class 1A devices.



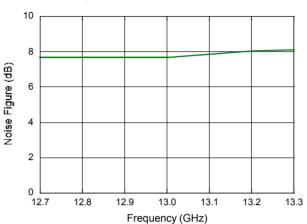
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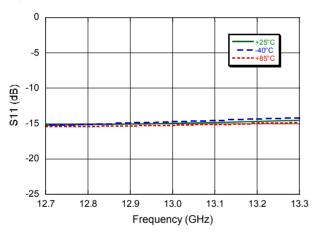
Typical Performance Curves



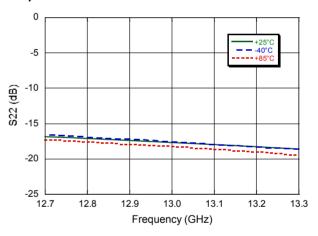
Noise Figure @ 25°C



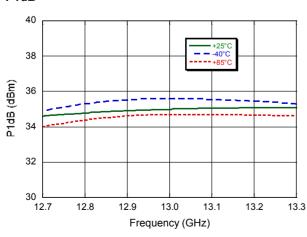
Input Return Loss



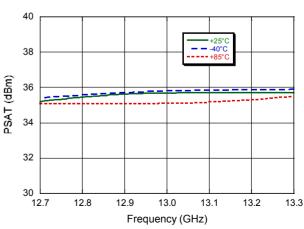
Output Return Loss



P1dB



PSAT



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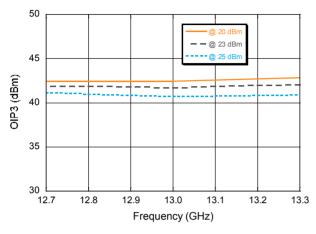


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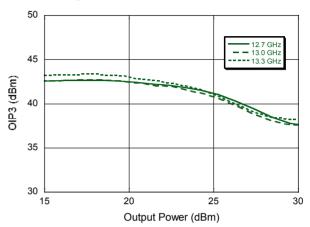
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Typical Performance Curves

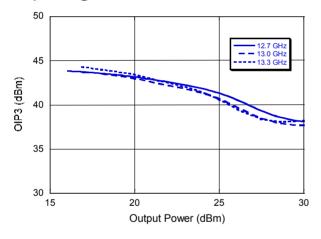
Output IP3 @ +25°C



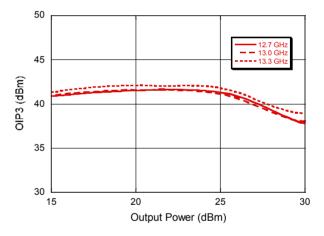
Output IP3 @ +25°C



Output IP3 @ -40°C



Output IP3 @ +85°C



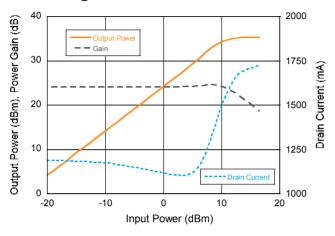


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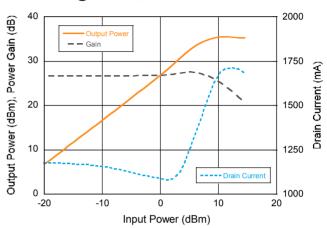
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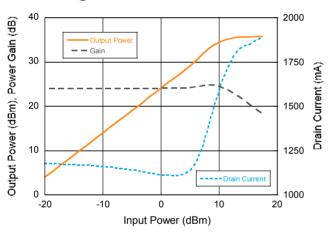
Power Data @ 12.7 GHz, +25°C



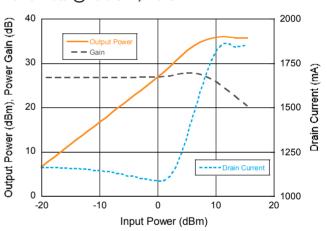
Power Data @ 12.7 GHz, -40°C



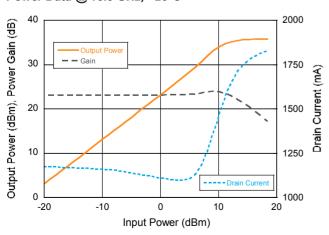
Power Data @ 13.0 GHz, +25°C



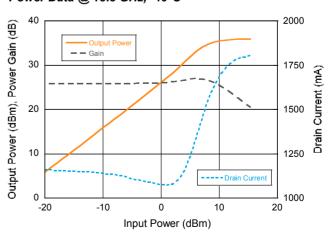
Power Data @ 13.0 GHz, -40°C



Power Data @ 13.3 GHz, +25°C



Power Data @ 13.3 GHz, -40°C



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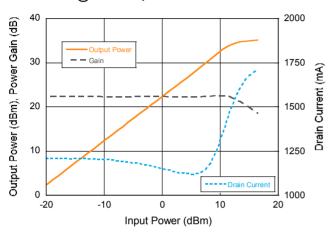


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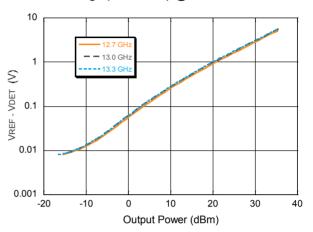
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Typical Performance Curves

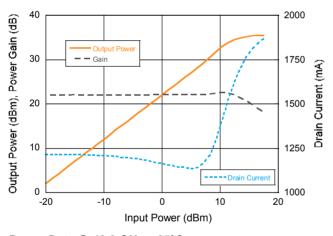
Power Data @ 12.7 GHz, +85°C



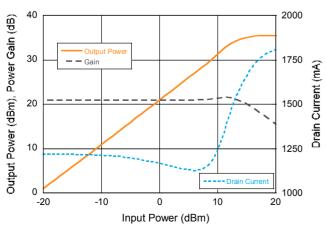
Detected Voltage (V_{REF} - V_{DET}) @ +25°C



Power Data @ 13.0 GHz, +85°C



Power Data @ 13.3 GHz, +85°C



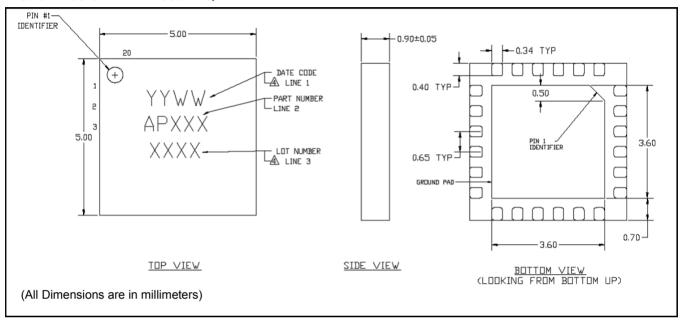
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Lead-Free 5mm 24-lead PQFN



[†] Reference Application Note S2083 for lead-free solder reflow recommendations. Meets JEDEC moisture sensitivity level 1 requirements. Plating is matte tin over Copper.



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