

Wideband Distributed Amplifier

30 kHz - 44 GHz



MAAM-011286-DIE

Rev. V4

Features

- Wide Frequency Range: 30 kHz - 44 GHz
- 16 dB Gain
- 3 - 8 V DC, 200 mA
- 22 dBm P1dB @ 22 GHz
- Integrated Power Detector with a Detector Reference Voltage Generator
- 50 Ω Input and Output Match
- RoHS* Compliant
- Die Size: 2.3 x 1.0 x 0.1 mm

Applications

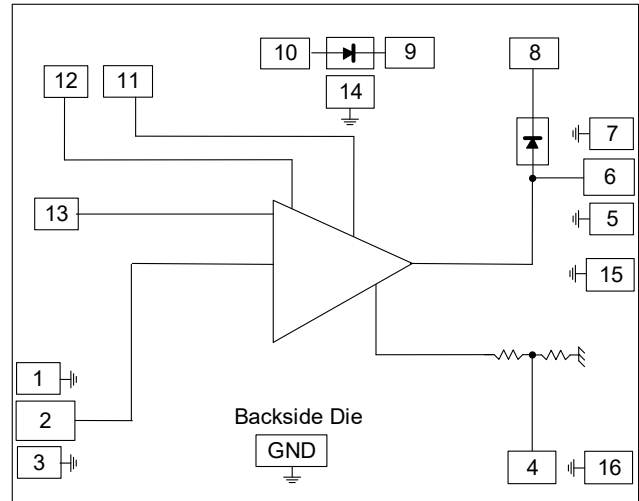
- Instrumentation and Communication Systems

Description

MAAM-011286-DIE is an easy-to-use, wideband amplifier that operates from 30 kHz to 44 GHz. The amplifier provides 16 dB gain, 22 dBm output power and 5.3 dB noise figure. It is matched to 50 Ω with typical return loss better than 13 dB.

MAAM-011286-DIE is suitable for a wide range of applications in instrumentation and communication systems.

Functional Schematic¹



1. Image not to scale.

Pad Configuration²

| Pad # | Pad Name | Description |
|------------------|------------------------------------|-------------------------|
| 1,3,5,7,14,15,16 | GND | Ground |
| 2 | RF _{IN} | RF Input |
| 4 | V _{G1} | Gate Voltage 1 |
| 6 | RF _{OUT} /V _{DD} | RF Output |
| 8 | DET _{OUT} | Output Detector |
| 9 | DET _{REF} | Reference Detector |
| 10 | DET _{BIAS} | Detector Bias |
| 11 | V _{DD} | Drain Voltage |
| 12 | V _{DAUX} | Auxiliary Drain Voltage |
| 13 | V _{G2} | Gate Voltage 2 |

2. Backside of die must be connected to RF, DC and thermal ground.

Ordering Information

| Part Number | Package |
|-----------------|----------|
| MAAM-011286-DIE | Gel Pack |

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

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Electrical Specifications: $T_C = 25\text{ }^\circ\text{C}$, $V_{DD} = 7\text{ V}$, $Z_0 = 50\text{ }\Omega$

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|----------------------------|--|-------|------|------------|------|
| Gain | 1 - 44 GHz | dB | 15 | 16 | — |
| Gain Flatness | 1 - 44 GHz | dB | — | ± 1.0 | — |
| Input Return Loss | 1 - 44 GHz | dB | — | 15 | — |
| Output Return Loss | 1 - 44 GHz | dB | — | 13 | — |
| P1dB | 22 GHz | dBm | 20 | 22 | — |
| P3dB | 22 GHz | dBm | 23 | 24 | — |
| Output IP3 | $P_{IN} = +2\text{ dBm / tone}$, 22 GHz tone spacing = 2 MHz | dBm | — | 30 | — |
| Noise Figure | 26 GHz 40 GHz | dB | — | 5.3 6.8 | — |
| Drain Current ³ | Quiescent bias | mA | — | 200 | — |

3. Set by adjusting V_{G1} as outlined in operating conditions on page 3.

Absolute Maximum Ratings^{4,5}

| Parameter | Absolute Maximum |
|-------------------------------------|--|
| Input Power | 17 dBm |
| Drain Supply Voltage | 10 V |
| V_{G1} | $-4\text{ V} < V_{G1} < 0\text{ V}$ |
| V_{G2} | $-3.5\text{ V} < V_{G2} < +4\text{ V}$ |
| Drain Supply Current | 340 mA |
| Junction Temperature ^{6,7} | +150°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.
- MACOM does not recommend sustained operation near these survivability limits.
- Operating at nominal conditions with $T_J \leq +150\text{ }^\circ\text{C}$ will ensure $MTTF > 1 \times 10^6$ hours.
- Junction Temperature (T_J) = $T_A + \theta_{JC} * ((V * I) - (P_{OUT} - P_{IN}))$
Typical thermal resistance (θ_{JC}) = 14.2°C/W.

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.

Operating Conditions

The recommended biasing conditions are $V_{DD} = 7\text{ V}$ and $I_{DSQ} = 200\text{ mA}$, with I_{DSQ} set by adjusting V_{G1} after correctly setting V_{DD} (refer to turn on sequence). To maintain the best performance MACOM recommends using an active bias circuit for constant I_{DD} .

It is noted that any biasing arrangement used, including active biasing, must be able to source at least 10 mA into the V_{G1} port. This is because the V_{G1} port contains a resistive divider with a total resistance to ground of 244 Ω . For the recommended I_{DSQ} of 200 mA obtained at a V_{G1} voltage of around 2.5 V, 10 mA of V_{G1} current (I_{G1}) is expected. These values of V_{G1} and I_{G1} will vary slightly between devices.

There are two possible methods for biasing V_{DD} :

1. Apply V_{DD} through a bias tee connected to the RF_{OUT}/V_{DD} port and connect an external DC block to the RF_{IN} port. This provides wide band performance of 40 MHz to 50 GHz (depending on the bandwidth of the bias tee).
2. Apply V_{DD} through a wideband conical inductor connected to the V_{DD} port. No external bias tee is required at the RF_{OUT}/V_{DD} port; however, external DC blocks are required at both the RF_{IN} and RF_{OUT} ports. Using this method provides for an operational frequency of 40 MHz to 50 GHz.

V_{G2} can be used for gain control in all bias configurations. If gain control is not required, V_{G2} should be left open-circuited.

Regardless of bias method used, 2 bypass capacitors of 100 pF and 1 μF should be connected to V_{DAUX} . This provides for improved gain flatness below 2 GHz down to 30 kHz when required.

The 100 pF capacitor can be a single layer capacitor or an SMT device on the PCB. Although it should be positioned as closely to the device as practically possible, the frequency response is not particularly sensitive to this. The 1 μF capacitor can be placed further away on the PCB.

Data in this datasheet was measured using bias option 1 and 100 pF (C1) and 1 μF (C3) capacitors on V_{DAUX} .

Operating the MAAM-011286-DIE

Turn-on

1. Apply V_{G1} (-4 V).
2. Increase V_{DD} to +7 V.
3. Set I_{DSQ} by adjusting V_{G1} more positive. (typically -2.5 V for $I_{DSQ} = 200\text{ mA}$).
4. Apply RF_{IN} signal.

Turn-off

1. Remove RF_{IN} signal.
2. Decrease V_{G1} to -4 V.
3. Decrease V_{DD} to 0 V.

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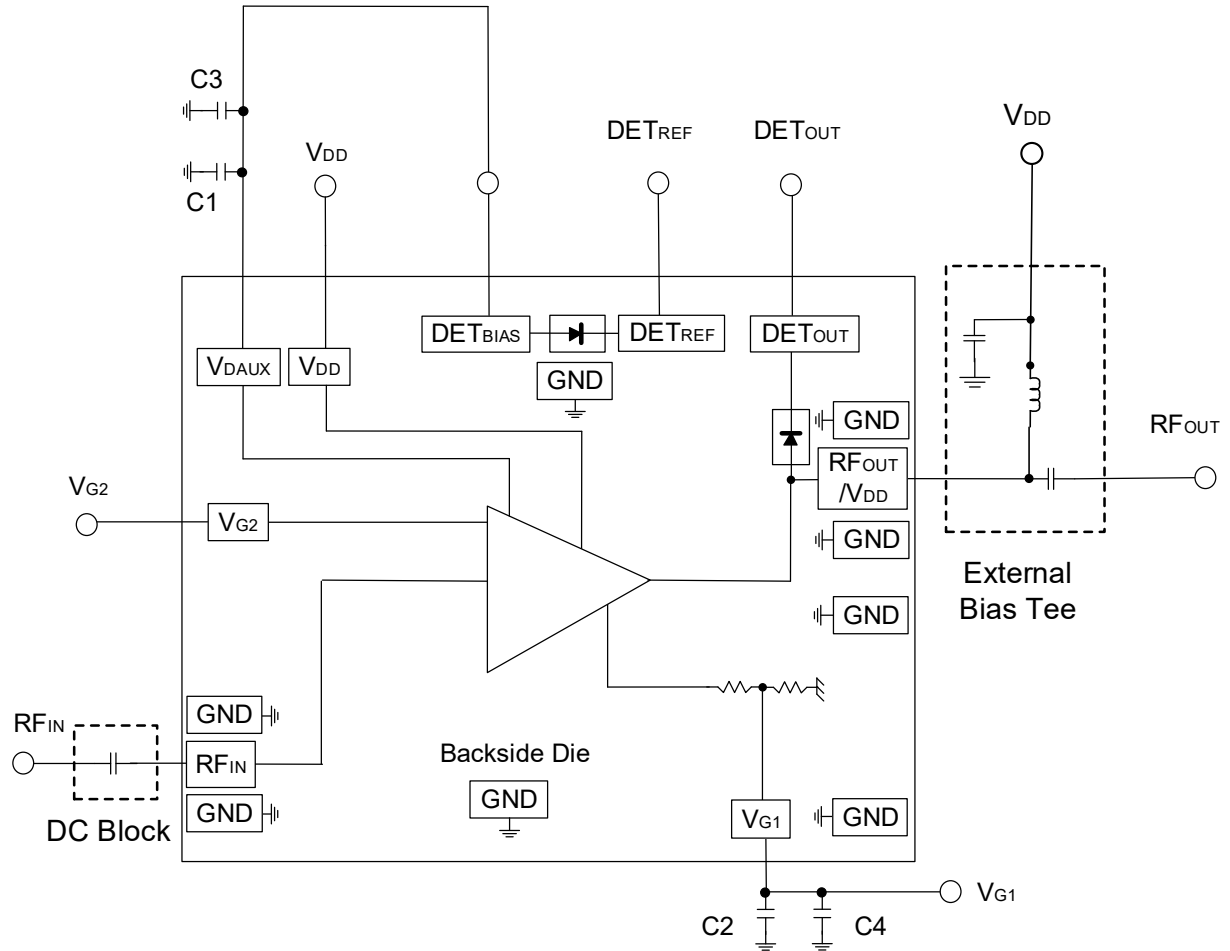
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Application Schematic



All bond pads labelled GND have vias to the backside metal. Bond wires on these pads are optional.

Component List

| Part | Value | Size |
|--------|-----------|--------------|
| C1 | 100 pF | Single Layer |
| C2 | 1000 pF | 0402 |
| C3, C4 | 1 μ F | 0402 |

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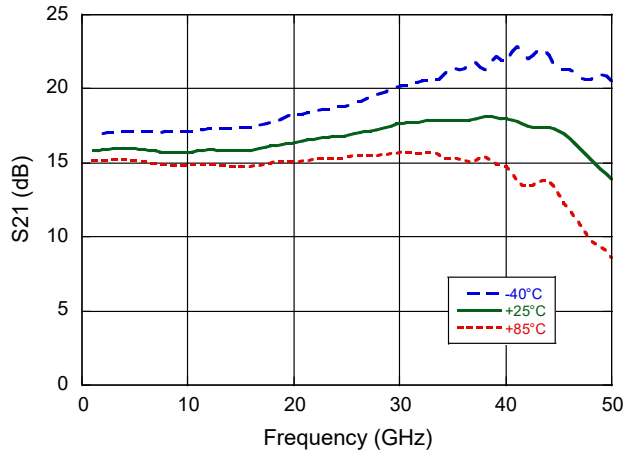


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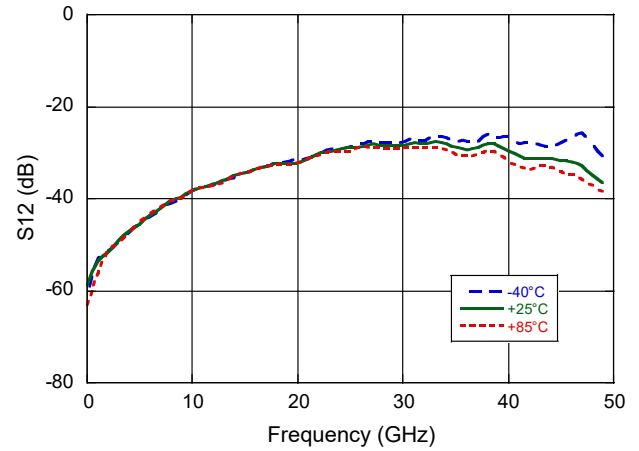
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Typical Performance Curves: $V_{DD} = 7\text{ V}$, $I_{DSQ} = 200\text{ mA}$

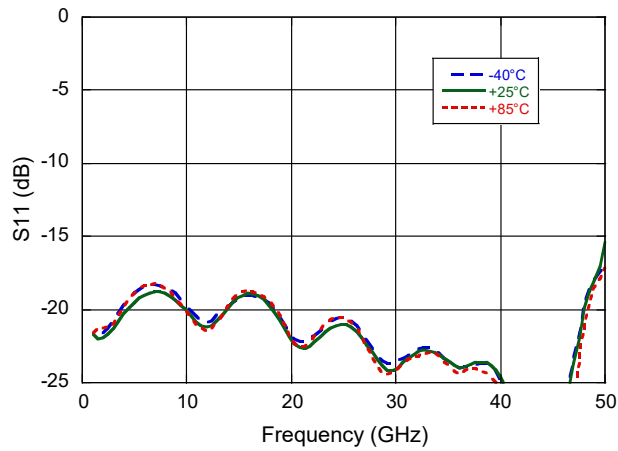
Gain



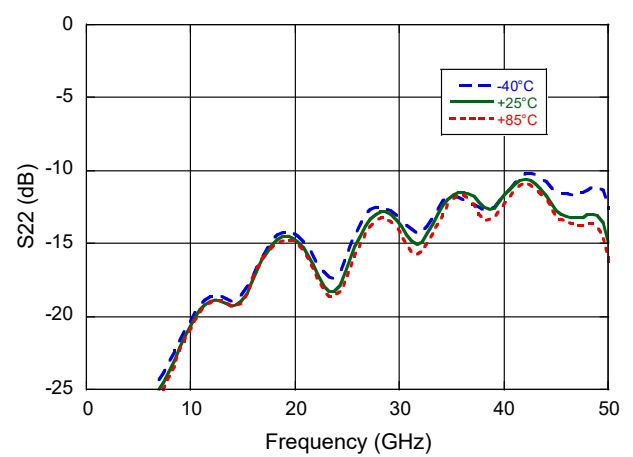
Reverse Isolation



Input Return Loss



Output Return Loss



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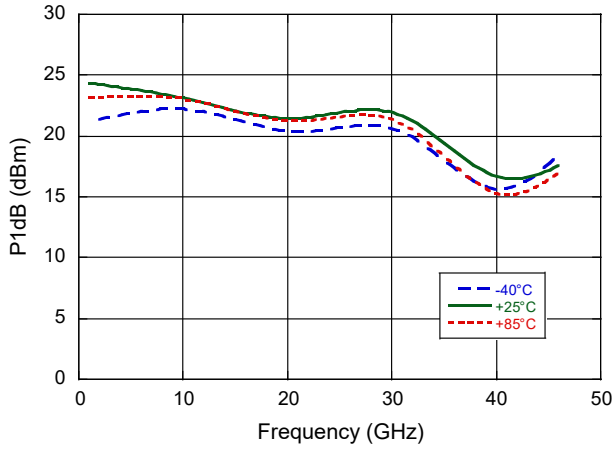


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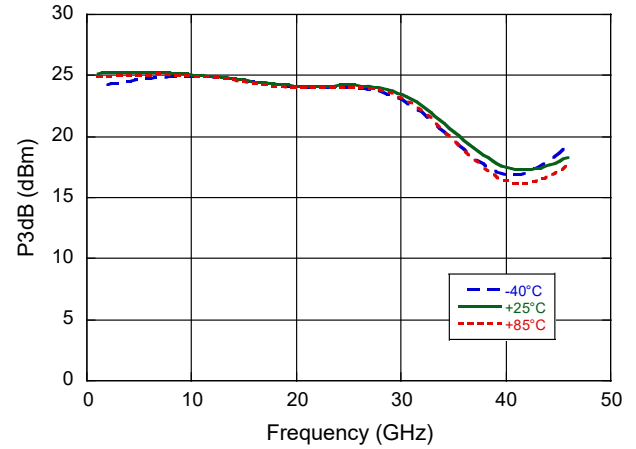
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Typical Performance Curves: $V_{DD} = 7\text{ V}$, $I_{DSQ} = 200\text{ mA}$

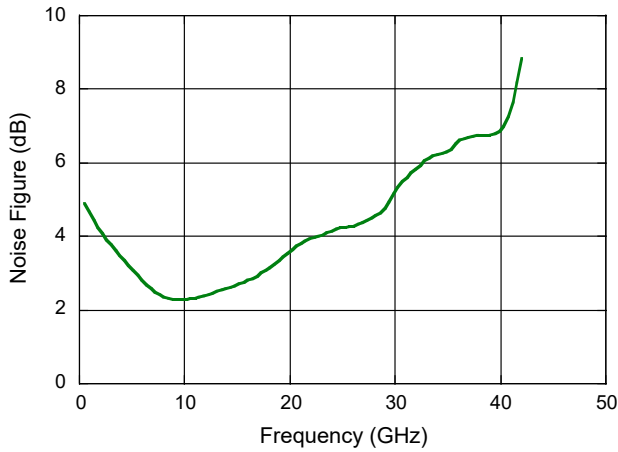
Output P1dB



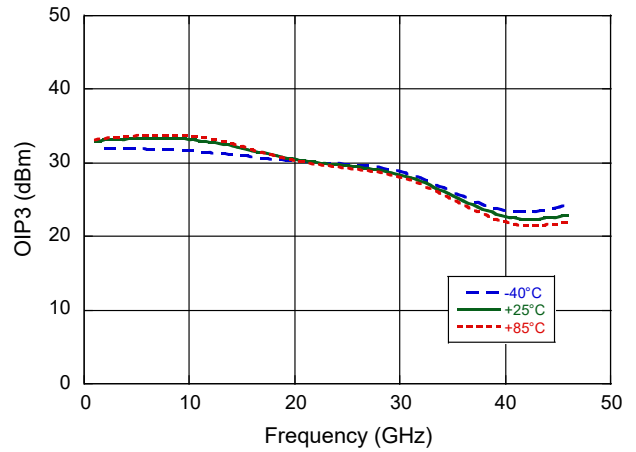
Output P3dB



Noise Figure @ +25°C



OIP3, +2 dBm / tone, tone spacing = 2 MHz



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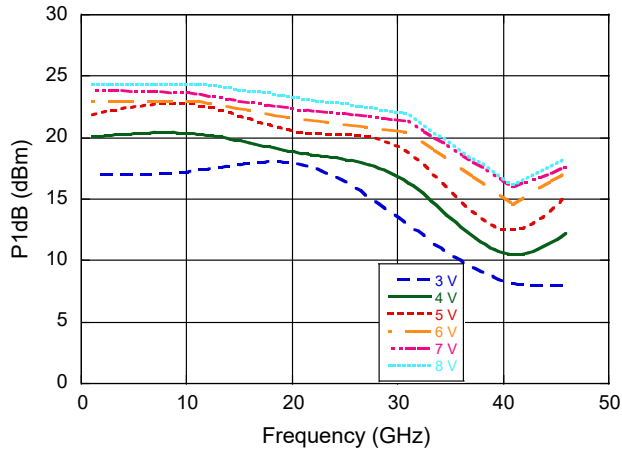


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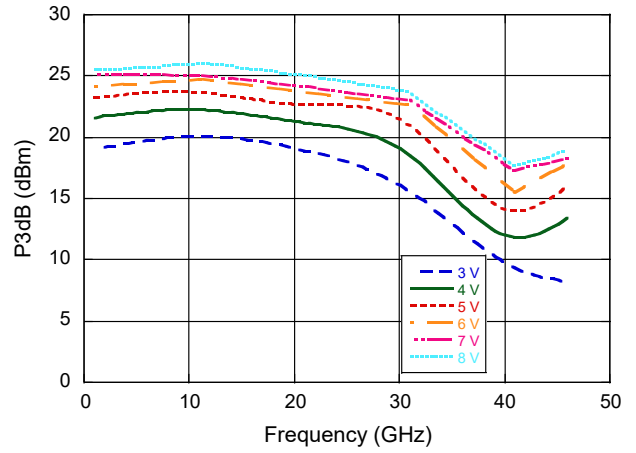
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Typical Performance Curves: $T_A = +25^\circ\text{C}$, $I_{DSQ} = 200\text{ mA}$

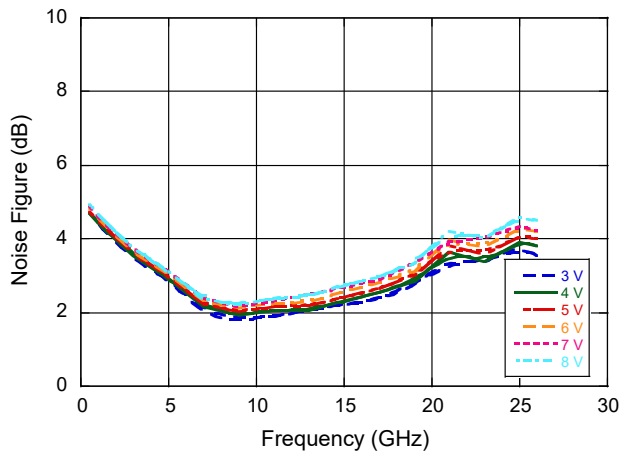
Output P1dB vs. V_{DD}



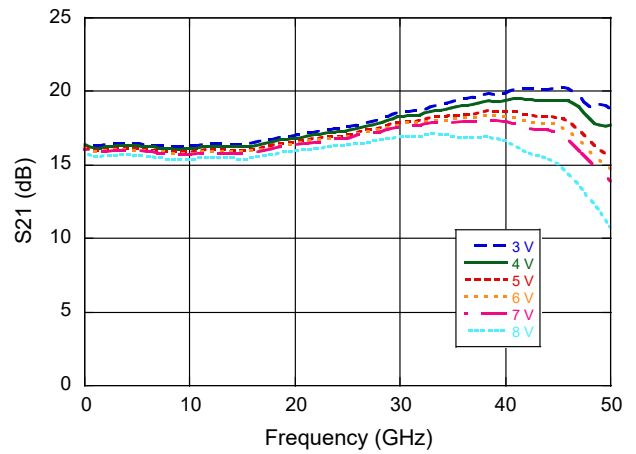
P3dB vs. V_{DD}



Noise Figure vs. V_{DD}



Gain vs. V_{DD}



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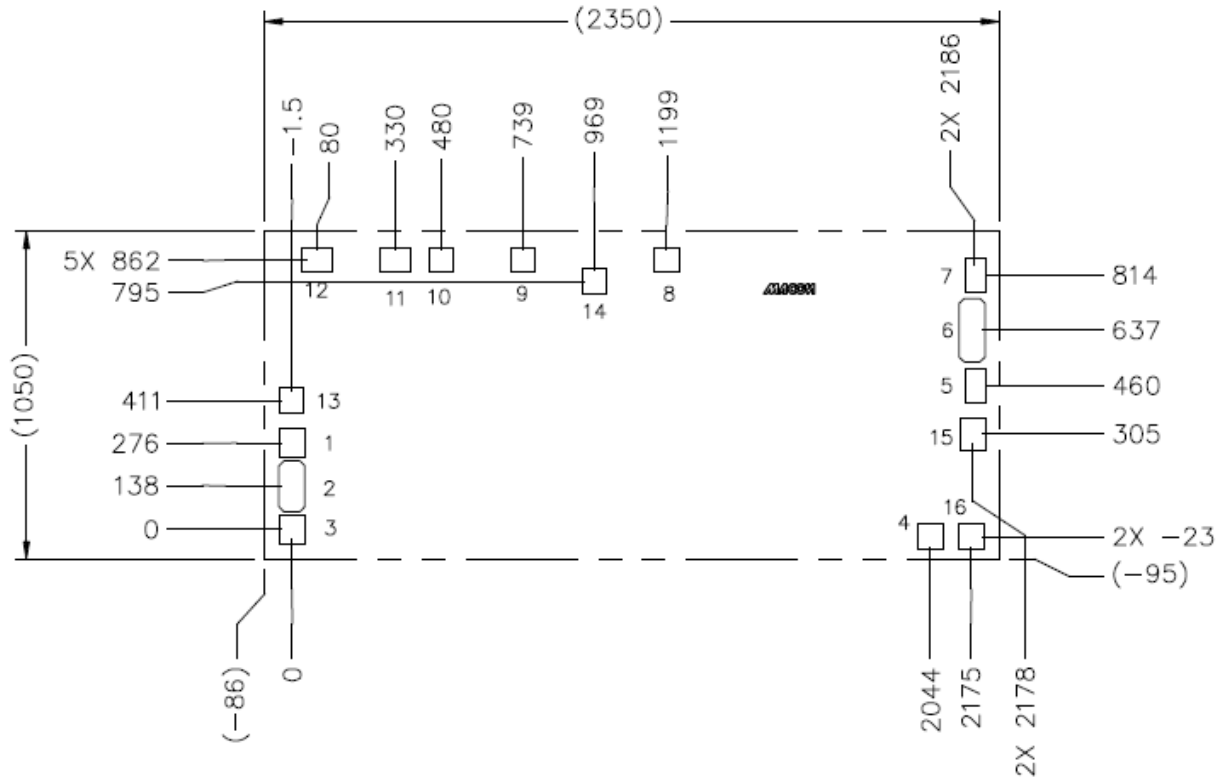
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Die Dimensions^{9,10,11,12}



- 9. All units in μm , unless otherwise noted, with a tolerance of $\pm 5 \mu\text{m}$.
- 10. Die thickness is $100 \pm 10 \mu\text{m}$.
- 11. Die size reflects un-cut dimensions. Laser kerf reduces die size by $\sim 25 \mu\text{m}$ each dimension.
- 12. Bond Pad / Backside Metallization : Gold

Bond Pad Detail

| Pad | X (μm) | Y (μm) |
|-------------------|---------------------|---------------------|
| 1,3 | 80 | 90 |
| 2 | 80 | 160 |
| 4,8,9,10,13,14,16 | 77 | 77 |
| 5,7 | 63 | 107 |
| 6 | 80 | 200 |
| 11,12 | 97 | 77 |
| 15 | 77 | 97 |

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