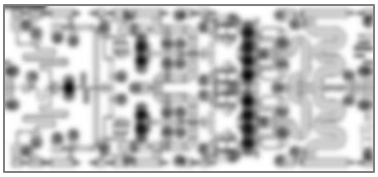
# NPA1000-DE

## 12.5 – 15.5 GHz GaN 20W Power Amplifier

## Product Description

The Nxbeam NPA1000-DE is a Ku-band high power GaN MMIC fabricated in 0.2um GaN HEMT on SiC. This part is ideally suited for satellite communications, point-to-point radios, and radar applications. The MMIC operates from 12.5 to 15.5 GHz and provides 20 W of saturated output power and 15 W of linear power in an ultra-small footprint of 9.2 $mm^2$ (4.6 mm x 2.0 mm).

The NPA1000-DE comes in die form with RF input and output matched to 50 Ω with DC blocking capacitors for easy system integration. The HEMT devices are fully passivated for reliable operation. Bond pad and backside metallization are Au-based for compatibility with eutectic die attachment methods.



## Key Features

- Frequency: 12.5– 15.5 GHz
- Linear Gain: 26 dB
- Psat: >43 dBm
- Linear Power: 41.7 dBm at -25 dBc
- PAE: >25%
- Chip Dimensions: 4.6 x 2.0 x 0.1 mm

## Electrical Specifications

Test Condition: Vd = 28V, Idq = 2.0 A, Temp. = 25 °C (all data is CW in-fixture)

| Parameter | Min | Typical | Max | Unit |
|---|---|---|---|---|
| Frequency | 12.5 | | 15.5 | GHz |
| Gain (small signal) | | 26 | | dB |
| Output Power (Pin = 21 dBm) | | > 43 | | dBm |
| Power Gain (Pin = 21 dBm) | | > 22 | | dB |
| Power Added Efficiency (Pin = 21 dBm) | | > 25 | | % |
| Input Return Loss | | > 12 | | dB |
| Output Return Loss | | > 9 | | dB |

## Electrical Specifications (Linear Power Operation)

Test Condition: Vd = 26V, Idq = 0.88 A, Temp. = 25 °C
Measured at -25 dBc under QPSK modulation, Channel BW = 1 MHz

| Parameter | Min | Typical | Max | Unit |
|---|---|---|---|---|
| Frequency | 12.5 | | 15.5 | GHz |
| Small Signal Gain | | 22 | | dB |
| Linear Output Power | | 41.7 | | dBm |
| Power Gain | | 20 | | dB |
| Power Added Efficiency | | 22 | | % |

## Absolute Maximum Ratings (Temp. = 25°C)

| Parameter | Min | Max | Unit |
|---|---|---|---|
| Drain Voltage (Vd1, Vd2, Vd3) | | 28 | V |
| Drain Current (Id1) | | 300 | mA |
| Drain Current (Id2) | | 1050 | mA |
| Drain Current (Id3) | | 2700 | mA |
| Gate Voltage (Vg1, Vg2, Vg3) | -7 | 0 | V |
| Input Power (Pin) | | TBD | dBm |
| Assembly Temperature (30 seconds) | | 320 | °C |

## Recommended Operating Condition

| Parameter | Value | Unit |
|---|---|---|
| Drain Voltage (Vd) | 20 - 28 | V |
| Drain Current (Idq) | up to 2 | A |
| Gate Voltage (Vg) (Typical) | -3.8 | V |



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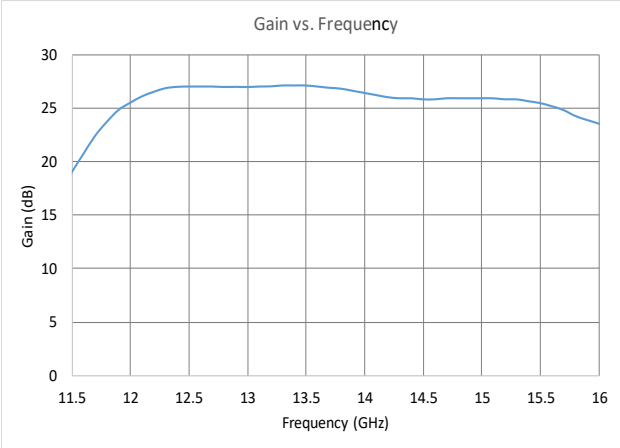
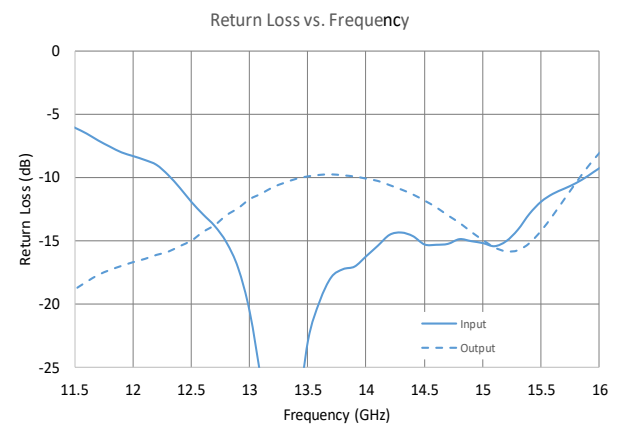
## Small Signal Performance

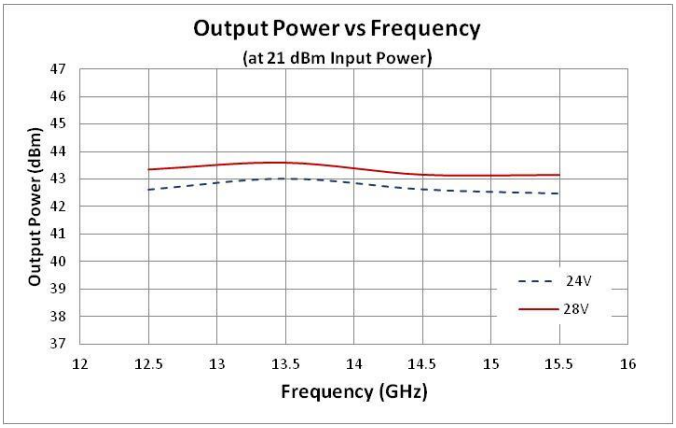
Test Condition: Vd = 28 V, Idq = 1.8 A, Temp. = 25 °C, (all data is CW in-fixture)

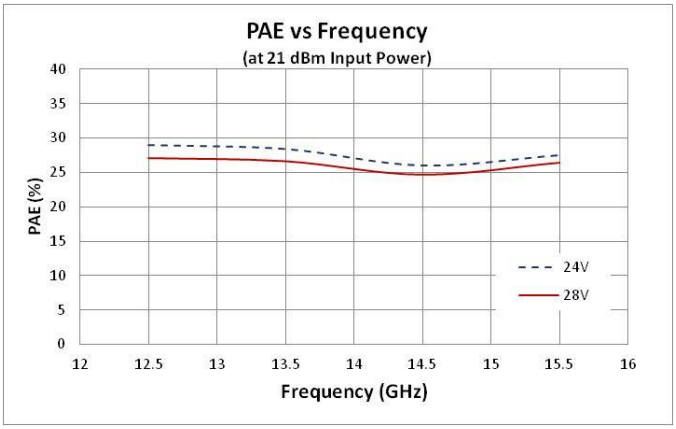


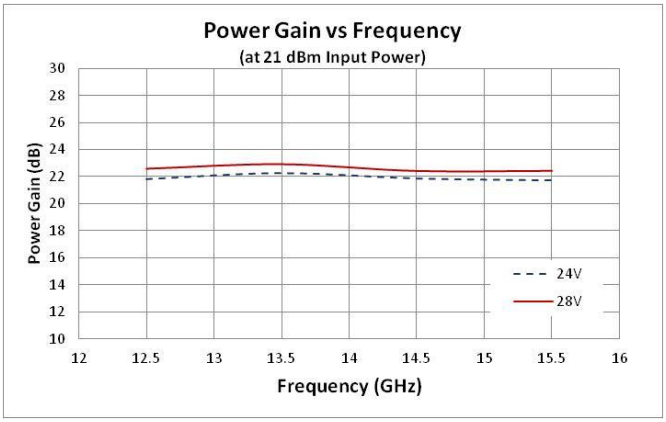




## Large Signal Performance

Test Condition: Vd = 28, 24 V, Idq = 2 A, Temp. = 25 °C, (all data is CW in-fixture)



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## Large Signal Performance

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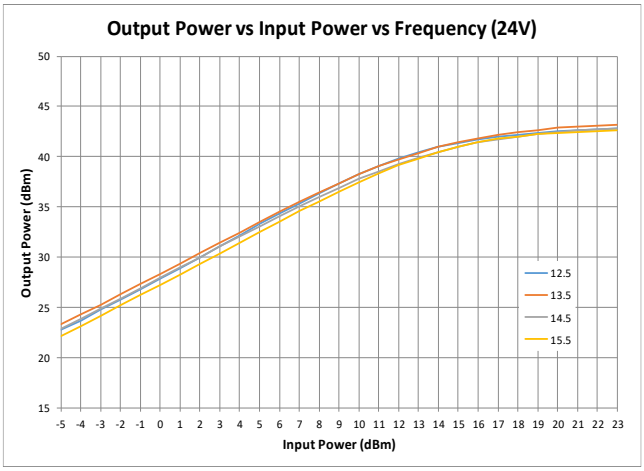


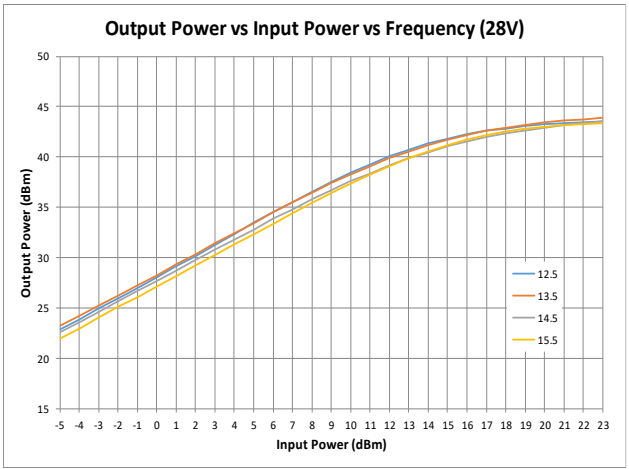


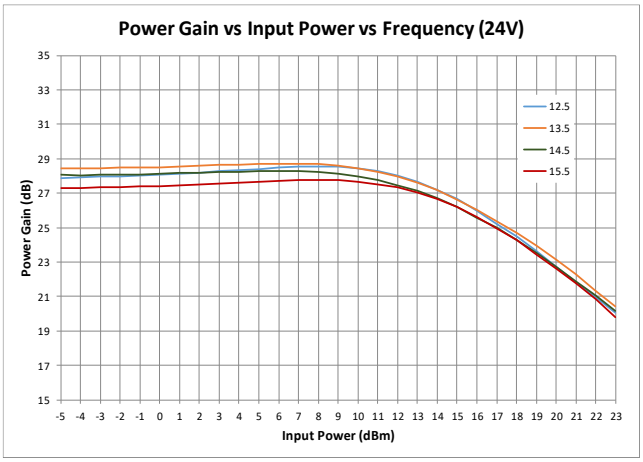


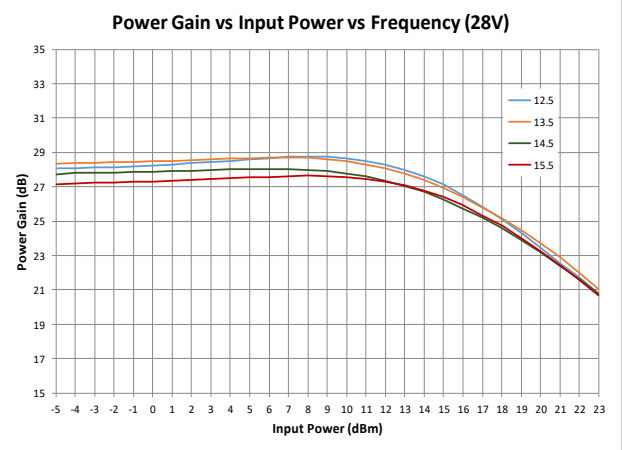


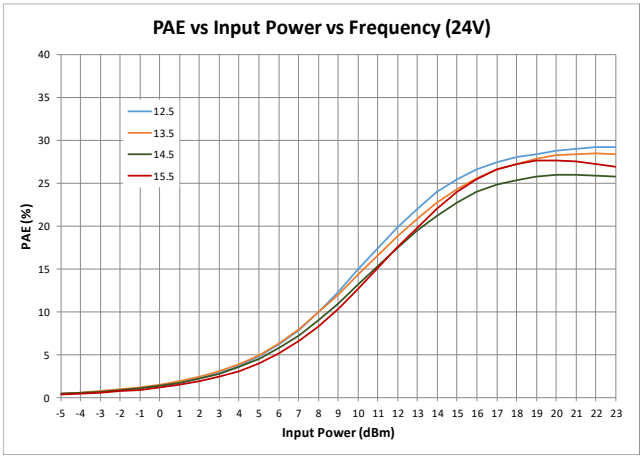


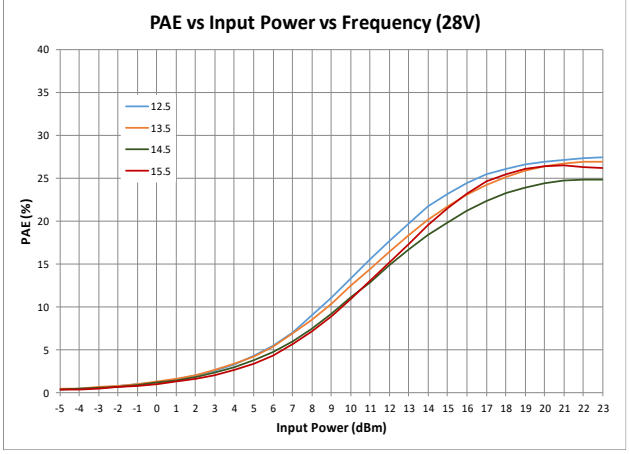




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## Large Signal Performance

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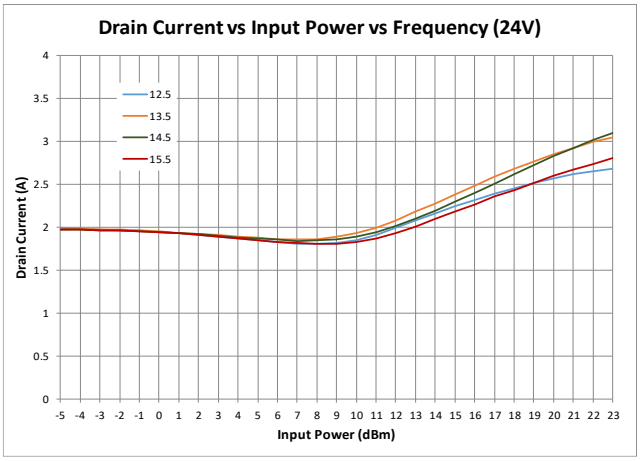
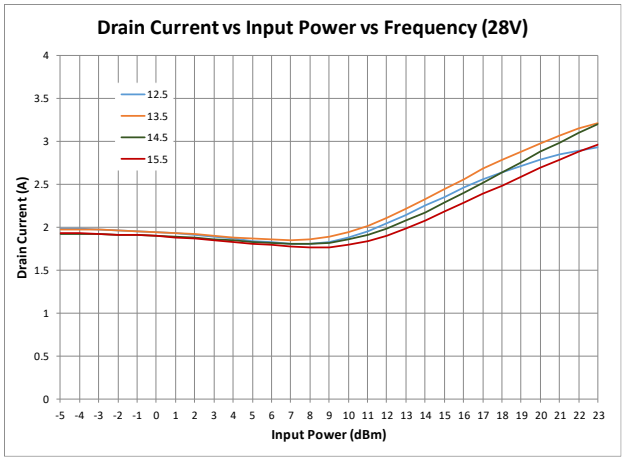
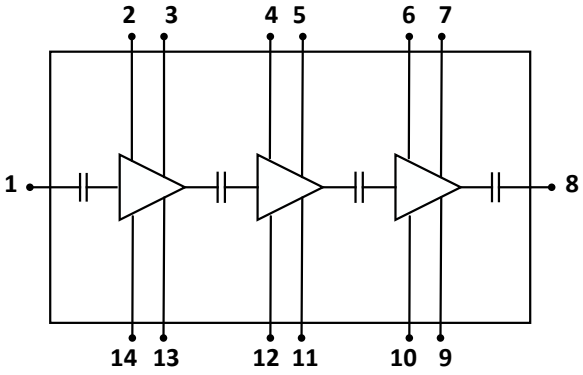



## Circuit Block Diagram




Pin number information detailed under Die Size and Bond Pad Information



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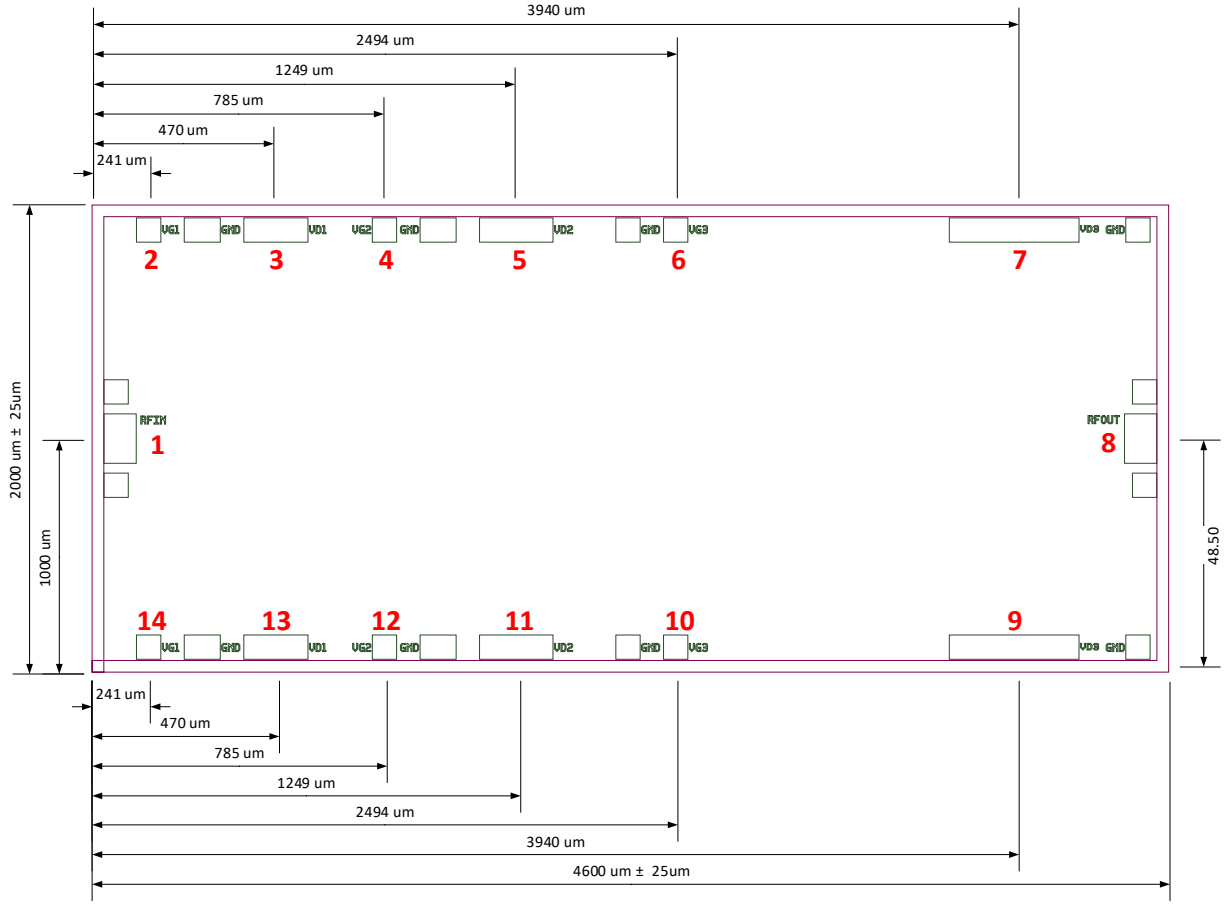
## Die Size and Bond Pad Information

Chip Size = 4600 ±25 um x 2000 ±25 um
Chip Thickness = 100 um
Chip Backside metal is ground

RF Input/Output Pad Dimensions = 134 um x 208 um
DC Pad Dimensions:

- Vg1, Vg2, Vg3 = 100 um x 100 um
- Vd1 = 270 um x 100 um
- Vd2 = 310 um x 100 um
- Vd3 = 550 um x 100 um

| Pad Num. | Function |
|---|---|
| 1 | RF in |
| 2, 14 | Vg1 |
| 3, 13 | Vd1 |
| 4, 12 | Vg2 |
| 5, 11 | Vd2 |
| 6, 10 | Vg3 |
| 7, 9 | Vd3 |
| 8 | RF out |



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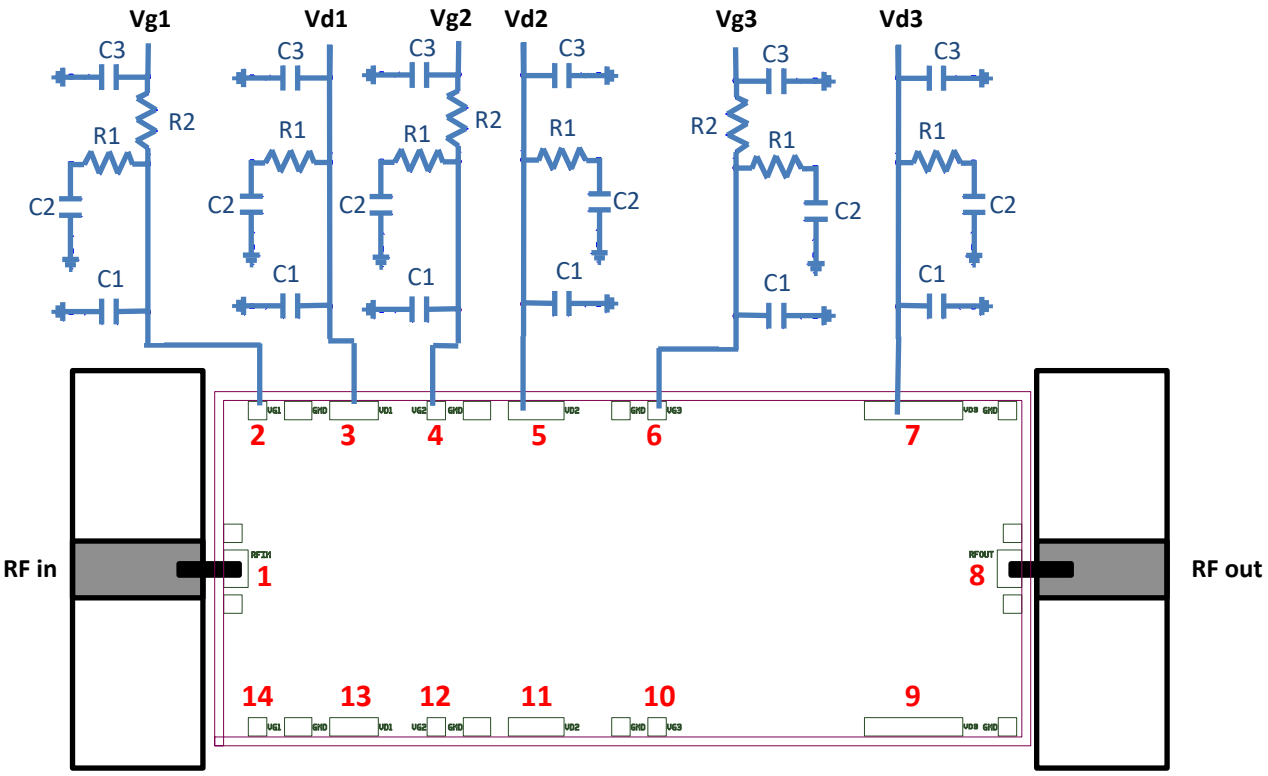
## Suggested Bonding Arraignment

The following diagram is a suggested bonding arraignment but other arraignments are possible. It is also possible to tie all gate voltages together as well as all drain voltages together.




## Off-Chip Component Values

| Capacitor | Value |
|---|---|
| C1 | 100 pF |
| C2 | 0.01 µF |
| C3 | 1 µF |

| Resistor | Value |
|---|---|
| R1 | 10 Ω |
| R2 | 100 Ω |
| | |

## Assembly Process

- This product has gold backside metallization and can be mounted using either a conductive epoxy or AuSn attachment.
- Nxbeam recommends the use of AuSn attachment due to the high power level of this product to ensure good thermal conductivity.
- Maximum recommended temperature during die attachment is 320 °C for 30 seconds.
- This product contains metal air bridges so caution should be taken when handling the die to avoid damage.



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## Bias Information

The NPA1000-DE can be biased from either top or bottom of the chip.

**Bias-up Procedure:**
1.) It is recommended that voltage and current limits are set on the voltage supply's prior to biasing the product.
2.) Ensure power supplies are properly grounded to the product test fixture.
3.) Apply negative gate voltage (-6 V) to ensure all devices are pinched off.
4.) Gradually increase the drain bias voltage to the desired bias level but not to exceed the maximum voltage of 28 V.
5.) Gradually increase the gate voltage while monitoring the drain current until the desired drain current is achieved.
6.) Apply RF signal.

**Bias-down Procedure:**
1.) Turn off RF signal.
2.) Gradually decrease the gate voltage down to -6 V.
3.) Gradually decrease the drain voltage down to 0 V.
4.) Gradually increase gate voltage to 0 V.
5.) Turn off supply voltages

**ESD Sensitive Product**

## Important Information

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