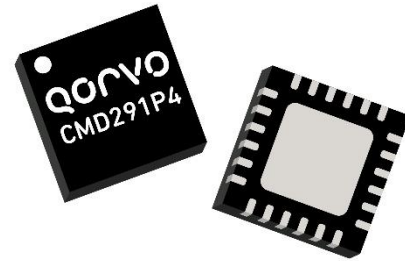
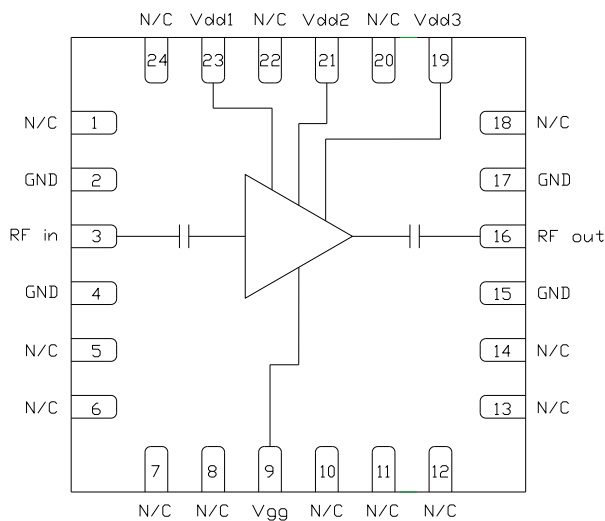


### Product Overview

The CMD291P4 is a wideband GaAs MMIC driver amplifier housed in a leadless 4x4 mm surface mount package. The broadband device operates from 16 to 24 GHz and is ideally suited for applications requiring high dynamic range. The CMD291P4 delivers 22 dB of gain with a corresponding output 1 dB compression point of +25.5 dBm and output IP3 of 31.5 dBm at 20 GHz. The amplifier is a 50 ohm matched design which eliminates the need for external DC blocks and RF port matching.



### Functional Block Diagram



### Key Features

- Wideband Performance
- High Gain
- High Linearity
- HMC498LC4 Replacement
- Pb-Free RoHs Compliant 4x4 QFN Package

### Ordering Information

| Part No.     | Description                                   |
|--------------|---|
| CMD291P4     | 16-24 GHz Driver Amplifier, 100 Piece 7" Reel |
| CMD291P4-EVB | Evaluation Board                              |

### Electrical Performance ( $V_{dd} = 5\text{ V}$ , $I_{dd} = 250\text{ mA}$ , $T_A = 25\text{ }^\circ\text{C}$ , $F = 20\text{ GHz}$ )

| Parameter          | Min | Typ     | Max | Units |
|--------------------|-----|---------|-----|-------|
| Frequency Range    |     | 16 - 24 |     | GHz   |
| Gain               |     | 22      |     | dB    |
| Noise Figure       |     | 5       |     | dB    |
| Input Return Loss  |     | 18      |     | dB    |
| Output Return Loss |     | 13      |     | dB    |
| Output P1dB        |     | 25.5    |     | dBm   |
| Psat               |     | 26.5    |     | dBm   |
| Output IP3         |     | 31.5    |     | dBm   |
| Supply Current     |     | 250     |     | mA    |

## Absolute Maximum Ratings

| Parameter                         | Rating        |
|-----------------------------------|---------------|
| Drain Voltage, $V_{dd}$           | 5.75          |
| Gate Voltage, $V_{gg}$            | -2.5 V to 0 V |
| RF Input Power                    | +18 dBm       |
| Channel Temperature, $T_{ch}$     | 150 °C        |
| Power Dissipation, $P_{diss}$     | 1.83 W        |
| Thermal Resistance, $\theta_{JC}$ | 35.5 °C/W     |
| Operating Temperature             | -40 to 85 °C  |
| Storage Temperature               | -55 to 150 °C |

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

## Recommended Operating Conditions

| Parameter | Min | Typ  | Max | Units |
|-----------|-----|------|-----|-------|
| $V_{dd}$  | 3   | 5    | 5.5 | V     |
| $I_{dd}$  |     | 250  |     | mA    |
| $V_{gg}$  |     | -0.5 |     | V     |

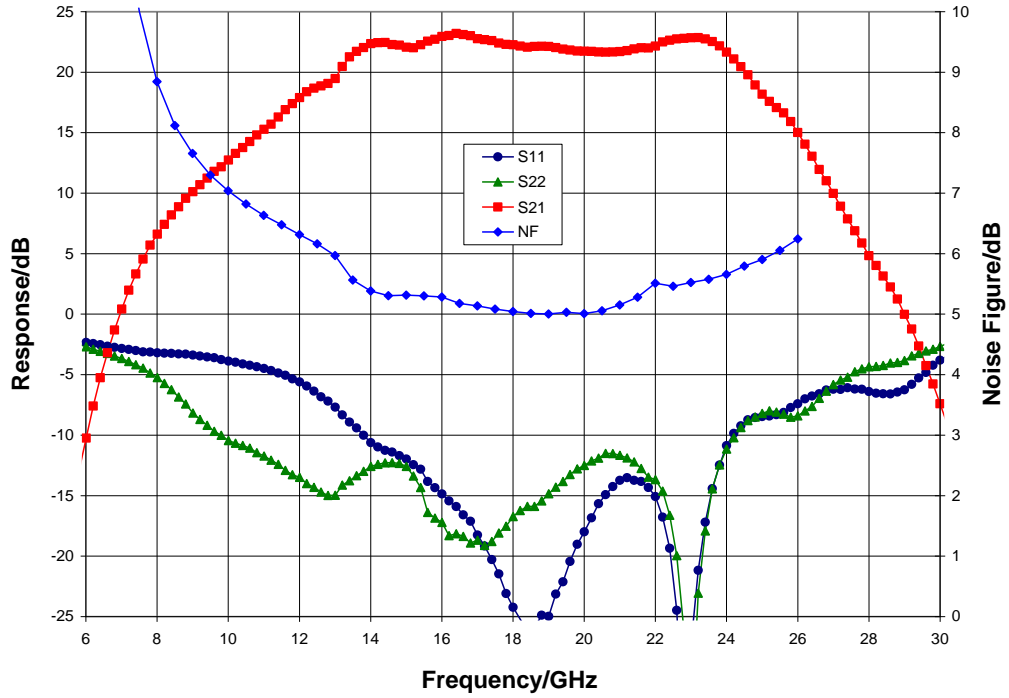
Electrical performance is measured at specific test conditions.  
Electrical specifications are not guaranteed over all recommended operating conditions.

## Electrical Specifications ( $V_{dd} = 5$ V, $I_{dd} = 250$ mA, $T_A = 25$ °C)

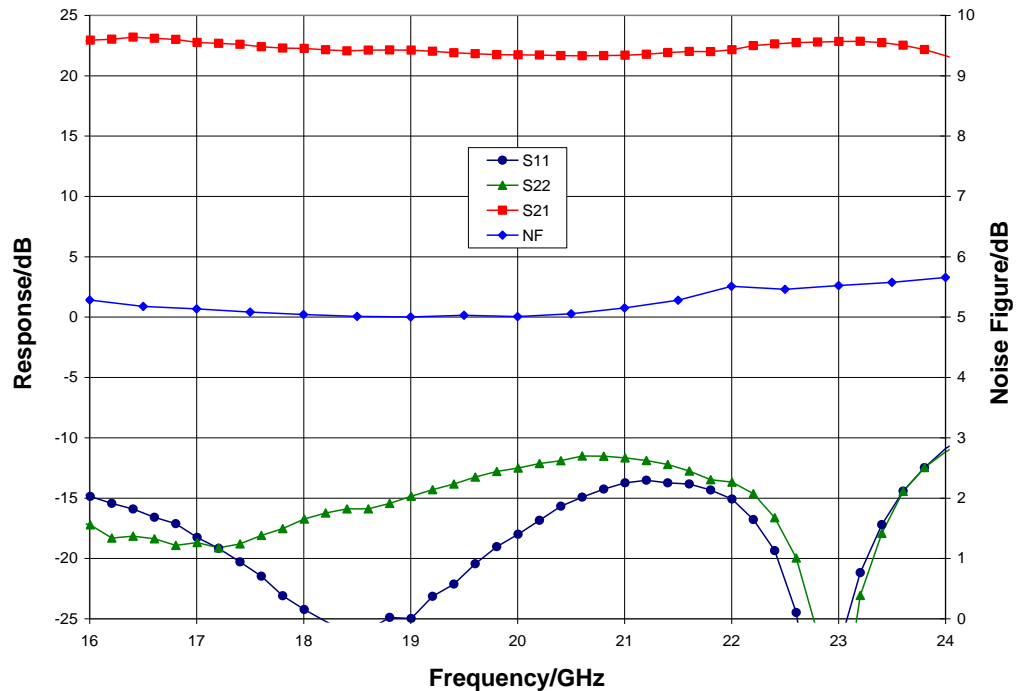
| Parameter                            | Min     | Typ   | Max | Min     | Typ   | Max | Units |
|--------------------------------------|---------|-------|-----|---------|-------|-----|-------|
| Frequency Range                      | 16 - 20 |       |     | 20 - 24 |       |     | GHz   |
| Gain                                 | 19      | 22    |     | 19      | 22    |     | dB    |
| Noise Figure                         |         | 5     |     |         | 5.5   |     | dB    |
| Input Return Loss                    |         | 20    |     |         | 15    |     | dB    |
| Output Return Loss                   |         | 15    |     |         | 13    |     | dB    |
| Output P1dB                          | 22.5    | 25.5  |     | 22      | 25.5  |     | dBm   |
| Psat                                 |         | 26.5  |     |         | 26    |     | dBm   |
| Output IP3                           |         | 32.5  |     |         | 31    |     | dBm   |
| Supply Current                       | 175     | 250   | 325 | 175     | 250   | 325 | mA    |
| Gain Temperature Coefficient         |         | 0.032 |     |         | 0.032 |     | dB/°C |
| Noise Figure Temperature Coefficient |         | 0.013 |     |         | 0.014 |     | dB/°C |

Typical Performance

Broadband Performance,  $V_{dd} = 5\text{ V}$ ,  $I_{dd} = 250\text{ mA}$ ,  $T_A = 25\text{ }^\circ\text{C}$

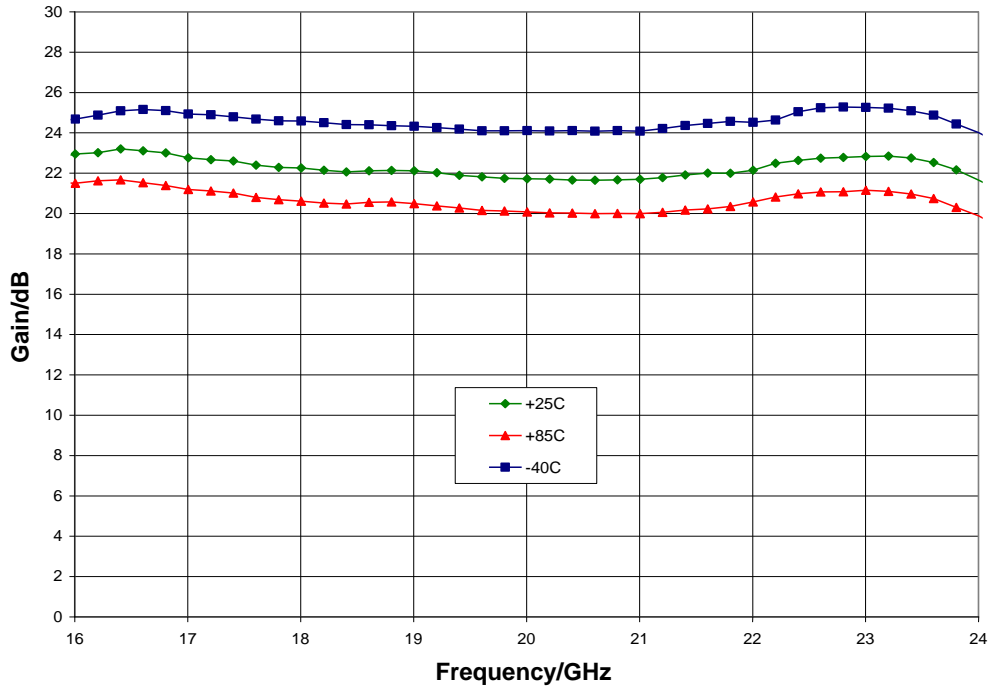


Narrow-band Performance,  $V_{dd} = 5\text{ V}$ ,  $I_{dd} = 250\text{ mA}$ ,  $T_A = 25\text{ }^\circ\text{C}$

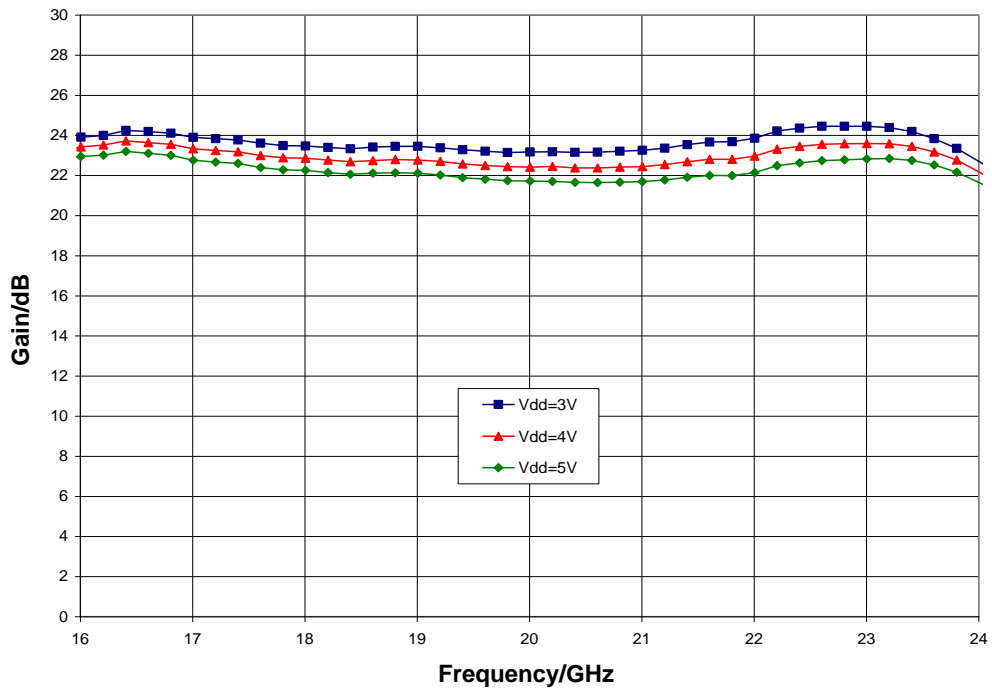


Typical Performance

Gain vs. Temperature,  $V_{dd} = 5\text{ V}$

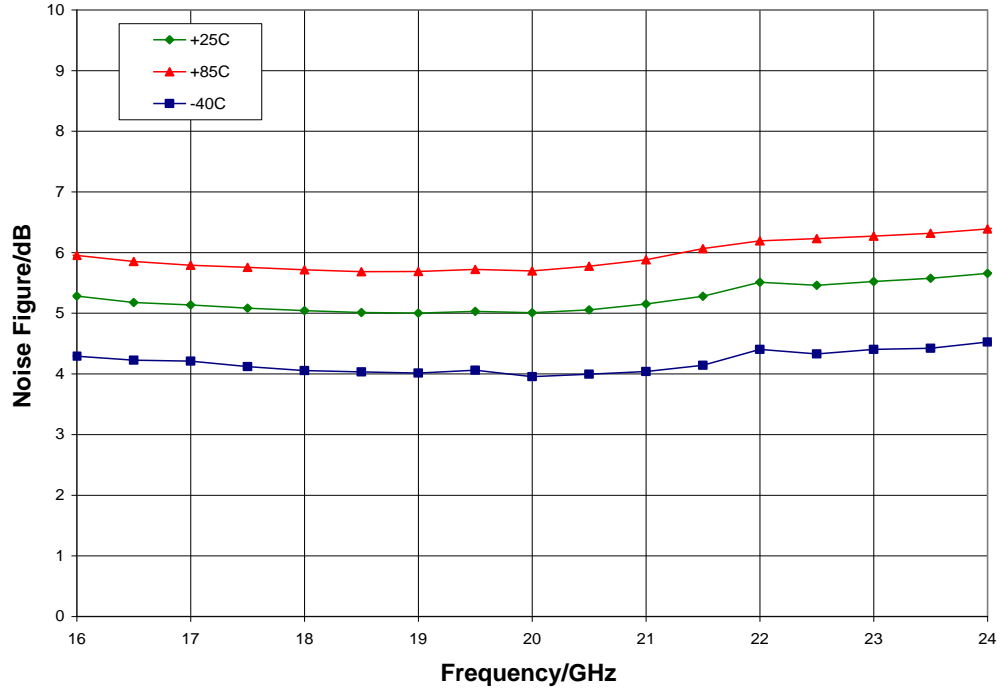


Gain vs.  $V_{dd}$ ,  $I_{dd} = 250\text{ mA}$ ,  $T_A = 25\text{ }^\circ\text{C}$

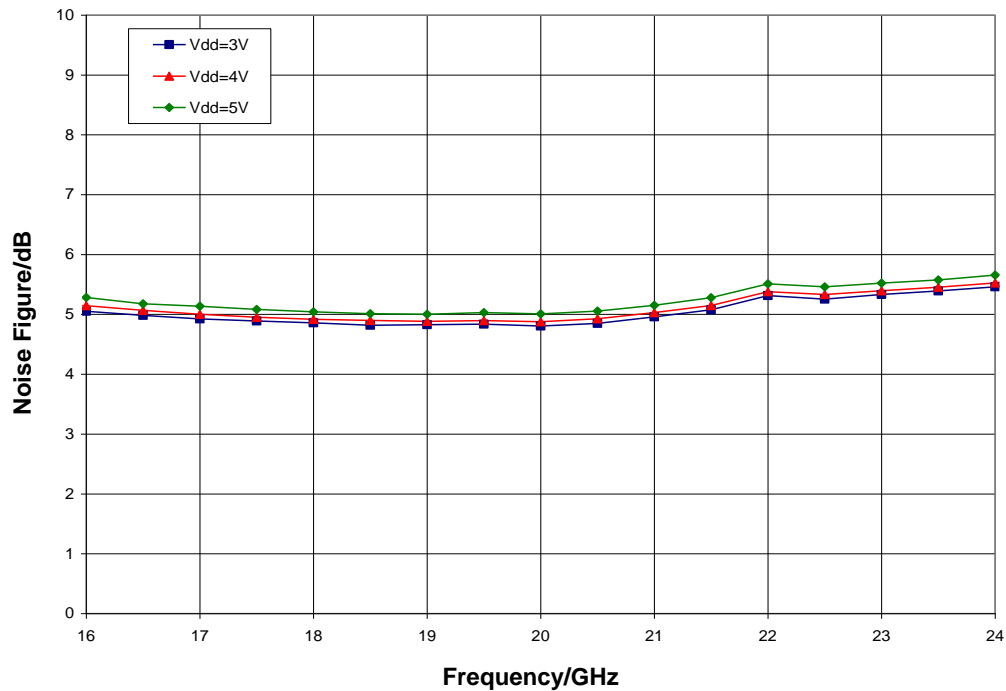


Typical Performance

Noise Figure vs. Temperature,  $V_{dd} = 5\text{ V}$

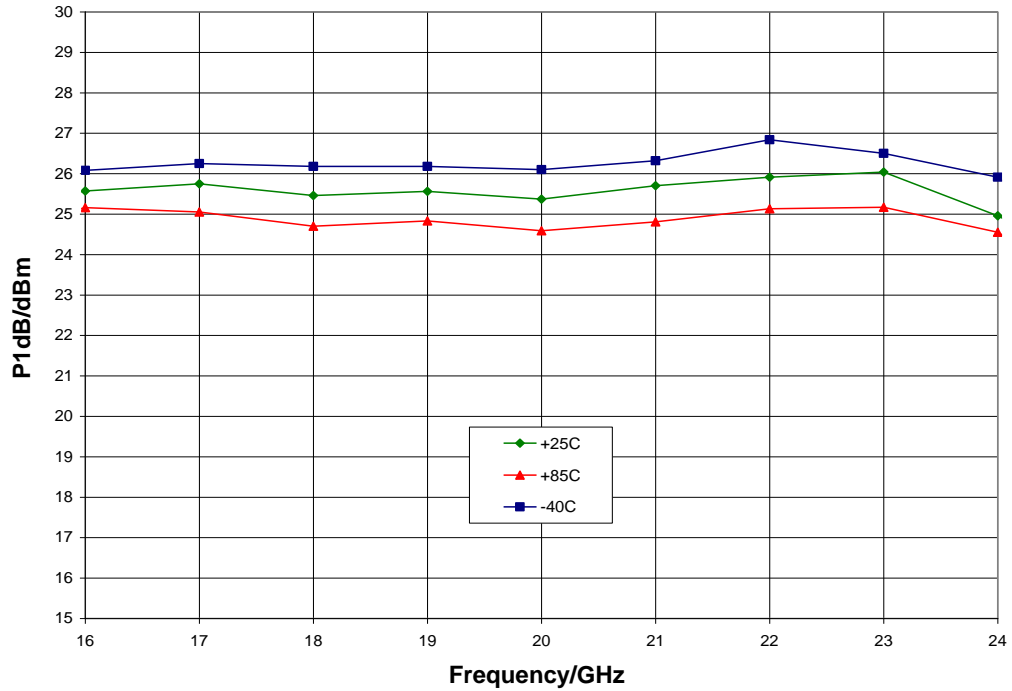


Noise Figure vs.  $V_{dd}$ ,  $I_{dd} = 250\text{ mA}$ ,  $T_A = 25\text{ }^\circ\text{C}$

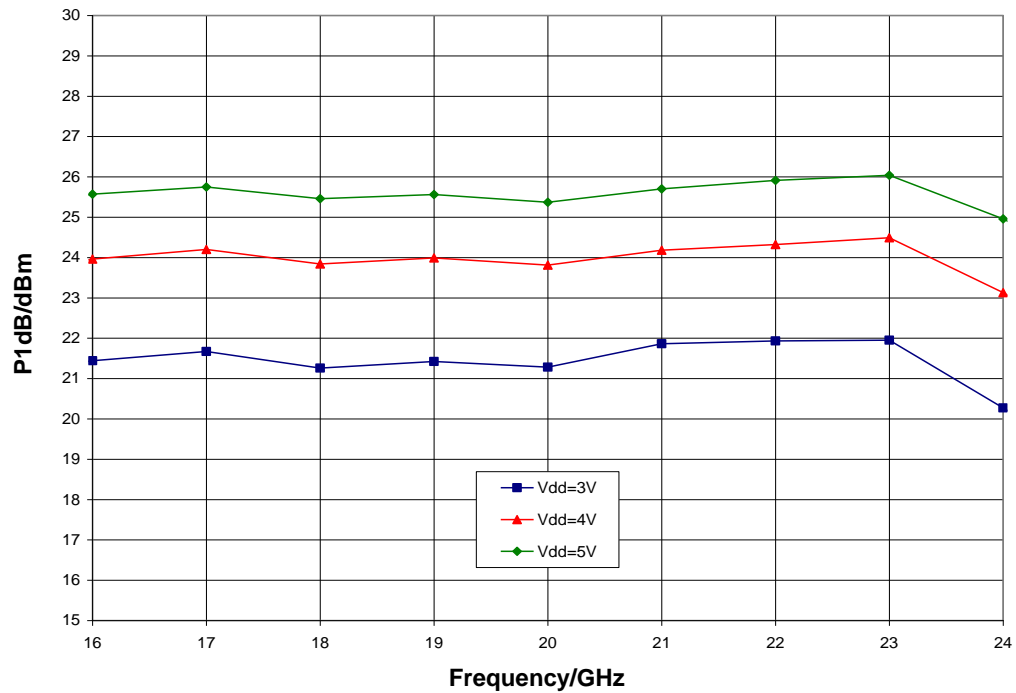


Typical Performance

P1dB vs. Temperature,  $V_{dd} = 5\text{ V}$

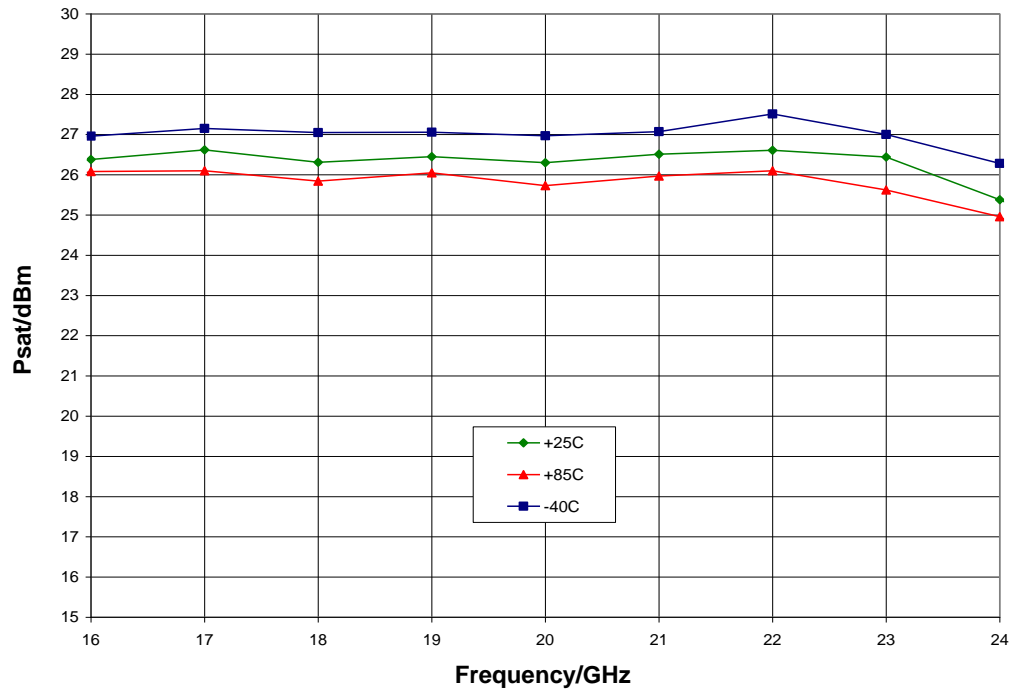


P1dB vs.  $V_{dd}$ ,  $I_{dd} = 250\text{ mA}$ ,  $T_A = 25\text{ }^\circ\text{C}$

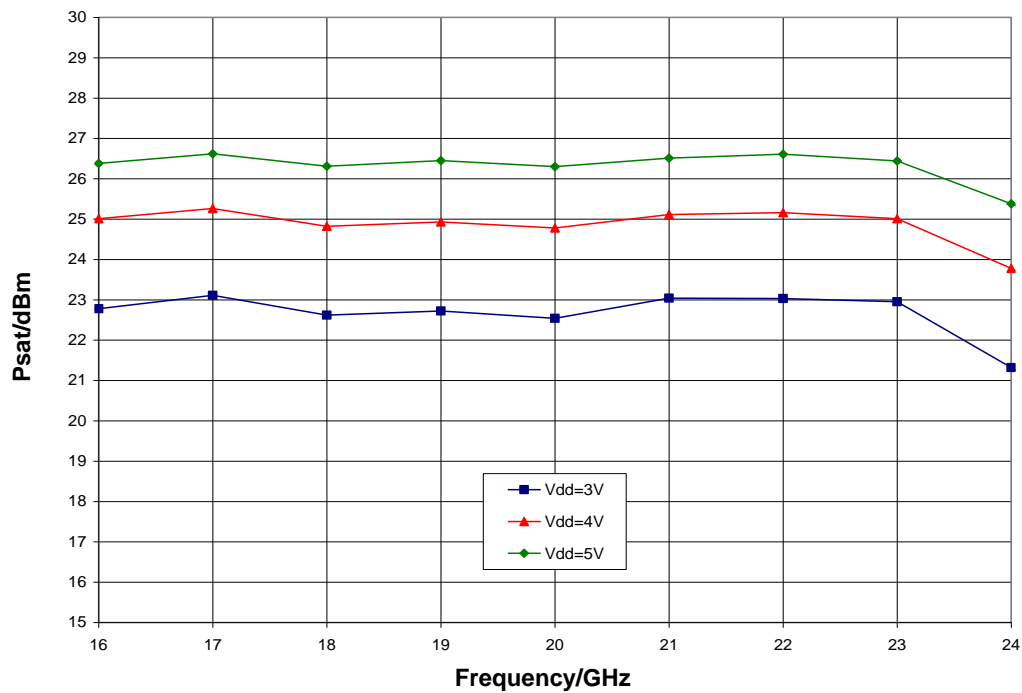


Typical Performance

Psat vs. Temperature,  $V_{dd} = 5\text{ V}$

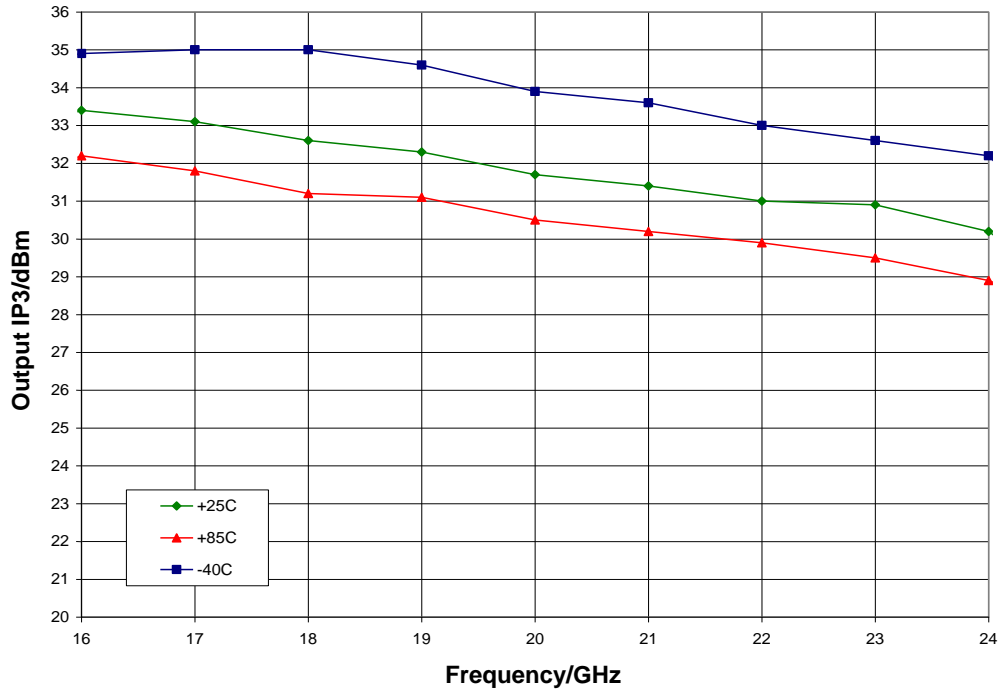


Psat vs.  $V_{dd}$ ,  $I_{dd} = 250\text{ mA}$ ,  $T_A = 25\text{ °C}$

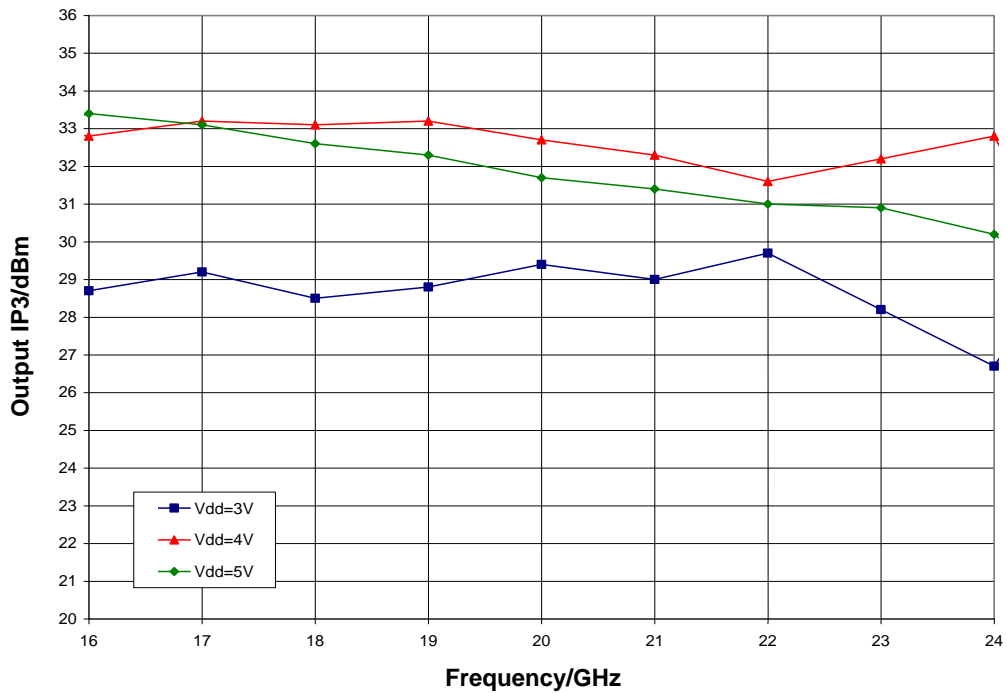


Typical Performance

Output IP3 vs. Temperature,  $V_{dd} = 5\text{ V}$



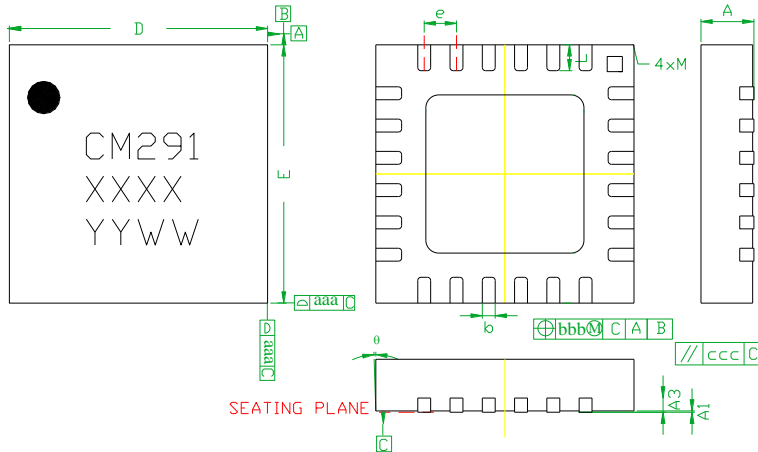
Output IP3 vs.  $V_{dd}$ ,  $I_{dd} = 250\text{ mA}$ ,  $T_A = 25\text{ °C}$





**Mechanical Information**

**Package Information and Dimensions**



| SYMBOLS | DIMENSIONS IN MILLIMETERS |          |      |
|---------|---------------------------|----------|------|
|         | MIN                       | NOM      | MAX  |
| A       | 0.80                      | 0.90     | 1.00 |
| A1      | 0                         | 0.02     | 0.05 |
| A3      | ---                       | 0.25REF. | ---  |
| b       | 0.18                      | 0.23     | 0.30 |
| D       | 3.85                      | 4.00     | 4.15 |
| D1      | ---                       | 2.45BSC  | ---  |
| E       | 3.85                      | 4.00     | 4.15 |
| E1      | ---                       | 2.45BSC  | ---  |
| e       | ---                       | 0.50BSC  | ---  |
| L       | 0.30                      | 0.40     | 0.50 |
| theta   | 0                         | ---      | 12   |
| aaa     | ---                       | 0.25     | ---  |
| bbb     | ---                       | 0.10     | ---  |
| ccc     | ---                       | 0.10     | ---  |
| M       | ---                       | ---      | 0.05 |

**Notes:**

1. Dimensions are in millimeters
2. RoHS compliant mold compound
3. Lead frame material: Copper alloy
4. Lead finish: 100% Matte Sn
5. Indicated dimension/tolerance applies to leads and exposed pads

**Recommended PCB Land Pattern**

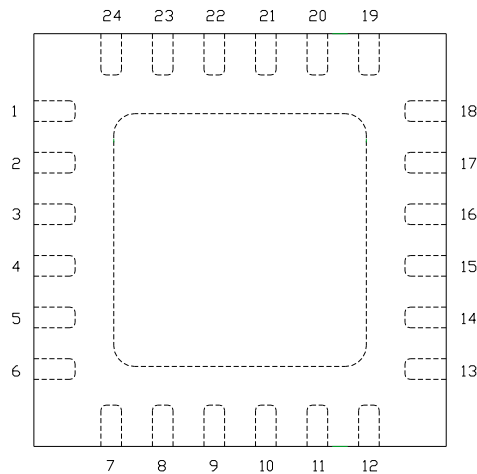
Qorvo recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Qorvo Application Note AN 105 for a recommended land pattern approach.

**Recommended Solder Reflow Profile**

Qorvo recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Qorvo Application Note AN 102 for a recommended solder reflow profile.

## Pin Description

### Pin Diagram

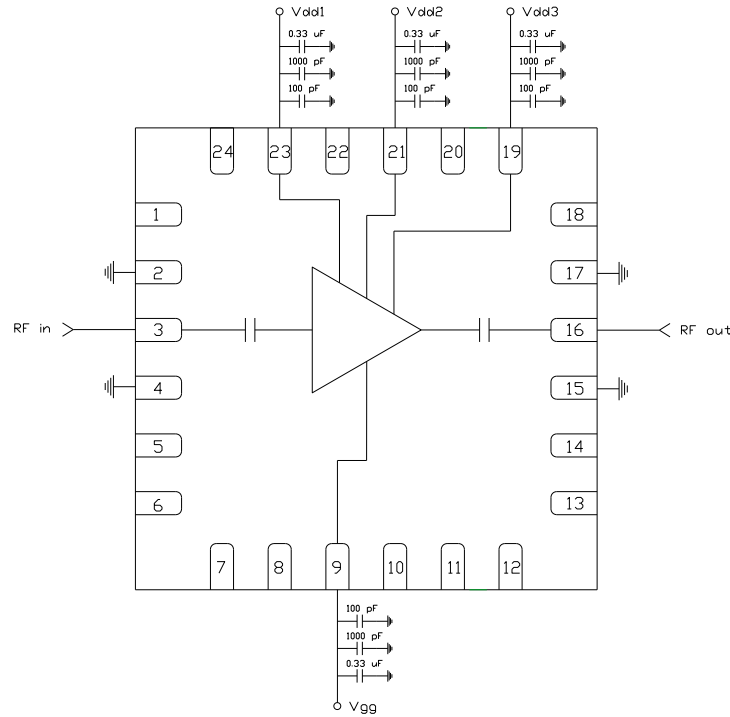


### Functional Description

| Pad                               | Function               | Description   | Schematic |
|-----------------------------------|------------------------|---|-----------|
| 1, 5 - 8, 10 - 14, 18, 20, 22, 24 | N/C                    | No connection required<br>These pins may be connected to RF/DC ground |           |
| 3                                 | RF in                  | DC blocked and 50 ohm matched   |           |
| 9                                 | V <sub>gg</sub>        | Power supply voltage<br>Decoupling and bypass caps required           |           |
| 16                                | RF out                 | DC blocked and 50 ohm matched   |           |
| 23, 21, 19                        | V <sub>dd1, 2, 3</sub> | Power supply voltage<br>Decoupling and bypass caps required           |           |
| 2, 4, 15, 17 and die paddle       | Ground                 | Connect to RF / DC ground   |           |

## Applications Information

### Application Circuit



### Biasing and Operation

The CMD291P4 is biased with a positive drain supply and a negative gate supply. Performance is optimized when the drain voltage is set to +5 V, though it may be set to as low as +3 V. The nominal gate voltage is -0.5 V.

Turn ON procedure:

1. Apply gate voltage  $V_{gg}$  and set to -2 V
2. Apply drain voltage  $V_{dd}$  and set to +5 V
3. Increase  $V_{gg}$  (less negative) to achieve a drain current of 250 mA

Turn OFF procedure:

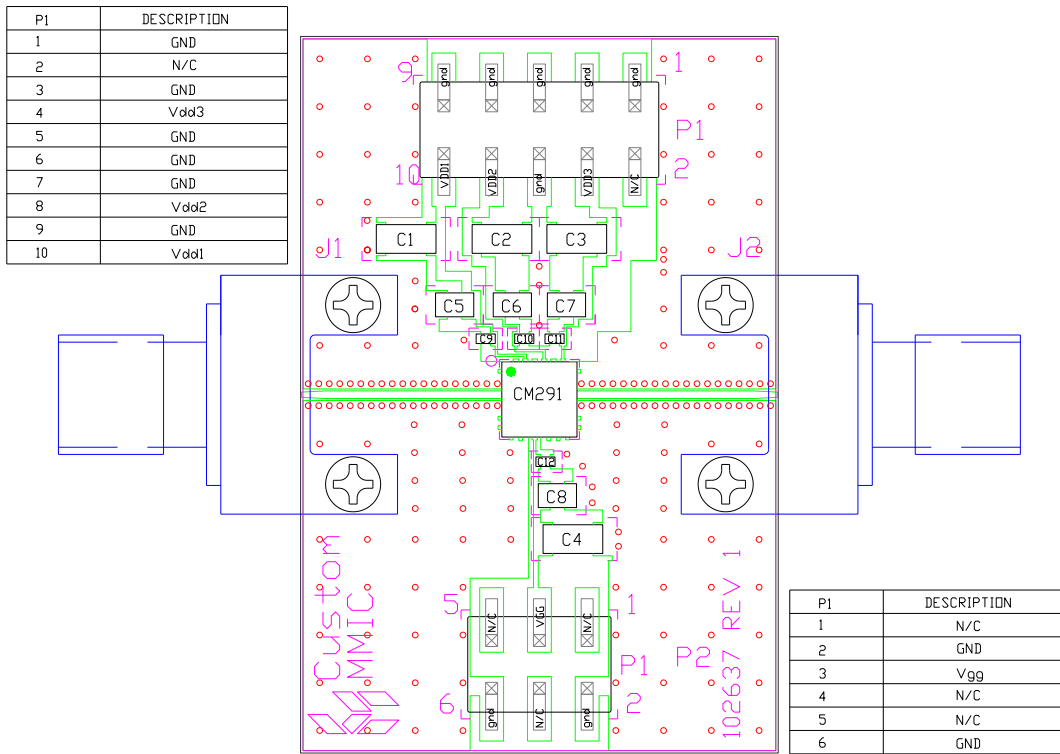
1. Turn off drain voltage  $V_{dd}$
2. Turn off gate voltage  $V_{gg}$

RF power can be applied at any time.

**GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.**

## Applications Information

### Evaluation Board



### Bill of Material

| Designator | Value        | Description                  |
|------------|--------------|------------------------------|
| J1, J2     |              | 2.92 mm End Launch Connector |
| P1         |              | 10 Pin DC Header             |
| P2         |              | 6 Pin DC Header              |
| C1 - C4    | 0.33 $\mu$ F | Capacitor, Tantalum          |
| C5 - C8    | 1000 pF      | Capacitor, 0603              |
| C9 - C12   | 100 pF       | Capacitor, 0402              |
| U1         |              | CMD291P4 Driver Amplifier    |
| PCB        |              | 102637 Evaluation PCB        |

## Handling Precautions

| Parameter                        | Rating   | Standard                           |
|----------------------------------|----------|------------------------------------|
| ESD – Human Body Model (HBM)     | Class 1A | ESDA / JEDEC JS-001-2012           |
| MSL – Moisture Sensitivity Level | Level 1  | JEDEC standard IPC/JEDEC J-STD-020 |



Caution!  
ESD-Sensitive Device

## RoHS Compliance

This part is compliant with 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) as amended by Directive 2015/863/EU.

This product also has the following attributes:

- Lead Free
- Antimony Free
- TBBP-A (C<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) Free
- SVHC Free
- Halogen Free
- PFOS Free

## Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

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**Tel:** 1-844-890-8163

**Email:** [customer.support@qorvo.com](mailto:customer.support@qorvo.com)

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