



# QPA2308

## 5 – 6 GHz 60 Watt GaN Power Amplifier

### Product Overview

Qorvo's QPA2308 is a MMIC power amplifier fabricated on Qorvo's production 0.25  $\mu\text{m}$  GaN on SiC process (QGaN25). Operating from 5.0–6.0 GHz, the QPA2308 produces greater than 60 W of saturated output power and greater than 21 dB of large-signal gain while achieving greater than 47% power-added efficiency.

The QPA2308 is offered in a 10-lead 0.6 x 0.6 in bolt-down package. Assembled with a pure-copper base, coupled with its high efficiency, the QPA2308 minimizes the strain on the system-level cooling requirements, further reducing system operating costs. The QPA2308's performance makes it well suited for both commercial and military applications

Both RF ports are fully matched to 50 ohms with integrated DC blocking capacitors thereby simplifying system integration.

Lead-free and RoHS compliant.

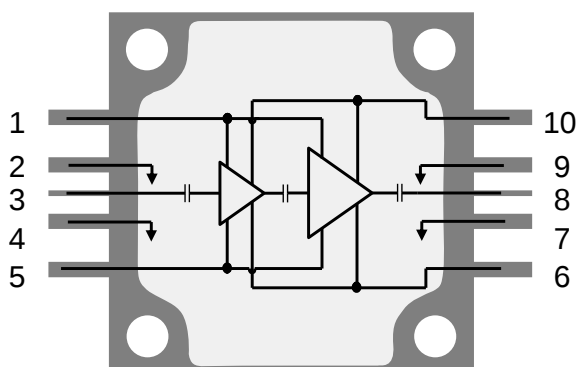


### Key Features

- Frequency Range: 5.0 – 6.0 GHz
- $P_{\text{SAT}}$  ( $P_{\text{IN}}=26$  dBm): 48 dBm
- PAE ( $P_{\text{IN}}=26$  dBm): 47 %
- Power Gain ( $P_{\text{IN}}=26$  dBm): 22 dB
- Small Signal Gain: > 30 dB
- Bias (pulsed):  $V_D = 28$  V,  $I_{DQ} = 1200$  mA
- Package Dimensions: 0.6 x 0.6 x 0.138 in.
- Package base is pure Cu offering superior thermal management.

*Performance is typical across frequency. Please reference electrical specification table and data plots for more details.*

### Functional Block Diagram



### Applications

- C-Band Radar
- Satellite Communications

### Ordering Information

| Part No.    | Description                         |
|-------------|-------------------------------------|
| QPA2308     | 5-6 GHz 60 Watt GaN Power Amplifier |
| QPA2308S2   | Samples (2 pcs.)                    |
| QPA2308EVB1 | Evaluation Board for QPA2308        |

## Absolute Maximum Ratings

| Parameter                                                                         | Value / Range  |
|-----------------------------------------------------------------------------------|----------------|
| Drain Voltage ( $V_D$ )                                                           | 40 V           |
| Gate Voltage Range ( $V_G$ )                                                      | -8 V to +1 V   |
| Drain Current ( $I_D$ )                                                           | 7600 mA        |
| Gate Current ( $I_G$ )                                                            | See plot pg.12 |
| Power Dissipation ( $P_{DISS}$ ), 50 $\Omega$ , Pulsed, 85 °C                     | 169 W          |
| Input Power ( $P_{IN}$ ), 50 $\Omega$ , Pulsed, $V_D=28$ V, $I_{DQ}=1.2$ A, 85 °C | 32 dBm         |
| Input Power ( $P_{IN}$ ), 3.5:1 VSWR, Pulsed, $V_D=28$ V, $I_{DQ}=1.2$ A, 85 °C   | 32 dBm         |
| Soldering Temperature (30 seconds, maximum)                                       | 320 °C         |
| Storage Temperature                                                               | -55 to +125 °C |

Operation of this device outside the parameter ranges given above may cause permanent damage. These are stress ratings only, and functional operation of the device at these conditions is not implied.

## Recommended Operating Conditions

| Parameter                  | Value / Range |
|----------------------------|---------------|
| Drain Voltage ( $V_D$ )    | 28 V          |
| Drain Current ( $I_{DQ}$ ) | 1200 mA       |
| Operating Temperature      | -40 to +85 °C |

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

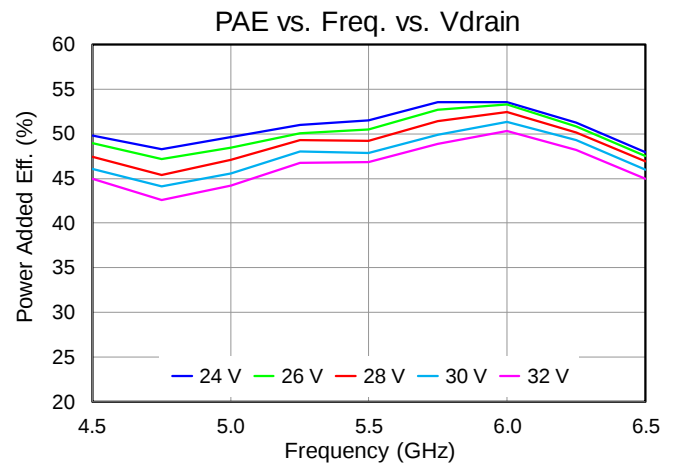
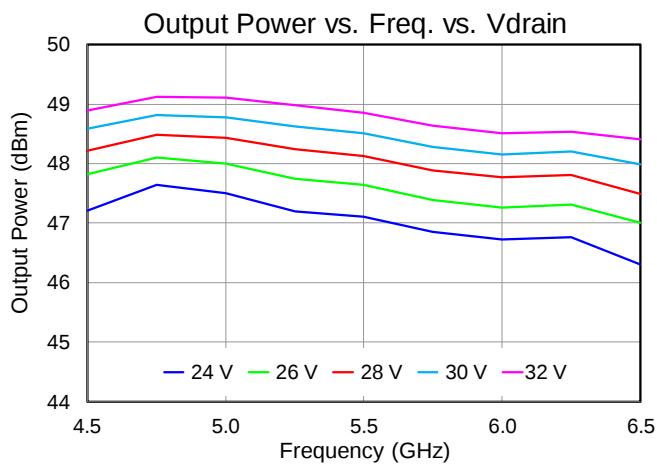
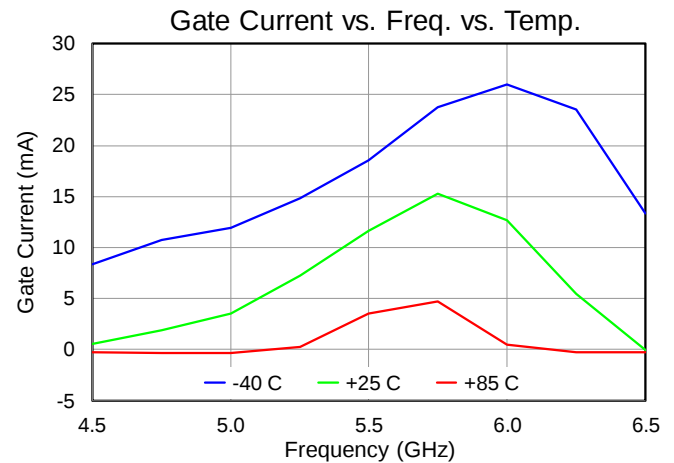
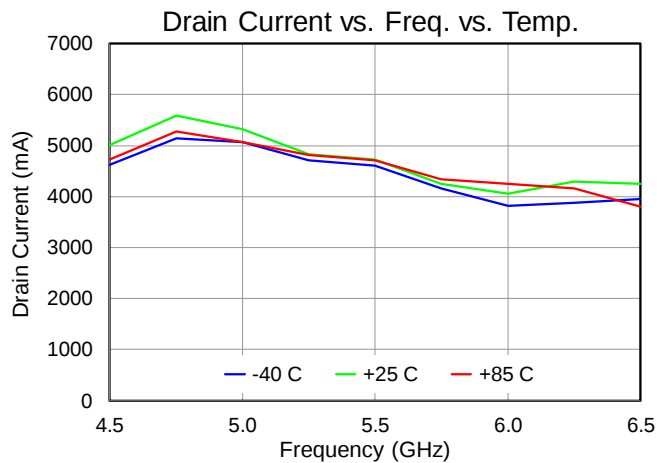
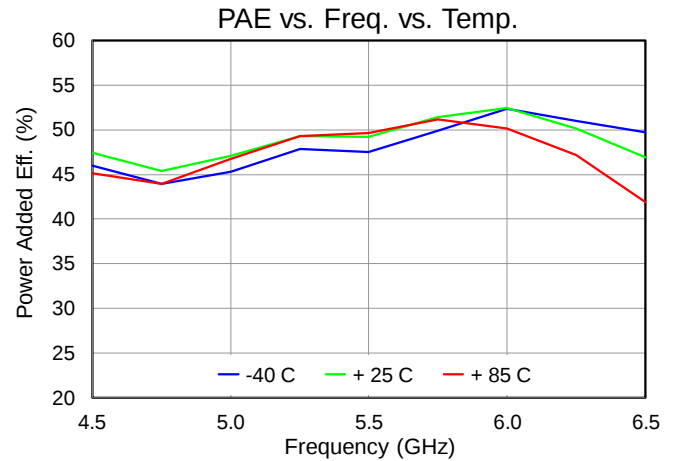
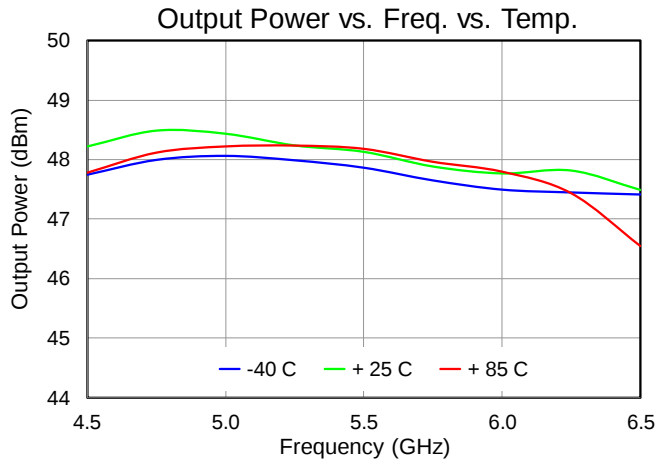
## Electrical Specifications

| Parameter                                         | Conditions              | Min  | Typ     | Max | Units |
|---------------------------------------------------|-------------------------|------|---------|-----|-------|
| Operational Frequency                             |                         | 5    |         | 6   | GHz   |
| Output Power ( $P_{IN}=26$ dBm)                   | Freq. = 5.0 GHz         | 46.5 | 48.4    |     | dBm   |
|                                                   | Freq. = 5.5 GHz         | 46.5 | 48.1    |     |       |
|                                                   | Freq. = 6.0 GHz         | 46.5 | 47.7    |     |       |
| Power Added Efficiency ( $P_{IN}=26$ dBm)         | Freq. = 5.0 GHz         |      | 47.0    |     | %     |
|                                                   | Freq. = 5.5 GHz         |      | 49.2    |     |       |
|                                                   | Freq. = 6.0 GHz         |      | 52.4    |     |       |
| Small Signal Gain                                 | Freq. = 5.0 GHz         |      | 31.5    |     | dB    |
|                                                   | Freq. = 5.5 GHz         |      | 32.4    |     |       |
|                                                   | Freq. = 6.0GHz          |      | 30.5    |     |       |
| Input Return Loss                                 | Freq. = 5.0 GHz         |      | 23      |     | dB    |
|                                                   | Freq. = 5.5 GHz         |      | 14      |     |       |
|                                                   | Freq. = 6.0 GHz         |      | 14      |     |       |
| Output Return Loss                                | Freq. = 5.0 GHz         |      | 13      |     | dB    |
|                                                   | Freq. = 5.5 GHz         |      | 13      |     |       |
|                                                   | Freq. = 6.0 GHz         |      | 13      |     |       |
| Second Harmonic ( $P_{OUT} = 45$ dBm)             | Freq. = 5.5 GHz         |      | -38     |     | dBc   |
| Third Harmonic ( $P_{OUT} = 45$ dBm)              | Freq. = 5.5 GHz         |      | -60     |     | dBc   |
| $P_{OUT}$ Temp. Coefficient. ( $P_{IN} = 26$ dBm) | Temp.: +25 °C to +85 °C |      | -0.0001 |     | dB/°C |
| Sm. Sig. Gain Temp. Coefficient                   | Temp.: -40 °C to +85 °C |      | -0.047  |     | dB/°C |

Test conditions, unless otherwise noted: T = 25 °C,  $V_D$  = 28 V,  $I_{DQ}$  = 1200 mA, PW = 600 us, Duty Cycle = 20%

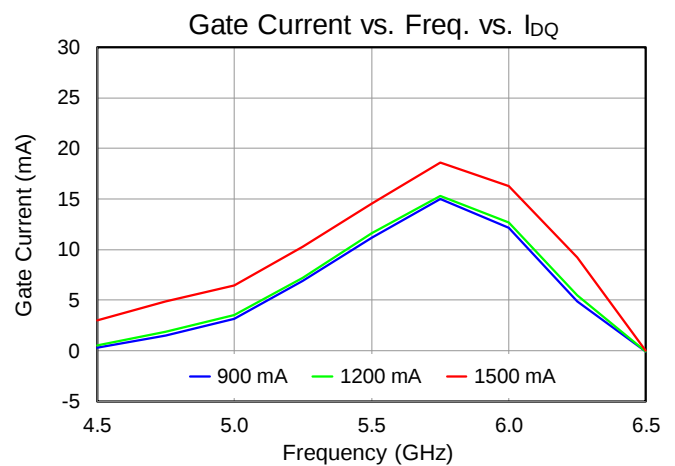
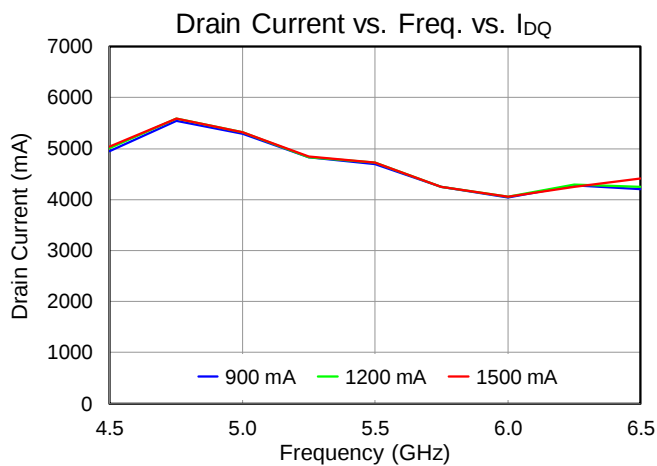
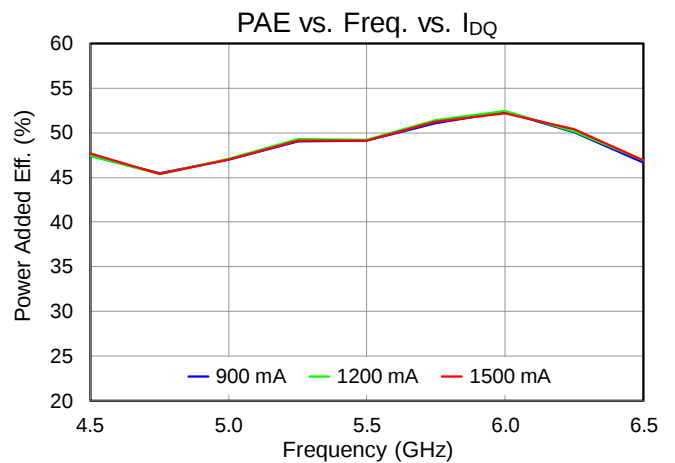
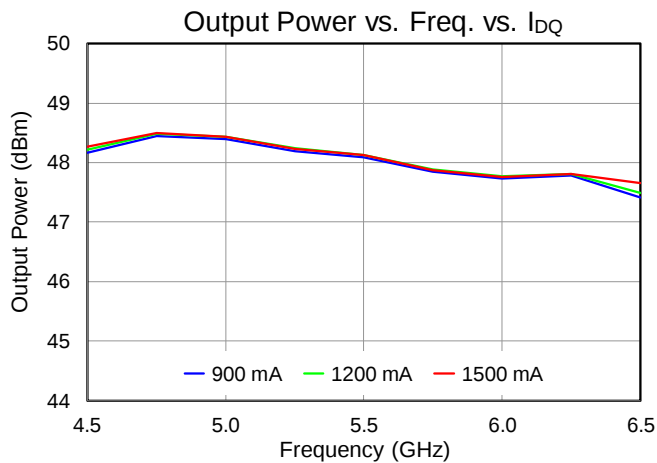
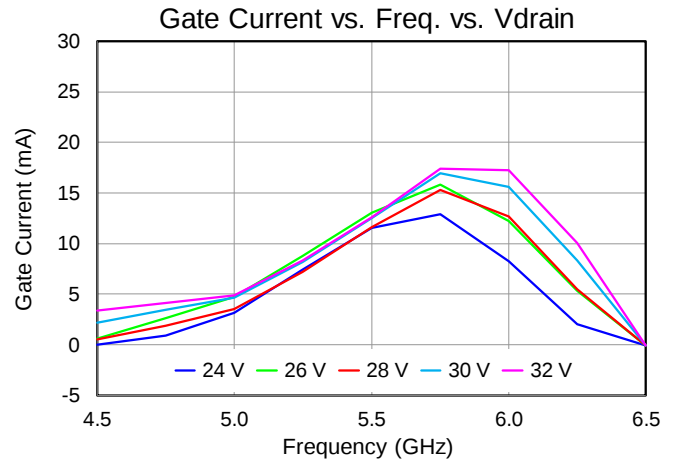
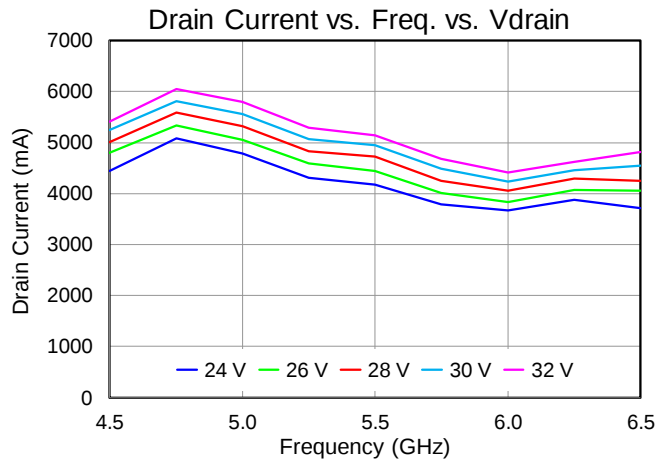
## Performance Plots – Large Signal

Test conditions, unless otherwise noted:  $V_D = 28\text{ V}$ ,  $I_{DQ} = 1200\text{ mA}$ ,  $T = +25^\circ\text{C}$ ,  $P_{IN} = 26\text{ dBm}$ ,  $PW = 600\text{ us}$ , Duty Cycle = 20%



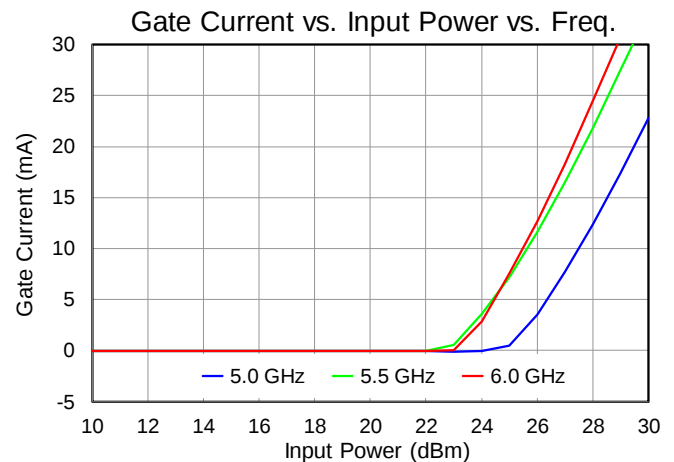
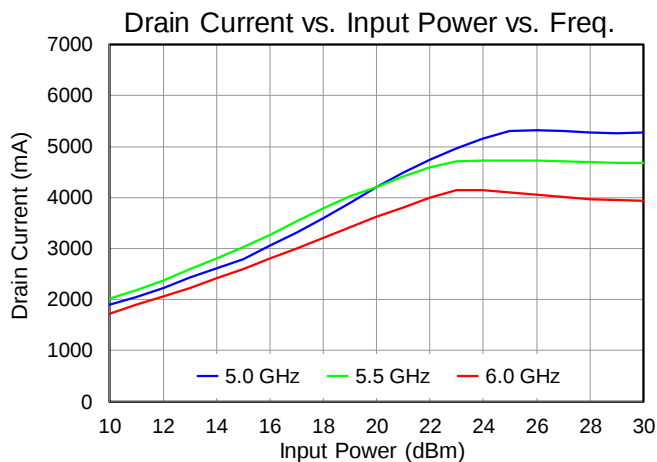
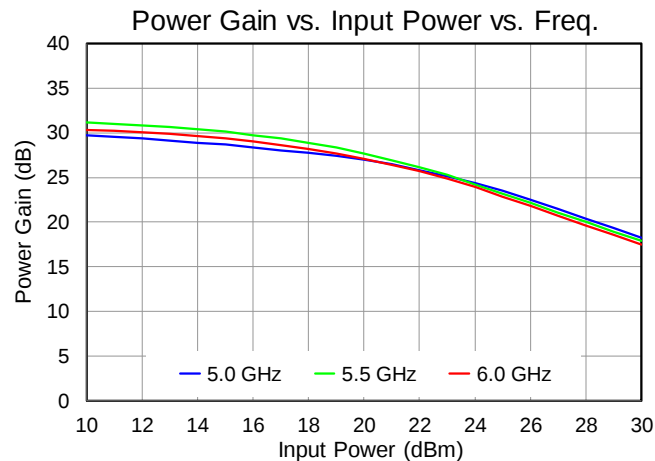
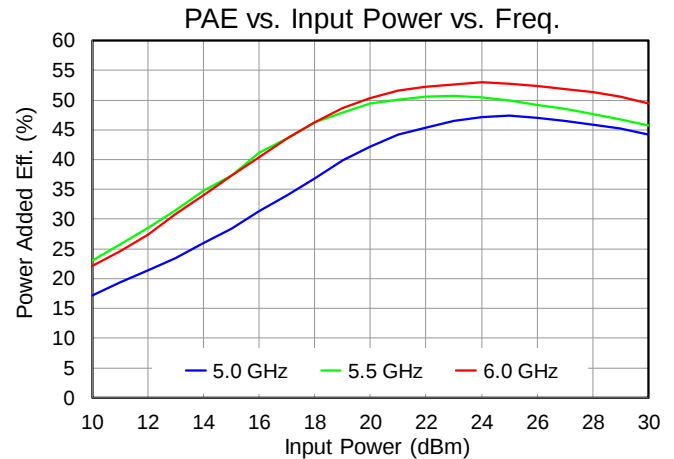
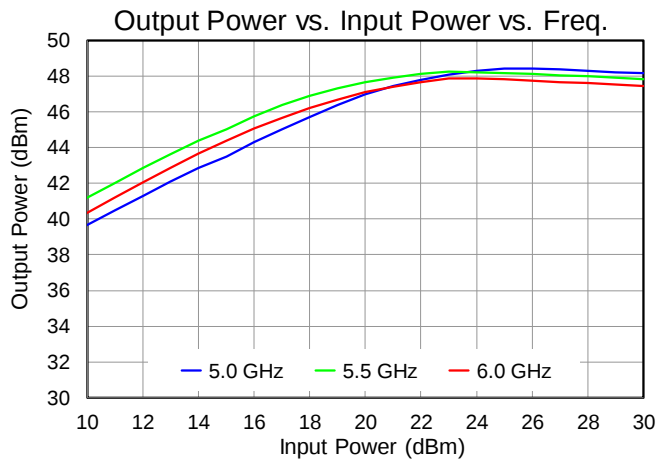
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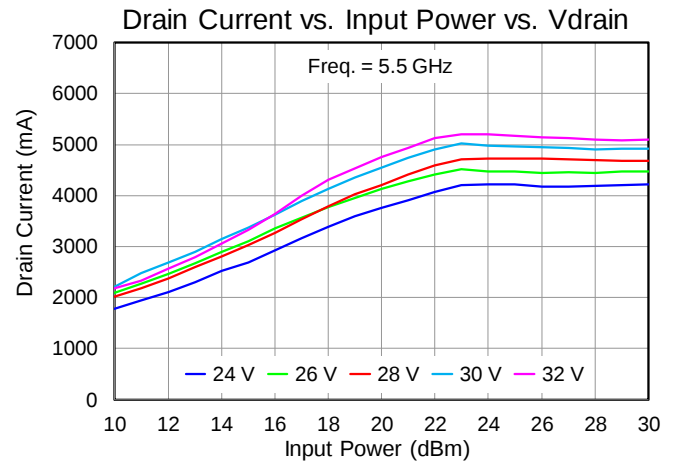
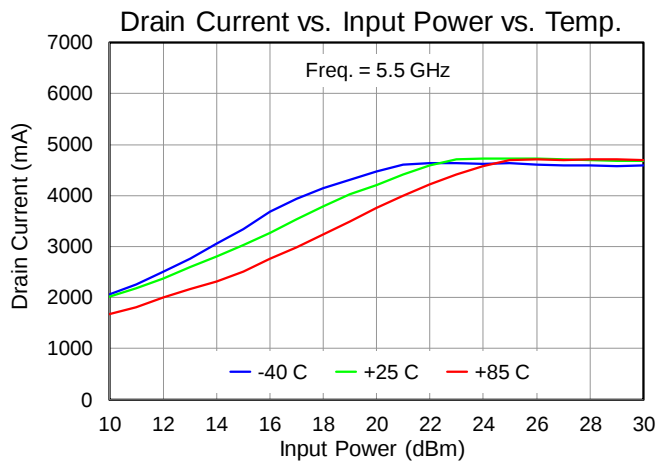
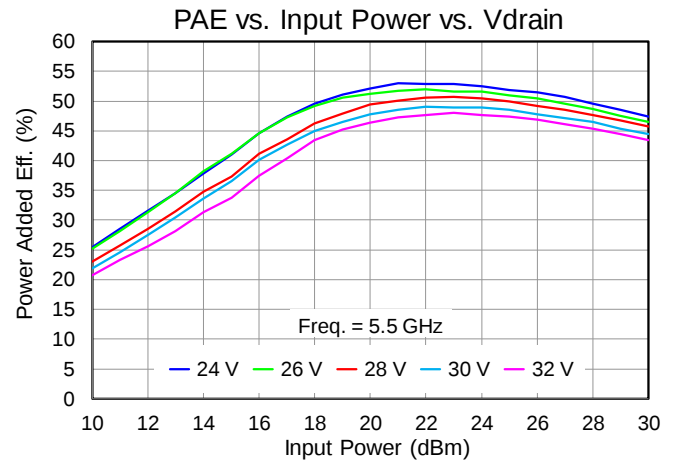
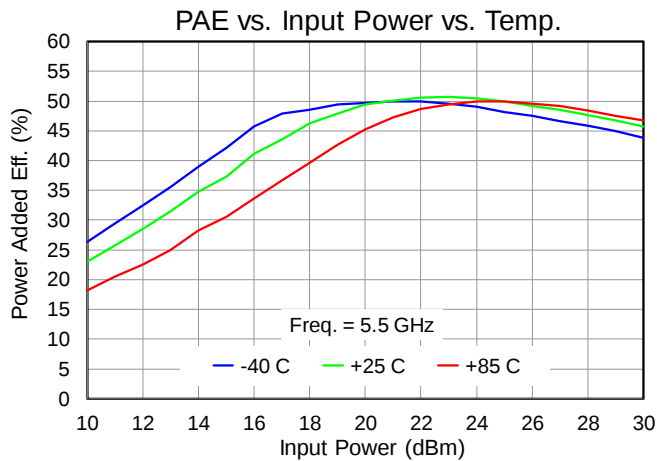
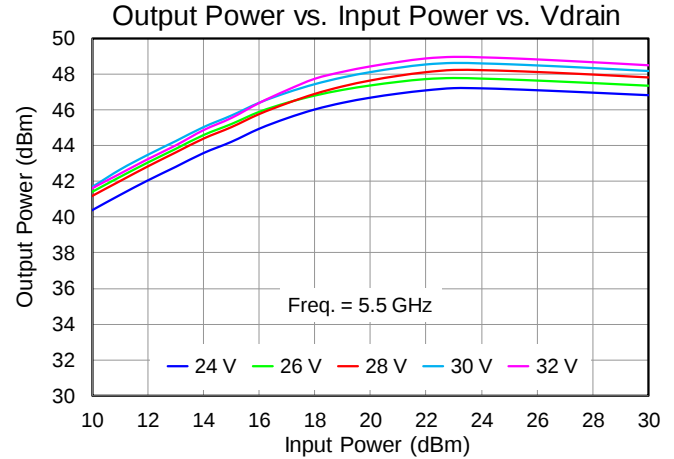
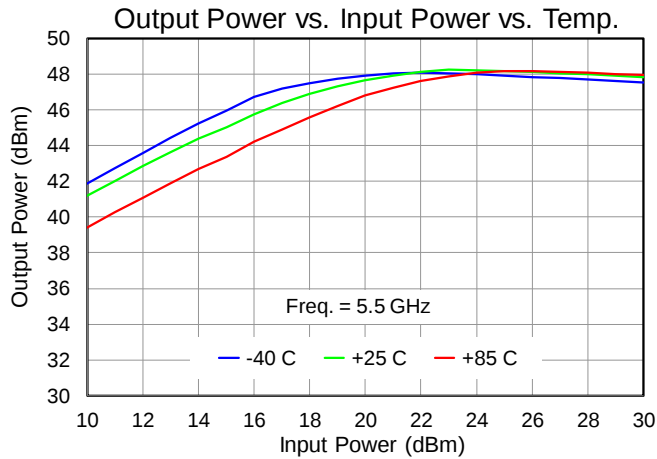
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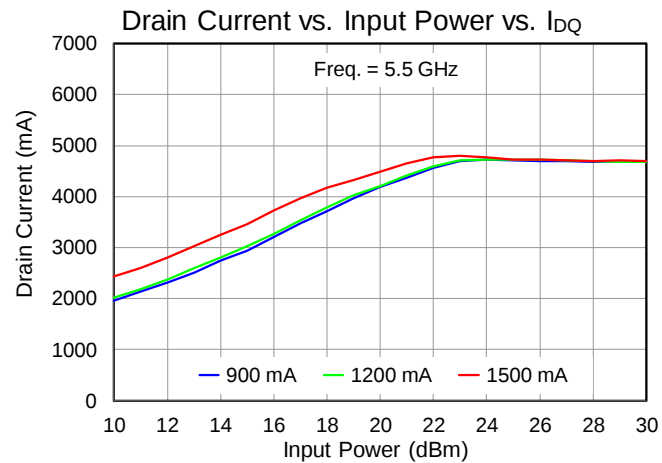
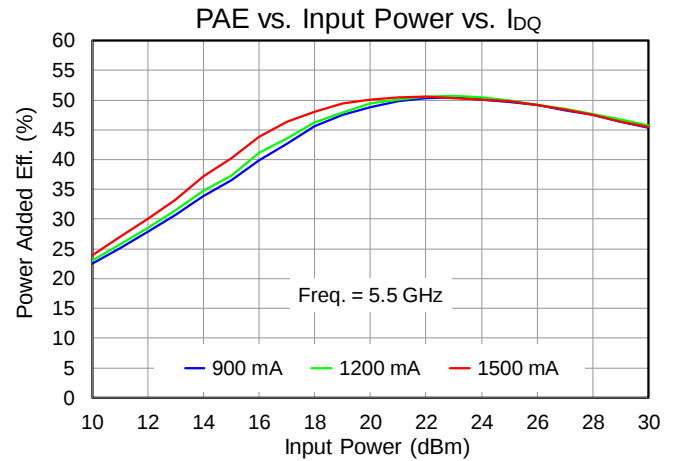
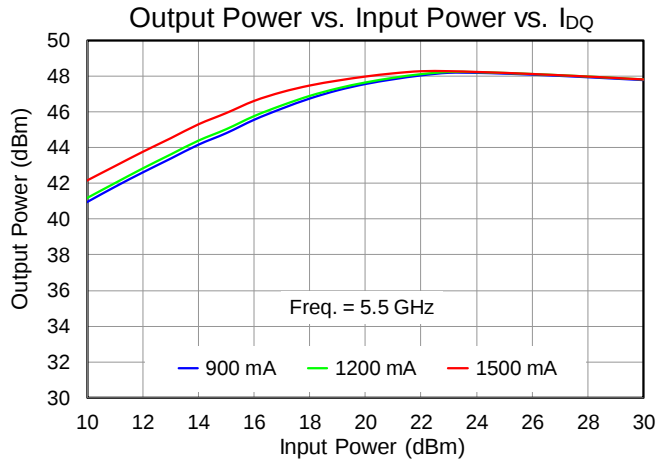
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Test conditions, unless otherwise noted:  $V_D = 28\text{ V}$ ,  $I_{DQ} = 1200\text{ mA}$ ,  $T = +25^\circ\text{C}$ ,  $PW = 600\text{ us}$ , Duty Cycle = 20%



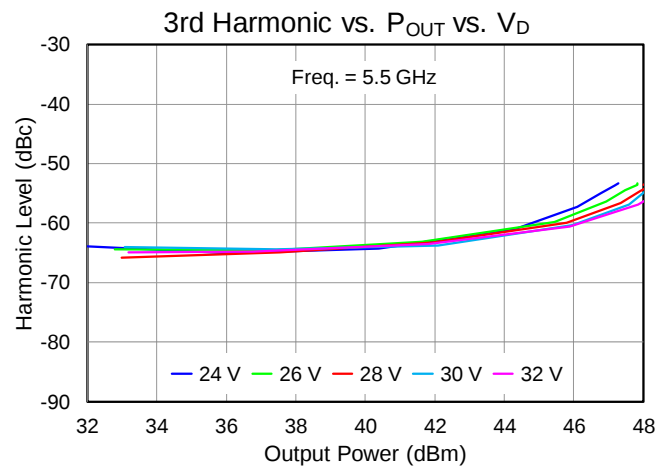
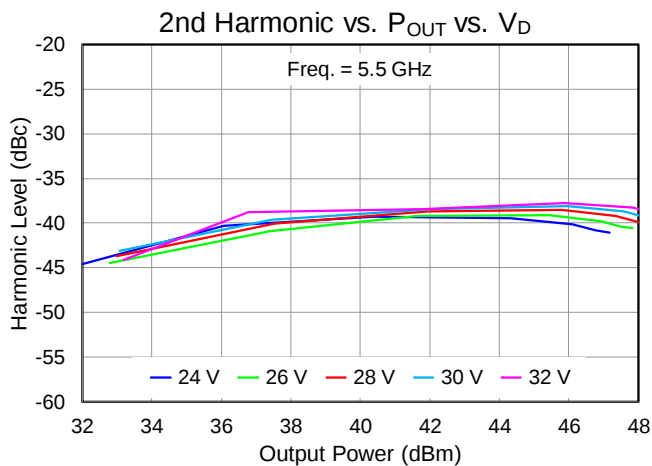
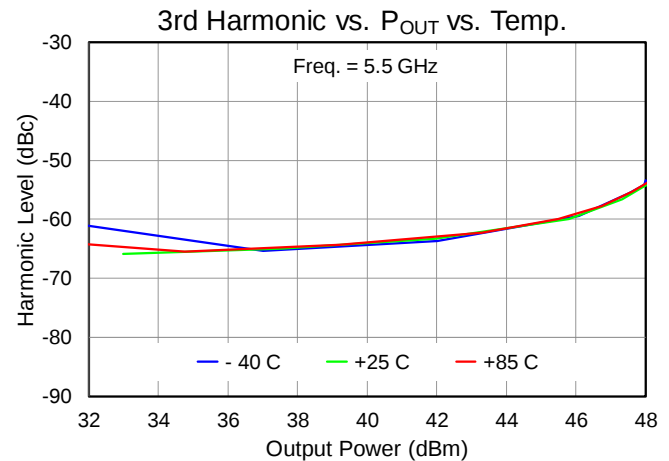
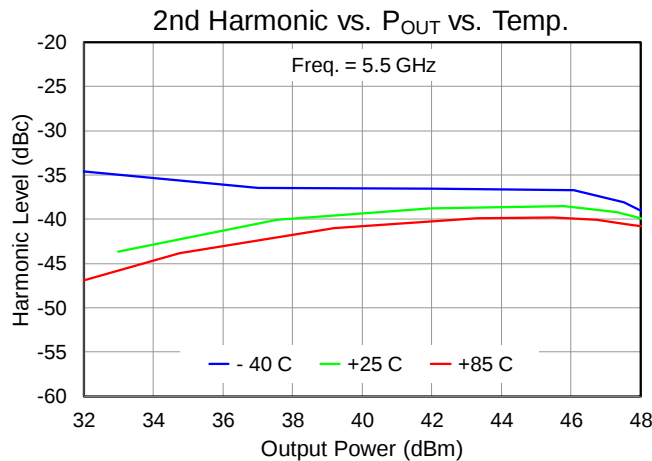
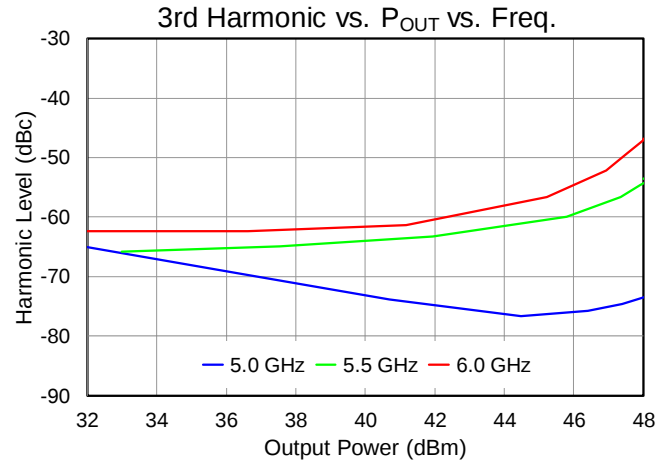
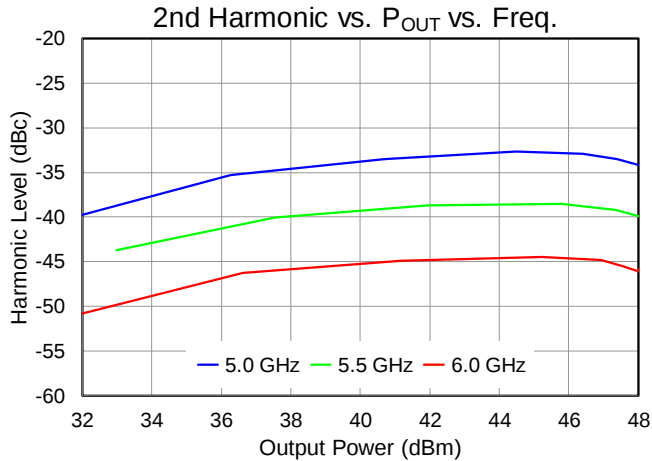
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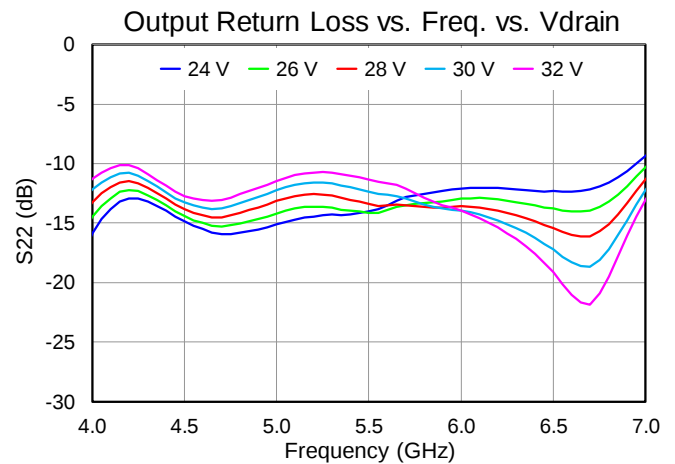
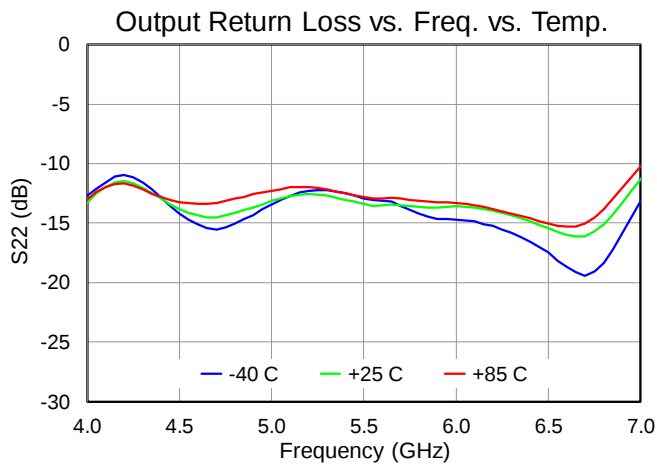
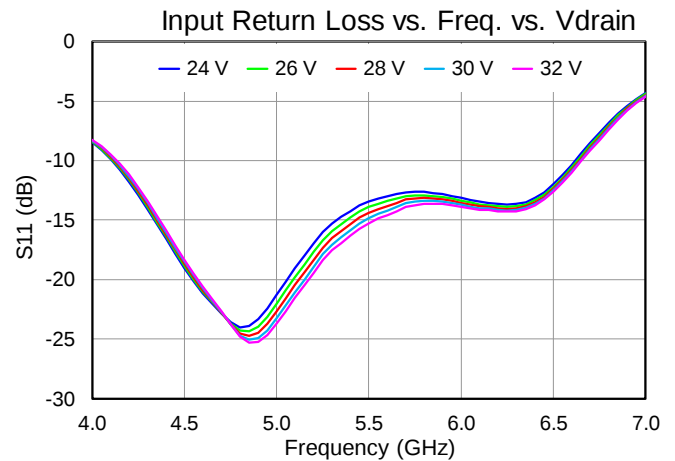
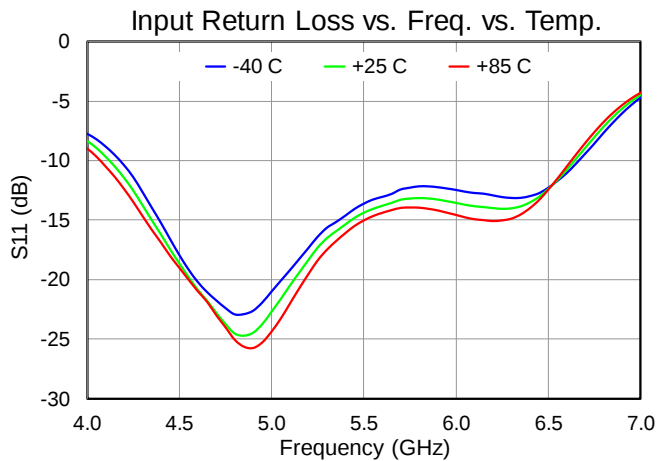
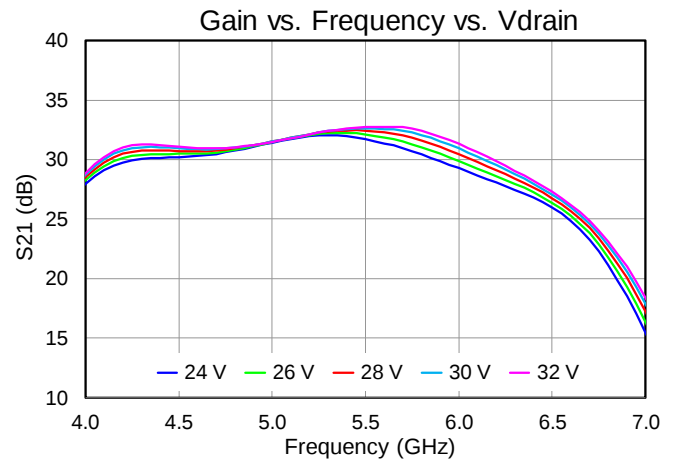
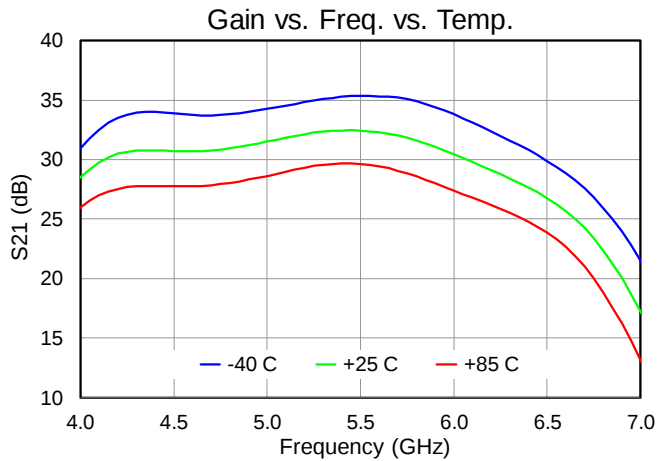
## Performance Plots – Harmonics

Test conditions, unless otherwise noted:  $V_D = 28\text{ V}$ ,  $I_{DQ} = 1200\text{ mA}$ ,  $T = +25^\circ\text{C}$ ,  $PW = 600\text{ us}$ , Duty Cycle = 20%



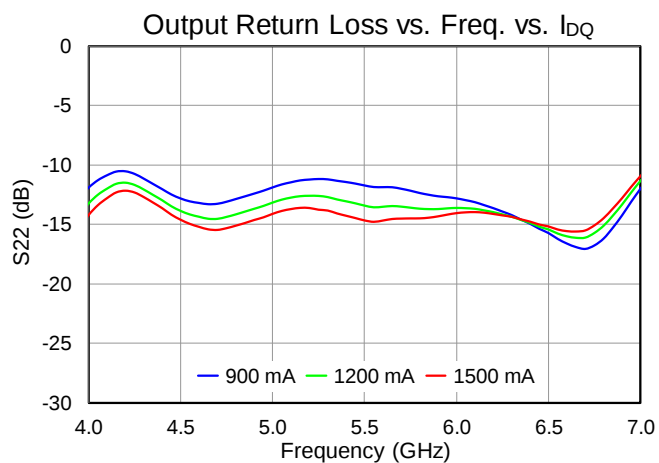
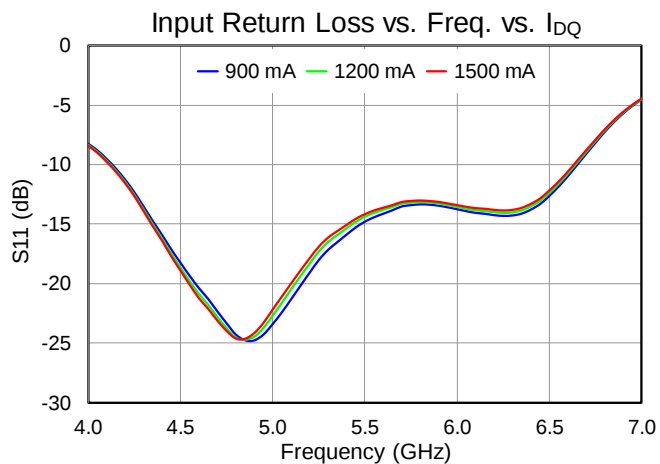
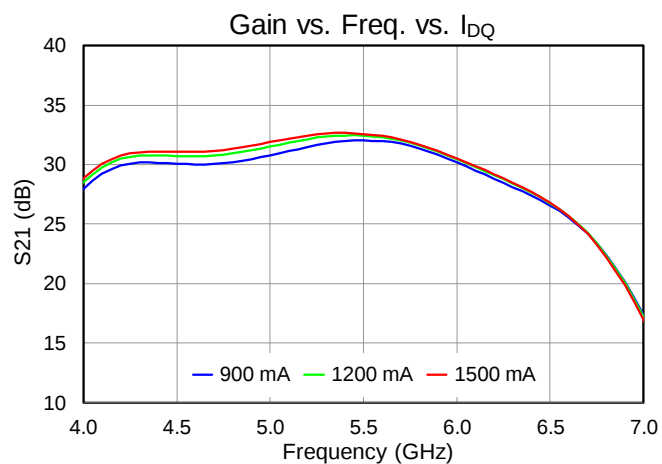
## Performance Plots – Small Signal

Test conditions, unless otherwise noted:  $V_D = 28\text{ V}$ ,  $I_{DQ} = 1200\text{ mA}$ ,  $T = +25^\circ\text{C}$



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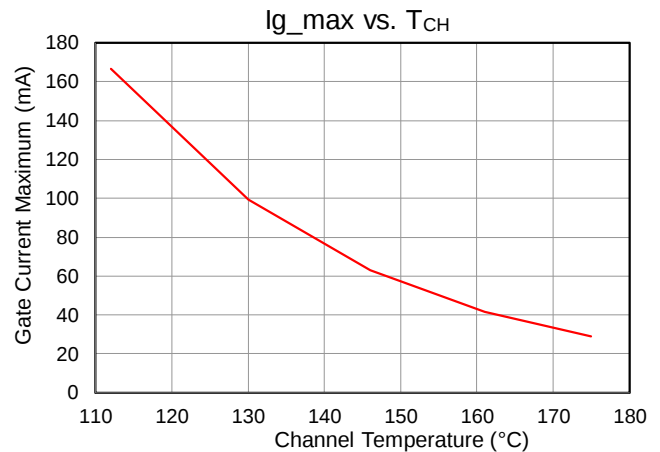
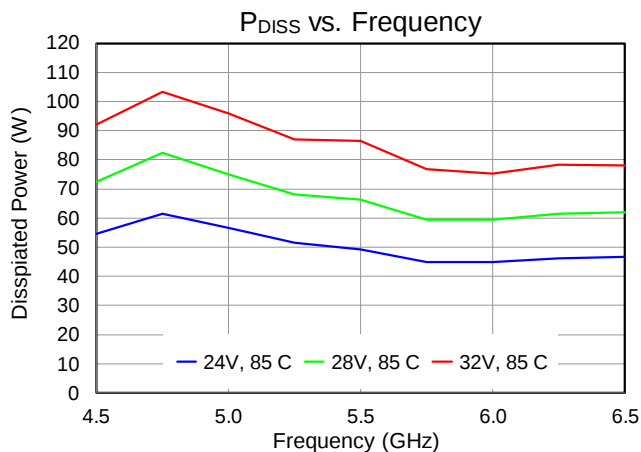
## Thermal and Reliability Information

| Parameter                                               | Test Conditions                                                                                                                                                                                                                | Value | Units                |
|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------|
| Thermal Resistance ( $\theta_{JC}$ ) <sup>(1)</sup>     | $T_{base} = 85^{\circ}\text{C}$ , $V_D = 28\text{ V}$ , $I_{DQ} = 1200\text{ mA}$ , $P_{DISS} = 33.6\text{ W}$ ,<br>No RF (quiescent DC operation)                                                                             | 0.65  | $^{\circ}\text{C/W}$ |
| Channel Temperature, $T_{CH}$ (No RF) <sup>(2)</sup>    |                                                                                                                                                                                                                                | 107   | $^{\circ}\text{C}$   |
| Thermal Resistance ( $\theta_{JC}$ ) <sup>(1)</sup>     | $T_{base} = 85^{\circ}\text{C}$ , $V_D = 28\text{ V}$ , $I_{DQ} = 1200\text{ mA}$ , Freq = 5.0 GHz,<br>$I_{D\_Drive} = 5.1\text{ A}$ , $P_{IN} = 26\text{ dBm}$ , $P_{OUT} = 48.2\text{ dBm}$ ,<br>$P_{DISS} = 75.1\text{ W}$  | 0.72  | $^{\circ}\text{C/W}$ |
| Channel Temperature, $T_{CH}$ (Under RF) <sup>(2)</sup> |                                                                                                                                                                                                                                | 139   | $^{\circ}\text{C}$   |
| Thermal Resistance ( $\theta_{JC}$ ) <sup>(1)</sup>     | $T_{base} = 85^{\circ}\text{C}$ , $V_D = 32\text{ V}$ , $I_{DQ} = 1200\text{ mA}$ , Freq = 5.0 GHz,<br>$I_{D\_Drive} = 5.41\text{ A}$ , $P_{IN} = 26\text{ dBm}$ , $P_{OUT} = 48.8\text{ dBm}$ ,<br>$P_{DISS} = 95.9\text{ W}$ | 0.73  | $^{\circ}\text{C/W}$ |
| Channel Temperature, $T_{CH}$ (Under RF) <sup>(2)</sup> |                                                                                                                                                                                                                                | 155   | $^{\circ}\text{C}$   |

Notes:

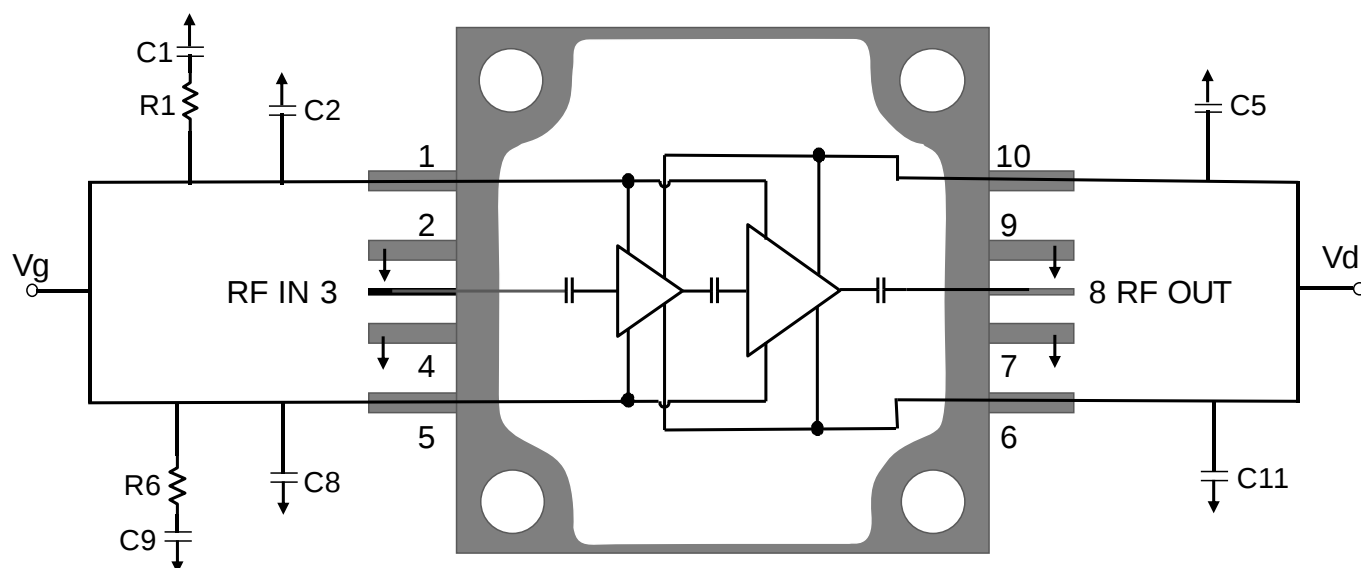
1. Thermal resistance is referenced to the back of package ( $85^{\circ}\text{C}$ )
2. Refer to the following document: [GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates](#)

## Dissipated Power and Maximum Gate Current



Test conditions, unless otherwise noted:  $V_D = 28\text{ V}$ ,  $I_{DQ} = 1200\text{ mA}$ ,  $P_{IN} = 26\text{ dBm}$ ,  $PW = 600\text{ us}$ , Duty Cycle = 20%

## Applications Information



Note: Both top and bottom of Vg and Vd should be biased.

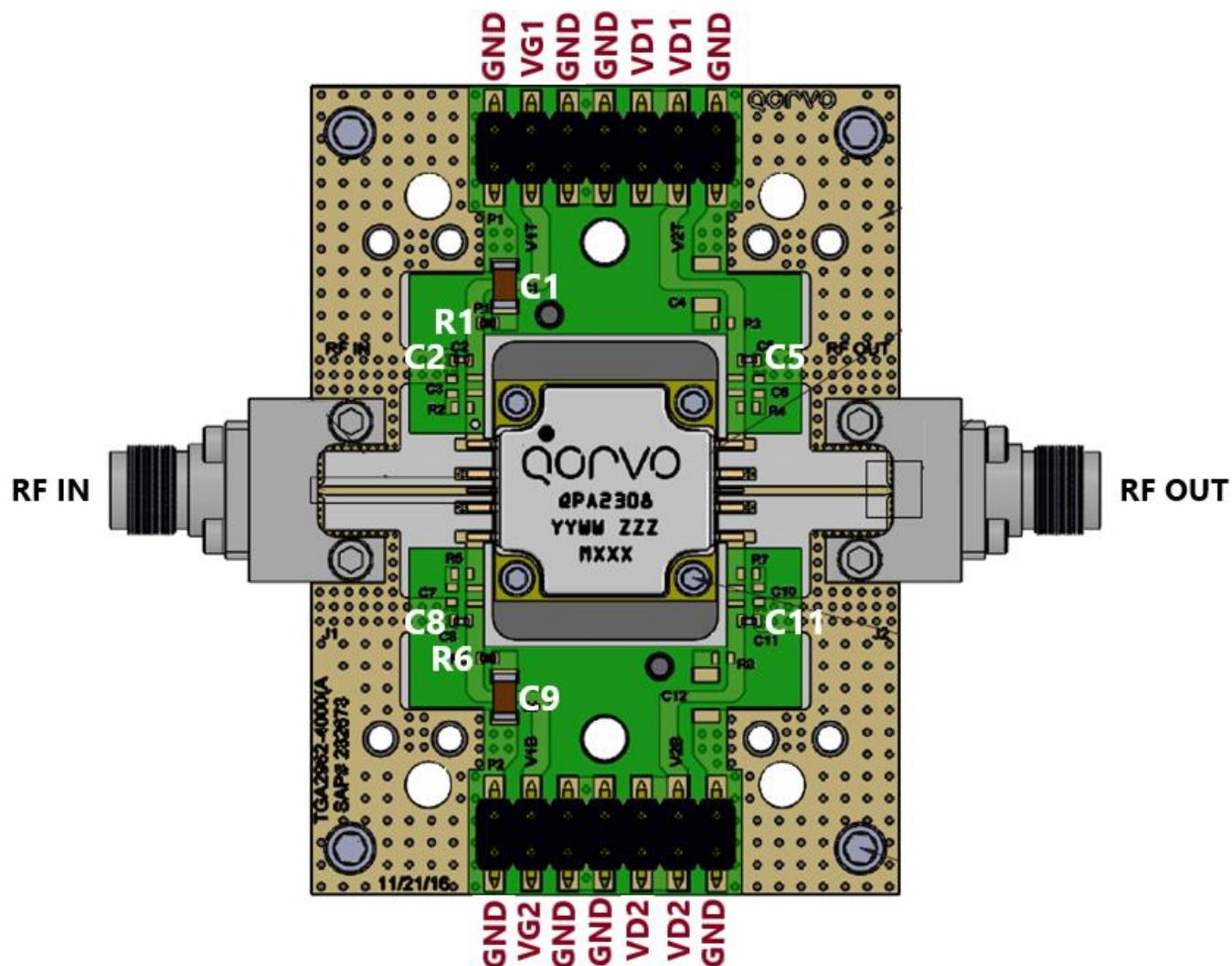
### Bias-Up Procedure

1. Set  $I_D$  limit to 5500 mA,  $I_G$  limit to 30 mA
2. Set  $V_G$  to -5.0 V
3. Set  $V_D$  +28 V
4. Adjust  $V_G$  more positive until  $I_{DQ} \approx 1200$  mA
5. Apply RF signal

### Bias-Down Procedure

1. Turn off RF signal
2. Reduce  $V_G$  to -5.0 V. Ensure  $I_{DQ} \sim 0$  mA
4. Set  $V_D$  to 0 V
5. Turn off  $V_D$  supply
6. Turn off  $V_G$  supply

## Evaluation Board (EVB) Layout Assembly



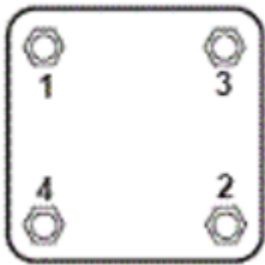
PCB is made from Rogers 6035HTC dielectric, .010 inch thick, 0.5 oz. copper both sides.

## Bill of Materials

| Reference Des.  | Value   | Description                           | Manuf.              | Part Number |
|-----------------|---------|---------------------------------------|---------------------|-------------|
| C1, C9          | 10 uF   | CAP, 10 uF, 20%, 50 V, 20%, X5R, 1206 | Various             |             |
| C2, C5, C8, C11 | 0.01 uF | CAP, 0.01 uF, 10%, 50 V, X7R, 0402    | Various             |             |
| R1, R6          | 5.1 Ω   | RES, 5.1 OHM, 5%, 50 V, 0402          | Various             |             |
| J1, J2          | 2.92 mm | CONNECTOR, FEMALE, ENDLAUNCH          | Southwest Microwave | 1092-01A-5  |

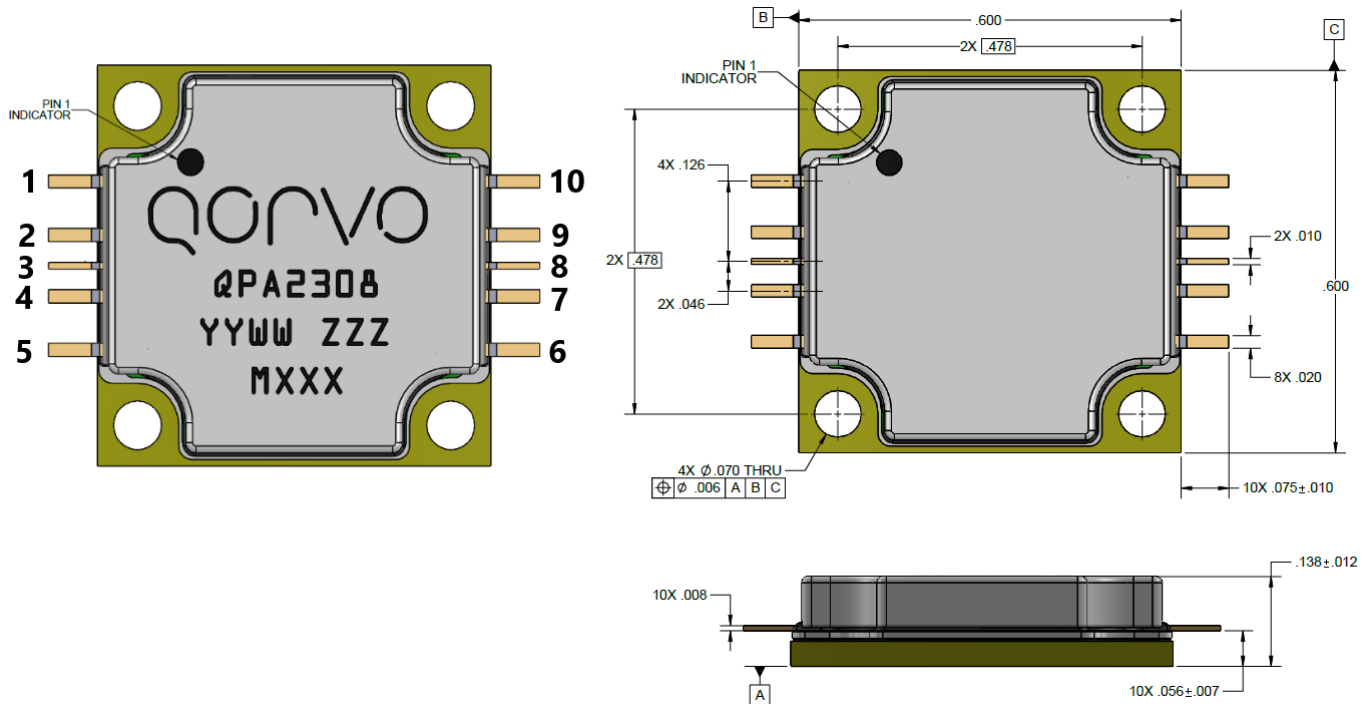
## Assembly Notes

1. Carefully clean the PC board and package leads with alcohol. Allow it to dry fully.
2. To improve the thermal and RF performance, Qorvo recommends attaching a heat sink to the bottom of the PCB and apply thermal compound (Arctic Silver 5 recommended) or 4 mil indium shim between the heat sink and the package.
3. (The following is for *information only*. There are many variables in a second level assembly that Qorvo does not control, so Qorvo does not recommend an absolute torque value.) Use screws to attach the component to the heat sink. A suggested torque value is 16 in-oz. for a 0-80 screw. Start with screws finger tight, then torque to 8 in-oz., then torque to final value. Use the following tightening pattern:



4. Apply no-flux solder to each pin of the QPA2308. The component leads should be manually soldered, and the package cannot be subjected to conventional reflow processes. The use of no-clean solder to avoid washing after soldering is recommended.

## Mechanical Information



Units: inches

Tolerances: unless specified; x.xxx =  $\pm 0.005$

Materials:

Base: Copper

Lid: LCP (Liquid Crystal Polymer)

Lead: Alloy 194

All metalized features are gold plated

Part is epoxy sealed

Marking:

2308: Part number

YY: Part Assembly year

WW: Part Assembly week

ZZZ: Serial Number

MXXX: Batch ID

## Pin Description

| Pin No. | Symbol | Description                                                                                |
|---------|--------|--------------------------------------------------------------------------------------------|
| 1,5     | VG     | Gate Voltage; Bias network is required; must be biased from both sides; refer to page 13.  |
| 3       | RF IN  | RF output. 50 Ohms. DC blocked.                                                            |
| 2,4,7,9 | GND    | Must be grounded on the PCB.                                                               |
| 6,10    | VD     | Drain voltage; Bias network is required; must be biased from both sides; refer to page 13. |
| 8       | RF OUT | RF output. 50 Ohms. DC blocked.                                                            |

## Handling Precautions

| Parameter                    | Rating | Standard              |
|------------------------------|--------|-----------------------|
| ESD – Human Body Model (HBM) | 1A     | ANSI/ESD/JEDEC JS-001 |



Caution!  
ESD-Sensitive Device

## Solderability

Compatible with the latest version of J-STD-020. Lead-free solder, 260 °C.

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

## Contact Information

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

**Web:** [www.qorvo.com](http://www.qorvo.com)

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

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

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