

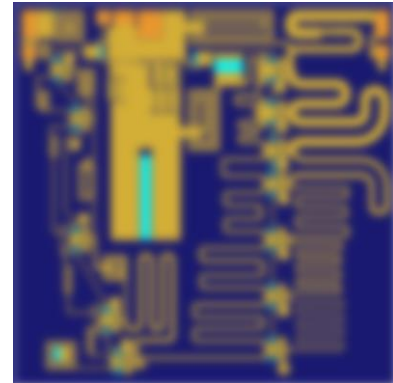
Product Overview

Qorvo’s QPA2213D is a wide band driver amplifier MMIC fabricated on Qorvo’s production 0.15 um GaN on SiC process (QGaN15). Covering 2.0–20.0 GHz, the QPA2213D provides > 2 W of saturated output power and 16 dB of large-signal gain while achieving > 23% power-added efficiency.

The QPA2213D MMIC dimensions are 2.75 x 2.75 x 0.10 mm. It can support a variety of operating conditions to best support system requirements. With good thermal properties, it can support a range of bias voltages.

The QPA2213D has DC blocking capacitors on both RF ports, which are matched to 50 ohms. The QPA2213D is ideal for both commercial and military wide band or narrow band systems.

Lead-free and RoHS compliant.

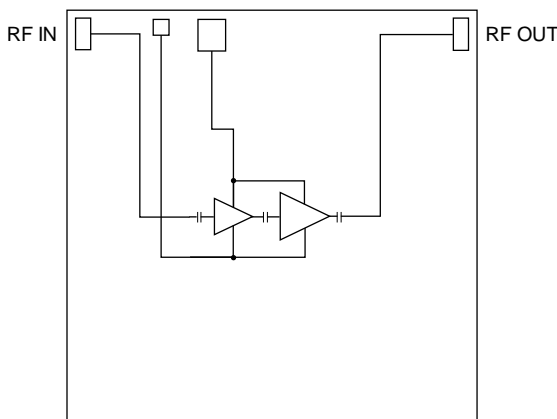


Key Features

- Frequency Range: 2 – 20 GHz
- P_{SAT} (P_{IN}=18 dBm): 34 dBm
- PAE (P_{IN}=18 dBm): 23 %
- Power Gain (P_{IN}=18 dBm): 16 dB
- Small Signal Gain: 25 dB
- Noise Figure: 4.0 dB
- Bias: V_D = 18 V, I_{DQ} = 330 mA, P_{IN} = 18 dBm
- Die Dimensions: 2.75 x 2.75 x 0.10 mm

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

Functional Block Diagram



Top View

Applications

- HPA Driver Amplifier
- Radar Systems

Ordering Information

| Part No. | Description |
|--------------|--|
| QPA2213D | 2 –20 GHz 2 Watt GaN Amplifier (10 Pcs.) |
| QPA2213DS2 | Samples (2 pcs.) |
| QPA2213DEVB1 | Evaluation Board for QPA2213D |

Absolute Maximum Ratings

| Parameter | Value / Range |
|---|-----------------|
| Drain Voltage (V_D) | 29.5 V |
| Gate Voltage Range (V_G) | -4 V to 0 V |
| Drain Current (I_D) | 890 mA |
| Gate Current (I_G) | See plot pg. 23 |
| Power Dissipation (P_{DISS}), 85 °C | 13.7 W |
| Input Power (P_{IN}), 50 Ω , $V_D=18$ V, $I_{DQ}=330$ mA, 85 °C | 20 dBm |
| Input Power (P_{IN}), 3:1 VSWR, $V_D=18$ V, $I_{DQ}=330$ mA, 85 °C | 17 dBm |
| Soldering Temperature | 260 °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) | 18 V |
| Drain Current (I_{DQ}) | 330 mA |
| Operating Temperature | -40 to +85 °C |

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

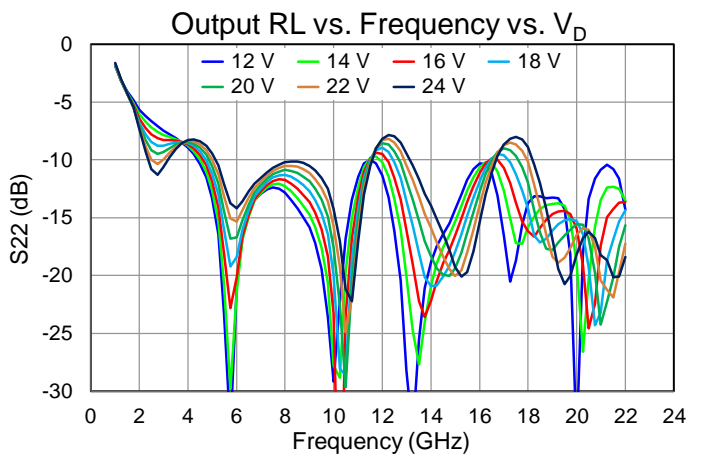
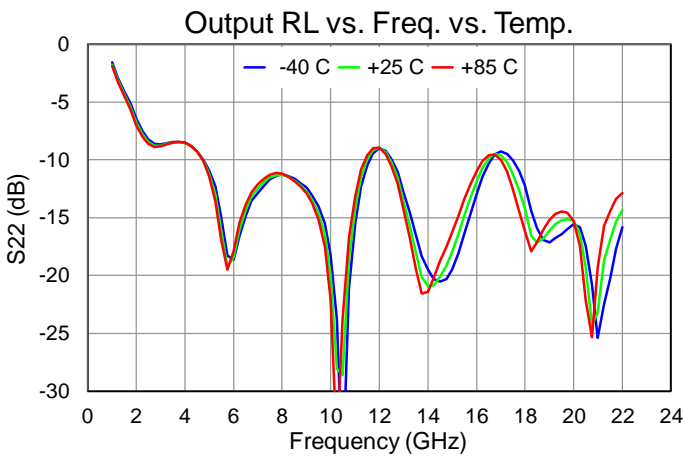
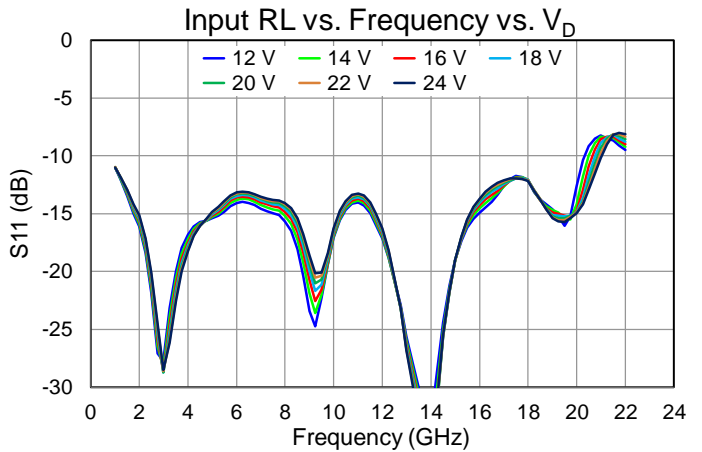
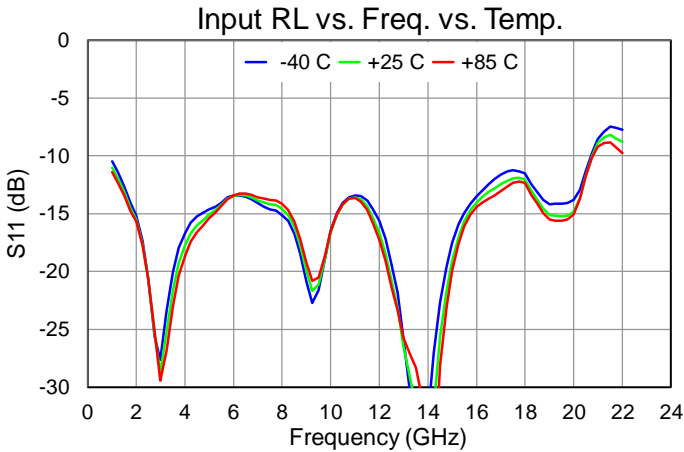
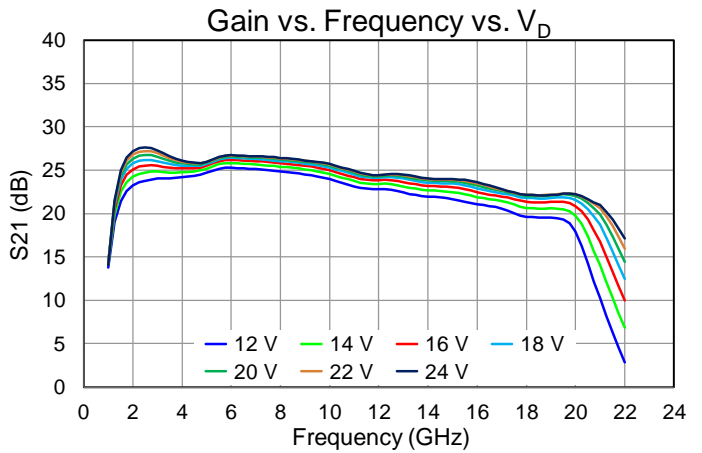
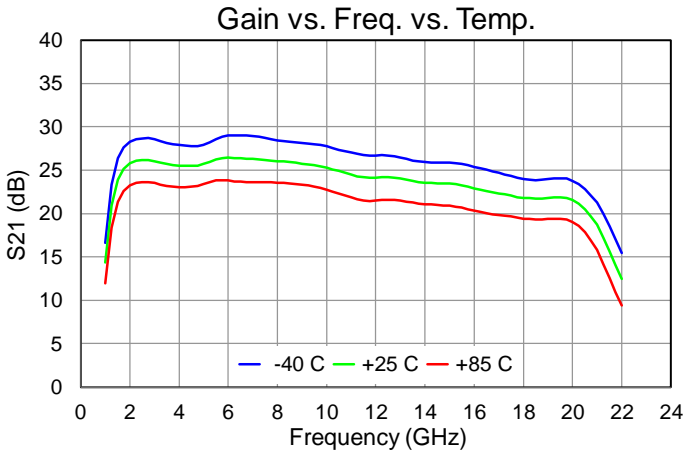
Electrical Specifications

| Parameter | | Min | Typ | Max | Units |
|---|--------|-----|--------|-----|-------|
| Operational Frequency | | 2 | | 20 | GHz |
| Output Power (P _{IN} =18 dBm) | 2 GHz | | 34.2 | | dBm |
| | 6 GHz | | 34.9 | | dBm |
| | 10 GHz | | 34.5 | | dBm |
| | 15 GHz | | 34.4 | | dBm |
| | 20 GHz | | 33.7 | | dBm |
| Power Added Efficiency (P _{IN} =18 dBm) | 2 GHz | | 37.1 | | % |
| | 6 GHz | | 24.7 | | % |
| | 10 GHz | | 24.4 | | % |
| | 15 GHz | | 22.7 | | % |
| | 20 GHz | | 21.4 | | % |
| Small Signal Gain | 2 GHz | | 25.8 | | dB |
| | 6 GHz | | 26.4 | | dB |
| | 10 GHz | | 25.3 | | dB |
| | 15 GHz | | 23.4 | | dB |
| | 20 GHz | | 21.6 | | dB |
| Input Return Loss | 2 GHz | | 16 | | dB |
| | 6 GHz | | 14 | | dB |
| | 10 GHz | | 17 | | dB |
| | 15 GHz | | 19 | | dB |
| | 20 GHz | | 15 | | dB |
| Output Return Loss | 2 GHz | | 7 | | dB |
| | 6 GHz | | 18 | | dB |
| | 10 GHz | | 20 | | dB |
| | 15 GHz | | 18 | | dB |
| | 20 GHz | | 15 | | dB |
| Noise Figure | 2 GHz | | 7.6 | | dB |
| | 6 GHz | | 4.5 | | dB |
| | 10 GHz | | 3.2 | | dB |
| | 15 GHz | | 4.0 | | dB |
| | 20 GHz | | 5.3 | | dB |
| IMD3 (P _{OUT} /Tone=27 dBm) (100 MHz tone spacing) | 2 GHz | | -23.6 | | dBc |
| | 6 GHz | | -21.9 | | dBc |
| | 10 GHz | | -21.9 | | dBc |
| | 15 GHz | | -21.8 | | dBc |
| | 20 GHz | | -20.3 | | dBc |
| P _{OUT} Temp. Coeff. (85 °C to 25 °C, P _{IN} = 18 dBm)) | | | -0.004 | | dB/°C |
| Sm. Sig. Gain Temp. Coefficient (85 °C to -40 °C) | | | -0.040 | | dB/°C |

Test conditions, unless otherwise noted: T = 25 °C, V_D = 18 V, I_{DQ} = 330 mA

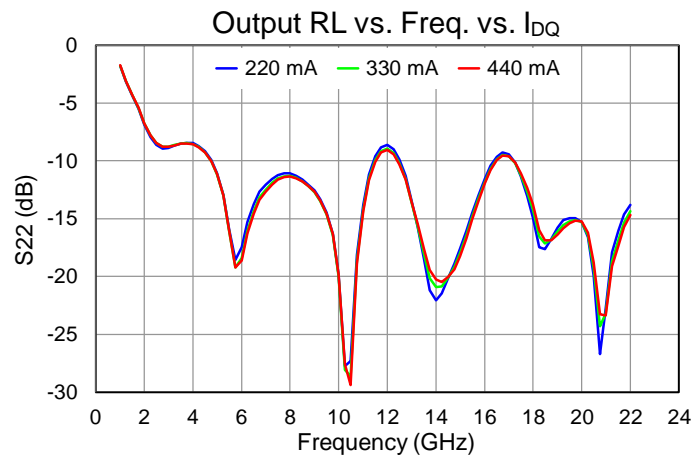
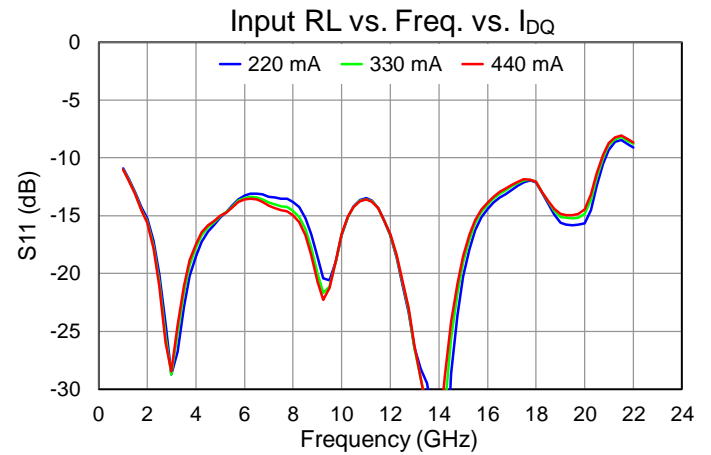
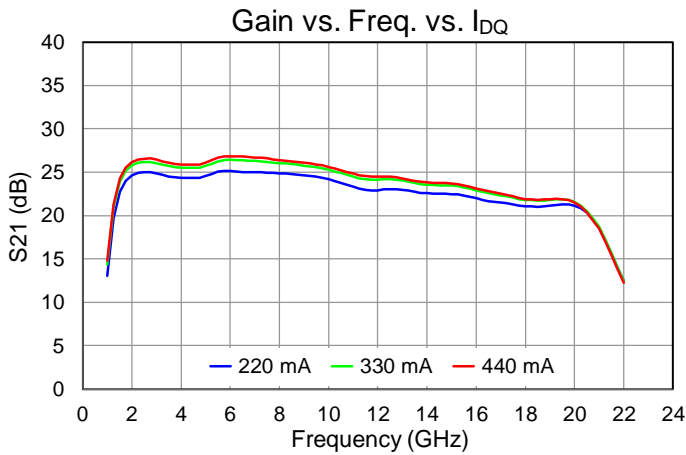
Performance Plots – Small Signal

Test conditions, unless otherwise noted: $V_D = 18\text{ V}$, $I_{DQ} = 330\text{ mA}$, $T = +25\text{ }^\circ\text{C}$



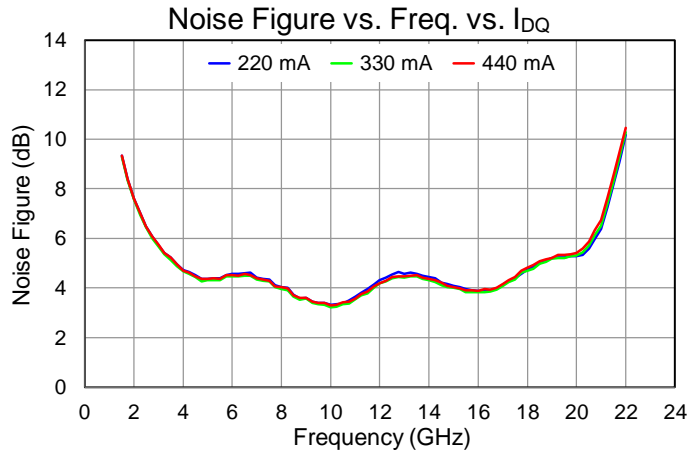
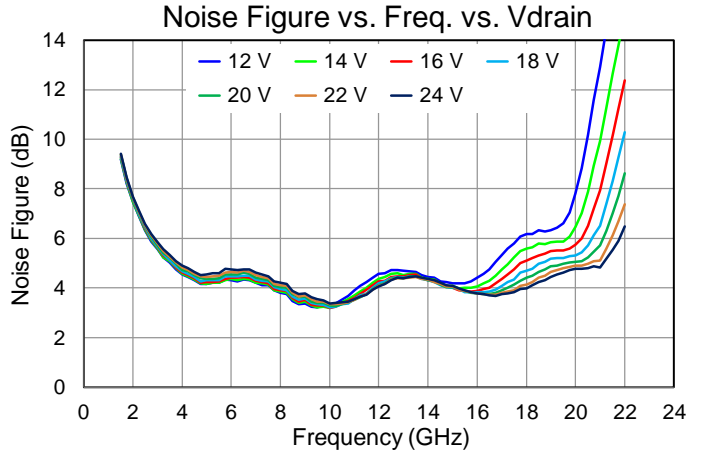
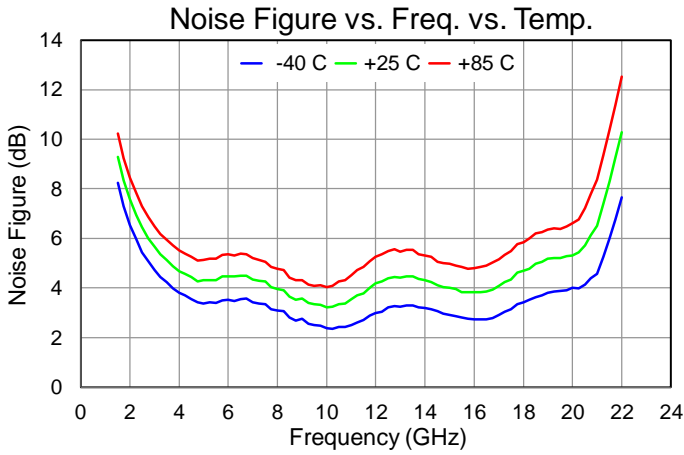
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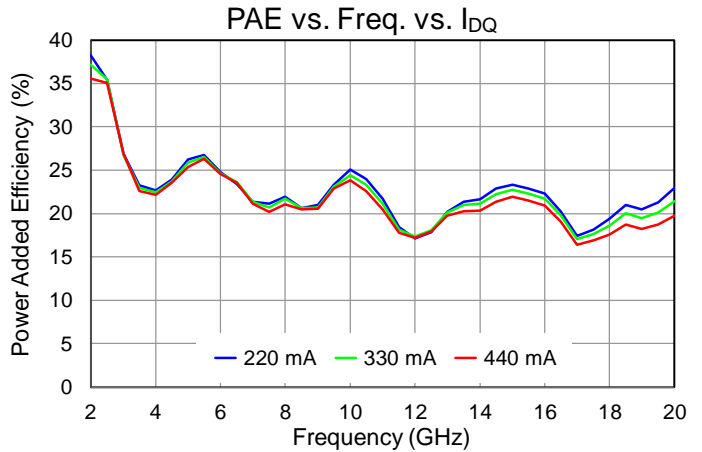
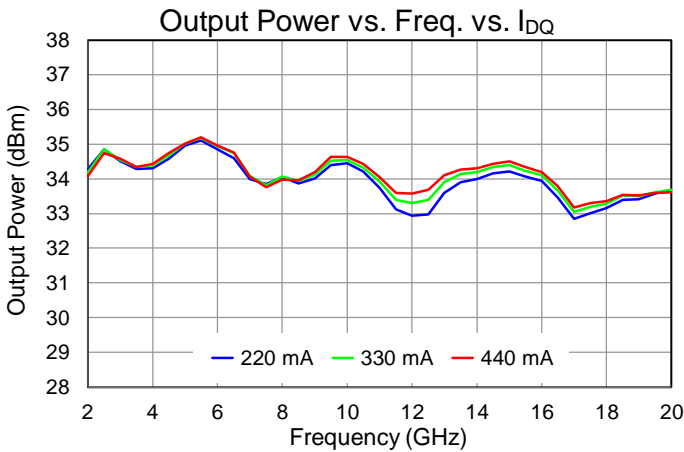
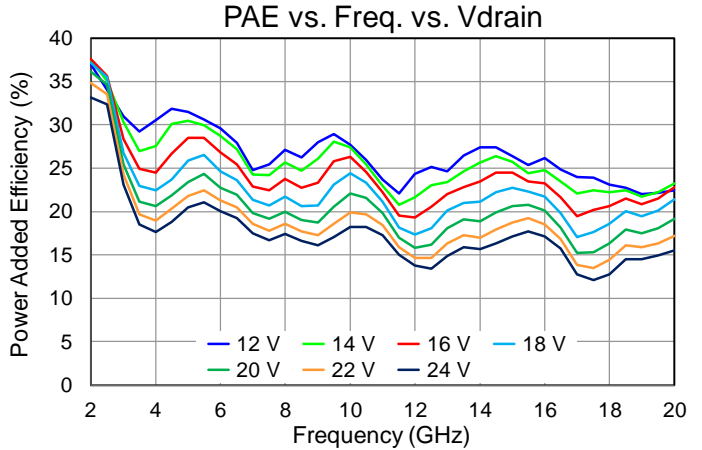
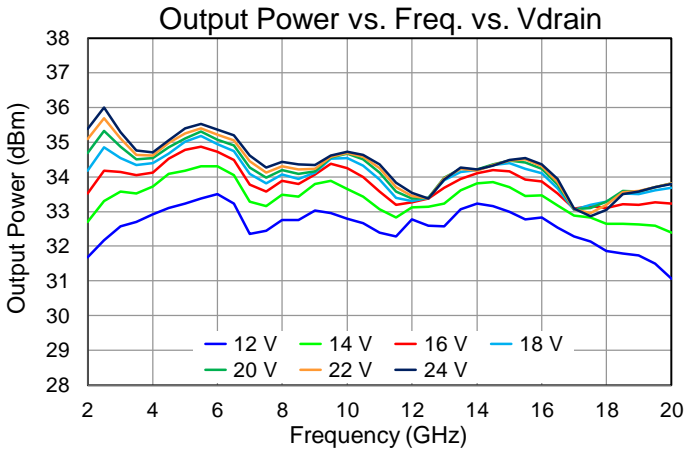
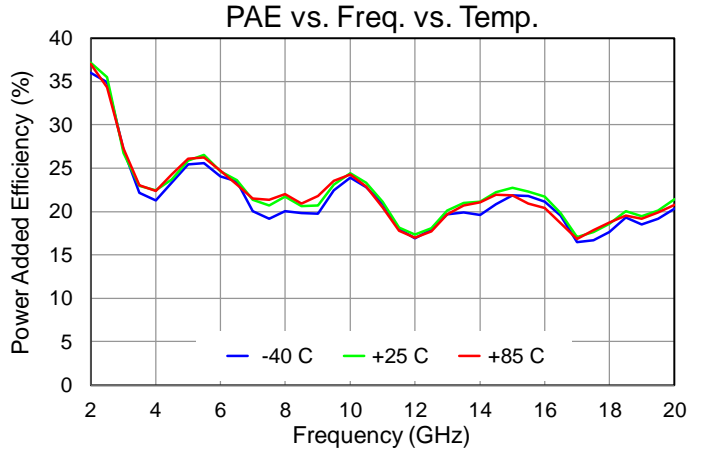
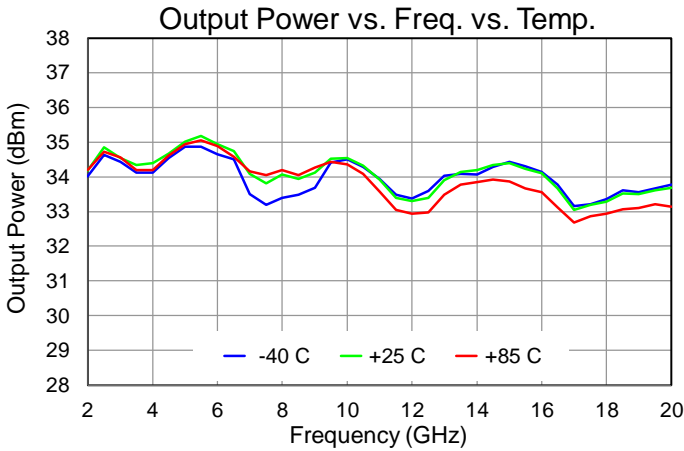
Performance Plots – Noise Figure

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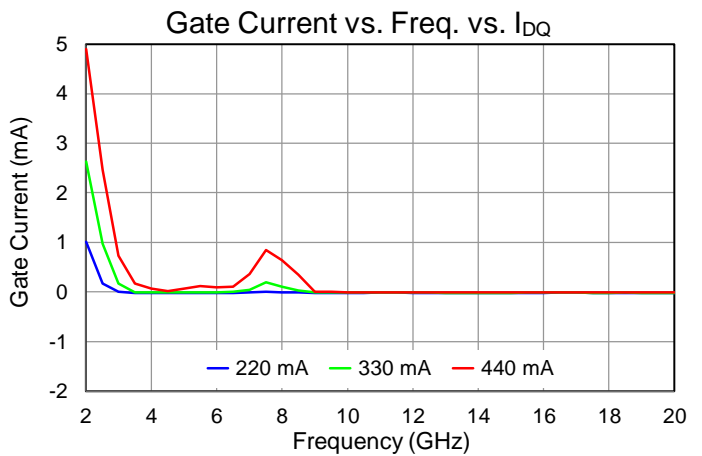
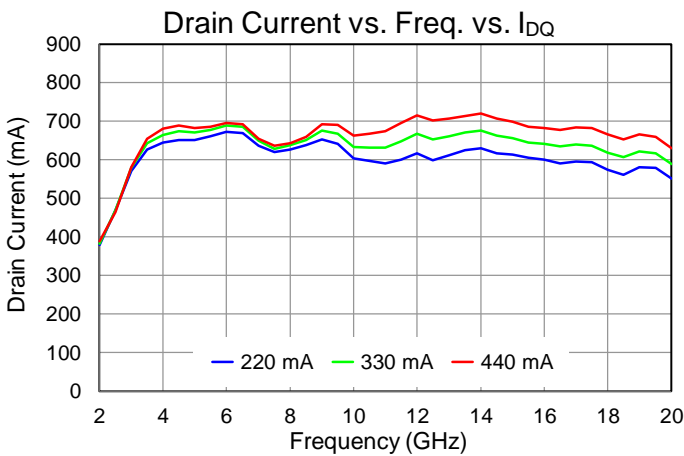
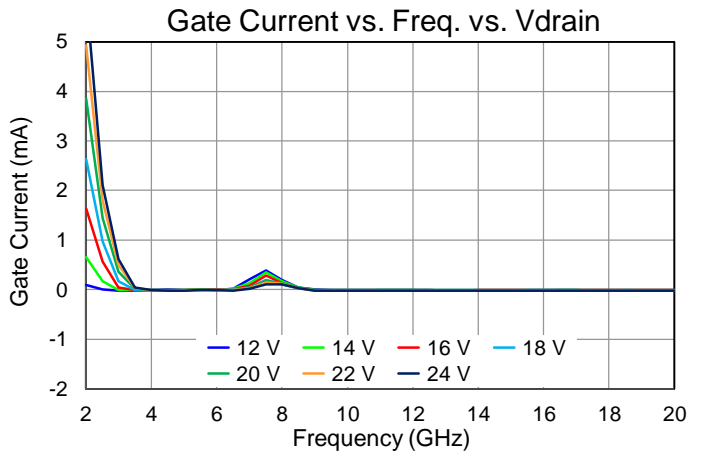
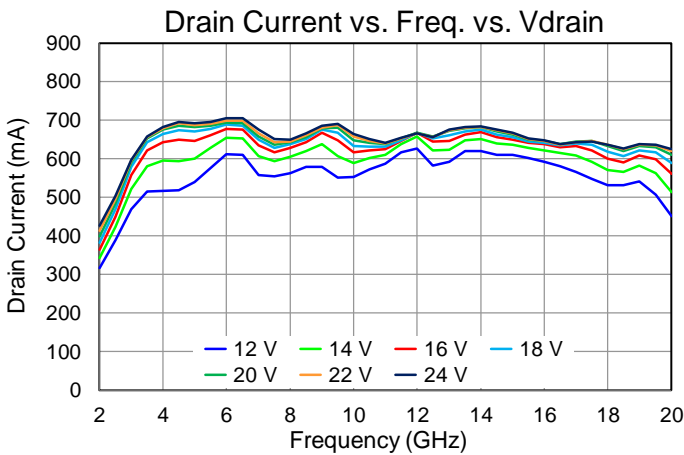
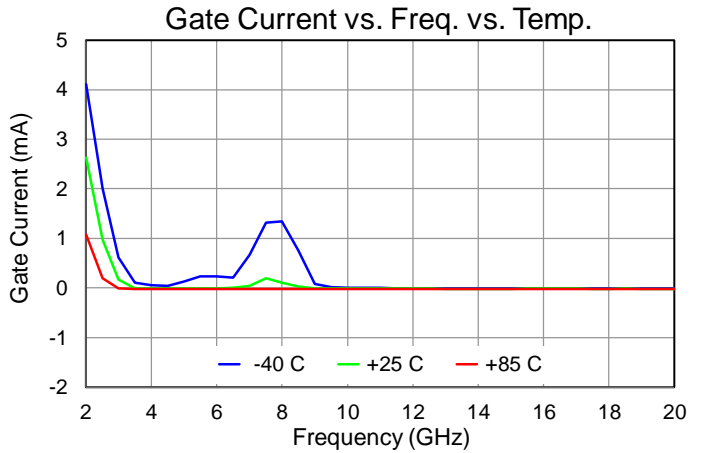
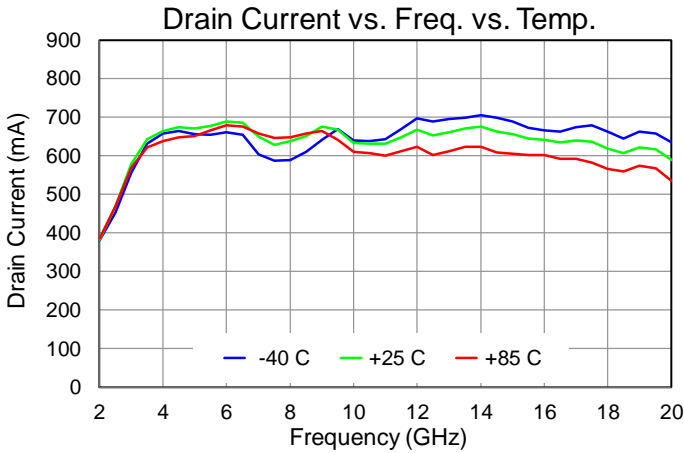
Performance Plots – Large Signal

Test conditions, unless otherwise noted: $V_D = 18\text{ V}$, $I_{DQ} = 330\text{ mA}$, $T = +25\text{ }^\circ\text{C}$, $P_{in} = 18\text{ dBm}$



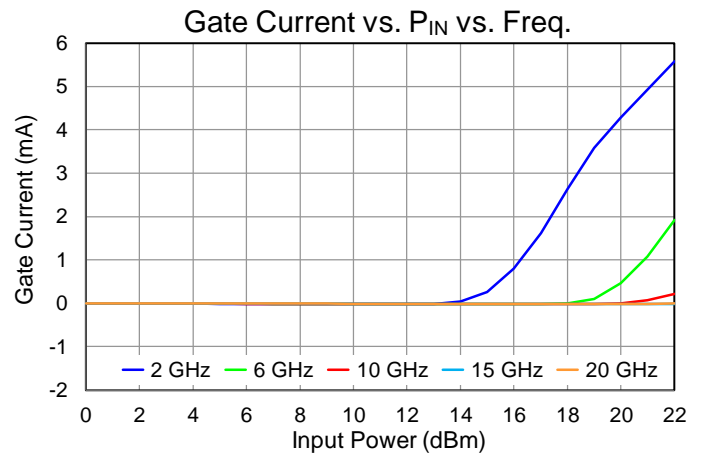
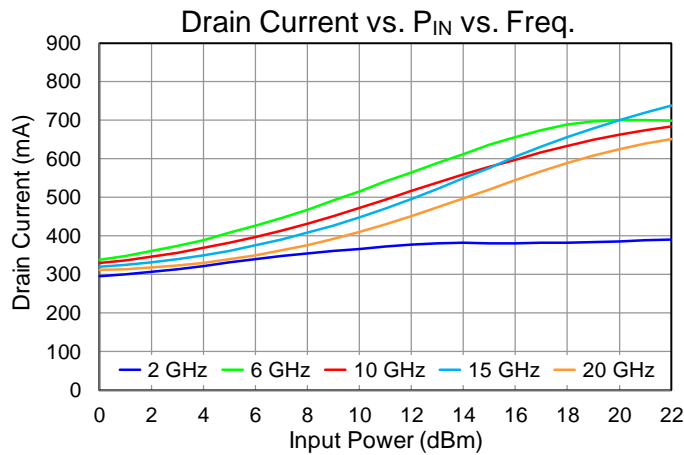
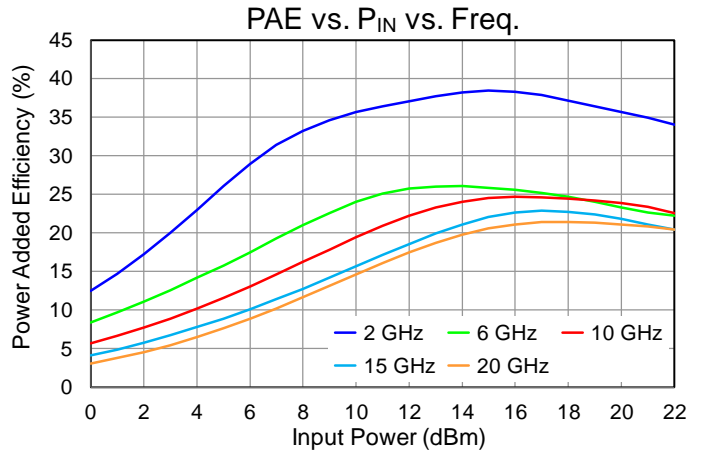
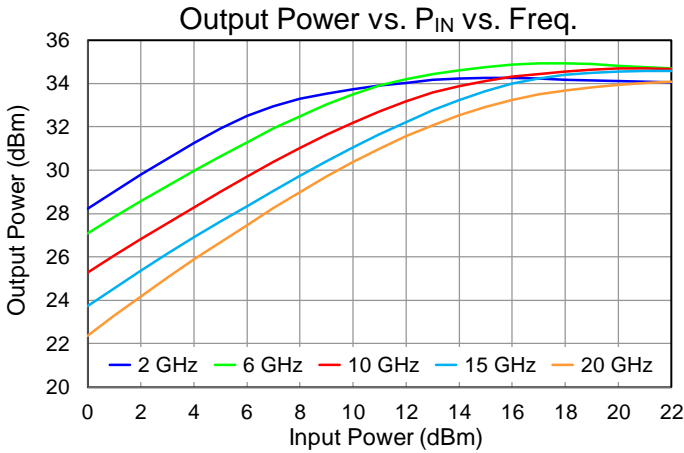
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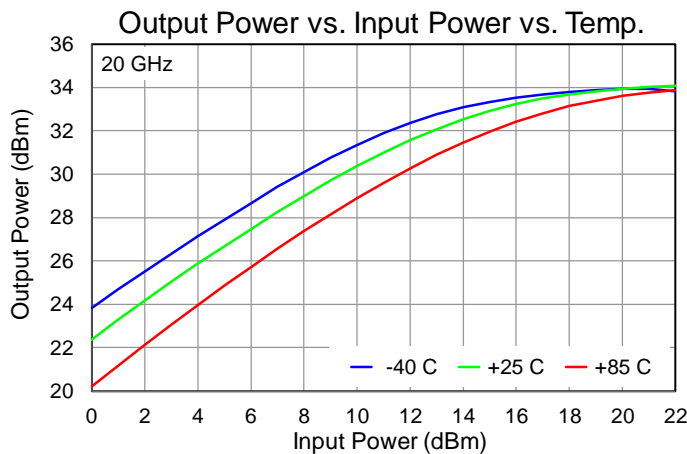
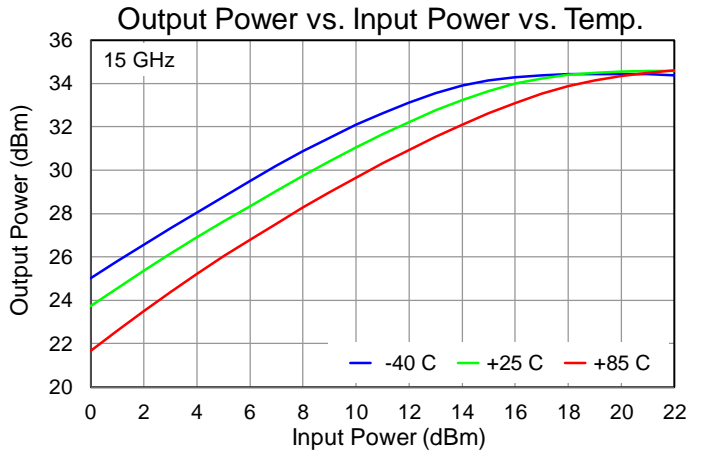
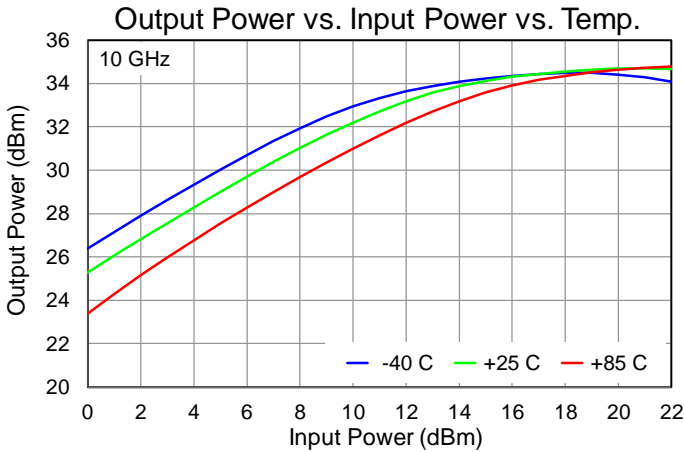
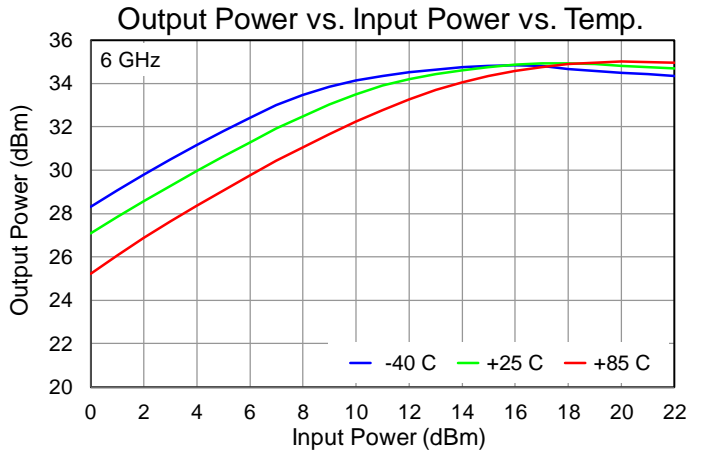
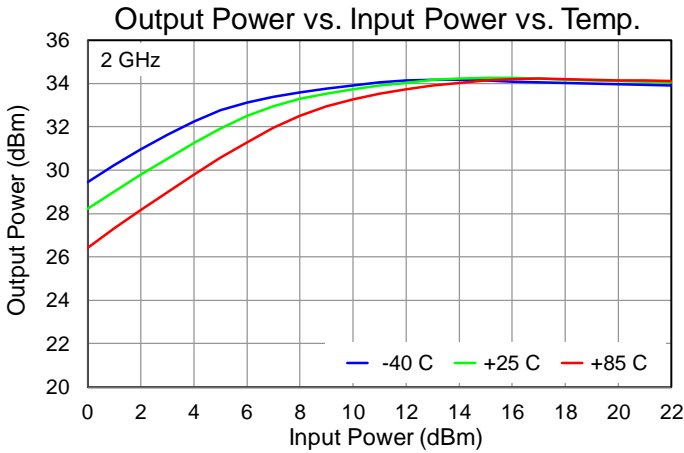
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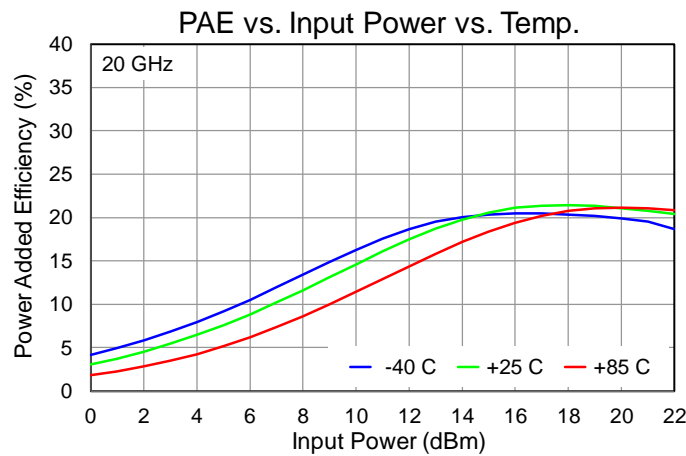
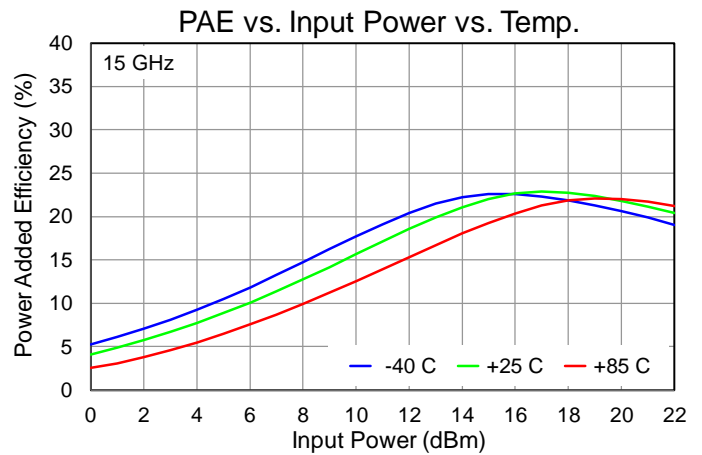
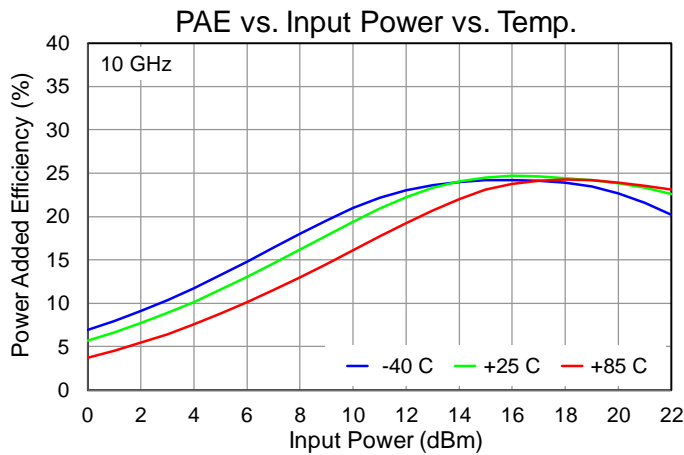
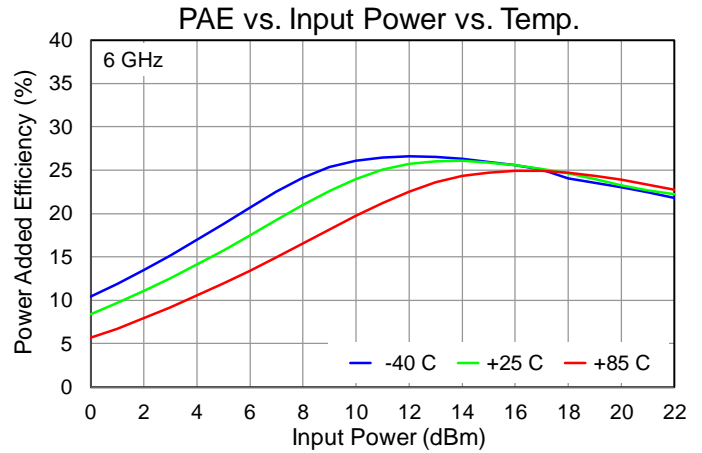
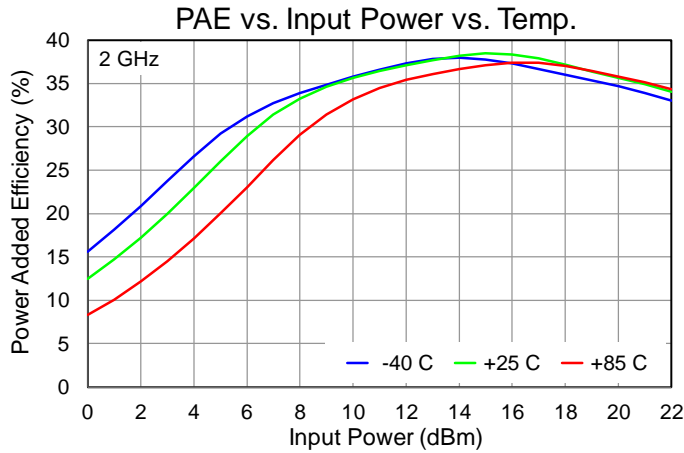
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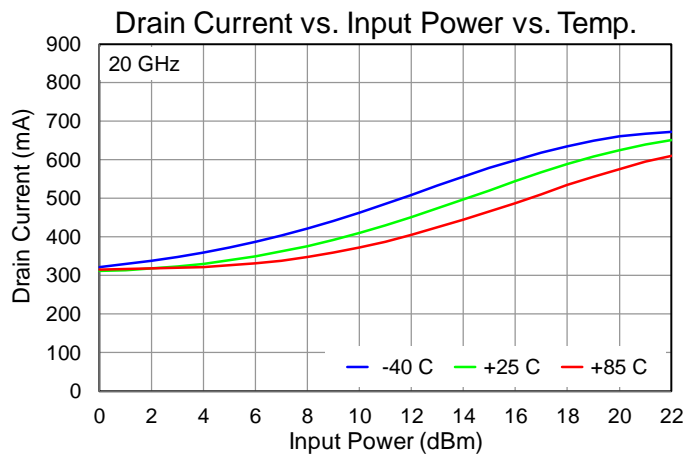
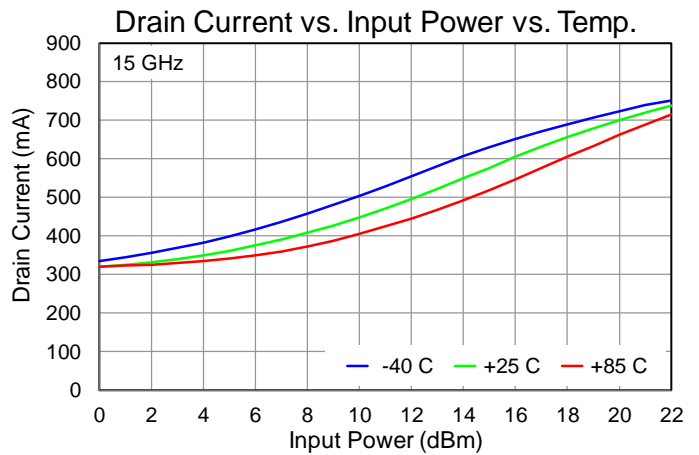
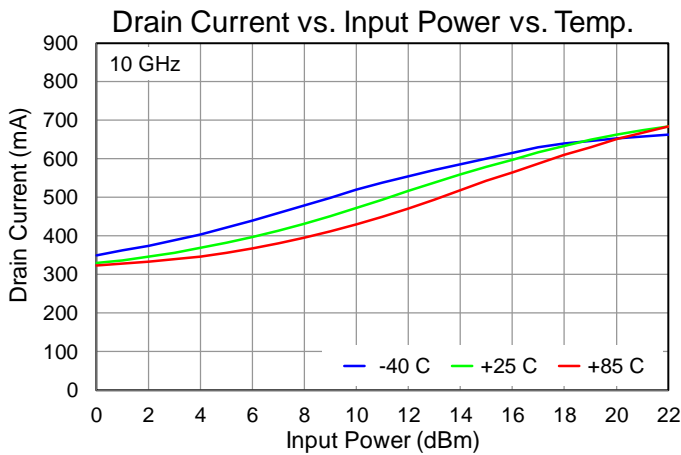
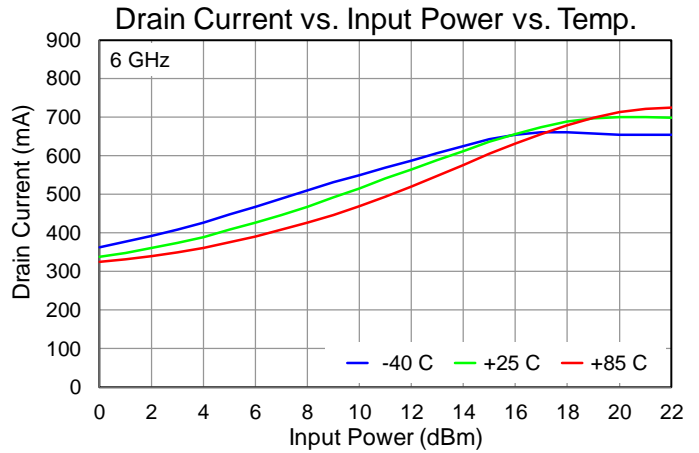
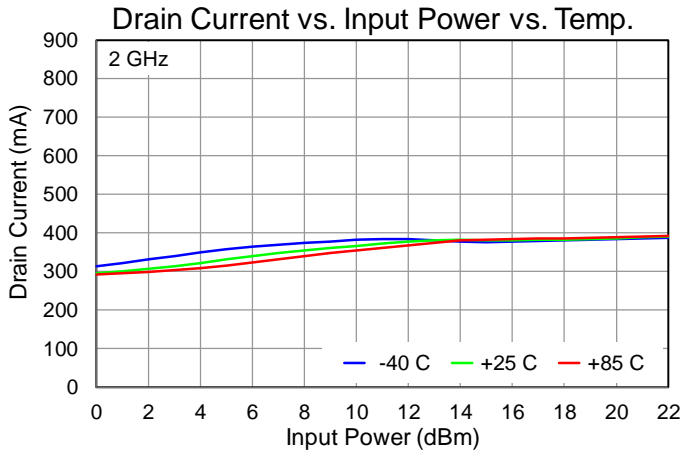
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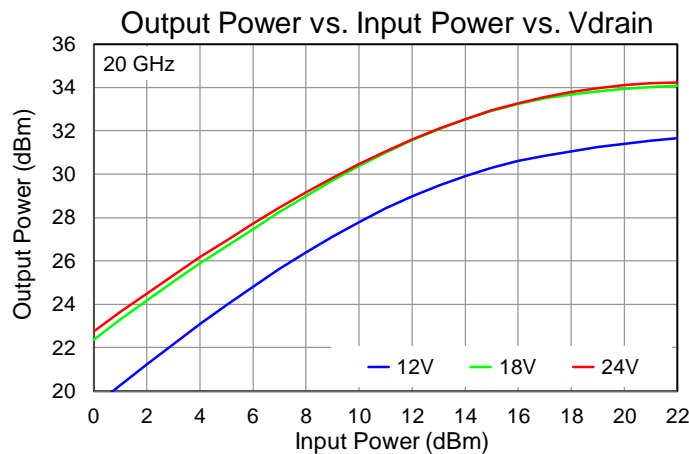
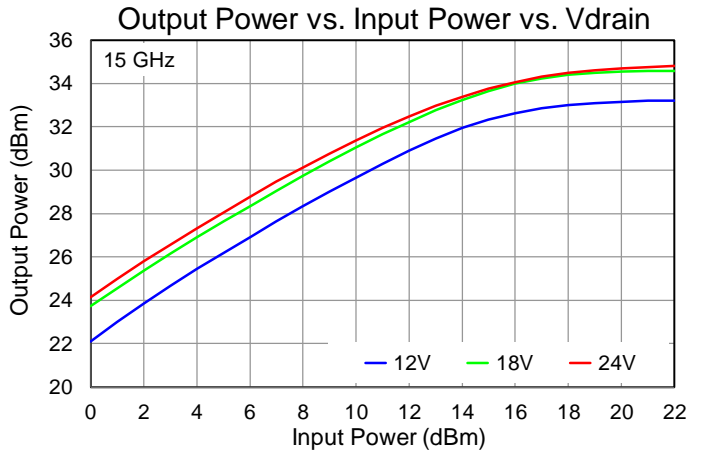
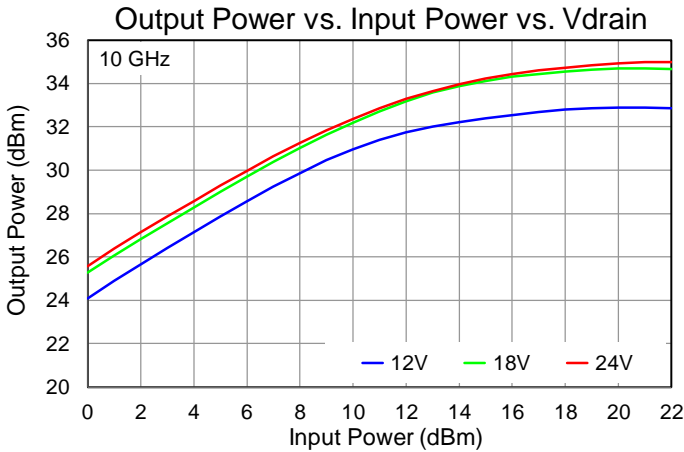
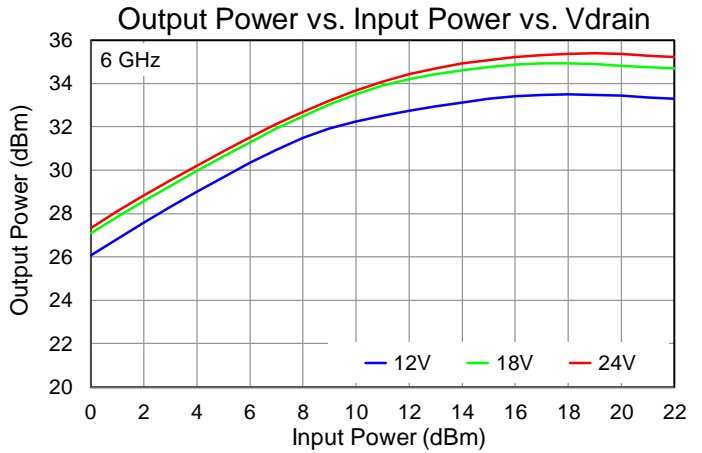
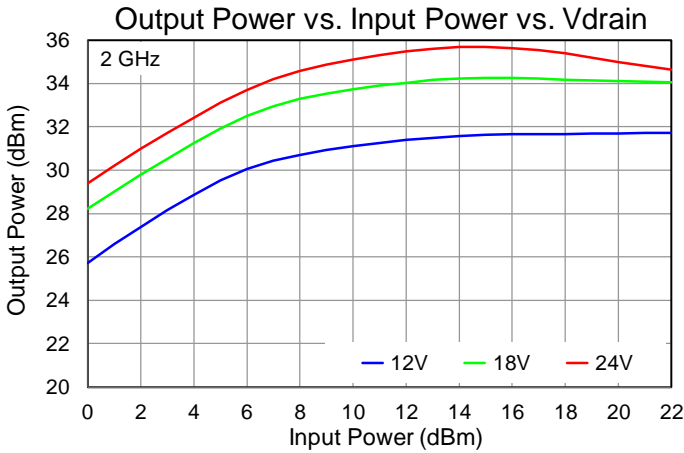
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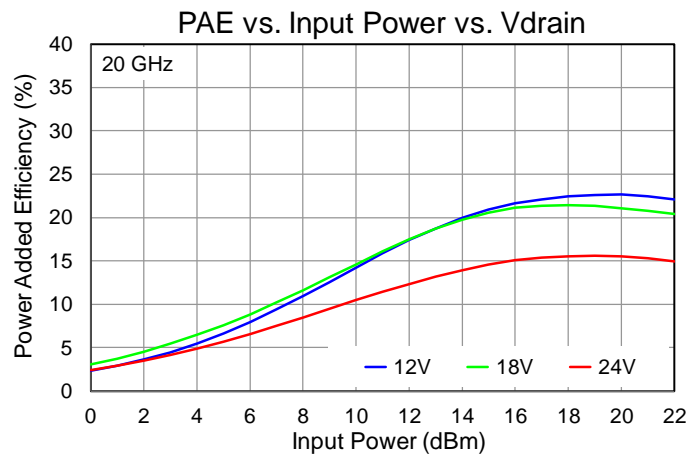
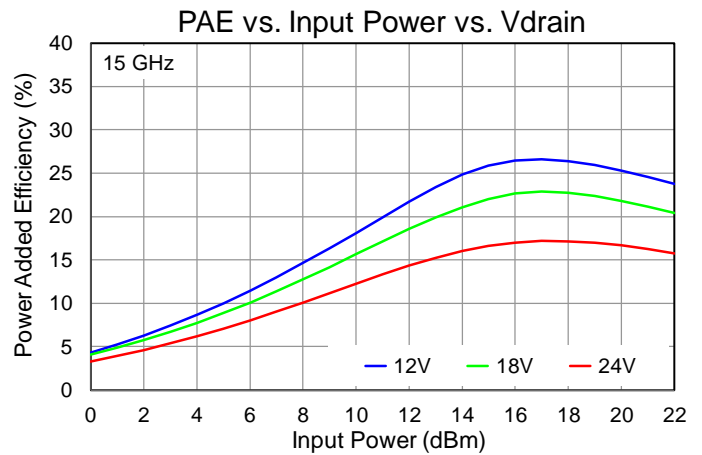
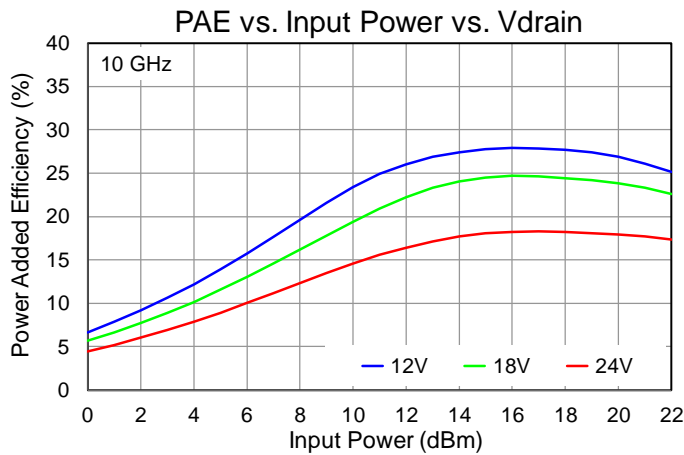
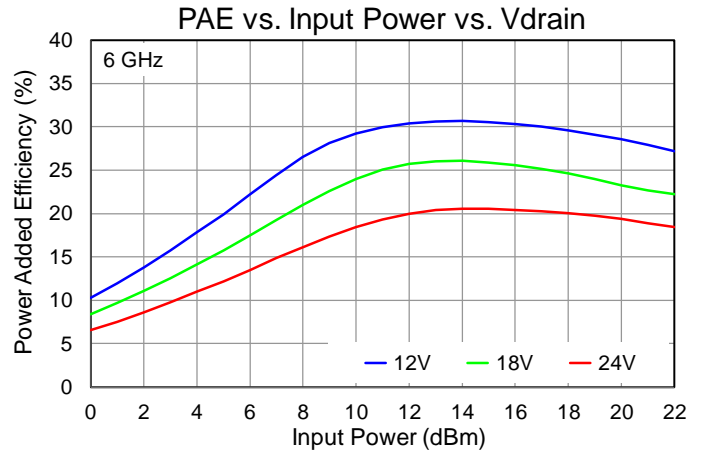
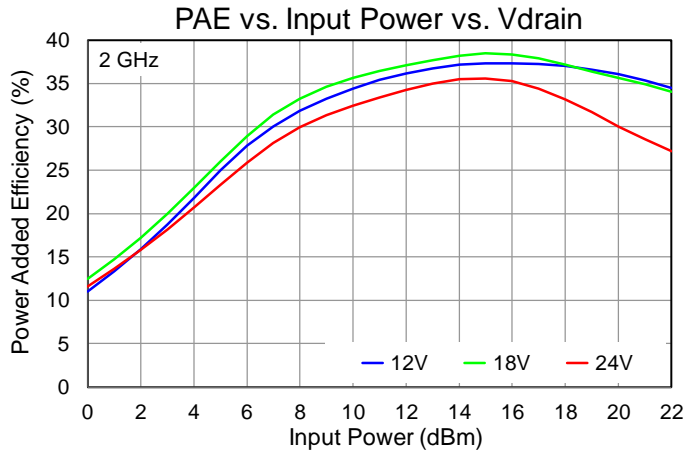
Performance Plots – Large Signal

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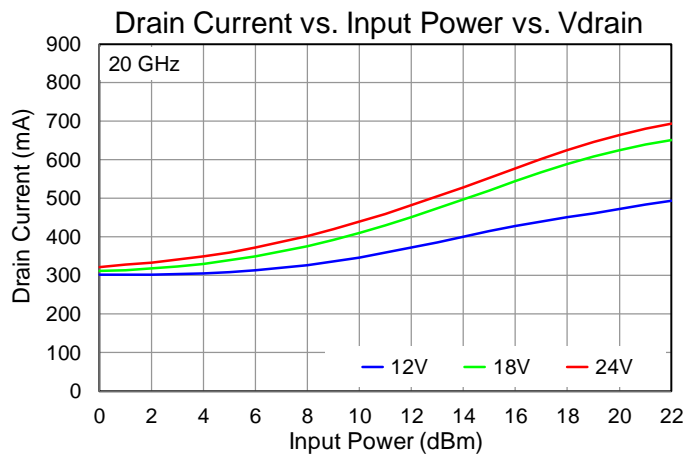
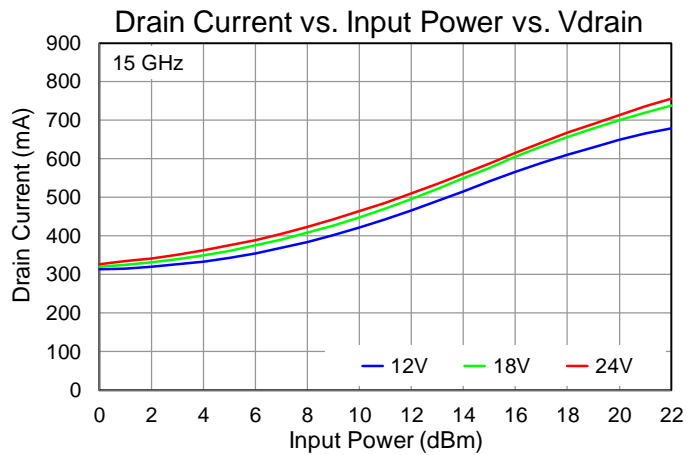
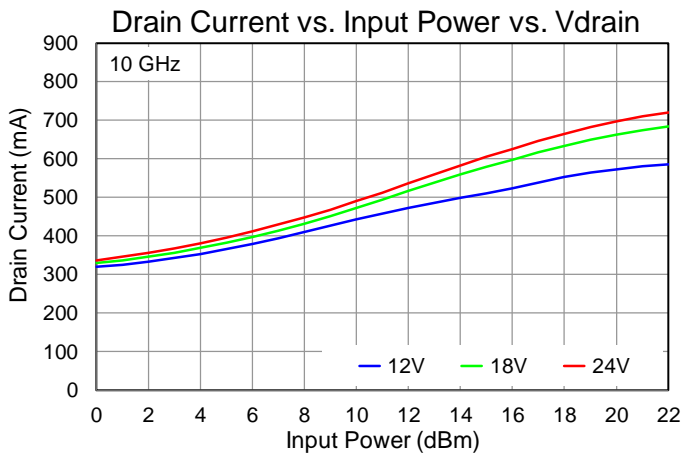
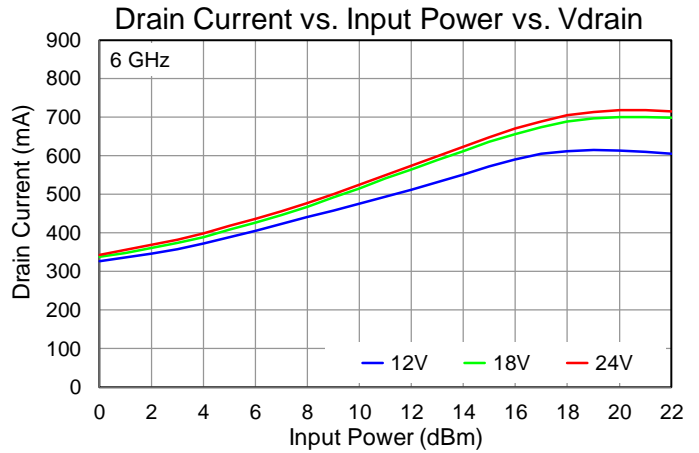
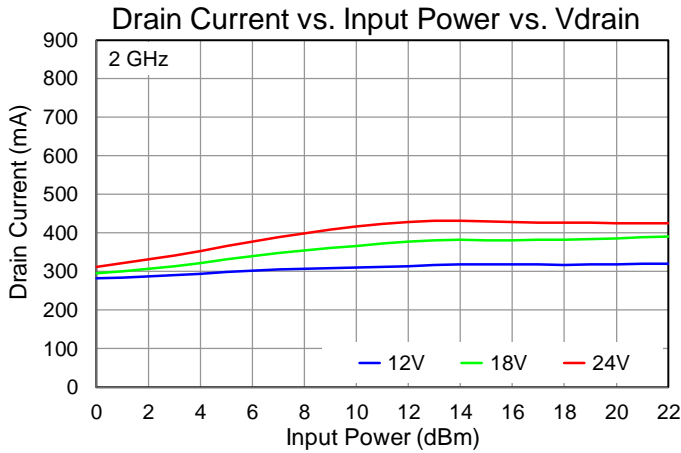
Performance Plots – Large Signal

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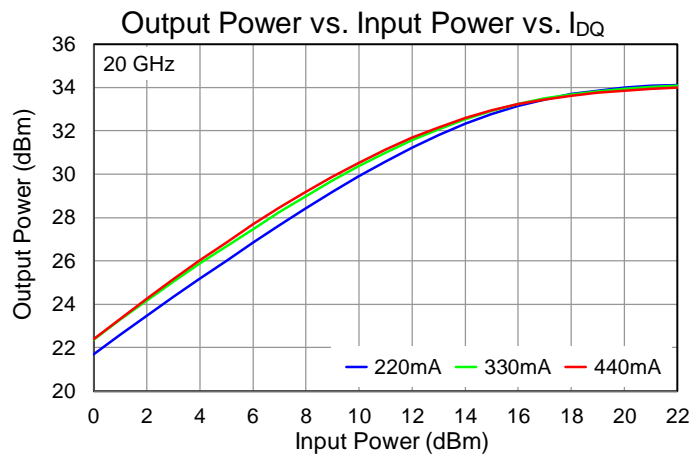
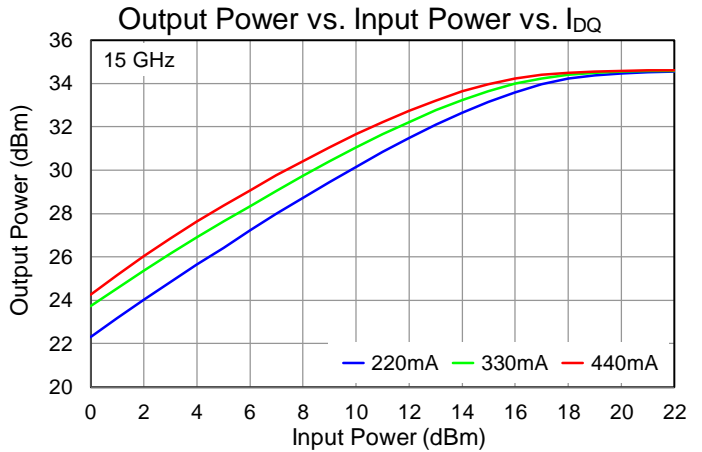
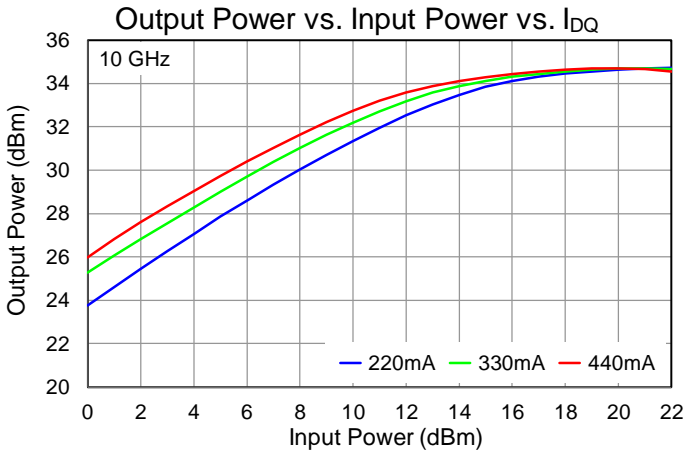
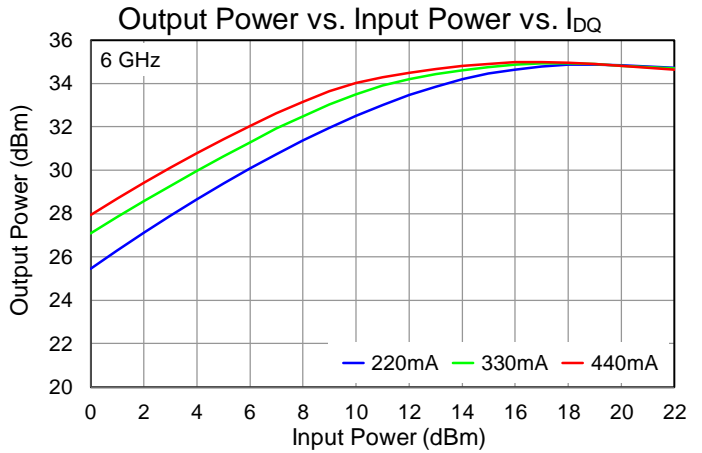
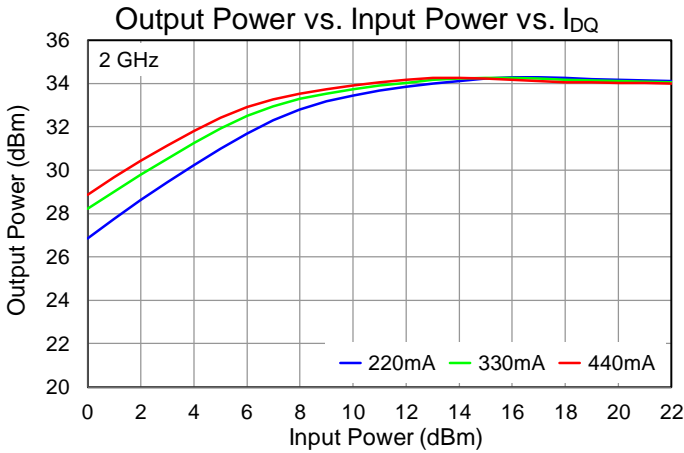
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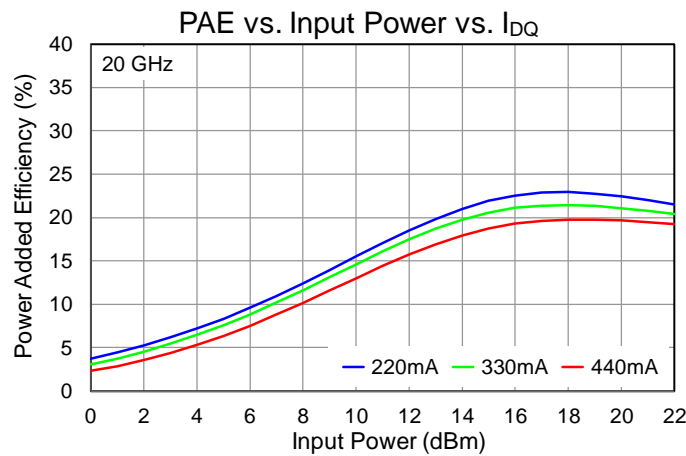
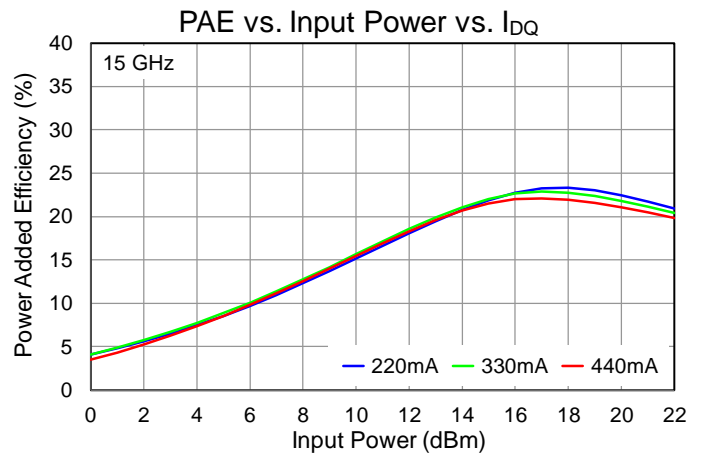
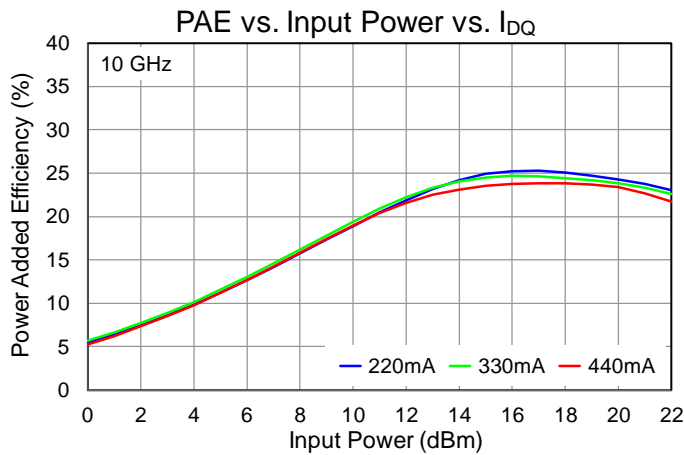
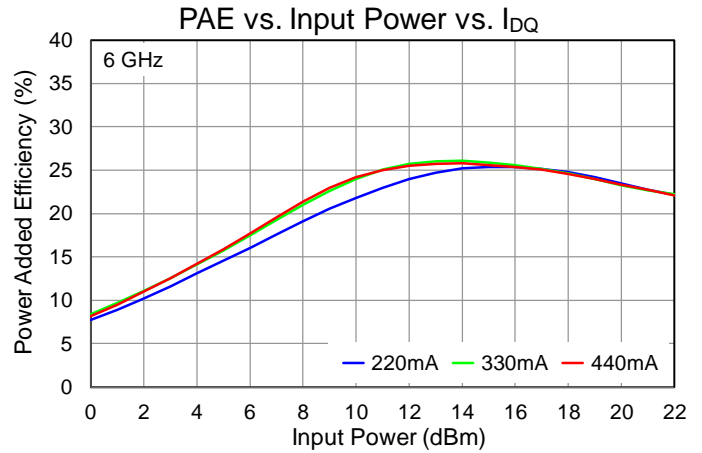
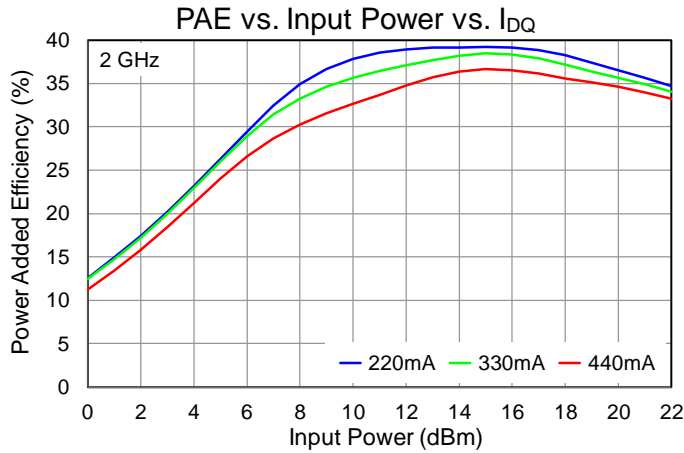
Performance Plots – Large Signal

Test conditions, unless otherwise noted: $V_D = 18\text{ V}$, $I_{DQ} = 330\text{ mA}$, $T = +25\text{ }^\circ\text{C}$



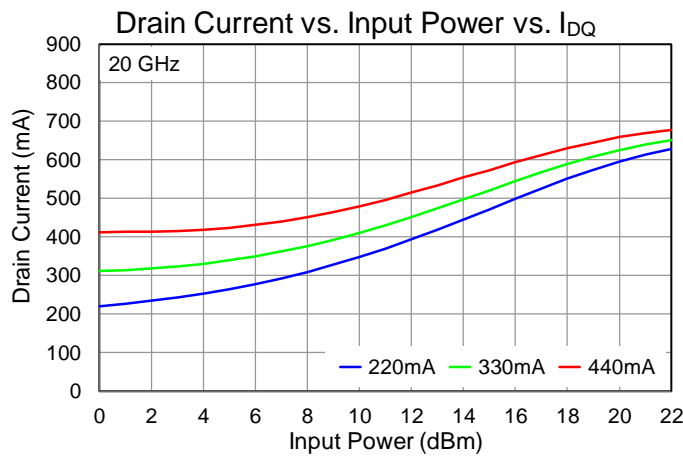
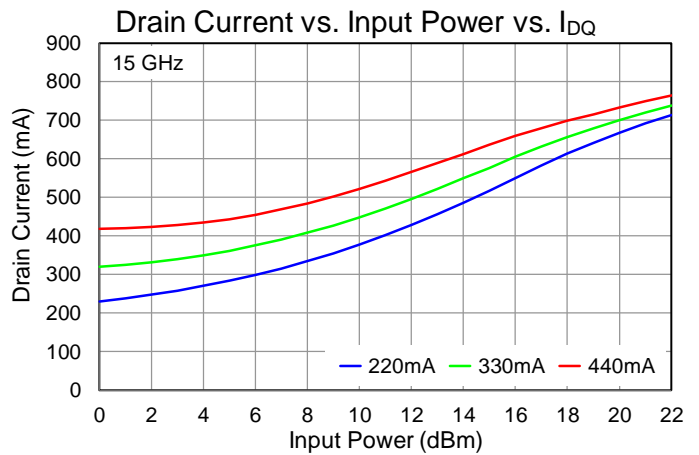
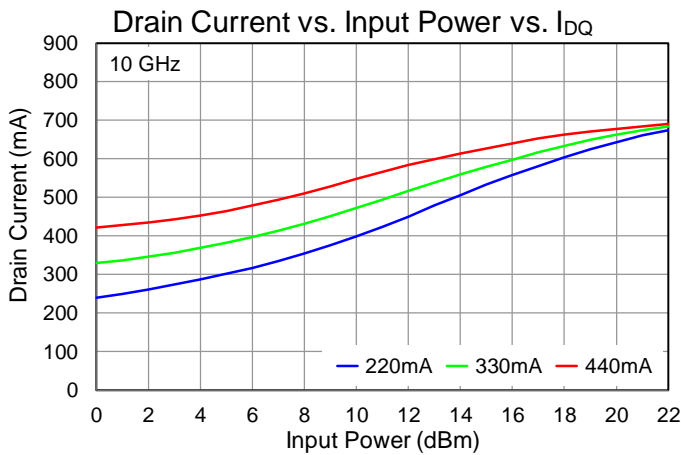
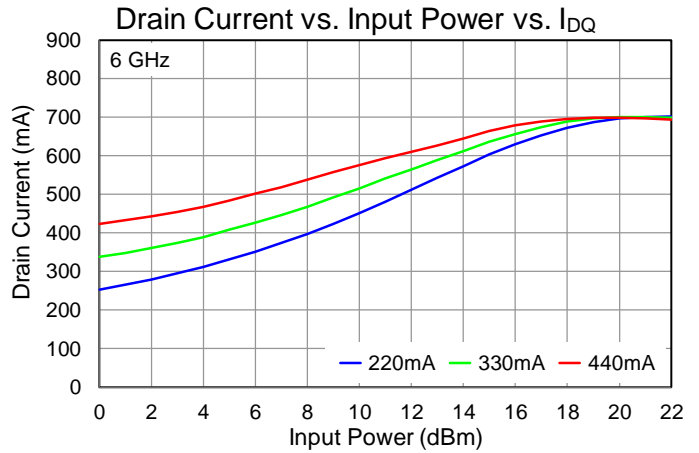
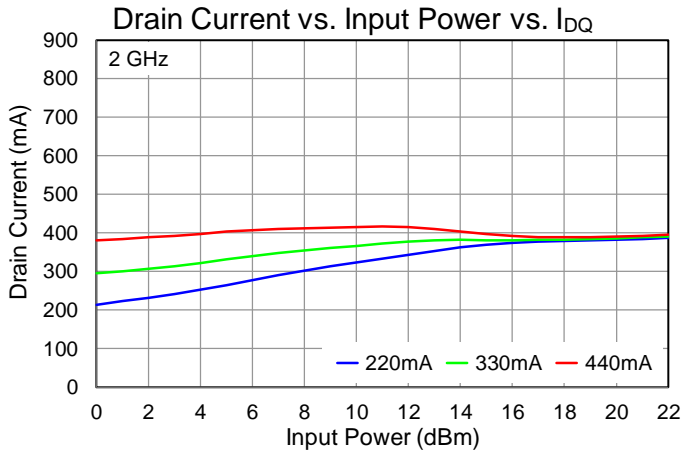
Performance Plots – Large Signal

Test conditions, unless otherwise noted: $V_D = 18\text{ V}$, $I_{DQ} = 330\text{ mA}$, $T = +25\text{ }^\circ\text{C}$



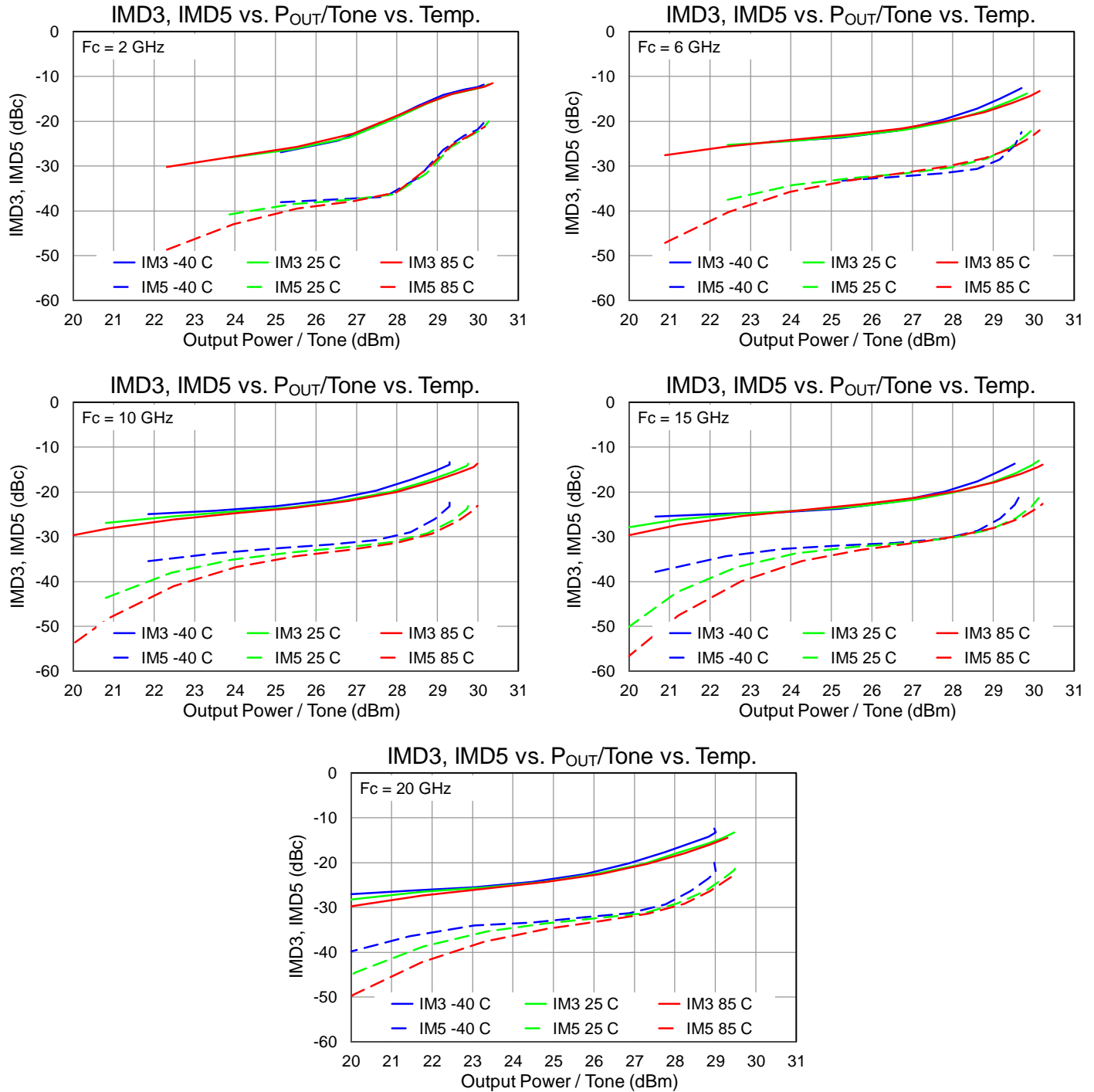
Performance Plots – Large Signal

Test conditions, unless otherwise noted: $V_D = 18\text{ V}$, $I_{DQ} = 330\text{ mA}$, $T = +25\text{ }^\circ\text{C}$



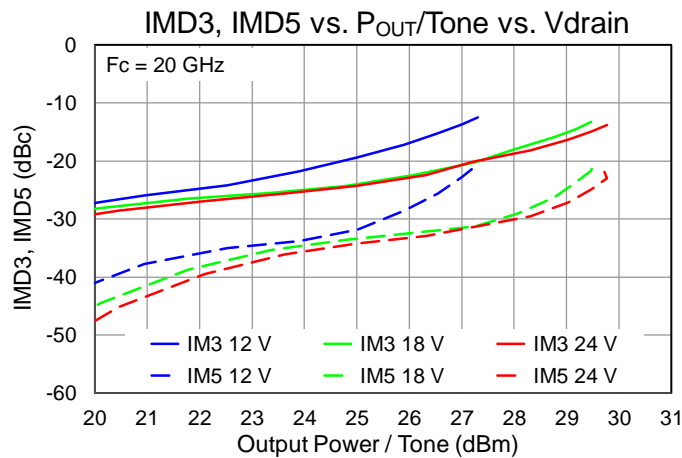
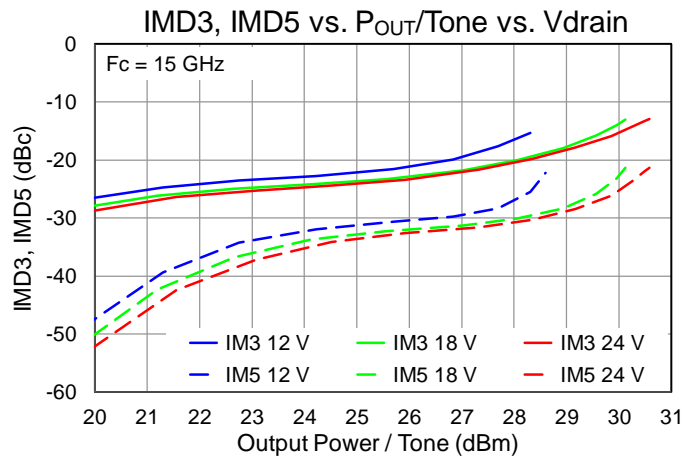
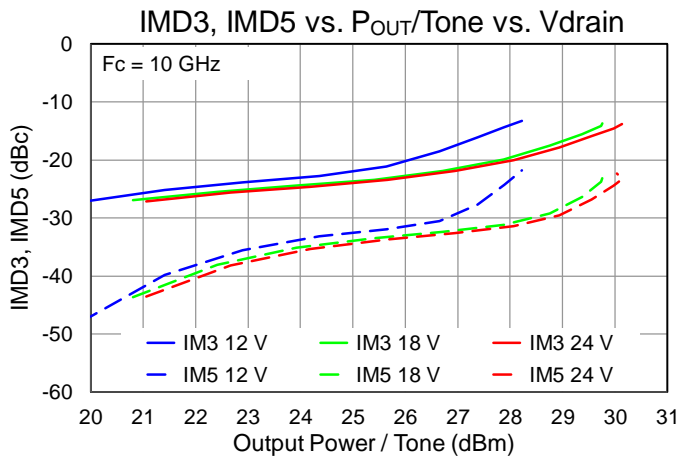
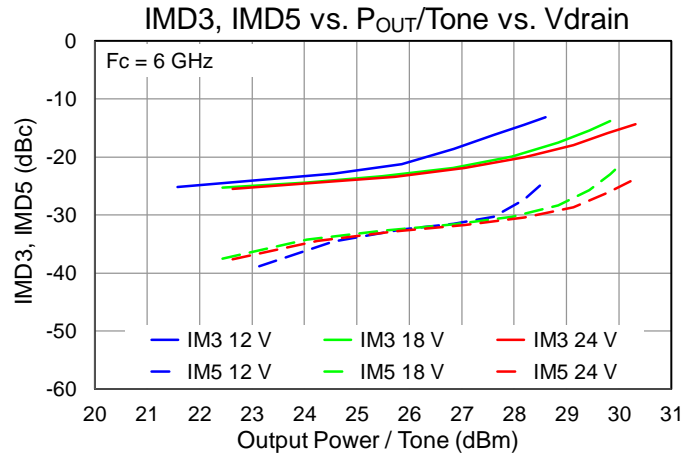
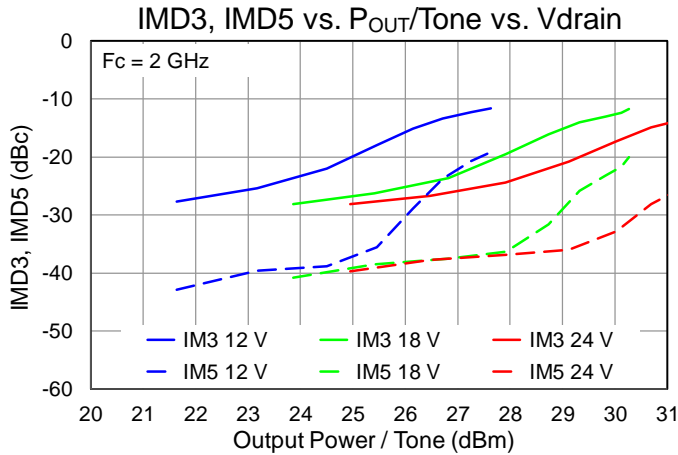
Performance Plots – Linearity

Test conditions, unless otherwise noted: $V_D = 18\text{ V}$, $I_{DQ} = 330\text{ mA}$, $T = +25\text{ }^\circ\text{C}$, 100 MHz tone spacing



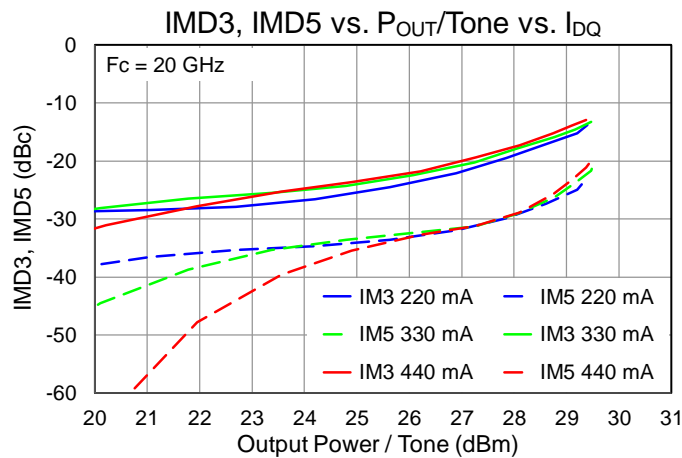
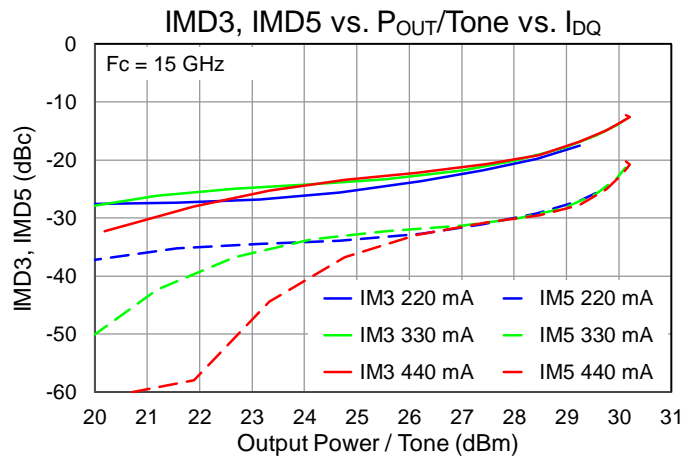
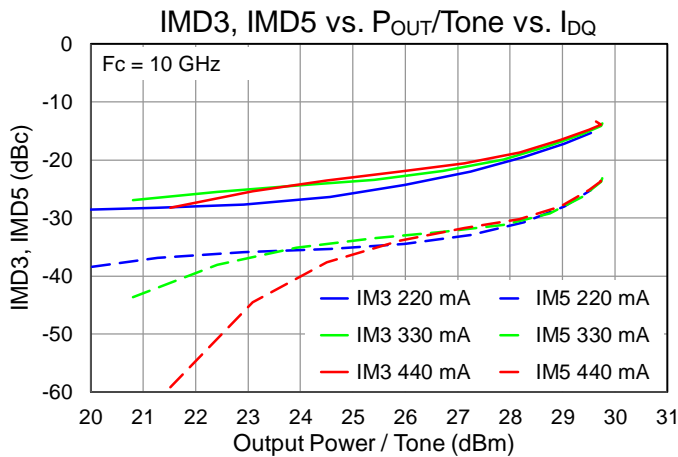
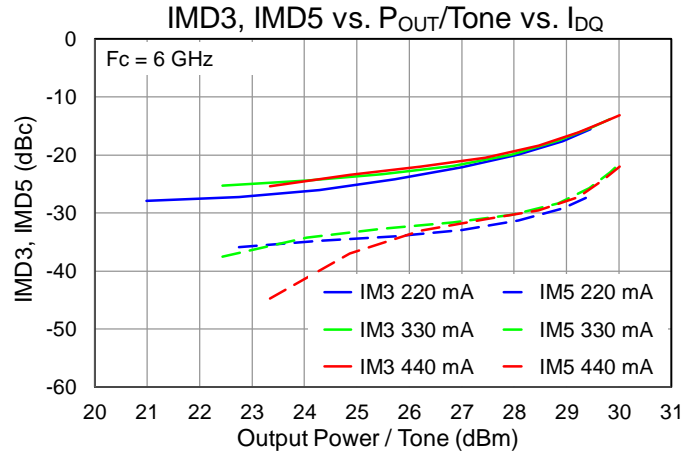
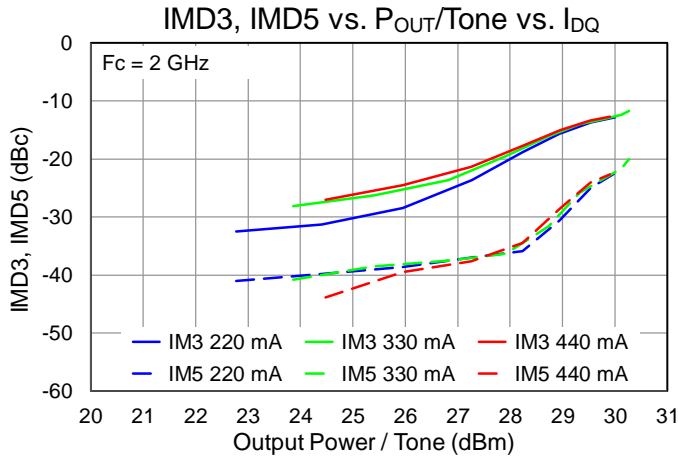
Performance Plots – Linearity

Test conditions, unless otherwise noted: $V_D = 18\text{ V}$, $I_{DQ} = 330\text{ mA}$, $T = +25\text{ }^\circ\text{C}$, 100 MHz tone spacing



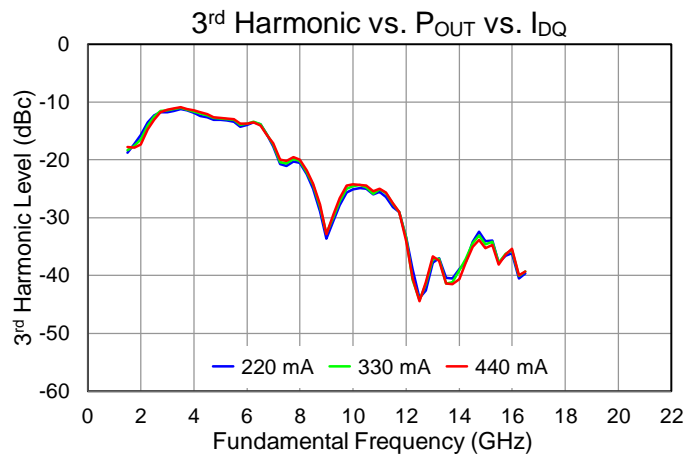
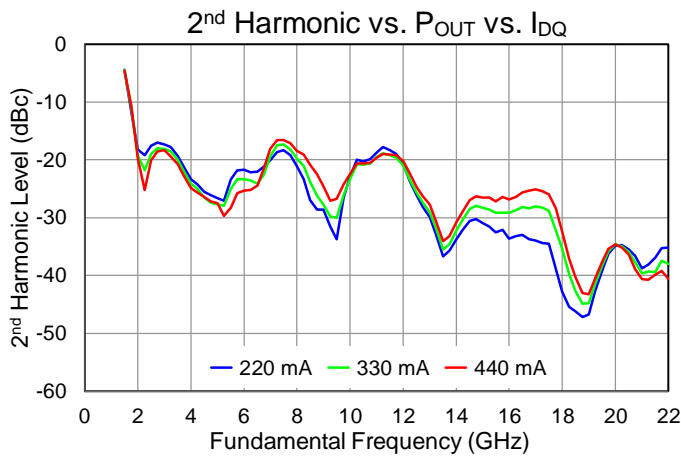
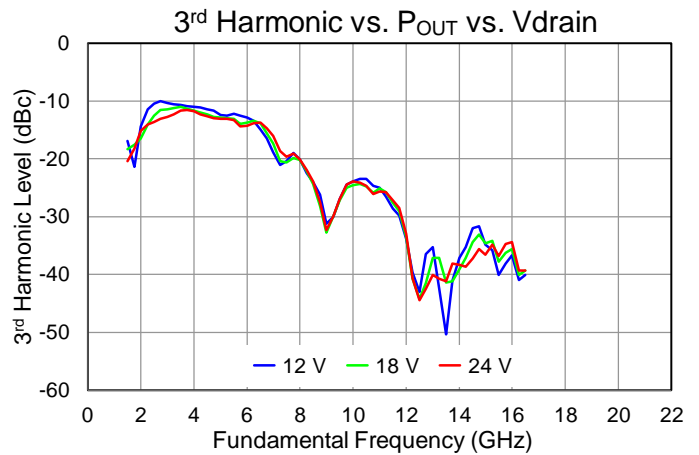
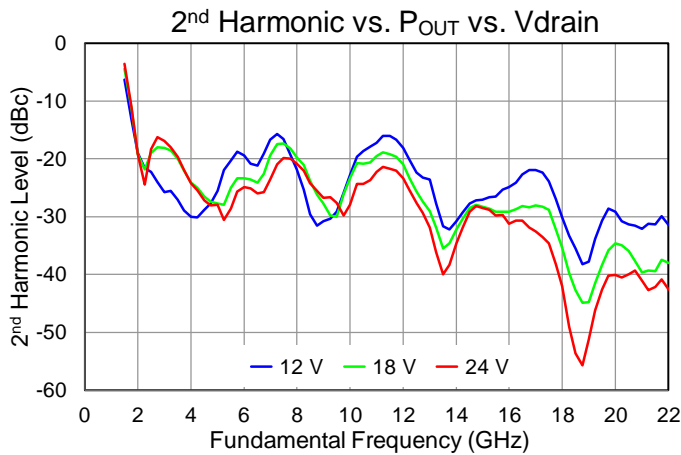
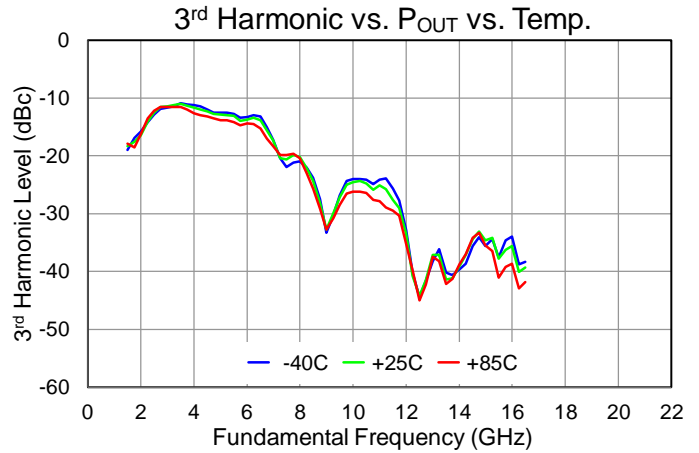
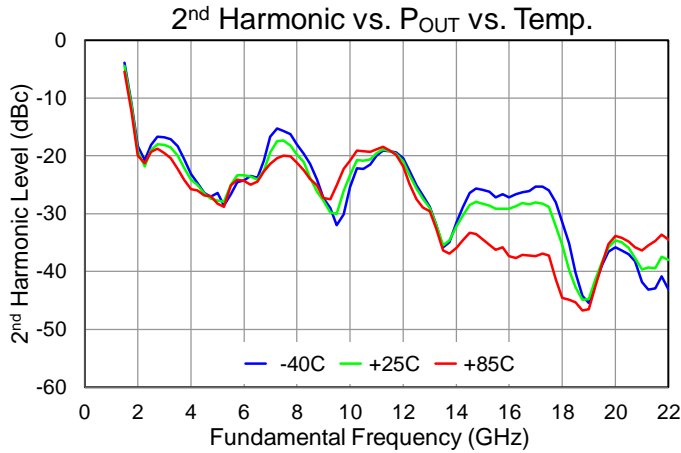
Performance Plots – Linearity

Test conditions, unless otherwise noted: $V_D = 18\text{ V}$, $I_{DQ} = 330\text{ mA}$, $T = +25\text{ }^\circ\text{C}$, 100 MHz tone spacing



Performance Plots – Harmonics

Test conditions, unless otherwise noted: $V_D = 18\text{ V}$, $I_{DQ} = 330\text{ mA}$, $T = +25\text{ }^\circ\text{C}$, $P_{in} = 18\text{ dBm}$



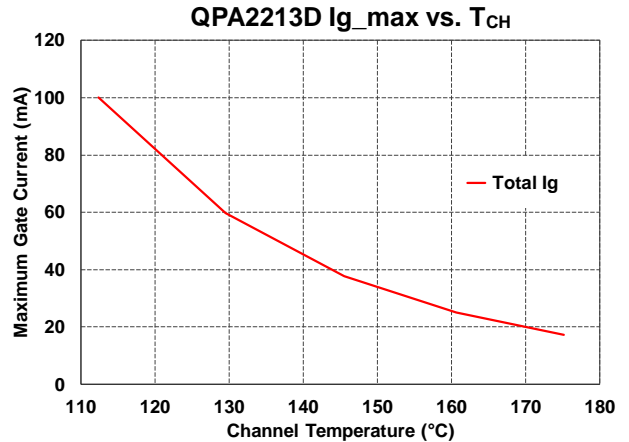
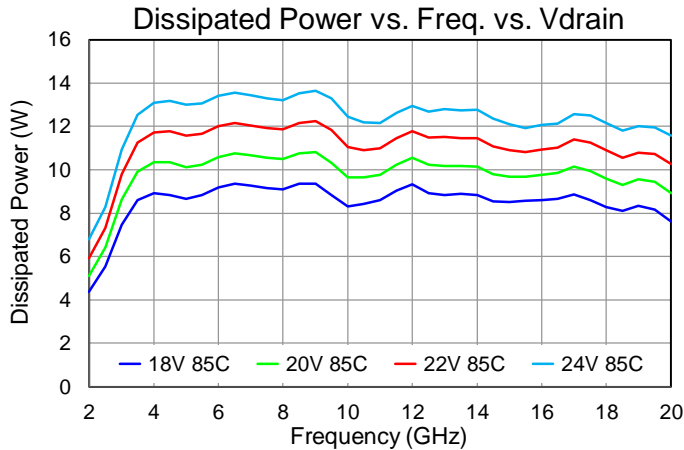
Thermal and Reliability Information

| Parameter | Test Conditions | Value | Units |
|---|--|-------|--------------------|
| Thermal Resistance (θ_{JC}) ⁽¹⁾ | $T_{base} = 85\text{ }^\circ\text{C}$, $V_D = 18\text{ V}$, $I_{DQ} = 330\text{ mA}$, $P_{DISS} = 5.94\text{ W}$, No RF (quiescent DC operation) | 5.16 | $^\circ\text{C/W}$ |
| Channel Temperature, T_{CH} (Under RF) ⁽²⁾ | | 116 | $^\circ\text{C}$ |
| Thermal Resistance (θ_{JC}) ⁽¹⁾ | $T_{base} = 85\text{ }^\circ\text{C}$, $V_D = 18\text{ V}$, $I_{DQ} = 330\text{ mA}$, $\text{Freq} = 6.5\text{ GHz}$, $I_{D_Drive} = 676\text{ mA}$, $P_{IN} = 18\text{ dBm}$, $P_{OUT} = 34.6\text{ dBm}$, $P_{DISS} = 9.36\text{ W}$ | 7.15 | $^\circ\text{C/W}$ |
| Channel Temperature, T_{CH} (Under RF) ⁽²⁾ | | 152 | $^\circ\text{C}$ |
| Thermal Resistance (θ_{JC}) ⁽¹⁾ | $T_{base} = 85\text{ }^\circ\text{C}$, $V_D = 22\text{ V}$, $I_{DQ} = 330\text{ mA}$, $\text{Freq} = 9.0\text{ GHz}$, $I_{D_Drive} = 679\text{ A}$, $P_{IN} = 18\text{ dBm}$, $P_{OUT} = 34.4\text{ dBm}$, $P_{DISS} = 12.25\text{ W}$ | 7.31 | $^\circ\text{C/W}$ |
| Channel Temperature, T_{CH} (Under RF) ⁽²⁾ | | 175 | $^\circ\text{C}$ |

Notes:

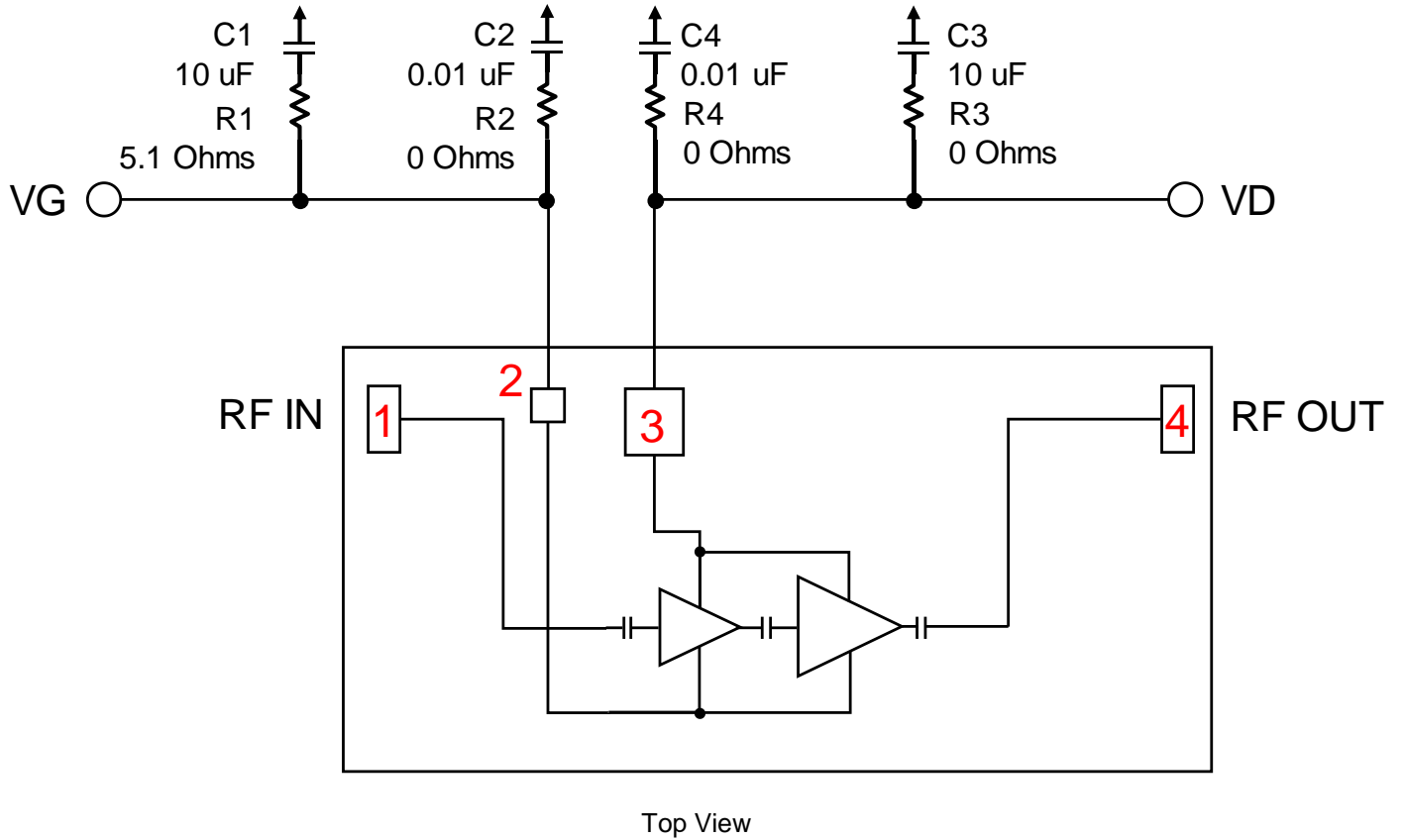
1. Thermal resistance determined to the back of package ($85\text{ }^\circ\text{C}$)
2. Refer to the following document: [GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates](#)

Dissipated Power and Maximum Gate Current



Test conditions, unless otherwise noted: $V_D = 18\text{ V}$, $I_{DQ} = 330\text{ mA}$, $T = +25\text{ }^\circ\text{C}$, $P_{in} = 18\text{ dBm}$

Applications Information



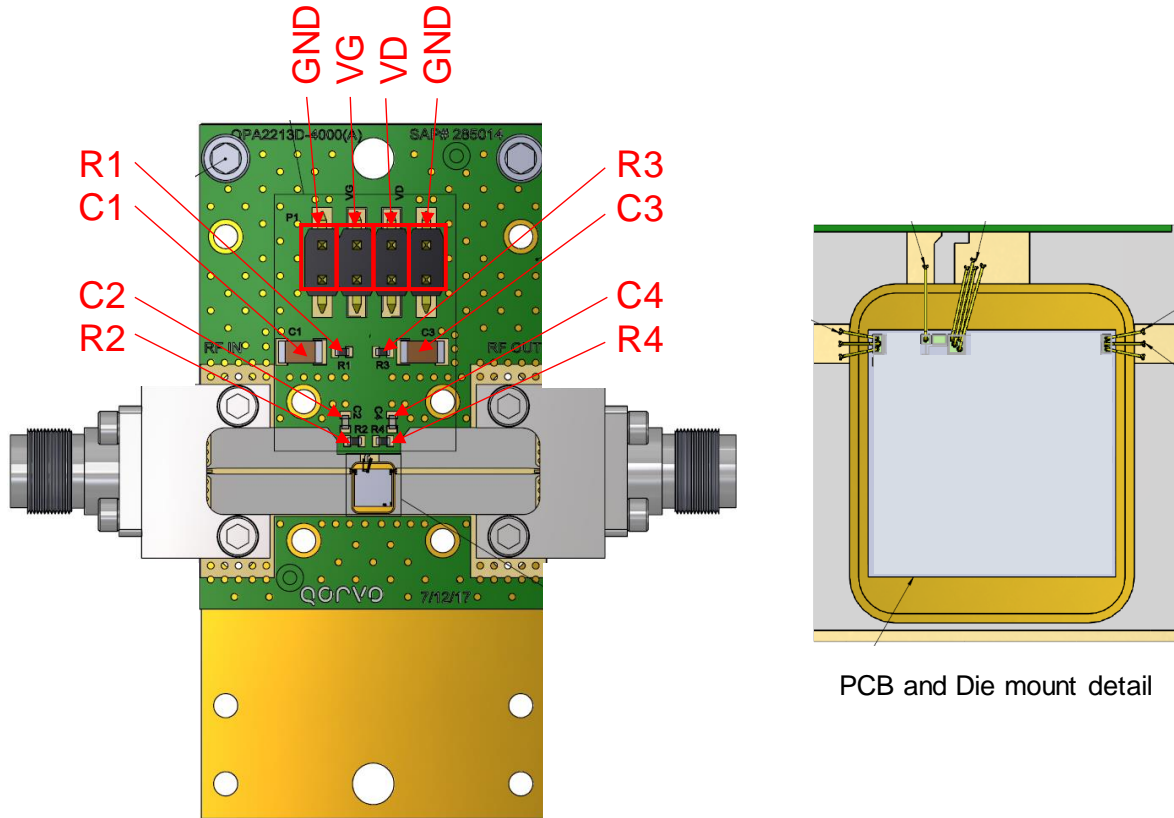
Bias-Up Procedure

1. Set I_D limit to 900 mA, I_G limit to 10 mA
2. Set V_G to -4.0 V
3. Set V_D +18 V
4. Adjust V_G more positive until $I_{DQ} \approx 330$ mA
5. Apply RF signal

Bias-Down Procedure

1. Turn off RF signal
2. Reduce V_G to -4.0 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



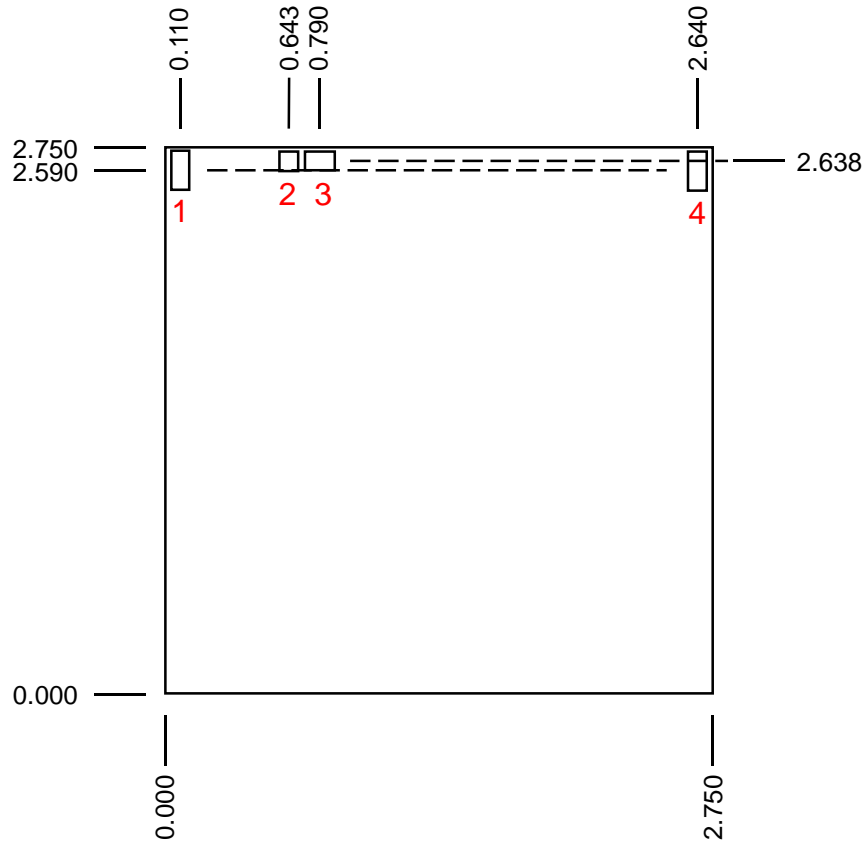
PCB and Die mount detail

PCB is made from Rogers 4003C dielectric, .008 inch thick, 0.5 oz. copper both sides.
Carrier plate has a raised pedestal to contact the back of the die.

Bill of Materials

| Reference Des. | Value | Description | Manuf. | Part Number |
|----------------|---------|---------------------------------------|---------------------|-------------|
| C1, C3 | 10 uF | CAP, 10 uF, 20%, 50 V, 20%, X5R, 1206 | Various | |
| C2, C4 | 0.01 uF | CAP, 0.01 uF, 10%, 50 V, X7R, 0402 | Various | |
| R1 | 5.1 Ω | RES, 5.1 OHM, 5%, 50 V, 0402 | Various | |
| R2, R3, R4 | 0 Ω | RES, 0 OHM, JMPR, 0402 | Various | |
| J1, J2 | 2.92 mm | CONNECTOR, FEMALE, ENDLAUNCH | Southwest Microwave | 1092-01A-5 |

Mechanical Information



Dimensions are in mm
Thickness: 0.100
Die x, y size tolerance: ± 0.050
Ground is backside of die

Bond Pad Description

| Pad No. | Symbol | Description |
|---------|--------|---|
| 1 | RF IN | RF input. 50 Ohms. DC blocked. |
| 2 | VG | Gate voltage. Bypass network required; refer to page 24. |
| 3 | VD | Drain voltage. Bypass network required; refer to page 24. |
| 4 | RF OUT | RF output. 50 Ohms. DC blocked. |

Assembly Notes

Component placement and adhesive attachment assembly notes:

- Vacuum pencils and/or vacuum collets are the preferred method of pick up.
- Air bridges must be avoided during placement.
- The force impact is critical during auto placement.

Reflow process assembly notes:

- Use AuSn (80/20) solder and limit exposure to temperatures above 300 °C to 3–4 minutes, maximum.
- An alloy station or conveyor furnace with reducing atmosphere should be used.
- Do not use any kind of flux.
- Coefficient of thermal expansion matching is critical for long-term reliability.
- Devices must be stored in a dry nitrogen atmosphere.

Interconnect process assembly notes:

- Thermosonic ball bonding is the preferred interconnect technique.
- Force, time, and ultrasonic are critical parameters.
- Aluminum wire should not be used.
- Devices with small pad sizes should be bonded with 0.0007-inch wire.

Handling Precautions

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



Caution!
ESD-Sensitive Device

Solderability

Use only AuSn (80/20) solder, and limit exposure to temperatures above 300 °C to 3–4 minutes, maximum.

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 (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free

Contact Information

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

Web: www.qorvo.com

Tel: 1-844-890-8163

Email: customer.support@qorvo.com

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