

### Product Description

Qorvo's TGA2239-CP is a 3-stage, 50 W power amplifier operating over the 13.4 to 15.5 GHz band. Fabricated on Qorvo's production 0.15  $\mu$ m GaN on SiC technology, this high performance amplifier offers greater than 30 dB small-signal gain and greater than 31 % power-added efficiency, allowing the system designer to achieve superior performance levels in a cost efficient manner.

The TGA2239-CP is offered in a 10-lead 15 x 15 mm bolt-down package. Assembled with a pure-copper base, coupled with its high efficiency, the TGA2239-CP minimizes the strain on the system-level cooling requirements, further reducing system operating costs. Superior electrical performance and thermal management makes the TGA2239-CP ideal for supporting communications and radar applications in both commercial and military markets.

Both RF ports have integrated DC blocking capacitors and are fully matched to 50 Ohms.

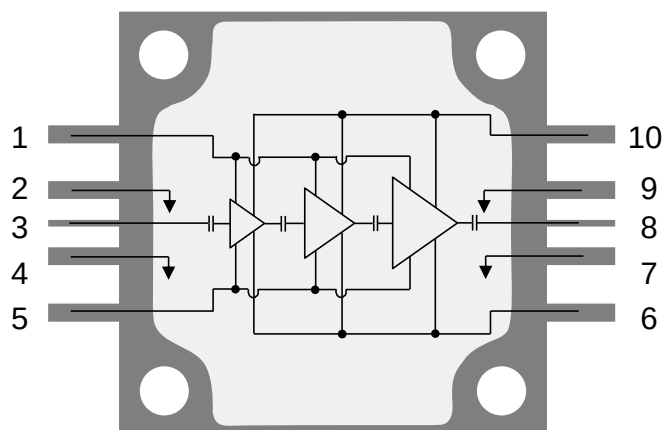
RoHS compliant.



### Product Features

- Frequency Range: 13.4 – 15.5 GHz
- $P_{OUT}$ : >45.5 dBm ( $P_{IN}$  = 22 dBm)
- PAE: > 31 % ( $P_{IN}$  = 22 dBm)
- Small Signal Gain: > 30 dB
- IM3: < -19 dBc @ 38 dBm  $P_{OUT}$  / Tone
- Bias:  $V_D$  = +28 V,  $I_{DQ}$  = 900 mA,  $V_G$  = -2.7 V Typical
- Package Dimensions: 15.2 x 15.2 x 3.5 mm
- Process Technology: QGaN15
- Package base is pure Cu offering superior thermal management

### Functional Block Diagram



### Applications

- Commercial VSAT
- Military Satcom
- Datalinks
- Radar

### Ordering Information

| Part No.        | Description                                          |
|-----------------|------------------------------------------------------|
| TGA2239-CP      | 13.4 – 15.5 GHz 50 W GaN Power Amplifier (10 pieces) |
| TGA2239-CPEVB01 | TGA2239-CP Evaluation Board                          |

### Absolute Maximum Ratings

| Parameter                                                        | Value / Range      |
|------------------------------------------------------------------|--------------------|
| Drain Voltage ( $V_D$ )                                          | +29.5 V            |
| Gate Voltage Range ( $V_G$ )                                     | –5 to 0 V          |
| Drain Current ( $I_D$ )                                          | 7.2 A              |
| Forward Gate Current ( $I_G$ )                                   | See plot on page 3 |
| Power Dissipation ( $P_{DISS}$ ), 85 °C                          | 140 W              |
| Input Power ( $P_{IN}$ ), CW, 50 $\Omega$ , $V_D = +28$ V, 85 °C | 33 dBm             |
| Input Power ( $P_{IN}$ ), CW, 3:1 VSWR, $V_D = +28$ V, 85 °C     | 30 dBm             |
| Mounting Temperature (30 Seconds)                                | 260 °C             |
| Storage Temperature                                              | –55 to 150 °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

| Parameter                                       | Value / Range  |
|-------------------------------------------------|----------------|
| Drain Voltage ( $V_D$ )                         | +28 V          |
| Drain Current ( $I_{DQ}$ )                      | 900 mA         |
| Drain Current Under RF Drive ( $I_{D\_DRIVE}$ ) | See plots p. 7 |
| Gate Current Under RF Drive ( $I_{G\_DRIVE}$ )  | See plots p. 7 |
| Temperature ( $T_{BASE}$ )                      | –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 Range                                                        |          | 13.4 | –      | 15.5 | GHz    |
| Small Signal Gain                                                                  |          | –    | > 30   | –    | dB     |
| Input Return Loss                                                                  |          | –    | > 14   | –    | dB     |
| Output Return Loss                                                                 |          | –    | > 9    | –    | dB     |
| Output Power ( $P_{IN} = 22$ dBm)                                                  | 13.0 GHz | 46   | 46.5   | –    | dBm    |
|                                                                                    | 14.5 GHz | 46   | 47     |      |        |
|                                                                                    | 15.5 GHz | 45   | 47     |      |        |
| Power Added Efficiency ( $P_{IN} = 22$ dBm)                                        | 13.0 GHz | 25   | 30     | –    | %      |
|                                                                                    | 14.5 GHz | 25   | 32     |      |        |
|                                                                                    | 15.5 GHz | 30   | 33     |      |        |
| IM3 ( $P_{OUT}$ / Tone = 38 dBm / Tone, 1 MHz Spacing)                             |          | –    | < –19  | –    | dBc    |
| IM5 ( $P_{OUT}$ / Tone = 38 dBm / Tone, 1 MHz Spacing)                             |          | –    | < –30  | –    | dBc    |
| Small Signal Gain Temperature Coefficient                                          |          | –    | –0.09  | –    | dB/°C  |
| Output Power Temperature Coefficient ( $P_{IN} = 22$ dBm)<br>(From 25 °C to 85 °C) |          | –    | –0.014 | –    | dBm/°C |
| Recommended Operating Voltage                                                      |          | –    | +28    | +28  | V      |

Test conditions unless otherwise noted: 25 °C,  $V_D = +28$  V,  $I_{DQ} = 900$  mA, CW operation

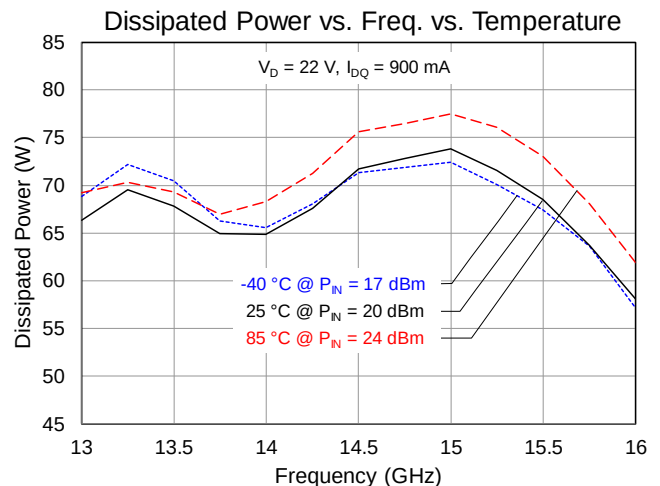
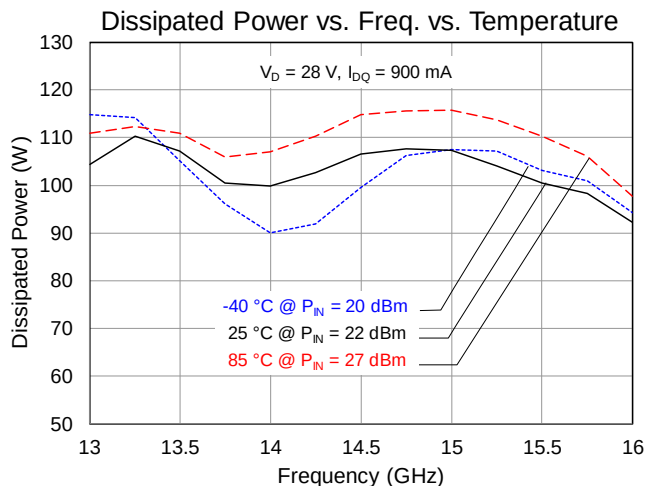
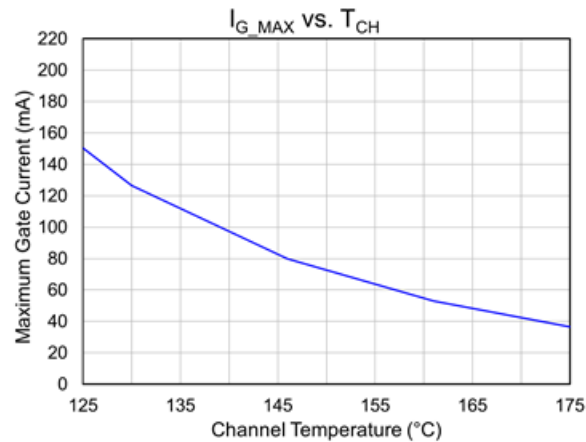
### Thermal and Reliability Information

| Parameter                                           | Test Conditions                                                                                                                                                     | Value | Units                |
|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------|
| Thermal Resistance ( $\theta_{JC}$ ) <sup>(1)</sup> | $T_{BASE} = 85^{\circ}\text{C}$ , $V_D = +28\text{ V}$ (CW)                                                                                                         | 0.52  | $^{\circ}\text{C/W}$ |
| Channel Temperature ( $T_{CH}$ ) (Quiescent)        | At $I_{DQ} = 900\text{ mA}$ , $P_{DISS} = 25.2\text{ W}$                                                                                                            | 98    | $^{\circ}\text{C}$   |
| Thermal Resistance ( $\theta_{JC}$ ) <sup>(1)</sup> | $T_{BASE} = 85^{\circ}\text{C}$ , $V_D = +22\text{ V}$ (CW)                                                                                                         | 0.79  | $^{\circ}\text{C/W}$ |
| Channel Temperature ( $T_{CH}$ ) (Under RF drive)   | At Freq = 15 GHz, $P_{IN} = 24\text{ dBm}$ :<br>$I_{DQ} = 900\text{ mA}$ , $I_{D\_Drive} = 5.1\text{ A}$<br>$P_{OUT} = 45.4\text{ dBm}$ , $P_{DISS} = 77\text{ W}$  | 146   | $^{\circ}\text{C}$   |
| Thermal Resistance ( $\theta_{JC}$ ) <sup>(1)</sup> | $T_{BASE} = 85^{\circ}\text{C}$ , $V_D = +28\text{ V}$ (CW)                                                                                                         | 0.79  | $^{\circ}\text{C/W}$ |
| Channel Temperature ( $T_{CH}$ ) (Under RF drive)   | At Freq = 15 GHz, $P_{IN} = 27\text{ dBm}$ :<br>$I_{DQ} = 900\text{ mA}$ , $I_{D\_Drive} = 5.8\text{ A}$<br>$P_{OUT} = 46.7\text{ dBm}$ , $P_{DISS} = 116\text{ W}$ | 177   | $^{\circ}\text{C}$   |

Notes:

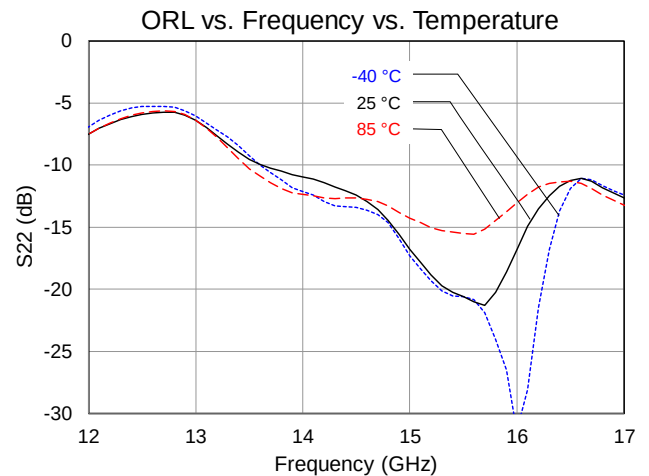
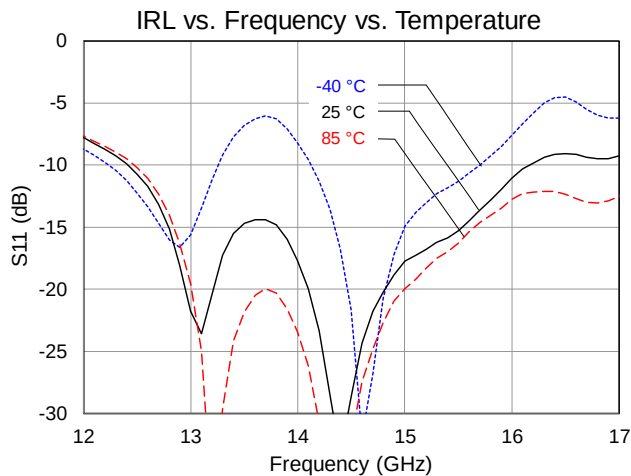
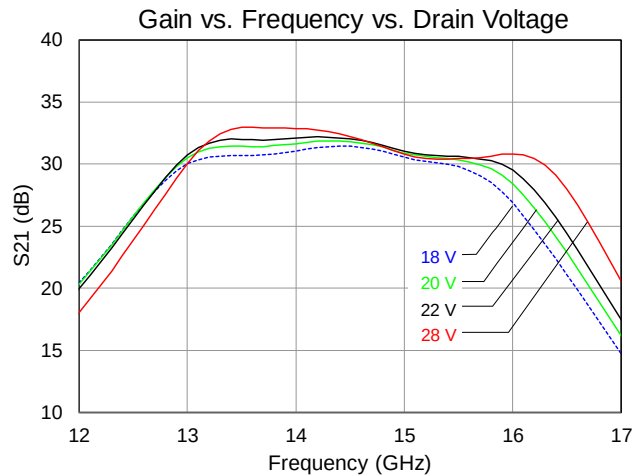
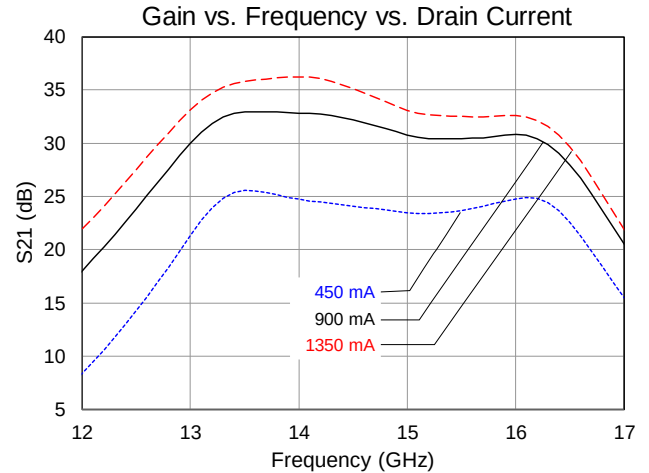
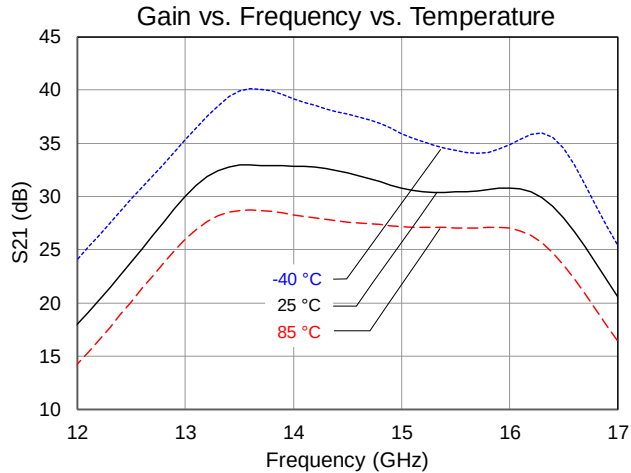
1. Thermal resistance measured to back of package.
2. Refer to the following document: [GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates](#)

### Dissipated Power



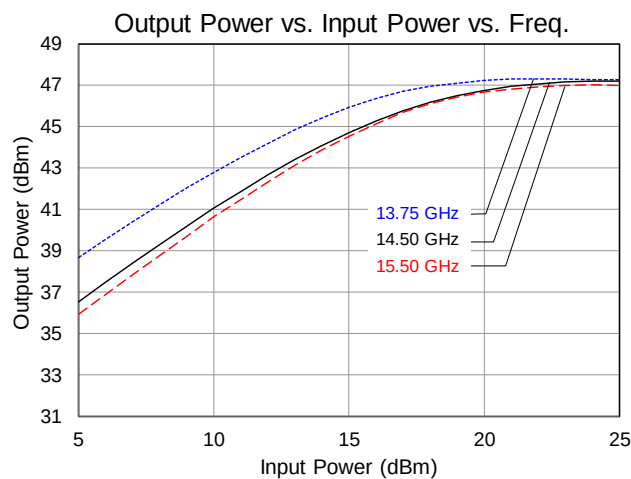
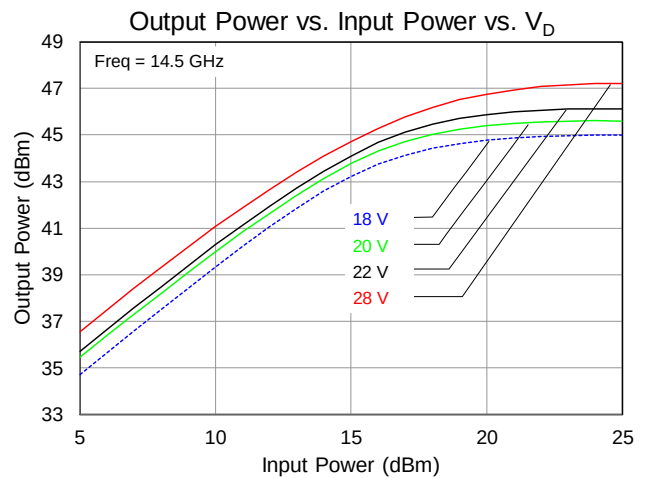
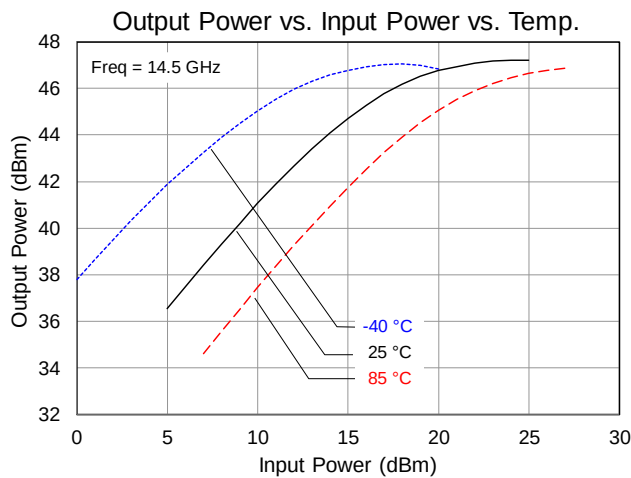
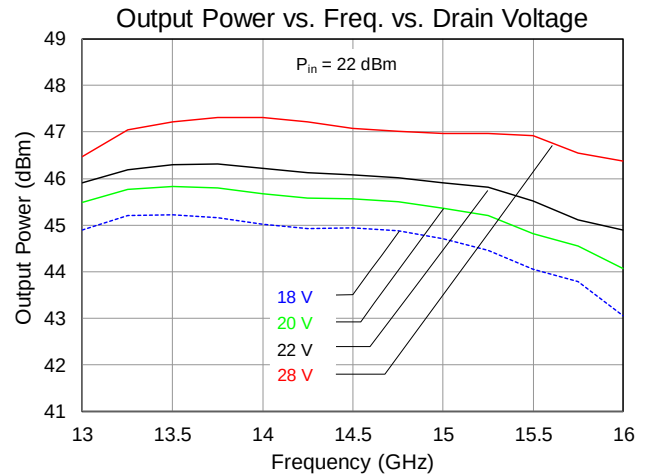
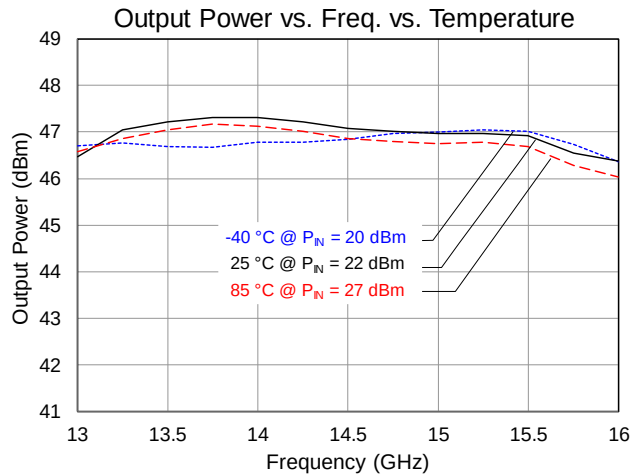
### Performance Plots – Small Signal

Conditions unless otherwise specified:  $V_D = +28\text{ V}$ ,  $I_{DQ} = 900\text{ mA}$ , Temp. =  $25\text{ }^{\circ}\text{C}$ , CW operation



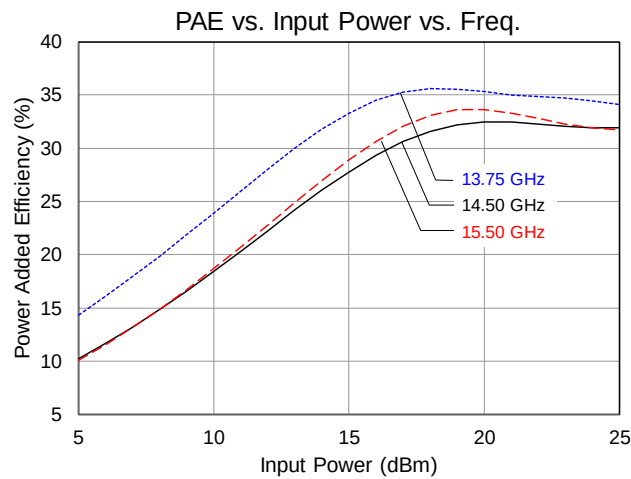
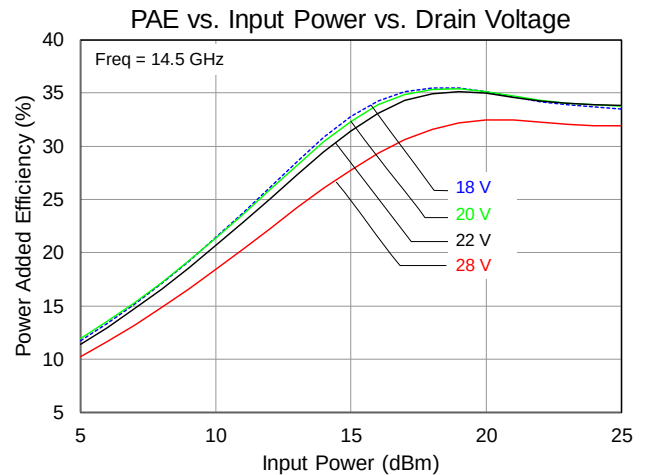
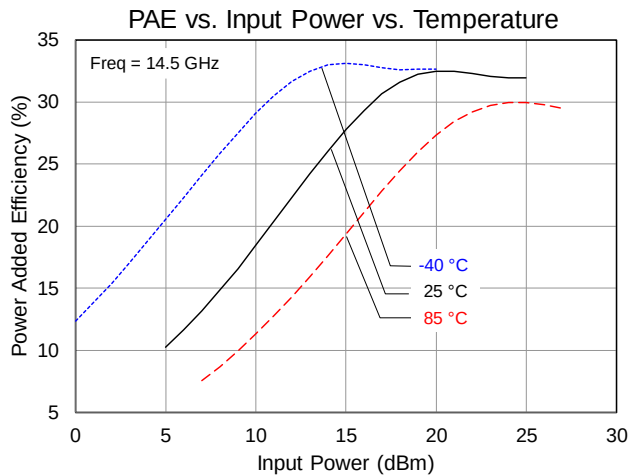
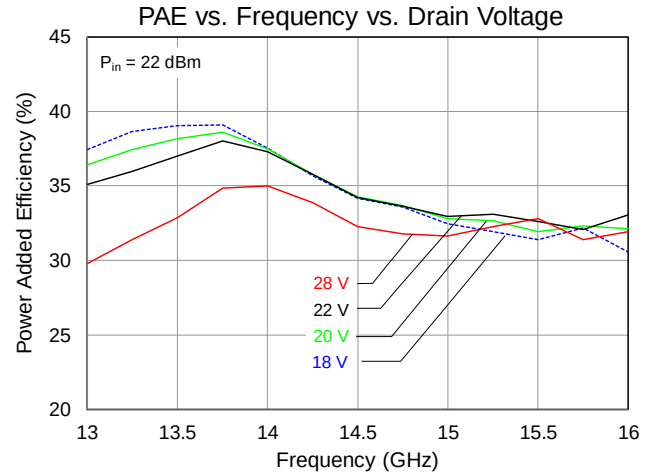
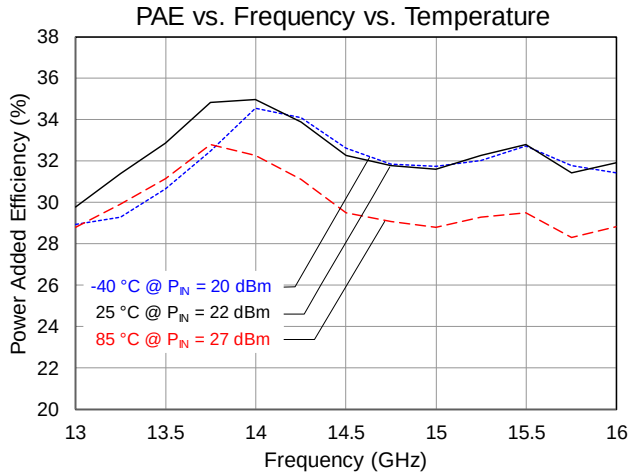
### Performance Plots – Large Signal

Conditions unless otherwise specified:  $V_D = +28\text{ V}$ ,  $I_{DQ} = 900\text{ mA}$ , Temp. =  $25\text{ }^{\circ}\text{C}$ , CW operation



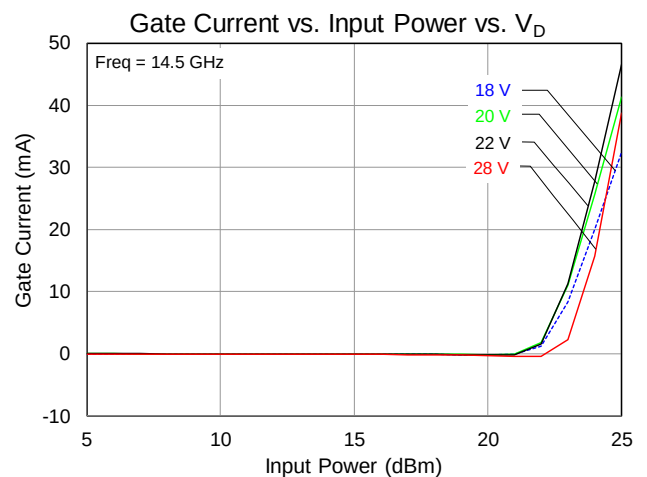
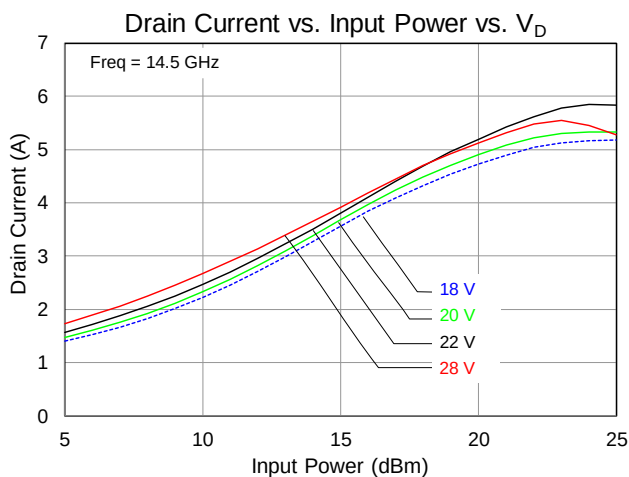
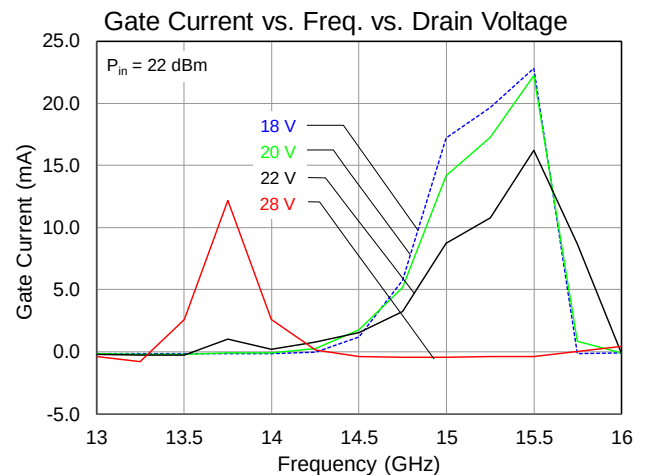
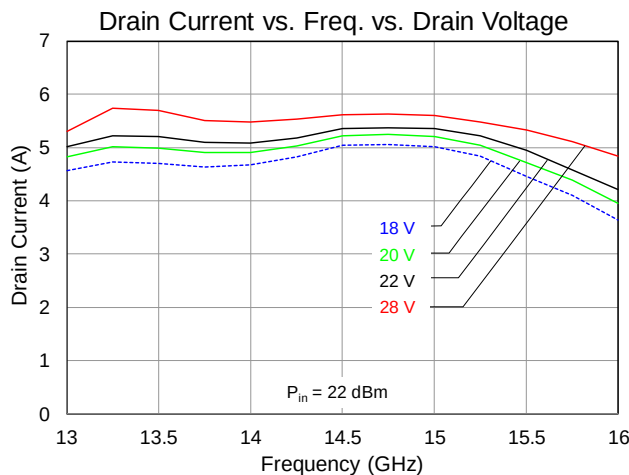
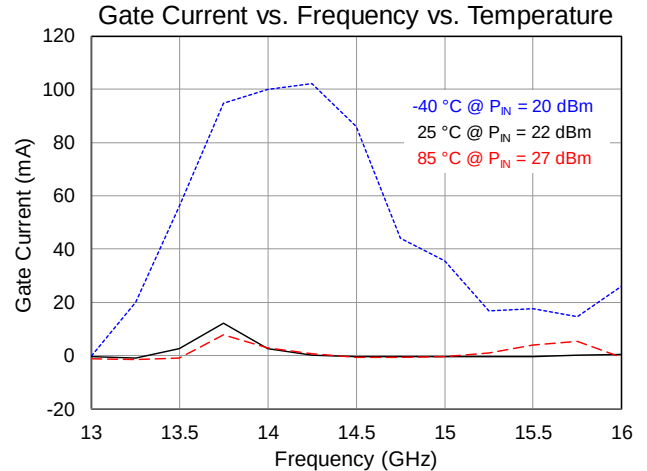
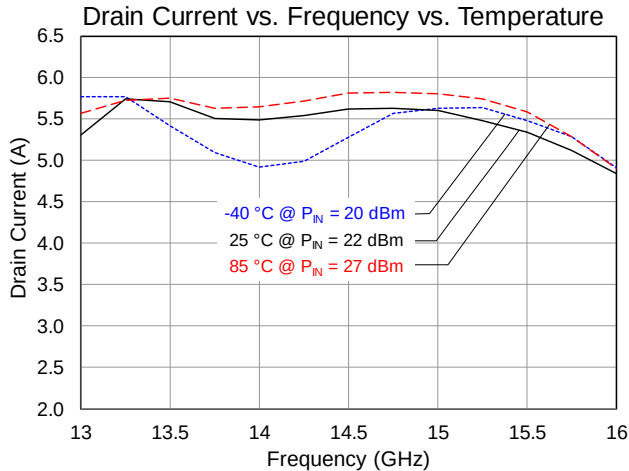
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Conditions unless otherwise specified:  $V_D = +28\text{ V}$ ,  $I_{DQ} = 900\text{ mA}$ , Temp. =  $25\text{ }^\circ\text{C}$ , CW operation



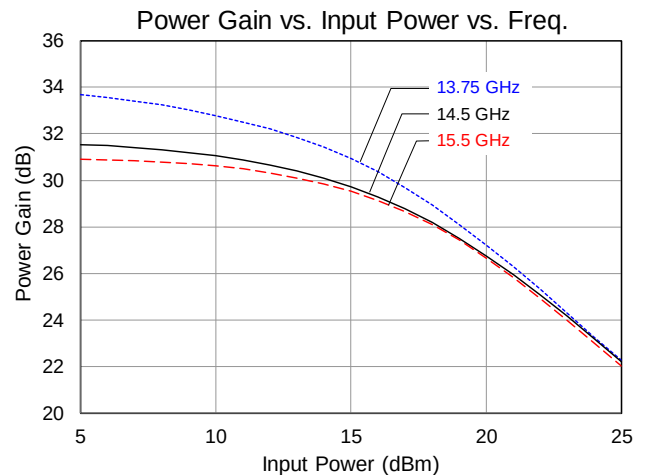
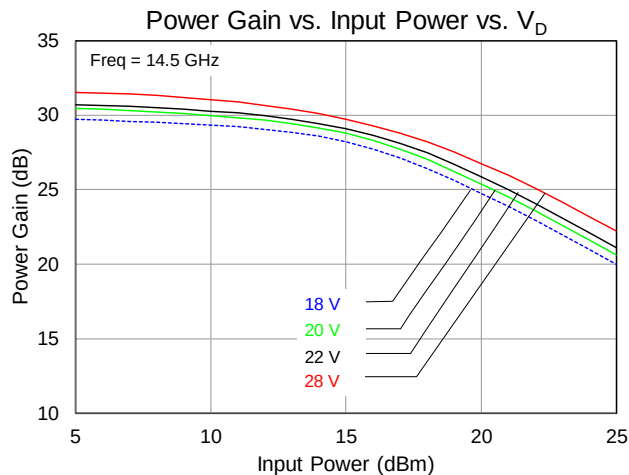
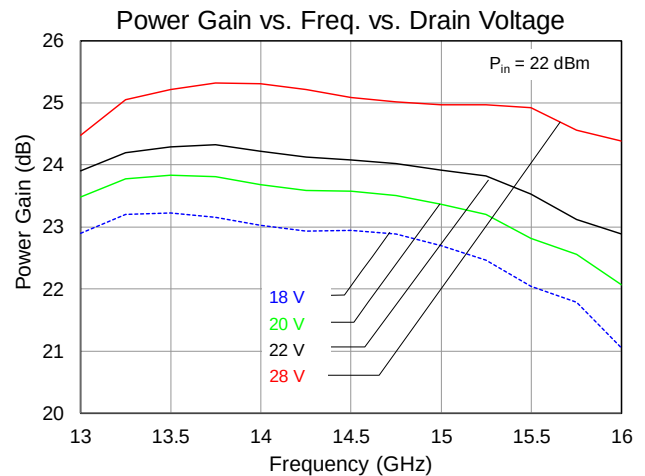
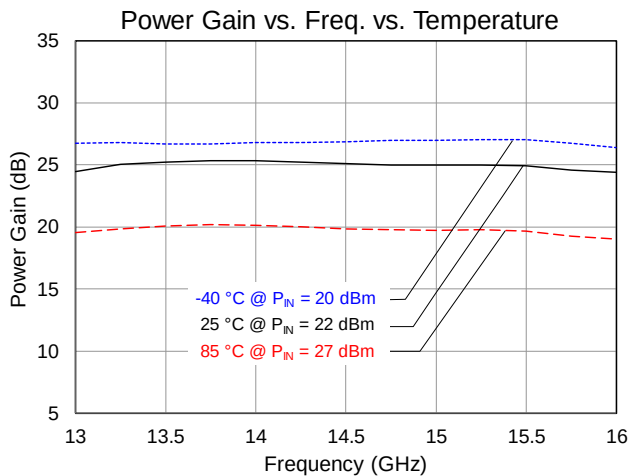
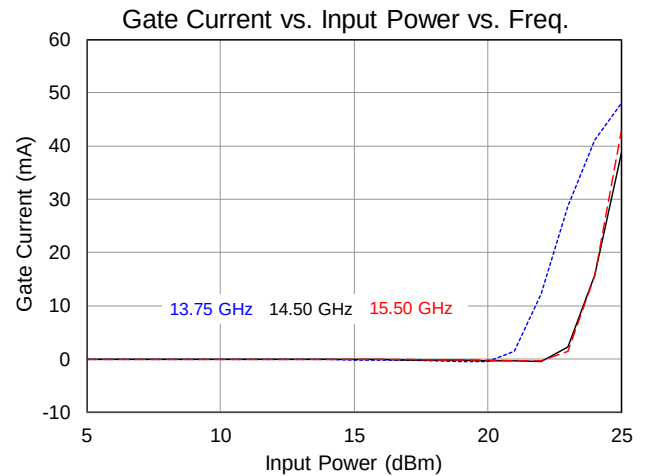
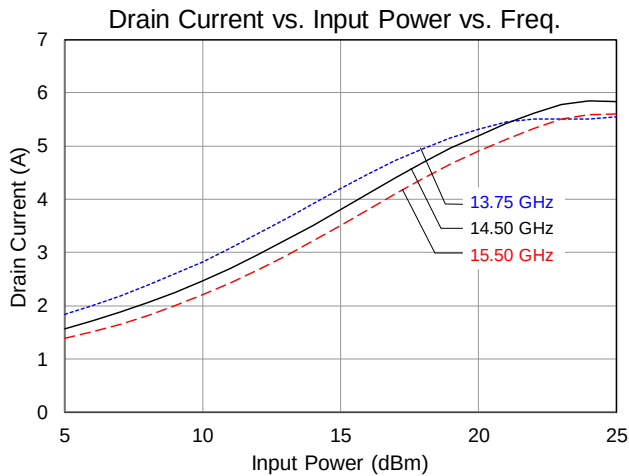
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Conditions unless otherwise specified:  $V_D = +28\text{ V}$ ,  $I_{DQ} = 900\text{ mA}$ , Temp. =  $25\text{ }^{\circ}\text{C}$ , CW operation



### Performance Plots – Large Signal

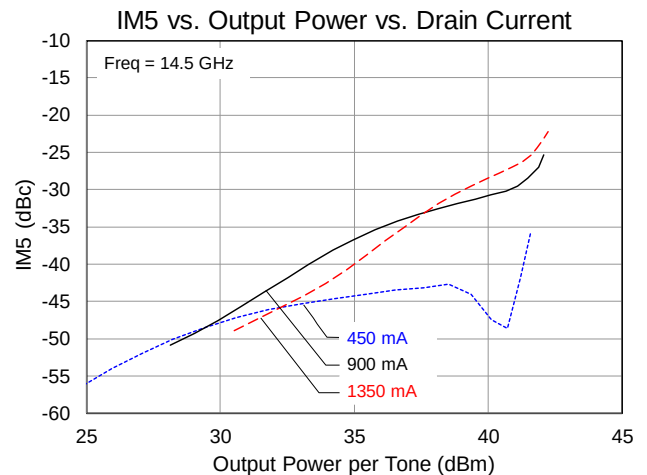
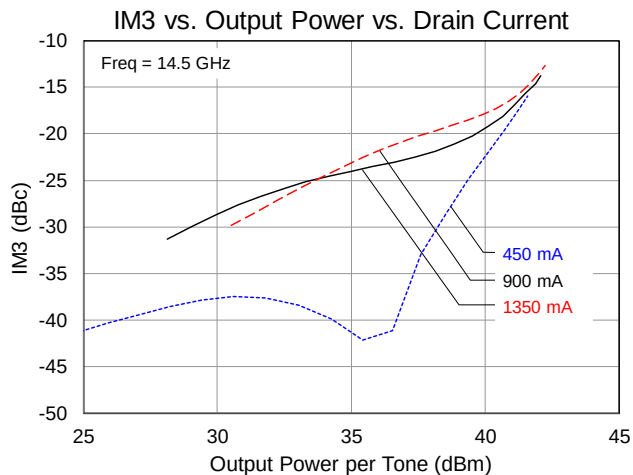
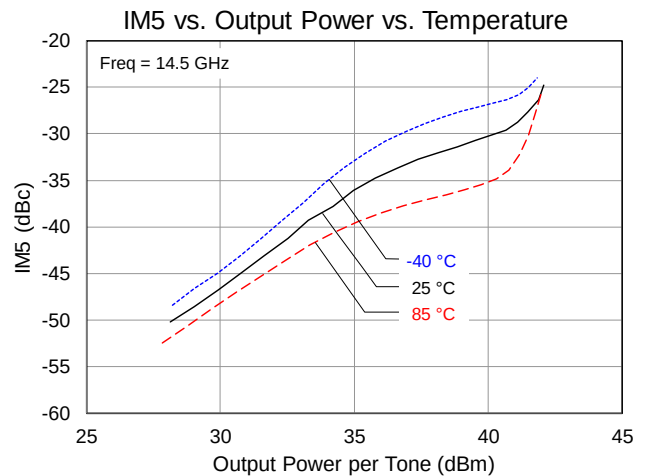
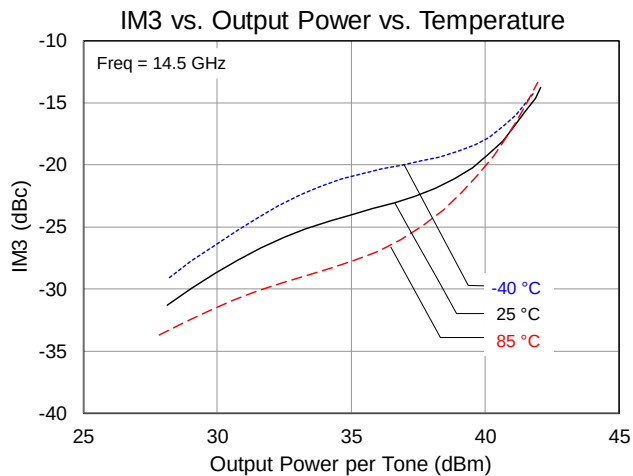
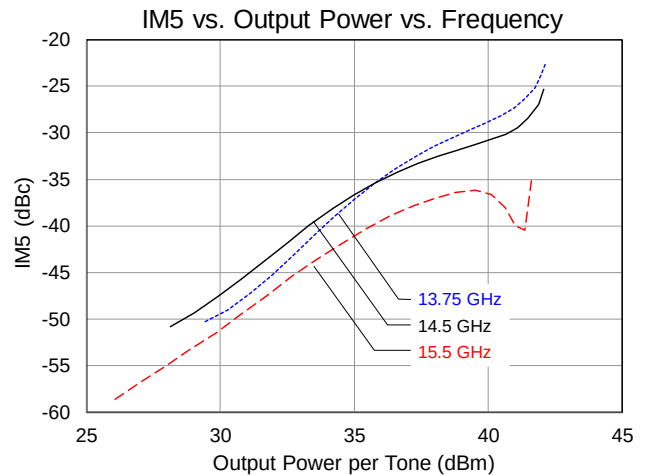
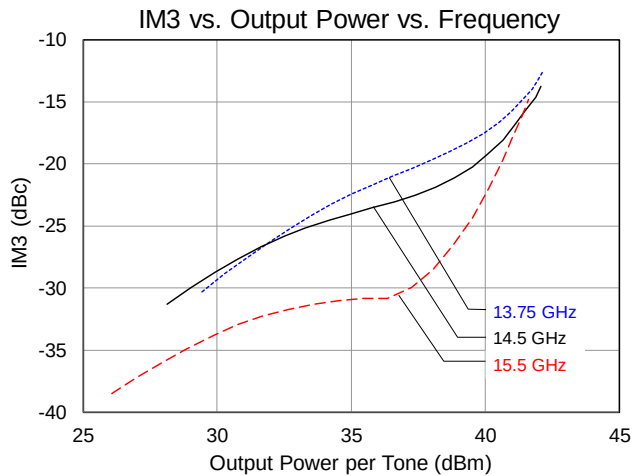
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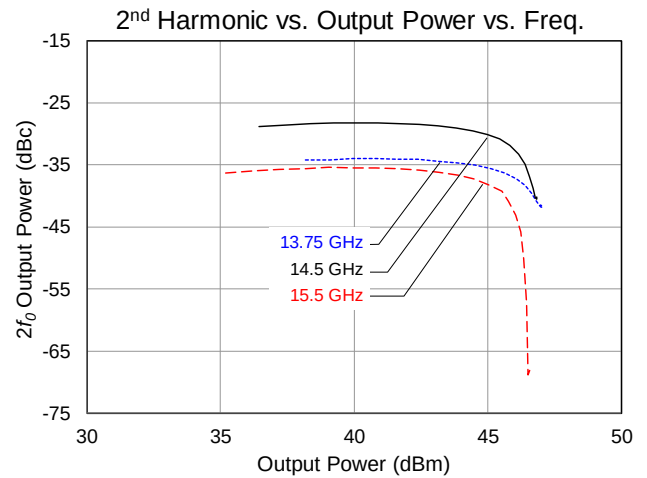
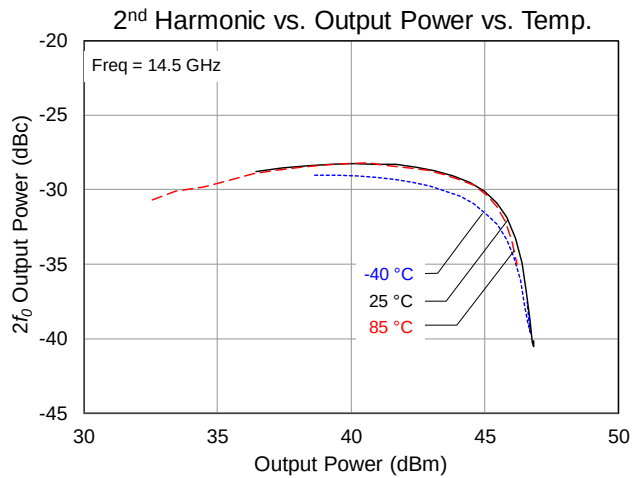
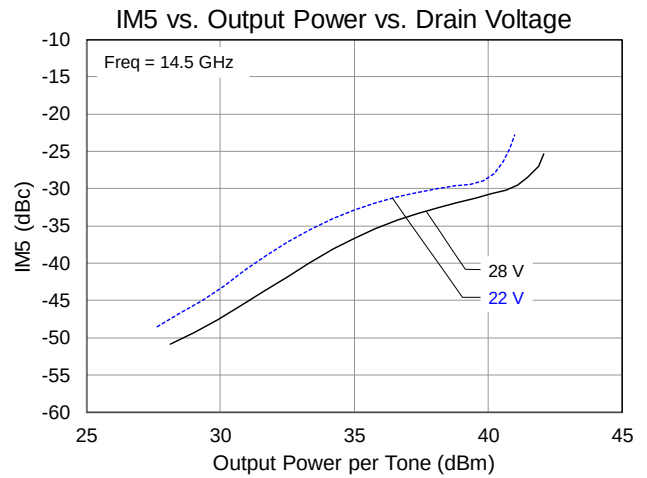
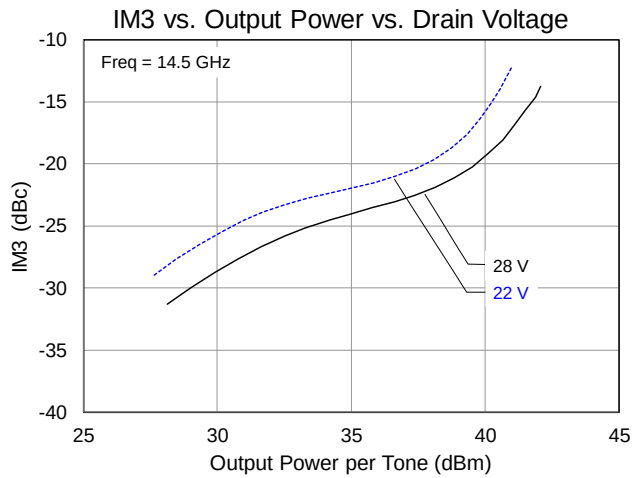
### Performance Plots – Linearity

Conditions unless otherwise specified:  $V_D = +28\text{ V}$ ,  $I_{DQ} = 900\text{ mA}$ , Temp. =  $25\text{ }^{\circ}\text{C}$ , CW operation, Input Tone Spacing =  $1\text{ MHz}$

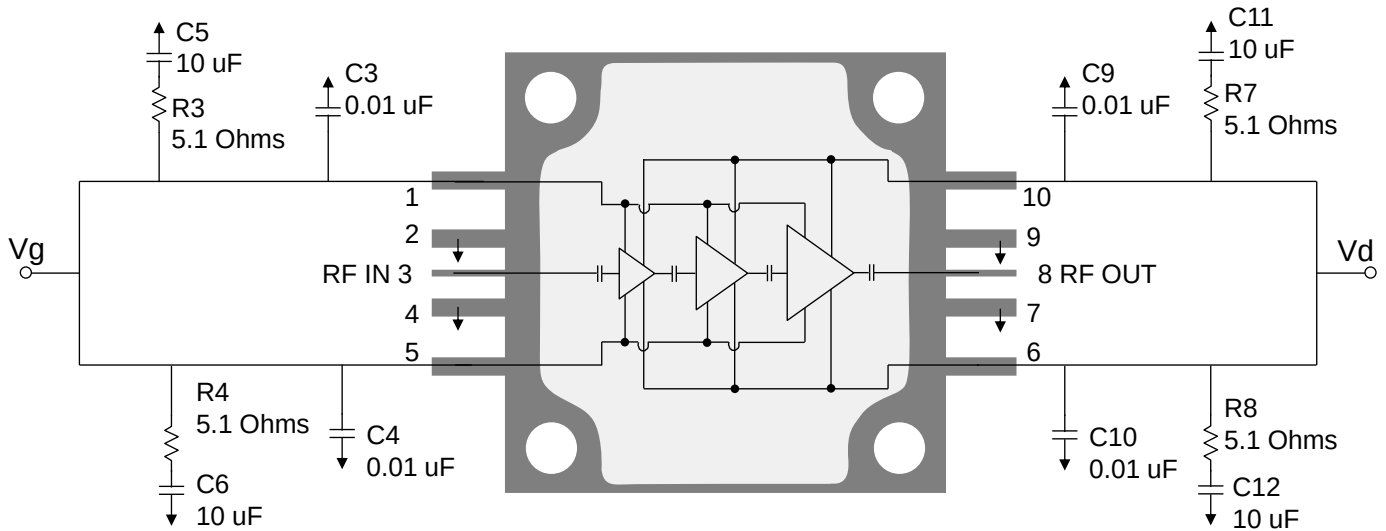


### Performance Plots – Linearity

Conditions unless otherwise specified:  $V_D = +28\text{ V}$ ,  $I_{DQ} = 900\text{ mA}$ , Temp. =  $25^\circ\text{C}$ , CW operation, Input Tone Spacing =  $1\text{ MHz}$



### Applications Information and Pad Layout



### Bias Up Procedure

1. Set  $I_D$  limit to 6.3 A,  $I_G$  limit to 110 mA
2. Apply -5 V to  $V_G$
3. Apply +28 V to  $V_D$ ; ensure  $I_{DQ}$  is approx. 0 mA
4. Adjust  $V_G$  until  $I_{DQ} = 900$  mA ( $V_G \sim -2.7$  V Typ.).
5. Turn on RF supply

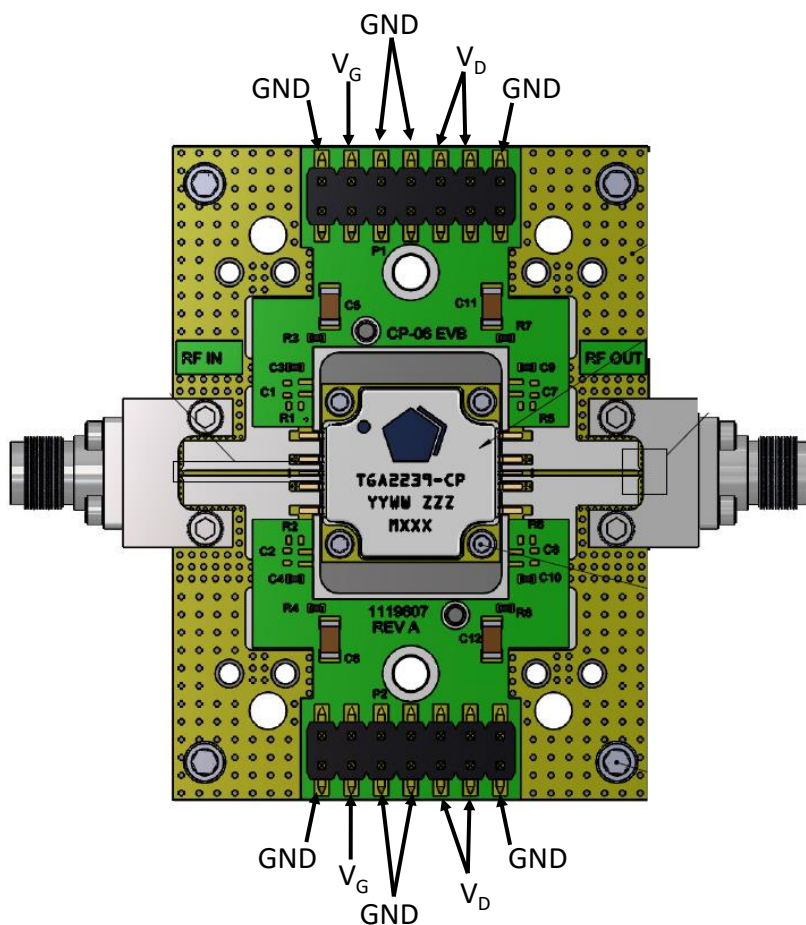
### Bias Down Procedure

1. Turn off RF supply
2. Reduce  $V_G$  to -5 V; ensure  $I_{DQ}$  is approx. 0 mA
3. Set  $V_D$  to 0 V
4. Turn off  $V_D$  supply
5. Turn off  $V_G$  supply

### Pin Description

| Pad No. | Symbol     | Description                                                                                                             |
|---------|------------|-------------------------------------------------------------------------------------------------------------------------|
| 1,5     | $V_G$      | Gate Voltage; Bias network is required; must be biased from both sides; see recommended Application Information above.  |
| 3       | $RF_{IN}$  | Input; matched to 50 $\Omega$ ; DC blocked                                                                              |
| 2,4,7,9 | GND        | Must be grounded on the PCB.                                                                                            |
| 6,10    | $V_D$      | Drain voltage; Bias network is required; must be biased from both sides; see recommended Application Information above. |
| 8       | $RF_{OUT}$ | Output; matched to 50 $\Omega$ ; DC blocked                                                                             |

### Evaluation Board



#### Notes:

- Both Top and Bottom Vd and Vg must be biased.

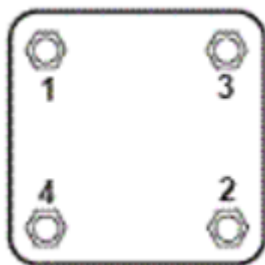
### Bill of Materials

| Reference Des.   | Value        | Description                | Manuf.  | Part Number |
|------------------|--------------|----------------------------|---------|-------------|
| C3, C4, C9, C10  | 0.01 $\mu$ F | Cap, 0402, 50 V, 10 %, X7R | Various | –           |
| C5, C6, C11, C12 | 10 $\mu$ F   | Cap, 1206, 50 V, 20 %, X5R | Various | –           |
| R3, R4, R7, R8   | 5.1 Ohm      | Res, 0402, 50 V, 5 %       | Various | –           |

### Assembly Notes

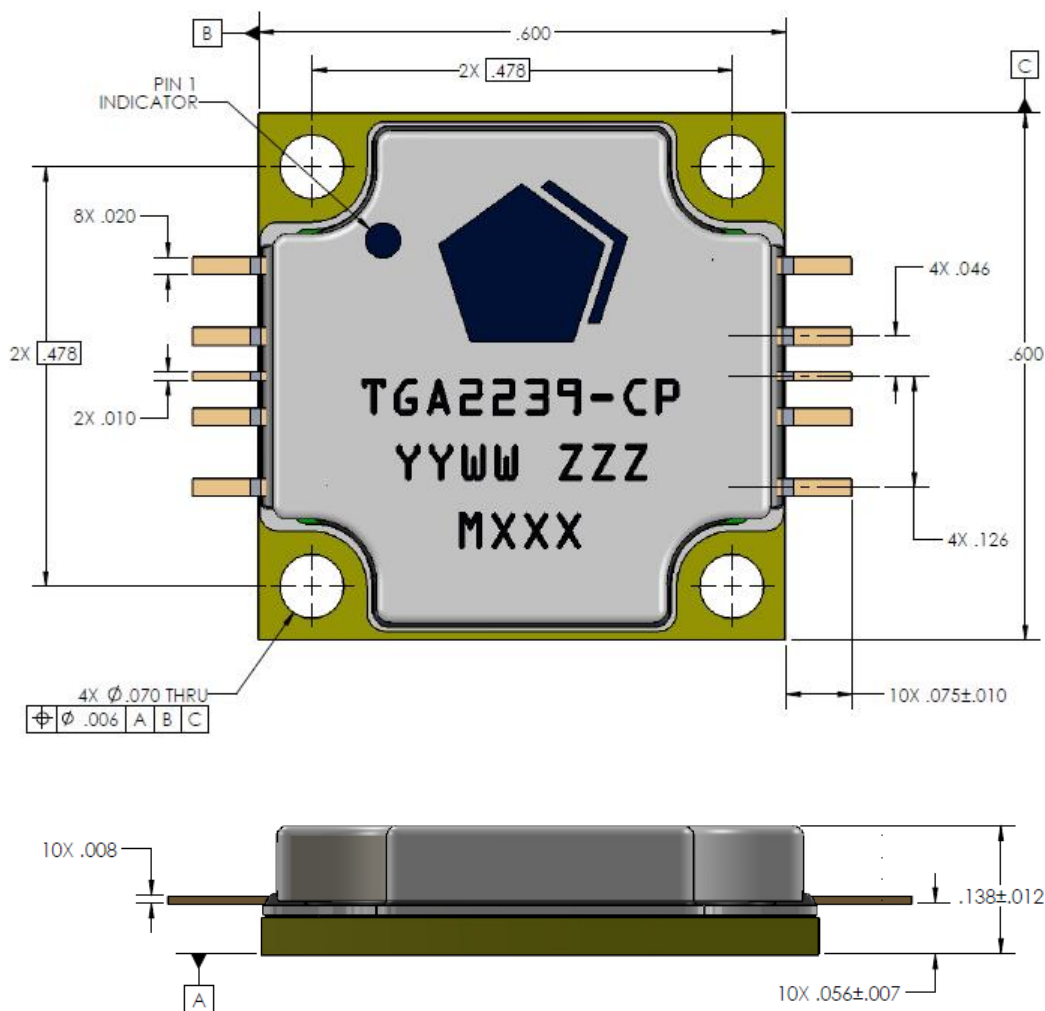
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1. Carefully clean the PC board and package leads with alcohol. Allow it to dry fully.
2. To improve the thermal and RF performance, Qorvo recommends attaching a heat sink to the bottom of the PCB and apply thermal compound (Arctic Silver 5 recommended) 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 TGA2239-CP. 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.xx = ± 0.01

x.xxx = ± 0.005

Materials:

Base: Copper

Lid: Plastic

All metalized features are gold plated

Part is epoxy sealed

Marking:

2239: Part number

YY: Part Assembly year

WW: Part Assembly week

ZZZ: Serial Number

MXXX: Batch ID

### Handling Precautions

| Parameter                        | Rating   | Standard                   |
|----------------------------------|----------|----------------------------|
| ESD – Human Body Model (HBM)     | Class 1B | JEDEC Standard JESD22 A114 |
| MSL – Moisture Sensitivity Level | N/A      |                            |



Caution!  
ESD-Sensitive Device

### Solderability

The component leads should be manually soldered, and the package cannot be subjected to conventional reflow processes. Soldering of the component leads is compatible with the latest version of J-STD-020, lead-free solder, 260 °C. The use of no-clean solder to avoid washing after soldering is recommended.

### RoHS Compliance

This product is compliant with the 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:

- Product uses RoHS Exemption 7c-1 to meet RoHS Compliance requirements
- 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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