

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 μm 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.

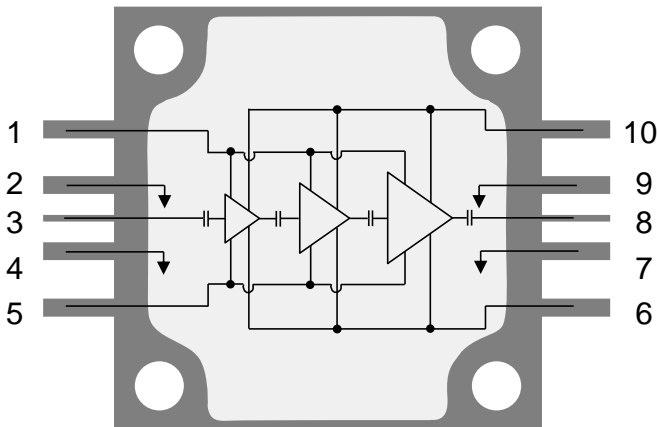
RoHS compliant.



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 Ω , $V_D = +28$ 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) (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

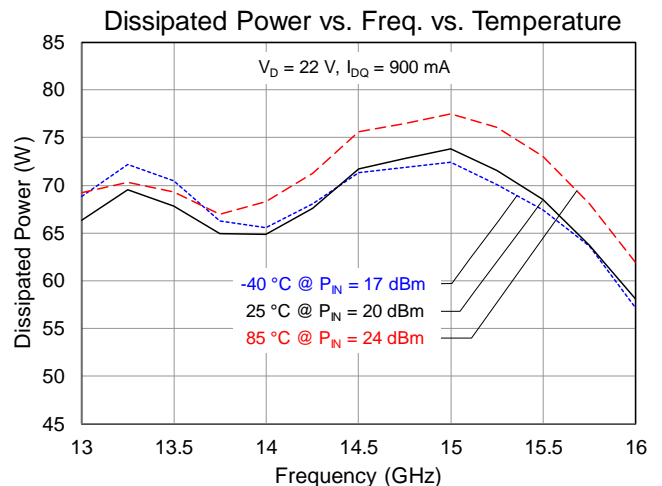
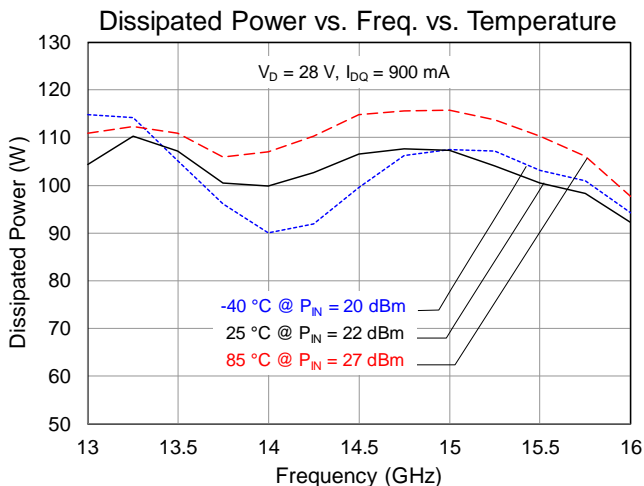
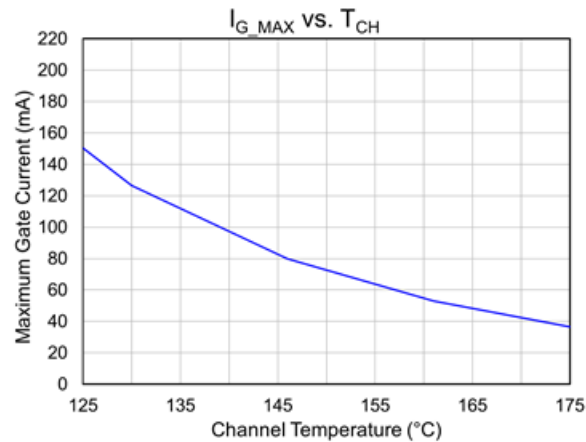
Thermal and Reliability Information

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

Notes:

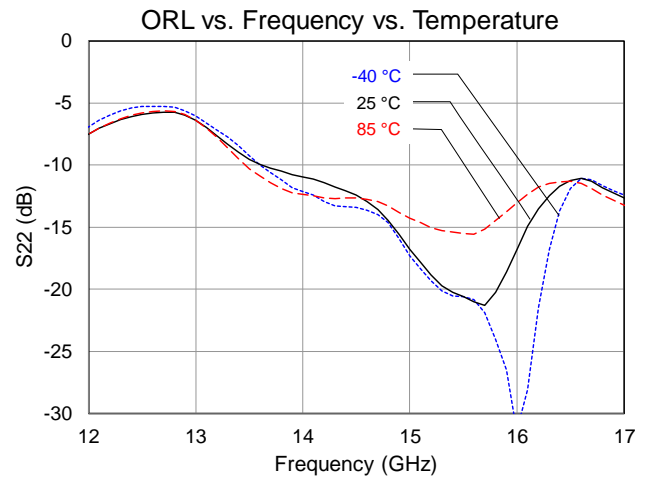
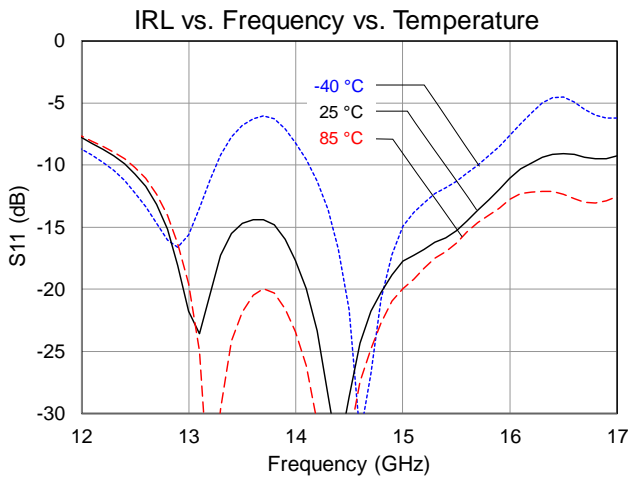
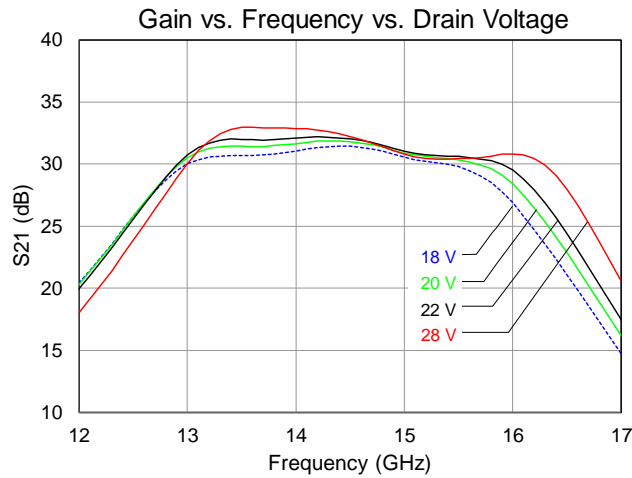
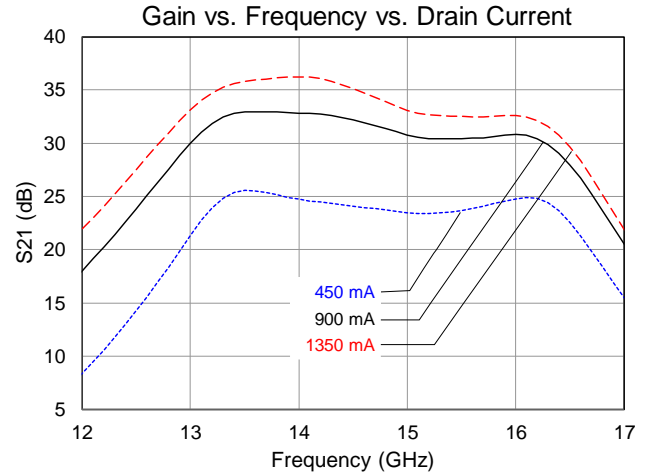
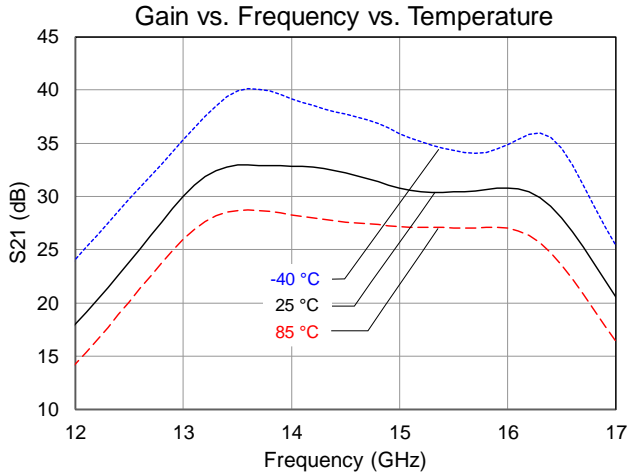
1. Thermal resistance measured to back of package.
2. Refer to the following document: [GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates](#)

Dissipated Power



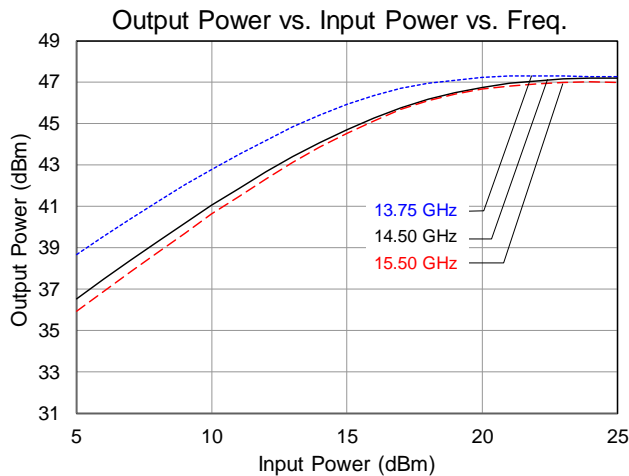
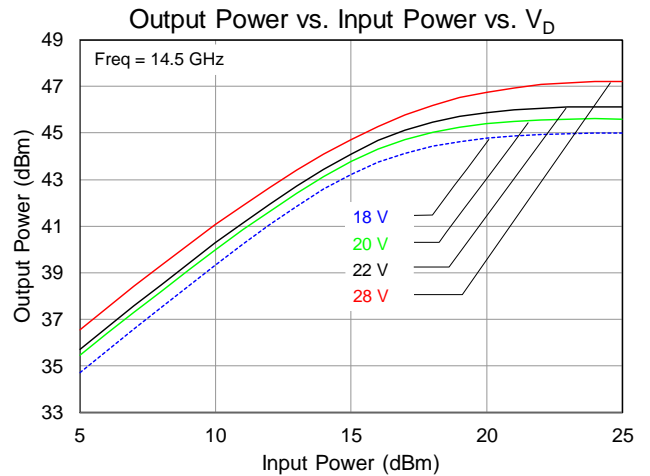
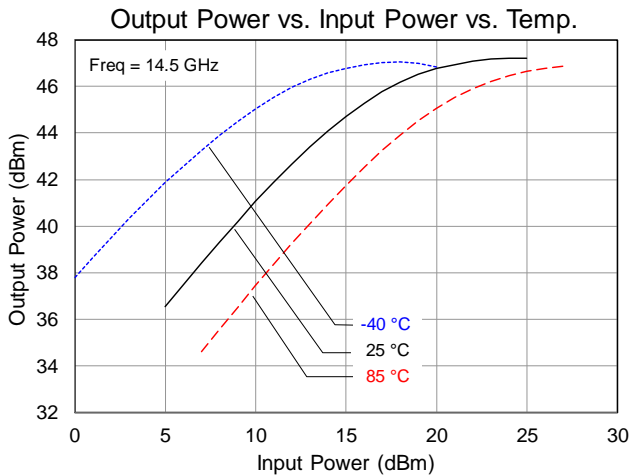
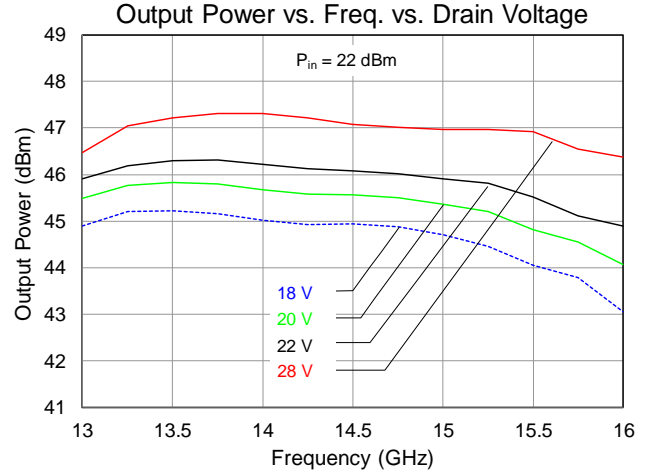
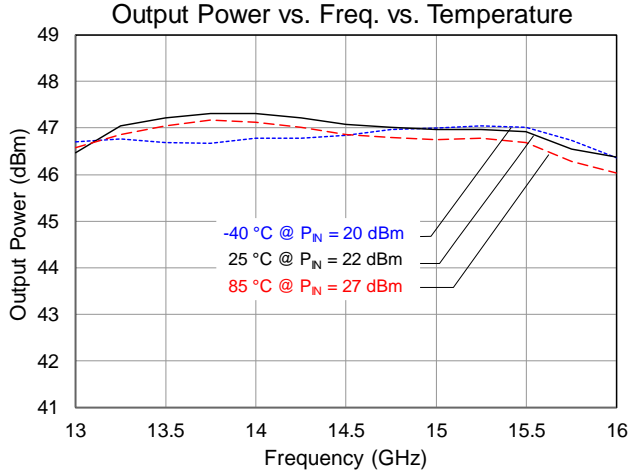
Performance Plots – Small Signal

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



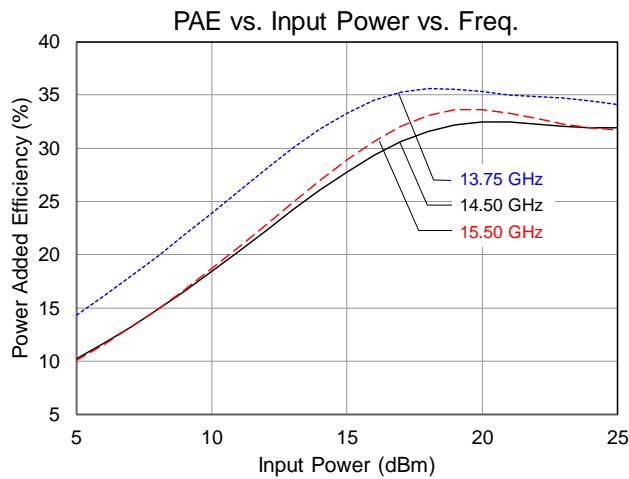
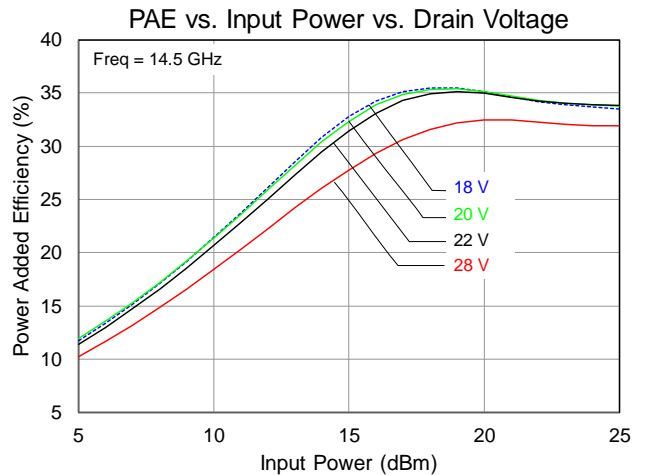
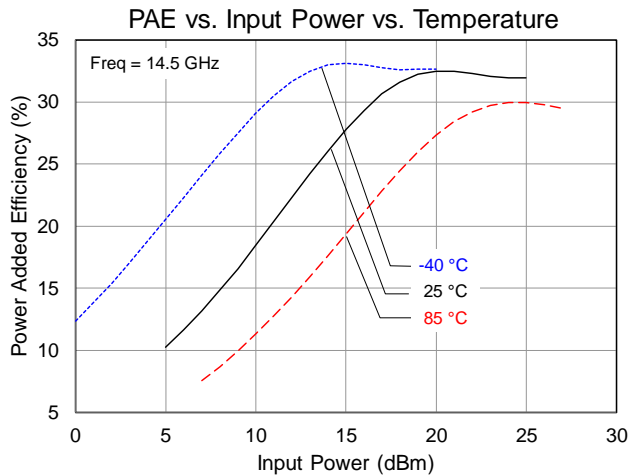
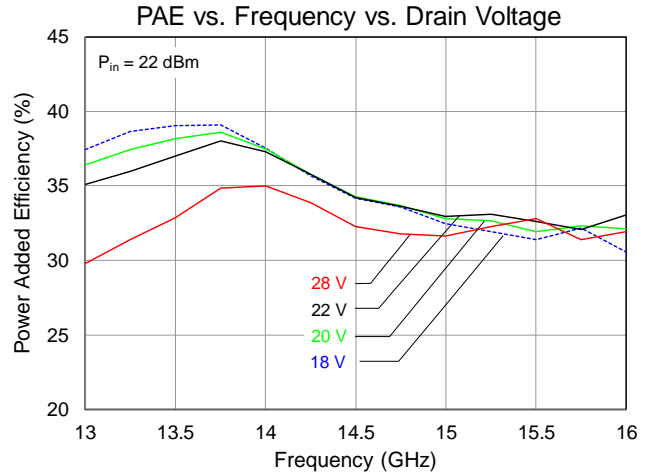
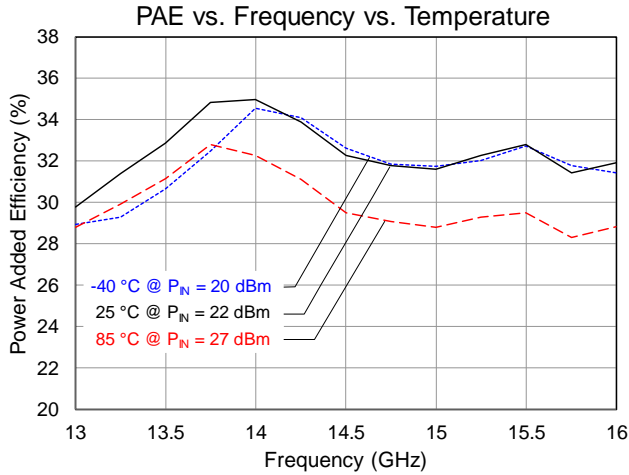
Performance Plots – Large Signal

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



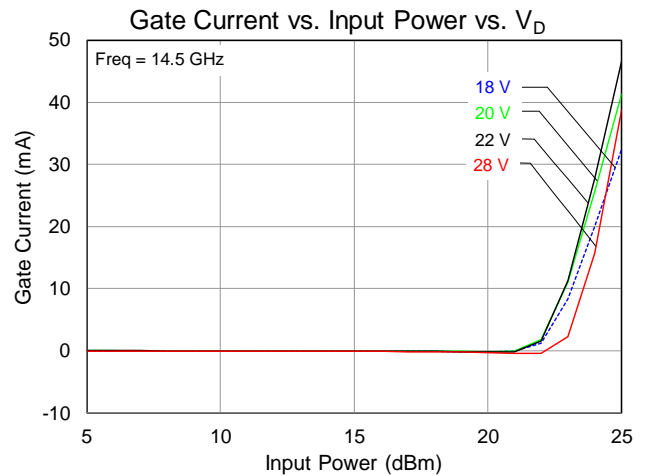
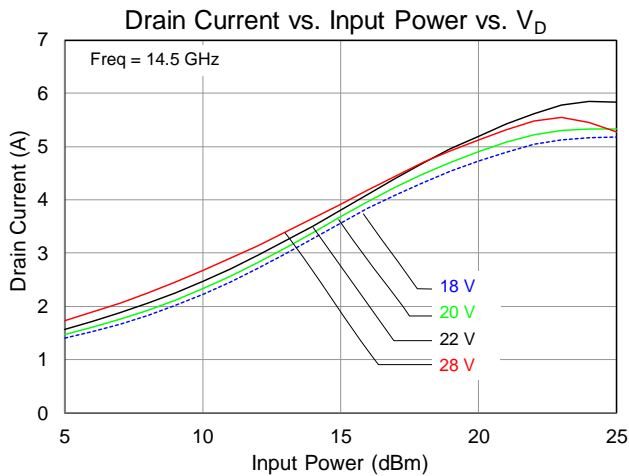
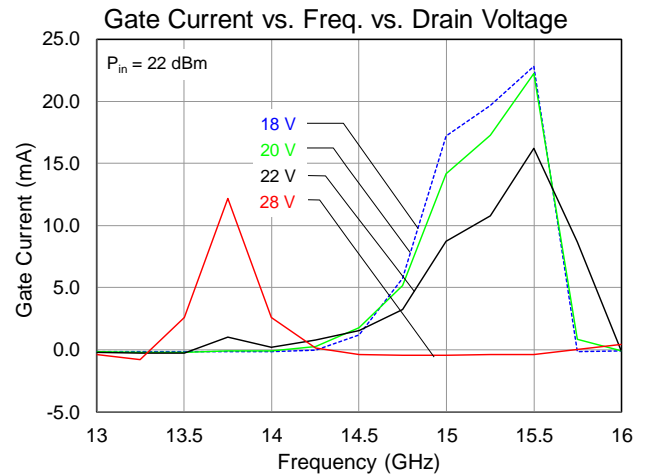
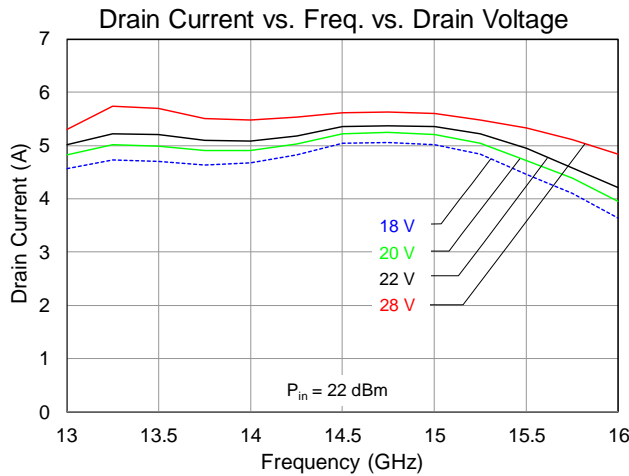
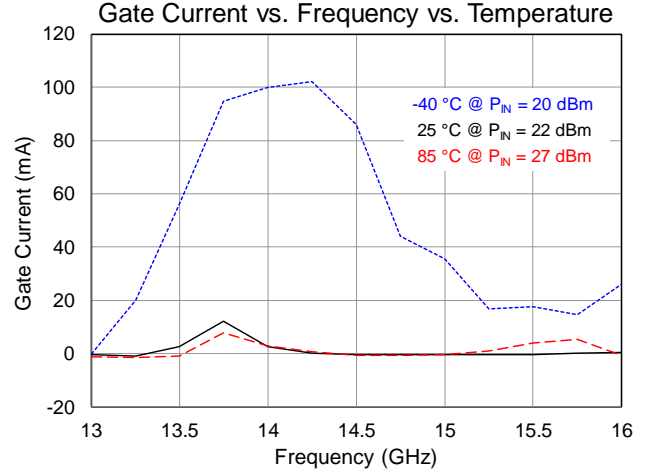
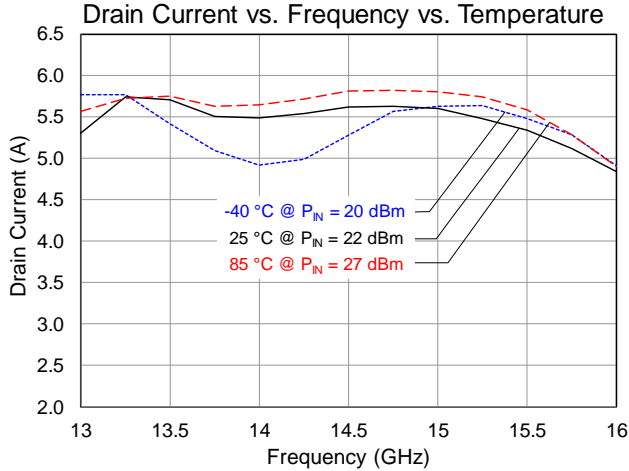
Performance Plots – Large Signal

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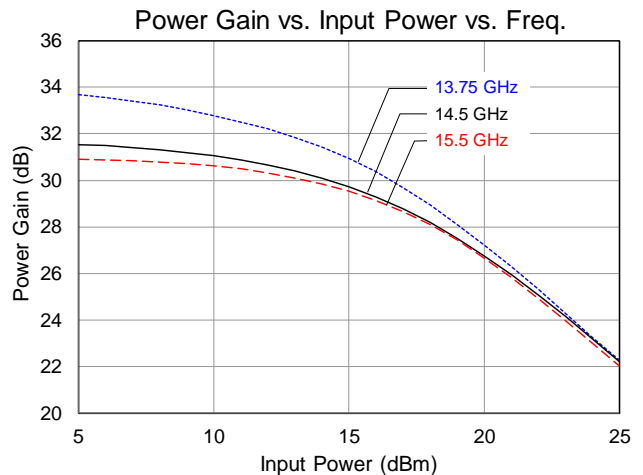
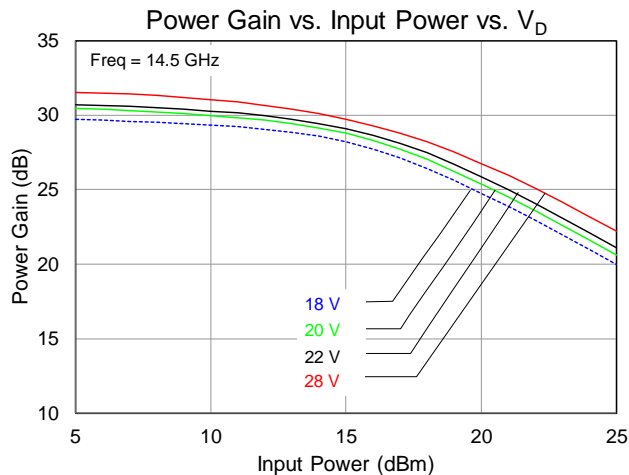
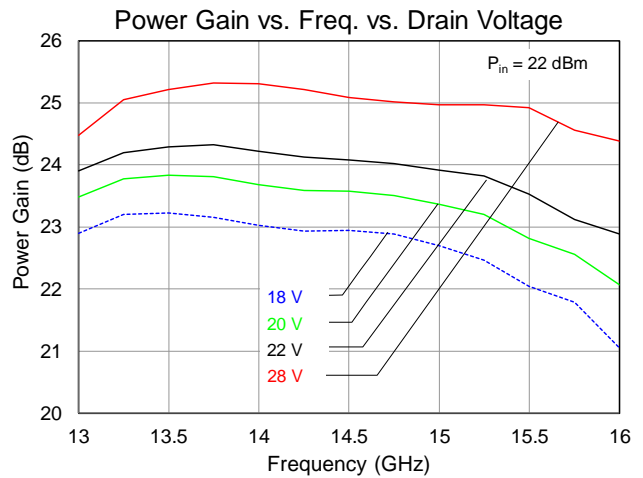
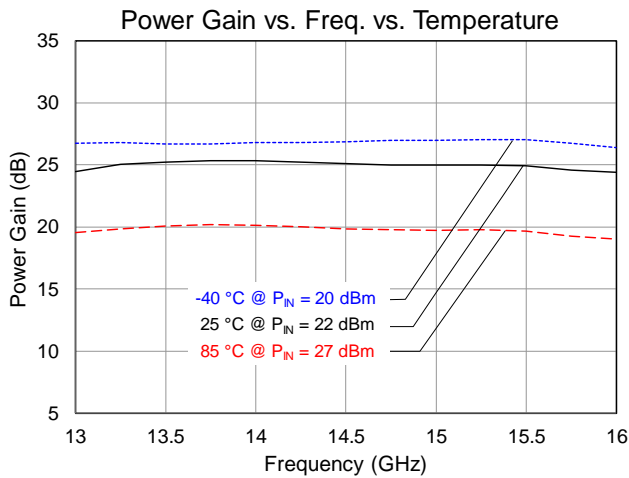
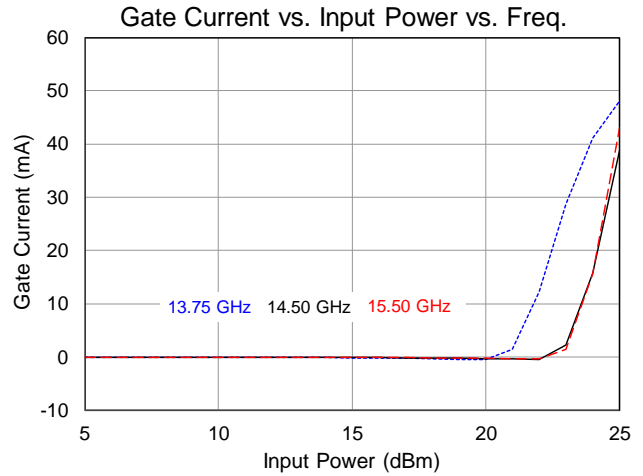
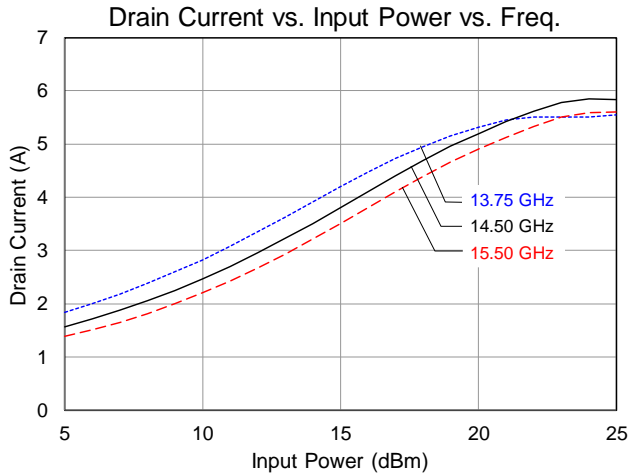
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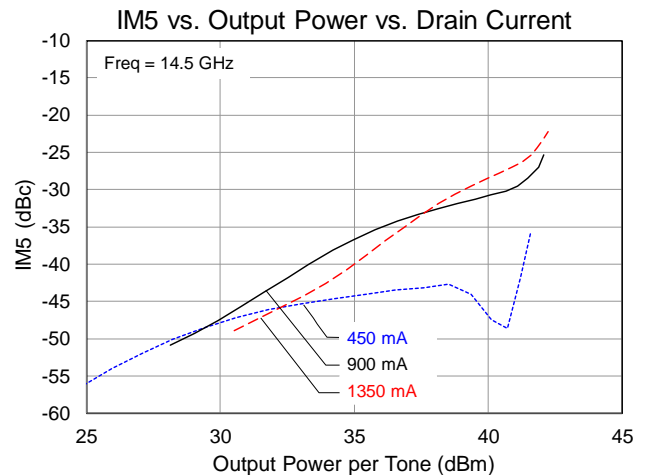
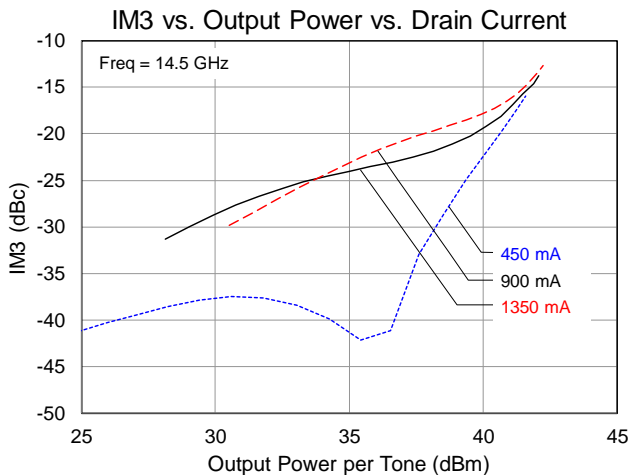
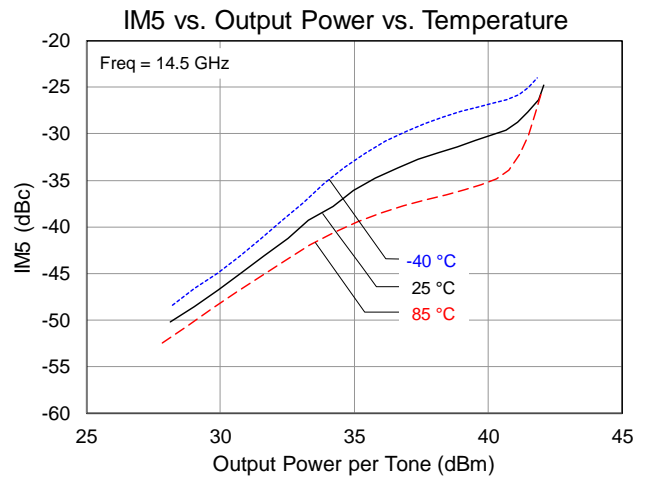
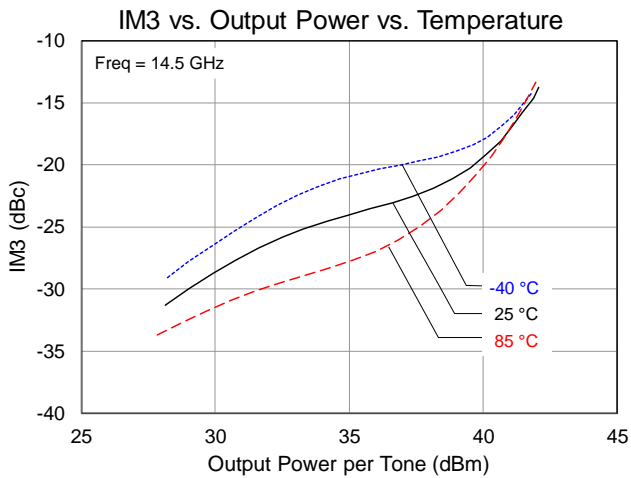
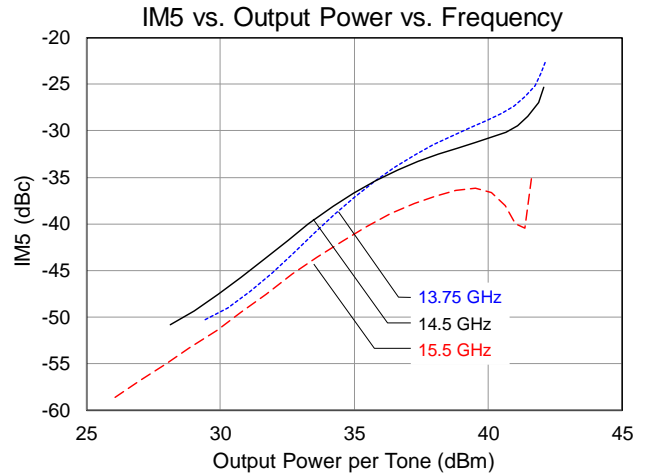
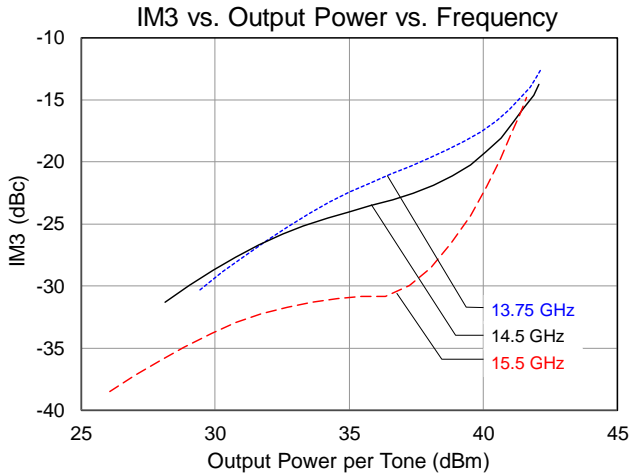
Performance Plots – Large Signal

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



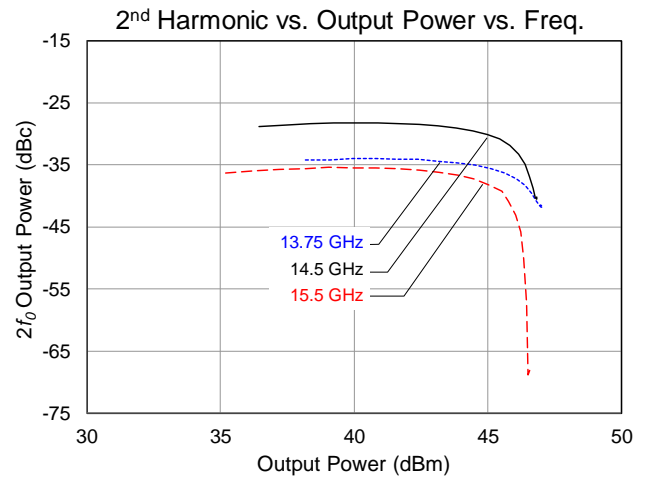
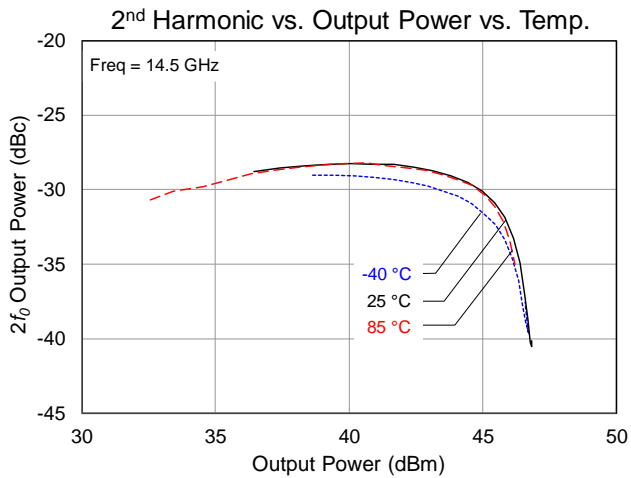
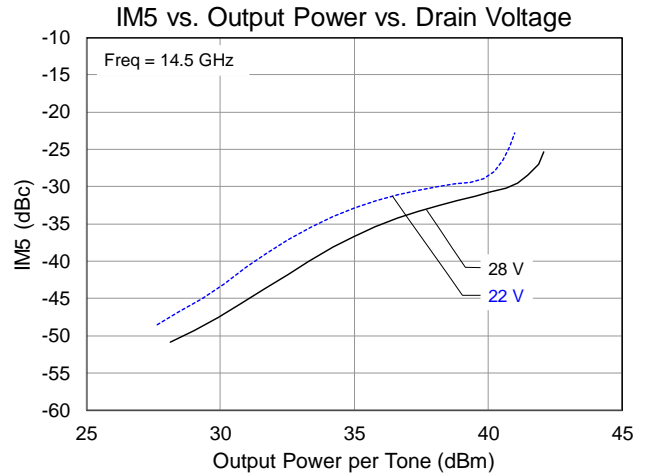
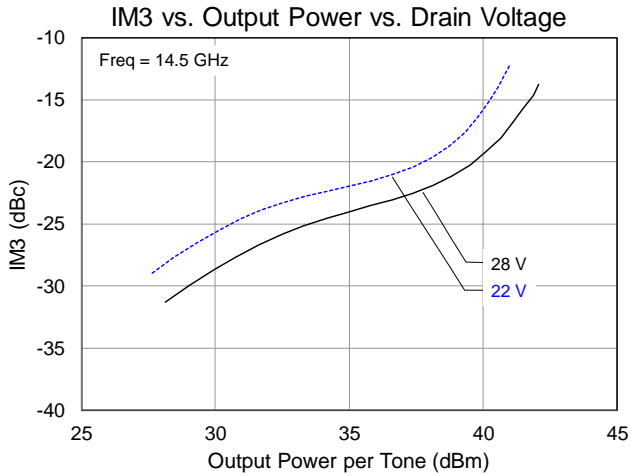
Performance Plots – Linearity

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 MHz

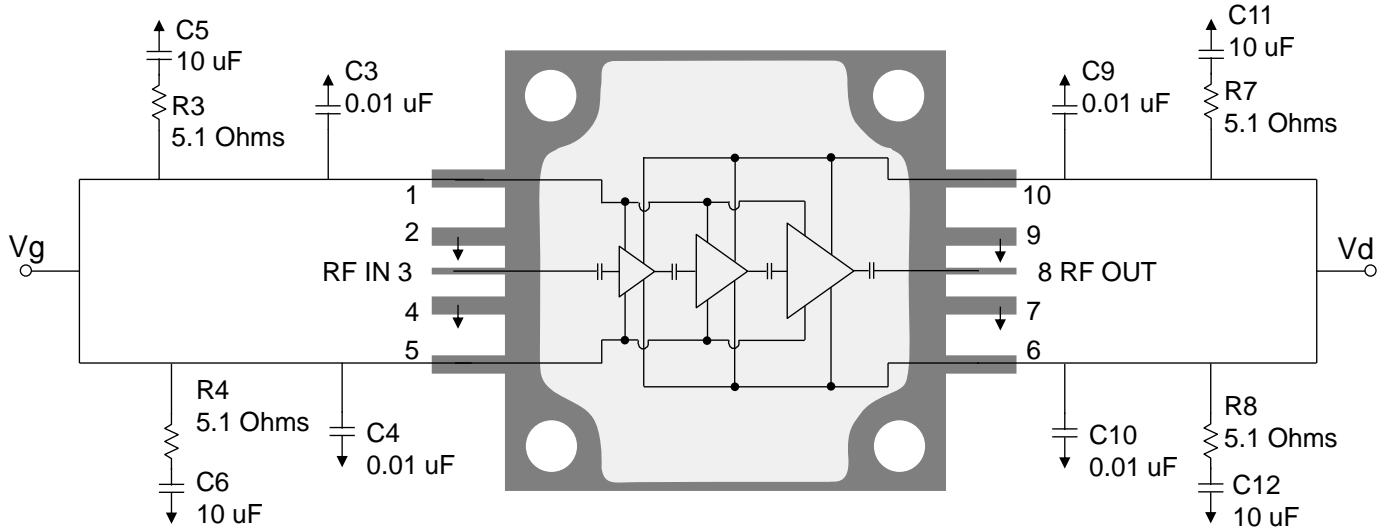


Performance Plots – Linearity

Conditions unless otherwise specified: $V_D = +28\text{ V}$, $I_{DQ} = 900\text{ mA}$, $\text{Temp.} = 25\text{ }^\circ\text{C}$, CW operation, Input Tone Spacing = 1 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 $+28\text{ V}$ to V_D ; ensure I_{DQ} is approx. 0 mA
4. Adjust V_G until $I_{DQ} = 900\text{ mA}$ ($V_G \sim -2.7\text{ V Typ.}$).
5. Turn on RF supply

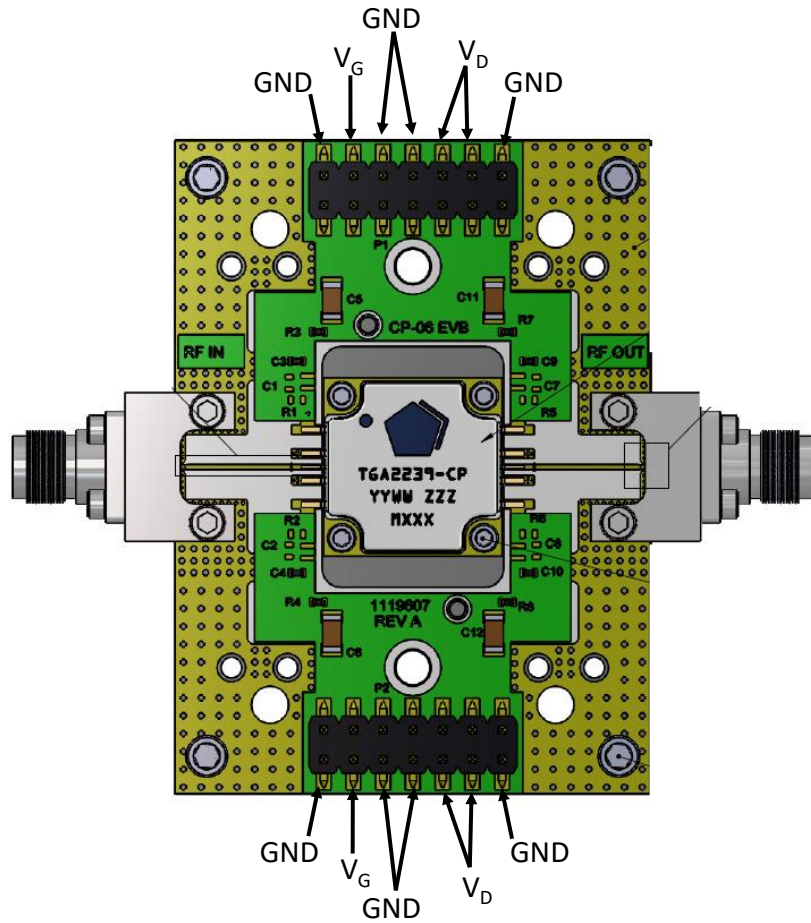
Bias Down Procedure

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



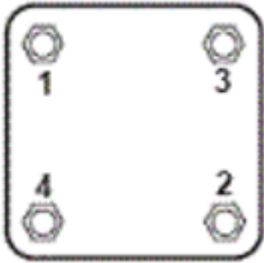
- Notes:
- Both Top and Bottom Vd and Vg must be biased.

Bill of Materials

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

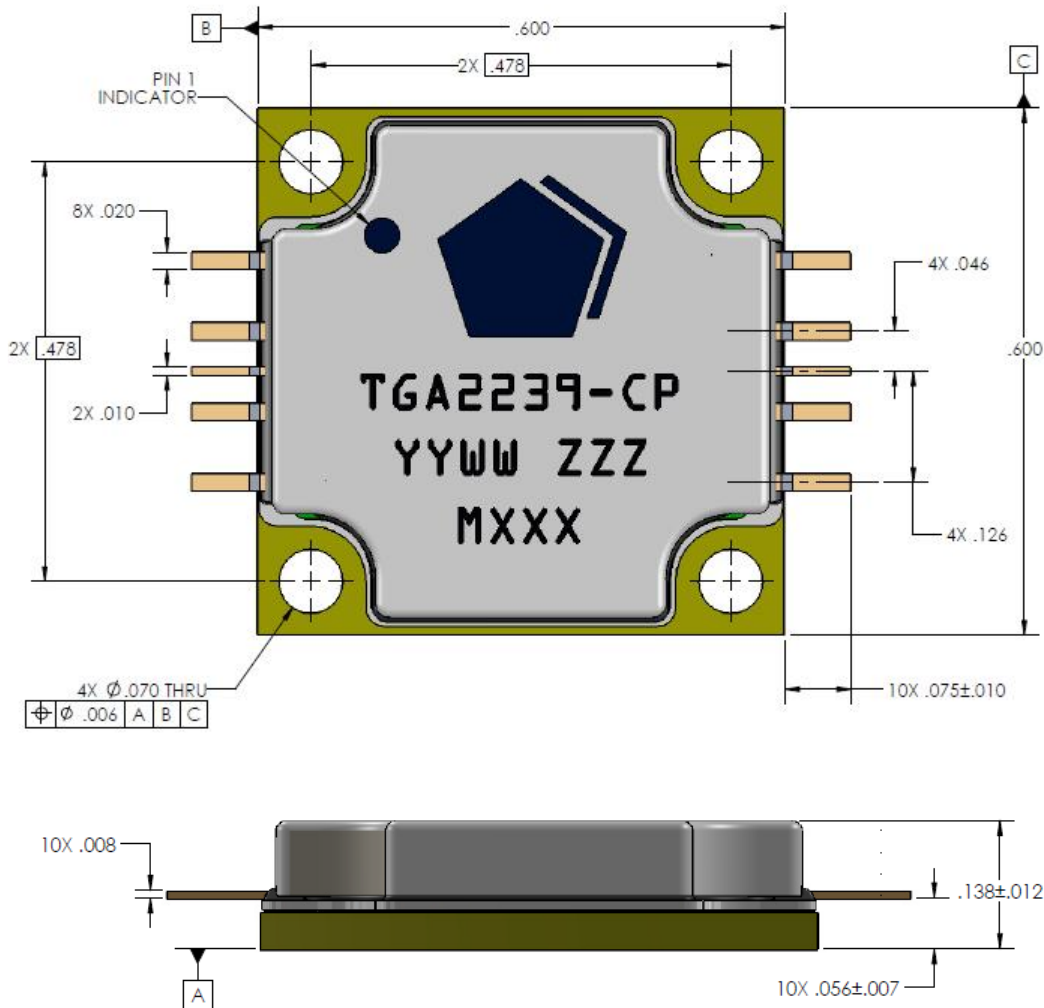
Assembly Notes

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 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