

Product Description

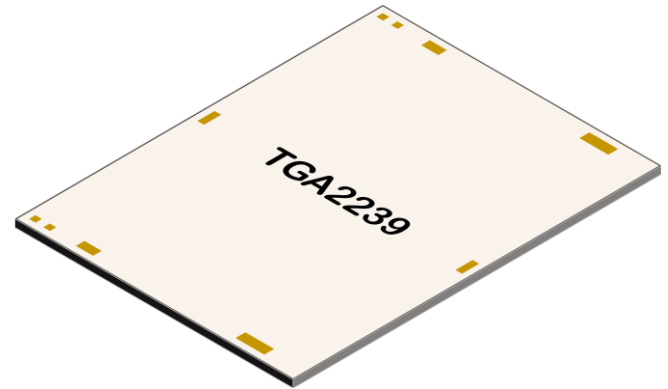
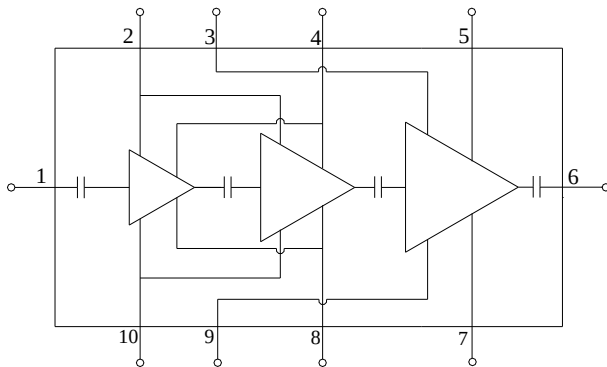
Qorvo's TGA2239 is a Ku-band, high power MMIC amplifier fabricated on Qorvo's production 0.15 μm GaN on SiC process (QGaN15). The TGA2239 operates from 13.0 – 15.5 GHz and provides a superior combination of power, gain and efficiency by achieving greater than 50 W (47 dBm) of saturated output power with 26.5 dB of large signal gain and greater than 36 % power-added efficiency.

This superior performance provides system designers the flexibility to improve system performance while reducing size and cost.

The TGA2239 is fully matched to 50 Ω with integrated DC blocking capacitors on RF ports simplifying system integration. It is ideally suited for military and commercial Ku-band radar and satellite communication systems.

Lead-free and RoHS compliant.

Functional Block Diagram



Product Features

- Frequency Range: 13.0 – 15.5 GHz
- P_{SAT} : 47.5 dBm ($P_{\text{IN}} = 21$ dBm)
- PAE: 36.2 % ($P_{\text{IN}} = 21$ dBm)
- Large Signal Gain: 26.5 dB
- Small Signal Gain: 34.4 dB
- Bias: $V_D = 28$ V, $I_{DQ} = 900$ mA
- Chip Dimensions: 5.00 x 6.65 x 0.10 mm
- Performance under CW conditions

Applications

- Satellite Communications
- Data Link
- Radar

Ordering Information

Part No.	Description
TGA2239	13.0 – 15.5 GHz 35 W GaN Power Amplifier
TGA2239EVB1	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_{D1-2})	2.8 A
Drain Current (I_{D3})	4.3 A
Gate Current	See plot page 10
Power Dissipation, 85°C, CW	149 W
Input Power (P_{IN}), CW, 50 Ω , $V_D = 28$ V, $I_{DQ} = 900$ mA, 85 °C	33 dBm
Input Power (P_{IN}), CW, VSWR 3:1, $V_D = 28$ V, $I_{DQ} = 900$ mA, 85 °C	33 dBm
Mounting Temperature (30 seconds)	320 °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 Conditions

Parameter	Value / Range
Drain Voltage (V_D)	28 V
Drain Current (I_{DQ})	900 mA
Operating Temperature	-40 to 85 °C

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

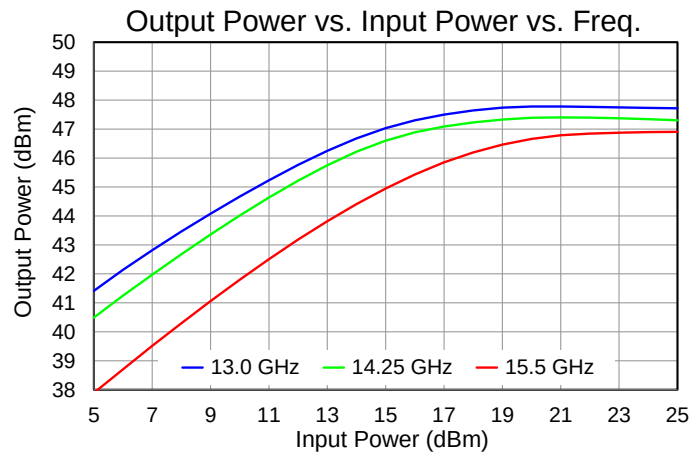
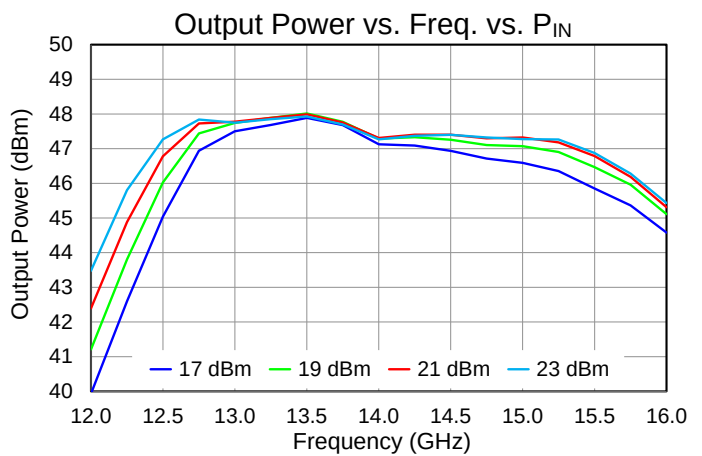
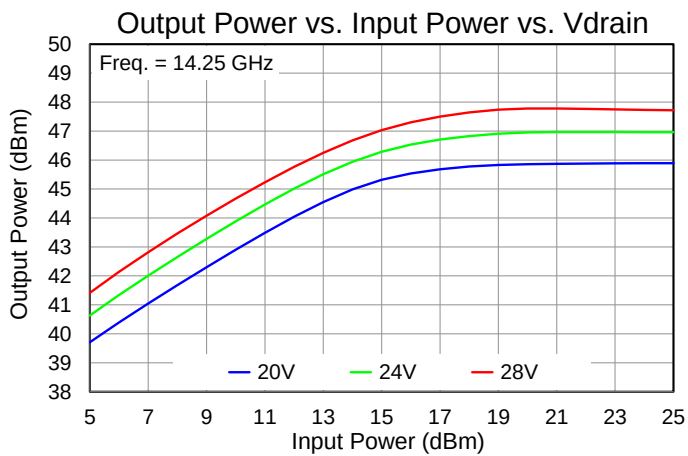
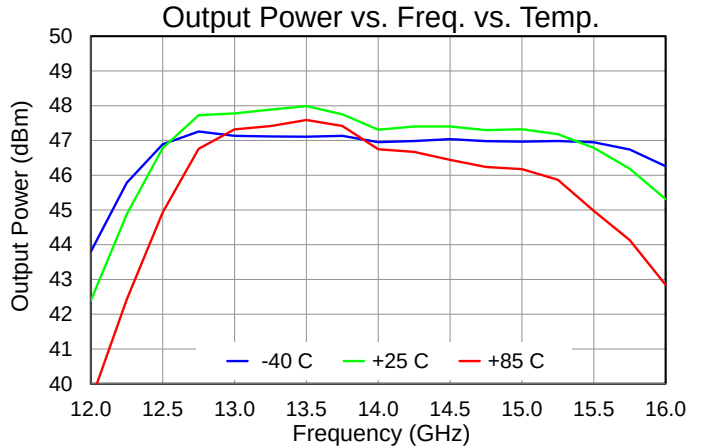
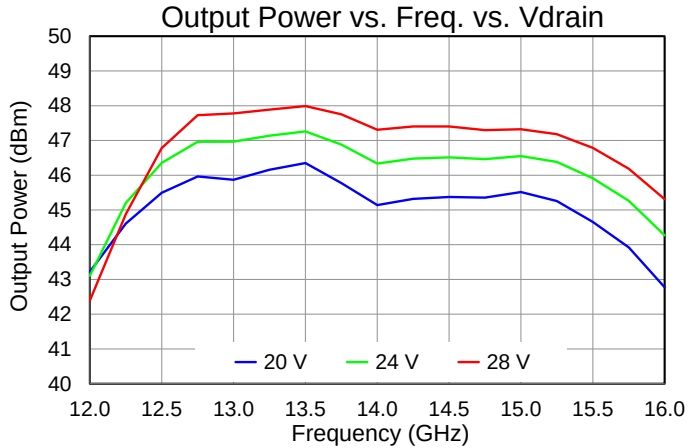
Electrical Specifications

Parameter		Min	Typ	Max	Units
Operational Frequency Range		13	–	15.5	GHz
Output Power ($P_{IN} = 21$ dBm)	13.0 GHz	46.0	47.8	–	dBm
	13.5 GHz	46.0	48.0	–	dBm
	13.75 GHz	46.0	47.8	–	dBm
	14.5 GHz	46.0	47.4	–	dBm
	15.5 GHz	45.5	46.8	–	dBm
Power Added Efficiency ($P_{IN} = 21$ dBm)	13.0 GHz	30.0	40.2	–	%
	13.5 GHz	30.0	39.6	–	%
	13.75 GHz	25.0	42.3	–	%
	14.5 GHz	25.0	34.2	–	%
	15.5 GHz	25.0	31.5	–	%
Power Gain ($P_{IN} = 21$ dBm)		–	26.5	–	dB
Small Signal Gain		–	34.4	–	dB
Input Return Loss		–	19	–	dB
Output Return Loss		–	11	–	dB
Sm. Sig. Gain Temperature Coefficient (85 to -40 °C)		–	-0.100	–	dB/°C
Output Power Temperature Coefficient (85 to 25 °C)		–	-0.014	–	dB/°C

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

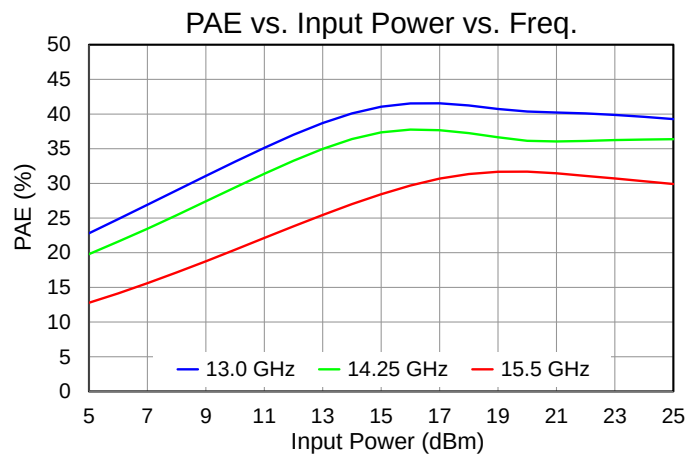
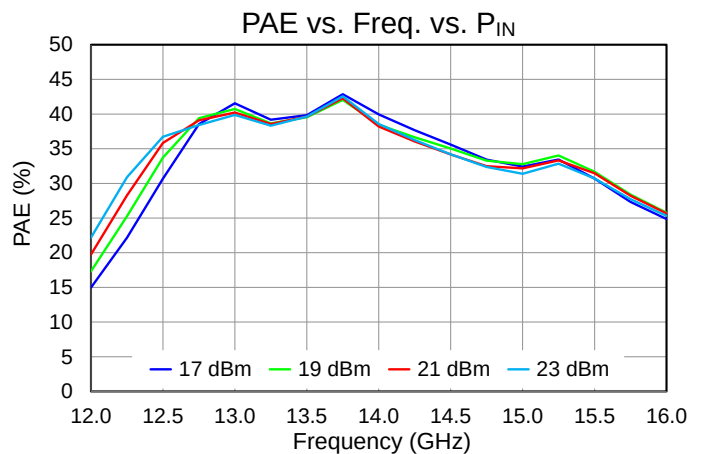
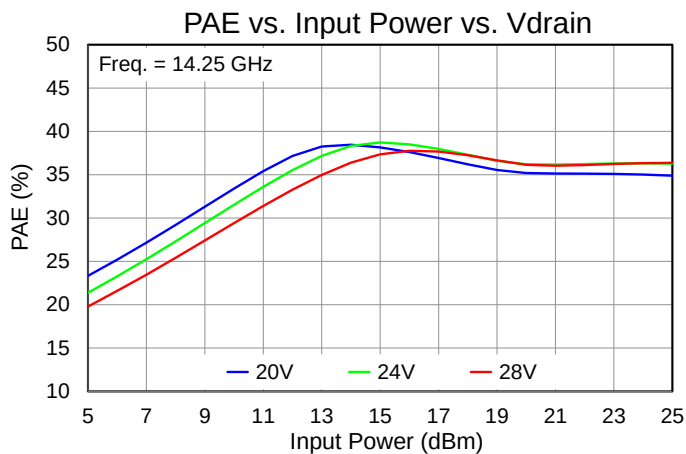
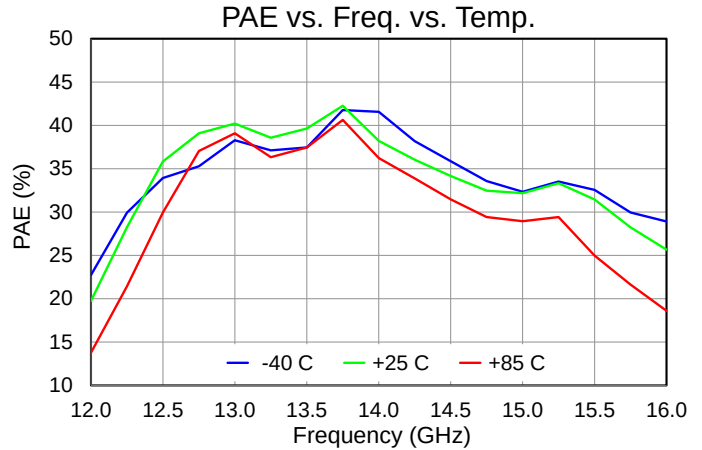
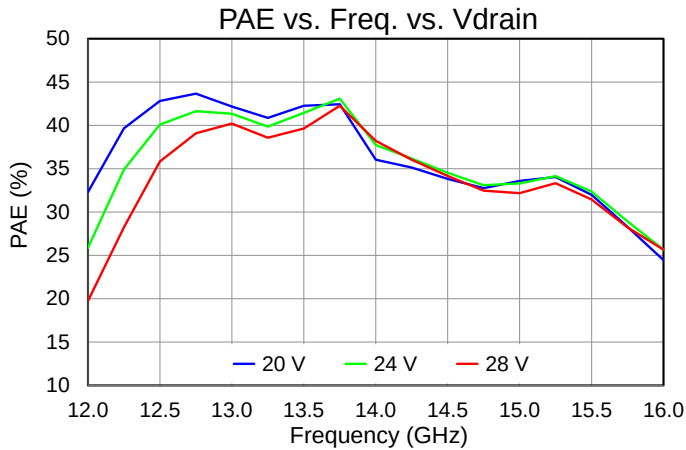
Typical Performance – CW Operation

Test conditions, unless otherwise noted: $V_D = 28\text{ V}$, $I_{DQ} = 900\text{ mA}$, $P_{IN} = 21\text{ dBm}$, $T = +25\text{ }^{\circ}\text{C}$



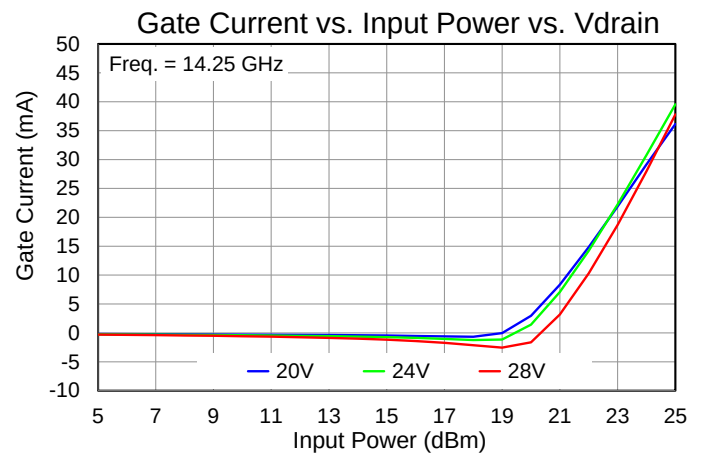
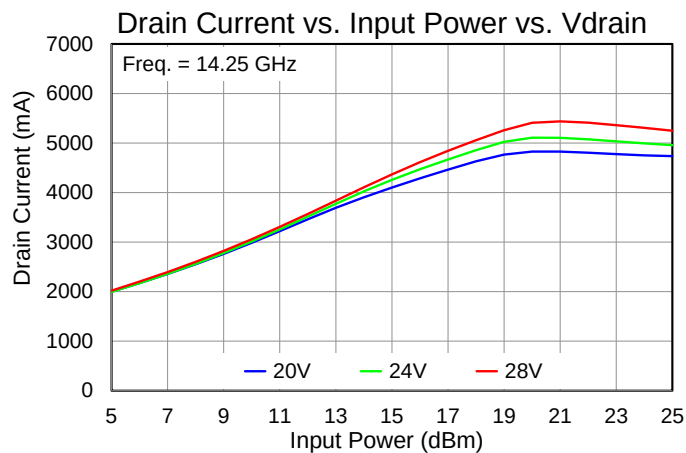
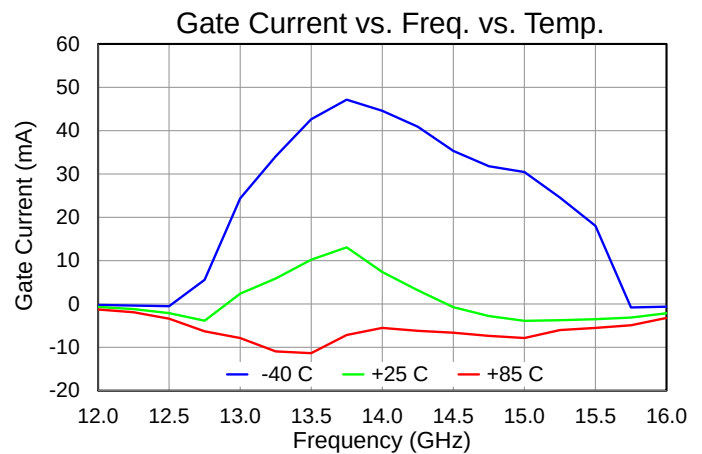
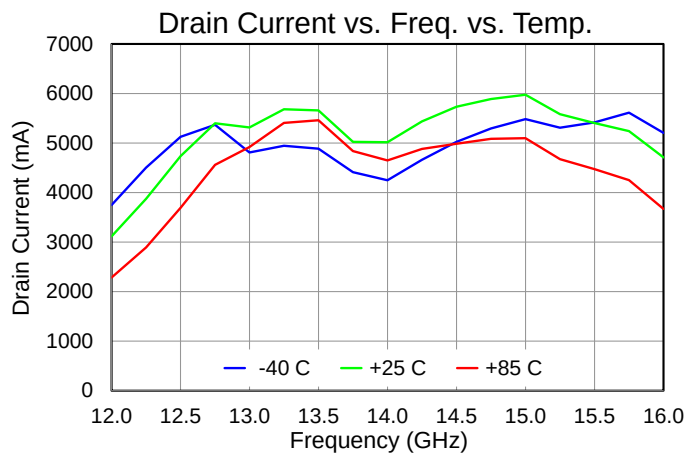
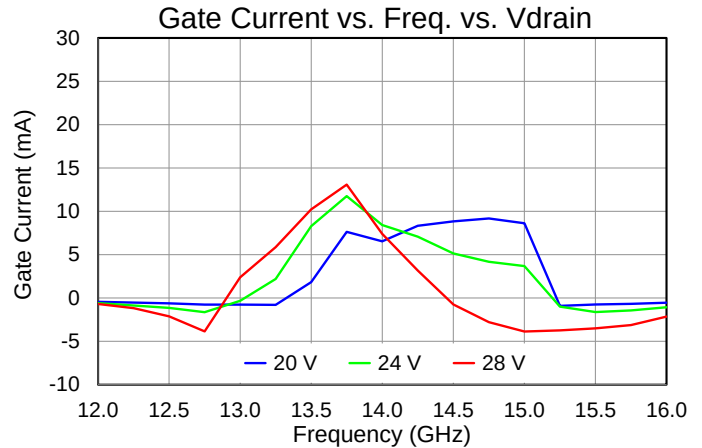
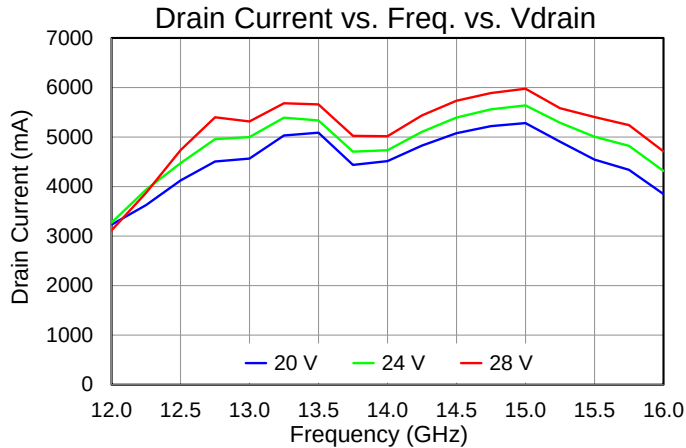
Typical Performance – CW Operation

Test conditions, unless otherwise noted: $V_D = 28\text{ V}$, $I_{DQ} = 900\text{ mA}$, $P_{IN} = 21\text{ dBm}$, $T = +25\text{ }^{\circ}\text{C}$



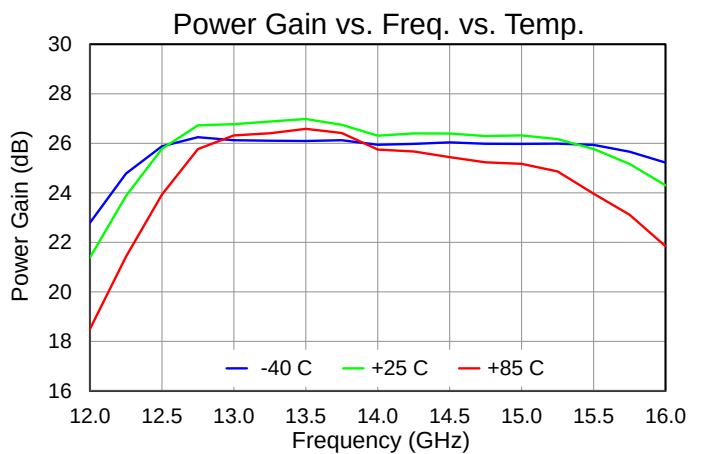
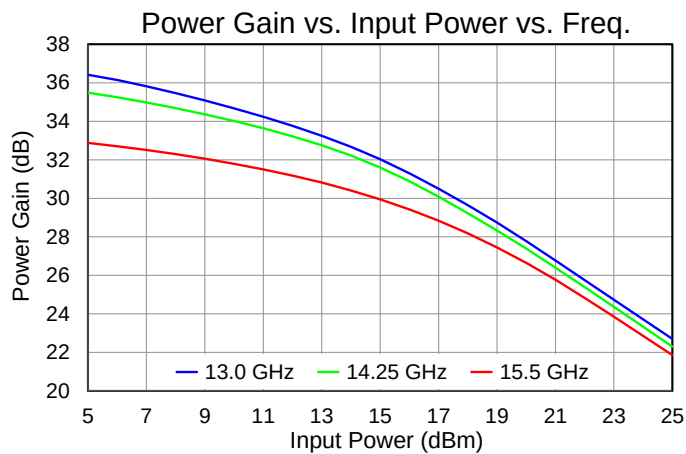
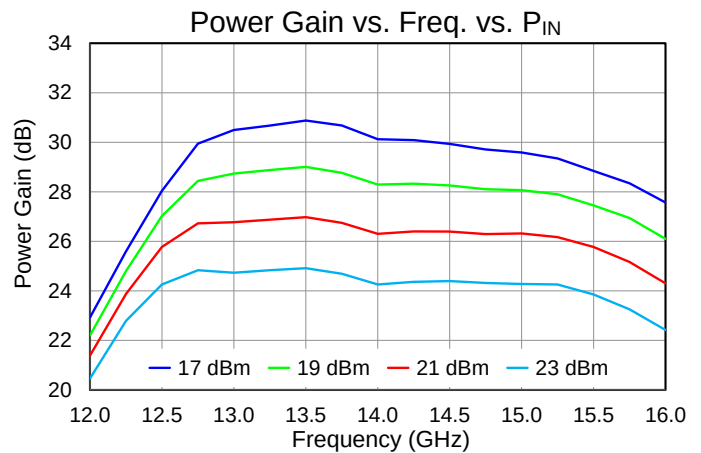
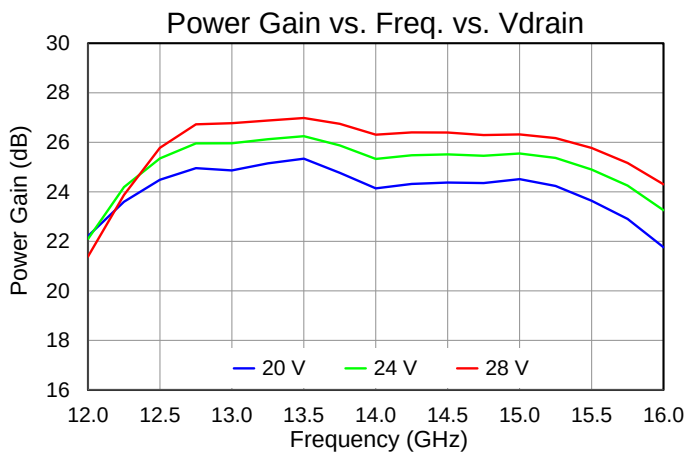
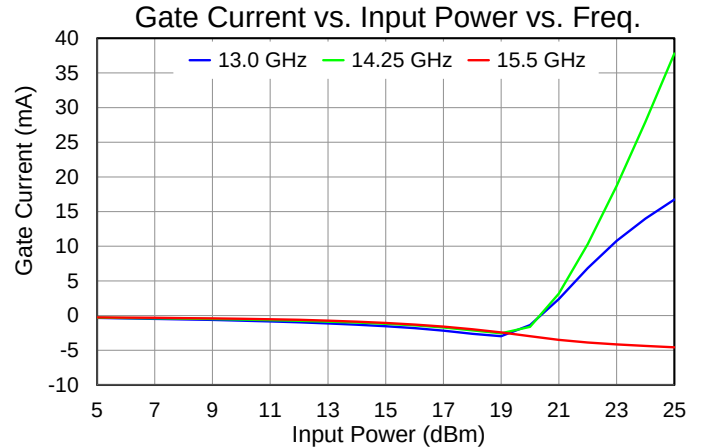
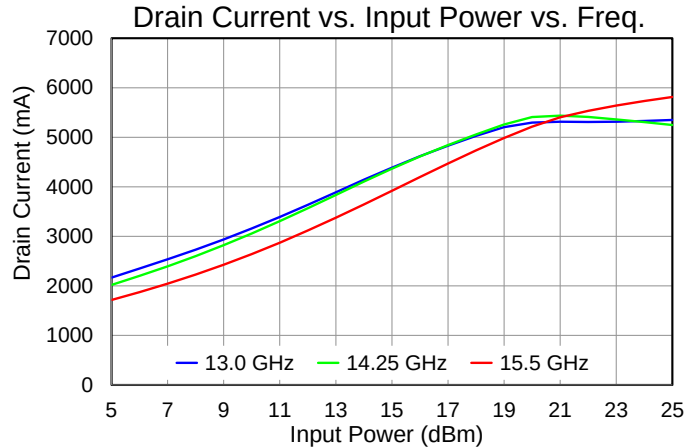
Typical Performance – CW Operation

Test conditions, unless otherwise noted: $V_D = 28\text{ V}$, $I_{DQ} = 900\text{ mA}$, $P_{IN} = 21\text{ dBm}$, $T = +25\text{ }^\circ\text{C}$



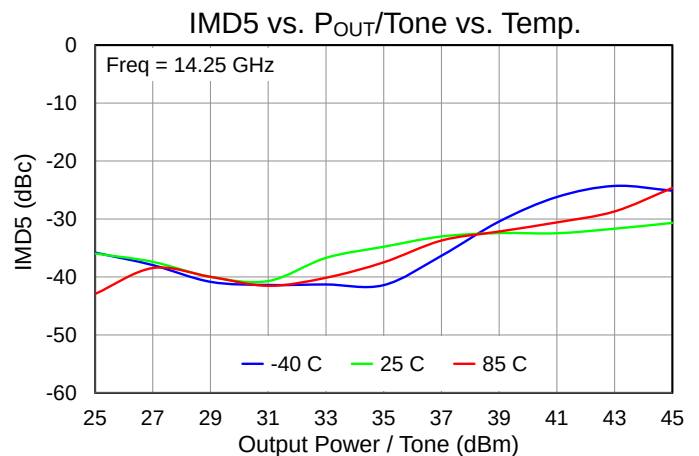
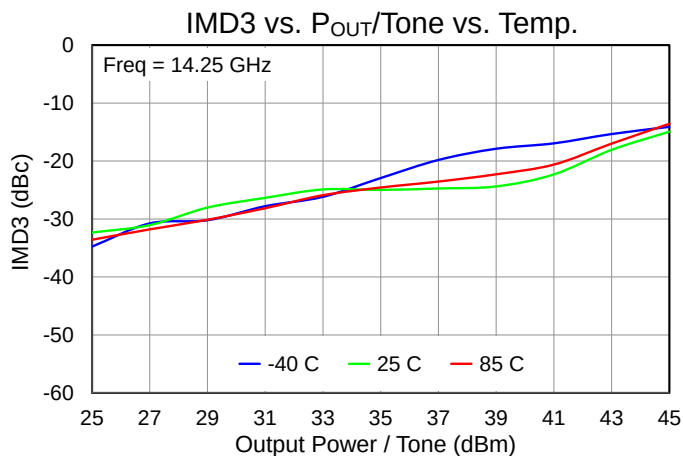
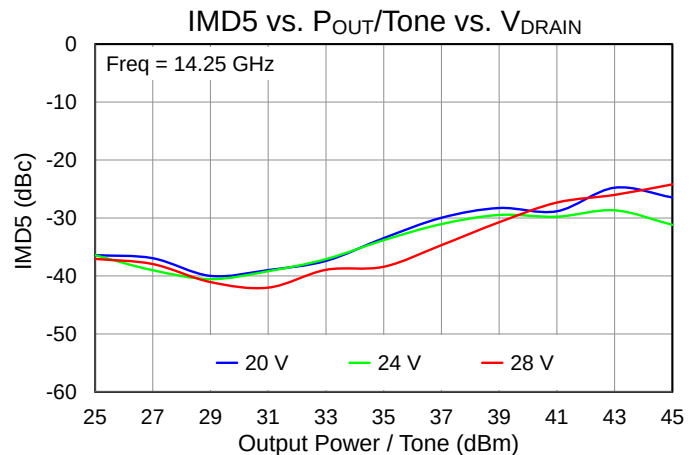
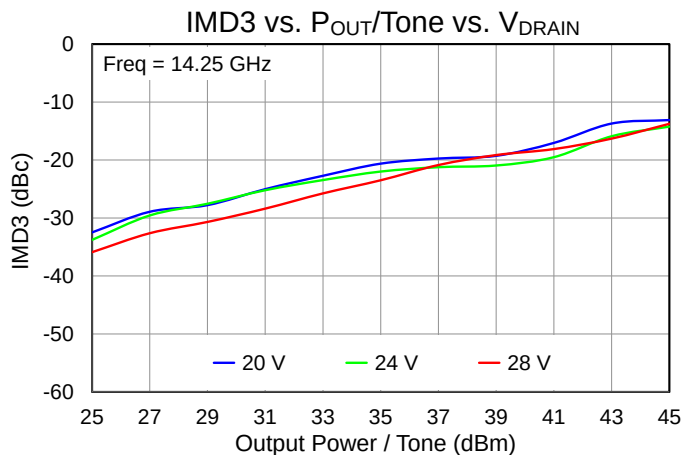
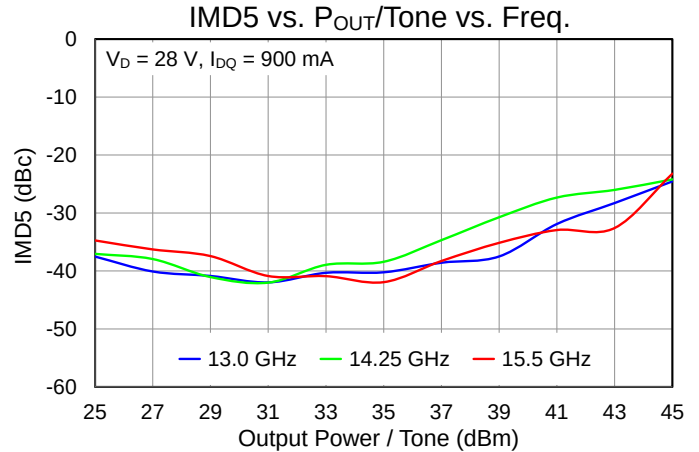
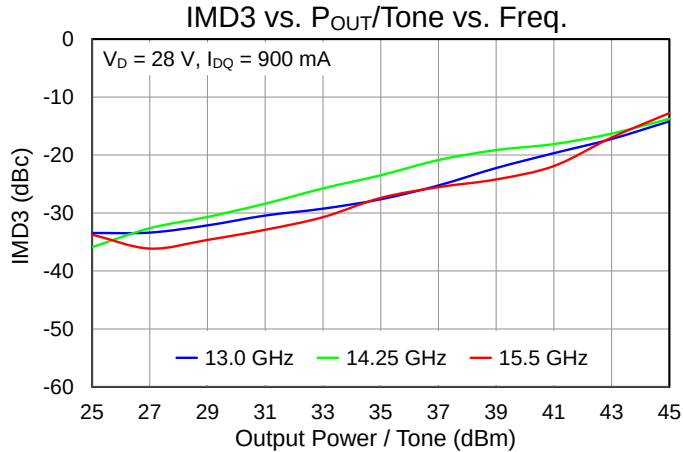
Typical Performance – (CW Operation)

Test conditions, unless otherwise noted: $V_D = 28\text{ V}$, $I_{DQ} = 900\text{ mA}$, $P_{IN} = 21\text{ dBm}$, $T = +25\text{ }^{\circ}\text{C}$



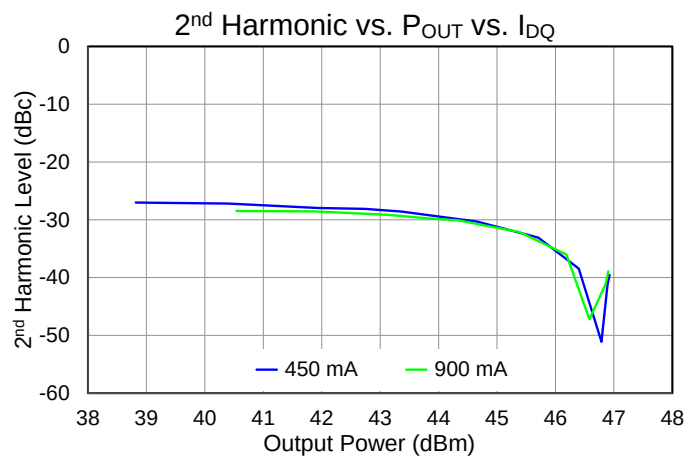
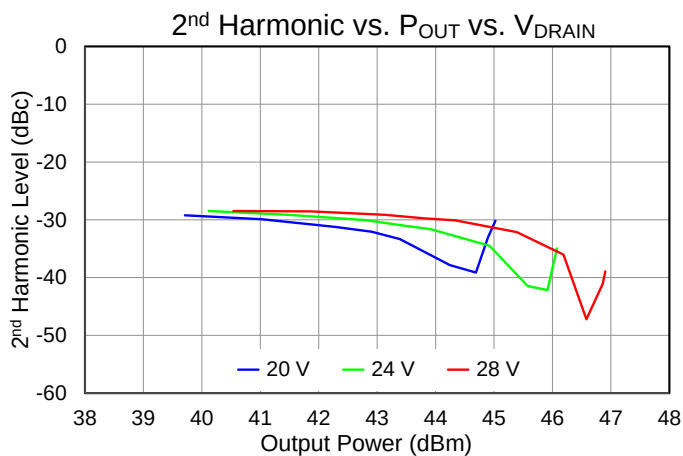
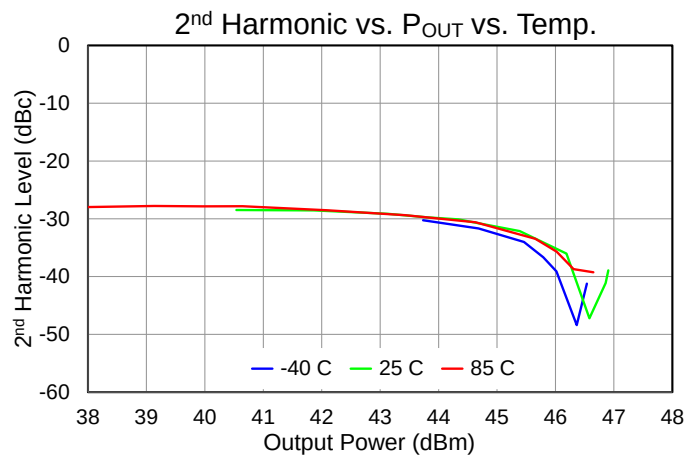
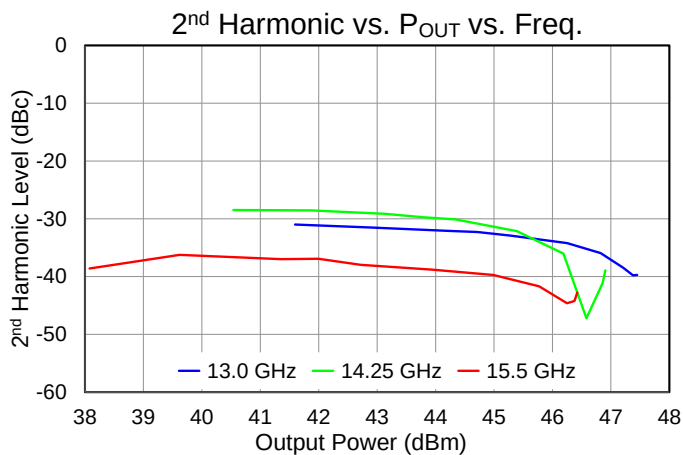
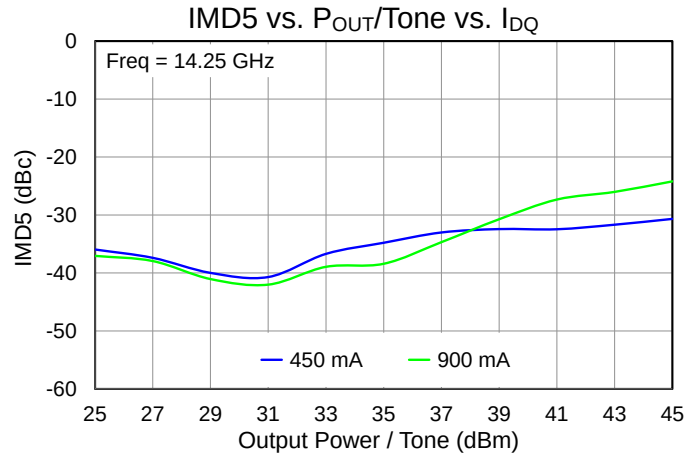
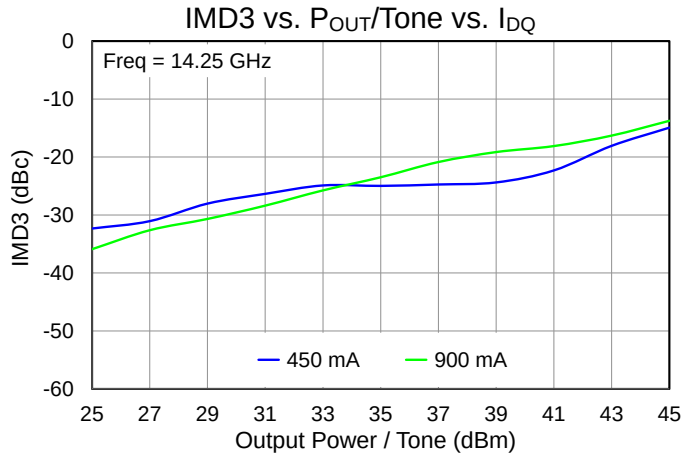
Typical Performance – Linearity

Test conditions, unless otherwise noted: $V_D = 28\text{ V}$, $I_{DQ} = 900\text{ mA}$, $T = +25\text{ }^{\circ}\text{C}$, Tone Spacing = 10 MHz



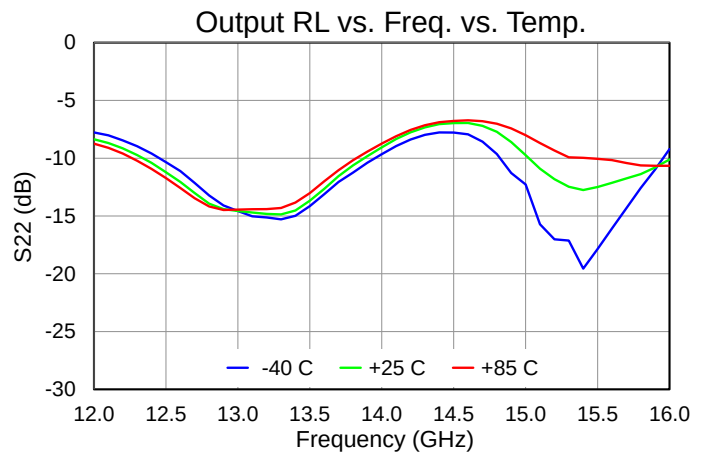
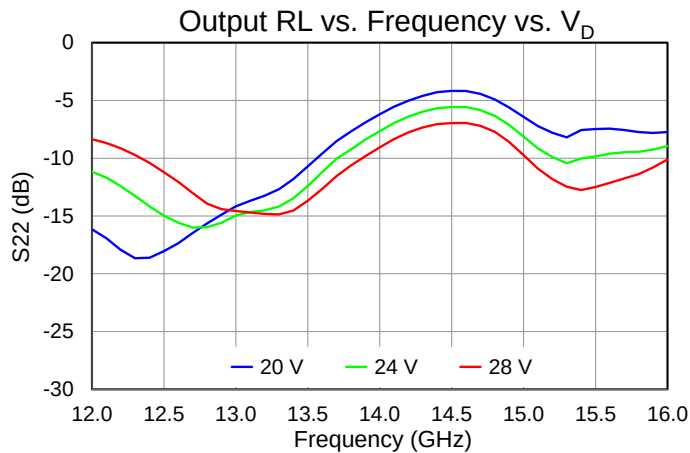
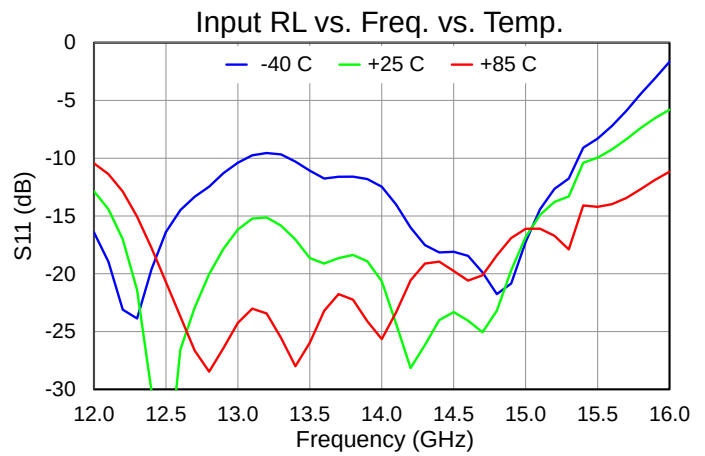
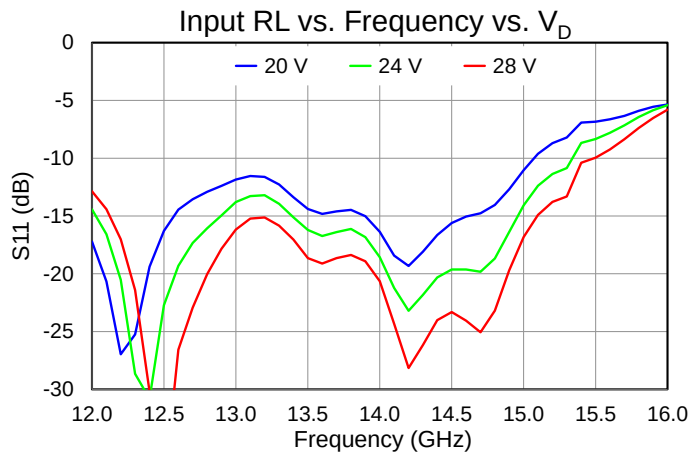
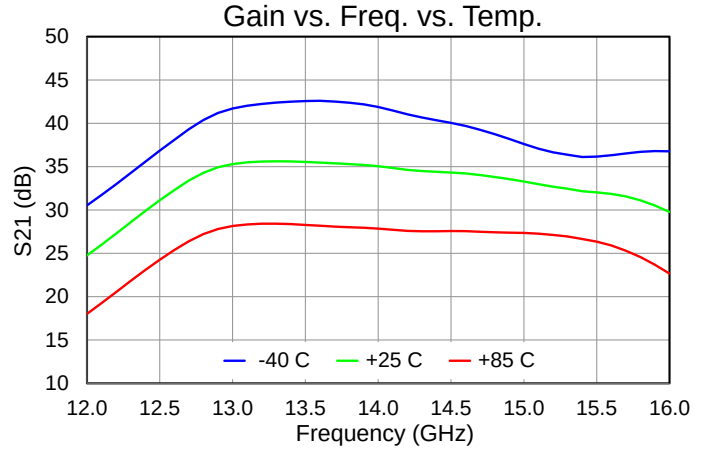
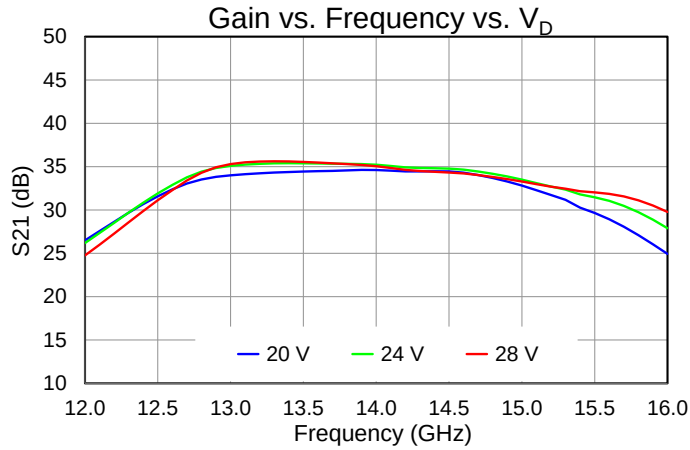
Typical Performance – Linearity

Test conditions, unless otherwise noted: $V_D = 28\text{ V}$, $I_{DQ} = 900\text{ mA}$, $T = +25\text{ }^\circ\text{C}$, Tone Spacing = 10 MHz



Typical Performance – Small Signal

Test conditions, unless otherwise noted: $V_D = 28\text{ V}$, $I_{DQ} = 900\text{ mA}$, $T = +25\text{ }^\circ\text{C}$



Thermal and Reliability Information

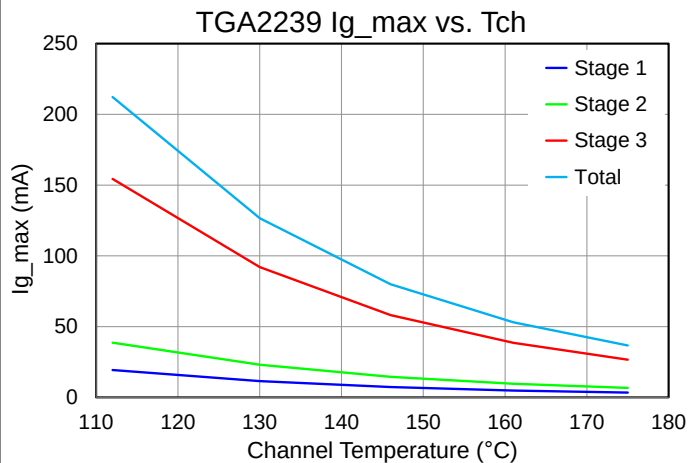
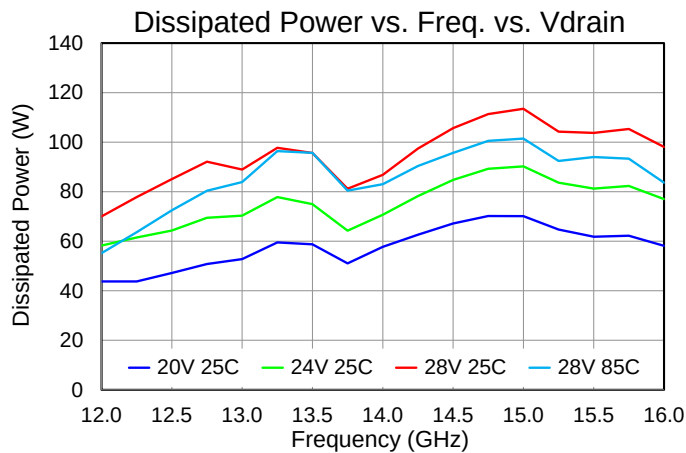
Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) ⁽¹⁾	$T_{base} = 85^{\circ}\text{C}$, $V_D = 28\text{ V}$, $I_{DQ} = 900\text{ mA}$, $P_{DISS} = 25.2\text{ W}$	0.798	$^{\circ}\text{C/W}$
Channel Temperature (T_{CH}) (No RF drive) ⁽²⁾		105.1	$^{\circ}\text{C}$
Thermal Resistance (θ_{JC}) ⁽¹⁾	$T_{base} = 85^{\circ}\text{C}$, CW, $V_D = 28\text{ V}$, $I_{DQ} = 900\text{ mA}$ Freq = 15.0 GHz, $I_{D_Drive} = 5.10\text{ A}$, $P_{IN} = 21\text{ dBm}$, $P_{OUT} = 46.2\text{ dBm}$, $P_{DISS} = 101.4\text{ W}$	0.804	$^{\circ}\text{C/W}$
Channel Temperature (T_{CH}) (Under RF drive) ⁽²⁾		166.5	$^{\circ}\text{C}$

Notes:

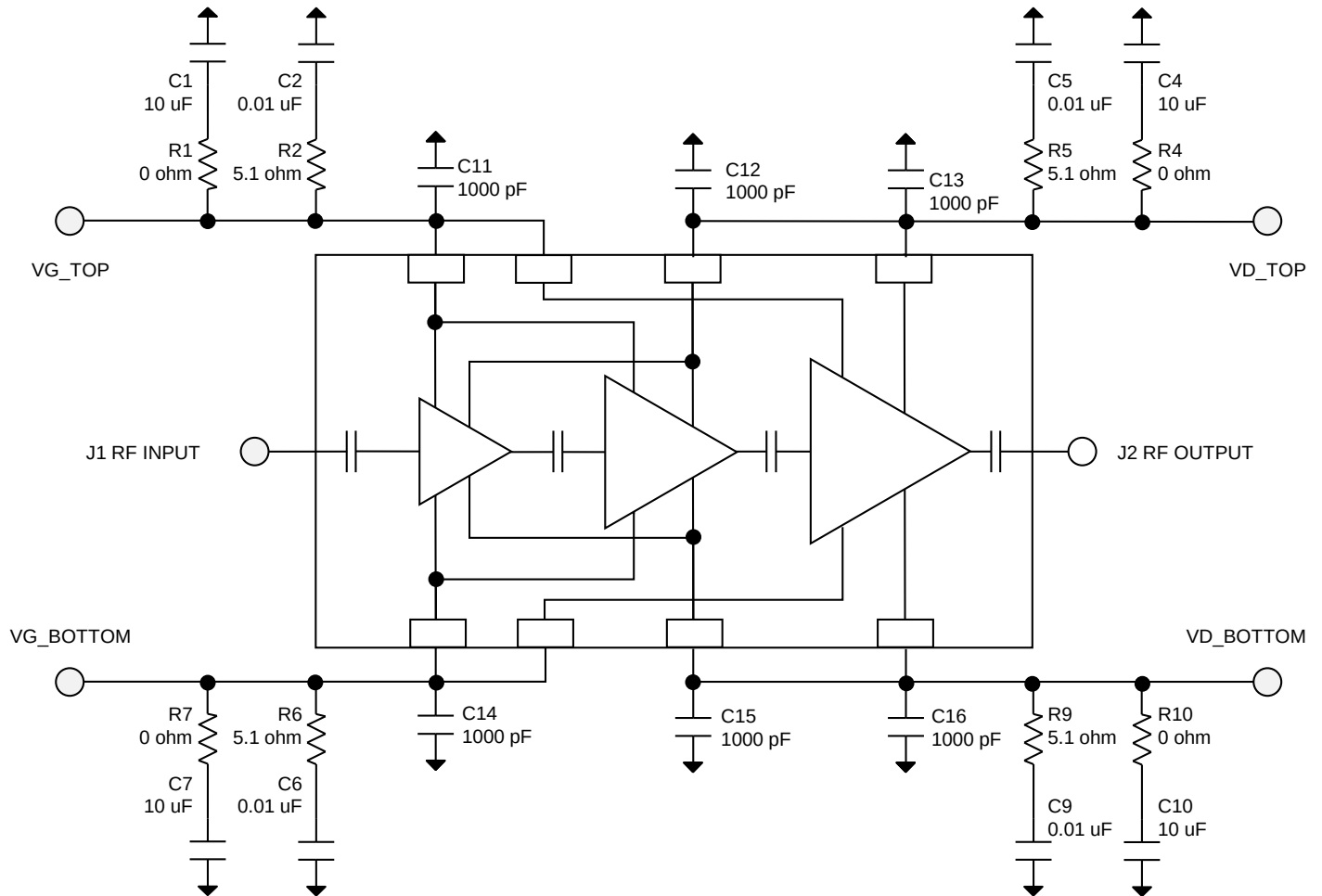
1. Thermal resistance measured to back of 20 mil CM15 carrier plate.
2. IR Scan equivalent temperature. Refer to the following document for more details: [GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates](#)

Power Dissipation and Gate Current

Test conditions, unless otherwise noted: $V_D = 28\text{ V}$, $I_{DQ} = 900\text{ mA}$, $P_{IN} = 21\text{ dBm}$



Application Circuit



Notes: VG & VD must be biased from both sides, top and bottom.

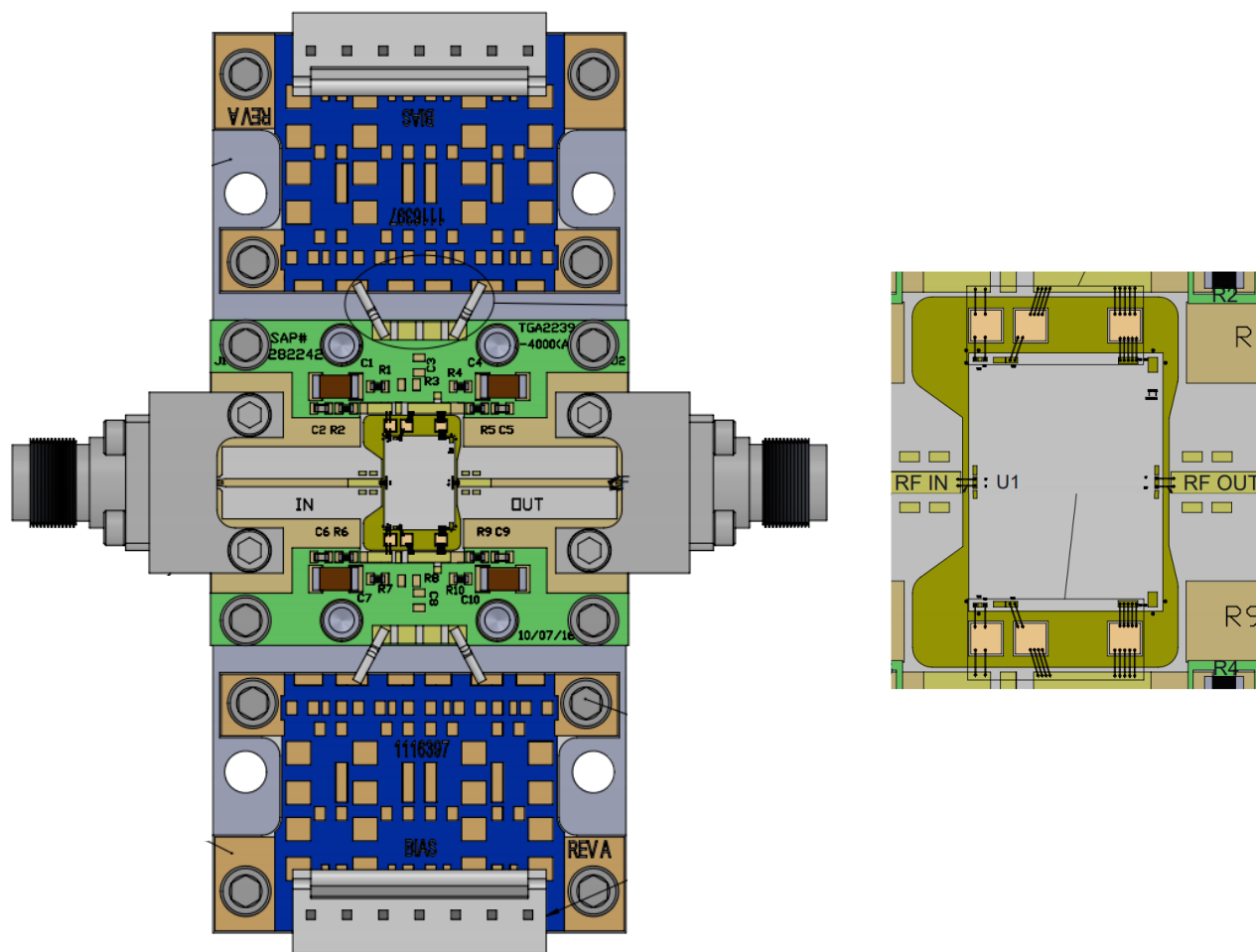
Bias Up Procedure

1. Set I_D limit to 6 A, I_G limit to 50 mA
2. Set V_G to -5 V
3. Set $V_D = 28$ V
4. Adjust V_G until $I_{DQ} = 900$ mA
5. Apply RF signal

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

Evaluation Board (EVB) Layout Assembly

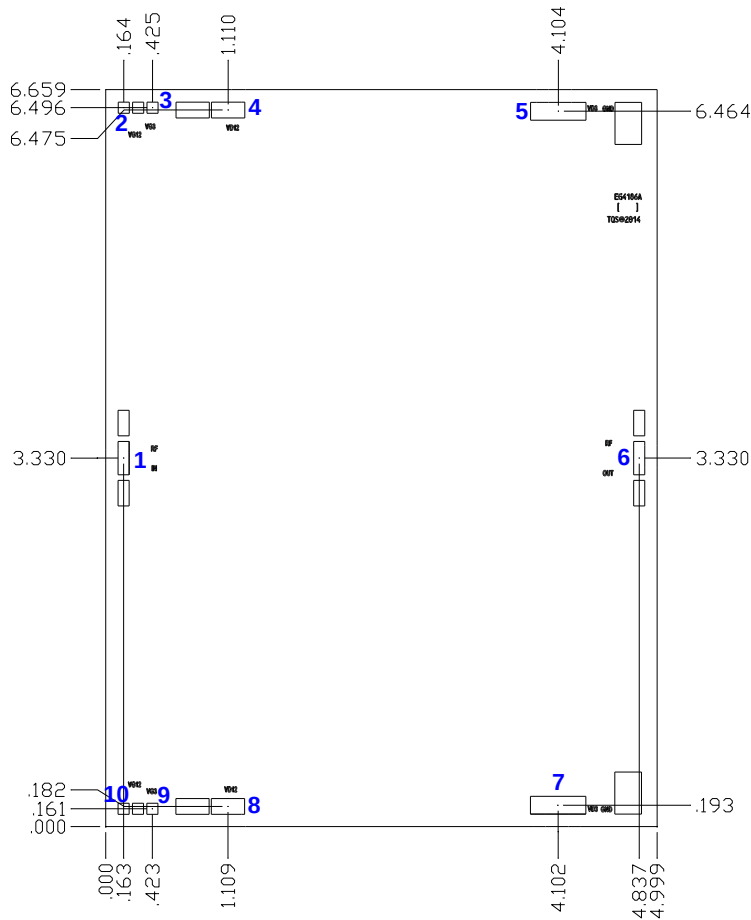


Notes: VG & VD must be biased from both sides, top and bottom.

Bill of Materials

Reference Des.	Value	Description	Manuf.	Part No.
C1,C4,C7,C10	10 uF	CAP, 10uF, 20%, 50V, 20%, X5R, 1206	Various	–
C2,C5,C6,C9	0.01 uF	CAP, 0.01uF, 10%, 50V, X7R, 0402	Various	–
C11,C12,C13,C14,C15,C16	1000 pF	CAP, 1000pF, ±10% 50V, BORDER, SL	Various	–
R1,R4,R7,R10	0 Ohm	RES, 0 OHM, JMPR, 0402	Various	–
R2,R5,R6,R9	5.1 Ohm	RES, 5.1 OHM, 5%, 50V, 0402	Various	–
J1,J2	2.92 mm	CONN, 2.92, END, F, PIN .005, DIEL .029	SW Microwave	1092-01A-5

Mechanical Drawing



Unit: millimeters
 Thickness: 0.10
 Die x, y size tolerance: +/- 0.050
 Chip edge to bond pad dimensions are shown to center of pad
 Ground is backside of die

Bond Pad Description

Pad No.	Symbol	Pad Size	Description
1	RF In	0.101 x 0.302	RF Input; matched to 50 Ω , DC blocked
2, 10	VG1-2	0.101 x 0.101	Gate voltage 1, bias network is required; see Application Circuit on page 11 as an example.
3, 9	VG3	0.101 x 0.101	Gate voltage 3, bias network is required; see Application Circuit on page 11 as an example.
4, 8	VD1-2	0.302 x 0.143	Drain voltage 1, bias network is required; see Application Circuit on page 11 as an example.
5, 7	VD3	0.503 x 0.161	Drain voltage 3, bias network is required; see Application Circuit on page 11 as an example.
6	RF Out	0.101 x 0.302	RF Output; matched to 50 Ω , 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		Caution! ESD-Sensitive Device
ESD – Human Body Model (HBM)	0B	JEDEC Standard JS-001-2017		

Solderability

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

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:

- 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:

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Email: customer.support@qorvo.com

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