

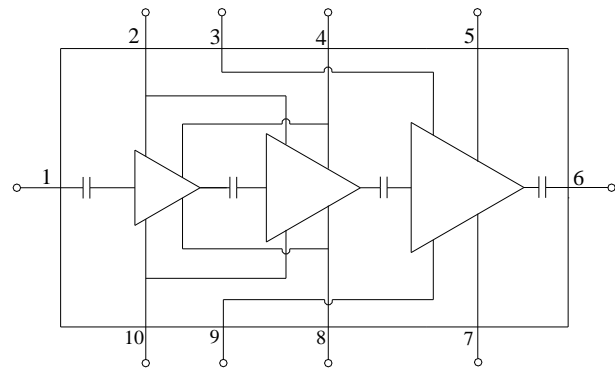
Applications

- Satellite Communications
- Data Link
- Radar

Product Features

- Frequency Range: 13 – 15.5 GHz
- P_{SAT} : >45.5 dBm @ PIN = 21 dBm
- PAE: >32% @ PIN = 21 dBm
- Large Signal Gain: >24.5 dB
- Small Signal Gain: 29.5 dB
- Bias: $V_D = 22$ V, $I_{DQ} = 900$ mA, $V_G = -2.7$ V Typical
- Process Technology GaN-TQGaN15
- Chip Dimensions: 5.00 x 6.65 x 0.10 mm
- Performance Under CW Operation

Functional Block Diagram



General Description

TriQuint's TGA2239 is a Ku-band, high power MMIC amplifier fabricated on TriQuint's production 0.15um GaN on SiC process. The TGA2239 operates from 13 – 15.5 GHz and provides a superior combination of power, gain and efficiency by achieving greater than 35 W of saturated output power with 24.5dB of large signal gain and greater than 32% 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 Ohms 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.

Evaluation boards are available upon request.

Pad Configuration

Pad No.	Symbol
1	RF In
2, 10	V_{G1-2}
3, 9	V_{G3}
4, 8	V_{D1-2}
5, 7	V_{D3}
6	RF Out

Ordering Information

Part	ECCN	Description
TGA2239	3A001.b.2.b	13 – 15.5 GHz 35W GaN Power Amplifier

Absolute Maximum Ratings

Parameter	Value
Drain Voltage (V_D)	23 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 (I_{G1-2}) @ $T_{CH} = 200^\circ\text{C}$	-5 to 14.5 mA
Gate Current (I_{G3}) @ $T_{CH} = 200^\circ\text{C}$	-12.5 to 38 mA
Power Dissipation (P_{DISS}), 85°C , CW	117 W
Input Power (P_{IN}), CW, 50Ω , $V_D = 22\text{ V}$, $I_{DQ} = 900\text{ mA}$, 85°C	33 dBm
Input Power (P_{IN}), CW, VSWR 3:1, $V_D = 22\text{ V}$, $I_{DQ} = 900\text{ mA}$, 85°C	30 dBm
Channel Temperature (T_{CH})	275°C
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
Drain Voltage (V_D)	22 V
Drain Current (I_{DQ})	900 mA (Total)
Gate Voltage (V_G)	-2.7 V (Typ.)

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

Electrical Specifications

Test conditions unless otherwise noted: 25°C , $V_D = 22\text{ V}$, $I_{DQ} = 900\text{ mA}$, $V_G = -2.7\text{ V}$ Typical, CW

Parameter	Min	Typical	Max	Units
Operational Frequency Range	13		15.5	GHz
Small Signal Gain		29.5		dB
Input Return Loss		>13		dB
Output Return Loss		>7.5		dB
Power Gain ($P_{in} = 21\text{dBm}$)		>24.5		dB
Output Power ($P_{in} = 21\text{dBm}$)		>45.5		dBm
Power Added Efficiency ($P_{in} = 21\text{dBm}$)		>32		%
Small Signal Gain Temperature Coefficient		-0.09		dB/ $^\circ\text{C}$
Output Power Temperature Coefficient		-0.028		dB/ $^\circ\text{C}$

Thermal and Reliability Information

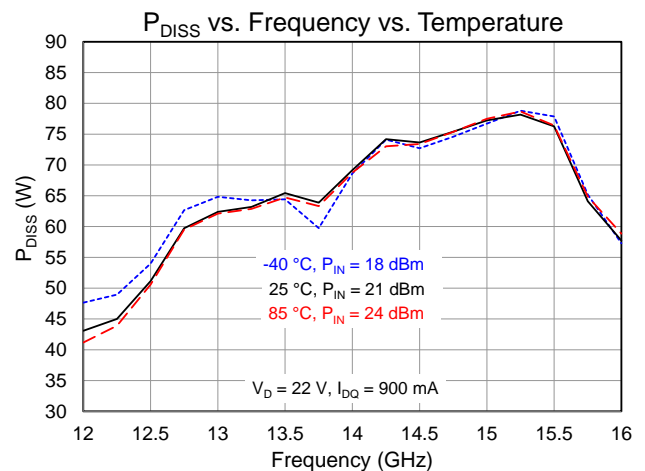
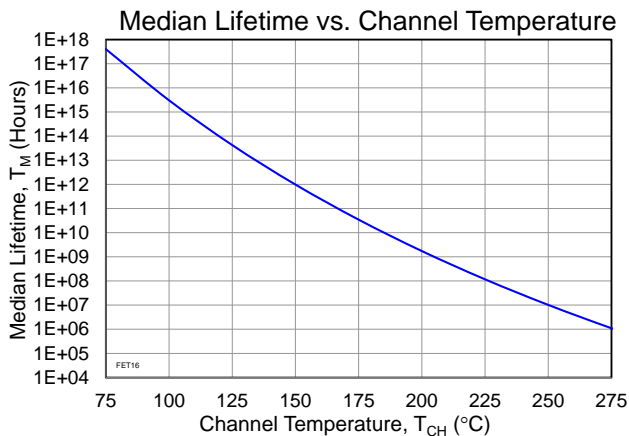
Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) ⁽¹⁾	$T_{base} = 85^{\circ}C$	1.26	$^{\circ}C/W$
Channel Temperature (T_{CH}) (No RF drive)	$V_D = 22 V, I_{DQ} = 900 mA$	110	$^{\circ}C$
Median Lifetime (T_M)	$P_{DISS} = 19.8 W$	4.0×10^{14}	Hrs
Thermal Resistance (θ_{JC}) ⁽¹⁾	$T_{base} = 85^{\circ}C, CW, V_D = 22 V, I_{DQ} = 900 mA$	1.13	$^{\circ}C/W$
Channel Temperature (T_{CH}) (Under RF drive)	Freq = 15.25 GHz, $V_D = 22 V, I_{D_Drive} = 5 A,$	174	$^{\circ}C$
Median Lifetime (T_M)	$P_{IN} = 24 dBm, P_{OUT} = 45.2 dBm, P_{DISS} = 79 W$	3.46×10^{10}	Hrs

Notes:

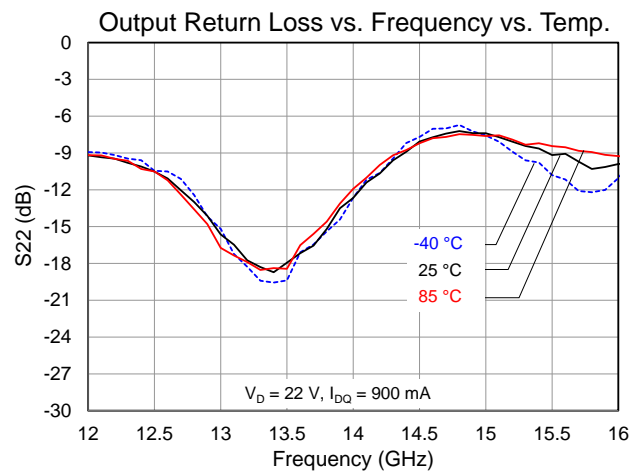
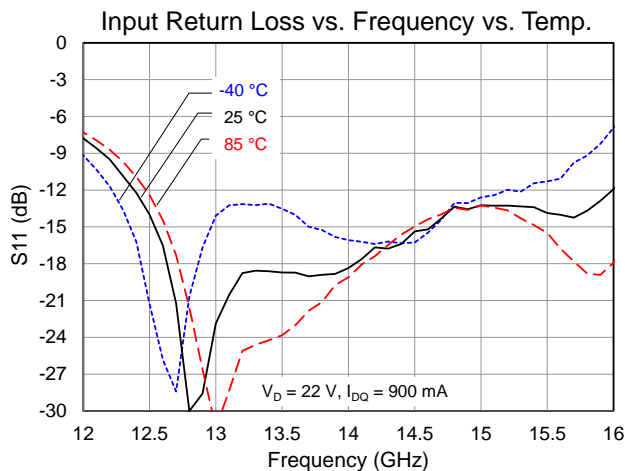
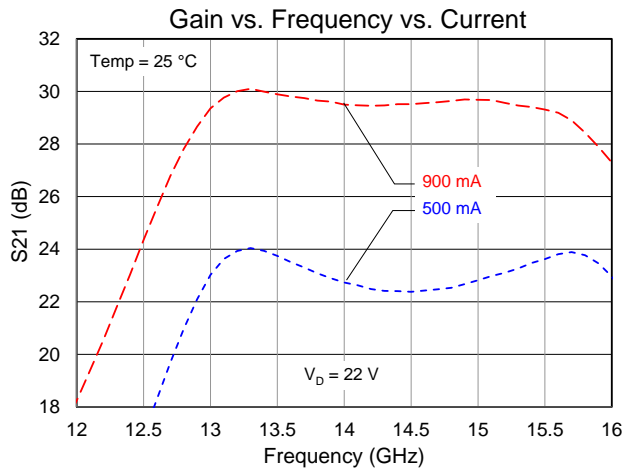
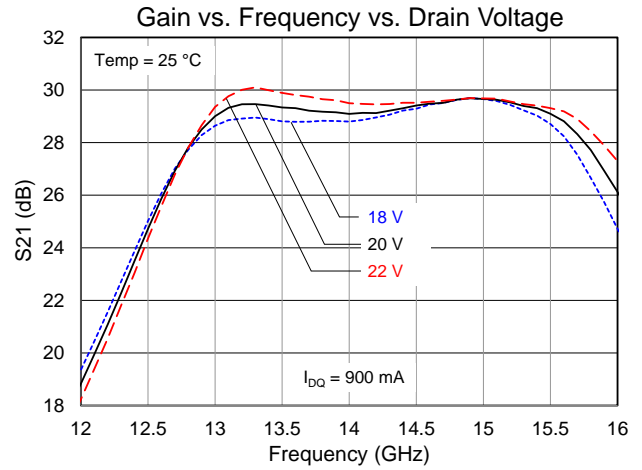
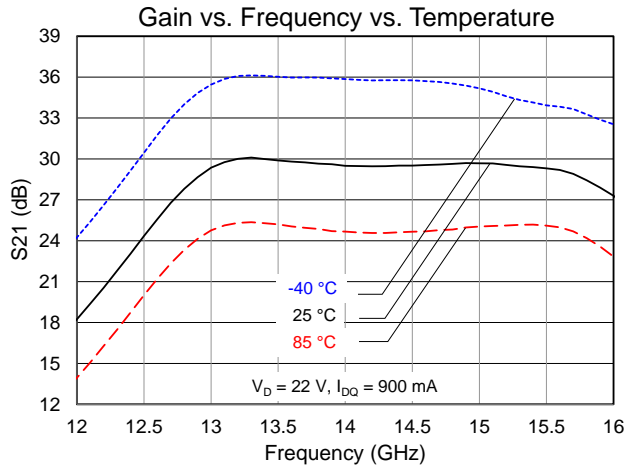
1. Thermal resistance measured to back of carrier plate. MMIC mounted on 40 mils CuMo (80/20) carrier using 1.5 mil AuSn.

Median Lifetime

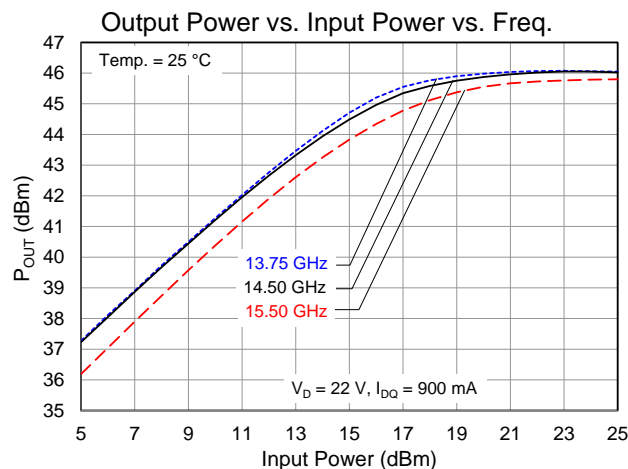
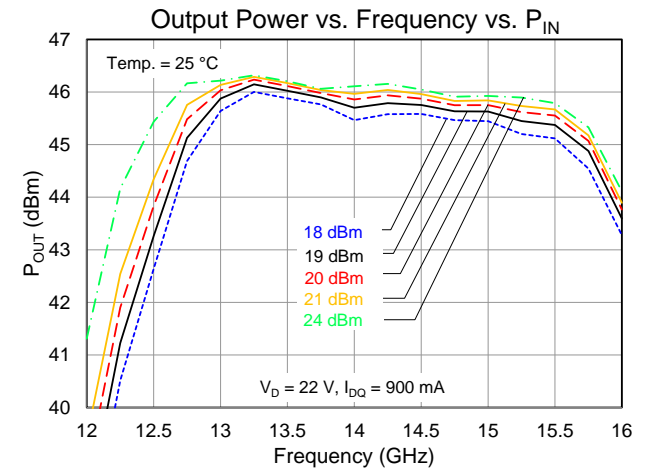
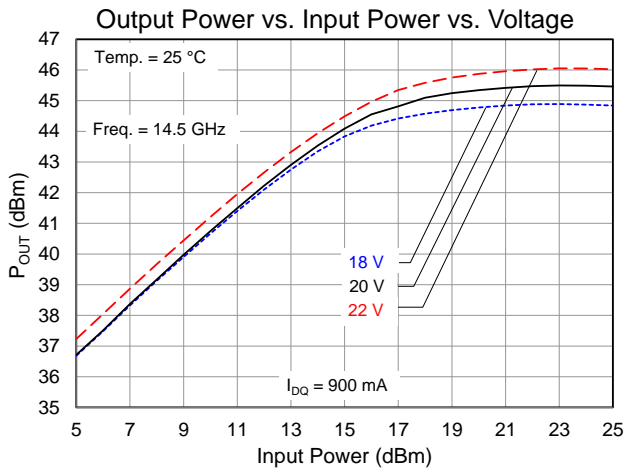
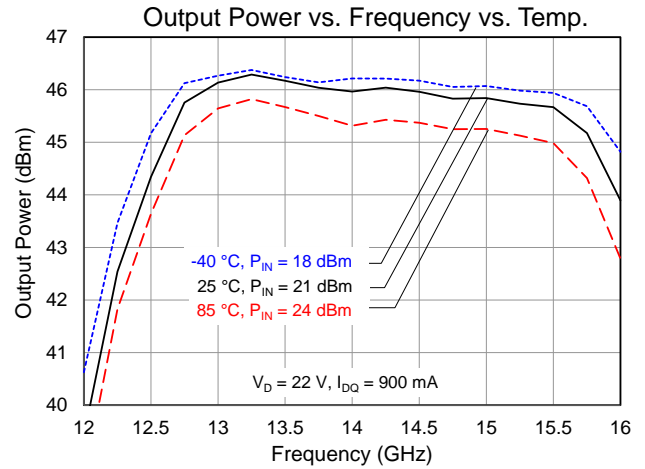
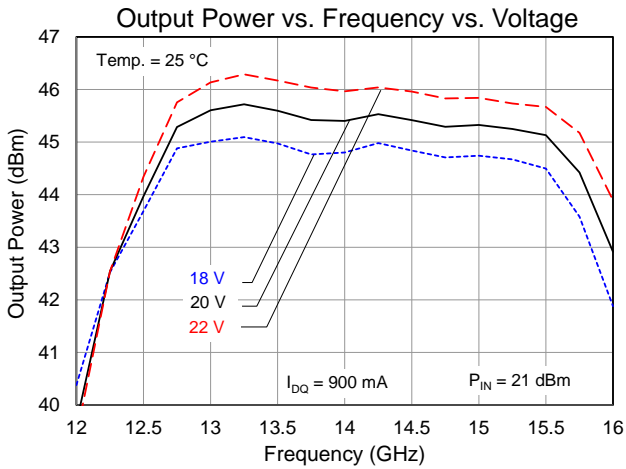
Test Conditions: $V_D = 23 V$; Failure Criteria = 10% reduction in I_{D_MAX}



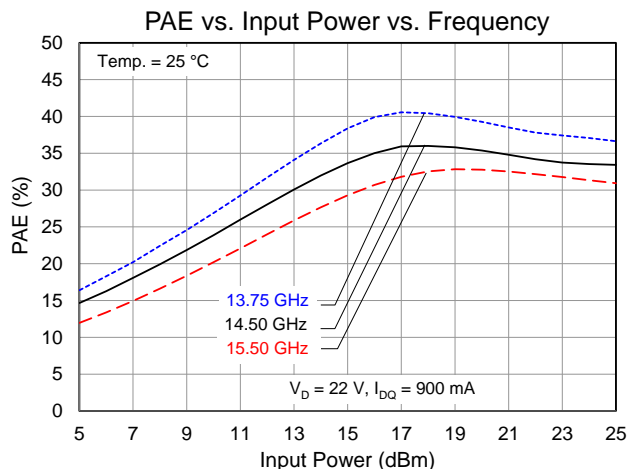
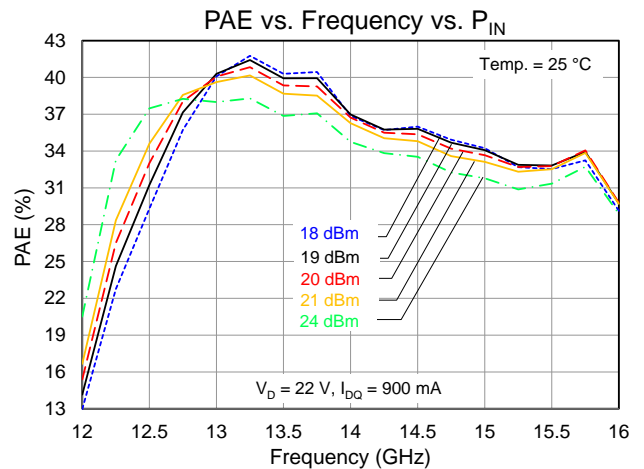
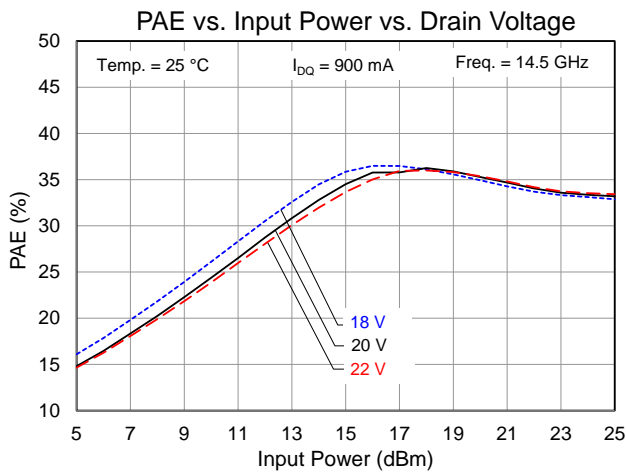
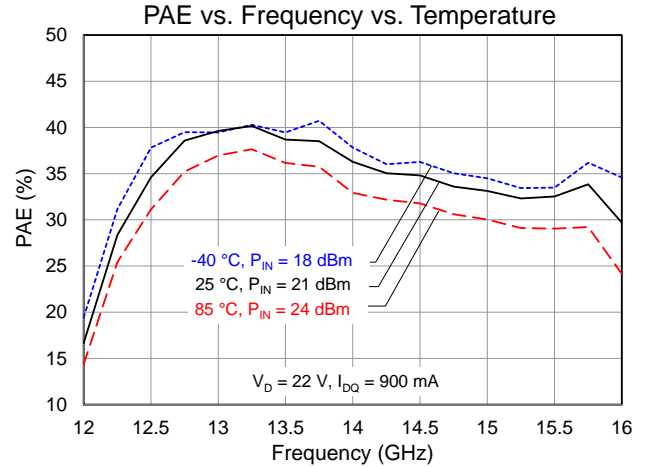
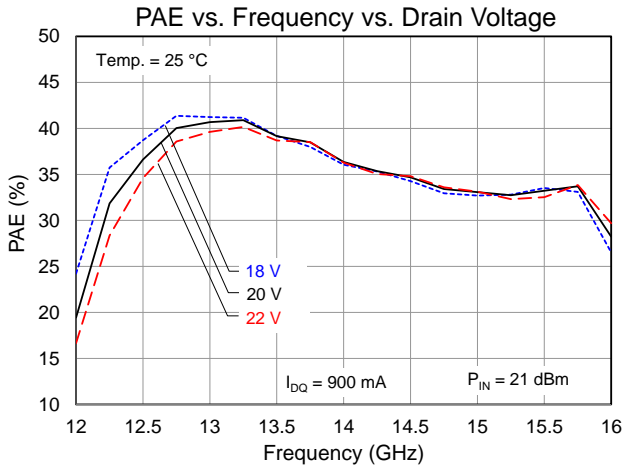
Typical Performance (Small Signal)



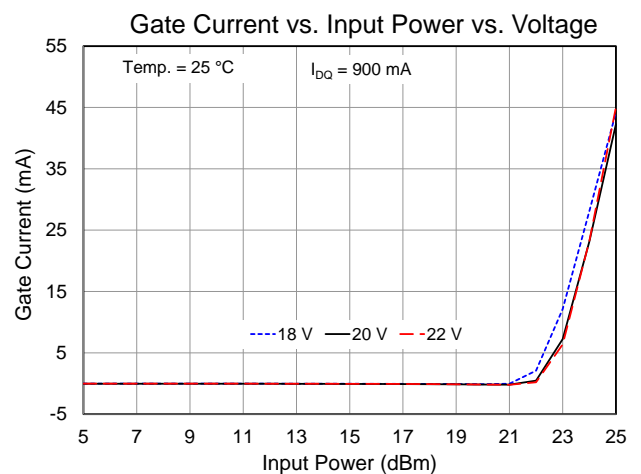
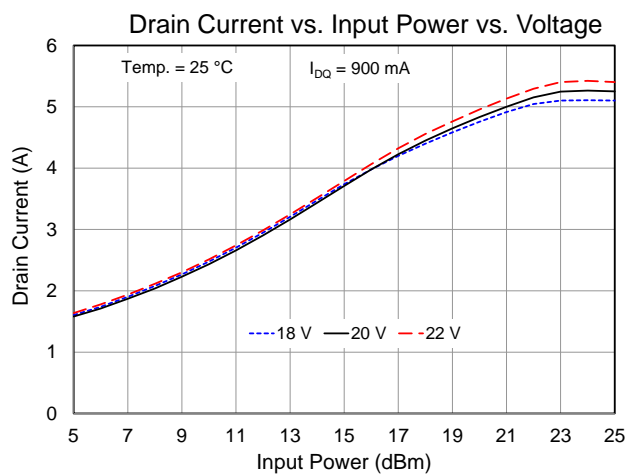
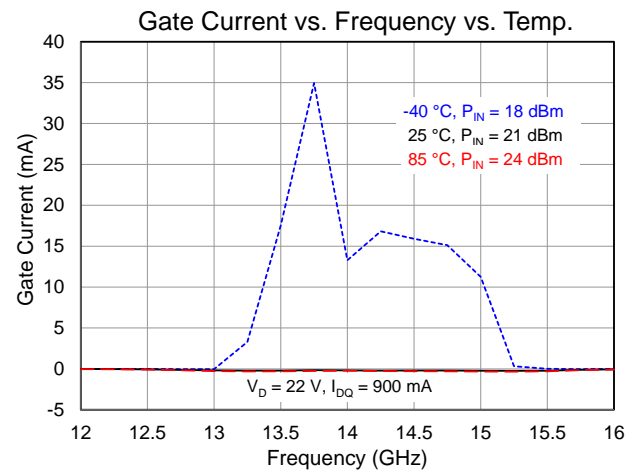
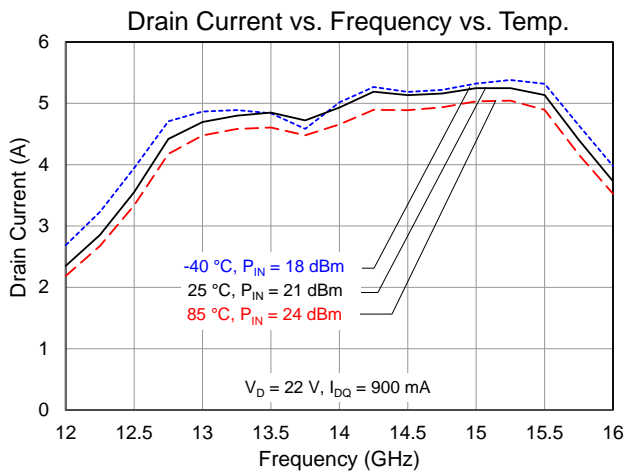
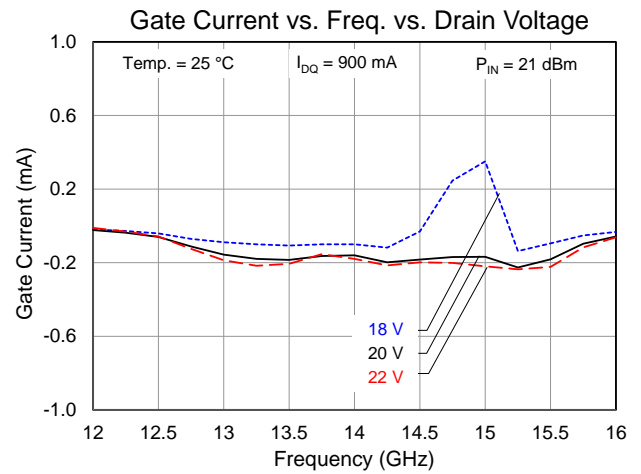
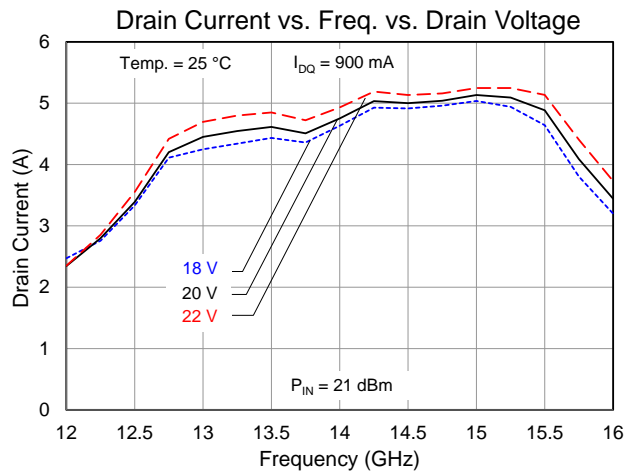
Typical Performance (CW Operation)



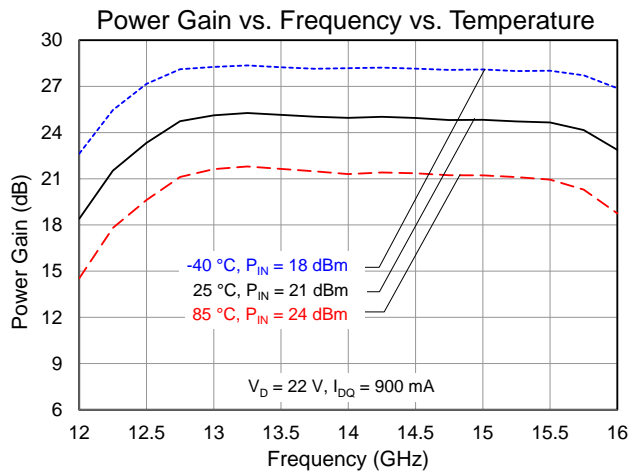
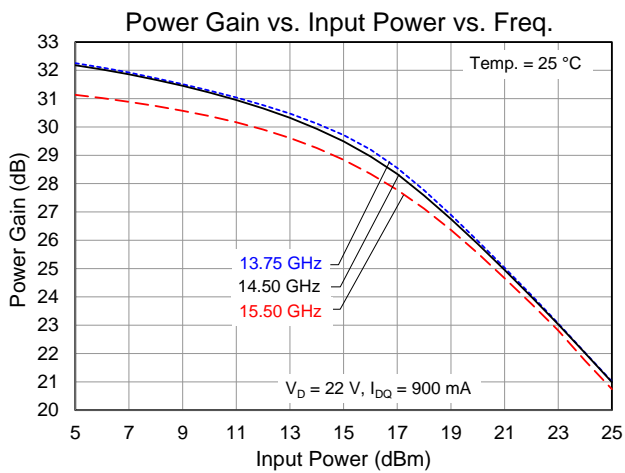
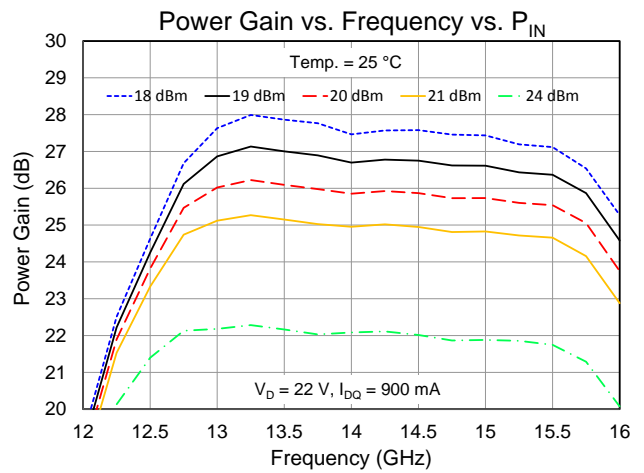
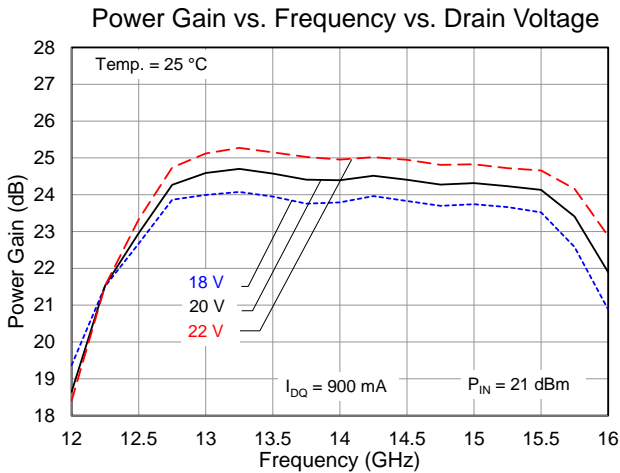
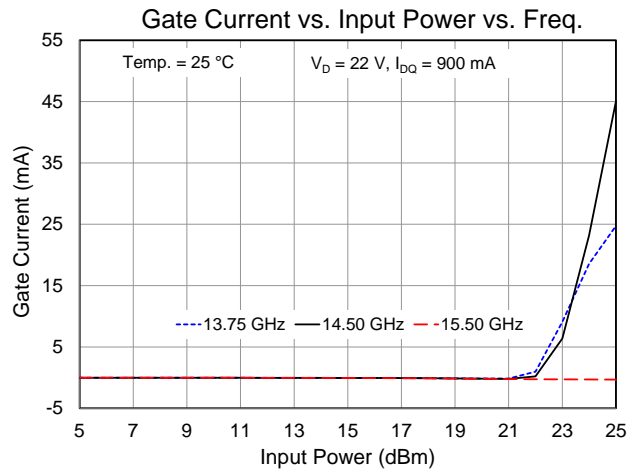
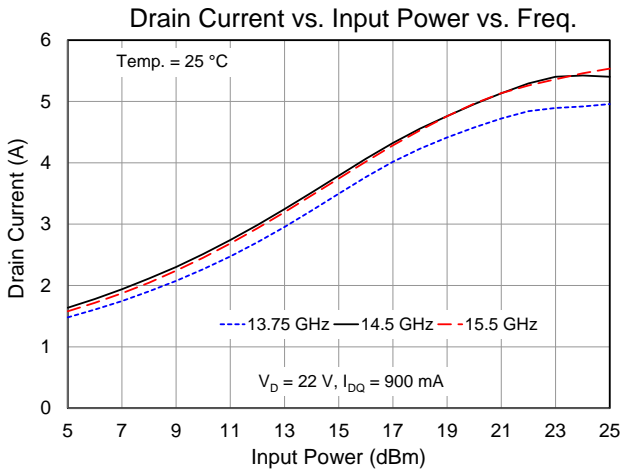
Typical Performance (CW Operation)



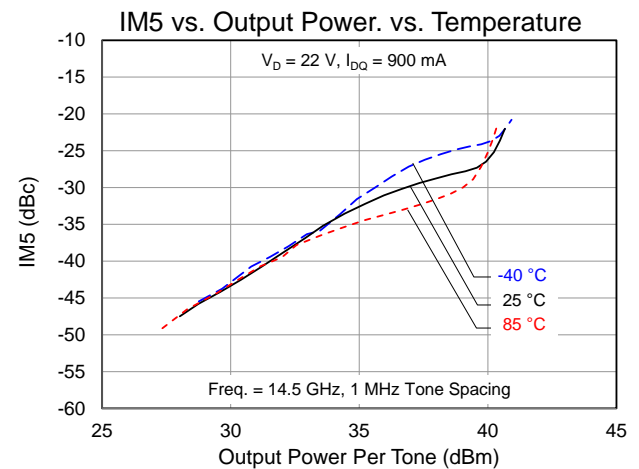
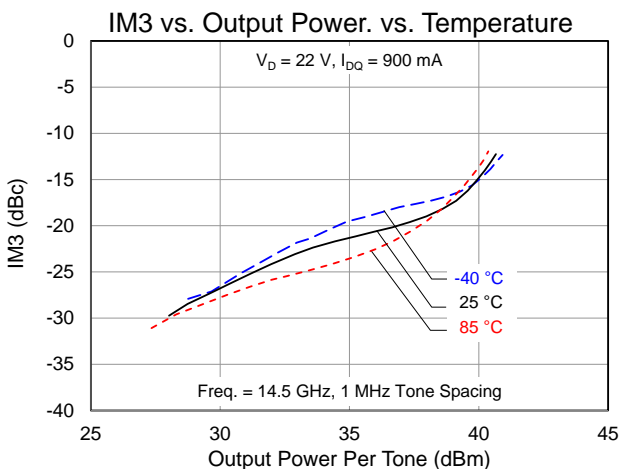
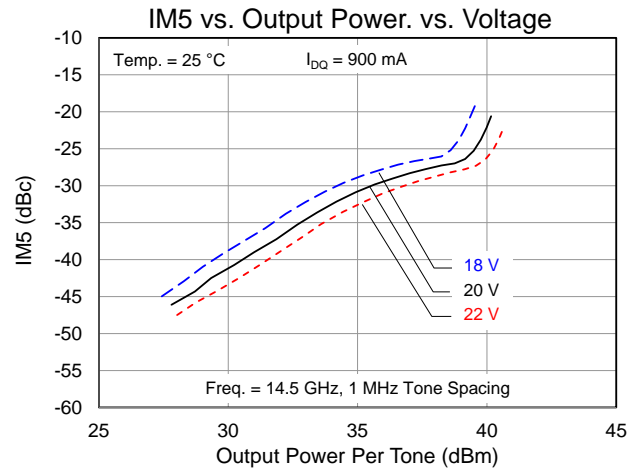
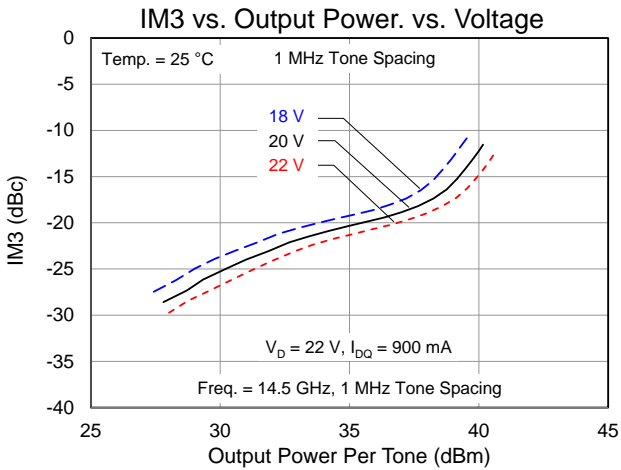
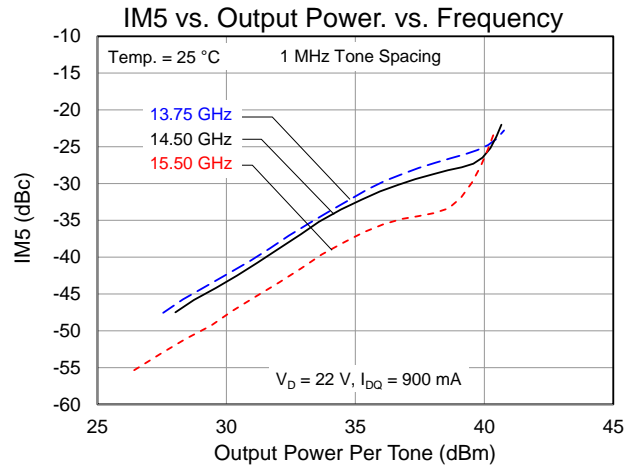
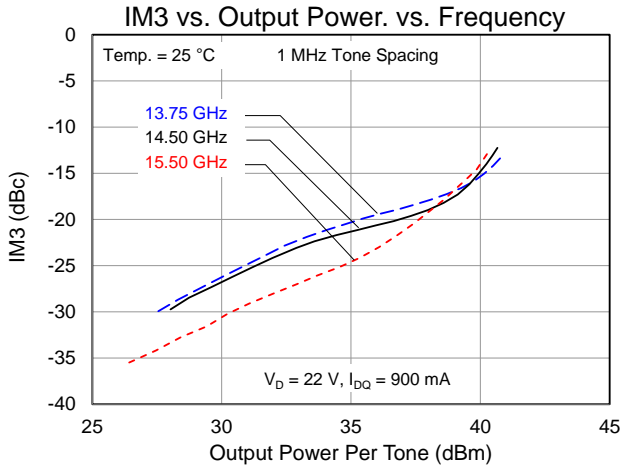
Typical Performance (CW Operation)



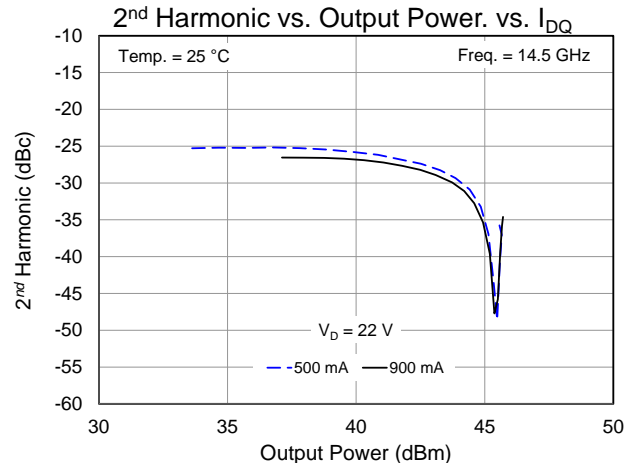
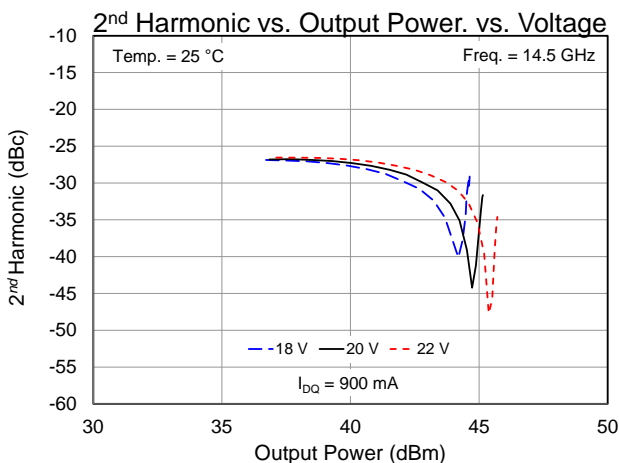
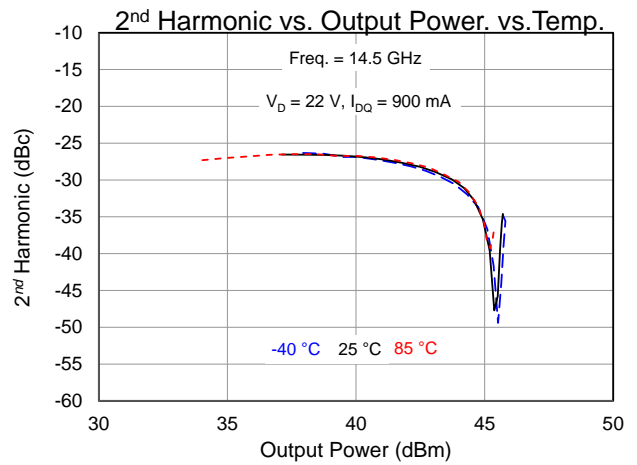
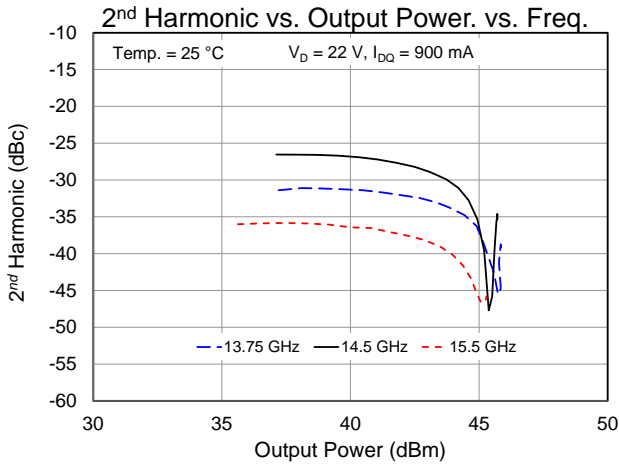
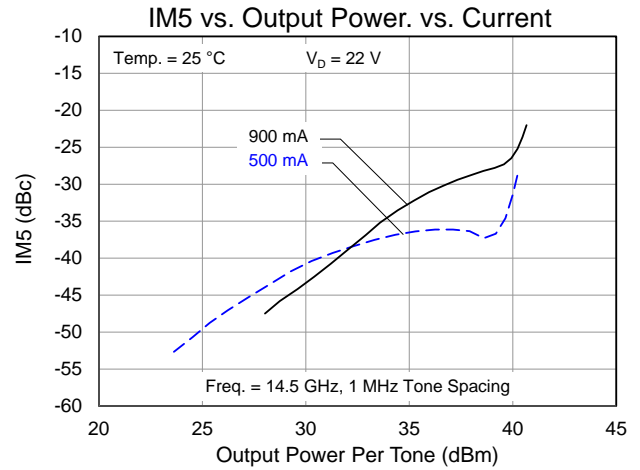
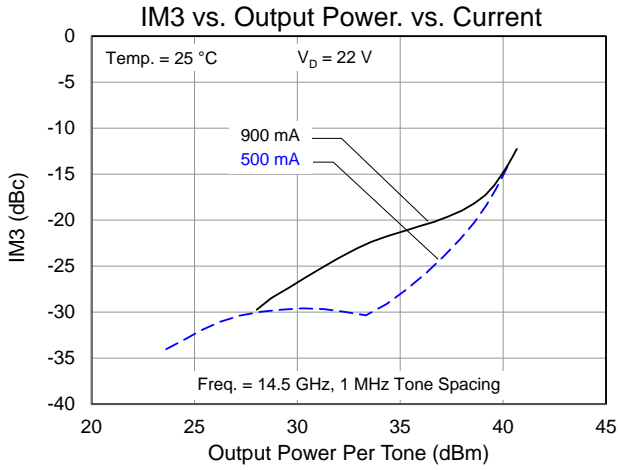
Typical Performance (CW Operation)



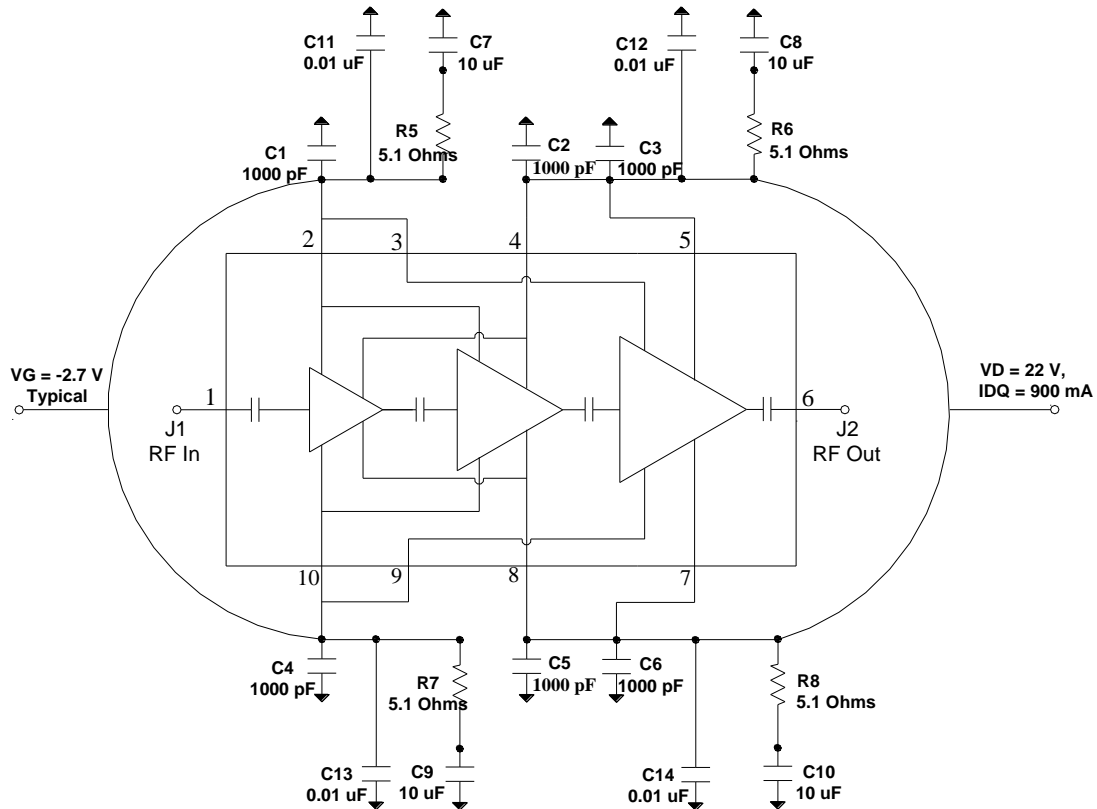
Typical Performance (Linearity)



Typical Performance (Linearity)



Application Circuit



Notes:

V_G & V_D must be biased from both sides top and bottom.

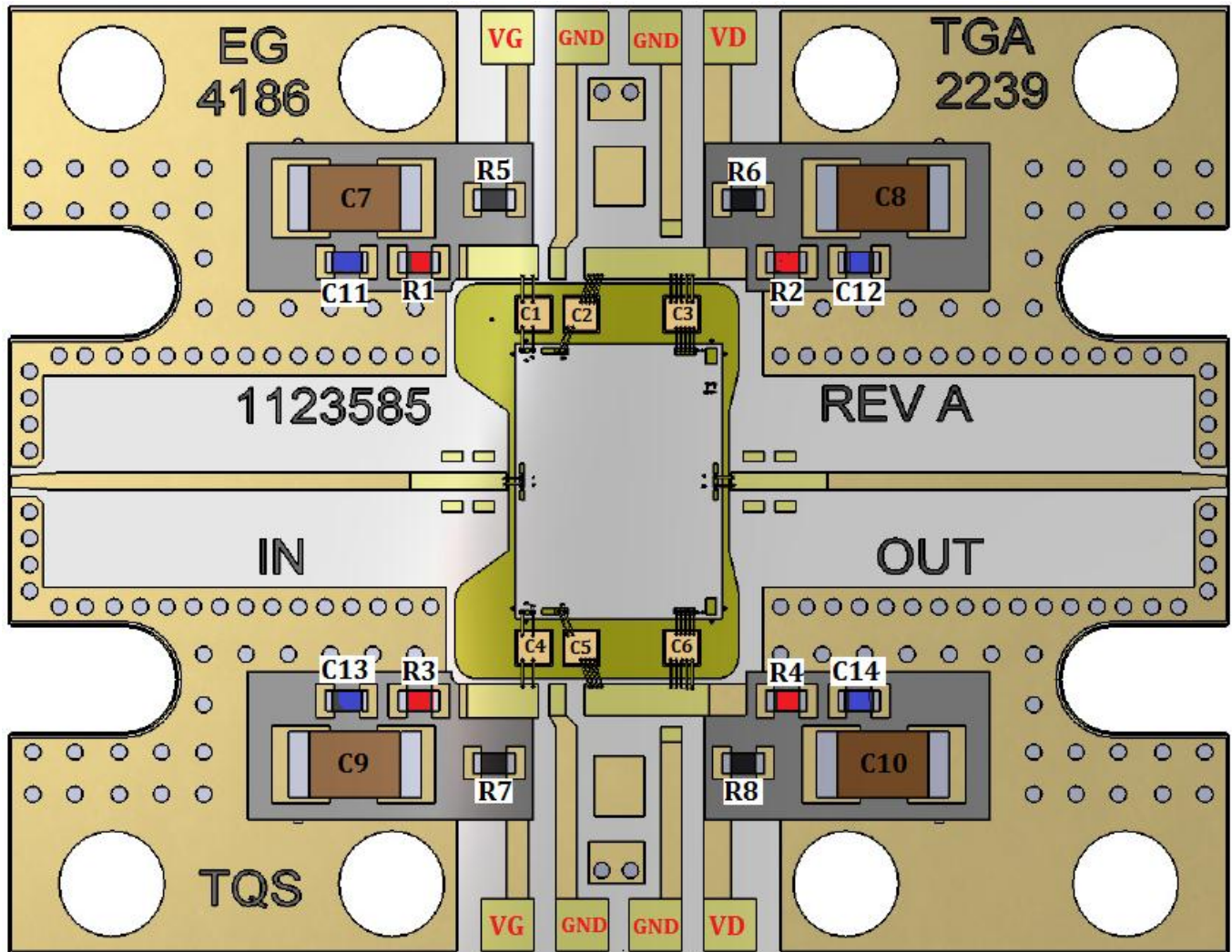
Bias-up Procedure

1. Set I_D limit to 6 A, I_G limit to 50 mA
2. Set V_G to -5.0 V
3. Set V_D +22 V
4. Adjust V_G more positive until $I_{DQ} = 900$ mA ($V_G \sim -2.7$ V Typical)
5. Apply RF signal

Bias-down Procedure

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

Evaluation Board (EVB) Layout Assembly

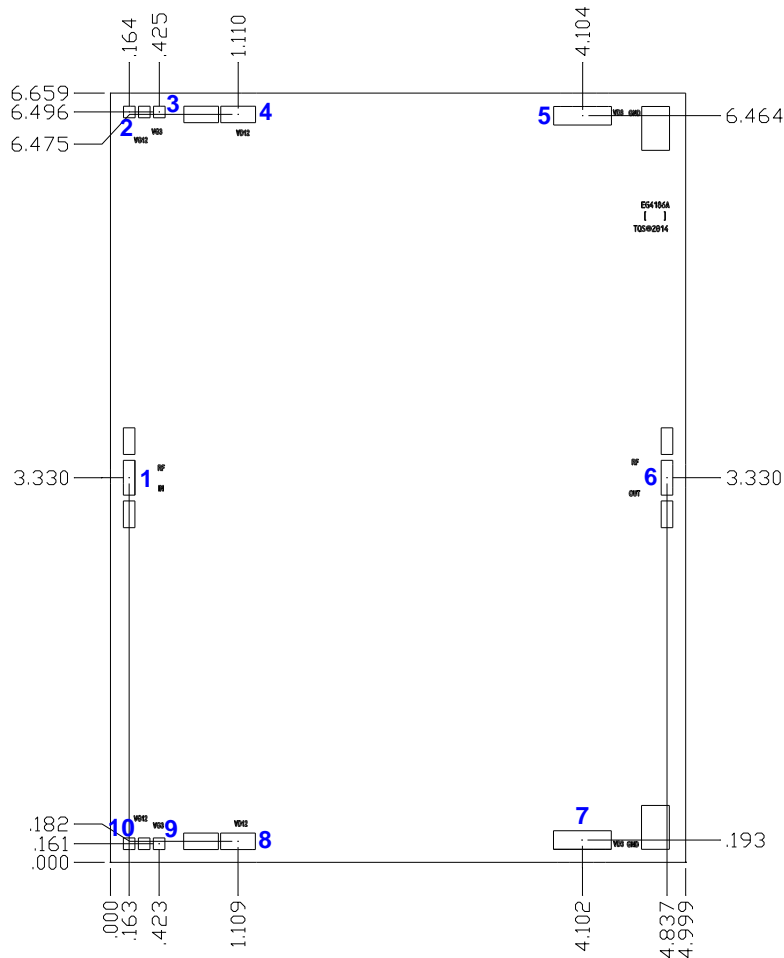


Notes: V_G & V_D must be biased from both sides top and bottom.

Bill of Materials

Reference Design	Value	Description	Manufacturer	Part Number
C1 – C6	1000pF	SLC, 50V	Various	
C7 – C10	10 uF	Cap, 1206, 50V, 20%, X5R	Various	
C11, C14	0.01uF	Cap, 0402, 50V, 10%, X7R	Various	
R1 – R4	0 Ω	Res, 0402, 5%, SMD	Various	
R5 – R8	5.1 Ω	Res, 0402, 5%, ROHS	Various	

Mechanical Drawing & Bond Pad Description



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	Symbol	Pad Size	Description
1	RF In	0.101 x 0.302	RF Input; matched to 50Ω
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 50Ω

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.
- Organic attachment (i.e. epoxy) can be used in low-power applications.
- Curing should be done in a convection oven; proper exhaust is a safety concern.

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.

Product Compliance Information

ESD Sensitivity Ratings



Caution! ESD-Sensitive Device

ESD Rating: TBD
Value: TBD
Test: Human Body Model (HBM)
Standard: JEDEC Standard JESD22-A114

ECCN

US Department of Commerce: 3A001.b.2.b

Solderability

This part is compliant with EU 2002/95/EC RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

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, and information about TriQuint:

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