TGA2239-CP

13.4 to 15.5 GHz, 35W GaN Power Amplifier

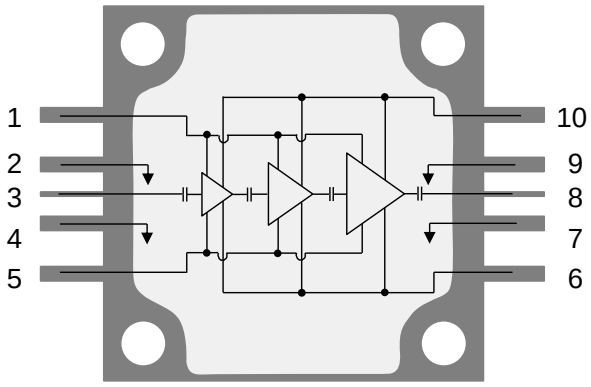
Applications

- Commercial VSAT
- Military Satcom
- Datalinks
- Radar

Product Features

- Frequency Range: 13.4 – 15.5 GHz
- Pout: 45.5 dBm at P_{IN} = 20 dBm
- PAE: > 33.8%
- Small Signal Gain: > 30 dB
- IM3: < -18 dBc @ 38 dBm Pout/Tone
- Bias: V_D = 22 V, I_{DQ} = 900 mA, V_G = -2.7 V Typical
- Package Dimensions: 15.2 x 15.2 x 3.5 mm
- Package base is pure Cu offering superior thermal management

Functional Block Diagram



General Description

Qorvo's TGA2239-CP is a 3-stage, 35W power amplifier operating over the 13.4 to 15.5GHz band. Fabricated on Qorvo's production 0.15um GaN on SiC technology, this high performance amplifier offers > 30dB small-signal gain with 34% PAE, 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.

Lead free and RoHS compliant.

Evaluation Boards are available upon request.

Pin Configuration

Pad No.	Symbol
1, 5	V_G
2, 4, 7, 9	GND
3	RF_{IN}
6, 10	V_D
8	RF_{OUT}

Ordering Information

Part	ECCN	Description
TGA2239-CP	3A001.b.2.b	13.4 – 15.5 GHz, 35 W GaN Power Amplifier

Absolute Maximum Ratings

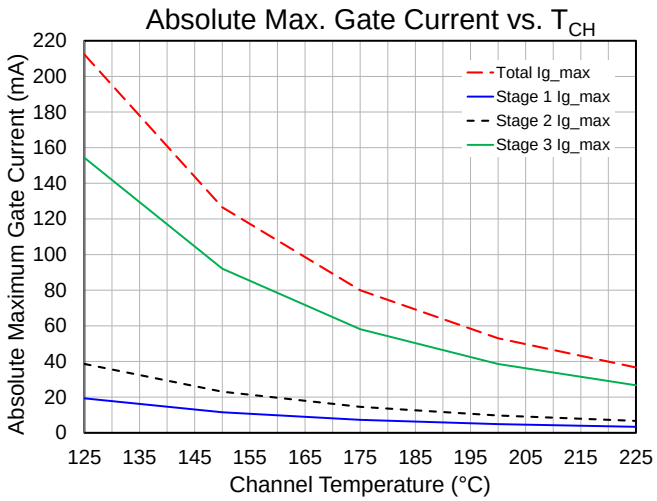
Parameter	Value
Drain Voltage (V_D)	23 V
Gate Voltage Range (V_G)	-5 to 0 V
Drain Current (I_D) - 1st stage - 2nd stage - 3rd stage	 1.15 A 1.73 A 4.35 A
Forward Gate Current (I_G)	See graph this page
Power Dissipation (P_{DISS}), 85°C	97 W
Input Power, CW, 50 Ω, (P_{IN})	33 dBm
Input Power, CW, VSWR 3:1, V_D = 30 V, 85 °C, (P_{IN})	30 dBm
Channel Temperature (T_{CH})	275 °C
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 Conditions

Parameter	Value
Drain Voltage (V_D)	22 V
Drain Current (I_{DQ})	900 mA
Drain Current Under RF Drive (I_{D_DRIVE})	See plots p. 7
Gate Voltage (V_G)	−2.7 V (Typ.)
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

Test conditions unless otherwise noted: 25 °C, V_D = 22 V, I_{DQ} = 900 mA, V_G = −2.7 V Typ, CW.

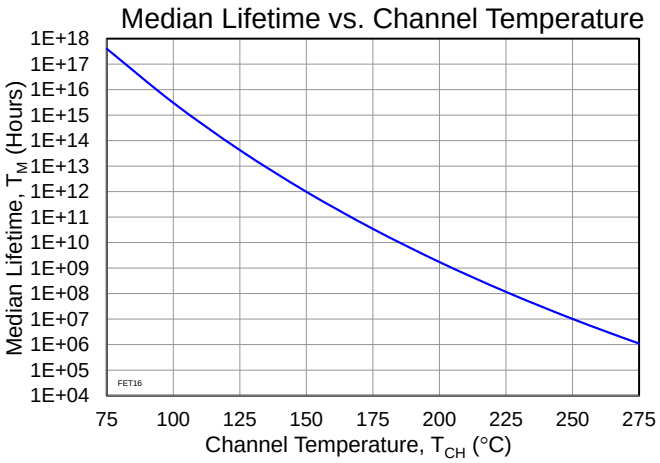
Parameter	Min	Typical	Max	Units
Operational Frequency Range	13.4		15.5	GHz
Small Signal Gain		> 30		dB
Input Return Loss		> 12		dB
Output Return Loss		> 10		dB
Output Power at Pin = 20 dBm		45.5		dBm
Power Added Efficiency at Pin = 20 dBm		> 33.8		%
IM3 (Pout/tone = 38 dBm/Tone)		< -18		dBc
IM5 (Pout/tone = 38 dBm/Tone)		< -28		dBc
Small Signal Gain Temperature Coefficient		-0.07		dB/°C
Output Power Temperature Coefficient		-0.025		dBm/°C
Recommended Operating Voltage		22	22	V

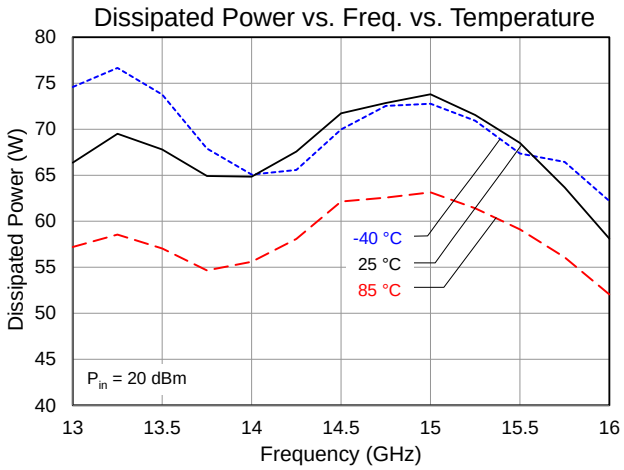
Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = 85°C, V_D = 22 V (CW) At I_{DQ} = 900 mA, P_{DISS} = 15.8 W	1.7	°C/W
Channel Temperature (T_{CH}) (Quiescent)		105	°C
Median Lifetime (T_M)		1.2E+15	Hrs
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = 85°C, V_D = 22 V (CW) At Freq = 15 GHz, P_{IN} = 10 dBm: I_{DQ} = 900 mA, I_{D_Drive} = 1.6 A P_{OUT} = 36.5 dBm, P_{DISS} = 30.5 W	1.5	°C/W
Channel Temperature (T_{CH}) (Under RF drive)		112	°C
Median Lifetime (T_M)		3.5E+14	Hrs
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = 85°C, V_D = 22 V (CW) At Freq = 15 GHz, P_{IN} = 24 dBm: I_{DQ} = 900 mA, I_{D_Drive} = 5.1 A P_{OUT} = 45.4 dBm, P_{DISS} = 77 W	1.96	°C/W
Channel Temperature (T_{CH}) (Under RF drive)		176	°C
Median Lifetime (T_M)		2.7E+10	Hrs

Notes:
1. Thermal resistance measured to back of package.

Test Conditions: V_D = 22 V; Failure Criteria = 10% reduction in I_{D_MAX}

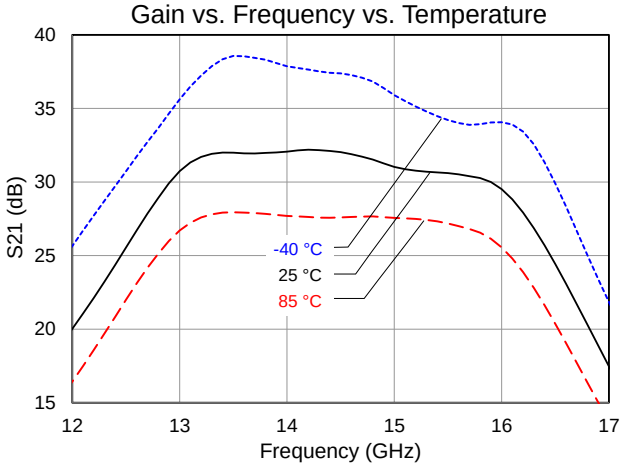




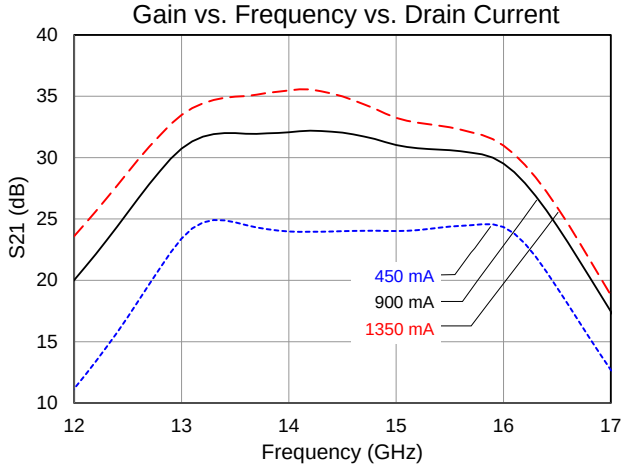
Typical Performance: Small Signal

Conditions unless otherwise specified: V_D = 22 V, I_{DQ} = 900 mA, V_G = -2.7 V Typical, CW.

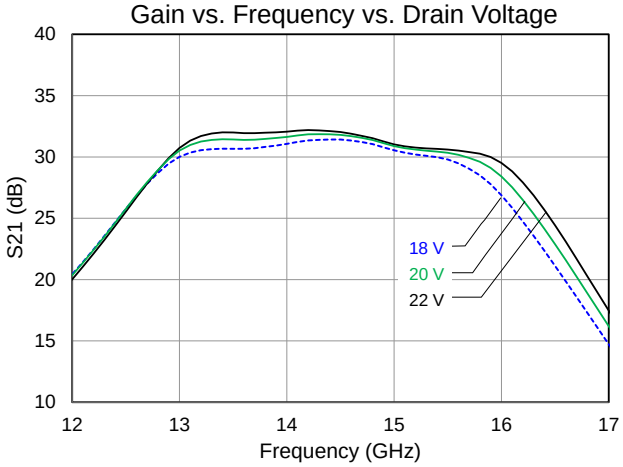
Gain vs. Frequency vs. Temperature



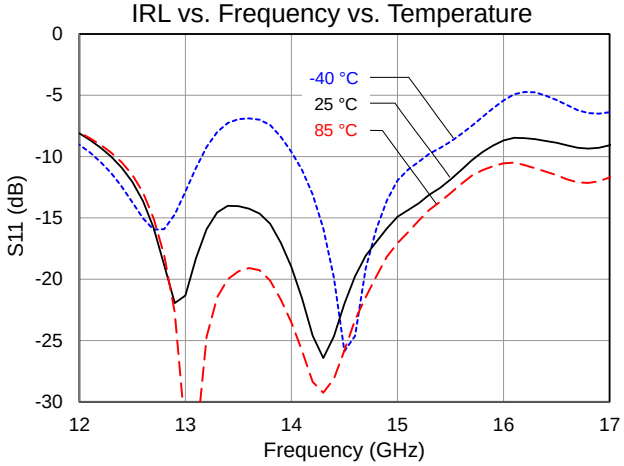
Gain vs. Frequency vs. Drain Current



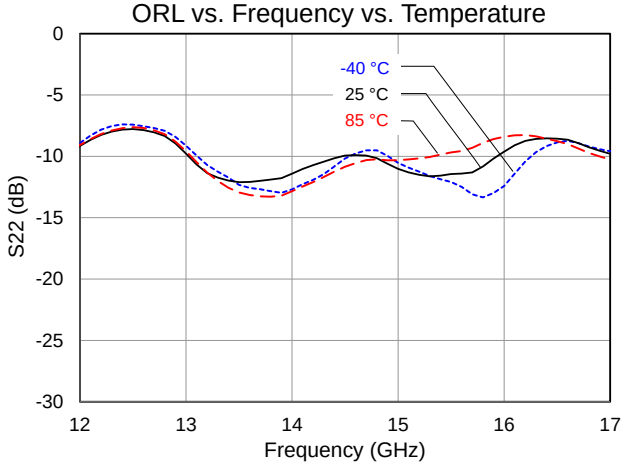
Gain vs. Frequency vs. Drain Voltage



IRL vs. Frequency vs. Temperature



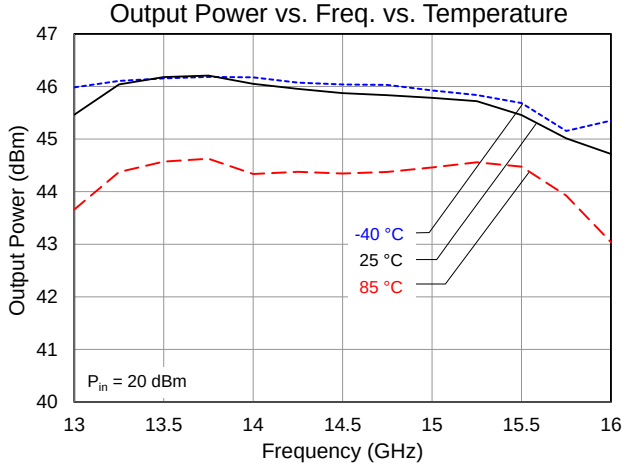
ORL vs. Frequency vs. Temperature



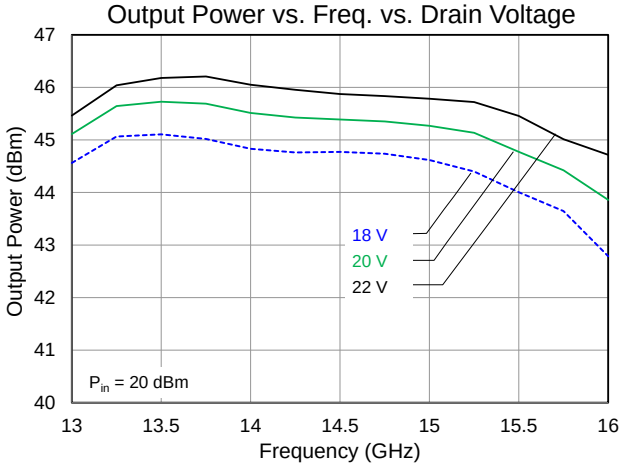
Typical Performance: Large Signal

Conditions unless otherwise specified: V_D = 22 V, I_{DQ} = 900 mA, -2.7 V Typical, CW.

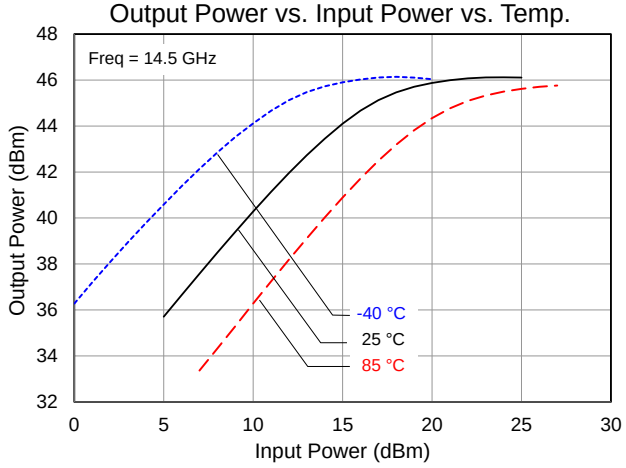
Output Power vs. Freq. vs. Temperature



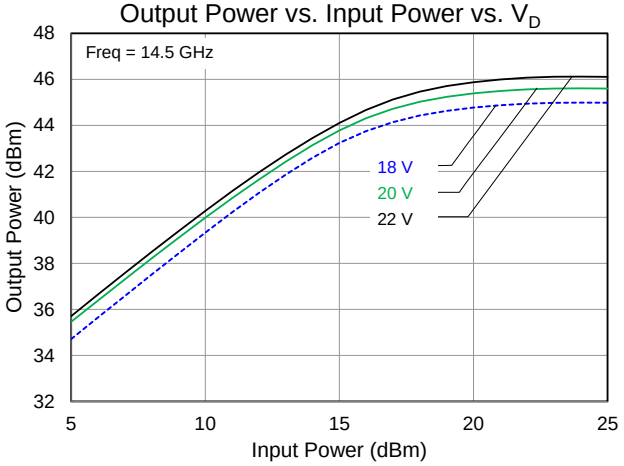
Output Power vs. Freq. vs. Drain Voltage



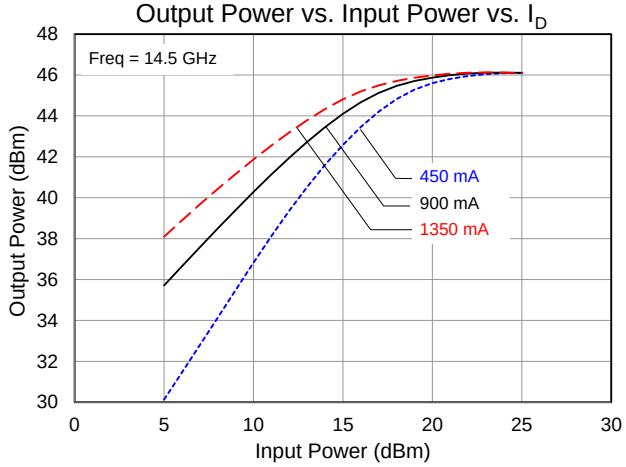
Output Power vs. Input Power vs. Temp.



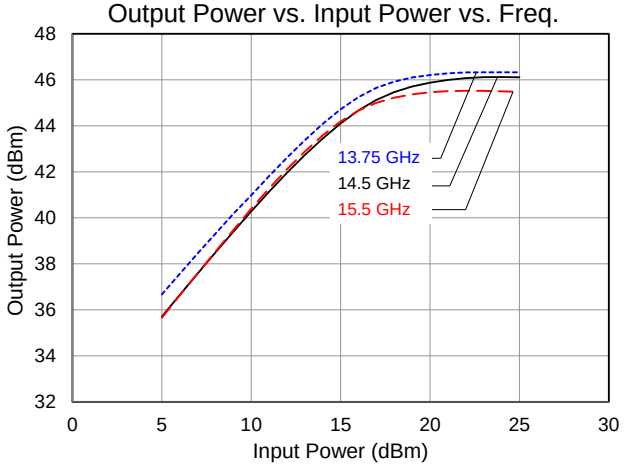
Output Power vs. Input Power vs. V_D



Output Power vs. Input Power vs. I_D



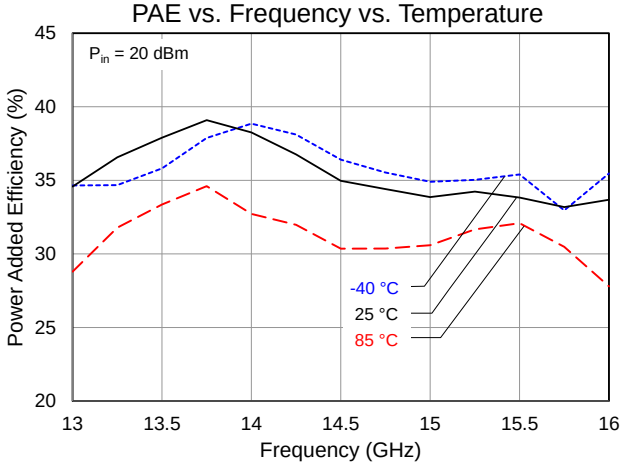
Output Power vs. Input Power vs. Freq.



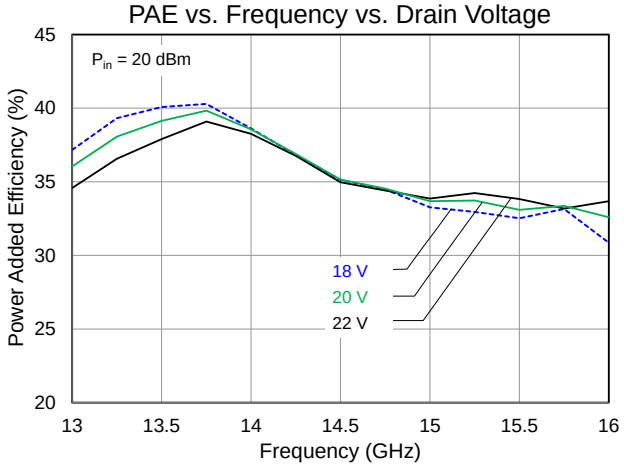
Typical Performance: Large Signal

Conditions unless otherwise specified: V_D = 22 V, I_{DQ} = 900 mA, V_G = -2.7 V Typical, CW.

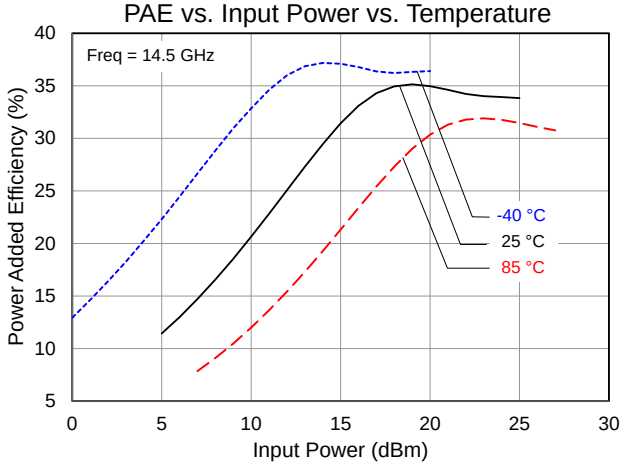
PAE vs. Frequency vs. Temperature



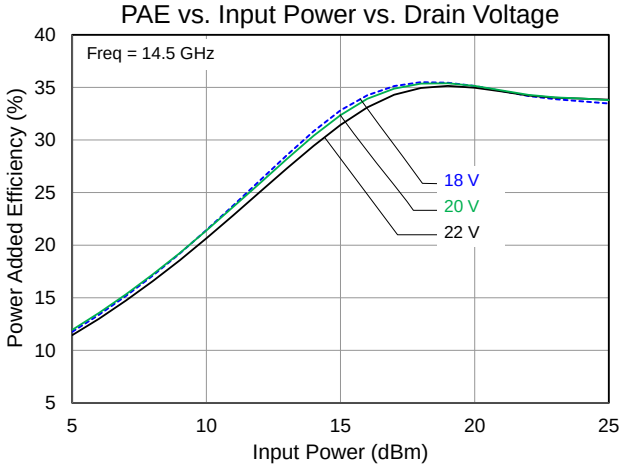
PAE vs. Frequency vs. Drain Voltage



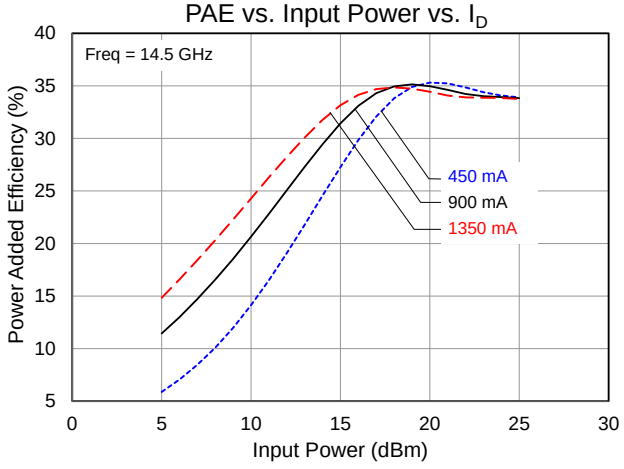
PAE vs. Input Power vs. Temperature



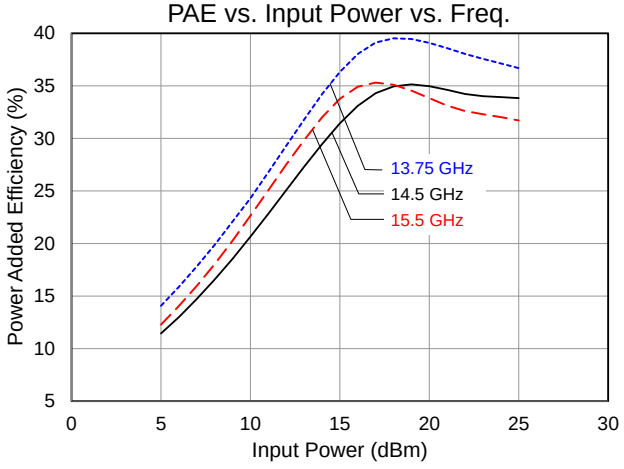
PAE vs. Input Power vs. Drain Voltage



PAE vs. Input Power vs. I_D



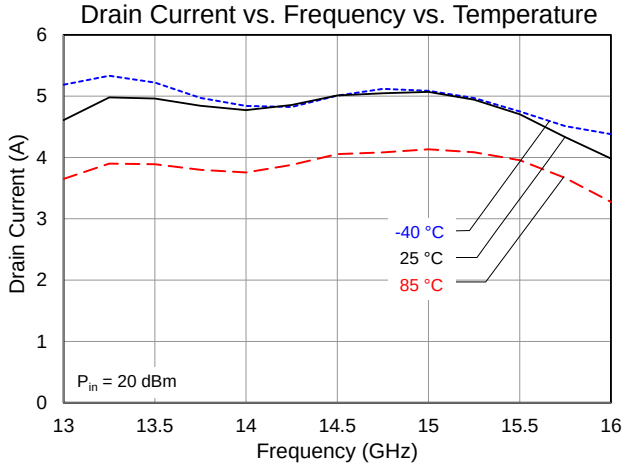
PAE vs. Input Power vs. Freq.



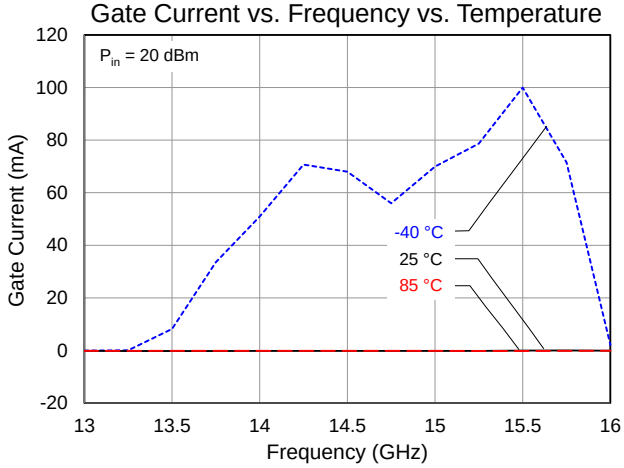
Typical Performance: Large Signal

Conditions unless otherwise specified: V_D = 22 V, I_{DQ} = 900 mA, V_G = -2.7 V Typical, CW.

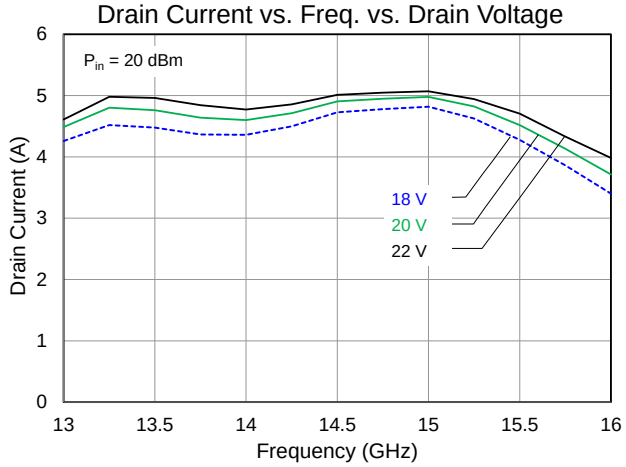
Drain Current vs. Frequency vs. Temperature



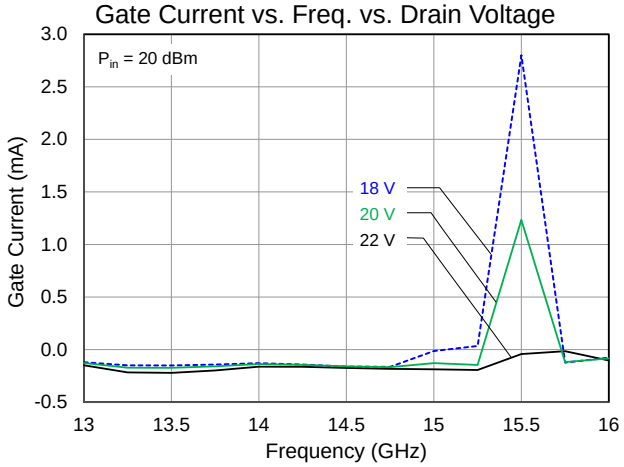
Gate Current vs. Frequency vs. Temperature



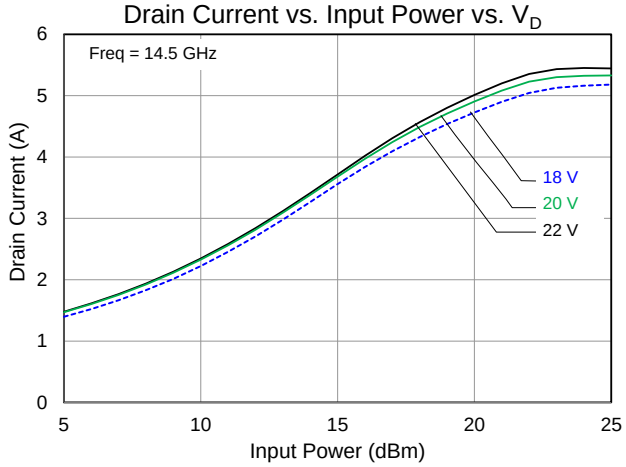
Drain Current vs. Freq. vs. Drain Voltage



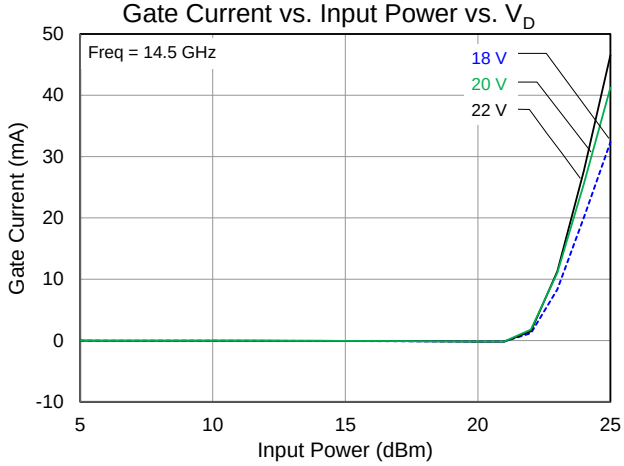
Gate Current vs. Freq. vs. Drain Voltage



Drain Current vs. Input Power vs. V_D



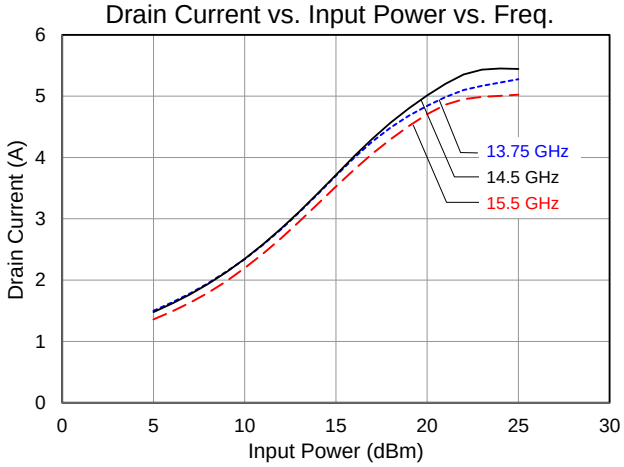
Gate Current vs. Input Power vs. V_D



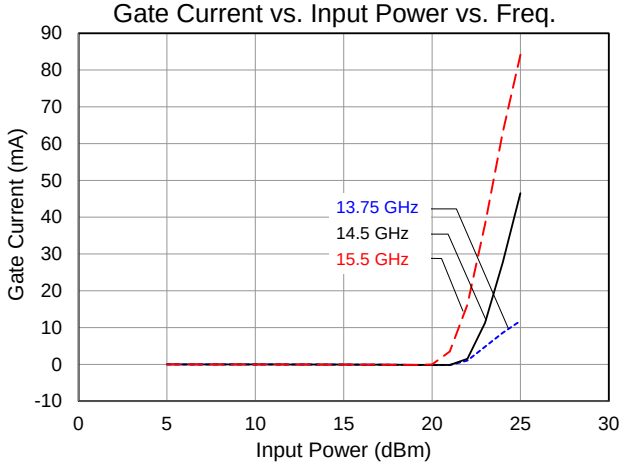
Typical Performance: Large Signal

Conditions unless otherwise specified: V_D = 22 V, I_{DQ} = 900 mA, V_G = -2.7 V Typical, CW.

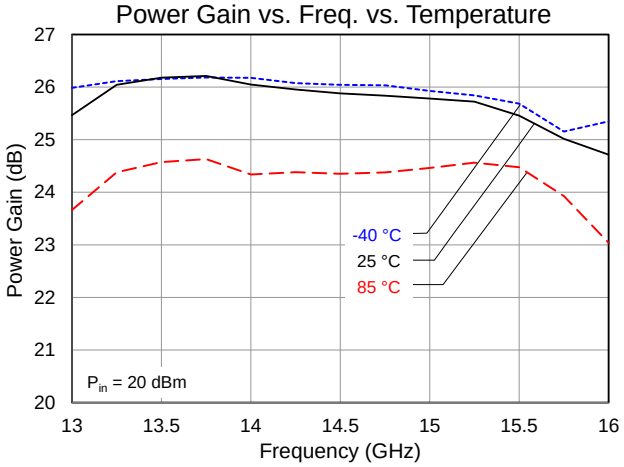
Drain Current vs. Input Power vs. Freq.



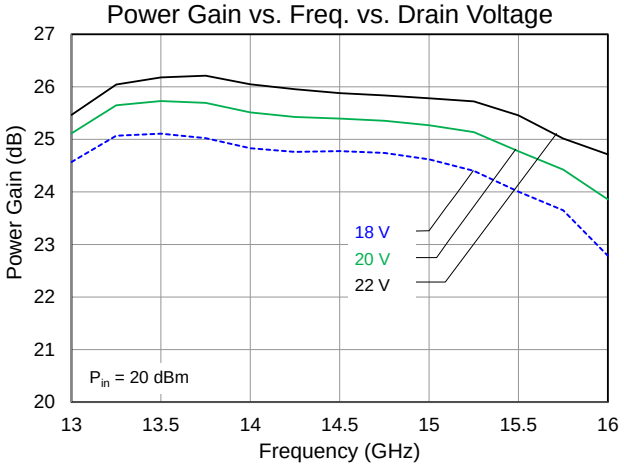
Gate Current vs. Input Power vs. Freq.



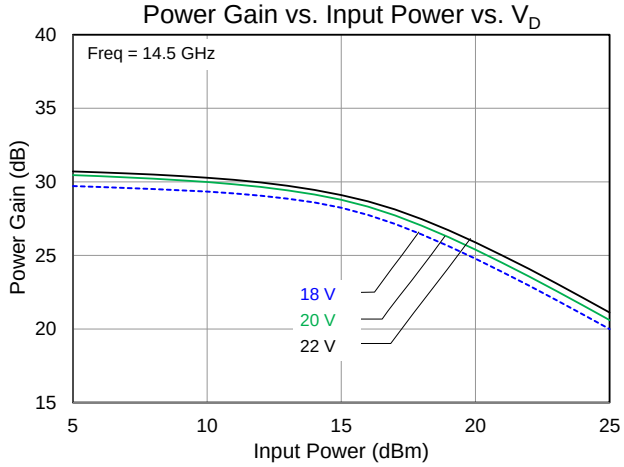
Power Gain vs. Freq. vs. Temperature



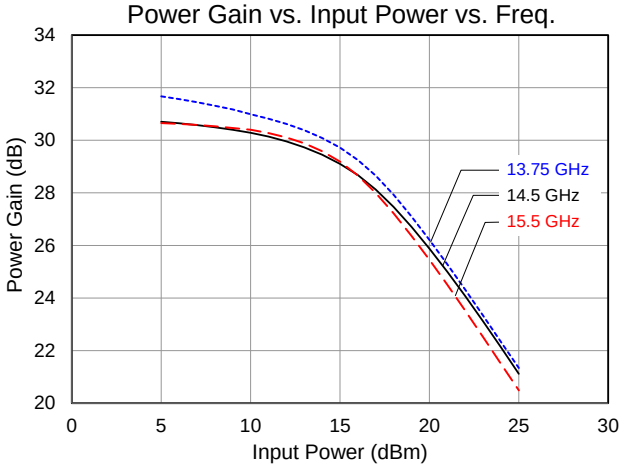
Power Gain vs. Freq. vs. Drain Voltage



Power Gain vs. Input Power vs. V_D



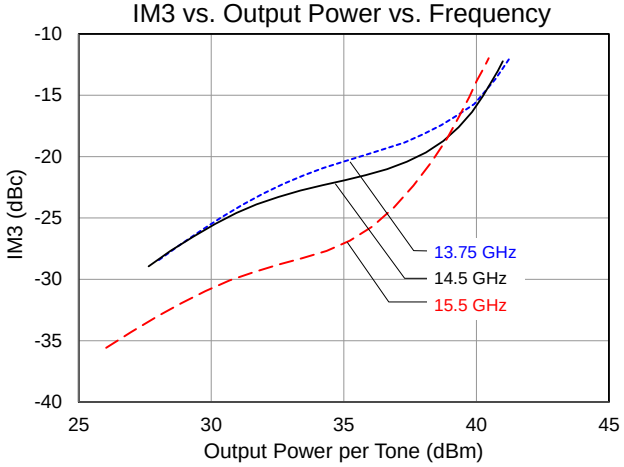
Power Gain vs. Input Power vs. Freq.



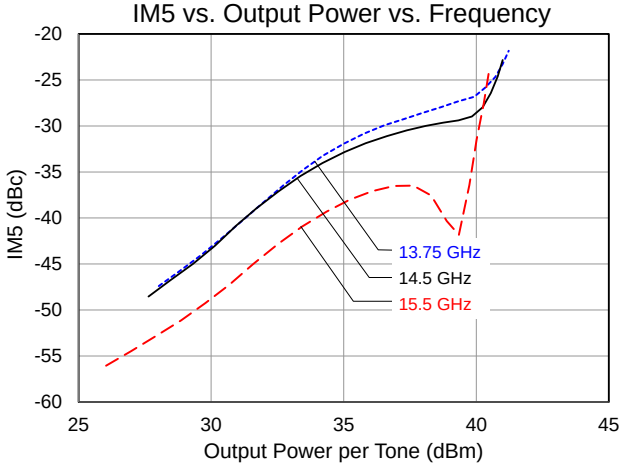
Typical Performance: Linearity

Conditions unless otherwise specified: V_D = 22 V, I_{DQ} = 900 mA, V_G = -2.7 V Typical, CW.

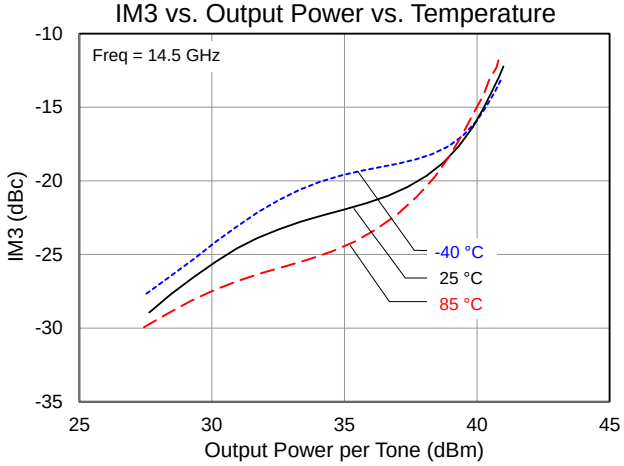
IM3 vs. Output Power vs. Frequency



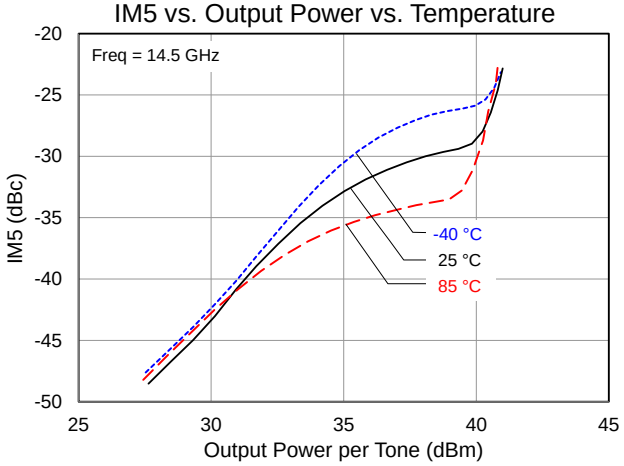
IM5 vs. Output Power vs. Frequency



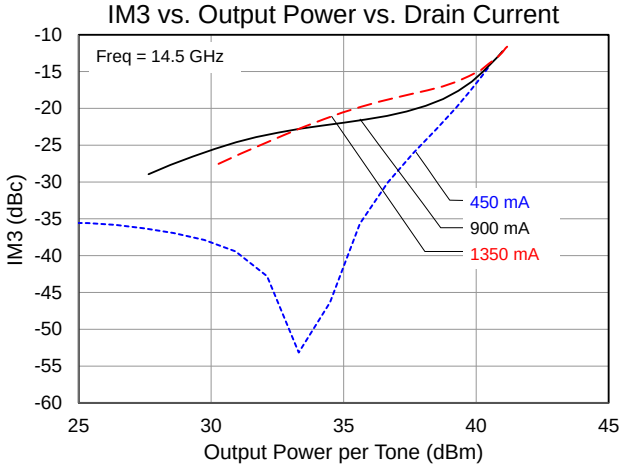
IM3 vs. Output Power vs. Temperature



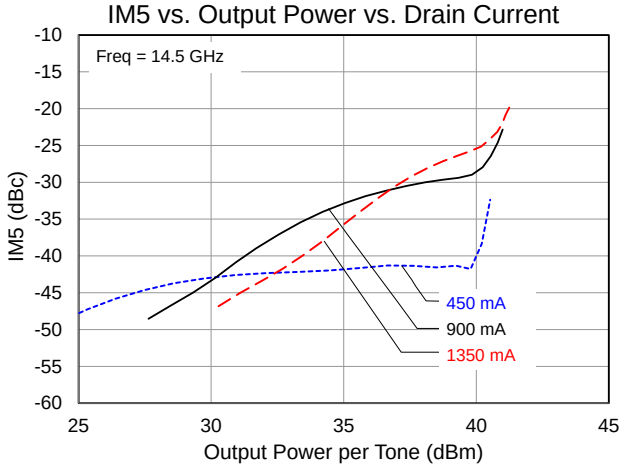
IM5 vs. Output Power vs. Temperature



IM3 vs. Output Power vs. Drain Current



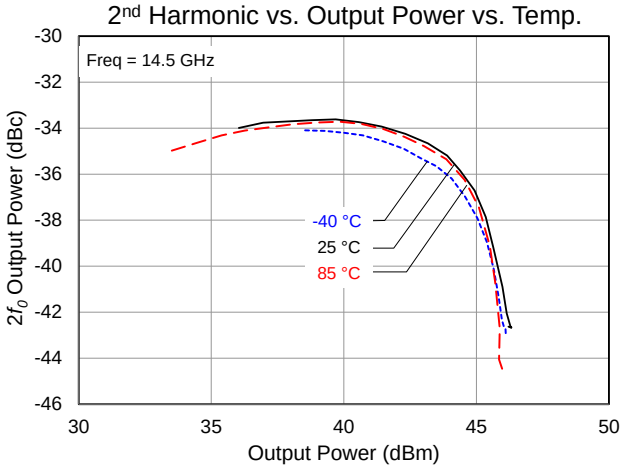
IM5 vs. Output Power vs. Drain Current



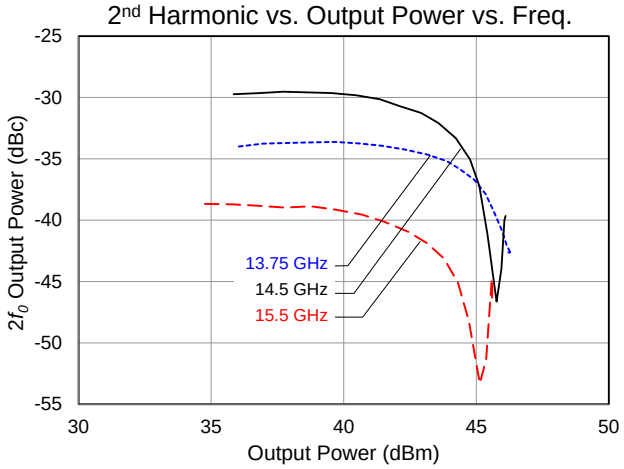
Typical Performance: Large Signal

Conditions unless otherwise specified: V_D = 22 V, I_{DQ} = 900 mA, V_G = -2.7 V Typical, CW.

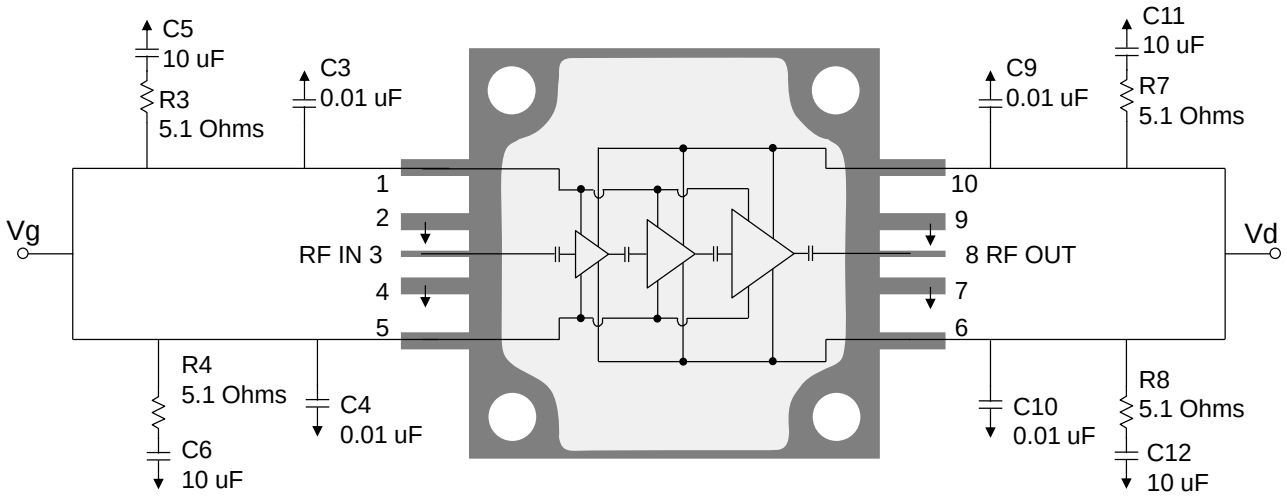
2nd Harmonic vs. Output Power vs. Temp.



2nd Harmonic vs. Output Power vs. Freq.



Applications Information and Pin Layout



Bias-up Procedure

1. Set I_D limit to 6 A, I_G limit to 100 mA
2. Apply −5 V to V_G
3. Apply +22 V to V_D; ensure I_{DQ} is approx. 0 mA
4. Adjust V_G until I_{DQ} = 900 mA (V_G ~ −2.7 V Typ.).
5. Turn on RF supply

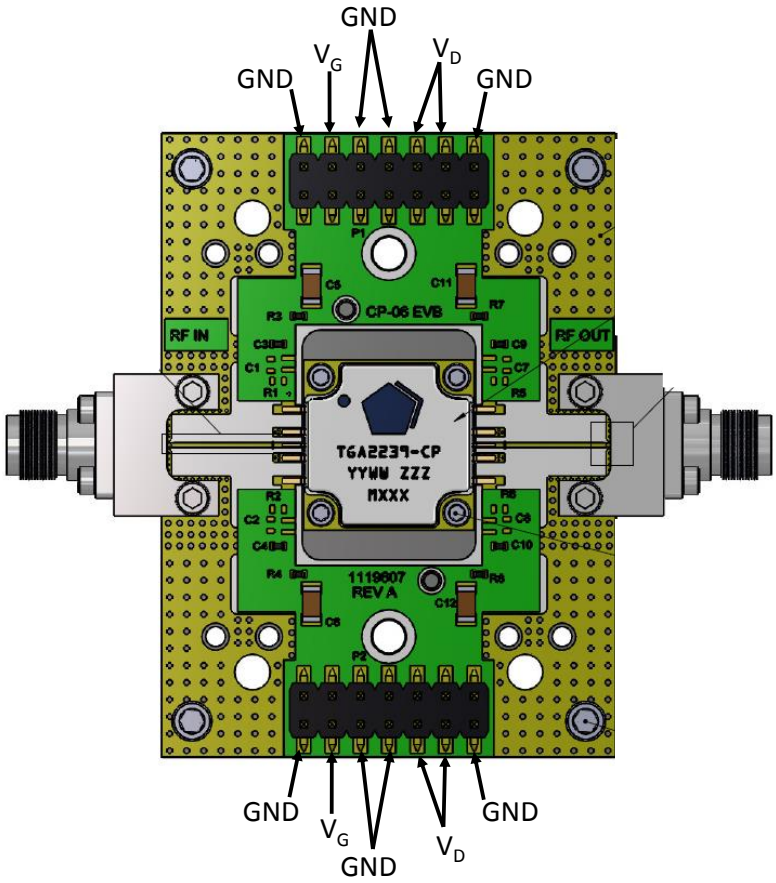
Bias-down Procedure

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

Pin 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 Ω; 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 Ω; DC blocked

Evaluation Board



NOTE: Both Top and Bottom Vd and Vg must be biased.

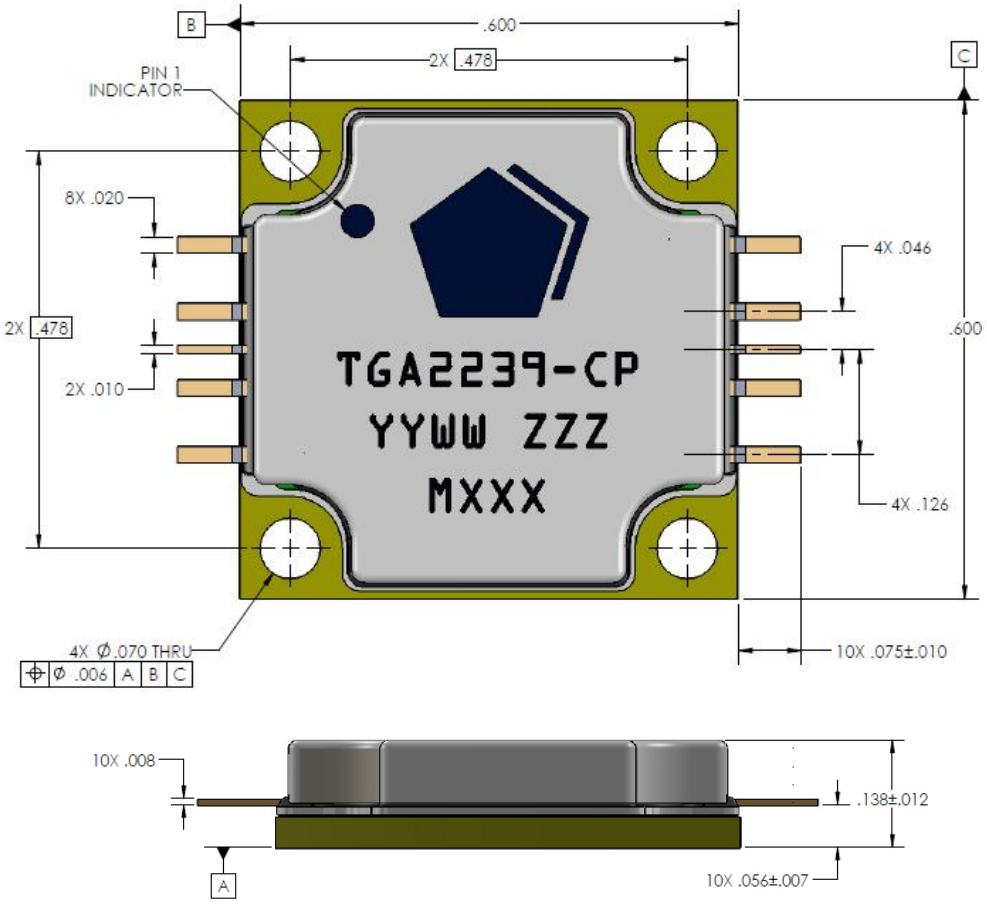
Bill of Material

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

Assembly Notes

1. Clean the board or module with alcohol. Allow it to dry fully.
2. Nylock screws are recommended for mounting the TGA2239-CP to the board.
3. To improve the thermal and RF performance, we recommend the following:
   a. Apply thermal compound or 4 mils indium shim between the package and the board.
   b. Attach a heat sink to the bottom of the board and apply thermal compound or 4 mils indium shim between the heat sink and the board.
4. Apply solder to each pin of the TGA2239-CP.
5. Clean the assembly with alcohol.

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

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

MSL Rating

Level 5A at 260 °C convection reflow.
The part is rated Moisture Sensitivity Level 5A at 260 °C per JEDEC standard IPC/JEDEC J-STD-020.

ECCN

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

Solderability

Compatible with the latest version of J-STD-020, Lead-free solder, 260°C

RoHS Compliance

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 ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free

Contact Information

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