TGA2238-CP

8 – 11 GHz 50 W GaN Power Amplifier

Applications

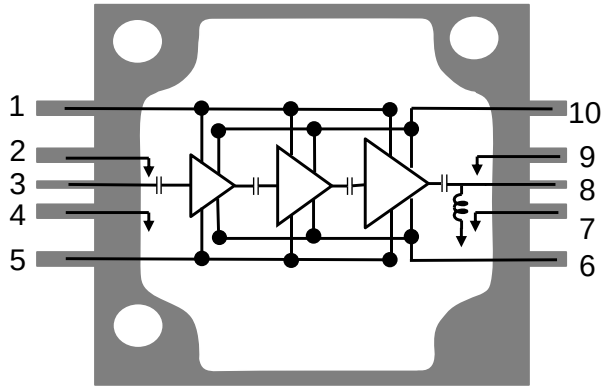
- X-band radar
- Data Links



Product Features

- Frequency Range: 8 – 11 GHz
- P_{SAT}: 47 dBm @ P_{IN} = 23 dBm
- PAE: 34% @ P_{IN} = 23 dBm
- Power Gain: 24 dB @ P_{IN} = 23 dBm
- Small Signal Gain: >28 dB
- Return Loss: > 9 dB
- Bias: V_D = 28 V, I_{DQ} = 650 mA, V_G = -2.6 V Typical (Pulsed V_D: PW = 100 µs and DC = 10 %)
- 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

TriQuint's TGA2238-CP is a packaged, high power X-band amplifier fabricated on TriQuint's 0.25 um GaN on SiC production process. Operating from 8 – 11 GHz, the TGA2238-CP achieves 50 W saturated output power with 24 dB power gain and 34 % power-added efficiency.

The TGA2238-CP is packaged in a 10-lead 15 x 15 mm bolt-down package with a Cu base for superior thermal management. Both RF ports (RF input internally DC blocked) are matched to 50 ohms allowing for simple system integration.

The TGA2238-CP is ideally suited for both military and commercial x-band radar systems and data links.

Lead-free and RoHS compliant.

Evaluation boards are available upon request.

Pad 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
TGA2238-CP	3A001.b.2.b	8 – 11 GHz 50 W GaN Power Amplifier

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Absolute Maximum Ratings

Parameter	Value
Drain Voltage (V_D)	40 V
Gate Voltage Range (V_G)	-8 to 0V
Drain Current (I_D)	8 A
Gate Current (I_G) @ T_{CH} = 200°C	-26 to 62 mA
Power Dissipation (P_{DISS}), 85°C Pulsed: PW = 100 µs, DC = 10%	158 W
Input Power (P_{IN}), 50Ω, 85°C, V_D = 28V, Pulsed: PW = 100 µs, DC = 10%	30 dBm
Input Power (P_{IN}), 85°C, VSWR 3:1, V_D = 28V, Pulsed: PW = 100 µs, DC = 10%	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): Pulsed	28 V
Drain Current (I_{DQ})	650 mA
Gate Voltage (V_G)	-2.6 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 = 28 V, I_{DQ} = 650 mA, V_G = -2.6 V Typical, Pulsed V_D: PW = 100 µs, DC = 10 %

Parameter	Min	Typical	Max	Units
Operational Frequency Range	8		11	GHz
Small Signal Gain		>28		dB
Input Return Loss		>9		dB
Output Return Loss		>10		dB
Output Power (Pin = 23dBm)		47		dBm
Power Added Efficiency (Pin = 23dBm)		34		%
Power Gain (Pin = 23dBm)		24		dB
Small Signal Gain Temperature Coefficient		- 0.056		dB/°C

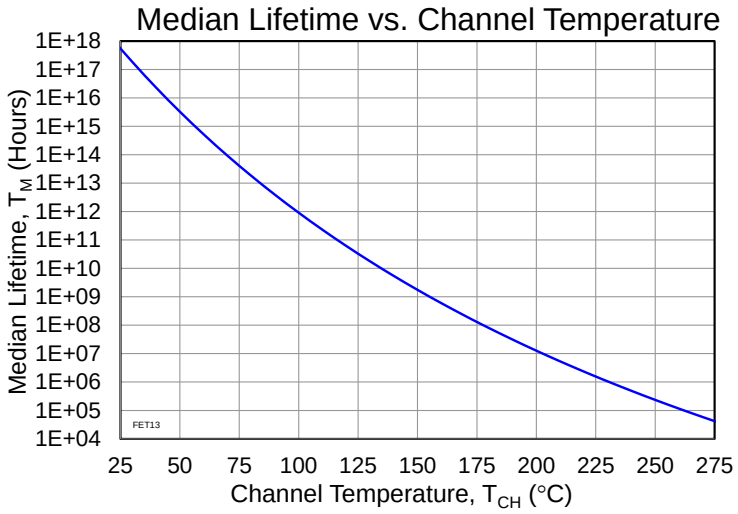
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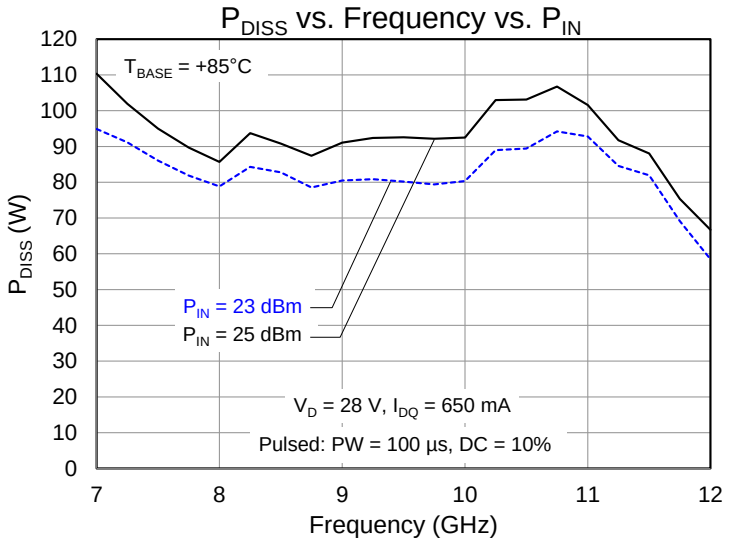
Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	V_D = 28 V, I_{DQ} = 650 mA, T_{base} = 85 °C, P_{DISS} = 18.2 W	0.66	ºC/W
Channel Temperature (T_{CH}) (No RF drive)		97	°C
Median Lifetime (T_M)		2.0 x 10^12	Hrs
Thermal Resistance (θ_{JC}) (1)	V_D = 28 V, I_{DQ} = 650 mA, (Pulsed V_D : PW = 100 µs, DC = 10 %), T_{base} = 85 °C, V_D = 28 V, $I_{D\ Drive}$ = 5.9 A, P_{IN} = 25 dBm, P_{OUT} = 47.5dBm, P_{DISS} = 108 W	0.76	ºC/W
Channel Temperature (T_{CH}) (Under RF drive)		167	°C
Median Lifetime (T_M)		2.89 x 10^9	Hrs

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

Test Conditions: V_D = 40 V; Failure Criteria = 10% reduction in I_{D_MAX}

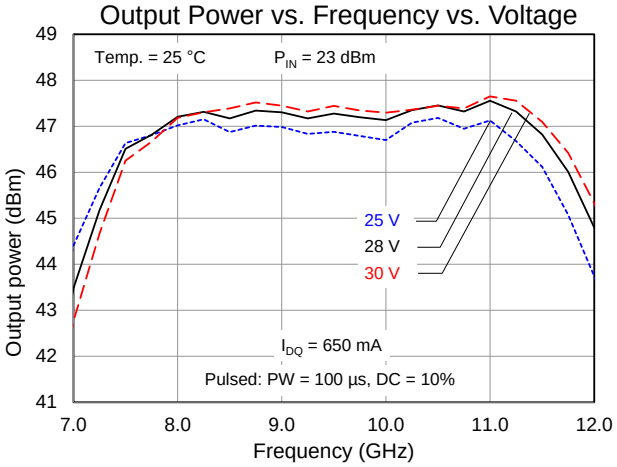




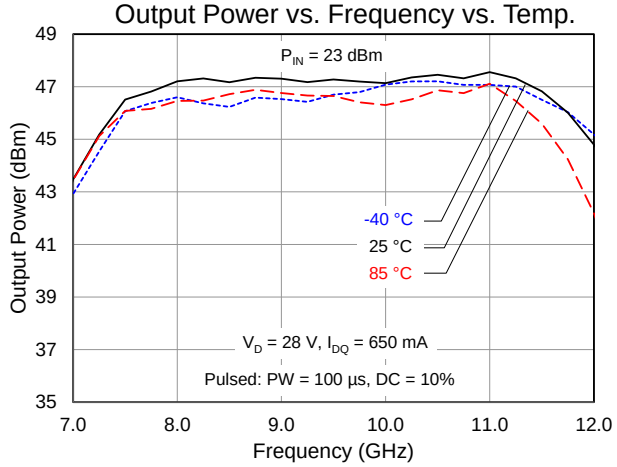
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Typical Performance: Large Signal (Pulsed Operation)

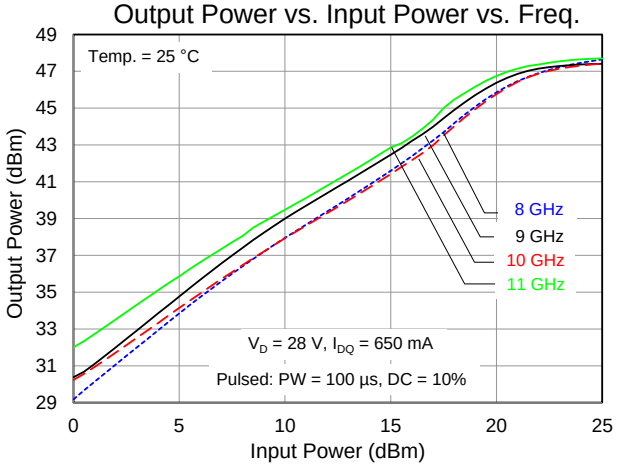
Output Power vs. Frequency vs. Voltage



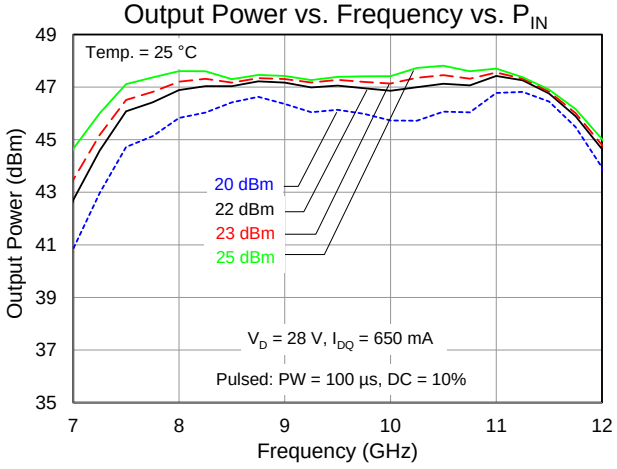
Output Power vs. Frequency vs. Temp.



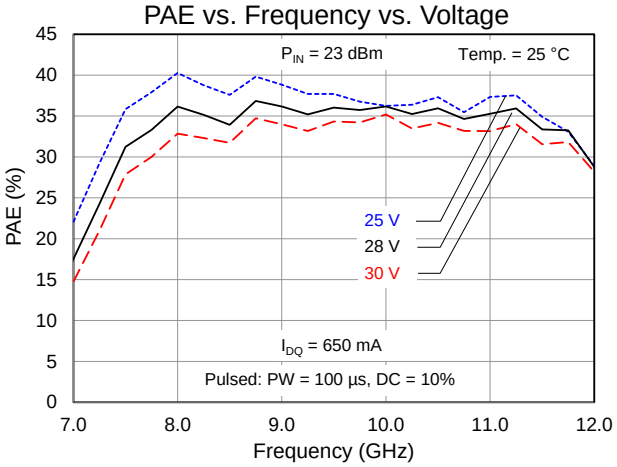
Output Power vs. Input Power vs. Freq.



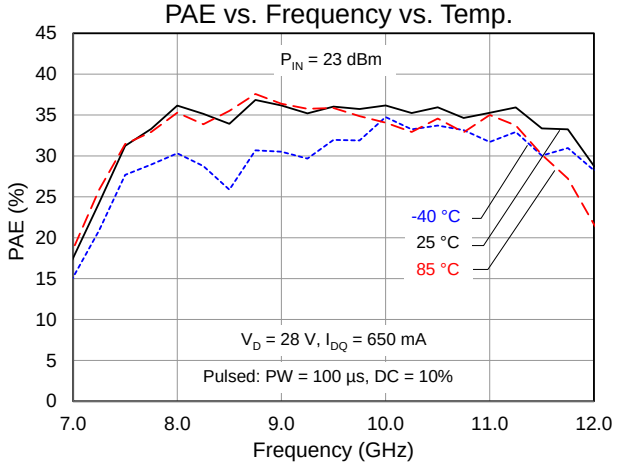
Output Power vs. Frequency vs. P_{IN}



PAE vs. Frequency vs. Voltage



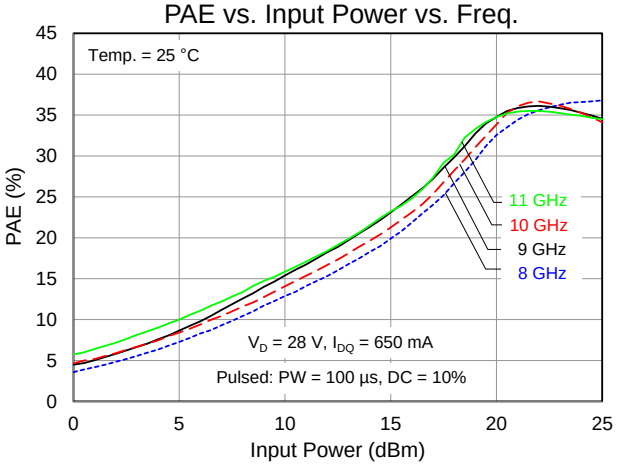
PAE vs. Frequency vs. Temp.



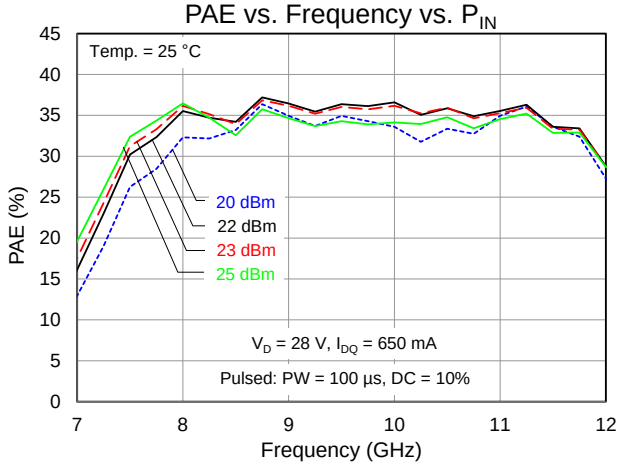
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Typical Performance: Large Signal (Pulsed Operation)

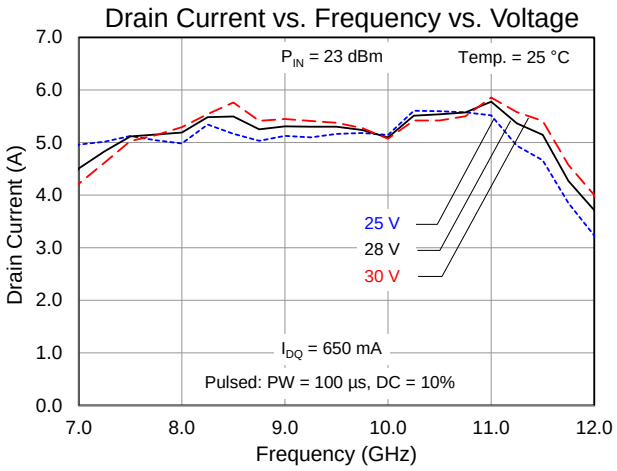
PAE vs. Input Power vs. Freq.



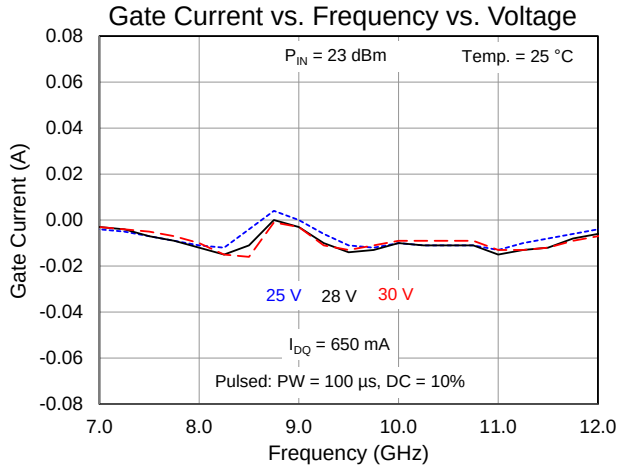
PAE vs. Frequency vs. P_{IN}



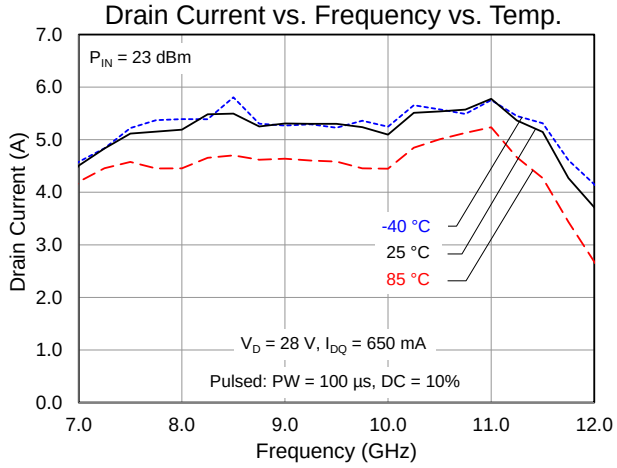
Drain Current vs. Frequency vs. Voltage



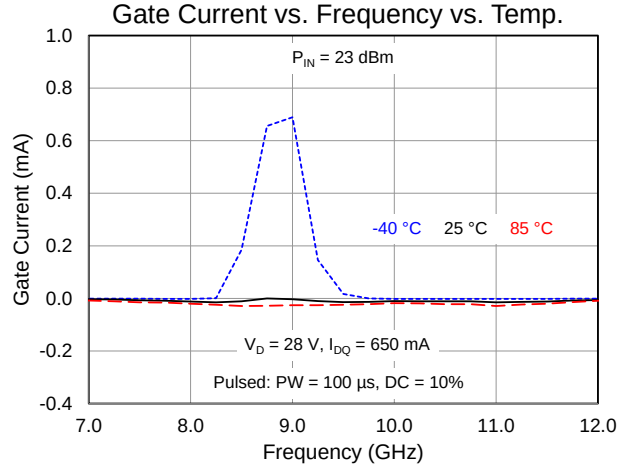
Gate Current vs. Frequency vs. Voltage



Drain Current vs. Frequency vs. Temp.



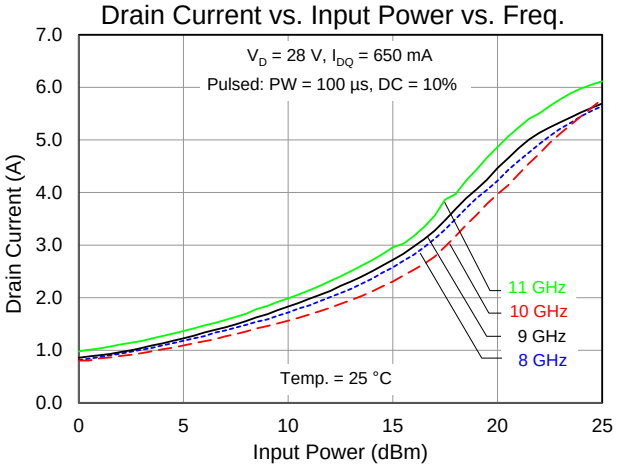
Gate Current vs. Frequency vs. Temp.



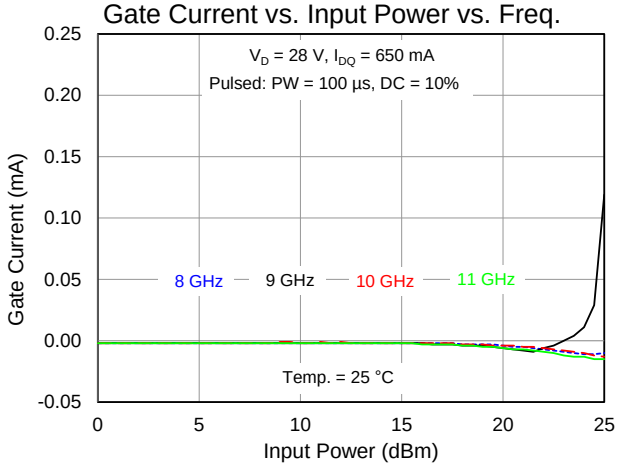
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Typical Performance: Large Signal (Pulsed Operation)

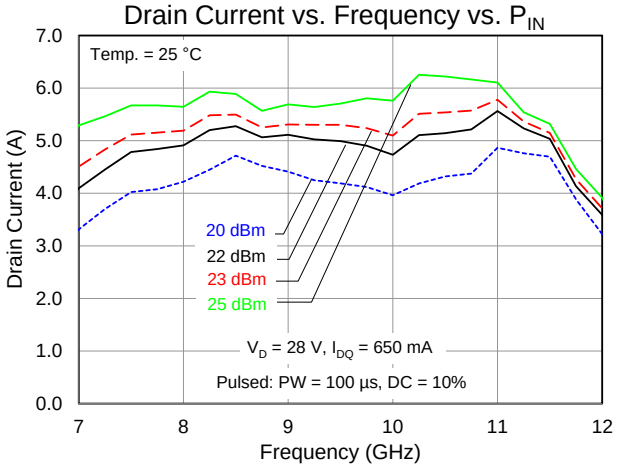
Drain Current vs. Input Power vs. Freq.



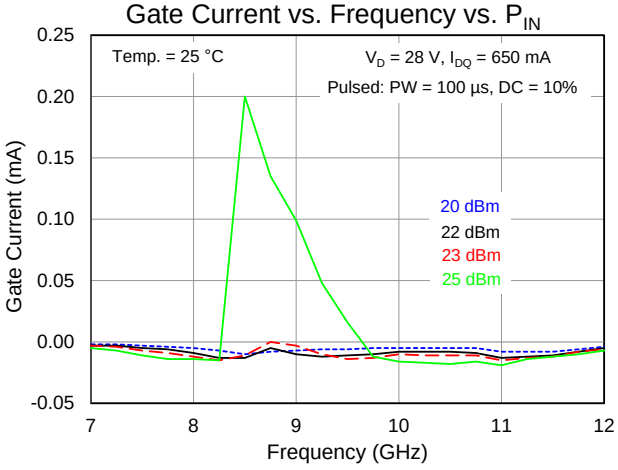
Gate Current vs. Input Power vs. Freq.



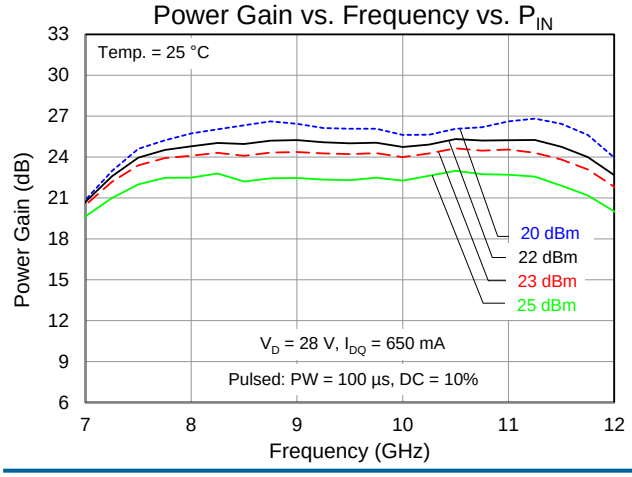
Drain Current vs. Frequency vs. P_{IN}



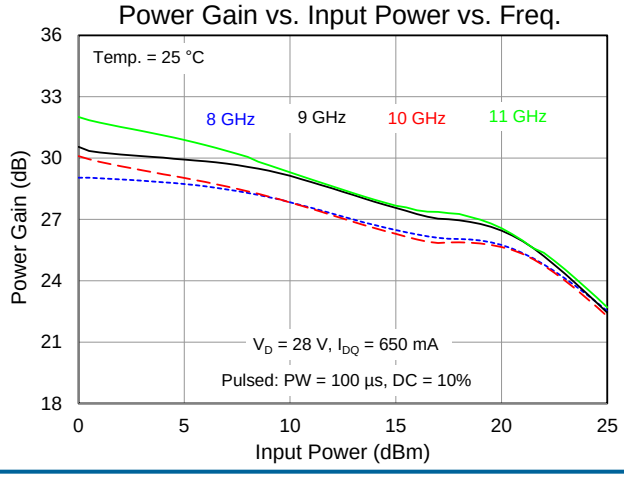
Gate Current vs. Frequency vs. P_{IN}



Power Gain vs. Frequency vs. P_{IN}



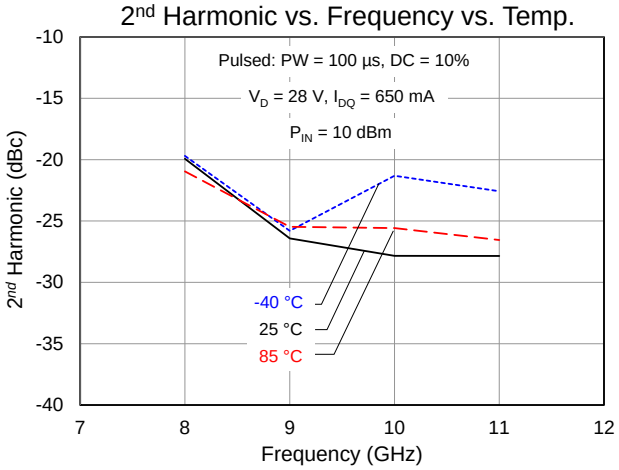
Power Gain vs. Input Power vs. Freq.



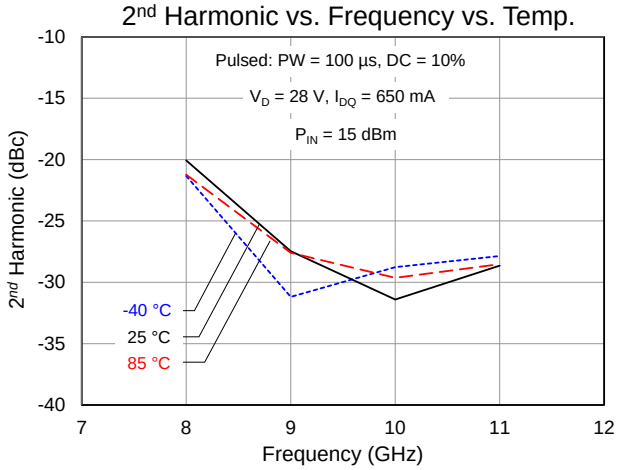
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Typical Performance: Large Signal (Pulsed Operation)

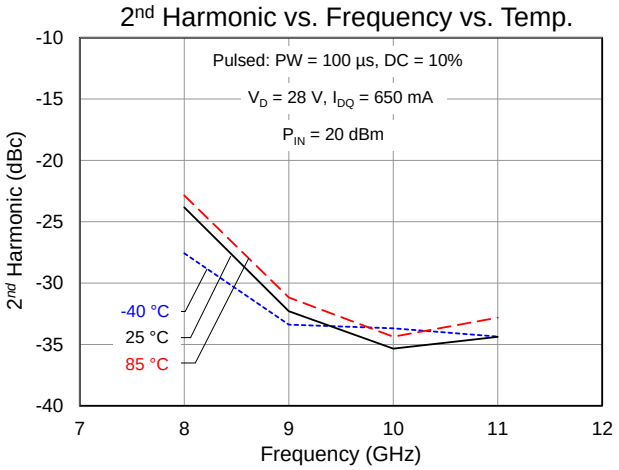
2nd Harmonic vs. Frequency vs. Temp.



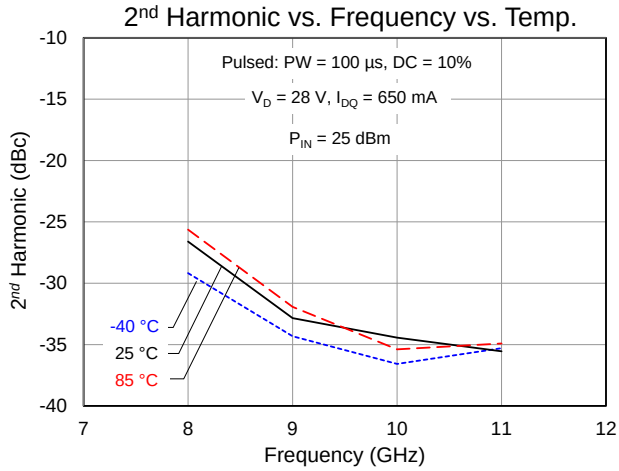
2nd Harmonic vs. Frequency vs. Temp.



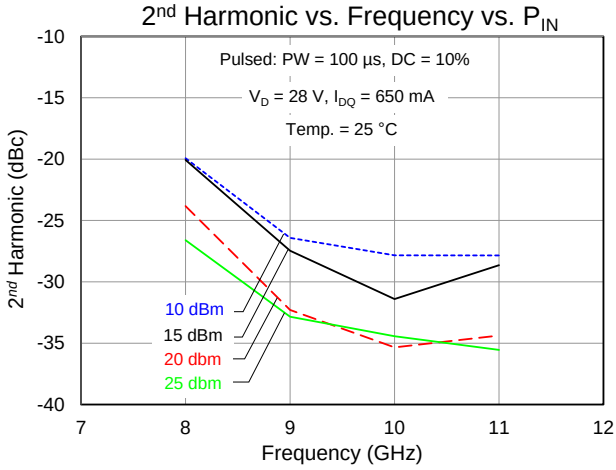
2nd Harmonic vs. Frequency vs. Temp.



2nd Harmonic vs. Frequency vs. Temp.



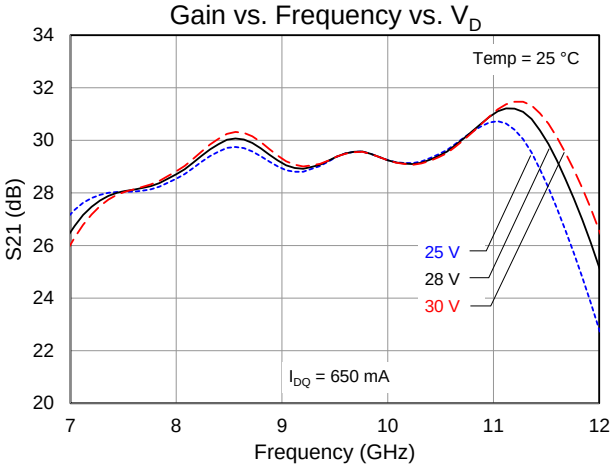
2nd Harmonic vs. Frequency vs. P_{IN}



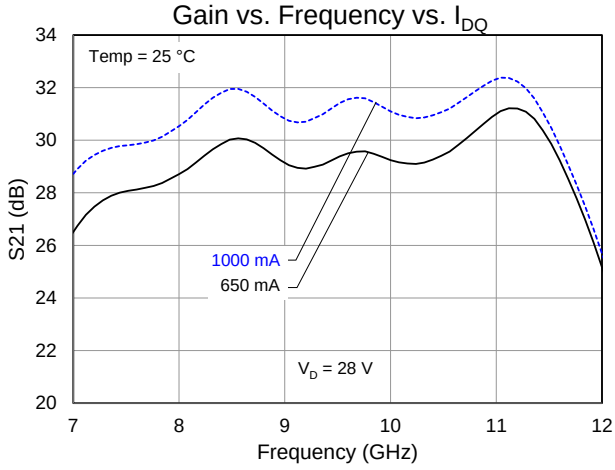
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Typical Performance: Small Signal (CW Operation)

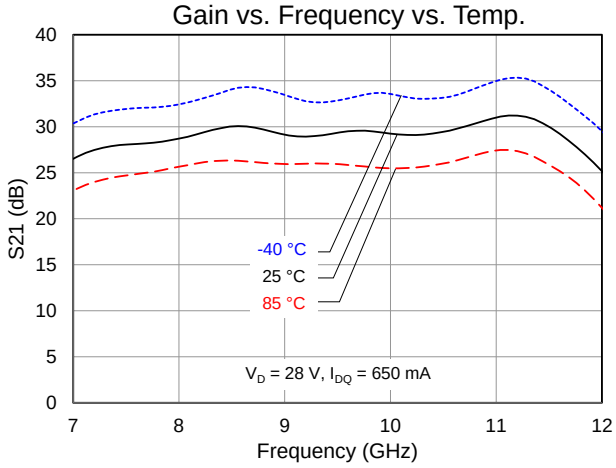
Gain vs. Frequency vs. V_D



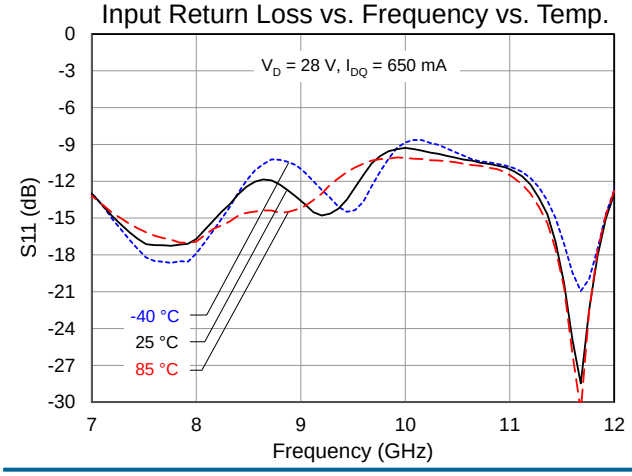
Gain vs. Frequency vs. I_{DQ}



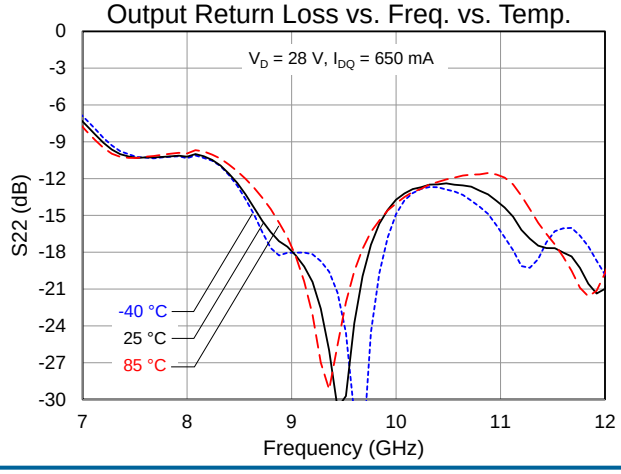
Gain vs. Frequency vs. Temp.



Input Return Loss vs. Frequency vs. Temp.



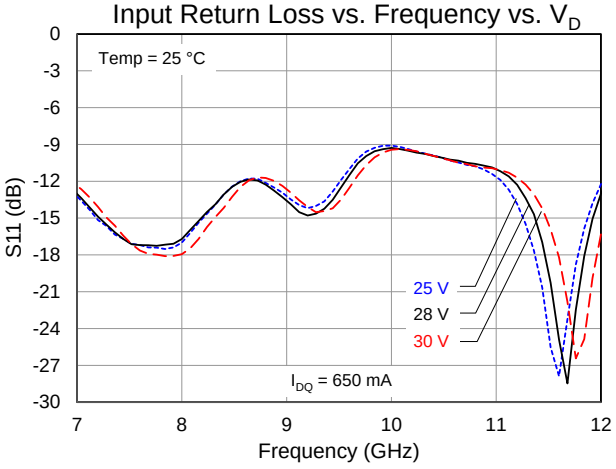
Output Return Loss vs. Freq. vs. Temp.



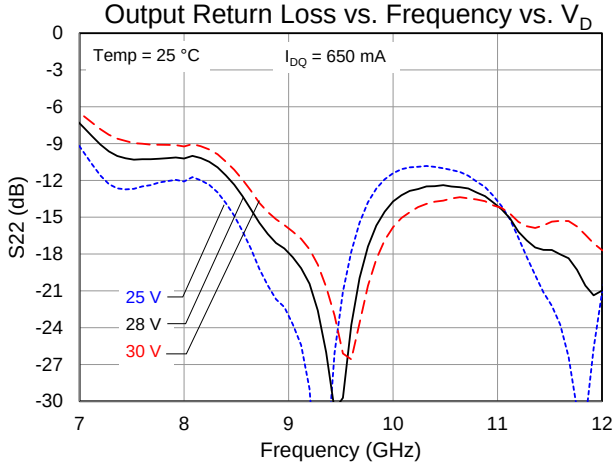
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Typical Performance: Small Signal (CW Operation)

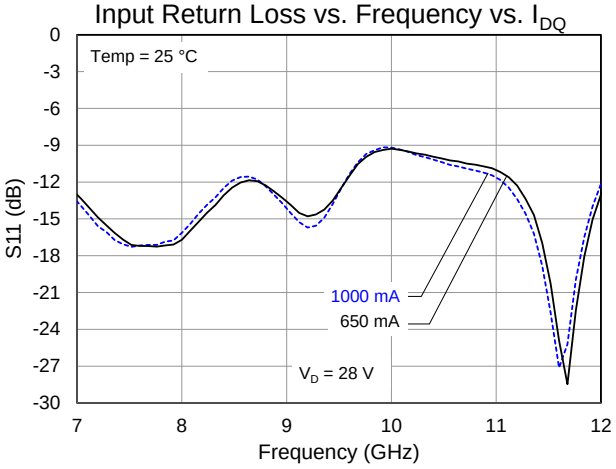
Input Return Loss vs. Frequency vs. V_D



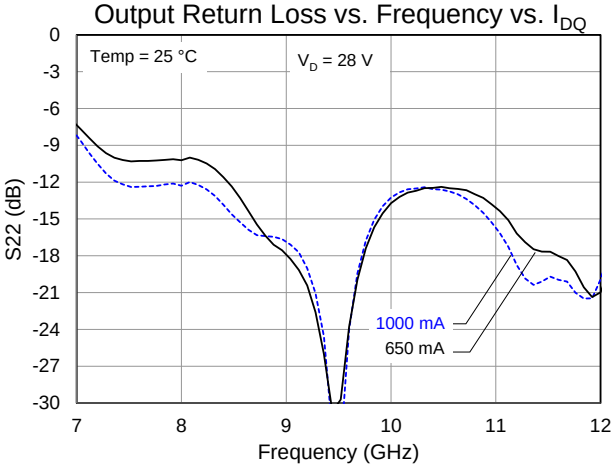
Output Return Loss vs. Frequency vs. V_D



Input Return Loss vs. Frequency vs. I_{DQ}

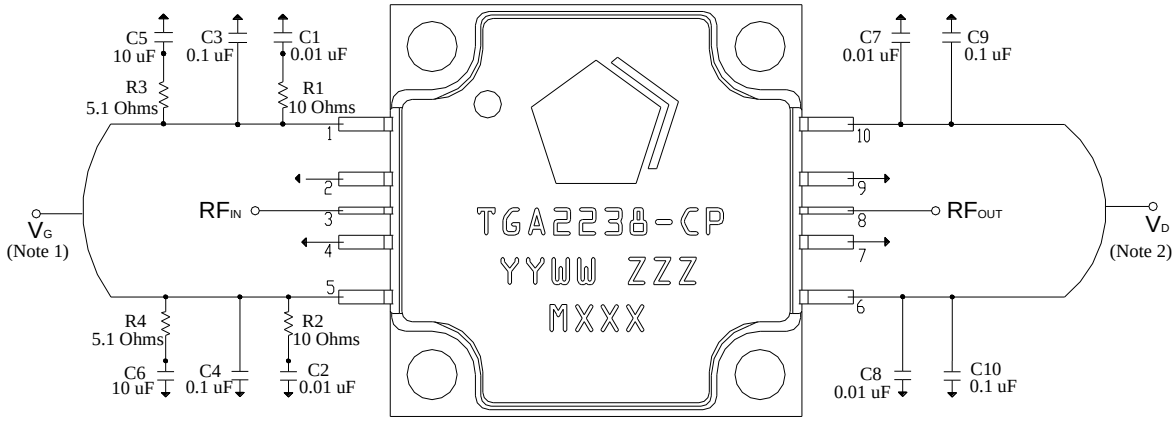


Output Return Loss vs. Frequency vs. I_{DQ}



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Application Circuit



Notes:

1. V_G must be biased from both sides (Pins 1 and 5)
2. V_D must be biased from both sides (Pins 6 and 10)

Bias-up Procedure

1. Set power supply: I_D limit to 7 A, I_G limit to 20 mA
2. Apply -5.0 V to V_G (for pinch-off)
3. Increase V_D to +28 V; Ensure I_{DQ} is approx. 0 mA
4. Adjust V_G more positive until I_{DQ} = 650 mA V_G ~ -2.6 V typical
5. Apply RF signal

Bias-down Procedure

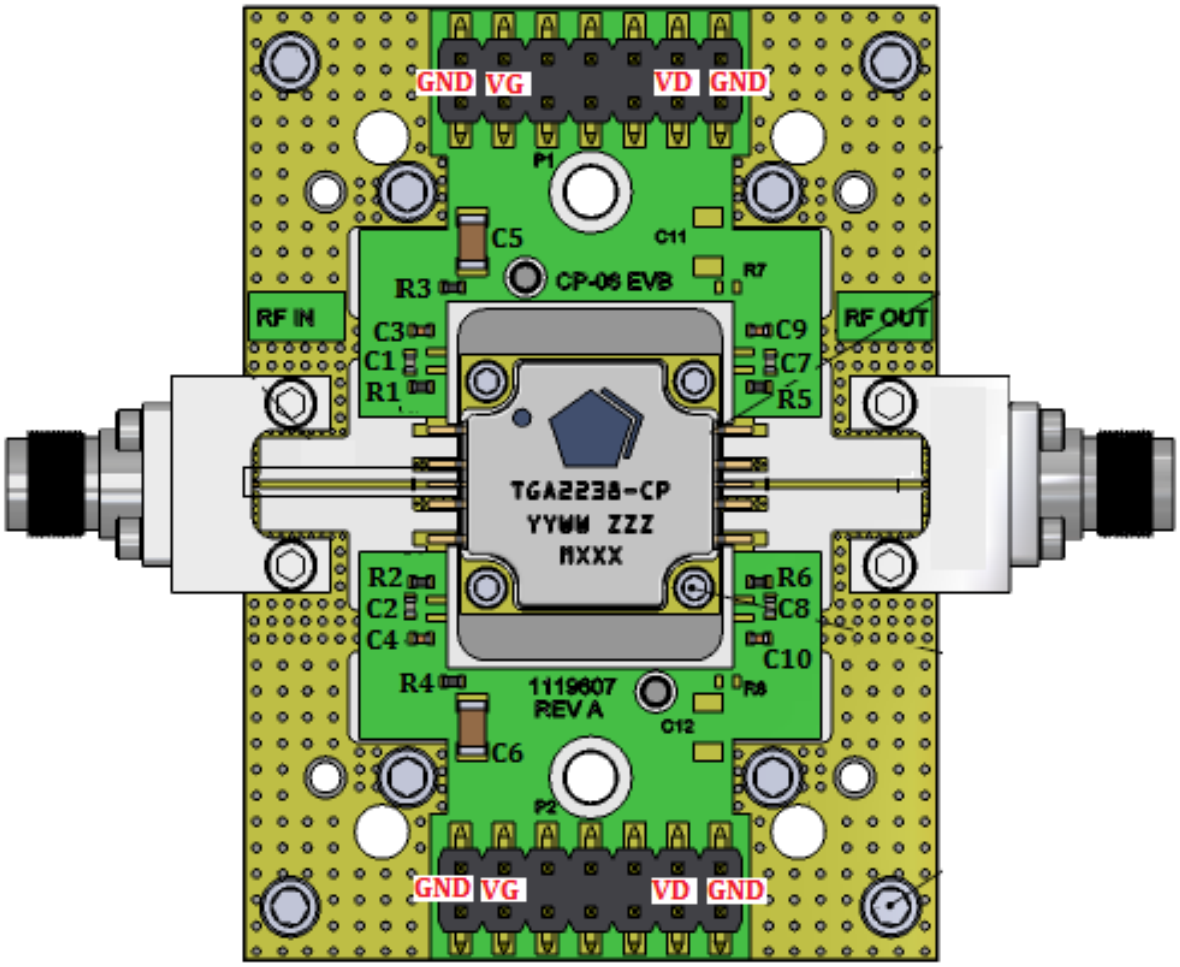
1. Turn off RF signal
2. Reduce V_G to −5.0 V; Ensure I_{DQ} ~ 0 mA
3. Reduce V_D to 0 V
4. Turn off V_D supply
5. Turn off V_G supply

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 shorted to ground.

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Evaluation Board Layout



Notes: Both Top and Bottom V_D and V_G must be biased.

Bill of Material

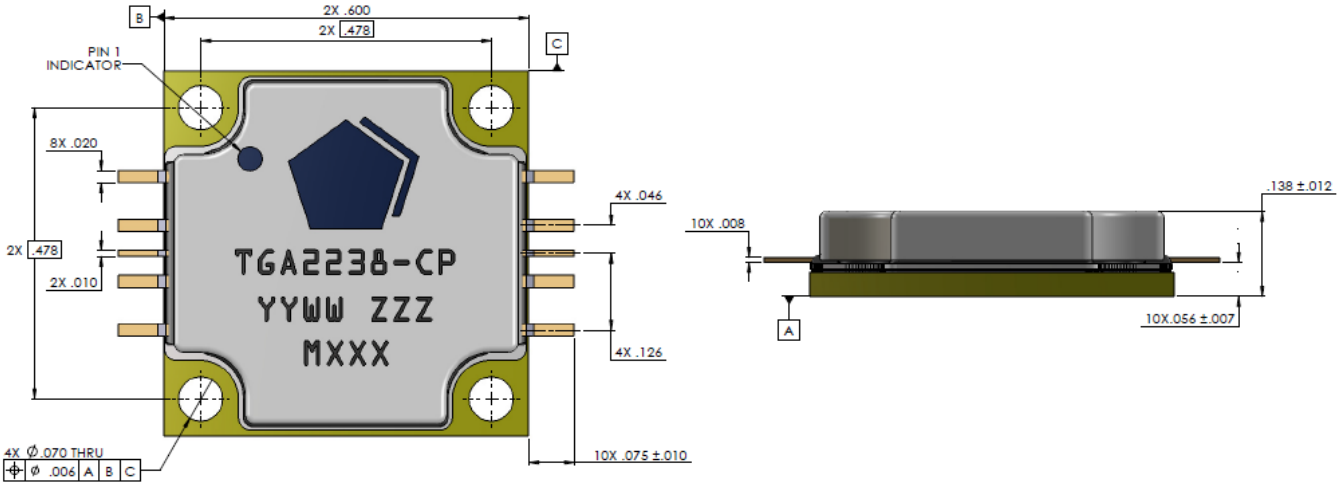
Reference Des.	Value	Description	Manuf.	Part Number
C1, C2, C7, C8	0.01 µF	Cap, 0402, 50 V, 10%, X7R	Various	
C3, C4, C9, C10	0.1 µF	Cap, 0402, 50 V, 10%, X7R	Various	
C5, C6	10 µF	Cap, 1206, 50 V, 20%, X5R	Various	
R1, R2	10 Ohm	Res, 0402, 5%, SMD	Various	
R3, R4	5.1 Ohm	Res, 0402, 5%, ROHS	Various	
R5, R6	0 Ohm	Res, 0402, SMD, jumpers required for the above EVB	Various	

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Assembly Notes

1. Clean the board or module with alcohol. Allow it to dry fully.
2. Nylock screws are recommended for mounting the TGA2238-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 TGA2238-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

Leads: Alloy 194

Lid: LCP (Liquid Crystal Polymer)

Finish: Gold

Part is epoxy sealed

Marking:

TGA2238-CP: Part number

YY: Part Assembly year

WW: Part Assembly week

ZZZ: Serial Number

MXXX: Batch ID

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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 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

For the latest specifications, additional product information, worldwide sales and distribution locations, and information about TriQuint:

Web: www.triquint.com **Tel:** +1.972.994.8465
Email: info-sales@triquint.com **Fax:** +1.972.994.8504

For technical questions and application information: **Email:** info-products@triquint.com

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