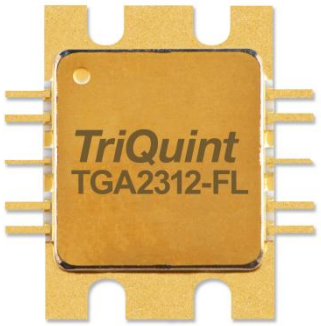
# TGA2312-FL

***X-band 60W GaN Power Amplifier***

## Applications

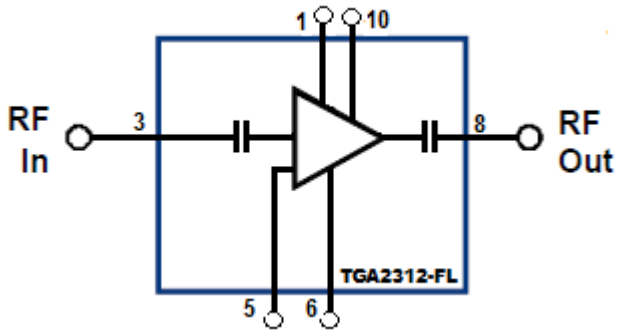
- Commercial and Military Radar
- Communications




## Product Features

- Frequency Range: 9 – 10 GHz
- $P_{SAT}$ : 48 dBm
- PAE: 38%
- Small Signal Gain: 13 dB
- Bias: $V_D$ = 24 V, $I_{DQ}$ = 2.4 A, $V_G$ = -2.6 V Typical
- Pulsed: PW = 100us, DC = 10%
- Integrated Thermistor Temperature Monitor
- Package Dimensions: 17.4 x 24.0 x 3.9 mm

## Functional Block Diagram




## General Description

TriQuint's TGA2312-FL is a high power amplifier operating between 9 and 10 GHz and typically providing 48dBm of saturated output power, 38% power-added efficiency and 13dB small signal gain.

Ideally suited for marine and weather radar, the TGA2312-FL is packaged in a CuW-base, flanged package for superior thermal management.

The TGA2312-FL uses TriQuint's 0.25um GaN on SiC technology which provides superior performance while maintaining high reliability. In addition, the use of SiC substrates provides optimum thermal performance necessary for reliable high power operation.

Lead-free and RoHS compliant.

Evaluation Boards are available upon request.

## Pad Configuration

| Pad No. | Symbol |
|---|---|
| 1 | $V_G$ |
| 2, 4, 7, 9 | N/C |
| 3 | RF IN |
| 5 | Temp (Thermistor) |
| 6 | $V_D$ |
| 8 | RF OUT |
| 10 | $V_D$ |

## Ordering Information

| Part | ECCN | Description |
|---|---|---|
| TGA2312-FL | 3A001.b.3.b | GaN High Power Amplifier |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## Absolute Maximum Ratings

| Parameter | Value |
|---|---|
| Drain Voltage ($V_D$) | 40 V |
| Drain to Gate Voltage ($V_D$-$V_G$) | 100 V |
| Gate Voltage Range ($V_G$) | -5 to 0 V |
| Drain Current ($I_D$) | 10 A |
| Gate Current ($I_G$) | -25 to 56 mA |
| Power Dissipation ($P_{DISS}$) | 225 W |
| RF Input Power, CW, 50 Ω, T = 25 °C ($P_{IN}$) | +44 dBm |
| Channel Temperature ($T_{CH}$) | 275 °C |
| Mounting Temperature (30 Seconds) | 260 °C |
| Storage Temperature | -40 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 ($V_D$) | 24 V |
| Drain Current ($I_{DQ}$) | 2400 mA |
| Drain Current Under RF Drive ( $I_{D\_Drive}$) | 6360 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, $V_D$ = 24 V, $I_{DQ}$ = 2400 mA , Pulsed: PW = 100us, DC = 10%, $V_G$ = -2.6 V

| Parameter | Min | Typical | Max | Units |
|---|---|---|---|---|
| Operational Frequency Range | 9 | | 10 | GHz |
| Small Signal Gain | | 13 | | dB |
| Input Return Loss | | 15 | | dB |
| Output Return Loss | | 14 | | dB |
| Output Power at Saturation (Pin = 38dBm) | | 48 | | dBm |
| Power-Added Efficiency (Pin = 38dBm) | | 38 | | % |
| Output TOI | | 49 | | dBm |
| Gain Temperature Coefficient | | -0.02 | | dB/°C |
| Power Temperature Coefficient | | -0.001 | | dBm/°C |
| TOI Temperature Coefficient | | -0.001 | | dBm/°C |


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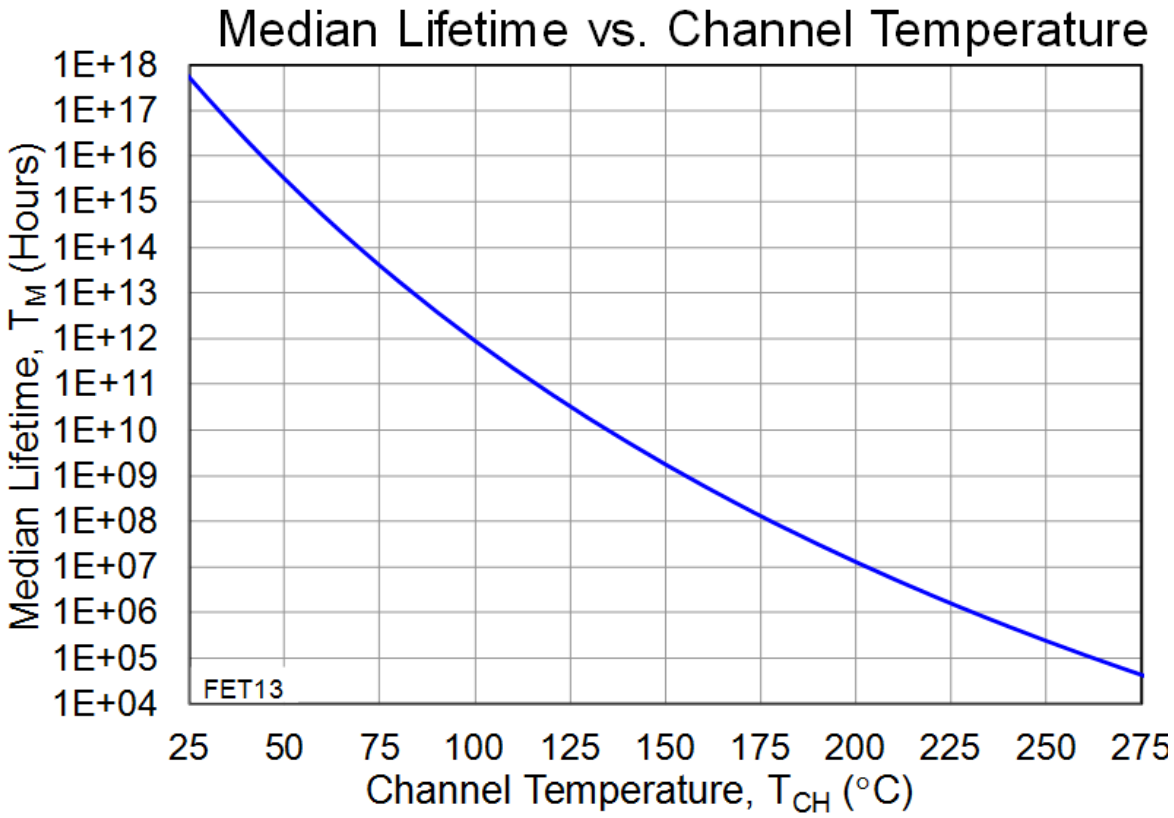
## Thermal and Reliability Information

| Parameter | Test Conditions | Value | Units |
|---|---|---|---|
| Thermal Resistance, $\theta_{JC}$ (Note 1) | Tbaseplate = 85 °C | 0.85 | ºC/W |
| Channel Temperature, $T_{CH}$ (Without RF Drive) | Tbaseplate = 85 °C, **$V_D$ = 24 V**, $I_{DQ}$ = 2400 mA, $P_{DISS}$ = 58 W, Pulsed: PW = 100us, DC = 10% | 135 | °C |
| Median Lifetime, $T_M$ (Without RF Drive) | | 9.75 x 10^10 | Hrs |
| Channel Temperature, $T_{CH}$ (Under RF Drive) | Tbaseplate = 85 °C, **$V_D$ = 24 V**, $I_{D\ Drive}$ = 6360 mA, $P_{OUT}$ = 48 dBm, $P_{DISS}$ = 87 W, Pulsed: PW = 100us, DC = 10% | 158 | °C |
| Median Lifetime, $T_M$ (Under RF Drive) | | 7.38 x 10^9 | Hrs |
| Channel Temperature, $T_{CH}$ (Under RF Drive) | Tbaseplate = 85 °C, **$V_D$ = 30 V**, $I_{D\ Drive}$ = 6670 mA, $P_{OUT}$ = 48.8 dBm, $P_{DISS}$ = 124 W, Pulsed: PW = 100us, DC = 10% | 190 | °C |
| Median Lifetime, $T_M$ (Under RF Drive) | | 3.12 x 10^8 | Hrs |

Notes: (1) Thermal resistance measured at back of the package.

## Median Lifetime

Test Conditions: $V_D$ = 40V; Failure Criteria is 10% reduction in $I_{D\ MAX}$





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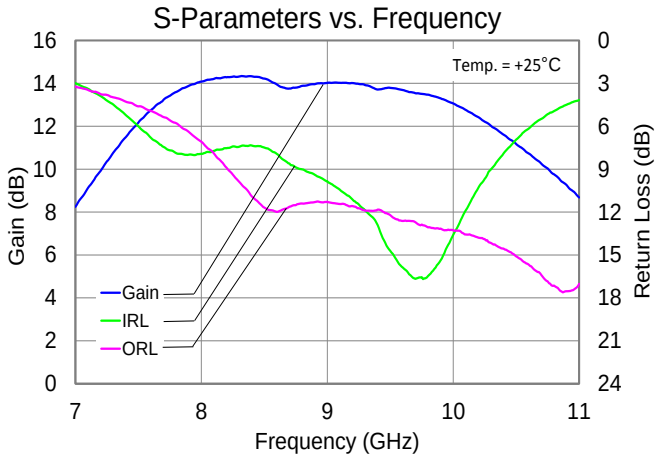
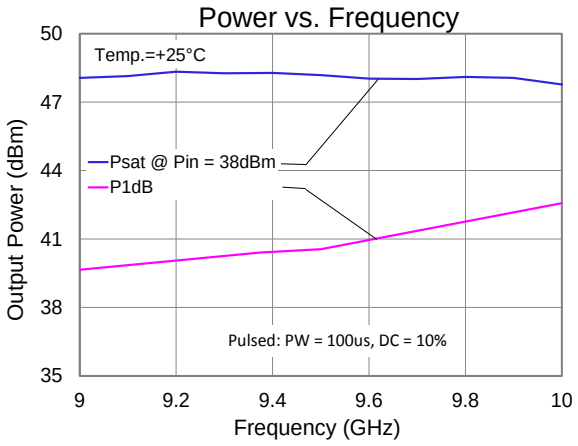
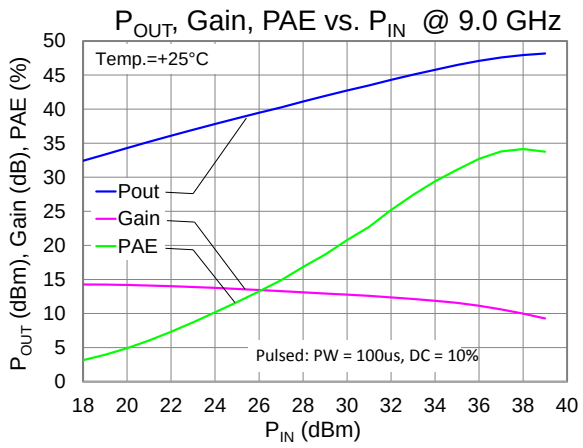
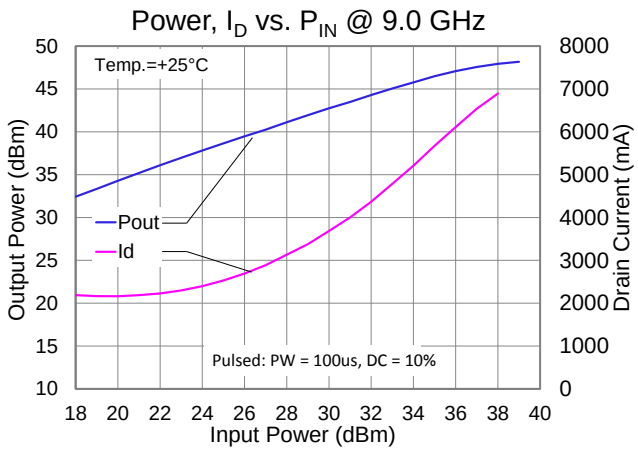
## Typical Performance

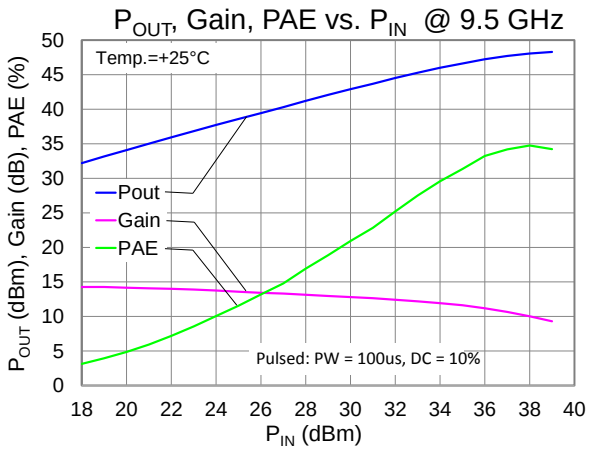
Conditions unless otherwise specified: $V_D$ = 24 V, $I_{DQ}$ = 2.4 A, $V_G$ = -2.6 V Typical

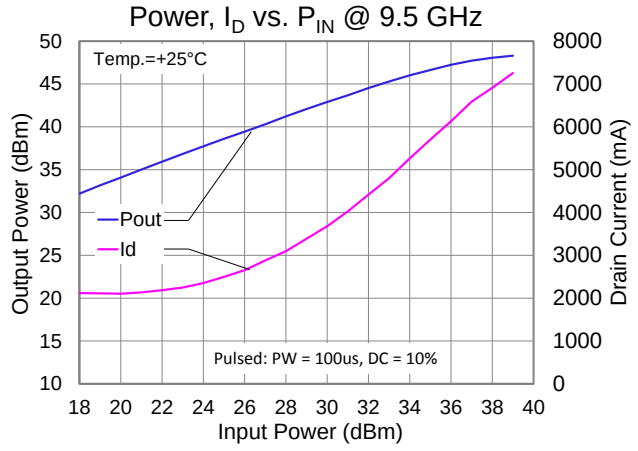




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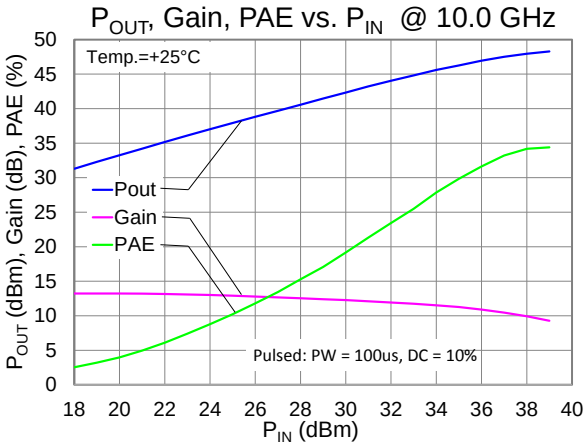
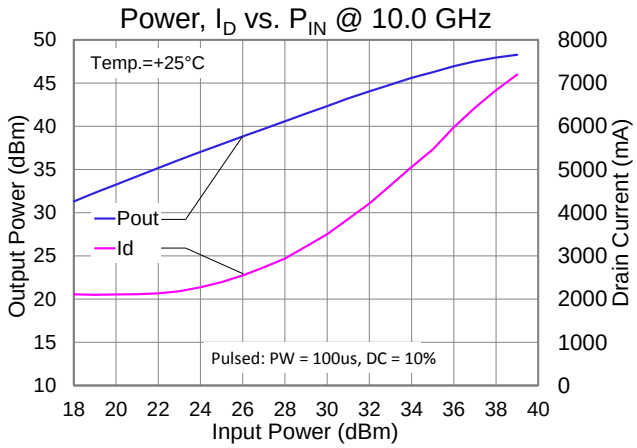
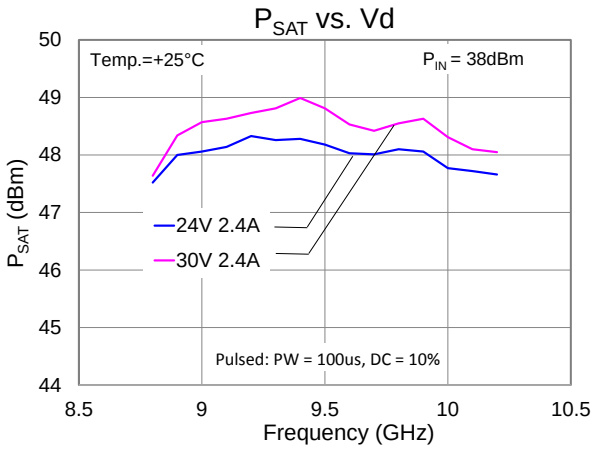
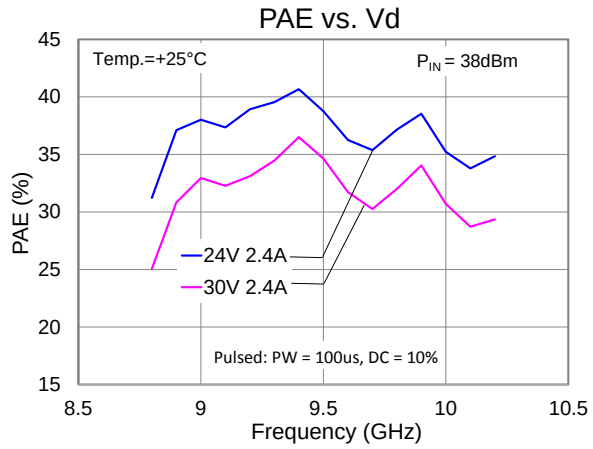
## Typical Performance

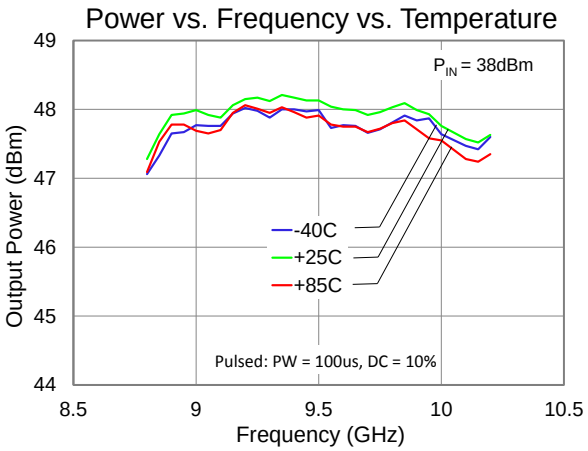
Conditions unless otherwise specified: $V_D$ = 24 V, $I_{DQ}$ = 2.4 A, $V_G$ = -2.6 V Typical

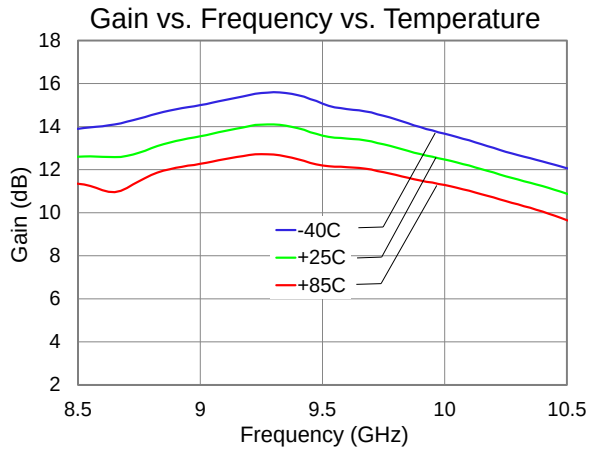




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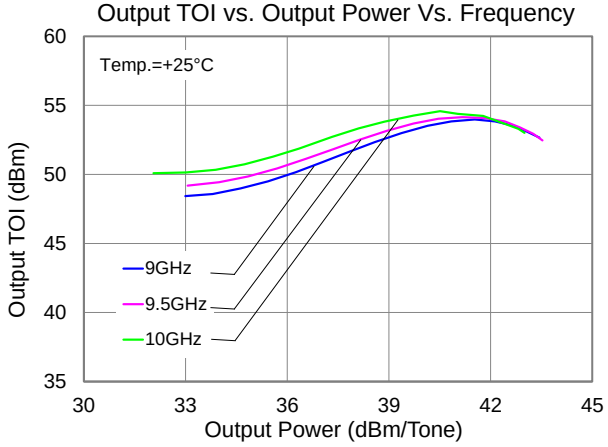
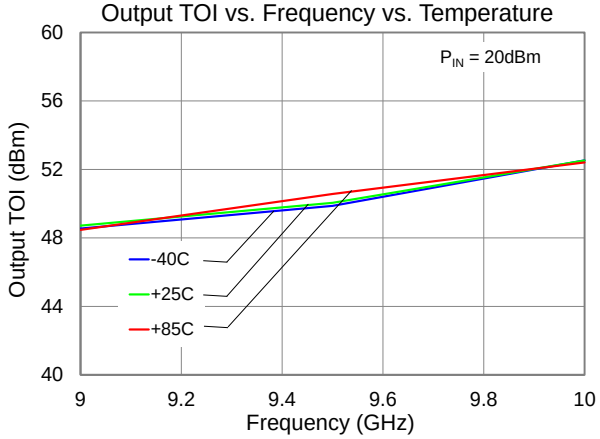
## Typical Performance

Conditions unless otherwise specified: $V_D$ = 24 V, $I_{DQ}$ = 2.4 A, $V_G$ = -2.6 V Typical

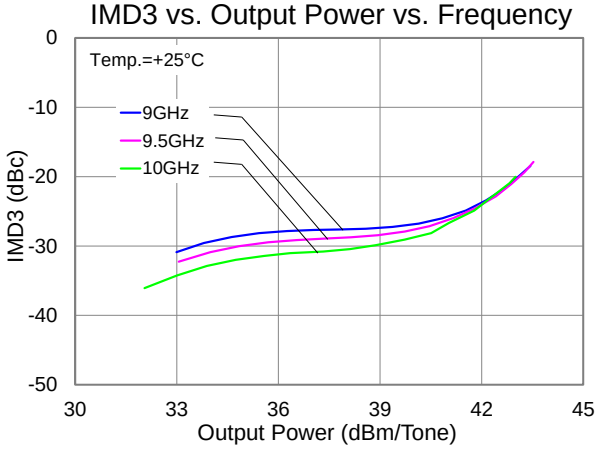
Output TOI vs. Output Power Vs. Frequency



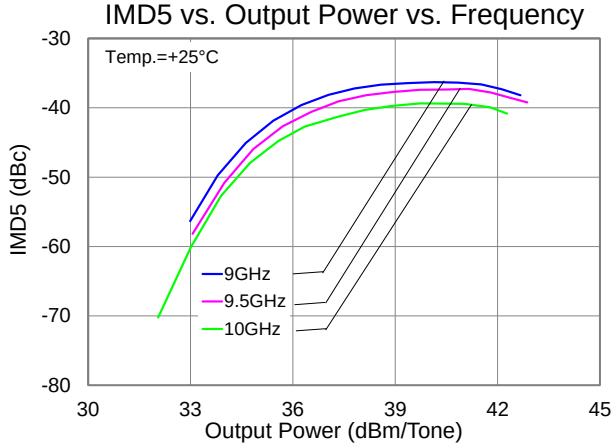

Output TOI vs. Frequency vs. Temperature




IMD3 vs. Output Power vs. Frequency




IMD5 vs. Output Power vs. Frequency





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## Typical Performance

A 100K Ω thermistor is assembled inside the TGA2312-FL package. Nominal resistance versus temperature is shown in the table below. The resistance measurement is taken between the Temp pin and ground pin to provide a useful indicator of the maximum package temperature.

| deg C | R (Kohm) | deg C | R (Kohm) |
|---|---|---|---|
| 0 | 378.80 | 65 | 17.89 |
| 5 | 284.71 | 70 | 14.84 |
| 10 | 216.16 | 75 | 12.37 |
| 15 | 165.70 | 80 | 10.37 |
| 20 | 128.17 | 85 | 8.74 |
| 25 | 100.00 | 90 | 7.40 |
| 30 | 78.66 | 95 | 6.29 |
| 35 | 62.36 | 100 | 5.37 |
| 40 | 49.81 | 105 | 4.61 |
| 45 | 40.06 | 110 | 3.96 |
| 50 | 32.44 | 115 | 3.43 |
| 55 | 26.44 | 120 | 2.97 |
| 60 | 21.68 | 125 | 2.59 |


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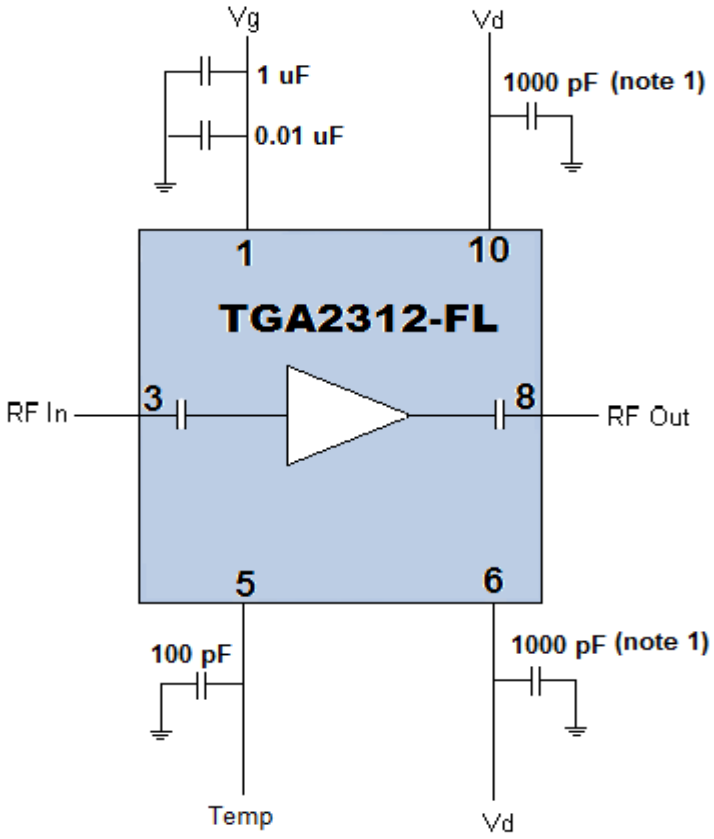
## Application Circuit




**Note 1: One of these caps can be removed for drain pulsing. Drain voltage can be applied to either Vd pins.**

Notes: To prevent damage to the device due to overshoot or oscillation issues, TriQuint recommends that current limits for all power supplies are set properly for each power supply before applying the voltage. The following are recommended current limits for each power supply:

Set 50 mA current limit to $V_G$.
Set 8 A current limit to $V_D$.

## Bias-up Procedure

1. Apply -5.0 V to $V_G$.
2. Apply +24 V to $V_D$.
3. Adjust $V_G$ until $I_{DQ}$ = 2400 mA ($V_G$ ~ -2.6 V Typ.)
4. Turn on RF supply.

## Bias-down Procedure

1. Turn off RF supply.
2. Reduce $V_G$ to -5.0 V. Ensure $I_{DQ}$ ~ 0 mA.
3. Set $V_D$ to 0 V.
4. Set $V_G$ to 0 V.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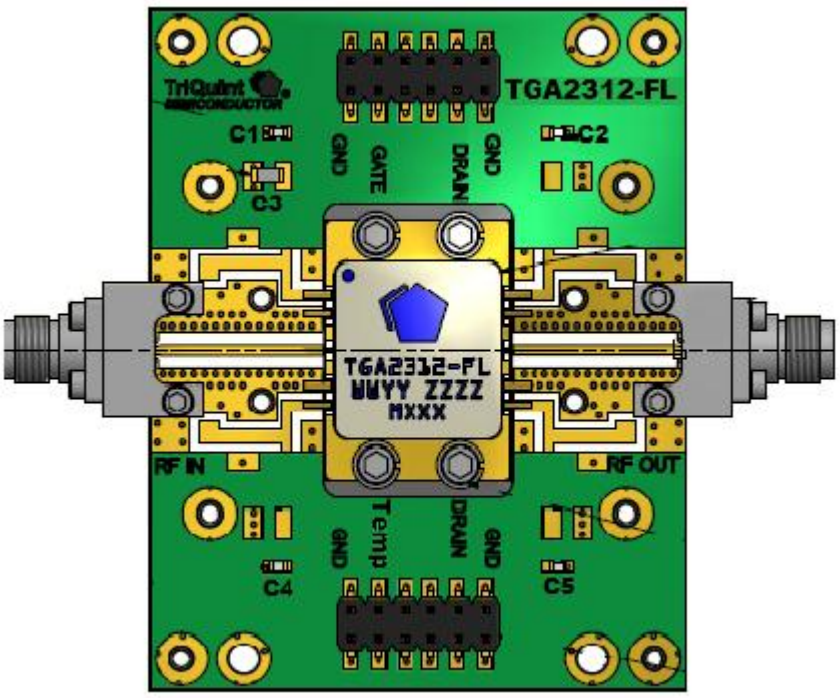
## Recommended Board Layout Assembly

Top dielectric material is RO4350 0.020 inch thickness with 0.5 oz. copper.




## Bill of Materials

| Reference Design | Value | Description | Manufacturer |
|---|---|---|---|
| C1 | 0.01 uF | Cap, 0603, 50V, 10% | Various |
| C2, C5 | 1000 pF | Cap, 0603, 50V, 5% | Various |
| C3 | 1.0 uF | Cap, 1206, 16V, 10% | Various |
| C4 | 100 pF | Cap, 0603, 50V, 5% | Various |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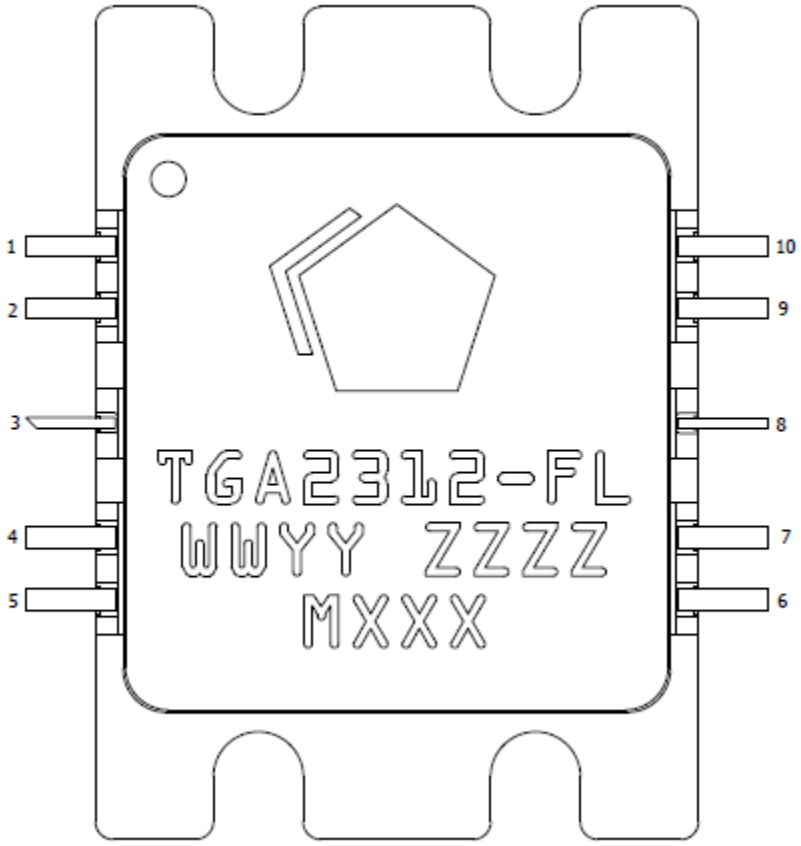
## Pin Layout




## Pin Description

| Pin | Symbol | Description |
|---|---|---|
| 1 | $V_G$ | Gate voltage. Bias network is required. (1) |
| 2, 4, 7, 9 | N/C | No internal connection; must be grounded on PCB. |
| 3 | RF IN | RF input. |
| 5 | TEMP | Temperature sensing pin (Thermistor) (2) |
| 6 | $V_D$ | Bottom Drain voltage. Bias network is required. (1) |
| 8 | RF OUT | RF output. |
| 10 | $V_D$ | Top Drain voltage Bias network is required. (1) |

Notes:

1. See Application Circuit on page 8 as an example.
2. See page 7 for addition thermal information.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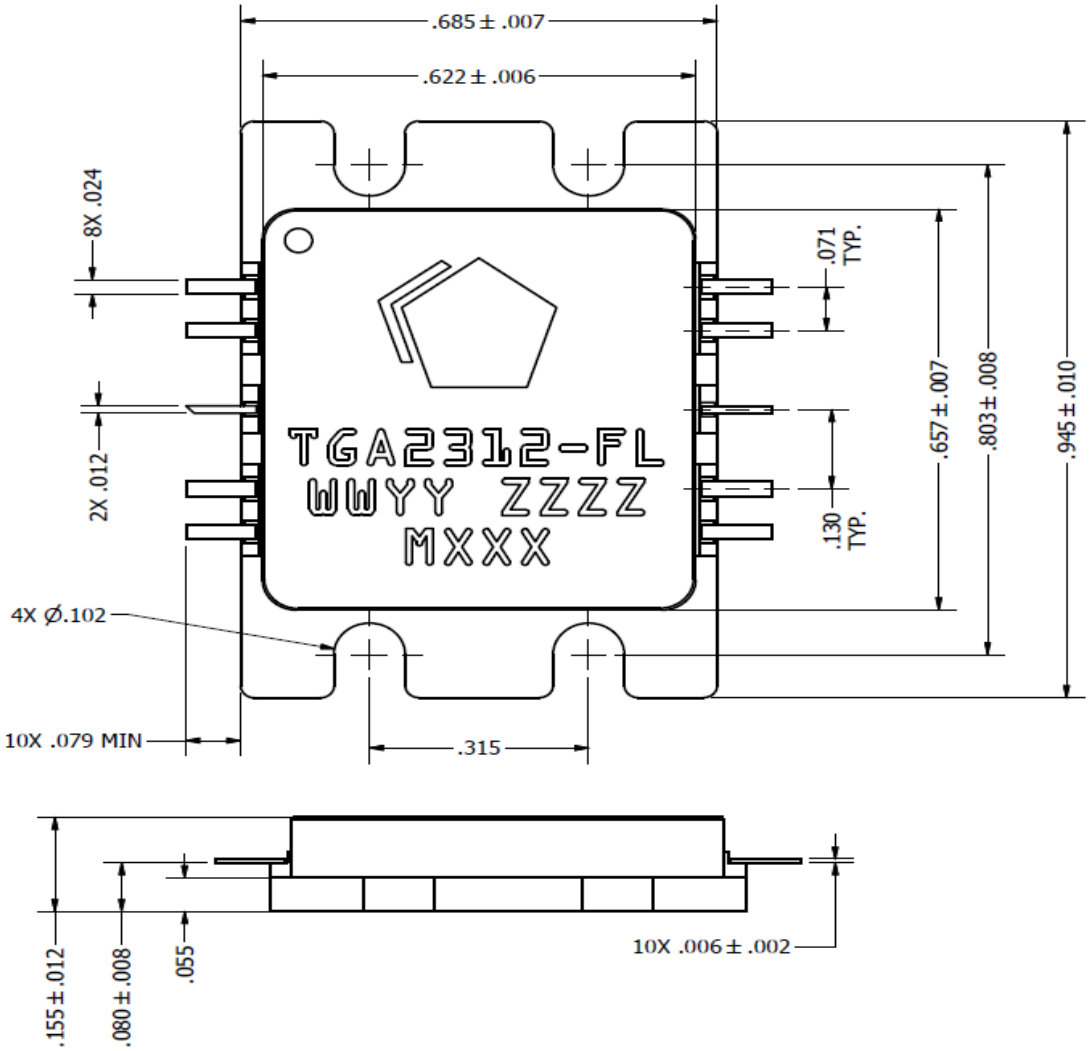
## Mechanical Information

All dimensions are in inches. Unless specified otherwise.




Marking: Part number – TGA2312-FL
Week/Year code – WWYY
Serial Number - ZZZZ
Batch ID – MXXX

Package Materials:

| | |
|---|---|
| Base | Copper Tungsten (CuW) |
| Lead | Copper Alloy 194 |
| Lid | Kovar |
| Plating Finish | Gold Plating |

Part Is Hermetically Sealed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## Assembly Notes

1. Clean the board or module with alcohol. Allow it to fully dry.
2. Nylock screws are recommended for mounting the TGA2312-FL 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 TGA2312-FL.
5. Clean the assembly with alcohol.


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## Product Compliance Information

### ESD Sensitivity Ratings

Caution! ESD-Sensitive Device

ESD Rating: Class 1C
Value: 1800V
Test: Human Body Model (HBM)
Standard: JEDEC Standard JESD22-A114

### MSL Rating

Level:: TBD

### ECCN

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

### 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

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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