# T1G6003028-FS

***30W, 28V, DC – 6 GHz, GaN RF Power Transistor***

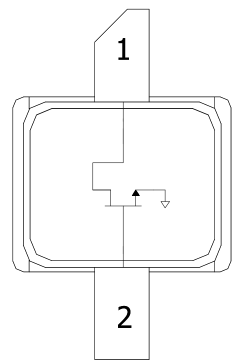
## Applications

- Military radar
- Civilian radar
- Professional and military radio communications
- Test instrumentation
- Wideband or narrowband amplifiers
- Jammers


## Product Features

- Frequency: DC to 6 GHz
- Output Power (P3dB): 30 W at 6 GHz
- Linear Gain: >14 dB at 6 GHz
- Operating Voltage: 28 V
- Low thermal resistance package

## Functional Block Diagram




## General Description

The TriQuint T1G6003028-FS is a 30 W ($P_{3dB}$) discrete GaN on SiC HEMT which operates from DC to 6 GHz. The device is constructed with TriQuint's proven 0.25 µm process, which features advanced field plate techniques to optimize power and efficiency at high drain bias operating conditions. This optimization can potentially lower system costs in terms of fewer amplifier line-ups and lower thermal management costs.

Lead-free and RoHS compliant

Evaluation Boards are available upon request.

## Pin Configuration

| Pin # | Symbol |
|---|---|
| 1 | Vd/RF OUT |
| 2 | Vg/RF IN |
| Flange | Source |

## Ordering Information

| Material No. | Part No. | Description | ECCN |
|---|---|---|---|
| 1080206 | T1G6003028-FS | Packaged part: Flangeless | EAR99 |
| 1093989 | T1G6003028-FS-EVB1 | 5.4-5.9 GHz Eval. Board | EAR99 |

## Specifications

### Absolute Maximum Ratings

| Parameter | Rating |
|---|---|
| Drain to Gate Voltage, Vd – Vg | 40 V |
| Drain Voltage, Vd | +40 V |
| Gate Voltage, Vg | -8 to 0 V |
| Drain Current, Id | 5.5 A |
| Gate Current, Ig | -10 to 10 mA |
| Power Dissipation, Pdiss | 47.5 W |
| RF Input Power, CW, T = 25ºC | 40 dBm |
| Channel Temperature, Tch | 275 °C |
| Mounting Temperature (30 sec) | 320 °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 | Min | Typical | Max | Units |
|---|---|---|---|---|
| Vd | | 28 | | V |
| Idq | | 200 | | mA |
| Id (Peak Current) | | 2500 | | mA |
| Vg | | -3.6 | | V |
| Channel Temperature, Tch | | 205 | | °C |
| Power Dissipation, Pdiss (CW) | | | 30 | W |
| Power Dissipation, Pdiss (Pulse) | | | 40 | W |

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

## Electrical Specifications

Recommended operating conditions apply unless otherwise specified: $T_A$ = 25 °C, Vd = 28 V, Idq = 200 mA, Vg = -3.6 V

### RF Characteristics

| Characteristics | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| **Load Pull Performance at 3.0 GHz ($V_{DS}$ = 28 V, $I_{DQ}$ = 200 mA; Pulse: 100µs, 20%)** | | | | | |
| Linear Gain | $G_{LIN}$ | | 15.2 | | dB |
| Output Power at 3 dB Gain Compression | $P_{3dB}$ | | 33.5 | | W |
| Drain Efficiency at 3 dB Gain Compression | $DE_{3dB}$ | | 68.2 | | % |
| Power-Added Efficiency at 3 dB Gain Compression | $PAE_{3dB}$ | | 64.1 | | % |
| Gain at 3 dB Compression | $G_{3dB}$ | | 12.2 | | dB |
| **Load Pull Performance at 6.0 GHz ($V_{DS}$ = 28 V, $I_{DQ}$ = 200 mA; Pulse: 100µs, 20%)** | | | | | |
| Linear Gain | $G_{LIN}$ | | 14.5 | | dB |
| Output Power at 3 dB Gain Compression | $P_{3dB}$ | | 33.0 | | W |
| Drain Efficiency at 3 dB Gain Compression | $DE_{3dB}$ | | 50.0 | | % |
| Power-Added Efficiency at 3 dB Gain Compression | $PAE_{3dB}$ | | 46.5 | | % |
| Gain at 3 dB Compression | $G_{3dB}$ | | 11.5 | | dB |
| **Performance at 5.60 GHz in the 5.4 to 5.9 GHz Eval. Board ($V_{DS}$ = 28 V, $I_{DQ}$ = 200 mA; Pulse: 100µs, 20%)** | | | | | |
| Linear Gain | $G_{LIN}$ | 12.0 | 14.0 | | dB |
| Output Power at 3 dB Gain Compression | $P_{3dB}$ | 22.5 | 32.5 | | W |
| Drain Efficiency at 3 dB Gain Compression | $DE_{3dB}$ | 45.0 | 50.0 | | % |
| Gain at 3 dB Compression | $G_{3dB}$ | 9.0 | 11.0 | | dB |
| **Narrow Band Performance at 5.60 GHz ($V_{DS}$ = 28 V, $I_{DQ}$ = 200 mA, CW at P1dB)** | | | | | |
| Impedance Mismatch Ruggedness | VSWR | | | 10:1 | |

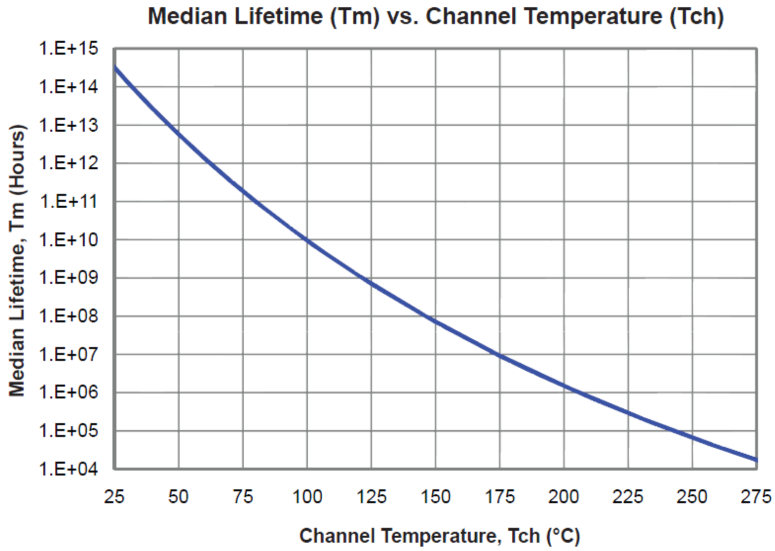
Note: VSWR testing performed with increasing real impedance value only from reference Z to 10 times reference Z.

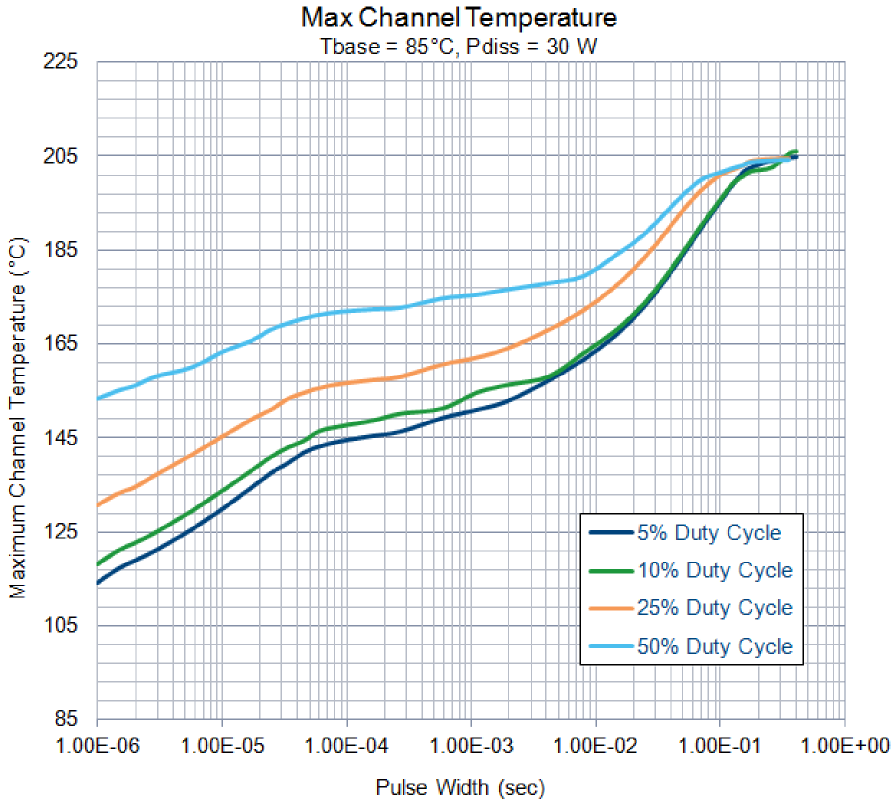
## Specifications (cont.)

### Thermal and Reliability Information

| Test Conditions | $T_{CH}$ (°C) | $\Theta_{JC}$ (°C/W) |
|---|---|---|
| DC at 85 °C | 205 | 4.0 |

Note: Thermal resistance, $\Theta_{JC}$, measured to bottom of package



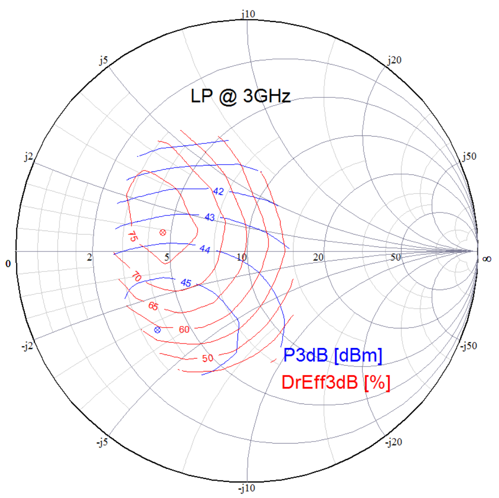



## Load Pull Smith Chart

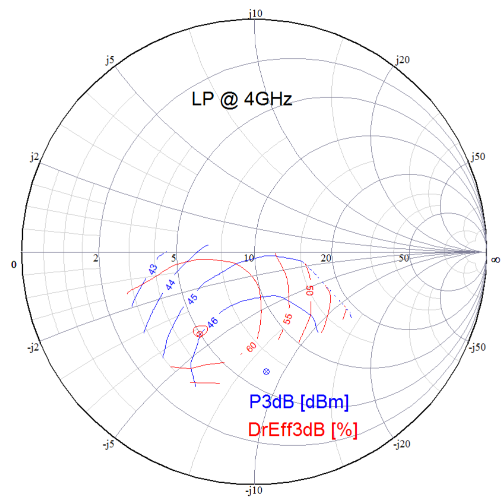
RF performance that the device typically exhibits when placed in the specified impedance environment. The impedances are not the impedances of the device, they are the impedances presented to the device via an RF circuit or load-pull system. The impedances listed follow an optimized trajectory to maintain high power and high efficiency.

**Test Conditions:** $V_{DS}$ = 28 V, $I_{DQ}$ = 200 mA  **Test Signal:** Pulse Width = 100 µsec, Duty Cycle = 20%

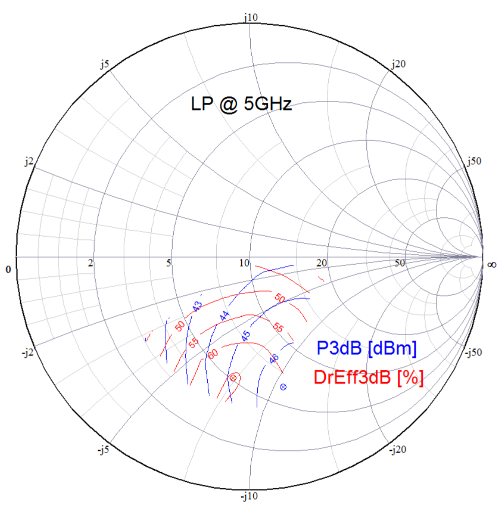
**Load-Pull Data at 3 GHz**



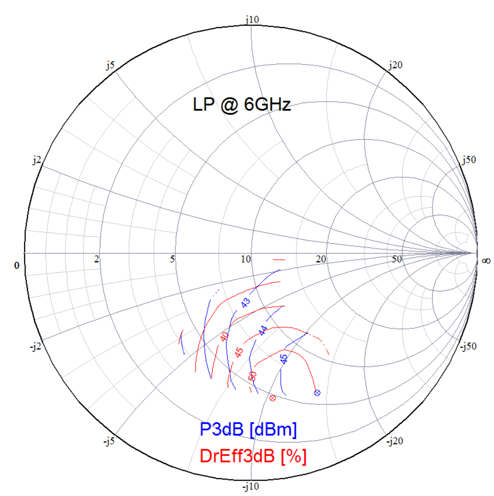

**Load-Pull Data at 4 GHz**




**Load-Pull Data at 5 GHz**

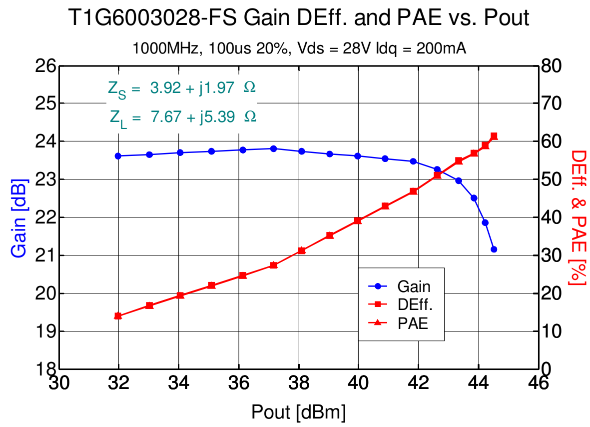


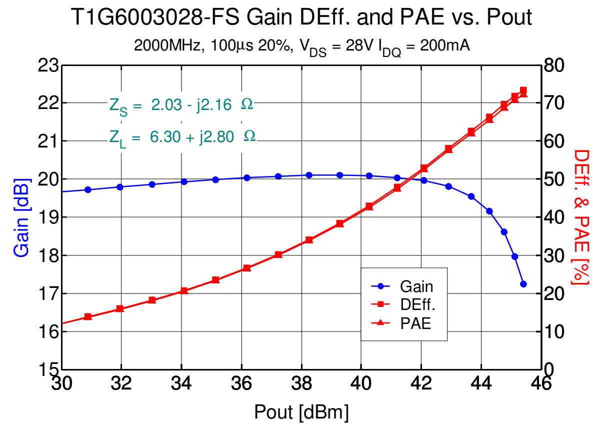

**Load-Pull Data at 6 GHz**

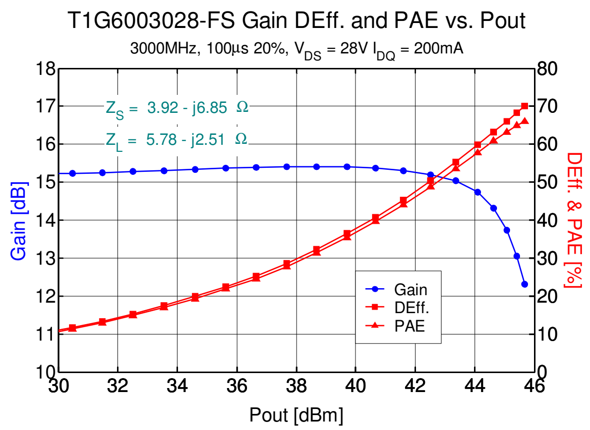


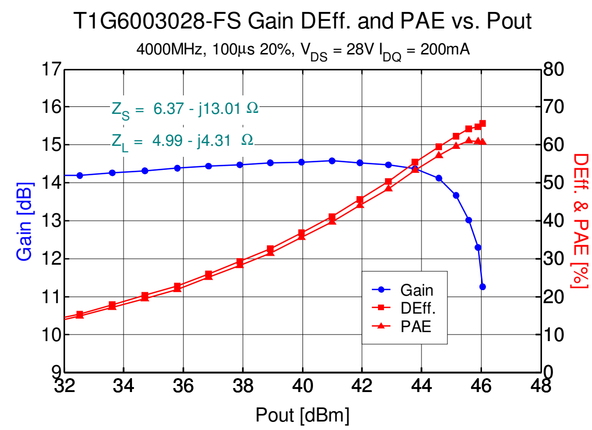
## Typical Performance (cont.)

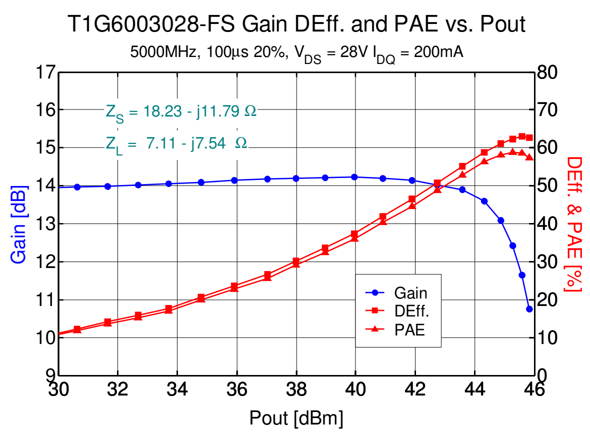
Performance is measured at DUT reference plane

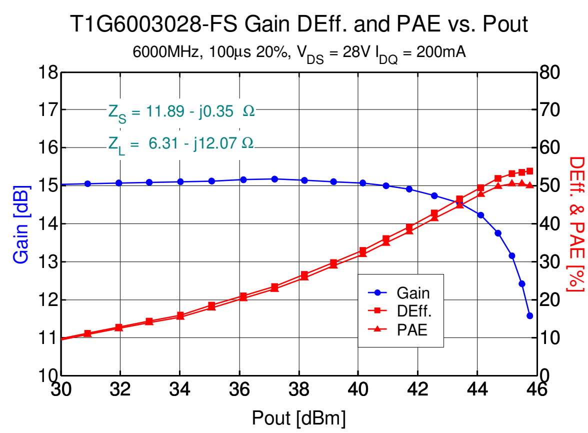


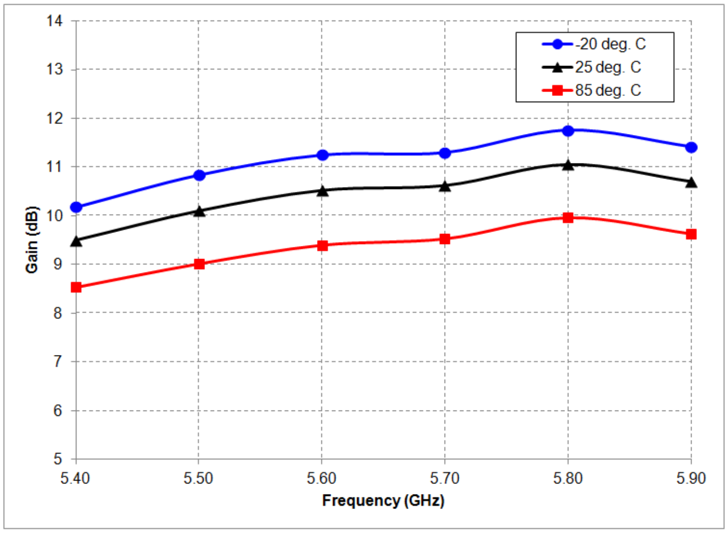



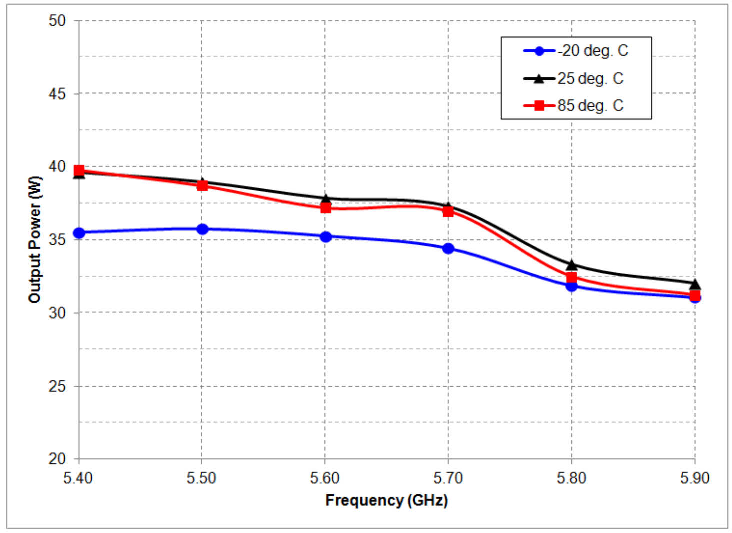
## Performance over Temperature: Gain, Efficiency and Output Power

Performance measured in TriQuint's 5.4 GHz to 5.9 GHz Evaluation Board at 3 dB compression.

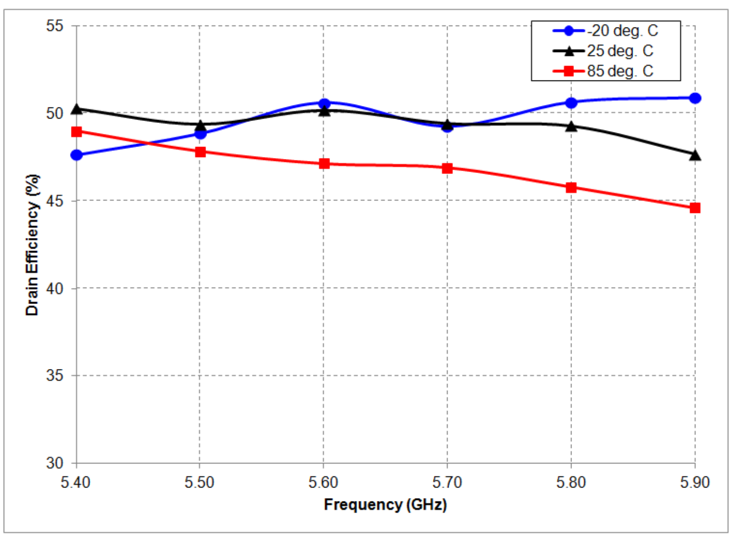
**T1G6003028-FS Gain vs. Temp.**
**$V_{DS}$ = 28 V, $I_{DQ}$ = 200 mA; Pulse: 100 µs, 20%**



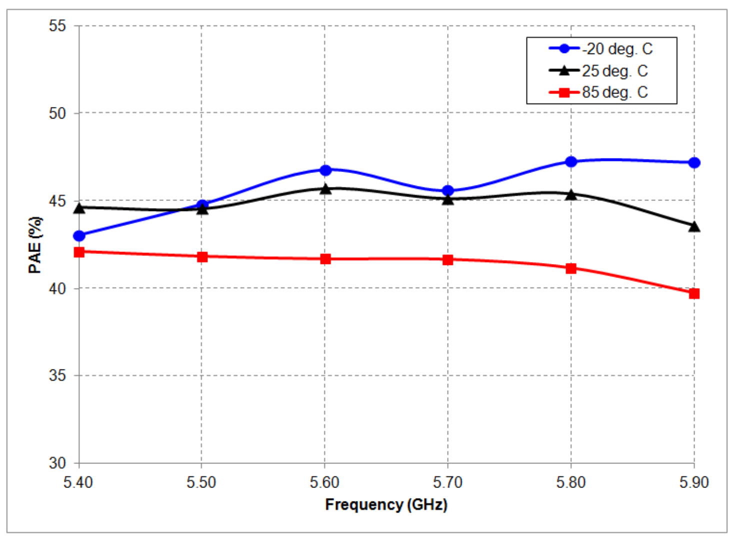

**T1G6003028-FS Power vs. Temp.**
**$V_{DS}$ = 28 V, $I_{DQ}$ = 200 mA; Pulse: 100 µs, 20%**




**T1G6003028-FS Drain Eff. vs. Temp.**
**$V_{DS}$ = 28 V, $I_{DQ}$ = 200 mA; Pulse: 100 µs, 20%**

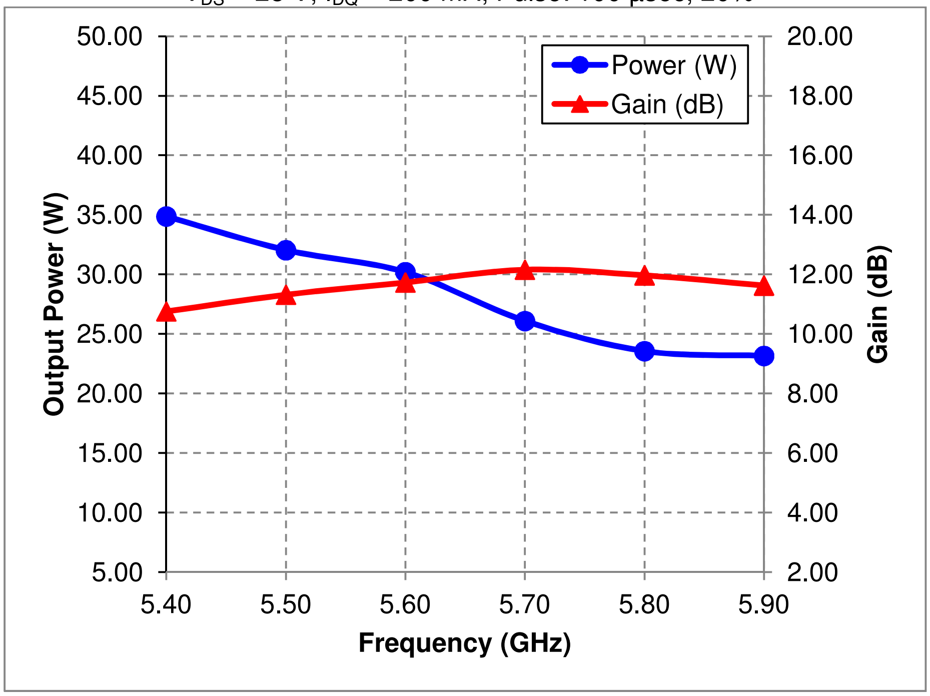



**T1G6003028-FS PAE vs. Temp.**
**$V_{DS}$ = 28 V, $I_{DQ}$ = 200 mA; Pulse: 100 µs, 20%**

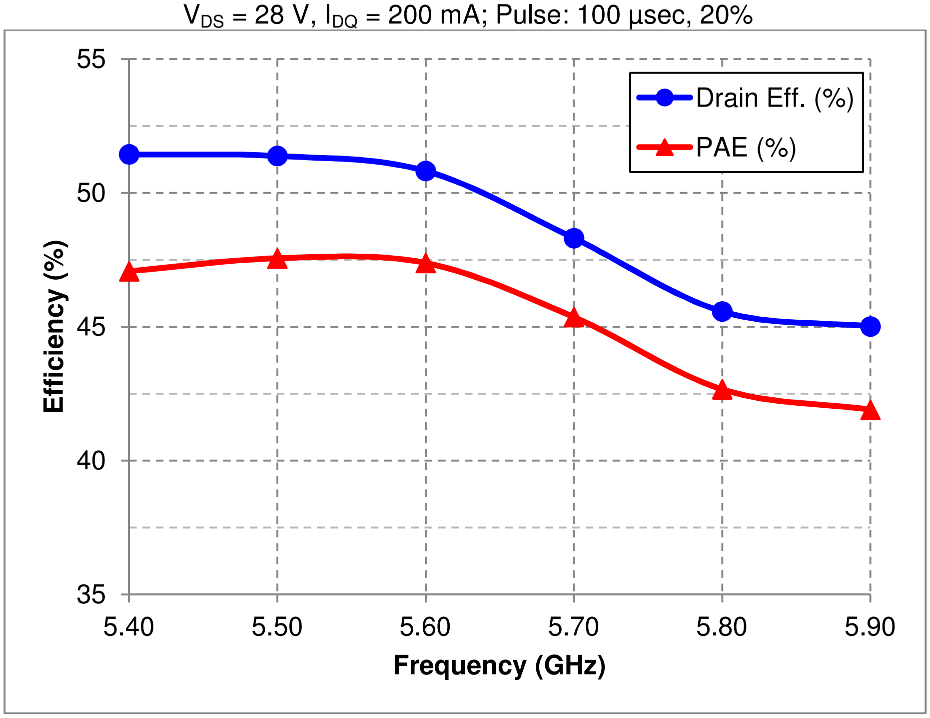


## Evaluation Board Performance: 5.4 to 5.9 GHz

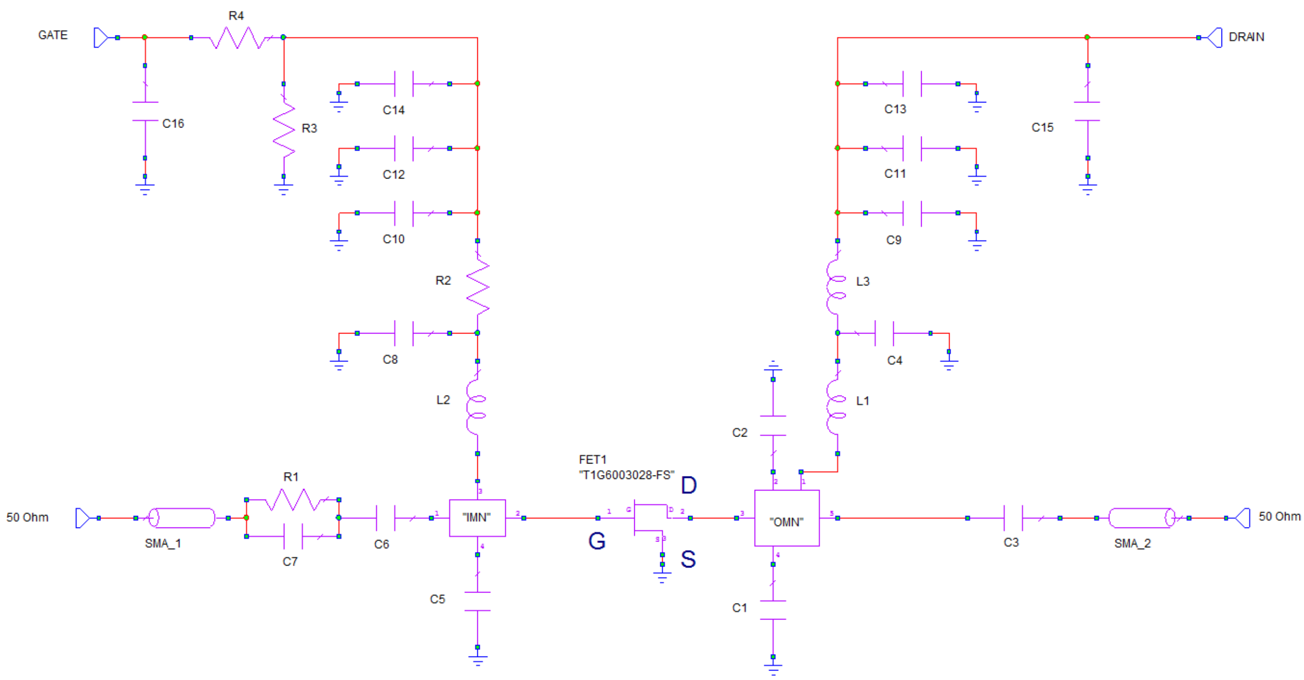
Output Power and Gain at 3 dB Compression
$V_{DS}$ = 28 V, $I_{DQ}$ = 200 mA; Pulse: 100 µsec, 20%




Drain Efficiency and Power Added Efficiency at 3 dB Compression
$V_{DS}$ = 28 V, $I_{DQ}$ = 200 mA; Pulse: 100 µsec, 20%



## Application Circuit

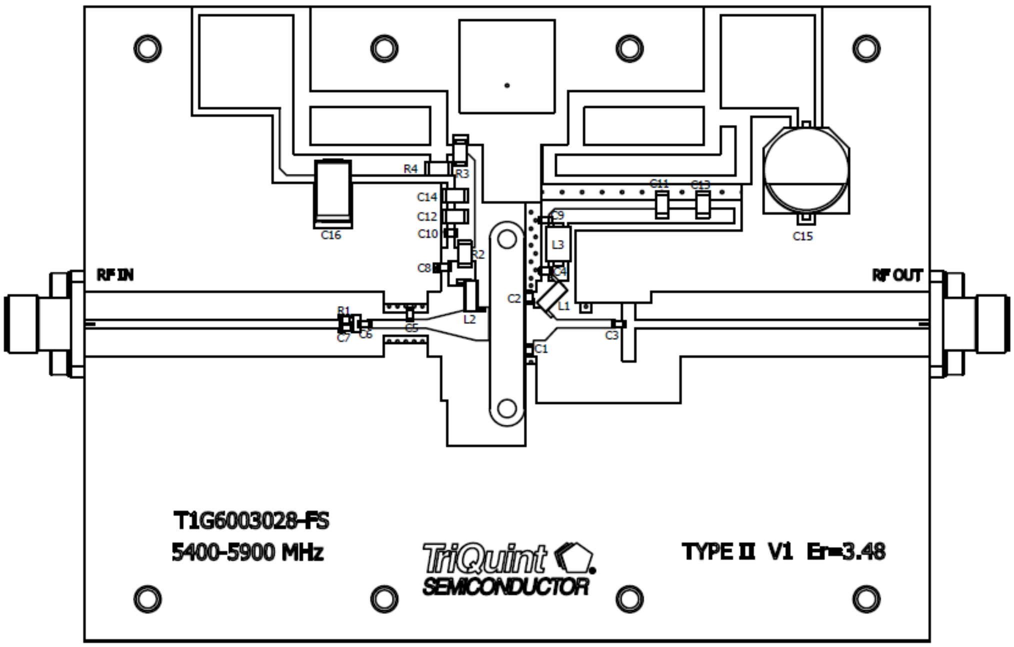



| Bias-up Procedure | Bias-down Procedure |
|---|---|
| Vg set to -5.0V | Turn off RF signal |
| Vd set to 28 V | Turn off Vd and wait 1 second to allow drain capacitor dissipation |
| Adjust Vg more positive until quiescent Id is 200 mA. This will be ~ Vg = -3.6 V typical | Turn off Vg |
| Apply RF signal | |

## Applications Information

### Evaluation Board Layout

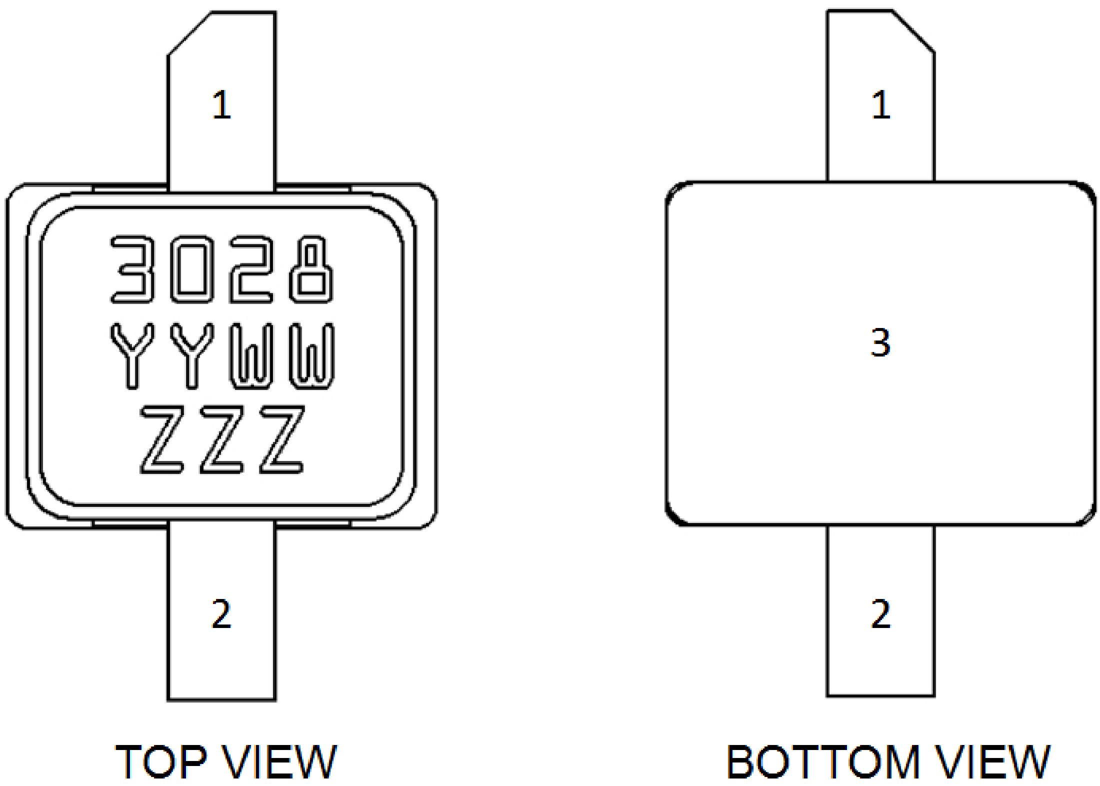
Top RF layer is 0.020" thick Rogers RO4350B, $\varepsilon_r$ = 3.48.
The pad pattern shown has been developed and tested for optimized assembly at TriQuint Semiconductor. The PCB land pattern has been developed to accommodate lead and package tolerances.




**Bill of Materials**

| Reference Des. | Value | Qty | Manufacturer | Part Number |
|---|---|---|---|---|
| C1 | 0.3 pF | 1 | ATC | ATC600S0R3 |
| C2 | 0.2 pF | 1 | ATC | ATC600S0R2 |
| L1, L2 | 8.8 NH | 2 | COILCRAFT | 1606-8 |
| C3, C4, C6, C7, C8 | 3 pF | 5 | ATC | ATC600S3R0 |
| C5 | 0.4 pF | 1 | ATC | ATC600S0R5 |
| R1 | 97.6 Ohms | 1 | Venkel | CR0604-16w-97R6FT |
| R2 | 4.7 Ohms | 1 | Newark | 37C0064 |
| R3 | 330 Ohms | 1 | Newark | TNPW1206330RBT9ET1-E3 |
| R4 | 50 Ohms | 1 | ATC | CRCW120651R0FKEA |
| C9, C10 | 220 pF | 2 | AVX | AVX06035C22KAT2A |
| C11, C12 | 2200 pF | 2 | Vitramon | VJ1206Y222KXA |
| C13, C14 | 22000 pF | 2 | Vitramon | VJ1206Y223KXA |
| C15 | 220 uF | 1 | United Chemi-Con | EMVY500ADA221MJA0G |
| C16 | 1.0 uF | 1 | Allied | 541-1231 |
| L3 | 48 Ohm | 1 | Ferrite, Laird Tech. | 28F0121-0SR-10 |

## PIN Description



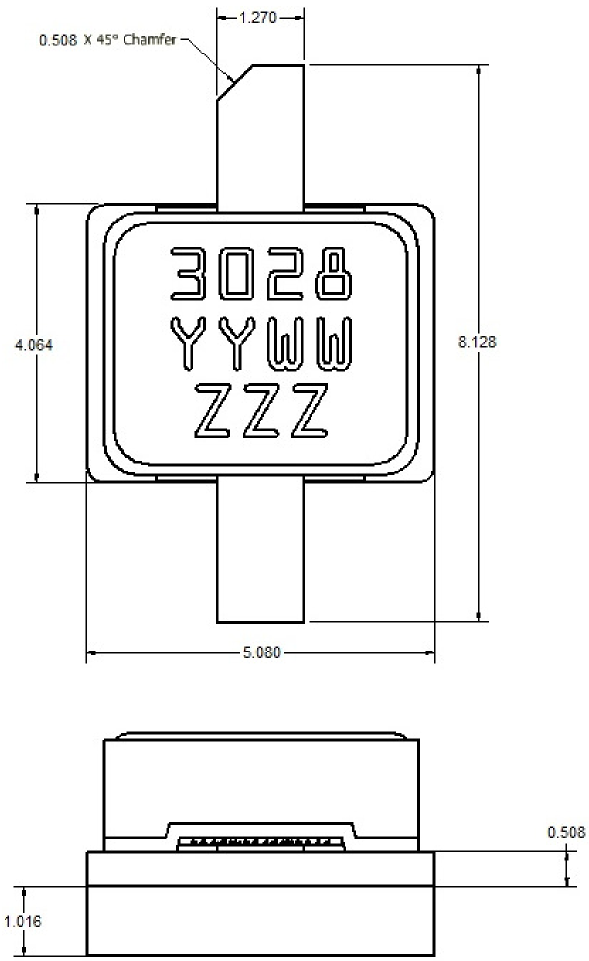

| Pin | Symbol | Description |
|---|---|---|
| 1 | Vd/ RF OUT | Drain voltage/ RF Output matched to 50 ohms; see Application Circuit on page 8 as an example. |
| 2 | Vg/RF IN | Gate voltage/ RF Input matched to 50 ohms; see Application Circuit on page 8 as an example |
| 3 | Flange | Source connected to ground; see Application Circuit on page 8 as an example. |

The T1G6003028-FS will be marked with the "3028" designator and a lot code marked below the part designator. The "YY" represents the last two digits of the year the part was manufactured, the "WW" is the work week, and the "ZZZ" is an auto-generated number.

## Mechanical Information

### Package Information and Dimensions

All dimensions are in millimeters.




This package is lead-free/RoHS-compliant. The plating material on the leads is NiAu. It is compatible with both lead-free (maximum 260 °C reflow temperature) and tin-lead (maximum 245 °C reflow temperature) soldering processes.

## Product Compliance Information

### ESD Information

**Caution! ESD-Sensitive Device**

| | |
|---|---|
| ESD Rating: | Class 1A |
| Value: | ≥ 250 V |
| Test: | Human Body Model (HBM) |
| Standard: | JEDEC Standard JESD22-A114 |

### MSL Rating

Level 3 at +260 ℃ convection reflow
The part is rated Moisture Sensitivity Level 3 at 260℃ per JEDEC standard IPC/JEDEC J-STD-020.

### Solderability

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

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

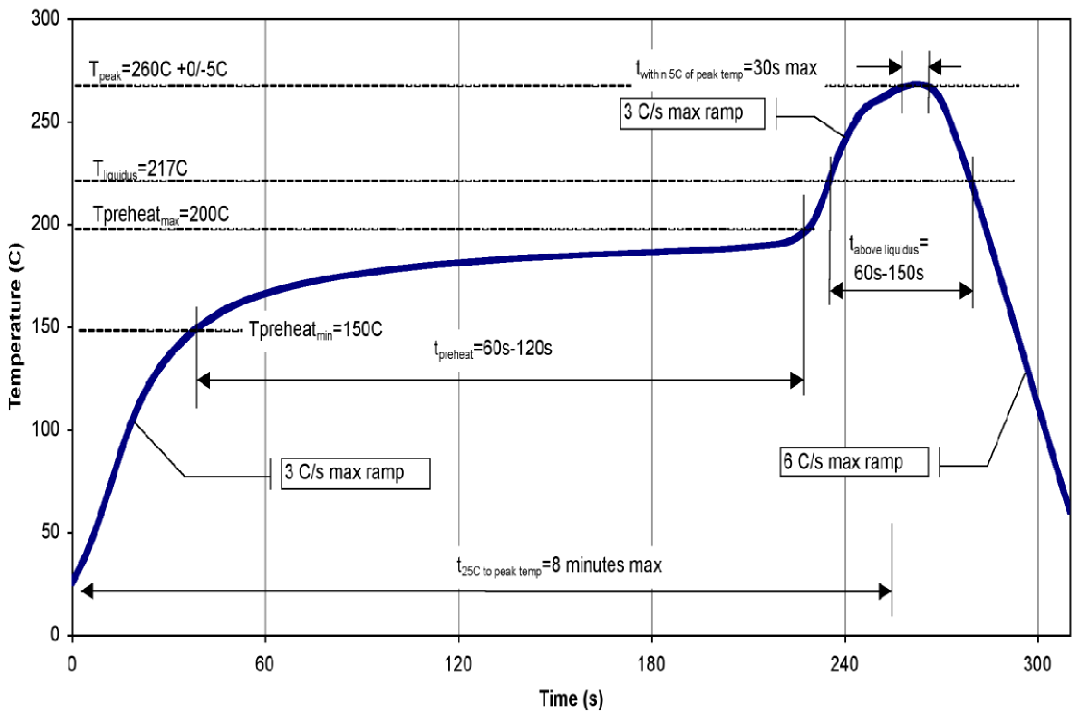
This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free

### ECCN

US Department of Commerce EAR99

## Recommended Soldering Temperature Profile



## Contact Information

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**Email:** info-sales@tqs.com **Fax:** +1.972.994.8504

For technical questions and application information:

**Email:** info-products@tqs.com

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