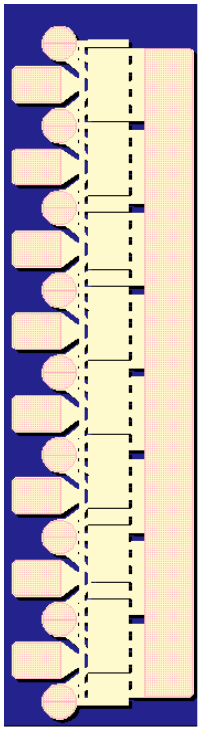
# TGF2023-10

# 50 Watt Discrete Power GaN on SiC HEMT



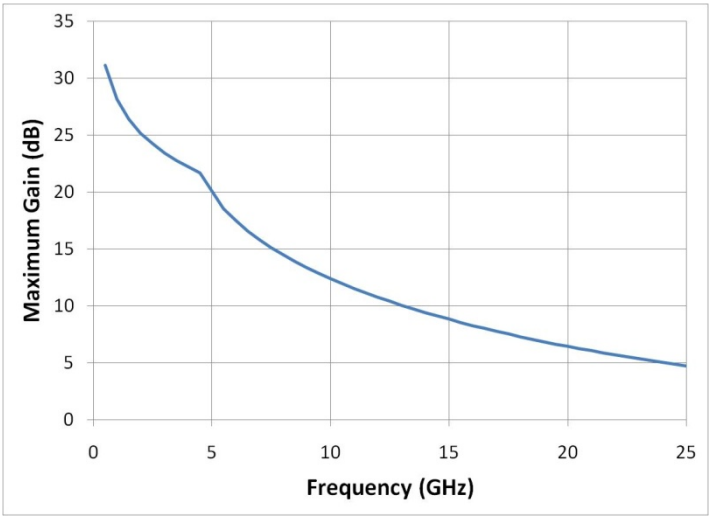
## Key Features

- Frequency Range: DC - 18 GHz
- 47 dBm Nominal Psat
- 55% Maximum PAE
- 8.7 dB Nominal Power Gain
- Bias: Vd = 28 - 35 V, Idq = 1 A, Vg = -3.6 V Typical
- Technology: 0.25 um Power GaN on SiC
- Chip Dimensions: 0.82 x 2.48 x 0.10 mm

## Primary Applications

- Defense & Aerospace
- Broadband Wireless

Bias conditions: Vd = 30 V, Idq = 1 A, Vg = -3.6 V Typical




## Product Description

The TriQuint TGF2023-10 is a discrete 10 mm GaN on SiC HEMT which operates from DC-18 GHz. The TGF2023-10 is designed using TriQuint's proven 0.25um GaN production process. This process features advanced field plate techniques to optimize microwave power and efficiency at high drain bias operating conditions.

The TGF2023-10 typically provides 47 dBm of saturated output power with power gain of 8.2 dB. The maximum power added efficiency is 55% which makes the TGF2023-10 appropriate for high efficiency applications.

Lead-free and RoHS compliant

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*Datasheet subject to change without notice.*



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## Table I
## Absolute Maximum Ratings 1/

| Symbol | Parameter | Value | Notes |
|---|---|---|---|
| Vd | Drain Voltage | 40 V | 2/ |
| Vg | Gate Voltage Range | -10 to 0 V | |
| Id | Drain Current | 10 A | 2/ |
| Ig | Gate Current | 56 mA | |
| Pin | Input Continuous Wave Power | 40 dBm | 2/ |
| Tch | Channel Temperature | 200 °C | |

1/ These ratings represent the maximum operable values for this device. Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device and / or affect device lifetime. These are stress ratings only, and functional operation of the device at these conditions is not implied.

2/ Combinations of supply voltage, supply current, input power, and output power shall not exceed the maximum power dissipation listed in Table IV.

## Table II
## Recommended Operating Conditions

| Symbol | Parameter | Value |
|---|---|---|
| Vd | Drain Voltage | 28 - 35 V |
| Idq | Drain Current | 1 A |
| Id_Drive | Drain Current under RF Drive | 3 A |
| Vg | Gate Voltage | -3.6 V |



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# Table III
# RF Characterization Table 1/

**Bias: Vd = 30 V, Idq = 1000 mA, Vg = -3.6V Typical, Frequency = 10 GHz**

| SYMBOL | PARAMETER | Vd = 30 V | UNITS |
|---|---|---|---|
| **Power Tuned:** | | | |
| Psat | Saturated Output Power | 47 | dBm |
| PAE | Power Added Efficiency | 50 | % |
| Gain | Power Gain | 8.2 | dB |
| $\Gamma_L$ 2/ | Load Reflection Coefficient | $0.92\angle 174$ | - |
| **Efficiency Tuned:** | | | |
| Psat | Saturated Output Power | 46 | dBm |
| PAE | Power Added Efficiency | 55 | % |
| Gain | Power Gain | 8.7 | dB |
| $\Gamma_L$ 2/ | Load Reflection Coefficient | $0.94\angle 172$ | - |

| SYMBOL | PARAMETER | Vd = 30 V | UNITS |
|---|---|---|---|
| **Power Tuned:** | | | |
| Rp 3/ | Parallel Output Resistance | 54.5 | Ω·mm |
| Cp 3/ | Parallel Output Capacitance | 0.376 | pF/mm |
| **Efficiency Tuned:** | | | |
| Rp 3/ | Parallel Output Resistance | 86.0 | Ω·mm |
| Cp 3/ | Parallel Output Capacitance | 0.384 | pF/mm |

1/ Values in this table are scaled from measurements on a 1.25 mm GaN/SiC unit cell at 10 GHz

2/ Optimum Gamma_Load ($\Gamma_L$) for maximum power or maximum PAE at 10 GHz, assuming all gates and drains are connected together

3/ Large signal equivalent output network (normalized) (see figure, pg 7)

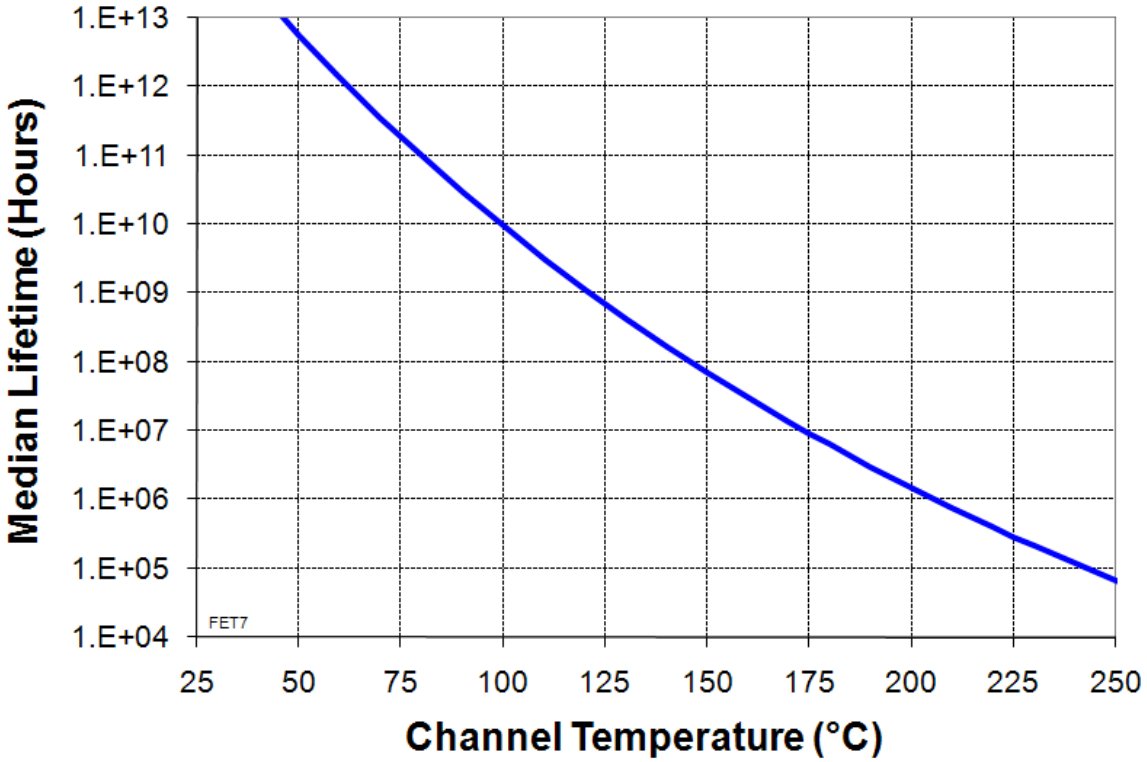
## Table IV
## Power Dissipation and Thermal Properties 1/

| Parameter | Test Conditions | Value | Notes |
|---|---|---|---|
| Maximum Power Dissipation | Tbaseplate = 70 ºC | Pd = 64 W<br>Tchannel = 200 ºC<br>Tm = 1.5E+6 Hrs | 2/ |
| Thermal Resistance, θjc | Vd = 30 V<br>Id = 1 A<br>Pd = 30 W<br>Tbaseplate = 70 ºC | θjc = 2.0 (ºC/W)<br>Tchannel = 130 ºC<br>Tm = 4.4E+8 Hrs | |
| Thermal Resistance, θjc<br>Under RF Drive | Vd = 30 V<br>Id = 2.97 A<br>Pout = 47 dBm<br>Pd = 44.5 W<br>Tbaseplate = 70 ºC | θjc = 2.0 (ºC/W)<br>Tchannel = 160 ºC<br>Tm = 3.2E+7 Hrs | |
| Mounting Temperature | 30 Seconds | 320 ºC | |
| Storage Temperature | | -65 to 150 ºC | |

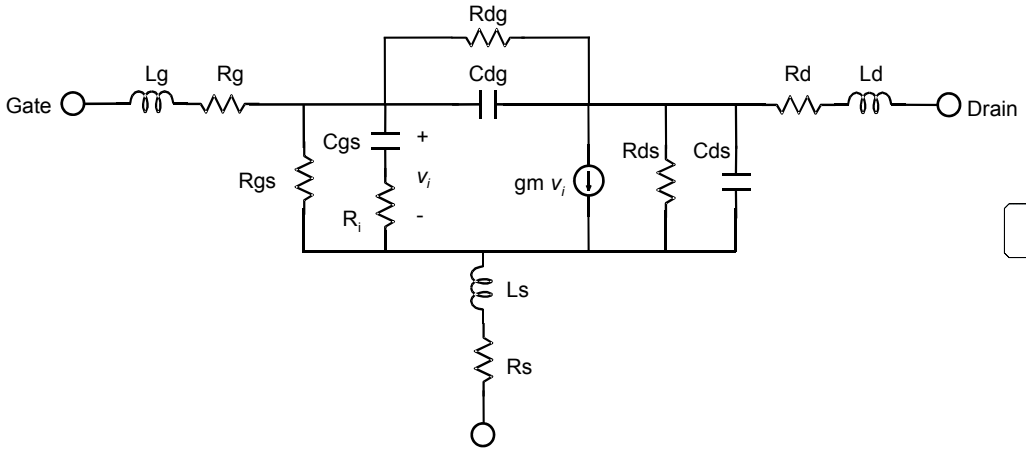
1/ Assumes eutectic attach using 1mil thick 80/20 AuSn mounted to a 10mil CuMo Carrier Plate

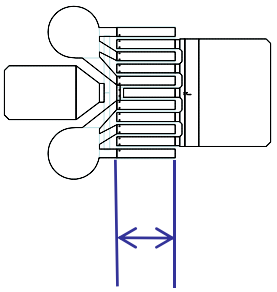
2/ Channel operating temperature will directly affect the device median lifetime. For maximum life, it is recommended that channel temperatures be maintained at the lowest possible levels.

## Median Lifetime vs Channel Temperature



# Linear Model for 1.25 mm Unit GaN Cell (UGC)



Unit GaN cell
Reference Plane

| MODEL PARAMETER | Vd = 30V Idq = 125mA | UNITS |
|---|---|---|
| Rg | 0.42 | Ω |
| Rs | 0.13 | Ω |
| Rd | 0.70 | Ω |
| gm | 0.302 | S |
| Cgs | 1.994 | pF |
| Ri | 2.62 | Ω |
| Cds | 0.275 | pF |
| Rds | 98.08 | Ω |
| Cgd | 0.068 | pF |
| Tau | 0.19 | pS |
| Ls | -0.002 | nH |
| Lg | -0.026 | nH |
| Ld | -0.017 | nH |
| Rgs | 37800 | Ω |
| Rgd | 303000 | Ω |



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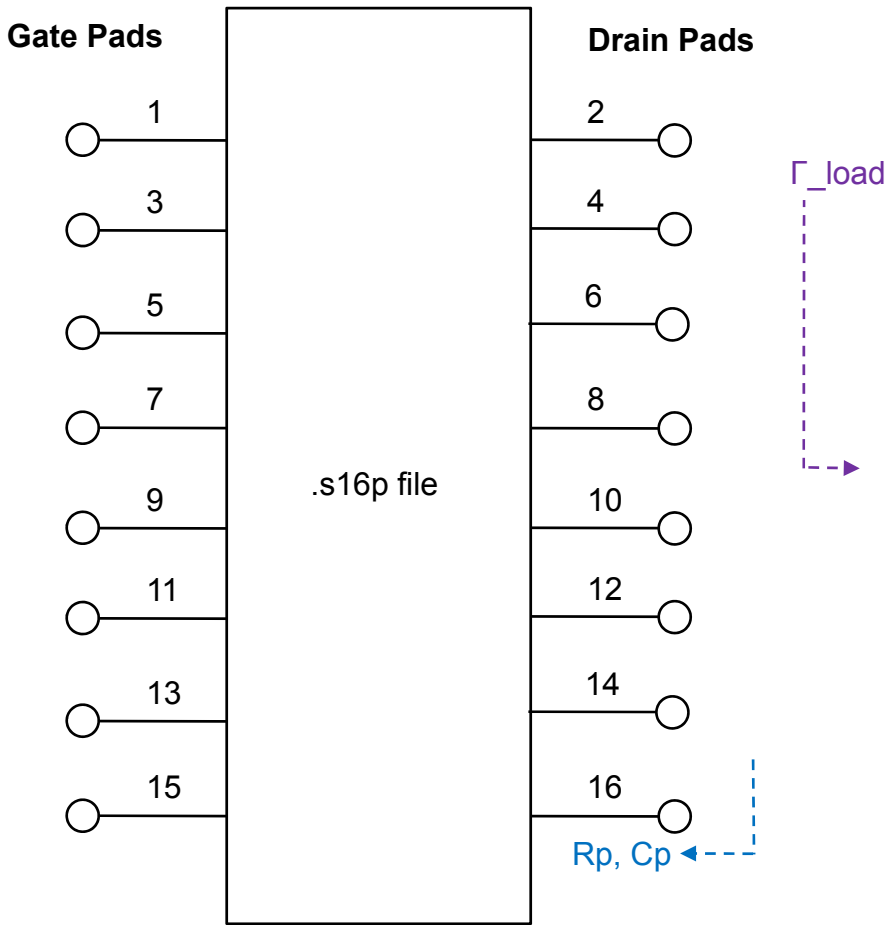
# Complete 10mm GaN HEMT Linear Model

Includes 8 UGC, 9 vias, and bonding pads



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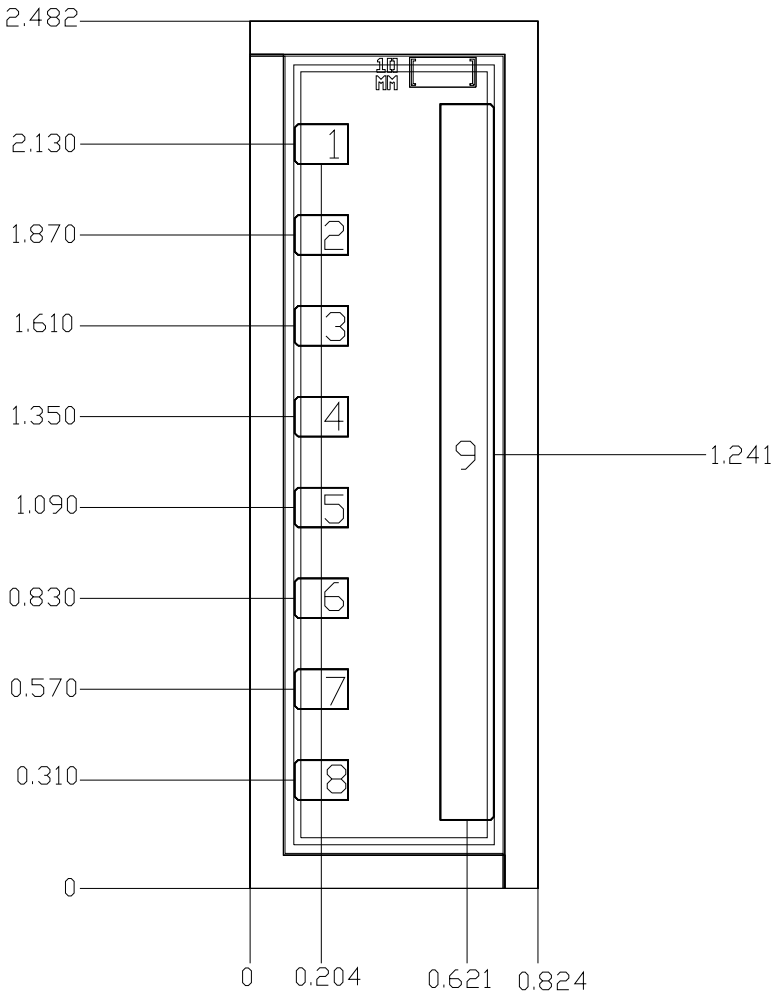
# Mechanical Drawing




Units: millimeters

Thickness: 0.100

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 #1 - 8 | Vg | 0.154 x 0.115 |
| Bond Pad #9 | Vd | 0.154 x 2.050 |

***GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.***

# 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:

- Ball bonding is the preferred interconnect technique, except where noted on the assembly diagram.
- Force, time, and ultrasonics are critical bonding parameters.
- Aluminum wire should not be used.
- Devices with small pad sizes should be bonded with 0.0007-inch wire.

# Ordering Information

| Part | ECCN | Package Style |
|---|---|---|
| TGF2023-10 | 3A001.b.3.b | GaN on SiC Die |

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